NOTES

EARTHQUAKES EXCEEDING MAGNITUDE 5 OCCUR AGAIN IN THE KOYNA REGION

Earthquakes of magnitude 5 occurred in the Koyna region on August 28 and September 3, 1993, after a lapse of some 13 years. The last such event was on September 20, 1980.

Earthquakes began to occur in the vicinity of Shivaji Sagar Lake, created by the Koyna Dam in Maharashtra, soon after its impoundment in 1962. Memories of disastrous Koyna earthquake of December 10, 1967 of magnitude exceeding 6 are fresh in our minds. This earthquake claimed over 200 human lives, rendered thousands homeless and caused severe damage to Koyna Nagar township. As of today, globally, there are some 70 reservoir sites which are known to have induced earthquakes (Gupta, 1992a). Koyna is the best known example. In most of the places, induced earthquakes have ceased to occur after a few years. In Koyna, however, seismic activity is continuing.

Table I gives hypocentral parameters of all earthquakes exceeding magnitude 5 in the Koyna region.

TABLE I. List of Koyna Earthquakes of magnitude 5 and larger.
Note : Aftershocks of December 10, 1967 earthquake are not included.

Sl. No.	Date (m/d/yr)	Latitude (N)	Longitude (E)	Depth (km)	Magnitude	Remarks
1.	9-13-67	17°23.80′	73°44.50′	4.0	5.2	Guha *et al.* (1974)
2.	12-10-67	17°22.61′	73°45.10′	10.7	6.2	Rastogi and Talwani (1980)
3.	10-17-73	17°23.92′	73°42.75′	5.9	5.4	Rastogi and Talwani (1983)
4.	9-02-80	17°10.80′	73°42.60′	33.0	5.2	U.S. Geological Survey
5.	9-20-80	17°09-60′	73°48.00′	33.0	5.3	U.S. Geological Survey
6.	9-20-80	17°18.60′	73°34.80′	33.0	5.4	U.S. Geological Survey
7.	8-28-93	17°12′	73°43.8′	12.4	5.3	MERI (Maharashtra Engg. Res. Inst.)
8.	9-03-93	Not yet available			5.0	NGRI (National Geophy. Res. Institute)

Epicentres are depicted in Figure 1. Over the past 30 years several thousand earthquakes have occurred in the vicinity of the Koyna reservoir, about 150 of them being of magnitude 4 or larger.

Earlier studies have indicated a close relation between the rate of loading of the reservoir and earthquake frequency at Koyna. Earthquakes of magnitude equal or greater than 5 occurred in the Koyna region when the rate of loading exceeded forty feet per week. This rate of loading was found to be a necessary but not sufficient condition for earthquakes of $M \geq 5$ to occur (Gupta, 1983). This year also it is reported that Shivaji Sagar Lake has got filled to capacity. It would be of interest to observe whether the rate of loading continues to be an important

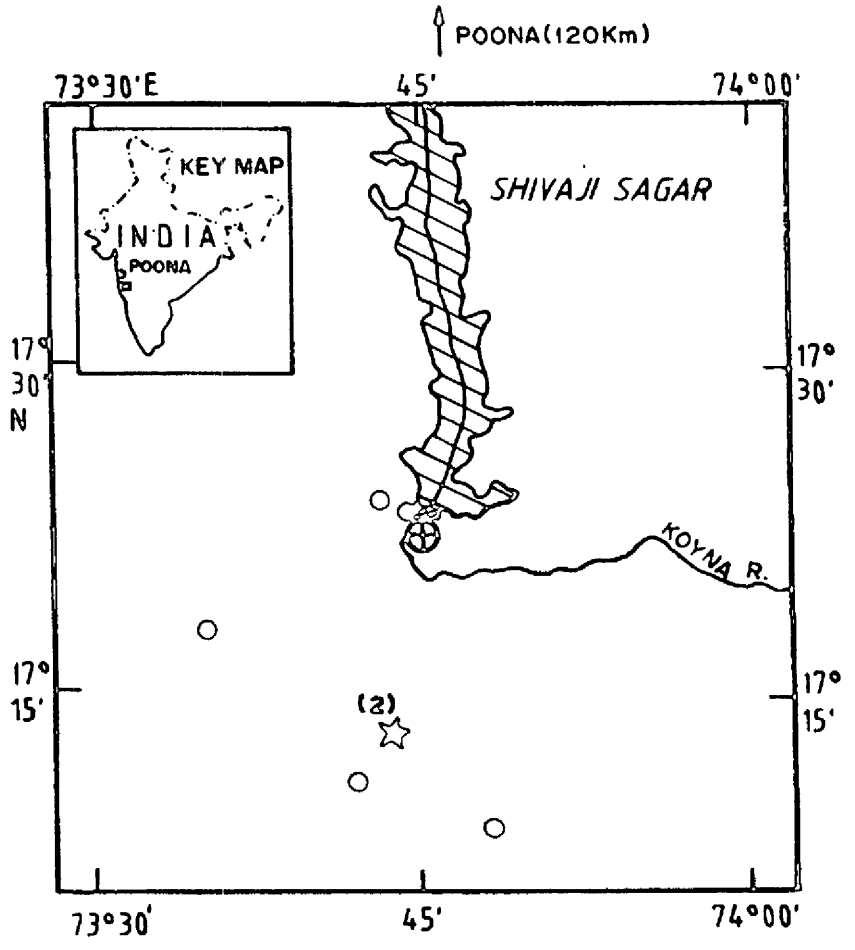

Figure 1. Earthquakes of magnitude 5 and larger in the Koyna region. Circle with cross is the epicentre of December 10, 1967 earthquake of magnitude 6.3. Star is the epicentre of the August 28, 1993 earthquake. The other earthquake of September 3, 1993 occurred in the same region. Its epicentre is not yet available. Hence (2).

factor in enhancing seismic activity at Koyna region. All earthquakes of magnitude 5 or larger in Koyna region have been preceded by a couple of foreshocks exceeding magnitude 4. It has also been demonstrated that more than one-half of induced earthquakes of magnitude ≥ 5 globally were preceded by a couple of foreshocks of magnitude ≥ 4 in the preceding fortnight (Gupta and Iyer, 1984; Gupta, 1992b).

In 1980, 3 earthquakes of maguitude equal or greater than 5 occurred in the Koyna region on September 2 and September 20 (*see* Table I). However, till today, the December 10, 1967 earthquke is the only earthquake which exceeded magnitude 6. It is not possible at this stage to hazard a guess whether the current enhanced seismic activity in Koyna region will die out as it did in 1980, or whether it will culminate into a larger earthquake. As a matter of fact, the RIS site at Koyna provides an excellent natural laboratory to test various hypotheses and earthquake prediction models. Induced earthquakes are usually confined to a small area and

very often RIS sites are located in a stable region which has a very low natural seismicity. For example, at Koyna moderate size earthquakes have been occurring for the past 30 years in an area of some 25 km × 25 km. It is most desirable to take up detailed induced earthquake related studies in the Koyna region without further loss of time.

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A REPORT ON GROUP DISCUSSION ON DEEP CONTINENTAL STUDIES ALONG JAIPUR–RAIPUR CORRIDOR

One of the important components of the evolution of shield areas is the understanding of the development and the nature of the continental crust, particularly, the deeper sections, which have relevance to the geophysical and petro-geochemical characteristics. The information on these aspects in the Indian Shield is not adequate. In this context, the Northwestern and the Central Indian Shield segments are important in that these areas contain evidences of resurgent tectonics and geological evolution through the Precambrian that led to the development of superposed fold belt systems like the Aravallis, the Delhis, the Sausars and the Sakolis, etc. There are extensive late Precambrian cover sequences whose tectonic setting and development history, particularly in relation to crustal tectonics, is yet to be clearly understood. Major dislocation zones, (e.g., Great Boundary Fault), suspected palaeosutures, important ductile shear zones, and significant lineaments (e.g. Narmada-Son lineament) are indications of significant crustal interactions in these terrains.

In view of the above, the DST launched in 1987 a multidisciplinary research programme entitled 'Deep Continental Studies in India' (DCS), starting with the