BMR Journal of Australian Geology & Geophysics, 9, 361-364

Late Triassic conodonts from Sahul Shoals No. 1, Ashmore Block, northwestern Australia

P.J. Jones[1] & Robert S. Nicoll[1]

The conodont *Epigondolella primitia* Mosher, 1970 has been recovered from core 4 (1883.2–1889.6 m) in Sahul Shoals No. 1 well on the Ashmore Block, offshore northwestern Australia. It has been dated as latest Karnian to earliest Norian (Late Triassic). The Late Triassic sequence in the well is correlated with the Triassic of Austria and British Columbia, Canada.

Introduction

The recovery of a small conodont fauna of Late Triassic age from Sahul Shoals No. 1 petroleum exploration well drilled on the Ashmore Block off the northwestern Australian coast is important because it is the first record of conodonts of this age in Australia.

McTavish's (1973) description of an Early Triassic fauna from the offshore Perth and Carnarvon Basins is the only previously published description of Triassic conodonts from Australia. This is partly because Triassic rocks are mostly restricted to the offshore margins, and the wells that have penetrated marine sequences have not been specifically examined for conodonts. A study of material from both old and new offshore wells would probably yield many more conodont faunas of Triassic age, which could be very useful in the establishment of a detailed biostratigraphic zonation for the Triassic sequence in these areas.

Localities in Timor (Nogami, 1968), Papua New Guinea (Skwarko & others, 1976) and New Zealand (Jenkins & Jenkins, 1971) represent the only Late Triassic conodont faunas to have been described in areas immediately adjacent to Australia.

Geologic setting

Sahul Shoals No. 1 well is situated at the western end of the offshore Bonaparte Basin (11°25′36″S, 124°32′50″E), 375 km northwest of Cape Londonderry, Western Australia, and 137 km south of Timor, Indonesia (Fig. 1). Structurally, it is on the eastern end of the Ashmore Block (Laws & Kraus, 1974), near the point where this structure and the Vulcan Sub-basin are truncated by the southern margin of the Timor Trough (Kraus & Parker, 1979, fig. 3). The well, sited in 28 m of water, was drilled in late 1969–early 1970 by Burmah Oil Company of Australia Limited (BOCAL) to a total depth of 3802 m.

The well completion report (BOCAL, 1970) includes palaeontological studies on Foraminiferida by D.R. Wall, M. Apthorpe, and A.R. Lloyd; Ostracoda by P.J. Jones; Mollusca by S.K. Skwarko; Polyzoa and Brachiopoda by K.S.W. Campbell; and microflora by B.E. Balme.

Stratigraphy

The well passed through 1756 m of Quaternary, Tertiary, and Cretaceous carbonates and minor shale that unconformably overlie Triassic rocks. The Triassic sequence (Fig. 2) is 1955 m thick and can be separated into an upper marine unit of mixed shale and calcareous lithology; a middle unit, partly non-marine, of sandstone and shale; and a lower marine unit of siltstone and shale. The hole bottomed in 53 m of recrystallised Permian limestone.

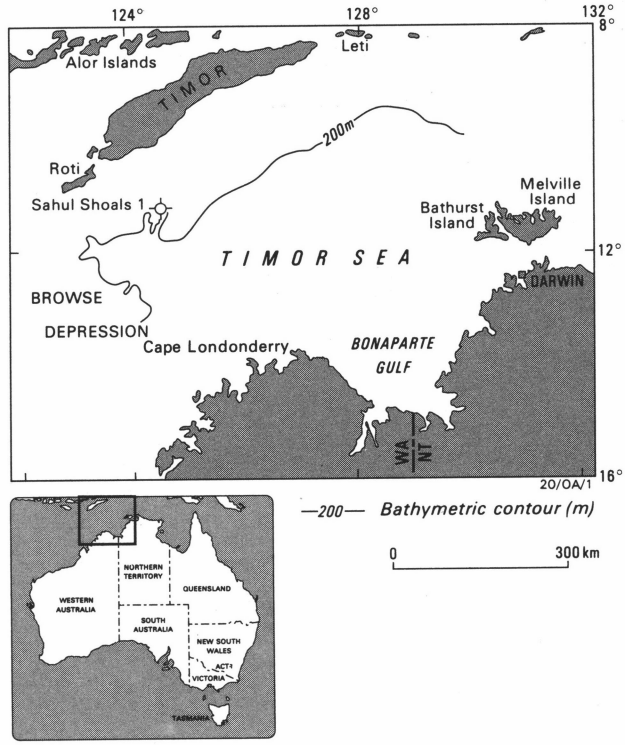

Figure 1. Location of BOCAL Sahul Shoals No. 1 well, Ashmore Platform, northwestern Australia.

Stratigraphic control of the Triassic succession (1793.66–3748.86 m) is based on evidence from palynology by B.E. Balme, Ostracoda by P.J. Jones, and Mollusca by S.K. Skwarko (in BOCAL, 1970). Balme assigned the strata between 3529.4 and 3748.86 m to the Lower Triassic, which is consistent with the early Middle Triassic age determined by Skwarko (in BOCAL, 1970) for molluscans slightly higher in the succession. Balme referred the sequence between 1811 and 2564 m to the Upper Triassic, but was unable to establish a boundary between the Middle and Upper Triassic on a palynological basis. He recognised that the Upper Triassic spore–pollen assemblages resembled those from the Mungaroo Beds of the Carnarvon Basin. The ostracods between 1828.9 and 1888.4 m are marine and indicate a general Late Triassic age (Jones in BOCAL, 1970).

Material

Four samples from Sahul Shoals No. 1, core 4 (1883.2–1889.6 m) were examined for microfossils. Ostracods were recovered from all samples, but conodonts were found only in the intervals 1884.45–1885.67 m and 1888.35–1889.56 m. They were obtained from a shaly limestone as a by-product of the ostracod processing; the samples have not been treated with acid.

[1] Division of Continental Geology, BMR.

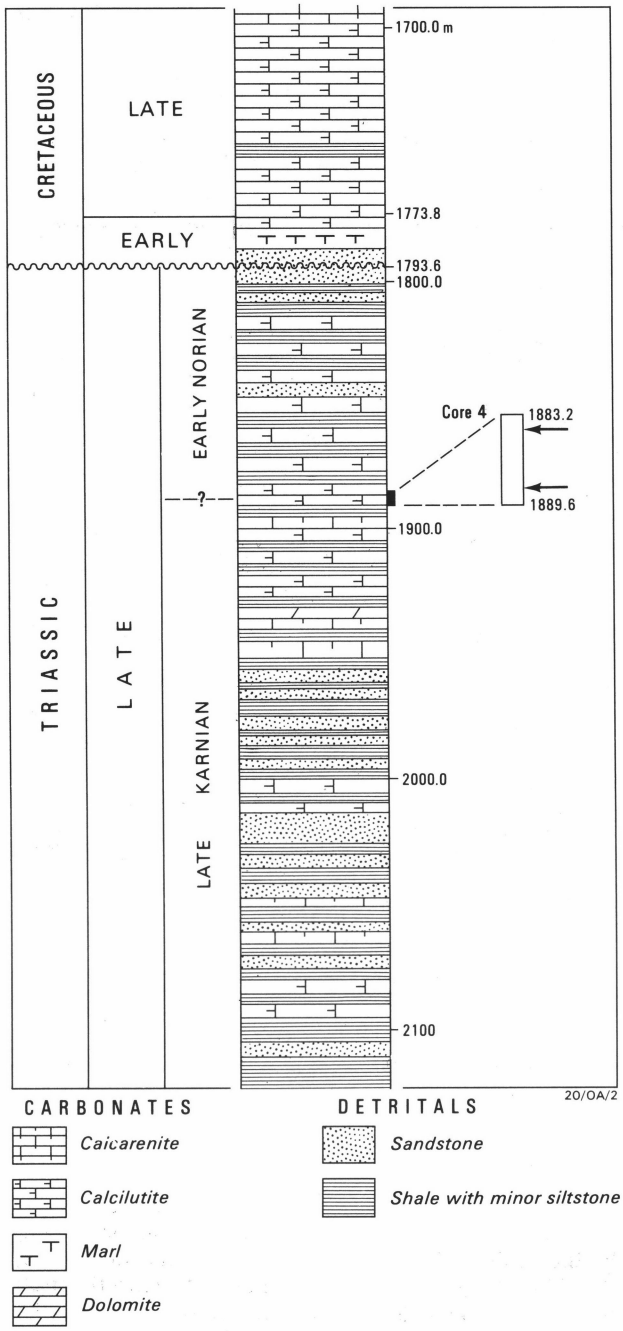

Figure 2. Portion of the graphic log of Sahul Shoals No. 1 well (adapted from BOCAL, 1970), showing the location of conodonts (arrowed) in core 4; 1883.2 m (6177 ft) to 1889.6 m (6198 ft).

Conodont fauna

The conodont fauna recovered as part of this study is restricted to a single species, *Epigondolella primitia* Mosher, 1970. The material has a conodont colour alteration index (CAI) value of 1, indicating that the sediments containing the conodont fauna have not been exposed to temperatures greater than about 80°C. (Epstein & others, 1977).

Systematic palaeontology

Genus ***Epigondolella*** Mosher, 1968

Type species *Polygnathus abneptis* Huckriede, 1958

Epigondolella primitia Mosher, 1970

Figure 3

Synonymy

1970 *Epigondolella primitia* n. sp.; Mosher, p. 740, Pl. 110, figs 7–13, 16, 17.

1980 *Epigondolella primitia* Mosher; Krystyn, p. 76, P. 13, figs 1–7.

1982 *Epigondolella primitia* Mosher; Koike, p. 18, Pl. 1, fig. 29–36.

Material studied. Six specimens; all deposited in the Commonwealth Palaeontological Collection (CPC) at the Bureau of Mineral Resources, Canberra under the CPC numbers 25712 to 25717. (Specimens 25716 and 25717 are not figured.)

Remarks. The specimens are all broken: two have complete platforms (Fig. 3C, D), one has the anterior part of the platform preserved (Fig. 3B), and a fourth is a blade with only the anteriormost part of the platform attached (Fig. 3A). Two additional specimens are partial blades that closely resemble the specimen illustrated. No ramiform elements were recovered.

The specimens are unquestionably assigned to *Epigondolella primitia* on the basis of the presence of nodes on the anterior part of the platform and reduced node development on the posterior part of the element. The aboral surface has a well-developed keel that bifurcates posteriorly to the pit. The oral surface ornamentation distinguishes our material from *E. abneptis* and the well developed bifurcated keel distinguishes the specimens from *Gondolella nodosa.*

Age

Epigondolella primitia has a very restricted stratigraphic range. In the Salzkammergut area of Austria (Krystyn, 1980) it is found in the uppermost part of the Upper Karnian (Tuvalian) and extends into the lowermost part of the Lower Noriann (Lacian), over a maximum thickness of less than 10 m. In terms of Krystyn's conodont zonation it extends from the Upper *Gondolella nodosa* Assemblage Zone to the top of the *Epigondolella primitia* Assemblage Zone. This corresponds to the upper part of the *Anatropites* Bereich through to the lower part of the *Guembelites jandianus* Zone of the ammonoid zonation (Krystyn, 1980).

In British Columbia, Canada, Orchard (1983) reported *E. primitia* from the uppermost part of the Upper Karnian and extending into the lowermost part of the Lower Norian in what he refers to as the *E. primitia* conodont zone. This corresponds to the upper part of the *Klamathites macrolobatus* and most of the *Mojsisovicsites kerri* zones of Tozer's (1967) ammonoid zonation.

The recovery of additional diagnostic conodont elements is required to determine if the fauna described in this study belongs in the Late Karnian or the Early Norian (viz., *Gondolella polygnathiformis* or *G. navicula,* respectively).

Discussion

The recorded distribution of Triassic conodont faunas in Australia and adjacent areas is very limited (McTavish, 1975). McTavish (1973) reported an Early Triassic conodont fauna from the subsurface of the offshore Perth and Carnarvon Basins. Unidentified conodonts have been recovered from the Blina Shale (Lower Triassic) in wells from the onshore portion of the Canning Basin (Nicoll, 1984). Berry & others (1984) reported on a limited Lower Triassic fauna from the northern side of eastern Timor.

Upper Triassic conodont localities are more common in the Indonesian Archipelago. Nogami (1968) described a series

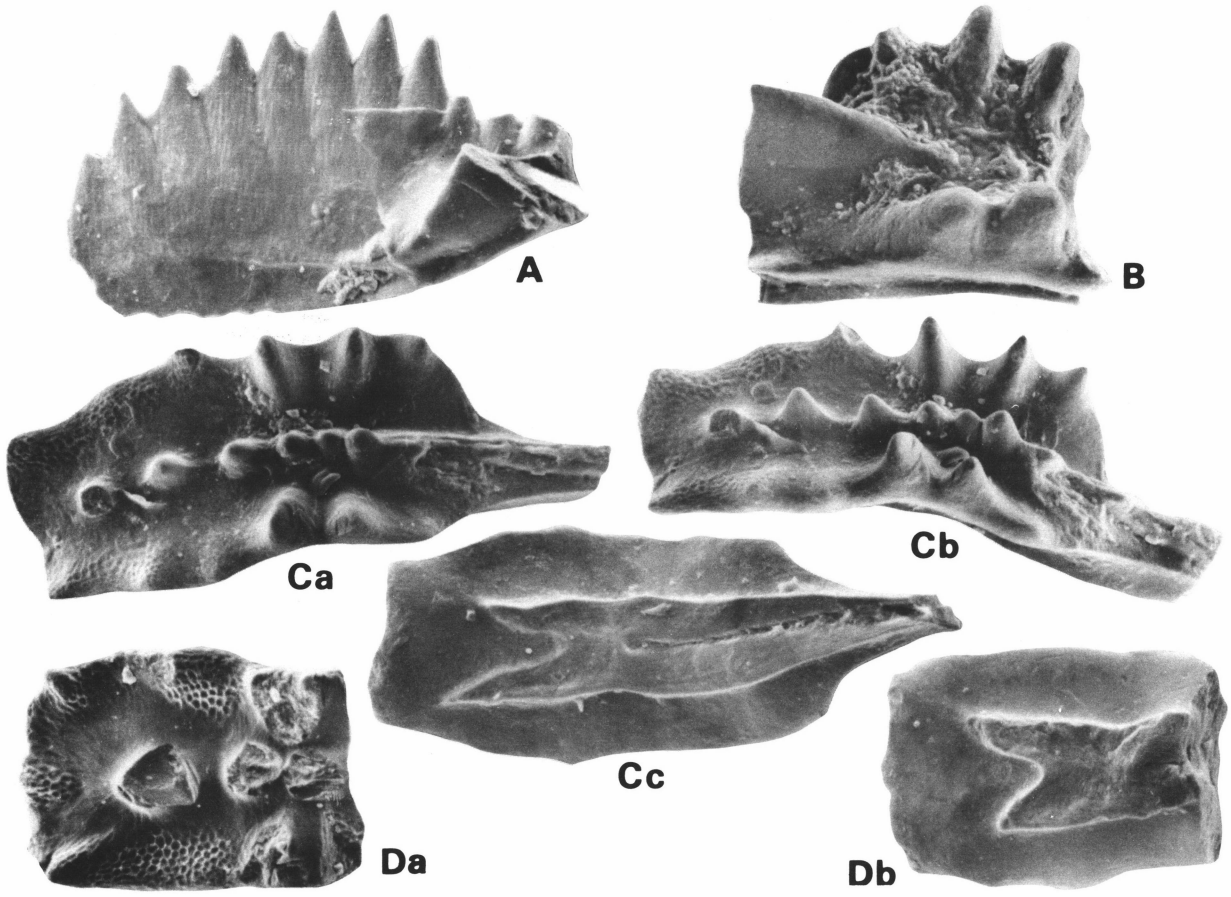

Figure 3. ***Epigondolella primitia,*** **Pa elements.**

All figs. × 150. A–C from Sahul Shoals No. 1, core 4, interval 1888.35–1889.45 m; D from core 4, interval 1884.45–1885.67. A, lateral view (CPC25712). B, lateral view (CPC25713). Ca, oral view; Cb, lateral view; Cc, aboral view (CPC25714). Da, oral view; Db, aboral view (CPC25715).

of conodont faunas from spot samples obtained from Timor, and one of his illustrated specimens (Nogami, 1968, Pl. 8, fig. 8) has since been assigned to *Epigondolella primitia* by Mosher (1973).

Metcalfe & others (1979) described a Late Karnian conodont fauna from Sumatra that includes *E. primitia.* Other Upper Triassic conodont faunas have been reported from peninsular Malaysia (Koike, 1973), western Thailand (Kemper & others, 1976), and Papua New Guinea (Skwarko & others, 1976).

The initial biostratigraphy proposed for Sahul Shoals No. 1 well (BOCAL, 1970) has been refined by later studies. Skwarko & Kummel (1974) studied the ammonite and pelecypod fauna present in core 9 (3268.2–3274.7 m) and suggested that the association of the ammonite *Nicomedites*? with halobiid pelecypods probably indicated an early Middle Triassic (early Anisian) age.

Application of Dolby & Balme's (1976) Triassic spore–pollen zonation of the Carnarvon Basin to Balme's spore–pollen distribution (in BOCAL, 1970) indicates that in the Upper Triassic succession in Sahul Shoals No. 1 the interval between at least 1859 m and 2564 m falls within the *Samaropollenites speciosus* Zone of the Onslow Microflora. Dolby & Balme regarded this zone as Late Karnian in age. Recent studies of the dinoflagellate floras (Helby & others, in press) in Sahul Shoals No. 1 indicate a Late Karnian or possibly basal Norian age for the interval 1808.8–2102.7 m.

The discovery of the conodont species *Epigondolella primitia* Mosher 1970 in Sahul Shoals No. 1, core 4 (1883.2–1889.6 m) adds more precision to the dinoflagellate and spore–pollen data, in that this species indicates that the Karnian–Norian boundary is within a few metres of this depth, and suggests a basal Norian age for at least the upper 75 m of the Triassic sequence in this well.

Finally, this find has certain palaeogeographical implications. On the basis of Triassic conodont distributions, McTavish (1975) argued for the presence of Malaya adjacent to northwestern Australia and Timor as part of the Gondwanaland margin. Audley-Charles (1983) later recognised a Late Triassic magmatic arc that united eastern Australia, the Kubor range of New Guinea, Borneo, Sumatra, the Thai-Malay Peninsula, Burma, and southern Tibet into an active continental margin during the Late Permian to Late Triassic. The discovery of *Epigondolella primitia* in an autochthonous Upper Triassic sequence on the northwestern continental margin of Australia now provides a palaeogeographical link with the Late Triassic (latest Karnian–earliest Norian) conodont faunas of Timor, western Malaya, Thailand, and Sumatra.

Acknowledgements

We thank Frank Hadzel (BMR) for preparation of the material and Arthur T. Wilson (BMR) for the photography and assistance with plate preparation. The manuscript was critically reviewed by D.J. Belford and E. M. Truswell (BMR).

References

Audley-Charles, M.G., 1983 — Reconstruction of eastern Gondwanaland. *Nature,* 306, 48–50.

Berry, R., Burrett, C., & Banks, M., 1984 — New Triassic faunas from East Timor and their tectonic significance. *Geologica et Palaeontologica,* 18, 127–138.

BOCAL, 1970 — Sahul Shoals No. 1, Well Completion Report. *Bureau of Mineral Resources, Australia, Petroleum Search Subsidy Acts File* 69/2042 (unpublished).

Dolby, J.H. & Balme, B.E. 1976 — Triassic palynology of the Carnarvon Basin, Western Australia. *Review of Palaeobotany & Palynology* 22, 105–169.

Epstein, A.G., Epstein, J.B. & Harris, L.D., 1977 — Conodont colour alteration—an index to organic metamorphism. *United States Geological Survey, Professional Paper* 995, 1–27.

Helby, R., Morgan, R. & Partridge, A., in press — A palynological zonation of the Australian Mesozoic. *Memoirs of the Association of Australasian Palaeontologists.*

Jenkins, T.B.H. & Jenkins, D.G., 1971 — Conodonts of the Haast and Torlesse Groups of New Zealand. Part 1—Biostratigraphic significance of the Triassic conodonts from the Mount Mason and Okulu Limestones. *New Zealand Journal of Geology & Geophysics,* 14, 782–794.

Kemper, E., Maronde, H.-D. & Stoppel, D., 1976 — Triassic and Jurassic Limestone in the region northwest and west of Si Sawat (Kanchanaburi Province, western Thailand). *Geologisches Jahrbuch,* B, 21, 93–127.

Koike, T., 1973 — Triassic conodonts from Kedah and Pahang, Malaysia. *Geology & Palaeontology of Southeast Asia,* 12, 91–113.

Kraus, G.P. & Parker, K.A., 1979 — Geochemical evaluation of petroleum source rock in Bonaparte Gulf-Timor Sea region, northwestern Australia. *American Association of Petroleum Geologists Bulletin* 63(11), 2021–2041.

Krystyn, L., 1980 — Stratigraphy of the Hallstatt region. *Abhandlungen der geologischen Bundesanstalt,* 35, 69–98.

Laws, R.A. & Kraus, G.P., 1974 — The regional geology of the Bonaparte Gulf-Timor Sea area. *The APEA Journal,* 14, 77–84.

McTavish, R.A., 1973 — Triassic conodont faunas from Western Australia. *Neues Jahrbuch fur Geologie und Palaontologie Abhandlungen,* 143, 275–303.

McTavish, R.A., 1975 — Triassic conodonts and Gondwana stratigraphy. *In* Campbell, K.S.W., (editor), Gondwana geology: papers from the 3rd Gondwana Symposium. *Australian National University Press, Canberra.* 481–490.

Metcalfe, I., Koike, T., Rafek, M.B. & Haile, N.S., 1979 — Triassic conodonts from Sumatra. *Palaeontology,* 22, 737–746.

Mosher, L.C., 1970 — New conodont species as Triassic guide fossils. *Journal of Palaeontology,* 44, 737–742.

Mosher, L.C., 1973 — Triassic conodonts from British Columbia and the northern Arctic Islands. *Geological Survey of Canada, Bulletin,* 222, 140–193.

Nicoll, R.S., 1984 — Conodont studies in the Canning Basin—a review and update. *In* Purcell, P.G., (editor), The Canning Basin, W.A. *Proceedings of Geological Society of Australia/Petroleum Exploration Society of Australia Symposium, Perth, 1984,* 439–443.

Nogami, Y., 1968 — Trias-conodonten von Timor, Malaysien und Japan (Palaeontological study of Portuguese Timor, 5). *Memoirs of the Faculty of Science, Kyoto University, Series of Geology & Mineralogy,* 34, 115–136.

Orchard, M.J., 1983 — *Epigondolella* populations and their phylogeny and zonation in the Upper Triassic. *Fossils and Strata,* 15, 177–192.

Skwarko, S.K. & Kummel, B., 1974 — Marine Triassic Mollusca of Australia and Papua New Guinea. *Bureau of Mineral Resources, Australia, Bulletin,* 150, 111–127.

Skwarko, S.K., Nicoll, R.S. & Campbell, K.S.W., 1976 — The Late Triassic molluscs, conodonts, and brachiopods of the Kuta Formation, Papua New Guinea. *BMR Journal of Australian Geology & Geophysics,* 1, 219–230.

Tozer, E.T., 1967 — A standard for Triassic time. *Geological Survey of Canada, Bulletin,* 156.