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Extreme multi-millennial slip rate variations on the Garlock fault, California: geomorphology and geochronology of slip rate constraints

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Combining existing paleoseismology with new geomorphic constraints for the same part of the Central Garlock fault in California, USA, allows us to demonstrate pronounced variations in slip rate during the Holocene for this left-lateral strike-slip system. Our results have basic implications for understanding how faults store and release strain energy in large earthquakes, and for Probabilistic Seismic Hazard Assessment (PSHA). A series of well-preserved fluvial terraces within alluvial fans provide offset markers, and newly developed single grain K-feldspar IRSL dating allows us to constrain depositional ages and subsequent erosion of terrace risers with good precision, using multiple samples from several different locations. This new dating approach has wide applicability for paleoseismology and slip rate studies, besides understanding environmental response to climatic events; agreement with independent age control provided by C-14 and Be-10 profiles comes from sites in the USA, Mexico, Tibet and Mongolia. Sediments dominated by a range of grain sizes from silt to boulders can be dated, and the technique is often applicable in locations where quartz OSL does not work well. We examine the interplay and coupling between climate and tectonics at millennial timescales, along with sedimentary and geomorphic responses, and consider how our understanding of fault dynamics can be improved with the benefit of these new approaches.