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Active tectonics and rheology of slow-moving thrusts in the Tibetan foreland of peninsular India

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Peninsular India is cut by active thrust faults that break in earthquakes in response to the compressive force exerted between India and the Tibetan Plateau. The rate of deformation is low, with 2 +/- 1 mm/yr of shortening being accommodated over the entire N-S extent of the Indian sub-continent. However, the large seismogenic thickness in the region (40–50 km), and the long faults, mean that the rare earthquakes that do occur can have magnitudes up to at least 8.

This contribution describes studies of two large Indian earthquakes, and their rheological and hazard implications, using a range of techniques. First, the Mw 7.6 Bhuj (Gujarat) earthquake of 2001 is examined using a combination of seismology, InSAR, and levelling data. A slip model for the earthquake will be presented, which allows the material properties of the fault plane to be examined. Second, a Holocene-age earthquake rupture from central India will be discussed. Geomorphic analysis of the scarps produced by the event suggest a magnitude of 7.6 – 8.4. Both of these earthquakes had unusually large stress-drops, amongst the largest recorded for shallow earthquakes. The information provided by these two events will be combined with calculations for the total compressive force being transmitted through the Indian peninsular in order to suggest that the faults are characterised by a low coefficient of friction (approximately 0.1), and that the stress-drops in the earthquakes are close to complete. In turn, these results imply that the majority of the force being transmitted through the Indian plate is supported by the brittle crust. Finally, the along-strike continuation of the faults will be described, with implications for hazard assessment and material properties throughout India.