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New record of *Barthelia subbetica* Olóriz & Schairer (Jurassic Ammonitina) from the South Iberian paleomargin (Prebetic zone, Spain)

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With 3 figures in the text

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Abstract: In a section from the Sierra de Cazorla (External Prebetic, Province of Jaen) comprising the Upper Oxfordian (Bimammatum/Planula Zones) and Lower Kimmeridgian (Platynota Zone), the ammonite fauna includes a specimen of *Barthelia subbetica* Olóriz & Schairer. Similar to other Upper Jurassic ammonites known from epicontinental shelves as well as neighbouring epioceanic environments, *Barthelia subbetica* appears with a delay in the epicontinental record. The phylogeny of Ataxioceratinae is discussed.

Zusammenfassung: Aus der Sierra de Cazorla, Äußeres Präbeticum (Provinz Jaen, Südspanien) wird ein Profil beschrieben, das Schichten des Oberoxford (Bimammatum-/Planula-Zonen) und des Unterkimmeridge (Platynota-Zone) umfaßt. Es wird eine Liste der Ammonitenfauna gegeben und ein Exemplar von *Barthelia subbetica* Olóriz & Schairer beschrieben. Anhand anderer Ammoniten des Oberen Juras aus epikontinentalen Schelf- und benachbarten epiozeanischen Bereichen kann belegt werden, daß *Barthelia subbetica* in den epikontinentalen Arealen später einsetzt. Die Entwicklungsgeschichte der Ataxioceratinae wird diskutiert.

Location and geological setting

The outcrop is located on the western side of the Sierra de Cazorla (Province of Jaen) at the road from La Iruela to El Chorro (3° 00′ 30″ – 37° 53′ 10″ in the topographical sheet No. 21–37 [928], Cazorla; Fig. 1B). Geologically, the region is located in the External Prebetic; this zone contains the proximal areas of epicontinental deposits that formed in the Upper Jurassic along the central and eastern South Iberian Margin (Fig. 1A).

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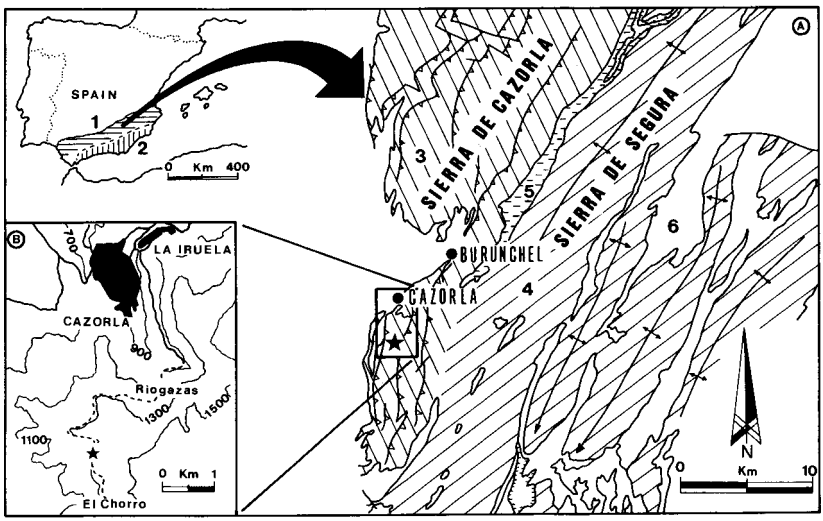

Fig. 1. Location and geological sketch. 1: External zones; 2: Internal zones; 3: External Prebetic; 4: Internal Prebetic; 5: Triassic; 6: Cenozoic indifferentiated; asterisk: outcrop.

Rhythmic successions of marls, marly limestones and limestones were deposited during the Lower Kimmeridgian, generally with a more or less obvious, but significant marly intercalation at the base. This is underlain by Upper Oxfordian sediments. The uppermost Oxfordian deposits are condensed and ferruginized on paleotopographical highs, or represented by a continuous marl/marly limestone succession in comparatively depressed areas. As far as we know, a stratigraphic hiatus of varying duration is present within the uppermost Oxfordian Planula Zone, perhaps continuing into the lowermost Kimmeridgian.

The section

The uppermost Oxfordian is at the top of a rhythmic succession of marls and marly limestones, dominantly wackestones, 18 to 19 m thick, representing the Oxfordian sedimentation in the area. Only the top part of the preserved Oxfordian deposits is represented in Fig. 2. This well-stratified section belongs to the uppermost Bimammatum and the lower Planula Zones, which are lithologically distinguished by a slightly more nodular character of the younger beds. The well-bedded marly limestone beds are about 20 cm thick, while more nodular horizons are generally

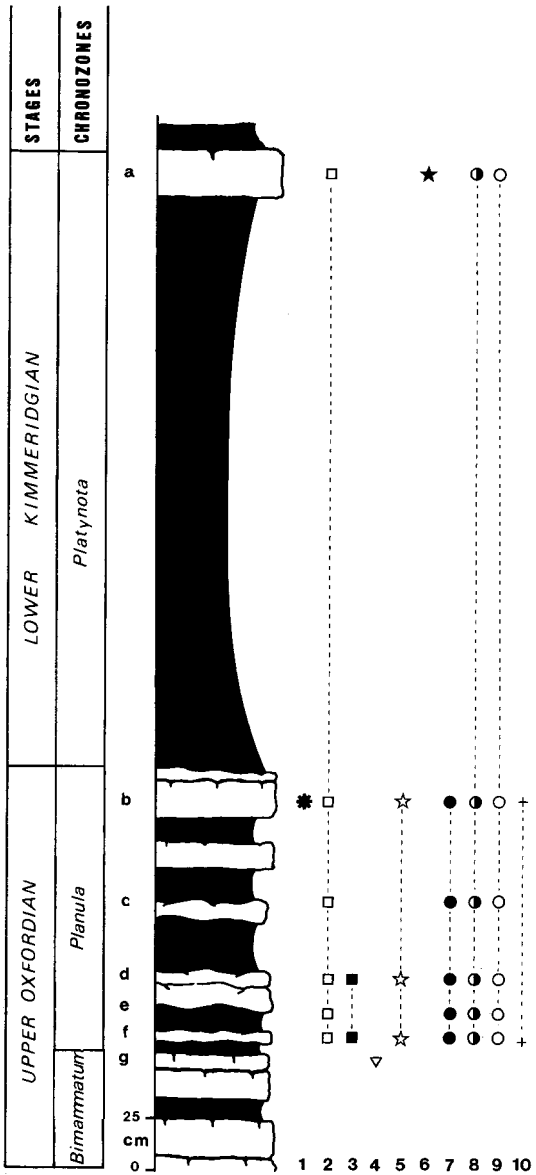

Fig. 2. Chronozones and stratigraphical distribution of significant genera and some species of ammonites in the upper part of the section of Riogazas - El Chorro (External Prebetic, sector of Cazorla, Province of Jaen, southern Spain). 1: *Barthelia subbetica;* 2: *Taramelliceras* (*Metahaploceras*): 3: *T.* (*Taramelliceras*); 4: *Epipeltoceras;* 5: *Sutneria* sp. ex gr. *S. galar;* 6: *S. platynota;* 7: *Orthosphinctes* (*Orthosphinctes*); 8: *O.* (*Ardescia*); 9: *O.* (*Lithacosphinctes*); 10: *Subnebrodites.*

thinner and less continuous. The significant intercalation of marls in the upper part of the section coincides with the end of the local ammonite record belonging unequivocally to the Oxfordian, and with an increase of terrigenous clastic influx. The section exemplifies depositional environments on depressed areas of the External Prebetic during the Upper Oxfordian. As in all studied regions, sedimentation during the early Kimmeridgian begins with marly deposits.

Paleontological description

Taramelliceratinae Spath, 1928

Barthelia subbetica Olóriz & Schairer

Fig. 3

v 1983 *Barthelia subbetica* n. sp. – Olóriz & Schairer: 578; fig. 1, 2, 3a.

Material: 1 specimen, internal mold (RG-CH.b); Departamento de Estratigrafía y Paleontología, Universidad de Granada, Spain.

Description: As the completely chambered specimen is deformed almost vertically, the last whorl appears elbow-shaped at two points on the diagonal line. Therefore, the whorl section seems to be depressed as well, and the umbilici are varying in shape. Suture lines are poorly preserved. The keel on the ventral surface is accompanied by narrow grooves, at which the ribbs end, and bears small tubercles opposite the external ribs.

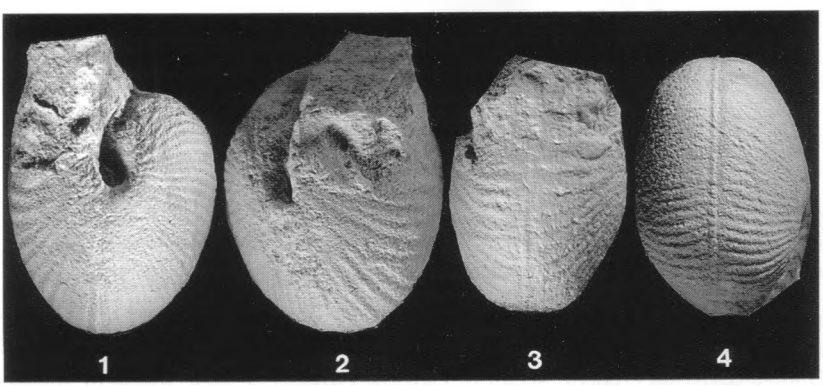

Fig. 3. *Barthelia subbetica,* Oxfordian, Planula zone, Sierra de Cazorla, El Chorro, Province of Jaen, southern Spain. 1–2: Lateral view; 3: Ventral view, anterior part; 4: Ventral view, posterior part; ×3.

Ribbing is blunt; fine on the posterior part of the whorl, coarser on the anterior part. The rursiradiate and straight primary ribs begin at the umbilical edge. Initially, the secondary ribs are also rursiradiate, then they curve forward, and end mostly at the ventral grooves, where they stand opposite, and form a very obtuse angle.

The ribs on the posterior part of the whorl are triplicate and biplicate, although simple; intercalatoring ribs exist as well. The branching points are situated in the umbilical third of the flank. On the anterior part of the whorl, the ribs are biplicate or simple with an intercalatory rib. Points of division are located at about the middle of the flank.

Remarks: The holotype of *Barthelia subbetica* OLÓRIZ & SCHAIRER (1983: fig. 1, 1–4) is an almost complete, undeformed specimen with the peristome, while the paratype (fig. 1, 5–6) is a somewhat incompletely preserved, undeformed specimen lacking the peristome. The reason for the differences between holotype and paratype and the specimen from El Chorro is, that the latter is a small, completely chambered, and deformed specimen. As in the beginning of the last whorl of the paratype, the specimen from El Chorro contains weak grooves on the sides of the keel, which bears fine tubercles opposite the secondary ribs. Considering the deformation of the new specimen, the ribbing is very similar to that of the posterior part of the last whorl of the paratype. For comparison with other dwarfed forms of Taramelliceratinae see OLÓRIZ & SCHAIRER (1983: 580–583; fig. 4).

Remarks on the ammonite fauna

In an attempt to precisely locate the Oxfordian/Kimmeridgian boundary, bed-by-bed sampling provided a faunal association which is dominated by molluscs, predominantly ammonites, belemnites and bivalves; other fossil remains are extremely scarce. In the bed in which *Barthelia* was found, the faunal spectrum is composed of Ataxioceratinae and Passendorferiinae: 51%, Haploceratacеae: 18%, *Sutneria:* 6%, Phylloceratacеae: 16%, and belemnites and bivalves: 8%. Among the ammonites collected from the prospected horizons, the following taxa are biostratigraphically and evolutionarily significant (Fig. 2):

g: *Epipeltoceras* sp. ex gr. *E. semiarmatum* (QUENSTEDT)

f: *Taramelliceras* (*Metahaploceras*) *litocerum* (OPPEL), *T.* (*Taramelliceras*) *pseudoflexuosum* (FAVRE), *Glochiceras* (*Coryceras*) *modestiforme* (OPPEL), *Orthosphinctes* (*Ardescia*) sp. ex gr. *O.* (*A.*) *enayi* ATROPS, *O.* (*Lithacosphinctes*) *evolutus* (QUENSTEDT), *O.* (*Orthosphinctes*) *polygyratus* (REINECKE), *Sutneria* sp. ex gr. *S. galar* (OPPEL), *Sowerbyceras* sp., *Holcophylloceras* sp., *Lytoceras* sp.

e: *Taramelliceras* (*Metahaploceras*) sp. ex gr. *T.* (*M.*) *subnereus* (WEGELE), *Orthosphinctes* (*Ardescia*) sp. ex gr. *O.* (*A.*) *enayi* ATROPS, *O.* (*Lithacosphinctes*) *evolutus*

(QUENSTEDT), *O.* (*Orthosphinctes*) sp. aff. *O.* (*O.*) *mogosensis* (CHOFFAT), *O.* (*O.*) sp. ex gr. *O.* (*O.*) *delgadoi* (CHOFFAT), *Sowerbyceras* sp., *Phylloceras* sp., *Lytoceras* sp., *Hibolithes* sp.

d: *Taramelliceras* (*Metahaploceras*) *litocerum* (OPPEL), *T.* (*M.*) sp. ex gr. *T.* (*M.*) *ausfeldi* – *pseudowenzeli* (WEGELE), *Glochiceras* (*Coryceras*) *modestiforme* (OPPEL), *Orthosphinctes* (*Orthosphinctes*) *polygyratus* (REINECKE) morph. *fontannesi* (CHOFFAT), *Aspidoceras* sp., *Sowerbyceras* sp., *Holcophylloceras* sp.

c: *Glochiceras* (*Coryceras*) *modestiforme* (OPPEL), *Orthosphinctes* (*Ardescia*) sp. ex gr. *O.* (*A.*) *enayi* ATROPS, *O.* (*Lithacosphinctes*) *evolutus* (QUENSTEDT), *O.* (*Orthosphinctes*) sp. ex gr. *O.* (*O.*) *delgadoi* – *mogosensis* (CHOFFAT), *Sowerbyceras* sp., *Holcophylloceras* sp., *Phylloceras* sp., *Hibolithes* sp.

b: *Barthelia subbetica* OLÓRIZ & SCHAIRER, *Taramelliceras* (*Metahaploceras*) *litocerum* (OPPEL), *Subnebrodites minutum* (DIETERICH), *S. laxevolutum* (FONTANNES), *S. planula* (HEHL in ZIETEN), *Sutneria* sp. ex gr. *S. galar* (OPPEL), *Sowerbyceras* sp., *Holcophylloceras* sp., *Hibolithes* sp.

a: *Taramelliceras* (*Metahaploceras*) sp., *Orthosphinctes* (*Ardescia*) sp., *O.* (*Lithacosphinctes*) sp., *Aspidoceras* sp., *Sutneria platynota* (REINECKE), *Sowerbyceras* sp.

For biostratigraphic purposes, the boundary between the Bimammatum and Planula Zones is demarcated by the last appearance of the genus *Epipeltoceras,* followed by the first appearance of *Sutneria* and *Orthosphinctes* (*Ardescia*). This boundary is also lithologically marked by a marly intercalation of 6 cm. In the upper part of the section, the last appearance of the genus *Subnebrodites* together with the Oxfordian *Sutneria* sp. ex gr. *S. galar* (OPPEL), in the uppermost bed below a thick intercalation of marly sediments, and the first record of *Sutneria platynota* (REINECKE) directly above it, allows an approximation to the precise Oxfordian/Kimmeridgian boundary. This boundary has been placed at the base of the above mentioned thick marly intercalations, marls being very poor in ammonites – but containing only Kimmeridgian specimens – according to regional observations by OLÓRIZ & RODRÍGUEZ-TOVAR (in prep.) and MARQUES et al. (1991).

The record of *Sutneria* sp. ex gr. *S. galar* directly above *Epipeltoceras* sp. ex gr. *E. semiarmatum,* and the occurrence of *Orthosphinctes* (*Ardescia*) in the same bed has consequences for biostratigraphy as well as ammonite evolution. *Epipeltoceras* sp. ex gr. *E. semiarmatum* directly below *Sutneria* sp. ex gr. *galar* could be interpreted as evidence for sedimentary discontinuities between the Bimammatum and Planula Zones, such as proposed by MARQUES & OLÓRIZ (1989) for the eastern Algarve (S Portugal), but more paleontological, biostratigraphical, and sedimentological work is necessary to evaluate the geographical extension and significance of these discontinuities. The early appearance of *O.* (*Ardescia*) seems to be typical for Iberian epicontinental margins during the Planula Zone (see ATROPS & MARQUES 1986 and 1988 for the Lusitanian Basin; ATROPS et al. 1987 for the central sector of the Iberian Chain, and data in the present

paper for the Prebetic zone). In addition, MARQUES (1983) figured, without description, *O.* (*Ardescia*) sp. from the Bimammatum Zone in the eastern Algarve (S Portugal) and also *O.* (*A.*) sp. ex gr. *O.* (*A.*) *enay* ATROPS from the same area (cf. MARQUES 1984). This was tentatively related by MARQUES & OLÓRIZ (1989) to a sedimentary discontinuity in connection with a relative sea-level fall. Therefore, some phases in the evolution of the Ataxioceratinae appear to be geographically heterochronous. This has been suggested by ATROPS & MARQUES (1986), and allows us to consider some interesting aspects of ammonite evolution, such as iterative and/or parallel evolution, which have been repeatedly alluded to by OLÓRIZ (1985, 1988), and OLÓRIZ in CHECA & OLÓRIZ (1988). If true, this would require a careful reconsideration of biostratigraphic and biogeographic interpretations.

In closing, three open questions are relevant: 1. is the acme of *Subnebrodites minutum* (DIETRICH) isochronous within the Planula Zone in the epicontinental margins of the east and south of Iberia? 2. Could *Barthelia* be a rare but complementary index fossil within the Planula Zone, when associated with the acme of *S. minutum*? This assumption seems to be in line with the published information (see MELENDEZ et al. 1983, and this paper). 3. The last open question concerns the delayed appearance of *Barthelia* in epicontinental shelves as compared to known records in the distal epioceanic areas of the South Iberian Margin (Subbetic zone; cf. OLÓRIZ & SCHAIRER 1983). At present, available information is too limited to be conclusive, but it is consistent with the general pattern of earlier records in more offshore areas for those Upper Jurassic ammonites, which occur in both epicontinental and epioceanic environments.

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