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Comment

The non-equilibrium landscape of the Sierra Nevada, California

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Clark et al. (2005) describe longitudinal profiles of rivers in the southern Sierra Nevada they (1) take to be graded, (2) assume to debouch on a well-fixed regional base level, (3) assume to erode better when the surface beneath is being elevated tectonically, and (4) assume that when a river mouth has a change in base-level target, that information is somehow conveyed upstream to tributaries that respond by altering contiguous hillslopes. Seemingly, water is implicitly assumed to be "on tap" and stands "at the ready" when erosion is called for by earth movements—concepts that stem from William Morris Davis (1899, 1902).

Taking the foregoing assumptions in order: (1) The graded stream was the elusive unicorn of the Davisian Geographical Cycle. In a century, no one has ever bragged of finding one (Dury, 1966; Garner, 1974). (2) Regional base level is not a firm limit on river erosion (Wheeler, 1964; Garner, 1965). Running water erosion does not really stop there. And the sea level target moves up and down 100 m or more during glacial episodes (as should stream profiles tied to it). (3) The uplift/erosion notion harks back to the stream rejuvenation mythology of the Davisian era. Running water erosion in streams moving several feet per second is, however, largely the product of vortex action along water shears that form downflow from obstacles, and as such can hardly respond to uplift of a few millimeters per century. (4) Both the Kern and Kings rivers flow in extremely deep valleys—and at least the Kern River channel is armored. For kilometers, its channel is choked with outhouse-size angular blocks of rock, probably introduced by mass wasting. They constitute a local erosional base level for any upstream tributaries and would prohibit any upstream passage of an erosional signal.

At least as important to Sierra Nevada river behavior as any channel morphology is discharge, which depends largely upon evaporation yield from the adjacent California Current. Like its Humboldt Current counterpart along west coast South America, the California Current moisture yield depends on its temperature, which can vary. Sierra precipitation is governed by California Current evaporative yield, which increases when the Japan Kuo Shio (warm) influence dominates and decreases when Arctic effects prevail on the current. There is evidence (Dunai et al. 2005; Garner, 1983) that Humboldt Current frigidity and related Atacama Desert have continued unchanged since the Oligocene. That current yields virtually no moisture to the land, and when the California Current is coldest, the results are probably the same. Stream discharge and erosion would be much reduced. A warmer current would reverse the effect, so I argue that accelerated stream incision attributed to uplift by Clark et al. (2005) was as probably caused by ocean warming.

Clark et al.'s (2005) identification of an elevated, slightly dissected low relief surface they term a relict landscape is important because mountains start out low, and low land by a cold sea is often arid. An increase in water warmth would encourage adjacent fluvial dissection, and such a history is indicated for the Sierra Nevada relict surface.

The Sierra Nevada orogen has been undergoing isostatic uplift due to erosional unloading since Jurassic time. Its position close to the California Current subjects it to variable precipitation and stream discharge, and the tying of each accelerated river erosion episode to uplift does not fit the situation. The Sierra Nevada orogen will be incised by rivers whether it is being uplifted or not.

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