Carboniferous and Triassic conodonts from Syrian boreholes

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ABSTRACT - A sparse but important collection of conodonts recovered from four boreholes in north-eastern and central Syria contains Neogondolella monbergensis, which is the first record of Triassic conodonts from Syria. The Carboniferous rocks are characterised by species of Gnathodus which indicate the presence of late Tournaisian to late Viséan strata.

THE CARBONIFEROUS OF SYRIA

Prior to 1960, knowledge of the Carboniferous rocks of Syria was very limited partly because strata of this age are poorly exposed. The earliest reference to the Carboniferous rocks of Syria was by Dubortret (1932), who reported the occurrence of Lower Carboniferous strata in the Abd-Al-Aziz mountain region. Later Weber (1964), Wolfart (1967) and Ponikarov (1969) described the deposits of the Carboniferous System in Syria. Yankauskas (1976), with the help of geologists from the Syrian Petroleum Company, studied the microfossils of the Palaeozoic formations, which had been penetrated at depth in different parts of Syria. Acritarchs in particular were used to determine the geological age of these deposits. Stoppel (1970), reported the occurrence of conodonts in Lower Carboniferous rocks outcropping in the Abd-Al-Aziz mountain. This is the only previously published record of conodonts in Syria.

The only outcrop of Tournaisian rocks in the whole of Syria occurs in the Abd-Al-Aziz anticline, within the Twal-el-Aba-Sinjar rampart. It consists of 21 m of thinly stratified marine shale, with intercalations of sandstone and limestone. The rocks occur as a fault-bounded block forming a dismembered unit surrounded by Cretaceous beds. They are fossiliferous containing the brachiopods Chonetes sp., Laguessianus sp., Spirifer aff. S. tourna- censis and Buxtonia scabricula. The exact nature of the outcrop is not certain, but it is most probable that the Carboniferous represents an exotic block, or an upthrown block within Cretaceous rocks.

In other parts of Syria, the Carboniferous deposits are unexposed being overlain by a thick sedimentary cover of deposits of Mesozoic-Cenozoic age. Consequently, a number of deep boreholes have been drilled in different areas to enable the buried formations to be studied. Study of the borehole data has established that marine Lower Carboniferous deposits occur at depth over most of Syria with a thickness of up to 1100 m in the north-eastern part (in the Markada Borehole - 101). They become thinner towards the central part, being about 338 m in the Dalaa Borehole and 310 m in the Doubayat Borehole. Lower Carboniferous deposits are absent from the extreme southern portion of the country. The deposits show regional variations in facies. In the southern and central part of Syria (in the Tenf and Swab Boreholes), they are represented by sandstones, intercalated with grey argillites and cream coloured dolomites with fragments of coal and fossil wood. These rest unconformably on Silurian rocks at Tenf and on Ordovician rocks at Swab. They are overlain unconformably by carbonates of Upper Cretaceous age. In the northeast of Syria (in the Markada - 101 and El-Bowab Boreholes) the Lower Carboniferous is represented by massive, black, schistose, argillites with intercations of dolomite, which rest unconformably on Silurian rocks at Markada and on Ordovician rocks at El-Bowab. They are overlain unconformably by Triassic deposits. Wolfart (1967) found spores in the boreholes at El-Bowab and Al-Barde, which indicated that the Lower Carboniferous is conformably overlain by rocks of Upper Carboniferous (Stephanian - Westphalian and Namurian) age.

THE LOCATION OF THE BOREHOLES AND SAMPLES PROCESSED FOR CONODONTS

Samples from boreholes at four selected localities in north-eastern and central Syria (Fig. 1) were studied in an attempt to establish a biostratigraphic zonation utilising conodonts.

The boreholes studied were those of Swab-1, Markada -101, Jbissa-207 and Roumylan-6. The numbering system follows that employed by the Syrian Petroleum Company.

I - THE SWAB BOREHOLE Swab is located to the south of the city of Dier-Al-Zor. Four cores were taken from different horizons at the depths indicated. The samples studied were as follows:-
| Core 5: | 1251.85 m | Light grey siltstone with very thin streaks of dark grey shale. |
|--------|------------|-------------------------------------------------------------|
| (0.9 Kg) | 1296.80 m | Dark grey, thin laminated fossiliferous shale.               |
| Core 6: | 1297.60 m | Dark grey, coarse, crystalline dolomite intercalated with dark grey laminated shale, containing conodonts. |
| (5.2 Kg) | 1298.70 m | 1330.30 m Dark grey, coarse, crystalline dolomite, with pure crystalline barite. |
| Core 7: | 1379.95 m | Light grey microcrystalline sandstone cemented by dolomite. |
| (5.05 Kg) | 1380.90 m | 1382.90 m sandstone cemented by dolomite.                   |
|        |            | 1384.65 m Light grey sandstone cemented by silicified material, interbedded with very thin beds of black micaceous shale. |
|        |            | 1386.80 m Light grey sandstone cemented by silicified material, interbedded with very thin beds of black micaceous shale. |
|        | 1383.75 m | Light grey sandstone cemented by silicified material, interbedded with very thin beds of black micaceous shale. |
|        |            | 1491.85 m White sandstones with siliceous cement.           |
| Core 8: | 1496.80 m | 1499.70 m Light grey sandstone intercalated with thin streaks of micaceous shale. |
| (3.25 Kg) | 1493.70 m | 1498.75 m Dark grey laminated shale.                        |
|        | 1498.75 m | 1501.85 m Light grey microcrystalline sandstone cemented by dolomite. |
|        |            | 1503.80 m Light grey sandstone cemented by silicified material, interbedded with very thin beds of black micaceous shale. |
|        |            | 1506.80 m Light grey sandstone cemented by silicified material, interbedded with very thin beds of black micaceous shale. |
|        |            | 1508.75 m Light grey sandstone cemented by silicified material, interbedded with very thin beds of black micaceous shale. |
|        |            | 1511.85 m Light grey microcrystalline sandstone cemented by dolomite. |
|        |            | 1514.70 m Light grey sandstone cemented by silicified material, interbedded with very thin beds of black micaceous shale. |
|        |            | 1516.75 m Light grey sandstone cemented by silicified material, interbedded with very thin beds of black micaceous shale. |
|        |            | 1519.80 m Light grey microcrystalline sandstone cemented by dolomite. |
|        |            | 1521.70 m Light grey sandstone cemented by silicified material, interbedded with very thin beds of black micaceous shale. |
|        |            | 1523.75 m Light grey sandstone cemented by silicified material, interbedded with very thin beds of black micaceous shale. |

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**Fig. 1.** Locality map showing sites of boreholes.
II – THE MARKADA BOREHOLE-101 Markada is situated on the east bank of Khabur River. Four cores were taken from different horizons at the depths indicated. The following samples were studied:

| Core 18: 3117.80m (5.9 Kg) | 3120.30m 3122.45m 3123.80m 3125.10m |
|-----------------------------|--------------------------------------|
| Core 19: 3361.90m (2.8 Kg)  | 3362.60m 3363.80m |
| Core 20: 3428.95m (3.5 Kg)  | 3429.85m 3435.90m 3436.40m |
| Core 21: 3752.70m (2.5 Kg)  | 3753.90m 3755.80m 3757.60m |

Dark grey microcrystalline dolomite, intercalated with streaks of dark grey laminated shale. The dolomite partly fractured, the fractures filled with calcite. Red brown, sandstone, cemented by ferruginous material.

Dark grey, microcrystalline limestone, interbedded with thin, black fossiliferous shale.

Black laminated shale containing foraminifera, spores and conodonts.

Dark grey, microcrystalline limestone, interbedded with thin, black fossiliferous shale.

Core 21: Dark grey sandstone cemented by silicified material, interbedded with thin beds of black, micaceous shale.

III – THE JBISSA BOREHOLE-207 Jbissa is situated 40 km to the North of the Markada structure. The following samples were taken at the depths indicated:

| Core 1: 3867.80m (2.2 Kg) | 3869.40m |
|---------------------------|---------|
| Core 2: 3936.90m (2.2 Kg) | 3838.70m 3939.60m |
| Core 3: 4146.30m (3.9 Kg) | 4147.80m 4149.85m |
| Core 4: 4178.90m (3.7 Kg) | 4180.80m |
| Core 5: 4252.75m (3.0 Kg) | |

Dark grey sandstone intercalated with very thin laminated grey shale.

Green laminated shale.

Dark grey, microcrystalline limestone, which is fractured, the fractures being filled with calcite and barite.

Black laminated fossiliferous shale.

Dark grey, microcrystalline limestone.

Core 2: Black laminated shale with streaks of grey dolomite.

Core 3: Dark grey, microcrystalline limestone containing conodonts. Black shale.

Core 5: Black laminated shale.

THE CONODONT FAUNA

The present study is based upon 55 rock samples, each approximately one kilogram in weight, which were collected from the mainly Lower Carboniferous deposits present in four boreholes in north-eastern and central Syria. Eleven samples contained conodonts. The conodonts were not very abundant and generally occurred as fragments. The Carboniferous fauna is dominated by the genus Gnathodus. The numerical distribution of the conodont elements recovered is illustrated (Figs. 2-4).

THE SWAB BOREHOLE: (Fig. 2)

Samples from Cores 5, 7 and 8 failed to yield any conodonts. Samples from Core 6 yielded elements representing 16 species and 7 genera. The composition of the fauna changes through the depth interval 1296.60 m to 1300.30 m. The species Gnathodus bilineatus and Gnathodus girtyi girtyi are present at the top and Gnathodus pseudosemiglaber characterises the lower interval. Gnathodus cuneiformis and Gnathodus homopunctatus are found only at a depth of 1297.60 m. Samples from the depth range 1297.60 – 1298.70 m produced Gnathodus texanus. A single specimen of Gnathodus symmutatus symmutatus occurs at a depth of 1298.70 m.

The occurrence of the species Gnathodus bilineatus, Gnathodus girtyi, Gnathodus cuneiformis, Gnathodus texanus and Gnathodus pseudosemiglaber in samples from the Swab Borehole allows approximate correlation to be made with the Lower Carboniferous conodont zones recognised in western Europe. The appearance of the species G. bilineatus and G. girtyi at a depth of 1296.80 m is of considerable importance as they are the
### Table 1: Conodont species, Swab Borehole

| Conodonts | Core 6 |
|-----------|--------|
|           | 1296-80 | 1297-60 | 1298-70 | 1299-80 | 1300-30 |
| Apatognathus geminus | 1 | 1 | | | |
| Apatognathus sp. | 2 | 4 | | | |
| Gnathodus cuneiformis | 3 | 1 | | | |
| Gnathodus homopunctatus | 1 | | | | |
| Gnathodus symmetatus symmetatus | 13 | 4 | 1 | 1 | |
| Gnathodus pseudosemiglaber | 2 | 1 | | | |
| Gnathodus texanus | 4 | 2 | | | |
| Hindeodella iberiensis | 1 | 2 | | | |
| Hindeodella sp. | 3 | 2 | | | |
| Ligonodina roundyi | 1 | | | | |
| Lonchodina furnishi | 2 | 2 | 1 | | |
| Lonchodina sp. | 1 | | | | |
| Neoprioniodus sp. | 4 | 1 | 13 | 2 | 4 |
| Ozarkodina plana | | | | | |
| Fragments | | | | | |

**Fig. 2.** Conodont species, Swab Borehole.

### Table 2: Conodont species, Markada Borehole

| Conodonts | Core 18 | Core 19 | Core 20 |
|-----------|---------|---------|---------|
| Apatognathus geminus | 2 | | |
| Apatognathus sp. | 1 | 2 | | |
| Gnathodus cuneiformis | 1 | 4 | 5 | 1 | 1 |
| Gnathodus pseudosemiglaber | | | | | |
| Gnathodus texanus | 1 | | | | |
| Lonchodina furnishi | | | | 1 | 1 |
| Lonchodina sp. | | | | | |
| Neogondolella mambergensis | 2 | | | | |
| Neoprioniodus scitulus | 1 | 1 | 1 | 1 | |
| Neoprioniodus sp. | | | | | |
| Spathognathodus scitulus | | | | 1 | |
| Genus sp. indeterminate | 1 | | | | |
| Fragments | | 9 | 3 | 6 | 5 | 6 | 1 |

**Fig. 3.** Conodont species, Markada Borehole.
indices for late Viséan and early Namurian age strata (Rhodes et al. 1969, Higgins 1975 and Meischner 1970).
The presence of *Gnathodus homopunctatus* indicates a Viséan age at least to a depth of 1297.60 m *Gnathodus texanus* and *Gnathodus pseudosemiglaber* which are present below the first appearance of *Gnathodus homopunctatus* have their oldest stratigraphic occurrence in the *Scalognathus anchoralis* Zone, which is of late Tournaisian age (Lane, Sandberg & Ziegler, 1980).

Despite the low yield of conodonts we suspect the Tournaisian-Viséan boundary to fall within the interval of Core 6.

THE MARKADA BOREHOLE: (Fig. 3)
Samples from Core 21 contained no conodonts. Only one horizon in Core 18 contained conodonts. Samples from the Markada Borehole at a depth of 3120.30 m contained two broken specimens of *Neogondolella mombergensis*. The specimens clearly exhibit the fairly broad platform features, which are rounded posteriorly. The platform forms a point at the anterior end and the carina is low. The presence of this species in Core 18 is indicative of a Middle Triassic age (Mosher, 1968). The genus was not recovered from any other sample. It represents the first record of Triassic conodonts from Syria.

Samples from the interval 3363.80 m – 3436.40 m of Cores 19 and 20 are characterised by the presence of *Gnathodus pseudosemiglaber*. At depth 3362.60 m, a single specimen of *G. cuneiformis* occurs together with a specimen of *G. texanus*. The sample from depth 3435.90 m produced two specimens of *Apatoiognathus geminus* together with *Spathognathodus scitulus*. This association indicates that at this level there is a shallow water facies (Austin, 1976). *Gnathodus texanus* occurs again at depths of 3436.40 m and 3429.85 m.

The presence of *Gnathod tus texanus*, *Gnathodus cuneiformis* and *Gnathodus pseudosemiglaber* implies that the rocks present in Cores 19 and 20 of the Markada Borehole are of late Tournaisian-early Viséan age.

THE JIBISSA BOREHOLE: (Fig. 4)

Only three samples from the Jibissa borehole at depths of 3869.40 m, 4147.80 m and 4178.90 m in Cores 1, 3 and 4 yielded conodonts. Cores 2 and 5 did not yield any conodonts. The specimens recovered are mostly fragmentary, but a few are sufficiently well preserved for generic and specific identifications to be made. The species *Gnathodus pseudosemiglaber* and *Gnathodus cuneiformis* are recognised in Core 4 and *Gnathodus pseudosemiglaber* in Core 3, which implies an age close to the Tournaisian-Viséan boundary.

THE ROUMYLAN BOREHOLE:
All samples from the Roumylan Borehole were devoid of conodonts.

REPOSITORY OF SPECIMENS

The conodont specimens of this study are deposited at the Department of Geology, The University, Damascus.

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REFERENCES

Austin, R. L. 1976. Evidence from Great Britain and Ireland concerning West European Dinantian conodont paleoecology. *In Barnes, C. R. (Ed.), Conodont Paleocology. Geol. Ass. Can.*, 15, 201-224.

Duborret, L. 1932. Les formes structurales de la Syria et de Palestine, leur origine. *C.r. Seances Acad Sci.*, 195, 66-68.

Higgins, A. C. 1975. Conodont-zonation of the late Viséan-early Westphalian strata of the south and central Pennines of northern England. *Bull. Geol. Surv. Geol. Surv*, 53, 90 pp. pls. 1-18.

Lane, R. H., Sandberg, C. A. & Ziegler, W. 1980. Taxonomy and phylogeny of some Lower Carboniferous conodonts and preliminary standard post-Siphonodella zonation. *Geologica et Palaenontologica*, 14, 117-164, pls. 1-10.

Meischner, D. 1970. Conodonten-Chronologie des deutschen Karbons. *Congres Avanc Etud Stratigr. Carb. Sheffield*, 1967, 111, 1167-1180.

Mosher, L. C. 1968. Triassic conodonts from Western North America and Europe and their correlation. *J. Paleont.*, 42, 895-946, pls. 113-118.

Ponikarov, V. P. 1969. *The geology of Syria. “Nedra” Leninograd* (in Russian).

Rhodes, F. H. T., Austin, R. L. & Druce, E. C. 1969. British Avonian (Carboniferous) conodont faunas, and their value in local and intercontinental correlation. *Bull. Br. Mus. nat. Hist. (Geol)*, Supplement 5, 313 pp. 31 pls.

Stoppel, D. 1970. Die Fauna des Karbons vom Djebel Abd-el-Aziz (Nordost-Syrien) *N. Jb. geol. Paläont. Abh.*, 135, 213-225, pl. 29.

Weber, H. 1964. Ergebnisse erdölgeologischer Aufschlussarbeiten der DEA in Nordost Syrien. *Erdöl und Kholn, Erdgas, Petrochemie*, 16.

Wolfart, R. 1967. *Geologie von Syrien und Libanon*. Gebrüder Borntraeger. Berlin, 326 pp.

Yankauskas, T. 1976. Stratigraphic Scheme of Paleozoic in Syria. *Syrian Petroleum Company*. Unpublished Report.

![Fig. 4. Conodont species, Jibissa Borehole.](image-url)
Explanation of Plate 1

Figs. 1, 13, 15, 16. *Gnathodus pseudoemiglaber* Thompson & Fellows Oral view of specimens Sy. 4, 31, 18, 20, 1, 13, sample M.K.20, 3428.95, × 54. 15, 16, sample SWB.6, 1297.60, ×66.

Figs. 2, 8, 9, 12. *Gnathodus cuneiformis* Mehl & Thomas Oral view of specimens Sy. 29, 5, 21, 33. 2, sample M.K.20, 3429.85, SWB.1298, × 56, sample SWB.6, 1297.80, × 72. 12, sample JB.4178.90, ×120.

Figs. 3, 7. *Gnathodus texanus* Roundy 3, Lateral view of specimen Sy. 26, sample SWB.6, 1298.80, ×45.7, Oral view of specimen Sy. 3, sample SWB.6, 1298.80, ×53.

Figs. 4, 5, 14. *Gnathodus girtyi girtyi* Hass Oral view of specimens Sy. 8, 6, 2, sample SWB.6, 1296.80, 4, 5, ×50, 14, ×80.

Fig. 6. *Gnathodus symmutatus symmutatus* Rhodes, Austin & Druce Oral view of specimen Sy. 1, sample SWB.6, 1298.70, ×68.

Fig. 10. *Gnathodus bilineatus* Roundy Oral view of specimen Sy. 13, sample SWB.6, 1296.80, ×71.

Fig. 11. *Gnathodus homopunctatus* Ziegler Oral view of specimen Sy. 17, sample SWB.6, 1297.60, ×92.

Fig. 17. *Spathognathodus scitulus* Hinde Lateral view of specimen Sy. 12, sample M.K.20, 3435.90, ×53.

Figs. 18a, b, 19. *Neogondolella mombergensis* Tatge 18a, 18b Oral and lateral view of specimen Sy. 14, ×63. 19, Lateral view of specimen Sy. 15, sample M.K. 18, 3120.30, ×80.

Fig. 20. Gen. et sp. indeterminate Lateral view of specimen Sy. 16, sample M.K. 18, 3120.30, ×107.

Fig. 21. *Lonchodina furnishi* Rexroad Lateral view of specimen Sy. 23, sample SWB.6, 1296.80, ×57.

Fig. 22. *Neoprioniodus scitulus* Branson & Mehl Lateral view of specimen Sy. 30, sample M.K. 20, 3436.40, ×53.

Fig. 23. *Lonchodina sp.* Lateral view of specimen Sy. 19, sample SWB.6, 1297.60, ×65.

Fig. 24. *Ligonodina roundyi* Hass Lateral view of specimen Sy. 22, sample SWB.6, 1297.60, ×67.

Fig. 25. *Euprioniodina microdentata* (Ellison) Lateral view of specimen Sy. 24, sample SWB.6, 1297.60, ×53.

Fig. 26. *Hindeodella ibergensis* Bischoff Lateral view of specimen Sy. 28, sample SWB.6, 1269.80, ×57.

Fig. 27. *Ozarkodina plana* Huddle Lateral view of specimen Sy. 27, SWB.6, 1298.70, ×60.

Fig. 28. *Lonchodina furnishi* Rexroad Lateral view of specimen Sy. 28, M.K. 20, 3436, ×80.

Fig. 29. *Lonchodina Sp. A.* Lateral view of specimen Sy. 32, M.K. 20, 3429, ×65.

Fig. 30, 32. *Apatognathus geminus* Hinde Lateral view of specimens Sy. 9, 10, sample M.K. 20, 3435.90, ×53.

Fig. 31. *Apatognathus sp.* Lateral view of specimen Sy. 11, sample M.K.20, 3435.90, ×53.

Fig. 33. *Neoprioniodus sp.* Lateral view of specimen Sy. 7, sample M.K.20, 3436.40, ×53.
