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Stratal, sedimentary and faunal relationships in the Coniacian 3rd-order sequence of the Iberian Basin, Spain

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ABSTRACT

The Coniacian 3rd-order sequence in the Iberian Basin is represented by a carbonate ramp-like open platform. The biofacies is mainly dominated by nekto-benthic (such as ammonites) and benthic organisms (such as bivalves, mainly rudists) with scarce solitary corals (hermatypics are absent), showing major differences among the Transgressive System Tract (TST) and Highstand Normal Regression (HNR). During the TST, platform environments were dominated by *Pycnodonte*, other oysters and molluscs (with only subordinate rudists) and ammonites, which were represented by ornamented platycones (*Tissotioides* and *Prionocycloceras*), and by smooth oxycones (*Tissotia* and *Hemitissotia*). During the HNR, shallow water depositional areas were occupied by rudist-dominated associations. Storm- and wind-induced currents and waves acting on these associations produced large amounts of loose bioclastic debris that covered outer platform areas. This facies belt graded landwards into protected, lower-energy settings (inner platform, lagoon and littoral environments). Rudist biostromes were preserved in seaward areas of these protected shallow environments of overall moderate to low hydrodynamic gradient, which was punctuated by storms. In this environment and landwards, large areas of marly substrate favoured the presence of gastropods, other bivalves, echinoderms, benthic foraminifera and solitary corals. Because of the input of siliciclastics and, probably, the lack of nutrients in suspension, the establishment of rudist communities was difficult in more landward areas of the lagoon and in tidal environments. This heterozoan carbonate factory was thus controlled by warm-water conditions and high energy levels, which were responsible for high-nutrient contents in suspension.

1. Introduction

The Upper Cretaceous carbonate platforms in the Iberian Basin are represented by successive transgressive–regressive 3rd-order sequences, suggesting the presence of extremely dynamic sedimentary systems over time in this basin. The stacking of these sequences generally shows a similar palaeogeographic pattern with a siliciclastic facies belt at the coastal margin and an inner carbonate platform facies in central areas of the basin (Gil et al., 2006a, 2008; García-Hidalgo et al., 2007). In these facies, biostratigraphically useful fossils are relatively poor because early diagenetic processes (mainly dolomitization) obliterated primary sedimentary structures and fossil content. Nevertheless, there are two particular sequences displaying deep and open platform facies in most of the basin, which flooded wide areas of the coastal margins with the development of thick carbonate platforms (Segura et al., 1989, 2001; Floquet, 1998; Gräfe, 1999; García et al., 2004), in which dolomitization processes during early diagenesis did not significantly affect carbonate facies; consequently, fossils are common and relevant in both deep and open facies (Barroso-Barcenilla, 2006) and shallow platform facies (Gil et al., 2002, 2009). These sequences are related to the globally recognised Cenomanian/Turonian boundary and late Coniacian eustatic maxima (Haq et al., 1988; Hardenbol et al., 1998).

Studies of the older sequence (Late Cenomanian–Early Turonian) have been undertaken by Segura et al. (1989, 1993a, b), García-Hidalgo et al. (2003, 2007), Barroso-Barcenilla (2006) and Barroso-Barcenilla et al. (2009, 2011) among others, and have provided: (1) a deep understanding of its stratal and depositional framework, with a superimposed high-frequency depositional stacking pattern; (2) a detailed biostratigraphy based on ammonite faunas, allowing the revision of several ammonite families; and (3) an understanding of the geological history of this interval.

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In contrast, the palaeoenvironments along the entire basin of the second episode (Coniacian) are less well understood and previous interest has mainly focused on rudist associations and their vertical successions, fabrics and facies of shallow carbonate-platform settings (Gil et al., 2002, 2009, among others). In the past, the detailed sedimentology and fossil content of the succession were typically overlooked, although biotic communities are particularly important for sedimentological analysis, because they record ecological and environmental conditions with many different features, determining accumulation rates and facies distribution, thus controlling platform geometry (Pomar, 2001).

The Coniacian sequence (named here DS-2), which constitutes the main objective of this paper, is a superb example of a symmetrical depositional event, with faunas and facies of both deep and shallow platform environments that retrogradate and progradate depending on the eustatic signal (system tract). Thus, the main aims of this paper are to: (1) describe the stratal architecture of the sequence from distal platform environments to coastal margin areas; (2) identify the main stratigraphic reference surfaces in order to define the system tracts, describing the vertical succession of facies in different areas of the basin; (3) describe the faunal succession of ammonites, rudists and other bivalves, and their correlation from carbonate platform to coastal margin areas; (4) relate their occurrence with the depositional stacking pattern; and (5) discuss their biostratigraphic and palaeoecological implications.

2. Geological setting

The deposition of Cretaceous strata on the Iberian Microplate took place in an intracratonic basin, with maximum subsidence and sediment accumulation rates in the areas between the Hesperian Massif and the Ebro Massif: the Iberian Basin (Fig. 1A). Reduced subsidence in the west and southeast, and siliciclastic sediment input, mainly derived from the Hesperian Massif, resulted in deposition of the Coniacian sequence with an overall wedge-shaped, westwards- and southeastwards-thinning geometry. In northeastern Iberia, the emerged Ebro Massif and different highs separated the Iberian Basin from the Pyrenean Trough. Connection with the Tethyan Realm occurred discontinuously along southeastern Iberia (García et al., 2004).

During these times, the Iberian Microplate was located in the tropical belt, south of a latitude of 30°N (Dercourt et al., 2000), and was exposed to the warm, circum-global Tethyan current and away from cold Boreal influences. This palaeogeographic location favoured a warm, humid climate and the proliferation of benthic communities in the Tethyan peri-continental areas (Philip, 2003). As a consequence, significant carbonate production together with a remarkable widespread development of platforms took place in the basin.

The significant global eustatic sea-level rise during the Late Cretaceous was the main factor controlling the depositional episodes in the Iberian Basin (Rat, 1982; García et al., 1996, 2004; Segura et al., 2001; Gil et al., 2004). Owing to the shallow character of the Iberian Basin, it was particularly sensitive to any sea-level oscillation, registering even those of smaller amplitude (high frequency) (Gil et al., 2006a, b; García-Hidalgo et al., 2007). Four 2nd order eustatic sea-level cycles have been described for the Late Cretaceous in the Iberian Basin (MS-1 to MS-4 megasequences; Segura et al., 2006). For the interval discussed in this paper, the DS-2 sequence represents the transgressive peak and the onset of the regressive phase of the upper Turonian–lower Campanian megasequence (MS-2; Segura et al., 2006).

Several of the stratigraphic sections discussed in this paper (Fig. 1B) have been previously studied by others. The ammonites of the Cervera section were first studied by Wiedmann (1975), who erected *Hemitissotia celtiberica* Wiedmann, 1975 here (for author names and dates of all species mentioned in the text, see Table 1); later the stratigraphy and sedimentology of this outcrop was described by Floquet (1991). The Castrojimeno section was first described by Alonso (1981), who reported ammonite and rudist assemblages; more recently it has also been studied by Gil et al. (2009), with a description and interpretation of the evolution of

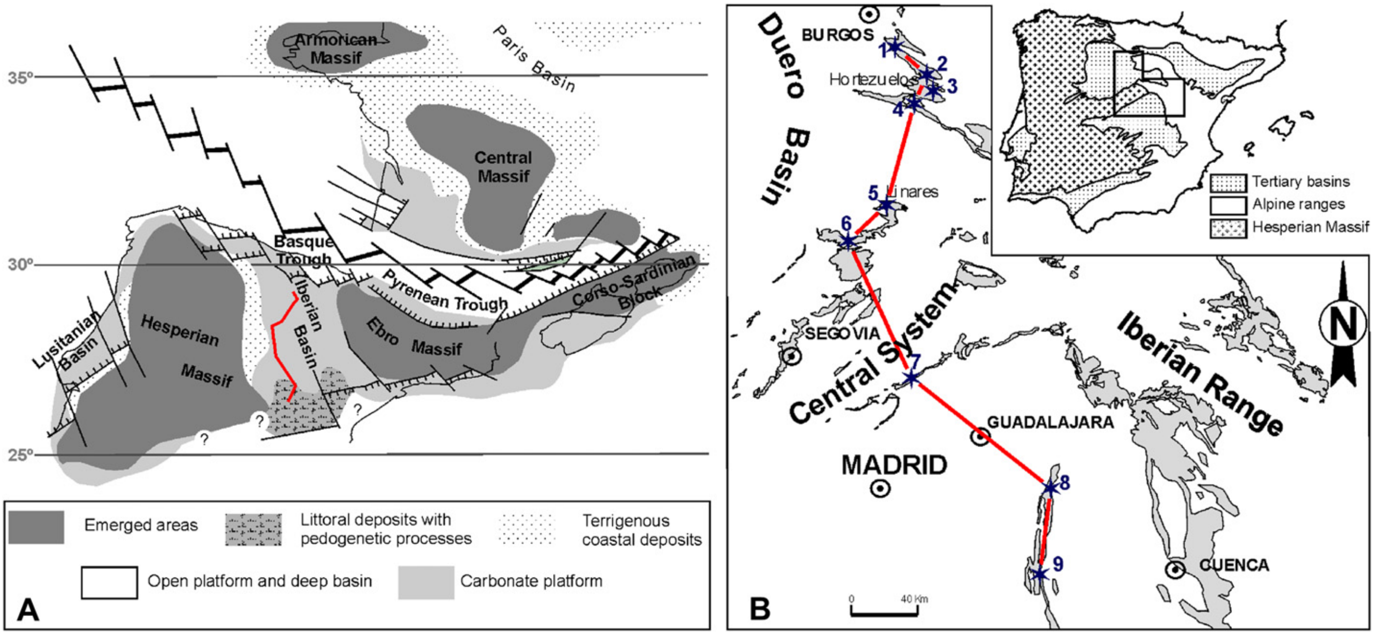

Fig. 1. Location of the study area. A, palaeogeographical scheme of the Iberian Basin within the Tethyan Domain during the Coniacian, indicating main depositional environments and the cross-section of Fig. 7 (red line). B, geographical and geological scheme showing the cross-section of Fig. 7 (red line) and the location of the following reference key sections: 1, Cuevas de San Clemente; 2, Contreras; 3, Hoz de Silos; 4, Hortezuelos; 5, Casuar-Linares; 6, Castrojimeno-Castroserracín; 7, Barranco de las Cuevas; 8, Embalse de Entrepeñas; 9, Estrecho de Paredes. Modified from Gil et al. (2009). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)