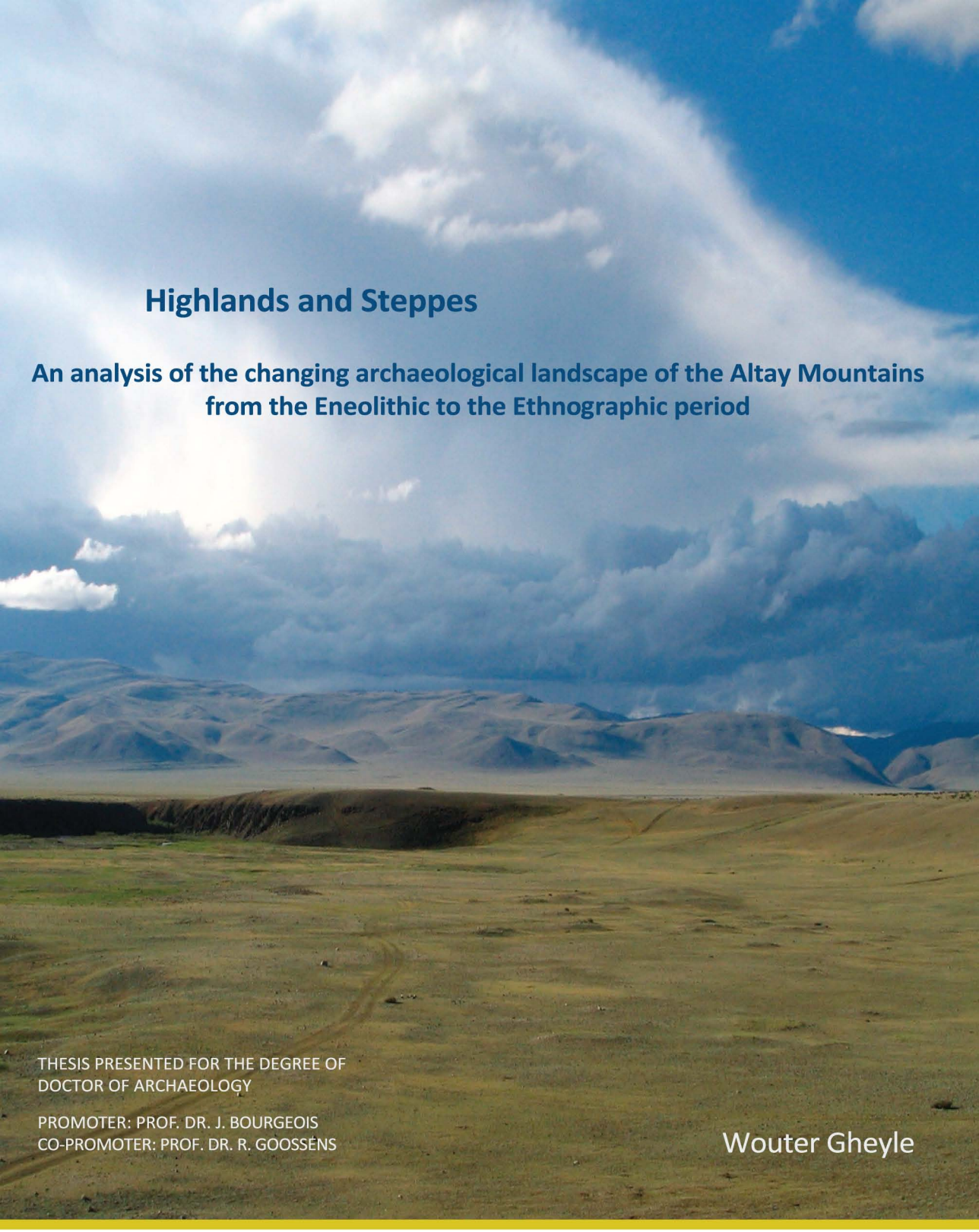


Highlands and Steppes

An analysis of the changing archaeological landscape of the Altay Mountains from the Eneolithic to the Ethnographic period

THESIS PRESENTED FOR THE DEGREE OF
DOCTOR OF ARCHAEOLOGY

PROMOTER: PROF. DR. J. BOURGEOIS
CO-PROMOTER: PROF. DR. R. GOOSSENS

Wouter Gheyle

UNIVERSITEIT GENT

FACULTEIT LETTEREN EN WIJSBEGEERTE

This thesis is dedicated to our dear friend

Viktor Nikolaevich Luk'yanenko



04.08.1954 - 22.06.2008

Promoters:	Prof. Dr. Jean Bourgeois
	Department of Archaeology and Ancient History of Europe
	Prof. Dr. Rudi Goossens
	Department of Geography
Dean:	Prof. Dr. Freddy Mortier
Vice-chancellor:	Prof. Dr. Paul Van Cauwenberge

Nederlandse vertaling:
“Hooglanden en steppes. Een analyse van het veranderende archeologische landschap in het Altaj-gebergte van het Eneolithicum tot de Etnografische periode (3de millennium v.Chr. tot het begin van de 20ste eeuw n.Chr.)”

Cover: The fascinating landscape of the Altay Mountains: view over the Chuya steppe from the Bar-Burgazy River (Kosh-Agatch region, Russian Altay) during the fieldwork in 2004

Back: Bronze Age *kereksur* and alignments of Iron Age burial mounds decorate the landscape of the Yustyd valley in the eastern part of the Russian Altay (Kosh-Agach region): view from the higher part of the valley towards the west during the fieldwork in 2006

Reference: Gheyle W., 2009. Highlands and Steppes. An Analysis of the Changing Archaeological Landscape of the Altay Mountains from the Eneolithic to the Ethnographic period. *Department of Archaeology*. Ghent, Ghent University

The author and the promoter give the authorisation to consult and to copy parts of this work for personal use only. Every other use is subject to the copyright laws. Permission to reproduce any material contained in this work should be obtained from the author.

UNIVERSITEIT
GENT

Faculty of Arts & Philosophy

Wouter Gheyle

Highlands and Steppes

An Analysis of the Changing Archaeological Landscape of the Altay Mountains from the Eneolithic to the Ethnographic Period

Thesis presented for the Degree of

Doctor of Archaeology

2009

Preface

In September 2002, Prof. Dr. Jean Bourgeois called me to his office and suggested I start a PhD on the archaeology of the Altay Mountains. It was an offer I could not refuse. The goal of our Master's research, during 2001 and 2002, was to evaluate the use of CORONA imagery for the study of archaeological monuments in remote areas; this included a study of the visibility of archaeological surface monuments, the production of morphographic maps based on stereoscopic imagery, and a digital photogrammetric restitution of satellite images. The hours upon hours of looking through a stereoscope at the three-dimensional black and white images of mountains, valleys and steppes had awakened in me a deep interest and fascination for the archaeological landscape of Altay. During the first survey expedition in the project, in the summer of 2003, these hours of immersion in the three-dimensional world of Altay proved extremely useful; we hardly needed any maps to find our way around the research area and had a clear idea of the topographical layout of the valleys being studied.

The first project in 2003-2004 gave us the possibility to establish a good methodology for mapping the landscape and for the actual archaeological survey. Getting to know our Russian colleagues during the first fieldwork campaigns and testing the first Russian words learned in language classes was a great experience. We seized the opportunities to publish the work in some scientific papers and conference bundles, and started the search for new funding to continue our work in Altay. UNESCO's Science and Culture sectors were interested in co-operation, and a project was launched for 2005-2006 for the protection and preservation of the frozen tombs in Altay. We organised two survey campaigns in Russia and Kazakhstan, set up several international meetings with specialists to discuss the problems and possible solutions, and organised exhibitions in Ghent, Paris and Gorno-Altaysk to bring the archaeological heritage and the frozen tombs of Altay to the attention of a larger public. Although to a large extent all these activities drew our attention away from the PhD research presented here, it was a very interesting period and we are certainly hoping to continue the project in the future. From mid-2007, we refocused on the scientific research and organised two additional surveys in the following summers to complete our dataset.

This PhD thesis is the result of all this. Although it certainly is the end point of a phase in the research, we plan both to continue and elaborate on the research in the future. This includes incorporating small excavations to deal with problems of chronology, working out the in-depth analysis of the archaeological landscape using more GIS-techniques, discussing the suggested typology with colleagues, presenting the results and discussions in papers and at conferences, etc.

Being the end of a research phase also means that there are some shortcomings. Although we have been studying Russian since the first years of study, our active and passive knowledge is still quite basic. We have tried to use as much Russian literature as possible, but we certainly do

not pretend to have been able to incorporate all relevant Russian literature into this study. Inevitable, this will result in shortcomings, for which we apologise in advance.

Acknowledgements

The work here before you is not the result of an isolated effort. It could not have been realised without the help and support of many people, some of whom also 'suffered' during the realisation of this project. Therefore, let me first thank my partner Kaat for her amazing patience, her strong belief, the valuable feedback and, especially in the last months, her unremitting care. My parents stood by my side during the whole trip, as they always have done, and so did my 'little' sister: for this, I cannot thank them enough. Love you all…

Dozens of people have assisted in the research, be it directly or indirectly, and helped me to complete this task as well as possible. First, I would like to thank Prof. Dr. Jean Bourgeois for enabling me to work on this fascinating subject and for giving me the opportunities to grow as much as possible in the process. He has supported me from the beginning, as a student, and continued to do so during the successive projects we have worked on together. I am extremely thankful for that. His supervision and scientific input have been essential. Equally important has been the input of Prof. Dr. Rudi Goossens who was willing to act as co-promoter of this research. He supervised all remote-sensing aspects, participated in the expeditions and supported me wherever needed during my research. For the technical advice and the guidance in using GPS equipment, setting up a topographical survey in the field and processing the data, I am much obliged to Prof. Dr. Ir. Alain De Wulf. In addition, I would like to thank them all for the great times we had during the many expeditions in Altay.

The successive projects were realised thanks to the co-operation and collaboration of many institutions and individuals. First we would like to thank the partners in Russia and Kazakhstan: Rector Yuri Tabakaev, Vice-Rector Valerii Babin and Prof. Viktor Lukyanenko (†) for their valuable assistance in organising all the different aspects of the project; Prof Alexander V. Ebel, Dr. Eduard P. Dvornikov and their team for their participation in the fieldwork and organising the campaigns; Dimitri Cheremisin for working with us during the first year of fieldwork in Elangash; Andrei Karanin for participating in the exchange and working with us in Dzhazator; Prof. Z. Samashev and his assistants G. Bazarbaeva, G. Dzhumabekova, A. Ongar and A. Chotbayev for organising the campaign in Kazakhstan, participating in the workshops and contributing to the exhibitions in Gorno-Altaysk, Ghent and Paris; Sergei Marchenko for his valuable contributions to the project as a permafrost specialist and for participating twice in our campaigns; and Danil Mamyev and the staff of the Uch-Enmek Ethno-Natural Park for their support and hospitality.

We would never have been able to gather the amount of data we have had at our disposal without the voluntary work of the following participants in the expeditions of 2003 to 2007, both students and professional archaeologists, most of whom have become diehard Altay lovers: Quentin Bourgeois, Ruben Capelle, Delphine Corneillie, Tijs De Bus, Tijs De Schacht, Kaatje De Langhe, Dries Dossche, Stéphanie Loute, Élise Luneau, Anne Malmendier, Dorien te Kiefte, Benjamin Van Bever, Ruben Van de Kerchove, Steven Van der Sype, Leon van Hoof, Matthijs Vanommeslaeghe, and the Russian and Kazakh students who assisted in the fieldwork and in

organising the camps over all these years. Many thanks for their work, for their enjoyable company in the field, and for enduring the sometimes difficult circumstances during fieldwork for the sake of our project and, consequently, this PhD. Thank you!

Tom Amez and Benjamin Van Bever produced the first maps of the Altay region based on satellite imagery in 2003 and 2004 (Amez 2004, Van Bever 2005), perfecting the methodology as presented in my Master's thesis. Their work was of primary importance to the later expeditions. In 2005, 2006 and 2007, Matthijs Vanommeslaeghe, Dries Dossche and Ruben Cappelle, respectively, took care of the geographical fieldwork and the processing of the GPS data and satellite images, in the framework of their Master's thesis or training (Vanommeslaeghe 2006, Dossche 2007, Cappelle 2008a, Cappelle 2008b). Tijs De Bus joined the expedition in 2005 to study the permafrost in Dzhazator, which resulted in the first Master's thesis on this subject (De Bus 2007).

For technical assistance, we would like to thank Prof. Dr. Em. Marc Kunnen (Department of Radiology, Ghent University) for testing the Leica S1 PRO digital scanning camera in the initial phase of the project; Norbert Maes and Tijs De Schacht for the use of the Imacon Flextight scanner; Dr.-Ing. Karsten Jacobsen (Institute of Photogrammetry and GeoInformation, University of Hanover) for the final scans with the Vexcel Ultrascan 5000; Dr. Tony Vanderstraete and Dennis Devriendt for their help with VirtuoZo and other remote-sensing-related problems during the research; and Dr. Tom Willems for his assistance during the first years of the Altay research and the use of his self-developed software and GPS equipment. We received a lot of support from Ivo Verhaeghe for creating the exhibition in December 2006, with accompanying catalogue, flyers, posters, etc. Some of the illustrations we made together have made it into this work too. Stéphanie Loute and Marina Petintseva helped us with the organisation of the conference and the exhibition, especially with the Russian letters and documents. Together with Madina Paragulova, they translated the abstract in this thesis into Russian. Thanks!

For the many fruitful discussions on the archaeological landscape of Altay and the typology of the monuments, our sincere thanks goes out to Esther Jacobson-Tepfer (University of Oregon), Igor Slyusarenko (Institute of Archaeology and Ethnography, SB RAS) and Eduard Dvornikov (Gorno-Altaysk State University). Without them, this work would not have been complete.

Funding was provided by the Research Council of Ghent University for 2003-2004. Additional funding by the Belgian Science Policy made it possible to organise a second campaign in the summer of 2004. The Flemish/UNESCOFund-in-Trust supported the Frozen Tombs Project 2005-2006 and fieldwork in 2006 to 2008 was co-funded by the Flemish-Russian Bilateral Agreements. We are much obliged to Dredging International (DEME Group) for the free use of the C-Nav GPS system in the early years, and to C&C Technologies for providing the C-Nav correction signal. Our thanks also go to UNESCO (in Paris and Moscow), especially to Mr. Mario Hernandez and Ms. Junhi Han, the Russian and Kazakh embassies in Brussels, Paris and The Hague and finally the Belgian embassy in Moscow and Almaty.

Russian abstract - Русский краткий обзор

Введение

Алтайские горы, расположенные на стыке Южной Сибири и Ценральной Азии, на границе между Китаем, Казахстаном, Монголией и Республикой Алтай (Российская Федерация), обладают уникальным культурным наследием, что позволяет причислить Алтай к одним из важнейших археологических областей мира. В горах Алтая разбросаны тысячи наземных объектов – погребальные монументы, ритуальные сооружения, петроглифы – принадлежащие разным, преимущественно кочевым цивилизациям, от периода неолита до этнографического периода (3-е тыс. до н.э. – XIX в.), являющиеся безмолвными свидетелями важной роли, которую играл Алтайский регион в развитии человеческой цивилизации, его взаимодействия и взаимовлияния с соседними регионами, родиной важнейших культур древней Центральной Азии.

Эти наземные объекты удивительно хорошо сохранились, благодаря географическим особенностям, незначительному оседанию и эрозии почвы, низкой плотности населения и ограниченной до настоящего времени урбанизации. Даже небольшие, состоящие из нескольких камней памятники хорошо различимы до сих пор, давая реальное представление о древнем ландшафте.

Хорошо сохранившийся археологический ландшафт даёт уникальную возможность изучения жизни древних популяций, населявших эту область последние пять тысячелетий, поскольку сохранившиеся на почве памятники отражают различные аспекты их жизни и быта. В отличии от раскопок, проводимых на отдельных участках, и потому ограниченных их пределами, изучение археологического ландшафта области в целом позволяет рассматривать обнаруженные памятники и артефакты как составную часть жизни обществ, ранее населявших данную местность.

Начиная с 1995 г. археологический факультет университета Гента проводит исследования на Алтае, раскопки захоронений, научные экспедиции. Представляемое вашему вниманию научное исследование было начато в 2003 г. в рамках двухгодичного проекта Фонда особых исследований университета с организацией двух экспедиций на Алтай (2003-2004 гг.).

В 2005 г. кафедра археологии совместно с коллегами из России, Казахстана, Германии, Франции, Бельгии и США приняла участие в проекте «Сохранение замороженных захоронений Алтайских гор». Целью этого проекта является защита уникальных скифских захоронений на Алтае (VIII – III вв. до н. э.), которым грозит опасность уничтожения в результате климатических изменений, попытка их сохранения путём проведения полной инвентаризации существующих замороженных могильников, изучение последствий потепления климата и поиск способов защиты памятников в условиях потепления. Были

организованы две экспедиции с археологическими и географическими полевыми работами летом 2005 г. в России и 2006 г. в Казахстане.

В 2007-2008 гг. кафедра продолжала работу по инвентаризации археологических памятников в русской части Алтая в рамках двустороннего сотрудничества Фландрии и России (Университет Гента совместно с Государственным Горно-Алтайским Университетом).

Цели и результаты

Настоящая диссертация имеет три основные цели.

Первая: создание географических и археологических карт исследуемой местности на Алтае с использованием снимков, сделанных спутником Корона, и применение их при археологических исследованиях.

Вторая: создание чёткой и полной типологии археологических объектов, обнаруженных во время экспедиций в исследуемых областях. Такой типологии памятников Алтая до сих пор не существовало, а те, что имеются, используют неверную терминологию,

Третья и завершающая цель: изучение археологического ландшафта Алтая на основании археологической информации и географических продуктов, созданных на базе изображений, полученных посредством космической съёмки.

Для осуществления первой цели (создания карт) нами разработан эффективный метод точного отбора контрольных точек на местности на исследуемых территориях (GCP = Ground Control Points, см. глава 2), который необходим для создания карт и дигитальных моделей почвы с использованием снимков, сделанных спутиком Корона. Архив Короны является источником ценной информации и отличается доступными ценами, особенно при сравнении со стоимостью других снимков с высокой степенью разрешения. Стереоснимки дают возможность создавать карты незнакомого ландшафта со значительно меньшими затратами по сравнению с обычными топографическими методами. К тому же эти фотографии 40-летней давности дают представление о происшедших за последние десятилетия изменениях ландшафта, т.е. являются по сути источниками исторической информации.

Тем не менее, есть свои минусы при работе с такими старыми снимками: имеющиеся изображения порой отличаются плохим качеством, низкой степенью разрешения на почве, иногда им недостаёт контрастности, к тому же невозможно заказать недостающие снимки неохваченных районов. Более того, иногда трудно, а порой невозможно создать модели, охватывающие всю исследуемую область, пробелы составляют несколько километров. Старые фотографии затрудняют нахождение GCP, особенно в районах с активным изменением ландшафта, где, например, были перенесены или проложены новые дороги, построены новые здания, мосты и т.п. Тем не менее, разработанная нами методика

позволяет создавать карты всех изучаемых участков как основу для сбора археологической информации и как инструмент для дальнейшего анализа археологического ландшафта.

Места проведения шести экспедиций с 2003 по 2008 гг. определялись совместно с Горно-Алтайским Государственным Университетом (Россия) и Маргуланским Институтом Археологии Алматы (Казахстан).

Экспедиция 2003 г., осуществлённая в рамках проекта Фонда особых исследований университета Гента, проходила в долинах, примыкающих к Чуйской степи на юго-западе Республики Алтай (Российская Федерация), с востока на запад, в долинах Себистей, Озёк, Ирбисту, Сарикобу и Элангаш, в зону исследования попала также часть южной границы Чуйской степи. Экспедиция 2004 г. проходила в долине Юстид, на востоке Чуйской степи.

Первая полевая кампания в рамках проекта ЮНЕСКО «Сохранение замороженных захоронений Алтайских гор» была организована летом 2005 г. в высокогорной долине Джазатор, расположенной в южной части русского Алтая, на севере плато Укок. Годом позже местом исследования стали три разные области на казахском Алтае: верхняя часть долины Каракабы, Бухтармы и курган Берель.

В 2007-2008 гг. объектом научного изучения в рамках совместного двустороннего проекта Фландрии и России стал заповедник Уч-Енмек.

Нами разработаны эффективные способы археологических исследований, в том числе точное определение местонахождения отдельных археологических структур с точностью до нескольких дециметров (глава 3).

Использование портативного ресивера GPS Leika SR-20 позволило проводить эффективные работы по созданию подробного географического плана изучаемых объектов и их немедленного занесения в GIS (Географическая Информационная Система). Вся информация заносилась в базу данных Алтари (Altari: Алтайская археологическая база данных), включая тип памятника, его размеры, строительный материал, расположение, общее описание, предполагаемая дата, фотографии и т.д.

Визуальная проверка полученных данных при пеших перемещениях на местности позволила убедиться, что нам удалось зарегистрировать все видимые археологические объекты в исследуемой области. Хотя трудно определить количество пропущенных объектов, мы убеждены, что их немного и проделанная нами работа представляет значительную научную ценность.

Во время шести экспедиций 2003-2008 гг. в горах Алтая нам удалось испытать и усовершенствовать используемые нами методы работы (глава 4). Результатом стало создание обширной базы данных с информацией о более, чем 12 047 археологических объектах, обнаруженных в десяти долинах (глава 4), большинство которых датируется периодом начала железного века: 4 406 или приблизительно 37%. 3 073 объекта (25%) относятся к Тюркскому периоду, 1 896 структур (16%) были созданы во времена бронзового века. Примерно 6% объектов относится к этнографическому периоду, большая часть из

этих 701 захоронений расположена в долине Бухтармы, где на одном кладбище обнаружено 400 могильников. 213 объектов были отнесены к гунно-сарматскому периоду, 47 – к периоду позднего неолита, 10 памятников железного века (неясно, скифского или гунно-сарматского происхождения). Дату возникновения значительной части объектов (14% или 1 701) не удалось установить без дальнейшего изучения.

Второй основной задачей настоящего научного исследования является создание типологии археологического наследия Алтайских гор (глава 5). На основании литературного исследования нами была сделана попытка выявить все известные типы монументов, при этом возникли значительные трудности с их наименованием. Хотя мы использовали русские источники в этой научной работе, следует признать, что наши познания русской литературы в области типологии нельзя назвать исчерпывающими. Тем не менее, очень быстро стало ясно, что не существует единой типологии, а отсутствие единых наименований приводит к недопониманию. Полевые работы на Алтае, а также многочисленные беседы с русскими, казахскими и западными археологами доказывают необходимость создания единой терминологии археологических объектов. Эта проблема впервые обсуждалась во время семинаров ЮНЕСКО в марте и декабре 2006г. (см. текст 1.4.3.6). Впоследствии были собеседования по теме с Игорем Слюсаренко (Институт Археологии и Этнографии РАН г. Новосибирска), Эстер Якобсон-Тепфер (Университет Орегона) и Эдуардом Дворниковым (Государственный Университет Горно-Алтайска). Созданная нами в результате типология и терминология частично основывается на этом ценном сотрудничестве, за что мы весьма благодарны коллегам.

В результате проделанной работы нами разработана эффективная и насколько это возможно полная типология археологических структур на почве в горах Алтая, которые можно подразделить на следущие типы: курганы, керексуры, оградки, каменные кладки (геометрические формы и линии), так называемые «жилища», стоячие камни, каменные окружности, каменные тротуары, петроглифы и могилы этнографического периода. Большинство из этих основных категорий имеют несколько субкатегорий. Современные кладбища, *овоо* и современные ритуальные сооружения, такие как бурханистские или буддистские алтари не входят в эту типологию.

Мы надеемся, что разработанная нами типология будет способствовать использованию единой терминологии при исследовании типов археологических памятников Алтая, что внесёт вклад в изучение его богатого археологического наследия. Мы не считаем, что эта работа завершена и готовы к дискуссиям с коллегами и внесению дополнений и изменений на основании их замечаний и предложений. Дальнейшие исследования, инвентаризация, раскопки несомненно дадут нам возможность совершенствовать типологию.

Последней основной задачей настоящей работы является изучение археологического ландшафта (глава 6).

Горы Алтая идеально подходят для реконструкции древнего культурного ландшафта по меньшей мере до второго тысячелетия до н.э. Открытые степи и речные террасы являются прекрасными примерами неизменённого во времени ландшафта. Плотность населения и в наше время здесь очень низкая, поэтому большинство памятников хорошо сохранились.

На основании результатов археологических изысканий, обработок фотоснимков, сделанных спутником Корона, и созданием на их основе необходимых карт, нами осуществлено изучение различных областей на различном уровне. Первые исследования были связаны с анализом распространения памятников разных типов и эпох на всей изучаемой территории. Отсутствие или наличие их в определённых местах интересно тем, что порой указывает на специфические особенности природного ландшафта в различных областях. Иногда это свидетельствует об определённом культурном уровне (как, например, в случае с монгольскими керексурами, которые встречаются ещё только на востоке русского Алтая).

Нами изучались особенности расположения и ориентации памятников разного типа в пределах отдельно взятого участка. Большинство объектов отличается сходным расположением (глава 5), что свидетельствует о передаче традиций от поколения к поколению на протяжении многих веков.

К сожалению, многие вопросы пока остаются безответными, что затрудняет понимание исторического прошлого некоторых культур Алтая. Почему, например, скифы располагали свои могилы в определённом направлении относительно юга и севера? Почему тюркские стоячие камни расположены всегда вблизи скифских могил, рядами, направленными на восток? Почему расположение керексуров настолько сложное, и какое значение имеет каждый элемент памятника?

Хотя настоящее исследование ясно указывает, что собранные нами данные позволяют осуществлять подробное изучение археологического ландшафта, мы понимаем, что при написании данной диссертации нами использованы далеко не все возможности. Нам предстоит много исследовательской работы, особенно по статистическому анализу археологического ландшафта, во время которой мы будем использовать и в дальнейшем пространственные данные GIS. К тому же было бы интересно задействовать информацию, полученную при раскопках и изучении артефактов для прослеживания социальных различий в местах захоронений, хронологии памятников, и возможности существования родственных связей между индивидумами, похороненными в одном могильнике (родственные связи, принадлежность к одному социальному слою, и т. д.).

Перспективы на будущее

Представленное здесь исследование безусловно должно быть развито и продолжено в нескольких направлениях.

В первую очередь хотелось бы развить и углубить изучение ландшафта с использованием технологий GIS. Мы счастливы сообщить, что Национальный фонд научных исследований Бельгии одобрил новый исследовательский проект по изучению археологического ландшафта Алтайских гор, который будет осуществляться в 2009-2012 гг. (FWO no. 3G004209). Главной целью этого проекта является изучение ментальных структур ландшафта с упором на образ жизни кочевников. Основным объектом нашего внимания станут погребальные и ритуальные памятники.

Дополнительной целью проекта является исследование социальных структур во всём их многообразии, с углублённым изучением различий между жизнью «элиты» скифов и «простого народа», преимущественно в период раннего железного века.

Этот проект даст нам возможность продолжить представленную здесь вашему вниманию работу и устранить имеющиеся в ней пробелы. Мы с нетерпением ждём, когда можно будет приступить к его осуществлению.

Другой важный аспект данного проекта – возможность провести ряд ограниченных раскопок на структурах неизвестного до сих пор происхождения, так называемых «жилищах» , («dwellings», глава 5), чтобы выявить связь этих памятников с определенной культурой.

Кроме этого мы намерены и дальше участвовать в программе «Замороженные захоронения и меры по их защите», которую в настоящее время осуществляет Центр всемирного наследия ЮНЕСКО. Мы планируем (при наличии необходимого финансирования) продолжить работы по сохранению археологического наследия Алтая и созданию необходимых для этого карт.

Кафедрой географии Гентского университета в рамках докторской диссертации будет проводиться длительное (2008-2011 гг.) исследование состояния вечной мерзлоты в горах Алтая. Доктор Рубен Ван де Керхове (Ruben Van de Kerchove) будет изучать состояние вечной мерзлоты на основании данных термального дистанционного контроля, полученных при помощи спутников Landsat и Aster. Исследование проводится под руководством проф. доктора Руди Гооссенса (Rudi Goossens).

Результаты

Основные достижения данного научного исследования:

Во-первых, впервые при археологических исследованиях на Алтае сбор данных осуществлялся методом дистанционного контроля при помощи космического спутника, что открывает новые возможности для местных исследователей, т.к. снимки, сделанные сателлитом, доступны и имеют сравнительно низкую стоимость. Этот метод, разумеется, может использоваться и в других отдалённых и труднодоступных районах как эффективный способ проведения топографических работ.

Во-вторых, мы убеждены, что разработанные нами методы будут способствовать повышению эффективности и качества археологических изысканий на Алтае а также, возможно, и в других областях.

Алтайский горный массив простирается на обширной территории четырёх государств, изобилующей неисчислимым количеством археологических памятников, которым грозит разрушение, а порой и полное уничтожение. Поэтому представляется чрезвычайно важным в ближайшие годы осуществить подробное описание и регистрацию как можно большего количества объектов культурного наследия Алтая, и эту работу мы собираемся продолжить.

В третьих, нами впервые проведён анализ и перепись более 12 000 памятников на Алтае, с подробным описанием их типа и с использованием единой терминологии, отсутствие которой прежде служило причиной многих разночтений и недоразумений в литературе по археологии.

И последнее, изучение археологического ландшафта даёт уникальную информацию, которую невозможно получить, ограничиваясь только раскопками. Надеемся, что проведённая нами работа поможет изменить, к сожалению, весьма распространённое мнение, что раскопки являются единственным эффективным способом проведения археологических изысканий.

Dutch abstract - Nederlandse samenvatting

Inleiding

Het Altaj-gebergte strekt zich uit over het grensgebied tussen Rusland, Mongolië, China en Kazachstan, waar Zuid-Siberië en Centraal-Azië elkaar raken. Het heeft een uitzonderlijk archeologisch erfgoed en kan worden beschouwd als één van de belangrijkste archeologische vindplaatsen ter wereld. Het vormt al duizenden jaren een belangrijk overgangsgebied tussen de Mongoolse steppe en de Kazachse steppe, en de wederzijdse contacten (handelsroutes, uitwisseling, etc.) maken het tot een uiterst interessant archeologisch gebied. Een enorme rijkdom aan archeologische monumenten ligt verspreid over de valleien, steppes en plateaus van Altaj, daterend van het Eneolithicum (3de millennium v.Chr.) tot de zogenaamde Etnografische periode (16de eeuw n.Chr. tot de Russische revolutie in 1917). De monumenten – zowel graven als rituele structuren en rotsgraveringen – zijn nog steeds zichtbaar boven het grondoppervlak, en zijn uitzonderlijk goed bewaard: de specifieke eigenschappen van het landschap, met weinig sedimentatie en erosie sinds de laatste ijstijden, en de lage bevolkingsdichtheid en beperkte urbanisatie zorgden ervoor dat het landschap van duizenden jaren geleden tot op de dag van vandaag bijna intact bewaard bleef. Zelfs kleine structuren, bestaande uit niet meer dan een paar stenen, zijn nu nog steeds zichtbaar.

Dit geeft ons een uniek zicht op het toenmalige en hedendaagse archeologische landschap, en biedt uitstekende mogelijkheden om de opeenvolgende archeologische culturen in Altaj te bestuderen. De structuren belichten diverse aspecten uit het dagelijks leven van de volkeren die dit gebied de laatste vijf millennia bewoonden. In tegenstelling tot opgravingen, die beperkt blijven tot enkele geïsoleerde monumenten of vindplaatsen, analyseert een studie van het archeologische landschap gegevens over sites en structuren uit een groter studiegebied op een geïntegreerde en regionale manier.

Al sinds 1995 wordt door de Vakgroep Archeologie van UGent onderzoek uitgevoerd in Altaj, waarbij zowel opgravingen van grafheuvels als uitgebreide surveycampagnes aan bod kwamen. Het onderzoek dat hier gepresenteerd wordt begon in 2003 met een tweejarig onderzoeksproject van het Bijzonder Onderzoeksfonds van de Universiteit Gent (BOF), waarbij twee expedities in Altaj werden uitgevoerd (2003-2004). In 2005 is de Vakgroep Archeologie één van de voortrekkers geworden van een project met Russische, Kazachse, Duitse, Franse, Belgische en Amerikaanse collega's: 'The Preservation of the Frozen Tombs of the Altay Mountains'. Het doel van dit project is de bescherming van de unieke bevroren graven van de Scythische cultuur in Altaj (8ste tot 3de eeuw v.Chr.), die door de klimaatsverandering worden bedreigd, door middel van een complete inventarisatie van de aanwezige bevroren graven, een onderzoek naar de gevolgen van de opwarming van het klimaat en het zoeken naar maatregelen die de monumenten kunnen beschermen tegen die opwarming. Twee expedities werden georganiseerd, met archeologisch en geografisch veldwerk, in de zomers van 2005 (in Rusland) en 2006 (in Kazachstan). In 2007 en 2008 werkte de vakgroep verder aan de inventarisatie van

archeologische monumenten in het Russische deel van Altaj, in het kader van een Bilaterale wetenschappelijke samenwerking tussen Vlaanderen (Universiteit Gent) en Rusland (Staatsuniversiteit Gorno-Altajsk).

Doelstellingen en resultaten

Dit doctoraatsonderzoek heeft drie hoofddoelstellingen. De eerste doelstelling is het ontwikkelen van een methode om de onderzoeksgebieden in Altaj zo efficiënt mogelijk te karteren, zowel geografisch als archeologisch, door het gebruik van CORONA satellietfotografie te onderzoeken en het ontwikkelen van een efficiënte en nauwkeurige manier van archeologische survey. De tweede hoofddoelstelling is het opstellen van een duidelijke en complete typologie van de archeologische monumenten die tijdens het archeologisch veldwerk in de geselecteerde onderzoeksgebieden zijn gevonden. Een dergelijke typologie voor de monumenten in Altaj is alsnog onbestaande, en de in gebruik zijnde terminologie is verre van correct. De derde doelstelling, ten slotte, is het bestuderen van het archeologische landschap van het Altaj-gebergte, gebruik makend van de archeologische informatie en de geografische producten die op basis van de satellietbeelden geproduceerd zijn.

De geografische kartering is gebaseerd op de fotogrammetrische verwerking van stereoscopische CORONA hoge resolutie-satellietbeelden. Met behulp van grondcontrolepunten (punten op de beelden waarvan de exacte coördinaten gekend zijn) kunnen digitale terreinmodellen (DTM) en betrouwbare topografische kaarten geproduceerd worden op basis van de CORONA stereokoppels. Deze punten moeten echter op het terrein gezocht en nauwkeurig ingemeten worden, met behulp van een GPS ontvanger. In een verafgelegen gebied zoals het Altaj-gebergte is dat geen sinecure. Door verschillende toestellen te testen en hun nauwkeurigheden met elkaar te vergelijken, werd de beste configuratie geselecteerd (Hoofdstuk 2). Het Amerikaanse CORONA archief is een waardevolle informatiebron, toegankelijk en betaalbaar – zeker vergeleken met andere, recentere satellieten die hoge resolutiebeelden leveren. Het is bovendien essentieel dat het CORONA programma stereoscopische beelden maakte, wat het mogelijk maakt om hoogte-informatie te generen. Dit stelt ons in staat een landschap in detail te karteren, veel sneller dan tot nu toe mogelijk was met traditionele topografische technieken. Bovendien zijn de beelden meer dan 40 jaar oud, en tonen ze ons een landschap dat sindsdien op sommige plaatsen drastisch is veranderd.

Er zijn echter ook enkele nadelen aan het gebruik van historische satellietbeelden. Enkel de beschikbare beelden kunnen worden gebruikt en er is geen mogelijkheid om nieuwe beelden te bestellen. Sommige regio's zijn niet gefotografeerd, of de beelden zijn verloren gegaan. Veel van de beelden tonen vooral wolken, hebben weinig contrast, of hebben niet de geschikte grondresolutie. Bovendien is het soms moeilijk om bruikbare grondcontrolepunten te vinden op beelden van 40 jaar terug, daar die punten ook nog in het landschap te zien moeten zijn. Vooral wegen kunnen heraangelegd of verplaatst zijn, gebouwen werden aangepast of afgebroken, en de meeste bruggen werden ondertussen vervangen door grotere exemplaren om het moderne

verkeer aan te kunnen. Toch waren we in staat om voor alle onderzoeksgebieden de nodige cartografische documenten te produceren op basis van de ontwikkelde methode. Deze producten dienden als achtergrond en situering van de archeologische informatie en werden gebruikt bij de verdere analyse van het archeologische landschap.

De onderzoeksgebieden voor de zes expedities in de zomers van 2003 tot 2008 werden geselecteerd in overleg met de archeologen van de Universiteit van Gorno-Altajsk (Rusland) en het Margulan Archeologisch Instituut van Almaty (Kazachstan). In het kader van het tweejarig project van het Bijzonder Onderzoeksfonds van de Universiteit Gent (BOF) werden in 2003 en 2004 verschillende valleien geselecteerd in het zuidwesten en het oosten van de Chuya steppe, in het zuidwesten van de Altaj Republiek (Rusland). In 2003 waren dat de Sebystey, Ozyok, Irbistu, Sarikobu en Elangash valleien, plus een deel van de zuidelijke rand van de depressie. Het jaar daarop selecteerden we de Yustyd vallei als onderzoeksgebeid voor de tweede expeditie. Voor UNESCO's *Preservation of the Frozen Tombs of the Altay Mountains* project (2005-2006) werkten we zowel in het Russische als Kazachse deel van het gebergte. In 2005 werd de Dzhazator vallei geselecteerd, een hooggelegen vallei net ten noorden van het Ukok plateau, in het zuiden van de Russische Altaj, terwijl in 2006 drie verschillende gebieden in de Kazachse vallei als onderzoeksgebied werden gekozen: de Karakaba vallei, het hoger gelegen deel van de Bukhtarma vallei en de archeologische site Berel. In 2007-2008, tenslotte, werkten we aan de inventaris van het Etno-Natuurpark Uch-Enmek, in de vallei van de Karakol (Russische Altaj), in het kader van een Bilaterale wetenschappelijke samenwerking tussen de Universiteit Gent en de Staatsuniversiteit van Gorno-Altajsk.

Om de expedities tot een goed einde te brengen en zo productief mogelijk te maken werd een zo efficiënt mogelijke vorm van archeologische survey ontwikkeld, waarbij alle individuele archeologische structuren tot op een paar decimeter nauwkeurig werden gelokaliseerd met GPS (zie Hoofdstuk 3). Vooral het gebruik van de Leica SR-20, een kleine GPS ontvanger, is belangrijk, daar die ons in staat stelt snel een gedetailleerd site plan te genereren, rechtstreeks in het juiste coördinatenstelsel. Dit kan dan zonder probleem gekoppeld worden aan de satellietbeelden en DTMs uit de fotogrammetrische verwerking, in een geografisch informatie systeem (GIS).

De onderzoeksgebieden worden systematisch onderzocht op archeologische sites door te voet en in groep alle gebieden te controleren, de zogenaamde *field walking* of oppervlakte-prospectie. Hoewel het moeilijk is om in te schatten of alle structuren en sites op die manier werden gevonden, zijn we vrij zeker dat we weinig monumenten gemist hebben, en we zijn er dan ook van overtuigd dat de opgestelde inventaris zeker representatief is. Alle gegevens over de archeologische structuren – onder andere afmetingen, monument type, bouwmateriaal, beschrijving, voorlopige datering, foto's enz. – worden opgeslagen in de speciaal ontwikkelde Altari databank (Altaj Archeologische Inventaris).

Deze werkwijze werd getest en waar nodig aangepast tijdens de zes archeologische expedities van 2003 tot 2008. Het resultaat van deze archeologische prospecties is een lijvige databank met informatie over 12.047 individuele archeologische structuren in 10 valleien of 15 kleinere onderzoeksgebieden (Hoofdstuk 4). De structuren werden aangetroffen in meer dan

1.000 archeologische sites of concentraties van monumenten – hoewel over de definitie van het begrip 'site' kan gediscussieerd worden (zie 3.3.4 in de tekst). De meeste structuren dateren van de Vroege IJzertijd of Scythische periode: 4.406 structuren of ongeveer 37%. Eén vierde van de opgetekende monumenten, 25% of 3.073 structuren, dateert vermoedelijk van de Turkse periode, en 16% of 1.896 structuren werden gebouwd in de Bronstijd. Ongeveer 6% van de monumenten zijn Etnografische graven; het grootste deel van deze 701 graven lag in de Bukhtarma vallei, waar één begraafplaats zelfs uit 400 structuren bestond. Ten slotte konden 213 structuren toegeschreven worden aan de Hunno-Sarmatische periode, 47 stammen vermoedelijk uit het Laat Neolithicum, en 10 andere monumenten uit de IJzertijd (deze zijn niet duidelijk Scythisch of Hunno-Sarmatisch). Een aanzienlijk deel van de aangetroffen structuren kon niet gedateerd worden, omdat er geen duidelijke aanwijzingen waren in de vorm of de bouw van de monumenten, of omdat de monumenten niet worden vermeld in de bestaande archeologische literatuur. Soms kan de relatie tussen monumenten een aanwijzing zijn voor de datering van ongekende structuren, maar het is vooral een gedetailleerde typologie die dit probleem zo goed mogelijk moet kunnen oplossen (Hoofdstuk 5). Ongeveer 14% van de structuren (1.701 monumenten) konden niet gedateerd worden zonder verder onderzoek.

De tweede hoofddoelstelling was het opstellen van een typologie voor het archeologisch erfgoed van het Altaj-gebergte (Hoofdstuk 5). Aan de hand van literatuuronderzoek werden de gekende monument types op een rij gezet, waarbij vooral de problemen in naamgeving in kaart werden gebracht. Hoewel ook Russische werken werden gebruikt, is onze kennis van de Russische archeologische literatuur nog niet grondig genoeg om er zeker van te zijn dat we alle typologische studies hebben doorgenomen. Toch werd al snel duidelijk dat er nog geen alomvattende typologie bestond, en dat er veel verschillende namen in gebruik zijn die zorgen voor misverstanden. Ook het veldwerk in Altaj en diverse gesprekken met Russische, Kazachse en westerse archeologen wees op de noodzaak om de terminologie van de monumenten grondig te bespreken. Tijdens UNESCO workshops in maart en december 2006 werd hierover een eerste keer gediscussieerd (zie 1.4.3.6 in de tekst), waarna verder overleg werd georganiseerd met Igor Slyusarenko (Archeologisch en Etnografisch Instituut, Russische Academie voor Wetenschappen, Novosibirsk), Esther Jacobson-Tepfer (Universiteit van Oregon) en Eduard Dvornikov (Staatsuniversiteit van Gorno-Altajsk). De uiteindelijke typologie en terminologie is gedeeltelijk hierop gebaseerd en we zijn hen zeer dankbaar voor hun waardevolle bijdrage.

De gegevens van het veldwerk, de informatie uit de archeologische literatuur en de discussies met collega's stelden ons in staat om een grondige typologie op te stellen. De monumenten in Altaj kunnen in de volgende categorieën worden onderverdeeld (de terminologie wordt hier zo goed mogelijk vertaald vanuit het Engels): stenen heuvels, omwallingen, steenzettingen (geometrische vormen en lijnen), rechtopstaande stenen, steencirkels, plaveisels, *kereksur* (typische monumenten met centrale heuvel en cirkelvormige of rechthoekige omwalling), etnografische graven en plaatsen met rotsgravures. De meeste van deze categorieën zijn verder onderverdeeld in subklassen. Moderne grafvelden bij dorpen, rituele altaren of *ovoo* (stapels van stenen met gebedswimpels) en recente rituele structuren zoals Boerchanistische of

Boeddhistische altaren werden niet geregistreerd tijdens het veldwerk en werden dus ook niet uitgewerkt in de typologie.

We durven hopen dat de opgestelde typologie zal bijdragen tot een meer gestandaardiseerde terminologie voor de monumententypes in Altaj, die het onderzoek en de interpretatie van het archeologisch erfgoed in Altaj vooruit zal helpen. We willen echter niet beweren dat de voorgestelde typologie af is; ze staat ter discussie en we zijn maar al te bereid om ze te vervolledigen of verbeteren aan de hand van opmerkingen en suggesties van andere specialisten. Ook verder onderzoek – zowel verdere prospectie en inventarisatie als eventuele opgravingen – zal ons ongetwijfeld in staat stellen de typologie verder te verfijnen.

De laatste hoofddoelstelling was het bestuderen van het archeologische landschap (Hoofdstuk 6). Het Altaj-gebergte is immers zeer geschikt om het archeologische landschap tot ten minste het tweede millennium v.Chr. te bestuderen. De open steppes en rivierterrassen zijn perfecte voorbeelden van landschappen die al die tijd intact bewaard zijn gebleven. Bewoning is hier altijd zeer beperkt gebleven, zelfs tijdens de laatste decennia, en de monumenten zijn grotendeels intact bewaard gebleven.

Vertrekkende vanuit de resultaten van de archeologische survey en van de verwerking van de CORONA satellietbeelden tot bruikbaar kaartmateriaal, bestudeerden we de verschillende onderzoeksgebieden op verschillende niveaus. Een eerste analyse had betrekking op de verspreiding van monumententypes uit diverse perioden over het totale studiegebied. Hun afwezigheid of aanwezigheid in specifieke valleien is interessant, en kan gekoppeld worden aan specifieke kenmerken van het natuurlijke landschap in de verschillende gebieden. Soms wijst een verspreidingspatroon duidelijk op het bereik van een bepaalde culturele horizont (zoals de *kereksur* monumenten, die duidelijk hun parallellen vinden in het Mongoolse binnenland, en dan ook enkel in de oostelijke studiegebieden van de Russische Altaj voorkomen).

Daarna bestudeerden we de specifieke locatie, organisatie en oriëntatie van de verschillende monumententypes op het niveau van de sites. De meeste monumententypes en sites hebben een zeer regelmatige opbouw, wat wijst op wijd verspreide en goed gekende tradities die over verschillende generaties werden doorgegeven. Ook de interactie tussen monumenten van verschillende periodes – hun locatie ten opzicht van elkaar en het al dan niet respecteren van oudere monumenten – werd onderzocht en leverde interessante observaties.

Spijtig genoeg bleef de waaromvraag verschillende malen onbeantwoord, wat het soms moeilijk maakte om een coherent archeologisch verhaal te vertellen. Waarom plaatste de Scythische bevolking zijn graven in een noord zuid georiënteerde rij? Waarom bouwden de Turken hun monumenten veelal dicht bij de Scythische monumenten, en richtten ze hun rijen rechtopstaande stenen naar het oosten? Waarom is grondplan van een *kereksur* zo complex, en wat betekenen die centrale heuvel, omwalling, straalvormige muurtjes en bijhorende structuren?

Hoewel dit onderzoek duidelijk de vele mogelijkheden toont die de verzamelde data ons geven om het archeologische landschap in detail te bestuderen, zijn we er ons bewust van dat

nog niet al die mogelijkheden hier ten volle zijn uitgebaat. Er is nog veel verder onderzoek mogelijk, en nodig. Vooral de mogelijkheden van ruimtelijke analyse met behulp van GIS technieken en statistische analyse moeten bij verder onderzoek aangewend worden. Ook zou het interessant zijn om meer informatie uit opgravingsverslagen en materiaalstudies (ook en vooral uit de Russische literatuur) bij de analyse te betrekken. Dit zou ons in staat stellen om de sociale differentiatie van grafvelden te analyseren, de chronologie van de monumenten and de mogelijke verbanden tussen de begraven individuen binnen één of tussen verschillende grafvelden.

Toekomstperspectieven

Het werk dat hier werd gepresenteerd moet zeker worden verdergezet en uitgediept, en dit op verschillende vlakken. Ten eerste zouden we graag de studie van het landschap verder uitwerken aan de hand van geavanceerde GIS technieken. In dit opzicht is het gunstig dat het Nationale Fonds voor Wetenschappelijk Onderzoek (België) nieuw onderzoek aangaande het archeologische landschap van het Altaj-gebergte heeft goedgekeurd. Het project zal lopen van 2009 tot 2012 (FWO no. 3G004209). Het hoofddoel van dit project is de studie van de mentale structuur van het landschap zoals het gezien en ervaren wordt door de nomadische bevolking in Altaj, door te focussen op hun funeraire en rituele monumenten. Een bijkomend doel is het bestuderen van de sociale structuren en hun complexiteit, waarbij we de totnogtoe gebruikte binaire opvatting van “elite” versus “gewone volk” verder willen uitdiepen, meer specifiek met betrekking tot de Vroege IJzertijd of de Scythische samenleving. Het project zal ons toelaten het hier voorgestelde werk verder uit te werken en de tekortkomingen op te lossen. We kijken er naar uit om zo snel mogelijk aan de slag te gaan.

Een ander belangrijk aspect van dit project is dat het ons de kans biedt om een aantal beperkte opgravingen te doen op enkele tot op heden onbekende structuurtypes zoals de ‘virtual dwellings’ (besproken in Hoofdstuk 5), om functie en/of toewijzing aan een bepaalde cultuur te achterhalen.

Buiten deze landschappelijke aspecten zijn we ook vastbesloten om het ‘Frozen Tombs Initiative’, dat nu wordt geleid door UNESCO’s Wereld Erfgoed Centrum, verder op te volgen. Indien mogelijk – afhankelijk van het vinden van de nodige financiering – zouden we graag verdere stappen zetten in het proces van conservatie en het in kaart brengen van het bedreigde archeologische erfgoed van het Altaj-gebergte.

Continuïteit op het vlak van het in kaart brengen en controleren van de permafrost regio’s in Altaj werd reeds verzekerd door een doctoraatsonderzoek aan de Vakgroep Geografie (2008-2011). Drs. Ruben Van de Kerchove zal de permafrost bestuderen aan de hand van thermale remote sensing data zoals Landsat en Aster en een kaart produceren van de permafrost gebieden in Altaj. Prof. Dr. Rudi Goossens is de promotor van dit onderzoek.

Resultaten

De belangrijkste verdiensten van dit onderzoek zijn de volgende:

Ten eerste, het is de eerste keer dat satelliet remote sensing gebruikt werd om de archeologie van Altaj te bestuderen. Dit opent nieuwe perspectieven voor lokale onderzoekers, zeker omdat de beelden gemakkelijk te verkrijgen zijn aan een lage kostprijs. Vanzelfsprekend kan de methodologie ook buiten Altaj toegepast worden om – vooral verafgelegen en moeilijk bereikbare – gebieden op een efficiënte manier in kaart te brengen.

Ten tweede zijn we er van overtuigd dat de ontwikkelde prospectiemethode kan bijdragen tot de efficiëntie en kwaliteit van archeologische survey projecten in de Altaj. Het gebergte strekt zich uit over een enorm gebied dat verdeeld wordt over vier landen en is bedekt met een ontelbaar aantal archeologische monumenten. Aangezien meer en meer van deze monumenten vernield worden is het, los van het wetenschappelijk belang, zeer belangrijk dat zoveel mogelijk van dit culturele erfgoed gedetailleerd wordt geregistreerd in de komende jaren.

Ten derde is dit de eerste keer dat een dataset van meer dan 12.000 monumenten uit het gebied geanalyseerd werd, resulterend in een uitgebreid overzicht van de monumenttypes in de Altaj. Tot nu toe was er geen bruikbare typologie voor handen, en de uiteenlopende en onnauwkeurige terminologie van monumenttypes zorgde voor danige verwarring in de archeologische literatuur.

Ten laatste, de studie van het archeologische landschap levert inzichten die nooit verkregen kunnen worden door enkel opgravingen. We hopen hiermee aan te tonen dat archeologische survey en landschapsanalyse veel voordelen hebben. Op deze manier willen we ook de – helaas – nog steeds aanwezige opvatting tegenspreken dat opgraven de enige echte manier is om aan archeologisch onderzoek te doen.

List of abbreviations

3-D	Three-dimensional
ASTER	Advanced Spaceborne Thermal Emission and Reflection radiometer
BCE	Before the Common Era
BP	Before Present
CE	Common Era
CIA	Central Intelligence Agency
DEM	Digital Elevation Model
DSM	Digital Surface Model
DTM	Digital Terrain Model
DGPS	Differential Global Positioning System
EROS	Earth Resources Observation Systems
GASU	Gorno-Altaysk State University
GCPs	Ground Control Points
GIS	Geographical Information Systems
GPS	Global Positioning System
IAE SBRAS	Institute of Archaeology and Ethnography, Siberian Branch of the Russian Academy of Sciences
KH-4A	Keyhole 4A, CORONA sensor type
KH-4B	Keyhole 4B, CORONA sensor type
msl	metre above sea level
NARA	National Archives and Records Administration (USA)
NASA	National Aeronautics Space Administration (USA)
NRO	National Reconnaissance Office (USA)
RMAH	Royal Museums of Art and History, Brussels
RMS	Root Mean Square
SB RAS	Siberian Branch, Russian Academy of Sciences (Novosibirsk)
SRTM	Shuttle Radar Topographic Mission
TIR	Thermal Infra Red
UGent	Ghent University
USGS	United States Geological Service
USSR	Union of Soviet Socialist Republics
UTM	Universal Transverse Mercator

Technical notes

The accompanying data discs, which you will find at the back of this thesis, contain the Altari database and all cartographic data. Some extracts of site plans have been inserted in the text as an illustration, and so have some larger overview maps. However, a detailed site plan of all archaeological sites recorded can be found on the disc as Adobe PDF file. The large, folded overview maps at the back of this volume have been downscaled (63.5%) from the original A2 format maps. The original, digital versions can be found on the disc as well, in full format. Please keep in mind that the scale mentioned on the hard copies is the original scale of the A2 document. For more information on how to consult the data discs, please see 13 - Deliverables.

The spelling of Russian names (persons, geographical names, cultures etc.) in this work has been done according to the British national transcription system[1]. However, common English spellings of well-known Russian names (for example, the Tsar Peter, instead of Pyotr) have been retained. For the sake of consistency with earlier papers and other reference works, or to aid pronunciation, some names have a slightly different transliteration.

Transcribing geographical and other names is often problematic, especially if names have been changed during history, or if different transcriptions are in use. Some Altayan place names, for example, have several different transcriptions in Russian, and what is written on a map may not necessarily have the same spelling as what you read on road signs. Although the transliteration is consistent throughout this text, it may differ from that used in other texts.The transliteration for monument types, if required, is done following the same system. If the words are not included in the Oxford English Dictionary, they are italicised in the text: e.g. *kereksur*, *balbal*, *ogradka*. We decided not to use plural forms of these words as these would have to be the correct Russian or Turkic forms, which might be confusing for the reader. However, the Russian word for burial mound, a kurgan, is included in the Oxford English Dictionary and has a plural form: kurgans.

A special word is needed to explain the bibliographical system. The transliteration of author names can vary widely, depending on the language of the publication. We respected the original transliteration in the references (e.g. Slyusarenko 2004, Sljusarenko 2007, Slusarenko 2001) as this facilitated research. However, this means that it may be possible that work from the same author is not listed together in our list of references. In the text, we use the above-mentioned transliteration system and thus refer to 'Slyusarenko' in all cases.

[1] We chose this simplified transcription system to facilitate reading. Other transliteration systems (such as LC, BSI or ISI) have been devised to transliterate the Russian original as precisely as possible. That is certainly essential for literary studies, etc. but did not seem necessary here. We have only added the transliteration of the Russian soft and hard sounds to the UK transcription system: ' for **ь** and " for **ъ**. For example: Полос**ь**мак - Polos'mak.

Table of contents

Preface ..... **i**

Acknowledgements ..... **iii**

Russian abstract - Русский краткий обзор ..... **v**

Dutch abstract - Nederlandse samenvatting ..... **xiii**

List of abbreviations ..... **xxi**

Technical notes ..... **xxiii**

Table of contents ..... **xxv**

1 Introduction **31**

1.1 Aims and objectives of the research 34
1.2 Structure of this PhD thesis 35
1.3 Geographical setting and cultural overview 36
1.3.1 The Altay Mountains and the Eurasian steppe 36
1.3.2 The archaeology of the Altay Mountains 39
1.4 History of the archaeological research in Altay 49
1.4.1 Archaeological research in the Altay Mountains 49
1.4.2 From excavation to survey 53
1.4.3 Belgian archaeological research in Altay, 1992-2008 57
1.4.4 The Frozen Tombs of the Altay Mountains project 63

2 Methodology for mapping the Altay Mountains **69**

2.1 Introduction 69
2.2 Using CORONA satellite imagery for mapping purposes 70
2.2.1 The CORONA reconnaissance programme 70
2.2.2 CORONA satellite imagery and the archaeological research 74
2.2.3 Stereoscopic properties of CORONA 74
2.2.4 Image distortions in CORONA imagery 76
2.2.5 Use of CORONA Imagery 78
2.2.6 Digitising the imagery 84
2.2.7 USGS scans of CORONA images 84
2.2.8 Stereoscopic viewing and morphographic maps 89

2.3 Gathering GCPs for the restitution 89
2.3.1 The Global Positioning System (GPS): an introduction 89
2.3.2 Comparison of three different GPS systems 90
2.3.3 Results for the positioning accuracy of the three systems 91
2.3.4 Overview of the systems used, 2004-2007 92
2.3.5 Selection of GCPs, 2003-2007 92
2.4 Digital photogrammetrical restitution 95
2.4.1 The restitution process 95
2.4.2 Resulting products 97
2.5 Overview of the restitution process in the different research areas 99
2.5.1 The southern part of the Chuya depression 100
2.5.2 The Yustyd valley 104
2.5.3 The Dzhazator valley 104
2.5.4 The Kazakh Altay Mountains 108
2.5.5 The Karakol valley and Uch-Enmek Park 113
2.6 Conclusions 116

3 Methodology for the archaeological survey 117

3.1 Systematic survey of the research areas 118
3.2 Localisation of the sites and monuments 123
3.2.1 General localisation of the sites 123
3.2.2 Precise localisation of the individual structures 123
3.3 Recording the archaeological heritage 127
3.3.1 Site and structure description in the field 127
3.3.2 Defining the chronology of the monuments 128
3.3.3 The numbering of sites and structures 130
3.3.4 Definition of a 'site' 131
3.3.5 Remarks on the orientation of sites and structures 134
3.4 A GIS-related archaeological database: Altari 136
3.4.1 Description of the database 136
3.4.2 Database fields in English and Russian 138
3.4.3 The Geographical Information System 141
3.5 Conclusions 144

4 Data gathering: overview of the survey campaigns 2003-2007 145

4.1 Survey of Sebystey, Irbistu, Ozyok, Elangash and the Southern Chuya steppe in 2003 146
4.1.1 Survey results 146
4.2 Surveys in the Yustyd valley in 2004 and 2006 149
4.2.1 Survey results in Yustyd 150
4.3 Survey in the Dzhazator valley in 2005 151

4.3.1 Survey results in Dzhazator 152
4.4 Survey in the Kazakh Altay in 2006: the valleys of Buktharma and Karakaba 153
4.4.1 Overview of the research area 153
4.4.2 Survey results in Karakaba, Bukhtarma and Berel 153
4.5 Survey of the Uch-Enmek Park in the summer of 2007-2008 156
4.5.1 Overview of the research area 156
4.5.2 The Uch-Enmek Ethno-Natural Park 156
4.5.3 Archaeological fieldwork in Karakol 157
4.6 Overview of the survey results, 2003-2008 158
4.7 Additional information on the survey campaigns 160
4.7.1 Permafrost research in Dzhazator, 2005 160
4.7.2 Permafrost research in 2006 160
4.7.3 Permafrost research in Karakol, 2007 162
4.7.4 Aerial survey and photogrammetry in Karakol, 2007 163

5 Typology of the monuments in the Altay Mountains 167

5.1 Defining the monument types 169
5.1.1 General problems of naming 169
5.1.2 Overview of the monument types in Altay 171
5.2 Stone mounds 173
5.2.1 Scythian burial mounds 176
5.2.2 Turkic burial mounds 185
5.2.3 Hunno-Sarmatian burial mounds 187
5.2.4 Mounds with a demarcating stone setting or 'collared mounds' 189
5.2.5 Four-cornered mound, with or without marked border 192
5.3 Kereksur monuments 194
5.3.1 General layout 194
5.3.2 Interpretation and chronology 195
5.3.3 Overview of the types of *kereksur* in our research areas 196
5.3.4 Analysis 202
5.4 Stone enclosures 209
5.4.1 Rectangular Turkic enclosure or *ogradka* 209
5.4.2 Round enclosures of the Afanas'ev culture 212
5.5 Stone settings and stone lines 213
5.6 Rectangular stone setting or 'dwelling' 216
5.6.1 Different dwelling types in our research areas 218
5.6.2 Associated structures: stone lines, stone pavements, standing stones 223
5.7 Standing stones 225
5.7.1 Steles or massive standing stones 226
5.7.2 Deer stones 228
5.7.3 Turkic image stones or *izvayanie* 240

5.7.4 False image stone 245
5.7.5 *Balbal* or row of standing stones 247
5.8 Circular stone settings 248
5.8.1 Stone circles in our research areas 249
5.8.2 Solitary stone circles and semi-circles in the research areas 251
5.9 Stone concentrations and pavements 251
5.10 Petroglyphs, tamga and inscriptions 252
5.11 Ethnographic graves 254
5.12 Other structures 255
5.13 Conclusions 257

6 The archaeological landscape of the Altay Mountains 259

6.1 Introduction 259
6.2 The different natural landscapes in the research areas 260
6.2.1 The Chuya steppe 260
6.2.2 The Sebystey valley 262
6.2.3 The Ozyok valley 262
6.2.4 Irbistu and Sarikobu 263
6.2.5 The Elangash valley 265
6.2.6 The Yustyd valley 267
6.2.7 The Dzhazator valley 269
6.2.8 The Karakaba valley 270
6.2.9 The Bukhtarma valley and the Berel site 271
6.2.10 The Karakol valley (Uch-Enmek Ethno-Natural Park) 272
6.2.11 Conclusions 274
6.3 The distribution of the main monument types over the different research areas 275
6.3.1 Afanas'ev graves or round enclosures 275
6.3.2 *Kereksur* monuments 276
6.3.3 Four-cornered mounds and collared mounds 280
6.3.4 Deer stones 280
6.3.5 Dwellings 283
6.3.6 Early Iron Age or Scythian burial mounds 283
6.3.7 Hunno-Sarmatian graves 285
6.3.8 Turkic burial mounds and enclosures 285
6.3.9 Ethnographic burials 288
6.3.10 Conclusions: shifting cultural landscapes 290
6.4 Regional differences in the archaeological landscape 290
6.4.1 Distribution of monuments in the southern part of the Chuya region 290
6.4.2 Organisation of the Yustyd archaeological complex 295
6.4.3 The duality of the archaeological landscape in Dzhazator 300
6.4.4 The Karakaba valley 307

6.4.5 The archaeological landscape of the Bukhtarma valley 311
6.4.6 Preliminary observations in the Karakol valley 314
6.5 Some reflections on the location and interaction of individual monuments 315
6.5.1 The organisation of Scythian burial mounds 315
6.5.2 Organisation of the Yustyd archaeological complex 317
6.5.3 Interaction between monuments of different date 319
6.5.4 Orientation and preoccupation with the cardinal directions 322
6.6 Conclusions 324

7 Protection and preservation 325

7.1 Threats to archaeological heritage 325
7.1.1 Natural threats 325
7.1.2 Human threats 328
7.2 Use of the resulting database for the protection of the Altay heritage 331

8 Conclusions and future perspectives 333

8.1 Conclusions 333
8.2 Future perspectives 336

9 Appendix 343

9.1 Appendix 1: recommendations – UNESCO International Workshop 343
9.2 Appendix 2: Ghent declaration – UNESCO International Conference 346

10 Bibliography 349

11 List of figures 365

12 List of tables 377

13 Deliverables 379

1 Introduction

The Altay Mountains or Gorny Altay are situated where south-western Siberia meets Central Asia, near the boundaries of China, Kazakhstan, Mongolia and the Altay Republic (Russian Federation) (Figure 1.1). The Altay has a unique cultural heritage and is considered to be one of the major archaeological areas in the world. Scattered across the Altay Mountains are thousands of surface structures – funerary monuments, ritual structures and petroglyphs – of different, mainly nomadic civilisations, from the Eneolithic to the Ethnographic period (from the 3rd millennium BCE to the beginning of the 20th century CE). They are silent witnesses of the important role the Altay region has played in human civilisation, with interaction and mutual influence between the Altay and neighbouring regions, home of the major cultures of ancient Central Asia. These surface structures are uncommonly well preserved; thanks to the specific geographical context with little sedimentation and erosion, low population density and limited urbanisation, until the present day. Even smaller monuments, comprising no more than a few stones, are still visible today, presenting us with a unique view of past and present landscapes. Together, the fascinating spread of mountain ranges, high plateaus, welcoming valleys and vast intermontane steppes make it easy to appreciate this magnificent cultural landscape.

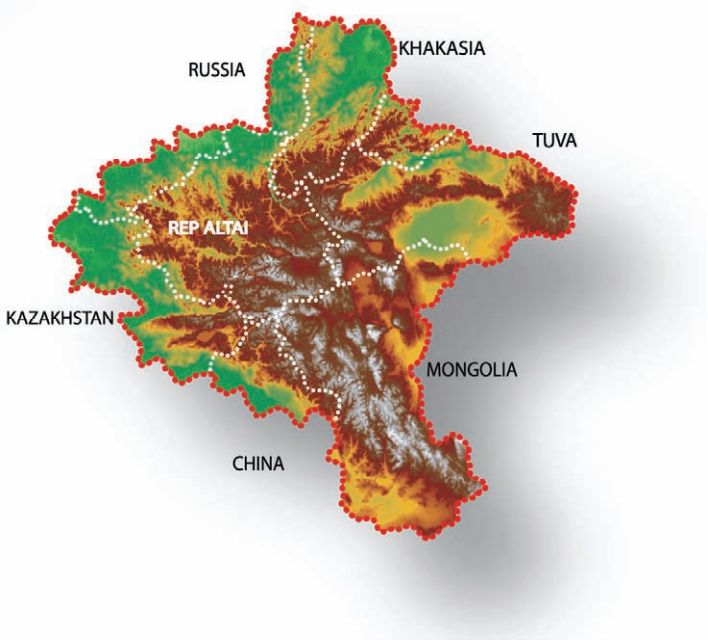


Figure 1.1: An overview of the Altay Mountains with the present-day borders of the Russian Federation and its republics, Mongolia, China and Kazakhstan (white dots). The red dots roughly indicate the extent of the Altay

The well-preserved archaeological landscape is, of course, not only aesthetically valuable. It offers a unique opportunity to study the ancient populations who have inhabited the area over the last four to five millennia. Studying the cultural landscape as a whole could help us to understand how these peoples lived, as the surface monuments reflect many different aspects of daily life. In the last decades, the concept of studying the archaeological landscape as a whole

has developed quickly, and is rightly considered an important part of archaeological research. Other than excavating single monuments or single sites, study of an archaeological landscape involves an integrated, regional study of sites and artefacts, as aspects of living societies that once occupied the landscape. The term 'landscape archaeology' first came into use in Britain in the mid-1970s and has evolved significantly ever since. Conventional landscape archaeology tends to be empirical and heuristic, while more recent forms of 'post-processual' landscape archaeology, which have emerged since the beginning of the 1990s, try to go beyond the evidence to develop more experiential approaches, including phenomenology (Fleming 2006).

Landscape archaeology is a rather new way of looking at the archaeology of the Altay Mountains. In the past, research was mainly limited to excavations, sometimes with little consideration for the context of the monument or the site under investigation, and the landscape was excluded from most studies. Some survey projects have emerged in the last decades, bringing the landscape into focus and giving better balance to the archaeological research. Not all of these projects included a real study of the archaeological landscape – some are strictly executed for purposes of heritage management or to prepare for excavation campaigns – but it is important that these survey initiatives are continued and developed (see 1.4.2). The method of mapping sites and the geographical background could be improved in some of these survey projects, and we hope this study can contribute to this. Gathering data for the study of landscapes is done by organising regional surveys. These should be broad, accurate and comprehensive, and should include registration of all forms of surface structures or surface archaeology: burial mounds, stone circles, *kereksur*[1], standing stones, petroglyphs and many more. It is important to locate these structures as accurately and precisely as possible to enable a study of the spatial context and geographical distribution of sites and structures, which is essential for interpreting and understanding the archaeological landscape. In addition, it is important to have background geographical data – topographical maps – on a suitably large scale; preferably 1:20,000 to 1:50,000. If these data are not available, as is the case for the Altay Mountains, alternatives must be found.

Gathering topographical data from the ground, using GPS receivers or total stations – a combination of a theodolite, a distance meter and a data collector – might be a possibility, but is extremely expensive for large-scale surveys. Therefore, archaeologists are becoming increasingly interested in cost-effective methods of gathering information from other sources. In particular, in areas where organising fieldwork is difficult or very expensive, remote sensing data may be the solution. Aerial photography can serve mapping purposes, especially if the photos are taken in photogrammetric surveys with the usual 60% overlap. These photos can then be used as stereo images and provide information on height. In addition, aerial photos are highly detailed and reveal a whole array of archaeological traces, including surface structures, soil marks and

[1] *Kereksur* is the transliteration from Russian. When transliterating from Mongolian – it is a Mongolian term – the name is *khirigsuur*

crop marks. However, aerial photography coverage is still not available to the public in many countries. Satellite remote sensing is a viable alternative, as historical images like those from the American CORONA reconnaissance satellite achieved details up to 6 feet (1.8 m). The images have been freely available since the declassification in 1995 and 2002, and deliver stereo coverage.

During 2002-2003, a study at Ghent University in Belgium evaluated the use of CORONA KH-4A imagery for mapping remote areas, using some valleys in the Altay Mountains as the research area (Gheyle & Trommelmans 2002). An investigation was made into the appearance of archaeological structures on the imagery. The conclusion drawn was that only the major archaeological structures, such as burial mounds – generally 4 to 12 metres (m) in diameter – could be distinguished – the smaller, more numerous associated structures were invisible. More importantly, a photogrammetrical restitution was done of a CORONA stereo pair over the Sebystey valley, resulting in a usable stereo model and contour map (Gheyle et al. 2004).

We decided to use CORONA imagery for our study of the archaeological landscape of the Altay Mountains. During the first years of this research, imagery processing was refined with the help of the university's geography department. The resulting data forms the background for the intensive archaeological surveys that were organised every summer from 2003 to 2008, in which over 12,000 archaeological monuments were recorded. A methodology was developed to locate these structures with sub-metre accuracy in a time-efficient way, using GPS measurements with post-processing. A specially devised archaeological database stores all the data, making it available for analysis. Combining the archaeological data with the geographical products makes it possible to study the archaeological landscape in an integrated way: Where did the population of a certain culture prefer to build their burial sites or individual graves? Where on the landscape are the ritual monuments located? We can reconstruct the archaeological landscapes from the different chronological and cultural subdivisions, and analyse to what extend the successive populations or cultures actually reused the settings of older burial or ritual sites or, alternatively, avoided them.

The main accomplishments of this research are the following:

First, it is the first time satellite remote sensing has been used to study the archaeology of Altay. This opens up new perspectives for local researchers, especially as the imagery is freely available at little cost. The methodology is of course not limited to the Altay Mountains – it can be used to map remote areas all over the world in an efficient and cost-effective way.

Secondly, we are convinced that the methodology developed can contribute to the efficiency and quality of archaeological survey projects in the Altay and possibly elsewhere. The Altay Mountains cover vast areas over four different countries and the archaeological monuments are countless. Apart from the scientific value of detailed records, it is important that as much of this invaluable cultural heritage as possible is recorded in years to come, as more and more destruction is taking place (see 7.1).

Thirdly, this is the first time that a dataset of over 12,000 monuments has been analysed, resulting in a comprehensive overview of monument types in the Altay. Archaeological literature includes many different and somewhat confusing names for monument types, meaning that a usable typology is virtually non-existent at the moment.

Finally, the study of the archaeological landscape provides insights that could never have been attained based only on excavations. We hope to demonstrate that archaeological survey and landscape analysis do have many benefits, thereby countering the – sadly – still smouldering notion that excavating is the only real way of carrying out archaeological research.

1.1 Aims and objectives of the research

The general objectives of this research are threefold:

- To develop a methodology for the detailed mapping of the research areas in the Altay Mountains, by assessing the potential of CORONA satellite imagery as a mapping technique and developing a way of efficient and accurate archaeological survey;
- To build up a clear and comprehensive typology of the archaeological monuments that were recorded during surveys in the selected research areas; and
- To study the archaeological landscape of the Altay Mountains, using the resulting archaeological database and the geographical products resulting from the digital photogrammetrical process.

Further objectives go deeper into these three general aims. In the first category of mapping and survey, these are:

- To develop a usable and efficient methodology for gathering ground control points (GCPs) in the research areas as accurately as possible during the annual fieldwork;
- To develop a methodology for the production of reliable maps and digital surface models (DSMs) based on the CORONA imagery. This was done entirely with the co-operation of the geography department;
- To develop an efficient means of archaeological survey, including the accurate positioning of all individual archaeological structures; and
- To implement and test these techniques in archaeological surveys of selected research areas in the Altay Mountains. The use of broad, accurate and comprehensive surveys is essential when studying the archaeological landscape, and should therefore be promoted as much as possible.

The second objective on the typology of the archaeological heritage in Altay includes the following goals:

- To review the literature for general use of monument types, including as many Russian works as possible, and to identify problems in naming monument types, be they language-related or other difficulties; and
- To develop a typology that is as efficient and correct as possible, taking into account the problems of interpretation in visual surface surveys without excavations, more specifically problems with chronology.

The study of the archaeological landscape is a compilation of the following objectives:

- To analyse the distribution of monument types from different periods at intra-site and inter-site level, and to analyse the interaction between these different monuments; and
- To analyse the different archaeological landscapes in the research areas, and to establish possible factors that caused these differences.

1.2 Structure of this PhD thesis

This thesis is divided into seven chapters, each focusing on a different aspect of the research. The first chapter is an introduction covering the aims and objectives of the research, as stated above, plus a geographical overview of the research area. It also includes a cultural overview of the archaeology of the Altay Mountains, and a history of the archaeological research, including successive projects in this area researched at Ghent University.

Chapter 2 discusses the methodology for mapping the research areas with CORONA imagery. Questions covered include what is the CORONA project, how can we use the imagery for archaeological research, and what do we need for the photogrammetrical restitution? An overview is given of the products that resulted from the topographical fieldwork and the image processing for all research areas from 2003 to 2008.

All aspects of the archaeological survey are covered in Chapter 3, beginning with the actual fieldwork. The search for an accurate and efficient localisation system is described, as well as the resulting database and geographical information system (GIS) project.

An overview of the successive expeditions is given in Chapter 4, with a summary of the survey results.

Chapter 5 focuses on the complex typology of the archaeological structures in the research areas and, to a large extent, in the Altay Mountains as a whole. In collaboration with colleagues who are also active in this area, we set up a comprehensive typology that takes into account the many confusing or incorrect names of monument types which are currently in use.

The deeper analysis of the survey results is discussed in Chapter 6, within the archaeological landscape. This study involves the distribution of monument types in the various research areas, and the interaction between monuments from different chronological layers. We look for differences between the individual research areas and try to link these with the geographical and geomorphographical characteristics of the varying landscapes. Alternatively, the question is

asked whether a pattern can be identified which is visible on a larger scale. The link with the Mongolian archaeological landscape is clear, although not in all of our study areas.

Finally, Chapter 7 delves into the factors that are endangering the archaeological heritage of the Altay Mountains, and threatening the existence of this unique cultural landscape. Our survey work can help to protect it from some of the menacing elements.

A conclusion is given in Chapter 8, after which the reader can find the appendix, lists of references, figures and tables, and an overview of the deliverables.

1.3 Geographical setting and cultural overview

1.3.1 The Altay Mountains and the Eurasian steppe

The Altay Mountains comprise Siberia's highest mountain system and stretch out over parts of China, Kazakhstan, Mongolia and the Altay Republic (Russian Federation) (see Figure 1.2). The Altay was formed between the middle Cambrian and the beginning of the Devonian (the late Caledonides), its present geomorphology resulting from a complex geological history, repeated folding and glaciations. The Altay Mountains form the headwaters of the Irtysh, Ob and Yenisei Rivers, and represent a complex system of chains separated by large valleys, intermontane basins and plateau-topped highlands. The highest point is part of the Katun Ridge in the central Altay. Its highest peak, the Belukha, reaches 4,506 m. The second highest point is located in the south-east, where the Kuitun peak dominates the massif Tabyn-Bogdo-Ola (Tavan-Bogd or Five Holy Mountains) at an altitude of 4,374 m. This is the highest point in Mongolia. Three major types of landscape can be distinguished in the Altay: the ancient peneplain, alpine glacial relief, and intermediate mountainous landscapes. They account for approximately one-third, one-sixth, and half of the total area, respectively (Shahgedanova 2002: 314-349).

Ancient peneplains are sharply defined, broad elevated plateaus with isolated peaks or ridges, and are among the Altay's most remarkable feature. They are particularly characteristic of the southern and eastern Altay. Examples include the Ukok plateau, on the border with China, Mongolia and Kazakhstan – also well known for its archaeological heritage – and the Chulyshman plateau in the east, near the border between the Altay Republic and Tuva. These plateau-topped highlands consist of meadow and small trees forming mountain tundra vegetation. Even today, they are used as summer pastures for cattle. At an altitude above 2,000 m, the plateaus are dominated by periglacial landscapes with moraines, boulders and shallow lakes of glacial origin (Shahgedanova 2002: 314-349).

The alpine landscapes are typical in the central part of the mountains. The highest parts of the Katun, Chuya, Kuray, Sailyugem and Cikhachev ridges (up to 4,000 to 4,500 m) make up these stepped landscapes of high-alpine relief, with strong contrasts in elevation, deeply incised glacial valleys and cirques, which often contain lakes. This higher mountain area is covered by (sub) alpine meadow or mountain steppe vegetation.

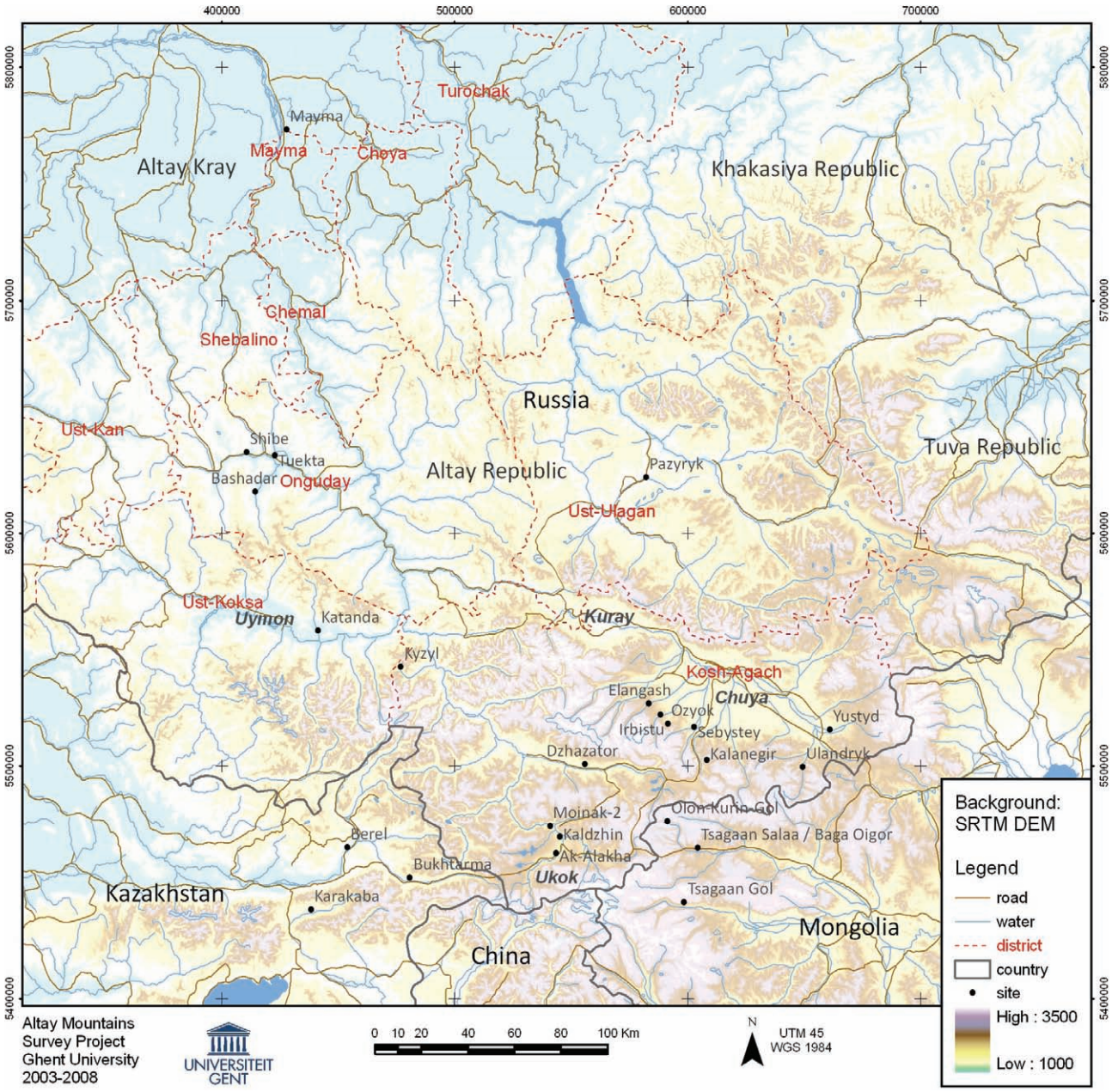


Figure 1.2: Overview map of the Altay Mountains and the Russian Altay Republic, with indication of some of the important archaeological sites mentioned in the text

In the northern and western regions, between 800 and 1,800 to 2,000 m, the intermediate mountainous landscapes develop. They are strongly dissected by a well-developed hydrographic network. River valleys reach 300 to 800 m in depth. Mountain taiga (coniferous forest) covers most of the lower mountain ranges. Heavily eroded ridges mark the marginal sections of the Altay, where the intermediate landscapes pass into the foothill steppes (Bourgeois et al. 2000a: 13-14).

Typical for the south-eastern and eastern part of the Altay are the vast flat-bottomed intermontane depressions (among others the Chuya, Kuray and Uymon steppes), known locally as ‘steppes’ because of their typical vegetation (see Figure 1.2). These intermontane basins form the driest areas of the Altay. The bottom of these depressions comprises alluvial and glacial

sediments coming from the surrounding ridges that can be 2,000 to 3,500 m higher. Many of the intermontane depressions and flat-bottomed valleys are former lake basins which were formed when streams were dammed by glaciers or moraines during the intermediate interval of the late Pleistocene glaciation (Novikov et al. 1996). The two largest lakes were located in the Kuray and Chuya steppes (Figure 1.3), holding at least 1,000 km³ of water. In recent years, much attention has been given to catastrophic flooding caused by these ice-dammed lakes bursting. Indeed, the landforms and sedimentary deposits, such as coarse-gravel dune fields in both Chuya and Kuray, testify to such events. Although the exact scale of the flooding is still disputed, some reconstructions suggest that discharges from the glacial lakes might have been among the most dramatic cataclysmic floods ever (Franz 1973: 338-343).



Figure 1.3: Overview of the Chuya steppe towards the North Chuya range, about 30 km away

A temperate continental climate with relatively short but hot summers from June to August and long, cold winters from November to March dominates the Altay Mountains. The average annual temperatures lay between +1°C and -6.7°C, depending on the specific location. The relief greatly affects the climate of Altay and forms vertical climatic zones: the lowlands (up to 500 m); the midlands (up to 2,000 m) and the highlands (over 2,000 m). Thus, mean temperatures in January range from -9.2°C to -31°C. Winter is especially severe in the intermontane basins where the 'heavier' cold air stagnates, making it 10 to 15°C colder here than higher in the mountains. Over 2,300 glaciers cover the high ridges of the Altay, with a combined area in excess of 1,500 km² and a total water reserve of 39 km³ (Shahgedanova 2002: 322). The south-east of the Altay Mountains is underlain by discontinuous permafrost or perennial frozen ground. Permafrost is widely but irregularly distributed in the Altay, with island permafrost in the western and north-western regions and only seasonal freezing of the ground in the margins of the mountains (Marchenko 2008).

The mountains form a transition zone in the Eurasian steppe, which stretches out east and west of the Altay. The Eurasian steppe zone occupies the areas between 55° and 40° north, from the borders of the Black Sea to Manchuria, over more than 5,000 km (Figure 1.4). It is divided

into the Black Sea steppe, the Kazakh steppe and the Mongolian steppe by the Altay-Sayan mountain system and the Urals. The combination of forest steppe, grassland steppe, semi-desert steppe and mountain steppe provide the perfect natural environment for a nomadic pastoral way of life (Bourgeois et al. 2000a: 13).

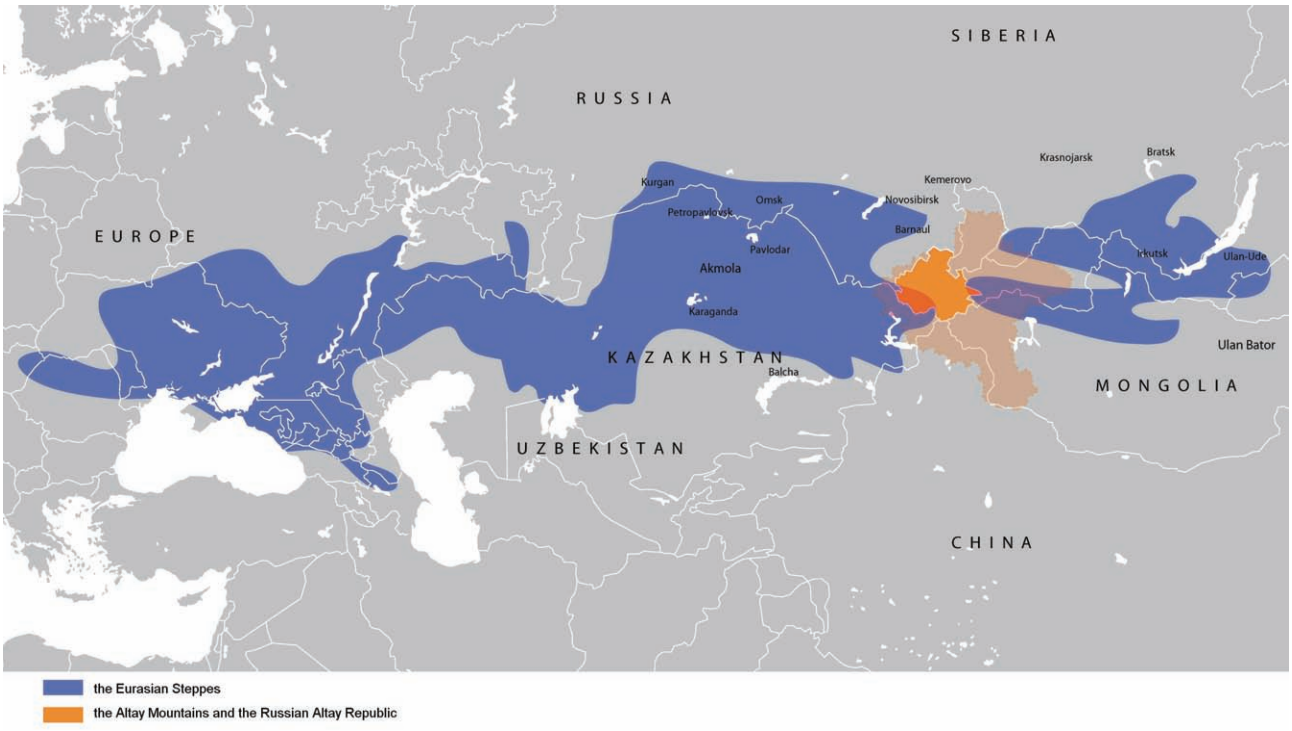


Figure 1.4: The Eurasian steppes stretching from the Black Sea to Manchuria, showing the location of the Altay Mountains

1.3.2 The archaeology of the Altay Mountains

For thousands of years, the Altay Mountains have been an important transitional region between the Mongolian and Kazakh steppe. The exchange of trade and culture make it a very interesting archaeological area. The region has an extraordinary number of archaeological monuments which can be assigned to many different archaeological cultures with a complex chronology.

In this chapter, we give a summary overview of region's archaeology as a framework for the survey results. However, it is impossible to go into too much detail here. A recent publication by H. Parzinger has made a detailed overview somewhat redundant; *Die Frühen Völker Eurasiens vom Neolithikum bis zum Mittelalter* is an exhaustive historical overview of the archaeological cultures in Eurasia, based on a huge amount of both local and international literature (Parzinger 2006a). In our more condensed overview, we have chosen to go deeper into the archaeological heritage of monuments which forms the subject of our research: surface structures, such as funerary structures and ritual monuments. Moreover, the period within the scope of this thesis – from the Eneolithic to the Ethnographic period – will thus be given more attention.

1.3.2.1 The first traces of human activities, from Early Palaeolithic to Late Neolithic

The first traces of human activities in the Altay go back many thousands of years. The most ancient site in the Altay Republic territory is believed to have been Ulalinka, an open-air site on the outskirts of the modern city of Gorno-Altaysk, capital of the Altay Republic. This site, discovered in 1961 and excavated by A.P. Okladnikov and L.A. Ragozin between 1969 and 1980, revealed various pebble-stone tools found in a layer composed of boulders, gravel, sand and natural cobbles. The archaeologists dated them at between 1.5 million to 150,000 years BP, marking the site as Early Palaeolithic (Okladnikov 1972, Okladnikov & Pospelova 1982). However, this date is currently being disputed, as the layer containing the earliest finds appeared to have been re-deposited. The layer below this was dated at 1.5 million years BP, hence the date proposed. In addition, the actual number of artefacts is also under discussion (Davis 1998). They were selected from many natural cobbles, and even Okladnikov himself admitted that the anthropogenic nature of some of the tools is not very clear. He attributed this to a special production process whereby stones are heated in the fire and then thrown into water for rapid cooling, thus creating chips and splinters. A critical re-evaluation of this site would seem useful.

This image changes when looking at the Middle and Upper Palaeolithic periods, where sites show clear evidence of occupation. Both caves and open-air sites have been excavated, mainly in the Anuy valley (Altay province, Russian Federation). The most famous one is the Denisova cave – under excavation by A.P. Derevyanko and V.I. Molodin since 1977 – as it has yielded the oldest reliable man-made materials. Levels with late Acheulean/early Mousterian artefacts date back to around 282,000 to 155,000 BP (Derevyanko & Molodin 1994, Derevyanko et al. 1999). In addition, Ust'-Karakol', an open-air site in the same Anuy basin, 3 km from Denisova, dates back to 133,000 ±33,000 BP (Derevjanko & Sun'kov 1998). The first Mousterian site to have been excavated in Altay is Ust'-Kan cave, in 1954 by S.I. Rudenko. New excavations since 2000 by the Siberian Branch of the Russian Academy of Sciences (SB RAS, Novosibirsk) and the Gorno-Altaysk State University (GASU) confirm the existence of Middle and Late Palaeolithic layers. The researchers even propose that the lower layers possibly date from before 100,000 BP, as the analysis of faunal remains suggests (Postnov et al. 2000). The last example of an open-air site is Kara-Bom, excavated originally by Okladnikov at the beginning of the 1980s, and later by A.P. Derevianko and V.T. Petrin. The site was occupied during the transition of the Middle to Upper Palaeolithic period, which is spread over seven clearly defined stratigraphic layers (Goebel et al. 1993: 452).

Mesolithic (12/11,000 to 6000 BCE) and Neolithic (5500 to 3200 BCE) finds in Altay are rather rare, and, in most cases, poorly dated. The corpus includes a limited number of radiocarbon dates (^{14}C), restricted to Early Mesolithic. The most important sites include the multilayered Ust'-Sema (Kungurov 1997), along the Katun River, and Tytkesken' 3, in the Shebalinsky region of the

Altay Republic (Kiryushin et al. 1995)[2]. For the Neolithic period, the only differentiation between Early Neolithic (5500 to 4250 BCE) and Late Neolithic (4250 to 3200 BCE) is based on ceramic objects (Parzinger 2006a: 72). Information is mainly limited to the multi-period site of Ust'-Kuyum (Kungurov 1994a, Kungurov 1994b), Mayma III (Kireev 1988) and Tytkesken', excavated by Yu.F. Kiryushin. This site mainly yielded stone tools, while ceramic finds were limited to some vessels with pointed and rounded bottoms, and outwardly curving edges. The site Tytkesken 6 represents earlier forms, dating to Early Neolithic, whilst finds from Tytkesken 2 are dated to the Late Neolithic (Glushkov et al. 2004). Another example is Mayma XII, excavated in 2000. The artefacts found there are characteristic of the entire Mesolithic and Neolithic periods, so giving the site a more precise date is not possible (Kireev et al. 2002). Monuments or surface structures from the Neolithic period are unknown in the Altay.

1.3.2.2 The Eneolithic: the start of metal working

The Eneolithic period (3200 to 2400 BCE) saw the introduction of copper usage in Altay. The northern part of Altay, Tuva and the north-east of the Minusinsk basin were inhabited by different regional subgroups of the Afanas'ev culture. Calibrated ^{14}C dates from finds in Altay place it between the late 4th millennium and the early 3rd millennium BCE. W. Radloff was the first archaeologist to excavate an Afanas'ev site in 1865, in Onguday (Altay Republic, see Figure 1.2). In the 1960s and 70s, many new Afanas'ev sites were discovered (Parzinger 2006a: 186-187). Some examples are Kara-Koba (Onguday district, Altay Republic) (Vladimirov & Tsyb 1982), Kara-Tenesh (Chemal, Atlay Republic)(Pogozheva & Kadikov 1980, Pogozheva & Molodin 1980) and Elo 1 and 2 (Onguday district), excavated by V.A. Posrednikov in 1977-1978 (Bourgeois et al. 2000a: 24). Settlements are rarely found. Slightly rectangular pit-dwellings are known from the Kara-Tenesh site, with fireplaces inside and pit holes marking the edges. The people seem to have lived mainly by hunting, as indicated by the animal remains in the settlements, and there are indications of animal husbandry. Sheep excreta were found in some caves sites, pointing to their use as stables. However, no real indications of agriculture have yet been found (Parzinger 2006a: 191).

The Afanas'ev funerary structures form the oldest surface structures still visible in the Altay today. There are two types: graves marked by large stone circles with jutted slabs (cromlechs) or graves that are enclosed by a stone bank or wall (round enclosures). They have a rectangular grave pit in the centre covered with stone plates. In some places, the inner space of the stone enclosure is filled with a layer of stones, or with a stone-earth mixture. Typical circular fireplaces can be found in the surroundings of the burial monuments, although not all monuments have these secondary structures (see 5.4.2 for our survey results). The fireplaces are encircled by stones and were used for burnt offerings. They may be seen as remains of funerary rituals. Burial

[2] The materials from Tytkesken' 3 are indirectly published in this work, which actually considers another cave site: Nyizhnetytkesken' 1.

sites are usually situated on river terraces, and number between 6 and 12 funerary monuments on average. Petroglyphs can also be found in the vicinity of Afanas'ev burial sites, but it is very difficult to prove that these engravings are contemporary as it is difficult to discern them from later Bronze Age petroglyphs. However, the fact that many Afanas'ev sites are located next to sites with similar rock engravings could indicate that this art form was already in use in the Eneolithic period (Parzinger 2006a: 191).

1.3.2.3 The Bronze Age in Altay (2400 to 800 BCE)

The transition to the Bronze Age brings a shift from hunting, gathering and fishing to agriculture and animal husbandry. Domesticated herds of sheep, goats, cows and horses grazed the alpine meadows during summer and the lower valleys and intermontane basins in winter. Information on the Early Bronze Age in Altay (2400 to 1800 BCE) is rather limited. There are finds, however, that are certainly younger than the Afanas'ev culture, but which cannot be placed in a Middle Bronze Age context. The archaeologist V.D. Kubarev was the first one to study this Karakol culture thoroughly in the middle of the 1980s, although the first grave belonging to this culture had been found some years earlier in Ozernoe (Onguday district, Altay Republic) (Kubarev 2007a). He named it after a site he had excavated near the village of Karakol in 1985 (Kubarev 1988a). Clear parallels with the contemporary Krotovo (and Samus') culture at the Ob River and in the Barbara steppe, and with the Okunev culture in the Minusinsk basin and in Tuva, make it possible to date the Karakol culture rather clearly (Parzinger 2006a: 299). Little is known about the settlements and the general way of life of the Karakol people, as most of the information comes from burial sites**.** The graves are covered with a modest earthen burial mound surrounded by a circle of stones. The mounds cover rectangular grave pits with a stone cover (as also seen in the graves of the Krotovo culture) or with a stone coffin (which is a clear parallel with the Okunev culture). The stone slabs are decorated with unique polychromatic drawings (Figure 1.5): anthropomorphic figures with masks and feather-like headdresses, as well as animals, sometimes beautifully arranged in friezes (Surazakov & Larin 1994). Most of the graves where robbed, so there are no complete grave inventories. The dead are buried on the back, sometimes stretched out (parallel with the Krotovo graves) or in a crouched position (as in the Okunev graves) (Parzinger 2006a: 299).



Figure 1.5: Polychromatic drawings on stone slabs from a Karakol burial (Photo: V.D. Kubarev, IAE SBRAS, Novosibirsk)

The beginning of the second millennium BCE, during the transition to the Middle Bronze Age (1800 to 1500 BCE), saw an increase in the exploitation of ores, with this growing specialisation creating the need for specialised settlements. The Andronovo-Federovka cultural group in particular profited significantly from this evolution. Access to large quantities of copper and tin ore in the Ural Mountains enabled a huge expansion in that period. One of the Andronovo-Federovka groups inhabited the higher Ob valley and the northern slopes of the Altay Mountains. Although it is unclear whether or not they also lived in the higher mountains, there is some evidence of their strong influence as far as the Ukok plateau. In Bertek, in the early 1990s, archaeologist V.I. Molodin discovered a burial mound with a stone circle (Molodin 1992b). The graves found inside contained two stone coffins with the crouched bodies of two men. Although no objects where found in the graves themselves, the ceramics found within the stone circle and in some fireplaces are clearly influenced by the Andronovo-Federovka culture (Molodin et al. 2004: 124-140). The actual Andronovo-Federovka graves, somewhat to the north, are slightly different. The graves, up to three per burial mound, are covered by a mound of a maximum one metre high. There is no stone or wood used for the grave, and both contemporary inhumations and cremations have been found. There is no social stratification in the burial infrastructure, and the grave inventories are rather modest: some ceramics and in some cases a bronze object. Cenotaphs have also been found containing ceramics but no human remains whatsoever (Parzinger 2006a: 377-378).

With the start of the Late Bronze Age (1400 to 800 BCE), the use of bronze spread everywhere. The Altay Mountains had become part of the sphere of the West- and South-Siberian Bronze Age cultures with influences from the south-east. Again, the research in Altay is rather limited. Some ceramics from Maima XII (Kireev et al. 2002), Maima VII (Kireev 1988) and Denisova Cave (Derevyanko & Molodin 1994), in the northern part of Altay point to influences from the more northerly located Irmen and Kochazhino cultures, along the Ob River (Molodin 2001: 37). On the other hand, it is worth mentioning that bronze daggers and knives were found all over the Altay Mountains – thus not restricted to the northern, lower parts – that are clearly

linked with styles typical of the Karasuk culture of Tuva and the Minusinsk basin (Parzinger 2006a: 462-463).

1.3.2.4 The Iron Age in Altay (ca. 800 BCE to 400 CE) and the Early Nomads

At the beginning of the first millennium BCE, bronze was still the main material for the production of weaponry and artefacts, and remained so for some centuries. The first attempts to exploit and forge iron introduced a new era in Central Asia: the Early Iron Age (9th to 8th century BCE – 3rd to 2nd century BCE). Important changes were taking place: the emergence of groups of nomadic warriors on horseback, defending pasture ground for their herds of sheep, goats and horses (Kuzmina 2000). Although these groups inhabited the entire Eurasian steppe zone and comprise many ethnicities that were never bound by any political or social factors, they had a very similar material culture and way of live, and can thus be seen as one cultural 'unit' (Askarov et al. 1996). We will use the name 'Scythian' to refer to these different groups, cross-referencing it with 'Early Nomads'. The use of the term 'Scythian' is not without risk as it is being discouraged by different scholars: in essence, it is an ethnonym that incorrectly points to an ethnic unity between the different early nomadic populations. The use of the term would have created a psychological basis for the theory that unity existed within the early nomadic cultures who inhabited the steppe lands from the Danube to Mongolia (Yablonsky 2000, Yablonsky 2006). Completely correct alternative names for these cultures, however, are rare – Early Nomads is the most common. When the term 'Scythian' is used in this text, it should be clear that it has no ethnic meaning whatsoever, and must simply be seen as a chronological and cultural concept that tries to define the cultural horizon in which the early nomadic cultures are located.

One of the most striking elements of the homogenous ecology and way of life is the so-called 'Animal Style' of decoration that developed during the first millennium BCE in the Eurasian steppes. Animal patterns form one of the basic elements of artistic expression in the steppe art, including horses, deer, sheep, goats, birds of prey and predators, as well as a whole array of mythological creatures which combine features of the above-mentioned animals. This transformation into a combination of predator and prey is characteristic. Another typical element is the supernatural antlered deer or 'flying' deer, with curly stretched-out antlers, sometimes with bird's heads, and legs that are bent towards each other (Figure 1.6). The Animal Style or steppe art is one of the components of the so-called 'Scythian Triad': a complex of goods consisting of weaponry, horse harnesses, and items decorated in the Animal Style. These were found in many graves of Scythian-type populations from the Black Sea area to Mongolia, and were considered essential elements in the culture of the early nomadic populations.



Figure 1.6: Mythological creatures combining elements of predator and prey, as found in tattoos on Early Iron Age people buried in the tombs of Pazyryk (Russian Altay). Reconstruction: Ivo Verhaeghe, Ghent University

For the first time in the history of Siberia and Altay, archaeological research is not the only source of information. Written sources from contemporary cultures contain detailed descriptions of this mainly nomadic civilisation. The Greek historian Herodotus (5th century BC) is particularly important here as he devoted the fourth book of his *Histories* to the nomads living in the Black Sea area. He refers to them as 'Scythes' or Scythians, and names the groups that live further to the east (as far as the Volga basin) 'Sauromates'. He does not mention the Central Asian groups and gives no direct information about the situation in the Altay Mountains, but later excavations in Siberia will show that his detailed descriptions are of great value in understanding the Scythians in Altay. The Persian Empire repeatedly suffers from raids by Scythian-type hordes at the northern borders of the empire. The Persians call them 'Saka', a name that is given to all the Early Iron Age cultures of that type extending from Turkmenistan to faraway South Kazakhstan (see also Jacobs 2007). Chinese sources mention rebellious groups at the northern border of their vast empire, but it is very difficult to identify these and link them with the archaeological material (Parzinger 2007).

Archaeological research on the Iron Age in Altay started quite early, driven by an interest in the Scythian tombs and the beautiful artefacts found inside the burial chambers. Already at the beginning of the 18th century CE, Tsar Peter I (1689-1725) had objects from the Siberian steppes in his archaeological collection, and the first Scythian-type objects from the Altay Mountains were reported in following decades. However, the first real scientific excavations were organised by V.V. Radlov in the 1860s, with his excavations in Berel (now Kazakhstan) and Katanda (Altay Republic, see Figure 1.2) (Radlov 1888, Radlov 1895). Since then, numerous excavations have been carried out on Iron Age sites (see 1.4.1 for a detailed overview). Despite of all this research, the actual starting date of Scythian-type cultures in Altay remains a point of discussion. Early research dated it to the 7th century BCE, although it is now generally believed that the first traces go back as early as the late 9th, beginning of the 8th century BCE. The following three subdivisions can be noted in the chronology of Scythian culture in Altay: an Early Scythian Mayemir-Kurtu phase, the Classic Scythian Pazyryk culture, and the Late Scythian Kara-Koba culture.

The Early Scythian Mayemir-Kurtu culture (9th/8th to 6th century BCE) is mainly represented by isolated finds such as bronze artefacts and deer stones. No settlements are known, and the burials consist of simple earthen graves or stone coffins, similar to burials of the Late Bronze Age.

The 5th century BCE sees the beginning of the Pazyryk culture (until the 3rd century BCE), named after the famous site of Pazyryk in the Russian Altay (Gryaznov & Golomshtok 1933, Gryaznov 1969, Molodin 2000). Most typical are the well-known funerary sites, with chains of burial mounds stretching from north to south. The graves are covered with stone mounds. Inside the burial pit is a wooden burial chamber topped with a wooden roof, or a stone chamber. In the northern part of the pit, typically on a step, there is often an accompanying horse burial plot. Hundreds of such sites are spread throughout the Altay, comprising thousands of burial mounds. Numerous sites have already been excavated and thoroughly researched: Pazyryk, Bashadar, Tuekta, Shibe, Ulandryk, Ukok and Yustyd are just some examples (a.o. Rudenko 1960, Rudenko 1970, Kubarev 1987, Kubarev 1991, Polosmak & Molodin 2000) (Figure 1.2). Some of the graves were perfectly preserved in the frozen underground and revealed intact artefacts of stunning beauty (see 1.4.4): metal chisels, knives, daggers, grivnas (pectoral or chest ornaments), mirrors, bits, buckles, bone artefacts, as well as organic materials: wooden sarcophaguses, furniture, carpets, weaponry, clothing, horse harnesses, etc. Compared to this abundance of information providing a very clear view about burial rituals, figurative art and weaponry, data on other parts of daily life is very limited (Barkova 2007). There are no settlements found in the Altay, although wooden buildings (like the wooden burial chambers) or yurts could by used for housing, as remains the case today. The burial mounds are not the only sources of information about cultural life. Funerary complexes are accompanied by ritual structures such as fire altars and standing stones or *balbal*. Further monuments included standing stones, sculptured deer stones and thousands of engravings on rock surfaces (see 5.2.1).

The Late Scythian Kara-Koba culture (5th to 3rd century BCE) is very similar to the Pazyryk culture, but indicates a different way of burying the dead. The burial mound, as excavated in sites such as Kara-Koba II, Kyzyl-Telan I, Borotal III and Taldura I, consists of a flat stone cover with stone coffins inside (and not the characteristic wooden chamber in the Pazyryk graves). The deceased were not at rest on their backs, but crouching on their right sides, their heads to the east or the south. Almost no horse burials have been found in these graves. The grave artefacts reveal many similarities with the Pazyryk grave inventory, although the ceramics are slightly different. The Kara-Koba culture graves are to be found mainly in the western part of the Altay Mountains, while the Pazyryk graves are mainly located in the eastern part. There is, however, an overlap and both the material culture and the fact that the graves are sometimes found next to each other on the same burial ground indicates that the Kara-Koba and Pazyryk cultures are contemporary (Parzinger 2006a: 606).

The Late Iron Age (200 BCE to 400 CE) is characterised by the start of major migrations in Eurasia, the first expansion of the Western Han Dynasty among others. At the end of the 3rd century BCE, we see important changes in the Altay region. New groups, belonging to the

Hsiung-nu culture, took over in a process which was complete by 200 BCE, defining the end of the Early Iron Age in the Altay Mountains. At that time, the 24 Hsiung-nu or Hun tribes – as they were called in the west – united in the powerful Hsiung-nu Empire. The western Hsiung-nu would later organise the famous raids against the Goths in the west. In the east, the empire slowly disintegrated in the first century CE, and other Hunno-type cultures, such as the Hsien-pi and later Juan-juan, took over (Ishjamts 1996, Kyzlasov 1996, Litvinsky et al. 1996: 19-33). In Russia, this period is generally referred to as the Hunno-Sarmatian period.

The data obtained from investigations in the Altay Mountains suggest that the Pazyryk culture did not disappear without a trace, but was transformed into Hunno-type cultures. In the first phase of the Late Iron Age, the traditions of the Pazyryk culture continued to be present in the material culture. This can be seen in the graves from the Shibe-culture, named after the 'royal' burial mound excavated by M.P. Gryaznov in Shibe (Gryaznov 1930). The mound is the biggest known example of its kind, and contained a frozen burial chamber. Ceramics and wooden carved objects are clearly linked with the Pazyryk culture, while the horse bits and hundreds of gold plates are made in a typical Hunno-Sarmatian style. Finds from the large burial mounds in Berel and Katanda yielded the same materials, although it cannot be completely discounted that some of these are remnants from a late Pazyryk phase in the Late Iron Age (Parzinger 2006a: 740-742).

The later phases of the Hunno-Sarmatian period in Altay were not very well documented until recently. In the 1980s and 1990s, about 20 sites of the so-called Bulan-Koba culture were discovered and investigated, dating from the first two centuries CE. Ust'-Edigan, Chendek, Verkh-Uymont, Sary-Bel, Bulan-Koba, Airydash and Kuraika are some examples (see a.o. Mamadakov 1985, Soyonov & Ebel' 1988, Soyonov & Ebel' 1992, Chudjakov 1997, Soyonov 1999, Khudjakov 2005). These graves generally have a small, usually oval stone cover measuring just 5 to 10 cm high. They are grouped in sometimes large burial sites where they lay clustered or are organised in roughly parallel lines.

The transition from the Hunno-Sarmatian to the Early Turkic period in Altay is still problematic. Some scholars suggest an intermediate Kok-Pash phase from the 3rd to the 5th century CE, thus partly contemporary with the Early Turkic period (Parzinger 2006a: 742).

1.3.2.5 From the Middle Ages in Altay (400 to 1500 CE) up to the present

The Early Middle Ages in the Altay region (400 to 900 CE) are mainly represented by the Turkic period. Originally, the Turks – or Türks – in Altay supplied the Juan-juan with ferrous metal products such as weapons, tools and iron blooms. There are no indications that the Turks were ethnically or linguistically different from the dominant Juan-juan, but they formed a social layer of metallurgist, who became particularly powerful in the 530s CE. They revolted against their rulers in 552; an event which marked the start of the First Turkic *khaganat*. The Turks were the first Altaic people to leave indigenous historical documents which, in addition, were the first ones to be written in an Altaic language. The empire quickly became very powerful until political developments and military defeats ended the Turkic reign in the 8th century CE. In 745 CE, the

Second Turk Empire ceased to exist, and the last reference to Turk tribes in Chinese sources relates to the year 941 (Kyzlasov 1996, Sinor & Klyashtorny 1996).

Various archaeological monuments in Altay date from the Turkic period. The most famous are the burial mounds and commemoration complexes of, for example, Kudyrge (580 to 900 CE) which gave its name to the Old-Turkic Kudyrge culture (Gavrilova 1965), Kuray, Tuekta and Yakonur. However, monuments from the Turkic period can be found everywhere and are extremely numerous. The burial monuments are round mounds with a burial pit where the deceased and a horse are buried. Commemoration complexes include a rectangular or square stone enclosure, a stele or a statue and rows of relatively small, vertical stones called *balbal* in Russian literature. The design of the statues or memorial pillars for the Turkic warriors varies from rough unpolished stone pillars with vague anthropomorphic features to real masterpieces of sculpture (see 5.7.3 for more information on these image stones). The Turkic period also covers a considerable amount of petroglyphs created by the stamp or pecking technique, and about 100 examples of runic writing are known in Altay. Other monuments include forts, production centres, ancient town sites, irrigation canals, roads, etc. (Bourgeois et al. 2000a: 25-26).

The first half of the 2nd millennium CE in Altay, the Mongol Period, has been poorly researched. In these Late Middle Ages (900 to 1500 CE), we see the centre of political life transferred to Central Asia, and the Altay population migrating. At the beginning of the 13th century CE, Altay was conquered by Dzuchi, the elder son of Ghengis Khan, making it part of the Mongolian Empire. Following the disintegration of this Empire, Altay became part of the Mongolian states that were formed: first the Golden Horde and the Empire of Yan, later the White Horde and the Siberian Khanat. The traditional economy of the people in the southern Altay was destroyed by the occupation and military actions – settlements and fields were abandoned and the population turned to semi-nomadic cattle husbandry. In the north, hunting and gathering food became the main occupation due to changing environmental conditions (Bourgeois et al. 2000a: 25-26). Archaeological monuments from this period in Altay are rather unknown, and no surface structures can be assigned to the Mongol occupation period.

During the following Ethnographic period (1500 to 1900 CE), Russia's borders came closer and closer to Altay. In the 17th century, China and Russia both tried to stamp their authority on Altay, a battle that was finally won by Russia. For a while, Altay remained under the influence of both empires, until the largest part of the Altay Mountains officially joined Russia in the middle of the 18th century. The further history of the Altaic population has a close link with all stages of Russian history (Bourgeois et al. 2000a: 28-29). Monuments from the Ethnographic period mainly include graves which can be found near to present-day villages or closely linked to older Turkic or Iron Age burial sites. The form these monuments take is closely related to the populations that constructed them. Different Altaic and Kazakh populations built different types of graves, including stone mounds, wooden constructions and even complete mud-brick buildings with small towers at the four corners.

1.4 History of the archaeological research in Altay

Although the previous pages have shown that much archaeological research has been done on every aspect of the chronology of Altay (and that was just a very short overview), in the main, the following chapter is restricted to research into the Scythian-type cultures. There are several reasons for this. The first is that the origin of archaeological research in Altay is rooted in an emerging interest in Scythian art at the beginning of the 18th century. In particular, the Scythians' golden artefacts, first discovered in the steppes of the Black Sea region, appealed to the imagination of many art collectors and archaeologists – as they still do today. Therefore, early archaeological research in Altay focused mainly on the excavation of Scythian burial mounds.

A second reason is that the archaeological heritage of the Scythian-type cultures, especially the Pazyryk culture, has been thoroughly researched, and numerous excavations have been carried out since then. They are world famous because of the frozen contexts in which some of the tombs were found, and have attracted many international research teams. In fact, it was the excavation of Scythian-type burial mounds which brought Belgian and Russian archaeologists together at the beginning of the 1990s. Moreover, part of the survey projects in this study focused on the inventory of possible frozen tombs, within the framework of UNESCO's Preservation of the Frozen Tombs of Altay Project.

1.4.1 Archaeological research in the Altay Mountains

Interest in Scythian art began during the reign of Peter the Great (1672-1725). Back in 1715-1716, Tsar Peter I had already received pure gold objects from the Siberian steppes. His collection, including about 240 golden objects from Scythian elite graves, were placed in the Winter Palace of the Hermitage in Saint Petersburg in 1859, where they can still be visited today (Korol'kova 2007). Although in the following decades similar objects were found all over the Eurasian steppes, from the Danube to China's Great Wall, archaeological research mainly focused on the Black Sea region. Back in 1763, a first burial mound had already been excavated in Ukraine, near the city of Kirovograd. However, the Scythian cultures of the Altay Mountains remained largely unknown until the beginning of the 20th century, although Scythian-type objects are known to have been found in the Altay Mountains as early as the early 18th century (Parzinger 2006a: 586-588).

The first real scientific expedition had to wait until the second half of the 19th century. The archaeologist V.V. Radlov organised excavations in Altay in the 1860s, and discovered, among others, the famous kurgans of Berel' and Katanda (Radlov 1888, Radlov 1895) (Figure 1.2). His work was continued by A.V. Adrianov at the beginning of the 20th century, who excavated Scythian burial mounds in the western Altay. In 1929-1949, the discovery of the frozen mummies in Altay attracted worldwide interest, thanks to research by M.P. Gryaznov and S.I. Rudenko in Pazyryk, Shibe, Tuekta and Bashadar (Gryaznov & Golomshtok 1933, Rudenko 1960, Gryaznov 1969, Rudenko 1970). More than 20 burial mounds are recorded in Pazyryk (Figure 1.2). Kurgan 1 was excavated in 1929 by M.P. Gryaznov, while kurgans 2 and 5 were excavated in the late

1940s by S.I. Rudenko. These large kurgans (more than 40 m in diameter and 2 to 4 m high) can be considered as elite burials by their dimensions and the richness of the perfectly preserved grave artefacts. A man was buried in Kurgan 1, while in each of the other large kurgans both a man and a woman were buried. Some were wearing beautiful tattoos that can be considered as masterpieces of Scythian Animal Art. The collection has been placed in the Hermitage Museum, and research into the finds continues even today. In 2003-2004, scientists discovered previously unseen tattoos on the mummified bodies of two women and a man from Pazyryk. Their skin had darkened due to exposure to the air after excavation, and the tattoos only became visible again under infrared rays (Barkova & Pankova 2005).

Archaeologist S.I. Rudenko excavated two big burial mounds on the Bashadar site, in 1950. This site is situated in the Karakol valley, just to the north of the village of Kulada (Figure 1.2). It consists of 57 burial mounds and dozens of smaller associated structures (Figure 1.8). The large diameter of three of the mounds makes them stand out from the rest of the burial ground. One of these, mound 51, was robbed, and Rudenko excavated the other two, Bashadar 1 and Bashadar 2 (Figure 1.7) (see Rudenko 1960: 23). He discovered perfectly preserved burials with magnificent finds, conserved in the permafrost. Some 15 km to the north, along the Ursul River, is the Tuekta site, which has 197 burial mounds (Figure 1.2). Four of them are clearly bigger than the rest of the monuments. Two were excavated by S.I. Rudenko and his team in 1954 (Rudenko 1960, Rudenko 1970). Tuekta I is extremely large, measuring about 50 m in diameter. The grave pit was 7 m deep, and was covered by a huge stone mound (Figure 1.7).

At the beginning of the 1970s, M.P. Gryaznov discovered one of the earliest examples of Scythian burial mounds in the Republic of Tuva, north-east of the Altay Republic. The site, Arzhan, is located in the so-called ‘Valley of the Kings’, a name given by the local people because of the many large burial mounds there. Burial mound Arzhan 1, with a diameter of 120 m and three to four m high, covered a complex wooden structure of 70 compartments, including the grave of a ‘royal’ couple. The man and woman were accompanied by eight other people, and six harnessed horses. Sadly, the burial was robbed in ancient times. However, hundreds of small, golden objects, left behind by the robbers, suggest an extraordinary beauty and richness. Next to this central burial chamber, the mound contained the graves of another seven men, and 160 fully harnessed horses. The bronze weaponry and many parts of the horse harnesses enabled the researchers to date the burial to the end of the 9th, beginning of the 8th century BC (Grjaznov 1984, Bokovenko 1994).

More recently, in the 1990s, the fascinating world of the Altay Mountains’ Scythian graves came back into the limelight, following the excavation of some frozen tombs on the high plateau of Ukok (Altay Republic) by the Institute of Archaeology and Ethnography of the Siberian Branch of the Russian Academy of Sciences (IAE SBRAS, Novosibirsk). In contrast to the early discoveries of frozen tombs by V.V. Radlov, M.P. Gryaznov and S.I. Rudenko, it was the first time that perfectly preserved Scythian graves had been excavated using modern research and conservation techniques (Polosmak 1991, Molodin 1996, Molodin & Polosmak 2000, Molodin et al. 2004).



Figure 1.7: The burial mounds of Tuekta (left: Tuekta-1 is the second mound from the right) and Bashadar (right: mound Bashadar-2) as pictured by J. Bourgeois during a reconnaissance flight in 2007

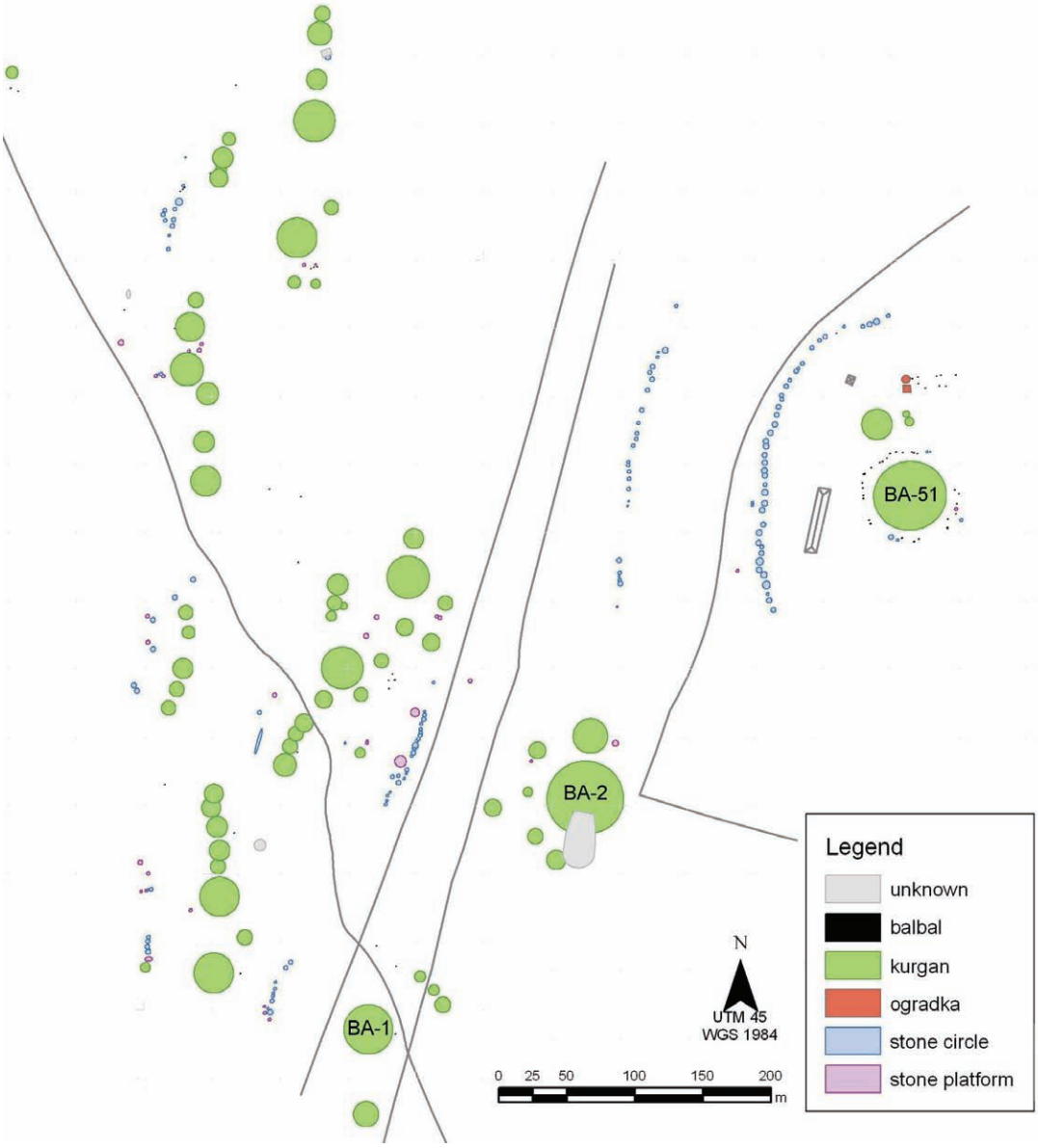


Figure 1.8: The site plan of the Bashadar complex, as measured in 2007 by Ghent University (UGent) and the Gorno-Altaysk State University (GASU)

In the summer of 1993, a team lead by N .I. Polos'mak investigated kurgan 1 of the Ak-Alakha 3 site, on the Ukok plateau (Figure 1.2). The archaeologists discovered a tomb dating from the end of the 5th century BCE, completely filled with ice. Inside, a 25-year-old woman was buried, her skin covered with magnificent tattoos. Her body, clothes and weaponry were almost completely intact. The grave goods, including weapons, are typical of an elite burial of the Pazyryk culture, but never before has a woman alone been found with these types of artefacts. An explanation for this is still unclear: was she a female priest, a princess, or a female warrior? The 'Ice Maiden' or 'Warrior Princess', as she was named afterwards, is one of the most fascinating finds ever discovered in a Scythian tomb (Polosmak 1994, Polosmak & Van Noten 1995, Polosmak 1996b, Polosmak 1996a, Polosmak & Seifert 1996, Polosmak 2004).

From 1997 onwards, the Margulan Archaeological Institute of Almaty, part of the Kazakh Academy of Sciences, has continued the work of V.V. Radlov in Berel (for an overview, see Gorbunov et al. 2005, Samašev 2007). The frozen kurgan which Radlov excavated – kurgan 1 or 'the Big Kurgan' – is the largest on the terrace, about 2.5 m high and 33.5 by 22.8 m wide. Berel is located in a picturesque and mountainous valley, at 1,100 m above sea level (Figure 1.2). The site, located on the third terrace of the Bukhtarma River, consists of about 70 archaeological monuments, most of them dating to the period of the early nomads. In total, 31 burial mounds are constructed on the terrace, structured in several approximately north-south-oriented lines. Since 1997, the Margulan Institute has excavated 16 other barrows, two of which had an ice lens under the stone covering and a frozen tomb inside: kurgan 10, excavated in 2005, and kurgan 11, excavated in 1998-1999 (Gorbunov et al. 2005, Kashkinbaev & Samashev 2005, Samashev et al. 2006). An international excavation team, with researchers from the Margulan Archaeological Institute, the French CNRS and Ghent University, excavated Kurgan 11. Six metres underneath an enormous stone burial mound, 3 m high and 25 m in diameter, they found a wooden burial chamber measuring 2 by 3 m. It contained a sarcophagus, made from a hollowed trunk and a wooden cover, decorated with gryphons and sphinxes. Inside were the remains of an old woman and a young man with a long braid. In the north side of the burial pit 13 fully harnessed horses had been sacrificed. The rich harnesses were abundantly decorated with wooden sculptures, mainly animal and floral motives. The wood was decorated with gold foil, tin and copper, and was combined with leather pieces to produce magnificent decorations. Four decorated saddle pads were also found, made of leather, felt, textile and fur. It seems that every horse had its own personal decoration theme as there is, for example, a 'tiger horse', an 'elk horse' and a 'mouflon[3] horse' (Francfort et al. 2000, Samashev et al. 2000, Francfort et al. 2006).

A new highlight in the study of the Scythian culture was the excavation of Arzhan 2, in 2000-2002 (Parzinger et al. 2001, Chugunov et al. 2004, Čugunov et al. 2007). A team of archaeologists from Germany, Russia and Tuva found one of the richest graves ever discovered in a large burial mound not far from the above-mentioned mound Arzhan 1. The somewhat smaller Arzhan 2

[3] *Ovis orientalis orientalis,* a wild sheep.

mound, measuring 80 m in diameter, contained the very-well-preserved grave of a Scythian couple (grave 5). About 9,300 objects were found in the wooden burial chamber, of which over 5,700 were made of gold. Although the tomb was not frozen, the grave goods were quite well preserved: metal objects, ceramics, wooden artefacts, skeletons etc. were all intact, and traces of felt and textiles could be studied, making the grave an extremely interesting source of information (see different chapters in Menghin 2007). Details of the magnificent golden objects, including the massive torques, were published in a separate catalogue (Čugunov et al. 2006).

Two years ago, a completely undisturbed, well-preserved frozen tomb was excavated in Mongolia by a team of German, Russian and Mongolian archaeologists. In 2004 and 2005, the team executed a survey in the Oigor Gol region, in north-western Mongolia, and carried out geophysical surveys to find out information about the possible preservation of ice lenses under the Scythian-time monuments. Four burials were selected for excavation, which began in 2006 (Figure 1.2: Olon Kurin Gol). While two of them appeared to be ritual cairns without burial pits (Olon Kurin Gol 7, kurgan 2 and Ulan Daba 1), the other two mounds contained frozen graves. In Olon Kurin Gol 6, kurgan 2, the team found the severely disturbed grave of a woman and a prematurely born child. The tomb had been robbed and most of the grave goods removed. However, kurgan 1 of Olon Kurin Gol 10 contained a more spectacular find: the undisturbed and intact frozen burial of a Late Pazyryk warrior. A man of between 30 and 40 years old had been buried here 2,300 years ago. His mummified body was fully dressed, including a magnificently decorated coat made from four kinds of fur, a felt cap, trousers and beautiful wooden ornaments covered with gold foil. His collection of weapons includes the only complete Scythian composite bow known to date, a quiver with arrows, a battleaxe and an iron dagger (Parzinger 2006b, Molodin et al. 2007, Parzinger et al. 2008).

However, excavations were not limited to the discovery of frozen tombs, or the investigation into burials from the Scythian period. But it would take us far too long to discuss all these research projects. Next to excavations that are organised from a scientific point of view, more and more rescue excavations are being organised in the framework of construction works. Examples include the building of dams for hydropower stations, vast areas being flooded by the resulting lakes (among others along the Katun River and, much further to the east, the Angara River), road building works and the possible construction of a gas pipeline from Russia to China, right through the Altay Mountains.

1.4.2 From excavation to survey

Until recently, archaeological research in Altay, both by local or international research teams, was mainly limited to excavations. However, during the last decades, research has increasingly focused on surveying. In the Russian part of the Altay Mountains, this switch from excavation to survey was partly due to problems with excavation permits. In 1996, the Altay government prohibited excavations of burial mounds on its territory. Several teams, among them the Belgian researchers (see 1.4.3.2), chose to stop excavation projects. Instead, a switch was made to the inventory of surface structures in the research areas.

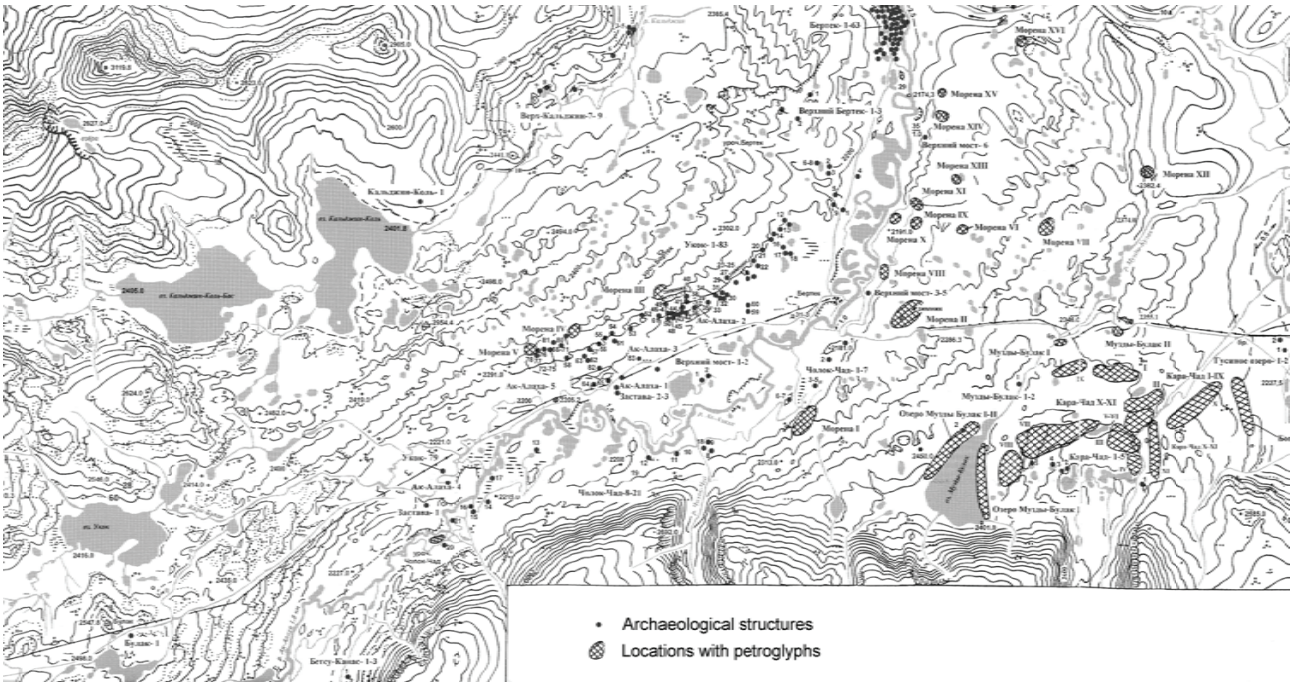


Figure 1.9: The IAE SBRAS survey project: extract of the resulting map showing part of the Ukok plateau (Molodin et al. 2004)

The same applies to the Russian archaeologists from the IAE SBRAS in Novosibirsk, who were active on the Ukok plateau. The Ukok high plateau is situated in the south-west of the Altay Republic, at 2,500 m above sea level (Figure 1.2: see Moinak-2, Kaldzhin and Ak-Alakha). The plateau is a very remote place, only accessible through some narrow passes, and the climate is harsh. However, favourable conditions for winter habitation and herding have attracted herders from the Bronze Age up to the present day. The plateau houses hundreds of archaeological sites with petroglyphs, burial places, ritual monuments, etc. Even today, it remains a sacred place for the Altay population.

The fact that the area is still untouched by modern activities, the presence of permafrost and the unique setting of the sites make it an extremely interesting place for archaeological research. Research in this area started in the 1970s, with some surveying by V .D. Kubarev. The first excavation of a man and a woman in a frozen Pazyryk burial was realised in 1990 by N .V. Polosmak, while from 1991 to 1995, two teams from the IAE SBRAS excavated several frozen and unfrozen kurgans. From 1996 onwards, activities changed to a thorough survey of the plateau: 406 sites were documented, 46 of which had petroglyphs (Molodin 1992a, Molodin et al. 2004). The sites were located with a Global Positioning System (GPS) and all sites were plotted on the topographic map of 1:200,000 (Figure 1.9).

In the Mongolian part of the Altay Mountains, a Mongolian-American team is working on the exhaustive Mongolian Altay Inventory. Leading investigators include Esther Jacobson-Tepfer, James Meacham and Gary Tepfer, supported by Ayatkhan Atai, Altangerel Enkhbat and Damdinsurenjin Tseveendorj. The Inventory is dedicated to the identification and documentation of all significant concentrations of surface monuments in mountainous Bayan Ölgiy aimag, in north-western Mongolia (Figure 1.2: two large complexes are Tsagaan Salaa/Baga Ojgor and

Tsagaan Gol). The points of documentation now include several thousand surface structures including *kereksur*, a variety of mounds and altars, and carved and un-carved standing stones (Figure 1.10).



Figure 1.10: The Mongolian Altay Inventory: overview map indicating all study points in north-western Mongolia (Copyright 2008, University of Oregon)

In the inventory database, these surface monuments are distinguished by size, context, and their relationship to aspects of the larger landscape. In addition, several thousand concentrations of petroglyphs have been located and documented, distinguished in the database by subject, style, and probable chronological horizon. The development of the Inventory builds on the understanding that surface archaeology in this part of Mongolia reflects an ancient and many-layered cultural landscape (Jacobson-Tepfer et al. 1994, Jacobson-Tepfer et al. 2001, Jacobson-Tepfer et al. 2006a). The results of the Inventory will be published in the near future in the form of an exhaustive cultural atlas (Jacobson-Tepfer et al. Forthcoming).

The two above-mentioned projects are not the only initiatives that involve survey work, although they are certainly the most ambitious ones. Another example is the survey work being carried out by Igor Slyusarenko, archaeologist at the IAE SBRAS in Novosibirsk, on the left bank of the Yustyd valley, which is complimentary to our work on the right bank (see 4.2). In Mongolia, most survey projects do not focus on the Altay, but rather on the *kereksur* monuments and deer stones in central Mongolia. Examples are the American-Mongolian Deer Stone Project by W. Fitzhugh and colleagues (Fitzhugh 2008, Fitzhugh & Bayarsaikhan 2008), the research of Bronze Age burial mounds and *kereksur* by B. Frohlich and colleagues (Frohlich et al. 2007, Frohlich et al. 2008), and the inventory work in northern central Mongolia by P.-Y. Milcent and the Museum of Prehistoric Anthropology of Monaco, focusing mainly on deer stones (Arnaud 2008).

Alongside these survey projects, which are based on a scientific question, some work is also being done within the framework of large infrastructure studies. These are either being done for preservation purposes – to decide where roads or pipelines should be built to have the least impact on the archaeological structures – or for the documentation of as many monuments as possible before they are destroyed.

1.4.3 Belgian archaeological research in Altay, 1992-2008

1.4.3.1 Research by the Royal Museums of Art and History, 1992-1994

Belgian archaeological research in the Altay Mountains started with the exhibition 'The Gold of the Scythians' organised in 1991 at the Royal Museums of Art and History (RMAH) in Brussels (Cahen-Delhaye 1991). That year, a large public could admire the prestigious collections coming from the famous graves of Pazyryk alongside part of the treasures of the Hermitage Museum in Saint Petersburg. This exhibition was the starting point of the bilateral relations with Russian archaeologists, first with the Hermitage Museum, and later with the Academy of Sciences of Siberia. Initial research focused on the excavation of Scythian-type burial mounds in the southern part of the Altay Republic (Bourgeois et al. 2000a: 9-11).

From 16 June to 2 August 1992, the RMAH took part in the first excavation campaign organised by the IAE SBRAS and conducted by V.L. Molodin, by sending three of their archaeologists to accompany the Russian team in Altay during the summer. They excavated a middle-sized kurgan on the Moinak-2 site, situated on the Ukok plateau (Figure 1.2). The results of that research were published in Russian in a preliminary report in the review *Altaica* (Molodin et al. 1993), edited by the Siberian Academy, an initiative that brought the bilateral relations between both research teams into being[4].

In 1993, a second excavation campaign was organised on the Ukok plateau, this time along the Kaldzhin River, a tributary of the Ak-Alakha (Figure 1.2). However, the Belgian archaeologists were prohibited from excavating the burial mound of their choice, and the results did not equal the expectations (Bourgeois et al. 2000a: 62-71). Relations worsened in 1994 when the Russian partners decided to increase the financial contribution from the RMAH to the Altay International Centre, neglecting the agreements signed by both parties. That year, the excavation campaign had to be cancelled.

1.4.3.2 From excavations to archaeological survey, 1995-1997

The results from the first campaigns were promising, however, and the RMAH was able to engage an archaeologist on the project for four years, thanks to financing from the Fund for Fundamental and Collective Research of Ministerial Initiative (Lotto) (1994-1998: 'Contribution to the Archaeological Exploration of Central Asia. The Scytho-Siberian Graves of the Altay Mountains'). As it seemed essential to increase the manpower needed to survey the sites and undertake the excavations by engaging, among others, glaciologists and pedologists, the Research Foundation - Flanders (FWO) supported the project (1995-1999: 'Multidisciplinary Research in the Scytho-Siberian Graves of the Altay Mountains in Siberia'), and the Free University of Brussels and Ghent University became research partners. The Federal Services for

[4] A more definite report in English can be found in Bourgeois et al. 2000 (p54-62).

Scientific, Technical and Cultural Affairs supported the logistical part of the fieldwork (1995-1997: 'Archaeological Researches in the Scytho-Siberian Graves in the Altay Mountains') (Bourgeois et al. 2000a: 9-11).

In the meantime, a new problem had arisen in the Altay Republic. The evolution of the political situation and deterioration of relations between the Russian researchers and the Altay Republic led to the refusal of the excavation authorisation for the archaeologists at the IAE SBRAS. So as to continue their work, the team had to establish new collaboration with local researchers. Collaboration with the Agency for the Historical and Cultural Heritage of Gorno-Altay resulted in the excavation of burial mounds at the site of Kyzyl in the Belukha massif (Figure 1.2) in the summer of 1995 (Bourgeois et al. 2000a, Massart et al. 2000).

From 1996 onwards, a fruitful co-operation began with the Department of History at the Gorno-Altaysk State University (GASU). Two summer campaigns in 1996 and 1997 allowed the gathering of much information about the archaeological features in several valleys in the eastern and southern part of the Chuya steppe. In 1996, particular attention was paid to research in the Sebystey valley (Figure 1.2). Excavating two Scythian kurgans and making an initial inventory of the archaeological structures took up the largest part of this research (Bourgeois et al. 1999a). Similar work was to be done in the Kalanegir valley in 1997, but new problems arose (Figure 1.2). Already in the field, the Belgian team was surprised to learn that the Expert Council of the Government of the Altay Republic did not agree with the excavation permit, having consulted the local population. It was clear that the research would be undertaken against the law and against the will of the local representatives. Therefore, the team decided to end the archaeological excavations in Sebystey and Kalanegir, replacing them with an inventory of the archaeological structures of the Sebystey valley plus environmental and topographical studies of the sites of both valleys (Bourgeois et al. 1998, Bourgeois et al. 1999b, Bourgeois et al. 1999c, Mikkelsen et al. 1999). As a result of these developments, the RMAH decided to stop archaeological research in Altay. Nevertheless, Ghent University saw the potential for archaeological survey in the area, and continued joined assignments with the GASU.

1.4.3.3 Survey campaigns by Ghent University, 1999-2000

Having completed surveys during two summers in the high mountain area where modern human impact is negligible, we decided to change the focus towards lower-lying areas where human impact is more evident. In 1999, the left bank of the Uymon steppe was the subject of some new research (Bourgeois et al. 2000b, Bourgeois & Bourgeois 2006)(Figure 1.2). Most sites were exclusively made up of Early Iron Age burial mounds, damaged largely by human activities (agriculture and construction work). Because of these problems, some sites that had been previously located in 1991 by a Russian colleague were now very hard to find. Thus, a meticulous localisation of the archaeological monuments seemed necessary, using adequate maps and modern accurate measuring equipment and techniques. The data from this survey were recently processed by Anne Malmendier, a student from the Free University of Brussels (ULB), and bundled in her Master's paper (Malmendier 2007).

The campaign in 2000 focused on the study of the Maima area, which is situated along the right bank of the Katun River, in the north of the Altay Republic, close to the capital Gorno-Altaysk (Figure 1.2). A small excavation of a Early Iron Age settlement yielded no traces of archaeological structures, but a large amount of early Scythian pottery shards and some wooden and metal objects were unearthed (Kireev et al. 2002). Adjoining this excavation, the opportunity was seized to locate the different sites in the area by means of a GPS. In this way, the research focused increasingly on surveying and making an inventory of all archaeological monuments, for the purposes of analysis, preservation and protection. As detailed maps are not available in the region, the team encountered many localisation problems during these surveys. In the Altay region, the best topographical maps have a scale of 1:200,000, while classified military maps go up to 1:100,000. These are not sufficiently detailed to form the basis of a thorough survey.

1.4.3.4 The introduction of remote sensing

As a result of the above, a subsequent interdisciplinary research started in 2001 (see Gheyle & Trommelmans 2002). Within the framework of a Master's paper, the use of CORONA satellite photography for archaeological survey methods was examined. Starting from fieldwork in the Sebystey valley (1996-1997), three neighbouring valleys in the Kosh-Agach region of the Altay Mountains were selected as research areas – Sebystey itself, Elangash and Irbistu. The satellite images were systematically searched for archaeological monuments (Figure 1.11), and two kinds of maps were produced: a morphographic map by means of stereoscopic viewing and a high-resolution Digital Surface Model (DSM) based on the photos and a minimum of GPS data (see Chapter 2).

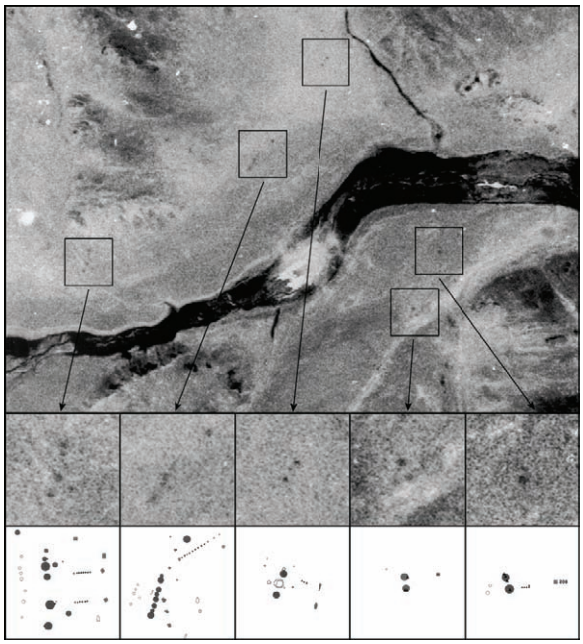


Figure 1.11: Located archaeological clusters on the satellite imagery compared to the GPS-made cluster plans (1996-1997) in Bourgeois et al. (2000a: 111-121). The photo covers an area of 2,230 by 1,600 metres in the Sebystey valley

1.4.3.5 Ghent University's Special Research Fund, 2003-2004

The work presented here actually began in January 2003, when Prof. Dr. Jean Bourgeois applied to the Research Council of Ghent University for a grant for the following project: 'Archaeological Survey and CORONA Satellite Imagery in the Altay Mountains (South Siberia). A Multidisciplinary Contribution to the Study of Occupational Patterns of Nomadic Populations (1000 BCE-present)'. The project plant was to evaluate the methodology used in previous years, expand the research area and gather GCPs for further processing the satellite imagery. Two field campaigns were organised in the southern part of the Chuya steppe and in the Yustyd valley (Figure 1.12) and over 3,000 archaeological monuments were recorded, in an area of about 600 km² (see 4.1 and 4.2 for an overview of these campaigns). Among these were hundreds of Scythian kurgans or burial mounds, many of them located in possibly frozen conditions. It became clear that the inventory and detailed database could also be used for conservation and protection purposes. In particular the frozen tombs of the Scythians, which were not only threatened by expanding tourism in the area and infrastructure works, but also by the changing climate, caught our attention (see 7.1).

In 2004, after several meetings with the Flemish government – concerned with culture and heritage in Flanders – and with the UNESCO division for Culture, UNESCO decided to support the protection of the frozen tombs in Altay and launched the Frozen Tombs Initiative.

1.4.3.6 The UNESCO/Flanders Funds-in-Trust Project, 2005-2006

The first project within the Frozen Tombs Initiative, which we will discuss in more detail in chapter 1.4.4**,** started immediately after the initiative was launched in January 2005. It was put together by Ghent University with the support of UNESCO and a generous contribution from Belgium's Flemish Community through the Flemish/UNESCO Funds-in-Trust, and was planned as a pilot project covering the period 2005-2006.

Within this project, we worked in both the Russian and Kazakh parts of the Altay Mountains. The archaeological survey was continued, and we started to assess climatic change in the Altay and to analyse the threats it poses to the frozen tombs. During fieldwork in the summer of 2005, in collaboration with the Gorno-Altaysk State University, we mapped more than 50 km of the Dzhazator valley (Figure 1.12) and gathered detailed information of over 1,600 archaeological structures (Goossens et al. 2006c, Gheyle et al. 2007). In 2006, the team surveyed the valleys of Karakaba and Bukhtarma (east Kazakhstan, see Figure 1.12), in collaboration with the Margulan Institute of Archaeology (Almaty, Kazakhstan), by mapping 1,194 structures in detail (Bourgeois & Gheyle 2008).

Other activities included two workshops and an exhibition on the Frozen Tombs of the Altay Mountains. From 28 to 31 March 2006, an international workshop was organised in Gorno-Altaysk by UNESCO's World Heritage Centre, in co-operation with Ghent University and Gorno-Altaysk State University, and hosted by Gorno-Altaysk University.

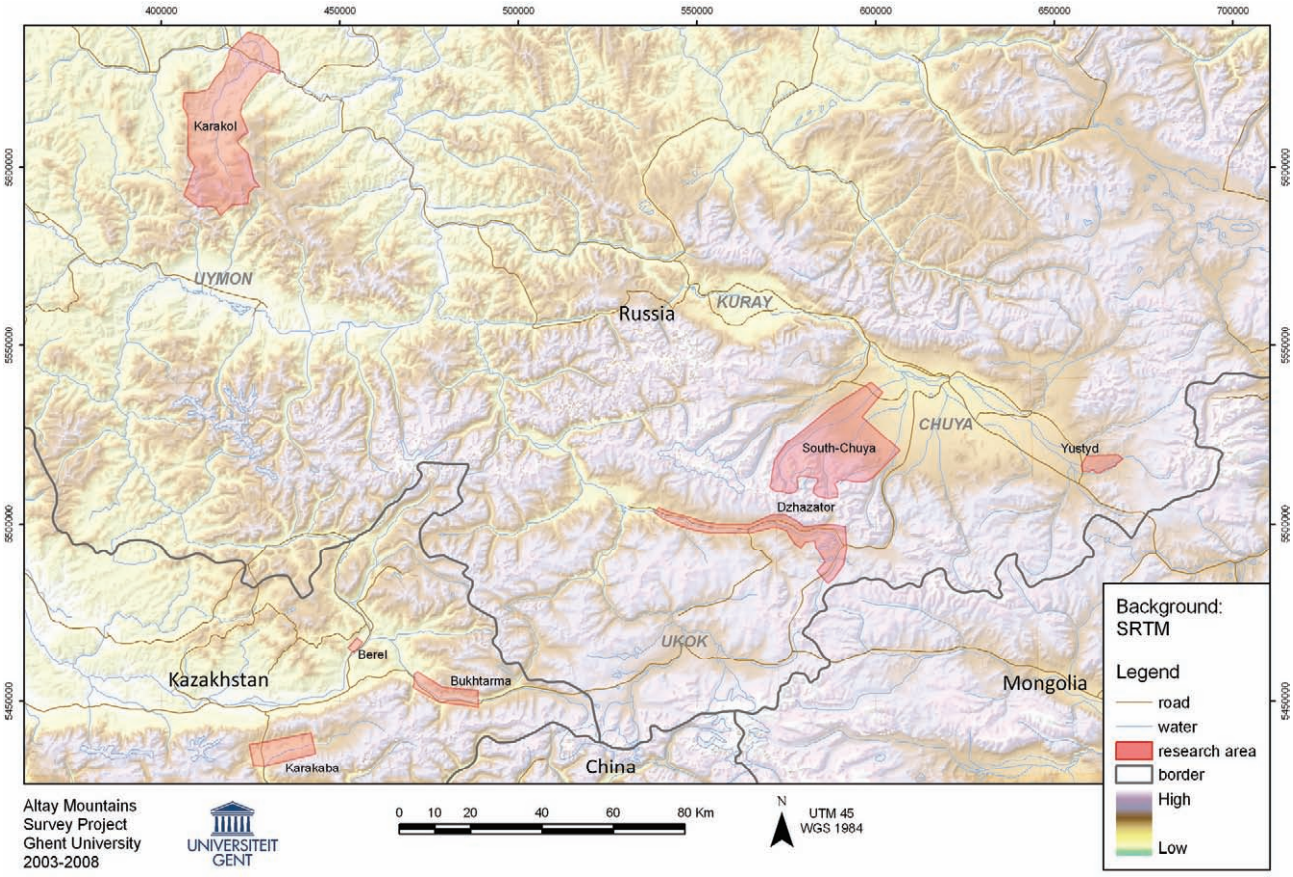


Figure 1.12: Research areas in the 2003-2008 fieldwork, in the Russian and Kazakh parts of the Altay Mountains

The goal of this meeting, entitled 'The Frozen Tombs of the Altay Mountains: Strategies and Perspectives', was to bring together international experts on Scythian tombs, archaeologists, geographers and climatologists. Some 40 participants from UNESCO, the Russian Federation, Mongolia, China, Kazakhstan, the United States, France, the Netherlands and Belgium were present. Under the auspices of Mr. Laurent Lévi-Strauss, Deputy Director of UNESCO's Division of Cultural Heritage, a text was accepted as a recommendation from all expert participants to the official bodies in charge of the archaeological landscape of the Altay Mountains. It is cited in Appendix 1 (see 9.1).

As a follow up to this meeting, an international conference on the problems of the frozen tombs and on Scythian archaeology in general was held in Ghent, from 4 to 6 December 2006 (Cheremisin 2008). Some 60 participants were present at the 'International Conference on Scythian Archaeology and the Archaeology of the Altay Mountains' hosted by Ghent University, representing Russia, Kazakhstan, France, Germany, the Netherlands, Switzerland and the United States. A declaration was drawn up with the conclusions of this meeting: 'Ghent Declaration on the Preservation of the Altay Mountains in their Integrity: Archaeological Heritage and Cultural Landscape' (see Appendix 2, 1.1).

Alongside the meeting, an exhibition presented the frozen tombs and the Altay Mountains to a larger public (Bourgeois & Gheyle 2006). The official opening of the exhibition, in the presence

of several authorities from UNESCO and the university, as well as the participants in the Ghent conference, took place on 5 December 2006. It was open to the public from 6 to 28 December. Afterwards, it was moved to Gorno-Altaysk, in the buildings of the GASU (from 22 May to 12 June 2007). The exhibition's last stop was Paris, where it was on display from March to April 2008, in the UNESCO buildings.

1.4.3.7 Bilateral Agreements between Russia and Flanders, 2006-2007

In 2006, a new project started, funded by a Bilateral Scientific Co-operation between Flanders and the Russian Federation (Research Council, Ghent University): 'A reflection of the world in the landscape. Aspects of ritual and funerary practices of the ancient people of the Sayan-Altay region'.

The first field campaign within this project was executed in July 2006 in Yustyd (Figure 1.12), after which the team moved to Kazakhstan to complete the work planned in the UNESCO project. The goal of the fieldwork within the Bilateral Scientific Co-operation was to finish the inventory from the very rich Yustyd valley (Kosh-Agach region), that was initiated during the expedition of 2004.

The Co-operation enabled us to continue the survey work in 2007, although there were no active projects on the frozen tombs. We organised a campaign in the Russian part of Altay, in the famous valley of Karakol (Onguday district, see Figure 1.12), where the frozen tombs of Bashadar were excavated in 1950 by archaeologist Rudenko (see 1.3.2.4). With a minimum of resources, we recorded over 1,200 structures in the valley. However, only half of the valley was finished because of the huge number of structures present; we continued the work in Karakol in the summer of 2008. The results of this survey have yet to be processed.

1.4.3.8 Mapping and monitoring of permafrost by using thermal remote sensing data (Landsat-ASTER), PhD research 2008-2011

Simultaneously with the archaeological expedition in 2008, a periglacial survey was performed in and around the Dzhazator and Tarkhata valleys. The expedition was part of new project funded by the Institute for the Promotion of Innovation through Science and Technology in Flanders (IWT-Vlaanderen), in the form of a PhD research at the department of Geography. The goal of the project is to model the current state of permafrost distribution by means of ground truth measurements, remote sensing data, and numerical modelling and analysis. The 2008-expedition was mainly intended to install the necessary technical equipment, and to explore the Dzhazator and Tarkhata area for periglacial phenomena. Additional funding was provided by a UNESCO Small Scale Activities grant which covered travel expenses and the acquisition of necessary technical equipment. In the summer of 2009, a new expedition will be organised to read out the different loggers. Some of these will stay in the same location, while others will be moved to gather information about a larger area (Bourgeois et al. 2008: 20-33).

1.4.4 The Frozen Tombs of the Altay Mountains project

1.4.4.1 Introduction

During 2005-2006, Ghent University was a main partner in the first phase of the international project 'Preservation of the Frozen Tombs of the Altay Mountains' (Bourgeois & Gheyle 2007, Han 2008, Han et al. 2008). In collaboration with different UNESCO sectors (culture, science), and funded by the UNESCO/Flanders Trust Fund for the Support of UNESCO Activities, the main objective is protection of the frozen tombs in the area and monitoring permafrost. With the support of the authorities of Russia, Kazakhstan, China, and Mongolia, it may be possible to add these valuable monuments to the World Heritage List.

1.4.4.2 Global warming

Warming is now occurring across most of the globe and is consistent with the global retreat of mountain glaciers, reduction in the extent of snow cover, the earlier spring melting of ice on rivers and lakes, and increases in sea-surface temperatures and ocean heat content. The earth's surface is currently warming at a rate of about 0.17°C per decade or 1.8°C per century, and the top ten warmest years have all occurred since 1990 (NASA 2005, NOAA NCDC 2005). Climatic changes have been reported recently from many regions of Central Asia. Air temperature in the Altay Mountains has increased at a higher rate than the global mean during the 20th century (McCarthy et al. 2001). In the western Mongolian sector of the Altay Mountains, the rise in mean annual air temperature has been 0.3°C per decade over the last 50 years. Winter warming is strongly pronounced in high mountain areas and in intermountain valleys (0.6°C per decade) of the Mongolian Altay but less detectable in the adjacent plains. Glacier research shows that the glaciers in the Altay Mountains are melting rapidly. Rough estimates show that the glaciers have lost up to 27% of their mass over the last 100 years. Their average annual rates of retreat are 9 to 20 m. Further degradation of glaciers is most likely and significant reduction in or disappearance of the permafrost is predicted for the middle of this century in the Altay Mountains. The most significant impacts will be observed near the lower boundary of alpine permafrost where the frozen grounds are very sensitive to climate change. Many frozen tombs in Altay are situated within this area of sporadic and discontinuous permafrost, and are therefore extremely vulnerable (Marchenko 1999, Marchenko 2008).

In these areas, the formation of permafrost under a burial mound is partially due to the structure of the mound itself: although the surroundings have no traces of permafrost, the tombs are frozen due to the cooling influence of the stone mound on top of the burial (Figure 1.13). Studies show that the temperatures inside the stone mound are typically 3 to 5°C colder than the air temperature outside (Marchenko 2006).

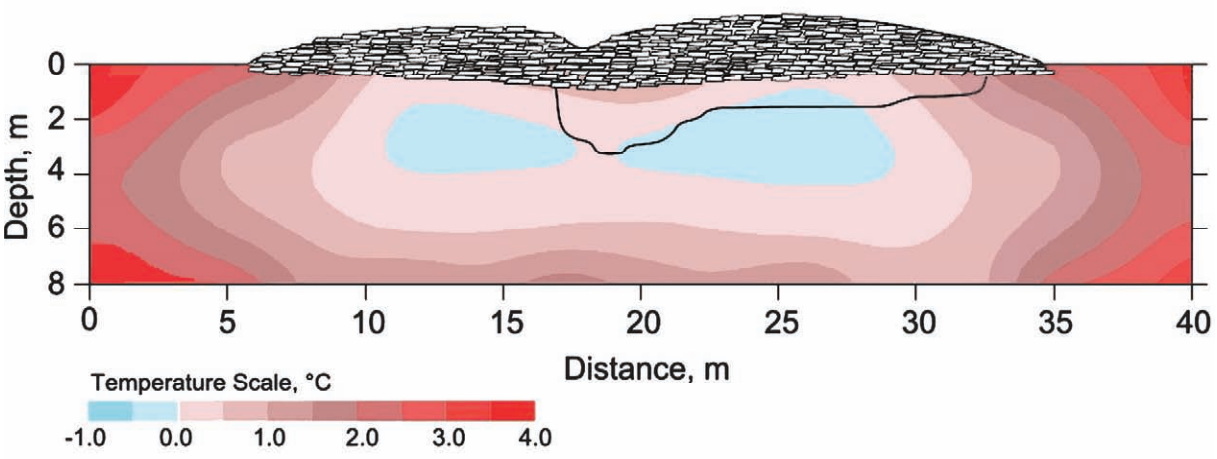


Figure 1.13: Temperature profile under a stone burial mound: the blue area represents the preserved ice lens (Image: Sergei Marchenko)

1.4.4.3 World Heritage

The Scythian-type cultures inhabiting the vast Eurasian steppe zone were influenced by all the great civilisations bordering the steppe. Their nomadic way of life brought them into contact with Greece, the Black Sea area, Mesopotamia, India and even with Ancient China. The similarities between the different Scythian-type cultures make the frozen tombs of the Altay Mountains a very important source of information for all the cultures dominating the Eurasian steppe zone in the first millennium BCE. They form one of the main sources of information for the archaeology of this huge region, covering parts of Europe and Asia. It is clear that these frozen tombs are of major importance for the international scientific community.

The grave goods form an accurate representation of their material culture. In addition, the description of Scythian funeral practices given by Herodotus in the 5th century BCE find their material expression in the Altay Mountains' tombs. This is an exceptional opportunity to combine archaeology and history. The frozen state of the graves preserves all of the tombs' contents. This means that not only is the infrastructure of each grave perfectly conserved, but so are all organic and inorganic materials that accompany the dead to the afterlife. These generally include textiles, wooden objects, bone, bronze, iron and gold objects, weaponry, fully harnessed horses, and even food for survival during the journey to the hereafter. The body of the deceased provides an even more important source of information since, being mummified, it comes to us in a perfect state of conservation, with clothing, headdress, and in many cases wonderful tattoos (Polosmak 2004). The conservation of organic material gives the scientist the opportunity to conduct forensic research and, thanks to DNA research, even family ties can be examined.

The exceptional conservation combined with the rich heritage of the Scythians make these tombs extremely valuable for scientific research. Together with the international organisations, the scientific community has the responsibility to preserve these treasures of our past for future generations. UNESCO is interested in including the frozen Scythian tombs in the World Heritage List, and a part of the Russian Altay Mountains is already listed in UNESCO's Natural World Heritage as 'The Golden Mountains of Altay', briefly mentioning the archaeological monuments

in the area[5]. The discussion has started about developing a transboundary reserve, including the natural and cultural heritage of the Altay Mountains in the four countries involved, the so-called 'Altay Mountain Knot' (Badenkov 2007).

The frozen tombs are situated in the upper part of the Altay Mountains, at an altitude ranging from 1,000 m to 2,300 m. The severe climate in these regions, with long cold winters and short warm summers certainly prevents these tombs from thawing, especially those located in the higher valleys. However, many other frozen tombs are situated in a (geographically) discontinuous and very unstable permafrost setting.

1.4.4.4 A global UNESCO project

Considering the importance of this archaeological heritage for our world, and the threat caused by climatic change, a global and ambitious project 'The Frozen Tombs of the Altay Mountains' was set up and supported by UNESCO, with a grant from the UNESCO/Flanders Funds-in-Trust for a first, preliminary programme (2005-2006). Such a project necessitates international co-operation, which was set up with American, Belgian, Chinese, French, German, Kazakh, Mongolian and Russian colleagues at different levels.[6]

The objectives of the project are (Figure 1.14):

- An inventory of the frozen tombs;
- Examination of the evolution of permafrost conditions to indicate which tombs are likely to defrost within the coming decades;
- Finding solutions for the preservation of permafrost in these cases; and
- As a last step, tombs that are thawing and cannot be saved should be excavated.

1.4.4.5 Inventory of the Frozen Tombs

For the purpose of an inventory, accurate maps are needed for the precise location of all archaeological structures. These maps do not exist for all of the research areas. Taking into account the area covered by the research areas, the high cost of topographic measurements and the non-existence of total coverage with aerial photography, the mapping is being executed with the help of existing satellite images (CORONA, ASTER). With the resulting maps as background, all the known information about archaeological sites and frozen tombs can be centralised and mapped. Survey campaigns are set up to complete the picture. Surveying such a large research area is a huge task, but it is an indispensable aspect of the project. Since the work can be divided up between different partners, it is possible to survey large areas, as has been shown in recent campaigns.

[5] See: http://whc.unesco.org/en/list/768 for a description of The Golden Mountains of Altay.

[6] See the project website: http://www.archaeology.ugent.be/altai/

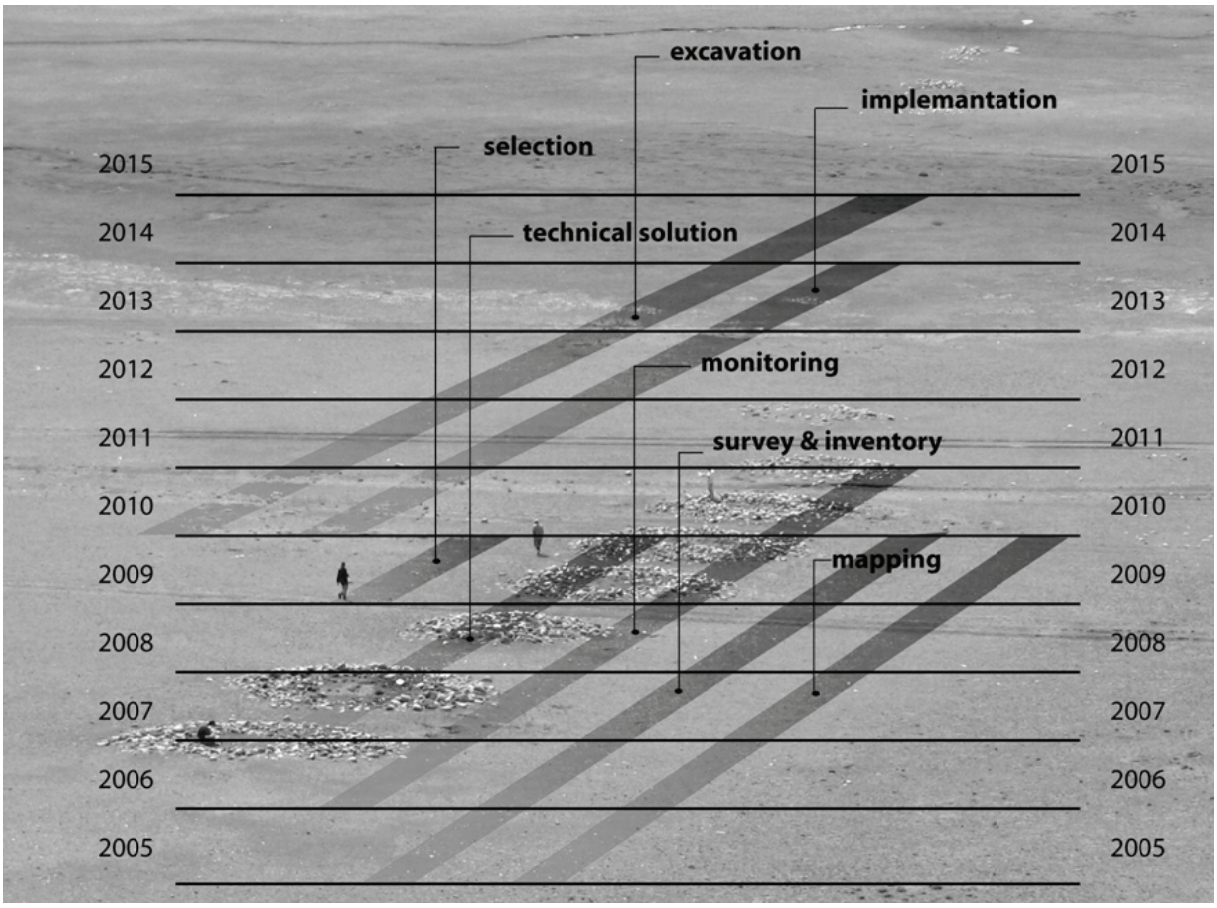


Figure 1.14: Original layout of the Frozen Tombs Initiative showing the different phases of the project

1.4.4.6 Detection of the frozen tombs

We also had to think of techniques to detect frozen tombs. It was not possible within the first part of the UNESCO global project to undertake any serious foray into the detection of individual kurgans, but there is already significant experience in geophysical prospecting methods for small-scale surveys in archaeological zones (Gorbunov et al. 2005). Obviously, this part of the global project has to be developed in the near future. The experience of the German Archaeological Institute (as shown in Mongolia) is of prime importance in this field (Parzinger 2006b).

On a larger scale, we should be able to map the permafrost of the Altay Mountains, its past and future evolution, in order to contextualise the frozen tombs. First preliminary attempts in this field were realised by Ghent University, based on field measurements and borings, and on ASTER imagery, carried out by Dr. S. Marchenko (University of Alaska Fairbanks) and Prof. Dr. E. V. Severskii (Russian Academy of Sciences, Almaty)(see 4.7).

Frozen graves that have been discovered will then be monitored for changes in the condition of the permafrost, preferably over several years. The results of this research will indicate which tombs are endangered. Geophysical research enables us to detect and evaluate ice lenses under kurgans. If the consequences of global climate change are detectable in the kurgans, methods

should be developed to preserve the graves in their frozen condition. It is obvious that we will not be able to apply these methods and technologies to all the frozen tombs. A well-considered selection will probably be required.

1.4.4.7 Preservation of the selected frozen tombs

As stated above, if the consequences of global climate change are detectable in individual tombs, ways of preserving the graves in their frozen condition must be considered. The search for technical solutions to preserve the ice lens in situ has already started, and different methods of frozen ground preservation and prevention of permafrost degradation are being studied (Marchenko 2006). The height and thickness of the coarse debris (the stone burial mound) is a determining factor for the formation and preservation of an ice lens. Thus, the easiest way to protect the frozen core of a tomb could be by enlarging the stone cover. From a heritage point of view, of course, this is not applicable. A second possibility is to protect the kurgan from rainfall, sunlight and snowfall by shading the burial mound. This method lowers the ground temperature by 3 to 7°C (Zhang & Liu 1998). Since the visual impact on the natural landscape is also great here perhaps we should focus on a third possible solution – installing self-regulating seasonally acting cooling devices or thermosyphons (Figure 1.15). These act like refrigerators, but without requiring an external power source. By extracting heat from the ground and dissipating it into the air, they lower the ground temperature and prevent the degradation of permafrost (Haynes & Zarling 1988).

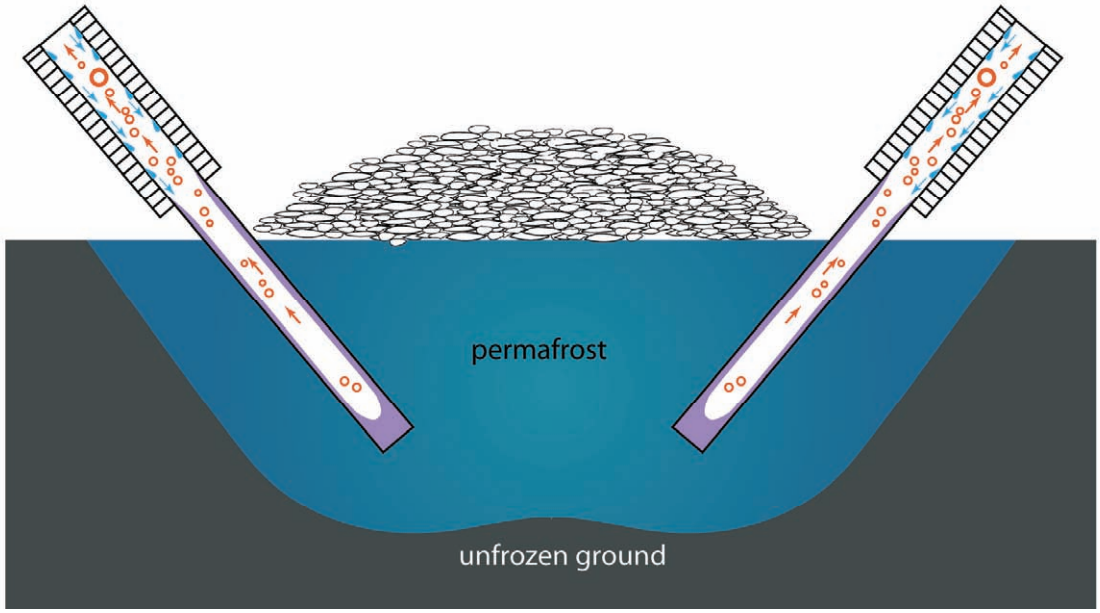


Figure 1.15: Thermosyphons extract warm air from the underground and replace it by cold air. They could be installed in burial mounds to preserve permafrost under the stone mound (Image: Sergei Marchenko)

Obviously, more research has to be done here. There is no doubt that other techniques and methods will be designed in the future, all of which should, of course, consider the problems of sustainability and respect for the landscape.

It is evident that we will not be able to apply these methods and technologies to all the frozen tombs in the region. A well-balanced selection will probably have to be made which will take into consideration the totality of the archaeological heritage in the area and the distribution of the monuments (geographically as well as chronologically or socially).

1.4.4.8 Possible rescue excavations in thawing tombs

Finally, there is the issue of what to do with the tombs that cannot be saved from defrosting. If excavation is the only solution, it will be necessary to work with different groups of experts, using the latest techniques and equipment. Much attention should also be paid to the conservation and restoration of the finds, and to their final destination. In the case of excavations, we also have to take into account the attitude of the local population towards the graves of their ancestors.

2 Methodology for mapping the Altay Mountains

This chapter is partly a synthesis of some recent publications written in co-authorship with colleagues from the archaeology and geography departments, on the methodology for working with CORONA imagery. The initial methodology was first published in *Antiquity* in 2004 (Gheyle et al. 2004). Subsequently, we devoted an article to the problems of working with CORONA and stereoscopic imagery in the *Journal of Archaeological Science* (Goossens et al. 2006a), and presented these findings at the Fifth International Conference on Archaeology of the Ancient Near East (ICAANE) in 2006 (De Schacht et al. 2008).

The methodology described below has evolved considerably since the first expedition in July and August 2003. Part of the initial methodology was based on the joint Master's thesis that was presented by the author and his colleague Raf Trommelmans in September 2002 (Gheyle & Trommelmans 2002). However, most of it came from the expertise already present in the departments of archaeology and of geography at Ghent University. We will try to indicate the evolution where necessary.

2.1 Introduction

Detailed maps are needed to carry out an archaeological survey, both for the localisation of the archaeological sites and structures during the survey and for the detailed study of the archaeological landscape based on the survey results. Detailed maps of the region are not available: the best topographical maps have a scale of 1:200,000, while classified military maps go up to 1:100,000.

During the earliest surveys by Ghent University (see 0), the team encountered many localisation problems. In Sebystey (1996-1997), the archaeologists tried to solve this problem by making their own topographic map of the research area. Using a differential GPS system, the Leica SR 9500, they measured 1234 topographic points in an area of some 10 square kilometres. This was done by surveying the area on foot and manually measuring points on the way. It resulted in a very detailed and useful topographic map of the middle part of the Sebystey valley, about 30% of the total research area (Figure 2.1). The location of the sites outside of this area had to be determined by using the existing topographical maps of a 1:100,000 scale (Bourgeois et al. 2000a: 95-97).

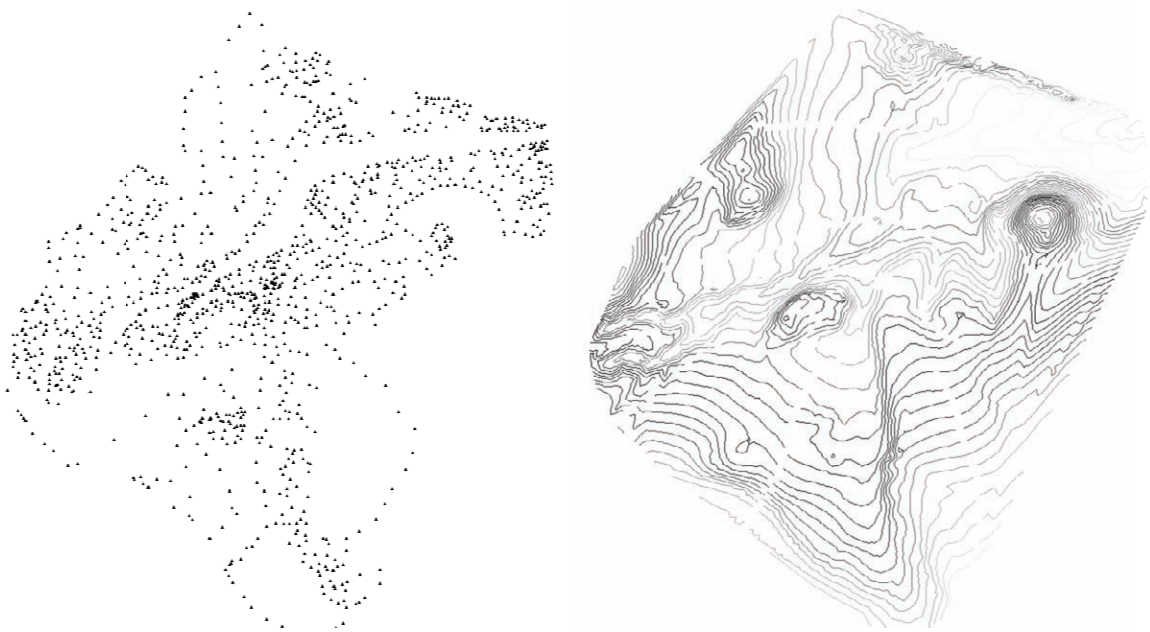


Figure 2.1: Sebystey 1996-1997: measured points during the topographical GPS survey (left), and resulting contour map of the middle part of the valley (right)

It is clear that this method of map-making is very time-consuming, and therefore limited to smaller research areas. Moreover, it is only possible to map the accessible parts of the terrain. If the area of research is considerably larger, as is the case in this PhD thesis, other solutions must be found. In addition, taking into account the high costs of time-consuming topographic measurements and the non-existence of total coverage with aerial photographs, we decided to use satellite images as a basis for the production of topographical maps. The satellite imagery produced by the US CORONA programme seemed to be the perfect tool for this purpose (Goossens et al. 2007).

2.2 Using CORONA satellite imagery for mapping purposes

2.2.1 The CORONA reconnaissance programme

CORONA is a well-known American espionage satellite programme, designed to assess Russian military potential at the time of the 'missile gap'[8] at the beginning of the Cold War. During the operational phase of CORONA, between 1960 and 1972, more than 100 spacecrafts delivered over 866,000 high-resolution images, the equivalent of 642,890 metres of film. The resolution of the images ranged from 40 feet to 6 feet, depending on the sensor type and camera system

[8] The 'missile gap' was the term used in the United States for the preceived inferiority in the number of intercontinental ballistic missiles with nuclear warheads available to the United States as compared to the number available to the Soviet Union at the end of the 1950s.

(USGS EROS 2006c). This impressive detail has only recently been surpassed by highly expensive commercial satellite systems such as IKONOS and Quickbird.

During 1995-1996, American President Bill Clinton ordered the declassification of part of the CORONA data. From then on, the imagery captured by camera systems KH-1 to KH-6 was made available to the public (USGS EROS 2006b). The films from sensors KH-7 and KH-9 were declassified in 2002 (USGS EROS 2006a). A digital archive of the imagery, devised by the United States Geological Service, can be found on the Earth Explorer website (USGS EROS 2007), but the images can only be ordered by contacting USGS Customer Service (USGS EROS 2006b). The National Archives and Records Administration (NARA) are now in charge of the CORONA archives, and the original film is stored in the National Archives in College Park, Maryland (USA). Before September 2004, the images were available in different formats including, among others, negative film versions and positive photos. Since September 2004, the imagery is no longer available as film negatives, but only as digital images (scan resolutions of 23, 14 and 7 micrometres, the last resolution listed only for KH-4A and KH-4B).

The following table (Table 2.1) summarises major developments in the CORONA satellite programme from 1959 to 1972, with the evolution from the KH-1 to KH-4B camera system. Improvements were incorporated with every new mission: different lens types, better film, and enhancements to the rocket or the sensor platform. Full details of all CORONA missions can be found in the original CIA reports that were drawn up for every mission and now available at NARA, and in the National Reconnaissance Office (NRO) reports about the development, acquisition and operation of the CORONA, Argon and Lanyard systems, available on the NRO website. A detailed overview of these reports can be found in Galiatsatos 2004 (chapter 2.1.16: 42).

The different CORONA systems where named after the camera systems that were mounted on the platform, using the prefix ‘key-hole’ (KH). This numbering continued even after the actual CORONA programme had finished. KH-1 to KH-3 were the first three camera systems within the CORONA project, with a maximum ground resolution of 40 ft (12.2 m), 25 ft (7.62 m) and 12 ft (3.66 m) respectively. From KH-4 onwards, CORONA had two cameras on-board and provided stereoscopic coverage. It was the first camera to do so from space. The platform consisted of two KH-3 cameras, one looking 15 degrees forwards (FWD), the other looking 15 degrees backwards (AFT). The KH-4 cameras had a ground resolution of 10 ft (3.05 m) at best, improving to 9 ft (2.74 m) with KH-4A and to 6 ft (1.83 m) with KH-4B.

	KH-1	*KH-2*	*KH-3*	*KH-4*	*KH-4A*	*KH-4B*
Period of operation	27/6/59-13/9/60	26/10/60-23/10/61	30/8/61-13/1/62	27/2/62-24/3/64	24/8/63-22/9/69	15/9/67-25/5/72
Number of frames	1,432	7,246	9,918	101,743	517,688	188,526
Film footage (ft)	3,548	17,949	24,676	239,299	1,293,025	505,970
Mission life (days)	1	2-3	1-4	6-7	4-15	19
Mission numbers	9001-9010	9011-9021	9022-9030	9031-9066A	1001-1052	1101-1117
Succesful missions	1	3	5	20	49	16
Succesful mission numbers	9009	9013/17/19	9022-23/25/28-29	9031-32/35/37-41/43-45/47-48/50-51/53-54/56-57/62	1001/02/04/06-31/33-51	1101-12/1114-17
Targets	USSR	Emphasis on USSR		World-wide/emphasis on denied areas		
Higher altitude (estimated km)	817	704	232	415	n/a	n/a
Lower altitude (estimated km)	192	252	217	211	180	150
Aperture width	5.265°	5.265°	5.265°	5.265°	5.265°	5.265°
Pan angle	71.16°	71.16°	71.16°	71.16°	71.16°	71.16°
Stereo angle	n/a	n/a	n/a	30°	30°	30°
Lens	F/5.0 Tessar	F/5.0 Tessar	F/3.5 Petzval	F/3.5 Petzval	F/3.5 Petzval	F/3.5 Petzval
Focal length (cm)	61	61	61	61	61	61
Ground resolution (ft)	40	25	12-25	10-25	9-25	6-25
Film resolution (lp/mm)	50-100	50-100	50-100	50-100	120	160
Nominal ground coverage	15.3 x 209 to 42 x 579 (km)				17 x 232 (km)	13.8 x 188 (km)
Approximate frame format	2.18 x 29.8 (inch)					
Nominal photoscale in film	1:275,000 to 1:760,000			1:300,000	1:305,000	1:247,500

Table 2.1: Overview of the CORONA camera systems

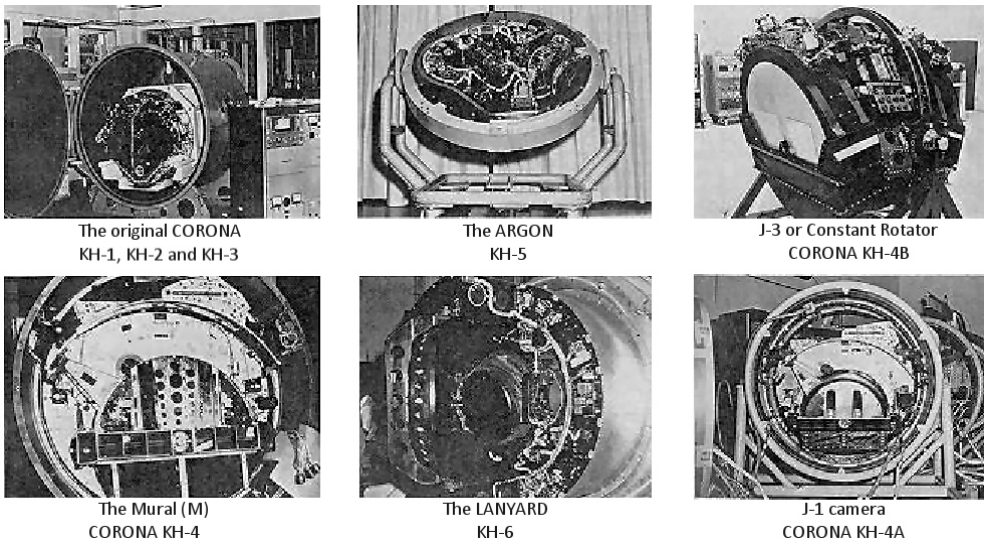


Figure 2.2: The CORONA camera systems used in KH-1 to KH-6 (after NRO 2008)

It is rather unclear where the CORONA story ends. The actual CORONA programme only included the KH-1 to KH-4B camera systems, and the last launch of a CORONA KH-4B satellite took place on 25 May 1972. However, the development of reconnaissance satellites continued. In 1963, the search was already on to improve the resolution of the CORONA cameras to 2 ft (61 cm). However, the size of the CORONA camera systems made this impossible, so other systems where developed with different names, and sometimes with completely different goals.

The KH-5 was actually devised as a mapping system that worked in parallel with CORONA, and was code-named the ARGON system. Its estimated ground resolution was 460 ft or about 140 m, but each frame covered approximately 555 x 555 km. The next system, KH-6 or LANYARD, was devised to provide a 2 ft ground resolution (about 61 cm), but only one mission was achieved and the resolution was only 6 ft (1.83 m). A higher resolution was achieved with the KH-7 GAMBIT system, active from July 1963 to June 1967. This sensor only targeted selected urban areas and specific military installations, and had a ground resolution of up to 2 ft (61 cm) (Ur 2005: 318, Fowler 2008). In 1973, the KH-9 system was revealed, and was in operation until October 1980. This HEXAGON system had a ground resolution of between 20 and 30 ft (6.1-9.1 m).

Here ends the declassified history of CORONA and its successors. Other US reconnaissance systems stay classified, but it is likely that the programme continued alongside other camera systems including the KH-8A GAMBIT, KH-8B GAMBIT, KH-10 DORIAN, KH-11 CRYSTAL KENNAN (the first digital spy satellite, sending images over from space in 1976), KH-11 DRAGON, KH-12 IMINT and KH-13 8X. The imagery from these and possibly other US reconnaissance programmes is still highly classified and not available for scientific research.

However, this is not the place to delve further into interesting history of the CORONA programme. Very detailed information can be found on the previously mentioned USGS websites and in numerous publications on the CORONA programme and its characteristics (a.o. MacDonald 1995, Ruffner 1995, Campbell 1996, Peebles 1997, Wheelon 1997, Day et al. 1998).

For a thorough synthesis, we refer to Nikolaos Galiatsatos' very complete PhD study (Galiatsatos 2004).

2.2.2 CORONA satellite imagery and the archaeological research

The availability of satellite images to the public, the relatively high ground resolutions and the low cost per square kilometre – in addition to a handling fee and the media costs (CD, FTP or DVD), a scanned image only costs USD 24.00 – make such imagery a valuable instrument for scientific research in subject areas such as geography and archaeology, among others. Moreover, images are analogue, panchromatic (black and white), and are therefore easy to read. Another advantage, especially for archaeologists, is that the imagery dates from the 1960s and 1970s. As such, it is an historical source which reflects a landscape that has changed significantly over the last 30 years.

Last but not least is the ability of CORONA to produce images in a stereoscopic way, thereby delivering detailed three-dimensional information to the user. This information can either be used for detailed observation of surface structures, or for studying the actual landscape. Kennedy (1998), Goossens et al. (2001), and Philip et al. (2002) have already stressed the importance of CORONA data for regions that are not covered by detailed maps or aerial photography.

Almost immediately after 1996, archaeologists started to use CORONA for the detection of archaeological remains. It is very valuable, especially in the Middle East where images are available and aerial photographs are sometimes very difficult to obtain. Several projects have used CORONA imagery in the search for ancient roads and hollow-ways (Ur 2003), bridges and river crossings (Comfort et al. 2000), old cities and settlements (Kennedy 1998, Philip et al. 2002, de Meyer 2004), Roman military camps (Fowler 2004), irrigation networks (De Schacht 2007), canals and levees (Hritz 2004, Ur 2005), or for researching urbanisation (Challis et al. 2002).

2.2.3 Stereoscopic properties of CORONA

The CORONA sensors produce both a forward and a backward (afterward) image of the same area with a different viewing angle (Figure 2.3). This process is called stereoscopy. Much of the same type of observation is used in conventional aerial photography for mapping purposes. Aerial photography uses two vertical images with an overlap of 60%, recorded one after the other at regular intervals, while the plane moves forward. The images from space, on the other hand, are recorded in an oblique way with a different viewing angle. This principle is illustrated for CORONA in Figure 2.4, showing the forward- and backward-looking cameras.

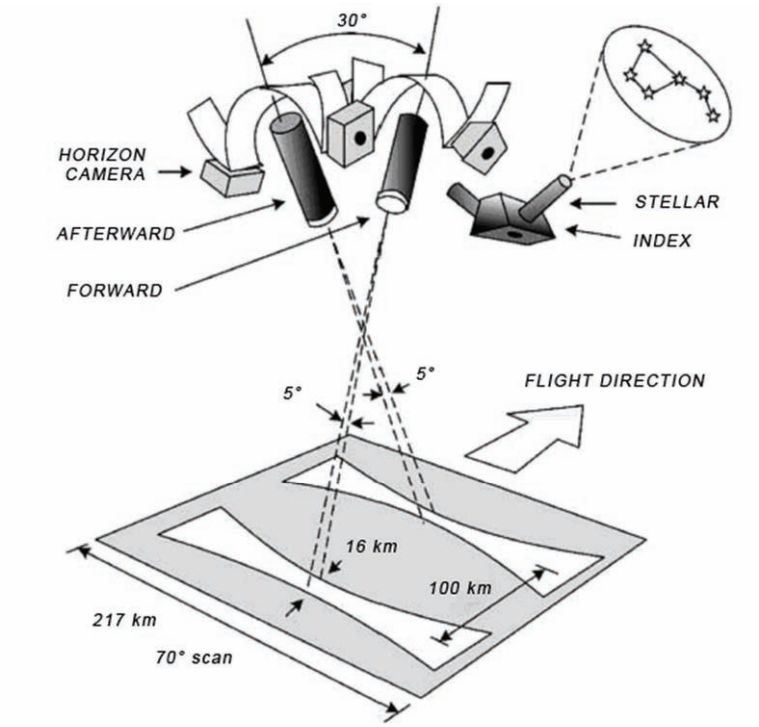


Figure 2.3: The CORONA system's backward- and forward-looking cameras and the process of stereoscopic capturing (from Sohn et al. 2004)

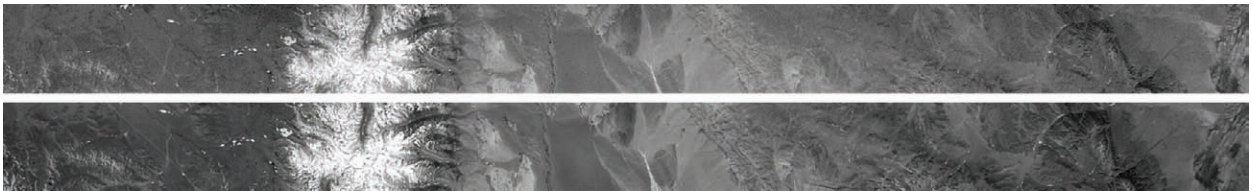


Figure 2.4: An example of the CORONA system's stereoscopic coverage: CORONA mission 1110-1, revolution 052D, made on 20 May 1970. Above is forward image DS1110-1052DF046, below is backward image DS1110-1052DA052

Stereoscopic viewing can be explained by the fact that every optical image corresponds to a conical projection, rather than an orthogonal one. An image is only orthogonal at the point directly below the satellite, known as the nadir point. All other points in the image are projected in a conical way, away from the nadir point, as seen in Figure 2.5. The geometric difference between an orthogonal projection and the image is called image displacement. The difference between two images in a stereoscopic pair, caused by viewing from different directions, is called parallax. This parallax forms the basis for the three-dimensional information.

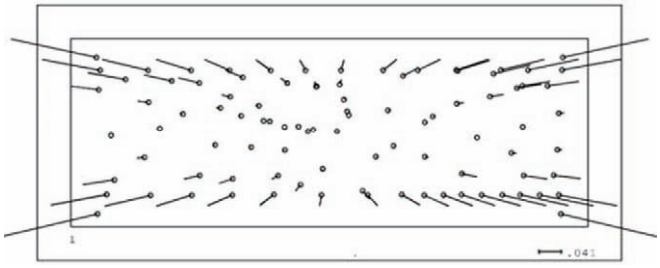


Figure 2.5: Image displacements in a KH-4B image (from Schneider et al. 2001)

Several parameters define the image displacements: the distance of the object from the image centre, the focal length, the flight altitude, the image resolution, the viewing angle and, most importantly, the height of the objects or relief elements. Theoretically speaking, in an absolutely flat landscape, the image parallaxes are equal. But as soon as a landscape has some relief (natural relief, vegetation, or anthropogenic structures) the parallaxes change. Therefore, an image can never be considered as a map. Moreover, the bigger the relief differences, the greater the image displacements. Depending on the resolution, relief differences of 1 m can already cause some visible parallax changes. In a mountainous area such as the Altay Mountains, the changes are overwhelming. The correct three-dimensional locations can only be determined using the forward and backward images. The displacement caused by the conical projection is the same in both images, while height differences on the ground cause parallaxes. The influence of the height differences on the image position is the same for both images, but in opposite directions.

Stereoscopic CORONA imagery is very helpful in archaeological research, and it is necessary to use both the forward- and backward-looking images for the following reasons:

1. Stereoscopic viewing is essential in visual interpretation. The two stereo images of the same surface are always different in contrast as they are taken from a different point of view, using a different viewing angle. As a result of these changes, the shadows and other features are also different. This can make quite a difference in the interpretation of archaeological features. By combining two images in one, stereoscopic view will give the best of the two images and thus much more (reliable) visual information.

2. More importantly, if the stereoscopic images are combined they can be used for relief mapping and a three-dimensional interpretation of the landscape (and archaeological monuments). It is even possible to employ the images for topographic mapping when using specific software. It is evident that this gives us a useful tool to use in areas where detailed maps are lacking. Such information is lost when only one image is used.

2.2.4 Image distortions in CORONA imagery

One important drawback and the principal problem for the integration of data is the complex geometry of the CORONA imagery. As with all photography, satellite images are characterised by image distortions. An orthophoto, the orthogonal depiction of a surface or object, has no deformations. The image has a fixed scale and, all over the images, objects are reliable depictions of what can be seen. They can be measured and form a true ‘map’. In a digital image, this means the pixels represent the same amount of surface over the whole image, and form a regular grid (Figure 2.6). The CORONA images are not orthophotos, and therefore cannot be seen as a realistic depiction of the surface of the earth.

In some research projects, the images are analysed directly for archaeological traces, which are then logged. The result is seen as a map and is used as such. However, this is a big mistake because it does not represent reality. Use of such a document in the field or an attempt to

match it with existing maps would show that it is not a reliable source of information. Using only one of the images is not an option; geo-referencing only one image does not eliminate the parallax differences and image displacements. We will show that geographic techniques and photogrammetric software can correct the distortion, take care of the restitution of the images, and produce true maps.

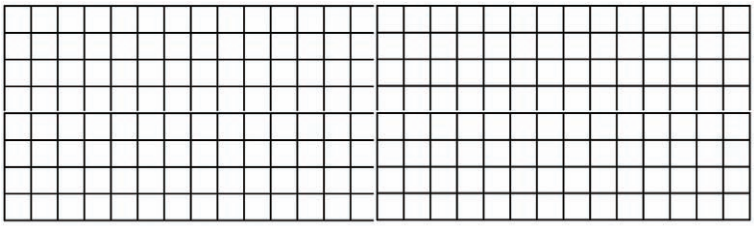


Figure 2.6: Presumed ground coverage of a CORONA image, not taking into account the conical and S-shaped distortion: each quadrangle represents 5 x 5 km

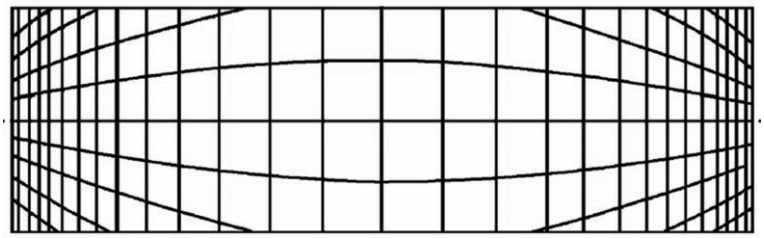


Figure 2.7: Typical geometrical distortions due to the conical projection: each quadrangle represents 5 x 5 km (after Slama 1980)

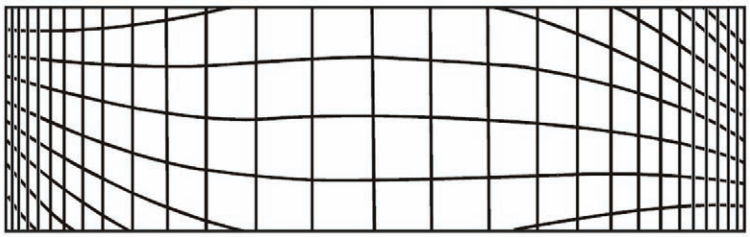


Figure 2.8: The S-shaped distortion on a CORONA negative caused by the specific way of recording: each quadrangle represents 5 x 5 km (after Schneider et al. 2001).

As a result of the specific way in which the CORONA system records images, it produces images with significant deformation at different levels. Of course, image displacements may be caused by imaging geometry, as mentioned above. However, on a larger scale, the first thing to observe is that optical photographs, like those produced by CORONA, have a conical projection with typical geometrical distortions (Figure 2.7). Secondly, it is noteworthy that the film negatives are exposed via a system called a 'constant rotator', from left to right through an aperture in a rotating wheel. As the satellite keeps moving forward during the exposure time, this results in a significant S-shaped distortion of the image (Figure 2.8).

The S-shaped distortion is not important at the centre of the image – along the flight axis – but becomes increasingly so towards the edges. This means that there is a different geometry throughout the image. Moreover, as the rotator switches from left to right, the distance from the scanning camera to the surface is less at the nadir point than at the border of the images. In

the digital image, the pixels are of fixed size; at the nadir point, the same number of pixels will cover a much smaller area than they do to the extreme left or right of the image. Thus, there is a different resolution throughout the image – the resolution becomes lower away from the flight axis. Finally, this means that there is a different scale throughout the image – the scale becomes smaller away from the flight axis. By comparing Figure 2.6 with Figure 2.8 the important differences between the presumed and the actual ground coverage can be clearly seen, taking into account that each quadrangular subdivision represents equal squares of 5 km² on the ground.

Alongside these distortions, mention should be made of the unpredictable movements of the satellite (tilt, altitude differences, etc.) that will also result in changes in the images. It is obvious that because of a combination of all these distortions, a CORONA image cannot be considered as a 'photomap', and cannot be used in a GIS without correction. The S-shaped distortion can be corrected in two ways. Since the movements of the rotator are known, the parameters of the S-shaped distortion are also known (Jacobsen 2004). Schneider et al. (2001) describe a method that corrects the geometry of the images before any photogrammetrical restitution work is done, using these parameters. Another method compensates the S-shaped distortion during the photogrammetrical restitution itself (Schmidt et al. 2001). This second method will be described briefly in the following chapters (see also Altmaier & Kany 2002, Sohn et al. 2004).

2.2.5 Use of CORONA Imagery

Different types of CORONA imagery were used in the research from 2003 to 2007, mainly according to availability. In general, there is large coverage of the area being researched, as the Altay Mountains formed a strategically important region during the Cold War: the borders of the USSR with Mongolia and China. The USSR was a main focus of the CORONA programme from the earliest missions. Later, interest was also directed towards areas where aircraft overflight was denied to the USA, or in conflict areas (for example, during the Arab-Israel war). However, the coverage was not really systematic. According to the need for reconnaissance in a particular area and depending on the weather above the research area, the controllers in the ground station could switch the capture on and off by using telemetry (Figure 2.9). The availability of imagery above a certain area is largely dependent on these factors (Galiatsatos 2004: 31). Moreover, much information was lost due to failed missions or difficult re-entries. It is known that CORONA film capsules have been lost at sea or captured by enemy states.

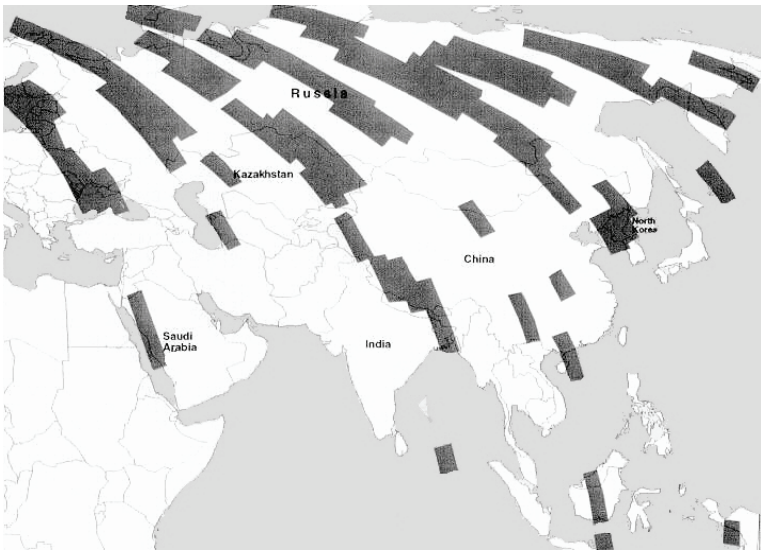


Figure 2.9: Example of four-day coverage of Eurasia during KH-4A Mission 1017, showing the selective coverage of the cameras (after NRO 2008)

Not all available images are usable as there is a huge variety in image quality. The cloud cover is very important: although the capture was switched on and off depending on the weather, many images are partly or completely covered with clouds. In addition, dust clouds and snow cover can make them unusable. Finally, but importantly, the amount of solar reflection affects the image quality significantly. In general, the solar reflection is higher on the backward images, resulting in a significant loss of detail and tone. Some of these factors are easy to detect on the previews when ordering the images (an indication of cloud cover is even given as a percentage of the total area covered), but others are rather difficult to assess.

Taking into account the visibility of the archaeological features – no snow cover and a limited amount of vegetation – only images from missions that took place in the summer (from late May to the first half of August) were selected. Where possible, KH-4B imagery was used as it has a smaller ground resolution of 6 feet and a higher image quality with better contrast. However, such imagery was not available for all research areas. In 2003, for example, we had to use the less-suited KH-4A imagery (Figure 2.10). As the results of the photogrammetrical restitution and the localisation of the ground control points (GCPs) depends largely on image resolution and quality, the availability of good imagery for certain areas was a factor in the selection of the research areas (see Chapter 4).

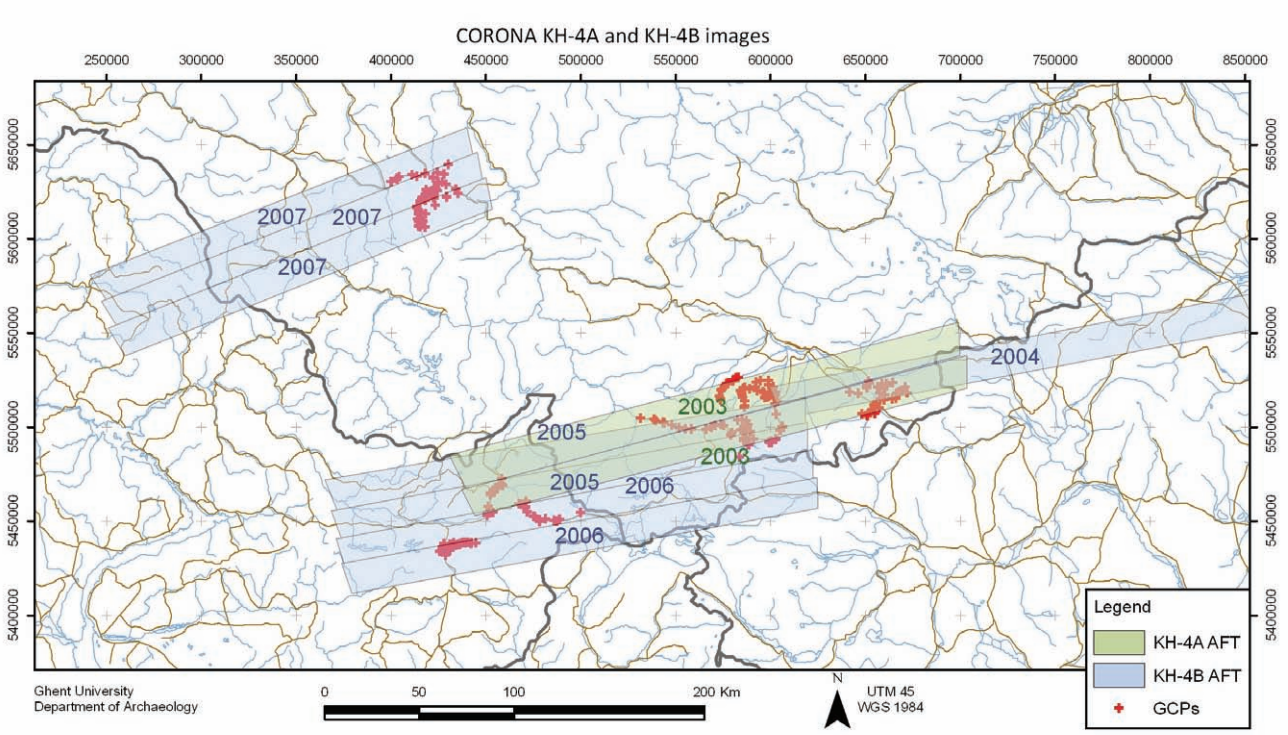


Figure 2.10: Map showing the CORONA KH-4A and KH-4B images used above the research areas. Only the backward images are shown: the forward images cover the same areas

For the research of the Sebystey, Ozyok, Irbistu and Elangash valleys, we studied images made by CORONA mission 1042-1, revolution 086D (22 June 1969). This mission used a KH-4A sensor (best ground resolution of 9 ft), which was the best imagery available for that region. We printed the images, having enlarged the film negatives 18 times, and scanned the printed photos with a resolution of 1200 dpi (see 2.2.6). Because of the specific way the images overlapped, we used one forward image and two backward images.

Negative number	*Angle*	*Scan*	*Research areas*
DS1042-1086DF032	FWD	Photo scan	Elangash, Irbistu, Ozyok and Sebystey
DS1042-1086DA031	AFT[9]	Photo scan	Ozyok and the lower part of Elangash and Irbistu
DS1042-1086DA032	AFT	Photo scan	Sebystey and the higher part of Elangash and Irbistu

Table 2.2: CORONA imagery used for research in 2003, covering the southern part of the Chuya depression and the valleys dissecting the South Chuya Range

[9] 'AFT' stands for 'afterward': images made by the backward-looking camera, as opposed to 'FWD' or the forward-looking camera.

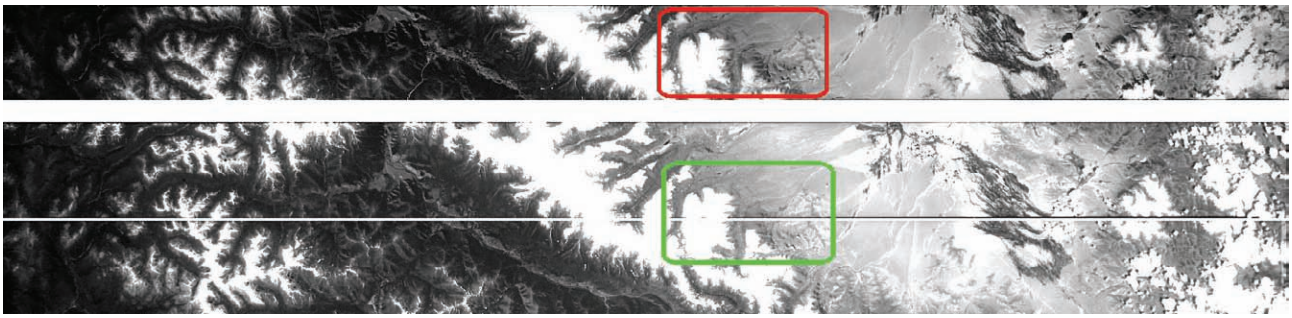


Figure 2.11: The forward (above) and backward (below) images used for research in 2003, produced by the CORONA KH-4A sensor. The research areas are indicated with a rectangle: north is top right

The images covering the Yustyd valley, our research area in 2004, had a better ground resolution (up to 6 ft), as they where made by CORONA mission 1110-1, revolution 052D, on 20 May 1970. A KH-4B sensor was on-board. The images were scanned directly on to the negatives, with an 8 µm scanning resolution.

Negative number	*Angle*	*Scan*	*Research areas*
DS1110-1052DF046	FWD	8 µm	Yustyd valley
DS1110-1052DA052	AFT	8 µm	Yustyd valley

Table 2.3: CORONA imagery used for research in 2004, covering the eastern part of the Chuya depression and the Yustyd valley

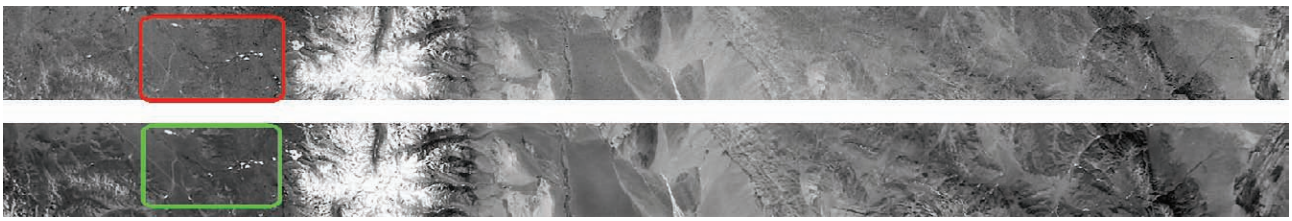


Figure 2.12: The forward (above) and backward (below) image of the CORONA KH-4B sensor, covering 13.8 x 188 km. The study area is indicated with a rectangle on the left-hand side of the images: north is top right

For our research in Dzhazator, images were available form the same KH-4B sensor (ground resolution of 6 ft). The photos were made by mission DS 1104-1, revolution 039D, on 10 August 1968. Unfortunately, the eastern part of the images (the higher Dzhazator valley) is rather cloudy, but no other KH-4B images were available. The film negatives were scanned by USGS with a 7 µm resolution.

Negative number	*Angle*	*Scan*	*Research areas*
DS1104-1039DF001	FWD	USGS, part a	Middle and lower part of the Dzhazator valley
DS1104-1039DF002	FWD	USGS, part a	Higher part of the Dzhazator valley
DS1104-1039DA007	AFT	USGS, part d	Middle and lower part of the Dzhazator valley
DS1104-1039DA008	AFT	USGS, part d	Higher part of the Dzhazator valley

Table 2.4: CORONA imagery used for research in 2005, covering the Dzhazator valley and surroundings

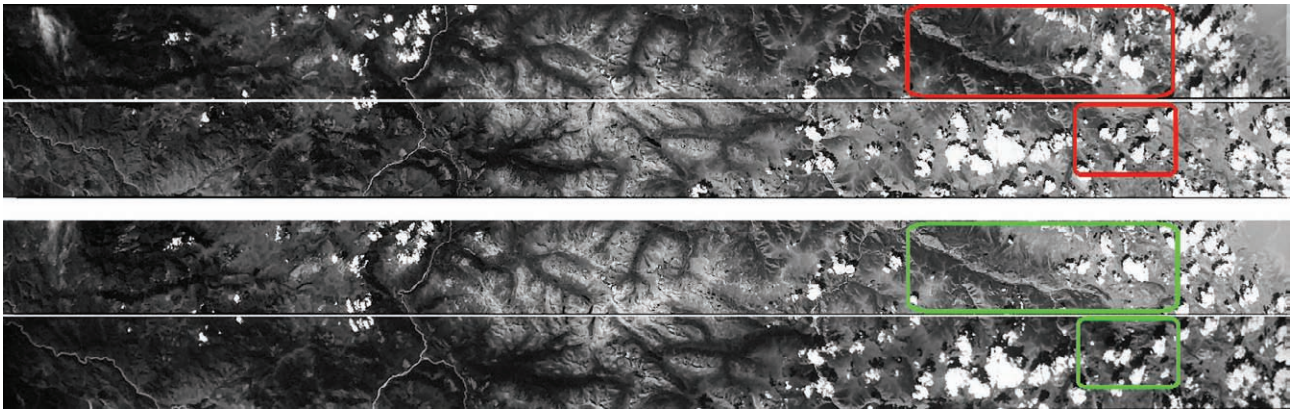


Figure 2.13: The forward (above) and backward (below) images of the CORONA KH-4B sensor covering the study area in the Dzhazator valley. It is indicated with rectangles: north is top right

The same KH-4B images could be used for the fieldwork in Kazakhstan in summer 2006. However, the images made by mission DS1104-1, revolution 039D, on 10 August 1968 are very clear for this area in the absence of any clouds. The film negatives were scanned by USGS with a 7 µm resolution.

Negative number	*Angle*	*Scan*	*Research areas*
DS1104-1039DF002	FWD	USGS, part c	Berel archaeological site (Bukhtarma valley)
DS1104-1039DF003	FWD	USGS, part c	Middle and higher part of the Bukhtarma valley
DS1104-1039DF004	FWD	USGS, part d	Karakaba valley
DS1104-1039DA008	AFT	USGS, part b	Berel archaeological site (Bukhtarma valley)
DS1104-1039DA009	AFT	USGS, part b	Middle and higher part of the Bukhtarma valley
DS1104-1039DA010	AFT	USGS, part a	Karakaba valley

Table 2.5: CORONA imagery used for research in 2006, covering the Kazakh part of the Altay Mountains

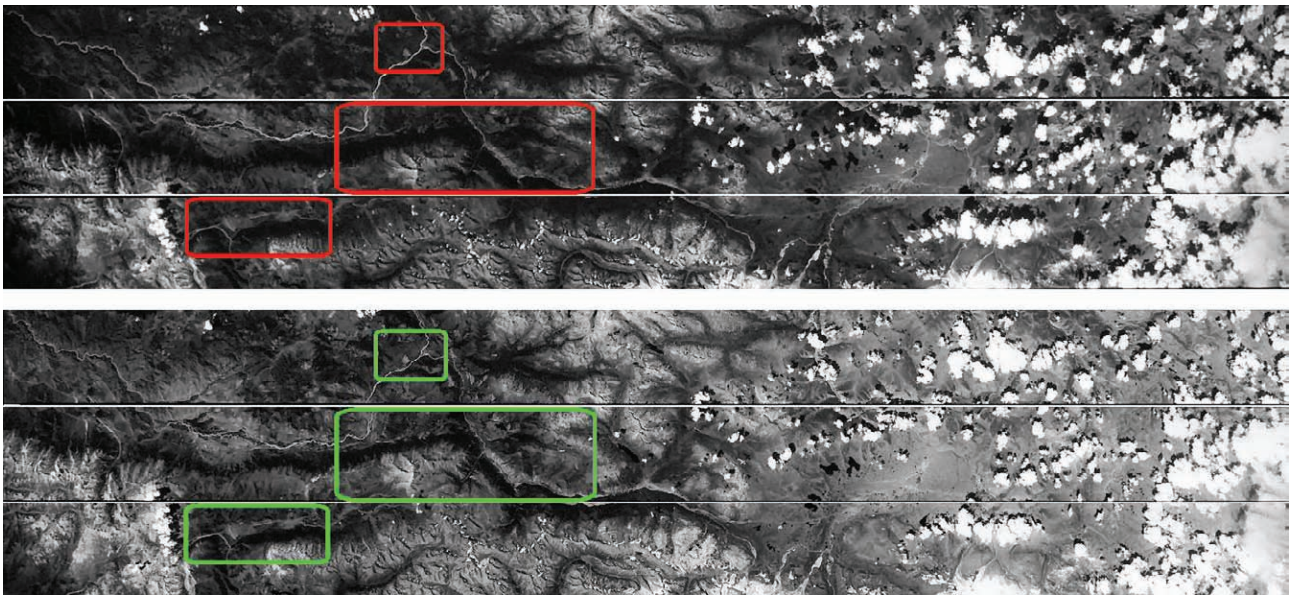


Figure 2.14: The forward (above) and backward (below) images of the CORONA KH-4B sensor, covering 13.8 x 188 km. The study areas are situated on the left-hand side of the images, and are indicated with rectangles: above is Berel, then Bukhtarma and Karakaba: north is above right

The images used for the study of Karakol were made by CORONA mission 1115-1, revolution 055D, on 14 September 1971. The satellite was equipped with a KH-4B sensor (maximum ground resolution of 6 ft).

Negative number	*Angle*	*Scan*	*Research areas*
DS1115-1055DF060	FWD	USGS, part a	Lower part of Karakol and the Tuekta site
DS1115-1055DF061	FWD	USGS, part a	Middle part of the Karakol valley
DS1115-1055DF062	FWD	USGS, part a	Higher part of the Karakol valley
DS1115-1055DA066	AFT	USGS, part d	Lower part of Karakol and the Tuekta site
DS1115-1055DA067	AFT	USGS, part d	Middle part of the Karakol valley
DS1115-1055DA068	AFT	USGS, part d	Higher part of the Karakol valley

Table 2.6: CORONA imagery used for research in 2007, covering the Karakol valley and the Uch-Enmek Park

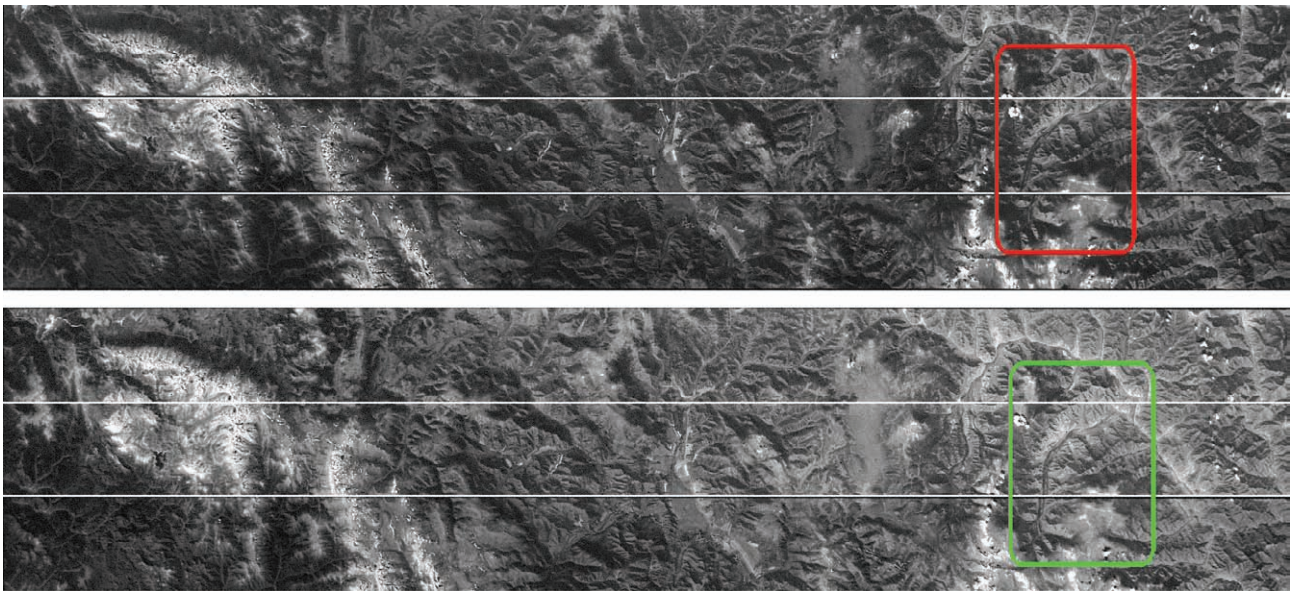


Figure 2.15: The forward (above) and backward (below) images of the CORONA KH-4B sensor, covering the study area. The Karakol valley is situated on the right-hand side of the images, running approximately north-south (see rectangle): north is top right

2.2.6 Digitising the imagery

Before any digital restitution of the images can be carried out, the negatives must be digitised. This process has witnessed quite an evolution during this PhD research. During the first attempts to work with the imagery in 2001-2002, the images were enlarged and printed on photographic paper. A Durst Laborator 138 S photo enlarger was used, with Ilford Multi Grade IV paper. Developing and fixing was done with Agfa's Neutol and Agefix. Then the images were scanned with a resolution of 1200 dpi.

This time-consuming and now redundant, but very interesting process was quickly replaced by scanning the film negatives directly with high-resolution negative scanners. During 2003 and 2004, we worked with copied film negatives delivered by the USGS, and scanned the images ourselves. We tested a Leica S1 PRO digital scanning camera (3175 dpi) and Flextight Precision III scanner (3200 dpi, with tests up to 5760 dpi). These scanners produced good-quality digital images, but had one disadvantage – they could not give a scan of an entire CORONA negative because of its large size. This is important for the correction of the images afterwards. Indeed, digitising one negative in 20 digital images requires the correction of 20 images. Therefore, the negatives were scanned as one image at the Institute of Photogrammetry and GeoInformation in Hanover with a Vexcel Ultrascan 5000 with 8 µm pixel size (about 3175 dpi) and a geometrical accuracy of 1-2 µm.

2.2.7 USGS scans of CORONA images

Dating back to September 2004, it is no longer possible to order the film negatives. The USGS scans the images on demand, in different resolutions (scan resolutions of 23, 14 and 7 µm, the last resolution being only for KH-4A and KH-4B). Therefore, the imagery for our research from

2005 to 2007 was ordered in digital format, using 7 µm pixel size. This change in policy seems to facilitate working with the imagery, as it is no longer necessary for the user to scan the images him- or herself. However, not being able to overview the scanning process can be a disadvantage, too.

While working with the imagery in 2006, we encountered problems in the digital photogrammetrical process. A linear artefact appeared on the digital surface model (DSM) of the Karakaba valley in Kazakhstan. A shift of up to 20 m in height split the northern and southern part of the DSM, with a sharp edge running the length of the image (Figure 2.16). This linear feature, resembling a sharp terrace edge, looked extremely artificial and certainly did not represent reality; we were working in the area in summer 2006 and there is no indication of such a feature in the field. A search for this problem brought us back to the basic imagery where we found what might have caused this deformation.

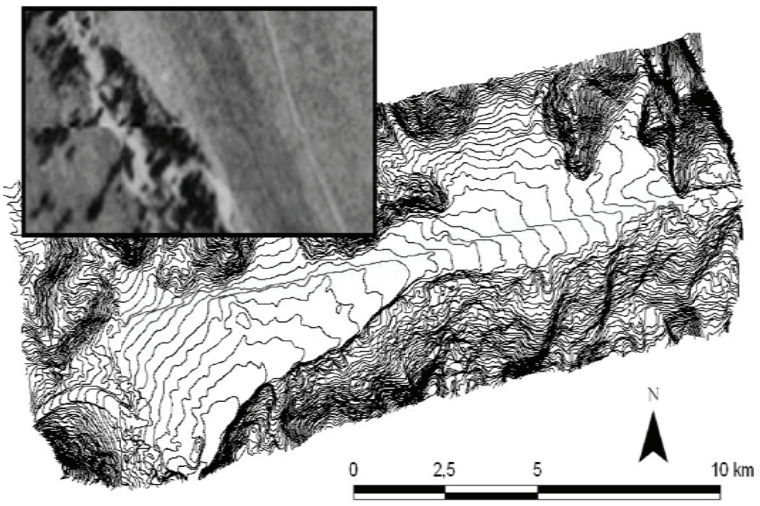


Figure 2.16: An unnatural height difference of up to 20 m, clearly visible on the contour map, runs through the Karakaba valley, for the length of the CORONA film negative. Zooming into the scanned image shows a scan error on the same spot (image: Dries Dossche)

The problem was found in the scans made by the USGS. While examining them in detail, we detected several places with scanning errors. There are clear shifts between scan lines with shifting pixels or small strips of the image that have disappeared. The errors always run all the way through the image and in both directions (vertical or horizontal).

It is important to notice that the original CORONA film negatives sometimes have comparable linear features: lines that run the length of the image and seem to be (possibly old) scratches (Figure 2.17). These may have been caused during image capturing in the satellite, or (more likely) during image processing or copying afterwards in the archives. However, these lines always run in one direction (the length of the negative) and are never very sharp in the digital image (where several pixels can form the edge of the lines). Therefore, we are certain that the problem discussed here is something completely different.

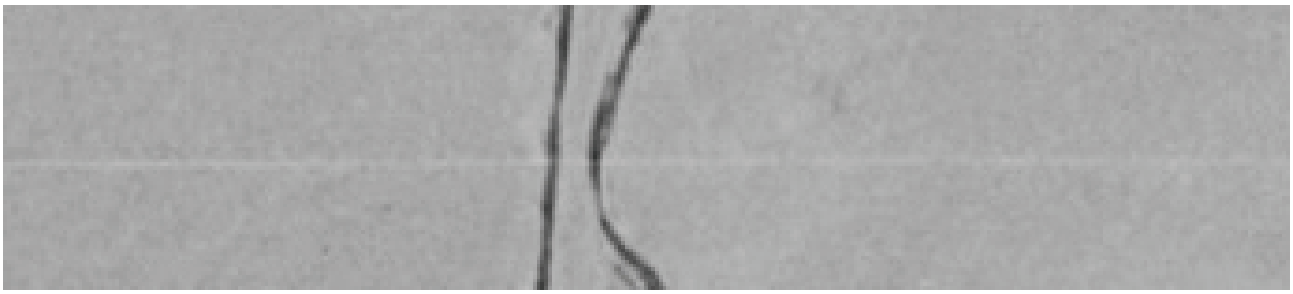


Figure 2.17: Scratch on a CORONA film negative, probably caused by handling the film during processing. It can be seen running horizontally through the image, the length of the negative, 'crossing' the two rivers

An example of an overview of one of the scans can be seen in Figure 2.18. The six scan errors (shifts or missing strips) illustrated below in Figure 2.19 are indicated with a red line, and the zoom images of the figure are indicated with red boxes. These are not the only errors in the image, only six examples of such. There seems to be regularity as the scan errors are equidistant. There is a vertical line every 3776 pixels, plus two horizontal lines can be found – one 2470 pixels from the bottom, and one 2470 pixels from the top of the images. This means the lines form rectangles 3776 pixels wide and 5120 pixels high in the middle of the digital image, which would appear to indicate that the scanning process itself is the cause of the errors.

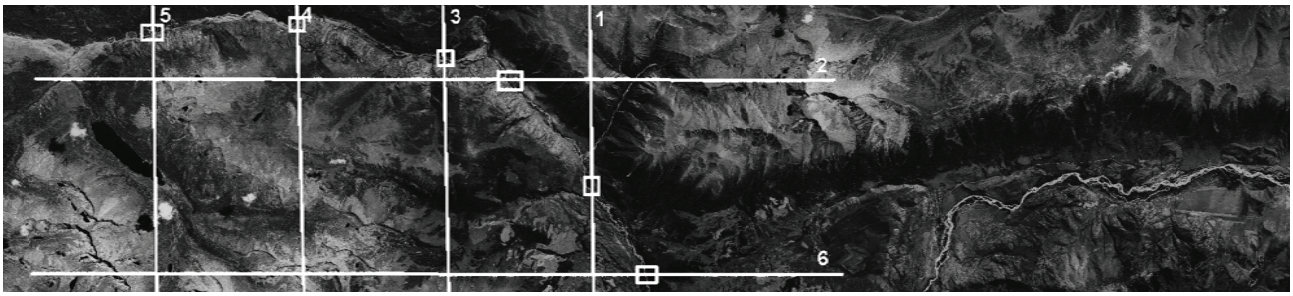


Figure 2.18: Scan errors on CORONA image DS1104-1039DA009

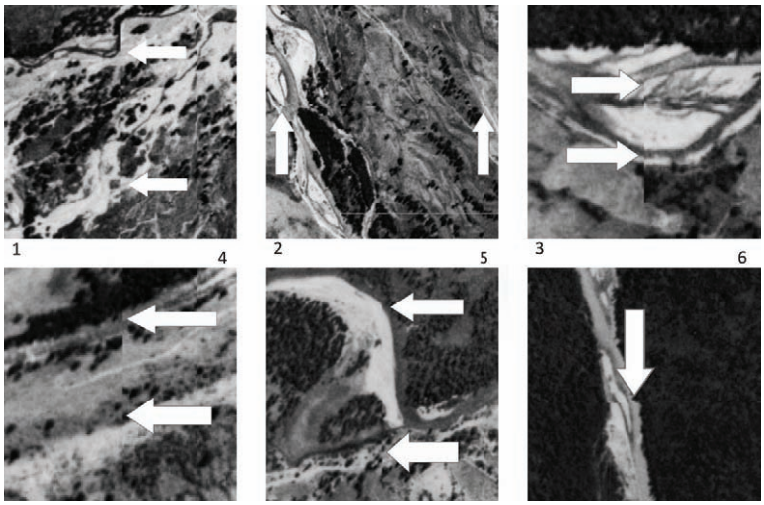


Figure 2.19: Six examples of scan errors in CORONA image DS1104-1039DA009. The exact location of the errors is specified in Figure 2.18

The film negatives are very big (5.5 x 75.7 cm), and the scan resolution of 7 µm produces huge files. Therefore, the images are saved in four parts (a-b-c-d), each measuring about 33,420 x 10,060 pixels. Even then, a good processor and sufficient memory will be necessary to process the images, which are each 323,233 kB large. Between the four image parts, the USGS has foreseen an overlap of about 5980 pixels to make sure no information is lost and to enable a refitting of the images. Therefore, a reconstructed image (a+b+c+d) has the following dimensions: 115,740 pixels wide and 10,060 pixels high (about 1,119,419 kB or, if printed on a resolution of 600 dpi, 489 x 42 cm).

It is possible that the scanner processes the images in several small pieces, using its temporary memory, and fits the pieces back together in one TIFF file. If the scanner is not perfectly calibrated, this process can result in small overlaps or shifts (7 µm or more, so 1 or more pixels) between the individual scanning parts. It is possible that each of these scanning parts is about 3776 pixels wide and 5120 pixels high – the distance between the vertical and horizontal errors.

As several shifts are visible on one image, in two directions (two horizontally and six or more vertically) and these errors are different on the forward and backward images, it is clear that this generates problems when comparing them. The stereoscopic link between the images is damaged. If an effort is made to generate DSMs from this imagery – a process that worked perfectly for us when we used our own scanned images – these problems may result in linear artefacts which are immediately visible on the DSM or contour map. In addition, the rest of the DSM may contain considerable errors, as the image displacements or parallaxes have changed. In September 2007, we contacted the USGS with these comments, and asked for an explanation. By the end of November, the costumer service answered that the scanning department was looking into the problems on our scans, and a new order was made to replace the images in question, free of charge. These images finally arrived in January 2008, but without further explanation from the scanning department.

In the near future, we will reprocess the imagery from 2006 and 2007 and compare the resulting DSMs to see the degree of deviation caused by scanning errors. Until this work has not been finished, it is important to keep any possible errors in mind while using the present VirtuoZo products.

In 2005, Fowler made an evaluation of the scanned CORONA imagery. Strangely enough, he did not mention possible scan errors, and concluded that the new digital CORONA product is superior to the previously available analogue photographic product scanned with a desktop scanner (Fowler 2005).

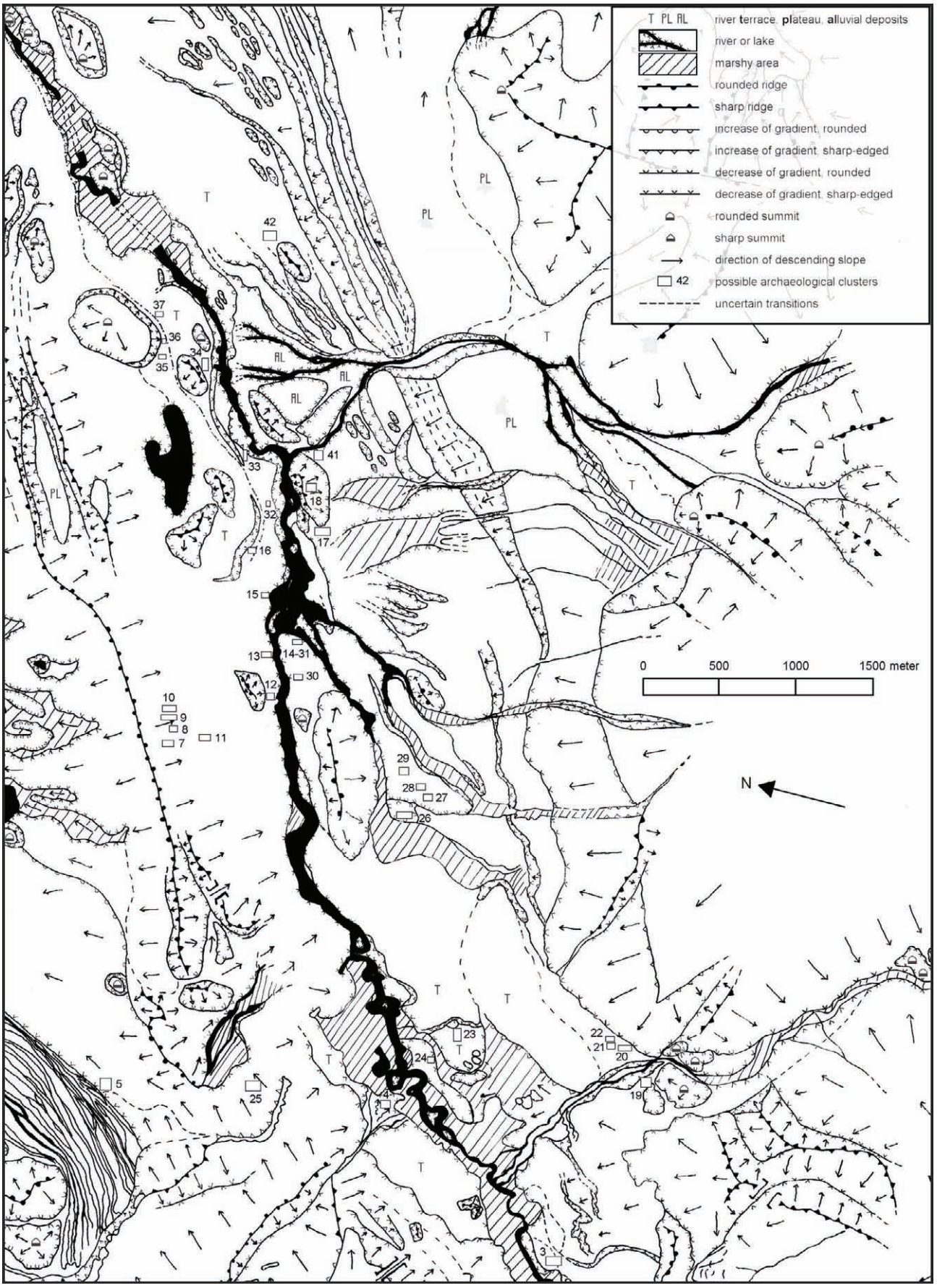


Figure 2.20: Morphographic map of the Elangash valley, made in 2002 using CORONA KH-4A imagery

2.2.8 Stereoscopic viewing and morphographic maps

The images can be viewed stereoscopically, without restitution, under a conventional stereoscope. This is often done just to view the relief or to draw morphographic maps of the research area. First, the scanned forward and backward images must be geometrically corrected, for example with the ILWIS 3.2 remote-sensing software, to prepare them for stereoscopic viewing. By marking recognisable points on each picture in a couple, the program is able to recalculate one of the photos in such a way that the same points on both pictures correspond – a process called relative orientation. After that, the two images are situated 'in the same plane'. This procedure does not alter the parallax differences in the two images, so the images are corrected without losing their stereoscopic capacity. The final stage of the preparations involves making a new hard copy of each couple by creating a high-resolution print of the new images. The photographs have been printed using a TEKTRONIX 850 solid ink printer at a resolution of 1200 dpi.

In 2002, a morphographic map was made for the Sebystey, Irbistu and Elangash valleys (Figure 2.20). A traditional coding system was used to identify the different types of slope, mountain range, plateau, etc. In this way, we drew up maps with a scale up to 1:20,000. These maps, detailing all relief elements, are very useful in the field and help us to interpret the landscape units. However, as preparing the images, inspecting them carefully with a stereoscope and drawing the morphographic maps is a time-consuming process, it was not done for the other research areas.

The resulting morphographic maps are not georeferenced as they were made before the digital photogrammetrical restitution took place.

2.3 Gathering GCPs for the restitution

2.3.1 The Global Positioning System (GPS): an introduction

Ground control points are necessary for the photogrammetrical restitution of the images, points in the landscape with known coordinates in X, Y and Z. In the absence of this information, we had to collect the GCPs in the field using Global Positioning System receivers.

The US Departments of Defence's GPS is the primary satellite-based positioning system commonly used today. About 30 GPS satellites orbit the earth. From a height of approximately 20,200 km above the earth's surface, these satellites continuously transmit radio signals that enable GPS receivers on earth to determine their distance from each satellite in view. The satellites also broadcast their current position. In addition to each satellite's position, simultaneous distance measurements from a minimum of four satellites allow GPS receivers on earth to calculate their own position. The accuracy of the position determination that can be obtained by using the stand-alone GPS system is in the 10 m range (95% of the time, planimetric). However, since greater accuracy (1-2 m) was required for our application, it was necessary to use differential techniques (Parkinson & Spilker 1996).

2.3.2 Comparison of three different GPS systems

In 2003, measurements were carried out with three different GPS systems: C&C C-Nav, Garmin 12XL, and Motorola Oncore VP. We compared the results obtained from these different devices in order to determine which one is best suited for archaeological purposes and for mapping, taking into account their accuracy and practical characteristics (weight, power supply, technical properties, etc.).

The C-Nav system, provided courtesy of Dredging International (DEME Group), was the first to be used in the field (Figure 2.21). This system includes a dual-frequency, geodetic-grade, GPS receiver (Roscoe Hudson & Sharp 2001, C&C Technologies 2005). More importantly, it is also able to receive and process StarFire differential GPS correction signals. The C-Nav system, originally developed by NASA's Jet Propulsion Laboratory (JPL), is operated commercially by NavCom Technology. It uses a global network of reference sites equipped with high-quality GPS receivers to monitor the entire GPS constellation. Their observation data are used to calculate corrections for each of these satellites (Yunck et al. 1996). These corrections are uplinked to the geostationary INMARSAT communication satellites for global broadcast to all StarFire users in real time. As the C-Nav receiver applies these corrections, its performance is superior to the more experimental systems that have also been used. Therefore, we consider the C-Nav's results as a benchmark for the other two systems detailed below.

The second receiver used was the Garmin 12XL, a common hand-held, off-the-shelf receiver (Garmin 2007). With a standard use in real time, this receiver has a planimetric accuracy of 5-10 m. Altimetric accuracy is generally two to three times worse (10-30 m). In this case, however, as more accurate results were needed, a post-processing scheme was employed to increase positioning accuracy. Raw satellite observation data from the Garmin 12XL was gathered and recorded in the field by means of the GRINGO software package. GRINGO is available from the Institute of Engineering Surveying and Space Geodesy at Nottingham University (UK) (Hill et al. 1999, University of Nottingham 2002). After the expedition, observation data were acquired from surrounding permanent GPS reference sites (Novosibirsk at 650 km, Krasnoyarsk at 750 km, Urumqi at 800 km and others). Next, in order to obtain improved position reports, the different data collections were processed in an integrated way (Willems et al. 2002).

The Motorola Oncore VP, a specialised 'bare-bones' receiver, was the third receiver used in the field (Motorola 2008). Raw satellite observation data were collected and recorded by means of a software package specifically developed by Tom Willems (PhD student at the time, Department of Applied Mathematics and Computer Science, Ghent University). Post-processing, as described for the Garmin 12XL, was used to increase position accuracy.



Figure 2.21: The C-Nav receiver and the antenna in the field

2.3.3 Results for the positioning accuracy of the three systems

At each of the surveyed points, the C-Nav receiver was initialised for approximately 30 minutes. During initialisation, accuracy estimates, as reported by the receiver, were monitored. These values are computed by the receiver through an extensive statistical analysis of the residuals following its internal position computation, and gradually decrease while the receiver initialises. Actual data logging was started once the altimetric accuracy estimate went below 1 m, resulting in an initialisation time of approximately 30 minutes. The mean altimetric accuracy estimate when logging began was 0.91 m and the mean planimetric accuracy estimate at that time was 0.52 m (Table 2.7). After initialisation, the position reports output by the receiver were logged for a few minutes. The standard deviations of the coordinates were typically 0.03 m, which is an indication of the high stability of this system (Table 2.8).

Mean position accuracy	*C&C C-Nav, excluding initialisation in real time*	*Motorola Oncore VP mismatch, after post-processing*	*Garmin 12XL mismatch, after post-processing*
Planimetric (m)	0.52	2.68	2.14
Altimetric (m)	0.91	4.25	2.44

Table 2.7: Mean position accuracy of the C&C C-Nav (receiver estimate) and mean mismatch between the C-Nav average position and the other two systems

Standard deviation	*C&C C-Nav*	*Motorola Oncore VP*	*Garmin 12XL*
Planimetric (m)	0.02	0.88	1.98
Altimetric (m)	0.03	1.75	2.82

Table 2.8: Mean (taken over all processed points) standard deviation of the position solution sets resulting from the set-ups of the three systems

The other two systems do not require any initialisation time. However, the significantly lower accuracy is an important drawback. Multi-station differential post-processing results from the Motorola Oncore VP yield a mean (taken over all processed points) standard deviation of 0.88 m in planimetry and 1.75 m in altimetry. For the Garmin 12XL, the mean standard deviation is 1.98 m in planimetry and 2.82 m in altimetry (Table 2.8). The mean mismatch between the C-Nav average position, considered as a benchmark, and the Motorola Oncore VP position is 2.68 m in planimetry and 4.25 m in altimetry. The mean mismatch between C-Nav and Garmin 12XL position is 2.14 m in planimetry and 2.44 m in altimetry (Table 2.7).

It seems clear that the proposed techniques involving the Motorola Oncore VP and the Garmin 12XL are useful when the stand-alone GPS accuracy is insufficient. Their main disadvantage, however, is that the results are not available in real time and require post-processing. The accuracy that can be obtained using these techniques is primarily dependent on the distance from each of the reference stations used in the procedure. In this case, there was no reference station closer than 650 km. Even better results can be obtained in areas with nearby reference stations (many locations are covered by a reference station at 100 km or less). It is obvious that when the highest possible accuracy is required, much more costly equipment, such as the C&C C-Nav system, is indispensable. For photogrammetrical restitution, the accuracy of the GCPs (positioning results) must be less than half the pixel size of the image being researched. This means that the Motorola Oncore VP and the Garmin 12XL can be used for processing images with a ground resolution of 2-4 m and more, such as CORONA (best resolution 1.8-2.4 m) and ASTER data (10 m resolution). However, more detailed images, like the QUICKBIRD and IKONOS images (0.6 and 1.0 m resolution), need localisation accuracies in the range of 30-50 cm (decimetre level). These can be provided by the C&C C-Nav system, in real time, but not by the alternative systems.

2.3.4 Overview of the systems used, 2004-2007

In 2004, it was not possible to use Dredging International's C-Nav system as it was installed on a dredger somewhere in the Amazon. As we had no budget to buy the equipment at that time, we had to fall back on one of the other evaluated systems. Taking into account the results of our analysis, we decided to use the Garmin 12 XL system, confident of having an accuracy of 1-2 m.

An application by Prof. Dr. Ir. Alain De Wulf to buy a differential GPS receiver was approved by the Special Research Fund of Flanders (FWO) in 2004, and a C-Nav 2050 receiver was acquired by the geography department in 2005. It was used in all subsequent campaigns to the gather GCPs, and to measure the location of reference stations in the camp and in the field during archaeological research (see 3.2.2).

2.3.5 Selection of GCPs, 2003-2007

GCPs are points that are visible both on the images and in the field. During the fieldwork, the research area was systematically searched for points that could be traced back on the satellite

imagery. The points to be measured must be selected carefully, taking into account the following requirements:

- Need for unique and clear identification of points on both CORONA images, forward and backward. If a point is only visible on one of the images, it cannot be used for the restitution;
- Uniform spread of those points over the images, with a good distribution in x, y and z; and
- Stable positioning of the GPS receivers (a more or less flat surface).

The specifications of the CORONA images play an important role in the choice of GCPs. The black and white images have a ground resolution of 1.8 metres, so only major objects with a clear contrast can be seen. The age of the imagery – about 40 years – implies extra caution is required. Since the end of the 1960s, many structures have either changed location or disappeared completely. Farms and large buildings, clearly visible on the images, were sometimes difficult to trace back. Renovations had changed the appearance of buildings, or only the foundations remained. Other constructions were simply rebuilt next to former ones, which was particularly true for bridges. Older (mostly wooden) bridges were replaced by new ones either to support heavier traffic or because the original structures had been destroyed during floods. In many cases, new bridges were constructed next to older ones, the bridgeheads of former construction remaining visible. This sometimes resulted in three bridges standing next to each other, making it difficult to locate the actual bridge indicated on the imagery (usually the oldest one). Similarly, roads and tracks can change course: new roads are built, sometimes just next to older tracks. Smaller tracks tend to move over the years as drivers choose to deviate from older ones that are too wet or too deeply eroded to drive through. When selecting natural features as GCPs, they had to be points which had been geographically stable for the last 40 years (e.g. no river banks as they move from year to year) (De Wulf et al. 2007).

The most identifiable features on the landscape include (Figure 2.22):

- Corners of old farms or other buildings (if built before 1968-69, thus present on the images); sometimes only the foundations could be identified;
- Crossings and forks of clearly visible tracks and roads;
- Crossings of roads and tracks through rivers;
- Archaeological monuments, if they are large enough to be seen on the images;
- Bridges, or remnants of destroyed bridges;
- Striking natural features, such as sharp rock outcrops, clearly visible banks, slopes and inclinations.



Figure 2.22: Some examples of GCPs, measured with the C-Nav 2050 receiver.

In general, only six GCPs are required for the restitution of a CORONA stereo pair. To ensure sufficient usable GCPs were collected, a minimum of 20 to 30 points were measured per image. Figure 2.23 shows the location of all GCPs measured during the campaigns from 2003 to 2007. A more detailed overview is given below.

In 2003, we collected 43 points in an area of around 20 x 30 km, spread as much as possible over the total area being studied. Due to the specific geographical conditions, we had to limit the topographical survey to the narrow valleys, which resultet in an unbalanced spread of GCPs. The distribution was mainly linear and not very diverse in height (Figure 2.23). Consequently, the restitution of the two CORONA stereo pairs was not an easy task.

In 2004, 47 GCPs were localised with the Garmin 12 XL, attached to a laptop with the GRINGO software, which recorded the signals received. In addition, all individual archaeological sites were located with the same system (338 measurements on 291 sites), some of which could serve as GCPs for the topographical mapping as they were clearly visible on the satellite imagery. This was a huge amount of work and a full-time job for the geographer in the team. The GCPs were spread over the whole area of the Yustyd valley and surroundings, an area of some 30 x 18 km (Figure 2.23).

The quality of the measured GCPs was excellent, for several reasons:

- The GCPs have a very good spread in X and Y, covering the whole of the satellite image, as the Yustyd valley and surroundings proved to be relatively accessible;
- The GCPs have a good spread in Z, as we took measurements at an altitude of ca. 1,800 to 2,200 msl; and
- The CORONA imagery available for Yustyd was made by a KH4B sensor and had a better resolution (KH4B: 6ft, KH4A: 9ft). This means it was easier to locate reliable GCPs on the satellite images and was possible to locate them more precisely than in 2003.

In the 2005 campaign, using the new C-Nav system, we measured 110 points over the entire River Dzhazator area, including its tributaries and the higher part of Tarkhata, to guarantee the high-quality processing of the satellite imagery, both CORONA (for the geographical mapping) and ASTER (for the mapping of permafrost)(Figure 2.23).

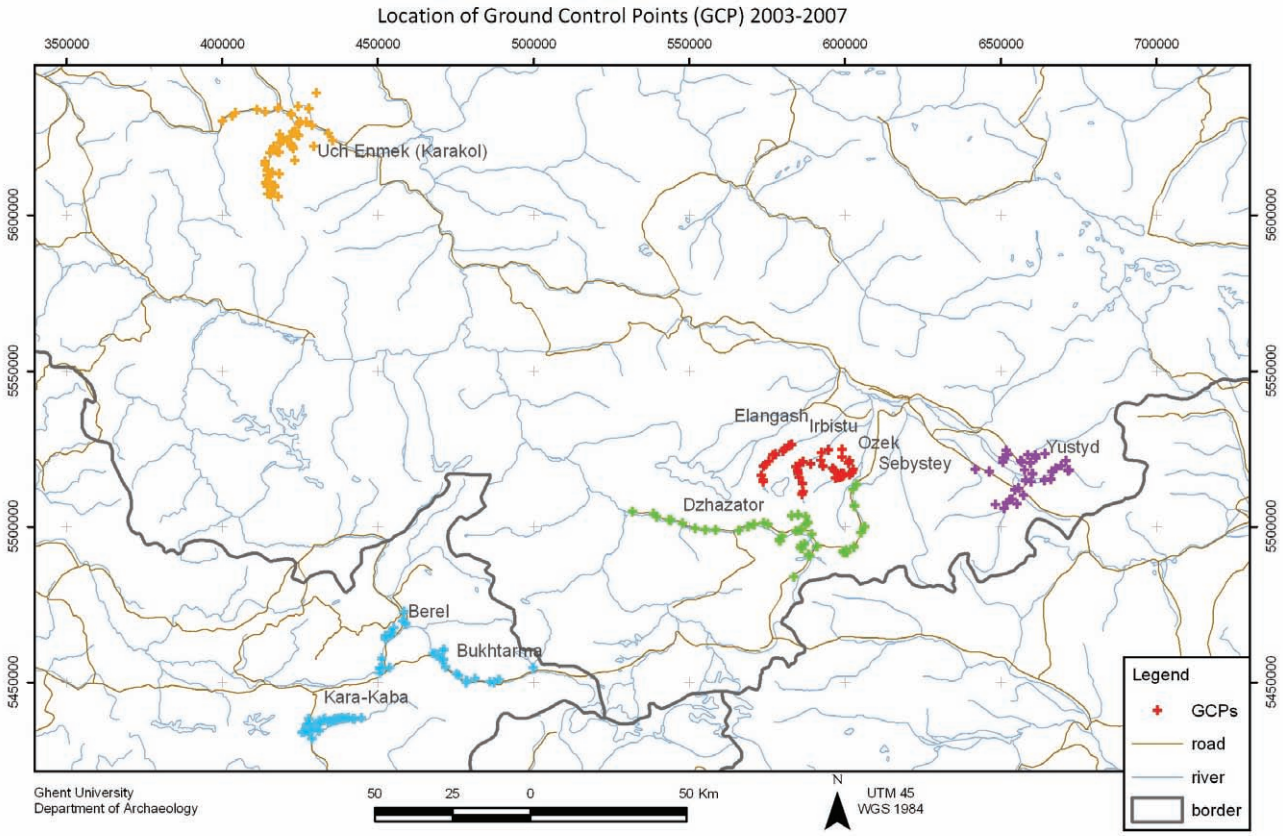


Figure 2.23: Location of GCPs: 2003: red; 2004, purple; 2005, green; 2006, blue; 2007, orange

In 2006, the research area covered three different valleys; 49 GCPs were measured during fieldwork in Karakaba, 38 in Bukhtarma and 15 in Berel, giving a total of 102 measured points (Figure 2.23). The distribution of points over the covered area was quite good in Karakaba. The specific form of the Bukhtarma valley and the limited accessibility of higher terrain resulted in a bad distribution of GCPs for this part of the area, limited to the valley bottom. However, the altimetric distribution was quite good. The height difference between the lowest and highest GCP was 271 metres in Karakaba, 704 metres in Bukhtarma, and 66 metres in Berel.

The Karakol valley is about 40 km long and mainly north-south oriented. As the CORONA images are roughly east-west oriented, three stereo images were needed to cover the whole research area, thereby tripling the number of points required. In total, 88 points were measured with the C-Nav (Figure 2.23).

2.4 Digital photogrammetrical restitution

2.4.1 The restitution process

The stereoscopic properties of the CORONA images make it possible to see the relief directly on the photographs. With the known principles of aerial photography and photogrammetry, the height differences between different points on the image can be measured (stereoscopic parallax measuring). In this respect, an intensive study of the entire area on the photos can

result in the creation of a complete topographical map, based on relative heights. But that would require a huge effort, and without GPS data the resulting map cannot be geo-referenced. Furthermore, certain properties of the CORONA images do not allow for these analogue photogrammetrical procedures: the exact altitude of the satellite is unknown (required to calculate the height differences), and the extreme enlargement of part of the negative results in the absence of one or two other indispensable photogrammetrical parameters.

Using GPS measurements and processing the images in a digital photogrammetric workstation is the only way to solve these problems. Digital restitution methods and photogrammetrical techniques also eliminate deformations in the images and the S-shaped distortion (see 2.2.4). We used the VirtuoZo V.3 software program from Supresoft Inc. (Supresoft Inc. 2004). This automatically corrects the images and shows the stereo image directly on the computer, by means of 3D visualisation with special glasses.

The principle behind photogrammetrical restitution is reconstruction of the circumstances of image capturing, on a smaller scale. In a normal restitution process, three steps are required to correct the images: an internal orientation, a relative orientation, and an absolute orientation. The internal orientation is based on three parameters: the calibrated focus distance, the coordinates coming from fiducial marks, and the geometrical distortion characteristics of the lenses. With the help of these parameters, it is possible to calculate the geometrical position of the photo film to the camera at the moment of capture, which should be done for both photos in a stereo pair. Nevertheless, the necessary parameters are only known if a (semi-) metrical camera takes the photo. CORONA cameras are non-metrical: the negatives do not have fiducial marks and no camera calibration data is known. Therefore, internal orientation is not possible and must be left out.

The next step is the relative orientation between the two images; the objective of this process is to restore the original position of the two images in relation to each other. VirtuoZo does this completely automatically, although intervention in the process is possible for quality control. A minimum of five corresponding points are required to compare the parallaxes in the images. VirtuoZo uses image matching to find these points automatically, and even takes 100 to over 200 corresponding points into account. All these points can be checked to make sure the image-matching process does not make any errors.

The stereo model resulting from the relative orientation must be put in an absolute coordinate system to complete the restitution. This is done with the absolute orientation: a transformation from model coordinates to geographical coordinates. VirtuoZo needs a minimum of six GCPs, points on the images that have known coordinates. The user has to enter the coordinates of these points and localise them manually on the images. Entering more than six GCPs improves the result of the absolute orientation, and gives the user the possibility to check the result. The output will also be better if the GCPs have a good altimetric and planimetric distribution. With this information, the program is able to calculate the absolute coordinates of all the pixels in the imported images, in three dimensions.

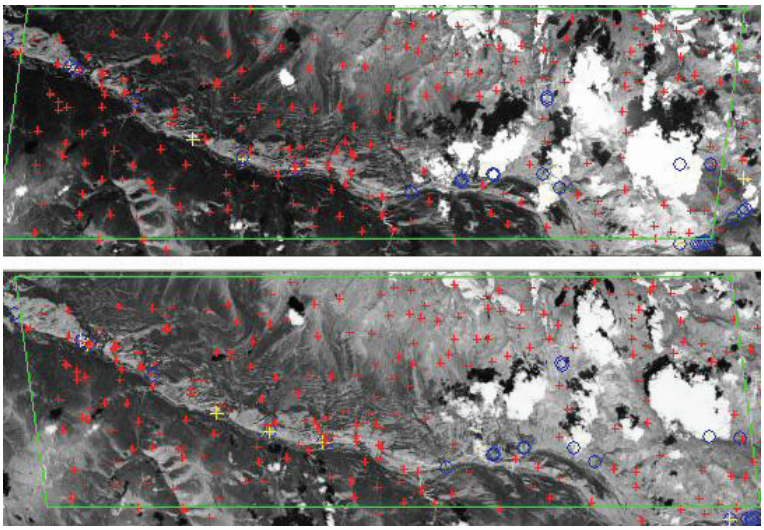


Figure 2.24: The process of relative orientation in the VirtuoZo environment. Corresponding points, selected by image matching, are indicated by red crosses. This example shows the Dzhazator valley: the forward image is above, the backward image is below. The green quadrangle is the restitution area

2.4.2 Resulting products

The result of the restitution process is a digital terrain model (DTM), an irregular grid of points with X, Y and Z coordinates. Afterwards, the DTM is converted into a regular rectangular or quadrangular grid using interpolation: a digital surface model (DSM). This is the basis for all the other resulting products.

The height information in the DSM makes it possible to recalculate the image. As mentioned above, a photo is a conical projection, and an object is projected correctly only at the nadir point. The DSM provides VirtuoZo with the information necessary to correct al the image deformations and produce an orthophoto. This is an orthogonal depiction of an object, and contains information from both stereo images, without the parallaxes. As the information in an orthophoto is geometrically correct, it is also called an orthophotomap (Figure 2.25). Draping the orthophoto over the DSM gives an accurate 3D image of the research areas, as can be seen in Figure 2.26.

The DSM can also be used to generate contour lines. This is done outside of VirtuoZo, in a GIS environment. The resulting contour lines need to be cleaned up afterwards – being generated purely mathematically, following the actual DSM, they are rather jagged and form many small islets that are unreadable on the map (Figure 2.27). All contour lines shorter than 100 m are deleted, and other redundant lines cleaned up manually. This is done with the orthophoto at the background, so as not to delete any essential information. Afterwards, the contour lines are smoothed to improve the readability of the map.

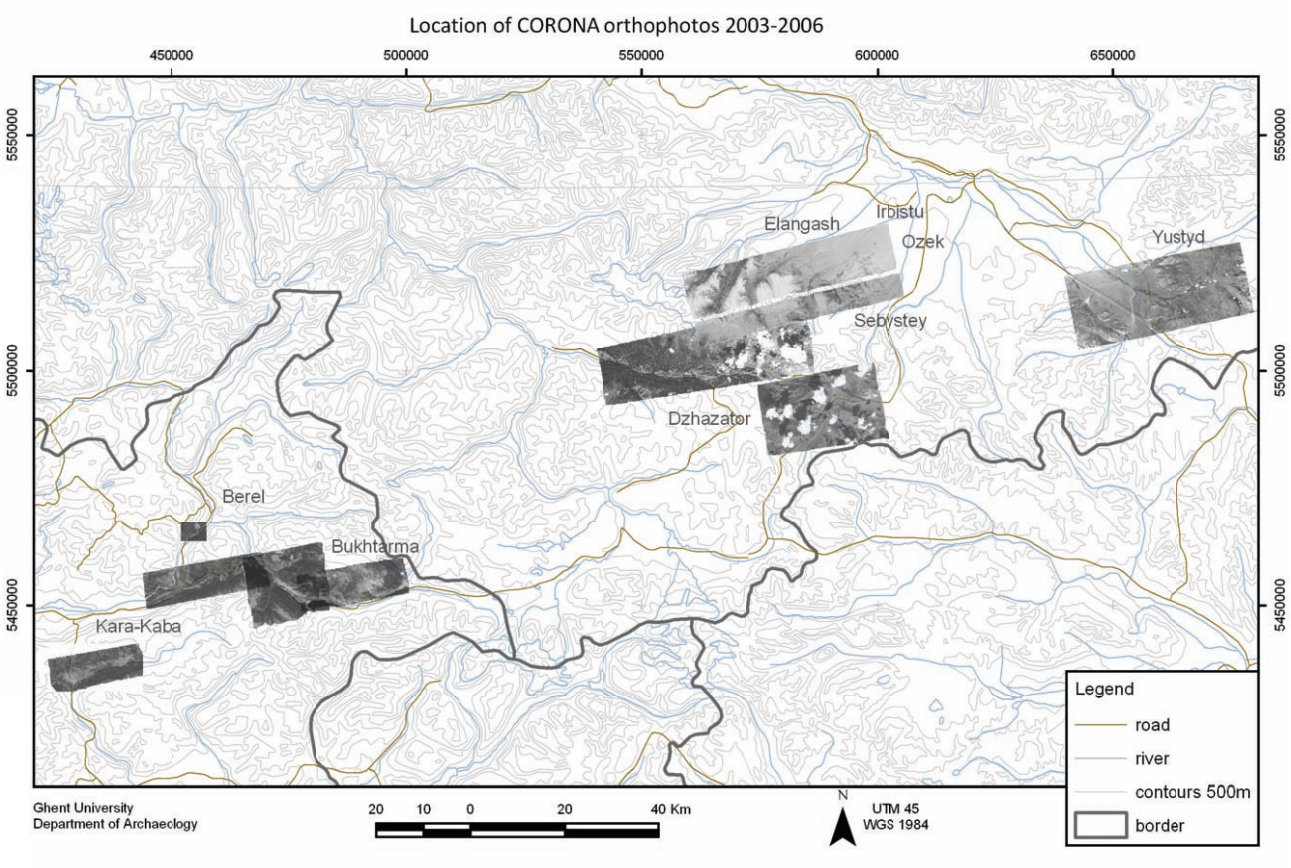


Figure 2.25: Overview of the CORONA orthophotos from the research areas in 2003-2006. The Karakol valley is not included on the map, as it lies too far to the north-west to be shown using the same scale

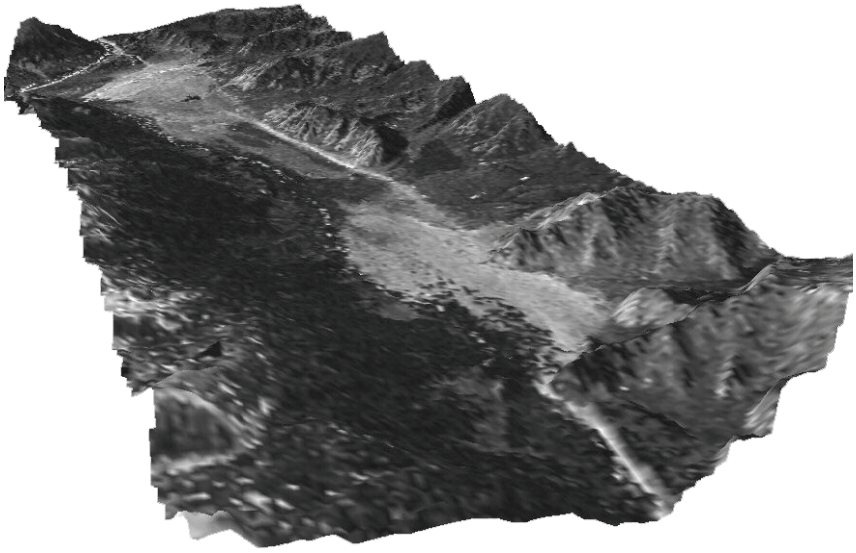


Figure 2.26: Karakaba valley: overlay or drape of the resulting orthophoto on the DSM (research: Dries Dossche)

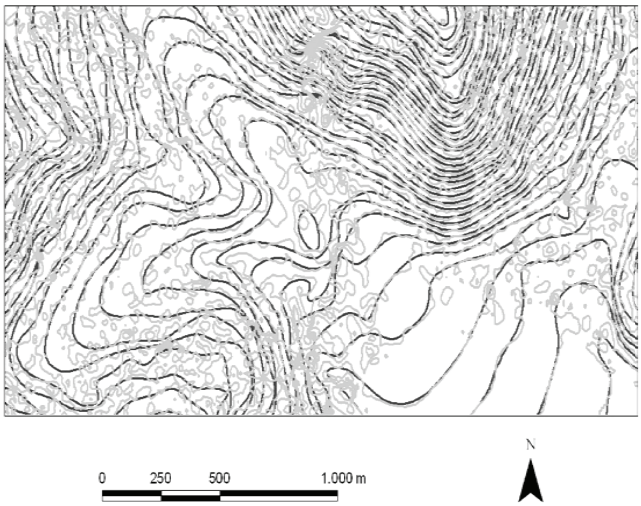


Figure 2.27: Difference between original VirtuoZo contour lines (grey) and contour lines after drawing, clean-up and smoothing (black) (image: Dries Dossche)

The resulting map has a scale of 1:20,000. In general, the minimum scale of mapping based on photographic products is considered to be 1/10 of the nominal photo scale. The CORONA KH-4B negatives have a nominal photo scale of 1:247,500 (resulting in normal circumstances in a map of 1:25,000). However, as the film resolution of the KH-4B negatives (160 lp/mm) is much higher than in conventional photographic film (70-120 lp/mm) and earlier CORONA missions (50-120 lp/mm), it is possible to map with a higher level of detail, up to 1:20,000.

2.5 Overview of the restitution process in the different research areas

It should be clearly stated that the work described in this chapter was not the work of the author alone. For the restitution of the CORONA imagery and production of the maps, we were able to count on the expertise of the university's geography department, especially that of Prof. Dr. Rudi Goossens and Prof. Dr. Ir. Alain De Wulf. Every year since 2003, one of their students has devoted his Master's thesis to topographical and photogrammetrical work within our project. Most of these students accompanied the team in the field in summer to carry out the GPS measurements themselves and assist with the archaeological fieldwork.

This is not the place to discuss their work in detail; reference will be made to reports and papers for further reading. However, as the output of the restitution work was of major importance to the research, we will give a summary of the work done and the resulting products. For more details on the campaigns and location of the research areas, see Chapter 4.

The first test with VirtuoZo, a DSM of the Sebystey valley based on CORONA KH-4A imagery, was created in 2002, as part of our Master's thesis. Using the coordinates of nine GCPs from the 1,234 GPS measurements from the 1997 fieldwork, it was possible to create an orthophoto of the valley, plus a DSM, without having to go to the Altay for additional measurements (Gheyle et al. 2004).

2.5.1 The southern part of the Chuya depression

The first maps of the Altay region based on CORONA satellite imagery were produced in 2003, within the framework of a Master's thesis on geography by Tom Amez (Amez 2004). Using the 43 GCPs gathered during the fieldwork of 2003 (in which he was unable to take part), he produced the cartographic material for the Sebystey, Irbistu, Ozyok and Elangash valleys, using the same methodology as in the Sebystey valley test case. His work was based on two stereo pairs from the CORONA KH-4A sensor (see 2.2.5), and resulted in two parallel orthophotos and DSMs: one for the northern part of the research area, and one for the southern (Figure 2.28). A contour map was generated based on the DSM (Figure 2.29).

The 24 GCPs used for the restitution of the northern part had a very good planimetric and altimetric distribution (Table 2.9). They covered both the high parts of the valleys and the lower Chuya steppe, with a maximum height difference of 592.1 m. The restitution was a success. Unfortunately, the RMS errors reported by VirtuoZo after the absolute orientation process, which enable us to see the accuracy of the process, are not included in the thesis and could not be traced back. Therefore, they have not been included in Table 2.10. Only areas that are very poor in contrast – snow-topped mountains and the evenly grey steppe in the north-east – show some strange contour lines that are not fitting with the contour lines of the SRTM in the background (Figure 2.29).

The restitution of the southern model gave more problems. This was probably due to the bad contrast in the backward images, the limited number of GCPs in that part of the research area and their poor distribution in X, Y and Z. As a result, the DSM of the southern part was not useable, and no reliable contour lines could be generated for this part of the research area (Figure 2.29). The orthophoto which has automatically been produced on the basis of the DSM, however, appears to be without major errors.

The bad quality of the backward images, due to the angle of the sun, is an important factor for these problems. The CORONA satellite flew from north to south over the Altay. The research area lays at about 50° north latitude which means the forward camera was directed towards the sun (having a 15° inclination in the flight direction, so to the south). This resulted in more contrast. However, the backward camera was tilted 15° to the north, away from the sun, giving the resulting photos a very bad contrast. The differences between the two images make it difficult to view them stereoscopically, as not all corresponding points from the forward image can be found on the backward image. The differences in contrast make it difficult for the software to create a perfect link between the two stereoscopic images (the internal orientation process), which played an important role in the results.

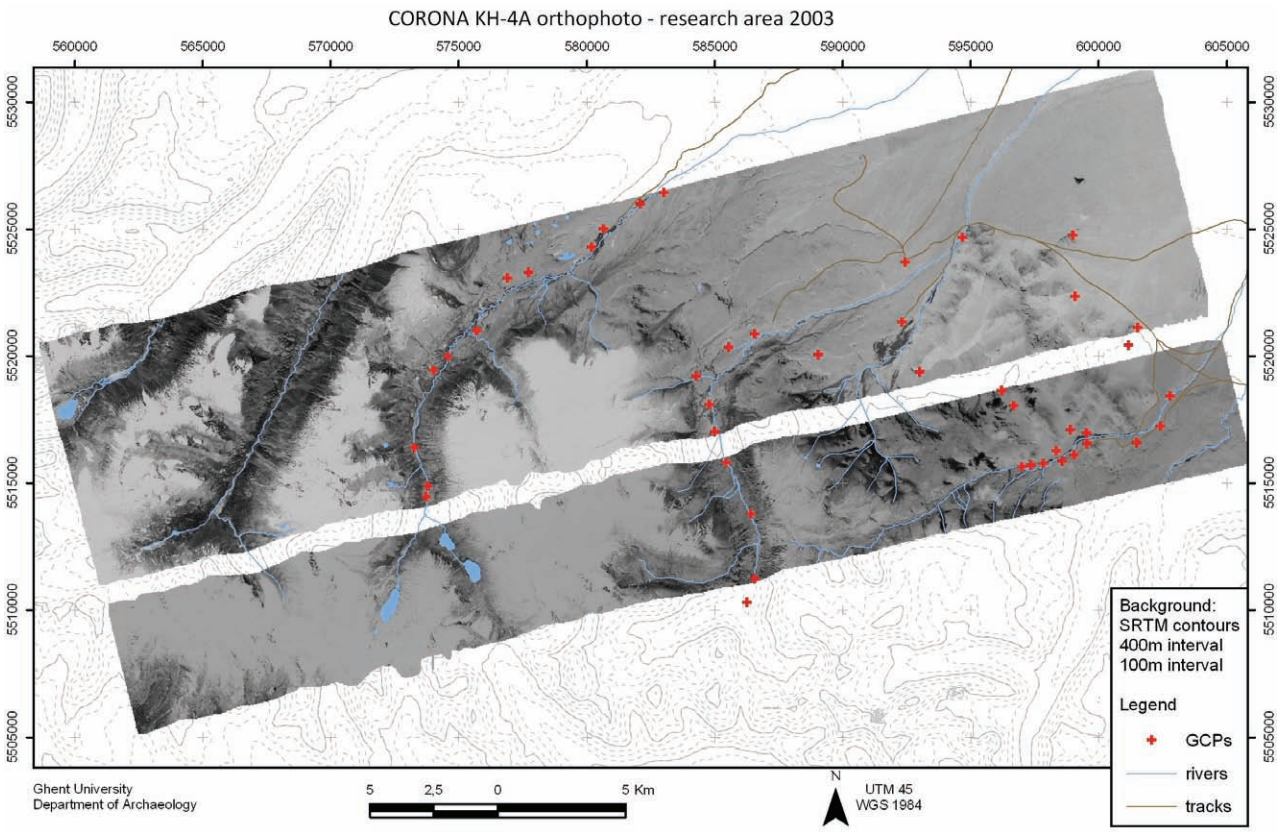


Figure 2.28: Orthophoto of the research areas in 2003, based on CORONA KH-4A imagery

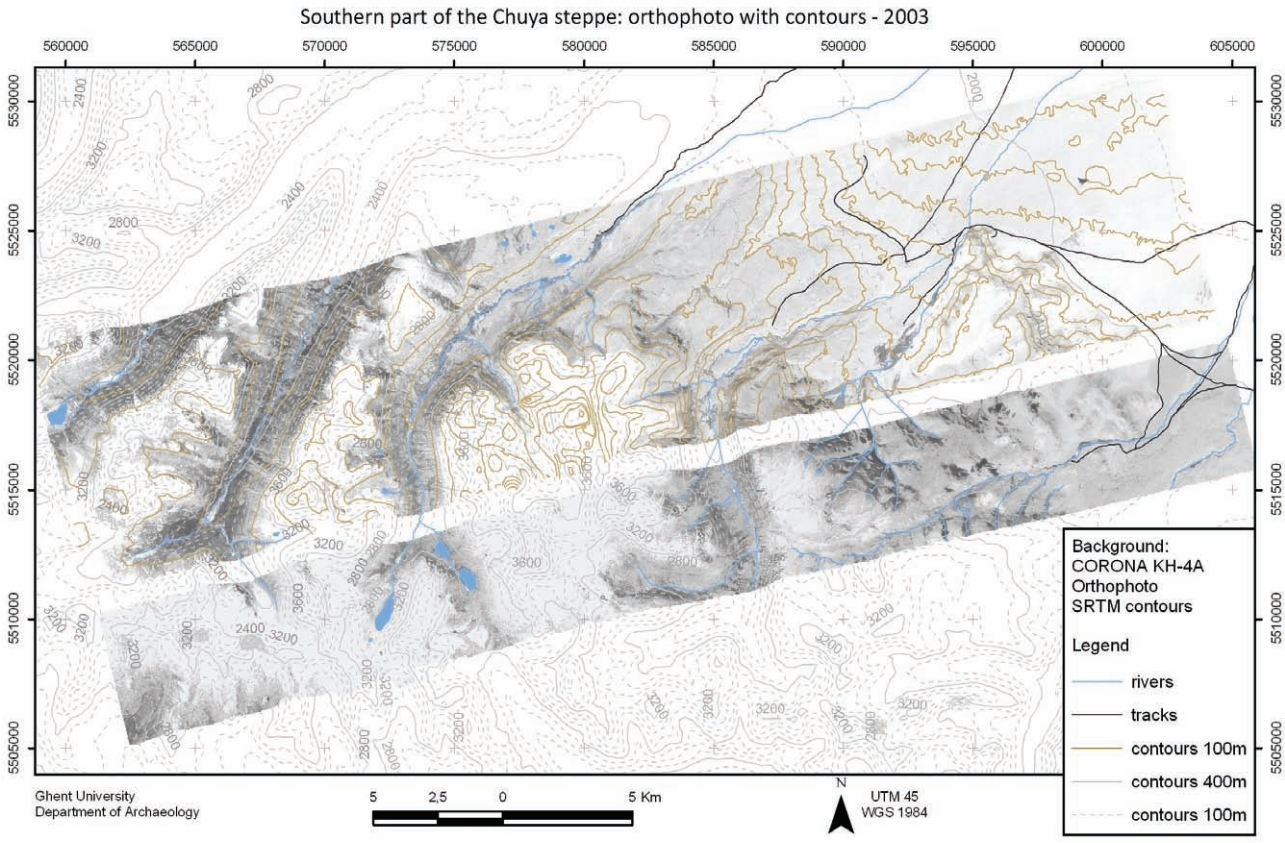


Figure 2.29: Contour map of the research areas in 2003, only for the northern part of the research area

More importantly, some of the GCPs that were clearly visible on the forward imagery could not be found back on the backward imagery. Therefore, they had to be excluded from the restitution process. The limited resolution of the KH-4A images (9 to 25 ft, or 2.7 to 7.5 m) was another problem, making it more difficult to select good GCPs and to find them back on the scanned imagery. Consequently, the number of good points was limited, even though some of them could not be traced back on one of the two images.

Another factor concerns the way the stereoscopic images overlap. In other missions, especially those in the keyhole 4-B series, the area covered by the forward and backward images is the same. Thus, in theory the overlap is 100% – the different viewing angle and the image distortions cause some shifts. The overlap between two forward or backward images is about 10%. For this mission, however, the forward images do not overlap the backward images 100%. There is a shift: every forward image covers about 50% of one backward image, and about 50% of a second backward image. This means that if you want to make a stereoscopic model of one forward image, you need to work with two separate backward images, which means that you have to make two stereoscopic models and merge them together. We had to make a northern and southern DSM to cover the total research area. However, the area was mainly located on the northern part of the forward image, and only one valley (Sebystey) was located in the southern half. This means that the GCPs that were measured are also largely situated in the northern part of the forward image (and thus in the first backward image), and only a limited number of points were measured in the southern part of the forward image (and in the second backward image). In addition, almost all of these points were measured inside the Sebystey valley, running the length of the image, except for four in the higher part of the Irbistu valley. The linear spread of the GCPs and their limited distribution in height[10] in Sebystey certainly had an influence on the results of the restitution of the southern model (Table 2.9).

The resulting DSM from the northern and southern images could not be merged. There is a gap of some 920 to 980 metres, depending on the point of measuring. This is caused by several factors. First, the overlap of the CORONA imagery is not that big. Unlike conventional aerial photography, which has an overlap of 60% between two vertical images and thus an overlap of 20% between two subsequent stereoscopic zones, the CORONA images are taken in an oblique way and have a different way of overlapping. The subsequent forward images only overlap by about 10% or less (this represents about 1,300 m), as do the subsequent backward images. In the KH-4A series, the forward and backward images of one stereo couple overlap about 50%. This means that you need two backward images to cover one forward image completely (as is mentioned above). However, the two resulting stereoscopic zones show the same maximally

[10] All the GCPs were located in the valley, although some efforts were made to include some of the adjoining hilltops: the lowest point was located at 2,052.6 msl, the highest point at 2,237.4 msl, giving a height difference of 184.8 metres. Some kilometres further to the west, additional points were measured in the Iribistu valley, the highest at 2,501.0 msl.

10% overlap as the original backward images. In addition, there is some loss during restitution. The researcher has to define the research zone on the images, but the system does not allow for including the edges of the images. Therefore, the small zone of overlap (10% or less) is not part of the resulting DSMs.

We see the same gap in models from other research areas (see below). The images used are those of the CORONA KH-4B. In these series, the two images of one stereo couple cover in theory about the same area, but not perfectly (an overlap of about 90%). The stereoscopic zone is thus twice as big as was the case with the KH-4A imagery, covering about 90% of an image, but the overlap between the stereoscopic zones, theoretically 10%, disappears almost completely.

Area	*Lowest GCP (msl)*	*Highest GCP (msl)*	*Altimetric distribution (m)*
Chuya (north)	1,990.0	2,582.1	592.1
Chuya (south)	2,052.6	2,501.0	448.4
Yustyd	1,916.2	2,282.3	366.1
Dzhazator	1,546.6	2,542.2	995.6
Karakaba	1,551.7	1,822.7	271.0
Bukhtarma	964.5	1,668.2	703.7
Berel	1,031.1	1,097.2	66.1
Karakol (north)	883.4	974.2	90.8
Karakol (central)	925.6	1,231.4	305.8

Table 2.9: Altimetric distribution of GCPs in the different research areas from 2003 to 2008

Area	*RMS in X (m)*	*RMS in Y (m)*	*RMS in Z (m)*
Chuya	NA	NA	NA
Yustyd	4.46	3.64	3.08
Dzhazator (north)	0.53	0.31	0.73
Dzhazator (south)	0.87	0.56	0.84
Karakaba	0.88	0.85	3.56
Bukhtarma (west)	0.35	1.59	1.13
Bukhtarma (central)	0.06	0.17	1.19
Bukhtarma (east)	0.80	1.38	1.40
Berel	1.94	0.70	0.76
Karakol (north)	0.15	0.21	0.34
Karakol (central)	6.75	3.89	7.76

Table 2.10: Root mean square (RMS) errors for the absolute orientation in VirtuoZo during restitution for the different research areas from 2003 to 2008

2.5.2 The Yustyd valley

Benjamin Van Bever, geography student at the time, was responsible for the geographical fieldwork and the processing of the GPS data and satellite images during the research in Yustyd in 2004 (Van Bever 2005). He was able to join the team for the fieldwork and was responsible for GCPs measurements in the field, which almost certainly had a positive effect on the processing of the images afterwards. As shown previously in 2.3.5, the measured GCPs were of good quality and had good planimetric and altimetric distribution (Table 2.9), bearing in mind the limited accessibility of some parts of the research area (Figure 2.30). The maximum height difference between the GCPs was 366.1 m. Of the 47 GCPs measured, 34 were selected to be used for the restitution process. It appeared that the measured coordinates of some of these points did not correspond to the right pixels on the stereo image: an error of several metres was indicated, which is much more than the accuracy of the GPS measurements would suggest.

Therefore, 20 points were excluded from the dataset – points located on ambiguous crossroads (several tracks running parallel to each other), on corners of farms that appeared to have changed shape since the photo was taken (new buildings in the place of older ones, restoration works), unclear points on natural features (e.g. rocky outcrops), and points that were too close to other GCPs.

The result of the restitution process is an orthophoto of the Yustyd valley and surrounding area, a DSM in 10-metre resolution, and a contour map with 10- and 50-metre intervals (Figure 2.31). A layer was added with some topographic information, digitised from the orthophoto: roads, tracks, rivers, lakes and some villages or toponyms.

The root mean square (RMS) errors from the resulting model, as given by the software report, were acceptable (Table 2.10), bearing in mind the ground resolution of the satellite images (1.8 m at best) and the accuracy of the GPS measurements (about 1 m after post-processing). A comparison with the DSM and the height of the 20 GPS measurements that were not used in the restitution process gives an idea of the quality of the DEM. This shows that the mean height difference is 7.3 m (Van Bever 2005: 74).

2.5.3 The Dzhazator valley

In 2005, geography student Matthijs Vanommeslaeghe produced the orthophoto and related products for the Dzhazator valley and its surroundings, using two CORONA KH-4B stereo pairs (Vanommeslaeghe 2006). He took part in the fieldwork and was in charge of GPS measurements for the GCPs. In total, a dataset of 109 points was collected, which included some measurements from the 2003 campaign. After a first selection, 70 of these points appeared to be usable for the restitution process. The planimetric distribution was not very good, especially in the western part of the valley where the measurements are limited to the valley bottom and show a linear distribution. In contrast, the altimetric distribution is excellent, with a maximum height difference of 995.6 m (Table 2.9 and Figure 2.32).

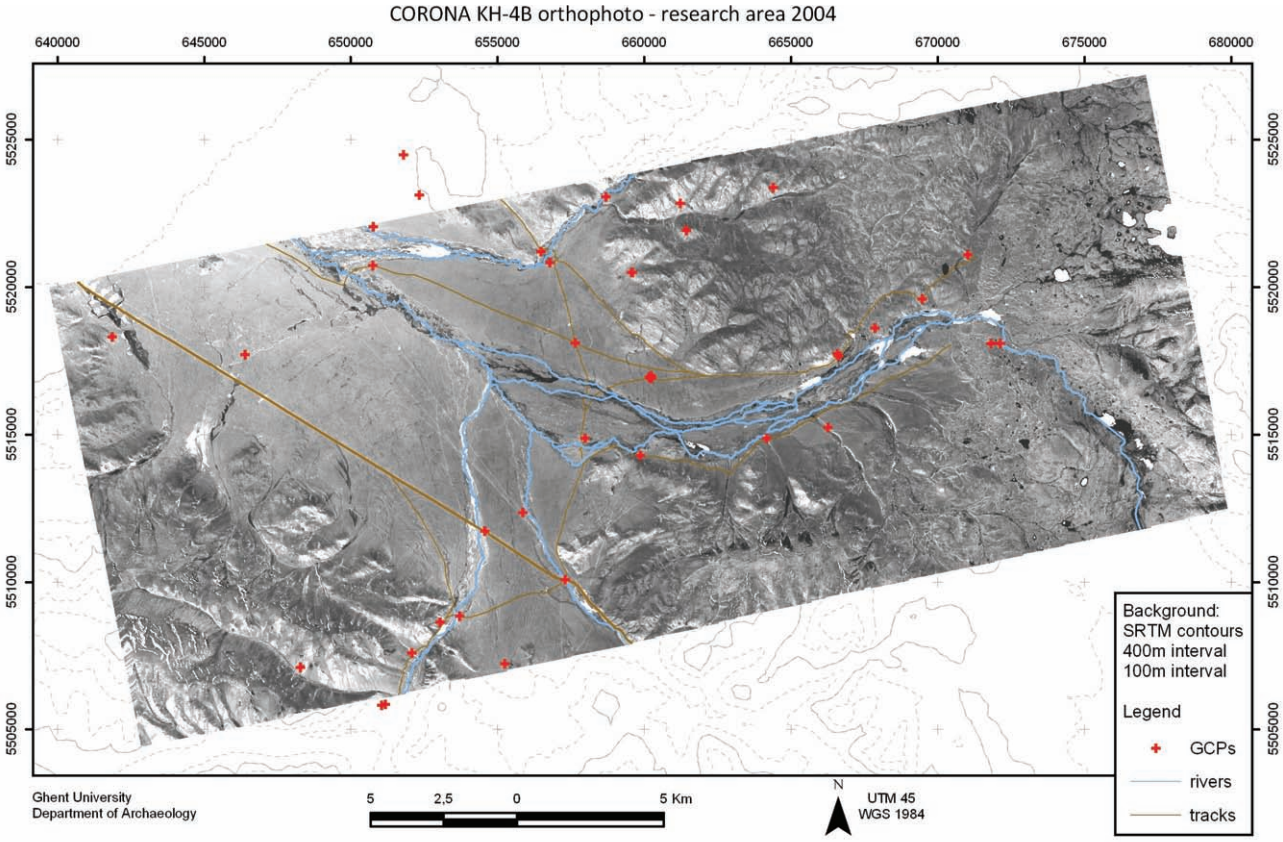


Figure 2.30: Orthophoto of the Yustyd valley based on CORONA KH-4B imagery

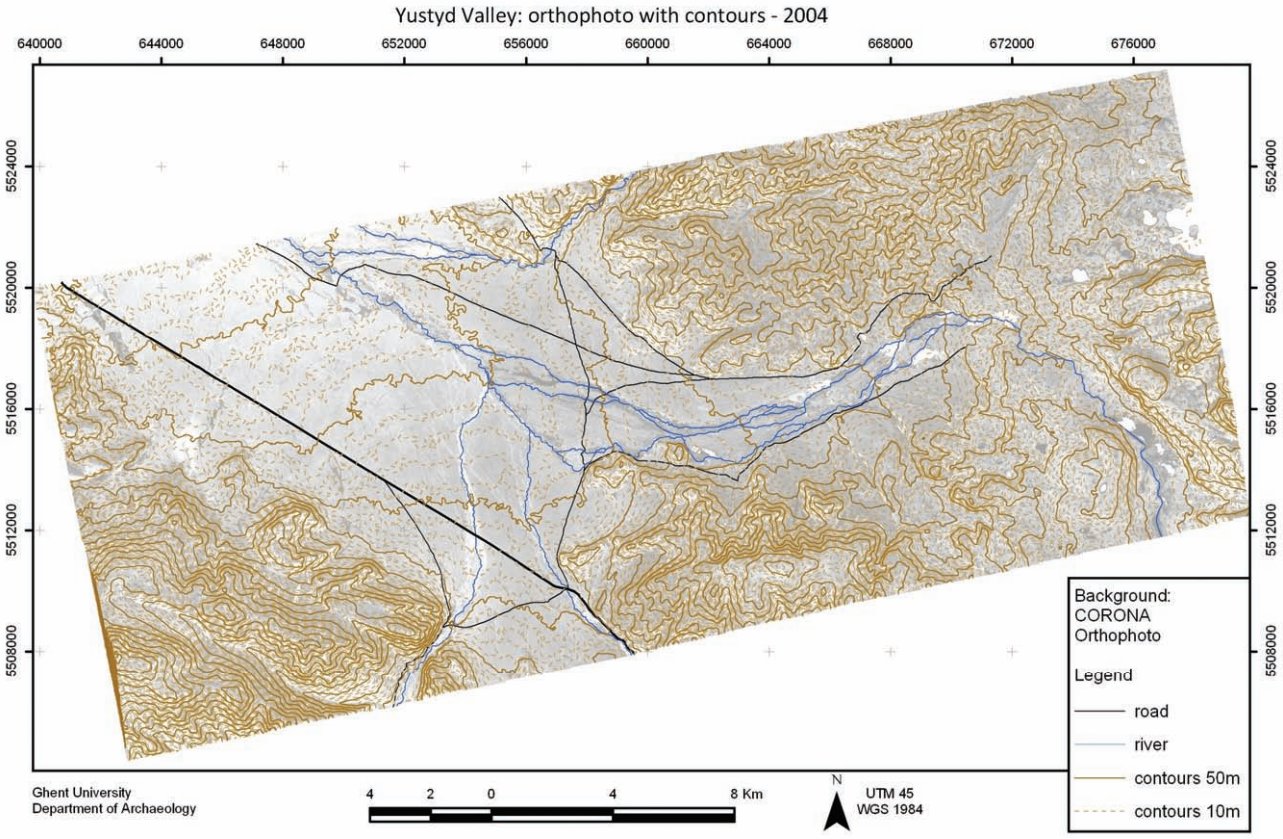


Figure 2.31: Yustyd valley: resulting orthophoto with contour map

Having excluded all ambiguous points, those that are located too close to other GCPs, and points that gave a large error (possibly because they were not located precisely in the field), only seven GCPs were used for the restitution of the northern strip. Nine GCPs were selected to process the southern stereo couple. The accuracy of the absolute orientation in VirtuoZo was good, for both models (Table 2.10). A DSM was generated with a 10-metre resolution, forming the basis for the production of contour lines in a GIS environment (Figure 2.33 and Figure 2.34).

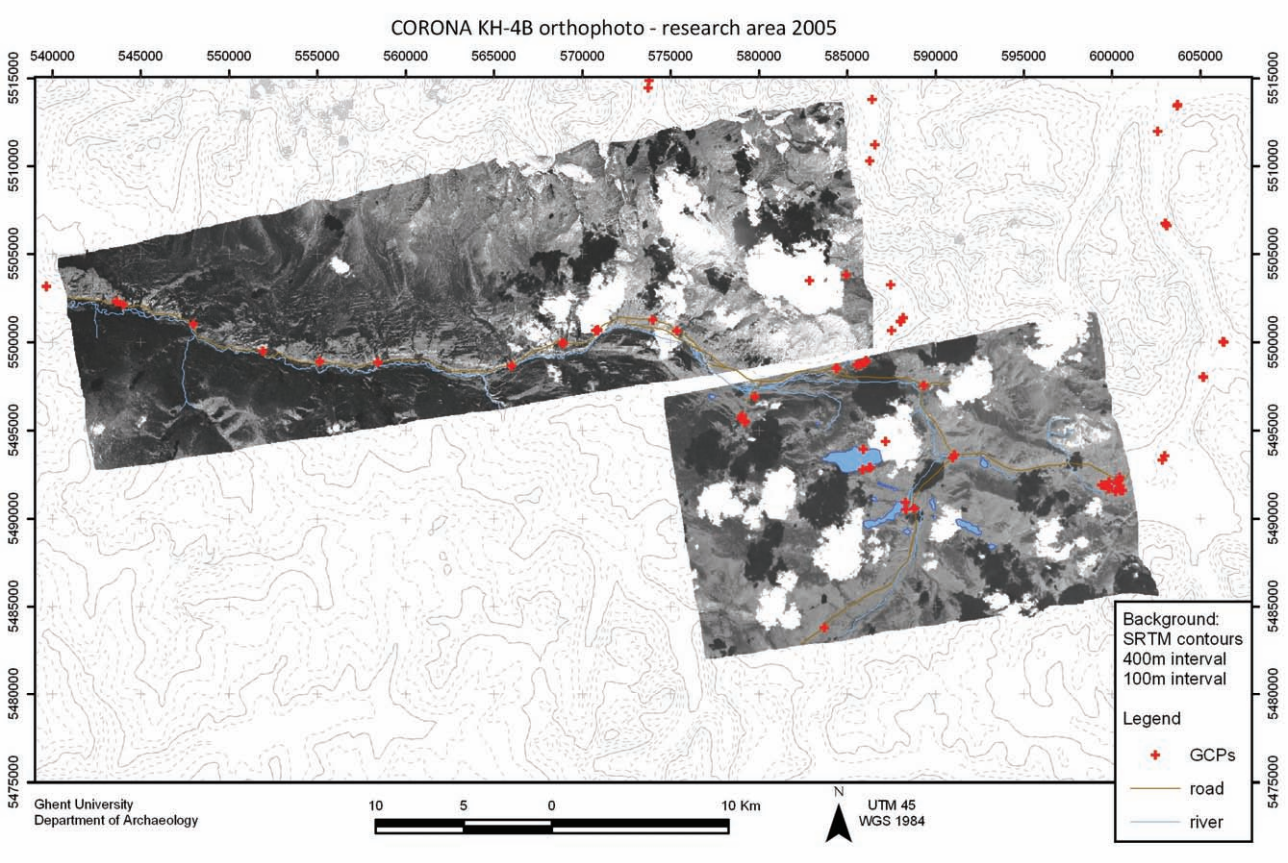


Figure 2.32: Dzhazator valley: orthophoto resulting from two stereo pairs of CORONA KH-4B imagery. Notice the number of clouds in the eastern and southern parts of the valley

The clouds that cover part of the Dzhazator valley, mainly in the east and southeast, are a major drawback. Not only is the area covered by clouds unusable, but also the areas in shadow are too dark to contain any information. Moreover, the clouds in the forward and the backward images moved during the time interval between the two photos, and thus cover slightly different areas. This effect is even worse due to the different viewing angle and perspective, with the clouds hanging several hundreds of metres above the research area[11]. As it is necessary to have information on both images to achieve a stereoscopic view, it is clear that all these factors obscure most areas in the eastern and southern parts of the research area. However, since these photos were the only ones in the CORONA archive, we had to work with them.

[11] This effect is not visible in Figure 2.32, which shows the resulting orthophoto: the forward and backward images are merged together in the orthophoto, as are the clouds and shadow areas.

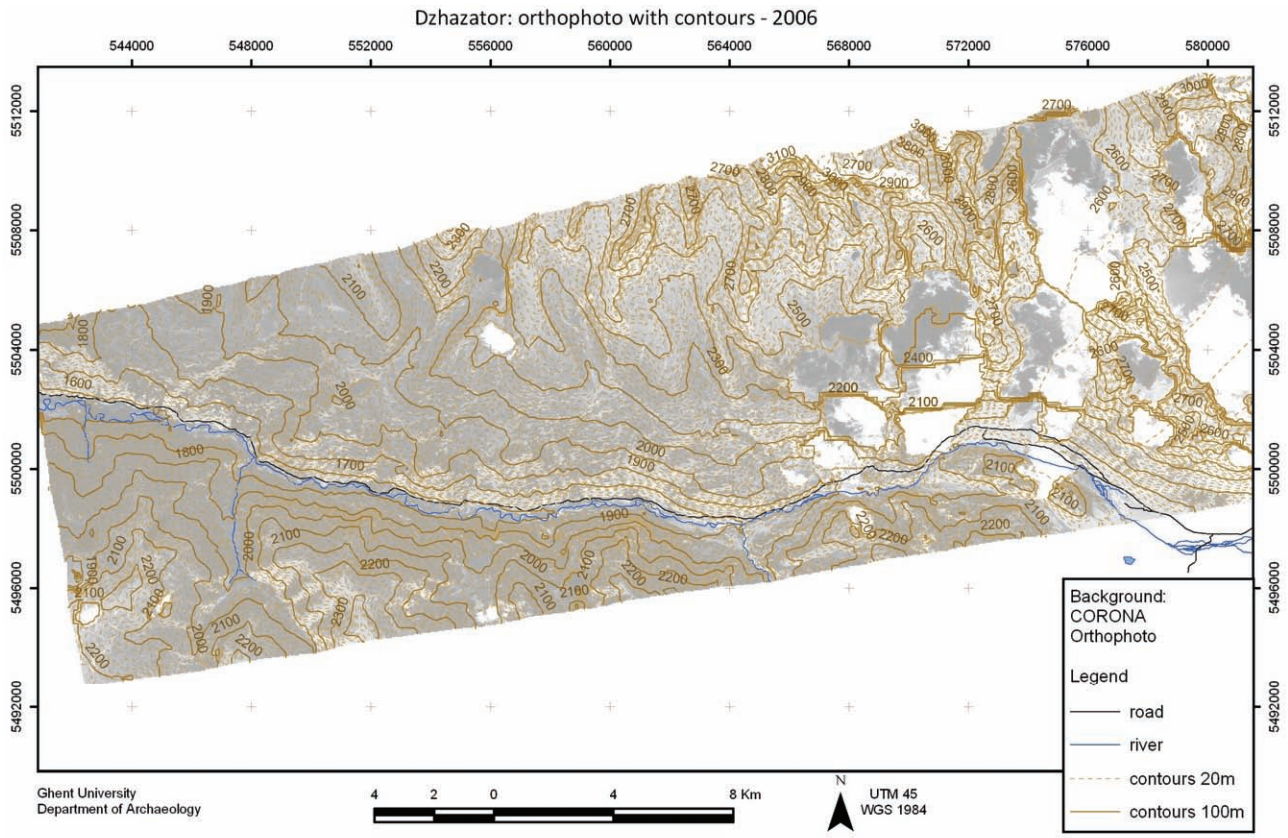


Figure 2.33: Dzhazator valley, north-western part: contour lines and CORONA orthophoto

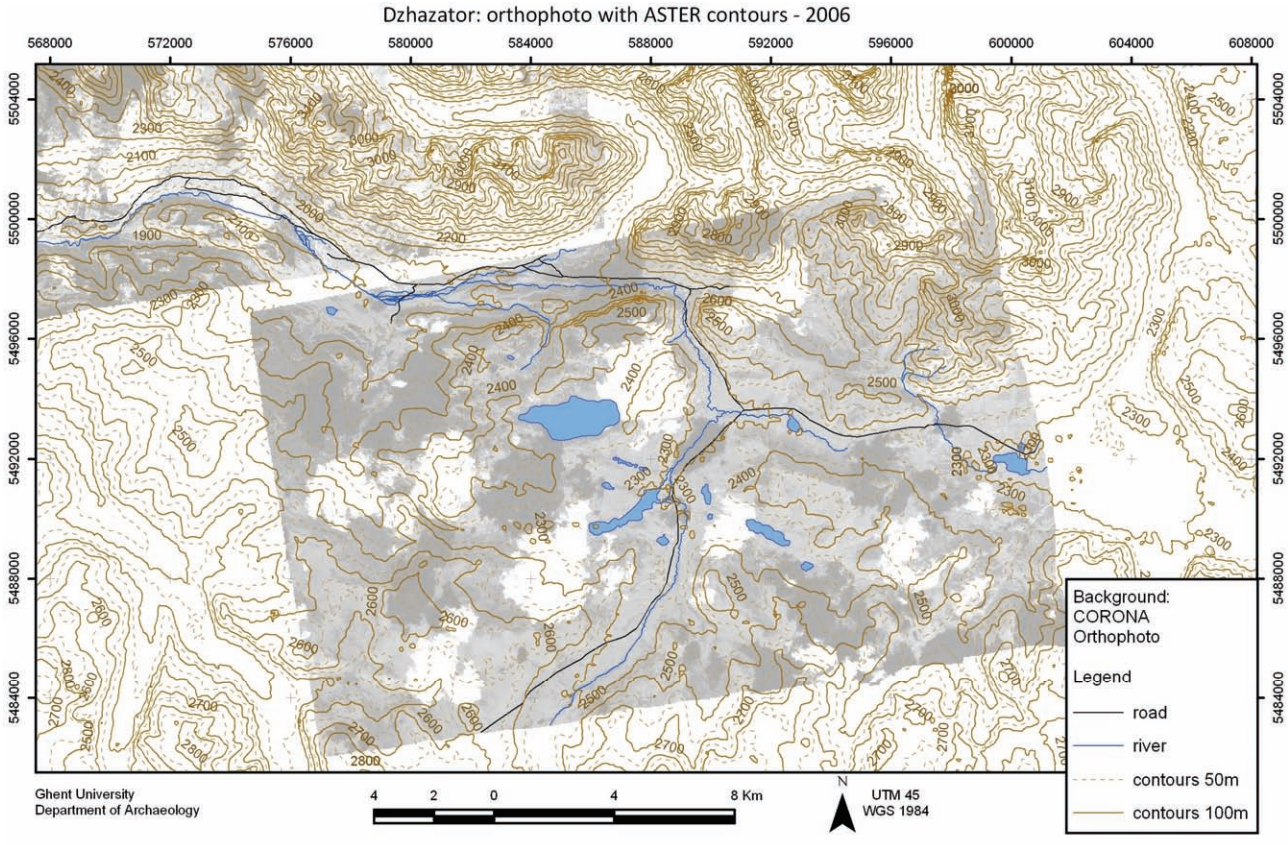


Figure 2.34: Dzhazator valley, south-eastern part: contour lines from ASTER and orthophoto

We solved these problems by filling in gaps in the resulting stereo model and DSM with information from the ASTER satellite. Tijs de Bus, another geography student, was doing research on the occurrence of permafrost in the Dzhazator valley (see 4.7.1). He used the thermal bands of the ASTER satellite to investigate ground-surface temperatures, and produced a DSM of the ASTER research area (i.e. the eastern part of the Dzhazator valley) using the satellite's stereoscopic near-infrared bands (De Bus 2007: 73). The result can be seen in the overview map of the Dzhazator valley at the back of this volume or on the data discs.

Although special attention was paid to trying to retain the overlap between the northern and southern parts of the research area, this was not possible. The reason is not completely clear as the gap of about 500 metres only appeared in the final stage of the restitution process. One of the GCPs was even used for both of the stereo pairs, proving that the overlap was still there at the beginning of the process (Figure 2.35). This is particularly unfortunate as one of the main river terraces in Dzhazator, along with some of the largest and most interesting archaeological complexes, are situated in the 500-metre gap.

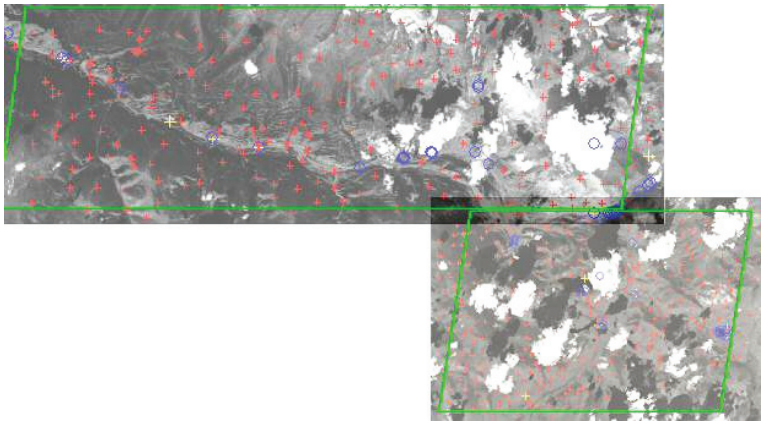


Figure 2.35: An overview of the two CORONA strips in Dzhazator clearly shows the overlap of 10% between the two forward images. However, the two areas for the restitution process (green quadrangles) are smaller and no longer have an overlap

2.5.4 The Kazakh Altay Mountains

Three different research areas were surveyed in 2006, in the Kazakh part of the Altay Mountains. This time, Dries Dossche took part in the fieldwork as a student. He was able to generate models for the Karakaba valley, the Bukhtarma valley, and the archaeological site at Berel (Dossche 2007).

One CORONA stereo pair was used to generate the model of the Karakaba valley (Figure 2.36). The CORONA KH-4B images are of very good quality, and the resulting orthophoto and DSM is aesthetically one of the most beautiful in our dataset. Forty-nine GCPs were measured in Karakaba, with a relatively good planimetric distribution and a very good altimetric distribution of 271 metres (Table 2.9). Having excluded any ambiguous or poorly defined points, 14 GCPs were used for the restitution process. This resulted in a model with a RMS error of 0.88 metres in X, 0.85 metres in Y and 3.56 metres in Z (Table 2.10).

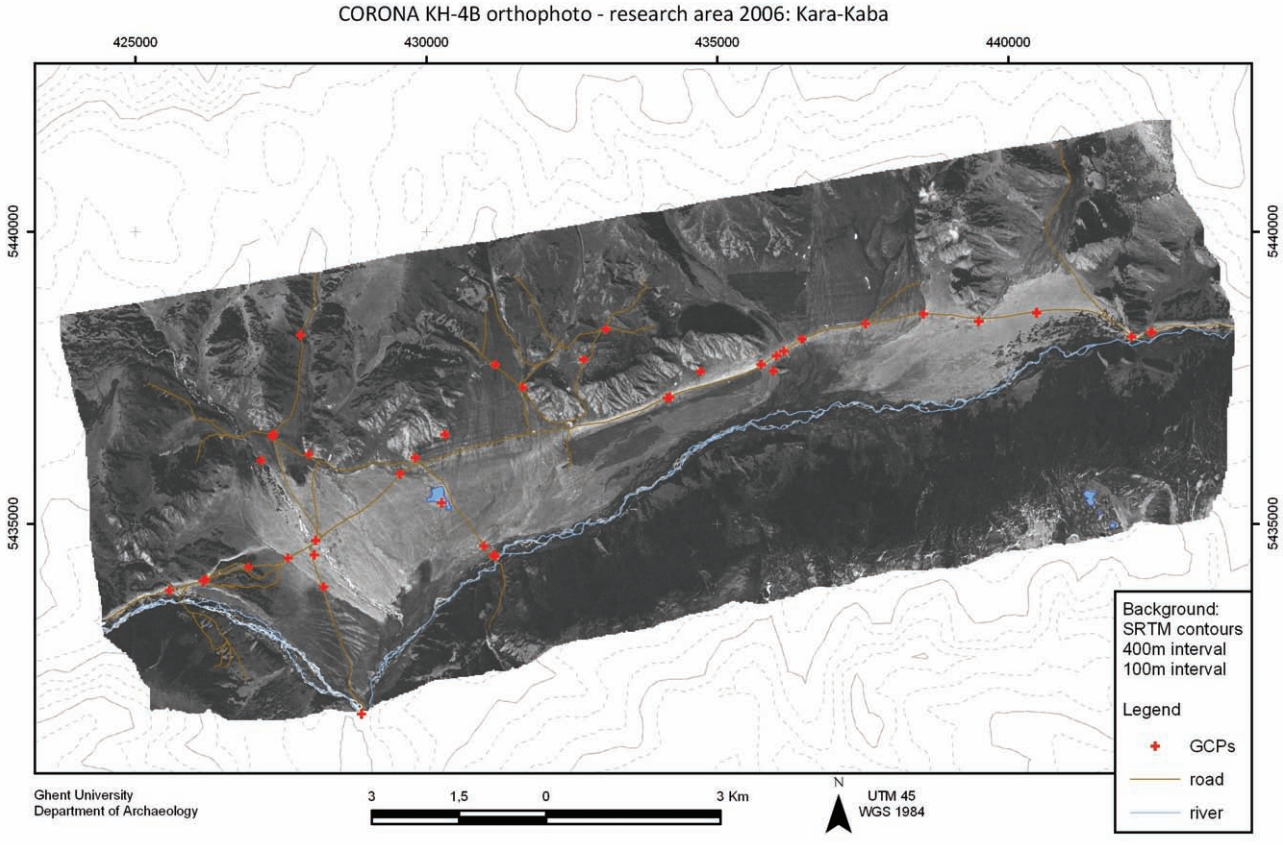


Figure 2.36: Karakaba valley: orthophoto indicating GCPs

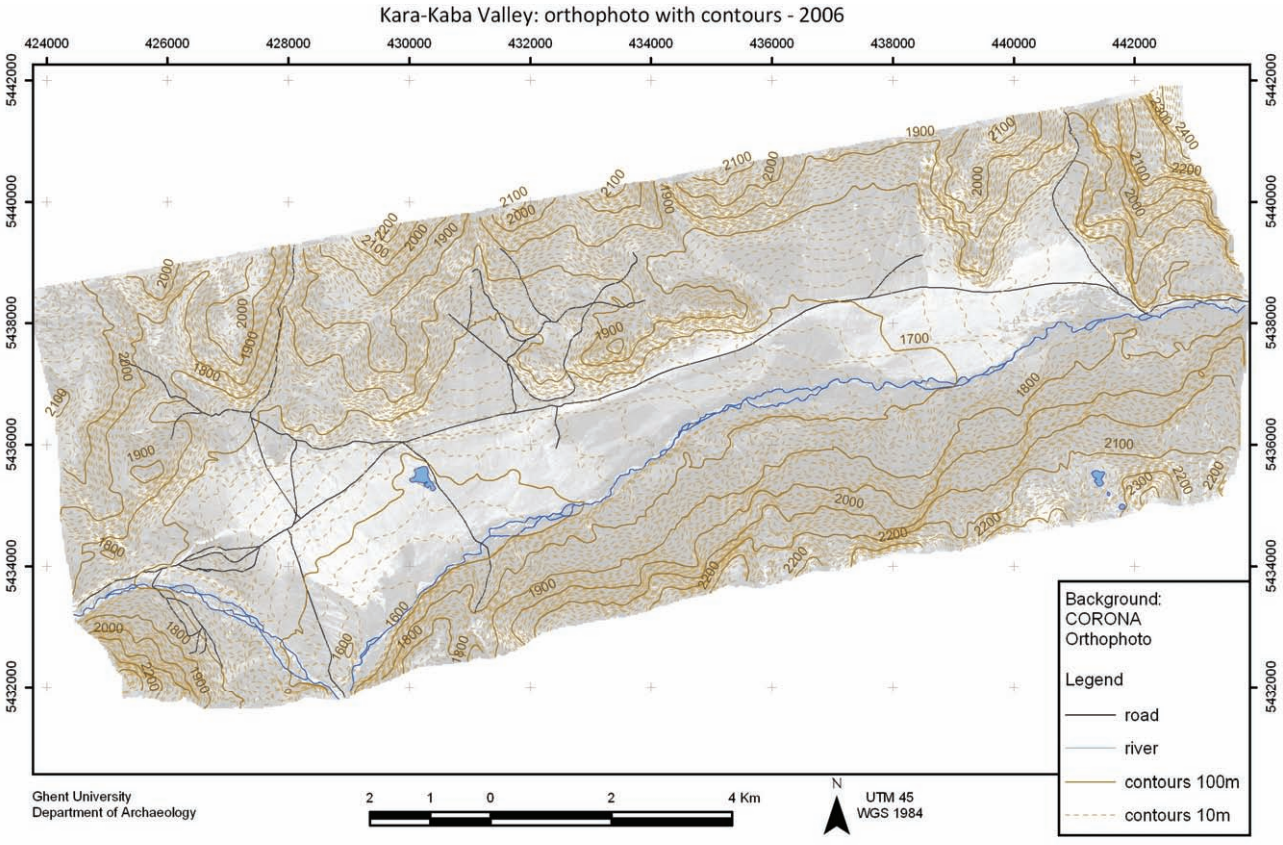


Figure 2.37: Karakaba valley: contour map with 10- and 100-metre intervals

Although the orthophoto looks perfect, there seemed to be a problem with the DSM when the contour map was produced (Figure 2.37). An anomaly was visible in the contour lines: a linear artefact, going through the model from east to west, as previously discussed in chapter 2.2.7 and clearly visible in Figure 2.16. Looking at a hillshade model, a DSM that is virtually lit from a specific angle, two other parallel lines can also be seen, above and below the central anomaly (Figure 2.38). Such anomalies were caused by scan errors. Unfortunately, there has been no time up to now to reprocess the model with the newly scanned USGS images to compare the results, although this will be done in the near future.

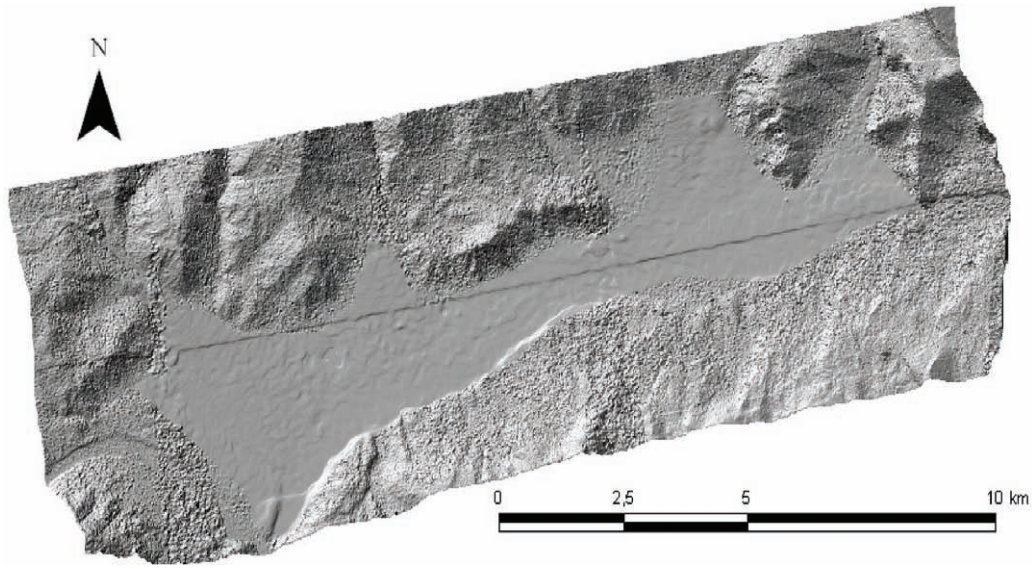


Figure 2.38: Karakaba: hillshade model of the valley, clearly showing three parallel lines. They are parallel with the long axis of the satellite images

For the processing of the Bukhtarma valley, the research area had to be split in three parts because of problems with the workstation – a shortage of memory capacity (RAM). The total area was too big to be processed in one go. Three models were generated with sufficient overlap: the western area with the village of Uryl, the central area where most of the survey was carried out, and an eastern area with the higher part of Bukhtarma almost at the border with Russia (Figure 2.39). Thirty-eight GCPs were measured in Bukhtarma, of which 14 were selected for the processing: the first part included six of these points, the second part seven, and the third part six. When viewing the total research area, their planimetric distribution is fine. However, having split the area into three parts, it is no longer that good, especially in the central area where the points are mainly located along the river, forming a diagonal axis over the research area. The same applies to the altimetric distribution for the GCPs, which was originally 703.7 m[12] (Table 2.9). The RMS errors for the three resulting DSMs are summarised in Table 2.10. Figure 2.40 shows the resulting contour map.

[12] Dries Dossche did not collect the GCPs in Bukhtarma as the geographers had to go home early. We, the archaeologists, took over. Although this was fine, it complicated the image processing slightly as some points were ambiguous or located too close together.

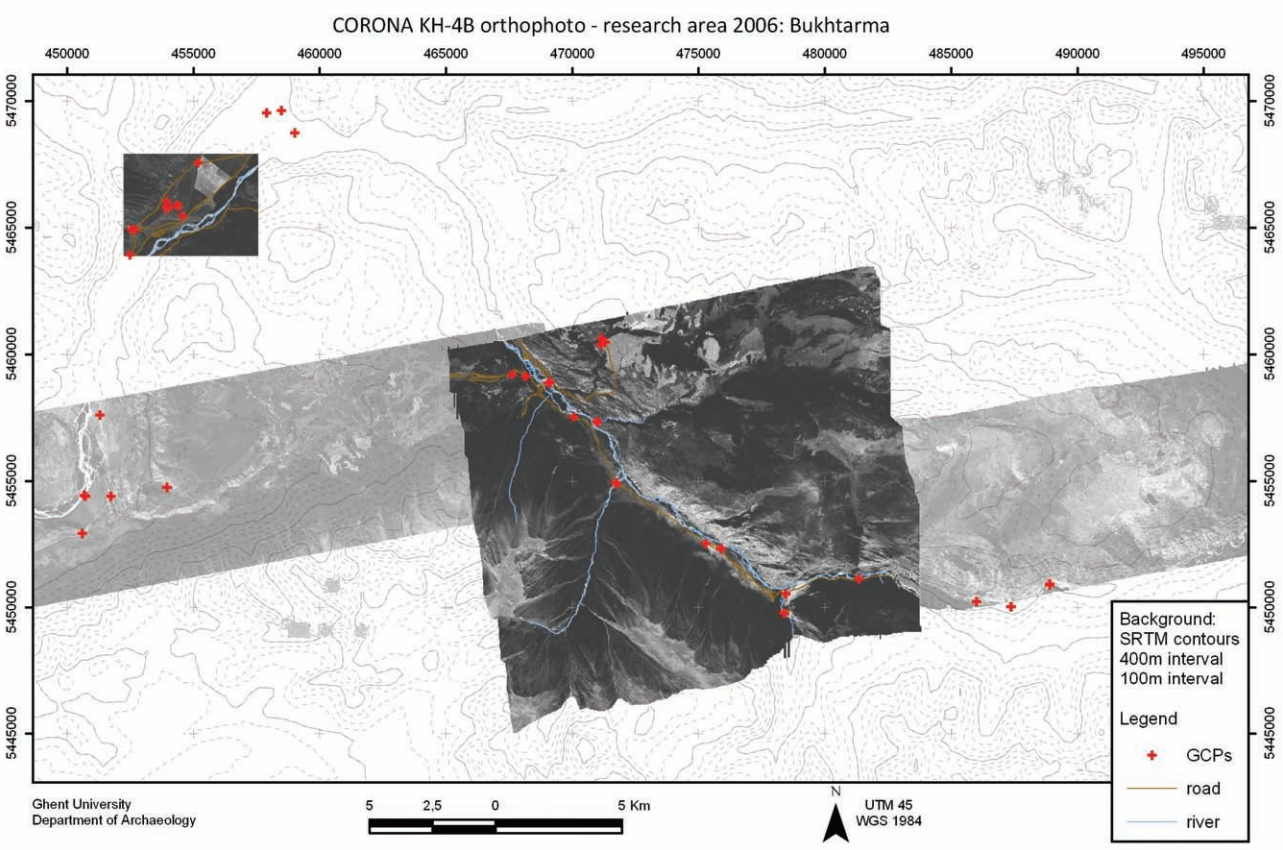


Figure 2.39: Bukhtarma valley: orthophoto resulting from two stereo pairs of CORONA KH-4B imagery. The southern stereo couple covers the central part of the Bukhtarma valley where the survey took place. Two additional orthophotos were created to the west and to the east of this area (faded), for possible surveys in the future. The Berel site is located in the north-west corner of the map

A third model was created to cover the archaeological site at Berel, using a third CORONA stereo pair. As it was not originally planned to include Berel, there was not much time left to measure the GCPs So it was decided to make a very limited model of the site itself and the direct surroundings, excluding the rest of the Bukhtarma valley (Figure 2.39). It was not easy to gather GPS measurements in the area as roads, fields and buildings appeared to have changed a lot since the CORONA images were captured. All 15 points were measured in the valley itself, giving a poor altimetric distribution of only 66.1 metres (Table 2.9). In the end, eigth GCPs were used for the processing. The accuracy of the absolute orientation was fine (Table 2.10) and a contour map could be generated (Figure 2.40 and Figure 2.41). Some years earlier, the Margulan Archaeological Institute in Almaty had already made a topographic plan of the site. A comparison is difficult as their plan does not mention contour intervals and shows some topographic elements. Nevertheless, our contour map seems to lack some detail compared to the topographic plan (Figure 2.42).

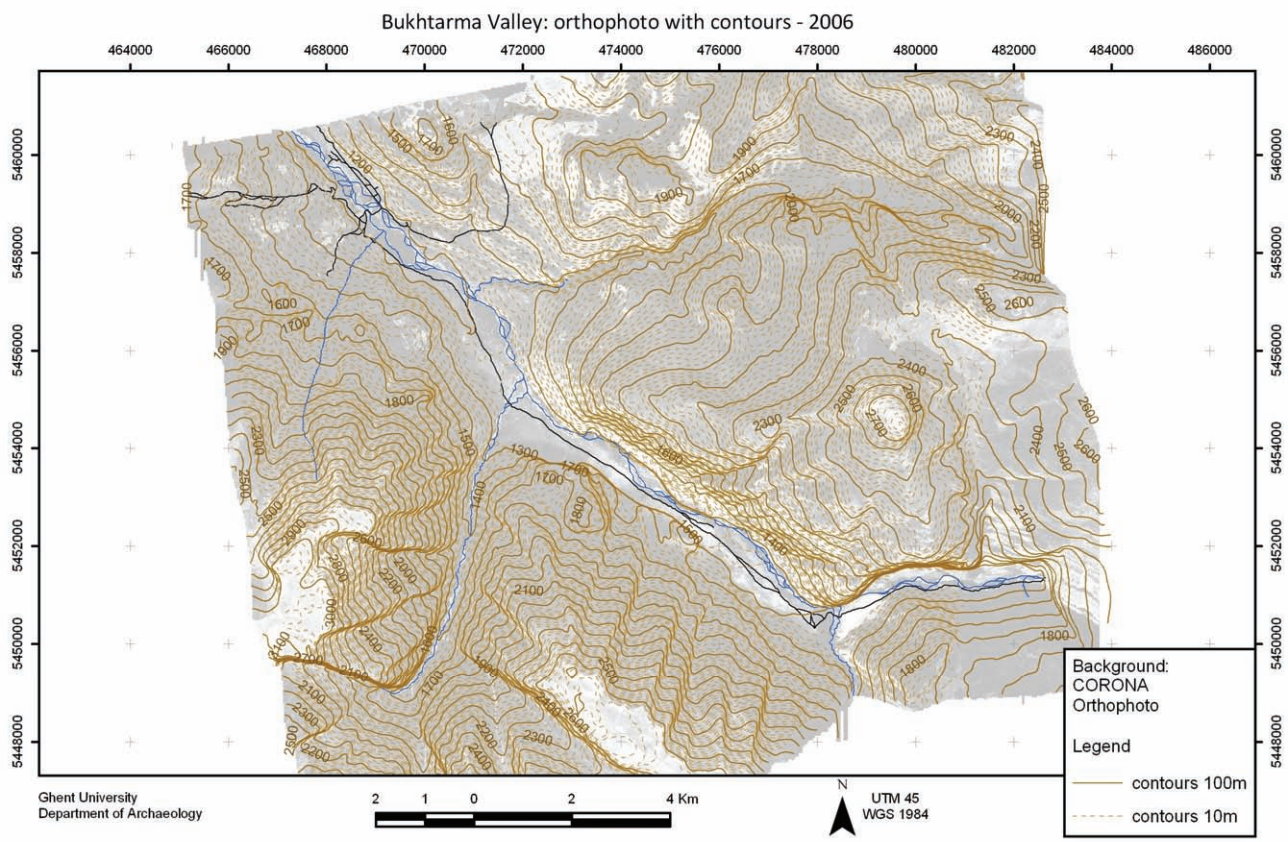


Figure 2.40: Contour map of the central part of the Bukhtarma valley

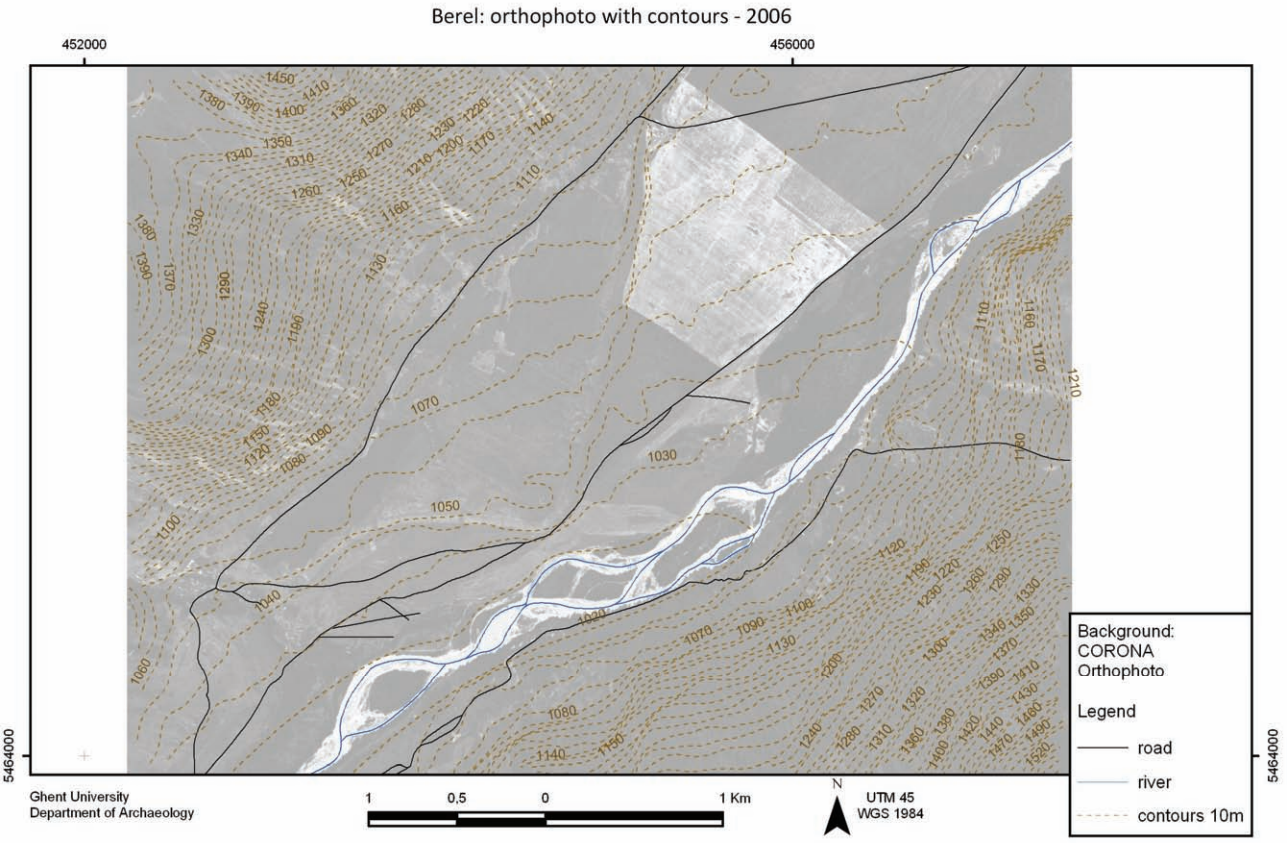


Figure 2.41: Contour map of the triangular terrace of the Berel site and its direct surroundings

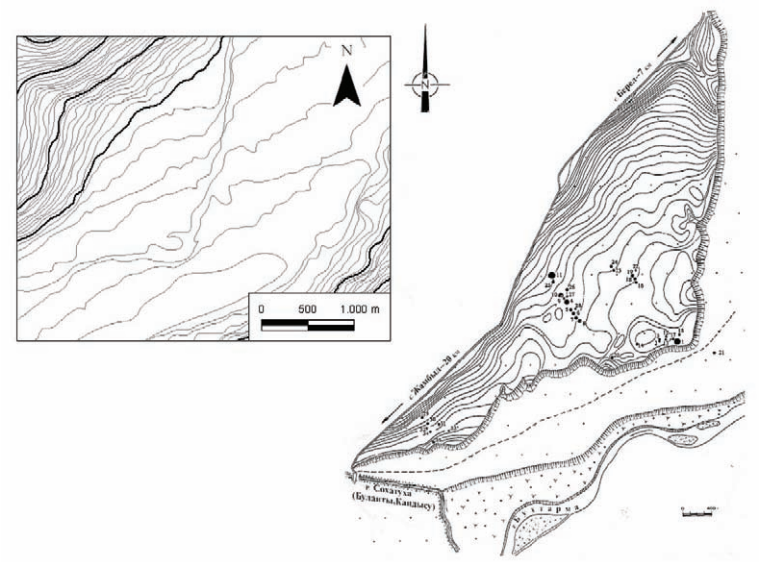


Figure 2.42: Berel: the resulting contour map (left) and an earlier topographic plan (right: image from Margulan Archaeological Institute)

2.5.5 The Karakol valley and Uch-Enmek Park

Ruben Cappelle joined the team in 2007, within the framework of his training in geomatics and photogrammetry (Cappelle 2008a, Cappelle 2008b). Together with Prof. Dr. Rudi Goossens, they measured 94 GCPs over the whole Karakol area. Since the valley is oriented north south, three CORONA stereo pairs were needed to cover its entirety. Consequently, three DSMs had to be generated. The restitution of the northern strip was based on 12 GPS measurements with an altimetric distribution of 90.8 metres (Table 2.9). Six points were finally selected for the actual restitution. The resulting RMS errors are acceptable (Table 2.10). For the central strip, 13 of 37 available GCPs were used, with a maximum height difference of 305.8 metres (Table 2.9). RMS errors are more problematic (Table 2.10): the norm of 0.9 metres (half the pixel dimensions) is substantially transgressed. Cappelle explains that he chose to include more GCPs (13 instead of the minimum of six) in order to have a good distribution over the total area, even if that meant the overall accuracy diminished (Cappelle 2008a: 15). Another factor for the lower quality of the restitution is, once again, the scan errors in the USGS digital CORONA images – several of these errors could be found in the images ordered for the Karakol research area. The shifts in pixels change the parallax differences and thus the corresponding location of the GCPs in the stereo images. This gives bad results in the absolute orientation and consequently affects the DSM itself.

Notwithstanding these scan errors, it was possible to make a model of the northern and central CORONA strip, covering all areas where archaeological sites from the 2007 fieldwork were situated. As can be seen in Figure 2.43, it was possible to avoid a gap between the northern and central CORONA stereo models.

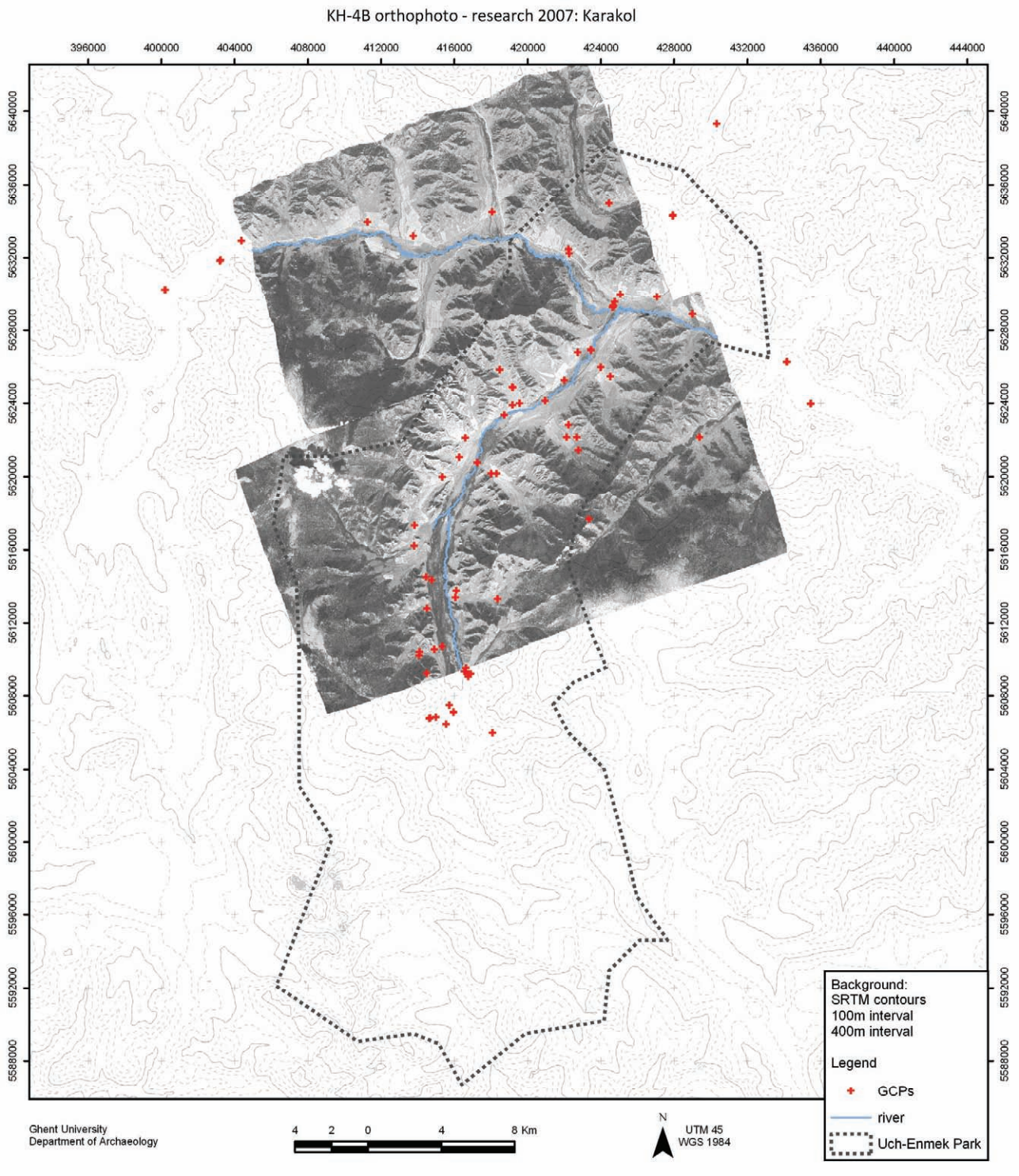


Figure 2.43: Karakol valley: orthophotos of the northern and central CORONA image

However, there was no possibility of generating good contour lines. As a provisional solution, the geographers from the Gorno-Altaysk State University gave us vector data covering the Uch-Enmek Park, including the park boundaries and a contour map with 40-metre intervals. These contour lines are the digital version of the official 1:200,000 topographical maps, and seem to fit our DSM perfectly.

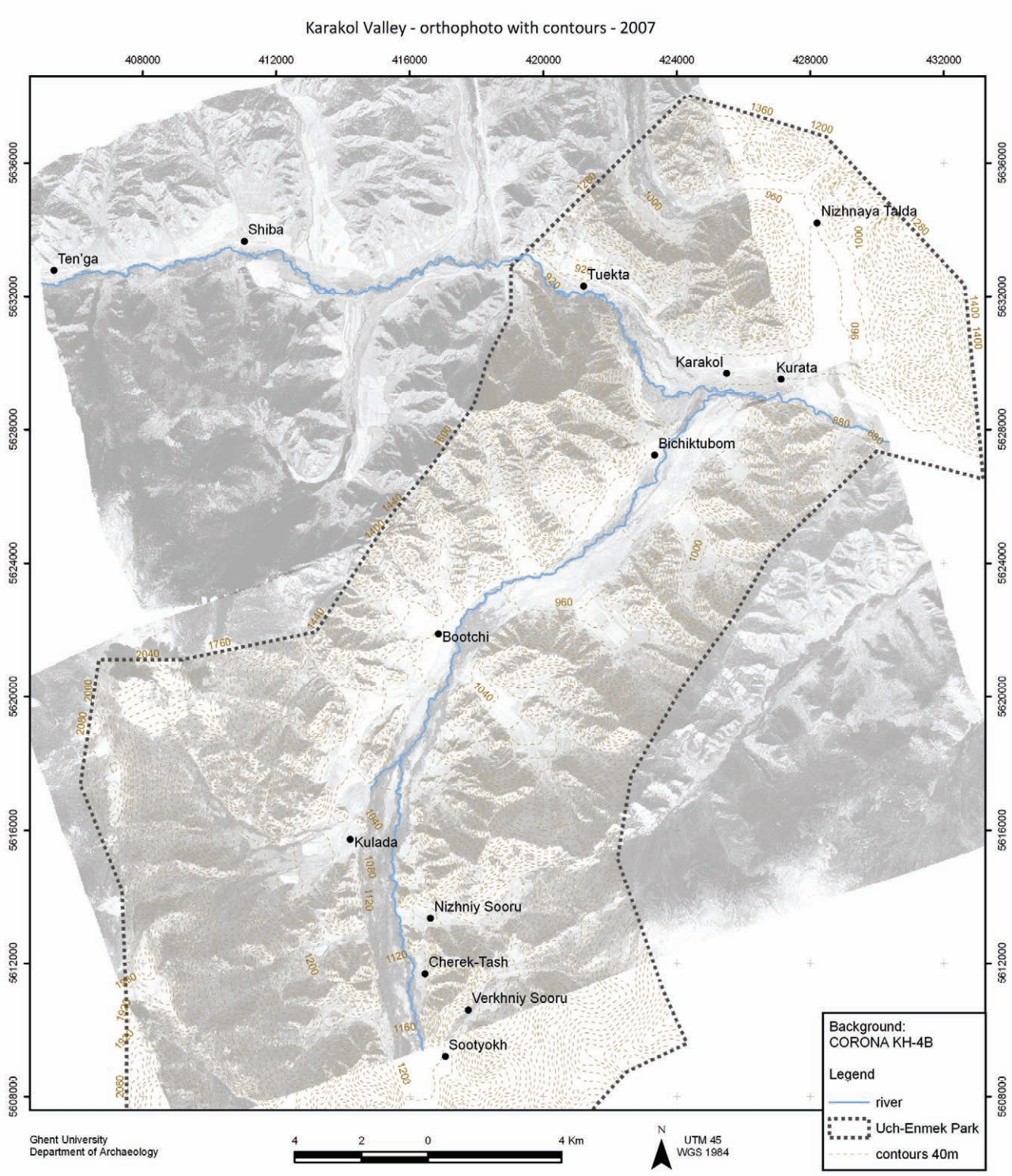


Figure 2.44: Contour map of the Uch-Enmek Park and the Karakol valley with the CORONA orthophotos in the background

The restitution of the southern part of the valley was more problematic because of an inadequate number of usable GCPs: only the northern part of the area is accessible with a terrain vehicle, and even there it was very hard to find good GCPs in-between the woods. Six GCPs were selected to start the restitution, but because of their bad distribution (they are all situated just

south of the central strip, see Figure 2.43) and in some cases poorly defined location, it was not possible for the workstation to complete the process.

We decided to measure some additional GCPs in adjoining valleys during the 2008 fieldwork in Karakol, and hope to finish the post-processing of the south of the valley in the near future. It should also be possible to reprocess the northern and central CORONA strip, using the re-scanned images without scan errors. The final result will be the complete coverage of the Karakol valley, with three CORONA images and three contour-line maps linked together.

2.6 Conclusions

The CORONA archive is a valuable source of information, available at little cost – especially when compared to the price of other high-resolution imagery. The stereoscopic coverage is very useful, enabling us to map an unknown landscape with far less effort than conventional topographic mapping. Moreover, the images are a historical source of over 40 years old and reflect a landscape that has changed considerably in the last decennia.

However, working with historical imagery has some disadvantages. The available images have to be used even if they are clouded, have little contrast, or do not have the ideal ground resolution, and there is no possibility of ordering new images of uncovered areas. Furthermore, it is sometimes difficult or even impossible to generate models that cover the entire research area, with gaps of up to several kilometres between successive stereo models. Finally, yet importantly, the age of the images makes it difficult to find the necessary GCPs for the restitution process, especially in areas where evolution of the human landscape is very active – for example, roads have been moved or are newly constructed, many buildings have changed, and bridges have been rebuilt for heavy traffic.

It is easy to acquire CORONA satellite imagery and to view the images without any processing, but the rectification process can seem rather complicated. Moreover, the necessary GCPs have to be measured in the field with GPS. In many areas, especially the Near East, this is not possible. Another possibility is to look for GCPs on geo-referenced high-resolution satellite imagery, but these are mainly very expensive. Recently, Casana and Cothren have suggested a simplified way to orthorectify CORONA imagery, using coordinates from freely available SPOT satellite data from the early 1990s, with a resolution of only 10 metres (Casana & Cothren 2008). This limited resolution – compared to the precision of our GPS measurements and to the 1.2-metre ground resolution of the CORONA images – might imply that the resulting model is not very accurate, and thus should be tested first. It would certainly be interesting to test their technique of modelling and compare the results with our products.

3 Methodology for the archaeological survey

The way archaeological sites and structures are detected, recorded and mapped differs in every survey project. Most of the decisions made about adapting a methodology for the survey depend on the project's specific goals. Also important, especially when working in far-away and not easily accessible areas with only one expedition possible every year, is maximising the efficiency of the survey work. This chapter gives an overview of the archaeological survey process, and describes the evolution of the methodology towards an efficient way of recording the archaeological structures in the research areas selected for this study.

An archaeological field survey, the discovery and documentation of prehistoric and historical cultural remains on present-day surfaces, is one of the primary methods of data collection in archaeology today. Where once a survey was simply a preliminary stage in fieldwork – looking for sites to excavate – it has developed over the last few decades to become an independent form of enquiry. Archaeologists have become more interested in reconstructing the complete human involvement in the landscape, while the study of the distribution of sites across a landscape within a given region is becoming increasingly important. Only a field survey can give information about these specific questions (Wandsnider & Camilli 1992: 169).

In most survey projects, sites are only visible on the surface as a scattering of surface materials: lithic artefacts, potsherds, metal objects, construction materials, etc. Such sites require very thorough and detailed survey methods, including field-walking, the setting up of a grid system or transects, and possibly sampling methods if the area of research is too large to be covered completely in such detail. The subjects of our research are surface monuments, many of which have prominent remains and are clearly visible in the landscape. Our methodology is therefore somewhat different; the goal is to provide a maximum amount of information for minimum cost and effort.

Back in 1966, Ruppe discerned four major types of survey (Ruppe 1966: 313):

> "… (1) reconnaissance, which is extensive rather than intensive, and results in a catalogue of sites; (2) survey which is done in conjunction with a specific program of excavation and is designed to increase the sample of material culture; (3) limited survey that is problem oriented and is conducted for a specific reason … and (4) survey that involves intensive study of a local area and is designed to extract all possible information from each site found."

Our field survey does not fall into any one of these categories. Although the first definition seems to apply, the word 'reconnaissance' is not suitable as it gives the impression that the survey is quite superficial. In addition, it is intensive rather than extensive. We would define our survey as a systematic, intensive and non-intrusive site-less survey. It is non-intrusive in that no objects or artefacts are collected or taken away from the area, and there is no effect on the

monuments. It is site-less in that it is not limited to the territory of one or more archaeological sites but rather considers the archaeological landscape as a whole.

3.1 Systematic survey of the research areas

We systematically survey all accessible parts of valleys: terraces, plateaus, valley bottom, hills, etc. The basic method is visual-surface detection or field-walking, whereby the team walks in equidistant, parallel lines over the terrain, looking for surface structures. We use a small four-wheel drive UAZ minibus to travel through the area, and survey all relatively flat terrains by foot. Although this is done as systematically as possible, ours cannot be considered to be a 'systematic survey' as such (Renfrew & Bahn 1991: 74). No grid system or series of equally spaced traverses or transects have been employed, and no sampling methods have been used. Since the intervals are not set beforehand or measured out, they are somewhat unsystematic. They are variable, ranging between 10 and 30 metres. If there is good visibility, the team members form equidistant lines that cover a wider area. In contrast, when the conditions are not that good, e.g. in the case of higher or denser vegetation, the intervals are smaller. When one of the team members discovers a structure, the team comes together to record the monument in detail. The direct surroundings are double-checked for smaller side structures, as structures are mostly clustered. After recording, the field-walk continues.

The nature of the research objects, being quite obtrusive surface structures and monuments, means the use of a measured grid system is not required. More importantly, the enormous scale of the research areas and the very diverse landscapes, including terraces, slopes, plateaus, hills, alluvia, etc. make it very difficult to implement such grid systems. Efficiency is the main factor: the methodology is designed to get as much as possible from the limited time we can spend each year in the field.

The progress of the survey is marked on print-outs of the satellite imagery as these are the most detailed 'maps' during the fieldwork, even though at this point they are not geo-referenced. That is done afterwards using the GPS measurements that are gathered during fieldwork. With the satellite imagery, it is possible to plan the survey ahead and even to discover interesting terrains that are not clearly visible in the field itself (e.g. small valleys over passes or higher terraces and plateaus that are not noticeable from within the valley).

All detected structures are recorded, from huge *kereksur* and kurgans to small stone circles and simple standing stones, even if they are of an unknown type and have unidentified functions. The structures date from all periods from the earliest cultures with surface structures in the Late Neolithic until the end of the Middle Ages. We have even recorded some burial places dating back to the 19th century/beginning of the 20th century, as they were constructed next to older funerary structures as a continuation of the sites. Monuments, graveyards or settlements that are more recent have not been recorded.



Figure 3.1: Visual surface detection or field walking in Karakaba, Kazakh Altay, and the recording of an archaeological site in Dzhazator, Russian Altay

The survey did not directly involve the inventory of petroglyph sites: searching for petroglyphs demands another way of surveying and is very time-consuming if detailed recordings are required. Nevertheless, we did record some places with rock engravings and included them in the database. In some cases, this was because they were clearly related to a site with monuments, while in other cases because we found them by accident and decided to pinpoint them and describe them briefly. However, most of the petroglyph sites in the database were found and recorded by Leon van Hoof[13]. He assumed the good habit of checking 'tempting' rock surfaces in the direct surroundings of sites, or simply those that happened to be on our path during the survey.

Next to these randomly found sites, we did some more systematic work on petroglyphs in Elangash and Karakol. In Elangash, we carried out some inventory work in co-operation with Dimitri Cheremisin (archaeologist at the IAE SBRAS, Novosibirsk), while in Karakol we located most of the petroglyph sites in co-operation with Anatoliy Martynov (visiting professor at the GASU). In both cases, our main contribution was to apply our GPS configuration to locate the many petroglyph panels precisely. It should be made clear, however, that the rock engravings recorded in the database are only a small sample of the total petroglyphs sites in the research area. The sites from Elangash are not included at all, and the other sites are not described in detail in the database.

In addition, the survey did not include settlements or surface finds, so none are recorded in the database. Primarily, the reason for this is that field surveys which focus on surface materials (fragments of pottery or other small artefacts) go into much more detail and require a systematic survey with a grid system, sampling strategies, etc. This was not the goal of our

[13] Leon Van Hoof, graduated as an archaeologist at the University of Leiden, has participated in many of Ghent University's expeditions since 1997. He currently prepares a PhD at the Deutsches Archäologisches Institut, within the framework of the Excellence Cluster TOPOI - The Formation and Transformation of Space and Knowledge in Ancient Civilizations. See: http://www.topoi.org/

research. In addition, settlements are very difficult to find and we never found one piece of pottery during the survey, even by accident. We did find some smelters that were used to extract metal from ore, in Yustyd and in Karakol (already known in literature) among others, but we did not include them in the database.

Some areas are only checked by driving through with the car, e.g. vast plains with little or no change for archaeological structures, etc. Surveying these areas by foot would have been a huge waste of time and energy, so we chose to focus on the more interesting parts of the valleys. Of course, in these areas, there was a greater chance of discovering burial mounds and *kereksur* because of their dimensions. Nevertheless, we remain convinced that we recorded the vast majority of the archaeological structures in the research areas.

As in any conventional archaeological surface survey, it is important to recognise the limits and possible problems attached to the survey, and consider any possible biases in the survey results. One of the major problems is the differential visibility determined by the vegetation. High grasses and shrubs make it difficult sometimes to see the smaller structure types, e.g. stone circles, small stone concentrations and small standing stones. The varying amounts of ground cover might also have introduced a bias in the results. In most of the research areas (2003-2005), the terrains had excellent short mountain steppe vegetation: short grasses, small, dry bushes and some trees, to the extent that every small structure immediately caught the eye of the field-walker.

In Kazakhstan (fieldwork 2006) and Karakol (2007-2008) the situation was quite different. These areas are situated at a lower altitude and seem to be much more humid. Grasses and herbs grow tall and make it very hard to locate smaller structures. In addition, most of the flat areas in Karakaba, Bukhtarma (Kazakhstan) and Karakol (Russia) are used by the local population as hay fields – in the middle of August, the hay is brought in and stored for the cattle. In some fields, only the wild grass is harvested, but other areas are sown with other grasses or corn crops. The time of survey is thus far from ideal in these areas. Nevertheless, we always organise the fieldwork in July and August as the rest of the year can be very cold, especially for camping in the mountains. May or June would be better, but since both our university and local partner universities organise examinations at that time, the professors are unable to leave their offices during those months.

Another problem for these areas is the much more active soil formation. In the sparsely vegetated areas of the south of the Altay Republic, the soil cover is extremely thin. In most places, only 5 to 10 cm of earth covers the stony material of the river terraces. Each individual stone that has been placed on top of this soil is still visible: the mostly round stones are somewhat sedimented, but stand out very clearly. In those areas, we recorded hundreds of small stone circles, flat stone concentrations (only visible at the surface, no elevation), small standing stones etc. This image changes dramatically when looking to the 2006-2008 research areas: on the fields that are used for hay, there are far fewer smaller monuments.



Figure 3.2: Difference in visibility due to ground cover: Yustyd (mountain steppe, arid) and Karakol (alpine vegetation, humid): both taken on 6 July (in 2006 and in 2008)

The effect of soil formation was clearly visible especially in Berel (Bukhtarma valley, Kazakhstan). The excavations there done by the Margulan Archaeological Institute showed the large layer of vegetable mould that covered the original surface in the Scythian time: about 30 cm of dark brown soil had to be removed to reveal the small side structures around a burial mound (Figure 3.3). It is clear that small surface structures like stone settings, stone circles and even small standing stones are completely covered. The impact of humans is also much larger in those cultivated areas. As farming and harvesting require the use of agricultural machinery, although quite primitive, it seems that most of the smaller monuments simply disappeared. The fields are cleared of stones to avoid damage to the machines, even if those stones belong to small archaeological structures. Numerous small stone heaps, mixed with rubbish, are the silent witnesses to this practice. They are located at regular distances all over the fields. Furrows are cut around them, leaving almond-shaped patches of fallow ground with stones at their centres (Figure 3.4). Although it is obvious from the layout of the heaps, the rubbish and the very loose stones that they are quite recent, it is sometimes difficult to set them apart from archaeological monuments such as burial mounds. Maybe some of these stone heaps are put on top of older monuments – as that patch of land was already deemed useless.

Another possible bias is the potential fluctuation in crew-member interest and/or experience, although we believe that this factor is very limited in our team. Every year, new volunteers join the team. It is true that they have no experience in recognising the specific types of archaeological objects in Altay, but they get an overview of the monuments types before starting the survey. In addition, they receive support from the more experienced team members who are never far away. At the beginning, most difficulties were related to the difference between natural and possibly anthropogenic features.



Figure 3.3: The excavations in Berel clearly show around 30 cm of soil formation that covers the Iron Age surface level, and thus most of the smaller archaeological structures

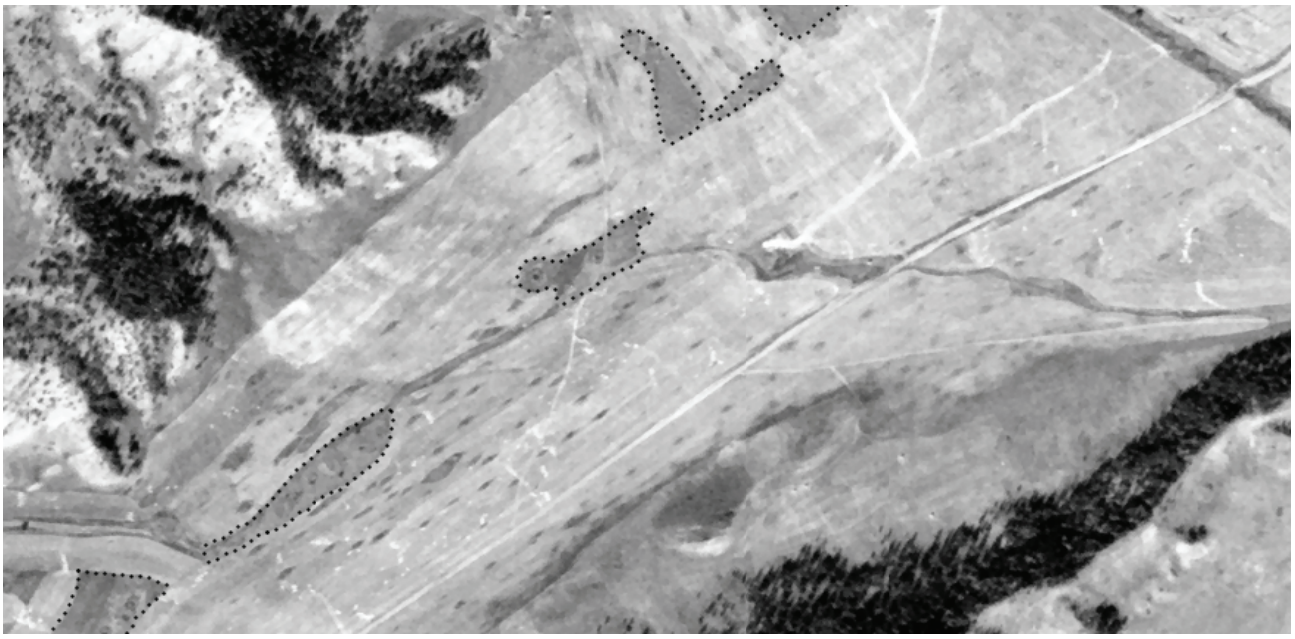


Figure 3.4: Recent stone accumulations in Karakol, visible on the CORONA imagery as small almond-shaped dots in a more or less regular grid on the fields parallel to the direction of the plough furrows. The stones are cleared from the field to prepare it for agricultural activities. Areas with larger monuments, e.g. burial mounds, are not cleared and are left as fallow ground with grasses and bushes (see the darker areas marked with dots)

3.2 Localisation of the sites and monuments

3.2.1 General localisation of the sites

The general localisation of the archaeological sites was done with Garmin Etrex Vista devices which are cheap, quite trustworthy, and give information in real time. However, the precision of these devices is at best some 5 to 10 metres in X and Y coordinates. This is obviously not sufficient for the production of reliable intra-site plans. Nevertheless, we continued to measure a point on every site for general localisation and ultimately as a back-up in the case of major data loss or unreliable GPS data. The Garmin measurements are listed in the archaeological database at the level of the site description (see 3.4.1).

3.2.2 Precise localisation of the individual structures

For the localisation of each site, a precision of 1 or 2 metres in X and Y coordinates is sufficient. However, a higher precision is needed for the localisation of monuments within a single site. In order to produce reliable plans, the individual monuments must be measured with a planimetric precision less than 0.5 m, and preferably even 10 to 20 cm.

During the campaigns of 2003 and 2004, we used a GPS with external antenna connected to a laptop (the Motorola Oncore VP or Garmin 12XL configuration with post-processing, as discussed above) to localise the archaeological sites precisely. Depending on the size of the archaeological site, a GPS measurement was done on one to up to four individual structures. An isolated structure or a small cluster of monuments was localised with one measurement, while a long row of Scythian burial mounds was localised, for example, with two – one on the northern-most mound, and one on the southern-most. Starting from these reference points, the other monuments were localised using decameters and goniometers. This method was quite primitive and time-consuming, but the result was a detailed site plan, with maximum precision (considering the circumstances). After plotting the GPS points on a plan, all individual structures were drawn using auxiliary lines, starting from these GPS points. This process also took quite some time.

Back in 2004, we had already started looking for a more efficient, but still affordable solution. A more effective configuration was introduced in 2005, using multiple rovers in the field in combination with one or more reference stations to get a differential (thus more precise) positioning. The selected system was the Leica SR-20 hand-held receiver, four sets of which were acquired[14]. Although the Leica devices are less precise when used in a stand-alone configuration, the link with the fixed C-Nav reference station in the base camp gives us a relative precision between 10 and 20 cm, after post-processing in the base camp.

[14] With the help of the Flanders/UNESCO Funds-in-Trust we acquired three additional Leica SR-20 receivers and necessary accessories for the Gorno-Altaysk State University, our local partner.



Figure 3.5: Measuring with the rover station (the Leica SR 20 GPS receiver, left), the positioning of a reference antenna in the field (centre), and the location of the reference station in the base camp, powered by solar panels (right)

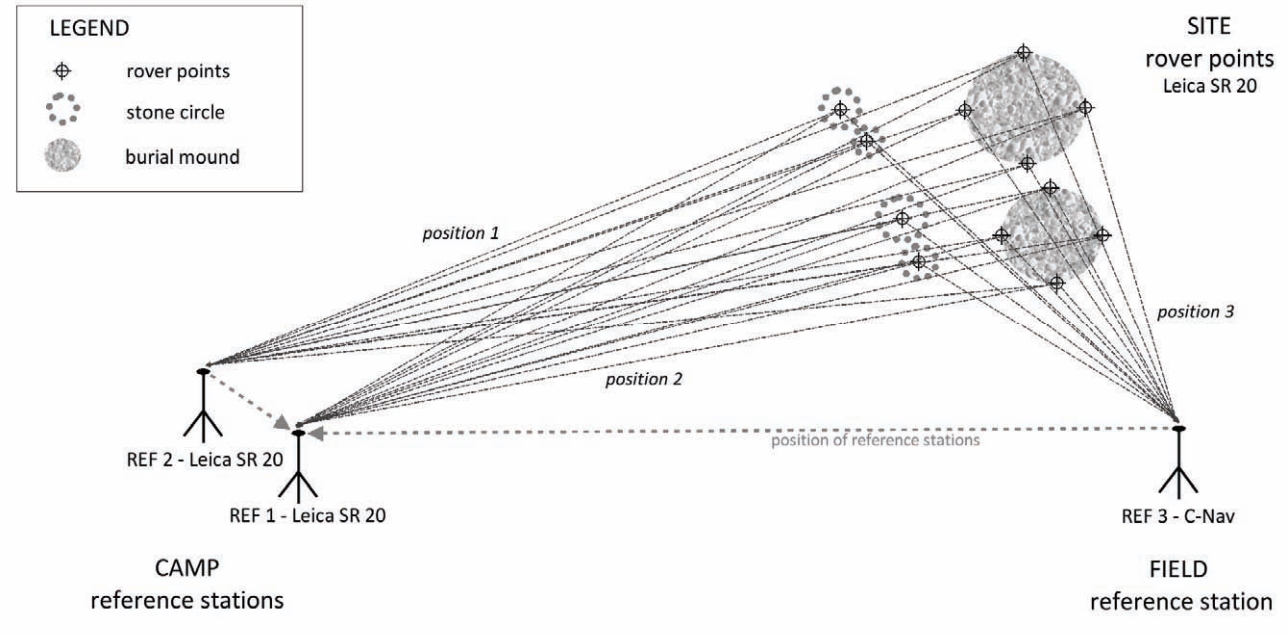


Figure 3.6: Plan of a GPS configuration with two reference stations in the camp, one in the field, and rovers that are used to measure individual points. The position of reference station 1 and 3 is recalculated in relation to reference station 1, to improve the relative accuracy. For every rover point, three positioning results are obtained. The final position is the mean of these three results

This means that during the actual archaeological survey, the C-Nav GPS receiver is installed in the camp as a permanent reference station for the smaller Leica SR 20s which are used as rovers. One of the Leica receivers is also installed as a reference station, next to the C-Nav, to use as a back-up in case of failure of the C-Nav (no contact with the reference satellite, battery failure, etc.). Every evening, the positions of the measured rover points (archaeological structures) are recalculated with each of the reference stations. This gives us one positioning result per reference station for each point. Afterwards, we calculate the mean position of every rover point.

When working far from the base camp, we move one of the reference antennae closer to the work area to improve the accuracy (Figure 3.5). The preference is to install the C-Nav in the field while one or two Leica SR 20 reference stations stay in the camp. However, if power supply in the field is not sufficient to support the C-Nav (a fully charged car battery is needed to log a whole day), a Leica SR 20 can be used for this purpose too. In this configuration, we receive three position solutions for every rover point, and therefore a more accurate mean position (Figure 3.6).

As the Leica SR 20 is very quick and precise, we decided to locate not only every site, but also every individual structure within one site. This method is very time-effective (measurements with compass and measuring rod were no longer needed) and resulted in detailed plans at intra-site level. The point file with GPS measurements can easily be transformed into a site plan in AutoCAD (Figure 3.7). Working with this configuration had several advantages:

- The Leica's are small devices, comparable to a palmtop, very handy for use in the field and with long-life battery power. This is very different to moving about with a receiver, a laptop, an external antenna and batteries to power all these devices;
- Measuring a point with the rovers takes just 20 seconds, which made it possible to localise every structure, or even several points per structure;
- We had four receivers at our disposal which means we could work with two archaeological survey teams who worked in parallel, almost doubling the output;
- The configuration is much safer when using the third Leica as a back-up for the reference station, and the fourth one as a back-up for the two rovers. Also, we checked the output every evening in the base camp, so any lost data or mistakes could be retrieved or re-measured the following day;
- The process of drawing the actual site plans is significantly helped by the fact that every structure is located, and large structures are easy to draw thanks to the multiple GPS points on distinctive features.

We outlined a strategy for using the Leica SR 20 in the field, mainly based on the results of the campaign that first involved this GPS configuration, in Dzhazator. The new rovers enabled us to measure quickly, and to measure multiple points on one structure. In most cases, this was very useful: the outlines of large monuments are measured at several places, and distinct features can be located separately. For example, a *kereksur* can be positioned using a minimum of four points along its outer circular or rectangular fence, by another four points on the edges of the

central mound, and by two points for each stone path connecting mound and fence. A simple burial mound can be defined by four GPS points along its edges.

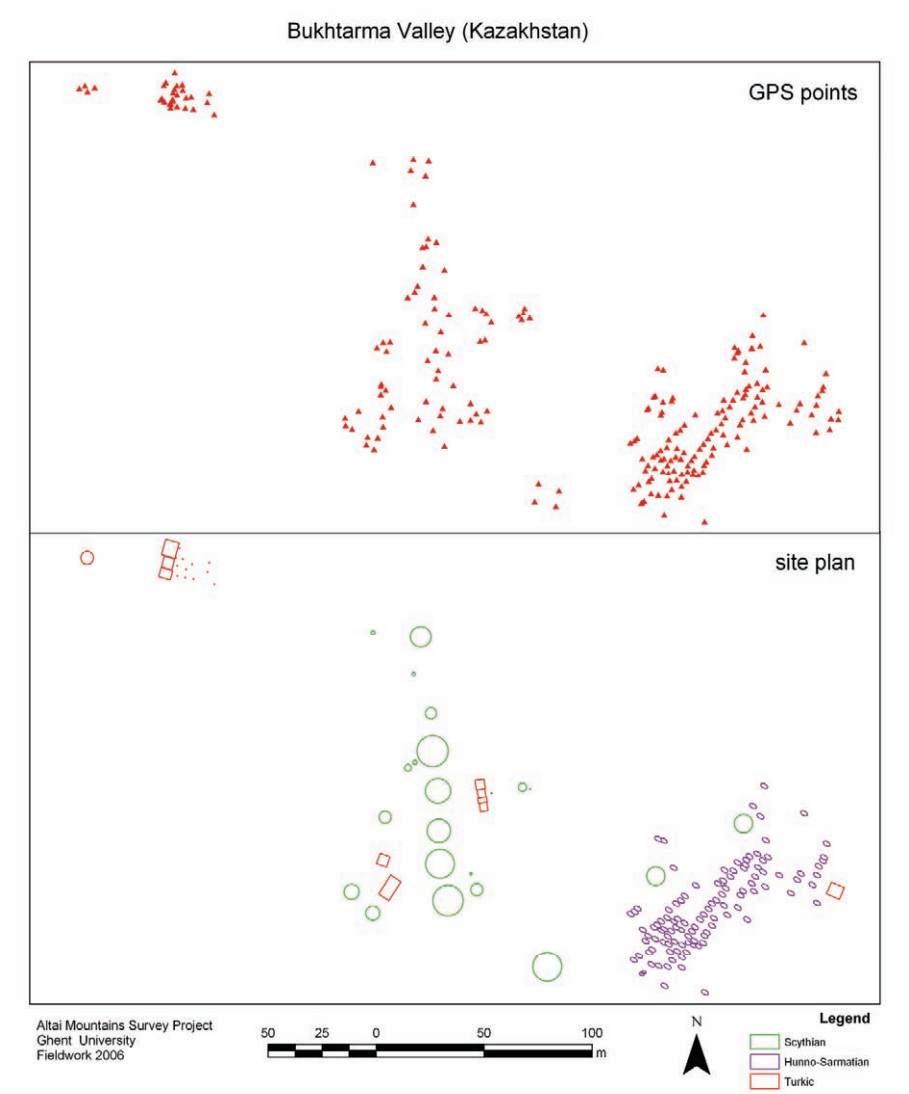


Figure 3.7: Leica SR 20 GPS measurements are transformed into a site plan in AutoCAD

However, the precision of 20 cm is very important in this respect. It means that rover points can deviate from the actual point, in all directions, by about 20 cm. If you define a 10-metre large, north-south oriented square by four rover points, these deviations will not be very visible: the square will be between 10.4 and 9.6 metres long, making it slightly trapezoid, and there could be some deviation from the north axis. However, this difference will be clearly noticeable if the square is only 100 cm in diameter: as the four corner points can shift 20 cm in every direction, the square will be represented by a heavily irregular trapezium, with sides of 60 to 140 cm. Therefore, it is clear that using multiple GPS points for a small rectangular enclosure is not to be advised: it is better to locate one of the corners and take manual measurements with a meter or measuring tape to define its size and draw its outline. The orientation of these monuments can be measured with a compass, keeping in mind the difference between the geographic and the magnetic north (see 3.3.5).

We decided to use the following strategy, different for large monuments and small monuments (< ca. 2 metres in diameter):

- large round or oval structure: four or more points along the edge;
- large rectangular or polygonal structure: one point on each corner;
- long lines: two points at the start and end point;
- possibly other features inside or outside of the structure: as many points as necessary;
- small round or oval structures: one point in the centre, orientation of oval structure with compass;
- small polygonal structures: one point on a corner (specifying which corner), orientation with compass;
- short lines: one point at the start point, orientation with compass;
- possible other features on small monuments: detailed manual measurements with tape;
- point features: one point.

In all cases where the orientation of a structure or feature is of interest (lines, rectangular monuments and some polygonal structures) a compass reading was taken to backup the GPS measurements.

3.3 Recording the archaeological heritage

3.3.1 Site and structure description in the field

The recording of the archaeological structures during fieldwork is done at two levels. First information is gathered about the site and its surroundings. This is then completed with more detailed observations at the level of each individual structure. The description of the 'site' itself (see discussion in 3.3.4) starts with general information on the location: coordinates as measured with GPS, political district, valley name, possible toponyms. This is followed by more details on the geographical and topographical context. Possible indications for permafrost occurrence (periglacial phenomena such as pingos, solifluction etc.) are noted. A general description of the site completes the record: what the complex looks like, what the general layout is, the approximate number of structures, are there special observations on the condition of the site, etc. All this information is noted in a field book with filing cards (Figure 3.8). One or more overview photos are added to illustrate the record, preferably taken from a nearby hill top or higher ground.

The description of the individual structures is done in more detail, as are the GPS measurements and the photographic recording. The filing cards in the field book (Figure 3.8) include a typological attribution and a general observation of the structure, complete with details of construction materials, dimensions and the condition of the monument: are there traces of bioturbation, erosion or sedimentation; has the structure been excavated or possibly robbed; is it intact or (partly) destroyed by natural or anthropogenic factors? Also important is the link with other monuments: does the structure go together with another, possibly large monument, or has it smaller secondary structures around it?

We would like to expand this description in order to come to a trustworthy expertise system that automatically tries to define the monument type and its possible cultural attribution, on the basis of well-defined characteristics. This automatic definition should be accompanied by an estimate of its reliability, by appointing values to the different characteristics that are being used. When used with caution and thoroughly tested, such a system could improve the interpretation of the monuments, and make the approach more objective.

All monuments are measured in detail with a measuring tape, and the dimensions are noted on the structure sheet. In 2003 and 2004, this was the only way to record the size of the monuments. From 2005 onwards, we were able to rely on increasingly accurate GPS measurements, but we kept measuring as a back-up for the GPS measurements. Only when structures were too big to use a conventional measuring rod did we rely entirely on GPS measurements to determine the size of the monuments. The orientation of the structures is recorded as much as possible, using a compass, or relying on the output of the GPS measurements (see 3.3.5 for remarks).

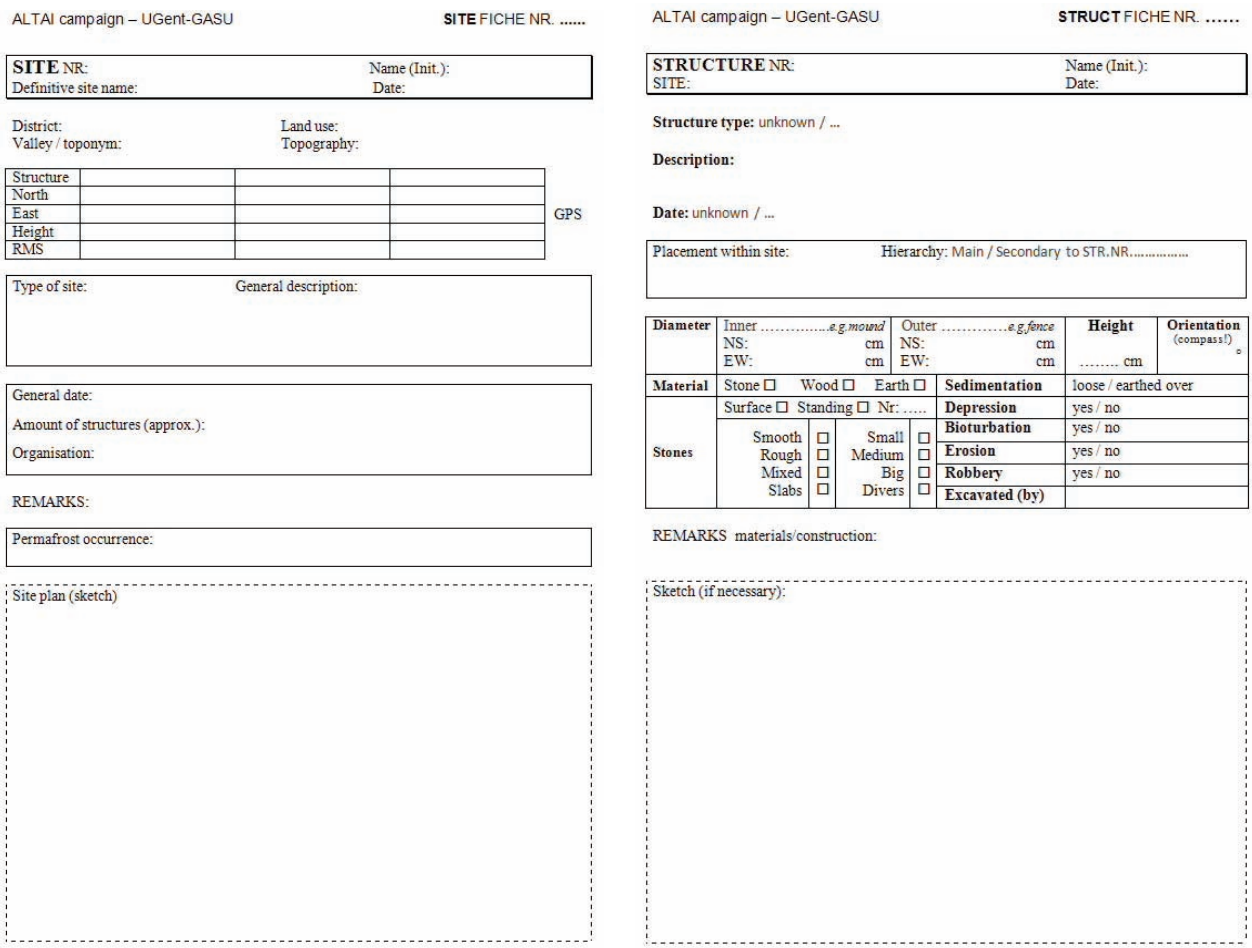
Photographic recording is done with two CANON EOS 350D digital cameras[15]. The resulting photos have a resolution of 3,456 x 2,304 pixels (8 MP), which makes them sufficiently detailed and of good quality. All structures are recorded individually, at least twice and preferably from two different points of view[16]. The photos include a 50-cm red-white photo-scale bar, a north arrow and a board with date, valley name and object number.

3.3.2 Defining the chronology of the monuments

Finally, we give the structures a tentative chronological attribution. To do so, we use a combination of the following factors. Of course, typology is the main aspect: in most cases, the morphology of the structure itself can define to which specific type of monument the structure belongs, or can at least exclude some other possibilities. Many types of monuments are strictly linked either to one archaeological culture, or to several. Information from archaeological literature, especially on excavations, and comparisons with other sites and regions can help to determine the specific type.

[15] In 2003, we did not have a digital camera for the fieldwork and used conventional film negatives that were later processed as slides. These slides were then scanned and added to the digital archive.

[16] Not all structures were recorded by two or more photographs. In many cases, only one picture was taken. In addition, long rows of standing stones are mainly recorded as a whole; it is not necessary to have separate pictures of each individual stone unless it has some specific features.



ALTAI campaign – UGent-GASU **SITE** FICHE NR. .....

SITE NR: Name (Init.):
Definitive site name: Date:

District: Land use:
Valley / toponym: Topography:

Structure			
North			
East			GPS
Height			
RMS			

Type of site: General description:

General date:
Amount of structures (approx.):
Organisation:

REMARKS:

Permafrost occurrence:

Site plan (sketch)

ALTAI campaign – UGent-GASU **STRUCT** FICHE NR. .....

STRUCTURE NR: Name (Init.):
SITE: Date:

Structure type: unknown / ...

Description:

Date: unknown / ...

Placement within site: Hierarchy: Main / Secondary to STR.NR.....

Diameter	Inner .....*e.g.mound* NS: cm EW: cm			Outer .....*e.g.fence* NS: cm EW: cm		**Height** ..... cm	**Orientation** (compass!) °
Material	Stone ☐ Wood ☐ Earth ☐				**Sedimentation**	loose / earthed over	
Stones	Surface ☐ Standing ☐ Nr:				**Depression**	yes / no	
	Smooth	☐	Small	☐	**Bioturbation**	yes / no	
	Rough	☐	Medium	☐	**Erosion**	yes / no	
	Mixed	☐	Big	☐	**Robbery**	yes / no	
	Slabs	☐	Divers	☐	**Excavated (by)**		

REMARKS materials/construction:

Sketch (if necessary):

Figure 3.8: Field book as used for the registration of the sites or locations were structures are found (site level) and for the registration of individual structures (structure level)

Context is the second factor. Sometimes, structures of the same type are constructed during several periods, which makes it impossible to know their date. The context gives valuable information: what is the layout of the site, do the structures have a specific orientation, do they belong to or are built next to other monuments that can be attributed to one archaeological culture? Stone burial mounds, for example, can be very alike. It is not possible to date them just by looking at the morphology. However, their place in the landscape and the layout of the sites enable us to differentiate. Burial mounds that are placed in broadly north-south oriented rows should be placed in the Scythian period, for example.

The link with other monuments is equally important: a group of stone circles around a late Bronze Age *kereksur* will be given a different chronological attribution than a group of stone circles to the west of a row of Scythian burial mounds. The link with other monuments sometimes enables us to date the monuments relatively: the layout of a group of monuments can be clearly altered by the presence of an older monument or monument group. The clearest example is a group of two *kereksur* monuments and side structures in the valley of Yustyd (Figure 3.9). The two monuments, one with a rectangular and the other with a circular fence, are built just six metres from each other, giving little space for the surrounding secondary structures. The large circle of 33 stone circles surrounding the round *kereksur* is too big to fit into the space

between the monuments, and clearly avoids the rectangular fence around the second *kereksur*. This means that in this case the round *kereksur* – or at least its stone circles – post-date the rectangular one.

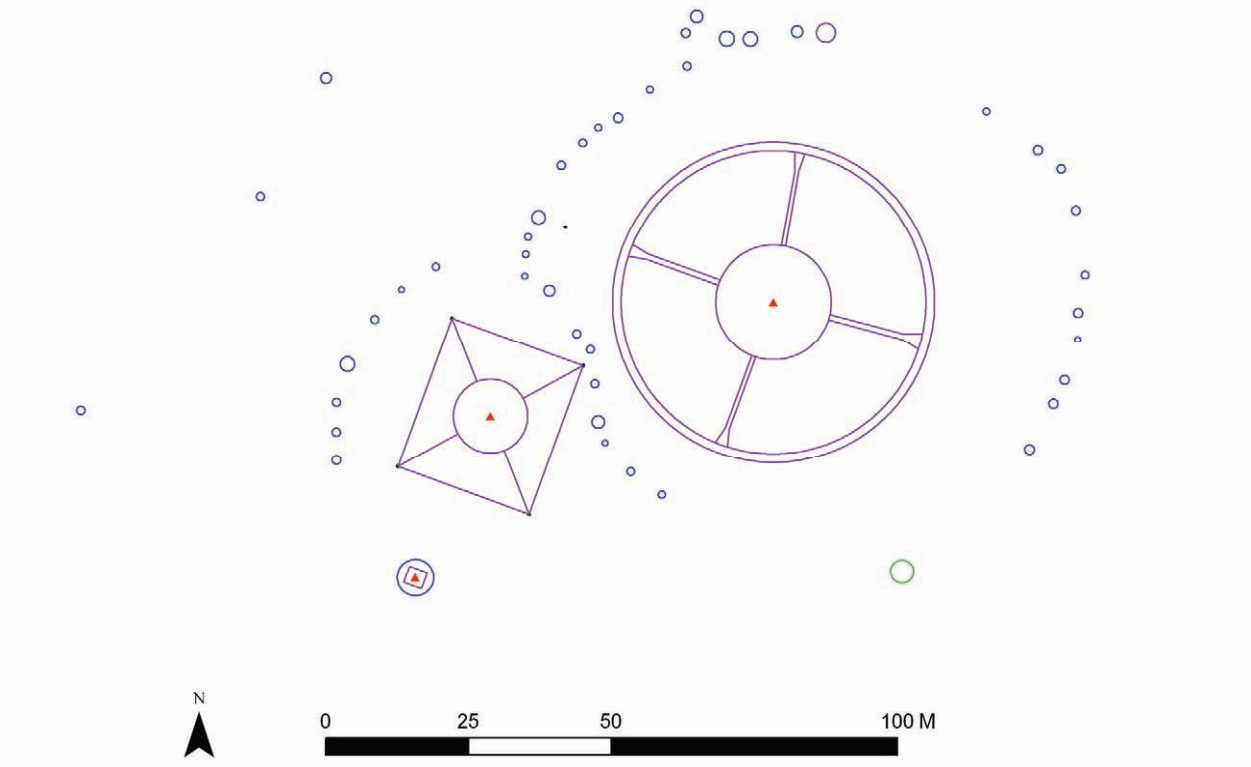


Figure 3.9: An example of two monuments that enable a relative date to be proposed: two *kereksur* surrounded by stone circles in the valley of Yustyd

In many cases, it is not possible to determine even a rough estimate of chronology for the structure – either the specific type of monument occurs over a long period in time, covering many archaeological cultures, or the monuments are completely unknown in archaeological literature. In the latter case, they should be researched to obtain more information.

We realise that this method of determining the cultural attribution and rough estimate of date is not perfect. However, it is certainly valuable and can be used if its limitations are kept in mind. Only excavations make it possible to date an archaeological object more precisely. Although we plan to organise some small excavations on certain unknown types of monuments in our records (see Chapter 0), there have been no excavations within the framework of this PhD research.

3.3.3 The numbering of sites and structures

All sites were recorded with a prefix of two characters, referring to the administrative region they are located in, and a number of three digits. The KA prefix was given to all sites in the Kosh-Agach region, and starting from there, sites are numbered KA-001, KA-002, etc. Until now, only

the following prefixes have been used in the Altari numbering system: KA (Kosh-Agach region, Altay Republic), ON (Onguday district, Altay Republic) and KK (Katunkaragay district, Kazakhstan).

Every individual structure within a cluster or site was given a number or three digits: KA-001-001, KA-001-002, and so on. These unique codes were used for registration in the Altari database (see 3.4), and form the link between the database, the photographs and the GIS files.

In some cases, we converted names of sites and structures from earlier fieldwork into the Altari numbering system. This makes the numbering system uniform and workable. The link with the old name is stored in the database so that the original information can always be traced back. This was done with the survey work of 1996-1997 in the Sebystey valley, but our own inventories of 2003 and 2004 also had to be converted. The following table gives an overview of the link between old and new site numbers:

Old site/structure name	*Fieldwork*	*Altari numbering*	*Location*	*Input*
SEB-01 to SEB-17	1996-1997	KA-071 to KA-087	Sebystey	2008
EL-01 to EL-19	2003	KA-001 to KA-019	Elangash	2004
SAR-01 to SAR-05	2003	KA-020 to KA-024	Sarikobu	2004
IRB-01 to IRB-25	2003	KA-024 to KA-049	Irbistu	2004
OZ-01 to OZ-22	2003	KA-050 to KA-070	Ozyok	2004
SEB-18 to SEB-29	2003	KA-088 to KA-099	Sebystey	2004
SEBOZ, KOSEB, OZEL etc.	2003	KA-100 to KA-157	Southern Chuya	2004
YU-001 to YU-291	2004	KA-158 to KA-448	Yustyd	2005
-	2005	KA-449 to KA-673	Dzhazator	2006
-	2006	KA-674 to KA-846	Yustyd	2007
-	2006	KK-001 to KK-107	Kazakh Altay	2006
-	2007	ON-001 to ON-061	Karakol	2007
	2008	ON-062 to ON-100	Karakol	2008

Table 3.1: Overview of the relation between old site names and Altari numbering

3.3.4 Definition of a 'site'

As can be seen in previous paragraphs, we use the term 'site' both in the field book and in the database. These 'sites' define clusters of archaeological structures or locales where these structures are situated. However, the precise definition of what should be considered as a site is more complex. A site is a place, a spatial entity, where significant traces of human activity have been identified (Renfrew & Bahn 1991: 46). However, these entities must be analytically defined which may be done in a variety of ways, using different criteria. Thus, there is an essential arbitrariness in the concept of the site which does not facilitate the archaeological discussion. A site can be a small scatter of pottery shards, a place with rock engravings, a complex cluster of funerary and ritual monuments, or a whole city, complete with houses, churches, catacombs and city walls. Sites can also be defined by the limits of their intended development and cultural resources. So are the fields that surround the city and deliver its provisions not part of the same

site? Landscape archaeologists attempt to see each discrete unit of human activity in the context of the wider environment, further distorting the concept of the site as a demarcated area.

R. Dunnel and C. Dancey (Dunnell & Dancey 1983) stressed the importance of remembering that sites are more a matter of archaeological definition than behavioural realities, which means that the areas in between sites are just as important as the sites themselves. The 'non-site' or off-site areas, with a low density of archaeological remains, should be recorded and located too, particularly in regions where people leading a mobile way of life have left only a sparse archaeological record. Therefore, the idea of an archaeological site may even be a limitation. Anschuetz *et al.* follow P. Darvill in his view that the idea of the site represents the greatest impediment to interpretive thinking in landscape archaeology and to the interpretation of survey results (Anschuetz et al. 2001: 162).

If sites form spatially consistent units with archaeological traces, possibly dating from different periods, then this implies that there is an archaeological sterile zone between different sites. This definition seems to be a problem, especially in archaeological surveys. It begs the question what should be done with 'background noise' or 'background scatter' in-between sites, areas that deliver very low, but undeniable amounts of artefacts or, in our case, surface structures? We decided to record every new location with one or more archaeological structures as a site, even if that structure was just one standing stone. Even places where no traces of human activity have been found can be equally important in the interpretation of the survey results – the so-called 'negative spaces'.

The way the concept of the site is used during the fieldwork and in the database does not fit into any of the above-mentioned definitions. It is only to be considered here as a useful way to record 'places of archaeological interest' during the survey, and describe more specifically the location and context of the individual structures. It is not possible to delimit archaeological sites from the minute you start working in the field: if it is necessary to define sites, then this should be done afterwards, using well-defined criteria.

In the database, some sites concern one single structure (e.g. an isolated stone mound), although in many cases one site may also comprise many structures, in most cases from different periods in time, and with a different function. A site can be a Bronze Age *kereksur*, followed by a Scythian burial place of, for example, 12 burial mounds, a number of stone circles to the west of it, some standing stones to the east, followed by some Turkic enclosures and ethnographic burials. The clusters of structures are thus spatially defined: they are part of one cluster and could be set apart from other clusters or isolated monuments.

During fieldwork, it was sometimes difficult to delimit the archaeological clusters because of the high density of structures in some of the research areas. We tried to set up a system based on distance buffering, but since the typology of the sites appeared to be so diverse it was not possible to stick to one simplified system.

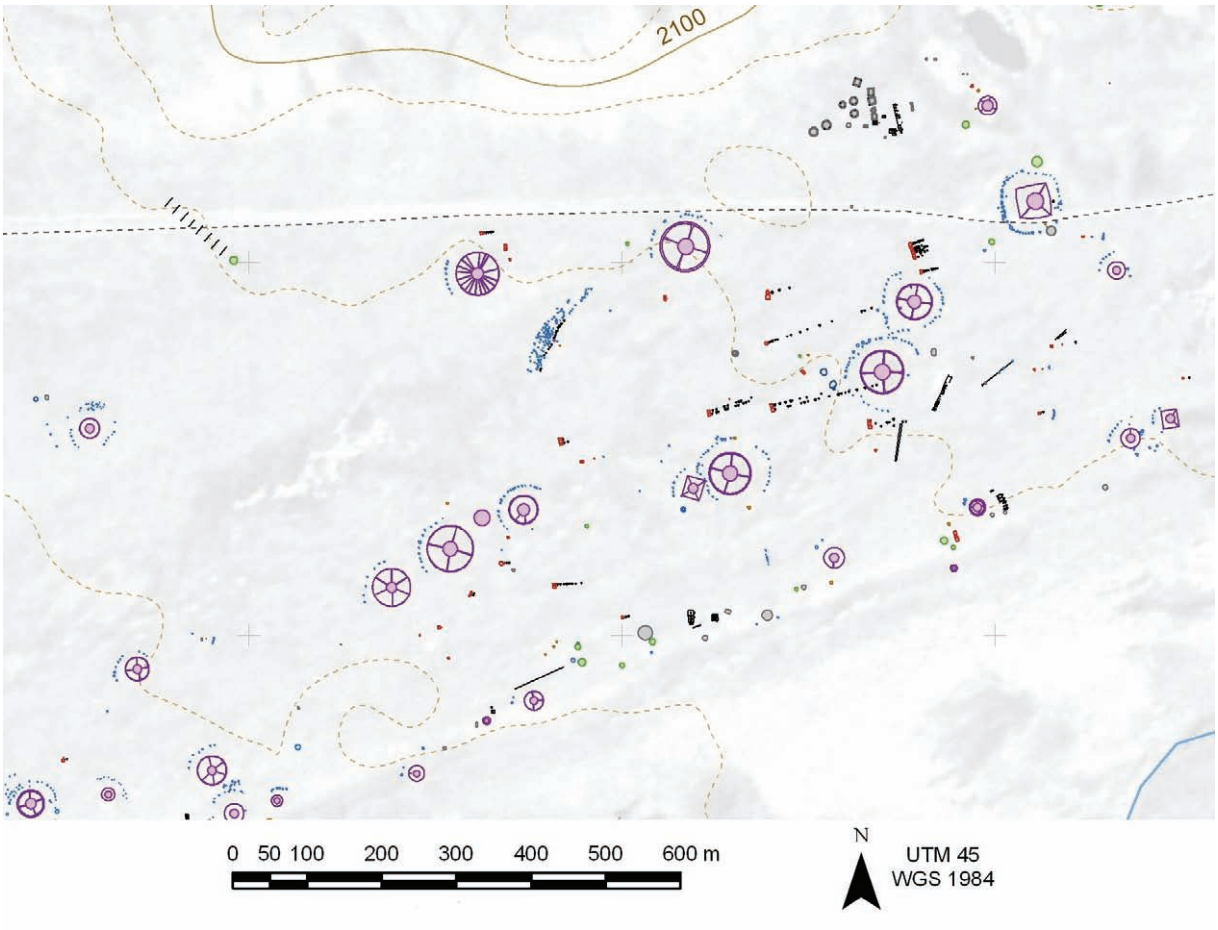


Figure 3.10: An overview of part of the right bank of the Yustyd valley: the density of structures makes it difficult to define sites

The middle part of the Yustyd valley has such a density of archaeological monuments that it should be considered as one site if distance buffers alone are being used, even if this means that the site then has over 5,000 structures in an area of about 8 by 3 kilometres (Figure 3.10). We did our best to split it into meaningful units, introducing some typological or chronological criteria based on what we had seen in other areas. A Scythian burial place, for example, can be clearly defined: a central row of burial mounds with some side structure in both the east and west. The same can be said about a *kereksur* complex with a central monument and smaller associated mounds and stone circles. But what about the numerous structures that are located in-between the different Scythian burial places and *kereksur* monuments, or even inside of their boundaries?

The same problem was found in the Karakol valley, especially on the site of Nizhniy Sooru, a small tributary of the Karakol in the southern part of the valley. Several lines of Scythian burial mounds are located next to each other, with numerous Turkic monuments in-between them, including hundreds of standing stones. There is no empty space whatsoever, so it is not possible to separate the monuments into different complexes. However, could those different parallel rows of Scythian burial mounds be seen as different sites? They are meaningful units which are spatially separated, if you take into consideration a chronological factor and only look at the Iron Age component. The many Turkic monuments, placed in roughly east-west lines with long lines

of standing stones leading to the north, cover all the interspaces between the Scythian burial mounds. Are they part of one complex, covering the whole valley and 'denying' the location of the Scythian burial mounds that seem to separate them in different zones, and should they be considered as a site?

In this case, we recorded the different rows of Scythian burial mounds as different sites. Again, this should not be seen as a final decision. Practical considerations also played a part in this approach: it is much more practical to record a complex cluster of hundreds of monuments in well-defined parts, it helps to retain a good overview and certainly reduces the chance of errors.

It is clear that the term 'site' in the field records and database is therefore not correct. It defines preliminary divisions in clusters of structures. However, it is meaningful: for every individual structure in the database, the site-form sketches the geographical background and related archaeological structures. If we keep in mind this limitation, then there is no problem in using the term as such.

If it was necessary to separate the 12,000 documented structures in different sites, we would have to reconsider the divisions we made in the field by analysing the database and the resulting archaeological plans. Future research will certainly include further analysis into these aspects, including a study of the necessity of dividing the structures into sites. It may be much more meaningful to study the interrelation between clusters of associated structures than to decide if they belong to the same site or have to be divided into several.

3.3.5 Remarks on the orientation of sites and structures

Combining compass reading and GPS-based orientation is problematic as they are based on the magnetic and the geographic north, respectively. There is a difference between the magnetic and the geographic north, known as magnetic declination. The size of this declination depends on the geographic location where the compass readings are taken. In addition, this fluctuates in time. The following map from the NOOA NGDC of the US/UK World Magnetic Model (Main Field Declination) shows this magnetic declination with isolines.

It might be of importance here to shed some light on the evolution of the recording methodology. In 2003 and 2004, most of the internal site layout was measured with compass, as was the orientation of individual monuments. From 2005 onwards, the internal site layout and site orientation was defined by the more numerous GPS points. Measurements were still taken with a compass for the orientation of small monuments, or as a back-up to the GPS-based site plans, and these orientations were recorded on the field sheets, or on the sketch plans.

This means that all compass readings have to be recalculated to make them uniform and compatible with the orientations from the GPS-based site plans. As we have bearings from over five years and from different locations, the magnetic declination was different in every research area.

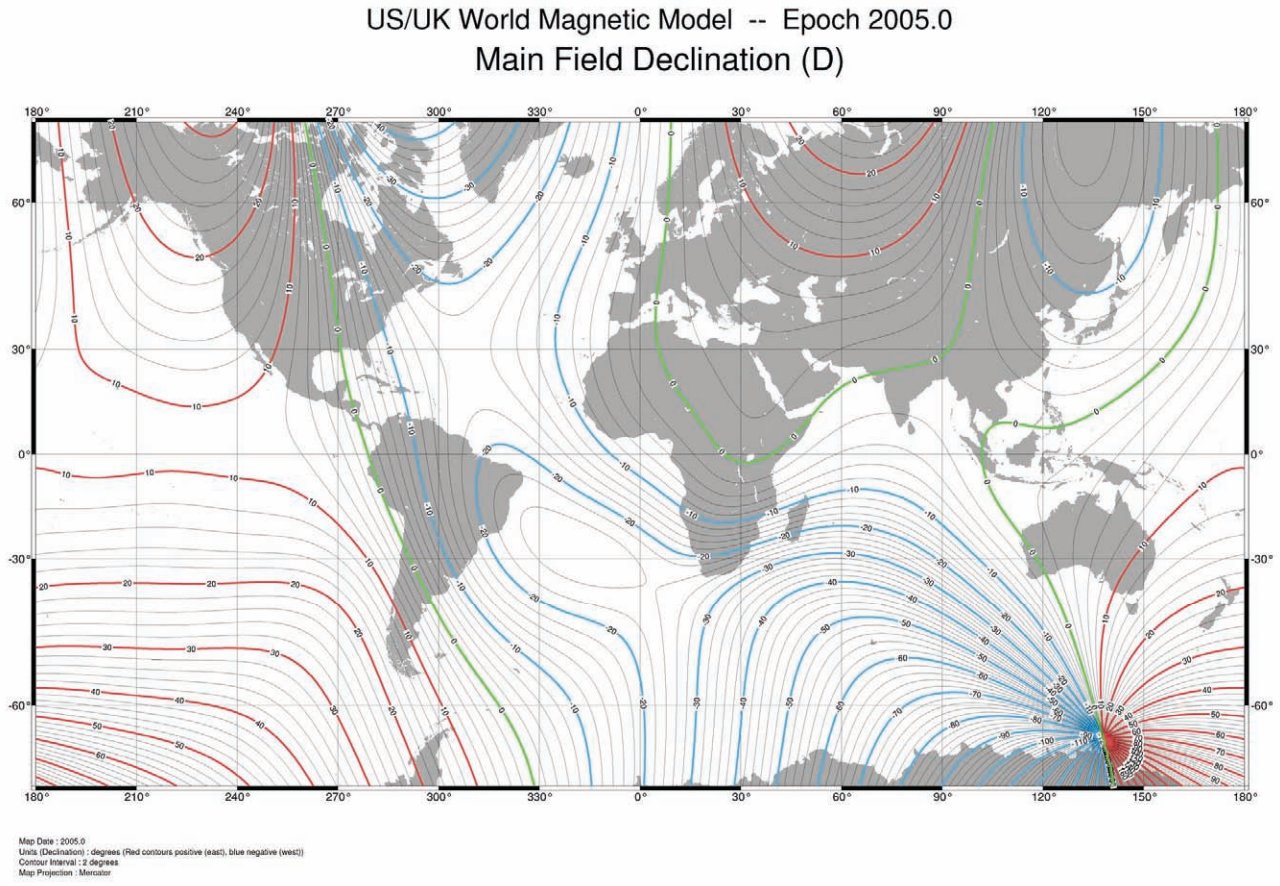


Figure 3.11: World map showing the magnetic declination (NOOA NGDC)

On the NOOA NGDC website there is a magnetic declination calculator that covers the whole Earth, and goes back to 1900 CE (NOOA NGDC 2008). Entering the dates and coordinates of our research areas gives the following results:

Research area	*Date*	*Lat*	*Lon*	*Declination*
Irbistu	07/2003	49° 51' N	88°17' E	4° 21' East
Yustyd	07/2004	49° 46' N	89° 19' E	3° 44' East
Dzhazator	07/2005	49° 38' N	87° 41' E	4° 31' East
Yustyd	07/2006	49° 46' N	89° 19' E	3° 50' East
Bukhtarma	07/2006	49° 22' N	86° 25' E	4° 45' East
Karakol	07/2007	50° 42' N	85° 47' E	5° 23' East

Table 3.2: Magnetic declination for all research areas in Altay

Keeping the different methods for site registration in mind, it was necessary to recalculate all bearings from 2003 and 2004 (except those that were corrected by GPS measurements) and some of the bearings taken from 2005 to 2007.

3.4 A GIS-related archaeological database: Altari

3.4.1 Description of the database

All descriptions, photographs, and measurements are recorded in a database. The Altari-database is written in Access software and covers three levels of information.

The 'site-location level' gives a general description of the site and its location – how the site looks and in which geographic unit it is located. GPS measurements are entered for the general location of the site. It is possible to give a first date, but as most sites cover structures from multiple periods, this date only applies to the central monuments. It cannot be used for analysis and must therefore be considered as purely illustrative. An overview image of the site is shown, with a link to the photo database (a query automatically gives you all the photos relating to the site in question) (Figure 3.12).

A second level shows the organisation of the site. Central here is the site plan, although comments can also be added on the general organisation of the site (Figure 3.13).

The most detailed level is that of the structures. Alongside a general description it contains information on the dimensions, used materials, general condition of the monument (bioturbation, erosion, robbery or excavation, etc.), orientation and date. For some of the more complex structures, it is possible to give more details about the exact number of stones, the general form of the monument, or – for *kereksur* – the number of stone banks that connect the central mound with the fence and some other specific characteristics. To give an idea of the hierarchy of the monuments, it is possible to attribute the term 'secondary' to those structures that are clearly associated with 'main' monuments, including a link to the number of the main monument they are related to. Again, a photograph can be imported to support all this information (Figure 3.14).

The database fields are in English, and a Russian translation is given were possible – for some of the monument types, a Russian equivalent is not found yet. The database records are in English, except for the information gathered before 2004: this has still to be translated from Dutch. The Altari database can be found on the accompanying data disc for consultation. It is important to keep in mind that the database is a work in progress and a work document – the descriptions are sometimes very short and not in perfect English, as they were inputted in the field. Moreover, some links to site plans and photos still have to be completed.

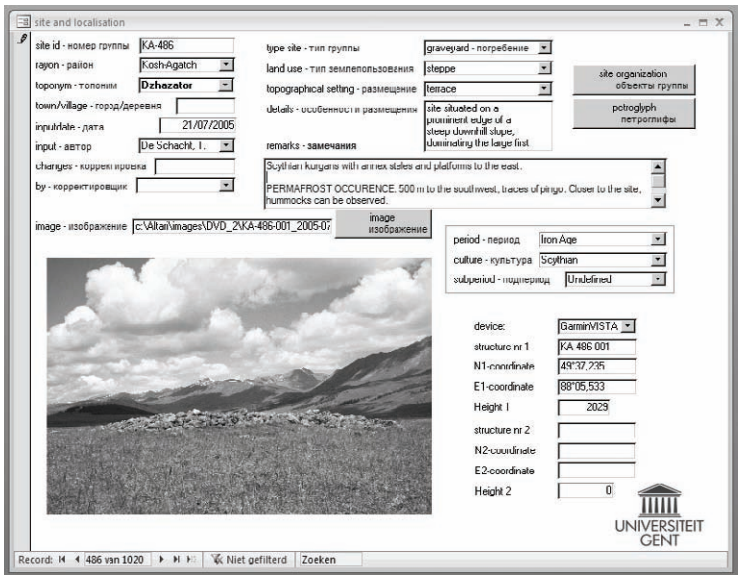


Figure 3.12: Site location level

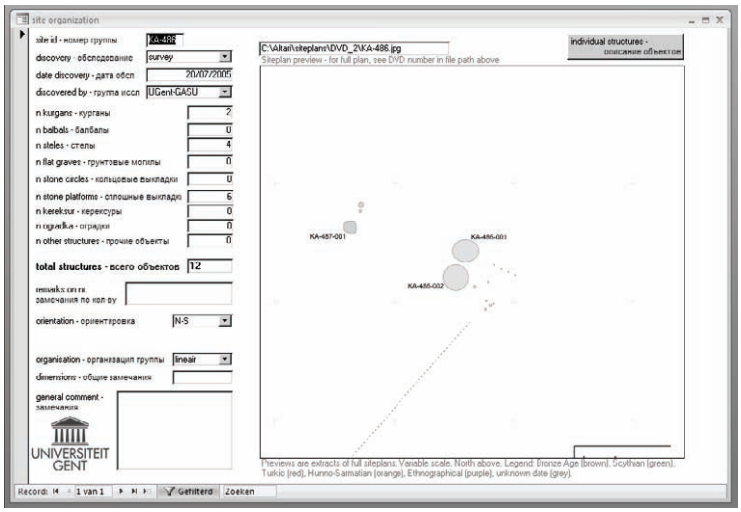


Figure 3.13: Site organisation level

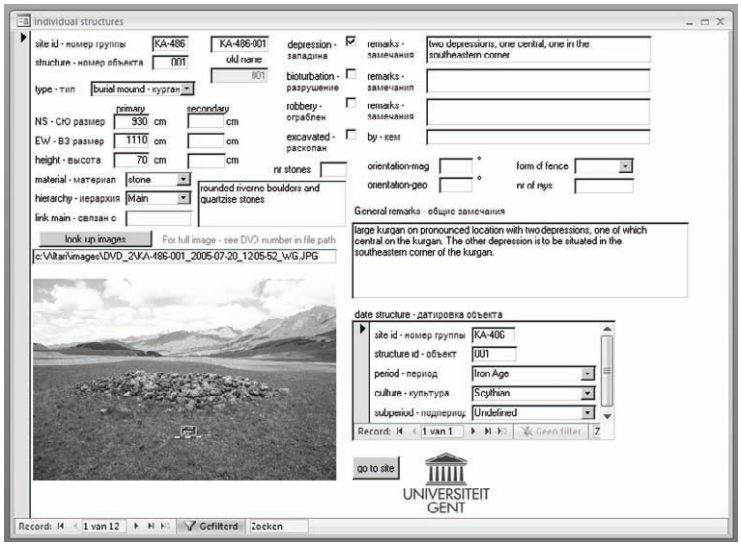


Figure 3.14: Individual structure level

3.4.2 Database fields in English and Russian

3.4.2.1 Site and location – группа и размещение

Site number	номер группы
Rayon / province	район / провинция
Toponym	топоним
City / village	город / деревня
Date of input	дата
Input by (person)	автор
Date of change	корректировка
Changed by (person)	корректировщик
Image (link to an image)	изображение
Type of site	тип группы
Burial site	погребение
Ritual site	ритуальный/другой
Settlement site	поселение
Petroglyphs	петроглифы
Land use	тип землепользования
Field	поле
Grassland	пастбища
Rocky surface	каменистые поверхости
Forest	леса
Steppe	степи
Town extension	зона жилого поселения
Industrial zone	индустриальная зона
Village / town	город / деревня
Quarry	карьер
Mountain steppe	горная степь
Unknown	неизвестно
Topographical setting	размещение
Alluvial zone	аллювиальная зона
Valley	долина
River terrace	терраса
Plateau	плато
Hill top	подножие горы / холма
Slope	склон
Plain	равнина
Foot slope	вершина
Unknown	неизвестно
Remarks on setting	особенности размещения
Description of the site	замечания

General date of the site	хронология
Period	период
Cultural attribution	культура
Subperiod	подпериод
Link to ‘site organisation’	объекты группы

3.4.2.2 Site organisation – объекты группы

Site number (ID)	номер группы
Discovery (method)	обследование
Loose find	случайная находка
Excavation	раскопка
Survey	рекогносцировка
Combination	смешанное
Data discovery	дата обследования
Discovered by	группа исследователей
Total number of objects	всего объектов
Remarks on the number	замечания по кол-ву
Organisation of the site	организация группы
Orientation of the site	ориентировка
Maximum dimensions	общие замечания
General comments	описание объектов

3.4.2.3 Individual structures – описание объектов

Site number (ID)	номер группы
Structure number (ID)	номер объекта
Structure type	тип объекта
undefined	неизвестно
stone mound	насыпь
burial mound	курган
collared mound	насыпь (Russian equivalent?)
four-cornered mound	насыпь (Russian equivalent?)
kereksur	керексур
enclosure	оградка
round enclosure	оградка
standing stone	стоящий камень
stele	стела
deer stone	оленный камень
image stone	изваяния (commemoration statue)
false image stone	(Russian equivalent?)
balbal	балбал

stone circle	кольцевая выкладка
stone platform	сплошная выкладка
stone line	каменная линия
semi-circle	полукруг
rectangular stone setting	прямоугольный объект (dwelling)
ethnographic grave	этнографические погребения
adjoining structure	смежный объект
zone	зона
petroglyph panel	петроглиф
Dimensions NS	СЮ размер
Dimensions EW	ВЗ размер
Object height	высота объекта
Construction materials	материал
Earth	земля
Stone	камень
Wood	дерево
Mud brick	кирпич
Hierarchy	иерархия
Main structure	главный
Secondary structure	второстепенный
Link to main structure	связан с
Depression	западина
Remarks on depression	замечания о западинах
Bioturbation	разрушение
Remarks on bioturbation	замечания о разрушении
Robbery	ограблен
Remarks on robbery	замечания об ограблении
Excavation	раскопан
Excavated by	кем
General remarks on structure	общие замечания
Chronology	датировка объекта
Period	период
Cultural attribution	культура
Subperiod	подпериод
Image (link to an image)	изображение

3.4.3 The Geographical Information System

Finally, all information is combined in a GIS (Geographic Information System) project, using ESRI ArcView 3.1 and ESRI ArcInfo/ArcMap 9.2. The Universal Transverse Mercator (UTM) system was used as coordinate system, with UTM zone 45N covering the Altay region; WGS84 (World Geododetic System 1984) is the applied geodetic datum. This system was chosen over the various national surveying systems of China, Kazakhstan, Mongolia and Russia, all covering parts of the Altay Mountains, in order to make the data in the different areas uniform.

The GIS project first includes some geographic background data – vector files with state boundaries, major roads and river systems form the first level. This is completed with a 90-metre resolution DEM from the SRTM (Shuttle Radar Topographic Mission), downloaded for all degree tiles covering the research areas. A hillshade model was made based on the DEM tiles and contour lines at 100- and 400-metre intervals. Original SRTM data can be downloaded through the US Geological Survey's EROS Data Center[17] via File Transfer Protocol (ftp). Other sites offer SRTM data in other formats – in particular, the archive at the Global Land Cover Facility is interesting[18].

The CORONA orthophotos are added (group layer CORONA) in a 2-metre resolution. All vector files with topographic and geographic information are organised in group layers, including the location of all GCPs, layers with contour maps for every research area, and vector files with more detailed topographic information, such as rivers, tracks and roads, villages, campsites, etc.

The actual archaeological information is stored at different levels, and in different layers per research area (see Figure 3.15 and Figure 3.16 for an example). The ‘sites’ or locations of archaeological interest are put in a first layer, as points. Another layer contains the archaeological structures themselves: they are drawn as polygons (e.g. the central mound of a *kereksur*). Characteristics of the structures that cannot be shown as polygons are stored in a third layer as polylines (e.g. the circular fence and four radii of the same *kereksur*).

Both the ‘polygon’ file and the ‘details’ file are linked with the tables in the Altari database, using the full structure number as a common field. This means the type, date, dimensions and description can be seen by clicking the info button on a structure. There is also a hyperlink to possible photos. The field with the image type and the possible date of the structures is used to make a standard symbology.

To consult the GIS files that are included on the accompanying data disc, please read the information in chapter 13-Deliverables.

[17] See: http://seamless.usgs.gov/index.php

[18] See: http://glcf.umiacs.umd.edu/data/srtm/index.shtml

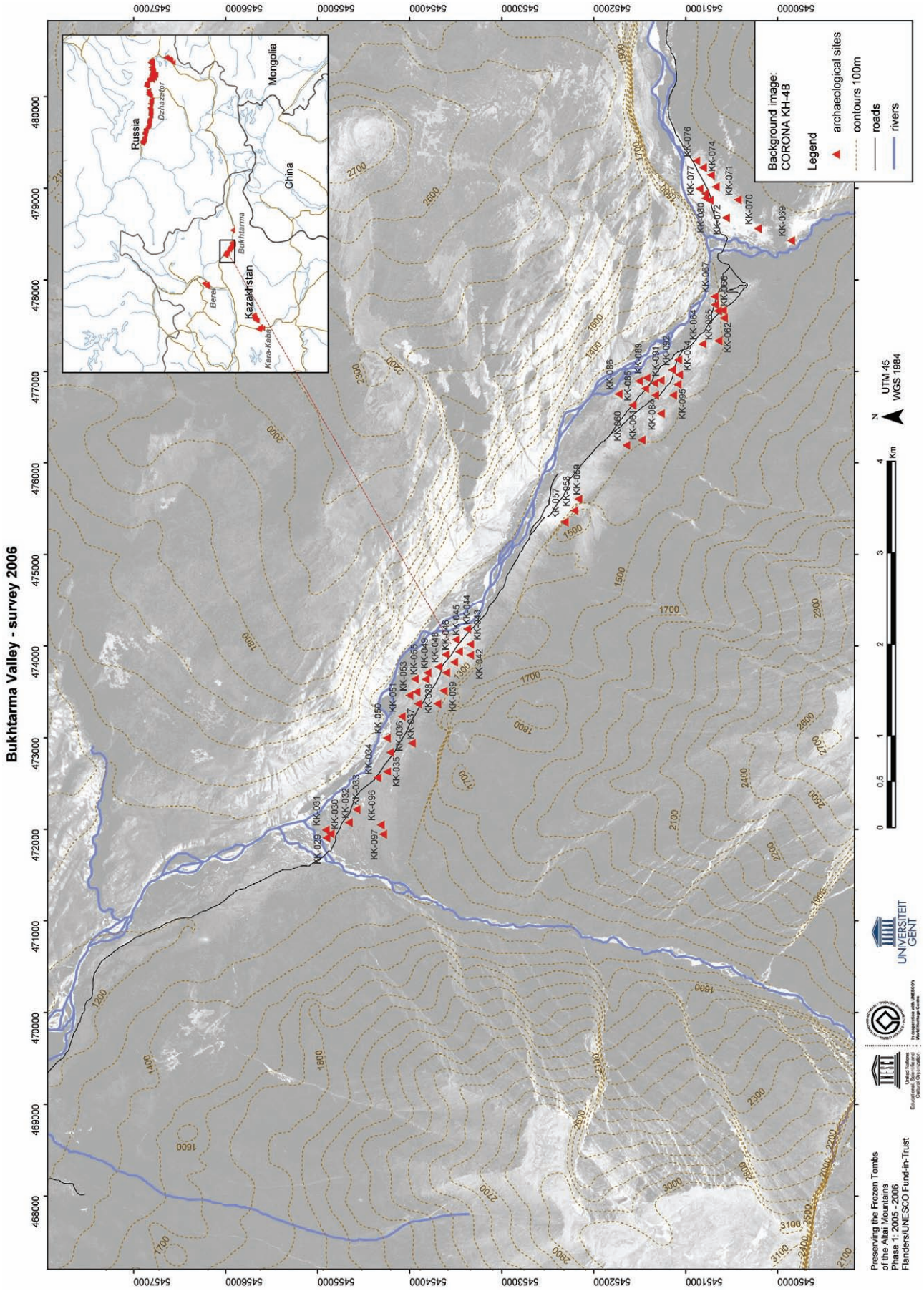


Figure 3.15: An illustration of the different levels of information in the GIS: overview

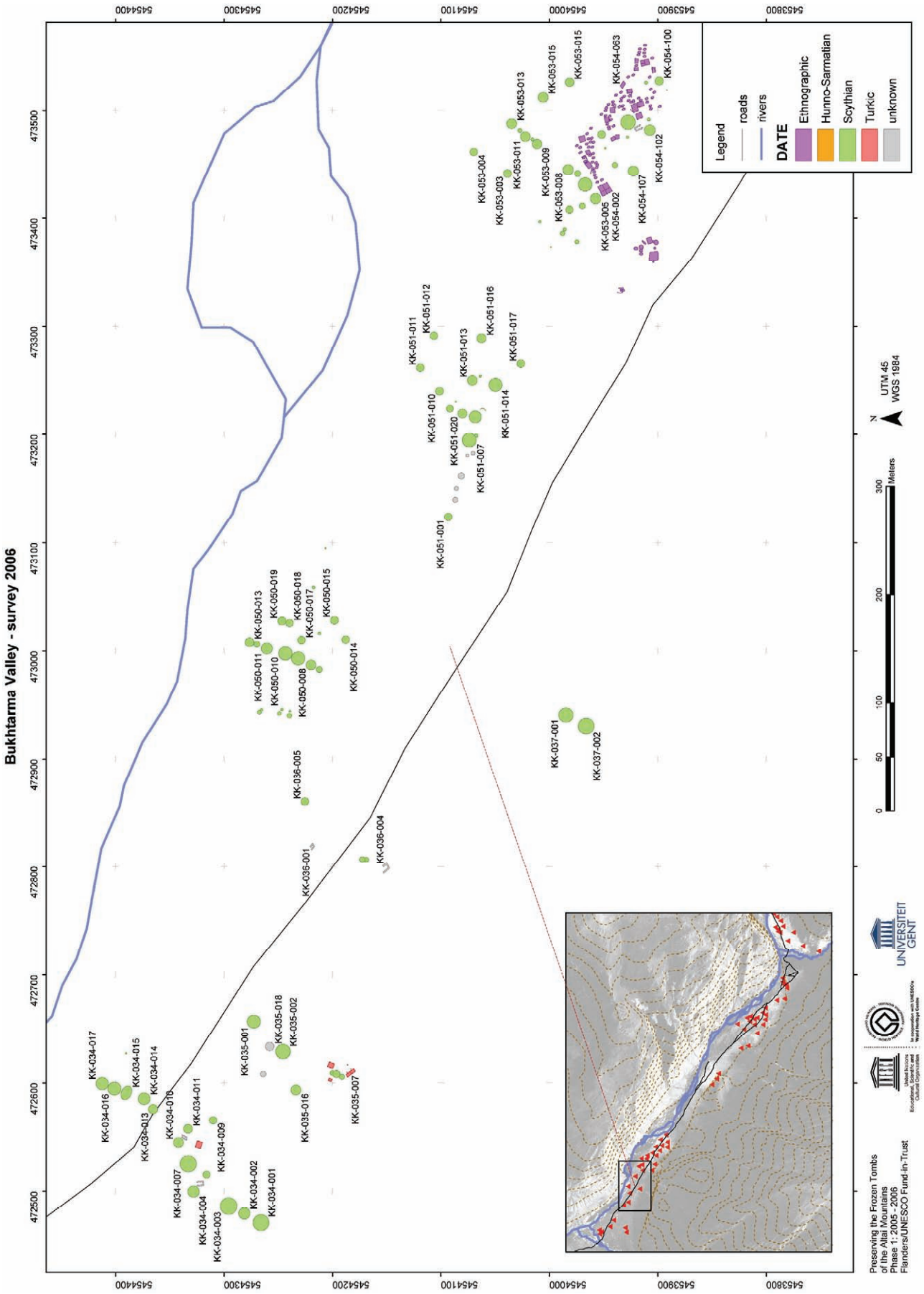


Figure 3.16: An illustration of the different levels of information in the GIS: site level

3.5 Conclusions

The process of archaeological survey has evolved considerably since our first surveys in 2003, and certainly since the first surveys by the university in 1996-1997. In particular, the introduction of the hand-held GPS receiver with decimetre precision, the Leica SR-20, has enabled us to work very efficiently. The result is a detailed geo-referenced site plan that can be linked immediately to the geographical products in a GIS.

The site plans of all individual sites or 'locations', on a 1/1,000 or 1/2,000 scale in A4 format, have been added to the accompanying data disc. Overview maps of the different research areas, in variable scales, have been inserted at the back of this thesis, and can be found on the data disc in digital format.

The Altari database is a very basic one but contains all the information necessary. If required, it can be refined for specific monument types, and we plan to add a more detailed part for the description of petroglyphs in the future.

Visual surface detection or field walking ensures that we have documented all visible archaeological structures in the research area. However, it is possible that we have missed some structures, due to vegetation, poor visibility, or because the terrace or plateau was not noticed in the field or on the satellite images. Although it is very difficult to asses the amount of missed structures, we are convinced that these are very few, and that the recorded inventory is certainly representative.

Typical of non-intrusive survey is the difficulty of assigning the monuments to a specific culture or period in time. The date of many of the recorded structures remains unknown. However, working out a detailed typology can help to determine the age of the monuments (see Chapter 5), and relative chronology and associations between different structures can assist this.

4 Data gathering: overview of the survey campaigns 2003-2007

This chapter will give an overview of all the survey campaigns that were organised by Ghent University, the Gorno-Altaysk State University and the Margulan Archaeological Institute in Almaty during the summers of 2003 to 2008. The fieldwork in the Karakol valley in 2007 and 2008 is also included here, and the resulting data can be consulted in the Altari database. However, the data gathered in July and August 2008 have not been fully processed yet: the archaeological maps are not finished and are not included on the accompanying disc. Consequently, we decided not to include the Karakol dataset in the analysis of Chapters 5 and 6. However, some aspects of the archaeological heritage in Karakol are interesting enough to be mentioned in the text as an illustration, especially as the landscape there is quite different from the other research areas.

The results of the survey campaigns are summarised for every research area. For a detailed description of the monument types mentioned here, see Chapter 5. The distribution of the monument types will be studied in Chapter 6.

The selection of the research areas was done in close consultation with local partners in Russia and Kazakhstan, and was influenced by several factors. The history of research in the specific areas was important: we decided only to work in areas that had not been mapped before (for example, the Ukok plateau). Secondly, we chose the areas with a scientific question, and tried to incorporate as many different natural landscapes as possible over the years: high and low mountain valleys, open and closed valleys, steppes etc. Not only did this give us the opportunity to study the differences between diverse archaeological landscapes, but we are also convinced that the resulting database is representative for the most of Altay, although the research areas are not connected.

Also important were the questions asked of the consequent projects that supported the fieldwork. The first two years of the survey focused on the Chuya Region in the south of the Altay Republic. During the UNESCO project on the frozen tombs which followed during 2005-2006, the proximity of permafrost areas played a significant role, and the research areas had to be located in both the Russian and the Kazakh part of Altay. The last two years of fieldwork were organised within the framework of the protection and disclosure of the archaeological heritage of the Uch-Enmek archaeological park in the Karakol valley.

Some more technical criteria were also involved. The areas had to be accessible, and we required permission from the border patrol to work in the border zone of China, Kazakhstan, Mongolia and Russia. Finally, yet importantly, the availability of CORONA imagery was essential. Although most of the region – which is a military border zone and therefore strategically of major importance – has been covered by the CORONA reconnaissance programme, there are some gaps. In certain cases, the negatives are useless because of the very dense cloud cover. Images may be taken in wintertime, showing only vast, snow-covered and thus completely white plains and mountain ridges. Finally, there are some lacunas in the archive of film negatives: gaps

in the negative numbers show that film negatives have disappeared. They may have been damaged or lost during processing; some CORONA film capsules were lost when they were returned to earth, resulting in the loss of an entire mission.

4.1 Survey of Sebystey, Irbistu, Ozyok, Elangash and the Southern Chuya steppe in 2003

In 2003, within the framework of the Ghent University's Special Research Fund (BOF) project (see 0), research was focused on several valleys bordering the Chuya depression, in the south-east of the Altay Republic (Russian Federation). The archaeological survey of the area was built up in different phases. From 18 to 22 July, our work concentrated on the valley of Elangash. Then the camp was moved to Irbistu and during the next five days a survey was carried out in Irsibtu and Sarikobu. In a third phase, from 27 July to 1 August, the valley of Ozyok was the object of our research. In the last four days of the fieldwork, we surveyed the southern border of the Chuya steppe, from the Sebystey valley up to the hills west of the Elangash River, 10 km south of the village of Ortolyk.

A first systematic survey of the Sebystey valley had already been conducted in 1996-1997. Initial preparations began during the excavation campaign of 1996, and the actual survey was continued during the summer of 1997. We decided to come back here to link the results of these campaigns to our database, to complete the inventory work with more detailed measurements, and to gather GCPs with GPS to enable the processing of the CORONA imagery.

4.1.1 Survey results

In 2003, the archaeological survey of the area resulted in the recording of 751 archaeological structures from 136 different locations ('sites' in the database). About 152 of these were located using GPS, while 599 other structures were located by simple topographical sketching starting from these GPS measurements, defining the azimuth and distance. In combination with the structures and sites already known from the 1996-1997 survey, the database now contains information about 1,255 structures spread over 158 locations.

However, a minority of structures documented in 1996-1997 have not been put on the map yet. These 118 structures form the 'background scatter' in Sebystey, and were not documented by the team as being archaeological sites. The publication of the project in 2000 focused on the 17 sites or clusters in Sebystey and only briefly mentioned the isolated structures. Consequently, no digital plans were made and they are not in the GIS system. Since there is a description in the field books, and GPS measurements were made, it should be possible to include them in the near future.

Table 4.1 summarises the structure types recorded in 2003 in the different valleys. The southern part of the Chuya steppe is considered as one research area, although it was originally separated into five parts – every part bordered by a river flowing into the steppe. For a detailed description of the monument types, see Chapter 5. Almost half of the structures (529) are

located in the Sebystey valley. The Scythian burial complexes in that valley, with lots of stone circles and rows of *balbal*, account for this total. The same can also be said about the neighbouring Ozyok valley, with 308 individual structures. Irbistu and Elangash are less accessible and there are not a lot of places that are suited for the construction of large complexes there. This is reflected in the structure count of respectively 109 and 73 structures. Another seven isolated structures were found in Sarikobu, located between Elangash and Irbistu. Finally, the southern border of the Chuya steppe appeared to be covered with monuments. In particular, the 24 *kereksur* monuments with 76 associated stone circles are interesting and account for almost half of the 229 structures recorded there.

Structure Type	*2003*	*Sebystey*	*Ozyok*	*Irbistu*	*Sarikobu*	*Elangash*	*S- Chuya*
mound - undefined	51	15	4	4	-	-	28
burial mound	333	106	81	44	4	33	65
collared mound	5	1	3	1	-	-	-
kereksur	38	6	4	2	-	2	24
enclosure (Turk.)	103	81	13	1	-	2	6
round enclosure (Afan.)	19	5	-	-	-	3	11
stone circle	269	83	79	18	-	13	76
stone platform	83	1	74	1	-	7	-
stone line	15	5	1	8	-	1	-
semi-circle	2	1	-	-	-	-	1
rectangular stone setting	1	-	-	1	-	-	-
standing stone - undefined	7	-	1	1	-	5	-
stele	15	1	3	3	3	1	4
image stone	4	3	-	-	-	-	1
balbal	227	147	45	25	-	4	6
ethnographic grave	3	2	-	-	-	1	-
petroglyph panel	1	1	-	-	-	-	-
undefined	79	71	-	-	-	1	7
Total no. of structures	1,255	529	308	109	7	73	229

Table 4.1: Overview of structure types recorded in the fieldwork done in 2003

The number of petroglyphs in Table 4.1 does not reflect reality. Only one panel was documented in detail during the research in 2003, however, there are many more petroglyph panels in Elangash. We located them with GPS, but they were studied by D. Cheremisin from the IAE SBRAS and we have no further details on these panels. An earlier study by Okladnikov et al. gives a quite complete overview (Okladnikov et al. 1979). In the Sebystey valley, a thorough survey in search for petroglyphs was done in 1997. This resulted in the recording of 178 engravings, in 64 different panels. The detailed descriptions of these images are not yet included in the database and the panels are not mentioned in the table (Bourgeois et al. 2000a: 122-129).

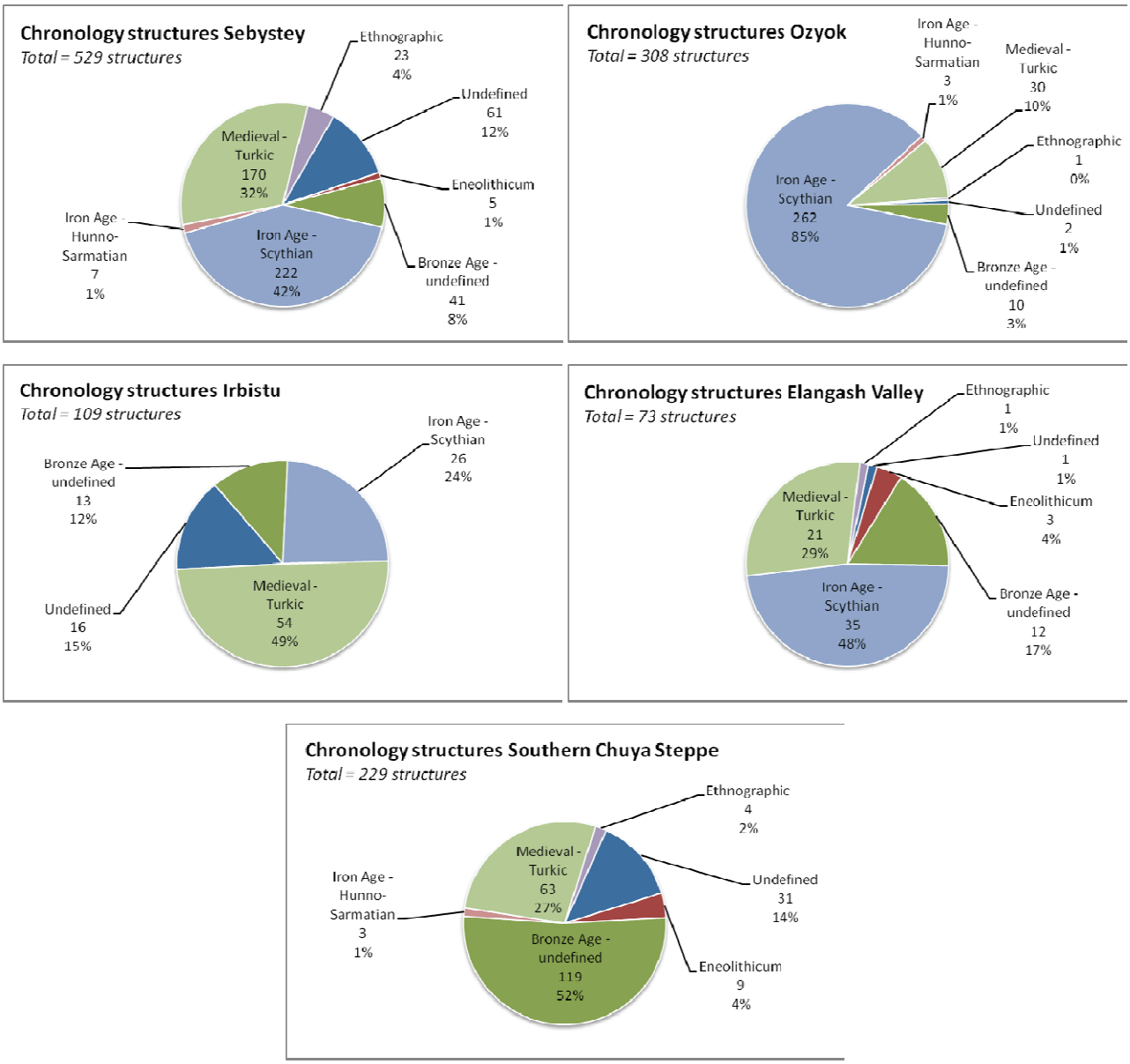


Figure 4.1: Chronological distribution of archaeological structures in the different research areas surveyed in 2003: Sebystey, Ozyok, Irbistu, Elangash and the southern border of the Chuya steppe

It is interesting to look at the chronological distribution of the monuments in the different research areas (Figure 4.1), although we will discuss this more thoroughly in Chapter 6. The diagram for Sarikobu is not included, as a total of seven structures, most of them undated, is not relevant. The difference between the various valleys is striking. The Elangash valley and the Sebystey valley show a more or less typical distribution, with mostly Iron Age burial complexes and a considerable number of Turkic monuments, mainly enclosures. Ozyok, however, has only 10% of Turkic monuments; the Scythian-type monuments in that valley are very dominant. It is a wide-open valley with vast terraces, and some of the largest Iron Age burial complexes of the region were constructed here. The preponderance of Turkic structures in Irbistu is partly due to a series of burial mounds which are located against the hilly moraines that border the valley. These were assigned to the Turkic period, but there is some discussion about this (see 5.2.2 on Turkic burial mounds). Most striking, however, is the concentration of Bronze Age monuments

on the southern border of the Chuya steppe. Most of these are *kereksur* with associated smaller structures that overlook the vast Chuya basin – a typical setting for these monuments.

4.2 Surveys in the Yustyd valley in 2004 and 2006

The valley of Yustyd is one of the most extraordinary archaeological areas of the Russian Altay. Situated at an altitude of some 2,000 to 2,200 msl, the valley consists of a rather inaccessible higher part, covered with hilly moraines and mainly lacking any archaeological sites, and a broad and open lower part. A huge concentration of monuments is located on the vast terraces in this lower part, both on the left and right bank of the river. From there, the river streams through the Chuya steppe until it merges with the Bar-Burgazy and forms the Chuya River. The valley was chosen as research area for the second campaign within the BOF research project. The expedition was organised from 11 July to 10 August, and the actual fieldwork took place from 17 July to 5 August. It was our intention to survey the whole area of the Yustyd valley and, if possible, its surroundings, but this appeared to be an impossible mission. The density of archaeological structures, especially in the middle part of the Yustyd valley, was tremendously high. Therefore, we decided to focus on the right bank of the lower part of the river, including the alluvial plain.

The terrace on the right bank is only 200 m wide at the highest points but widens to a plain of more than 1,600 meter wide where it enters the Chuya steppe. The river itself has shifting courses and an alluvial plain of up to 1,400 m wide, separating the right bank from the left bank. Nearly 2,400 structures were recorded, even though the surveyed area was quite limited (some 8x3 km or 24 km²). We estimated at the time that at least one and very likely two more survey campaigns would be necessary to cover the whole Yustyd valley area exhaustively. Thanks to financing by the Bilateral Agreements Flanders-Russia, we were able to organise a second expedition to Yustyd in July 2006, during which we completely finished the survey of the right bank of the Yustyd.

Research was also done on the left bank of the Yustyd River. Our colleague Igor Slyusarenko, archaeologist at the IAE SBRAS in Novosibirsk, decided to help us with the research in Yustyd, and organised surveys in the summers of 2005, 2006 and 2007. He recorded some 700 archaeological structures on the left bank. A meeting in March 2007 indicated that it is possible to merge all of our data into one common GIS platform. The Novosibirsk team was hoping that the work would be completed in the summer of 2007, but they were unable to achieve that goal in the ten days of fieldwork, due the discovery of some additional sites (Slyusarenko et al. 2007). Since the processing of the site plans and database is not finished yet it is not included in the analysis of Chapters 5 and 6.

4.2.1 Survey results in Yustyd

In 2004, 2,397 structures were recorded in Yustyd by covering just a part of the right bank of the river. The campaign in 2006 enabled us to finish the work on the right bank, giving us an excellent overview of one of the most complex sites in the entire Altay Mountains. Another 1,807 structures where recorded, bringing the total to 4,204 monuments. In the database, these structures are categorised in 463 locations. However, it should be clearly stated that these divisions are very artificial; the complete eastern part of the terrace on the right bank can be seen as one archaeological complex.

It is important to mention that not all monuments we discovered could be recorded in detail. In the middle part of the Yustyd valley, four zones were recorded with a very high density of small structures: uncommon circular and rectangular stone settings known as ‘dwellings’ (see 5.6), alignments of buried stones, standing stones etc. Some of these structures were very hard to identify, and the chronology of the majority is unknown. As these structures were not easy to describe without identifying and drawing all individual stones on a very detailed plan, – a process that would have taken several days per concentration – we had to limit the recording of these zones to a generalised description. We located all zones using multiple GPS measurements, and made dozens of photographs for illustration. They have been input in the database under the category ‘zone’.

The largest category of structures in Yustyd, as can be seen in Table 4.2, is the stone circle; no less than 1,998 circular stone settings were recorded. Most of these are associated with the 127 *kereksur* or with the 178 Scythian burial mounds. Others are located east of Turkic enclosures, or next to five Bronze Age steles and nine deer stones that were also found. The total number of mounds is 439: 70 of these cannot be assigned any function or date, 334 resemble burial mounds (including the 178 Scythian burial mounds), and 24 are collared mounds. Yustyd is the only area where we found so-called four-cornered mounds – a total of 11 were recorded. During the survey, we found only one petroglyph site, which was clearly associated with one of the Bronze Age steles. However, we have not looked for petroglyphs, and we do not pretend that this is the only one in Yustyd.

With a large number of *kereksur* and associated stone circles, it seems logic that structures dated to the Bronze Age make up 40% of the archaeological heritage on the right bank of Yustyd (see Figure 4.2). The other two main types of monument groups, Iron Age Scythian burial complexes with associated monuments and Turkic enclosures with occasionally long rows of standing stones, take care of respectively 24% and 17% of the total. Quite a lot of monuments – 819 to be exact – could not be dated. Most of these are mounds and burial mounds that are difficult to assign to a specific period, or small, isolated monuments such as standing stones and stone lines. Important here is the category of rectangular stone settings or ‘dwellings’, with 248 structures. These are sometimes dated to the Bronze Age, but we decided to leave their date as ‘undefined’ (see 5.6 for a typology).

Structure Type	*No. of structures*	*Structure Type*	*No. of structures*
mound - undefined	70	standing stone	90
burial mound	334	stele	5
collared mound	24	image stone	3
four-cornered mound	11	*balbal*	482
kereksur	127	deer stone	9
enclosure (Turkic)	158	ethnographic grave	9
stone circle	1,998	adjoining structure	12
stone platform	432	petroglyph panel	1
stone line	91	zone of structures	4
rectangular stone setting	248	undefined	96
Total	**4,204**		

Table 4.2: Overview of structure types recorded in Yustyd during the fieldwork in 2004 and 2006

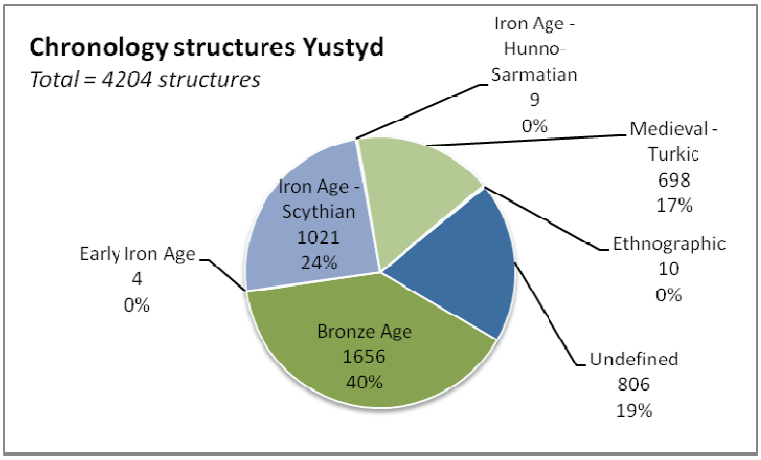


Figure 4.2: Chronological distribution of the archaeological structures on the right bank of the Yustyd River

4.3 Survey in the Dzhazator valley in 2005

The first fieldwork campaign within the UNESCO project took place in the summer of 2005, in co-operation with the Gorno-Altaysk State University. The team comprised 20 Russian, Belgian, Dutch and French archaeologists and geographers, which gave us the opportunity to work quickly and cover a vast area. The chosen area of research was a high valley in the southern part of the Russian Altay Mountains just north of the Ukok plateau: the Dzhazator valley (Gheyle et al. 2007). This area was selected for various reasons. First, the valley is located between the research areas of the 2003 fieldwork and the Ukok plateau, the area where the IAE SBRAS team has been active (Molodin et al. 2004). Secondly, the area is known for a rich and interesting archaeological heritage. Finally, the higher parts of the valley go up to more than 2,200 msl, an altitude where frozen conditions can be expected. This was important for the geographical fieldwork within the Frozen Tombs of the Altay Mountains project.

The entire upper valley of Dzhazator was surveyed, from 2,304 msl to an altitude of 1,569 msl, with a total area of 284 km². Several terraces on the left and right bank of the river yielded monuments. For the area from the east of Lake Tsjugur, from an altitude of ca. 2,050 msl downwards, to less than 3 km east of the village of Dzhazator/Belyashi, we had to limit the survey to the terraces of the right bank. It was not possible to cross the river, except for a bridge in the village of Dzhazator, which would take a long time and would add administrative problems as we were working in areas controlled by the Russian army. Moreover, the chance of discovering areas of permafrost was quite low in that lower part of the valley. In the higher part of the valley, we also surveyed the tributaries of Dzhazator (Ayut and Tara) and the valley of Usay.

4.3.1 Survey results in Dzhazator

During the field survey, 2,060 individual structures were located and described, spread over 225 locations. Table 4.3 summarises the different structure types found in Dzhazator. As 62% of the structures are assigned to the Early Iron Age or Scythian period, and 25% to the Turkic period it is not strange that the most numerous structures in Dzhazator are the *balbal* (629), stone circles 350) and stone platforms (248). The 453 burial mounds are mostly Scythian, too. An interesting feature is the large amount of 122 Turkic enclosures, sometimes beautifully preserved. Nine images stones and 12 false image stones were found east of these enclosures. Many of the image stones have been damaged or pulled down, and at least one has been taken away (see 5.7.3.1) (Sorokin 1969).

Structure Type	*Number*	*Structure Type*	*Number*
mound - undefined	20	standing stone - undefined	3
burial mound	453	stele	9
collared mound	1	image stone	9
four-cornered mound	0	false images stone	12
kereksur	2	*balbal*	629
enclosure (Turkic)	122	deer stone	0
round enclosure (Afanas'ev)	2	ethnographic grave	86
stone circle	350	adjoining structure	9
stone platform	248	petroglyph panel	13
stone line	8	zone of structures	0
semi-circle	2	undefined	77
rectangular stone setting	5		
Total	**2,060**		

Table 4.3: Overview of the archaeological structures recorded in Dzhazator

Figure 4.3 shows the chronological distribution of the monuments in Dzhazator. The large share of Scythian and Turkic monuments is clearly visible. In addition, 86 ethnographic structures were recorded, plus 151 structures of unknown date. Eneolithic and Bronze Age monuments are very rare, making up just 1% of the archaeological heritage.

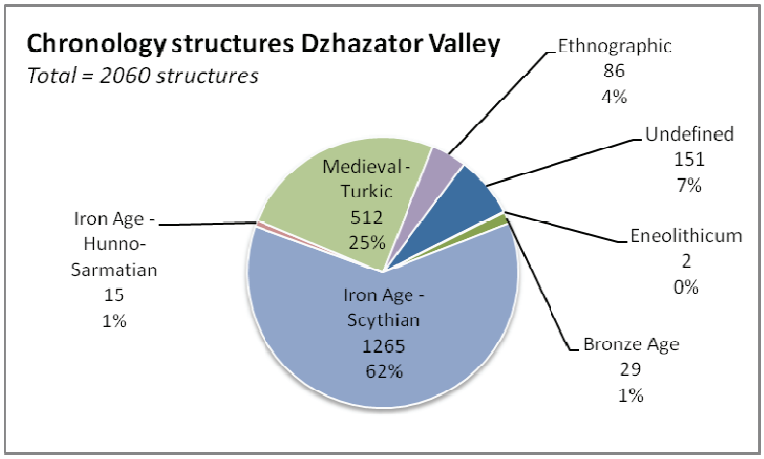


Figure 4.3: Chronological distribution of the archaeological structures in the Dzhazator valley

4.4 Survey in the Kazakh Altay in 2006: the valleys of Buktharma and Karakaba

4.4.1 Overview of the research area

In 2006, the team chose the Kazakh Altay as a research area, in collaboration with the Gorno-Altaysk State University and the Margulan Institute of Archaeology. After working for two weeks in Yustyd (Russian Altay), where our team finished the inventory of a survey that had been initiated in 2004 (see 4.2), the camp was moved to the Kazakh part of the Altay Mountains. Here, three different valleys were surveyed, all in the Katonkaragay district where the well-known archaeological site of Berel is situated. The team of archaeologists and geographers worked in the higher part of the Karakaba valley, the higher part of the Bukhtarma valley, and in the Berel area of the same valley.

The high part of the Bukhtarma valley was selected mainly for reasons of permafrost conservation probability (within the framework of the UNESCO project). However, we were limited by the presence of the Kazakh border patrol: they prohibited us to work in the region close to the Russian and Chinese border. Our limit was a bridge over the Bukhtarma, about 10 km from the borders. The lower limit of our research area was a sharp turn in the valley, just to the south of the village Arshaty.

4.4.2 Survey results in Karakaba, Bukhtarma and Berel

It was clear from the beginning that Karakaba was not very rich in archaeological monuments. In addition, it was very hard to carry out a survey there because of the high grasses that cover the whole area. The valley is being used as hay fields, and the accumulation of humus and grasses made it very difficult to distinguish the archaeological structures. Moreover, many of these

structures appeared to be recent stone accumulations or possible ethnographic graves. Nevertheless, there are several Scythian burial sites (these had been known since a previous reconnaissance survey in 2002) in Karakaba, and geocryological research has shown that the valley is a favourable place for permafrost conservation (see the report by E. Severskiy, 4.7.2). In total, 116 structures were recorded in Karakaba, spread over 28 locations (Table 4.4). From the 53 burial mounds, 48 appeared to be Scythian. The 32 small stone accumulations were dated to the ethnographical period, and we recorded 33 structures of unknown date (Figure 4.4).

Structure Type	*Total*	*Karakaba*	*Bukhtarma*	*Berel*
mound - undefined	**0**	-	-	-
burial mound	**423**	54	321	48
collared mound	**0**	-	-	-
four-cornered mound	**0**	-	-	-
kereksur	**0**	-	-	-
enclosure (Turkic)	**59**	-	54	5
round enclosure (Afanas'ev)	**0**	-	-	-
stone circle	**25**	5	20	-
stone platform	**46**	5	41	-
stone line	**5**	2	2	1
semi-circle	**11**	-	11	-
rectangular stone setting	**2**	-	2	-
standing stone - undefined	**5**	4	1	-
stele	**1**	-	1	-
image stone	**0**	-	-	-
false images stone	**1**	-	1	-
balbal	**31**	-	27	4
deer stone	**0**	-	-	-
ethnographic grave	**561**	32	529	-
adjoining structure	**15**	1	6	8
petroglyph panel	**2**	2	-	-
zone of structures	**0**	-	-	-
undefined	**44**	11	27	6
Total	**1,231**	**116**	**1,043**	**72**

Table 4.4: Overview of the archaeological structures recorded in Karakaba and Bukhtarma

In the Bukhtarma research area, we recorded 1,043 archaeological structures in 69 locations. Once again, the Scythian period is well represented, with 222 individual monuments. A total of 128 Hunno-Sarmatian burials was recorded; this find is interesting as these graves are very uncommon in the Kazakh part of the Altay Mountains, so this is interesting. The biggest category of monuments in Bukhtarma, however, is that of the ethnographic monuments: 538 structures of different types were recorded during the survey, of which 529 were certainly graves. In the pie chart, it is clearly visible that the number of ethnographic structures is almost half of the

inventory total – about 52% (Figure 4.4). However, this is misleading as it is caused by one specific ethnographical site in Bukhtarma (site KK-102) where we recorded no less than 400 individual structures. Another 84 monuments were dated to the Turkic period, and 71 structures could not be dated.

The river terrace in Berel is also used as a hay field, making it difficult to survey. It is not only the high grass which limited the view, but also the large amount of humus (soil formation) caused by the dense vegetation. In the excavation trenches made by the Kazakh archaeologists who have been excavating the site since the nineties, it can be seen quite clearly that the original soil level is about 20-30 cm below the present level. This means that only the central, higher part of the burial mounds is visible, while smaller structures, such as stone circles, small standing stones, etc., cannot be detected visually. This means that only the major structures could be identified. In total, 72 structures were recorded on the Berel river terrace, in ten different archaeological sites. Most of these – 37 structures or 51% of the total – can be dated to the Early Iron Age or Scythian period. We further recorded nine Turkic structures, and 24 structures of unknown date (Figure 4.4). This brings the total of recorded structures in the Kazakh Altay to 1,231, spread over 107 locations.

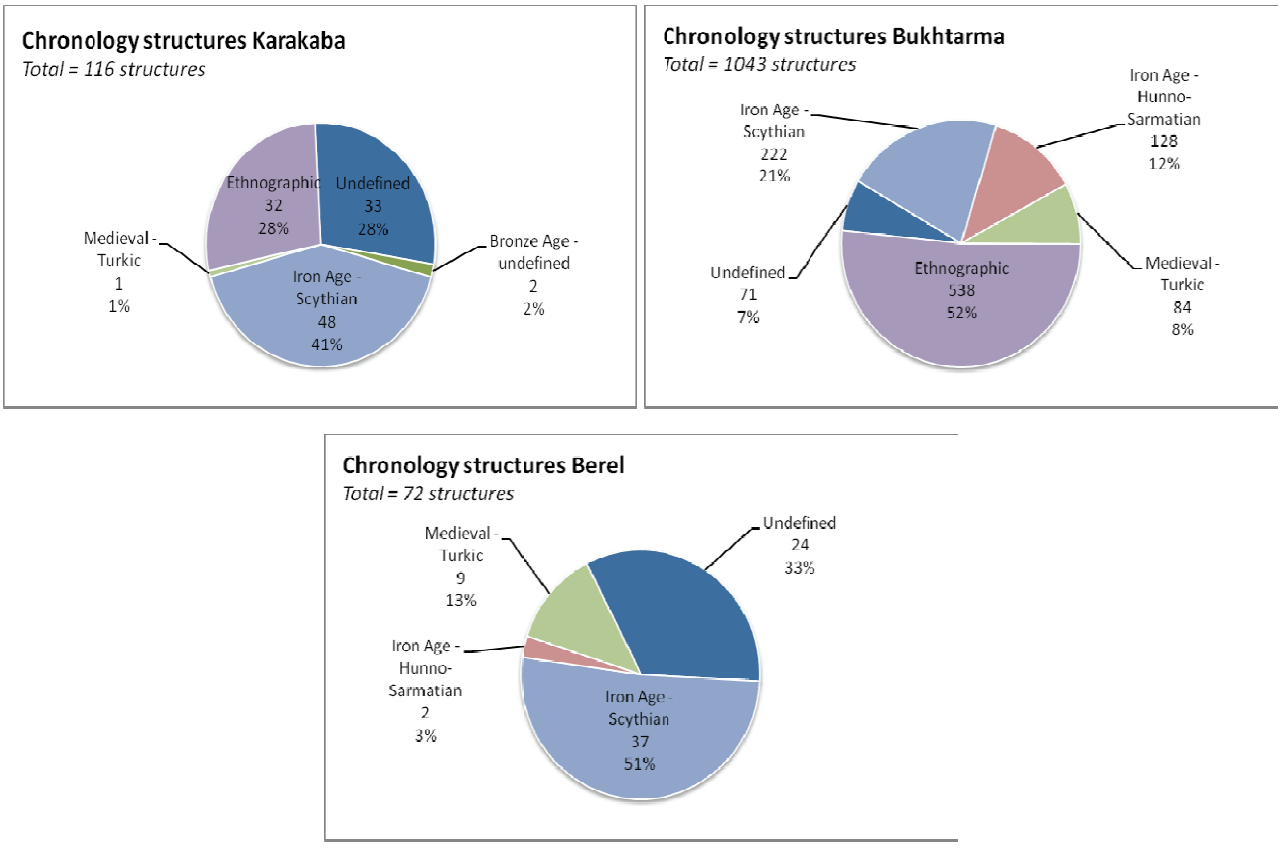


Figure 4.4: Chronological distribution of the archaeological structures in Karakaba, Bukhtarma and the Bukhtarma river terrace in Berel

4.5 Survey of the Uch-Enmek Park in the summer of 2007-2008

4.5.1 Overview of the research area

The second campaign within the Bilateral Co-operation project was organised from 12 July to 12 August 2007. This time, the valley of the Karakol River was our research area. This valley is part of the Ethno-Natural Park Uch-Enmek, and contains a few of the most famous Scythian burial sites in Altay. In 1950, archaeologist N.M. Rudenko excavated two big burial mounds on the site of Bashadar, just to the north of the village of Kulada, and found perfectly preserved burials with magnificent finds, preserved in the permafrost (see 1.4.1). The park also covers the very rich site of Tuekta, along the Ursul River, excavated by N.M. Rudenko and his team in 1954 (Rudenko 1960, Rudenko 1970). Next to these large sites, there are thousands of smaller monuments. They are spread over the total area of the park, measuring about 40 km from north to south and 15 km from east to west.

4.5.2 The Uch-Enmek Ethno-Natural Park

The park was founded by director Danil Ivanovich Mamyev in 2001, to protect the native lands and sacred archaeological and petroglyphs sites in Karakol and surroundings from damage by the increasing number of tourists. However, there is also a very strong spiritual component. Along with the park's directors, the indigenous Altay people have considered the Karakol valley to be a sacred valley since time immemorial: *Uch* in the Altay language means 'three', and *Enmek* signifies the vulnerable, important energy spot on the crown of a newborn child's head. The valley is dominated by the centrally located Uch-Enmek mountain that is believed to be the 'navel of the Earth', connecting our world with the world of the spirits and the cosmos in general. Therefore, the nature itself, as well as the archaeological heritage, is considered to be sacred. Many of the burial mounds have been dug up long since, and the park's staff wants to avoid future destruction by tourists or by unnecessary excavations.

We were asked by the local authorities to work in the park and to make an archaeological plan of the whole area, an offer we accepted with great pleasure. It is certainly necessary to protect the monuments and only a detailed map can make this possible. Moreover, an inventory of one of the most special valleys in the Russian Altay Mountains would certainly be a valuable contribution to our project.

As part of a project to involve local populations in the protection of the Karakol valley and its archaeological heritage, the Ethno-Natural Park Uch-Enmek set up a small project with the five schools in the area, lead by Dr. Irina Aleksandrovna Zhernosenko. Young pupils (about 12 to 15 years old) participated to the different aspects of our research – the geographical fieldwork as well as the archaeological inventory.

4.5.3 Archaeological fieldwork in Karakol

From the first days of fieldwork, it was clear that the valley of Karakol was too rich to finish the job in one campaign. There were simply too many sites and we were not able to record them all. The team decided to start work at the village of Bichikti-Boom, and was able to complete the entire left bank up to Kulada village, including the village of Boochi. This area, roughly 14 km long and 4 km wide, is located in the centre of the valley, surrounding the sacred mountain Uch-Enmek, and can be considered as the most important area in the park. The altitude ranges from 1,100 to 950 msl. In the summer of 2008, the work in Karakol was continued using funds from, among others, the Flemish Research Fund. An additional grant from the Flemish UNESCO Trust Fund for Science enabled the geographical team to more work on the question of permafrost preservation; however, they chose Dzhazator and the surrounding valleys as their research area (Bourgeois et al. 2008). The survey in 2008 first focused on some small tributary valleys of the Karakol River, higher up in the valley, and south of Kulada village. The sites at Nizhniy Sooru and Sootyokh, in particular, yielded a large number of structures. In a next phase, all other annex valleys and the whole of the higher part of Karakol were surveyed. Next, our survey concentrated on the right bank of Karakol, from Kulada up to Bichikti-Boom. Generally speaking, almost the entire valley of Karakol has been surveyed now. The only part remaining is the area north of the village of Bichikti-Boom up to the confluence of Karakol and Ursul as well as the famous Tuekta site. We hope to finish this part of the Uch-Enmek Park in the near future, and plan to return in one or two years.

We should note that the archaeological survey was hampered in part by the fairly high grasses: most of the steppes are used as hay fields. Therefore, we suggest that further surveys in that type of valleys should be focused on the early spring rather than July/August. We do not think that any major sites have been missed, although unfortunately this could be the case for minor structures, such as stone circles, platforms, etc. In total, 3,291 different structures were located and described, spread over 100 archaeological sites. Another six structures were added to the database – these petroglyph panels are however located in Tuekta and Nizhnaya Talda, two other areas within the Uch-Enmek Park. They are not mentioned in the graph in Figure 4.5. The total number of structures is thus 3,297.

The astonishing number of 1,023 burial mounds were recorded in Karakol (Table 4.5.). Most of these mounds (653) are part of the large Scythian-type burial complexes, and 243 are dated to the Turkic period. These are small, high mounds with rows of *balbal* stretching northwards; the Turkic assignment is provisional. Another 34 are possible Hunno-Sarmatian graves, and 93 could not be assigned to a specific culture. Associated with the Scythian burial mounds are 387 stone circles and 137 stone platforms, and most of the *balbal* are part of the north-south stretching lines of standing stones associated with the possibly Turkic burial mounds.

The large number of burial mounds with associated structures – stone circles, stone platforms and *balbal* –, dating from both the Scythian and Turkic periods, immediately explains why structures from these two periods outnumber the other categories shown in Figure 4.5. About 15% of the structures could not be assigned to a specific period, and the other 2% is spread over

the Eneolithic (28 Afanas'ev graves), the Bronze Age, the Hunno-Sarmatian period and the Ethnographic period.

Structure Type	*Number*	*Structure Type*	*Number*
mound - undefined	13	standing stone - undefined	62
burial mound	1023	stele	22
collared mound	0	image stone	3
four-cornered mound	0	false images stone	6
kereksur	0	*balbal*	1328
enclosure (Turkic)	63	deer stone	0
round enclosure (Afanas'ev)	28	ethnographic grave	0
stone circle	387	adjoining structure	8
stone platform	137	petroglyph panel	36
stone line	1	zone of structures	2
semi-circle	4	undefined	173
rectangular stone setting	1		
Total	**3,297**		

Table 4.5: Overview of the recorded structures in Karakol

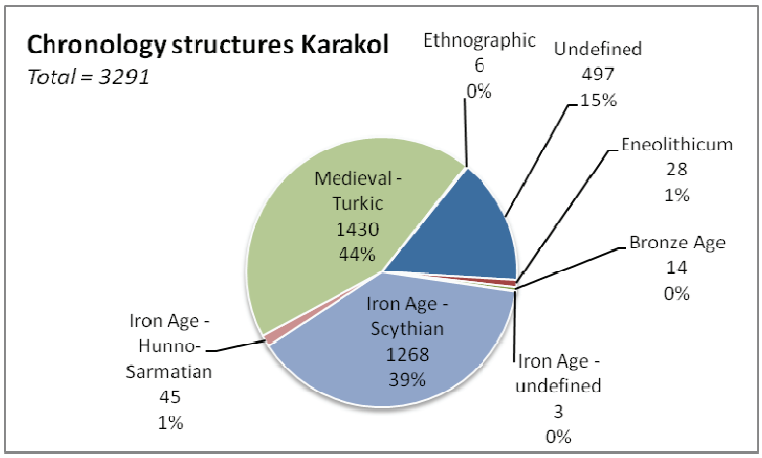


Figure 4.5: Chronological distribution of the archaeological structures in the Karakol valley

4.6 Overview of the survey results, 2003-2008

The six years of archaeological survey have yielded a voluminous database with information about 12,047 archaeological structures, spread over 10 valleys or 15 smaller research areas (Table 4.6). We recorded 1,053 locations with monuments – although it should be kept in mind that these 'sites' do not represent the archaeological reality (see 3.3.4).

Figure 4.6 gives us an overview of the chronological distribution of the monuments. Three major classes can be seen. Most of the structures, 4,406 to be precise, date tentatively from the Early Iron Age or Scythian period (37%). Another 3,073 structures have been assigned to the Turkic period (25%), and 1,896 monuments were probably constructed in the Bronze Age (16%). About 6% of the monuments are Ethnographic graves; most of these 701 graves were located in

Bukhtarma, with one site alone comprising 400 structures. Finally, 213 structures were dated to the Hunno-Sarmatian period, 47 to the Eneolithic, and ten to the Iron Age, without giving a cultural attribution. As is typical for visual surface inspection or field survey, many monuments could not be given a tentative date; so about 14% or 1,701 structures remain undefined.

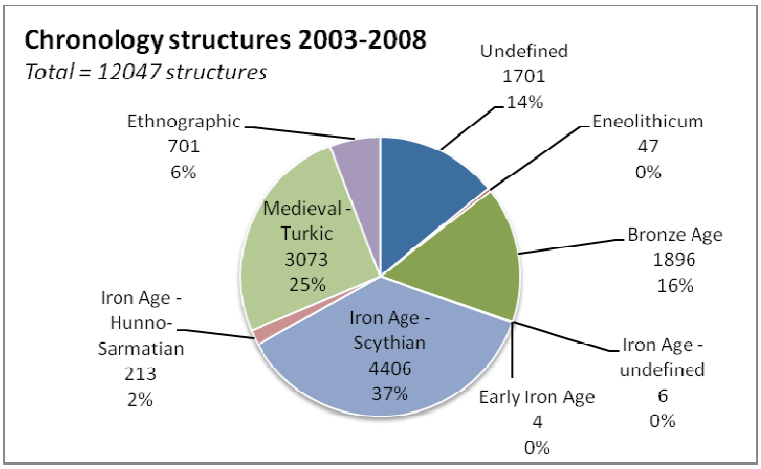


Figure 4.6: Chronological distribution of all 12,047 structures in the database

District	*Year*	*Toponym*	*No. of locations*	*No. of structures*
Kosh-Agach	2003	**total**	**158**	**1,255**
		Elangash	19	73
		Irbistu	25	109
		Ozyok	21	308
		Sarikobu	5	7
		Sebystei	30	529
		Elangash-West	25	137
		Irbistu-Elangash	13	21
		Kokozyok-Sebystey	2	3
		Sebystey-Ozyok	18	68
	2004-2006	**Yustyd**	**463**	**4,204**
	2005	**Dzhazator**	**225**	**2,060**
Katon-Karagay	2006	**total**	**107**	**1,231**
		Berel	10	72
		Bukhtarma	69	1,043
		Karakaba	28	116
Onguday	2007-2008	**total**	**100**	**3,297**
		Karakol	98	3,291
		Nizhnaya Talda	1	2
		Tuekta	1	4
All districts	2003-2008		**1,053**	**12,047**

Table 4.6: Overview of the number of locations with surface structures in the database, per valley

4.7 Additional information on the survey campaigns

Parts of the expeditions were devoted to geographical fieldwork, mainly organised within the framework of the Frozen Tombs of the Altay Mountains project. This research should be mentioned here briefly, although it is not really part of this doctoral research. The text is an abstract of the different field reports that were made every year.

4.7.1 Permafrost research in Dzhazator, 2005

During the fieldwork in Dzhazator, the geographers focused on the use of geomorphological and geological techniques to determine the areas where frozen contexts can be expected. The team defined good GCPs for the Aster and Landsat satellite images and made measurements of the soil and subsoil temperature, via drillings with an auger (Figure 4.7) and test pits. The main idea of this fieldwork is to use the Landsat thermal band for defining areas where permafrost is estimated as very probable. Details of the methodology were presented at the EARSeL-conference in Porto, Portugal (see Goossens et al. 2006b). Interestingly, although the processing of the results is still in progress in the Geography Department, in the higher parts of the Dzhazator valley we discovered several areas where, even in midsummer, the subsoil was cold enough to maintain permafrost conditions. Pingos and other wet settings (valley areas), in particular, had frozen subsoil from a depth of a few decimetres. The work with the satellite data (ASTER, Landsat) was done by the student that took part in the expedition, and presented as a Master's thesis in 2007 (De Bus 2007).

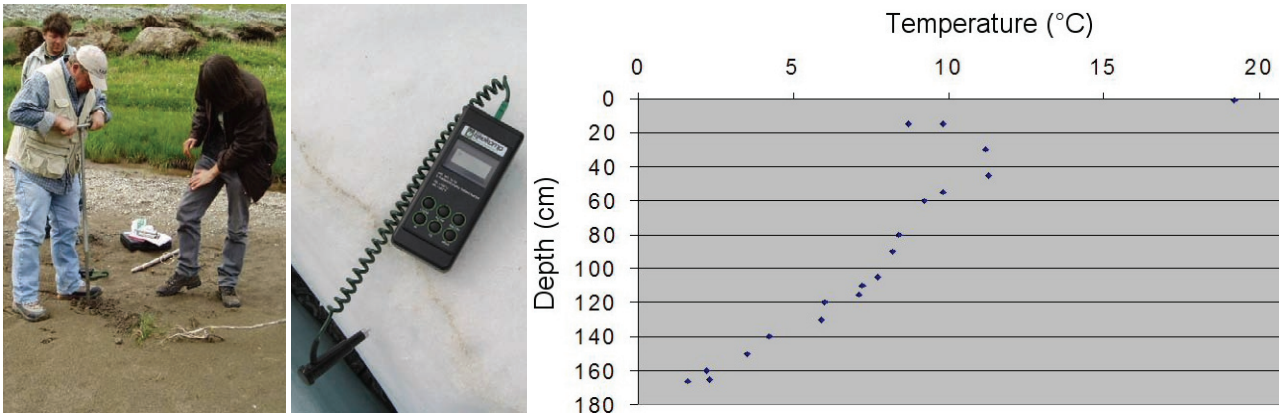


Figure 4.7: Augering and temperature measurements in the Dzhazator valley, in search of permafrost zones

4.7.2 Permafrost research in 2006

Also in 2006, part of the expedition was focused on the study of the permafrost. This was done at two levels: permafrost presence was studied in and around Scythian kurgans, and the general location of permafrost areas in the landscape was analysed. During the field research in the Yustyd valley, Sergei Marchenko (University of Alaska Fairbanks) studied the location, condition and depth of permafrost in the neighbouring Ulandryk valley (Bourgeois et al. 2007: 19-20). He installed data loggers at several well-defined places in the valley, within an altitudinal range of

2,300 to 2,100 msl, to measure year-round ground temperatures (Figure 4.8). After one year of logging the temperature, these measurements will give insights into the evolution of temperatures and, very importantly, the maximum depth of thawing during the short summertime in different parts of the valley. Armed with this information, it will be possible to determine which tombs lay in the areas where the thawing of permafrost is most active.



Figure 4.8: Sergei Marchenko at work in the Ulandryk valley, implanting data loggers at several depths in the surroundings of Scythian burial mounds to monitor the temperature over a whole year

During the fieldwork in the UNESCO project, the permafrost research in Kazakhstan was done by members of the high mountainous geocryogenics laboratory of the Institute of Permafrost (Siberian Branch of the Russian Academy of Sciences, Kazakhstan). Eduard Severskii and his team executed geocryogenic research in the basin of the upper course of the Karakaba. The goal was to analyse the forming of the permafrost lens under burial mounds. In 2002, the team registered parts of the archaeological heritage in the valley. As a result, 28 sites, comprising more than 100 objects, were selected for further study during the field campaign of 2006. A large part of the Karakaba depression is situated in the area of isolated areas of permafrost, mainly located on the surrounding exposed northern slopes. The geothermic research has been carried out under variably sized stone mounds and around their borders. It has been proved that, the more porous the stone mound, the more it influences the lowering of the temperature of the soil beneath. Burial mounds lower than 0.6 m have a temperature of 1.6°C at a depth of 2.7 m; mounds with a height of 0.7 m have a temperature of 1.4°C at the same depth; and for mounds that are 1.0 m or higher, this temperature drops to 0.3°C, with presence of old frozen layers. Outside the influence limits of stone mounds, the upper boundary of the permafrost is as deep as 3.7 m. Under stone mounds, the seasonal thaw depth is thinner and the upper limit of the old permafrost comes closer to the present surface, at about 2.7 m. The limited height of some of the burial mounds can thus cause the layer of seasonal thaw to sink below the level of the burial chamber. This does not allow for a good conservation of biomaterials (Bourgeois et al. 2007: 19-20).

4.7.3 Permafrost research in Karakol, 2007

During the expedition of 2007, Sergei Marchenko collected the temperature data loggers he installed the year before in the valley of Ulandryk and was able to download all the data successfully. Figure 4.9 shows the annual temperatures at a depth of 0.7 m inside the burial mounds and within natural coarse debris at different altitudes. The coldest mean annual ground temperature was recorded in coarse debris, where a free convection of air occurs. The burial mounds are partly covered with fine-grained soils which insulate them from the cold air in wintertime, which explains why the temperatures measured are somewhat higher in the burial mounds (Marchenko 2008).

Sergei Marchenko also studied permafrost evolution in the Karakol valley. This was done at two levels: permafrost presence was studied in and around Scythian burial mounds, and the general location of permafrost areas in the landscape was analysed. He installed data loggers in the surroundings of the Bashadar burial site, at several well-defined places and at different depths. After one year of logging the temperature, these measurements will give insights into the evolution of temperatures and, very importantly, the maximum depth of thawing during the short summertime in and around the huge kurgans at Bashadar (ca. 40 m diameter). Armed with this information, it will be possible to determine how the climate affects the frozen tombs, how stable the permafrost actually is, and how fast climatic change may cause the disappearance of the frozen conditions.

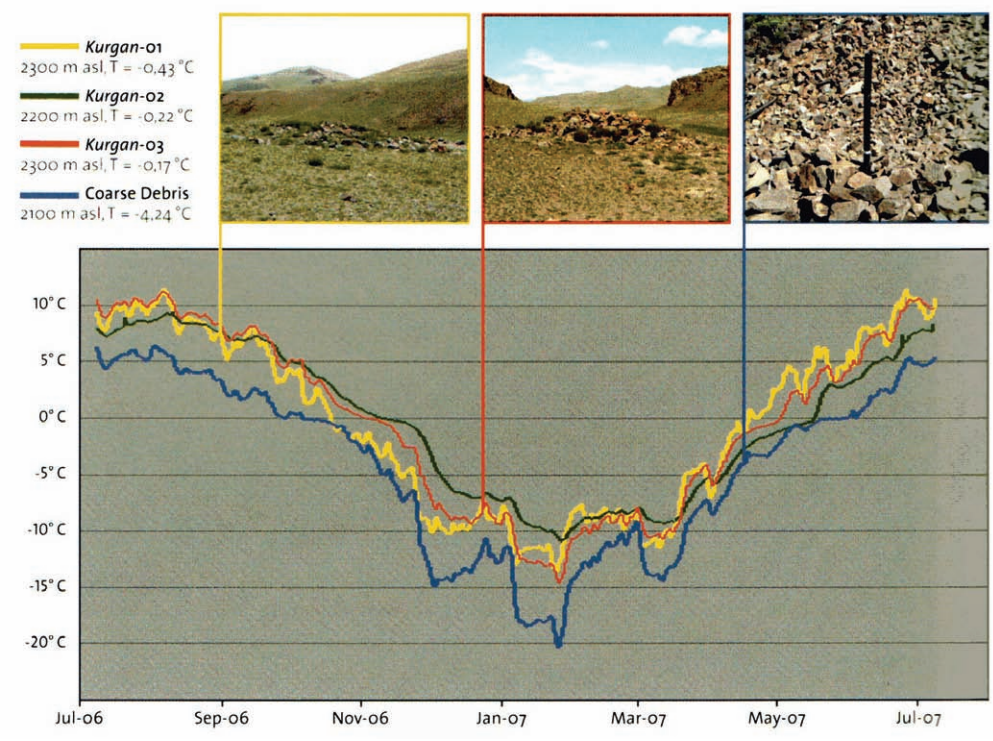


Figure 4.9: Temperatures in the Ulandryk valley, June 2006 to July 2007 (Marchenko 2008)

4.7.4 Aerial survey and photogrammetry in Karakol, 2007

During the fieldwork in Karakol, an aerial survey of the research area was done with a motorised deltaplane. A plane with a pilot was hired for one day, and Prof. Dr. Jean Bourgeois acted as the photographer. The purpose of this flight was twofold:

- The first goal was to carry out an archaeological survey of the whole valley. For this purpose, the photographer used a digital Canon EOS D300 camera with 22-55mm lens. In total, about 600 photos were taken over the whole area, covering most of the archaeological sites in the area (Figure 4.10).

- The second plan was to make a digital surface model (DSM) of site ON-022, one of the biggest sites in the area, by taking stereoscopic images and using photogrammetrical techniques. The preferred flight height and focus length was calculated, and a Canon EOS D300 camera with fixed 25mm lens was used to take the images, both in RAW and high-quality JPEG. Before the flight, we installed 40 quadrangular, white boards (50x50cm) on the site, with a black point in the centre. These boards acted as clearly defined GCPs which were necessary for the processing of the stereo images. Their position was measured with the C-Nav GPS reciever, with a precision of 12 cm.



Figure 4.10: An example of the many aerial photos that were made during the survey: two north south alignments of Early Nomadic burial mounds, just south of Boochi. Right: the deltaplane

One day before the flight was planned, the weather changed: clouds covered the whole valley, it rained almost continuously, and there was thunder and lightning in the evenings and at night. One Saturday, the flight took place during a short period without rain in the afternoon. Nevertheless, it was very cloudy and difficult to take good pictures, so most of the images are not very bright. The plane had fuel for some two hours, so the flight route was carefully planned (Figure 4.11). It took off from the track at base camp and flew south, over the village of Boochi, surveying that part of the valley. Half an hour later, it landed near site ON-022 to check if all preparations for the photogrammetrical flight were ready.

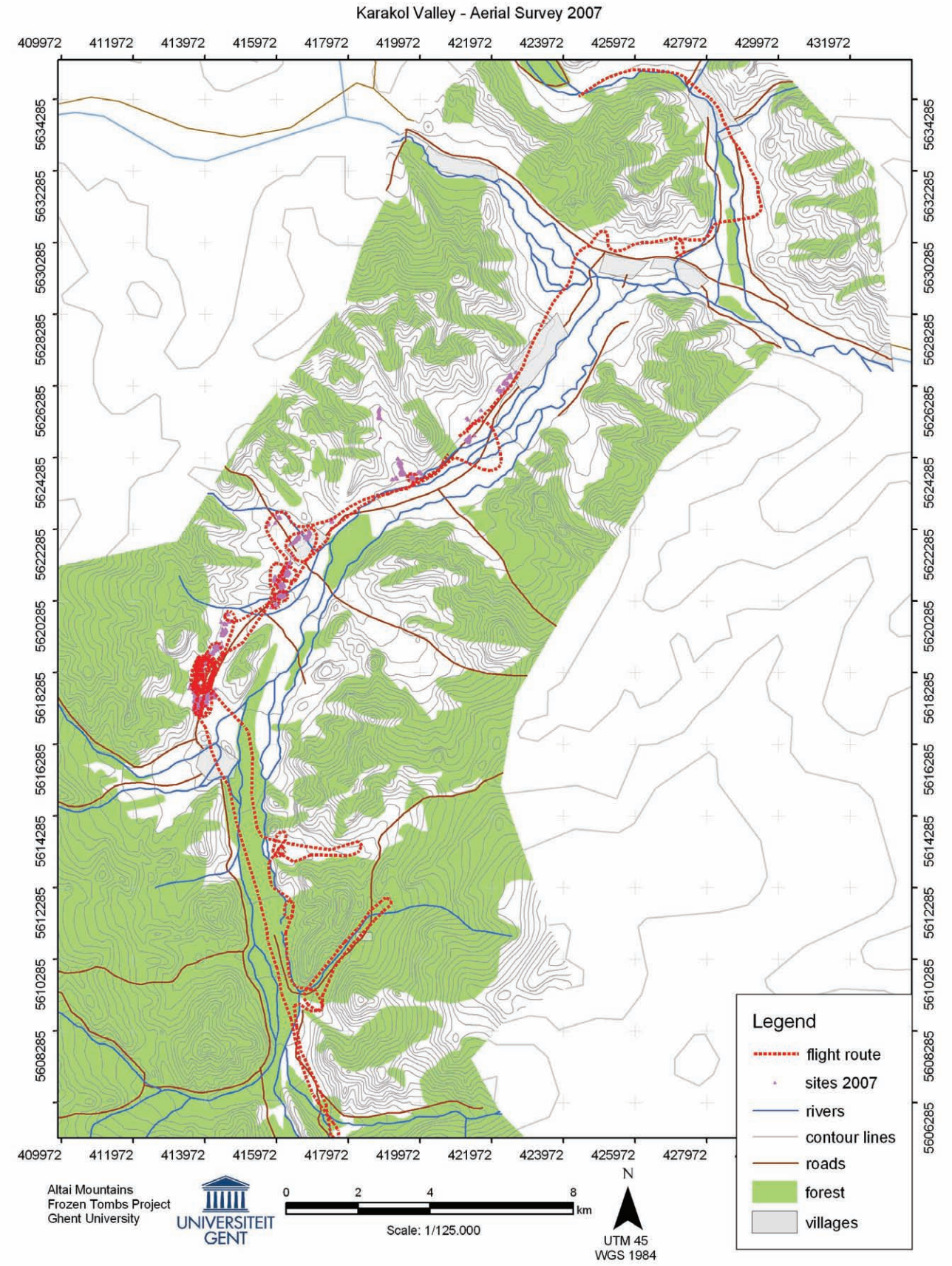


Figure 4.11: Flight route (red dots) of the aerial survey in the Uch-Enmek Park, logged by an on-board GPS receiver (Garmin Vista)

It then took off again and surveyed the southern part of the valley, flying over the village of Kulada and surveying the higher part of Karakol, including the two tributary valleys of Nizhniy Sooru and Sootyokh. After 40 minutes, it landed again near site ON-022 to refuel and change cameras. Then it flew over the site several times, enabling the photographer to take several series of oblique, overlapping photos. Then it continued northwards and surveyed the northern part of the valley, over the villages of Bichikti-Boom and Karakol, and the famous archaeological site of Tuekta. The flight was a success, providing very good additional documentation of the sites in the area. The data from the photogrammetrical coverage of site ON-022 is now being processed in the Geography Department.

5 Typology of the monuments in the Altay Mountains

The diversity of monument types in the Altay is enormous. The surface structures date from many different periods, have several different functions and have witnessed a complex evolution. At this moment, there is no clear overview of all the monument types and no consensus on the terminology. Researchers use different terms to point to similar structures; there is a confusing mixture of Russian, Mongolian and Kazakh terms plus new terms in western languages – concerning both translations and descriptive terms. In addition, many monument types remain unresearched and are therefore too often categorised by vague terms such as 'stone concentration' or 'stone setting'.

Initially, we used the terminology already in use in Russian archaeology, but soon had to add new types of monuments to define all of the structures in the database clearly. The archaeologist V.D. Kubarev has done extensive research in Altay, especially in the region of the Chuya steppe. He carried out numerous excavations in, among others, the valleys of Yustyd, Ulandryk, Bar-Burgazy and Saylyugem (Kubarev 1987, Kubarev 1988b, Kubarev 1991, Kubarev 1992). In 1980, he published an article on the archaeology of the Kosh-Agach region, in which he discusses the different monument types he found there (Kubarev 1980). He mentions different kinds of *kereksur*, burial mounds, enclosures, stone circles and other stone settings (see Figure 5.1 for an overview of the types found in the Yustyd valley). With the exception of number 13 – a complex setting of river stones – and a strange type of Turkic enclosure surrounded by a circle of stones (number 12, example 2), we encountered all these types during our survey, although our classification is somewhat different. Most of them will be discussed later in more detail.

A second overview of monument types was given by V. Molodin et al. in a publication covering both excavations and survey work on the Ukok plateau, in the south of the Altay Republic (Molodin et al. 2004). A brief chronological overview of monuments, excavated artefacts and petroglyphs is given in the concluding chapters of the book (Figure 5.2), but more important are the mainly detailed site plans that are published for every recorded group of monuments. They enable us to compare the layout of individual structures, especially the occasionally complex stone settings, in every detail. Some of the plans will be revisited in the following paragraphs.

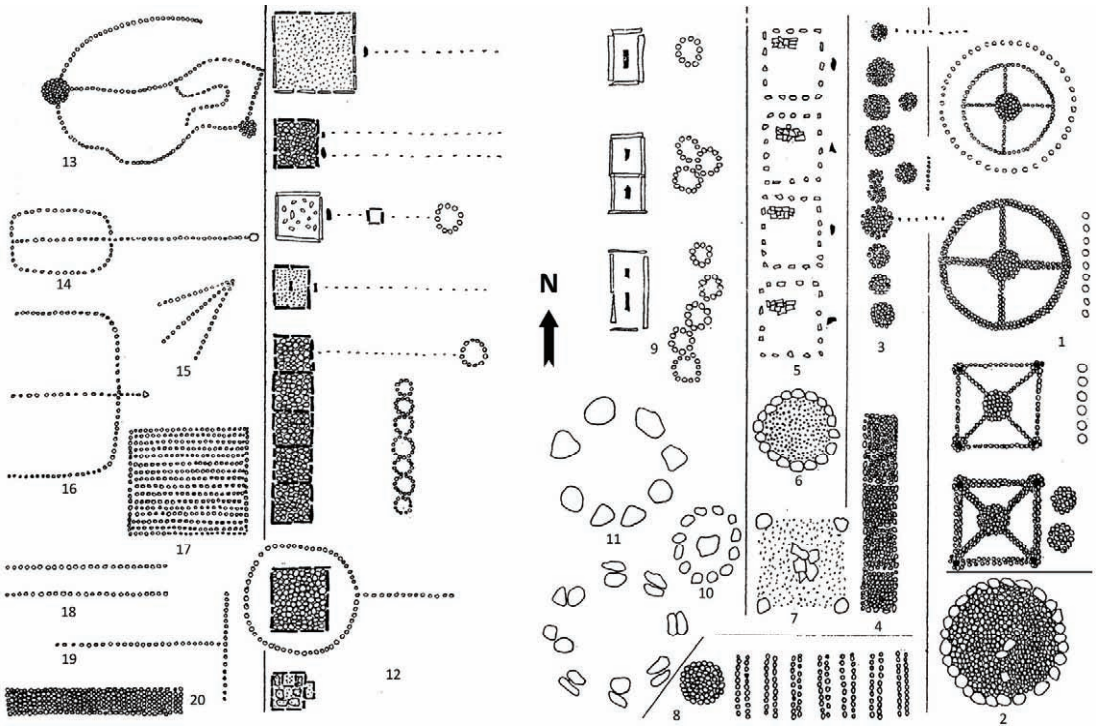


Figure 5.1: Overview of monument types in the Yustyd valley, as defined by Kubarev. North is above; the scale varies throughout the image. He mentions, from right to left: 1) *kereksur*; 2) possibly late Bronze Age burial mound; 3) burial mound from the Early Nomads and Turkic period; 4) possibly Hunnic burial mounds; 5) ritual enclosures; 6-8) ritual mounds; 9) Scythian rectangular enclosures with standing stones; 10-11) ritual stone circles; 12) different types of Turkic enclosures; 13-20) stone settings made of river boulders (Kubarev 1980: 88-89)

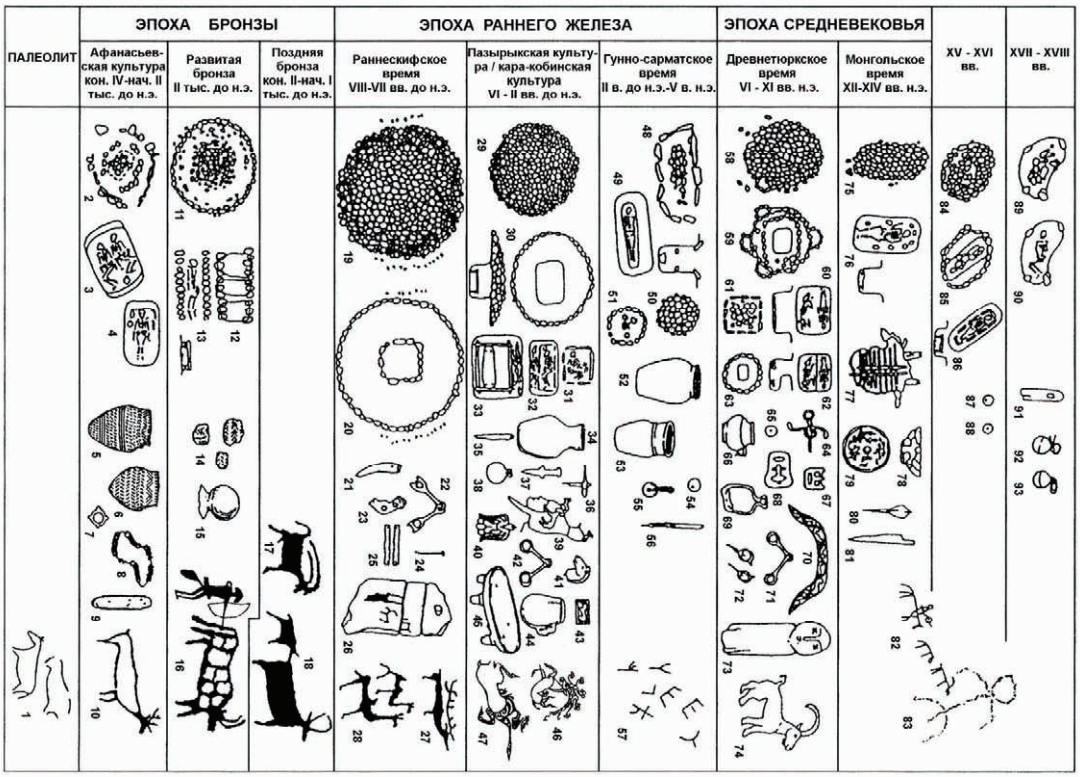


Figure 5.2: Chronological overview of the archaeology of the Ukok plateau, including burial monuments, excavated artefacts and petroglyphs (Molodin et al. 2004: 223)

5.1 Defining the monument types

From fieldwork in Altay and communications with Russian, Kazakh and Western archaeologists it was clear that we would have to discuss the terminology for the monuments thoroughly. This was necessary not only to facilitate joint research and discussions, but also to enable us to link the results of our fieldwork, and merge the resulting databases. This discussion was first started during the UNESCO project workshops in March and December 2006 (see 1.4.3.6). Afterwards, it was further elaborated by conversations with Igor Slyusarenko (IAE SBRAS), Esther Jacobson-Tepfer (University of Oregon) and Eduard Dvornikov (GASU). We are much obliged to them for their valuable contributions. This input from both local archaeologists in Altay, from the Russian Academy of Science and from international research teams is the best way to compile a comprehensive typology. Although this typology is far from final – it should be tested repeatedly, adapted where necessary and discussed further with other archaeologists – it is a good starting point.

5.1.1 General problems of naming

5.1.1.1 Language problems

Many of the existing names for monuments types cannot be used as sometimes they are not specific enough, they are ambiguous or limited in use and not known to other researchers, or simply they are used wrongly. One of the biggest problems is the use of Russian, Mongolian and Kazakh terms and transliterations of these terms in other languages. These sometimes very general words are given a more specific meaning in their transliteration. The Russian word kurgan *i*s commonly used to describe Scythian burial mounds (French *kourgane*, Dutch *koergan*, etc.), while it is a simple word for a small hill or hill, barrow or burial mound. The same can be said for *ogradka* – although this is commonly seen as a specific type of monument, mostly from the Turkic period (and used in other languages as a transliteration), it is the Russian diminutive for *ograda*, a fence, palings, wall or enclosure. For these terms, we would like to suggest using a translation rather than a transliteration – in this case, Scythian burial mound and Turkic enclosure (as opposed to burial mounds and enclosures from other periods), linking it with the Russian translation.

Esther Jacobson-Tepfer pointed out three reasons for moving away from transliterations[19]:

- As mentioned above, the Russian terminology is sometimes too imprecise (e.g. *ogradka*);
- The terms are not sufficiently transparent in their meaning; and
- Not all archaeologists have enough background in Russian archaeology.

[19] Jacobson-Tepfer, Esther. Letter to author, 01-10-2008.

Sometimes, local terms are specific enough to be used in the typology, especially if no alternative exists in other languages. The Mongolian term *khirigsuur* is one of these words: it is transliterated to the Russian word *kereksur* or *khereksur*, and Mongolian and Russian variants are used in foreign scientific literature. It would be quite confusing to invent a new term for this monument type.

Some terms are used to refer to several very different types of monuments. The Old Turkic term *balbal* is generally used by Russian archaeologists to define small standing stones that are placed in rows to the east of Turkic enclosures or Scythian burial mounds. However, a *balbal* can also be an anthropomorphic stone figure placed next to a Turkic enclosure. The term *balbal* appears in the Orkhon inscriptions[20] several times, where it specifically refers to a stone image that symbolised or depicted an enemy, and was erected when a relative had died (Ross & Thomsen 1930):

> "I E 14 - I E 16: … to the North Baz kagan and the people of the Tokuz Oguz's were our foes… Forty-seven times he [my father the kagan] went campaigning, and fought in twenty fights… After having won so great a kingdom and such great power he died. Instead of my father the kagan we raised up Baz kagan as first balbal.
>
> "II E 20 - I E 25: … Through your foolishness and cowardice my father's brother the kagan found his death. As the first one I had the Kirghiz kagan raised to be balbal.
>
> "II S 8: Küg Sängün came at the head of an army of 40,000 men; I met him at the mountain Tüngkär, and defeated him and hewed down 3,000 men … After my eldest son had died of sickness, I had Küg Sängün set up as balbal…"

The term is used in the text to refer to the 'enemies' of the deceased or of his relatives. However, it is not mentioned that the *balbal* is an anthropomorphic depiction, and can thus bear reference to both the larger anthropomorphic image stones and the smaller uncarved standing stones in alignments. In addition, the text does not describe the exact place of the *balbal* and gives no information on the number of *balbal* that may be associated with a single memorial structure. However, it does say that the important enemies were raised "as first *balbal*". There is no decisive answer in the text, and the issue remains unresolved. The term was applied to the small stones to the east of a Turkic enclosure, based on the theory that those stones indicate the slain enemies of the individual being honoured with the enclosure. Other archaeologists use the same term for the much larger, beautifully carved memorial statues or *izvayanie*.

[20] These 8th century inscriptions were found in the Orkhon valley in Mongolia, south of lake Baykal, during an 1889 expedition by Nikolay Yadrintsev. They were published by Vasily Radlov and deciphered by the Danish philologist Vilhelm Thomsen in 1893. The inscriptions were found on two great square monoliths, originally standing in two bases. These were erected in 732 and 735 in honour of two Turkic princes, Kül-Tegin and his brother Bilgä Kagan. They include the oldest known examples of Turkic writing.

The two types are, however, very different, so we decided to use the English term ‘image stone’, as suggested by E. Jacobson-Tepfer, for the anthropomorphic standing stones, and *balbal* or ‘alignment of standing stones’ for the smaller stones.

5.1.1.2 Choice between descriptive or interpretative terminology

Terminology for archaeological structures can simply be descriptive and related to the appearance of the monument, e.g. a circle of stones, a rectangular stone setting, a mound, a quadrangular enclosure. When we take into account the possible function of the structure, the terminology becomes interpretative: the stone circle becomes a round fire altar, the mound a burial mound or ritual mound, the quadrangular enclosure a Turkic memorial structure. The latter option is far from neutral, and includes interpretations that may be too definitive to give simply on the basis of the appearance of the structures during an archaeological survey (and without excavations to see if there are in fact burnt offerings under the fire altar, or burials under the mound). On the other hand, the purely descriptive terminology tends to be very general: most monuments are built from stones that are put together in a mound or are set in a special form on the surface.

It seems necessary to adopt a middle course: on the first level, the terminology is purely descriptive. However, when defining the different types in greater detail, it will be necessary to include some functional parameters, and even chronological attributes. A Scythian and a Turkic burial mound have completely different characteristics. The *kereksur* is an exception to this – the name is so widely used that we chose to keep it as a main category, at the first level. The ‘dwelling’ is another exception; there is no brief and correct way to describe the very diverse and complicated geometrical stone settings that are bundled in this category.

All terms in the second level are unique names which are used in the database. The possible date of the structures is given in other database fields (and is not actually part of the name of the structure type) but we will include them here to avoid confusion.

5.1.2 Overview of the monument types in Altay

The surface structures in the Altay Mountains can be divided into the following types: mounds, *kereksur*, enclosures, stone settings (geometric forms and stone lines), so-called ‘dwellings’, standing stones, stone circles, stone pavements, petroglyph sites and graves from the Ethnographic period. The dwelling is actually a special kind of geometric stone setting; we decided to consider it as a discrete category because of the specific characteristics.

TYPE	*SUB-TYPE*	*Specification*	*Russian term*
1 Mound	Mound	Undefined	насыпь
	Burial mound		курган
	Collared mound	Simple	насыпь (?)
	“	Toothed*	насыпь (?)
	Four-cornered		насыпь (?)
2 Kereksur	*Kereksur*	Round / Square	керексур
	“	Boulder*	керексур
	“	Platform	керексур
3 Enclosure	Rectangular enclosure	Turkic	Тюрская оградка
	Round enclosure	Afanas’ev grave	оградка (?)
4 Stone setting	Stone setting	Undefined	каменная выкладка
	Stone line	Linear stone setting	каменная геометрическая выкладка
5 Dwelling	Dwelling	Simple	оградка из редко вкопанных камней с камменным ящиком
	“	Tripartite	оградка сложной внутренней планировки с камменным ящиком
	“	Round	геометрическая выкладка (?)
	“	Chain or ‘ladder’	каменная геометрическая выкладка типа 'лестница'
	“	Hanging circle	геометрическая выкладка (?)
6 Standing stone	Standing stone	Undefined	стоящий камень
	Stele		стелла
	Deer stone		оленный камень
	Image stone*	Turkic	изваяние
	False image stone*		изваяние (?)
	Balbal		балбал / отдельно стоящий камень
7 Stone circle	Stone circle	Associated	каменное кольцо / кольцевая выкладка
	“	Solitary	каменное кольцо
	Semi-circle		полукруг
8 Stone pavement	Stone platform	Oval / round	каменная выкладка /сплошная выкладка
9 Petroglyph	Petroglyph panel		петроглиф
10 Grave	Ethnographic grave		этнографические погребения
11 Other	*Ovoo, burkhanistic sanctuary, modern graveyards*		*Not included in our database*

Tabel 5.1: Overview of monument types in the Altay Mountains. Names with (*) were adopted from the Mongolian Altay Inventory (E. Jacobson-Tepfer); names with (?) are to be discussed

Before starting a detailed overview of the monuments, we would like to add a comment concerning the building materials. Although wood, earth or mud brick are occasionally used in some of the structure types, the main construction material is stone. The variety of stones is rather large, but can easily be divided into two main categories: stones that are rough and come from the mountains and rocky outcrops, and stones that are smooth and rounded and come from the river terraces and alluvial plains. These two types are deliberately used in many of the monuments, sometimes in contrast with each other. The difference in colour – the rough stones being dark grey, brown or black and the round stones being white, grey or light brown – enhances this contrast. Although it is easy to use 'gravel' (up to 6 cm in diameter), 'pebbles' (6 to 25 cm in diameter) and 'boulders' (25 cm or more) to differentiate between the different smooth stones, this is not the case with the rough mountain stones. We will refer to these as small, medium-sized and big rough stones.

5.2 Stone mounds

Mounds are certainly the most common features in the archaeology of Altay. Literally thousands of them decorate the Altayan landscape, in valleys, on river terraces, against gently sloping hills, on ridge tops and on high plateaus. They are mostly round in form, and comprise piled-up stones, both rough mountain stones and round river ones. Their diameter can vary widely from a few metres to over 50 metres, as does their height. Depending on the specific sub-type, mounds can be several metres high or very low and barely noticeable even from nearby. In some cases, they are bordered by a regular setting of contrasting stones, e.g. round boulders forming a circle around a mound of smaller pebbles and rough stones. Mounds can appear isolated or in groups; in the latter, the internal organisation of the group can help to define its function and cultural attribution. In this way, mounds arranged in rows roughly aligned from north to south can be interpreted as Early Iron Age burial mounds, while small, low, oval-shaped mounds in a cluster are assigned to the Hunno-Sarmatian period, etc.

However, many stone mounds are of unknown date and function. Without excavation, it is not possible to define them more precisely. These structures are recorded in the database as 'stone mound' without further specification. It is believed that a significant number of these simple mounds can be dated back to the Bronze Age – these heavy stone mounds appear individually or in randomly organised groups along a terrace, against high slopes or even on top of ridges (Figure 5.3).



Figure 5.3: Bronze Age stone mounds overlooking the vast Chuya steppe on top of a hill, just north of the Yustyd valley (Turu-Alty ridge, research 2004)

In total, 2,759 mounds were recorded during the surveys – in the database, they are called 'stone mounds'. Of these, 2,548 structures were defined as burial mounds (Table 5.2). It may be argued that it is difficult, or even impossible, to assign a burial function to stone mounds without excavating, which is partly true – we cannot be sure there is a grave or burial chamber underneath. However, their location in burial complexes at least points to a funerary function – even if they served ritual purposes rather than covered a burial. It is possible that the 270 burial mounds of undefined date could have been placed in the category of simple stone mounds. However, their characteristics and context have given us the impression that they too could have had a funerary function.

Structure type	*Total*	*Chronology*	*Total*	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARa*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CH*
Mound	170	Undefined	65	-	-	18	-	4	-	13	1	-	-	23	6
		Bronze Age	80	-	-	2	-	5	-	-	2	-	2	49	20
		Iron Age - Early	4	-	-	-	-	-	-	-	-	-	-	4	-
		Iron Age - Scythian	2	-	-	1	-	-	-	-	-	-	-	1	-
		Medieval - Turkic	2	-	-	1	-	-	-	-	-	-	-	1	-
		Ethnographic	17	-	-	-	-	-	-	-	1	-	13	1	2
Burial mound	2548	Undefined	270	10	22	22	1	2	16	93	1	4	7	76	16
		Iron Age - Scythian	1631	33	171	389	17	12	37	653	69	-	72	178	-
		Iron Age - Hunno-Sarmatian	192	2	128	10	-	-	-	34	3	-	4	8	3
		Medieval - Turkic	455	3	-	30	15	25	1	243	8	-	23	61	46
Collared mound	30	Bronze Age	30	-	-	1	-	1	-	-	3	-	1	24	-
Four-cornered mound	11	Bronze Age	11	-	-	-	-	-	-	-	-	-	-	11	-
Total	**2,759**			**48**	**321**	**474**	**33**	**49**	**54**	**1,036**	**88**	**4**	**122**	**437**	**93**

Table 5.2: Overview of different types of mounds. The abbreviations stand for: Berel (BER), Bukhtarma (BUK), Dzhazator (DZH), Elangash (ELA), Irbistu (IRB), Karakaba (KARa), Karakol (KARol), Ozyok (OZY), Sarikobu (SAR), Sebystey (SEB), Yustyd (YUS) and the southern border of the Chuya steppe (S-CH)

5.2.1 Scythian burial mounds

Burial mounds from the Early Iron Age (9th-8th century BCE – 3rd-2nd century BCE) are well known. They are mostly referred to as 'Scythian', although many researchers prefer the more neutral term 'Early Nomadic'. Hundreds of burial complexes can be found in the Altay, and dozens of excavations have revealed the interesting objects to be found inside. Sadly, this richness has been known since their date of construction, and many of the tombs have been looted. In fact, the burial complexes are rarely intact. The mounds or kurgans are easily recognisable and attract attention mainly because of their specific organisation. They are found in groups of up to 20 or more mounds built in rows (Figure 5.4). Most of these lines stretch roughly from north to south, although there are many deviations and some major exceptions. Typically, the burial mounds are surrounded by standing stones or *balbal* in the east (see 5.7.5), and ritual stone circles and stone platforms in the west (see 5.8.1 and 5.9).



Figure 5.4: This overview of a typical Scythian type burial complex in Sebystey (site KA-081) shows the central line of burial mounds, the rows of standing stones or *balbal* in the east (left) and the stone circles in the west (right). The picture is taken on hills north-west of the site, looking to the south-east

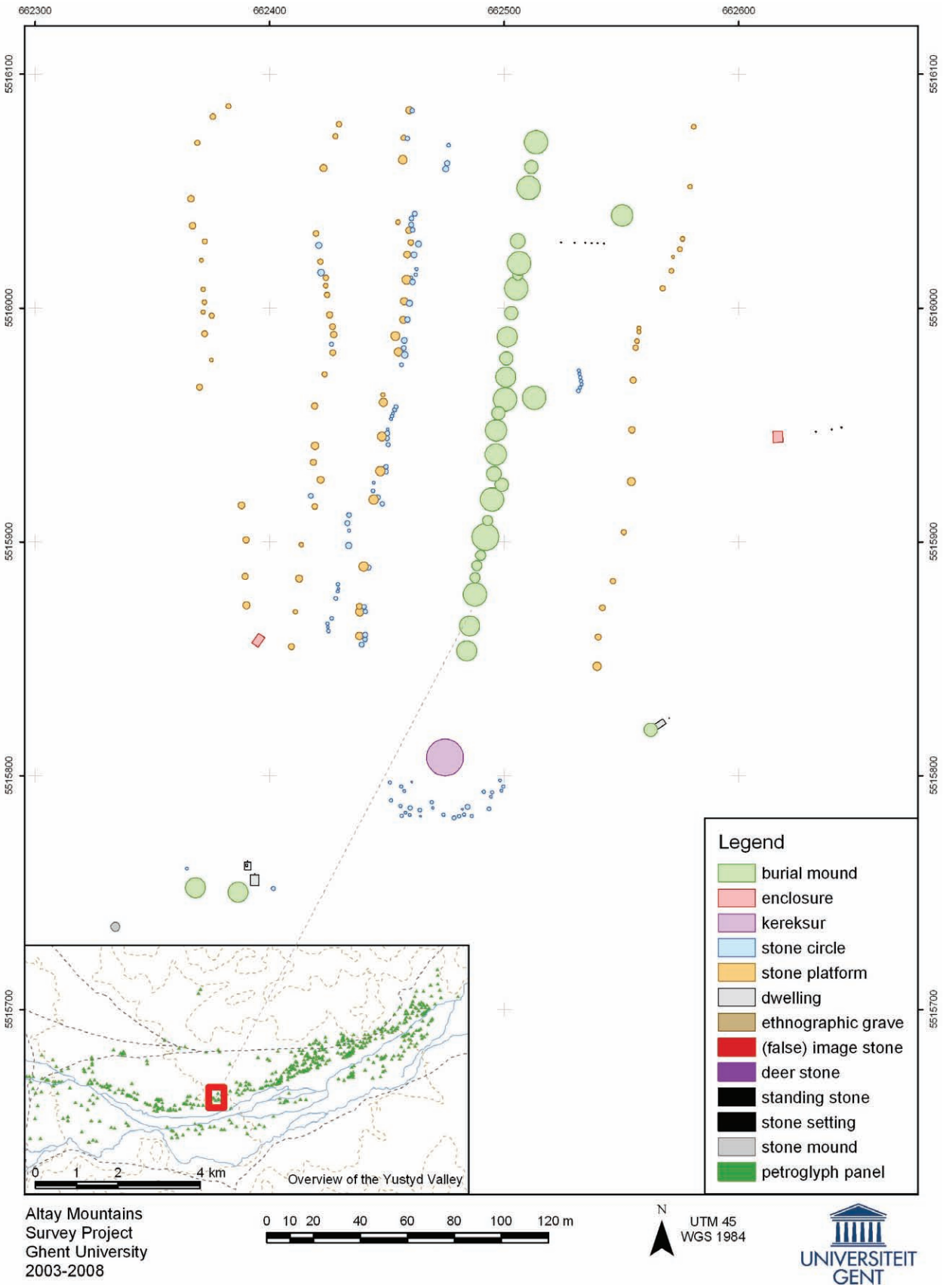


Figure 5.5: Plan of site KA-233 in Yustyd (Kubarev's number Yustyd XII). Several lines of ritual stone circles and associated stone platforms are constructed west of the burial mounds. In the east, some mounds have a row of standing stones or *balbal*. In addition, there is a small group of stone circles and a long line of stone platforms

The Scythian burial mounds can be constructed from pebbles and boulders or small to medium-sized rough stones, or a combination of these. In many cases, the stones seem to be carefully selected by size or shape. First, most of the bigger burial mounds are made up of a mixture of big rough stones to build the core quickly, then a layer of very small stones is put on top to smoothen the surface. Also typical is the presence of a central depression caused by the collapse of the burial chamber. If the mounds have not sunk there is a good chance that the burial chamber is filled with ice due to local permafrost conditions. Another possibility is that there is no burial chamber underneath; several excavations have revealed cenotaphs, with small offerings instead of a real burial.

5.2.1.1 Scythian burial mounds in our research areas

We recorded Scythian burial places in all research areas except in the very small Sarikobu valley and, more interestingly, the southern border of the Chuya steppe (Tabel 5.3). The burial mounds are always located in valleys, near rivers, mostly on top of flat river terraces; however, the open Chuya steppe does not answer these criteria. In total, 1,631 Scythian burial mounds were recorded.

Total	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARa*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CH*
1631	33	171	389	17	12	37	653	69	-	72	178	-

Tabel 5.3: Number of Scythian burial mounds in the research areas

Average dimensions (m)	*NS*	*EW*	*Height*	*Maximum NS diameter*	
Bukhtarma	8.49	8.88	0.31	17.00	
Dzhazator	8.14	8.46	0.38	18.40	
Elangash	9.53	9.60	0.42	11.40	
Irbistu	7.30	7.49	0.30	11.90	
Karakaba	9.52	9.34	0.32	17.60	
Ozyok	8.41	8.69	0.35	13.40	
Sebystei	8.31	8.47	0.42	13.50	
Yustyd	8.17	8.46	0.42	14.20	
Berel	17.75	17.49	0.75	**36.10**	
Karakol	11.81	12.18	0.46	**58.80**	
Karakol – category 1	*9.11*	*9.43*	*0.34*	***18.20***	*(561 structures)*
Karakol – category 2	*27.86*	*28.71*	*1.12*	***58.80***	*(92 structures)*
Average total	9.93	10.28	0.43		

Table 5.4: The average dimensions of the Scythian burial mounds in the different research areas

We do not have any dimensions for 57 structures because they were excavated or destroyed and it was not possible to reconstruct their diameter or height. The average diameter of the other 1,574 mounds is 9.93 m north-south (NS) and 10.28 m east-west (EW); they are 43 cm high. These average dimensions do not have much meaning as such. However, there appears to be a discrepancy between the research areas: the numbers are lower in all research areas except for Berel and Karakol, where they are much higher: around 12 m for Karakol and even over 17 m for Berel. Apart from these, the average is only 8.48 m NS, 8.68 m EW and 0.37 m high (Table 5.4).

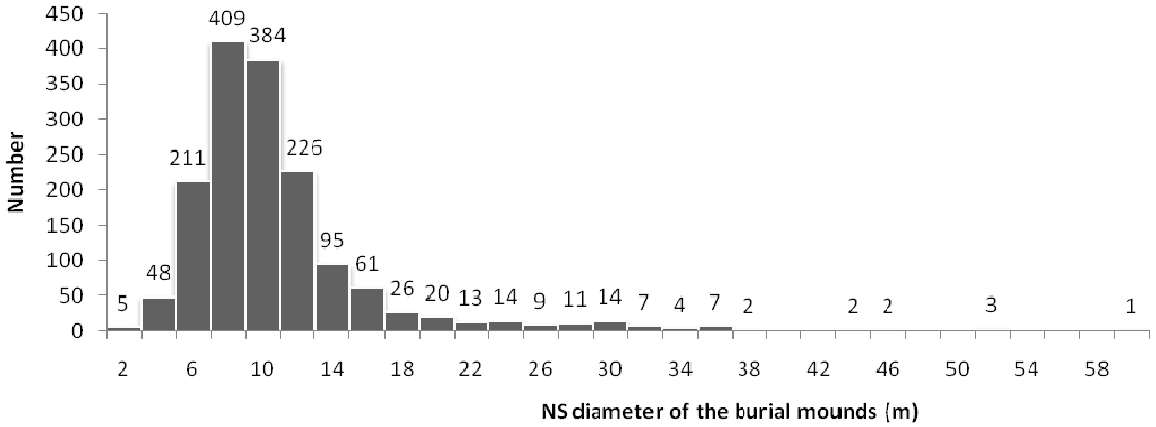


Figure 5.6: The NS diameter of Scythian burial mounds: 94% of the mounds are smaller than 20 m, and 793 are between 6 and 10 m in diameter (409+384)

There appear to be two well-defined classes of burial mounds. About 94% of the mounds are smaller than 20 m in diameter, and most mounds are between 6 and 8 m in diameter (409), and between 8 and 10 m (384) (Figure 5.6). In fact, except in Berel and Karakol, no mound in the other research areas has a diameter larger than 18.4 m. These mounds belong to the first category; the widespread normal burial mounds. In Berel, however, the largest mound is 36.10 m NS, and in Karakol it is as large as 58.80 m. Figure 5.7 shows clearly that these dimensions are exceptional. We are convinced that these larger mounds should be seen as a different class of monuments. Outside of Berel and Karakol, this category 2 is known from famous sites such as, among others, Tuekta, Bashadar, Shibe, Ten'ga and Pazyryk; the so-called 'royal' tombs. In our database, only eight mounds are over 40 m in diameter, 23 are between 30 and 40 m, and another 61 between 20 and 30 m.

It is difficult, however, to clearly differentiate between categories 1 and 2. What is the maximum dimension for a common Scythian burial? Our data seem to suggest that this figure should be placed around 18 to 20 m, since the maximum dimension of all mounds outside of Karakol and Berel is 18.4 m. Mounds larger than 18 to 20 m would then make up category 2.

In Karakol, both types are found together; 561 mounds are smaller than 18.4 m, while 92 are larger. If you consider these two classes apart, the average of 11.81 m for Karakol changes considerably. Category 1 fits perfectly within the numbers for the other research areas, with an average of 9.11 m NS, while the average for category 2 is no less than 27.86 m NS. Nevertheless,

it is difficult to defend this limit of 18 to 20 m (or 18.4 m in the extreme), although the differences between Berel and Karakol, on the one hand, and the other research areas, on the other, are striking.

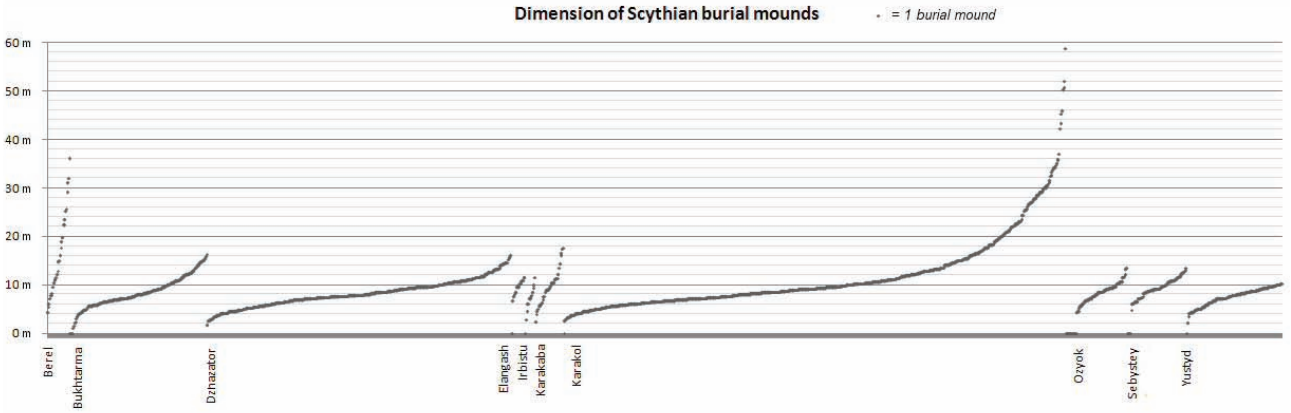


Figure 5.7: This somewhat strange graph shows the NS diameter of every individual burial mound in the database. It is clearly visible that most mounds are smaller than 18 m; only Berel and Karakol have mounds that double and even triple this maximum measurement

5.2.1.2 Alignments of burial mounds with associated structures

Scythian burial mounds appear grouped, in lines that are roughly north-south oriented. In our research areas, 332 such alignments were found, with an average of 4.9 mounds per row. The biggest alignment was found in Yustyd, with 28 mounds over a distance of 230 metres (site KA-233, see Figure 5.5 on page 177). On the other hand, 91 sites were found with only one burial mound.

The orientation of the burial complexes is generally roughly north-south, with an average of 6.1° over all research areas. However, the exact orientation varies considerably – most alignments have an orientation in the range of 344° to 33°, and there are even a few very clear exceptions in the range of 318° to 44° (Figure 5.8). Topography seems to be a very important factor. The lines are oriented along the course of a river, or against slopes, but always with some consideration of the cardinal directions. If a burial complex is built on large terraces and open areas with enough space, the alignments seem to start from the terrace border and appear to have a rather strict orientation towards the north or south, with an inclination of 6° to 11° to the east.

In contrast, when the location is not that spacious, there is a strong 'economical' factor. The lines are oriented to maximise the use of the available space. Examples include narrow terraces, or parts of valleys that are divided into smaller parts by gullies. In cases where the complex is built against a north- or south-facing slope, the row of mounds will be built at right angles to the aspect of the slope – and thus mainly to the course of the river – even if that means there is a strong inclination from the north-south axis. In Yustyd, four parallel lines of burial mounds are built this way, all with a declination of 13° to 30° to the west (sites KA-722, -741, -742 and -74, see the overview map of the eastern part of the Yustyd valley at the back of this volume or on the accompanying discs.

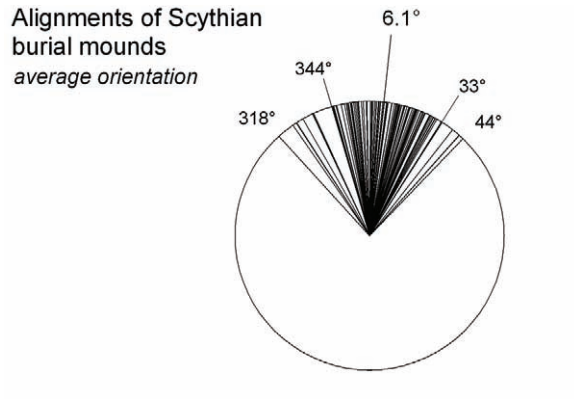


Figure 5.8: This diagram shows the orientation of the rows of Scythian burial mounds, with an average of 6.1°

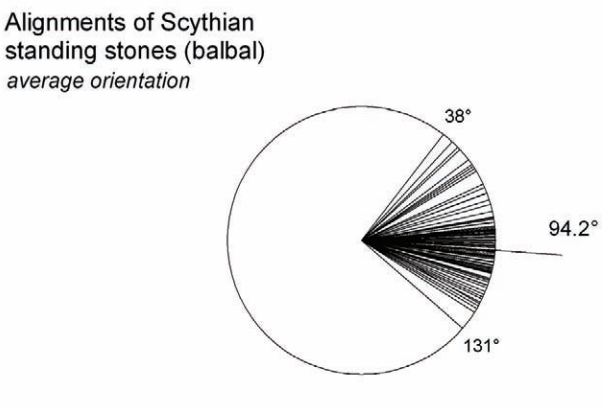


Figure 5.9: Average orientation of alignments of standing stones or *balbal* east of Scythian burial mounds

Typically associated with the burial mounds are different forms of ritual fire altars, used for burnt offerings. They come in two different forms: circular settings of jutted or buried stones, or low, circular stone concentrations or pavements (platforms) (see 5.8.1 and 5.9). They are mainly organised in parallel rows west of the burial mounds, and occasionally also in a single line east of them. In many cases, the circles and platforms appear to be paired, with a platform just west of every stone circle. Not all burial mounds have these associated structures, but most have at least one of the two types; we recorded 1,168 stone circles and 740 stone platforms in our research areas, for 1,631 mounds.

Alignments of standing stones are often constructed east of the burial mounds. This feature is characteristic, although only about one-third of the burial mounds actually have associated *balbal*. In Yustyd, for example, 34.4% of the burial mounds in the alignments have a row of standing stones. The number of *balbal* varies between 1 and 22, with an average of 4.7 stones per line.

The orientation of the rows of *balbal* depends on the orientation of the row of burial mounds; the lines of stones are mainly at right angles to the alignment of burial mounds, although there are some exceptions to this rule. The average orientation is 94.2°, while extreme declinations to the north and south are 38° and 131°. This means that they generally point slightly more to the

north than if they were at right angles to the burial mounds; 1.8° for the average, 10° for the northern extreme and 3° for the southern extreme, respectively. Although it is unclear what this means, it is certainly interesting and might be important.

5.2.1.3 Variables in site layout

We have seen quite a lot of variation in the typical site layout during our survey campaigns. The variable size of the burial mounds themselves has already been mentioned. The mounds are mainly placed in juxtaposition, with a small overlap, or with small interval, resulting in a very clear, condensed line. Site KA-050 in Ozyok is an exception; small groups of burial mounds and isolated mounds are placed in one long north-south alignment, with intervals of 50 to 250 m (Figure 5.10). With a total length of 720 m, this is definitely the longest line in our research areas, although it only has 17 burial mounds.

The organisation of the associated stone circles and stone platforms is not uniform. In Yustyd, for example, we noticed two types of Scythian burial complexes. The clearest example is site KA-741 where the two types are combined in one single row of burial mounds (Figure 5.11). Site 722 and the southern part of site 741 have only a single row of stone circles in the west, with rather clear, large stone circles. They also have a more elaborate layout in the east, with a row of stone platforms east of the rows of *balbal* (Type I). The northern part of site 741 is very different – it has some standing stones in the east, but a much more complex setting of stone circles and stone platforms in the west (Type II). First, there is a line of paired stone circles and stone platforms followed by several parallel lines of single stone circles or platforms. Some other complexes, for example KA-233 (Figure 5.5), are even more elaborate and combine Types I and II.

It seems most likely that these variations reflect changes in the funerary traditions. It is fascinating to see a shift between the two types in the same burial complex – could this mean that the funerary rituals were changing during the use of this graveyard?

In the Karakol valley, we see sites with a completely different layout than the usual Scythian burial site. Most of the bigger, category 2 burial mounds are not part of a row and do not have the usual associated standing stones, stone circles and stone platforms. In the west, they are surrounded by one or two curved lines of stone circles (Figure 5.12). These stone circles are always made of jutted rough stones that can be huge (Figure 5.13).

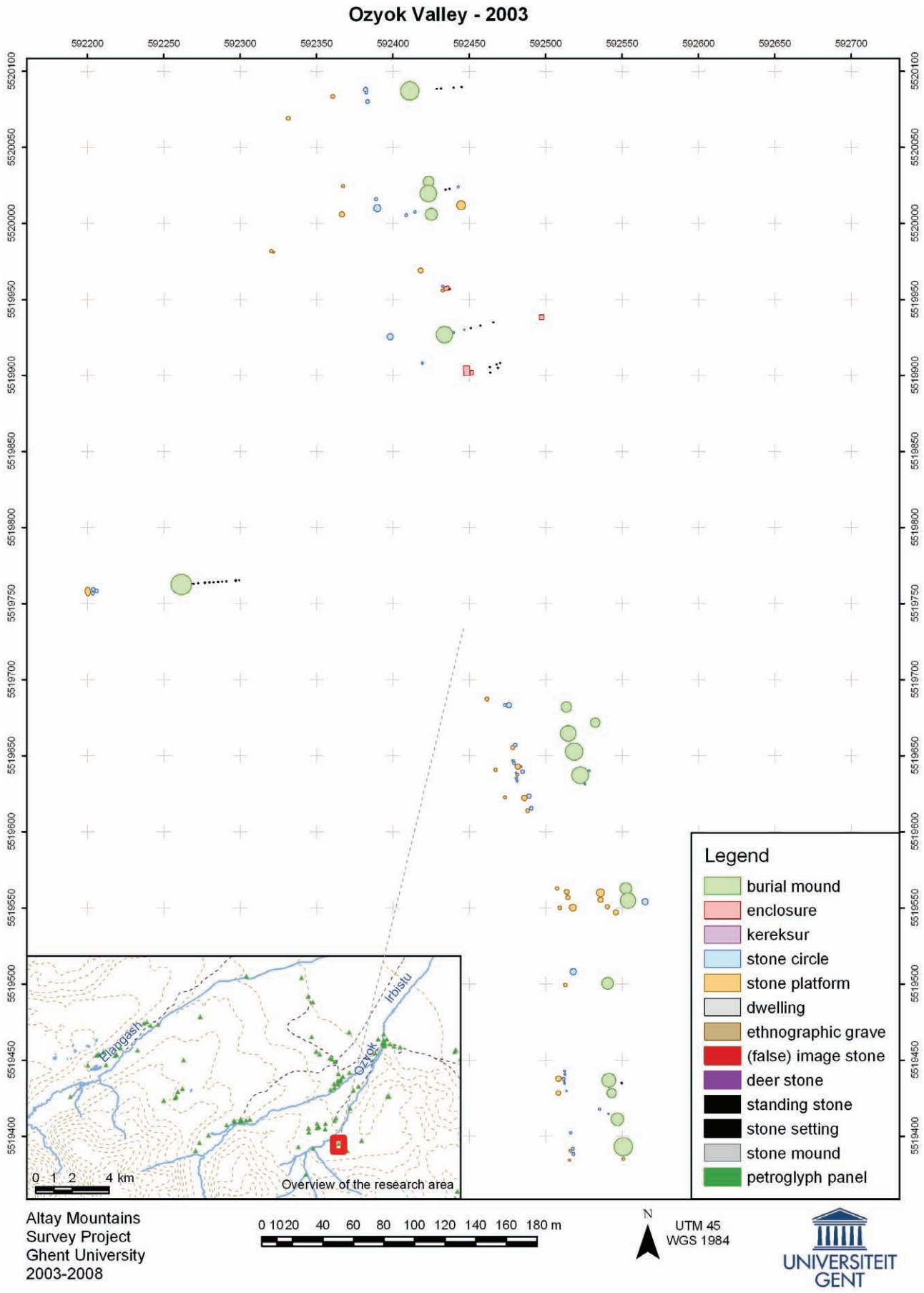


Figure 5.10: Site KA-050 in the Ozyok valley, stretching over more than 720 m

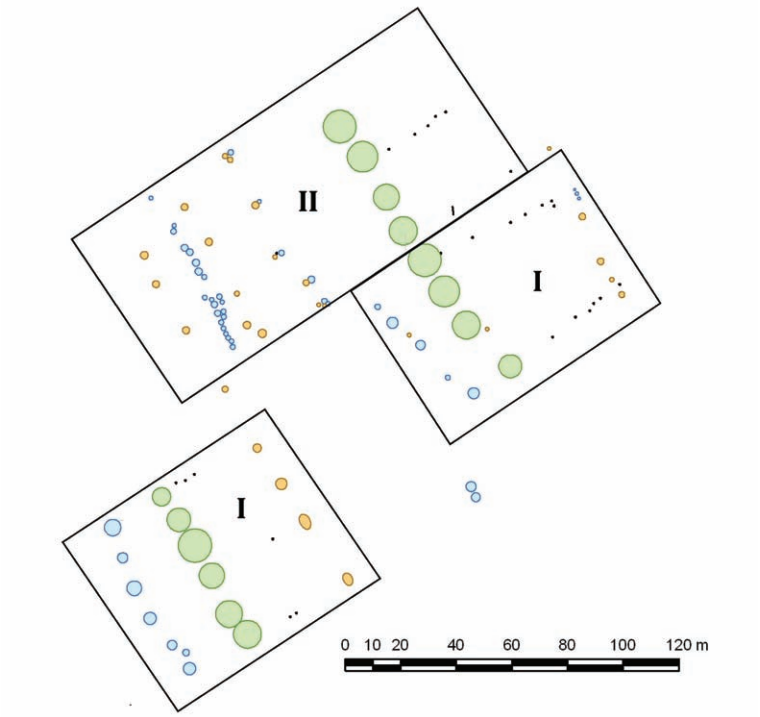


Figure 5.11: Site KA-722 (left) and KA-741 (right) in Yustyd have a different site layout. Site 722 and the southern part of 741 have only a single row of stone circles in the west, and a more elaborate layout in the east, with stone platforms (Type I). In contrast, the northern part of site 741 has only some standing stones in the east, and a complex setting of stone circles and stone platforms in the west (Type II)

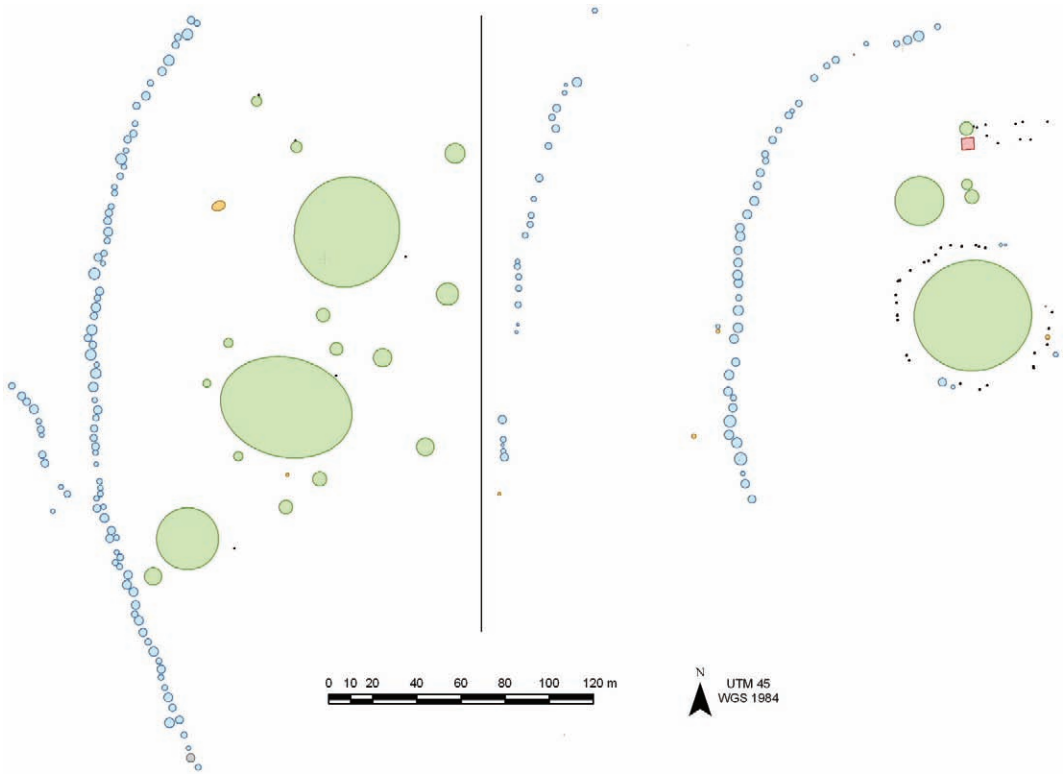


Figure 5.12: Typical site layout for the largest burial mounds in the Karakol valley, with one or two curved lines of stone circles west of the mounds. Left is site ON-022, right is site ON-042



Figure 5.13: The row of stone circles west of the burial mounds at site ON-022, seen from the south

5.2.2 Turkic burial mounds

Burial mounds of the Turkic period are located in small groups or appear individually, sometimes with one or more *balbal*. The mounds never have a central depression and are less earthed over than the Scythian burial mounds (Figure 5.14). Archaeologists in Russia and Mongolia have noticed larch posts projecting from the north or west side of the burial mounds that may be the remains of felled trees on which the skins of sacrificed horses were once hung. However, in our research areas we never found remnants of wooden posts.

Turkic burial mounds look different to Scythian burial mounds, but are not very easy to discern from other simple stone mounds. Defining them as Turkic in the database, therefore, is preliminary. During fieldwork in Russia, archaeologists told us that most isolated mounds could be considered as being Turkic, and many mounds were recorded thus in the database. E. Jacobson-Tepfer, however, assigns many of these mounds to the Bronze Age, especially if they are located against slopes and on hilltops or ridges. Most of the mounds in those locations are massive and built with heavy boulders, so her interpretation could be right. In that case, we will have to reconsider the chronology of many of the Turkic burial mounds in our database. It is quite difficult to confirm either one of these interpretations as these isolated mounds are rarely excavated.



Figure 5.14: A Turkic burial mound in Irbistu, at the border of the Chuya basin (site KA-038)

5.2.2.1 Turkic burial mounds in the research areas

We recorded 455 Turkic burial mounds during our research. As mentioned above, it is possible that some of these are actually Bronze Age mounds. In particular, in Elangash, Irbistu, Sebystey, Ozyok and the southern part of the Chuya steppe we have recorded mounds that are located against the hills, overlooking the valleys or the Chuya steppe.

Total	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARba*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CHU*
455	3	0	30	15	25	1	243	8	0	23	61	46

Table 5.5 Number of Turkic burial mounds in the different research areas

The 243 Turkic mounds from Karakol are a different type of monument – we have already mentioned them briefly during discussions on the definition of a 'site' (3.3.4). In Nizhniy Sooru, a small tributary valley to the south of the village of Kulada, we recorded dozens of these structures. This site is very complex: it starts from long north-south rows of Scythian burial mounds, some of which are quite large – up to 50 m (site ON-062, Figure 5.15). Both rows are split by a broad gulley running from east to west – the empty zone shown in the middle of the plan. In-between the Scythian alignments there are dozens of smaller stone mounds, organised in roughly east-west oriented lines, which seem to be Turkic burial mounds. They take the form of small, high mounds that are neither sunken nor earthed over. Long parallel alignments of *balbal* stretch out to the north, which is very unusual. We see the same pattern, although in smaller numbers, in at least two other sites in Karakol (ON-021 and ON-075). The association with Early Nomadic burial mounds is consistent, so the mounds and *balbal* are either contemporary or of a later date, most probably the Turkic period. However, the north-south alignment is exceptional and could indicate that the monuments should be assigned to another period. It would be very interesting to know more about these structures, and to clarify their link with the Scythian monuments.

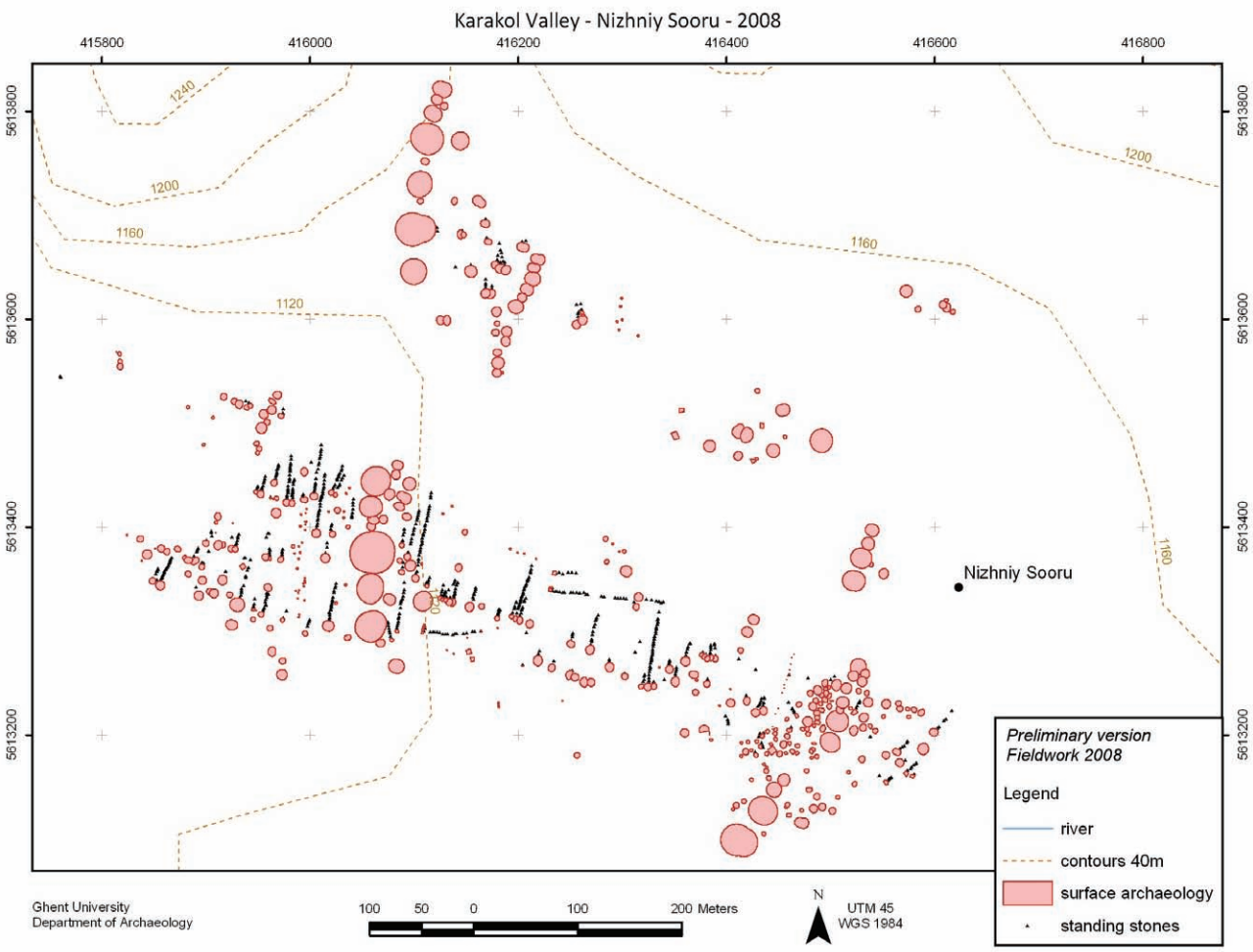


Figure 5.15: The preliminary site plan of Nizhniy Sooru, in the Karakol valley (site ON-062). The bigger circles are rows of Scythian burial mounds while the smaller ones with lines of standing stones to the north of them are possibly Turkic mounds

5.2.3 Hunno-Sarmatian burial mounds

Burial mounds from the Hunno-Sarmatian culture (Iron Age, 2nd cent. BCE to 5th century CE) are well known in some regions of the Russian Altay Mountains. Archaeologists have found extensive graveyards with dozens of relatively small, oval-shaped graves (see 1.3.2.4). Their size varies from 2 to 5 m in diameter, and they are always very low, sometimes merely a pavement of stones. In most cases, the mound is demarcated by a sometimes clear oval-shaped border of stones.

The graves are mainly found in groups, generally consisting of several parallel rows along the north-south axis. The graves themselves are oriented towards the east and west. In general, the burial sites can be found on river terraces or flat areas. In many cases, they are placed close to or in the middle of larger Scythian burial mounds, as is shown by this example on the Ukok plateau, site Ust'-Akkol -1 (Figure 5.16). It is located in-between three burial mounds (named site Ust'-Akkol-4) and consists of 42 oval-rectangular burial mounds measuring 6 m long and 3 m wide. Structure 3 was excavated by V. Molodin in 1994 and the findings (a burial with a wooden sarcophagus) were dated to the Hunnic period (Molodin et al. 2004: 153-155).

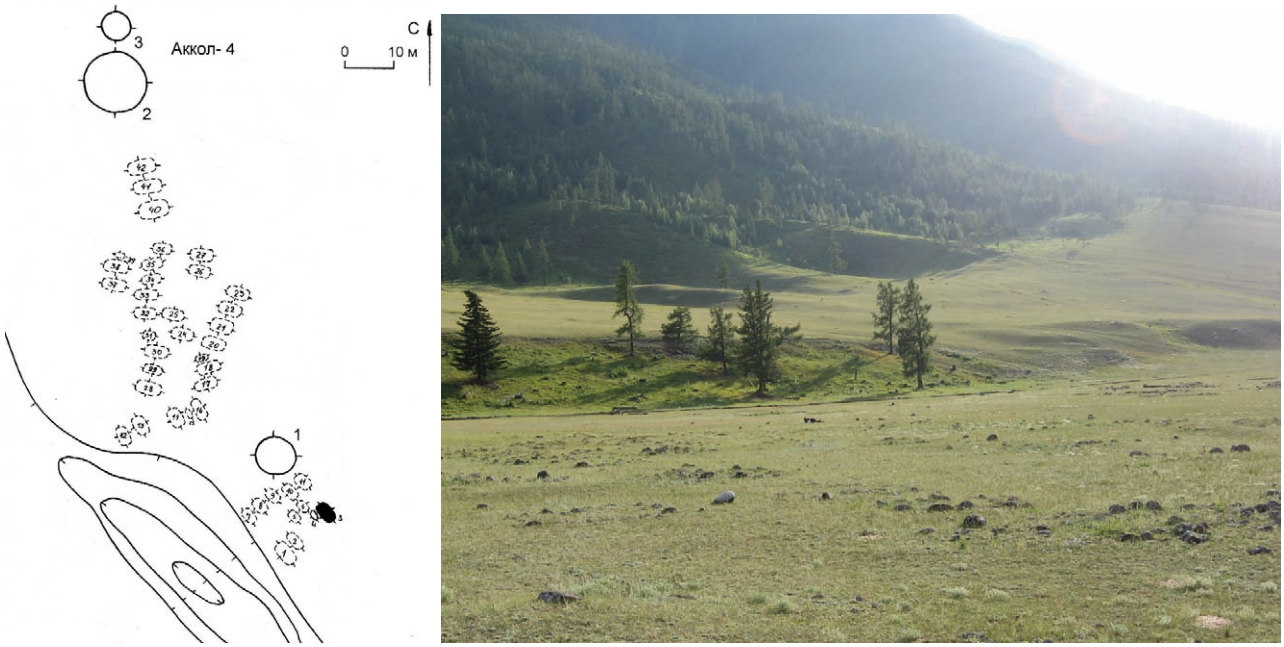


Figure 5.16: A group of small, oval-shaped Hunno-Sarmatian graves on the Ukok Plateau: site Ust'-Akkol -1, recorded by V. Molodin in 1994 (Molodin et al. 2004: 153-55), and an overview of site KA-059, with rows of small Hunno-Sarmatian graves (right)

5.2.3.1 Occurrence in the research areas

We now have information about 192 Hunno-Sarmatian burial mounds in our research areas. Some problems with the definition of these Hunno-Sarmatian monuments were encountered during our first year of survey. We recorded dozens of relatively small stone concentrations (2x1m, 3x2m etc.) in the southern part of the Chuya depression, and dated them to the Hunno-Sarmatian period, mainly due to lack of experience. It soon became clear that most of them where located in association with Scythian burial complexes, where they were paired with the ritual stone circles to the west of the burial mounds; they are ritual 'stone platforms' and not late Iron Age graves (see 5.9).

Total	*BER*	*BUK*	*DZH*	*ELA*	*S-CHU*	*KARa*	*KARol*	*OZY*	*SEB*	*YUS*
192	2	128	10	-	3	-	34	3	4	8

Table 5.6: Overview of Hunno-Sarmatian burial mounds in the different research areas

Most of the 192 burial mounds are located in small groups, or are isolated. In the Bukhtarma valley, we discovered a typical Hunno-Sarmatian burial place, with 109 graves nicely placed in parallel rows, and several monuments from other periods (KK-059, see Figure 5.17). The site layout is comparable with the Ust'-Akkol-1 site on the Ukok Plateau (Figure 5.16).

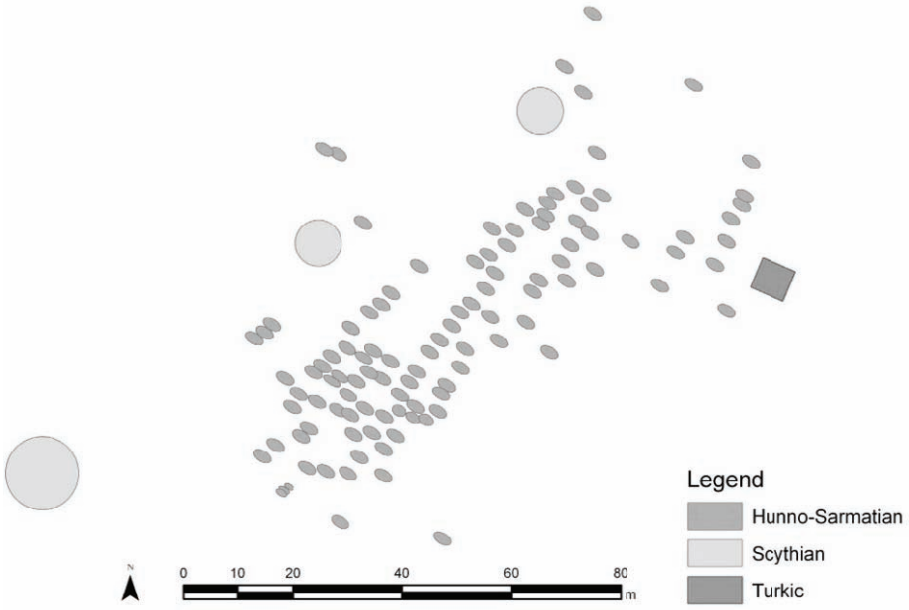


Figure 5.17: Site KK-059 in the Bukhtarma valley, consisting of 109 Hunno-Sarmatian graves and some structures from other periods (for full site plan, see DVD 2)

5.2.4 Mounds with a demarcating stone setting or 'collared mounds'

Some mounds are clearly marked by a circular setting of stones at their borders. The stones are generally of regular size, somewhat bigger than the stones used for the mound itself or in contrasting materials (e.g. river boulders instead of small rough stones). The mound can be massive, in which case it resembles a *kereksur*, or very low, like the regular-shaped example in Figure 5.18.

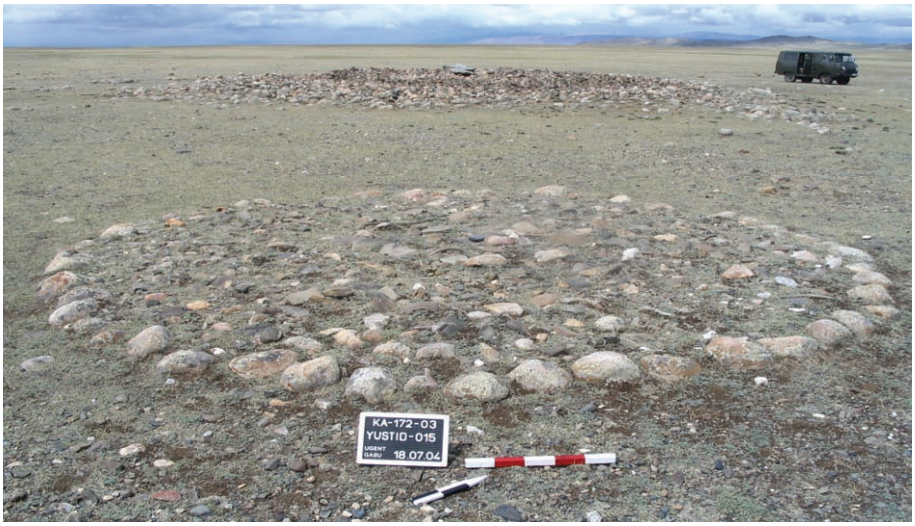


Figure 5.18: Low collared mound in Yustyd, tentatively dated back to the Bronze Age (structure KA-172-003)

The date of these structures is still unknown. V. Kubarev suggests in his overview of the archaeological surface monuments in the Kosh-Agach region that the massive mounds should be seen as burial mounds from the Late Bronze Age, whereas the low collared mound is a 'ritual

burial mound' of unknown date (Kubarev 1980: 88-89). E. Jacobson-Tepfer agrees with the Bronze Age attribution for the massive mounds, and places the 'low mounds' tentatively in the same period. In northwest Mongolia, they are always found together with massive collared mounds and *kereksur*, but never with Scythian burials[21].

A special variant of the collared mound is what E. Jacobson-Tepfer calls the 'toothed collared mound'. These have a border of standing stones or slabs that are tilted inwards towards the centre of the mound. Like the other collared mounds, they are generally dated to the Bronze Age. In our database, these structures simply belong to the category of collared mounds, although the characteristics are mentioned in the description of the monument.



Figure 5.19: A clear and undisturbed example of the so-called toothed collared mounds was found somewhat north of Yustyd in the Chuya steppe, where the Bar-Burgazy River flows into the Chuya basin. This site has not been recorded in the database yet

5.2.4.1 Collared mounds in our research areas

Until now, 30 mounds have been recorded as being collared mounds, most of which are located in the Yustyd valley. A special example of collared mounds is site KA-373 in Yustyd. It is a north-south alignment of four burial mounds, of which the two most southern ones have a very clear circular stone setting (Figure 5.21). The burial site is constructed just north of a large round *kereksur*. This seems to point to a continuation from the Bronze Age well into the Early Iron Age – this layout was found repeatedly in the different areas (see 6.5.3). Is it possible that the two first mounds with the collar pre-date the two typical Early Iron Age burial mounds, and form the link with the *kereksur*? This would suggest that the burial site is built from south to north (see 6.5.1).

[21] Jacobson-Tepfer, Esther. Letter to author, 01-10-2008.

Total	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARa*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CHU*
30	-	-	1	-	1	-	-	3	-	1	24	-

Table 5.7: Occurrence of collared mounds in all research areas

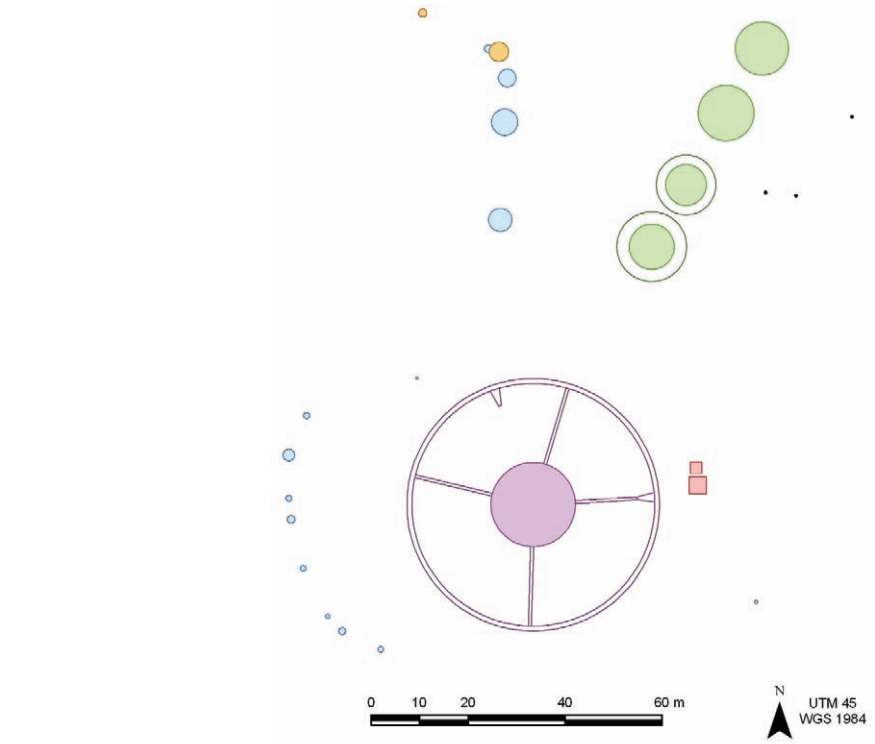


Figure 5.20: Collared mounds occasionally appear in north-south aligned rows of Early Iron Age burial mounds, as shown by this site plan of cluster KA-373 in Yustyd (see data disc for full site plan)



Figure 5.21: Collared mound KA-373-001 in Yustyd, with a clear circular setting of stones at the edge

5.2.5 Four-cornered mound, with or without marked border

Four-cornered mounds are a very specific type of structure. They are rarely found in the Russian and Kazakh part of the Altay Mountains and are more current in the archaeological heritage of the Mongolian Altay. The most characteristic element is the presence of impressive boulders on the four corners, and sometimes in the centre. These big stones are often really eye-catching, being made out of shiny conglomerate and light in colour. The mounds can be square or round, in which case the boulders are placed along the edges as if the circle has four corners. In both cases, the mound is very low and is mainly bordered with stones in juxtaposition. They are generally aligned with their sides to the four quarters. In Mongolia, they are found alone or in small groups, frequently in proximity to a *kereksur*. The four-cornered mounds have been definitively identified as modest Bronze Age burials[22].

In 1979, A. Surazakov investigated a site on the southern border of the Chuya steppe where the Irbistu and Ozyok Rivers merge and reach the steppe (Surazakov 1988). He named the site Irbistu-1 and divided it into three parts – it is recorded in our database as numbers KA-109 to KA-119. During the expedition, Surazakov and his team excavated 15 monuments. One of the burial mounds appears to be a four-cornered mound. It was not recognised as such during the fieldwork of 2003 as it was destroyed by the excavation. The structure is 3.4 m by 2.6 m, and its sides are oriented to the four quarters. All corners, except the north-eastern one, have standing stones. Surazakov found a burial pit in the centre of the mound, 0.56 m by 1.6 m wide and oriented along the east-west axis. Inside was a human skeleton, placed on its left side with the head to the west. No grave artefacts were found, and the report does not give a possible date for the structure.

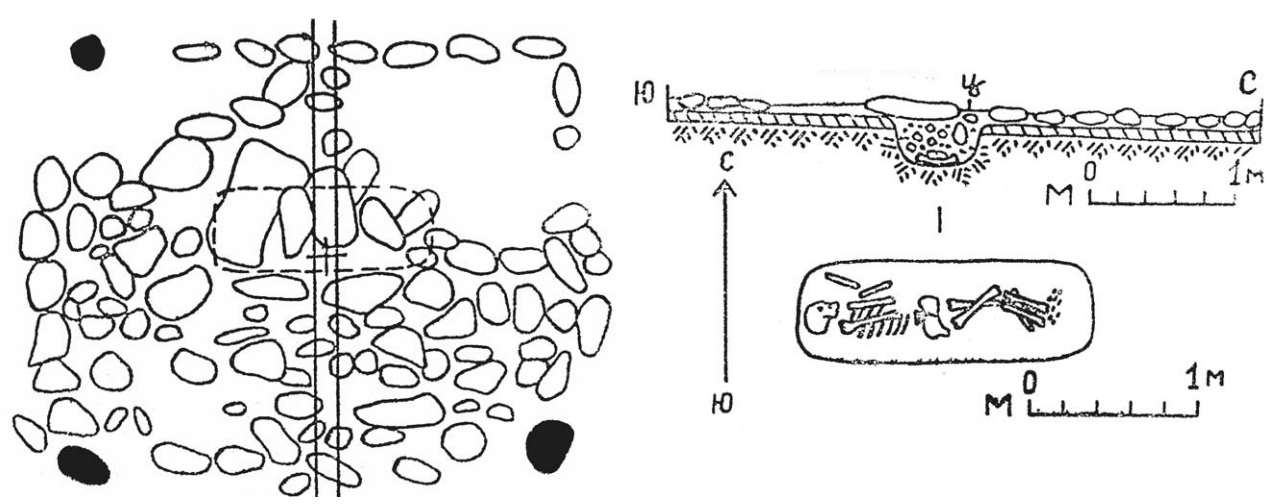


Figure 5.22: Layout, transect and burial pit of the four-cornered mound that was excavated by S. Surazakov in Irbistu in 1979: site Irbistu-1, 'enclosure' no. 7 (Surazakov 1988: Figure 5)

[22] Jacobson-Tepfer, Esther. Letter to author, 01-10-2008.

In his overview of the archaeological monuments in the Kosh-Agach region, V. Kubarev mentions the four-cornered mounds, referring to them as ‘stone settings’ (Figure 5.1, structure 7). He gives no further interpretation or chronological attribution (Kubarev 1980).

5.2.5.1 Four-cornered mounds in our research areas

Except for the possible four-cornered mound in Irbistu that was excavated and was therefore no longer visible, we only found this striking structure type in Yustyd. Site KA-350 is situated on a somewhat higher part of the terrace on the right bank, against the northern hills. It is a cluster of 11 ‘four-cornered’ structures, most of them round and with a clear circular stone setting along the borders. The corner stones are not always present, and only one structure has a clear massive stone in the centre. Just to the south and east of them were some remnants of rectangular stone settings or dwellings. This relationship is interesting and is not the only example; the four-cornered mound in Surazakov’s Irbistu-1 site was also found in association with very clear examples of dwellings. Moreover, Surazakov interpreted the four-cornered mound as a variant of the dwelling he excavated in its surroundings (Surazakov 1988: 34). This close relation could help to define a date for the dwelling structures (see 5.6 for more information).

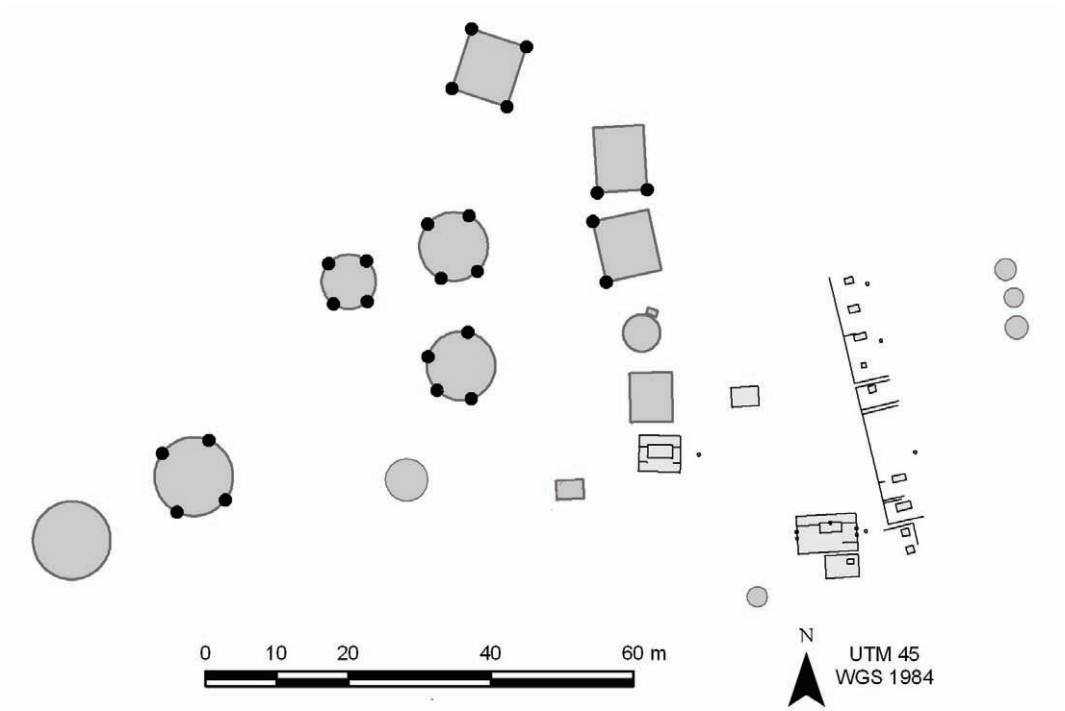


Figure 5.23: Plan of site KA-350 with round and rectangular four-cornered mounds, interestingly associated with different types of dwellings (see data disc for full site plan)



Figure 5.24: Four-cornered mounds can be square (left) or round (right), and the 'corners' are accentuated by massive standing stones: site KA-350 in Yustyd, fieldwork 2004

5.3 Kereksur monuments

The *kereksur* – also called *khirigsuur* or *khereksur* – is one of the major archaeological monument types of the Bronze Age and Early Iron Age in the Mongolian steppe and Central Southern Siberia. *Kereksur* can be found in the western two-thirds of Mongolia, in the regions to its north-west (Tuva, Gorno-Altay) and to its north (east and west of Lake Baikal). It is a very special type of structure and is considered here as a discrete category because of its very distinctive and complex layout.

5.3.1 General layout

Kereksur are highly variable in form, but they share some common and highly distinctive features. A quite large and high central mound forms the centre of the monument. The diameter varies from several metres up to 30 m and more, and a height of up to several metres. The mound is enclosed by a circular or quadrangular fence of surface stones (also called 'wall', 'bank' or 'frame'), which can be up to 100 m in diameter. Mound and fence are sometimes linked by rays, made by single stone settings or real stone banks (also referred to as 'spokes', 'radii' or 'paths'). In other cases, a type of pavement or platform fills the area between the mound and the fence.

Next to this internal organisation, there is a whole array of features outside of the fence, including small stone circles, standing stones, mounds and other stone pavements. This layout can be very complex, particularly in Mongolia, and may include components not present in the *kereksur* in the Russian Altay. In our research areas, the associated structures are mostly limited to small stone circles that are usually found on the west and north sides, and occasionally to the east and south. In some cases, there are some small satellite mounds to the east or south of the *kereksur*. An overview of all possible additions parts is given in Table 5.8. Both the size, form, internal and external organisation of *kereksur* can be highly variable, even if they are found in the same group or even next to each other. In particular, the associated ground level features or additional parts can appear in many different forms, varying in type, location in the *kereksur* site,

and orientation. These associated features are meaningful and enable us to make a typology of the monuments.

Type of associated feature	*Definition*
Mound	Stone mound located in the centre of the *kereksur*, the main part of the monument
Fence/wall/frame/bank	Round or rectangular bank of stones built around the mound
Rays/spokes /radii/ paths/arms	Line or bank of surface stones, connecting the fence with the mound; mainly four with square *kereksur* and four or more with round *kereksur*
Stone circles/satellites	Circular stone setting placed outside of the fence: mainly in the west and north, but possibly all around
Satellite mounds/satellites	Small stone mounds arranged around the *kereksur*: mainly in the east
Corners/corner mounds	In some cases the corners of a quadrangular fence is accentuated by small stone mounds or standing stones
Standing stones	Standing stones at the corners of, on top of, or around *kereksur*
Pavements	*Regularly shaped cobble surfaces appearing in various places inside and outside the fence*
Porches	*Blocks of pavement protruding from the kereksur and sometimes connecting the mound and the fence*
Negative circles	*Circular alignments that make a complete circle, usually within the fence, creating a negative space in contrast to the mound*
Slab burials	*Bronze Age and Early Iron Age burials commonly found in Mongolia but not in Altay: sometimes integrated into the kereksur*
Cardinal corner stones	*Single stones placed away from the mound at cardinal points*

Table 5.8: Different parts of *kereksur* monuments. The types in *italic* are not found in our research areas and were taken from a study by J. Wright (Wright 2007: 355, Table 1)

5.3.2 Interpretation and chronology

The monuments are generally considered to be ritual structures. In central Mongolia, *kereksur* appear to have functioned as burials sometimes, but most of the time they are found empty. Cists of stone slabs can be found inside the central mound, but they rarely contain artefacts or inhumations. Many *kereksur* probably served a non-funerary function (Allard & Erdenebaatar 2005). Within the Altay-Sayan region, their function is uncertain – it is either funerary or memorial or related to other ceremonies. An interesting monument is the Beiram mound, a *kereksur* located at the top of a mountain pass in Uvs aimag, western Mongolia; a large stone mound with a circular fence, four rays connecting the fence with the central mound, and a circle of stone circles all around the structure. In June 1999, a joint American-Mongolian expedition

excavated the mound and discovered over 4,000 votive objects between the stones, covering all different periods from the Early Iron Age up to the Middle Ages. An *ovoo* was constructed in the north side of the mound in the 1930s: it is still in use today and seems to be a continuation of the ritual function of the older monument. No skeletons or funerary objects were found (Davis-Kimball 2000). It is worth mentioning, however, that on the left bank of the River Yustyd, the archaeologist V. Kubarev excavated two stone mounds with a square enclosure, and discovered several burials (Kubarev 1991: 39, see also plates LXIII to LXV).

Alongside this ritual or burial function, Allard and Erdenebaatar suggest several other functions for the *kereksur*. They may be reminders of ancestral links to specific sectors of the landscape. This seems very probable as the locations of the *kereksur* in our areas point in the same direction. In Elangash, the most important clusters of *kereksur* are situated at the only place where there is an opening in the hills to go to the Chagan valley and the present-day village of Beltyr; the passageway could have been important in earlier times, as it is still today. In Yustyd, the largest known *kereksur* in the Russian Altay is built on a small elevation in the wide-open valley, right at the spot were it opens completely into the Chuya steppe. It is over 90 m in diameter and can be seen from far away. Yustyd has dozens of smaller *kereksur* monuments, but these are clustered deeper in the valley. The big *kereksur* seems to act as a marker, a beacon which must be passed before entering Yustyd. Hatakeyama marks that *kereksur* in Mongolia are located on the gentle slope toward the south of the east, at the foot of a mountain or hill, so as to give a better overview of the complicated plan of the complexes (Hatakeyama 2002).

Kereksur are generally dated to the Bronze Age and seem to have been built between the mid-late second millennium BC and the seventh century BC. Excavations in central Mongolia by F. Allard and D. Erdenebaatar yielded the following ^{14}C dates: 1390-910 BC (2 σ) for structure KYR 57; 930-785 BC (2 σ) for structure KYR 119; and 1040-850 BC and 975-680 BC (2 σ) for structure KYR 1 (Allard & Erdenebaatar 2005).

5.3.3 Overview of the types of *kereksur* in our research areas

The database now includes 169 *kereksur* monuments (Table 5.9). Most of these were found in the Yustyd valley, where 129 *kereksur* are spread over the river terrace and the alluvial plain. Another important cluster of *kereksur* is located on the western border of the Chuya steppe along the Elangash River, some 10 km south of the village of Ortolyk. The other monuments are spread along the southern border of the Chuya steppe, where the Sebystey, Ozyok and Irbistu rivers enter the steppe. Only two possible *kereksur* were found in Dzhazator, and the research areas in the Kazakh Altay and in Karakol have no *kereksur* at all. So it is clear that the *kereksur* phenomenon is linked with the eastern part of our research areas – a region with a very specific landscape and close to the borders with Mongolia (see Chapter 6). The *kereksur* are mostly found in clusters, although some isolated monuments are known. Typical complexes range from a few monuments up to dozens of structures that cover a vast area. They are usually located on broad plains or overlooking vast steppes, especially at passageways through hills or at the opening of small valleys into large ones.

Total	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARba*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CHU*
169	-	-	2	2	2	-	-	4	-	6	129	24

Table 5.9: Distribution of *kereksur* over the different research areas

5.3.3.1 Round and square kereksur

The main characteristic of the *kereksur* is its form. This is defined by the fence, which can be circular or quadrangular (Figure 5.25). Almost 70% of all *kereksur* in our research areas are round (118), while the other 30% are square (51). Figure 5.27 gives an overview of some of the common types of round *kereksur*. They do not all have a clear circular fence; 22 of them have no fence but merely a circular stone setting around the mound. They are seen as a simplified form of the *kereksur*. The difference with other stone mounds or burial mounds is that they mainly have typical associated structures, most of which are stone circles, and the shape of the mound is very similar to other *kereksur* mounds. Rays connecting the mound with the fence are rather common; about 30% of the round *kereksur* has at least one ray. Most round *kereksur* (85 or 72%) are accompanied by small stone circles, while only five have clear satellite mounds.

Figure 5.28 gives an overview of the different types of square *kereksur* in our research areas (Figure 5.26). Like round *kereksur*, square ones can have rays extending from the central mound to the outer wall (11 *kereksur* or 21.6%). The rays usually start at the corners of the fence. It is common to find the corners marked by piles of boulders or by single large boulders or standing stones – exactly one-third of the square *kereksur* had these accentuations. Almost 60% of the square *kereksur* have small stone circles outside of the fence, and only 7.5% have satellite mounds.

Kereksur	*Number*	*Percent %*	*Round*	*Percent %*	*Square*	*Percent %*
	169	100.0				
Round *kereksur*	**118**	69.8	**118**	100.0		
Square *kereksur*	**51**	30.2			**51**	100.0
Platform *kereksur*	**34**	20.1	**31**	26.3	**3**	5.9
No fence	**22**	13.0	**22**	18.6	**0**	0.0
Rays	**47**	27.8	**36**	30.5	**11**	21.6
Marked corners	**17**	10.1	**0**	0.0	**17**	33.3
Small stone circles	**115**	68.0	**85**	72.0	**30**	58.8
Satellite mounds	**9**	5.3	**5**	4.2	**4**	7.8

Table 5.10: Numbers of the different kinds of *kereksur* in the research areas, with an indication of the most characteristic features – first for all *kereksur*, then for both round and square *kereksur*

A comparison of the ratio of round and square *kereksur* in our research areas with the numbers from the Lower Egiin Gol research area (Wright 2007) and the Khanuy valley (Allard &

Erdenebaatar 2005) in Mongolia shows a striking difference (Table 5.11). In our research area, most *kereksur* are round (65%); in Mongolia, this is quite the opposite (36% and 19%). It is not known if there is a functional difference between round and square *kereksur*. One hypothesis is that square *kereksur* were intended for female dead and round *kereksur* for male dead, but this seems somewhat far-fetched, especially as excavations do not reveal such a pattern, and the *kereksur* clearly were not necessary burials.

Kereksur	*Lower Egiin Gol*		*Khanuy valley*		*Our research areas*	
	137*	100%	27	100%	147°	100%
Square	88	**64%**	22	**81%**	51	**35%**
Round	49	**36%**	5	**19%**	96	**65%**

Table 5.11: Proportion of round and square *kereksur* in different research areas. (*) Elaborated *kereksur* (28) are excluded, as there is no mention of the shape of the fence. (°) Round *kereksur* without a fence (22) are excluded

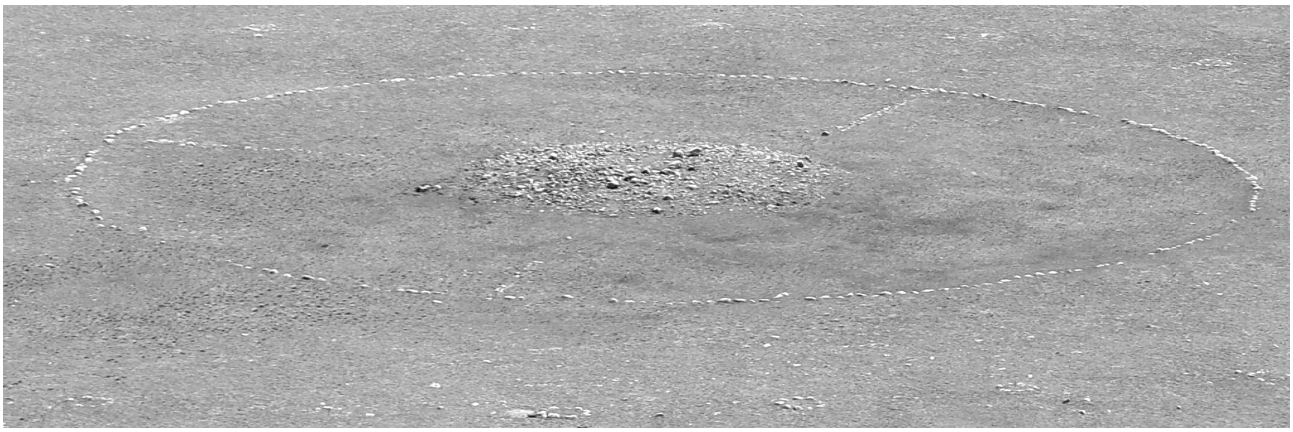


Figure 5.25: A typical round *kereksur* in Yustyd: central mound, round fence, three rays and associated small stone circles (foreground and background) are clearly visible



Figure 5.26: A typical square *kereksur* in Yustyd: central mound, rectangular fence, two rays and associated small stone circles (foreground and background) are clearly visible

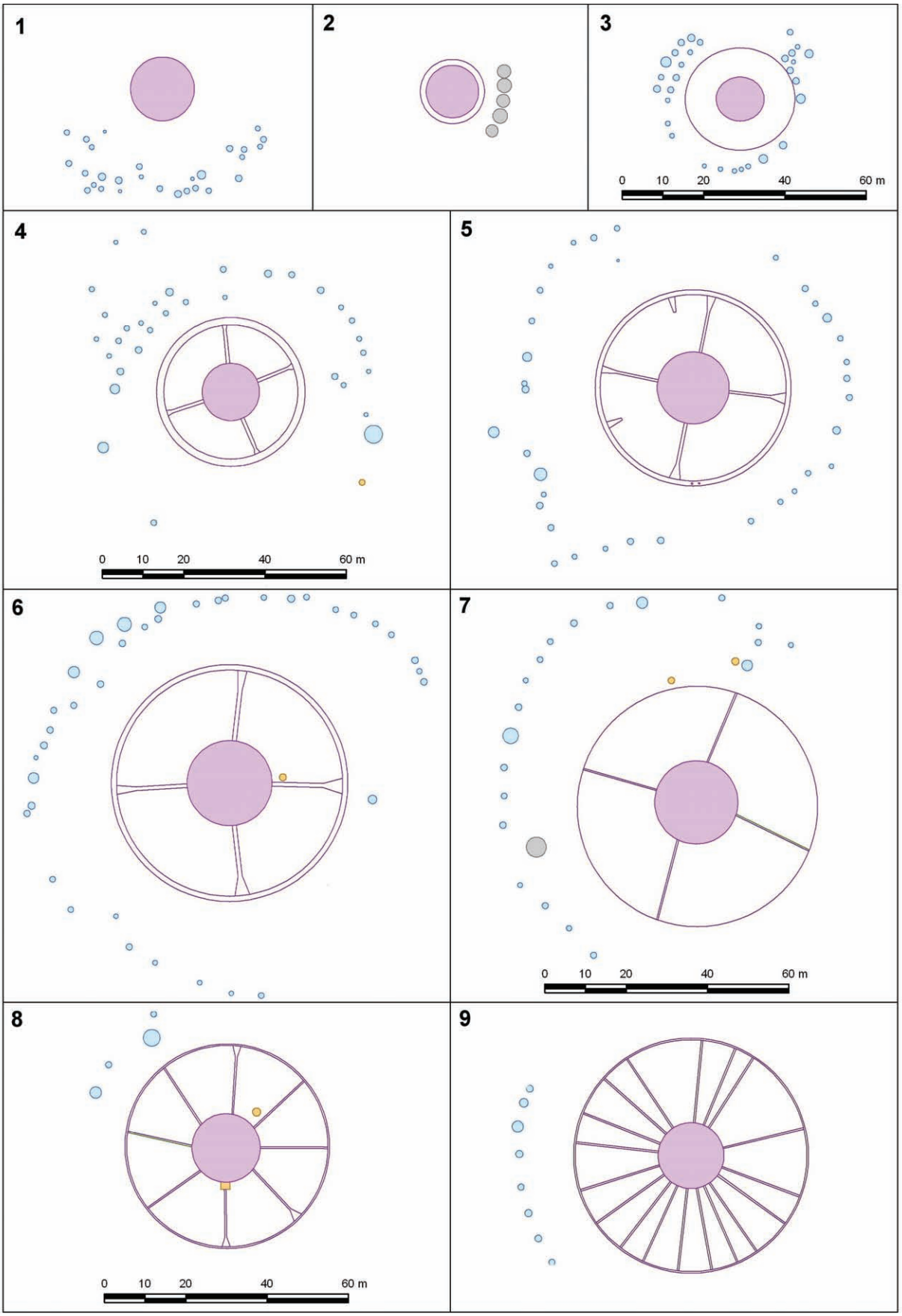


Figure 5.27: Different types of round *kereksur*: 1) without fence, 2-3) fence, but no spokes, 4-7) fence and four spokes, 8-9) round *kereksur* with multiple spokes

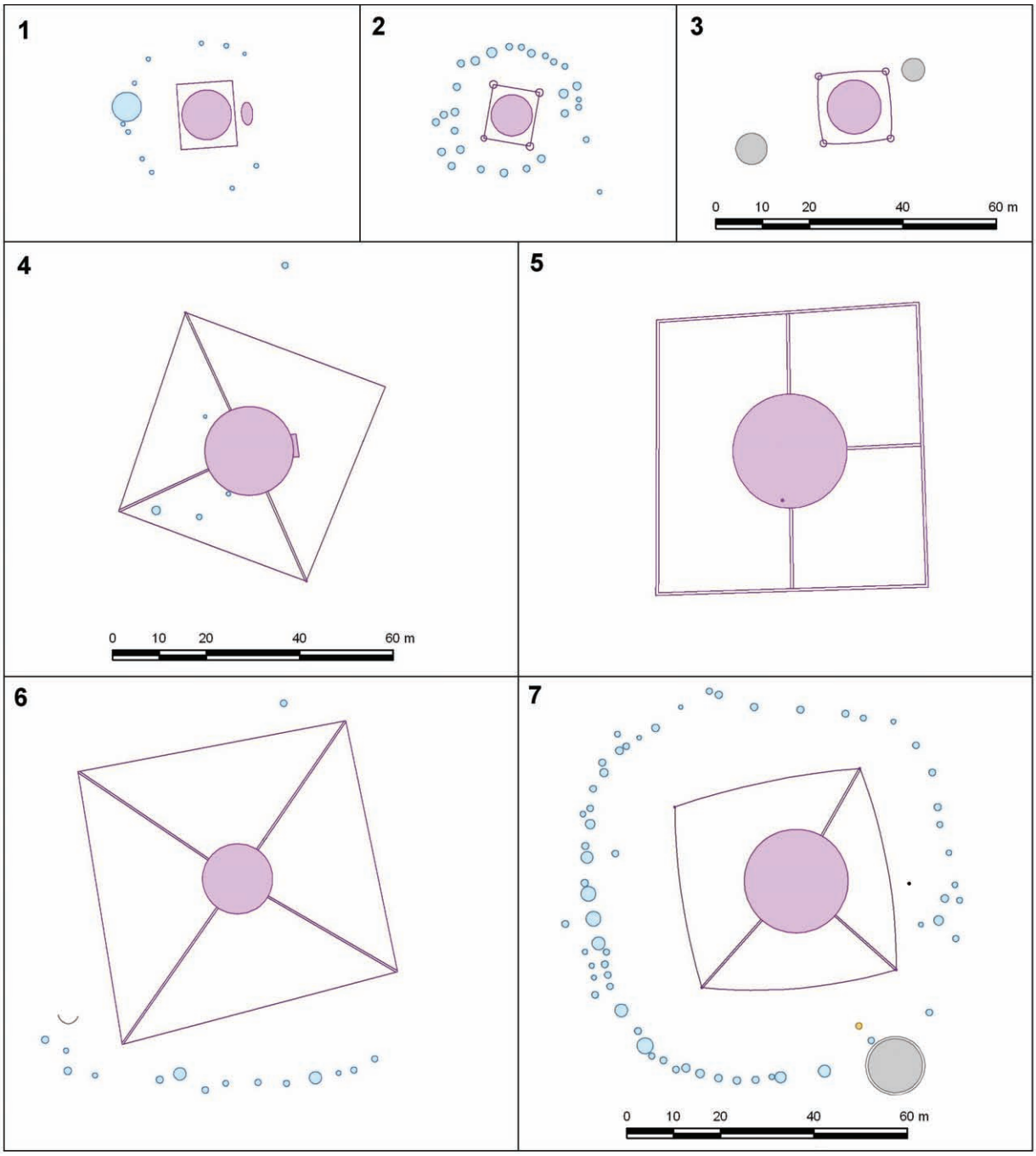


Figure 5.28: Different types of square *kereksur*: 1) simple fence, 2-3) fence with corner mounds, 4) fence and spokes going to the corners, with standing stones on the corners, 5) rectangular *kereksur* with spokes going to the sides, 6) *kereksur* with four spokes, 7) *kereksur* with curved sides, spokes and standing stones on the corner

5.3.3.2 Platform kereksur

Sometimes the area between central mound and fence is covered by a pavement of pebbles or boulders, giving the impression that the central mound consists of two levels. These are called platform *kereksur*, of which 34 were recorded (20.1 % of all *kereksur*). The pavement can be quite high, up to 30-40 cm, and built of boulders, or it can also be very low, simply comprising a scattering of smaller stones and quite well earthed over. Platforms mainly occur with round *kereksur* (31, or 26.3% of the round monuments). The square *kereksur* rarely have a platform – only three are known.



Figure 5.29: Two examples of platform *kereksur*; left, a low and 'light' platform (site KA-202 in Yustyd), right, a much larger platform *kereksur* (site KA-717 in Yustyd)

5.3.3.3 Boulder *kereksur*

E. Jacobson-Tepfer mentioned the existence of a special type of *kereksur* in her research areas in mountainous Bayan lgiy aimag, in north-western Mongolia. There is no central mound in these monuments, but a huge, naturally located boulder around which has been arranged an extended skirt and external fence. These 'boulder *kereksur*' are generally found at the base of rocky slopes or cliffs from which the boulders presumably rolled. They are particularly interesting since they may suggest something about the conceptual origins of the *kereksur* as a monument type itself[23].

This type of *kereksur* does not appear in our research area, but one *kereksur* in the database does have a couple of the above-mentioned characteristics. However, the centre of these monuments is not one boulder, but an accumulation of a few very heavy boulders – an estimate of 200 to 400 kg was made during fieldwork – that seem to have rolled from the rocky outcrops. Smaller stones have been put on top to make a real 'mound', and a circle of stones is built around it. The structure KA-093-001 overlooks the Chuya steppe, just east of where the Sebystey valley opens into the steppe.

[23] Jacobson-Tepfer, Esther. Letter to author, 10-10-2008.



Figure 5.30: The KA-093-001 *kereksur* could be a variant of the Mongolian boulder *kereksur*. Some of the boulders inside the circular stone setting are huge and seem to have rolled down from the hill

5.3.4 Analysis

The complexity of the typology of the *kereksur* and the variety of associated features present some possibilities for a deeper analysis of the monuments. It might be interesting to compare our results with data from other research projects on *kereksur*. All of this research is located in Mongolia where *kereksur* are one of the main monuments in the archaeological heritage. Although it might be dangerous to compare data from sites that are hundreds of kilometres away from our research areas, it is very clear that the *kereksur* in Russia are part of the same tradition and it is quite interesting to compare them with the Mongolian examples.

An interesting research on *kereksur* monuments was carried out by F. Allard and D. Erdenebaatar in the Khanuy valley in the central Mongolian Arkhangai aimag (Allard & Erdenebaatar 2005). The 'Khanuy Valley Project on Early Nomadic Pastoralism in Mongolia' includes excavations, surveys, identification of campsites and an ethnographic study, in a research area of 330 km². During the research, fieldwork was done at 27 *kereksur* sites, some of which are extremely large (up to 400 m in diameter, with a central mound of 5 m high and consisting of about 500,000 stones). Another survey project is the Egiin Gol Survey (EGS) in the Lower Egiin Gol valley in Northern Mongolia, organised between 1997 and 2000 (Wright 2007). The survey covered 246 km² and recorded 171 sites with 372 individual *kereksur*, among 533 sites with archaeological structures. Nine of the *kereksur* were excavated, but rarely contained artefacts or burials. Wright did a thorough analysis on the organisational principles of the *kereksur* monuments, focusing mainly on the wide variety of associated structures and the way and level in which the *kereksur* were developed. A third project is the previously mentioned Mongolian Altai Inventory by E. Jacobson, J. Meacham and G. Tepfer (Jacobson-Tepfer et al. 1994, Jacobson-Tepfer et al. 2006b, Jacobson-Tepfer et al. Forthcoming) in north-western Mongolia.

5.3.4.1 Average surface of the central mound and the fenced area

The mound footprints of the *kereksur* in our research area cluster rather evenly around the average of 124.86 m², except for some larger exceptions (Figure 5.31). Seventeen of the mounds are larger than 260 m². The enclosed or fenced areas are distributed in the same way, with a few extreme outliers that are considerably bigger than the main part of the fenced *kereksur*. The average of 583.26 m² is therefore heavily influenced by these extreme outliers of up to 7,330 m² (Figure 5.34). Interestingly, J. Wright noticed a rather different distribution in the footprints and enclosed areas of the 372 *kereksur* he investigated in the Lower Egiin Gol (northern Mongolia). The footprints of the mounds cluster around 72 m², with very few outliers. Numbers are the same for the enclosed areas. He concludes that roughly the same amount of labour was mobilised to build most of the *kereksur* in his research area (Wright 2007: 357-358). The larger *kereksur* in our research areas would have required considerably more effort to build, suggesting a sort of differentiation in function or size of the group of people who 'used' the *kereksur*. A clear example is the largest *kereksur* in our database, KA-158, in the lower part of the Yustyd valley (see site plan KA-158 on the data disc, or Figure 5.82 on page 250).

There is quite a difference between the round and the square *kereksur*. The average round *kereksur* has a diameter of 24.49 m NS and 24.48 m EW, which gives an average surface of 630.78 m² (6.31 ares). However, 50% of the *kereksur* are smaller than 300 m², i.e. they have a diameter that is smaller than 19.54 m. The average square *kereksur* has sides of 18.10 m NS by 17.67 EW, resulting in a surface of 484.99 m² (4.85 ares). This is considerably smaller than the round *kereksur*. However, 50% of the rectangular *kereksur* are smaller than 200 m², i.e. have sides that are shorter than 14.14 m. The difference is clearly illustrated by Figure 5.33, showing the distribution of enclosed areas for round and square *kereksur*.

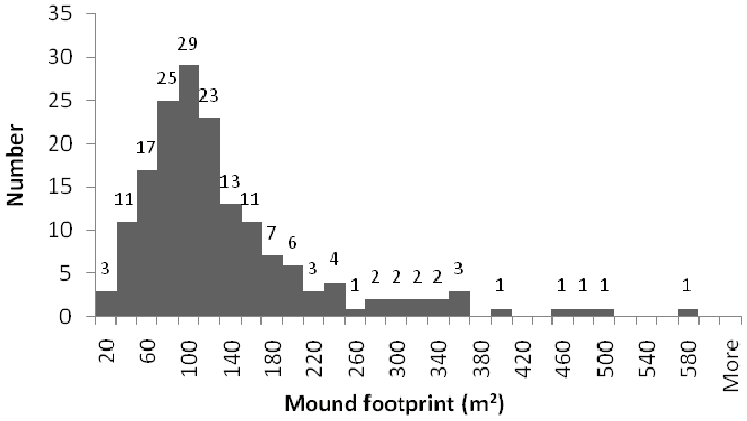


Figure 5.31: The distribution of the central mound footprints for the *kereksur* in our research areas: the average is 124.86 m²

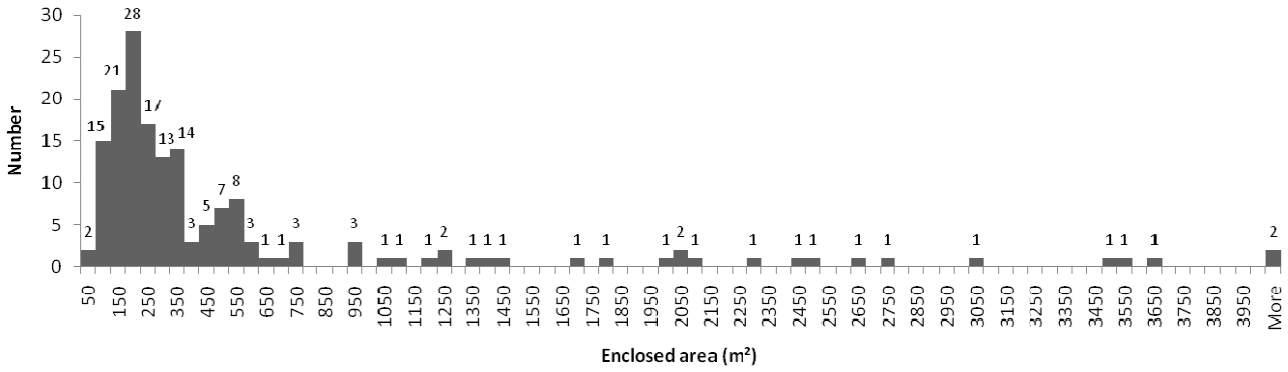


Figure 5.32: The distribution of the enclosed area of the *kereksur* in our research areas: the average is 583.26 m²

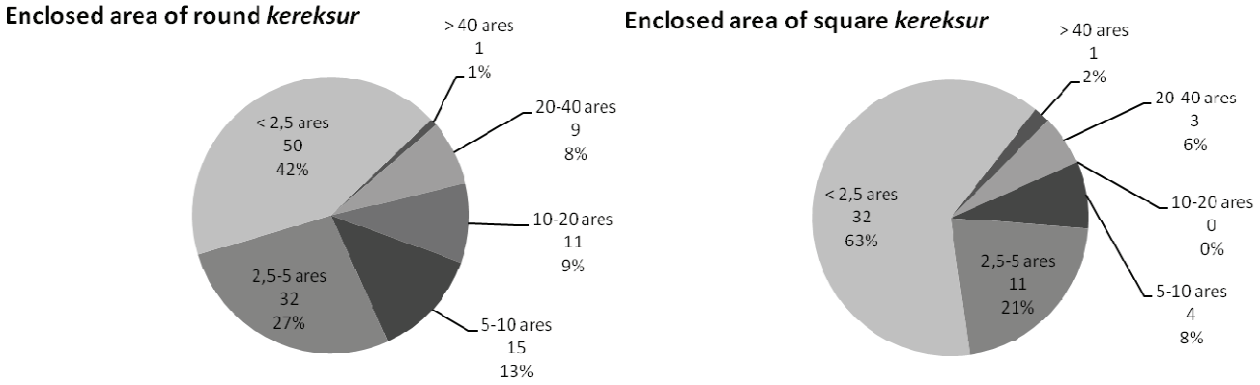


Figure 5.33: A comparison between the distribution of enclosed areas for round *kereksur* (left) and square *kereksur* (right)

When we examine the relationship between mound size and enclosed area, once again there is a rather ordered distribution. Although not exclusively linear, there is a pattern of correlation between the two values. In general, the largest mounds have the largest enclosed areas, as can be seen in the scatter gram (Figure 5.34). Although we excluded the round *kereksur* without fence – in which case we cannot calculate the mound/area ratio – there appear to be two groups. One group is clustered around the average of R^2=0.689, including the largest monuments. However, another group clusters just above the 1/1 axis, almost parallel with the X-axis (light grey line). This group has fences that are only slightly bigger than the mound itself, as number 2 in Figure 5.27, and numbers 1-3 in Figure 5.28 show. Again, this observation is different from that of Wright in the Lower Egiin Gol. He says there is no significant pattern of correlation between mound size and enclosed area, and the largest mounds do not have the largest enclosed areas (Wright 2007: 357-358). This could mean that there is a more consistent design ratio for mound and fence complexes in our research areas than there is in the Egiin Gol valley. One reason for this could be that most of our *kereksur* are found in a limited area, the Yustyd valley. Perhaps the *kereksur* there are built by the same groups of people, using a more consistent plan. In addition, the proximity of the monuments would certainly have facilitated the copying of existing site layouts. Another reason could be the larger proportion of round *kereksur* in our research areas (69.8%); this is only 36% in Egiin Gol. Indeed, the round *kereksur* show a more linear distribution in the scatter gram.

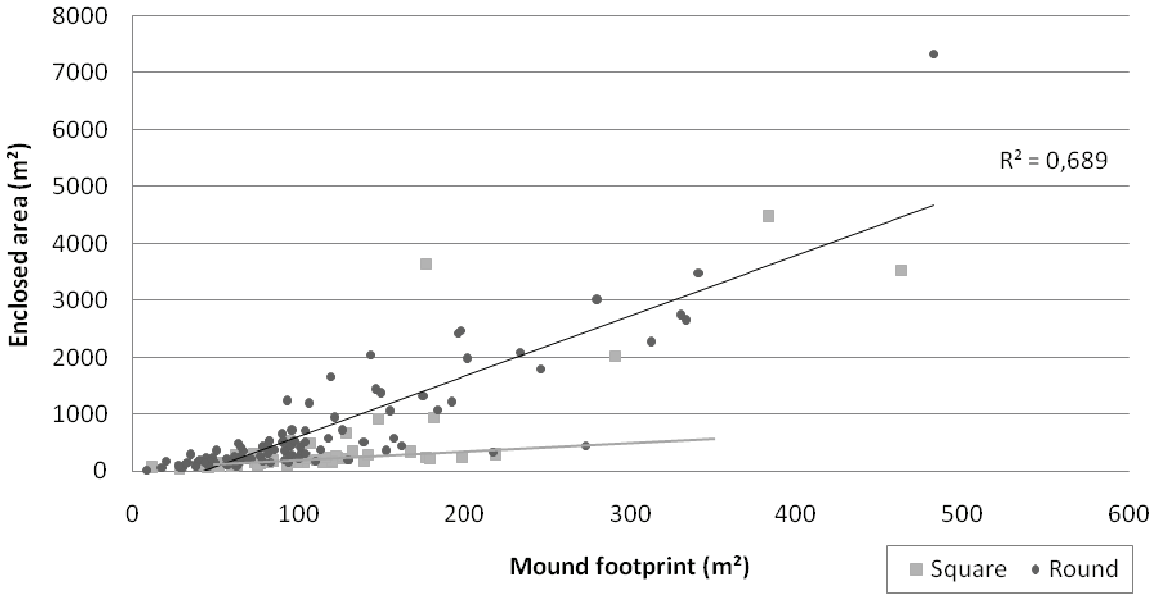


Figure 5.34: The scatter gram compares the characteristics of mound footprints and enclosed areas for round and square *kereksur* in our research areas. The trend line (dark) is based on all monuments. The light grey line indicates a special cluster of monuments

5.3.4.2 Rays, satellite stone circles and satellite mounds

Kereksur with rays are rather common in our research areas; 47 have clear rays (36 round, 11 square), i.e. about 28%. *Kereksur* with rays have one to 18 different spokes, with an average of 3.9. The 36 round *kereksur* generally have more rays, with a maximum of 18 and an average of 4.3. Most of these actually have four rays, roughly oriented to the four quarters (see 5.3.4.3). The 11 square *kereksur* have a maximum of four rays and an average of 2.7. Generally, the rays connect the mound with the corners of the fence, but in one *kereksur* the rays start from the centre of each side of the fence (Figure 5.28, number 5). The rays for both round and square *kereksur* can be very different: a single stone setting in juxtaposition, a double line of stones, or a complete pavement or bank of more than one metre wide (Figure 5.35). Round *kereksur* often have spokes that widen considerably when they reach the outer fence of the *kereksur*, for example in number 5-6-8 in Figure 5.27.



Figure 5.35: Different types of rays: single stone setting (left), clear double stone setting (centre) and wider pavement or bank (right)

As can be seen from the different types of *kereksur* in Figure 5.27 and Figure 5.28, small stone circles are definitely the most common associated structures. Exactly 68% of the *kereksur* have stone circles surrounding them, with an average of 7.1 circles. Again, the round *kereksur* are more complex; 72% of the monuments have circles, with a maximum of 78 and an average of 7.8 circles. The 30 square *kereksur* (58.8%) have 5.5 circles on average, with a maximum of 63. The stone circles are always made of cobbles or boulders in juxtaposition, which are partly buried (Figure 5.81).

Associated satellite mounds are rather rare in our research areas. Only nine *kereksur* (5.3%) have one or more satellite mounds – five round and four square *kereksur*. In most cases, these are located east or south-east of the monuments. The satellite mounds can be oval, placed parallel with the eastern edge of the *kereksur* (Figure 5.28: 2), or smaller round mounds (Figure 5.27: 2).

The variability in associated structures is much more limited in our research areas in the Russian Altay than can be found in Mongolia. In particular, the small number of satellite mounds and other paths and stone settings outside of the *kereksur* is striking, and is in strong contrast to the Mongolian *kereksur*. In the Khanuy valley, for example, *kereksur* are found with dozens of satellite mounds in fields north, east and south of the monuments (Figure 5.36). The maximum is 1,700 satellite mounds for a single *kereksur*, recorded in Urt Bulagyn, KYR 1 (Allard & Erdenebaatar 2005: 549). The satellite mounds are large enough to be clearly visible on the satellite image, which clearly shows the impressive scale of some of the larger *kereksur* sites (Figure 5.37).

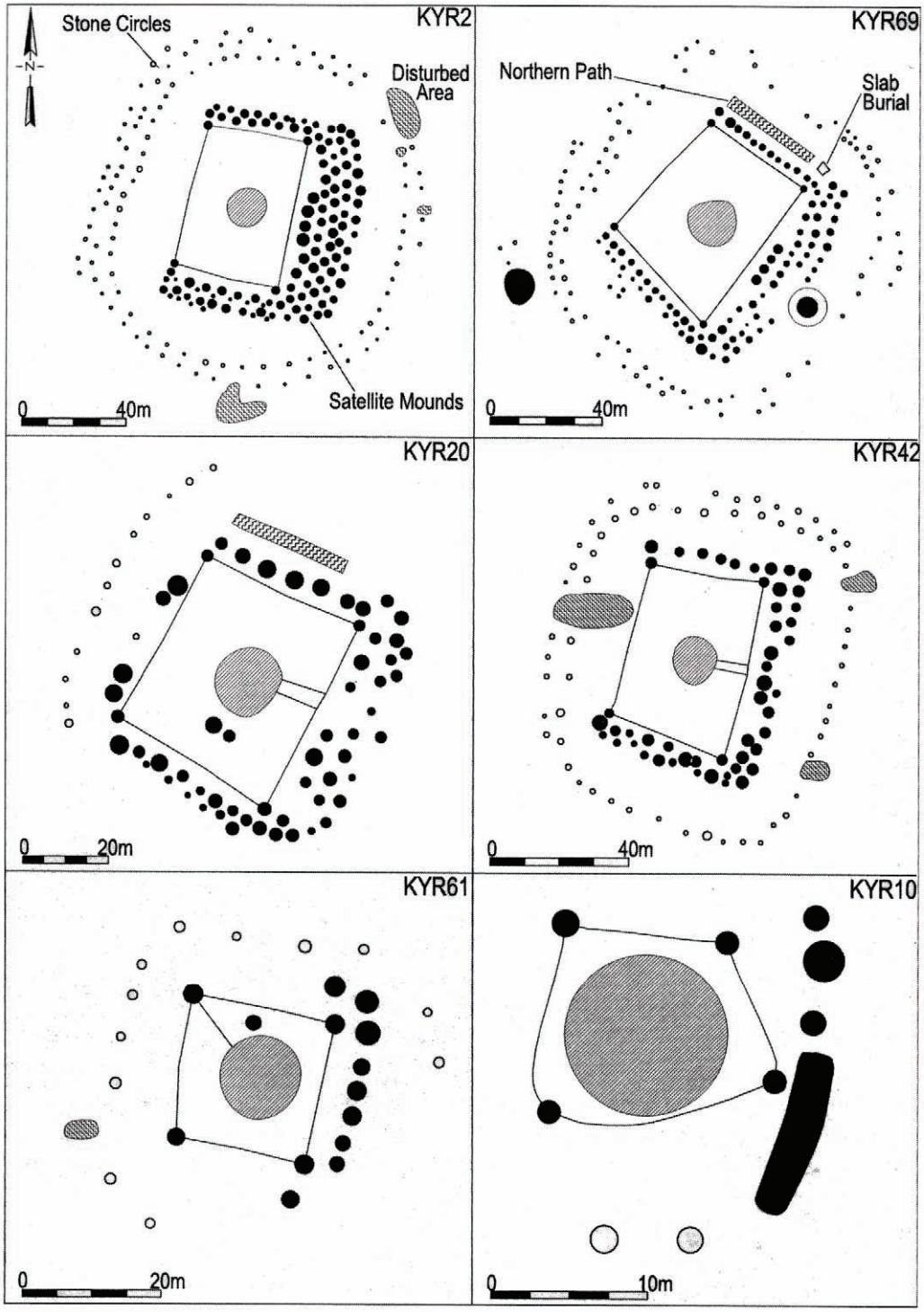


Figure 5.36: A selection of *kereksur* in the Khanuy valley research area, showing the large variety of associated structures, including numerous satellite mounds (figure from Allard & Erdenebaatar 2005: 555)

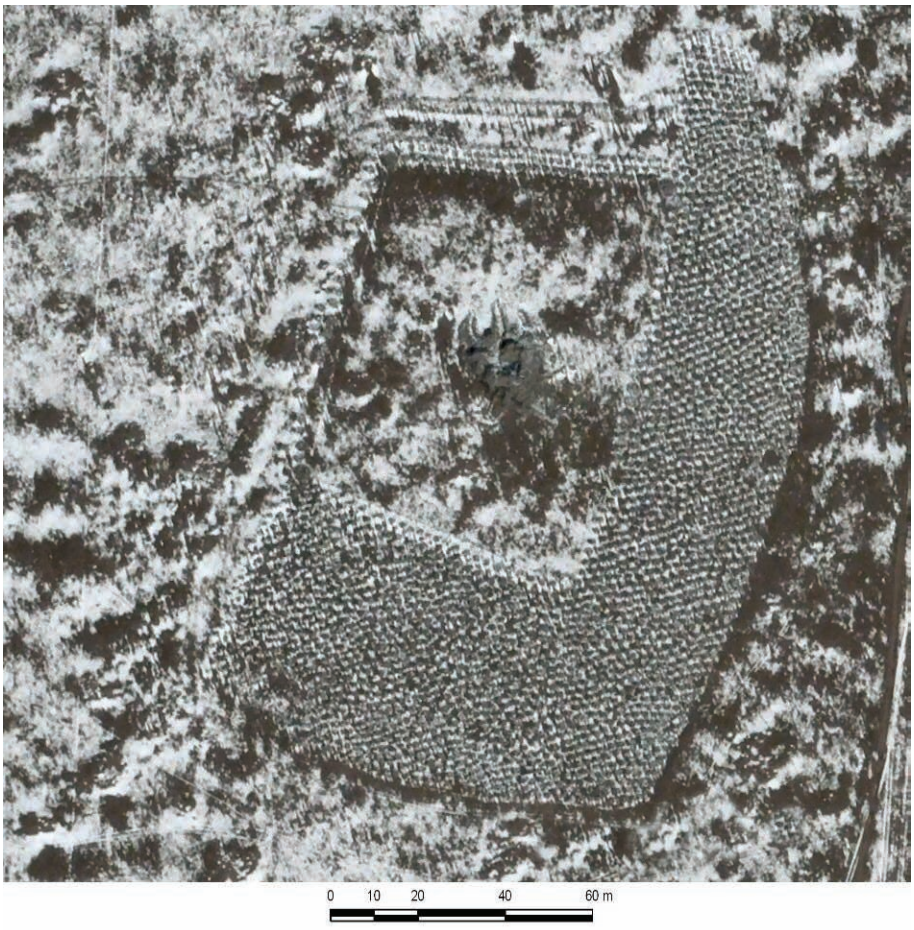


Figure 5.37: One of the *kereksur* in the Khanuy valley, as seen with Google Earth on Quickbird satellite images. Clearly visible is the central mound, the rectangular enclosed area, and the large field of hundreds of satellite mounds south and east of the *kereksur*. The snow in the image makes them quite visible. The stone circles, most probably located west of the *kereksur*, are not big enough to be seen here

5.3.4.3 The orientation of the monuments

If we look at the orientation of the *kereksur* in our research areas it is clear that the cardinal directions are very important. Although the orientation of most of the monuments is not strictly based on the four quarters, the average of both round and square *kereksur* definitely point roughly to the north. We based the calculation of the orientation of round *kereksur* on the spokes, only using those with a maximum of four spokes. For the other *kereksur* – those without spokes and those with more than four – it is impossible to do any calculations. The result is shown in Figure 5.38. On average, round *kereksur* show a positive declination of 5.6° for the north axis. This is quite consistent for all four quarters, with 6.5° for the east, 5.3° for the south and 9.3° for the west axis. Interestingly enough, this declination is very similar to the orientation of the alignments of Early Iron Age burial mounds, with 6.1° of declination from the north (see 5.2.1.2).

For the orientation of the square *kereksur*, we used the north-south oriented east and west sides of the fence. As can be seen in Figure 5.38, there is quite some variation, all between 349°

and 45°. However, once again the average is roughly northwards, with a declination of 10.8°. Allard has pointed out that the *kereksur* in Mongolia tend to be facing the east and west, rather than north or south, based on the layout of the site and the placement of satellite mounds, circles and pavements. Although this could be possible for the *kereksur* in our research areas, there are no clear indications of a preference for any one of the four quarters. However, all of our *kereksur* display a relative consistent orientation that falls exactly in the range of the Mongolian *kereksur*, all oriented along a west-northwest east-southeast axis (Allard & Erdenebaatar 2005: 554). As Alard notes, this consistency suggests an orientation toward a feature or event in the sky rather than toward a single marker on the landscape.

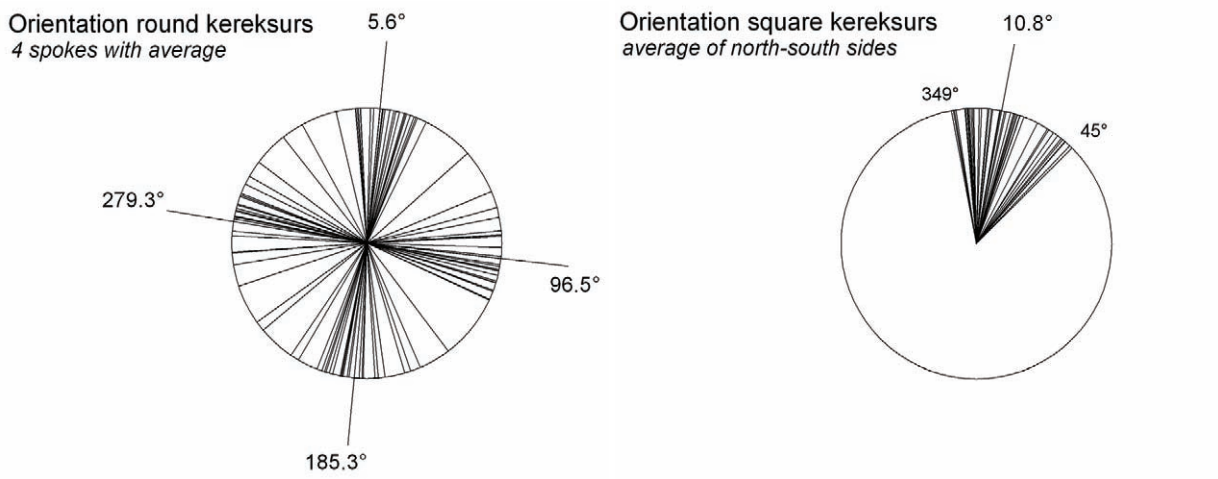


Figure 5.38: The orientation of round (left) and square (right) *kereksur* in our research areas, using the rays for the round *kereksur* and the east and west sides (pointing north-south) for the square *kereksur*

5.4 Stone enclosures

5.4.1 Rectangular Turkic enclosure or *ogradka*

Turkic enclosures are square or rectangular low mounds framed by black schistose or granite slabs. They are often accompanied by rows of standing stones, roughly oriented to the east, with up to 90 stones and sometimes over 200 m long. Other structures standing on top of the enclosure or just east of them are the so-called image stones and false image stones (see 5.7). Some of the enclosures also have small stone boxes positioned some metres to the east of the main structure, or a cluster of small stone circles. The memorial structures are generally oriented with their sides to the four quarters, with the rows of stones at a right angle roughly to the east. Occasionally, the enclosures appear isolated, but they are mainly clustered in north-south rows of three to five monuments.

The Turkic enclosures are generally considered to be commemorative in function, and date from ca. 500 to 900 CE. They are not typically associated with recognisable burials, and excavations have indicated that they originally covered a pit into which ritual libations were probably poured. The remains of larch poles in these pits and sometimes at one side of the

enclosure indicates the ancient mounting of young trees or poles for ritual purposes, as is the case with the Turkic burial mounds (see 5.2.2)[24].

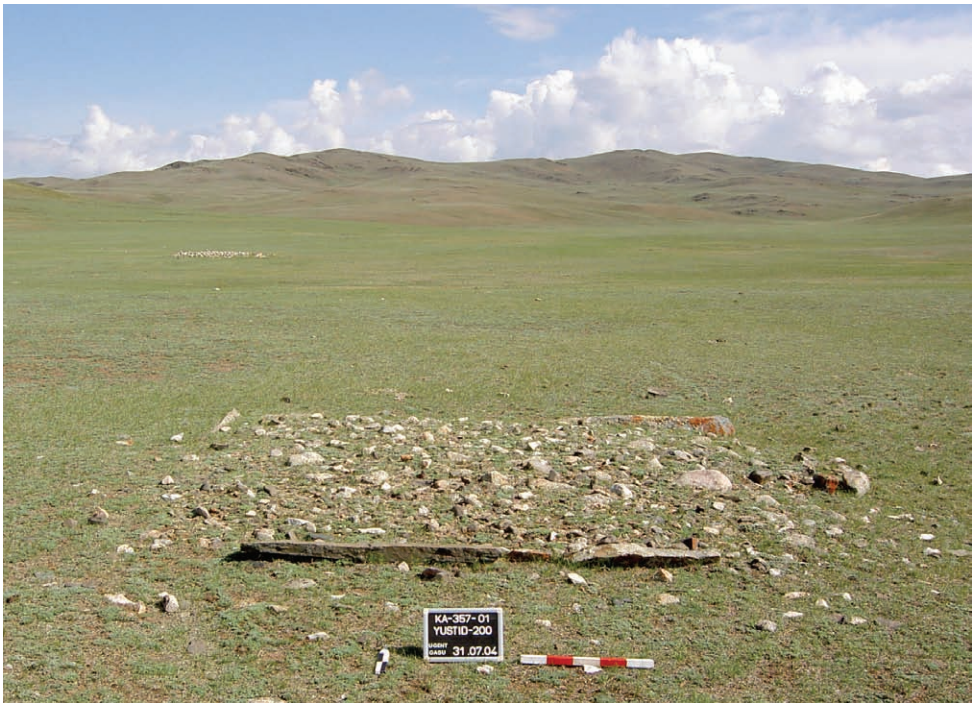


Figure 5.39: A typical Turkic enclosure in the Yustyd valley (structure KA-357-001)

5.4.1.1 Turkic enclosures in our research areas

Turkic memorial enclosures are very well represented in our research areas. We recorded 503 structures in the different areas, especially in the Sebystey, Dzhazator and Yustyd valleys. In Sebystey, one of the smaller valleys in our inventory, we found 81 Turkic memorial structures. The 158 enclosures in Yustyd are also interesting, but the Turkic structures are not denser than the monuments of other periods. In Dzhazator, the Turkic sites are spread over the whole valley, covering more than 40 km. The same distribution can be seen in Karakol, where the enclosures seem to be built mainly close to Scythian burial sites.

Total	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARba*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CHU*
503	5	54	122	2	1	0	63	13	0	81	158	6

Table 5.12: Distribution of Turkic enclosures over the different research areas

[24] Jacobson-Tepfer, Esther. Letter to author, 01-10-2008.

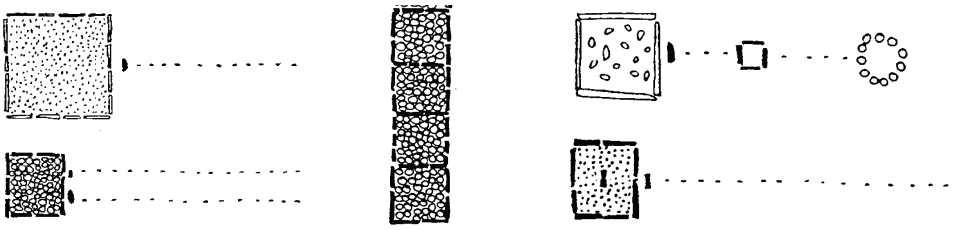


Figure 5.40: Some types of Turkic enclosures as mentioned by V. Kubarev (figure based on Kubarev 1980: 88-89, Fig. 9)



Figure 5.41: An enclosure of the Ayutinsky type in the wide, higher part of the valley (site KA-465). Left, a sketch in Sorokin's publication of his 1964 fieldwork (drawings from Sorokin 1969: 78), right, a photo made during the fieldwork in 2005

There is quite a variety of sub-types in our research areas. They are either isolated or placed next to one another, and are often built against each other, forming one north-south oriented line. Enclosures can have one or two rows of standing stones, or none. In some cases, there is a large standing stone just east of the enclosure, or on top of the structure. This standing stone can be sculptured in different ways – the so-called image stone – or not sculptured at all. Finally, some enclosures have small rectangular stone boxes to the east of them, and one or more small stone circles. The following overview by V. Kubarev summarises the different types of enclosures (Figure 5.40).

One special type is the Ayutinsky enclosure, named after the Ayut River, a tributary of the Dzhazator. It is not mentioned in V. Kubarev's overview because there are no examples in the Chuya region. This type of enclosure consists generally of two typical rectangular enclosures encircled by a rectangular ditch and embankment. We first recorded it in Dzhazator in 2005 (Figure 5.41, site KA-465). The ditch and bank are still clearly visible, enclosing an area of 20.7 m NS by 18.4 m EW. The two central stone enclosures were originally flanked by two nice stone images but only one is preserved today. On the bank itself are the remnants of at least one false image stone. From there, a row of *balbal* goes to the east (see site plan KA-465 on DVD 2). Further to the west in the valley, we found a second, similar enclosure, measuring 14.5 m NS by 9.3 m EW (KA-546). The two enclosures inside were once again flanked by two image stones, both fallen over. The only examples outside of Dzhazator were recorded in the Bukhtarma valley

in the Kazakh Altay, where we found two structures close to each other. The first enclosure measured 12.4 m NS by 11.3 m EW, while the other was 9.5 by 6.7 m. No image stones were found here.

As it is difficult to measure the orientation of the small enclosures themselves (both GPS and manual compass bearings have quite an error margin when measuring over small distances), we looked at the orientation of the rows of standing stones to their east. The lines of *balbal* are mostly oriented at right angles to the Turkic enclosures, and they all show an orientation ranging from between 55° and 143° or roughly east-north-east to east-south-east. The average is almost perfectly eastwards at 89.6°.

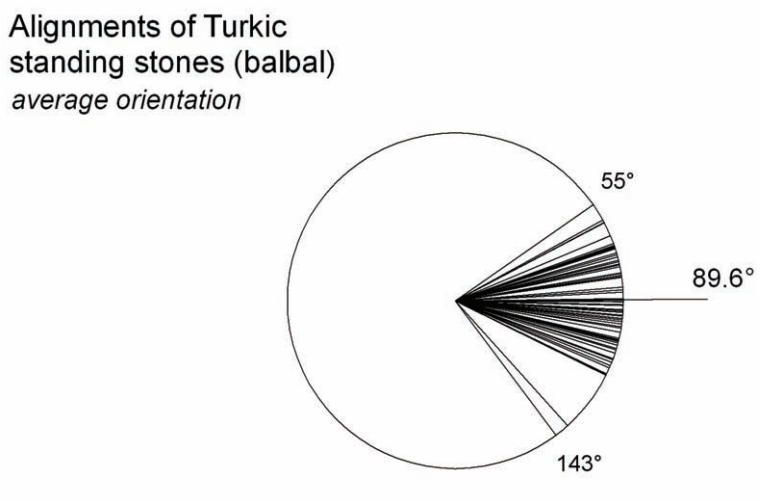


Figure 5.42: Average orientation of the alignments of standing stones east of Turkic enclosures

5.4.2 Round enclosures of the Afanas'ev culture

The oldest recorded structures date back to the Late Neolithic Afanas'ev culture (end 4th – first half of 3rd millennium BCE). The sites are all burial places consisting of a round or oval setting of large stones, with a central grave, which is mainly rectangular. We do not have much information about these graves, but there seem to be two variants. The first one is a circle of standing slabs, sometimes with remnants of a stone box inside, but mostly apparently empty. The other variant is a circular bank of smaller stones with an empty smaller part, sometimes with the remnants of a smaller structure in the centre.

5.4.2.1 Circular enclosures in our research areas

The circular enclosures of the Afanas'ev period are not numerous (Table 5.13). In fact, except for the 28 structures that were recorded in the Karakol valley (Figure 5.43, above) – all of them with jutted stones in a circle – they are scarce. Nine enclosures with stone banks were recorded along the southern border of the Chuya steppe, plus five in Sebystey and three in Elangash. The two structures in Dzhazator are made from large boulders and are rather unclear.



Figure 5.43: Above: two examples of Afanas'ev circular enclosures made from large standing slabs: both are located in the Karakol valley: structure ON-075-021 (left) and structure ON-077-001 (right). Below: two examples of circular enclosures comprising a bank or path of stones: site KA-156 on the southern border of the Chuya steppe, along the Elangash River, and site KA-018 in Elangash (right)

Total	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARa*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CHU*
47	-	-	2	3	-	-	28	-	-	5	-	9

Table 5.13: Distribution of circular enclosures in our research areas

5.5 Stone settings and stone lines

Stones – mostly boulders – are often used to form patterns on the surface. These patterns can be limited to single lines, but often take very complicated forms. The visibility of these rather light structures is strongly hampered even where vegetation is scarce, so they are not always noticeable. Moreover, the smallest amount of sedimentation can make them disappear forever. The function of the linear stone settings is unclear. Many lines are found in association with dwellings (see 5.6). Some long lines appear to delimit the groups of dwellings (see Figure 5.44 where some are over 100 m long), while other lines seem to have a function within the site itself. Figure 5.56, showing site KA-033 in Irbistu, is a perfect example. Different linear features are pointing away from the central rectangular stone setting, as if they are reaching towards the nearby Irbistu River or are pointing to some unknown features. In Yustyd, several clusters of

stone settings were recorded, usually close to dwellings. A large field with mainly linear features was found in the east of the valley (Figure 5.45). Various linear stone settings and geometrical features, most of them oriented to the east/north-east, divide the terrace into different parts and form unknown patterns. One of the stone lines is actually an enlarged form of a dwelling (central to the image, south of the row of Turkic standing stones). In the north is a group of dwellings with a small field to the east of it housing 24 dense parallel stone lines (Figure 5.46). These lines are remarkable, and this is the only example in our database and in the Altay, as far as we know.

It is possible that these lines once had a ritual meaning. However, we cannot exclude a practical function. They may be remnants of large meetings or other group activities, possibly comparable to the traditional Altaic folk festivals or *El-Oiyn*, in which games and rituals play an important role.

Linear stone settings can also be found in association with mounds. In the central part of the Yustyd valley, at the foothills in the north, an isolated mound of 13 m in diameter is accompanied by eight parallel linear features (Figure 5.44). The lines are formed by single stones or small heaps of stones, set well apart but clearly belonging together. The mound was excavated by V. Kubarev in 1979 and appeared to be a cenotaph. No burial was found, only a small pit in the north-eastern part of the mound. It contained a single but complete vessel that could be assigned to the Early Nomads (Early Iron Age) (Kubarev 1988b: 116-117 and Fig. 3).

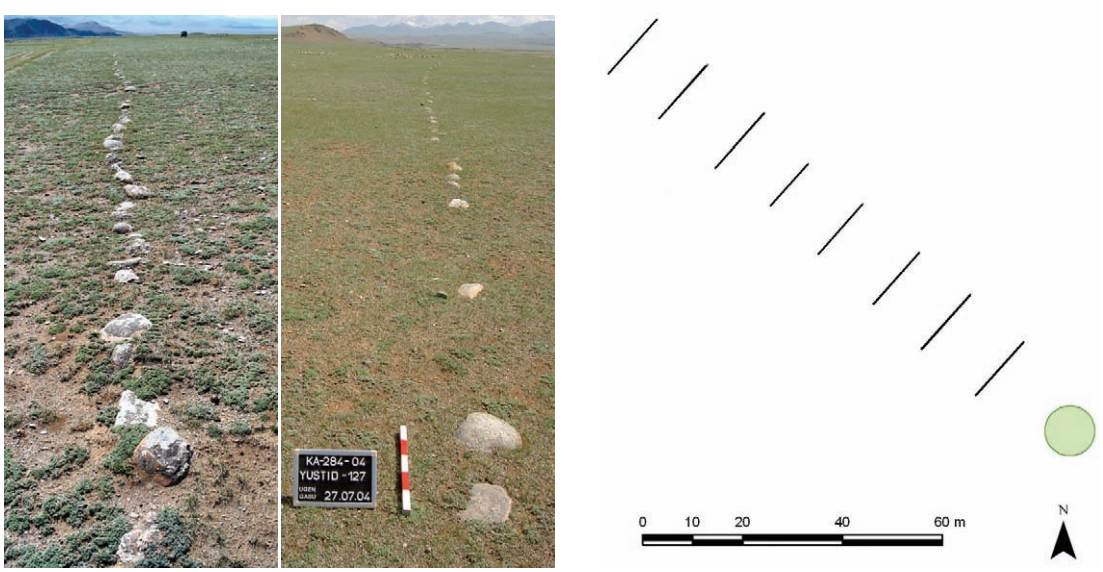


Figure 5.44: Linear stone settings in the Yustyd valley: long lines seem to delimit fields with so-called dwellings (left). In site KA-297, an Early Nomadic mound is accompanied by at least eight parallel lines of stones (right)

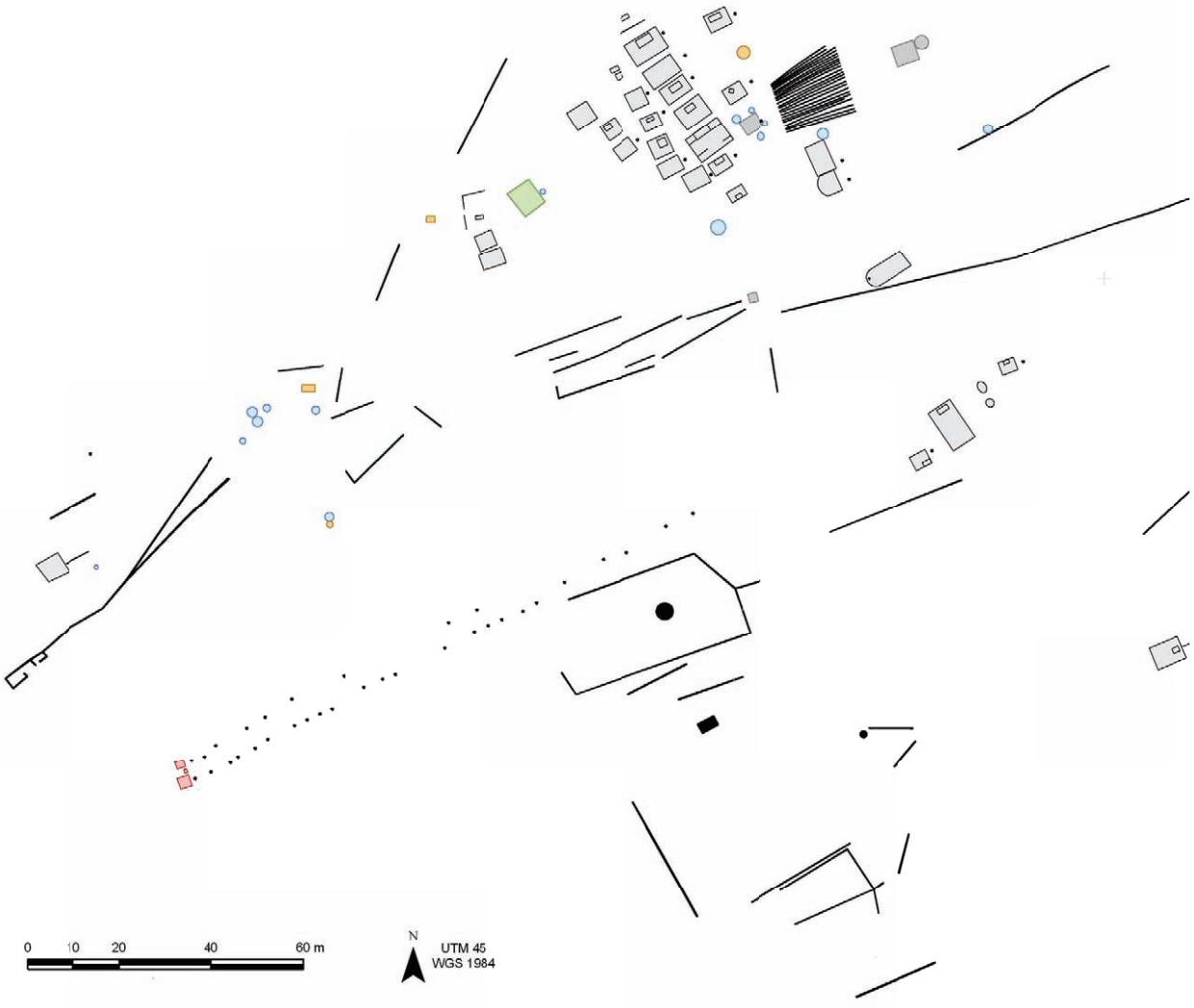


Figure 5.45: Various linear stone settings and geometrical features in the eastern part of the Yustyd valley, with a group of dwellings and a field of dense lines in the north (see Figure 5.46)



Figure 5.46: Site KA-802 in Yustyd, a small field with 24 parallel lines of stones, oriented east/northeast as most of the structures in this part of the valley (see Figure 5.45)

Period	*Total*	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARa*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*
Undefined	91	-	2	6	-	8	2	1	-	-	1	71
Bronze Age	7	-	-	-	-	-	-	-	-	-	-	7
Scythian	21	1	-	2	-	-	-	-	1	-	4	13
Turkic	1	-	-	-	1	-	-	-	-	-	-	-
Total	120	1	2	8	1	8	2	1	1	0	5	91

Table 5.14: Distribution of linear stone settings over the different research areas

Most of the stone settings in our research areas were found in Yustyd; 91 out of 120 structures (Table 5.14). Once again this points to the special character of the archaeological landscape of the Yustyd valley, but it is probably also the result of the excellent visibility in the valley, with very low grasses because of the stony ground. The stone lines are difficult to date although their association with other structures helps to assign them to a specific period. Most structures are of unknown date as they are associated with the hardly studied rectangular stone settings or dwellings.

5.6 Rectangular stone setting or 'dwelling'

During the survey in 2003, we came across a very special type of stone setting in the Irbistu valley. This type of structure soon appeared to be very numerous in the surface archaeology of Altay. We found dozens of them in the Yustyd and Dzhazator valleys, and they are known on the Ukok plateau and in the Mongolian Altay. Their function or date is still very unclear. The stereotype is rectangular and takes the form of a clear geometric stone setting. A single or double line of stones forms the outline or 'wall', always oriented to the cardinal directions. In many cases, there is a clear entrance in both short sides. In the most typical form, the interior space is divided by single stone lines running the length of the monument, usually in three more or less equal parts, and there are always one or two small, rectangular pavements in the centre or along the long north or south sides. About one metre to the east of the eastern entrance there is a heavy standing stone, mainly massive river boulders which mark the eastern entrance. However, many variants are known, including round and triangular ones.

These are rarely mentioned in Russian literature. V.I. Molodin recorded the structures during his survey work on the Ukok plateau (Molodin et al. 2004) (more details below), and V.D. Kubarev mentions them in his overview of the archaeological heritage of the Kosh-Agach region (Kubarev 1980). However, they are never precisely defined; nobody actually knows what they are and there is no indication when they were constructed. Thus, it would be very interesting to devote some detailed research to these monuments. Kubarev refers to them as different types of monuments: some of them are just called 'stone concentrations made out of river stones', while others are called 'ritual enclosures'. Molodin uses the terms 'ritual structure', 'stone settings' and 'stone enclosures'. In our database, they are recorded as 'rectangular stone setting'.

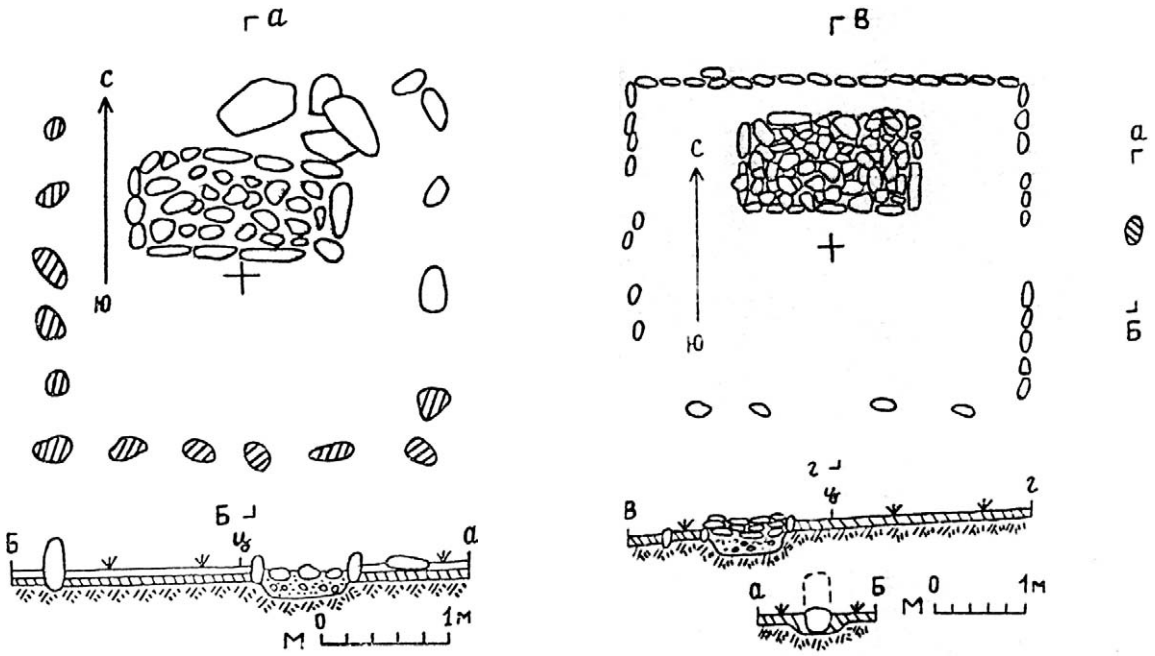


Figure 5.47: Enclosure 12 (left) and enclosure 2 (right) in site Irbistu-1, excavated by S. Surazakov in 1979 (from Surazakov 1988: Figure 9 and Figure 3)

During an expedition in 1979 in Irbistu, already mentioned in 5.2.5, A. Surazakov excavated 15 monuments on a site located on the right bank of the river, just at the border of the Chuya steppe (Surazakov 1988). Next to seven burial mounds, he reports what appear to be six nice examples of rectangular stone settings, and two associated small rectangular stone concentrations or pavements. He refers to them as 'enclosures'. All structures, except for one, have a small rectangular pavement in the northern part, with a shallow pit underneath the stone cover. These pits are 20-30 cm deep, and appeared to be empty. Only one pit revealed an isolated bone fragment. Therefore, Surazakov was not able to suggest a date or function for any of the structures.

Because of the striking resemblance with a house layout, we refer to these structures as 'dwellings'. Esther Jacobson-Tepfer is quite convinced that the structures are meant to refer to the dwellings of the (now) dead. They could be seen as virtual burials – structures that commemorated a person's death and provided that person with a house in the next world. The actual placement of the bodies for which those dwelling were intended remains a mystery (Jacobson-Tepfer 2008: 33). They closely reflect the clear representations of actual dwellings often found in late Bronze Age rock art, and it is possible that they may be assigned to that period. Another argument to support this hypothesis is the fact that dwellings seem to occur in the same areas as *kereksur*. Areas that have many *kereksur* also have many dwellings – for example, the eastern part of the Yustyd valley – and areas without *kereksur* are without dwellings. However, they are not really linked together at a structure level; there is no clear pattern in the distribution of the dwellings in relation to *kereksur* monuments. Dwellings are rarely found in-between alignments of Iron Age burial mounds, which could mean that the tradition of constructing dwellings stopped somewhere in the late Bronze Age.

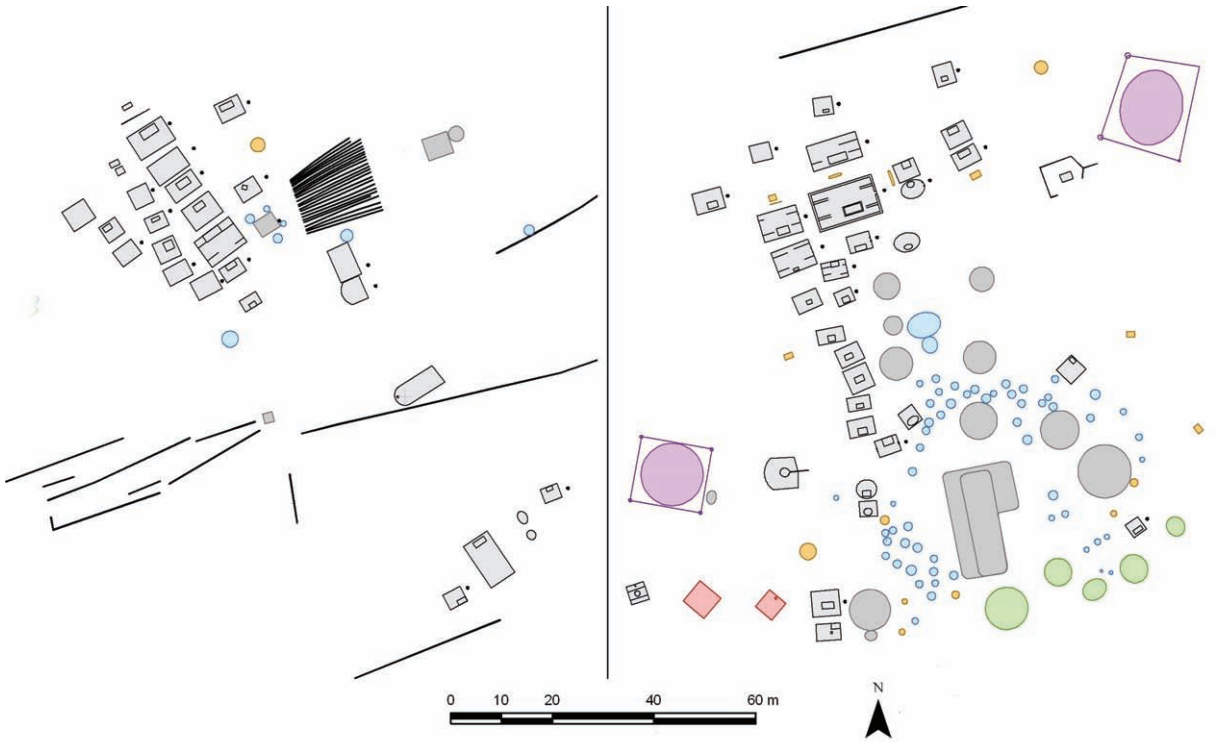


Figure 5.48: Extracts of sites KA-802 and KA-753 (see DVD for full site plans): the dwellings are the rectangular structures in grey

The structures can be found isolated or, more often, in large concentrations stretched out over river terraces (Figure 5.48). They are usually arranged in approximately north-south lines, and are accompanied by a variety of smaller stone settings, among which lines of stones are the most common.

5.6.1 Different dwelling types in our research areas

Most of the dwellings recorded during our surveys are located in the Yustyd valley. Only nine of the 258 dwellings were found elsewhere; two in Bukhtarma, five in Dzhazator, one in Irbistu and the other one in Karakol (Table 5.15).

It is worth mentioning that not even all dwellings and associated stone settings in Yustyd could be recorded in detail. During the work in Yustyd in 2004, we found three zones with a very high density of small structures, such as uncommon circular and rectangular stone settings, alignments of buried stones, etc. Some of these structures were very hard to identify, especially since it was the first time we had seen this density of stone settings during the survey. These structures were not easy to describe and locate precisely with the equipment we had at that time (see 3.2.2 – the amount of GPS measurements was very limited). One possibility would have been to identify and draw all individual stones on a very detailed plan – as was done in Irbistu for site KA-033 (Figure 5.56) – but that would have taken several days per concentration. Therefore, we limited the recording of these four zones in Yustyd to a generalised description; we located them by multiple GPS measurements and took dozens of photographs for illustration. In 2006, with the new GPS equipment, we recorded several comparable zones with ‘virtual

dwellings' plus other side structures in the eastern part of the Yustyd valley, but had no time to go back to those we recorded in 2004 to map them in detail. It would be interesting to complete that work during one of the next expeditions, in particular to do further research on the phenomenon of these 'virtual dwellings'.

Another remark concerns the absence of dwellings in the southern border of the Chuya steppe, which does not reflect the archaeological reality. Surazakov's site Irbistu-1, situated in the Chuya steppe, was recorded during our survey in 2003 as sites KA-111 to KA-113 (Surazakov 1988). As all dwellings were destroyed by the excavations, it was not possible to identify them as such during our fieldwork. The structures are recorded in the database as 'undefined' excavated structures (possible Turkic enclosure) or mentioned in the site description merely as a place where excavations have been carried out. Six dwellings and two small rectangular pavements should thus be added to the total number.

Total	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARa*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CHU*
258	-	2	5	-	1	-	1	-	-	-	249	-

Table 5.15: Distribution of the dwellings in our research areas

The dwelling structures show a huge variety in floor plans, the treatment of the walls, and the choice of stones that are used. However, all variants seem to have a comparable function, and they are mainly found together.

5.6.1.1 Tripartite dwelling

The elaborate 'tripartite dwelling' is the most common and most typical dwelling. It has all the characteristics mentioned above and generally has walls of a single or double stone setting in juxtaposition. There are often openings in the east and the west, and a standing stone east of the structure. The internal division in three parts is the defining element; short lines of single stones run parallel with the north and south sides of the dwelling. The hearth or small rectangular pavement is mostly placed in the north of the structure, but can also be found in the centre or in the south.

5.6.1.2 Simple dwelling

A simplified version of the tripartite dwelling is a rectangular structure with a single stone setting for the walls, a simple hearth, mainly along the north side, and no interior divisions. There are two clear sub-types: the first is built with buried stones in juxtaposition, while the second sub-type has walls of jutted stones that are 10 to 40 cm apart (Figure 5.50). The simple dwellings are very common and are found in all areas already mentioned, including our research areas, the Ukok plateau and the Mongolian Altay (see also Figure 5.47).

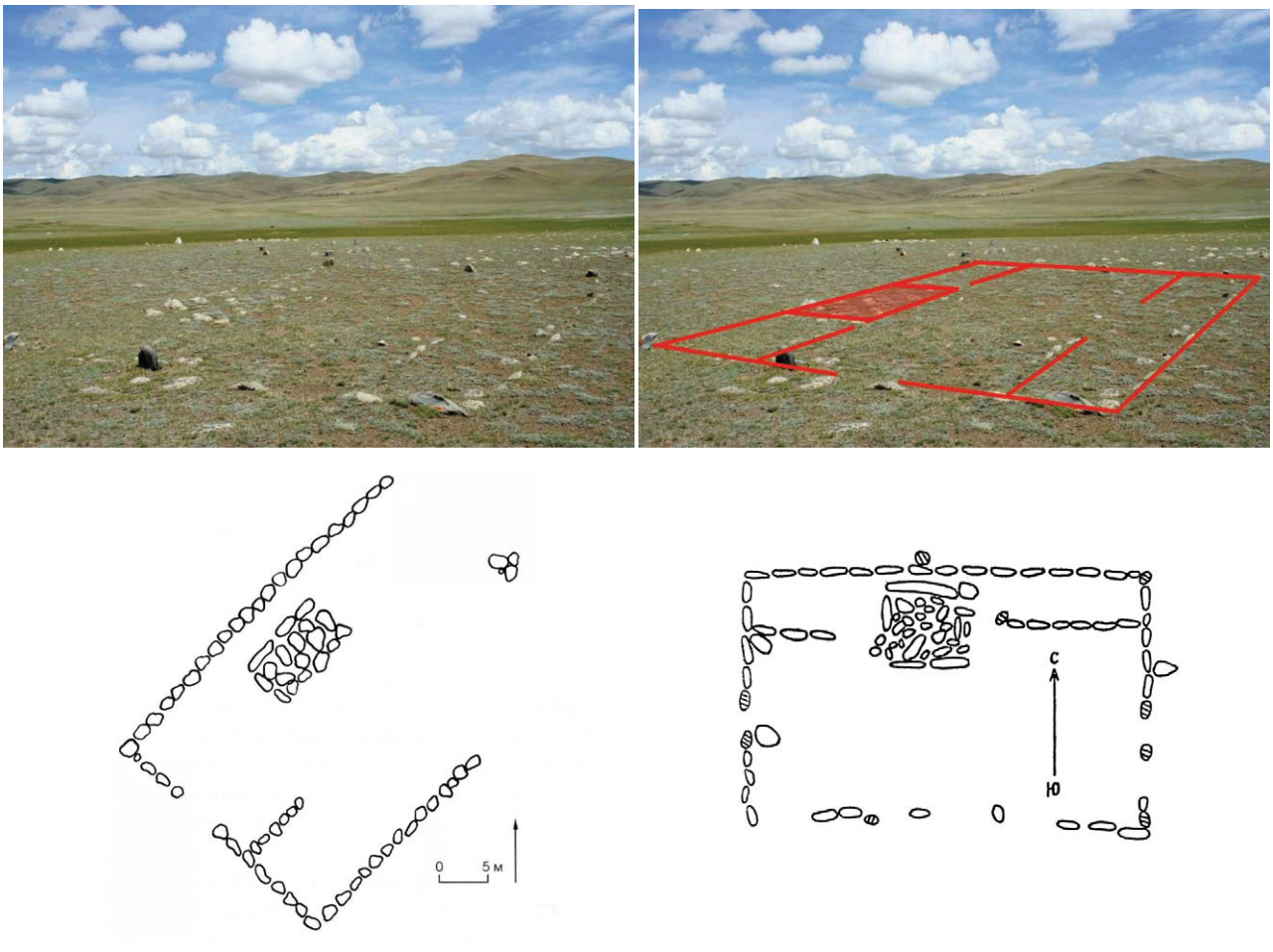


Figure 5.49: Typical examples of tripartite dwellings. Above, one of the structures in the KA-802 site in Yustyd, with an indication of the internal features: below, two floor plans from other research areas: site Ukok-5 (from Molodin et al. 2004: Figure 124) and site Irbistu-1 (from Surazakov 1988: Figure 7)



Figure 5.50 Two sub-types of simple dwellings: buried stones in juxtaposition (left) and jutted stones set apart (right)

5.6.1.3 Variations on the same theme: round dwellings, triangular stone settings and more elaborate structures

The dwellings are not limited to rectangular types. A round dwelling was found at site KA-693 in Yustyd. It has a round hearth, a single wall and an opening in both the east and west. Small standing stones accentuate the diagonal directions (Figure 5.51). These standing stones are remnants of the tripartite subdivisions, as can be seen at site Argamdzhi-5 in Ukok (from Molodin et al. 2004: 30) (Figure 5.52). A triangular version of the dwelling type was only recorded once, structure KA-267-001 in Yustyd (see database and site plan on DVD). Once again in Yustyd, in the lower part of the valley, we recorded a more elaborate version of the simple dwelling type. The dwelling itself and the stone east of it were completely enclosed by a double stone setting (Figure 5.52).



Figure 5.51: Round dwellings: an example from Yustyd (KA-693)

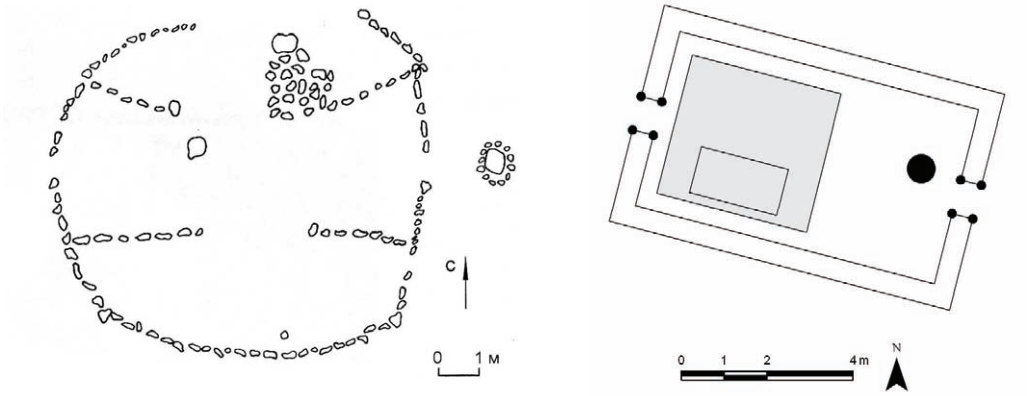


Figure 5.52: A tripartite example of a round dwelling from the site Argamdzhi-5 on the Ukok plateau (from Molodin et al. 2004: 30) (left), and site KA-378 in Yustyd, a more elaborated version of the simple dwelling type, with a double wall surrounding the structure (right)

5.6.1.4 Chain of rectangular stone settings or 'ladder'

A completely different form is the so-called 'ladder' structure. This is actually a long line of square enclosures, resembling different dwellings which had been built against one another. They have no central hearth and, for the most part, the standing stones are absent. Interestingly,

the ladder often has a slight curve somewhere in the middle, with its southern part turned slightly towards the east/south-east. We only found this type in Dzhazator (KA-462, Figure 5.53), but they are common on the Ukok plateau where the IAE SB RAS documented several good examples (Figure 5.53). It was V. Molodin who first used the term ladder to refer to these items – examples include Ukok-72 and Cholok-Chad-5.

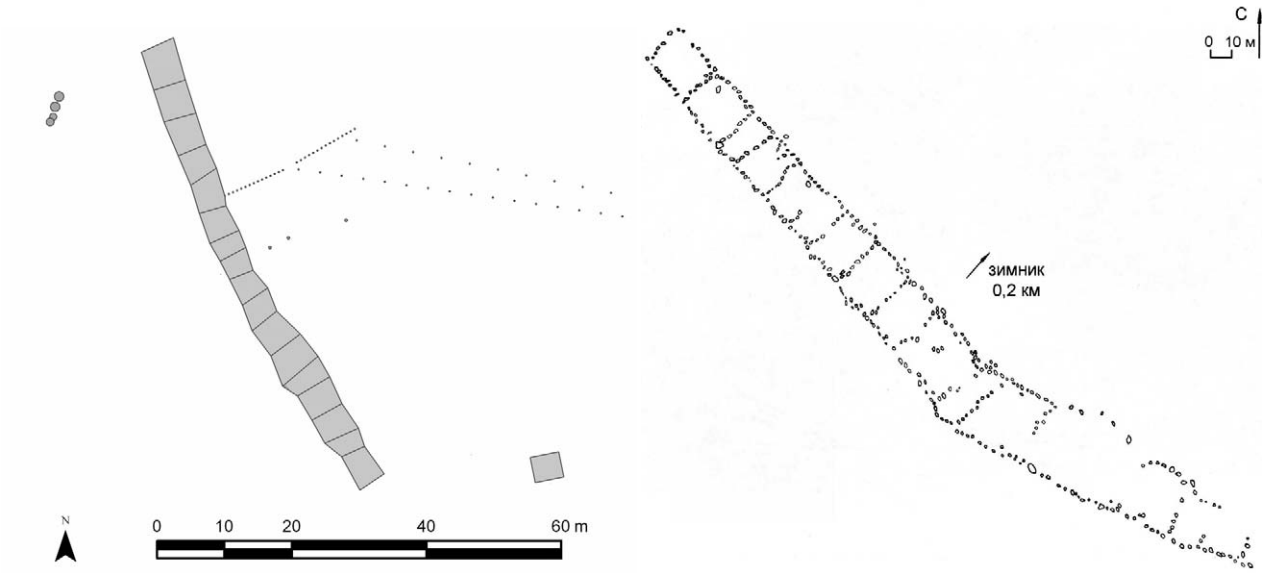


Figure 5.53: Left: site KA-462 in Dzhazator. Right: the archaeological survey on the Ukok plateau by the IAE SB RAS included the recording of some good examples of ladder structures (from Molodin et al. 2004: 102)

5.6.1.5 Rectangular stone setting with central 'hanging circle'

The last dwelling sub-type is quite different from the other rectangular structures as it has two striking features that are absent in all other types. Once again the basis is a rectangular stone setting, always with single stones in juxtaposition. The west or east side is often curved. In the centre of the rectangle is an oval-to-rectangular stone setting, sometimes in the form of a 'drop'. It is 'hanging' from, or connected to, the eastern side of the dwelling. A line of stones points to the east, sometimes ending in a stone concentration or stone circle (Figure 5.55). The structures are roughly oriented to the east or northeast (Figure 5.54, A). A dozen of these structures were found on the right bank of the Yustyd River, including some large examples up to 35 m long. These larger virtual dwellings could mean that they had a communal function rather than an individual one.

This sub-type was also found on the Ukok plateau by V. Molodin and his team (Figure 5.54, B). He calls them near-rectangular enclosures with 'beams'. In 1994, on the site of Kal'dzhin-5 in Ukok, they excavated a simple rectangular stone setting with slightly oval stone circle in the centre, and with a possible entrance in the eastern side. The structure was oriented east-west, but had no stone line or beam pointing to the east (Molodin et al. 2004: 158-159). There was no pit inside the structure or under the central circle, and no artefacts or bone fragments were found. The date is unknown, as is the function of these monuments.

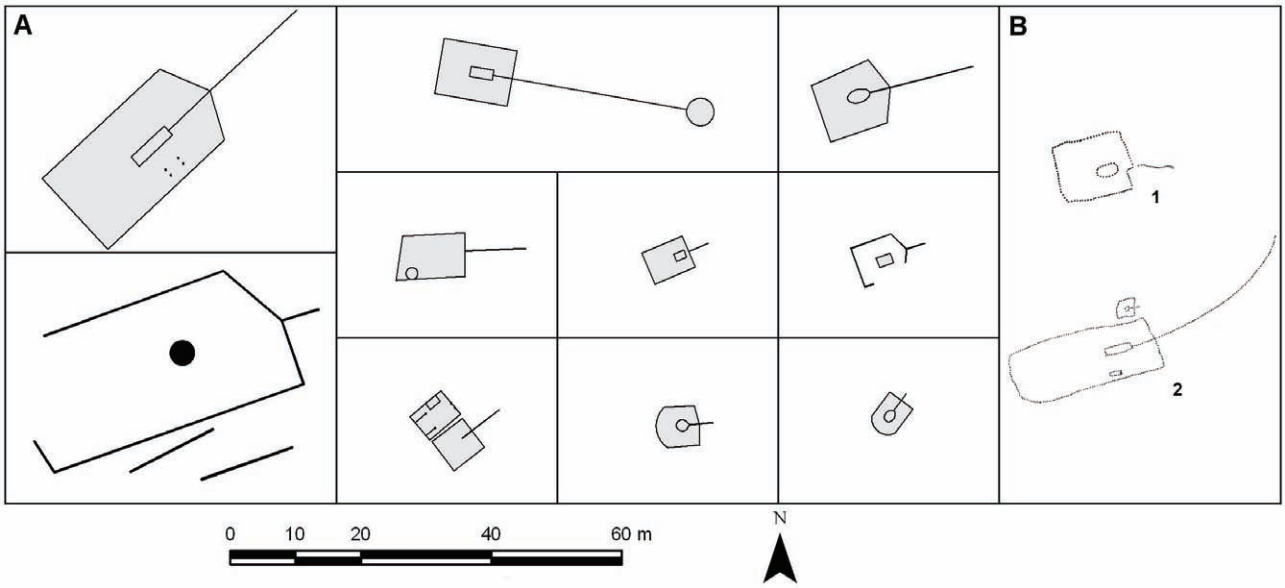


Figure 5.54: Different types of dwellings with hanging circle and east-pointing beam in Yustyd (A) and on the plateau of Ukok (B): site Argamdzhi-16 (1) and site Bogdo-Ula-9 (2) (B from Molodin et al. 2004: 32 and 52)



Figure 5.55: Site KA-752 in Yustyd is a clear example of the dwelling type with central circle and stone line to the east. Here seen from the south-west (left) and from the east (right)

Kubarev (1988) mentions one type of Turkic enclosure that clearly shows a circle of stones with a line towards the east; a typical rectangular Turkic enclosure is built inside the circle (Figure 5.1, number 12). Although we never saw this type of monument in or around Yustyd, we are of the opinion that the circle with a line is related to the types described herein.

5.6.2 Associated structures: stone lines, stone pavements, standing stones

Lines of stones are often found stretching out inside or around the fields of 'dwellings', dividing the interior space or sometimes even delimiting the concentrations of structures. They can form complex patterns or extend from the dwellings down to nearby rivers or other features on the landscape (see 5.5).

The first dwelling in our database, recorded during the fieldwork of 2003 in the Irbistu valley, was a complex one, with many associated stone settings. Site Irbistu 9 (KA-033) is located on a vast, slightly sloping river terrace, looking out over the river. It is completely built with round river stones, probably selected from the river terrace itself and half buried in the ground. Although the whole area is completely covered with stones, the structure is very visible: the selected stones are larger than average and are carefully set. The central element is a rectangular 'virtual dwelling' (5.2 x 3.7 m) with a small rectangular hearth in its north-eastern corner (1.4 x 2.8 m). Two standing stones in the eastern 'wall' seem to mark an entrance. A stele stands about 1 m to the east of the entrance, as is often the case. The stone, 60 cm high and 35 x 15 cm wide, has three small petroglyphs on its south-western side: small, roughly carved caprids.

However, the site is much more complex, and is unique in this respect. The virtual dwelling is surrounded by several linear stone settings (Figure 5.56). First, there is a strange, crooked 'path' that starts at the northwestern corner of the dwelling and runs over a distance of 60 m in a westerly direction (compass reading: 284°). The path, which is marked by two parallel lines of buried stones, is between 1.2 and 1.5 m wide and ends in an unclear stone concentration that seems to have some kind of internal layout. The path appears to continue to the east of the dwelling, but this time by a single line of stones (compass reading: 104°) of about 16 m and composed of 19 buried stones. Secondly, a group of radial lines is located to the south of the dwelling structure. Six somewhat crooked lines of stones seem to depart from an unmarked point about 2 m to the east of the south-eastern corner of the rectangular structure. The lines are 17 m (35 stones), 9 m (ten stones), 25 m (50 stones), 9 m (19 stones), 9 m (13 stones) and 18 m (40 stones) long, respectively, and their orientation ranges from 200° (S-SW) to 250° (W). An additional line of stones is situated somewhat to the south-west of the complex (not located on the detailed site plan in Figure 5.56, see the full site plan KA-033 on DVD 2). This 50-m long line of single stones originated from a circular stone concentration of 3.0 x 2.5 m diameter, and runs towards the west (compass reading: 240°), with a small bend after 44 m. It consists of about 75 buried stones.

It is difficult, if not impossible, to unravel the meaning of all these lines and stone settings. They are clearly intentional and will have had a clear function. Aesthetic reasons do not apply here as the layout is too complex and cannot be overviewed: the stones are too small and the site is too stretched out. It is possible that the lines are pointing to important features in the landscape or in the sky: rivers, springs, mountain peaks, positions of the sun or other astronomical elements or events. If the rectangular structures really acted as virtual dwellings for the dead, as suggested by E. Jacobson-Tepfer, the path to the west may symbolise the way to afterlife, with the sunset as a clear reference to the end of life. In that perspective, it would be interesting to investigate the stone concentration at the end of the path.

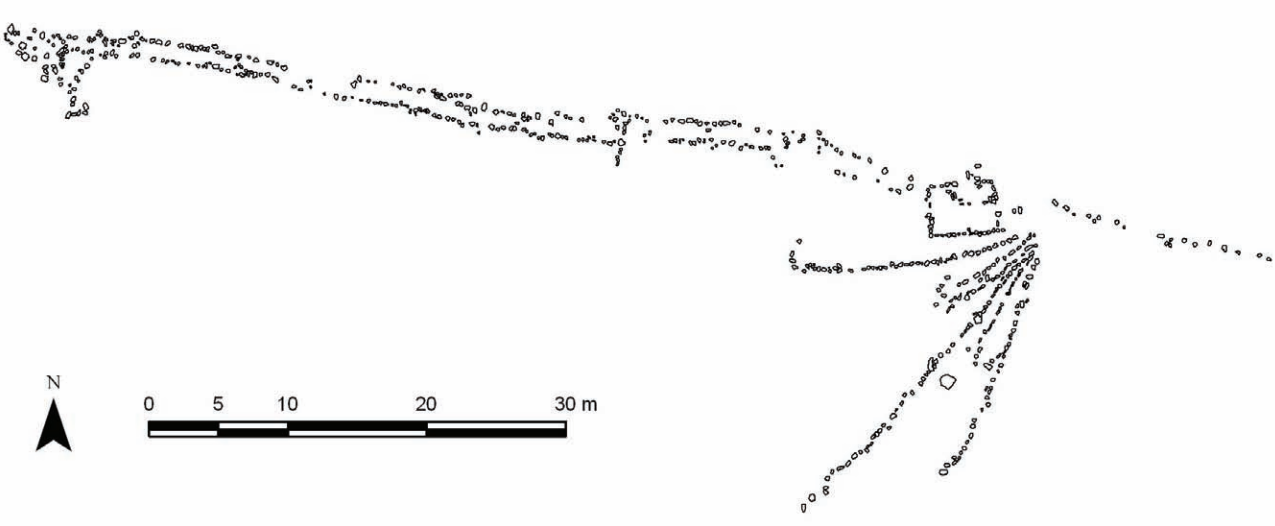


Figure 5.56: Site KA-033 in Irbistu, recorded in 2003 and drawn in full on a scale of 1/100

A second type of associated structure is a small rectangular enclosure with dark slabs for the frame and boulders in the interior. These possible altars may be distinguished from Turkic enclosures by their pronounced rectangularity, as well as by their location with reference to other surface archaeology, as they usually occur on the west side of a group of dwellings[25]. We did not find many of these altars in our research areas, although we did record a couple of dozen small, rectangular stone concentrations in the surroundings of the dwellings. They were interpreted as remnants of hearths of badly preserved dwellings, as there are sometimes indications of partly preserved walls around these small structures.

5.7 Standing stones

In the Altay Mountains, there is an important tradition of erecting standing stones. There is a huge variety and they were set in place during every period of human occupation, probably starting with the Early Bronze Age. They range from small to really massive, carved or uncarved, with or without decorations or petroglyphs, isolated or grouped, and with or without small associated structures.

The stones can be divided into several sub-types, including steles, deer stones, images stones and *balbal*, although there is also a class of undefined 'standing stones' in the database. These stones have no specific characteristics and are not part of one of the sub-classes. From the 2964 standing stones in our research areas, 167 were assigned thus. Next to these undefined stones, 52 steles were recorded, as well as nine deer stones, 20 Turkic image stones, 19 false image stones and 2,697 *balbal*.

[25] Jacobson-Tepfer, Esther. Letter to author, 01-10-2008.

Type	*Number*
standing stone	167
stele	52
deer stone	9
image stone	20
false image stone	19
balbal	2,697
Total	**2,964**

Table 5.16: Different types of standing stones in our research areas

5.7.1 Steles or massive standing stones

A stele is a standing stone, mostly uncarved, solitary or in small groups, with or without a circular or rectangular enclosure around the base. Most of these stones can be dated back to the Bronze Age. Massive standing stones with stone frames, aligned from north to south, are among the most striking of the Bronze Age monuments. They have a powerful stature and are located at particular places in the landscape. Sometimes, they have small stone circles to the east of them, clustered or in alignments of five to ten circles, following the cardinal directions.



Figure 5.57: Massive standing stones, isolated or in groups of two to four stones: examples from Turu-Alty, north of the Yustyd valley (left), Dzhazator (middle) and the Chuya steppe near Yustyd (right)

5.7.1.1 Steles in our research areas

The steles are fairly evenly spread over the research areas. We found them everywhere, except for Berel and Karakaba (Table 5.17). But steles are more common in Karakol, although most of the stones found there are not typical – we did not find any isolated standing stones in Karakol. They may have been pulled down by farmers to clear the fields, and piled up on the many heaps of stones that border the hay fields in the valley. We believe many of the smaller structures have disappeared in this way. However, there are some very large standing stones,

mostly west of large Iron Age burial mounds (Figure 5.58). That is strange since massive standing stones are not commonly associated with Iron Age mounds, and certainly not in the west. The stones themselves look typically Bronze Age, so they may have preceded the mounds. The distance and the direction between the mounds and the standing stones are very consistent suggesting they must have been put together on purpose. Could it be possible that the Iron Age mounds were placed at that specific location because of the Bronze Age steles? This seems unlikely as the location of the site fits perfectly within the configuration of Iron Age burial sites in the valley; conversely, it is an atypical location for Bronze Age steles. Moreover, it seems too coincidental that the stones are placed at such intervals that they give way to the construction of huge burial mounds. They may have been reused, which is unlikely considering their dimensions. Most probably, the stones are contemporary with the mounds and should be dated to the Early Iron Age, although it is impossible to prove this.

Total	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARa*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CHU*
52	-	1	9	1	3	-	22	3	3	1	5	4

Table 5.17: Distribution of steles or massive standing stones over our research areas



Figure 5.58: Site ON-020 (above) and site ON-021 (below) in Karakol, with the large standing stones (right) indicated as purple dots (for a detailed site plan, see DVD 2)

In Dzhazator, three locations with Bronze Age steles were recorded, all in the middle part of the valley. The first was a single enclosure with a double stele, the second, a row of three steles with some fallen stones next to them, and the third, one isolated standing stone. These stones are all set in a very limited part of the valley, along the river, at 2,000 m and 1,300 m intervals. The same 3,300-m stretch of the valley also includes four out of the five petroglyphs sites we recorded in Dzhazator. This is certainly no coincidence. Although we do not pretend to have recorded all petroglyph sites in the valley, this relationship between steles and petroglyphs may

be meaningful. The same was found in Yustyd, where an isolated Bronze Age stele was clearly linked with a petroglyph site (Figure 5.59). The site is located in one of the small tributary valleys to the north of the Yustyd River, and no sites were found for hundreds of metres around it.



Figure 5.59: Yustyd KA-376: Bronze Age stele in a square frame, with outcrops with petroglyphs in the background (see also right-hand photo)

5.7.2 Deer stones

The image of the highly stylised deer with wave-like antlers appeared in northern Mongolia sometime during the late Bronze Age (ca. 1000 BCE), and is one of the most typical motives from the Eurasian Early Nomadic world (Figure 5.60). It persisted for approximately 500 years, pecked into rocky outcrops and into standing stones (Jacobson-Tepfer 2001: 31). These standing stones are referred to as 'deer stones': they are covered with distinct petroglyphs and carved images, of which the deer is the most arresting element. They generally date back to the Bronze Age and Early Iron Age, representing an early form of animal-style art. However, the term deer stone creates a false sense of unity; there are many different types of so-called deer stones bearing radically different stylistic characteristics and types of imagery. The recumbent deer is not always the main motive, and is sometimes missing completely. Nevertheless, all deer stones are presumed to be of one essential sculptural and iconographic type; what they have in common is the general anthropomorphic reference, both in details of the carving as well as in size and shape. The term is now so widely spread in archaeological literature that it would be confusing to use other names for the different variants. Instead, scholars have worked out a typology of the deer stones, mainly defining four distinct monument types, depending on the imagery that is used in the carvings. The types are more or less regionally bound, although there is considerable overlap and stylistic elements have penetrated into adjacent areas.



Figure 5.60: An elk or red deer, and a typical stylised version, pecked into a deer stone in Uushigiin Uver (Mongolia)

5.7.2.1 Typology of the deer stones

The first type of deer stones is primarily found in Mongolia and in the Transbaykal, and is usually referred to as the 'Mongolian type'. This is the classical deer stone which is covered with stylised images of recumbent deer with bird beak-like heads and extremely large antlers. In between the deer images, the empty space is filled in with smaller deer, horses, weapons and tools. There is a clear anthropomorphic reference; most of the stones have a carved belt, and bead-like ornaments around the head form a typical 'necklace'. Three slash lines on the upper part of the stone seem to refer to certain schematic details of the face, while circular elements on the 'head' of the stone (with a short line going down) are often referred to as 'earrings'. In addition, tools and weapons hang down from the belt, such as axes, daggers, hooks, and an unidentified shield-like trapezoidal object. The 'face' of the stone or 'body', sometimes literally with a human mask, is oriented to the east, while the earrings are always carved on the broader north- and south-facing sides. The stones are mostly part of complex architectural ensembles. They can be found in the surroundings of Late Bronze Age – Early Iron Age slab graves, or are placed in relation to *kereksur* monuments, as guard stones or corner markers (Jacobson 1993: 143-144).

Type II, the Sayan deer stone, is found in the Sayan Mountains of Tuva, and usually has images of deer, wild caprids and occasionally horses and wild boar. The depictions have some typical characteristics which are different from the Mongolian type: the animals have an enlarged mouth area and the bodies are strongly curved. In some case, the animals are depicted in the length of the stone, one next to the other, as if they are standing on their hind legs.

Deer stones from the Altay region, type III, usually lack zoomorphic imagery. They are often carved relatively crudely. Deer stones from the Sayan-Altay regions (type II and III) have a less clear anthropomorphic reference. In most cases, only some of the earlier mentioned elements are present, in more or less simplified forms: a chain of beads or necklace, three parallel slashes, circular carvings or earrings, and sometimes a belt with weapons hanging from it. Also important is the fact that the images of animals, if any, are carved more roughly and take less space on the surface of the stone.

V.D. Kubarev distinguished two types of deer stones within the Altay type during his work in the Chuya and Katun river valleys (Kubarev 1979, with reference to Kubarev 1997). The first type (type III-a) is tall and thin with its 'face' on the thin eastern side. These can be up to 3 m high, and the upper part often slopes down from east to west, resembling a standing human figure. The stones can be quite roughly cut. The second type (type III-b) is short and heavy, square in shape and usually no higher than one m. Some examples of this kind of monument were recorded in the Yustyd valley during the fieldwork in 2004.

A fourth type of deer stones is not found in Mongolia and South Siberia, but on the far western edge of the early nomadic world: the Black Sea area. There are no deer visible at all on these Scythian and Cimmerian anthropomorphic images, but they immediately call to mind the stones of Mongolia and South Siberia. The stone human images from the Scythians are traditionally referred to as *baba* (see also 5.7.3), and recently approximately 45 of them, from the Kuban, the Black Sea region and Bulgaria, have been published. They can be rather ungainly and virtually all of them are crudely carved. The stone figures represent male warriors holding rhyta (a container for drinking or libation) and sometimes wearing armour. It is difficult to date the figures as most of them were found within disrupted sites, and many are badly damaged. The same goes for the Cimmerian anthropomorphic steles. These stones are even cruder than the Scythian variant. Zoomorphic images can be found on some of them. However, the most striking link with the Sayan-Altay types of deer stones is the abstract character of the anthropomorphic reference: the typical necklaces with cup-marks or a band that defines the 'head' of the stone, circular markings or earrings and the absence of a real human face (see Jacobson 1993: 158-160).

5.7.2.2 Deer stones in our research areas

The results from our inventory work seem to fit perfectly within this typology. All research areas are located in the western part of the Altay Mountains, and only type III deer stones have been recorded. In addition, it is very clear that most deer stones in the database are located in the most eastern research areas. The Yustyd valley, located very near to the present-day border with Mongolia, clearly has the biggest number of deer stones in our inventory. Yustyd is a special place, in more than one respect, as it really forms the transition between the cultural landscape of the Mongolian Altay and that of the Russian and Kazakh Altay (see Chapter 6). Unfortunately, many stones in Yustyd have been removed, are broken, or seem to have a clearly indicate reuse in younger archaeological complexes. It is thus difficult to make a good interpretation regarding their original function. As the number of recorded deer stones is limited to nine, all of which are located in the Yustyd valley, we have included an overview. The context of the deer stones in Yustyd reflects the degree of reuse: only two were actually in their original Bronze Age context, three were integrated in Scythian sites, and four were part of Turkic memorial complexes, mostly reused as *balbal*.

The only clear example of Kubarev's first type of Altayan deer stone (type III-a) in our database is structure KA-298-001 in Yustyd. It is a large, standing stone slab, 277 cm high, 105

cm wide and 20 cm thick (Figure 5.61). It is roughly cut, and only three images can be found on the stele: a hammer on the south side, a dagger on the thinner east side and a quiver on the north side (Figure 5.62). Jacobson-Tepfer suggest that the images might have been cut long after the stone was erected as they appear to be isolated, without a belt or any other anthropomorphic references (Jacobson 1993: 149). Only the general form of the stone suggests that of a man standing; the top of the stone slopes down to the west, resembling the head, neck and slightly curved back of someone looking eastwards.



Figure 5.61: Deer stone KA-298-001 in the Yustyd valley (Kubarev's no. 6): view from the south, east and north



Figure 5.62: Carved images on deer stone KA-298-001 in the Yustyd valley: a hammer on the south side (left), a dagger on the thinner east side (centre) and a quiver on the north side (right)

The stone is the central structure of a very complex setting of small standing stones and fire altars. In turn, this complex is integrated into the larger complex of *kereksur*, burial mounds and enclosures that fill the vast terrace on the right bank of the Yustyd valley. There is no direct link

with the surrounding monuments, which are mainly *kereksur* monuments, but the stone should not be seen as an isolated monument. The general layout of the complex is formed by 111 stone circles and one stone platform in a long, stretched oval concentration (Figure 5.63). The group stretches out over 137 m, approximately north-south, and has a maximum width of 21 m. The deer stone is located here, 51 m north of the most southern stone circle and right on the eastern edge of the group. South and north of the stone, a line of small standing stones borders the zone of stone circles over a length of 76 m. We recorded 18 of these stones, although there were probably more originally.

The complex has already been described by Kubarev in 1979 and by Jacobson-Tepfer in 1993 (deer stone no. 6). They mention 104 stone circles, and some 30 small standing stones, which Kubarev also calls deer stones (Kubarev 1979, Jacobson 1993). Kubarev did some small excavations at the base of the deer stone and on some of the small side structures. These showed that the stone circles were indeed fire altars, and that the chronology of the site was rather complex. In particular, some strange artefacts at the base of the deer stone – including pieces of at least four other deer stones, a group of stone pestles, a stone carved with a mask-like image and fragments of thin ceramic and black crystal – complicate the dating of the stone. The stone pestles suggest an early date, so Jacobson-Tepfer concludes it is possible that the stone is ancient – perhaps even Neolithic – but was reset in the Early Iron Age period when the carvings of the three weapons were added (Jacobson 1993: 150).

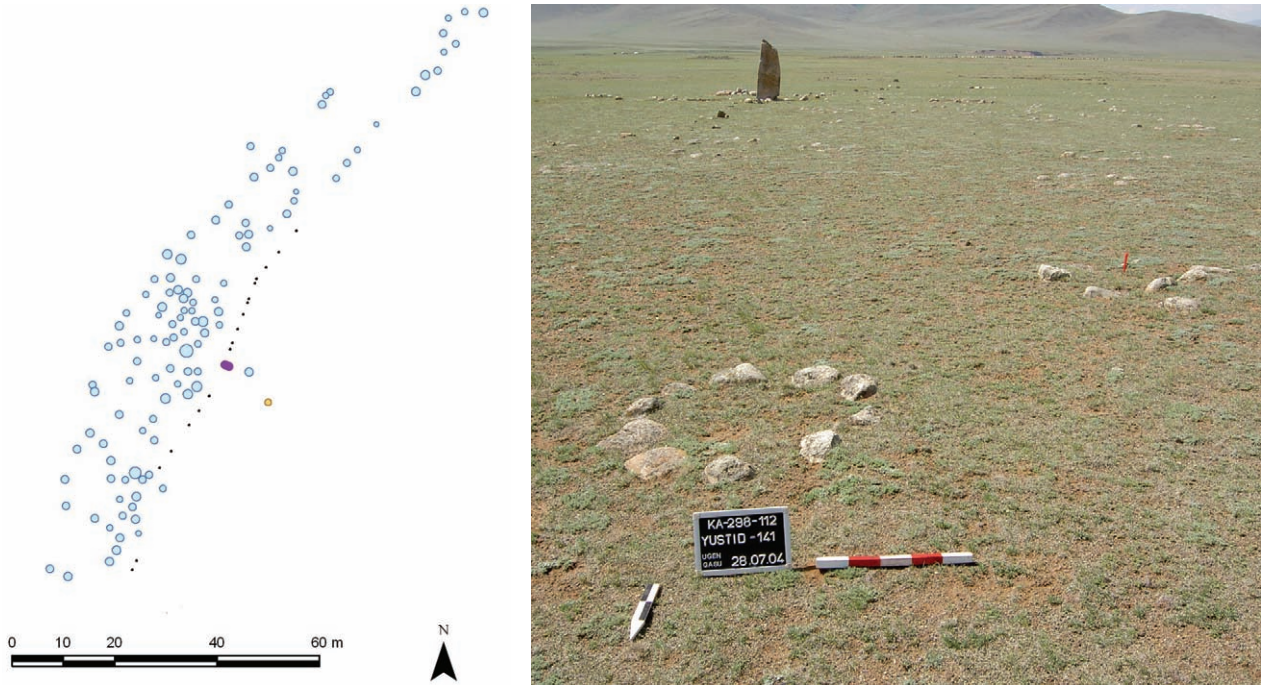


Figure 5.63: Left, the general layout of the complex setting of deer stone KA-298-001 in Yustyd, including 111 stone circles (blue circles), one circular stone concentration (orange circle) and 18 small standing stones (black dots). Right, an overview picture

Another standing stone is very similar to deer stone KA-298 or Yustyd no. 6, but has no carvings at all. Structure KA-433-001 is 220 cm high and 70 by 12 cm thick. It is placed with the thin sides facing north- and southwards (Figure 5.64). A huge chunk of stone has broken off the top part of

the stone, with makes it difficult to see its original form. However, there appears to be no clear anthropomorphic reference at all. Although the location of the stone appears to be original, the orientation is not the usual one to the east. Ten stone circles are constructed to the east of the stone, in two rough rows of five. Some very recent drawings and texts are carved on the stone, but there are no indications of ancient carvings or marks whatsoever. All these elements suggest that the stone cannot be seen as a deer stone, and we recorded it as a stele or massive standing stone. Its original date is unclear: it possibly dates from the Bronze Age, although an earlier date cannot be excluded without further research – as has been noted in the previous example.



Figure 5.64: Stele KA-433-001 has approximately the same size and form as that at site KA-298, but was not identified as a deer stone: no carvings were found, there are no anthropomorphic elements and the stone is oriented towards the north

The second, smaller type of Altayan deer stones are more numerous (type III-b). Structure KA-214-053 is a small deer stone which is part of a Scythian burial site with 13 burial mounds. The stone is located to the west of the row of burial mounds, and is standing between the 'stone platforms' and ritual stone circles or fire altars. This connection with a Scythian site is unusual. The stone is 40.2 cm high, 29.8 cm wide and 12.9 cm thick, with the thin sides pointing north- and southwards. Both the east and the west side are decorated with a 9 cm large ring, which has a small pearl hanging from the bottom, just out of the central axis: on the east side it is carved somewhat to the right, on the west side somewhat to the left. Thus in both cases, the pearl is oriented slightly to the north. The earring motive is not complete on the west side, as the top of the stone is damaged and some schist layers have come off. The thin south side has another carving: three short, parallel, diagonal slash lines of about 6 cm long (**///**). The stone is carved as leaning towards this 'face' side with slash lines (Figure 5.65).



Figure 5.65: A type III-b deer stone in the valley of Yustyd, KA-214-053: west side, south side and east side. It has very clear markings on three of its four sides (slash lines and two earring motives) and the shape of the stone is leaning towards the thin 'face' side with three slashes

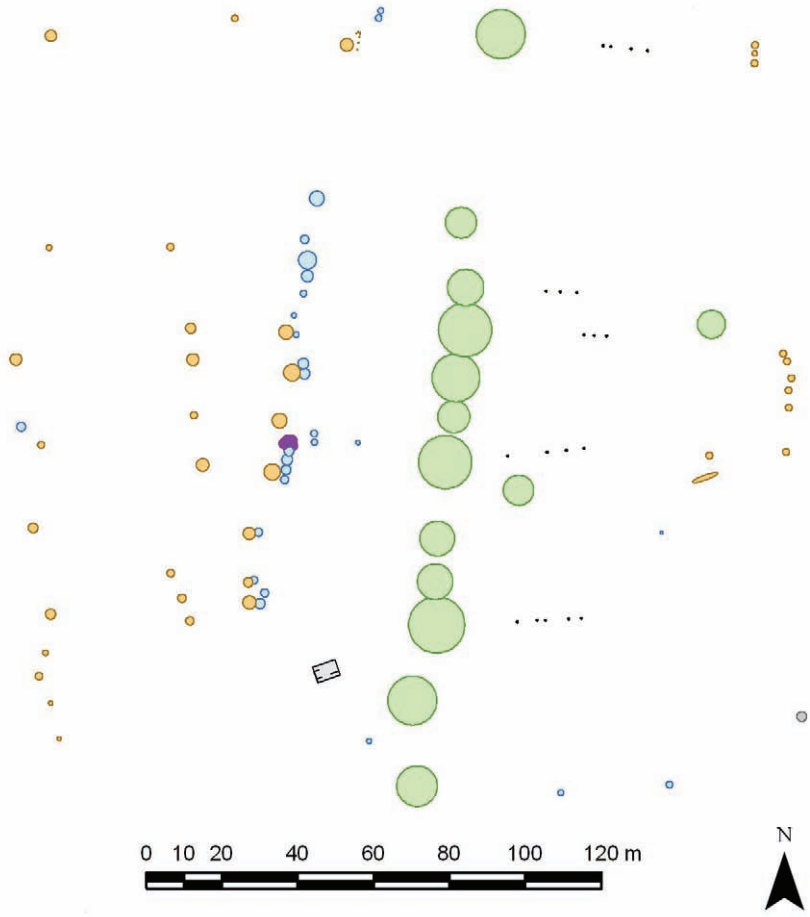


Figure 5.66: Yustyd: location of deer stone KA-214-053 (purple) to the west of a row of Scythian burial mounds (green), between stone circles (blue) and platforms (orange)

The stone may not have been reused in the Scythian complex, although its location is far from typical for a Scythian site; normally, there are no standing stones of any kind located within the zone of stone circles and stone platforms west of the burial mounds (Figure 5.66). However, the orientation of the stone does not comply with the usual deer stone standards. The thin 'face'

side of the stone is pointing to the south rather than the east. This gives the impression that the orientation of the stone is parallel to the lines of burial mounds and associated lines of stone circles and stone platforms. This emphasises the now east-facing side, with the clearest circular marking. The anthropomorphic reference is somewhat negated by this 'new' position, as the 'face' side of the stone is turned away from what seems to be the focal point: the Scythian burial mounds. Therefore, we suggest that the stone has indeed been replaced and reused in this new context.

Deer stone KA-243-004 was also found in a disturbed context; it was standing loose on one of three rectangular stone concentrations, possibly Turkic enclosures, placed in a north-south oriented row. In the middle of the central structure was a large stone, measuring about 50 cm in height and 30 by 11 cm in diameter (Figure 5.67). The stone was standing, but very loose. It might have been replaced recently so nothing is known about the original orientation. The flat sides both have a roughly carved circular symbol, about 6 cm in diameter, with a 3-cm-long line going down from it. On one of the thin sides, a symbol looks like the three slash lines (**///**) from earlier examples. However, the three lines, about 1 cm thick, are clearly connected with a cross-line, forming a 7-cm-long trident that is pointing slightly downwards. According to archaeologist A.V. Ebel, the trident could be a symbolic image of a bird of prey, flying upwards. This side of the stone was most probably facing east. It is higher, with the top of the stone sloping downwards to the other thin side.



Figure 5.67: KA-243-004 in Yustyd is a typical type III-b deer stone, although it has no necklace. The stone is small, has a sloping top, and has three marks on its sides: a rather unclear circle on one wide side (left), three slash lines on the highest thin side (middle) and a clear earring motive on the other wide side (right)

The clearest example of the typical 'necklace' was found on deer stone KA-286-011 in Yustyd. It stood east of a rectangular Turkic enclosure, on the western-most end of a row of small standing stones (*balbal*) running eastwards. In this case, the stone is aligned with the direction of the row of stones, with the thin sides to the east and west. It is squat in form and has an angled top, sloping down to the west, measuring 32 cm high and 28 cm by 18 cm wide (Figure 5.68). The cup-marks on the necklace are very well defined on the southern face of the stone. They are about 4-5 cm in diameter and 8 cm above the ground, and run over the short side of the stone to the north side, almost touching the ground there. Here they are very elementary and not round; the continuation of the necklace is merely indicated by some irregular pecked zones. More

interesting is a very vague, 7-cm large circular symbol on the south side (possibly the earring again) and a more complex engraving on the north side, just above the necklace. The carving resembles the head, neck and beginning of the front legs of an unidentifiable animal, with a circular blank space representing an eye. It is difficult to determine the animal, but it could be a cervid or a horse.



Figure 5.68: Yustyd, reused deer stone KA-286-011: south side with cup-marks and circle, east side and south side with possible zoomorphic image

The odd placement of the stone, in a Turkic complex, suggests its reuse. It is quite possible that the stone was originally placed in another context, as has already been suggested by Jacobson-Tepfer and Kubarev (with reference to Kubarev 1979, Jacobson 1993: 150, note 12). It seems likely that the stone was damaged and only the upper part used to belong to this row of *balbal*. Normally, the necklace would have been much higher from the ground, as is the case in the next example.

In KA-293-001 in Yustyd, the small deer stone in grey-pink granite is 82 cm high and 40 cm by 45 cm wide (Figure 5.69). It is regularly shaped and squat-like. About 55 cm above ground level, there is a bead-like necklace which encircles the stone. In addition, three parallel slash lines (**///**) can be found on the upper part of the west face of the stone. The stone was found just north of a completely destroyed structure, which had probably been excavated. It was unrecognisable and therefore cannot be dated. The stone appeared to be standing in its original location although it is remarkable that the slash lines are carved on the west-facing side. The stone was found in the middle of the vast terrace of the Yustyd River, and is very isolated – there are no other structures within a radius of 380 m, which is quite unusual for Yustyd.



Figure 5.69: Structure KA-293-001 in Yustyd: deer stone with clear necklace and three slash lines on the west side

Deer stone KA-696-003 is part of an attractive rectangular Turkic enclosure that is bordered by standing schist slabs and filled with river stones. Some 10 m to the east are 15 stone circles in two north-south rows (one row of nine and one row of six circles). The deer stone is standing just west of them, and is 27 cm high, 18 cm wide and 11 cm thick. A clear, fine line is cut around the top of the stone, like a necklace (but without cup-marks). Some other lines are probably natural: three parallel lines follow the line of the stone (Figure 5.70).

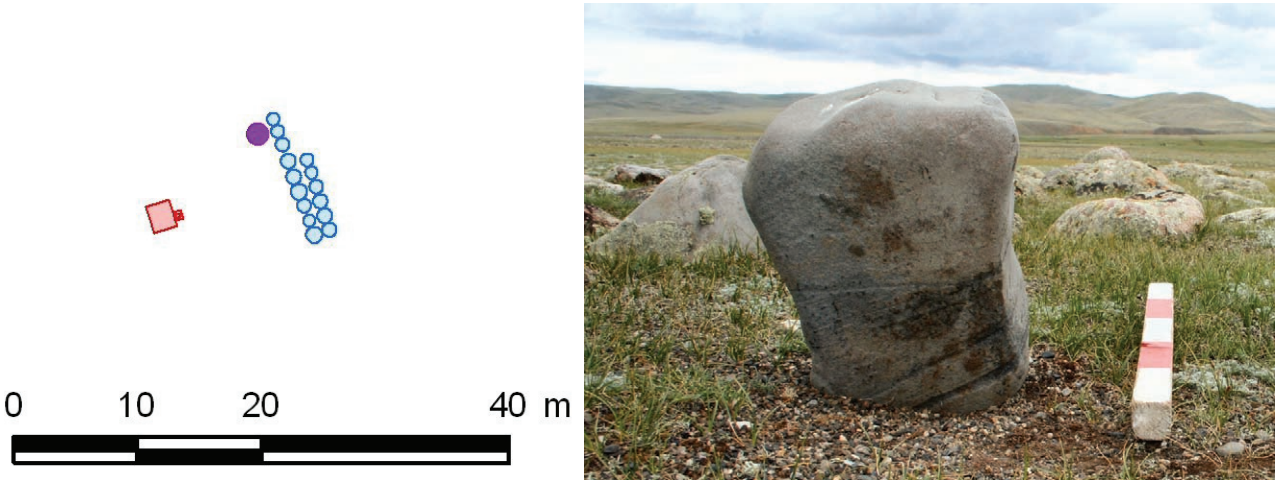


Figure 5.70: Reused deer stone KA-696-003 in a Turkic memorial complex: extract of site plan (left) and view on the north side (right)

Deer stone KA-745-022 was found lying on the surface, some 6 m south of the pit in which it originally stood (Figure 5.71). However, its location to the east of a row of Scythian burial mounds suggests its reuse as a *balbal* in the burial complex, although its original context is unknown. The stone has a total length of 130 cm and is 23 by 37 cm wide. A wide band seems to be carved out of the stone all around the top. Our first impression was that this was a natural feature, as if softer parts of the stone had been eroded by water, but a closer look revealed that the band at least had been altered by some peckings. Just underneath the band and parallel with it is a clear necklace of cup-marks. Other marks were not found.

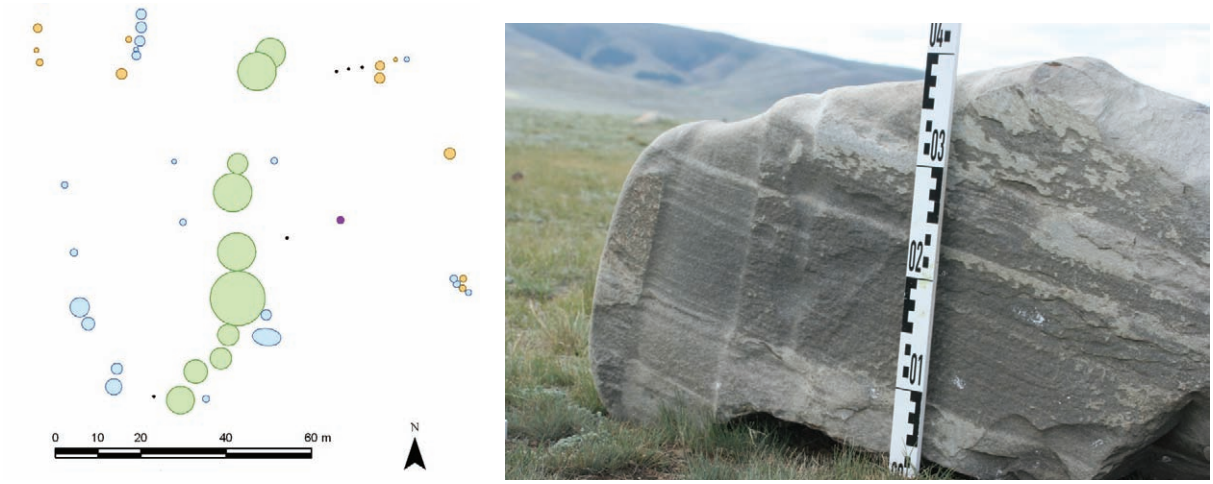


Figure 5.71: Fallen and possibly repositioned deer stone KA-745-022 (right), lying east of a row of burial mounds (left)

The next deer stone was also found in an Early Iron Age burial complex. Structure KA-807-016 is integrated as the central stone of a long line of *balbal*. Interestingly, a *balbal* west of it (no. 12) and one just east of it (no. 17) are decorated with small petroglyphs. The stone itself is 80 cm high, 40 by 30 cm wide, and is made of a white-greyish conglomerate. It has a belt of round marks all around the top and three lines on the east side (Figure 5.72).

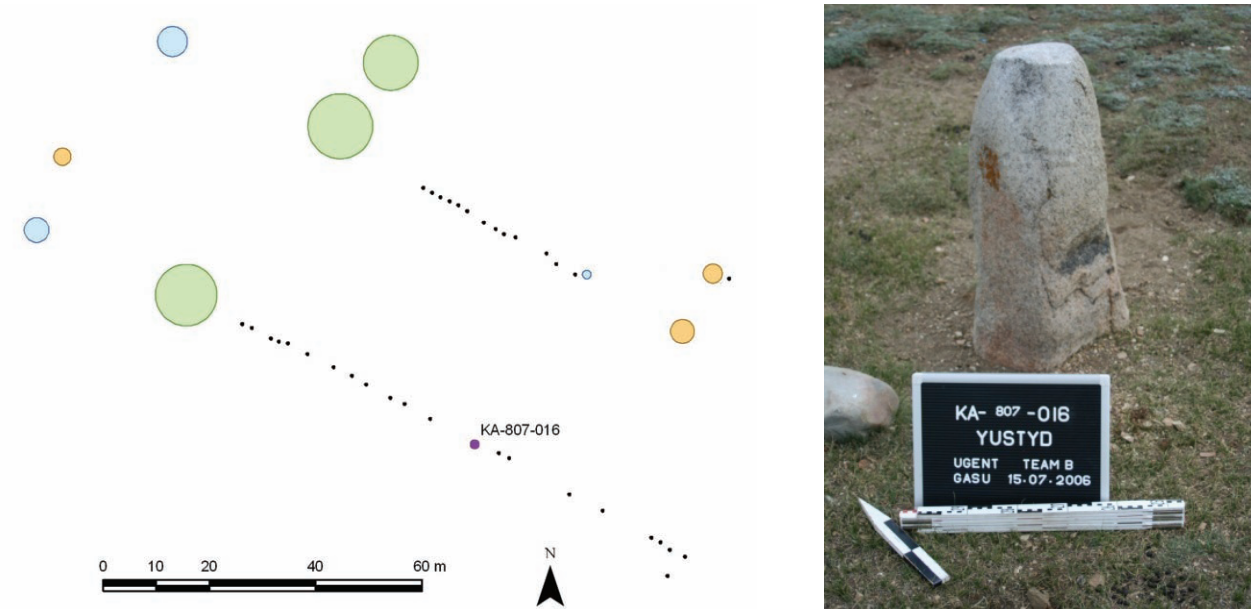


Figure 5.72: Yustyd valley, deer stone KA-807-016: it is placed within a row of *balbal* to the east of a Scythian burial mound (left) and has an unclear necklace of cup-marks around the top of the stone and three slash lines on its eastern face (right)

A more problematic case is deer stone KA-777-002. It is located on top of one of the bigger *kereksur* monuments in the Yustyd valley (KA-777-001), and seems to be part of the stone mound itself. It stands loose, and is most probably not in its original place. Although heavy, it can be transported. The stone is laying in a small depression on top of the mound, which makes it not distinctly visible. This is probably one of the deer stones Kubarev mentions as lying in the centre of a *kereksur*, suggesting that they were reused for piling up the huge central mound

(Kubarev 1979, Jacobson 1993: 150, note 12). The stone itself is 100 cm high, 40 by 45 cm wide, and is decorated with a line of roughly carved cup-marks around the top of the stone.



Figure 5.73: Yustyd valley: on top of *kereksur* KA-777-001 stands a deer stone of type III-b. It is decorated with a line of roughly carved cup-marks around the top of the stone, resembling a necklace

Deer stones in the Russian Altay are thus rarely found in their original context. This makes it difficult, if not impossible, to understand their function or meaning. In addition, as is often the case with the most interesting or beautiful archaeological sites, many of the stones have disappeared in recent times. Sites have been significantly altered by archaeological research and many of the stones have been taken away for display in local or far-off museums – sometimes to protect them from destruction or theft.

Reports of past archaeological research can alone hold information about these stones. In fact, a number of deer stones from the Yustyd valley are mentioned in archaeological literature:

- Jacobson-Tepfer mentions a tall stone, examined by Kubarev in 1979, that stood at the north end of the Yustyd complex. The elongated deer stone was deliberately broken into two pieces. Four stylised deer images were carved on it, resembling that characteristic of the Mongolian deer stones, as well as crouching wolf-like predators, a belt and the typical circular and slash markings at the top (Jacobson 1993: 150)(Figure 5.74).
- A second deer stone was short and rough shouldered, with a necklace, earrings and three slash markings, a deer, a hammer, a dagger and some other small carvings. No original location is mentioned in the text (Jacobson 1993 plate XXa)(Figure 5.74).

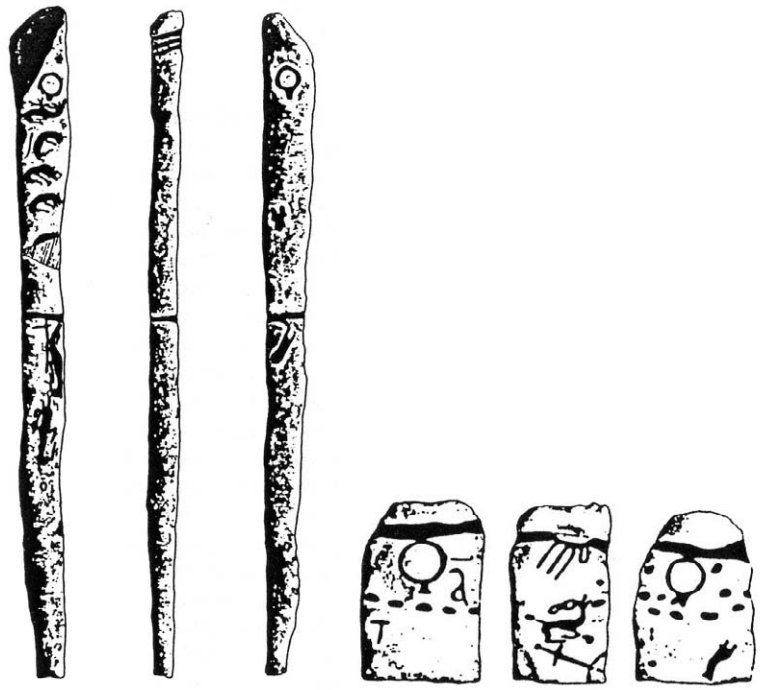


Figure 5.74: Two of the missing deer stones in Yustyd: a tall stone with deer motives in the north of the Yustyd complex (left) and a small deer stone with clear markings and weaponry (right) (Jacobson 1993 plate XXa)

Survey projects can be of particular significant importance in documenting monuments before they disappear. In Mongolia, a lot of deer stone research has been carried out, such as the American-Mongolian Deer Stone Project by W. Fitzhugh and colleagues, in central Mongolia (Fitzhugh & Bayarsaikhan 2008). For the Mongolian Altay, we refer to the Joint Mongolian/American Russian Project 'Altay' (1994-2004), which was continued by the Mongolian Altay Inventory (Jacobson-Tepfer et al. 1994, Jacobson-Tepfer et al. 2001, Jacobson-Tepfer et al. 2006a, Jacobson-Tepfer et al. 2006b, Jacobson-Tepfer et al. Forthcoming). In Xinyang in China, deer stones are called *lushi* (*lu* meaning stag and *shi* meaning stone). Since the 1980s, significant research has been carried out by, among others, by Wang Bo, Qi Xiaoshan and Wang Binghua (Hatakeyama 2002). In 2001, Wang Bo reported about 60 deer stones in Xinjiang, most of them located in the area of the Altay Mountains (Wang 2001).

5.7.3 Turkic image stones or *izvayanie*

The last major expression of the standing stone tradition in the Altay Mountains is the Turkic *izvayanie* or image stone: in its elaborated form, it is the most realistic depiction of a standing human figure. Many have very realistic facial features, including typically a moustache and small beard. They are shown in full dress, including headdress, earrings, necklace, and a belt of figured plates and weaponry. Usually, the left hand holds the belt or the sword while the right hand holds a vessel or a cup.

Standing stones with human faces from the pre-Turkic period are rare. In the Russian Altay, the most famous example is the sculptured Chuya stele, standing northwest of Kalbak-Tash. A beautiful carved face tops the massive stone, which is oriented to the east. Quite a lot of other carvings are visible on the stone, including a dagger, a horse, a deer and some other zoomorphological and geometrical forms (Figure 5.75). However, there are no other details of the body. The stone is generally considered to be a deer stone dating from the Late Bronze Age (transition of the 2nd to the 1st millennium BCE). Other examples include the four Early Nomadic image stones located just south of the village of Inya, along the Katun River. Apart from stylised faces, these stones bear carvings that indicate the neck and belt, and are thought to date from the Early Iron Age (Figure 5.75).



Figure 5.75: Pre-Turkic stones with anthropomorphic features in the Russian Altay. The Chuya stele or deer stone (left) with details of the carved dagger (middle), and the four Early Iron Age image stones in Inya (right)

In her research areas in Mongolia, E. Jacobson-Tepfer mentions only four or five documented pre-Turkic image stones. Three of these are deer stones and two are massive standing stones. In two cases, the stones are oriented to the east, a third faces the north, while a fourth has fallen over, and the fifth faces south. These early examples of image stones may shed light on the essential anthropomorphic reference of all standing stones for those peoples who erected them, and may be direct predecessors of their Turkic counterparts (Jacobson-Tepfer 2001: 39).

The Turkic image stones are sometimes erroneously referred to as *baba*, from the Russian word for 'peasant woman'. The term comes from the southern Russian steppes where female stone images are indeed common in the monuments erected by later nomadic populations (ca. 12th to 14th century CE). The term was imported into the Altay, although the images here are largely dominated by male figures, commonly seen as heroic warriors or *kezers* (Kubarev 1997: 35). The more appropriate Russian name, therefore, is *izvayanie* or commemoration statue. Esther Jacobson-Tepfer suggests using the term 'stone image' or 'image stone' instead of the

Russian name, cross-referencing it with *izvayanie* (Russian), with *balbal* (as used by the Kazakh and Kyrgyz archaeologists) and with 'stone men' (as used in Mongolia) [26].

The image stones typically stand on the east side of a Turkic enclosure, but they can also be found on top of them. They face east and are sometimes followed by a row of (smaller) standing stones, stretching eastwards (see 0). They date back to the second half of the first millennium CE, and most archaeologists use the analysis of carving technique and carved details for relative chronology – the more stylised and roughly carved the human features, the older the structures. The earliest examples look primitive and lack expression; many of them are highly stylised with a rough indication of a human face on their upper parts. Later images have very fine carvings and many details in the face (eyes, moustache, and jewellery) and in garments. These stones, with an unmistakable realism and great expression, are generally dated to the 8th and 9th century CE.

The image stones were probably memorial in function, as are the Turkic enclosures themselves. Whether the stones actually refer to specific deceased individuals, slain enemies (see 5.1.1), warrior ancestors or epic heroes is still under discussion (e.g. Kubarev 2007b).

5.7.3.1 Turkic image stones in our research areas

Most of the Turkic image stones, including the most beautiful ones, were recorded in the valley of the Dzhazator (Table 5.18). The nine stones, together with the many enclosures and special types of monuments in Dzhazator, indicate that the area was quite important in the Turkic period. Half of the stones were found lying on the ground, but some are still standing in their original setting. Sebystey also has numerous Turkic monuments, and four stones, mostly intact, were recorded there (Figure 5.76). Only three image stones were found in Yustyd, two of which were broken into several pieces, three in Karakol, and one along the Elangash River in the Chuya steppe. The image stones show a wide variety of carving styles, ranging from very elementary and roughly carved to highly detailed and elaborated (Figure 5.76 and Figure 5.77).

Total	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARa*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CHU*
20	-	-	9	-	-	-	3	-	-	4	3	1

Table 5.18: Distribution of Turkic image stones over the research areas

[26] The standing stones or *baba* are said to have been erected by the Polovets (or Polovtsy). This is the Russian name for a confederation of Turkic nomadic warriors who inhabited a vast area of the Eurasian steppes, including the northern borders of the Black Sea, the Caspian Sea and Lake Aral. The original Turkic name is Kipchaks.



Figure 5.76: Turkic stone images in the Sebystey valley. The head of two of the stones was badly damaged (image 1-2). The different levels of detail are clearly visible, from roughly carved stones (image 3) to very detailed facial features (image 4)



Figure 5.77: Different types of image stones: those with a beautiful, stylised head in relief and no further details on the body (Dzhazator, image 1-2), a stone with linear details such as a nose, ears and a belt or necklace on a flat stone (Karakol, image 3) and a very roughly carved stone with signs of a neck and shoulders (Yustyd, image 4)

In 1997, Kubarev mentioned over 300 Turkic stone images in the Altay that had been well documented. The great interest which ensued helped investigations into their origin and meaning, but unfortunately it also promoted the destruction of many unique monuments. They were either stolen and sold because of their aesthetic properties and artistic value, or simply destroyed. In the past, some of the images had already been destroyed by later populations – many stone images have been decapitated or pushed over. More recently, structures were destroyed by tractors exploiting new agricultural lands, or were simply used as building materials. Fortunately, many stone images were taken to schools or local museums, but for the most part their original context is unknown. They are now displayed in archaeological museums or stored in archaeological institutions (Kubarev 1997, Kydyev et al. 2007).

The following list includes some stones that have disappeared in our research areas. The list is certainly not complete, but gives an idea of the original number of stones in the research areas (Table 5.19). Four were removed in Yustyd, three in Karakol and one in Dzhazator:

- From Yustyd, now being exhibited at the museum in Biysk (Kubarev 1997: 60-61);
- From Yustyd, now being exhibited at the museum of the IAE SB RAS in Novosibirsk (Kubarev 1997: 60-61);
- From the left bank of Yustyd (Kubarev 1997: 158-159);
- From Yustyd (Kydyev et al. 2007: 120-121);
- The Kezer Stone: from Karakol, now in the museum in Barnaul, was located near the village of Kulada, where it was sketched by the painter G.I. Choros-Gurkin (Kubarev 1997: 108-109, Kydyev et al. 2007: 29);
- From Karakol, found near the village of Kulada and now in the local museum in the same village (Kubarev 1997: 110-111, Kydyev et al. 2007: 30);
- From Karakol, now in the museum at Kulada (Kydyev et al. 2007: 31);
- From Dzhazator, described in detail by S. Sorokin in 1964, but taken away from the site either by Sorokin or shortly after (Sorokin 1969)(Figure 5.78).

Sadly, the stones that were taken away tend to be the most beautiful or intact. Sometimes, their relocation to museums has preserved and protected them from any harm, but it is sad to see all the altered sites in the field.

A beautiful Turkic memorial site was found in Dzhazator, on one of the largest terrace on the left bank in the higher part of the valley. A delicately carved image stone is standing east of a Turkic enclosure of the 'Ayutinsky' type, and a long line of 47 *balbal* stretches out to the east over more than 280 m. The image stone is broken at the neck, but all details of the body are clearly visible. In 2005, this stone was standing alone on the site, although it was originally accompanied by an intact and evenly detailed second image stone. A sketch by S. Sorokin, who investigated the site in 1964, reveals the beauty of the stone (Figure 5.78) (Sorokin 1969: 78). The drawing gives us an idea how the other stone must have looked before being decapitated. In 1964, the stone was still standing. Sorokin must have taken it out of the ground (he drew the outlines of the part underground), but we do not know where the stone was taken to. In addition, the first stone was still standing straight at that time, and was some 30 cm deeper in the ground. After 1964, someone must have tried to pull it out.

Context	*Total*	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARa*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CHU*
In situ	20	-	-	9	-	-	-	3	-	-	4	3	1
Removed	8	-	-	1	-	-	-	3	-	-	-	4	-
Total	28	0	0	10	0	0	0	6	0	0	4	7	1

Table 5.19: Total number of image stones per research area, including those that have been removed

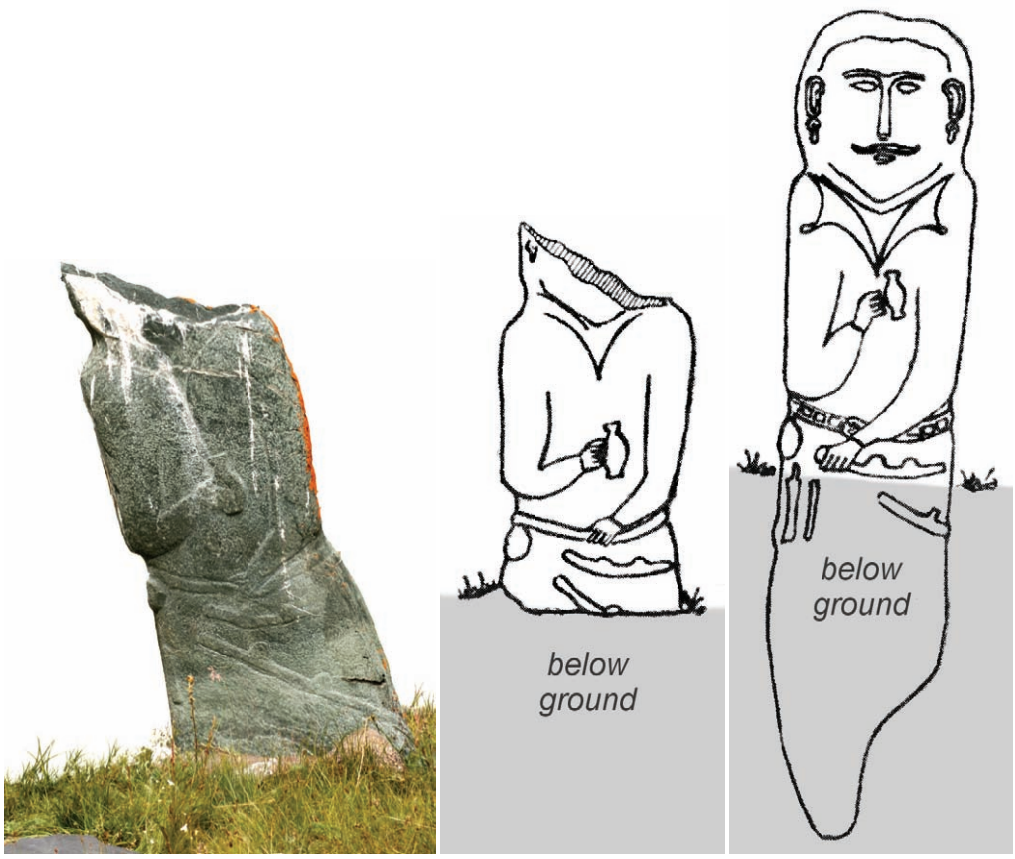


Figure 5.78: Dzhazator, Turkic image stone KA-465-005 as pictured in 2005 (left). In 1964, the stone was standing straight and some 30 cm deeper in the ground (centre), as can be seen from this drawing by S. Sorokin (see also the coloration on the image left). Just north of it was another, completely preserved image stone (right) (Drawings from Sorokin 1969: 78)

5.7.4 False image stone

Sometimes a large, undecorated stone can be found in the neighbourhood of a Turkic enclosure or *ogradka*. The stones are placed as if they were Turkic image stones, but remain uncarved (Figure 5.79). However, they are no *balbal* and are of much greater mass than the average stones that are part of the alignments. These so-called 'false image stones', a term taken from E. Jacobson-Tepfer's typology[27], could represent or stand in for the carved image stones; their function was certainly similar to that of the true Turkic images.

Nineteen of such stones were recorded during the surveys. Before using the term false image stone they were simply called *balbal*. Although the database was checked for possible false image stones, it is possible that more standing stones should be put in this category. Most of the false image stones were found in Dzhazator, with 12 individual examples. Six were found in Karakol, and another one in Bukhtarma.

[27] As agreed with Esther Jacobson-Tepfer. Letter to author, 01-10-2008.

Total	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARa*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CHU*
19	-	1	12	-	-	-	6	-	-	-	-	-

Table 5.20: Distribution of false image stones in our research areas

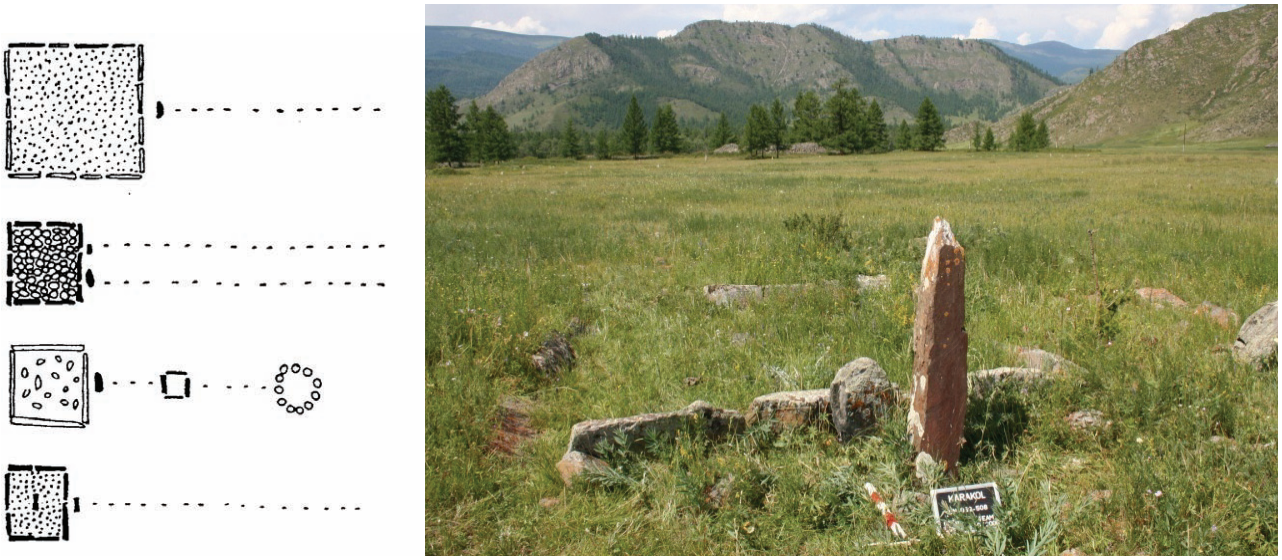


Figure 5.79: False image stones, standing east of Turkic enclosures. V. Kubarev depicted them as heavy black dots in his typology (left). An example is shown in site ON-062 in the Karakol valley (right)



Figure 5.80: Some examples of rows of standing stones in Chuya, Dzhazator and Ozyok

5.7.5 *Balbal* or row of standing stones

The term *balbal* is generally used in Russian archaeology to define small standing stones that are placed in rows to the east of Turkic enclosures (see discussion in 5.1.1). Scythian burial mounds have similar rows of standing stones, also pointing to the east. In our database, we use the term in that sense, but E. Jacobson-Tepfer suggests the term 'row of stones'. There is no certainty about the meaning of the stones. It is general understood that they refer to people, either to the followers of the person being remembered or, according to some authorities, to the number of adversaries killed by that person. This is mainly based on interpretations of Turkic inscriptions, but the presence of the same rows of relatively small standing stones in relation to Scythian burial mounds could mean that the symbology goes back to the Early Iron Age.

5.7.5.1 The distribution of *balbal* in our research areas

An impressive number of 2,697 *balbal* was recorded in the different research areas. Of course, the date of the standing stones depends on the monuments they are associated with (Table 5.21). For 1,750 *balbal*, this was a Turkic enclosure. Scythian burial mounds have, in total, 771 standing stones to the east of them, and 176 *balbal* were associated with monuments that could not be dated. Most of the *balbal* were found in Dzhazator, Yustyd and Karakol, as a result of the many Turkic and Scythian monuments in those valleys. In Karakol, most of the *balbal* were associated with the small burial mounds in Nizhniy Sooru, among others (see Figure 3.10 and chapter 5.2.2).

Date	*Total*	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARa*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CHU*
Unknown	176	-	2	2	-	-	-	140	-	-	-	31	-
Scythian	771	2	-	309	3	10	-	129	40	-	84	194	-
Turkic	1,750	2	25	318	1	15	-	1,059	5	-	63	257	-
Total	**2,697**	4	27	629	4	25	0	1,328	45	0	147	482	0

Table 5.21: The distribution of *balbal* in our research areas, by date

The layout of the sites and the orientation of the rows of *balbal* have already been discussed in 5.2.1.2 (for Scythian sites) and 5.2.2.1 (for Turkic sites). The average height of the 2,697 stones is 24.5 cm. Originally, this would have been somewhat higher, as quite a lot of *balbal* have been broken or have fallen down. E. Jacbson-Tepfer remarked that *balbal* of the Early Nomadic period may be relatively large, whereas those of the Turkic period are usually smaller. This is also reflected in our database, with an average height of 31.6 cm for the Scythian *balbal*, but only 20.7 cm for the Turkic ones.

5.8 Circular stone settings

The construction of stone circles is widely spread in Altay, both chronologically and geographically. There are many different types of stone circles and they differ widely in dimensions. The circles can be built of jutted rough mountain stones, set apart (Type 1), or made from smooth 'buried' boulders, usually in juxtaposition (Type 2)(Figure 5.81). The first type is always found in connection with Iron Age burial mounds, while the latter can be associated with a wide variety of monuments, including *kereksur*, steles or massive standing stones, deer stones, Turkic enclosures and Iron Age burial mounds. Stone circles can also occur in isolation in the landscape; in that case, they tend to be bigger.



Figure 5.81: The use of dark-coloured rough stones, set apart in a jutted position (left, an example from Sebystey) or greyish, smooth boulders in juxtaposition (right, an example from Yustyd) results in two very different types of stone circles

The function of the stone circles is a ritual one, with some researchers referring to them as altars or circular altars. Excavations have shown that they were used as a fire altar for offerings. Research at the Urt Bulagyn *kereksur* (KYR1) in the Khanuy valley (Arkhangai aimag, central Mongolia) has revealed over 1,000 circles arranged in lines all around the *kereksur*. They were built of surface stones, ranging in diameter from 1 to 3 m. The archaeologists excavated five stone circles, all of which had burnt bone fragments between 10 and 20cm below the modern ground surface, coming from various livestock. Most of the circles had less than 200 fragments, although one had over 33,000. Interestingly enough, cremation was not carried out in the circle; the fragments were scattered freely within the circle area after being burnt (Allard & Erdenebaatar 2005: 549-550).

Their large number, the association with different types of monuments and the prolonged use of stone circles is remarkable. As Jacobson-Tepfer puts it, the appropriateness of their form to their function probably dictated why their construction should have lasted several thousand years across the Bronze and Iron Age and Early Middle Ages (Jacobson-Tepfer 2001: note 57).

5.8.1 Stone circles in our research areas

The stone circle is the most common structure in our inventory. No less than 3,029 circles were mapped during our surveys, which is a quarter of the total amount of structures. Most of these are stone circles that are associated with other monuments. It is this association that enables us to date the circles: 1,422 circles belong to the Bronze Age, 1,168 were part of Scythian burial complexes, 219 circles were located east of Turkic enclosures, and 220 circles are of unknown date. By far the most circles were found in the Yustyd valley. In particular, the 1,317 stone circles in association with Bronze Age *kereksur* pushed the total in Yustyd to 1,998 structures, or two-thirds of the total.

Date	*Total*	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARa*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CHU*
Unknown	220	-	2	21	-	-	-	15	-	-	1	181	-
Bronze	1422	-	-	3	5	3	-	-	-	-	22	1317	-
Scythian	1168	-	18	313	8	3	5	372	78	-	60	311	-
Turkic	219	-	-	13	-	12	-	-	1	-	-	189	-
Total	**3,029**	0	20	350	13	18	5	387	79	0	83	1998	0

Table 5.22: Distribution of stone circles in our research areas, by date

The context of the stone circles has already been discussed above. They can be found in association with *kereksur*, built in a circle around them (Figure 5.27 and Figure 5.28), or to the west of Scythian burial mounds (Figure 5.5). In this case, they are commonly paired with so-called stone platforms (see 5.9). Circles are found east of steles or massive stones and, in one case in Yustyd, grouped around a large deer stone (Figure 5.61). Finally, they can be built to the east of Turkic enclosures, mostly arranged in roughly north-south oriented lines of two to ten circles.

One interesting question is whether or not the large concentrations of stone circles next to Scythian burial complexes and those encircling *kereksur* represent a single building phase or gradual additions. Most of the small circles typically surrounding *kereksur* form a circular line with regular intervals, but the number and disposition of the circles vary widely. This could suggest gradual additions over several years, generations or even centuries. If a *kereksur* was the place of ritual activities, each practice may have been represented by a new circular altar. The largest *kereksur* in Yustyd, KA-158, could illustrate this process (Figure 5.82). The group of altars completely encircles the *kereksur*, but the two ends do not touch each other – in the south-west, they run alongside. The distance between the altars and the fence is very irregular, resulting in a crooked line. If the altars were all constructed during the same building phase, a more regular layout might be expected. We suggest that the circles were built in different phases. The building probably started in the south-west, moving in a clockwise direction around the *kereksur* as circles are mainly located to the west and north of the *kereksur*, but less in the south.

F. Allard et al. found evidence for an extended period of growth and use at some of the *kereksur* in their research area. Radiocarbon dates obtained from satellite mounds at Urt Bulagyn suggest a possible outward growth over a period of a few centuries (Allard & Erdenebaatar 2005: 558).

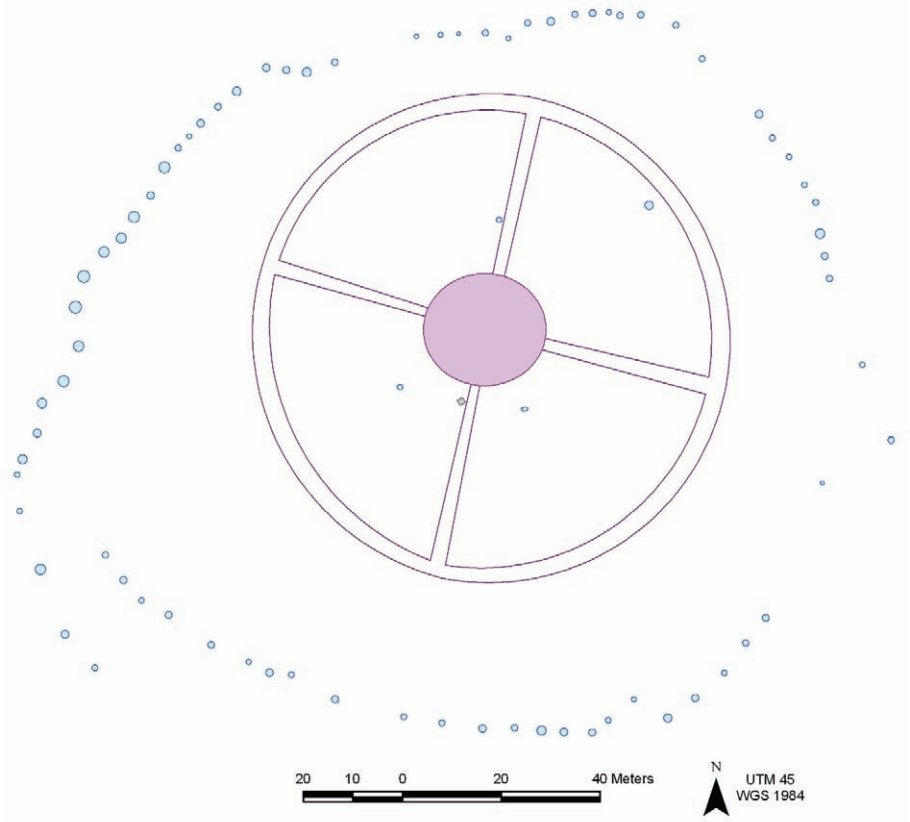


Figure 5.82: *Kereksur* KA-158 in Yustyd, with its complete circle of small stone circles

The same assumption possibly applies to Scythian burial complexes. The simplest sites have only one row of stone circles to the west, in many cases one structure per burial mound. The complex sites, however, have several lines of small altars running roughly parallel. If the fire altars were being used to commemorate the dead, it is possible this was done in several cycles, each resulting in a new (line of) fire altars.

Finally, we have a small comment on the number of stones in a single stone circle. V. Kubarev refers to the stone circles as *vos'mikamennye kol'tsa* or 'circle of eight stones', but this definition does not seem very accurate. Although some of the circles do have eight stones (13.6%), most have either more or less. The average is 8.7 stones per circle, with an even distribution around that average (Figure 5.83). As many of the stone circles are no longer intact, and are missing one or more stones, the numbers here are certainly minimal.

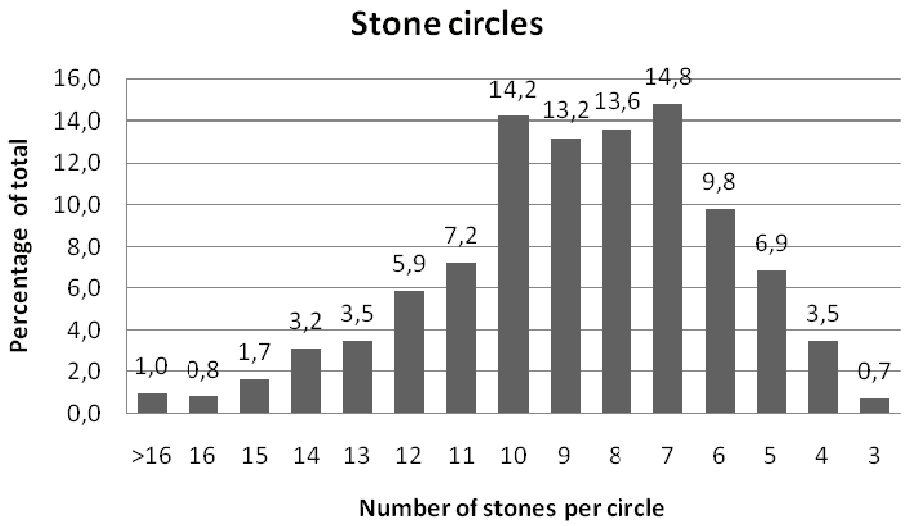


Figure 5.83: The number of stones in the circular altars, averaging 8.7 stones per circle

5.8.2 Solitary stone circles and semi-circles in the research areas

Stone circles that are not associated with other monuments are not that common. We recorded 104 of these solitary stone circles. Generally, they are larger than the circular altars associated with *kereksur* or burial mounds, but not always. Sometimes they take the form of Scythian or Turkic circles, but they are completely isolated. Large circles appear on terraces or ridges, without a clear pattern. The function and age of these circles are uncertain.

If circular stone settings seem to be deliberately incomplete we call them semi-circles. They are rare, however; only 21 were found during the survey. It is unclear whether or not most of these structures have the same function or meaning. The only thing they have in common is their shape – their function and age are uncertain.

5.9 Stone concentrations and pavements

A small variant on the stone circle is the so-called small 'stone platform'. It is a low stone concentration about the same size as the circles, and is round and completely filled with stones. It appears west of Scythian burial mounds, in most cases paired with a stone circle, and probably has the same function (Figure 5.84). We have called it a stone platform to link it clearly with the stone circle. Russian archaeologists refer to these two different types simply as *vykladka* or setting of stones. However, that is an extremely vague term that can be used for all kinds of stone heaps and stone concentrations.

However, not all the stone platforms in the database are typical Scythian altars, always in a clear context and related to the burial mounds. In the course of the surveys, we came across many small, low, oval-round stone concentrations that are not related to Scythian burial mounds. They were also called stone platform, but are of unknown function and, in many cases, are also of unknown date.



Figure 5.84: Two clear examples of paired stone circle and stone platform. The stone circle is always east, and the platform west or left in the images

Stone platforms are common, and can be found in every Scythian burial complex. We recorded 740 of these small altars, most of them in Yustyd and Dzhazator. The other 206 stone concentrations were found isolated, in association with Bronze Age monuments (possibly small satellite structures), in Hunno-Sarmatian burial complexes or in Turkic sites. There are 946 in total (Table 5.23).

Date	*Total*	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARa*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CHU*
Unknown	111	-	8	3	-	-	-	56	-	-	-	44	-
Bronze Age	61	-	-	1	-	-	-	-	-	-	-	60	-
Hun.-Sarm.	3	-	-	2	-	-	-	-	-	-	-	1	-
Scythian	740	-	33	238	7	1	5	69	74	-	1	312	-
Turkic	31	-	-	4	-	-	-	12	-	-	-	15	-
Total	**946**	0	41	248	7	1	5	137	74	0	1	432	0

Table 5.23: Distribution of stone platforms over the different research areas, by date

5.10 Petroglyphs, tamga and inscriptions

An important element in the archaeology of Altay is rock art. As in the surrounding areas, open-air rock art in Altay is solely preserved as engravings or peckings into standing stones or rock surfaces – there are no paintings or cave art. The engravings cover a wide range of periods, from the Neolithic to modern times, and there are literally thousands of places where rock art can be found. The compositions can be very complex, including hundreds of single images and motifs (Figure 5.85). The survey did not directly involve the inventory of petroglyph sites since searching for petroglyphs requires another way of surveying and it is very time consuming to record them in detail. Nevertheless, we did record certain places with rock engravings and included them in the database. In some cases, this was because they were clearly related to a site with monuments, while in other cases because we found them by accident and decided to pinpoint them and describe them briefly. Consequently, the following overview should never be seen as a complete list, and cannot be used for analysis (Table 5.24).



Figure 5.85: Some examples of petroglyphs in the Elangash valley

Date	*Total*	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARa*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CHU*
Unknown	19	-	-	10	-	-	-	9	-	-	-	-	-
Bronze Age	5	-	-	3	-	-	2	-	-	-	-	-	-
Irond Age	13	-	-	-	-	-	-	12	-	-	-	1	-
Turkic	10	-	-	-	-	-	-	10	-	-	-	-	-
Ethnographic	6	-	-	-	-	-	-	6	-	-	-	-	-
Total	**53**	0	0	13	0	0	2	37	0	0	0	1	0

Table 5.24: Overview of the petroglyph panels in the different research areas. The petroglyphs of Elangash are not included as we did not record them in detail and they are not in the database (for an overview, see Okladnikov et al. 1979)

As mentioned above in 4.1.1, both the petroglyph complexes of Elangash and Sebystey are not included in this table. Also absent are the many carvings, markings and inscriptions on other monuments – mainly standing stones. These have not been recorded as individual structures, although there is, of course, a detailed description in the database.

A *tamga* or *tamgha* is an abstract seal or sign that is believed to be the emblem of a particular tribe, clan or family. They were common among many nomadic populations, including the Early Nomads, but are most closely related to the Turkic period. Many scholars believe that they go back at least to the Bronze Age. *Tamga* can take a variety of forms including one resembling a stylised goat, another reminiscent of a hatchet, and another with the shape of eyeglasses held vertically; these forms were sometimes adopted by neighbouring sedentary populations in *tamga*-like symbols. The *tamga* are engraved or pecked into stone, mostly in standing stones such as Turkic image stones. In our research areas, *tamga* are rare. In fact, we did not identify any clear examples during our survey, although they can be found on standing stones in the surrounding areas. This is probably due in part to our methodology and the fact that we did not focus at all on engravings and petroglyphs. All markings we observed where documented by photographs, but not studied in detail.

The same is true for inscriptions that occur on rocky outcrops or on standing stones. We did not study them in detail, and they are not a separate category in our database. They are not very common, but are occasionally found in the regions we were working in. Inscriptions include two primary types: those from the Turkic period and others from the Mongolian period.



Figure 5.86: An example of an inscription, carved on a rocky outcrop in the Bar-Burgazy valley

5.11 Ethnographic graves

Graves dating from the so-called Ethnographic period (around 1500-1900 CE) are an elemental part of surface archaeology in the Altay Mountain. In some cases, they clearly interact with burial sites of other periods. Since they are rather recent, we decided to include them in the database, with a brief description, photographs and GPS measurements. Ethnographic graves can be built by different populations, reflecting varying beliefs – for example, the various Altayan groups or the many Kazakh people who inhabited the area in the past. These differences are reflected in the graves which indeed show some variation. We recorded wooden constructions, stone constructions, earthen barrows and real 'buildings' made of mud brick. In Bukhtarma, the ethnographic burial places were real graveyards with dozens of burials in different forms. No less than 531 graves were recorded in that valley, from a total of 661 in our research areas (Table 5.25).

Total	*BER*	*BUK*	*DZH*	*ELA*	*IRB*	*KARa*	*KARol*	*OZY*	*SAR*	*SEB*	*YUS*	*S-CHU*
661	-	531	86	1	-	32	-	-	-	2	9	-

Table 5.25: The distribution of ethnographic graves in our research areas



Figure 5.87: Different types of ethnographic graves, including (clockwise) mud-brick graves in Bukhtarma; wooden graves in Dzhazator, resembling log cabins; a grave made of stones, earth and wood in Bukhtarma; and small wooden and stone graves in Dzhazator

5.12 Other structures

Although we mapped graves from the Ethnographic period, we decided not to include other, more recent monuments. Modern graveyards were excluded from the inventory as they are part of the present-day topography and not relevant to a study of the archaeological landscape – although this is open to debate. The same goes for Burkhanistic or Buddhistic altars or sanctuaries, which were found repeatedly against the slopes overlooking the valleys, mainly close to villages. They generally consist of one or more fire altars, a pole with coloured streamers and sometimes a sculptured peak, small stone heaps and poles or strings where white ribbons can be attached to stream in the wind.

Also *ovoo* or *oboo* were not documented, although the use of these structures might well go far back in time. An *ovoo* is a pile of rocks that has been raised over a period of many years or generations in honour of the indwelling spirit of the mountain, river, or spring where it appears. *Ovoo* are typically found in passes, along hazardous trails, at the edge of high ridges, or by springs. Today, travellers characteristically indicate their gratitude for a safe journey by adding a stone to the pile; in many cases they may add streamers, branches, or other objects. While *ovoo* are modern, it is most likely that they are continuing a tradition that goes back to an ancient period.



Figure 5.88: Some examples of *ovoo* and sanctuaries: (clockwise) an *ovoo* with streamers, built at the warm water source of Tyopliy Klyuch, at the eastern edge of the Plateau of Ukok; one of the very common sanctuaries with streamers and sometimes sculpted poles, located mainly at a source or on the top of a ridge; a fine *ovoo* on top of the Turu-Alty ridge, eastern part of the Chuya basin; sanctuary with fire altars in the Karakol valley, outside of the village of Bootchi

Finally, there are many recent additions and disturbances among older structures. Examples include the stone heaps on Scythian burial mounds, usually with an offering or the burial of a sheep (the bones are still visible). It is quite difficult to estimate a date for these remnants, but they are certainly quite recent. Although they seem to have a ritual function, it is most probable that they are solely practical in nature; a local boy told us that this was the easiest way to bury a dead sheep. The stones make it impossible for the dogs to get to the remains. These structures were not recorded as single structures, but we mention them in the structure description.

Some other unclear stone concentrations which appeared to be without clear function or date but were certainly man-made, were recorded under the category of 'undefined' or, in case it concerned small additions to other monuments without clear form or function, 'adjoining structure' (see database). We do not include them here in the typology.

5.13 Conclusions

The archaeology of the Altay Mountains has a complex typology, with structures ranging from a single standing stone to very elaborate *kereksur*. Most of the monuments types show subtle variations (among others, the dwellings, *kereksur* and Iron Age burial grounds) within quite regular, widespread and therefore commonly known layouts. These differences could point to locally bound preferences, family traditions or even personal tastes.

Several structures clearly have a burial function. However, even monuments without a grave may very well have acted as a funerary monument. Examples are the Turkic enclosures or memorial structures, and possibly the dwellings that provide the dead with a 'virtual home'. It seems likely that all monuments had some kind of ritual function, be it in a funerary context, a ceremonial context or a religious one. We also see that many of the monuments may have acted as altars, or are associated with altars. The small stone circles associated with *kereksur*, burial mounds, Turkic enclosures and steles or deer stones are most probably remnants of fire altars, as are the stone platforms or small stone pavements found with burial mounds and (in Mongolia) next to dwellings.

We certainly hope that this overview contributes to a general understanding and generalised use of monument types in the Altay. However, we do not pretend at all that the typology presented here is final; it is open to discussion and we look forward to completing or improving it with input from colleagues.

6 The archaeological landscape of the Altay Mountains

6.1 Introduction

The landscape of the Altay Mountains shows considerable potential for the reconstruction of the ancient landscape back to at least the second millennium BCE. The vast steppes and river terraces provide classic examples of landscapes of survival; subsequent settlement has been minimal, even in recent history, and burial mounds, ritual monuments and other surface structures have been preserved virtually intact.

Over the last decades, the concept of studying the archaeological landscape has rightly been considered as an important part of archaeological research. The term 'landscape archaeology' first came into use in Britain in the mid-1970s and has evolved significantly ever since (Anschuetz et al. 2001). Conventional landscape archaeology tends to be empirical and heuristic, while more recent forms of 'post-processual' landscape archaeology, which have emerged since the beginning of the 1990s, try to go beyond the evidence to develop more experiential approaches, including phenomenology (Fleming 2006).

Landscape archaeology examines: 1) how the land has been shaped and organised for economic, social, religious, symbolic, or cultural processes; 2) the role of landscape in the construction of myth and history; and 3) the shaping of human behaviours (Wilkinson 2004: 334).

Not all of these aspects are completely covered by the research presented here. We have analysed the archaeological landscape, the distribution of monuments types over the different research areas and their location within the different valleys under focus. The various natural landscapes show a different archaeological landscape; we analysed these differences and established possible factors that may have caused them.

The use of GIS offers many more possibilities than have been used in this phase of the research. Our detailed site plans, combined with the DSMs of the research areas, make it possible to go further than the observations made here: an analysis of the visibility of monuments or viewshed analysis (Wheatley 1995, Wheatley & Gillings 2000), the relationship between sites and structures and different landscape elements (rivers, terraces, hills, etc.) and specific prominent markers in the landscape (cliffs, mountain peaks, etc.) and many more. Using the DSMs and satellite images, the landscape itself can be analysed to find these prominent places and other defining elements (Llobera 2001). All these issues will definitely be the subject of future research.

This chapter starts with a study of the natural landscapes in the research areas and an overview of the distribution of the various monument types across the different areas. Then we zoom to the divers study areas and analyse the location, organisation and interaction of the monuments at site level.

6.2 The different natural landscapes in the research areas

The landscape is a combination of natural environment and cultural factors (Wilkinson 2004: 334). Before looking at the distribution of the different types of archaeological monuments over time, it is necessary to have a closer look at the natural landscapes of the various research areas. This may be able to help explain some of the differences we find in the composition of the archaeological heritage of the research areas.

6.2.1 The Chuya steppe

The Chuya depression or steppe is the largest intermontane basin of the Altay Mountains (Figure 6.1). It has played an important role in the history of human occupation as it is a transition zone between the north-western Russian Altay and the Mongolian Altay. Situated at an altitude of 1,800 msl, the depression is surrounded by glacier-covered mountain ranges of up to 3,900 msl. The South Chuya Range borders the depression in the south, and several small and medium-sized valleys lead from the high peaks to the vast Chuya plain, among others the Sebystey, Ozyok, Irbistu and Elangash. On the other side of the South Chuya Range is the Dzhazator valley, running from east to west. Because of the very dry climate, the vegetation in the Chuya steppe is very scarce – only thorny bushes, wormwood and small grasses are found here. The name of the village Kosh-Agach, in the centre of the steppe, illustrates this very well: it means "goodbye tree". Beyond this point, there are virtually no trees. Traditionally, the Chuya steppe was considered to be the end of the world, a last stop before reaching the vast, inhospitable desert-like mountains of the Mongolian Altay.

The bottom of the depression comprises alluvial and glacial sediments, coming from the surrounding ridges that can be 2,000 to 3,500 m higher (Franz 1973: 338-343). It is a former lake basin, formed during the intermediate interval of the late Pleistocene glaciation when streams were dammed by glaciers or moraines. The somewhat concave bottom of the depression, about 80 km long and 30 km wide, permits impressive views over the steppe up to the mountain ranges at the far side of the depression, which are not limited by any high vegetation (Figure 6.2). This open landscape forms the context of the research areas of the survey in 2003 along the southern border of the steppe.

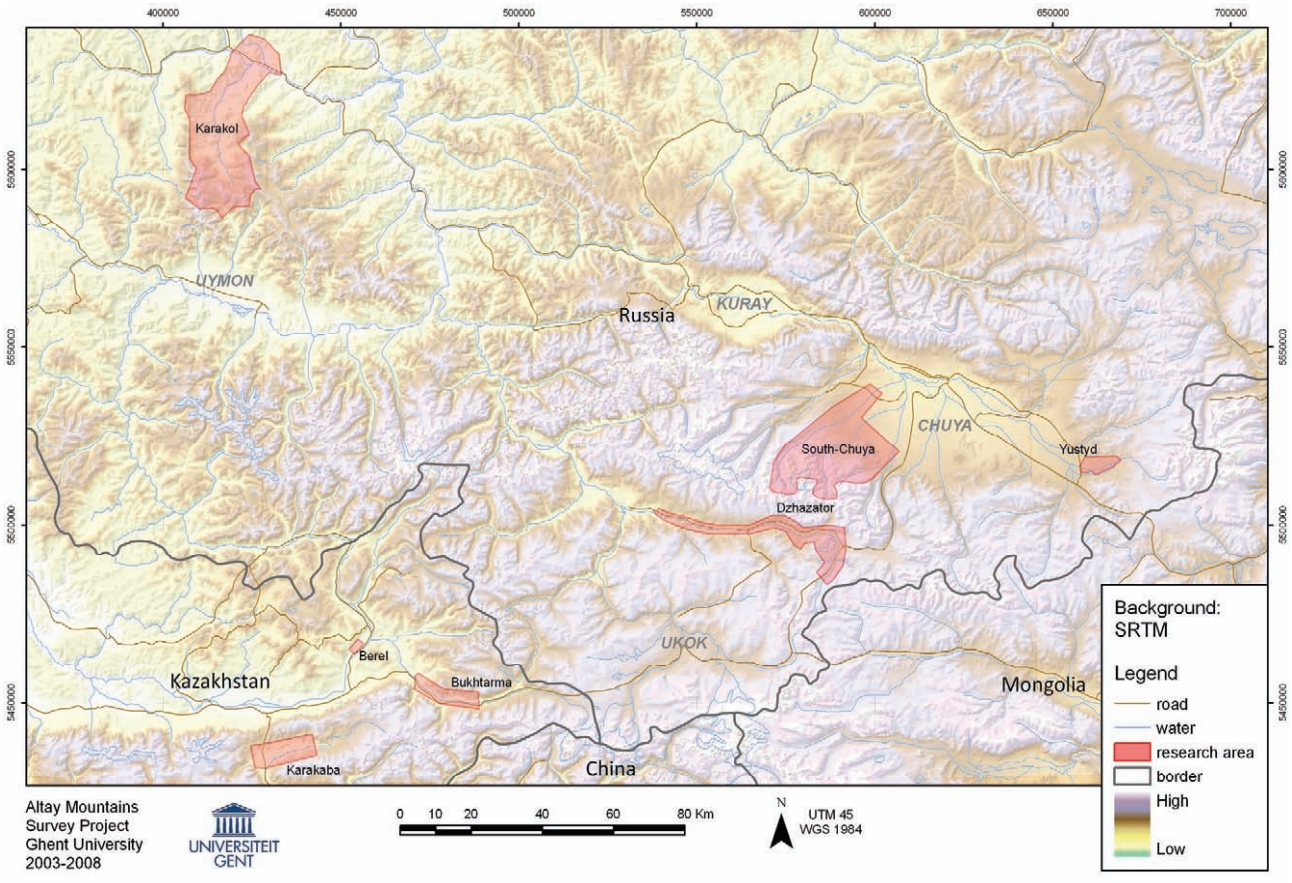


Figure 6.1: Location of the research areas (idem Figure 1.12)



Figure 6.2: The Chuya intermontane depression

6.2.2 The Sebystey valley

Sebystey, one of the smaller valleys on the northern side of the South Chuya Range, was the eastern limit of the research area in 2003 (Figure 6.1). During the research in 1996-1997, the geographical and pedological aspects of the Sebystey valley were studied thoroughly by specialised members of the team, as a background for the archaeological excavation. The information we have on Sebystey is thus more detailed than for the other valleys in our research areas. It is a south-west/north-east oriented valley that has it sources in several cirque lakes in the south-west, where it is closed by two cirques covered with patches of perennial snow. The valley can be divided into three geographical entities.

The higher part of the valley, incised between the remnants of a former peneplanation surface, forms the first geographical entity. It is covered with alpine meadow vegetation. Further downstream, the valley broadens considerably. Here, the river reaches the level of the former peneplanation surface, which was modified by periglacial processes. This more open, middle part of the valley can be seen as the second geographical entity. It has till terraces near the actual river, some of which are several metres high and rather steep (Figure 6.3). Most of the archaeological sites are located on top of these terraces, which have a flat surface and stretch out to the gentle slopes of the surrounding hills. This part of the valley is covered by typical mountain steppe vegetation, with small scrubs in the actual valley flood plain. Several hills and cliffs border this middle part, forming a narrow, gate-like transition to the lower part of the valley downstream. Here, the valley opens to the Chuya depression, and the broad floodplain is situated between outstanding cliffs, which are formed in the moraine deposits laid down by the Kokozyok-Tarkhata system (on the right bank) and in the remnants of the former peneplain surface (on the left bank). The vegetation here is the same as in the middle part of the valley: typical mountain steppe vegetation with small grasses and some shrubs (Bourgeois et al. 2000a: 93-102).

6.2.3 The Ozyok valley

The Ozyok River is a small right tributary of the Irbistu River; in fact, it is so small that it is not likely to be a permanent stream. The Ozyok and Irbistu merge just before entering the Chuya steppe. Ozyok is located just west of the Sebystey valley, only separated by some medium-sized hills. It is a very open valley, bordered by low hills in the east, the south Chuya range in the south and the Irbistu in the west. The valley consists of broad plains – terraces from the nearby Irbistu – and gently sloping areas in the east and south. Archaeological monuments can be found all over the valley, including some of the sloping areas. In the north, a massive rocky outcrop (from which the photo in

Figure 6.4 was taken) forms the border between the valley and the Chuya steppe.



Figure 6.3: The enclosed middle part of the Sebystey valley with terraces on both sides of the river



Figure 6.4: Overview of the Ozyok valley. The small steam to the left of the image is the Ozyok; right is the larger Irbistu. The South Chuya Range forms the background

6.2.4 Irbistu and Sarikobu

A completely different landscape is that of the Irbistu valley. The lower part of the valley, from the moment it flows out of the South Chuya Range to the point were the river reaches the Chuya steppe, is identical to the landscape of Ozyok (

Figure 6.4). Here, the river meanders in a broad box-like flood plain, bordered by occasionally steep till terraces. These terraces are ideal places for large burial sites and other monuments, and most of the monuments in Iribistu were found here.



Figure 6.5: The higher part of the Irbistu valley

The higher part of the Irbistu valley is much more closed: it is a typical glacier valley with a very rough relief and steep slopes. Flat areas are very limited in this part of the valley, as are the number of surface structures found here (Figure 6.5).

In addition, it is difficult to reach the higher part of this valley: an enormous field of moraines is located on the transition of the lower and higher parts. It completely blocks the entrance to the valley, making it difficult to travel through this hilly area containing thousands of small and large heaps of coarse debris. The Irbistu actually avoids the moraine field by bending to the east and joining the Ozyok. These terminal moraines reflect the maximum distance of glacier movement. On the south side of the Chuya depression, the glaciers stopped beyond the borders of the mountain ridges, while in other parts of the steppe, glaciers did not reach the Chuya depression at all. This is caused by microclimatic differences between south- and north-facing ridges, and by the very big glacier reservoirs on the more gentle northern slopes of the South Chuya Range (Novikov et al. 1996: 57).

The photos in Figure 6.6 and Figure 6.7 illustrate the very specific landscape of these moraines. The panorama image shows the Irbistu River, with the enormous moraine field in the background; the limit of the moraines and the beginning of the steppe is clearly visible. The two detailed views below show the inaccessible nature of this area. Measured on the CORONA orthophotos, the field is 6 km long and 3.5 km wide. In the west, it touches the moraine field of the Elangash River.

Just in-between is a third, smaller stream, called the Sarikobu. It is a temporal stream that originates in the gently sloping hills at the foot of the South Chuya Range. Most of the surface of the Sarikobu valley is comparable to the above-mentioned moraine fields, although there are some flat areas just next to the narrow flood plain. A limited amount of archaeological structures can be found in these areas.



Figure 6.6: The moraine field of the former glaciers of the Irbistu valley: an overview from the hills just east of Ozyok



Figure 6.7: The moraine field of Irbistu: some detailed impressions of the hilly landscape

6.2.5 The Elangash valley

More to the west, parallel with Irbistu and Ozyok, is the Elangash valley (Figure 6.1). Its morphography is comparable to that of the Iribistu valley, although Elangash is considerably larger and has a broader valley bottom, especially in its higher parts. Although there is a field of end-moraines, mainly on the right bank of the river, this does not block the course of the river. The higher part of Elangash – the first 7 km starting from the glacier and the three lakes that form the source of the river – has a very distinct U-shaped profile (Figure 6.8). The valley bottom is quite flat, but no archaeological structures were found here. Downstream, the valley opens considerably, although the flood plain is still bordered by rather steep slopes to the higher areas on the left bank, or the moraines on the right bank. On the transition from the higher to lower valley, many massive rocky outcrops are located in the centre of the valley; all of them significantly smoothened by thousands of years of glacial activity. These brown-coloured,

smooth rock surfaces form the perfect underground for petroglyphs: the pecking and carving removed the brown patina revealing the underlying grey colour of the stone. This gives the designs a remarkable contrast, a feature which has attracted creative minds since ancient times, as thousands of images decorate the outcrops (Figure 6.9). Surface structures were only found downstream from these petroglyph concentrations.



Figure 6.8: Elangash: the higher part of the valley with a distinctive U-profile (left), and the more open lower part of the valley (right)



Figure 6.9: Rocky outcrops in Elangash have been smoothened by glaciers to form the perfect surface for petroglyphs. Thousands of images have been carved and pecked into the brown patina

6.2.6 The Yustyd valley

The most eastern point of the Chuya depression is formed by the Yustyd valley (Figure 6.1). Situated at an altitude of some 2,000 to 2,200 msl, the valley consists of a higher part, covered with hilly moraines, and a broad and open lower part. The water from the Yustyd comes from two big lakes: Lake Kindyktykul' and Lake Boguty, both fed by drainage from the slopes of the Turgen-Ula mountain (4,029 msl). The higher part of Yustyd, also referred to as the Dzholin valley, includes the right tributary Naryn-Gol (coming from the Kindyktykul' lake) and the left tributary Boguty. It is rather inaccessible: the north side is mountainous, with some flat areas only around Lake Kindyktykul' and a smaller lake downstream of it. The south side is covered by hilly moraines (Figure 6.10), ending in a bank measuring some 6 to 8 m high on the left bank of the Yustyd. We searched these areas for GCPs but at first sight saw no archaeological sites. However, the area should be surveyed in detail to confirm this. V. Kubarev mentioned two sites in the northern part of the valley, Dzholin I and Dzholin II, so these two sites and possibly some more structures can be found in this higher part (Kubarev 1991: Fig. LXVI).

Directly west of the end moraines on the left bank and the hills on the right bank, the valley opens considerably (Figure 6.11). The left bank has broad, slightly sloping terraces, incised by gullies. The terraces narrow bit by bit until they disappear completely in the west. Here, just before entering the Chuya steppe, the Yustyd River flows past a massive cliff. This triangular, black cliff is visible for kilometres and forms one of the landscape markers in the area; it is known locally as 'the Oven of Chinggis Khan' (Jacobson-Tepfer & Kubarev 1994: 19). Most of the monuments on this left bank can be found in the broader, eastern upstream section. The situation on the right bank is completely different: the eastern part is only 200 to 300 m wide. However, it already houses a huge number of monuments. After some two kilometres, the terrace narrows considerably; here the valley bends slightly northwards, and the terrace borders approach the northern hills up to 120 m. Because the area is boggy, the concentration of monuments here is considerably lower. West of this point, the terrace quickly broadens to over 2,000 m, gradually becoming part of the Chuya steppe. A huge concentration of monuments is located on the vast terraces on this lower part of the right river bank. From there, the river streams through the Chuya steppe until it merges with the Bar-Burgazy and forms the Chuya River.



Figure 6.10: Higher part of the Yustyd valley with its hilly moraine landscape



Figure 6.11: Yustyd valley: view towards the west over the right bank and the gentle slopes with Scythian burial mounds

6.2.7 The Dzhazator valley

The Dzhazator stretches for over 70 kms, roughly east-west, from the high mountain plateau around Lake Zerlyukul'nur to the village of Belyashi[28]. Here it merges with the Ak-Alakha, forming the Argut River. Its headwaters can be found on the flat plateau around Lake Zeryukol, including the smaller Usay River and Lakes Karakol'-Nur and Tunguryuk, close to where the track to Bertek branches from the main Dzhazator-Kosh-Agach road. Along its course, it drains large parts of the Southern Chuya Range. The river crosses different landscape settings, and a general, small-scale description might divide the valley in two: the first part stretches from the source (2,300 msl) to somewhat higher than the confluence with the Dzhumaly valley and is characterised by a broad, rather U-shaped valley; while the second part is far more V-shaped, with a smaller valley floor and dominant tree vegetation.

In the U-shaped, higher part of the valley, the north-oriented slopes (left bank) are covered with pine woods, while land cover on the south-facing slopes (right bank) mainly comprises the typical short steppe grass which is the common vegetation type in the upper waters of the valley. Due to the harsh winter conditions, with severe cold and strong winds, the steppe grass is about the only species that can survive the winter months. Geologically, the U-shaped valley form refers to a history of glacial coverage during which it was carved out from the underlying substrate. The higher terraces, comprising fluvial-reworked glacial till, are also evidence of previously far more prominent glacial activity. This till is unsorted glacial sediment of varying mixtures of clay, sand, gravel and boulders. However, the active alluvial plain is made from a mixture of clay and peat, and holds a larger amount of water than the adjacent terraces. This results in the expression of more periglacial phenomena, emerging from the underlying permafrost. At a height of about 2,050 msl, and a couple of kilometres before the left tributary Dzhumaly joins the Dzhazator, the valley widens considerably. On both banks, terraces measuring several hundreds of metres wide were formed, with steep terrace borders of up to 10 m high (Figure 6.12). On the left bank, a small but open valley comes from the south and leads up to the headwaters of the Dzhumaly. The large terraces have the greatest concentrations of archaeological monuments in the entire valley, and are filled with dozens of archaeological sites.

The second part of the valley, from about 2,000 msl to 1,600 msl, has a more V-shaped profile which means that the valley floor is much smaller. The slopes and much of the valley floor are covered with trees. However, numerous smaller terraces can be found in-between the slopes and cliffs: some are very small and isolated; while others are more stretched out and can be found the one after the other. These flat areas, populated with only small grasses, are generally where archaeological sites can be found.

[28] This geographical description of the Dzhazator valley is based on a preliminary report by Ruben Van de Kerchove, UGent Department of Geography, made during fieldwork in 2008.



Figure 6.12: Dzhazator valley: overview of the open landscape and wide terraces of the higher, U-shaped part of the valley, towards the east

6.2.8 The Karakaba valley

The Karakaba is a large inner mountain valley located at an altitudinal range of 1,650 m to 1,900 msl. The higher part of the valley is east-west oriented, with wide terraces and gentle slopes. It has a very open character and has the characteristics of an intermontane depression. The accumulation of cold air in the depression means that the climatic conditions in Karakaba are considered the coldest in the Kazakh Altay. A large part of the Karakaba depression is situated in an area of isolated pieces of permafrost, mostly located on the surrounding northern exposed slopes. In the north-east, high in the valley, the beginning of the accumulation phase of the river is very plain to see, at the start of the river terraces. We began our survey here. Above this point, the area was not very accessible, even with a vehicle. We tried to go as high as possible, but did not see any more archaeological structures. To the south, the valley narrows to a point were only a road and the river itself can pass. The middle course of the river, which was not investigated, starts here; the bend in the river towards the south forms the lower border of the research area. The whole area between these limits is a very flat, vast plain (Figure 6.13). It is completely covered with grasses and is used as hayfields by the few inhabitants.



Figure 6.13: The Karakaba 'depression', or higher part of the valley

6.2.9 The Bukhtarma valley and the Berel site

The Bukhtarma rises in the highest parts of the Kazakh Altay, just at the borders with China and Russia; part of its headwaters are located on the Russian Ukok plateau. The altitude there is about 2,500 msl, while many small tributaries on the left come from the glacier-topped South Altay Range, with peaks of up to 3,871 msl where the three countries meet. This higher part of the valley is very rough, with narrow terraces and a very meandering river. Access is by means of just one road which is in bad condition. It leads to the military base of Ust'-Chindagatuy, at the confluence of the higher Bukhtarma and the Chindagatuy, and continues over the Russian border to the Ukok Plateau. However, the first, eastern 30 km of the valley is part of the military border zone, and is inaccessible. The limit is formed by a bridge over the Bukhtarma; below this point, the road continues on the left bank. We started our survey here and managed to cover the valley for a distance of 20 km, until the left tributary Tautekeli. About halfway, the valley bends slightly northwards. The first part, before the bend, resembles the first 30 km of the river: very narrow terraces and a valley bottom that is almost completely covered by bushes and trees. Very few monuments were found here. However, at the bend the valley opens considerably. This part is characterised by many different small and larger river terraces, bordered by conifers growing over the gentle valley slopes (Figure 6.14).



Figure 6.14: A typical view on the Bukhtarma valley towards the west, taken from a hilltop where the valley bends to the north

The necropolis of Berel is located about 60 to 70 km downstream from the headwaters, approximately 20 km west-north-west of the western limit of the Bukhtarma research area. It is situated on a large, triangular terrace on the right bank of the river Bukhtarma, at an absolute height of 1,070 msl. However, the work was limited to this river terrace alone, and the inventory does not reflect the real archaeological landscape of this part of the Bukhtarma River. In addition, we did not have time to survey the area between Berel and the other Bukhtarma research area, so it would be wrong to consider them as one. Surveying the Berel area was not part of the original schedule as there is already a plan of the Berel site and we were asked to complete this using our methodology. Because of such considerations, we do not go any deeper into the analysis of Berel's archaeological landscape in the following paragraphs.

6.2.10 The Karakol valley (Uch-Enmek Ethno-Natural Park)

The Karakol is a tributary of the Ursul River, in the Onguday district. The valley is over 40 km long and stretches roughly from south to north. The sources of the Karakol are formed by various small streams coming from the Terektinskiy Range; a rough mountain range with sharp peaks of up to 2,821 msl. The sharpest three peaks form the symbol of the Uch-Enmek Park, much as the three peaks of the Belukha Mountain embellish the official emblem of the Altay Republic. The area is very inaccessible, and can only be reached by foot or on horseback. This changes about 15 km downstream, where the right tributary Akkem and the left tributary Arygem join the Karakol, at an altitude of about 1,200 msl. The woods give way to a more open valley bottom, and the slopes are less steep. In particular, the small valleys to the east and west of the main valley are more open and are home to most of the archaeological monuments in this part of the valley (among others Nizhniy Sooru and Sootyokh).



Figure 6.15: Panoramic photo of the Karakol valley just north of Kulada. Left is the sacred mountain Uch-Enmek, in the middle is the Bashadar site, while left is the start of Kulada village



Figure 6.16: Looking out over the northern part of the Karakol valley, showing the confluence with the Ursul River in the distance. The first village is Bichikti-Bom, while Karakol and Kurata are in the background

Eight kms north of Akkem and Arygem is the village Kulada, from where the valley outlook changes considerably. Wide-open terrain can be found here, first only on the left bank, but downstream also on the right bank. Just north of Kulada is the large terrace where the Bashadar site is located (Figure 6.15). A single, massive hill or small mountain stands right in the middle of the valley; it is a striking feature and is locally considered as a sacred mountain. It is the opinion of the local population that the many archaeological sites found around the mountain prove that it has been sacred since ancient times. We were told that all monuments were oriented towards the mountain, although this is not clear from the plans we made of the valley.

About 4 kms north of the mountain, the river turns some 30 degrees to the north-east. The landscape stays the same, except that the valley widens slightly more until it reaches the Ursul valley, 10 kms further (Figure 6.16). The absolute height here is about 960 msl. The whole Karakol valley, including its headwaters and the surrounding peaks, is part of the Uch-Enmek Ethno-Natural Park. In addition, 15 km of the Ursul valley is part of the park, including the villages of Tuekta, Karakol and Kurata. The park ends just north of the Kurata River.

6.2.11 Conclusions

It is clear from the above that the research areas reflect very different natural landscapes. Vast steppe areas are only represented by the southern border of the Chuya steppe, although the transition zone of the Irbistu, Yustyd and Elangash Rivers to the steppe have a comparable, open landscape.

Yustyd is in general a very open valley, with unlimited views over the vast terraces and no vegetation whatsoever (except for the famous solitary tree in the middle of the flood plain).

The Sebystey, Ozyok and part of the Irbistu valley are examples of enclosed valleys with broad river terraces; they are very open, but cliffs or hills separate them from the open steppe, or at least form a kind of boundary.

High mountain valleys with alpine vegetation are represented by the Dzhazator and Bukhtarma. The sometimes-narrow valley floor houses mainly small river terraces. However, the valley occasionally broadens considerably, providing room for wide open terraces or flat areas.

Karakol is an example of a low mountain valley. It is very long and wide, with several hundreds of metres between the river and the surrounding hills, on both banks. The flood plain is very wide and is completely covered with woods.

6.3 The distribution of the main monument types over the different research areas

It is interesting to analyse the location of specific types of monuments. Their presence or absence in some of the research areas is significant and may be related to the natural environment and different natural landscapes, or to the extent of different cultural spheres. Below is a summary of the distribution of the main monument types across the different research areas; smaller associated monuments, such as *balbal*, stone circles, stone platforms, etc., have not been taken into account since their location depends on the main monuments.

6.3.1 Afanas'ev graves or round enclosures

Graves from the Afanas'ev culture were only found in the southern part of the Chuya steppe (Sebystey, Sarikobu, Elangash and the south-western border of the steppe), in Dzhazator and in Karakol. In Yustyd and in all research areas in the Kazakh Altay, these monuments are absent (Figure 6.17). In most cases, they are located in the lower part of the valleys or on open terrain; we only found some more Afanas'ev graves in the higher part of the valley during our research in the Karakol valley in 2008.

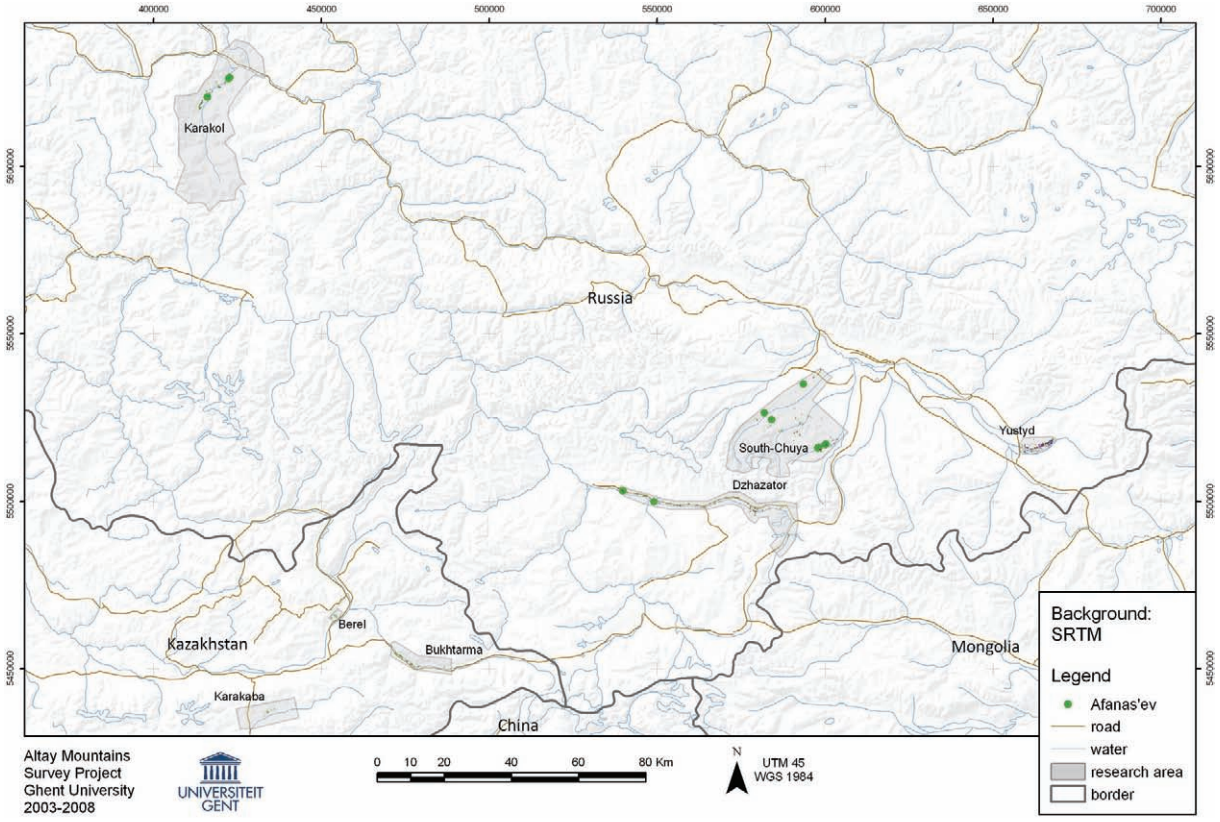


Figure 6.17: Distribution of Afanas'ev graves

6.3.2 *Kereksur* monuments

The distribution of *kereksur* in our research areas is clearly not random. Only the study areas in the eastern part of the Russian Altay have this type of monument, with a strong emphasis on the Kosh-Agach region (Figure 6.18). In the Dzhazator valley, two possible examples were found although they were far from typical and not at all clear. Along the southern border of the Chuya steppe, just at the foot of the hills overlooking the steppe, *kereksur* are common, and to a smaller extent in the Ozyok, Irbistu and Elangash valleys. The most *kereksur* by far were found in Yustyd. In addition, these *kereksur* seemed in general to be larger and neater; the stones making up the fences and rays being set out very orderly and apparently selected according to size and shape.

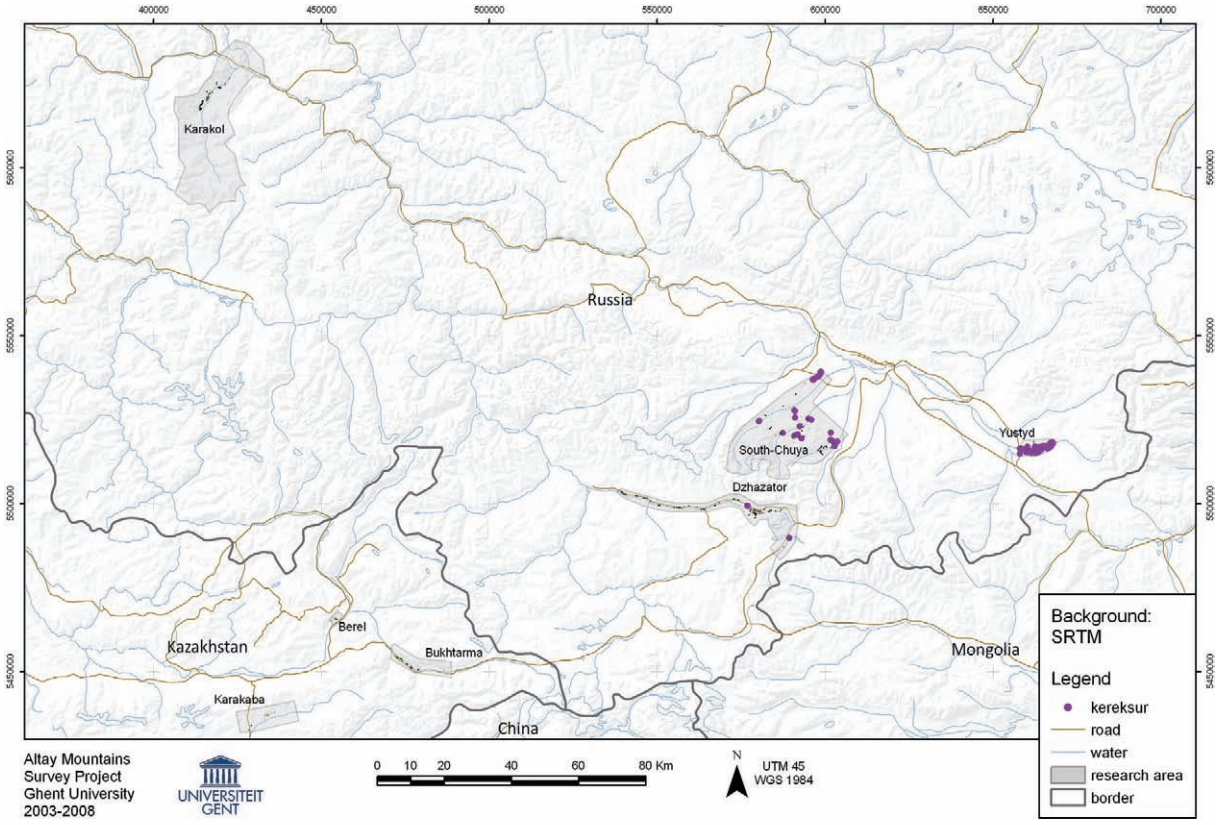


Figure 6.18: Distribution of *kereksur* over the different research areas

The absence or very limited presence of *kereksur* in Dzhazator, Karakaba, Bukhtarma and Karakol is striking. In Dzhazator, only two possible *kereksur* were documented. The first one is situated on a small river terrace, in the middle of the valley, and is very unclear. A more typical example is situated in the small Usay valley which runs from the Tarkhata depression to the Ukok plateau. As we now from Molodin et al., there are some *kereksur* in Ukok. In contrast, *kereksur* are numerous in the Kosh-Agach region, where large concentrations of big *kereksur* dominate parts of the valleys and steppes.

For the moment, the most western *kereksur* in our inventory are located on the western border of the Chuya steppe, where the Elangash River flows northwards along the hills that border the steppe, 10 km south-west of the confluence with the Chuya River and the village

Ortolyk. This is actually a whole cluster of *kereksur*, in a typical location – one of the only places where there is an opening in the hills into the Chagan valley and the present-day village of Beltyr. However, it is not possible to define this location as the limit of the distribution of *kereksur*: our research areas only cover parts of the total area, and we have not done any research between Elangash and Karakol to date. Although we do not have information about *kereksur* more to the west, it would not be surprising if there were some in the Kuray depression.

The reasoning behind this distribution may be related to the landscape: the Dzhazator and Karakol valleys and the research areas in Kazakhstan are closed valleys, with lots of trees, grasses and shrubs, not bordering a wide-open space or entering an intermontane plain like the Chuya steppe. The Kosh-Agach region and the Mongolian valleys and steppes are very different: wide, open valleys with little vegetation, opening into and overlooking wide plains and steppes. It seems as if these desert-like landscapes where chosen by Bronze Age people as places to build their monumental *kereksur*.

One possible reason for this is the monuments' visual impact. The view in these areas is much more impressive, and monuments can be seen from far away, especially if they are as impressive as *kereksur*. In addition, E. Jacobson-Tepfer mentions a definite correlation between the number of *kereksur* and the availability of stones in her research areas – the desert-like, stony areas offer an abundance of building materials. Both factors are closely related to each other: vegetated areas with lots of trees experience an active ground formation and more sedimentation which makes surface stones fewer in number.

Is the presence of *kereksur* only dependent on an abundance of small stones and on visibility in certain areas, or is the distribution of *kereksur* truly indicative of a cultural extent that spreads right across the eastern part of the Russian Altay, the Mongolian Altay, north Mongolia and much of the Sayan region?

It is important to keep in mind that visibility changes over the seasons. Even low mountain areas with alpine vegetation and high grasses that seriously limit the visibility of the surface structures are completely different during autumn, early winter and early spring. Everything dries out completely, and only naked ground remains. Moreover, snow cover during winter can make surface structures invisible, even large monuments such as *kereksur*. However, apparently snow cover is not very deep in the vast open areas of the Chuya steppe as it is blown away by constant winds and thus is unable to accumulate.

In addition, the availability of stones cannot be the main reason behind the selection of building sites for *kereksur*. Regions without *kereksur* sometimes have massive Iron Age burial mounds that were built using many more stones than used in an average *kereksur* (the sites of Bashadar and Tuekta, among others), so stones are available even in those vegetated areas.

Therefore, it seems that the distribution of *kereksur* in our research areas could reflect a cultural influence to which the eastern part of the Russian Altay belonged. Possibly, the distribution of other specific Bronze Age monuments, such as deer stones, collared mounds and

four-cornered mounds, will confirm this. Visibility and stoniness certainly are characteristic of the areas in which *kereksur* can be found, but they are probably not the only defining elements.

The distribution of round and square *kereksur* is something completely different. We cannot say much about Dzhazator as both possible *kereksur* there are round. However, both in Yustyd and in the southern part of the Chuya region, round *kereksur* are more common than square ones. In the southern part of the Chuya steppe, square *kereksur* are clearly clustered; all square examples are located in the lower part of the Elangash valley (along the western border of the Chuya steppe) and where the Sebystey valley opens into the Chuya steppe. All other *kereksur*, in the different valleys and along the southern border of the Chuya steppe from Sebystey to Elangash, are exclusively round (Figure 6.19). This could suggest that square *kereksur* are only found in places where valleys open into wide-open areas, such as the Chuya basin – transition areas or passageways between different parts of the landscape.

Such a clear distinction is completely absent in Yustyd. Round and square *kereksur* are found together, and no part of the valley is reserved exclusively for one or the other. However, square *kereksur* are more numerous in the far eastern, higher part of the terrace, deeper in the valley (Figure 6.19). Here, the ratio of round and square *kereksur* is almost even. In the more open, lower part of the right bank, round *kereksur* clearly outnumber the square ones, more than half of which are not situated on the terrace itself, but in the Yustyd flood plain.

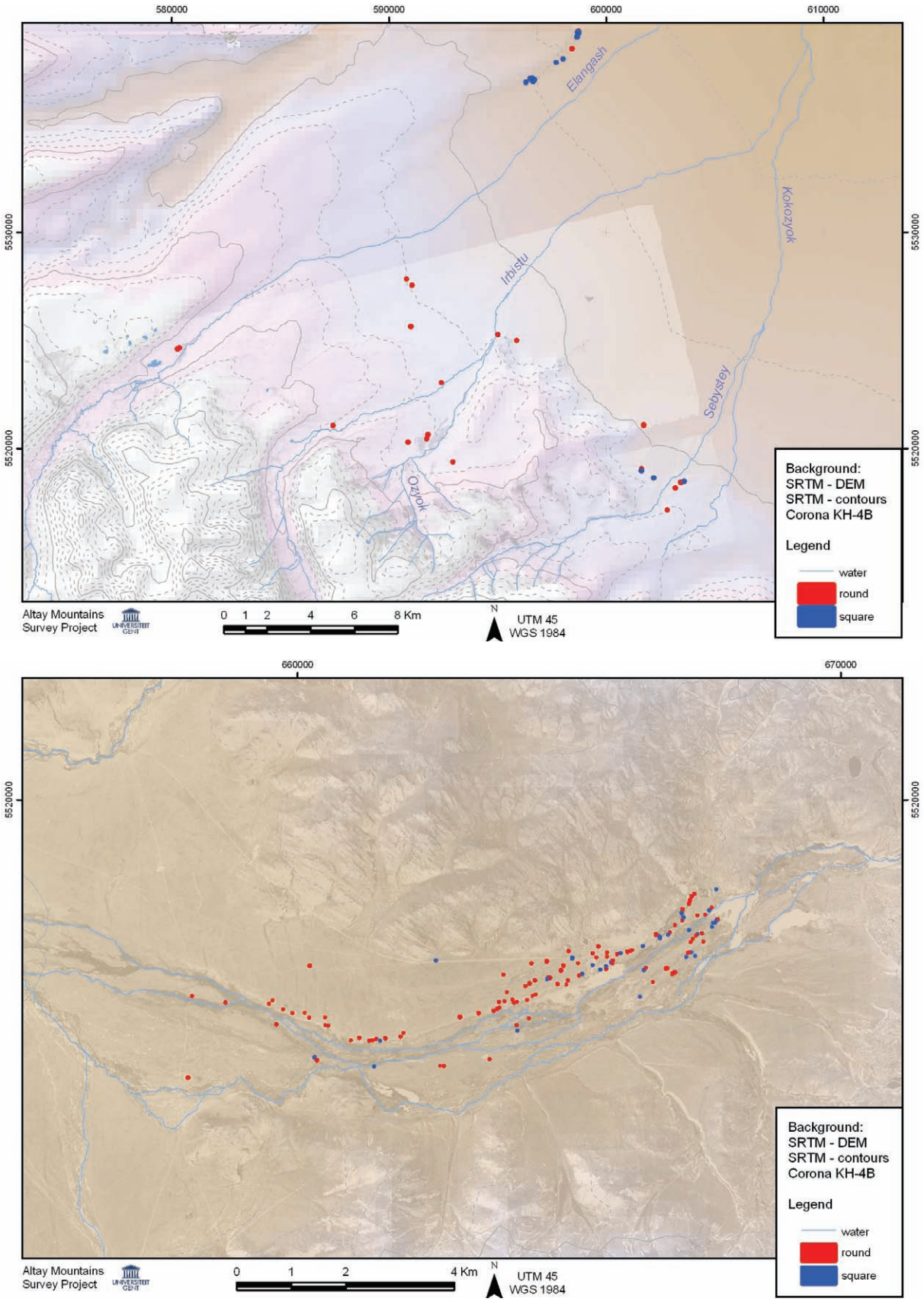


Figure 6.19: Distribution of round and square *kereksur* in the southern part of the Chuya region (above) and in the Yustyd research area (below)

6.3.3 Four-cornered mounds and collared mounds

As four-cornered mounds and collared mounds both date from the Bronze Age, they can be discussed here together. As can be seen in Figure 6.20, once again, most of these monuments were found in the Yustyd valley. In fact, no four-cornered mounds were recorded in the other research areas, although it is important to keep in mind the possible four-cornered mound that was excavated by S. Surazakov in Irbistu, along the Chuya steppe (Surazakov 1988).

The distribution of collared mounds closely resembles that of the *kereksur*; only a few collared mounds were found in Dzhazator and in the southern part of the Chuya basin, while most of them are located in Yustyd. It is possible they can be linked to the same cultural horizon. Again, it is significant that the four-cornered mounds can only be found in Yustyd and the Chuya steppe, while there are several known in the Mongolian Altay. There, they are found singly or in small groups, frequently in proximity to a *kereksur*[29].

6.3.4 Deer stones

A comparable distribution pattern is found when considering the deer stones, only this time the distribution is completely limited to the Yustyd area (Figure 6.21). All of these examples fit within the Sayan-Altay type of deer stone. They generally date to the Bronze Age or Early Iron Age, although many of the examples from Yustyd have been reused in later funerary or memorial complexes. Some deer stones have disappeared from Yustyd, and it is likely there has been more theft and destruction in the past. As this could have equally been the case in the other research areas, we must be cautious with the limited distribution of deer stones on our map. Examples are known from other areas more to the west, but we never found one in our other research areas.

[29] Jacobson-Tepfer, Esther. Letter to author, 01-10-2008.

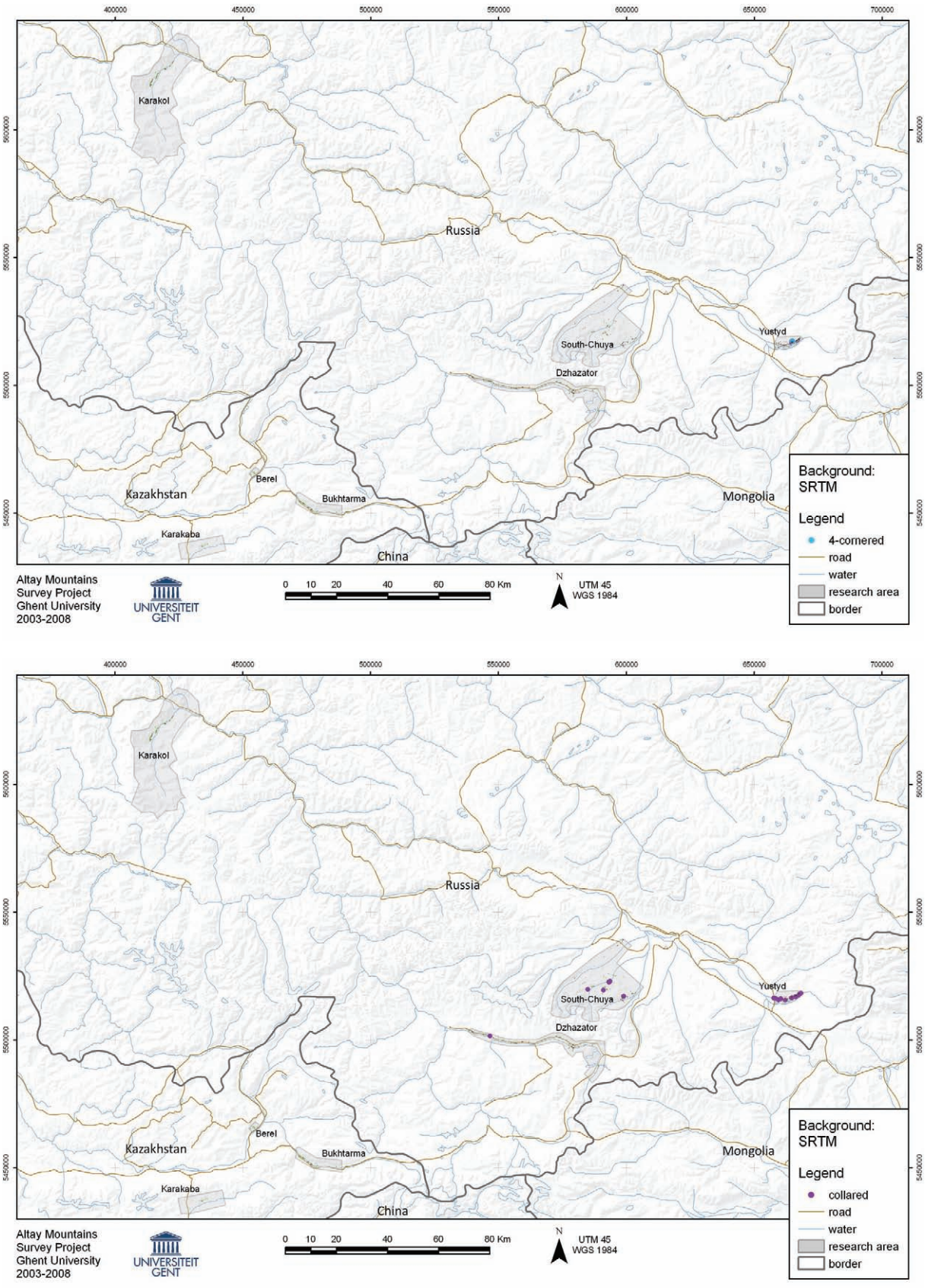


Figure 6.20: Distribution of four-cornered mounds (above) and collared mounds (below)

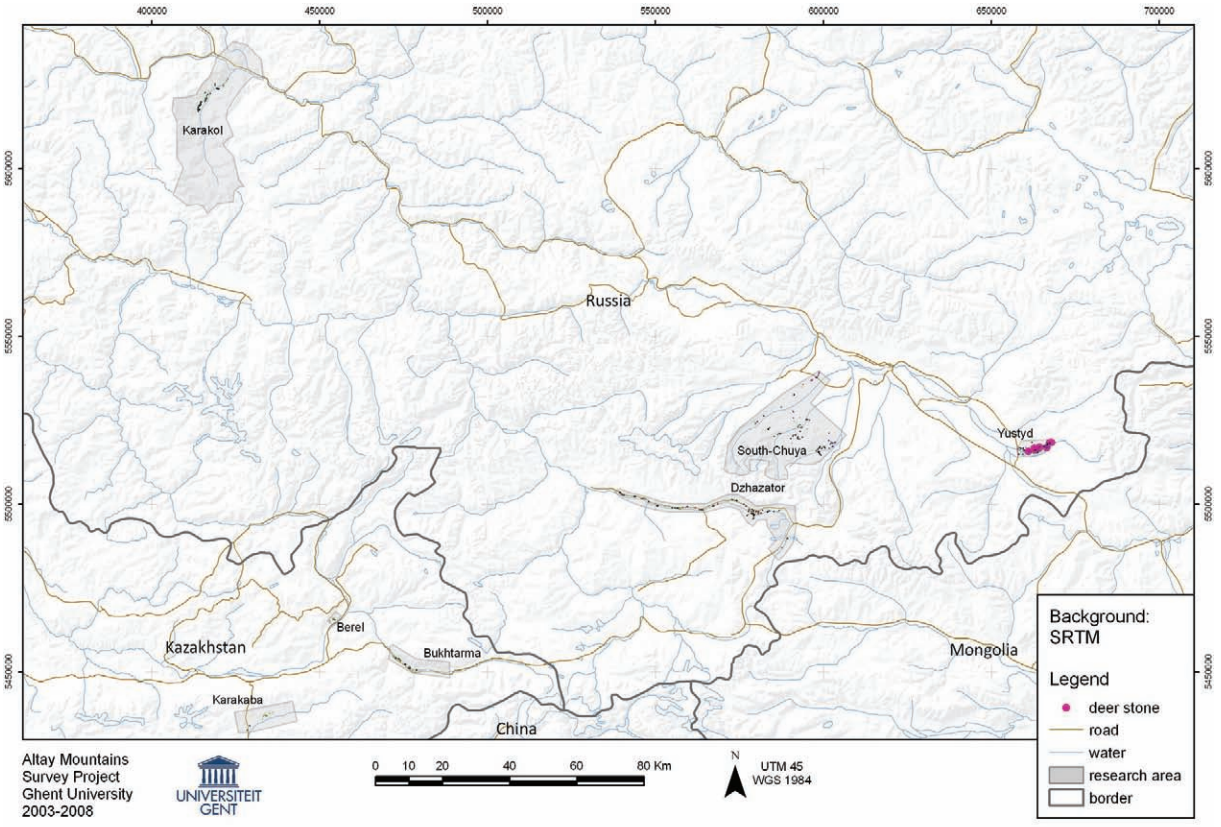


Figure 6.21: Distribution of deer stones in the research areas

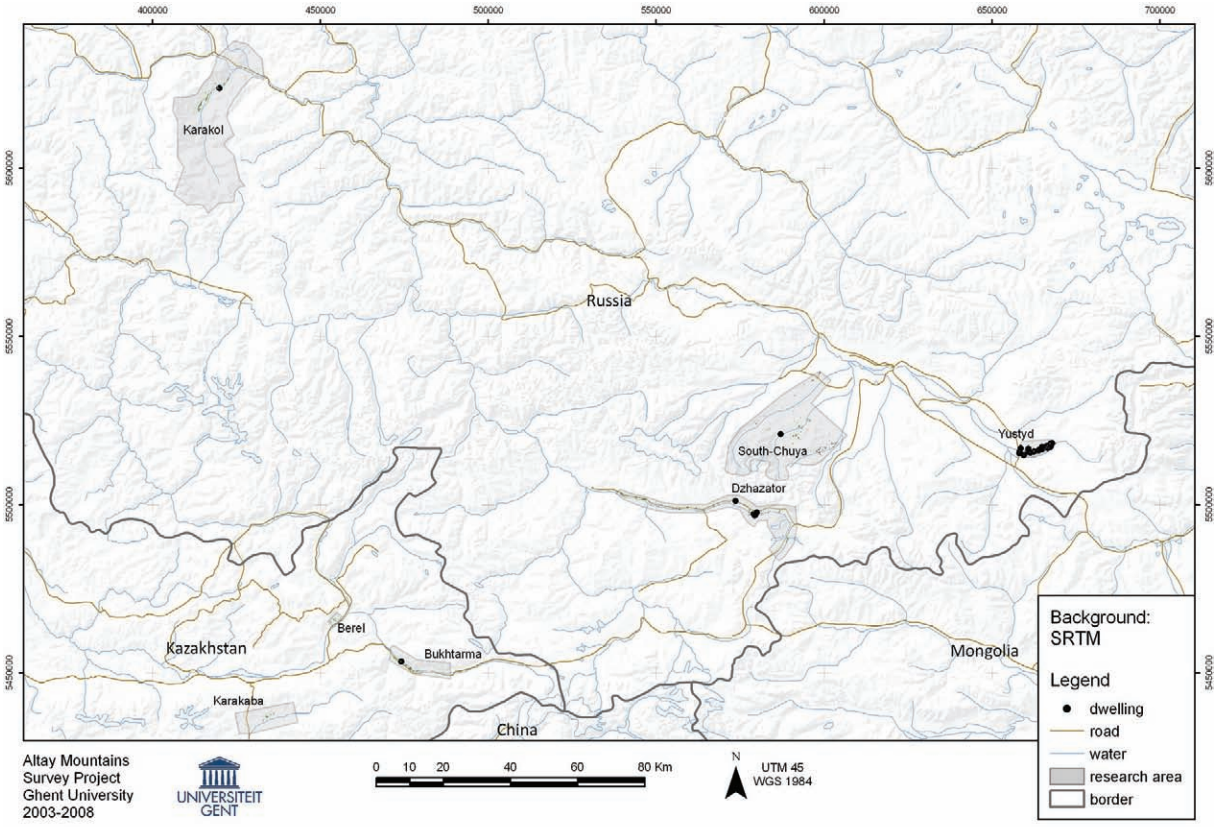


Figure 6.22: Distribution of dwellings in the research areas

6.3.5 Dwellings

Except for one example in Irbistu, one in Karakol and one in Bukhtarma, all dwellings are located in the Dzhazator valley and in Yustyd (Figure 6.22). Of course, we have to keep in mind the six excavated dwellings and two associated rectangular stone concentrations or 'altars' on the right bank of the Irbistu, at the border of the Chuya steppe (Surazakov 1988)(see 5.6). These structures, together with the elaborated dwelling and stone lines of site KA-033 upstream in Irbistu (see 5.6.1.5 and Figure 5.56), show that this monument type was well represented in the southern part of the Chuya steppe. In Dzhazator, only three single and badly preserved dwellings were found, most of them on the broad terrace in the middle part of the valley. The 'ladder' type dwelling is also located on this terrace and seems to be associated with some Turkic monuments, including the nice 'Ayutinsky' type enclosure (site KA-465)(Figure 5.41).

The largest number of dwellings by far recorded during our surveys are located in the Yustyd valley: 249 dwelling were found there, and this total is far from complete. An unknown number of dwellings have still to be recorded in the four 'zones' that were not measured in detail – presumably some dozens (5.6.1). In addition, several fields of dwellings are located on the left bank of the Yustyd. These were recorded by Igor Slyusarenko and his team and detailed information will be added to our database in the near future. It is clear that the very high density of these structures in Yustyd is extraordinary. In combination with the many *kereksur* and the deer stones, this underlines the special character of the archaeological landscape in Yustyd. The quite parallel distribution of these types of monuments could point to contemporaneity, which would support the hypothesis that the dwellings date from the Bronze Age or Early Iron Age.

6.3.6 Early Iron Age or Scythian burial mounds

The distribution of Scythian burial mounds over the different research areas is not very significant, as they can be found in all research areas, mainly in large numbers (Figure 6.23). However, it is interesting to see that Scythian burial mounds cannot be found in the actual Chuya steppe. All burial complexes are located in the valleys, and not on the border of the steppe. A second element concerns the limited distribution of the larger, category 1-type of burial mounds or so-called 'royal mounds' (see 5.2.1.1). These were only found in Karakol and Berel, i.e. in research areas in the lower parts of the Altay Mountains.

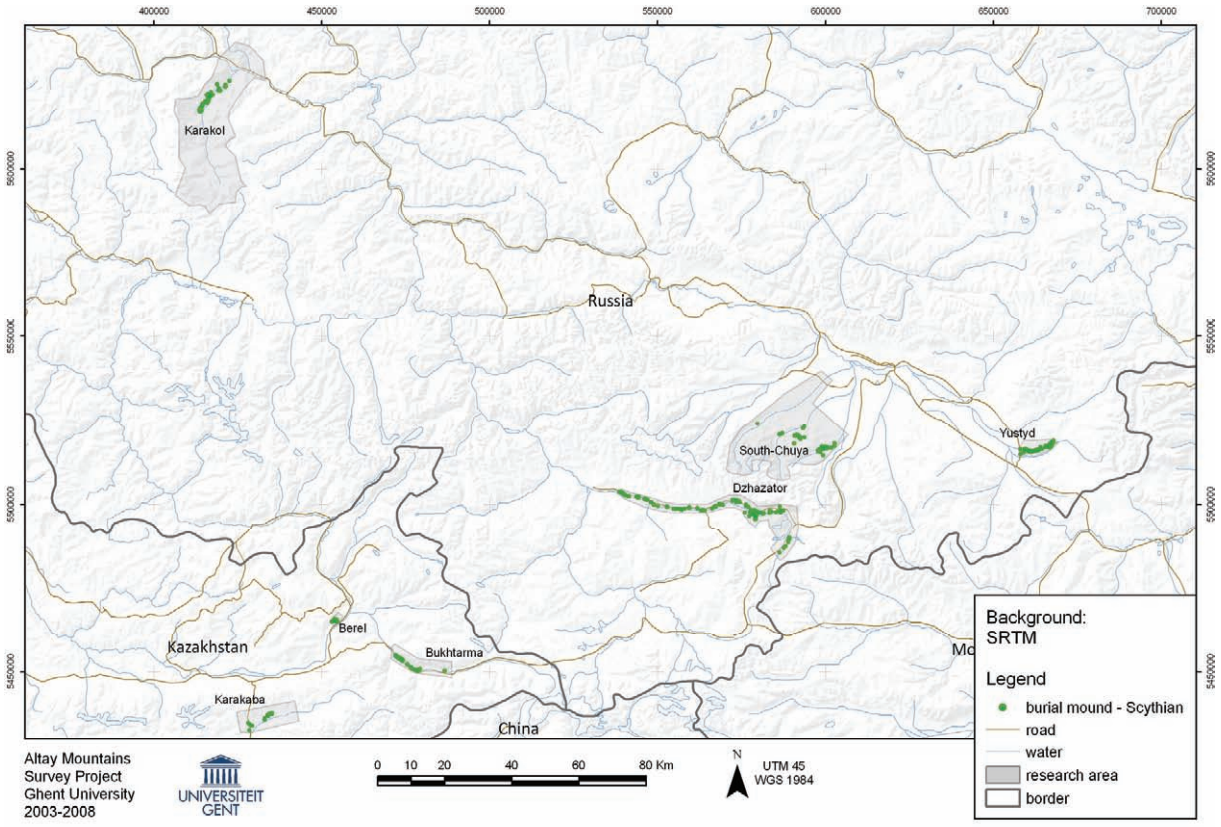


Figure 6.23: Distribution of Early Nomadic or Scythian burial mounds

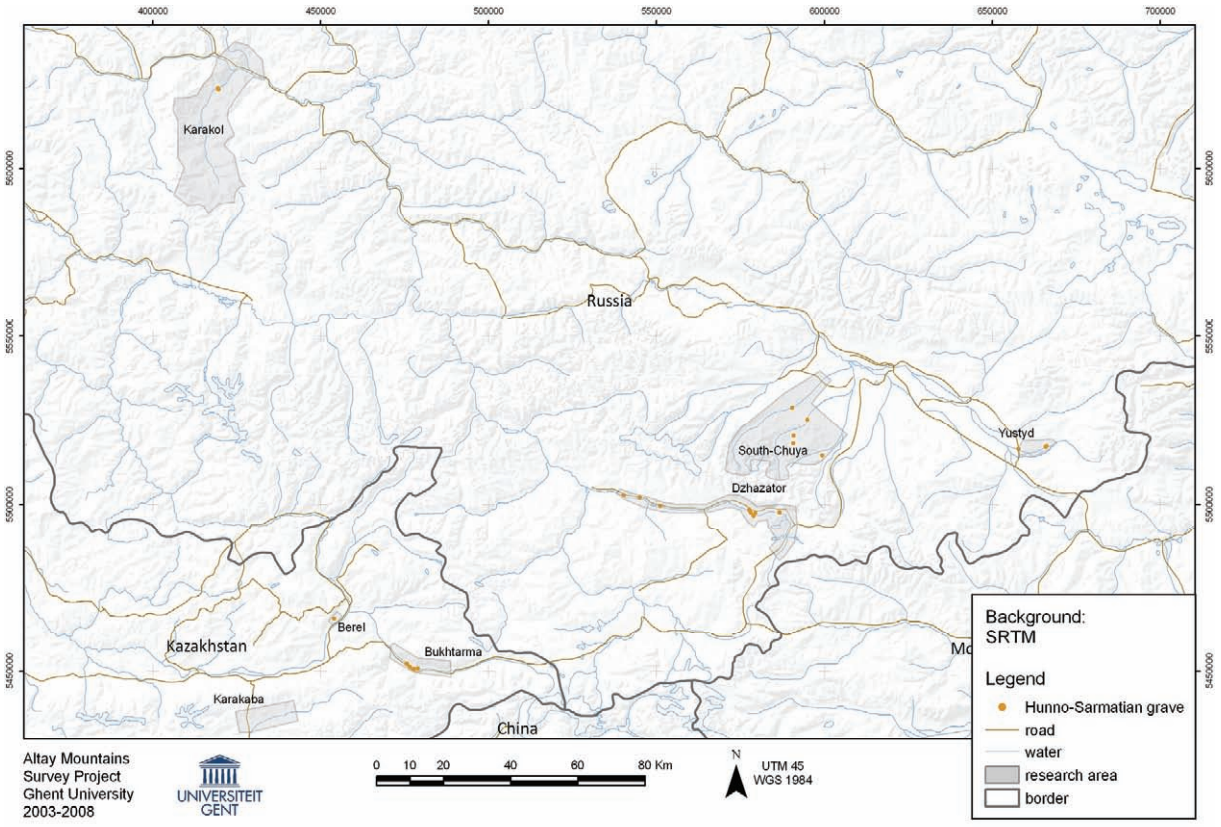


Figure 6.24: Distribution of Hunno-Sarmatian graves throughout the research areas

6.3.7 Hunno-Sarmatian graves

An overview of the Hunno-Sarmatian graves does not seem to reveal any clear patterns (Figure 6.24). Most of these small mounds appear to be randomly spread throughout the different research areas. We only recorded a large group of monuments in Bukhtarma, on a wide terrace in the middle part of the valley (Figure 5.17).

6.3.8 Turkic burial mounds and enclosures

Quite a lot of mounds were assigned to the Turkic period (455 monuments) and are spread over all research areas, except for the Bukhtarma valley (Figure 6.25). As mentioned above in 5.2.2, it is possible that some of these are actually Bronze Age mounds. In particular, in Elangash, Irbistu, Sebystey, Ozyok and the southern part of the Chuya steppe we have recorded mounds that are located against the hills, overlooking the valleys or the Chuya steppe; E. Jacobson-Tepfer assigns these mounds to the Bronze Age. Instead of drawing conclusions from a dataset that might be incorrect, we prefer to reinvestigate these mounds and discuss with colleagues about possible dates of such monuments.

Turkic enclosures are less problematic as they are very recognisable and well represented in all research areas, except for Karakaba (Figure 6.25). Single enclosures or small groups of two to four enclosures are most common, randomly distributed over all parts of the research areas. They can be found in all areas of the landscape that generally have archaeological monuments: flat areas, terraces, along the border of the steppe, etc. However, three locations clearly have a concentration of Turkic enclosures: first is the Sebystey valley where a whole field of Turkic enclosures was recorded in the middle, enclosed part of the valley (sites KA-075, -076 and -077). Secondly, a concentration of Turkic enclosures, some of which are of the special ‘Ayutinsky’ type and/or with image stones, was found on the wide terraces at the end of the higher part of the Dzhazator valley. Most of these enclosures were closely related to Scythian burial complexes. Thirdly, the considerable amount of enclosures in the Yustyd valley is also striking. Between the Scythian burial sites and *kereksur* monuments, 158 enclosures were recorded.

The location of the Turkic image stones is comparable; most of the stones being placed next to enclosures that are part of an important concentration (Figure 6.26). This can be seen in Dzhazator, where nine sculptured stones were recorded (and an additional one is known from the literature). In Sebystey, four stones were found, and three in Yustyd (plus four stones that have been taken away but are preserved in museums). Six examples are known from Karakol – three were recorded in 2007-2008, and three are preserved in museums. There are no large concentrations of enclosures in Karakol, but in the southern, higher part of the valley in particular, from Kulada to Sootyokh, a considerable number of enclosures is located in relation to Scythian burial mounds.

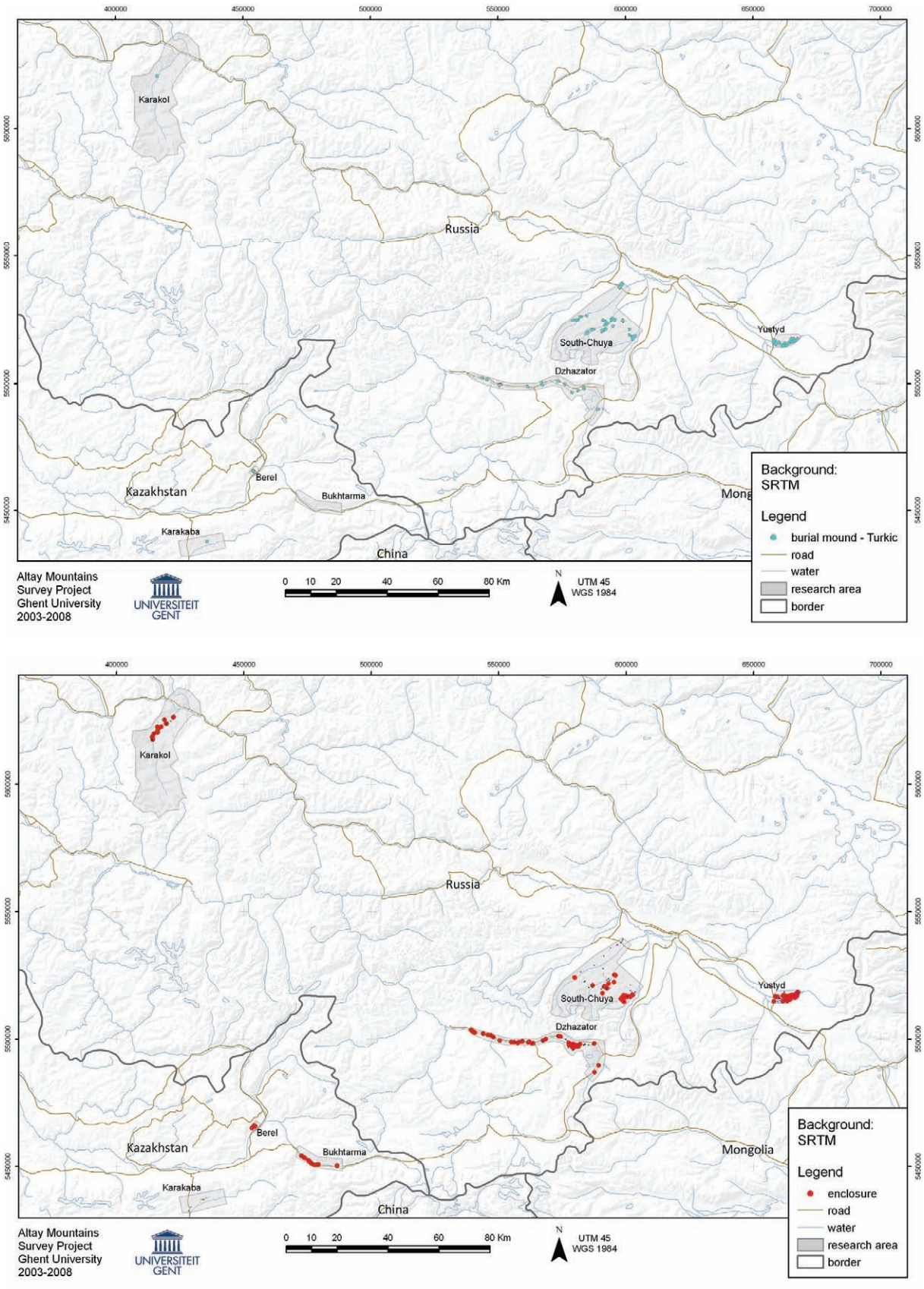


Figure 6.25: Distribution of Turkic burial mounds and Turkic enclosures

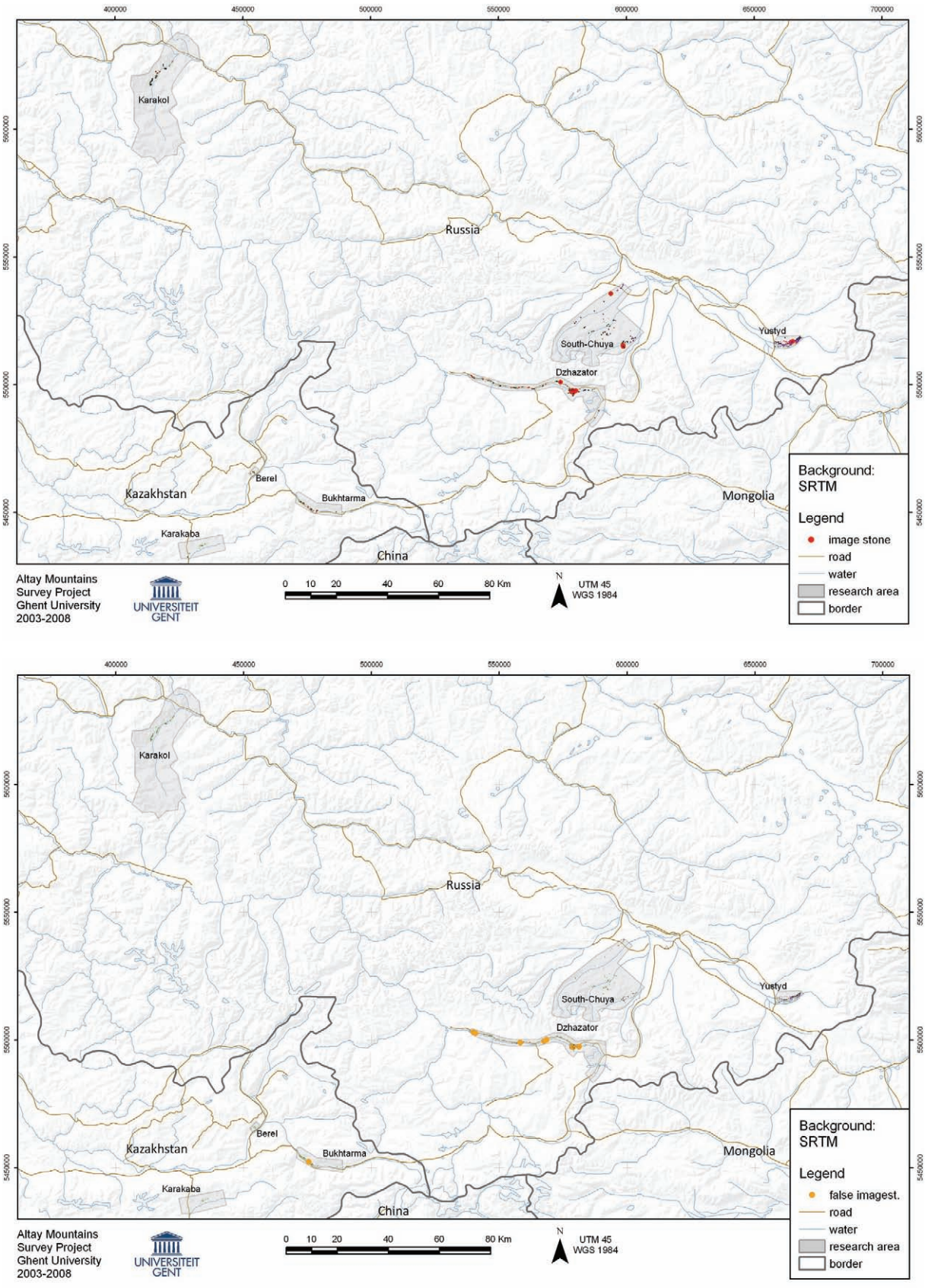


Figure 6.26: Turkic images stones (above) and false image stones (below)

Together with Bukhtarma, the Dzhazator valley is the only place were we recorded false image stones (Figure 6.26). The clearest examples of false image stones were recorded in Dzhazator: large, uncarved standing stones just east of the enclosures, followed by a row of smaller *balbal*, are common in this valley. In other areas, this is far less common – in fact, we never recorded clear examples.

The special monuments in the Sootyokh and Nizhniy Sooru valleys (Karakol), recorded in 2008, could prove an exception. The small mounds, initially assigned to the Turkic period, have rows of *balbal* that stretch out to the north of the monuments. The first stone in the row is always considerably larger than the other *balbal*. If the monuments are indeed Turkic, it is possible that these massive stones on the northern border of the mounds are variants of the false image stones. For now, they are categorised as 'standing stones' to differentiate them from the smaller *balbal*.

6.3.9 Ethnographic burials

Ethnographic burials are mainly concentrated in Dzhazator and in Bukhtarma (Figure 6.27). In both valleys, small and large burial sites are found along the course of the river. Especially in Dzhazator, the lower part of the valley has the largest number of graves. They are constructed on the terraces and flat plateaus or hilltops. The different types of graves (stone, wooden constructions, 'log cabin') mainly occur in the two valleys, except for the mud brick constructions which were only found in Bukhtarma, be it in large numbers.

The ethnographic burials in the other research areas – south Chuya, Yustyd and Karakaba – are very simple stone heaps with badly preserved remnants of wooden constructions on top, or even small heaps of massive stones, not earthed over. They seem to be very recent but are not typical ethnographic graves. However, they are different from piles of stones resulting from cleaning the fields for agriculture.

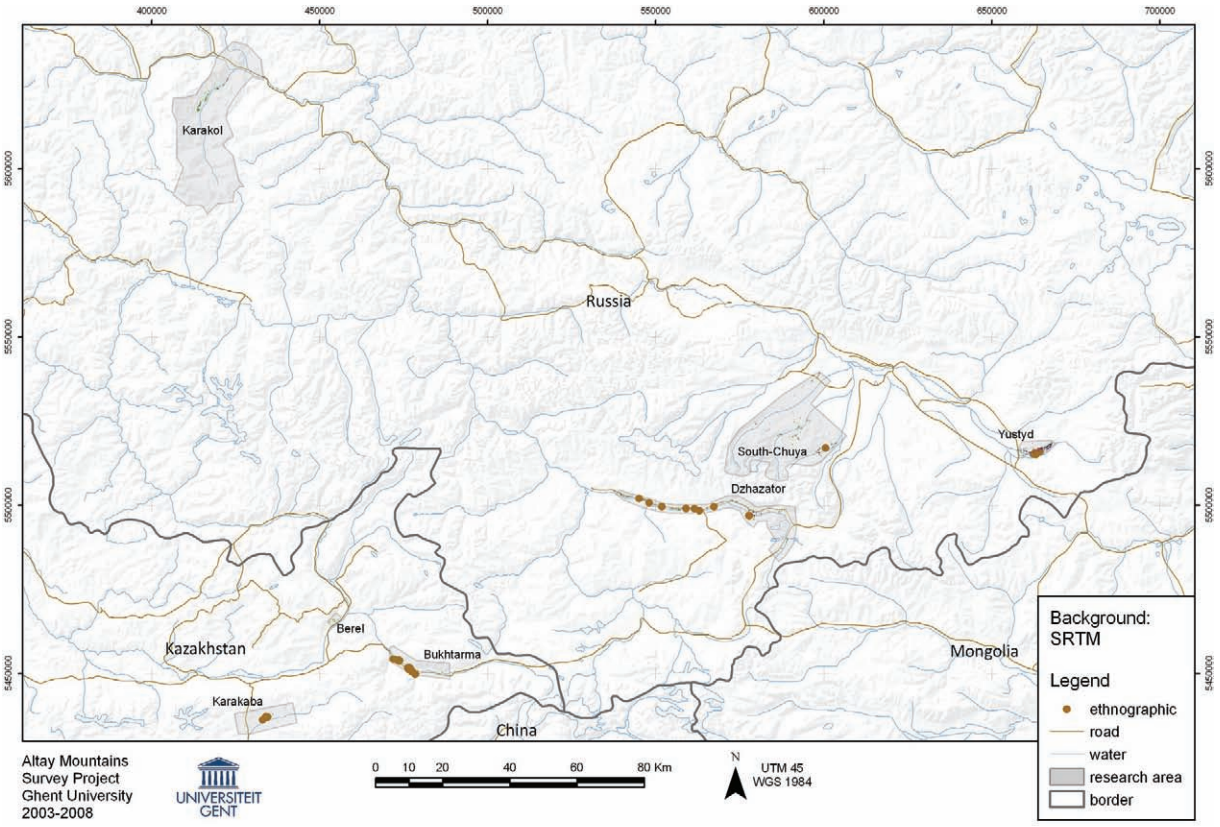


Figure 6.27: Distribution of ethnographic burials throughout the research areas

6.3.10 Conclusions: shifting cultural landscapes

The preceding paragraphs show that the distribution of monument types is not homogenous over all research areas. Although some periods are well presented in all areas, others seem to be limited to the eastern part of the Russian Altay. Early Iron Age burial mounds can be found everywhere, and so are their associated structures: *balbal*, stone circles and stone platforms. Turkic enclosures are also very numerous and can be found in all research areas, although there appear to be some clear concentrations in some of the valleys (Sebystey and Dzhazator, among others). In addition, Turkic image stones and false image stones are mostly limited to Dzhazator, Sebystey and Yustyd, although *balbal* show the same distribution as the enclosures.

In particular, Bronze Age monuments, such as *kereksur*, deer stones, four-cornered mounds, collared mounds and (possibly) dwellings, seem to be limited to the research areas in the Chuya region – the borders of the steppe, the adjacent valleys and especially Yustyd. The archaeological landscape of the Chuya steppe thus offers a striking continuity with that of the Mongolian side of the Altay ridges, where the same typical elements can be found. The discussion on the distribution of the *kereksur* in 0 is important in this respect since their presence could reflect a cultural influence covering large parts of Mongolia and Tuva, to which the eastern part of the Russian Altay belonged. The distribution of other specific Bronze Age monuments, such as deer stones, collared mounds and four-cornered mounds confirm this.

The question as to when this landscape shifts decisively cannot be answered based only on our survey results, as the research areas are not continuous and are too limited. However, the distribution is clearly linked with a specific type of landscape in which visibility and 'stoniness' play an important role. Therefore, a reasonable suggestion for the western limit of this cultural influence might be the western border of the Chuya basin or the Kuray steppe.

6.4 Regional differences in the archaeological landscape

Below is a more detailed look at the different research areas, starting with those at the southern border of the Chuya steppe.

6.4.1 Distribution of monuments in the southern part of the Chuya region

In Sebystey, no archaeological structures were found in the upper part of the valley, except for one Early Iron Age burial mound and some single Turkic enclosures, just at the transition with the middle part. Nearly two-thirds of the archaeological sites were found on the terraces in the middle part of the valley, including most of the Scythian burial sites and the main concentrations of Turkic enclosures (Figure 6.28). The archaeological sites in the lower part of the valley are found along both edges of the valley and, to a lesser degree, in the Chuya steppe. Most of the Bronze Age monuments, including some *kereksur*, are found in this area (Figure 6.29). This distribution of monuments appears to be typical for this type of valley, with Turkic and Scythian monuments in the broad but enclosed part of the valley, and Bronze Age monuments in the lower parts and at the borders of the steppe.

The archaeological landscape in Ozyok, a wide-open valley with vast terraces, shows about the same distribution. However, only 10% of the monuments here are Turkic; the Scythian type monuments are very dominant and some of the largest Iron Age burial complexes of the region were constructed here. The lower part of the Irbistu, where it flows in parallel with the Ozyok in the same plain and merges with it just before entering the steppe, has a comparable landscape.

The distribution of monuments in Irbistu, Sarikobu and Elangash is completely different. These closed valleys have only a few Scythian burial places, always located in the middle part of the valleys, where the terraces, if any, are somewhat larger. The higher parts of these valleys have no monuments at all. In addition, the fields of moraines that separate the middle parts of the valleys from the Chuya steppe are also devoid of any archaeological structures. The preponderance of Turkic structures in Irbistu and Elangash (Figure 6.30) is partly due to a series of possible burial mounds which are located against the hilly moraines that border the valleys. These were assigned to the Turkic period, but there is some discussion about this (see 5.2.2 on Turkic burial mounds).

Most striking, however, is the different character of the southern border of the Chuya steppe. In particular, the concentration of Bronze Age monuments here is interesting (Figure 6.29). Most of these are *kereksur* with associated smaller structures that overlook the vast Chuya basin – a typical setting for these monuments. No Scythian burial places are found here, underlining the fact that these are only constructed in the actual valleys (Figure 6.29). However, a large number of possible burial mounds are located against the hills, overlooking the steppe. Again, these were assigned to the Turkic period, although they may possibly date from the Bronze Age.

Structures from the Eneolithic period are rare, and their distribution appears to have no clear pattern (Figure 6.28). The same can be concluded when looking at the distribution of the Ethnographic graves, although it is striking that most of these are located in the Sebystey valley (Figure 6.30). Apparently, this valley has known the longest continuity for the construction of burial monuments (Figure 6.31).

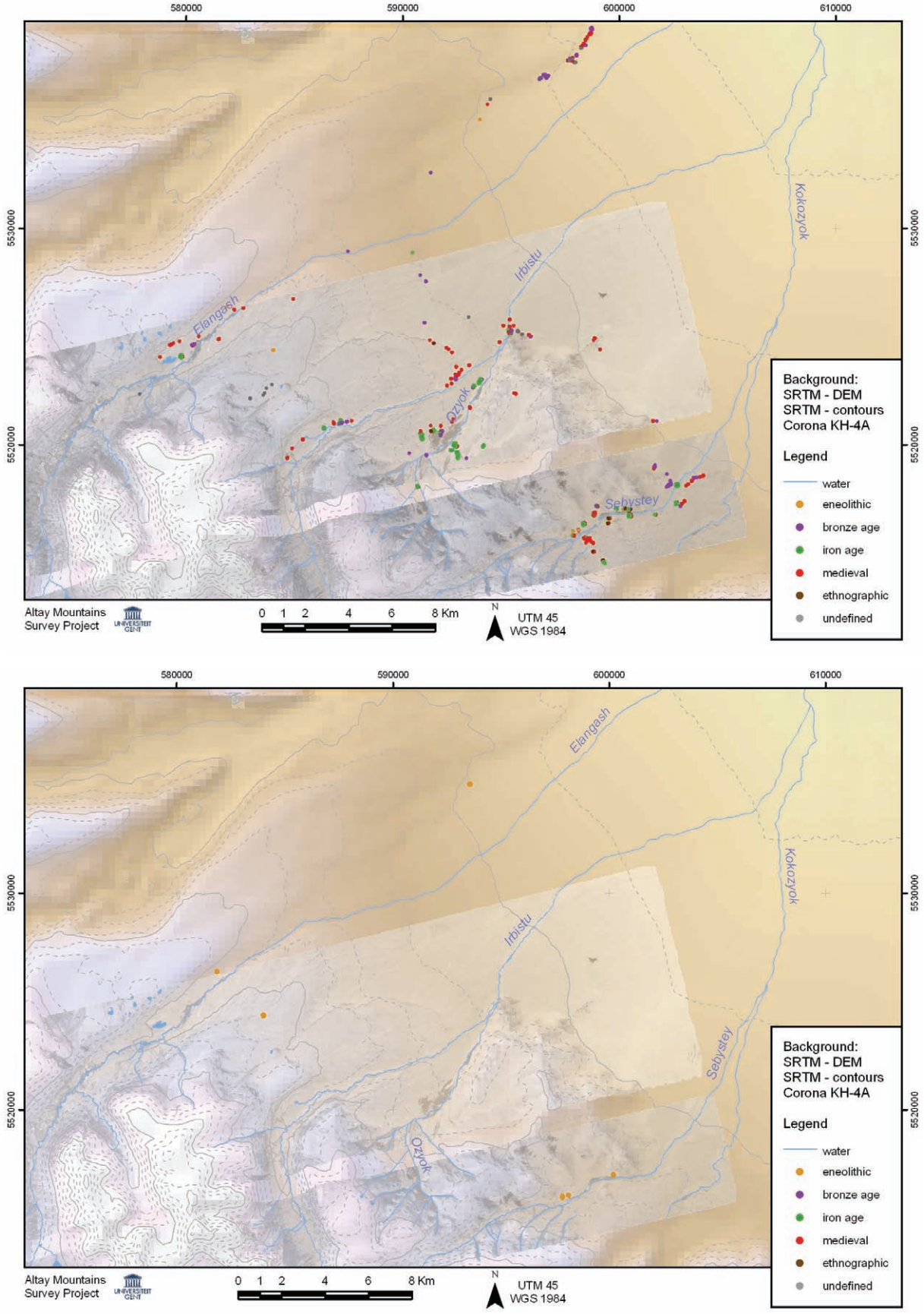


Figure 6.28: The distribution of monuments in the southern part of the Chuya steppe and adjacent valleys (above), and the location of Eneolithic structures in the same area (below)

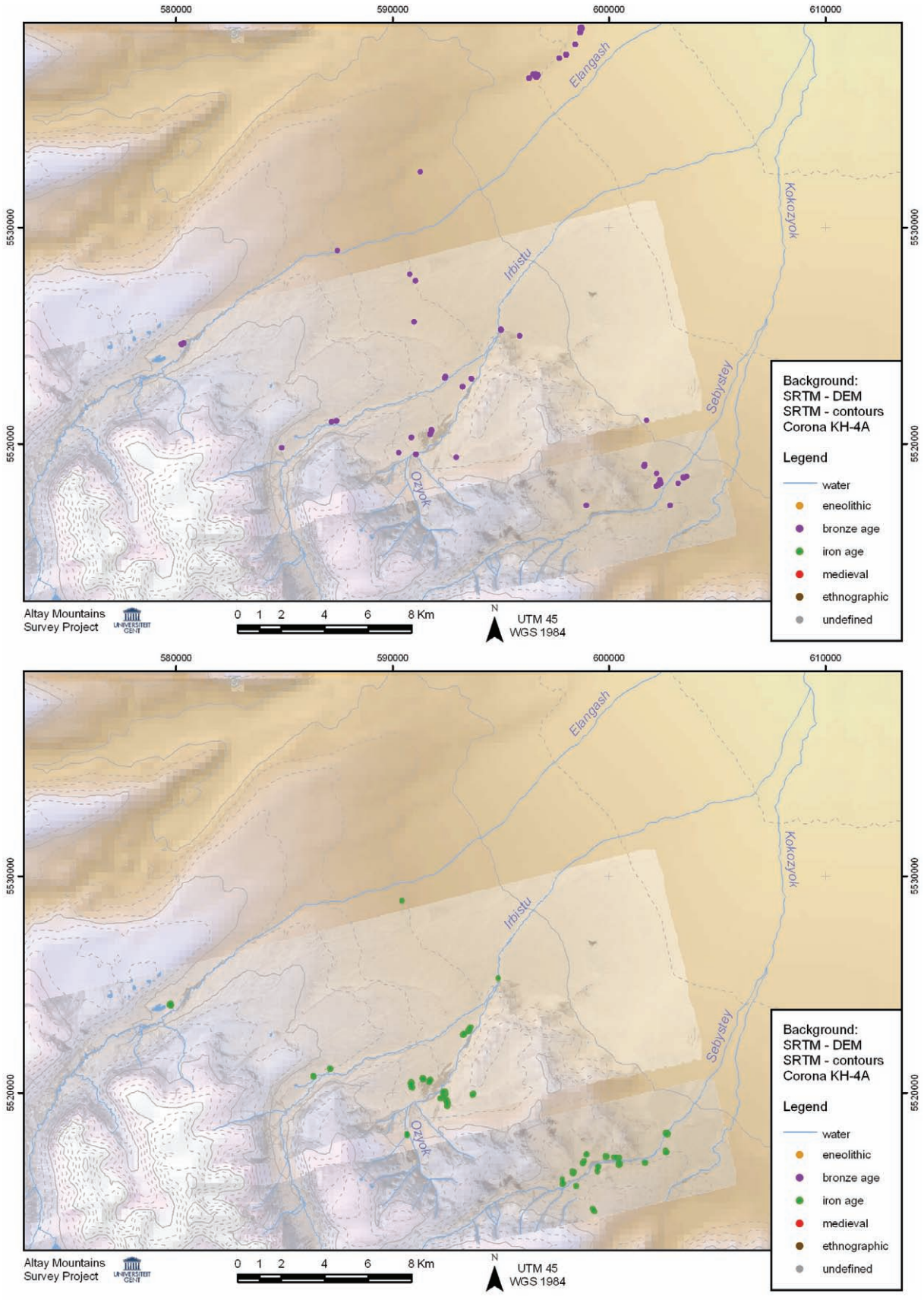


Figure 6.29: The distribution of Bronze Age (above) and Iron Age (below) monuments in the southern part of the Chuya steppe and adjacent valleys

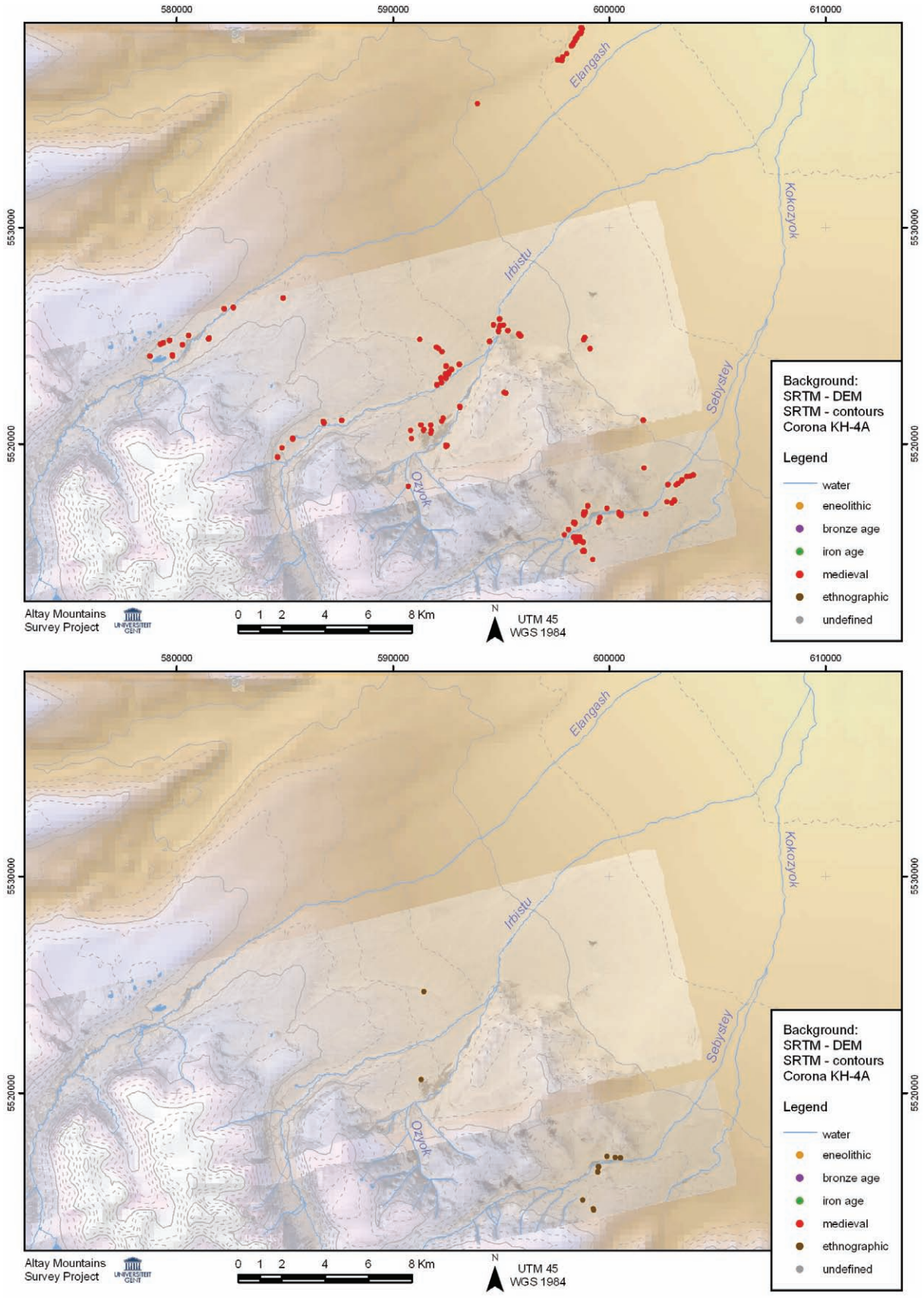


Figure 6.30: The distribution of Medieval or Turkic monuments (above) and Ethnographic graves (below) in the southern part of the Chuya steppe and adjacent valleys

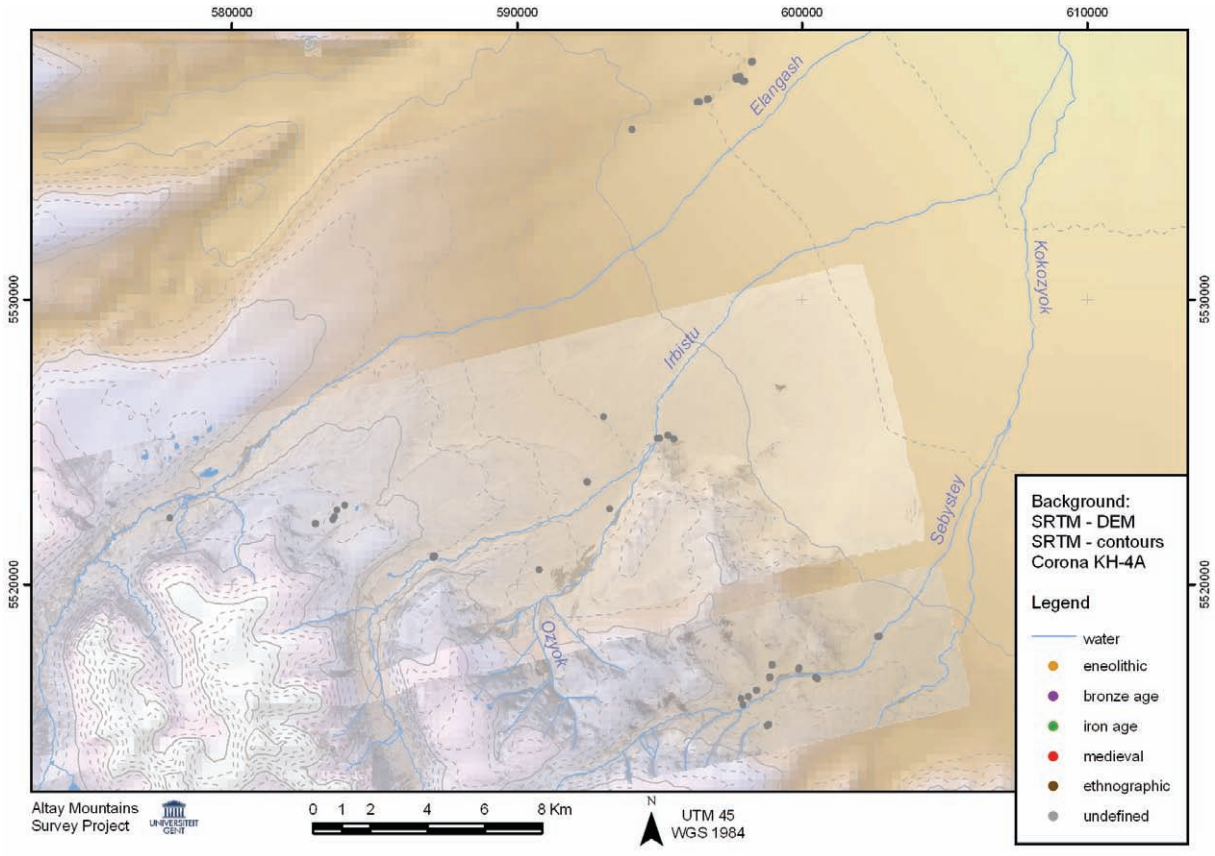


Figure 6.31: The distribution of monuments of unknown date in the southern part of the Chuya steppe and adjacent valleys

6.4.2 Organisation of the Yustyd archaeological complex

The Yustyd valley is a very interesting area in which to study the organisation of different monument types, the numerous examples there shaping a fascinating cultural landscape. On visiting Yustyd, one cannot deny the feeling that the monuments form a coherent ensemble and that there is some kind of system in their layout. However, the terrace stretches out over several kilometres, and it is hard to maintain an overview regarding the organisation of the structures.

On a large scale, looking at the overview map of Yustyd, the valley can be divided into different zones (Figure 6.32). The oldest structures in Yustyd – the Bronze Age monuments, in particular the many large *kereksur* – are mainly located in the eastern, higher part of the terrace (Figure 6.34). All larger *kereksur* are located here; except for one. This concentration stops where the valley opens and the terrace becomes wider than approximately 1,000 m. Apparently, the distance to neighbouring slopes or rivers became too great, and the terrace too open and steppe-like. One isolated, large *kereksur* (KA-158) is located in the middle of the terrace in the lower part of the valley, where the terrace opens into the Chuya steppe. It appears that this monument is 'guarding' the entrance to the valley – it is certainly a powerful marker.

The area between this impressive monument and the large concentration of *kereksur* in the east of the valley was put to use during the Iron Age, when six parallel lines of burial mounds were constructed on the southern border of the terrace (see also Figure 6.50 in paragraph 6.5).

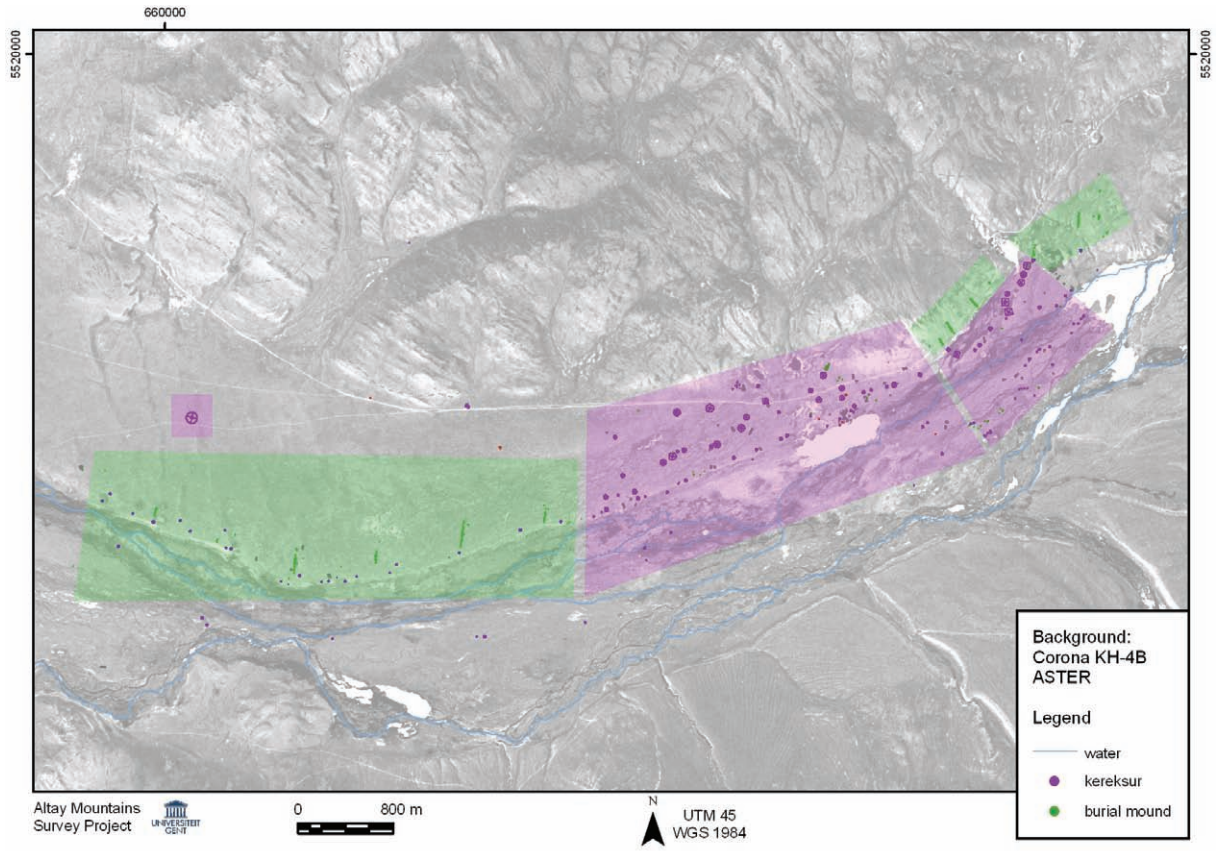


Figure 6.32: The archaeological complex on the right bank of the Yustyd, with an indication of zones with Bronze Age *kereksur* and zones with Iron Age burial mounds

No large *kereksur* are found here, but there are some smaller ones on the terrace border. Higher in the valley, east and north-east of the *kereksur* concentration, other burial places were built wherever space was available: against the hill slopes and on flat areas (small plateaus) at the start of the upper part of the valley (Figure 6.34). The orientation of some of these higher located sites is rather far from the average of 6.1°N, as they are constructed at right angle to the slopes.

It appears that the Iron Age population chose to continue to use the Yustyd valley as one of the centres of ritual and funerary practices, following the example of their predecessors. In so doing, they had to construct their extended sites on the available space – building long alignments of burial mounds between the *kereksur* would indeed be quite impractical. Monuments of the Turkic period, in particular the enclosures with occasional long rows of standing stones or *balbal*, are much smaller and are placed between the monuments of preceding periods. It is interesting to see that the enclosures are mainly concentrated in the eastern part of the valley, in the group of *kereksur* – they are not often constructed in the neighbourhood of Scythian sites (Figure 6.35). This is strange as there is a clear link between Scythian sites and Turkic enclosures in Sebystey, Ozyok and other research areas. The Turkic monuments in the flood plain of the river are mainly possible burial mounds.

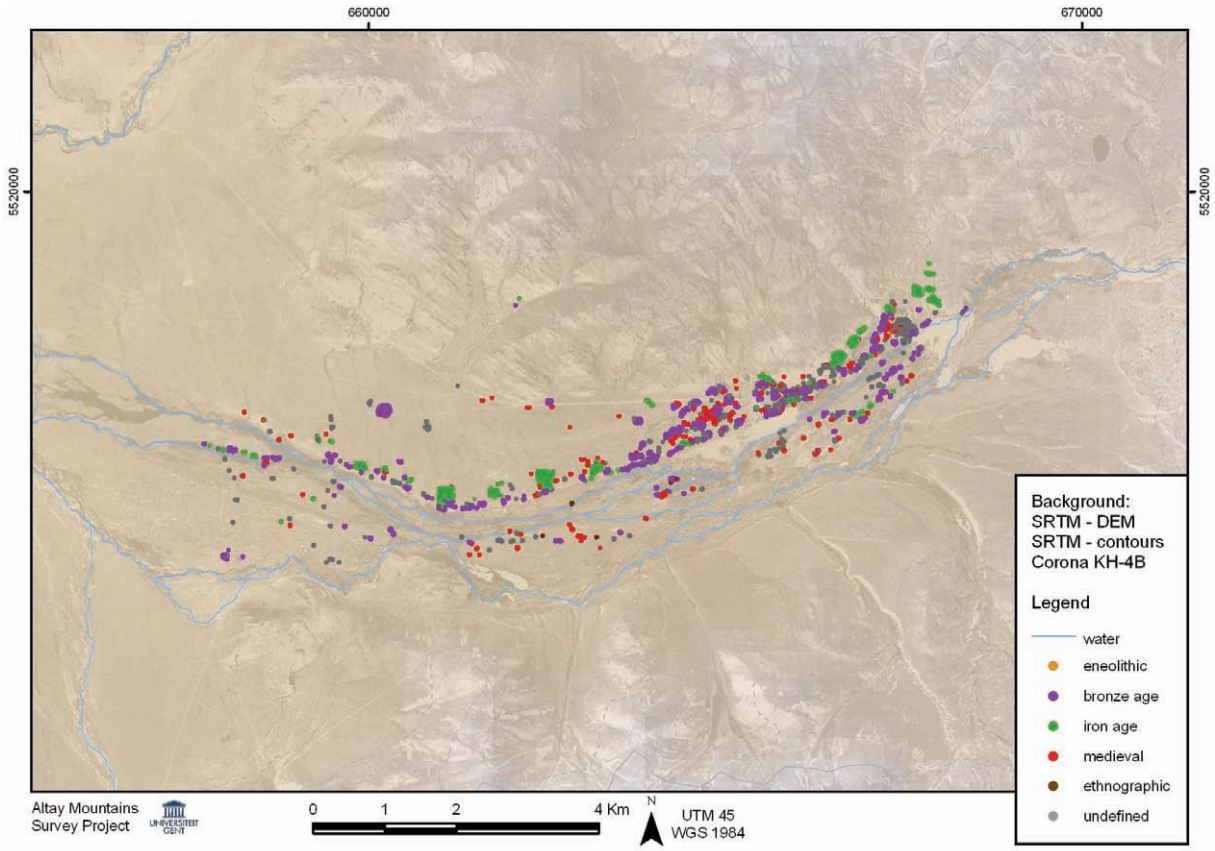


Figure 6.33: The distribution of monuments on the right bank and in the flood plain of the Yustyd River

Quite a lot of monuments – 819 to be exact – could not be dated (Figure 6.35). Most of these are either mounds and burial mounds that are difficult to assign to a specific period, or small, isolated monuments such as standing stones and stone lines. Important here is the category of rectangular stone settings or 'dwellings', with 248 structures. These are sometimes dated to the Bronze Age, but we decided to leave their date as 'undefined' (see 5.6 for a typology). However, once again these structures are concentrated in the eastern part of the valley, in the same area as the *kereksur* and Turkic enclosures.

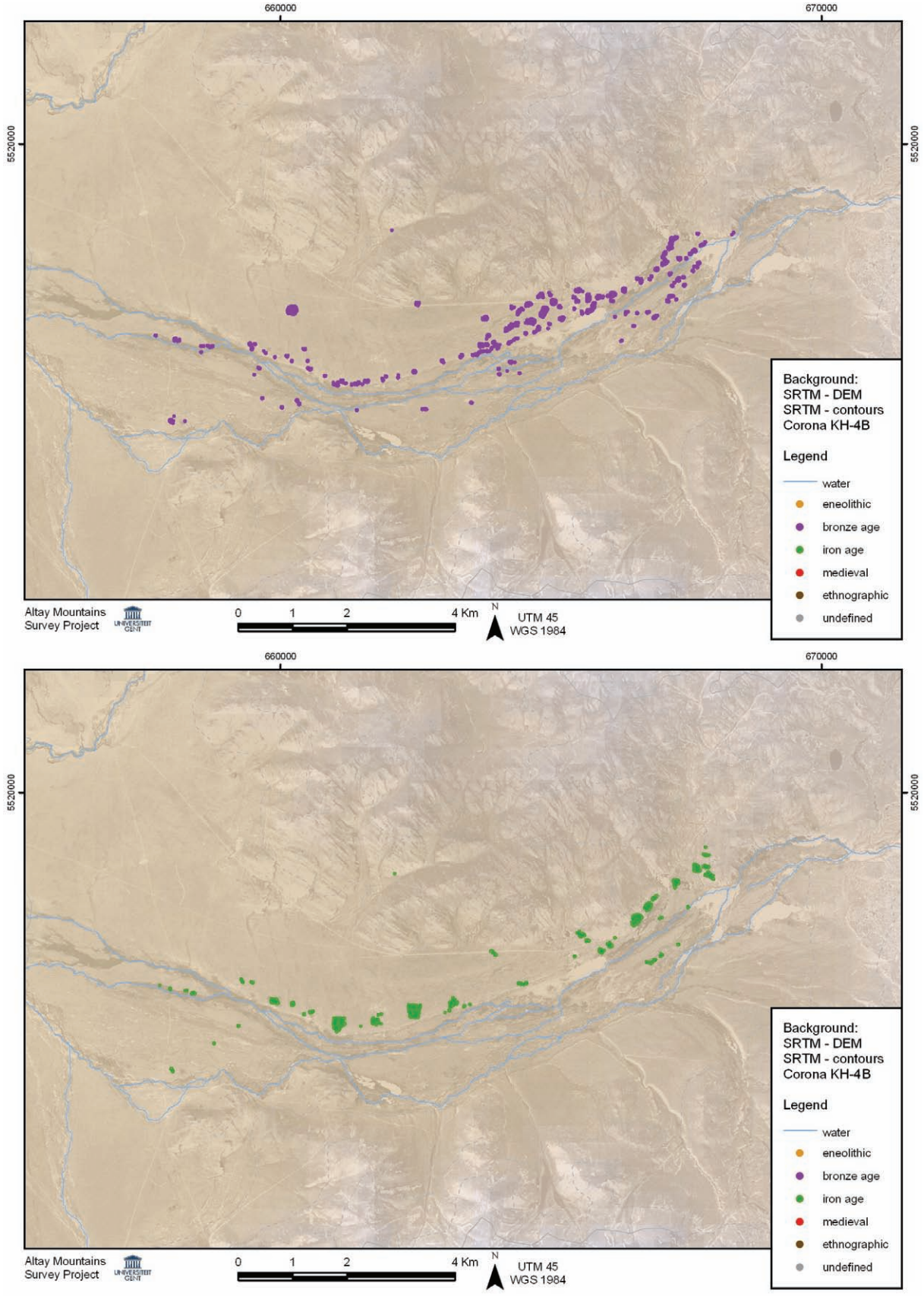


Figure 6.34: The distribution of Bronze Age monuments (above) and Iron Age monuments (below) on the right bank and in the flood plain of the Yustyd River

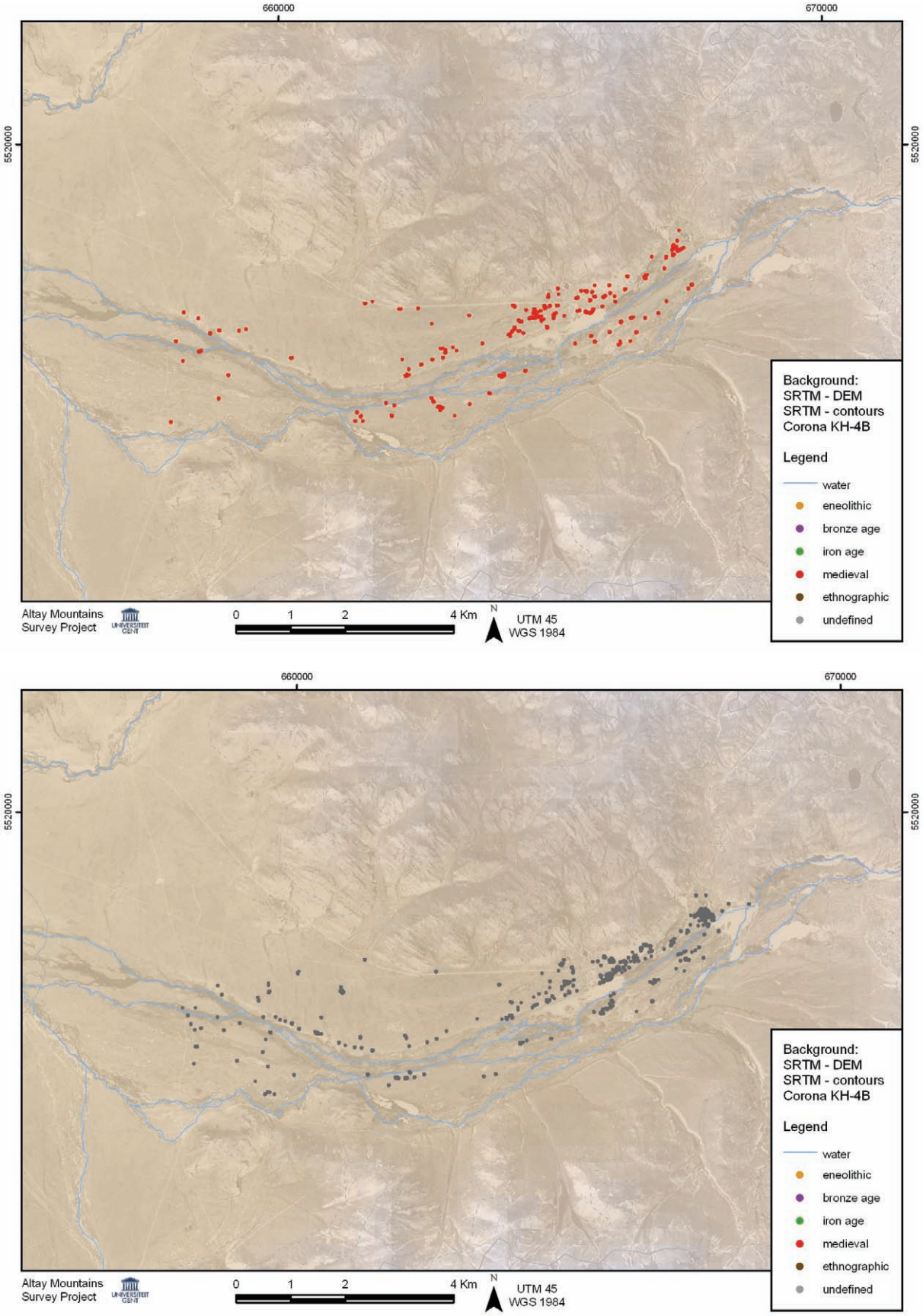


Figure 6.35: The distribution of monuments of unknown date on the right bank and in the flood plain of the Yustyd River

6.4.3 The duality of the archaeological landscape in Dzhazator

Looking at the Dzhazator valley, we see a clear distinction between the lower and the higher part of the valley. Across approximately 70 km, the river crosses different landscape settings: from the source at 2,300 msl to somewhat higher than the confluence with the Dzhumaly valley at about 2,050 msl, the valley is characterised by a broad, rather U-shaped valley. The lower part of the valley, from about 2,000 msl to 1,600 msl at the confluence with the Ak-Alakha River, is far more V-shaped, with a smaller valley floor and dominant tree vegetation. In the figures here below, the transition from the higher to the lower part roughly coincides with the beginning of the north-western CORONA image (the gap between the two images is clearly visible in the maps of the eastern part of the valley).

A second distinction between the lower and the higher part of the valley can be seen in the archaeological landscape (Figure 6.36). In the higher parts, the landscape is very open, with large terraces and flat areas. Mainly Scythian and Turkic monuments have been recorded here. Very few Bronze Age monuments are found in this part of the valley, as can be seen in Figure 6.37[30]; only two possible *kereksur*, but no steles, mounds or petroglyphs. Monuments from the Eneolithic period are completely absent, and Ethnographic graves are rare, too (Figure 6.40). The valley widens considerably at a height of about 2,050 msl. On both banks, terraces of several hundred of metres wide were formed, with steep terrace borders of up to 10 m high. These large terraces have the greatest concentrations of archaeological monuments in the entire valley, and are home to dozens of archaeological sites, including a long alignment of Scythian burial mounds and some of the most interesting Turkic enclosures in the area.

In the lower part of the valley, from an altitude of about 2,000 msl, the terraces yield monuments from the Eneolithic period and the Bronze Age, as well as Scythian, Hunno-Sarmatian, Turkic and Ethnographic structures. The two locations with Afanas'ev graves are both situated in the far lower part of the valley. Again, as was the case in the Chuya region, there appears to be no pattern (Figure 6.42). Three locations with Bronze Age steles were recorded, all in the middle part of the valley, but no *kereksur* at all. Other points include possible Bronze Age mounds and petroglyph panels (Figure 6.37). The steles are all set in a very limited part of the valley, along the river, at 2,000 m and 1,300 m intervals. The same 3,300-m stretch of the valley also includes four of the five petroglyphs sites we recorded in Dzhazator, all of them with, among others, Bronze Age images. In addition, Ethnographic burial places are mainly located in this part of the valley. They can be found at regular intervals throughout the entire western part, while there are very few in the eastern, higher part (Figure 6.40).

[30] We apologise for the fact that the figures are not in chronological order here: the map with Eneolithic monuments was moved to the back for layout reasons.

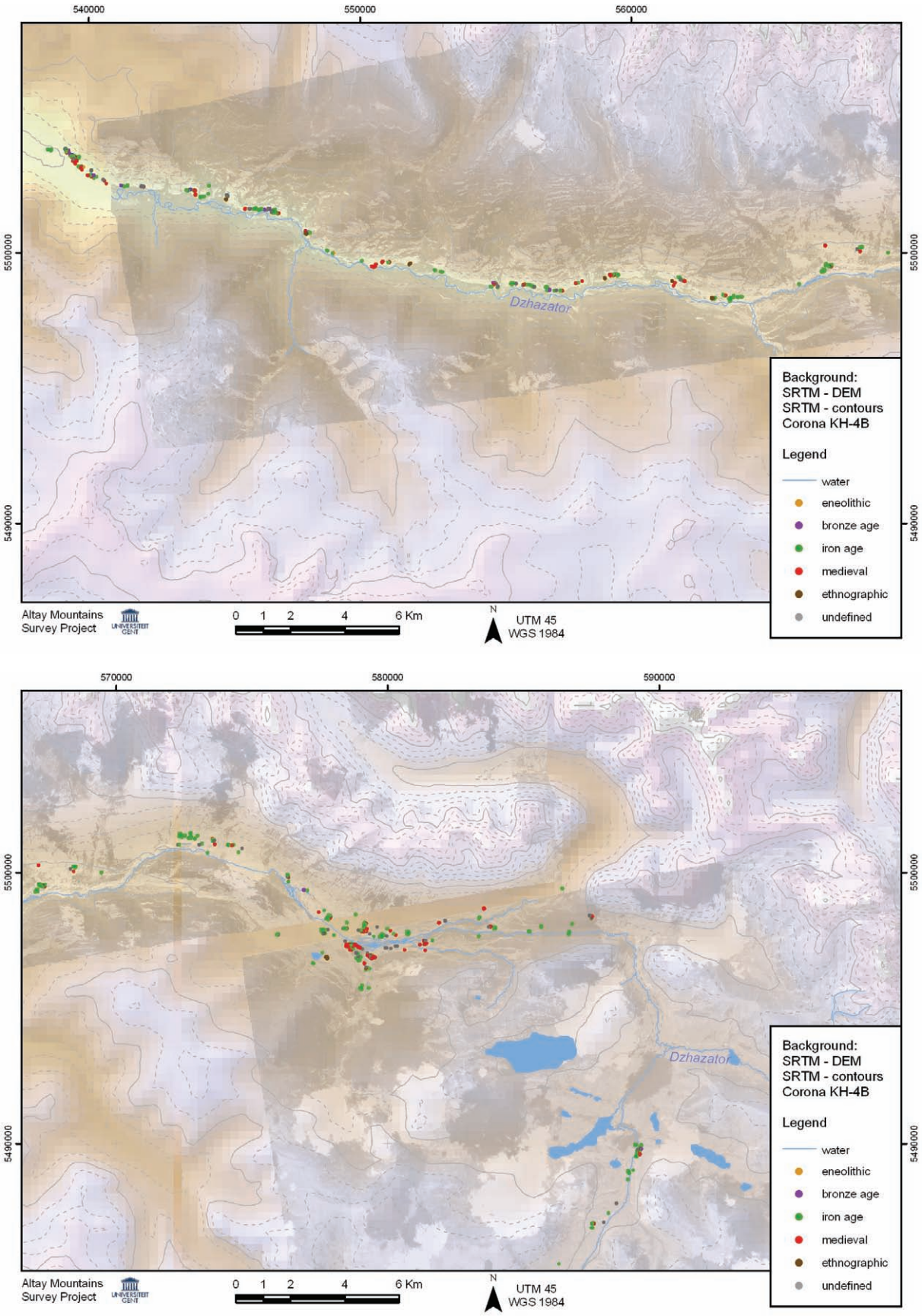


Figure 6.36: The distribution of monuments in the Dzhazator valley: the lower, western part of the valley (above) and the higher, eastern part (below)

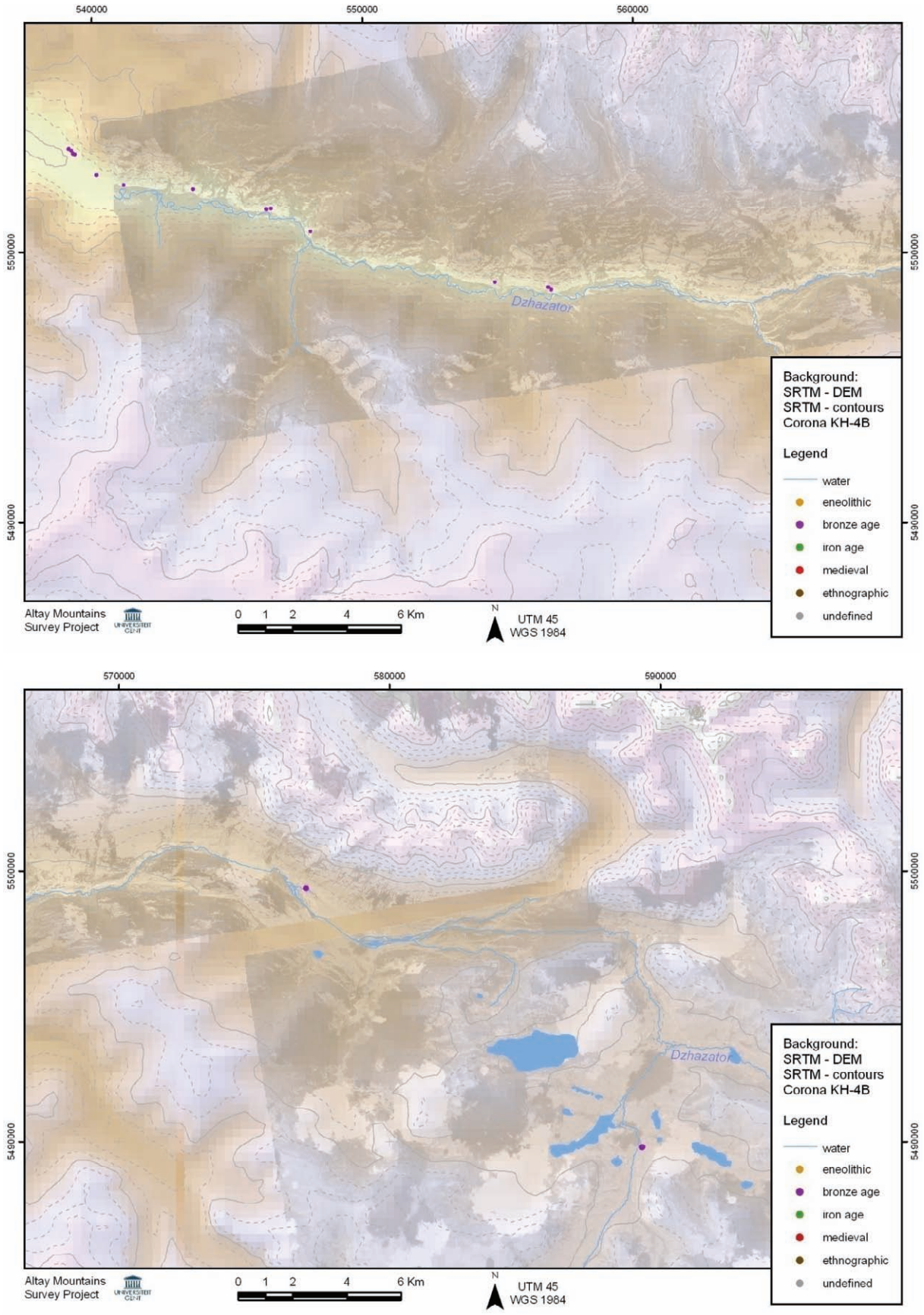


Figure 6.37: The distribution of Bronze Age monuments in the Dzhazator valley: the lower, western part of the valley (above) and the higher, eastern part (below)

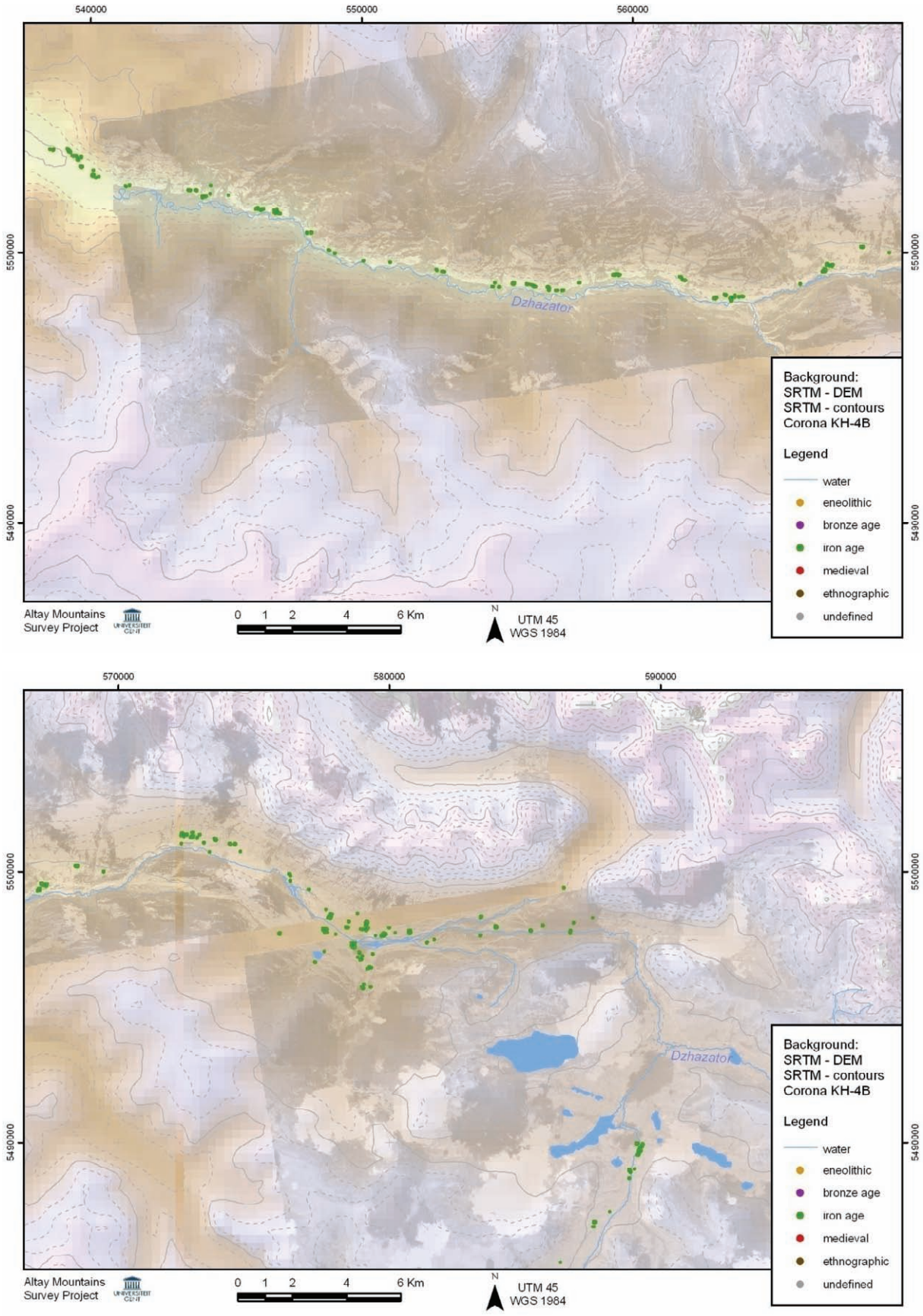


Figure 6.38: The distribution of Iron Age monuments in the Dzhazator valley: the lower, western part of the valley (above) and the higher, eastern part (below)

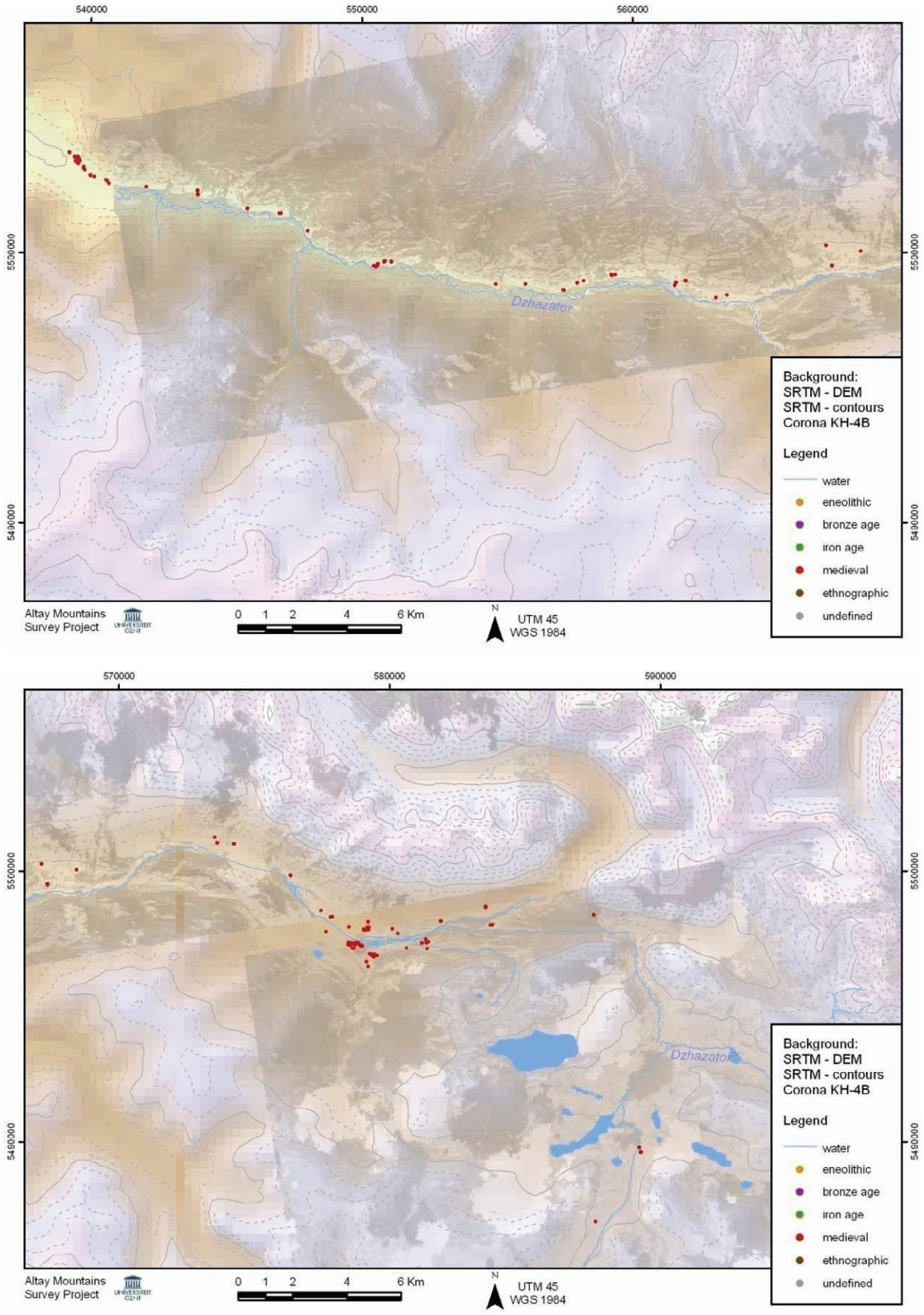


Figure 6.39: The distribution of Medieval or Turkic monuments in the Dzhazator valley: the lower, western part of the valley (above) and the higher, eastern part (below)

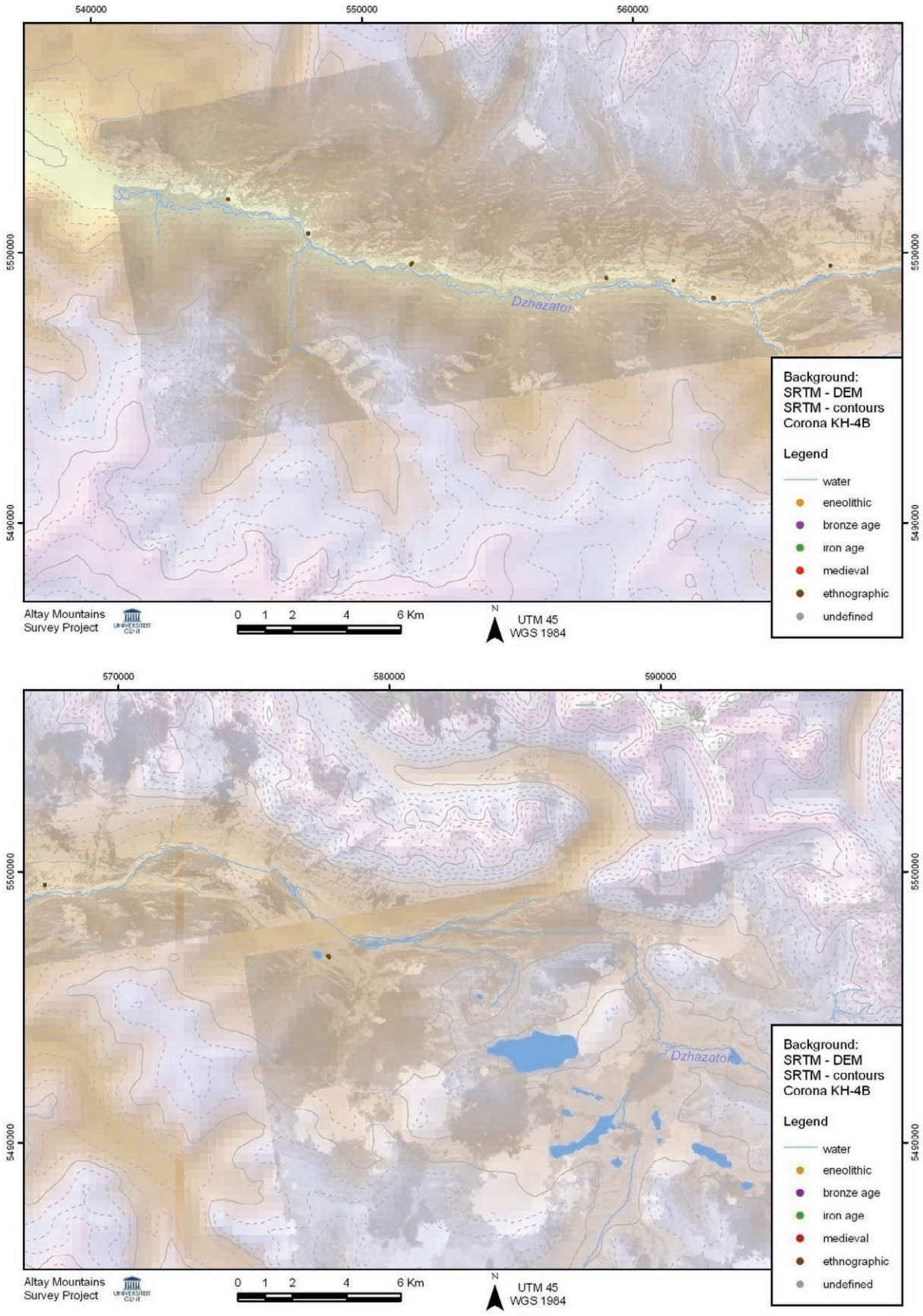


Figure 6.40: The distribution of Ethnographic graves in the Dzhazator valley: the lower, western part of the valley (above) and the higher, eastern part (below)

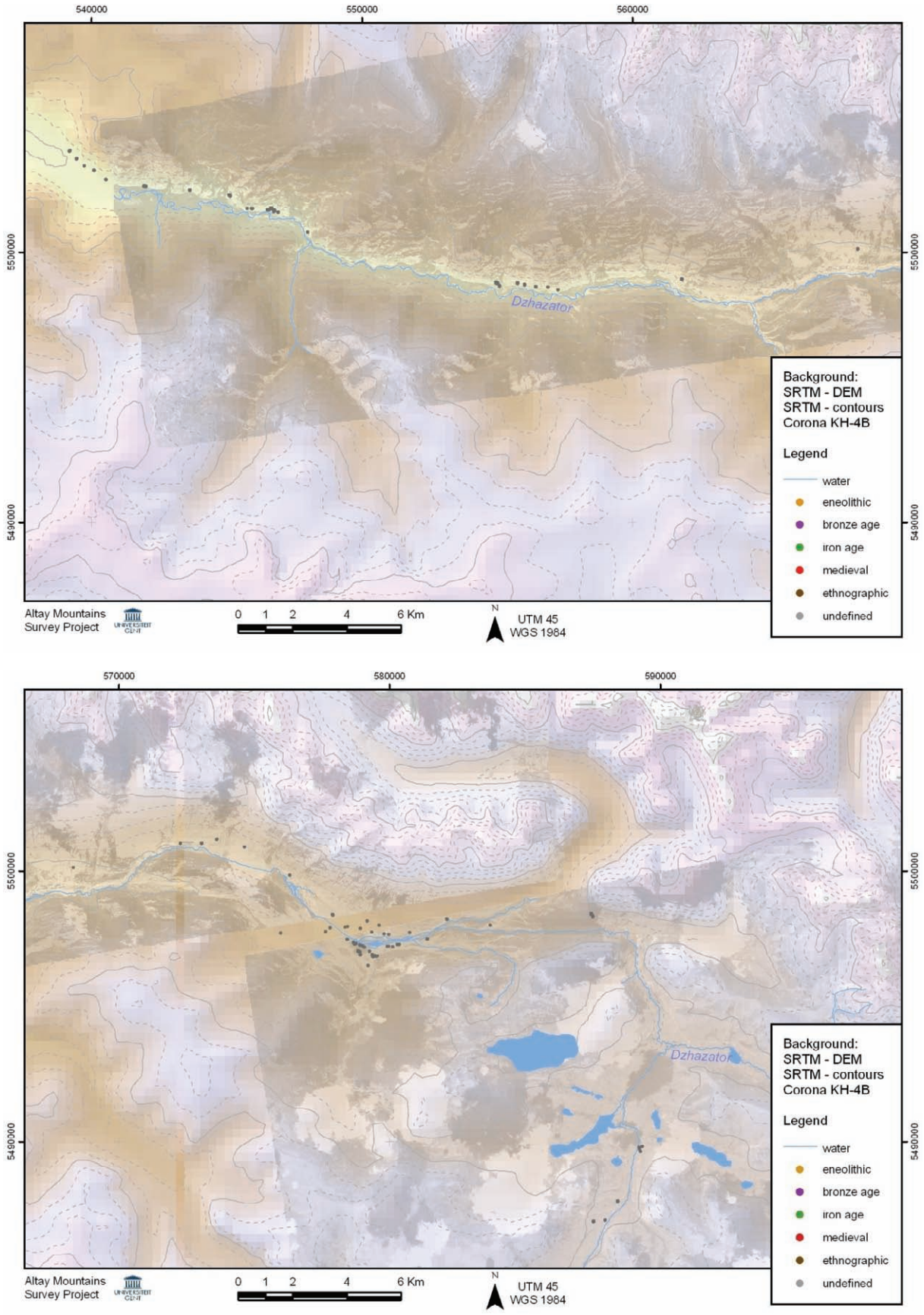


Figure 6.41: The distribution of monuments of unknown date in the Dzhazator valley: the lower, western part of the valley (above) and the higher, eastern part (below)

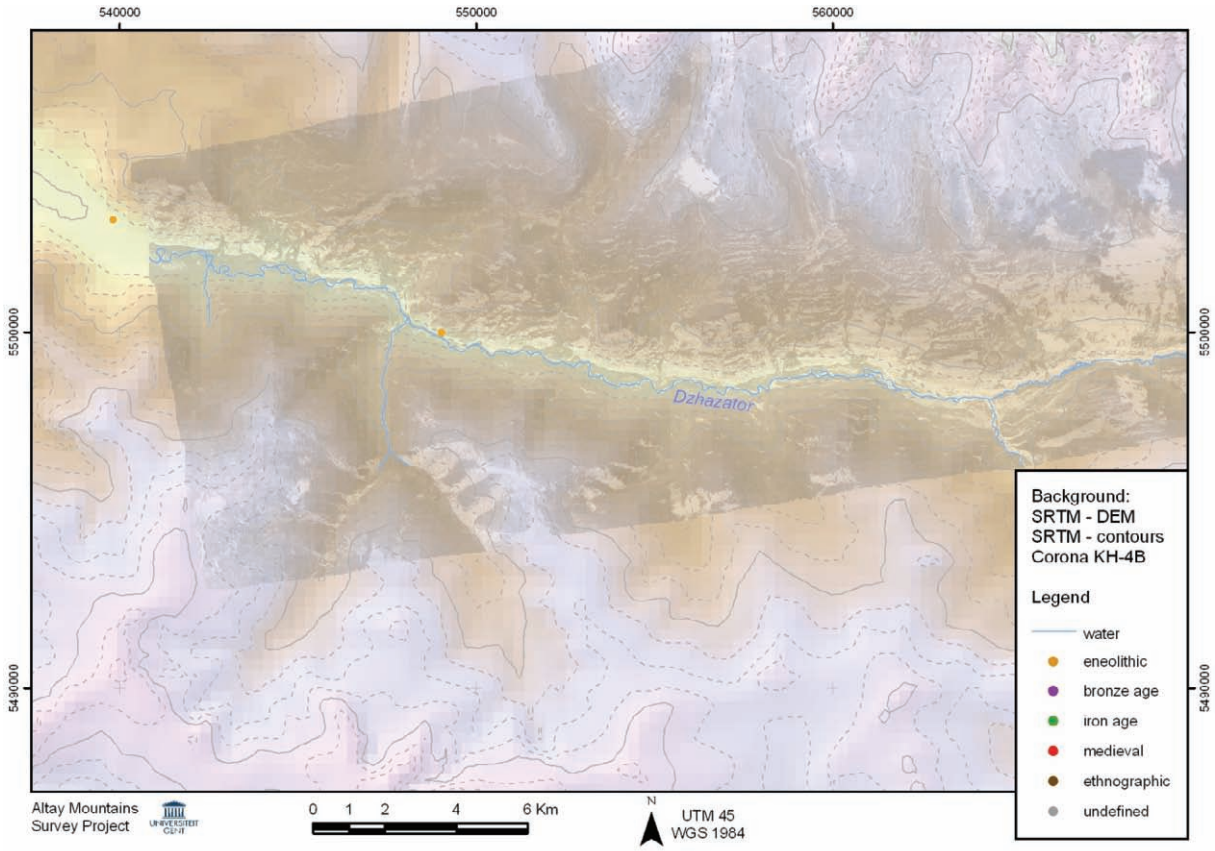


Figure 6.42: The distribution of Eneolithic monuments in the lower, western part of the Dzhazator valley – there are no Eneolithic monuments in the higher, eastern part

6.4.4 The Karakaba valley

The Karakaba valley is not a very interesting case study by which to investigate the archaeological landscape. Sites and structures are not numerous here, and they are all located in the same, broad part of the valley. The research area was limited to the higher part of the valley, and we have no idea what the archaeological landscape looks like further downstream. The first map in Figure 6.43 gives all the necessary information, but we have added the different maps with Bronze Age, Iron Age, Turkic and Ethnographic structures, and one with monuments of unknown date, for the sake of conformity (Figure 6.43 to Figure 6.45).

One observation is that most structures are concentrated in the middle of the research area, along the cliffs that form the northern border of the valley. Monuments from Bronze Age, Iron Age, Turkic period and Ethnographic period are located on this slightly sloping part of the valley, and there are some petroglyph panels on one of the most protruding rocky outcrops. The monuments in the western part of the research area, downstream, are mainly very unclear mounds that were occasionally assigned to the Iron Age but, for the most part, remain undated.

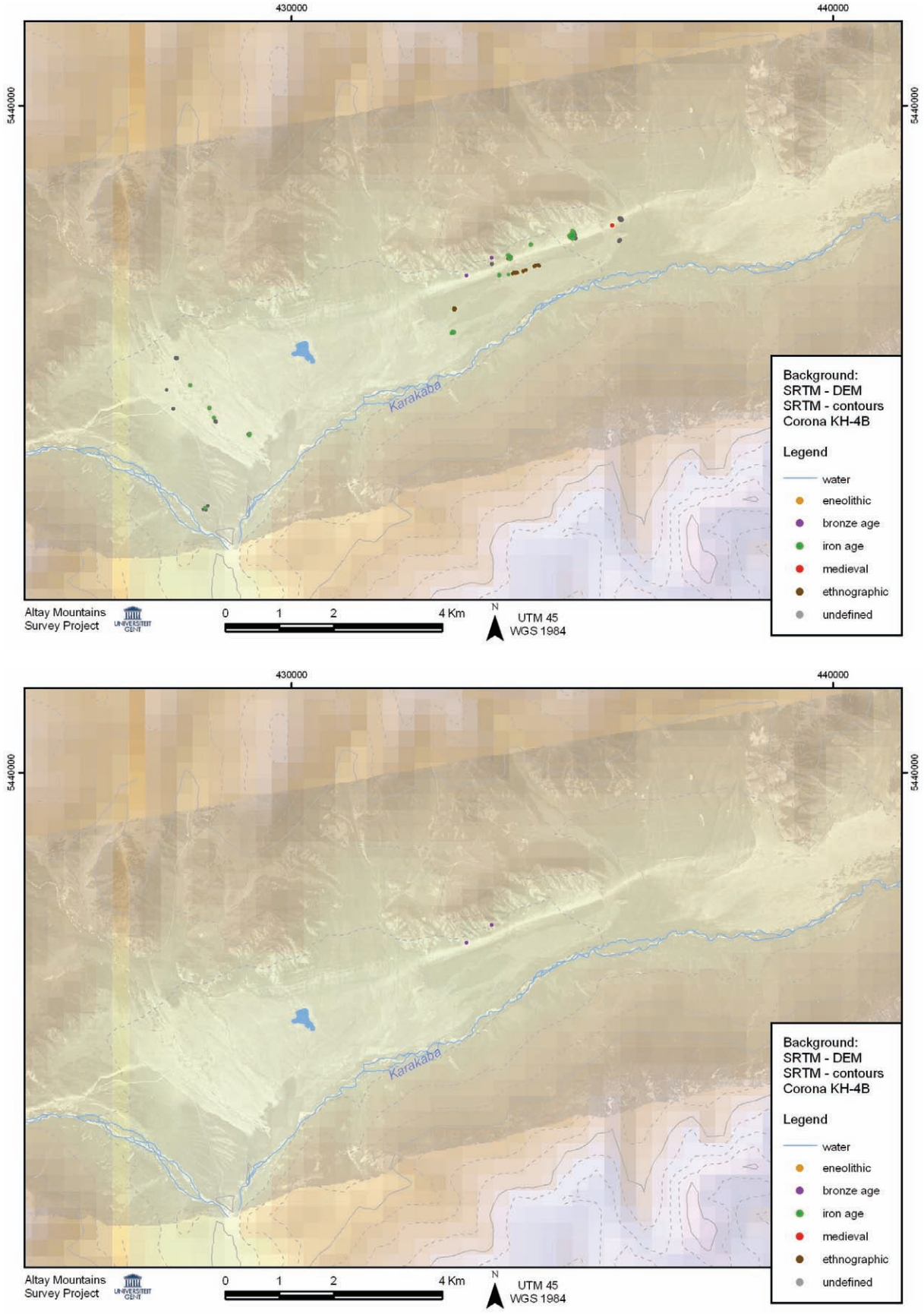


Figure 6.43: The distribution of monuments in the Karakaba valley (above), and the location of Bronze Age structures in the same area (below)

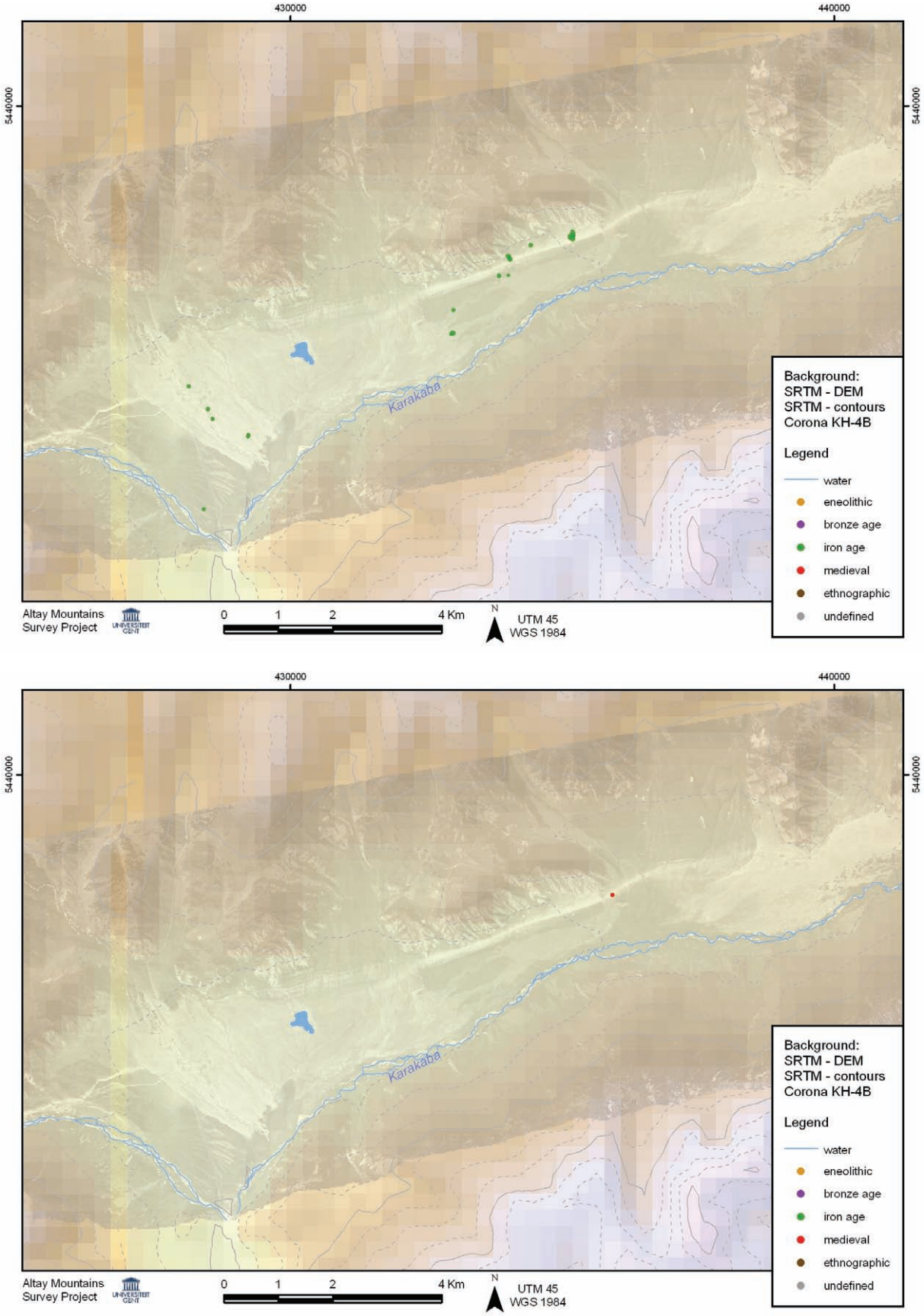


Figure 6.44: The distribution of Iron Age monuments (above) and Turkic or Medieval structures (below) in the Karakaba valley

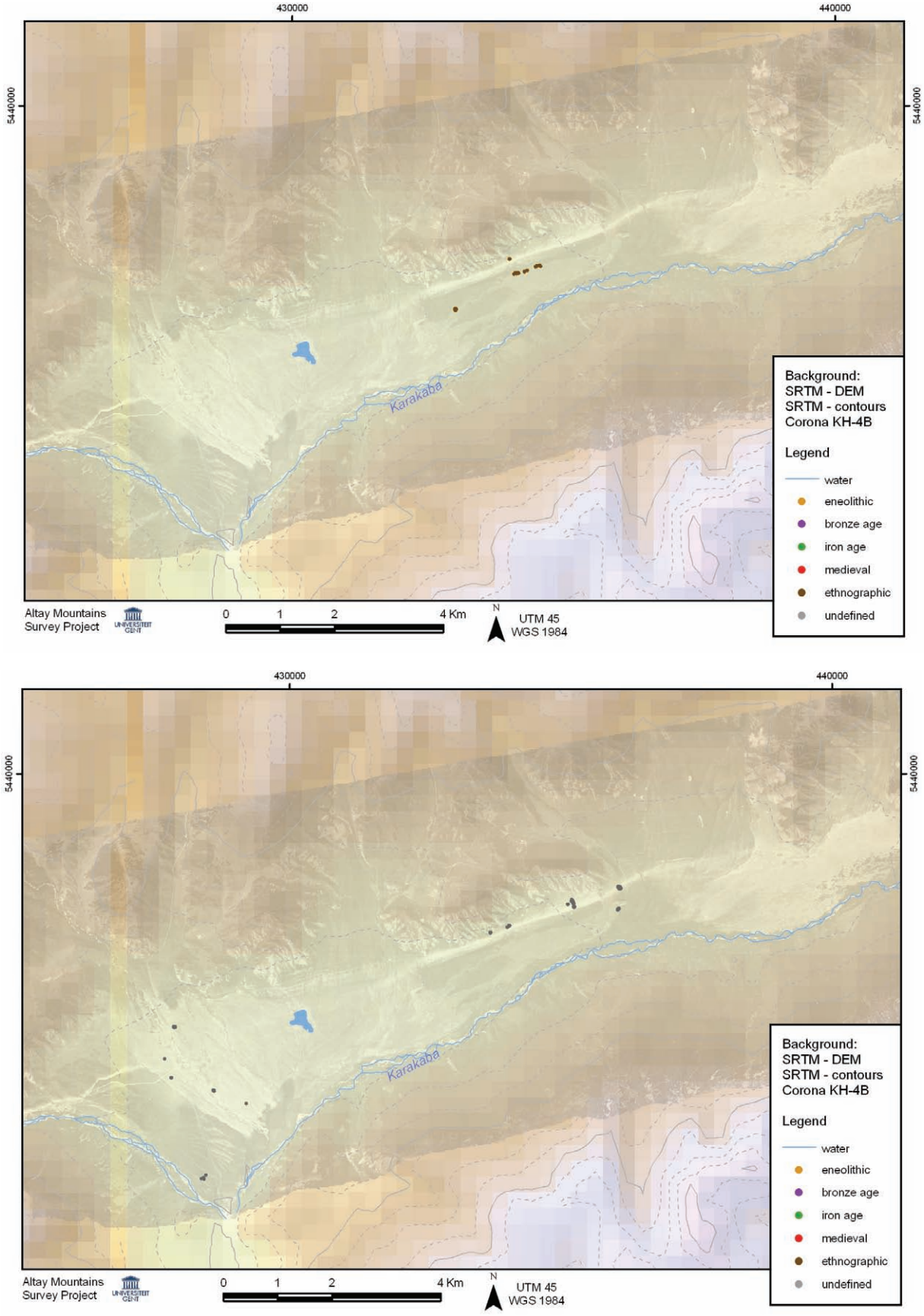


Figure 6.45: The distribution of Ethnographic monuments (above) and structures of unknown date (below) in the Karakaba valley

6.4.5 The archaeological landscape of the Bukhtarma valley

The survey of the Bukhtarma was hampered by the fact that the first, highest 30 km of the valley is part of the military border zone, and thus is inaccessible. We started our survey at a bridge over the river, which was the eastern-most point that was accessible, then worked westwards over a distance of 20 km, until reaching the left tributary Tautekeli. Nevertheless, we had the occasion to take a look at the higher part of the valley during the last days of the fieldwork as we were invited by the military to visit the base and take a trip to the Russian border. Although this exploration cannot be seen as a survey, and we certainly must have missed some archaeological sites, there appeared to be very few monuments in that part of the valley.

About halfway into the research area, the valley bends slightly northwards (Figure 6.1). The first part, east of the bend, is very similar to the first 30 km of the river: very narrow terraces and a valley floor that is almost completely covered by bushes and trees. Very few monuments were found here, and only one site was recorded just west of the bridge (KK-081). Between this site and the next surface monuments downstream, there is a gap of over 7,300 m without any structures at all. Site KK-081, comprising four Iron Age burial mounds, three Turkic enclosures, one stone circle and two small stone concentrations, is not included in the maps below, as that would have changed the scale of the maps considerably, thereby making them unreadable.

The valley opens considerably where it bends slightly north-westwards. This area is characterised by many different small and large river terraces, bordered by conifers that overgrow the gentle valley slopes. All these terraces comprise large numbers of archaeological monuments, covering all periods from the Iron Age to the Ethnographic period (Figure 6.46).

No monuments from the Bronze Age or Eneolithic were recorded, although it is possible that some of the undated monuments (Figure 6.48) should be assigned to these periods. The Scythian period is well represented, with 222 individual monuments. They are distributed over all flat areas and terraces in the valley, as can be seen in Figure 6.46. Other Iron Age monuments include a large site with Hunno-Sarmatian burials, located centrally in the research area. They are built just east of a large alignment of Scythian burial mounds. Monuments from the Turkic period are also closely related to the Iron Age sites, and are found between the older monuments in the same parts of the research areas (Figure 6.47).

The largest category of monuments in Bukhtarma is that of the Ethnographic graves: 529 burials of different types were recorded during the survey. Site KK-102 actually comprises no less than 400 individual graves (Figure 6.47). The Ethnographic sites show the same distribution as the other periods, although they are also located in areas that are without older structures, in particular the zone east and north of site KK-102.

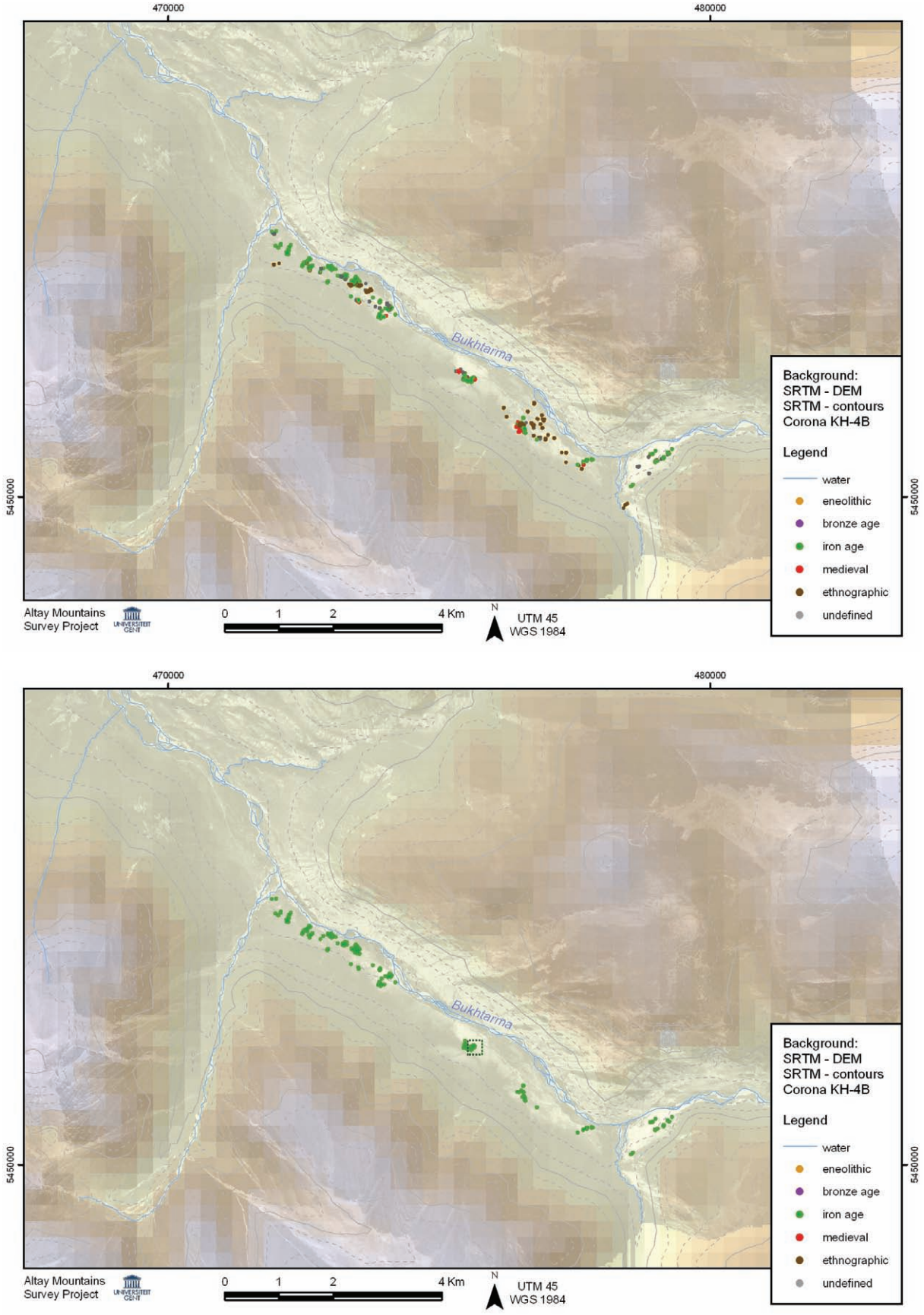


Figure 6.46: The distribution of monuments in the Bukhtarma research area (above), and the location of Iron Age structures in the same area (below: rectangle is the Hunno-Sarmatian site)

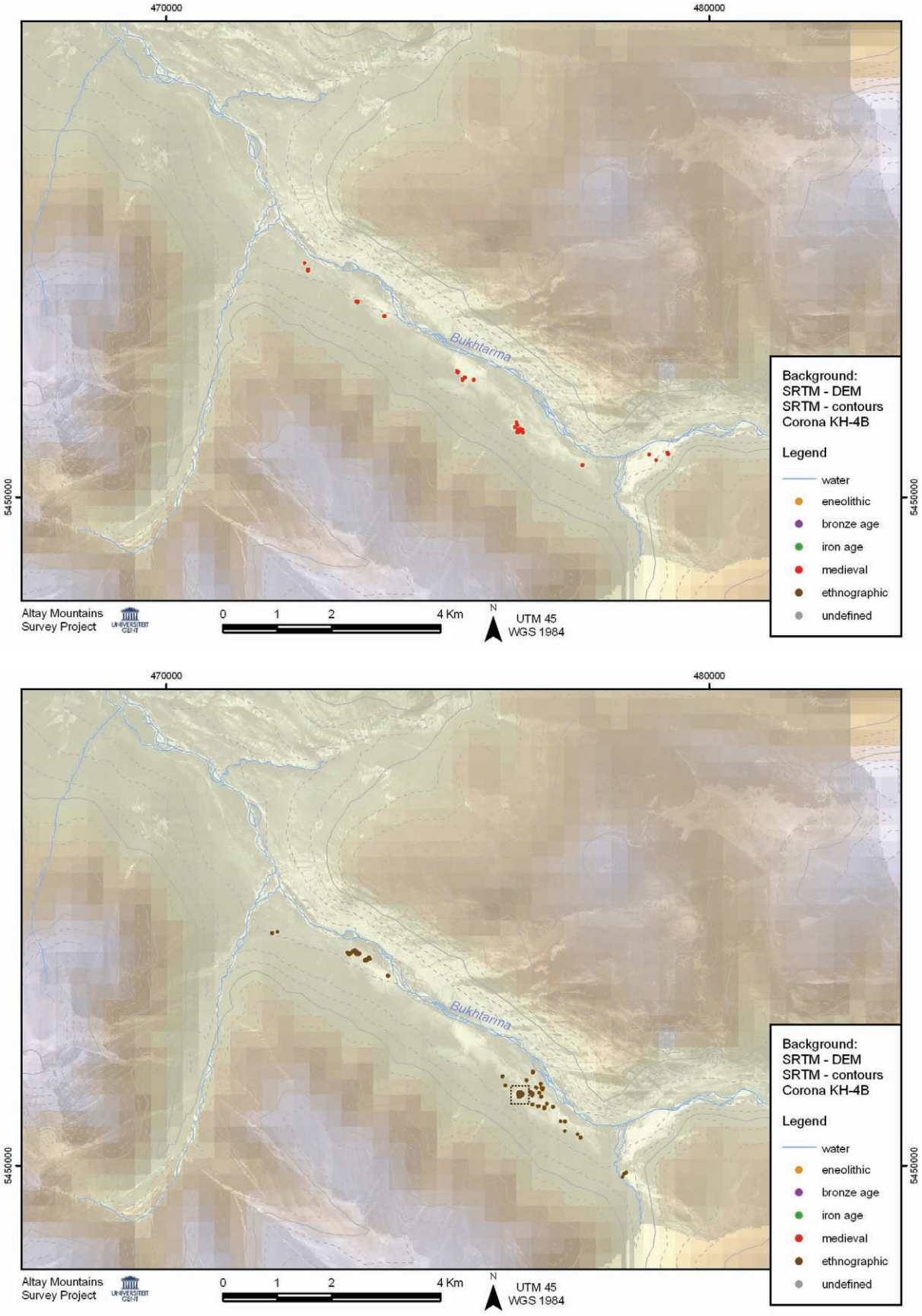


Figure 6.47: The distribution of Turkic or Medieval monuments (above) and Ethnographic graves (below) in the Bukhtarma research area (site KK-102 is indicated by a dotted rectangle)

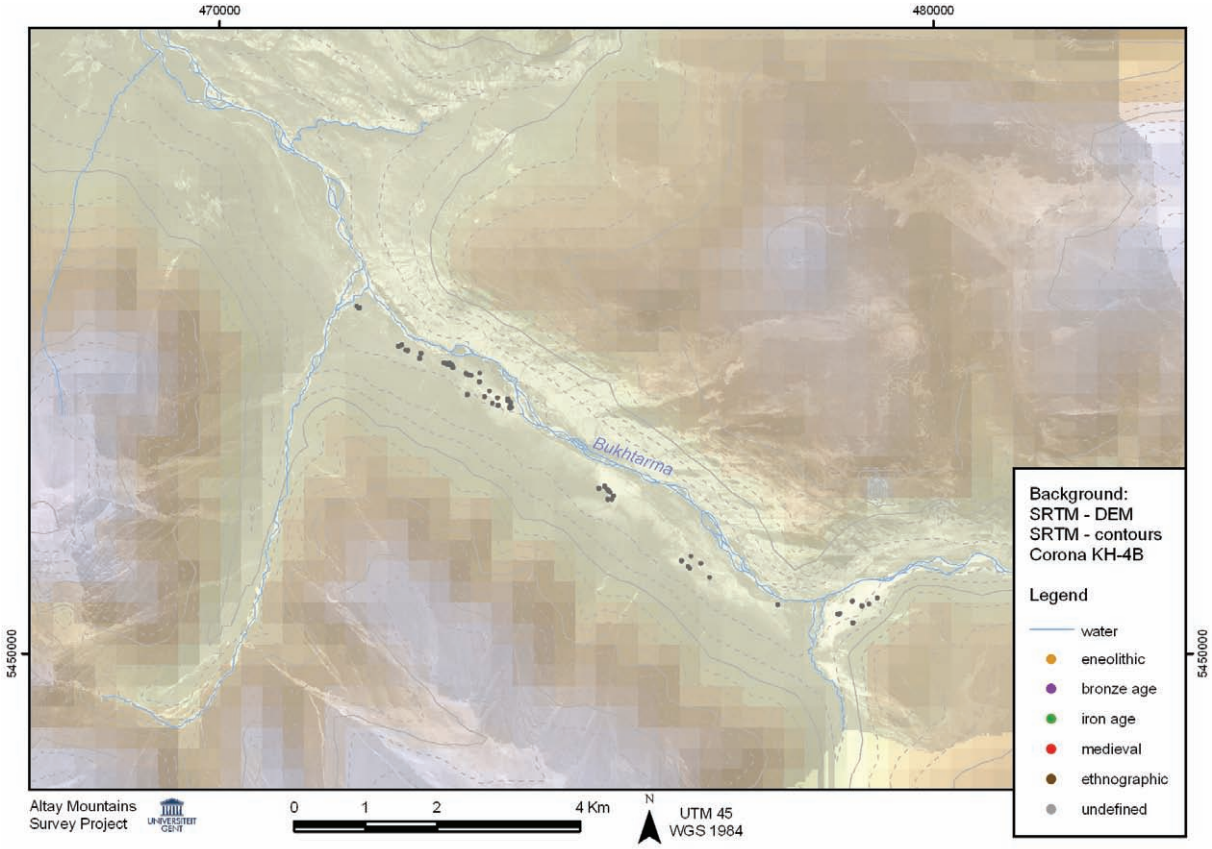


Figure 6.48: The location of monuments of unknown date in the Bukhtarma research area

6.4.6 Preliminary observations in the Karakol valley

As already mentioned, it is not possible yet to analyse the Karakol valley as the inventory is incomplete and the data gathered in July and August 2008 have yet to be processed. However, we note some patterns that we can already mention here. As regards the Early Iron Age burial places, there is an obvious difference with all other research areas. First, the burial mounds are of a different size (see 5.2.1.1), the larger category 2 burial mounds only being found in Berel and Karakol. These mounds are not found in the lower part of the valley, but seem to be clustered in the area just north and south of the central Uch-Enmek Mountain, considered to be sacred by the local population. Starting from Boochi village and going southwards, more and more of these large mounds dominate the landscape (Figure 6.49).

The layout of these burial places is also different from that in other research areas. Not only is the curved line of stone circles west of some of the category 2 burial mounds unique (see 5.2.1.3), but the different alignments of burial mounds appear to form a long, somewhat curved line of sites throughout the entire middle part of the valley.

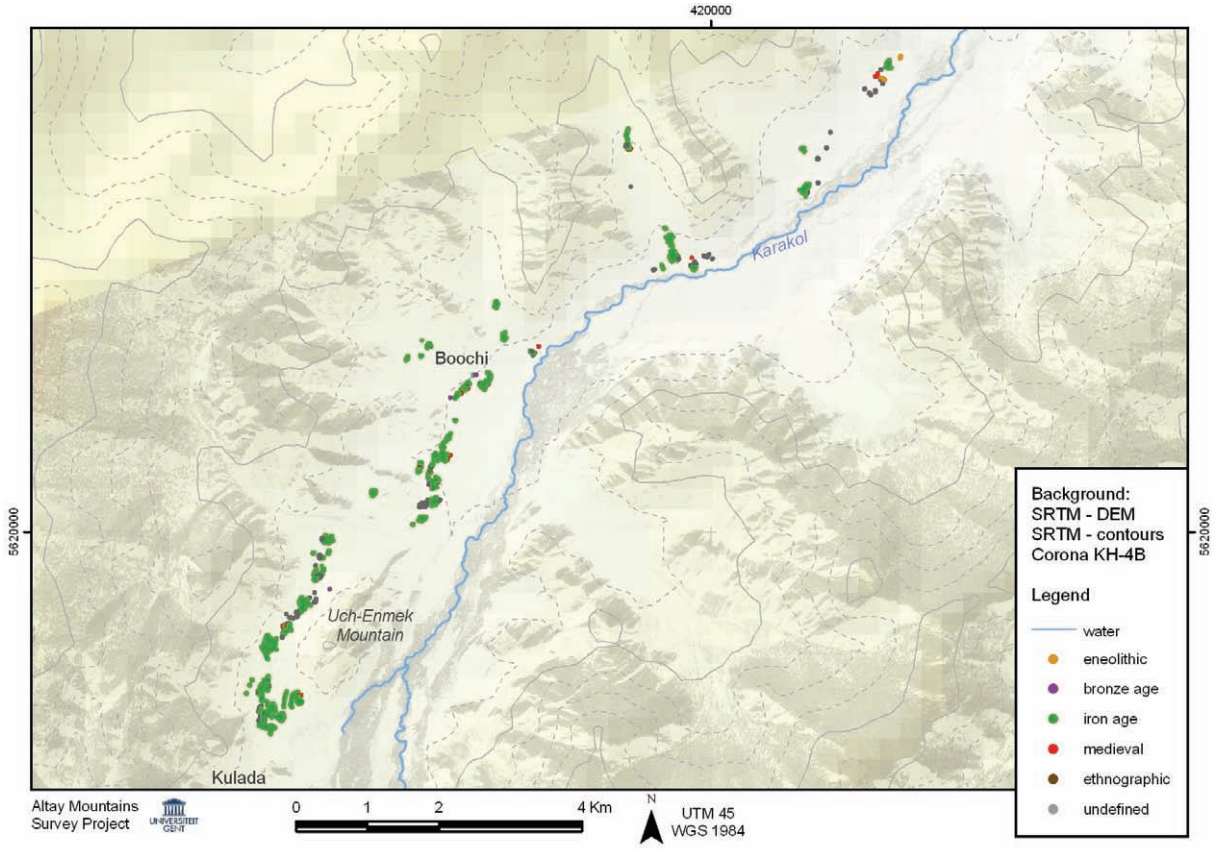


Figure 6.49: Preliminary overview map of the middle part of the Karakol valley: only sites recorded in 2007 are included

6.5 Some reflections on the location and interaction of individual monuments

6.5.1 The organisation of Scythian burial mounds

We have already discussed the fact that Scythian funerary sites have a strict layout, with an orientation roughly north-south. The morphographical context can change this general plan, for example if terraces are too narrow to construct long alignments in a north-south orientation (see 5.2.1.3).

However, if there is enough space to construct several large burial sites next to each other, we see a very regular system. All alignments are parallel, with an orientation that comes close to the average of 6.1° north (see 5.2.1). In Yustyd, six Scythian burial sites are located in the western part of the valley. The alignments are parallel, and are evenly distributed over a distance of about 3,300 metres. The distance between the different burial sites is very similar: about 655 m on average (Figure 6.50). All sites are located just at the border of the river terrace; the southern burial mound is constructed mainly on the edge of the terrace. This could mean that the lines were built from south to north, with the northern structure as the youngest monument (see also 5.2.4.1 and 6.5.3.1).

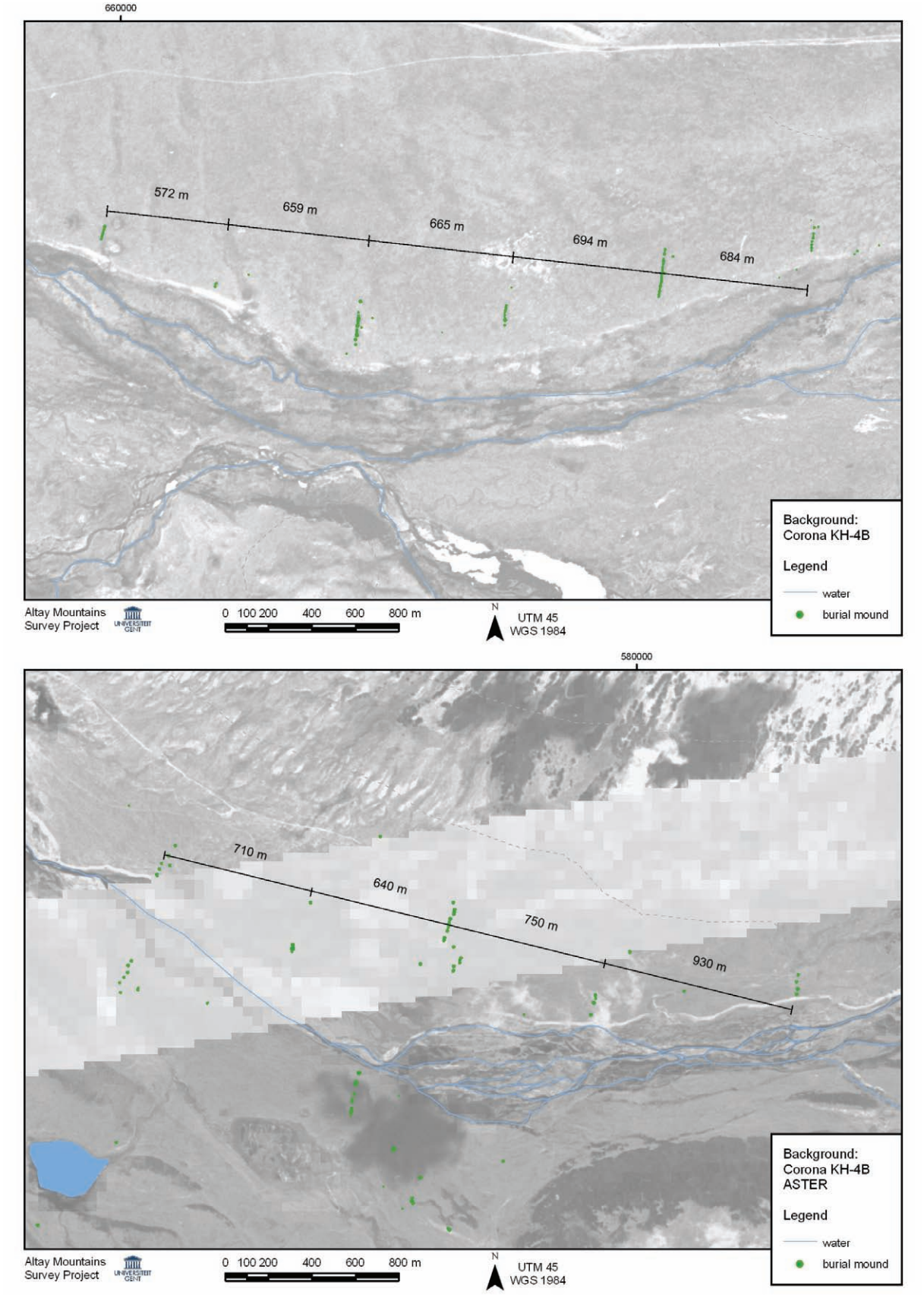


Figure 6.50: Alignments of Scythian burial mounds in Yustyd (above) and Dzhazator (below) are constructed at regular distances over the river terrace

The same can be seen in the Dzhazator valley (Figure 6.50). Five alignments of burial mounds are constructed on the right bank of the river, at the edge of the river terrace. Their orientation is roughly the same as the examples from Yustyd, and also the regular intervals are present here. The average distance between two sites is somewhat higher than in Yustyd: 758 m.

The significant and widespread regularity of these burial sites suggests the existence of a general plan for their construction. This implies the generational transmission of (ritual) knowledge over centuries, although recent dendrochronological research has provided evidence for the relative short lifespan of this type of monument in the Altay. A composite 486-year chronology was made using wood samples from tombs from the Pazyryk culture, representing the regional scale of Altay tree-ring width variability between about 720-240 BCE. This chronology dates the earliest construction of Pazyryk culture tombs to 320 BC and the latest ones to 240 BC (tomb 5 in Pazyryk) (Dergachev et al. 2000, Slusarenko et al. 2001, Kuzmin et al. 2004, Panyushkina et al. 2006).

6.5.2 Organisation of the Yustyd archaeological complex

An attempt to study the complex organisation of the *kereksur* and other Bronze Age and Early Iron Age monuments in Yustyd was undertaken by L.S. Marsadolov. He is convinced that the layout of the surface monuments follows geometrical patterns; by connecting *kereksur* and the large deer stone in the middle of the Yustyd valley (Kubarev's no. 6) he produces isosceles triangles, equilateral triangles, a parallelogram and other geometrical figures (some examples in Figure 6.51). The dimensions of these figures are expressed in the old distance unit sazhen[31], equalling 2.2 m, and Marsadolov observes that most of the lines are multiples of 100 or 200 of these sazhens, meaning about 220 or 440 m (Marsadolov 2002). By doing so, he is suggesting that the location of the monuments is carefully planned, using a system of fixed units.

Although it can be interesting to look for patterns in complex sites such as the Yustyd valley, it is important to be cautious. The monuments in Yustyd are so dense that it is easy to draw lines or geometrical figures between them. For the main part, these figures have no meaning whatsoever. Moreover, they reflect our way of thinking, and not what originally was intended by the peoples who constructed the monuments. In this specific case, we wonder why a distance unit of 2.2 m was used to explain the regularity and systematics of the geometrical patterns. Nevertheless, we decided to check the data with our site plans, wondering if indeed comparable patterns are clearly visible. Figure 6.52 shows Marsadolov's figures transposed on our maps. It illustrates the strange selection of monuments that were used as corner points of the figures.

[31] The *kosaya sazhen* – sazhen or sagene in English – is an old Russian distance unit that was in use until the Soviet Period when the government installed the metric system. Marsadolov equates it to 2.2 m, while dictionaries say it was made equal to 7 ft or 2.13 m. Originally, it was the distance between the left hand and right foot with stretched arms and legs.

Moreover, the actual dimensions are somewhat different from those stated in Figure 6.51: the figures do not appear to be parallelograms or isosceles triangles. The sides of 330 sazhen in the plan do not measure 726 m, but 756 m and 740 m, respectively; the sides of 200 sazhen are not 440 m, but 418 m, 443 m and 476 m, respectively.

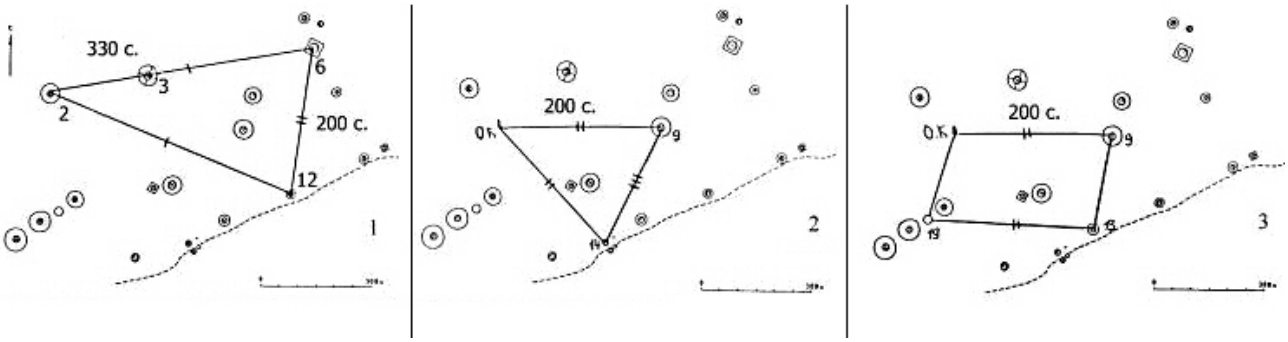


Figure 6.51: Part of the concentration of *kereksur* on the right bank of Yustyd, with three geometrical figures that connect round and square *kereksur* and deer stones: c = sazhen (distance unit), OK = deer stone (based on Marsadolov 2002: Figure 2)

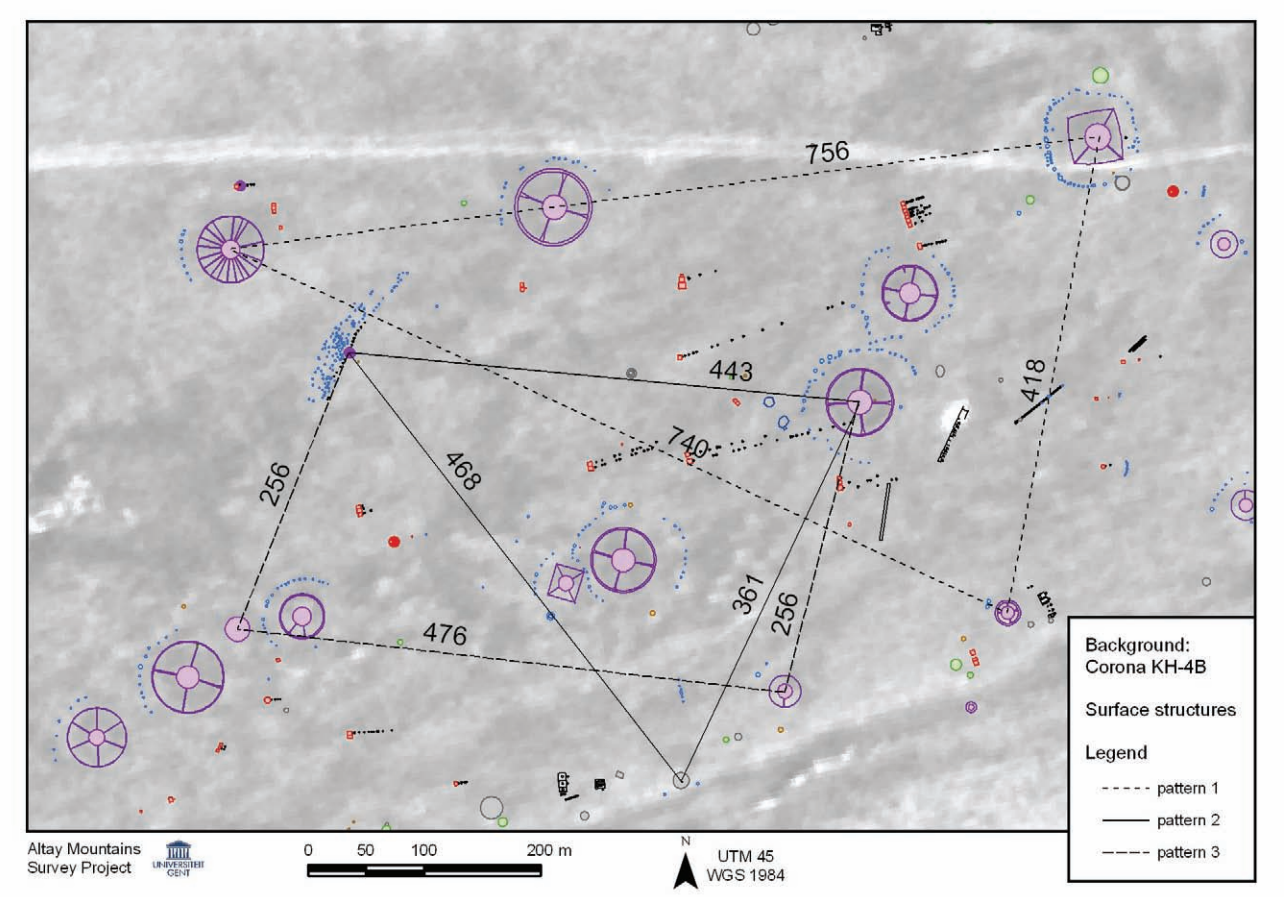


Figure 6.52: The geometrical figures and patterns as suggested by Marsadolov, transposed on our maps of the Yustyd valley: distances in metres

6.5.3 Interaction between monuments of different date

In the past, people have always been confronted by the surviving remains of antiquity. Many indications were found to suggest that sites were reused or continued during later periods, and the existing layout of the monuments was respected. At other sites, for example those with Turkic image stones, we see that monuments have been damaged or even destroyed. Most of the locations are multi-period sites, showing a palimpsest of structures of different ages that have accumulated.

The presence of older monuments seems to have attracted the construction of new funerary or ritual monuments. Or it may be that the reasons why specific locations were chosen by earlier populations remain valid (Bradley 2002: 112-113). However, the identification of these factors is very difficult.

The paragraphs below highlight some clear examples of interaction.

6.5.3.1 *Kereksur* and Early Iron Age burial mounds

The typical locations for *kereksur* are very different from those typical of Early Iron Age burial mounds. *Kereksur* are rarely found in enclosed valleys, even if the terraces are vast, and burial mounds are mainly absent in open steppe areas, such as the Chuya steppe. However, in areas where *kereksur* and Early Iron Age burial mounds are found together – large terraces with an open character that form a transition zone between valley and intermontane steppe, such as Yustyd – many sites show a very clear link between the Bronze Age *kereksur* and the alignments of burial mounds. At several locations, a large *kereksur* is the basis of a south-north alignment of mounds. This *kereksur* is always the most southern structure of the row, which points to the fact that Scythian burial mounds were built from south to north, as already suggested above (see also 5.2.4.1 and 6.5.1). A good example is the *kereksur* at site KA-233 (Kubarev's site Yustyd-XII, see Figure 5.5 on page 177). Other sites are KA-372 (with some collared burial mounds, see Figure 5.20 on page 191), site KA-191 and site KA-745 (see site plans on the accompanying DVD 2 and Figure 6.53).

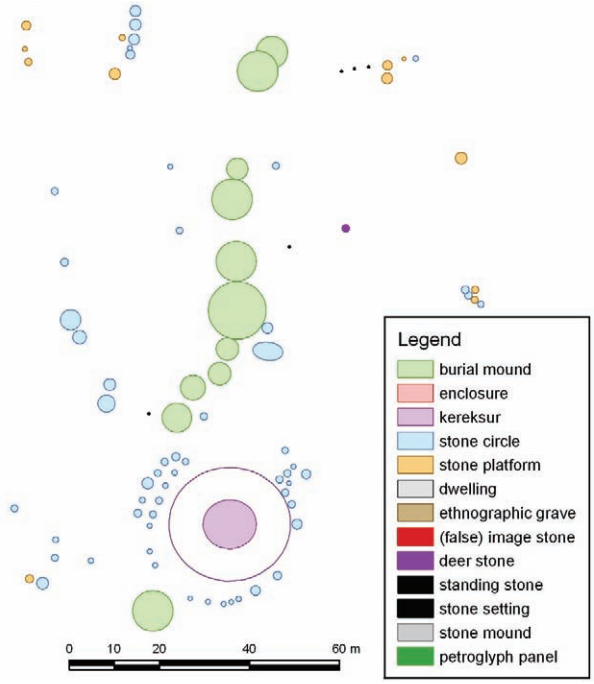


Figure 6.53: Yustyd, site KA-745: a *kereksur* forms the southernmost structure of an alignment of Early Iron Age burial mounds

6.5.3.2 The attraction of Early Iron Age sites for later structures

The Iron Age sites, in turn, continue to be important places in later periods. This can be seen in the location of Turkic enclosures which tend to be constructed close to alignments of Scythian burial mounds. In the Sebystey valley, in particular, there are some clear examples of this layout in which the Turkic enclosures are systematically placed in a roughly parallel north-south alignment east of the mounds (see, among others, site KA-071, 081 and 082 on DVD 2). This pattern was not so clear in other valleys; however, even though the enclosures are mainly constructed in the direct surroundings of Scythian burial sites (Figure 6.54: nos. 1-2-4).

Ethnographic burials are also usually found in association with Early Iron Age sites. In the Dzhazator valley, four graveyards are built just next to Scythian burial mounds, mainly to the west of them (Figure 6.54: no. 1-2). Both the largest and the second largest Ethnographic burial grounds in the Bukhtarma valley are associated with an Iron Age site. The graves of site KA-054 are built in a more or less rectangular zone between larger burial mounds, and also the large KA-084 site is situated in the middle of a Scythian burial site (Figure 6.54: no. 3-4).

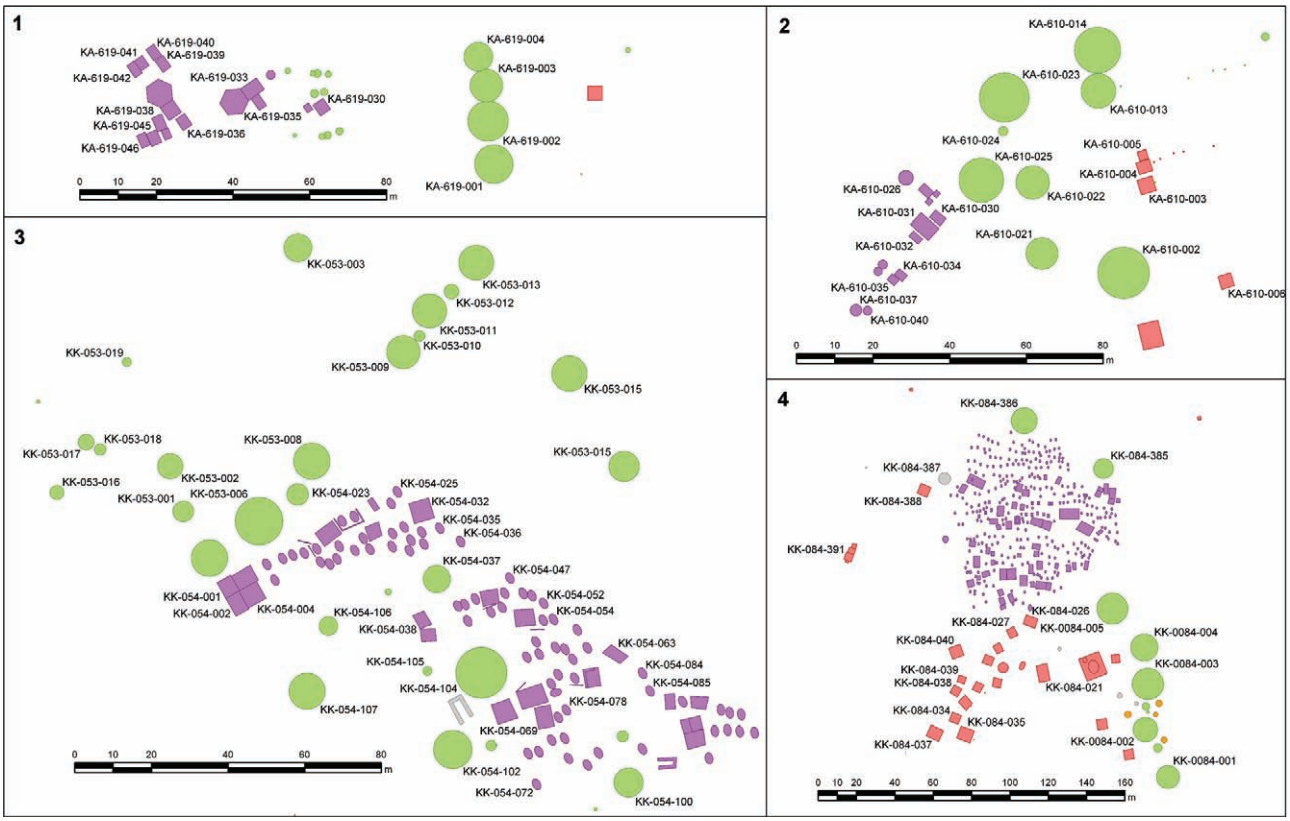


Figure 6.54: Some examples of Ethnographic burial grounds (purple) associated with Iron Age burial mounds (green): 1-2, site KA-619 and KA-610 in Dzhazator; 3-4, site KK-054 and KA-084 in Bukhtarma: Turkic enclosures are in red

6.5.3.3 Turkic or Bronze Age mounds in line with Early Iron Age sites

A strange feature was noticed in the Ozyok valley. Three parallel alignments of Early Iron Age burial mounds are located here on a terrace on the left bank of the river. In line with every burial site and north of them, just on top of the first hills or moraines in the Irbistu valley, is a single mound. The systematic layout is striking, and is certainly not coincidental. During the survey, we dated the mounds to the Turkic period, although they may be Bronze Age, too. The link with the Iron Age sites questions these interpretations. The mounds seem to have been placed after or at the same time as the burial sites, which would mean that they are Iron Age mounds or younger.

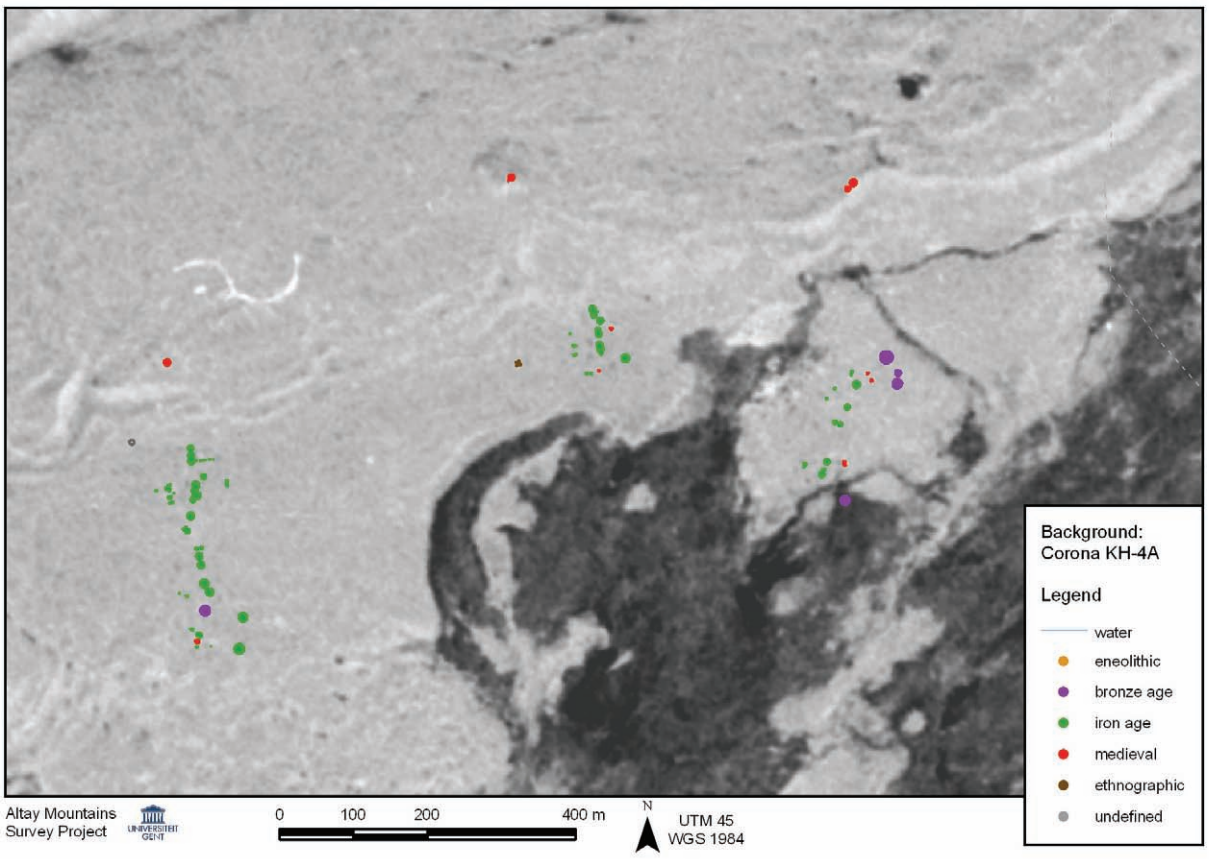


Figure 6.55: Ozyok valley: Scythian burial sites with Turkic (medieval) or possible Bronze Age mounds to the north of them, just on top of the first hills or moraines in the Irbistu valley

6.5.4 Orientation and preoccupation with the cardinal directions

The surface structures from Bronze Age, Iron Age and Turkic period in the research areas in Altay reflect a keen awareness of directionality. Most structures are roughly oriented to the cardinal directions, be it north-south or east-west, and show a striking consistency. The rays of round *kereksur* are roughly oriented to the four quarters, as are the sides of the square examples. Deer stones mainly face east, although we should be cautious because many had been reused so measuring the exact direction was not possible. Alignments of burial mounds show a rather strict orientation to the north and south, as do the Turkic enclosures. Lines of *balbal*, both in Iron Age and Turkic complexes, run towards the east, and all image stones and false image stones also face east. At the very least, such consistency suggests an orientation toward a feature or event in the sky rather than to a certain element in the landscape (pass, mountain peak, etc.).

Looking at the average orientation of the structures, it is interesting to see that those from the Bronze and Iron Age have a similar and consistent positive (clockwise) declination (Figure 6.56). The rays of round *kereksur* are respectively 5.6°, 6.5°, 5.3° and 9.3° away from the quarters. The north-south sides of square *kereksur* show a declination of 10.8° in the same clockwise direction. Alignments of burial mounds have a 6.1° declination, while the rows of *balbal* associated with the mounds are 4.2° off from the east. It would be interesting to try to link this consistent declination with a specific feature in the sky. As the position of stars and

celestial bodies in the sky is changing over time, that question should be the subject of some future archaeoastronomical research. Strangely, the average orientation of Turkic monuments does not show the same declination. While the orientation of the enclosures themselves cannot be measured in enough detail, the average orientation of the line of *balbal* is almost perfectly eastwards: only 0.4° of declination from the east (counter-clockwise). They could mean that the Turkic populations used another point of orientation than was the case in earlier periods.

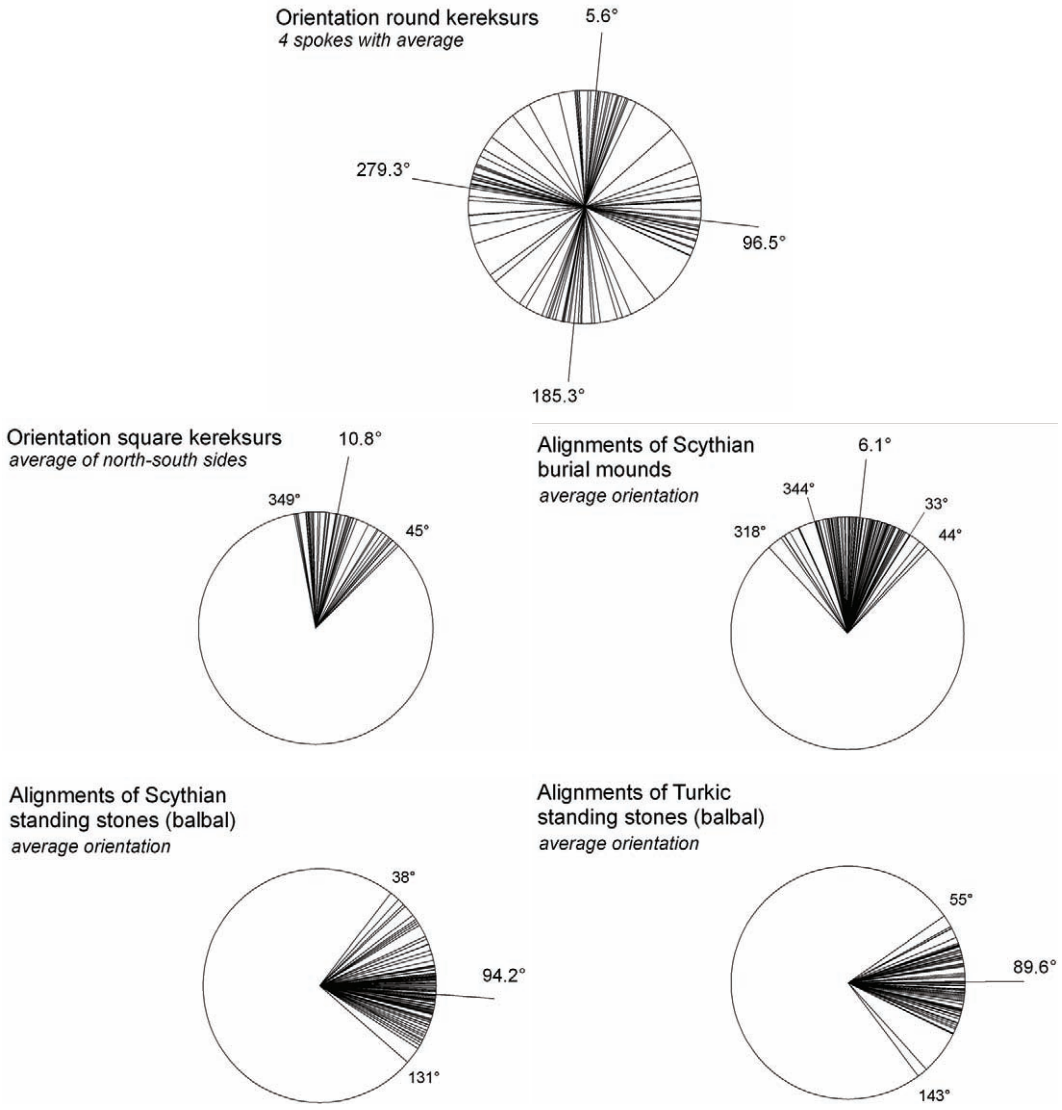


Figure 6.56: The average orientation of some of the monument types in our database (see different paragraphs in Chapter 5)

It is dangerous to suggest features that were used as points of orientation. The present-day situation is not the same as it was in ancient times, as the celestial bodies have a slightly different position (the pole star, the equinoxes, etc.). Also, we look at the organisation of the structures using the geographical north as a reference (GPS, maps, etc.), as that is our way of thinking. Was this the same in the past? Written sources about the Turkic Empire, for example, tell us that they used a system of orientation facing east, although that is atypical for Turkic peoples in general (Sinor & Klyashtorny 1996: 330). It is thus most likely that the orientation of the *balbal* is the main direction.

6.6 Conclusions

Using the information from the survey campaigns and the geographical products resulting from the photogrammetrical processing of the satellite images, we analysed the research areas on both a large and a small scale. First, we studied the distribution of monument types from various periods over the different research areas – their presence or absence in some of the research areas is significant. A comparison with the different natural landscapes of the research areas shows that there is a link between the natural environment and the distribution of some monument types (for example, the distribution of *kereksur* monuments). It is possible that the distribution patterns identify the extent of different cultural spheres.

Within the different research areas, we then analysed the specific location, organisation and orientation of the various monuments types, and studied their interactions with other monuments. The regular layout of most of the sites and monuments (also discussed in Chapter 5) is certainly interesting, and points to well-known traditions that survived over several centuries.

This study clearly shows the possibilities the data provide to study the archaeological landscape in detail. We are well aware that not all of these possibilities have been fully exploited in this thesis. As we plan to continue working on the study of the archaeological landscape, in particular statistical analysis and spatial analysis with GIS techniques should be implemented in any future research. In addition, it would be interesting to incorporate more information from the excavation reports and material studies, to investigate the social differentiation of burial places, the chronology of the monuments (burial mounds constructed from south to north?) and possible links between the individuals buried in one burial place (family, members of the same social level, etc.).

7 Protection and preservation

7.1 Threats to archaeological heritage

Although the archaeological heritage of the Altay Mountains is extremely rich and, for the most part, very well preserved, there are certain elements that form a direct threat to its preservation. This chapter explores the factors that are endangering the existence of this unique cultural landscape. We are convinced that our survey work can help to protect it from some of the menacing elements, be they natural man-made. The inventory is useful for heritage management, especially as all monuments have been mapped in detail.

7.1.1 Natural threats

Most parts of the Altay Mountains are considered to be 'landscapes of survival', meaning that, for the main part, the present-day surface is identical to the ancient surface. The archaeological structures are uncommonly well preserved in their original setting, thanks to the specific geographical context with little sedimentation and erosion. Even smaller monuments, comprising no more than a few stones, are still visible today. However, there are some small-scale events that can change the landscape locally, thereby damaging the surface structures. Geomorphological processes can result in either the wholesale disturbance of archaeological sites or their loss as a result of burial beneath a blanket of sediment or debris.

7.1.1.1 Erosion of till terraces

In most of the research areas, the river systems have a very active seasonal regime. The actual flood plain of the rivers is evolving yearly, and the moving riverbeds cause heavy erosion of the river terraces. Archaeological sites, in particular Iron Age burial mounds, tend to be constructed on the edge of these terraces, and in several places the sites are gradually destroyed by collapsing terrace borders. First examples of this destruction were found along the Irbistu River (Figure 7.1), especially in the Dzhazator valley, where we saw many places where mounds have been partly washed away by the river (Figure 7.2). All these sites are identified in the database. Although it is not possible to save them, it would be interesting to investigate the monuments before they are lost forever.



Figure 7.1: A burial mound on the right bank of the Irbistu River is being destroyed gradually by the erosion of the terrace borders: site KA-119



Figure 7.2: Dzhazator valley: two burial mounds that have been partly destroyed by the erosion of the terrace borders: structure KA-583-004 and structure KA-670-001

7.1.1.2 Erosion of the foot slopes

Another example of erosion is the accumulation of debris along the foothills. It is quite possible that archaeological structures have been covered by these deposits, although it is difficult to investigate this, and we have never recorded monuments that were partly buried. On the mountain slopes, gully incisions act like a drainage system. These intermittent rills and gullies become activated when there is sufficient rain or melt-water input. Fan-shaped deposits arise where the relief becomes gentler at the level of the foothill.

A second form of soil movement is the rock glacier. Many such glaciers can be found against the slopes of, among others, the Dzhazator, Elangash and Irbistu valleys. Some of them are still active, moving up by some decimetres every year, while others remain inactive, possibly since the small Ice Age (1650-1850 CE). However, catastrophic events, such as the earthquake of 27 September 2003, can cause major changes in the rock glaciers and even large landslides (Fukui et al. 2007: 132).



Figure 7.3: Small mammals, such as the *collared pika* or the *suslik,* cause severe damage to archaeological structures

7.1.1.3 Bioturbation by small mammals

In most areas, but in particular in the valleys bordering the Chuya depression, the archaeological structures are suffering severely from burrowing by small mammals. In particular, the hamster *collared pika* and the squirrel-like *suslik* are causing major damage to the monuments, especially where they have underground colonies. They prefer to build their nests and galleries underneath surface stones, making archaeological monuments the ideal habitat. The stones forming the monument become more and more undermined by the numerous animal galleries and finally fall over or start to sink into the ground.

7.1.1.4 Vegetation covering the monuments

Very often, vegetation grows on top of or just next to an archaeological structure. Scrubs cover the monument, and even trees grow on top of the stone mounds. In Bukhtarma, Dzhazator and Karakol, burial mounds with trees on top are abundant, even if there are no trees on the rest of the terrace (this could be caused partly by the annual reaping of grasses, as we have seen in Karakol and Karakaba, giving the trees no chance to grow bigger). The coarse debris of which the

monuments consist covers small and young plants, protecting them from the strong wind and giving them a chance to survive. In winter, the stone cover protects plant roots against severe frost.

The concentrated bioturbation by small mammals in the neighbourhood of archaeological structures can be another reason for the denser and more diverse vegetation on the archaeological sites. The galleries make the soils rich in organic matter, especially where they are filled with animal excrement. The higher fertility, with different concentrations of nitrogen and phosphor, probably cause other vegetation to grow in these locations. In the field, we repeatedly observed a 'crown' around stone mounds, consisting of grasses, scrubs and flowers that were not present elsewhere in the surroundings.

Vegetation can harm the monuments, as roots are strong enough to move stones and destroy part of the structure. In addition, the plant cover and resulting soil formation (humus) can make the monuments invisible. Clearing the sites of vegetation is, however, not always a good idea as the shade created by large trees on top of or next to burial mounds can protect them from too much sunshine, and keep them cool in summer – this effect is especially important in relation to tombs that are frozen, and to the next major threat: climate change.

7.1.1.5 Climate change

The problem climate change poses to the preservation of the frozen tombs in Altay has already been discussed thoroughly in 1.3.3. Warming is now occurring across most of the globe and is consistent with the global retreat of mountain glaciers, reduction in the extent of snow cover, the earlier spring melting of ice on rivers and lakes, and increases in sea-surface temperatures and ocean heat content (NASA 2005, NOAA NCDC 2005). Climatic changes have been reported recently from many regions of Central Asia. Air temperature in the Altay Mountains has increased at a higher rate than the global mean during the 20th century (McCarthy et al. 2001). Further degradation of glaciers is most likely and significant reduction in or disappearance of the permafrost is predicted for the middle of this century in the Altay Mountains. The most significant impacts will be observed near the lower boundary of alpine permafrost where the frozen grounds are very sensitive to climate change. Many frozen tombs in Altay are situated within this area of sporadic and discontinuous permafrost, and are therefore extremely vulnerable (Marchenko 1999, Marchenko 2008).

7.1.2 Human threats

7.1.2.1 Robbery and excavation of archaeological sites

Burial mounds in particular are often victims of robbery. Since ancient times, people have known about the attractive artefacts that can be found inside them, often made of precious metal, and many of the tombs have been destroyed for that very reason.



Figure 7.4: Examples of excavated burial mounds in the Yustyd valley. Reconstructing the mounds after excavation takes a lot of work but would minimise the impact of archaeological research on the landscape

However, it is not only these acts of theft which have changed the perspective of many burial sites in Altay; professional excavations are also responsible. Literally hundreds of burial mounds have been excavated, and only an extremely small percentage of these have been reconstructed after excavation. This is sad as the once impressive alignments of regularly built stone mounds, clear marks in the landscape and visible from far away, are now dismal rows of pits; the stones randomly thrown into the surrounding area.

Refilling the burial pit and reconstructing the stone mound takes a lot of work, but would ensure that any excavations would make a much smaller impact on the archaeological landscape.

7.1.2.2 Tourism

A less visible threat is undoubtedly the expansion of tourism in the area of the Altay Mountains. More and more tourists from all over the world are visiting this part of Asia, especially the Russian Altay. The nature and culture of Altay is very popular and attracts increasing numbers of visitors. Mountain hiking, skiing, rafting, camping and even hunting are all very popular. Thousands of tourists visit annually, and the area affected by tourist camps continue to expand, moving deeper and deeper into the hitherto untouched high mountainous area.

It is obvious that the growth in tourism offers many interesting financial opportunities, and that the region is profiting greatly from such possibilities. However, the presence of so many tourists constitutes a danger to the preservation of the archaeological heritage, mainly due to a lack of information. Often, people have no idea about the importance of the structures they are seeing. Campfires are made against rocky outcrops with petroglyphs, stones from surface structures are being replaced, etc.

In addition, there is a large international black market for rock art, while petroglyph sites in Altay are also endangered. Tourists can buy a boulder with a 2,000 year-old carving at a roadside stand, or try to break slates with engravings from the rocky outcrops themselves. The example

below is taken from a website, as we have never seen such a clear example of recent destruction before[1]. The photo was taken at the Chuy Ozy Nature Park, situated at the confluence of the Chuya and the Katun. The park was formed to protect natural heritage there, as well as the rock art and other cultural heritage, and includes the famous Kalbak-Tash petroglyph site. A person was trying to steal the image of an Argali mountain sheep, but a bad hammer stroke broke off one of the animal's horns. Having ruined the image, the thief gave up and walked away.



Figure 7.5: A petroglyph panel in the Chuy Ozy Nature Park, badly damaged by an attempt to steal it from the rocky outcrop[2]

7.1.2.3 Town expansion, road construction, infrastructure works

The area is also confronted with the threat of industrial expansion. The project to build a pipeline from Siberia to China through the Ukok plateau, as announced by former President V.V. Putin of Russia in March 2006, is probably the most obvious threat of this kind.

[1] Source: http://www.sacredland.org/weblog/category/3 "Stealing Chui Oozy", posted on June 18, 2007.

[2] Ibidem

7.2 Use of the resulting database for the protection of the Altay heritage

The archaeological database Altari and the detailed archaeological maps of our research areas in Altay can be used for the responsible management of the archaeological heritage. The data are therefore available to all local authorities that could use them.

The problem of growing tourism cannot be solved by limiting the number of tourists – even if that was possible, it would be an economical disaster for the region. However, it is certainly possible to work in the direction of guided tourism. By opening some sites to tourists and giving them detailed information about the cultural heritage in Altay, it should be possible to protect the sites that are not on the busy, scenic routes through the mountains. Our maps and information can help local authorities to work out programmes in that direction. Some of the more special sites should be closed to visitors, for example by setting up archaeological parks. Sites such as the Yustyd valley, or the petroglyph sites of Elangash, would be well suited to this.

Some steps have been taken in this direction, such as the above-mentioned Uch-Enmek Park in Karakol. Many tourists visit the park guided by Park Director D. Mamyev or one of the park staff. Everybody profits from such an arrangement: visitors get more information, and the monuments and petroglyphs are better protected.

Most parks in Altay, however, are installed purely and simply for the protection of natural heritage. Examples are the above-mentioned Chuy-Uzy park, and the Ukok plateau. Part of the Russian Altay Mountains is already listed in UNESCO's Natural World Heritage as 'The Golden Mountains of Altay', briefly mentioning the archaeological monuments in the area[3]. It is necessary to incorporate the cultural heritage in these parks, as natural and cultural landscapes in Altay are so closely linked. The discussion has started about developing a transboundary reserve, including the natural and cultural heritage of the Altay Mountains in the four countries involved, the so-called 'Altay Mountain Knot' (Badenkov 2007). The preservation of the frozen tombs, preserved in the frozen ground, is linked to these initiatives.

[3] See: http://whc.unesco.org/en/list/768 for a description of The Golden Mountains of Altay.

8 Conclusions and future perspectives

8.1 Conclusions

This thesis had three principal objectives. The first was to develop a methodology for the detailed mapping of the research areas in the Altay Mountains, by assessing the potential of CORONA satellite imagery as a mapping technique, and developing a means of efficient and accurate archaeological survey. The second was to build up a clear and comprehensive typology of the archaeological monuments that were recorded during surveys in the selected research areas. The third objective was to study the archaeological landscape of the Altay Mountains, using the resulting archaeological database and the geographical products resulting from the digital photogrammetrical process.

To fulfil the first objective of mapping and survey, we developed a usable and efficient methodology for gathering GCPs in the research areas as accurately as possible, by testing different devices and selecting the most suitable solution. These GCPs are needed for the production of reliable maps and digital surface models (DSMs) based on CORONA satellite imagery. The CORONA archive is a valuable source of information, available at little cost – especially when compared to the price of other high-resolution imagery. The stereoscopic coverage is very useful, enabling us to map an unknown landscape with far less effort than required by conventional topographic mapping. Moreover, the images are a historical source of over 40 years old and reflect a landscape that has changed considerably in the last decades.

However, working with historical imagery has some disadvantages. The available images have to be used even if they are clouded, have little contrast, or do not have an ideal ground resolution, and there is no possibility of ordering new images of uncovered areas. Furthermore, it is sometimes difficult or even impossible to generate models that cover the entire research area, with gaps of up to several kilometres between successive stereo models. Finally, yet importantly, the age of the images makes it difficult to find the necessary GCPs for the restitution process, especially in areas where evolution of the human landscape has been very active – for example, roads have been moved or are newly constructed, many buildings have changed, and bridges have been rebuilt for heavy traffic. Nevertheless, the methodology developed enabled us to produce cartographic documents for all of our research areas, as a background for the archaeological information, and as a tool for further analysis of the archaeological landscape.

We developed an efficient means of archaeological survey, including the accurate positioning of all individual archaeological structures at decimetre level. The introduction of the hand-held GPS receiver Leica SR-20 enabled us to work very efficiently, resulting in a detailed geo-referenced site plan that can be linked immediately to the geographical products in a GIS. The database is a very simple one but contains all the necessary information. Visual surface detection or field walking ensures that we have documented all visible archaeological structures in the

research area. Although it is very difficult to asses the number of structures missed, we are convinced that these are very few, and that the recorded inventory is certainly representative.

Six archaeological survey campaigns were organised to implement and test these techniques in selected research areas in the Altay Mountains. This approach enabled us to refine the methodology where necessary. More importantly, the six years of survey yielded a voluminous database with information about 12,047 archaeological structures, spread over ten valleys or 15 smaller research areas. We recorded about 1,000 locations with monuments – although it should be kept in mind that these 'sites' do not represent the archaeological reality (see 3.3.4). Looking at the chronological distribution of the monuments, three major classes can be seen. Most of the structures – 4,406 to be precise – date tentatively from the Early Iron Age or Scythian period (37%). Another 3,073 structures have been assigned to the Turkic period (25%), and 1,896 monuments were probably constructed in the Bronze Age (16%). About 6% of the monuments are Ethnographic graves – most of these 701 graves were located in Bukhtarma, with one site alone comprising 400 structures. Finally, 213 structures were dated to the Hunno-Sarmatian period, 47 to the Eneolithic, and ten to the Iron Age, without giving a cultural attribution. As is typical for visual surface inspection or field survey, many monuments could not be given a tentative date; so about 14% or 1,701 structures remain undefined. However, working out a detailed typology can help to determine the age of the monuments (see Chapter 5), and relative chronology and associations between different structures can help with this.

To fulfil the second objective on the typology of the archaeological heritage in Altay, we reviewed the literature for the general use of monument types and identified some of the problems in naming, be they language-related or based on problems of interpretation. Although we included Russian works in this study, it is important to mention that our knowledge of Russian literature is still not sufficiently exhaustive – we do not pretend to have reviewed all those studies that discuss typological aspects.

The diversity of monument types in the Altay is enormous. The surface structures date from many different periods, have several different functions and have witnessed a complex evolution. Structures range from a single standing stone to very elaborate *kereksur*. Most of the monument types show subtle variations (among others, the dwellings, *kereksur* and Iron Age burial grounds) within quite regular, widespread and therefore commonly known layouts. These differences could point to locally bound preferences, family traditions or even personal tastes. Several structures clearly have a burial function. However, even monuments without a grave may very well have acted as a funerary monument. Examples are the Turkic enclosures or memorial structures, and possibly the dwellings that provide the dead with a 'virtual home'. It seems likely that all monuments had some kind of ritual function, be it in a funerary context, a ceremonial context or a religious one. We also see that many of the monuments may have acted as altars, or are associated with altars. The small stone circles associated with *kereksur*, burial mounds, Turkic enclosures and steles or deer stones are most probably remnants of fire altars, as are the stone platforms or small stone pavements found with burial mounds and (in Mongolia) next to dwellings.

From fieldwork in Altay and communications with Russian, Kazakh and Western archaeologists it became clear that we would have to discuss the terminology for the monuments thoroughly. This discussion began during the UNESCO project workshops in March and December 2006 (see 1.4.3.6). Afterwards, it was further developed by conversations with Igor Slyusarenko (IAE SBRAS), Esther Jacobson-Tepfer (University of Oregon) and Eduard Dvornikov (GASU). We are much obliged to them for their valuable contributions. This input from both local archaeologists in Altay, from the Russian Academy of Science and from international research teams is the best way to compile a comprehensive typology.

Combining the observations from the archaeological literature, our own information gathered during the survey campaigns, and the results of the above-mentioned discussions, we developed a typology that is as efficient and correct as possible. The surface structures in the Altay Mountains can be divided into the following types: mounds, *kereksur*, enclosures, stone settings (geometric forms and stone lines), so-called 'dwellings', standing stones, stone circles, stone pavements, petroglyph sites and graves from the Ethnographic period. Most of these main categories have different subcategories to define the monuments more precisely. Modern graveyards, *ovoo* or recent ritual structures, such as Burkhanist or Buddhist altars are not included in the typology.

We certainly hope that this overview will contribute to a general understanding and generalised use of monument types in the Altay. However, we do not pretend that the typology presented here is final – it is open to discussion and we look forward to completing or improving it with input from colleagues. We also have to take into account the problems of interpretation in visual surface surveys. The determination of the monuments is based solely on morphological characteristics of visible surface structures, as excavations were not possible during the survey. This is especially important at the level of the chronological attribution.

The last principal objective was the study of the archaeological landscape. The landscape of the Altay Mountains shows considerable potential for the reconstruction of the ancient cultural landscape back to the second millennium BCE at least. The vast steppes and river terraces provide classic examples of landscapes of survival; subsequent settlement has been minimal, even in recent history, and burial mounds, ritual monuments and other surface structures are preserved virtually intact. Using the information from the survey campaigns and the geographical products resulting from the photogrammetrical processing of the satellite images, we analysed the research areas on both a large and a small scale. First, we studied the distribution of monument types from various periods over the different research areas – their presence or absence in some of the research areas is significant and can be related to the natural environment and different natural landscapes in the research areas, or possibly to the extent of different cultural spheres (for example, the distribution of *kereksur* monuments).

Within the different research areas, we then analysed the specific location, organisation and orientation of the different monuments types, and studied their interactions with other monuments. The regular layout of most of the sites and monuments (also discussed in Chapter

5) is certainly interesting, and points to well-known traditions that survived over several centuries.

Sadly, the 'why' question frequently remains unanswered, which makes it difficult to ascertain a real history of the archaeological cultures in Altay. Why did the Scythian population use a north-south orientation for their burial places? Why are Turkic standing stones placed in rows oriented to the east? Why is the layout of a *kereksur* so complex, with fence, rays and satellite structures? What is the actual meaning of these observations?

Although this study clearly shows the possibilities the data provide us to study the archaeological landscape in detail, we are well aware that not all of these possibilities have been fully exploited in this thesis. Much research still can and must be done. As we plan to continue working on the study of the archaeological landscape, in particular statistical analysis and spatial analysis with GIS techniques should be implemented. In addition, it would be interesting to incorporate more information from excavation reports and artefact studies, to investigate the social differentiation of burial places, the chronology of the monuments (burial mounds constructed from south to north?) and possible links between the individuals buried in one burial place (family, members of the same social level, etc.).

8.2 Future perspectives

The work presented here certainly has to be continued, and at several levels. First, we would like to study the landscape in more depth, using advanced GIS techniques. In this respect, it is favourable that the National Fund for Scientific Research (Belgium) has approved a new research project on the archaeological landscape of the Altay Mountains, for 2009-2012 (FWO no. 3G004209).

The main goal of this new project is the study of the mental structures of the landscapes as conceived and perceived by the nomadic populations in Altay, by focusing on their funeral and ritual monuments. This 'ritual landscape' is only a part of the actual archaeological landscape, which also includes settlement ecology (settlement patterns, land use, cultural evolution and change) (Anschuetz et al. 2001). As we have seen in the previous chapters of this current study, settlements of nomadic populations are archaeologically very difficult, if not impossible, to locate while funeral and ritual monuments are well preserved. In addition, the natural landscape will be analysed. By means of sets of topographic and morphographic maps, as designed with the methodology described in this thesis, combined with GIS techniques, it is possible to define and identify what landscape elements were important to the ancient populations of Altay.

Another goal is the study of the social structures and social complexity in the area. These are most probably more complex than the commonly used binary structure 'elite' versus 'ordinary people' – in particular, in the Early Iron Age or Scythian society. It has been shown in archaeology that several parameters can be used to get insight into social structures (Renfrew & Bahn 1991: 195-202). Quantitative parameters, such as size (and variation in size) of monuments are in a way a reflection of complex social structures: the larger the monument, the more

important a deceased member of the social group may be considered. Qualitative parameters are also important, as the position of the monument in the graveyard, within the landscape, the (inter-)visibility of the monuments, and the relation of the monuments to those of other periods.

The project will enable us to work further on the research presented here, and to solve the shortcomings that were pointed out. We are definitely looking forward to starting the work as soon as possible.

Another important aspect is that this project will give us the opportunity to do some limited excavations on a number of hitherto unknown structure types, such as the virtual dwellings. This will certainly improve the chronological assignments we have carried out to date.

Alongside these landscape aspects, we certainly intend to continue to follow up UNESCO's Frozen Tombs Initiative, now being lead by UNESCO's World Heritage Centre. If possible – it all depends on finding funds – we would like to initiate further steps in the preservation process, and continue the mapping of the archaeological heritage of the Altay Mountains.

The continuation of the mapping and monitoring of the permafrost areas in Altay has already been ensured by a PhD at the Geography Department in our university for the period 2008 to 2011. Ruben Van de Kerchove will study the permafrost by using thermal remote sensing data, such as Landsat and ASTER, and produce a map of the local permafrost areas in Altay. Prof. Dr. Rudi Goossens is the promoter of his research.



Figure 8.1: Chuya 2003: (from left to right) Evgeniy Chernikov, Rudi Goossens, Wouter Gheyle, Dimitri Cheremisin, Jean Bourgeois, Alexander Ebel, Maxim Cherepanov and a friend of the Russian colleagues



Figure 8.2: Yustyd 2004: (standing) Wouter Gheyle, Maxim Cherepanov, Tatyana Vdovina, Jean Bourgeois, Benjamin Van Bever, Leon Van Hoof, Alexander Ebel, (sitting) Sergey Sukhov, Evgeniy Chernikov and a student



Figure 8.3: Dzhazator 2005: (standing), Leon Van Hoof, Tamara Kamylina, student Tanya, Quentin Bourgeois, Maxim Cherepanov, Alexander Ebel, Wouter Gheyle, Tijs De Schacht, Tijs De Bus, Rudi Goossens, Matthijs Vanommeslaeghe, Alain De Wulf, (sitting) a driver, Evgeniy Chernikov, Sergey Sukhov, Alexander Sukhov, Vera Bedareva, Stéphanie Loute, Kaatje De Langhe and Elise Luneau



Figure 8.4: Kazakh Altay 2006: (standing) Gulnara Dzhumabekova, Galiya Bazarbaeva, Kuragay Mubarakova, unknown, Rudi Goossens, Alain De Wulf, Eduard Severskii, Kaatje De Langhe, Leon Van Hoof, Steven Van der Sype, Zeinola Samashev, Dries Dossche, unknown, a student, (sitting) a Kazakh geographer, student and driver, Wouter Gheyle, Delphine Corneillie, a student, Anne Malmendier and Stéphanie Loute



Figure 8.5: Karakol 2007: Aleksey Lapin, Eduard Dvornikov, Aleksey Cherepanov, Leon Van Hoof, Kaatje De Langhe, Ruben Cappelle, Maxim Pyankov, Jean Bourgeois, Vetcheslav Raseomakhin, Stéphanie Loute and Wouter Gheyle



Figure 8.6: Karakol 2008, archaeological team: (standing) Jean Bourgeois, Eduard Dvornikov, Vyacheslav Panov, Leon Van Hoof, Maxim Pyankov, Aleksey Cherepanov, (sitting) Wouter Gheyle, Kaatje De Langhe, Dorien te Kiefte and Anne Malmendier



Figure 8.7: Fieldwork 2008, geographical team: Alexander Ebel, Dimitri Apasenko, Evgeniy Chernikov, Ruben Van de Kerchove and Rudi Goossens

9 Appendix

9.1 Appendix 1: recommendations – UNESCO International Workshop

"The Frozen Tombs of the Altai Mountains: Strategies and Perspectives"
28-31 March 2006, Gorno-Altaisk, Altai Republic, Russia Federation
UNESCO, World Heritage Centre, in technical co-operation with Ghent University
Hosted by Gorno-Altaisk University, Republic of Altai, Russian Federation

Preamble

Participants in the International workshop on the Preservation of the Frozen Tombs of the Altai Mountains: Strategies and Perspectives", held in Gorno-Altaisk, 28-31 March 2006, namely 50 archaeologists and geologists, from Belgium, China, France, Kazakhstan, Mongolia, Russia Federation, the United States, and the representatives from UNESCO and UNESCO World Heritage Centre,

Noting that the Russian part of the Altai, namely Altaisky Zapovednik and a buffer zone around Lake Teletskoye; Katunsky Zapovednik and a buffer zone around Mount Belukha; and the Ukok Quiet Zone on the Ukok Plateau, was inscribed on the World Heritage List as a natural site;

Further noting that the Katunsky Zapovednik also figures in the list of the UNESCO Man and Biosphere Reserves;

Recognizing the importance and unique value of the archaeological and cultural remains, including the frozen tombs, scattered in the Altai Mountains, which cover a significant contiguous part of China, Mongolia, Kazakhstan and the Russian Federation, belong to the past shared between these countries, and in which truly international cultures developed, attested by contacts with major civilisations of the ancient world, including China, Persia, Greece and others, and which therefore constitute a common legacy for humanity;

Bearing in mind the fact that the global warming phenomenon is threatening the permafrost which allowed preservation of the tombs and their relics for several millennia;

Calling attention to the fact that the destruction of the frozen tombs as well as the valuable relics located inside would lead to a great loss of significant knowledge about one of the once flourishing civilisations in the history of humanity;

Appreciating the efforts made by UNESCO, in close co-operation with Ghent University, Belgium and thanks to the UNESCO/Flanders Funds-in-Trust, to take initiatives to preserve the frozen tombs;

Recommend, in the spirit of the resolution adopted by the workshop "Synergy of Natural and Cultural Diversity as Basis for Sustainable Development of the Altai Mountainous Region", held

at UNESCO in Paris, on October 11, 2005, attended by Government of Russia Federation as well as of the Altai Republic, that the authorities of the Russia Federation and of the Altai Republic,

- take all measures to preserve the World Heritage Value of the Altai Mountains and ensure that all the activities on the World Heritage Site be undertaken in accordance with the World Heritage Convention;
- start a co-operative process with neighbouring States Parties such as China, Mongolia and Kazakhstan, to consider a possible transboundary expansion, as recommended by the World Heritage Committee;
- make efforts to submit the request for the inclusion of the Ukok Plateau on the World Heritage List by extending the nomination of "Golden Mountains of Altai" into a mixed (natural and cultural) site;

that the other concerned countries, such as China, Mongolia, and Kazakhstan;

- take necessary steps to submit the site of the Altai Mountains on their respective territories for inscription on the World Heritage List and to the UNESCO MAB Reserves List for a better preservation of the Altai Mountain in its integrity;

that the concerned authorities, academics, scholars, institutes and universities;

- urgently take all the necessary measures to safeguard and preserve the frozen tombs in the Altai Mountains, endangered by thawing due to global warming. To this end, the following technical recommendations were made:
    - the establishment of an accurate map and a thorough inventory of all archaeological monuments, as a first step, accompanied by detailed information related to their location, and description, since the frozen tombs should be considered as part of the unique cultural landscape of the Altai Mountains. This will be the basis of long-term efforts for preservation of the frozen tombs endangered by thawing. It is of utmost importance that surveys focus upon all archaeological remains present in the area. During the selection of areas and monuments to be protected, all elements of the cultural and archaeological landscape should be taken into account;
    - the identification of a compatible methodology for mapping the Altai Mountains. Integration of maps is most important, and should take into account the norms and particular circumstances of each country. A discussion between archaeologists and other specialists should be organised, as there is a crucial need to determine the most appropriate scale of these maps;
    - the organisation of activities and the initiation of projects in order to develop models to understand better environmental conditions in the Altai Mountains in the field of geology, geo-cryology and climatology in the past (paleo-environment) and into the future;

    - the monitoring of the frozen burial sites. Given their deteriorating condition, all appropriate technologies should be used. Therefore the participants urge for the organization of a discussion between archaeologists and other specialists to determine the best methods to be used.

- carry out all activities related to survey and excavation on the frozen tombs according to the highest professional and ethical standards, including dialogue with and respect and consideration for, indigenous people, as well as respect for environmental integrity;
- undertake all the activities such as excavation, preservation, conservation and development in accordance with UNESCO recommendation on “International Principles Applicable to Archaeological Excavations” and International ICOMOS’s relevant charters;
- make efforts to launch a global strategy for preservation of the frozen tombs and cultural heritage of the Altai Mountains in a long-term perspective;

that UNESCO and UNESCO World Heritage Centre;

- support the initiative for launching a global strategy for the preservation of cultural heritage in the Altai Mountains, including the frozen tombs, which constitutes a unique cultural landscape in the Eurasian continent.

The participants of the workshop wish to express their gratitude to the UNESCO World Heritage Centre for the organisation of the Workshop and for the support of this initiative.

9.2 Appendix 2: Ghent declaration – UNESCO International Conference

"Scythian Archaeology and the Archaeology of the Altai Mountains"
4-6 December 2006, Ghent, Belgium
UNESCO, World Heritage Centre, in technical co-operation with Ghent University
Hosted by Ghent University, Belgium

Ghent Declaration on the Preservation of the Altai Mountains in their Integrity: Archaeological Heritage and Cultural Landscape

We, the experts: archaeologists and natural scientists, from Belgium, China, France, Germany, Kazakhstan, Mongolia, the Netherlands, the Russian Federation, the United States, assembled in Ghent on the occasion of the "International Conference on Scythian Archaeology and the Archaeology of the Altai Mountains" held from 4 to 6 December 2006,

express our gratitude to the organizers of the Conference and UNESCO World Heritage Centre for providing a forum to discuss important issues related to the Scythian archaeology and its archaeological heritage including frozen tombs lying scattered in the Altai Mountains, and

Noting that the Russian part of the Altai, namely Altaisky Zapovednik and a buffer zone around Lake Teletskoye; Katunsky Zapovednik and a buffer zone around Mount Belukha; and the Ukok Quiet Zone on the Ukok Plateau, was inscribed on the World Heritage List as a natural site in 1998;

Further noting that the Katunsky Zapovednik also figures in the list of the UNESCO Man and Biosphere Reserves;

Recognizing the importance and unique value of the archaeological and cultural remains, including the frozen tombs, scattered in the Altai Mountains, which cover a significant contiguous part of China, Mongolia, Kazakhstan and the Russian Federation, belong to the past shared between these countries, and in which truly international cultures developed, attested by contacts with major civilisations of the ancient world, including China, India, Persia, Greece and others, and which therefore constitute a common legacy for humanity;

Bearing in mind the fact that the global warming phenomenon is threatening the permafrost which allowed preservation of the tombs and their relics for several millennia,

Calling attention to the fact that the destruction of the frozen tombs as well as the valuable artefacts located inside would lead to a great loss of significant knowledge about one of the once flourishing civilisations in the history of humanity,

Appreciating the efforts made by UNESCO World Heritage Centre, in close co-operation with Ghent University, Belgium and thanks to the UNESCO/Flanders Funds-in-Trust, to take initiatives to preserve the frozen tombs,

we call upon,

in the spirit of the resolution adopted by the workshop “Synergy of Natural and Cultural Diversity as Basis for Sustainable Development of the Altai Mountainous Region”, held at UNESCO in Paris, on October 11, 2005, organized by the government of the Altai Republic in close co-operation with the federal government of the Russian Federation,

in the spirit of the resolution adopted by the workshop “The Frozen Tombs of the Altai Mountians: Strategies and Perspectives”, held in Gorno-Altaisk on March 28-31, 2006, organized by the Gorno)Altaisk State University in co-operation with Ghent University and UNESCO World Heritage Center,

the authorities of the Russia Federation and of the Altai Republic to:

- take all measures to preserve the World Heritage Value of the Altai Mountains and ensure that all the activities including tourism development and any infrastructure development programme on the World Heritage Site be undertaken in respect of the World Heritage Convention;
- start a co-operative process with neighbouring States Parties such as China, Mongolia and Kazakhstan, to consider a possible transboundary expansion, as recommended by the World Heritage Committee;

the other concerned countries by the Altai mountains such as China, Mongolia, and Kazakhstan to:

- take necessary steps to establish appropriate legislation for the protection of the Altai Mountains in their integrity on their respective territories including possibilities of its inscription on the World Heritage List as a natural and cultural site and to the UNESCO Man and Biosphere Reserves,

the concerned academics, scholars, institutes and universities to:

- carry out all activities related to survey and excavation on the archaeological sites including frozen tombs according to the highest professional and internationally recognized ethical standards, such as the UNESCO recommendation on “International Principles Applicable to Archaeological Excavations” and the International ICOMOS “Charter for the archaeological heritage 1990”, and with respect and consideration for local communities, as well as for environmental integrity;
- make efforts to launch a global strategy for preservation of the frozen tombs and cultural heritage of the Altai Mountains in its integrity and in a long-term perspective;

UNESCO World Heritage Centre to:

- support the initiative for launching a global strategy for the preservation of cultural heritage in the Altai Mountains, including the frozen tombs, which constitutes a unique cultural landscape in the Eurasian continent.

The participants of the workshop wish to express their gratitude to the UNESCO World Heritage Centre for the organisation of the Workshop and for the support of this initiative.

9 Appendix

10 Bibliography

(Allard & Erdenebaatar 2005)
Allard F. & Erdenebaatar D. 2005. Khirigsuurs, ritual and mobility in the Bronze Age of Mongolia. *Antiquity* 79**,** 305**,** 547-563.

(Altmaier & Kany 2002)
Altmaier A. & Kany C. 2002. Digital surface model generation from CORONA satellite images. *ISPRS Journal of Photogrammetry & Remote Sensing* 56**,** 221-235.

(Amez 2004)
Amez T. 2004. Van Coronabeeld tot DEM en morfografische kaart. Kartering van een gebied in het Altaïgebergte. *Vakgroep Geografie.* Gent, Universiteit Gent.

(Anschuetz et al. 2001)
Anschuetz K.F., Wilshusen R.H. & Scheick C.L. 2001. An Archaeology of Landscapes: Perspectives and Directions. *Journal of Archaeological Research* 9**,** 2**,** 157-211.

(Arnaud 2008)
Arnaud B. 2008. Mongolie l'empire des stèles. *Sciences et Avenir* 732.

(Askarov et al. 1996)
Askarov A., Volkov V.V. & Ser-Odjav N. 1996. Pastoral and nomadic tribes at the beginning of the first millennium B.C. In: Dani A.H. & Masson V.M. (Eds.) *History of civilizations of Central Asia. Volume I. The dawn of civilization: earliest times to 700 B.C.* Paris, UNESCO Publishing**,** 459-519.

(Badenkov 2007)
Badenkov Y.P. 2007. Altai Mountain Knot. Between Conservation and Development - Syndromes of Globalisation, Update. *Newsletter of the International Human Dimensions Programme on Global Environmental Change* 1.

(Barkova & Pankova 2005)
Barkova L.L. & Pankova S.V. - Баркова Л.Л. & Панкова С.В. 2005. Татуировки на мумиях из Больших Пазырыкских курганов (новые материалы) - Tattooed Mummies from the Large Pazyryk Mounds: New Findings. *Археология, Этнография и Антропология Евразии - Archaeology, Ethnology and Anthropology of Eurasia* 2**,** 22**,** 48-59. [in Russian and English]

(Barkova 2007)
Barkova L.L. 2007. Die Fürstengräber der Pazyryk-Kultur. In: Menghin W., Parzinger H., Nagler A. & Nawroth M. (Eds.) *Im Zeichen der Goldenen Greifen. Königsgräber der Skythen.* München, Prestel**,** 118-131.

(Bokovenko 1994)
Bokovenko N.A. 1994. Le Kourgane "royal" d'Arjan et son temps. In: Schiltz c. (Ed.) *Les Scythes.* Dijon**,** 30-37.

(Bourgeois et al. 1998)
Bourgeois I., Cammaert L., Mikkelsen J.H. & Van Huele W. 1998. A permafrost site in the valley of the Kalanegir (Kosh-Agash region, Gorno-Altaï). Potential frozen Scytho-Siberian tombs. Preliminary results. In: Molodin V.I. (Ed.) *Сибирь в Панораме Тысячелетий - Sibir' v Panorame Tysyacheletiy* Novosibirsk, IAE SBRAS**,** 93-97. [in English and Russian]

(Bourgeois et al. 1999a)
Bourgeois I., Bourgeois J., Cammaert L., Decleir H., Langohr R., Mikkelsen J.H. & Van Huele W. 1999a. Multidisciplinary archaeological research in the Sebÿstei valley 1996-1997 (Kosh-Agash region, Altai Republic). *Eurasia Antiqua* 5**,** 295 - 389.

(Bourgeois et al. 1999b)
Bourgeois I., Mikkelsen J.H., Van Hoof L., Van Huele W., Bourgeois J., Langohr R., Cammaert L. & Decleir H. 1999b. An archaeological survey of the Kalanegir valley (Kosh-Agash region, Altai Republic): petroglyphs and Scytho-Siberian kurgans in a permafrost area. A multidisciplinary approach. *From Scythia to Siberia* 6**,** 1-2**,** 77-101.

(Bourgeois et al. 1999c)
Bourgeois I., Van Hoof L. & Cheremisin D. 1999c. Découverte de pétroglyphes dans les vallèes de Sebÿstei et de Kalanegir (Gorno-Altaï). *International Newsletter on Rock Art***,** 6-13.

(Bourgeois et al. 2000a)

Bourgeois I., Cammaert L., Massart C., Mikkelsen J.H. & Van Heule W. 2000a. *Ancient Nomads of the Altai Mountains. Belgian-Russian Multidisciplinary Archaeological Research on the Scytho-Siberian Culture,* Brussels, Royal Museums of Art and History, 213p.

(Bourgeois & Bourgeois 2006)

Bourgeois I. & Bourgeois J. 2006. Unexplored valleys, potential frozen kurgans and heritage management. Belgian archaeological research in the Altai Republic (Russian Federation): survey and inventory 1996-2000. In: *Acts of the XIVth UISPP Congress, University of Liège Belgium, 2-8 September 2001, Section 16. Asian and Oceanic Prehistory, General sessions and posters.* 17-24.

(Bourgeois et al. 2000b)

Bourgeois J., Bourgeois I., Lukyanenko V.N., Kireev S.M. & Ebel' A. - Буржуа Ж., Буржуа И., Лукьяненко В.Н., Киреев С. & Эбель А. 2000b. Интеграционный подход к сохранению памятников историко-культурного наследия в с.Усть-Кокса Республика Алтай - Integratsionyy podkhod k sokhraneniyu pamyatnikov istoriko-kul'turnogo naslediya v s. Ust'-Koksa Respublika Altay. *Наука, культура, образование* 6**,** 7**,** 101-102. [in Russian]

(Bourgeois & Gheyle 2006)

Bourgeois J. & Gheyle W. (Eds.) 2006. *The Frozen Tombs of the Altai Mountains,* Ghent, Ghent University & UNESCO**,** 97p.

(Bourgeois & Gheyle 2007)

Bourgeois J. & Gheyle W. 2007. The Eurasian Steppe Culture in the first millennium BC. Outline of the UNESCO project - Замороженные погребения Алтайских Гор. Культура Евразийских степей в I-ом тысячелетии до н.э. In: Bourgeois J., Gheyle W., Babin V. & Luk'yanenko V. (Eds.) *The Frozen Tombs of the Altay Mountains: Strategies and Perspectives. UNESCO Workshop: compilation of papers following the conference held in Gorno-Altaysk, Altay Republic, Russian Federation, 28-31 March 2006.* Gorno-Altaysk, RIO GAGU**,** 190-193 / 17-19. [in English and Russian]

(Bourgeois et al. 2007)

Bourgeois J., Gheyle W., Goossens R. & De Wulf A. 2007. *The Frozen Tombs of the Altai Mountains. Phase I 2005-2006,* Gent, Universiteit Gent, 86p

(Bourgeois & Gheyle 2008)

Bourgeois J. & Gheyle W. 2008. UNESCO-sponsored Field Campaigns in the Russian and Kazakh Altai. In: Han J., Frank L. & Treselian D. (Eds.) *The Preservation of the Frozen Tombs of the Altai Mountains.* Paris, UNESCO World Heritage Centre**,** 55-60.

(Bourgeois et al. 2008)

Bourgeois J., Gheyle W., Goossens R., Van de Kerchove R., Dvornikov E.P., Ebel A.V., Van Hoof L., De Langhe K., Malmendier A. & te Kiefte D. 2008. *Survey and Inventory of the Archaeological Sites in the Valley of the Karakol (Uch Enmek Park), Part 2: 2008. Report on the Belgian-Russian Expedition in the Russian Altay Mountains,* Ghent, Ghent University, 23p

(Bradley 2002)

Bradley R. 2002. *The Past in Prehistoric Societies,* London and New York, Routledge, 171p.

(C&C Technologies 2005)

C&C Technologies 2005. http://www.cctechnol.com/cnav, C-Nav Globally Corrected GPS, 15-01-2008

(Cahen-Delhaye 1991)

Cahen-Delhaye A. (Ed.) 1991. *Het Goud der Skythen. Schatten uit de Hermitage, Leningrad,* Brussel, Koninklijke Musea van Kunst en Geschiedenis, Gemeentekrediet**,** 263p.

(Campbell 1996)

Campbell J.B. 1996. *Introduction to remote sensing,* London, Taylor & Francis Ltd.

(Cappelle 2008a)

Cappelle R. 2008a. *Stage 2: Aanmaak van DTM van de vallei van de Karakol,* Gent, Vakgroep Geografie, Universiteit Gent, 18p

(Cappelle 2008b)

Cappelle R. 2008b. *Stage 1: GPS-metingen voor inventarisatie van archeologische sites in het Altay-gebergte,* Gent, Vakgroep Geografie, Universiteit Gent, 18p

(Casana & Cothren 2008)

Casana J. & Cothren J. 2008. Stereo analysis, DEM extraction and orthorectification of CORONA satellite imagery: archaeological applications from the Near East. *Antiquity* 82**,** 317**,** 732-749.

(Challis et al. 2002)
Challis K., Priestnall G. & Gardner A. 2002. CORONA remotely-sensed imagery in dryland archaeology: the Islamic city of al-Raqqa, Syria. *Journal of Field Archaeology* 29**,** 1-2**,** 139-153.
(Cheremisin 2008)
Cheremisin D.V. 2008. International conference on Scythian archaeology and the archaeology of the Altai Mountains, Ghent, Het Pand, December 4–6, 2006. *Archaeology, Ethnology and Anthropology of Eurasia* 31**,** 3**,** 156-159. [in English and Russian]
(Chudjakov 1997)
Chudjakov J.S. 1997. Hunnenzeitliche Tracht einer Nomadin aus dem Hochaltai : Eine Rekonstruktion. *Eurasia antiqua* 3**,** 581-594.
(Chugunov et al. 2004)
Chugunov K.V., Dergachev V.A., Nagler A., Parzinger H., Possnert G., Sementsov A.A., Scott E.M., Van Geel B., Van der Plicht J., Vasiliev S.S. & Zaitseva G.I. 2004. First chronological data for the unique tsar burial mound Arzhan-2 in Tuva, Central Asia. In: *Radiocarbon an Archaeology, Fourth International Symposium, St Catherine's College, Oxford, 9-14 April 2002.* 171-175.
(Comfort et al. 2000)
Comfort A., Abadie-Reynal C. & Ergeç R. 2000. Crossing the Euphrates in antiquity: Zeugma seen from space. *Anatolian Studies. Journal of the British Institute of Archaeology at Ankara* 50**,** 99-126.
(Čugunov et al. 2006)
Čugunov C., Parzinger H. & Nagler A. 2006. *Der Goldschatz von Aržan. Ein Fürstengrab der Skythenzeit in der südsibirischen Steppe,* München, Schirmer/Mosel, 144p. [in German]
(Čugunov et al. 2007)
Čugunov C., Parzinger H. & Nagler A. 2007. Der Fürstenkurgan Aržan 2. In: Menghin W., Parzinger H., Nagler A. & Nawroth M. (Eds.) *Im Zeichen der Goldenen Greifen. Königsgräber der Skythen.* München, Prestel**,** 69-82.
(Davis-Kimball 2000)
Davis-Kimball J. 2000. The Beiram Mound: A Nomadic Cultic Site in the Altai Mountains (Western Mongolia). In: Davis-Kimball J., Murphy E.M., Koryakova L. & Yablonsky L.T. (Eds.) *Kurgans, Ritual Sites, and Settlements. Eurasian Bronze and Iron Age.* Oxford, Archeopress**,** 89-106.
(Davis 1998)
Davis R.S. 1998. The Enisei River of Central Siberia in the Late Pleistocene. *Journal of Archaeological Research* 6**,** 2**,** 169-194.
(Day et al. 1998)
Day D.A., Logsdon J.M. & Latell B. (Eds.) 1998. *Eye in the sky: the story of the Corona spy satellites,* Washington, Smithsonian Institution Press.
(De Bus 2007)
De Bus T. 2007. Het gebruik van thermale banden (Landsat en ASTER) in functie van het voorkomen van permafrost in het Altaï-gebergte (Dzhazator vallei, Siberië, Rusland). *Vakgroep Geografie.* Gent, Universiteit Gent.
(de Meyer 2004)
de Meyer M. 2004. Archaeological research using satellite remote sensing techniques (CORONA) in the Valleys of Shirwan and Chardawal (Pusht-i Kuh, Luristan), Iran. *Iranica Antiqua* XXXIX**,** 43-103.
(De Schacht 2007)
De Schacht T. 2007. Antieke damresten in het hinterland van Pasargadae (Fars, Iran). CORONA satellietbeelden als een krachtig maar miskend analysemiddel. In: Gehring E., Habermehl D., van 't Veer R. & Venderbos I. (Eds.) *SOJA Bundel 2006: Amsterdam.* Groningen, Stichting Onderzoek Jonge Archeologen**,** 73-80.
(De Schacht et al. 2008)
De Schacht T., Gheyle W., Goossens R. & De Wulf A. 2008. Archaeological research and CORONA: on the use, misuse and full potential of historical remote sensing data. *5th International Conference on the Archaeology of the Ancient Near East.* Madrid.

(De Wulf et al. 2007)

De Wulf A., Goossens R., Gheyle W. & Bourgeois J. 2007. GPS surveying methodology used for archaeological surveys in the Altai Mountains - Методология глоьальной системы распознавания расположения объекта (ГСРРО), использованния при археологических исследованиах на Алтае In: Bourgeois J., Gheyle W., Babin V. & Luk'yanenko V. (Eds.) *The Frozen Tombs of the Altay Mountains: Strategies and Perspectives. UNESCO Workshop: compilation of papers following the conference held in Gorno-Altaysk, Altay Republic, Russian Federation, 28-31 March 2006.* Gorno-Altaysk, RIO GAGU**,** 262-266 / 98-103. [in English and Russian]

(Derevjanko & Sun'kov 1998)

Derevjanko A.P. & Sun'kov M.V. 1998. Neue Ergebnisse zum Paläolithikum im Altai. *Eurasia antiqua* 4**,** 1-10.

(Derevyanko & Molodin 1994)

Derevyanko A.P. & Molodin V.I. - Деревянко А.П. & Молодин В.И. 1994. *Денисова пещера - Denisova peshchera,* Новосибирск Наука Сиб. изд. фирма. [in Russian]

(Derevyanko et al. 1999)

Derevyanko A.P., Shun'kov M.V. & Anoykin A.A. - Деревянко А.П., Шуньков М.В. & Анойкин А.А. 1999. Археологические материалы плейстоценовых отложений предвходовой площадки Денисовой пещеры - Arkheologicheskie materialy pleystotsenovykh otlozheniy predvkhodovoy ploshadki Denisovoy peshchery. *Древности Алтая - Drevnosti Altaya* 4. [in Russian]

(Dergachev et al. 2000)

Dergachev V.A., Vasiliev S.S., Sementsov A.A., Zaitseva G.I., Chugunov K.A. & Sljusarenko I.J. 2000. Dendrochronology and radiocarbon dating methods in archaeological studies of scythian sites. In: *17th International Radiocarbon Conference.* 417-424. [in English]

(Dossche 2007)

Dossche D. 2007. Fotogrammetrische restitutie van Corona KH-4B beelden voor de kartering van kourganen en andere archeologische structuren in het Kazachse gedeelte van het Altaïgebergte. *Vakgroep Geografie.* Gent, Universiteit Gent.

(Fitzhugh 2008)

Fitzhugh W. 2008. Exploring Wider Deer Stone Horizons. *Arctic Studies Center Newsletter* February 2008, 15**,** 24-27.

(Fitzhugh & Bayarsaikhan 2008)

Fitzhugh W. & Bayarsaikhan J. 2008. *American-Mongolian Deer Stone Project: Field Report 2007,* Washington, Smithsonian Institution, 133p

(Fleming 2006)

Fleming A. 2006. Post-processual landscape archaeology: a critique. *Cambridge Archaeological Journal* 16**,** 3**,** 267-280.

(Fowler 2004)

Fowler M.J.F. 2004. Declassified CORONA KH-4B satellite photography of remains from Rome's desert frontier. *International Journal of Remote Sensing* 25**,** 18**,** 3549-3554.

(Fowler 2005)

Fowler M.J.F. 2005. An evaluation of scanned CORONA intelligence satellite photography. *AARGnews***,** 31**,** 34-37.

(Fowler 2008)

Fowler M.J.F. 2008. The application of declassified KH-7 GAMBIT satellite photographs to studies of Cold War material culture: a case study from the former Soviet Union. *Antiquity* 82**,** 317**,** 714-731.

(Francfort et al. 2000)

Francfort H.-P., Ligabue G. & Samashev Z. 2000. La fouille d'un Kourgane Scythe gelé du Ive Siècle av. Notre ère à Berel' dans l'Altaï (Kazakhstan). *Académie des inscription & belles-lettres. Comptes rendus des séances de l'année 2000 Avril-Juin* 2000**,** Avril-Juin**,** 775-806.

(Francfort et al. 2006)

Francfort H.-P., Ligabue G. & Samashev Z. 2006. The Gold of the Griffins: Recent Excavation of a Frozen Tomb in Kazakhstan. In: Aruz J., Farkas A. & Valtz Fino E. (Eds.) *The Golden Deer of Eurasia. Perspectives on the Steppe Nomads of the Ancient World.* New York, The Metropolitan Museum of Art**,** 114-127.

(Franz 1973)

Franz H.-J. 1973. *Physische Geographie der Sovjetunion,* Leipzig, Gotha, 535p.

(Frohlich et al. 2007)

Frohlich B., Amgalan-tugs T. & Hunt D. 2007. Bronze Age Burial Mound Excavations in the Hovsgol Aimag, Northern Mongolia. In: Fitzhugh W. (Ed.) *American-Mongolian Deer Stone Project: Field Report 2007.* Washington, D.C., Arctic Studies Center, National Museum of Natural History, Smithsonian Institution**,** 101-103.

(Frohlich et al. 2008)

Frohlich B., Amgalantugs T. & Hunt D. 2008. Bronze Age Burial Mound Excavation in the Hovshol Aimag, Northern Mongolia. *Arctic Studies Center Newsletter* February 2008, 15**,** 27-28.

(Fukui et al. 2007)

Fukui K., Fujii Y., Mikhailov N., Ostanin O. & Iwahana G. 2007. The Lower Limit of Mountain Permafrost in the Russian Altai Mountains. *Permafrost and Periglacial Processes* 18**,** 129-136.

(Galiatsatos 2004)

Galiatsatos N. 2004. Assessment of the CORONA series of satellite imagery for landscape archaeology. A case study from the Orontes valley, Syria. *Department of Geography.* Durham, University of Durham.

(Garmin 2007)

Garmin 2007. http://www.garmin.com/products/gps12xl, Garmin GPS 12XL, 15-01-2008

(Gavrilova 1965)

Gavrilova A.A. - Гаврилова А.А. 1965. *Могильник Кудыргэ как источник по истории алтайских племён - Mogil'nik Kudyrge kak istochnik po istorii altayskikh plemyon,* Moscow - Leningrad, Nauka, 145p. [in Russian]

(Gheyle & Trommelmans 2002)

Gheyle W. & Trommelmans R. 2002. Archeologie en teledetectie. Een onderzoek naar de bruikbaarheid van CORONA-satellietbeelden voor het detecteren en in kaart brengen van archeologische structuren. *Vakgroep Archeologie en Oude Geschiedenis van Europa.* Gent, Universiteit Gent.

(Gheyle et al. 2004)

Gheyle W., Trommelmans R., Bourgeois J., Goossens R., Bourgeois I., De Wulf A. & Willems T. 2004. Evaluating CORONA: A case study in the Altai Republic (South Siberia). *Antiquity* 78**,** 300**,** 391-403.

(Gheyle et al. 2007)

Gheyle W., Bourgeois J., Dewulf A., Goossens R. & Ebel A.V. 2007. Survey and Inventory of the Archaeological Monuments and the Permafrost Occurrence in the Dzhazator Valley, 2005. A Belgian-Russian Expedition in the Altai Republic (Russia) - Исследование и инвентаризация археологических памятников с мерзлотой в долине Джазатор 2005 г. Бельгийско-Российская экспедиция в Республике Алтай (Россия). In: Bourgeois J., Gheyle W., Babin V. & Luk'yanenko V. (Eds.) *The Frozen Tombs of the Altay Mountains: Strategies and Perspectives. UNESCO Workshop: compilation of papers following the conference held in Gorno-Altaysk, Altay Republic, Russian Federation, 28-31 March 2006.* Gorno-Altaysk, RIO GAGU**,** 193-201 / 20-28. [in English and Russian]

(Glushkov et al. 2004)

Glushkov I.G., Kiryushin Y.F. & Kiryushin K.Y. - Глушков И.Г., Кирюшин Ю.Ф. & Кирюшин К.Ю. 2004. Специфика формовочных операций в гончарной традиции неолитических комплексов поселения Тыткескень-2 - Spetsifika formovochnykh operatsiy v goncharnoy traditsii neoliticheskikh kompleksov poseleniya. *Древности Алтая - Drevnosti Altaya* 12. [in Russian]

(Goebel et al. 1993)

Goebel T., Derevianko A.P. & Petrin V.T. 1993. Dating the Middle-to-Upper-Paleolithic Transition at Kara-Bom. *Current Anthropology* 34**,** 4**,** 452-458.

(Goossens et al. 2001)

Goossens R., De Man J. & De Dapper M. 2001. Research to possibilities of CORONA-Satellite-data to replace conventional aerial photographs in geo-archaeological studies, practised on Sai, Sudan. In: Buchroitner M. (Ed.) *A Decade of Trans-European Remote Sensing Cooperation.* 257-262.

(Goossens et al. 2006a)

Goossens R., De Wulf A., Bourgeois J., Gheyle W. & Willems T. 2006a. Satellite imagery and archaeology, the Example of CORONA in the Altai Mountains. *Journal of Archaeological Science* 33**,** 745-755.

(Goossens et al. 2006b)

Goossens R., De Wulf A., Gheyle W. & Bourgeois J. 2006b. Estimation of the permafrost area in the Altai Mountains (Russia) in the framework of the preservation of the Frozen Tombs of the Altai Mountains. In: Marçal A. (Ed.) *Global Developments in Environmental Earth Observation from Space. Proceedings of the 25th Symposium of the European Association for Remote Sensing Laboratories, Porto, Portugal, 6-11 June 2005.* Rotterdam, Millpress**,** 595-601.

(Goossens et al. 2006c)

Goossens R., Gheyle W., Bourgeois J. & De Wulf A. 2006c. Survey and inventory of archaeological sites and permafrost occurrence in the Dzhazator Valley. A Belgian-Russian Expedition in the Altai Republic, Russia (8 July – 18 August 2005). In: Modorov N.S. (Ed.) *Istoriya i kul'tura narodov Yuzhnoy Sibiri: istoriya, nastoyashshee, budushshee. Materialy chteniy, posvyashshennykh pamyati issledovatelya narodov Sibiri L.P. Potapova.* Gorno-Altaysk, RIO GAGU**,** 59-73. [in English and Russian]

(Goossens et al. 2007)

Goossens R., Gheyle W., Bourgeois J. & De Wulf A. 2007. On the use of satellite imagery for mapping and permafrost research in the framework of the Frozen Tombs of the Altai Mountains project - Использование спутниковой сьемки в топографии и исследовании вечной мерзлоты в рамках проекта «Погребальные комплексы с мерзлотой в горах Алтая». In: Bourgeois J., Gheyle W., Babin V. & Luk'yanenko V. (Eds.) *The Frozen Tombs of the Altay Mountains: Strategies and Perspectives. UNESCO Workshop: compilation of papers following the conference held in Gorno-Altaysk, Altay Republic, Russian Federation, 28-31 March 2006.* Gorno-Altaysk, RIO GAGU**,** 225-261 / 91-97. [in English and Russian]

(Gorbunov et al. 2005)

Gorbunov A.P., Samashev Z.S. & Severskii E.V. - Горбунов А.П., Самашев З.С. & Северский И.В. 2005. *Сокровища мерзлых курганов Казахского Алтая (по материалам могильника Берел) - The Treasures of Frozen Burial Mounds of the Kazakh Altai (Materials of the Berel Burial Site),* Алматы, ТОО Иль-Тех-Кітап, 111p. [in Russian and English]

(Grjaznov 1984)

Grjaznov M.P. 1984. Der Grosskurgan van Arzan in Tuva, Südsiberien. *Materialien zur Allgemeinen und Vergleichenden Archäologie* 23.

(Gryaznov 1930)

Gryaznov M.P. - Грязнов М.П. 1930. *Древние культуры Алтая. Материалы по изучения Сибири 2 - Drevnie kul'tury Altaya. Materialy po izucheniya Sibiri 2,* Novosibirsk. [in Russian]

(Gryaznov & Golomshtok 1933)

Gryaznov M.P. & Golomshtok E.A. 1933. The Pazirik Burial of Altai. *American Journal of Archaeology* Vol. 37**,** No. 1 (Jan.-Mar.)**,** 30-45.

(Gryaznov 1969)

Gryaznov M.P. 1969. *South Siberia,* London, Barrie & Rockliff: The Cresset Press.

(Han 2008)

Han J. 2008. Impact of the Climate Change on the Frozen Tombs in the Altai Mountains. In: Petzet M. & Ziesemer J. (Eds.) *Heritage at Risk. ICOMOS World Report 2006/2007 on Monuments and Sites in Danger.* Altenburg, E. Reinhold-Verlag**,** 215-217.

(Han et al. 2008)

Han J., Frank L. & Treselian D. (Eds.) 2008. *The Preservation of the Frozen Tombs of the Altai Mountains,* Paris, UNESCO World Heritage Centre**,** 79p.

(Hatakeyama 2002)

Hatakeyama T. 2002. The Tumulus and Stag Stones at Shiebar-kul in Xinjiang, China. *草原考古通信 (Newsletter on Steppe Archaeology)* 13.

(Haynes & Zarling 1988)

Haynes F.D. & Zarling J.P. 1988. Thermosyphons and foundations design in cold regions. *Cold Regions Science and Technology* 15 251-259.

(Hill et al. 1999)

Hill C.J., Moore T. & Dumville M. 1999. GRINGO: a RINEX logger for handheld GPS receivers. In: *12th International Technical Meeting of the Institute of Navigation.* 1647-1652.

(Hritz 2004)

Hritz C. 2004. The hidden landscape of Southern Mesopotamia. *Akkadica* 125**,** 93-106.

(Ishjamts 1996)
Ishjamts N. 1996. Nomads in eastern Central Asia. In: Harmatta J., Puri B.N. & Etemadi G.F. (Eds.) *History of civilizations of Central Asia. Volume II. The development of sedentary and nomadic civilizations: 700 B.C. to A.D. 250.* Paris, UNESCO Publishing**,** 151-169.

(Jacobs 2007)
Jacobs B. 2007. Saken und Skythen aus Persische Sicht. In: Menghin W., Parzinger H., Nagler A. & Nawroth M. (Eds.) *Im Zeichen der Goldenen Greifen. Königsgräber der Skythen.* München, Prestel**,** 158-161.

(Jacobsen 2004)
Jacobsen K. 2004. DEM generation from satellite data. In: Goossens R. (Ed.) *Remote Sensing in Transition.* Rotterdam, Millpress**,** 513-525.

(Jacobson-Tepfer & Kubarev 1994)
Jacobson-Tepfer E. & Kubarev V.D. 1994. Turu-Alty (Analysis of a Siberian "Sanctuary"). *Altaica* 1994/4**,** 18-29.

(Jacobson-Tepfer et al. 1994)
Jacobson-Tepfer E., Meacham J., Cutting D. & Tepfer G. 1994. Patterns on the Steppe: Applying GIS to the Archaeology of the Altay Mountains. *Geo Info Systems***,** 32-45.

(Jacobson-Tepfer 2001)
Jacobson-Tepfer E. 2001. Cultural Riddles: Stylized Deer and Deer Stones of the Mongolian Altai. *Bulletin of the Asia Institute, New Series* 15**,** 31-56.

(Jacobson-Tepfer et al. 2001)
Jacobson-Tepfer E., Kubarev V.D. & Tseveendorj D. 2001. *Mongolie du Nord-Ouest: Tsagaan Salaa/Baga Oigor,* Paris, De Boccard.

(Jacobson-Tepfer et al. 2006a)
Jacobson-Tepfer E., Kubarev V.D. & Tseveendorj D. 2006a. *Mongolie du Nord-Ouest: haut Tsagaan Gol,* Paris, De Boccard.

(Jacobson-Tepfer et al. 2006b)
Jacobson-Tepfer E., Meacham J. & Tepfer G. 2006b. The Mongolian Altai Inventory. In: Bourgeois J. & Gheyle W. (Eds.) *The Frozen Tombs of the Altai Mountains.* Ghent, Ghent University & UNESCO**,** 63-67.

(Jacobson-Tepfer 2008)
Jacobson-Tepfer E. 2008. Culture and Landscape of the High Altai. In: Han J., Frank L. & Treselian D. (Eds.) *The Preservation of the Frozen Tombs of the Altai Mountains.* Paris, UNESCO World Heritage Centre**,** 31-34.

(Jacobson-Tepfer et al. Forthcoming)
Jacobson-Tepfer E., Meacham J. & Tepfer G. Forthcoming. *Archaeology and Landscape in the Altai Mountains of Mongolia: An Atlas*.

(Jacobson 1993)
Jacobson E. 1993. *The Deer Goddess of Ancient Siberia. A Study in the Ecology of Belief,* Leiden / New York / Köln, E.J. Brill, 295p.

(Kashkinbaev & Samashev 2005)
Kashkinbaev K. & Samashev Z.S. - Кашкинбаев К. & Самашев З.С. 2005. *Лошади древних кочевников Казахского Алтая - Loshadi drevnikh kochevnikov Kazakhskogo Altaya,* Алматы, ТОО Иль-Тех-Кітап, 137p. [in Russian]

(Kennedy 1998)
Kennedy D. 1998. Declassified satellite photographs and archaeology in the Middle East: case studies from Turkey. *Antiquity* 72**,** 277**,** 553-561.

(Khudjakov 2005)
Khudjakov J.S. 2005. Armaments of Nomads of the Altai Mountains (First Half of the 1st Millennium AD) *Acta Orientalia Academiae Scientiarum Hungaricae* 58**,** 2**,** 177-133.

(Kireev 1988)
Kireev S.M. - Киреев С.М. 1988. Майминский археологический комплекс - Mayminskiy arkheologicheskiy kompleks. *Проблемы изучения культуры населения Горного Алтая - Problemy izycheniya kul'tury naseleniya Gornogo Altaya.* Горно-Алтайск**,** 162-182. [in Russian]

(Kireev et al. 2002)

Kireev S.M., Ebel' A., Alekhina E., Bourgeois J., Debunne B. & van Hoof L. - Киреев С., Эбель А., Алехина Е., Буржуа Ж., Дебен Б. & Ван Хооф Л. 2002. Предварительные итоги исследования поселения Майма-XII в 2000 г. - Predvaritel'nye itogi issledovaniya poseleniya Mayma-XII v 2000 g. In: Кирюшин Ю.Ф. & Тишкин А.А. (Eds.) *Северная Евразия в Эпоху Бронзы: пространство, время, культура - Severnaya Evraziya v Epokhu Bronzy: prostranstvo, vremya, kul'tura.* Барнаул, Изд-во Алт. ун-та**,** 49-51. [in Russian]

(Kiryushin et al. 1995)

Kiryushin Y.F., Kungurov A.L. & Stepanova N.F. - Кирюшин Ю.Ф., Кунгуров А.Л. & Степанова Н.Ф. 1995. *Археология Ныижнетыткескенской пещеры 1 - Arkheologiya Nyizhnetytkeskenskoy Peshchery 1,* Барнаул, Изд-во Алт. гос. ун-та, 150p. [in Russian]

(Korol'kova 2007)

Korol'kova E.F. 2007. Die Anfänge der Forschung: die Sibirische Sammlung Peters des Grossen. In: Menghin W., Parzinger H., Nagler A. & Nawroth M. (Eds.) *Im Zeichen der Goldenen Greifen. Königsgräber der Skythen.* München, Prestel**,** 49-57.

(Kubarev 1979)

Kubarev V.D. - Кубарев В.Д. 1979. *Каменные изваяния Алтая (Оленные камни) - Kamennye izvayaniya Altaya (Olennye kamni),* Новосибирск, Наука, 184p. [in Russian]

(Kubarev 1980)

Kubarev V.D. - Кубарев В.Д. 1980. Археологические Памятники Кош-Агачского Района - Arkheologicheskie Pamyatniki Kosh-Agachkogo Rayona. *Археологический Поиск (Северная Азия) - Arkheologicheskiy Poisk (Severnaya Aziya)***,** 69-91. [in Russian]

(Kubarev 1987)

Kubarev V.D. - Кубарев В.Д. 1987. *Курганы Уландрыка - Kurgany Ulandryka,* Новосибирск, Наука, 299p. [in Russian]

(Kubarev 1988a)

Kubarev V.D. - Кубарев В.Д. 1988a. *Древние росписи Каракола - Drevnie rospisi Karakola,* Novosibirsk. [in Russian]

(Kubarev 1988b)

Kubarev V.D. - Кубарев В.Д. 1988b. Археологические Памятники Истоков Чуи - Arkheologicheskie Pamyatniki Istokov Chui. *Проблемы Изучения Древней Культуры Населения Горного Алтая - Problemy izycheniya Drevney Kul'tury Naseleniya Gornogo Altaya.* Gorno-Altaysk**,** 107-145. [in Russian]

(Kubarev 1991)

Kubarev V.D. - Кубарев В.Д. 1991. *Курганы Юстыда - Kurgany Yustyda,* Новосибирск, Наука, 187p. [in Russian]

(Kubarev 1992)

Kubarev V.D. - Кубарев В.Д. 1992. *Курганы Сайлюгема - Kurgany Saylyugema,* Новосибирск, Наука, 218p. [in Russian]

(Kubarev 1997)

Kubarev V.D. - Кубарев В.Д. 1997. *Каменные изваяния Алтая (Краткий каталог) - Kamennye izvayaniya Altaya (Kratkiy katalog),* Новосибирск - Горно-Алтайск, Ак чекчек, 184p.

(Kubarev 2007a)

Kubarev V.D. 2007a. Archaeological Monuments in the Ursul River Basin: Results and Research Prospects. In: Bourgeois J., Gheyle W., Babin V. & Luk'yanenko V. (Eds.) *The Frozen Tombs of the Altay Mountains: Strategies and Perspectives. UNESCO Workshop: compilation of papers following the conference held in Gorno-Altaysk, Altay Republic, Russian Federation, 28-31 March 2006.* Gorno-Altaysk, Gorno-Altaysk State University**,** 235-241. [in English and Russian]

(Kubarev 2007b)

Kubarev V.D. 2007b. Ancient Turkic Statues: Epic Hero or Warrior Ancestor? *Archaeology, Ethnology and Anthropology of Eurasia* 1 (29)**,** 136-144. [in English and Russian]

(Kungurov 1994a)

Kungurov A.L. - Кунгуров А.Л. 1994a. Палеолитическое жилище на поселении Усть-Куюм - Paleoliticheskoe Zhilishche na poselenii Ust'-Kuyum. *Археологические и фольклорные источники по истории Алтая - Arkheologicheskie i fol'klorye istochniki po istorii Altaya* 9**,** 13**,** 193-197. [in Russian]

(Kungurov 1994b)

Kungurov A.L. - Кунгуров А.Л. 1994b. Палеолитическая стоянка Усть-Куюм - Paleoliticheskaya stoyanka Ust'-Kuyum. *Археологические и фольклорные источники по истории Алтая - Arkheologicheskie i fol'klorye istochniki po istorii Altaya* 3**,** 9**,** 188-192. [in Russian]

(Kungurov 1997)

Kungurov A.L. - Кунгуров А.Л. 1997. Многослойное поселение Усть-Сема - Mnogosloynoe poselenie Ust'-Sema. *Источники по истории республики Алтай - Istochniki po istorii respubliki Altay.* Горно-Алтайск, изд-во ГАГУ**,** 37-59. [in Russian]

(Kuzmin et al. 2004)

Kuzmin Y.V., Slusarenko I.Y., Hajdas I., Bonani G. & Christen J.A. 2004. The comparison of C-14 wiggle-matching results for the 'floating' tree-ring chronology of the Ulandryk-4 burial ground (Altai mountains, Siberia). *Radiocarbon* 46**,** 2**,** 943-948.

(Kuzmina 2000)

Kuzmina E. 2000. The Eurasian Steppes: The Transition from Early Urbanism to Nomadism. In: Davis-Kimball J., Murphy E.M., Koryakova L. & Yablonsky L.T. (Eds.) *Kurgans, Ritual Sites, and Settlements. Eurasian Bronze and Iron Age.* Oxford, Archeopress**,** 118-125.

(Kydyev et al. 2007)

Kydyev V.E., Kubarev V.D. & Petesheva K. - Кыдыев В.Э., Кубарев В.Д. & Петешева К. 2007. *Каменные изваяния Алтайских гор - Kamennye izvayaniya Altayskikh gor,* Горно-Алтайск, ОАО Горно-Алтайская типография, 167p. [in Russian]

(Kyzlasov 1996)

Kyzlasov L.R. 1996. Northern Nomads. In: Litvinsky B.A., Guang-da Z. & Samghabadi R.S. (Eds.) *History of civilizations of Central Asia. Volume III. The crossroads of civilization: A.D. 250 to 750.* Paris, UNESCO Publishing**,** 315-325.

(Litvinsky et al. 1996)

Litvinsky B.A., Guang-da Z. & Samghabadi R.S. (Eds.) 1996. *History of civilizations of Central Asia. Volume III. The crossroads of civilization: A.D. 250 to 750,* Paris, UNESCO Publishing.

(Llobera 2001)

Llobera M. 2001. Building Past Landscape Perception With GIS: Understanding Topgraphic Prominence. *Journal of Archaeological Science* 28**,** 1005-1014.

(MacDonald 1995)

MacDonald R. 1995. CORONA: success for space reconnaissance, a look into the cold war, and a revolution for intelligence. *Photogrammetric Engineering and Remote Sensing* 61**,** 689-720.

(Malmendier 2007)

Malmendier A. 2007. La vallée d'Ujmont: Inventaire archéologique et actualisation de la méthode. Traitement des données de la campagne 1999 de l'Université de Gand (Belgique). *Faculté de Philosophie et Lettres.* Bruxelles, Université Libre de Bruxelles.

(Mamadakov 1985)

Mamadakov Y.T. - Мамадаков Ю.Т. 1985. Новые материалы гунно-сарматского времени в Горном Алтае - Novye materialy gunno-sarmatskogo vremeni v Gornom Altae. *Алтай в эпоху камня и раннего металла - Altay v epokhu kamnya i rannego metalla.* Barnaul**,** 173-171. [in Russian]

(Marchenko 1999)

Marchenko S.S. 1999. Permafrost-Climatic Conditions in the Northern Tien Shan: Recent and Expected for 21th Century Changes. *Journal of Earth Cryosphere* 3**,** 13-21.

(Marchenko 2006)

Marchenko S.S. 2006. A new threat: climate change. The frozen tombs are thawing. In: Bourgeois J. & Gheyle W. (Eds.) *The Frozen Tombs of the Altai Mountains.* Ghent, UNESCO WHC & UGent**,** 70-71.

(Marchenko 2008)

Marchenko S.S. 2008. Climate Change and its Impact on the Frozen Tombs of the Altai Mountains. In: Han J., Frank L. & Treselian D. (Eds.) *The Preservation of the Frozen Tombs of the Altai Mountains.* Paris, UNESCO World Heritage Centre**,** 61-64.

(Marsadolov 2002)

Marsadolov L.S. - Марсадолов Л.С. 2002. Новые исследования на ритуальном центре в долине р. Юстыд (юго-восточный Алтай) - Novye issledovaniya na ritual'nom tsentre v doline r. Yustyd (Yugo-vostochnyy Altay). In: Alkin S.V. (Ed.) *История и культура Востока Азии / Материалы международной научной конференции (г. Новосибирск, 9 – 11 декабря 2002 г.).* Новосибирск, Институт археологии и этнографии СО РАН. [in Russian]

(Massart et al. 2000)
Massart C., Bourgeois J. & Sourasakov A. 2000. Multidisciplinary Archaeological Research at Kizil 1995. In: Bourgeois I., Cammaert L., Massart C., Mikkelsen J.H. & Van Huele W. (Eds.) *Ancient Nomads of the Altai Mountains. Belgian-Russian Multidisciplinary Archaeological Research on the Scytho-Siberian Culture.* Brussels**,** 71-84.
(McCarthy et al. 2001)
McCarthy J.J., Canziani O.F., Leary N.A., Dokken D.J. & White K. (Eds.) 2001. *IPCC, II. Climate Change 2001, Impacts, Adaptation, and Vulnerability,* Cambridge, Cambridge University Press.
(Menghin 2007)
Menghin W.P., H. (Hrsg.) (Ed.) 2007. *Im Zeichen des Goldenen Greifen. Königsgräber der Skythen,* München-Berlin-London-New York, Prestel**,** 340p.
(Mikkelsen et al. 1999)
Mikkelsen J.H., Langohr R. & Bourgeois I. 1999. Soilscape Studies in the Discontinuous Permafrost Zone of the Altaï Mountains, SW-Siberia, and the Relation with Permanently, Frozen Scyto-Siberian Graves. *Pedologie - Themata* 6**,** 108-111.
(Molodin 1992a)
Molodin V.I. 1992a. Archaeological researches on the Ukok Plateau (Gorny-Altay, Russia) in the summer of 1991. *Antiquity* 66**,** 253**,** 930-933.
(Molodin 1992b)
Molodin V.I. 1992b. Studies in the Bertek River Valley on the Ukok Plateau. *Altaica* 1992-1**,** 23-35.
(Molodin et al. 1993)
Molodin V.I., Kahen-Delhaye (sic.) A., Massart C., Mylnikov V.P. & Khokhlova O.N. 1993. The Study of the Moinak-2 Site on the Ukok Plateau. *Altaica* 2**,** 21-49.
(Molodin 1996)
Molodin V.I. 1996. Un kourgane gelé d'époque scythe. *Dossiers d'Archéologie***,** 212**,** 36-41.
(Molodin 2000)
Molodin V.I. 2000. The Pazyryk culture: problems of origins, ethnic history, and historical destiny. *Archaeology, ethnology and anthropology of Eurasia* 4**,** 4**,** 131-142.
(Molodin & Polosmak 2000)
Molodin V.I. & Polosmak N.V. 2000. Grave sites of the Pazyryk Culture on the Ukok Plateau. *Archaeology, ethnology and anthropology of Eurasia* 4**,** 66-87.
(Molodin 2001)
Molodin V.I. 2001. Bronzezeit im Berg-Altai. *Eurasia antiqua* 7**,** 1-51.
(Molodin et al. 2004)
Molodin V.I., Polos'mak N.V., Novikov A.V., Bogdanov E.S., Slyusarenko I.Y. & Cheremisin D.V. - Молодин В.И., Полосьмак Н.В., Новиков А.В., Богданов Е.С., Слюсаренко И.Ю., Черемисин Д.В. & 2004. *Археологические памятники плоскогорья Укок (Горный Алтай) - Archeologicheskie pamyatniki ploskogor'ya Ukok (Gornyy Altay),* Novosibirsk, Institut Archeologii i Etnografii SO RAN, 255p. [in Russian]
(Molodin et al. 2007)
Molodin V.I., Parzinger H. & Ceveendorž D. 2007. Das Kriegergrab von Olon-Kurin-Gol. In: Menghin W., Parzinger H., Nagler A. & Nawroth M. (Eds.) *Im Zeichen der Goldenen Greifen. Königsgräber der Skythen.* München, Prestel**,** 148-155.
(Motorola 2008)
Motorola 2008. http://www.motorola.com/gps, Motorola GPS, 15-01-2008
(NASA 2005)
NASA 2005. *GISS Surface Temperature Analysis. Global Temperature Trends: 2005 summation,* New York, Goddard Institute for Space Studies. http://data.giss.nasa.gov/gistemp/2005
(NOAA NCDC 2005)
NOAA NCDC 2005. *Climate of 2005 - in Historical Perspective. Annual Report,* Asheville, National Oceanic and Atmospheric Administration, National Climatic Data Center. http://www.ncdc.noaa.gov/oa/climate/research/2005/ann/global.html
(NOOA NGDC 2008)
NOOA NGDC 2008. http://www.ngdc.noaa.gov/geomagmodels/Declination.jsp NOOA NGDC Magnetic Field Calculator, 10-06-2008

(Novikov et al. 1996)

Novikov I.S., Misrukov A.A. & Trefois P. 1996. Geomorphological structure of the Chuya intramontane depression (Gorny Altai). *Russian Geology and Geophysics* 37**,** 11**,** 51-58.

(NRO 2008)

NRO 2008. http://www.nro.gov/corona/facts.html, Corona, 25-06-2008

(Okladnikov 1972)

Okladnikov A.P. - Окладников А.П. 1972. Улалинка - древнепалеолитический памятник Сибири - Ulalinka - drevnepaleoliticheskii pamiatnik Sibiri. *МИА - Materialy i issledovaniia po arkheologii SSSR* 185**,** 7-19. [in Russian]

(Okladnikov et al. 1979)

Okladnikov A.P., Okladnikova E.A., Zaporozhskaya V.D. & Skorynina E.A. - Окладников А.П., Окладникова Е.А., Запорожская В.Д. & Э.А. С. 1979. *Петроглифы долины реки Елангаш (юг Горного Алтая) - Petroglify doliny reki Elangash (yug Gornogo Altaya),* Novosibirsk, Новосибирск Наука, 136p. [in Russian]

(Okladnikov & Pospelova 1982)

Okladnikov A.P. & Pospelova G.A. 1982. Ulalinka, the Oldest Palaeolithic Site in Siberia. *Current Anthropology* 23**,** 6**,** 710-712.

(Panyushkina et al. 2006)

Panyushkina I., Sljusarenko I., Bikov N. & Bogdanov E. 2006. Floating larch tree-ring chronologies from archaeological timbers in the Russian Altai between about 800 BC and ad 800. In: *19th International Radiocarbon Conference.* 693-702. [in English]

(Parkinson & Spilker 1996)

Parkinson B.W. & Spilker J. (Eds.) 1996. *Global Positioning System: Theory and Applications,* s.l. USA, American Institute of Aeronautics and Astronautics.

(Parzinger et al. 2001)

Parzinger H., Nagler A. & Çugunov K. 2001. Der Fürst von Arzhan, Ausgrabungen im skythischen Fürstengrabhügel Arzhan 2 in der südsibirischen Republik Tuva. *Antike Welt* 32**,** 6**,** 607-614.

(Parzinger 2006a)

Parzinger H. 2006a. *Die frühen Völker eurasiens vom Neolithikum bis zum Mittelalter,* München, Verlag C.H. Beck oHG, 1045p.

(Parzinger 2006b)

Parzinger H. 2006b. Frozen Tombs of the Pazyryk culture in Mongolia. In: Bourgeois J. & Gheyle W. (Eds.) *The Frozen Tombs of the Altai Mountains.* Ghent, Ghent University & UNESCO**,** 57-61.

(Parzinger 2007)

Parzinger H. 2007. Die Reiternomaden der Eurasiatischen Steppe während der Skythenzeit. In: Menghin W., Parzinger H., Nagler A. & Nawroth M. (Eds.) *Im Zeichen der Goldenen Greifen. Königsgräber der Skythen.* München, Prestel**,** 30-48.

(Parzinger et al. 2008)

Parzinger H., Molodin V.I. & Ceveendorz D. 2008. *Der Skythenzeitliche Krieger aus dem Eis: Neue Entdeckungen im Mongolischen Altaj. Ergebnisse einer Russisch-Deutsch-Mongolischen Expedition im Sommer 2006,* Amsterdam, Stichting Nederlands Museum voor Anthropologie en Praehistorie, 66 p.

(Peebles 1997)

Peebles C. 1997. *The CORONA Project. America's First Spy Satellites,* Annapolis, Naval Institute Press.

(Philip et al. 2002)

Philip G., Donoghue D., Beck A. & Galiatsatos N. 2002. CORONA satellite photography: an archaeological application from the Middle East. *Antiquity* 76**,** 109-118.

(Pogozheva & Kadikov 1980)

Pogozheva A.P. & Kadikov B.K. - Погожева А.П. & Кадиков Б.Х. 1980. Раскопки многослойного поселения Кара-Тенеш в 1976 г. - Raskopki mnogosloynogo poseleniya Kara-Tenesh v 1976 g. *Источники по археологии Северной Азии - Istochniki po arkheologii Severnoy Azii.* Новосибирск**,** 199- 216. [in Russian]

(Pogozheva & Molodin 1980)

Pogozheva A.P. & Molodin V.I. - Погожева А.П. & Кадиков Б.Х. 1980. Раскопки на поселении Кара-Тенеш (1978 г.) - Raskopki na poselenii Kara-Tenesh (1978 g.). *Археологический поиск (Северная Азия) - Arkheologicheskiy poisk (Severnaya Aziya).* Новосибирск**,** 92-98. [in Russian]

(Polosmak 1991)
Polosmak N.V. 1991. Un nouveau kourgane à "tombe gelée" de l'Altaï (raport préliminaire). *Arts Asiatiques* XLVI**,** 5-13.
(Polosmak 1994)
Polosmak N.V. 1994. The Ak-Alakh "Frozen Grave" Barrow. *Ancient Civilizations from Scythia to Siberia* 1**,** 3**,** 346-354.
(Polosmak & Van Noten 1995)
Polosmak N.V. & Van Noten F. 1995. Les Scythes de l'Altaï. *La Recherche* 26**,** 276**,** 524-529.
(Polosmak 1996a)
Polosmak N.V. - Полосьмак Н.В. 1996а. Погребение Знатной Пазырыкской Женщины. *Вестник Древней Истории* 4**,** 219**,** 142-167.
(Polosmak 1996b)
Polosmak N.V. 1996b. La prêtresse altaïque. *Dossiers d'Archéologie***,** 212**,** 28-35.
(Polosmak & Seifert 1996)
Polosmak N.V. & Seifert M. 1996. Menschen aus dem Eis Sibiriens. Neuentdeckte Hügelgräber (Kurgane) im Permafrost des Altai. *Antike Welt* 27**,** 2**,** 87-108.
(Polosmak & Molodin 2000)
Polosmak N.V. & Molodin V.I. 2000. Памятники Пазырыкской культуры на плоскогорье Укок - Pamyatniki Pazyrykskoy kul'tury na ploskogor'e Ukok - Grave sites of the Pazyryk Culture on the Ukok Plateau. *Archaeology, ethnology and anthropology of Eurasia* 4**,** 4**,** 66-87. [in Russian and English]
(Polosmak 2004)
Polosmak N.V. 2004. Tattoos in the Pazyryk World. *Archaeology, ethnology and anthropology of Eurasia* 4**,** 95-102.
(Postnov et al. 2000)
Postnov A.V., Anoykin A.A. & Kulik N.A. 2000. Criteria for the selection of raw materials in Paleolithic industries of the Anui river basin (Gorny Altai). *Archaeology, Ethnology and Antrhropology of Eurasia* 3**,** 3**,** 18-30.
(Radlov 1888)
Radlov V.V. - Радлов В.В. 1888. *Сибирские древности - Sibirskie drevnosti,* Sankt-Peterburg, 80p. [in Russian]
(Radlov 1895)
Radlov V.V. - Радлов В.В. 1895. *Сибирские древности. Из путевых заметок по Сибири - Sibirskie drevnosti. Iz putevykh zametok po Sibiri,* Sankt-Peterburg. [in Russian]
(Renfrew & Bahn 1991)
Renfrew C. & Bahn P. 1991. *Archaeology. Theories, methods and practice,* London, Thames and Hudson.
(Roscoe Hudson & Sharp 2001)
Roscoe Hudson J. & Sharp T. 2001. Globally corrected GPS (GcGPS): C-Nav GPS system. In: *the Dynamic Positioning Conference.*
(Ross & Thomsen 1930)
Ross E.D. & Thomsen V. 1930. The Orkhon Inscriptions: Being a Translation of Professor Vilhelm Thomsen's Final Danish Rendering. *Bulletin of the School of Oriental Studies, University of London* 5**,** 4**,** 861-876.
(Rudenko 1960)
Rudenko S.I. - Руденко С.И. 1960. *Культура населения Централного Алтая в Скифское время - Kul'tura naseleniya Tsentralnogo Altaya v Skifskoe vremya,* Moskva/Leningrad, Uzd. Akademii Nauk SSSR, 351p. [in Russian]
(Rudenko 1970)
Rudenko S.I. 1970. *Frozen Tombs of Siberia. The Pazyryk Burials of Iron-Age Horsemen,* London, J.M. Dent & Sons Ltd.
(Ruffner 1995)
Ruffner K.C. 1995. *Americas First Satellite Program,* Washington, CIA History Staff.
(Ruppe 1966)
Ruppe R.J. 1966. The Archaeological Survey: A Defense. *American Antiquity* 31**,** 3**,** 313-333.
(Samašev 2007)
Samašev Z. 2007. Die Fürstengräber von Berel'. In: Menghin W., Parzinger H., Nagler A. & Nawroth M. (Eds.) *Im Zeichen der Goldenen Greifen. Königsgräber der Skythen.* München, Prestel**,** 132-139.

(Samashev et al. 2000)
Samashev Z.S., Bazarbaeva G.A., Zhumabekova G.S. & Francfort H.-P. 2000. Le kourgane de Berel' dans l'Altaï kazakhstanais. *Arts Asiatiques* 55**,** 5-20.

(Samashev et al. 2006)
Samashev Z.S., Bazarbaeva G. & Dzhumabekova G. 2006. Archaeological Research in Berel in 2006. In: Bourgeois J. & Gheyle W. (Eds.) *The Frozen Tombs of the Altai Mountains.* Ghent, Ghent University & UNESCO**,** 47-48.

(Schmidt et al. 2001)
Schmidt M., Goossens R., Menz G., Altmaier A. & Devriendt D. 2001. The use of CORONA satellite images for generating a high-resolution digital elevation model (DEM). *Scanning the Present and Resolving the Future* vol. VII**,** 3123-3125.

(Schneider et al. 2001)
Schneider T., Jacobsen K., Seitz R. & Förster B. 2001. Remote sensing based parameter extraction for erosion control purposes in the loess plateau of China. In: *Joint Workshop of ISPRS Working Groups I/2, I/5 and IV/7, High Resolution Mapping from space 2001.*

(Shahgedanova 2002)
Shahgedanova M. (Ed.) 2002. *The Physical Geography of Northern Eurasia,* Oxford, Oxford University Press**,** 571p.

(Sinor & Klyashtorny 1996)
Sinor D. & Klyashtorny S.G. 1996. The Türk Empire. In: Litvinsky B.A., Guang-da Z. & Samghabadi R.S. (Eds.) *History of civilizations of Central Asia. Volume III. The crossroads of civilization: A.D. 250 to 750.* Paris, UNESCO Publishing**,** 327-347.

(Slama 1980)
Slama C. 1980. *Manual of Photogrammetry,* Falls Church, The American Society of Photogrammetry and Remote Sensing, Falls Church.

(Slusarenko et al. 2001)
Slusarenko I.Y., Christen J.A., Orlova L.A., Kuzmin Y.V. & Burr G.S. 2001. C-14 wiggle matching of the 'floating' tree-ring chronology from the Altai Mountains, southern Siberia: The Ulandryk-4 case study. *Radiocarbon* 43**,** 2A**,** 425-431.

(Slyusarenko et al. 2007)
Slyusarenko I.Y., Krupochkin E.P. & Bykov N.I. 2007. Contemporary approaches to the problem of the cartography of archaeological monuments (case study of the Yustyd archaeological micro region, southeastern Altai). In: Bourgeois J., Gheyle W., Babin V. & Luk'yanenko V. (Eds.) *The Frozen Tombs of the Altay Mountains: Strategies and Perspectives. UNESCO Workshop: compilation of papers following the conference held in Gorno-Altaysk, Altay Republic, Russian Federation, 28-31 March 2006.* Gorno-Altaysk, RIO GAGU**,** 272-279. [in English and Russian]

(Sohn et al. 2004)
Sohn H.-G., Kim G.-H. & Yom J.-H. 2004. Mathematical modelling of historical reconnaissance CORONA KH-4B imagery. *The Photogrammetrical Record* 19**,** 105**,** 51-66.

(Sorokin 1969)
Sorokin S.S. - Сорокин С.С. 1969. Материалы к Археологии Горного Алтая - Materialy k Arkheologii Gornogo Altaya. *Uchenye Zapiski.* Barnaul, Gorno-Altayskiy Nauchno-Issledovatel'kiy Institut Istorii, Yazika i Literatury**,** 71-88. [in Russian]

(Soyonov & Ebel' 1988)
Soyonov V.I. & Ebel' A. - Соёнов В.И. & Эбель А.В. 1988. Исследования на могильнике Курайка - Issledovaniya na mogil'nike Kurayka. *Древности Алтая - Drevnosti Altaya* 3**,** 113-135. [in Russian]

(Soyonov & Ebel' 1992)
Soyonov V.I. & Ebel' A. - Соёнов В.И. & Эбель А. 1992. *Курганы гунно-сарматской эпохи на Верхней Катуни - Kurgany gunno-sarmatskoy epokhi na Verkhey Katuni,* Gorno-Altaysk, 116p. [in Russian]

(Soyonov 1999)
Soyonov V.I. - Соёнов В.И. 1999. Раскопки на могильнике Сары-Бел - Raskopki na mogil'nike Sary-Bel. *Древности Алтая - Drevnosti Altaya* 4**,** 134-152. [in Russian]

(Supresoft Inc. 2004)
Supresoft Inc. 2004. http://www.supresoft.com.cn/english/products/virtuozo/virtuzo.htm, VirtuoZo, 15-01-2008

(Surazakov 1988)
Surazakov A.S. - Суразаков А.С. 1988. Ирбисту 1 - Irbistu 1. *Проблемы изучения культуры населения Горного Алтая - Problemy izycheniya kul'tury naseleniya Gornogo Altaya.* Gorno-Altaysk, Gorno-Altayskiy Nauchno-Issledovatel'kiy Institut Istorii, Yazika i Literatury**,** 31-38. [in Russian]

(Surazakov & Larin 1994)
Surazakov A.S. & Larin O.V. - Суразаков А.С. & Ларин О.В. 1994. К семантике каракольских писаниц - K semantike karakol'skikh pisanits. *Археологические и фольклорные источники по истории Алтая - Arkheologicheskie i fol'klorye istochniki po istorii Altaya***,** 31-38. [in Russian]

(University of Nottingham 2002)
University of Nottingham 2002. http://www.bigf.ac.uk/gringo/index.html, Gringo Software, 15-01-2008

(Ur 2003)
Ur J. 2003. CORONA satellite photography and ancient road networks: a Northern Mesopotamian case study. *Antiquity* 77**,** 102-115.

(Ur 2005)
Ur J. 2005. Sennacherib's Northern Assyrian Canals: New Insights from Satellite Imagery and Aerial Photography. *Iraq* LXVII/I**,** 317-345.

(USGS EROS 2006a)
USGS EROS 2006a. http://edc.usgs.gov/products/satellite/declass2.html, Declassified Satellite Imagery - 2, 14-01-2008

(USGS EROS 2006b)
USGS EROS 2006b. http://edc.usgs.gov/products/satellite/declass1.html, Declassified Satellite Imagery - 1, 14-01-2008

(USGS EROS 2006c)
USGS EROS 2006c. http://edc.usgs.gov/guides/disp1.html, Declassified Satellite Imagery - 1 (1996), 14-01-2008

(USGS EROS 2007)
USGS EROS 2007. http://edcsns17.cr.usgs.gov/EarthExplorer/, EarthExplorer, 14-01-2008

(Van Bever 2005)
Van Bever B. 2005. De aanmaak van een DEM, orthofotoplan en hoogtelijnenkaart voor archeologisch gebruik, aan de hand van CORONA KH-4B beelden. Toegepast op de Yustidvallei (Altairepubliek, Rusland). *Vakgroep Geografie.* Gent, Universiteit Gent.

(Vanommeslaeghe 2006)
Vanommeslaeghe M. 2006. Fotogrammetrische restitutie van Corona KH-4B beelden voor de aanmaak van basisdocumenten voor archeologische survey. Toegepast of Dzjazatorvallei - Altaïrepubliek - Rusland. *Vakgroep Geografie.* Gent, Universiteit Gent.

(Vladimirov & Tsyb 1982)
Vladimirov V.I. & Tsyb S.V. - Владимиров В.Н. & Цыб С.В. 1982. Афанасьевское культовое место у с.Кара-Коба - Afanas'evskoe kul'tovoe mesto u s. Kara-Koba. *Археология Северной Азии - Arkheologiya Severnoy Azii.* Новосибирск**,** 55-62. [in Russian]

(Wandsnider & Camilli 1992)
Wandsnider L. & Camilli E.L. 1992. The Character of Surface Archaeological Deposits and its Influence on Survey Accuracy. *Journal of Field Archaeology* 19**,** 2**,** 169-188. [in English]

(Wang 2001)
Wang B. 2001. Hirschsteine in Xinjiang. *Eurasia Antiqua. Zeitschrift für Archäologie Eurasiens* Band 7**,** 105-129.

(Wheatley 1995)
Wheatley D. 1995. Cumulative Viewshed Analysis: a GIS-based method for investigating intervisibility, and its archaeological application In: Lock G. & Stancic Z. (Eds.) *Archaeology and GIS: A European Perspective.* London, Routledge**,** 171-185.

(Wheatley & Gillings 2000)
Wheatley D. & Gillings M. 2000. Vision, perception and GIS: developing enriched approaches to the study of archaeological visibility. In: Lock G. (Ed.) *Beyond the Map.* Amsterdam, IOS Press**,** 1-27.

(Wheelon 1997)
Wheelon A.D. 1997. CORONA: The First Reconnaissance Satellites. *Physics Today***,** February 1997**,** 24-30.

(Wilkinson 2004)

Wilkinson T.J. 2004. The Archaeology of Landscape. In: Bintliff J. (Ed.) *A Companion to Archaeology.* Oxford, Blackwell**,** 334-356.

(Willems et al. 2002)

Willems T., De Wulf A. & Brondeel M. 2002. Integration of multi-station longrange DGNSS data. In: *International Conference on Integrated Navigation Systems.* 88-94.

(Wright 2007)

Wright J. 2007. Organizational principles of Khirigsuur monuments in the lower Egiin Gol valley, Mongolia. *Journal of Anthropological Archaeology* 26**,** 3**,** 350-365.

(Yablonsky 2000)

Yablonsky L.T. 2000. "Scythian Triad" and "Scythian World". In: Davis-Kimball J., Murphy E.M., Koryakova L. & Yablonsky L.T. (Eds.) *Kurgans, Ritual Sites, and Settlements. Eurasian Bronze and Iron Age.* Oxford, Archeopress**,** 3-8.

(Yablonsky 2006)

Yablonsky L.T. 2006. Scythians and Saka: Ethnic Terminology and Archaeological Reality. In: Aruz J.F., A., Valtz Fino, E. (eds.) (Ed.) *The Golden Deer of Eurasia. Perspectives on the Steppe Nomads of the Ancient World.* New York, The Metropolitan Museum of Art**,** 24-31.

(Yunck et al. 1996)

Yunck T.P., Bar-Sever Y.E., Iijima B.A., Lichten S.M., Lindqwister U.J., Mannucci A.J., Muellerschoen R.J., Munson T.N., Romans L.J. & Wu S.C. 1996. A prototype WADGPS system for real time sub-meter positioning worldwide. In: *the Ninth International Technical Meeting of the Institute of Navigation.* 1819-1826.

(Zhang & Liu 1998)

Zhang L. & Liu J. 1998. *Numerical investigation of experimental roadbed thermal stability on Fenghuoshan permafrost in Tibet,* Yakutsk, SB RAS Publishers.

11 List of figures

Figure 1.1: An overview of the Altay Mountains with the present-day borders of the Russian Federation and its republics, Mongolia, China and Kazakhstan (white dots). The red dots roughly indicate the extent of the Altay 31
Figure 1.2: Overview map of the Altay Mountains and the Russian Altay Republic, with indication of some of the important archaeological sites mentioned in the text 37
Figure 1.3: Overview of the Chuya steppe towards the North Chuya range, about 30 km away 38
Figure 1.4: The Eurasian steppes stretching from the Black Sea to Manchuria, showing the location of the Altay Mountains 39
Figure 1.5: Polychromatic drawings on stone slabs from a Karakol burial (Photo: V.D. Kubarev, IAE SBRAS, Novosibirsk) 43
Figure 1.6: Mythological creatures combining elements of predator and prey, as found in tattoos on Early Iron Age people buried in the tombs of Pazyryk (Russian Altay). Reconstruction: Ivo Verhaeghe, Ghent University 45
Figure 1.7: The burial mounds of Tuekta (left: Tuekta-1 is the second mound from the right) and Bashadar (right: mound Bashadar-2) as pictured by J. Bourgeois during a reconnaissance flight in 2007 51
Figure 1.8: The site plan of the Bashadar complex, as measured in 2007 by Ghent University (UGent) and the Gorno-Altaysk State University (GASU) 51
Figure 1.9: The IAE SBRAS survey project: extract of the resulting map showing part of the Ukok plateau (Molodin et al. 2004) 54
Figure 1.10: The Mongolian Altay Inventory: overview map indicating all study points in north-western Mongolia (Copyright 2008, University of Oregon) 55
Figure 1.11: Located archaeological clusters on the satellite imagery compared to the GPS-made cluster plans (1996-1997) in Bourgeois et al. (2000a: 111-121). The photo covers an area of 2,230 by 1,600 metres in the Sebystey valley 59
Figure 1.12: Research areas in the 2003-2008 fieldwork, in the Russian and Kazakh parts of the Altay Mountains 61
Figure 1.13: Temperature profile under a stone burial mound: the blue area represents the preserved ice lens (Image: Sergei Marchenko) 64
Figure 1.14: Original layout of the Frozen Tombs Initiative showing the different phases of the project 66
Figure 1.15: Thermosyphons extract warm air from the underground and replace it by cold air. They could be installed in burial mounds to preserve permafrost under the stone mound (Image: Sergei Marchenko) 67
Figure 2.1: Sebystey 1996-1997: measured points during the topographical GPS survey (left), and resulting contour map of the middle part of the valley (right) 70
Figure 2.2: The CORONA camera systems used in KH-1 to KH-6 (after NRO 2008) 73
Figure 2.3: The CORONA system's backward- and forward-looking cameras and the process of stereoscopic capturing (from Sohn et al. 2004) 75
Figure 2.4: An example of the CORONA system's stereoscopic coverage: CORONA mission 1110-1, revolution 052D, made on 20 May 1970. Above is forward image DS1110-1052DF046, below is backward image DS1110-1052DA052 75
Figure 2.5: Image displacements in a KH-4B image (from Schneider et al. 2001) 75
Figure 2.6: Presumed ground coverage of a CORONA image, not taking into account the conical and S-shaped distortion: each quadrangle represents 5 x 5 km 77
Figure 2.7: Typical geometrical distortions due to the conical projection: each quadrangle represents 5 x 5 km (after Slama 1980) 77

Figure 2.8: The S-shaped distortion on a CORONA negative caused by the specific way of recording: each quadrangle represents 5 x 5 km (after Schneider et al. 2001). 77
Figure 2.9: Example of four-day coverage of Eurasia during KH-4A Mission 1017, showing the selective coverage of the cameras (after NRO 2008) 79
Figure 2.10: Map showing the CORONA KH-4A and KH-4B images used above the research areas. Only the backward images are shown: the forward images cover the same areas 80
Figure 2.11: The forward (above) and backward (below) images used for research in 2003, produced by the CORONA KH-4A sensor. The research areas are indicated with a rectangle: north is top right 81
Figure 2.12: The forward (above) and backward (below) image of the CORONA KH-4B sensor, covering 13.8 x 188 km. The study area is indicated with a rectangle on the left-hand side of the images: north is top right 81
Figure 2.13: The forward (above) and backward (below) images of the CORONA KH-4B sensor covering the study area in the Dzhazator valley. It is indicated with rectangles: north is top right 82
Figure 2.14: The forward (above) and backward (below) images of the CORONA KH-4B sensor, covering 13.8 x 188 km. The study areas are situated on the left-hand side of the images, and are indicated with rectangles: above is Berel, then Bukhtarma and Karakaba: north is above right 83
Figure 2.15: The forward (above) and backward (below) images of the CORONA KH-4B sensor, covering the study area. The Karakol valley is situated on the right-hand side of the images, running approximately north-south (see rectangle): north is top right 84
Figure 2.16: An unnatural height difference of up to 20 m, clearly visible on the contour map, runs through the Karakaba valley, for the length of the CORONA film negative. Zooming into the scanned image shows a scan error on the same spot (image: Dries Dossche) 85
Figure 2.17: Scratch on a CORONA film negative, probably caused by handling the film during processing. It can be seen running horizontally through the image, the length of the negative, ‘crossing’ the two rivers 86
Figure 2.18: Scan errors on CORONA image DS1104-1039DA009 86
Figure 2.19: Six examples of scan errors in CORONA image DS1104-1039DA009. The exact location of the errors is specified in Figure 2.18 86
Figure 2.20: Morphographic map of the Elangash valley, made in 2002 using CORONA KH-4A imagery 88
Figure 2.21: The C-Nav receiver and the antenna in the field 91
Figure 2.22: Some examples of GCPs, measured with the C-Nav 2050 receiver. 94
Figure 2.23: Location of GCPs: 2003: red; 2004, purple; 2005, green; 2006, blue; 2007, orange 95
Figure 2.24: The process of relative orientation in the VirtuoZo environment. Corresponding points, selected by image matching, are indicated by red crosses. This example shows the Dzhazator valley: the forward image is above, the backward image is below. The green quadrangle is the restitution area 97
Figure 2.25: Overview of the CORONA orthophotos from the research areas in 2003-2006. The Karakol valley is not included on the map, as it lies too far to the north-west to be shown using the same scale 98
Figure 2.26: Karakaba valley: overlay or drape of the resulting orthophoto on the DSM (research: Dries Dossche) 98
Figure 2.27: Difference between original VirtuoZo contour lines (grey) and contour lines after drawing, clean-up and smoothing (black) (image: Dries Dossche) 99
Figure 2.28: Orthophoto of the research areas in 2003, based on CORONA KH-4A imagery 101
Figure 2.29: Contour map of the research areas in 2003, only for the northern part of the research area 101
Figure 2.30: Orthophoto of the Yustyd valley based on CORONA KH-4B imagery 105
Figure 2.31: Yustyd valley: resulting orthophoto with contour map 105

Figure 2.32: Dzhazator valley: orthophoto resulting from two stereo pairs of CORONA KH-4B imagery. Notice the number of clouds in the eastern and southern parts of the valley. 106
Figure 2.33: Dzhazator valley, north-western part: contour lines and CORONA orthophoto 107
Figure 2.34: Dzhazator valley, south-eastern part: contour lines from ASTER and orthophoto 107
Figure 2.35: An overview of the two CORONA strips in Dzhazator clearly shows the overlap of 10% between the two forward images. However, the two areas for the restitution process (green quadrangles) are smaller and no longer have an overlap 108
Figure 2.36: Karakaba valley: orthophoto indicating GCPs 109
Figure 2.37: Karakaba valley: contour map with 10- and 100-metre intervals 109
Figure 2.38: Karakaba: hillshade model of the valley, clearly showing three parallel lines. They are parallel with the long axis of the satellite images 110
Figure 2.39: Bukhtarma valley: orthophoto resulting from two stereo pairs of CORONA KH-4B imagery. The southern stereo couple covers the central part of the Bukhtarma valley where the survey took place. Two additional orthophotos were created to the west and to the east of this area (faded), for possible surveys in the future. The Berel site is located in the north-west corner of the map 111
Figure 2.40: Contour map of the central part of the Bukhtarma valley 112
Figure 2.41: Contour map of the triangular terrace of the Berel site and its direct surroundings 112
Figure 2.42: Berel: the resulting contour map (left) and an earlier topographic plan (right: image from Margulan Archaeological Institute) 113
Figure 2.43: Karakol valley: orthophotos of the northern and central CORONA image 114
Figure 2.44: Contour map of the Uch-Enmek Park and the Karakol valley with the CORONA orthophotos in the background 115
Figure 3.1: Visual surface detection or field walking in Karakaba, Kazakh Altay, and the recording of an archaeological site in Dzhazator, Russian Altay 119
Figure 3.2: Difference in visibility due to ground cover: Yustyd (mountain steppe, arid) and Karakol (alpine vegetation, humid): both taken on 6 July (in 2006 and in 2008) 121
Figure 3.3: The excavations in Berel clearly show around 30 cm of soil formation that covers the Iron Age surface level, and thus most of the smaller archaeological structures 122
Figure 3.4: Recent stone accumulations in Karakol, visible on the CORONA imagery as small almond-shaped dots in a more or less regular grid on the fields parallel to the direction of the plough furrows. The stones are cleared from the field to prepare it for agricultural activities. Areas with larger monuments, e.g. burial mounds, are not cleared and are left as fallow ground with grasses and bushes (see the darker areas marked with dots) 122
Figure 3.5: Measuring with the rover station (the Leica SR 20 GPS receiver, left), the positioning of a reference antenna in the field (centre), and the location of the reference station in the base camp, powered by solar panels (right) 124
Figure 3.6: Plan of a GPS configuration with two reference stations in the camp, one in the field, and rovers that are used to measure individual points. The position of reference station 1 and 3 is recalculated in relation to reference station 1, to improve the relative accuracy. For every rover point, three positioning results are obtained. The final position is the mean of these three results 124
Figure 3.7: Leica SR 20 GPS measurements are transformed into a site plan in AutoCAD 126
Figure 3.8: Field book as used for the registration of the sites or locations were structures are found (site level) and for the registration of individual structures (structure level) 129
Figure 3.9: An example of two monuments that enable a relative date to be proposed: two *kereksur* surrounded by stone circles in the valley of Yustyd 130
Figure 3.10: An overview of part of the right bank of the Yustyd valley: the density of structures makes it difficult to define sites 133
Figure 3.11: World map showing the magnetic declination (NOOA NGDC) 135
Figure 3.12: Site location level 137
Figure 3.13: Site organisation level 137

Figure 3.14: Individual structure level 137
Figure 3.15: An illustration of the different levels of information in the GIS: overview 142
Figure 3.16: An illustration of the different levels of information in the GIS: site level 143
Figure 4.1: Chronological distribution of archaeological structures in the different research areas surveyed in 2003: Sebystey, Ozyok, Irbistu, Elangash and the southern border of the Chuya steppe 148
Figure 4.2: Chronological distribution of the archaeological structures on the right bank of the Yustyd River 151
Figure 4.3: Chronological distribution of the archaeological structures in the Dzhazator valley 153
Figure 4.4: Chronological distribution of the archaeological structures in Karakaba, Bukhtarma and the Bukhtarma river terrace in Berel 155
Figure 4.5: Chronological distribution of the archaeological structures in the Karakol valley 158
Figure 4.6: Chronological distribution of all 12,047 structures in the database 159
Figure 4.7: Augering and temperature measurements in the Dzhazator valley, in search of permafrost zones 160
Figure 4.8: Sergei Marchenko at work in the Ulandryk valley, implanting data loggers at several depths in the surroundings of Scythian burial mounds to monitor the temperature over a whole year 161
Figure 4.9: Temperatures in the Ulandryk valley, June 2006 to July 2007 (Marchenko 2008) 162
Figure 4.10: An example of the many aerial photos that were made during the survey: two north south alignments of Early Nomadic burial mounds, just south of Boochi. Right: the deltaplane 163
Figure 4.11: Flight route (red dots) of the aerial survey in the Uch-Enmek Park, logged by an on-board GPS receiver (Garmin Vista) 164
Figure 5.1: Overview of monument types in the Yustyd valley, as defined by Kubarev. North is above; the scale varies throughout the image. He mentions, from right to left: 1) *kereksur*; 2) possibly late Bronze Age burial mound; 3) burial mound from the Early Nomads and Turkic period; 4) possibly Hunnic burial mounds; 5) ritual enclosures; 6-8) ritual mounds; 9) Scythian rectangular enclosures with standing stones; 10-11) ritual stone circles; 12) different types of Turkic enclosures; 13-20) stone settings made of river boulders (Kubarev 1980: 88-89) 168
Figure 5.2: Chronological overview of the archaeology of the Ukok plateau, including burial monuments, excavated artefacts and petroglyphs (Molodin et al. 2004: 223) 168
Figure 5.3: Bronze Age stone mounds overlooking the vast Chuya steppe on top of a hill, just north of the Yustyd valley (Turu-Alty ridge, research 2004) 174
Figure 5.4: This overview of a typical Scythian type burial complex in Sebystey (site KA-081) shows the central line of burial mounds, the rows of standing stones or *balbal* in the east (left) and the stone circles in the west (right). The picture is taken on hills north-west of the site, looking to the south-east 176
Figure 5.5: Plan of site KA-233 in Yustyd (Kubarev's number Yustyd XII). Several lines of ritual stone circles and associated stone platforms are constructed west of the burial mounds. In the east, some mounds have a row of standing stones or *balbal*. In addition, there is a small group of stone circles and a long line of stone platforms 177
Figure 5.6: The NS diameter of Scythian burial mounds: 94% of the mounds are smaller than 20 m, and 793 are between 6 and 10 m in diameter (409+384) 179
Figure 5.7: This somewhat strange graph shows the NS diameter of every individual burial mound in the database. It is clearly visible that most mounds are smaller than 18 m; only Berel and Karakol have mounds that double and even triple this maximum measurement 180
Figure 5.8: This diagram shows the orientation of the rows of Scythian burial mounds, with an average of 6.1° 181
Figure 5.9: Average orientation of alignments of standing stones or *balbal* east of Scythian burial mounds 181
Figure 5.10: Site KA-050 in the Ozyok valley, stretching over more than 720 m 183

Figure 5.11: Site KA-722 (left) and KA-741 (right) in Yustyd have a different site layout. Site 722 and the southern part of 741 have only a single row of stone circles in the west, and a more elaborate layout in the east, with stone platforms (Type I). In contrast, the northern part of site 741 has only some standing stones in the east, and a complex setting of stone circles and stone platforms in the west (Type II) 184
Figure 5.12: Typical site layout for the largest burial mounds in the Karakol valley, with one or two curved lines of stone circles west of the mounds. Left is site ON-022, right is site ON-042 184
Figure 5.13: The row of stone circles west of the burial mounds at site ON-022, seen from the south 185
Figure 5.14: A Turkic burial mound in Irbistu, at the border of the Chuya basin (site KA-038) 186
Figure 5.15: The preliminary site plan of Nizhniy Sooru, in the Karakol valley (site ON-062). The bigger circles are rows of Scythian burial mounds while the smaller ones with lines of standing stones to the north of them are possibly Turkic mounds 187
Figure 5.16: A group of small, oval-shaped Hunno-Sarmatian graves on the Ukok Plateau: site Ust'-Akkol -1, recorded by V. Molodin in 1994 (Molodin et al. 2004: 153-55), and an overview of site KA-059, with rows of small Hunno-Sarmatian graves (right) 188
Figure 5.17: Site KK-059 in the Bukhtarma valley, consisting of 109 Hunno-Sarmatian graves and some structures from other periods (for full site plan, see DVD 2) 189
Figure 5.18: Low collared mound in Yustyd, tentatively dated back to the Bronze Age (structure KA-172-003) 189
Figure 5.19: A clear and undisturbed example of the so-called toothed collared mounds was found somewhat north of Yustyd in the Chuya steppe, where the Bar-Burgazy River flows into the Chuya basin. This site has not been recorded in the database yet 190
Figure 5.20: Collared mounds occasionally appear in north-south aligned rows of Early Iron Age burial mounds, as shown by this site plan of cluster KA-373 in Yustyd (see data disc for full site plan) 191
Figure 5.21: Collared mound KA-373-001 in Yustyd, with a clear circular setting of stones at the edge 191
Figure 5.22: Layout, transect and burial pit of the four-cornered mound that was excavated by S. Surazakov in Irbistu in 1979: site Irbistu-1, 'enclosure' no. 7 (Surazakov 1988: Figure 5) 192
Figure 5.23: Plan of site KA-350 with round and rectangular four-cornered mounds, interestingly associated with different types of dwellings (see data disc for full site plan) 193
Figure 5.24: Four-cornered mounds can be square (left) or round (right), and the 'corners' are accentuated by massive standing stones: site KA-350 in Yustyd, fieldwork 2004 194
Figure 5.25: A typical round *kereksur* in Yustyd: central mound, round fence, three rays and associated small stone circles (foreground and background) are clearly visible 198
Figure 5.26: A typical square *kereksur* in Yustyd: central mound, rectangular fence, two rays and associated small stone circles (foreground and background) are clearly visible 198
Figure 5.27: Different types of round *kereksur*: 1) without fence, 2-3) fence, but no spokes, 4-7) fence and four spokes, 8-9) round *kereksur* with multiple spokes 199
Figure 5.28: Different types of square *kereksur*: 1) simple fence, 2-3) fence with corner mounds, 4) fence and spokes going to the corners, with standing stones on the corners, 5) rectangular *kereksur* with spokes going to the sides, 6) *kereksur* with four spokes, 7) *kereksur* with curved sides, spokes and standing stones on the corner 200
Figure 5.29: Two examples of platform *kereksur*; left, a low and 'light' platform (site KA-202 in Yustyd), right, a much larger platform *kereksur* (site KA-717 in Yustyd) 201
Figure 5.30: The KA-093-001 *kereksur* could be a variant of the Mongolian boulder *kereksur*. Some of the boulders inside the circular stone setting are huge and seem to have rolled down from the hill .. 202
Figure 5.31: The distribution of the central mound footprints for the *kereksur* in our research areas: the average is 124.86 m² 203

Figure 5.32: The distribution of the enclosed area of the *kereksur* in our research areas: the average is 583.26 m² 204
Figure 5.33: A comparison between the distribution of enclosed areas for round *kereksur* (left) and square *kereksur* (right) 204
Figure 5.34: The scatter gram compares the characteristics of mound footprints and enclosed areas for round and square *kereksur* in our research areas. The trend line (dark) is based on all monuments. The light grey line indicates a special cluster of monuments 205
Figure 5.35: Different types of rays: single stone setting (left), clear double stone setting (centre) and wider pavement or bank (right) 206
Figure 5.36: A selection of *kereksur* in the Khanuy valley research area, showing the large variety of associated structures, including numerous satellite mounds (figure from Allard & Erdenebaatar 2005: 555) 207
Figure 5.37: One of the *kereksur* in the Khanuy valley, as seen with Google Earth on Quickbird satellite images. Clearly visible is the central mound, the rectangular enclosed area, and the large field of hundreds of satellite mounds south and east of the *kereksur*. The snow in the image makes them quite visible. The stone circles, most probably located west of the *kereksur*, are not big enough to be seen here 208
Figure 5.38: The orientation of round (left) and square (right) *kereksur* in our research areas, using the rays for the round *kereksur* and the east and west sides (pointing north-south) for the square *kereksur* 209
Figure 5.39: A typical Turkic enclosure in the Yustyd valley (structure KA-357-001) 210
Figure 5.40: Some types of Turkic enclosures as mentioned by V. Kubarev (figure based on Kubarev 1980: 88-89, Fig. 9) 211
Figure 5.41: An enclosure of the Ayutinsky type in the wide, higher part of the valley (site KA-465). Left, a sketch in Sorokin's publication of his 1964 fieldwork (drawings from Sorokin 1969: 78), right, a photo made during the fieldwork in 2005 211
Figure 5.42: Average orientation of the alignments of standing stones east of Turkic enclosures 212
Figure 5.43: Above: two examples of Afanas'ev circular enclosures made from large standing slabs: both are located in the Karakol valley: structure ON-075-021 (left) and structure ON-077-001 (right). Below: two examples of circular enclosures comprising a bank or path of stones: site KA-156 on the southern border of the Chuya steppe, along the Elangash River, and site KA-018 in Elangash (right) 213
Figure 5.44: Linear stone settings in the Yustyd valley: long lines seem to delimit fields with so-called dwellings (left). In site KA-297, an Early Nomadic mound is accompanied by at least eight parallel lines of stones (right) 214
Figure 5.45: Various linear stone settings and geometrical features in the eastern part of the Yustyd valley, with a group of dwellings and a field of dense lines in the north (see Figure 5.46) 215
Figure 5.46: Site KA-802 in Yustyd, a small field with 24 parallel lines of stones, oriented east/northeast as most of the structures in this part of the valley (see Figure 5.45) 215
Figure 5.47: Enclosure 12 (left) and enclosure 2 (right) in site Irbistu-1, excavated by S. Surazakov in 1979 (from Surazakov 1988: Figure 9 and Figure 3) 217
Figure 5.48: Extracts of sites KA-802 and KA-753 (see DVD for full site plans): the dwellings are the rectangular structures in grey 218
Figure 5.49: Typical examples of tripartite dwellings. Above, one of the structures in the KA-802 site in Yustyd, with an indication of the internal features: below, two floor plans from other research areas: site Ukok-5 (from Molodin et al. 2004: Figure 124) and site Irbistu-1 (from Surazakov 1988: Figure 7) 220
Figure 5.50 Two sub-types of simple dwellings: buried stones in juxtaposition (left) and jutted stones set apart (right) 220
Figure 5.51: Round dwellings: an example from Yustyd (KA-693) 221

Figure 5.52: A tripartite example of a round dwelling from the site Argamdzhi-5 on the Ukok plateau (from Molodin et al. 2004: 30) (left), and site KA-378 in Yustyd, a more elaborated version of the simple dwelling type, with a double wall surrounding the structure (right) 221
Figure 5.53: Left: site KA-462 in Dzhazator. Right: the archaeological survey on the Ukok plateau by the IAE SB RAS included the recording of some good examples of ladder structures (from Molodin et al. 2004: 102) 222
Figure 5.54: Different types of dwellings with hanging circle and east-pointing beam in Yustyd (A) and on the plateau of Ukok (B): site Argamdzhi-16 (1) and site Bogdo-Ula-9 (2) (B from Molodin et al. 2004: 32 and 52) 223
Figure 5.55: Site KA-752 in Yustyd is a clear example of the dwelling type with central circle and stone line to the east 223
Figure 5.56: Site KA-033 in Irbistu, recorded in 2003 and drawn in full on a scale of 1/100 225
Figure 5.57: Massive standing stones, isolated or in groups of two to four stones: examples from Turu-Alty, north of the Yustyd valley (left), Dzhazator (middle) and the Chuya steppe near Yustyd (right) 226
Figure 5.58: Site ON-020 (above) and site ON-021 (below) in Karakol, with the large standing stones (right) indicated as purple dots (for a detailed site plan, see DVD 2) 227
Figure 5.59: Yustyd KA-376: Bronze Age stele in a square frame, with outcrops with petroglyphs in the background (see also right-hand photo) 228
Figure 5.60: An elk or red deer, and a typical stylised version, pecked into a deer stone in Uushigiin Uver (Mongolia) 229
Figure 5.61: Deer stone KA-298-001 in the Yustyd valley (Kubarev's no. 6): view from the south, east and north 231
Figure 5.62: Carved images on deer stone KA-298-001 in the Yustyd valley: a hammer on the south side (left), a dagger on the thinner east side (centre) and a quiver on the north side (right) 231
Figure 5.63: Left, the general layout of the complex setting of deer stone KA-298-001 in Yustyd, including 111 stone circles (blue circles), one circular stone concentration (orange circle) and 18 small standing stones (black dots). Right, an overview picture 232
Figure 5.64: Stele KA-433-001 has approximately the same size and form as that at site KA-298, but was not identified as a deer stone: no carvings were found, there are no anthropomorphic elements and the stone is oriented towards the north 233
Figure 5.65: A type III-b deer stone in the valley of Yustyd, KA-214-053: west side, south side and east side. It has very clear markings on three of its four sides (slash lines and two earring motives) and the shape of the stone is leaning towards the thin 'face' side with three slashes 234
Figure 5.66: Yustyd: location of deer stone KA-214-053 (purple) to the west of a row of Scythian burial mounds (green), between stone circles (blue) and platforms (orange) 234
Figure 5.67: KA-243-004 in Yustyd is a typical type III-b deer stone, although it has no necklace. The stone is small, has a sloping top, and has three marks on its sides: a rather unclear circle on one wide side (left), three slash lines on the highest thin side (middle) and a clear earring motive on the other wide side (right) 235
Figure 5.68: Yustyd, reused deer stone KA-286-011: south side with cup-marks and circle, east side and south side with possible zoomorphic image 236
Figure 5.69: Structure KA-293-001 in Yustyd: deer stone with clear necklace and three slash lines on the west side 237
Figure 5.70: Reused deer stone KA-696-003 in a Turkic memorial complex: extract of site plan (left) and view on the north side (right) 237
Figure 5.71: Fallen and possibly repositioned deer stone KA-745-022 (right), lying east of a row of burial mounds (left) 238
Figure 5.72: Yustyd valley, deer stone KA-807-016: it is placed within a row of *balbal* to the east of a Scythian burial mound (left) and has an unclear necklace of cup-marks around the top of the stone and three slash lines on its eastern face (right) 238

Figure 5.73: Yustyd valley: on top of *kereksur* KA-777-001 stands a deer stone of type III-b. It is decorated with a line of roughly carved cup-marks around the top of the stone, resembling a necklace 239
Figure 5.74: Two of the missing deer stones in Yustyd: a tall stone with deer motives in the north of the Yustyd complex (left) and a small deer stone with clear markings and weaponry (right) (Jacobson 1993 plate XXa) 240
Figure 5.75: Pre-Turkic stones with anthropomorphic features in the Russian Altay. The Chuya stele or deer stone (left) with details of the carved dagger (middle), and the four Early Iron Age image stones in Inya (right) 241
Figure 5.76: Turkic stone images in the Sebystey valley. The head of two of the stones was badly damaged (image 1-2). The different levels of detail are clearly visible, from roughly carved stones (image 3) to very detailed facial features (image 4) 243
Figure 5.77: Different types of image stones: those with a beautiful, stylised head in relief and no further details on the body (Dzhazator, image 1-2), a stone with linear details such as a nose, ears and a belt or necklace on a flat stone (Karakol, image 3) and a very roughly carved stone with signs of a neck and shoulders (Yustyd, image 4) 243
Figure 5.78: Dzhazator, Turkic image stone KA-465-005 as pictured in 2005 (left). In 1964, the stone was standing straight and some 30 cm deeper in the ground (centre), as can be seen from this drawing by S. Sorokin (see also the coloration on the image left). Just north of it was another, completely preserved image stone (right) (Drawings from Sorokin 1969: 78) 245
Figure 5.79: False image stones, standing east of Turkic enclosures. V. Kubarev depicted them as heavy black dots in his typology (left). An example is shown in site ON-062 in the Karakol valley (right) 246
Figure 5.80: Some examples of rows of standing stones in Chuya, Dzhazator and Ozyok 246
Figure 5.81: The use of dark-coloured rough stones, set apart in a jutted position (left, an example from Sebystey) or greyish, smooth boulders in juxtaposition (right, an example from Yustyd) results in two very different types of stone circles 248
Figure 5.82: *Kereksur* KA-158 in Yustyd, with its complete circle of small stone circles 250
Figure 5.83: The number of stones in the circular altars, averaging 8.7 stones per circle 251
Figure 5.84: Two clear examples of paired stone circle and stone platform. The stone circle is always east, and the platform west or left in the images 252
Figure 5.85: Some examples of petroglyphs in the Elangash valley 253
Figure 5.86: An example of an inscription, carved on a rocky outcrop in the Bar-Burgazy valley 254
Figure 5.87: Different types of ethnographic graves, including (clockwise) mud-brick graves in Bukhtarma; wooden graves in Dzhazator, resembling log cabins; a grave made of stones, earth and wood in Bukhtarma; and small wooden and stone graves in Dzhazator 255
Figure 5.88: Some examples of *ovoo* and sanctuaries: (clockwise) an *ovoo* with streamers, built at the warm water source of Tyopliy Klyuch, at the eastern edge of the Plateau of Ukok; one of the very common sanctuaries with streamers and sometimes sculpted poles, located mainly at a source or on the top of a ridge; a fine *ovoo* on top of the Turu-Alty ridge, eastern part of the Chuya basin; sanctuary with fire altars in the Karakol valley, outside of the village of Bootchi 256
Figure 6.1: Location of the research areas (idem Figure 1.12) 261
Figure 6.2: The Chuya intermontane depression 261
Figure 6.3: The enclosed middle part of the Sebystey valley with terraces on both sides of the river 263
Figure 6.4: Overview of the Ozyok valley. The small steam to the left of the image is the Ozyok; right is the larger Irbistu. The South Chuya Range forms the background 263
Figure 6.5: The higher part of the Irbistu valley 264
Figure 6.6: The moraine field of the former glaciers of the Irbistu valley: an overview from the hills just east of Ozyok 265
Figure 6.7: The moraine field of Irbistu: some detailed impressions of the hilly landscape 265

Figure 6.8: Elangash: the higher part of the valley with a distinctive U-profile (left), and the more open lower part of the valley (right) 266
Figure 6.9: Rocky outcrops in Elangash have been smoothened by glaciers to form the perfect surface for petroglyphs. Thousands of images have been carved and pecked into the brown patina 266
Figure 6.10: Higher part of the Yustyd valley with its hilly moraine landscape 268
Figure 6.11: Yustyd valley: view towards the west over the right bank and the gentle slopes with Scythian burial mounds 268
Figure 6.12: Dzhazator valley: overview of the open landscape and wide terraces of the higher, U-shaped part of the valley, towards the east 270
Figure 6.13: The Karakaba 'depression', or higher part of the valley 271
Figure 6.14: A typical view on the Bukhtarma valley towards the west, taken from a hilltop where the valley bends to the north 272
Figure 6.15: Panoramic photo of the Karakol valley just north of Kulada. Left is the sacred mountain Uch-Enmek, in the middle is the Bashadar site, while left is the start of Kulada village 273
Figure 6.16: Looking out over the northern part of the Karakol valley, showing the confluence with the Ursul River in the distance. The first village is Bichikti-Bom, while Karakol and Kurata are in the background 273
Figure 6.17: Distribution of Afanas'ev graves 275
Figure 6.18: Distribution of *kereksur* over the different research areas 276
Figure 6.19: Distribution of round and square *kereksur* in the southern part of the Chuya region (above) and in the Yustyd research area (below) 279
Figure 6.20: Distribution of four-cornered mounds (above) and collared mounds (below) 281
Figure 6.21: Distribution of deer stones in the research areas 282
Figure 6.22: Distribution of dwellings in the research areas 282
Figure 6.23: Distribution of Early Nomadic or Scythian burial mounds 284
Figure 6.24: Distribution of Hunno-Sarmatian graves throughout the research areas 284
Figure 6.25: Distribution of Turkic burial mounds and Turkic enclosures 286
Figure 6.26: Turkic images stones (above) and false image stones (below) 287
Figure 6.27: Distribution of ethnographic burials throughout the research areas 289
Figure 6.28: The distribution of monuments in the southern part of the Chuya steppe and adjacent valleys (above), and the location of Eneolithic structures in the same area (below) 292
Figure 6.29: The distribution of Bronze Age (above) and Iron Age (below) monuments in the southern part of the Chuya steppe and adjacent valleys 293
Figure 6.30: The distribution of Medieval or Turkic monuments (above) and Ethnographic graves (below) in the southern part of the Chuya steppe and adjacent valleys 294
Figure 6.31: The distribution of monuments of unknown date in the southern part of the Chuya steppe and adjacent valleys 295
Figure 6.32: The archaeological complex on the right bank of the Yustyd, with an indication of zones with Bronze Age *kereksur* and zones with Iron Age burial mounds 296
Figure 6.33: The distribution of monuments on the right bank and in the flood plain of the Yustyd River 297
Figure 6.34: The distribution of Bronze Age monuments (above) and Iron Age monuments (below) on the right bank and in the flood plain of the Yustyd River 298
Figure 6.35: The distribution of monuments of unknown date on the right bank and in the flood plain of the Yustyd River 299
Figure 6.36: The distribution of monuments in the Dzhazator valley: the lower, western part of the valley (above) and the higher, eastern part (below) 301
Figure 6.37: The distribution of Bronze Age monuments in the Dzhazator valley: the lower, western part of the valley (above) and the higher, eastern part (below) 302

Figure 6.38: The distribution of Iron Age monuments in the Dzhazator valley: the lower, western part of the valley (above) and the higher, eastern part (below) 303
Figure 6.39: The distribution of Medieval or Turkic monuments in the Dzhazator valley: the lower, western part of the valley (above) and the higher, eastern part (below) 304
Figure 6.40: The distribution of Ethnographic graves in the Dzhazator valley: the lower, western part of the valley (above) and the higher, eastern part (below) 305
Figure 6.41: The distribution of monuments of unknown date in the Dzhazator valley: the lower, western part of the valley (above) and the higher, eastern part (below) 306
Figure 6.42: The distribution of Eneolithic monuments in the lower, western part of the Dzhazator valley – there are no Eneolithic monuments in the higher, eastern part 307
Figure 6.43: The distribution of monuments in the Karakaba valley (above), and the location of Bronze Age structures in the same area (below) 308
Figure 6.44: The distribution of Iron Age monuments (above) and Turkic or Medieval structures (below) in the Karakaba valley 309
Figure 6.45: The distribution of Ethnographic monuments (above) and structures of unknown date (below) in the Karakaba valley 310
Figure 6.46: The distribution of monuments in the Bukhtarma research area (above), and the location of Iron Age structures in the same area (below: rectangle is the Hunno-Sarmatian site) 312
Figure 6.47: The distribution of Turkic or Medieval monuments (above) and Ethnographic graves (below) in the Bukhtarma research area (site KK-102 is indicated by a dotted rectangle) 313
Figure 6.48: The location of monuments of unknown date in the Bukhtarma research area 314
Figure 6.49: Preliminary overview map of the middle part of the Karakol valley: only sites recorded in 2007 are included 315
Figure 6.50: Alignments of Scythian burial mounds in Yustyd (above) and Dzhazator (below) are constructed at regular distances over the river terrace 316
Figure 6.51: Part of the concentration of *kereksur* on the right bank of Yustyd, with three geometrical figures that connect round and square *kereksur* and deer stones: c = sazhen (distance unit), OK = deer stone (based on Marsadolov 2002: Figure 2) 318
Figure 6.52: The geometrical figures and patterns as suggested by Marsadolov, transposed on our maps of the Yustyd valley: distances in metres 318
Figure 6.53: Yustyd, site KA-745: a *kereksur* forms the southernmost structure of an alignment of Early Iron Age burial mounds 320
Figure 6.54: Some examples of Ethnographic burial grounds (purple) associated with Iron Age burial mounds (green): 1-2, site KA-619 and KA-610 in Dzhazator; 3-4, site KK-054 and KA-084 in Bukhtarma: Turkic enclosures are in red 321
Figure 6.55: Ozyok valley: Scythian burial sites with Turkic (medieval) or possible Bronze Age mounds to the north of them, just on top of the first hills or moraines in the Irbistu valley 322
Figure 6.56: The average orientation of some of the monument types in our database (see different paragraphs in Chapter 5) 323
Figure 7.1: A burial mound on the right bank of the Irbistu River is being destroyed gradually by the erosion of the terrace borders: site KA-119 326
Figure 7.2: Dzhazator valley: two burial mounds that have been partly destroyed by the erosion of the terrace borders: structure KA-583-004 and structure KA-670-001 326
Figure 7.3: Small mammals, such as the *collared pika* or the *suslik,* cause severe damage to archaeological structures 327
Figure 7.4: Examples of excavated burial mounds in the Yustyd valley. Reconstructing the mounds after excavation takes a lot of work but would minimise the impact of archaeological research on the landscape 329
Figure 7.5: A petroglyph panel in the Chuy Ozy Nature Park, badly damaged by an attempt to steal it from the rocky outcrop 330

Figure 8.1: Chuya 2003: (from left to right) Evgeniy Chernikov, Rudi Goossens, Wouter Gheyle, Dimitri Cheremisin, Jean Bourgeois, Alexander Ebel, Maxim Cherepanov and a friend of the Russian colleagues..... 338
Figure 8.2: Yustyd 2004: (standing) Wouter Gheyle, Maxim Cherepanov, Tatyana Vdovina, Jean Bourgeois, Benjamin Van Bever, Leon Van Hoof, Alexander Ebel, (sitting) Sergey Sukhov, Evgeniy Chernikov and a student..... 338
Figure 8.3: Dzhazator 2005: (standing), Leon Van Hoof, Tamara Kamylina, student Tanya, Quentin Bourgeois, Maxim Cherepanov, Alexander Ebel, Wouter Gheyle, Tijs De Schacht, Tijs De Bus, Rudi Goossens, Matthijs Vanommeslaeghe, Alain De Wulf, (sitting) a driver, Evgeniy Chernikov, Sergey Sukhov, Alexander Sukhov , Vera Bedareva, Stéphanie Loute, Kaatje De Langhe and Elise Luneau 339
Figure 8.4: Kazakh Altay 2006: (standing) Gulnara Dzhumabekova, Galiya Bazarbaeva, Kuragay Mubarakova, unknown, Rudi Goossens, Alain De Wulf, Eduard Severskii, Kaatje De Langhe, Leon Van Hoof, Steven Van der Sype, Zeinola Samashev, Dries Dossche, unknown, a student, (sitting) a Kazakh geographer, a student, a driver, Wouter Gheyle, Delphine Corneillie, a student, Anne Malmendier and Stéphanie Loute 339
Figure 8.5: Karakol 2007: Aleksey Lapin, Eduard Dvornikov, Aleksey Cherepanov, Leon Van Hoof, Kaatje De Langhe, Ruben Cappelle, Maxim Pyankov, Jean Bourgeois, Vetcheslav Raseomakhin, Stéphanie Loute and Wouter Gheyle 340
Figure 8.6: Karakol 2008, archaeological team: (standing) Jean Bourgeois, Eduard Dvornikov, Vyacheslav Panov, Leon Van Hoof, Maxim Pyankov, Aleksey Cherepanov, (sitting) Wouter Gheyle, Kaatje De Langhe, Dorien te Kiefte and Anne Malmendier 340
Figure 8.7: Fieldwork 2008, geographical team: Alexander Ebel, Dimitri Apasenko, Evgeniy Chernikov, Ruben Van de Kerchove and Rudi Goossens..... 341

12 List of tables

Table 2.1: Overview of the CORONA camera systems 72
Table 2.2: CORONA imagery used for research in 2003, covering the southern part of the Chuya depression and the valleys dissecting the South Chuya Range 80
Table 2.3: CORONA imagery used for research in 2004, covering the eastern part of the Chuya depression and the Yustyd valley 81
Table 2.4: CORONA imagery used for research in 2005, covering the Dzhazator valley and surroundings 82
Table 2.5: CORONA imagery used for research in 2006, covering the Kazakh part of the Altay Mountains 82
Table 2.6: CORONA imagery used for research in 2007, covering the Karakol valley and the Uch-Enmek Park 83
Table 2.7: Mean position accuracy of the C&C C-Nav (receiver estimate) and mean mismatch between the C-Nav average position and the other two systems 91
Table 2.8: Mean (taken over all processed points) standard deviation of the position solution sets resulting from the set-ups of the three systems 91
Table 2.9: Altimetric distribution of GCPs in the different research areas from 2003 to 2008 103
Table 2.10: Root mean square (RMS) errors for the absolute orientation in VirtuoZo during restitution for the different research areas from 2003 to 2008 103
Table 3.1: Overview of the relation between old site names and Altari numbering 131
Table 3.2: Magnetic declination for all research areas in Altay 135
Table 4.1: Overview of structure types recorded in the fieldwork done in 2003 147
Table 4.2: Overview of structure types recorded in Yustyd during the fieldwork in 2004 and 2006 ... 151
Table 4.3: Overview of the archaeological structures recorded in Dzhazator 152
Table 4.4: Overview of the archaeological structures recorded in Karakaba and Bukhtarma 154
Table 4.5: Overview of the recorded structures in Karakol 158
Table 4.6: Overview of the number of locations with surface structures in the database, per valley 159
Tabel 5.1: Overview of monument types in the Altay Mountains. Names with (*) were adopted from the Mongolian Altay Inventory (E. Jacobson-Tepfer); names with (?) are to be discussed 172
Table 5.2: Overview of different types of mounds. The abbreviations stand for: Berel (BER), Bukhtarma (BUK), Dzhazator (DZH), Elangash (ELA), Irbistu (IRB), Karakaba (KARa), Karakol (KARol), Ozyok (OZY), Sarikobu (SAR), Sebystey (SEB), Yustyd (YUS) and the southern border of the Chuya steppe (S-CH) 175
Tabel 5.3: Number of Scythian burial mounds in the research areas 178
Table 5.4: The average dimensions of the Scythian burial mounds in the different research areas .. 178
Table 5.5 Number of Turkic burial mounds in the different research areas 186
Table 5.6: Overview of Hunno-Sarmatian burial mounds in the different research areas 188
Table 5.7: Occurrence of collared mounds in all research areas 191
Table 5.8: Different parts of *kereksur* monuments. The types in *italic* are not found in our research areas and were taken from a study by J. Wright (Wright 2007: 355, Table 1) 195
Table 5.9: Distribution of *kereksur* over the different research areas 197
Table 5.10: Numbers of the different kinds of *kereksur* in the research areas, with an indication of the most characteristic features – first for all *kereksur*, then for both round and square *kereksur* 197
Table 5.11: Proportion of round and square *kereksur* in different research areas. (*) Elaborated *kereksur* (28) are excluded, as there is no mention of the shape of the fence. (°) Round *kereksur* without a fence (22) are excluded 198
Table 5.12: Distribution of Turkic enclosures over the different research areas 210
Table 5.13: Distribution of circular enclosures in our research areas 213

Table 5.14: Distribution of linear stone settings over the different research areas 216
Table 5.15: Distribution of the dwellings in our research areas 219
Table 5.16: Different types of standing stones in our research areas 226
Table 5.17: Distribution of steles or massive standing stones over our research areas 227
Table 5.18: Distribution of Turkic image stones over the research areas 242
Table 5.19: Total number of image stones per research area, including those that have been removed 244
Table 5.20: Distribution of false image stones in our research areas 246
Table 5.21: The distribution of *balbal* in our research areas, by date 247
Table 5.22: Distribution of stone circles in our research areas, by date 249
Table 5.23: Distribution of stone platforms over the different research areas, by date 252
Table 5.24: Overview of the petroglyph panels in the different research areas. The petroglyphs of Elangash are not included as we did not record them in detail and they are not in the database (for an overview, see Okladnikov et al. 1979) 253
Table 5.25: The distribution of ethnographic graves in our research areas 254

13 Deliverables

DVD 1: GIS files and viewer software

DVD 2: Altari database, site plans, topographic maps

GEOGRAPHICAL INFORMATION SYSTEM:

All spatial information – satellite imagery, DSMs, topographic maps with contour lines, archaeological plans and background data – have been bundled in a GIS project, using ArcMAP. The project has been saved as a PMF file (Published Map File) and can be consulted using the free viewer software ArcReader 9.3, which is included on the disc. If you have the full version of ArcMAP already on your computer, it is not necessary to install this viewer. For more information or in case of difficulties, see the website of ArcReader[35].

1. Install the ArcReader 9.3 software by running the *setup.exe* file in the folder 'ArcReader9-3' on DVD 1. Follow the steps of the installation process (this may take 5-10 minutes).

2. After installation, open the file *Altay_2003-2008.pmf* in the 'AltayGIS_2003-2008' folder on DVD 1.

3. All documents are automatically loaded into the program. The information is organised in various layers, grouped by theme in group layers. These include 'general information', 'sites', 'structures', 'geography', 'topography', layers with background data and CORONA satellite imagery. The user can activate and de-activate group layers and individual layers by clicking the check boxes. Group layers expand by clicking on them, and the tools in the main toolbar enable zooming, panning etc.

SITE PLANS:

Extracts of all archaeological sites can be found in the folder 'siteplans' on DVD 2. They have a scale of 1/1,000 (except for some larger sites, scale 1/2,000) and are made in a PDF file with A4 format. The site plans are arranged by site number in bundled PDF files.

MAPS:

The overview maps of the research areas are included on DVD 2 as a digital A2 format PDF file. The scales are variable due to the various sizes of the research areas (from 1/10,000 to 1/70,000). Please keep in mind that the scale mentioned on the maps only applies to the original A2 format. The hard copies in this volume are 63.5% of the original maps, so the scale should be

[35] See: http://www.esri.com/software/arcgis/arcreader/index.html

multiplied by factor 1.5748 (example given, the original scale 1/10,000 on the A2 format actually is 1/15,748 on the smaller hard copies). The scale bar can be used as a reference.

1. Topographical map of the research areas in the south-western part of the Chuya steppe, including the Sebystey, Irbistu, Ozyok, Sarikobu and Elangash valleys (research area 2003), with the location of the archaeological sites, scale 1/70,000, UTM WGS1984.

2. Topographical map of the western part of the Yustyd valley (research area 2004-2006), with the location of the archaeological sites, scale 1/10,000, UTM WGS1984.

3. Topographical map of the eastern part of the Yustyd valley (research area 2004-2006), with the location of the archaeological sites, scale 1/10,000, UTM WGS1984.

4. Topographical map of the western part of the Dzhazator valley (research area 2005), with the location of the archaeological sites, scale 1/50,000, UTM WGS1984.

5. Topographical map of the eastern part of the Dzhazator valley (research area 2005), with the location of the archaeological sites, scale 1/50,000, UTM WGS1984.

6. Topographical map of the Karakaba valley (research area 2006), with the location of the archaeological sites, scale 1/25,000, UTM WGS1984.

7. Topographical map of the Bukhtarma valley (research area 2006), with the location of the archaeological sites, scale 1/25,000, UTM WGS1984.

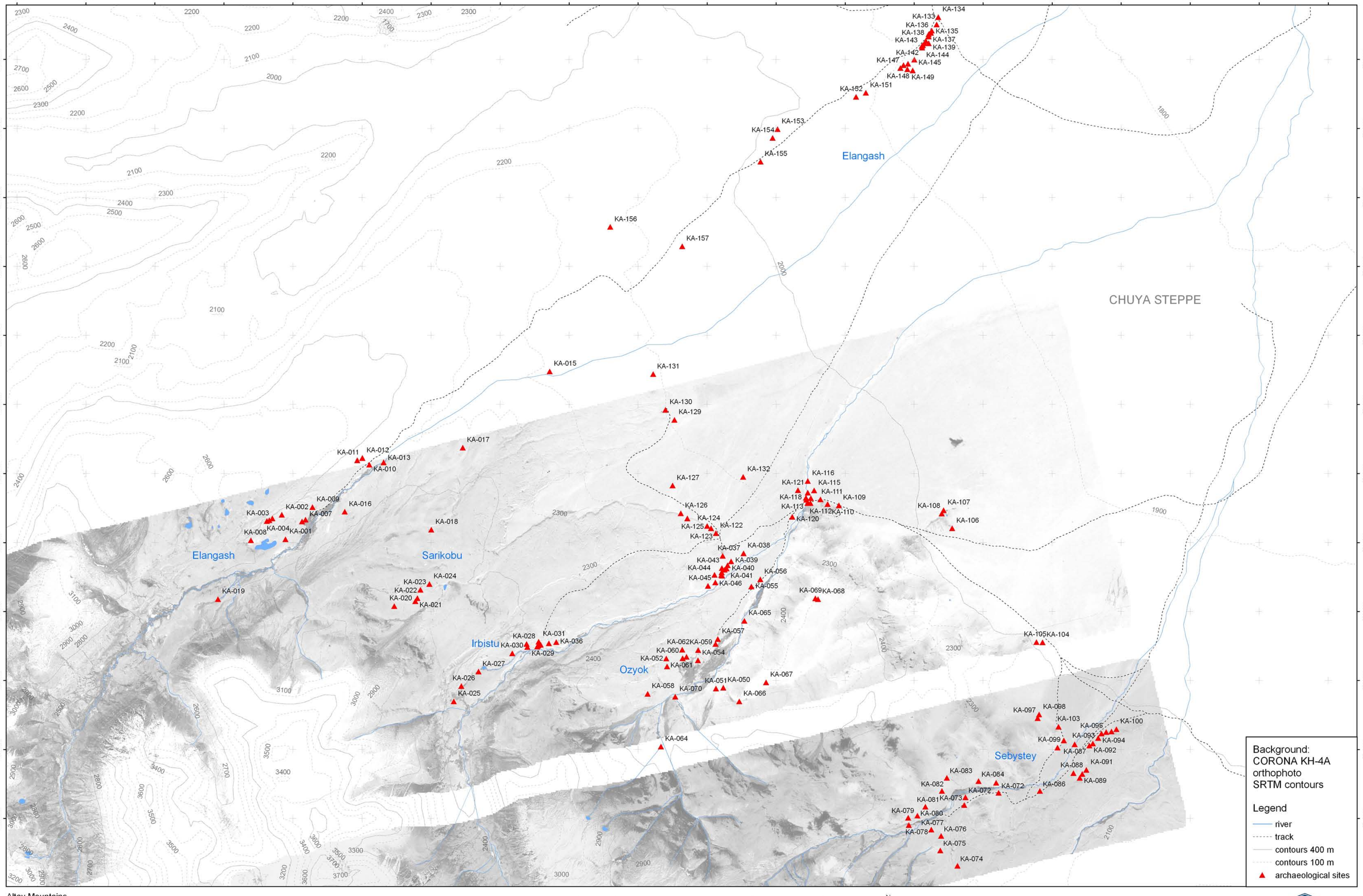
8. Topographical map of the Berel river terrace (research area 2006), with the location of the archaeological sites, scale 1/10,000, UTM WGS1984.

9. Topographical map of part of the Karakol valley (research area 2007), with the location of the archaeological sites, scale 1/30,000, UTM WGS1984.

DATABASE

The Altari database (Altay Archaeological Inventory) can be found on DVD 2. It includes all data recorded during the survey campaigns from 2003 to 2008 and is made with Microsoft Access. Open the *Altari_SITES_2003-2008.mdb* file in folder ‘Altari’ with MS Access. Because of the limited capacity of the DVD, it was not possible to include all 24,000 photos (even in a very small resolution) and 1,053 site plans. The latter can however be found in the folder ‘siteplans’ in PDF format. If links in the database fail to work, it may be a good idea to copy the entire ‘Altari’ folder to the C:\ drive of your computer and try again.

Southern border of the Chuya steppe - 2003



Background:
CORONA KH-4A
orthophoto
SRTM contours

Legend
- river
- track
- contours 400 m
- contours 100 m
- archaeological sites

Altay Mountains
Survey Project
Ghent University
2003-2008

0 1 2 4 6 8 km

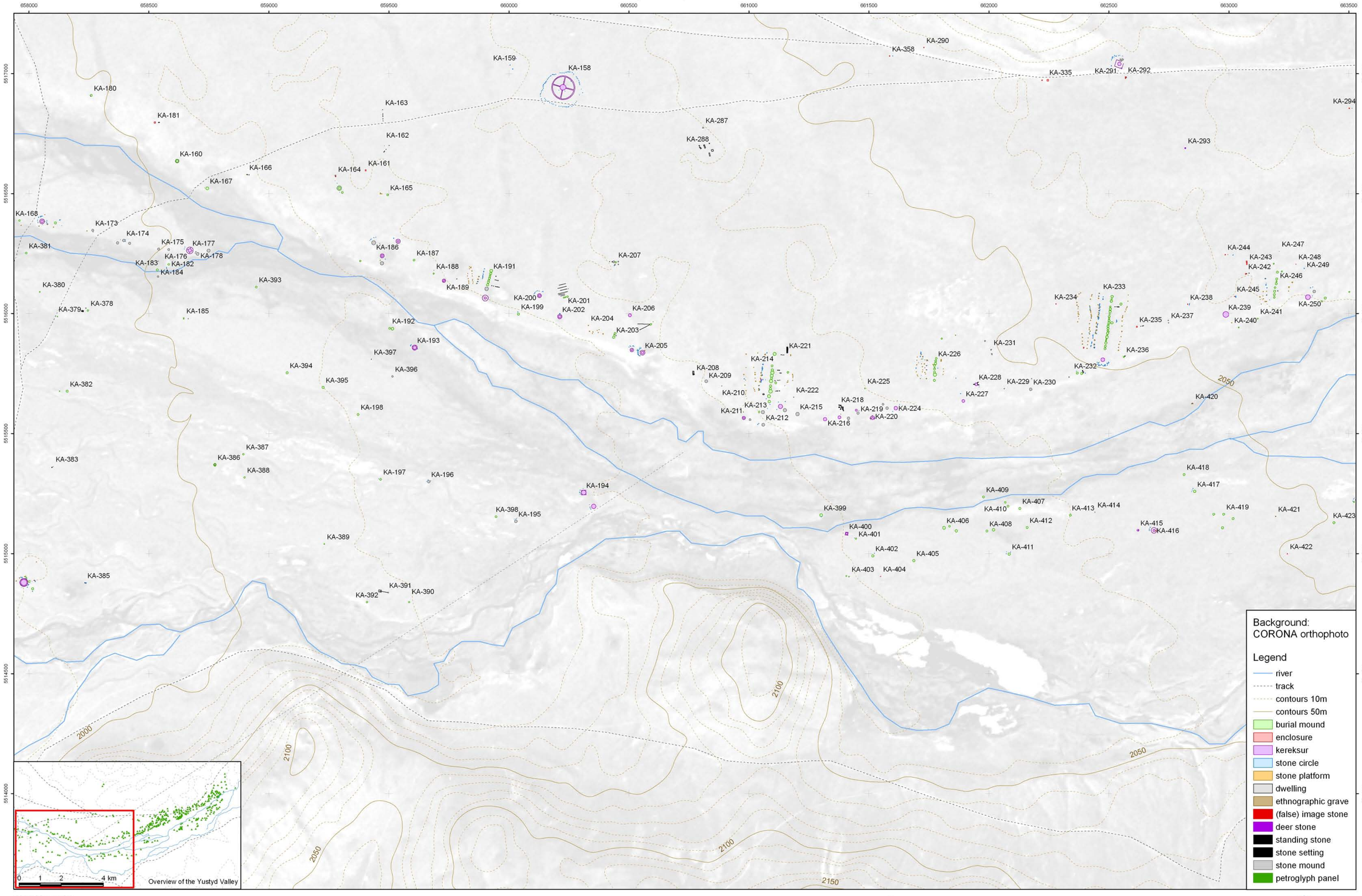
Original Scale (A2 Format): 1/70,000

N

UTM 45
WGS 1984

UNIVERSITEIT GENT

Yustyd Valley 2004-2006



Altay Mountains
Survey Project
Ghent University
2003-2008

0 100 200 400 600 800 1.000 1.200 m

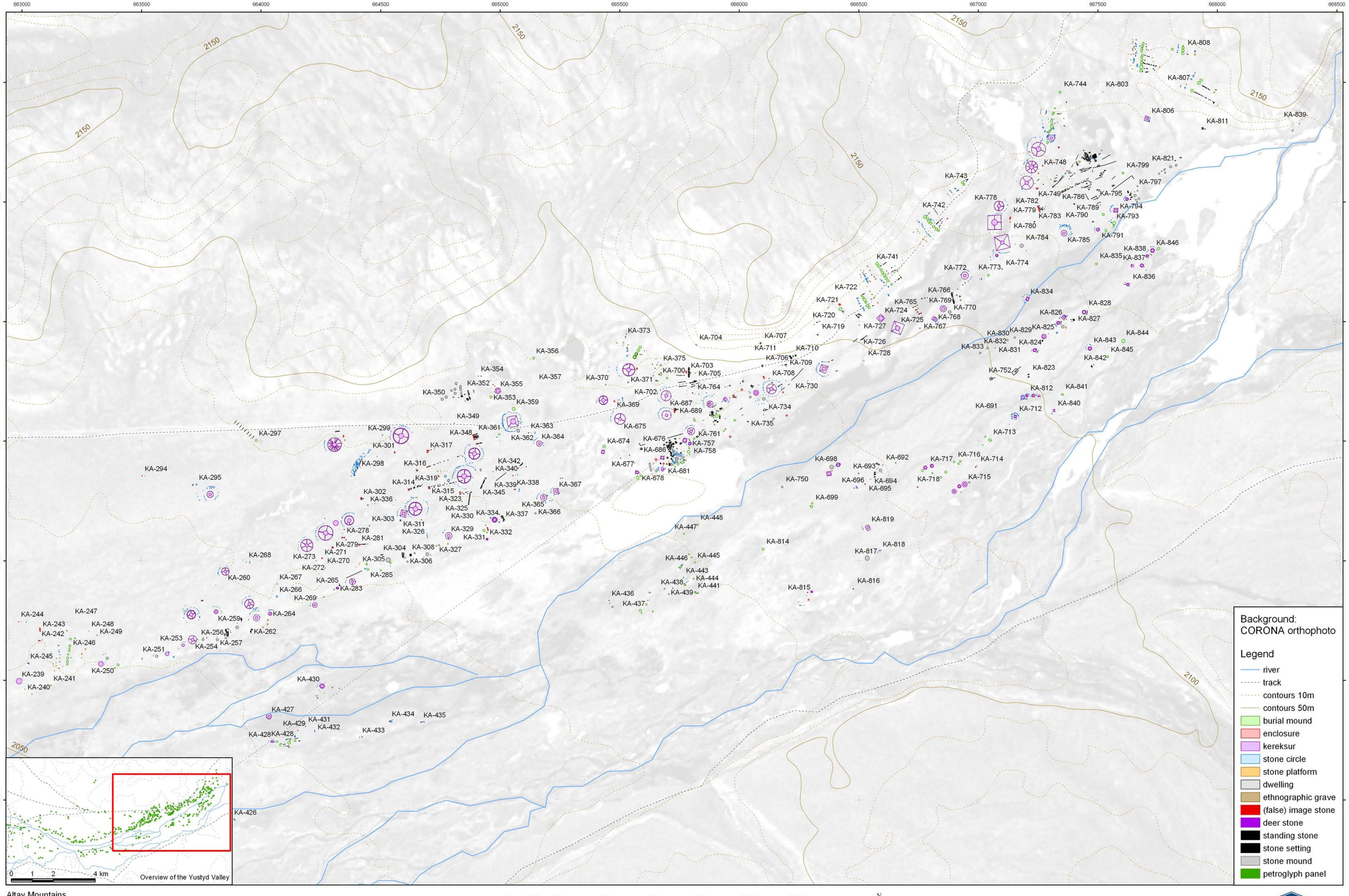
Original Scale (A2 Format): 1/10,000

N

UTM 45
WGS 1984

UNIVERSITEIT GENT

Yustyd Valley 2004-2006



Altay Mountains
Survey Project
Ghent University
2003-2008

0 100 200 400 600 800 1.000 1.200 m

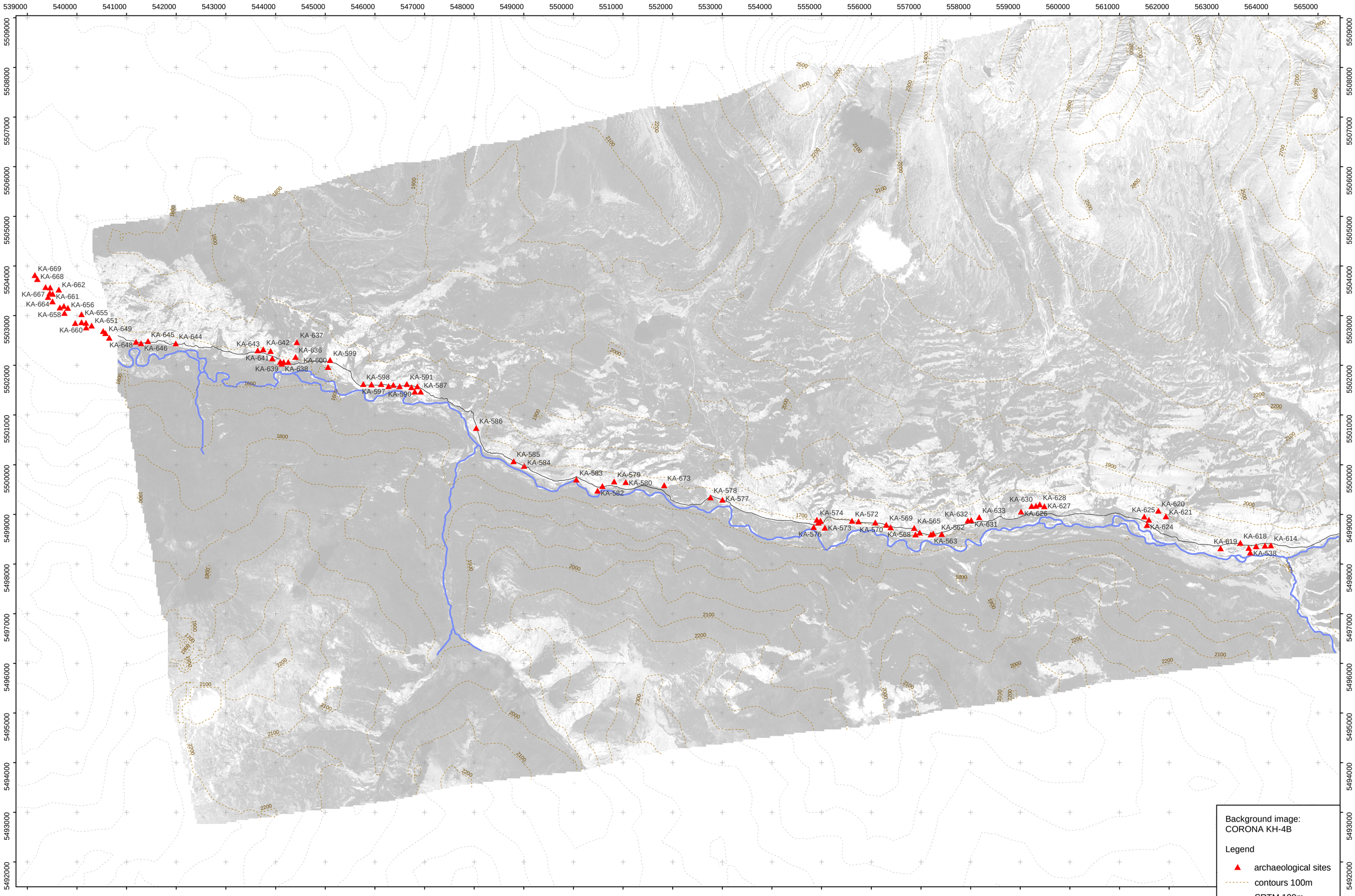
Original Scale (A2 Format): 1/10,000

N

UTM 45
WGS 1984

UNIVERSITEIT GENT

Dzhazator - west - survey 2005



Preserving the Frozen Tombs
of the Altai Mountains
Phase 1: 2005 - 2006
Flanders/UNESCO Fund-in-Trust

United Nations Educational, Scientific and Cultural Organization

In cooperation with UNESCO's World Heritage Centre

UNIVERSITEIT GENT

0 0,5 1 2 3 4 5 6 7 8 Kilometers

Original Scale (A2 Format): 1/50,000

N

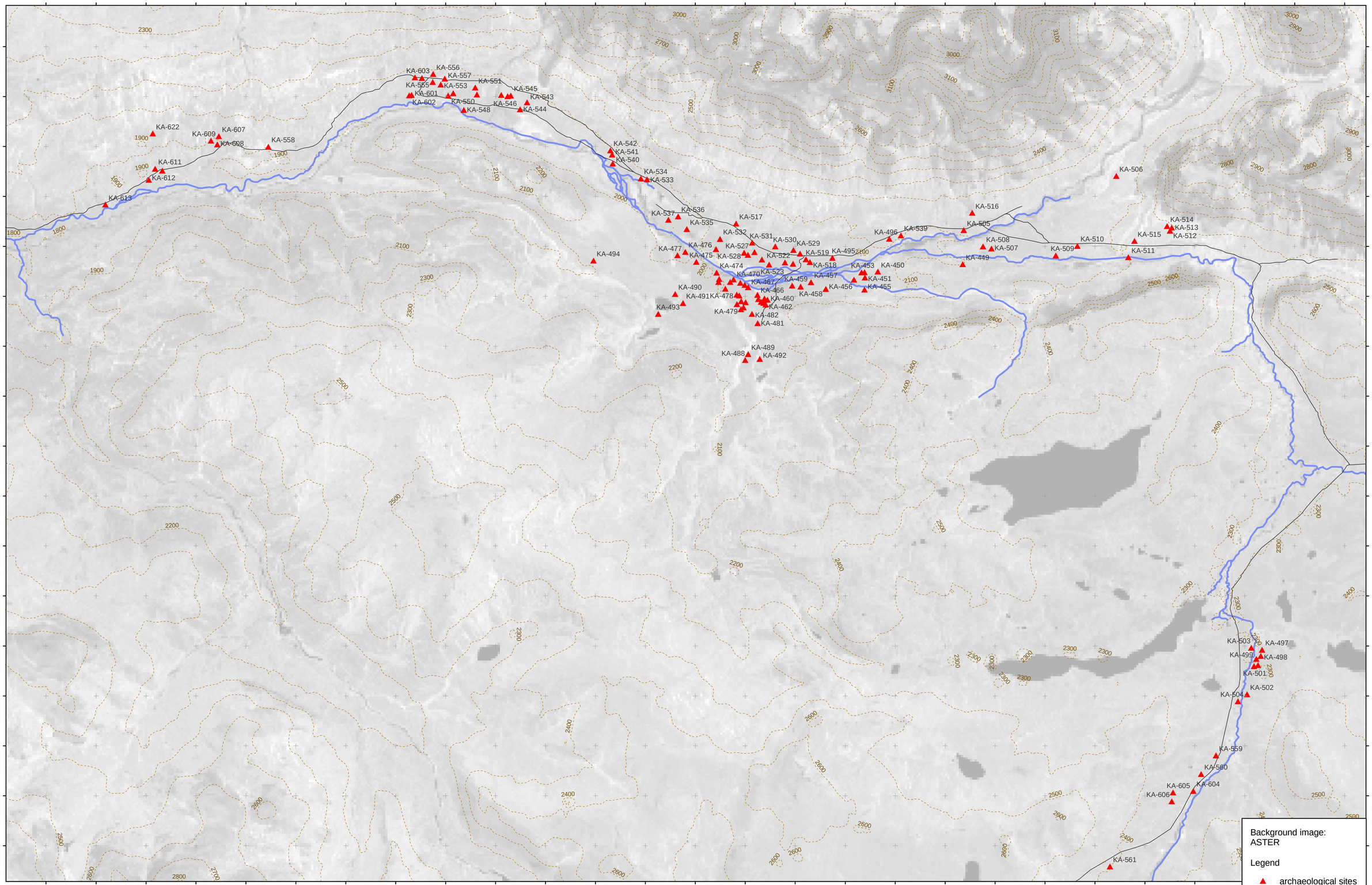
UTM 45
WGS 1984

Background image:
CORONA KH-4B

Legend

- archaeological sites
- contours 100m
- SRTM 100m
- roads
- rivers

Dzhazator Valley - survey 2005



Preserving the Frozen Tombs
of the Altai Mountains
Phase 1: 2005 - 2006
Flanders/UNESCO Fund-in-Trust

United Nations Educational, Scientific and Cultural Organization

In cooperation with UNESCO's World Heritage Centre

UNIVERSITEIT GENT

0 1 2 4 6 8 Km

Original Scale (A2 Format): 1/50,000

N

UTM 45
WGS 1984

Background image:
ASTER

Legend

- archaeological sites
- contours 100m
- roads
- rivers

Kara-Kaba Valley - survey 2006

426000 427000 428000 429000 430000 431000 432000 433000 434000 435000 436000 437000 438000 439000

5440000 5439000 5438000 5437000 5436000 5435000 5434000 5433000 5432000

KK-001
KK-002
KK-003
KK-004
KK-005
KK-006
KK-007
KK-008
KK-009
KK-009
KK-010
KK-011
KK-012
KK-013
KK-014
KK-015
KK-016
KK-019
KK-020
KK-021
KK-022
KK-023
KK-024
KK-025
KK-026
KK-027
KK-028

Preserving the Frozen Tombs
of the Altai Mountains
Phase 1: 2005 - 2006
Flanders/UNESCO Fund-in-Trust

United Nations Educational, Scientific and Cultural Organization

In cooperation with UNESCO's World Heritage Centre

UNIVERSITEIT GENT

0 0,5 1 2 3 4 Km

Original Scale (A2 Format): 1/50,000

N

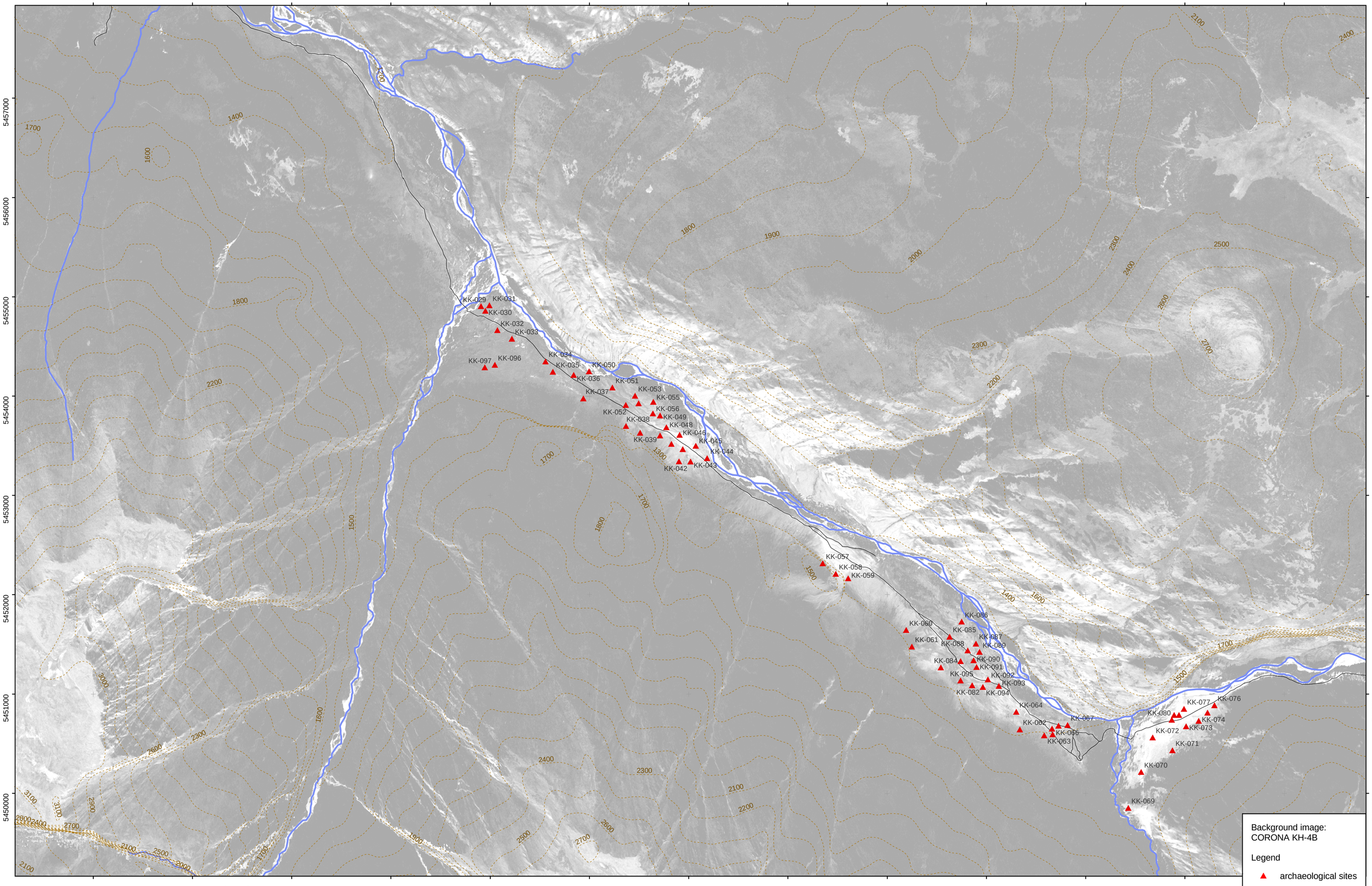
UTM 45
WGS 1984

Background image:
CORONA KH-4B

Legend

- archaeological sites
- recent stone heaps
- contours 10m
- roads
- rivers

Bukhtarma Valley - survey 2006



Preserving the Frozen Tombs
of the Altai Mountains
Phase 1: 2005 - 2006
Flanders/UNESCO Fund-in-Trust

United Nations Educational, Scientific and Cultural Organization

In cooperation with UNESCO's World Heritage Centre

UNIVERSITEIT GENT

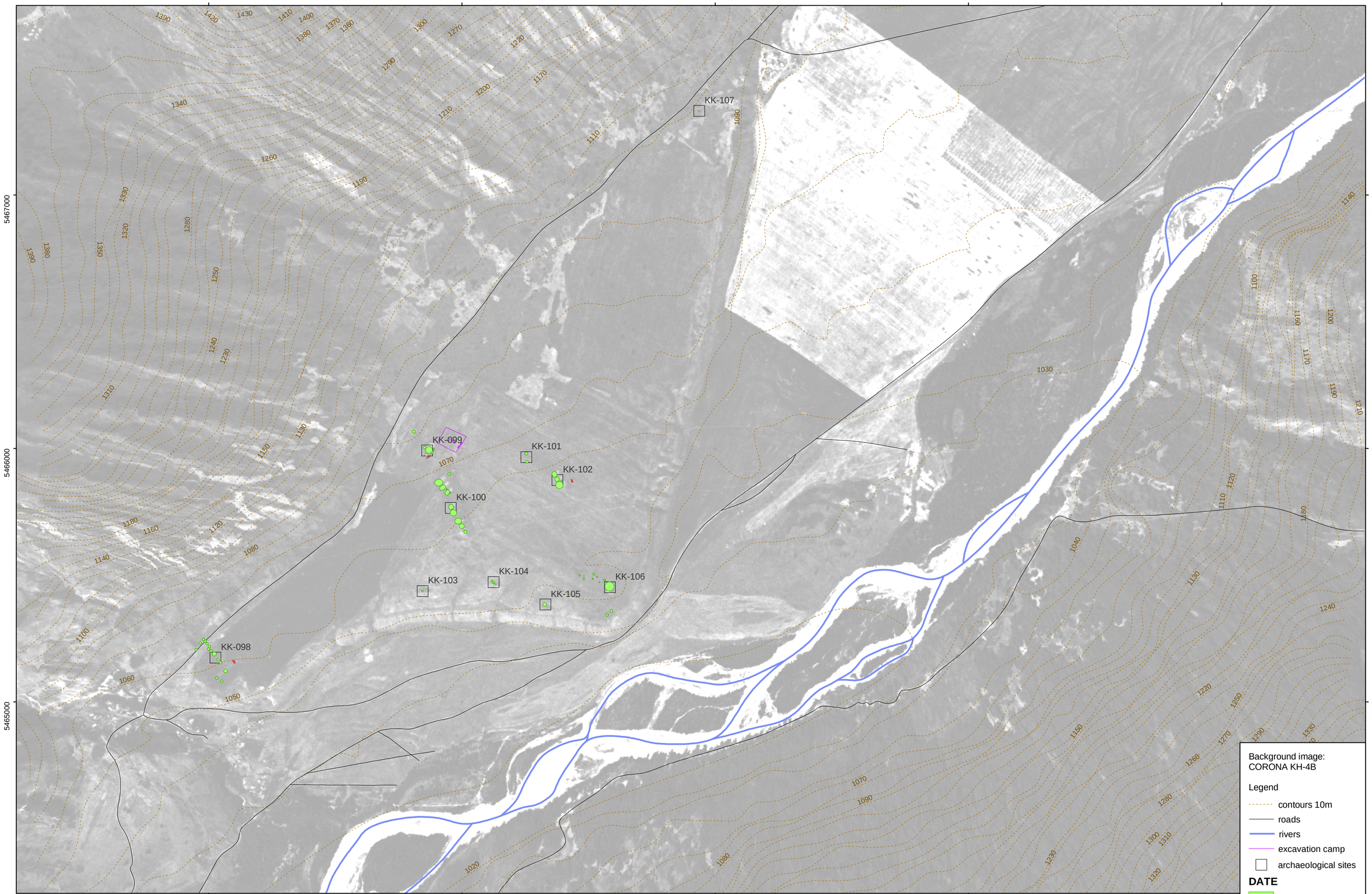
0 0,5 1 2 3 4 Km

Original Scale (A2 Format): 1/50,000

N

UTM 45
WGS 1984

Bukhtarma - Berel - survey 2006



Background image:
CORONA KH-4B

Legend

- contours 10m
- roads
- rivers
- excavation camp
- archaeological sites

DATE

- Scythian
- Turkic
- unknown

Preserving the Frozen Tombs
of the Altai Mountains
Phase 1: 2005 - 2006
Flanders/UNESCO Fund-in-Trust

United Nations Educational, Scientific and Cultural Organization

In cooperation with UNESCO's World Heritage Centre

UNIVERSITEIT GENT

0 100 200 400 600 800 1.000 1.200 1.400 1.600 1.800 2.000 Meters

N

UTM 45
WGS 1984

Original Scale (A2 Format): 1/10,000

Karakol valley (Uch-Enmek Park) - 2007

412000 414000 416000 418000 420000 422000 424000 426000

5626000 5624000 5622000 5620000 5618000

ON-001 ON-002 ON-003 ON-004 ON-005 ON-006 ON-007 ON-053 ON-054 ON-055 ON-056 ON-057 ON-058 ON-045 ON-046 ON-047 ON-048 ON-049 ON-051 ON-052 ON-059 ON-060 ON-012 ON-013 ON-043 ON-044 ON-009 ON-010 ON-011 ON-014 ON-008 ON-015 ON-016 ON-017 ON-018 ON-019 ON-020 ON-021 ON-032 ON-061 ON-031 ON-022 ON-023 ON-024 ON-025 ON-026 ON-027 ON-029 ON-030 ON-028 ON-033 ON-034 ON-035 ON-036 ON-037 ON-038 ON-039 ON-040 ON-041 ON-042

Karakol

Background:
CORONA KH-4B
orthophoto

Legend
- river
- contours 40 m
- Uch-Enmek Park
- archaeological sites

Altay Mountains
Survey Project
Ghent University
2003-2008

0 250 500 1.000 1.500 2.000 2.500 3.000 m

Original Scale (A2 Format): 1/30,000

N

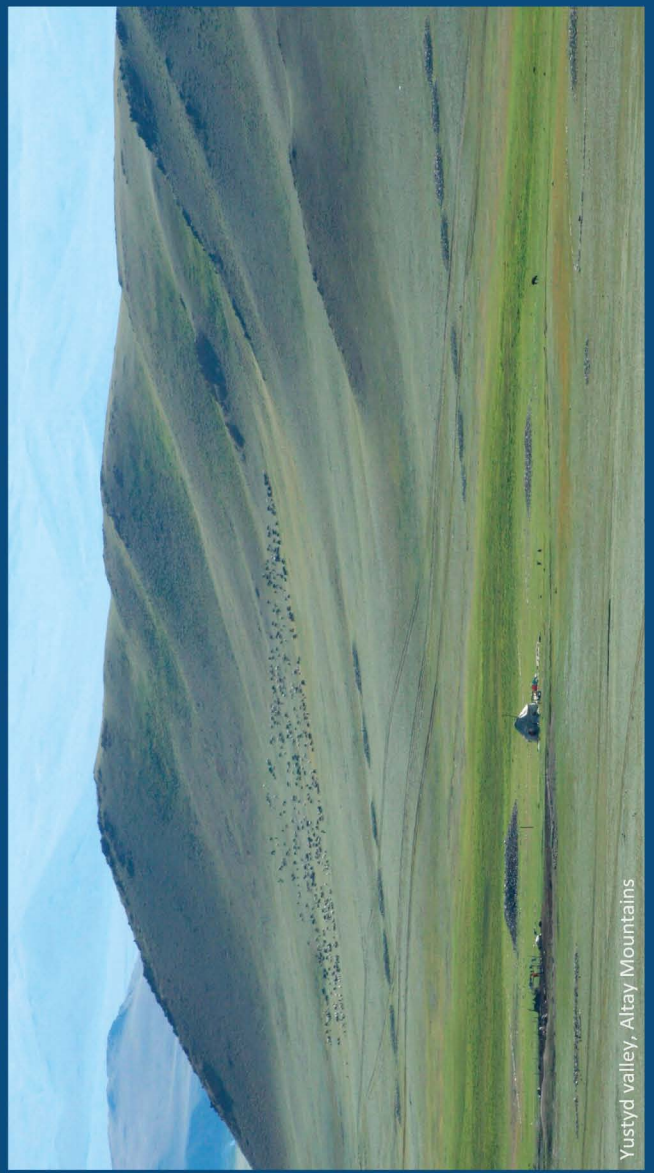
UTM 45
WGS 1984

UNIVERSITEIT GENT

Highlands and Steppes. An analysis of the changing archaeological landscape of the Altay Mountains

Wouter Gheyle

2009



Yustyd valley, Altay Mountains