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Badlands: too complex to be simple landscapes?

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Badlands are an intensively dissected barren landscape, devoid of soil cover, with a sparse or absent vegetation. The very high drainage densities, V-shaped valleys and steep slopes, have often led to believe that badlands represent a landscape where the frequency and magnitude of overland flow and erosion processes are very high, resulting in rapid landscape evolution and a close connection between form and process. This perceived proximity between form and process is the main reason why badlands have sometimes been regarded as "ideal field laboratories" for testing landscape evolution hypothesis.

Recent research has shed a critical light on the “simple landscape” perspective. Two key issues support this change in perspective. First, the erosion rates and sediment yields observed badland areas vary widely. As a consequence, only weak relationships were found between average annual rainfall and average erosion rates for annual rainfalls in the wide range of 80-1250 mm. Both the spatial variability and the limited relationship to annual rainfall present a serious barrier for the extrapolation of erosion rates from the hill slope to catchment scales and certainly to landscape evolution over longer geological time scales under changing climatic conditions. A second reason contradicting the simple landscape assessment is the mismatch observed between current erosion rates and the long-term denudation rates that have been reconstructed for several badland areas. Denudation rates, as observed on badland slopes, on the order of 2-5 cm y-1 would be expected to completely wipe out an area with a relative elevation of 10 m within the very short time of 200 to 500 years. This is quite unreasonable unless we assume those denudation rates equal extremely high rates of tectonic uplift, or alternatively that high erosion rates result from extreme rain events with an extremely high frequency.

In the light of this critical assessment of the idea of badlands as a “natural and simple laboratory” for landscape development, 40 years of research activities in the Zin Valley badlands in the Negev desert are reviewed in this presentation. The wide range of studies on different spatial and temporal scales illustrates the gradual development of our understanding of badlands and suggests some answers to some conflicting results mentioned above. Eventually we try to address the question whether badlands are too complex to be simple or whether geomorphic systems are just more complex than we thought.