

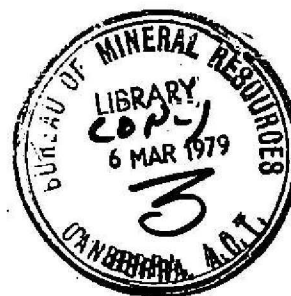
**DEPARTMENT OF  
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**BUREAU OF MINERAL RESOURCES,  
GEOLOGY AND GEOPHYSICS**

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Record 1979/16



**McARTHUR BASIN RESEARCH PROJECT PROGRESS REPORT**  
**DECEMBER QUARTER, 1978**

**Co-ordinator: K.A. Plumb**

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### PRINCIPAL RESULTS

- (1) Chemical analysis of selected samples has confirmed associations of anomalous copper values with unconformities and with evaporites.
- (2) Preliminary studies using SEM and X-ray microanalysis indicate complex mineral parageneses in the Eastern Creek Pb-Ba deposit. The deposit appears to be associated with the Roper Group basal unconformity.
- (3) A new microfossil assemblage from black shale in the Mallapunyah Formation more closely resembles Roper Group black shale assemblages than other assemblages from the McArthur Group.
- (4) Close analogies may be drawn between sedimentary structures of the Yalco Formation and the Coorong Lagoon of South Australia.
- (5) The 1978 detailed gravity survey has successfully delineated the gross aspects of the Batten Fault Zone and adjacent Wearyan Shelf, and confirms geological interpretations of their essential features.

### GEOLOGICAL RESEARCH

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

### REGIONAL STRATIGRAPHIC AND STRUCTURAL STUDIES

SOUTHERN AREA (M.J. Jackson)

Detailed photo-interpretation, using field control, has further elucidated the importance played by steeply dipping (commonly north-trending) faults in controlling the distribution of the units in the southern part of the area. In the Top Crossing area, especially, strike-faulting along the western edge of a new basin of Roper Group rocks (described in the last quarterly report) has produced repetitions of the sequence from the Masterton Sandstone up to the Emmerugga Dolomite, in narrow fault slices.

MINERALISATION (M.D. Muir, K.J. Armstrong, P. Brugman)

Samples collected during the 1978 field season from the Amelia Dolomite, Tatoola Sandstone, Leila Sandstone Member, Barney Creek Formation, and Balbirini Dolomite have been analysed. The Tatoola Sandstone sample was examined using SEM and X-ray microanalysis. The other specimens were analysed, mainly for copper but also for lead and zinc, using atomic absorption spectroscopy (Table A). The most striking result is 16% copper in a sample from the gossan at the Kilgour copper prospect. Stratigraphically this gossan occurs at about the middle of the Amelia Dolomite, but, because of mining, the relationship between the gossan and the orebody (now largely removed) is not clear.

The Leila Sandstone Member contains noticeable amounts of copper, but less zinc and lead, to the southeast of the Abner Range. Similar mineralisation (Cu, Ba) from this unit at Leila Creek has been known for some time. In the Abner samples the copper minerals occur in vuggy spaces formed by dissolution of dolomite intraclasts, whereas in the Leila Creek area the barite generally forms as discrete patches in the dolomite cement. The copper minerals in the Abner samples are always secondary - malachite, chalcocite and cuprite, the last often occurring as a thin precipitate on quartz crystals growing into the vugs. A sample from the Barney Creek Formation from the south of the Abner Range contains, suprisingly, more copper than lead or zinc.

Nine selected mineralised samples from the Balbirini Dolomite around the Abner Range were analysed. They contain between 7 and 134 ppm copper, with an average value of 27.5 ppm. Copper mineralisation frequently occurs at the base of the Balbirini Dolomite, near its unconformable contact with the Reward Dolomite. Similarly, chalcopyrite commonly occurs where the Balbirini Dolomite unconformably overlies the Yalco Formation.

Quantitative analysis of the Tatoola Sandstone samples was not undertaken, but the presence of crystals of malachite and chalcopyrite was confirmed. The malachite exhibits strange textural relationships with the host dolomite, and both minerals have been differently etched. The significance of these observations is not yet understood.

The mineralisation in the Tatoola Sandstone is associated with abundant pseudomorphs after gypsum, both as scattered pseudomorphs and as sideritic marble. Similarly, most of the Balbirini Dolomite samples (6, and 9-14) are either from beds with evaporite pseudomorphs, or closely associated

with evaporites. This relationship between mineralisation and evaporites is consistent with previous observations on the Amelia Dolomite, but the genetic relationship (if any) between the copper mineralisation and the evaporites is not yet understood. It may be significant in this connection that the three Leila Sandstone Member and Barney Creek Formation samples contained traces of K-feldspar (G.W.R. Barnes, X.R.D.) which is sometimes regarded as being the result of potassium metasomatism under evaporitic conditions.

EASTERN CREEK Pb-Ba DEPOSIT (M.D. Muir, K.J. Armstrong, P. Brugman)

#### Mineralogy

39 samples of drill core containing visible mineralisation from the C.R.A.E. EC1, 2, and 3 diamond-drillholes have been examined using SEM and X-ray microanalysis. Quantitative work was impossible, because fresh fractured or rough-cut surfaces were chosen to give textural information.

The host rocks are mainly dolomite and chert. On textural evidence, there appear to be several generations of dolomite, the latest of which is iron-rich. The chert is mainly cryptocrystalline, but in places is vuggy, with well-developed crystals and colloidal structures filling the vugs. The chert always contains potassium, which may form a major peak in the spectrum. The potassium-bearing mineral has not yet been positively identified, but is likely to be a K-feldspar. Iron and manganese, and traces of aluminium and titanium also occur.

The barite is usually more coarsely crystalline than any other mineral, but fine-grained barite, parallel to bedding, also occurs. The coarse-grained barite contains numerous fluid inclusions and invariably contains traces of iodine. The only metal so far discovered in crystals from the inclusions is potassium, presumably in the form of potassium iodide.

Pyrite is the commonest sulphide mineral and usually occurs in cross-cutting relationships with the dolomite or chert host. Chalcopyrite occurs rarely, but contains a detectable amount of unlocalised zinc. Both pyrite and chalcopyrite crystals are substantially etched on crystal faces, suggesting corrosion by later solutions (probably carbonate-rich).

As with barite, both fine and coarse-grained varieties of galena occur. Both varieties have smooth crystal faces, lacking corrosion, with growth steps on them suggesting that the galena developed after the corrosive fluids that etched the pyrite.

Much of the chert is disordered, but in many cases chalcedonic spherules are the predominant form. This would indicate a geologically recent origin for the chert.

#### General Notes

The deposit appears to be fairly closely associated with the Roper Group basal unconformity. Both bedding-confined and cross-cutting mineralisation stop at the unconformity and there is some evidence for snow-on-roof texture (sample 78109051A), in which fine-grained barite coats the tops of breccia fragments.

#### MICROFOSSIL ASSEMBLAGES (M.D. Muir)

A new microfossil assemblage from a McArthur Group shale has been found in a black shale from the Mallapunyah Formation. It contains large (up to 80 mm) acritarchs, and is morphologically much more similar to assemblages from Roper Group black shales than to the various McArthur Group black chert assemblages or to the shale assemblages in the H.Y.C. Pyritic Shale Member.

#### SEDIMENTOLOGICAL STUDIES

##### Yalco Formation (M.D. Muir)

A paper describing an environmental analysis of the Yalco Formation is nearly complete. Because of close similarities between the sedimentary structures of the Yalco Formation and those of the ephemeral lakes of the Coorong Lagoon in South Australia, a simple hydrological model can be applied to both cases. The model, which involves repeated refluxing of groundwater through a series of small evaporating pans, provides a means whereby extremely concentrated brines can be produced at drainage foci. These concentrated brines may precipitate accumulations of evaporites or even, under certain circumstances, metallic sulphides.

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## GEOPHYSICAL RESEARCH

### PALAEOMAGNETIC RESEARCH: M. Idnurm (Task Leader); J.W. Giddings.

The 1977 Kombolgie Formation magnetostratigraphic reconnaissance sections at Deaf Adder Creek and Edith River were extended vertically and augmented by further sampling, giving a 1-m stratigraphic sampling interval in all areas of continuous outcrop.

220 supplementary samples were collected at Deaf Adder Creek, and this section was extended to include the Nungbargarri Volcanic Member. The total stratigraphic thickness sampled at Deaf Adder Creek is now 250 m. Weathering and, in particular, the remobilization of iron are evident at this locality, and a number of mottled and iron sesquioxide-cemented samples were collected to isolate this possibly significant cause of secondary mineralisation in the rocks.

Approximately 450 supplementary samples were collected from the Edith River section. This section now commences in the Edith River Volcanics and extends 100 m beyond the McAddens Creek Volcanic Member, giving a total stratigraphic thickness of approximately 800 m. Test sampling was carried out at two localities to help determine the cause of the significant scatter in the remanence directions, which was found earlier in the Kombolgie Formation pilot specimens (q.v. September Quarterly Report). Samples were also collected from 5 units in the isotopically dated Edith River Volcanics, in order to fix the time scale for the Kombolgie Formation polar wander curve.

### MAGNETO-TELLURIC RESEARCH: D. Kerr (Task Leader), J.A. Major, A.G. Spence

Modifications to the processing software, to improve the quality of the data, have been completed prior to the commencement of 2-D modelling (D. Kerr).

Preliminary drafts of chapters in the survey Record, dealing with the pre-survey modelling and with the field operations, have been completed (J. Major).

GRAVITY RESEARCH: W. Anfiloff

The data from the 1978 gravity survey have been processed to the multiple-density Bouguer profile stage. Gravity modelling will commence in the New Year. The profiles provide important information on aspects of the Batten Fault Zone and the adjacent Wearyan Shelf, to the east.

(a) Bulk density information

Several ridges have been traversed in sufficient detail to allow calculation of the bulk densities of their rocks; these values will be applied to the quantitative interpretation of the profiles.

(b) Fault positions

The Bouguer profiles accurately indicate the position of the eastern fault margin of the Batten Trough. The northern traverse (2) suggests that the major boundary fault there is an easterly splay of the previously supposed main extension of the Emu Fault. The fault expression is the same on both traverses - there is a sharp gravity peak on the western side of the Emu Fault. The Emu Fault separates two distinctive gravity regimes: the gravity is smooth over the stable Wearyan Shelf, and very erratic over the Batten Fault Zone.

(c) Specific anomalies

Quantitative modelling has not yet begun, but it is apparent that large density contrasts exist within the Batten Fault Zone, and that some rocks are denser than those beneath the adjacent Wearyan Shelf. A distinctive steep gravity high next to the Emu Fault, on the main traverse (1), may indicate an abnormally dense, as yet unidentified body.

(d) Thickness of anomalous layers

Although the amplitudes of anomalies within the Batten Fault Zone are small (maximum  $50 \text{ um.s}^{-2}$ ), the gradients are steep, indicating large density contrasts at or near the surface. The thickness of the anomalous bodies must therefore be limited, possibly less than 3 km. It is possible that the anomalous layers lie within the McArthur Group.

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(e) Structure of the Wearyan Shelf

The gravity data confirm the geological thesis that the Wearyan Shelf, to the east of the Emu Fault, has remained fairly intact throughout the development of the Batten Trough and Fault Zone, but it may be tilted downwards, east of the fault zone. The cross-section across the eastern flank of the fault zone may therefore be that of a classic graben structure.

Summary

The 1978 detailed gravity survey has successfully delineated the gross aspects of the Batten Fault Zone, as well as numerous local features. The hinge-line role of the Emu Fault is depicted by the abrupt transition from smooth gravity over the Wearyan Shelf to irregular gravity within the fault zone.

The fact that all the important anomalies have amplitudes less than  $50 \text{ um.s}^{-2}$  and that topographic features complicate some of the anomalies, highlights the need for detailed surveys to interpret the gravity features of the area. The present results illustrate the unsuitability of the earlier reconnaissance helicopter gravity for delineating even the broad structural framework of the McArthur Basin.

TABLE A Atomic absorption results on McArthur Group samples (analysis by J.G. Pyke)

Sample No.	Formation	Lithology	Reason for analysis	Metals (ppm)		
				Cu	Pb	Zn
78101229A	? Amelia Dolomite	Ironstone	Gossan at Kilgour copper prospect	16%	-	-
78101111B	Leila Sandstone Mbr, Tooganinie Fm.	Medium sandstone with vugs	Cuprite and quartz in vugs	240	20	160
78101113	Leila Sandstone Mbr, Tooganinie Fm.	Medium sandstone with vugs	Chalcocite and quartz in vugs	120	n.d.	20
78101122	Leila Sandstone Mbr, Tooganinie Fm.	Medium/coarse sandstone with vugs	Quartz, pyrite and chalcocite in vugs	410	30	230
78101149D	Barney Creek Fm.	Turbiditic dolomite and siltstone	Pyritic in places	40	n.d.	20
78101032A	Balbirini Dolomite	Nodular dolarenite	Green spots in nodules	10	n.d.	20
78101225A	Balbirini Dolomite	Dolarenite	Green stain	31	-	-
78101293B	Balbirini Dolomite	Ironstone	Ironstone in karstic depression. Green stain below	134	-	-
78101218A	Balbirini Dolomite	"Tuffite"	Presence of crystal casts, possibly indicating evaporites	8	-	-

TABLE A - Continued

Sample No.	Formation	Lithology	Reason for analysis	Metals (ppm)		
				Cu	Pb	Zn
78101318C	Balbirini Dolomite	Ironstone	Gossanous appearance	7	-	-
78101321J	Balbirini Dolomite	Ironstone	Gossanous appearance	28	2	9
78101372A	Balbirini Dolomite	Dolarenite with gypsum casts	Green spots	9	-	-
78101372B	Balbirini Dolomite	Dolarenite/flake breccia with vugs	? chalcocite in vugs	8	-	-
78101373A	Balbirini Dolomite	Dolarenite/flake breccia with vugs	Green stain	13	-	-