What does it take to turn a rock into a badlands material?

Milica Kasanin-Grubin (1), Estela Nadal Romero (2), Marta Della Seta (3), and Juan F. Martinez-Murillo (4)

(1) University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Belgrade, Serbia
(mkasaningrubin@chem.bg.ac.rs), (2) Department of Geography and Spatial Planning, Environmental Sciences Institute,
Climate, Water, Global Change and Natural Systems Group, University of Zaragoza, Spain (estelanr@unizar.es), (3) Sapienza
University of Rome, Dipartimento di Scienzedella Terra, Centro di Ricerca CE.RI., P. le A. Moro 5, 00185 Roma, Italy
(marta.dellaseta@uniroma1.it), (4) Physical Geography and Land Management Team, Department of Geography, University
of Málaga, Campus de Teatinos. 29071 Málaga, Spain (jfmmurillo@uma.es)

Badlands can develop under different climatic conditions ranging from arid to humid on materials that have a complex combination of physico-chemical properties. The aim of this study is to determine the critical material properties for badland development based on current knowledge and new data. For that purpose we analyzed, both using the existing and new data, the importance of the distribution of grain size, mineralogical composition, and physico-chemical properties.

Generally, the badland materials are most commonly described as "fine—grained" however, the size of the dominant grain fractions is not the solely important parameter. We argue that there is a critical amount of each size fraction (sand, silt and clay) that makes these materials susceptible to erosion. Furthermore, sorting of the material is an important factor in material susceptibility to erosion. The well-sorted fine sediments are generally considered as materials prone to disintegration and piping, while sediments with a large range of sizes and higher degree of packing are more resistant. However, poorly sorted sediments can also be very erodible and are found in badlands. Besides quartz, feldspar and carbonates, clay minerals are always present in badland materials and these minerals are crucial for badland development.The dominant clay mineral determines the behaviour of badland material, regarding swelling/shrinking, dispersion and crust development.

Previous studies have shown that pH, SAR (sodium adsorption ratio), TDS (total dissolved salts), PS (percentage of sodium) and ESP (exchangeable sodium percentage) are distinctive parameters for both eroded and non-eroded slopes in badlands. Furthermore, our findings prove that content of organic carbon (Corg) is also a very important parameter and that materials with high SAR are less dispersive if the Corg is above 3%.

In conclusion, this study shows that there are a number of thresholds regarding grain size, mineralogical composition and physico-chemical parameters that have to be met to make sediment a badland material.