



## Ostracoda Assemblages of the Hartha Formation (Late Campanian - Early Maastrichtian) from Balad (8) well, Central Iraq

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### ABSTRACT

Fundamentally, the current study is concerned with the investigation and diagnosing of Ostracoda fossils from the subsurface section of the Hartha Formation (Late Campanian - Early Maastrichtian) from (Ba-8) well at central Iraq. Fifty-nine Ostracoda species belonging to (29) genera/ subgenera from (13) families are diagnosed and classified to their ranks according to the standard systematic paleontology. Whereat (57) species are attributed to species previously described from local and regional studies. Two species are left under open zoological nomenclature basically because of lack of specimens. As a result, the study inferred that the species diagnosed in the Hartha Formation belong to the Late Campanian - Early Maastricht. As These species are very similar in terms of the external appearance and geologic age to the same species that were compared with them and which were previously described in the regions of East, West, and North Africa as well as the Arabian Gulf region.

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## مجاميع الاوستراكودا في تكوين الهارثة (الكامباني المتأخر-الماسترختي المبكر) من بئر بلد (8)، وسط العراق

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قسم علوم الارض، كلية العلوم، جامعة الموصل، الموصل، العراق

المخلص	معلومات الارشفة
البحث الحالي عبارة عن دراسة تم من خلالها تشخيص وتصنيف متحجرات الاوستراكودا من مقطع تحت سطحي لتكوين هارثة (الكامبانيان المتأخر – الماسترختيان المبكر) من بئر (Ba-8) في وسط العراق. حيث تم تشخيص تسعة وخمسين نوعاً ينتمون إلى (29) جنساً / تحت جنس من (13) عائلة، منها (57) نوعاً تُنسب إلى الأنواع الموصوفة سابقاً من الدراسات المحلية والإقليمية. تم ترك نوعين تحت التسمية الحيوانية القياسية المفتوحة بسبب نقص العينات. من خلال هذه الدراسة، كان من الواضح جداً أن الأنواع التي تم تشخيصها ضمن تكوين هارثة هي من عمر (الكامبانيان المتأخر – الماسترختيان المبكر) وهي مشابهة جداً من حيث المظهر الخارجي والعمر الجيولوجي لنفس الأنواع التي قورنت معها والموصوفة سابقاً في مناطق شرق وغرب وشمال إفريقيا، وكذلك منطقة الخليج العربي.	تاريخ الاستلام: 16-ديسمبر-2021 تاريخ القبول: 06-مارس-2022 تاريخ النشر الالكتروني: 06-يونيو-2022
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### Introduction

The current study represents an investigation and diagnosing of Ostracoda microfossils within the stratigraphic successions representing the Hartha Formation in (Balad-8) well belonging to the Balad oil field, central Iraq. The upper Cretaceous is considered one of the important ages in terms of tectonic and sedimentary events, as it consists of many formations with similar facies. Among these formations is the Hartha Formation, where it is considered one of the important carbonate formations in Iraq that were deposited after the transgression occurred in the Late Campanian-Maastrichtian, at the end of the Cretaceous period which is distinguished by distinct lithological, structural, and biological aspects. The Hartha Formation is one of the formations that geologically acquired large importance because it has important petrophysical properties (such as good permeability and porosity) assisting for containing the hydrocarbons.

The Hartha Formation was described for the first time by (Rabanit, 1952; in Bellen *et al.*, 1959) unpublished report, in which glauconite limestone and dolomitic limestone with inter-fingering of marl and green shale are the main constituents.

Owen and Nasr (1958) considered the subsurface section of the well (Zubair-3) to be the type section for the Hartha Formation, which consists of glauconitic clastic organic limestone (partially dolomitic) with overlapping of marl and green shale.

The Hartha Formation has widespread in the surface outcrops and sub-surface sections in the North and South of Iraq, and the thickness of the formation varies from one place to

another. The average thickness in Southern Iraq is (200-250) meters, while in Northern Iraq reaches more than (350) meters, as for the structural highs in the stable shelf, its thickness reaches less than (100) meters. The reason for this variation in thickness is due to either overlapping with the Shiranish Formation laterally and vertically or because of the exposure to the erosion that followed the Cretaceous period on the other hand. (Al-Naqib, 1967; Buday, 1980).

Geographically, (Ba-8) well is set inside within the Balad oil field, which is located about 70 km Northern Baghdad city, at South of Tikrit city, on the western bank of the Tigris River within the coordinates (N: 3 765 578.826) and (E: 41 710.248) (Fig.1). Geologically, the area of the current study is located within the Mesopotamian zone within the unstable shelf. According to (Buday and Jassim, 1987; Aqrawi *et al.*, 2010), this shelf is divided into three secondary zones, Mesopotamian zone, Foothill zone, and High folded zone (Fig. 1).

The stratigraphy of the formation in the study area shows that the thickness of the Hartha Formation is about (429 m) (Fig. 2). The lower part of the section, which ranges approximately from (2000-2079 m) in depth, consists of limestone and marly limestone, light in color tending to yellow, of medium hardness, followed by beds of fine-grained white chalky limestone alternating slightly with marly limestone and dolomitic limestone showing oil content.

As for the central part of the formation, with a depth of (1820-2000 m) consists of layers of light-colored limestone and marly limestone with the presence of dolomite in some parts are shown, also oil show appears clearly, especially in the core samples. Other layers are followed by white chalky limestone, pale yellow colored marly limestone, and layers of marl and brittle claystone, which have a color that tends from dark brown to pale yellow.

The upper part is represented by a depth of about (1649-1820 m) consisting of layers of marly limestone alternating with brittle claystone in addition to layers of argillaceous limestone with medium hardness and fine-medium grain size of dark marly limestone with slight dolomitization.

Ostracoda fossils can be considered as microfossils of great importance in the study of the paleoenvironment and its changes, paleogeography, in addition to stratigraphy to some extent. It is found in most aquatic environments and different sedimentary basins with a wide geological age that extends from the early Paleozoic to the present time.

Many previous studies dealt with the Hartha Formation as an important formation in different regions within Iraq and from different geological aspects. They also dealt with the Late Campanian-Early Maastrichtian age or to the microfossils in general, including Ostracoda in particular. For instance, we mention some papers such as (Al-Naqib, 1967; Buday and Jassim, 1987; Al- Ubidee, 1989; Al-Shareefi *et al.*, 2010; Al-Shareefi *et al.*, 2014; Aqrawi *et al.* 2010; Aziz, 2018).

The main objective of the current study is to diagnose the different assemblages of Ostracoda microfossils within the Hartha Formation in a subsurface section in central Iraq. Subsequently, the classification of these assemblages to the rank of species by comparing them with the previously described species from variant regions locally and globally to conclude the age of the formation accurately has been accomplished.

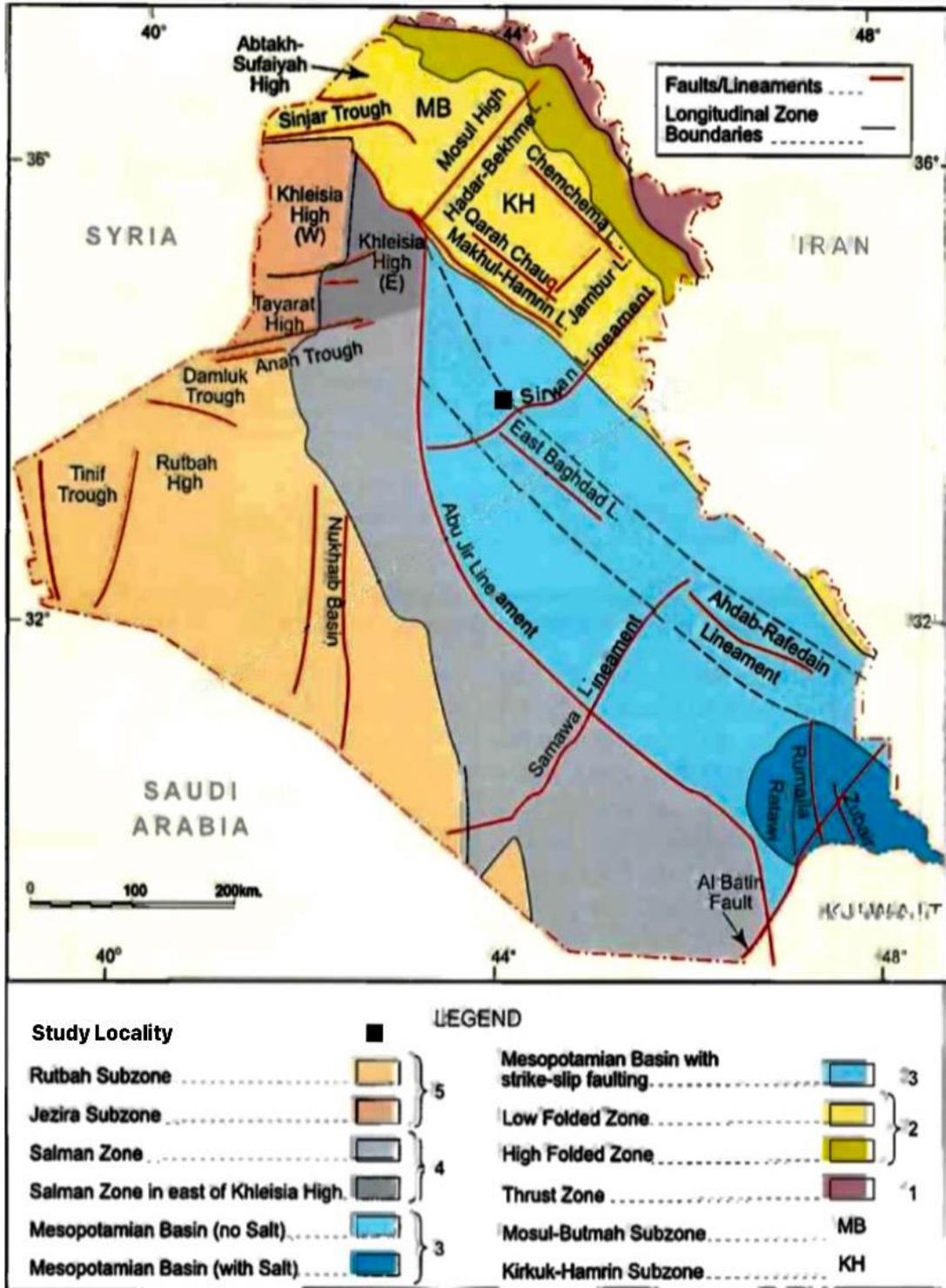


Fig. 1. Tectonic map of Iraq showing the location of the studied well (Aqrabi *et al.*, 2010)

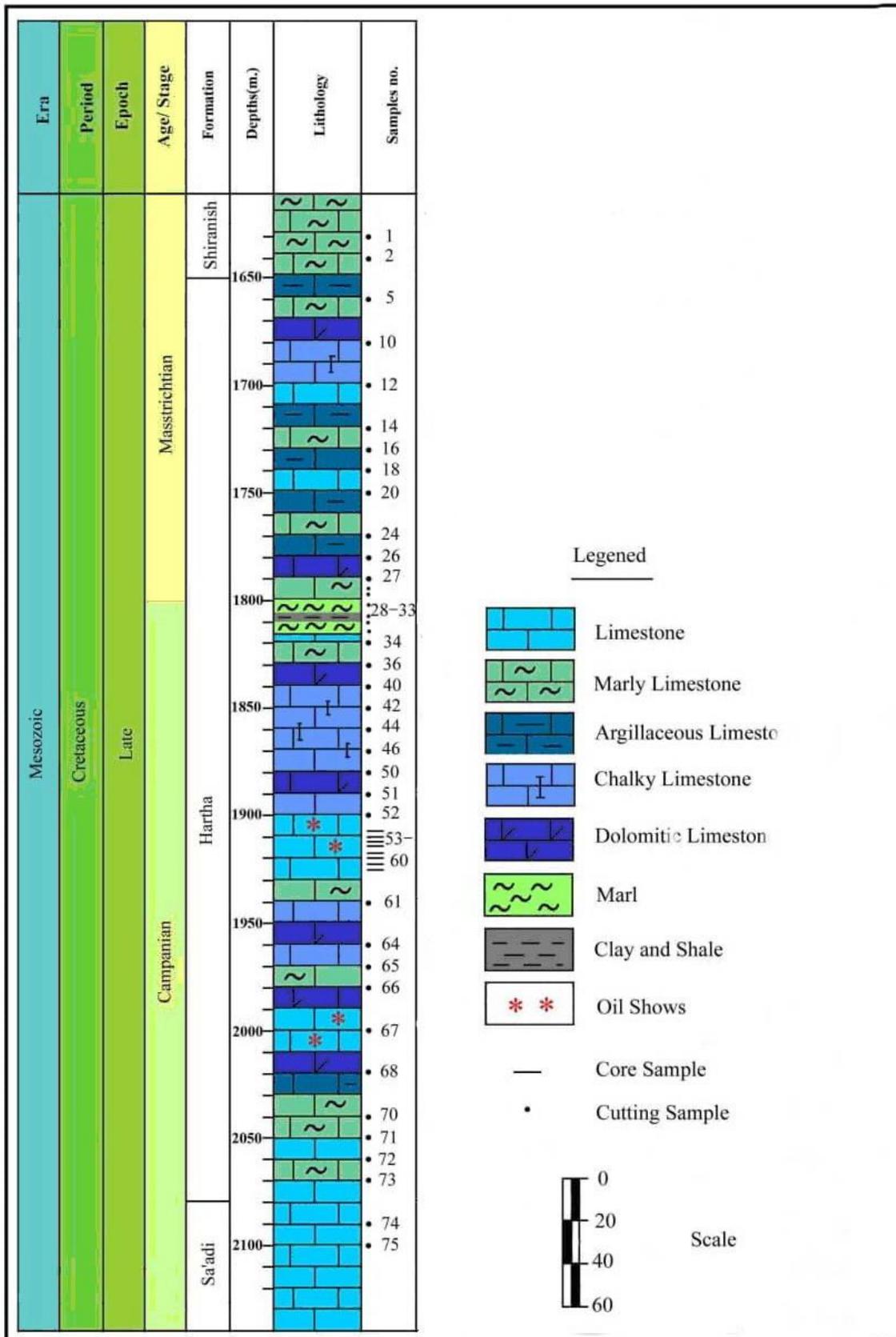


Fig. 2. Stratigraphic section of the Hartha Formation in Balad-8 well, central Iraq

## Materials and Methods

Seventy-three core and cutting rock samples are taken with different weights (10-100 g) for each sample in varying intervals depending on the degree of variation in the lithology characteristics.

In the laboratory, the rock samples are first sorted according to their location in the study section. Based on the principles set by (Moore and Pitrat, 1961) for microfossils preparations, a series of steps have been done starting with the initial washing operations to remove the suspended sediments in the fine fossils. The difference in hardness between the brittle and the hard samples is taken into consideration in order not to break the valves and carapaces of Ostracoda, which are essentially somewhat soft.

The rock samples are smashed using a hammer into small pieces that can pass through the apertures of the sieve of (1180) microns. Hard samples are soaked in hydrogen peroxide solution with (20-10%) in concentration for one day before boiling while the soft samples are passed to the boiling stage directly after the foremost washing. The samples are then boiled and cooked in water adding a teaspoon of sodium carbonate to it per 100 ml for about 4-6 hours with continuous stirring using a laboratory glass rod. The boiling process is repeated more than one time (especially for solid samples) with water change until becomes so clean. The residual is finally washed by wet sieving to dispose the remaining suspended sediments, and then the residual is filtered and dried.

After that, the dry residual is sieved again by using five sieves of different sizes (40, 60, 80, 100, 120, mesh) alternately, to isolate the different sizes needed for picking up the Ostracoda specimens.

The last stage is the microscopic study using a two-lens optical microscope, where the residue is gradually emptied into a small black tray divided into small numbered squares. Ostracoda fossils are picked up with a wet brush and transferred to special slides. Later, the process of recognizing and defining characteristics of external and internal structures and features in addition to sculptures begins to diagnose the rank of genus and species. The identification and classification of taxa have been carried out with the help of specialized Ostracoda references and catalogs. The specimens are photographed using a digital camera and a specific linear scale is used to determine the real size of each species in the image within the plates. The imaging technique by the scanning electron microscope (SEM) has not been used because the device is not available.

## Results and Discussion

Ostracoda fossils in this study are accurately classified based on many references and scientific researches such as (Moore and Pitrat, 1961; Morkhoven, 1963; Hartman and Puri, 1974 and Pieri *et al.*, 2020) in addition to many recent periodicals, valuable researches, and the Iraqi Virtual Library (IVSL) website. The taxa have been classified up to the level of genus/ subgenus and species (Pls. 1, 2). Based on all above, a total of (59) species belonging to (29) genera/ subgenera from (13) families (Fig. 3) have been classified as follows:

Kingdom Animalia Linnaeus, 1785

Phylum Arthropoda Siebold and Stannius, 1845

Subphylum Crustacea Pennaut, 1777

Class Ostracoda Latreille, 1806

Subclass Podocopa G.W. Müller, 1894

Order Podocopida Muller, 1894

Suborder Platycopina Sars, 1866

**Family Cytherellidae** Sars, 1866**Genus *Cytherella*** Sars, 1866

Type species *Cytherella ovata* Roemer, 1840

***Cytherella ragubaensis*** El-Sogher, 1991 (Pl.1, Fig.1)

Remarks: The current species conform to *Cytherella ragubaensis* El-Sogher described by (El-Sogher, 1991) from the Maastrichtian deposits in Libya, but it slightly differs in that the posterior is more tapered and thicker compared to the Iraqi species.

***Cytherella tuberculifera*** Alexander, 1929 (Pl.1, Fig. 2)

Remarks: The current species conforms to *Cytherella tuberculifera* Alexander recorded by (Puckett *et al.*, 2012) from the Maastrichtian deposits in Jamaica. This species is also similar to *Cytherella kuwaitensis* Al-Abdul Razzaq (1981) from the Middle Cretaceous deposits in the Arabian Gulf except that the latest has more bulging shield than the Iraqi species and the protrusion in the posterior is smaller.

***Cytherella sorrensis*** El-Sogher, 1991 (Pl.1, Fig. 3)

Remarks: The current species conforms to *Cytherella sorrensis* El-Sogher, described by (El-Sogher, 1991) from the Maastrichtian deposits in Libya, but it slightly differs in that the ventral region is more swollen and thicker from the dorsal view compared to the Iraqi species.

***Cytherella semicatillus*** Ceolin *et al.*, 2015 (Pl.1, Fig. 4)

Remarks: The current species conforms to *Cytherella semicatillus* Ceolin *et al.*, described by (Ceolin *et al.*, 2015) from the Maastrichtian-Early Paleocene deposits in Argentina, especially in the relatively large size of the carapace.

***Cytherella cf. sinaensis*** Morsi, 1999 (Pl.1, Fig. 5)

Remarks: The current species conforms to *Cytherella cf. sinaensis* Morsi recorded by (Ismail, 2005) from the Maastrichtian-Paleocene deposits in Egypt, but it slightly differs in that the posterior is narrower and thinner compared to the Iraqi species.

***Cytherella truncata*** (Bosquet), 1847 (Pl.1, Fig. 6)

Remarks: This species conforms to *Cytherella truncata* (Bosquet, 1847) recorded by (Luger, 2018) from the Campanian deposits in Somalia.

***Cytherella* spp.** Shirazi *et al.*, 2014 (Pl.1, Fig. 7)

Remarks: This species agrees with *Cytherella* spp Shirazi *et al.*, described by (Shirazi *et al.*, 2014) from the Campanian-Maastrichtian deposits in Iran but slightly differs in that the posterior is thicker compared to the Iraqi species.

***Cytherella* sp.** Luger, 2018 (Pl.1, Fig. 8)

Remarks: This species completely conforms to *Cytherella* sp. Luger described by (Luger, 2018) from the Cretaceous-Paleocene deposits in Somalia.

**Genus *Cytherelloidea*** Alexander, 1929

Type species *Cythere williamsoniana* Jones, 1849

***Cytherelloidea melleguensis*** Damotte and Said, 1982 (Pl.1, Fig. 9)

Remarks: This species conforms to *Cytherelloidea melleguensis* Damotte and Said described by (Itterbeeck *et al.*, 2007) from the Maastrichtian deposits in Tunisia since the shape of the carapace is longitudinal to semi-rectangular and the outer surface of the carapace ornamented by perforation and contains two U-shaped barriers.

Suborder Podocopina Sars, 1866

Superfamily Bairdiacea Sars, 1888

**Family Bairdiidae** Sars, 1888

**Genus *Bairdia*** McCoy, 1844

Type species *Bairdia curtus* McCoy, 1844

***Bairdia dianaensis*** Aziz, 2018 (Pl.1, Fig. 10)

Remarks: This species conforms to *Bairdia dianaensis* Aziz recorded by (Aziz, 2018) from the Late Campanian deposits in Northern Iraq.

***Bairdia ilaroensis*** Reyment and Reyment, 1959 (Pl.1, Fig. 11)

Remarks: This species conforms to *Bairdia ilaroensis* Reyment and Reyment, recorded by (Reyment, 1981) from Maastrichtian deposits of Ghana and also by (Shahin, 2005) from the Maastrichtian-Paleocene beds in Egypt.

***Bairdia austracretacea*** Bate, 1972 (Pl.1, Fig. 12)

Remarks: This species conforms to *Bairdia austracretacea* Bate recorded by (Bate, 1972) from the Campanian deposits of Australia.

***Bairdia septentrionalis*** Bonnema, 1941 (Pl.1, Fig. 13)

Remarks: The present species agrees with the *Bairdia septentrionalis* Bonnema recorded by (Al-Shareefi *et al.*, 2014) from the Late Campanian-Maastrichtian deposits in Central Iraq, but slightly differs in terms of the overlap of the two valves which is weaker and less clear compared to the current species.

***Bairdia* sp. aff. *Bairdia ilaroensis*** El-Sogher, 1991 (Pl.1, Fig. 14)

Remarks: This species conforms to *Bairdia* sp. aff. *Bairdia* described by (El-Sogher, 1991) from the Lower Paleocene deposits in Libya since the dorsal margin is divided into three parts, the first is strongly inclined towards the front, the central is semi-straight, and the third is strongly inclined towards the posterior and has a distinct angle with it.

***Bairdia* sp.1** Luger, 2018 (Pl.1, Fig. 15)

Remarks: This species conforms to *Bairdia* sp.1 Luger described by (Luger, 2018) from the Maastrichtian beds in Somalia.

***Bairdia* sp.** (Pl.1, Fig. 16)

Remarks: The current species is similar to the *Bairdia ilaroensis* (Reyment and Reyment) that described by (Reyment and Reyment, 1959) from the Paleocene sediments in Nigeria, but it slightly differs in the form of overlap between the two valves and that the overlap is weaker and less clear compared to the current species. The present species also resembles the *Bairdia* sp.1 Luger described by (Luger, 2018) from the Maastrichtian deposits in Somalia but slightly differs in the form and strength of the interaction between the two valves, as well as slightly different in the shape of the posterior compared to the current species.

**Genus *Bairdoppilata*** Coryell, Sample and Jennings, 1935

Type species *Bairdoppilata maryni* Coryell, Sample and Jennings, 1935

***Bairdoppilata magna*** (Alexander, 1927) (Pl.1, Fig. 17)

Remarks: This species conforms to *Bairdia* sp.1 Luger described by (Luger, 2018) from the Maastrichtian beds in Somalia.

***Bairdoppilata* spp.** Shirazi *et al.*, 2014 (Pl.1, Fig. 18)

Remarks: This species conforms to *Bairdoppilata* spp Shirazi described by (Shirazi *et al.*, 2014) from the Campanian-Maastrichtian deposits in Iran.

***Bairdoppilata* sp.1** Piovesan *et al.*, 2009 (Pl.1, Fig. 19)

Remarks: This species conforms to *Bairdoppilata* sp.1 Piovesan described by (Piovesan *et al.*, 2009) from the Early Maastrichtian beds in Brazil.

***Bairdoppilata* sp.** Luger, 2018 (Pl.1, Fig. 20)

Remarks: This species is fully compatible with *Bairdoppilata* sp Luger described by (Luger, 2018) from the Maastrichtian deposits in Somalia.

**Family Bythocyprididae** Maddocks, 1969

**Genus *Bythocypris*** Brady, 1880

Type Species *Bythocypris reniformis* Brady, 1880

***Bythocypris adunca*** Esker, 1968 (Pl.1, Fig. 21)

Remarks: The present species agrees with the *Bythocypris adunca* Esker recorded by (Shahin, 2005) of the Late Maastrichtian-Middle Eocene deposits in Egypt but it differs a little bit in that the overlap is weaker and less pronounced, as well as the posterior is less tapered compared to the Iraqi species.

***Bythocypris urbana*** El-Waer, 1992 (Pl.1, Fig. 22)

Remarks: This species has a similar appearance and characteristics to the *Bythocypris urbana* El-Waer described by (El-Waer, 1992) from the Maastrichtian deposits in Libya.

Superfamily Cypridacea Baird, 1845

**Family Pontocyprididae** Muller, 1894

Subfamily Pontocypridinae Muller, 1894

**Genus *Argilloecia*** Sars, 1866

Type species *Argilloecia cylyndrica* Sars, 1866

***Argilloecia concludus*** Ceolin *et al.*, 2015 (Pl.1, Fig. 23)

Remarks: This species conforms to *Argilloecia concludus* Ceolin *et al.*, described by (Ceolin *et al.*, 2015) from the Maastrichtian deposits in Argentina.

***Argilloecia* sp.2** Piovesan *et al.*, 2009 (Pl.1, Fig. 24)

Remarks: This species conforms to *Bairdoppilata* sp.2 Piovesan described by (Piovesan *et al.*, 2009) from the Early Maastrichtian deposits in Brazil.

**Genus *Abyssocypris*** Bold, 1974

Type species *Abyssocypris tipaca* Bold, 1974

***Abyssocypris tipaca*** Bold, 1974 (Pl.1, Fig. 25)

Remarks: This species conforms to *Abyssocypris tipaca* Bold described by (Bold, 1974) from the Tertiary deposits in Brazil. Also, it coincides in terms of form and characteristics with the same species described by (Al- Shareefi, *et al.*, 2010; 2014) from Maastrichtian deposits in Central Iraq.

***Abyssocypris adunca*** (Esker, 1968) (Pl.1, Fig. 26)

Remarks: This species conforms to *Abyssocypris adunca* Esker described by (Esker, 1968; Donze *et al.*, 1982) from the Late Campanian-Paleocene deposits in Tunisia. Also, it coincides with the same species described by (Al-Shareefi, *et al.*, 2010; 2014) from Early Campanian deposits in Central Iraq and (Morsi *et al.*, 2008) from Late Maastrichtian-Early Paleocene beds in Egypt.

***Abyssocypris* sp.** Al-Ubidee 1989 (Pl.1, Fig. 27)

Remarks: This species conforms to *Abyssocypris* sp. Al-Ubidee described by (Al-Ubidee 1989) from the Late Campanian deposits in Iraq.

**Genus *Pontocyprilla*** Lyubimova, 1955

Type species *Pontocyprilla praetexta* Sars, 1866

***Pontocyprilla rara*** El-Waer, 1992 (Pl.1, Fig. 28)

Remarks: This species conforms to *Pontocyprilla rara* El-Waer described by (El-Waer, 1992) from the Maastrichtian deposits in Libya.

***Pontocyprilla recurva*** Esker, 1968 (Pl.1, Fig. 29)

Remarks: The present species agrees with the *Pontocyprilla recurva* Esker described by (Esker, 1968) from the Late Maastrichtian-Danian deposits in Tunisia but slightly differs by being less thick in dorsal view compared to the Iraqi species.

**Genus *Paracyprideis*** Grosdidier, 1973

Type species *Cytheridae fennica* Hieschmann, 1909

***Paracyprideis IRC20*** Grosdidier, 1973 (Pl.1, Fig. 30)

Remarks: This species conforms to *Paracyprideis* IRC20 Grosdidier described by (Grosdidier, 1973) from the Maastrichtian deposits in Iran.

**Family Paracyprididae** Sars, 1923

Subfamily Paracypridinae Sars, 1923

**Genus *Paracypris*** Sars, 1866

Type species *Paracypris jonesi* Bonnema, 1941

***Paracypris sokotoensis*** Reyment, 1981 (Pl.2, Fig. 1)

Remarks: The current species agrees with the *Paracypris sokotoensis* Reyment recorded by (Gizli, 2017) from the Santonian-Campanian deposits in Turkey but it differs a little bit by the fact that the Turkish species is longer and the overlap is less clear compared to the Iraqi species.

***Paracypris bertelsae*** Ceolin *et al.*, 2015 (Pl.2, Fig. 2)

Remarks: This species conforms to *Paracypris bertelsae* Ceolin *et al.*, described by (Ceolin *et al.*, 2015) from the Maastrichtian-Danian sediments in Argentina.

***Paracypris nigeriensis*** Reyment, 1960 (Pl.2, Fig. 3)

Remarks: This species conforms to *Paracypris nigeriensis* Reyment recorded by (Shahin, 2005) from the Late Maastrichtian-Middle Eocene deposits in Egypt but the Egyptian species slightly differs in that the overlap is stronger and clearer compared to the Iraqi species.

***Paracypris* spp.** Shirazi *et al.*, 2014 (Pl.2, Fig. 4)

Remarks: The current species agrees with *Paracypris* spp Shirazi *et al.*, described by (Shirazi *et al.*, 2014) from the Campanian-Maastrichtian deposits in Iran, but the Iranian

species differs a little bit by the fact that the ventral margin is more straight compared to the Iraqi species.

**Family Krithidae** Maudelstam, 1960

Subfamily Krithinae Mandestam, 1960

**Genus *Krithe*** Brady, Crosskey, and Robertson, 1874

Type species *Ileyobates praetexta* Sars, 1866

***Krithe solomoni*** Honigstein, 1984 (Pl.2, Fig. 5)

Remarks: This species conforms to the *Krithe Solomoni* Honigstein recorded by (Gizli, 2017) of the Santonian-Campanian deposits in Turkey but it slightly differs in that the Turkish species has a posterior with lower elongation and more tapering compared to the Iraqi species.

***Krithe aljurfae*** El-Waer, 1992 (Pl.2, Fig. 6)

Remarks: This species has a similar appearance to the *Krithe aljurfae* El-Waer described by (El-Waer, 1992) from the Maastrichtian deposits in Libya.

***Krithe echolsae*** Esker, 1968 (Pl.2, Fig. 7)

Remarks: The present species matches with *Krithe echolsae* Esker described by (Esker, 1968) from the Late Campanian-Paleocene deposits in Tunisia, but the Tunisian species has a more inclined posterior compared to the Iraqi species.

**Genus *Parakrithe*** Van Den Bold, 1958

Type species *Cytheridea (Doloccytheridea) vermuniti* Van Den Bold, 1946

***Parakrithe crolifa*** Bassiouni and Luger, 1990 (Pl.2, Fig. 8)

Remarks: This species conforms to *Parakrithe crolifa* Bassiouni and Luger described by (Bassiouni and Luger, 1990) from the Maastrichtian-Early Eocene deposits in Egypt. Also, it coincides with the same species described by (Itterbech *et al.*, 2007) from Danian-Selandian deposits in Tunisia

***Parakrithe kalambainaensis*** (Reyment, 1981) (Pl.2, Fig. 9)

Remarks: This species conforms to *Parakrithe kalambainaensis* (Reyment, 1981) described by (El-Sogher, 1996) from the Maastrichtian-Paleocene deposits in Libya and (Shahin, 2005) from Paleocene-Middle Eocene deposits in Egypt.

Superfamily Cytheracea Baird, 1850

**Family Cytherideidae** Sars, 1925

**Genus *Cuneocythere*** Lienenklaus, 1894

Type species *Cuneocythere truncate* Lienenklaus, 1894

Subgenus *Monsmirabilia* Apostolescu, 1955

Type species *Monsmirabilia subovata* Apostolescu, 1955

***Cuneocythere (Monsmirabilia) altinota*** Al-Furaih, 1976 (Pl.2, Fig. 10)

Remarks: This species has a similar appearance to the *Cuneocythere (Monsmirabilia) altinota* Al-Furaih described by (Al-Furaih, 1976) from the Maastrichtian-Paleocene deposits in Saudi Arabia.

Subfamily Cytherideinae Sars, 1925

**Genus *Ovocytheridea*** Grekoff, 1951

Type species *Ovocytheridea nuda* Grekoff, 1951

***Ovocytheridea AUR1469*** Grekoff, 1951 (Pl.2, Fig. 11)

Remarks: This species conforms to *Ovocytheridea AUR1469* Grekoff described by (Grekoff, 1951) from the Coniacian beds in the United Arab Emirates.

**Genus *Dolocytheridea*** Triebel, 1938

Type species *Cytherina hilseana* Roemer, 1841

***Dolocytheride aff.D. atlasica*** Bassoullet and Damotte, 1969 (Pl.2, Fig. 12)

Remarks: This species has conformed to *Dolocytheride aff.D. atlasica* Bassoullet and Damotte described by (Bassoullet and Damotte, 1969) from the Cenomanian-Tronian deposits of Algeria and also with (Luger, 2018) from Campanian-Maastrichtian deposits of Somalia.

**Genus *Cushmanidea*** Blake, 1933

Type species *Cytheridea seminuda* Cushman, 1906

***Cushmanidea sp.*** Crane, 1965 (Pl.2, Fig. 13)

Remarks: The present species agrees with *Cushmanidea sp.* Crane recorded by (Piovesan *et al.*, 2009) from the Early Maastrichtian deposits in Brazil, but the Brazilian species has a more curved ventral edge compared to the Iraqi species.

**Genus *Haplocytheridea*** Stephenson, 1936

Type species *Cytheridea montgomeryensis* Howe and Chambers, 1935

***Haplocytheridea monmouthensis*** (Berry, 1925) (Pl.2, Fig. 14)

Remarks: This species conforms to *Haplocytheridea monmouthensis* Berry which was described for the first time by (Berry, 1925) from Late Cretaceous deposits from the USA. Also, has a similar appearance to the same species described after that by (Smith, 1978) from Maastrichtian-Paleocene in the USA too.

**Genus *Perissocytheridea*** Stephenson, 1938

Type species *Cytheridea matsoni* Stephenson, 1935.

***Perissocytheridea jandairensis*** Piovesan *et al.*, 2014 (Pl.2, Fig. 15)

Remarks: The current species agrees with *Perissocytheridea jandairensis* Piovesan *et al.*, that recorded by (Piovesan *et al.*, 2014) from the Santonian-Campanian deposits in Brazil but the Brazilian species has a straighter dorsal edge compared to the Iraqi species that has a simple convexity in the middle of the dorsal margin.

Subfamily Schulerideinae Mandelstam, 1959

**Genus *Schuleridea*** Swartz and Swain, 1946

Type species *Schuleridea acuminata* Swartz and Swain, 1946

***Schuleridea sp.*** Gizli, 2017 (Pl.2, Fig. 16)

Remarks: The present species conforms to *Schuleridea sp.* Gizli described by (Gizli, 2017) from the Santonian-Campanian deposits in Turkey but slightly differs in that the Turkish species has a straighter ventral edge with a slight concavity near the posterior.

**Family Brachycytheridae** Puri 1954

Subfamily Brachycytherinae Puri, 1954

**Genus *Brachycythere*** Alexander 1933

Type species *Cythere sphenoides* Reuss 1854

***Brachycythere ventrocomplanatus* Delicio *et al.*, 2000 (Pl.2, Fig. 17)**

Remarks: The current species agrees with *Brachycythere ventrocomplanatus* Delicio *et al.*, which was recorded for the first time by (Delicio *et al.*, 2000) from the Campanian deposits in Brazil and also conforms to the same species that described latterly by (Piovesan *et al.*, 2009) from the Santonian deposits in Brazil too. The latter Brazilian specimen has a more curved dorsal edge and a more pointed posterior compared to the Iraqi species.

***Brachycythere dakhlaensis* El-Sweify, 1984 (Pl.2, Fig. 18)**

Remarks: This species has conformed to the *Brachycythere dakhlaensis* El-Sweify which was described for the first time by (El-Sweify, 1984) from Maastrichtian deposits from Egypt. Also, has agreed in appearance to the same species described after that by (Bassiouni and Luger, 1990; Boukhary *et al.*, 2013) from the Maastrichtian sediments in Egypt too.

***Brachycythere tumida* Al-Furaih, 1985 (Pl.2, Fig. 19)**

Remarks: This species conforms to *Brachycythere* IRE5 Grosdidier which was described for the first time by (Grosdidier, 1973) from the Late Cretaceous deposits of Iran. Also, conformed and agreed in appearance to the same species described after that by (Al-Furaih, 1985; Athersuch, 1994 and Luger, 2018) from the Maastrichtian deposits in Saudi Arabia, Arabian Gulf and, Somalia respectively.

***Brachycythere* sp. [OMN2] Athersuch, 1988 (Pl.2, Fig. 20)**

Remarks: The present species agrees with *Brachycythere* sp. [OMN2] Athersuch which was recorded by (Athersuch, 1988) from the Maastrichtian deposits in Oman, but the Omani species has a more curved dorsal edge with a slight convexity near the posterior compared to the Iraqi one. On the other hand, the current species is also similar to *Brachycythere* sp. [OMN4] Athersuch recorded by the same researcher in Oman too, but to a lesser extent than the previous Omani species where it differs in that the anterior is more rounded and wider and the dorsal margin is slanted almost sub-straight.

**Genus *Kaesleria* Al-Furaih 1986**

Type species *Brachycythere bilirata* Al-Furaih 1980

***Kaesleria trahea* (Al-Furaih) 1980 (Pl.2, Fig. 21)**

Remarks: This species conforms to *Kaesleria trahea* Al-Furaih described by (Al-Furaih, 1986) from the Late Campanian-Maastrichtian deposits from Saudi Arabia. Also, conformed with the same species described after that by (Luger, 2018) from the Maastrichtian deposits in Somalia.

**Family Cytheruridae Muller, 1894**

Subfamily Cytherurinae G. W. Muller 1894

**Genus *Cytherura* Sars, 1866**

Type species *Cythere gibba* O.F.Mueller, 1785.

***Cytherura zeltensis* El-Sogher, 1991 (Pl.2, Fig. 22)**

Remarks: The current species agrees with the *Cytherura zeltensis* El-Sogher that was described by (El-Sogher, 1991) from the Maastrichtian-Danian deposits in Libya, but the Libyan species has a less curved dorsal margin and is more ornamented compared to the Iraqi species.

**Genus *Semicytherura* Wagner 1957**

Type species *Cythere nigrescens* Baird, 1838

***Semicytherura* sp. B** El-Sogher, 1991 (Pl.2, Fig. 23)

Remarks: The present species is consistent with *Semicytherura* sp. B. El-Sogher that was described by (El-Sogher, 1991) from the Maastrichtian deposits in Libya but the Libyan species has a less curved dorsal margin and a less tapered and wider posterior compared to the Iraqi one.

Subfamily Cytheropterinae Hanai 1957b

**Genus** *Cytheropteron* Sars, 1866

Type species *Cythere lattissima* Norman, 1865

Subgenus *Infracytheropteron* Kaye, 1964

***Cytheropteron (Infracytheropteron) anotum*** Bate, 1972 (Pl.2, Fig. 24)

Remarks: This species conforms to *Cytheropteron (Infracytheropteron) anotum* Bate described by (Bate, 1972) from the Campanian deposits in Australia.

Subfamily Cytheroptinae Hanai 1957

**Genus** *Tanzanicythere* Ahmad 1977

Type species *Cladarocythere pterota* Ahmad, 1977

***Tanzanicythere* sp.** Ahmad, 1977 (Pl.2, Fig. 25)

Remarks: This species conforms to *Tanzanicythere* sp. Ahmad described by (Ahmad, 1977) from the Late Campanian deposits from UK. Also, conforms to the same species described after that by (Luger, 2018) from the Campanian deposits in Somalia.

**Family Neocytherideididae** Puri, 1957

Subfamily Neocytherideidinae Puri, 1957

**Genus** *Copytus* Skogsberg, 1939

Type species *Copytus caligula* Skogsberg, 1939

***Copytus* sp.** Ceolin *et al.*, 2015 (Pl.2, Fig. 26)

Remarks: This species conforms to the *Copytus* sp. Ceolin *et al.*, which is described by (Ceolin *et al.*, 2015) from the Maastrichtian-Danian deposits from Argentina.

**Family Loxoconchidae** Sars, 1926

**Genus** *Loxoconchella* Triebel, 1954

Type species *Loxoconcha honoluluensis* Brady, 1880

***Loxoconchella* sp.** (Pl.2, Fig. 27)

Remarks: The current species is conformed to the genus *Loxoconchella* Triebel, in its sub-quadrate form from the lateral view with the presence of the caudal process at the posterior, and the semi-flat form from the dorsal view. This species also is similar to the genus *Loxocorniculum* Benson and Coleman except that the latter has a strong quadrilateral carapace that protrudes from the middle forming a height strongly curved in the ventral margin with nodes on the outer surface of the carapace. It is also comparable to the genus *Loxoconcha* Sara but the latter is flatter and has a wider anterior compared to the present species.

**Family Progonocytheridae** Lyubimova 1955

Subfamily Progonocytherinae

**Genus** *Paraphysocythere* Dingle 1969

Type species *Paraphysocythere thompsoni* Dingle, 1969

***Paraphysocythere palaeoalbiensis*** Luger, 2018 (Pl.2, Fig. 28)

Remarks: This species conforms to *Paraphysocythere palaeoalbiensis* Luger which was described by (Luger, 2018) from the Early Albian deposits from Somalia.

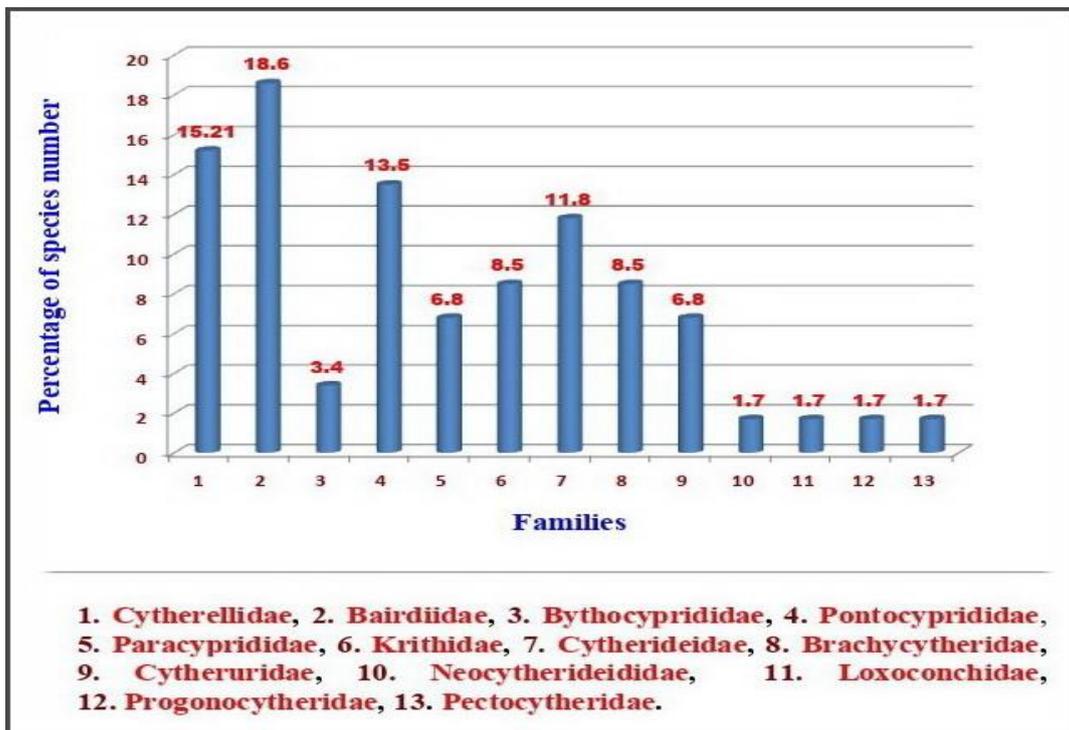
**Family Pectocytheridae** Hanai, 1957

**Genus Keijia** Teeter, 1975

Type species *Keijia demissa* (Brady, 1868) Teeter, 1975.

***Keijia circulodictyon*** Ceolin and Whatley, 2015 (Pl.2, Fig. 29)

Remarks: This species conforms to the *Keijia circulodictyon* Ceolin and Whatley which described by (Ceolin and Whatley, 2015) from the Danian deposits from Argentina.



**Fig. 3. Percentage of the different families in the study section, according to the number of species belonging to each family.**

### Conclusions

The present study is carried out by relying on the approved and standard micropaleontologic procedures, starting with the selection of the study section and sampling till the completion of the various laboratory processes. The optical microscope is used to diagnose and identify (59) species of Ostracoda fossils belonging to (29) genera of (13) families. Two new species are left open for nomenclature due to the lack of specimens. The diagnosed species belong to the following genera:

*Cytherella, Cytherelloidea, Bairdia, Bairdoppilata, Bythocypris, Argilloecia, Abyssocypris, Pontocyprilla, Paracyprideis, Paracypris, Krithe, Parakrithe, Cuneocythere, Ovocytheridea, Dolocytheride, Cushmanidea, Haplocytheridea, Perissocytheridea, Schuleridea, Brachycythere, Kaesleria, Cytherura, Semicytherura, Cytheropteron, Tanzanicocythere, Coptus, Loxoconchella, Paraphysocythere, Keijia.*

About the classification study, the identified taxa in Hartha Formation are compared to the similar taxa from local and regional areas with (Late Campanian-Early Maastrichtian)

age. They almost are identical to those described from Arabian Gulf regions and North, West, and East Africa.

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### References

- Ahmad, M., 1977. On Tanzanicythere Ahmad nom. nov. - Stereo-Atlas of Ostacod shells: 4 (27): 153 P., Llandudno.
- Al-Abdul-Razzaq, S., 1981. Cretaceous Cytherellidae from Kuwait. Jour. Palaeontol.Soc. India,25: pp. 13-20.
- Alexander, C.I., 1933. Shell structure of the ostracode genus Cytheropteron, and fossil species from the Cretaceous of Texas. J. Paleontol. 8, 206–237.
- Al-Furaih, A.A.F., 1976. On Paragrenocythere biclavata Al-Furiah gen. et sp. nov. Stereo-Atlas of Ostracoda Shells; 2: 37; 231 -238.
- Al-Furaih A.A.F., 1980. Upper Cretaceous and Lower Tertiary Ostracoda (Superfamily Cytheracea) from Saudi Arabia. Univ. Libraries. Univ.Riyadh.Saudi Arabia, 211 P.
- Al-Furaih, A.A.F., 1985. The Ostracod Genus Brachycythere from the Upper Cretaceous of Saudi Arabia. - Rev. Esp. Micropal. 17 (1): 113 - 122, 2 plates, Madrid.
- Al-Furaih, A.A.F., 1986. Kaesleria, a new Ostracode Genus from the Aruma Formation (Upper Cretaceous) of Saudi Arabia. Journal of Paleontology. 60 (3): 701 - 710, 5 ill., Tulsa.
- Al-Naqib, K.M., 1967. Geology of the Arabian Peninsula Southwestern Iraq. United States Government Printing Office, Washington, Professional Paper, :560-6.
- Al-Shareefi, I.Y., Khalaf, S.K., and Al-Eisa, M.A., 2010. Paleocology of some Upper Cretaceous Formations from Selected Wells Northwest and Middle Iraq. Iraqi Journal of Earth Sciences, Vol. 10, No. 2, pp. 67-96.
- Al-Shareefi, I.Y., Khalaf, S.K., and Al-Eisa, M.A., 2014. Ostracode Biostratigraphy of Shiranish, Hartha and Mushorah Formations from Selected Boreholes Northwest and Central Iraq. Iraqi National Journal of Earth Sciences, Vol. 14, No. 1, pp. 19 – 38.
- Al-Ubidee, W.Y., 1989. Upper Cretaceous Ostracoda from Well Khshab No. 1, Hemren area, Northeastern Iraq. M. Sc. Thesis, Univ. of Mosul. 155p. (in Arabic).
- Apostolescu, V., 1955. Description de quelques ostracodes du Lutétien du Bassin de Paris. Cahiers G6ol., nos. 28-29, pp. 241-279, pls. 1-8, text-figs. 1-2.
- Aqrawi, A.A.M., Goff, J.C., Horbury, A.D., and Sadooni, F.N., 2010. The Petroleum Geology of Iraq. UK: Scientific Press Ltd., 560 P.
- Athersuch, J., 1988. The Biostratigraphy of Cretaceous Ostracods from Oman. In: Hanaii, T., Ikeya, N. and Ishizaki, K. (Eds.): Evolutionary biology of Ostracoda, its fundamentals and applications; Proceeding of 9th International Symposium Ostracoda, Shizuoka, 1985; Developments in paleontology and stratigraphy 11: 1187-1206, 5 Plate Kodansha Ltd., Tokyo and Elsevier, Amsterdam, Oxford, New York, Tokyo.

- Athersuch, J., 1994. The biostratigraphic significance of Cretaceous ostracods from the Arabian Gulf. In: Simmons, M.D. (ed.) *Micropalaeontology and Hydrocarbon Exploration in the Middle East*. Chapman and Hall, London. Pls.3, pp.253-265.
- Aziz, N.M., 2018. Some Ostracoda Species of Tanjero Formation (Late Campanian-Maastrichtian) of Diana Area, NE Iraq. *Iraqi National Journal of Earth Sciences*, Vol. 18, No. 1, pp. 27 – 40.
- Bassiouni, M.A.A. and Luger, P., 1990. Maastrichtian to Early Eocene Ostracoda from southern Egypt. *Paleontology, Paleocology, Paleobiography and Biostratigraphy*. Berliner Geowissenschaftlichen Abhandlungen, Berlin, (A) 120(2):755-928, 16 figs, 14 tables, 25 Pls.
- Bassoullet, J.P., Damotte, R., 1969. Quelques Ostracodes nouveaux du Cenomano-Turonien de l'Atlas saharien occidental (Algérie). *Rev. Micropaleontol.* 12, pp. 130-144.
- Bate, R.H. 1972. Upper Cretaceous Ostracoda from the Carnarvon Basin Western Australia. *Spec. Publ. Paleont.* 10: 85 pp., 42 ill., 27 Plates, The Palaeontological Association, London.
- Bellen, Van R.C., Dunnington, H.V., Wetzel, R. and Morton, D.M., 1959. *Lexique stratigraphique international*, Iraq. International Geology Congress-Committee of Stratigraphy, Vol.3, Fasc.10a, 333 P.
- Berry E.W., 1925. The Upper Cretaceous ostracoda from Maryland: *American Journal of Science*, 5th ser., 9, pp. 481-487.
- Bold, W.A. van den, 1958. Ostracoda of the Brasso Formation of Trinidad. *Micropaleontology* 4, pp. 391–418.
- Bold, W.A. van den., 1974. Taxonomic status of *Cardobairdia* (Van Den Bold, 1960) and *Abyssocypris* N. Gen of Caribbean Tertiary. *Geoscience and Man.*, Vol. VI, pp. 65-79. 1 Pl., 7 Text-Figs.
- Bonnema, J.H., 1941. Ostracoden aus der Kreide des Untergrundes der nordöstlichen Niederlande. *Natuurhistorisch Maandblad*, 29 : 9-12; 30 : 1-6, 35 P.
- Buday, T., 1980. The regional geology of Iraq, Vol. 1, Stratigraphy and Paleogeography. Dar Al-Kutib Pub. House, Mosul, Iraq, 445P.
- Buday, R.T., and Jassim S.Z., 1987. The Regional Geology of Iraq, 2, Tectonism, Magmatism and Metamorphism. Baghdad, 352 P.
- Ceolin, D., Whatley, R., Fauth, G., and Concheyro, A., 2015. New genera and species of Ostracoda from the Maastrichtian and Danian of the Neuquén Basin, Argentina. *Palaeontology*, 1, 425–495.
- Crane, M.J., 1965. Upper Cretaceous Ostracoda of Gulf Coast area. *Micropaleontology.*, Vol. 11, No. 2, pp. 191-254, pls. 9.
- Delicio, M.P., Coimbra, J.C., and Carreño, A.L., 2000. Cretaceous marine Ostracoda from the Potiguar Basin, Northeastern Brazil. *Neues Jahrbuch für Geologie und Paläontologie-Abhandlungen*, 215(3): 321-345.
- Dingle, R.V., 1969. Upper Senonian Ostracods from the Coast of Pondoland, South Africa. *Transactions of the Royal Society of South Africa*, Vol. 38, No. 4, pp. 347-385
- Donze, P., Colin, J.P., Damotte, R., Oertli, H.J., Peypougvet, J.P., and Said, R., 1982. Les Ostracodes du Campanien terminal à l'Eocène terminal de la coupe d'kef. Tunisia Nordoccidentali. *Bull. Cet. Rech. Pav.*

- El-Sogher, A., 1991. Late Cretaceous and Palaeocene Ostracodas from the Waha and Heira Formations of the Sirt Basin, Libya. Unpublished M.Sc. Thesis, University of Glasgow, Scotland, 1-256.
- El-Sweify, A.A.R., 1984. Senonian and Paleocene Ostracoda (Cytherellidae, Cytheridae, Hemicytheridae and Trachyleberididae) from Dakhla Oasis (Edmonstone), Egypt. Unpublished M.Sc. Thesis, Ain Shams University, Cairo, pp. 118.
- El-Waer, A.A., 1992. Tertiary and Upper Cretaceous Ostracoda from NW off shore, Lybia. Their Tayanorny, Biostratigraphy and correlation with adjacent areas. In Research Center Publication No. 1, 445 P.
- Esker, G.C., 1968. Danin of Ostracoda from Tunisia. *Micropaleontology*. Vol. 14, No. 3, pp. 319-333.
- Gizli, H.T., 2017. Ostracoda biostratigraphy, chronostratigraphy and paleoenvironmental interpretation of the Late Cretaceous Incirli Formation in the Alci-Aşağı Yurtçu Region, Southwest Ankara. M. Sc. Thesis, Univ. of Hacettepe. 103p. (in Turkish).
- Grekoff, N., 1951. Quelques ostracodes nouveaux du Senonien superieur du Cameroun. *Rev. Inst. Franc. Petrol.*, 6, 2; 53-59, 2Pls.
- Grosdidier, E., 1973. Associations d' Ostracodes du Cretace d'Iran. *Rev. Inst. France Petrole*. Vol.28, No. 2, pp. 131-169.
- Hanai, T., 1957. Studies on the Ostracoda from Japan. III. Subfamilies Cytherurinae G. W. Müller (emend. G. O. Sars, 1925) and Cytheropterinae n. subfam. *Journal of the Faculty of Science, University of Tokyo*, 11 (1), 11-36.
- Hartmann, G., and Puri, H.S., 1974. Summary of Neontological and Paleontological classification of Ostracoda, *Mitt Hammdurg. Zool. Museum Inst.*, Band. 70, PP. 7-37, Hambury.
- Honigstein, A., 1984: Senonian ostracodes from Israel. *Israeli Geological Survey Bulletin of the Geological Survey of Israel*, 78: Figs.7, Pls.15, pp. 1-48.
- Ismail, A.S.A., 2005. Maastrichtian - Lower Eocene Ostracodes from Safaga area, Eastern Desert, Egypt. *Egyptian Journal of Paleontology*, 5: pp. 119-159.
- Itterbeeck, J.V. Sprong, J., Dupuis, C. Speijer, R.P., and Steurbaut, E., 2007. Danian/selandian boundary stratigraphy/ paleoenvironment and ostracoda from Sidi Nasseur, Tunisia. *Marine micropaleontology*. No.62, pp.211-234.
- Kaye, P., 1964. Revision of British Marine Cretaceous Ostracoda with notes on additional forms. *British Museum (Natural History), Bulletin, Geology*, 10 (2): 37-79, Pls 1-9.
- Luger, P., 2018. Mikropaläontologie (Foraminiferen, Ostrakoden), Biostratigraphie und fazielle Entwicklung der Kreide von Nordsomalia – miteinem Beitrag zur geodynamischen Entwicklung des östlichen Gondwanaim Mesozoikum und frühen Känozoikum. *Documenta naturae abhandlungen, Landshut*, 1 (2): 1-370, Tafelband 49.
- Lyubimova, P.S., 1955. Ostracoda Helovyk Rostochoni Mongo Narodoni Respubiliki ikh Znachenne Dlya Stratigoft. *V. N. I. G. R. I. Vol. 93*, pp. 1 - 174.
- Maddocks R., 1969., Revision of Recent Bairdiidae (Ostracoda). *U. S. National Museum Bulletin*, 295:1-126, Washington DC.
- Mandelstam, M.I., 1959., Ostracods from the Paleogene of Middle Asia. – In: *Microfauna of the USSR*, 10: 442-525; Leningrad (Gostoptechizdat) [in Russian].

- Mandelshtam, M.I., 1960. Ostracoda. In, Tschernysheva, E. N. ed. *Fundamentals of Paleontology, Arthropoda Volume*, p. 264–421. State Scientific Technological Publishing House, Moscow. (In Russian).
- Moore, R.C., and Pitrat, C.W. (eds.), 1961. *Treatise on Invertebrate Paleontology, Part Q. Arthropoda 3 Crustacea Ostracoda*. Geol. Soc. Amer., Univ. Kansas Press, New York, pp. 1- 442.
- Morkhoven, F.P.C.M. van, 1963. Post-Paleozoic ostracoda. Their morphology, taxonomy and economic use. Elsevier Publisher Company, New York 2, 408 P.
- Morsi, A.M., 1999. Paleocene to Early Eocene Ostracodes from the area of east- central Sinai, Egypt. *Revue de Paléobiologie*, Vol.18, No.1, pp.31-55.
- Owen, R.M.S., and Nasr, S.N., 1958. The stratigraphy of the Kuwiat-Basrah area. In: Weeks, G.L. (es). *Habitat of oil, A Symposium American Association Petroleum Geology*. Tulsa.
- Pieri, V., Marrone, F., Martens, K. and Rosset, G., 2020. An updated checklist of Recent ostracods (Crustacea: Ostracoda) from inland waters of Sicily and adjacent small islands with notes on their distribution and ecology V. *The European Zoological Journal*, Vol. 87, No. 1, pp. 714–740.
- Piovesan, E.K., Dergue, C.T., and Forth, G., 2009. Cretaceous ostracodes from para-Maranhao Basin, Brazil: taxonomy and preliminary paleoecological and paleobiogeographical inferences. *Revue du paleobiologie*, Genve. Vol, 28, N.2, pp.437-456.
- Piovesan, E.K., Cabral, M.C., Colin, J.P., Fauth, G., and Trescastro B.C., 2014. Ostracodes from the Upper Cretaceous deposits of the Potiguar Basin, northeastern Brazil: taxonomy, paleoecology and paleobiogeography. Part1: Turonian. *Carnets de Géologie/Notebooks on Geology* 14, pp. 211–252.
- Puri, H.S., 1954. Contribution to the study of the Miocene of the Florida panhandle. Ostracoda. *Florida Geological Survey Bulletin* 38, pp. 31–38.
- Puri, H.S., 1957. *Henryhowella*, new name for *Howella* Puri, 1956. *Journal of Paleontology*, 31, 982 P.
- Reyment, R.A., and Reyment, E., 1959. *Bairdia ilaroensiss nov. ausdem Paleozan Migeriens und die gültigkeit der Gattu ng Bairdoppilata (ostr. crust.)*. Stockholm Contr. In *Geology*, 3, no.2, pp. 59-68.
- Reyment, R.A., 1960. Studies on Nigerian Upper Cretaceous and lower Paleogene Ostracoda, Pt 1: Senonian and Maastrichtian Ostracoda. *Stockholm Contributions Geology*. Vol. 7, pp. 1-238, Pls 1-28, 71 Figs.
- Reyment, R.A., 1981. The Ostracoda of the Kalanaina Formation (Paleocene), northwestern Nigeria. *Bulletin Geological Institute, Uppsala University, N.S.*, Vol. 9, pp. 51-65.
- Shahin, A., 2005. Maastrichtian to Middle Eocene ostracodes from Sinai,Egypt: Systematics, biostratigraphy and paleobiogeography. *Revue Paléobiologie Genève*. Vol. 24, No. 2, pp. 749-779.
- Shirazi, B.G., Bakhshandeh, L., Yazdi, A., 2014. Paleoecology of Upper Cretaceous Sediments in Central Iran, Kerman (Bondar-e Bido Section) Based on Ostracods. *Marine Science*, 4(2): pp. 49-57.
- Smith, J.K., 1978. Ostracoda of the Prairie Bluff Chalk, Upper Cretaceous (Maestrichtian) and the Pine Barren Member of the Clayton Formation, Lower Paleocene (Danian) from exposures along Alabama State Highway 263 in Lowndes County, Alabama.

Transactions of the Gulf Coast Association of Geological Societies 28, 539–580.  
Teeter, W., 1975. Distribution of Holocene marine Ostracoda from Belize. American Association of Petroleum Geologists Studies in Geology. 2, pp. 400–499.

Triebel, E., 1954. *Loxoconchella* n. g. (Crust. Ostr.) Senckenb. Leth., 35, (1/2), 17-21, 2 Pls.

Wagner, C.W., 1957. Sur les ostracodes du Quaternaire Recent des Pays-Bas et leur utilisation dans l'étude géologique des dépôts Holocènes. Université de Paris, Thèse de la Faculté des Sciences, 259 P.

**Plate (1):** Scale 1 bar = 100  $\mu$ m. Fig. (1) *Cytherella ragubaensis* El Sogher, 1991. Carapace, LV.; Fig. (2) *Cytherella tuberculifera* Alexander, 1929. Carapace, LV.; Fig. (3) *Cytherella sorrensis* El Sogher, 1991. Carapace, LV.; Fig. (4) *Cytherella semicatillus* Ceolin *et al.*, 2015. Carapace, LV.; Fig. (5) *Cytherella cf. sinaensis* Morsi, 1999. Carapace, LV.; Fig. (6) *Cytherella truncata* (Bosquet), 1847. Carapace, LV.; Fig. (7) *Cytherella* spp. Shirazi *et al.*, 2014. Carapace, LV.; Fig. (8) *Cytherella* sp. Luger, 2018. Carapace, LV.; Fig. (9) *Cytherelloidea melleguensis* Damotte and Said, 1984. Carapace, RV.; Fig. (10) *Bairdia dianaensis* Aziz, 2019. Valve, RV.; Fig. (11) *Bairdia ilaroensis* Reymont and Reymont, 1959. Carapace, RV.; Fig. (12) *Bairdia austracretacea* Bate, 1972. Carapace, RV.; Fig. (13) *Bairdia septentrionalis* Bonnema, 1941. Carapace, RV.; Fig. (14) *Bairdia* sp. aff. *Bairdia ilaroensis* El Sogher, 1991. Carapace, RV.; Fig. (15) *Bairdia* sp.1 Luger, 2018. Carapace, RV.; Fig. (16) *Bairdia* sp. Carapace, RV.; Fig. (17) *Bairdoppilata magna* (Alexander, 1927). Carapace, RV.; Fig. (18) *Bairdoppilata* spp. Shirazi *et al.*, 2014. Carapace, RV.; Fig. (19) *Bairdoppilata* sp.1 Piovesan *et al.*, 2009. Valve, RV.; Fig. (20) *Bairdoppilata* sp. Luger, 2018. Valve, RV.; Fig. (21) *Bythocypris adunca* Esker, 1968. Carapace, RV.; Fig. (22) *Bythocypris urbana* El-Waer, 1992. Carapace, RV.; Fig. (23) *Argilloecia concludus* Ceolin *et al.*, 2015. Carapace, LV.; Fig. (24) *Argilloecia* sp.2 Piovesan *et al.*, 2009. Carapace, LV.; Fig. (25) *Abyssocypris tipaca* Bold, 1974. Carapace, RV.; Fig. (26) *Abyssocypris adunca* (Esker, 1968). Carapace, RV.; Fig. (27) *Abyssocypris* sp. AL-Ubidee, 1989. Carapace, RV.; Fig. (28) *Pontocyprilla rara* El-Waer, 1992. Valve, RV.; Fig. (29) *Pontocyprilla recurva* Esker, 1968. Carapace, RV.; Fig. (30) *Paracyprideis IRC20* Grosdidier, 1973. Carapace, RV.



Plate (1)

**Plate (2):** Scale 1bar = 100  $\mu$ m. Fig. (1) *Paracypris sokotoensis* Reyment, 1981. Carapace, RV.; Fig. (2) *Paracypris bertelsae* Ceolin *et al.*, 2015. Carapace, RV.; Fig. (3) *Paracypris nigeriensis* Reyment, 1960. Carapace, RV.; Fig. (4) *Paracypris* spp. Shirazi *et al.*, 2014. Carapace, RV.; Fig. (5) *Krithe solomoni* Honigstein, 1984. Carapace, RV.; Fig. (6) *Krithe aljurfae* El-Waer, 1992. Carapace, RV.; Fig. (7) *Krithe echolsae* Esker, 1968. Carapace, RV.; Fig. (8) *Parakrithe crolifa* Bassiouni and Luger, 1990. Carapace, RV.; Fig. (9) *Parakrithe kalambainaensis* (Reyment, 1981). Carapace, RV.; Fig. (10) *Cuneocythere (Monsmirabilia) altinota* Al-Furaih, 1976. Carapace, RV.; Fig. (11) *Ovocytheridea AUR1469* Grekoff, 1951. Carapace, RV.; Fig. (12) *Dolocytheride aff. D. atlasica* Bassoullet and Damotte, 1969. Carapace, RV.; Fig. (13) *Cushmanidea* sp. Crane, 1965. Carapace, RV.; Fig. (14) *Haplocytheridea monmouthensis* (Berry, 1925). Carapace, RV.; Fig. (15) *Perissocytheridea jandairensis* Piovesan *et al.*, 2014. Valve, RV.; Fig. (16) *Schuleridea* sp. Gizli, 2017. Carapace, RV.; Fig. (17) *Brachycythere ventrocomplanatus* Delicio *et al.*, 2000. Carapace, RV.; Fig. (18) *Brachycythere dakhlaensis* El- Sweify, 1984. Carapace, RV.; Fig. (19) *Brachycythere tumida* Al-Furaih, 1985. Carapace, RV.; Fig. (20) *Brachycythere* sp. [OMN2] Athersuch, 1988. Carapace, RV.; Fig. (21) *Kaesleria trahea* (Al-Furaih), 1980. Carapace, RV.; Fig. (22) *Cytherura zeltensis* El Sogher, 1991. Carapace, RV.; Fig. (23) *Semicytherura* sp. B. El Sogher, 1991. Carapace, LV.; Fig. (24) *Cytheropteron (Infracytheroperon) anotum* Bate, 1972. Carapace, LV.; Fig. (25) *Tanzanicythere* sp. Ahmad 1977. Carapace, RV.; Fig. (26) *Copytus* sp. Ceolin *et al.*, 2015. Carapace, RV.; Fig. (27) *Loxoconchella* sp. Carapace, RV.; Fig. (28) *Paraphysocythere palaeoalbiensis* Luger, 2018. Carapace, RV.; Fig. (29) *Keijia circulodictyon* Ceolin and Whatley, 2015. Carapace, RV.

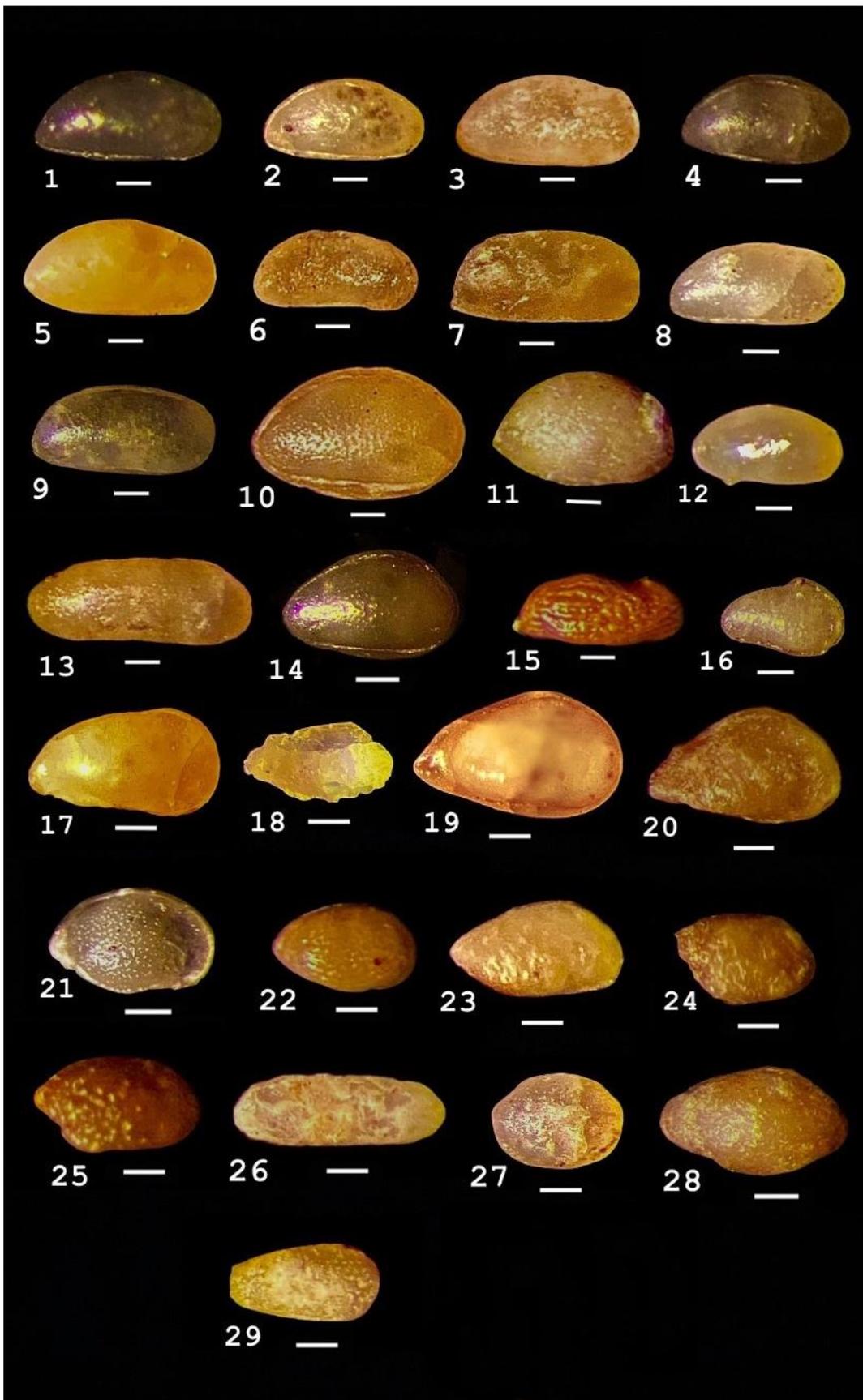


Plate (2)