DISCOVERY OF TUFFACEOUS MUDSTONES IN THE PINJOR FORMATION OF PANJAB SUB-HIMALAYA, INDIA

S. K. TANDON and R. KUMAR
Department of Geology, University of Delhi, Delhi 110 007, India.

SEVERAL volcanic ash and tuffaceous mudstone layers have been reported in recent years from the Siwalik Group of Pakistan[1,2]. Fission track dating of the zircons from these layers in combination with the remanent-polarity-stratigraphy of the sequences has resulted in building up of temporal constraints for the Siwalik Group in Pakistan. From the Siwalik Group in India, bentonitic beds have been known from the locality of Parmandal in the Jammu region.

We report, the occurrence of four levels of tuffaceous mudstones from the Pinjor Formation of the Upper Siwalik Subgroup in the area east of Chandigarh (figure 1). Two of the tuffaceous mudstones occur in the Ghaggar section and two others occur in the Khetpurali section (figures 1, 2). Detailed stratigraphic measurements of the Siwalik sequences in which they occur are published elsewhere[3].

Ghaggar Section: The tuffaceous mudstones occur 75 m above the base of the section as a couplet in the overbank interval of the ninth alternative (figure 2).

The thickness of the alternation in which the tuffaceous mudstones occur is 10 m. The channel sandstone facies measures 2 m and the overbank interval 8 m. The two tuffaceous mudstone layers are 13 cm and 5 cm thick respectively and are separated by about 1.35 m of stratigraphic thickness (figure 2). The tuffaceous mudstones have a sharp lower contact and occur as easily distinguishable units within the pedogenetically modified overbank deposits. The tuf-

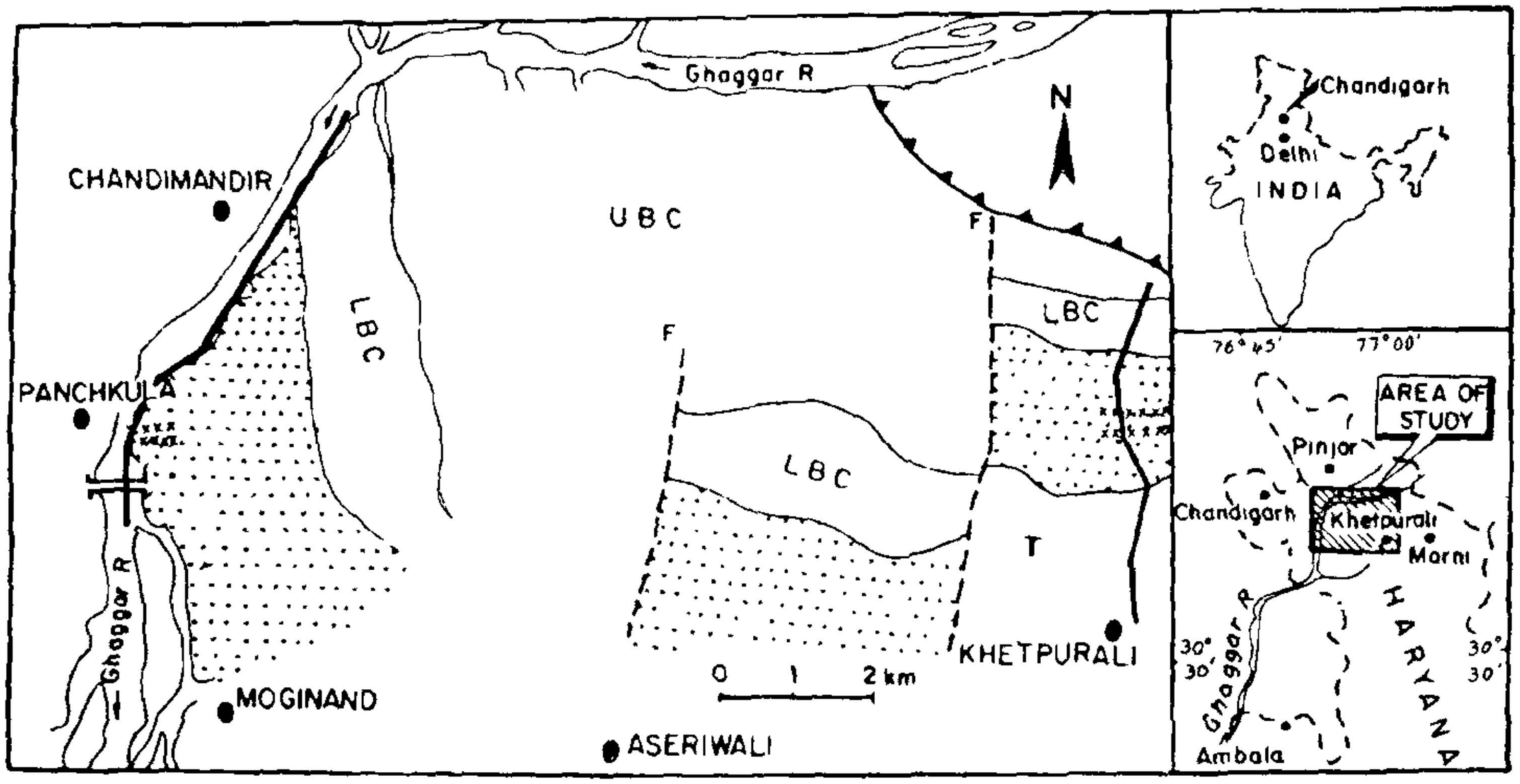

Figure 1. Sketch geological map of the Pinjor Formation, east of Chandigarh, Panjab Sub-Himalaya.

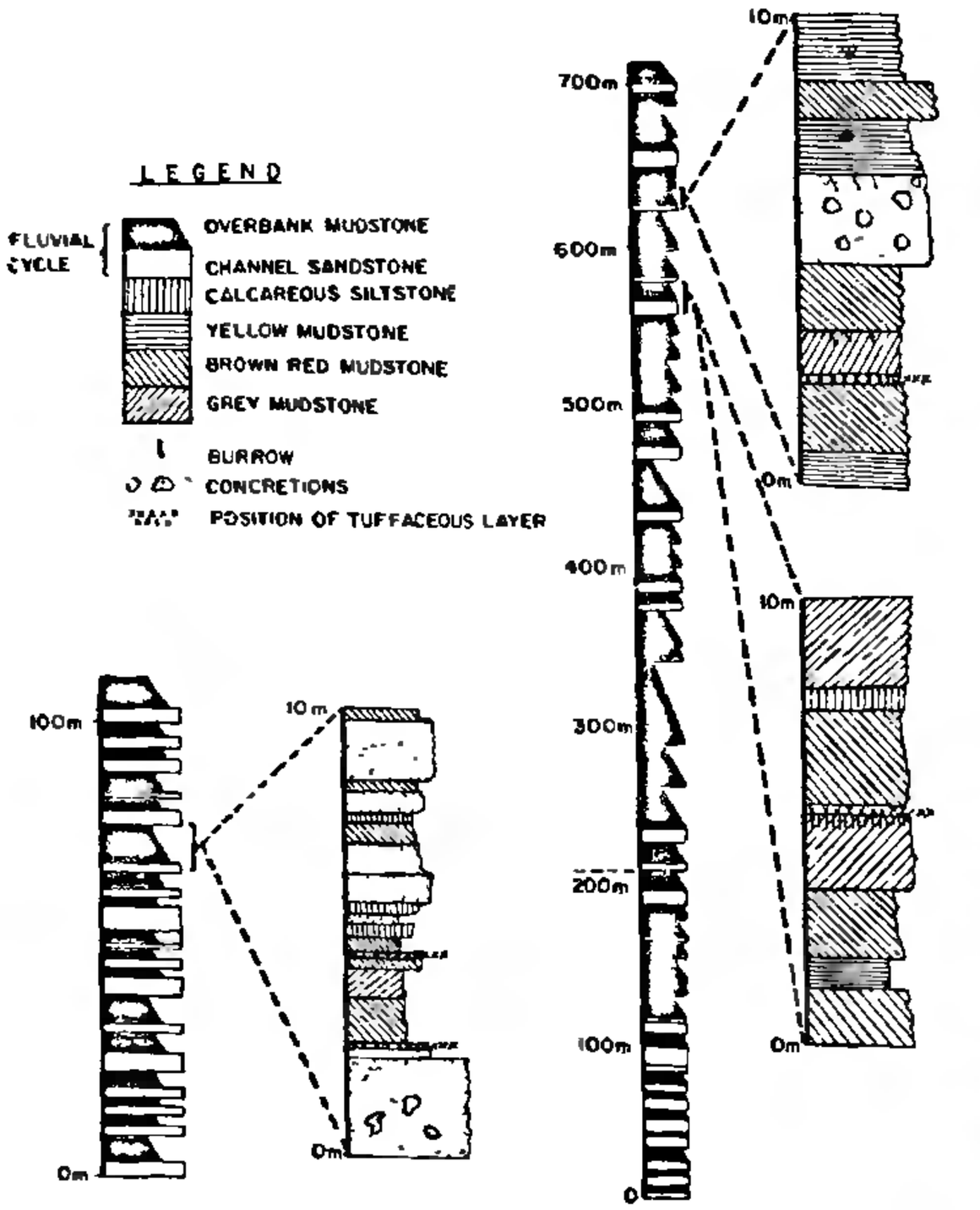

Figure 2. Lithological columns showing the position of the tuffaceous mudstones in the Ghaggar section (left) and the Khetpurali section (right).

faceous mudstones are greyish black and contain large euhedral grains of biotite in abundance. Trace activity is present along the upper boundary of the lower tuffaceous mudstone.

The upper part of the tuffaceous mudstone layer 2 shows a higher admixture of detrital constituents. This layer is followed by a palaeosol horizon which, in turn, is overlain by a thick channel sandstone unit.

Khetpurali Section: The tuffaceous mudstones occur in the upper part of the Pinjor Formation at 580 m from the base of this section (figure 2). The lowest stratigraphic occurrence of a tuffaceous mudstone in this section is in a 17.5 m thick sandstone—mudstone alternation of which the overbank deposits constitute 57%. The tuffaceous mudstone layer is 3 cm thick and occurs between brown and grey coloured mudstones.. The concentration of the tuffaceous component is low as compared to those occurring in the Ghaggar section. Euhedral biotite specks are recognised but they have an extremely low content. The second tuffaceous mudstone layer occurs 55 m above the first layer in this section. Both the tuffaceous mudstones lie in the magnetozone R5 interpreted to represent the post-Olduvai record[4].

Petrography: The tuffaceous mudstones with a relatively higher concentration of volcanic materials show large (up to 0.6 mm) slender and elongate euhedral grains of biotite (figure 3), showing pleochroism from light brown to dark brown. Many of the biotite grains show a coating of iron oxides. The groundmass consists of an argillaceous paste and glassy matter. In some of the specimens, elongate micas are common. Several other euhedral grains (figure 4) are distinguishable, amongst which zircon is most readily identified (figure 5). Zircon grains show a wide variation in size and shape. They vary in size from 100 to 300. Zircon

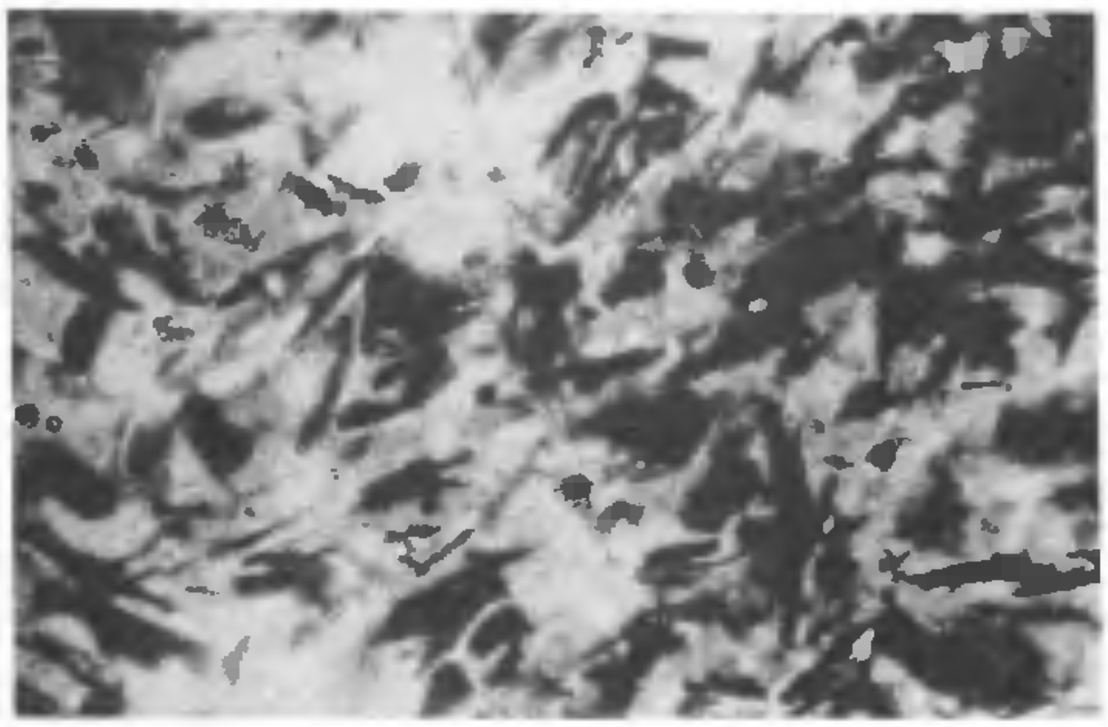

Figure 3. Slender and elongate euhedral grains of biotite in a thin section of the tuffaceous mudstone from the Ghaggar section (× nicols.).

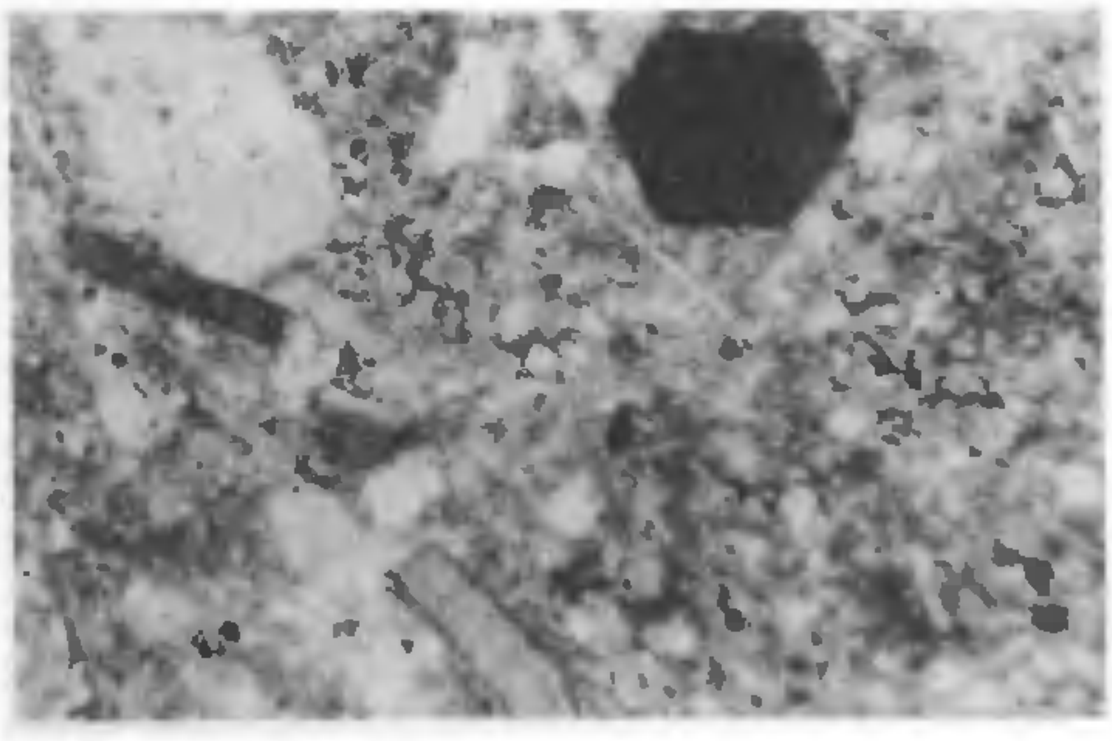

Figure 4. Euhedral biotite and dark opaque grains in the tuffaceous mudstone. Detrital quartz and matrix is also abundant (× nicols).

Figure 5. Photograph of loose grain mounts of zircon from the tuffaceous mudstones (× nicols).

varies from stout small grains to those, with well developed elongate prismatic faces and short bipyramidal terminations.

The tuffaceous character of the mudstones becomes obscure where the detrital constituent assumes major proportions. In such thin sections, a population of framework grains of mica and quartz is seen to float in a matrix of argillaceous paste and micas.

It has been shown that there is a dominance in the occurrence of these altered tuff horizons in the Siwalik Group of Pakistan from 3.0 to 1.5 M.Y. B.P.[2]. It has also been indicated that this corresponds with the period of activity of the Dacht-e-Nawar volcanic complex of East-Central Afghanistan.

At the present time, we have not been able to obtain fission track dates for the zircon separates of our samples. But from the geological and magneto-stratigraphic framework of this area[3,4], it is conjectured that the 2 tuffaceous mudstones in the Khetpurali section are post-Olduvai in age. However, in the Ghaggar section, the disposition of the tuffaceous mudstones as a couplet together with their stratigraphic occurrence towards the base of the Pinjor Formation allows for the inference that they correspond to the ash couplet dated between 2.4 and 2.5 M.Y.B.P. in the Siwalik Group of Pakistan[1,2].

It is also significant to point out that this report of tuffaceous mudstones lies almost 200 km farther to the east of those known earlier from the Jammu region. Late orogenic volcanism is not reported from the Himalaya. Following the line of argument present by earlier workers[2], it is suggested that these tuffaceous mudstones have been derived from the most westerly located volcanic centres (Dacht-e-Nawar Center) of Afghanistan. The Dacht-e-Nawar volcanic complex occurs in a large N-S trending graben in the Hazardadgat spur of the Hindu Kush[5]. This volcanic complex occurs 175 km southwest of Kabul and lies 1100 km to the west of Chandigarh.

If the inference regarding the source area of these occurrences is correct, the dimensions of the explosive volcanic activity would be significantly larger than what was thought of earlier.

The authors are grateful to Paramjit Singh and Bhaskar Jyoti Naug, University of Delhi who helped in the collection of data in the field. We also take this opportunity to thank Professor G. D. Johnson (Dartmouth College) for discussions.

Financial assistance to one of us (RK) from the University Grants Commission is thankfully acknowledged.

8 May 1984; Revised 4 June 1984

1. Opdyke, N. D., Lindsay, E., Johnson, G. D., Johnson, N. M., Tahirkheli, R. A. K. and Mirza, M. A., *Palaeogeo., Palaeoclim., Palaeoecol.*, 1979, **27**, 1.
2. Johnson, G. D., Zeitler, P., Naeser, C. W., Johnson, N. M., Summers, D. M., Frost, C. D., Opdyke, N. D. and Tahirkheli, R. A. K., *Palaeogeo., Palaeoclim., Palaeoecol.*, 1982, **37**, 63.
3. Kumar, R. and Tandon, S. K., *Sediment. Geol.*, (In Press).
4. Tandon, S. K., Kumar, R., Koyama, M. and Niitsuma, N., *J. Geol. Soc. India*, 1984, **25**, 45.
5. Bordet, P., *Ann. Sci. Univ. Clermeont. Geol. Mineral. Ser.*, 1975, **26**, 1.