



New Ostracoda Species in the Upper Part of the Tanjero Formation (Late Maastrichtian), Sulaimaniya City, Kurdistan Region-NE- Iraq

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Article info	Abstract
Original: 18 March 2020 Revised: 6 May 2020 Accepted: 23 August 2020 Published online: 20 December 2020	The present work is focused on the ostracoda study from the upper part of the Tanjero Formation (Late Maastrichtian), Qlyassan area, Sulaimaniya city, Northeastern Iraq. The Tanjero Formation in Qlyassan section (5 m thick) consists of brownish grey to dark gray marl to silty marl with thin graded sandstone, more than one hundred specimens picked up, fourteen species from nine genera of ostracods were identified and illustrated in the upper unit of the Tanjero Formation. Three new species from the fourteen identified species are recognized which are <i>Cytherella sulaimaniensis</i> sp. nov., <i>Cardobairdia tanjeroiensis</i> sp. nov. and <i>Pontocyprella qlyasaniensis</i> sp. nov. These three new species support the age of the Tanjero Formation as the Late Maastrichtian (Upper Cretaceous).
Key Words: Ostracoda, New Species, Upper Cretaceous (Maastrichtian), Tanjero Formation, Sulaimaniya City, Northeast Iraq.	

Introduction

Tanjero Formation was first described and named by Dunnington 1952 [4]. The type section of this formation located at Sirwan valley near Halabja town. According Bellen et al. 1959, the type section consists of two units, lower comprises of marl, siltstone and occasional beds of argillaceous limestone, while the upper comprise silty marl, sandstone, sandy or silty organic detrital limestone and conglomerate. However, Abdel-Kireem [1] focused on the study of foraminifera and stratigraphy of Tanjero Formation and subdivided the formation into three units. The thickness of the Tanjero Formation is about 2000 meters in the type section [8]. Karim and Surdasy [12-14]; Karim [10-11] studied in detail the basin analysis and sequence stratigraphy of Tanjero Formation. For the first time ostracoda in the Tanjero Formation from Sulaimaniya city were studied by the author. Qlyassan section was selected for this study and samples have been systematically taken from there (see figs 1.1, 1.3). Some of ostracods have been recognized at genus level and for determination of their age I identified and illustrated index fossils of foraminifera (Planktonic and benthonic) associated with ostracods.

Methodology

1. Collected 6 samples systematically of the Tanjero Formation with a thickness 5 m from Qlyassan section (T1a, T1b, T2a, T2b, T3a and T3b) (see fig. 1.1).
2. About 350g of each sample dried by the heater, and immersed in water for one day, then add soda and cooking for 20 minutes, then samples washing and sieves.
3. Dried samples in the oven then put it into a vial and later spread in a tray and ostracoda picked up under binocular microscopy.
4. After studying and took images under binocular microscopy was applied for identification.

- All material is deposited in the Geological Department, College of Science, University of Sulaimani, Kurdistan region underneath the list of the number TQ.

Geological Setting

The studied area located at the southern part of the boundary of Zagros Thrust Belt (Z.T.B.), which is settled from the basin fill of the Neo-Thethys [5]. According to Buday and Jassim, [6], structurally, the studied area is suited at the High Folded Zone (H. F. Z.).

Previous work

Abundant studies have been done of the Tanjero Formation from the Sulaimaniya area (for instance sedimentological and stratigraphical study), but there has not any study about ostracoda (see table 1.1).

Table 1.1. Previous works have been done of the Tanjero Formation at Sulaimaniya area.

Location	Authors	References
Planktonic Foraminifera and Stratigraphy of the Tanjero Formation (Maastrichtian), Northeastern Iraq	Abdel-Kireem	[1, 2]
Basin analysis of Tanjero Formation in Sulaimaniya area, NE-Iraq	Kamal Haji Karim	[10]
Sequence Stratigraphy of Upper Cretaceous Tanjero Formation in Sulaimaniya Area.	Karim and Surdasy	[14]
Tanjero Formation in Chwarta area.	Khalid M. Sharbazheri	[21]
Tanjero Formation in Smaqli, Barzinja, Dokan, Qala Cholan, Sirwan valley, Gali area.	Khalid M. Sharbazheri	[22]
Origin of Fossiliferous Limestone Beds outside the Upper Part of Tanjero Formation at the Northwest of Sulaimaniya Area, Kurdistan Region, NE-Iraq.	Kamal Haji Karim and Khalid M. Sharbazheri	[15]
Sedimentary Facies Analysis of the Tanjero Formation in Sulaimaniya District, NE-Iraq.	Ibrahim Muhammad Jaza	[9]

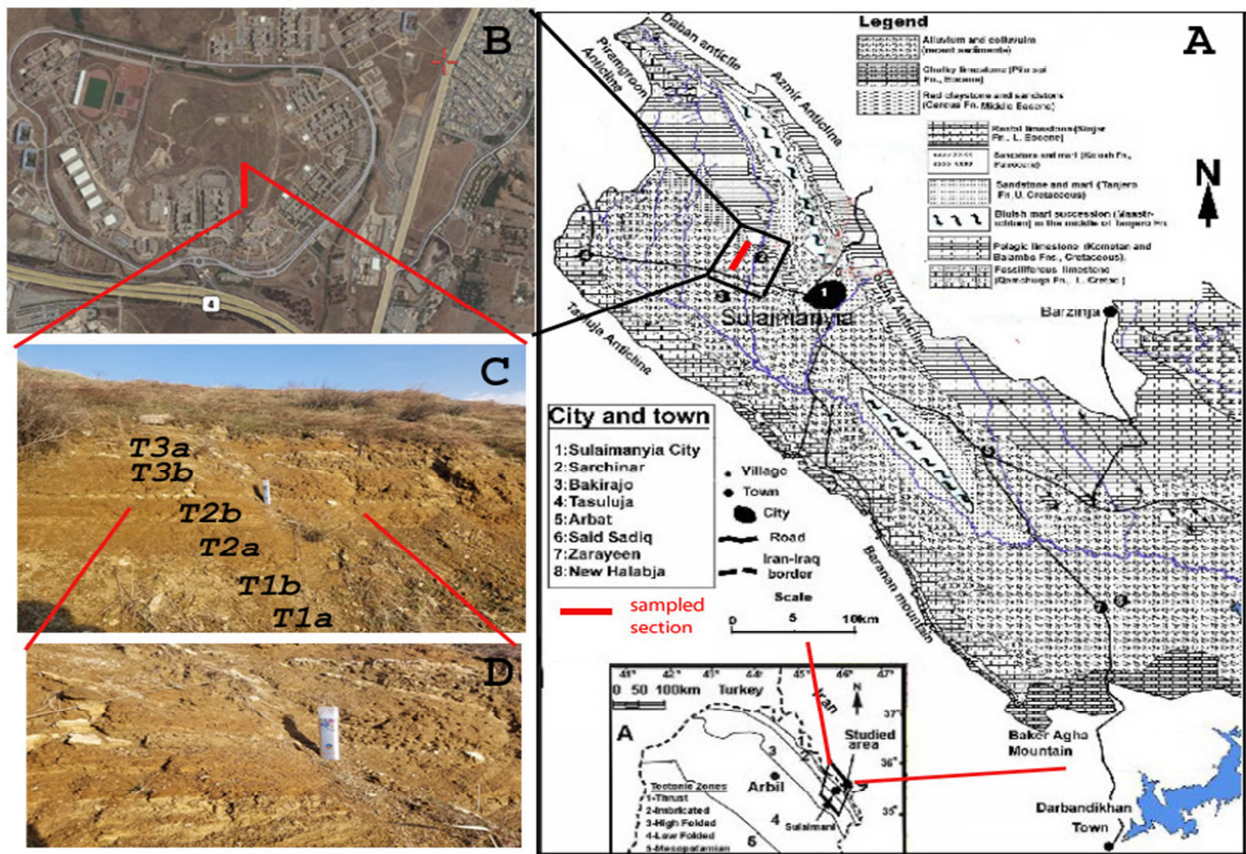


Fig. 1.1. A. Geological map of the studied area (after Karim and Sharbazheri 2015), B. location of the studied area, C and D section of the studied area (Qlyasan section).

Age			Fm	S.No	Lithology	Lithologic Description	Ostracods Species distribution
Late Cretaceous Maastrichtian Late	Tanjero Formation	4	T3a	~ ~ ~ ~	Brownish grey to dark grey softy fiscile silt, marl with thin graded sst.		
		3	T3b	~ ~ ~ ~	marl		
		2	T2b	~ ~ ~ ~	Greenish friable silty shale, interbedded with very thin sanastone		
			T2a	~ ~ ~ ~	marl		
		1	T1b	~ ~ ~ ~	Brownish yellow, friable silty marl		
		0	T1a	~ ~ ~ ~			

Fig. 1.2. Stratigraphic column of the Tanjero Formation (Qiyasan section).

Qiyasan Section

Qiyasan section located at the Qiyasan area in Sulaimaniya city at latitude 35°33'53"N and Longitude 45°25'58"E, which is placed approximately in side of new campus of University of Sulaimani, its opposite Sara Mountain (see Fig 1.1, Fig 1.3).



Fig. 1.3. Determination of the Qiyasan section (Upper unit of the Tanjero Formation).

Systematic Descriptions

The abbreviations of the ostracoda have been used in the paper text: RV (right valve), LV (left valve), D (dorsal), V (ventral), C (carapace), V (valve), T (samples number in the Tanjero Formation). Identified 14 species belongs to 9 genera and described three new species (see table 1.2).

Table 1.2. General taxonomic structure of the Late Maastrichtian ostracod fauna of the upper unit of the Tanjero Formation, Qlyasan section, Sulaimaniya city, Kurdistan region, NE-Iraq.

Class	Order	Suborder	Family	Genus	Species
Ostracod	Podocopida	Bairdiocopina	Bairdiidae	<i>Bairdoppilata</i>	<i>Bairdoppilata</i> sp1. <i>Bairdoppilata</i> sp2.
		Unknown	Bythocyprididae	<i>Bythocypris</i>	<i>Baythocypris brownie</i>
		Platycopina	Cytherellidae	<i>Cytherella</i>	<i>Cytherella sulaimaniensis</i> sp. nov.
					<i>Cytherella</i> sp. A.
				<i>Staringia</i>	<i>Staringia</i> sp.
		Metacopa	Saipanettidae	<i>Cardobairdia</i>	<i>Cardobairdia tanjeroiensis</i> sp. nov. <i>Cardobairdia</i> sp
		Unknown	<u>Pontocyprididae</u>	<i>Pontocyprilla</i>	<i>Pontocyprilla qlyasanensis</i> sp. nov.
		Cypridocopina	Candonidae	<i>Paracypris</i>	<i>Paracypris</i> sp. A. <i>Paracypris</i> sp. B.
		Cytherocopina	Limnocytheridae	<i>Frambocythere</i>	<i>Frambocythere</i> sp.
		Podocopina	Xestolebrididae	<i>Xestoleberis</i>	<i>Xestoleberis</i> sp.

Systematic descriptions

Phylum Arthropoda Siebold and Stannius, 1845

Subphylum Crustacea Pennant, 1777

Class Ostracoda Latreille, 1802

Subclass Podocopa Sars, 1866

Order Podocopida Muller, 1894

Suborder Platycopina Sars, 1866

Family Cytherellidae Sars, 1866

Genus *Cytherella* Jones, 1849

Type Species: *Cytherina ovate* Roemer, 1840

Cytherella sulaimaniensis sp. nov. Pl. 1, figs 3, 4, 5

Derivation of name. From its occurrence in the Sulaimaniya City area, North Iraq.

Holotype. Tanjero Formation (Late Maastrichtian) Sulaimaniya city, NE Iraq, Samples No. T1a, T1b, T2a, T2b, T3 and T3b.

Materials. 10 specimens.

Measurements. Length of valves between 1.0 to 1.2 mm and height of valves between 0.55 to 0.75 mm (see Fig. 2.11).

Diagnosis. Posterior margin wider (larger) than anterior margin, surface punctate.

Description. Carapace is sub-ovate to elongate in lateral view, posterior and anterior margins rounded, dorsal and ventral margins convex. Posterior side larger than anterior side, maximum high at the posterior side. No spines, Hinge line straight. Symmetrical valves. The surface of valves punctate.

Occurrence. Upper unit of the Tanjero Formation, Sulaimaniya city, Kurdistan region, NE-Iraq.

Remarks. *Cytherella sulaimaniensis* differs from other species of the genus *Cytherella* in the Tanjero Formation (see table 1.3).

Table 1.3. Comparison of Upper Cretaceous species of *Cytherell* from the Tanjero Formation, Qlyasan section.

Species	Length and height of Carapace (mm)	Type of ornament	Diagnostic features	References
<i>Cytherella sulaimaniensis</i> sp. nov.	1.2-0.75	punctate	Punctate surface , posterior side wider than anterior side.	Present study
<i>Cytherell</i> sp. A.	0.85-0.65	Smooth	Slightly depression in the posterior.	Present study
<i>Cytherell</i> sp. B.	1.0-0.7	Smooth	Slightly depression in both side (posterior and anterior)	Present study
<i>Cytherella omariansis</i>	0.84-0.55	Smooth	Blunt and broadly rounded anterior end.	[3]
<i>Cytherella suranensis</i>	0.86-0.52	Smooth	Having well developed depression in the half anterior.	[3]

Class Ostracoda Latreille, 1802

Subclass Podocopa Sars, 1866

Order Podocopida Muller, 1894

Suborder unknown

Subfamily Pontocypridinae Muller, 1894

Genus *Pontocyprrella* Lyubimeova, 1955

Type species: *Pontocyprrella recurva* Esker, 1968

***Pontocyprrella qlyasaniensis* sp. nov. Pl. 2, figs 2, 7**

Derivation of name. From it is the Qlyasan area, Sulaimaniya city in NE-Iraq.

Diagnosis. *Pontocyprrella qlyasaniensis* of the genera *Pontocyprrella* characterized by anterior and posterior margin well rounded maximum height in mid.

Holotype. Tanjero Formation (Late Maastrichtian) Sulaimaniya city, NE Iraq, Samples No. T1a, T1b, T2a, T2b, T3a and T3b.

Materials. 8 specimens.

Measurements. Length of valve 1.45 mm and height of valve 0.75 mm.

Description. Carapace elongate in lateral view. Asymmetrical valves, dorsal margin concaves, ventral margin slightly concave, posterior and anterior margin rounded. Short hinge line. Maximum high at mid. Valve surface smooth.

Remarks. This specimens larger than the other species of the genus *Pontocyprrella* and both margins side posterior and anterior are rounded.

Occurrence. Upper unit of the Tanjero Formation, Sulaimaniya city, Kurdistan region, NE-Iraq.

Class Ostracoda Latreille. 1802

Subclass Podocopa Sars, 1866

Order Podocopida G.W. Miiller, 1894

Suborder Metacopa Sylvester-Bradley, 1967

Superfamily Healdiacea Harlton, 1933

Family Saipanettidae McKenzie, 1968

Genus *Cardohairdia* Bold, 1960

***Cardobairdia tanjeroiensis* sp. nov. Pl. 2, figs 1, 6**

Derivation of name: From its occurrence in the Tanjero Formation.

Holotype. Tanjero Formation (Late Maastrichtian) Sulaimaniya city, NE Iraq, Samples No. T1a, T1b, T2a, T2b, T3a and T3b.

Diagnosis. *Cardobairdia tanjeroiensis* belonging to the genus *Cardobairdia*, distinguished by: rounded of the margin in the anterior and posterior margins.

Materials. 10 carapaces and broken valve.

Measurements. Length of valve 0.95 mm and height of valve 0.5 mm (see table 1.4).

Description. Carapace are sub-ovate in lateral view, a symmetrically rounded posterior and anterior margin. The ventral and dorsal margin is convex. The right and left valves are sub-triangular in shape, with swollen sides. The ventral and dorsal borders are gently convex. Right valve overlapping the left valve around the entire border. Surface is smooth.

Remarks. *Cardobairdia tanjeroiensis* varies from other species of the genus *Cardobairdia* in the Tanjero Formation (see table 1.4).

Occurrence. Upper unit of the Tanjero Formation, Sulaimaniya city, Kurdistan region, NE-Iraq.

Table 1.4. Comparison of Upper Cretaceous species of *Cardobairdia* from the Tanjero Formation, Qlyasan section.

Species	Length and height of Carapace (mm)	Type of ornament	Diagnostic features	References
<i>Cardobairdia tanjeroiensis</i> sp. nov.	0.95-0.5	Smooth	Posterior and anterior side well rounded	Present study
<i>Cardobairdia</i> sp	0.9-0.45	Smooth	Slightly depression on the anterior side.	Present study

EXPLANATION OF PLATE 1

Light photography

Fig. 1, 6. *Xestoleberis* sp. Tanjero Formation samples T1a, T1b, T2a, T2b, T3a and T3b.

1. Carapace, left lateral view x40.

6. Carapace, right lateral view x40.

Fig. 2. *Staringia* sp. Tanjero Formation sample x, carapace, right lateral view x40. T1a, T1b, T2a, T2b, T3a and T3b.

Fig. 3-5. *Cytherell sulaimaniensis* sp. nov. Tanjero Formation sample T1a, T1b, T2a, T2b, T3a and T3b.

3. carapace, right lateral view x40, 4. carapace, right lateral view x40, 5. carapace, left lateral view x40.

Fig. 7. *Frambocythere* sp. Tanjero Formation samples T1a, T1b, T2a, T2b, T3a and T3b.

Carapace, right lateral view x40.

Fig. 8, 9, 10. *Cardobairdia* sp. Carapace, samples T1a, T1b, T2a, T2b, T3a and T3b, left and right lateral views x40, Tanjero Formation.

EXPLANATION OF PLATE 2

Light photography

Fig. 1, 6. *Cardobairdia tanjeroiensis* sp. nov. Tanjero Formation samples T1a, T1b, T2a, T2b, T3a and T3b, right and left valves, lateral view x40.

Fig. 2, 7. *Pontocyprilla qlyasaniensis* sp. nov. Tanjero Formation samples T1a, T1b, T2a, T2b, T3a and T3b, carapace, right lateral view x40.

Fig. 3, 9. *Baythocypris brownie* Jones and Hinde, 1890 Tanjero Formation samples T1a, T1b, T2a, T2b, T3a and T3b. Carapace, left lateral view x40.

Fig. 4, 10. *Paracypris* sp. A. Tanjero Formation samples T1a, T1b, T2a, T2b, T3a and T3b, carapace, right lateral view x40.

Fig. 5. *Paracypris* sp. B. Tanjero Formation samples T1a, T1b, T2a, T2b, T3a and T3b.

Fig. 8. *Cytherell* sp. A. Carapace, sample T3a and T3b, right lateral view x40, Tanjero Formation. T1a, T1b, T2a, T2b, T3a and T3b.

PLATE 1

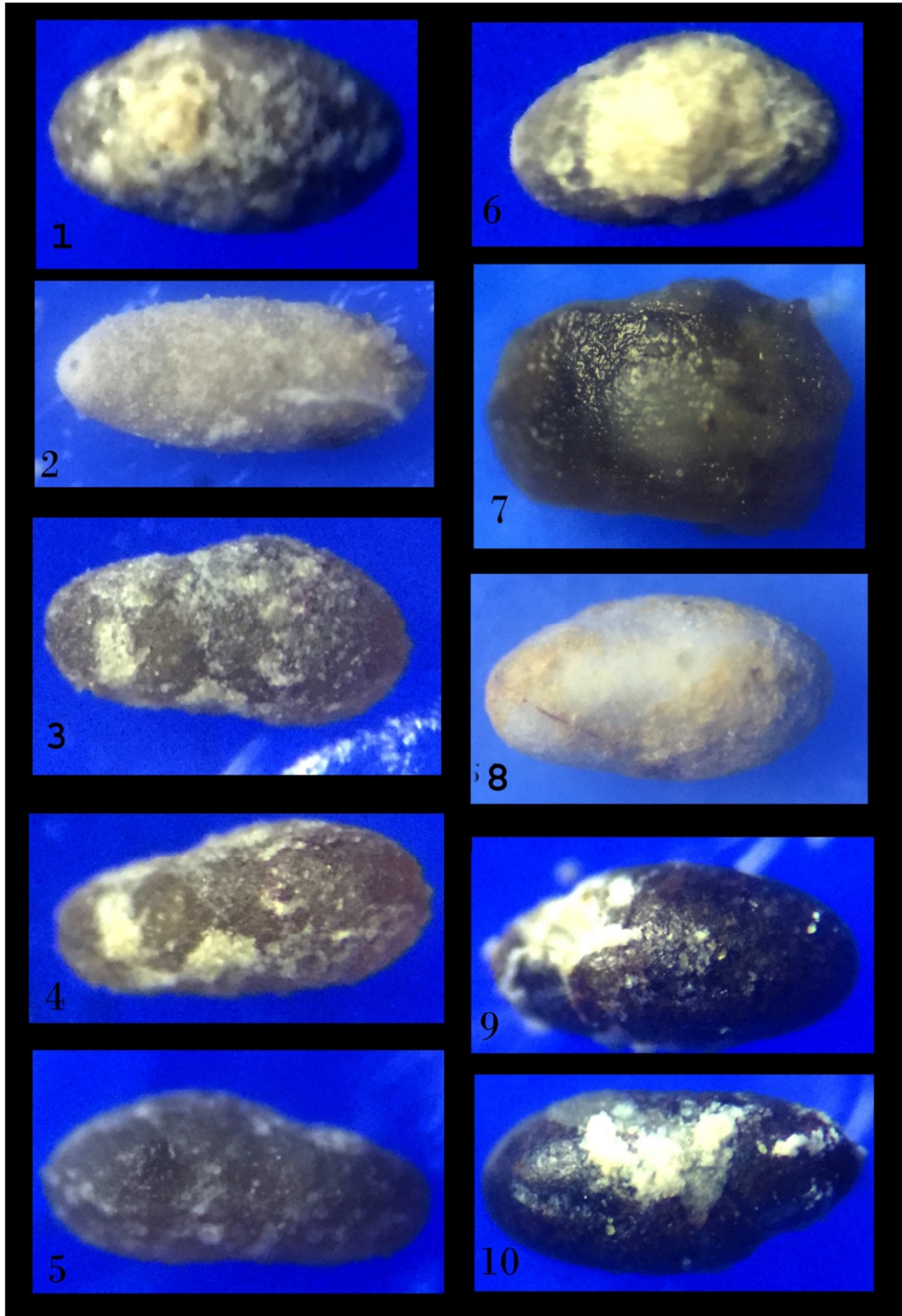
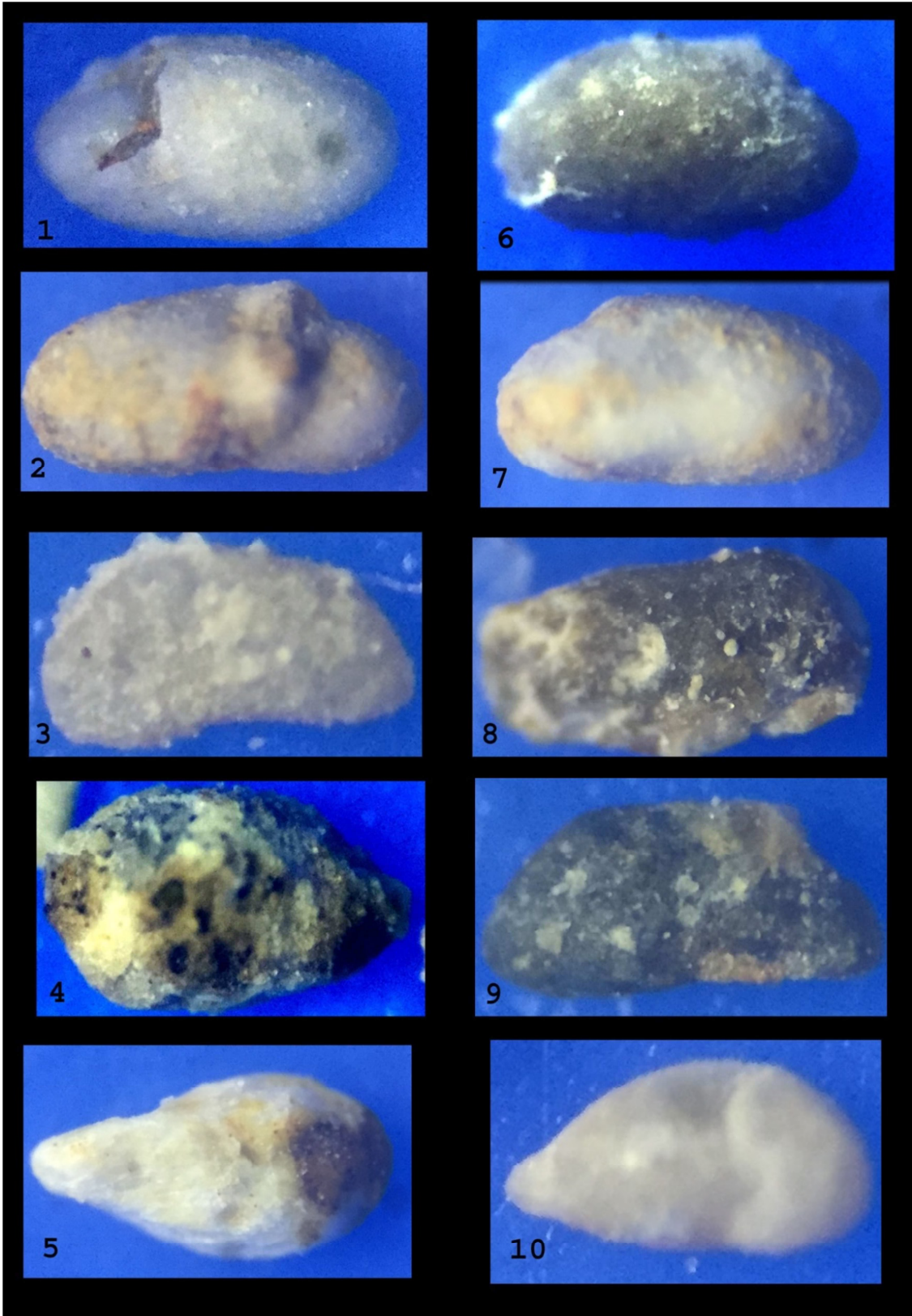


PLATE 2



EXPLANATION OF PLATE 3

Light photography

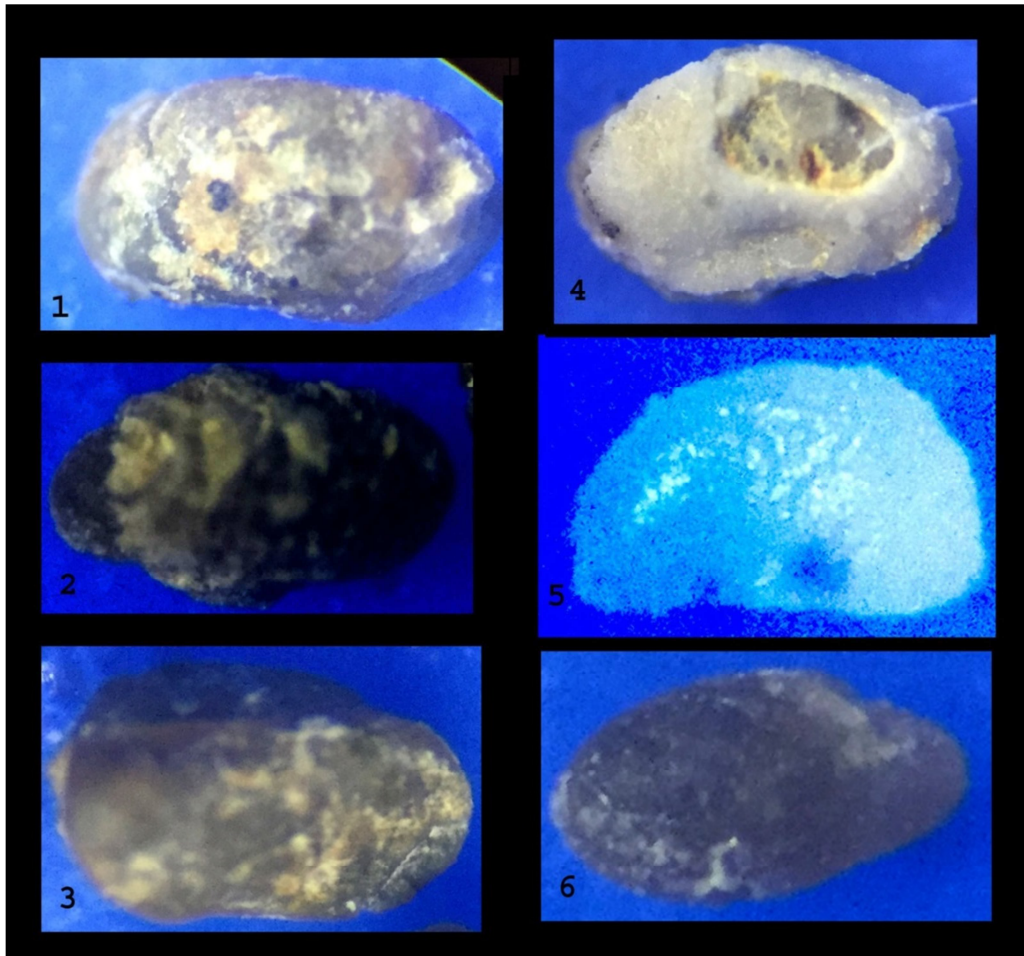
Fig. 1, 2, 3. *Cytherell* sp. B. Tanjero Formation samples T1a, T1b, T2a, T2b, T3a and T3b, carapace, right and left lateral view x40.

Fig. 4. *Bairdoppilata* sp1. Tanjero Formation samples T1a, T1b, T2a, T2b, T3a and T3b, carapace , Left lateral view x40.

Fig. 5. *Bairdoppilata* sp2. Tanjero Formation lower member samples T1a, T1b, T2a, T2b, T3a and T3b

Fig. 6. *Paracypris* sp. B. Carapace, samples T1a, T1b, T2a, T2b, T3a and T3b, left lateral view x40, Tanjero Formation.

PLATE 3



Age determination

The following foraminifera species picked up with ostracoda from the studied section (Qlyasan section) referred to Late Maastarichtian, named and identified depends on Sharbazheri, 2008: *Hedbergella monmuthensis* (Olsson), *Dentalinoides canulina*. Marie, *Oolina apiculata*. Reuss, *Dentalina inornata*. (d, Orbigny), *Gyroidinoides globosus*. (Hagenow), *Praebulimina carseyae* (Plummer), *Osangularia navarrana* (Cushman) (see plate 4).

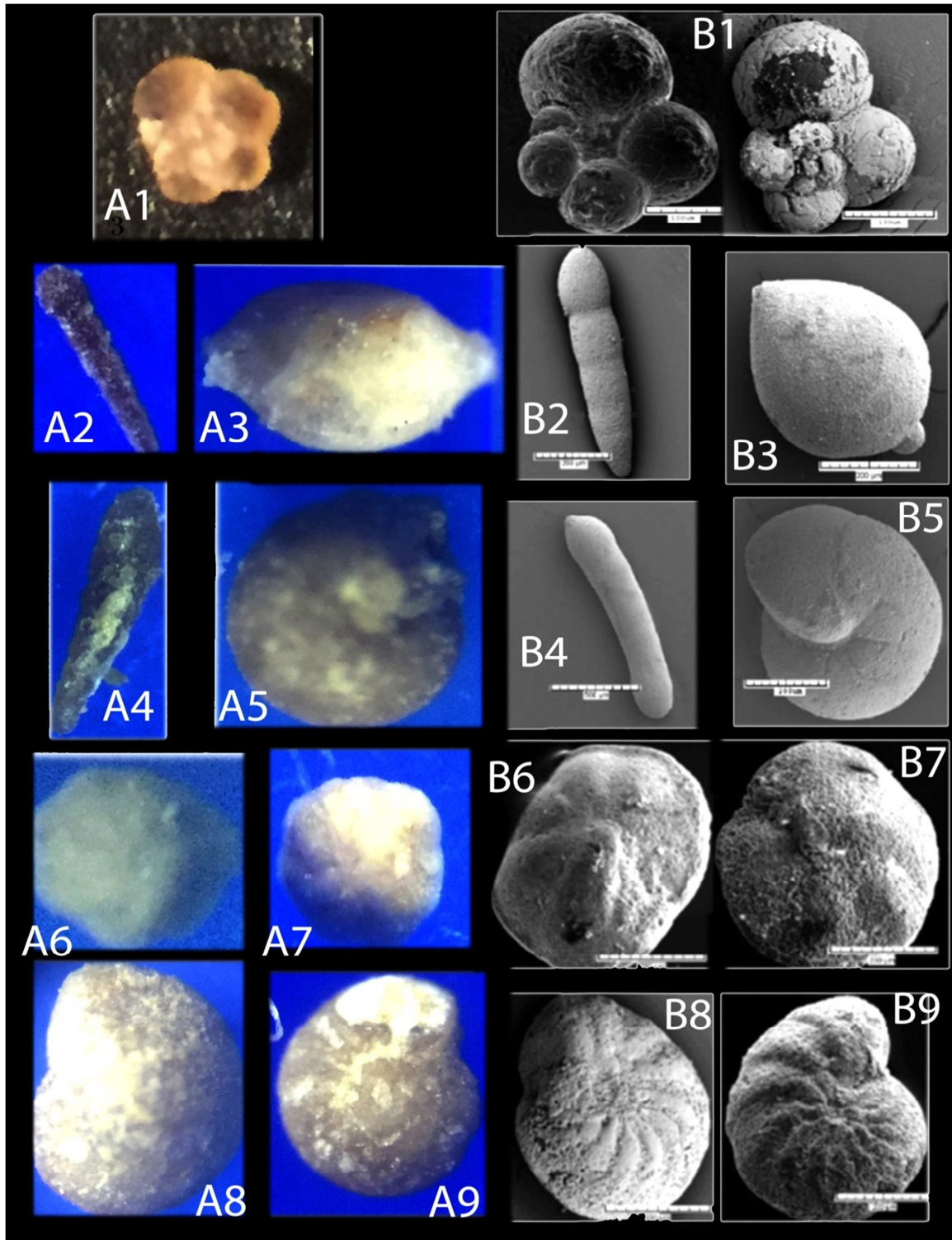
EXPLANATION OF PLATE 4

- (A1-A9) Light photograph (collected from this studied section).
- (B1-B9) Scanning Electronic Microscope (S.E.M.) by Sharbazheri, 2008, from the Tanjero Formation in the Kato, Dokan and Smaquli sections Late Maastichtian.

A1, B1. *Hedbergella monmuthensis* (Olsson). Samples T1a, T1b, T2a, T2b, T3a and T3b

- A2, B2. *Dentalinoides canulina*. Marie. Samples T1a, T1b, T2a, T2b, T3a and T3b
 A3, B3. *Oolina apiculata*. Reuss. Samples T1b, T2a, T3a and T3b
 A4, B4. *Dentalina inornata*. (d, Orbigny). Samples T1a, T1b, T2a, T2b, T3a and T3b
 A5, B5. *Gyroidinoides globosus*. (Hagenow). Samples T1a, T1b, T2a, T2b, T3a and T3b
 A6, B6. *Cibicides subcarinatus* Cushman & deaderi. Samples T1a, T2a, T2b and T3a.
 A7, B7. *Cibicides subcarinatus* Cushman & deaderi. Samples T1a, T1b, T2a and T3a.
 A8, B8. *Osangularia navarrana* (Cushman). Samples T1a, T1b, T2a and T3a.
 A9, B9. *Osangularia navarrana* (Cushman). Samples T1a, T1b, T2a and T3b

PLATE 4



Conclusion

1. Upper part of the Tanjero Formation (Late Maastichtian), in the Qlyasan area was studied for the first time.
2. Three new species of Ostracoda are recorded from the fourteen species which investigated in the upper unit of the Tanjero Formation (Late Maastichtian), Qlyasan section, Sulaimaniya city.
3. Three new species, illustrated and described systematically in detail.
4. Recorded Ostracoda species support that the age of the upper part of the Tanjero Formation to be Late Maastichtian (Upper Cretaceous).
5. Abundant Foraminifera (Planktonic and Benthonic) preserved in this section which determined the age as the Late Maastichtian for the upper unit of the Tanjero Formation.

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