Discovery of microvertebrates from the Pleistocene deposits of the Central Narmada Valley, India

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Pleistocene sediments of the Central Narmada Valley, Madhya Pradesh, widely known for their wealth of large vertebrates\(^1,2\), have yielded a partial hominid skull\(^3,4\) and an array of Stone Age implements\(^5\) for the first time, along with a diverse microvertebrate assemblage (micromammals, fish, amphibians and reptiles) during the 1991–92 field season. Preliminary taphonomical investigations reveal that the small mammal remains, primarily derived from scats, were deposited by fluvial processes. Faunal assemblage suggests the presence of sandy plains, grasslands with high sub-soil moisture content and shallow stream systems. Rodents like Millardia cf. M. meliata, Bandicota cf. B. bengalensis, Tatera cf. T. indica and Gerbillus sp. indicate an early emergence of the modern rodents of the Indian subcontinent.

The present announcement marks the first report of fossil microvertebrates from the Pleistocene sediments of the Central Narmada Valley. It may be noted that taphonomical and palaeoecological interpretations of the Central Narmada Valley were so far based on large mammal assemblages\(^7,8\). However, due to the absence of fossil microfauna, palaeoecological interpretations could not be deduced with precision. In this context, the recent discovery of microvertebrate assemblage from the Narmada Valley assumes greater significance. The present collection (Table 1) comes from a freshwater mollusc-bearing pebbly horizon (Figure 1 b) exposed near village Devakachar (23°23'N: 79°07'E) in Distt. Narsinghpur of Madhya Pradesh state (Figure 1 a).

As regards the chronological framework for the fossil occurrences, the molluscan shells (collected around Devakachar) were earlier analysed for \(^{14}\)C dating, which yielded a radiocarbon date\(^9\) of 31,750\(^\pm\)420 BP. Apart from this, based on fluorine/phosphate correlation\(^10\), palaeomagnetic studies\(^11\), percentage of nitrogen (late K. P. Oakley, personal communication) and occurrence of fossilized remains of large mammals like Cervus duvaucelii, Hexaprotodon palaeindicus, Elephas hysudricus, Bubalus cf. B. bubalis, Equus namadicus and Bos namadicus\(^8,12\), the fossiliferous sediments at Devakachar were assigned a Middle to Upper Pleistocene time bracket.

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Figure 1. Locality map (a) and lithostratigraphy (b) at Devakachar (after Badam and Grignon\(^2\)) BCS (black cotton soil), YBCS (yellow brown concretionary silt), M (microvertebrate-yielding horizon), SPG (sandy pebbly gravel) and RBCS (red brown concretionary silt)
Several comprehensive experiments carried out on scatological and fluvial microvertebrate accumulations provide the bases of interpretations in the present communication. The micromammal assemblage under consideration comprises a high percentage of complete limb bones, of which a few show angular breakages. Bones like femora, scapulae and humeri show frequent abrasion of their ends and processes. Most of the mandibles have their angle, coronoid and condyle worn out and commonly the sockets of the molars and pulp cavity for the incisors show holes at the base (Figure 2f, g). There is a higher proportional representation of incisors, tibia, femur and humerus, respectively (Table 2). The distribution of skeletal elements shows almost an entire range of skeletal parts.
together with those of fish, turtle, crocodile and frog (Table 1), well-rounded pebbles and concretions and haphazardly oriented molluscan shells. The nature and the extent of breakage, wearing and abrasion observed on the skeletal parts indicate a scatological origin. A comparison of the proportional representation percentage with skeletal elements in some of the Pleistocene microvertebrate accumulations suggests that the present microvertebrate remains might have been transported, sorted and finally deposited fluvially in a stream channel area. Large vertebrate fauna (in addition to those mentioned earlier, Panthera leo, Panthera tigris, Panthera pardus (?), Canis aureus, Rhinoceros sp., Stegodon insignis ganesa, Elephas namadicus, Hexaprotodon namadicus, Sus sp., Antilope cervicapra, Cervus sp., Axis axis, etc.) indicates the presence of open grasslands and wooded grasslands interspersed with perennial rivers and swamps. Since most of the taxa in the present collection of microvertebrates closely resemble the living forms, the preliminary interpretations of palaeoecology are based on the principle of actualism. Rodents like Tatera indica and Gerbillus indus prefer sandy plains and interdunal areas. African Tatera is found primarily in dry steppic countries and sometimes in thickets along the edges of alluvial flats. Bandicota bengalensis and Millardia melta are found in croplands where the sub-soil moisture is very high throughout the year. The latter sometimes prefer heavy shrubs and rocky terrains. Cyprinus, Crocodylus, Triomys and Rana are commonly associated with freshwater stream systems.

Tatera indica, Gerbillus indus, Bandicota bengalensis and Millardia melta are presently widespread all over the Indian subcontinent. The molars of Tatera cf. T. indica and Gerbillus sp. (Figure 2d, e) resemble those of Protatera cf. P. kabulense reported from Late Pleistocene of Siwaliks. Bandicota cf. B. bengalensis and Millardia cf. M. melta (Figure 2a–c) may have had some relationships with Bandicota sivalensis and cf. Millardia from Upper Siwaliks. However, keeping in view the relatively meagre record of fossil micromammals, interrelationship of Narmada and Siwalik rodents cannot be ascertained at the present state of our knowledge.


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Daytime measurements of optical auroral emissions from Antarctica


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Optical methods have enabled us to detect auroral emissions during daytime conditions, and to identify a narrow latitudinal region of energetic particle precipitation from the Indian station Maitri (11°38'0E; 70°45'S; 62.8°S I-lat.) in Antarctica. These observations are new. The energetic particles originate within the closed geomagnetic field lines close to the plasmapause region and maximize ~0830 h MLT (Magnetic Local Time) (~1200 UT). Enhanced proton precipitation activity could also be inferred during a moderate geomagnetic storm, suggesting the enhancement/activation of acceleration mechanisms during this event.

The auroral phenomenon, which is caused by the inter-action of high-energy charged particles with the atmospheric constituents is usually considered to be restricted to ±75° to ±80° magnetic latitudes in the dayside and ±65° to ±75° magnetic latitudes in the nightside of the earth. Due to the different locations of the geomagnetic