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Intraplate seismicity

The Indian subcontinent is a collage of various geologic and tectonic provinces of diverse age, from the southern stable peninsular shield to the actively deforming plate boundaries and rift systems, providing a wide range of exciting geo-scientific problems. This region is also host to some of the unique earthquakes in the world. The Kutch rift that has generated two large earthquakes in a span of less than 200 years is considered as a classic example of seismicity associated with ancient rift systems, analogous to the New Madrid (western US) rift zone, where comparable earthquakes and ground deformation have occurred in the stable continental region. Seismicity in the Koyna region is the only example of longevity of triggered sequences associated with filling of artificial reservoirs, anywhere in the world. This unique phenomenon occurring in the stable continental interior, characterized by low-level seismicity and slow strain build up makes this site all the more interesting for studies of earthquake source processes. This special section presents a series of papers that are borne out of an Indo-US workshop on 'Seismicity and Geodynamics' held at the National Geophysical Research Institute, Hyderabad, during 6–10 October 2003.

Having a high quality database on earthquake epicenters is basic to the understanding of earthquake process in a region. Like most stable regions of the world, Peninsular India was also not adequately instrumented until recently. Together with improvements in network instrumentation, many newer processing techniques for improving the epicentral locations have also evolved. Rastogi *et al.* (**page 1586**) use hypocentral decomposition method of multiple event location to refine the locations and origin times of 224 events clustered in three important source zones in India – Koyna, Kutch and Chamoli–Uttarkashi.

The Kutch rift in western India is known for its potential to generate large earthquakes – the 1819 Allah Bund and 2001 Bhuj earthquakes, for example, both having magnitude >8. A Mesozoic rift that got transformed in the post-collisional compressive regime, the Kutch rift hosts many faults and other imprints of its ancestry-intrusive rocks, rift geometry and presence of lower crustal ultramafic bodies. Biswas (**page 1592**) discusses the structure and tectonics of the Kutch basin in the context of the recent Bhuj earthquake.

Seismicity in the Kutch region is considered to be the result of the stress concentration resulting from the plate boundary forces and crustal heterogeneities. Chandrasekhar *et al.* (**page 1601**) discuss the analogies in the gravity and magnetic anomalies of Kutch and New Madrid rifts. The authors suggest that the gravity lows associated with both these rifts could be controlling the seismogenesis.

Occurrence of a large earthquake in Charleston, South Carolina makes this an important site for the study of intraplate seismicity. Stress concentration at the zone of fault intersection is considered as a plausible mechanism for seismogenesis in this region. Gangopadhyay and Talwani (**page 1609**) present a 2-D model to explain the current seismicity in the Middleton Place Summerville Seismic Zone, near Charleston, further supporting the idea that localization of stresses in a pre-existing weak crust may act as stress concentrators, leading to seismicity.

The aftershock patterns of earthquakes provide clues about the nature and dimension of the causative fault. Dimri *et al.* (**page 1617**) show that the decay constant for the 'intraplate' Bhuj earthquake is 0.88 similar to those observed for tectonically active regions. While a fractal dimension of 2.06 obtained from wavelet analysis indicates a 2D fault plane, a slip ratio of 0.48 suggests that 48% of the total slip took place on the main fault plane.

The Narmada Son Lineament (NSL) representing the Precambrian rift system that cuts across the Indian shield is the most spectacular regional feature that is also seismogenic. The 1997 Jabalpur earthquake, recorded by many broadband instruments provided well-constrained instrumental data; it has also revealed the potential of this structure for generating lower crustal earthquakes. Mall *et al.* (**page 1621**) evaluate the seismicity associated with NSL and relate the earthquakes to post-Gondwana uplift and reactivation of fault systems that flank the uplifted Satpura–Gondwana block.

The continued occurrence of earthquakes near Koyna, some of which, moderate remains an intriguing issue. The fact that this site is located in the stable continental region, marked by its low-level seismicity and low-strain build up makes it a rather unique site for studies on earthquake processes in the SCR, even offering the potential for earthquake forecasting. In the backdrop of a brief global review of reservoir-triggered seismicity, Gupta (**page 1628**) demonstrates how this site is ideal for such an experiment.

Earthquakes of the past hold much information and ability to estimate their magnitudes in assessing the future seismic hazard. Hough *et al.* (**page 1632**) use re-evaluated intensities for the 1897 Shillong and 1905 Kangra earthquakes to compare the observed intensity distributions with the theoretically predicted shaking. The paper presents many interesting observations; the 1905 earthquake might have triggered another earthquake near Dehra Dun, being the most provocative.

Comparison of geophysical data from North America and India leads to many insights into the geologic and tectonic histories of these two continental masses, as discussed by Mooney *et al.* (**page 1639**). Similarities exist in the nature of the deep structure of the crust as well as the development of fold and rift basins. A good understanding of the shallow crustal structure is useful in developing models of intraplate seismicity. Reddy (**page 1652**) attempts to bring out a correlation between the complexity of the *P*-wave velocity models for the upper crust and seismicity of the Indian shield.

Geodetic slip based on GPS measurements and the significant absence of great historic earthquakes that would match up with these estimates raise many important questions about our understanding of the past seismicity in the Himalaya. Bilham and Ambraseys (**page 1658**) offer several plausible explanations for this apparent paradox: incompleteness in archived information, underestimation of magnitudes, slow slip or aseismic creep, possibility for plate boundary slip without seismic radiation, among them. They provide many provocative ideas and raise the intriguing question whether we are missing four great earthquakes from the historic record.

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