The geomorphology of coarse clastic surfaces in arid environments

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Abstract

This study explores the linkages between slope form and slope process in arid environments. In doing so, questions of the development of slopes in arid environments are examined. The age of many arid environment surfaces, combined with the sporadic nature of formative events, means that long-term surface and slope development remains an elusive question in geomorphology. Deserts have inspired many of the most enduring theories of landscape evolution and continue to provide a test-bed for new and emerging ideas in geomorphology. The clast-mantled surface of the northeast Jordan Badia presents an ideal opportunity to study the links between surface character and slope processes in arid environments. The northeast Badia also provides an opportunity to explore theories of slope development and the behaviour of earth surface systems.

The nature of the clast covered ground surface has been assessed using a new digital aerial photography and image analysis technique. A field study of surface processes has been used to explore links between surface form and slope process. Additionally, a computer based simulation of long-term modification of the spatial distribution of surface clast has been undertaken. Given the subtle variation in earth surface form between disparate locations, a new semi-quantitative method of locating sample sites has been developed. The characterization of surface form has identified statistically significant relationships between ground surface character and two-dimensional slope form. Systematic variations in ground surface configuration, both within and between basalt flows, are found to be indicative of the action of slope processes.

The first study of ground surface hydrology in the northeastern Badia has been undertaken. The results from a series of rain-storm simulation experiments show subtle but significant links between the action of surface processes and variations in ground surface form. The controls on surface process are diverse and vary in significance with position in the landscape. A combination of ground surface characterization and process studies has identified several interesting geomorphological phenomena The surfaces exhibit systematic variations in structure and organization. Homeostatic links between form and process are clearly apparent, which suggests that surface form influences and is influenced by process action via a process of positive feedbacks.

Given the sporadic and infrequent recurrence of formative events in arid environments, a modelling approach has been developed to understand the long-term, spatial dynamics of the ground surface. The model has been used to simulate structure in the surface clast arrangement and the sensitivity of surface organization to physically constrained variations in model parameters. The model also allows the surfaces to be considered as self-organizing earth surface systems. The model results provide new insights into the process-form linkages in operation on clast-mantled arid surfaces. The model results provide new ways of examining and understanding the dynamics of clast mantled arid surfaces and have implications for the application of self-organization in geomorphology.