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The Long and the Short of it: Millennial-Scale and Contemporary Sediment Yields of Eastern Grand Canyon

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Dams on the Colorado River were constructed to regulate and store water for irrigation and domestic consumption, but flow regulation has had major impacts on hydrological and ecological processes within the watershed. Intrinsic to understanding these impacts requires a quantitative knowledge of the sediment yields in regulated reaches. Unfortunately, little is known about the long-term sediment yields, and contemporary data were either estimated or measured over only a few decades and only at only a few locations and therefore may not reflect the longer cycles of erosion and aggradation within the mainstem Colorado River or within the tributary basins. Here, we present data that compares contemporary sediment yield derived from models of ungaged tributaries in eastern Grand Canyon with millennial-scale sediment yield data derived from cosmogenic 10Be to highlight the sediment delivery

processes over the past several thousand years. Models of the contemporary sediment yield of eastern Grand Canyon suggest 349 Mg km-2 y-1 of sediment. Cosmogenic 10Be estimates of long-term (104 yr) yields are 227 Mg ky-2 y-1, only 65% of the contemporary estimates. The difference in these estimates most likely reflects a change in process during the effective range of cosmogenic 10Be (>10 ky). Hanks and Webb (2006) suggest that the bed of the Colorado River in this reach may have aggraded approximately 10 m as a result of a high debris-flow frequency from tributary canyons potentially related to the Pleistocene-Holocene climate change. Conversely, the cosmogenic 10Be data average the high contemporary yields with potentially lower yields of the early- Holocene and late-Pleistocene. If the contemporary sediment yields are extrapolated for the entirety of the Holocene, then the cosmogenic data suggest much lower average sediment yields prior to the Pleistocene-Holocene transition. If correct, these data suggest that Pleistocene-Holocene climate change increased sediment yields several fold. At a minimum, the face value the contemporary sediment yields are 1.5 times the long-term average and suggest that that climate change has had a significant impact on the sediment budget of the eastern Grand Canyon and probably the Colorado River basin.