UNDERSTANDING EARTH SURFACE PROCESSES WITH 10-BE (AND A LITTLE 26-AL)

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Berylium-10, together with 26-Al, give us a window into the past. Typically exploited as a chronometer of waning glaciers, fan deposition, and bolide impacts, increasingly precise measurements of 10-Be now help us understand and quantify surface processes. Using this cosmic-ray produced isotope, we can begin to learn a tantalizing story of near-surface existence from once-mute clasts, soils, and sand grains.

In Namibia, we used 10-Be to understand how long clasts survive at Earth's surface. Within and below the Great Escarpment, we collected 12 small clasts of quartz and chert exposed on 4 pavement surfaces. The longest-lived clasts (>3 My!) were found near the base of the escarpment and show isotopic evidence for shallow or short-lived burial. Clasts taken from a stable surface within the escarpment are consistent with steady erosion at a rate of about 2 m/My. Clast dosing and surface stability appear to decrease toward the hyper-arid coast where precipitation is < 30 mm/y but fog drip and salt weathering increase.

In Georgia, we collected 20 samples of saprolite/soil from a residual ridgetop weathering profile in order to measure rates of mass loss in a granitic piedmont. The upper 35 cm of the profile are well mixed; 10-Be abundance is unchanging in the uppermost 5 samples (2 to 35 cm depth). From 35 to 400 cm below the surface, 10-Be content decreases smoothly in a pattern not well modeled by the exponential decrease in neutron fluence. In order to match the measured data, our model suggests dissolution has removed >60% of the profile's mass.

In Arizona, sediment samples collected from 26-km-long Yuma Wash show a regular decrease in nuclide concentration well modeled by an exponential. We use these data to calculate mixing ratios between highly-dosed sediment coming from resistant highlands and less-dosed material coming from poorly consolidated and highly-dissected valley fill. When Yuma Wash dispatches to the Colorado River, over 40% of the sediment it transports by has been recycled through the valley fill.