



The influence of badland surfaces and erosion processes on vegetation cover

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To assess the links between badland geomorphology and vegetation cover, we used detailed mapping in the Avonlea badlands, 60 km southwest of Regina, Saskatchewan Canada. Three badlands surfaces are typical in the study area: a basal pediment surface, a mid-slope of bentonitic mudstone with typical popcorn surface, and an upper slope with mud-cemented sandstone. Badland development was triggered by rapid post Pleistocene incision of a meltwater channel in Upper Cretaceous marine and lagoonal sediments.

After surveying and mapping of a test area, sediment samples were taken to analyze geophysical parameters. A detailed geomorphic map and vegetation map (1:1000) were compared and analyzed in order to determine the geomorphic environment for plant colonization.

The shrink–swell capacity of the bentonitic bedrock, slaking potential and dispersivity are controlled by soil texture, clay mineralogy and chemistry, strongly influencing the timing and location of runoff and the relative significance of surface and subsurface erosional processes. The absence of shrink–swell cracking of the alluvial surfaces of the pediments indicates a low infiltration capacity and sheetflow. The compact lithology of the sandstone is responsible for its low permeability and high runoff coefficient. Slope drainage of steep sandstone slopes is routed through a deep corrasional pipe network.

Silver sagebrush (*Artemisia cana*) is the only species growing on the popcorn surface of the mudrock, which is in large parts vegetation free. The basal pediment shows a distinct 2 m band surrounding the mudrock outcrop without vegetation as a result of high sedimentation rate due to slope wash. Otherwise the typical pioneer vegetation of this basal pediment are grasses. In the transition zone below the steep sandstone cliffs and above the gentle bentonitic mudrock surfaces patches of short-grass vegetation are found, marking slumped blocks with intact vegetation and soil cover. These patches are surrounded by less dense pioneer vegetation consisting of grasses and sage bushes indicating minimal surface erosion or sedimentation. Geomorphic mapping documented a high density of active pipes in this area, transporting silt and fine sand from the sandstone cliffs to lower and basal pediments.

Vegetation cover alone is a poor indicator of badland surfaces and erosion processes because of the three-dimensional nature of badland erosion processes, and the shrink–swell capacity of the bentonitic bedrock. A combination of geomorphic and vegetation mapping is needed to identify badland surfaces and processes in the study area.