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Comparison of geodetic, late Quaternary, and geological rates of slip in regions of distributed active faulting: a case study from eastern Iran

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Recent measurements of crustal deformation have highlighted apparent discrepancies in the slip-rate of active faults when averaged over geodetic and late Quaternary to Holocene timescales. The origin of these apparent discrepancies, measured across entire deforming zones, is unresolved. They may result from switching of activity within a population of faults on timescales of several thousand years and have been used to infer the rheological properties and behaviour of the lower parts of the continental lithosphere. The existence of these slip-rate variations has profound implications both for the use of geodetic data in tectonic studies and for the use of average fault slip-rates in seismic hazard assessments.

Eastern Iran is one region where the switching of activity between numerous parallel strike-slip strands has been suggested to occur on a millennial timescale. We review a number of recent studies of the late Quaternary slip-rate on faults across eastern Iran. We then make a comparison with geodetic estimates of strain to address whether substantial temporal variations in slip-rate have occurred in the Holocene and late Quaternary.

Our results show a broad agreement between fault slip-rates derived from Quaternary dating studies and those derived from geodetic measurements of strain accumulation. There is, therefore, no requirement to invoke large variations in fault slip-rate. However, the distribution of slip at the present-day is inconsistent with the geological displacements across the major active faults; indicating that the distribution of active structures has changed dramatically over periods of > 1 Ma.