

## SHORT COMMUNICATIONS

### TIME STRATIGRAPHIC POSITION OF THE EARLY PALAEOLITHIC CULTURE IN THE SIWALIKS OF NORTHWEST INDIA BASED ON FISSION-TRACK AGE OF THE ASSOCIATED SEDIMENTS

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THE time stratigraphic position of the Early

Palaeolithic culture in northwest India is still not established mainly because of inadequate search and non-availability of material suitable for precise dating. Several workers<sup>1-3</sup> are of the view that the antiquity of the Early Palaeolithic culture in the Indian subcontinent does not go beyond the Middle Pleistocene. Its stratigraphic position has been presumed to be within the Middle and Late Pleistocene terraces which developed after the last Himalayan orogeny (Middle Pleistocene). Anthropologists believe that tool-making hominids migrated

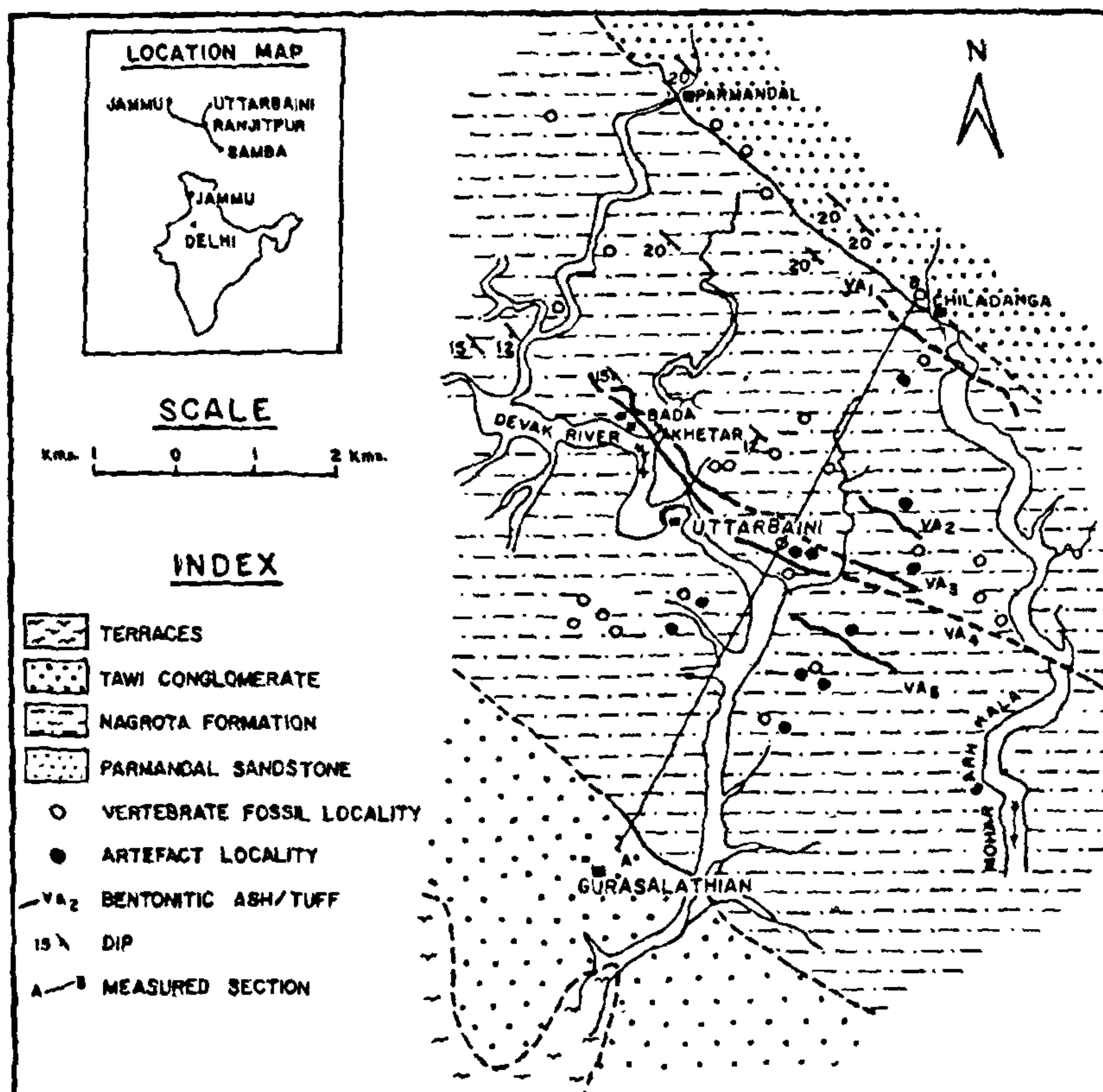


Figure 1. Geological map with location of bentonitic tuff/ash bands and fossil/artefact sites around Uttarbaini.

to the Indian subcontinent from Africa around 0.2 my ago.

The author, in an earlier paper<sup>4</sup>, pointed out the Pinjorian antiquity of this culture on the basis of numerous vertebrate fossils and closely associated stone artefacts recovered from the basal beds of Pinjor Formation exposed south of Nalagarh. Subsequent reports from the Lower Boulder Conglomerate<sup>5</sup> (Lower Pleistocene) and from the Tatrot beds<sup>6</sup> (Astian) of Markanda Valley also suggested greater antiquity for this culture. These reports, however, were doubted because such an antiquity for this culture is unexpected in this subcontinent and are contrary to the existing views.

A recent investigation<sup>7</sup> carried out in the Nagrota Formation (Astian and Villafranchian) of Uttarbaini area, Jammu district, Jammu and Kashmir, has revealed the presence of Early Palaeolithic artefacts in tuffaceous horizons dated on the basis of fission-track method. The find establishes the stratigraphic position of this culture and extends its lower limit down to 1.6 my or more instead of 0.2 my in this subcontinent.

The Nagrota Formation, with an estimated thickness of  $\pm 1650$  m, is well exposed in the southern limb of Suruin–Mastgarh Anticline<sup>8</sup> and contains

many volcanogenic bentonitic clays at different stratigraphic levels in the Chiladanga–Uttarbaini section (figure 1). One of the bentonitic clays, exposed in the middle part of this formation 1 km north of Uttarbaini, has been dated by fission-track method as  $1.6 \pm 0.2$  my old<sup>9</sup>. The 30-cm-thick, uncontaminated bentonitic clay layer (VA3, figure 1) is interbedded in a 2-m-thick siltstone band which yielded the stone artefacts (figure 2) from its main component.

The artefacts excavated contain unifacial and bifacial choppers, scrapers, cores and light-duty flake tools made from black, white, smoky and buff-coloured round quartzite pebbles. A 5-m-thick sandstone bed, resting conformably over the artefact-bearing siltstone, yielded cranial and post-cranial fossil remains of *Protelephas* (*Archidiskodon*) *planifrons*, *Elephas hysudricus*, *Equus sivalensis* and smaller bovids which have Villafranchian affinities.

In the same section, additional stone artefacts were collected from other sites as well occurring at different stratigraphic levels. Almost all the sites also contain vertebrate fossils of chelonia, proboscids, equids, giraffids, bovids, etc. Appearance of the earliest well-defined artefacts has been noticed in horizons about 150 m above the base of the Nagrota



Figure 2. Time stratigraphic position of the Early Palaeolithic culture in the Siwaliks of northwest India.



Formation. Their workmanship indicates pre-existence of the culture as well, and the lower limit of this culture is yet to be established.

The artefacts recovered from the excavations have typological affinities with those from the Olduvai Gorge in Africa. It is possible that tool-making hominids of Pliocene-Pleistocene were contemporary in the two continents and have the same antiquity.

The Early Palaeolithic culture of the Siwalik region, in view of its precise antiquity and stratigraphic position, is designated here as the "Siwalik Stone Age".

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1. Lal, B. B., *Ancient India*, 1956, 12, 58.
2. Joshi, R. V., Rajaguru, S. N., Badam, G. L. and Khanna, P. C., *J. Geol. Soc. India*, 1978, 19, 83.
3. Rajaguru, S. N., *Proc. Neogene/Quaternary Boundary Field Conference, India*, 1981, p. 127.
4. Verma, B. C., *J. Geol. Soc. India*, 1975, 16, 518.
5. Sharma, J. C., *Curr. Anthropol.*, 1977, 18, 94.
6. Verma, B. C. and Srivastava, J. P., *Man Environ.*, 1984, 8, 13.
7. Anon, *Geol. Surv. India. News Northern Region*, 1985, 5, 4.
8. Ranga Rao, A., Khan, K. N., Venkatachala, B. S. and Sastri, V. V., *Proc. Neogene/Quaternary Boundary Field Conference, India*, 1981, p. 131.
9. Yokoyama, T., Verma, B. C., Matsuda, T., Gupta, S. S. and Tewari, A. P., *Indian Min.*, 1988, (in press).

## GRADE DISTRIBUTIONS IN MANGANESE NODULES OF CENTRAL INDIAN OCEAN BASIN

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ECONOMIC potential of deep-sea manganese nodules has drawn considerable attention from various organizations investigating the seabed mineral re-

sources. The factors which limit deep-sea nodule mining are the economic grade (%Co + %Ni + %Cu) and abundance (kg/m<sup>2</sup>) of nodules on seafloor. Limited data are available on nodules from the Central Indian Ocean Basin (CIOB), for resource evaluation of these deposits.

Data concerning to geological setting, physical characteristics and bulk chemical composition of the

Table 1 Transition frequencies computed for eight directions shown in matrix tables

I				II			
169	20	1	0	169	21	0	0
21	161	34	0	20	161	39	0
0	39	258	53	1	34	258	63
0	0	63	415	0	0	53	415
III				IV			
163	27	0	0	163	11	0	0
11	160	49	0	27	160	16	0
0	16	268	75	0	49	268	39
0	0	39	420	0	0	75	420
V				VI			
164	22	0	0	158	29	3	0
35	203	42	0	16	143	57	4
3	78	275	56	0	28	232	93
0	4	103	430	0	0	53	382
VII				VIII			
153	33	1	0	154	20	0	0
18	110	43	0	35	140	28	0
0	15	146	60	1	56	227	56
0	0	40	579	0	0	93	378