Causative Mechanisms of the Intraplate Earthquakes in India

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A revised catalog of Earthquakes in Peninsular India indicates two earthquakes of Mw7-8, seven of Mw6-6.9, about hundred of Mw5-5.9 and a total of about 500 felt earthquakes. The regions in decreasing order of moment release are Kachchh, the northern part of West coast region, the Eastern Ghats belt including the southern shear zone and Aravalli belt. The significant earthquakes are Kachchh (Allah bund 1819 Mw7.8, Lakhpat 1845 M6.0, Anjar 1956, Mw6, Bhuj 2001Mw7.7). Bellary (1843 Mw5.7), Coimbatore (1900 Mw 5.8), Mt. Abu (1882 M5.7), Sone (1927 M6.5), Satpura (1938 Mw6.3), Khurja (1956, Mw6.1), Delhi (1960, Mw6.0), Koyna (1967 Mw6.3), Bhadrachalam (1969, Mw5.3), Latur (1993 Mw6.2) and Jabalpur (1997, Mw5.8). Nine earthquakes of Mw≥6 in 101 years give a repeat time of 12 years. However, at an individual site such earthquakes may recur after thousands of years as the strain rate is low 10^{-9} with a deformation of 2 mm/year as estimated from GPS measurements. As most parts of Peninsular India experience seismicity it is critically stressed. The pre-existing faults get reactivated due to strain accumulation or fault weakening. Though most of the areas show strike-slip, large earthquakes are associated with reverse faulting along nearly E-W planes in Kachchh and Narmada rifts and elsewhere due to tectonic inversion from tensile to compressive stress in last 10Mybp (Bhuj earthquake of 2001, Jabalpur earthquake of 1997, Latur earthquake of 1993 and Anjar earthquake of 1956). Strike slip faults trend NW or NE. The NW trending faults are of Gondwana time while the NE faults are generated after India-Eurasia collision. The reservoir triggered Koyna earthquake of 1967 and long sequence associated with it are along a NNE trending strike slip fault, while the Warna earthquakes that occurred since 1980 near a dam just south of Koyna are associated with a NW trending fault. The compression stress direction changes from NNW to N and then to NE direction from western to central part and then to eastern part of the Peninsula and indicates rotational tendency of the Peninsular. Though majority of the shocks are shallower than 13 km and are associated with subterranean sounds, focal depths of the order of 35 km are along the rifts and southern shear zones where the lower crust could be brittle due to under-plating, pillow lavas, mafic intrusion or dyhydration. The Bhuj earthquake nucleated from a fluid filled zone at depths of 15-25 km. Low velocity zones are found at shallower depths of about 5 km in

Koyna and Latur. As the faults are usually old and small the earthquakes of M>7 are not expected in Peninsular India except in Kachchh. Due to smaller rupture sizes the moment release is usually high. The aftershock sequences are usually long in Peninsular India and exceptionally long in case of a dozen reservoir triggered earthquake sequences.