SHORT COMMUNICATIONS

Drilling at Latur Earthquake Region Exposes a Peninsular Gneiss Basement

Drilling at Killari in the Meizoseismal area of the 1993 Latur earthquake has revealed that the Deccan Basalt sequence here is 338 m thick, and is underlain by Peninsular Gneiss basement with an intervening 8 m Infra-Trappean sequence.

The two M>6 earthquakes, Koyna (1967) and Latur (1993), point towards a relatively enhanced level of seismotectonic activity of the Deccan Volcanic Province in the Indian shield. Deccan basalts, the result of a major volcanic episode temporally close to the K-T boundary, mask nearly half a million sq. km of Precambrian geology (Fig.1). They are thickest near the west coast (>2 km), and taper off towards the eastern fringes. Earthquakes of the region originate in the underlying basement. A good discussion on plausible locales for strain

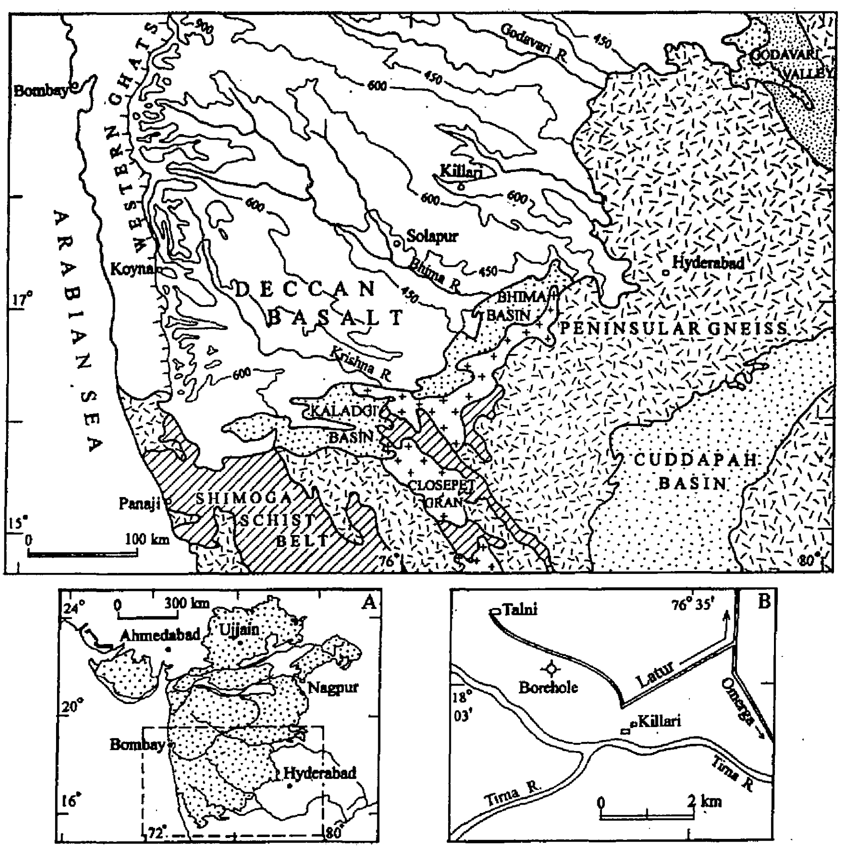

Fig.1. Simplified topographic map of southern part of the Deccan Volcanic Province (DVP) along with outlines of the surrounding geological units. Insets; (A) Outline of the DVP (B) Location of the borehole of the present study.

0016-7622/96-47-1-129/$ 1.00 © GEOL. SOC. INDIA

build-up can be found in the paper by Mahadevan (1995). Knowledge of the configuration and structure of the basement is crucial to the study of seismotectonics.

As a starting point, the National Geophysical Research Institute (NGRI), Hyderabad, in collaboration with the Atomic Minerals Division (AMD) has undertaken a project to obtain information about the basaltic sequence– its thickness, constitution and basement– directly by drilling, in the meizoseismal area of the M_w 6.1 Sept 30, 1993 Latur earthquake in Maharashtra. A vertical, totally cored borehole was planned and a site in the surface rupture zone, ~2 km northwest of Killari (coordinates: 18°03'07"N : 76°33'20"E, Toposheet: 56B/12; collar elevation:580 m; Fig.1) chosen. The AMD commenced drilling towards the end of November 1994. Drilling through the highly fractured basalt and cavernous zones has been challenging. A depth of 404 m was reached towards the end of November 1995. Care has been taken to maintain the borehole vertical. Borehole camera study indicated a deviation at the bottom of only 2°. Core recovery, overall, is ~80%, though over the cavernous zones it is near-zero. The rock quality designation of the sequence is quite variable and is not correlatable with core recovery.

The sequence of the basaltic layers ends at 338 m and is found to be mainly tholeiitic. Twelve to fifteen flows varying in thickness from 15 to 60 m are decipherable from the cores. Most of the flows are massive, compact and fine grained with vesicular and amygdaloidal top. The vesicles at places are filled with secondary quartz, zeolites, microcrystalline chlorite and calcite, and are occasionally rimmed with glass (altering to chlorophaeite) and red-brown ferruginous material. Moderate weathering is noticed in the rocks.

The basaltic layers are underlain by a 8 m thick Infratrappean sequence comprising a 1-2 m oxidised shaly section followed by a conglomeratic grit-sandstone section. Samples from the shaly section were studied palynologically. No pollen was found. The grit contains angular to subangular quartz pebbles varying in size (maximum 0.75 cm). The angularity and ill sorted nature of the grit-sandstone section indicate a near source.

The gneissic basement starts from 346 m. The upper 7 m core comprises broken pieces of weathered granite. The basement drilled so far is varied in composition from biotite rich granite-gneiss to clear pink granite. The gneiss exhibits a strong foliation, which when corrected for deviation, appears to have a steep dip of about 80°. Fractures with such steep dips filled with silica are also seen. Crude schistosity has also developed in otherwise massive granite. Other important features observed are sericitisation, chloritisation and development of pyrite and magnetite lumps. All these point to hydrothermal activity and reactivation of basement.

It is very satisfying to note that the estimated thickness of about 350 m of the basaltic sequence in this region through Magneto-Telluric Sounding (MTS) carried out by NGRI (S.V.S. Sarma *et al.* 1994; Fig.2) stands validated. It may be pointed out that in Saurashtra also, where the basaltic sequence is three to four times thicker than in this region, the MTS estimate was corroborated by subsequent drilling (S.V.S. Sarma *Pers. comm.*). MTS thus appears to be promising tool in estimating the thickness of volcanic flow sequences.

The Geological Survey of India has mapped the Killari and the surrounding region on 1:50,000 scale in the recent years (Records of GSI, 1993). Correlation of the flow units intersected by the present borehole with those delineated on the surface would be attempted. Further studies on core samples, for physical properties, petrological, geochemical, isotopic and rockmagnetic/paleomagnetic characteristics are planned. Temperature logging for heatflow evaluation and hydraulic fracturing in the granitic basement for *in situ* stress measurement are planned. This drill hole is planned to a depth of 600 m.

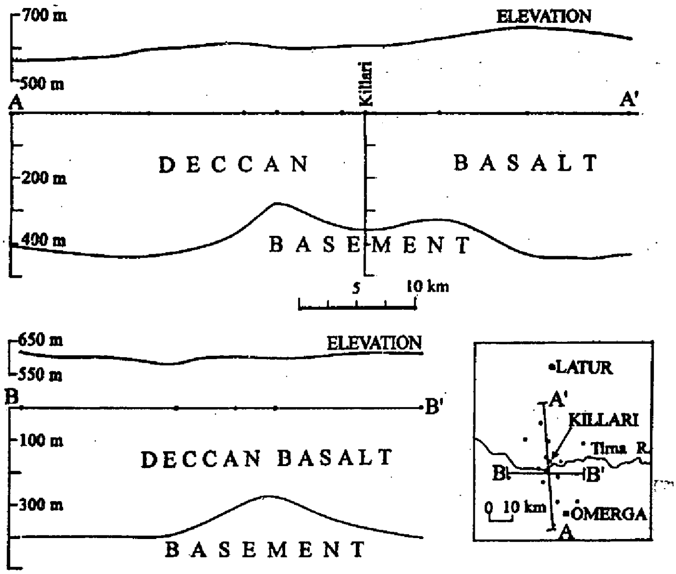

Fig.2. Deccan Basalt thickness inferred from 1D-modelling of MTS data along profiles AA' and BB' in the Latur earthquake region (Reproduced from Sarma S.V.S. *et al.* 1994).

Acknowledgements: A dedicated team of scientists and engineers from NGRI and AMD has generated the data that forms the basis of this note. The authors place on record the invaluable contribution of this team. They acknowledge the help rendered by Prof. C.G.K. Ramanujam and his associates at the Post Graduate College of Science, Saifabad, Osmania University, by carrying out palynological analysis. They thank Shri T.M. Mahadevan and Prof. K.V. Subbarao for the benifiting discussions in finalisation of the manuscript. The investigations have been partly funded by the Department of Science and Technology and the same is gratefully acknowledged.

National Geophysical Research Institute, HARSH K. GUPTA
Hyderabad - 500 007.

Atomic Minerals Division, Begumpet, K.K. DWIVEDY
Hyderabad - 500 016.

References

MAHADEVAN, T.M. (1995). Seismicity of the Indian Peninsular Shield - Constraints from Deep Continental Structure. Ind. Jour. Geol., v.67, No.1, pp.49-76.

Records Geological Survey of India (1993). v.126, pt.6, pp.45-57.

SARMA, S.V.S. *et al.* (1994). A Wide Band Magnetotelluric study of the Latur Earthquake Region, Maharashtra, India. Geol. Soc. India, Mem.35, pp.101-118.