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Tracking landscape-scale sediment generation and transport using in situ produced 10-Be and 26-Al

P.R. BIERMAN[1], K. K. NICHOLS[1], E.M. CLAPP[1], A. MATMON[1], M. CAFFEE[2], AND R. FINKEL[3]

[1]University of Vermont, Department of Geology, Burlington, VT 05405 (pbierman@zoo.uvm.edu, kknichol@zoo.uvm.edu, amatmon@zoo.uvm.edu)

[2]Lawerence Livermore National Laboratory, Livermore, CA 94550; now at PRIME Lab, Purdue University, West Lafayette, IN 47907 (mcaffee@physics.purdue.edu)

[3]Lawerence Livermore National Laboratory, Livermore, CA 94550 (finkel1@llnl.gov)

Measurement of ^{10}Be in quartz-bearing sediment provides a unique means by which to trace sediment from its production on hillslopes through transport down drainage networks. We use 5 examples to illustrate the utility of this methodology at different spatial scales.

Quantifying basin-scale sediment generation rates

Forty sediment samples from the 178 km^2 Drift Creek watershed drainage network in maritime coastal Oregon demonstrate that cosmogenic estimates of sediment production (about 100 m/My) are similar to those derived by other means including suspended sediment yield and the filling and emptying rates of colluvial hollows.

More than 70 samples from drainage basins ranging in size from 1 to >300 km^2 in the humid, temperate Great Smoky Mountains show that erosion in this part of the southern Appalachians is spatially and temporally uniform and occurs at an average rate of about 30 m/My.

Sediment samples (n=52) from the 14,000 km^2 semi-arid Rio Puerco drainage network of northern New Mexico demonstrate the utility of cosmogenic sediment analyses at much larger scales. We find that small drainage basins have highly variable rates of sediment generation (7 to 355 m/My) but that variability dampens significantly downstream as sediment is well mixed by fluvial processes.

Understanding Sediment Transport

Yuma Wash is an active ephemeral stream draining 187 km^2 of arid southern Arizona. Samples taken from the main stem show a distinct downstream lowering in nuclide activity. Using mixing models, we quantify the percentage of low-activity bank sediments entering the stream by lateral erosion. When Yuma Wash enters the Colorado River, about 40% of the sediment it carries is derived from its banks and 60% from highland erosion.

Cosmogenic nuclide analyses of amalgamated surface sediment samples show that cosmic-ray dosing, and thus sediment transport, are remarkably regular down kms-long desert piedmonts, both those with incised drainages and those where rapid channel migration occurs. Simple interpretative models indicate that the average sediment grain moves down piedmont at speeds of dm per year on the four Mojave Desert piedmonts we have sampled so far.

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