

Towards developing a better appreciation of the seismicity and tectonics of Andaman and Nicobar subduction zone*

The Andaman and Nicobar region, defining the subduction boundary between the Indian and Burmese plates presents many interesting geologic problems. Having generated several large earthquakes in the past, it is regarded as one of the most seismically active regions in the Indian subcontinent. Existence of the Barren Island, the only active volcano in this region is another factor that makes this region interesting from the geological perspective. With all these activities going on, this region is considered as an exceptional natural laboratory for studying a wide range of geological problems, such as subduction tectonics and earthquake processes, crustal deformation, active tectonics, volcanism, etc. The occurrence of the 26 December 2004 earthquake in the southern part of this subduction zone and the tsunami that followed has added vigour to these studies. The Department of Science and Technology (DST), New Delhi had evolved several research programmes to study the processes in these regions, prior to the December event. However, the occurrence of a giant earthquake places calls for more focused programmes in this region. This was one of the motivations behind the recent DST-sponsored workshop-cum-field trip at Port Blair. It brought together researchers from leading organizations in the country, officials from DST, Andaman Administration and researchers from local colleges at Port Blair.

Inaugurating the workshop, Janak Diggall, Development Commissioner, Andaman Administration, highlighted various issues that confront the administration, starting with creating public awareness, to implementation of programmes to change the land-use practices, in the wake of permanent landform changes caused by the earthquake. G. D. Gupta, Advisor, Seismology Division, DST highlighted DST's efforts to strengthen earthquake monitoring in the region and narrated the plans to set up a multiparametric observatory in the

islands, which will help measure several physical properties prior to large earthquakes. These efforts, he hoped, would improve the ability to provide some early warnings and also generate the necessary input to the tsunami warning system that the government is planning to set up, shortly. V. Krishnamurthy, Secretary, DST, Andaman and Nicobar Islands, highlighted the need to evolve a proper system for dissemination of information, which is indeed vital in disaster management.

The technical session started with the presentations from various organizations. Representatives from the Geological Survey, Survey of India, India Meteorological Department, National Geophysical Research Institute, National Oceanographic Institute, National Institute for Ocean Technology, Zoological Survey of India, Centre for Earth Science Studies, Centre for Island Studies (Pondicherry University), presented papers and discussed ideas for future work. An important issue that was highlighted by most participants is the lack of high quality data, especially seismic data that affects the precision of epicentral determination and therefore, the interpretations. Errors in epicentral location and depth estimates seemed to be a problem in finer interpretation of the spatial pattern of earthquakes. The possibility of setting up a few ocean bottom observatories was also discussed in this context. In addition, other geophysical experiments using techniques such as magnetotellurics could be planned, to map the electrical structure of the subduction zone. Another important work that was proposed was to run a few seismic profiles across the subduction zone, which would bring out details of the structures.

Most participants projected the need for more geophysical and bathymetric surveys. The Survey of India, having done some leading GPS studies in the Andaman and Nicobar Islands, is continuing with its observations and is engaged in close monitoring of the crustal deformation in the NE India region, where some workers have predicted increased seismic activity subsequent to the 2004 earthquake. An important question concerning the seismic

history of the region concerns the timing of the predecessor to the 2004 earthquake. Going by the experiences at other subduction zones, such as the Cascadia and Chile, where similar size earthquakes have occurred in the historic and recent times, it is logical that earthquakes, similar to the 2004 event, could have occurred in the past. Palaeoseismology and tsunami geology, the tools that are used elsewhere are being tried in the Andaman and Nicobar region. Understanding the seismic sources and assessing their future potential is only part of the task, assessing the effects and managing the hazard is the practical aspect of the problem. Preparation of inundation maps, identifying vulnerable areas and effectively presenting information for the disaster management bodies is a major issue. Organizations such as NIOT and several universities have taken up this task at the regional level. These ideas were discussed at the meeting.

The tsunami caused irreparable damage to the ecosystems in the Andaman and Nicobar Islands – damage to mangroves, destruction to coral colonies among them. A video presentation by the Zoological Survey of India, at Port Blair, brought out the extent and severity of the damage.

Creating awareness and expanding the scope of earth sciences education was also discussed at the workshop. While the availability of skilled manpower was impairing the progress of projects, it was felt by many participants that lack of career opportunities in earth sciences is certainly working against the retention of available manpower, affecting the long-term progress of the programmes.

Issues related to obtaining permission and arranging for logistical support were also discussed at the meeting. Representatives of the various departments felt it desirable that an agency should oversee the activities and help in obtaining the necessary permissions to work in the restricted areas and also in getting logistical support. It was suggested that DST, Andaman and Nicobar Islands, could act as a local agency to oversee such activities. This would also help the various departments to be aware of the work being done by sev-

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eral agencies and what kind of information is being generated.

The concluding session, led by G. D. Gupta and Brijesh Bansal touched upon all the major points discussed in the technical sessions. It also outlined DST's plans to expand studies in this region and made several suggestions to evolve projects and to generate better working arrangements. DST has already recognized the need to evolve some major programmes – possible installation of ocean bottom seismometers and geophysical survey (OBS); palaeoseismological studies and GPS-based deformation studies are among the projects under consideration. Other suggestions and ideas are as follows:

1. Information on the seismic sources, fault models and rupture, essential for tsunami modelling studies needs to be generated. Establishment of an Indian National Earthquake Information Centre with

near real-time information about the seismic activity in and around India and the Indian Ocean region was a possible solution, which will in the long term, provide the necessary input for tsunami modelling.

2. Systematic and detailed geophysical investigations of the region need to be taken up to image the geometry of the subducting Indian plate. More detailed bathymetry maps are needed for most studies, including tsunami modelling and these need to be generated.

3. Deployment of a passive OBS grid in the offshore of Andaman and Nicobar Islands to monitor the seismic activity was suggested as an option to complement the land stations and provide better constraints on earthquake.

4. Although the Barren Island is the only active volcano in the Indian subcontinent, there are only limited studies on the behaviour of this volcano. More studies need to be taken up in future.

5. Capacity-building and training of personnel and school-based earthquake monitoring were suggested as ways of creating awareness.

The field trip included visits to various locations affected by the tsunami. In summary, this meeting that brought together planners, researchers and administrators from local departments has helped highlight real issues and has provided a forum to discuss the problems and prospects for future work.

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