DEPARTMENT OF ~~NATIONAL RESOURCES~~ NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD 1980/37

GEORGINA RESEARCH

for the period October 1979-March 1980

Compiled by

C.J. SIMPSON

Project Co-ordinator

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Preface

J.H. Shergold, the compiler of previous issues of GEORGINA RESEARCH, is overseas until January 1981, and Project work is being coordinated by C.J. Simpson. Owing to currently reduced BMR staff numbers on the Project, GEORGINA RESEARCH will be produced at 6-month intervals commencing with this issue.

The following notes contain reports of activities submitted by K.S. Jackson, B.M. Radke, C.J. Simpson, BMR; P.M. Green, GSQ: P. Southgate, ANU, RSES: A. Hutton, Wollongong University.

1. Sedimentology

Phosphatic hardgrounds have been found within the Thorntonia Limestone near Riversleigh, Thorntonia, and D-Tree in the Undilla area, and at Rogers Ridge in the Burke River Structural Belt. A similar, non-dolomitised, phosphatic hardground sequence is present in the Currant Bush Limestone (Ptychagnostus atavus age) three kilometres south of Thorntonia. Individual hardgrounds range from 3 mm to 1 cm in thickness, but multiple hardgrounds are up to 10 cm thick. The hardgrounds are bored, have polished upper surfaces, are commonly iron-stained, and are often overlain by a lag of locally derived phosphate particles. Glauconite occurs both as grains and as surface coatings on hardgrounds. As a result of both boring and erosion, hardground surfaces may have relief of up to 8 cm. Fluorite and barite are associated with the phosphatic hardgrounds and tend to occur immediately beneath or sandwiched between phosphatic pavements.

Phosphatic stromatolites, both planar and columnar cryptalgalaminites, overlie scalloped surfaces in the Thorntonia Limestone near Riversleigh. Clasts of phosphatic cryptalgalaminite and ovules occur in the intercolumnar areas, which are otherwise non-phosphatic. Thus the presence of phosphatic clasts in the intercolumnar areas implies that phosphatisation was an early diagenetic or synsedimentary diagenetic event.

In the Riversleigh area west of the Gregory River, cauliflower chert nodules occur within the Thorntonia Limestone approximately 24 m above the Precambrian/Cambrian unconformity. The nodules are in a recrystallised dolomite 2 m thick, and are interpreted as pseudomorphs after anhydrite nodules. The nodules have a relict lath fabric and abundant $CaSO_4$ inclusions indicative of a primary anhydrite precursor. Phosphatic hardgrounds both underlie and overlie the anhydrite nodules which according to D.J. Shearman (Imperial College, personal communication, 1979) indicate subaerial sabkha diagenesis. Further evidence of either subaerial exposure or semi-emergent conditions was not observed because primary sedimentary structures have been obliterated by dolomitisation, recrystallisation, and stylolitisation. It is hoped that lateral tracing of this unit during the 1980 field season will provide further evidence of emergent and semi-emergent conditions in areas of reduced diagenetic overprinting. (P. Southgate, ANU, RSES).

The extensive dolostone unit of the Lower Ordovician Kelly Creek Formation in the Toko Syncline has variable porosity and permeability, and significant potential as a hydrocarbon reservoir. The porous dolostone intersected in GSQ Mount Whelan No. 2 is 107 metres thick. Measured porosities from the unit averaged 11%, while averaged horizontal permeability (gas) was 234 md, and vertical permeability (gas) 28 md. Permeability is more variable vertically, being generally low but with randomly distributed higher values. Porosity is dominantly intercrystalline in mottled and stratified distribution, with associated vug, channel, fracture, and breccia types. The porosity developed late in diagenesis, during and after pervasive dolomitisation of the sequence. Traces of liquid hydrocarbons in the dolostone, and previously reported gas flows from the overlying sandstone in AOD Ethabuka No. 1, indicate significant potential for these porous units as a reservoir in suitable structural traps. (B.M. Radke, BMR).

Recent investigations suggest that the intraformational conglomerates present in the Georgina Limestone were formed by the re-working of early lithification nodules within the sediment. An alternative explanation for the formation of the nodules is that they resulted from tectonic stress of the limestone. The features likely to form by this process include microstylolite swarms, pervasive solution dolomitisation, and stylolites. It is considered that the relationship exhibited by the nodules to the surrounding sediments, can result from early lithification processes with subsequent modification by tectonic stress. (P.M. Green, GSQ).

2. Geochemistry

A sample of oil shale from Mount Isa No. 1 (from a seam between 117.43 & 117.49 m) was sent to Wollongong University for petrographic and alginite content examination. Portions of the sample were mounted

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in cold-setting Astic resin so that one surface perpendicular to bedding and one surface parallel to bedding were polished, using water as a carrying agent. The polished blocks were examined in reflected white light and in blue light fluorescence mode in both air and oil immersion (n = 1.518). Reflectance measurements were taken with an MPVI microphotometer fitted to a Leitz Ortholux microscope and calibrated with glass standards of 0.53%, 1.01%, and 1.82% reflectance. 3 mm excitation filters (BG12 and BG3) and K490 and K510 suppression filters were used for fluorescence studies.

The alginite is lamellar in form with individual lamellae ranging in length from 0.01 to 0.5 mm and in thickness from 0.01 to 0.003 mm. It is pale brown and translucent in white light but fluoresces bright yellow in blue light.

Seventy percent of the organic matter (30% of the bulk rock) is vitrinite-like matter with a bimodal distribution of reflectance values. The higher-reflecting matter (R_o max = 0.4%) is pale grey and granular in form and resembles band vitrinite. The lower-reflecting matter (R_o max = 0.24%) is dark grey and resembles desmocollinite in form and texture. It occurs in both particulate and lamellar form and is associated with two faint fluorescence colours. Pits and edges of the bodies are characterised by an orange fluorescence which is probably emitted from matter below the grey bodies. Yellowish-orange fluorescence emanates from apparently homogeneous parts of the grey organic matter. Both fluorescence colours are observed only under high magnification. This lower-reflecting organic matter may have affinities with bituminite. Framboidal and massive pyrite occurs both with organic matter and in the inorganic mesostasis.

The lamellar alginite in the oil shale from Mount Isa No. 1 is similar to the lamellar alginite of Tertiary age from Rundle, Queensland (termed alginite B by Hutton & others, 1980) and was probably derived from green or blue-green algae. There is, however, a much higher percentage of humic-related macerals in the Mount Isa No. 1 oil shale than in Rundle oil shale. The origin of this humic-related organic matter is not known. Although it resembles vitrinite in higher rank coals it cannot be derived from higher plant matter since it is of too great an age (early Palaeozoic or older). The percentage of alginite B is lower than would be expected for an oil shale which is stated to yield 81 litres per tonne. Oil shales with a similar yield from Rundle have approximately 25% by volume alginite B. This apparent anomaly between yield and alginite content could result from one of three factors -

1. Alginite B from Mount Isa No. 1 may yield more shale oil per unit volume than alginite B from Rundle.

2. The sample examined may have a lower alginite content than the sample assayed.

3. The vitrinite-like material has affinities with bituminite, and may yield more oil than vitrinite derived from higher plant matter.

There is insufficient evidence to ascertain the environment of deposition of the Mount Isa oil shale. However, the presence of pyrite indicates a reducing environment during or after diagenesis. Further studies are needed to determine vertical variations, if any, within the oil shale seam.

Reflectance and maceral composition, Mount Isa No. 1

Yield (litres/tonne) - 81

% Reflectance R_o (max)

Band Vitrinite 0.49 (higher-reflecting vitrinite-like matter)

Desmocollinite 0.24 (higher-reflecting desmocollinite-like matter)

% Alginite 12 (Alginite B)

% Vitrinite 30 (Vitrinite-like and desmocollinite-like matter)

% Pyrite < 1

% Other Inorganics 58

Name of rock lamosite (term proposed by Hutton & others, 1980).

Reference. Hutton, A.C., Kantsler, A.J., Cook, A.C., &. McKirdy, D.M. 1980 - Organic matter in oil shales. APEA Journal, 20 (1) 44-67.

(A. Hutton, Wollongong University).

Source rock geochemistry on the GSQ Mount Whelan No. 1 and No. 2 holes indicates that:

1) the Late Cambrian Georgina Limestone rates as a very good source whereas the Ordovician sequence does not.

2) Oil staining at the top of the Coolibah Formation is most encouraging for petroleum potential.

Elemental analysis of extracted kerogens from Mount Whelan No. 1 cores are considered of dubious value because of high ash content which seems related to a high S content. This relationship has not yet been explained. Gas chromatography of saturated hydrocarbon fractions shows no evidence of thermal immaturity. In conjunction with vitrinite reflectance data from AMDEL, it indicates that both Cambrian and Ordovician rocks are mature, with a likelihood of overmaturity in the Middle Cambrian Thorntonia Limestone. (K.S. Jackson, BMR).

Samples from AOD Ethabuka No. 1 were submitted to AMDEL for reflectance and fluorescence measurement. Extracted organic matter was dominantly round, zoned balls of thucholite (hydrocarbon concentrated around radioactive cores) and vermicular material; both are residues of mobilised hydrocarbons. As kerogen macerals were difficult to identify, the reflectance data cannot be used to assess thermal maturity.

(B.M. Radke, BMR).

3. Maps

The 1:100 000 scale preliminary geological maps of Mount Whelan (produced by GSQ) and Toko (produced by BMR) were published in February and March 1980 respectively. Abudda Lakes, the one remaining geological sheet programmed for issue in the current 1:100 000 map series of the Georgina Basin, is nearing completion.

(C.J. Simpson).

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4. Publications

The following papers were published during the period October 1979-March 1980 (inclusive).

DRAPER, J.J., 1978 - Progress report on Georgina Basin geochemistry - results from 1975, 1976 field seasons. Bureau of Mineral Resources, Australia, Record 1978/23.

DRAPER, J.J., 1980 - *Rusophycus* (early Ordovician ichnofossil) from the Mithaka Formation, Georgina Basin. BMR Journal of Australian Geology & Geophysics, 5(1), 57-61.

GREEN, P.M., 1979 - Mineral exploration in the Boulia 1:250 000 sheet area. Queensland Government Mining Journal, 80(938), 610-616.

GREEN, P.M., & BALFE, P.E., 1980 - Stratigraphic drilling report - GSQ Mt Whelan 1 and 2. Queensland Government Mining Journal, 81(941), 162-178.

McKENZIE, K.G., & JONES, P.J., 1979 - Partially preserved soft anatomy of a Middle Cambrian Bradoriid (Ostracoda) from Queensland. Search, 10(12), 444-445.

PREISS, W.V., & FORBES, B.G., 1980 - Stratigraphic correlation and sedimentary history of Adelaidean (late Proterozoic) basins in Australia. South Australian Department of Mines and Energy, Rept Bk No. 80/7.

RADKE, B.M., 1980 - Saddle dolomite: an indicator of late diagenetic mineralisation in carbonates. Programmes and Abstracts, Fourth Australian Geological Convention 14-18 January, Hobart, 59.

RADKE, B.M., 1980 - Carbonate textures after Cambro-Ordovician sabkha deposits. Programmes and Abstracts, Fourth Australian Geological Convention 14-18 January, Hobart, 74.

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RADKE, B.M., 1980 - Cambro-Ordovician epeiric carbonate sedimentation: the Ninmaroo Formation, Georgina Basin. Programmes and Abstracts, Fourth Australian Geological Convention 14-18 January, Hobart, 70.

SHERGOLD, J.H., & WALTER, M.R., 1979 - Stratigraphic drilling in the Georgina Basin, 1977-78. Bureau of Mineral Resources, Australia, Record 1979/36.

TUCKER, D.H., WYATT, B.W., DRUCE, E.C., MATHUR, S.P., & HARRISON, P.L., 1979 - The upper crustal geology of the Georgina Basin region. BMR Journal of Australian Geology & Geophysics, 4(3), 209-226.

WALTER, M.R., KRYLOV, I.N., & PREISS, W.V., 1979 - Stromatolites from Adelaidean (late Proterozoic) sequences in central and South Australia. Alcheringa, 3(4), 287-305.

WALTER, M.R., SHERGOLD, J.H., MUIR, M.D., & KRUSE, P.D., 1979 - Early Cambrian and latest Proterozoic stratigraphy, Desert Syncline, southern Georgina Basin. Journal of the Geological Society of Australia, 26(6), 305-312.

WILSON, I.H., GUNN, M.J., & SMIT, J.A.J., 1979 - The Kajabbi Formation, a Middle Cambrian unit northwest of Cloncurry. Queensland Government Mining Journal, 80 (938), 629-633.

The following papers have been prepared, submitted for publication, or are in press as of 31 March 1980.

COOK, P.J., & SHERGOLD, J.H. - Proterozoic and Cambrian phosphorites of Australia and Asia - a progress report. Fertalizer Raw Material Workshop, Honolulu, August 1979.

DRAPER, J.J. - The Ethabuka Sandstone, a new Ordovician formation in the Toko Syncline, Georgina Basin, central Australia. Queensland Government Mining Journal.

DRUCE, E.C. - The Kelly Creek Formation and its conodont faunas, Georgina Basin, western Queensland and Northern Territory. Alcheringa.

DRUCE, E.C. - The Coolibah Formation and its conodont fauna, Georgina Basin, Queensland and Northern Territory. Bureau of Mineral Resources Australia, Bulletin.

DRUCE, E.C. - Conodonts of the Nora Formation and Carlo Sandstone, Georgina Basin, Queensland and Northern Territory. Bureau of Mineral Resources, Australia Bulletin.

DRUCE, E.C., RADKE, B.M. & SHERGOLD, J.H. - A reassessment of the Cambrian-Ordovician boundary section at Black Mountain, western Queensland, Australia. BMR Journal of Australian Geology & Geophysics.

GREEN, P.M. - Petrology and deposition environment of the Georgina Limestone. Queensland Government Mining Journal.

HARRISON, P.L. - The Toomba Fault and the western margin of the Toko Syncline, Georgina Basin, Queensland and Northern Territory. BMR Journal of Australian Geology & Geophysics.

JACKSON, K.S. - Petroleum source rock report - GSQ Mt Whelan 1 and 2. Queensland Government Mining Journal.

JONES, P.J., & McKENZIE, K.G. - Queensland Middle Cambrian Bradoriida (Crustacea): new taxa, paleobiogeography and biological affinities. Alcheringa.

KENNARD, J.M. - The Arrinthrunga Formation, Upper Cambrian epeiric carbonates in the Georgina Basin, central Australia. Bureau of Mineral Resources, Australia, Bulletin.

KRUSE, P.D., & WEST, P.W. - Early Cambrian Archaeocyatha of the Amadeus and Georgina Basins - an interbasin connection. BMR Journal of Australian Geology & Geophysics.

RADKE, B.M. - Epeiric carbonate sedimentation of the Ninmaroo Formation (Upper Cambrian-Lower Ordovician), Georgina Basin. Bureau of Mineral Resources, Australia, Report.

RADKE, B.M., & DUFF, P. - A potential dolostone reservoir in the Georgina Basin: the Lower Ordovician Kelly Creek Formation. BMR Journal of Australian Geology & Geophysics.

RADKE, B.M., & MATHIS, R.L. - The formation and occurrence of saddle dolomite. Journal of Sedimentary Petrology.

SANDSTROM, M.W. - Organic geochemistry of a Cambrian phosphorite. In Advances in Organic Geochemistry, 8.

SHERGOLD, J.H. - Late Cambrian trilobites of the Chatsworth Limestone, western Queensland. Bureau of Mineral Resources, Australia, Bulletin 186.

SHERGOLD, J.H. - Late Cambrian, Idamean trilobites: Burke River area, western Queensland. Bureau of Mineral Resources, Australia, Bulletin 187.

SHERGOLD, J.H., - Georgina Basin Project Progress Report 1974-1979. Bureau of Mineral Resources, Australia, Record.

SHERGOLD, J.H., & DRUCE, E.C. - Upper Proterozoic and lower Palaeozoic rocks of the Georgina Basin. In HENDERSON, R.A., & STEPHENSON, P.J. (Eds.) - Geology and Geophysics of northeastern Australia. Geological Society of Australia (Queensland Division), Brisbane.

SOUTHGATE, P.N. - Cambrian stromatolitic phosphorites from the Georgina Basin, Australia. Nature.

TURNER, S., JONES, P.J., & DRAPER, J.J. - Early Devonian thelodont remains and associated fauna from the Cravens Peak beds, Toko Syncline, western Queensland. BMR Journal of Australian Geology & Geophysics.

WALTER, M.R. - Adelaidean and Early Cambrian stratigraphy of the southerwestern Georgina Basin: correlation chart and accompanying notes. Bureau of Mineral Resources, Australia, Report 214.

WALTER, M.R. - Late Proterozoic tillites of the southwestern Georgina Basin, Australia. In HARLAND, W.B. (Ed.). Pre-Pleistocene tillites: a record of the Earth's glacial history.

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