Estudios Geológicos
julio-diciembre 2019, 75(2), e120
ISSN-L: 0367-0449
https://doi.org/10.3989/egeol.43725.575

Pre-conference fieldtrip, October 17–18, 2019: Ediacaran, Lower Palaeozoic and landscapes within the Villuercas-Ibores-Jara UNESCO Global Geopark

Guía de campo pre-congreso, 17-18 de Octubre de 2019: Ediacárico, Paleozoico Inferior y panorámicas en el Geoparque de la UNESCO Villuercas-Ibores-Jara

S. Jensen[1], J.J. Álvaro[2], T. Palacios[1]

[1]Área de Paleontología, Facultad de Ciencias, Universidad de Extremadura, 06071 Badajoz, Spain. Email: soren@unex.es, medrano@unex.es; ORCID ID: http://orcid.org/0000-0003-4573-9282, http://orcid.org/0000-0002-4917-0559
[2]Instituto de Geociencias (CSIC-UCM), Dr. Severo Ochoa 7, 28040 Madrid, Spain. Email: jj.alvaro@csic.es, ORCID ID: http://orcid.org/0000-0001-6294-1998

ABSTRACT

Several stratigraphic units characteristic of the Ediacaran-Cambrian transition between Guadalupe and Castañar de Ibor, north of the Villuercas-Ibores-Jara Geopark (Cáceres), are described and illustrated here. The outcrops of (i) the Castañar and Villarta formations (Ibor Group, terminal Ediacaran and Terreneuvian), together with their content in vendotaenids, sabelliditids and microbial reefs with *Cloudina*; and (ii) the San Lorenzo Formation (Terreneuvian) and its palaeoichnological content, are detailed. Finally, the palaeoichnological record of the Armorican Quartzite (Lower Ordovician), mainly of *Cruziana* and *Daedalus*, which characterize some sites of geological interest (geosites) in the Geopark, are highlighted.

Keywords: Ediacaran; Cambrian; Ordovician; Site of Geological Interest; Villuercas-Ibores-Jara Geopark.

RESUMEN

Se describen y figuran aquí varias unidades estratigráficas características del tránsito Ediacárico-Cámbrico entre Guadalupe y Castañar de Ibor, al norte del Geoparque de Villuercas-Ibores-Jara (Cáceres). Se detallan los afloramientos (i) de las formaciones de Castañar y Villarta (Grupo de Ibor, Ediacárico terminal y Terreneuviense), junto a su contenido en vendoténidos, sabellidítidos y arrecifes microbianos con *Cloudina*; y (ii) de la Formación de San Lorenzo (Terreneuviense) y su contenido paleoicnológico. Por último, se destaca el registro paleoicnológico de la Cuarcita Armoricana (Ordovícico Inferior), principalmente de *Cruziana* y *Daedalus*, que caracteriza algunos puntos de interés geológico (LIG) en el Geoparque.

Palabras clave: Ediacárico; Cámbrico; Ordovícico; LIG; Geoparque de Villuercas-Ibores-Jara.

Recibido el 17 de septiembre de 2019; Aceptado el 27 de septiembre de 2019; Publicado online el 2 de diciembre de 2019

Citation / Cómo citar este artículo: Jensen, S. et al. (2019). Pre-conference fieldtrip, October 17–18, 2019: Ediacaran, Lower Palaeozoic and landscapes within the Villuercas-Ibores-Jara UNESCO Global Geopark. Estudios Geológicos 75(2): e120. https://doi.org/10.3989/egeol.43725.575.

Introduction

The Villuercas-Ibores-Jara UNESCO Global Geopark (Cáceres province, Spain) comprises some key outcrops to constrain the Ediacaran-Cambrian boundary interval, and the Lower Ordovician strata sealing them, in the Iberian Peninsula. The stops of the International Meeting on the Ediacaran System and the Ediacaran-Cambrian transition (IMECT), pre-conference fieldtrip (October 17–18, 2019) are described and illustrated below.

October 17: Ibor Group in Ibor Anticline

The stops of this field trip provide examples of sedimentary rocks and landscapes within the Villuercas-Ibores-Jara UNESCO Global Geopark, from Guadalupe to Castañar de Ibor (for location of stops, see Fig. 2), in the Ibor Anticline. The latter is a Variscan large-scale vertical fold that belongs to the Domain of Vertical Folds (Díez-Balda *et al*., 1990). The fold has a N150E trend and shows a general box-fold geometry slightly verging to the SW. Large anticlines cored with Neoproterozoic strata are separated by narrow synclines delineated by the Lower Ordovician Armorican Quartzite. Syn- to late-Variscan granites crosscut these structures.

STOP 1. A glance at the Vendotaenid Realm, Ibor Group

Drive to Stop 1. Buses leave Guadalupe driving north following a winding stretch of road EX-118 (see Fig. 2). Outcrops along the road belong to the Lower Alcudian-Domo Extremeño Supergroup and are dominated by thick-bedded greywacke and shale strata. Detrital zircon dating in nearby regions to the west has given an age of about 582 Ma for the youngest concordant population of zircon grains (Orejana *et al*., 2015). No macroscopic fossils are known from this succession and organic-walled microfossils are restricted to *Sphaerocongregus*. After some 3 km we will turn left, onto a narrow paved road. This road is known as military pathway ("pista militar"), because it leads to a military plant at the summit of Las Villuercas hill (1601 m), the highest point within the Geopark. At the crossroad, a small whitish building stands on the right side: this is the "Ermita del Humilladero" or "Ermita de la Santa Cruz", a hermitage constructed in the 15th century as a place for pilgrims to pray upon seeing the Guadalupe Monastery.

Location and geological context. Stop 1 is reached after driving 2.1 km on "Pista Militar" climbing toward the Villuercas summit (WGS 84) at 39°28'02"N, 05°22'06"W (Point 1 on Fig. 2). This outcrop of the Ibor Group lies on the southern limb of the Ibor Anticline, in the north-central part of Geological/Topographic Map 707 (14–28) of Logrosán. The exact stratigraphic position of the outcrop within the Ibor Group can only be approximately placed, due to large covered intervening areas. This is part of García Hidalgo's (1985: p. 78–79) "pista militar" section, who located it at the transitional levels between subunits AS.2 and AS.3, which would place it stratigraphically

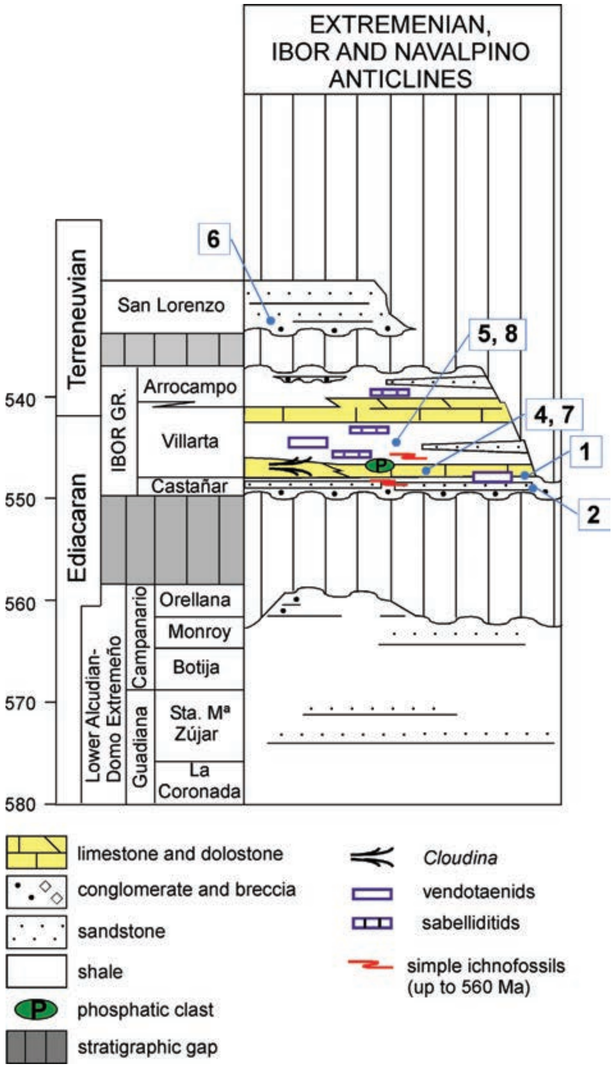

Figure 1.—Stratigraphic sketch of the Extremenian Anticlinorium and the Ibor and Nalvalpino anticlines (modified from Álvaro et al., 2019) with setting of stops (boxed numbers).

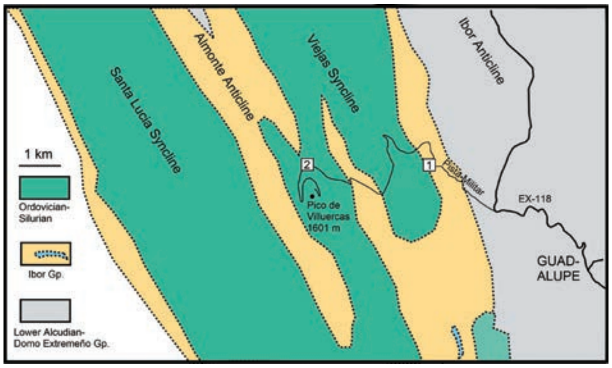

Figure 2.—Map showing location of Stops 1 (Ibor Group) and 2 (view of Appalachian relief). The geology is mainly based on Nozal Martín (1988) and Palacios *et al*. (2013) and is focused on Neoproterozoic-to-Silurian exposures, largely obviating the distribution of scree slopes.

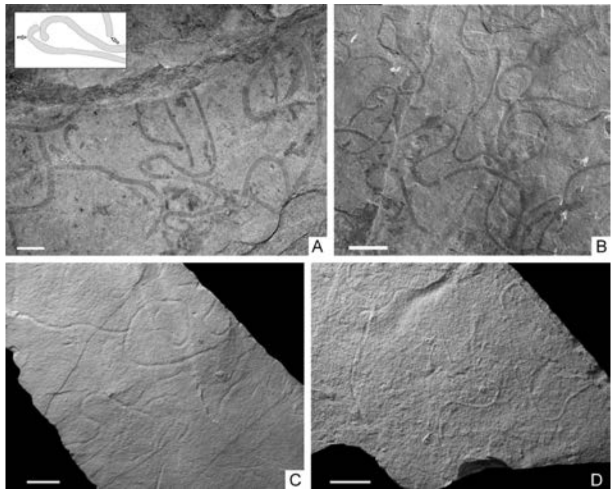

Figure 3.—Filamentous fossils in different types of preservation; parts C and D could be trace fossils. A. *Vendotaenia antiqua*; inset indicates kink and orthogonal termination in the central portion of image; scale bar is 5 mm. B. Filamentous fossil; note the length of some specimens and the general similarity in structures to parts C and D; scale bar is 10 mm. C-D. Filamentous fossils preserved in relief or trace fossils?; scale bars = 10 mm.

below the *Cloudina*-bearing carbonates (lower member of the Villarta Formation), close to the Castañar/Villarta formations contact. Two nearby sections will be looked at:

i. A short stretch of road is flanked by strata with inverted bedding. This outcrop shows the stratigraphically highest part of García Hidalgo's (1985: p. 78–79) "pista militar". A new opened trench provides fresh outcrops of decametre-scale greywacke and laminated sandstone/siltstone interbeds, the latter containing scattered centimetre-thick carbonate nodules. Filamentous fossils are ubiquitous on thinly laminated, very fine-grained sandstone and siltstone surfaces with thin dark clayey partings (Fig. 3A-B). Fragments of filamentous fossils can be seen on bed surface, but slabs from this outcrop will be available for examination. Notice the co-occurrence of filamentous material and irregularly winding low-relief ridges.
ii. At the beginning of the curve, a quarry excavation has left abundant blocks of loose material of thinly laminated sandstone and siltstone, which exhibit irregularly winding low-relief ridges. These form irregular trajectories that, if trace fossils, would be classified as *Helminthoidichnites* or *Gordia* (Fig. 3C-D).

Discussion. Filamentous fossils from the Ibor Group are relatively abundant in this stop. Despite ubiquitous cleavage, neither weathering nor tectonic deformation is significant. These organic filaments have been traditionally assigned to *Vendotaenia*. They do indeed show close similarities to vendotaenids reported from the East European Platform and Namibia. Features showing that these are filamentous fossils, and not trace fossils, include evidence of kinking and abrupt terminations (Fig. 3A). A characteristic feature of this log is that relatively flat filamentous fossils are associated with elevated ridges of comparable dimensions, forming similar general trajectories, which raises the question if the two have the same origin but display different modes of preservation. Some specimens were figured by Jensen *et al*. (2006: fig. 1e) and Jensen *et al*. (2007: fig. 4b) as case studies to differentiate between organic filaments and trace fossils. Where up-down orientations are available, specimens are preserved as raised convex up ridges. This has been found to be the case or this outcrop and several other locations from the Ibor Group. A possible stepwise taphonomic succession leading to the preservation of an originally tubular fossil is illustrated in Figure 4. This somewhat unusual style of preservation raises questions similar to those of Ediacara-type fossils preserved as negative hyporeliefs and corresponding counterpart casts. That is, if preservation was aided by some form of early mineralization by pyrite crusts, possibly mediated by microbial mats ("death masks"; Gehling, 1999; MacGabhann *et al*., 2019), silica precipitation (Tarhan *et al*., 2016), or if sediment properties alone would be sufficient (Bobrovskiy *et al*., 2019) to account for this type of preservation. Alternatively, there could be a case of co-occurring filamentous fossils and trace fossils. This question has some stratigraphic implications as simple filamentous organisms have deeper stratigraphic ranges than do trace fossils.

STOP 2. Panorama of Appalachian-style landscape

The bus continues along the "pista militar" to stop at a point that provides good views of the Appalachian-type orography (see point 2 on Fig. 2), where many of the typical geomorphological features that characterize the Geopark can be observed. The road leads to the highest peak of the Geopark, 1601 m above sea level and nearly 1 km higher than Guadalupe town. The view to the north shows a succession of synclines and anticlines. The weathering resistant Ordovician Armorican Quartzite forms the pronounced crests. Fracturation of the Armorican Quartzite has led to the accumulation of abundant large blocks on scree slopes. Toward the southeast, the strikingly horizontal landscape form of the "rañas" (piedmont infills) is observed.

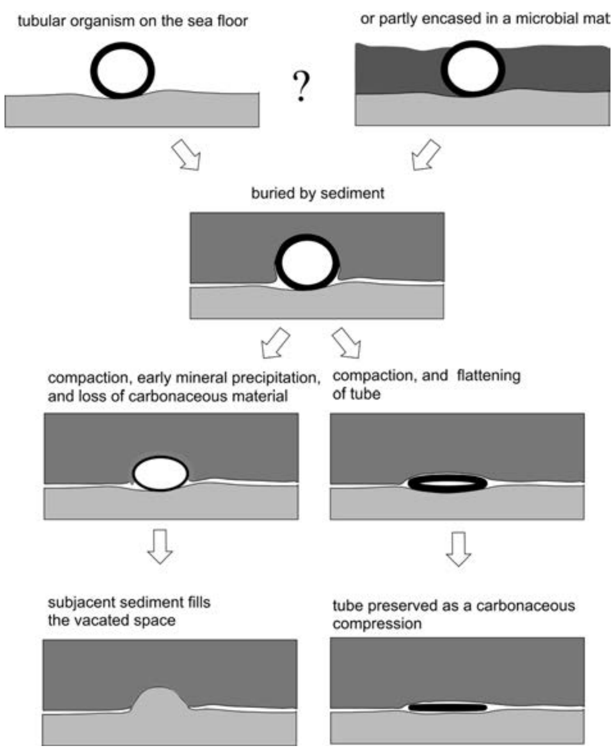

Figure 4.—Different preservation paths of filamentous fossils.

STOP 3. Slope-related interbeds, Castañar Formation

Drive to Stop 3. Bus returns to road EX-118 and drives north towards Castañar de Ibor village. During this drive, the road parallels the Ibor river cutting the strata of the Lower Alcudian-Domo Extremeño Supergroup, composed of thick-bedded greywacke and claystone sediments. After Navalvillar de Ibor, some carbonates of the Villarta Formation occur on the right side. As all carbonates in this area, they have undergone dolomitization and magnesitization processes (Herrero *et al*., 2011). *Cloudina* has not been identified in the carbonates of the Navalvillar de Ibor area, but these carbonates are believed to represent the lower member of the Villarta Formation. The bus will then cross a bridge over "Garganta de Salóbriga" (Salobriga gorge), which has given its name to one fossil described by Hufnagel (2008) –*Salobrigia*– from the lower parts of the Ibor Group further down the gorge. After the bridge, both sides of the road exhibit weathered siliciclastic strata of the middle member of the Villarta Formation, rich in vendotaenids. In Castañar de Ibor, exit onto EX-386.

Description. The base of the Castañar Formation (Ibor Group) is unconformable and currently recognized as an angular discordance. Along the road EX-386 (point 3 on Fig. 5), the base of the formation is covered, but its lower part is dominated by shales and fine-grained greywackes, locally interrupted by the presence of breccia and conglomerate interbeds (Fig. 6A-C), up to 2.4 m thick, and dolostone nodules and concretions, up to 0.8 m in size. Conglomerates and breccias, distinguished by the rounding vs. angular shape of their clasts, comprise erosive bases and display normal grading and local imbrication. Breccia interbeds are both clast- and matrix-supported (the latter also named diamictites, a descriptive –non genetic– term),

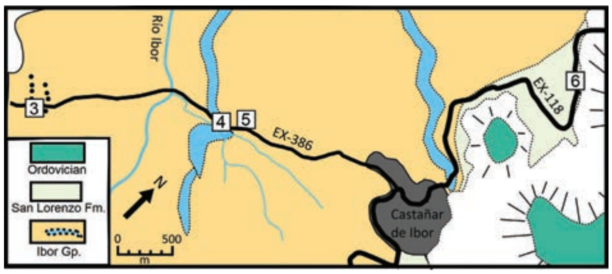

Figure 5.—Map showing location of Stops 3 to 5 at the Ibor Group, and Stop 6 at the San Lorenzo Formation; modified from Nozal Martín (1985).

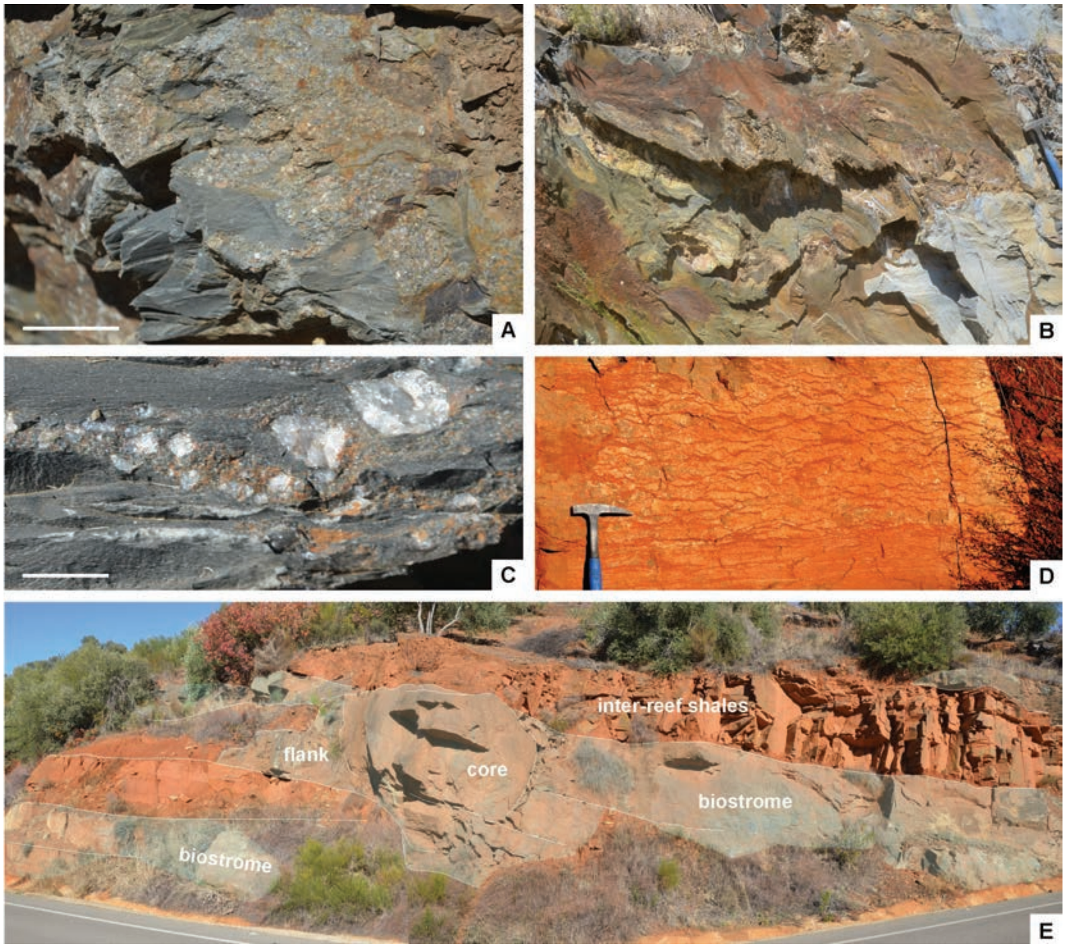

Figure 6.—Field aspects of the Castañar and Villarta (lower member) formations along the road EX 386, in the vicinity of Castañar de Ibor. A. Contorted aspect of a mixture of angular shale and conglomerate clasts infilling a channel, Castañar Formation; scale = 3 cm. B. Dolostone concretions within the Castañar Formation. C. Detail of channelized conglomerates rich in hydrothermal vein quartz clasts, Castañar Formation; scale = 1 cm. D. Bedded dolostone showing subparallel- to-wavy laminae, lower member of the Villarta Formation. E. Panorama showing geometrical relationships between *Cloudina*-thromboid biostromes, flanks and inter-reef shales, lower member of the Villarta Formation.

whereas conglomerate beds are clast-supported. Clasts are dominated by mono- and polycrystalline quartz, the latter related to contemporaneous hydrothermal activity (Fig. 6C), and intraformational shale, sandstone, greywacke and conglomerate clasts, up to 10 cm in size, and commonly polyphasic. Intraformational shale clasts are commonly distorted and contorted, linking to local slumping fabrics. This mosaic of facies points to high-energy, slope-related events interrupting background greywacke-to-shale sedimentation. High-energy events were controlled by the orogenic uplift pulsations recorded by the neighbouring Cadomian Arc, located to the SW of the area.

STOP 4. Cloudina*-microbial buildups, Villarta Formation*

Along the road EX 386 (point 4 on Fig 5), some outcrops of partly dolomitized limestones allow the recognition of a superposition of *Cloudina*-microbial biostromes and bioherms. Here, the lower member of the Villarta Formation, about 14 m thick, consists of four shale-to-carbonate cycles topped with amalgamated biostromes flanked by patch-reefs with poorly developed intraclastic flanks. These beds are fringed and sandwiched by claystone. Laminated carbonates show parallel lamination, ripple-cross, lenticular and flaser beddings and flat-pebble breccia at their tops. Boundstone and floatstone microfacies are strongly recrystallized into pseudospar, whereas a secondary porosity through dolomitization is conspicuous (Fig. 6D) Secondary porosity has increased the final permeability by connecting primary laminoid fenestral pores. *Cloudina* shells can be recognized by the replacement of their walls and occlusion of their intraparticle pores, leading to conical mosaics of sparry calcite floating in recrystallized thromboid masses. *Cloudina* is preserved both uplift (in life position) and lying on the surface (as parautochthonous assemblages).

Dolostone and magnesite packages crosscutting stratification display both massive and laminated features. Massive dolostones consist of a coarse mosaic of impure dolomite including scattered silt-sized quartz grains, ghosts of *Cloudina* and successive dolomitization and magnesitization phases (see Herrero *et al*., 2011). Within Castañar de Ibor, the upper member of the Villarta Formation hosts a hydrothermally induced giant karstic cave famous for aragonite, calcite, dolomite and magnesite speleothems (Martín-Pérez *et al*., 2012, 2015).

STOP 5. Middle Member of the Villarta Formation

Climbing the road to Castañar de Ibor, the disappearance of carbonate interbeds marks the top of the lower member. The middle member of the Villarta Formation consists of shales and greywacke sandstones, several hundred metres thick, exposed along a now abandoned stretch of road (point 5 in Fig. 5). This represents, in part, García Hidalgo's (1985, p. 59–61) Castañar de Ibor III log. Depositional sedimentary structures are well preserved, such as erosive bed bases and slumping and contorted interlaminae. The eastern continuation of the section contains packages of sandstone beds, a feature typical of this part of the Ibor Group. Rare poorly preserved filamentous fossils have been found in this section.

STOP 6. Shyly burrowed, variegated shale/ sandstone alternations, San Lorenzo Formation

Following the road EX 386 (point 6 in Fig. 5), we will cross the above mentioned sandstone package marking the middle member of the Villarta Formation, and a succession of dolostone/shale alternations (upper member) along EX-118 north of Castañar de Ibor. Following the latter, we will recognize, to the right side, the shales of the Arrocampo Formation, conformably overlain by an alternation of variegated shales and sandstones that belong to the San Lorenzo Formation. Yellowish silty interbeds display a typical Fortunian ichnofabric of small sandstone-filled burrows associated with thin sandstone/shale couplets (Fig. 7), mimicking the ichnofabrics that characterize the Chapel Island Formation of SE Newfoundland. Millimetric I- and J-shaped burrows are seen. Larger centrimetre-wide trace fossils are present on some sandstone bed soles, although poorly preserved.

October 18: Ibor Group and Armorican Quartzite, areas of Alía and Cañamero

STOP 7. Villarta Formation at La Calera: Lime kilns and cross-laminated sets

Drive to stop 7. This stop is located west of La Calera village (Calera means lime kiln or lime pit) at (WGS 84) 39°30'45"N, 05°15'31"W, within the northern flank of the Ibor-Guadalupe Anticlinorium. From Guadalupe this location can be reached by a narrow but paved road or by a more circuitous route through Alía. Stratigraphic logs of the area were illustrated by García Hidalgo (1985: p. 71–72 "La Calera I").

Description. Carbonates of the Ibor Group were exploited in several open quarries as source for lime and other products. The carbonate was burnt for several days at temperatures of 700–900 ºC transforming the carbonate to calcium oxide (quicklime, burnt lime). Mixed with sand this was used as a binding agent for walls and to chalk building walls.

The carbonate package visited here belongs to the lower member of the Villarta Formation and exhibits metre-scale muddy plano-convex geometries underlain, overlain and flanked by bedded carbonates with trough cross-laminated sets (Fig. 8A). These are commonly lined with pale-coloured angular intraclasts reflecting reworking of mudstone chips probably derived from polygonal desiccation cracks (Fig. 8B).

STOP 8. Middle Member of the Villarta Formation with sabelliditids

Location. Continuing the dirt road from Stop 7, some 1.5 km in a westerly direction, a shale-dominate outcrop is found at (WGS 84) 39°31'18"N, 05°16'11"W.

Description. This is one of the scattered outcrops of the Ibor Group with sabelliditids. The material is weathered and tectonically deformed, but the characteristic transverse wrinkling or divisions of the sabelliditids can

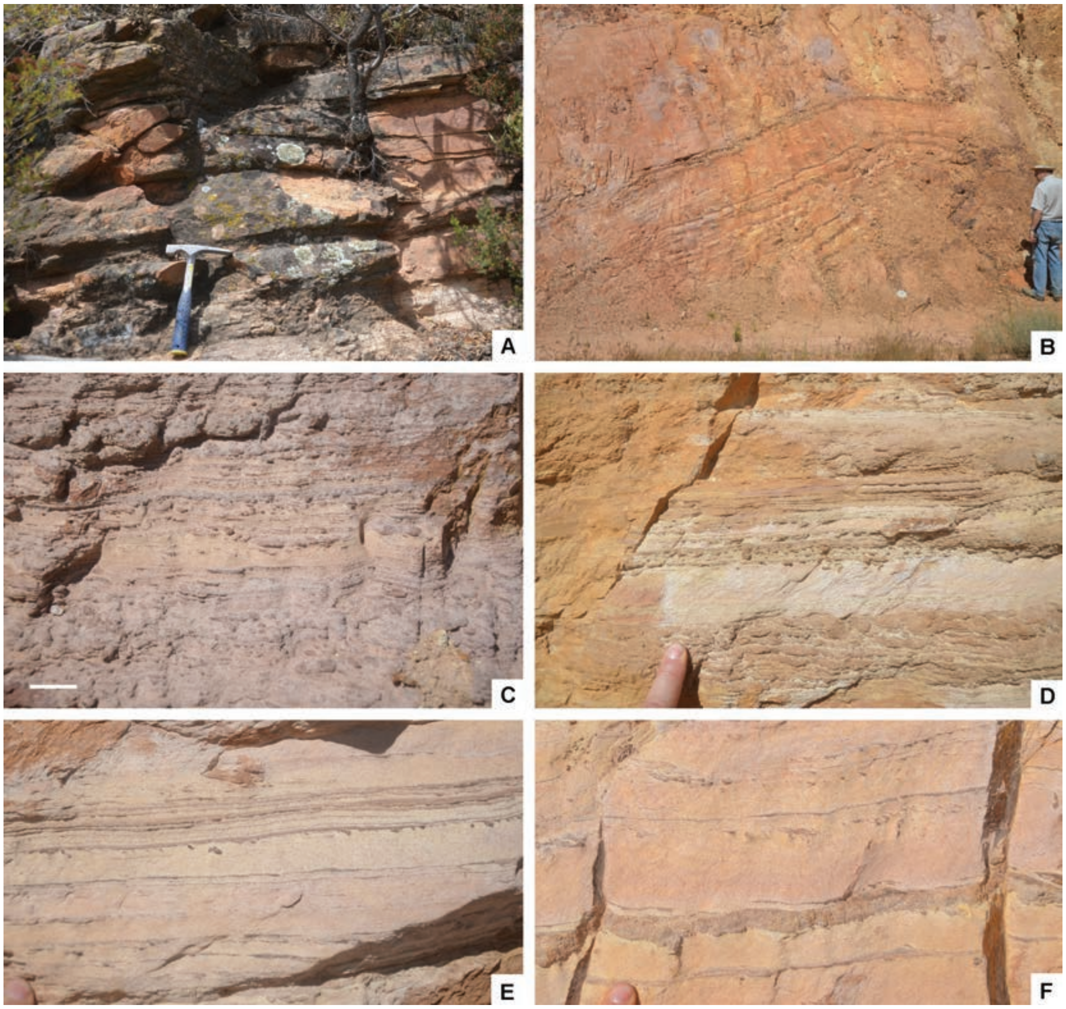

Figure 7.—Field aspect of facies characteristic of the San Lorenzo Formation along the EX 118 road, north of Castañar de Ibor. A. Superposition of ochre-stained trough cross-stratified sandstone sets. B. Cliff along the road showing the variegated colours of burrowed sandstone/shale couplets. C-F. Detail of centimetre-scale sandstone/shale couplets; remark trace fossils along the base of the purplish sandstone laminae exhibiting I- to J-shaped forms.

be observed (Jensen *et al*., 2007: fig. 6) (Fig. 8C). The sabelliditids of the Ibor Group have not yet been studied in detail, but Contreras Sánchez *et al*. (2006) identified *Sabellidites cambriensis* and *Saarina* sp. from this section. In a nearby section, Vidal *et al.* (1994) identified *Sabellidites* sp. (as *S. cambriensis* in Vidal *et al*., 1999). *Saarina* is characterized by widely spaced divisions, in some species with a distinct distal flarings in each division. A morphological similarity between *Saarina* and *Cloudina* has been repeatedly noted, most recently by Selly *et al*. (2019). *Sabellidites cambriensis* has a stratigraphic range largely restricted to the basal Fortunian, which suggests a Cambrian age for the upper part of the Ibor Group, as supported by trace fossils (see Álvaro *et al*., 2019). The base of the San Lorenzo Formation is recognized, a short distance to the west, by the occurrence of pinkish conglomerates (Fig. 8D) and sandstones. As a result, we interpret the base of the San Lorenzo Formation eroding, at least, the Arrocampo Formation and the upper member of the Villarta Formation in this area.

STOP 9. Estrecho de la Peña Amarilla – Guadarranque Syncline

Location. From Stop 8 return to Alía, drive east on EX-102 for about 8 km to enter a pass through “Sierra de Guadalupe”. Two areas for parking and observations are present on the left hand side.

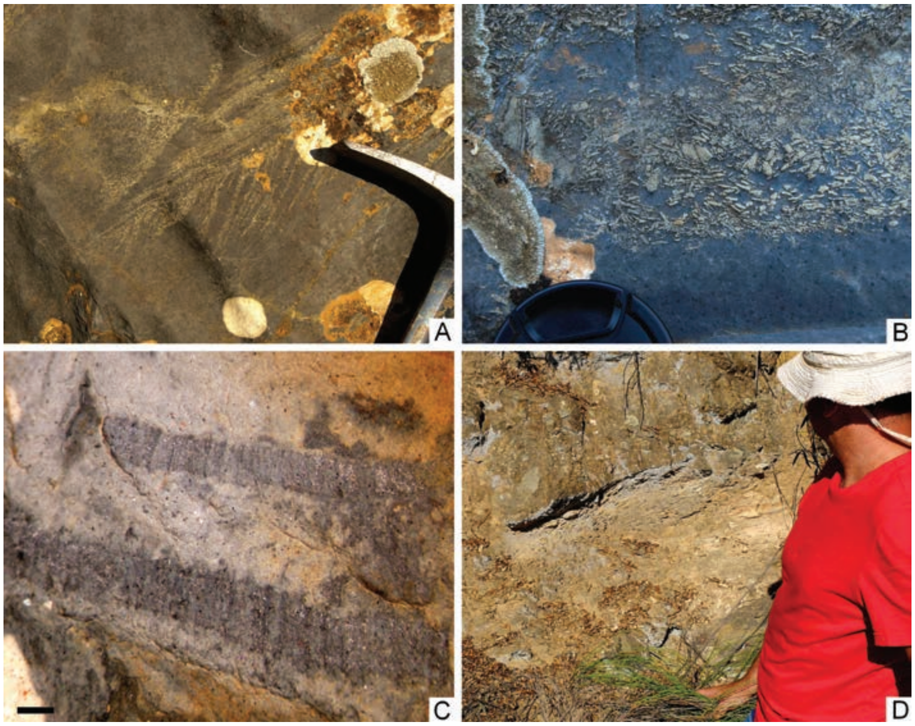

Figure 8.—Lower member of the Villarta Formation, west of La Calera village. A-B. Superposition of trough cross-laminated sets highlighted by intraformational millimetre-scale subangular intraclasts. C. Sabelliditids (*Saarina* sp.) from the middle member of the Villarta Formation; scale bar = 1 mm. D. Unconformable contact separating the shales of the Villarta Formation (middle member) from the first conglomerate of the San Lorenzo Formation.

Description. The "Strait of the Yellow Rock" provides impressive views of a landscape strongly shaped by the weathering-resistant Armorican Quartzite. Across the gorge formed by the Jariguela river, Griffon vultures, nesting in the area, are generally seen circling the higher pinnacles. The yellow colour of many rock surfaces is caused by lichens. Toward the northeast, a fine view is offered of the Guadarranque Syncline with the distant mountain range consisting of Amorican Quartzite of the north-east flank of the syncline. The syncline allows observation of Ordovician and Silurian siliciclastic rocks with sandstone-rich units marking gently raised areas. Sedimentary rocks showing influence of the Hirnantian glaciation have been described and this syncline has been the source for the description of a wide range of fossils.

The arthropod trace fossil *Cruziana* can be observed on bed soles in outcrop along the road, with examples of *Cruziana furcifera* and *C. goldfussi,*. Some surfaces are impressive by delicate preservation, both in vertical and horizontal views, of *Cruziana* loops crosscutting other trace fossils (Fig. 9A). This kind of surface brings home how deeply within the sediment were formed some *Cruziana*.

STOP 10. Burrowing the Armorican Quartzite – Las Amoladeras

Location.- This stop at (WGS 84) 39°23'01"N, 05°18'48"W represents a key geological touristic site of the Armorican Quartzite, surrounded by alluvial material close to a major divide which cuts the Santa Lucía Syncline to the north from an extensive development of "rañas" to the south.

Description. *Daedalus* is a highly characteristic trace fossil of the Armorican Quartzite, where it often occurs in great densities to totally dominate the aspect of the strata. It was formed by the gradual displacement of a straight or curved formative vertical elements in a straight or spiralling motion. Among many impressive localities with *Daedalus* in the Central Iberian Zone can be mentioned the "*Daedalus* mega-ichnosite" in the Naturtejo UNESCO Global Geopark in central Portugal (Neto de Carvalho *et al*., 2016) and Fontanarejo, Ciudad Real (Gutiérrez Marco *et al*., 2017). In the Villuercas-Ibores-Jara Geopark localities with well-preserved material of *Daedalus* include that of Risco Carbonero, a location that cannot be accessed

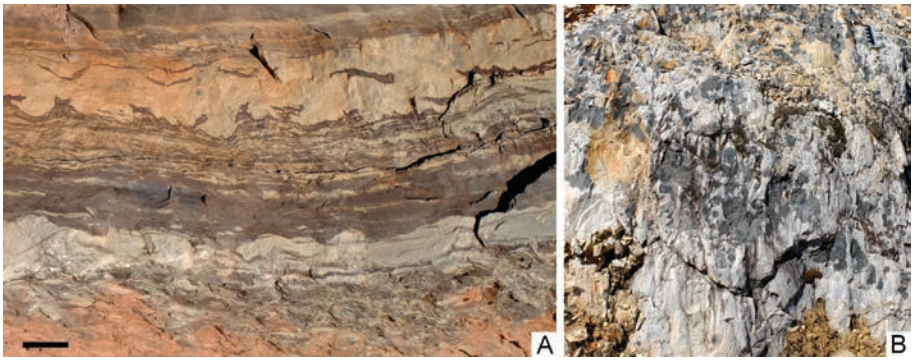

Figure 9.—Trace fossils in the Ordovician Armorican Quartzite. A. Exposure showing bedding and vertical sections of *Cruziana* and other trace fossils at Estrecho de la Peña Amarilla; scale = 5 cm. B. Sandstone completely dominated by *Daedalus* at Las Amoladeras; see centimetric scale at upper right.

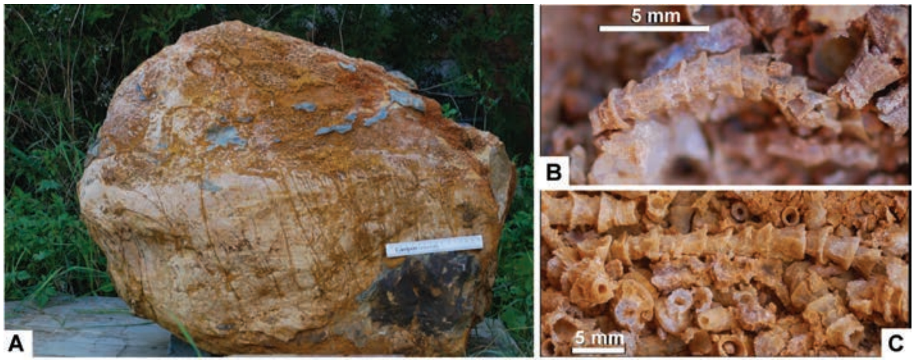

Figure 10.—A. Block from the Membrillar megabreccia that has yielded the types of *Cloudina carinata* Cortijo *et al*., 2010 housed at the Geopark interpretation Centre in Cañamero; scale = 15 cm. B–C. Selected specimens.

by bus. The Las Amoladeras site exhibits numerous specimens of *Daedalus desglandi*, an ichnospecies with relatively broad causative elements forming conical to toroid systems. *D. desglandi* is typically found in the lower but not lowest part of the Armorican Quartzite. Although the outcrop at Las Amoladeras is of relatively limited extension, it has the merit of exposing lateral views and gives a good impression of the density of *Daedalus* (Fig. 9B). The extent of sediment disturbance is particularly impressive when contrasted to the weak bioturbation seen in the pre-Ordovician stops visited during these fieldtrips.

STOP 11. Geopark interpretation Centre in Cañamero.

A visitor centre with information on the Villuercas-Ibores-Jara Geopark is located in Cañamero village. In addition to information on the Geopark, it contains rock samples and fossils from the area. Of special interest to the IMECT congress is that it hosts a large carbonate block containing the type material of *Cloudina carinata* described in Cortijo *et al.* (2010) (Fig. 10A–C). This block originated from the Membrillar megabreccia, the most impressive of the several megabreccias within the Valdelacasa Anticline.

ACKNOWLEDGEMENTS

The authors thank for revisions by I. Rábano (Madrid) and J. Esteve (Bogotá), which helped to improve a previous version. This paper is a contribution to Spanish Project CGL2017-87631-P.

References

Álvaro, J.J.; Cortijo, I.; Jensen, S.; Lorenzo, S.; Palacios, T. & Pieren, A. (2019). Updated stratigraphic framework and biota of the Ediacaran and Terreneuvian in the Alcudia-Toledo Mountains of the Central Iberian Zone, Spain. Estudios Geológicos, 75 (2): e093. https://doi.org/10.3989/egeol.43620.548

Bobrovskiy, I.; Krasnova, A.; Ivantsov, A.; Luzhnaya (Serezhnikova), E. & Brocks, J.J. (2019). Simple sediment rheology explains the Ediacara biota preservation. Nature Ecology & Evolution, 3: 582–589. https://doi.org/10.1038/s41559-019-0820-7

Conteras Sánchez, M.M.; Jensen, S. & Palacios, T. (2006). Sabelidítidos y vendoténidos del Anticlinal de Ibor. In: XXII Jornadas de la Sociedad Española de Paleontología, León. Libro de Resúmenes, 101–103.

Cortijo, I.; Martí Mus, M.; Jensen, S. & Palacios, T. (2010). A new species of *Cloudina* from the terminal Ediacaran of Spain. Precambrian Research, 176: 1–10. https://doi.org/10.1016/j.precamres.2009.10.010

Díez Balda, M.A.; Vegas, R. & González Lodeiro, F. (1990). Part IV. Central Iberian Zone. Structure. In: Pre-Mesozoic Geology of Iberia (Dallmeyer, R.D. & Martínez García, E. eds.). Springer-Verlag, Berlin, 172–188.

García Hidalgo, J.F. (1985). Estratigrafía y sedimentología del Alcudiense Superior en los anticlinorios de Ibor y Navezuelas-Robledollano. Seminarios de Estratigrafía, 12: 1–190.

Gehling, J.G. (1999). Microbial mats in Terminal Proterozoic siliciclastics: Ediacaran death masks. Palaios, 14: 40–57. https://doi.org/10.2307/3515360

Gutiérrez-Marco, J.C.; Lorenzo, S. & Sá, A.A. 2017. Fontanarejo (Ciudad Real) una localidad icnológica excepcional del Ordovícico Inferior en los Montes de Toledo meridionales. Geogaceta, 62: 47–50.

Herrero, M.J.; Martín-Pérez, A.; Alonso-Zarza, A.M.; Gil-Peña, I.; Meléndez, A. & Martín-García, R. (2011). Petrography and geochemistry of the magnesites and dolostones of the Ediacaran Ibor Group (635 to 542 Ma), Western Spain: Evidences of their hydrothermal origin. Sedimentary Geology, 240: 71–84. https://doi.org/10.1016/j.sedgeo.2011.08.007

Hufnagel, H. (2008). Kohlige Makroreste aus dem Oberen Proterozoikum der Ibor Antiklinale (Prov. Cáceres, Spanien). In: La Vida en el Terciario: del impacto del meteorito al origen del hombre. X Jornadas Aragonesas de Paleontología (Arcega Conesa, C. & Lahoz Gimeno, J. eds). Institución Fernando el Católico ed.; Zaragoza, 227–260.

Jensen, S.; Droser, M.L. & Gehling, J.G. (2006). A critical look at the Ediacaran trace fossil record. In: Neoproterozoic Geobiology and Paleobiology (Xiao, S. & Kaufman, A.J.; eds). Springer, Berlin, 115–157. https://doi.org/10.1007/1-4020-5202-2_5

Jensen, S.; Palacios, T. & Martí Mus, M. (2007). A brief review of the fossil record of the Ediacaran-Cambrian transition in the area of Montes de Toledo-Guadalupe (Spain). In: The Rise and Fall of the Ediacaran Biota (Vickers-Rich, P. & Komarover, P. eds). Geological Society, London, Special Publications, 286: 223–235. https://doi.org/10.1144/SP286.16

Martín Pérez, A.; Martín-García, R. & Alonso-Zarza, A.M. (2012). Diagenesis of a drapery speleothem from Castañar Cave: from dissolution to dolomitization. International Journal of Speleology, 41: 251–266. https://doi.org/10.5038/1827-806X.41.2.11

Martín Pérez, A.; Alonso-Zarza, A.M.; La Iglesia, A. & Martín-García, R. (2015). Do magnesian clays play a role in dolomite formation in alkaline environments? An example from Castañar Cave (Spain). Geogaceta, 57: 15–18.

MacGabhann, B.A.,Schiffbauer, J.D.; Hagadorn, J.W.; Van Roy, P.; Lynch, E.P.; Morrison, L. & Murray, J. (2019). Resolution of the earliest metazoan record: Differential taphonomy of Ediacaran and Paleozoic fossil molds and casts. Palaeogeography, Palaeoclimatology, Palaeoecology, 513: 146–165. https://doi.org/10.1016/j.palaeo.2018.11.009

Neto de Carvalho, C.; Baucon, A. & Gonçalves, D. (2016). *Daedalus* mega-ichnosite from the Muradal Mountain (Naturtejo Global Geopark, Central Portugal): between the Agronomic Revolution and the Ordovician Radiation. Comunicações Geológicas, 103 (especial 1): 59–70.

Nozal Martín, F. (1985). Mapa Geológico de España a escala 1: 50.000 (2ª Serie). Hoja 681 - Castañar de Ibor. IGME, Madrid.

Orejana, D.; Martínez, E.M.; Villaseca, C. & Andersen, T. (2015). Ediacaran-Cambrian paleogeography and geodynamic setting of the Central Iberian Zone: constraints from coupled U-Pb-Hf isotopes of detrital zircons. Precambrian Research, 261: 234–251. https://doi.org/10.1016/j.precamres.2015.02.009

Palacios, T.; Eguíluz, L.; Apalategui, O.; Jensen, S.; Martínez-Torres, L.; Carracedo, M.; Gil Ibarguchi, J.I.; Sarrioiandía, F. & Martí Mus, M. (2013). Mapa Geológico de Extremadura a escala 1:350.000. Servicio Editorial de la Universidad del País Vasco (UPV/EHU), Bilbao.

Selly, T.; Schiffbauer, J.D.; Jacquet, S., Smith, E.F.; Nelson, N.N.; Andreasen, B.D.; Huntley, J.W.; Strange, M.A.; O'Neil, G.; Thater, C.A.; Bykova, N.; Steiner, M.; Yang, B. & Cai, Y. (2019). A new cloudinid assemblage from the terminal Ediacaran of Nevada. Journal of Systematic Palaeontology, https://doi.org/10.1080/14772019.2019.1623333

Tarhan, L.G.; Hood, A.; Droser, M.L.; Gehling, J.G. & Briggs, D.E.G. (2016). Exceptional preservation of soft-bodied Ediacara biota promoted by silica-rich oceans. Geology, 44: 951–954. https://doi.org/10.1130/G38542.1

Vidal, G.; Jensen, S. & Palacios, T. (1994). Neoproterozoic (Vendian) ichnofossils from lower Alcudian strata in central Spain. Geological Magazine, 131: 169–179. https://doi.org/10.1017/S0016756800010700

Vidal, G.; Palacios, T.; Moczydłoska, M. & Gubanov, A.P. (1999). Age constraints from small shelly fossils on the early Cambrian terminal Cadomian Phase in Iberia. GFF, 121: 137–143. https://doi.org/10.1080/11035899901212137