Weathering, rock type, bedrock incision and landslides in a tropical environment: the Ruzizi gorge in the Kivu Rift, Africa

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Tropical environments favour chemical weathering and regolith development. Weathering induces textural, mineralogical and chemical changes in rocks, modifying their strength and thus affecting slope stability. Degree of weathering is, however, not only a function of climatic conditions, but is also influenced by e.g. bedrock composition and structure, exposure length and intensity, and slope angle. To investigate the role of weathering and rock type on landslide occurrence, we focus on the Ruzizi Gorge in the Kivu Rift segment of the western branch of the East African Rift System. Stretching along the border between the DR Congo and Rwanda, development of this 40-km long bedrock river began about 10,000 years ago, rejuvenating the landscape at a very high rate, with rather invariant slope angles outside of the landslides. The gorge stretches across a region where two main types of rocks constitute the geological substrate, i.e. late Miocene to Pleistocene volcanic rocks and Mesoproterozoic metasedimentary rocks. The gorge is a hotspot of deep-seated landslides in the region, with slope failures of up to 2 km². For the present study, we sampled weathering profiles developed on both mentioned rock types, in each case with sampling points within and outside the landslides as well as within and outside the rejuvenated landscape. The chemical composition of rock and regolith samples was determined by Inductively Coupled Plasma–Optical Emission Spectroscopy (ICP–OES) analysis, and their mineralogical composition by X-Ray Diffraction (XRD) analysis and thin section observations. Geotechnical tests were used to determine mechanical properties. Overall, we observe that lithological aspects alone control regolith characteristics, and that slope angle and exposure to landscape rejuvenation hence play no significant role. In areas with volcanic rock substrate, where the largest, mostly slide-type, landslides develop, stratified weathering profiles are observed. These profiles show a greater weathering depth than those over metasedimentary rocks, where flow- and avalanche-type landslides are more common. The regolith derived from volcanic rocks has higher clay content, greater plasticity and stronger cohesion than the sandy to silty weathering material that overlies the metasedimentary rocks. These preliminary results show that weathering and rock type are more important than landscape rejuvenation in controlling the type of deep-seated landslides.