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Causes of earthquakes in India

By Naresh Kochhar

PHYSIOGRAPHICALLY and tectonically, India can be divided into three broad ones: Peninsular India, Indo-Gangetic plains and the Extra-peninsular India (Himalayas).

The peninsular India comprises shield elements which are supposed to be geologically stable. But recent earthquakes of Jabalpur and Latur have shown that the shield areas are also prone to earthquakes. Himalayas as we know are seismically very active and there have been recent earthquakes e.g. Chamoli and Uttarkashi. Uttarkashi areas fall on main central thrust (MCT) whereas Shimla-Dehra Dun-Almora belt lies on the main boundary fault (MBF).

Gujarat, Kutch and Saurashtra and adjoining areas form a part of the western India shield. This region is known to be seismically active since historical times. There have been earthquakes in Rann of Kutch (1819), Surat (1856, 1864), Broach (1970); Koyana (1967), Latur (1993) and Jabalpur (1997).

The Gulf of Cambay lies on the triple junction as three major tectonic lineaments originate from here: Cambay rift and Panvel flexure running in north-south direction and Narmada-Son rift in EW direction. The Narmada-Son lineament is seismically very active and marks the boundary between shield and Indo-Gangetic plain (Fig. 1). What is a rift? Pulling apart of crust due to tensional stresses resulting in dropping down of elongated block. It is a weak zone vulnerable to tectonic movements.

The geological evolution of the region around Gujarat has been largely influenced by reactivation of primordial faults now occupied by these rifts. The region is characterised by high heat flow, gravity high and thinning of crust (16 to 20 km depth) as compared to the normal 35 km depth in the adjoining areas. Recently, Australian scientists have delineated a low seismic velocity zone beneath Cambay graben indicative of the presence of "fossil plume". Thus there is a crustal heterogeneity in the areas besides the tectonic junction of three main rifts.

According to scientists of the National Geophysical Research Institute (NGRI), Hyderabad, the sea floor in the Indian Ocean is spreading and thereby pushing land inwards in northeasterly direction at the rate of 5 cm per year and at the same time Saurashtra region is rotating in an anticlockwise direction. The advancement of sea-floor against Indian plate amounts to nearly 125 to 150 cm in 25 to 30 years. It causes earthquakes not only at the edge of Indian plate and elsewhere in the Himalayas. The rifts are inherently unstable due to pushing and movement of the Indian plate towards north.

The system seems to activate itself in the weak zones every 25 to 30 years because of the shift.

The Bhuj earthquake is an example of intraplate (within plate) earthquake as opposed to the Himalayan earthquakes which are due to collision of plate



boundaries. Intraplate stresses are due to the northward movement of Indian plate as a whole; and also due to heterogeneity of the plate and the presence of weak zones such as fault, rifts etc. Bhuj and Latur earthquakes are examples of stable continental region earthquakes.

Disaster management: Unfortunately, there has been no government policy to handle natural disasters. There is an urgent need to have interaction with scientists from NGRI and Wadia Institute of Himalayan Geology, Dehra Dun, who can help the local administration in identifying vulnerable areas (Gujarat earthquakes appear to be cyclic) and also taking steps to construct quakeproof/resistant houses. The houses in such areas should have lintel beams, dome shaped roofs and thick iron netting in their construction. Strengthening of joints between the vertical columns and the horizontal beams around which a reinforced concrete and cement structure is built, is recommended.

Such houses can withstand quake even seven on the Richter scale.

The Richter scale was devised in 1935 by Charles Richter, a US seismologist. The scale is logarithmic-it means that each step up the scale represents a 10-fold increase in the amplitude of energy wave emitted by the quake. It starts with terrestrial tremors detectable only by instrument (Magnitude 1) through to detectable within 20 miles of the epicentre (Magnitude 4-5) and moderately destructive (Magnitude 6) to major quake of Magnitude 7 and 8.

Magnitude of Bhuj earthquake has been compared to detonation of a 69 megaton hydrogen bomb.

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