AAPG International Conference
Barcelona, Spain
September 21-24, 2003

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The Position of The South Pyrenean Margin in The Late Cretaceous: Evidence for Larger Foraminifera

INTRODUCTION

During the most of the Cretaceous times, the place occupied nowadays by the Pyrenees was a deep and narrow furrow extending between the Iberian and European plates (Fig.1). The palaeogeography of the Pyrenean sea shows during the late Cretaceous times a basin axis oriented east-west, with its north and southern shoreline following the same general direction. There, within the neritic domain carbonate and/or mixed shallow platforms were developed. The Pyrenean tectonics (Alpine Convergence), that took place from the latest Cretaceous to Oligocene time, deformed, detached from its substrate and fragmented the previous deformed materials resulting in diverse tectonic units separated by several kilometres and not directly related with their neighbours.

In this scenario, mapping and detailed stratigraphical and sedimentological analysis of sediments is not always sufficient to establish a correlation permitting to reconstruct the position of the ancient margin and its environments. Thus, the use of larger foraminifera distribution appears as a good tool to precise the temporal and spatial setting of each unit in the Pyrenean Basin during the Upper Cretaceous times.

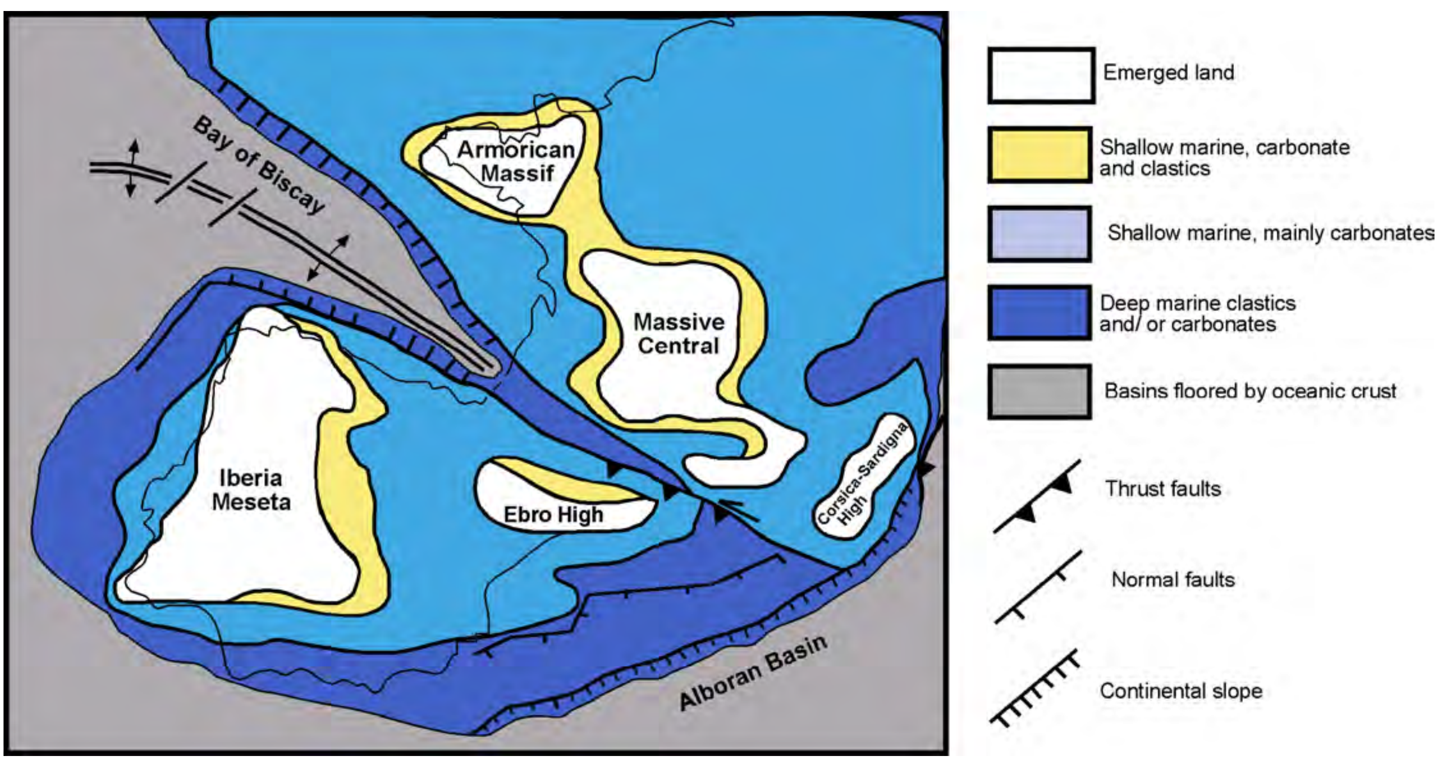

Figure 1: Palaeogeographical sketch of the Pyrenean basin during the Cretaceous times (after Ziggler, 1988).

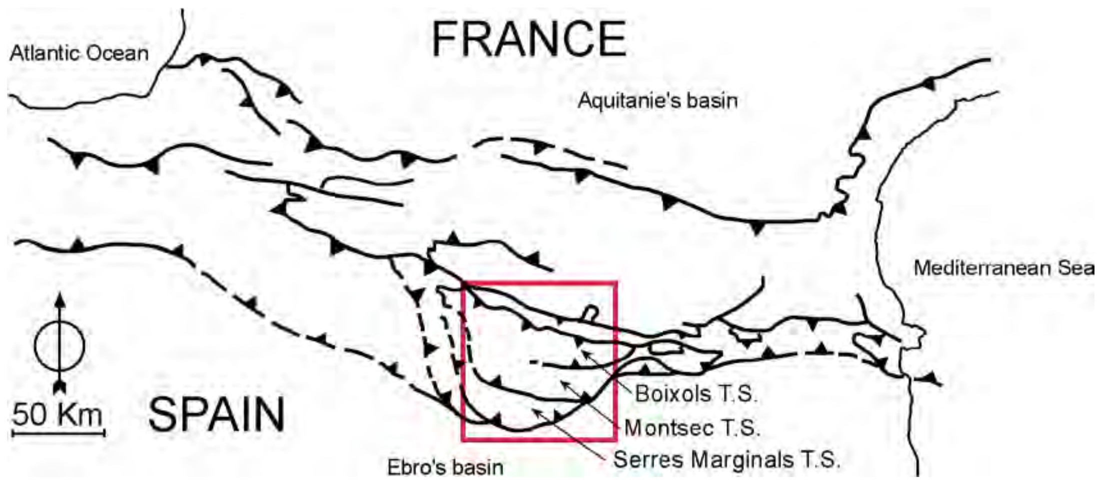

Figure 2: Geological setting of the studied area.

GEOLOGICAL SETTING AND STRATIGRAPHY

The present study is restricted to the Serres Marginals and Montsec thrust sheets from the south-central Pyrenean unit (Seguret, 1972; Muñoz et al., 1984) (Fig.2 and 3). The two South-Pyrenean tectonic units are oriented parallel to the basin axis, and document within the shallow platform different palaeoenvironmental settings.

In the Pyrenees, the late Cretaceous deposits belong to two main tectonostratigraphic cycles (Berastegui et al., 2002). The lower cycle (late Cenomanian- early Santonian) corresponds to a transition phase, in which the Upper Cretaceous deposits reflect homogeneous and moderate subsidence, related to lithostratigraphic thermal contraction after the initial extensional episodes that took place during the lower Cretaceous. During the Upper cycle (late Santonian- Maastrichtian), the northern edge of the Iberian plate became a convergent margin and the basin registered a big change.

In the study area, the lower cycle was represented by a stable carbonate platform, which deposits are only present in the Montsec T.S. The base of this cycle is marked by a middle Cenomanian unconformity, while the upper boundary is indicated by an intra-Santonian sea-level fall. From the base to the top, the following stratigraphic units have been recognised:

1) Praealveolina limestones (30-40 m.). Homogeneous grey limestones very rich in larger foraminifera, mainly alveolinids. Some beds register a great density of oyster fragments. The alveolinid limestones were deposited in a very shallow and wide platform during the Middle-Upper Cenomanian.

2) Calcisphaerid (Pithonella) limestones (up 45 m.). It is constitued by grey-to-white micritic limestones dominated by sections of calcisphaerid and some planktonic foraminifera from the Helvetoglobotruncana helvetica and Marginotruncana schneegansi zones (Middle and Upper Turonian, Caus et al., 1993), but no larger foraminifera have been found in this unit. This unit was deposited in an open platform. The boundary between the Prealveolina limestones and the Pithonella limestones marks a sharp contact, and a sedimentary hiatus due to the Cenomanian- Turonian eutrophication event has been pointed out by Caus et al. (1997).

3) Nodular marly limestones and marls interbedded with bioclastic limestones, which thickness varies from 100 to 300 meters. The base of this unit (Charophyte limestones) onlaps the underlying calcisphaerid limestones and a sedimentary gap is recorded (Caus et al., 1999). The larger foraminifera are very abundant and diversified, mainly agglutinated spiral to peneropliform or discoidal larger foraminifera, complex miliolids and larger rotalids. This unit shows one or several bars separating a well developed lagoon from the open sea. The age of this unit is Upper Coniacian?- Lower Santonian.

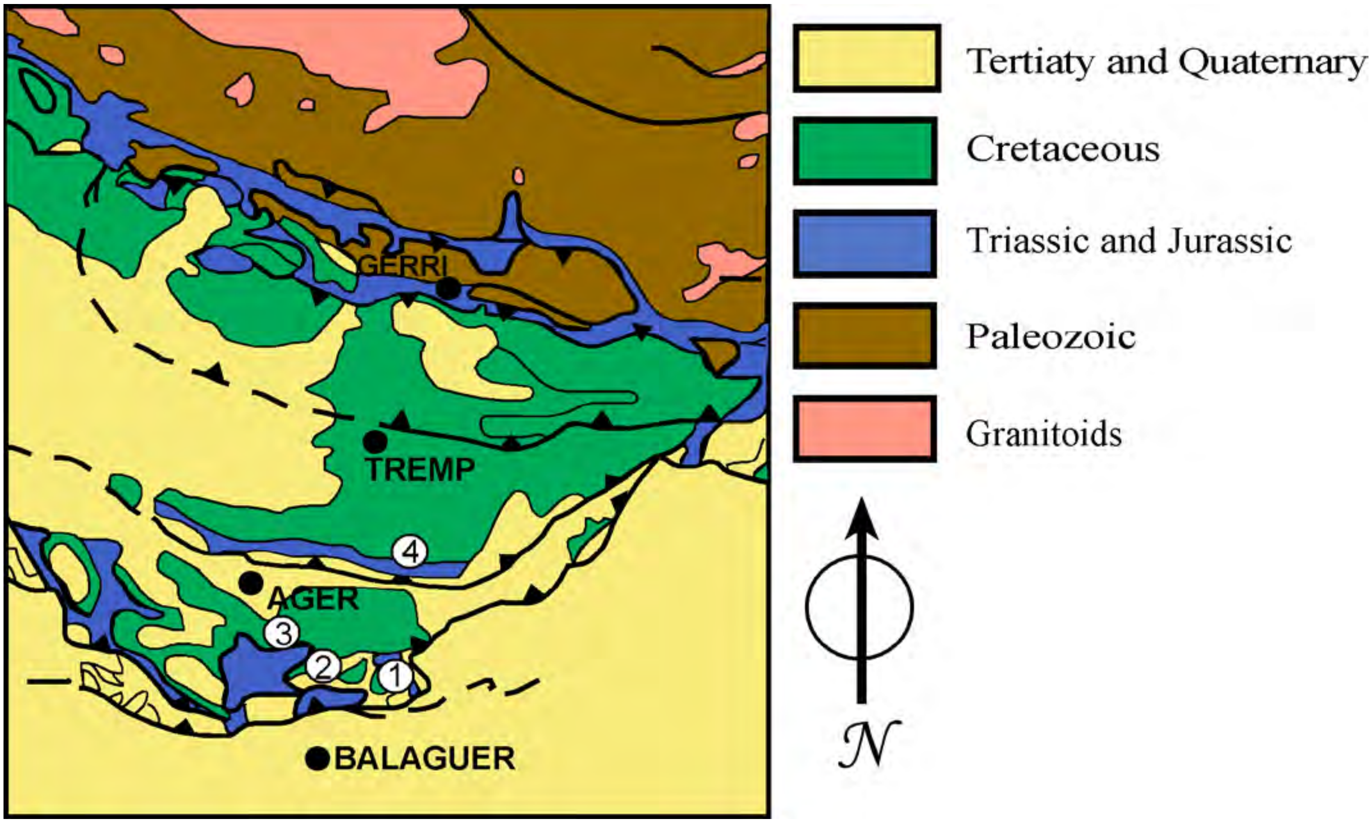

Figure 3: Geological sketch map of the studied area and the location of the sections represented in the figure 4.

The Upper cycle started with the generation of a rapidly subsiding, terrigenous basin through north of the study area (Boixols T.S.), while in the shallower areas of the basin a shallow platform developed extending progressively southwards (Serres Marginals T.S.). A change from the early convergence to a more widespread compression provokes in the study area a regressive tendency finishing with continental red beds (Garumnian facies). The stratigraphic units, from the base to the top, are:

4) In the deepest part of the studied area, the upper cycle starts with yellow and/or grey marls alternating with marly limestones very rich foraminifera, sponges, solitary corals and brachiopods, and up to 250 m. In shallow areas the unit is constituted by yellow sands with some interbedded sandy marls and/or limestones with larger foraminifera reaching 50 m thick. The assemblage characterising this unit was classically known as the "Tragó de Noguera assemblage" (Schlumberger, 1899) and it has been used for correlation in the Pyrenean Realm. The deposition of the materials from this unit ranges from a restricted and/or siliciclastic lagoon to open platform, but within the photic zone. The unit is attributed to the Middle?- Upper Santonian, but the early Campanian is not excluded and further work must be carried out.

5) Bioclastic thick-bedded limestones interbedded with some marly thin stratified limestones, which thickness varies from 350 m. in the north to 50 m. in the south. The bioclastic beds are very rich in larger foraminifera, mainly Orbitoidids and Siderolitinae, and fragmented rudists and bryozoa. The marly limestones contains larger foraminifera, mainly conical and discoidal agglutinated and rotalids, and rudist in position of life. This unit is quite homogeneous in all of the studied area and constitutes the highest cliffs, which can be easily recognised in the landscape. The age is Lower to Middle Campanian. This unit represents high-energy platform deposits separated by low-energy lagoonal sediments.

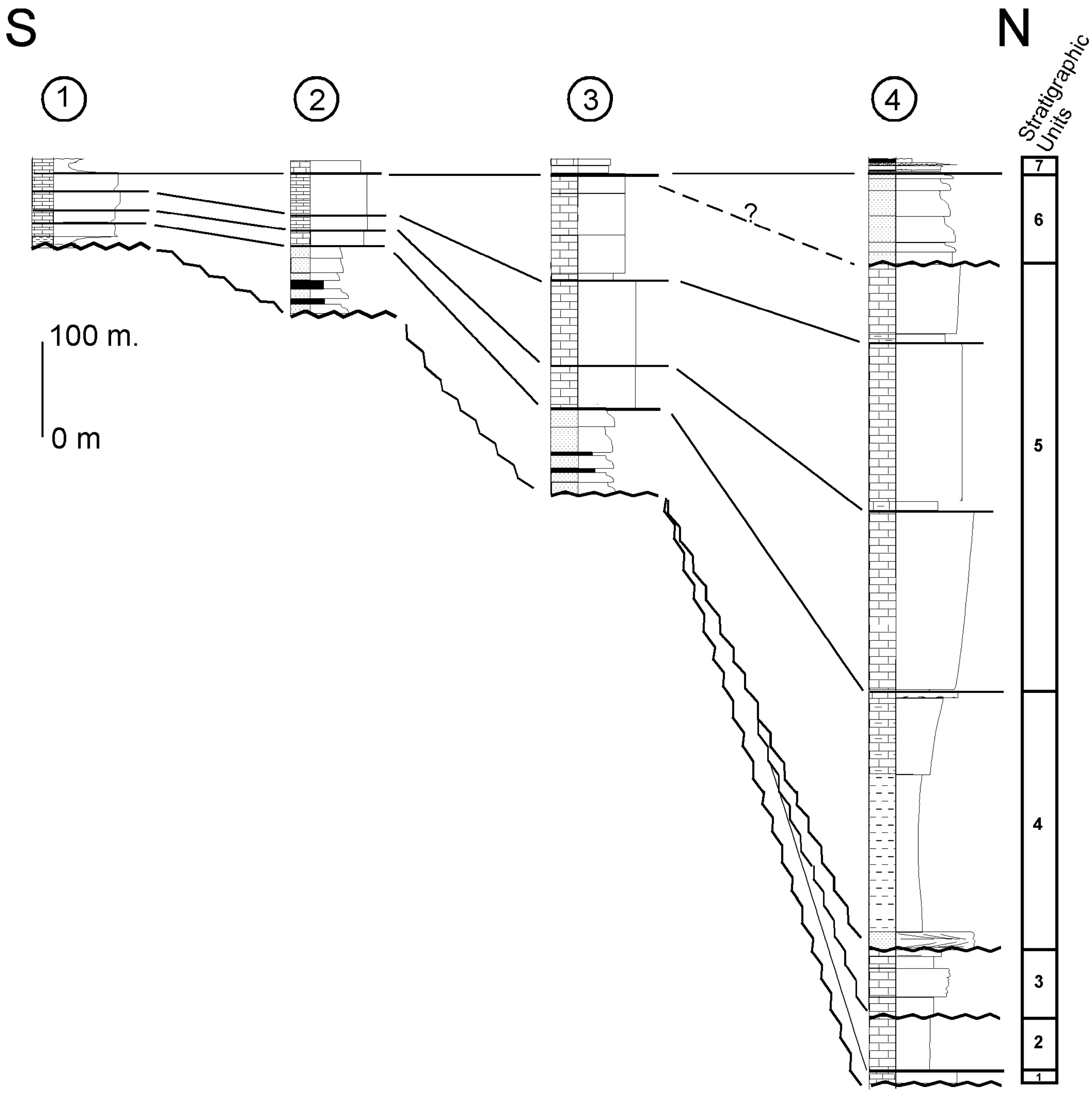

Figure 4: Correlation among the studied sections corresponding to different tectonic units (see the location in fig.3).

6) This unit is not uniform in the studied area, and in the Montsec Mountains is constituted by grey calcareous sandstones, sandy limestones and sandstones up to 200 m. In the upper part of the unit Orbitoides bars are very common. This unit is interpreted as deposited in a mixed platform, and attributed to Upper Campanian-Lower Maastrichtian.

7) Nodular marly limestones with rudists and micritic limestones with miliolids, nezzazatinellids, conical agglutinated larger foraminifera that grades to charophite limestones. This unit corresponds to the transition from very shallow marine deposits to fresh- water environments. The thickness of marine sediments is 15m.

WHY TO USE LARGER FORAMINIFERA?

Larger foraminifera are huge unicellular organisms, which shells obtained by growth-steps reflect the complex morphology and structures through the ontogeny. Therefore, the accurate analysis of such microfossils allow us to separate time depending characters, which can be used in biostratigraphy, from characters with environmental meaning, which can be used to interpret the palaeoenvironment.
Moreover, the larger foraminifera can be determinated in thin-section and cover all the environments in the photic zone.

RESULTS:

Although the work is not get finish, some results are already available. In figure 4 we presented the correlation among the studied tectonic units.

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