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ACCEPTING OUR DIFFERENCES: THE POWER OF AMALGAMATION AND 10BE AS A GEOMORPHIC TRACER FOR HILLSLOPE SOIL TRANSPORT

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Realizing that every hillslope is different, how then can we hope to find a widely applicable method for quantifying the rates and patterns of hillslope processes? Here, we report the results of adapting the transect/amalgamation methods that Nichols et al. (2002) first used on low gradient desert piedmonts to a steeper, wetter soil-mantled environment. By amalgamating samples, we account for the fact that hillslopes change across and downslope. By maintaining unamalgamated samples along one transect, we are able to assess point-to-point variability.

We used cosmogenic nuclide concentrations to track sediment down a 400-m-long hillslope in the humid, temperate Great Smoky Mountains (GSM) of North Carolina. In the GSM, (n = 40 samples), 10Be concentrations (4.1-6.1*105 atoms/g) for the upper three transects increased downslope, but the concentrations decreased for the final, lowest elevation transect. We used these concentrations in conjunction with soil production rates (12 m/My) calculated from 10Be concentrations at the soil-bedrock contact (Heimsath et al., 1997) to create simple mass balance models for soil flux downslope.

Best-fit models of the data require soil velocities of 1-3 cm*yr-1 in a well-mixed, 55 cm thick active layer of the soil. The thickness of this active transport layer is dependent on the rooting depth of trees on the slope and the related depth of soil turnover and mixing due to tree throw. Modeled soil fluxes range from 55-165 cm3*yr-1*cm-1 depending on whether soil velocity or the thickness of the actively transported layer is kept constant downslope.

By physically mixing samples to smooth the idiosyncratic histories of individual grains, and by measuring cosmogenic 10Be abundances in collections of those grains, we are able to consider hillslope processes on geologically meaningful spatial and temporal scales. Using 10Be as a geomorphic tracer, we do not rely on any assumed proportional relationship between soil production/transport and hillslope gradient; rather, our interpretation is constrained by measured nuclide concentrations and by the conservation of mass which mandates that soil flux increases downslope as soil is both produced from underlying bedrock and transported from upslope positions.

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