Tracing Sediment Through Drainage Basins with Cosmogenic Radionuclides, ^{10}Be and ^{26}Al

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We demonstrate that cosmogenically produced nuclides can be used to monitor the rate at which sediment is generated and in some cases transported through drainage basins. Using examples from the arid southwestern United States, the coastal plain of Namibia, and southern Israel, we demonstrate both the promise and pitfalls of interpreting ^{10}Be and ^{26}Al data in sediments.

Sixty-four samples from Yuma Wash, a 180 km^2 drainage basin in southern Arizona, indicate that the highlands are eroding at about 30 m My^{-1}. By analyzing multiple grain sizes in a variety of samples, we demonstrate that ^{10}Be and ^{26}Al concentrations are independent of grain size implying no size bias in the rate of sediment generation and transport. Nuclide concentration decreases downstream in the main stem of Yuma Wash, an observation that we suggest indicates the quarrying of less-well dosed sediment from the deeply-incised channel banks. At Yuma, as elsewhere, the greatest nuclide abundances and thus the lowest erosion rates were measured on bare rock outcrops.

At Nahal Yael in southern Israel, we use 32 samples to calculate a whole-basin sediment generation rate of 79+/-17 tons km^{-2} y^{-1} equivalent to a rock-lowering rate of 29+/-6 m My. Comparing our data to that generated by Schick's 30 years of sediment export monitoring, suggests that the rate of sediment export may be exceeding the rate of sediment generation by 30 to 50%. This disparity may be due to the removal of sediment from storage at the base of hillslopes. Similar to our findings at Yuma, the greatest nuclide abundances were measured on bare rock outcrops and we found no relationship between grain size and nuclide abundance.

In Namibia, we have collected three or four water-washed quartz clasts from each of four apparently stable surfaces on the hyper-arid coastal plain. These clasts have effective exposure ages ranging from 200 ka to 2 Ma. Ages cluster well on each surface and suggest that such surfaces are exceptionally stable. Unlike the other basins we have investigated, these sites in Namibia indicate extremely long sediment storage times and low integrated rates of sediment transport across the coastal plain.