Improving the Palaeoecological Understanding of the Lisboa–Sintra Region Cenomanian Units: The S. João Das Lampas Section

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Abstract The S. João das Lampas section, in the Sintra region (Lusitanian Basin, Portugal), exhibits a highly fossiliferous marl–limestone Cenomanian succession and belongs to the Caneças Formation. In this work, we present data from ongoing studies on ostracods and microfacies to address palaeoecological issues within the regional framework. The fossil assemblage comprises ostracods (very abundant and represented mainly by brackish and marine littoral species), benthic foraminifers, dasycladalean and bryopsidalean algae, bivalves, gastropods, serpulids, and echinoderms. The succession consists predominantly of oyster-rich marls and marly limestones, interbedded with skeletal/microfossil-rich carbonate and marly layers and skeletal storm beds or lenses. Overall, the data point to a low- to moderate-energy marginal-marine setting with frequent variations in salinity.

Keywords Ostracods · Foraminifers · Dasycladales · S. João das Lampas · Cretaceous · Portugal

Introduction

The S. João das Lampas section is exposed along the road between the localities of S. João das Lampas and Assafora in the Sintra region (north of Lisbon, Lusitanian Basin, Portugal; Fig. 1). This section exhibits a marl–limestone succession belonging to the Caneças Formation (Rey et al. 2006). The section (12 m, 22 levels) is assigned to the Cenomanian (e.g., Berthou 1984), but no descriptions of

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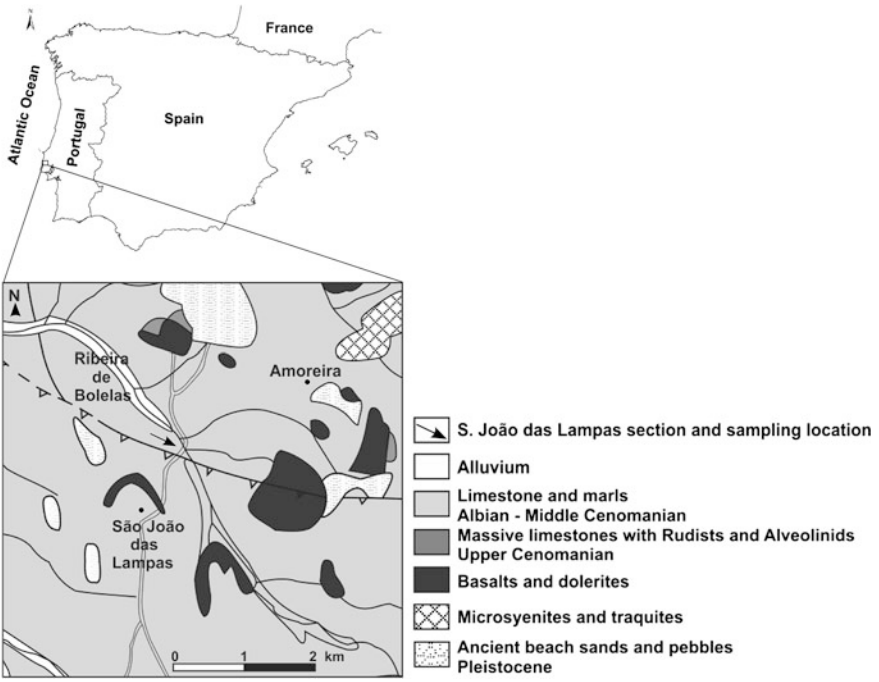

Fig. 1 Location map of the studied section (lat 38°52′49.54″N, long 9°23′46.41″W)

it have been published. In this work, we couple data from ongoing studies on ostracods (25 marl samples) and microfacies (25 limestone samples) to address palaeoecological issues within the regional framework.

The Studied Succession

General Aspects

The studied succession is dominated by highly fossiliferous marls and limestones, with a variable occurrence of ferruginous clay and fine-sand-grade, detrital, quartz-rich levels. The fossil assemblage comprises ostracods, benthic foraminifers, dasycladalean and bryopsidalean algae, bivalves (particularly oysters), gastropods, serpulids, and remains of echinoderms. The main overall features of this succession may be summarized as follows (Fig. 2): thick beds of oyster-rich marls and marly limestones, interbedded with thinner-bedded, skeletal/microfossil-rich carbonate and marly layers, often with undulated bedding surfaces and compactional features; highly skeletal, unevenly bounded storm beds or lenses; very abundant ostracods, including very common ostracodites; abundant bivalve–gastropod–ostracod or

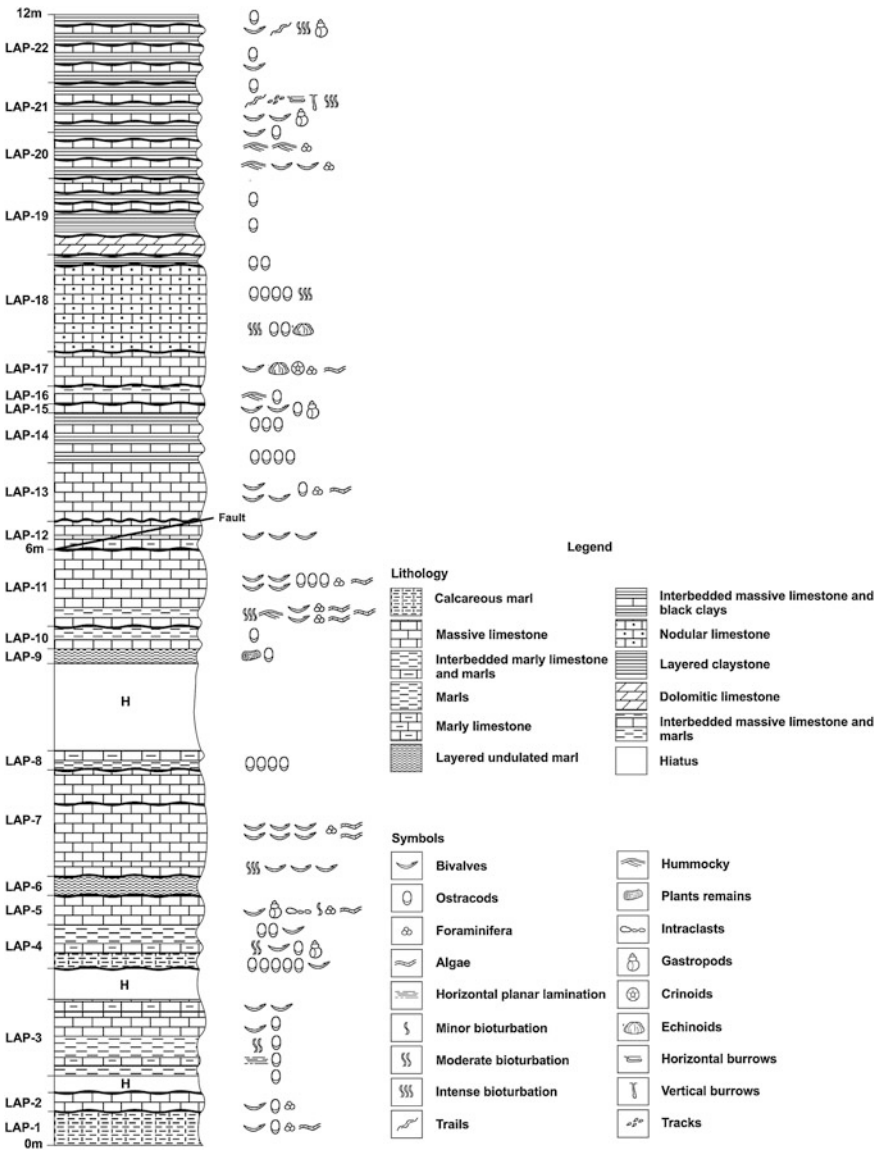

Fig. 2 Schematic lithostratigraphic column of the studied S. João das Lampas (LAP) succession

bivalve–serpulid coquinas; common dasycladales; the presence of (but neither abundant nor diversified) benthic foraminifers; and clear, high-frequency contrasts in palaeobiodiversity.

Microfossils

Regarding the ostracod assemblages, the brackish *Fossocytheridea merlensis* (Babinot and Colin 1976) is dominant in the ostracodite layers, but there are also (amongst others) *Perissocytheridea*? *estribeirensis* Andreu, 1981 (brackish), *Cythereis* cf. *condemiensis* Breman, 1976, *Cythereis ouillierensis* Babinot, 1971, *Cytherella* cf. *postangulata* Babinot, 1980, *Dolocytheridea iberica* Andreu, 1981, *Paracaudites* (*Dumontina*) aff. *grekoffi* (Babinot 1971), *P.* (*D.*) *juliensis* (Andreu 1981), *Platycythereis covoensis* Andreu, 1981, and *Trachyleberidea* aff. *arta* (Damotte 1971). Most of these species are typical marine littoral to sublittoral and are known from other western European countries, particularly France (e.g., Babinot et al. 1985), in levels of the same or similar age. Only very rare freshwater ostracods (*Darwinula* sp.) are found, in one level.

Among the algae, *Heteroporella lepina* (Praturlon 1967), Granier et al. 1995, *Neomeris cretacea* (Steinmann 1899), *Salpingoporella* spp., *Terquemella* sp., and *Boueina* sp. are the most common.

The foraminifer assemblages include *Pseudocyclammina rugosa* (d'Orbigny 1850), *Buccicrenata hedbergi* (Maync 1953), *Cuneolina* sp., *Daxia cenomana* Cuvillier and Szakall, 1949, miliolids, rare orbitolinids, and rare hyaline-walled forms.

Discussion and Conclusions

The levels with abundant *F. merlensis* are common in other locations in the region and also in Cenomanian units such as at Lousa, some 15 km to the east of S. João das Lampas (Cabral et al. 2008), and serve as a regional lithostratigraphic guide. At Lousa, other ostracods have been found, most of them belonging to the same genera/species identified at S. João das Lampas, but the assemblages at Lousa are more diversified, including a typical oligohaline one. *Heteroporella lepina* has been previously recorded in nearby sections, namely at Lousa (Cabral et al. 2008) and at Cacém, 25 km to the southeast of S. João das Lampas (Granier et al. 1995); the other algal species identified at S. João das Lampas have also been found at Lousa. With regard to the foraminifers, the S. João das Lampas succession yielded a much less diversified assemblage, with no record yet of the species that allowed beds at Lousa to be assigned to the middle Cenomanian to basal upper Cenomanian (Cabral et al. 2008).

The biofacies in the limestones (differing in both composition and diversity) and the diversity and abundance of ostracod assemblages in the marls attest to frequent palaeoecological variations, likely in salinity. Overall, the environment was shallow, of low to moderate energy, and marginal marine, with four main stages being recognized in the palaeoecological trends through the section:

(1) The lowermost interval suggests a shallow but relatively open lagoonal setting of near-normal marine salinity. This interval contains a moderate diversity of ostracods, with an absence of *F. merlensis*, and a presence of *Cytherella* cf. *postangulata*, *Cythereis* cf. *condemiensis*, and *Planileberis* spp. It also contains diverse algae and foraminifers, and diverse macrofossils.
(2) The overlying interval reflects more restricted, brackish lagoonal conditions, with almost-oligospecific ostracod assemblages represented by *F. merlensis* and gastropod–oyster–serpulid levels, intercalated by intervals indicating more open conditions (with higher diversity, as above, namely containing abundant dasycladaleans).
(3) Above this, a new more marine-influenced interval is indicated by the presence of more diversified ostracod assemblages (although still very rich in *F. merlensis*) or by assemblages poor in *F. merlensis*, coupled with a higher biodiversity recorded in the limestones again.
(4) Finally, the deposits record another stage of brackish depositional setting, punctuated by a more normal salinity episode, and very rich in marine ostracod genera such as *Cytherella* and *Paracaudites*. The dominant low- to moderate-energy hydrodynamic conditions were regularly subjected to stronger currents depositing tempestites. No clear evidence of subaerial exposure is found, suggesting that a shallow water body remained present even during local regressive coastal shifts.

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