2011 GSA Annual Meeting in Minneapolis (9–12 October 2011)

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MEASUREMENTS OF COSMOGENIC ^{10}BE REVEAL RAPID RESPONSE OF GRAND CANYON TRIBUTARY HILLSLOPES TO COLORADO RIVER INCISION

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Recent advances in geochronology have provided new data to test models relating Colorado River incision and Grand Canyon evolution. Incision rates of the Colorado River in Grand Canyon generally rely on dating geologic deposits such as lava flows, speleothems, and river gravels that represent the paleo-river elevation divided by the distance to the modern river. Thus, they often provide information about incision integrated over hundreds of thousands to millions of years and assume continual base level lowering. However, only a few studies have investigated the timescale of hillslope response in Grand Canyon tributary basins climatic perturbations and to the base level lowering and of the Colorado River. For example, Anders et al. (2005) found that while tributary drainages are well-linked to sediment sources, tributary basin response lagged Colorado River incision by up to several tens of millennia in eastern Grand Canyon.

Using a different approach, we collected samples of fluvial sediment from tributary mouths throughout Grand Canyon. We separated quartz from the sand fraction and measured in situ produced cosmogenic ^{10}Be. The basin-scale data suggest strong correlation between tributary erosion rates and Colorado River incision rates. Basin-scale erosion in the eastern Grand Canyon averages 147 +/- 13 m/My (n=19), integrated over millennia. This rate corresponds with the multiple incision rate data that average ~150 m/My in this reach. Similarly, basin-wide erosion rates in western Grand Canyon downstream of the Hurricane and Toroweap faults average 61 +/- 18 m/My (n=4), compared with incision estimates that average ~70 m/My in this reach. Our data suggest that tributary hillslope response to Colorado River incision is rapid enough over the effective window of cosmogenic ^{10}Be that tributaries quickly adjust to incision by the Colorado River.

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