Paper No. 3
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LANDSCAPE EVOLUTION IN THE GRAND CANYON REGION: INSIGHTS FROM EROSION RATES AND TRIBUTARY STREAM PROFILES

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The Colorado Plateau is a landscape of steep-walled, high-relief canyons carved into low-relief plateaus. Relief production through the Neogene is apparent from basalt flows on canyon rims; however, two scenarios may explain this observation. An increase in base-level fall rate along the Colorado River may be driving relief production since integration of the Colorado River through Grand Canyon. Alternatively, the generally greater rock strength of Permian and older rocks relative to overlying units above canyon rims could induce relief production without an increase in the rate of mainstem incision.

Both scenarios involve relief production: erosion rates within the canyon are higher than erosion rates on the surrounding plateau. The question is whether or not the rate of mainstem river incision increased. Fortunately, the similar morphology of the canyons and surrounding landscape in both scenarios are formed by a different and thus diagnostic spatial distribution of erosion rates. In each case, erosion rates on the surrounding bench are lower than in the canyons, but only in the baselevel-fall scenario are erosion rates in the canyons greater than erosion rates in catchment headwaters still incising through the weaker cover rocks. Erosion rates in headwater catchments cut in the weaker overlying rocks are expected to reflect the rate of baselevel fall before the exposure of the stronger rocks, allowing a space-for-time substitution: erosion rates of subsequent catchments within canyons reflect the recent rate of mainstem river incision and erosion rates in headwater catchments reflect the incision rate before canyon incision. In summary, if the present-day landscape results from baselevel fall then we will measure higher erosion rates within the canyon than in headwater streams. Conversely, if incision is driven by rock strength, erosion rates in canyons and in headwater catchments will be similar. We test these hypotheses by measuring erosion rates in the canyon and in the headwater streams. Measurements of ^{10}Be from detrital quartz sand are used to calculate erosion rates within the canyon and in the surrounding headwaters once nuclide production rates are corrected for quartz distribution. In-canyon erosion rate samples will be compared to headwater erosion rate data that will distinguish these hypotheses.

Session No. 198

Special Session: CRevolution 2: Cenozoic Landscape Evolution of the Colorado Plateau–Rocky Mountain Region and the Carving of Grand Canyon III
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