Conodont faunas from Portugal and southwestern Spain

Part 3. Carboniferous conodonts at Sotiel Coronada

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Samples from limestones occurring stratigraphically between and near to the pyrite lenses at Sotiel Coronada in the Spanish Pyrite Belt yielded several tectonically deformed conodonts of Early Visean age.

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Introduction

Sotiel Coronada is an old pyrite mine in the Spanish Pyrite Belt (the location is shown in Fig. 1 of the preceding note 'A Famennian conodont fauna at Cabezas del Pasto'), where the ore occurs intercalated in slates which also contain limestone lenses. To date the mineralization these limestones were sampled in exposures and from drillcores from a recent vertical borehole sunk by the Empresa Nacional 'Adaro' de Investigaciones Mineras, S.A.

The presence of limestones at Sotiel has been known for a long time. Thus, Hereza (1926) remarks, 'Il existe dans les mines de Sotiel, aux environs de l'ermitage de la Coronada, un banc de ces calcaires qui ont dû servir à la fabrication des mortiers employés dans la construction du pont sur l'Odiel.' Until 1971 they were correlated with Devonian limestones outcropping elsewhere in the Pyrite Belt although the existence of Carboniferous limestones has been known since 1963 (van den Boogaard, 1963).

In 1971 we received the limestone samples from the mine and its surroundings. They yielded a small amount of conodonts which had considerably suffered from tectonic deformation. A first identification showed that the faunas contained *Gnathodus semiglaber* and *Gnathodus* sp. The age of the limestone therefore would be between Late Tournaisian and Late Visean. This information has subsequently been published by Armengot de Pedro & Vázquez Guzmán (1972). A reinvestigation of broken specimens showed that the fauna also contained *Geniculatus claviger* and *Pseudopolygnathus triangulus pinnatus*. One of the authors (M. v. d. B.) visited Dr E. Groessens of the Belgian Geologic Survey at Brussels and could with his help identify some of the specimens of *Gnathodus* sp. These showed to be *Gnathodus cuneiformis* and *G. typicus*. Consequently the age of the limestone will be Early Visean.

Acknowledgements

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Geological setting

The general stratigraphy of the Iberian Pyrite Belt is referred to in the preceding note, and discussed at length in Schermerhorn (1971a). At Sotiel, the Volcanic-Siliceous Complex (VS) crops out as slates enclosing the orebodies, and as felsic and mafic volcanics. Culm is present farther south, and the Phyllite-Quartzite Group (PQ) appears farther north. The Sotiel region lies in the south flank of a large anticlinorium with a PQ core mantled by VS, which stretches far eastwards. West of Sotiel the anticlinorium plunges below Culm, to emerge again near Tharsis in the eastern part of the Puebla de Guzmán anticlinorium (see preceding note).

In recent years much geological mapping, prospection and development work has been done at Sotiel by the E.N. 'Adaro' and the accompanying map, Fig. 4, represents the results of their survey.

A sequence of well-bedded submarine felsic tuffs, showing a variety of sedimentary structures (mostly graded bedding with load casts), passes conformably up — by means of a rapid transition over dust tuffs — into dark grey carbonaceous slates and phyllites, enclosing ore and some other rock types. The slate outcrop containing the limestone lenses C56 and C57 south of Sotiel (Fig. 4) shows northerly to northeasterly dips. To the north lies the slate outcrop containing the orebodies at Sotiel. The surface rocks are medium to dark grey slates and phyllites, sometimes silty, often strongly sheared. They enclose lenses of quartzite and quartzwacke, and locally conglomeratic layers of rounded quartzite and siltstone pebbles in a phyllitic matrix (similar rocks were cut in boring S42-3, as shown in Fig. 5). The pyrite lenses, worked since Roman times, appear not far above the base of the north-dipping slaty sequence, and are interbedded with limestone levels. As can be seen in Fig. 4, the limestone occurrences in the slate outcrop to the south are likewise confined to a level not far above the felsic volcanics. The implications of the association of pyritic orebodies as stratiform volcanic-derived resediments with bioclastic limestone are discussed in Schermerhorn (1971b).

Sample C56 (RGM 172 509) was taken from a small lens, about 20 cm thick and less than 10 m long, composed of medium grey impure sandy limestone, enclosed in phyllites.

C57 (RGM 172 510) is from a limestone zone about 250 m long, which has been quarried on a small scale. It consists of limestone lenses up to 60 cm thick,

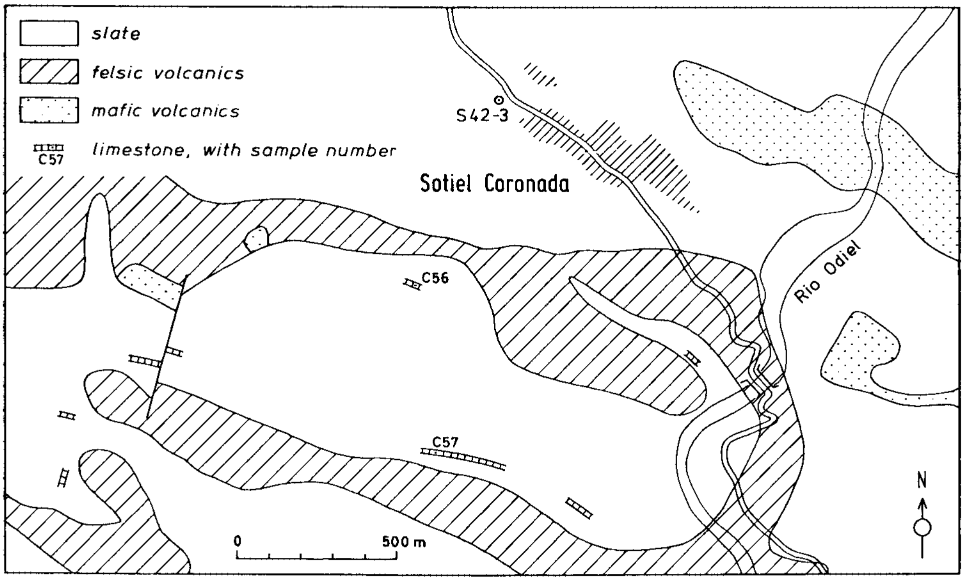

Fig. 4. General geology of the Sotiel region, after data (in 1972) of the Empresa Nacional 'Adaro'.

separated by phyllite, and dipping about 25° N. The rock is a medium grey, somewhat sandy, medium to coarse-grained calcarenite.

C58, C59 (RGM 172 512), C60 (RGM 172 513) and C61 (RGM 172 514) were taken between 212 m and 215.60 m depth in borehole S42-3. C58 (RGM 172 709) was sliced for microscopical examination and the other samples, including later additional material from 210.32-213 m depth (RGM 172 522), were investigated for their microfossil content. The rocks are medium grey, medium to coarse-grained, somewhat sandy calcarenites, rather sheared. Thin section C58 shows a bioclastic calcarenite containing crinoid fragments.

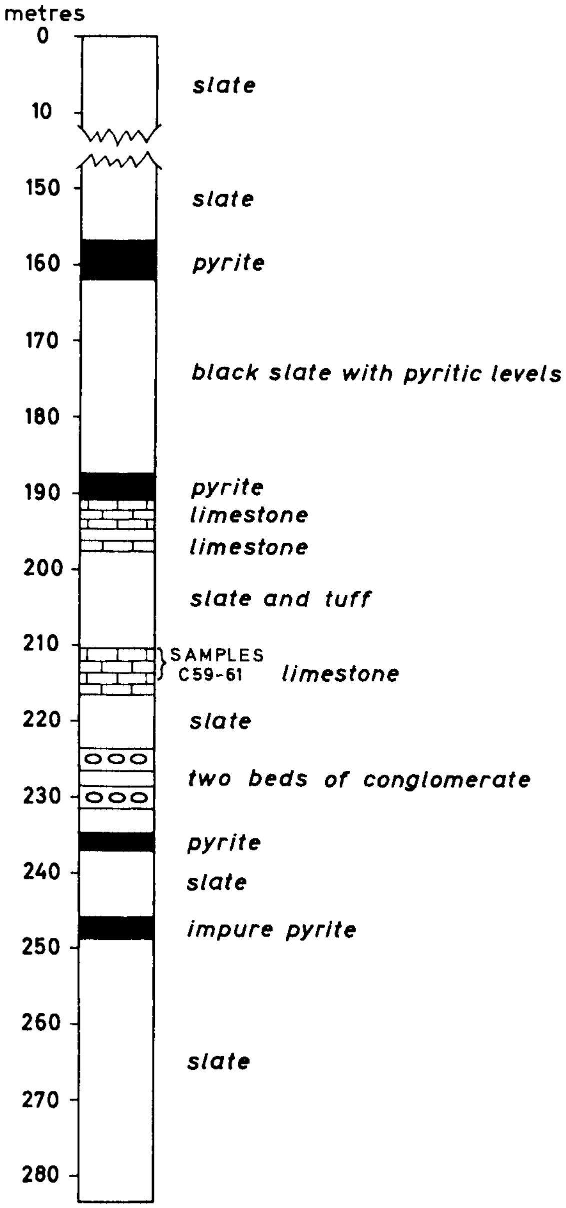

Fig. 5. Section of the vertical borehole S42-3 (E.N. 'Adaro'). Location shown in Fig. 1.

Fossil content of the samples

Apart from some crinoid fragments only conodonts were encountered. The latter are heavily damaged by tectonic deformation and for an important part broken into small fragments. Some specimens, however, were in a somewhat better shape and could be identified.

Sample C57 (5700 g) contains: 1 specimen of *Gnathodus cuneiformis* Mehl & Thomas, 1947, 16 specimens of *Gnathodus semiglaber* Bischoff, 1957, 2 specimens of *Gnathodus typicus* Cooper, 1939, 1 specimen of *Geniculatus claviger* (Roundy, 1926), 1 specimen of *Pseudopolygnathus triangulus pinnatus* Voges, 1959, and 1 specimen of *Metalonchodina bidentata* (Gunnell, 1931). Sample C56 (5000 g) contains 2 specimens of *Gnathodus typicus* Cooper, 1939. Samples C59, C60 and C61 (together 2200 g) yielded unrecognizable fragments, but RGM 172 522 (4900 g) (also from borehole S42-3) contains 4 specimens of *Gnathodus typicus* Cooper, 1939.

The specimens of *Gnathodus semiglaber* (see Pl. 18, fig. 3) show the following characteristics: A somewhat convex parapet parallels the carina on the narrow inner side of the platform. The outer side of the platform bears some scattered nodes or a row of low nodes. The carina widens posteriorly and coalesces with the parapet. The specimens of *Gnathodus typicus* (see Pl. 18, figs. 1, 2) seem to be highly similar to those described by Thompson & Fellows (1969) and Marks & Wensink (1970). They are tectonically deformed but still show the single row of nodes or parapet which at its posterior end is slightly broader than anteriorly and the outer margin of which slightly diverges outward towards the posterior. The carina widens posteriorly and the nodes tend to broaden into transverse ridges across the carina. The outer side of the platform seems to be smooth. The specimen of *Pseudopolygnathus triangulus pinnatus* (see Pl. 18, fig. 4) misses its free blade, but the platform seems to be identical to that of specimens figured by Voges (1959, Pl. 35, figs. 1, 2).

Age of limestones

According to Marks & Wensink (1970) *Gnathodus typicus* already occurs in the upper part of the *Scaliognathus anchoralis* zone. *Gnathodus cuneiformis* extends into the lower part of the *Gnathodus typicus* zone, which according to Marks & Wensink, 1970 probably is equivalent to the *Scaliognathus-bilineatus* interregnum. Thus the fauna of sample C57 will belong to the upper part of the *Scaliognathus anchoralis* zone or the lower part of the *Gnathodus typicus* zone. The joint occurrence of *Pseudopolygnathus triangulus pinnatus* and *Geniculatus claviger* even suggests an age near the boundary between both zones. In chronostratigraphical terms the age is considered to be Early Visean. Samples C56 and RGM 172 522 probably have about the same age as C57 as they also contain *Gnathodus typicus*.

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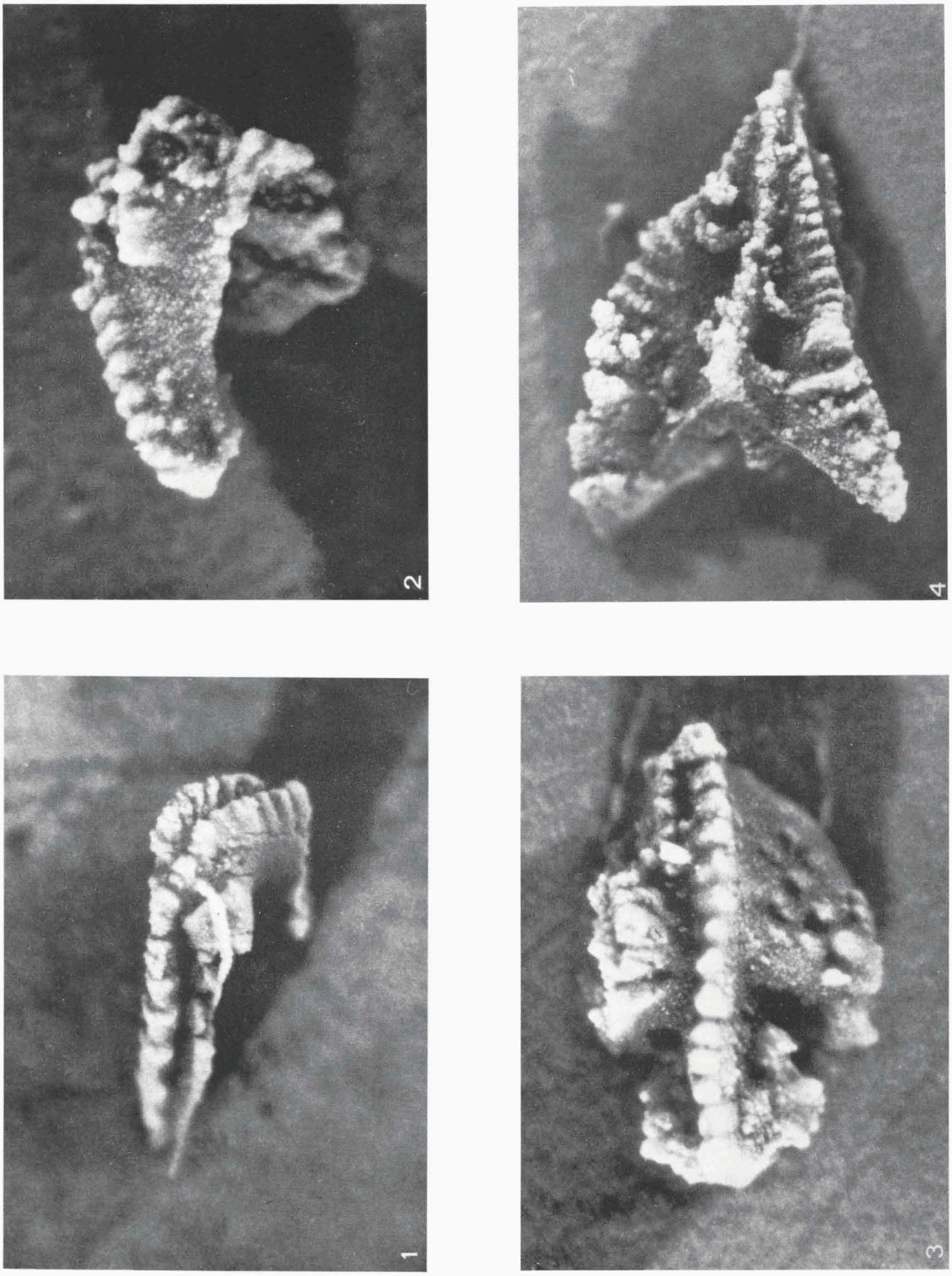
Plate 18

Fig. 1. *Gnathodus typicus* Cooper. Oblique view of oral side of specimen RGM 172 724 from sample RGM 172 522, 70 x.

Fig. 2. *Gnathodus typicus* Cooper. Lateral view of specimen RGM 172 717 from sample RGM 172 510, 85 x.

Fig. 3. *Gnathodus semiglaber* Bischoff. Oral view of specimen RGM 172 711 from sample RGM 172 510, 90 x.

Fig. 4. *Pseudopolygnathus triangulus pinnatus* Voges. Oral view of specimen RGM 172 719 from sample RGM 172 510, 60 x.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