

A NOTE ON SOME EARLY EOCENE OSTRACODES FROM THE SUBATHU FORMATION, MORNİ, SHIMLA HILLS, LESSER HIMALAYAS

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ABSTRACT

Twenty-three ostracode taxa were collected from the Subathu Formation exposed in the Morni area of the Shimla Hills in the Lesser Himalayas. Eleven of these are recorded for the first time from the Subathu Formation. These are *Cytheridea* sp., *Cushmanidea* cf. *C. tewarii*, *Eucytherura vimali*, *Semicytherura rameshi*, *Schizocythere rakhensis*, *S. prolata*, *Alocopocythere abstracta*, *Gyrocythere mitigata*, *Occultocythereis* cf. *O. peristica*, *C. subspinelloso*, *Cytherella palanaensis*. The assemblages is indicative of Early Eocene age.

INTRODUCTION AND PREVIOUS WORK

The ostracodes of the Subathu Formation, Lesser Himalayas are less well known than other groups of fossils. The only two works dealing at length with the ostracodes are by Tewari and Singh (1967) from the Kalakot area of Jammu and Kashmir and by Mathur (1977) from the Shimla Hills. In the former paper, the authors have identified sixteen species of Early Eocene ostracodes from the Nummulitic beds of Kalakot area of Jammu & Kashmir, viz., *Bairdia kalakotensis*, *B. jammuensis*, *B. beraguaensis*, *Bairdoppilata kalakotensis*, *Bythocypris kashmirensis*, *B. westi*, *Paracypris jhingrani*, *Krithe indica*, *Aurila kohli*, *Caudites indica*, *Cythereis rajnathi*, *Echino-cythereis cheropodiensis*, *Hermanites wadai*, *H. purii*, *Quadracythere sahnii*, *Cytherella tawaica*. Mathur (1977) has described and illustrated twenty-six taxa of ostracoda viz., *Leguminocythereis lune-jensis*, *Leguminocythereis* sp., *Schizocythere* cf. *S. appendiculata*, *Schizocythere* sp. indet., *Xestoleberis subglobosa*, *Cytherella protuberantis*, *Cytherella* sp. indet., *Cytherelloidea* cf. *C. barkhanensis*, *C. sp. insolensa*, *Paracypris contracta*, *P. jhingrani*, *Ilyocypris khoslai*, *Ilyocypris* sp., indet., *Krithe bartonensis*, *K. rutoti*, *Krithe* sp., *Cytherura* sp. indet., *Semicytherura* sp. I, *Semicytherura* sp. II and *Paijenborchella* (*Eupaijenborchella*) cf. *P. eocaenica*.

GEOLOGY AND BIOSTRATIGRAPHY

The outcrops of the Lower Tertiary formations (Subathu, Dagshai and Kasauli in ascending order) in the Lesser Himalayas are repeated several times. The repetition has elicited much interest among geologists and various reasons have been assigned for it. Detailed analysis is beyond the scope of this paper.

The geology and biostratigraphy of the Subathu Formation in the Lesser Himalayas has been described in detail by Medlicott (1879), Datta *et al.* (1965), Raiverman and Raman (1971), Mathur (1978), Singh (1980), Sahni (1981) and Bhatia (1982) among others. Batra (1987) has subdivided the upper part of the Subathu Formation of the Shimla Hills area into three distinct faunal zones viz., faunal Zone I (Early-Middle Ypresian), faunal Zone II (Late Ypresian) and faunal Zone III (Early Lutetian). This classification has been followed in this paper.

PRESENT WORK

The authors examined the ostracodes of the Subathu Formation exposed in the Morni area (Fig. 1).

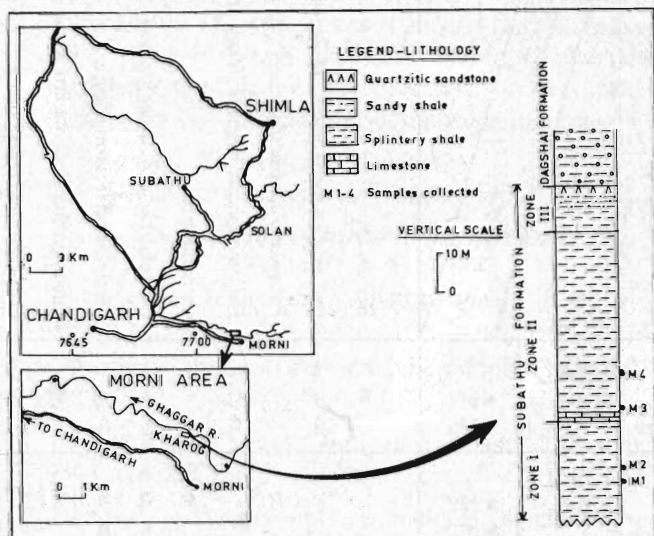


Fig. 1. Showing location of Morni area, section of the Subathu beds exposed at Kharog and the location of ostracode bearing samples.

The material for the present work was collected in the month of July, 1984. The locality lies on the left bank of the Ghaggar river at village Kharog, and falls in the Bilaspur tectonic unit (Bhandari and Agarwal, 1967; Raiverman *et al.* 1983). The base of the Subathu Formation is exposed in the Morni area. It shows an unconformable contact with the Pre-Tertiary Tundapathar Limestone. Lithologically, the Subathu Formation in this locality consists of black carbonaceous shales at the base, green or grey shales intercalated with lenticular limestone in the middle, and variegated shales intercalated with sandstones capped by white quartzitic sandstone towards the top.

The present collection of ostracodes comes from the middle part of the Subathu Formation. The stratigraphic placement of the samples yielding ostracods is shown in Fig. 1. In all, four rock samples (M₁-M₄) have yielded ostracodes. They occur in the green and/or grey shales of two faunal zones equivalent to faunal Zone I and faunal Zone II (Batra, 1987). Their distribution is shown in Table 1.

In all, twenty-three taxa were found. Fifteen of these have been identified to the specific level while

three have been compared with previously known taxa; the rest are either indeterminate or left under open nomenclature because the material was insufficient or badly preserved. These ostracodes occur mostly as moulds and casts of carapaces. A few of the indeterminate taxa are likely to be new species but more material is required before they can be described. The classification followed is that of Moore (1961). For the genera *Alocopocythere* and *Gyrocythere* which are not given in the Treatise, Siddiqui (1971), the original author has been followed. Only the systematics of those ostracode taxa which are being recorded for the first time from the Subathu Formation is dealt with in the present paper.

All the illustrated specimens have been deposited in the museum of the Centre of Advanced Study in Geology, Panjab University, Chandigarh under the numbers CASGMF 1484-1494.

Check list of ostracodes from the Subathu Formation of Morni area

1. *Bairdia* sp.
2. *Bythocypris westi* Singh and Tewari
3. *Paracypris contracta* (Jones)

Table 1: Stratigraphic distribution of ostracodes in the Subathu Formation exposed in the Morni area.

FAUNAL ZONES	SAMPLE	TAXA	FAUNAL ZONE II		FAUNAL ZONE I		
			M4 M3	M2 M1	M2 M1	M1	
		<i>Bairdia</i> sp.	R				
		<i>Bythocypris westi</i> Singh and Tewari	R				
		<i>Paracypris contracta</i> [Jones]		R			
		<i>Phlyctenophora jhingrani</i> [Singh and Tewari]		R			
		<i>Cytheridea</i> sp.		R			
		<i>Dentokrithe bartonensis</i> [Jones]		A	A		
		<i>Dentokrithe</i> [?] <i>rutori</i> [Keij]		A	A		
		<i>Cushmanidea</i> cf. <i>C. tewarii</i> Khosla			R		
		<i>Eucytherura vimali</i> [Singh and Misra]			R		
		<i>Semicytherura rameshi</i> [Singh and Misra]			R		
		<i>Schizocythere rakhiensis</i> Siddiqui			R		
		<i>Schizocythere prolata</i> Siddiqui			R		
		<i>Schizocythere</i> sp.			R		
		<i>Paijenborchella eocaenica</i> Triebel			R		
		<i>Paijenborchella</i> sp. I			R		
		<i>Paijenborchella</i> sp. II			R		
		<i>Alocopocythere abstracta</i> Siddiqui			A		
		<i>Gyrocythere mitigata</i> Siddiqui			A		
		<i>Occultocythereis</i> cf. <i>O. peristicta</i> Siddiqui			C		
		<i>Occultocythereis subspinelloso</i> Khosla			C		
		<i>Xestoleberis subglobosa</i> [Bosquet]			C		
		<i>Cytherella palanaensis</i> Khosla			C		
		<i>Cytherelloidea</i> cf. <i>C. barkhanensis</i> Tewari and Tandon			R		

Frequency: A = Abundant (>10 specimens); C = Common (5-10 specimens); R = Rare (<5 specimens)

4. *Phlyctenophora jhingrani* (Singh and Tewari)
5. *Cytheridea* sp.
6. *Dentokrithe bartonensis* (Jones)
7. *Dentokrithe* (?) *rutoti* (Keij)
8. *Cushmanidea* cf. *C. tewarii* Khosla
9. *Eucytherura vimali* (Singh and Misra)
10. *Semicytherura rameshi* (Singh and Misra)
11. *Schizocythere rakhienensis* Siddiqui
12. *Schizocythere prolata* Siddiqui
13. *Schizocythere* sp.
14. *Paijenborchella eoacaenica* Triebel
15. *Paijenborchella* sp. I
16. *Paijenborchella* sp. II
17. *Alocopocythere abstracta* Siddiqui
18. *Gyrocythere mitigata* Siddiqui
19. *Occultocythereis* cf. *O. peristicta* Siddiqui
20. *Occultocythereis subspinellosa* Khosla
21. *Xestoleberis subglobosa* (Bosquet)
22. *Cytherella palanaensis* Khosla
23. *Cytherelloidea* cf. *C. barkhanensis* Tewari and Tandon

SYSTEMATIC DESCRIPTION

- Subclass Ostracoda LATREILLE, 1806
 Order Podocopida MÜLLER, 1894
 Suborder Podocopina SARS, 1866
 Superfamily Cytheracea BAIRD, 1850
 Family Cytherideidae SARS, 1925
 Subfamily Cytherideinae SARS, 1925
 Genus *Cytheridea* BOSQUET, 1852

Cytheridea sp.
 (Plate I — 9)

Material: Five specimens; hypotype CASGMF 1484

Dimensions: Length 0.66 mm, height 0.33 mm, thickness 0.33 mm.

Remarks: The specimens in our collection are typical of the genus *Cytheridea*. It appears to be a new species but more specimens are required to determine exact placement. This, however, forms the first record of this genus from the Subathu Formation.

Family Neocytherideidinae PURI, 1957

Genus *Cushmanidea* BLAKE, 1933

Cushmanidea cf. *C. tewarii* KHOSLA, 1972
 (Plate I — 3)

Cushmanidea tewarii Khosla, 1972, pp. 484-485, pl. 1, figs. 17-18, pl. 4, fig. 1

Material: Two specimens, hypotype CASGMF 1485

Dimensions: Length 0.85 mm, height 0.41 mm, thickness 0.36 mm.

Remarks: The Subathu specimens may be compared with *C. tewarii*, the types of which were des-

cribed by Khosla (1972) from the Early Eocene rocks of the Khuiala Formation of Rajasthan. The specimens were compared with the topotype material. Our specimens are, however, larger in size.

Family Cytheruridae MÜLLER, 1894

Genus *Eucytherura* MÜLLER, 1894

Eucytherura vimali (SINGH & MISRA)
 (Plate I — 2)

Schizocythere vimali Singh and Misra, 1968, pp. 29-30, pl. 7, figs. 8-10.

Eucytherura vimali (Singh and Misra), Khosla, 1972, p. 494, pl. 3, fig. 12, pl. 4, fig. 16.

Material: Three specimens; hypotype CASGMF 1486

Dimensions: Length 0.38 mm, height 0.23 mm, thickness 0.23 mm

Remarks: The specimens in our collection come within the range of variation of *E. vimali* as described by Khosla (1972). Our specimens show faint reticulation and appear to be slightly worn out.

Genus *Semicytherura* WAGNER, 1957

Semicytherura rameshi (SINGH & MISRA)
 (Plate I — 6)

Cytherura rameshi Singh and Misra, 1968, pp. 31-32, pl. 8, figs. 4-6
Semicytherura rameshi (Singh and Mishra), Khosla 1972, p. 495, pl. 3, fig. 11.

Material: Five specimens; hypotype CASGMF 1487

Dimensions: Length 0.40 mm, height 0.26 mm, thickness 0.21 mm

Remarks: The specimens recorded herein resemble *S. rameshi* (Singh and Misra), the types of which were from the Eocene beds of Rajasthan. The specimens were compared with the topotype material.

Family Schizocytheridae HOWE

Genus *Schizocythere* TRIEBEL, 1950

Schizocythere rakhienensis SIDDIQUI
 (Plate I — 5)

Schizocythere rakhienensis Siddiqui, 1981, pp. 234-235, pl. 18.2, figs. 1-4.

Material: Four specimens; hypotype CASGMF 1488

Dimensions: Length 0.47 mm, height 0.28 mm, thickness 0.26 mm

Remarks: The present specimens are similar to the one described by Siddiqui (1981) as *S. rakhienensis* from the Early Eocene rocks of Pakistan. Specimens recorded as *S. appendiculata* by Khosla (1972) from

Rajasthan and by Mathur (1977) from the Simla Hills appear to be synonymous with Siddiqui's specimens.

Schizocythere prolata SIDDIQUI
(Plate I — 4)

Schizocythere prolata Siddiqui, 1981, pp. 232-234, pl. 18.1, fig. 1-7.

Material: Two specimens; hypotype CASGMF 1489

Dimensions: Length 0.43 mm, height 0.28 mm, thickness 0.26 mm

Remarks: The specimens from the Morni area come within the range of variation of *S. prolata*, the types of which were described by Siddiqui (1981) from the Late Paleocene rocks of Pakistan. This is the first record of this species from the Subathu Formation.

Family Trachyleberididae SYLVESTER-
BRADLEY, 1948

Genus *Alocopocythere* SIDDIQUI, 1971

Alocopocythere abstracta SIDDIQUI
(Plate I — 11)

Alocopocythere abstracta Siddiqui, 1971, p. 17, pl. 3, figs. 5-11, pl. 4, fig. 1; Siddiqui, 1983, pl. 11, fig. 2

Material: Two hundred specimens; hypotype CASGMF 1490

Dimensions: Length 0.68 mm, height 0.41 mm, thickness 0.40 mm

Remarks: The specimens in our collection come within the range of variation of *A. abstracta*, the types of which were from the Upper Rakhi Gaj Shales (Early Eocene) of the Rakhi Nala section of Pakistan. Siddiqui (1983) has also recorded the same species from the Green Nodular Shales and Rubbly Limestones (Early Eocene). This forms the first record of this species from the Subathu Formation. Specimens identified as *Leguminocythereis lunejensis* by Mathur (1977) probably belong to the present taxon.

Genus *Gyrocythere* SIDDIQUI, 1971
Gyrocythere mitigata SIDDIQUI
(Plate I — 10)

Gyrocythere mitigata Siddiqui, 1971, pp. 42-43, pl. 21, figs. 5-11; Siddiqui, 1983, pl. 1, fig. 11.

Material: Ten specimens; hypotype CASGMF 1491

Dimensions: Length 0.85 mm, height 0.48 mm, thickness 0.48 mm

Remarks: The Subathu specimens are identical to *G. mitigata*, the types of which were described by Siddiqui (1971) from the Early Eocene rocks of Pakistan. According to Siddiqui (1983), this genus is so far

known only from the Eocene to Miocene rocks of the Indian Subcontinent. This forms the first record of the present taxon from the Subathu formation.

Genus *Occultocythereis* HOWE, 1951

Occultocythereis cf. *O. peristicta* SIDDIQUI
(Plate I — 8)

Occultocythereis peristicta Siddiqui, 1971, pp. 50-51, pl. 25, figs. 13-17, pl. 26, pl. 27, figs. 1-2.

Material: Five specimens; hypotype CASGMF 1492

Dimensions: Length 0.66 mm, height 0.30 mm, thickness 0.25 mm

Remarks: The Subathu specimens may be compared with *O. peristicta* Siddiqui recorded from the Rakhi Nala Section of Pakistan. The present specimens are bigger in size than the ones described by Siddiqui. It may represent a new species. However, more specimens are required for proper placement. This is the first record of this taxon from the Subathu Formation.

Occultocythereis subspinelloso KHOSLA
(Plate I — 7)

Occultocythereis subspinelloso Khosla, 1972, p. 491, pl. 2, figs. 21-22, pl. 4, fig. 11, pl. 5, fig. 8.

Material: Ten specimens; hypotype CASGMF 1493

Dimensions: Length 0.58 mm, height 0.33 mm, thickness, 0.23 mm.

Remarks: The specimens recorded herein closely resemble *O. subspinelloso*, the types of which were described by Khosla (1972) from the Early Eocene rocks of Rajasthan. However, our specimens have greater width and fewer spines. The specimens were compared with the topotype material.

Suborder Platycopina SARS, 1866
Family Cytherellidae SARS, 1866
Genus *Cytherella* JONES, 1849

Cytherella palanaensis KHOSLA, 1972
(Plate I — 1)

Cytherella palanaensis Khosla, 1972, p. 482, pl. 1, figs. 1-2, pl. 5, fig. 1.

Material: Five specimens; hypotype CASGMF 1494

Dimensions: Length 0.55 mm, height 0.30 mm, thickness 0.20 mm

Remarks: The specimens in our collection closely resemble *C. palanaensis*, the types of which were described by Khosla (1972) from the Early Eocene

rocks of the Khuiala Formation of Rajasthan. The specimens were compared with the topotype material.

AGE AND AFFINITY OF THE OSTRACODE FAUNA

Faunal Zone I contains nine of the twenty-three ostracode taxa listed here; seven of these have been identified up to the specific level. Two species, *Paracypris contracta* and *Cushmanidea* cf. *C. tewarii*, are restricted to this Zone. *P. contracta* is common here and is widely distributed in the Eocene rocks of India (Mathur, 1977) and Europe (Keij, 1957; Haskins, 1968-71; Monostori, 1985). *Cushmanidea* cf. *C. tewarii* described by Khosla (1972) from the Early Eocene of Rajasthan, is rare in the present material; this is the first record of the taxon in the Subathu Formation. According to Neale and Singh (1985), *Cushmanidea* is not often encountered in the Tertiary rocks of the Indian Subcontinent.

In Faunal Zone II twenty ostracode taxa have been found; fourteen have been identified up to the specific level and two have been compared with previously known taxa. Ten species are restricted to this zone *Cytherella palanaensis*, *Cytherelloidea* cf. *C. barkhanensis*, *Bythocypris westi*, *Phlyctenophora jhingrani*, *Schizocythere rakhensis*, *S. prolata*, *Occultocythereis* cf. *O. peristicta*, *Eucytherura vimali*, *Gyrocythere mitigata* and *Paijenborchella eocaenica*. Five of these species, *C. palanaensis*, *B. westi*, *P. jhingrani*, *S. rakhensis* and *E. vimali* are so far known only from Early Eocene rocks. *S. prolata* has hitherto been known only from the Palaeocene, thus extending its range to Late Ypresian. *Paijenborchella eocaenica* is a typical Eocene species and has been recorded from India (Mathur, 1977), Europe (Monostori, 1985) and other places. *Cytherelloidea* cf. *C. barkhanensis* and *G. mitigata* are long ranging and have been recorded from the Eocene to Miocene in the Indian Subcontinent (Tewari and Tandon, 1960; Guha, 1965; Lubimova and Guha, 1968; Mathur, 1977; Siddiqui, 1971, 1983; Bhatia, 1984).

Six species are common to both faunal zones and these include *Dentokrithe bartonensis*, *D.? rutoti*, *Alocopocythere abstracta*, *Occultocythereis subspinello*, *Semicytherura rameshi* and *Xestoleberis subglobosa*. Of these, *D. bartonensis* and *D.? rutoti* are well known cosmopolitan species (Keij, 1957; Haskins, 1968-71; Khosla, 1972; Mathur 1977; Khosla and Haskins, 1980; Monostori, 1985), while *Alocopocythere abstracta* and *X. subglobosa* are typical Tethyan species (Keij, 1957; Guha, 1968; Khosla, 1972; Mathur, 1977; Siddiqui, 1971; 1983; Khosla and

Pant, 1981). *X. subglobosa* is characteristic of the Eocene (Khosla, 1972). The genus *Alocopocythere* evolved rapidly in the Early Tertiary; as a consequence its species have a relatively short range in time making them invaluable for biostratigraphic zonation (Neale and Singh, 1985) *O. subspinello* and *S. rameshi*, previously known only from the Eocene of Rajasthan are being recorded for the first time from the Lesser Himalayas.

The ostracode fauna from faunal Zone I and II show striking similarity with those recorded elsewhere from the Subathu Formation (Tewari and Singh, 1967; Mathur, 1977), Rajasthan and Kutch in India (Tewari and Tandon, 1960; Lubimova and Guha, 1960; Guha, 1968; Singh and Misra, 1968; Khosla, 1972; Khosla and Pant 1981) and from Pakistan (Siddiqui, 1971, 1981, 1983). The beds of faunal zones I and II have also yielded typical Early Eocene larger foraminifera such as *Assilina granulosa*, *A. laminosa*, *A. daviesi nammalensis* and *Nummulites praedisorbium* among others (Batra, 1987). The age of these zones as indicated by the ostracode assemblage is consistent with the evidence of the foraminiferal assemblage.

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EXPLANATION OF PLATE

PLATE I

1. *Cytherella palanaensis* Right valve view (X74)
2. *Eucytherura vimali* Left valve view (X102)
3. *Cushmanidea* c. *C. tewarii* Right valve view (X53)
4. *Schizocythere prolata* Right valve view (X120)
5. *Schizocythere rakhiensis* Left valve view (X119)
6. *Semicytherura rameshi* Right valve view (X127)
7. *Occultocythereis subspinellosa* Left valve view (X106)
8. *Occultocythereis* cf. *O. peristicta* Left valve view (X94)
9. *Cytheridea* sp. Right valve view (X83)
10. *Gyrocythere mitigata* Right valve view (X71)
11. *Alocopocythere abstracta* Left valve view (X74)

