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JUST HOW FAST DOES MADAGASCAR ERODE? EVIDENCE FROM 10BE ANALYSIS OF LAVAKA, SLOPE, AND RIVER SEDIMENT

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Dramatic gullies (lavakas) in the highlands, limited soil erosion data, and inferred estuarine sedimentation rates suggest that contemporary Malagasy sediment yields are extremely high (20-250 tons*ha-1*yr-1, equal to 100-1000 m/Ma). In contrast, 10Be measured in fluvial sand from 6 central Madagascar drainages indicates a more modest long-term erosion rate of 12 m/Ma. To set the river data in context, we examined the 10Be content of lavaka deposits and surficial material from ungullied slopes. River sand has 0.5 x 106 atoms/g 10Be (n=6), deposits in and near active lavakas have 0.08-1.0 x 106 atoms/g (n=4), and surficial material on non-gullied slopes has 0.12-2.1x106 atoms/g 10Be (n =8).

Two points are notable. First, average 10Be content of lavaka-derived sediment (0.4 x 106) is lower than that of slope sediment moving by soil creep (0.8 x 106), indicating that lavakas are excavating some deep, less-irradiated saprolite. Lightly-irradiated saprolite is certainly tapped at the bases of young lavakas, which average about 15 m deep; this excavation is recorded in the low values (0.08 x 106 atoms/g) recorded from some lavaka sediment. But lavaka-derived sediment is not dominated by this deep material, and we infer that the deep saprolite is exposed and actively eroded only in the initial phase of lavaka formation. Subsequent activity is dominated by wall-fall events, by which debris from nearer the surface is deposited on the floor of the lavaka, occluding the deep saprolite. As lavakas fill over time the deep saprolite is reburied, the average wall height decreases, and the 10Be content of exported sediment increases.

The second—and most significant—result of our comparison is that the comparable 10Be values from river sands and their present-day sediment sources suggest that the sampled rivers typify the modern sediment contribution from their lavaka-bearing hinterland. The calculated basin-scale erosion rate of 12 m/Ma is therefore an upper limit on longer-term erosion of Madagascar. Consequently, claims that human impact has dramatically increased erosion in the last 1500 ky (by triggering lavaka activation) must be rigorously tested — especially in light of several pairs of samples that indicate modern fluvial sediment and sediment from adjacent older terraces have similar 10Be concentrations.

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