Temporal evolution of detrital cosmogenic denudation rates in transient landscapes from *in situ*-produced ^{10}Be

J.K. WILLENBRING[1]*; G. BROCARD[1]; N. M. GASPARINI[2] AND B.T. CROSBY[3]

[1]Department of Earth and Environmental Sciences, University of Pennsylvania, Philadelphia, PA, USA erosion@upenn.edu
[2]Department of Earth and Environmental Sciences, Tulane University, New Orleans, Louisiana, USA
[3]Department of Geosciences, Idaho State University, Pocatello, Idaho, USA

Following a shift in tectonic forcing, the Earth's surface progressively adjusts its topographic form over millions of years, seeking to reestablish equilibrium with the new forcing. Though this adjustment has been recognized in landscapes for over a hundred years, its geologic pace limits our ability to directly measure or observe its form or rate over the entire cycle. In transient landscapes detrital quartz is derived from both the incising, adjusting lowland and the unadjusted, relict upland, the integrated ^{10}Be concentrations provide a denudation rate averaged across the two domains. Because field samples using *in situ*-produced ^{10}Be can only provide a snapshot of the current upstream-averaged erosion rate, we employ a numerical landscape evolution model to explore how ^{10}Be derived denudation rates vary over time and space during long-term transient adjustment. Model results suggest that the longitudinal pattern of mean erosion rates is generated by the river's progressive dilution of low-volume, high-concentration detritus from relict uplands by the integration of high-volume, low-concentration detritus from adjusting lowlands. The proportion of these materials in any detrital sample depends on what fraction of the upstream area remains unadjusted. This fraction and the rate change over time.

We test this model in two Critical Zone Observatories (CZOs): the El Yunque (Luquillo) National Forest, Puerto Rico and in the South Fork Eel River catchment in N. California. We find that denudation rates increase in the downstream direction by factor of 2-3. We show that this pattern of denudation rates, paired with the distribution of relict topography throughout the watershed, reflect the immaturity of the landscape's transient adjustment. We propose that the manner in which a landscape responds can be indicative of the type of uplift perturbation.