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Tectonically-dominated Quaternary landscape evolution of the Ventura basin, southern California, quantified using cosmogenic isotopes and topographic analyses

Dylan Rood[1], **Alex Hughes**[1], Alex Whittaker[1], Rebecca Bell[1], Klaus Wilcken[2], Ashley Corbett[3], Paul Bierman[3], Duane DeVecchio[4], and Thomas Rockwell[5]

[1]Department of Earth Science and Engineering, Imperial College London, London, UK
[2]Australian Nuclear Science and Technology Organization (ANSTO), Lucas Heights, NSW, Australia
[3]Department of Geology and Rubenstein School of the Environment and Natural Resources, University of Vermont, Burlington, VT, USA
[4]School of Earth and Space Exploration, Arizona State University, Phoenix, AZ, USA
[5]San Diego State University, San Diego, CA, USA

Spatial and temporal variations in fault activity informs models of seismic hazards and can affect local patterns of relief generation and channel morphology. Therefore, the quantification of rates of fault activity has important applications for understanding natural hazards and landscape evolution. Here, we quantify the complex interplay among tectonic uplift, topographic development, and channel erosion recorded in the hanging walls of several seismically-active reverse faults in the Ventura basin, southern California, USA. We use cosmogenic $^{26}Al/^{10}Be$ isochron burial dating to construct a basin-wide geochronology for the Saugus Formation: an important, but poorly dated, regional Quaternary strain marker. Our geochronology of the Saugus Formation is used to calculate tectonically-driven rock uplift rates and reduce uncertainties in fault-slip rates. In addition, we calculate ^{10}Be catchment-averaged erosion rates, characterise patterns of catchment relief and channel steepness indices, and analyse river long-profiles in fault hanging walls to compare with patterns of fault displacement rates averaged over various temporal scales.

The results of the burial dating confirm that the Saugus Formation is time-transgressive with ages for the top of the exposed Saugus Formation of ~0.4 Ma in the western Ventura basin and ~2.5 Ma in the eastern Ventura basin. The burial ages for the base of shallow marine sands, which underlie the Saugus Formation throughout the basin, are ~0.6 Ma in the western Ventura basin and ~3.3 Ma in the eastern Ventura basin. The results of the landscape analysis indicate that relief, channel steepness, and erosion rates are still adjusting to tectonic boundary conditions imposed by different tectonic perturbations that have occurred at various times since ~1.5 Ma, which include fault initiation and fault linkage. The data presented here suggest that, for transient landscapes in sedimentary basins up to 2500 km^2, where climate can be considered uniform, fault activity is the primary control on patterns of relief generation and channel morphology over periods of 10^4 to

10^6 years.

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