

NEWS AND NOTES

Indo-US Workshop on Intraplate Seismicity – B.K. Rastogi, Institute of Seismological Research, Gandhinagar - 382 009; Email: dg-isr@gujarat.gov.in

The Indo-US workshop on Intraplate Seismicity was held at Institute of Seismological Research, Gandhinagar, Gujarat during January 15-18, 2012 and was supported by Indo-US Science & Technology Forum (IUSSTF), New Delhi and Coordinated by BK Rastogi, Director General, Institute of Seismological Research, Gandhinagar, India and Susan E Hough, US Geological Survey, Pasadena, CA, (Email:hough@gps.caltech.edu). Scientific agenda was to take stock of Intraplate Seismicity study in USA and India and chart the future directions to understand this phenomenon.

Highlights of Scientific Presentations/ Deliberations

Nine US participants, including six senior scientists and three PhD students, and 100 Indian delegates attended the workshop. The Indian participants were from 25 institutions throughout the country. There were 50 oral presentations and 25 poster presentations. The poster presentations were judged and the top five were awarded prizes. The workshop provided an opportunity for

participants to share results and gain a better understanding of recent research in the two countries in the field of Intraplate Seismicity. A number of speakers presented results from analysis of data collected in the Kachchh region since the 2001 Bhuj earthquake. The results of these studies have important implications for the eastern/central United States, which experiences similar infrequent intraplate earthquakes but has not experienced a large earthquake in recent times. The data sets generated in last decade in Kachchh and the results thereof were rated extraordinary by several key US and Indian delegates.

New Developments Presented at the Workshop

Harsh Gupta presented the latest views on reservoir-triggered earthquakes and the plan of deep drilling at Koyna which overwhelmed the delegates. In a collaborative study of ISR and ISRO it was presented that the horizontal deformation in Kachchh was found to be negligible as deduced from GPS measurements. Still seismicity in Kachchh is continuing and

expanding. It was found that the vertical deformation in Kachchh region is high, which is probably causing seismicity.

The 2001 Bhuj earthquake has triggered seismicity to 200 km distance and for a decade. The increased seismicity in Kachchh and even in Saurashtra is inferred to be caused by stress perturbation due to the 2001 Bhuj earthquake by viscoelastic process. Compelling evidences for the presence of active faults by 3D satellite imagery and trenching in Kachchh. Roger Bilham presented the Wedge fault model to explain deformation several tens of km away from a fault.

He also presented a Crest-Trough Model for explaining belts of seismically active zones in intraplate regions of India formed by the arrested ridge-push by continent-continent collision.

Alternate model of uplift of the intraplate region by continuing ridge-push/back-lash stress of plate tectonics was presented by BK Rastogi. Rastogi, Prantik Mandal and Pradeep Talwani explained occurrences of deeper crustal earthquakes in rift valleys of Kachchh and Narmada due to accumulation of stresses / strains around



the mafic high density, high velocity bodies. Low velocity fractured, fluid-filled low velocity zones within them act as asperities or starting/nucleation zones. Such zones give large reverse-fault earthquakes up to M 8 in Kachchh and M 6.8 in Narmada. In other parts the upper crustal moderate/small earthquakes may be due to low velocity zones / fault weakening along reverse / strike slip faults. Evidences were presented for a M9 earthquake in 1505 in Kashmir by Roger Bilham which many delegates found unconvincing. ETAS model to define anomalous behavior of the seismicity in many parts of the world before the large earthquakes in term of activation and quiescence was presented by V.P. Dimri and Abhay Bansal. John Ebel opined that in intraplate regions aftershocks of strong earthquakes can be observed for many hundreds of years or even longer. This may be because regional stresses build up very slowly within the tectonic plates, and thus relatively little of the intraplate seismicity reflects regional stress accumulation. Gravity model was presented by V.M. Tiwari and Bijendra Singh and heat flow models by Sukanta Roy and M.L. Gupta to

explain intraplate seismicity. Faults and structures from deep seismic studies were presented by Kalachand Sain, Dipankar Sarkar and P.R. Reddy. Ambient vibration tomography has emerged as a powerful tool for the study of crustal structure. Results of such studies in India were presented by P.C. Rao. M. Ravi presented the crustal structure from Receiver transfer Function and strain field from shear-wave splitting study. Crustal deformation results from GPS were presented by V. Gahalaut and stress field by Kalpana.

Major recommendations: Modeling to infer cause of vertical upliftment in Kachchh, Development of Ground Motion Prediction Equation (GMPE) of India, Strong motion modeling for Kachchh, Development of two arrays viz. Kachchh Lithosphere Investigation (KALI) and Kachchh Crustal Imaging Array (KACIA) in Kachchh to decipher details of crustal structure and Preparation of high resolution aeromagnetic map of Gujarat.

Specific outcomes: During the workshop potential collaborative projects

were formed to further investigate key remaining questions about intraplate earthquakes, including which regions are most at risk of damaging earthquakes, the average long-term rate of large earthquakes in different regions, and the overall scientific framework to explain why intraplate earthquakes occur. Collaborative programs will include ISR and NGRI from India and USGS, Memphis, Northwestern and Missouri Univ. USA. Specific targets for collaborations were identified, including projects to better understand the geological setting of the Kachchh region; the ongoing deformation of the crust in Kachchh and elsewhere in India; the rates of past earthquakes as revealed by geological investigations; the ground motions that are expected to occur when future large earthquakes strike; and assessment of long-term earthquake hazard.

The US delegates felt that India is an important country to study both Intraplate and plate boundary earthquakes; and Indian colleagues have made great progress in this field.