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Precursory Swarm Identification and Long-term Earthquake Prediction in Western Nepal Himalaya its adjoining Indian Region

D. Shanker (1), Harihar paudyal (2), and H.N. Singh (3)

(1) Department of Earthquake Engineering, Indian Institute of Technology Roorkee, Roorkee-247667, India (dayasfeq@iitr.ernet.in, +91 01332 78699), (2) Department of Physics, Birendra Multiple Campus, Bharatpur, Chitwan, Nepal , (3) Department of Geophysics, Banaras Hindu University, Varanasi-221005

Anomalous seismicity is first to take place as compared to other precursory phenomena due to formation of various ruptures where considerable strain energy are accumulated, hence it may be an important parameter for the prediction of long-range earthquake related hazards in a region. Anomalous seismic activity associated with major earthquakes in the Western Nepal Himalaya and its adjoining Indian region have been studied in an area bounded by 28.0^o-31.0^o N and 79.5^o-82.2^o E, using seismicity data from 1963-2006. In the present study, anomalous/precursory swarm seismicity and the delineation of preparation zones (sim1.1 x 10^4 km^2) are carried out for the future earthquake hazard using the temporal and the spatial distribution of events considering the total events and the events with m$_b$ ge 4.3 in four anomalous episodes: Normal/ background (N); Anomalous/ swarm (A); Precursory gap (G) and Mainshock sequence (M), respectively. Five cases of anomalous seismicity have been identified: prior to three earthquakes that have already occurred and two cases for which quiescence episodes still continues. Three medium size earthquakes of 1980 (m$_b$ 6.1), 1984 (m$_b$ 5.6) and 1999 (m$_b$ 6.6) occurred in the Western Nepal and its adjoining Indian region were preceded by well defined patterns of anomalous seismicity/ precursory swarm. The first of these was the Bajhang earthquake of which most of its preparatory processes during 1967-1980 were confined approximately in the central part of the area between the MCT and the MBT. Subsequently, the seismic activity shifted towards east in the northeast-southwest direction which produced another mainshock of 1984 (m$_b$5.6). Seismic activity started concentrating in and around Chamoli area (India) since 27 November 1995 which was preceded by a quiet low seismicity in the region. After Chamoli earthquake in 1999, a low seismic activity was observed in the region which continued for the next two years till 14 April 2001. The seismic activity again shifted towards southeast and started concentrating in the region east-northeast of Bajhang earthquake, since April 2001, in which anomalous pattern in seismicity is observed on two occasions. On analyzing the seismicity data from 1999 to 2006, two additional cases of characteristic seismicity patterns were observed: (1) 1999-2006, and (2) 2003-2006. In these two cases, though the anomalous seismicity exists, no mainshock has occurred so far. After critical analysis of the data, it is observed that the seismicity from 1999 onwards fluctuates in the order as low-high-low phases. The analyses suggest that a shallow focus (h le30 km) earthquake of about M 6.5 and more may occur at any time in the delineated preparatory area (29.4^o-30.6^o N and 81.3^o-81.8^o E) in its southern part till 2011.

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