1980 ANNUAL REPORT
E.L. 1330, 1331, 1332 and 1943
McARTHUR RIVER AND GLYDE RIVER PROJECTS
NORTHERN TERRITORY

Gavin Thomas
January, 1981

CONTENTS

1980 ANNUAL REPORT
E.L. 1330, 1331, 1332 and 1943
McARTHUR RIVER AND GLYDE RIVER PROJECTS
NORTHERN TERRITORY

Gavin Thomas
January, 1981

CONTENTS

1. SUMMARY

Kennecott Explorations (Australia) Ltd entered into a joint venture on November 6, 1979 with Amoco Minerals Australia Company, to explore for lead/zinc mineralisation similar to that which occurs at the H.Y.C. mine, in the McArthur River region of the Northern Territory. The McArthur River area lies some 700 kms southeast of Darwin and the joint venture area covered Exploration Licences 1330, 1331, 1332, 1943 and 45 mineral claims on the southern boundary of E.L. 1332. The E.L.'s occur immediately along strike both north and south of the H.Y.C. mine and associated lead-zinc deposits at McArthur River with the northern area being called Caranbirini and the southern area Glyde River.

The area is remote and only superficial exploration work was carried out prior to Amoco's activities.

Mineralisation at the H.Y.C. mine and associated deposits is located on the eastern margin of the Batten Trough in Middle Proterozoic Carpentarian sediments. These sediments were deposited in a rift zone and comprise red-beds, carbonates, dolomitic shales and siltstones and pyritic shales. The deposits occur in localised pyritic sub-basin associated with a major growth fault, the Emu Fault Zone, which is believed to be a major control to ore solutions. All known mineralisation is restricted to the basal pyritic section of the dolomitic bituminous shale sequence; the Barnay Creek Formation. In the Kennecott program these shales comprised the target horizon.

Amoco's exploration program consisted of extensive airborne Input E.M. and magnetics, ground I.P. and gravity, geological photointerpretation, geological mapping and percussion drilling. Amoco's preliminary work showed there was potential for the prospective target horizon in the northern area and in the southern area a new fault controlled sub-basin was delineated. Amoco carried out diamond drilling in both areas with two holes being completed at Caranbirini and seven in the Glyde River area.

2/

Amoco's drilling showed that in the Caranbirini area the only remaining potential for economic lead-zinc mineralisation was in a postulated euxinic basin adjacent to the Emu Fault which had an associated 3-4 mgal anomaly similar to that at the H.Y.C. mine. Kennecott drilled this anomaly with negative results. An unexpected thickening in an overlying formation made the depth of potential mineralisation to deep to be economic.

In the Glyde River area Kennecott drilled four holes, two of which consisted of deepening previous Amoco holes to the target horizon. These two holes, GR5 and GR7, tested a northern sub-basin developed along the Hot Springs Fault while the remaining two holes GR8 and GR9 tested a southern sub-basin developed along the Emu Fault. Both of these sub-basins had the prospective pyritic shale member developed but had only negligible values of base metals associated. As these sub-basins were tested at the base of the postulated syncline where the best trap site for metalliferous solutions was to be expected it is considered that there is no further potential for an economic stratiform lead-zinc deposit in the Glyde River area.

Testing of both the Caranbirini and Glyde River areas has shown that no further drill targets exist within these areas for stratiform lead-zinc mineralisation at economic depths. It is recommended that the joint venture be terminated.

2. CONCLUSIONS AND RECOMMENDATIONS

The drilling in the northern Caranbirini area has shown that no potential exists for economic stratiform lead-zinc mineralisation to be located at depths less than 1km. This depth does not meet the present Kennecott economic parameters and thus no further drill targets are recommended in the area.

In the southern Glyde River area the fault controlled Glyde River sub-basin, which has identical stratigraphy to the McArthur River area, has been shown to have thick accumulations of the prospective Barney Creek Formation. Throughout the basin the basal pyritic shale target horizon is developed within the Barney Creek Formation along with an increase in vitric tuffs showing volcanic emanations were active at the time. However, all drilling and sampling to date has shown that only negligible base metal values were associated with the brines.

Kennecott drilled the base of two inferred synclines in sub-basins which paralled the Hot Springs and Emu Faults. This zone was expected to be the best trapsite for metalliferous brines emanating from the growth faults. Mapping and geophysical interpretation has shown no better trap site and thus the low base metal values encountered in the prospective pyritic horizon are the best that can be expected within the basin. As the results encountered were discouraging no further work is warrented within the sub-basin.

As results from the Caranbirini and Glyde River areas are disappointing and no further drill targets can be justified it is recommended the joint venture with Amoco be terminated.

3. INTRODUCTION

Kennecott Explorations (Australia) Ltd. entered into a joint venture with Amoco Minerals Australia Company on the 6th. November, 1979, to explore for lead-zinc mineralization, similar to that which occurs at the H.Y.C. mine, in the McArthur River region of the Northern Territory (see Fig.1). The joint venture covered the following Exploration Licences which are held by Amoco and are shown on Fig. 2.

E.L. No	Granted	First Reduction	Second Reduction
1330	October 5, 1976	October 5, 1978	October 5, 1979
1331	October 6, 1979	October 6, 1978	October 6, 1979
1332	November 2, 1976	November 2, 1978	November 2, 1979
1943	January 4, 1979	January 4, 1981	

In addition Amoco hold title to 45 claims on the southern boundary of the Caranbirini area. These claims, Pandanus 23C to 67C, are each 132 hectares.

Mineralization at the H.Y.C. and associated deposits in the McArthur River area is located at the eastern margin of the Batten Trough. The deposits occur in localised pyritic sub-basins associated with a major growth fault, the Emu Fault zone. All known stratiform mineralization is restricted to the basal pyritic section of a dolomitic bituminous shale sequence; the Barney Creek Formation. In the Kennecott program these pyritic shales comprised the target horizon.

Kennecott Explorations (Australia) Ltd. could earn a 50% interest in the project by matching Amoco Mineral's expenditure dollar for dollar. Kennecott could not withdraw from the joint venture until $US300,000 had been spent and also a specified 5 hole drilling program completed.

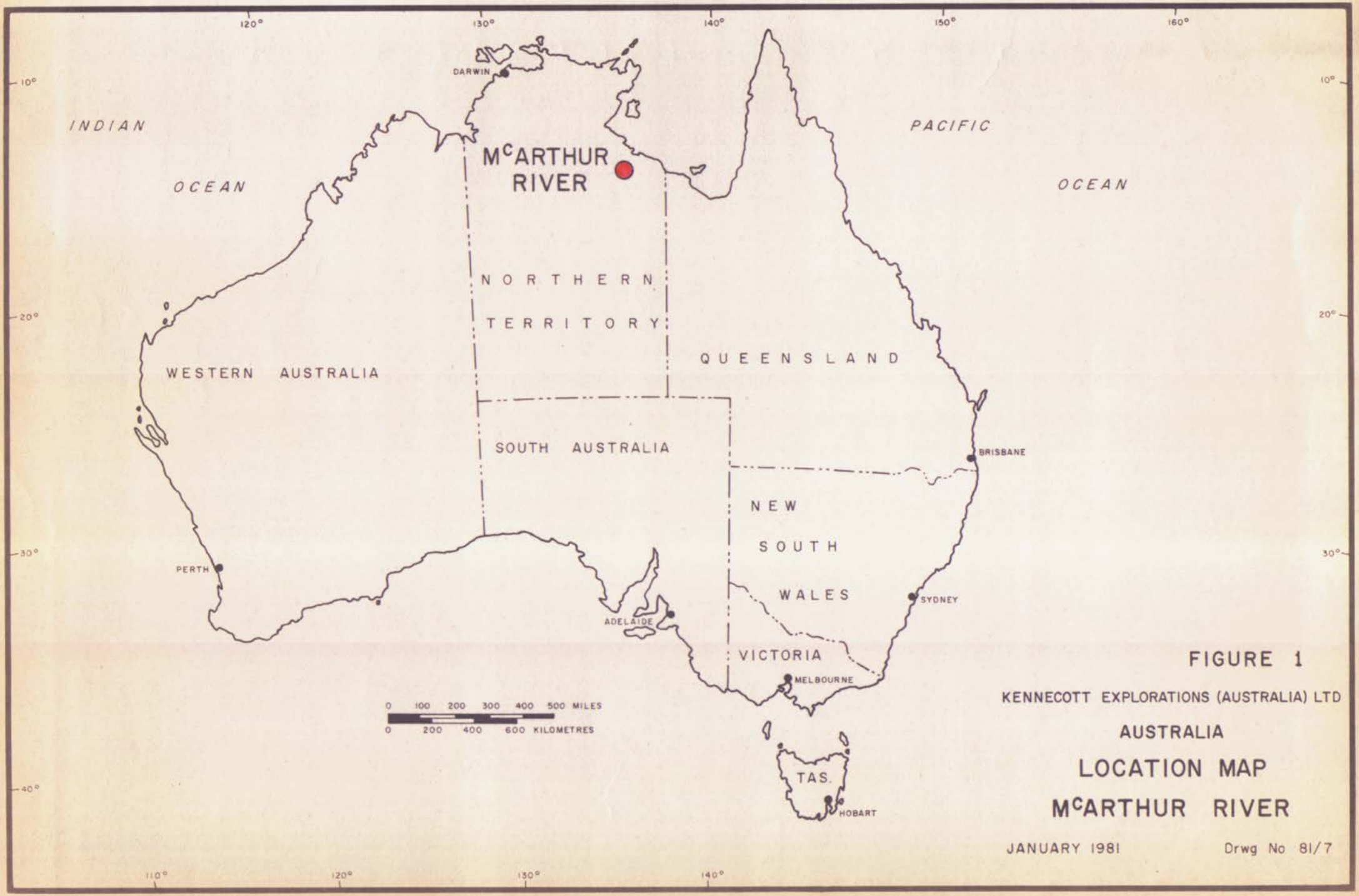


FIGURE 1

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

AUSTRALIA

LOCATION MAP

McARTHUR RIVER

JANUARY 1981 Drwg No 81/7

Previous work by Amoco had not fully evaluated their tenements and a number of drill targets remained to be tested. This report details diamond drill work carried out in November - December 1979, which evaluated the remaining targets.

CARANBIRINI AREA

MANT 78-1

MANT 79-2

MANT 79-3

EL 1332

EL 1375

N

McArthur River Project Area

Glyde River Project Area

EL 1331

EL 1331

GRNT 79-3

GRNT 79-1

GRNT 79-5

GRNT 79-7

GRNT 79-6

GRNT 79-2

GRNT 79-9

GRNT 79-8

GRNT 79-4

EL 1943

Areas stippled relinquished October 1979

Location

Legend

- Exploration licence boundary
- Principal road or highway
- Minor road
- Vehicular track
- Watercourse
- Bore or well. Lock or small dam
- Fence
- Mine, quarry
- Buildings, yard
- Trigonometrical station
- Benchmark, spot elevation

● diamond drill holes

Kilometres

0 5 10 15 20

FIGURE 2

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

NORTHERN TERRITORY

McARTHUR RIVER JOINT VENTURE

CARANBIRINI - GLYDE RIVER PROJECT

TENEMENT MAP

JANUARY 1981

Drwg No 81/8

4. LOCATION & ACCESS

The project area is located south of the small township of Borroloola in the McArthur River region of the Northern Territory and is divided into two areas situated immediately along strike both north and south of the known McArthur River Pb/Zn deposits. The northern project area, termed Caranbirini or McArthur River, lies some 20 kms south southwest of Borroloola while the southern project area, termed Glyde River, lies some 100 kms to the south (see Fig. 2).

Access to the area is provided by a single lane sealed road which connects Borroloola with the Barkley Highway some 500 kms west of Mt. Isa in Queensland.

The main sealed road passes through the northern Caranbirini area which is mainly low rolling countryside. Numerous dirt tracks leading off this main road enables access apart from a very rough bulldozed track into the northern portion of EL's 1330 and 1331. Access to the area for the November - December, 1979 diamond drilling program was by helicopter which was supported from a fly-camp base at William Yard. William Yard is some 60 kms by 4WD track from Bessie Springs (McArthur River) station.

The climate in the area is monsoonal and during the January to March period widespread flooding disrupts all surface transport.

5. REGIONAL GEOLOGY AND MINERALISATION

The joint venture project area is located on the eastern margin of the Batten Trough immediately along strike both north & south from the known McArthur River Pb-Zn-Ag deposits. These deposits occur in a north northwest trending trough of Carpentarian sediments which are of Middle Proterozoic age.

5.1 GEOLOGY

The sediments were deposited within the McArthur Basin which unconformably overlies a Lower Proterozoic basement. The lower section of the Carpentarian sequence, the Tawallah Group, is composed of quartz rich arenites with basic volcanics, carbonates and lutites whereas the upper section of the sequence, the McArthur group is composed predominantly of evaporite bearing shallow water dolostones with some shales, siltstones and arenites. All lead-zinc mineralization in the area is restricted to the McArthur Group sediments.

The generalised stratigraphy of the McArthur Group is summarised in Table 1 below, however, in general the unit is a cyclical transgressive sequence involving the progressive deposition of red-beds, carbonate and sulphate evaporites and then pyritic shales. The initial transition to pyritic shales is marked by a sudden influx of fine grained potassic rich tuffaceous material and development of marked fault movements. Associated with the scarp faults developed are extreme variations in sea level. This lowermost pyritic shale unit, i.e. the H.Y.C. Pyritic Shale member of the Barney Creek Formation, is the host to the stratiform silver-lead-zinc mineralization in all McArthur River deposits. Laterally the pyritic shales grade progressively into tuffaceous dolomitic siltstones, sulphate evaporites and eventually into an unconformity with fossil karst features. Adjacent to the Emu Fault, the transition is very rapid, involving thick and complex breccia zones.

TABLE 1

Generalised Stratigraphic Succession in the McArthur River Area

(from N. Williams, Economic Geology, Vol. 73, No.6, p1007)

TABLE 1. Generalized Stratigraphic Succession in the McArthur River Area (after Lambert and Scott, 1973; Oehler and Logan, 1977; Plumb and Brown, 1975; and Walker et al., 1977b)

SYSTEM	GROUP	SUB-GROUP	FORMATION	MEMBER	THICKNESS (m)	GENERAL LITHOLOGIES
Adelaidean	Roper					Sandstones; siltstones; minor conglomerates.
			Stott Fm.		750	Massive and stromatolitic dolostones; dolomitic shale; gypsum and/or anhydrite pseudomorphs.
			Smythe Sandstone		0-180	Quartz-chert sandstones; chert conglomerates.
		Batten			1,000	Sandstones and siltstones; minor dolostones with gypsum and/or anhydrite pseudomorphs and cauliflower chert nodules after anhydrite.
			Reward Dolomite		30-300	Dololutites; dolarenites; cherty stromatolitic dolostones.
			Barney Creek Fm.	H.Y.C. Pyritic Shale / Cooley Dolomite	0-500 / 0-500	Shales rich in carbonaceous matter, pyrite, dolomite, and K-spar; vitric tuffs; sedimentary breccias; concordant Pb-Zn mineralization. / Brecciated (?talus) dolostones and stromatolitic dolostones; gypsum and/or anhydrite pseudomorphs; minor discordant Pb-Zn mineralization.
				W-Fold Shale ?	15-150 ?	Tuffaceous and dolomitic shales; vitric tuffs. ?
				Coxco Dolomite	15-80	Massive laminated and stromatolitic dolostone; gypsum and/or anhydrite pseudomorphs.
			Teena Dolomite		6-30	Laminated dololutites; stromatolitic and oolitic dolostones; mudstones; halite casts.
Carpentarian	McArthur		Emmerugga Dolomite	Mitchell Yard Dolomite	15-120	Thickly-bedded dololutites; brecciated dolostones; (?)solution collapse features.
		Umbolooga		Mara Dolomite	100-500	Massive to laminated dololutites and dolarenites with stromatolites, oncolites, oolites, gypsum and/or anhydrite pseudomorphs, and halite casts.
				Myrtle Shale	30-240	Red and green dolomitic shales, siltstones, and arenites; halite casts.
			Tooganinie Fm.	Leila Sandstone	0-180	Quartz sandstones; dolomitic sandstones.
					400-800	Dololutites; dolarenites; stromatolitic dolostones; mudstones; shales; gypsum and/or anhydrite pseudomorphs; halite casts.
			Tatoola Sandstone		30-150	Quartzitic and dolomitic sandstones; dolomitic siltstones; gypsum and/or anhydrite pseudomorphs.
			Amelia Dolomite		90-240	Dololutites; laminated and stromatolitic dolostones; massive gypsum-pseudomorph beds; gypsum and/or anhydrite pseudomorphs; halite casts.
			Mallapunyah Fm.		30-750	Red and green dolomitic siltstones; quartz arenites; halite casts, cauliflower chert nodules after anhydrite; barite concretions.
	Tawallah					Sandstones; siltstones; conglomerates; basic volcanics.

U — U = Unconformity

Much of the Proterozoic McArthur Group has been overlain by a variety of younger sequences. These include the Adelaidian Roper Group (sandstones, siltstones and minor conglomerates) and the Cambrian Bukalara Sandstone. These overlying cover rocks have often hampered exploration previously, especially in the southern Glyde River project area, where the Bukalara Sandstone is virtually the only outcropping unit.

In the entire McArthur Basin only minor folding and faulting have affected the sediments with dips in the Proterozoic units in excess of 30^{o} being rare more than 2km away from the Emu Fault and present synclinal axis reflect original sedimentary sub-basins within the trough. The sediments have only undergone "load metamorphism" and are still effectively unmetamorphosed, e.g. the hydrocarbon content of the rocks has not been converted to graphite. The dominant structural feature in the area is the Emu Fault Zone which defines the eastern margin of a major north-northwest trending rift zone. The Emu Fault zone has been an active major crustal break for a very long time over its 600 km length although hiatus periods have occurred.

During the sedimentation of the prospective Barney Creek Formation the Emu Fault zone suddenly became very active and caused the development of thick basins of pyritic bituminous siltstones with abundant sedimentary breccias near the basin margins and/or close to fault block movement. Major movements since that time have been variable but before Cambrian time in the northern Caranbirini area a net downward movement on the eastern side of the fault has placed Adelaidian Roper Group sediments adjacent to the McArthur Group sediments while in the Glyde River area a new downward movement occurred on the western side of the fault where Barney Creek Formation occur adjacent to older Tawallah Group sediments.

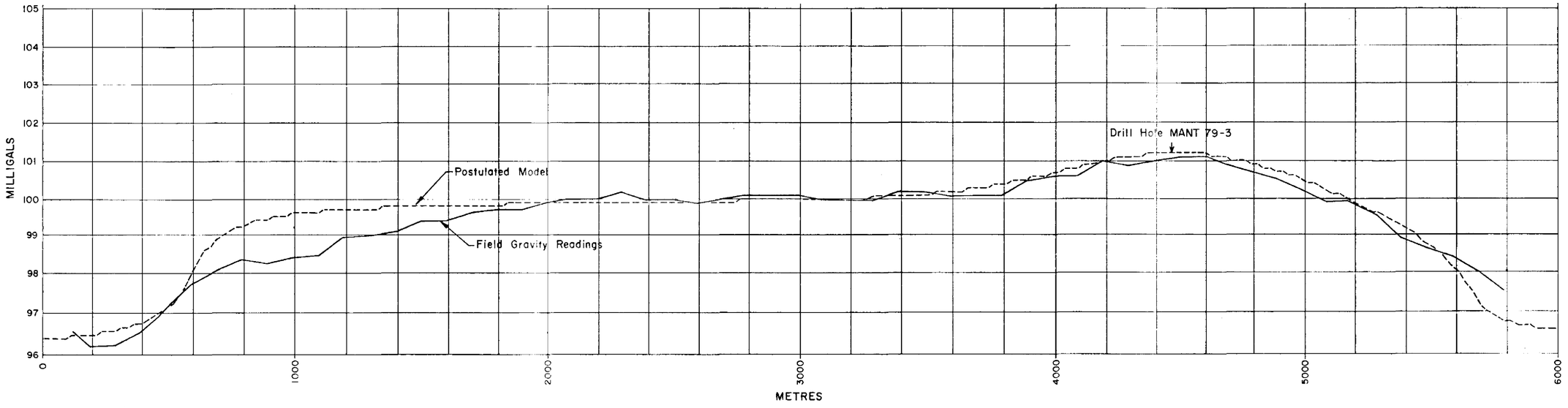
5.2 MINERALISATION

Within the McArthur Group sediments the main style of mineralization is the fine grained stratiform, lead-zinc-silver mineralization associated with the pyritic shales of the Barney Creek Formation. The most notable deposit of this type is the H.Y.C. orebody which has delineated reserves of 240 million tonnes of 9.5% Zn, 4% Pb and 45 gm/t Ag. Other similar deposits of this type include the large Emu deposit and the smaller Wickens Hill, W-Fold Shale and Teena deposits. In the Kennecott drilling program these pyritic shales comprised the target horizon.

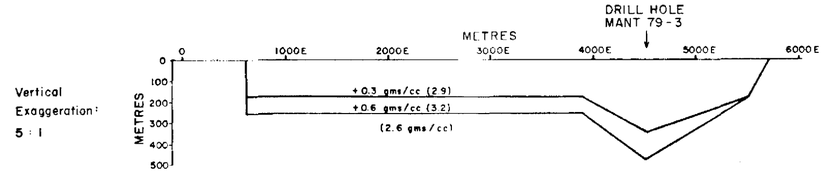
The H.Y.C. Pyritic shale member of the Barney Creek Formation is variable in thickness and at the McArthur River deposits, formed in deep water conditions in a sub-basin depression. The ore zones are contained in the basal member of this unit and are associated with potassic rich tuff horizons. The ore solutions are thought to have emanated from the nearby growth fault, the Emu Fault Zone.

Associated within the growth fault zone are smaller tonnage and lower grade, coarse grained Zn/Pb deposits which are stratabound within carbonate lithologies which are lateral equivalents to or underlying the Barney Creek Formation. Within the carbonate horizons the mineralization has uneven distribution and is quite often discordant, especially in brecciated units. The main examples of these deposits are Ridge II, Cooley II and Coxco deposits which have reserves in the order of 1-5 million tonnes of 3-7% Zn/Pb $\pm$ Cu.

On the continental shelf areas adjacent to the rift basins stratabound copper mineralization within the basal members of the McArthur Group occur at several places. The mineralization is generally chalcocite, bornite, and chalcopyrite associated with bituminous, sulphate evaporites with a sequence of "red beds". The tonnage is usually fairly large but grades to date have been low (0.1% to 1% Cu). At Mountain Home, originally within the Amoco tenements, visible malachite, chalcocite and bornite occur within a dolomitic breccia which overlies a thick sequence of red beds. Drill testing by Amoco at this prospect indicated low grade mineralization was present from 80-150m but most analysed sections assayed less than 0.1% Cu. Only one metre (87.5 - 88.5m) assayed over 0.5% Cu.



AMOCO GRID LINE 90500N



POSTULATED MODEL
90500 N
PRIOR TO DRILLING
MANT-79-3

FIGURE 3

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

NORTHERN TERRITORY

McARTHUR RIVER

E.L. 1332

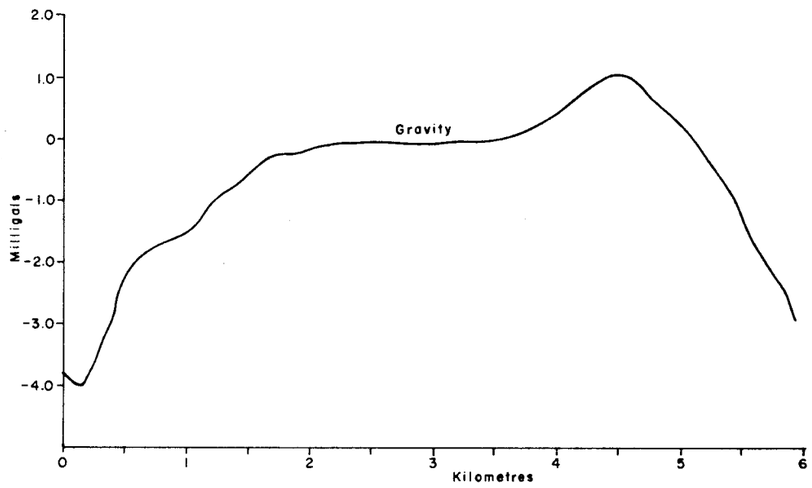
CARANBIRINI

GRAVITY MODEL

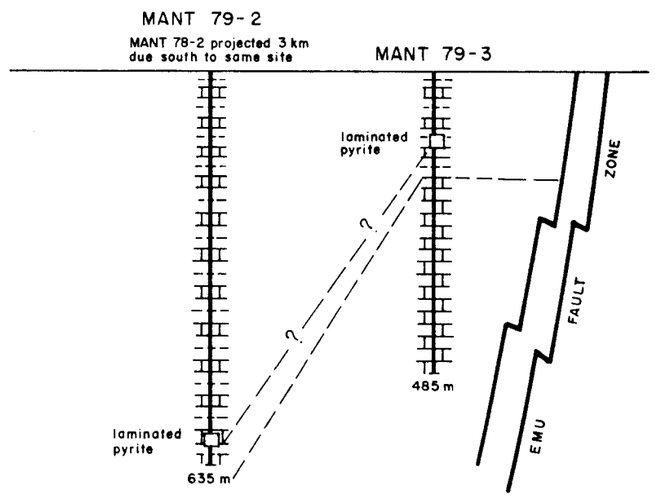
JANUARY 1981

Drwg No 81/6

SECTION GEOPHYSICAL PROFILE



West East



CARANBIRINI AREA

LEGEND

CAMBRIAN

Bukalara Sandstone — Massive, medium to coarse grained lithic sandstone; basal 1m pyritic.

CARPENTARIAN

Lower Lynott Formation — Dolomite, dololutite, carbonaceous dololutite, carbonaceous shale ± pyritic

Reward Dolomite — Dololutites, dolarenites, cherty stromatolitic dolostones

Barney Creek Formation *(Vitric Tuff Marker)* — Carbonaceous, bituminous dolomitic siltstones; pyritic shales, vitric tuff and tuffaceous dolomitic siltstone

H.Y.C. Pyrite Horizon — Dolomitic, bituminous carbonaceous siltstone with abundant disseminated fine grained pyrite

Transition Zone — Pyritic, dolomitic siltstones and dolomitic tuffaceous shales

W - Fold Shale — Tuffaceous and dolomitic shales

Coxco Dolomite — Massive, laminated and stromatolitic dolostone, gypsum and/or anhydrite pseudomorphs.

SCALE

0 1 2 3km

1:50000

$\frac{V}{H} = \frac{5}{1}$

FIGURE 4

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

NORTHERN TERRITORY

McARTHUR RIVER JOINT VENTURE

CROSS SECTION CARANBIRINI

JANUARY 1981 Drwg No 81/10

Subcropping, flat lying, shelf of Lynott Formation

Extensive Cambrian sandstone cover

EL 1331

EL 1330

EL 1943

NORTHERN SUB BASIN

SOUTHERN SUB BASIN

CROSS SECTION SEE FIGURE 6

CROSS SECTION SEE FIGURE 7

Cooleys Breccias

Coxco Dolomites

W-Fold Shale

Hot Springs Fault Zone

Emu Fault Zone

Mountain Home Copper Prospect

Coxco Dolomite

Emmerugga Dolomite

Toonganinie Formation

Amelia Dolomite

Mallapunyah Fm.

Myrtle shale member

Masterton Formation

Magnetically erratic zone indicating basal volcanics - ?domal structure

GR-1 GR-2 GR-3 GR-4 GR-5 GR-6 GR-7 GR-8 GR-9

H.Y.C. Mine

Barney Creek Crossing

BARNEY HILL

SLAB TOP HILL

MASSACRE HILL

LEILA HILL

MT LYNOTT

Aerodrome

Mc Arthur River

Leila Yard

Nimble Yard

Gum Yard

Windy Gully

Possum Point Yard

Landing ground

McCoach Spring

Spring Creek

Numerous waterholes

Rocky Waterhole

Old Trap Yard

Quarries

Gravel

Barney

CARPENTARIA HIGHWAY

McARTHUR RIVER

KILGOUR RIVER

COXCO RANGE

GLYDE VALLEY

LAMONT PASS

ABNER RANGE

Pm Pmn Pmx Pmq Pt

AMOCO REGIONAL MAPPING GRID

70 000 N 60 000 N 50 000 N 40 000 N 30 000 N 20 000 N 10 000 N 0 N

10 000 E 20 000 E 30 000 E 40 000 E 50 000 E 60 000 E 70 000 E

16° 30' 17° 00' 136° 00' 136° 30'

Location

Compiled from the Batten, Borroloola, Glyde and Mallapunyah sheets of the 1:100 000 scale National Topographic Map Series. Transverse Mercator Projection

Legend

- Exploration Licence boundary
- Principal road or highway
- Minor road
- Vehicular track
- Watercourse
- Bore or well; tank or small dam
- Fence
- Mine; quarry
- Buildings; yard
- Trigonometrical station
- Benchmark; spot elevation

Base map drawn by AMOCO Minerals Australia Company

TN MN 4°48' TN - GN

1:100000

0 1 5 kilometers

McArthur Group

- Pmn Lynott Formation
- Pmx Reward Dolomite
- Pmq Barney Creek Formation
- Pm Underlying McArthur Group
- Pt Underlying Tawallah Group

● GR-7 Drill hole location

N.B. where outcrop has permitted, individual units have been named. No Upper Proterozoic or Cambrian rocks are shown.

..... Boundary between interpreted and inferred geology

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD.

NORTHERN TERRITORY

McARTHUR RIVER AREA

E.L. 1330-1331 - 1943

GLYDE RIVER

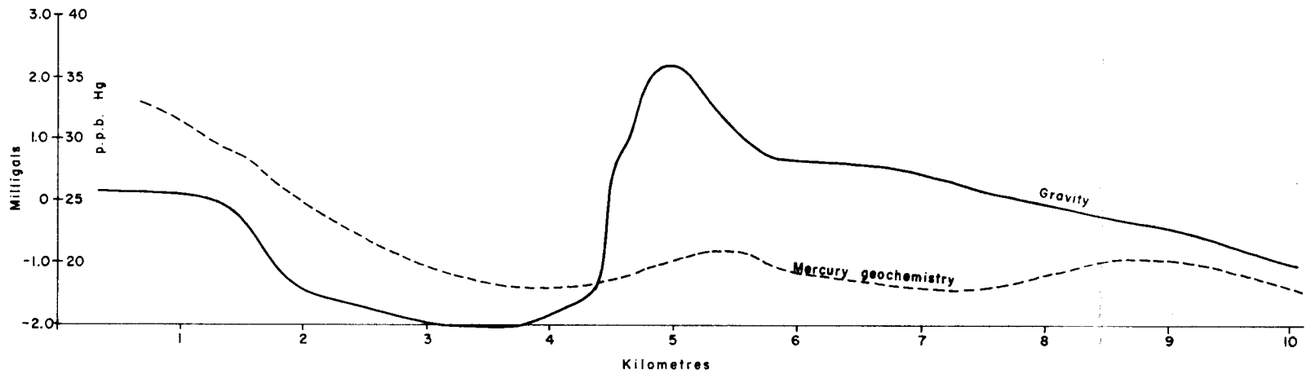
INTERPRETATIVE GEOLOGY

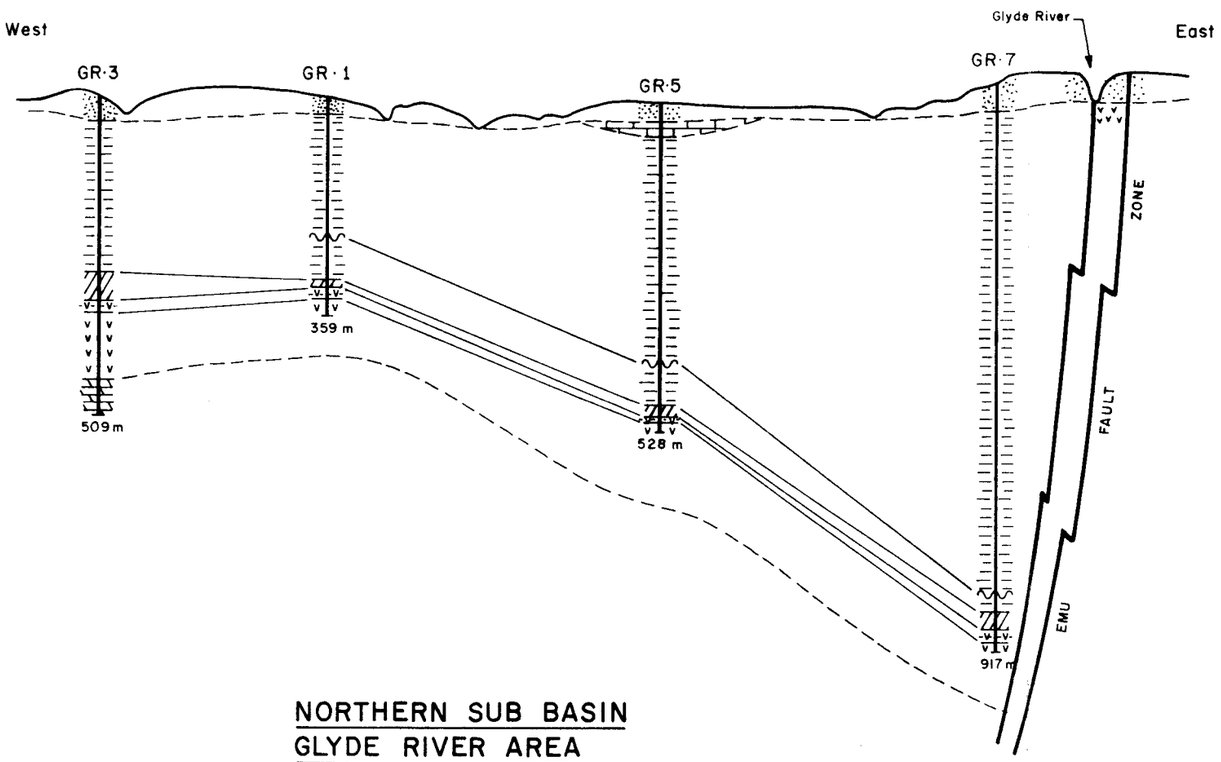
CR81/28

Data by: G. Thomas	Date: January 1981
Drawn by: W.D.C.	Drwg. No.: 81/11

FIGURE 5

SECTION GEOPHYSICAL PROFILE





NORTHERN SUB BASIN
GLYDE RIVER AREA

LEGEND

CAMBRIAN

Bukalara Sandstone — Massive, medium to coarse grained lithic sandstone; basal 1m pyritic.

CARPENTARIAN

Lower Lynott Formation — Dolomite, dololutite, carbonaceous dololutite, carbonaceous shale ± pyritic

Reward Dolomite — Dololutites, dolarenites, cherty stromatolitic dolostones

Barney Creek Formation (Vitric Tuff Marker) — Carbonaceous, bituminous dolomitic siltstones; pyritic shales, vitric tuff and tuffaceous dolomitic siltstone

H.Y.C Pyrite Horizon — Dolomitic, bituminous carbonaceous siltstone with abundant disseminated fine grained pyrite

Transition Zone — Pyritic, dolomitic siltstones and dolomitic tuffaceous shales

W-Fold Shale — Tuffaceous and dolomitic shales

Coxco Dolomite — Massive, laminated and stromatolitic dolostone, gypsum and/or anhydrite pseudomorphs.

SCALE

0 1 2 3 km

1:50000

$\frac{V}{H} = \frac{5}{1}$

FIGURE 6

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

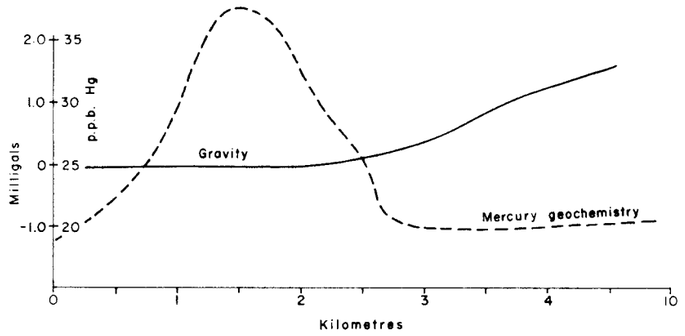
NORTHERN TERRITORY

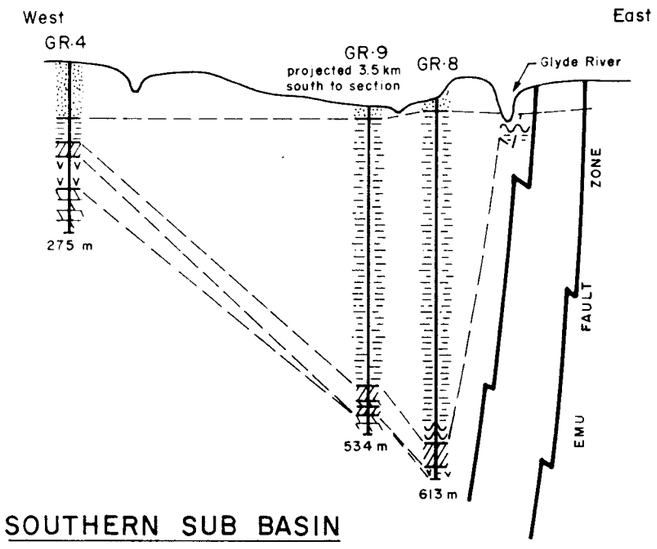
McARTHUR RIVER JOINT VENTURE

CROSS SECTION GLYDE RIVER

JANUARY 1981 Drwg No 81/12

SECTION GEOPHYSICAL PROFILE





SOUTHERN SUB BASIN
GLYDE RIVER AREA

LEGEND

CAMBRIAN

Bukalara Sandstone — Massive, medium to coarse grained lithic sandstone; basal 1m pyritic.

CARPENTARIAN

Lower Lynott Formation — Dolomite, dololutite, carbonaceous dololutite, carbonaceous shale ± pyritic

Reward Dolomite — Dololutites, dolarenites, cherty stromatolitic dolostones

Barney Creek Formation (*Vitric Tuff Marker*) — Carbonaceous, bituminous dolomitic siltstones; pyritic shales, vitric tuff and tuffaceous dolomitic siltstone

HYC Pyrite Horizon — Dolomitic, bituminous carbonaceous siltstone with abundant disseminated fine grained pyrite

Transition Zone — Pyritic, dolomitic siltstones and dolomitic tuffaceous shales

W-Fold Shale — Tuffaceous and dolomitic shales

Coxco Dolomite — Massive, laminated and stromatolitic dolostone, gypsum and/or anhydrite pseudomorphs.

SCALE

0 1 2 3 km

1:50000

$\frac{V}{H} = \frac{5}{1}$

FIGURE 7

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

NORTHERN TERRITORY

McARTHUR RIVER JOINT VENTURE

CROSS SECTION GLYDE RIVER

JANUARY 1981

Drwg No 81/13

6. PREVIOUS EXPLORATION

The only previous exploration in the area prior to Amoco's work consisted of limited regional geochemical and geological investigations which was carried out by various companies in the late sixties and early seventies. In the southern Glyde River area this work was severely limited by the fact that there is an extensive cover of Cambrian sandstone. The only detailed geological work within Amoco's tenements was carried out on the Mountain Home prospect which is a stratabound red bed copper prospect some 10 km east of E.L. 1331 (originally within E.L. 1331). Work by Austral Geophysical in 1968 delineated weak copper mineralization in bituminous dolomites, dolomite conglomerates and dolomitic siltstones, along a 4 km strike length. Although small higher grade pockets occurred in some areas numerous faults disturbed the generally flat lying sediments and the mineralisation was uneconomic.

Since 1978 Amoco has carried out extensive exploration in both areas, The initial work included surface geological mapping, airphoto geological interpretation, geochemistry, airborne input E.M. surveys, aeromagnetic surveys, gravity surveys and induced polarization surveys in both Caranbirini and the Glyde River project areas. In the Caranbirini area 14 percussion holes were drilled to test I.P. anomalies and to help with the stratigraphic interpretation. The above exploration program by Amoco delineated several drill targets in both Caranbirini and Glyde River areas.

In the northern Caranbirini project area Amoco drilled two diamond drill holes, MANT 78/1 and MANT 79/2 on geophysical anomalies (main emphasis on gravity lows) which failed to reach the target horizon. A newly recognised pyritic member of the overlying Lynott Formation was mistaken for the prospective H.Y.C. Formation and the hole terminated. Both holes were sited in the centre of a large synclinal structure and were terminated at depths of over 600m. As the target horizon was interpreted to be 500m - 1000m deeper no further drilling was undertaken in this zone.

In the southern Glyde River project area Amoco's exploration was aimed at defining a postulated continuation of the Batten Trough rift zone under the Cambrian sandstone. Amoco's work delineated a fault controlled basin some 25km long by 5km wide, within the rift zone which contained the prospective Barney Creek Formation. The fault controlled Basin was termed the Glyde River sub Basin or in some Amoco literature the M-12 EM anomaly zone. Amoco subsequently drilled 6 diamond drill holes within this area with 4 holes testing a sub basin developed along the northern end of the Glyde River Basin and also parallel and adjacent to the Hot Springs Fault.

Two of these holes GR1 and GR3 penetrated the lower Barney Creek horizon and encountered a basal pyritic member with geochemical base metal values. The other holes GR5 and GR7 were sighted closer to the Hot Springs Fault and intersected a thicker sequence of Barney Creek Formation and thus did not intersect the lower pyritic target zone. Amoco also drilled two holes GR2 and GR4 in a southern sub basin which paralled the Emu Fault. These two holes tested the Barney Creek Formation again indicating the presence of prospective pyritic horizon with geochemical base metal values.

Amoco also drilled one hole GR6 on the Mountain Home red-bed coper prospect but because of disappointing results no further work was carried out.

Amoco's testing did not fully evaluate the economic stratiform lead-zinc potential of the area and diamond drill targets remained in the Caranbirini and Glyde River Areas.

7. WORK COMPLETED BY KENNECOTT

During November and December 1979 Kennecott completed 1,950 metres of diamond drilling in the two project areas.

In the Caranbirini area one hole to a depth of 485.35m was terminated in Reward Dolomite without testing the prospective target, i.e. the Barney Creek Formation.

In the Glyde River area 4 diamond drill holes were completed. Two previous holes drilled by Amoco were extended so they tested the prospective pyritic horizon of the Barney Creek Formation. In addition two holes were drilled from surface which tested the prospective pyritic horizon.

Additional geological traversing was carried out in the Glyde River area.

7.1 CARANBIRINI AREA

In this area Amoco had completed extensive geological mapping, gravity, input E.M. and I.P. and geochemistry. In addition Amoco drilled 14 percussion holes and two diamond drill holes.

Two diamond drill holes were drilled by Amoco the assumption that the gravity lows represented a deepening of the sediments in a synclinal structure and therefore a favourable trapsite for ore solutions. However, both holes only intersected the overlying Lynott Formation and were terminated at 632m and 617m. As the prospective horizon occurs at the base of the Barney Creek Formation which is extrapolated to be at least 400-600m thick in this area it was considered any mineralization would be at depth greater than 1km and thus not economic. Amoco's testing of the area determined that for a majority of the Caranbirini area any mineralization would be too deep to be economic except for a small uplifted section adjacent to the Emu Fault Zone.

A reinterpretation of the gravity and geology was carried out by Amoco and Kennecott. This reinterpretation indicated that an uplifted euxinic basin was developed along the Emu Fault. The basin had an associated 3-4 mgal gravity anomaly indicating the presence of a denser mass at depth (n.b. the H.Y.C. Pb/Zn deposit has an associated 3-4 mgal gravity anomaly). The target area was indicated to have the prospective Barney Creek Formation present because a few breccia outcrops in the southern extrapolation to the basin had rare Masterton Formation fragments (at H.Y.C. these fragments within breccia units are indicative of the Barney Creek Formation). Also the non outcropping shale units surrounding these breccia units had elevated Pb and Zn geochemistry in soil. The reinterpretation of the detailed gravity survey was carried out by Amoco indicating that associated with this possible basin was a dense mass similar to the H.Y.C. deposit at a depth of approximately 500 metres while a regional traverse carried out by the BMR indicated the dense mass at a depth of 300m. The Amoco gravity model for the area prior to drilling is shown on Fig. 3.

One hole, MANT - 79 - 3, was drilled to test this concept and was situated in the centre of the gravity anomaly. The hole was collared in the overlying lower Lynott Formation which consisted of interbedded dololutite, shaley dolarenite, dolomitic shale and minor pyritic shales. At 175.2m the hole passed into Reward Dolomite, the formation overlying the Barney Creek Formation. The Reward Dolomite is predominantly a shallow water carbonate cycle of variable thickness (30-400m in the McArthur River area) and consisted of dolomite, dololutite, bituminous dolomite, dolomitic breccia and dolomitic replaced evaporites.

The hole was suspended at 485.35m for a Christmas break after numerous breakdowns had slowed drilling progress.

During the Christmas break a re-evaluation of the geology and the gravity was undertaken. The Reward Dolomite was thought to be thinning in this area as previously indicated by percussion holes but in fact had thickened substantially. A stratigraphic extrapolation indicated the target horizon was at least 600m below the terminated depth of the hole. This depth was considered to be too deep for mineralization to be economic and the hole was consequently terminated. Specific density test on drill core was carried out on this core and results are attached on Appendix 3. (Cross Section, Fig 4).

The unexpected thickness of Reward Dolomite in this area precludes any further drill targets being delineated at reasonable depths. The only area where mineralization could be found at a reasonable depth within the project area is the outcropping section of the Barney Creek Formation in the south but the lack of a gravity anomaly is considered to preclude any discovery of an economic stratiform lead-zinc deposit.

7.2 GLYDE RIVER AREA

This project area lies some 80km south of the H.Y.C. deposit and is virtually unexplored except for work carried out by Amoco. A thin veneer of Cambrian sandstone cover has limited surface evaluation of this area in the past. Amoco completed airborne magnetics and input E.M., regional gravity, photo-geology, regional Hg soil geochemistry and minor geological mapping over a postulated continuation of the Batten Trough rift zone. The extensive airborne work delineated a fault controlled basin some 25km long by 5km wide within the Batten Trough. Followup geology in the area indicated the basin contained the prospective Barney Creek Formation and it was named the Glyde River Basin or M12 EM anomaly.

Amoco drilled six diamond drill holes within this basin with the main emphasis on determining the nature and extent of the basin limits and determining the significance of geophysical anomalies. Amoco's work showed that the input E.M. was useful in determining the extent of the subcropping pyritic shales within the Barney Creek Formation and that gravity is helpful in establishing regional basinal structures. Gravity highs indicated a thickening in the Barney Creek Formation and ridges of gravity highs seem to indicate synclinal axis. The mercury soil sampling and magnetics were less definitive but the former indicated the presence of the Barney Creek Formation within the basin while the latter depicted broad regional structures.

The results of the Amoco diamond drilling program were that four of these holes tested a sub-basin which developed along the Hot Springs Fault at the northern end of the Glyde River Basin. Two of these holes GR1, and GR3 penetrated the lower Barney Creek horizon and encountered geochemical base metal values. The other holes, GR5 and GR7, were sited closer to the Fault and intersected a thicker sequence of Barney Creek Formation though did not reach the lower pyritic target zone. This suggested a local basin adjacent to the Fault which would form an excellent sedimentary trap for metalliferous brine solutions. GR1 and GR3 indicated the presence of base metals in the system. Amoco drilled two holes, GR2 and GR4 in a southern sub-basin parallel to the Emu Fault. These holes were sited well away from the best trap site which gravity data suggested was against the Fault.

Kennecott tested the two sub-basins by deepening GR5 and GR7 in the northern basin and drilling two new holes, GR8 and GR9 in the southern basin. A total of 1465m of diamond drilling was completed in the Glyde River Basin and for drill hole locations and an interpretative geological map, see attached Fig. 5 . Geological traversing was completed in all creeks where outcrops may have been found as indicated by the air photos and helicopter reconnaissance. The main result of the mapping showed that the Glyde River sub-basin continued southward into E.L. 1943 and mainly consisted of stratigraphic units below the Barney Creek Formation.

The Emmerugga Dolomite was found to be well developed while the Toonganinie Formation and Amelia Dolomite were very poorly developed. The interpretative geological map of the Glyde River area is attached. The areas of outcrop are generally indicated by zones with dips and strikes.

The results of the work carried out are described below in relation to each sub-basin.

7.2.1 Northern Sub-Basin

Amoco terminated GR5 at the top of the prospective pyritic section at 492m. Kennecott deepened this hole and intersected 20.7m of pyritic shales and siltstones before grading into the underlying tuffaceous dolomitic unit, the W-fold Shale. The hole was terminated in W-fold Shale at 528m. The pyritic section had minor visible sphalerite as stratabound wisps or as coarser blebs in arenite layers. Other base metal values were negligible.

GR7 was extended from 635m and passed through 216.2m of dolomitic bituminous siltstones with minor interbedded tuffaceous siltstones, dolarenites and vitric tuffs. The hole then intersected 32.8m of dolomitic bituminous pyritic siltstones containing 10-30% pyrite and minor visible sphalerite which correlates with the ore horizon at H.Y.C. The hole then passed through 197.7m of bituminous pyritic dolomitic siltstones and tuffaceous siltstones with minor sphalerite and then into the underlying W-fold Shale at 903.7m. The hole was terminated at 917m having intersected the prospective section which averaged only 209 ppm Zn with the highest 3m Zn value within this interval being 800 ppm. Representative rock samples from GR7 were thin sectioned and descriptions of these occur in Appendix 2. The steeply dipping and brecciated basal sediments in GR7 were slumped indicating severe faulting occurred prior to and during the pyritic shale sedimentation. The position of GR7 is adjacent to the intersection of the Emu and Hot Springs Faults which created an active tectonic zone for a deep basin to occur (over 900m of Barney Creek Formation).

This sub-basin is definately fault bounded with the above faults being active after sedimentation as shown by the uplifted block of shallow dipping W-fold Shale and Coxco Dolomite 1 km to the southeast of GR7, (see Fig. 6).

Results of GR5 and GR7 were disappointing. GR5 tested flat lying pyritic shales at the base of a thick sequence of Barney Creek Formation adjacent to the fault which indicated the zone tested was the base of syncline where the best trap site for metalliferous brines should occur. Also GR7 tested the down dip extension of this synclinal zone and, although not testing the axis, severely limited any potential size for a mineralised ore zone. Due to poor results no further targets remained to be tested in this sub-basin for economic stratiform lead-zinc mineralisation. Drill logs for these holes are in Appendix 1.

7.2.2. Southern Sub-Basin

Kennecott drilled two holes adjacent to the Emu Fault aimed at testing the base of a proposed syncline abutting the fault and were generally sighted in areas where outcrop indicated vitric tuffs were well developed. (At the H.Y.C. mine mineralisation tends to be associated with an increase in vitric tuffs).

GR8 was collared towards the southern end of the southern sub-basin. After intersecting 10.2m of Cambrian sandstone the hole passed through 549.8m of flat lying dolomitic siltstones with interbedded vitric tuffs increasing towards the base. Between 340m and 365m several 3m sections assayed high lead values (up to 0.44%) but this could not be explained on examination. The hole then intersected 39.5m of weakly pyritised dolomitic siltstones containing 4% pyrite and trace sphalerite. The pyritic section averaged 206 ppm Zn with the highest 3m section being 760 ppm Zn. At 601.5 flatlying W-fold shales were intersected and the hole was terminated at 613m.

Representative thin sections were taken from GR8 and descriptions occur in Appendix 2. The thin sections confirmed pyroclastic detritus and shards in some of the vitric tuff layers.

GR9 was located towards the northern end of the southern sub-basin, and encountered 42.5m of Cambrian sandstone before passing into 413.7m of dolomitic bituminous Barney Creek Formation. Towards the base of the Barney Creek Formation interbedded tuffaceous siltstones and vitric tuffs increased. The prospective pyritic section occurred from 456.2m to 501.75m and contained about 8% disseminated pyrite and rare sphalerite. Within the pyritic section, the interval from 483m to 493.85m consisted of bedded and partly brecciated, porous bituminous dolomite. The top 2m of this unit consisted of brecciated fragments from the lower 8.75m section. Underlying the pyritic section was the Coxco Dolomite, the W-Fold Shale unit not being present. The Coxco Dolomite was very porous and fractured, often containing bitumen clots in open fractures.

In GR9 gas flows became evident towards the base of the drill hole. Very small gas flows were evident in all drilled in the Glyde River Basin but in GR9 they were more significant. A gas sample was taken for analysis and assayed by Amdel. The sample contained 0.78% Oxygen as air contaminant and in the following analysis this had been deleted to give results on an air free basis. The gas contained 10.75% nitrogen, 0.2% carbon dioxide, 74.25% methane, 10.25% ethane, 3.25% propane, 0.175% iso butane, 0.6% N-butane, 0.105% N-pentane, 0.165% hexanes and 0.08% heptanes and higher. Due to the high gas flows from GR9 the hole was plugged with cement.

Again both GR8 and GR9 intersected a thick section of flat lying sediments indicating they were at the base of a synclinel adjacent to the fault. This provided an excellent trap site for metalliferous brines but only disappointing values were encountered. It was felt that these two holes tested the best trap site in the sub-basin where volcanic related emanations were abundant.(see Fig.7)

Due to the poor results no further drill targets remain in the sub-basin.

Drill logs for these two holes occur in Appendix 1.

7.3 DISCUSSIONS

In the Caranbirini area the detailed work to date has shown that any economic stratiform lead-zinc deposit similar to the H.Y.C. mine would be a depth approaching or greater than 1 km. This does not meet the present economic parameters of Kennecott. The only area where the Barney Creek Formation is thought to outcrop is near the southern boundary of E.L. 1332 but the lack of a gravity anomaly from the detailed survey precludes any mineralisation of an economic size.

In the Glyde River area the holes drilled intersected the pyritic shale unit in the deepest part of the two sub-basins. This was the best trap site for metalliferous brines but only geochemically anomalous pyritic shales were evident. The abundant vitric tuffs intersected in drill holes indicated the exhalitive process was operative but no significant basemetals were associated with the brines.

Geological mapping of creeks in the area showed that the prospective Barney Creek Formation was not very extensive in the southern portion of the Glyde River Basin, i.e. in E.L. 1943. It appears as if the southern boundary was not tectonically active and the whole basin plunged northward towards the very active Hot Springs Fault. Only small outliers of the very base of the pyritic shale units were preserved in the southern portion and previous sampling of these outcrops showed no significant base metals were present.

Due to the above it is felt there is no remaining potential for an economic stratiform lead-zinc deposit in the Glyde River Basin.

McARTHUR RIVER LEAD/ZINC PROJECT

EXPLORATION LICENCES 1330, 1331, 1332, & 1943

ANNUAL EXPENDITURE 1979 - 1980

	$AUST
SALARIES	29,489
SUPPLIES	10,362
DRILLING SERVICES	158,047
CONSULTING FEES	11,190
FLYING SERVICES	56,894
FREIGHT & MAINTENANCE	7,809
TRAVEL	15,104
OTHER DIRECT EXPENSES	3,104
	292,035
PLUS: ADMIN. OVERHEADS (10%)	29,203
TOTAL	321,238

APPENDIX 1.

DRILL LOGS

MANT - 79 - 3	0 - 485.35m
GRNT - 79 -5	492m - 528m
GRNT - 79 - 7	635m - 917m
GRNT - 79 - 8	0 - 613m
GRNT - 79 - 9	0 - 534m

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No 1 OF 1 SHEETS
LOGGED BY G. Thomas

PROJECT GLYDE RIVER, N.T.

DDH No. - GRNT - 79-5 COORDINATES 24500 N 47000 E

COLLAR ELEVATION 117m a.s.l.

DATE STARTED 13.11.79
DATE COMPLETED 15.11.79
DRILLING Co Longyear
FINAL DEPTH 528m
CASING DEPTH 3m

CORE SIZE	FROM	TO
HQ	0m	3m
NQ	3m	50m
BQ	50m	528m

BORE HOLE SURVEY

DEPTH-M	DIP	BEARING	DEPTH-M	DIP	BEARING
0	vert.				

GRAPHIC LOGS

GEOLOGIC NOTES Use also for general comments

DEPTH IN METRES	CORE REC. M.	R.Q.D.	GEOLOGY	TOTAL SULPHIDES (vol. %)	DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE	MINERALIZATION: DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY	SAMPLE No.	FROM M	TO M.	ASSAY VALUES Pb	Zn	Ag	Cu
490					492 (cont. from 191m)	512.7	BARNEY CK. FM. BITUMINOUS DOLOMITIC SILTSTONE	Dark brownish-black, dolomitic Bituminous siltstone. Bedding is indistinct except for pyrite lrs. Bitumen wisps (1mm thick) occur throughout & a very distinct bitumen smell is present when filleting core. Minor dolomitic veining (1-2mm) occurs. At 498.35 a slumped dolarenite bed occurs and has coarse of pyrite associated. Greenish-grey vitric tuffs or potassic rich illitic shale bands occur and increase towards base of unit. beds of tuff are 0.5 cm thick.	493.5	80	Pyrite layer in rock	Pyrite is dominant sulphide (15%) & occurs mainly disseminated throughout the rock with subordinate coarse blebs (up to 4mm) & several fine grained pyrite laminations. At 493.4m a 5mm massive pyrite layer occurs. Trace coarse grained sphalerite occurs on fractures or as flecks throughout.	R1	492	495	82	155	-	60
495									495	83			R2	495	498	110	318	-	51
500											Minor dolomitic veining RQD factor is less than 10% after filleting core. Also appears to decrease drastically if left to dry out.		R3	498	501	101	241	-	44
505													R4	501	504	100	276	-	57
510													R5	504	507	71	258	-	46
													R6	507	510	130	285	-	62
													R7	510	513	85	92	-	55
													R8	513	516	52	62	-	123
													R9	516	519	64	40	-	10
													R10	519	522	67	40	-	31
													R11	522	525	73	38	-	13
515									513.7	75			R12	525	528	76	37	-	31
									516	65									
520																			
525									525	80									
530	EOH		END OF HOLE		512.7	528	W-FOLD SHALE	Greenish grey dolomitic siltstone dolomitic tuff and cream to maroon dolarenite. Maroon colour increases towards base. Beds are commonly 1cm thick. Minor clay interbeds occur near top. Dolomitised radiating Gypsum Pseudomorphs occur between 524-526m. A solution collapse breccia is present at 521.8-522m.			Minor solution collapse structures & some soft sediment deformation present.	Pyrite content decrease to from top to bottom of section ranging from 3% to 0.5%. Pyrite is usually disseminated but coarser grained in dolarenite units. Minor large blebs of pyrite.								

NB. for 0.492 m see Amoco log

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No. 1 OF 3 SHEETS
LOGGED BY G. THOMAS

PROJECT GLYDE RIVER, N.T.

DDH No. GRNT-79-7 COORDINATES 23250 N 49500 E
COLLAR ELEVATION 135 m

DATE STARTED 17.11.79
DATE COMPLETED 23.11.79
DRILLING Co. LONGYEAR
FINAL DEPTH 917m
CASING DEPTH 3m

CORE SIZE	FROM	TO
HQ	0	3m
NQ	3m	50m
BQ	50m	917m

BORE HOLE SURVEY

DEPTH-M	DIP	BEARING	DEPTH-M	DIP	BEARING
0	Vertical				
450	88°				
916	82°				

GRAPHIC LOGS — GEOLOGIC NOTES — Use also for general comments

DEPTH	ROCK TYPE	DESCRIPTION (MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE)	STRUCTURE: DOWN HOLE DIST. M	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES (BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE)
		for 0.635 see previous Amoco log.			
635 – 722.1 (Cont'd from 615.6)	BARNEY CK FM. INTERBEDDED DOLOMITIC SILTSTONE & DOLARENITE	Interbedded light grey dolomitic siltstone & dolarenite, brown grey dolomitic bituminous pyritic siltstones, minor green-grey tuffaceous siltstones & rare microbreccias. There is a variable ratio of thinly bedded light grey & brown grey dolomitic bituminous siltstone throughout, but *40:60. Dolarenites tend to be < 1cm & generally 2 - 5 mm thick. In coarser layers show scour & fill structures & minor sedimentary slumping. Microbreccias occur at 664.1 m & 664.6m & have fragments of Barney Ck. Fm. & pinkish dolomite. At 647.25 have dolomitic vein rich in petroleum residue. At 667.9 a 1cm pink calcite vein. At 669.7m largest green tuff occur (0.5m).	638	40°	Minor brecciation, slumping, microfaulting and dolomitic-calcite veining throughout. N.B. RQD factor nil to 10% after grinding on core filleter for whole hole
			647.7	35°	
			654	40°	
			659	40°	
			667	35°	
			671	40°	
			684	40°	
722.1 – 728.8	TUFFACEOUS ARENITE & SILTSTONE	Thinly bedded white & brown arenite & siltstone which has minor dolomitic beds interbedded. Green tuffaceous? illitic shale bands are common up to 4cm. The green colour alteration is associated with diagenetic joints & cracks (? dewatering). Bitumen flecks & blebs are common in discrete beds. The top boundary is transitional but bottom boundary is very sharp.	701	45°	
			707	45°	
			712	5°	
			713	50°	
			719	30°	
728.8 – 751.65	INTERBEDDED DOLOMITIC SILTSTONE & ARENITE	Interbedded grey-brown & grey dolomitic, bituminous siltstone with subordinate creamish-white dolarenite beds (Dolarenite beds less than between 635-722.1m). A Microbreccia occurs at 749.5m (1 cm).	727	65°	Minor micro faulting & dolomite veins & gashes. Minor slumping in some units.

MINERALIZATION

DISTRIBUTION & TYPE (MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY)	SAMPLE No.	FROM M	TO M	ASSAY VALUES Pb	Zn	Ag	Cu
Pyrite is dominant sulphide & very finely disseminated throughout. The content is variable on small scale but fairly uniform at 6% overall. In dolarenites pyrite is coarser grained & often forms 2-5mm blebs. In dolarenites disseminated pyrite has limonite rings sometimes. Massive pyrite layers are rare & occurs at 684.65 (a 2mm bed of 60% py) (708.35 a 1 cm bed of 60% pyrite). At 694.85 a 4 cm bed of green tuff & 60% py. Sphalerite occurs as trace disseminations (up to 2mm) throughout. Coarse sphalerite occurs in microbreccia at 635.85.	R13	635	638	69	107	-	36
	R14	638	641	55	76	-	31
	R15	641	644	105	104	-	50
	R16	644	647	43	76	-	37
	R17	647	650	60	89	-	35
	R18	650	653	59	94	-	30
	R19	653	656	76	113	-	32
	R20	656	659	57	81	-	31
	R21	659	662	61	63	-	32
	R22	662	665	54	182	-	27
	R23	665	668	53	56	-	27
	R24	668	671	56	144	-	41
	R25	671	674	84	160	-	32
	R26	674	677	167	81	-	27
	R27	677	680	55	97	-	26
	R28	680	683	70	257	-	25
	R29	683	686	64	54	-	25
	R30	686	689	90	54	-	31
	R31	689	692	73	98	-	27
	R32	692	695	52	65	-	27
	R33	695	698	62	75	-	33
	R34	698	701	57	62	-	21
	R35	701	704	60	62	-	23
	R36	704	707	58	86	-	24
	R37	707	710	54	41	-	25
	R38	710	713	56	161	-	27
	R39	713	716	55	88	-	27
	R40	716	719	53	91	-	41
	R41	719	722	76	129	-	36
Trace pyrite is finely disseminated or occurs as occasional blebs. In some green tuff beds pyrite occurs up to 10% over 1cm.	R42	722	725	84	129	-	130
	R43	725	728	45	173	-	175
	R44	728	731	60	74	-	73
	R45	731	734	55	82	-	32
	R46	734	737	62	65	-	41
	R47	737	740	60	103	-	30
	R48	740	743	60	92	-	34
	R49	743	746	59	143	-	33
Pyrite occurs as very finely disseminated throughout (~5%) & occasionally as 2-5mm blebs. Rare semi massive pyrite beds & at 742.5m macroframboidal pyrite accumulation. Trace sphalerite occurs as flecks & as coarse grained patches on fracture at 739.35m.							

CORE RECOVERY 100%

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No 2 OF 3 SHEETS
LOGGED BY G. THOMAS

PROJECT GLYDE RIVER, N.T.

DDH No. GRNT-79-7 COORDINATES 23250 N 49500 E

COLLAR ELEVATION 135m

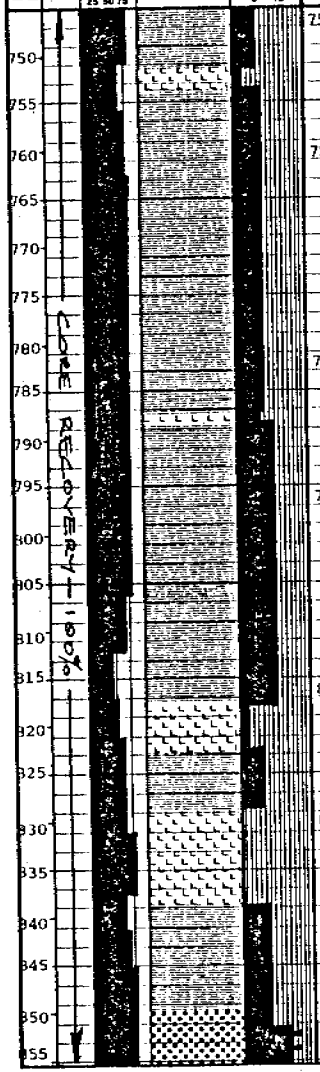
DATE STARTED 17.11.79
DATE COMPLETED 23.11.79
DRILLING Co. LONGYEAR
FINAL DEPTH 917 M
CASING DEPTH 3 M

CORE SIZE	FROM	TO
HQ	0	3m
NQ	3m	50m
BQ	50m	917m

BORE HOLE SURVEY

DEPTH-M	DIP	BEARING	DEPTH-M	DIP	BEARING
0	90°				
45	88°				
916	82°				

GRAPHIC LOGS



GEOLOGIC NOTES Use also for general comments

DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE
751.65	753.55	TUFFACEOUS ARENITE & SILTSTONE	Light brown siltstone & arenite with subordinative green tuffaceous siltstone bands. Bitumen flecks common in some layers. Unit becomes dolomitic towards base.	750	65°	Minor scour of field structures observed especially in arenites.
				757	65°	
753.55	787.25	INTERBEDDED DOLOMITIC SILTSTONE & DOLARENITE	Interbedded dark grey & grey brown Dolomitic bituminous siltstone & creamish white dolarenite. Dolarenite often has minor slumping & commonly scour & fill structures. Microfaulting common. A 1cm microbreccia occurs at 753.45m. In siltstone clay casts are common towards top of unit.	767	65°	Occasional dolomite veins usually at varying angles.
				775	55°	
787.25	788.4	TUFFACEOUS ARENITE SILTSTONE	Fairly massive brownish to light brown dolarenite with subordinate siltstone. All units have a fairly large ? tuffaceous component but does not have green colour. Strong scour & fill structures on base of most beds.	782	55°	Occasional small scale slumping.
				788	70°	
				794	30°	
788.4	817.75	DOLOMITIC SILTSTONE	Dark grey & brown grey dolomitic bituminous siltstone with minor cream dolarenite layers. Bitumen flecks & wisps up to 1-2cm common. Unit is fairly uniform.	798	70°	In siltstone slumping is common & dips can be variable.
				804	70°	
				810	70°	
817.75	822.70	TUFFACEOUS DOLARENITE	Brown dolarenite with minor blue-green tuffaceous shale lenses. Abundant bitumen flecks in dolarenite. A yellow-green clay like ? carbonate alteration in open gashes.	818	60°	Unit partly slumped & brecciated. Scour & fill structures common.
				828	60°	
822.70	828.8	DOLOMITE SILTSTONE	Dark grey & grey-brown dolomitic bituminous siltstone with minor dolarenite lenses.			Minor dolomitic veins 2mm & gashes 1mm. Between 825-827 unit is slumped & minor brecc-iation of sediments occur.
828.8	838.55	TUFFACEOUS ARENITE	Brownish fairly thickly bedded arenite unit which is weakly dolomitic interbedded with blue-green tuffaceous shale beds (1-4 cm thick) Bitumen flecks throughout. One 5 cm layer of dark grey dolomitic bituminous siltstone 836.90m.	841.6	15°	Unit slumped & brecciated in part.
				846	45°	Scour & fill structure dips vary erratically
				850	30°	due to brecciation & slumping.

MINERALIZATION

DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY	SAMPLE No.	FROM M	TO M.	ASSAY VALUES Pb	Zn	Ag	Cu
Pyrite occurs as fine disseminations 1-2% Macrframbiodal pyrite occurs & is concentrated in layers.	R50	746	749	52	55	-	33
	R51	749	752	64	274	-	38
	R52	752	755	72	127	-	42
	R53	755	758	64	65	-	33
	R54	758	761	58	65	-	33
	R55	761	764	64	203	-	34
	R56	764	767	60	82	-	37
Very fine grained pyrite is disseminated throughout & also occurs in subordinate form as coarse blebs (especially in dolarenite macro framboids & small layers of massive sulphide. Only rare flecks of sphalerite observed.	R57	767	770	60	109	-	52
	R58	770	773	65	415	-	51
	R59	773	776	74	66	-	30
	R60	776	779	58	59	-	30
	R61	779	782	70	217	-	33
	R62	782	785	60	38	-	35
	R63	785	788	56	102	-	40
	R64	788	791	57	52	-	38
	R65	791	794	60	87	-	42
	R66	794	797	78	350	-	34
	R67	797	800	56	64	-	34
Fine grained disseminated pyrite slightly coarser than in Siltstone (~5%). Macroframboidal pyrite common towards base of unit.	R68	800	803	58	165	-	42
	R69	803	806	55	113	-	29
	R70	806	809	61	67	-	31
	R71	809	812	98	101	-	31
	R72	812	815	72	96	-	31
	R73	815	818	83	340	-	26
	R74	818	821	45	261	-	301
Pyrite occurs as very fine disseminations throughout framboidal pyrite increasing & thin beds of pyrite becoming more frequent. Pyrite content varies slightly but overall ~8% . Rare to trace sphalerite observed eg. 806m as coarse blebs.	R75	821	824	50	93	-	77
	R76	824	827	64	48	-	29
	R77	827	830	80	312	-	58
	R78	830	833	41	104	-	94
	R79	833	836	42	130	-	166
	R80	836	839	70	212	-	65
	R81	839	842	65	62	-	33
	R82	842	845	55	148	-	52
	R83	845	848	60	64	-	41
	R84	848	851	54	44	-	41
	R85	851	854	87	815	-	36
Pyrite occurs as fine disseminations & minor coarser blebs-highly variable but average ~1-2%.							
Pyrite is very finely disseminated throughout with minor coarser blebs. Average content of unit is 5%.							
Pyrite occurs of minor fine disseminations, descrete semi massive beds or as fracture infills. Locally very high content but overall <1%.							

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No 3 OF 3 SHEETS
LOGGED BY G. THOMAS

PROJECT GLYDE RIVER, N.T.

DDH No. GRNT-79-7 COORDINATES 23250 N 49500 E

COLLAR ELEVATION 135m

DATE STARTED 17.11.79
DATE COMPLETED 23.11.79
DRILLING Co LONGYEAR
FINAL DEPTH 917m
CASING DEPTH 3m

CORE SIZE	FROM	TO
HQ	0m	3m
NQ	3m	50m
BQ	50m	917m

BORE HOLE SURVEY

DEPTH-M	DIP	BEARING	DEPTH-M	DIP	BEARING
0	90°				
480	88°				
916	82°				

GRAPHIC LOGS — GEOLOGIC NOTES — Use also for general comments

DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE
838.95	851.20	DOLOMITIC SILTSTONE	Brown grey & dark grey dolomitic bituminous siltstone with minor dolarenite layers. Dolarenite layers are partly slumped when thicker (~1cm) & show scour & fill features. Bituminous flecks throughout unit.			Unit slumped a little in places vary dips. Minor dolomitic vein 2mm wide.
851.2	884	DOLOMITIC BITUMINOUS PYRITIC SILTSTONE POTENTIAL ORE HORIZON	Dark brownish grey dolomitic bituminous siltstone. Unit is very uniform & bedding very indistinct except for pyrite laminae. Dolarenite is absent except for one slumped 3cm at 874.50 m. Slickensides occurred on many of the fractures.	878		Bedding very poorly developed & seen only where pyrite layers occur. Dips are erratic as unit is slumped & brecciated. Dips vary from 70-30° but average about 55°.
				888	35°	
			Minor dolomite veining. Rock jointed & fractured especially at base of unit.	895	45°	
				903	45°	
				908	20°	
				911	25°	
				915	50°	
884	901.70	TUFFACEOUS DOLOMITIC SILTSTONE	Grey brown siltstones & green to blue green tuffaceous siltstones & shales which are weakly dolomitic. Tuffaceous layers are about 50% of rock. Fractures are slickensided.			Soft sediment deformation common in zones of high tuffaceous X component. Rock fractured.
901.70	917	W-FOLD SHALE	Steeply dipping green & white dolomitic siltstone & arenite (arenite sometimes maroon). Siltstone layers have abundant tuffaceous component clay on joints & fractures towards top of unit. Arenite layers are brecciated within themselves. Minor dark grey bituminous dolomitic siltstone fragments occur as infill between some of the brecciated arenite layers. Transitional boundary at top of unit.			Dips are erratic due to slumping & brecciation but unit overall is steeply dipping ~30°. Rock brecciated badly from slumping

SAMPLE No	FROM M.	TO M.	Pb	Zn	Ag	Cu
R 86	854	857	96	158	-	57
R 87	857	860	90	263	-	43
R 88	860	863	100	222	-	42
R 89	863	866	88	143	-	47
R 90	866	869	142	195	-	44
R 91	869	872	145	800	-	46
R 92	872	875	80	100	-	46
R 93	875	878	80	442	-	52
R 94	878	881	81	81	-	52
R 95	881	884	86	93	-	51
R 96	884	887	90	50	-	52
R 97	887	890	69	54	-	115
R 98	890	893	130	158	-	77
R 99	893	896	164	167	-	68
R100	896	899	89	56	-	75
R101	899	902	61	47	-	33
R102	902	905	53	48	-	45
R103	905	908	55	47	-	10
R104	908	911	70	59	-	10
R105	911	914	56	42	-	10
R106	914	917	65	42	-	10

MINERALIZATION

DISTRIBUTION & TYPE (MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY)

very fine grained pyrite is dominant sulphide & occurs as very fine disseminations, often forming semi-massive layers with hazy outlines of 1-2cm. Also have some coarser grained blebs & minor macro-framboidal pyrite.

High percentages of pyrite occurs in slumped & brecciated layers. Weak sphalerite mineralisation was observed throughout unit as minor fine disseminations & coarser accretions in microbreccias & dolomitic veins. Coarse grained sphalerite at 852.1,852.2,852.8,865.9,866.3,867.8, 870.7 & 871.55 which is sometimes associated with pyritic rich layers. Galena associated at 871.55m. Sphalerite also occurs as fine disseminations forming balls & usually associated with slumped beds. At 867.1m sphalerite occurs as fine dissem. & rims pyrite balls.

Pyrite occurs as fine to very fine disseminations although content variable. Average 1-5%. Some macro-framboidal pyrite occurs. Trace sphalerite at top of unit. Coarse sphalerite as 888.5m.

Trace to minor pyrite occurs as disseminations & blebs. Pyrite content decreases towards base of unit.

END OF HOLE

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No. 1 OF 6 SHEETS
LOGGED BY G. THOMAS

PROJECT GLYDE RIVER

DDH No. GRNT-79-8 COORDINATES 13500 N 52650 E

COLLAR ELEVATION 145m asl

DATE STARTED 25.11.79
DATE COMPLETED 4.12.79
DRILLING Co LONGYEAR
FINAL DEPTH 613m
CASING DEPTH 3m

CORE SIZE	FROM	TO
HQ	0m	3m
NQ	3m	42m
BQ	42m	613m

BORE HOLE SURVEY

DEPTH - M	DIP	BEARING	DEPTH - M	DIP	BEARING
0	90°				
600	81°				

GRAPHIC LOGS

GEOLOGIC NOTES Use also for general comments

DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE	MINERALIZATION: DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY	SAMPLE No.	FROM M	TO M.	ASSAY VALUES Pb	Zn	Ag	Cu
0	10.2	BUKALARA SANDSTONE	Medium To Gritty Quartz Lithic Sandstone with minor green shale (weathered) clasts. Also have minor green shale/siltstone bands 1-3mm thick which are also weathered green. Becomes more gritty at base.			coarse cross-bedding features observed. Individual beds up to 2 cm thick but generally 1-3 mm.	Hematitic (oxidised pyrite) laminations throughout. In basal 50 cm pyrite content 5-20%. Pyrite occurs as coarse blebs in sands tone matrix							
				10.7	87									
				13	88									
		BARNEY C K FORMATION						R107	17	20	90	35	-	
				20	88			R108	20	23	75	40	-	
10.2	15.0	WEATHERED DOLOMITIC SILTSTONE	Weathered light grey & light green dolomitic silts tones. Variable colour content but green colour decreases from top of section.			Thinly to medium bedded siltstones		R109	23	26	65	73	-	
								R110	26	29	61	104	-	
								R111	29	32	6	35	-	
				26	87			R112	32	35	58	16	-	
								R113	35	38	55	30	-	
								R114	38	41	59	77	-	
15.0	96.0	DOLOMITIC SILTSTONE	Medium bedded light grey & light brown bituminous dolomitic siltstone with minor thin dark grey bituminous siltstone beds. The ratio of the above is light grey siltstone 35%, light brown siltstone 60%, dark grey siltstone 5%.			Minor cross bedding observed on very small scale, scour & fill features & some flame structures.	Variable pyrite content from 3-6% but average is about 4%. Pyrite occurs as very fine disseminations through out with occasional coarse blebs in coarser grained units. Pyrite is mainly associated with bituminous areas & correlation occurs in most of section ie higher content in more bituminous areas.	R115	41	44	61	30	-	
								R116	44	47	63	33	-	
				30	89			R117	47	50	58	30	-	
								R118	50	53	53	31	-	
								R119	53	56	54	33	-	
				46	89	Occasional dolomitic veins up to 2mm wide.		R120	56	59	53	41	-	
								R121	59	62	58	39	-	
								R122	62	65	56	36	-	
			Rare to occasional white dolarenite beds occur, increasing towards base of section.					R123	65	68	53	35	-	
								R124	68	71	52	31	-	
				55	89			R125	71	74	55	35	-	
			Bituminous wisps occur disseminated throughout section. The dark grey beds are mainly caused by an increase in bitumen and shale fragment content. Wisps vary in size but generally are 1 mm wide & up to 1 cm long.					R126	74	77	62	34	-	
								R127	77	80	49	29	-	
								R128	80	83	56	45	-	
				63	89			R129	83	86	55	48	-	
								R130	86	89	56	37	-	
								R131	89	92	60	38	-	
								R132	92	95	57	30	-	
			Throughout section have poorly developed tuffaceous beds. They are greenish grey & have a high dolomitic content. In places abundant illitic clay beds are present. Tuffaceous &/or illitic clay beds occur at 50.0m, 52.3, 50.5, 60.5, 64.15m, 70.25, 77.55, 79, 90.5m. They are mostly a few cm thick & have slightly elevated py content					R133	95	98	50	28	-	
				72	88			R134	98	101	40	30	-	
								R135	101	104	56	34	-	
								R136	104	107	51	59	-	
								R137	107	110	56	57	-	
				81	89									
				89	89									
96.0	101.0	TUFFACEOUS ARENITE	Green & white tuffaceous illitic siltstone & arenite (non dolomite) Bitumen occurs along fractures, joints & disseminations On dolomite veins & fractures bitumen is remobilised to margins or faces. Top & bottom boundaries are transitional over 20-30 cms.	95	85	Beds become thicker towards base. Minor dolomitic veining	Trace pyrite which is very finely disseminated throughout.							
				99	65									
				107	80									
				110	78									

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No. 2 OF 6 SHEETS
LOGGED BY G. THOMAS

PROJECT GLYDE RIVER

DDH No. GRNT - 79-8 COORDINATES 13500 N 52650 E

COLLAR ELEVATION 145 m asl

DATE STARTED 25.11.79
DATE COMPLETED 4.12.79
DRILLING Co. LONGYEAR
FINAL DEPTH 613m
CASING DEPTH 3m

CORE SIZE	FROM	TO
HQ	0	3
NQ	3	42
BQ	42	613

BORE HOLE SURVEY

DEPTH - M	DIP	BEARING	DEPTH - M	DIP	BEARING
0	90°				
600	81°				

GRAPHIC LOGS: DEPTH IN METRES; CORE REC. M.; R.Q.D. %; GEOLOGY; TOTAL SULPHIDES (Vol %)

GEOLOGIC NOTES — Use also for general comments

DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE
101.0	145.0	DOLOMITIC SILTSTONE	Interbedded dark grey, light grey & brownish dolomitic siltstone, with minor white dolarenites & tuffaceous greenish illitic siltstone. Between 106-107 thin green-grey tuffaceous layers occur. Some are very pyritic (up to 15%) but never more than 1 cm thick. In some tuff layers a non-dolomitic cream arenite is developed which has abundant bitumen present along joints & fractures as well as in matrix - especially 117.5-118.0m Weakly developed tuff beds increase to base of section. At 128m coarse arenite-breccia	113	86°	Dolomitic veining and microfaulting occur spasmodically Common between 108-109.50m
				120	86°	
				126	85°	
				130	82°	
				135	78°	
				142	84°	
145.0	146.15	TUFFACEOUS ARENITE	Light grey & cream bituminous arenite interbedded with greenish bituminous tuffaceous siltstone & illitic shale.	149	84°	Bedding is more massive up to 5-10 cms
				155	82°	Minor dolomitic veining
146.15	155.8	DOLOMITIC SILTSTONE	Interbedded light grey, dark grey & brownish dolomitic siltstone with rare arenite layers. Minor weakly developed green grey tuffaceous siltstones at base of unit.	160	82°	Bedded siltstone with microfaulting & rare scour & fill structures
				167	85°	
155.8	160.7	TUFFACEOUS SILTSTONE-ARENITE	Light grey & cream bituminous arenite-siltstone interbedded with illitic shale layers - more than between 145-146.15m. Within section poorly developed vitric tuffs occur up to 5-10 cms.	173	85½	Bedding more massive than in dolomite siltstones - scour & fill structures more common.
				181	83°	
				185	85°	
160.7	180.55	DOLOMITIC BITUMINOUS SILTSTONE	Light grey & brownish dolomitic bituminous siltstone with minor dolarenite layers. Between 176-177m interbedded are greenish tuffaceous dolomitic siltstone beds with abundant pyrite layers up to 2 cm of variable content. Minor clay beds associated.	193	85°	Bedded dolomites with occasional soft sediment deformation structure & rare slumping on small scale. Graded beds common in dolarenites. Dolomitic veining minor.
				201	85°	165.9m brown orange carbonate vein.
180.55	181.7	TUFFACEOUS DOLOMITIC SILTSTONE & ARENITE	As for 155.8-160.7 except matrix dolomitic. Vitric tuffs are better developed.	207	85°	Minor slumping, graded bedding & occasional dolomite
				213	85°	vein
				218	85°	

MINERALIZATION

DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY	SAMPLE No.	FROM M.	TO M.	ASSAY VALUES Pb	Zn	Ag	Cu
Pyrite content variable but averages 6%. Pyrite occurs as very fine disseminations throughout & occasional blebs in coarser grained units. Also have rare thin massive pyrite beds 2-5mm. Usually have weakly developed tuffaceous bed 1-2 cm nearby. Rare macroframboidal pyrite present	R138	110	113	52	55	-	
	R139	113	116	48	55	-	
	R140	116	119	50	48	-	
	R141	119	122	48	57	-	
	R142	122	125	49	90	-	
	R143	125	128	52	77	-	
	R144	128	131	52	63	-	
	R145	131	134	55	50	-	
	R146	134	137	51	58	-	
	R147	137	140	53	98	-	
	R148	140	143	60	56	-	
	R149	143	146	51	38	-	
	R150	146	149	49	56	-	
	R151	149	152	57	80	-	
	R152	152	155	52	52	-	
	R153	155	158	42	27	-	
	R154	158	161	37	34	-	
	R155	161	164	54	56	-	
Trace disseminated fine grained pyrite - coarser than before.	R156	164	167	52	227	-	
	R157	167	170	60	85	-	
	R158	170	173	52	47	-	
	R159	173	176	58	61	-	
	R160	176	179	56	45	-	
Very finely disseminated pyrite with rare coarse blebs in arenite layers. Pyrite content variable but average for section is about 6%	R161	179	182	50	40	-	
	R162	182	185	59	61	-	
	R163	185	188	58	59	-	
	R164	188	191	52	39	-	
	R165	191	194	55	50	-	
	R166	194	197	53	76	-	
	R167	197	200	58	64	-	
Trace disseminated fine grained pyrite. Occasionally coarse grained blebs.	R168	200	203	55	88	-	
	R169	203	206	57	105	-	
	R170	206	209	64	80	-	
	R171	212	215	49	43	-	
	R172	215	218	58	68	-	
	R174	218	221	57	69	-	
Disseminated very fine grained pyrite throughout with occasional coarse blebs in arenite layers. Average pyrite content is about 5%. At 170m trace sphalerite in microbreccia.							
3% Disseminated very fine grained pyrite increasing towards base. Also pyrite occurs in 1cm belts in bituminous rich layer of arenites. Macroframboid at 196.3m							

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No. 3 OF 6 SHEETS
LOGGED BY G. THOMAS

PROJECT GLYDE RIVER

DDH No. GRNT-79-8 COORDINATES 13500 N 52650 E

COLLAR ELEVATION 145 asl

DATE STARTED 25.11.79
DATE COMPLETED 4.12.79
DRILLING Co. LONG YEAR
FINAL DEPTH 613m
CASING DEPTH 3m

CORE SIZE	FROM	TO
HQ	0m	3m
NQ	3m	42m
BQ	42m	613m

BORE HOLE SURVEY

DEPTH-M	DIP	BEARING	DEPTH-M	DIP	BEARING
0	90				
600	81				

GRAPHIC LOGS

GEOLOGIC NOTES Use also for general comments

DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE
181.7	221.8	DOLOMITIC SILTSTONE	Dark grey & brown dolomitic siltstone with minor bituminous arenites. Interbedded throughout are weakly developed greenish tuffaceous, bituminous, dolomitic siltstone & arenites with minor illitic clay beds. These occur between 190.6 - 191.25m, 202.4m, 205.4-206.05, 212-212.3, 214.6-214.8m.	223	86°	Minor slumping features throughout. Graded bedding associated with all arenite beds.
221.8	222.9	TUFFACEOUS DOLOMITIC SILTSTONES & ARENITES	Cream-grey dolomitic bituminous arenite with greenish tuffaceous siltstone & minor vitric tuffs. Bitumen seems to be preferentially developed in bedding planes of arenites. Minor green illitic clay beds usually very thin.	248	84°	Minor dolomite veining. Unit also has unoriented fracture pattern which has a 1-3mm greenish tuffaceous selvage along them.
222.9	275.7	DOLOMITIC SILTSTONE	Light grey & dark grey bituminous dolomitic siltstones with minor interbedded arenites. Bitumen does not occur throughout unit but concentrated in dark units. Also interbedded are occasional greenish tuffaceous siltstone with minor dark green illitic clay beds. Tuffaceous zones occur at 230, 248.75 253.3 & 263.3m.-N.B. Creamy arenite layers increase in areas of tuffaceous activity. Bare microbreccias or grit layers occur at 245.2 & 258.6-258.7. At 258.6-258.7 fragments of Barney Ck Fm & mineralised vitric tuffs present	254 264 274 285	84° 86° 84° 86°	Uniformly bedded siltstones with coarser arenite layers showing graded bedding. At base of arenites scour & fill structures common although better developed near tuffaceous activity. Minor slumping associated with microbreccia at 258.6 - 258.7m.
275.	278.5	TUFFACEOUS DOLOMITIC ARENITE & SILTSONE	Cream dolarenites interbedded with greenish, tuffaceous, illitic siltstones & shale & light grey siltstone. Tuffaceous layers are almost vitric.	296 302	82° 85°	Minor slumping in one arenite bed.
278.5	373.2	DOLOMITIC SILTSTONE WITH MINOR ARENITE BEDS	Bedded dark grey & light grey dolomitic siltsone with minor cream dolarenite beds. Dolarenite beds increase from units before but still only minor. Most dolarenite layers show graded beds. Minor bitumen is associated with dolarenites as wisps & clots of 2-3mm. Possible dolomite concretions at 334.4-334.5m. Rare poorly developed tuffaceous (cont'd).	310 315 322 330	86° 85° 83° 84°	Minor to rare dolomite veins throughout. Slumping in beds up to 10 cm occurs. Scour & fill structures at base of dolarenite beds usually. Microfaulting throughout.

MINERALIZATION: DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY	SAMPLE No.	FROM M	TO M	ASSAY VALUES Pb	Zn	Ag	Cu
Pyrite occurs as very fine grained disseminations but variable. Overall average content 7%.	R175	221	224	58	39	-	
	R176	224	227	57	72	-	
	R177	227	230	58	75	-	
	R178	230	233	59	56	-	
	R179	233	236	58	70	-	
Pyrite content decreases in tuffaceous sections.	R180	236	239	62	81	-	
	R181	239	242	60	76	-	
	R182	242	245	57	57	-	
	R183	245	248	60	65	-	
	R184	248	251	52	69	-	
Trace to 1% fine disseminated pyrite occurs throughout.	R185	251	254	53	59	-	
	R186	254	257	62	56	-	
	R187	257	260	46	91	1	25
	R188	260	263	43	61	-	24
	R189	263	266	47	64	-	25
	R190	266	269	60	70	1	30
	R191	269	272	35	68	-	21
Pyrite content varies from 5-10% increasing towards base of unit. Pyrite is very finely disseminated throughout with occasional coarse blebs in arenite layers. At 270m some pyrite has limonite rings. Sphalerite is associate in microbreccia layers & arenite layers at 245.2, 254.95 as coarse blebs. At 249.55m a 1-3mm band of bedded sphalerite in dolarenite. In microbreccia at 258.6-258.7 have frag's of pyritic vitric tuff, sphalerite in arenite & one vitric tuff has galena. Minor very fine grained disseminated pyrite.	R192	272	275	36	105	-	18
	R193	275	278	34	69	-	21
	R194	278	281	69	77	-	28
	R195	281	284	49	52	-	40
	R196	284	287	50	100	-	40
	R197	287	290	40	77	-	29
	R198	290	293	79	63	-	32
	R199	293	296	161	58	-	28
	R200	296	299	115	95	-	26
	R201	299	302	42	70	-	26
	R202	302	305	48	110	-	27
	R203	305	308	81	62	-	41
	R204	308	311	43	76	-	28
	R205	311	314	39	84	-	27
	R206	314	317	45	60	-	25
	R207	317	320	39	68	-	27
	R208	320	323	49	79	-	24
	R209	323	326	42	57	-	25
	R210	325	329	37	81	-	25
	R211	329	332	46	56	-	25
Pyrite is uniformily distributed throughout as very fine grained disseminations. Pyrite is slightly coarser in arenites. Rare pyrite is easily visible to naked eye. Massive sulphide beds associated with illitic clay up to 5mm thick occur at 350.							

CORE RECOVERY = 100%

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No. 4 OF 6 SHEETS
LOGGED BY G. THOMAS

PROJECT GLYDE RIVER

DDH No. GRNT-79-8 COORDINATES 13500 N 52650 E
COLLAR ELEVATION 145m asl

DATE STARTED 25.11.79
DATE COMPLETED 4.12.79
DRILLING Co. LONG YEAR
FINAL DEPTH 613m
CASING DEPTH 3m

CORE SIZE	FROM	TO
HQ	0m	3m
NQ	3m	42m
BQ	42m	613m

BORE HOLE SURVEY

DEPTH-M	DIP	BEARING	DEPTH-M	DIP	BEARING
0	90				
600	81				

GRAPHIC LOGS: DEPTH IN METRES; CORE REC. M.; R.Q.D. 25 50 75; GEOLOGY; TOTAL SULPHIDES (vol %) 5 10

GEOLOGIC NOTES Use also for general comments

DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE	MINERALIZATION: DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY
			green-grey illitic siltstone beds occur at 295.25, 295.95, 303.2-303.5, 350.25 & 350.8m.	335	85°		At 320m associated with dolarenite layer are coarse 1cm. blebs of sphalerite
			Between 360.2-360.8 & 368.8-370.2m there is thinly bedded cream & light brown arenite beds which have bituminous & ?shale wisps. Appears to have some tuffaceous content & is probably related to underlying unit.	343 351	85° 85°	368.8-370.2 Scour & fill common in arenite beds.	368.8-370.2 pyrite content decreases rapidly to minor-2%.
373.2	387.1	TUFFACEOUS PARTLY DOLOMITIC ARENITE - SILTSTONE	Cream & light grey, weakly to non-dolomitic tuffaceous siltst. & arenite. Common interbeds of green illitic clay rich, K rich siltstones. Bitumen flecks common in coarser arenite beds. Some green tuffaceous alteration associated with fractures.	357 361 368	85° 85° 85°	Fairly massive bedding except for green tuff layers which are finely bedded. Graded beds & scour & fill features common. Concretions occur in arenite beds.	Minor fine grained disseminated pyrite content < 1%.
				375	85°		
				382	85°		
387.1	473.3	DOLOMITIC SILTSTONE WITH MINOR DOLARENITE BEDS	Thinly bedded dark grey & light grey (ratio 70:30) dolomitic siltstone with minor cream to white dolarenite beds. The arenite beds are generally graded & usually show soft sediment deformation features. The dolarenite component increase towards base of unit & especially from 420-445m & 457-473.3m. Minor weakly developed greenish tuffaceous, illitic siltstone horizons usually with bituminous pyritic beds occur at 437.25-437.4, 441-444, 447.5. Between 441-444 dolarenite beds are common with coarse pyrite. Between 420-440m some dark brown siltstone occurs. At 447 dolomitic concretions occur. There seems to be a correlation with increasing arenites, increasing dolomite veining & increasing bitumen content.	387 392 400 407 412 420 429 437	85° 85° 85° 85° 80° 85° 85° 85°	Scour & fill features common on base of dolarenites, dolarenite usually graded. Microfaulting common. Rare dolomite veining but increasing towards base of unit. At 420.1m a calcite bitumen vein of 3mm occurs. Dolomite veining increases towards base of unit. At 441-444 soft sediment deformation common. Slumping increasing in dolarenite layers.	Very finely disseminated pyrite throughout with rare trace sphalerite observed also in base of most basal arenite beds of graded beds. Coarser grained pyrite & macroframboids occur at 395.5m. Occasional massive pyrite beds up to a few mm thick occur at 395.75, 400.5m & 439.4m. Sphalerite also occurs in larger clots in arenite layers at 395.5, 397.6, 398.3, 405.6, 408.55, 435.6, 436.1, 448.8 & 454.4. At 454.3 sphalerite & pyrite are associated in larger clots in siltstone. At 439.8 & 451.9 sphalerite content increases to large quantities over 1-2 cm. Tuffaceous components seem to be associated with sphalerite rich arenites.

MINERALIZATION

SAMPLE No.	FROM M.	TO M.	ASSAY VALUES Pb	Zn	Ag	Cu
R212	332	335	39	77	-	32
R213	335	338	40	110	-	25
R214	338	341	68	54	-	26
R215	341	344	4360	190	-	52
R216	344	347	240	64	-	30
R217	347	350	41	63	-	24
R218	350	353	147	63	1	24
R219	353	356	52	49	1	22
R220	356	359	61	80	1	26
R221	359	362	66	71	1	25
R222	362	365	1610	70	-	31
R223	365	368	62	92	-	36
R224	368	371	86	62	-	29
R225	371	374	134	52	1	31
R226	374	377	146	40	-	26
R227	377	380	26	36	1	26
R228	380	383	25	52	-	42
R229	383	386	45	43	1	34
R230	386	389	47	50	-	55
R231	389	392	50	55	-	26
R232	392	395	62	183	-	25
R233	395	398	143	55	-	25
R234	398	401	41	84	-	25
R235	401	404	46	54	-	20
R236	404	407	40	76	-	22
R237	407	410	106	108	1	25
R238	410	418	41	69	1	28
R239	413	416	35	96	-	57
R240	416	419	42	160	1	40
R241	419	422	32	80	1	26
R242	422	425	43	55	-	26
R243	425	428	35	66	-	24
R244	428	431	64	86	-	20
R245	431	434	38	75	-	25
R246	434	437	42	150	-	26
R247	437	440	35	75	-	27

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No. 5 OF 6 SHEETS
LOGGED BY G. THOMAS

PROJECT GLYDE RIVER

DDH No. GRNT-79-8 COORDINATES 13500 N 52650 E
COLLAR ELEVATION 145m asl

DATE STARTED 25.11.79
DATE COMPLETED 4.12.79
DRILLING Co. LONGYEAR
FINAL DEPTH 613m
CASING DEPTH 3m

CORE SIZE	FROM	TO
HQ	0m	3m
NQ	3m	42m
BQ	42m	613m

BORE HOLE SURVEY

DEPTH-M	DIP	BEARING	DEPTH-M	DIP	BEARING
0	90°				
600	81°				

GRAPHIC LOGS: DEPTH IN METRES; CORE REC. M; R.Q.D. 25 50 75; GEOLOGY; TOTAL SULPHIDES 5 10 (vol %)

CORE RECOVERY — 100%

GEOLOGIC NOTES — Use also for general comments

DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE
			Basal contact with next unit is transitional over 50 cms.	444	85°	
473.3	481	TUFFACEOUS SILTSTONE - ARENITE WITH VITRIC TUFFS	Creamy to light grey bituminous, tuffaceous arenites & creamy-brown vitric tuffs with greenish, illitic K-rich, tuffaceous siltstone which are mostly in well defined thin beds. In arenites sometimes has disseminated greenish tuffaceous alteration (?chlorite) & also along fractures & joints.	452	85°	Most arenite beds are graded & bases show scour & fill features. Unit has many micro-faults throughout. Beds are massive but of variable thickness.
			Bitumen content increases towards base of unit & occurs up to 2mm blebs & on joints & bedding planes.	470	85°	
				474	85°	
			Minor dolomitic concretions.	480	85°	
481	500.2	DOLOMITIC SILTSTONES WITH MINOR DOLARENITES	Thinly bedded dark grey & dark brown dolomitic siltstones with thin interbeds of dolarenite. Some dolarenites are thick - up to 10cm & always graded. A 2cm microbreccia occurs at 494.55 & sediments above are slumped. Weakly developed tuffaceous, pyritic siltstones occur at 494.9 & 495.7-496 with the latter having vitric tuffs associated.	488	85°	Most dolarenites graded & the bases of the thicker unit have scour & fill features. The dolareniteunits have minor slumping.
				500	85°	
500.2	544.4	DOLOMITIC SILTSTONES & ARENITES WITH ABUNDANT VITRIC TUFFS	Light grey & dark grey dolomitic siltstones interbedded with numerous units of vitric tuffs, tuffaceous siltstones & illitic clay beds. Minor dolarenites occur throughout in siltstone units but are usually graded. The main tuffaceous or tuff units are detailed below:	515	85°	Siltstone units are thinly bedded with scour & fill features at base of dolarenites.
			-500.2-502.25: creamy brown vitric tuff with subordinate green illitic siltstone & creamy bituminous dolarenite - the bitumen content increasing towards base of section.	528	85°	-tuffaceous unit thinly bedded. Scour & fill features common.
			-506.3-506.95m: tuffaceous green & brown siltstone & arenite which is bituminous. ? Vitric tuff in unit. Shale fragments occur at base of unit.	540	85°	Arenite units graded.
			-509.2 to 509.3m: tuffaceous, cream arenite & vitric tuff, (cont'd)	546	85°	Thinly bedded.

MINERALIZATION

DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY	SAMPLE No.	FROM M	TO M.	ASSAY VALUES Pb	Zn	Ag	Cu
From 441-444m there is an increase in pyrite content to ~ 14%. Grain size increases also & trace sphalerite	R248	440	443	31	73	-	21
	R249	443	446	52	81	-	30
	R250	446	449	64	146	-	24
	R501	449	452	55	88	-	22
	R502	452	455	57	72	-	25
	R503	455	458	56	82	-	22
Minor fine grained pyrite disseminated throughout.	R504	458	461	50	44	-	24
	R505	461	464	48	46	-	25
	R506	464	467	62	42	-	25
	R507	467	470	58	85	-	22
	R508	470	473	47	92	-	30
	R509	473	476	37	48	-	25
	R510	476	479	52	90	-	75
	R511	479	482	53	52	-	42
	R512	482	485	47	144	-	36
	R513	485	488	40	78	-	33
	R514	488	491	65	84	-	30
	R515	491	494	44	58	-	29
	R516	494	497	40	69	-	30
	R517	497	500	59	88	-	31
Very finely disseminated pyrite throughout up to ~ 5-10%, average about 8%. Occasional massive pyrite beds & qvoids with rare macroframboids. Sphaler-ite occurs in tuffaceous dolarenite at 478.15m.	R518	500	503	58	112	-	64
	R519	503	506	40	53	-	35
	R520	506	509	61	74	-	54
	R521	509	512	80	240	-	50
	R522	512	515	44	80	-	35
	R523	515	518	44	115	-	45
	R524	518	521	96	69	-	40
	R525	521	524	50	485	-	45
	R526	524	527	32	51	-	31
	R527	527	530	54	56	-	29
	R528	530	533	38	88	-	31
	R529	533	536	154	128	-	28
	R530	536	539	42	92	-	30
Pyrite in the siltstone units occurs as very finely disseminated pyrite at ~ 6%. Macroframboids occur in top of unit in siltstone.	R531	539	542	72	146	-	36
	R532	542	545	38	178	-	35
	R533	545	548	50	72	1	34
	R534	548	551	35	136	1	35
-minor pyrite in unit with a large macroframboid at base.							
-minor pyrite							
-minor pyrite.							

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No. 6 OF 6 SHEETS
LOGGED BY G. THOMAS

PROJECT CLYDE RIVER

DDH No. GRNT 79-8 COORDINATES 13500 N 52650 E
COLLAR ELEVATION 145m asl

DATE STARTED 25.11.79
DATE COMPLETED 4.12.79
DRILLING Co. LONGYEAR
FINAL DEPTH 613m
CASING DEPTH 3m

CORE SIZE	FROM	TO
HQ	0m	3m
NQ	3m	42m
BQ	42m	613m

BORE HOLE SURVEY

DEPTH - M	DIP	BEARING	DEPTH - M	DIP	BEARING
0	90°				
600	81°				

GRAPHIC LOGS

GEOLOGIC NOTES Use also for general comments

DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE
			Cont'd. -514.25 to 515.25m: Creamy vitric tuffs, green illitic clay horizons & creamy dolarenite. Minor dark grey dolomitic siltstones.	553	80°	
			-524.6 to 525.1m: dolomitic vitric tuff, creamy. -536.25 to 544.4m: Vitric tuffs & dolomitic tuffaceous siltstones with subordinate bituminous dolarenites & illitic clay beds.	564	83°	= unit slumped
				570	85°	coarsly bedded in vitric tuff - up to 10 cm.
544.5	560	DOLOMITIC SILTSTONE & MINOR DOLARENITES	Dark grey & light grey dolomitic siltstone with subordinate dolarenite which is fairly thickly bedded. Dolarenites are graded & base of beds can be very coarse (almost gritty). Some dolarenites almost look tuffaceous.	582	83°	Dolomitic veins with bitumen residue on fractures.
				594	85°	
560	599.5	DOLOMITIC SILTSTONE	Fairly massive, dark grey bituminous siltstone which has abundant dolomitic concretions up to 10cm. There are occasional dolarenite beds which commonly have bituminous concretions at their base.	602	85°	Minor slumping in beds from 579-582m. Unit has dolomitic veins which seem to be related from diagenetic compaction.
			At 567.8 at 2 cm. red-brown clay layer. At 583.2m a 10cm creamy vitric & tuffaceous siltstone bed. In basal contact area vitric tuffs & clay beds increase making boundary transitional.	611	85°	
599.5	601.5	TUFFACEOUS DOLOMITIC SILTSTONE	Green grey & grey interbedded tuffaceous dolomitic siltstone & dark grey siltstone. All boundaries transitional. Some vitric tuff occur in this unit.			Thinly bedded.
601.5	613	W-FOLD SHALE	Transitional contact with above. Thinly bedded green white & red silty dolomite. Unit becoming coarser bedded towards base of hole. Occasional lime green illitic clay bands up to 1 cm. Also have bright red to pink very thin clay layers throughout. Red dolomite colour increases towards base of hole.			Flat lying thinly bedded dolomite. Rare dolomite veining. Soft sediment deformation structures common.

END OF HOLE

MINERALIZATION

DISTRIBUTION & TYPE: MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY	SAMPLE No.	FROM M	TO M.	ASSAY VALUES Pb	Zn	Ag	Cu
	R535	551	554	37	27	-	35
Pyrite variable from minor to 3% as fine disseminations.	R536	554	557	41	72	-	34
	R537	557	560	45	96	-	33
	R538	560	563	53	67	-	35
	R539	563	566	107	192	-	38
Pyrite occurs at base of unit. -Variable pyrite Minor to 4%.	R540	566	569	69	73	-	33
	R541	569	572	99	345	-	36
	R542	572	575	86	188	-	42
	R543	575	578	61	126	-	31
	R544	578	581	71	760	-	36
	R545	581	584	71	98	1	36
	R546	584	587	110	312	-	41
Pyrite occurs as very fine grained disseminations. Content ~ 5%	R547	587	590	104	363	-	80
	R548	590	593	59	403	1	37
	R549	593	596	52	206	-	48
Minor blebs & beds of massive pyrite plus minor remobilized pyrite into fractures. Rare sphalerite blebs in base of graded beds. Rare specks in siltstones. Extremely fine grained disseminated pyrite - content ~ 4%. Pyrite also occurs in thin massive beds, blebs & coarser grains in dolarenites.	R550	596	599	64	326	-	57
	R551	599	602	42	75	1	53
	R552	602	605	10	44	-	37
	R553	605	608	26	70	-	17
	R554	608	611	29	62	1	18
	R555	611	613	27	60	-	25
Pyrite very finely disseminated ~ 2%.							
Pyrite occurs as minor disseminations at top of the unit becoming trace at base of hole. Pyrite coarser than in siltstone.							

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No. 1 OF 5 SHEETS
LOGGED BY G. THOMAS

PROJECT GLYDE RIVER

DDH No. GRNT-79-9 COORDINATES 16550 N 51350 E

COLLAR ELEVATION 143m

DATE STARTED 7.12.79
DATE COMPLETED 10.12.79
DRILLING Co. LONGYEAR
FINAL DEPTH 534 m
CASING DEPTH 3.4 m

CORE SIZE	FROM	TO
HQ	0m	3.4m
NQ	3.4m	45m
BQ	45m	534m

BORE HOLE SURVEY

DEPTH-M	DIP	BEARING	DEPTH-M	DIP	BEARING
0	verticle				
520	80°				

GRAPHIC LOGS: DEPTH IN METRES; CORE REC M.; R.Q.D. 25 50 75; GEOLOGY; TOTAL SULPHIDES (Vol %) 5 10

GEOLOGIC NOTES — Use also for general comments

DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE	MINERALIZATION: DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY
0	42.5	BUKALARA SANDSTONE	Medium to coarse quartzlithic sandstone with subordinate green and red mottled clay &/or silt interbeds. The green colour increases towards base. The basal 1.5m becomes very gritty and almost conglomeratic.	2	85	Coarsely bedded sandstone with cross bedding features. Bedding planes angles used are base of beds.	The basal 1.5m has about 4% coarse pyrite interstitial to grains. This content decreases stratigraphically up. In top 35m much iron staining after pyrite.
				19	90		
		BARNEY CK FORMATION					
		WEAKLY					
42.5	83	DOLOMITIC SILTSONE WITH MINOR MICROBRECCIA	Interbedded light grey, grey & light grey brown weakly dolomitic siltstone with minor microbreccia layers up to 1m. Microbreccia units are graded. Microbreccia zones very common 61-64.5m. Bitumen & carbonaceous wisps common throughout unit. Between 81.5 83 light grey siltstone dominates over other siltstone & appears to have tuffaceous component. Illitic clay band at 76.45m.	30	90	Bedded dolomite sequence The microbreccias are graded but have fairly sharp tops	Minor (1%) very fine disseminated pyrite throughout. At 45.5 coarse pyrite with bituminous fracture in arenite bed. In microbreccias bituminous residue & pyrite associated on fractures - especially 45.5m
				25	90		
				48	88	Rare vertical dolomite veins. At 58m have a flat dolomitic - bituminous vein.	
			The unit is partly weathered to 46.5m & top layers are commonly greenish in colour (same green as in Bukalara S'st)	60	86		
			Transitional boundary at base of unit.	68	88		
83	100.5	DOLOMITIC SILTSTONE	Inter bedded light grey, grey & light brown dolomitic siltstone Some as unit above but more dolomitic. Light grey siltstone dominates in basal 20m but otherwise the ratio of colours the same. Light grey siltstone appear to have weak hydrocarbon emanations from them.	75	90	Rare dolomitic veins	Very fine disseminated pyrite throughout with pyrite content increasing from 1 to 2% at top of unit.
				86	87		
100.5	103.2	TUFFACEOUS ARENITE	Coarsely bedded, creamy, weakly dolomitic arenite & minor dark brown siltstone with abundant tuffaceous green illitic clay beds throughout. Sometimes green colour weakly dispersed in arenite. Abundant bitumen throughout arenite & siltstone with bitumen weeping from dolomite vein at 101.10. (con't)	93	86	Arenite beds are much coarser bedded than in siltstones. Scour & fill features at base of beds	Minor to 1% fine disseminated pyrite.
				104	88	Rare dolomite vein	

ASSAY VALUES

SAMPLE No.	FROM M	TO M
R556	47	50
R557	50	53
R558	53	56
R559	56	59
R560	59	62
R561	62	65
R562	65	68
R563	68	71
R564	71	74
R565	74	77
R566	77	80
R567	80	83
R568	83	86
R569	86	89
R570	89	91
R571	92	95
R572	95	98
R573	98	101
R574	101	104
R575	104	107
R576	107	110

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No. 2 OF 5 SHEETS
LOGGED BY G. THOMAS

PROJECT GLYDE RIVER

DDH No. GRNT-79-9 COORDINATES 16550 N 51350 E

COLLAR ELEVATION 143m a.s.l.

DATE STARTED 7.12.79
DATE COMPLETED 10.12.79
DRILLING Co. LONGYEAR
FINAL DEPTH 534m
CASING DEPTH 3.4m

CORE SIZE	FROM	TO
HQ	0	3.4m
NQ	3.4m	45m
BQ	45m	534m

BORE HOLE SURVEY

DEPTH-M	DIP	BEARING	DEPTH-M	DIP	BEARING
0	90°				
520m	80°				

GRAPHIC LOGS: DEPTH IN METRES; CORE REC. M; R.Q.D. 25 50 75; GEOLOGY; TOTAL SULPHIDES (Vol. %) 3 10

GEOLOGIC NOTES — Use also for general comments

DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE	MINERALIZATION: DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY	SAMPLE No.	ASSAY VALUES: FROM M	ASSAY VALUES: TO M
			A small 1cm off white vitric tuff occurs at base of unit.	113	87			R577	110	113
								R578	113	116
								R579	116	119
103.2	152	DOLOMITIC BITUMINOUS SILTSTONE	Light grey brown, light grey & grey dolomitic bituminous siltstone with rare dolarenite beds. Bitumen & carbonaceous wisps throughout unit. Bitumen & carbonaceous wisps occur as bigger wisps in light grey dolomitic siltstone. Bituminous residue weeping out of core in many sections.	129	86	Thinly bedded dolomite with rare to minor dolomitic veins. Numerous 5-20 cm thin veinlets representing early diagenetic features	Pyrite occurs as very fine dissemination throughout. Up to 125m content about 2% from 125-152 content about 4% Also pyrite occurs in semi vertical fractures as coarser remobilised pyrite (but still fine grained). Pyrite also occurs in rare blebs in diagentic fractures with minor ? chlorite alteration surrounding.	R580	119	122
								R581	122	125
								R582	125	128
								R583	125	131
								R584	131	134
								R585	134	137
								R586	137	140
								R587	140	143
								R588	143	146
								R589	146	149
								R590	149	152
								R591	152	155
								R592	155	158
								R593	158	161
								R594	161	164
				145	88			R595	164	167
								R596	167	170
152	155.25	DOLOMITIC SILTSTONE WITH MINOR TUFFACEOUS BEDS	Siltstone unit same as above with abundant bitumen & carbonaceous wisps but interbedded within unit are minor cream, weakly pyritic tuffs & green illitic shale bands. The largest tuff zone is 10cm & near base of unit	164	86	Minor soft sediment deformation associated with arenite bed. Beds are graded but not to extent of other holes Minor fractures.	Pyrite is very finely disseminated in siltstones but minor in tuffaceous arenites. Average content 1-2%	R597	170	173
								R598	173	176
								R599	176	179
								R600	179	182
								R601	182	185
								R602	185	188
								R603	188	191
								R604	191	194
155.25	198.3	DOLOMITIC BITUMINOUS SILTSTONE	Light grey, grey & light brown dolomitic bituminous siltstone with minor dolarenites & rarethin tuffaceous wisps common & bitumen residue on outside of core. Some areas can become very bituminous. At 157.6m dolomitic pseudomarphis after gypsum layers. From 181.6-182.2 a very bituminous tuffaceous arenite occurs with weakly developed green illitic clay beds.	186	88	Diagenetic features common. Minor graded beds in dolarenite beds Rare dolomite veins Bitumen common in fractures especially in dollarenites.	Very fine disseminated pyrite throughout with content 4%. Occasionally pyrite occurs up to 20% when associated with thin tuffaceous bands.	R605	194	197
								R606	197	200
								R607	200	201
								R608	203	206
								R609	206	209
								R610	209	212
								R611	212	215
								R12	215	218
								R613	218	221
198.3	202	TUFFACEOUS DOLARENITE	Cream & light brown tuffaceous dolarenite with subordinate green-ish illitic clay layers. Green alteration common on joints & fractures in dolarenites. bitumen & carbonaceous wisps common in arenite in matrix	197	87	Coarsely bedded unit except for green illitic clay beds. Occasional dolomite veins.	Minor fine disseminated pyrite. Pyrite coarser in arenites than in siltstones.			
				215	87					

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No 3 OF 5 SHEETS
LOGGED BY G. THOMAS

PROJECT GLYDE RIVER

DDH No. GRNT-79-9 COORDINATES 16550 N 51350 E

COLLAR ELEVATION 143m asl.

DATE STARTED 7.12.79
DATE COMPLETED 10.12.79
DRILLING Co LONGYEAR
FINAL DEPTH 534m
CASING DEPTH 3.4m

CORE SIZE	FROM	TO
HQ	0	3.4m
NQ	3.4m	45m
BQ	45m	534m

BORE HOLE SURVEY

DEPTH-M	DIP	BEARING	DEPTH-M	DIP	BEARING
0	90°				
520m	80°				

GRAPHIC LOGS | GEOLOGIC NOTES — Use also for general comments

DEPTH IN METRES	CORE REC M	R.Q.D. 25 50 75	GEOLOGY	TOTAL SULPHIDES (Vol %) 5 10	DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE	MINERALIZATION: DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY	MINERALIZATION: SAMPLE No.	MINERALIZATION: FROM M	MINERALIZATION: TO M	ASSAY VALUES
225	CORE RECOVERY — 100%				202	225	DOLOMITIC BITUMINOUS SILTSTONE	Light grey, grey & light brown dolomitic bituminous siltstone with minor dolarenite beds. Bitumen & carbonaceous wisps abundant. Minor residue on core.	225	86	Dolarenite beds are usually graded. Bitumen residue commonly on fractures. Rare dolomite veins	Very fine disseminated pyrite throughout & content is about 4%. Rare blebs	R614	221	224	
													R615	224	227	
													R616	227	230	
													R617	230	233	
230													R618	233	236	
													R619	236	239	
													R620	239	242	
235					225	254	DOLOMITIC BITUMINOUS TURBIDITIC SILTSTONE	Light grey, grey & grey brown dolomitic bituminous siltstone with graded cream dolarenite beds. Dolarenite beds. Dolarenites become more common. Rare weakly developed tuffaceous siltstone. Bitumen & carbonaceous matter reasonably abundant but not as much as before. Both top & bottom boundaries transitional.			Soft sediment deformation & graded beds in dolarenite common. Occasional dolomite veins following diagenetic fractures.	Pyrite occurs as very fine disseminations throughout at about 5-6%. In coarser dolarenites pyrite slightly coarsar & clearly visible to naked eye.	R621	242	245
													R622	245	248	
240									240	85			R623	248	251	
													R624	251	254	
245													R625	254	257	
													R626	257	260	
									247	86			R627	260	263	
													R628	263	266	
250													R629	266	269	
													R630	269	272	
													R631	272	275	
255													R632	275	278	
									260	85			R633	278	281	
260					254	257.2	TUFFACEOUS DOLARENITE	Cream & light brown tuffaceous dolarenite with subordinate greenish illitic clay beds. Green chlorite alteration common on joints & sometimes disseminated. Bitumen & carbonaceous matter wisps common in arenite interstices as well as on some joints & fractures. Bitumen is never associated with illitic clay beds.			Arenite bedding is much coarser than siltstone except for illitic beds Illitic clay beds break up easily. Unit is jointed & slightly fractured	Minor fine disseminated pyrite. Pyrite tends to be coarser than in siltstone.	R634	281	284
													R635	284	287	
265													R636	287	290	
													R637	290	293	
270													R638	293	296	
													R639	296	299	
													R640	299	302	
275									274	85			R641	302	305	
													R642	305	308	
													R643	308	311	
280													R644	311	314	
													R645	314	317	
285					257.2	287.25	DOLOMITIC BITUMINOUS SILTSTONE	Light grey, grey & light brown dolomitic bituminous siltstone with minor cream dolarenite beds. Bitumen & carbonaceous wisps common throughout. Dolarenites are less common than in 22.5-254 m Some dolarenites have many tuffaceous like components.	286	85	Scour & fill features common at base of dolarenites have dolomite veins	Very fine dissemination of pyrite throughout of about 5-6%. In dolarenite beds pyrite tends to be coarser.	R646	317	320	
													R647	320	323	
290													R648	323	326	
													R649	326	329	
295													R650	329	332	
300									301	85						
305					287.25	287.8	TUFFACEOUS BITUMINOUS DOLARENITE	Cream & light brown tuffaceous bituminous dolarenite with weakly developed green illitic clay beds.	309	85	Coarsely bedded dolarenite with clay beds thinly bedded	Minor fine grained disseminated pyrite.				
310																
315																
									317	81						
320																
325																
									328	85						

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No. 4 OF 5 SHEETS
LOGGED BY G. THOMAS

PROJECT GLYDE RIVER

DDH No. GRNT-79-9 COORDINATES 16550 N 51350 E

COLLAR ELEVATION 143m asl.

DATE STARTED 7.12.79
DATE COMPLETED 10.12.79
DRILLING Co LONGYEAR
FINAL DEPTH 534 m
CASING DEPTH 3.4 m

CORE SIZE	FROM	TO
HQ	0	3.4
NQ	3.4	45
BQ	45	534

BORE HOLE SURVEY

DEPTH-M	DIP	BEARING	DEPTH-M	DIP	BEARING
0	90°				
520	80°				

GRAPHIC LOGS: DEPTH IN METRES; CORE REC. M.; R.Q.D.; GEOLOGY; TOTAL SULPHIDES (Vol. %)

CORE RECOVERY - 100%

GEOLOGIC NOTES — Use also for general comments

DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE	MINERALIZATION: DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY
287.8	446.5	DOLOMITIC BITUMINOUS SILTSTONE	Light grey, dark grey & brown dolomitic bituminous siltstone with minor dolarenite beds. Dolarenite beds increase from 335-385 & 420-446.5 m. Bitumen & carbonaceous wisps common throughout with minor bitumen residue on outside of core. Coarse bitumen flakes occur at base of graded beds in dolarenites from 360m to 446.5m. Between 385-420 there is abundant bitumen & carbonaceous wisps (n.b. dolarenites decrease in this area). Interbedded throughout the unit are tuffaceous & vitric tuff units -338.7-339.5m: creamy fractured vitric tuff. -351-351.5m: creamy brown weakly developed tuff. -358.4-358.6m: white vitric tuff with thin interbeds of bituminous dolomite -364.65 to 365.65: weakly dolomitic green illitic clay beds siltstone interbedded with well developed creamy vitric tuffs. Green alteration follows joints & fractures. -387 -387.1: creamy tuffaceous siltstone. -439.2-439.9m: white & light brown vitric tuff. From 420-450 light brown dolomite colour is very minor. Basal contact is transitional	336	83	Bedded dolomites. Some dolarenites are graded & base show scour &fill features. Abundant micro faulting & soft sediment compaction features. From 385-420 there is much more soft sediment compaction structures. Massive unit with rare bedding. Soft sediment deformation very common	Pyrite occurs as very fine disseminations throughout. Content is about 4% rising to 5% from about 360-446. - trace pyrite, fine disseminations. - Minor pyrite, fine disseminations. - Pyrite 3%. - coarse pyrite associated. 3%. - Pyrite minor. - trace pyrite.
				368	87		
				377	88		
				390	85		
				403	88		
446.5	456.2	VITRIC TUFFS & TUFFACEOUS DOLARENITES	Cream & off white K-rich vitric tuffs, weakly dolomitic tuffaceous arenites & greenish illitic clay beds up to 7cm thick. Green ? chlorite alteration common along joints & fractures. Bitumen is present in arenites but not as much as before. Bitumen is rare in vitric tuffs & absent in illitic clay beds. Bitumen residue present on some fractures & joints.	420	85	Unit fractured. Minor slumping & scour & fill structures common. Dolarenites generally show graded bedding & scour & fill structures at base of dolarenite.	Minor to trace fine grained disseminated pyrite. Very finely disseminated pyrite throughout at about 8%. Rare massive pyrite beds. At base last 3m is very pyritic, up to 15%.
				431	86		

ASSAY VALUES

SAMPLE No.	FROM M.	TO M.
R651	332	335
R652	335	338
R653	338	341
R654	341	344
R655	344	347
R656	347	350
R657	350	353
R658	353	356
R659	356	359
R660	359	362
R661	362	365
R662	365	368
R663	368	371
R664	371	374
R665	374	377
R666	377	380
R667	380	383
R668	383	386
R669	386	389
R670	389	392
R671	392	395
R672	395	398
R673	398	401
R674	401	404
R675	404	407
R676	407	410
R677	410	413
R678	413	416
R679	416	419
R680	419	422
R681	422	425
R682	425	428
R683	428	431
R684	431	434
R685	434	437
R686	437	440

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No 5 OF 5 SHEETS
LOGGED BY G. THOMAS

PROJECT GLYDE RIVER
DDH No. GRNT-79-9
COORDINATES 16550 N 51350 E
COLLAR ELEVATION 143m asl

DATE STARTED 7.12.79
DATE COMPLETED 10.12.79
DRILLING Co LONGYEAR
FINAL DEPTH 534m
CASING DEPTH 3.4m

CORE SIZE	FROM	TO
HQ	0	3.4
NQ	3.4	45
BQ	45	534m

BORE HOLE SURVEY

DEPTH-M	DIP	BEARING	DEPTH-M	DIP	BEARING
0	90°				
520	80°				

GRAPHIC LOGS

DEPTH IN METRES | CORE REC. M. | R.Q.D. 25 50 75 | GEOLOGY | TOTAL SULPHIDES (Vol. %) 5 10

445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535

CORE RECOVERY 100%

EOH — END OF HOLE 534m

GEOLOGIC NOTES — Use also for general comments

DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE	MINERALIZATION: DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY
456.2	483	TURBIDITIC BITUMINOUS DOLOMITIC SILTSTONE	Light grey & dark grey dolomitic bituminous siltstones with subordinate cream dolarenite beds-all-graded. Bitumen & carbonaceous wisps common throughout. Basal 3m of unit is fairly massive bituminous siltstone. Bitumen wisps become coarser in dolarenites. At 693.1m a 5cm microbreccia occurs. In basal 1m there is a breccia layer & microbreccia. Fragments in breccia up to 2cm and all lower units in hole represented (mostly bedded dolomite from 483-493.85)	445	86	Dolarenites generally show graded bedding & scour & fill structures at base of dolarenites.	Very finely disseminated pyrite throughout at about 8%. Rare massive pyrite beds. At base last 3m is very pyritic, up to 15%.
483	493.85	POROUS BEDDED DOLOMITE	Porous, thinly bedded, "dirty" dolomite with abundant bitumen clots & wisps throughout. Bitumen frequently weeps from cores & occurs on all fractures & is present along stylolites. From 483-485.9 the unit is brecciated but fragments composed of itself.	459 468 485	85 87 88	Unit is brecciated at top & fragments composed of own beds from 485.9-493.85. Bedded section has some solution collapse breccias. N.B. rock very porous-up to 1mm open space between beds.	Rare coarse grained pyrite.
493.85	501.75	DOLOMITIC BITUMINOUS SILTSTONE	Massive dark grey to grey dolomitic bituminous siltstone with minor arenite beds. Rare illitic clay beds occur as well as a 1cm greenish tuffaceous siltstone. At 494.5-494.7 two cream vitric tuff bands occur which have disseminated bitumen. At top of unit there are macrobreccia fragments of Coxco Dolomite up to 10cm.	494 510	87 87	Arenite beds graded. Flat dolomite veins parallel bedding.	Pyrite occurs as very fine grained disseminations up to 6% throughout. Occasional coarse blebs in arenite beds.
501.75	534	COXCO DOLOMITE	White & cream bedded dolomite with solution collapse breccias common. Bitumen & hydrocarbon clots & weeping associated with solution collapse breccias & fractures. Some bitumen clots up to 6mm. Unit very fractured & vughy in bitumen rich areas. Dolomite pseudomorphs after gypsum occurs towards base of unit	530	86	Abundant dolomite veining throughout up to 1 cm. Solution & collapse breccias common with veinlet network throughout.	Rare coarse pyrite at top. Fluorite & bitumen at 512m.

SAMPLE No.	FROM M	TO M	ASSAY VALUES
R687	440	443	
R688	443	446	
R689	446	449	
R690	449	452	
R691	452	455	
R692	455	458	
R693	458	461	
R694	461	464	
R695	464	467	
R696	467	470	
R697	470	473	
R698	473	476	
R699	476	479	
R700	479	482	

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No 1 OF 5 SHEETS
LOGGED BY S.B. WARNE

PROJECT MAC ARTHUR RIVER JOINT VENTURE

DDH No. MA/NT/79/3 COORDINATES 90500 N 24500 E

CARANBIRINI COLLAR ELEVATION

DATE STARTED 22.11.1979
DATE COMPLETED
DRILLING Co. AUSTRAL UNITED
FINAL DEPTH
CASING DEPTH HW-3.07; HQ-17.87
BOYLES 45A Rig.

CORE SIZE	FROM	TO
PQ	0	3.07
HQ	0	17.87
NQ	17.87	E of Hole

BORE HOLE SURVEY

DEPTH-M	DIP	BEARING	DEPTH-M	DIP	BEARING

GRAPHIC LOGS: DEPTH IN METRES; CORE REC. M.; R.Q.D. FS 50 75; GEOLOGY; TOTAL SULPHIDES (Vol. %) 5 10

GEOLOGIC NOTES — Use also for general comments

DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M	ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE	MINERALIZATION: DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY	SAMPLE No.	FROM M	TO M	ASSAY VALUES Cu	Pb	Zn	Ag
0	20.2	DOLOLUTITE	Mustard weathering dolom. siltstone and dolom to ~4m, then grey silty dolomite partially weathered by solution effects adjacent to fractures to cream dolomite. Minor thin pink weathering silty shaley interbeds. Weak K stain 12m. (minor tuffaceous contact?)	0.5	90	Horizontal bedding fractures 30°/210°; some open with limonite and with/without MnO_2 dendritic films at ~1.5/m. Some healed with calcite/dolomite approx 2/m.	Unmineralized. Very thin MnO_2 films on some fracture surfaces. Dissem. py on edges chert nodules ~15m.							
				15		4cm. black chert nodules ~ 14m and 15.2m.								
20.2	27.25	INTERCALATIONS DOLOLUTITE & BLACK SHALE	Decr. dolom content and grading into black slightly dolomitic and carbonac shale with grey, shaley dololutite interbeds.	20	45	Slumped bedding and breccia with white dolom. cement = 6cm.	Black shale has v.fine dissem. and layers py 3 vol %.							
				25		Siltstone bedding and stylolites show horizontal attitude fractures 5/m at 15°, 50° some white dolom infilled, others open and limonite stained to 42.91. Dolom. infilled fract. and joints at angles 90° - 15° to core axis.								
27.25	31.77	DOLOLUTITE	f.g., K bearing with infrequent few cm. finely laminated sections. Brecciated at base with fragments rimmed by dolomites.	27			Streaks (vary) in dololutite carry v.fine py ~1 vol%.							
31.77	45.91	CARB. DOLOLUTITE	Grey with varying C content. Thin bands blue-grey dolom. rich sections without carbonaceous matter. Py. dissem. in C bearing rock. Dolomitic throughout.	31.77			Py content 1-3 vol % with thin, few cm. sections black shale ~20 vol.%.							
45.91	48.95	CARB.SHALE/ DOLOLUTITE	Dk. grey carbonac. silty dolomite rock grading into C rich black shale with fine py layering which is portion of slump terminating at 47m., then decr. C content to lighter grey dololutite.	45.91	47	Irreg.calcite veining in slump section.	1-5 vol % dissem. py in dololutite; to 30 vol% in black shale.	751	45.91	48.95	56	88	106	
				48.95	90	Bedding angle most of section.		752	48.95	57.32	67	57	102	1
				53	60	0.5 cm calcite with green illite clay.	v. fine 3 vol % py.							
48.95	57.32	DOLOLUTITE	Grey, silty, carbonaceous dolomite											
57.32	61.50	INTERCALATIONS DOLOLUTITE/ PYR.SHALE	Grey, poorly banded silty dolom. with bands black shale carrying significant bedded pyrite. K stain in grey dolom.	58.5		Brecc. slumped black shale overlain by 2 cm unbanded dolom layer.	Bedded py to 20 vol %; av. 10 Grey dololutite 5 vol %.							
				61.5		Rare compaction micro faults/slumps. Bedding 90° core axis.	Py ~3-5 vol.% in silty dolom. & 5± vol.% in black shales as bedding & disseminations. At 72.8 - 73.45 black shale with bedded pyr. to 25 vol.%. Py. content decr. toward base to ~3 vol.%.							
61.50	86.30	INTERBEDDED DOLOM.SILTSTONE IND. BLACK SHALE	A section of more confused interbedding of silty dolomite and well laminated pyr. black shale. Dolomite sections characteristically streaked with fine intermittent layers composed of finer pyrite and carbonaceous material. Dolomitic sections give K stain.			Calcite filled fractures frequent at 0° -90° to core. Numerous calcite healed fractures; core mainly breaks along bedding planes.		753	72.80	73.45	72	80	188	
				82.51	60	1.5cm cryst. calcite vein. Bedding 90° core axis	Py content in carb. shale (86.30-109.5 section) 3-5 vol.%; in green-grey dolomite layers 1-2 vol.%.							
86.30	109.5	SHALEY DOLOLITITE	Lighter grey silty dolomite, carbonac. siltstones with lesser pyr. content and thin blue-green dolom. rich layers. Larger blue-green dolom sections 87.01-87.44, 87.51-87.78, 92.14-92.40, 93.47-93.78.	93.9	0°-15°	Fracture S zone. Bedding 90° core axis throughout section.	Vein fill of calcite/illite.							

CORE RECOVERY — Top

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No 2 OF 5 SHEETS
LOGGED BY S.B. WARNE

PROJECT MAC ARTHUR RIVER JOINT VENTURE

DDH No. MA/NT/79/3 CARANBIRINI

COORDINATES 90500 N 24500 E

COLLAR ELEVATION

DATE STARTED 22.11.1979
DATE COMPLETED
DRILLING Co. AUSTRAL UNITED
FINAL DEPTH
CASING DEPTH HW 3.07; HQ 17.87
BOYLES 45A RIG

CORE SIZE	FROM	TO
PQ	0	3.07
HQ	0	17.87
NQ	17.87	E of hole

BORE HOLE SURVEY

DEPTH-M	DIP	BEARING	DEPTH-M	DIP	BEARING

GRAPHIC LOGS: DEPTH IN METRES; CORE REC. M.; R.Q.D. ES 50 75; GEOLOGY; TOTAL SULPHIDES (Vol. %) 5 10

CORE RECOVERY + 100%

DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE
109.5	120.22	PYRITIC BLACK SHALE	Irregularly spaced layers of varying thickness (commonly 1cm.) of pyrite in black, carbonaceous pyritic, dolomitic shale. Calcite veining & minor compaction breccia 45° to core axis at 116.74-116.86.	109.5	—	Bedding generally 90° core axis with minor slumping in py.richer zones giving angles to 90°. Irreg calcite filled veining at random attitudes.
120.22	122.53	DOLOM. SHALE	Grey to black py. poorer, K and C bearing dolomitic shale.	120.61	45°	Slickensided green tuffite face minor shear.
122.53	124.84	PYRITIC BLACK SHALE	Strongly developed by bedding.	122	85°	
124.84	126.90	SHALEY DOLOMITE	Massive unbanded dolom.in thin layers within grey shale.//Layers	124.2	80°	Shallow slumping of py. layers.
126.90	129.30	PYRITIC SHALE	by shale & grey shale. Low C content	125	90°	Bedding.
129.30	135.86	DOLOM. SHALE	Dominantly grey shaley to massive dolom. with minor bedded py. banding irregular, poorly developed.	129.30	Var	Approx.7 fractures/metre rehealed with dolomite/calcite and pyrite.
135.86	149.15	DOLOM.PY. SHALE	Black, carbonaceous bedded by horizons within overall dolomitic zone. Dolom.sections shaley with variable C content & also occur as massive blue-grey, lightly banded sections 139.05-139.16; 139.50-140.10; 147.73-147.95 and thinner bands elsewhere.	139	90°	Bedding.
149.15	157	CARB. DOLOLUTITE	Alternating bands carbon.dolomitic silty rock with poorly developed layering of Py. & grey, py. C poor dololutite.	145.75	30°	Pyr.sections relatively unfractured (5-30 vol.%). Fracture
157	175.2	DOLOLUTITE/? TUFFAC.SILTSTONE	Grey dololutite with thin bitumen flecks // to bedding. Widely separated,thin blacker shale bands becoming rarer down section. More silty and lower carbonate content toward base; K staining indicates probable existance of & increasing tuffaceous content.	154.10	10-60	Several fine calcite fractures to 156.9; fractures section with minor breccia healed with calcite. Rare,minor, shallow slumps. Section generally 1 vol% py with higher cont. in black shale layers. Several minor calcite filled fractures(~3 4/m).
LOWER LYNNOTT INFORM.				163	90°	Bedding.
REWARD DOLOMITE					157-175	core breaks along bedding planes. Well healed calcite filled fractures 300-45° core; approx. 4/m
175.2	206	DOLOMITE	Dominantly grey, massive dolomite with numberous stylol. sufaces with which are associated thin sections of carbonaceous siltstone.	176	30°	Py lined fracture.
				177.32	40°	first calcite-fluorite lined frac. to 182.16; sedimentary collapse breccia with bitumen clots.
				180.61		
				184.50		Coarse breccia.
				185.43	30°	0.5cm.calcite/dolom filled fracture.
				189		to 1 cm.diam. mud balls
			194.50-196.78. Series 10-15cm. sections C richer, bituminous dolomite C in thin layers giving core striated appearance due to harder and softer laminae.	191.8	10°	Fracture
				192.9	10°	Fracture
				193.8	20°	Calcite fluorite filled fracture.
				195.36	25°	Fracture.
				199.68	30°	Two parallel fractures
206	216	BITUMINOUS [illegible]	Grey dolomite layers within dominantly dark grey-black bituminous dolomite which fractures across core with convex/concave surfaces Highest C content in base breccia.	206	90°	Bedding in very finely lamin. carbon.siltst. 214.42-214.72
				212.65		15cm.collapse breccia, calcite cement
216		DOLOMITE/ DOLOLUTITE	Grey,massive,carbonaceous, algal-dolom. & silty, finely laminated dolomite/dolomitic siltstone.	214.40		12cm.c.g.collapse breccia.~213m.
				216		from 215.30 c.g.sed.breccia f.g. sed.breccia with py bearing

GEOLOGIC NOTES Use also for general comments

MINERALIZATION

DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY	SAMPLE No	FROM M	TO M	ASSAY VALUES Pb	Zn	Ag	Cu
Overall py. content 150 vol.%; within bands 40% Py dissem through out shale with concent. in Py.bearing layers ~5%. Trace honey coloured sph. flecks.	754	109.5	112.5	91	186	-	33
	755	112.5	115.5	116	360	-	56
	756	115.5	118.5	92	61	-	48
	757	118.5	120.22	93	28	-	51
Py.dissem. 3vol%,minor py layers. 40vol%;inter layers 85% Py 1-3 vol%,minor py beds. Trace sph (geochemically insignif.)	758	122.53	124.84	136	200	-	53
Grey massive siltstone 3-5 vol.%. Shaley py. shale to 15 vol.% py.	959	135.86	137.04	74	127	1	49
Banded py dolom.shale	960	142.4	149.15	61	57	-	36
135-137.04 (15-25 vol % py.) 142.4-149.15 (5-30 vol.%).							
C rich: 10-15 vol.py; C poor:2 vol.%. Bitumen clots in breccia. Very rare sph. flecks.							
Py content 157-175.2 variable, & dissem. fm. 1-5 vol.%.							
Bitumen films along some stylol.surfaces through section. Py. in dolom ~1 vol.%; in C richer. thin bands 5 vol %; in silty dolomite ~3 vol.% py.							
0.5cm.calcite/dolom filled fracture. in silty dolomite. flecks bitumen							
W.fine dissem.py with some py. layering but volume generally 2-3% overall with thin sections to 5-6 vol.%. Bitumen calcite vein							

black shale & carbonate fragments in calcite/ dolom. matrix.

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No. 3 OF 5 SHEETS
LOGGED BY

PROJECT MAC ARTHUR RIVER JOINT VENTURE

DDH No. MA/NT/79/3 CARANBIRINI

COORDINATES 90500 N 24500 E

COLLAR ELEVATION

DATE STARTED 22.11.1979
DATE COMPLETED
DRILLING Co. AUSTRAL UNITED
FINAL DEPTH
CASING DEPTH HW 3.07; HQ 17.87
BOYLES 45A RIG

CORE SIZE	FROM	TO
PQ	0	3.07
HQ	3.07	17.87
NQ	17.87	E of Hole

BORE HOLE SURVEY

DEPTH - M	DIP	BEARING	DEPTH - M	DIP	BEARING

GRAPHIC LOGS

DEPTH IN METRES | CORE REC. M. | R.Q.D. | GEOLOGY | TOTAL SULPHIDES (Vol. %)

CORE RECOVERY = 100%

GEOLOGIC NOTES

Use also for general comments

DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE
216	352.82	DOLOMITE/ DOLOLUTITE	(con'd) Variable C content but with bituminous coatings on fresh parting surfaces throughout. Grades from C rich dolomite to finely laminated silty dolomite with high C content. Silty horizons show low angle sedim. slumping. slump breccia and layers sedim. breccia composed up silty dolom clusts (original anhydrite bearing section?)	218.9	25°	Calcite/fluorite fill -ed fracture.
				218.9	30°	Thin calcite/fluorite fracture.
				226.24	35°	Compaction breccia (anhyd?)
				229.62	90°	1cm.breccia; bitumen
				229.88	10°	0.5cm.calc/fluorite filled fracture; also bitumen to 236.76. Dewatering breccia; irreg.dolom(after anhydrite?) veining with clasts of adjoining strata.
				235		
			Distances between stylolites quite irregular.	242	0-20	Thin calcite veins
				244.04	30°	Fine fracture, no infilling.
			252.81-253.75: DK grey silty? carbonaceous dolomite with varying C content giving irregular layering. Numerous stylolite surfaces. Rock very hard, brittle & suspect high original C content. Slightly bituminous.	253	85/90	Bedding
				253.5	25°	Pink dolom.filled thin fracture.
				254.15	25/35°	To 257. Thin carbonate filled joints/fractures.
			258.22 2.5 cm. carbonac.silty dolom. with 3 mm calcite/sphal. layer. Cross bedding 268.0-284.35. Increasingly carbonaceous faintly banded dolomite with fine silty layers. Irregular calcite veining (1 fluor) throughout.	258.22	85°	
			Brecciated 281.91-284; black bitum. shale 282.92-283.16 & 283.36-283.48.			
			From 283.16 dolomite is grey, C & py. poor. Numerous thin dolom. veins at random attitudes to core.	283	90°	Bedding
			Appearance of concretionary growths from 297 m.			
			Banding in grey dolomite 90° core but thinner silty bands are finely laminated, give weak K stain and at angles 85-80 to core axis	297		to 299 - concretionary growths in dolomite.
			Cyclic deposition becoming evident viz: anhydrite/silt/dolomite.			
				308.84		to 312.37. Irreg.fract-uring, veining, partial brecciation & disruption of beds, particulary dolom.siltstone layers (which probably directly overlay anhyd. bearing beds).
			319.22-322.60: Pelletal dolomite in which rounded dolomite masses (concretions?) dissolved & part-ially infilled with crystalline dolomite.	319.22		Grey porous rock to 322.6 Trace Py. only.
				319.64	3°	fracture/joint
				326.2	25°	Thin dolom. filled fracture.

MINERALIZATION

DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY	SAMPLE No.	FROM M.	TO M.	ASSAY VALUES Pb	Zn	Ag	Cu
Section py poor: generally < 1 vol.%. Bitumen richer sections to 3 vol.%.							
Dissem.Py absent.							
Dissem.sphal. 1 vol.%; portion of bed massive sphalerite. No sulphides.	761	258.22	258.47	664	18%	-	45
	762	262.90	-	38	77	-	10
Pyrite rare.							
Dissem. f.g./m.g. py. 2 vol.%.							
Py to 1 vol.% Dolom. infilling fracture and breccia spaces.							
Trace Py. only.							

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No 4 OF 5 SHEETS
LOGGED BY S. B. WARNE

PROJECT MAC ARTHUR RIVER JOINT VENTURE

DDH No. MA/NT/79/3 COORDINATES 90500 N 24500 E
CARANBIRTHIE COLLAR ELEVATION

DATE STARTED 22.11.1979
DATE COMPLETED
DRILLING Co. AUSTRAL UNITED
FINAL DEPTH
CASING DEPTH HW 3.07; HQ 17.87
BOYLES 45A RIG

CORE SIZE	FROM	TO
PQ	0	3.07
HQ	3.07	17.87
NQ	17.87	E.of Hole

BORE HOLE SURVEY

DEPTH-M	DIP	BEARING	DEPTH-M	DIP	BEARING

GRAPHIC LOGS: DEPTH IN METRES; CORE REC. M.; R.Q.D. (25 50 75); GEOLOGY; TOTAL SULPHIDES (Vol. %) (5 10)

GEOLOGIC NOTES — Use also for general comments

DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE	MINERALIZATION: DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY	SAMPLE No.	FROM M	TO M	ASSAY VALUES Pb	Zn	Ag	Cu
216		DOLOMITE/	Grey dolomite with v.fine silty,												
	352.89	DOLOLUTITE	carbonac bands. Rapidly increasing												
			C content. Toward 352m bedding	336.2	25°	Fine dolom filled									
			slumped and partially brecciated.			fracture.									
			Abundant stylolites throughout												
			which are often lined by thin C												
			rich and py bearing layer.	343.5		Ovoid concretionary	Trace py.								
						growths to 3cm x 5cm.									
352.89		BRECCIA	Clasts black py, dolomitic silt-	351	90°	Fine dololutite bedding	Py 3-5 vol.% in C.								
	356.66		stone in matrix of C rich silt, re-			fine planar calcite	dolom. siltst.	763	352.89	354.89	74	140	-	40	
			cryst. dolomite, tuff fragments.			veins mainly 35° core;	355.89-356.66: clots	764	354.89	356.66	47	231	-	36	
356.66		DOLOMITE/	Grey dolomite with thin bands fine-			also irreg veining.	recryst. py & honey								
	385.98	DOLOLUTITE	ly laminated dol arenite at 0.5m.				coloured sphal.(0.5 -								
			intervals. Bedding generally 90°	362.5	15°	Open fracture joint.	1 vol.%); rare fluorite								
			to core but in arenite layers more												
			variable (to 70°).												
				366.88		Rock brecciated from									
				368.08	30°	366.58 fractured 0.5cm.	Dissem, c.g.Xtalline								
						dolom. vein with dolom.	py.								
						fragments enclosed.	Py content generally								
				375	30°	1 cm dolom. healed	1 vol.% typically								
						fracture; other C lined	crystalline and c.g.								
				379.55	7°	slip surfaces.	near or in fractures.								
						Irreg. fractures.									
			Rounded fragments white f.g. recryst.												
385.98		DOLOM.'BREC-	dolom. in matrix fine siltstone &												
	387.84	CIA (AFT.ENAP?)	dolomite.												
387.84		INTERBED	At 388.02, 18 cm. band slumped	387.84		Bedding angles siltst-	In this section py. in								
	401.55	DOLOM./	e.g. pyr. bearing, carbonac. lamin-			one and stylolites very	dolomite < 1 vol.%; in								
		TUFFAC.	ated siltstone, then bands dolomite			irreg Siltstone 80o-90o	siltstone sections (e.g.393.5?)								
		DOLOM.	with thin interbeds laminated silt-			stylolites 0°- 90°	Some remob. sph. in replaced								
		SILTSTONE	stones carrying tuffaceous material	395.26		Round solution cavity	evap. beds -rare & geochem. insignificant								
			varying from 5-12 cm. in thickness.			in dk. dolomite - drill	Py rare, sph.specks 402.99;								
401.55		DOLOMITE/	Siltstone beds have cryst.dolomite	401.55		water lost about this	Breccia 401.55-402.15;404.80-405.10;409 in silty dolomite; 405.55 -								
	441.80	REPLACED	(replacing evap. layers) bearing			zone.	405.83; 408.16;408.33-409.55;413.43-414.04;417.40-420+								
		EVAP.	bitumen and c.g. py. Section of			Series open fractures	These breccias appear to be compaction fracture features related to								
			intricately slumped beds (compact-			at rate of one 30cm &	incompetent evaporite horizons with later healing replacement by								
			ion/dewatering) with minor dis-			fracture/3m with angles	dolomite/calcite.								
			placement of beds. Very irreg.			0-30 and numerous small									
			stylolite surface varying from 90°			-er fractures, both									
			to 0° to core, bedding angles 90°			dolom.healed & open,									
			(most common) to 60°. Rock is			90-60° to core axis.									
			dolomite with varying C content			Hole stopped 428m in	Bituminous/carbon clots in								
			occuring in irreg. layers and as			effort to stop water	replaced evap. sections.								
			infill between rounded carbonate			loss by cementing									
			fragments. Irreg. zones breccia			fractured zone.									
			with clasts of white and dark												
			carbonate. Intricate calcite/dolo-	428	80°	Concretionary layers.	Tuffaceous section -								
			mite veining result of dewatering	429.26	-	flecks sp. in evap.	siltstone with dk. green,								
			flow of gypsum with later dolomite			breccia zone.	hard, siliceous band.								
			replacement.												
			Concretionary developments at base.												

Core Recovery - 100%

KENNECOTT EXPLORATIONS (AUSTRALIA) LTD

SHEET No. 5 OF 5 SHEETS
LOGGED BY S.B. WARNE

PROJECT MAC ARTHUR RIVER JOINT VENTURE

DDH No. MA/NT/79/3 CARANBIRINI

COORDINATES 90500 N 24500 E

COLLAR ELEVATION

DATE STARTED 22.11.1979
DATE COMPLETED
DRILLING Co AUSTRAL UNITED
FINAL DEPTH
CASING DEPTH HW 1.07; HQ 17.87
BOYLES 45A RIG

CORE SIZE	FROM	TO
PQ	0	1.07
HQ	1.07	17.87
NQ	17.87	E of hole

BORE HOLE SURVEY

DEPTH-M	DIP	BEARING	DEPTH-M	DIP	BEARING

GRAPHIC LOGS | GEOLOGIC NOTES — Use also for general comments

DEPTH IN METRES	CORE REC M.	R.Q.D.	GEOLOGY	TOTAL SULPHIDES (Vol %)	DEPTH FROM-M	DEPTH TO-M	ROCK TYPE	DESCRIPTION: MINERALOGY, ALTERATION, TEXTURES, GRAIN SIZE, FRAGMENT SIZE	STRUCTURE: DOWN HOLE DIST. M.	STRUCTURE: ANGLE WITH CORE	STRUCTURE: DESCRIPTION OF STRUCTURES BEDDING, FRACTURES, FOLIATION, FRACTURES PER METRE	MINERALIZATION: DISTRIBUTION & TYPE MASSIVE, DISSEMINATED, VEINFILL, ORE & LIMONITE MINERALOGY	MINERALIZATION: SAMPLE No	MINERALIZATION: FROM M	MINERALIZATION: TO M.	ASSAY VALUES
445	CORE RECOVERY 100%	25 50 75		5 10	441.55	441.90	DOLOMITE/ REPLACED EVAP. SEQUENCE? DOLOMITE AND DOLOM. SILTST.	Lt. grey, faintly banded dolomite C poor recryst. material in replaced evap. layers and grey, finely laminated silty layers from 455m. Stylolites 90° core at first but become more irregular (→ 45) with steepening bedding angles down section.			fractures most commonly 30-60 to core at rate 2-3 per metre to 450m. Partings/siltstone bedding.	Py grains rare in dolomite & silty sections. C/bitumen commonly along stylolite surfaces.				
450									450.30	Irreg	Concretionary carbonate growths, and at 456 = bituminous bands.					
455									455.7	"						
460									459.4		Cubic 5mm.py growth in	dolomite.				
465																
470								Rare thin carbon/bitumen layers with up to 5 vol. % fine dissem. pyrite.	469	0°	to 470m. Open fracture	Fine calcite Xtals in fracture. Dolomite Py poor-rare grains.				
475																
480									480.58		3.5cm. pink dolomite vein at slight angle to adjacent bedding (80°)					
485								End of 1979 drilling (14.12.79)								

APPENDIX 2.

THIN SECTION DESCRIPTIONS

SAMPLE NO.	HOLE NO.	DEPTH
702	GRNT - 79 -7	670.5m
703	"	724.6m
704	"	797.6m
705	"	834 m
706	"	866.5m
707	"	870.5m
708	"	889. m
710	GRNT - 79 -8	277.6m
711	"	336.3m
712	"	383.9m
713	"	478.65m
714	"	479.35m
716	"	544 m

Lowder Geoscience

Ore Petrology and Exploration Research

BRIEF PETROGRAPHY OF 13 CORE SAMPLES

FROM THE McARTHUR RIVER AREA, N.T.

Report No.: 80/29 2nd May, 1980

For: Kennecott Explorations (Aust.) Ltd.

G. G. LOWDER
Consulting Petrologist

Sample No. 702

Hole & Depth GRNT-79-7; 670.50m

Rock Type Carbonate-rich, tuffaceous siltstone

Log Description Bedded dolarenite & dolomitic siltstone

Description The rock is very prominently laminated, with bands ranging from dark grey to white in colour and up to 5 mm in width. The lighter coloured bands effervesce fairly strongly in HCl, indicating a significant calcite component. Staining for potash feldspar gave weakly positive results and the mineral does occur as small scattered grains. Under the microscope the rock can be seen to be very carbonate-rich but it also contains much brown clay and numerous grains of quartz and feldspar. These minerals vary in proportion from one layer to another and the lighter coloured layers are those with more carbonate and less brown clay, whereas the dark layers tend to be more abundantly argillic. Some variation in grain size does occur between different layers but generally individual crystals are below 0.05 mm in size. At least two carbonate phases appear to be present, probably comprising dolomite and calcite. Feldspar and quartz are generally of angular or even sliver shape and the feldspar includes both plagioclase and potash feldspar. Small patches of cryptofelsite are also quite common and are probably potassic. Minor phases include mica flakes, zircon crystals and opaque granules, some of which comprise sulphide. Most of the more elongate grains are aligned parallel with the layering. The presence of angular quartz and feldspar grains in this rock suggests a pyroclastic component and this is confirmed by the recognition of sporadic but fairly common pseudomorphed glass shards. These mostly now consist of carbonate but display quite diagnostic angular or cuspate and spicule shapes. Lithologically this sample is a hybrid rock, as it contains components of pelitic sedimentation, pyroclastic deposition and chemical origin. It may be described as carbonate-rich (not simply dolomitic), tuffaceous siltstone.

Sample No. 703

Hole & Depth GRNT-79-7; 724.6m

Rock Type Dolomitic tuffite

Log Description Tuffaceous siltstone

Description This rock is also very well banded but in this case the individual bands are commonly much broader than in the previous sample, up to 2 or 3 cm wide. Colour of the bands is generally rather light, ranging from pale brownish-grey to pale green. Effervescence in HCl is confined to a few

narrow bands. Staining for potash feldspar gave quite strongly positive results, indicating that the mineral is present in most layers and is quite abundant in some. Microscopic examination shows that the major constituents of the rock are cryptofelsite, carbonate and sericite. Brown clay is also quite abundant in irregular to angular patches, which correspond to the darker spots in the hand specimen. Small clastic grains of quartz and feldspar are also quite common, but less so than in the previous sample. The most striking and important feature of the rock is the abundance of very well defined glass shard outlines, some of which are preserved in carbonate, while others consist of cryptofelsite. This vitroclastic texture is much more prominently developed than in the previous sample and almost every layer displays some shard shapes, while many layers are composed almost entirely of this former glassy material. Abundance of carbonate varies substantially between different layers and the mineral is more or less lacking in some cases. The very weak effervescence obtained in the hand specimen confirms that most of this carbonate is dolomite. Sericite is developed rather unevenly throughout the rock and is clearly an alteration product of primary cryptofelsite, itself formed as a devitrification of original volcanic glass. In some cases shards are preferentially sericitised and it is the relative abundance of sericite which is responsible for the greenish colour of much of the hand specimen. Some layers are lightly dusted by minute (around 0.01 mm) cubes of opaque matter, which probably comprise pyrite. Somewhat larger grains of pyrite occur sporadically elsewhere. This rock is clearly principally of tuffaceous origin, although it incorporates a minor pelitic sedimentary component and carbonate is abundant. Nevertheless, it is also clear that much of the carbonate is a later alteration product, as it pseudomorphs former glass shards. The rock may therefore be described as dolomitic tuffite which has undergone moderate sericitic alteration and contains minor syngenetic pyrite.

Sample No.	704
Hole & Depth	GRNT-79-7; 797.6 m
Rock Type	Tuffaceous silty dolomite
Log Description	Dolomitic siltstone
Description	This rock is mostly dark brownish-grey in colour and

although part of it is well laminated, much of it is rather massive in character. The lighter coloured bands in the more laminated part of the sample effervesce rather weakly in HCl. Staining for potash feldspar gave distinctly positive results, showing that the mineral is quite abundant pervasively in

some of the finer more laminated parts of the sample and occurs as discrete crystals and irregular masses in the more massive part of the sample. In thin section the rock can be seen to be very rich in carbonate and in view of the weak effervescence in hand specimen it is clear that most of this carbonate is likely to be dolomite. In the massive part of the sample carbonate is of somewhat uneven grain size, whereas in the laminated rock the lighter coloured bands are relatively coarse (up to 0.05 mm) and the darker coloured bands contain micritic carbonate. In addition to the carbonate the rock contains fairly numerous but scattered small clastic grains of quartz, feldspar and mica. The darker layers in both the laminated and the massive part of the rock also appear to contain substantial amounts of cryptocrystalline brown clay. Much of the potash feldspar indicated by staining of the hand specimen has a rather clandestine form in thin section. This is especially true in the very fine grained, laminated part of the sample. Pyrite occurs as an accessory phase and is quite abundant in some layers, where it forms aggregates up to 0.3 mm across. Although relict vitroclastic texture is not recognisable in this sample, a tuffaceous component is indicated by the relative abundance of potash feldspar, as well as the scattered, angular clasts of quartz and feldspar. The rock is thus another hybrid lithology, containing various mixtures of pelitic, tuffaceous and chemical sedimentation. Because carbonate seems to predominate the rock is described as tuffaceous silty dolomite.

Sample No.	705
Hole & Depth	GRNT-79-7; 834m
Rock Type	Albitised, dolomitic and argillaceous tuffite
Log Description	Tuffaceous arenite
Description	Layering is well developed in this sample and individual bands range up to about 1 cm across. Colour is generally various shades of brown and grain size does not appear to be as fine as in the previous sample. There is very little effervescence in HCl and staining for potash feldspar gave negative results except right at one end of the sample. In section, the rock can be seen to consist dominantly of a tightly interlocking mosaic of feldspar, with grain size of the order of 0.03 mm. Negative staining results indicate that this feldspar is sodic rather than potassic and indeed, diagnostic albite twinning is commonly visible. Scattered through this feldspar mosaic are numerous irregular to angular masses of dark brown, essentially isotropic clay. This argillic material tends to occur in lenticular bodies which show strong preferred orientation parallel to the layering and variation in abundance

of this material is responsible for the colour lamination visible in hand specimen. Most of the brown clay masses are also dusted by extremely fine grained carbonate and the rock contains additional carbonate in the form of euhedral rhombs which are disseminated throughout the section. A few more irregular patches of carbonate occur in certain layers. Clastic grains of quartz and feldspar are present but rather sparse. The part of the sample which gave a positive potash feldspar stain in the hand specimen does not appear any different in thin section from the remainder of the rock. Opaque matter is rather sparse in this rock and does not appear to consist of sulphide. The other important feature of the sample is the preservation of relict vitroclastic texture. This is visible as pseudomorphed glass shards only within the brown argillic patches, where the characteristic shard shapes are preserved as fine grained feldspar surrounded by brown clay. These shapes are visible wherever the brown argillic material remains and the rock clearly once consisted almost entirely of clay and volcanic glass. It appears that the original argillaceous and somewhat dolomitic tuffite has undergone rather strong albitisation.

Sample No.	706
Hole & Depth	GRNT-79-7, 866.5m
Rock Type	Dolomitic argillite
Log Description	Pyritic, bituminous, dolomitic siltstone.

Description This is a dark brown, rather massive and fine grained rock, with no obvious layering. There is only a very weak effervescence in HCl and staining for potash feldspar gave negative results. In thin section, the rock has a uniform, fine grained texture and the principal constituents are brown clay and fine grained carbonate. These two phases are intimately mixed throughout the rock and their proportions are difficult to estimate, although clay seems to predominate. Small clastic grains of quartz, feldspar and mica are sparsely scattered throughout the rock. Fine to extremely fine opaque matter is quite common in this rock and seems to consist largely or entirely of pyrite. Much of it occurs as minute granules, below 0.01 mm in size. The angular nature of quartz and plagioclase clasts in this rock may be an indication of pyroclastic origin, but apart from those grains there is no direct evidence of a tuffaceous component in this rock. The pelitic and chemical components clearly predominate and the rock is therefore described as dolomitic argillite.

Sample No. 707

Hole & Depth GRNT-79-7; 870.5m.

Rock Type Mineralised argillaceous dolomite (with dolomitic argillite)

Log Description Pyritic, sphaleritic, dolomitic, siltstone

Description The rock is mostly dark brown and very fine grained, with a massive character disrupted by irregular pods of slightly coarser grained material, as well as numerous veinlets or fracture fillings of remobilized sulphide and carbonate. For the most part, the sample effervesces only weakly in HCl, but the remobilized white veinlets effervesce strongly and clearly consist principally of calcite. Staining for potash feldspar gave negative results. Under the microscope it is clear that most of the sample consists of a fine grained, uniform mosaic of dolomite, with grain size of the order of 0.01 to 0.04 mm. Brown clay occurs along grain boundaries and in interstitial sites and is sufficiently abundant to impart an overall brownish colour to the rock, both in thin section and especially in hand specimen. Dolomite nevertheless is clearly the major component of the sample. Small quartz grains are very sparsely scattered through the micritic dolomite mosaic. At one end of the section the dolomitic rock is in sharp but irregular contact with a more pelitic rock, which also contains some carbonate but is principally argillaceous in nature. The most important feature of the rock is the widespread occurrence of sulphide mineralisation, which is most conspicuous as irregular, remobilized bodies that are probably fracture fillings, but sulphide is also quite abundant as small disseminated grains. Pyrite predominates but yellow sphalerite is also abundant, especially in disseminated form. Grain size of the sphalerite is of the order of 0.05 mm and it commonly occurs as irregular to somewhat bedded aggregates. In a few places its abundance increases to the point where it is almost massive. Sphalerite is much more abundant than pyrite in disseminated form, whereas the large angular bodies of remobilized sulphide consist of dominant pyrite and only minor sphalerite. Sulphide is much less abundant in the argillaceous rock and appears to consist simply of minute cubes of pyrite dusted rather sparsely throughout. The major part of this sample consists of mineralised, somewhat argillaceous dolomite, while the minor lithology is dolomitic argillite. The irregular nature of the contact between these two rock types is probably a relict of penecontemporaneous deformation. The sample is noteworthy for the significant development of syngenetic and partly remobilized sulphide mineralisation.

Sample No. 708
Hole & Depth GRNT-79-7; 889m
Rock Type Pyritic, dolomitic argillite
Log Description Interbedded tuffaceous siltstone & siltstone
Description The rock consists of grey-brown, very fine grained and rather massive material, with a somewhat streaky appearance on some surfaces but no real layering. There is no effervescence in HCl except for very minor calcite-filled fractures. Staining for potash feldspar gave negative results. Under the microscope a crude layering is visible in the rock but it tends to be somewhat lenticular and is marked only by rather minor colour changes. The rock consists principally of brown clay, much of which is very massively developed. Carbonate is quite abundant, especially in some parts of the sample and occurs both as tiny disseminated granules and also as irregular patches of very finely granular material. In some parts of the sample the clay is relatively dark brown, while elsewhere it is of very pale brown colour. A number of angular bodies of lighter or darker clay are enclosed in some layers and probably represent penecontemporaneous brecciation. Pyrite mineralisation is quite abundant both as minute syngenetic cubes dusted throughout most layers and as small, very locally remobilized fracture fillings and veinlets. No sphalerite is recognisable in this case. The rock is essentially a pelitic sediment which has undergone some slumping or brecciation soon after deposition and incorporates a significant but relatively subordinate dolomitic component. Syngenetic pyrite, although only a few percent of the rock overall, is quite conspicuous and characterises the rock as pyritic, dolomitic argillite.

Sample No. 710
Hole & Depth GRNT-79-8; 277.6m
Rock Type Carbonate-rich, albitised tuffite
Log Description Tuffaceous dolomitic siltstone
Description This is a rather well banded, mainly light coloured rock, with layers up to about 15 mm across. Colour ranges from pale grey-brown to light green and some layers are notably darker brown. Moderate effervescence in HCl indicates a significant calcite component but staining for potash feldspar gave negative results. In thin section, the rock has a rather uniform appearance, with not a great deal of difference between separate layers. There is, however, some variation in grain size and in relative abundance of the principal components. Carbonate is a major component in all of the layers and is dominant in some of them. Both calcite and dolomite appear to be present. The other main constituents of the rock are quartz and feldspar, the latter including both clastic grains and finely granular mosaic material.

The clastic grains of quartz are commonly elongate or sliver-shaped and are oriented parallel to the layering. Plagioclase is the only clastic feldspar recognisable. Enclosing these clastic grains and occurring as a matrix to the dolomite there is a fine grained felsic mosaic which resembles that in the earlier sample 705. It is somewhat finer grained than in that case but once again clearly consists of albite. Minor components of the rock include clastic flakes of muscovite and biotite, as well as scattered grains of opaque matter. These range up to about 0.5 mm in size and tend to have subrounded shapes. They are black in reflected light and clearly do not consist of sulphide but their actual identity is uncertain. Brown clay is also quite widely developed in the rock, occurring mainly as cryptocrystalline interstital or matrix material. Vitroclastic texture is not particularly prominent in this rock but is unmistakably preserved in many places, where glass shards are pseudomorphed either by carbonate or by albite. It is clear, therefore, that this rock is of tuffaceous origin and originally consisted principally of glassy volcanic material. It has undergone devitrification and strong albitisation, together with the development of a substantial carbonate component.

Sample No.	711
Hole and Depth	GRNT-79-8; 336.3m
Rock Type	Pyritic, carbonate-rich argillite and silty, dolomitic limestone
Log Description	Bituminous dolomitic silstone with graded dolarenite
Description	Some, fairly broad scale layering is visible in the rock, part of which is fairly light grey-brown in colour, while the reminder is fairly dark brown. Grain size is uniformly fine and there is strong effervescence in HCl, especially in the lighter coloured parts of the sample. No potash feldspar was detected by staining. In thin section it is clear that the rock consists essentially of two related and gradational lithologies, one comprising principally carbonate, the other consisting of both carbonate and argillaceous material. The very carbonate-rich part of the sample, corresponding to the lighter coloured parts in hand specimen, consist essentially of a massive aggregate mosaic of carbonate, with grain size of the order of 0.3 to 0.5 mm and an abundance of both clear carbonate, presumably calcite, and brownish carbonate, presumably dolomite. Clastic quartz and rare feldspar grains are a minor component of this carbonate rock. Opaque matter is also conspicuous and includes both very fine, syngenetic or locally remobilized pyrite as well as somewhat coarser grained (up to 0.2 mm) black opaque matter of uncertain identity. The main part of the sample consists of carbonate rich argillite,

comprising a mixture of brown clay and fine grained carbonate, the latter apparently including both dolomite and calcite. Small lenticular patches of brown clay are abundantly scattered through this lithology and show a strong preferred orientation, parallel to the layering. Clastic grains of quartz and rarer feldspar and mica are scattered through this rock. Dusty, disseminated pyrite is also quite common and there are a number of subrounded bodies of the unidentified black opaque phase. Although this sample could contain a tuffaceous component there is no direct evidence of such and the sample may therefore be described as carbonate-rich argillite and silty, dolomitic limestone. Syngenetic pyrite is not abundant but is widely developed and is perhaps an important feature.

Sample No. 712

Hole and Depth GRNT-79-8; 383.9m

Rock Type Argillaceous and dolomitic tuffite

Log Description Light green bituminous tuffaceous arenite

Description Most of the sample is fairly uniform, rather massive and pale green in colour. There is some indication of banding towards one end of the sample and there are numerous dark spots disseminated throughout the fine green matrix. Effervescence in HCl is confined to one of the bands at one end of the sample. Staining for potash feldspar gave rather strongly positive results, except in the carbonate-bearing part of the sample, where potash feldspar is much less abundant. Microscopic examination of this sample shows immediately that it is of pyroclastic origin. Relict vitroclastic texture is clearly recognisable in most parts of the section and the rock consists principally of a potash feldspar-rich, cryptofelsic mosaic. Small, angular quartz grains are scattered throughout that mosaic and there are numerous irregular to lenticular bodies of brown clay or clay/carbonate mixture, which corresponds to the dark spots visible in hand specimen. Carbonate is also developed as colourless, irregular to spongy patches scattered throughout the sample and although common this carbonate is not really a dominant component. Towards one end of the thin section there is a band where carbonate is very dominant and this corresponds to that part of the sample which effervesces in hand specimen. Within this band vitroclastic texture is particularly distinct because of pseudomorphing of glass shards by carbonate. Adjacent to the carbonate-rich band, on both sides, the cryptofelsic mosaic has undergone substantial sericitic alteration. Sericite is lacking or at most only a very minor component in the remainder of the sample. This rock may readily be identified as of tuffaceous origin, although it also incorporates

some argillaceous material and a substantial carbonate component. It is very probably closely related to sample 705 and 710, but it has not suffered the pervasive albitisation which characterises those rocks. Opaque matter is rather sparse in this rock but subrounded grains of black opaque matter occur sporadically.

Sample No.	713
Hole & Depth	GRNT-79-8; 478.65m
Rock Type	Sericitised tuffite
Log Description	Greenish tuffaceous arenite/siltstone

Description This sample has quite a uniform character although there is a very well defined foliation visible especially on a cut surface. It is of light green colour but contains numerous small dark spots. There is only very minor effervescence in HCl but staining for potash feldspar gave rather strongly positive results. Microscopic examination shows that this rock is very similar to the previous sample, except that the cryptofelsic material has undergone strong, pervasive sericitisation. The dark spots visible in hand specimen correspond to lenticular bodies of brown clay or clay-carbonate mixture and the section also contains numerous irregular to spongy patches of colourless carbonate. Vitroclastic texture is commonly well preserved within these carbonate patches and is more vaguely recognisable in the sericitised areas. Positive staining results in the hand specimen confirm that not all of the cryptofelsite has been sericitised, and in a few places there are well defined shards composed of potash feldspar. The strong pervasive sericitisation developed in this rock is responsible for its green colour in hand specimen and the strong, lenticular foliation visible in the hand specimen is defined mainly by the carbonate patches. Tiny cubes of pyrite are dusted through this rock although they are rather sparse and widely spaced. There are also a few subrounded bodies of the unidentified black opaque mineral. The rock clearly consists of tuffite and has significant argillaceous and dolomitic components but it is characterised principally by the development of sericite. It is therefore described as sericitised tuffite.

Sample No.	714
Hole & Depth	GRNT-79-8; 479.35m.
Rock Type	Dolomitic chert
Log description	Creamy brown vitric tuff

Description This is a very light coloured, grey-brown rock with some

rather indistinct layering. There is no effervescence in HCl and staining for potash feldspar gave completely negative results. Under the microscope the rock consists of a very uniform, finely granular aggregate of carbonate and felsic material, the latter apparently consisting mostly of quartz. Grain size is generally of the order of 0.01 to 0.02 mm and hence precise mineralogy is difficult to determine. Clastic grains of quartz, feldspar and mica are sparsely scattered through this fine mosaic and elongate grains are generally lined up parallel to each other and to vague colour lamination visible. Precise origin and lithology of this rock are rather uncertain, but it is clearly somewhat bedded and the dominance of quartz and dolomite favour a chemical sediment origin. It is therefore tentatively identified as dolomitic chert, although it could have a tuffaceous component which has been silicified.

Sample No. 716

Hole & Depth GRNT-79-8; 544m

Rock Type Carbonated, partly albitised, fine tuffaceous sandstone, with dolomitic chert.

Log Description Interbedded vitric tuffs & bituminous tuffaceous arenites.

Description This rock displays very prominent layering, both on a fine and on a broad scale. Colour varies from brown to grey and some layers are quite dark, while others are very light coloured. No potash feldspar was detected by staining but there is significant effervescence in HCl, especially in the lighter coloured layers. At least two distinct lithologies are recognisable in thin section. One of these is rather similar to the previous sample and may be described as dolomitic chert. This corresponds to the fine, light brownish-grey part of the hand specimen. The remainder of the thin section is made up of several layers in which carbonate, quartz, feldspar and brown clay are mixed in various proportions. Fine sandy grains of quartz and plagioclase are scattered in considerable abundance throughout this part of the rock and in one particular band the quartz and feldspar form a granular mosaic. Grains within this mosaic and scattered throughout the remainder of the sample are of the order of 0.1 mm in size. Scattered zircon crystals occur within the quartz-plagioclase mosaic and there is a substantial amount of patchy carbonate. This band apparently represents a fairly well sorted layer of fine sandstone. Elsewhere, there are lenticular to irregular bodies of brown clay, generally with a distinct preferred orientation. Much of the material in the remainder of the sample consists of quartz and feldspar grains enclosed in massive, coarse grained but irregular bodies of carbonate. In a few places there are aggregates of finely granular,

felsic mosaic in which albite appears to predominate. Pervasive albitisation, however, is not well developed. Opaque matter is only a very minor constituent in this rock. Several cross-cutting veins of remobilized calcite are present in the section. It seems quite likely that there is a tuffaceous component in this rock and that the albitic mosaic represents former vitric material. However, diagnostic pyroclastic textures are not preserved. The rock is therefore described as fine tuffaceous sandstone, partly albitised and subsequently largely carbonated, with a subordinate second lithology described as dolomitic chert.

APPENDIX 3.

SPECIFIC DENSITIES

DRILL CORE

MANT - 79 - 3

ACI Technical Centre Pty. Ltd.
Central Science Services Department

813 Dowling Street, Waterloo, N.S.W. 2017
Postal Address: Box 1, P.O. Waterloo, 2017
Telephone: 699 0055 x 397

TEST REPORT

Client: Kennecott Explorations (Aust) Limited
Box 471
GPO SYDNEY NSW 2001

Attention: Mr G Thomas

No.: 917003

Date: 11th January 1980

Client O/No.: K 0704

BULK DENSITIES OF DRILL CORE SAMPLES MANT - 79 - 3

SAMPLE (m)	MASS (g)	BULK DENSITY
3 weathered rock	8.70	1.60
21	39.35	2.59
31	46.59	2.37
36	21.19	2.61
38	53.83	2.67
47	52.27	2.59
56	43.36	2.70
60	73.22	2.65
73	27.45	2.64
88	44.30	2.66
108	31.07	2.67
127 pyritic shale	31.20	3.04
133	19.71	2.65
160	9.34	2.64
181	26.20	2.65
253	40.54	2.67
257	20.10	2.67
262.9	59.93	2.74
306	20.47	2.68
315	30.50	2.62
320.2	18.14	2.47
328.6	15.30	2.97
354.9	36.86	2.69
367.6	21.7	2.76

G RICHARDS
Glass Department

form no. T 56

Approved by:

This laboratory is registered by the National Association of Testing Authorities, Australia. The test(s) reported herein have been performed in accordance with its terms of Registration.

APPENDIX 4.

Selected references on the
Mc Arthur River Geology and
Lead-Zinc Deposits and
previous Amoco Annual Reports
on the Mc Arthur River and
Glyde River Project Areas.

J.A.CORBETT,I.B.LAMBERT & K.M.SCOTT	1975	Results of Analyses of Rocks from the McArthur Area, Northern Territory Technical Communication 57 of the Minerals Research Laboratories C.S.I.R.O.
N.J.W. CROXFORD and S. JEPHCOTT	1972	The McArthur Lead-Zinc-Silver Deposit, N.T. Proc.Aust.Inst.Min.Met. No.243, Sept. 1972
N.J.W. CROXFORD, B.L. GULSON and J.W. SMITH	1975	The McArthur Deposit: A Review of the Current Situation Mineral Deposita (Berl.) 10,302-304
T. FINLOW-BATES	1979	Cyclicity in the Lead-Zinc-Silver bearing sediments at Mount Isa Mine, Queensland, Australia, and Rates of Sulfide Accumulation Economic Geology Vol.74,P.P.1408-1419
T. FINLOW-BATES	1979	Studies of the Base Metal Sulphide Deposits at McArthur River, Northern Territory, Australia:II. The Sulfide-S and Organic-C Relationships of the Concordant Deposits. -A Discussion Economic Geology Vol.74,1697-1699
B.L. GULSON	1975	Differences in Lead Isotope Composition in the Stratiform McArthur Zinc-Lead-Silver Deposit. Mineral Deposita (Berl.) 10,277-286
I.B. LAMBERT and K.M. SCOTT	1973	Implications of Geochemical Investigations of Sedimentary Rocks within and around the McArthur Zinc-Lead-Silver Deposit, Northern Territory. Journal of Geochemical Exploration, 2 p.p. 307-330
A.J.M. MEHLISS	1979	The Time-Bound Character of Uranium Deposits - A Disscussion Economic Geology Vol.74, 1702
J.H.OEHLER	1977	Microflora of the H.Y.C. Pyritic Shale Member of the Barney Creek Formation (McArthur Group), middle Proterozoic of northern Australia. Alcheringa 1,315-349 ISSN 0311-5518.

J.H. OEHLER and R.G. LOGAN	1977	Microfossils, Cherts, and Associated Mineralization in the Proterozoic McArthur (H.Y.C.) Lead-Zinc-Silver Deposit. Bull.Soc.Eco.Geol. Vol.72,No.8, 1393-1409
D.S. ROBERTSON, J.E. TILSLEY and G.M. HOGG	1979	The Time-Bound Character of Uranium Deposits - A Reply Economic Geology Vol.74, p.1702
K.M. SCOTT and I.B. LAMBERT	1979	Studies of the Base Metal Sulfide Deposits at McArthur River, Northern Territory, Australia: II The Sulfide-S and Organic-C Relationships of the Concordant Deposits. - A Discussion Economic Geology Vol.74,1693-1694
J.W. SMITH and N.J.W. CROXFORD	1975	An Isotopic Investigation of the Environment of Deposition of the McArthur Mineralization. Mineral Deposita (Berl.) 10,269-27(
R.N. WALKER, R.G. LOGAN and J.G. BINNEKAMP	1977	Recent Geological Advances Concerning the H.Y.C. and Associated Deposits, McArthur River, N.T. J.Geol.Soc.Aust., Vol.24,Pt.8, p.365-380
N. WILLIAMS	1978	Studies of the Base Metal Sulfide Deposits at McArthur River, Northern Territory, Australia: I The Cooley and Ridge Deposits. Bull.Soc.Eco. Geol. Vol.73, No.6, 1005-1035
N. WILLIAMS	1978	Studies of the Base Metal Sulfide Deposits at McArthur River, Northern Territory, Australia: II. The Sulfide-S and Organic-C Relationships of the Concordant Deposits and their Significance. Economic Geology Vol.73,1036-1056
N. WILLIAMS	1979	Studies of the Base Metal Sulphide Deposits at McArthur River, Northern Territory, Australia: II. The Sulfide-S and Organic-C Relationships of the Concordant Deposits and their Significance - A Reply. Economic Geology Vol.74, 1695-1697

AMOCO ANNUAL REPORTS

B.ROXBURGH	1977	1976 Annual Report McArthur River Project E.L. 1330, 1331, 1332, 1333 and 1375, N.T. Amoco Report 54.
P.STAPLES	1978	1977 Annual Report McArthur River Project E.L. 1330,1331, 1332, 1333 and 1375, N.T. Amoco Report 80.
P.STAPLES & N.WILKENS	1979	1978 Annual Report McArthur River Project E.L. 1330,1331, 1332, 1333, 1375 & 1803, N.T. Amoco Report 120.
N.WILKENS	1980	1979 Annual Report McArthur River and Glyde River Projects. E.L. 1330, 1331, 1332, 1333, 1375, 1803 and 1943, N.T. Amoco Report 168.