

## The Tithonian Ammonite Genus *Chigaroceras* Howarth (1992) as a Bioevent Marker Between Iraq and Argentina

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### Abstract

Since many years it is known that most of the Upper Tithonian Andean ammonites previously classified as *Berriasella* do not belong indeed to this genus. This is the case of "*Berriasella*" *gerthi* Krantz, which perfectly displays the diagnostic features of the genus *Chigaroceras* Howarth [2]. The species of Krantz is present in the Upper Tithonian from Argentina in the *Alternans* Zone. The presence of *Chigaroceras* in Iraq in the *Durangites* Zone several meters below beds with *Groebiceras* and *Substeuroceras* and above *Pseudolissoceras* allow an excellent opportunity to establish a fine correlation through this precise bioevent marker between the western Tethyan and the Andean realms. At least the uppermost part of the *Alternans* Zone several can be correlated by means of *Chigaroceras* with the *Durangites* Zone, suggesting as the more likely communication route the western perigondwanic seas via Somaliland, Madagascar and southern South America.

### Introduction

Since many years ago it is known that most of the Upper Tithonian andean ammonites previously classified in *Berriasella* Uhlig [11] do not belong indeed into this genus. Howarth [2] while studying a rich Tithonian/Berriasian ammonite fauna from the Iraqi Kurdistan, recently established the genus *Chigaroceras* to distinguish involute and compressed shells, with rounded venter, with strong primary ribs mid-laterally divided into two or three secondaries, and small umbilical and medium to large mid-lateral tubercles on most ribs. These characteristic are present in the Tithonian "*Berriasella*" *gerthi* described by Krantz [4]. For this reason, this species is ascribed to the genus *Chigaroceras* for the first time. In the Andean region, *Chigaroceras* occurs in the Vaca Muerta Formation in the *Corongoceras alternans* Zone, above beds with *Pseudolissoceras* and below beds with *Substeuroceras*, *Groebiceras* and *Spiticeras*. The same successional pattern has been observed in the iraqi Chia Gara Formation, thus constituting an excellent opportunity to establish a fine correlation through this precise bioevent marker between the western Tethyan and the Andean realms. At least the uppermost part of the *Alternans* Zone can be correlated by means of *Chigaroceras* with the *Durangites* Zone.

In addition, the lithological facies in the Chia Gara Formation in the Tithonian strongly resembles that of the Vaca Muerta Formation in the Argentine Andes, as Howarth [2 : 605] described marly shales with calcareous concretions all highly bituminous. This might represent a highly bituminous world wide episode worth to be considered as a high resolution stratigraphic event [3].

### *Chigaroceras* and its representatives in Argentina

The ammonite genus *Chigaroceras* was established by Howarth [2] with *Ch. banikense* Howarth [2, p. 643, Pl. 10, figs. 1-3,6, Pl. 12, figs. 6-8] as the type species. The original diagnosis was the following: "Involute, compressed, rounded venter without a groove, angled or well-defined umbilical edge, undercut umbilical walls. Weak to strong primary ribs divide mid-laterally into two or three secondaries and pass over the venter without interruption. Small umbilical and medium to large mid-lateral tubercles occur on most ribs". In the same paper, Howarth [2] described two additional species: *Ch. wetzeli* (Pl.10, figs. 4-5, Pl. 11, figs. 1, 3-5)) and *Ch. planum* (Pl.11, figs.2,6), all from bed 23, at Banik.

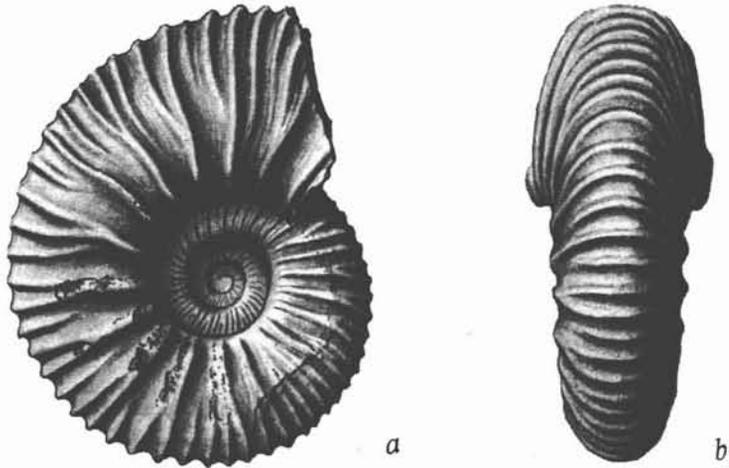


Fig. 1: *Chigaroceras gerthi* (Krantz). a, lateral view, b) ventral view. Reproduction of Krantz's (1926) Holotype. Vaca Muerta Formation. *Corongoceras alternans* Zone. Upper Tithonian. Bardas Blancas. Southern Mendoza, Argentina

According to Howarth [2], *Chigaroceras* seems to be derivated from *Dalmasiceras* Djanélidzé [1] by an increase in the strenght of the ribs and tubercles, and continuity of the ribs across the venter in the body chamber. Based on the differential diagnosis given above, "*Berriasella*" *gerthi* [4, p. 22, pl. 1, figs. 8a-b] can be refered to *Chigaroceras*: This species was originally reported by Krantz [4] from Tithonian beds at Bardas Blancas, southern Mendoza province, in association with "*Berriasella*" *bardensis* Krantz, *Parodontoceras calistoides* (Behrendsen) and *Paraulacosphinctes striolatus* (Steuer). *Chigaroceras gerthi* (Krantz) closely resembles

*Chigaroceras wetzeli* [see 4, pl. 10, figs. 4-5] in shell shape and ornamentation, although the Iraqi species appear to be slightly more involute.

"*Berriasella*" *bardensis* Krantz [4, p. 21, pl. 1, figs. 7a-b] was also described and figured by A. F. Leanza [5, p. 38, pl. 2, figs. 3-4 = H. A. Leanza, 8, pl. 3, figs. 7-8] from Tithonian beds at Mallín Redondo, Sierra Azul region, Mendoza, in beds belonging to the *Corongoceras alternans* Zone. Although this species resembles in some extent the flank ornamentation of *Chigaroceras*, it shows an angled ventro-lateral edge, a flat or slightly concave venter, and the ribs almost disappear in the center of the venter, resembling a strong ribbed *Dalmsiceras* Djanéldzé [1], if not indeed a new genus.

### **Tithonian stratigraphy and ammonites in the Iraqi Kurdistan**

The Tithonian/Berriasian (Jurassic/Cretaceous) boundary is verified in the Iraqi Kurdistan mountains in the Chia Gara Formation [13]. According to Howarth [2], this unit attains 30 m to 290 m in thickness, and consists of a succession of thin bedded limestones, marls and shales with high bituminous content and calcareous concretions. The thinner developments are due in part to the erosion of the top of the Formation in some areas. It overlies the Kimmeridgian Barsarin Formation conformably, and runs in age from the base of the Tithonian up just below the top of the Berriasian. It is overlain by the Garagu Formation which is latest Berriasian and Valanginian in age. This unit in some sections conformably overlies the Chia Gara Formation, but in others considerable erosion has removed its upper part before deposition of the Garagu Formation. The Tithonian/Berriasian stratigraphy of the Iraqi Mountains according to Howarth [2, p. 602] can be summarized as follows:

92,2 m Garagu Formation (Valanginian-Barremian):

Marls, limestones, and sandstones.

232,4 m Chia Gara Formation (Berriasian/Tithonian):

Limestones and shales with high bituminous content.

23,7 m Barsarin Formation (Kimmeridgian):

Limestones and dolomites

Spath [10] was the first who described ammonites from the Chia Gara Formation in his paper on Tithonian ammonites from Kurdistan, in which five new genera and twelve new species were established. The ammonite succession of the Chia Gara Formation at Banik given by Howarth [2], from top to base, can be summarized as follows:

### **BERRIASIAN**

*Zone of Fauriella boissieri*

- *Thurmanniceras (Erdenella) isare* (Pomel), ? *Neocomites* sp.

Subzone of *Berriasella (Malbosiceras) paramimouna*

- *Groebericeras laevigatum* Howarth
- ? *Thurmanniceras* sp. indet.
- *Groebericeras rocardi* (Pomel)
- *Groebericeras rocardi*, *Dalmasiceras (Elenaella) prorsiradiatum* Howarth.
- *Spiticeras (S.) spitiense* (Blanford)
- *Groebericeras rocardi*, *Thurmanniceras (Erdenella)* sp. indet., *Banikoceras involutum* Howarth
- *Groebericeras rocardi*

TITHONIAN

Zone of *Durangites*

- *Oxytenticeras lepidum* Spath, *Proniceras* cf. *jimulcense* Imlay,  
*Berriasella (Malbosiceras) chaperi* (Pictet), *B. (M.)* cf. *asper* Mazenot, *Berriasella* sp. indet. *Chigaroceras banikense* Howarth, *Ch. wetzeli* Howarth, *Ch. planum* Howarth.
- *Protancyloceras* sp. indet. ? *Neocosmoceras* sp. indet.

Zone of *Micranthoceras microcanthum*

- *Phanerostephanus* sp. indet., *Notostephanus* sp. indet.
- *Protancyloceras* sp. indet., *Phanerostephanus subsenex* Spath,
- *Protancyloceras* sp. indet., *Cochlocrioceras* sp. indet., *Oxytenticeras lepidum* Spath, *Notostephanus* sp. indet., *Lamellaptychus*.
- *Pesudolissoceras advena* Spath *Oxytenticeras lepidum*, *Phanerostephanus subsenex* Spath, *Lamellaptychus*, ? *Virgatosphinctes* sp. indet.
- *Phanerostephanus* sp. indet.

In the type section of the Chia Gara Formation near Gara, Howarth [2 : 604] reported also other ammonites in the *Durangites* Zone, including *Parodontoceras* aff. *calistoides* (Behrendsen) and *Protacanthodiscus* spp.

### Correlation with west central Argentina

Leaving apart the misidentification of *Substeueroceras koeneni* (Steuer) by Howarth [2 : Pl. 2, figs. 3, 10] in beds below the *Durangites* Zone, which indeed is in my opinion a true *Kossmatia*, as it displays arched ribs over the venter (Pl. 2, fig. 10), the ammonite succession and the lithological facies from the Tithonian/Berriasian beds of the Iraqui Kurdistan are surprisingly similar to those of the Argentine Andes.

*Phanerostephanus* Spath and its close allies *Nothostephanus* and *Nannostephanus* [see 10] occur at the base of the Tithonian, including a remain of ? *Virgatosphinctes*, and can be correlated with the *Virgatosphinctinae* Beds [6] of west central Argentina, represented by the *Virgatosphinctes mendozanus* Zone, which is considered late Lower Tithonian in age [6, 7, 8]. It is worth noting that Leanza [6], while describing the ammonite fauna from Cerro Lotena, already stressed the close affinities existing between the group of *Phanerostephanus* and allies with the Andean *Chocensisphinctes* Leanza [6], a characteristic genus of the *Mendozanus* Zone.

The genus *Pseudolissoceras*, present in the Iraqui Kurdistan, is composed by the species *zitteli* (Burckhardt) and *advena* Spath, allowing instant correlation with the widespread Andean *Pseudolissoceras zitteli* Zone, which is considered of early Middle Tithonian age [6].

Above the *Pseudolissoceras* beds lies again "*Phanerosphanus*", but in this case, after judging by the illustrations of Howarth [2 : Pl. 1, figs. 7-8] this occurrence could indeed be interpreted as a coeval equivalent of the genus *Zapalia* Leanza and Zeiss [14] and related forms, which constitutes part of an entirely new Tithonian ammonite fauna within the Andean *Windhauseniceratops internispinosum* Zone of latest Middle Tithonian/early Upper Tithonian age. The study of the *Zapalia* fauna is actually being undertaken by Zeiss and Leanza (in preparation). The previously referred horizons from Iraq were included by Howarth [2] in the *Micranthoceras microcanthum* Zone.

The following ammonite horizons recorded in Iraq consist of several species of *Chigaioceras* which are present equally in Iraq at the top of the *Durangites* Zone, or in Argentina - a single species - at the top of the *Alternans* Zone. Ammonites registered at Iraq in the *Durangites* Zone are, between others, *Parodontoceras* aff. *calistoides* (Behrendsen), *Protacanthodiscus* aff. *perornatus* (Retowski), *Berriasella* (including *B.* aff. *privasensis* (d'Orbigny), *Protancyloceras hondense* (Imlay), *P.* cf. *kurdistanense* Spath, *Blanfordiceras* sp. indet., ? *Kossmatia* sp. and "*Leptoceras*" sp.

In the *Alternans* Zone the list formerly given by A.F. Leanza [5] includes, apart from the nominal species, *Micranthoceras tapiai* Leanza, *M. lamberti* Leanza, *Berriasella australis* Leanza, *B. krantzi* Leanza, *B. pastorei* Leanza, *B. groeberi* Leanza, *B. (?) delhaesi* Leanza, *B. inaequicostata* Gerth, *Corongoceras rigali* Leanza, "*Berriasella*" *bardensis* Krantz and *Chigaroceras. gerthi* (Krantz). On the basis of this faunal content, the top part of the *Durangites* Zone from Iraq might be correlated with the latest *Alternans* Zone of the Andean region.

The next ammonite assemblage recorded in Iraq in the upper part of the Chia Gara Formation is represented by several species of *Groebericeras*, *Spiticeras*, *Banikoceras*, *Thurmanniceras*, *Euthymiceras*, *Dalmasiceras*, *Berriasella*, *Protacanthodiscus* and ? *Neocosmoceras*. They can be easily correlated with the interval dominated by the *Koeneni*, *Noduliferum* and *Damesi* Zones of the Andean region, ranging in age from the late Upper Tithonian to the Upper Berriasian (Leanza, 1981a).

The lithological facies of the Chia Gara Formation in the Tithonian strongly resembles that of the Vaca Muerta Formation in the Argentine Andes, as Howarth [2 : 605] describes many horizons constituted by dark gray to dark brown marly shales containing numerous big sized ("Phacoids") calcareous concretions all of them deposited in a highly bituminous environment, suggesting a primary short-term depositional control on their formation. This clearly represents a highly bituminous world wide episode worth to be considered a high resolution chemical-stratigraphic event in the sense of Kauffman [3].

### Conclusions

One who ever had worked in the Jurassic/Cretaceous transition in the Andean region immediately will notice the strong similarities existing with the Iraqi Kurdistan section, both in lithology as well in ammonite successional pattern. Leaving apart personal interpretations of some taxa by different paleontologists, it becomes clearly evident that the existing Andean zonation becomes quite useful for perigondwanic correlations out of the Andean region. A migration way *via* the Mozambique Channel, Somaliland, eastern India (Spiti), Madagascar and eastern Antarctica to southwestern Gondwanaland seems more acceptable, than through the Hispanic seaway, which unites the Tethyan faunas with those of Central and South America. Therefore it is highly recommended to insist in examination of asiatic sections and compare them with the closely related facies and faunas of South America, which had indeed formed a very uniform Perigondwanic Realm at the Jurassic/Cretaceous transition.

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