RELATIONSHIP BETWEEN FLUVIAL GEOMORPHOLOGY AND EROSION IN THE PENNSYLVANIA APPALACHIANS: IMPLICATIONS FOR LANDSCAPE EVOLUTION

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Abstract

The central Appalachian Mountains have served as the proving ground for two, end-member conceptual models of relief evolution in mountain ranges: dynamic equilibrium and cyclical evolution. Here we present quantitative geomorphic and erosion rate data from the northern Valley and Ridge province of Pennsylvania that provides a test of these models. Analysis of streams draining a 106 km^2 upland plateau reveals transient profiles, characterized by steep reaches incised into narrow, steep-sided valleys below knickpoints that are not associated with lithologic contacts or contrasts in rock strength. Streams atop the plateau are ~1/3 as steep and drain watersheds with a mean slope of 5° that cross-cuts bedding at a low angle (10°–15°). Normalized steepness indices in these channels correlate linearly with watershed-averaged erosion rates from cosmogenic ^{10}Be in detrital quartz, indicating that steeper reaches are eroding at rates two to five times greater than those atop the plateau (23–80 m/Ma compared to 9–17 m/Ma, respectively). Reconstruction of relict profiles suggests that higher rates of incision are a response to ~200 m of relative base level fall on the West Branch Susquehanna River. Similar relationships between erosion rate, channel steepness, and estimated base-level drop occur on the Appalachian Plateau. Our results provide direct evidence that portions of the Appalachian landscape are still seeking equilibrium among lithology, topography, and erosion rate.

Northeastern/Southeastern Joint Section Meeting, Geological Society of America (14–16 March 2009)