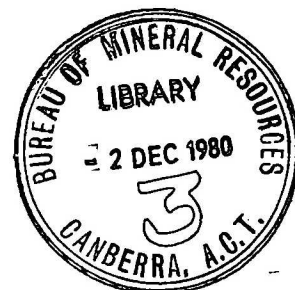




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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD



Record 1980/55

McARTHUR BASIN RESEARCH
JUNE QUARTER, 1980

K.A. Plumb (co-ordinator)

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Contents

	<u>Page</u>
PRINCIPAL RESULTS	1
PUBLICATIONS	1
GEOLOGY (M.J. Jackson, Task Leader; K.J. Armstrong)	2
SEDIMENTOLOGICAL STUDIES	2
Wollogorang Formation	2
PALAEOMAGNETISM (M. Idnurm, Task Leader; J.W. Giddings)	3
GEOPHYSICS	4
SEISMIC SURVEYS (C.D.N. Collins; J. Pinchin)	5
Refraction	5
MAGNETO-TELLURICS (A.G. Spence, Task Leader; J.P. Cull)	5
GRAVITY (W. Anfiloff)	6

PRINCIPAL RESULTS

- 1) Chemical analyses of DDH BMR Mount Young 2 reveal overall low metal values in apparently prospective strata. There is an association of slightly anomalous silver values and high organic carbon in some beds.
- 2) Palaeomagnetic evidence is now accumulating to indicate a major error in the Carpentarian segment of the published Australian polar wander path.
- 3) Seismic refraction models have been refined by introducing major velocity gradients in the deep crust.

PUBLICATIONS

The following manuscripts were completed or published during the quarter:

CULL, J.C., SPENCE, A.G., MAJOR, J.A., KERR, D.W., & PLUMB, K.A., in prep. - The 1978 McArthur Basin magneto-telluric survey.
Bureau of Mineral Resources, Australia, Record.

JACKSON, M.J., 1980 - Stratigraphy and sedimentology of three formations in the McArthur Basin. Seminar to M.Sc. Course, James Cook University (unpublished).

MUIR, M.D., 1980 - Palaeontological evidence for the Early Cambrian age of the Bukalara Sandstone, McArthur Basin, N.T. BMR Journal of Australian Geology & Geophysics, 5, 159-160.

MUIR, M.D., ARMSTRONG, K.J., & JACKSON, M.J., 1980. Precambrian hydrocarbons in the McArthur Basin, N.T. BMR Journal of Australian Geology & Geophysics, 5(4), (in press).

GEOLOGY

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

K.J. Armstrong spent most of the quarter with the Croydon Geochemical Project.

SEDIMENTOLOGICAL STUDIESWollogorang Formation

Some geochemical analyses, of 52 samples from the Wollogorang Formation intersected in DDH BMR Mount Young 2, were received from AMDEL. As described previously (Record 1980/38), the Wollogorang Formation in Mount Young 2 comprises 20 m of sandstone overlying 110 m of dolomitic siltstone and mudstone with breccia beds, tuffaceous beds, and nodular concretions. Detailed petrographic studies of the analysed samples have not yet been done, but some initial observations of the geochemistry can be made.

Metal values throughout the drillhole were surprisingly low, even in the black pyritic shale sequence between 50 and 100 m. Copper values ranged from 2-1500 ppm, with a mean of 180 ppm and standard deviation (s) of 290 ppm. Anomalous copper values (defined as more than 3s above the mean) are present in grey pyritic siltstones near the top of the formation (depth 20 m), and also near the base (depth 115 m). Lead values range from 5-95 ppm, with a mean of 24 ppm (s of 17 ppm). The only anomalous lead is near the base of the ovoid beds (80-84 m), in thinly laminated dolomitic siltstones. Zinc values range from 5-55 ppm, with a mean of 19 ppm (s of 15 ppm); there are no significant anomalies. Silver values were generally low throughout, except in the basal part of the ovoid beds (5-80 m), where values up to 2 ppm were recorded. Similarly, organic carbon values were generally low, except in the ovoid beds (62-80 m), where the average values were between 1.5-2.0%, with a maximum value of 6%. This association between anomalous silver and carbon-rich black pyritic shales is well documented (Boyle, 1968; Geological Survey Canada Bulletin 160); the average silver values for shales is around 0.1 ppm, whereas black carbonaceous shales with fine-grained sulphides commonly have values up to several ppm.

4

The Wollongorang Formation in Mount Young 2 contains some of the characteristics that I.B. Lambert (1973: Journal of Geochemical Exploration, 2, 307-330), considers attractive when prospecting for shale-hosted stratiform base-metal deposits: pyritic black shales with vitric tuff bands and ferroan dolomites. However, Lambert concludes that for an area to be prospective the pyritic shales should have major zinc and lead anomalies; this does not appear to be the case in Mount Young 2.

PALAEOMAGNETISM

M. Idnurm (Task Leader), J.W. Giddings

Pilot thermal demagnetisation results were analysed for a series of samples collected from various parts of a large drag fold that occurs in the Masterton Formation. The fold is associated with a fault that has brought the upper part of the Masterton Formation against the upper part of the overlying Mallapunyah Formation - a throw of 150-200 m. It is located along the Kilgour River, a few hundred metres downstream from the Archie Creek junction.

The analysis shows that, besides a viscous recent field component, the remanence contains two very stable components. The first of these has a range of intermediate to high blocking temperatures, with a fairly sharp cut-off at 400-450°C. It is inclined upwards at a moderate angle and points northwest. Such a component has not been encountered previously in the McArthur Basin, and the fold test indicates that it is not pre-folding in origin. It seems likely that this component represents thermoremanent magnetisation, acquired from frictional heat released at the time of faulting. Its single polarity of remanence tends to support the concept of rapid acquisition of magnetisation, and the sharp cut-off temperature is consistent with thermoremanent magnetisation. The corresponding palaeomagnetic pole may be fitted to either of two segments of the Australian polar wander path, depending on the choice of polarity. From this, the age of the regional block faulting is deduced as either approximately 500 m.y. or 750 m.y.

The second remanence component has a high blocking temperature, and a direction that is similar to a magnetisation direction found in a silicified and ferruginous weathered zone on top of the Masterton Formation in Section K11. Since the folded sediments also belong to the uppermost part of the Masterton Formation, it seems likely that these two magnetisations record the same weathering event. Indeed, it was noted in the field that silicification made the folded rock difficult to sample by drilling.

As discussed in Record 1980/38, the remanence direction in the upper weathered zone in Section K11 is similar to that in the middle to upper parts of the Mallapunyah Formation, and there is a possibility that both directions represent overprinting due to Tertiary weathering. However, the balance of evidence was found to favour a pre-Tertiary origin. Unfortunately, the present fold test was not sufficiently sensitive to settle whether the remanence is Tertiary or pre-Tertiary, because the magnetisation vector lies nearly in the axial plane of the fold. It may be argued however that weathering is unlikely to affect a steeply dipping fold limb like this one (the bedding dips range up to 68°), and that the weathered zone must therefore be folded (an indirect fold test that excludes the possibility of Tertiary weathering). This is a critical point, as it determines the integrity of the results that indicate a wide southward swing of the pole at the time of the middle to upper Mallapunyah Formation sedimentation. Accumulating evidence now points to a major error in the early to middle Carpentarian part of the existing published Australian polar wander path. A new path has been tentatively constructed, but needs refinement by additional measurements on the present collection of samples. This is an important issue because it affects many geotectonic interpretations, such as evidence for changes in the Earth's radius, or plate tectonic processes in the Proterozoic.

GEOPHYSICS

Following the intensive period of interpretation and data analysis during the March Quarter for the BMR Symposium, the emphasis during the June Quarter has been on reporting of results, and little new data has been added.

SEISMIC SURVEYS C.D.N. Collins, J. Pinchin

The reflection information was interpreted to the limits of the available data during the March Quarter, and the interpretation remains unchanged from that in Record 1980/38. Preparation of a publication is awaiting the completion of the refraction analysis.

Refraction C.D.N. Collins

The original models derived from first-arrival data (Record 1980/38) have been refined by ray-tracing and synthetic seismogram modelling. Principal changes involve the introduction of velocity gradient zones to account for the lack of strong reflection branches and, consequently, an increase in total crustal thickness.

There is evidence from the traverse to the east of the Emu Fault for a much higher Upper Mantle velocity than originally proposed, and at a deeper level. The velocity could be as high as 8.4 km/s, which is similar to the velocity at 8.3 km/s found previously in the west. However, this velocity was recorded only at the three farthest stations, when shooting both north and south. A traverse longer than 300 km would be required to define it better. There appears to be a large gradient at the Moho, as shown by the lack of strong Upper Mantle reflections, which also makes it difficult to define the velocity. The depth is uncertain for the same reason, but a maximum of 55 km fits the data fairly well.

Along each traverse there is obvious lateral structure, which cannot be modelled using synthetic seismograms. Further refinement of the models will take structure into account, and will incorporate any detailed shallow information recorded along the short traverses near the Emu Fault. All models will be tested for compatibility with the observed gravity results.

MAGNETO-TELLURICS A.G. Spence (Task Leader), J.P. Cull

Little progress has been made on processing of the 1979 data. A draft Record describing all the results of the 1978 survey has had a first edit, but final completion is awaiting Cull's return from France, in mid-September.

GRAVITY W. Anfiloff

A comprehensive Record describing all the results and a variety of gravity models from the 1978-79 gravity surveys in the McArthur Basin is nearing completion.

During the 1980 field season (September Quarter) the 1978-79 gravity coverage will be extended by about 400 km, westwards along the Carpentaria and Buchanan Highways and along the Tanumbirini-Newcastle Waters road.

