

Late Tithonian Ammonites from Chia Gara Formation at Maten Anticline, Northern Iraq

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ABSTRACT

The present study included identification and systematic description of some ammonites from the upper part of Chia Gara Formation, on the southern limb of Maten anticline at Amadia area, northern Iraq. Six species belong to five genera and three families were described. The two species; *Berriasella privasensis* and *Parodontoceras calistoides* were previously identified, and four species were left under open nomenclature, due to bad preservation and lack of material, these are; *Parodontoceras* sp., *Spiticeras (Kilianiceras)* sp., *Substeueroceras* sp. and *Haploceras* sp.

The studied ammonites occur as an assemblage fauna in the Durangites Zone, which indicates Late Tithonian age for the upper part of Chia Gara Formation in the Amadia area.

Keywords: Tithonian, Ammonites, Chia Gara Formation, Maten anticline.

أمونيات التيثوني المتأخر لتكوين جياكارا في طية متين، شمال العراق

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الملخص

تتضمن الدراسة الحالية تشخيص ووصف بعض متحجرات الأمونيات من الجزء العلوي لتكوين جياكارا ضمن الطرف الجنوبي لطية متين في منطقة العمادية، شمال العراق. اشتملت حشود الأمونيات الموصوفة

في الدراسة الحالية على ستة انواع تابعة لخمسة اجناس وثلاثة عوائل، اثنان منهم موصوفين سابقا: *Berriasella privasensis* و *Parodontoceras calistoides*. واربعة انواع تركت مفتوحة التسمية بسبب رداءة الحفظ وقلة عدد العينات وهم:

Substeueroceras sp., *Spiticeras (Kilianiceras)* sp., *Parodontoceras* sp.,
Haploceras sp.

تتواجد هذه الحشود الموصوفة ضمن نطاق *Durangites* الدال على التيثوني المتأخر. وعليه فان

الجزء العلوي لتكوين جياكارا في منطقة العمادية يمثل التيثوني المتأخر.

الكلمات الدالة: التيثوني، الأمونايت، تكوين جياكارا، طية متين.

INTRODUCTION

The studied section is located at the southern limb of Maten anticline, about (2 km) northeastern Amadia area. The midpoint of the section at (37° 06' 30" N) Latitude and (43° 30' 33" E) Longitude.

Maten anticline is asymmetrical fold, lying East – West trend within the high folded zone of the unstable shelf (Jassim and Buday, 2006), the southern limb is steeper than the northern limb, (Fig. 1).

The Chia Gara Formation (M. Tithonian-Berriasian) was first defined by Wetzel (1950 in Bellen *et al.*, 1959) at the Chia Gara anticline, south of Amadia town in the high folded zone of north Iraq. The formation at its type locality is 232m thick, it is composed of unbroken succession of thin bedded limestone and shales, containing rich ammonite faunas, grading upwards to yellowish marly limestone and shale with a zone of bullion beds, 21m thick at the base (Bellen *et al.*, 1959). The studied section is composed about 90m thick of alternation beds of pale to dark brown shale and white-yellowish limestone (the lithological description of the studied section is shown in (Fig. 2). The lower boundary is sharp between the tough dolostone of Barsarin Formation (Late Kimmeridgian) and thin bedded limestone of Chia Gara Formation, without any indication of unconformable evidences. The upper boundary is unconformable with the overlying Sarmord Formation (Valanginian), indicated by thin beds of conglomerate.

The previous studies of ammonites in Chia Gara Formation carried out by Spath (1950) was done on the identification and description of new Tithonian ammonites in this formation. Howarth (1992) gave a detailed paleontological study of ammonites zonation in two section (Banki and Chia Gara areas) of Chia Gara Formation. Leanza (1996) studied The Tithonian ammonite Genus *Chigaroceras* in Chia Gara Formation as a bioevent marker between the western Tethyan and the Andean realms.

The aim of the present study is to identify and describe ammonite fauna from Chia Gara Formation (Fig. 2), in order to obtain the age of the studied section.

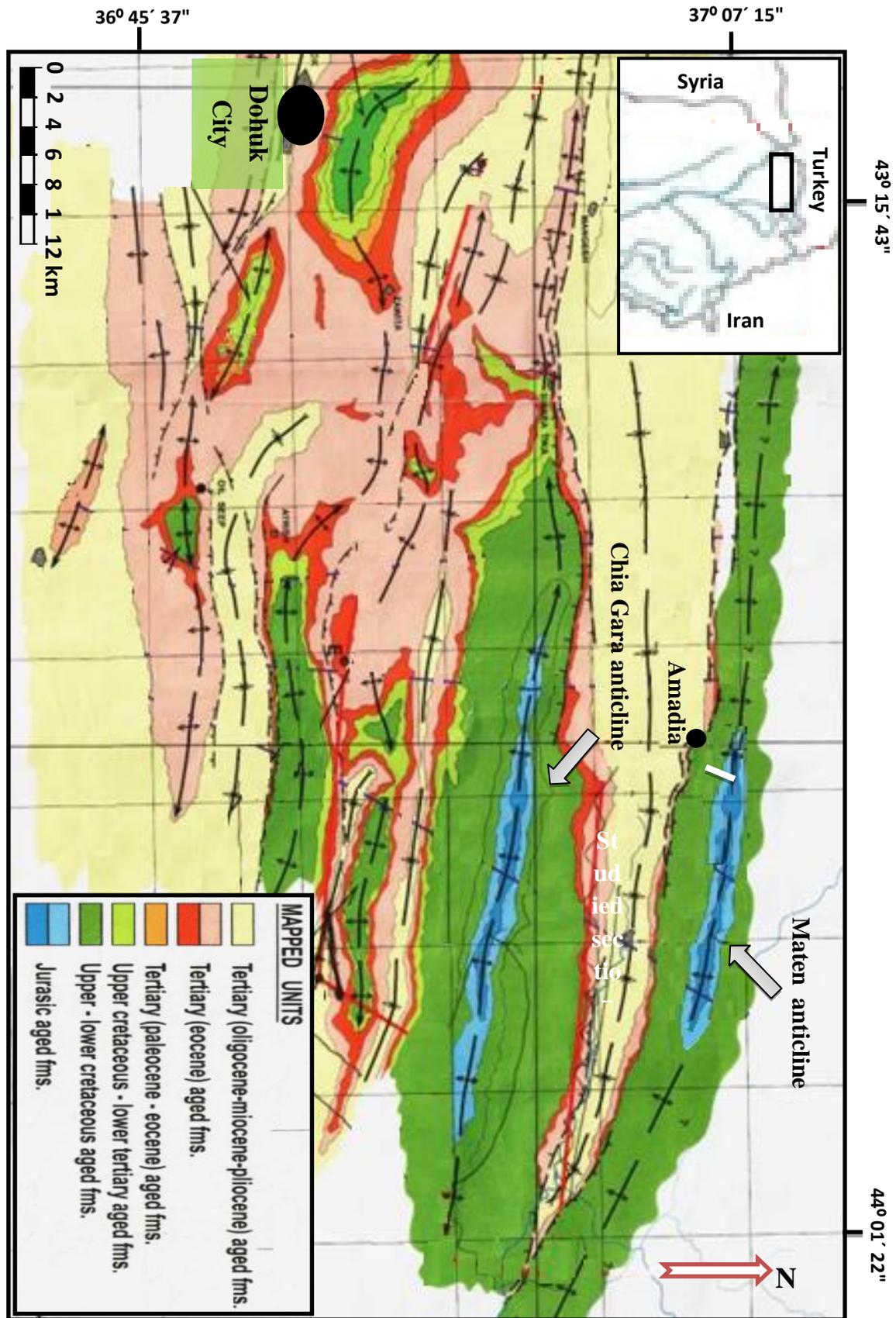


Fig. 1: Geological Map with Indication to the Studied Section, Modified from (Merty Energy Company, 2004).

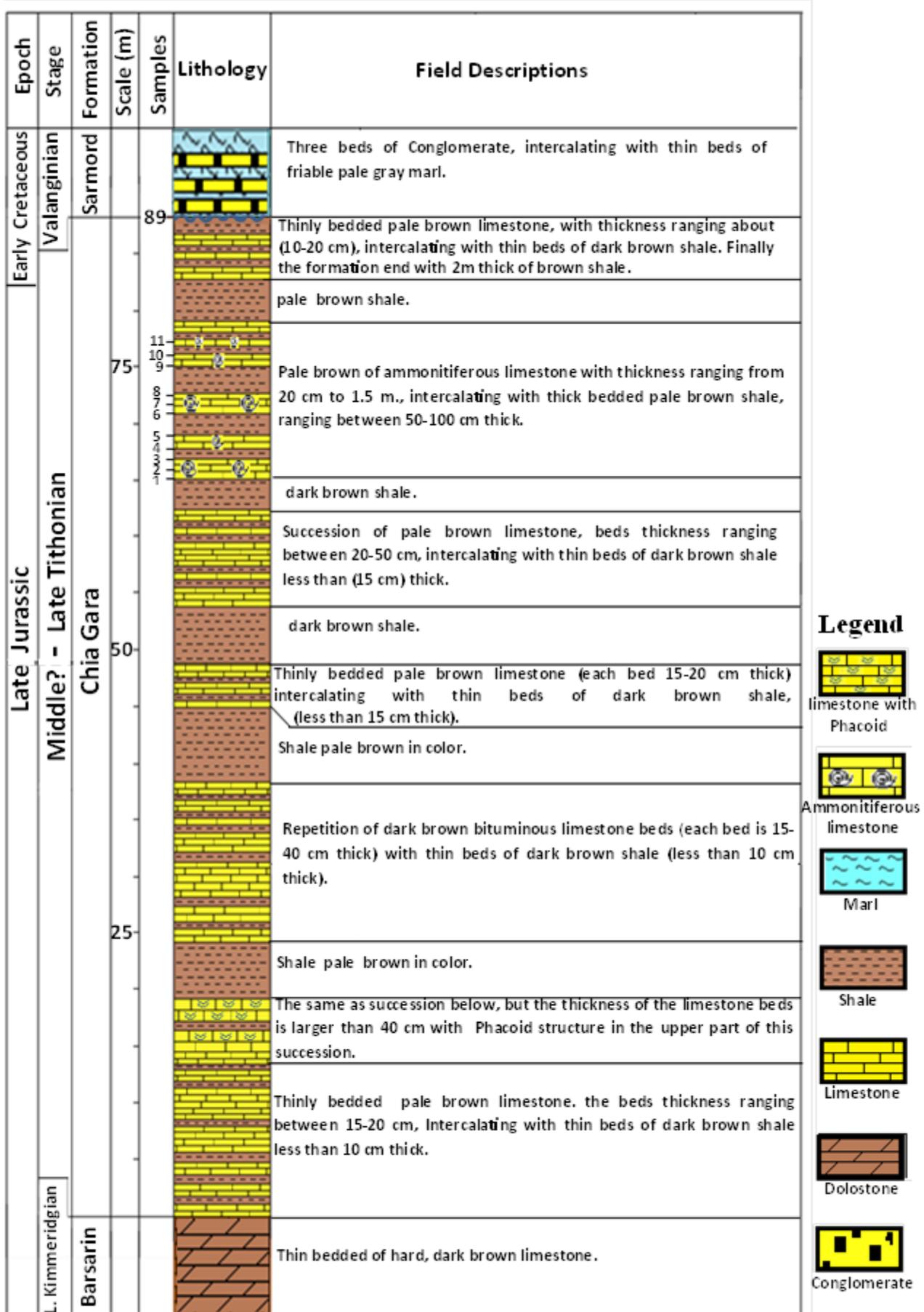


Fig. 2: Lithological section of Chia Gara Formation, at southern limb of Maten anticline

Systematic Description

The identification of the Ammonite fauna in the current study which is moderately to well preserved at several horizons in the upper part of the section, at the interval (65-77m), were mainly depended on Spath (1950), Spath (1952), Imlay and Jones (1970), Pszczolkowski and Myszynski (2004) and Vašiček (2010). This study used Moore (1957) for classification of the species.

Six species belonging to five genera and three families were described by using their external shell features and parameter's: shell diameter (D), umbilicus diameter (u), whorl height (H) and the ratio of umbilicus diameter to shell diameter (see sketch diagram Fig. 3).

The synonyms references which are not mentioned in the references list were cited by Leanza (1945), Khimchiachvili (1987) and Parent *et al.* (2011).

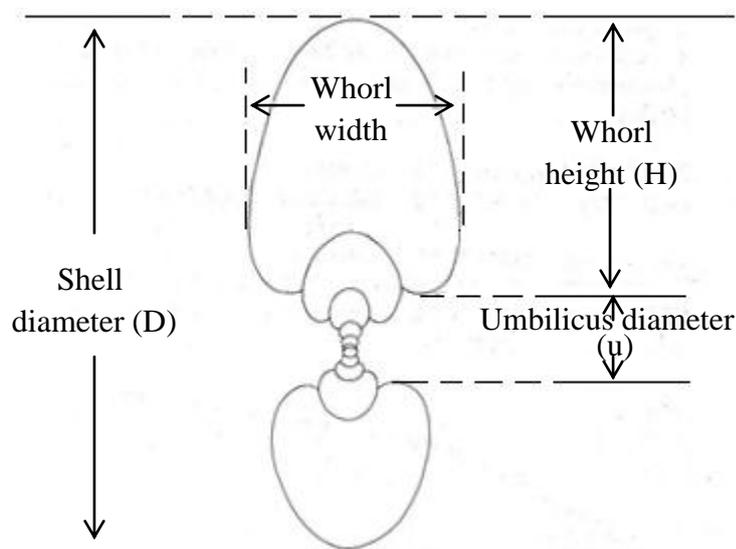


Fig. 3: Schematic Diagram of the Ammonite shell, Modified from (Murray, 1985).

Depositary

All the studied species were deposited in the Mosul University, Department of Geology, lab number (201), under the specimens numbers (1-11).

Phylum: MOLLUSCA

Class: CEPHALOPODA Leach, 1817

Order: AMMONOIDEA Zittel, 1884

Suborder: AMMONITINA Hyatt 1889

Superfamily PERISPHINCTOIDEA Steinmann, 1890

Family: OLCOSTEPHANIDAE Haug, 1910

Genus: *Spiticeras* Uhlig, 1903

Subgenus: *Kilianiceras* Djanelidze, 1922

Type species: *Ammonites spitiensis* Blanford, 1864

Diagnosis: Planispiral, evolute, ornamentation characterized by numerous coarse ribs in the last whorl, in addition to some tubercles in the moderate whorl.

Spiticeras (Kilianiceras) sp.

(Plate 1, Fig. A)

Studied material: One cast specimen, sample number 11.

Description: Planispiral, partially evolute, shell dimensions are D=56mm, u=15mm and H=21mm, umbilicus deep and wide, the ratio of the umbilicus diameter to the shell diameter about 27%. The body chamber is unclear, and the phragmocone is inflated cone. The outer whorls of this ammonite bear fairly strong, radially trending primary ribs that divide into two ribs on the upper part of the flanks, (Bifurcate) and some tubercles in the moderate whorl.

Occurrence: The subgenus is described by Moore (1957) from late Tithonian to Berriasian, while it is described in the Berriasian age from the northwestern California and southwestern Oregon by Imlay and Jones (1970). Furthermore, this subgenus is recorded in Tithonian age by Spath (1950) from Chia Gara Formation in northern Iraq. In this study, the authors recorded it in the upper part of Chia Gara Formation.

Family: BERRIASSELLIDAE Spath, 1922

Subfamily: BERRIASSELLINAE Spath, 1922

Genus: *Barriasella* Uhlig, 1905

Type species: *Ammonites privasensis* Pictet, 1867

Diagnosis: This genus is characterized by having Planispiral compressed shell, and numerous bifurcating inclined coarse ribs.

Barriasella privasensis (Pictet, 1867)

(Plate 1, Figs. B and C)

1867 *Ammonites privasensis* Pictet, p. 84, p. 18, Fig. 1 a - b, Fig. 2.

1973 *Barriasella privasensis* (Pictet)- Hegarat, p.61, Fig. 3 - 9

1976 *Barriasella privasensis* (Pictet)- Khimchiachvili, p.84, Fig.1 - 3.

1982 *Barriasella privasensis* (Pictet)-Nikolov, p. 57, Fig. 2 - 4.

1987 *Barriasella privasensis* (Pictet)-Khimchiachvili, p.377, pl. 1, Fig. 4.

Studied material: Two cast specimen, samples number 3 and 7.

Dimensions:

No. of Specimen (n)	Shell diameter (D)	Umbilical diameter (u)	Whorl height (H)
1	58	21	19
2	48	16	15
Average	53	19	17

Description: Planispiral, evolute, average dimension is, D=53mm, u=19mm, H=17mm. The ratio of the umbilical diameter to the shell diameter about 36%. The body chamber is moderate and coiled, the phragmocone compressed. There are about 18 strong inclined ribs on the half of the whorl. The most of them are bifurcate nearly above the middle of the whorl height. The anterior (adoral) one continues the direction of the primary rib, and the other branch is curved posteriorly, undivided ribs are also present. The incomplete inner cast is slightly deformed, but the ratio of dimensions and main characters of the sculpture allow us to assign this specimen to the species.

Occurrence: This species was firstly described by Pictet (1867), and it is identified from the late Tithonian by Spath (1952). On the other hand, it is recorded from Georgia in Berriasian age by Khimchiachvili (1987). Moreover, it identified in the late Tithonian age from the middle part of Chia Gara Formation, northern Iraq by Spath (1950) and Leanza (1996). In the current study, the species is recorded in the upper part of Chia Gara Formation.

Genus: *Parodontoceras* Spath 1923

Type species: *Hoplites calistoides* Behrendsen, 1891

Diagnosis: Planispiral, involute. The shell is sculptured by numerous fine inclined ribs, which form bifurcated in the end.

Parodontoceras calistoides (Behrendsen, 1891)

(Plate 1, Figs. D, E)

1891 *Hoplites calistoides* Behrendsen, p. 402, Figs. 1a - 1b.1897 *Odontoceras calistoides* (Behrendsen) -Stener, p. 41, Fig.13 - 16.1923 *Parodontoceras calistoides* (Behrendsen) - Spath, p. 305.1945 *Parodontoceras calistoides* (Behrendsen) - Leanza, p. 40, pl. V, Figs. 5, 6.2011 *Parodontoceras calistoides* (Behrendsen) - Parent *et al.*, p.54, Figs. 23A - B.**Studied material:** Four cast specimen, samples number 1,4,5 and 9.**Dimensions:**

No. of Specimen (n)	Shell diameter (D)	Umbilical diameter (u)	Whorl height (H)
*1	29	8	9
*2	41	10	13
3	52	12	14
4	53	12	15
Average	44	11	13

***photographed specimen.**

Description: Planispiral, moderately involute, average dimension is D=44mm, u=11mm, H=13mm. Umbilicus slightly shallow, the ratio of the umbilical diameter to the shell diameter about 25%. The body chamber is wide and uncoiled, the phragmocone is platycone. The external surface is well ornamented by numerous fine wavy ribs, in the inner part of the whorls. While it became gradational slightly strong in the last whorl and bifurcated before ends.

Occurrence: The present species was firstly recorded by Behrendsen (1891). In addition to this, it is described from Argentina in the late Tithonian by Leanza (1945) and from Northern Peruvian Andes by Enay *et al.* (1996), While it is described from Tithonian - Berriasian age by Parent *et al.* (2011). Locally, it is described in the late Tithonian from the middle part of Chia Gara Formation in

northern Iraq by Spath (1950), Howrth (1992) and Leanza (1996). In the current study it is identified from Chia Gara Formation, particularly in the upper part.

Parodontoceras sp.

(Plate 1, Fig. F)

Studied material: One cast specimens, sample number 6.

Description: Planispiral, involute, ammonite dimension is $D=41$ mm, $u=13$ mm, $H=12$ mm. Umbilicus slightly deep, the ratio of the umbilical diameter to the shell diameter about 32%. The body chamber is wide and coiled, the phragmocone is platycone. The ornamentation is similar to these in the species *P. calistoides*, with more fine rather *P. calistoides*.

The present species resembles *P. calistoides* in the general shape and outline, but it differs in body chamber, which is coiled, rather than the uncoiled body chamber of *P. calistoides*. In addition to the ratio of the umbilical diameter to the shell diameter, which is large than of *P. calistoides*.

Occurrence: The current species was described from late Tithonian by Moore (1957), and it is identified in this study in the upper part of Chia Gara Formation.

Genus: *Substeueroceras* Spath, 1923

Type species: *Odontoceras koeneni* Steuer, 1897

Diagnosis: Planispiral, involute - moderately involute. Shell is ornamented by distinctive numerous fine wavy ribs, with very short distances.

Substeueroceras sp.

(Plate 1, Fig. G)

Studied material: Tow cast specimen, samples number 8 and 10.

Dimensions:

No. of Specimen (n)	Shell diameter (D)	Umbilicus diameter (u)	Whorl height (H)
*1	50	10	14
2	41	9	10
Average	46	10	12

* photographed specimen.

Description: Planispiral, moderately involute, average dimension are D=46mm, u=10mm, H=12mm. Umbilicus slightly deep, the umbilical wall is low. The ratio of the umbilicus diameter to the shell diameter about 22%. The body chamber is crushed, the phragmocone is slightly inflated cone. The outer whorl overlaps about one-fourth of the preceding whorl. Before being crushed the specimen probably had a high subquadrate whorl section and flattened flanks. The venter is gently rounded. The ribs are fine, moderately spaced, and inclined gently forward on the flanks and are strongest on the venter. They are inflected slightly forward near the middle of the flanks and are arched gently forward on the venter. Some of the ribs are weakly swollen near the umbilicus. other ribs bifurcate at two levels. Many secondary ribs are indistinctly connected with the primary ribs. The ribs are not thinned along the midline of the venter.

The present species is fairly identical with the diagnostic features of the genus *Substeueroceras*, rather than the genus *Parodontoceras*, and it is described under open nomenclature due to the bad preservation of the material.

Occurrence: This species was described from late Tithonian by Leanza (1945) and Moore (1957), and it is distinguished in the current study in the upper part of Chia Gara Formation.

Superfamily: HAPLOCERATACEAE Zittel, 1884

Family: HAPLOCERATIDAE Zittel, 1884

Genus: *Haploceras* Zittel, 1870

Type Species: *Amaltheus elimatus* Oppel, 1868

Diagnosis: This genus is distinguished by having a smooth shell and a large body chamber.

Haploceras sp.
(Plate 1, Fig. H)

Studied material: One cast specimen, sample number 2.

Description: Planispiral, involute, ammonite dimensions is D=42mm, u=13mm, H=16mm. Umbilicus wide and deep, the ratio of the umbilical diameter to the shell diameter about 31%. The body chamber is wide and coiled, the phragmocone is inflated cone. External shell surface is smooth.

This species let under open nomenclature due to the lack of material.

Occurrence: The present species is described from Kimmeridgian – Tithonian by (Moore, 1957). Locally it is recorded in the current study from the upper part of the Chia Gara Formation northern Iraq.

Age determination

Six species belonging to five genera and three families were identified in the current study. Two of them are previously described; *Berriasella privasensis* and *Parodontoceras calistoides*, and four species left under open nomenclature. These are; *Parodontoceras* sp., *Spiticeras* (*Kilianiceras*) sp., *Substeueroceras* sp. and *Haploceras* sp.

Age determination of the studied samples is relied on the whole cephalopod fauna. The species *P. calistoides* is well located and ascribed to the upper part of the late Tithonian by (Leanza, 1945), (Howarth, 1992). (Enay et al., 1996) and (Leanza, 1996). Furthermore, Spath (1952, P. 25) mentioned that "the *P. calistoides* were known to occur both above and below the border line between the Jurassic and Cretaceous; but Leanza (1945) established the real range of *P. calistoides* at the top of Argentinian Jurassic, so that species clearly cannot be used as a zone fossil for the lower Berriasian". This revealed that the existence of this species in the current study indicate the upper Tithonian age.

Also Spath (1952, P. 25) stated that "Lombard and Coaz (1932) proposed a twenty meter zone between the Tithonian and Berriasian, characterized chiefly by *B. privasensis* and *B. Calisto*, this is natural; the former species has long been the zonal index for the highest zone in the Jurassic, the latter, as has just been shown in common in the lowest Cretaceous". Moreover, Howarth (1992) refer that the *P. calistoides* and *B. privasensis*, in addition to *Spiticeras* (*Kilianiceras*) sp., *Substeueroceras* sp. and *Haploceras* sp. represent the main assemblages of *Durangites* Zone, which indicate to late Tithonian age. Besides that, Leanza (1996, P. 455) cited that "Ammonites registered at Iraq in (*Durangites* zone, late Tithonian) are *P. aff. calistoides* and *B. aff. Privasensis*".

Substeueroceras is diagnostic at the top Jurassic beds in Mexico by Imlay (1939), in Argentina by Leanza (1945) and in general study by Moore (1957). *Spiticeras* range from the top of the Tithonian through the Berriasian but not so high (Djauélidzé, 1922; in Imlay and Jones, 1970). On the other hand, the *Spiticeras* (*Kilianiceras*) ranges from upper Tithonian to Berriasian by Moore (1957). *Haploceras* ranges from Kimmeridgian - Tithonian (Moore, 1957).

The studied ammonites represent the main assemblage fauna of *Durangites* Zone which had been previously recorded in Iraq by Howarth (1992) and Leanza (1996) corresponding late Tithonian age. Accordingly, all the biostratigraphic evidences of the studied ammonite indicated that the upper part of the Chia Gara Formation in Amadia area represents the late Tithonian age, while the lower part of the formation in the studied section had been registered as Middle Tithonian age according to the previous study at the type section (Bellen *et al.*, 1959).

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PLATE 1

Fig. A: *Spiticeras (Kilianiceras) sp.* Chia Gara Formation. Sample number 11.

Figs. B and C: *Berriasella privasensis* (Pictet, 1867). Chia Gara Formation. Sample numbers 3 and 7.

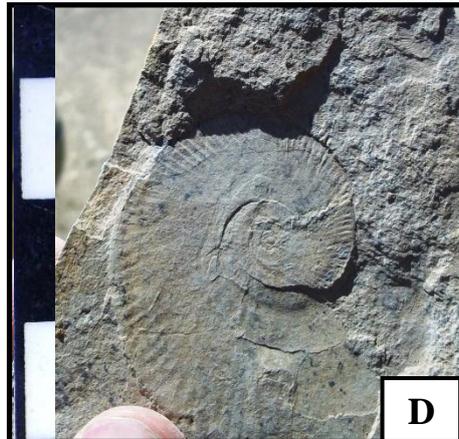
Figs. D and E: *Parodontoceras calistoides* (Behrendsen, 1891). Chia Gara Formation. Sample numbers 1 and 9.

Fig. F: *Parodontoceras sp.* Chia Gara Formation. Sample number 6.

Fig. G: *Substeueroceras sp.* Chia Gara Formation. Sample number 8.

Fig. H: *Haploceras sp.* Chia Gara Formation. Sample number 2.

PLATE 1



1 bar = 1 cm