Bacterial colonization on weathered monuments: a case study on Lede Stone

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Belgian city centers consist of important heritage made of natural building stones. These stones are oligotrophic and exposed to intense conditions such as extreme temperature variations, desiccation, UV radiation and pollution. This makes it an extreme habitat for organisms to thrive but bacteria and other microorganisms still colonize these building stones, causing biodeterioration. On top of that, our monuments undergo further forms of chemical and physical deterioration. Air pollution is one of the main actors, leading for example to the typical gypsum crusts in limestones. Little is known about the microbial habitat and the impact of bacteria on specific forms of weathering such as the gypsum crusts. Therefore, the outer layer of weathered Lede stone, a sandy limestone has been sampled at two historic monuments: one in the polluted urban environment (City hall, Ghent, Belgium) and one on the countryside (Castle of Berlare, Belgium). The stones of Ghent contain thick botryoidal gypsum crusts while the crusts in Berlare are thin. DNA extraction, 16S rRNA gene amplification followed by Illumina Mi-Seq Next Generation Sequencing (NGS) revealed several extremophiles. High abundances of Rubrobacter, Deinococcus-Thermus and Thermomicrobiales in several samples indicate a high tolerance for radiation and high temperatures. The isolation campaign in Ghent and Berlare captured many of the dominating genera such as Arthrobacter, Blastococcus and Noviherbaspirillum. Some of them are adapted to extreme cold temperatures. Culture dependent and independent techniques revealed in both localities a variable, diverse, but similar microbial community. It did not identify a significant impact of pollution and the gypsum crusts. The isolates verify the NGS data and next steps will include lab-based experiments to test their influence on stone degradation and potential gypsum crust formation.