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Revisiting the Sierra de la Zarzuela succession: the latest Ediacaran-?early Fortunian record from the Central Extremenian Great Anticlinory, Southern Central Iberian Zone, Iberian Massif, Spain

Revisión de la sucesión de la Sierra de la Zarzuela: último registro del Ediacárico-¿Fortuniense inferior? del Gran Anticlinorio Extremeño central, Zona Centroibérica meridional, Macizo Ibérico, España

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ABSTRACT

In the southern Central Iberian Zone, unconformably lying on the Cadomian folded Lower Alcudian-Domo Extremeño Supergroup the most complete succession of late Ediacaran rocks crops out at the Sierra de la Zarzuela syncline. The purpose of this contribution is to study and redefine a regional lithostratigraphic framework for the "Upper Alcudian" rocks of this area related to the Ibor Group.

Keywords: Central Iberian Zone; Ediacaran; Cambrian; Stratigraphy; Iberian Massif; Spain.

RESUMEN

En la Zona Centroibérica meridional se reconoce la sucesión más completa de rocas del Ediacárico tardío que afloran en el sinclinal de la Sierra de la Zarzuela, discordantes sobre el Supergroup del Alcudiense inferior-Domo Extremeño. El objetivo de esta contribución es estudiar y redefinir un marco litoestratigráfico regional para las rocas del "Alcudiense inferior" de este área relacionada con el Grupo de Ibor.

Palabras clave: Zona Centroibérica; Ediacárico; Cámbrico; Estratigrafía; Macizo Ibérico; España.

Introduction

In the southern Central Iberian Zone (CIZ) of the Iberian Massif, late Ediacaran and early Cambrian rocks crop out as cores of large anticlines clearly depicted by the Ordovician quartzites. These successions represent the retro-arc sediments in the northwestern margin of Gondwana and show low to middle anchimetamorphic grade, and therefore, the late Ediacaran- Terreneuvian record of the southern

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CIZ can be characterized with stratigraphic and palaeontological purposes.

In the southern margin of the CIZ, the late Ediacaran to early Cambrian rocks shows regionally an angular and erosional unconformity. That unconformity was initially reported in the Alcudia anticline and, therefore, the successions below and above the unconformity were informally subdivided in "Lower Alcudian" and "Upper Alcudian", respectively (Crespo & Tamain 1971; Crespo & Rey 1971). These subdivisions have been commonly used. However, they have received other informal names as "Domo Extremeño group" and "Ibor group" respectively (Álvarez Nava *et al.,* 1988, Vidal *et al.*, 1994). An updated lithostratigraphic framework is proposed in this volume (Álvaro *et al.*, this vol.) proposing the Lower Alcudia-Domo Extremeño Supergroup, and the Ibor Group which correlates with the "Upper Alcudian".

In the Central Extremenian Great anticlinory the Lower Alcudia-Domo Extremeño Supergroup rocks display Cadomian gentle folds and the outcrops exposed below that unconformity show signs of palaeoalteration in several localities, from West to East, Orellana de la Sierra, Sierra de la Zarzuela, Talarrubias, El Nevazo (Cabeza del Buey), Risco (Pieren 2000), Agudo (Pieren *et al*., 1987) and the area of Cabezarrubias - Hinojosas in the Alcudia anticline (Peláez *et al.*, 1986). In some of these places the basal levels of the Ibor group (attributed to the "Upper Alcudian" in the mentioned works) contain reddish clasts of palaeoaltered greywackes and siltstones.

Results

In the area limited at the South by the Variscan "Los Pedroches batholith", the largest outcrops correspond to the Lower Alcudia-Domo Extremeño Supergroup, which base does not appear in the CIZ, its thickness exceeds 4000 m and it has been interpreted as a prograding turbidite system (García Hidalgo *et al.*, 1993, Pieren 2000). In this region it has been informally divided in three formations (Pieren 2000, Linnemann *et al.*2018) at present formally reorganised by Alvaro *et al*., this vol.) which describe from the base towards the top the Guadiana Group formed by "La Coronada Shales Formation" and "Santa María del Zújar Formation" and the Campanario Group formed by the Botija Formation, the Monroy formation (Palacios *et al.*, 2010), and the Orellana Formation where matrix supported conglomerates occur (Pieren *et al*., 2000). The Guadiana Group is mainly composed of shales siltstones and litharenites followed by greywackes, shales and microconglomerates. The Campanario Group starts with shales, then shales and greywackes, and the Orellana Formation is characterized by abundant matrix supported conglomerates, shales and greywackes. Geochemistry data support an active margin setting for the greywacke bodies of the turbidites sampled in "Santa María del Zújar Formation" (Fuenlabrada *et al.*, 2016). The Orellana Formation in the Central Extremenian Great Anticlinory, has been interpreted as diamictite deposits and dated with a maximum depositional age of 565 ± 4 Ma by Linnemann *et al.* (2018) based on its zircons content.

Further East, the Lower Alcudia-Domo Extremeño Supergroup turbidites from Alcudia anticline display concordia ages of 580-576 Ma from zircons whereas the "Upper Alcudian" zircons in the same area yielded ages of 555-552 Ma (Talavera *et al.*, 2015). These data confirm an Ediacaran age for the angular unconformity between the "lower and upper Alcudian" either in Alcudia or the Central Extremenian Great Anticlinory (CEGA) two of the largest Variscan structures at the southern boundary of this region.

In the CEGA, the "Upper Alcudian" outcrops are now related to the Ibor Group and they do not have continuity and appear scattered in isolated outcrops (Fig. 1). The Ibor Group crops out from W to E, in the Barca-Tamborrío hills (N of Villanueva de la Serena), Orellanita, Sierra de la Zarzuela, Talarrubias (Pieren *et al.*, 1991). In the western neighbouring Alcudia Anticline, the Ibor Group crops out at Risco and Garlitos localities (Pieren & Herranz 1988). The Ibor Group sediments were filling the existing palaeotopography in semigrabens. Thus, they were preserved from the erosion related to the Toledanian phase (late Cambrian-Early Ordovician), after which the structural-controlled palaeotopography was covered by the Lower Ordovician transgression sediments.

The purpose of this contribution is to synthetize and redefine a common and regional lithostratigraphic framework for the "Upper Alcudian" rocks which are related to the Ibor Group (Álvaro *et al*. this vol) in

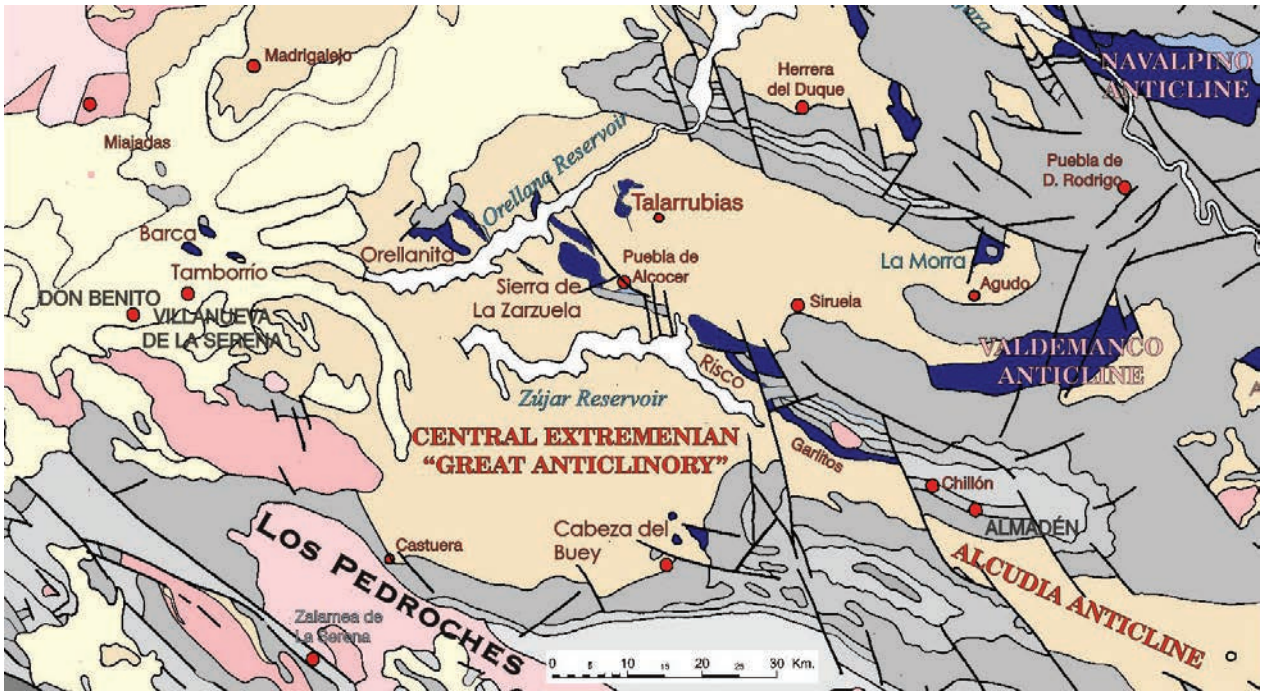

Figure 1.—Geological setting. Light brown: Lower Alcudia- Domo Extremeño Supergroup; blue: Ibor Group; light blue Pusa formation; grey: Ordovician-Carboniferous rocks; pink: Variscan batholiths; yellow: Cenozoic sediments; modified from Pieren & Herranz (2004).

the Central Extremenian Great Anticlinory (San José *et al.,*1990). The detailed mapping and stratigraphy data are based on Pieren's studies (2000). The palaeontological study of trace fossils is based in new data from the Sierra de la Zarzuela and Talarrubias areas. A new, detailed microfacies and geochemical analysis from Talarrubias dolostones is here presented.

Based on the regional stratigraphic correlations and fossil content a latest Ediacaran -? early Fortunian can be inferred for the "Upper Alcudian" rocks. In the CEGA the most complete and continuous succession of the "Upper Alcudian" crops out at Sierra de la Zarzuela (Fig 1). The succession mainly consists of siliciclastic deposits, but two different carbonate intervals occur (Pieren *et al*., 1991, Pieren, 2000, Rodríguez Alonso *et al.*, 2004). In fact, the lowermost carbonate levels at Sierra de la Zarzuela could be considered the oldest carbonate sedimentation in the southernmost Central Iberian Zone.

Six informal units are proposed for this area (Fig. 2):

(U1) Orellanita conglomerates. This unit lies unconformably on the folded, eroded and altered Lower Alcudia- Domo Extremeño Supergroup rocks, and the existence of a palaeotopography is evident even at the outcrop scale. It is formed by clast supported conglomerates, siltstones, greywackes, microconglomerates and banded sandy siltstones. The thickness is very variable, the unit reaches 70 m but can disappear laterally. Neither fossil nor trace fossil has been reported in this unit.

(U2) Cogolludo siltstones and sandstones. This unit is primarily composed of coloured siltstones and sandy siltstones, fine to medium graywackes, which change upwards to shales or alternating shales and siltstones. The thickness varies between 50 and 72 m. The sediments correspond to middle to distal fan deposits (Barca and Cabeza del Buey localities), flood plain deposits (Orellanita and Sierra de la Zarzuela). The upper part of the unit represents shallow marine deposits where sabelliditids fauna occur (Palacios *et al.,* 2013: pl. 30) (Fig 3). The abundance of pyrite possibly could be related with a high content of organic matter in the original sediments.

(U3) Talarrubias dolostones. Massive black dolostones form lenticular bodies and most of them have been exploited in small quarries. The dolostones are more than 12 m thick but they have been mined almost completely at Sierra de la Zarzuela. The Talarrubias dolostones almost disappear westwards (Orellanita, Barco), where thin layers of

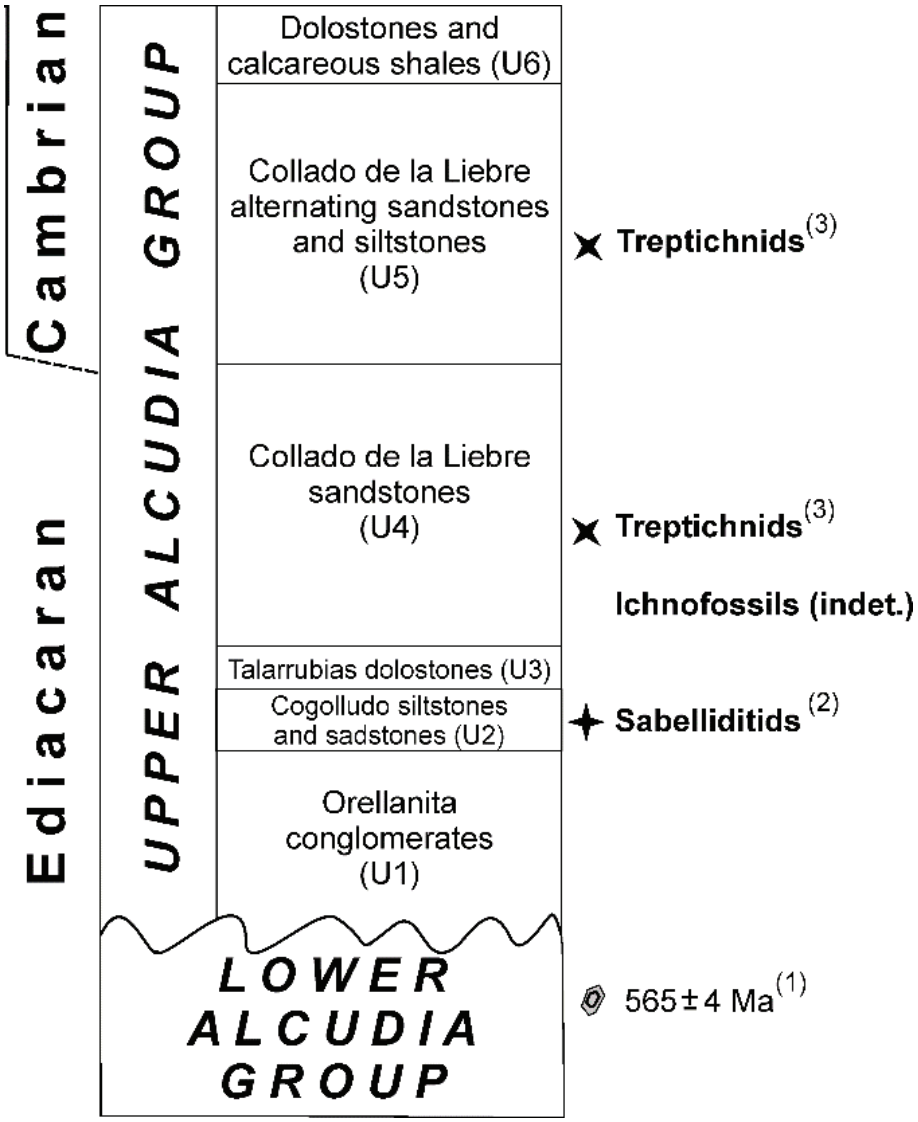

Figure 2.—Sierra de la Zarzuela lithostratigraphic units scheme based on Pieren (2000). (1) Linnemann *et al.* (2018). (2) Palacios *et al.* (2013). (3) Jensen (*pers. comm.*)

dolostones and calcareous shales occur interbedded with fine grained coloured sandstones. The best exposures of this unit are at Las Cañameras, West of Talarrubias.

These dolostones crop out at Las Cañameras displaying thin to very thick beds from the base toward the top. At the top, an irregular altered surface separated the massive dolostones from the upper unit (Collado de la Liebre sandstones U4). The base corresponds to alternating mm-cm siltstones and finely laminated silty to sandy dolostones. The lamination is disturbed by burrows, where circular sections are around 1mm (Fig 3). The massive thick beds from the Talarrubias dolostones at Las Cañameras show a variety of textures. Dolomite textures range from finely to medium crystalline nonmimic replacement fabrics (planar-s to planar-e and nonplanar mosaics, Sibley & Gregg, 1987). Dolomite cements are observed as crystal overgrowths in pore- and fracture fillings. Zoning and cloudy cores are common in dolomite rhomb crystals. Fractures with medium to coarse quartz mosaics postdate the observed dolomite fabrics and cements. The petrographic and geochemical analyses of samples are in progress to

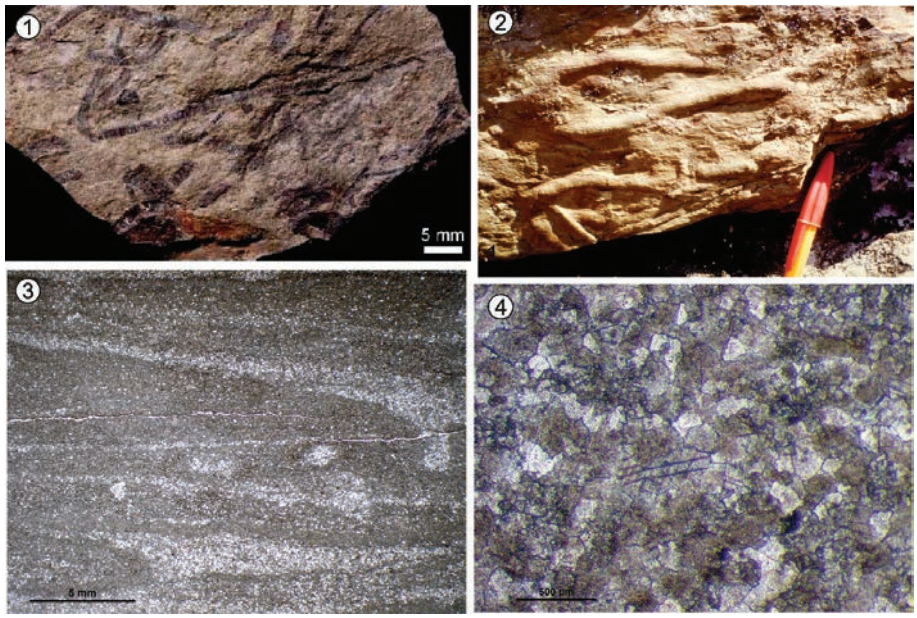

Figure 3.—1. Sabelliditids from Talarrubias (U2) (Palacios *et al.,* 2013, lam 30 B). 2. Treptichnids from El Risquillo (U5) (Pieren, 2000). 3. Las Cañameras dolostones where lamination is disturbed by burrows, circular sections are around 1mm (thin section CAÑ-0A-01). 4. Detail of nonplanar mosaic fabric from las Cañameras dolostones (thin section CAÑ-3-02).

decipher the diagenetic evolution of the Talarrubias dolostones.

(U4) Collado de la Liebre sandstones. This unit overlies U3 at Sierra de la Zarzuela, Talarrubias and Risco-Garlitos localities. At kilometric scale this unit crops out forming a cartographic unconformity on the underlying units. The boundary between units 3 and 4 represents a paraconformity at the different quarries at Las Cañameras (Talarrubias). The thickness varies from 100 m at the Sierra de la Zarzuela to at least 75 m at the Risco locality. This unit is characterized by the prevalence of quartzitic sandstones, although greywackes and lithoarenites also occur frequently as well as some silststone layers. At Las Cañameras abundant treptichnids fauna appear in alternating fine-grained sandstones and siltstones. A shallow marine environment is interpreted for the presence of wave ripples, megaripples, herringbone cross bedding and common hummocky cross stratification.

(U5) Alternating sandstones and siltstones. This unit is only preserved at the Sierra de la Zarzuela and the Risco-Garlitos sector. The boundary between units 4 and 5 is transitional. The unit 5 is composed by alternating light brown-greenish medium to fine-grained greywackes and siltstones. The total thickness is 80 m. In the top 20 m, the presence of dolostones, calcisiltstones and carbonate cement occur. This unit is rich in ichnofossils like *Planolites* and abundant treptichnids, which have been found at the Risquillo hill on the Orellana reservoir shore, and at the Risco locality (Fig. 3).

(U6) Dolostones and calcareous shales. This is the youngest unit of the succession. It is only preserved at the core of the Sierra de la Zarzuela syncline. The base is laterally interlayered with the fine litharenites and calcisiltstones of unit U5. It is a 25 m thick unit formed by alternating calcareous shales, siltstones and thin layered black dolostones. Lateral changes between calcareous shales and dolostones are common. No trace fossil has been reported in this unit but it was lithologically correlated with Valdemanco dolostones (Pieren 2000).

The maximum age of the Lower Alcudia- Domo Extremeño Supergroup at the studied area is given by its zircon content (565 ± 4 Ma; Linnemann *et al.*, 2018). The age of the Orellanita conglomerates (U1) at the base of the "Upper Alcudian" can be inferred by the trace fossil content of the overlying units as late Ediacaran. The new trace fossil data (Jensen & Palacios 2016) and the geochemical analyses of the carbonate samples may allow locating more precisely

the record of the Ediacaran-Cambrian boundary in the southern Central Iberian Zone.

Conclusions

In the southern Central Iberian Zone, unconformably lying on the Cadomian folded Lower Alcudian-Domo Extremeño Supergroup the most complete succession of late Ediacaran rocks crops out at the Sierra de la Zarzuela syncline. There, Six informal units are proposed, from bottom to top: (i) the Orellanita conglomerates, (ii) the Cogolludo siltstones and sandstones, (iii) the Talarrubias dolostones, (iv) the Collado de la Liebre sandstones, (v) some alternating sandstones and siltstones, and (vi) dolostones and calcareous shales. This sedimentary package represents the Castañar and Villarta formations of the Ibor Group.

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