

Thin-shelled bivalve ("filament") buildup of the Aalenian-lowest Bajocian in the Subbetic (South Iberian Paleomargin)

Acumulación de "filamentos" (bivalvos) del Aaleniano-Bajociense inferior en el Subbético (Paleomargen Sudibérico)

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ABSTRACT

An exceptional buildup of thin-shelled bivalves ("filaments") is reported from the External Subbetic. This is the biggest "filament" buildup related on the world (3.5 m thick and more than 12 m length). This work is focused in the characterization of microfacies and the preservation of "filament" accumulations. The analysis of assemblages of calcareous nannofossils allows the identification of the NJT8 biozone (Aalenian) below the buildup and the NJT9 biozone (Bajocian) at the base of the buildup. The "filaments" are tentatively interpreted as *Bositra*, an opportunistic bivalve that flourished under stressed conditions in the water column related to trophic and oxygenation changes. They were accumulated in the bottom favoured by hydrodynamic conditions and sea-bottom topography.

Key-words: Pelagic bivalve, calcareous nannofossils, Middle Jurassic, External Subbetic.

RESUMEN

En este trabajo se analiza una acumulación de "filamentos" (bivalvos de concha muy fina) del Subbético Externo. Esta bioconstrucción de "filamentos" es la mayor encontrada hasta ahora (3,5 m de espesor y un mínimo de 12 m de longitud). Se ha realizado el análisis de las microfacies y de la preservación de los "filamentos". La edad del afloramiento ha sido determinada a partir del estudio de las asociaciones de nanoplancton calcáreo que han permitido identificar la biozona NJT8 (Aaleniano) bajo la bioconstrucción y la biozona NJT9 (Bajociense) en la base de la bioconstrucción. Los "filamentos" se han asignado tentativamente al género *Bositra*, un bivalvo oportunista que prospera en condiciones de estrés relacionadas con cambios en las condiciones tróficas y la oxigenación en la columna de agua. Su acumulación fue favorecida por su comportamiento hidrodinámico y la propia topografía submarina.

Palabras clave: Bivalvo pelágico, nanofósil calcáreo, Jurásico Medio, Subbético Externo.

Geogaceta, 61 (2017), 31-34
ISSN (versión impresa): 0213-683X
ISSN (Internet): 2173-6545

Recepción: 15 de julio de 2016
Revisión: 3 de noviembre de 2016
Aceptación: 25 de noviembre 2016

Introduction

Bivalve shell enriched beds are an important source of paleoecological information and have been recognized as a significant tool for paleoenvironmental reconstructions (e.g., Rivas *et al.*, 1997; Fürsich and Pandey, 2003; Navarro *et al.*, 2009; Caswell and Coe, 2013). In the Subbetic, these facies have been previously described in specific papers (Rivas 1975, 1997; Rivas *et al.*, 1997; Navarro *et al.*, 2009).

The aim of this work is to examine a spectacular thin-shelled bivalve buildup (textures and structures based on microscopic and field study), to date it based on calcareous nannofossils, and to interpret the sedimentary environment where it was deposited. This is the largest and thickest "filament" buildup reported in the literature.

Geological setting

The studied outcrop belongs to the Gaena Unit in the External Subbetic of the External Zones of the Betic Cordillera (Molina, 1987). This unit was a pelagic carbonate platform during Middle and Upper Jurassic (Molina, 1987, Molina *et al.*, 1997). The studied stratigraphic section (9 m thick) is located in the Barranco de Losilla (coord. 4°24'28"N, 37°25'18"W) at the boundary between the Zegrí (upper Pliensbachian-Aalenian) and Veleta (lower-middle Bajocian) formations (Molina, 1987; Fig. 1 A, B and C).

Samples and methods

The studied interval is a 9 m thick marl-limestone alternance where is located a buildup 3.5 m thick (Figs. 1D and 2A). Litho-

facies and microfacies were analysed by field observations in a detailed log section and adjacent outcrops, and from a total of 20 samples, with 9 samples coming from the buildup. Analysis of calcareous nannofossils was carried out on 25 samples. The microscopic study is based on a detailed analysis of orientated polished and uncovered thin-sections under the petrographic microscope and magnification lenses.

Lithofacies and microfacies

The studied section is composed of marls and marly limestones with brown color in the lower part and grey color in the upper part. Trace fossils are scarce. The buildup is 3.5 m thick and presents a minimum length of 12 m. The marly limestones are mudstones that just below the buildup

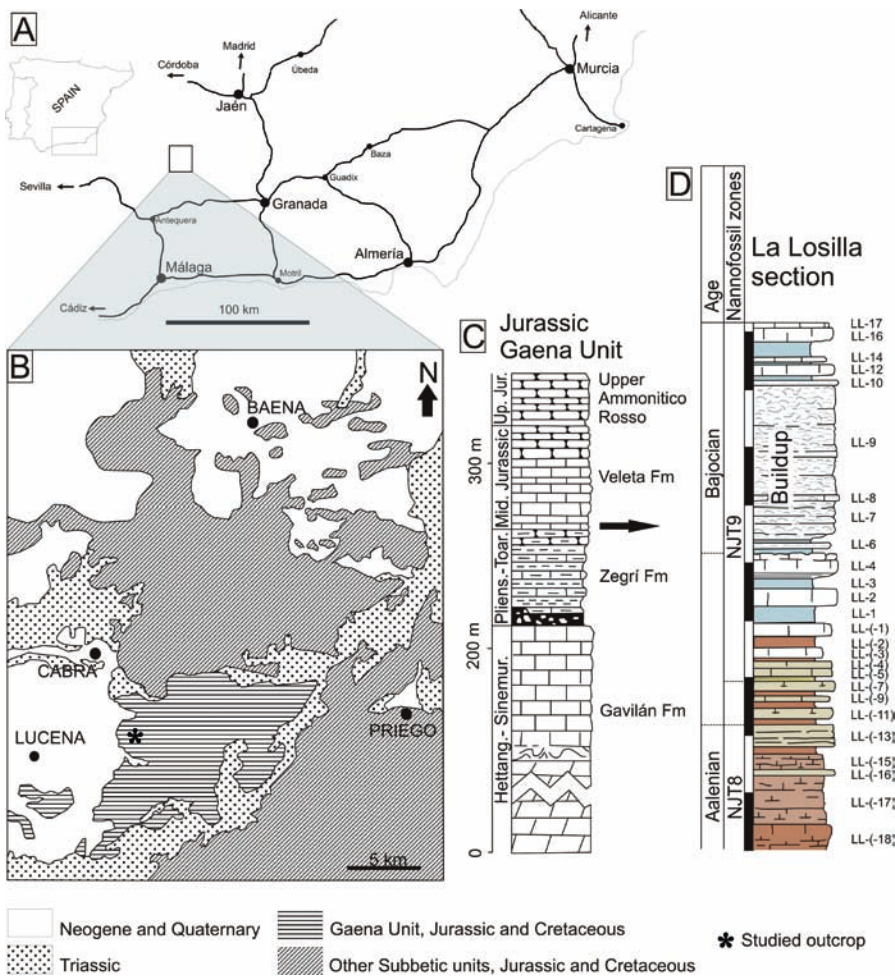


Fig. 1.- Geographic setting (A) and geological setting (B) of the La Losilla section. C) General Jurassic succession of the Gaena Unit and D) detail of the La Losilla section.

Fig. 1.- Localización geográfica (A) y geológica (B) de la sección de La Losilla. C) Sucesión estratigráfica del Jurásico de la Unidad de Gaena y D) intervalo estratigráfico estudiado en la sección de La Losilla.

change to wackestone-packstone with radiolarians, filaments, juvenile ammonoids, and some echinoderms. Therefore, the transition to buildup is gradual.

The field appearance of the buildup is laminated due the abundance of thin-shelled bivalves. Microscopically the skeletal concentrations are a "filament" rudstone or shellstone forming a densely packed "filament" concentration, bioclast-supported and very common bioclast/bioclast contacts without micrite matrix, constituting the "filaments" more than 90 % of the rock volume (Figs. 2B and C). There are also calcified radiolaria with micrite geopetal filling, in some cases, aptychi, juvenile ammonites and echinoid bioclasts. Bivalve shells are 2.9 mm in average length and 0.02 mm in average thickness. A significant proportion of shells are broken and disarticulated, but encrustations and borings are unusual. The

probable original internal microstructure of these shells consists of calcite crystals oblique to the inner and outer shell surfaces. These calcite crystals could be the result of originally bi-mineralic shells after aragonite dissolution below the aragonite compensation depth (Jach, 2007). Shells show preferred orientation subparallel to the bedding (Fig. 2C). These shells are often wrapped around more rigid bioclasts such as aptychi and echinoderms. Stylolite and microstylolite sets have also been observed. Very well preserved complete specimens have not been found in the outcrop, and only the "filament" size (length and thickness) and the internal structures of the valves have been observed in thin sections. One of the more distinctive features of this facies is the particular structure of the lumachelle as seen with the polarization microscope. At this scale, the undulating lamination formed by

the massive accumulation of "filaments" is broken by deformation-adaptation structures (Fig. 2B). The presence of these types of structures and the stylolitization observed in the outcrops suggest lithostatic pressure from the overlying sediments and a high compaction rate as probable factors influencing their origin.

Calcareous nanofossils and age

Fossil calcareous nanofossil preservation is generally poor (in 14 of the studied samples), most specimens exhibit dissolution or overgrowth, primary morphological characteristics are sometimes destroyed and fragmentation has occurred. In other cases (11 of the studied samples) the preservation is moderate to moderate-poor with little evidence of dissolution or overgrowth and primary morphological characteristics are sometimes altered. In figure 3 are shown some of the most characteristic nanofossil species. Calcareous nanofossil Biozones NJT8 and NJT9 have been identified.

Recorded species of calcareous nanofossils indicate the Aalenian-Bajocian boundary. Namely, *Watznaueria britannica* that first occurs in the uppermost Aalenian and *W. communis* at the very base of Bajocian (Mattioli and Erba, 1999; Suchéras-Marx *et al.*, 2015).

Paleoenvironmental interpretation

We need more study, mainly examination by microscopy and SEM, but until now we interpret the studied "filaments" as *Bositra*-like shells of pelagic bivalves, probably *Bositra buchi* Römer, the most commonly reported for the Middle Jurassic in the Subbetic (Navarro *et al.*, 2009). The life habitat of this kind of posidoniids has been considered as controversial for a long time. Different interpretations such a benthic, pseudoplanktic and free swimming mode of life, as well as a life cycle with pro-genetic holopelagic reproduction and a chemosymbiotic life style of life have all been proposed. However, at present is mostly considered that *Bositra* had a benthic mode of life (Schmid-Röhl and Röhl, 2003; Abdula *et al.*, 2015). It is a typical opportunistic bivalve genus characterized by short life cycles, high fecundity, and large recruitment pulses (see e.g., Caswell and Coe, 2013). *Bositra* prevails on dysaerobic, fine-

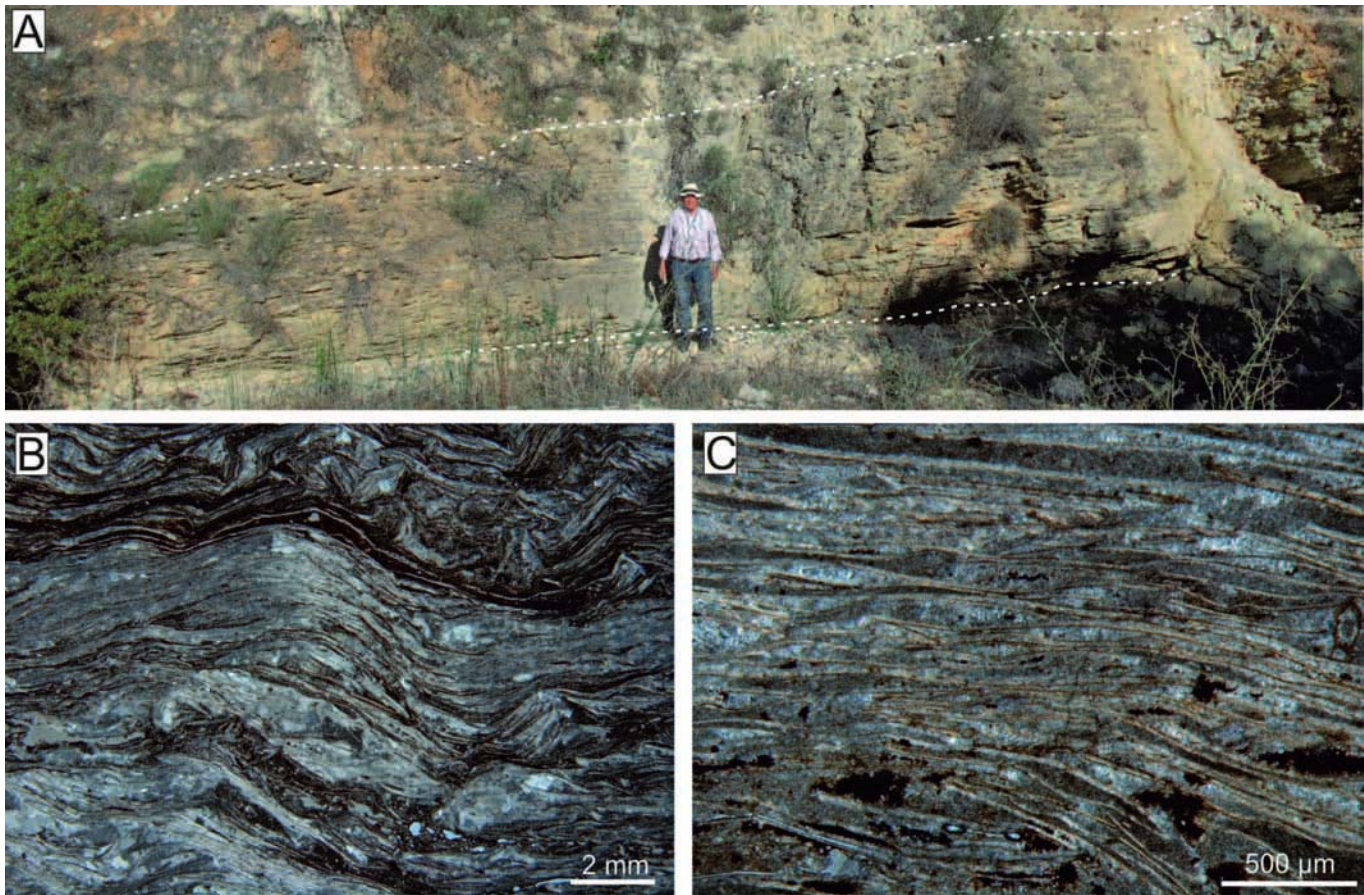


Fig. 2.- A) Field view of the buildup (white lines indicate the top and bottom). **B)** Dense accumulation of thin-shelled bivalves ("filaments") from the buildup with some sparite cement and reorientation by compaction. **C)** Dense accumulation of thin-shelled bivalves ("filaments") from the buildup. "Filaments" show subparallel preferred orientation..

Fig. 2.- A) Aspecto del afloramiento de la bioconstrucción (las líneas blancas indican el techo y el muro de la misma). B) Acumulación densa de filamentos en la bioconstrucción con algo de cemento esparítico y reorientación por compactación. C) Acumulación densa de filamentos en la bioconstrucción. Los "filamentos" se disponen preferentemente subparalelos.

grained to coarse-grained substrates employing a "snowshoe" strategy (Fürsich *et al.*, 1991; Etter, 1996; Rivas *et al.*, 1997).

The absence or scarcity of benthic organisms with calcitic skeletons (such as brachiopods, echinoids or foraminifera) and trace fossils indicate unfavorable conditions on the sea bottom for the development of a diverse benthic community or could be a consequence of the different hydrodynamic behavior of the skeletal grains under current activity. However, there are no sedimentary structures indicating high energy currents.

Shell beds have been interpreted as hiatal shell concentrations, as transgressive or high-stand lag deposits associated with storms, or as primary biogenic concentrations, among other origins (Kidwell, 1991; Fürsich and Oschman, 1993; Rivas *et al.*, 1997; Fürsich and Pandey, 2003). Monospecific shell beds, with broken and disarticulated valves that show no sign of abrasion or bioerosion indicate

brief transport and deposition times, most likely by distal storm flows (Fürsich and Oschmann, 1993). The horizontal lamination of filaments has been a key feature in interpreting them as tempestites (Molina *et al.*, 1997). Lack of breccias or relatively coarse grains and erosional bases are features incompatible with deposits linked to tsunami or hurricane deposits. The great abundance of *Bositra*-like shells has been related to taphonomic, ecological and dissolution factors (Jach, 2007). More specifically, several factors influence massive bivalve growth including food supply, temperature, salinity and oxygen; but of these the most important is food supply. During periods of low food availability huge populations of bivalves can no longer be supported, and very important mass mortalities occur. The tiny bivalve shells were deposited and preserved from strong currents or storms in small sedimentary traps constituted by topographic depressions, in a perched basin type, near the edge of the pelagic carbonate

platform. These small basins could be of tectonic origin in relation to minor faults, or made by erosive currents before the deposition of the skeletal deposits.

Acknowledgements

This investigation is supported by grants of research group RNM-200 and research project CGL 2014-55274-P. We thank the revisions of Profs. Julio Aguirre and Ana Márquez. This a contribution in the context of the IGCP Project 655. We also thank Ghislaine Broilmet (Université Lyon 1) for smear slide preparation.

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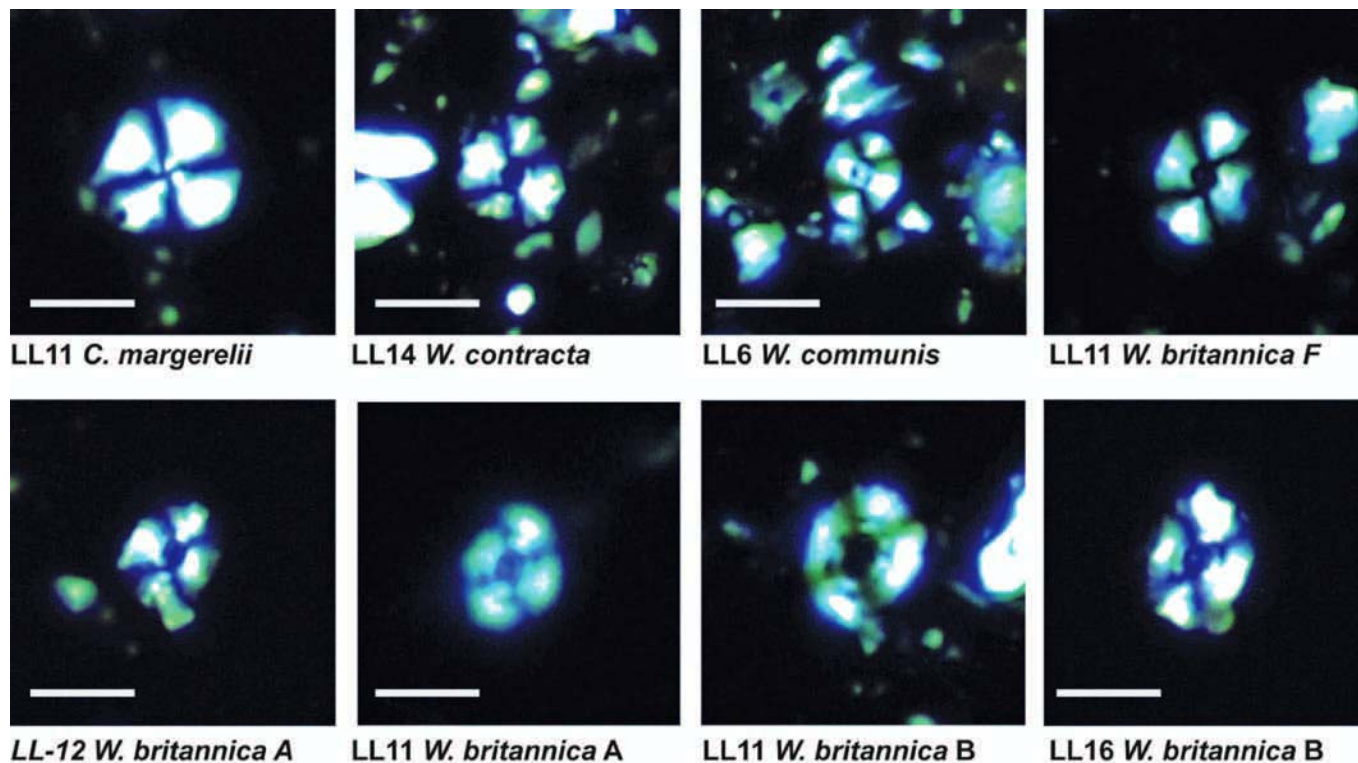


Fig. 3.- Selected calcareous nannofossils with biostratigraphic interest. *Cyclagelosphaera margerelii*, *Watznaueria contracta*, *W. communis* and *W. britannica*. Scale bar 5 μ m.

Fig. 3.- Nanofósiles calcáreos con interés bioestratigráfico. *Cyclagelosphaera margerelii*, *Watznaueria contracta*, *W. communis* y *W. britannica*. Escala: 5 μ m.

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