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The Jurassic /Cretaceous boundary beds in Kurdistan – a preliminary note on wider correlations

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Abstract

Ammonites, nannofossils and calpionellids have been studied from Chia Gara Formation at Banik village (Zakho area, Dohuk Governorate, Kurdistan). New micropalaeontological work at Banik makes it possible for the first time to identify useful western Tethyan Jurassic /Cretaceous boundary marker species (calpionellids and nannofossils) and to make precise correlations with the boundary interval in Europe and elsewhere. Kurdistan at the end of the Jurassic was positioned on the south side of Tethys, on the opposite side of that ocean from the type sites and regions for the Tithonian and Berriasian stages.

Introduction

The litho- and biostratigraphy of the Jurassic/Cretaceous marine sedimentary rocks of Kurdistan (northern Iraq) have been little studied. Early oil exploration by Wetzel in the 1940s resulted in collections of macrofossils and outline descriptions of the sequences. These were described in part in unpublished reports by L.F. Spath. However, Wetzel's mapping and logging for the Iraq Petroleum Company was apparently the last concerted fieldwork. A monographic treatment of the discontinuous ammonite faunas collected by Wetzel at Banik (30km ENE of Zakho: see Hakimi et al., 2015) and in the Chia Gara anticline (30 km NE of Dohuk) was previously published (Howarth, 1992). Howarth (1992) summarized Wetzel's account of the Chia Gara Formation, using Wetzel's bed numbering, giving the unit a thickness of 126.6 metres, and positioning it spanning the Tithonian and Berriasian stages.

The presumed Jurassic / Cretaceous succession in the Chia Gara Formation at Banik has been studied for the first time applying stratigraphically useful species of calpionellids and nannofossils (Figure: 1). The main purpose of this study was to precisely identify and locate these within the section and then to determine the position of the J/K system boundary.

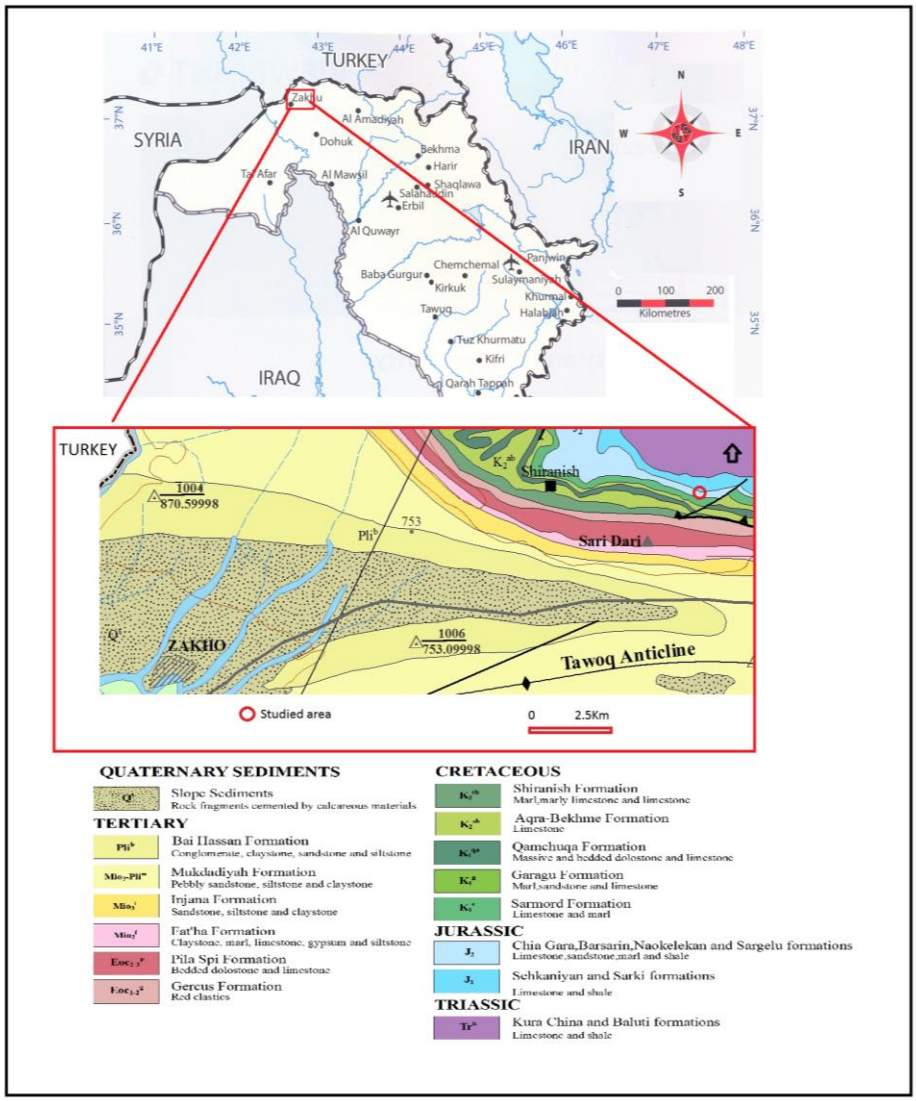


Figure-1: Location map for Banik Village in the Kurdistan Region, with a geological map of the studied area (modified after GEOSURV, 2012).

Materials and Methods

In a preliminary examination, 24 samples were collected from the lower part of the carbonate-rich succession of the Chia Gara Formation at Banik village, Dohuk Governorate, Kurdistan. Samples for nannofossils have been prepared for study as smear slides and calpionellids as thin sections (See Wimbledon et al. (2013) and Casellato (2010), and references therein, for identifications and descriptions of cited biostratigraphically important species).

Description & Discussion

There have been no modern studies of the Chia Gara sediments at Garagu or Banik for biostratigraphy, though the geochemistry of the Banik area has received attention (Edilibi, 2010; Hakimi et al., 2015). In 2012, fieldwork was undertaken by the authors at both Banik and Garagu (Gara anticline) at the sites described by Wetzel. The Garagu sequence is more problematic, and its calpionellids, calcareous nannofossils and ammonites are still being studied; but here we can present some preliminary observations on the Banik section that have a bearing on the ammonites described by Howarth and on the position of the Jurassic/Cretaceous boundary in Iraq (Figure: 2) . Even this first reconnaissance allows accurate correlations, for the first time, with the classical sections for the Tithonian and Berriasian in western Tethys,

such as Brodno, Les Combes, Berrias, Rio Argos etc. However, micropalaeontological collecting at Banik needs to be extended, as deep weathering and burial of marl horizons hampered collecting during the preliminary fieldwork.

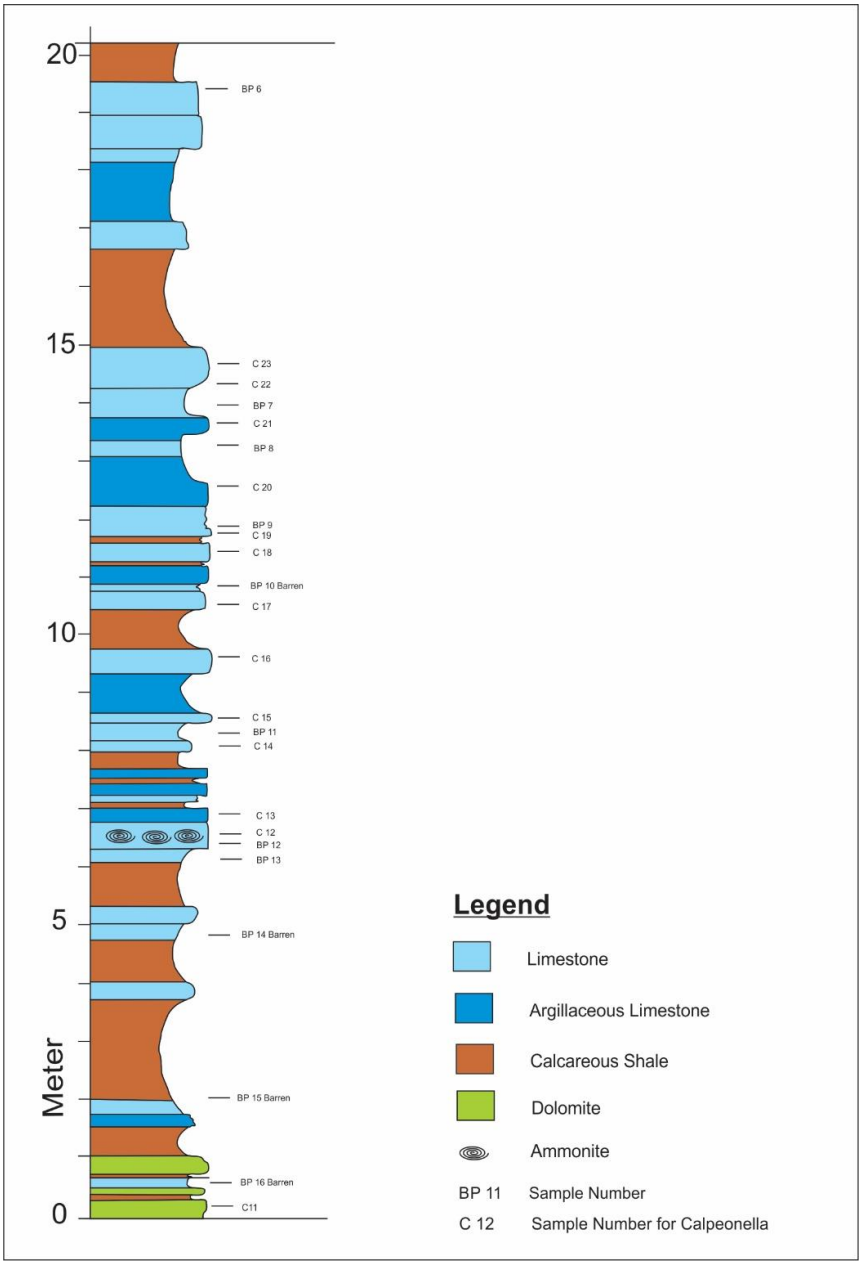


Figure-2: Stratigraphic column of the studied section, Banik Village, Dohuk Governorate, Kurdistan, and the location of studied samples (after Hakimi et al., 2015).

The Banik sequence is hydrocarbon rich; it comprises organic rich shales and dolomites below and marls and limestone (micritic and bioclastic) above (Figures: 2 and 3). One ammonite-rich bioclastic bed is prominent, Wetzel's bed 23 (0.45m thick). It occurs 49.30m above the base of the continuous section. As to its relation to other ammonite-bearing units, "indeterminate berriasellids and ?*Neocosmoceras*" have been recorded 4m below, and Howarth identified *Phanerostephanus* and *Nothostephanus* 12m lower in the succession. In higher units there are only rare traces of ammonites, until 53m above, where a fauna dominated by *Groebericeras rocardi* appears.

Figure - 3: Chia Gara Formation Upper Tithonian sediments at Banik Village, Zakho Area, Dohuk Governorate, Kurdistan.

The ammonites of the 0.45m fossil bed were described by Howarth as species of a new genus, *Chigaroceras*, plus *Proniceras jimulcense, Protancycloceras, Malbosiceras chaperi* and *M.* cf. *asper*. However, the stratigraphic position of the bed and its fauna has only been approximated (Howarth, 1992) to the "Zone of *Durangites*". The ammonite assemblage has no equivalent in European or north African Tethyan sites, and thus relative dating based on ammonites has remained imperfect. The fauna of Wetzel's bed 23 is of particular interest, because the name *Chigaroceras* has been ascribed to specimens originating in the Mendoza Province of Argentina (Leanza, 1996). One ("*Berriasella*" *gerthi* Krantz 1928) was found with *Parodontoceras calistoides* in the Substeueroceras koeneni Zone (at Bardas Blancas; Krantz, 1928), and another specimen came from the Corongoceras alternans Zone (at Mallín Redondo, Mendoza Province; Leanza, 1945). Other Andean material has been figured by Salazar Soto (2012) and Parent et al. (2011). The Corongoceras alternans Zone has been recorded in northern Peru, and there a fauna of *Chigaroceras, Corongoceras* and *Micracanthoceras* is apparently associated with *Moravisphinctes* sp. and *Zittelia* sp., two genera identified in the Microcanthum Zone of Spain (Tavera, 1985). Taking the Andean occurrences at face value, they present interesting possible correlations (Riccardi, 2015), but correlation to Europe and north Africa using ammonites remains vague.

In our collecting in 2012, we found no new ammonite species that could cast light on a presumed late Tithonian Microcanthum Zone or "Durangites" Zone correlation. However, search for nannofossils and calpionellids has produced results that bring greater accuracy to correlations with Mediterranean Tethys, if not to the Andes.

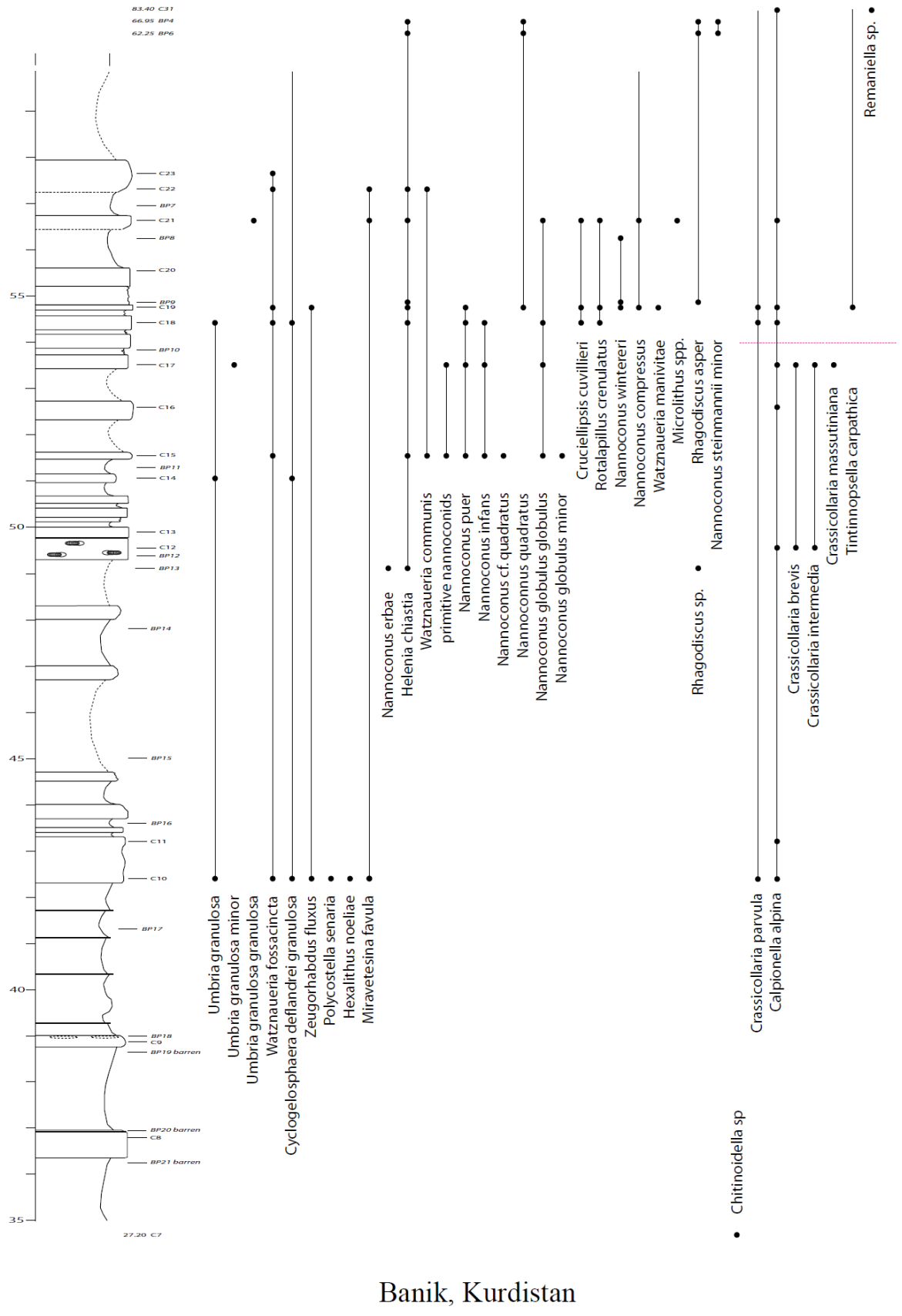
Numerous recent studies in western Tethys have established a number of fossil datums integrated with magnetostratigraphy in the highest Tithonian to lowest Berriasian (e.g. Michalik & Rehakova, 2011; Wimbledon et al., 2013; Casellato, 2010). One, in particular is a turnover in calpionellid faunas in the middle of magnetozone M19n.2n. Here an assemblage of *Crassicollaria* species (*C. brevis* Remane, *C. intermedia* Durand-Delga and *C. massutiniana* Colom) and larger species of *Calpionella* disappear, to be replaced by small orbicular *Calpionella alpina* Lorenz (normally accompanied by *Crassicollaria parvula* Remane and *Tintinopsella carpathica* Murgeanu & Filipescu). This level has been widely used as a workable J/K boundary in recent years. The *Chigaroceras* bed at Banik can now be related to several well-established microfossil datums from western Tethys (Figure: 4). The ammonite bed is at a level less than five metres

below the first appearance of small orbicular *Calpionella alpina*, whereas the first appearances of *Crassicollaria brevis* and *Crassicollaria intermedia* are in the ammonite bed itself, and these species and *Crassicollaria massutiniana* have their last occurrences just below the appearance of small *C. alpina*.

Three nannofossil species, which normally have their FADs in the middle of M19n.2n, were also found: the FAD of *Nannoconus globulus globulus* (Bronnimann) 1.5m above the *Chigaroceras* bed, and the FADs of *Cruciellipsis cuvillieri* (Manivit) and *N. wintereri* Bralower & Thierstein 4.5m above. *Nannoconus steinmannii minor* Deres & Acheriteguy, which normally has its FAD high in magnetozone M19n, at Banik makes it first appearance 12.5m above the top of the ammonite bed.

Conclusion

On the basis of the preliminary microfossil evidence and comparison to sites in western Tethys (France. Central Europe, Italy), it seems likely that the *Chigaroceras* bed at Banik lies, in terms of calpionellid zones, in the Crassicollaria Zone, In terms of ammonite zones, this would thus might equate to the upper Microcanthum Zone - Andreaei Zone and the lower Jacobi Subzone (see Wimbledon et al., 2013), that is, the lower part of the Pseudosubplanites euxinus Zone as it was employed by Howarth (1992), following Wiedmann (1975). This represents a stratigraphic advance, as it places the Jurassic/Cretaceous boundary in Kurdistan with some precision, and allows, for the first time, a precise correlation with the classical Tithonian and Berriasian type localities, as well as other regions such as Mexico, N. Africa, Iran etc.



Banik, Kurdistan

Figure - 4: Range chart of the calpionellids and nannofossils in the studied section at Banik, Kurdistan.

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