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

Amelia Calonge[1], Esmeralda Caus[2], Dolores López-Carrillo[1] (1) Universidad de Alcalá de Henares, Alcalá de Henares, Spain (2) Universitat Autònoma de Barcelona, Bellaterra, Spain

Biostratigraphy of The Shallow-Water Cenomanian Deposits from The Iberian Ranges (Spain)

Introduction

The Cenomanian shallow-water platform sediments deposited in several parts of the world have an important interest as oil and/or gas reservoirs. In corresponding deposits, where pelagic microfossils and anmonoids are absent, it is interesting to look for alternative fossils to date the sediments. In this way, the larger Foraminifera become the most useful markers for shallow-water Cenomanian high resolution biostratigraphy.

Thus, the aim of this work is to contribute to the knowledge of the Cenomanian shallow-water platform biostratigraphy by means of larger Foraminifera. The study was carried out in the Iberian Range, where the previous studies and the good quality of the outcrops facilitate detailed correlations.

In the Iberian Ranges, Middle Cretaceous sedimentation took place in a very shallow platform, which constitutes probably one of the best developed platform in the Tethyan Realm. In the resulting deposits larger Foraminifera are abundant and well diversified, which permits to observe the superposition of microfossil assemblages from the base to the top of the Cenomanian.

Geological setting and stratigraphy

The Iberian Ranges (Fig. 1) are an Alpine orogenic belt that extend for about 55.000 km^2 in the eastern part of Spain. It is bounded to the north by the Ebro Basin, to the west by the the Duero and Tajo Basins and to the east and south-east by he Mediterranean sea and the Betics. Within the Iberian Ranges the study area comprises almost all of the so-called south-western (Valencia province) and Castilian (Cuenca province) Iberian Ranges, the Maestrazgo (Teruel and Castellón provinces) and the Catalanids (Tarragona province), where more than fifty sections have been measured and sampled.

The current state of knowledge allows to divide the Middle Cretaceous deposits into two main cycles separated by a stratigraphical disconformity located by the Middle Cenomanian that suggests a basin wide sedimentary and paleogeographic changes. During the lower cycle the Tethyan sea advanced from east to west covering the eastern margin of the Iberian Ranges, while the upper cycle represents an Atlantic rapid transgression that flooded the Iberian furrow from NW to SE (Garcia *et al*.1993).

The lower cycle shows a Tethyan succession of shallow marine deposits that in the central part of the basin can reach a thickness of up to 400 m, and it is constituted, from the base to the top, by the following main lithostratigraphic units (fig. 2):

Unit 1. Brown bioclastic limestones (packestones and grainstones) with fragmented bivalves mainly rudists, gastropods and larger foraminifera. These deposits belong to the Limestones of Aras de Alpuente Formation, which grade to the northern margin of the basin to limestones, sands and clays of the Santa Maria de las Hoyas Formation, and sands of the sandstones of Utrillas Formation. These deposits are interpreted as high-energy carbonate platforms with terrigenous influence.

Figure 1. Cenomanian outcrops and location of the studied sections in the Iberian Ranges (eastern Spain).

Unit 2. Yellow-to-green marls with some intercalated oyster banks and limestones (wakestones and packestones) beds very rich in larger foraminifera. From a lithostratigraphic point of view this marly formation has been designed using various local names, such as marls of Chera, marls of Pinarueco, marls of Poveda or marls of Pozuel (see García *et al.*, 1989) or marls of Mosqueruela (Calonge, 1989). This middle unit was deposited in a very flat, low-energy and shallow lagoon.

Unit 3. Nodular thin-bedded to massive limestones (mainly wakestones and packstones), and marly limestones with dolomitic limestones and dolomites intercalated. The limestones record are rich in fossils as bivalves, gastrops, ostracods ans larger foraminifera. The materials from this have been attributed by different authors to Dolomitic limestones from Puerto de Villaroya, Dolomites of Alatoz, Thin-bedded dolomites of Sierra de Llabería and Thin-bedded dolomites of Villa de Vés units, but García *et al.*, (1989) proposed to use Dolomites of Cortes de Pallas Formation and to avoid the previous local names. The sediments from this upper unit were deposited in a shallow wide platform, and during its deposition the lower Middle Cretaceous cycle expanded the maximum to the margins of the basin.

The upper cycle is very homogeneous along the Iberian Ranges, its thickness varies from 15 m. in Tarragona (under Roman Walls) to more than 100 m. in Villarroya (Teruel province), and it is composed of two main units:

Unit 4. Thin-bedded limestones with a rich fauna of larger foraminifera and bivalves alternating with massive dolomites. The materials of this unit were deposited in a shallow-water carbonate platform and they have been included in several equivalent lithostratigraphic units: Limestones and marls of the Casa Medina Formation, Dolomitic limestones of Núevalos Formation, dolomitic limestones of Barranco de los Degollados Formation, and Thin-bedded dolomites and limestones with Praealveolinas of the Sierra de Llabería Formation.

Unit 5. Massive dolomites with large scale cross-bedding, locally clinoforms were developed from the Dolomites of Ciudad Encantada Formation, dolomitic limestones of Barranco de los Degollados Formation, and Thin-bedded dolomites and Massive limestones of the Sierra de Llabería Formation.

The overlying deposits are constituted by thin bedded limestones (mudstones and wakestones) very rich in calcisphaerids and some plantktonic foraminifera sedimented in an open marine platform.

Larger Foraminifera assemblages

The larger Foraminifera distribution is based in their presence in more than fifty sections measured at various sites of the Iberian Ranges and in about 850 thin-sections from samples. From bottom to top, the following larger foraminifera assemblages have been observed (Fig. 2):

Assemblage 1. It is dominated by Orbitolinids: *Orbitolina* (*Conicorbitolina*) *cuvillieri* (MOULLADE), *Orbitolina* (*Orbitolina*) cf. *sefini* HENSON, *Carinoconus casterasi* CHERCHI & SCHROEDER, and *Hensonina lenticularis* (HENSON). This assemblage is present in unit 1.

Assemblage 2. It is dominated by alveolinids: *Sellialveolina viallii* (COLALONGO) and *Ovalveolina? maccagnoae* DE CASTRO are abundant, while small *Praealveolina iberica* REICHEL is scarce. The assemblage contain also *Peneroplis parvus* DE CASTRO, *Orbitolina (Conicorbitolina) cuvillieri*, *Orbitolina* (*O.*) cf. *sefini* and indetermined miliolids. It is present in unit 2.

Assemblage 3. The faunal content includes abundant *Praealveolina iberica* REICHEL within the alveolinids, but *Sellialveolina* characerising the assemblage 2 is not present. It also includes *Charentia cuvillieri* NEUMANN, *Daxia cenomana* CUVILLIER & SZAKALL *Chrysalidina gradata* D´ORBIGNY, *Cuneolina* sp., *Orbitolina* (*Orbitolina*) *cóncava* (LAMARK), *Orbitolina duranddelgai* SCHROEDER, some nezzazatids and miliolids. This assemblage characterises the lower part of the unit 3, at whose base in Montalban (Teruel) the locality-type of *Praealveolina iberica* is placed.

Assemblage 4. This assemblage is very similar to the assemblage 3, but the specimens of *Praealveolina* are attributed to the *Praealveolina pennensi*s REICHEL, and there are plenty of nezzazatids and lituolids samples. It characterises the middle part of the unit 3.

Assemblage 5. It is characterised by *Praealveolina debil*is REICHEL, *Pseudedomia drorimensis* REISS, HAMAOUI & REICHEL, nezzazatids (*Nezzazata simples* OMARA, *Trochospira avnimelechi* HAMAOUI & SAINT-MARC and *Biplanata peneropliforis* HAMAOUI & SAINT-MARC), *Charentia cuvillieri*, *Dictyopsella libanic*a SAINT-MARC, *Vidalina radoicicae* CHERCHI & SCHROEDER, orbitolinids and miliolids. It corresponds to the upper part of the unit 3. The locality-type of P. *debilis* is placed at the top of unit 3 in Montalban. In some sections this assemblage can be difficult to recognise due to the dolomitisation processes affecting the upper part of the unit 3.

Assemblage 6. It is characterized by the presence of a very typical elongated alveolinid: *Praealveolina tenuis* REICHEL, which is associated to *Praealveolina* (*Simplalveolina*) *simplex* REICHEL and *Ovalveolina ovum* (D´ORBIGNY), *Pseudorhapydionina dubia* (De CASTRO), *Pseudorhiopidionia casertana* (DE CASTRO), *Dictyopsella libanica*, *Nezzazata simplex*, *Biconcava bentori* HAMAOUI & SAINT-MARC and *Chrysalidina gradata* D´ORBIGNY. This assemblage characterises the upper part of unit 4. The unit 5 is represented by dolomites, but where the dolomitisation is not strong enough to destroy all faunal elements, some remains of P. tenuis have also been observed.

Biostratigraphy: discussion about age

Three biozones of *Praealveolina*: *P. iberica* (assemblage 3), *P. pennensis* (assemblage 4) and *P. debilis* (assemblage 5), which replaced each other during Lower to Middle Cenomanian times (Calonge *et al.*, 2002) have been recognised in the lower cycle. The biozone of *P. tenuis* (assemblage 6), which indicates an upper Cenomanian age (Calonge *et al.*, 2002) extends through the upper cycle. Therefore, the units 3, 4 and 5 have a typical Cenomanian age.

The limit Albian-Cenomanian is unclear. The unit 2 (assemblage 2) containing small *P. iberica* and *Sellialveolina vialli* has also been placed in the lowermost part of the Cenomanian, but no ammonites and/or planktonic microfossils prove this assignation in the western Tethys; so, the occurrence of *Sellialveolina viallii* need to be studied somewhere in the eastern Tethys where the relationship with plankton organisms could be proved. The unit 1 have been attributed to the Upper Albian because no alveolinids are present but the main orbitolinids extend through the Lower Cenomanian in other areas.

Up to the unit 5 (assemblage 6), the carbonate platform had been flooded by open marine sediments that contains

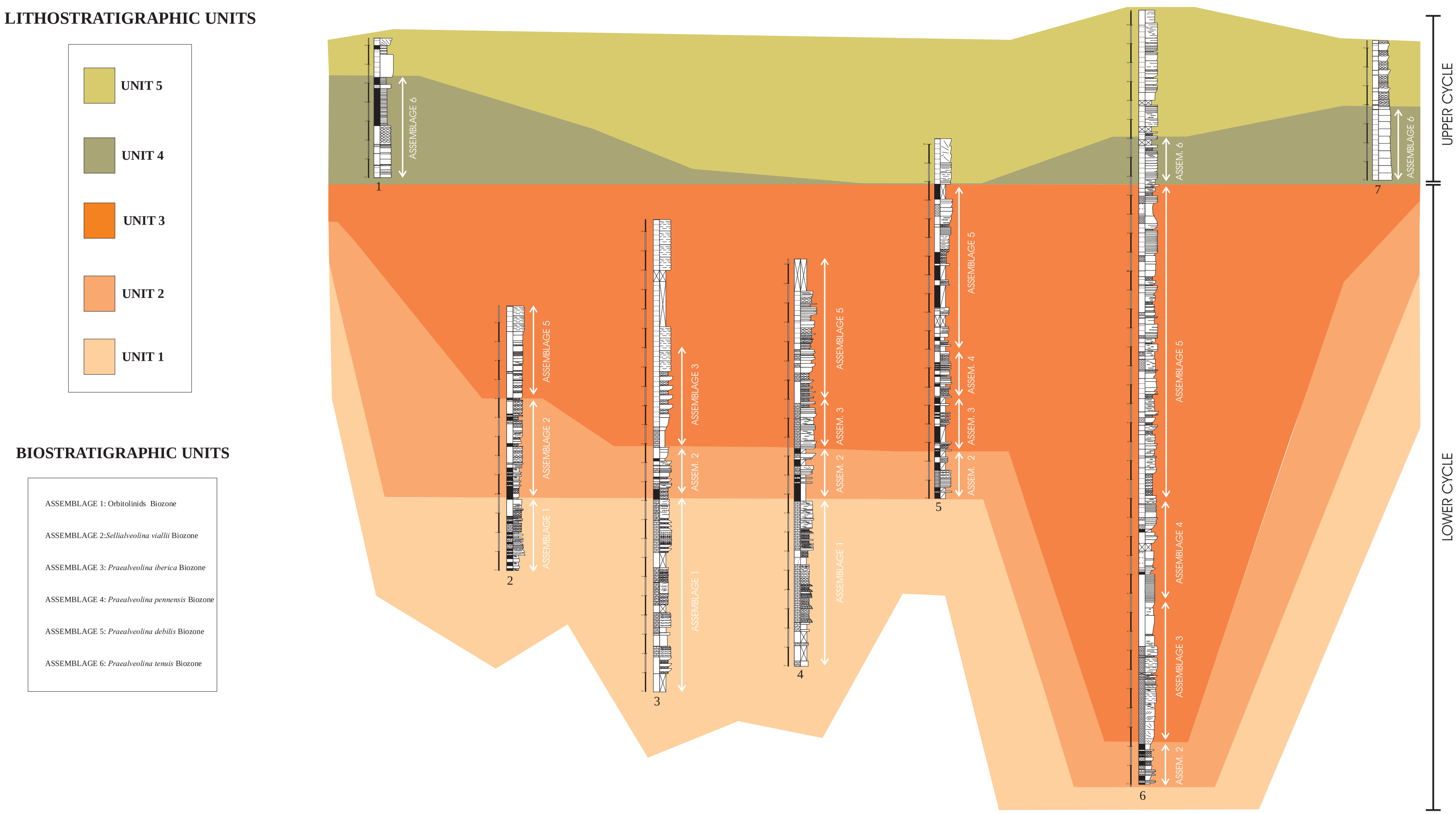

Figure 2. Correlation of the vertical profiles based on field data in the Iberian Ranges. Seven profiles developed: 1, VIRGEN DE LAS ANGUSTIAS (Cuenca province); 2, NUÉVALOS (Zaragoza province); 3, ERMITA DE MONTIEL (Valencia province); 4, BARRANCO DE ARMANJUELA (Valencia province); 5, MINA SALOMÉ (Teruel province); 6, PUERTO DEL REMOLCADOR (Castellón province); and 7, SANATORIO DE LA SALUD (Tarragona province). 1-5 Lithostratigraphic units and 1-7 biostratigraphic units.

planktonic foraminifera from the *Helvetoglobotruncana helvetica* zone, which indicate a Middle Turonian age. So an important sedimentary gap in time is registered in this area near the end of the Cenomanian, due to the Cenomanian-Turonian eutrophication event (Caus *et al.*, 1997; Calonge *et al.*, 2002). Therefore, the disappearance of Praealveolinids can be used to place the boundary between the Cenomanian and Turonian.

Acknowledgements

This work has been supported by the project BTE 2000-0158.

References

Calonge, A., (1989) - Biostratigrafía del Cenomaniense de la Cordillera Ibérica por Foraminíferos bentónicos. Tesis de la Univ. Complutense de Madrid, n.2117/89, 568 p.

Calonge, A., Caus, E., Bernaus, J.M. and Aguilar, M. (2002) - Praealveolina (Foraminifera) species: a tool to date Cenomanian platform sediments. Microplaeontology, **48**: 53-66, text-figures 1-4, plates 1-7, table 1.

Caus, E., Teixell, A. and Bernaus, J.M. (1997) - Depositional model of a cenomanian - Turonian extensional basin (Sopeira Basin, NE Spain): interplay between tectonics, eustasy and biological productivity. Paleogeography, Paleoclimatology, Paleoecologu, **129**: 23-36.

García, A., Segura, M., Calonge, A. and Carenas, B. (1989)- Unidades estratigráficas para la organización de la sucesión sedimentaria de la plataforma del Albiense-Cenomaniense de la Cordillera Ibérica. Rev. Soc. Geol. España, **2**, (3-4): 302-333.

García, A., Segura, M., García-Hidalgo, J.P. and Carenas, B. (1993) - Mixed siliciclastics and carbonate platform of Albian-Cenomanian age from the Iberian Basin, Spain. En: Cretaceous Carbonate platforms, Simó, A. y Masse, J.P. (eds.). American Association Petroleum Geologists, 56, 283-295.

Reichel, M. (1936-37) - Etude sur les Alvéolines. Mém. Soc. Paléont. Suisse, **57**, (4), 93 págs.

Reichel, M. (1936-37) - Etude sur les Alvéolines. Mém. Soc. Paléont. Suisse, **59**, (3), 95 -147.