Ostracods and Biostratigraphy of Sarmord Formation (Lower Cretaceous), Surdash Anticline, Sulaimani, Kurdistan Province, North of Iraq

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Abstract
A detailed systematic study of ostracods fauna in outcropped section of Sarmord Formation (Hauterivian -Barremian) in Surdash Anticline allows to detect 28 species belong to 16 genera. Among these species Twelve were previously recorded in the surrounding area, Thirteen new species were recorded for the first time and One species renamed according to the international system of scientific nomenclature. According to the diversity and the appearance of ostracod individuals along the studied section, Two biozones were recognized, the first one include about 58% of the recorded ostracod specimens, while the other one includes only 42%.

Keywords: Ostracods; Sarmord Formation; New species; Systematic study; Surdash Anticline; Lower Cretaceous, Hauterivian-Barremian age

1. Introduction

Sarmord Formation (Hauterivian -Barremian) is a part of the Lower Cretaceous sequence in Surdash Anticline, in which this sequence represent the deposition of Balambo, Sarmord and Qamchuqa formations respectively. The First description of Sarmord Formation were noted by Wetzel (1950) in Surdash anticline, Sulaimani area. The formation have a wide distribution in Iraq, it extends from the Iraqi-Iranian borders toward northwest and west of Kurdistan, with frequent interfingering with Balambo and Qamchuqa formations. The upper contact of the formation in the studied outcrop in Surdash Anticline is conformable with Qamchuqa Formation (Aptian-Albian), while the lower contact is covered with recent deposits stratigraphically, Balambo Formation (Valanginian-Berriasian) is the lower boundary of Sarmord Formation.

The formation consist mainly of marly limestone that have variable hardness (consecutive of friable and hard marly limestone layers) with presence of thinly bedded marl and occasionally thin limestone beds. The present study represent the first study that deals with the ostracods of Sarmord Formation in Iraq, it could be the base for the subsequent studies in the surrounding areas.

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There are no detailed studies had been done on the Ostracods of Sarmord Formation, so in the terms of Ostracod studies, the present study represent the first record of Ostracods from the Hauterivian-Barremian age in Kurdistan region.

The present study aimed mainly in recognizing and describing the Ostracods fauna of the Sarmurd Formation, since these fauna have not been studied before in the previous studies in this age in Kurdistan region. For this why the present study represent a basic study for the subsequent studies.

2. Materials and Methods

Fifty rock samples were collected from an outcrop section of Sarmord Formation (~400 m thickness) in Sargalu village in Surdash Antcline (latitude: 35º 52’ 34” N, longitude: 045º 08’ 07” E) near Sekanyan village, North West of Sulaimani Town as shown in Fig. 1. Only Twenty-six samples were contained ostracod faunas, the illustrated samples in Fig. 2 represent the locations of ostracod bearing sample. The samples preparation were applied by modifying the method that established by Moore and Pitrat (1961) with refereing to the used method are based only on the mechanical processing of the samples without using any chemical components, where as the traditional methods requires adding hydrogen peroxide (H₂O₂) and Sodium bicarbonate (NaHCO₃), also by using the least amount of boiling, in another words the samples preparation were includes only washing the samples under the tap water many times until to the extent of the clays free amount of the sample. This method were very effective to obtain very clean and washed ostracods fauna.

Fig.1. (a) Tectonic map of North Iraq show the location of studied area (source: http://www.geoexoro.com) (b) Photographic picture of Sarmord Formation outcropped section

In order to observe the the diversity and calculate the total number of ostracod individuuals, 300 gm of each rock sample were used during the preparation of the samples. Twenty six of the obtained rock samples were contains ostracods, and named as Sar.S. refereing to Sarmord Sample (Fig. 2). The Ostracod specimens are reposit in Sulaimani Polytechnic University, Technical college of Applied Sciences-Halabja with abbreviation of Sar.Fm.Sur. (Sarmord Formation Surdash).
3. Systimatic Descriptions

The classification system that used to describe the obtained ostracods in the present study were the classification system that established by Hartman and Puri (1974). With considering that numbers were given for the newly described genera because of lack of specimens. The new species will be named later according to the rules of scientific nomenclature in the case of sufficient well-preserved materials. The ranges of all species across the studied section are shown in Fig. 3.

| Phylum : Crustacea | Period : Cretaceous | Sample Location : Sarmord Formation |
|------------------|-------------------|------------------------------------|
| Class : Ostracoda | Epoch : Barremian  | Lithology : Limestone               |
| Order : Podocopida | Formation : Sarmord | Thickness : 50                      |
| Suborder : Podocopina | Formation : Sarmord | 100                                 |
| Family : Polycopida | Formation : Sarmord | 150                                 |
| Genus : Polycopina | Formation : Sarmord | 200                                 |
| Type species : Polycop orbicularis | Sarmord, 1866 | 250                                 |
| Polycop orbicularis sp.nov (Pl. 1, Figs. 1-3) | 300 | 350 | 400 |

Derivation of the name: After the circular outline of the carapace (from the Latin word circularis = circular).
Diagnosis: A small sized species of *Polycope* with distinctive circular outline and somehow drawn posterior.

Holotype: Sar.Fm.Sur.1
Paratype: Sar.Fm.Sur.2, Sar.Fm.Sur.3
Type Horizon: Sar.S.No.17
Type Locality: Sargalu village section.
Materials: 18 carapaces.
Dimensions (μm): Length: 349, Height: 306, Width: 210.

Description: Carapace nearly circular in the side view, maximum height locate at the middle, maximum length pass above the middle. Anterior is broadly rounded and somehow inclined ventrally. Posterior narrow and slightly drawn backward, tend to be a weak caudal process. Dorsal margin convex and sloped steeply toward the anterior and the posterior. Ventral margin nearly straight and merges steeply with the anterior but rapidly with the posterior. The outer surface is covered with small normal pores, no clear ornamentation observer. The valves are subequal in size, the left one is slightly bigger than the right.

Remarks: The present species is similler to *P. lunaplena* Slipper, 1997 from the Late Cretaceous of England, but differs in having more straighter ventral margin and narrower posterior. The present species is more similar to *P. orbicularis* Sars, 1866 but differs in the inclined anterior in which make the ventral margin being nearly strait.

*Polycope magnusoculata* sp. n ov (Pl. 1, Figs. 4-6)

Derivation of the name: After the shape of the carapace outline in which looks like a big eye, (from the Latin words magnu = big, soculata = eye).

Diagnosis: A small sized species of *Polycope* with circular outline, swollen in the middle and thinned around the margins.

Holotype: Sar. Fm. Sur.4.
Paratype: Sar. Fm. Sur. 5, Sar. Fm. Sur. 6.
Type Horizon: Sar.S. No.17
Type Locality: Sargalu village section.
Materials: 11 carapaces and 2 valavs..
Dimensions (μm): Length: 327, Height: 293, Width: 212

Description: Carapace nearly circular in the side view, sub-fusiform in the dorsal view. The height is almost equal to the length. Maximum height and length locates at the middle. Anterior is rounded, slightly narrow related to the carapace, and somehow inclined ventrally. Posterior narrow and slightly drawn backwardly making it looks like a primitive caudal process, somewhat concave in the dorsal part. Dorsal margin convex and sloped steeply toward the anterior and the posterior. Ventral margin straight and merges steeply with the anterior and the posterior. The outer surface is covered with very small normal pores, no clear ornamentation observer. The valves are tend to be subequal in size, the left one is slightly bigger than the right.

Remarks: The present species is differs from *Polycope circularis* in having narrower anterior and being concave in the dorsal part of the posterior. Also, the present species is similler to *P. lunaplena* Slipper, 1997 from the Late Cretaceous of England, but differs in having more straighter ventral margin and narrower posterior.

Family: Cytherellidae Sars, 1866
Genus: Cytherella Jones, 1849
Type species: *Cytherina ovata* Roemer, 1840

*Cytherella dhalalensis* (Morsi and Bauer, 2001) (Pl. 1, Figs. 7-9)
Plate 1: 1-3 Polycope circularis sp.nov. 1. lateral view of the R.V., 2. lateral view of the L.V., 3. dorsal view. 4-6 Polycope magnusoculata sp.nov., 4. lateral view of the R.V., 5. lateral view of the L.V., 6. dorsal view. 7-9 Cytherella dhalalensis Morsi and Bauer, 2001, 7. lateral view of the R.V., 8. lateral view of the L.V., 9. dorsal view. 10-12 Cytherella cf. C. kuwaitensis Al-Abdul Razzaq, 1981, 10. lateral view of the R.V., 11. lateral view of the L.V., 12. dorsal view. 13-15 Cytherella naderensis new name, 13. lateral view of the R.V., 14. lateral view of the L.V., 15. dorsal view. 16-18 Cytherelloidea khalafensis sp.nov., 16. lateral view of the R.V., 17. lateral view of the L.V., 18. dorsal view. 19-21 Cytherelloidea oertlii Singh, 1997, 19. lateral view of the R.V., 20. lateral view of the L.V., 21. dorsal view. 22-24 Bythocypris sarmordensis new name, 22. lateral view of the R.V., 23. lateral view of the L.V., 24. dorsal view. 25-27 Neomonocyrattina sp.1, 25. lateral view of the R.V., 26. lateral view of the L.V., 27. dorsal view.

Figured specimen: Sar.Fm.Sur.7, Sar.Fm.Sur.8, Sar.Fm.Sur.9
Materials: 51 carapaces and 6 valves.
Dimensions (μm): Length: 595, Height: 332, Thickness: 176.
Type Horizon: Sar.S.No.3
Remarks: This species was originally described from the Middle Cenomanian of Morocco by Andreu and Boussut, 1991, than it is found in the Cenomanian of Egypt and renamed by Morsi and Bauer, 2001. Also recorded by Bergue et al. (2016) from the Late Albian-Early Cenomanian of Jordan.

**Fig. 3.** Distribution of the obtained ostracods in the studied section

*Cytherella cf. C. kuwaitensis* (Al-Abdul Razzaq, 1981) (Pl. 1, Figs. 10-12)
Figured specimen: Sar.Fm.Sur.10, Sar.Fm.Sur.11, Sar.Fm.Sur.12.
Materials:
Dimensions (μm): Length: 535, Height: 319, Width: 253.
Type Horizon: Sar.S.No.3.
Remarks: this species was recorded for the first time by Al-Abdul Razzaq (1981) from the Ear-Middle Cenomanian of Kuwait.
Cytherella naderensis new name (Pl. 1, Figs. 13-15)

Derivation of the name: in honour of the paleontologist Prof. Dr. Amer D. Nader for his great works in the paleontology fields in Iraq.

Diagnosis: a medium sized species of cytherella with distinct nearly ovate outline and perfectly rounded anterior.

Holotype: Sar. Fm. Sur. 13.
Paratype: Sar. Fm. Sur. 14, Sar. Fm. Sur.15.
Type Horizon: Sar. S. No.2
Type Locality: Sargalu village section.
Materials: 47 carapaces and 3 valves.
Dimensions (μm): Length: 520, Height: 321, Thickness: 249

Description: Carapace nearly ovate in the side view, maximum height locate in front of the middle, maximum length pass through the middle, the carapace is compressed laterally at the anterior half. Anterior is broadly rounded and inflated in the dorsal view. Posterior narrow than the anterior and slightly tilted ventrally. Dorsal margin straight at the middle and sloped posteriorly, merge steeply with the anterior. Ventral margin nearly straight and merges steeply with the anterior but rapidly with the posterior. The outer surface is smooth and has very small normal pores. The right valve is bigger than the left, the overlapping presence at the dorsal margin.

Remarks: The present species was originally described as Cytherella sp.1 from the Early-Late Cretaceous of India by Andreu et al. (2008). The Iraqi species has a straighter dorsal margin.

Genus: Cytherelloidea Alexander,1929
Type species: Cythere williamsoniana Jones,1849

Cytherelloidea khalafensis sp. nov (Pl. 1, Figs. 16-18)

Derivation of the name: in the honour of Prof. Dr. Saleh K. Khalaf for his great works in the ostracod fossils in Iraq.

Diagnosis: A small sized species of cytherelloidia with distinct two short ridges.

Holotype: Sar. Fm. Sur.16.
Paratype: Sar. Fm. Sur.17, Sar. Fm. Sur.18.
Type Horizon: Sar. S. No.2
Type Locality: Sargalu village section.
Materials: 14 carapaces.
Dimensions (μm): Length: 433, Height: 241, Thickness: 137

Description: Carapace quadrate in the side view, maximum height locate at the antero-dorsal cardinal angle, maximum length pass through the middle. Anterior is broadly rounded and has a thick marginal lips. Posterior subrounded and narrower than the anterior. Dorsal margin substraighte to slightly curved at the middle and merges with the anterior and the posterior by the anterior and posterior cardinal angles. Ventral margin slightly curved inward, merges rapidly with the anterior and the posterior. The outer surface is ornamented with two short ridges, one of them is somehow curved in parallel to the antero-dorsal curved angle, the other one is locate near the postero-ventral angle. The left valve is somewhat bigger than right the, the overlapping is presence at the anterior margin.

Remarks: The present species is resemble to C. flexicostata Khalaf, 1993 in the outline but deffirs in the arrangement of the ridges. The distinct shape of the two ridges in the present species make it very different to all corresponding species of Cytherelloidea.

Cytherelloidea oertlii (Singh, 1997) (Pl. 1, Figs. 19-21)

Figured specimen: Sar. Fm. Sur. 19, Sar. Fm. Sur. 20, Sar. Fm. Sur. 21.
Materials: 18 carapaces.
Dimensions (μm): Length: 329, Height: 242, Thickness: 146.
Type Horizon: Sar. S. No.2
Remarks: The present species is fairly similar to the Indian species Cytherelloidea oertlii that described by Singh (1997), with referring to that the present species has narrower posterior. Also this species is recorded by Andreu et al. (2008) from the Coniacian-Middle Cenomanian of India, and from the Albian-Turonian of Madagascar by Bibinot et al. (2009).

**Family:** Bythocyprididae
**Genus:** Bythocypris
**Type species:** *Bythocypris sarmordensis* Brady, 1880

*Bythocypris sarmordensis* new name (Pl. 1, Figs. 22-24)
Derivation of the name: after the name of the formation where the species was recorded.
Diagnosis: a small sized species of Bythocypris with distinct comma-like outline.
Holotype: Sar. Fm. Sur. 22.
Paratype: Sar. Fm. Sur. 23, Sar. Fm. Sur. 24.
Type Horizon: Sar. S. No.3.
Type Locality: Sargalu village section.
Materials: 32 carapaces.
Dimensions (μm): Length: 380, Height: 191, Thickness: 116

Description: Carapace comma-like in the side view, maximum height locate at infront of the middle, maximum length pass right above the ventral margin. Anterior is extremely broad relative to the carapace, rounded and tilted ventrally. Posterior narrow, narrowly rounded and also tilted ventrally. Dorsal margin convex and slopes steeply toward the anterior and the posterior. Ventral margin concave and merges steeply with the anterior and the posterior. The carapace is moderately calcified and non ornamented. The left valve is bigger than the right, the overlapping is occur at the ventral margin.

Remarks: the present species was originally described as Bythocypris sp.1 from the Paleocene of Nigeria by Foster et al. (1983), new name has been given to this species. This species is recorded in Iraq by Aziz (2013) from the Paleocene –Eocene of West, North and Central Iraq, and also recorded by Al-Shareefi et al. (2014) from the Masstrichtian of Northeastern and Central Iraq.

**Family:** Cytheridae
**Genus:** Neomonocyratina
**Type species:** *Neomonocyratina columbiformis* Kingma, 1948

*Neomonocyratina* sp.1 (Pl. 1, Figs. 25-27)
Figured specimen: Sar. Fm. Sur. 25, Sar. Fm. Sur. 26, Sar. Fm. Sur. 27.
Materials: 52 carapaces.
Dimensions (μm): Length: 312, Height: 117, Thickness: 105

Description: Carapace well calcified, thinned around all the margins, quadrate, subrectangular in the side view. Maximum height pass through the anterior cardinal angle, and maximum length locate bellow the middle. The anterior narrowly rounded, have a small concavity in the dorsal part and. The posterior is drawn backward forming a short caudal process. Dorsal margin straight combined with the anterior and the posterior by rounded anterior and posterior cardinal angles. Ventral margin nearly straight, merges steeply with the anterior and the posterior. The outer surface ornamented with very fine reticulate ornamentation, short ala is presence in the middle above the ventral margin, eye tubercle is weakly presence. The left valve is slightly bigger than the right, the overlapping is occur at the dorsal margin.

Remarks: The present species is differs with N. columbiformis Kingma, 1948 in having more quadrate outline. Also, it differs from N. macropora Kingma, 1948 in length of the ala and the caudal process.
Family: Cytherideidae
Genus: Neocyprideis
Type species: Cyprideis (Neocyprideis) durocortoriensis

Neocypridies kurdii sp.nov (Pl. 2, Figs. 1-3)

Derivation of the name: After Kurdistan, the name of the territory where the outcrop section of Sarmord Formation has been studied.

Diagnosis: A medium sized species of Neocypridies with distinctively convex dorsal margin and narrow posterior.

Holotype: Sar. Fm. Sur. 28.
Paratype: Sar. Fm. Sur. 29, Sar. Fm. Sur. 30.
Type Horizon: Sar. S. No.2
Type Locality: Sargalu village section.
Materials: 49 carapaces
Dimensions (μm): Length: 450, Height: 281, Thickness: 169.
Description: Carapace moderately calcified, unevenly ovoid in the side view and fusiform in the dorsal view, maximum height and length locates at the middle. Anterior is very broad, rounded and somewhat tilted ventrally. Posterior it seems to be a half in size of the anterior, narrowly rounded and also tilted ventrally. Dorsal margin distinctively convex as it peak-like shaped, slopes steeply toward the anterior and the posterior. Ventral margin straight and merg steeply with the anterior and the posterior. No distinctive ornamentation occurs at the outer surface of the carapace. The left valve is bigger than the right, the overlapping is occure at the dorsal margin.
Remarks: The nearest resemblness for the present species is N. raoi Khosla and Nagori, 2002 from the Early Paleocene of India, however, the present species has an acute convexity in the dorsal margin, and narrowest posteropr margin.

Neocyprideis vandenboldi (Gerry and Rosenfeld, 1973) (Pl. 2, Figs. 4-6)

Neocyprideis vandenboldi (Gerry and Rosenfeld, 1973) (pl. 1, Figs 1–9; pl. 2, Figs 1–6).
Figured specimen: Sar. Fm. Sur. 31, Sar. Fm. Sur. 32, Sar. Fm. Sur. 33.
Materials: 52 carapaces.
Dimensions (μm): Length: 664, Height: 384, Width: 212
Type Horizon: Sh. S. No.33
Remarks: The present species has the same diagnosis of N. vandenboldi Gerry and Rosenfeld, 1973 that described from the Upper Cenomanian and Lower Turonian of Palestine, although the present species has thiner carapace in the dorsal view. The present species is also recorded in various regions such as the Upper Cenomanian and Lower Turonian of Egypt (Bold 1964; Shahin 1991; Bassiouni 2002), Middle Cenomanian of Jordan (Schulze et al., 2004) and Upper Cenomanian of Jordan (Morsi and Wendler, 2010).
Plate 2. 1-3 Neocypridies kurdii sp.nov., 1. lateral view of the R.V., 2. lateral view of the L.V., 3.dorsal view. 4-6 Neocyprideis vandenboldi Gerry and Rosenfeld, 1973, 4. lateral view of the R.V., 5. lateral view of the L.V., 6.dorsal view. 7-9 Acanthocythereis sp.1, 7. lateral view of the R.V., 8. lateral view of the L.V., 9.dorsal view. 10-12 Brachycythere iraquensis sp. nov., 10. lateral view of the R.V., 11. lateral view of the L.V., 12.dorsal view. 13-15 Brachycythere sp.4 Andreu etal., 2008, 13. lateral view of the R.V., 14. lateral view of the L.V., 15.dorsal view. 16-18 Cytheris longaeva longaeva Pokorney, 1963a, 16. lateral view of the R.V., 17. lateral view of the L.V., 18.dorsal view. 19-21 Protobuntonia elongate sp. nov., 19. lateral view of the R.V., 20. lateral view of the L.V., 21.dorsal view. 22-24 Protobuntonia sarmordensis sp. nov., 22. lateral view of the R.V., 23. lateral view of the L.V., 24.dorsal view. 25-27 Cytheropteron praeoukaryi Bassiouni and Luger, 1990, 25. lateral view of the R.V., 26. lateral view of the L.V., 27.dorsal view.

Family : Trachyleberididae  Sylvestor and Bradley, 1947
Genus : Acanthocythereis  Howe, 1963
Type species: Acanthocythereis araneosq  Howe, 1963
Acanthocythereis sp.1 (Pl. 2, Figs. 7-9)
Figured specimen: Sar. Fm. Sur. 34, Sar. Fm. Sur. 35, Sar. Fm. Sur. 36.
Type Horizon: Sar. S. No. 17.
Materials: 4 carapaces.
Dimensions (μm): Length: 600, Height: 318, Thickness: 308.
Description: Carapace well calcified, elongate, subtriangular in the side view. Maximum height pass through the eye tubercle, maximum length locate at the middle, the thickness is about to be equal to the height. The anterior is rounded and wide relative to the carapace. Posterior surrounded and narrowing backward. The dorsal margin is sinous and combin with the posterior and the anterior by rounded cardinal angles. Ventral margin slightly curved inward, merging steeply with the anterior and the posterior. The outer surface is covered with medium sized nodular ornamentation, the eye tubercle is rounded and distinctively prominent. The valves are nearly equal in size, but the left one is somehow bigger than the right, the overlapping is occure at the anterior.
Remarks: The present species is differs from Acanthocythereis erbilensis Aziz and Al-Sharo, 2014 from Iraq, in the outline and the details of the ornamentation. The present species could be a new species because it is distinct nodular ornamentation. The present species is left under open nomenclature due to the lack of well preserved specimens.
Genus: Brachycythere Alexander, 1933
Type species: Cythere sphenoides Reuss, 1854
Brachycythere iraqensis sp. nov. (Pl. 2, Figs. 10-12)
Derivation of the name: After the Republic of Iraq where the outcrop section was studied.
Diagnosis: A large sized species of Brachycythere with subtriangular carapace and smooth outer surface.
Holotype: Sar. Fm. Sur. 37.
Paratype: Sar. Fm. Sur. 38, Sar. Fm. Sur. 39.
Type Horizon: Sar. S. No. 17.
Type Locality: Sargalu village section.
Materials: 39 carapaces.
Dimensions (μm): Length: 602, Height: 389, Thickness: 327.
Description: Carapace moderately well calcified, subtriangular in the side view and the anterior view, fusiform in the dorsal view. The carapace is swollen in the middle near all the margins. Maximum height pass through the eye tubercle, and maximum length locate above the ventral margin, while maximum thickness locate behind the middle. The anterior extremely wide relative to the carapace, rounded as like as a half circle and has thick marginal lip. Posterior narrowly rounded and tapering backward. Dorsal margin straight, located diagonally due to the large size of the anterior, combined steeply with the posterior, while joins the anterior by rounded cardinal angle. Ventral margin slightly curved outward, merging steeply with the anterior and the posterior. The outer surface ornamented with very fine pits or pores, eye tubercle rounded and weakly prominent. The left valve bigger than the right, the overlapping is occure at the anterior and dorsal margins.
Remarks: The present species is very simmiler in the outline to Brachycythere sp.4 Andreu et al., 2008 from the Late Cretaceous of India, but differs in having smoother outer surface. The present species is differ from Brachycythere trahea Al-Furaih, 1980 and Brachycythere bilirata Al-Furaih, 1980 from the Upper Cretaceous of Saudi Arabia, in havig very distinct outline that make it a new species of Brachycythere.
Brachycythere sp.4 (Andreu et al., 2008) (Pl. 2, Figs. 13-15)
Figured specimen: Sar. Fm. Sur. 40, Sar. Fm. Sur. 41, Sar. Fm. Sur. 42.
Materials: 45 carapaces.
Dimensions (μm): Length: 559, Height: 411, Thickness: 338
Type Horizon: Sar. S. No. 25.
Remarks: The present species was recorded originally from the Upper Cretaceous (Coniacian) of India by Andreu et al., (2008).

Genus: Cytheries Jones, 1849

Type species: Cytherina ornatissima Reuss, 1846

Cytheris longaeva longaeva (Pokorney, 1963a) (Pl. 2, Figs. 16-18)

Figured specimen: Sar. Fm. Sur. 43, Sar. Fm. Sur. 44, Sar. Fm. Sur. 45.

Materials: 12 carapaces.

Dimensions (μm): Length: 710, Height: 361, Thickness: 339.

Type Horizon: Sar. S. No. 15.

Remarks: The present species recorded from the Middle Coniacian of Czech Republic and the Santonian of the Netherlands (Pokorney, 1965b), also from the Santonian and Campanian of Germany (Clarke, 1983), and from Turonian of south-East England (Slipper, 2021).

Genus: Protobuntonia Grekoff, 1954

Type Species: Protobuntonia numidica Grekoff, 1954

Protobuntonia elongate sp. nov. (Pl. 2, Figs. 19-21).

Derivation of the name: After the elongated shape of the carapace, from the Latin.

Diagnosis: A large species of Protobuntonia with distinct large anterior and elongated carapace.

Holotype: Sar. Fm. Sur. 46.

Paratype: Sar. Fm. Sur. 47, Sar. Fm. Sur. 48.

Type Horizon: Sar. S. No. 23.

Type Locality: Sargalu village section.

Materials: 26 carapaces.

Dimensions (μm): Length: 364, Height: 180, Thickness: 139

Description: Carapace mild calcified, elongated, sub ovate in the side view, fusiform in the dorsal view. Maximum length pass through the middle, maximum height pass through the eye tubercle. Anterior broadly rounded, very large relative to the carapace, while the posterior narrow and sub rounded. Dorsal margin is straight, ventral margin is sub straight, both merges steeply with the anterior and the posterior. The outer surface is covered with small normal pores, the eye tubercle is prominent and rounded. The left valve is larger than the right, the overlapping is occure at the anterior.

Remarks: The present species have the general outline of the species that belong to Protobuntonia, but it has a very wide anterior and elongated carapace in which make it very distinct from the other genera that belong to Protobuntonia. For this why the present nomenclature have been established.

Protobuntonia sarmordensis sp. nov. (Pl. 2, Figs. 22-24)

Derivation of the name: After the name of Sarmord Formation.

Diagnosis: Large species of Protobuntonia with sub rectangular carapace and promenant eye tubercle.

Holotype: Sar. Fm. Sur. 49.

Paratype: Sar. Fm. Sur. 50, Sar. Fm. Sur. 51.

Type Horizon: Sar. S. No. 23.

Type Locality: Sargalu village section.

Materials: 13 carapaces.

Dimensions (μm): Length: 688, Height: 392, Thickness: 215

Description: Carapace well calcified, sub rectangular in the side view, fusiform in the dorsal view. Maximum length locate at the middle, maximum height pass through the eye tubercle. Anterior is wide and rounded, the posterior is narrower than the anterior, sub rounded. The dorsal margin is straight, slopes steeply toward the anterior and the posterior. Ventral margin is straight and also merges steeply with the anterior and the posterior. The outer surface has no visible ornamentation, but small normal pores are presence. The left valve is larger than the right, the overlapping is occure at the dorsal margin.
Remarks: The present species is different from Protobutonia elongate in having shorter carapace and wider posterior end, in addition to that, the carapace of the the present species is more calcified than the other species.

Family: Cytheruridae Müller, 1894
Genus: Cytheropteron Sars, 1966
Type species: Cythere latissima Norman 1865

*Cytheropteron praeboukaryi* (Bassiouni and Luger, 1990) (Pl. 2, Figs. 25-27)
Figured specimen: Sar. Fm. Sur. 52, Sar. Fm. Sur. 53, Sar. Fm. Sur. 54.
Materials: 12 carapaces.
Dimensions (µm): Length: 304, Height: 164, Thickness: 217
Type Horizon: Sar. S. No. 17.

Remarks: The present species is originally described from the Lower Crataceous of Egypt by Bassiouni and Luger, 1990. Also recorded by Youssef et al., 2017 from the Danian of Egypt.

Family: Bythocytheridae Sars, 1866
Genus: Microceratina Swanson, 1980
Type species: *Microceratina quadrat* Swanson, 1980

*Microceratina rectangularis* sp.nov (Pl. 3, Figs. 1-3)

Derivation of the name: related to the general outline of the carapace (from the Latin word *rectangularis* = rectangular).

Diagnosis: A medium sized species of Microceratina with subrectangular and swollen carapace.
Holotype: Sar. Fm. Sur. 55.
Paratype: Sar. Fm. Sur. 56, Sar. Fm. Sur. 57.
Type Horizon: Sar. S. No. 17.
Type Locality: Sargalu village section.
Materials: 8 carapaces.
Dimensions (µm): Length: 317, Height: 169, Thickness: 149.

Description: Carapace elongated-subrectangular in the side view, tapering toward the posterior. Maximum height pass above the middle and maximum length locate behind the anterior carinal angle. The carapace is swollen in the middle above the ventral margin. The anterior extremely wide relative to the posterior, compacted and sub-rounded. Posterior narrowly rounded, tapering backward tending to be a weak caudal process, have a thinned margin and sited in the dorsal half of the carapace. Dorsal margin straight, goins the anterior and the posterior by the anterior and posterior cardinal angles. Ventral margin straight at the anterior half of the carapace, slopes upward in the posterior half. The outer surface ornamented with fine pits, it could be very weak reticulate ornamentation. The left valve slightly bigger than the right, the overlapping is occure at the anterior.

Remarks: The present species is simmiler to Microceratina quadrat, Swanson, 1980 but differs in the type of the reticulate ornamentation, and the well developed anterior cardinal angle. The compacted anterior, the anterior cardinal angle and the pitted outer surface make the present species different from the other described species of Microceratina.
Plate 3. 1-3 Microceratina rectangularis sp. nov., 1. lateral view of the R.V., 2. lateral view of the L.V., 3. dorsal view. 4-6 Xestoleberis lunaplena sp. nov., 4. lateral view of the L.V., 5. lateral view of the R.V., 6. dorsal view. 7-9 Xestoleberis cf. X. tunisiensis Esker, 1968, 7. lateral view of the R.V., 8. lateral view of the L.V., 9. dorsal view. 10-12 Pontocyprilla maynici Oertli, 1958, 10. lateral view of the R.V., 11. lateral view of the L.V., 12. dorsal view. 13-15 Propontocypris triangularis sp. nov., 13. lateral view of the R.V., 14. lateral view of the L.V., 15. dorsal view. 16,17 Paracypris cf. duberteti Damotte and Saint-Marc, 1972, 16. lateral view of the R.V., 17. dorsal view. 18-20 Paracypris sahui Bhandari, 1992, 18. lateral view of the R.V., 19. lateral view of the L.V., 20. dorsal view. 21-23 Paracypris siddiquii Bhandari, 1992, 21. lateral view of the R.V., 22. lateral view of the L.V., 23. dorsal view. 24-26 Paracypris ondulata sp. nov., 24. lateral view of the R.V., 25. lateral view of the L.V., 26. dorsal view. 27-29 Paracypris anterotruncata sp. nov., 27. lateral view of the R.V., 28. lateral view of the L.V., 29. dorsal view.

Family: Xestoleberididae Sars, 1928
Genus: Xestoleberis Sars, 1866
Type species: Cythere aurantia Baird, 1838
Xestoleberis lunaplena sp. nov. (Pl. 3, Figs. 4-6)

Derivation of the name: After the outline of the carapace, (from the Latin words luna=moon and plena=full).

Diagnosis: A large sized species of Xestoleberis with distinct nearly circular outline and moderately calcified carapace.

Holotype: Sar. Fm. Sur. 58.
Paratype: Sar. Fm. Sur. 59, Sar. Fm. Sur. 60.
Type Horizon: Sar. S. No. 17.
Type Locality: Sargalu village section.
Materials: 19 carapaces.
Dimensions (μm): Length: 365, Height: 280, Thickness: 211.

Description: Carapace moderately calcified, nearly circular in the side view and ovoidal in the dorsal view. Maximum height locate at the middle, and maximum length locate above the ventral margin, the height is about to be equal to the length. The anterior is rounded and narrow relative to the carapace. Posterior widdly rounded as like as a half circle. Dorsal margin convex and combined steeply with the posterior and the anterior. Ventral margin slightly concaved, merging steeply with the anterior and the posterior. The outer surface is non ornamented, very fine normal pores are presence. The valves are nearly equal in size, but the left one is somehow bigger than the right, the overlapping is occure at the anteriodorsal part of the carapace.

Remarks: The present species is differs from Xestoleberis tunisiensis that described by Esker, 1968 from the Danian of Tunisia, in having a higher carapace and circular outline.

Xestoleberis cf. X. tunisiensis (Esker, 1968) (Pl. 3, Figs. 7-9)

Figured specimen: Sar. Fm. Sur. 61, Sar. Fm. Sur. 62, Sar. Fm. Sur. 63.
Materials: 23 carapaces.
Dimensions (μm): Length: 428, Height: 292, Thickness: 210.

Type Horizon: Sar. S. No. 23.

Remarks: The present species have the same diagnosis of Xestoleberis tunisiensis Esker, 1968 that recorded from the Danian of Tunisia, noting that the Iraqi species have more rounded posterior end. the present species had been recorded in various ages and localities such as the Upper Campanian-Paleocene of Tunisia (Esker, 1968; Said, 1978; Donze et al., 1982; Said-Benzarti, 1998; Morsi et al., 2011), the Maastrichtian of Algeria (Damotte and Fleury, 1987), the Santonian of Morocco (Andreu, 2002), the Maastrichtian to the lower Eocene of Egypt (Bassiouni and Lugur, 1990; Ismail, 1992; Bassiouni and Morsi, 2000; Morsi and Speijer, 2003; Morsi and Scheibner, 2009) The Eocene of Somalia (Bassiouni and Lugur, 1996), in the Maastrichtian of North and Western Iraq (Al-Sheikhly and Kamil, 2016), in the Upper Maastrichtian of Northwest and Central Iraq (Al-Shareefi et al., 2014).

Family: Pontocyprididae G. W. Muller, 1894
Genus: Pontocyprilla Lyubimova,1955
Type species: Bairdia harrisiana Jones,1949

Pontocyprilla maynici (Oertli, 1958) (Pl. 3, Figs. 10-12)

Figured specimen: Sar. Fm. Sur. 64, Sar. Fm. Sur. 65, Sar. Fm. Sur. 66.
Materials: 52 carapaces.
Dimensions (μm): Length: 536, Height: 318, Thickness: 249.

Type Horizon: Sar. S. No. 3.

Remarks: The present species has shorter carapace related to P. maynici that described by Oertli, 1958 from the Early Cretaceous of France. Also recorded by Kemper et al. (1975) in the Early Cretaceous of Germany.

Genus: Propontocypris Sylvester-Bradly, 1947
Type species: *Propontocypris trigonella* Sars, 1866

*Propontocypris triangularis* sp. nov (Pl. 3, Figs. 13-15)

Derivation of the name: After the general outline of the carapace that are nearly triangular in the side view, (from the Latin word triangularis = triangular)

Diagnosis: A large sized species of Propontocypris with triangular carapace.

Holotype: Sar. Fm. Sur. 67.

Paratype: Sar. Fm. Sur. 68, Sar. Fm. Sur. 69.

Type Horizon: Sar. S. No. 17.

Type Locality: Sargalu village section.

Materials: 26 carapaces.

Dimensions (μm): Length: 644, Height: 284, Thickness: 138.

Description: Carapace moderately calcified, subtriangular in the side view. Maximum height pass infront of the middle, and maximum length locate at the ventral margin. The anterior narrowly rounded, wide relative to the carapace, rounded as like as a half circle and has thick marginal lip. Posterior narrowly riunded and tapering backward. Dorsal margin straight, located diagonally due to the large size of the anterior, combined steeply with the posterior, while joins the anterior by rounded cardinal angle. Ventral margin slightly curved outward, merging steeply with the anterior and the posterior. The outer surface ornamented with very fine pits or pores, eye tubercle rounded and weakly prominent. The left valve bigger than the right, the overlapping is ocure at the anterior and dosal margins.

Remarks: The present species resemble *Propontocypris herdmani* (Scott, 1905) in having triangular outline, but the present species have a longer carapace and narrower anterior. The present species is very d
derent from all genera that described with in Propontocypris by its distinct triangular outline.

Family: Candonidae Müller, 1894

Genus: Paracypris Sars, 1866

Type Species: *Paracypris polita* Sars, 1866

*Paracypris cf. P. dubertreti* (Damotte and Saint-Marc, 1972) (Pl. 3, Figs. 16,17)

Figured specimen: Sar. Fm. Sur. 70, Sar. Fm. Sur.71.

Materials: 56 carapaces.

Dimensions (μm): Length: 550, Height: 201, Width: 177.

Type Horizon: Sar. S. No. 17.

Remarks: The present species has a larger carapace and straighter ventral margin than the Upper Cenomanian Lebanese species of Damotte and Saint-Marc, 1972. This species is recorded abundantly in many ages like the Cenomanian-Turonian of Algeria (Vivière, 1985), Turonian of Potiguar Basin, Brazil (Piovesan et al., 2014), Cenomanian of Palestine (Rosenfeld and Raab, 1974), Cenomanian of Algeria (Majoran, 1989) and Cenomano-Turonian of Algeria (Mebarki et al., 2016), Cenomanian of Morocco (Andreu, 1991) and (Andreu et al., 2013), Cenomanian of Tunisia (Bismuth et al., 1995) and Lower and Middle Turonian of Tunisia (Abdallah et al., 2003) Cenomanian of Jordan (Morsi and Wendler, 2010), Late Cenomanian of Egypt (Boukhary et al., 2009), Lower Cenomanian of Kuwait (Al-Abdul-Razzaq, 1977), and Aptian-Albian of Somalia (Luger, 2018).

*Paracypris sahu*i (Bhandari, 1992) (Pl. 3, Figs. 18-20)

Figured specimen: Sar. Fm. Sur. 72, Sar. Fm. Sur. 73, Sar. Fm. Sur. 74.

Materials: 134 carapaces.

Dimensions (μm): Length: 373, Height: 149, Width: 112.

Type Horizon: Sar.S.No.1.

Remarks: The present species has the same dignostics of *P. sahui* (Bhandari, 1992) that described from the Eocene of India.

*Paracypris siddiquii* (Bhandari, 1992) (Pl. 3, Figs. 21-23)
Figured specimen: Sar. Fm. Sur. 75, Sar. Fm. Sur. 76, Sar. Fm. Sur. 77.
Materials: 33 carapaces.
Dimensions (μm): Length: 473, Height: 232, Width: 229
Type Horizon: Sar. S. No. 1.
Remarks: The present species has same dignostics of *P. siddiquii* (Bhandari, 1992) that described from the Eocene of India. This species also recorded by Nagori and Khosla, 2019 from the Early Eocene of India.

*Paracypris ondulata* sp.nov. (Pl. 3, Figs. 24-26)
Derivation of the name: related to the wavy appearance of the carapace (from the Latin word ondulata= wavy).
Diagnosis: A large sized species of *Paracypris* with distinctive wavy carapace and ventrally tilted anterior.
Holotype: Sar. Fm. Sur. 78.
Paratype: Sar. Fm. Sur. 79, Sar. Fm. Sur. 80.
Type Horizon: Sar. S. No. 7.
Type Locality: Sargalu village section.
Materials: 6 carapaces.
Dimensions (μm): Length: 579, Height: 269, Thickness: 210.
Description: Carapace elongated, wavy in the side view, fusiform in the dorsal view, maximum height pass through the middle and maximum length locate at the ventral margin. Anterior is broadly rounded, tilted ventrally and have a thin margin. Posterior narrow, semi-acute, it seems to be triangular with subrounded end, lie above the ventral margin. Dorsal margin distinctively concave at the anterior half and econvex at the middle, slopes steeply toward the posterior and linked with the anterior by the prominent anterior carginal angle. Ventral margin curved inward at the middle, merg steeply with the posterior, while join the anterior with rounded angle. The outer surface has no distinctive ornamentation, but covered with very small normal pores. The left valve is bigger than the right, the overlapping is obvious at the dorsal margin.
Remarks: The present species is distinguished by its appearance wich make it different from the other *Paracypris* species. The best way to recognize the present species is by the shape of the anterior and th concavity-convixy of the dorsal margin.

*Paracypris anterotruncata* sp.nov. (Pl. 3, Figs. 27-29)
Derivation of the name: related to the truncated anterio (from the Latin word truncata= truncated).
Diagnosis: A medium sized species of *Paracypris* with distinctive truncated anterior and tapered posterior.
Holotype: Sar. Fm. Sur. 81.
Paratype: Sar. Fm. Sur. 82, Sar. Fm. Sur. 83.
Type Horizon: Sar. S. No. 17.
Type Locality: Sargalu village section.
Materials: 57 carapaces.
Dimensions (μm): Length: 368, Height: 135, Thickness: 128.
Description: Carapace elongated-subtriangular in the side view, tapering toward the posterior, acutely pointed posteroventrally. Maximum height pass through the middle and maximum length locate at the ventral margin, the thickness of the carapace is tend to be equal to the height. The anterior seems to be truncated, extremely wide relative to the posterior, tilted ventrally due to the curvature of bothe the dorsal and ventral margins. Posterior narrow, tapering backward, tilted toward the ventral margin. Dorsal margin perfectly convex, slopes steeply anteriorly and posteriorly. Ventral margin slightly curved inward at the middle, merg rapidly with the anterior and steeply with the posterior. The outer
surface has no distinctive ornamentation, but covered with very small normal pores. The left valve is bigger than the right, the overlapping is occure at the dorsal margin.

Remarks: The present species is very simmiler to Paracypris keiji Guernet et al., 2012 from the Middle Eocene of France, but differs in the truncated anterior. Also the present species is differs from Paracypris propinquua Triebel, 1963 from the Oligocene of Germany in the curving of the dorsal margin and having truncated anterior.

4. Discussion

The first age dating of Sarmord Formation was mentioned by Bellen et al., 1959 as Valanginian-Aptian. Sissakian and Al-Jiburi (2015) mentioned that the age of Sarmord Formation is (Hauterivian - Barremian), while based on the calcareous nanofossils, Karim et al. (2021) referred that Sarmord Formation in Quiban Anticline (about 30 km in the South East of the studied section) are deposited in the age of Late Valanginana-Barremian. However, the age of Sarmord Formation at least represent the both ages (Hauterivian -Barremian). The desrtibution of the attained ostracod individual in Fig.3 show a perfect match between theis two ages. Where as to identical bio assemblage were detected: The Hauterivian assemblage: the range of this assemblage is match the Hauteriovian age of the formation in which extend from Sar. S.1 to Sar. S.19 (about 300m thickness), and represent a ratio of ~42% of the total obtained ostracod faunas. Generally, this assemblage have the lowest ostracod diversity and number of individuals, but more stability in the faunal presence. The Barremian assemblage: the range of this assemblage is match the Barremian age of the formation in which extend from Sar. S.20 to Sar. S.26 (about 100m thickness), and represent a ratio of ~58% of the total obtained ostracod faunas. This assemblage have the highest ostracod diversity and number of individuals, but unstable faunal presence. From this point of view, its concluded that the upper part (Barremian part) of the formation have more sutible environmental conditions for ostracods presence, than the lower part (Hauteriovian part).

5. Conclusions

Twenty-eight species belong to 16 genera were recorded in the present study. Including Twelve species previously recorded in the sorounding area, Fourteen new species are recorded for the first time and one species are renamed according to the international system of scientific nomenclature. Based on the diversity and the total ostracod individual, Two distinct bio assemblages were detected, Hauteriovian assemblage and Barremian assemblage, in which both represent the varaiblity of the environmental conditions among the depositional environment of Sarmord Formation.

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