TWO NEW SPECIES OF RUDIST FROM AQRA FORMATION (MAASTRICHTIAN), KURDISTAN REGION, IRAQ

Salam. I. Al-Dulaimi[1] and Sa'ad S. Al-Sheikhly[2]

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ABSTRACT

Two new species of rudist (*Dictyoptychus acutidentatus* n.sp.; *Dictyoptychus mukabaensis* n.sp.) have been described from the Maastrichtian Aqra Formation in Iraq. Rudist species and other associated microfossils indicate a Maastichtian age.

The depositional environment of Aqra Formation is determined by the occurrence of the rudist, foraminifera, and microfacies analysis. These gave a clue that the formation was deposited over an elongated discontinuous paleo-ridge that extended from North West towards South East of Iraq, and they indicate a shallow warm marine environment, with high energy at the beginning graded upward to low/ medium energy. The deposition of the formation was characterized by high rate of sedimentation and frequent relative sea level fluctuation.

نوعان جديدان من الرودست في تكوين عقرة (ماسترختيان)، اقليم كردستان، العراق

سلام اسماعيل الدليمي و سعد سامي الشيخلي

المستخلص

تم تحديد ووصف نوعين جديدين من الرودست (Dictyoptychus acutidentatus n.sp.، Dictyoptychus mukabaensis n.sp.) في تكوين عقرة (ماسترختيان) في أقليم كردستان شمال العراق. ومن خلال دراسة الرودست والمتحجرات الدقيقة المصاحبة للنوعين الجديدين تم تحديد عمرهما بالماسترختيان.

أما البيئة الترسيبية للتكوين فقد تم تحديدها اعتمادا على بيئة الرودست والفورامينيفرا إضافة إلى السحنات الدقيقة، والتي أثبتت أن التكوين ترسب على حاجز طولي قديم غير مستمر أمتد من الشمال الغربي إلى الجنوب الشرقي من شمال العراق، ضمن ظروف بيئية بحرية ضحلة دافئة وذات طاقة عالية في بداية الترسيب تدرجت إلى طاقة متوسطة أو قليلة في الجزء الأوسط والأعلى للتكوين. امتاز التكوين بنسبة عالية من الترسبات وتذبذب متكرر لمستوى سطح البحر.

INTRODUCTION

The Aqra Formation (Upper Cretaceous) is well exposed in Kurdistan region, north and northeastern Iraq. It forms massive cliffs and comprises reef limestone complex with massive rudist shoal reef, detrital fore reef limestone which is locally dolomitized and shows bitumen impregnations in many parts. The formation wedges out rapidly, towards northwest and southeast, and form tongues within Shiranish and Tanjero Formations (Bellen *et al*., 1959). It is generally characterized by rudists, gastropoda, *Acteonella* sp. and larger foraminifera.

The Aqra Formation was studied in six different localities within Kurdistan Region, Iraq (Table 1) namely, Gulley Zinta, Gulley Abdul Aziz, Gulley Esmawa, Sari-Sada, Mukaba and ZardaBee.

[1] Assistant Professor, Department of Geology, College of Science, University of Baghdad, e-mail: salamrudist@yahoo.com
[2] Professor, Department of Geology, College of Science, University of Baghdad,

Table 1: the location of the selected sections

Select sections	Position	Latitude	Longitude
Gulley Zinta	Aqra-Dinarta area	36° 44' 00" N	43° 58' 20" N
Gulley Abdul Aziz	Aqra city	36° 55' 26" N	43° 55' 26" N
Gulley Esmawa	Aqra – Bakerman area	36° 50' 31" N	43° 39' 20" N
Sari – Sada	Bijel village	36° 45' 36" N	44° 01' 36" N
Mukaba	Mukaba village	35° 43' 26.2" N	45° 27' 48.6" N
Zarda Bee	Zard Bee village	35° 31' 32" N	45° 39' 46.6" N

The two new species were found only in Mukaba section. This section cropping out at Mukaba village, 13 Km northwest of Chowarta Town, along Chowarta – Mawat road (Sulaimaniyah Governorate) (Fig.1).

The lithological characteristics of the Aqra Formation at the Mukaba section consists of 100 m of dolomitized massive rudist bearing gray limestone, with bitumen at the lower part, occurs as tongues within the Tanjero Formation (Fig.2). The Tanjero Formation attains a thickness 280 m, consisting of marl and rare marly limestone, silty limestone, siltstone, conglomerate and silty organic at the upper part.

The aim of this study is mainly to describe the new species of *Dictyoptychus* Douvillem, 1905 from Aqra Formation. All studied material including holotypes are deposited at the department of Earth Science, College of Science, University of Baghdad.

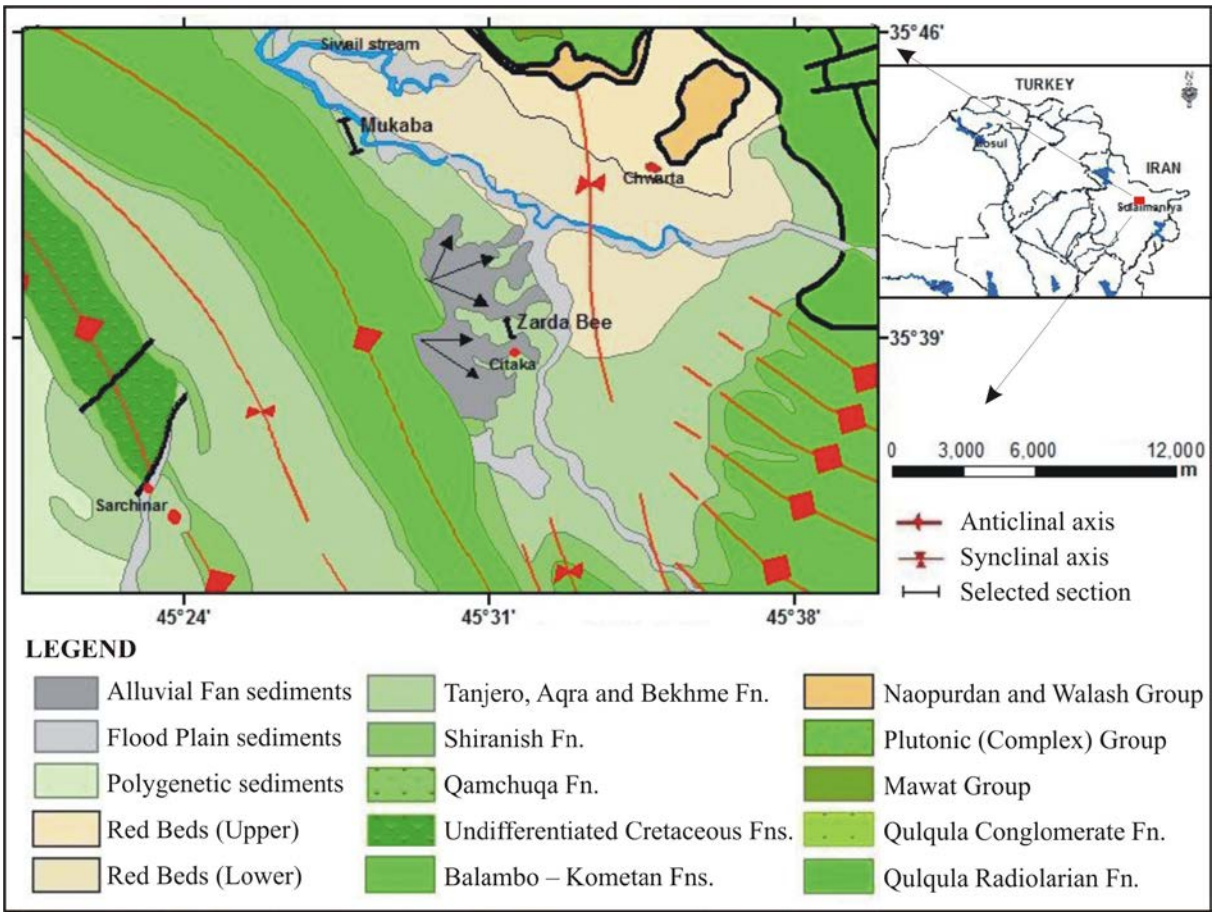

Fig.1: Location and geological map of the studied area
(Modified from Ma'ala, 2008)

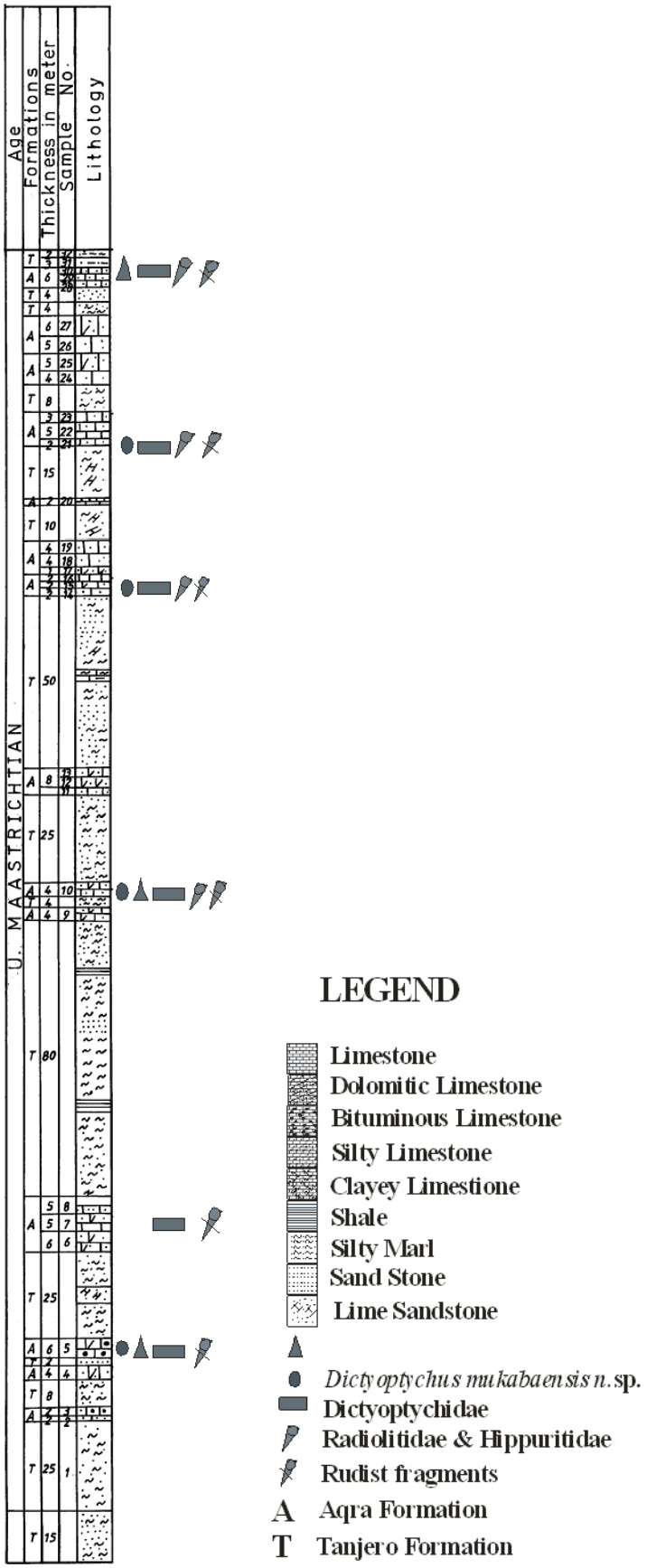

Fig.2: Mukaba stratigraphic section, showing the *Dictyoptychus* level and other rudist

SYSTEMATIC STUDY

▪ **Phylum Mollusca**

– Class Pelecypoda (bivalvia) Linne, 1758
– Subclass Heterodonta Neumayer, 1884
– Order Hippuritoida Newell, 1965
– Superfamily Hippuritoidea Gray, 1848
– Family Dictyoptychidae Skelton, 1993
– Genus *Dictyoptychus* Douville, 1905
– Type Species *Polyptychus morgani* Douville, 1904

▪ ***Dictyoptychus acutidentatus* n.sp.** (Fig.3 and Fig.4; 1, 2, 3, 4 and 5)

─ Derivation of name: *acutus* (L.) sharp, *dentatus* (L.) tooth, with reference to the sharp teeth prolongations in the inner layer of the attached valve.

─ Diagnosis: A species of *Dictyoptychus*, with a conical attached valve, siphoned region with thin longitudinal ribs and tight growth lamellae. Cross-section semicircular. Internal layer contains two to three row of small dense, elongated, polygonal and rectangular canals around the whole periphery of the valve. The inner layer is characterized by prolongetes like sharp teeth. The free valve partly preserved, conical shape, apex eccentric.

─ Holotype: Specimen no.1103

─ Type locality: Mukaba village, NW Chowarta Town.

─ Stratigraphic level: Maastrichtian.

─ Material: Two specimens of the attached valves poorly preserved and one well preserved specimen comprises attached valve and partly preserved free valve.

─ Description: Attached and free valve are two cones with opposite base. Summits of the both valves are situated on a line which cuts the commissure with an angle 65°; therefore, valves are in shape of cones with their summits slid to reverse sides.

Attached valve is conical in shape with eccentric summit, the height is 15 cm with a diameter of 13 cm. Surface is ornamented with dense and fine growth lamellae and broad (12) costae.

Cross-section of the attached valve semicircular and rounded. The maximum thickness of the outer layer is 1.5 – 2 mm, and the inner layer 0.5 – 1.6 cm. The inner layer consists of two to three of small thin walled canals, polygonal and rectangular in form, are situated along antero margin. The inner layer is characterized by 10 – 12 prolongates like sharp teeth, sharpen toward the shell cavity. The costae approximately corresponding with prolongates of the inner layer and separated by fine furrows.

The free valve is partly preserved. It is depressed conical and cap like, 2 cm high; apex is inclined strongly toward the antero-dorsal margin. At the eroded part of the thin external layer, dense and radial canals of the internal layer could be observed.

The presence of one partly preserved specimen make it difficult to obtain across-section of the free valve.

─ Comparison and remarks: *Dictyoptychus acutidentatus* n.sp. resembles *Dictyoptychus orontica* Karacaby-Oztemur, 1979 and *Dictyoptychus quadrizonalis* Ozer, 2005 by the

numerous smaller rectangular canals in the inner wall layer.But differs from them and other species of *Dictyoptychus* such as *Dictyoptychus euphratica* Karacaby-Oztemure, 1992, *Dictyoptychus morgani* (Douville) Ozer, 2008 by the 12 prolongate like sharp teeth of inner layer. These prolongate sharp teeth are located toward the shell cavity.

– **Association:** Rudist fauna such as *Dictyoptychus morgani*, *Dictyoptychus mukabaensis* n.sp., *Dictyoptychus quadrizonalis*, *Hippurites bioculata* and *Lapeirousia jouanneti*, are present and associated with this species. And microfossils, i.e. *Orbitoides medius* (d'Archiac), *Orbitoides apiculatus* Schlumberger, *Siderolites calcitropoides* Lamarck, *Omphalocyclus macroporus* Lamarck present abundantly in matrix filling the valves.

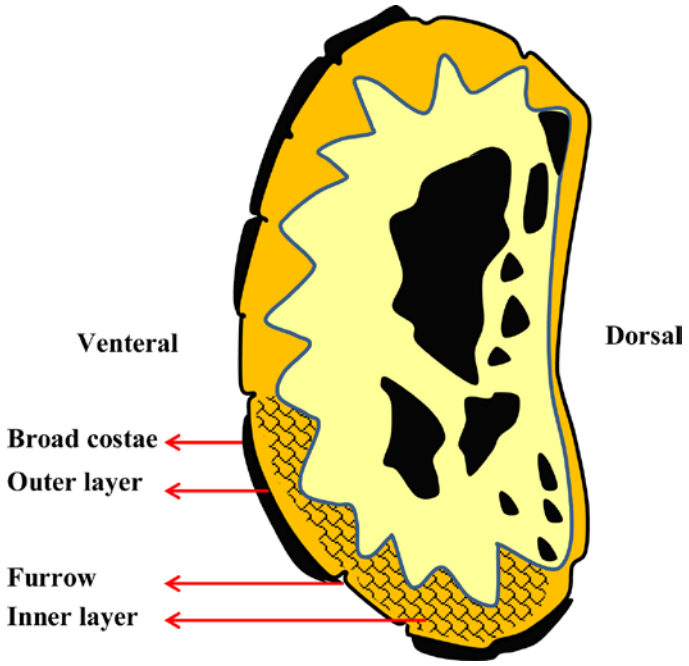

Fig.3: Transverse section showing the canal structures of the inner shell layer of AV of *Dictyoptychus acutidentatus* n.sp.

▪ ***Dictyoptychus mukabaensis* n.sp.** (Fig.5; 1, 2 and 3)
– **Derivation of name:** After the type locality Mukaba village.

– **Diagnosis:** A species of *Dictyoptychus* with attached valve appear as regular cone. Small central cavity, with accessory cavities. Free valve is depressed capuloid in shap.

– **Holotype:** Specimen no.1104.

– **Type locality:** Mukaba village, NW Chowarta Town.

– **Stratigraphic level:** Maastrichtian.

– **Material:** One specimen with two valves.

– **Description:** The attached valve is regular, curved conical in shape. It is 20 cm of height and the width at the commissure is 15 cm. Surface is totally smooth and in some places shows growth lines separated by small furrows. At the siphonal region, there is not any distinct characteristic marking siphonal bands. Cross-section of the attached valve rounded semicircular. The inner shell layer of the attached valve of this species is characterized by two

different types of canals; in the exterior part there are two to three rows of small dense and polygonal canals around the whole periphery of the valve, while the interior part of the layer is characterized by large polygonal canals. Central cavity is small with accessory cavities. The outer layer of the attached valve is 2 – 4 mm in thickness, consisting of two rows.

Free valve is depressed cap-like in shape. Its height is 2 cm. At the eroded part of the free valve, narrow canals could be seen. The thickness of the outer layer is 2 – 4 mm. Internal layer is thick at the dorsal side and thin at the ventral side. The canals of this layer are very thinned wall and broken or not preserved at most places.

– Comparison and remarks: This species resembles *Dictyptychus vanensis* (Ozer, 2010), in having a compressed conical attached valve, with inner layer consisting of polygonal small canals, but in the new species they are arranged in two to three rows, and characterized by small central cavity with clear accessory cavities, while the central cavity *of Dictyoptychus vanensis* occupies more than half of the attached valve cross-section. The interior row of the inner layer is characterized by a large polygonal canals are similar to *Dictyoptychus morgani*, with different disposition (Douville, 1904; Kuhn, 1937; Moore, 1969; Skelton and Gili, 1991; Skelton and El-Asaad, 1992; Pons *et al*., 1992; Skelton, 1995; Morise and Skelton, 1995; Skelton and Smith, 2000; Steuber, 2002; Ozer, 2005, 2008 and 2010; and Khazei *et al*., 2010).

– Association: Rudist fauna such as *Dictyoptychus morgani*; *Dictyoptychus quadrizonalis*; and *Dictyoptychus acutidentatus* n.sp., are associated with this species. The filling brownish grey limestone matrix and the preserved sediments of this species contain the following benthic foraminifera: *Orbitoides medius* (d'Archiac), *Orbitoides apiculatus* Schlumberger; *Siderolites calcitropoides* Lamarek; *Omphalocyclus macroporus* Lamarck; Miliolidae; *Loftusia morgani* Douville.

DEPOSITIONAL MODEL OF ○○AQRA FORMATION

Nearly all the previous studies mentioned that the sediments of Aqra Formation deposited over discontinuous paleo-ridge that extended from Zakho city at northwest to Zarda Bee village at the southeast. This is happened through a transgressive cycle that covered most Iraqi territory at that time (Dunnington, 1953; Buday, 1980; Al-Sheikhly, 1980; Al-Ameri and Lawa, 1986; Jassim and Goff, 2006; Al-Dulaimi, 2011). The transgressive event resulted in forming a shallow warm marine environment prevailed over Aqra ridge. This environment that occurred during the Maastrichtian age was suitable for the flourishing of variety of rudist (Jones and Nicole, 1986; Kauffman and Johnson, 1988). Aqra Formation at the beginning of its deposition is characterized bya mobile, coarse and accompanied by recumbent rudist fragments, beside the presence of benthic foraminifera. Such sedimentation indicates a shallow marine water, high energy, favorable for the flourishing of recumbent rudist such as *Titanosarcolites* sp. in Aqra Formation (Kauffman and Sohl, 1974; Skelton *et al*., 1990 and Skelton and Gili, 1991).

By continuing sea level rise that overwhelm the remaining elevated Aqra ridge by shallow water, with high rate of sedimentation and low to medium energy. Such an environment is an ideal one for the growth of elevator rudist that is located near the shelf margin. This is supported by a finding that the elevator rudist occupies deeper parts of the shelf margin as compared with the recumbent rudist dwell at shallower environment. The Aqra Formation consist mainly of elevator rudist with various sizes including: *Agriopleura* sp.; *Colveria variabilis*; *Biradiolites conaliculatus*; *Distefanella salmojraphii*; *Dictyoptychus morgani*; *D. quadrizonalis*; *D. acutidentatus* n.sp.; *D. mukabansis* n.sp.; *hippurites bioculata*;

hippuritella maestrei; *Thyrastylon adhaerens*, managed to survive at times of high sedimentation rates, but initiate thickets the needed episodes or non-sedimentation. However the cluster rudist mostly dwell in areas of low/ medium energy and discontinuous sedimentation (Skelton and Gili, 1991).

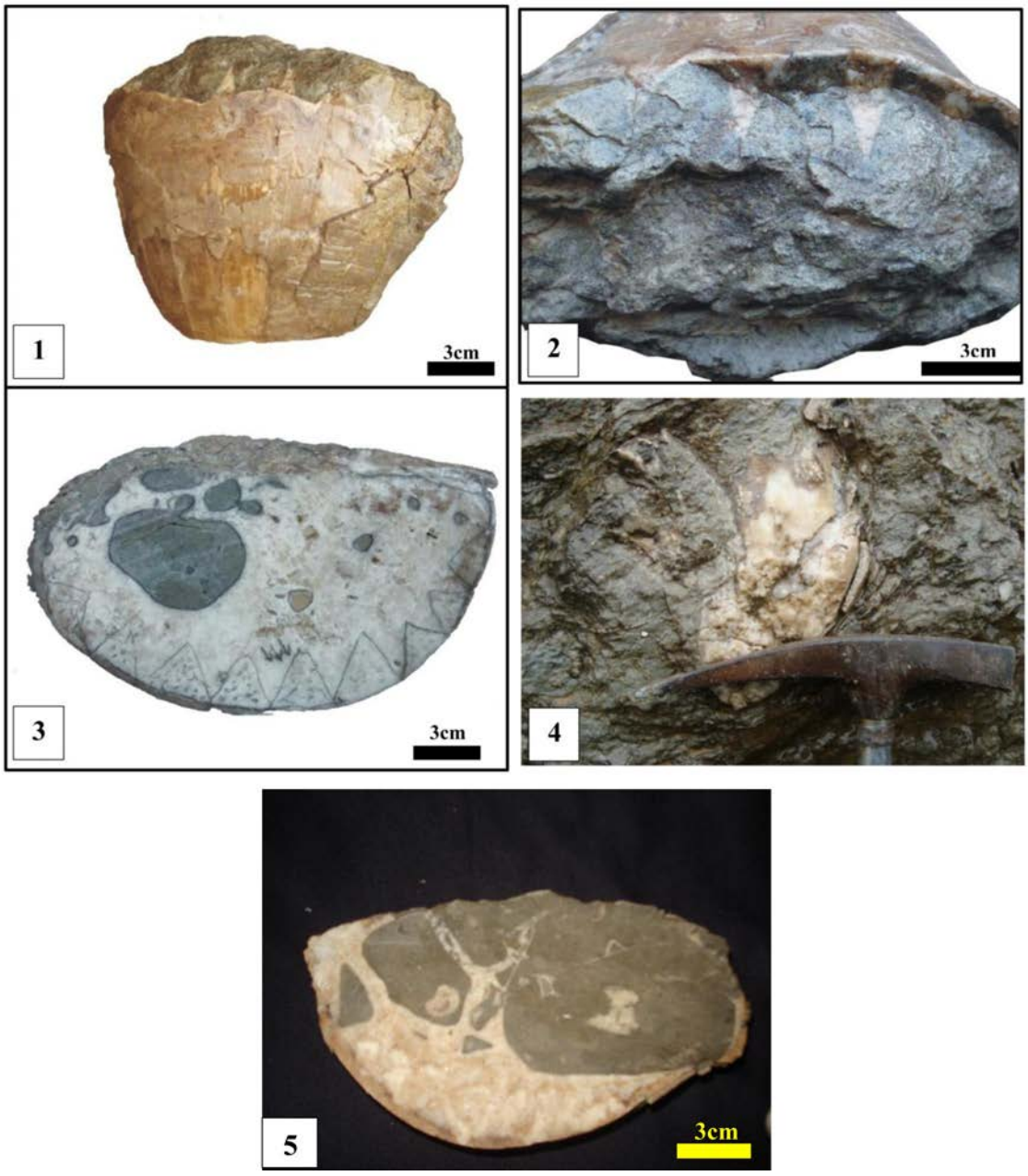

Fig.4: *Dictyoptychus acutidentatus* n.sp.

1. Attached and free valve, anterio view. Showing the broad costae separated by fine ferrow and the growth lines. Scale bar is 3 cm.
2. Attached valve. Tope view. Showing the inner and outer layer. Scale bar is 3 cm.
3. Attached valve, cross-section, passing approximately 6 cm below the commissure, illustrate the inner layer growth (like sharp teeth), and the small canal of inner layer. Scale bar is 30 mm.
4. Attached valve, longitudinal section.
5. Attached valve, cross-section, passing approximately 2 cm below the commissure.

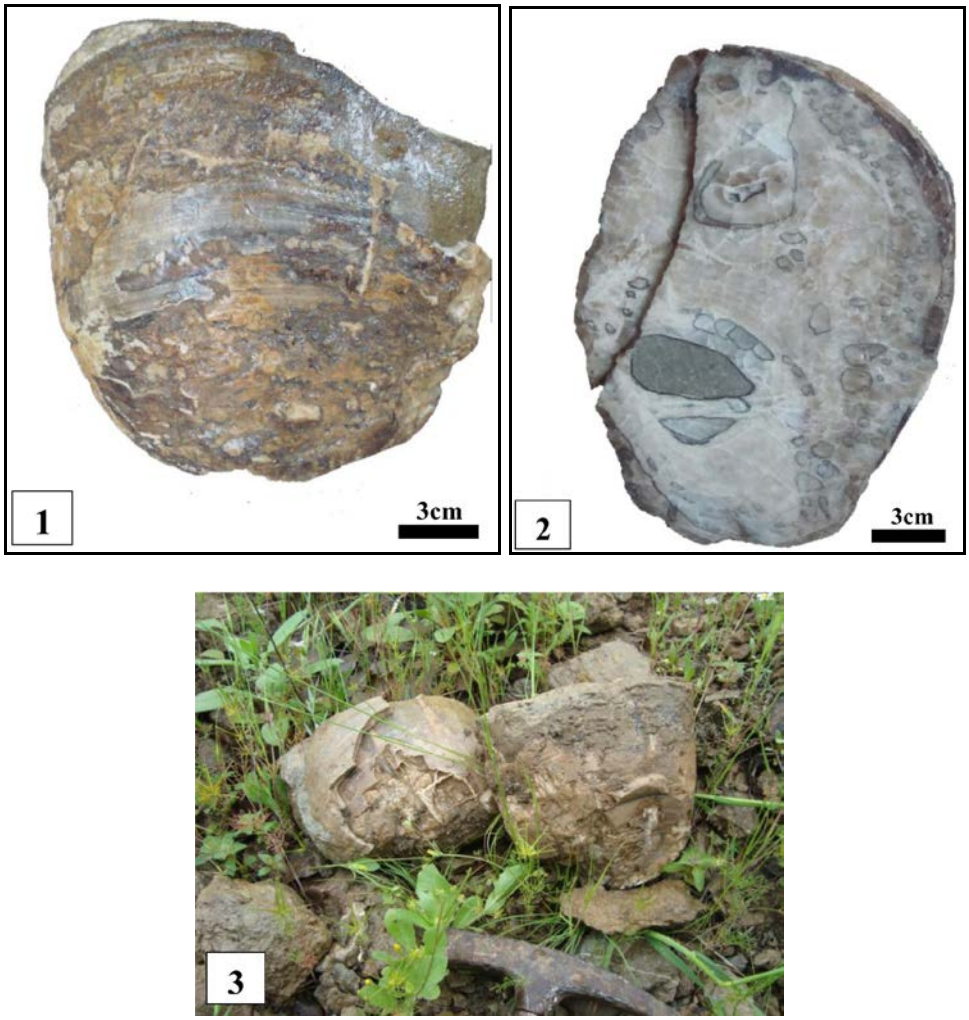

Fig.5: *Dictyoptychus mukabaensis* n.sp.

1. Attached and free valve, anterio view. Showing the growth lines. Scale bar is 30 mm.
2. Attached valve, cross-section, passing approximately 15 cm below the commissure. Showing the large polygonal canals and the small shell cavity. Scale bar is 3 cm.
3. Two specimens of attached valve.

CONCLUSIONS

The studied specimens are collected from Aqra Formation (Maastrichtian) northern Iraq; show the occurrance of two new species belonging to genus *Dictyoptychus* Douville, 1905.

- *D. acutidentatus* n.sp., characterized by attached and free valve are two cones with opposite base.This new species resembles *D. ortica* and *D. quadrizonalis* by the numerous of smaller rectangular canals in the inner layer, but differs from other species of *Dictyoptychus* by the occurrence of 12 prolongates like sharp teeth of the inner layer.
- *D. mukabaensis* n.sp. The inner layer of this species consiste of polygonal small canals which resembles *D. vanensis*. However the canals in the new species are arranged in two to three rows. In addition, the new species is characterized by small centeral cavity, while the centeral cavity of *D. vanensis* occupies more than half of the attached valve cross-section.

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