

The westernmost sector of the lower-Cambrian Los Navalucillos Formation: microbialites in tidal deposits, Central Iberian Zone, Toledo Mountains, Spain

El sector más occidental de la Formación de Los Navalucillos, Cámbrico inferior: microbialitas en yacimientos mareales de la Zona Centroibérica, Monte de Toledo, España

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ABSTRACT

In the Central Iberian Zone of the Iberian Massif, the Los Navalucillos Formation, interpreted as tidal and shallow-marine carbonate deposits, contains a significant archaeocyathan faunal assemblage. Two new characteristic exposures are described here from the westernmost outcrops of the formation, close to La Nava de Ricomalillo area: (i) La Estrella, where the rocks are strongly affected by contact metamorphism due to the nearby plutonic complex; and (ii) the Finca Higuera succession, without calcimicrobial-archaeocyathan boundstones, although different microbialites as stromatolites and oncolites are conspicuous.

Keywords: Botoman; Central Iberian Zone; Microbialites; Tidal environment; Upper Ovetian.

RESUMEN

En la Zona Centroibérica del Macizo Ibérico, la Formación de Los Navalucillos, interpretada como depósitos carbonatados mareales y de aguas someras, contiene un importante conjunto faunístico de arqueociatos. Se describen aquí dos nuevos afloramientos característicos de la parte más occidental, cerca de La Nava de Ricomalillo: (i) la Estrella, donde las rocas están fuertemente afectadas por el metamorfismo de contacto debido a un complejo plutónico cercano; y (ii) la sucesión de la Finca Higuera, sin facies bioconstructoras de calcimicrobios y arqueociatos, aunque se observan diferentes microbialitas, como estromatolitos y oncolitos.

Palabras clave: Botomiense; Zona Centroibérica; Microbialitas; Ambiente mareal; Ovetiense superior.

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Introduction and geological setting

Lower Cambrian strata are well exposed in the Central Iberian Zone (Iberian Massif). The lithostratigraphic record is formed, from bottom to top, by the Pusa, Azorejo, Los Navalucillos, Soleras and Los Cortijos formations. The lowermost Pusa Formation consists of 2000 m of siltstones, mudstones and finely laminated thin sandstones. This unit is well exposed in La Nava de Ricomalillo and contains acritarchs, some groups of small shelly fossils (SSF) and trace fossils, diverse organic filamentous fossils and trilobites. The presence of archaeocyathan moulds have been reported at the upper part of this unit (Jensen *et al.*, 2010). The Azorejo Formation is formed by 550-600 m of coarse-grained sandstones with significant lateral facies changes and siltstone/sandstone alternations towards the top. Trace fossils as *Astropolichnus hispanicus*, *Diplocraterion* sp. are recorded as well as arthropod-type traces (Moreno *et al.*, 1976; Liñán *et al.*, 2004). The Los Navalucillos Formation consists of 150 m of limestones and dolostones interbedded with claystones and siltstones. In this formation the development of calcimicrobial-archaeocyathan boundstones is very common. Archaeocyaths recorded in many of the Los Navalucillos Formation outcrops throughout the Toledo Mountains are characteristic of Zones VI-VII (late Ovetian=Botoman 1-2=Series 2, Stage 3) (Menéndez, 2012, 2014). Trilobites were also mentioned and identified as *Granolenus midi* (Gil Cid *et al.*, 1976; Liñán & Gámez-Vintaned, 1993). The Soleras Formation is about 200 m thick, and mostly consists of siltstones bearing trilobites such as *Andalusiana* and *Serrodiscus speciosus* (Gil Cid, 1981; Liñán *et al.*, 1993). This fauna points to a mid-late Marianian age. The Los Cortijos Formation is made up of 50-60 m of mainly arkosic sandstones with some siltstone interbeds. It contains an assorted trilobite fauna that suggests Bilbilian age (Liñán *et al.*, 2004 and references within).

The westernmost outcrops of the Los Navalucillos Formation

In the study area, the Los Navalucillos Formation seems conformably overlying the Azorejo Formation. However, the presence of large E-W faults suggests

a faulted contact between both formations (Fig. 1). The Los Navalucillos Formation has been interpreted as tidal and shallow-marine carbonate deposits (Gil Cid *et al.*, 1976; Zamarreño *et al.*, 1976; Perejón & Moreno, 1978; Monteserín, 1978; Moreno Serrano & Gómez Pérez, 1986). Lately a comprehensive study has been carried out on the carbonate materials of the whole area, especially focused on microfacies, archaeocyathan systematics and biostratigraphy (Menéndez, 2012, 2014). The westernmost outcrops of the Los Navalucillos Formation occur at La Nava de Ricomalillo area (Fig. 1). There, two localities are known: (i) La Estrella has already been studied by Martín-Caro (1980) and Martín-Caro *et al.* (1979), where the rocks are strongly affected by contact metamorphism due to the nearby plutonic complex; the presence of archaeocyaths was cited in these same levels, but its poor preservation did not allow

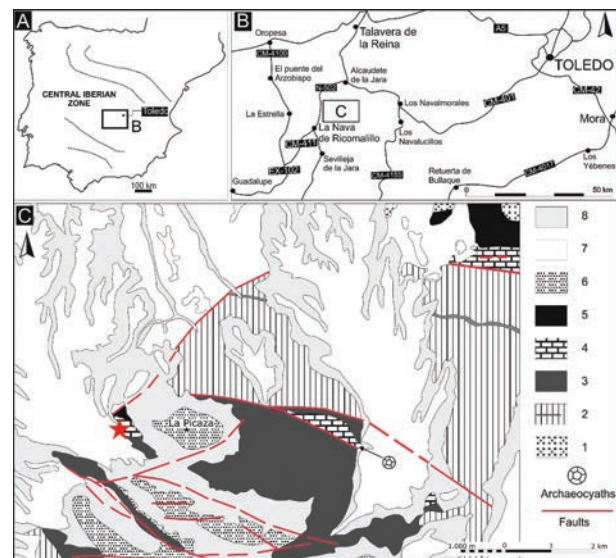


Figure 1.—A. Location of the study area in the Central Iberian Zone of the Iberian Massif. B. Situation of the study area in the central part of Spain, near Toledo city. C. Sketch of the geological map of the studied area (Olivé Davó *et al.* 1986). 1. Plutonic rocks. 2. Pusa Formation, siltstones, mudstones and sandstones. 3. Azorejo Formation, siltstones and sandstones. 4. Los Navalucillos Formation, limestones, dolomites and siltstones. 5. Soleras and Los Cortijos Formations, siltstones and sandstones. 6. Ordovician, conglomerates, sandstones, quartzites, siltstones and shales. 7. Miocene conglomerates and limolites and Pliocene gravels, cobbles and blocks with a clay-limose matrix (colluvial deposits) 8. Holocene gravels, sand, silt and mud (alluvial deposits). The archaeocyathan symbol refers the presence of this fossil group in other studied localities (Menéndez, 2012, 2014). The red star indicates Finca Higuera (FH) locality, the study section.

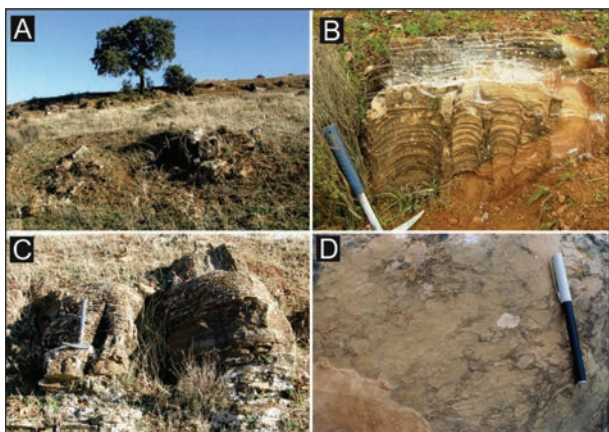


Figure 2.—A. General view of the Finca Higuera succession. B-D. Field photographs with some examples of the early Cambrian microbialites in the westernmost sector of Los Navalucillos Formation (La Nava de Ricomalillo area): (B) columnar stromatolites; (C) planar stromatolites with laminar lamination; (D) oncolites facies.

their identification; and (ii) the Finca Higuera succession (FH), best exposed. The latter represents a tidal-related succession, 21 m thick (Fig. 2A), without calcimicrobial-archaeocyathan boundstones, although different microbialites as stromatolites and oncolites are conspicuous (Fig. 2B-D).

Concluding remarks

The two new exposures described here from the westernmost outcrops of the formation, close to La Nava de Ricomalillo area, include: (i) La Estrella, strongly affected by contact metamorphism caused by the nearby plutonic complex; and (ii) the Finca Higuera succession, where different microbialites as stromatolites and oncolites are present.

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