FINAL REPORT

E.L. 1438

7th November, 1977 - 25th June, 1979

A.O. (AUSTRALIA) PTY. LIMITED
131 Elizabeth Street,
Brisbane.

September, 1979.

C O N T E N T S

C O N T E N T S (Contd.)

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1.00 INTRODUCTION

Exploration Licence 1438, covering 79.82 square miles is situated in the Billengarrah Creek area, in the northwestern portion of the Bauhinia Downs 1:250,000 sheet. The licence was granted on 7th November, 1978 and held by Electrolytic Zinc Company of Australasia Ltd. until 25th June, 1979.

Exploration Licence 1438 was one of a number of licences in the McArthur River region subject of a Joint Venture Agreement known as the Bauhinia Joint Venture in which the following companies are participants:

A.O. (Australia Pty. Ltd.
Penarroya (Australia) Pty. Ltd.
Preussag Australia Pty. Ltd.
Electrolytic Zinc Company of Australasia Ltd.

The Joint Venture Agreement was approved and registered under the Northern Territory Mining Ordinance on the 28th January, 1977. A.O. (Australia) Pty. Ltd. is the Manager of the Bauhinia Joint Venture.

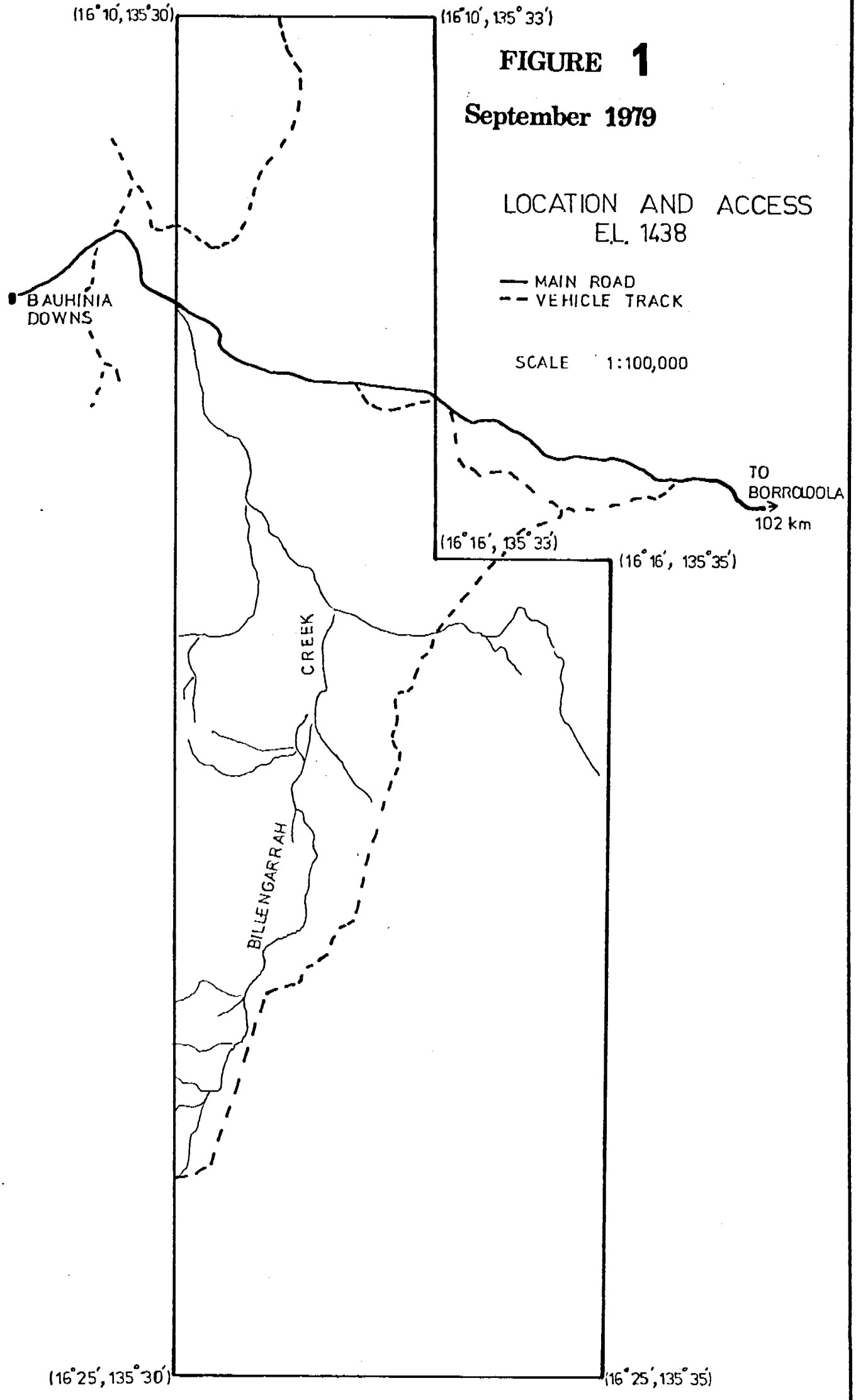
The basic philosophy of exploration to date is that potential exists within the McArthur River region for further H.Y.C. - type ore bodies. Consideration has also been given to the potential of stratabound sedimentary copper deposits.

Investigations undertaken in Exploration Licence 1438 included a review of previous company exploration, a literature study to assess the potential of the licence for the development of stratabound sedimentary copper mineralization, 1:50,000 scale mapping and geochemical sampling.

The contents of this report detail the investigations undertaken and the expenditure incurred in E.L. 1438 during

the period, 7th November, 1977 to 25th June, 1979. The report is submitted in compliance with sub-section (9) of section 38.0(1) of the Mining Act.

Why are all the diagrams upside-down ?



2.00 LOCATION AND ACCESS

The location of E.L. 1438 is illustrated in Figure 1. The northern portion of the licence is located approximately five kilometres to the east of Bauhinia Downs Homestead and is traversed by a well maintained road from the homestead to Borroloola approximately 100 kilometres further east.

Within the licence access is provided by a track in the Billengarrah Pastoral Lease which connects with the Bauhinia Downs - Borroloola road in the central eastern section and traverses, in a southwesterly direction, moderately vegetated open ground terminating in the southern portion of the licence. Many of the creek crossings on this track are difficult to negotiate by four wheel drive vehicles and progress is impeded by the poor condition of the road. However all ground investigations within Exploration Licence 1438 were undertaken using four wheel drive vehicles.

3.00 GEOLOGY

Prior to 1967 all published B.M.R. literature on the McArthur Group generally propounded that the important Barney Creek Member of the Amelia Dolomite was a unit localized only in the vicinity of the H.Y.C. deposit, and therefore the chances of finding a repetition of the H.Y.C. ore body elsewhere were small.

Mapping by Plumb and Brown in 1967 resulted in the publication of a paper* in which a detailed revision of the McArthur Group stratigraphy took place. The old name Bauhinia Downs Sub-Group was abandoned and a new sub-group, the Umbolooga Sub-Group, was defined to include all units previously mapped as Amelia Dolomite east of the Tawallah Fault; viz.: the Reward Dolomite, Barney Creek Formation, Teena Dolomite, Emmerugga Dolomite, Tooganinie Formation, Tatoola Sandstone and Amelia Dolomite (as mapped in the west) plus the Mallapunyah Formation.

The crucial point was the recognition by Plumb and Brown that the Barney Creek Formation was not localized only in the vicinity of the H.Y.C. deposit, but can be mapped both east and west of the Tawallah Fault.

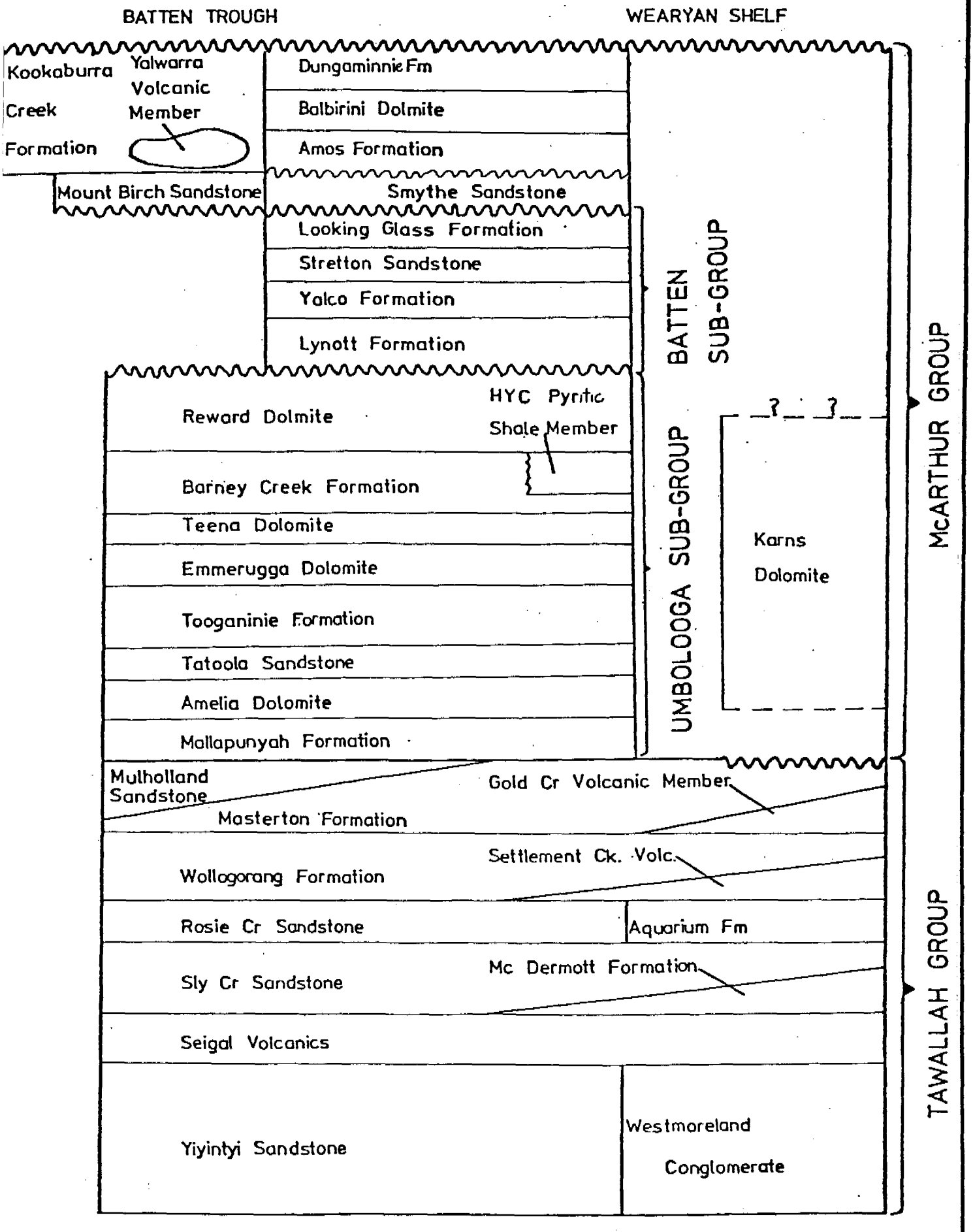
Plumb and Brown implied that the Barney Creek Formation could occur at the appropriate stratigraphic level wherever the Umbolooga Sub-Group was present. However, in their paper, only the identification of the Barney Creek Formation at the Top Crossing area was discussed.

In 1968 and 1969 Brown carried out further detailed field studies in several small areas over a total area of about

* *Plumb, K.A., and Brown, M.C., 1973. Revised correlation and stratigraphic nomenclature in the Proterozoic carbonate complex of the McArthur Group, N.T.* Bur. Miner. Resour. Aust. Bull. *139: 103-115.*

FIGURE 2

CORRELATION CHART FOR TAWALLAH AND McARTHUR GROUPS



(after Plumb & Derrick, 1975).
and Plumb, 1978

5,000 km^2.* Several sections of Barney Creek Formation were measured and described (including one in the northern portion of E.L. 1438), while other areas of Barney Creek Formation were visited and mapped. Following the 1968 field work air photo interpretation was used to delineate outcrops of Barney Creek Formation, Reward Dolomite, Teena Dolomite and Emmerugga Dolomite. Further field work was carried out in 1969 to check the air photo interpretation and examine other areas of outcrop.

The significance of this work to E.L. 1438 was the recognition that the old Barney Creek Member of the Amelia Dolomite was not a localized unit but also occurred for a considerable strike extent within Exploration Licence 1438.

Much work remains to be done to elucidate the complexities of the stratigraphy of the McArthur River region. The B.M.R. is currently engaged in a 12 year study of the McArthur Basin which commenced July 1977. One of the major aims of the study is the revision of the stratigraphic framework of the basin.

The present B.M.R. stratigraphic nomenclature in the Batten Trough region of the McArthur Basin is given in Figure 2 and a summary of the revised stratigraphy as currently known is detailed in Table 1.

* *B.M.R. Record 1969/145 (unpubl.).*

TABLE 1: SUMMARY OF REVISED STRATIGRAPHY, McARTHUR GROUP, McARTHUR RIVER REGION

Rock Unit	Thickness (in metres)	Lithology	Stratigraphic Relationships	Comparison with Previous Nomenclature
Kookaburra Ck. Formation	up to 300	Oolitic chert, banded chert, quartz sandstone, chert breccia, dolomitic siltstone, stromatolitic dolomite.	Unconformably overlain by Roper Group. Conformably overlies Mount Birch Sandstone. Considered to be northwestern stratigraphic equivalent of Stott Formation.	Unchanged.
Mount Birch Sandstone	15 to 60	Feldspathic and quartz sandstone, abundant chert fragments. Chert and quartz conglomerate.	Conformably overlain by Kookaburra Creek Formation. Unconformably overlies Vizard Formation and units as low as Tooganinie Formation of Umbolooga Sub-Group. Considered to be northwestern stratigraphic equivalent of Smythe Sandstone.	Unchanged.
Stott Formation	c. 750	Oolitic chert, massive chert, minor dolomite, quartz sandstone.	Unconformably overlain by Roper Group. Conformably overlies Smythe Sandstone. Considered to correlate with Kookaburra Creek Formation in northwest and with Amos Formation plus Balbirini Dolomite and Dungaminnie Formation in south.	Unchanged.
Dungaminnie Formation	c. 150	Siltstone, sandstone, oolitic and stromalolitic dolomite, chert breccia.	Unconformably overlain by Roper Group. Unconformably overlies Balbirini Dolomite.	Previously incorrectly mapped as Billengarrah Formation in Abner Range area.
Balbirini Dolomite	579	Dolomite, generally flaggy, and laminated dolarenite, and dolomitic conglomerate. Some stromatolitic dolomite. Minor dolomitic sandstone, dolomitic siltstone, chert, chert breccia.	Conformably overlain by Dungaminnie Formation. Conformably overlies Smythe Sandstone.	Previously incorrectly correlated with and mapped as, Emmerugga Dol. in Abner Range area.
Amos Formation	350	Dolomite siltstone, shale, local siderite bearing mudstone.	Conformably overlain by Balbirini Dolomite. Conformably overlies Smythe Sandstone.	Unchanged. Overlying unit was previously wrongly correlated and now has a new name; underlying unit was not previously recognized.

Rock Unit	Thickness (in metres)	Lithology	Stratigraphic Relationships	Comparison with Previous Nomenclature
Smythe Sandstone	0 to 180	Chert quartz sandstone, chert conglomerate.	Overlain conformably by either Amos Formation or Stott Formation. Overlies Looking Glass Formation, apparently conformably but possibly disconformably. South of Abner Range, locally rests with strong disconformity on Mara Member of Emmerugga Dolomite. Correlated with Mount Birch Sandstone.	Unchanged, except previously not recognized beneath Amos Formation in Top Crossing area, where it was mapped as Looking Glass Formation.
Vizard Formation	up to 1000	Dolomitic and cherty siltstone, chert, chert breccia, dolomite, stromatolitic dolomite, dolomitic feldspathic, or quartz-rich sandstone.	Unconformably overlain by Mount Birch Sandstone. Unconformably overlies Mount Reid Beds (Urapunga Sheet area). Correlated with Batten Sub-Group but probably also includes equivalents of Umbolooga Sub-Group; lower part of section generally not exposed.	Unchanged.
Billengarrah Formation	up to 1200	Chert, sandstone, dolomite, shale, siltstone, chert breccia.	Unconformably overlain by Roper Group. Unconformably overlies Umbolooga Sub-Group. Correlated with Batten Sub-Group although individual units cannot be recognized. Locally eroded before deposition of Mount Birch Sandstone.	Essentially unchanged although as previously mapped in the west and south it included some Reward Dolomite and Barney Creek Formation. Incorrectly identified in Abner Range area.
Batten Sub-Group		Constituent units: Looking Glass Formation Stretton Sandstone Yalco Formation Lynott Formation	Overlain, apparently conformably but possibly disconformably, by Smythe Sandstone. Overlies Umbolooga Sub-Group with local unconformity. Correlated with Billengarrah Formation.	Constituent formations, boundaries distribution, etc. unchanged. Stratigraphic relationships with Umbolooga Sub-Group revised.
Looking Glass Formation	80 to 230	Chert, cherty siltstone, chert breccia, subsidiary sandstone.	Top unit of Batten Sub-Group. Overlain conformably or possibly disconformably, by Smythe Sandstone. Overlies Stretton Sandstone conformably. Locally, in Top Crossing area, directly overlies Yalco Formation.	Unchanged except for modified stratigraphic relationships. Includes rocks previously incorrectly mapped as Stretton Sandstone in Top Crossing area Rocks which were mapped there as Lookin Glass Formation are mainly Smythe Sandstone.

Rock Unit	Thickness (in metres)	Lithology	Stratigraphic Relationships	Comparison with Previous Nomenclature
Stretton Sandstone	30 to 245	Flaggy quartz sandstone, sometimes micaceous.	Overlain conformably by Looking Glass Formation. Conformably overlies Yalco Formation.	Unchanged, except no longer present in Top Crossing area as originally mapped.
Yalco Formation	c.130	Chert, siltstone, shale, chert breccia.	Conformably overlain by Stretton Sandstone and conformably overlies Lynott Formation. Cannot be differentiated from Lynott Formation in Top Crossing area.	Unchanged.
Lynott Formation	520 to 760	Dolomitic siltstone, dolomitic sandstone, quartz sandstone, dolomite, shale, chert breccia, dolomite breccia, tuffaceous siltstone.	Lowest unit of Batten Sub-Group. Overlies with local unconformity, Umbolooga Sub-Group. Overlain conformably by Yalco Formation.	Unchanged except rocks previously mapped as Lynott Formation in Top Crossing area are now Reward Dolomite and Barney Creek Formation.
Donnegan Member (of the Lynott Formation)	105	Quartz, sandstone, dolomitic sandstone.	Occurs at top of Lynott Formation.	Unchanged.
Umbolooga Sub-Group		Constituent units: Reward Dolomite Barney Creek Formation Cooley Dolomite Member H.Y.C.Pyritic Shale Member W-Fold Shale Member Teena Dolomite Coxco Dolomite Member Emmerugga Dolomite Mitchell Yard Dolomite Member Mara Dolomite Member Tooganinie Formation Myrtle Shale Member Leila Sandstone Member Tatoola Sandstone Amelia Dolomite Mallapunyah Formation	Overlain with local unconformity by Batten Sub-Group. Conformably overlies Tawallah Group.	Replaces old Bauhinia Downs Sub-Group because definition contains new constituent units including units previously mapped as'Eastern Amelia Dolomite'. Stratigraphic relationships with Batten Sub-Group also revised. Contains a conformable sequence of rocks of related origins, distinctly different to overlying Batten Sub-Group.

Rock Unit	Thickness (in metres)	Lithology	Stratigraphic Relationships	Comparison with Previous Nomenclature
Reward Dolomite	c.300	Dolomite with characteristic chert pellets, dolomitic sandstone and shale, tuffaceous quartz arenite, breccia, tuffs, local stromatolitic dolomite.	Upper unit of Umbolooga Sub-Group, overlain by Batten Sub-Group. Conformably overlies Barney Creek Formation.	Previously mapped as part of the 'Eastern Amelia Dolomite'. Minor exposures mapped as Lynott Formation near Top Crossing and near Reward Prospect, as lower part of Billengarra Formation in west, and upper part of Emmerugga Dolomite in southwest.
Barney Creek Formation	up to 530	Characteristically dolomitic, tuffaceous, bituminous and pyritic shale. Dolomite breccia and graded dolarenite.	Conformably overlies Teena Dolomite. Conformably overlain by Reward Dolomite, locally unconformably overlain by Batten Sub-Group.	Corresponds roughly to previous Barney Creek Member of 'Eastern Ameli Dolomite'. Previously, locally mappe as Lynott Formation in Top Crossing area, or in lower part of Billengarra Formation or upper part of the Emmerugga Dolomite in west and south.
Cooley Dolomite Member (of Barney Creek Formation)	490	Massive and brecciated dolomite and dololutite, stromatolitic dolomite. Minor sandstone and mudstone. Complex of reef, lagoon, and basinal dolomites.	Conformably overlies W-Fold Shale Member. Conformably overlain by Reward Dolomite. Interfingers with H.Y.C. Pyritic Shale Member.	Newly discovered member; originally recognized in subsurface.
H.Y.C. Pyritic Shale Member (of Barney Creek Formation)	0 to 490	Bituminous and tuffaceous pyritic shale, tuff, bituminous dolomitic shale, dolarenite, dolomite breccia, bedded sphalerite and galena.	Conformably overlain by Reward Dolomite. Conformably overlies W-Fold Shale Member. Only found in Bulburra Depression;? lenses out elsewhere. Upper and lower boundaries probably diachronous. Interfingers with Cooley Dolomite Member near Emu Fault.	Contains H.Y.C. orebody. Previously mapped as part of Barney Creek Member
W-Fold Shale Member (of Barney Creek Formation)	15 to 150	Green tuff; red potash-rich tuffaceous mudstone; dolomitic tuff; bituminous dolomitic shale; minor dolomite breccia, limestone breccia.	Conformably overlain by H.Y.C. Pyritic Shale Member of Cooley Dolomite Member. Only recognized in Bulburra Depression. Passes laterally into dolomitic shales of undifferentiated Barney Creek Formation. Conformably overlies Teena Dolomite. Upper and lower boundaries probably diachronous.	Previously mapped as part of Barney Creek Member.

Rock Unit	Thickness (in metres)	Lithology	Stratigraphic Relationships	Comparison with Previous Nomenclature
Teena Dolomite	57 (reference section)	Laminated to thick bedded dololutite sometimes containing stromatolites, dolomite flake breccia, dolarenite, dolomitic sandstone, silty dolomite, rare halite casts, occasional potassium-rich mudstone.	Conformably overlain by Barney Creek Formation. Locally unconformably overlain by Batten Sub-Group or Billengarrah Formation. Conformably overlies Emmerugga Dolomite.	New formation. Previously mapped as part of Emmerugga Dolomite. Transitio al unit between Emmerugga Dolomite and Barney Creek Formation.
Coxco Dolomite Member (of Teena Dolomite)	15 to 70	Massive dololutite with occasional interbeds of potassium-rich mudstone. Characteristic pseudomorphs of radiating (?)aragonite needles.	Occurs at top of Teena Dolomite conformably overlying undifferentiated Teena Dolomite. Conformably overlain by Barney Creek Formation.	Newly recognized member.
Emmerugga Dolomite	300 (reference section)	Dolomite, with or without stromatolites. Minor breccia, dolomitic siltstone and sandstone, potassium-rich (?) tuffaceous mudstone, solution collapse dolomite breccias. Superficial chert breccias common in outcrop.	Conformably overlain by Teena Dolomite. Conformably overlies Tooganinie Formation.	Includes all the rocks except the Teena Dolomite previously mapped as Emmerugga Dolomite in the west. Local previously mapped as Top Crossing Dolomite at Top Crossing and as part of 'Eastern Amelia Dolomite' or Hammer Creek Member in east.
Mitchell Yard Dolomite Member (of Emmerugga Dolomite)	15 to 120	Thick bedded clean dololutite. Very minor potassium-rich mudstone.	Top member of Emmerugga Dolomite. Conformably overlain by Teena Dolomite. Conformably overlies Mara Dolomite Member.	Newly recognized member, previously mapped as part of Emmerugga Dolomite in west and'Eastern Amelia Dolomite' in east.
Mara Dolomite Member (of Emmerugga Dolomite)	c.240	Cherty dololutite with stromatolites and algal laminations. Minor flake breccia, dolarenite, dolomitic siltstone, dolomitic sandstone, potassium-rich mudstone, solution collapse dolomite breccias. Outcrops commonly altered to chert breccia.	Lower member of Emmerugga Dolomite. Conformably overlain by Mitchell Yard Dolomite Member. Conformably overlies Tooganinie Formation.	Newly recognized member, previously mapped as part of Emmerugga Dolomite in west and 'Eastern Amelia Dolomite' in east.

Rock Unit	Thickness (in metres)	Lithology	Stratigraphic Relationships	Comparison with Previous Nomenclature
Tooganinie Formation	807	Dolomite, with chert bands and nodules, often stromatolitic, occasionally oolitic. Dolomitic sandstone, dolomitic siltstone, dolomitic shale, subsidiary ferruginous shale, intraformational conglomerate; halite casts common.	Conformably overlain by Emmerugga Dolomite. Locally unconformably overlain by Mount Birch Sandstone. Conformably overlies Tatoola Sandstone.	Corresponds to Tooganinie Formation as originally mapped in the west. In the east previously included in 'Eastern Amelia Dolomite' or in Hammer Creek Member.
Myrtle Shale Member (of Tooganinie Formation)	30 to 240	Dolomitic shale; minor dolomitic sandstone, silty dolomite.	Top member of Tooganinie Formation. Conformably overlain by Emmerugga Dolomite. Conformably overlies Leila Sandstone Member.	New member. Previously mapped as undifferentiated Tooganinie Formation overlying Leila Sandstone Member. 'Red beds' characteristic.
Leila Sandstone Member (of Tooganinie Formation)	c.140	Dolomitic sandstone, sandy dolomite, quartz sandstone. Subsidiary dolomite, often stromatolitic.	Conformably overlain by Myrtle Shale Member. Conformably overlies undifferentiated Tooganinie Formation.	Corresponds to original Leila Sandstone Member.
Tatoola Sandstone	c.140	Quartz sandstone, feldspathic sandstone, dolomitic sandstone. Minor dolomite and siltstone, more abundant near base.	Conformably overlain by Tooganinie Formation. Conformably overlies Amelia Dolomite.	Corresponds to Tatoola Sandstone as originally mapped in west. In east originally mapped as Warramana Sandstone (with which it was correlated) or as part of 'Eastern Amelia Dolomit
Amelia Dolomite	90 to 240	Bedded dolomite, commonly stromatolitic. Regular silicified beds. Some thin beds of dolomite breccia, green shale, white calcilutite.	Conformably overlain by Tatoola Sandstone. Conformably overlies Mallapunyah Formation.	Corresponds to Amelia Dolomite previously mapped in the west. In t east previously mapped as part of 'Eastern Amelia Dolomite', or Festing Creek Formation, with which it was correlated.
Mallapunyah Formation	30 to 750	Quartz sandstone, ferruginous sandstone, ferruginous shale, dolomite, dolomitic siltstone, chert, sideritic bands.	Lowest unit of McArthur Group and Umbolooga Sub-Group. Conformably overlain by Amelia Dolomite. Conformably overlies Tawallah Group.	Corresponds to Mallapunyah Formation as previously mapped. In northeast, was included in Festing Creek Formati with which it was correlated 'Red bed characteristic.

4.00 PREVIOUS EXPLORATION

4.10 Carpentaria Exploration Co. Pty. Ltd.

4.11 Reconnaissance Geological Traversing

In 1966 Carpentaria decided that helicopter-supported, reconnaissance geological traversing should be undertaken west of the Tawallah Fault in order that the development of the Barney Creek Formation at the appropriate stratigraphic level between the Emmerugga Dolomite and Billengarrah Formation as formerly mapped by the B.M.R. could be evaluated.

Sixty-two helicopter traverses were made in the Bauhinia Downs Homestead - Three Knobs region, of which seven occurred within E.L. 1438. Traverses were based on a 1 mile or 2 mile separation and planned to cover areas considered to represent best outcrop.

It was expected that any silver-lead-zinc mineralization would occur as a lens within an unmineralized pyritic shale horizon having a reasonable strike length. With a 1 mile to 2 mile separation, it was thought unlikely that any significant development of pyritic shale would be missed, let along any development of mineralized pyritic shale.

Within E.L. 1438, Carpentaria geologists concluded that there was a remarkable close correlation with the sequence at the H.Y.C. up to and including the equivalent of the Teena Dolomite, but that the upper sequences, which would include the Barney Creek Formation held little resemblance to those of the McArthur deposits.

However, the northern reconnaissance traverses in E.L.1438

were conducted over areas of poor outcrop where sequences of pyritic shales could occur masked by alluvium or chert screes.

C.E.C. contended that the consistent lithology and relatively uniform thickness of the Teena Dolomite in the western area indicated that deposition had taken place in a stable shelf environment; whereas at McArthur, sharp thickness variations, particularly in the Basal Tuff Beds, were features which indicated deposition in restricted basins. This type of environment, in contrast to the stable shelf environment was considered more suitable for the accumulation of sedimentary base metal deposits.

4.12 Geochemical Programs

During 1969-1970, the ground covered by E.L. 1438 formed part of a large area west of the Tawallah Fault which was subjected to stream sediment sampling. The regional survey averaged 4 to 5 samples per square mile.

Within E.L. 1438, two isolated anomalous stream sediment values were located. One of these samples was collected from the extreme southwestern corner of licence and assayed 520 ppm Ni, while the second sample assaying 140 ppm Pb, was located in the northern section of the licence.

Carpentaria undertook a number of regional soil traverses in conjunction with their stream sediment sampling program. Sample localities were 200 feet apart, the sample being collected from a depth of 6-12 inches.

Two of these regional soil lines crossed ground covered by the southern part of E.L. 1438. An elevated value of

170 ppm Pb was found associated with the Leila Sandstone Member of the Tooganinie Formation and a value of 150 ppm Pb in a unit since mapped by Bauhinia Joint Venture geologists as Yalco Formation.

4.20 C.R.A. Exploration Pty. Ltd.

The northern portion of E.L. 1438 was held previously by C.R.A. as E.L. 879. C.R.A. geologists were aware of the remapping by the B.M.R. of the Billengarrah Formation as Barney Creek Formation and Reward Dolomite. They undertook to investigate the Barney Creek Formation.

C.R.A. considered that the maximum development of Barney Creek Formation was found to occur in the south of E.L. 879 near Four Mile Creek (east of Bauhinia Downs Homestead) where the formation comprises 80 metres of dark grey, carbonaceous, dolomitic siltstones with thin interbeds of dololutite and pink tuffaceous shales. In this area beds dip at 8-10^{o} to the west and the formation was interpretated as thinning gradually along strike to the north.

As the Barney Creek Formation outcrops poorly, a power auger was employed to obtain bedrock samples. Twenty-nine samples were collected at one kilometre spacing throughout E.L. 879. All samples were assayed for Pb, Zn, Cu, Ni, Co, Cu, Mn and Ag.

Most samples assayed in the range 11-170 ppm Pb and 9-560 ppm Zn. One sample to the north of E.L. 1438 assayed 1480 ppm Pb and 900 ppm Zn. At this locality an additional 18 samples were collected on a 500m grid. Assays for this second group of samples had an overall range of 34-640 ppm Pb and 9-360 ppm Zn, with most falling in the range of 60-240 ppm Pb and 21-57 ppm Zn.

C.R.A. concluded that results indicated that although Barney Creek Formation within the grid area is anomalous in lead and zinc, significant values were only sporadically distributed.

5.00 POTENTIAL FOR STRATABOUND COPPER IN THE McARTHUR BASIN

5.10 Introduction

This section gives a brief resumé of an office research study into the potential for development of stratabound sedimentary copper deposits within the Bauhinia Joint Venture Exploration area of the McArthur Basin. The characteristics of stratabound sedimentary copper deposits were studied in detail with extensive use being made of two review papers - Pelissonier (1972) and Bowen and Gunatilak (1977). The stratigraphic nomenclature used is that of the B.M.R. (Plumb and Derrick, 1975 - see Figure 2)

For the purpose of this report, the term "stratabound sedimentary copper deposits" is used to include both the so-called red-bed type and the Mansfield-type deposits.

5.20 Characteristics of Stratabound Sedimentary Copper Deposits

5.21 Regional Geological Parameters

Bowen and Gunatilaka (1977) have divided the time of formation of these types of copper deposits into two main periods. The earliest period is between 1300 m.y. and 840 m.y., with a maximum development at circa 1000 m.y., in the Central African Copperbelt of Zambia and Zaire. The second great period of copper accumulation was mainly during the Middle Devonian to Permian (circa 380 m.y. to 250 m.y. ago) in the northern continents.

Pelissonier (1972) summarizes other regional parameters. The sediments which enclose the copper mineralization are part of a sequence of layered sediments deposited in continental basins or on continental platforms. The deposits have a terrestrial provenance and are of a post-

orogenic or epeirogenic nature. The substratum often shows an eroded,irregular surface. The distance, therefore, between the mineralized horizon and true basement is very variable and there may be no apparent association. The deposits are generally associated with transgressive and cyclic sedimentary sequences of intraplate environments.

The sediments have not usually been subjected to folding after deposition but patterns of fractures and faults are always present. In the majority of cases regional metamorphism is very weak or absent.

5.22 Local Geological Parameters

The host rocks to mineralization are diverse; conglomeratic arkoses, sandstones, clays, marls and dolomites. In the metallogenic unit the mineralization usually prefers a single lithological facies which may occur cyclically through the series. The enclosing rocks are usually characterized by the presence, often abundance, of organic debris (often bituminous or carbonaceous material).

5.23 Chemical and Mineralogical Parameters

Pelissonier (1972) characterizes stratabound sedimentary copper deposits by the relative lack of sulphur and iron in the ore minerals; primary ores being chalcocite and bornite with minor chalcopyrite and pyrite.

Apart from copper, cobalt occurs in several of the deposits as carrollite-linnaeite. Sphalerite, galena and uranium minerals are often associated. Silver is contained within most deposits but is generally less than 10 ppm.

Lateral and vertical zonation of metal content is common where lead and zinc are present. Upwards from the base and seawards away from the margins of the basin the sequence is Cu-Pb-Zn-Fe.

5.24 Environmental Parameters

Bowen and Gunatilaka (1977) indicate that the sedimentary environments for deposition are either:

(a) marine to marginal-marine environments of mainly terrigenous accumulations that are indicative of extensive subtidal to supratidal flats and shallow enclosed embayments

(b) shallow lagoonal and lacustrine type settings of inferred continental basins with possibly internal drainage.

5.30 Origin of Mineralization

The most commonly accepted origin for this type of copper mineralization is from the weathering and drainage of an adjacent land mass. However, Raybould (1978) considers that the supply of copper is rift-controlled with a "fundamental fracture" beneath the host rocks acting as a channelway for the mineralizing fluids. The ore minerals would thus be deposited with the sediments or shortly afterwards. Raybould interprets the Batten Trough in the McArthur Basin as an intracratonic rift and this would enhance the possibility of finding copper deposits near this area. The presence of mainly Pb-Zn mineralization at the H.Y.C. deposit would be interpreted as a result of zoning with the copper being deposited elsewhere.

5.40 McArthur Basin Succession

5.41 Regional Setting

The McArthur Basin is the largest of the several mid-Proterozoic mildly deformed platform covers which compose

the North Australian Platform Cover unconformably overlying a highly deformed basement. The Basin contains up to 12,000 metres of Carpentarian sediments which are exposed over about 170,000 square kilometres, see Figure 3. The depositional limits, during the various stages of the basin's development, are poorly known.

5.42 Stratigraphy and Geochronology

The McArthur Basin succession has a maximum composite thickness of about 12,000 metres (Figure 3), although 10,500 to 11,000 is more typical in the central belt of maximum thickness. The succession comprises three major subdivisions. In order of deposition they are, respectively: the Tawallah Group and equivalents consisting of quartz-rich arenites, subordinate basic volcanics, carbonates and lutites up to 6,000 metres thick; a dominantly carbonate sequence, the McArthur Group and equivalents, up to 5,500 metres thick; and the Roper Group and equivalents, which consist of alternating quartz arenites and micaceous lutites up to 5,000 metres thick. The succession is illustrated in Table 2 .

5.43 Known Copper Mineralization

Plumb (1977) discusses known copper occurrences in sedimentary rocks in the McArthur River region. He notes that:

> " The deposits so far known in sedimentary rocks are all small and usually show some structural control. However, all occur in similar facies and probably represent remobilised stratabound deposits. The host rocks are very shallow-water or red-bed carbonate and terrigenous sediments; a preliminary investigation tends to suggest that they occur in the dolomitic silts rather than the nearby carbonates. Recent detailed work by M.D. Muir has revealed very fine-grained disseminated copper in thin sections of otherwise apparently unmineralized rocks. Most .. "

Table 2. Summary of Stratigraphy, McArthur Basin

Unit and locality	Main rock types. Thickness in m	Remarks
ROPER GROUP (Throughout basin)	Quartz sandstone, minor ferruginous sandstone, shale (*Limmen, Abner, Bessie Cr Ssts*); micaceous siltstone (*Mainoru Fm*); micaceous glauconitic sandstone (*Crawford Fm*); interbedded micaceous fine sandstone, siltstone, & shale (*Corcoran, Cobanbirini Fms, Malwok Sub-Gp*). 500–5 000	Fe (*Roper R*) in Sherwin Ironstone Mbr of McMinn Fm. Overlies McArthur & Mt Rigg Gps with regional unconformity
McARTHUR GROUP	Dominantly carbonate rocks. 0–5 500	
Batten Trough–McArthurRiver area	Chert-quartz sandstone, conglomerate (*Smythe Sst*); dolomite, siltstone, shale, chert, oolitic chert (*Amos, Dungaminnie, Stott Fms*); dolomite, dololutite, some stromatolites (*Balbirini Dol*). 1 250	Locally unconformable on Batten Sub-Gp
Batten Sub-Group	Dolomitic siltstone, sandstone, shale (*Lynott Fm*); interlaminated siltstone-chert (*Yalco Fm*); quartz sandstone (*Stretton Sst*); chert, cherty siltstone (*Looking Glass Fm*). 1 000	Locally unconformable on Umbolooga Sub-Gp
Billengarrah Formation	Chert, sandstone, dolomite, shale. 1 000	Correlated with Batten Sub-Gp
Umbolooga Sub-Group	Ferruginous & dolomitic sandstone & siltstone, dolomite (*Mallapunyah Fm*); dolomite, dololutite, abundant stromatolites (*Amelia, Emmerugga, Teena, Reward Dols*); flaggy sandstone (*Tatoola Sst*); alternating dolomite (stromatolites), dolomitic siltstone & sandstone (*Tooganinie Fm*); dolomitic, tuffaceous, bituminous, & pyritic shale (*Barney Creek Fm*), basic to intermediate volcanics (*?Amelia Dol*). Up to 3 250	Pb-Zn (*H.Y.C.*) in H.Y.C. Pyritic Sh Mbr of Barney Cr Fm. Minor Pb in Emmerugga Dol & Cu in Amelia Dol & Tooganinie Fm
Urapunga Tectonic Ridge	Dolomitic & cherty siltstone; dolomite, stromatolitic dolomite; dolomitic, feldspathic, & quartz sandstones (*Vizard, Kookaburra Cr Fms*); feldspathic chert-quartz sandstone, conglomerate (*Mt Birch Sst*); oolitic chert (*Kookaburra Cr Fm*); basic to intermediate volcanics (*Yalwarra Volc Mbr* of *Kookaburra Cr Fm*). 750+	Minor Pb, Cu in Kookaburra Cr Fm
TAWALLAH GROUP (Wearyan Shelf, Batten Trough-McArthur River area)	Quartz and feldspathic sandstones, conglomerate (*Yiyintyi, Sly Creek, Mulholland Ssts, Westmoreland Cgl, Masterton Fm*). Subordinate basic to intermediate volcanics, (*Peters Cr, Settlement Cr Volcs, Gold Cr Volc Mbr* of Masterton Fm); acid volcanics (*Hobblechain Rhyolite & Tanumbirini Volc. Mbrs* of Masterton Fm); dolomite, dolomitic siltstone & sandstone (*Wollogorang, McDermott Fms*); glauconitic sandstone & siltstone (*Aquarium Fm, Rosie Cr Sst*). 4 000–5 000	U (*Westmoreland*) in dolerite dykes in Westmoreland Cgl. Minor U in Peters Cr Volc. Cu (*Redbank*) in breccia pipes in Gold Cr Volc Mbr

(After Plumb & Derrick, 1975)

".. deposits at the surface comprise secondary carbonates and oxides. Workings are collapsed and inaccessible. The nature of the deposits at depth is unknown.

There appears to be potential for the discovery of large low-grade bedded copper deposits. "

5.50 The Potential of McArthur Basin Strata

5.51 General

Several features of the McArthur Basin succession are in keeping with the regional setting of stratabound sedimentary copper deposits. These features are summarized below:

(a) The succession represents a sequence of layered sediments deposited on a continental platform.

(b) A terrestrial provenance with denudation of continental masses is envisaged.

(c) The succession represents post orogenic accumulation.

(d) Transgressions and regressions are a feature of sedimentation.

(e) Syn-sedimentary faults are the dominant structural feature compared to post depositional folding.

(f) Regional metamorphism is absent.

5.52 Application of Selection Criteria

The criteria used for selecting possible target horizons within the McArthur Basin succession are listed in Table 3 and a brief summary of exploration guidelines is given in Table 4

5.521 Tawallah Group. On present information one formation of the Tawallah Group satisfies a significant number of the selection criteria. This is the Wollogorang Formation. This formation contains suitable host lithologies, bituminous horizons, dolomites, ferruginous horizons and associated stratabound copper (and lead - zinc) mineralization. Volcanics occur at the base of the Group.

TABLE 3: SELECTION CRITERIA FOR DETERMINING POSSIBLE TARGET HORIZONS

GEOLOGICAL CRITERIA

1. Substratum usually eroded with an irregular surface

2. Substratum -

   either (i) strongly metamorphosed basement predating sedimentation by a large amount of time

   or (ii) consists of sediments with a marked volcanogenic character usually, but not always, predating host formation. No apparent association with basement.

3. Forms part of a transgressive series

4. Presence of alternating layers with different granulometric composition (reflecting possible cyclic sedimentation)

5. Presence of a suitable host lithology i.e. reduced sandstones, shales, argillites, dolomites (often stromatolitic) or a combination of these lithologies

6. Presence of, or underlain by, red-beds or other oxidized continental clastic sediments

7. Presence of, or overlain by evaporitic lithologies (dolomite, anhydrite, gypsum)

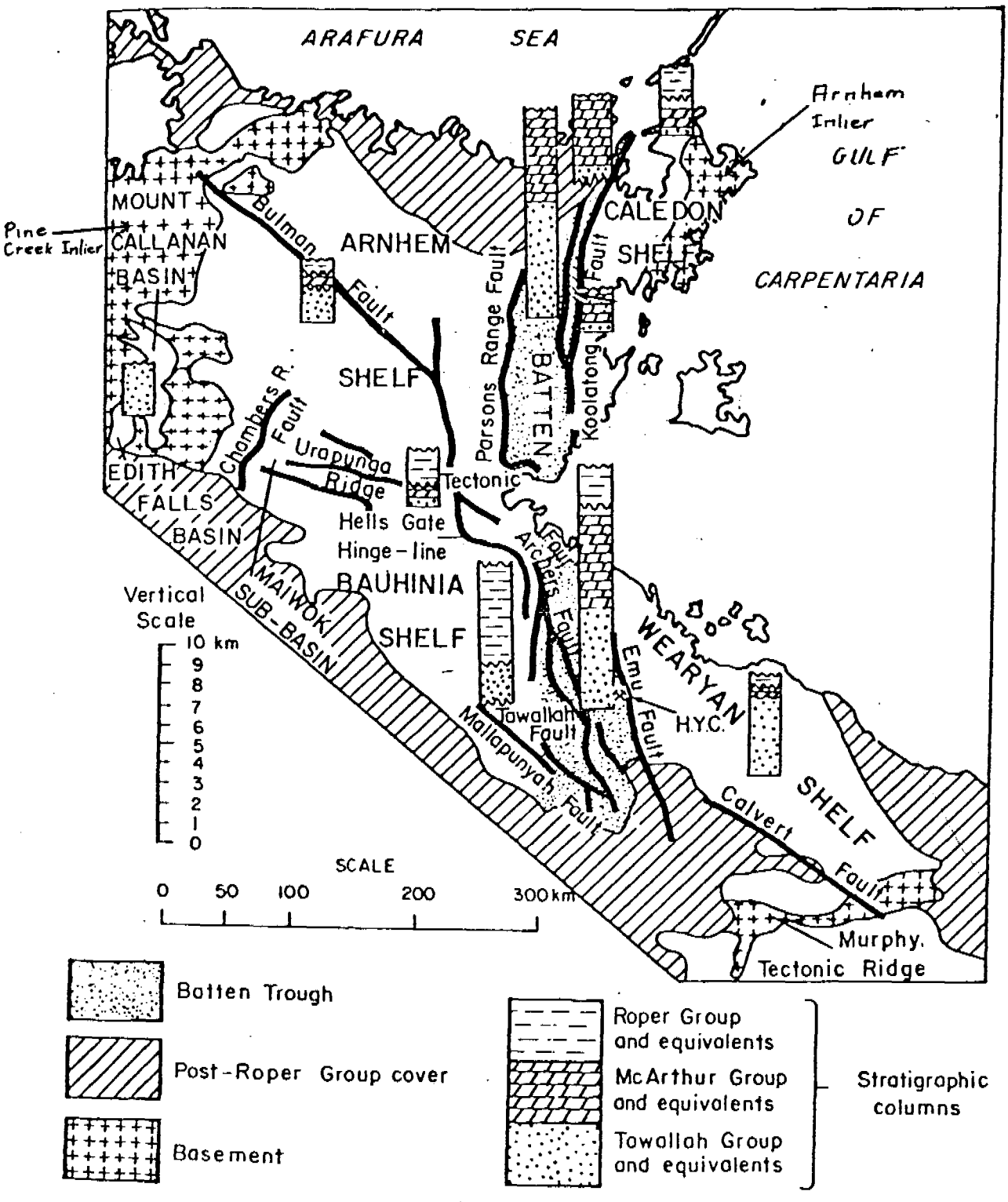
8. Presence of carbonaceous material, bituminous material or organic debris

CHEMICAL/MINERALOGICAL CRITERION

9. Associated copper mineralization and/or anomalous copper rock or soil geochemistry.

ENVIRONMENTAL CRITERION

10. Part of, or wholly represents,a subtidal - intertidal - supratidal setting similar to Recent sabkhas.



Major tectonic elements, Mc Arthur Basin (after Plumb & Derrick, 1975).

5.522 Umbolooga Sub-Group. It is envisaged that two major cycles of transgression-regression occurred during Umbolooga Sub-Group times: from the top of the Mallapunyah Formation to the Myrtle Shale Member of the Tooganinie Formation and from the top of the Myrtle Shale Member to the top of the Reward Dolomite. The Umbolooga Sub-Group was deposited in an arid hypersaline environment alternating between supratidal, intertidal and shallow subtidal conditions. Three formations of the Umbolooga Sub-Group fulfil a number of the remaining selection criteria. They are the Mallapunyah Formation, Amelia Dolomite and Tooganinie Formation. The Mallapunyah Formation has a suitable non-eroded substratum, suitable host lithologies, presence of red beds, evaporites and algal dolomites, a suitable environmental setting and known stratabound copper mineralization. Carbonaceous lithologies have not been located.

The Amelia Dolomite forms part of a transgressive sequence; contains suitable reduced lithologies, evaporitic rocks and local carbonaceous shales; conformably overlies a predominantly red bed sequence (Mallapunyah Formation) as well as containing red siltstone horizons itself; contains known weak stratabound copper mineralization; and has a suitable environmental setting.

The Tooganinie Formation has a suitable environmental setting, is part of a transgressive sequence, contains regularly alternating lithologies which include stromatolitic dolomite, reduced and oxidized shales, siltstones and dolomitic sandstone. Evaporite relicts are present and some copper anomalism is associated with the "Slab Top Dolomite" and Leila Sandstone Members. The formation however, is not

TABLE 4.

SUMMARY OF EXPLORATION GUIDELINES FOR COPPER IN THE McARTHUR RIVER REGION.

Identification of palaeohighs

Identification of palaeoshorelines

Identification of carbonaceous or bituminous horizons

Presence of evaporitic lithologies

Presence of red-beds or other oxidized continental clastic sediments

Identification of reefal dolomites

Recognition of cyclic sedimentation

Recognition of transgressions and regressions

Presence of a lateral zonation in Cu-Pb-Zn-Fe

Presence of vertical zonation in Cu-Pb-Zn-Fe

known to contain carbonaceous, bituminous lithologies. The substratum is not eroded and does not contain stratigraphically close basic volcanics.

5.523 Batten Sub-Group and Equivalents. The formation which satisfies the largest number of criteria is the Lynott Formation. This has a suitable substratum and contains a variety of lithologies including reduced pyritic units, rocks with evaporite pseudomorphs and dolomite with stromatolites. The environmental setting may be suitable. However, the formation lacks copper mineralization, red beds, known cyclic sedimentation, or carbonaceous and bituminous host lithologies.

5.524 "Upper" McArthur Group. The units comprise the upper transgressive sequence, namely Smythe Sandstone, Mount Birch Sandstone and the overlying McArthur Group units. Evaluation is hampered by the lack of published data concerning these units. Favourable features include:

(a) part of a transgressive series

(b) unconformity at base

(c) volcanogenic component in the Smythe Sandstone

(d) suitable environment

(e) indication of evaporites

(f) a variety of shallow water lithologies which could host mineralization if reduced facies present

(g) minor associated copper mineralization

5.525 Roper Group. The application of selection criteria to this group is difficult due to the lack of detailed studies by the B.M.R. and exploration companies. Based on present,

available data, the group satisfies only a few selection criteria; namely:

(a) base marked by an erosional unconformity

(b) presence of reduced siltstones and shales

(c) shallow water marine conditions (although not interpreted as indicative of sabkha development)

(d) copper mineralization reported at one locality

5.60 Conclusions

Of the McArthur Basin succession units in E.L. 1438 which were considered on the basis of the study, to hold the best potential for the development of stratabound copper mineralization, none gave anomalous copper values from the geochemical sampling undertaken in the licence (refer to Section 7.00, Table 5).

6.00 MAPPING

6.10 General

Plan 1 illustrates the geology of Exploration Licence 1438 mapped at a scale 1:50,000. The stratigraphic nomenclature used in the mapping is that adopted by A.O. (Australia) Pty. Ltd. during the course of its exploration program in the McArthur River region.

The nomenclature initially arose from detailed mapping of several areas east of the Tawallah Fault, but has been found, during the three years of exploration by the Bauhinia Joint Venture to be applicable over an extensive area covering the Bauhinia Downs and Mount Young 1:250,000 sheets. Figure 4 gives a comparison between the nomenclature used in the mapping of E.L. 1438 by the Bauhinia Joint Venture with that published to date by the B.M.R..

6.20 Teena Formation

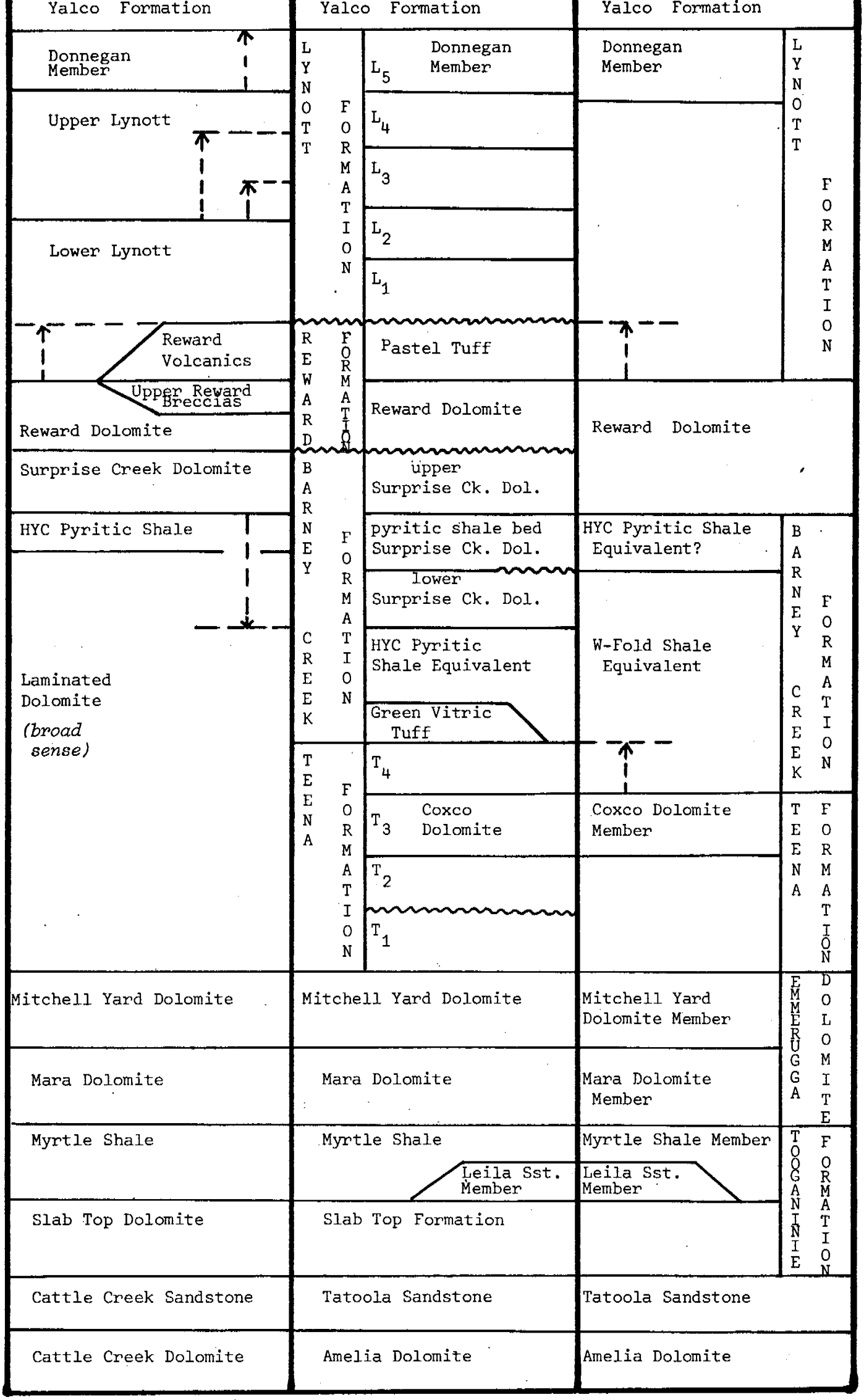
6.21 T_1

This unit is not often encountered, but is recognized in outcrops where it overlies the Mitchell Yard Dolomite by an abrupt change to yellow laminated dolomite in which thin pink tuff beds are common. Recorded outcrops in the McArthur River region vary from 1 to 30 metres.

Outcrop of this member is sporadic and not well developed in E.L. 1438.

6.22 T_2

This is a poorly outcropping unit which appears to consist of well bedded mudstones, tuffaceous dolomitic siltstones and pink tuff beds. The tuff beds may be up to 4 metres



COMPARISON A.O., C.E.C. AND B.M.R. NOMENCLATURE.

East of Tawallah Fault and excluding environs of H.Y.C. deposit.

thick and provide a means of distinguishing the unit from the Barney Creek Formation which it otherwise resembles closely. The unit is even less likely to outcrop than the H.Y.C. Pyritic Shale equivalent. It is difficult to be sure of the distinction between T_2 and the H.Y.C. Pyritic Shale equivalent where reference cannot be made to a nearby Coxco Dolomite outcrop.

Unit T_2 is not well developed within Exploration Licence 1438.

6.23 T_3 Coxco Dolomite

The Coxco Dolomite is almost always identifiable by the radiating pseudomorphs after gypsum, and usually also by the presence of pink tuff beds. Where neither of these are obvious identification can still be attempted on outcrop character; in particular the absence of blockiness relative to the Mitchell Yard Dolomite. Karst weathering tends to produce "pothole" like structures instead. Colour is hardly ever the dark blue grey most common in the Mitchell Yard Dolomite. The most common colour is pale yellowish grey. Lamination is absent. Some bedding controlled concretions of chert are found, and breccia is common in places.

In E.L. 1438, the T_3 member is represented by massive, grey-weathering dolomite. Some chocolate coloured surface weathering, indicating ferroan alteration was observed, but not in abundance and usually associated with sinkhole fills.

6.24 T_4

The B.M.R. tend to place this unit in the Barney Creek Formation. The beds are comprised of thin interbedded dark dolomite and pink tuff, which reduces to mainly tuff with laminations as the dolomite is eliminated. The beds tend to outcrop strongly and small karst towers are common in low dip areas. The laminations distinguish it from the Coxco Dolomite below, and the abrupt disappearance of pink feldspathic tuffs marks the top. Both boundaries are sharp. The pseudomorphs after gypsum characteristic of the Coxco Dolomite are very rare or absent from T_4.

In E.L. 1438, the T_4 member is difficult to define as there are two major beds of laminated dolomitic tuff with dolomite between them. It was considered convenient to include this dolomite in T_4 as it is yellow weathering and distinctly laminated relative to the more massive, grey weathering T_3.

6.30 Barney Creek Formation

The H.Y.C. shale equivalent in Exploration Licence 1438 consists of typical carbonaceous, dolomitic siltstones with some pink tuff beds for most of its thickness. In areas where basal H.Y.C. equivalent was accessible, flinty tuffaceous interbeds were common and samples of this material generally have anomalous geochemistry (refer to Section 7.00). It is thought that this material is the equivalent of the Green Vitric Tuff Beds.

One area in which the base of the H.Y.C. equivalent was sampled proved to be barren. The "flinty tuff" was absent from this locality, and the Barney Creek Formation appears

to be thinner than usual. It seems that the flinty tuff is an indicator of basin subsidence operating during deposition of the Barney Creek Formation.

The Surprise Creek Dolomite is well developed in the area. Below the pyritic shale marker bed, the formation is a uniform flaggy dolomite which thins northwards outside the exploration licence. The thickness variation reflects the facies boundary with the H.Y.C. Pyritic Shale equivalent. The Upper Surprise Creek Dolomite is a more diverse unit although dominated by smooth yellow surfaced flaggy dolomite. Other pyritic shales are present together with two thick beds of tuffaceous dolomitic siltstone which develop into tuffs to the immediate north of E.L. 1438.

6.40 Reward Formation

In Exploration Licence 1438, the Reward Dolomite appears to represent the base of an unusually thick Reward section from which the upper beds have been removed. Nearer the H.Y.C. deposit area, the basal thin-bedded and dolomite-nodule-bearing, cherty dolomite is overlain by dolomites with larger chert nodules, dolomite breccia and/or the Pastel Tuff Beds.

The Pastel Tuffs are reworked 'albitic' tuffs whose chief characteristic is their tendency to outcrop as fist-sized rubble in which the fragments have conchoidal fracture surfaces. There are dolomites associated with the tuffs which are similar to those in the Reward Dolomite except that the concretions are of silty material.

The best developed sections of the Reward, (which in E.L. 1438 may be 100 metres thick) consist wholly of the dolomite-

nodule cherty dolomite which is more usually less than 20 metres thick. Much of the variation in thickness of the Reward occurs through development of chert breccia at the expense of the dolomite, probably through solution-collapse prior to deposition of the Lynott Formation.

6.50 Lynott Formation

6.51 L_1

The characteristic tuffs of unit L_1 are generally pale weathering or khaki-green tuffs which are tough relative to most other rocks in the section. Beds near the top and bottom may show slump folds. Clear quartz in matrix is rare but distinctive. The tuffs tend to dominate in outcrop but it would appear that shales make up fully half the section.

There is a slight unconformity with channels at the base, which may remove the underlying Pastel Tuffs. A pyritic shale usually 10-20 metres thick occurs low in the section.

In E.L. 1438 the Lynott Formation L_1 member is very well developed with abundant pyritic shale.

6.52 L_2

The appearance of this unit depends greatly on the degree of weathering. The freshest exposures usually produce a terraced effect on hillsides due to the alternation of tuffaceous dolomitic siltstone beds with dolomite and black shales. Near the top of the unit is a dolomite/siltstone slump breccia.

This unit is developed only in the northern section of E.L. 1438.

6.53 L_3

The main feature in moderately leached outcrops of the L_3 member is a series of cliff-forming, thinly bedded tuffaceous dolomitic siltstones. These are most prominent and are concentrated near the top of the unit, extending into the basal part of the overlying unit.

The lowermost shale of the L_3 is often characterized by distinctive fossil mudcracks. The shale is followed by a thick siltstone or dolomitic sandstone bed which tends to remain recognizable in more leached areas.

The L_3 unit is only developed in the northern portion of E.L. 1438. The hard shale with mudcracks are absent from the Lynott sequence and this is attributed to erosion at the L_4 unconformity surface. However the dolomitic sandstone beds characteristic of L_3 are common.

6.54 L_4

The base of this unit is taken at a unique and persistent white sandstone marker bed. The sandstone is quartzose with cross bedding and large scale ripple marks.

Within 20 metres of the base of the L_4 unit the first of the lumpy chert beds occurs. These are typically grey with stromatolites, and the tops of these beds are often stripped, revealing pillow-like humps about 1 metre across. These features distinguish the cherts from others lower in the sequence.

Towards the top of the L_4 unit, dolomite with rare cauliflower-like concreations appears.

In E.L. 1438, the L_4 member makes up most of the formation, but its base cannot always be determined as the white sandstone marker is not well developed and stromatolitic cherts are less abundant than usual. Pyritic shale is present.

6.55 L_5 Donnegan Member

This unit, as used by field staff consists of cliff-forming dolomitic, shaly, siltstone with cauliflower nodules. In E.L. 1438 a thin Donnegan Member was observed below the Yalco Formation at only one locality. The characteristic lithologies and cauliflower chert nodules are present.

6.60 Yalco Formation

The base of the Yalco Formation is a thick bed of chert nodule rock, with small smooth chert nodules making up the bulk of the rock and set in a reddish matrix. In less leached areas the matrix is a dolomite. In the field the unit proved very distinctive.

The characteristic nodular chert beds of the Yalco Formation are well developed in E.L. 1438 and are cliff forming.

6.70 Smythe Sandstone

The Smythe Sandstone is the highest McArthur Group unit exposed in E.L. 1438. It is equivalent to the Mt. Birch Sandstone, but has very few chert clasts. An unconformity at the base of the Smythe Sandstone cuts out the Looking Glass and Stretton Sandstone Formations so that the Smythe rests directly on the Yalco Formation.

6.80 Geological Structure

South of Four Mile Creek and in the central position of E.L. 1438, there is a chevron-shaped, minor syncline plunging to the west. South of this structure, outcrops indicate substantial thinning of the Teena-Reward intervals. Immediately to the south east of the "Chevron Syncline", a small structure, which was originally interpreted as a dome, is now considered to be a small basin.

7.00 GEOCHEMISTRY

The results of the geochemical sampling for E.L. 1438 are presented in Table 5. The mean values computed for various units sampled in E.L. 1438 (and E.L. 1439 to the north) are given in the table below:

Formation	Computed Means (ppm)		
	Cu	Pb	Zn
Lynott Formation	160	37	100
Reward Dolomite	693	180	400
Surprise Creek Dolomite	173	111	67
Barney Creek Formation	54	520	151
Teena Formation	53	56	103

For the Barney Creek Formation a maximum value of 0.58% Pb was determined for a gossanous float sample. Accompanying zinc values are elevated with up to 320 ppm Zn.

An interesting feature of Table 5 is the high copper content of the Surprise Creek Dolomite (maximum 800 ppm) with no apparent consistent anomalism in lead and/or zinc.

In contrast, copper values in the Barney Creek Formation are low. The other formations which were sampled had generally low base metal geochemistry.

TABLE 5: ROCK GEOCHEMISTRY, E.L.1438

Formation	Sample No.	Cu ppm	Pb ppm	Zn ppm	Remarks
Yalco Formation	7566	5	5	390	Secondary gossan
Lynott Formation	7535	10	10	120	Limonite haematite with pyrolusite in sandstone and shales above the white sandstone marker
	7536	10	2	70	Limonite haematite and pyrolusite in sandstone below the white sandstone marker
	7538	95	10	160	Limonitic shale with limonitic joint fillings
	7539	175	55	10	Pyritic carbonaceous shale
	7540	5	2	20	Purple-green flinty siltstone
	7541	<2	2	10	as above
	7564	140	45	130	20m section of limonitic shale
	7565	30	5	155	5m section of limonitic sandstone, siltstone and shale
Reward Dolomite	7537	110	60	350	Limonite, haematite and pyrolusite in chert breccia and jasperoid breccia
Surprise Creek Dolomite	7533	800	30	10	Pyritic carbonaceous shale
	7534	200	10	80	Limonitic shale above sample 7533
	7546	35	120	20	Shale with liesegang banding
	7552	90	80	10	10m section of shale
	7563	120	55	15	10m section of liesegang banded shales
Barney Creek Fm.	7531	10	56	230	Limonitic chert
	7542	10	10	15	Complete 40m section
	7543	40	10	10	Basal 2m section
	7544	10	10	10	Basal 20m section
	7547	65	330	40	Ferruginous tuff selected for Fe content
	7548	210	0.58%	320	Gossanous Float
	7550	20	270	30	Dolomitic tuff, possibly W-Fold Shale equivalent
	7551	15	220	20	10m section of carbonaceous dolomite above the equivalent of the H.Y.C. ore horizon
	7553	160	640	40	Wall rock replacement vein
	7557	60	50	170	Gossan located in a sinkhole
	7558	60	45	310	Limonite and pyrolusite in sinkhole filling
	7560	15	20	10	Thin ferruginous bed
	7561	50	105	80	Selective sample of flinty, ferruginous material from ?W-fold Shale equivalent
	7562	30	80	15	Basal section from H.Y.C. Shale equivalent

TABLE 5 (Contd.)

Formation	Sample No.	Cu ppm	Pb ppm	Zn ppm	Remarks
Teena Dolomite	7545	155	120	290	Limonite and pyrolusite with white efflorescence as karst infill in Coxco Dolomite
	7549	25	30	15	Quartz veins in Coxco Dolomite
	7554	10	10	90	Grey dolomite and tuff in Coxco Dolomite
	7556	60	155	35	Ferruginous tuff and dolomite in Coxco Dolomite
	7559	60	10	110	Coxco Dolomite with recrystallized veins
Mara Dolomite	7555	2	10	10	Recrystallized dolomite near top of unit

8.00 CONCLUSIONS

Although the Barney Creek Formation containing anomalous levels in lead and zinc has been identified in the area, and although elevated copper values have been located in the Surprise Creek Dolomite, it was considered that the potential of the licence for the development of an ore body was limited and it was subsequently decided, that in view of areas of greater potential existing elsewhere in the McArthur River region, the licence should be relinquished. The surrender of E.L. 1438 was granted by the Department of Mines and Energy effective from 26th June, 1979.

A statement of expenditure for the period 7th November, 1977 to 25th June, 1977 inclusive is given the page opposite.

BAUHINIA JOINT VENTURE

EXPLORATION LICENCE NO. 1438

EXPENDITURE 7/11/77 to 25/6/79 (Relinquishment Date)

	$
Salaries	3,985
Field Expenses	2,644
Miscellaneous	1,368
Expenditure for quarter ended	$ 7,997

A.O.(AUSTRALIA) PTY LTD
Secretary

L.R.B. 6/9/79

MISCELLANEOUS LEGEND

- Fault
- Inferred fault under alluvium
- Formational boundary
- Inferred boundary under alluvium
- Visible bedding trace on photo
- Creek
- E.L. boundary
- Anticline
- Syncline
- 3456 Sample point

LEGEND

- Qa alluvium
- Qm white "sugary" sandstone (silcrete)

ROPER GROUP

- Limmen Sandstone — medium grained quartz sandstone
- "Basal Roper Red Beds" — red and green micaceous sandstone and micaceous siltstone

McARTHUR GROUP

Upper McArthur Group

- Smythe Sandstone — medium to coarse grained quartz sandstone

Batten Sub-Group

- Yalco Formation — nodular chert, stromatolitic chert, minor thin-bedded fine grained sandstone
- Lynott Formation — leached siltstone and stromatolitic chert, tuff; pyritic shale minor coarse grained quartz sandstone at base, lithic sandstone and tuff with cauliflower chert nodules at top
- silty dolomite and "dolohilite", breccia laminated dolomitic siltstone, dolomitic sandstone
- pyritic shale, shale

UMBOLOOGA SUB-GROUP

- Reward Dolomite — Thinbedded and cherty dolomite, with grey dolomite nodules in yellow matrix, chert breccia, mineralized replacement chert bars.
- Surprise Ck. Dolomite — yellow-weathering laminated, flaggy, carbonaceous fine trained dolomite, pyritic shale, tuffaceous dolomitic siltstone, tuff
- Barney Creek Formation — laminated carbonaceous dolomitic siltstone, minor tuff
- Teena Dolomite — laminated tuffaceous dolomite and dolomite at top, massive dolomite, stromatolitic dolomite, non outcropping beds at base arcicular gypsum pseudomorphs
- Mara Dolomite — churty dolomite, stromatolitic chert dolomite, chert breccia, recrystallized dolomite
- Myrtle Shale — purple shale, minor dolomite calcrete replacement common in outcrop
- Leila Sandstone — dolomitic sandstone quartz sandstone
- Tooganinie Formation — stromatolitic, flaggy and massive dolomite, siltstone, sandstone
- Tatoola Sandstone — shale quartz sandstone, dolomitic sandstone, feldspathic sandstone
- Amelia Dolomite — recrystallized dolomite, dolomitic siltstone, stromatolitic dolomite
- Mallapunyah Formation — red shale, grey green siltstone with cauliflower chert nodules
- Mulholland Sandstone — quartz sandstone

BAUHINIA JOINT VENTURE

BAUHINIA DOWNS AREA

McARTHUR RIVER, N.T.
E.L. 1438

MAP 1

GEOLOGY AND SAMPLE LOCATIONS

2 1 0 2 km
1:50,000

Compiled by: C.H.C. SHANNON | Date: September, 1979

CR79/128

CR79/128