# *Bathonian-Callovian(Middle Jurassic)ammonite faunas of the Northwest Iberian Ranges: biostratigraphy and palaeobiogeography*

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## ABSTRACT

The Bathonian-Callovian carbonated sediments, sometimes sandy or silty and clayish, of the Iberian platform in the Sierras de la Demanda, Cameros and Moncayo near Burgos, Logroño, Soria and Zaragoza (Northwest Iberian Ranges) yeld significant ammonite faunas for a precise biostratigraphic approach; these also allow some biogeographic remarks about this region situated in platform environments almost off on the North Tethyan margin.

During the Bathonian (Montenegro, Soria, Olvega and Ricla formations) the faunas are dominated by the Perisphinctidae (*Procerites, Siemiradkia, Wagnericeras, Homeoplanulites, Choffatia* −70 %); the other taxa are some Oppelidae (*Oxycerites, Oecotraustes, Prohecticoceras* −20 %), Parkinsoniidae (*Gonolkites, Epistrenoceras* −5 %) and Tulitidae (*Bullatimorphites* −5 %). The various recognized species allow to conclude that the Lower Bathonian (Zigzag zone; Convergens and Yeovilensis subzones) is represented as well as the Middle Bathonian (Progracilis and Subcontractus zones; Subcontractus and Morrisi subzones) and the Upper Bathonian (Retrocostatum zone and subzone). It must be noted that Morphoceratidae of Lowermost Bathonian and Clydoniceratidae of Uppermost Bathonian are missing.

In Callovian, (Montenegro, Pozalmuro and Ricla formations) only the lower part of this stage is rich in ammonites. The Macrocephalus and Gracilis zones are well distinguished with prevalent Macrocephalitidae (*Macrocephalites* −45 %) and Perisphinctidae (*Choffatia, Homeoplanulites, Indosphinctes, Grossouvria* −40 %). The Tulitidae (*Bullatimorphites*), Reineckeidae (*Rehmannia*) and Oppeliidae (*Chanasia*) are very rare (15 %). The Middle, and overall, the Upper Callovian are less fossiliferous and uncom-

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plete: howewer, the Anceps, Coronatum and Athleta zones are sometimes recognized with Hecticoceratinae (*Hecticoceras, Rossiensisseras, Lunuloceras*) and Perisphinctidae (*Grossouvria, Indosphinctes, Flabellisphinctes*). One shall note the absence of the Pachyceratidae (*Erymnoceras*) and Peltoceratidae.

From the biogeographic point of view, we corroborate that this region takes place in the so-called- «Sub-Tethyan realm» where the boreal Callovian Kosmoceratidae and Cardioceratidae are missing while in the Bathonian, the faunas look like all that of the other South-West European areas- «Sub-Boreal realm» -as a consequence of historical factors of distribution.

Nevertheless, ecological factors play an important part in the geographical distribution of the ammonites. The bathymetry appears as the most important factor considering the complete missing of Phylloceratids and Lytoceratids both in Bathonian and Callovian in comparison, for instance, with the Prebetic and Subbetic Ranges which are under oceanic influences in the «Tethyan realm». Localy, ammonites are also exclused from the very shallow facies while they are relatively more abundant in deeper facies; sandy or silty-clayish deposits respectively in South-West Demanda and North-West Moncayo seems to have no influence upon ammonite faunas in comparison with that in the more carbonated sediments.

**Key words:** Biostratigraphy, Palaeobiogeography, Ammonites, Middle-Jurassic, Bathonian-Callovian, Iberic Ranges.

## RESUMEN

En los Ibérides noroccidentales (Sierras de la Demanda, Cameros y Moncayo) los sedimentos referidos al Bathoniense-Calloviense se presentan generalmente como calizas micríticas más o menos detríticas y bioclásticas. Se estudia aquí, con concurso de las faunas de ammonites, los aspectos de la bioestratigrafía y de la paleobiogeografía en el sector Burgos-Logroño-Soria-Zaragoza.

Durante el Bathoniense (Formaciones Montenegro, Neila, Olvega y Ricla) las faunas son dominadas por los Perisphinctidae (*Procerites, Siemiradekia, Wagnericeras, Homeoplanulites, Choffatia* −70 %) y los Oppelidae (*Oxycerites, Oecotraustes, Prohecticoceras* −20 %); algunos Parkinsoniidae (*Gonolkites, Epistrenoceras*) y Tulitidae (*Bullatimorphites*) completan esta fauna (10 %). Se puede reconocer el Bathoniense inferior (zona de Zigzag; subzonas de Convergens y Yeovilensis), el Bathoniense medio (zonas de Progracilis y Subcontractus; subzonas de Subcontractus y Morris) y el Bathoniense superior (zona y subzona de Retrocostatum). Faltan totalmente las familias *Morphoceratidae* de la base del Bathoniense y *Clydoniceratidae* de la parte más superior de este piso.

Solamente el Calloviense inferior es muy fosilífero (Formaciones de Montenegro, Pozalmuro y Ricla). Las zonas de *Macrocephalus* y *Gracilis* se caracterizan por la abundancia de los Macrocephalitidae (*Macrocephalites* —45 %) y Perisphinctidae (*Choffatia, Homeoplanulites, Indosphinctes, Grossouvria* —40 %). Los Tulitidae (*Bullatimorphites*), Reineickeidae (*Rehmannia*) y Oppelidae (*Chanasia*) no representan juntos, más del 15% de la fauna ammonítica. El Calloviense medio y el Calloviense superior faltan en muchos perfiles; cuando existen son poco fosilíferos. La zona de Anceps, y a veces las zonas de Coronatum y Athela, revelan sobre todo Hecticoceratinae (*Hecticoceras, Rossiensiceras, Lunuloceras*) y Perisphinctidae (*Grossouvria, Indosphinctes, Flabellisphinctes*); los Pachyceratidae (*Erymnoceras*) y Peltoceratidae no existen.

Estos datos confirman la pertenencia de los Ibérides noroccidentales a la «Provincia subthethisiana». En el Calloviense faltan totalmente los *Kosmoceratidae* y *Cardioceratidae* de las áreas boreales, mientras que en el Bathoniense la fauna se parece a la que se encuentra corrientemente en el suroeste de Europa. Los factores históricos desempeñan aquí un papel muy importante. Sin embargo, los factores ecológicos son responsables de la ausencia de los Phylloceratidae y Lytoceratidae cuya distribución está condicionada por la profundidad. Localmente, el factor batimétrico interviene también: los ammonites son mas abundantes y diversificados en las áreas profundas que en las plataformas superficiales. La composición del sedimento, más o menos carbonatado y más o menos bioclástico, arenoso y margoso, parece no influir sobre el porcentaje respectivo de las familias.

**Palabras claves:** Bioestratigrafía, Paleobiogeografía, Ammonites, Jurásico Medio, Bathoniense-Calloviense, Cordillera Ibérica.

## INTRODUCTION

The Northwestern areas of the Iberian Ranges between Burgos, Logroño, Zaragoza and Soria is built with the Sierras de la Demanda/de los Cameros and the Sierras del Madero/del Moncayo. The general stratigraphical and palaegeographical elements of the Bathonian and Callovian stages have been studied by Mensink (1966) and Bulard (1972). Later, various authors gave more precise details in sedimentay facies about the carbonated rocks of these regions (Valladares, 1976; Benke, 1981; Mensink and Mertmann, 1984; Wilde, 1988).

From the biostratigraphical and palaeobiogeographical points of view, the North-West Iberian ranges are not so well known as the South-Eastern part of the «Rama Aragonesa» —South of Zaragoza— and the «Rama Castellana» —South of Teruel— (Marín and Toulouse, 1972; Bulard *et al.*, 1974; Sequeiros, 1980, 1982 a,b, 1984; Sequeiros and Cariou, 1984; Sequei-

ros *et al.*, 1984; Conze *et al.*, 1984; Sequeiros and Melendez, 1979, 1987; Cariou *et al.*, 1987).

The recent work in the North West Iberian Range of one of us (S. Wilde), the determination of about 270 new collected ammonites and the revision of the faunas of Bulard's collections preserved in Dijon (J. Thierry), allow us to give a more detailed biostratigraphical framework of this realm. The transition area between the North-West Iberian Range, The Zaragoza region near Ricla, Aguilon and Belchite, is included in the study by literature comparisons. Some biostratigraphical and biogeographical remarks on ammonites can be stated and comparisons with other South-West European regions can be made to replace this Iberian area in the wider context of the North Tethyan margin during the Middle-Jurassic.

## AMMONITE FAUNAS AND BIOSTRATIGRAPHY

### The Bathonian

In West Madero, Madero and Northwest Moncayo regions, Middle and Upper Bathonian is missing partly or entirely. In other areas the stage is enough fossiliferous. The bathonian sequence is separated from the Bajocian by an important guide horizon with unconformities and ammonite enrichment levels which indicate the Upper Bajocian, mostly Niortense, Garantiana and Parkinsoni zones or parts of this.

The most fossiliferous facies is the Montenegro Formation of the Demanda-Cameros regions, some ammonites are also found in the Neila Formation. In the Madero-Moncayo territory ammonites are rare in the Olvega, absent in the Manubles and Soria Formations. Again they are aboundant in the open marine Ricla Formation south of Zaragoza. The main biostratigraphic subdivisions can be recognized. In the Lower Bathonian, the Zigzag zones is well represented with distinctive Parkinsoniidae (10 %) of the Convergens subzone-*Parkinsonia (Gonolkites) cf. eimensis, P. (G.) cf. neuffensis* and *P. (G.) cf. convergens.* The Perisphinctidae (80 %) are omnipresent; these are overall *Procerites cf. stephanovi, P. schloenbachi, P. clausiprocerus, P. laeviplex* and *Siemiradzkia.* Some Oppelidae (10 %) —*Oxycerites cf. gr. fallax-limosus*—, show that the Yeovilensis subzone is present.

In spite of a relatively abundant fauna, the subdivisions of the Middle Bathonian are not easy to recognize. The Perisphinctidae are always dominant (80 %) with *Procerites fullonicus, P. imitator, Siemiradzkia lissajousi, S. pseudorjasanensis, Gracilisphinctes cf. progracilis* and some *Wagnericeras. The Oppelidae (10%) and Tulitidae (10%)* are rare enough, with respectively *Oxycerites oxus* and *Bullatimorphites costatus:* the Subcontractus and Morrisi zo-

nes may be partly present, at least the Gracilisphinctes, Daubenyi and Wagnericeras horizons.

The Upper Bathonian is uncomplete. On the one hand, the Discus zone faunas are always missing as in all the Iberian Península; on the other hand, the Retrocostatum zone can be easily recognized. The Perisphinctidae are still dominant (60 to 80 %) with *Homeoplanulites acuticosta, H. homeomorphus, Parachoffatia sp., Choffatia (Subgrossouvria) richei.* The Oppelidae are well represented (15 to 30 %) with *Oxycerites cf. oppeli, O. orbis, Hecticoceras (Prohecticoceras) angulicostatum, Oecotraustes claraiensis.* In addition, rare Tulitidae -*Bullatimorphites cf. bullatimorphus, B. cf. costatus*- and *Epistrenoceras cf. hystricoides, E. sp.* bear out the Mirabilis, Blanazense and Retrocostatum horizons.

**The Callovian**

A significant unconformity exists within the Lower Callovian in the whole studied area except in the Demanda and Zaragoza basin regions (Mensink and Mertmann, 1984) where the facies of the Lower Callovian is in continuity with the Upper Bathonian. In South-West Cameros, South-West Demanda, North and partially South Demanda, the Middle and Upper Callovian are missing. There usually, the Macrocephalus and the Gracilis zone are in the upper part of the Montenegro formation. In other areas as the South East Demanda, East Demanda/North Cameros, South West Cameros and West Zaragoza regions, the Callovian is well known, highly fossiliferous and seems to be complete. The main sections, Canales in the Montenegro formation, Ciria in the Pozalmuro formation and Ricla in the Ricla formation, provide good enough ammonite faunas. In the Agreda and Pozalmuro Formations of the Madero/Moncayo territoy except of the South West (Ciria), the Callovian is unfossiliferous and very poor in ammonites but surely exists. In nearly the whole studied area, the Dogger/Malm Boundary Unconformity separates the Callovian from the Oxfordian sequence (Mensink, 1966; Bulard, 1972; Geyer *et al.*, 1974; Benke, 1981; Wilde, 1987). The Upper, if not also the Middle Callovian are in contrast to the Lower Callovian, only recognized in some sections with a scarce and bad preserved fauna.

The Lower Callovian is the best known. In the Macrocephalus zone the Perisphinctidae (40 to 45 %) —*Homeoplanulites cf. furculus, H. sp., Choffatia sp., Parachoffatia sp., Grossouvria sp., Indosphinctes sp.*— and the Macrocephalitidae (40 to 45 %) —*Macrocephalites transitorius, M. cf. macrocephalus, M. typicus, M. kamptus*— are prevalent. The Tulitidae —*Bullatimorphites bullatus, B. prahecquense*— are less represented (15 or 25 %); in some sections they can reach 30 %. Rare Oppellidae —*Oxycerites sp.* and *Reineckeidae-Rehmannia sp., Loczyceras sp.* do not go up to 1 or 20 %. In the Gracilis zone

the ratio slightly changes with the disappearance of the Tulitidae, the growing up to 10-20 % of the Reineckeidae —*Rehmannia (Loczyceras) greppini, R. (R.) laugieri* and some representative Oppelidae —*Chanasia chartroni.* The Perisphinctidae —*Indosphinctes rusticus, I. luceyensis, I. sp.*— and the Macrocephalitidae-*Macrocephalites compressus, M. gracilis*— stay the more representative ammonites (45 to 50 %).

The scarceness of the Middle and Upper Callovian ammonites do not allow to establish reliable ratios. The Anceps and sometimes the Coronatum zones can be recognized overall with Reineckeiidae —*Reineckeia (Reneckeia)* cf. *anceps, Rehmannia (Loczyceras)* gr. *reissi, R. (L.) richei*— Hecticoceratidae —*Hecticoceras chanaziense, H. pseudopunctatum, H. (Lunuloceras) orbignyi, H. (Rossiensiceras) metomphatum, H. (R.) subnodosum*— and the always prevalent Perisphinctidae —*Indosphinctes, Flabellisphinctes, Grossouyria.* With respect to the Upper Callovian, the very rare Hecticoceratidae collected are not indisputable evidence; one can only say that Athleta zone may exist (Sequeiros and Meléndez, 1987).

## PALAEOGEOGRAPHY AND AMMONITES BIOGEOGRAPHY

### Main palaeogeographical and sedimentological aspects

According to various authors (Bulard, 1972; Gomez, 1979), the genereal palaeogeographical outline depicted is the so called «Soria Strait» between the Ebro and Iberic (Central Meseta and Asturias) massifs. Opened to the North West on the «Cantabric Sea» and to the South East on the «Levantin Sea», it makes the connection between the Atlantic and the Tethys Oceans. The limits and extension of the «Soria Strait» are highly variable during the Jurassic; but, all the authors agree with a general regressive trend which narrow it from Lower Jurassic (Toarcian) to Late Middle Jurassic (Callovian). Always typicals of an epicontinental platform, the sediments, mainly carbonated in the Bajocian-Bathonian, become detritical (sandy, silty and clayish) in the North-West Iberic Ranges during the Callovian and Oxfordian.

### Ammonite faunas and biogeographical comments

a) The Bathonian

Because of a relative scarceness of the specimens in the sections it is not possible to give quantitative results. Nevertheless, the four major taxa recorded are Ammonitina commonly known on the european cratonic platforms, almost off to the North on the Tethyan margin («Subtethyan realm»;

Cariou *et al.* 1985); it can be noted that they are not so diversified as in other West European areas. Some taxa, commonly recorded from Western Europe platforms and Betic Ranges are missing or very little known. Such are the Morphoceratidae; rare specimens exists more to the South East in the «Rama Aragonesa» near Calanda and Rafales (Bulard, 1972) in the «Sector Levantino» of the «Rama Castellana» near Sot de Chera (Gómez *et al.*, 1971) and in the Montes Universales near Hontanar and Moscardón (Tintant and Viallard, 1970; Fernández *et al.*, 1978). The same situation exists with the Middle Bathonian Cadomitinae and the Upper Bathonian *Epistrenoceras* and *Hemigarantia*. Some other remarks can be stated about the genera *Tulites* and *Morriceras* never surely identified up to the present (Gómez *et al.*, 1971). With regard to the simplified suture line ammonites, the so-called «Faunes arabo-malgaches» (Cariou *et al.*, 1985) as *Micromphalites* (Middle Bathonian) and *Clydoniceras* (Upper Bathonian) are unknown. Phylloceratina and Lytoceratina are always missing like in the whole Iberic ranges; this features highly constrasts with the Betic Ranges (Sandoval-Gabarrón, 1983) where these taxa, linked to deap and oceanic environments («Tethyan bioma», Dommergues and Marchand, 1988; Thierry, 1988 a, b) are present and often dominant on Ammonitina.

These differences within the ammonite faunas between Middle Western Europe, Iberian Ranges and Betic Ranges is not caused only by gaps in the fossil record but is the consequense of the environment water depth. Phylloceratidae, Lytoceratidae and Morphoceratidae are missing here because it is too shallow; as to Clydoniceratidae and some Tulitidae, it is too deep. It remains the problem of the scarceness or missing of the Middle Bathonian *Cadomites* and Upper Bathonian *Epistrenoceras, Hemigarantia*, and a relative low species diversity within the other Ammonitina. If we consider the general palaeogeography, the «Soria Strait» may stands in the way of the spreading of the ammonite faunas. The North West Iberian ranges may have been relatively isolated on the narrower part of this «strait», they are not very well in connection with the Atlantic areas because of the expansion of the emerged areas. This may explain the few diversified and impoverished Bathonian Ammonites Faunas.

b) The Callovian

In the Lower Callovian the Macrocephalus zone (Valgañon-Gar-ganchon, Canales and Ciria) yelds the prevalent families Tulitidae, Macrocephalitidae and Perisphinctidae with rare Hecticoceratidae (Valganón-Garganchón and Canales) and Reineckeidae (Ciria). With the Gracilis zone (Torrelara-La Aceña, Canales, Luezas and Ciria) the Tulitidae desappear, the Hecticoceratidae-Reineckeidae go up and the Macrocephalitidae- Perisphinctidae stay at an identical ratio or slightly increase (Fig. 1). The more detailed investigations conducted South of Zaragoza (Ricla, Aguilon and Belchite —Sequeiros, 1984; Sequeiros and Cariou, 1984; Cariou *et al.*,

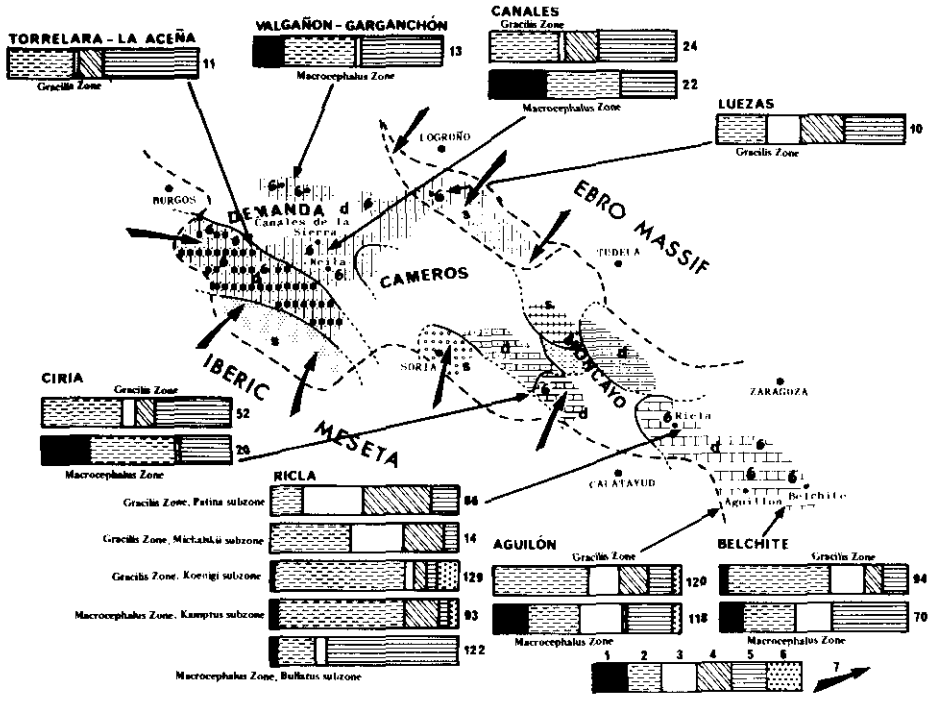


Fig. 1.—Palaeogeography of the Lower Callovian (Macrocephalus and Gracilis zones) and geographical distribution of Ammonites in the «Soria Strait» (dotted line). North West Iberic ranges - Ammonite faunas: 1-Tulitidae, 2-Macrocephalitidae, 3-Oppellidae, 4-Reineckeiidae, 5-Perisphinctidae, 6-Spiroceratidae. The number on the right of each diagram is the total ammonite fauna for the considered biostratigraphical unit. Palaeogeographical data (modified from Wilde, 1988): 7-clastic influences (mainly sandy), -s: shallow facies (superficial platforms), -d:deaper facies (deap platforms). The white areas are without deposits.

Fig. 1.—Paleogeografía del Calloviense Inferior (Zonas Macrocephalus y Gracilis) y distribución geográfica de Ammonites en el «Estrecho de Soria» (línea discontinua). Noroeste de la Cordillera Ibérica. Faunas de Ammonites: 1-Tulitidae, 2-Macrocephalitidae, 3-Oppellidae, 4-Reineckeiidae, 5-Perisphinctidae, 6-Spiroceratidae. El número de la derecha de cada diagrama es el total de la fauna de Ammonites para la unidad bioestratigráfica considerada Datos paleogeográficos (modificados de Wilde, 1988): 7- influencias clásticas (principalmente arenosas), -s: facies poco profundas (plataformas superficiales), -d:facies más profundas (plataformas profundas). En las áreas en blanco no hay depósitos.

1987) or more to the South East in the «Rama Aragonesa» (Ariño, Marín and Toulouse 1972; Sequeiros, 1984— Moneva, Sequeiros, 1982, 1984) show the same distributions. Some differences can be noted in the sections where the data are given at the subzone level: the Tulitidae pursues at the base of the Gracilis zone (Ricla and Belchite) while at the same time the Macrocephalitidae reach 70 % of the fauna; some heteromorphs (Spiroceratidae) can be noted (Ricla, Aguilon) with an important ratio (5 to 10 %).

In the Middle Callovian (Fig. 2) only the Anceps zone can be investigated in spite of a rare enough fauna (Canales and Ciria). Similar ratios as that compiled South of Zaragoza on more abundant collections (Ricla, Aguilon and Belchite; op. cit.) show the important part played by the Hecticoceratidae and the ever present Reineckeidae and Perisphinctidae. The Coronatum zone is only well detailed in Ricla (Sequeiros and Cariou, 1984, Cariou *et al.*, 1987) and Aguilón (Sequeiros and Meléndez, 1979; Sequeiros *et al.*, 1984) but the fauna is too rare to give significant quantitative data. The Pachyceratidae —*Erymnoceras*— are obviously very rare and the fauna is parted like in the Anceps zone with similar ratios between Hecticoceratidae, Reineckeidae and Perisphinctidae. *Erymnoceras* is only cited in two other points of the Iberic Ranges: near Torrecilla de Cameros (Bulard, 1972) and in the «Rincon de Ademuz» (Levantin area; Gómez, 1979).

The Upper Callovian ammonite fauna is too scanty to a quantitative approach. However some discoveries are of interest. The Athela (and per-

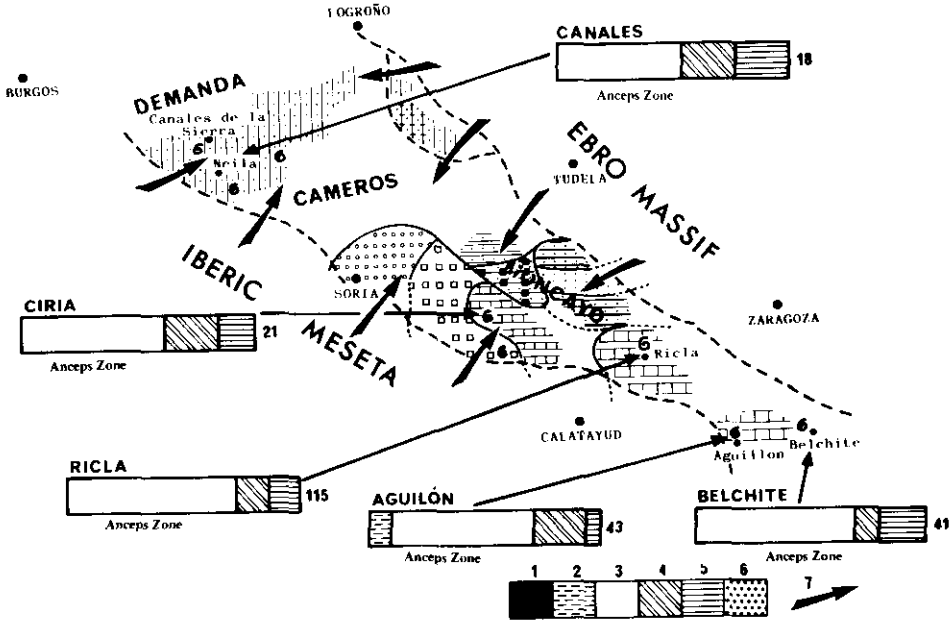


Fig. 2.—Palaeogeography of the Middle Callovian (Anceps zone) and geographical distribution of Ammonites in the «Soria Strait» (dotted line), North West Iberic ranges (same legend as in Fig. 1).

Fig. 2.—Paleogeografía del Calloviense Medio (Zona Anceps) y distribución geográfica de Ammonites en el «Estrecho de Soria» (línea discontinua), Noroeste de la Cordillera Ibérica (leyenda igual que en la Fig. 1.).

haps Lower Lamberti zone) of Ricla (Sequeiros and Cariou, 1984, Cariou *et al.*, 1987) and Aguilón (Sequeiros and Meléndez, 1979; Sequeiros *et al.*, 1984; Sequeiros and Meléndez, 1987) yelds overall Reineckeidae, Hecticoceratidae and rare Peltoceratidae like in other places of the South Western Europe. One must point out the discovery of rare Kosmoceratidae in Ricla, Aguilón (Conze *et al.*, 1984) and Anquela de Pedregal in the «Rama Castellana» (Meléndez *et al.*, 1982). The *Kosmoceras* recorded from Neila (Mensink, 1962) and the *Quenstedtoceras* from Ciria and Canales (Mensink, 1966; Bulard, 1972) remain very doubtfull.

In brief, during the Callovian, the North West Iberic ranges are not influenced neither by the «Tethyan bioma» nor by the «Boreal biota» (Dommergues and Marchand, 1988; Thierry, 1988 a,b). On the one hand the Tethyan Phylloceratidae and Lytoceratidae are totaly missing contrasting once more with the ammonite faunas of the Betic Ranges (Sequeiros, 1974; 1979 a,b; 1987). On the other hand the Boreal Cardioceratidae are also totaly missing while the Kosmoceratidae are very rare and restricted to the Upper Callovian. Considering there cosmopolitan faunas, one can state that the Iberic Ranges belong to the «Subtethyan realm» (Cariou *et al.*, 1985). Like in the Bathonian, the faunas appear to be not so rich and diversified as in other areas (Marchand and Thierry 1986; Thierry, 1988 a, b); one more time, we can put forward the situation of the North West Iberic Ranges in the narrowest part of the «Soria strait» and the consequently bad intercommunications with the «Levantin Sea» and the «Asturian Sea».

## CONCLUSIONS

The geographical distribution of ammonites in the Iberian ranges has been still discussed overall for the Callovian (Sequeiros, 1984, 1986; Sequeiros *et al.*, 1986) but not for the Bathonian. Our investigations give important complements about the North Western areas not yet well known from this palaeobiogeographical point of view. The results leads us to discuss the part played both by the historical and/or ecological factors in the distribution of ammonites at two different scales: the regional Western Europe and the local Iberian Ranges.

The cosmopolitan fauna of the Bathonian, and the missing of the Boreal families Cardioceratidea and Kosmoceratidae in the Callovian are the consequences of historical factors playing a part at the European scale (Cariou *et al.*, 1985; Dommergues *et al.*, 1987; Dommergues and Marchand, 1988; Dommergues *et al.*, 1988; Thierry, 1988 a,b). The spreading of these two families from the «Boreal biota» to the South of Europe takes place in the general transgressive context of the Callovian stage: Portugal (Rocha and Tintant, 1975), Spain (Melendez *et al.*, 1982; Conze *et al.*, 1984) and

Bulgaria (Howarth and Stephanov, 1965) are reached only in the Upper Callovian. Conversely the missing of Phylloceratidae and Lytoceratidae, both in Bathonian and Callovian, is a consequence of ecological factors mainly the bathymetry. The Iberic Ranges don't belong to the «Tethyan bioma» (oceanic influences) which is evidently settled down on the Southern Europe areas but does not pass beyond the Betic Ranges. Such a distribution leads some authors to speak of a «Subtethyan realm» while the Middle Europe is under the influences of a «Subboreal (or Euroboreal) realm» (cratonic influences).

The local palaeogeography can interfere on this regional distribution. Once more, the bathymetry appears as the most important factor: ammonites are rare or exclused from the very shallow facies while they are relatively more abundant in deeper facies (Thierry, 1988 a). But, the different kinds of sediments seems to have no influence upon the ammonite faunas; one must compare that of the sandy or silty-clayish depostis respectively in South-West Demanda and North West Moncayo versus that in the more carbonated sediments on the South of Zaragoza. Last but not the least, the so called «Soria Strait» appears to play as an impediment for the spreading of the ammonites. In the general transgressive context of the Lower Callovian, the relations between the Iberic Ranges and the «Bassin d'Aquitaine» (France), through the «País Vasco» and the «Pyrennées Occidentales» seems to be easy; the ammonite faunas of the «Sierra de Aralar» and the «Massif des Arbailles» are similar (Thierry, unpublished data). In the Middle and Upper Callovian, the rare records of Pachyceratidae and Kosmoceratidae may allow us to think that the communications with the Atlantic areas (Asturias and Portugal, West of France and England) are not so easy than in the Lower Callovian. These ammonites are for instance more diversified and numerous in Portugal (Ruget, 1961; Rocha and Tintant, 1975) than in the Iberic Ranges.

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