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Record 1979/57

McARTHUR BASIN RESEARCH,

JUNE QUARTER, 1979

K.A. Plumb (Co-ordinator)

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McARTHUR BASIN RESEARCH

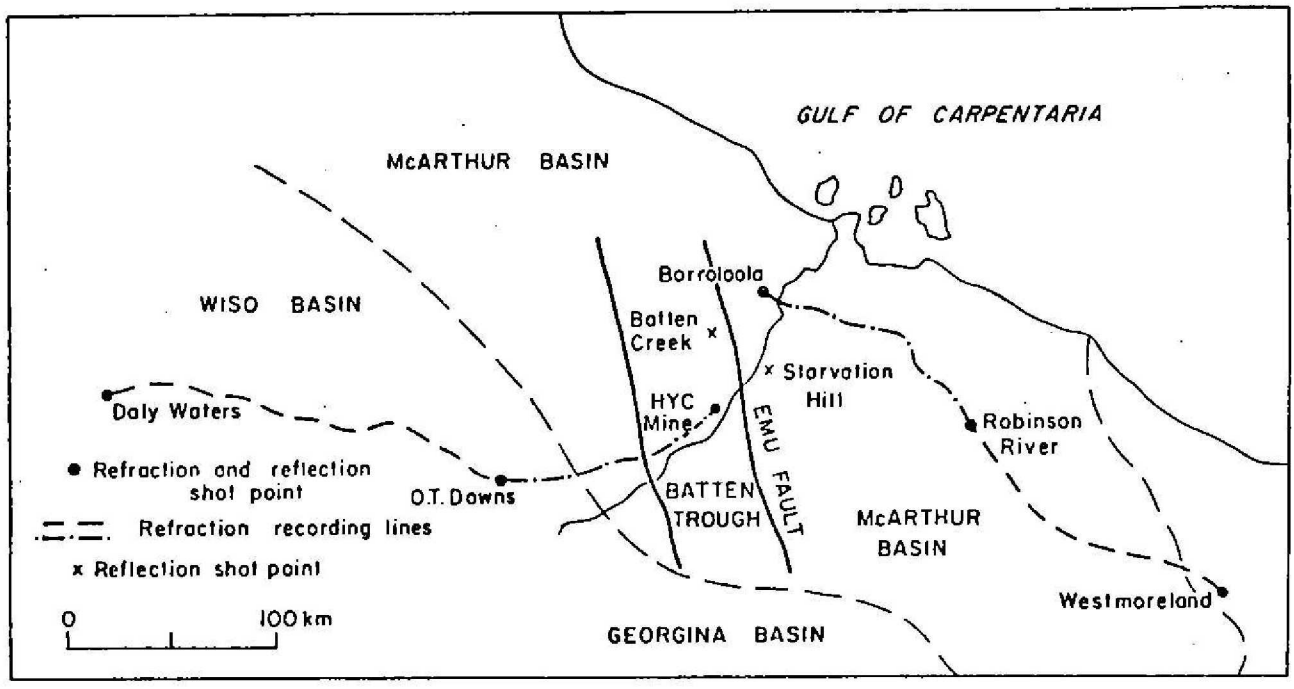
June Quarter 1979

PRINCIPAL RESULTS

(1) Marked facies changes occur in the Wollogorang Formation on the Wearyan Shelf. Disseminated mineralisation is widespread at two levels, and is probably diagenetic.

(2) Good data have been obtained from regional seismic reflection and refraction surveys across the southern McArthur Basin.

(3) Preliminary 2-D modelling of magneto-telluric data shows a major difference in thickness of the McArthur Group east (thin) and west (thick) of the Emu Fault, and appears to be consistent with previously accepted geological models for the form of the Batten Trough.



McArthur Basin seismic location sketch map

GEOLOGY

M.J. Jackson (Task Leader), K.J. Armstrong, M.D. Muir.

Much of the quarter was spent working on other projects. Fieldwork commenced during mid-June.

SEDIMENTOLOGICAL STUDIES (M.J. Jackson, M.D. Muir)

Wollogorang Formation (M.J. Jackson)

Fieldwork was concentrated in the Settlement Creek area, on the Wearyan Shelf. Here the upper part of the formation is a similar sequence of fluviatile well-sorted cross-bedded dolomitic sandstones to that of the same interval in the Mallapunyah Dome, but it is much thicker (up to 60 m), and rapid facies changes have been established over a strike length of about 40 km. Disseminated mineralisation has been found at two levels throughout the Settlement Creek Valley: disseminated copper near the base, and disseminated limonite pseudomorphs after galena and pyrite about the middle of the formation. Field relationships indicate a genetic relationship between the mineralisation and the formation of dolomitic nodules; this suggests a diagenetic origin for the mineralisation.

Balbirini Dolomite (M.D. Muir)

Work is continuing on facies distributions within the Balbirini Dolomite, and a brief examination has been made of some microfossil assemblages from surface samples collected during 1978.

PALAEONTOLOGY (M.D. Muir)

A first draft of a manuscript by Walter, Krylov, and Muir, on stromatolites from the McArthur Basin, is being revised. A first draft manuscript has been proposed, describing a microflora from the Wollogorang Formation.

GEOPHYSICS

SEISMIC SURVEYS

C.D.N. Collins, J. Pinchin, task leaders; D. Pfister, D. Pownall, J.W. Williams.

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During June and July a seismic refraction/reflection survey was carried out. The purpose was to determine the crustal structure across the basin and, in particular, to investigate the structural differences east and west of the Emu Fault. One long refraction line (300 km) and one shorter line of 100 km were recorded, on each side of the Fault (Figure 1).

For the long refraction lines, between Daly Waters and H.Y.C. Mine, and between Borroloola and Westmoreland, shots of 2000 kg were fired and recorded at 21 stations at 15-km intervals. For the shorter traverses, the charge size was 400 kg and the 21 recording stations were positioned at 5-km intervals.

Seismic reflections were recorded at each shot-point over a 3-km reflection spread and a 1-km cross-traverse. In addition, a single shot was recorded by a reflection spread near Starvation Hill, on the east side of the Emu Fault, and at Batten Creek, adjacent to the road.

Reflection Results (J. Pinchin)

Good reflections were recorded at all locations, except at Daly Waters and at O.T. Downs. At Daly Waters it is thought that shallow high-velocity interbeds, of perhaps limestone or shale, prevented the vertical penetration of seismic energy. At O.T. Downs the deep weathering of the Cretaceous rocks was probably the reason for the lack of seismic reflections. At the other sites, good reflections were recorded from estimated depths of between 2 km and 45 km; shallower reflections may be revealed by digital processing.

The seismic reflection data will be digitally processed by Geophysical Service International, Sydney; the processing will include time-variant filtering and deconvolution, to enhance the data quality.

Shallow refraction results (J. Pinchin)

The first breaks along the reflection spreads were plotted to obtain information on weathering depths and on shallow refracting horizons. In addition, a continuous shallow refraction profile was recorded along the main road near Mallapunyah Station.

The results showed generally high velocities at shallow depths. At Daly Waters, thin beds with velocities of around 4700 m/s were found at depths of 175 m, 325 m, and 450 m; these could be thin beds of limestone or shale. At H.Y.C. Mine a velocity of 5640 m/s at 45 m depth probably correlates with the Emmerugga Dolomite. A 6400 m/s refractor at Borroloola probably marks the top of a sandstone unit in the Roper Group. It was hoped that the shallow refraction profiling near Mallapunyah would reveal a distinct refraction velocity for each of the major sedimentary rock units, but the area proved too complex for this simple profiling. However, velocities of around 5500 m/s are thought to be associated with the Tooganinie Formation; 6000 m/s may mark the top of the Leila Sandstone Member, and refractors with velocities 5300 m/s and 5800 m/s, but with conflicting dips, are associated with the Emmerugga Dolomite.

Refraction Results (C.D.N. Collins)

All seismic refraction recordings were made using magnetic tape recorders, and playback of these will be done at BMR, Canberra. A few representative examples of the refraction records have been played back, using a portable field-play-back system. The quality of records produced by this system is poor and no filtering is possible to enhance the arrivals. However, the records which have been played back to date show that all shots were recorded to the maximum distance of their respective traverses.

A plot of the first-arrival times versus distance for the Daly Waters to McArthur River traverse has been made. No timing corrections were applied, and the distances are only approximate. Only two crustal phases can be clearly identified, but the scatter due to the uncorrected data and poor-quality playback may mask much of the detail. Mantle arrivals were recorded beyond about 200 km. No large differences in arrival times are apparent between seismic waves travelling east and those travelling west, indicating uniform horizontal layering between Daly Waters and McArthur River.

MAGNETO-TELLURICS D. Kerr (Task Leader), J.A. Major, A.G. Spence

Preliminary 2-D modelling has been carried out on the data from the main 1978 traverse, westwards from the Wearyan River (see September

Quarter, Record 1979/15). Progress is limited by the memory capacity of the computer, and further detailing of the complex area near the Emu Fault is still required.

East of the Emu Fault

Highly resistive basement is about 3.5 km deep at the eastern end of the line, increasing westwards to about 4.5 km near the Emu Fault. The basement is overlain by a conductive sequence, consistent with sandstones of the Tawallah Group; a lateral increase in conductivity towards the Emu Fault may indicate more volcanics in the sequence. The increase in depth to basement correlates with the appearance of a 1 km-thick conductive layer at the top of the section, which may be correlated with a known shallow basin of the Roper Group rocks. There is no significant thickness of any resistive rocks that can be correlated with the McArthur Group.

West of the Emu Fault

West of the Emu Fault, a layered sequence of highly resistive rocks, about 5 km thick, is underlain by a conductive layer, the thickness of which has not yet been computed. The resistive rocks may be clearly identified with the carbonate rocks of the McArthur Group, underlain by conductive Tawallah Group rocks.

The thickness of McArthur Group rocks west of the Emu Fault, and of Tawallah Group rocks east of the Fault, agrees well with that predicted from surface geology. There is clearly a major difference in the thickness of the McArthur Group across the Fault. The preliminary modelling clearly supports the previously accepted geological model for the form of the Batten Trough. However, it is in conflict with the preliminary model suggested from gravity (see March Quarter, Record 1979/44), and further modelling and rationalisation of both sets of data is required.

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