2010 GSA Denver Annual Meeting (31 October –3 November 2010)

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COSMOGENIC ^{10}BE ANALYSIS OF RIVER SANDS PROVIDES BACKGROUND EROSION RATES FOR MADAGASCAR

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Madagascar is considered one of the world's most ravaged landscapes, with inferred erosion rates 100-1000 m/m.y. Lavakas—saprolite gullies of the central highlands—are cited as evidence of catastrophic anthropogenic degradation. But this picure is based on few data, mostly from bare-plot runoff and short-term estuary sedimentation records. There are no long-term (>1 yr) stream-sediment gauge data. Cosmogenic ^{10}Be in quartz sand from rivers provides quantitative constraints on regional erosion rates at millenial timescales for specific geomorphologic settings.

Data from 32 rivers spanning Madagascar from W to E indicate basin-scale erosion rates of 3-76 m/m.y. (^{10}Be concentrations 18.5-0.5 x 10^5 atoms/g). In contrast to other studied regions (e.g. Sri Lanka and Europe), the highest rates (50-76 m/m.y.) are associated with some of the smallest (3-26 km^2) and lowest-lying (mean elevations 35-535 m) watersheds. Three of the highest erosion rates (49-75 m/m.y., i.e. 0.7-0.5 x 10^5 atoms/g) are measured in small basins (3-26 km^2) on the western coastal lowlands. The single highest rate (76 m/m.y., 0.6 x 10^5 atoms/g) comes from a 10 km^2 mountain drainage on the eastern escarpment. In contrast, the largest (2500-19,000 km^2) and highest basins (mean elev. 725-1500 m), draining the steep and deeply weathered central uplands, yield rates of only 6-16 m/m.y. (^{10}Be of 5.0-2.8 x 10^5 atoms/g).

The results challenge conventional interpretations of the role of lavakas in Malagasy erosion. For lavaka-bearing watersheds, cosmogenic erosion rates are correlated with lavaka density (R^2=0.8, p<0.0001). That we see this trend in the well buffered ^{10}Be system suggests that these are long-term, natural denudation rates, and the effect of lavakas pre-dates the ≈2000 k.y. arrival of humans in Madagascar. Perhaps more surprising is the result that that rates from lavaka-hosting watersheds are all <20 m/m.y. In strong contrast, the 6 highest erosion rates (30-76 m/m.y.) are all measured from zero-lavaka watersheds: i.e. high natural erosion rates occur in the absence of lavakas.

These data provide a time-integrated background from which to interpret erosion in Madagascar's varied environments, and show that erosion—although most dramatically expressed in the lavaka-bearing highlands—may be greatest in coastal lowlands.

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