

Rocky Mountain Section - 64th Annual Meeting (9-11 May 2012)

Paper No. 10-7

Presentation Time: 8:00 AM-5:30 PM

TRANSIENT INCISION IN LAYER-CAKE STRATIGRAPHY: COSMOGENIC RATES AND DATES IN THE CONTEXT OF GLEN CANYON

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Erosion of the Colorado Plateau by the Colorado River has eroded upwards of 300,000 km³ of rock since the Miocene. Exact erosion patterns are uncertain. One debate is whether the knickpoint (KP) at Lees Ferry (upstream end of Grand Canyon and downstream limit of Glen Canyon) is transient (reflecting the head-ward propagation of incision driven by the base-level drop at the Grand Wash Cliffs) and/or a reflection of resistant rock layers in Grand Canyon. A KP due to the oft weak Mesozoic strata upstream of Lees Ferry should show no change in incision rate in space or time. Measured long term incision rates favor the migrating KP: the rates are greater downstream of the Lees Ferry KP. In contrast, short term dates from multiple methods have been used elsewhere to infer an increase in rate in the late-Pleistocene. Cook et al. (2009) suggested that the interaction of a transient wave of incision with the geometry of the contacts of dipping beds with different strengths may be responsible for this complex pattern, such that incision through the east-dipping Kaibab limestone effectively released an incision wave through the softer Mesozoic rocks. We seek to further test this hypothesis.

An isochron burial date at Bullfrog Bay in Glen Canyon (1.48 +/-0.13 Ma, 190 m above river) and a sample suite below the effective range of isochron burial dating (<~0.3 Ma, 110 m above river) at Hite Crossing imply bedrock incision rates increased between 1.5 Ma and ca. 0.3 Ma. A suite of published dates are compatible with this result. This increase marks a base-level drop for tributaries. Resultant smaller transient KPs in these tributaries would appear at similar elevations and separate low relief from high relief terrains in detachment-limited streams, as observed. This expectation is confounded by layer-cake strata that create topography similar to a transient landscape. Thus discerning transient or steady-state incision through the horizontal strata is necessary. Theory suggests KPs separate the low erosion rate above from the faster erosion rate below in a transient. Thus the test for this hypothesis lies in measuring erosion rate above and below KPs in tributaries. Results can be compared with terrace dates to corroborate incision and distinguish the roles of steady-state incision in the variable substrate and a transient incision wave in Glen Canyon.

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Session No. 10--Booth# 48

[Cenozoic Landscape Evolution in the Rocky Mountains and Colorado Plateau: Deciphering the Interplay between Mantle Buoyancy and Surface Processes \(Posters\)](#)

Hotel Albuquerque: Alvarado D&E

8:00 AM-5:30 PM, Wednesday, 9 May 2012

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