Insight into the processes of erosion derived from the distribution of single-clast Be-10 measurements, Pisco River, Peru

Details

Meeting	2012 Fall Meeting
Section	Earth and Planetary Surface Processes
Session	Process-Oriented Multiapproach Erosion Analysis in High Mountains: Decade to Millennia Timescales II Posters
Identifier	EP53E-1077
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Index Terms	Cosmogenic-nuclide exposure dating [1150] Geomorphology: fluvial [1825] Geomorphology: hillslope [1826]

Abstract

Although cosmogenic nuclides such as Be-10 are routinely measured in detrital stream sediments, the results are generally amalgamated to find drainage-average erosion rates. This approach ignores additional information in the probability distribution of cosmogenic nuclide concentrations assembled from individual particles of sediment. We explore the utility of single-clast Be-10 measurements from granitic cobbles in the Quebrada Veladera, a moderately large (~300 km2) tributary of the Pisco River, which drains the northern boundary of the Altiplano. First, we compare 5 preliminary, single-clast, Be-10 measurements with amalgamated measurements from the sand-size fraction of sediment. Clast counts from several points in the drainage suggest that transport processes thoroughly mix cobbles of different lithologies (and therefore from different sources), providing a representative sample. Although the preliminary single-clast measurements constitute an exceptionally small sample set, the range of apparent erosion rates (19±1.4 to 113±8.1 mm/kyr) is similar to the range of 14 sand-size amalgamated measurements (33±2.5 to 102±7.7 mm/kyr) collected from throughout the Quebrada. Next, we apply Monte Carlo methods to a simple model of cosmogenic production in landscapes subject to landslides in order to develop predictions for the distribution of single-clast Be-10 concentrations across the landscape. The modeling predicts significant differences in the distributions, depending on the relative importance of processes such as landsliding or creep. We are currently testing these predictions by measuring a much larger set of cobbles.

Cite as: Author(s) (2012), Title, Abstract EP53E-1077 presented at 2012 Fall Meeting, AGU, San Francisco, Calif., 3-7 Dec.