Conodont faunas from Portugal and southwestern Spain

Part 5. Lower Carboniferous conodonts at Santa Olalla del Cala (Spain)

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Boogaard, M. van den & F. Vázquez Guzmán. Conodont faunas from Portugal and southwestern Spain. Part 5. Lower Carboniferous conodonts at Santa Olalla del Cala (Spain). — Scripta Geol., 61: 1 - 8, 3 figs., Leiden, August 1981.

The conodont faunule of a limestone deposit at Santa Olalla del Cala (province of Huelva, Spain) is described. The age of the limestones, hitherto unknown, appears to be either Late Tournaisian or Early Viséan.

Se describe la fauna de conodontos de unas calizas existentes en la Hoja de Santa Olalla del Cala (Huelva, España). La edad de las calizas se considera Turnaisiense Superior o Viseense Inferior.

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Introduction

On the southwestern flank of the large Olivenza-Monesterio anticlinorium, limestones with crinoid remains were discovered and mapped by one of us (Vázquez Guzmán, 1967, 1968). This area is notably poor in fossils.

I. Quintero of the Instituto Geológico y Minero de España (I.G.M.E.) considered a late Middle Devonian age for these limestones most likely, because of the presence of *Cyathocrinus pentagonus?* Goldf. In order to verify these results and to define their stratigraphic position more precisely, these crinoidal limestones have now been restudied for their microfossil content, in particular conodonts.

The limestone occurrences were mainly mapped in the area covered by the Santa Olalla del Cala and Almadén de la Plata sheets of the Geological Map of Spain (1:50 000, nrs 918, 919).

Geological setting

The southwestern flank of the large Olivenza-Monesterio anticlinorium is composed of Precambrian, Cambrian, Ordovician, Silurian, Devonian, and Carboniferous sediments, folded by Hercynian orogeny. The metamorphism and granitization affected predominantly the scarce subsided parts of the anticlinorium. Some magmatic events resulted in mineral deposits of economic interest. Among these may be mentioned the skarn-type metamorphic iron deposits in Cala (Huelva); and the volcanic-sedimentary type Cu-Pb-Zn deposits in La Nava (Huelva). To the south the volcanogenic sulphide deposits of the Palaeozoic Iberian Pyrite Belt are found.

The southwestern flank is considered to consist of two structural features (Vázquez Guzmán & Fernández Pompa, 1976): the Villanueva del Fresno-Santa Olalla del Cala axis, a long synclinal structure with allochtonous or para-autochtonous units belonging to important isoclinal folded phases of southwards vergency; and the Aroche-Aracena-Almadén de la Plata axis, corresponding to a large antiformal structure trending NW-SE, and E-W east of the Zufre-Santa Olalla del Cala fault (Fig. 1).

The limestones, the conodonts of which are described in the present note, are intercalated in a flysch sequence of slates and greywackes, in the easternmost segment of the Villanueva del Fresno-Santa Olalla del Cala synclinal structure. The stratigraphy and structural position of this sequence in relation with the 'El Cubito' unit is going to be studied by I.G.M.E. This latter unit, including the volcanic rocks of the Rivera de Huelva (Fig. 2), is supposed to be a shearing zone of Precambrian-Silurian sediments (Apalategui et al., 1981). This is a stratigraphically and tectonically extremely complex area.

Fig. 1. Map showing the most important structural axis in SW Spain (Vázquez Guzmán & Fernández Pompa, 1975, in Vázquez Guzmán & Fernández Pompa, 1976). 1 = Llera - Valencia de las Torres axis; 2 = Zafra - Alanis axis; 3 = Olivenza - Monesterio - El Pedroso axis; 4 = Villanueva del Fresno - Santa Olalla del Cala axis; 5 = Aroche - Aracena - Almadén de la Plata axis.

Postpalaeozoic deposits
Posttectonic granitic rocks
Syntectonic granitic rocks
Gabbros and epidiorites
Volcanic rocks
Carboniferous
Devonian - Carboniferous
Devonian
Ordovician - Silurian
Cambrian { Carbonates / Detritic sediments
Infracambrian
Fault
Concordant contact
Discordant contact
Tectonic contact
Thrust fault
Mine in operation
Abandoned mine
area of sampling
PORTUGAL
ZAFRA
LLERA
VALENCIA DE LAS TORRES
ALANIS
MONESTERIO
OLIVENZA
VILLANUEVA DEL FRESNO
MINA CABRA BAJA
MINA MONCHI
MINA PILAR
APOCHE
STA OLALLA DEL CALA
ALMADEN DE LA PLATA
EL PEDROSO
0 5 10 15 20 25 km

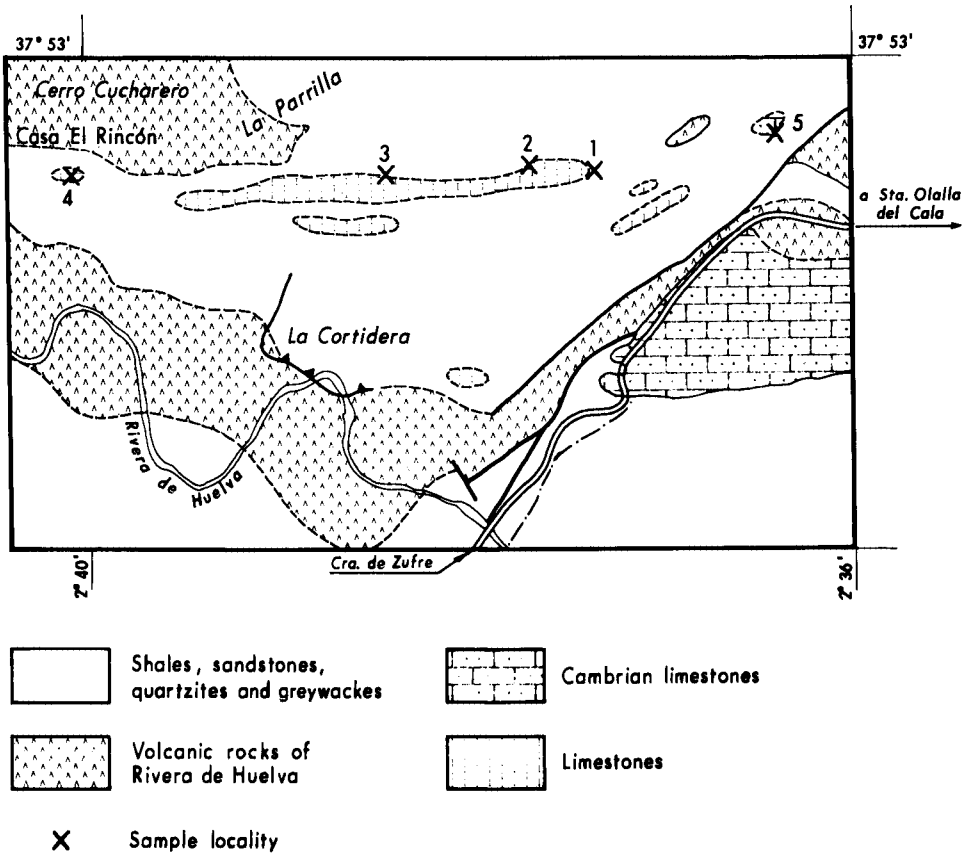

Fig. 2. Localities of the samples in the area of Santa Olalla del Cala.

The limestone outcrops

In the southern region of the Sierra Cucharera, near the confluence of Rivera de Huelva and the Santa Olalla del Cala-Zufre road, there are good limestone outcrops from which the samples now investigated for their conodont content (indicated in Fig. 2) were collected by one of us (F.V.G.).

There are also other good limestone outcrops, south of the Santa Olalla granitic stock, between km 2 and 3 of the road from Santa Olalla to Almadén de la Plata, and at several other places towards the east.

The limestone lenses are intercalated in a flysch sequence of slates and greywackes; the thickness of the lenses being variable. Along the old bridle path from Zufre to Cala, the limestone lenses are about 40 m thick but south of Casa El Rincón the thickness is only 4 m. They are dark grey with abundant crinoid remains. Some limestone lenses are almost in contact with the volcanic rocks of Rivera de Huelva.

Palaeontology

The conodont content of the Santa Olalla limestones is very low. Six samples with a total weight of 110.2 kg have been processed yielding about a dozen identifiable specimens and about thirty small fragments. The sample localities are indicated in Fig. 2. The 1975 sample comes from about the same locality as sample 1976/3.
Sample 1975 (15.1 kg) some conodont fragments, i.a. possibly a fragment of *Gnathodus cuneiformis.*
Sample 1976/1 (14.2 kg) no fauna.
Sample 1976/2 (13.5 kg) some fragments, i.a. one of *Mestognathus beckmanni.*
Sample 1976/3 (23.1 kg) 8 specimens of *Mestognathus beckmanni,* 1 of *Protognathodus cordiformis,* 3 of *Hindeodella segaformis* and some fragments.
Sample 1976/4 (23.3 kg) no fauna.
Sample 1976/5 (21 kg) some fragments, i.a. possibly one of *Gnathodus cuneiformis.*

The specimens are stored in the Rijksmuseum van Geologie en Mineralogie, Leiden, The Netherlands, with registration numbers RGM 296158 - 296164.

Hindeodella segaformis Bischoff, 1957
Fig. 3 B.

1957 *Hindeodella segaformis* n. sp. — Bischoff, pp. 28 - 29, pl. 5, figs. 40, 41, 43.

The specimens are severely damaged. Nevertheless the pronounced, angular zig-zag bending of the bar, with a larger denticle on the apex of each bend could be observed.

The species first appears in the Upper *G. typicus* Zone and disappears in the upper part of the *S. anchoralis - D. latus* Zone (Lane et al., 1980).

Mestognathus beckmanni Bischoff, 1957
Fig. 3 A.

1957 *Mestognathus beckmanni* n. sp. — Bischoff, p. 37, pl. 2, figs. 4, 5, 6, 8, 9.

The specimens conform to the description given by Bischoff. The carina is a low ridge which meets the antero-lateral inner edge of the platform at a narrow angle, more or less at a point opposite to the larger denticle of the outer lateral blade. The anterior part of the element does not show the divergence of the anterior blade and the antero-inner edge of the platform typical for *M. bipluti.*

The stratigraphic range of *M. beckmanni* is not exactly known. According to many authors its first appearance is directly above the *S. anchoralis - D. latus* Zone. Voges (1959) found *M. beckmanni* at the base of his *anchoralis* Zone. Lane et al. (1980) place this occurrence provisionally in the top part of the *G. typicus* Zone, somewhat below the base of the *S. anchoralis - D. latus* Zone.

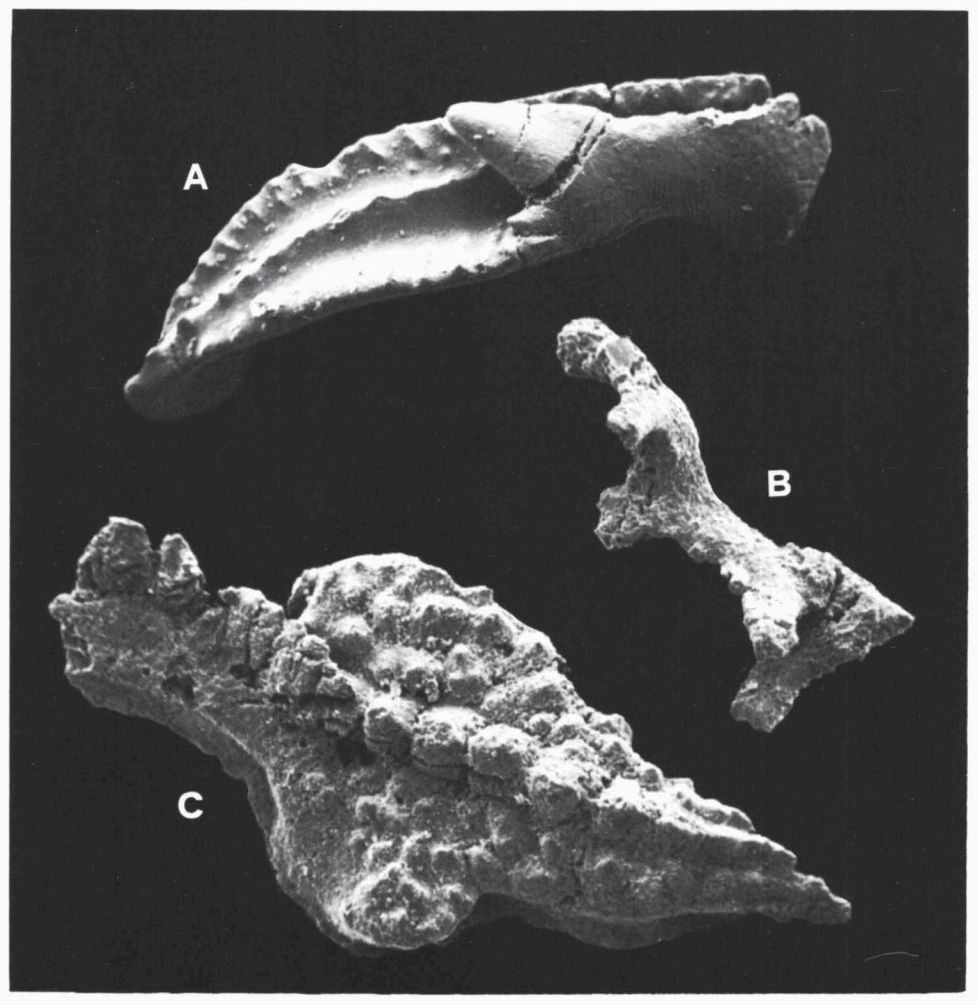

Fig. 3 A. *Mestognathus beckmanni* Bischoff, 1957. Oblique oral view, × 75. Specimen RGM 296 164a, sample 1976/3.
B. *Hindeodella segaformis* Bischoff, 1957. Oblique oral view, × 100. Specimen RGM 296 164b, sample 1976/3.
C. *Protognathodus cordiformis* Lane, Sandberg & Ziegler, 1980. Oral view, × 100. Specimen RGM 296 164c, sample 1976/3.

Protognathodus cordiformis Lane, Sandberg & Ziegler, 1980
Fig. 3 C.

1980 *Protognathodus cordiformis* n. sp. — Lane, Sandberg & Ziegler, p. 134, pl. 3, figs. 12 - 16.

The only specimen very much resembles the specimens shown by Lane et al. and conforms to their description.

The stratigraphic range of the species is according to Lane et al. Upper *G. typicus* Zone upto about the middle of the *S. anchoralis* - *D. latus* Zone.

Age of the limestone

Because of the occurrence of *Protognathodus cordiformis* and *Hindeodella segaformis* the age could be Late Tournaisian (Upper *G. typicus* Zone and/or Lower *S. anchoralis - D. latus* Zone). *Mestognathus beckmanni,* although reported from older strata (Lane et al., 1980), is typical for the *G. texanus* Zone (= Early Viséan). We thus must consider the possibility that indeed *M. beckmanni* already appears near the base of the *S. anchoralis - D. latus* Zone in which case the age of the Santa Olalla limestone is Late Tournaisian or the alternative that the limestone is Early Viséan in age and that *Pr. cordiformis* and *H. segaformis* represent reworked conodonts. Consequently as long as the exact range of *M. beckmanni* is not established it cannot be decided whether the age of the Santa Olalla limestone is Late Tournaisian or Early Viséan.

Its age may approximately be the same as that of the other known Lower Carboniferous limestone deposits in the Pyrite Belt, those at Carvoeiro and Sotiel Coronada. The age of the limestone at Carvoeiro is Late Tournaisian ranging into Early Viséan because of the occurrence of *Scaliognathus anchoralis* and *Mestognathus beckmanni* (van den Boogaard, 1963). The limestone of Sotiel Coronada contained *Gnathodus cuneiformis, G. semiglaber, G. typicus, Geniculatus claviger,* and *Pseudopolygnathus pinnatus* (van den Boogaard & Schermerhorn, 1975). These authors considered the Sotiel Coronada limestone to be of Early Viséan age but now that Lane et al. (1980) have established the ranges of the important conodont species more accurately we can say that its age is Late Tournaisian (Upper *G. typicus* Zone up to about the top of the *S. anchoralis - D. latus* Zone).

Palaeoecology

According to Austin (1976) conodonts with a lateral anterior blade like *Mestognathus* are found in sediments deposited in a shallow near shore high-energy environment. Also Von Bitter (1976) reports *Mestognathus* from units indicative of high-energy conditions. The Santa Olalla limestone in which *Mestognathus* is the dominant conodont genus thus may be considered a deposit in a shallow near shore high-energy environment. It therefore differs from the limestones at Carvoeiro (van den Boogaard, 1963) and Sotiel Coronada (van den Boogaard & Schermerhorn, 1975) which are deeper water deposits as they contain faunas in which *Gnathodus* is dominant and that genus generally indicates deeper water (Austin, 1974, 1976; Von Bitter, 1976).

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Manuscript received 26 May 1981.