Geophysical Research Abstracts
Vol. 18, EGU2016-2694, 2016
EGU General Assembly 2016


# Tectonic, lithologic and climatic controls on knickpoint retreat rates and landscape response times

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The plan-view and vertical rates at which transient knickpoints propagate through a landscape fundamentally controls geomorphic response times to tectonic and climatic perturbations. Here we present knickpoint retreat rates upstream of active faults for bedrock catchments in the Gediz graben of Turkey where past climate is well documented but where the history of faulting is not fully constrained.

The rivers upstream of the normal fault-bounded graben each contain a non-lithologic knickpoint, including those that drain through inferred fault segment boundaries. Knickpoint heights measured vertically from the fault scale with footwall relief and documented fault throw (vertical displacement). Consequently, we deduce these knickpoints were initiated by an increase in slip rate on the basin-bounding fault, driven by linkage of the three main fault segments of the high-angle graben-bounding fault array. Fault interaction theory and ratios of channel steepness suggest that the slip rate enhancement factor on linkage was a factor of 3. We combine this information with geomorphic and structural constraints to estimate that linkage took place between 0.6 Ma and 1 Ma. Calculated pre- and post- linkage throw rates are 0.6 and 2 mm/yr respectively.

Maximum plan-view knickpoint retreat rates upstream of the faults range from 4.5 to 28 mm/yr, and when normalised by drainage area, they are 2-7 times faster than for similar catchments upstream of normal faults in the Central Apennines of Italy and the Hatay Graben of Turkey. These knickpoint retreat rates imply a fluvial response time to fault growth and interaction of 1.6 to 2.7 My. However, marked along-strike disparities in retreat rates exist. We demonstrate that climate differences may explain the variation in rates between these study areas, but not within the Gediz graben itself. Consequently, we evaluate the extent to which measureable differences in bedrock lithology and erodibility modulate the propagation of knickpoints upstream of active faults in this area.