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FRESHWATER OSTRACODA FROM THE (?) PALAEOCENE-AGE DECCAN INTERTRAPPEAN BEDS OF LALITPUR (UTTAR PRADESH), INDIA

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ABSTRACT

A fairly diverse freshwater ostracod assemblage comprising 14 species has been recovered for the first time from the Deccan intertrappean beds at Papro, near Lalitpur (U.P.), on the eastern fringe of the Deccan Traps volcanic province of peninsular India. The probable Palaeocene age (based on palynomorphs) of the Lalitpur locality makes this intertrappean section potentially important in addressing the issue of faunal survivorship in fresh water aquatic systems across the Cretaceous-Tertiary boundary in the Deccan. The Lalitpur assemblage includes *Gomphocythere akalypton*, *G. paucisulcatus*, *Mongolianella cylindrica*, *M. subarcuata*, *Cypridopsis hyperectyphos*, *Cypridopsis* sp., *E. ucypris intervolcanus*, *E. catantion*, *E.* sp., *Zonocypris spirula*, *Frambocythere tumiensis*, *Cypria cyrtonidion*, cf. *Paracypretta elizabethae* and *Cyprois rostellum*. While this diversity may further increase with additional investigations, the recorded assemblage from Lalitpur significantly shows a striking similarity to ostracod faunas previously documented from a number of Maastrichtian intertrappean localities in the Deccan volcanic province. If the Palaeocene age of the Lalitpur section is correct, then it is apparent that freshwater ostracods were not significantly affected, at least qualitatively, by the initiation of Deccan volcanic activity, a situation that is reminiscent of some other groups of freshwater organisms, particularly molluscs.

Keywords: non-marine Ostracoda, Palaeocene, Deccan Traps, Intertrappean, India

INTRODUCTION

The Deccan intertrappean section near Papro, District Lalitpur (UP), lying on the eastern fringe of the main Deccan Trap volcanic province of peninsular India, occupies a special place in the province as it is the only known continental intertrappean locality in India that is possibly Palaeocene in age. This section came to light in 1978 with the description of a small charophyte assemblage (Singh and Mathur, 1978; Singh, 1980). Subsequently, Kumar *et al.* (1980) gave a general geological account of the area and suggested an Eocene age based on charophytes. Recently, Singh and Kar (2002) described palynofossils from the black cherts of this intertrappean section, and the assemblage recovered by them includes *Phragmothyrites eocaenica*, *Inapertusporites kedvesii*, *Cyathidites minor*, *Todisporites major*, *Dandotiaspora dilata*, *Dandotiaspora pseudoauriculata*, *Spinizonocolpites echinatus* and *Lakiapollis ovatus*. Significantly, a Palaeocene age was suggested by Singh and Kar (2002) based on correlation of this palynoassemblage with that from the Matanomadh Formation of Kutch, western India. It is important to note that the continental intertrappean deposits occurring in the main volcanic province are mostly considered to be latest Cretaceous (Maastrichtian) in age (e.g. Sahni and Bajpai, 1988). Prior to a Palaeocene age determination by Singh and Kar (2002), there was no firm basis to assign such an age to any intertrappean deposit except for the well-known marine intertrappean outcrops occurring near Rajahmundry on the southeast coast of India, hundreds of kilometers away from the main Deccan province (Keller *et al.*, 2008), and the recently studied intertrappean section at Jhilmili, Chhindwara District, M. P. (Keller *et al.*, accepted; Keller *et al.*, under revision).

Intertrappean deposits near Lalitpur are exposed in a stream-cutting about 3 km north east of the Papro village (24°48'20":24°14') (Fig.1). The Deccan Traps in this locality (fig. 1) rest over the Kaimur Sandstone of the Vindhyan Supergroup (Late Precambrian), and the two are separated by a major unconformity represented by conglomerates (Kumar *et al.*, 1980). Geological data on this section (Fig. 1) have been provided by Kumar *et al.* (1980) and Singh and Kar (2002). Intertrappeans in this section include about a meter and half of grey and black chert that yielded charophytes described previously by Singh (1980). Kumar *et al.* (1980) noted the presence of ostracods in these cherts. In addition, freshwater molluscs, particularly *Physa* and *Lymnaea*, have also been recorded (but not described or illustrated) by Singh and Mathur (1980) and Singh (1980). Ongoing investigations by Joseph Hartman (University of North Dakota, USA, personal communication) have led to the recognition of a few more molluscan taxa in these cherts. The presently described ostracod fauna was recovered from chert samples collected by one of us (MPS).

The ostracods described in this paper are housed in the Paleontology Laboratory, Department of Earth Sciences, Indian Institute of Technology, Roorkee, under the acronym IITR/SB/LI.

SYSTEMATIC PALAEONTOLOGY

Phylum **Crustacea** Pennant, 1777
Class **Ostracoda** Latreille, 1806
Order **Podocopida** Muller, 1894
Suborder **Podocopina** Muller, 1894
Superfamily **Cytheracea** Baird, 1850
Family **Limnocytheridae** Klie, 1938
Subfamily **Timiriaseviinae** Mandelstam, 1960
Genus ***Gomphocythere*** Sars, 1924
Gomphocythere akalypton Whatley *et al.*, 2002
(Pl. I, figs. A-D)

Material: 11 carapaces.

Description: Medium- sized species of *Gomphocythere*; subrectangular in lateral view; s-shaped median sulcus strongly

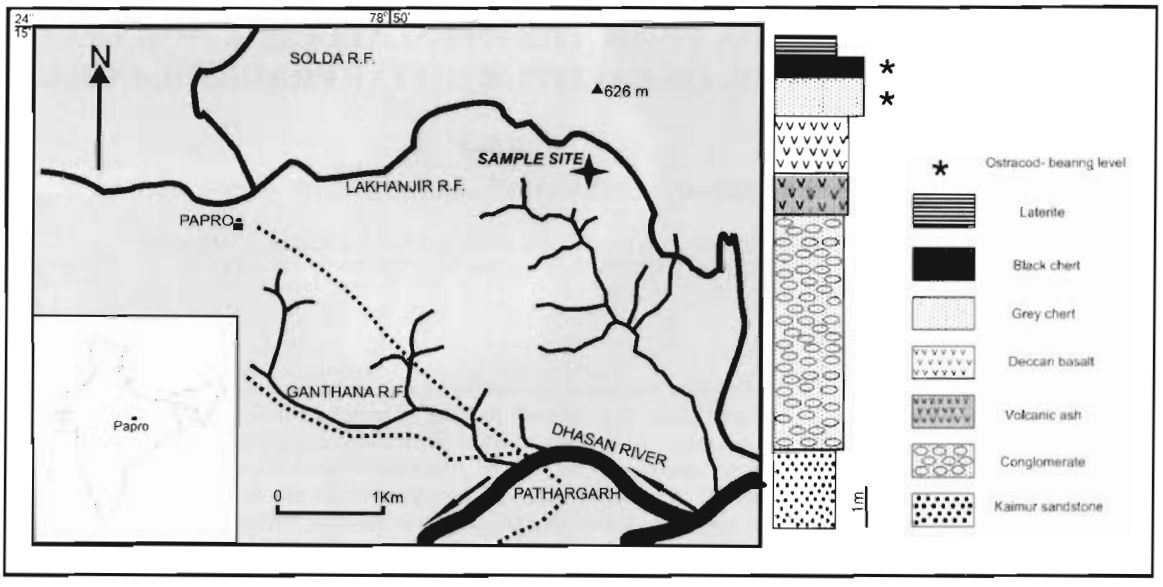


Fig. 1. Map showing the geographic location and litholog of the ostracod-yielding Deccan intertrappean beds at Papro, District Lalitpur, UP (litholog, after Singh and Kar, 2002).

pronounced in both valves; a smaller shorter sulcus occurs antero-dorsally of the main one; original ornamentation not preserved in the present carapaces due to removal of the outer lamella; ornamentation reticulate.

Remarks: Apart from the type locality at Chandarki in District Gulbarga, Karnataka (Whatley *et al.*, 2002a), this species has also been recorded from the intertrappean beds at Phulsagar, District Mandla, Madhya Pradesh (Bajpai *et al.*, 2004).

Gomphocythere paucisulcatus Whatley *et al.*, 2002
(Pl. I, figs. E-G)

Material: 4 carapaces.

Description: Medium-sized species of *Gomphocythere*; subovate to subrectangular in lateral view; slight median sulcus, dorsal margin long and straight; ventral margin with slight oral concavity.

Remarks: This species has been previously recorded from the intertrappean beds of Mohangaonkala, District Chhindwara (Whatley *et al.*, 2002b), Bombay (Whatley *et al.*, 2003a), Anjar, Kutch (Khosla and Nagori, 2005) and Takli, Nagpur (Khosla and Nagori, 2007) as well as from the Lameta Formation of Dongargaon (Khosla *et al.*, 2005)

Genus ***Frambocythere*** Colin, 1980
Frambocythere tumiensis Helmdach, 1978
(Pl. II, fig. L)

Material: 2 carapaces.

Description: A very small species; highly inflated; median sulcus pronounced.

Remarks: Poor preservation does not allow the identification of subspecies that these carapaces pertain to.

Superfamily **Cypridacea** Baird, 1845
Family **Cyprididae** Braid, 1845
Subfamily **Cypridopsinae** Kaufmann, 1900
Genus ***Cypridopsis*** Brady, 1868
Cypridopsis hyperectyphos Whatley and Bajpai, 2000
(Pl. II, figs. A-C)

Material: 10 carapaces.

Description: Medium-sized; very strongly inflated and delicately punctuate species of *Cypridopsis* with LV overlapping RV; anterior margin very broadly rounded; posterior margin more narrowly rounded; dorsal margin umbonate with apex at about mid-height; ornamentation not seen in the present specimens due to absence of outer lamella.

EXPLANATION OF PLATE I

(scale bar equals 100μm for A, C, M & N; 90μm for B; 60μm for D-L & O)

A-D. ***Gomphocythere akalypton*** Whatley *et al.*, 2002
A. carapace, dorsal view (IITR/SB/LI/11)
B. carapace, right lateral view (IITR/SB/LI/11)
C. carapace, dorsal view (IITR/SB/LI/9)
D. carapace, left lateral view (IITR/SB/LI/17)

E-G. ***Gomphocythere paucisulcatus*** Whatley *et al.*, 2002
E. carapace, right lateral view (IITR/SB/LI/23)
F. carapace, left lateral view (IITR/SB/LI/52)
G. carapace, dorsal view (IITR/SB/LI/21)

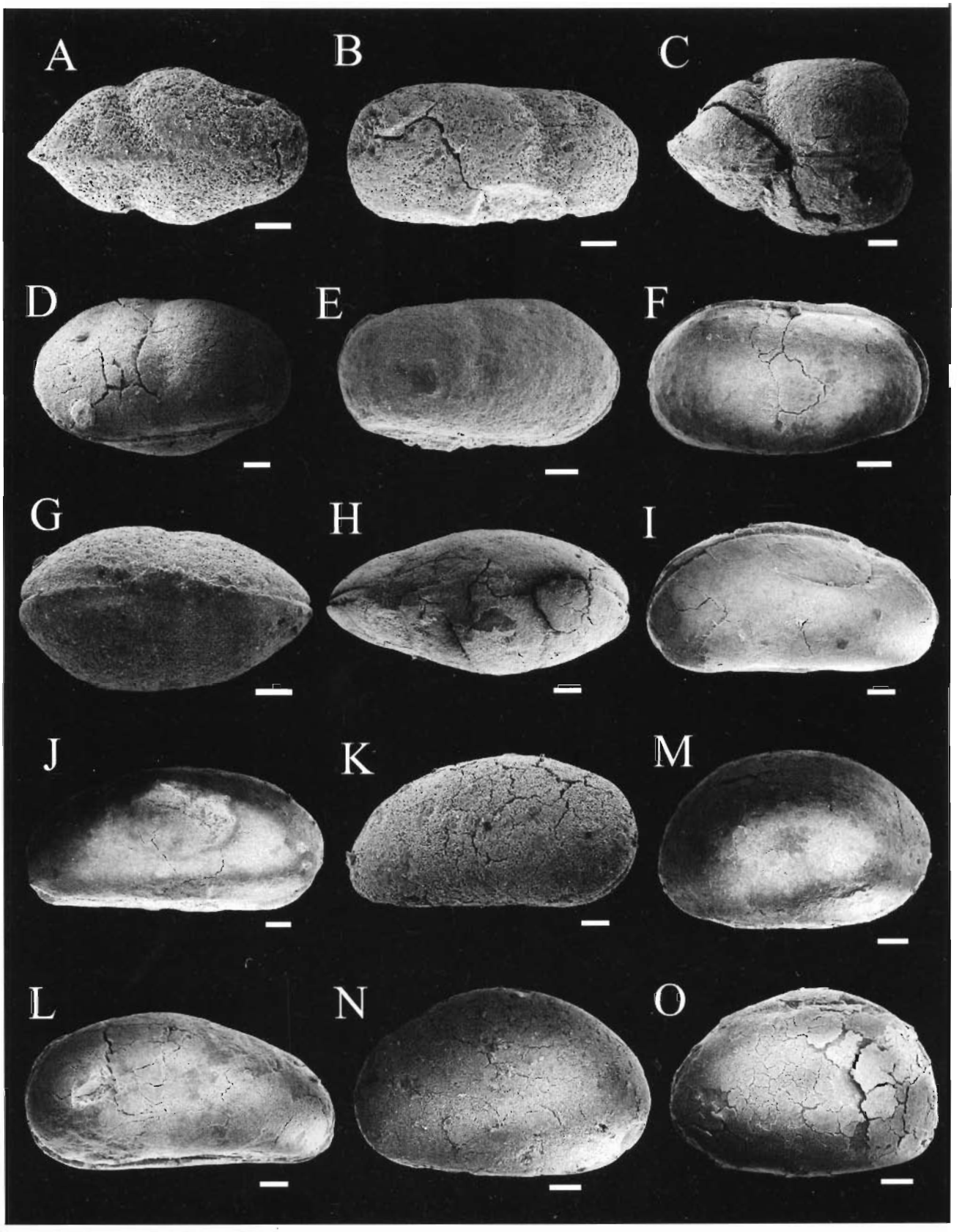
H-K. ***Eucypris intervolcanus*** Whatley and Bajpai, 2004
H. carapace, dorsal view (IITR/SB/LI/55)
I. carapace, right lateral view (IITR/SB/LI/54)
J. carapace, left lateral view (IITR/SB/LI/39)
K. carapace, left lateral view (IITR/SB/LI/8)

L. ***Eucypris catantion*** Whatley *et al.*, 2003
carapace, right lateral view (IITR/SB/LI/53)

M-N. ***Eucypris*** sp.
M. carapace, left lateral view (IITR/SB/LI/44)
N. carapace, left lateral view (IITR/SB/LI/33)

O. ***Cypria cyrtonidion*** Whatley and Bajpai, 2003
carapace, left lateral view (IITR/SB/LI/45)

Plate I



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Remarks: So far, this species has been recorded from the intertrappean localities of Lakshmipur (Whatley and Bajpai, 2000) and Kora in Kutch District of Gujarat (Bajpai and Whatley, 2001), Mamoni in Rajasthan (Whatley *et al.*, 2003b), Yanagundi in Karnataka (Whatley *et al.*, 2002a), Takli in Nagpur District of Maharashtra (Khosla and Nagori, 2007) as well as from the Lameta Formation of Dongargaon near Nagpur (Khosla *et al.*, 2005).

Cypridopsis sp.
(Pl. II, figs.D-E)

Material: 3 specimens.

Description: Medium-sized; subspherical in dorsal and ventral views; valves same in size.

Remarks: The material is rare and cannot be identified below generic level. Apparently, this species is confined to the present locality.

Family **Candonidae** Kaufmann, 1900
Subfamily **Herpetocypridinae** Kaufmann, 1900
Genus ***Mongolianella*** Mandelstam, 1956
Mongolianella cylindrica (Sowerby, 1840)
(Pl. II, figs. I-K)

Material: 10 carapaces.

Description: Very large, elongate, subrectangular to subcylindrical species of *Mongolianella* with LV overlapping RV strongly around the free margins; anterior margin broadly rounded; posterior margin bluntly pointed; dorsal margin straight and ventral margin with very shallow oral incurvature.

Remarks: *M. cylindrica* is one of the most widely occurring and oldest known intertrappean species in India. It has been reported previously from Sichel hills, AP (Sowerby, 1840), Mamoni, Rajasthan (Whatley *et al.*, 2003b), Lakshmipur (Whatley and Bajpai 2000) and Kora (Bajpai and Whatley, 2001)in Kutch, Gujarat, Phulsagar in MP (Bajpai *et al.*, 2004), Gulbarga in Karnataka (Whatley *et al.*, 2002a), Asifabad in AP (Bhatia *et al.*, 1996) and Bombay (Singh and Sahni, 1996), Narli, Jhalawar District Rajasthan (Mathur and Verma, 1985), Takli, Nagpur, Maharshtra (Bhatia and Rana, 1984; Khosla and Nagori, 2007) and from the Lameta Formation of Jabalpur, MP (Sahni and Khosla, 1994; Khosla and Sahni, 2000).

Mongolianella subarcuata Whatley *et al.*, 2003
(Pl. II, figs. F-H)

Material: 4 carapaces.

Description: Small species of *Mongolianella*; subarcuate in shape; arched dorsal margin; medianly concave ventral margin; anterior margin narrowly and asymmetrically rounded; LV larger than RV.

Remarks: This is a relatively rare species amongst the intertrappean ostracodes, and has been recorded so far only from Mamoni (Whatley *et al.*, 2003b) and Kora (Bajpai and Whatley, 2001).

Subfamily **Eucypridinae** Bronshtein 1947
Genus ***Eucypris*** Vávra, 1991
Eucypris intervolcanus Whatley and Bajpai, 2004
(Pl. I, figs. H-K)

Material: 7 carapaces.

Description: Large species of *Eucypris* with well rounded end margins; greatest height at mid length; long antero-dorsal slope; anterior margin narrowly rounded; posterior margin broadly rounded; apex below mid-height.

Remarks: This species has already been recorded from Lakshmipur (Whatley and Bajpai, 2000) Yanagundi (Whatley *et al.*, 2002a), Kora (Bajpai and Whatley, 2001), Phulsagar (Bajpai *et al.*, 2004), Mohagaonkala, Chhindwara District, MP (Whatley *et al.*, 2002) and Takli, Nagpur District (Khosla and Nagori, 2007).

Eucypris catantion Whatley *et al.*, 2003
(Pl. I, fig. L)

Material: Single carapace.

Description: large species of *Eucypris* with a narrowly pointed anterior margin; LV larger than RV but RV overlapping LV mid-dorsally; greatest height at mid-length.

Remarks: This species is also relatively uncommon and was previously known only from Kora (Bajpai and Whatley, 2001) and Mamoni (Whatley *et al.*, 2003b)

Eucypris sp.
(Pl. I, figs. M-N)

Material: 2 carapaces.

Description: carapace large, subovate, anterior margin slightly more compressed than posterior margin; both valves of equal size.

Remarks: The two valves in this species are equal in size

EXPLANATION OF PLATE II

(Scale Bar equals 60μm for A –E, G, J & L; 30 μm for F, H & O; 90 for I; 100μm for K, M, N & R; 20 μm for P; 200 μm for Q)

A-D. ***Cypridopsis hyperectyphos*** Whatley and Bajpai, 2000
A. carapace, dorsal view (IITR/SB/LI/15)
B. carapace, right lateral view (IITR/SB/LI/14)
C. carapace, left lateral view (IITR/SB/LI/14)

D-E. ***Cypridopsis* sp.**
D. carapace, left lateral view (IITR/SB/LI/49)
E. carapace, dorsal view (IITR/SB/LI/48)

F-H. ***Mongolianella subarcuata* Whatley *et al.*, 2003**
F. carapace, right lateral view (IITR/SB/LI/58)
G. carapace, left lateral view (IITR/SB/LI/57)
H. carapace, dorsal view, (IIT/SB/LI/27)

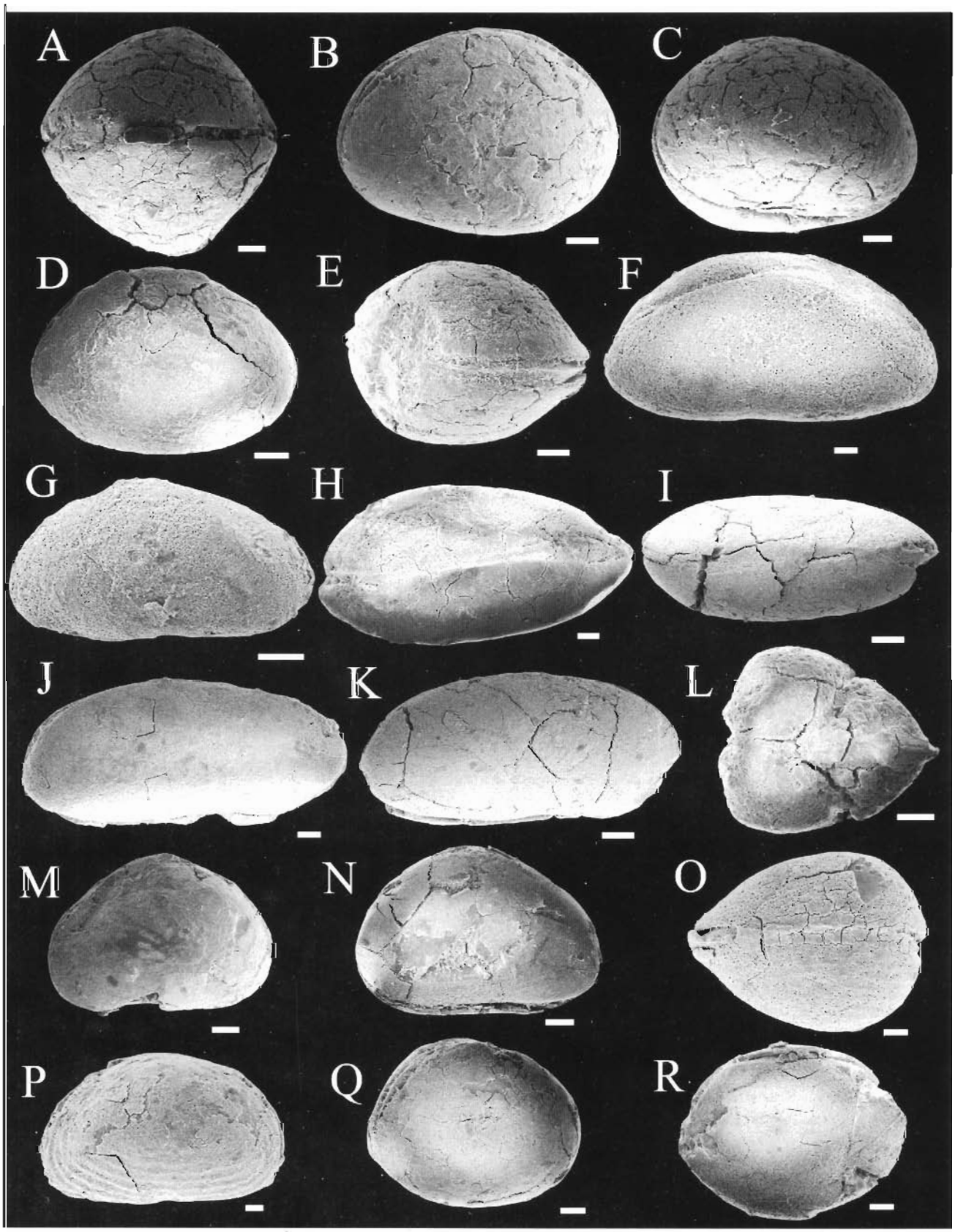
I-K. ***Mongolianella cylindrica*** (Sowerby, 1840)
I. carapace, dorsal view (IITR/SB/LI/5)
J. carapace, left lateral view (IITR/SB/LI/30)
K. carapace, right lateral view (IITR/SB/LI/30)

L. ***Frambocythere tumiensis*** Helmdach, 1978
carapace, dorsal view (IITR/SB/LI/46)

M-N. cf. ***Paracypretta elizabethae*** Whatley *et al.*, 2002
M. carapace, left lateral view (IITR/SB/LI/37)
N. carapace, right lateral view (IITR/SB/LI/36)

O-P. ***Zonocypris spirula*** Whatley and Bajpai, 2000
O. carapace, dorsal view (IITR/SB/LI/60)
P. carapace, right lateral view (IITR/SB/LI/59)

Q-R. ***Cyprois rostellum*** Whatley and Bajpai, 2000
Q. carapace, left lateral view (IITR/SB/LI/50)
R. carapace, left lateral view (IITR/SB/LI/61)


A
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unlike *Eucypris pelasgicos* and *Eucypris intervolcanus* in which LV is larger than RV. In *Eucypris catantion* the anterior margin is more narrowly pointed. *Eucypris phulsagarensis* differs from the present *Eucypris* sp. in having wart like papillae on the surface and in its much more broadly rounded anterior angle.

Subfamily **Cyclocypridinae** Kaufmann, 1900
Genus ***Cypria*** Zenker, 1854
Cypria cyrtonidion Whatley and Bajpai, 2000
(Pl. I, fig. O)

Material: 1 carapace.

Description: Medium-sized species of *Cypria*; subquadrate to subcircular in lateral view; LV larger than RV except dorsally where RV overlaps LV; dorsal margin short, straight and slightly inclined toward the posterior; anterior margin bluntly rounded; posterior margin subtruncate.

Remarks: So far, this species has been reported from Mohagaonkalan (Whatley *et al.*, 2002b), Lakshmipur (Whatley and Bajpai, 2000), Yanagundi and Chandarki (Whatley *et al.*, 2002a), Gitti khadan (Bhatia and Rana, 1984), Mamoni (Whatley *et al.*, 2003b), Narli (Mathur and Verma, 1988), Kora (Bajpai and Whatley, 2001), Anjar, Kutch (Khosla and Nagori, 2005), Takli, Nagpur (Khosla and Nagori, 2007) as well as from Lameta formation of Dongargaon in Chandrapur District (Khosla *et al.*, 2005).

Family **Cyprididae** Baird, 1845
Subfamily **Cyprettinae** Hartmann, 1963
Genus ***Paracypretta*** Sars, 1924
cf. *Paracypretta elizabethae* Whatley *et al.*, 2002
(Pl. II, fig. M-N)

Material: 2 carapaces.

Description: Large, subovate; LV larger than RV with preferential overlapping at ventral margin; dorsal margin highly arched and umbonate.

Remarks: Because of insufficient material, this species is left in an open nomenclature.

Genus ***Zonocypris*** Muller, 1898
Zonocypris spirula Whatley and Bajpai, 2000
(Pl. II, figs. O-P)

Material: 2 carapaces.

Description: Very small species of *Zonocypris* with spirally arranged ornamentation; anterior margin well rounded; dorsal margin short, straight and inclined posteriorly.

Remarks: So far, this species has been recorded from Lakshmipur (Whatley and Bajpai, 2000a), Yanagundi (Whatley *et al.*, 2002a) and Kora (Bajpai and Whatley, 2001), Mohagaonkala, Chhindwara, MP (Whatley *et al.*, 2002b) as well as from Lameta Formation of Dongargaon in Chandrapur District (Khosla *et al.*, 2005).

Family **Notodromadidae**
Subfamily **Cyproidinae** Hartmann, 1963
Genus ***Cyprois*** Zenker, 1845
Cyprois rostellum Whatley and Bajpai, 2000
(Pl. II, figs. Q-R)

Material: 2 carapaces.

Description: Very large smooth species of *Cyprois*; subrounded in lateral view; slightly laterally inflated in dorsal view.

Remarks: This species was previously recorded from Lakshmipur (Whatley and Bajpai, 2000), Kora (Bajpai and Whatley, 2001) and Mohagaonkala, Chhindwara District (Khosla and Nagori, 2007).

CONCLUDING REMARKS

As noted above, the probable Palaeocene age of the Lalitpur section based on palynofossils (Singh and Kar, 2002) makes it a unique intertrappean locality in the main Deccan province. A fairly diverse assemblage of freshwater ostracods comprising 14 species is documented here for the first time from this section. This is the first faunal group being documented from these outcrops.

The Lalitpur ostracod assemblage is dominated by 4 species: *Gomphocythere akalypton*, *Cypridopsis hyperectyphos*, *Eucypris intervolcanus* and *Mongolianella cylindrica*. Palaeoecologically, the Lalitpur fauna comprises a mixture of swimmers (e.g. *Cypridopsis, Paracypretta, Cypria, Mongolianella, Zonocypris*) and non-swimmers (e.g. *Frambocythere, Gomphocythere, Eucypris*). All the swimmers require permanent water body as they need open water. Non-swimmers can survive both in permanent as well as temporary environment depending upon their palaeoecology. Among non-swimmers, *Frambocythere* and *Gomphocythere* are epibenthonic which live in permanent waters, whereas modern *Eucypris* lives in temporary pools (Whatley and Bajpai, 2005). Overall, the Lalitpur assemblage is dominated by taxa that required a core of permanent water body which flooded out during rains and dried out along the periphery during the dry season, a setting similar to other localities.

Furthermore, the Lalitpur ostracod fauna is strikingly similar to those known from a number of Maastrichtian-aged intertrappean localities across the Deccan province, a situation similar to that suggested by the Lalitpur molluscs (Hartman *et al.*, 2007). If the Palaeocene age assessment based on palynomophs is correct, then the freshwater ostracods described here would appear to indicate that some faunal elements crossed the Cretaceous/Tertiary boundary in this region, at least qualitatively, and that the impact of the Deccan volcanic activity was limited in freshwater aquatic communities. In addition, the Lalitpur ostracods reinforces the endemic character of this group, as shown recently by Whatley and Bajpai (2006) for the Maastrichtian-aged intertrappean ostracod assemblages. A clearer picture will emerge only after the diversity and abundance of the Lalitpur ostracod fauna is worked out in greater detail.

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REFERENCES

Bajpai, S., Mohabey, D. M., Kapur, V. and Sharma, R. 2004. A Late Cretaceous (Maastrichtian) freshwater ostracod fauna from Deccan intertrappean sediments from Phulsagar, Mandla District, Madhya Pradesh. *Gondwana Geological Magazine*, **19** (2), 147-157.

Bajpai, S., and Whatley, R.C. 2001. Late Cretaceous non-marine ostracodes from the Deccan intertrappean beds, Kora (western Kachchh, India). *Revista Espanola de Micropalaeontologia*, **33**: 91-111.

Bhandari, A. and Colin, J. P. 1999. Ostracodes limniques des sediments inter- état trappéens (Maastrictien terminal-Paléocene basal) de la region d'Anjar (Kachchh, Etat de Gujarat), Inde: systématique, paléoécologie et affinités paléobiogéographiques. *Revue De Micropalontologie*, **42** (1): 3-20.

Bhatia, S. B., Prasad, G. V. R. and Rana, R. S. 1996. Maastrichtian non-marine ostracodes from Peninsular India: palaeobiogeographic and age implication. *Memoir of the Geological Society of India*, **37**: 297-311.

Bhatia, S. B. and Rana, R. S. 1984. Palaeogeographic implication of Charophyta and Ostracoda of the intertrappean beds of peninsular India. *Memoire de la Societe Geologique de France*, **147**: 29-36.

Hartman , J. H., Bingle, M and Bajpai, S. 2007. Documenting Paleocene-age Deccan intertrappean mollusks, Uttar Pradesh, India. *Annual Meeting of the Geological Society of America*, Denver, **208**: 20 (*Abstract*).

Keller, G., Adatte, T., Gardin, S., Bartolini, A. and Bajpai, S. 2008. Main Deccan volcanism phase ends near the K-T boundary: Evidence from the Krishna-Godavari Basin, SE India. *Earth and Planetary Science Letters*, **268**: 293-311.

Keller, G., Khosla, S.C., Sharma, R., Khosla, A. and Bajpai, S. 2008. Early Danian Planktic Foraminifera from K-T Intertrappean beds at Jhilmili, Chhindwara District, Madhya Pradesh, India. *Journal of Foraminiferal Research* (in press).

Keller, G., Adatte, T., Bajpai, S., Mohabey, D.M., Widdowson, M., Khosla, A., Sharma, R., Khosla, S.C., Gertsch, B., Fleitmann, D. and Sahni, A. 2008. K-T transition in Deccan Traps of central India marks major marine seaway across India. *Earth and Planetary Science Letter* (in review).

Kumar, S., Singh, M. P. and Singh, S. N. 1980. Lithostratigraphy, age and Palaeogeography of the newly discovered fossiliferous Intratrappeans. Lalitpur District, Uttar Pradesh. *Geophytology*, **10** (1): 72-80.

Khosla, A. and Sahni, A. 2000. Late Cretaceous (Maastrichtian) ostracodes from the Lameta Formation, Jabalpur Cantonment Area, Madhya Pradesh, India. *Journal of the Palaeontological Society of India*, **45**: 57-78.

Khosla, S. C. and Nagori, M. L. 2005. A Restudy of ostracode fauna from the Inter-Trappean beds of Anjar, Kachchh District, Gujarat. *Journal of the Geological Society of India*. **66**: 573-580.

Khosla, S. C. , Nagori, M. L and Mohabey, D. M. 2005. Effect of Deccan Volcanism on non-marine Late Cretaceous ostracode fauna: a case study from Lameta Formation of Dongargaon area (Nand-Dongargaon basin), Chandrapur District, Maharashtra. *Gondwana Geological Magazine Special Volume* **8**: 133-146

Khosla, S. C. and Nagori, M. L. 2007. Ostracode fauna from the Inter-Trappean beds of Mohgaon-Haveli, Chhindwara District, Madhya Pradesh. *Journal of the Geological Society of India*, **69**: 209-221.

Mathur, A. K. and Verma, K. K. 1988. Freshwater ostracodes from the intertrappean of southeastern Rajasthan. *Geological Survey of India Special Publication*, **11**: 169–174.

Sahni, A. and Khosla, A. 1994. A Maastrichtian ostracode assemblage (Lameta Formation) from Jabalpur Cantonment, Madhya Pradesh, India. *Current Science*, **67** (6): 456-460.

Sahni, A and Bajpai, S. 1988. Cretaceous –Tertiary boundary events: the fossil vertebrate, palaeomagnetic and radiometric evidence from peninsular India. *Journal of the Geological Society of India*, **32**: 382 –396.

Sowerby, J. de C. 1840. On the fossils of the eastern portion of the Great Basaltic District of India. In MALCOLMSON, J. C. (Ed.). *Transactions of the Geological Society of London*, **5**: 532-575.

Singh, M. P and Mathur, D. K. 1978. Discovery of some charophyta from the fossiliferous Intratrappean beds of Lalitpur, Uttar Pradesh, *Current Science*, **48** (5): 208-209.

Singh, M. P. 1980. Charophytes from the infratrappean beds of Papro, Lalitpur District, Uttar Pradesh. *Journal of the Palaeontological Society of India*, **23-24**: 144-150.

Singh, R. S. and Kar, R. K 2002. Palaeocene Palynofossils from the Lalitpur Intertrappean beds, Uttar Pradesh, India. *Journal of the Geological Society of India*, **60**: 213-216.

Singh, S. D. and Sahni, A. 1996. Bombay Inter-trappeans: new data on age and faunal affinities. In PANDEY, J. *et al.* (Eds.), *Contributions, XV Indian Colloquium on Micropalaentology &. Stratigraphy, Dehradun*, 465-469.

Whatley, R and Bajpai, S. 2000. A new fauna of Late Cretaceous non-marine ostracoda from the Deccan intertrappean beds of Lakshmipur, Kachchh (Kutch) District, Gujarat, western India. *Revista Espanola de Micropalaeontologia*, **32** (3): 385-409.

Whatley, R. and Bajpai, S. 2005. Some aspects of the palaeoecology and distribution of non-marine Ostracoda from Upper Cretaceous intertrappean deposits and the Lameta Formation of peninsular India, *Journal of the Palaeontological Society of India*, **50** (2): 61-76.

Whatley R. and Bajpai, S. 2006. Extensive endemism among the Maastrichtian non-marine Ostracoda of India with implications for palaeobiogeography and "Out of India" dispersal. *Revista Espanola de Micropalaeontologia*, **38** (2-3): 229-244.

Whatley, R., Bajpai, S. and Srinivasan, S. 2002a. Upper Cretaceous nonmarine Ostracoda from intertrappean horizons in Gulbarga District, Karnataka State, South India. *Revista Espanola de Micropalaeontologia*, **34** (2): 163-186.

Whatley, R., Bajpai, S. and Srinivasan, S. 2002b. Upper Cretaceous intertrappean non-marine Ostracoda from Mohagaonkala (Mohgaon-Kalan), Chhindwara District, Madhya Pradesh State, Central India. *Journal of Micropalaeontology*, **21**(2): 105-114.

Whatley, R., Bajpai, S. and Whittaker, J. E. 2003a. Indian intertrappean Ostracoda in the collection of the Natural History Museum, London. *Cretaceous Research*, **24**: 73-88.

Whatley, R., Bajpai, S. and Whittaker, J. E. 2003b. Freshwater ostracoda from the Upper Cretaceous intertrappean beds at Mamoni (Kota District), southeastern Rajasthan. *Revista Espanola de Micropaleontologia,* **35** (1): 75-86.

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