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Topographic fingerprints of hillslope erosion in the North American Appalachians

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The increasing availability of high resolution topographic datasets has engendered increasingly sophisticated analyses of earth surface processes. However, these analyses require equally sophisticated measurements of fluxes occurring at the Earth's surface to calibrate measurements made from high resolution digital topography. Here, we use a combination of meteoric and *in situ* ^{10}Be to directly measure downslope fluxes and erosion rates of regolith in forested watersheds developed within the Valley and Ridge physiographic province of the eastern United States. We pair these data with analysis of ridgetop curvature values, derived from high resolution, LiDAR digital elevation models. Under the conditions of steady state, where regolith thickness is constant, and weathering and erosion are in balance, rates of regolith production and erosion are directly proportional to the hillslope curvature.

Meteoric ^{10}Be concentrations measured in regolith at the Susquehanna Shale Hills Critical Zone Observatory (SSHO) were used to measure downslope flux rates which increase from $\sim$ 5 cm^2/y near the ridgetops to $\sim$ 30 cm^2/y near the toe slopes. Regolith flux rates near the ridgetops correspond well with previously determined rates of regolith production, suggesting that regolith production and transport are in balance. Near the ridgetops at SSHO, fluxes of regolith are linearly correlated with topographic gradient; however, lower on the hillslopes, regolith flux is linearly correlated to the product of regolith depth and local gradient. Following the simple linear relation between flux and slope, the transport efficiency value near the SSHO ridgetops (K) is $\sim$ 28 cm^2/y. On ridgetops at SSHO, where slope and accumulation area are both small ($<$5 m^2), the mean curvature is relatively constant (-0.008 m^{-1}). When combined with an average SSHO erosion rate of 17 m/My, the calculated transport efficiency for SSHO is $\sim$21 cm^2/y, similar to the K value inferred from meteoric ^{10}Be. Extending this analysis to other watersheds in the Valley and Ridge province, where basin-averaged erosion rates were measured with *in situ* ^{10}Be, suggests that the transport efficiency of watersheds developed on sandstone are higher than in watersheds developed on shale. Our results suggest that the combination of ^{10}Be measures of erosion rates along the Valley and Ridge province with digital topographic datasets can be used to "read" changes in lithology and climate in the landscape.