2006 Philadelphia Annual Meeting (22-25 October 2006)

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ASYMMETRIC TRIBUTARY EROSION RATES OF EASTERN GRAND CANYON BASED ON COSMOGENIC 10BE

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The use of cosmogenic 10Be to quantify basin wide erosion rates assumes a uniform (or known) distribution of quartz within the basin. However, in the Grand Canyon, several sedimentary units overlie the crystalline basement resulting in variable quartz distributions in tributary basins as a function of area and elevation. Thus, in addition to measuring 10Be in basin sediment, it is important to consider sources of quartz in each tributary in order to estimate effective production rates and therefore model erosion rates for lithologically heterogeneous, high-relief basins. To quantify the erosion rate of 7 eastern Grand Canyon tributaries, we measured in situ-produced cosmogenic 10Be in sediment. In general, sediment collected from river right tributaries, Nankoweap Creek, Lava Chuar, Unkar Creek, and Basalt Creek (average AD = 48 km2), contains more 10Be (9.38 ± 1.02 x 104 atoms g-1) than river left tributaries (Comanche Creek and 75 Mile Wash; AD = 9.2 km2; 4.48 ± 2.07 x 104 atoms g-1), except for Escalante Creek, which has the highest content of 10Be (1.33 x 105 atoms g-1; AD = 4.7 km2). The abundance of 10Be is not correlated with either drainage area or with surface area of Pleistocene deposits; rather, there is an inverse correlation with basin average slope. Translating 10Be abundances into basin-wide erosion rates requires that we know the quartz distribution within each tributary. Assuming evenly distributed quartz throughout each basin suggests average erosion rates of 113±23 m/My for river right tributaries and 220±82 m/My for river left tributaries. Escalante Creek has the slowest erosion rate ~60 m/My. Alternatively, estimating the quartz distribution in each lithologic unit and using the resulting elevation-weighted average for production rate calculation yields upper limit erosion rates of 118±28 m/My for river right tributaries and 226±90 m/My for river left tributaries

with Escalante Creek eroding at ~59 m/My – a minor difference. Even with uncertainty in quartz distribution, these data suggest that erosion rates of steep tributaries that drain the South Rim are ~2 fold higher than the erosion rates of tributary basins that drain the North Rim in the eastern Grand Canyon. Erosion rate estimates for the larger, lower slope basins are consistent with prior estimates of Colorado Plateau erosion (~100 m/My).

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General Information for this Meeting
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Pennsylvania Convention Center: Exhibit Hall C
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