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Cretaceous Research 28 (2007) 18–29

CRETACEOUS RESEARCH

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Planktonic foraminiferal bioevents in the Coniacian/Santonian boundary interval at Olazagutia, Navarra province, Spain

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Received 2 April 2003; accepted in revised form 26 May 2006
Available online 24 January 2007

Abstract

The interval studied comprises a 45-m-thick section of uppermost Coniacian and lower Santonian strata. More than 30 planktonic foraminiferal species were recorded. The following sequence of bioevents is recorded from bottom to top: (1) FO of *Sigalia carpatica*; (2) FO of *Costellagerina pilula*; (3) FO of typical ''pill-box-like'' morphotypes of *Globotruncana linneiana*. The planktonic foraminifera allow the subdivision of the section studied into two heterohelicid zones: *Pseudotextularia nuttalli* and *Sigalia carpatica*, and the correlation of the zonal boundary with the inoceramid scheme. The Coniacian/Santonian boundary, as defined by the first occurrence of *Platyceramus undulatoplicatus* (Roemer), falls in the lower part of the *Sigalia carpatica* Zone. FOs of *Costellagerina pilula* and typical ''pill-box-like'' morphotypes of *Globotruncana linneiana* are a good proxy for the stage boundary.

Keywords: Planktonic foraminifera; Coniacian/Santonian boundary; Biostratigraphy; Chronostratigraphy; Olazagutia; Spain

1. Introduction

Foraminifera, especially planktonic species, and other components of the plankton have been used for a long time to recognize Upper Coniacian and Lower Santonian sedimentary rocks. Salaj and Samuel (1966) and Sigal (1977) proposed the first occurrences (FOs) of the planktonic foraminiferal species *Sigalia deflaensis* (Sigal) and *S. carpatica* Salaj and Samuel to characterize the Upper Coniacian and Lower Santonian, respectively. Both species are well known in the literature, although the latter seems to be restricted to the western Tethys, from the Middle East to Spain. During the Second International Symposium on Cretaceous Stage Boundaries, held in Brussels, 1995, the FO of *S. carpatica* was proposed as a secondary marker of the Coniacian/Santonian boundary (Lamolda and Hancock, 1996). The FO of *Dicarinella asymetrica* (Sigal) has also been used as a proxy for the Coniacian/Santonian boundary defined by the FO of the ammonite *Texanites* (e.g., Nederbragt, 1990; Premoli Silva and Sliter, 1995; Robaszynski and Caron, 1995; Robaszynski, 1999). However, Ion and Szasz (1994) have found *Di. asymetrica* in the middle part of Coniacian strata in Romania (Babadag Basin, North Dobrogea), with fauna belonging to the *Peroniceras tridorsatum* Zone and *Inoceramus mantelli* Assemblage Zone.

Both *S. carpatica* and *Di. asymetrica* occur in the section studied, and preliminary results have suggested their importance for characterizing the Coniacian/Santonian boundary (Lamolda, 1995; Lamolda et al., 1999; Lamolda and Peryt, 2002), defined by the FO of *Platyceramus undulatoplicatus* (Roemer) (Lamolda and Hancock, 1996). These biostratigraphically important foraminiferal species are relatively scarce. In fact, planktonic assemblages are dominated by

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0195-6671/$ - see front matter © 2006 Elsevier Ltd. All rights reserved.
doi:10.1016/j.cretres.2006.05.020

keeled globotruncanids, especially biconvex morphotypes of *Marginotruncana* spp.

Ramírez del Pozo (1971) proposed a planktonic foraminiferal biozonation based on a study of exposures near Olazagutia. He recorded the occurrence of *Globotruncana concavata carinata* Dalbiez [=*Dicarinella asymetrica* (Sigal)] in sediments from upper part of the Santonian. Wiedmann (1980) recorded several *Globotruncana* species in sediments from lower part of the Santonian in the ''Cantera de Margas'', as well as the macrofauna *Muniericeras inconstans* (=*Pseudoschloenbachia inconstans*) and *Hemitissotia turzoi* of late Coniacian, and *Texanites hispanicus* of early Santonian ages in that quarry. Both Wolz (1985) and Zander (1988) studied foraminifera from several sections near Olazagutia, characterizing within their assemblages the *Dicarinella asymetrica* Zone in the lower and middle parts of the Santonian. Gräfe (1994) cited *Di. asymetrica* at the ''Cantera de Margas'' as characteristic of his eponymous biozone, but his lower record of this species is definitely younger than the datum established by Lamolda et al. (1999).

In the Losa Valley, west of Olazagutia, in Burgos Province, the relationship between *Di. asymetrica* and the Coniacian/Santonian boundary was reported by Lamolda (1984). Later, Lamolda and Martínez (1987) recorded the close FOs of the ammonite *Texanites* s.s. and the foraminiferan *S. carpatica*, followed by *Di. asymetrica.* An up-to-date summary of the Cenomanian—Santonian stratigraphy from Navarra to Burgos provinces, indicating bioevents useful for chronostratigraphy, was given by Martínez et al. (1996).

Flores et al. (1987) recorded nannofossil assemblages from the Coniacian—Santonian transition in the Losa Valley. They did not find any marker species, but emphasized increases in abundance of both *Lithastrinus grillii* Stradner and *Micula concava* (Stradner) Bukry in Santonian sediments when compared with Coniacian deposits. In fact, the lower boundaries of the *M. concava* and *Di. asymetrica* zones are slightly separated. Therefore, an early Santonian age was preferred for the former boundary (Flores et al., 1987, fig. 6). Preliminary results on calcareous nannofossils from the section studied were published by Lamolda et al. (1999), and presented during a meeting on the Coniacian/Santonian boundary (Lamolda et al., 2002). A detailed biostratigraphy and its chronostratigraphic importance for the boundary were discussed by Melinte and Lamolda (2002).

The aim of this study is to add to the published preliminary data with a more detailed sampling, mainly below and around the Coniacian/Santonian boundary as defined by the FO of *Platyceramus undulatoplicatus*. We obtain more precise foraminiferal stratigraphic ranges that allow us to make a more accurate correlation with other indices, especially inoceramids and nannofossils.

2. Geological setting

The Basque-Cantabrian Region (BCR) is located in northern Spain, to the west of the Pyrenees. It has an exclusively Mesozoic alpine history largely affected by pronounced salt diapirism. After the main Alpine orogenic movements of Eocene age in the region, large continental basins subsided during the Oligocene and Miocene, e.g., the Ebro Basin, which forms the southern border of the BCR. Its geological origin is related to the opening of the Bay of Biscay. During the Cretaceous Period a thinned continental crust was produced by the separation of the Iberian and European plates. This determined the development of the BCR on its southwest side (Rat et al., 1982). Depositional sequences differ both in thickness and nature of the sediments. In the central part a thickness of several thousand metres is found (e.g., 4000 m for the Upper Cretaceous). The region was part of a gulf open to the Atlantic, except during Cenomanian—Turonian times when an open connection with the Western Tethys southwards and eastwards was established.

The area around Olazagutia was a distal part of the Navarro-Cantabrian Platform during the Late Cretaceous, except in the Maastrichtian when it was a proximal ramp with shallow facies. This platform is subdivided by both longitudinal (NW—SE) and transverse (NE—SW) faults, resulting in a group of areas with different subsidence histories. In spite of local and/or temporary fluctuations, the Navarro-Cantabrian Platform remained typically an outer shelf environment where deposits are mainly fine pelitic sediments (Amiot et al., 1983; Wiedmann et al., 1983).

In the area studied (Fig. 1), both Coniacian and Santonian stages consist of marls and marly limestones whose carbonate content increases upwards. Therefore, Coniacian sediments look marly whereas Santonian deposits are an alternation of marl and marly limestone, with some limestone marker beds. Ramírez del Pozo (1971) and, later, Zander (1988) estimated a thickness of 400—600 m for the Coniacian beds, whereas the Santonian beds have an estimated thickness about 230 m in the ''Cantera de Margas'' (Kannenberg, 1985).

Details on the general stratigraphy around Olazagutia are given in Küchler (2002). A general overview of Upper Cretaceous sequence stratigraphy of the BCR may be found in Gräfe and Wiedmann (1998), in which the boundary between cycles UC11 and UC12 was defined as being close to and above the Coniacian/Santonian boundary.

3. Material and methods

Twenty-seven samples from a 45-m-thick sequence in the Olazagutia section were studied. They were collected every 1.5—2 m, with a closer sampling rate through the 7-m-thick interval in the middle part of the section within which the Coniacian/Santonian boundary is situated. Washed residues were obtained by disaggregating the rocks with Na_2SO_4. Between 400 and 500 specimens from the >100 μm size fraction were picked and all species in each sample were identified. Planktonic foraminiferal assemblages are abundant and highly diverse in the material. However, the state of preservation of tests is poor (infilled and recrystallized specimens, often fragmented) to moderate (clearly recognizable specimens, although mainly recrystallized).