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GEORGINA RESEARCH
December Quarter, 1978

Compiled by

J.H. Shergold

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During the December Quarter, E.C. Druce left the Bureau of Mineral Resources, but continued to complete work for the Georgina Basin Project. B.M. Radke returned to the Bureau after two years postgraduate study at the Rensselaer Polytechnic Institute, New York.

Sedimentology

Studies of the Ninmaroo Formation have shown that sedimentation occurred under epeiric to peritidal conditions delineated by a seaward barrier-shoal complex and by marginal semi-emergent shingle pavements. Following deposition the carbonates of this formation were modified by a sabkha overprint and further interaction with hypersaline fluids that resulted in mesogenetic dolomitisation, sulphide mineralisation, and telogenetic dedolomitisation (B.M. Radke).

The Kelly Creek Formation, of Early Arenigian age, was deposited in shallow marine to emergent conditions on a wide platform during a period of emergence of the 'Smoky Anticline'. It overlies the Ninmaroo Formation and Tomahawk Beds conformably to the west of the Toko Range and the Ninmaroo Formation and Georgina Limestone unconformably to the east. The upper portion of the formation is commonly dolomitic and is mapped as the Withillindarmna Dolomite Member. This member interfingers with the overlying Coolibah Formation (E.C. Druce).

The Mithaka Formation consists of bioturbated fine quartzose sandstone with shale and siltstone interbeds, and bioturbated mudstone with fine-grained sandstone lenses. The lower part of the formation is characterised by an abundance of biogenic sedimentary structures, which include large bilobate trilobite resting traces assigned to Rusophycus. These are associated with large asaphid trilobites which are thought to be responsible for making them. Other ichnofossils, Diplocraterion, Monocraterion, Arenicolites and numerous irregular burrows are also common (J.J. Draper, GSQ).

Palaeontology

Bradoriid crustacean families Bradoriidae, Comptalutidae, Indianidae and Svealutidae are represented in the Middle Cambrian (Templetonian) Beetle Creek Formation north of Mount Murray, in the Burke River Structural Belt. A new genus of Comptalutidae occurring in the Currant Bush Limestone has traces of thoracic segmentation. This unusual preservation of part of its soft anatomy may contribute towards the problem of the biological affinity of the Bradoriida (P.J. Jones).

The presence of an asterolepid antiarch has been confirmed in the fauna from the "limestone locality" ("thelodont-bearing rocks"), Craven's Peak Beds, in the southern Toomba Range. Antiarchs are not reported in the Wuttagoonaspis fauna of the Mulga Downs Group of western New South Wales, with which the Craven's Peak Beds have been correlated. Pre-late Devonian antiarchs are otherwise known in Australia from the Hatchery Creek Conglomerate at Wee Jasper, NSW, which also contains thelodonts, and overlies Emsian limestones. The association of antiarchs and thelodonts has not been reported from any other continent (G.C. Young).

At the present time only conodonts permit precise dating of the Kelly Creek Formation, in which four faunas occur. The oldest fauna, from the southern part of the Toomba Range, indicates the Early Ordovician, Warendian, Cordylodus rotundatus - C. angulatus Zone. Fauna 2, from the southern Tarlton Range represents the earliest Arenigian Scolopodus sexplicatus Zone. Faunas 3 and 4, previously unrecorded from Australia, also indicate an early Arenigian age (E.C. Druce).

An archaeocyathan-radiocyathan fauna correlated with the Atdabanian and/or early Lenian stages of Siberia (Early Cambrian) occurs in the Todd River Dolomite of the Amadeus Basin and Mount Baldwin Formation of the Georgina Basin (P.D. Kruse, Sydney University; P.W. West, ANU).

Drilling results

Hay River No. 10 penetrated 102 m of dark grey to black shale with thin beds and lenses of dolomite overlying the Yardida Tillite. This confirmed interpretation

of the lithology based on deeply weathered surface outcrops and the previous correlation with the Aralka Formation of the Amadeus Basin (M.R. Walter).

Hay River Nos. 11, 11A and 11B penetrated several previously unknown or poorly known stratigraphic units. A brown and green siltstone was discovered lying unconformably on the Grant Bluff Formation and below archaeocyathan-bearing dolomite. This siltstone is considered to have an earliest Cambrian age on the basis of correlation with similar units in the Amadeus Basin and Adelaide Geosyncline. No fossils have been recognised in it, but some intervals are bioturbated. The overlying dolomite contains archaeocyathans (determined by P. Kruse, University of Sydney) consistent with correlation with the Todd River Dolomite of the Amadeus Basin. The ichnofossil burrow Diplocraterion has been identified from a sandy unit at the base of the dolomite (M.R. Walter).

This Lower Cambrian sequence is overlain with erosional contact by a dominantly shaly Middle Cambrian sequence of rocks. From the base the sequence includes: (1) shelly dolomite and black shale with phosphatised shell fragments, molluscs, hyolithids and inarticulate brachiopods; (2) black shale; (3) fetid black wackestone and calcareous shale containing Redlichia and eodiscid trilobites, bradoriid crustaceans, and inarticulate brachiopods; (4) a thin intraclastic grainstone containing the trilobite Xystridura; (5) an intercalated black shale and black silty wackestone succession, the latter containing sponge spicules and agnostid trilobites. Possible disconformities occur between units (1) and (2) where brecciation and ferruginisation occur; andi(4)eandi(5)lwhere dolomitisation and oxidation has occurred. The contact between (3) and (4) is erosional and an inferred fault separates (2) and (3) (J.H. Shergold).

GSQ Mount Whelan No. 1 core has been examined by Walter and Shergold in Brisbane. The basal sequence, from 502.8 - 606 m, resting on granite, is interpreted by Walter as glacial throughout, and is thought to be correlative with the Yardida Tillite (lower tillite) of the Hay River area. A very coarse arkose above 502.8 m grades up into bioturbated dark red-brown shale so that this sequence is considered to be Cambrian. This shaly sequence grades conformably into a micritic carbonate unit, and this into a coarse vuggy coquinite (456-462 m) which contains abundant secondary silica and resembles the archaeocyathan-bearing dolomite of the Desert Syncline. It is overlain conformably by a brecciated stylolitised sequence (436.61-456.15 m) containing the trilobite Redlichia, hyolithids and inarticulate brachiopods, capped (435.41 - 436.61 m)

by a coarse brachiopod coquinite. Finely laminated black and dark grey calcareous shale and silty limestone appear suddenly at 435.41 m, and grade up into paler laminated micritic carbonates with sedimentary boudinage structures. This basal unit contains agnostid trilobites which give an age between late in the Ptychagnostus atavus Zone to early in that of P. punctuosus, and indicate a considerable time break at the base of the laminated carbonate sequence.

P.M. Green (GSQ) has concentrated on the petrological examination of GSQ Mount Whelan Nos 1 and 2 cores using stained acetate peels, and reports the following conclusions. (1) The brown matrix of the tillitic sequence in GSQ Mount Whelan No. 1 consists of quartz, hematite, chlorite, illite, plagioclase, microcline and ankerite, differing from the green matrix because of its hematite content. (2) The Nora Formation consists mainly of thin beds of calcareous sandstone with skeletal fragments, in a green chlorite, quartz, muscovite, plagioclase feldspar matrix. (3) The Coolibah Formation contains a high proportion of calcareous mud. Skeletal fragments and peloids/clasts are common. Recrystallisation present throughout, often producing a radial fibrous fabric in the peloids. Some geopetal fabrics present. (4) Dolomite at the top of the Ninmaroo Formation usually consists of very fine to fine rhombs or irregular grains with minor ?quartz. A cement is usually present. The dolomite may have a detrital origin. (5) Recrystallisation of the limestones of the Ninmaroo Formation has occurred but relic textures are nearly always preserved. (6) Replacement within the limestone is usually by an Fe-calcite or dolomite. (7) Intraformational conglomerate and micrite are more abundant in the bottom of the limestone sequence.

Drilling of BMR Mayhew Mount Isa No. 1 was completed in November. This hole achieved 250.5 m and will be assessed for hydrocarbon content. Eight horizons of potential oil shale occur between intersections at 82-117 m (D. Gibson).

Geochemistry

Mesophase has been identified by MRL (G.H. Taylor) from Hay River No. 11A corehole, from the same interval containing the hydrothermal quartz crystals earlier reported (Georgina Research, March Quarter 1978). The presence of this mineral suggests that the sediments have been subject to temperatures between 400-470°C. Reappraisal of fluid inclusion homogeneity temperatures by MRL

(R. Wilkins) tends to support these figures. Reflectivity from organic material in shale overlying this interval is high (3%) and suggests temperatures in excess of 200°C. Available evidence suggests that a shortlived thermal event used porous biohermal dolomite as a pathway. The timing of this event is not yet known (C.J. Simpson, K. Jackson).

Analysis of surface samples of silicified coquinite from the Desert Syncline by AMDEL indicated some enrichment in silver (M.R. Walter).

Analysis on galena from Watchie Hut (Mount Whelan 1:250 000 Sheet area) shows low silver (0.1%, 6000-8000 ppm). Plattnerite (PbO_2) coats galena in several samples (C.J. Simpson).

Upper Cambrian carbonates in GSQ Mount Whelan No. 1 assessed for total organic carbon have values up to 2.30%. On the contrary, samples from the Lower Ordovician in GSQ Mount Whelan No. 2 prove quite lean with values of maximum total organic carbon of 0.21% (K. Jackson).

1:100 000 Geological Series Maps

Final editing of the Adam 1:100 000 Special Series Sheet has commenced, and this Sheet should be available for printing towards the end of January 1979 (D. Walton). The southern portion of the Toko 1:100 000 Sheet was photo-interpreted in conjunction with all available field data to complete the geology of the Proterozoic occurrences, and the Sheet is now ready for compilation by the BMR Preliminary Map Compilation Section (C.J. Simpson). Photo-interpretation of the Abudda Lakes Sheet has also been completed. Mount Whelan and Mount Barrington 1:100 000 Sheets remain at a preliminary compilation stage.

Structural geology

Preliminary structural interpretations of the northeast Hay River area indicate the presence south of the Adam Fault Zone of another major northwest trending fault that passes between Mount Gardner and Mount Knuckey. The east-west fault linking the Craigie and Toomba Faults is interpreted as a major thrust, and the north-south splays from these faults are thought to produce only minor displacements (M.R. Walter).

Crustal geology

On the basis of pattern recognition in regional maps of Bouguer anomalies and total magnetic intensity contours the basement to the Georgina Basin can be divided into four regions. Three of these are subsurface extensions of the Tennant Creek Block, Arunta Block and Mount Isa Block. The fourth, in the south, has no known outcrop and probably has a different composition from the others. The boundaries between these regions are in most cases not visible in outcrop.

The basement to the Georgina Basin thus consists predominently of metamorphic rocks and granites inferred to be similar to the outcrop areas which surround it. This basement is overlain by Adelaidean and Phanerozoic sedimentary accumulations which locally are up to 8000 m thick. With the exception of the Toko Syncline, Dulcie Syncline, Lander Trough and Burke River Structure where up to 3500 m of Palaeozoic sediments are preserved, only a thin veneer (up to 500 m) of Phanerozoic sediments occurs in the basin. However considerable thicknesses of Adelaidean sediments are interpreted to occur both beneath these structures and locally elsewhere, e.g. 3000 m in the Toko Syncline, 8500 m near Camooweal, and 7000 m in the Glenormiston-Sandover River area.

In synthesising a geological history of the basement, the most important event recognised is a phase of extensive thrusting to the northwest of the Arunta Block at about 1200 - 1000 m.y. which produced scalloped thrusts, some of which may cut Mount Isa Block rocks. It is inferred that thick Adelaidean sediments were subsequently deposited in grabens with active margins along these thrusts, and later after a brief hiatus, a similar reactivation accompanied Palaeozoic sedimentation.

Modelling suggests that the crust thins by approximately 4000 m across the area from Tennant Creek and Barrow Creek to Mount Isa, and accounts for the regional Bouguer anomaly high of the Mount Isa Block (D. Tucker, B. Wyatt, E. Druce, P. Harrison).