DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT.BK.NO. 86/18
BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
Final Report, Stages 1 and 2

vol 1 of 2

GEOLOGICAL SURVEY

VOLUME 1 (OF 2)

by

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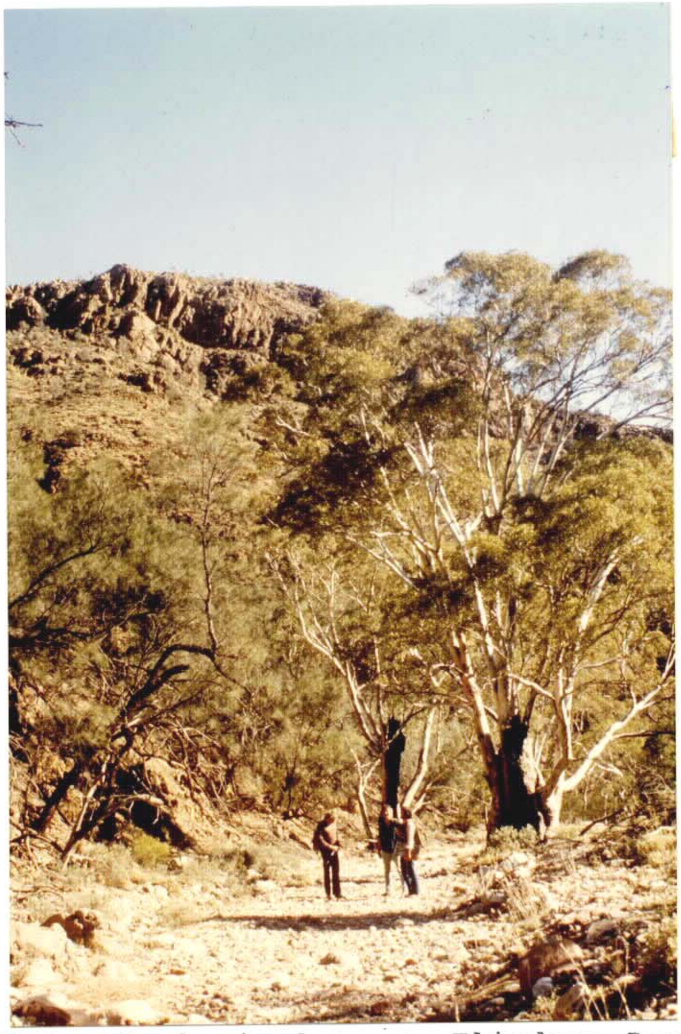

FRONTISPIECE: Geological team, Flinders Ranges National Park. July 1985
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DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

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# BASE METAL EXPLORATION
# FLINDERS RANGES NATIONAL PARK
## Final Report, Stages 1 and 2.


## ABSTRACT

Exploration for Mississippi Valley-type (MVT) lead-zinc deposits along the western margin of the Flinders Ranges National Park has been confined to the upper part of Wilkawillina Limestone, part of Hawker Group sediments of Cambrian age, where surface lead, zinc and copper mineralization and karstic features have been recognised associated with a palaeo-surface at the top of Wilkawillina Limestone and a possible unconformity lower in the sequence. Stage 1 exploration, comprising regional geological mapping, stream sediment and rock chip sampling has delineated eight prospect areas; Southern, Camp, Manga, Llina, Hayward, Concert, Willa and Northern Prospects. Stage 2 exploration, comprising detailed rock chip, soil sampling, geological mapping and geophysical surveys has shown that Southern, Manga, Concert and Willa Prospects have the most potential for MVT mineralization. Diamond drilling would be required to determine the extent of karstic features of upper member of Wilkawillina Limestone and it's potential to host economic lead-zinc mineralization both inside the Flinders Ranges National Park and elsewhere in the Flinders Ranges. No further work is proposed at this stage pending the outcome of company exploration elsewhere in similar environments.


## INTRODUCTION

BHP Minerals Ltd. (BHP) have been exploring Lower Cambrian limestone in Flinders Ranges for Mississippi Valley-type (MVT) lead-zinc mineralization since 1978, to find an alternative feedstock for Port Pirie smelter, which relies on Broken Hill lead-zinc sulphide ore. These reserves are expected to be exhausted by about the year 2000.

MVT lead-zinc mineralization has been known in Lower Cambrian rocks since the detailed study by Departmental geologists at Ediacara in 1960 and 1961 (Nixon, 1967), supported by a sampling programme throughout Flinders and Mount Lofty Ranges (Thomson, 1962).

This work identified a prospective zone in Wilkawillina Limestone for 45 km along the western flank of Heysen Range of which 25 km, extending from Edeowie Gorge northwards to beyond Brachina Gorge, lies within Flinders Ranges National Park. In 1980, when BHP was granted five Exploration Licences (EL) in Flinders Ranges, the National Park was excluded from EL726.

As BHP is unable to carry out mineral exploration within the Park, it was proposed in mid 1981 that the S. Aust. Dept. of Mines and Energy (SADME) undertake this project. Most of the prospective rocks north of the Park are concealed by alluvium and exploration of good exposures in the Park would assist work outside.

A two stage exploration programme was approved by the Minister of Mines and Energy on 18 April 1983 as follows:

Stage 1 - geological mapping, soil sampling and rock chip sampling.

Stage 2 - detailed geological mapping and geochemical sampling.
- ground geophysics, possibly Induced Polarization.

A progress report of investigations between July 1983 and September 1984 was completed in November 1985 (Morris, 1985) and a summary report for the period July 1983 to February 1986 was completed in April 1986 (Horn and Morris, 1986).

This report details the following exploration completed between 18 July 1983 and 7 November 1985:

Sampling - collection of 829 stream sediment samples, 2 682 rock chip samples, 55 rock samples for petrology and 141 soil samples.

Mapping - about 25 km of strike length of Wilkawillina Limestone, 300 m to 700 m wide, between Edeowie Creek and the northern boundary of Flinders Ranges National Park, was mapped on 1:5 000 scale black and white air photographs enlarged from 1:20 000 scale colour air photographs.

Geophysics - ground Induced Polarization (IP) and Sirotem by SADME Geophysics Branch.

Geological and geochemical surveys were completed by C.M. Horn (Principal Geologist); B.J. Morris, R.S. Robertson and D.C. Scott (Senior Geologists); E.A. Dubowski and A.H. Shepherd (Geologists); M.W. Flintoft, S.J. Ewen, P.P. Crettenden, J. Safta, B.W. Atterton and A.J. Smith (Field Assistants) and J. Williams (Technical Officer I).

C. Mills and A. Johnson (S. Aust. Dept. of Environment and Planning) and R. Tynan (Acting Ranger In Charge of Flinders Ranges National Park) were shown the area of interest and briefed on mapping and sampling techniques on 19 July 1983. T. Fraser (Acting Ranger In Charge of Flinders Ranges National Park) was briefed on mapping and sampling techniques in the field on 18 July 1985.

Base camps were established outside of the Park on Edeowie Station at Bunyeroo Creek (18 July 1983 - 29 September 1983 and 13 August 1984 - 20 September 1984) and Brachina Creek (24 October 1983 - 3 November 1983) by arrangement with Mr. R. Nutts (Perpetual lessee, Edeowie Station). Parachilna Hotel (12 June 1985 - 21 June 1985) and Angorichina Village (15 July 1985 - 26 July 1985, 19 August 1985 - 30 August 1985 and 28 October 1985 - 7 November 1985) were also used as base camps.

## LOCATION AND ACCESS

The area of investigation is located on the western flank of the Heysen Range in hundreds Parachilna, Bunyeroo and Edeowie, county Taunton, out of district councils, part of the Flinders Ranges Planning Area and within the Flinders Ranges National Park (Figs. 1 and 2) and is 25 km long and 300 m to 700 m wide, extending from Edeowie Creek northwards to the park boundary 9.5 km north of Brachina Gorge (Fig. 2).

Access from the sealed north-south Hawker-Leigh Creek South road 10-13 km to the west is provided by the graded tourist road through Brachina Gorge and a track to the mouth of Bunyeroo Gorge.

Local access was on foot from existing graded roads or four-wheel drive tracks (Figs 3a, 3b and 3c), vehicles being left outside the Park except where there are existing tracks. A four-wheel drive track extends along the park boundary between Brachina Gorge and Edeowie Creek. Vehicle access within the park is limited to:

- four-wheel drive track to the abandoned manganese mine 1.9 km north of Bunyeroo Gorge;
- graded road through Brachina Gorge with four-wheel drive tracks turning off; southwards for 6.5 km to the manganese mine, and northwards for about 4 km;
- easterly track, 8 km north of Brachina Gorge, that stops at the foot of Heysen Range and provides access to Bookartoo Ochre deposit;
- easterly track along northern boundary of park supplies access to Galena Creek lead prospect.

## CLIMATE AND TOPOGRAPHY

The western flank of Heysen Range consists of low rounded hills in the south grading to rugged rounded hills in the north, all dwarfed by the mountainous quartzite ridge forming the backbone of Heysen Range to the east (Plate 1).

The climate is semi-arid with annual rainfall averaging about 250 mm. Hence creeks flow only for brief periods during heavy rain. Bunyeroo and Brachina Gorges generally contain water holes for most of the year. January and February are the hottest months when mean-maximum temperature is 32°C at Port Augusta.

Vegetation is dry sclerophyll to savannah with Eremophila sp., Dodonaea attenuata, spinifex grass, Yacca, salt bush and blue bush and occasional stands of Casuarina cristata, Eucalyptus socialis and Heterodendrum oleaefolium (bullock bush) on rounded rocky hills. Eucalyptus camaldulensis (red gum), Melaleuca glomerata, Acacia victoriae and Callitris calumellaris (native pine) grow in gullies, valleys and gorges.

## TENURE

Flinders Ranges National Park is designated an Environmental Class A Zone in the Development Plan (S. Aust. Planning Act, 1982). The western face of Heysen Range is a locality where no mining operations should take place except where:

(a) the deposits are of such paramount significance that all other environmental, heritage or conservation considerations may be overriden;

(b) the exploitation of the deposits is in the National or State interest;

(c) investigations have shown that alternative deposits are not available on other land in the locality outside the Zone; and

(d) the operations are subject to stringent safeguards to protect the landscape and natural environment.

Excluded from the park is section 85, hundred Parachilna county Taunton, of 8.091 ha and centred on Bookartoo Ochre deposit about 8.5 km north of Brachina Gorge (Fig. 3C). This section was reserved from the operation of the Mining Act in 1905 (S. Aust. Government Gazette, 26 January 1905) and granted to the Aboriginal Lands Trust on 1 March 1979.

Sections 188 and 189, hundred Bunyeroo country Taunton, each of 32.4 ha and 3 km north of Bunyeroo Gorge were recently added to the Flinders Ranges National Park (S. Aust. Government Gazette, 30 May 1985). These sections were the site of Mineral Leases (ML) 1046 and 1047 over a manganese deposit (Table 1).

TABLE 1
MINERAL TENURE

Production Tenements

| Tenement | Holder | Deposit | From | To |
|---|---|---|---|---|
| ML 1046 (formerly MC 18783) | A.W.T. White | Mn, 3 km N. of Bunyeroo Gorge | 30 June 1890 | 18 Nov. 1897 |
| ML 1047 (formerly MC 18784) | A.T. Prout | Mn, 3 km N. of Bunyeroo Gorge | 30 June 1890 | 11 Jan. 1894 |
| MC 10898 | G.S. DeLorne | Mn, 1.4 km S. of Bunyeroo Gorge | 19 July 1918 | 1919 |
| MC 10899, 10900 | " | " | 24 July 1918 | 1919 |
| MC 586 | M.M. Lyford | " | 29 Dec. 1943 | 9 Jan. 1968 |
| MC 1427 | C.A. Bairstow | Ag-Pb, 9.5 km N. of Brachina Gorge | 3 July 1949 | 7 July 1950 |
| MC 1946 | " | " | 7 March 1955 | 2 Feb. 1958 |
| MC 5281 | " | " | 12 July 1968 | 3 July 1973 |
| MC 293 | " | " | 4 Sept. 1973 | 3 Sept. 1974 |

Regional Exploration by Special Mining Lease (SML)

| Tenement | Holder | From | To |
|---|---|---|---|
| SML 115 | Mines Expl. Pty. Ltd. | 15 June 1966 | 14 Sept. 1966 |
| SML 131, 131A | " " " " | 14 Sept. 1966 | 24 April 1969 |
| SML 302 | E.Z. Co. of A/Asia Ltd. | 8 May 1969 | 7 May 1970 |
| SML 576 | " " " " " | 13 May 1971 | 12 May 1972 |

## PREVIOUS MINERAL INVESTIGATIONS

Bookartoo Ochre deposit (Fig. 3c), one of the oldest mining operations in Australia, was the focus of an extensive trade network that existed in Aboriginal Australia. Masey (1882) reported that Dr. George Ulrich (Geologist) first described the workings and concluded that friable ochre fills narrow seams traversing a hard band of almost pure hematite with minor calcite. He also detected small beads of mercury, which was confirmed by the Technological Museum, Melbourne who determined

0.5% Hg in one sample. F.R. George (Assistant Govt. Geologist) inspected the site in 1905 and, as a result, an area of about 8 ha. was withdrawn from the operation of the Mining Act and reserved for the aborigines. Ochre was derived from weathering of pyrite and minor sphalerite precipitated from mineralizing fluids in karst-type cavities. Some willemite is associated with the ochre (Keeling, 1984).

Manganese deposit 3 km north of Bunyeroo Gorge was covered by two Mineral Leases (Table 1) in the 1890's and although a surveyed plan, dated 1890, of Mineral Claims shows two shafts, one 38.4 m and the other 21.3 m deep (Fig. 3b), there is no recorded production (Plate 2).

Galena Creek Lead Prospect (Plate 3) at top of Wilkawillina Limestone, 9.5 km north of Brachina Gorge (Fig. 3c), consisting of coarse crystalline galena in 1 m wide quartz and calcite vein, striking approximately north-south, was held under Mineral Claims by C.A. Bairstow between 1949 and 1974 (Table 1). Production of about 150 tonnes of crude ore is recorded.

S. Aust. Dept. of Mines (SADM) investigated Wilkawillina Limestone as a source of high grade limestone and dolomite. In 1963, Johns (1967) reported the results of reconnaissance sampling from 4 km south of Brachina Gorge to 3 km south of Parachilna Gorge (Fig. 2). Rock chip samples were taken every 3 m and bulked over 61 m intervals along major gullies that cut across the stratigraphy. $CaCO_3$, $MgCO_3$ and $SiO_2$ contents were determined. In 1964, detailed follow-up sampling from Brachina Gorge southwards for 4 km consisted of rock chip samples every metre and bulked over 15 m intervals along east-west gullies. $CaCO_3$ and $MgCO_3$ contents were determined and selected samples were assayed for $SiO_2$, $Fe_2O_3$ and S or submitted for petrological examination. Plane table mapping and sampling confirmed the presence of two separate deposits:

- about 3 km south of Brachina Gorge: high grade limestone (averaging 97% $CaCO_3$), with a maximum thickness of 274 m and estimated reserves of 9.9 million $m^3$ at top of Wilkawillina Limestone (Olliver and Cramsie, 1967a);

- about 1 km south of Brachina Gorge: dolomite (averaging 54% $CaCO_3$ and 40% $MgCO_3$), with a maximum thickness of 259 m and estimated reserves of 7.6 million $m^3$ at base of Wilkawillina Limestone (Olliver and Cramsie, 1967b).

In 1965, three diamond drill holes were drilled to test the limestone deposit and a fourth was drilled to test an underlying dolomite in the same area (Cramsie, 1967). Core was split and 6 m lengths were assayed for $CaCO_3$, $MgCO_3$ and $SiO_2$ content. Drill hole details are shown on Table 2 and locations on figure 3b. Drilling proved reserves of 5 million $m^3$ of high grade limestone averaging over 95% $CaCO_3$ and indicated 73 m of underlying dolomite averaging 54% $CaCO_3$ and 42% $MgCO_3$.

TABLE 2
SADME DIAMOND DRILLING, limestone deposit

| Hole No. | Depth(m) | Inclination | Comments |
|---|---|---|---|
| DDH1 | 185.6 | 10°E | Light grey, fine grained to micro-crystalline limestone. Abundant archaeocyathids to 60 m. |
| DDH2 | 153.9 | 5°E | Light grey micro-crystalline limestone. Archaeocyathids abundant to 121 m and prominent to 153.9 m. |
| DDH3 | 183.8 | 5°E | Mid-dark grey micro-crystalline limestone to 30 m, then light grey fine grained limestone. Archaeocyathids abundant throughout. |
| DDH4 | 184.1 | 20°E | Fawn-grey dolomite with small solution cavities (2 mm) to 75 m, then interbedded limestone, dolomite and dolomitic limestone. |

Mines Exploration Pty. Ltd. (MEPL) conducted base metal exploration on SML 115, 131 and 131A between 1966 and 1969 (Table 1). Detailed geochemical surveys, geological mapping, geophysical surveys and diamond drilling were directed at Lower Cambrian carbonate rocks along the western margin of Flinders Ranges (Roberts, 1966, 1968a, 1968b, 1968c, 1969a and 1969b) and are summarised by Johns (1972). Over 3 300 stream sediment samples were collected from Edeowie Gorge to 13 km north of Parachilna Gorge. Samples were collected from gullies over a 4.5-9 $m^2$ area, combined and sieved to minus 80 mesh fraction and assayed for Cu, Pb and Zn. About 320 rock chips were collected from Mn-Fe gossans and analysed for Cu, Pb and Zn. Mapping was drawn at 1:12 000 scale. Lead mineralization was concluded to be of two broad types:

- Generally conformable galena as disseminations and fracture fillings in two horizons up to 20 m wide extending for up to 300 m along strike within basal dolomite member of Wilkawillina Limestone from 3.2 km south of Bunyeroo Gorge to 11 km north of Brachina Gorge. Associated high zinc values were thought to be zinc silicate.
- Sporadic disseminations and veinlets associated with breccia zones and calcite veining in upper limestone member of Wilkawillina Limestone, particularly about 8 km north of Brachina Gorge.

Traverse lines were selected across three favourable areas where Induced Polarization (IP), ground magnetics, soil and rock chip surveys were conducted:

- about 8 km north of Brachina Gorge centred on Bookartoo ochre deposit
- Brachina Gorge
- Bunyeroo Gorge

A large manganese gossan, 1 220 m long and 30 m wide, 3 km north of Bunyeroo Gorge (Fig. 3b) was chosen as a prime target. Gossan samples had assayed up to 9 500 ppm Zn, 1 500 ppm Pb and 12 ppm Ag. A grid was established and soil, rock chip, IP and ground magnetometer surveys were carried out. Geochemistry verified high Pb and Zn values over the gossan and showed high Pb and Zn in manganiferous carbonate east of the gossan. There was no magnetic response but IP anomalies were indicated in the gossan zone. Four inclined diamond drill holes (Table 3) were drilled to test the gossan (Fig. 3b). Contents of up to 18 500 ppm Zn and 19 ppm Ag were recorded but the gossan thinned rapidly with depth and was considered to be a 'false' gossan comprising transported manganese and iron oxides in a fault zone. Galena-bearing dolomite near base of Wilkawillina Limestone and other possible Cambrian basins between the ranges and Lake Torrens were concluded as worthy of exploration.

TABLE 3
MEPL DIAMOND DRILLING

| Hole No. | Depth (m) | Inclination | Mineralization From | To | Pb (%) | Zn (%) | Ag (oz per ton) |
|---|---|---|---|---|---|---|---|
| LT.1 | 135.3 | 55°E | No Mineralization | | | | |
| LT.2 | 120.4 | 60°W | 30.5 | 38.7 | - | 0.6 | 0.4 |
| | | | 38.7 | 42.7 | - | 0.6 | 0.6 |
| | | | 42.7 | 43.3 | - | 0.6 | 0.4 |
| LT.3 | 183.2 | 60°W | 150.3 | 151.6 | - | 1.05 | - |
| | | | 153.6 | 155.6 | - | 1.32 | - |
| LT.4 | 117 | 50°W | 18.3 | 30.6 | 0.43 | 0.79 | 0.43 |
| | | | 30.6 | 37.3 | - | 0.76 | 0.2 |
| | | | 57 | 65.2 | - | 1.24 | 0.17 |
| | | | 66.8 | 79.9 | - | 1.11 | 0.16 |
| | | | 82.9 | 89.6 | - | 1.85 | 0.15 |

In 1969-1972, Electrolytic Zinc Co. of Australasia Ltd. (EZ) conducted base metal exploration on SML302 and SML 576 (Table 1) covering Lower Cambrian carbonates extending from Edeowie Gorge to northern park boundary (Fig. 2). A regional stream sediment survey at a density of about 20 samples per km$^2$ was completed with minus 20 mesh-plus 80 mesh fraction assayed for Pb and Zn. Highly anomalous stream sediment samples assaying above 1 000 ppm Pb and 2 000 ppm Zn were examined mineralogically. Willemite, galena and malachite were found, particularly over a strike length of about 5 km centred on Bookartoo Ochre deposit, about 8.5 km north of Brachina Gorge (Fig. 3c). This area was referred to as Toondana Prospect (Muller, 1970a). Detailed mapping at 1:4 800 located several willemite occurrences, the first recorded in this area, but detailed rock chip sampling, adjacent to a major fault and a previously untested MEPL IP anomaly, gave disappointing results with the exception of two 1.5 m sample intervals that assayed 11% and 8% combined Pb and Zn (Muller, 1970b).

During the course of exploration, the area was declared a National Park on 22 October 1970. To minimise damage to the park, small portable diamond drill machines were used to drill four holes (Table 4) to test surface mineralization (Horn, 1972). T1 was drilled with an E550 Mindrill to test a willemite-chalcocite-malachite occurrence near top of Wilkawillina Limestone while T2, 3 and 4 were drilled with an oil-impelled lightweight Mindrill to test a massive willemite occurrence near the middle of upper member of Wilkawillina Limestone. Drilling results are summarised on Table 4.

TABLE 4
EZ Diamond Drilling

| Hole No. | Core Size | Depth (m) | Inclination | Mineralization From | to | True thickness | Pb (%) | Zn (%) |
|---|---|---|---|---|---|---|---|---|
| T1 | Ex | 45.7 | + 5°E | No Mineralization | | | | |
| T2 | Ex | 4.6 | -60°E | 0 - | 1.2 | 1.2 | 0.9 | 31.0 |
| T3 | Ex | 7.6 | + 5°E | 8 - | 7.6 | 5.2 | 0.2 | 12.7 |
| T4 | Ex | 5.2 | -60°E | 0 - | 1.8 | 1.8 | 0.05 | 13.5 |
| | | | | 3.7- | 4.3 | 0.6 | 0.06 | 16.2 |

Drilling indicated that mineralization was tectonically controlled supergene-enriched and that further testing would require a larger drill rig which would not only cause damage to land surface and local vegetation but would be economically unjustified (Horn, 1972).

SADM (Johns, 1972) recognised the importance of Lower Cambrian strata of northern Flinders Ranges for Cu, Pb, Zn and Ag mineralization and compiled a summary of exploration on SML's between 1965 and 1969.

In 1977, AMDEL were commissioned by SADME to undertake a literature review of local and worldwide MVT lead-zinc mineralization. Moeskops (1977) concluded that Lower Cambrian carbonate rocks of the Ediacara Basin and elsewhere in this State are potential hosts for economic MVT deposits. Exploration would largely involve detailed mapping, to delineate appropriate paleographic and structural elements, followed by extensive drilling to locate hidden ore bodies.

In 1983, SADME conducted a seminar entitled 'South Australia-Exploration Potential' where Robertson (1984) presented a paper on 'Potential of the Cambrian for Mississippi Valley Type Lead-Zinc Mineralization'. He concluded that Wilkawillina Limestone is a likely host for MVT lead-zinc mineralization owing to suitable lithology and stratigraphic position, good porosity and perhaps karstic features providing suitable open spaces. At least one unconformity is associated with the unit. The limestone has undergone partial dolomitization with some evidence of lead and zinc mineralization associated with this dolomitization and with particular horizons within upper Wilkawillina Limestone. Localities where limestone is cut by major faults which may have been pathways for mineralized brines are particularly prospective.

Conservation groups lobbied against SADME activities inside Flinders Ranges National Park after Cabinet approved Stage 1 and 2 exploration in April 1983. This culminated in 'The Case Against Mineral Exploration In The Flinders Ranges National Park' prepared in October 1983 by the Flinders Ranges Action Committee for the Conservation Council of South Australia Inc. (1983). This submission was appraised and justification for SADME involvement was documented by Olliver (1984).

## REGIONAL GEOLOGICAL SETTING

Regional geology, shown on figure 2, is based on PARACHILNA (Dalgarno and Johnson, 1966), Oraparinna (Dalgarno and Johnson, 1965) and Preiss (1983) and described by Forbes (1972), Wopfner (1969) and Preiss (1979).

Oldest member of Adelaidean sediments in the study area is even grained quartzite of Pound Subgroup, part of Wilpena Group, unconformably overlain by Hawker Group sediments of Cambrian age and comprising the following units in ascending stratigraphic order:

Parachilna Formation - argillaceous sandstone, with minor oolitic and shaley lenses characterised by vertical worm burrows, marks the beginning of an early Cambrian transgressive sea and accompanying basin subsidence.

Wilkawillina Limestone - bedded oolitic, sandy dolomite at base (Plate 4) with massive biostromal and biohermal archaeocyathid limestone (Plate 5) with brachiopods at top, which is marked by a red-brown palaeo-surface (Plates 6 and 7) representing a brief period of subaerial exposure and stabilization of basin subsidence. The carbonates are typically shelf facies and outline the margins of the Cambrian sea that covered the site of Adelaide Geosyncline (Fig. 4).

Parara Limestone - basinal flaggy limestone with shaley interbeds, overlies and intertongues Wilkawillina Limestone in some areas (Fig. 4).
Oraparinna Shale - green carbonaceous siltstone with trilobites, overlies and intertongues Wilkawillina Limestone in some areas (Fig. 4).
Billy Creek Formation - red-brown micaceous sandstone with red and green shale and tuffaceous interbeds, disconformably overlies Wilkawillina Limestone and marks a time of regression and minor volcanism.

These sediments are among the last deposited prior to major Ordovician folding of Delamerian Orogeny which resulted in regional broad open folds striking approximately north-south. Heysen Range represents the eastern limb of a southerly-plunging syncline, with beds dipping 40 to 60 degrees west. The rocks are undeformed except for drag folding adjacent to some major, generally left lateral, northeasterly trending faults with displacements of up to 2.7 km. Syn-depositional faulting related to diapiric movements in Adelaide Geosyncline caused facies and thickness changes particularly 3 km north of Bunyeroo Gorge (Fig. 3b) where south of a fault, upper member of Wilkawillina Limestone is reduced from about 350 m to about 200 m in thickness and archaeocyathid limestone has changed to a weakly fossiliferous limestone and then nodular limestone (Plate 8).

## GEOLOGICAL MODEL AND METHODS

MVT base metal deposits generally occur in shallow water carbonate sequences on the margins of large sedimentary basins. Lead-zinc deposits are considered to be concentrated in sedimentary carbonate rocks due to the formation of hydrogen sulphide and subsequent accumulation acting as a precipitant of metallic sulphides (Anderson and Beales, 1983). Regional faults and permeable horizons provide access for metal-carrying brines passing from the basins through the hydrogen sulphide-bearing carbonate reservoirs. Sulphide mineralization is deposited in open spaces where faults, facies changes, unconformities, karsting and dolomitization have prepared the ground.

The upper member of Wilkawillina Limestone (generally archaeocyathid-rich limestone) was the target. In particular, the sequence immediately below the top palaeo-surface is favourable for karstic development and hence MVT lead-zinc mineralization (Robertson, 1984).

Coloured aerial photographs with photo-interpretation at 1:20 000 scale of the area between Edeowie Creek and the northern Park boundary were supplied by BHP in 1983. Mapping was plotted on 1:5 000 scale aerial photographs and is presented herein on three 1:10 000 scale map sheets (Figs. 3a, 3b and 3c). Locations of 55 rock samples collected for petrological examination are shown on figures 5a, 5b and 5c and sample descriptions are presented in Appendix A.

## GEOLOGY

Wilkawillina Limestone (Table 5) has been divided into lower and upper members (Dalgarno, 1964), the lower member is probably equivalent to Woodendinna Dolomite of Haslett (1975).

TABLE 5

Stratigraphy, Wilkawillina Limestone

| Upper Member | North | South |
|---|---|---|
| | Palaeo-surface | |
| | - Massive Archaeocyatha Lmst. (100 m) | |
| | - Crystalline Weakly Fossiliferous Lmst. (100 m) | - Nodular Lmst. (100 m) |
| | - Nodular Lmst. (30 m) | |
| | ? Possible unconformity ? | |
| | Calc - Dolomite (100 m) | |
| Lower Member (Woodendinna Dolomite) | | Nodular Lmst. (5 m) |
| | Bedded Dolomite (300 m) | |

Lower member - bedded dark grey-brown crystalline sandy and oolitic dolomite (Plate 4). Southwards from 3 km north of Bunyeroo Gorge, the top of lower member is marked by a bed of nodular limestone about 5 m thick, nodules are dark grey with a pale brown dolomitic matrix.

Upper member - massive off-white porous calc-dolomite (Plate 9) about 100 m thick representing dolomitized, recrystallized limestone (sample RS234 Appendix A) forms basal unit of upper member. The top of this calc-dolomite unit may represent an unconformity. Solution collapse breccias mark the top (Plate 10) and overlying lenticular nodular limestone up to 30 m thick represents a change of depositional environment. This nodular limestone comprises medium grey nodules in buff to mauve matrix. This is overlain by about 100 m of massive fine to medium grained light grey to off-white crystalline weakly fossiliferous limestone that underlies about 100 m of massive, fine-grained, predominantly pale to dark-grey, buff, brown and pink archaeocyathid-rich limestone with brachiopods (Plate 5). Dark grey archaeocyathid limestone is described by Wopfner (1970) as a bituminous limestone and commonly occurs between a point just south of Brachina Gorge and the northern park boundary. Southwards from 3 km north of Bunyeroo Gorge (Figs. 3a and 3b), massive light grey fossiliferous limestone becomes weakly fossiliferous and then grades into bedded nodular limestone (Plates 8 and 11) with light to medium grey limestone nodules in a light brown dolomitized matrix (Sample RS253 Appendix A).

The top of Wilkawillina Limestone is characterised by a palaeo-surface; red-brown recrystallized calcite crust (Samples RS279 and RS283 Appendix A), up to 10 cms thick, (plates 6 and 7), similar to indurated laminated calcitic crusts on Pleistocene marine limestone at Florida Keys (Multer and Hoffmeister, 1975). This palaeo-surface marks an unconformity and a period of subaerial exposure, when karstic features developed on and below the surface, and is located at the same stratigraphic position throughout the Flinders Ranges. In the study area, the red-brown calcrete crust mantles an undulating surface with up to 2 m relief and lines cavities and crevices.

The following karstic features have been found:

- irregular surface, crevices and cavities at palaeo-surface defined by red-brown calcrete crust (Plates 6 and 7).
- about 5.5 km north of Brachina Gorge, major collapsed karst about 200 m in diameter (Plate 12). Others are suspected 2 km and 3.5 km north of Brachina Gorge.

- about 2.5 km north of Bunyeroo Gorge, numerous solution cavities up to 30 m in diameter contain manganese oxides adjacent to a major cross fault and an area of dolomitization (Fig. 3b).
- solution collapse breccia (Plates 10 and 13), 140 m by 40 m, at Bookartoo Ochre deposit (Fig. 3c) adjacent to major cross fault and at top of off-white calc-dolomite unit. Sub-angular blocks, a few centimetres to several metres in diameter, of archaeocyathid limestone derived from overlying sequence are set in red-brown hematitic crystalline calcite matrix (Sample RS284, Appendix A) (Keeling, 1984).
- laminar calcrete or calcite (Plate 14), coarse calcite crystals and caves as shown on figures 3a, 3b and 3c may indicate karsting.

## METALLIC MINERALIZATION

Lead-zinc minerals have been observed throughout most of study area, the main localities being:

- 2 km south of Bunyeroo Gorge (Fig. 3a) - several exposures of yellow-brown and orange smithsonite gossan (Samples R24/1, R26 and R26/1, Appendix A) up to 10 $m^2$ are present at top of and replacing off-white calc-dolomite unit (Plates 15 and 16). Some hydrozincite is also associated. Massive pods and irregular veins strike about 075° and 145°. Origin is supergene with calc-dolomite host showing evidence of cavity filling (CMS Rept. 83/9/2, Appendix B).
- manganese-iron oxide concentrations are common, generally along fault lines. The largest concentration at the abandoned manganese mine about 3 km north of Bunyeroo Gorge (Plate 2) consists mainly of psilomelane (Sample RS258, Appendix A), is enriched in zinc (up to 1.85%) and silver (up to 19 ppm) and was drilled by MEPL (Fig. 3b).
- from 6.5 km north of Brachina Gorge to the northern Park boundary, a distance of about 3 km, willemite, associated with coarse calcite and pink-mauve hematite colouring is common (Fig. 3c) apparently being fault-

controlled supergene enrichment (Horn, 1972), and also as karstic cavity infillings within limestone (Plate 17). Malachite, chalcocite, galena, sphalerite and hydrozincite have also been observed as fracture fillings with associated silicification; particularly just north of Bundulla Creek.

## ALTERATION

Dolomitization and mauve-pink hematite colouration are the most obvious signs of alteration although recrystallization of limestone is widespread.

Off-white calc-dolomite unit is dolomitised, recrystallized limestone and probably represents an early phase of dolomitization (Sample RS234, Appendix A). Overlying nodular limestone is more argillaceous and has probably acted as cap rock confining magnesium-rich groundwater to the more porous calc-dolomite.

A later phase of dolomitization is shown adjacent to a major cross fault 3 km north of Bunyeroo Gorge (Fig. 3b). Dolomitization is widespread, is superimposed on massive archaeocyathid limestone and calc-dolomite and is probably due to magnesium-rich groundwater emanating from the fault zone.

Patches of pale pink recrystallized limestone occur irregularly throughout the area. Pink colouration is due to secondary ferruginous oxide (Sample R S235 Appendix A).

Between Brachina Gorge and the northern park boundary, zones of mauve-pink colouration are common particularly at top of calc-dolomite unit. Colouration is due to hematite impregnating and replacing dolomite and limestone. Earthy red-brown ochreous deposits with calcite infill joints and fractures and have been mined by aborigines at Bookartoo Ochre deposit (Keeling, 1984).

Late stage silicification is present south of Bunyeroo Gorge where chalcedony replaces archaeocyathids just below the palaeo-surface and some silicification of calc-dolomite, in vicinity of smithsonite gossans, has been observed. North of Bundulla Creek (Fig. 3c) zones of silicification about 3 m wide are developed along faults and some quartz veining is present just below the palaeo-surface.

## GEOCHEMISTRY

### Methods

Stream sediment samples (Plate 18) were generally collected from minor gullies that locally drain upper member of Wilkawillina Limestone (Figs. 7a, 7b and 7c). The minus 20 plus 40 mesh fraction, sieved on site, of 829 stream sediment samples was analysed by Australian Mineral Development Laboratories (AMDEL) for Pb, Zn and Mn by atomic absorption spectroscopy (AAS). Detailed rock chip sample lines were up to 1 100 m long, generally 100 m apart and orientated east-west across the stratigraphy. Rock chips were taken about every metre and bulked over 25 m intervals (Plate 19). Detailed soil samples were collected at 10 m intervals and sieved on site, retaining the minus 20 mesh fraction. Most rock chips samples (2 464) and soil samples (141) were assayed by AAS at AMDEL for Cu, Pb, Zn, Mn, Cd and As. In addition, selected rock chips samples were assayed for Cr, Au, Hg, Co, Ni, Ag, Mo and Fe. An additional 218 rock chip samples were assayed by AAS at Comlabs Pty. Ltd. for Cu, Pb and Zn while selected samples were assayed for Ni, Co, Cd, Fe, Mn, Ag, Mo, Sn, As, Au, Ca, Mg and $SiO_2$. Petrological descriptions were carried out by AMDEL (52 samples) and Central Mineralogical Services (3 samples).

### Orientation

Stream sediment (24 samples), rock chip (20 samples) and soil (33 samples) sampling was conducted near smithsonite exposures 2 km south of Bunyeroo Gorge (Fig. 5a), and results are shown in Appendix B.

The minus 20 mesh plus 40 mesh fraction of stream sediment samples gave best contrast of Pb and Zn and was selected for the regional survey.

The various size fractions used for soil samples showed little variation of assays and minus 20 mesh fraction was selected for sampling.

Rock chip samples consisted of a composite of approximately 10 chips taken over 10 m intervals. High Pb, Zn and Cd values associated with background Mn and Fe values identified smithsonite gossans.

## Regional Rock Chip Sampling

A total of 255 rock chip samples of selected rock types were collected from locations shown on figures 5a, 5b and 5c.

Significant results from assays tabled in Appendix C are as follows:

- smithsonite gossan 2 km south of Bunyeroo Gorge contains up to 690 ppm Cu, 1 700 ppm Pb, 43% Zn and 1 200 ppm Cd.
- massive manganese gossan 3 km north of Bunyeroo Gorge contains up to 130 ppm Cu, 28 ppm Pb and 3 900 ppm Zn. Adjacent manganiferous, dolomitized limestone contains up to 26 ppm Cu, 44 ppm Pb and 1.7% Zn.
- manganese oxides filling solution cavities 2.5 km north of Bunyeroo Gorge contain up to 90 ppm Cu, 480 ppm Pb, 1.4% Zn and 16 ppm Cd.
- willemite outcrops in the north contain up to 460 ppm Cu, 5 200 ppm Pb, 49.5% Zn and 1 350 ppm As.
- small iron-manganese concentrations along fault lines contain about 1 000 ppm Cu, 300 ppm Pb and 3 000 ppm Zn with 2 700 ppm Cu, 6 100 ppm Pb and 7 800 ppm Zn in sample R406 from near Bundulla Creek (Fig. 5c).
- pink-red altered limestone contains up to 12 ppm Cu, 620 ppm Pb and 2 700 ppm Zn, compared to unaltered limestone with up to 12 ppm Cu, 44 ppm Pb and 140 ppm Zn.

Generally zinc has been enriched in Mn-Fe gossans and areas of dolomitization and pink alteration.

## Stream Sediment Sampling

Assay results for 829 samples are summarized on table 6 and figures 7a, 7b and 7c.

TABLE 6
Statistical Results - Stream Sediment Samples

| | Pb (ppm) | Zn (ppm) | Mn (ppm) |
|---|---|---|---|
| Arithmetic Mean | 120 | 200 | 2 170 |
| Threshold | 250 | 300 | 3 500 |

Spearman Rank Correlation Coefficients

| | |
|---|---|
| Pb-Zn | 0.6030 |
| Pb-Mn | 0.3643 |
| Zn-Mn | 0.3792 |

The following conclusions are based on frequency distribution graphs (Figs. 8) and log-probability curves (Fig. 9).

Lead - three distinct but not widely separated populations, probably representing lithological variations with a weak superimposed mineralized phase.

Zinc - three populations, two of which are probably lithological variations with a higher superimposed population representing mineralization and supergene enrichment.

Manganese - two widely separated populations reflecting supergene enrichment along fault lines.

Lead and zinc correlate strongly and both correlate weakly to manganese.

As can be seen on figures 7a, 7b and 7c, anomalous samples are generally related to major northeasterly trending faults.

The following eight prospects have been selected for detailed investigation; Southern, Camp, Manga, Llina, Hayward, Concert, Willa and Northern prospects (Figs. 7a, 7b and 7c).

## SOUTHERN PROSPECT

### Geology

Geological plan at 1:5 000 scale is shown on figure 10. Parara Limestone comprising flaggy limestone with shale interbeds overlies Wilkawillina Limestone. The palaeo-surface is evident at top of Wilkawillina Limestone and caps a massive grey-brown crystalline limestone bed about 20 m thick overlying about 60 m of nodular limestone, which in turn overlies about 70 m of off-white porous calc-dolomite (Plate 11) that contains smithsonite gossans near the top. About 20 m of massive light-grey limestone forms the base of upper member of Wilkawillina Limestone. Top of lower member is marked by dark-grey nodular limestone. Northeasterly trending faults are well-developed causing displacement of the sequence. A remnant outcrop of Tertiary silcrete is present adjacent to a major fault. Manganese oxide concentrations are developed just below the palaeo-surface.

Geochemistry

Twenty-four rock chip lines up to 800 m long and either 50 m or 100 m apart were sampled (Fig. 11) Assay results of 482 samples (Appendix D) are summarized on Table 7. There were insufficient cadmium assays above detection limit of 1 ppm for statistical treatment, consequently a cadmium assay of 2 ppm or greater was regarded as significant.

TABLE 7
Statistical Results - Southern Prospect

| | Cu (ppm) | Pb (ppm) | Zn (ppm) | Mn (ppm) |
|---|---|---|---|---|
| Median | 4 | 30 | 40 | 840 |
| Threshold | 20 | 350 | 400 | 12 000 |

Spearman Rank Correlation Coefficients

| | | | |
|---|---|---|---|
| Cu-Pb | 0.3051 | Pb-Zn | 0.6499 |
| Cu-Zn | 0.3175 | Pb-Mn | -0.0843 |
| Cu-Mn | 0.4893 | Zn-Mn | -0.0895 |

There is good correlation between Pb and Zn and interestingly, no correlation of either with Mn, indicating that Pb and Zn have not been mobilised by the same phase of supergene processes that deposited Mn in this area.

The following conclusions are based on contour plans (Figs. 12, 13, 14, 15 and 16), frequency distribution graphs (Fig. 17) and log-probability curves (Fig. 18).

- for Cu, Pb, Zn and Mn there are generally two background populations representing lithology and a superimposed anomalous population representing supergene enrichment and/or mineralisation.
- concentrations of Cu, Pb and Zn are in lower member of Wilkawillina Limestone adjacent to major faulting.
- Pb, Zn and Cd concentrations are in calc-dolomite unit near known smithsonite exposures.
- Mn shows a striking concentration along palaeo-surface with associated Cu, Pb and Zn.

Coincident lead, zinc and cadmium anomalies in association with smithsonite gossans and possible karsting, between sample lines 7 and 14, delineate a prime target.

Geophysics

Figure 19 shows locations and results of IP and Sirotem surveys detailed by Ivic (1986). Coincident IP and Sirotem anomalies lie along palaeosurface on lines 1 000 to 1 600 and may be a response to downdip extensions of smithsonite gossans observed near top of calc-dolomite unit.

## CAMP PROSPECT

Geology

A geological plan at 1:5 000 scale is shown on figure 20. Parara Limestone comprising flaggy limestone with shale interbeds overlies Wilkawillina Limestone. The red-brown palaeo-surface is evident at top of Wilkawillina Limestone and caps about 130 m of massive light grey archaeocyathid limestone, that contains a 50 m bed of nodular limestone which thins to about 25 m in the north of the prospect. Below massive limestone is about 70 m of off-white porous calc-dolomite which overlies about 30 m of massive light grey limestone that forms the base of upper member of Wilkawillina Limestone. Top of lower member is marked by dark-grey nodular limestone. Several surface depressions 20m-30m across, containing manganese oxides may represent karstic features.

Geochemistry

Six rock chip lines, 300 m long and 100 m apart were sampled (Fig. 21). Assay results of 72 samples (Appendix D) are summarised on Table 8. There were insufficient cadmium and arsenic assays above detection limit of 1 ppm and 40 ppm respectively for statistical treatment, consequently a cadmium assay of 1 ppm and arsenic assay of 50 ppm or greater was regarded as significant.

TABLE 8

Statistical Results - Camp Prospect

| | Cu (ppm) | Pb (ppm) | Zn (ppm) | Mn (ppm) |
|---|---|---|---|---|
| Median | 5.5 | 33 | 50 | 1440 |
| Threshold | 15 | 75 | 150 | 15000 |

Spearman Rank Correlation Coefficients

| | | | |
|---|---|---|---|
| Cu-Pb | 0.0819 | Pb-Zn | 0.2044 |
| Cu-Zn | 0.5192 | Pb-Mn | 0.001 |
| Cu-Mn | 0.5309 | Zn-Mn | 0.5839 |

Correlation coefficients indicate that copper and zinc have been mobilised by supergene processes and deposited with manganese while lead has been relatively immobile.

The following conclusions are based on contour plans (Figs. 22, 23, 24, 25, 26, & 27), frequency distribution graphs (Fig. 28) and log probability curves (Fig. 29):

- for Cu, Pb, Zn and Mn there is generally one background population with a superimposed anomalous population representing supergene enrichment.
- assays are generally low but Cu, Pb, Zn, As and Mn concentrations are located along palaeo-surface, particularly near possible karsting on lines 1, 2 and 3.
- the calc-dolomite unit is high in Cu, Zn, Mn and As.

## MANGA PROSPECT

### Geology

A geological plan at 1:5 000 scale is shown on figure 30. Parara Limestone comprising flaggy limestone with shale interbeds overlies Wilkawillina Limestone. The palaeo-surface at top of Wilkawillina Limestone is mostly concealed but where present caps about 100 m of massive light grey archaeocyathid limestone with brachiopods which overlies a 2 m thick bed of nodular limestone which in turn overlies about 110 m of off-white calc-dolomite. About 10 m of massive light grey limestone forms the base of upper member of Wilkawillina Limestone. The top of lower member is marked by dark grey nodular limestone over dark grey brown sandy dolomite. A major northeasterly trending sinistral fault zone with massive manganese oxide concentrations (Plate 2) displaces the sequence 2.7 km horizontally. The rocks are dolomitized for about 800 m south of this fault zone. Several circular solution cavities containing manganese oxide, up to 30 m in diameter, are developed in archaeocyathid limestone below the palaeo-surface in the centre of the prospect. At the southern end of the prospect about 1.5 ha of archaeocyathid limestone, immediately below the palaeo-surface, is dolomitized.

## Geochemistry

Twenty-nine rock chip lines, up to 750 m long and either 50 m or 100 m apart were sampled (Fig. 31). Assay results of 422 samples (Appendix D) are summarized on Table 9.

TABLE 9
Statistical Results - Manga Prospect

| | Cu (ppm) | Pb (ppm) | Zn (ppm) | Mn (ppm) | Cd (ppm) |
|---|---|---|---|---|---|
| Median | 5 | 20 | 115 | 2 160 | 1 |
| Threshold | 20 | 200 | 1 000 | 65 000 | 12 |

Spearman Rank Correlation Coefficients

| | | | |
|---|---|---|---|
| Cu-Pb | 0.4441 | Pb-Zn | 0.1487 |
| Cu-Zn | 0.3959 | Pb-Mn | 0.0050 |
| Cu-Mn | 0.4457 | Pb-Cd | 0.3511 |
| Cu-Cd | 0.2166 | Zn-Mn | 0.8410 |
| Mn-Cd | 0.4368 | Zn-Cd | 0.6262 |

Correlation coefficients indicate that zinc, being mobile, has been largely scavenged by manganese whereas lead has remained in place. Significantly, there is also a zinc-cadmium component not associated with manganese.

The following conclusions are based on contour plans (Figs. 32, 33, 34, 35 and 36), frequency distribution graphs (Figs. 37) and log probability curves (Fig. 38)

- for Cu, Pb, Zn, Mn and Cd there are two background populations representing lithology and a superimposed anomalous population that represents supergene enrichment and/or possible mineralization
- concentrations of Cu, Pb, Zn, Mn and Cd occur along the major fault coincident with massive manganese oxide exposures.

- concentrations of Cu, Pb, Zn, Mn and Cd occur over an area of karsting in massive archaeocyathid limestone just below the palaeo-surface on lines 11-14.
- concentrations of Cu and Pb occur over an area of dolomitized archaeocyathid limestone just below the palaeo-surface on lines 17-20.
- the large area of dolomitization adjacent to the major fault is high in Zn, Mn, Cd and low in Pb.

Anomalous zinc, manganese and cadmium associated with dolomitization show that the dolomitizing fluids were mineralized. The massive zinc-rich manganese oxides along the major fault have been shown by drilling (Roberts, 1969a), to be a supergene enriched 'false' gossan, and further testing is not required at this stage. Karstic features between lines 10 and 14 with coincident copper, lead, zinc and manganese anomalies with high cadmium delineate a prime target zone.

Geophysics

Figure 39 shows locations and results of IP (Plate 20) and Sirotem surveys detailed by Ivic (1986). Coincident IP and Sirotem anomalies on lines 10N to 16N are associated with massive manganese oxide adjacent to major fault. IP anomalies just west of the palaeo-surface, on lines 4N to 8N, may be a response to possible mineralization associated with down dip extension of area of karsting and dolomitization.

## LLINA PROSPECT

Geology

Geological plan at 1:5 000 scale is shown on figure 40. Billy Creek Formation with basal dolomite and flaggy limestone followed by red and green shale overlies Wilkawillina Limestone. The red-brown palaeo-surface is evident at top of Wilkawillina Limestone and caps about 300 m of massive light grey limestone, the top 100 m of which is archaeocyathid-rich with some brachiopods. Massive limestone is underlain by about 40 m of nodular limestone that overlies about 130 m of off-white porous calc-dolomite which forms the base of upper member of Wilkawillina Limestone. Top of lower member is marked by dark grey-brown sandy dolomite. A major dextral fault defines Brachina Gorge and the rock sequence is displaced 900 m

(Fig. 36). A remnant brecciated block of dark grey-brown sandy dolomite of lower member occurs in the southwestern corner of the prospect. Several bands of magnesite, 30 cms wide and up to 10 m long, occur in calc-dolomite in the southeast of the prospect.

Geochemistry

Fourteen rock chip lines up to 1 050 m long and 100 m apart were sampled (Fig. 41). Assay results of 355 samples (Appendix D) are summarised on Table 10. There were insufficient arsenic assays above detection limits of 40 ppm for statistical treatment, consequently an arsenic assay of 80 ppm or greater was regarded as significant.

TABLE 10

Statistical Results - Llina Prospect

| | Cu (ppm) | Pb (ppm) | Zn (ppm) | Mn (ppm) | Cd (ppm) |
|---|---|---|---|---|---|
| Median | 3 | 32 | 66 | 465 | 0.6 |
| Threshold | 25 | 200 | 750 | 2000 | 5 |

Spearman Rank Correlation Coefficients

| | | | |
|---|---|---|---|
| Cu-Pb | 0.3077 | Pb-Mn | 0.2824 |
| Cu-Zn | 0.2140 | Pb-Cd | 0.3688 |
| Cu-Mn | 0.2745 | Zn-Mn | 0.8065 |
| Cu-Cd | 0.1240 | Zn-Cd | 0.5599 |
| Pb-Zn | 0.2961 | Mn-Cd | 0.3422 |

There is a strong correlation between Zn and Mn indicating the mobility of Zn and Mn during supergene processes. A Zn-Cd component not associated with Mn is indicated and may represent smithsonite mineralization.

The following conclusions are based on contour plans (Figs. 42, 43, 44, 45, 46 & 47), frequency distribution graphs (Figs. 48) and log-probability curves (Figs. 49):

- for Cu, Pb, Zn, Mn and Cd there are generally two background populations that represent lithology and a superimposed anomalous population.
- Pb, Mn and Cd anomalies occur near the contact between light grey massive limestone and nodular limestone, particularly on lines 4, 5 and 6.
- anomalous Zn assays are concentrated along the contact between nodular limestone and calc-dolomite.

- minor concentrations of Pb, Zn, Mn and As occur at and just below the palaeo-surface.
- the block of brecciated grey-brown dolomite of lower member in south-west of prospect contains anomalous assays of Cu, Pb, Zn, Mn and Cd.

## HAYWARD PROSPECT

### Geology

Geological plan at 1:5 000 scale is shown on figure 50. Billy Creek Formation with basal dolomite and flaggy limestone followed by red and green shale overlies Wilkawillina Limestone. The red-brown palaeo-surface is evident at top of Wilkawillina Limestone and caps about 300 m of massive light grey limestone the top 100 m of which is archaeocyathid-rich with some brachiopods. Massive limestone is underlain by about 70 m of nodular limestone that overlies about 130 m of off-white porous calc-dolomite which forms the base of upper member of Wilkawillina Limestone. Top of lower member is marked by dark grey-brown sandy dolomite. Within massive limestone on line 7 are two large surface depressions, 50 m - 100 m across, containing soil with some exposures of manganese oxide, coarse calcite crystals and laminar calcrete. These depressions probably represent karsts. A scree-covered break in the palaeo-surface on line 5 with associated north-easterly trending fault may also represent a karst feature.

### Geochemistry

Ten rock chip lines up to 400 m long and 100 m apart were sampled (Fig. 51). Assay results of 117 samples (Appendix D) are summarised on Table 11. There are insufficient cadmium and arsenic assays above detection limit of 1 ppm and 40 ppm respectively for statistical treatment consequently a cadmium assay of 2 ppm or greater and an arsenic assay of 50 ppm or greater was regarded as significant.

TABLE 11

Statistical Results - Hayward Prospect

| | Cu (ppm) | Pb (ppm) | Zn (ppm) | Mn (ppm) |
|---|---|---|---|---|
| Median | 1.5 | 31 | 42 | 289 |
| Threshold | 7 | 70 | 115 | 1100 |

Spearman Rank Coorelation Coefficients

| | | | |
|---|---|---|---|
| Cu-Pb | 0.4643 | Pb-Zn | 0.6347 |
| Cu-Zn | 0.4211 | Pb-Mn | 0.4732 |
| Cu-Mn | 0.4765 | Zn-Mn | 0.5418 |

Correlation coefficients indicate that Cu, Pb and Zn have been mobile during supergene processes and deposited with Mn. A Pb-Zn component not associated with Mn is indicated and may represent primary mineralisation.

The following conclusions are based on contour plans (Figs. 52, 53, 54, 55, 56 & 57), frequency distribution graphs (Figs. 58) and log probability curves (Fig. 59):

- for Cu, Pb, Zn and Mn there are generally two background populations representing lithology and a superimposed anomalous population probably representing supergene enrichment
- assays are generally low but Pb, Zn, Mn and As concentrations are located on lines 6 and 7 in the vicinity of possible karsts.
- Zn and As concentrations are located on line 5 over a possible karst on the palaeo-surface.

## CONCERT PROSPECT

### Geology

Figure 60 at 1:1 000 scale covers a circular depression, about 200 m in diameter, immediately below the palaeo-surface at top of Wilkawillina Limestone in massive archaeocyathid limestone (Plate 12). Much of the depression contains scree of angular blocks about 30-60 cm in size and is considered to be a partly eroded ancient collapsed solution cavity. An area of breccia, 80 m long by 15 m wide striking northeasterly, comprises angular archaeocyathid limestone fragments about 10 cm in size set in hematitic matrix with coarse calcite crystals and probably represents a fault-controlled breccia.

## Geochemistry

The minus 20 mesh fraction of 103 soil samples was collected at 10 m intervals from four lines orientated approximately north-south (240 m long), east-west (280 m long) northeast-southwest (240 m long) and northwest-southeast (290 m long). Assay results are shown in Appendix F and summarised on figure 60. Lead and zinc values are up to 335 ppm and 610 ppm respectively, which is anomalous for soil samples and enhances the possibility that the palaeo-karst feature is mineralized.

# WILLA PROSPECT

## Geology

Geological plan at 1:5 000 scale is shown on figure 61. Billy Creek Formation with basal dolomite and flaggy limestone followed by red and green shale overlies Wilkawillina Limestone. The red-brown palaeo-surface is evident at top of Wilkawillina Limestone and caps about 300 m of massive light grey limestone, the top 100 m of which is archaeocyathid-rich with some brachipods. Massive limestone is underlain by about 40 m of nodular limestone that overlies about 70 m of off-white porous calc-dolomite which forms the base of upper member of Wilkawillina Limestone. Top of lower member is marked by dark grey-brown sandy dolomite. At northern end of prospect at top of calc-dolomite unit is a large area, 0.6 ha, of solution collapse breccia (Plate 10) consisting of sub-angular blocks, a few centimetres to several metres across, of archaeocyathid limestone derived from overlying sequence and set in red-brown hematitic crystalline calcite matrix. Fine grained red-brown hematite pervades the rocks along the contact between nodular limestone and calc-dolomite causing a distinct reddening and giving rise to the Bookartoo Ochre deposit 30 m north of the collapse breccia (Keeling, 1984). There are several exposures of willemite, generally associated with hematitic coarse calcite crystals, as fault controlled and karst infilling supergene enrichments (Plate 17). The exposures about 1 m wide and up to 70 m long occur in nodular limestone, calc-dolomite, collapse breccia and massive archaeocyathid limestone just below the palaeo-surface. Several pods of malachite and chalcocite up to 20 m across are located in massive archaeocyathid limestone just below the palaeo-surface.

In the southwestern corner of the prospect, coarse galena is common in northwesterly trending, 20 cms wide quartz veins that dip 050°NE and are associated with silicified limestone. At one locality just below an irregular palaeo-surface, coarse galena blebs up to 5 cm wide with malachite and hydrozincite occur within limestone in a 2 m wide zone striking about 010°, dipping steeply east and extending for about 50 m. A 20 cm wide quartz vein with galena is located on the eastern margin of this mineralized zone. Several beds of magnesite, 30cms wide and up to 10 m long occur in calc-dolomite and lower member sandy dolomite in the northeast of the prospect

Geochemistry

Twenty rock chip lines up to 1 100 m long and 100 m apart were sampled (Fig. 62). Assay results of 438 samples (Appendix D) are summarised on Table 12. Lines 13, 14, 15, 16 and 17 are incomplete due to inaccessible terrain.

TABLE 12

Statistical Results - Willa Prospect

| | Cu (ppm) | Pb (ppm) | Zn (ppm) | Mn (ppm) | Cd (ppm) | As (ppm) |
|---|---|---|---|---|---|---|
| Median | 5 | 27 | 76 | 558 | 2 | 0.6 |
| Threshold | 50 | 300 | 900 | 3000 | 4 | 20 |

Spearman Rank Correlation Coefficients

| | | | | | |
|---|---|---|---|---|---|
| Cu-Pb | 0.5888 | Pb-Zn | 0.2769 | Zn-Cd | 0.0283 |
| Cu-Zn | 0.2311 | Pb-Mn | 0.1849 | Zn-As | 0.0951 |
| Cu-Mn | 0.1995 | Pb-Cd | 0.1210 | Mn-Cd | 0.0552 |
| Cu-Cd | -0.0055 | Pb-As | 0.2626 | Mn-As | 0.1160 |
| Cu-As | 0.2403 | Zn-Mn | 0.7426 | Cd-As | 0.0391 |

There is a strong correlation between Zn and Mn indicating their mobility during supergene processes. There is a good correlation between Cu and Pb indicating primary mineralization.

The following conclusions are based on contour plans (Figs. 63, 64, 65, 66, 67 and 68), frequency distribution graphs (Fig. 69) and log probability curves (Fig. 70):

- for Cu, Pb, Zn, Mn, Cd and As there are generally two background populations that represent lithology and a superimposed anomalous population.

- anomalous Cu, Pb, Zn, Cd and As occur in massive archaeocyathid limestone below an irregular palaeo-surface in the southwest associated with surface mineralization.
- Zn and Mn concentrations are associated with zone of hematite reddening at contact between nodular limestone and calc-dolomite.

Coincident copper, lead, zinc, cadmium and arsenic anomalies and surface lead, copper and zinc mineralisation with major faulting just below an irregular palaeo-surface delineate a prime target zone in the southwestern corner of the prospect.

## NORTHERN PROSPECT

### Geology

Geological plan at 1:5 000 scale is shown on figure 71. Billy Creek Formation with basal dolomite and flaggy limestone followed by red and green shale overlies Wilkawillina Limestone. The red-brown palaeo-surface is evident at top of Wilkawillina Limestone and caps about 300 m of massive light grey limestone the top 100 m of which is archaeocyathid-rich with some brachipods. Massive limestone is underlain by about 50 m of nodular limestone that overlies about 100 m of off-white porous calc-dolomite which forms the base of upper member of Wilkawillina Limestone. Top of lower member is marked by dark grey-brown sandy dolomite. In the northeast of the prospect is a solution collapse breccia, 0.42 ha in area, comprising sub-angular blocks of light grey massive limestone, 1 cm to 30 cms in size, in a fine grained yellow-brown calcite matrix. Galena Creek Lead Prospect lies in the northwest of the prospect where galena has been mined from surface trenches on a vertical north-south trending quartz vein, about 1 m wide and about 130 m in extent, located immediately below the palaeo-surface (Plate 3). In the centre of the prospect, blebs of galena, about 1 cm in size, with associated hydrozincite occur immediately below the palaeo-surface. In the same area, two small exposures of willemite, about 1 m in size, with associated coarse calcite and hematite reddening were also found. Several beds of magnesite about 30 cms wide and up to 10 m long occur in calc-dolomite and lower member sandy dolomite. Two major sinistral faults cross the prospect and displace the sequence about 1 km in the south and 650 m in the north (Fig. 3c). In the southwest of the prospect the palaeo-surface and part of the massive light grey archaeocyathid limestone is repeated by a north-south trending and steep westerly dipping fault.

Geochemistry

Fifteen rock chip lines up to 1 100 m long and 100 m apart were sampled (Fig. 72). Assay results of 504 samples (Appendix D) are summarised on Table 13. There were insufficient cadmium assays above detection limit of 1 ppm for statistical treatment, consequently a cadmium assay of 2 ppm or greater was regarded as significant.

TABLE 13

Statistical Results - Northern Prospect

| | Cu (ppm) | Pb (ppm) | Zn (ppm) | Mn (ppm) | As (ppm) |
|---|---|---|---|---|---|
| Median | 5 | 26 | 36 | 500 | 1.5 |
| Threshold | 50 | 350 | 450 | 1800 | 40 |

Spearman Rank Correlation Coefficients

| | | | |
|---|---|---|---|
| Cu-Pb | 0.5245 | Pb-As | 0.0947 |
| Cu-Zn | 0.4494 | Pb-Mn | 0.2106 |
| Cu-As | 0.1869 | Zn-As | 0.1030 |
| Cu-Mn | 0.2791 | Zn-Mn | 0.5726 |
| Pb-Zn | 0.3447 | As-Mn | 0.0613 |

There is good correlation between Zn and Mn indicating the mobility of Zn and Mn during supergene processes. There is a good correlation between Cu and Pb with an associated Zn component indicating primary mineralisation.

The following conclusions are based on contour plans (Figs. 73, 74, 75, 75, 77 and 78), frequency distribution graphs (Fig. 79) and log probability curves (Fig. 80):

- anomalous metal values are generally 'spotty'.
- anomalous Cu, Pb and Zn occur in lower member sandy dolomite.
- anomalous Cu, Pb, Zn and As occur in massive light grey limestone, with Pb in particular confined to just below the palaeo-surface.
- anomalous Mn occurs in calc-dolomite unit.

# CONCLUSIONS

Many of the features favourable for Mississippi Valley-type lead-zinc mineralization are present in the upper part of Wilkawillina Limestone that forms the western flank of Heysen Range between Edeowie Creek and the northern boundary of Flinders Ranges National Park.

Characteristics of Mississippi Valley-type ore deposits present in the study area are:

- Platform carbonates at margin of large basin.
- Structurally uncomplicated and unmetamorphosed.
- Dolomite generally host rock; areas of dolomitization and extensive calc-dolomite unit mapped.
- No igneous rocks nearby.
- Epigenetic mineralization with permeability control; mineralization found in open space fillings, fracture zones and porous calc-dolomite.
- Often near unconformities; major unconformity at top of Wilkawillina Limestone and probable unconformity at top of calc-dolomite unit.
- Overlain by impervious shale; Wilkawillina Limestone overlain by interbedded flaggy limestone and shale of Parara Limestone, Oraparinna Shales and Billy Creek Formation shale. Calc-dolomite unit overlain by argillaceous nodular limestone.
- Commonly related to positive structural features such as faults, reefs and basin ridges; several syndepositional faults are present.
- Often near facies fronts; archaeocyathid limestone grades to nodular limestone just north of Bunyeroo Gorge.
- Ore districts often large; mineralization in Wilkawillina Limestone and equivalent is widespread throughout Flinders Ranges. For example, Ediacara is compared to Mississippi Valley-type mineralization (Drew and Both, 1984 and Nixon, 1967), and willemite is mined at Puttapa (Muller, 1972).
- Organic material common in ore or nearby; bituminous limestone has been described by Wopfner (1970) near top of Wilkawillina Limestone.

- Karstic features; circular depressions of no outcrop, collapse breccias, laminar calcrete or calcite, coarse crystalline calcite, limestone caves and red-brown palaeo-calcrete crust coating crevices and defining an uneven surface are present.

Stage 1 exploration comprising regional geological mapping, stream sediment and rock chip surveys defined eight prospective areas; Southern, Camp, Manga, Llina, Hayward, Concert, Will and Northern.

Stage 2 exploration comprising detailed geological mapping, rock chip, soil and geophysical surveys indicate that Southern, Manga, Concert and Willa Prospects are worthy of further investigation as evidenced by:

- <u>Southern Prospect</u>. Concident lead, zinc and cadmium rock chip sample anomalies, geophysical anomalies, smithsonite gossans and possible karsting at an unconformity at top of porous calc-dolomite unit.
- <u>Manga Prospect</u>. Coincident copper, lead, zinc, manganese and cadmium rock chip sample anomalies, geophysical anomalies, karsting and dolomitization below the palaeo-surface, adjacent to a major syndepositional north-east trending cross fault.
- <u>Concert Prospect</u>. Anomalous lead and zinc soil sample assays within a major karstic feature, 200 m across, immediately below the palaeo-surface.
- <u>Willa Prospect</u>. Coincident copper, lead, zinc, cadmium, and arsenic rock chip sample anomalies, silicification, faulting and surface lead, zinc and copper mineralization below an irregular palaeo-surface.

## RECOMMENDATIONS

No further work is recommended for Camp, Llina, Hayward and Northern Prospects.

MVT lead-zinc mineralisation typically has poor surface expressions with narrow geochemical dispersion haloes. Diamond drilling would be required at Southern, Manga, Concert and Willa Prospects as the next step to confirm the persistence with depth of the karstic nature of upper member of Wilkawillina Limestone, and it's potential to host economic lead-zinc mineralization both inside the Flinders Ranges National Park and elsewhere in the Flinders Ranges. However such work is not justified at the present time pending results of company exploration elsewhere in the Flinders Ranges.

BJM:AM

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# APPENDIX A

## Petrological Reports

AMDEL Reports: GS 1944/84 by Dr. Roger Brown
GS 5900/84 and GS 6061/84 by Dr. Brian Steveson
GS 6207/84 by Mark Fanning

Central Mineralogical Services Report: CMS 83/9/2 by D. Cowan

# IDENTIFICATION OF TWO MINERAL SAMPLES

## 1. INTRODUCTION

Three mineral samples from the Brachina Gorge area were submitted by Mr B.J. Morris of the South Australian Department of Mines and Energy. They were to be identified.

## 2. PROCEDURE

Subsamples were pulverised and used to produce X-ray powder diffractometer traces which were interpreted.

## 3. RESULTS AND REMARKS

### A3491/83 (M330A)

The diffraction trace showed the presence of calcite only. The fact that the sample is so dark in colour (very dark grey) must therefore be attributed to the presence of some fine-grained amorphous pigmentation (? possibly carbonaceous).

### A3492/83 (R403)

The rock sample was largely very dark in colour (almost black) but with numerous joints filled with a bright green mineral. There were rare deep earthy red patches widely scattered. The diffraction trace showed malachite as by far the dominant constituent, with a moderate amount of quartz and some minor poorly-crystalline goethite.

The very dark colour of the rock appears anomalous in view of the high malachite percentage. It is, however, our experience from previous occasions that it takes very little dark mineral to tint malachite severely and impart a very dark colour. Close inspection of the massive dark area of the sample shows that much fine-grained green malachite can be seen dispersed through the dark massive part of the rock. It may be that the goethite is sufficient to tint the malachite severely; alternatively amorphous dark material (?carbonaceous) may be present. The small red earthy patches are almost certainly hematite, although the XRD examination did not detect this.

### A3493/83 (M432)

The white massive mineral is magnesite.

## 1. SUMMARY

Twenty one samples of Wilkawillina Limestone were submitted for petrography.

As might be expected the limestones show the effects of post-depositional recrystallisation, solution, alteration etc., and features of the original limestone are consequently obscured. Some fossil fragments can be seen within the recrystallised calcite and some broken fossil remnants are commonly present. In contrast to these calcareous remnants there are phosphatic shell remnants also in a few instances.

Where dolomitisation has occurred features of the original limestone are absent; variations in crystal size of the dolomite, in reality, probably represent slightly different stages of dolomitisation rather than grain size differences in the limestone. Some samples show a late (commonly vein) phase of ferroan carbonates.

The suite of samples includes a pure quartz sandstone tightly cemented by quartz overgrowths on the grains and a banded acid volcanic (or tuff). These are in the minority: most of the samples are probably related to reef facies much altered and recrystallised during diagenesis.

Sample: 6635; RS234; TS44973

Rock Name:
Recrystallised dolomite

Hand Specimen:
A massive and compact rock with a distinctly irregular fracture. For the most part the sample is a distinct pale buff colour but there are some fine grained spottings possibly of sulphide minerals. The rock shows reflections of cleavage planes of carbonate minerals which suggest that it is medium grained.

Thin Section:
Calcite comprises 3 5% of the rock and there are trace amounts of brown spotting or ferruginous material. The whole of the remainder of the sample consists of granular mosaic dolomite.

The crystal size of the dolomite varies markedly from place to place in the thin section; there are patches in which the average size of the dolomite crystals is of the order of 0.4 mm but distinctive granular areas with an average crystal size of about 0.1 mm. The finer grained patches are very distinct and generally have sharp boundaries against other materials in the rock. The fine grained material has an equigranular appearance and the crystals are 'well-sorted'. Elsewhere in the sample there is a greater mixture of both large and small dolomite crystals but all show essentially granular mosaics with little or no intergranular porosity. In some instances the rational crystal faces of the dolomite can be seen but there is only rarely any systematic appearance to this.

Only in a few places does there appear to be an identifiable crystallisation sequence. This occurs where coarse grained dolomite shows rational crystal faces against calcite. The texture strongly suggests that the dolomite has largely replaced pre-existing calcite and the latter now remains in the irregular, triangular and cuspate patches between the dolomite rhombs. In one instance the calcite forms an irregular area more than 1 mm in size but most of the calcite patches are not more than about 0.3 mm in overall size and there is generally one calcite crystal which is in optical continuity with one of the large adjacent dolomite rhombs.

There are small patches and semi-opaque indefinite areas of translucent material which is taken to be some kind of secondary iron oxide or hydroxide mineral.

The sample is, therefore, essentially a dolomite which has developed by the almost complete replacement of a pre-existing calcite rock. The texture is now entirely that of a dolomite and although there are variations in the crystal size and, to some extent, texture these do not appear to reflect, in any identifiable way, nature of the pre-existing limestone.

Sample: 6635; RS235; TS44974

Rock Name:
Recrystallised limestone

Hand Specimen:
This is a fine grained pink blotchy rock and the cut surface contains some indefinite grey patches amongst the aphanitic pink material. There is also a small proportion of very thin veinlets and the sample has a somewhat iron-stained appearance.

Thin Section:
The rock consists essentially of calcite with only trace amounts of opaque and semi-opaque ferruginous secondary material. There is no dolomite or any silicate material. The rock has an even granular texture and appears to be some kind of completely recrystallised limestone. The blotchy appearance seen in the cut surface of the hand specimen cannot be detected in the thin section and it probably relates simply to the patchy distribution of the ferruginous minerals rather than any feature, inherently, of the well-crystallised carbonate.

Over the great bulk of the thin section the calcite forms a mosaic of equant very irregular crystals with complex intergranular boundaries. The average crystal size is the same from place to place in the thin section and the crystals appear to be 'well-sorted'. The average size is about 0.1 mm. Only in a few places are there any variations in the crystal size and this is shown in a few patches (less than 1 mm in size) of somewhat coarser grained calcite which shows relatively smooth intercrystalline boundaries. Even in these patches the average crystal size of the calcite is probably not more than about 0.15-0.2 mm. Some of these large patches appear to be particularly associated with secondary ferruginous oxides. In addition the sample contains one or two veins of very fine grained calcite, probably fractures which have been healed during recrystallisation.

There are traces of quartz and this occurs both as very fine grained silt grade grains and also as very rare single larger crystals. These large crystals have irregular outlines but this is due to partial corrosion by the calcite. These larger crystals are up to about 0.3 mm in size.

The sample is a completely recrystallised homogeneous granular rock which consists almost entirely of equigranular calcite.

Sample: 6635; RS236; TS44975

Rock Name:

Partly dolomitised fossiliferous limestone

Hand Specimen:

A grey to buff coloured rock which shows some iron-staining. The cut surface shows a mottled texture with a rather irregular distribution of different shades of grey. There are, however, within this cut surface patches of circular fossiliferous fragments and many other features which may be broken fossil shells.

Thin Section:

The rock contains traces of secondary ferruginous material and of a pale brown apparently isotropic phase which is taken to be phosphatic fossil debris. Dolomite comprises about 15% of the volume of the rock and the remainder is calcite. The sample has a complex texture but is clearly essentially a fossiliferous limestone which has been much modified both by dolomitisation and probably at least one phase of fracturing and brecciation. There are late veinlets of ferroan calcite.

In many parts of the thin section calcite is present as a mosaic of interlocked granular material with a crystal size which varies commonly from about 0.05 mm to about 0.25 mm. Elsewhere the crystal size of the calcite is distinctly different from this and there are irregular calcite plates more than 1 mm in size in some parts of the rock. Where there are groups of larger calcite crystals these tend to have fairly well defined and smooth contacts against each other whereas in the finer grained bulk of the rock there is more impression of interdigitation of these small crystals one with another. Patches of larger and smaller crystals occur in many places in this section in an apparently random fashion and it is only where there are large fossil fragments that any organisation of the crystal size of the calcite can be detected. Some smaller fossil fragments consist in fact of extremely fine grained micritic calcite with coarser grained material in the cell cavities. Elsewhere it appears that the fossil fragments had been recrystallised to form coarser grained calcite mosaics.

With respect to the largest fossil fragments, it is the distribution of dolomite which essentially defines the fossil fragments. There appears to have been some kind of selective replacement of the original fossil material in places by dolomite and fine grained dolomite mosaics form an annular feature in one part of the thin section defining a larger circular fossil remnant. The textures between the dolomite material and adjacent calcite rather suggest some brecciation of the calcite and penetration of dolomitic material between the calcite crystals. The dolomite itself is finely granular with a considerable proportion of small crystals showing at least some rhombic crystal outlines. In the bulk of the rock dolomite is widely distributed as small patches apparently in some way later in age than adjacent rather brecciated and fragmented-appearing calcite.

In one or two places there are fossil fragments which are dark between crossed Nicols, have a low relief and are a pale brown colour. This material is assumed to be phosphatic fossil debris. It comprises only a very small proportion of the total volume of the sample.

A final feature of the rock is the presence of moderately coarse grained calcite which shows a purplish stain due to the presence of iron in the calcite molecule. Most of this ferroan calcite forms a veinlet about 0.25 mm in width but there are other elongate patches of the material and these are also probably late-formed vein materials.

Sample: 6635; RS237; TS44976

Rock Name:
Dolomite

Hand Specimen:
A buff coloured rock with a rather hackly irregular fracture. The cut surface shows some fine spotting by secondary ferruginous material and a distinctly porous appearance.

Thin Section:
Pores visible in the thin section comprise about 3-5% of the rock and there is possibly about a similar amount of calcite. Apart from a scattering of opaque and translucent secondary ferruginous material, the remainder of the rock consists of a mosaic of dolomite crystals. Calcite is widely distributed throughout the rock but occurs generally as very small ptaches and it forms irregular crystals bordered commonly by rational crystal faces of dolomite. The patches of calcite are generally not more than about 0.2 mm in size but there is one exceptional instance of a calcite aggregate 1 mm in diameter. These larger calcite aggregates have a curious texture with a markedly undulose extinction. There is also a tendency for large patches of calcite to be associated with cavities in the rock. In general it appears that the calcite preceded the dolomite and has been partly replaced by the latter.

The bulk of the rock consists of a mosaic of tightly interlocked granular dolomite with a crystal size which varies somewhat from place to place but is, overall, about 0.2 mm. There are few patches, or indeed single crystals, of dolomite more than about 0.4 mm in size and only a few places where the average crystal size decreases towards 0.1 mm. Spaces within the otherwise tight mosaic of dolomite are represented by small cavities or pores commonly not more than 0.2 mm in size. Typically such pores are lined by rational crystal faces of dolomite but there is some association of the translucent ferruginous material and the calcite with the pore spaces within the dolomite.

No doubt the rock is some kind of secondary dolomite which is formed by the complete replacement of pre-existing limestone.

Sample: 6635; RS238; TS44977

Rock Name:

Recrystallised dolomitised limestone

Hand Specimen:

A pale grey to buff coloured rock with a rather irregular fracture. Broken surfaces have a fine granular appearance but the cut surface shows a variety of textures including some shadowy remnants of macrofossils.

Thin Section:

Approximately 80-85% of the volume of this rock consists of calcite with much of the remainder being somewhat widely distributed dolomite. There are traces of opaque and semi-opaque material but no silicates.

The calcite shows remnant textures indicative of original fossil fragments but, even so, appears to be essentially completely recrystallised. The finest grained calcite occurs as fossil fragments and many of these are circular or sub-circular objects several millimetres in size. Original cell walls now consist of micritic material with coarser grained equigranular material in the cell cavities themselves. In addition to these apparently closed structures there are also a few elongate irregular fragments and parts of very large fossils which are inferred from the micritic nature of the recrystallised fragments. In places in the thin section the calcite appears to have filled some cavities and now occurs as relatively coarse grained material in which equant anhedral crystals are of the order of 0.1-0.2 mm in size. In some of these patches there is evidence of the calcite crystals having grown outwards from cavity walls as the material precipitated. In the bulk of the rock the calcite is finely granular with an average crystal size which is probably less than 0.01 mm but still a little larger than the micritic fossil fragments.

Dolomite occurs in the thin section mainly in one aggregate of very large crystals which have strain extinction. This aggregate is more than 1 cm in size and individual dolomite crystals are of the order of several millimetres. The dolomite appears to be some kind of late infilling of original fractures. Elsewhere the dolomite occurs in smaller aggregates in which dolomite crystals are not more than about 0.2 mm in size. Even in the smaller accumulation the textural evidence suggests that the dolomite in some way filled the cavities but, even so, there may have been a later, final stage of calcite recrystallisation. The textures are not wholly unambiguous.

In brief, the sample is a fossiliferous limestone which has undergone a probably complex sequence of recrystallisation and dolomitisation.

Sample: 6635; RS239; TS44978

Rock Name:
Dolomitised limestone

Hand Specimen:
The sample is a dinstinctly grey colour on cut and broken surfaces and it has the irregular fracture rather typical of carbonate rocks. The weathered surfaces are a pale brown colour and have irregular patterns which appear to be associated with an indefinite fracturing which can be seen on the cut surface. As far as can be determined it seems that brown veins and fracture systems of dolomite have been less deeply weathered than the original calcite.

Thin Section:
The thin section contains sub-equal amounts of dolomite and calcite with traces of detrital quartz and mica. There is also a little poorly crystalline material which is interpreted as being fine grained chalcedony. Some of the latter forms in well defined veinlets but elsewhere there is a close intergrowth of dolomite and this chalcedony and the optical identification of the latter in this instance should be taken as tentative only.

In may fields of veiw there is a somewhat complex intergrowth of dolomite and calcite; the dolomite commonly forms subhedral rhombs up to about 0.1 mm in size and these are closely intergrown with distinctly finer grained calcite. In addition, calcite forms essentially monomineralic patches which are fine grained and granular and often have a somewhat maculose appearance possibly as a result of recrystallisation of grumose material. Material of the type described immediately above is typical of this sample but there are many variations in detailed relationships between the two carbonate minerals. Overall, however, there is a tendency for the dolomite to form fairly well crystallised subhedral crystals in either definite patches or intergrown with finer grained calcite. Calcite, on the other hand, more often occurs as monomineralic aggregates with rather varied crystal size probably derived from the original (pre-recrystallisation) limestone.

In one part of the thin section there is a large area in which the carbonate minerals are associated with a low relief, very low birefringence phase. This forms very irregular patches and it is thought most likely that this material is chalcedony. There appears to be a rim of this material and within this irregular rim and closely intergrown with the chalcedony is fine grained dolomite and calcite. It is therefore thought at least possible that this is some kind of early concretionary feature of the limestone which, since it contains siliceous material, has survived phases of recrystallisation of calcite and dolomitisation. Within this general chalcedony-rich area, there are patches and veinlets up to about 2 mm long of well formed chalcedonic material or secondary vein quartz.

The overall texture of the rock can be seen as well in the hand specimen as it can in the thin section: the dark grey parts of the sample are original recrystallised limestone and the veins of tan material between these patches are secondary, recrystallised dolomitic patches. The sample is therefore interpreted as some kind of limestone possibly with a grumose texture which has been fragmented or brecciated and subjected to localised dolomitisation and the introduction of dolomite within the brecciated material. Siliceous concretion have essentially survived these processes.

Sample: 6635; RS240; TS44979

Rock Name:

Fossiliferous limestone with secondary dolomite

Hand Specimen:

The sample is coarsely mottled in shades of grey and brownish pink. The mottling is on a scale of about 1 cm and apart from this the sample appears to be extremely fine grained and homogeneous.

Thin Section:

The brown to pink parts of the rock are calcite and the large grey areas consist very largely of dolomite. The minerals are present in approximately equal amounts and they occur together with a small amount of secondary iron oxide and traces of detrital silt grade quartz and mica.

Considering the texture of the rock broadly, the calcite is interpreted as being partly recrystallised limestone material and much of it shows some remnants of fossil fragments. Dolomite tends to be more coarsely granular and forms in some cases monomineralic patches but elsewhere it is somewhat intergrown with calcite and ferroan calcite. The dolomite is interpreted as being a later mineral than the calcite and this can be seen particularly clearly in one or two places where there are dolomite rhombs adjacent to the calcite. There has been a phase of veining in the sample and the veins contain both dolomite rhombs and large dusty crystals of calcite.

In detail, most of the calcite is present as a mosaic of an extremely fine grained material with an average crystal size of 0.01 mm. Even so, fossil fragments are even finer grained and micritic; these tend to be rather shadowy but under low magnification can be seen to be (?)cell walls. Some of the structures may be (?)stromatilitic. A little dolomite generally occurs within the fine grained mosaic of calcite and present as slightly larger crystals commonly showing rational crystal faces.

Dolomite aggregates themselves have an average crystal size of about 0.05-0.1 mm with a tendency in places to formation of rhombic outlines. Calcite is invariably intergrown with the dolomite but the proportion of calcite varies from less than 5% to about 25%. Some of the coarser grained calcite associated with the dolomite tends to be a ferroan variety. The overall shape of the dolomite mosaics can be seen as well in the hand specimen as in the thin section.

The cross cutting veinlets are as much as 1 mm in width and one or two of them have rather unusual textures. They are also characterised by the presence of calcite which is sieved with secondary ferruginous material. The calcite tends to be coarse grained and there is a medium grained ferroan calcite, clear calcite and dolomite rhombs.

Sample: 6635; RS241; TS44980

Rock Name:
Extensively altered limestone

Hand Specimen:
The rock has a buff coloured weathered surface which has an irregular appearance with some mottling. Cut surfaces are grey, fine-grained and show a broken texture on a scale of 1-5 cm.

Thin Section:
The mineralogical proportions in this sample vary considerably from place to place in the thin section but, overall, there is probably of the order of 50% of chalcedonic material and sub-equal amounts of calcite and dolomite. There is a trace of ferruginous oxide/hydroxide materials and rare silt grade quartz grains. The rock contains some materials stained with potassium ferricyanide and this is probably ferroan dolomite and possibly ferroan calcite as well.

The sample contains distinct patches of essentially monomineralic calcite. The calcite commonly forms an interlocked mosaic of clear crystals each about 0.1-0.2 mm in size. The most distinctive feature of these calcite patches is the spotted or grumose texture which they show. The spots are now defined by darker aggregates up to about 0.1 mm in size. It is the presence of these patches which has been used to infer that the well crystallised patches of calcite are relics of an original limestone. Not all the calcite patches show these grumose features but they are highly characteristic where they occur. Elsewhere the calcite forms simply a monomineralic fine grained mosaic with an average crystal size in the region of 0.05-0.1 mm.

A considerable proportion of the rock is occupied by material which is largely fine grained and chalcedonic within which are distinctly irregular but small patches of carbonate minerals. The chalcedony itself is generally a mosaic of extremely fine granular material ranging, in places, to small cavity fillings which have rather distinctive radial textures. Within this chalcedonic material ferroan dolomite and calcite form both individual crystals up to 0.25 mm in size and small aggregates. The calcite patches are invariably irregular in shape and fairly evenly distributed throughout the chalcedonic material. The textures suggest that the chalcedony probably crystallised after the carbonates.

In other parts of the rock there are complexly intergrown textures of different carbonate minerals. These areas are characterised by fine grained mosaics of granular dolomite within which are calcite crystals as much as 0.1 mm in size. Also in these parts of the rock there is some ferroan carbonate, probably dolomite and this, too, is generally well crystallised. The overall texture of some of these parts of the rock is rather distinctive with some elongate features possibly in some way derived from relics of fossil fragments. In addition, the fine grained aggregates could be some relics of an original grumose texture.

The rock contains in one place, particularly, a larger patch of ferroan carbonate associated with intergrown fine grained chalcedony.

As the description above suggests, the sample has a complex texture but it is thought essentially to be derived from a limestone which has undergone a process of dolomitisation and, more particularly, invasion by chalcedonic material. There are indications of a subsequent, later phase of deposition of ferroan dolomite in veinlets and certain patches in the rock. The original limestone is inferred from grumose textures shown in different parts of the thin section.

Sample: 6635; RS242; TS44981

Rock Name:
Recrystallised limestone

Hand Specimen:
This is a grey very fine grained rock which has the mottled buff coloured surface of a typical limestone. The cut surface is generally grey but there are some irregular tan areas apparently rimmed by irregular veinlets of secondary ferruginous material.

Thin Section:
The great bulk of the thin section consists of calcite but there is as much, possibly, as 5% of dolomite and traces of detrital quartz and of secondary ferruginous material in small veinlets or microstylolites.

The bulk of the rock consists of an equigranular mosaic of calcite in which the average crystal size varies from place to place. Some parts of the thin section contain clear calcite crystals as much as 0.1 mm in size but the average grain size is commonly much smaller than this. Different blocks of the limestone (separated by seams of ferruginous material) have somewhat different textures and grain sizes. Commonly, however, the recrystallised calcite does show some evidence of an original limestone origin and there are small fine grained patches which are taken to be relics of broken shells. Most of the calcite also shows a more or less spotted texture characteristic of material derived from the recrystallisation of limestones.

Some of the patches of calcite contain secondary dolomite. This is generally not more abundant than about 10% and commonly forms subhedral to anhedral crystals up to about 0.1 mm in size. These tend to be evenly scattered through a mosaic of much finer grained calcite. In one or two places there are silt grade quartz grains also.

The original limestone has been brecciated to a small extent and the fractures are partially filled with a secondary ferroan calcite and they are also now partly represented by darker narrow seams. Some of these seams are as much as about 0.5 mm in width and contain rather indeterminate dark material including fine grained calcite and dolomite and opaque and semi-opaque ferruginous material. Under intense illumination some of the latter material is a distinct yellowish colour which may indicate a titaniferous component. In one or two places in the thin section there are zones of fibrous ferroan calcite associated with the cross cutting fractures.

The sample is, apparently, a fairly fine grained fossiliferous and spotted limestone which has been recrystallised and somewhat brecciated and possibly preferentially dissolved. One or two patches have been partly dolomitised but this is by no means as abundant as in many other samples in this collection. There appears to have been a late pahse of vein and fracture filling by ferroan calcite.

Sample: 6635; RS243; TS44982

Rock Name:
Dolomite

Hand Specimen:
This is a buff coloured rock which is extremely fine grained. The broken surface shows a few reflecting faces but generally has the irregular fracture of fine grained carbonate rocks.

Thin Section:
Quartz grains are present in the rock as silt grade fragments somewhat corroded generally by carbonate and they comprise less than 1% of the volume of the rock. Calcite forms about 5-10% of the sample and there are traces of intergranular fine grained secondary iron oxide/hydroxide material. All of the remainder of the sample is a farily homogeneous mosaic of granular dolomite.

Calcite occurs apparently intergranular to the dolomite in single crystals or patches. The largest of these patches is about 2 mm in size and contains crystals as much as 1 mm maximum dimension. The calcite is invariably relatively coarse grained and the shape of individual calcite crystals is commonly determined by adjacent rational crystal faces of dolomite. In some cases the calcite is associated with pores but this is by no means always the case and there are one or two void spaces which are interpreted being an integral part of the rock. There is also a slight tendency for the ptaches of calcite to occur in approximate linear features and to be associated with the ferruginous material as though they both represent some kind of vein or fracture in the sample which has been filled.

For the remainder, the rock consists of a tightly interlocked aggregate of dolomite crystals. Although the crystal size varies somewhat from place to place this is generally at least 0.05 mm and there are many dolomite crystals of the order of 0.1-0.15 mm in size. Where the dolomite abuts against calcite or a void it tends to show rational crystal faces but in the bulk of the rock the dolomite crystals are equant but distinctly anhedral in shape. The dolomite aggregate shows scarcely any variations in crystal size which can be related to, for example, the nature of any pre-existing rock replaced by the dolomite.

It is interesting to see that in this sample ferroan carbonates are apparently completely absent.

Sample: 6635; RS244; TS44983

Rock Name:
Dolomitised limestone

Hand Specimen:
This is a dark grey very fine grained rock and the broken surface shows the hackly and irregular fracture typical of carbonate. Within the grey material there are veins and patches of a tan or buff coloured material which comprises about 15-20% of the rock. There are very thin narrow white veinlets.

Thin Section:
The dolomite comprises approximately 20% of the volume of the rock and mostly occurs in irregular patches which are clearly those buff patches seen in the hand specimen. The remainder of the rock is a somewhat recrystallised limestone. Detrital grains of silt grade quartz are present but only to the extent of trace amounts.

As in many other limestones in this collection, the aggregates of calcite have a distinctly mottled appearance probably akin to a grumose texture. This results from variations in the crystal size of the calcite and reflects the nature of the original limestone. In addition to the grumose texture there are also relics of small fossil fragments and these are generally represented by very fine grained micritic calcite. Most of the rock in fact consists of almost sub-microscopic calcite with rare patches of (?)late calcite which themselves consist of relatively coarse grained granular material.

Dolomite occurs in irregular patches which in places form a network. Only a very small amount of the dolomite occurs with some of the coarser grained patches of calcite. For the most part the dolomite is finely granular but is rarely as fine grained as calcite and does show a tendency towards the formation of rational crystal faces. Some rhombs of dolomite are as much as 0.1 mm in size and few identifiable crystals are less than about 0.04 mm. Most of the patches termed dolomite in fact contain a little intergranular calcite and the texture strongly suggests that the dolomite has replaced some of the calcite, probably having been introduced along fracture planes in the original calcareous material.

The thin section contains two cross cutting veinlets of a distinctly ferroan calcite. One of these veinlets is 0.3 mm in width and consists of equigranular calcite with an average crystal size of about 0.1 mm but the other veinlet is much thinner and less continuous across the width of the thin section. It appears likely that the samples in this suite are commonly characterised by a last crystallisation phase of distinctly ferroan carbonate minerals.

Sample: 6635; RS245; TS44984

Rock Name:
Porous dolomite

Hand Specimen:
A pale buff to grey rock which is massive and fairly compact. The brown weathered surfaces have a distinctly honeycombed appearance. On the cut surface the sample is homogeneous and fine grained but is characterised by the presence of about 3-5% of visible pores some of which are as much as 2 mm in size. The pores are partly filled by white, soft material and this appears to be more prevalent on one side of each pore than on the other.

Thin Section:
The sample consists almost entirely of dolomite with a little dark secondary ferruginous material and a little quartz which is probably in some way of secondary origin. Calcite appears to be completely absent.

The dolomite has a well defined granular texture but there are considerable variations in crystal size from place to place in the thin section. Some dolomite crystals are as much as 1.5 mm in size but the average in most parts of the thin section is of the order of 0.2 mm. The dolomite very largely forms equant anhedral crystals tightly interlocked together with little evidence of rational crystal faces.

The most interesting feature in the rock in the presence of partly filled pores. The pores range from 0.2 mm to more than 2 mm in size. Many of the smaller ones are completely empty but larger pores contain rather characteristic material which can be equated with the white soft infillings mentioned in the description of the hand specimen. In thin section these infillings are seen to consist of fine grained dolomite characterised both by the abundance of ferruginous staining/inclusions and also by the development of conchoidal textures. In the thin section as well as in the hand specimen, these conchoidal aggregates of dolomite appear, indeed to be preferably on one side of the pores. This tends to suggest the growth of the conchoidal dolomite from the floor of each pore upwards; although this is a tentative hypothesis only. In one or two instances the pores degenerate into irregular spaces between dolomite crystals but these spaces tend to be filled with the conchoidal, iron-stained dolomite.

Sample: 6635; RS246; TS44985

Rock Name:
Recrystallised limestone

Hand Specimen:
The sample is a pale grey to buff colour and appears to be fine to medium grained. Broken surfaces show many reflectant surfaces from carbonate crystals. The weathered surfaces have a distinctly irregular hackly appearance.

Thin Section:
Approximately 7-10% of the volume of the rock consists of secondary silica; there is a small amount of opaque and semi-opaque ferruginous material and the remainder of the sample is essentially calcite. Some elongate features show very low relief and birefringence and these are interpreted as being phosphatic fossil remnants (?conodonts). Some of these features have distinctly tooth-like shapes but they do not comprise more than about 2-3% of the volume of the sample.

The calcite is well crystallised in this rock and there are plates of this mineral as much as 1 mm in size. In most places in the thin section the average crystal size of the calcite is of the order of 0.1-0.2 mm but large and small crystals commonly occur together. The mixture of crystals of different size probably reflects the complex history of recrystallisation of the original limestone and slightly different ages and speeds of crystallisation of the calcite. This is also shown by the presence of fossil fragments of calcite. These are commonly very fine grained indeed but they are not well formed and generally occur as elongate or ovoid features within coarser grained material which shows no evidence of the nature of the original limestone. Several ages of calcite crystallisation are also shown by the presence of indistinct veinlets of a more ferroan calcite. One or two of these veinlets are fairly well defined cross cutting features about 0.2-0.4 mm in width but elsewhere there are irregular patches and even some indication of intergranular fine grained calcite showing a ferroan composition.

The sample has a considerable amount of silica and this is present as notably irregular patches commonly 0.5-1 mm in size. These patches have an interfingered texture with the adjacent calcite and commonly include relatively large patches of the carbonate. The silica has a distinctly irregular extinction but individual crystals are often 0.1-0.2 mm in size and are seen with both large and very small specks of carbonate. The silica does not appear to be detrital quartz but, instead, it is interpreted as being some kind of late vein-quartz or chalcedony. Even relatively clear quartz crystals have somewhat irregular extinction. The textures between the quartz and the calcite are by no means unambiguous but tend to suggest that the silica post-dates the carbonate.

The sample is, therefore, a recrystallised limestone now consisting very largely of granular calcite plates. There is some evidence of fossil remnants including (?)conodonts. There appears to have been a late phase of the introduction of ferroan calcite and some late replacement of calcite by low-temperature silica. The distribution of the latter may well be shown by the more resistant parts of the rock as seen on the weathered surface of the hand specimen.

Sample: 6635; RS247; TS44986

Rock Name:

Altered (?)rhyolite or rhyolitic tuff

Hand Specimen:

This is a massive and compact hand specimen which is brown in colour. The cut surfaces show a markedly laminar texture with a few cross cutting microfaults. The lamination is on a scale of less than 1 mm and is shown by distinct colour variations. There are one or two indefinite laminae which are somewhat coarser grained and paler.

Thin Section:

This sample is quite different from those described above and it has been identified as an acid volcanic rock. The thin section is rather turbid and grey in plane polarised light and much of it consists of a low birefringence mineral densely dusted with secondary iron oxide/hydroxide, clays and carbonates. In view of the turbidity in much of this material the sample was subjected to X-ray diffraction analysis which showed that the predominant mineral, by far, was potassium feldspar. Also present are clear crystals within the bulk of the rock and these possibly represent a sparse phase of quartz microphenocrysts. These clear quartz crystals comprise not more than about 3% of the volume of the sample. The overall mineral proportion is therefore estimated to be, very approximately, K-feldspar 70%, clay 15%, carbonate approximately 5%, secondary iron oxides 5-15% and quartz 3%.

The sample is essentially homogeneous and much of it is turbid obscure K-feldspar which apparently has a granular texture and an average crystal size of less than 0.1 mm. The K-feldspar is dusted with dark material much of which is probably clay with an admixture of secondary iron oxide/hydroxide. Clearer quartz crystals are commonly 0.1-0.2 mm in size and are very varied in shape. Some have sharp outlines and some shape features possibly indicative of their origin as microphenocrysts. One or two quartz aggregates are much more irregular in shape and are polycrystalline and these may be some kind of late infilling of irregular fractures.

Carbonate minerals occur in a very distinctive fashion in the rock, partly as isolated rhombs and partly as vein infillings. The rhombs comprise up to about 3-5% of the volume of the rock and are commonly of the order of 0.1 mm in size. They are widely scattered throughout the volume of the rhyolite but most show extensive alteration to secondary ferruginous material and this suggests that the carbonate was originally siderite. Some of these (?)siderite rhombs are now represented by a mixture of iron oxide and a carbonate mineral which may now well be calcite. Carbonate also occurs in a few cross cutting fractures (?)sub-parallel to the foliation. The carbonate in these fractures is a ferroan dolomite and it probably represents the last phase of the introduction of carbonate into the rock. Some of these veinlets are as much as 0.6 mm in width and have a finely granular texture in which the ferroan dolomite occurs with small amounts of calcite and secondary quartz.

The sample is interpreted as being a fine grained acid volcanic rock which now consists largely of rather turbid K-feldspar. The rock has undergone widely disseminated alteration and replacement by dusty clays and iron oxide. The rhyolite underwent some replacement, also, by rhombs of siderite and these have been subsequently replaced by iron oxides and calcite. There are cross cutting broad fractures which now contain a late phase of ferroan (?)dolomite intergrown with secondary quartz and calcite. As can be seen the sample has a complex history but it is interesting to see a late phase of ferroan carbonate which corresponds with a similar phase interpreted from the petrology of the limestones described above.

Sample: 6635; RS248; TS44987

Rock Name:
Dolomitised limestone

Hand Specimen:
The cut surface of this sample shows fairly large scale but indefinite intergrown areas in shades of light and dark grey. It appears that the darker grey material is probably a secondary dolomite whereas the lighter grey patches are remnants of the original limestone. There is a system of small white fractures also.

Thin Section:
The thin section contains distinct areas each rich in either calcite or dolomite. The relationship between the two areas is not as clear in the thin section as in the hand specimen. The calcite-rich areas however, do appear to be recrystallised limestones whereas the dolomite has a more granular texture and more evidence of rational crystal faces and hence appears to be secondary in origin. The relative proportions of the two minerals are probably 60% of calcite and about 40% of dolomite. Silicate minerals are present to a very small extent and occur as secondary (?)chalcedony rather than as detrital quartz.

Calcite forms a fine grained mosaic with some variation in crystal size which determines a rather indefinite grumose texture. In many calcite aggregates the very fine grained micritic spots constitute the bulk of the material and there is an indefinite network of slightly coarser grained calcite between these. Most of the patches of calcite contain a little dolomite but generally not more than about 5%. In one or two instances there are shadowy outlines within the calcite of somewhat larger and more sub-rectangular features which may be recrystallised shell fragments.

The dolomite aggregates are generally even grained and consist mainly of subhedral dolomite rhombs up to about 0.06 mm in size. There is some intergrown fine grained calcite and a little semi-opaque ferruginous material but these together comprise not more than about 10% of most of the dolomite aggregates. The dolomite is even grained and commonly has a fairly sharp outline against the aggregates of recrystallised calcite.

There is one area in the thin section which shows somewhat different mineralogy and texture from that described above; here there is an intergrowth of dolomite and calcite and both occur with a fine grained colourless mineral which appears to be secondary silica. This part of the rock is outlined by a fairly sharp but irregular 'front' of the chalcedonic material against recrystallised calcite. Away from this marginal area the amount of chalcedony apparently decreases and there is correspondingly more calcite and dolomite. This part of the rock contains small rectangular features now filled with the secondary silica. The whole feature which contains the silica comprises about 1/5 of the area of thin section but the actual amount of silica is probably not more than about 5-10%. The origin of the feature is rather difficult to determine but its very irregular outline in detail suggests that it is some kind of alteration feature rather than a pseudomorph of some pre-existing feature of the limestone.

Sample: 6635; RS249; TS44988

Rock Name:
Dolomite

Hand Specimen:
This is a massive and compact buff to grey rock with a distinctly cavernous appearance. This can be seen particularly in the cut surface where there are cavities several millimetres in size, some showing partial infilling by a white soft material. The bulk of the rock appears to be fine to medium-grained and is essentially homogeneous apart from the weathered surface.

Thin Section:
The most characteristic feature of the thin section is the presence of large pores filled with fine grained material on one side and the rock is, in this respect, distinctly similar to RS245. In the present instance the cavities are somewhat larger but the fine grained, almost botryoidal appearance of the infillings is quite distinctive. The bulk of the rock consists of relatively coarse grained granular dolomite which is clearly of secondary origin and there are patches of quartz and the latter mineral possibly comprises as much as about 7% of the volume of the rock. There are traces of calcite also.

The average crystal size of the mosaic of dolomite in this rock is approximately 0.3 mm and the crystals are equant anhedra commonly tightly interlocked together. There are some patches and irregular elongate areas in which the crystal size of the dolomite is about 0.05 mm but these area are commonly not well defined and certainly show no specific pattern in the areas of thin section. Quartz occurs in certain patches within the area of dolomite. These quartz patches vary considerably in size and shape but many are at least 1 mm in size. Individual quartz crystals range from 0.1 to approximately 0.3 mm in overall size and most of the crystals contain a rather high proportion of minute inclusions rather more characteristic of secondary, low temperature quartz than of relict detrital material. In addition some of the quartz crystals (particularly the larger ones) have strain extinction and this also is rather more characteristic of less well crystallised low temperature quartz.

As indicated below, the thin section contains cavities which are an integral part of the rock. Some of these are empty and some contain rimmings of semi-opaque ferruginous material but many of the larger ones have rather characteristic partial infillings. Some of these infillings are of fine grained calcite, generally with a more or less granular texture. Elsewhere the calcite shows the presence of crystals slightly misaligned from each other and hence having an irregular extinction; these crystals commonly grow on one side of the pores outwards from the adjacent dolomite. A similar one-sided partial infilling is also shown by dolomite in some of these pores. In one or two instances dolomite forms small circular objects (less than 0.05 mm in size) possibly partly intergrown with a little clay. Many of these small dolomite spheres have a partial rim of calcite and the dolomite itself shows a very fine grained radial structure.

The sample is a medium grained secondary dolomite with a little secondary vein quartz also. The most unusual feature of the rock is the post-dolomite partial infillings of cavities which has resulted in the deposition of fine grained calcite and the dolomite commonly showing a rather unusual texture. The author is aware that what is being described for simplicity sake as partial infillings of the cavities may be, in fact, the result of a more complex process whereby, for example, the pores might originally have been filled with an abundant phase which was subsequently dissolved from the pores leaving the apparent partial infillings now seen.

Sample: 6635; RS250; TS44989

Rock Name:
Quartz-cemented sandstone

Hand Specimen:
A buff coloured rock with a distinctly irregular hackly fracture. The cut surface shows an even colouration and there are a few very small pores.

Thin Section:
Apart from void space, the thin section consists entirely of quartz with a light speckling of secondary ferruginous and possibly argillaceous material.

The sample has been much affected by compaction and pressure solution and it is by no means clear to what extent the characteristics of the quartz now seen reflect those of the original sedimentary material; however, there is a tendency towards a bimodal grain size diatribution and this may be a genuine feature of the original sandstone. The less abundant mode is at a grain size of approximately 0.3-0.5 mm whereas the more abundant one is at a grain size of about 0.15 mm. Large and small grains are widely distributed and the bimodality of grain size distribution is by no means well defined. All of the grains show evidence of overgrowths but within these it appears likely that the original detrital grains were originally sub-round to perhaps round in shape. This is shown much better by the larger grains than by the smaller. The overgrowths are generally not continuous around grains and interlock together as a result of pressure solution and the dissolution of quartz from high pressure areas. The sample is now essentially tight as a result of the development of the overgrowths and from the presence together of both large and small grains (since this tends to reduce intergranular space). Some very fine grained areas of quartz may represent completely recrystallised material.

There are very rare aggregates of fine grained material which may be chalcedonic grains and one or two (only) mica flakes.

The thin section contains a small percentage of voids and these generally have irregular shapes and are bounded by rational crystal faces of secondary silica. The pores are probably not interconnected in three dimensions and most are less than 0.1 mm in size. One or two contain a little translucent secondary iron oxide.

This sample is a bimodal pure quartz sandstone much affected by the partial recrystallisation of quartz during compaction.

Sample: 6635; RS251; TS44990

Rock Name:
Dolomite

Hand Specimen:
This is a pale buff to cream coloured rock with an irregular mottled brown surface. The cut section shows an apparently medium to fine grained rock with notably abundant pores up to about 5 mm in size.

Thin Section:
The body of the rock consists of medium to fine grained dolomite but there is a significant proportion of cavities most of which are at least partly filled with relatively fine grained calcite.

Some dolomite crystals are as much as 1 mm in size and these tend to be at least subhedral and show curved crystal faces. Some large crystals also show evidence of zonation during growth particularly by the presence of narrow inclusions parallel to the rational crystal faces. Elsewhere the dolomite mosaic is fairly even grained and consists essentially of anhedral crystals notably tightly interlocked together. There are considerable variations in the average crystal size of the dolomite from place to place with some relatively fine grained patches amongst the more medium grained and even grained material. The fine grained patches are generally equant in shape and commonly have gradational contacts with the coarser grained material. In one place in the thin section, however, there is a sharp break between coarse grained and fine grained dolomite and the latter then, on the other side of the fine grained material, grades into coarse grained dolomite again. This may represent some feature of the limestone originally replaced by the dolomite but, considering the thin section overall, there is little organisation in the disposition of coarse and fine dolomite.

As in the case of samples 245 and 249, much of the petrographic interest in the rock is in the partial infillings of large pores. In this case the pores tend to be filled in a fairly symmetrical fashion and most contain at least some calcite. This shows some zonation of development with a central phase of the development of very fine grained calcite with a somewhat botryoidal texture. Before this botryoidal calcite and after it, this mineral grew in a more systematic and coarser grained fashion although, even so, there is some indication of control of the development of the calcite crystallography by the adjacent coarse grained dolomite. Many smaller cavities are either completely filled with calcite or empty, but larger ones tend to show these partial infilling textures.

Sample: 6635; RS252; TS44991

Rock Name:
Dolomite

Hand Specimen:
A tan coloured rock which is massive and compact but has a subconchoidal fracture. The cut surface shows some colour variations but these appear to be associated more with weathering and a little secondary ferruginous material than being an integral part of the sample. There are a few widely dispersed small pores.

Thin Section:
The rock consists virtually entirely of dolomite with a few small pores and possibly 2-3% of detrital quartz. In one place in the thin section there is an elongate brown isotropic object which could well be some kind of phosphatic fossil remnant. A few indeterminate dark patches elsewhere in the rock may be of similar origin.

For the most part the dolomite in the sample is uncommonly evenly crystallised and most of the equant anhedra are about 0.1 mm in size. Some show rational crystal faces but for the most part the dolomite crystals are closely interlocked in a tight granular mosaic. Within this material there are rare small crystals of quartz commonly not more than 0.05 mm in size. These are probably in some way of detrital origin but there is some evidence that they may have been partly corroded by the adjacent carbonate and the quartz crystals do not now show any evidence of rounding during transport and deposition. The proportion of this quartz varies somewhat from place to place and in one or two fields of view small quartz crystals are relatively common; the impression given is that the dolomite crystals here do not fit together as closely as in other parts of the rock and there is, correspondingly, more quartz.

The sample has a few small pores which are generally not filled with anything apart from a little indefinite dark ferruginous material in some instances.

There are a couple of cross cutting very fine grained fractures, one of which is filled with a fine grained carbonate which may be calcite rather than dolomite. The other fracture is represented by a discontinuous seam of ferruginous material associated in one place with a little relatively coarse grained and porous dolomite.

Sample: 6635; RS253; TS44992

Rock Name:
Dolomitised recrystallised limestone

Hand Specimen:
A massive and compact grey rock with a pale brown weathered surface. The cut surface shows essentially aphanitic material which is grey in colour but with wispy and indefinite pale brown patches. There are also very thin white veinlets.

Thin Section:
The thin section contains sub-equal amounts of calcite and dolomite with 1-2% of quartz.

The calcite and dolomite both form granular mosaics but the two minerals are commonly separate from each other and it is clear that the dolomite can be referred to the wispy brown material seen in the cut surface of the hand specimen, whereas the grey bulk of the rock is calcite. The texture of the calcite is distinctly more variable than that of the dolomite and this is probably a reflection of textural features of the original limestone. Indeed, there are some fossil relics which can be seen by the marked variation in calcite crystal size. Most of the fossil fragments consist of micrite whereas adjacent calcite is granular and has an average crystal size probably of the order of 0.02-0.05 mm. Elsewhere in the rock the calcite also shows marked variations in crystal size but these cannot often be related to specific fossil fragments. The texture is, however, indefinitely brecciated rather than, for example, grumose. One or two patches of calcite are notably coarse grained and there is a tendency for ferroan calcite to occur here and it seems likely that these represent the last recrystallisation or introduction of calcite into the system.

Dolomite has a habit of secondary dolomite in the limestones in this collection in that it forms somewhat even grained aggregates with a tendency towards the formation of subhedral rhombs. In addition the dolomite often has fine grained calcite between these rhombs. The average crystal size of the dolomite is, for the most part, of the order of 0.02 mm and most of the aggregates are even grained. The dolomite forms a more or less continuous network through the thin section but there is no uniformity in the size of the aggregates of calcite within the network of dolomite.

The sample contains a little translucent secondary iron oxide and there are one or two small grains of quartz, probably within the coarse silt size range. As indicated above there is some somewhat coarser grained ferroan calcite in elongate structures and rather indefinite patches and this is interpreted as being the last phase of carbonate to crystallise in the rock.

Sample: 6635; RS254; TS44993

Rock Name:
Calcrete

Hand Specimen:
This appears to be a fairly typical compact and massive calcrete. The rock has an irregular fracture and it consists of aphanitic buff material within which are a few rather large and varied fragments. These range in size up to about 2 cm and some are buff colour, some black and others have a pale grey shade. All of the fragments appear to be very fine grained and this applies even to significantly smaller, widely dispersed fragments.

Thin Section:
This is a markedly heterogeneous rock but the appearance of the hand specimen and indeed the heterogeneity of the thin section indicate that the rock is probably a calcrete. The sample contains perhaps of the order of 10-15% of detrital quartz and much of the remainder is a fine grained aggregate probably of calcite and clay. In addition to these constituents the rock contains a pale brown isotropic material which cannot be identified from thin section analysis alone, and a considerable amount of ferruginous opaques. The texture varies markedly from place to place with the only constant feature being the groundmass of the calcrete.

This groundmass consists mainly of calcite and yellowish-brown patches which are probably very fine grained clay of some kind. The calcite is equigranular and has an average crystal size of about 0.01 mm. Within this fairly homogeneous mosaic of calcite there are brown patches of (?)clay up to about 0.3 mm in size but commonly not more than about 0.1 mm. These clay balls are abundant and some of them have rather shadowy outlines and appear to be closely intergrown with the calcite. Others are simply present as coherent massive and brown aggregates. Also within the groundmass is widely dispersed detrital quartz and the grains of this mineral are up to approximately 0.15 mm in size. The quartz grains are not, however, very well sorted and most are distinctly angular in shape. Minor features of the groundmass are patches or opaque and semi-opaque ferruginous oxides and rather large and tabular aggregates of brown aphanitic (?)clay.

The description of the above refers to a groundmass which comprises, as can be seen in the hand specimen, the bulk of the rock. The thin section does, however, contain a sampling of the detrital fragments and these will be described briefly since there is no evidence to indicate whether they are a typical sample of the detrital materials. The largest fragment is an extremely fine grained micritic rock consisting of calcite largely. Within this micritic mosaic there are patches of distinctly coarser grained granular calcite and, in addition, a sprinkling of fine grained quartz and brown clay. This fragment therefore appears to represent a calcrete of a somewhat different kind from the bulk of the rock and it is interpreted as an earlier calcrete which has been broken in some way and reworked. The fragment is rather irregular in shape and it is not possible to reach any definite conclusions as to whether it can be described as rounded or angular. There are other fragments which are probably best interpreted as omewhat earlier calcretes although the textures in each tend to vary somewhat. Other fragments consist of opaques (as much as 1 mm in diameter) and there is one large fragment which consists mainly of calcite with a spotting of dolomite throughout. In some cases the dolomites show crystal outlines and it is probably safest to interpret this as a dolomitised limestone fragment which has been incorporated within the calcrete.

AMDEL Rept. GS 6061/84

# PETROGRAPHIC DESCRIPTION OF ROCKS FROM THE BUNYEROO-BRACHINA GORGE AREA

## Sample: 6635 RS 255; TS45069

Rock Name:

Recrystallised limestone

Hand Specimen:

This is a notably striped rock showing fine banding on a scale of up to 5 mm. The banding is shown by discrete layers of grey and cream material. Although the banding is generally essentially laminar there are some notable disturbances in some parts of the hand specimen.

Thin Section:

The great bulk of the thin section consists of calcite and there is up to about 3% of opaque and semi-opaque ferruginous material. Silicates and dolomite appear to be absent.

For the most part the textures of the calcite reflect those of the original limestone material and there is considerable variety from place to place in the thin section. In the banded parts of the rock there are fields of view which contain mostly micritic calcite and these possibly represent the paler bands in the hand specimen which are free from much ferruginous material. Within the micritic calcite there are widely dispersed patches of coarser-grained material and one or two elongate features which may be pseudomorphs after pre-existing phases. The intervening bands are commonly somewhat fine-grained and they are characterised by the abundance of semi-opaque brown material which is clearly secondary iron oxide/hydroxide.

In other parts of the thin section, where the texture is more contorted, the calcite is equally varied; there are bands and patches of coarsely granular material having a crystal size up to 0.4 mm interleafing with more finely granular material in which iron oxide/hydroxide is notably abundant. In many of these places in the thin section the texture suggests that the coarse-grained calcite is later in age than the finer-grained.

In places there are calcite pseudomorphs apparently after rhombs of dolomite. These occur in only a few places in the thin section but may testify to a complex history involving a phase of re-dolomitisation. Whatever the complexities of these processes, the sample now consists essentially of calcite and retains evidence of the bedded nature of the original limestone.

Sample: 6635 RS 256; TS45070

Rock Name:
Fossiliferous limestone

Hand Specimen:
This is a brown weathered rock which is clearly a limestone. The cut surface shows patches of a pale brown and grey shade and in some instances there are circular cross-sections of fossils up to about 1 cm in diameter and long curved objects also.

Thin Section:
The great bulk of the thin section consists of calcite and there are trace amounts of ferruginous iron oxide/hydroxide. Dolomite and silicates appear to be essentially absent.

The macroscopic texture of the rock can easily be seen when the thin section is examined by eye. Darker parts of the thin section represent finer-grained calcite and the outline of fossil fragments can easily be seen. Systematic variations in the infilling of the fossil fragments may also be noted. It is thought likely that the finer-grained infillings represent the lower part of the fragment and the cavity above this has subsequently been filled by coarser-grained later calcite.

The fossil cell walls are generally represented in the thin section by micritic calcite which has a dark grey appearance in the thin section. Elsewhere the calcite ranges from very finely granular material to quite coarse. In places the calcite crystals show a feather-like texture with the crystals being in almost parallel optical alignment. This is thought to be due to the mode of crystallisation (probably from a surface) rather than a stress effect. For the most part, the calcite is essentially granular in texture.

In general, therefore, the sample shows evidence of recrystallisation of the originally deposited calcite and probably infilling of void spaces by some introduced material; nevertheless, the textures of the original limestone have been preserved.

Sample: 6635 RS 257; TS45071

Rock Name:
Recrystallised limestone

Hand Specimen:
This is a buff-coloured rock which is compact. The sample has a rather porous appearance and a distinctly banded texture. The cut surface, particularly, shows many lenticular cavities up to about 1 mm in width.

Thin Section:
The thin section consists very largely of calcite with trace amounts of ferruginous material and less than 1% of brown isotropic material which is probably phosphatic. Detrital silicates appear to be absent.

The texture of the calcite varies considerably from place to place and there are crystals more than 2 mm in size as well as fields of view which are significantly finer-grained. For the most part the calcite is, however, granular and interlocked and the banded texture results from the presence of lenticular cavities rather than any feature of the mineralogy of the calcite. The latter is, in fact, more commonly controlled by features of the original limestone and particularly, fossil fragments. These are not abundant so far as can be distinguished in the now recrystallised material but there are many places where the calcite is fine-grained which may be recrystallised spotted or grumose limestone. Elsewhere there are relatively large curved features now consisting of fine-grained calcite and these are thought to be remnants of shells. Pale brown or yellow isotropic fragments are probably phosphatic. These are of the order of 1 to 2 mm in length and very thin and most are straight and do not show any characteristic shapes.

The coarsest grained calcite shows no original textures and simply has a granular mosaic texture. The only feature of any significance in this part of the rock is the presence of the elongate cavities.

These cavities can be seen as well in the hand specimen as in the thin section; they appear to be an integral part of the rock (not a function of the thin section preparation) and may represent, possibly, dolomitic parts which have been preferentially removed during diagenesis.

The sample is, therefore, a somewhat fossiliferous limestone which contains both carbonate and phosphatic shell fragments. The sample has been significantly recrystallised and during diagenesis there appears to have been some preferential solution of elongate, relatively large features.

Sample: 6635 RS 259; TS45073

Rock Name:
Recrystallised fossiliferous limestone

Hand Specimen:
This is an aphanitic buff-coloured rock with a characteristic irregular and conchoidal fracture. There are a few elongate patches and spots of secondary ferruginous material but for the most part the sample clearly consists very largely of carbonate minerals.

Thin Section:
Calcite comprises more than 90% of the volume of the rock and the remainder is composed of a few patches of dark ferruginous material and a little quartz. The texture of the sample is dominated by replacement textures controlled by pre-existing fossil fragments. Between these there is relatively coarse-grained sparry calcite and within the latter there are some remnants of a silicate mineral which appears to be quartz.

Fossil fragments are represented most often by sub-circular chambered features which can be distinguished by the extremely fine-grained nature of the calcite where it has replaced the cell walls. Some of these fossil features are as much as about 3 mm in diameter and there are rather less well defined fragments considerably larger than this. Elsewhere in the limestone fine-grained calcite occupies some fields of view in irregular patches with a somewhat spotty texture. This may be derived from the replacement of finer-grained more broken fossil material.

About 50% of the area of the thin section consists of significantly coarser calcite, however, and this has probably not preserved any fossil features but, rather,filled intervening spaces. In some places the calcite is granular on a scale of about 0.2 to 0.3 mm whereas elsewhere it forms elongate crystals which grow-out from fossil fragment cell walls.

Quartz has a finely intergrown texture where it occurs with the coarser-grained calcite and this is interpreted as being quartz remaining from a process in which most of the quartz has been replaced by calcite. Many of the quartz crystals contain numerous small specks of calcite. Ferruginous material is goethitic and translucent and generally is associated with the coarse-grained calcite.

Sample: 6635 RS 260; TS45074

Rock Name:

Recrystallised ?brecciated limestone

Hand Specimen:

This a notably dark limestone with a chocolate brown appearance. The cut surface shows a fine-grained texture, apparently consisting to a considerable extent of small broken fossil fragments.

Thin Section:

At least 30% of the area of the thin section consists of translucent reddish-brown material which is probably carbonate partly replaced by fine-grained iron oxide/hydroxide material. Where clear carbonate occurs this is calcite and it seems likely that this material comprises probably about 80% of the volume of the rock with much of the remainder consisting of goethite/limonite.

Variations in the texture of the calcite/goethite aggregates give the sample a mottled appearance but also indicate, to some extent, the nature of the pre-existing limestone. Within this aggregate there are particularly dark patches commonly of the order of 0.1 to 0.3 mm in size. Some of these are essentially spherical or oval in shape but others are more irregular and appear to be broken fragments of fossils. In some fields of view these darker patches comprise about 20% of the volume of the rock but commonly somewhat less. Between these dark patches there is a finer-grained intergrowth of iron oxide and calcite but even this appears to have a broken texture. In places there are also pseudomorphs of euhedral calcite or dolomite crystals which suggest an earlier stage of recrystallisation of the carbonate which preceded the introduction of the ferruginous material.

In clearer parts of the rock dark ferruginous fossil fragments have a greater appearance of curved shell fragments within mosaics of sparry calcite. Some of these shell fragments are several millimetres in size. Others are more irregular in shape and some could be phosphatic. This is difficult to distinguish because of the pervasive iron oxide/hydroxide material. Sparry calcite itself is generally clear and probably represents relatively late material. In one or two places there are, within the sparry calcite aggregates, more ferruginous patches and it may be that these represent a different carbonate phase preferentially partly altered by the iron oxides.

This is a complex limestone which has undergone several phases of recrystallisation and the introduction of ferruginous material. There is considerable evidence that the rock is some kind of fossiliferous limestone which has been broken probably at a early stage in diagenesis of the sample.

Sample: 6635 RS 261; TS45075

Rock Name:
Recrystallised fossiliferous limestone

Hand Specimen:
This is a grey rock with a characteristic irregular fracture. The cut surface shows a slightly mottled appearance on a fairly large scale and there are irregular discontinuous microstylolites.

Thin Section:
The rock consists virtually entirely of calcite with the only other constituent being dark ferruginous matter which is concentrated in microstylolitic zones. There are one or two dark elongate patches which are probably phosphatic fossil remnants.

Much of the calcite is micritic and forms a grey turbid homogeneous mosaic throughout the rock. Within this there are varying amounts of coarser and clearer calcite,some of which are clearly fossil remnants whereas others are simply large equant but irregular calcite crystals. Some of these large crystals are as much as about 0.2 mm in size. The fossil remnants are generally not more than about 0.6 mm in size and most of them are probably broken fragments of shell. In general, however, distinctive shapes cannot be seen and the rock simply has a angular mottled heterogeneous appearance. Elsewhere there are one or two very fine-grained patches of calcite, some of which are tabular and angular and not more than 0.2 mm in size and there is a gradation to well-defined multi-cellular fossil fragments which are oval in shape and about 2 mm in the longer dimension.

As indicated above, there are traces of pale yellow material which has a very low birefringence and this is taken to be phosphatic. Remnants of this material are slightly curved tabular features not more than 0.3 mm in length. These phosphatic remnants are present to the extent of less than 1%.

The sample has clearly undergone some compaction and there are rather irregular and varied discontinuous microstylolites. Within these there appear to be concentrations of clearer fossil fragments and dark red translucent ferruginous material. Some of the latter also occurs in very cross-cutting veinlets.

This is a fossiliferous limestone which has probably been somewhat brecciated (possibly in a wave zone soon after deposition). The sample has been recrystallised and much of it now consists of micritic calcite.

Sample: 6635 RS 262; TS45076

Rock Name:
Coarse recrystallised fossiliferous limestone

Hand Specimen:
The sample has a mottled buff to grey colour and a medium-grained granular texture. The broken surfaces show a large number of cleavage faces of the carbonate crystals.

Thin Section:
The bulk of the thin section consists of calcite and there are traces of quartz and of dispersed translucent ferruginous material.

One part of the sample is a fine to medium-grained mosaic of secondary calcite within which is fairly abundant, apparently later, ferruginous material. Much of the latter forms in a network between the calcite crystals.

The bulk of the thin section, however, is somewhat different and this is characterised by the relatively large crystal size of the calcite. There are crystals as much as 1 mm in size and the average is probably at least 0.3 mm. This coarse-grained sparry calcite is quite clear and can readily be distinguished from recrystallised remnants of fossil fragments which are much finer-grained, darker and contain dispersed ferruginous material. In many places the fossil fragments are widely dispersed and separate from each other; elsewhere they are sufficiently close together almost to give the impression of a framework. Most of these fossil fragments are about 0.1 to 0.3 mm in size and are tabular to equant. Some are well formed circular or oval shapes but others are more irregular and are clearly parts of broken shell. Rare examples are more than 1 mm in length and less than 0.05 mm in width. Within the coarse-grained calcite there are a few examples of shadowy traces of replaced fossils but these occur to only a very small extent compared to the dark fine-grained material.

Ferruginous material is concentrated within the fossil fragments but quartz occurs in a few places as distinct small patches. These generally have a fine-grained granular appearance and presumably represent a very small input of terrigenous material into the original fossiliferous limestone.

This sample is an unusually coarse-grained recrystallised limestone now characterised by the abundance of an equigranular mosaic of clear sparry calcite. Fossil fragments are relatively small and comprise not more than about 10 to 15% of the total volume of the rock.

Sample: 6635 RS 263; TS45077

Rock Name:
Dolomite

Hand Specimen:
The sample appears to be a medium to fine-grained carbonate rock and it has a rather characteristic irregular fracture. The bulk of the hand specimen is more or less grey to buff in colour but the cut surface is distinctly grey and aphanitic. The sample appears to be homogeneous and compact.

Thin Section:
Apart from a little ferruginous material in irregular microstylolites and rare small remnants of phosphatic fossils, this sample consists wholly of dolomite. The dolomite forms an equigranular interlocked mosaic which, for the most part, is completely homogeneous and featureless. The only variations in the dolomitic material are in crystal size. There are some fields of view in which the average crystal size is about 0.06 mm but elsewhere there are patches (particularly associated with a little porosity) in which dolomite crystals are as much as 0.2 mm in size. These patches of coarse-grained material appear to represent partial infillings of original cavities and some of them retain some central cores. For the remainder, however, the dolomite consists of an interlocked mosaic of anhedral equant crystals which have an average size of about 0.1 to 0.15 mm. Apart from some rather indefinite grain size variations, there is no evidence of the nature of the pre-existing rock.

The sample does contain a few patches and thin seams of dark ferruginous material and in one or two instances there is an approach towards the columnar structure of microstylolites.

Sample: 6635 RS 264; TS45078

Rock Name:
Recrystallised limestone

Hand Specimen:
A massive and compact grey rock with some iron staining. The cut surface shows a finely mottled texture in shades of grey (this can be seen on fresh broken surface) with some fine-grained porosity apparently associated with ferruginous patches.

Thin Section:
This limestone has a rather more complex mineralogy and texture than most of those described above. Basically the rock consists of a mosaic of sparry calcite within which are sub-circular features which now consist of relatively coarsely granular dolomite. The calcite also contains well-formed small crystals of quartz which are thought to represent a late stage of silicification. In one or two places there appears to be mineral of moderate relief and marked cleavage and this may be barite. The sub-circular aggregates of dolomite comprise as much as 50% of the rock in some fields of view but probably only about 30% overall. These features are commonly about 0.5 mm in size and have a distinctly circular shape. The dolomite of which they consist is invariably equigranular and most of dolomite crystals are 0.1 to 0.2 mm in size. There is some tendency for the dolomite to show textural features parallel to the outline of these features but there is barely any zonation in the texture or grain size of the dolomite and some of them have a distinctly equigranular aspect. In one or two cases there is fine-grained calcite associated with these dolomitic circular structures but dolomite generally comprises at least 80% of each one.

The calcite which comprises the bulk of the remainder of the rock is sparry in nature and notably clear in plane polarized light but the crystal size varies in an apparently random fashion from place to place in the thin section. In some fields of view there is well formed calcite with a crystal size of about 0.15 mm but elsewhere the calcite is distinctly finer-grained. The calcite has a random texture not affected by the presence of the circular dolomite aggregates. In some places within the calcite there are shadowy textures (grain size differences mainly) which indicate that the calcite has replaced some features which were also circular in shape and about 0.3 to 0.4 mm in size commonly. Around these features there does tend to be sparry calcite which forms radiating crystals.

In one or two places within the calcite there are patches of opaque and semi-opaque secondary ferruginous material which presumably represents some kind of late alteration.

Quartz comprises about 3% of the volume of the rock and tends to be concentrated in a few particular areas of the thin section. In these quartz may comprise as much as 20% of the material. The quartz forms well-defined crystals which range from hexagonal cross-sections up to 0.2 mm in size down to small elongate crystals and cross-sections less than 0.02 mm in size. The quartz shows sharp crystal outlines and is interpreted as being a late mineral which has resulted from the partial replacement of calcite.

In one or two places there are small crystals of ?barite and these are associated invariably with the dolomitic patches.

It is difficult to interpret the origin of this rock but it must be stressed that the dolomitic patches are essentially circular and all are similar in size. They do not apparently touch each other but are supported by the mosaic of calcite. The dolomite of which they occur is clearly of secondary origin and has completely replaced any original textures by a granular mosaic.

Sample: 6635 RS 265; TS45079

Rock Name:
Quartz-cemented sandstone

Hand Specimen:
The sample is a slightly friable buff-coloured sandstone and as far as can be determined the rock is massive although the hand specimen has a somewhat tabular shape.

Thin Section:
Apart from pores, the great bulk of the thin section consists of detrital grains of quartz many of which show optically continuous overgrowths. There are traces of heavy minerals and possibly about 2 to 3% of lithic fragments. Feldspar appears to be absent.

In many fields of view the quartz grains range in size commonly from about 0.05 mm to approximately 0.3 mm in size and there is a tendency towards a bimodal grain size distribution. This is most apparent in those parts of the thin section where there are relatively small grains in little clusters between the larger grains. Elsewhere in the rock the sandstone shows evidence of better sorting, about an average grain size of about 0.15 to 0.2 mm. The quartz is, in some cases, characterised by the presence of dusty material and vacuoles but for the most part appears to be common or plutonic quartz. The original grains were generally sub-round in shape but many now have narrow overgrowths which give them an apparently more angular aspect. The development of these overgrowths has contributed to the lithification of the sample. Original tangential grain boundaries have also been modified during compaction and lithification and poorly developed long and concavo-convex boundaries are the commonest type in the thin section.

Lithic fragments are generally of a stable type and they are either quartzites of one sort or another or cherts. Some of the quartzites are finely granular rocks probably of metamorphic origin but others are rather indeterminate rock types and may possibly be derived from high-level acid igneous rocks. None of these lithic fragment types is at all abundant.

There are a few heavy minerals of which zircon is by far the most abundant.

The sample is, therefore, a distinctly mature sandstone characterised by the absence of original detrital clays(?) and of any authigenic phases apart from quartz overgrowths. Both lithic fragments and heavy minerals are of the most stable type.

Sample: 6635 RS 266; TS45080

Rock Name:
Recrystallised ?algal limestone

Hand Specimen:
This is a massive and compact grey rock with a characteristic fracture shown by fine-grained limestones. The cut surface shows a mottled appearance in various shades of grey and buff and there are circular structures up to about 3 mm in size.

Thin Section:
The thin section consists essentially of calcite with only very rare crystals of detrital quartz. The calcite shows variations in crystal size and most of these appear to be related to the recrystallisation and replacement of original fossil fragments. Cell walls and the like are generally replaced by micritic calcite which appears to be very dark in plane polarized light. In contrast, apparently more open areas of the limestone have been replaced by coarser-grained sparry calcite in which crystals are as much as 0.1 mm in size. In some instances the sparry calcite has a radial texture probably relating to the mode of infilling of cavities in original limestone.

The fossil fragments themselves are generally apparently multi-cellular features and they vary from distinctly circular cross-sections to more irregular features. The most characteristic fossil fragments are circular in shape and consist of annular structure with many cells and an apparently central void space. These could well be cross-sections of Archaeocyathids. Other features are distinctly more irregular in shape and generally larger than the Archaeocyathids and could possibly be sponges of some kind. Probably about 30% of the area of the thin section can be related to recognisable fossil fragments whereas the remainder is patchy granular calcite with irregular variations in crystal size but generally of a sparry nature.

The sample is, therefore, a recrystallised limestone which contains a small number of features possibly related to Cambrian fossil assemblages.

Sample: 6635 RS 267; TS45081

Rock Name:
Recrystallised fossiliferous limestone

Hand Specimen:
The sample is paler than that described immediately above but it is otherwise similar in that it is massive, compact and has an irregular fracture. In addition, the cut surface shows some variations in colour and these can be related to fossil fragments as much as about 1 cm in size.

Thin Section:
This limestone appears to have been recrystallised and veined but it consists almost entirely of calcite. Some ferruginous material is present in thin irregular bands which somewhat resemble microstylolites.

The calcite varies in terms of its crystal size considerably from place to place in the thin section and this is a reflection on the one hand of the petrography of the initial limestone and also of the presence of a vein system of calcite imposed on the rock after recrystallisation. Fossil fragments are commonly represented by dark micritic calcite which cannot be resolved even under high magnification. In many places, the fossil fragments are not more than about 0.4 mm in size and these appear almost certainly to be broken remnants of original larger fragments and cell walls. The presence of these broken remnants indicates some brecciation and fragmentation of the limestone possibly relatively soon after deposition (within the environment of the development of the fossil fragments themselves). Elsewhere, there are large apparently whole fossil fragments and, as far as the author can determine, many of these resemble sponges, Archaeocyathids and possibly algae. In general it appears that some of the sub-circular fossil fragments have well preserved cell walls and therefore are more likely to be Archaeocyathids than algae. Many of the larger fossil fragments have a rather random and ill-oriented appearance and hence are thought more likely to be sponges.

Coarser-grained calcite occurs between the fossil fragments and commonly contains angular anhedral crystals in a granular mosaic. Many of the crystals are at least 0.2 mm in size. The rock also contains a prominent system of cross-cutting veins in which calcite is commonly at least 0.3 mm in size in the larger vein systems.

Sample: 6635 RS 268; TS45082

Rock Name:
Recrystallised limestone

Hand Specimen:
A slightly weathered grey aphanitic rock which is massive and compact. The cut surface shows microstylolites and some brecciation features but these are on a rather large scale and there are fragments several centimetres in size separated either by thin seams of ferruginous material or small patches of broken limestone.

Thin Section:
The brecciated nature of the sample is fairly apparent in the thin section apart from the presence of irregular thin bands of fine-grained ferruginous material. For the most part (apart from this goethite or limonite) the rock consists of calcite which forms granular aggregates occupying the whole of the thin section.

The most notable feature of the calcite is the presence of a spotted texture (grumose or maculose). This is more apparent in some fields of view than others but typically there are irregular small patches not more than about 0.1 mm in size of micritic calcite somewhat separated by more coarsely granular sparry material which has a crystal size of up to 0.2 mm. In some instances the small spots of micritic material are joined together so that it forms almost a contiguous network throughout the rock. This grumose texture is irregularly developed and there are many fields of view which consist simply of a granular, featureless mosaic of sparry calcite.

The sample is free from fossils and apart from the brecciated appearance seen in the hand specimen and a poorly developed grumose texture in places, the rock is simply a recrystallised mosaic of sparry calcite.

Sample: 6635 RS 269; TS45083

Rock Name:
Banded ferruginous limestone

Hand Specimen:
This is a dense rock which has a dark black and orange appearance. The cut surface is crudely banded with some brown to orange aphanitic beds separated by more irregular beds in which there is dark ferruginous material closely intergrown with the fine-grained brown material.

Thin Section:
Much of the thin section is opaque or translucent and clearly consists of goethite, limonite or a related mineral. The sample contains approximately 5% of quartz and the remainder is more or less fine-grained carbonate closely intergrown with the translucent ferruginous phases. The exact nature of the carbonate is somewhat difficult to determine in thin section but some of the coarser material, at least, appears to be dolomite.

In most of the thin section there is very abundant translucent ferruginous material which appears to have a patchy texture possibly correlating with the fineness or otherwise of the material or its degree of crystallinity. There tend to be core areas of very dark ferruginous material surrounded by large areas of more translucent matter closely intergrown with carbonate. In these finely intergrown areas which are banded, there are some fine-grained textures which possibly can be related to fossil material such as algae or stromatolites. Elsewhere carbonate forms a few relatively coarse-grained patches with crystals up to about 0.1 mm in size. For the most part this appears to be late ?dolomite which may have filled cavities in the original material. Some of these patches of dolomite are as much as 0.3 mm in size and there are some fields of view where dolomite comprises as much as 30% of the volume of the rock.

Quartz also tends to occur in small patches not more than about 0.4 mm in overall size. The quartz forms small irregular crystals which generally have a rather patchy extinction so that the quartz appears to be a secondary material rather than, for example, remnants of detrital quartz. Overall the quartz does not comprise more than about 3 to 5% of the volume of the rock.

The sample is, therefore, interpreted as being possibly an algal or stromatolitic limestone which has undergone considerable diagenesis with the introduction of ferruginous oxide/hydroxide phases as well as late relatively widely dispersed dolomite and silica.

Sample: 6635 RS 258; PS32045 .

Rock Name:
?Oxidised manganese minerals (?psilomelane)

Polished Section:
The bulk of the polished section consists of opaque phases and this is reflected in the dense, black nature of the hand specimen. The opaques could not be identified unambiguously by optical means but optical properties are consistent with oxidised manganese minerals, particularly, psilomelane. In addition, the section is characterised by colloform and botryoidal textures where fine-grained phases encrust more massive aggregates. Largest areas in the polished section consist either of coarsely-granular ?psilomelane or very fine-grained mosaics of markedly anisotropic, grey phases. Botryoidal encrustations appear to consist of the same minerals.

It is unlikely that this rock consists of iron oxide/hydroxide phases and the preferred interpretation is that the sample is composed very largely of manganese oxide minerals in characteristic colloform textures.

AMDEL Rept. GS 6207/84

# PETROGRAPHIC DESCRIPTIONS OF 16 SAMPLES FROM THE WILKAWILLINA LIMESTONE, BRACHINA GORGE AREA

## 1. INTRODUCTION

Sixteen samples from the Brachina Gorge area were received from Mr B.J. Morris, Mineral Resources Section, South Australian Department of Mines & Energy, with a request for routine petrographic descriptions. The samples of the Wilkawillina Limestone and comments were requested with a view to Mississippi Valley-type mineralisation. Comments on alteration and environment of deposition were also requested.

Standard thin sections of the sixteen samples were prepared and stained with alizarin red-S to differeniate the carbonate phases. Petrographic descriptions follow.

Summary

The dominant lithology is a variably recrystallised, dolomitised, limestone. The original limestones appear to have been fine-grained carbonates formed in a shallow marine environment, with many containing fragments of archaeocyathids and phosphatic shelly material. Two of the samples 6635 RS 279 and RS 283 are stromatolitic limestones. Fine-grained detrital quartz and ?feldspar are variable minor constituents in most of the limestones, reaching significant proportions in sample 6635 RS 281, a calcarenite.

Post-depositional recrystallisation solution, alteration, etc., are common features giving rise to calcite veins, various dolomitic developments and authigenic quartz. Three samples, 6635 RS 274, RS 282, and RS 284 represent "younger" carbonate deposits possibly derived from reworking of the limestones.

The willemite-bearing rocks 6635 RS 272 and RS 285 are similar to those described from the Beltana lead-zinc deposits.

In general, these carbonates display many of the characteristics seen in host rocks for Mississippi Valley type deposits.

## 2. PETROGAPHY

Sample: 6635 RS 270; TSC41470

Rock Name:
Dolomitic limestone with columnar secondary limonite

Hand Specimen:
The host limestone in this sample is white and coarsely crystalline. It has prominent limonite which occurs in columnar developments through the calcite with radial cross-sections having a ragged outline and slightly porous, ?more hydrous cores of iron-rich clays.

Thin Section:
A visual estimate of the constituents present gives the following:

| | % |
|---|---|
| Calcite | 70 |
| Limonite | 20 |
| Dolomite | 10 |

This sample is dominated by relict coarse crystal outlines of ?primary calcite and irregular sections of columnar limonite as noted in hand specimen.

The relict calcite grains or domains have an average grain size of 1.5 mm in diameter. The margins to these domains are straight to simple curves with primary triple point junctions modified by later recrystallisation. Internally the domains consist of calcite with ?fine intergrowths of secondary dolomite. The calcite is in optical continuity within each domain and usually shows an undulose extinction consistent with a superimposed strain. In some of these domains subgrain developments can be seen. It is probable that these domains represent recrystallisation of earlier calcite.

The dolomite marks many of the domainal boundaries and is clearly a secondary development after the calcite formation. The marginal dolomite is continuous with the finer dolomite intergrowths within and ?replacing the calcite.

The limonitic columnar developments can be seen to have an internal colloform structure. In places the columnar sections clearly postdate the coarse calcite domainal texture and hence it is probable that the limonite is formed in solution pipes. The relationship of the limonite to the dolomite is not clear but there is some evidence to suggest that the dolomitisation is earlier.

This is a dolomitic limestone that appears to have suffered later solution activity with the introduction of hydrous iron oxides in columnar solution cavities.

Sample: 6635 RS 271; TSC41471

Rock Name:
Dolomitic, siliceous, fossiliferous limestone

Hand Specimen:
On the weathered surface this is a fine-grained, olive-brown coloured limestone with prominent thin secondary dolomite and siliceous veins. On the cut surface the fresh rock is mottled a pale pink and white colour with possible thin curved fossil fragments.

Thin Section:
A visual estimate of the constituents present gives the following:

| | % |
|---|---|
| Calcite | 50-55 |
| Quartz | 25-30 |
| Opaques/clay fine mixtures | 5-10 |
| Dolomite | 5 |
| ?Phosphatic shelly fragments | trace |

This rock has had a complex history of recrystallisation and veining. Calcite appears to be the early formed major constituent occurring as massive fine-grained mosaics with an average grain size of 0.01 mm. These fine massive aggregates have been recrystallised in places giving rise to coarser domains of calcite showing a range in grain sizes, usually up to circa 0.5 mm in diameter. The coarse calcite may be formed in secondary vein developments and in one of these veins associated with dolomite the calcite crystals reach 3 mm.

Within the calcite matrix quartz mostly occurs as euhedral discrete crystals exhibiting prismatic terminations or cross-sections. The quartz crystals range up to 3 mm in length and tend to occur in diffuse zones, in places as aggregates or veins. The coarser quartz encloses fine calcite in zonations reflecting growth stages in the quartz.

Two types of fossiliferous material are evident. One obvious form consists of thin ?shelly fragments which are composed of a colourless to pale fawn material which is isotropic. This possibly is phosphatic in composition and is the fossil fragments seen in hand specimen. Some of the shelly fragments have a crenulated structure and may be ?brachiopod shells.

The other fossil relicts are Archaeocythiads which have been greatly modified by recrystallisation and secondary silica developments. In one instance the intervallum of the Archaeocythiad has been infilled with euhedral quartz, and the ?original micrite of the walls has been recrystallised into fine calcite aggregates as noted above. In places aggregates of fine clays and ?opaques appear to define possible relict fossiliferous structures, bounding finer interstitial calcite. Some of these opaques/fine clay mixtures may be of a sideritic composition.

The dolomite occurs as coarse euhedral to subhedral crystals in veins which stand out prominently on the weathered surface of the hand specimen. Individual dolomite crystals range up to 3 mm in diameter. Many show a growth zonation emphasised by fine dust-like inclusions on earlier-formed crystal faces.

This is originally a fossiliferous limestone that has been extensively recrystallised with secondary developments of quartz and dolomite in part in veins. Secondary recrystallisation of the calcite also leads to coarse veining.

Sample: 6635 RS 272; TSC41472

Rock Name:
Calcite-bearing willemite rock

Hand Specimen:
This is a pale pink coloured dense rock with prominent colloform bands enclosing aggregates of fine radial structures.

Thin Section:
A visual estimate of the constituents present gives the following:

| | % |
|---|---|
| Willemite | 85 |
| Calcite | 10 |
| Opaques | 5 |
| Quartz | trace |

This rock is dominated by a colourless mineral which occurs in spectacular colloform and radial crystalline structures. An X-ray diffractometer scan indicates that this mineral is willemite. The early-formed willemite occurs as smaller circular structures with radiating crystals and concentric growth zones. These circular structures average between 0.3 and 0.4 mm in radii and are clouded, particularly at their margins, by very fine-grained alteration products. There are classic uniaxial interference patterns produced due to the radial crystal growth structures. Of note are the development of the concentric patterns from adjacent nucleating sites, with successive growth zones extending until in contact with an adjacent crystal. This pattern develops into colloform bands around the margins of vugs with coarser radial willemite developed as a late stage infilling of these vugs. The colloform band is an extension of several concentric growth structures.

Several of the vugs are infilled with coarse calcite with opaque inclusions, whilst in one instance quartz can be seen. The calcite has an unusual texture occurring in one vug as an apparent large crystal, 7 mm in length, with abundant fine opaque inclusions and strain shadows which give rise to sub-grain developments. The quartz infill similarly occurs as a single crystal with strongly undulose extinction and sub-grain developments.

Elsewhere finer-grained calcite occurs as secondary developments interstitial to the willemite. In some cases it is found preferentially along a particular colloform band. The opaques are very irregular and late-stage, as they can be seen to cut across the prominent willemite textures.

This is a willemite rock with minor calcite and opaques. It appears to have developed from the hydrothermal precipitation of willemite around many nuclei with further growth giving rise to colloform structures around remaining interstices or vugs.

Sample: 6635 RS 273; TSC41473

Rock Name:

Dolomitised, partly recrystallised, fossiliferous limestone

Hand Specimen:

On the fresh surfaces this is a pink-fawn coloured limestone which is generally massive and fine-grained. It has darker pink-purple coloured, very thin secondary veins.

Thin Section:

A visual estimate of the constituents present gives the following:

| | % |
|---|---|
| Calcite | 55-60 |
| Dolomite | 30-35 |
| Quartz | 5 |
| Opaques/fine clays | 5 |
| Shelly fragments | trace |

This rock consists principally of calcite in a wide range of grain sizes, and secondary dolomite. Micrite was probably the primary carbonate phase occurring as massive aggregates. Some micrite patches remain and appear to be fine relict fossils. These fossils are mostly circular to curved structures with micritic cores and coarser recrystallised calcite margins. Some of the fossils are elongate in outline, and appear to have been ?Archaeocyatha.

The coarser calcite ranges up to 1.5 mm in length with some showing multiple twinning. Apart from replacing ?walls to fossil material, the coarser calcite also occurs as veins and as interstitial secondary infills. In the veins the calcite is associated with later dolomite which can be seen ?intergrown with and replacing calcite.

Dolomite is a secondary development occurring as euhedral to subhedral crystals generally with a range in grain sizes up to 0.6 mm. Much of the dolomite, however, is finer-grained, less than 0.2 mm, and is found as aggregates and disseminated rhombohedral grains in the finer calcite matrix. Fine-grained opaques and clays form conspicuous rims to many of the dolomite grains, giving rise locally to possibly more ferroan carbonates.

Quartz occurs as discrete euhedral to anhedral grains generally less than 0.1 mm. The euhedral quartz is clearly authigenic in origin and shows straight extinctions. The anhedral quartz on the other hand tends to be rounded with undulose extinction, implying a detrital origin.

There are several scattered thin shelly fragments which are probably phosphatic in composition.

This is a fossiliferous limestone that shows the effects of recrystallisation of the calcite and a secondary dolomitisation. Authigenic quartz and possibly detrital quartz are also present.

Sample: 6635 RS 274; TSC41474

Rock Name:
Dolocrete

Hand Specimen:
This is a brown coloured, porous rock which contains prominent coarser opaque and white nodules which are up to 1 cm in length. The rock is generally massive with little or no preferred orientation.

Thin Section:
A visual estimate of the constituents present gives the following:

| | % |
|---|---|
| Dolomite | 60-65 |
| Opaque nodules | 20-25 |
| ?Goethite | 5-10 |
| Fine opaques/clays | 10-15 |
| Calcite | trace |
| Mica | trace |

This rock dominantly consists of very fine-grained dolomite with opaque nodules. Relatively pure dolomite occurs in nodules which range up to 3 mm in length and represent the white patches noted in hand specimen. The grain size within the dolomite nodules is extremely fine-grained, being less than 0.01 mm. The margins of these nodules are accentuated by thin rims of very fine opaques and clays, and this material occurs together with fine dolomite as a cement, binding the nodules together. Some traces of calcite also occur together with dolomite in the cement.

The opaque nodules show a range in grain size up to 3 mm in this thin section. The coarse opaques have ragged grain margins and many of them have a thin rim of relatively clear dolomite, which is slightly coarser than the surrounding dolomitic cement. Some of the opaques are cracked with secondary dolomite infilling these cracks. There are prominent red to orange coloured iron-rich phases which also occur as coarser nodules. These are probably goethite. Traces of mica, ?biotite, also occur as coarse clastics in the dolomitic cement.

This rock was probably formed as a surficial deposit of oxidised opaque phases, pellets of dolomite, and detrital mica, which have subsequently been cemented by dolomite.

Sample: 6635 RS 275; TSC41475

Rock Name:
Well laminated, dolomitised, slightly impure limestone

Hand Specimen:
This is a grey coloured, well laminated limestone that is generally fine-grained. There is evidence for some solution/precipitation activity on the weathered surface which appears to have been a relatively recent event.

Thin Section:
A visual estimate of the constituents present gives the following:

| | % |
|---|---|
| Calcite | 60-65 |
| Dolomite | 15-20 |
| Quartz and feldspar | 10-15 |
| Mica | 2 |
| Opaques | 1 |
| Secondary opaques/siderite/ clays | 5 |

The well laminated nature of this rock seen in hand specimen is due to thin intercalations of some more siliceous material and dolomite, with calcite-rich layers. The calcite-rich layers show variable detrital components and grain sizes.

The wide range of calcite grain sizes is a consequence of secondary recrystallisation and veining. The primary calcite occurs as fine-grained aggregates with an average grain size between 0.02 and 0.04 mm. It is generally found in bands which have a moderate detrital component; quartz, feldspar and mica, together with dolomite. Recrystallised calcite is coarser-grained with an average grain size of approximately 0.1 mm. It occurs as relatively pure carbonate layers with minimal detrital components but some dolomite. Vein calcite postdates both the above and is much coarser-grained. Here the calcite ranges up to 0.7 mm, with most being twinned. These calcite grains cut across the original sedimentary layers and also penetrate along bedding plane weaknesses.

Quartz, feldspar, mica, and opaques all occur as detrital minerals within the primary fine calcite layers. Quartz is more prevalent than feldspar, which is usually a twinned plagioclase. Most grains are anhedral with a grain size of less or than equal to 0.1 mm. In several places there are lenticular aggregates of quartz and feldspar, with secondary dolomite, and these lie in the bedding planes, indicating primary detrital layers. Some of the quartz has euhedral outlines with prismatic terminations, consistent with an authigenic origin. The mica is colourless and is probably muscovite in composition. Detrital opaques are irregular elongate grains and most have been modified by secondary solution activity.

Dolomite appears to be a secondary phase occurring as subhedral to euhedral rhombs or as interstitial irregular material found preferentially along bedding surfaces, being formed during later dolomitisation. In places there are thin layers which are highlighted by the presence of fine opaques and/or clays. These layers may contain some sideritic material.

This is an impure limestone originally consisting of pure carbonate layers interbanded with carbonate layers which contain a moderate detrital component. Secondary dolomitisation and recrystallisation of the carbonates is subsequently followed by a late-stage calcite veining episode.

Sample: 6635 RS 276; TSC41476

Rock Name:
Dolomitised limestone

Hand Specimen:
This is a grey coloured, fine-grained limestone with ?secondary, fawn coloured irregularly-shaped veins or mottlings. Small patches of coarser crystalline carbonate can be seen in places.

Thin Section:
A visual estimate of the constituents present gives the following:

| | % |
|---|---|
| Calcite | 45-50 |
| Dolomite | 40-45 |
| Quartz and feldspar | 5 |
| Opaques | 5 |

The host grey coloured limestone seen in hand specimen consists of massive aggregates of fine calcite with an average grain size of 0.02 mm. Associated with the primary calcite are anhedral granular quartz and feldspar with a similar grain size. The shape of these grains suggests that they are of detrital origin, incorporated in the limestone at the time of deposition.

Euhedral quartz occurs in the host calcite as well and this is probably of an authigenic origin. Subhedral rhombs of dolomite can also be seen and these may be considered contemporaneous with the dolomitisation.

The fawn coloured mottling consists dominantly of fine granular aggregates of dolomite with an average grain size of 0.02 mm. Some slightly coarser more rhombohedral dolomite grains occur together with minor quartz and feldspar. In places there is a gradation from the primary calcite host through a mixture of calcite and dolomite to a pure dolomite end-member and this appears consistent with incomplete dolomitisation of the limestone.

Fine-grained anhedral opaques occur both in the dolomite and the calcite. They invariably have iron-stained haloes in the surrounding carbonate. Very fine granular opaque and clays occur along cracks through the specimen.

Secondary calcite and dolomite occur in generally fairly thin veins. Some coarser more sinuous calcite veining is evident with a range in grain sizes up to 0.2 mm.

This is a fine-grained limestone or micrite with a minor detrital component of quartz and feldspar. It has been partially dolomitised leading to a coarse mottling, and there has been some later thin carbonate veining.

Sample: 6635 RS 277; TSC41477

Rock Name:

Dolomitised extensively recrystallised limestone

Hand Specimen:

This is a white to grey coloured limestone which is coarsely crystalline. It is generally massive and on the weathered surface has a typical jagged limestone surface. In one or two places ghost fossil structures can be seen.

Thin Section:

A visual estimate of the constituents present gives the following:

| | % |
|---|---|
| Calcite | 60-65 |
| Quartz and feldspar | 10-15 |
| Dolomite | 10-15 |
| Opaques/fine clays | 5 |
| ?Siderite | 1 |
| Phospathic shelly fragments | trace |

This sample is dominated by coarse calcite which ranges in grain size up to 2 mm. Many of these coarse grains exhibit multiple twinning. They have straight to mildly sutured grain margins and most show the effects of strain in the form of weakly undulose extinction and some sub-grain developments. In places the margins are marked by secondary dolomite developments.

Finer-grained calcite aggregates are also present, having an average grain size of 0.01 mm. This calcite appears to be the early-formed carbonate, and occurs in circular to ovoid structures which are relict fossil fragments. Other ?phosphatic shelly fragments can also be seen. Recrystallisation of the fine calcite has resulted in the coarser carbonate which now dominates.

In several areas of the rock there are fine-grained aggregates of quartzo-feldspathic material. The grain size of these aggregates is approximately 0.2 to 0.4 mm and the irregular-shape of the grains coupled with the undulose extinction of the quartz suggest that it is of a detrital origin.

The quartzo-feldspathic aggregates have interstitial finer dolomite and calcite. In one area, these carbonate and silicate aggregates protrude into the massive coarser calcite in a vein-like fashion. This was probably formed by remobilisation of the silicates in a carbonate-rich fluid.

Euhedral quartz is present both in the quartzo-feldspathic aggregates and in the coarser calcite host. These crystals have prismatic terminations and average 0.1 mm in length. They are clearly of an authigenic origin.

Euhedral secondary carbonates are also present. Fine rhombohedral crystals associated with the quartzo-feldspathic aggregates have distinctive opaque and ?clay-rich rims. Coarser rhombs, up to 1.5 mm in diameter, are altered and rimmed by ?hydrous iron oxide material. These may be of a sideritic composition.

This is a fossiliferous limestone that has a small detrital component. It has been extensively recrystallised giving rise to coarser calcite aggregates. Later dolomite and minor euhedral silicate has developed.

Sample: 6635 RS 278; TSC41478

Rock Name:
Well-banded, partly recrystallised, fine-grained limestone

Hand Specimen:
This is a well-layered off-white coloured limestone, that is generally fine-grained. There are several yellow to buff coloured layers which are up to 5 mm thick.

Thin Section:
A visual estimate of the constituents present gives the following:

| | % |
|---|---|
| Calcite - fine | 35-40 |
| - coarse | 30-35 |
| Quartz (including ?feldspar) | 10-15 |
| Dolomite | 10-15 |
| Opaques | 1-5 |
| Phosphatic shelly fragments | 1 |

The well-layered nature of this rock is due to an intercalation of coarse and fine-grained calcite layers.

The fine-grained calcite layers represent a more primary texture of the rock. These consist of aggregates or mosaics of calcite with an average grain size of 0.01 to 0.02 mm in diameter. There has been patchy replacement by dolomite with the irregular dolomite appearing mostly as discrete regular grains of the order of 0.05 mm.

Two varieties of quartz are prominent in the fine calcite layers. Probably detrital quartz occurs as irregular grains with undulose extinction. There may be some feldspar with similar morphology and optical properties. The detrital quartz and feldspar material ranges in grain size up to 0.1 mm in length. Euehdral quartz with prismatic terminations is probably of an authigenic origin. This occurs as discrete crystals within the fine calcite host, and ranges up to 0.1 mm in length.

The coarse-grained calcite occurs in generally subparallel bands up to 3 mm thick. Some of these bands are irregular in orientation and are clearly secondary vein developments. The calcite within the bands occurs as elongate crystals, orientated perpendicular to the band length. Individual crystals are up to 1.5 mm in length. Many are twinned and in some cases the twin lamellae are curved giving an overall herring-bone texture to some bands. The orientation and elongate nature of the coarse calcite suggest that the bands may have formed as infills to voids; they certainly are of a secondary origin.

There are some secondary veins which cut the fine calcite host and consist of aggregates of dolomite and granular quartz. Minor hydrous iron oxides also occur in these veins.

Phosphatic shelly fragments are a minor but conspicuous constituent. These occur in the fine calcite host material. They are usually elongate forms but some irregular more equidimensional fragments also can be seen. The shelly fragments are not observed in the coarse calcite bands adding weight to these bands being secondary in nature.

This is a banded, partly recrystallised, fine-grained limestone with phospathic shelly fragments and detrital quartzo-feldspathic material. Diagenesis has resulted in coarse calcite bands which may lie in a similar orientation to early sedimentary structures or phases. Dolomite and euhedral quartz are of a secondary nature.

Sample: 6635 RS 279; TSC41479

Rock Name:
Stromatolitic limestone

Hand Specimen:
This is a reddish-brown coloured, fine-grained, carbonate rock which is well laminated. On the cut surface these laminations are continuous in some bands, whilst in others they can be seen to be stromatolitic in nature.

Thin Section:
A visual estimate of the constituents present gives the following:

| | % |
|---|---|
| Fine carbonate and opaques (algal) | 60-65 |
| Calcite | 25-30 |
| Quartz and feldspar | 5-10 |
| Opaques | 1-5 |
| Phospathic shelly fragments | trace |
| Zircon | trace |

This sample is dominated by very fine-grained carbonate and opaques which appear to have been formed through entrapment/precipitation by algal matter. This fine red-brown material occurs both in semi-continuous mats which are consistent with a bedding plane and also as discontinous curved laminae stacked on top of each other giving rise to the stromatolitic texture seen in the hand specimen.

Interstitial to the stromatolites are detrital fossil fragments. Some phosphatic shelly material can be seen, however, most of the fossiliferous material consists of calcite which ranges in grain size up to 0.4 mm. Possibly primary micrite composes some of the irregular ovoid to circular fossil structures. Recrystallised or secondary calcite occurs in ovoid structures and as irregular, elongate ?shelly fragments.

Quartz and feldspar is also interstitial to the stromatolites. Multiply twinned plagioclase can be seen in some instances. Quartz is more dominant, however, occurring as irregular grains with undulose extinction, indicating a detrital origin. Subhedral quartz is present and this is probably of an authigenic origin. Rare, round grains of zircon are clearly detrital and there are some secondary irregular opaque phases.

Calcite veins are both concordant with, and discordant to, the algal laminations. This secondary calcite appears as granoblastic aggregates, ranges in grain size up to 0.1 mm in diameter, and is commonly twinned.

This is a stromatolitic or algal limestone with fossiliferous material and detrital quartz and feldspar interstitial to the algal domes. Secondary calcite veins and recrystallised calcite has modified the fossiliferous fragments and penetrate into spaces along the algal laminations.

Sample: 6635 RS 280; TSC41480

Rock Name:
Recrystallised limestone

Hand Specimen:
This is a pale pink-brown coloured limestone which is generally massive and fine-grained. On the weathered surface rare fossiliferous material is evident, one piece appearing to be a ribbed shelly fragment.

Thin Section:
A visual estimate of the constituents present gives the following:

| | % |
|---|---|
| Calcite | 85-90 |
| Dolomite | 5-10 |
| Quartz and feldspar | 1-5 |
| Opaques | 1-5 |
| Phosphatic shelly fragments | trace |

This sample is dominated by calcite with a range in grain sizes. Possible early-formed calcite appears to be fine-grained mosaics or aggregates with an average grain size of 0.01 mm. There are patchy remnants of this fine calcite which can be seen to have subsequently recrystallised into coarser calcite grains. These coarser grains range up to 1 mm in diameter with most being less than or equal to 0.5 mm. They commonly exhibit multiple twinning. Secondary veining postdates this recrystallisation event. The veins consist mostly of calcite and some dolomite, are up to 0.6 mm in width, and have an internal grain size ranging up to 0.5 mm.

Irregular thin phosphatic shelly fragments can be seen in places. They are usually pale fawn to yellow in colour and almost isotropic.

Irregular fine vein-like developments can also be seen, consisting of iron-stained dolomite and quartzo-feldspathic material. The quartz and feldspar have anhedral outlines and an average grain size of the order of 0.05 mm. They are incorporated in the calcite host adjacent to and within the iron-stained veins. There may be some associated fine micas (?muscovite) in some of these veins. The opaques are generally irregular in outline and also occur as discrete grains in the carbonate host.

Dolomite is a minor constituent, replacing calcite at grain margins and in some instances replacing shelly material. There are rare scattered coarse grains of dolomite, subhedral in outline and up to 0.6 mm.

This is a fine-grained, fossiliferous limestone that has been extensively recrystallised. Secondary calcite veining is evident and there is minor dolomitisations.

Sample: 6635 RS 281; TSC41481

Rock Name:
Fossiliferous dolomitic calc-arenite

Hand Specimen:
This is a grey to fawn coloured carbonate rock which is fine-grained and massive. Some yellow mottling is evident on the cut surface and there are scattered silicate grains.

Thin Section:
A visual estimate of the constituents present gives the following:

| | % |
|---|---|
| Quartz and feldspars | 30 |
| Dolomite | 30 |
| Calcite | 25 |
| Mica | 5 |
| Opaques | 5 |
| Fossil fragments | 5 |
| Tourmaline | trace |

This sample consists of detrital fragments of quartz, feldspar, mica, opaques, and fossil material set in a carbonate matrix.

The quartz and feldspar framework grains range from angular through to subangular morphologies, and are up to 0.2 mm in length. Undulose extinction is commonly observed in the simple quartz grains, and there are minor composite grains and quartz mosaics. Multiply twinned plagioclase and perthitic orthoclase are both present.

The mica occurs as discrete flakes in a generally random orientation. They are mostly muscovite which ranges up to 0.2 mm in length. Blocky to anhedral opaque grains are up to 0.1 mm in diameter. Minor secondary alteration leads to some staining of the carbonate matrix adjacent to the opaques, and there are scattered fine opaque rims to many grains. Trace amounts of tourmaline can also be seen.

Grains of dolomite up to 3 mm in length are present and are conspicuous due to a thin coating of orange-brown, very fine-grained, hydrous iron oxide. In places the dolomite has euhedral rhombohedral morphologies, but for the majority the grains are anhedral. It is probable that this dolomite is detrital and comes from reworking of older carbonates. The euhedral morphologies of some grains does, however, imply dolomitisation post-deposition. In places there are preferential concentrations of the dolomite with little interstitial calcite. These most probably represent the paler mottling seen in hand specimen.

The above framework constituents are enclosed in calcite, which is of variable grain size depending on the interstice between the framework grains. Rare remnant fine calcite mosaics can be seen, but most of the calcite appears to have been recrystallised. This is particularly evidenced by the fossil fragments. Elongate curved shelly fragments and ovoid to circular structures now consist of recrystallised calcite with little evidence of the original composition. In places the calcite appears to have occupied a pore space and here individual grains range up to 0.5 mm in diameter. Many of these coarser grains show multiple twinning.

This is a fossiliferous dolomitic calc-arenite that appears to have formed through cementation of the framework constituents with calcite. There has been some secondary recrystallisation of the carbonate matrix.

Sampel: 6635 RS 282; TSC41482

Rock Name:
Silicified, ferruginised, carbonate-cemented, quartz-bearing dolomitic conglomerate

Hand Specimen:
This is a grey-brown coloured rock which is generally massive. On the cut surface it can be seen to consist of fragments and granules with a wide range in grain sizes. Some elongate fragments are up to 1 cm in length.

Thin Section:
A visual estimate of the constituents present gives the following:

| | % |
|---|---|
| Dolomite - framework grains | 30 |
| - cement | 25 |
| Quartz | 15 |
| Opaques/limonite/?clays | 30 |
| Calcite | trace |

This rock consists of rounded to subrounded dolomitic aggregates and individual quartz grains as framework components which are bounded by secondary carbonate, limonite, and silica.

The dolomite fragments are up to 1.3 cm long in this thin section, and typically have elongate outlines. The fragments themselves consist of granoblastic aggregates of dolomite with a range in average grain sizes. Some average 0.1 mm whilst others are coarser ranging up to 0.5 mm. Most of the dolomite fragments are highlighted by a coating of fine-grained limonitic material. Some have indistinct margins and tend to merge with the secondary interstitial anhedral carbonate, presumably a consequence of diagenesis and cementation.

The detrital quartz grains are well rounded, show undulose to weakly undulose extinction, and range in grain size up to 1 mm. Most have significant quartz overgrowths, with the primary quartz grain clearly discernible by the line of inclusions marking its boundary. There are some granoblastic quartz aggregates with an average grain size of 0.15 mm. These aggregates have irregular margins compared with the other framework components, and in places can be seen to merge with clearly authigenic quartz.

The secondary quartz is differentiated by straight extinction and partly euhedral morphologies. Elongate crystals with poor to well-formed prismatic terminations range up to 0.7 mm in length.

Carbonate and limonite are the dominant interstitial components. The carbonate occurs both as anhedral granular aggregates and as subhedral to euhedral coarser crystals with growth zonations. The granular dolomite ranges in grain size up to 0.2 mm and is often stained with limonitic or clay material. The well-formed dolomite appears to have formed as an open space infilling, with the rhombohedral crystals highlighted by rims of very fine opaques. Several growth stages are evident in most crystals, being marked by fine opaques. Some voids remain which have not been infilled and traces of calcite occur in some of these voids.

This is a conglomerate consisting of framework dolomite and lesser quartz with secondary dolomitic, siliceous, and limonitic cement. Several stages of secondary dolomite are evidenced by the growth stages seen in euhedral dolomitic void infills.

Sample: 6635 RS 283; TSC41483

Rock Name:
Well-banded partially stromatolitic limestone

Hand Specimen:
This is a purplish-brown coloured banded rock consisting of interlayered darker and lighter coloured bands up to 1 cm in thickness. The rock is generally fine-grained and carbonate-rich.

Thin Section:
A visual estimate of the constituents present gives the following:

| | % |
|---|---|
| Carbonate and opaques | 40-45 |
| Calcite - fine | 35-40 |
| - coarse | 20-25 |

The well-banded nature of this rock seen in hand specimen is due to an alternation of coarser and finer calcite layers with thinner, laminated layers of carbonate and opaque material.

The carbonate and opaque material appears to have been the primary constituent of this rock. It is probably of an algal origin, presumably deposited by the action of algal mats and domes. In places small stromatolitic structures are evident both as small scale domes and columns. This material is microcrystalline and appears to be dominantly carbonate and opaques. In places it is iron-stained carbonate whilst elsewhere it is mostly opaque material with minor carbonate. Vermicular developments appear to be a consequence of solution activity and these have secondary calcite infillings.

The paler coloured bands seen in hand specimen consist of calcite in two distinct grain sizes. The early-formed calcite is very fine-grained aggregates or mosaics with an average grain size of 0.01 to 0.02 mm. Finely disseminated opaques (and ?limonite) occur in this micrite and there are also some colourless circular to ovoid patches, up to 0.04 mm in diameter, which are probably of a clay composition. These micrite bands postdate the algal laminae as they can be seen to cut across these bands at their margins.

Coarser-grained calcite occurs both as bands interlayered with the "algal laminae" and as secondary grains which also cut the micrite bands. In places, this later-formed calcite shows multiple twinning, with individual calcite grains ranging up to 0.3 mm in diameter.

This is a well-banded fine-grained limestone that has prominent algal laminations which are in part stromatolitic. Secondary post-to syn-depositional micritic bands are also present and there is some late-stage calcite veining which is both discordant and concordant with the algal laminations.

Sample: 6635 RS 284; TSC41484

Rock Name:
Limestone breccia

Hand Specimen:
This rock consists of pale coloured, angular fragments with a wide range in grain sizes, which are set in a darker reddish-purple coloured fine-grained matrix. On one of the angular fragments a partial longitudinal section of an Archaeocyatha can be seen.

Thin Section:
A visual estimate of the constituents present gives the following:

| | % |
|---|---|
| Calcite | 75-80 |
| Opaques | 20-25 |
| ?Dolomite | trace |

The angular fragments which compose the bulk of this rock are highlighted in thin section by rims of fine-grained opaques. The fragments range up to 1 cm in thin section, however, in hand specimen they are up to 3 cm in length. These fragments are composed of calcite in a variety of grain sizes, ranging up to individual multiply twinned crystals 4.5 mm in diameter. From this coarser grain size the calcite ranges down to rare microcrystalline mosaics with an average grain size of less than 0.01 mm. In some of the fragments the micrite exhibits relict fossil material possibly of an Archaeocyatha.

The interstitial material binding the angular fragments is calcite and opaques. This calcite also shows a range in grain sizes up to 1.5 mm, however, there is no interstitial micrite. The opaques are very fine-grained and occur as rims to angular fragments or infill interstices between the fragments. There are traces of ?dolomite which appear to have replaced other fossil fragments, probably shelly material.

This is a limestone breccia which has been cemented by opaques and calcite. The fragments are entirely of a recrystallised fossiliferous limestone.

Sample: 6635 RS 285; TSC41485

Rock Name:

Partly ferruginised, carbonate-bearing, willemite rock

Hand Specimen:

This is a dense coarsely crystalline rock consisting of white crystalline material both as radiating aggregates and as partly columnar structures, and fine purple-red coloured interstitial ?carbonate.

Thin Section:

A visual estimate of the constituents present gives the following:

| | % |
|---|---|
| Willemite | 60 |
| Calcite | 20 |
| Opaques | 15 |
| Quartz | 5 |

This sample is dominated by a colourless mineral which occurs as radiating aggregates of elongate crystals. X-ray diffractometer traces indicate that this mineral is willemite. Individual willemite crystals are up to 1.5 mm in length and their radial orientation gives rise to a pseudo-unaxial figure under crossed nicols. In places several radiating aggregates form around the margins of quartz aggregates or individual grains, with the terminations of the crystals protruding into the quartz. Some of the aggregates appear to form relict domainal structures or angular fragments which are bounded by opaque rims. In one case it appears that an angular fragment of a quartz aggregate has been partly replaced by secondary willemite.

The quartz typically shows undulose extinction and ranges in grain size up to 3 mm in diameter. Some of the quartz has euhedral morphologies and seems to have been formed as prismatic quartz crystals protruding into vugs or spaces. This authigenic quartz occurs prior to the willemite growth.

Calcite is a late-stage development and occurs in interstices or possibly relict vugs. The calcite exhibits a wide range in grain sizes with coarse, multiply twinned crystals up to 7 mm in length seen in one prominent vug infill. Elsewhere the calcite is finer-grained and is interstitial to or partly replacing some altered willemite.

The opaques occur as fine granular interstitial material that is generally very irregular in outline. There are some more massive very irregular patches bounding the margins of the willemite aggregates. It appears that the opaques are also of a secondary nature and possibly of ferruginous material.

This rock now consists dominantly of willemite with lesser secondary carbonates and opaques, and possibly relict quartz. The apparent order of crystallisation of these minerals seems to have been early-formed quartz, in part prismatic, which has been replaced by willemite, and there is later carbonate which has infilled any remaining interstices.

# REPORT CMS 83/9/2

Three samples of carbonate rock were received for petrological examination and comment. Representative thin-sections were prepared and semi-detailed descriptions are attached.

## Summary

All three rocks can be categorised as altered dolomites and consist essentially entirely of dolomite (confirmed by XRD) and impure smithsonite in varying proportions. Smithsonite is dolomite-replacive and is a ferroan variety, distinctly brown in hand specimen, where it is readily distinguished from the primary dolomite. Chemical tests indicate the smithsonite is non-manganiferous. Cadmium, cobalt and copper are not uncommon "possible" components in smithsonite and this aspect may warrant investigation by assays.

In hand specimen the smithsonite is distinctive in terms of colour, due to its partly oxidised siderite component. Relatively pure smithsonite may not be colour-distinctive, but field estimations of bulk density and Mohs hardness (with smithsonite circa 4.5 contrasting with dolomite circa 3.5) should provide a guide to its presence in otherwise featureless carbonate rocks.

Relict textural features in the altered dolomites range from weakly banded microcrystalline to dolocreted breccia-like, and there is a single example (R 26) of relatively coarse-grained dolomite marble. This may represent a coarse cavity filling rather than a metamorphic paragenesis, as the fabric is partly obscured by stress effects. Interpretation will thus be dependant on field relationships. General features are consistent with a partly weathered/partly regolithic microcrystalline dolomite with smithsonite developing as temporally late, groundwater-controlled replacements. There are affinities with the Beltana zinc mineralisation, although in comparison the "exotic" Zn-Pb mineral assemblage (arsenates, phosphates, silicates) that characterises the Beltana situation. is absent from the three samples examined.

D. Cowan, B. Sc.

## REPORT CMS 83/9/2

### Petrological Descriptions

R 24/1 (T.S. 47015)

This rock may be classified broadly as an altered dolomitic breccia. General features are consistent with a pelletal dolocrete, with the dolomite component partly replaced by secondary impure smithsonite.

Much of the sectioned area consists of Fe-stained microcrystalline "ferrosmithsonite" with subordinate but variable proportions of microcrystalline dolomite as discontinuous films, marginally corroded vugs and irregular marginally corroded zones of dolomite breccia. Elsewhere, the rock comprises weakly altered dolomite breccia with partly altered clasts of porcellaneous dolomite (25 μ to 1 mm), subangular to angular single grains and simple composites of carbonate and minor silt- to fine-sand-sized, marginally corroded quartz grains in a microcrystalline to semi-porcellaneous dolomite cement.

Sporadic late-stage films of calcite are present, partly lining isolated vugs or solution cavities resulting from the partial replacement of dolomite by smithsonite.

R 26 (T.S. 47016)

This rock can be classified as an impure dolomite "marble", although whether this is strictly metamorphic in origin is speculative. It consists essentially of medium-grained, mildly stressed sparry dolomite with minor intergranular clots of kaolin-illite and microcrystalline quartz. The rock is weakly banded in terms of modal sizing and the distribution of impurities (i.e. clays, quartz), and exhibits a weak concordant dimensional preferred orientation.

In comparison with R 24/1, this rock is rather incipiently altered. Minor clots and crude films of porcellaneous to microcrystalline Fe-stained smithsonite have developed interstitially to the sparry dolomite, partly by replacement of the clay aggregates. These replacive aggregates grade into discontinuous films, marginally corroding dolomite or penetrating cleavage planes in the host carbonate as microscale dendritic "veinlets".

R 26/1 (T.S. 47017)

This rock consists largely (70-85 %) of Fe-stained microcrystalline to locally colloform smithsonite, with the remainder comprising corroded relict grains, microcrystalline aggregates and films of dolomite. Sporadic irregular sub- to fine millimetric scale solution cavities are partly infilled with late secondary calcite films. Marginal to these features the rock is relatively Fe-stained, reflecting relatively enhanced oxidation of the siderite component in the impure smithsonite.

The relict fabric is uniformly microcrystalline and weakly banded, contrasting with the R 24/1 breccia and the R 26 marble.

D. Cowan, B. Sc.

# APPENDIX B

## Orientation Geochemistry Assay Results

AMDEL REPORT AC 314/84

## STREAM SEDIMENTS
(AMDEL Rept. AC 314/84)

| Locality (Fig. 5a) | Size Fraction | Sample No. | Pb (ppm) | Zn (ppm) | Mn (ppm) | Fe (%) |
|---|---|---|---|---|---|---|
| A | -80 | A2661/83 | 220 | 250 | 590 | 1.9 |
| " | -20 | A2662/83 | 290 | 300 | 730 | 1.5 |
| " | -40 | A2663/83 | 270 | 300 | 690 | 1.6 |
| " | -20,+80 | A2664/83 | 300 | 310 | 800 | 1.4 |
| " | -40,+80 | A2665/83 | 310 | 310 | 800 | 1.5 |
| " | -20,+40 | A2666/83 | 360 | 340 | 910 | 1.4 |
| B | -80 | A2667/83 | 120 | 140 | 590 | 1.6 |
| " | -20 | A2668/83 | 170 | 170 | 690 | 1.5 |
| " | -40 | A2669/83 | 170 | 170 | 700 | 1.8 |
| " | -20,+80 | A2670/83 | 170 | 180 | 700 | 1.7 |
| " | -40,+80 | A2671/83 | 180 | 170 | 710 | 1.7 |
| " | -20,+40 | A2672/83 | 200 | 200 | 760 | 1.7 |
| C | -80 | A2673/83 | 85 | 120 | 690 | 1.6 |
| " | -20 | A2674/83 | 120 | 140 | 880 | 1.4 |
| " | -40 | A2675/83 | 110 | 130 | 860 | 1.3 |
| " | -20,+40 | A2676/83 | 120 | 140 | 940 | 1.3 |
| " | -40,+80 | A2677/83 | 120 | 130 | 960 | 1.3 |
| " | -20,+40 | A2678/83 | 150 | 170 | 1000 | 1.3 |
| D | -80 | A2679/83 | 75 | 90 | 650 | 1.6 |
| " | -20 | A2680/83 | 100 | 110 | 740 | 1.5 |
| " | -40 | A2681/83 | 120 | 120 | 820 | 1.5 |
| " | -20,+40 | A2682/83 | 110 | 110 | 790 | 1.5 |
| " | -40,+80 | A2683/83 | 110 | 110 | 810 | 1.4 |
| " | -20,+40 | A2684/83 | 160 | 130 | 960 | 1.3 |

SOIL SAMPLES
(AMDEL Rept. AC 314/84)

| Locality (Fig. 5a) | Size Fraction | Sample No. | Pb (ppm) | Zn (ppm) | Mn (ppm) | Fe (%) |
|---|---|---|---|---|---|---|
| T2, 0 m | -20 | A2685/83 | 160 | 310 | 830 | 1.5 |
| | -80 | A2686/83 | 140 | 290 | 740 | 1.5 |
| | -20,+80 | A2687/83 | 170 | 300 | 920 | 1.4 |
| T2, 10 m | -20 | A2688/83 | 120 | 180 | 700 | 1.2 |
| | -80 | A2689/83 | 95 | 160 | 640 | 1.4 |
| | -20,+80 | A2690/83 | 160 | 180 | 800 | 1.1 |
| T2, 20 m | -20 | A2691/83 | 140 | 230 | 770 | 1.3 |
| | -80 | A2692/83 | 130 | 240 | 740 | 1.6 |
| | -20,+80 | A2693/83 | 150 | 220 | 840 | 1.1 |
| T2, 30 m | -20 | A2694/83 | 120 | 210 | 690 | 1.1 |
| | -80 | A2695/83 | 110 | 210 | 640 | 1.2 |
| | -20,+80 | A2696/83 | 140 | 210 | 750 | 0.98 |
| T2, 40 m | -20 | A2697/83 | 120 | 170 | 740 | 1.1 |
| | -80 | A2698/83 | 120 | 180 | 710 | 1.2 |
| | -20,+80 | A2699/83 | 140 | 170 | 810 | 0.97 |
| T2, 50 m | -20 | A2700/83 | 95 | 140 | 730 | 0.98 |
| | -80 | A2701/83 | 85 | 130 | 670 | 1.0 |
| | -20,+80 | A2702.83 | 120 | 140 | 810 | 0.85 |
| T2, 60 m | -20 | A2703/83 | 100 | 150 | 820 | 0.98 |
| | -80 | A2704/83 | 85 | 150 | 720 | 1.2 |
| | -20,+80 | A2705/83 | 120 | 150 | 930 | 0.93 |
| T2, 70 m | -20 | A2706/83 | 120 | 170 | 830 | 1.0 |
| | -80 | A2707/83 | 100 | 180 | 740 | 1.2 |
| | -20,+80 | A2708/83 | 110 | 170 | 830 | 0.97 |
| T2, 80 m | -20 | A2709/83 | 95 | 140 | 790 | 1.3 |
| | -80 | A2710/83 | 70 | 130 | 650 | 1.5 |
| | -20,+80 | A2711/83 | 95 | 130 | 810 | 1.1 |

ROCK CHIPS
(AMDEL Rept. AC 314/84)

| Locality (Fig. 5a) | Sample No. | Cu (ppm) | Pb (ppm) | Zn (ppm) | Cd (ppm) | Mn (ppm) |
|---|---|---|---|---|---|---|
| T.1, 0- 10m | A2718/83 | 8 | 30 | 85 | <1 | 290 |
| " 10- 20m | A2719/83 | 6 | 330 | 250 | 4 | 560 |
| " 20- 30m | A2720/83 | 8 | 440 | 260 | 5 | 650 |
| " 30- 40m | A2721/83 | 8 | 690 | 6200 | 17 | 920 |
| " 40- 50m | A2722/83 | 12 | 400 | 1.3% | 75 | 580 |
| " 50- 60m | A2723/83 | 8 | 430 | 490 | <1 | 790 |
| " 60- 70m | A2724/83 | 4 | 110 | 130 | <1 | 670 |
| " 70- 80m | A2725/83 | 8 | 85 | 70 | <1 | 820 |
| " 80- 90m | A2726/83 | 6 | 65 | 90 | <1 | 740 |
| " 90-100m | A2727/83 | 4 | 55 | 65 | <1 | 550 |
| T.2, 0- 10m | A2728/83 | 4 | 70 | 150 | <1 | 630 |
| " 10- 20m | A2729/83 | 4 | 75 | 55 | <1 | 600 |
| " 20- 30m | A2730/83 | 10 | 150 | 120 | <1 | 740 |
| " 30- 40m | A2731/83 | 10 | 120 | 190 | <1 | 910 |
| " 40- 50m | A2732/83 | 8 | 160 | 110 | <1 | 730 |
| " 50- 60m | A2733/83 | 6 | 85 | 85 | <1 | 710 |
| " 60- 70m | A2734/83 | 4 | 65 | 80 | <1 | 700 |
| " 70- 80m | A2735/83 | 4 | 65 | 75 | <1 | 640 |
| " 80- 90m | A2736/83 | 4 | 85 | 170 | <1 | 770 |
| " 90-100m | A2737/83 | 8 | 170 | 310 | <1 | 1700 |

# APPENDIX C

## Regional Rock Chip Assay Results

| | |
|---|---|
| COMLABS Reports: | COM 831897 |
| | COM 832245 |
| | COM 832597 |
| AMDEL Reports: | AC 314/84 |
| | AC 1484/84 |
| | AC 66/85 |
| | AC 1109/85 |
| | AC 2006/85 |

ROCK CHIP ASSAY RESULTS

| Sample No. | Cu (ppm) | Pb (ppm) | Zn (ppm) | Comments |
|---|---|---|---|---|
| | | COMLABS JOB COM 831897 | | |
| M1 | 20 | 55 | 150 | Palaeo-surface |
| M3 | 16 | 500 | 500 | Fe/Mn breccia |
| M4 | 6 | 65 | 42 | pink limestone |
| M6 | <2 | 34 | 55 | calc-dolomite |
| M7 | <2 | 55 | 90 | vuggy calc-dolomite |
| M12/1 | 16 | 44 | 260 | Mn/Fe gossan |
| M12/2 | 2 | 6 | 50 | recrystallized lmst. |
| M13 | 20 | 18 | 210 | Mn/Fe gossan |
| M14/1 | 12 | 85 | 1650 | Mn/Fe gossan |
| M14/2 | <2 | <4 | 32 | recrystallized lmst. |
| M18 | 2 | 165 | 460 | dolomitic Fe breccia |
| M20 | 6 | 10 | 20 | nodular lmst. |
| M21/2 | 14 | 30 | 34 | calc-dolomite |
| M23 | 14 | 370 | 110 | brecciated calc-dolomite |
| M24/1 | 16 | 60 | 880 | Mn/Fe breccia |
| M24/2 | 6 | 42 | 130 | calc-dolomite |
| M25/2 | 6 | 6 | 80 | calc-dolomite |
| M26/2 | 22 | 100 | 1800 | nodular lmst. |
| M29 | 14 | 160 | 1250 | vuggy calc-dolomite |
| M30 | 10 | 60 | 260 | vuggy calc-dolomite |
| M37 | 8 | 50 | 130 | vuggy calc-dolomite |
| M42 | 8 | 180 | 60 | calc-dolomite |
| M43 | 10 | 110 | 1600 | Fe/Mn gossan |
| M45/1 | 10 | 42 | 260 | Fe rich calc-dolomite |
| M45/2 | 6 | 14 | 48 | massive archaeo-lmst. |
| M46 | 22 | 6 | 40 | dolomite |
| M47/1 | 4 | 6 | 28 | massive archaeo-lmst. |
| M47/2 | 6 | 42 | 70 | vuggy calc-dolomite |
| M50 | 26 | 170 | 140 | calc-dolomite breccia |
| M58/1 | 12 | 14 | 28 | massive lmst. |
| M58/2 | 8 | <4 | 32 | vuggy calc-dolomite |
| M63/1 | 14 | 16 | 32 | dolomite |
| M63/2 | <2 | <4 | 16 | massive archaeo-lmst. |
| M63/3 | 12 | 12 | 50 | calc-dolomite |
| M64/1 | 8 | 4 | 20 | massive lmst. |
| M64/2 | 12 | 32 | 36 | pink calc-dolomite |
| M65 | 14 | 14 | 50 | calc-dolomite |
| M66 | 6 | 6 | 26 | massive lmst. |
| M67/1 | 6 | <4 | 22 | massive lmst. |
| M67/2 | 8 | 26 | 115 | nodular lmst. |
| M70/2 | 8 | 12 | 38 | massive archaeo-lmst. |
| M72 | 10 | 60 | 34 | vuggy calc-dolomite |
| M76 | 10 | 12 | 28 | pink massive lmst. |
| M81 | 4 | 10 | 60 | massive lmst. |
| M85 | 6 | 8 | 42 | massive lmst. with Fe |
| M88 | 10 | 6 | 95 | massive lmst. with Fe |
| M90 | 22 | 12 | 210 | massive lmst. with Fe |
| M91 | 2 | 8 | 26 | nodular lmst. |
| M93 | 18 | 30 | 120 | nodular lmst. with Fe |
| M102 | <2 | <4 | 32 | massive lmst. with Fe |

ROCK CHIP ASSAY RESULTS

| Sample No. | Cu (ppm) | Pb (ppm) | Zn (ppm) | Comments |
|---|---|---|---|---|
| M105 | 2 | 42 | 32 | pink calc-dolomite |
| M106 | 2 | 50 | 28 | pink calc-dolomite |
| M107 | 6 | 60 | 50 | massive lmst. |
| M108 | 8 | 70 | 100 | fault breccia |
| R4/1 | 8 | 80 | 70 | calc-dolomite |
| R4/2 | 6 | 48 | 95 | pink calc-dolomite |
| R7/1 | 16 | 290 | 1100 | calc-dolomite with Fe/Mn |
| R7/2 | 2 | 55 | 48 | calc-dolomite |
| R10 | 2 | 22 | 44 | massive lmst. |
| R11 | 18 | 38 | 90 | Mn/Fe gossan |
| R14 | 20 | 75 | 260 | massive lmst. with Fe |
| R16/1 | 4 | 46 | 60 | massive lmst. |
| R16/2 | 16 | 30 | 100 | calc-dolomite |
| R18 | 4 | <4 | 24 | massive lmst. with Fe |
| R23/1 | 6 | 42 | 80 | calc-dolomite |
| R23/2 | 8 | 34 | 380 | massive lmst. with Fe |
| R24/1* | 690 | 790 | 32.0% | smithsonite gossan |
| R24/2 | 28 | 22 | 2700 | calc-dolomite |
| R26* | 14 | 960 | 4.3% | smithsonite gossan |
| R26/1* | 160 | 1700 | 43.0% | smithsonite gossan |
| R32/1 | 4 | 4 | 190 | palaeo-surface |
| R34 | 6 | 410 | 240 | calc-dolomite with Fe |
| R39 | 10 | 36 | 160 | massive lmst. with Fe |
| R41 | 6 | 85 | 320 | massive lmst. with Fe |
| R44 | 8 | 10 | 120 | massive lmst. with Fe |
| R46 | 10 | 310 | 730 | massive lmst. with Fe |
| R49 | 8 | <4 | 280 | massive lmst. with Fe |
| R50/1 | 4 | <4 | 24 | massive lmst. |
| R50/2 | 4 | <4 | 32 | calc-dolomite |
| R54 | 8 | 6 | 46 | nodular lmst. |
| R58 | <2 | <4 | 42 | pink massive lmst. |
| R67 | 8 | 44 | 100 | nodular lmst. |
| R72 | 8 | 18 | 48 | massive lmst. with Fe |
| R77 | 12 | 38 | 680 | red nodular lmst. |
| R83 | 12 | 10 | 260 | FeO |
| R93 | 30 | 4 | 14 | massive lmst. |
| R99 | 6 | 10 | 115 | massive lmst. with Fe |
| R107 | 10 | 340 | 250 | calc-dolomite |
| R110 | <2 | 26 | 50 | massive lmst. |

COMLABS JOB COM 832245

| | | | | |
|---|---|---|---|---|
| M27X/1 | 16 | 65 | 90 | red calc-dolomite |
| M27X/2 | 32 | 1050 | 1400 | FeO gossan |
| M126/2 | 14 | 65 | 55 | pink calc-dolomite |
| M127/2 | 16 | 55 | 160 | pink calc-dolomite |
| M130 | 8 | 38 | 36 | pink calc-dolomite |
| M140/2 | 10 | 70 | 70 | calc-dolomite |
| M142 | 14 | 34 | 95 | Fe/Mn lmst. breccia |
| M147 | 12 | 55 | 65 | calc-dolomite |

*Full analysis at rear Appendix C.

ROCK CHIP ASSAY RESULTS

| Sample No. | Cu (ppm) | Pb (ppm) | Zn (ppm) | Comments |
|---|---|---|---|---|
| M154 | 8 | 24 | 16 | massive lmst. with Fe |
| M161/1 | 12 | 44 | 38 | massive lmst. |
| M161/2 | 12 | 42 | 46 | pink calc-dolomite |
| M163 | 44 | 180 | 150 | pink dolomitized lmst. |
| M164 | 24 | 110 | 60 | dolomitized lmst. |
| M167 | 2 | 46 | 48 | pink calc-dolomite |
| M172 | 12 | 65 | 60 | massive archaeo-lmst. |
| M176 | 6 | 34 | 26 | pink & white archaeo-lmst. |
| M180 | 130 | 16 | 3200 | Mn/Fe gossan |
| M182/1 | 14 | 40 | 1450 | Mn/Fe breccia |
| M182/2 | 12 | 46 | 700 | manganiferous dolomite |
| M184* | 24 | 32 | 1.6% | Mn/Fe breccia |
| M191 | 16 | 36 | 950 | manganiferous dolomite |
| M199 | 12 | 90 | 250 | dolomite with Mn |
| M200 | 8 | 65 | 130 | dolomite |
| M202 | 6 | 50 | 65 | recrystallized lmst. |
| M205 | 6 | 32 | 20 | pink-white recrystallized lmst. |
| M209 | 10 | 36 | 26 | massive archaeo-lmst. |
| M218 | 8 | 32 | 22 | massive lmst. |
| M218/A | 18 | 100 | 280 | massive lmst. with Fe |
| M219/1 | 10 | 70 | 40 | massive lmst. |
| M219/2 | 10 | 46 | 80 | dolomitized lmst. |
| M227 | 8 | 48 | 20 | dark grey archaeo-lmst. |
| M232 | 12 | 75 | 38 | massive lmst. minor dolomitization |
| M236 | 12 | 36 | 18 | massive lmst. |
| M249/2 | 18 | 42 | 950 | Fe gossan |
| M251 | 8 | 55 | 30 | massive archaeo-lmst. |
| M253/1 | 12 | 42 | 120 | pink/white massive lmst. |
| M253/2 | 14 | 50 | 300 | dolomitized massive lmst. |
| M256 | 14 | 150 | 100 | pink-grey lmst. breccia |
| M258 | 12 | 210 | 220 | lmst. breccia, hematite matrix |
| M259 | 34 | 210 | 750 | red massive lmst. |
| M260 | 8 | 200 | 1300 | red recrystallized lmst. |
| M262 | 8 | 70 | 1650 | red dolomite |
| M269 | 4 | 42 | 160 | laminated lmst. |
| M274 | 6 | 44 | 550 | pink calc-dolomite |
| M275 | 6 | 140 | 120 | lmst. breccia, hematite matrix |
| M295 | 8 | 42 | 55 | mauve massive archaeo-lmst. |
| M296 | 12 | 620 | 2700 | red matrix of lmst. breccia |
| M308 | 10 | 40 | 20 | mauve nodular lmst. |
| M310 | 14 | 55 | 190 | pink calc-dolomite |
| M311 | 14 | 65 | 130 | calc-dolomite |
| R136 | 8 | 65 | 34 | pink dolomitized lmst. |
| R142 | 14 | 44 | 160 | massive lmst. with Fe |
| R143 | 12 | 60 | 85 | pink massive lmst. |
| R149 | 12 | 55 | 34 | pink massive lmst. |
| R150 | 18 | 55 | 240 | calc-dolomite |

*Full analysis at rear Appendix C.

ROCK CHIP ASSAY RESULTS

| Sample No. | Cu (ppm) | Pb (ppm) | Zn (ppm) | Comments |
|---|---|---|---|---|
| R151 | 22 | 65 | 260 | pink calc-dolomite |
| R159 | 12 | 46 | 40 | massive lmst. |
| R162 | 10 | 38 | 26 | massive lmst. |
| R167 | 10 | 40 | 70 | massive lmst. with Fe |
| R171A | 34 | 34 | 810 | massive Mno |
| R171B | 14 | 65 | 210 | massive lmst. |
| R181 | 18 | 170 | 720 | massive recrystallized lmst. |
| R182 | 20 | 95 | 210 | massive lmst. with Mn |
| R186 | 14 | 55 | 90 | massive lmst. |
| R188 | 12 | 55 | 60 | calc-dolomite |
| R195 | 10 | 55 | 260 | dolomitized lmst. |
| R196 | 12 | 55 | 44 | pink recrystallized lmst. |
| R199 | 16 | 90 | 85 | dolomitized lmst. |
| R203 | 14 | 60 | 60 | massive lmst. with Mn |
| R206 | 14 | 560 | 1600 | Mn/Fe oxides |
| R208 | 12 | 55 | 500 | red dolomitized calc-dolomite |
| R217 | 8 | 44 | 150 | calc-dolomite with Mn |
| R221* | 26 | 44 | 1.7% | manganiferous dolomitized lmst. |
| R224 | 10 | 46 | 430 | red dolomitized calc-dolomite |
| R225 | 12 | 55 | 1400 | red dolomitized calc-dolomite |
| R247 | 10 | 75 | 38 | massive lmst. |
| R280A | 150 | 540 | 1550 | Fe oxide veins in lmst. |
| R280B | 12 | 55 | 65 | massive archaeo-lmst. |
| R300 | 10 | 36 | 70 | massive lmst. |
| R314 | 10 | 38 | 110 | massive lmst. with Fe |
| R317 | 70 | 180 | 740 | massive lmst. with Fe |
| R322A | 42 | 28 | 3900 | massive manganese oxides |

COMLABS JOB COM832597

| Sample No. | Cu (ppm) | Pb (ppm) | Zn (ppm) | Comments |
|---|---|---|---|---|
| K5* | 16 | 1200 | 35.5% | willemite |
| K8C | 6 | 65 | 65 | massive archaeo-lmst. breccia |
| K11* | 8 | 2000 | 49.5% | willemite |
| K23* | 8 | 850 | 32.0% | willemite |
| K24* | 16 | 5200 | 38.0% | willemite |
| K30* | 8 | 580 | 26.0% | willemite |
| K41 | 12 | 30 | 650 | magnesite |
| M319 | 10 | 40 | 310 | vuggy pink calc-dolomite |
| M330A | 38 | 32 | 980 | calcite, siderite, limonite |
| M330B | 14 | 40 | 110 | dolomitized archaeo-lmst. |
| M337 | 95 | 120 | 120 | palaeo-surface |
| M343 | 16 | 80 | 3400 | calcite with FeO rods |
| M343A | 48 | 80 | 1550 | dolomitic lmst. with Fe |
| M344* | 440 | 300 | 5200 | FeO gossan |
| M347 | 14 | 2850 | 1100 | mauve calcite |
| M353 | 40 | 110 | 700 | red-grey archaeo-lmst. |
| M360* | 150 | 3050 | 45.0% | willemite |
| M360A | 8 | 42 | 780 | mauve massive lmst. |
| M361* | 190 | 1950 | 32.5% | willemite |

*Full analysis at rear Appendix C.

ROCK CHIP ASSAY RESULTS

| Sample No. | Cu (ppm) | Pb (ppm) | Zn (ppm) | Comments |
|---|---|---|---|---|
| M364A | 8 | 65 | 200 | mauve massive lmst. |
| M371 | 26 | 220 | 2400 | FeO gossan |
| M372 | 160 | 310 | 1750 | red-brown ochre |
| M372A | 80 | 1600 | 2600 | calcrete breccia |
| M373 | 14 | 30 | 290 | magnesite |
| M394* | 24 | 1350 | 17.8% | willemite |
| M396* | 16 | 1550 | 19.5% | willemite |
| M396A | 10 | 70 | 200 | pink-grey archaeo-lmst. |
| M417 | 30 | 110 | 1250 | pink-grey dolomitized lmst. |
| M439 | 8 | 32 | 140 | massive lmst. |
| M439A | 16 | 36 | 120 | dolomitized lmst. |
| M425 | 42 | 100 | 680 | archaeo-lmst. breccia |
| M462 | 14 | 250 | 120 | recrystallized lmst. |
| R338 | 12 | 38 | 120 | recrystallized lmst. |
| R351 | 16 | 115 | 48 | palaeo-surface |
| R355 | 12 | 30 | 55 | pink-grey nodular lmst. |
| R383 | 22 | 330 | 110 | palaeo-surface |
| R395 | 16 | 105 | 90 | red-brown ochre |
| R397* | 50 | 790 | 19.0% | willemite |
| R397A | 14 | 730 | 1650 | mauve lmst. |
| R402 | 32 | 360 | 440 | mauve lmst. |
| R403* | 31.7% | 700 | 3.8% | malachite, chalcocite, willemite |
| R406* | 2700 | 6100 | 7800 | ironstone |
| R409* | 460 | 3800 | 39.0% | willemite |
| R449 | 260 | 55 | 1950 | quartz-calcite vein |
| R450 | 100 | 75 | 750 | calcite veins |
| R453* | 40 | 520 | 6.5% | willemite |
| SS3468 | 28 | 1450 | 34.5% | willemite |
| AMDEL Rept. AC 314/84 | | | | |
| A2738/83* | 40 | 2000 | 3300 | Fe/Mn gossan |
| A2739/83* | 8 | 140 | 120 | pink nodular lmst. |
| A2740/83* | 8 | 110 | 150 | red archaeo-lmst. |
| A2741/83* | 32 | 80 | 170 | massive Mn oxides |
| A2742/83* | 4 | 70 | 55 | calc-dolomite |
| A2743/83* | 70 | 6900 | 1400 | brecciated calc-dolomite |
| A2744/83* | 140 | 1300 | 34% | smithsonite gossan |
| A2745/83* | 24 | 1400 | 2.9% | smithsonite gossan |
| AMDEL Rept. AC 1484/84 | | | | |
| A4899/83* | 4 | 15 | 5400 | manganiferous dolomite |
| A4900/83* | 6 | 15 | 1450 | manganiferous dolomite |
| A4901/83* | 170 | 315 | 235 | manganiferous dolomite |
| A4902/83* | 2 | 10 | 1730 | manganiferous dolomite |
| A4903/83* | 36 | 150 | 135 | red recrystallized lmst. |
| A4904/83* | 36 | 240 | 500 | red recrystallized lmst. |
| A4905/83* | 4 | 20 | 500 | red recrystallized lmst. |
| A4906/83* | 12 | 40 | 770 | red recrystallized lmst. |

*Full analysis at rear Appendix C.

ROCK CHIP ASSAY RESULTS

| Sample No. | Cu (ppm) | Pb (ppm) | Zn (ppm) | Comments |
|---|---|---|---|---|
| | | | | **AMDEL Rept. AC 66/85** |
| A1071/84* | 4 | 46 | 120 | archaeo-lmst. breccia |
| A1072/84* | 4 | 100 | 750 | red-brown ochre |
| A1073/84* | 170 | 940 | 8500 | FeO gossan |
| A1074/84* | 350 | 6.6% | 66 | galena, quartz, calcite vein |
| A1075/84* | 48 | 2.5% | 2.5% | galena, hydrozincite |
| A1076/84* | 36 | 480 | 1.4% | $MnO_2$ pod |
| A1077/84* | 6 | 70 | 880 | dolomitized lmst. |
| A1078/84* | 2 | 30 | 760 | dolomitized lmst. |
| A1079/84* | 66 | 300 | 4600 | $MnO_2$ pod |
| A1080/84* | 18 | 230 | 680 | $MnO_2$ pod |
| A1081/84* | 90 | 280 | 4600 | $MnO_2$ pod |
| A1082/84* | 6 | 36 | 56 | red recrystallized lmst. |
| | | | | **AMDEL Rept. AC 1109/85** |
| A1825/84* | 12 | 45 | 1800 | Fe/Mn gossan |
| A1826/84* | 18 | 80 | 560 | Fe/Mn gossan |
| A1827/84* | 22 | 200 | 1690 | Fe/Mn gossan |
| A1828/84* | 2 | 70 | 90 | pink calc-dolomite |
| A1829/84* | 2 | 25 | 730 | pink vuggy calc-dolomite |
| A1830/84* | 16 | 1000 | 36.7% | willemite |
| A1831/84* | 6 | 320 | 2000 | mauve lmst. breccia with calcite |
| | | | | **AMDEL Rept. AC 2006/85** |
| A2177/84* | 175 | 780 | 3080 | FeO gossan |
| A2178/84* | 52 | 500 | 370 | pink calc-dolomite |

*Full analysis at rear Appendix C.

ROCK CHIP ASSAY RESULTS
Full analysis

| Sample No. | Sn (ppm) | As (ppm) | Ni (ppm) | Co (ppm) | Cd (ppm) | Cr (ppm) | Hg (ppm) | Fe (ppm) | Mn (ppm) | Mo (ppm) | Au (ppm) | Ag (ppm) | Ca (%) | Mg (%) | $SiO_2$ (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R24/1 | 10 | 50 | 10 | 6 | 540 | - | - | 8% | 770 | <4 | <0.05 | <1 | 3.5 | 2.35 | 2.6 |
| R26 | <4 | 3 | <4 | <4 | 240 | - | - | 8000 | 1200 | <4 | <0.05 | <1 | 22 | 11 | 2.35 |
| R26/1 | 12 | 12 | 10 | <4 | 300 | - | - | 4.2% | 700 | <4 | <0.05 | <1 | 1.1 | 1.3 | 6.45 |
| M184 | 4 | 12 | 200 | 240 | 40 | - | - | 33% | 15% | 6 | <0.05 | 2 | 1.05 | 0.5 | 2.95 |
| R221 | 4 | 2 | 190 | 110 | 39 | - | - | 11% | 9.7% | 6 | 0.2 | 2 | 5.2 | 0.9 | 37.0 |
| K5 | 8 | 580 | 6 | <4 | 3 | - | - | 4000 | 710 | 8 | <0.05 | <1 | 13.1 | 0.17 | 20.7 |
| K11 | <4 | 290 | <4 | <4 | 1 | - | - | 800 | 105 | <4 | <0.05 | <1 | 3.6 | 0.08 | 24.2 |
| K23 | 4 | 55 | <4 | <4 | <1 | - | - | 3000 | 360 | 6 | <0.05 | <1 | 8.0 | 0.11 | 26.8 |
| K24 | <4 | 1350 | 10 | 4 | 2 | - | - | 3000 | 290 | <4 | <0.05 | <2 | 6.0 | 1.55 | 26.4 |
| K30 | <4 | 360 | 8 | <4 | 1 | - | - | 4000 | 600 | 8 | <0.05 | <1 | 19.5 | 0.17 | 22.6 |
| M344 | 8 | 3850 | 110 | 90 | <1 | - | - | 30% | 930 | 95 | <0.05 | 3 | 8.6 | 0.27 | 6.27 |
| M360 | 6 | 550 | 8 | 6 | 1 | - | - | 4500 | 3800 | 4 | <0.05 | <1 | 4.1 | 0.07 | 25.7 |
| M361 | <4 | 470 | 6 | <4 | 1 | - | - | 9000 | 1.75% | 10 | <0.05 | <1 | 14.3 | 0.10 | 20.8 |
| M394 | 8 | 480 | <4 | <4 | 1 | - | - | 3000 | 1100 | 8 | <0.05 | <1 | 27.5 | 0.13 | 12.5 |
| M396 | 8 | 570 | <4 | <4 | 1 | - | - | 6000 | 520 | 10 | <0.05 | <1 | 20.0 | 0.16 | 25.5 |
| R397 | <4 | 390 | <4 | <4 | <1 | - | - | 2.9% | 4500 | 10 | <0.05 | <1 | 4.7 | 0.15 | 58.1 |
| R403 | 50 | 200 | 22 | 4 | <1 | - | - | 5% | 90 | 8 | <0.05 | 4 | 1.4 | 0.13 | 23.2 |
| R406 | <4 | 780 | 34 | 26 | 26 | - | - | 19% | 2.2% | 30 | <0.05 | 2 | 22.0 | 0.24 | 2.12 |
| R409 | 4 | 1050 | 6 | 6 | <1 | - | - | 3000 | 1.45% | 14 | <0.05 | <1 | 8.8 | 0.12 | 22.9 |
| R453 | 8 | 30 | 8 | <4 | <1 | - | - | 1.5% | 1600 | <4 | <0.05 | 1 | 25 | 4.7 | 14.1 |
| SS3468 | <4 | 690 | <4 | <4 | <1 | - | - | 1.6% | 440 | <4 | <0.05 | 1 | 11.8 | 0.2 | 26.1 |
| A2738/83 | - | 50 | 75 | 95 | 2 | - | - | 5.3% | 21.8% | - | - | 1 | - | - | - |
| A2739/83 | - | <20 | 50 | 25 | <1 | - | - | 1.1% | 2300 | - | - | <1 | - | - | - |
| A2740/83 | - | <20 | 35 | 20 | <1 | - | - | 9000 | 2400 | - | - | <1 | - | - | - |
| A2741/83 | - | <20 | 55 | 40 | <1 | - | - | 5.6% | 3.7% | - | - | <1 | - | - | - |
| A2742/83 | - | <20 | 35 | 20 | <1 | - | - | 3900 | 9.9% | - | - | <1 | - | - | - |
| A2743/83 | - | 30 | 55 | 80 | 5 | - | - | 3.5% | 2.6% | - | - | <1 | - | - | - |
| A2744/83 | - | <20 | 20 | 25 | 1200 | - | - | 13.4% | 890 | - | - | <1 | - | - | - |
| A2745/83 | - | <20 | 30 | 20 | 130 | - | - | 5400 | 830 | - | - | <1 | - | - | - |

ROCK CHIP ASSAY RESULTS
Full analysis

| Sample No. | Sn (ppm) | As (ppm) | Ni (ppm) | Co (ppm) | Cd (ppm) | Cr (ppm) | Hg (ppm) | Fe (ppm) | Mn (ppm) | Mo (ppm) | Au (ppm) | Ag (ppm) | Ca (%) | Mg (%) | $SiO_2$ (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A4899/83 | – | – | – | – | – | – | – | 1.35% | 8700 | – | – | – | – | – | – |
| A4900/83 | – | – | – | – | – | – | – | 1.21% | 4600 | – | – | – | – | – | – |
| A4901/83 | – | – | – | – | – | – | – | 3.09% | 1.75% | – | – | – | – | – | – |
| A4902/83 | – | – | – | – | – | – | – | 1.13% | 5600 | – | – | – | – | – | – |
| A4903/83 | – | – | – | – | – | – | – | 2.64% | 1% | – | – | – | – | – | – |
| A4904/83 | – | – | – | – | – | – | – | 1.87% | 7200 | – | – | – | – | – | – |
| A4905/83 | – | – | – | – | – | – | – | 1.79% | 8900 | – | – | – | – | – | – |
| A4906/83 | – | – | – | – | – | – | – | 2.02% | 1.01% | – | – | – | – | – | – |
| A1071/84 | – | <20 | <5 | <5 | 2 | 10 | 0.04 | 1.2% | 2700 | <1 | 0.02 | <1 | – | – | – |
| A1072/84 | – | 40 | 6 | 6 | <1 | 20 | 0.01 | 27.0% | 1300 | 3 | 0.04 | <1 | – | – | – |
| A1073/84 | – | 60 | 46 | 40 | <1 | 60 | 0.03 | 36.9% | 780 | 7 | 0.05 | <1 | – | – | – |
| A1074/84 | – | <20 | 6 | <5 | <1 | 10 | 0.06 | 4400 | 66 | <1 | 0.01 | 7 | – | – | – |
| A1075/84 | – | <20 | 6 | <5 | 56 | <10 | 0.65 | 1900 | 480 | <1 | 0.02 | 1 | – | – | – |
| A1076/84 | – | <20 | 86 | 96 | 16 | 20 | 0.16 | 13.5% | 12.9% | <1 | 0.06 | <1 | – | – | – |
| A1077/84 | – | <20 | 20 | 16 | 1 | 10 | 0.02 | 1.4% | 6100 | 1 | 0.24 | <1 | – | – | – |
| A1078/84 | – | <20 | 16 | 6 | 3 | 10 | 0.04 | 3.0% | 3200 | <1 | 0.01 | <1 | – | – | – |
| A1079/84 | – | <20 | 240 | 86 | 7 | 10 | 0.04 | 14.7% | 22.2% | <1 | 0.04 | <1 | – | – | – |
| A1080/84 | – | <20 | 50 | 20 | 1 | 10 | 0.01 | 3.7% | 3.0% | 1 | 0.02 | <1 | – | – | – |
| A1081/84 | – | <20 | 210 | 130 | 3 | 10 | 0.04 | 20.5% | 1.7% | 1 | 0.03 | <1 | – | – | – |
| A1082/84 | – | <20 | 6 | 6 | <1 | <10 | 0.01 | 5500 | 2000 | 2 | 0.19 | <1 | – | – | – |
| A1825/84 | – | 420 | 140 | 90 | <1 | – | – | 32.5% | 8720 | 12 | – | <1 | – | – | – |
| A1826/84 | – | 40 | 15 | 20 | 2 | – | – | 2.62% | 20.6% | 2 | – | <1 | – | – | – |
| A1827/84 | – | 360 | 35 | 40 | <1 | – | – | 38.9% | 9470 | 6 | – | <1 | – | – | – |
| A1828/84 | – | <20 | <5 | <5 | 2 | – | – | 1.27% | 6680 | <2 | – | <1 | – | – | – |
| A1829/84 | – | <20 | <5 | <5 | 1 | – | – | 4600 | 1390 | <2 | – | <1 | – | – | – |
| A1830/84 | – | 700 | <5 | <5 | <1 | – | – | 2800 | 340 | <2 | – | <1 | – | – | – |
| A1831/84 | – | 20 | <5 | <5 | 42 | – | – | 1.3% | 3200 | <2 | – | <1 | – | – | – |
| A2177/84 | – | – | 90 | 50 | <1 | – | – | 48.0% | 1.15% | 16 | – | <1 | – | – | – |
| A2178/84 | – | – | 10 | <5 | <1 | – | – | 1.3% | 1380 | <1 | – | <1 | – | – | – |

# APPENDIX D

Southern, Camp, Manga, Llina, Hayward, Willa and Northern Prospects, Rock Chip Assay Results

AMDEL Reports: AC 987/85
AC 1429/85, AC 5301/85,
AC 443/86, AC 1037/86,
AC 1058/86, AC 2198/86

amdel

Analysis code C1 Report AC 987/85 

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A1395/84 | 8 | 6 | 23 | 1300 | <1 |
| A1396/84 | 5 | 16 | 25 | 1140 | <1 |
| A1397/84 | 4 | 10 | 16 | 890 | <1 |
| A1398/84 | 13 | 22 | 66 | 1.73% | <1 |
| A1399/84 | 12 | 8 | 42 | 3.56% | <1 |
| A1400/84 | 7 | 16 | 22 | 1.65% | <1 |
| A1401/84 | 4 | 16 | 76 | 3320 | <1 |
| A1402/84 | 4 | 10 | 19 | 1800 | <1 |
| A1403/84 | 13 | 20 | 70 | 1760 | <1 |
| A1404/84 | 5 | 12 | 25 | 1880 | <1 |
| A1405/84 | 6 | 16 | 50 | 2980 | <1 |
| A1406/84 | 5 | 28 | 46 | 9400 | <1 |
| A1407/84 | 6 | 12 | 30 | 700 | <1 |
| A1408/84 | 3 | 38 | 35 | 1480 | <1 |
| A1409/84 | 4 | 60 | 32 | 360 | <1 |
| A1410/84 | 3 | 24 | 21 | 330 | <1 |
| A1411/84 | 4 | 195 | 37 | 265 | <1 |
| A1412/84 | 4 | 325 | 56 | 365 | <1 |
| A1413/84 | 4 | 205 | 62 | 360 | <1 |
| A1414/84 | 3 | 250 | 35 | 400 | <1 |
| A1415/84 | 4 | 130 | 130 | 610 | <1 |
| A1416/84 | 4 | 98 | 42 | 325 | <1 |
| A1417/84 | 9 | 230 | 84 | 790 | <1 |
| A1418/84 | 21 | 1160 | 240 | 1480 | <1 |
| A1419/84 | 10 | 320 | 300 | 600 | 2 |
| A1420/84 | 12 | 245 | 340 | 2500 | <1 |
| A1421/84 | 11 | 160 | 240 | 1800 | <1 |
| A1422/84 | 21 | 820 | 415 | 2640 | <1 |
| A1423/84 | 7 | 175 | 200 | 1360 | <1 |
| A1424/84 | 10 | 145 | 125 | 1360 | <1 |
| A1425/84 | 18 | 470 | 165 | 1600 | <1 |
| A1426/84 | 18 | 345 | 125 | 1700 | <1 |
| A1427/84 | 7 | 375 | 115 | 1100 | <1 |
| A1428/84 | 9 | 335 | 88 | 1360 | <1 |
| A1429/84 | 14 | 260 | 185 | 1100 | <1 |
| A1430/84 | 11 | 50 | 40 | 1520 | <1 |
| A1431/84 | 12 | 160 | 180 | 970 | <1 |
| A1432/84 | 5 | 160 | 190 | 445 | <1 |
| A1433/84 | 6 | 295 | 88 | 490 | <1 |
| A1434/84 | 5 | 74 | 155 | 2300 | <1 |
| Detn limit | (2) | (5) | (2) | (5) | (1) |

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Analysis code C1 Report AC 987/85 Page G2

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A1435/84 | 3 | 165 | 70 | 355 | <1 |
| A1436/84 | 4 | 24 | 33 | 910 | <1 |
| A1437/84 | 3 | 22 | 26 | 1120 | <1 |
| A1438/84 | <2 | <5 | <2 | <5 | <1 |
| A1439/84 | 3 | 32 | 32 | 570 | <1 |
| A1440/84 | 4 | 28 | 33 | 760 | <1 |
| A1441/84 | 5 | 18 | 25 | 2600 | <1 |
| A1442/84 | 6 | 14 | 24 | 3460 | <1 |
| A1443/84 | 6 | 50 | 100 | 1.11% | <1 |
| A1444/84 | 15 | 24 | 37 | 5200 | <1 |
| A1445/84 | 9 | 18 | 190 | 2.52% | <1 |
| A1446/84 | 4 | 6 | 16 | 1360 | <1 |
| A1447/84 | 3 | <5 | 13 | 750 | <1 |
| A1448/84 | 3 | 12 | 62 | 1540 | <1 |
| A1449/84 | 3 | 10 | 25 | 1820 | <1 |
| A1450/84 | 3 | 6 | 10 | 1540 | <1 |
| A1451/84 | 4 | 8 | 13 | 1360 | <1 |
| A1452/84 | 3 | 8 | 17 | 730 | <1 |
| A1453/84 | 4 | 24 | 80 | 1220 | <1 |
| A1454/84 | 3 | 10 | 17 | 580 | <1 |
| A1455/84 | 8 | 8 | 19 | 5550 | <1 |
| A1456/84 | 5 | 12 | 20 | 1.05% | <1 |
| A1457/84 | 5 | 18 | 29 | 1200 | <1 |
| A1458/84 | 4 | 18 | 35 | 920 | <1 |
| A1459/84 | 4 | 24 | 47 | 870 | <1 |
| A1460/84 | 7 | 28 | 35 | 300 | <1 |
| A1461/84 | 6 | 16 | 72 | 710 | <1 |
| A1462/84 | 7 | 18 | 30 | 590 | <1 |
| A1463/84 | 4 | 44 | 33 | 1380 | <1 |
| A1464/84 | 4 | 58 | 150 | 1720 | <1 |
| A1465/84 | 3 | 70 | 33 | 710 | <1 |
| A1466/84 | 5 | 205 | 74 | 760 | <1 |
| A1467/84 | 5 | 145 | 76 | 680 | <1 |
| A1468/84 | 5 | 94 | 40 | 550 | <1 |
| A1469/84 | 7 | 140 | 84 | 550 | <1 |
| A1470/84 | 10 | 185 | 120 | 540 | <1 |
| A1471/84 | 11 | 300 | 150 | 375 | <1 |
| A1472/84 | 39 | 440 | 100 | 830 | <1 |
| A1473/84 | 12 | 175 | 185 | 1060 | <1 |
| A1474/84 | 11 | 235 | 42 | 730 | <1 |
| Detn limit | (2) | (5) | (2) | (5) | (1) |

amdel

Analysis code Cl        Report AC 987/85        Page G3

NATA Certificate        Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A1475/84 | 9 | 40 | 74 | 830 | <1 |
| A1476/84 | 50 | 305 | 56 | 1400 | <1 |
| A1477/84 | 17 | 62 | 155 | 1960 | <1 |
| A1478/84 | 9 | 22 | 20 | 3800 | <1 |
| A1479/84 | 5 | 14 | 11 | 1880 | <1 |
| A1480/84 | 6 | 46 | 76 | 1220 | <1 |
| A1481/84 | 3 | 12 | 30 | 1100 | <1 |
| A1482/84 | 8 | 26 | 36 | 1.67% | <1 |
| A1483/84 | 9 | 18 | 22 | 1.11% | <1 |
| A1484/84 | 10 | 62 | 66 | 2920 | <1 |
| A1485/84 | 6 | 46 | 19 | 1660 | <1 |
| A1486/84 | 4 | 80 | 12 | 1320 | <1 |
| A1487/84 | 3 | 62 | 11 | 1080 | <1 |
| A1488/84 | 4 | 74 | 15 | 530 | <1 |
| A1489/84 | 4 | 54 | 54 | 180 | <1 |
| A1490/84 | 2 | 12 | 4 | 86 | <1 |
| A1491/84 | 4 | 325 | 25 | 450 | <1 |
| A1492/84 | 76 | 1140 | 235 | 1220 | <1 |
| A1493/84 | 25 | 530 | 120 | 810 | <1 |
| A1494/84 | 38 | 155 | 275 | 750 | <1 |
| A1495/84 | 12 | 105 | 465 | 330 | <1 |
| A1496/84 | 10 | 245 | 2800 | 1060 | <1 |
| A1497/84 | 29 | 170 | 295 | 355 | <1 |
| A1498/84 | 38 | 265 | 390 | 510 | <1 |
| A1499/84 | 20 | 180 | 180 | 610 | <1 |
| A1500/84 | 18 | 260 | 155 | 450 | <1 |
| A1501/84 | 50 | 1620 | 80 | 1220 | <1 |
| A1502/84 | 24 | 420 | 105 | 1080 | <1 |
| A1503/84 | 24 | 620 | 155 | 960 | <1 |
| A1504/84 | 240 | 70 | 25 | 1500 | <1 |
| A1505/84 | 9 | 125 | 25 | 500 | <1 |
| A1506/84 | 8 | 98 | 35 | 350 | <1 |
| A1507/84 | 4 | 34 | 25 | 145 | <1 |
| A1508/84 | 4 | 28 | 21 | 720 | <1 |
| A1509/84 | 5 | 22 | 13 | 1400 | <1 |
| A1510/84 | 3 | 48 | 11 | 1300 | <1 |
| A1511/84 | 2 | 86 | 9 | 940 | <1 |
| A1512/84 | 4 | 165 | 14 | 900 | 2 |
| A1513/84 | 4 | 110 | 17 | 1000 | 5 |
| A1514/84 | 5 | 46 | 25 | 850 | 6 |
| Detn limit | (2) | (5) | (2) | (5) | (1) |

amdel

Analysis code Cl    Report AC 987/85    Page G4

NATA Certificate    Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A1515/84 | 3 | 52 | 26 | 1460 | 2 |
| A1516/84 | 11 | 46 | 34 | 2.00% | 3 |
| A1517/84 | 17 | 18 | 245 | 3.18% | 3 |
| A1518/84 | 4 | 16 | 11 | 1000 | 1 |
| A1519/84 | 9 | 24 | 30 | 2060 | <1 |
| A1520/84 | 5 | 12 | 9 | 1020 | <1 |
| A1521/84 | 11 | 16 | 16 | 3600 | <1 |
| A1522/84 | 9 | 10 | 21 | 1940 | <1 |
| A1523/84 | 6 | 12 | 30 | 2360 | <1 |
| A1524/84 | 8 | 14 | 37 | 6450 | <1 |
| A1525/84 | 5 | 50 | 120 | 1480 | <1 |
| A1526/84 | 6 | 88 | 74 | 2980 | <1 |
| A1527/84 | 5 | 18 | 26 | 1020 | <1 |
| A1528/84 | 9 | 130 | 20 | 600 | <1 |
| A1529/84 | 4 | 235 | 15 | 1440 | <1 |
| A1530/84 | 3 | 50 | 13 | 1020 | <1 |
| A1531/84 | 5 | 32 | 9 | 760 | <1 |
| A1532/84 | 4 | 24 | 32 | 1500 | <1 |
| A1533/84 | 3 | 12 | 6 | 82 | <1 |
| A1534/84 | 5 | 32 | 30 | 600 | <1 |
| A1535/84 | 4 | 100 | 28 | 420 | <1 |
| A1536/84 | 8 | 94 | 34 | 1360 | <1 |
| A1537/84 | 4 | 20 | 45 | 510 | <1 |
| A1538/84 | 6 | 82 | 41 | 365 | <1 |
| A1539/84 | 20 | 245 | 340 | 870 | <1 |
| A1540/84 | 14 | 550 | 140 | 710 | <1 |
| A1541/84 | 15 | 80 | 88 | 1200 | <1 |
| A1542/84 | 29 | 140 | 240 | 950 | <1 |
| A1543/84 | 13 | 275 | 140 | 910 | <1 |
| A1544/84 | 16 | 370 | 940 | 475 | <1 |
| A1545/84 | 8 | 330 | 485 | 550 | <1 |
| A1546/84 | 11 | 425 | 430 | 495 | <1 |
| A1547/84 | 9 | 255 | 76 | 220 | <1 |
| A1548/84 | 10 | 84 | 76 | 180 | <1 |
| A1549/84 | 17 | 230 | 170 | 630 | <1 |
| A1550/84 | 6 | 100 | 98 | 365 | <1 |
| A1551/84 | 3 | 32 | 66 | 305 | <1 |
| A1552/84 | 5 | 105 | 34 | 255 | <1 |
| A1553/84 | 4 | 16 | 31 | 230 | <1 |
| A1554/84 | 3 | 32 | 88 | 590 | <1 |
| Detn limit | (2) | (5) | (2) | (5) | (1) |

amdel

Analysis code C1 Report AC 987/85 Page G5

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A1555/84 | 3 | 38 | 29 | 1160 | <1 |
| A1556/84 | 6 | 18 | 47 | 1700 | <1 |
| A1557/84 | 6 | 215 | 37 | 1300 | <1 |
| A1558/84 | 4 | 46 | 68 | 1120 | <1 |
| A1559/84 | 5 | 32 | 19 | 910 | <1 |
| A1560/84 | 4 | 54 | 19 | 1460 | <1 |
| A1561/84 | 7 | 125 | 52 | 980 | 5 |
| A1562/84 | 4 | 12 | 9 | 415 | 2 |
| A1563/84 | 15 | 46 | 46 | 2.44% | 2 |
| A1564/84 | 13 | 22 | 34 | 2.23% | 2 |
| A1565/84 | 15 | 18 | 24 | 1.02% | <1 |
| A1566/84 | 12 | 16 | 17 | 2.31% | <1 |
| A1567/84 | 14 | 18 | 88 | 1.51% | <1 |
| A1568/84 | 4 | 6 | 14 | 1540 | <1 |
| A1569/84 | 3 | 6 | 9 | 850 | <1 |
| A1570/84 | 3 | 6 | 9 | 700 | <1 |
| A1571/84 | 11 | 6 | 23 | 3840 | <1 |
| A1572/84 | 14 | 14 | 32 | 1.21% | <1 |
| A1573/84 | 17 | 16 | 30 | 2.33% | <1 |
| A1574/84 | 9 | 24 | 35 | 1.20% | <1 |
| A1575/84 | 4 | 20 | 19 | 690 | <1 |
| A1576/84 | 5 | 18 | 34 | 1000 | <1 |
| A1577/84 | 17 | 110 | 26 | 1540 | <1 |
| A1578/84 | 2 | 58 | 14 | 1080 | <1 |
| A1579/84 | 2 | 34 | 155 | 1280 | <1 |
| A1580/84 | 4 | 175 | 54 | 1800 | <1 |
| A1581/84 | 2 | 52 | 20 | 1140 | <1 |
| A1582/84 | 3 | 140 | 27 | 1100 | <1 |
| A1583/84 | 2 | 54 | 36 | 1240 | <1 |
| A1584/84 | 4 | 530 | 98 | 405 | <1 |
| A1585/84 | 3 | 46 | 82 | 265 | <1 |
| A1586/84 | 3 | 30 | 41 | 215 | <1 |
| A1587/84 | 4 | 72 | 47 | 355 | <1 |
| A1588/84 | 3 | 30 | 52 | 245 | <1 |
| A1589/84 | 7 | 220 | 88 | 440 | <1 |
| A1590/84 | 5 | 42 | 130 | 485 | <1 |
| A1591/84 | 5 | 125 | 37 | 195 | <1 |
| A1592/84 | 6 | 485 | 125 | 600 | <1 |
| A1593/84 | 10 | 320 | 180 | 320 | 2 |
| A1594/84 | 7 | 210 | 150 | 300 | <1 |
| | | | | | |
| Detn limit | (2) | (5) | (2) | (5) | (1) |

amdel

Analysis code C1 Report AC 987/85 Page G6

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A1595/84 | 7 | 160 | 120 | 185 | <1 |
| A1596/84 | 13 | 335 | 380 | 570 | <1 |
| A1597/84 | 4 | 125 | 105 | 280 | <1 |
| A1598/84 | 4 | 26 | 36 | 240 | <1 |
| A1599/84 | 11 | 48 | 48 | 320 | <1 |
| A1600/84 | 3 | 94 | 30 | 225 | <1 |
| A1601/84 | 3 | 32 | 47 | 235 | <1 |
| A1602/84 | 12 | 560 | 910 | 3620 | <1 |
| A1603/84 | 5 | 670 | 155 | 1820 | <1 |
| A1604/84 | 3 | 92 | 48 | 930 | <1 |
| A1605/84 | 3 | 42 | 28 | 940 | <1 |
| A1606/84 | 3 | 66 | 32 | 930 | <1 |
| A1607/84 | 6 | 145 | 43 | 1640 | <1 |
| A1608/84 | 6 | 44 | 20 | 940 | <1 |
| A1609/84 | 4 | 30 | 60 | 790 | <1 |
| A1610/84 | 5 | 16 | 41 | 1280 | <1 |
| A1611/84 | 7 | 420 | 52 | 2580 | <1 |
| A1612/84 | 7 | 14 | 20 | 360 | <1 |
| A1613/84 | 6 | 6 | 18 | 920 | <1 |
| A1614/84 | 8 | 20 | 19 | 860 | <1 |
| A1615/84 | 11 | 28 | 86 | 2.87% | <1 |
| A1616/84 | 5 | 14 | 14 | 950 | <1 |
| A1617/84 | 4 | 14 | 22 | 920 | <1 |
| A1618/84 | 6 | 6 | 10 | 1540 | <1 |
| A1619/84 | 5 | <5 | 15 | 1800 | <1 |
| A1620/84 | 4 | <5 | 12 | 1120 | <1 |
| A1621/84 | 5 | 8 | 18 | 1120 | <1 |
| A1622/84 | 11 | 20 | 115 | 1.40% | <1 |
| A1623/84 | 15 | 20 | 60 | 3.97% | <1 |
| A1624/84 | 6 | 18 | 100 | 8450 | <1 |
| A1625/84 | 5 | 16 | 22 | 1020 | <1 |
| A1626/84 | 5 | 14 | 27 | 425 | <1 |
| A1627/84 | 6 | 28 | 31 | 610 | <1 |
| A1628/84 | 5 | 38 | 56 | 840 | <1 |
| A1629/84 | 5 | 52 | 27 | 820 | <1 |
| A1630/84 | 4 | 150 | 47 | 1040 | <1 |
| A1631/84 | 3 | 74 | 110 | 1380 | <1 |
| A1632/84 | 2 | 48 | 49 | 1420 | <1 |
| A1633/84 | 4 | 210 | 64 | 280 | <1 |
| A1634/84 | 4 | 110 | 64 | 355 | <1 |
| Detn limit | (2) | (5) | (2) | (5) | (1) |

amdel

Analysis code C1 — Report AC 987/85 — Page G7

NATA Certificate — Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A1635/84 | 3 | 38 | 66 | 230 | <1 |
| A1636/84 | 4 | 58 | 68 | 345 | <1 |
| A1637/84 | 3 | 48 | 54 | 200 | <1 |
| A1638/84 | 5 | 100 | 64 | 275 | <1 |
| A1639/84 | 5 | 76 | 115 | 285 | <1 |
| A1640/84 | 4 | 60 | 125 | 345 | <1 |
| A1641/84 | 3 | 26 | 68 | 230 | <1 |
| A1642/84 | 3 | 24 | 68 | 280 | <1 |
| A1643/84 | 4 | 24 | 66 | 345 | <1 |
| A1644/84 | 3 | 22 | 60 | 220 | <1 |
| A1645/84 | 2 | 24 | 47 | 240 | <1 |
| A1646/84 | 3 | 60 | 94 | 265 | <1 |
| A1647/84 | 3 | 34 | 66 | 235 | <1 |
| A1648/84 | 4 | 28 | 56 | 220 | <1 |
| A1649/84 | 4 | 44 | 60 | 235 | <1 |
| A1650/84 | 3 | 32 | 34 | 125 | <1 |
| A1651/84 | 2 | 10 | 40 | 225 | <1 |
| A1652/84 | 5 | 400 | 125 | 1360 | <1 |
| A1653/84 | 3 | 100 | 105 | 750 | <1 |
| A1654/84 | 18 | 370 | 680 | 1080 | 4 |
| A1655/84 | 4 | 66 | 110 | 650 | <1 |
| A1656/84 | 4 | 64 | 49 | 710 | <1 |
| A1657/84 | 5 | 110 | 98 | 600 | <1 |
| A1658/84 | 5 | 22 | 41 | 560 | <1 |
| A1659/84 | 9 | 22 | 64 | 5450 | <1 |
| A1660/84 | 10 | 34 | 78 | 1.02% | <1 |
| A1661/84 | 13 | 18 | 165 | 1.94% | <1 |
| A1662/84 | 7 | 14 | 37 | 1200 | <1 |
| A1663/84 | 19 | 18 | 500 | 2240 | <1 |
| A1664/84 | 4 | 6 | 13 | 1160 | <1 |
| A1665/84 | 5 | 8 | 12 | 1060 | <1 |
| A1666/84 | 5 | 10 | 9 | 1440 | <1 |
| A1667/84 | 3 | 8 | 8 | 1300 | <1 |
| A1668/84 | 3 | <5 | 9 | 1120 | <1 |
| A1669/84 | 5 | 6 | 16 | 3080 | <1 |
| A1670/84 | 4 | <5 | 21 | 1040 | <1 |
| A1671/84 | 12 | 12 | 15 | 1.39% | <1 |
| A1672/84 | 5 | 52 | 120 | 3660 | <1 |
| A1673/84 | 9 | 10 | 27 | 900 | <1 |
| A1674/84 | 3 | 46 | 110 | 670 | <1 |
| | | | | | |
| Detn limit | (2) | (5) | (2) | (5) | (1) |

amdel

Analysis code Cl | Report AC 987/85 | Page G8

NATA Certificate | Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A1675/84 | 3 | 115 | 84 | 680 | <1 |
| A1676/84 | 2 | 42 | 46 | 920 | <1 |
| A1677/84 | 2 | 62 | 64 | 950 | <1 |
| A1678/84 | 3 | 16 | 42 | 660 | <1 |
| A1679/84 | 3 | 10 | 30 | 245 | <1 |
| A1680/84 | 4 | 56 | 110 | 315 | <1 |
| A1681/84 | 3 | 22 | 38 | 200 | <1 |
| A1682/84 | 4 | 22 | 84 | 370 | <1 |
| A1683/84 | 3 | 22 | 60 | 180 | <1 |
| A1684/84 | 3 | 12 | 32 | 210 | <1 |
| A1685/84 | 3 | 16 | 31 | 145 | <1 |
| A1686/84 | 3 | 12 | 15 | 180 | <1 |
| A1687/84 | 3 | 14 | 48 | 210 | <1 |
| A1688/84 | 3 | 16 | 45 | 190 | <1 |
| A1689/84 | 2 | 12 | 22 | 190 | <1 |
| A1690/84 | 3 | 14 | 60 | 220 | <1 |
| A1691/84 | 3 | 16 | 40 | 200 | <1 |
| A1692/84 | 3 | 24 | 44 | 195 | <1 |
| A1693/84 | 3 | 18 | 58 | 150 | <1 |
| A1694/84 | 3 | 14 | 32 | 145 | <1 |
| A1695/84 | 2 | 10 | 20 | 165 | <1 |
| A1696/84 | 3 | 22 | 20 | 175 | <1 |
| A1697/84 | 6 | 185 | 185 | 1940 | <1 |
| A1698/84 | 4 | 82 | 80 | 870 | <1 |
| A1699/84 | 3 | 52 | 115 | 640 | <1 |
| A1700/84 | 4 | 105 | 155 | 730 | <1 |
| A1701/84 | 6 | 260 | 750 | 740 | <1 |
| A1702/84 | 10 | 700 | 2.16% | 850 | 155 |
| A1703/84 | 5 | 82 | 245 | 530 | 1 |
| A1704/84 | 5 | 8 | 115 | 320 | <1 |
| A1705/84 | 5 | 8 | 28 | 335 | <1 |
| A1706/84 | 4 | 10 | 35 | 770 | <1 |
| A1707/84 | 6 | 12 | 22 | 1360 | <1 |
| A1708/84 | 4 | 8 | 26 | 5350 | <1 |
| A1709/84 | 4 | 8 | 27 | 1200 | <1 |
| A1710/84 | 5 | 6 | 16 | 1740 | <1 |
| A1711/84 | 11 | 10 | 20 | 2640 | <1 |
| A1712/84 | 12 | 16 | 29 | 9250 | <1 |
| A1713/84 | 19 | 14 | 23 | 2.09% | <1 |
| A1714/84 | 9 | 10 | 19 | 5400 | <1 |
| Detn limit | (2) | (5) | (2) | (5) | (1) |

amdel

Analysis code C1 | Report AC 987/85 | Page G9

NATA Certificate | Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A1715/84 | 6 | 10 | 10 | 1300 | <1 |
| A1716/84 | 4 | 8 | 22 | 530 | <1 |
| A1717/84 | 5 | 10 | 16 | 450 | <1 |
| A1718/84 | 5 | 16 | 24 | 245 | <1 |
| A1719/84 | 3 | 18 | 21 | 265 | <1 |
| A1720/84 | 4 | 12 | 40 | 215 | <1 |
| A1721/84 | 4 | 50 | 140 | 780 | <1 |
| A1722/84 | 5 | 180 | 105 | 920 | <1 |
| A1723/84 | 3 | 40 | 36 | 870 | <1 |
| A1724/84 | 4 | 64 | 200 | 1780 | <1 |
| A1725/84 | 4 | 86 | 56 | 380 | <1 |
| A1726/84 | 3 | 14 | 42 | 205 | <1 |
| A1727/84 | 3 | 26 | 45 | 180 | <1 |
| A1728/84 | 3 | 14 | 35 | 220 | <1 |
| A1729/84 | 3 | 14 | 30 | 165 | <1 |
| A1730/84 | 3 | 12 | 35 | 200 | <1 |
| A1731/84 | 2 | 6 | 47 | 210 | <1 |
| A1732/84 | 3 | 10 | 30 | 210 | <1 |
| A1733/84 | 3 | 20 | 82 | 350 | <1 |
| A1734/84 | 5 | 24 | 110 | 450 | <1 |
| A1735/84 | 3 | 12 | 36 | 310 | <1 |
| A1736/84 | 2 | 18 | 58 | 205 | <1 |
| A1737/84 | 3 | 16 | 35 | 195 | <1 |
| A1738/84 | 4 | 14 | 165 | 265 | <1 |
| A1739/84 | 3 | 12 | 72 | 420 | <1 |
| A1740/84 | 3 | 10 | 37 | 230 | <1 |
| A1741/84 | 4 | 46 | 42 | 290 | <1 |
| A1742/84 | 4 | 48 | 105 | 1860 | <1 |
| A1743/84 | 5 | 100 | 80 | 1120 | <1 |
| A1744/84 | 2 | 44 | 26 | 660 | <1 |
| A1745/84 | 3 | 18 | 56 | 540 | <1 |
| A1746/84 | 3 | 20 | 20 | 350 | <1 |
| A1747/84 | 4 | 6 | 12 | 800 | <1 |
| A1748/84 | 5 | 10 | 15 | 7700 | <1 |
| A1749/84 | 20 | 12 | 28 | 2.39% | <1 |
| A1750/84 | 7 | 12 | 37 | 1720 | <1 |
| A1751/84 | 4 | 12 | 17 | 840 | <1 |
| A1752/84 | 5 | 6 | 39 | 1640 | <1 |
| A1753/84 | 4 | 6 | 14 | 870 | <1 |
| A1754/84 | 3 | 8 | 9 | 1420 | <1 |
| Detn limit | (2) | (5) | (2) | (5) | (1) |

amdel

Analysis code C1 | Report AC 987/85 | Page G10

NATA Certificate | Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A1755/84 | 11 | 6 | 14 | 6300 | <1 |
| A1756/84 | 3 | 8 | 24 | 2840 | <1 |
| A1757/84 | 3 | 8 | 18 | 1500 | <1 |
| A1758/84 | 3 | 8 | 45 | 720 | <1 |
| A1759/84 | 3 | 14 | 20 | 265 | <1 |
| A1760/84 | 2 | 14 | 15 | 285 | <1 |
| A1761/84 | 2 | 16 | 16 | 290 | <1 |
| A1762/84 | 2 | 12 | 33 | 700 | <1 |
| A1763/84 | 2 | 30 | 37 | 670 | <1 |
| A1764/84 | 2 | 62 | 28 | 620 | <1 |
| A1765/84 | 3 | 36 | 33 | 730 | <1 |
| A1766/84 | 3 | 120 | 47 | 880 | <1 |
| A1767/84 | 4 | 66 | 74 | 570 | <1 |
| A1768/84 | 3 | 14 | 32 | 230 | <1 |
| A1769/84 | 3 | 14 | 56 | 280 | <1 |
| A1770/84 | 4 | 74 | 84 | 170 | <1 |
| A1771/84 | 3 | 16 | 40 | 235 | <1 |
| A1772/84 | 2 | 36 | 37 | 160 | <1 |
| A1773/84 | 2 | 32 | 54 | 180 | <1 |
| A1774/84 | 3 | 38 | 52 | 265 | <1 |
| A1775/84 | 2 | 68 | 56 | 820 | <1 |
| A1776/84 | <2 | 22 | 58 | 530 | <1 |
| A1777/84 | 2 | 44 | 54 | 730 | <1 |
| A1778/84 | 4 | 80 | 54 | 530 | <1 |
| A1779/84 | 4 | 14 | 30 | 420 | <1 |
| A1780/84 | 4 | 14 | 14 | 600 | <1 |
| A1781/84 | 5 | 6 | 14 | 1.01% | <1 |
| A1782/84 | 3 | 8 | 13 | 1940 | <1 |
| A1783/84 | 7 | 64 | 35 | 1140 | <1 |
| A1784/84 | 46 | 370 | 210 | 4060 | <1 |
| A1785/84 | 9 | 100 | 43 | 1140 | <1 |
| A1786/84 | 3 | 14 | 22 | 670 | <1 |
| A1787/84 | 3 | 14 | 20 | 425 | <1 |
| A1788/84 | 3 | 12 | 25 | 440 | <1 |
| A1789/84 | 2 | 12 | 26 | 520 | <1 |
| A1790/84 | 4 | 24 | 24 | 345 | <1 |
| A1791/84 | 5 | 6 | 38 | 2300 | <1 |
| A1792/84 | 5 | 18 | 35 | 2700 | <1 |
| A1793/84 | 2 | <5 | 21 | 1700 | <1 |
| A1794/84 | <2 | 6 | 40 | 1400 | <1 |
| | | | | | |
| Detn limit | (2) | (5) | (2) | (5) | (1) |

amdel

Analysis code C1 | Report AC 987/85 | Page G11

NATA Certificate | Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A1795/84 | 2 | 12 | 110 | 1480 | <1 |
| A1796/84 | 4 | 96 | 49 | 520 | <1 |
| A1797/84 | 5 | 66 | 25 | 315 | <1 |
| A1798/84 | 3 | 14 | 52 | 430 | <1 |
| A1799/84 | 2 | <5 | 72 | 1620 | <1 |
| A1800/84 | 3 | <5 | 37 | 1060 | <1 |
| A1801/84 | 4 | <5 | 34 | 1520 | <1 |
| A1802/84 | 2 | <5 | 31 | 2580 | <1 |
| A1803/84 | 2 | <5 | 45 | 2180 | <1 |
| A1804/84 | 2 | 10 | 58 | 2000 | <1 |
| A1805/84 | 2 | 14 | 26 | 510 | <1 |
| A1806/84 | 2 | 6 | 21 | 445 | <1 |
| A1807/84 | 5 | 18 | 18 | 460 | <1 |
| A1808/84 | 8 | 48 | 76 | 2300 | <1 |
| A1809/84 | 4 | 26 | 25 | 435 | <1 |
| A1810/84 | 7 | 100 | 470 | 1.70% | <1 |
| A1811/84 | 3 | 18 | 35 | 970 | <1 |
| A1812/84 | 2 | 10 | 20 | 760 | <1 |
| A1813/84 | 2 | 6 | 14 | 320 | <1 |
| A1814/84 | 3 | 24 | 13 | 295 | <1 |
| A1815/84 | 2 | 8 | 66 | 820 | <1 |
| A1816/84 | 2 | 6 | 62 | 2060 | <1 |
| A1817/84 | 17 | 18 | 42 | 5300 | <1 |
| A1818/84 | 5 | 8 | 18 | 790 | <1 |
| A1819/84 | 5 | 8 | 30 | 2600 | <1 |
| A1820/84 | 2 | 6 | 190 | 1880 | <1 |
| A1821/84 | 3 | 44 | 145 | 2020 | <1 |
| A1822/84 | 4 | 54 | 44 | 410 | <1 |
| A1823/84 | 3 | 44 | 36 | 345 | <1 |
| A1824/84 | 3 | 46 | 39 | 490 | <1 |
| | | | | | |
| Detn limit | (2) | (5) | (2) | (5) | (1) |

amdel

Analysis code A1/1 Report AC 1429/85 

NATA Certificate Order No. EX-242 Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A1832/84 | 21 | 80 | 195 | 4220 | <1 |
| A1833/84 | 8 | 27 | 180 | 2140 | <1 |
| A1834/84 | 9 | 35 | 185 | 4000 | <1 |
| A1835/84 | 7 | 23 | 86 | 1760 | <1 |
| A1836/84 | 4 | 19 | 28 | 435 | <1 |
| A1837/84 | 3 | 13 | 66 | 1200 | <1 |
| A1838/84 | 6 | 11 | 120 | 3520 | <1 |
| A1839/84 | 9 | 11 | 84 | 3740 | <1 |
| A1840/84 | 4 | 6 | 72 | 3740 | <1 |
| A1841/84 | 6 | 7 | 56 | 1860 | <1 |
| A1842/84 | 4 | <2 | 50 | 1460 | <1 |
| A1843/84 | 4 | 4 | 130 | 2100 | <1 |
| A1844/84 | 5 | 7 | 135 | 1880 | 1 |
| A1845/84 | 4 | 8 | 120 | 1660 | 1 |
| A1846/84 | 6 | 33 | 56 | 330 | <1 |
| A1847/84 | 6 | 37 | 40 | 395 | 1 |
| A1848/84 | 6 | 80 | 44 | 460 | 1 |
| A1849/84 | 9 | 66 | 68 | 335 | <1 |
| A1850/84 | 5 | 56 | 52 | 455 | <1 |
| A1851/84 | 7 | 26 | 50 | 285 | <1 |
| A1852/84 | 4 | 7 | 76 | 1480 | 2 |
| A1853/84 | 6 | 17 | 62 | 1960 | <1 |
| A1854/84 | 4 | 50 | 235 | 2100 | 2 |
| A1855/84 | 5 | 41 | 360 | 2520 | 2 |
| A1856/84 | 4 | 18 | 150 | 2040 | 1 |
| A1857/84 | 3 | 8 | 105 | 1920 | <1 |
| A1858/84 | 5 | 9 | 88 | 1920 | <1 |
| A1859/84 | 2 | 18 | 145 | 4060 | <1 |
| A1860/84 | 3 | 21 | 135 | 3080 | <1 |
| A1861/84 | 3 | 14 | 44 | 680 | <1 |
| A1862/84 | 3 | 12 | 42 | 550 | <1 |
| A1863/84 | 20 | 66 | 62 | 2700 | <1 |
| A1864/84 | 11 | 32 | 90 | 2.43% | <1 |
| A1865/84 | 11 | 150 | 260 | 7500 | 1 |
| A1866/84 | 8 | 29 | 76 | 6550 | <1 |
| A1867/84 | 5 | 64 | 92 | 2340 | <1 |
| A1868/84 | 52 | 125 | 260 | 9150 | <1 |
| A1869/84 | 34 | 74 | 280 | 6750 | 1 |
| A1870/84 | 8 | 18 | 325 | 6400 | 1 |
| A1871/84 | 4 | 8 | 92 | 4720 | <1 |
| Detn limit | (2) | (2) | (5) | (5) | (1) |

amdel

| Analysis code A1/1 | Report AC 1429/85 |  |
|---|---|---|
| NATA Certificate | Order No. EX-242 | Results in ppm |

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A1872/84 | 48 | 200 | 1540 | 4.33% | 1 |
| A1873/84 | 12 | 62 | 450 | 1.80% | <1 |
| A1874/84 | 5 | 20 | 170 | 2460 | 1 |
| A1875/84 | 4 | 13 | 110 | 2720 | <1 |
| A1876/84 | 4 | 7 | 90 | 1820 | <1 |
| A1877/84 | 2 | 5 | 88 | 1560 | <1 |
| A1878/84 | 3 | 4 | 56 | 2160 | <1 |
| A1879/84 | 4 | 5 | 52 | 1820 | <1 |
| A1880/84 | 6 | 19 | 62 | 1220 | 1 |
| A1881/84 | 7 | 90 | 42 | 440 | 1 |
| A1882/84 | 3 | 60 | 34 | 320 | <1 |
| A1883/84 | 5 | 62 | 46 | 310 | <1 |
| A1884/84 | 6 | 80 | 52 | 390 | <1 |
| A1885/84 | 3 | 38 | 38 | 305 | <1 |
| A1886/84 | 5 | 160 | 96 | 415 | 1 |
| A1887/84 | 5 | 64 | 68 | 410 | <1 |
| A1888/84 | 2 | 56 | 54 | 520 | 1 |
| A1889/84 | 4 | 41 | 46 | 315 | <1 |
| A1890/84 | 4 | 56 | 38 | 305 | <1 |
| A1891/84 | 5 | 70 | 42 | 265 | <1 |
| A1892/84 | 7 | 78 | 44 | 395 | <1 |
| A1893/84 | 6 | 42 | 34 | 1240 | <1 |
| A1894/84 | 4 | 19 | 38 | 1880 | <1 |
| A1895/84 | 3 | 13 | 105 | 1920 | 1 |
| A1896/84 | 7 | 7 | 115 | 2060 | 1 |
| A1897/84 | 2 | 4 | 120 | 2160 | 1 |
| A1898/84 | 2 | 13 | 180 | 3380 | 1 |
| A1899/84 | 4 | 23 | 410 | 3140 | 3 |
| A1900/84 | 9 | 52 | 1220 | 2.43% | 8 |
| A1901/84 | 24 | 320 | 4380 | 26.0% | 10 |
| A1902/84 | 6 | 44 | 485 | 5500 | 3 |
| A1903/84 | 7 | 62 | 2980 | 17.0% | 2 |
| A1904/84 | 3 | 32 | 68 | 2340 | 1 |
| A1905/84 | 4 | 22 | 54 | 1840 | <1 |
| A1906/84 | 8 | 54 | 86 | 2440 | 1 |
| A1907/84 | 8 | 45 | 62 | 1400 | 1 |
| A1908/84 | 8 | 37 | 78 | 1780 | <1 |
| A1909/84 | 9 | 56 | 1780 | 3.04% | 3 |
| A1910/84 | 6 | 13 | 720 | 1.46% | 1 |
| A1911/84 | 7 | 22 | 450 | 8750 | 1 |
| Detn limit | (2) | (2) | (5) | (5) | (1) |

amdel

Analysis code A1/1 Report AC 1429/85 Page 3

NATA Certificate Order No. EX-242 Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A1912/84 | 14 | 27 | 275 | 5050 | 1 |
| A1913/84 | 6 | 86 | 130 | 2040 | 4 |
| A1914/84 | 4 | 60 | 170 | 2780 | 1 |
| A1915/84 | 20 | 105 | 140 | 2060 | 1 |
| A1916/84 | 10 | 52 | 275 | 4540 | 1 |
| A1917/84 | 6 | 8 | 175 | 5150 | <1 |
| A1918/84 | 4 | 10 | 320 | 5150 | 1 |
| A1919/84 | 5 | 12 | 225 | 5000 | 1 |
| A1920/84 | 5 | 190 | 335 | 6450 | 6 |
| A1921/84 | 3 | 23 | 145 | 5050 | 1 |
| A1922/84 | 4 | 16 | 210 | 3520 | 1 |
| A1923/84 | 4 | 46 | 520 | 4280 | 4 |
| A1924/84 | 3 | 11 | 115 | 2400 | 1 |
| A1925/84 | 4 | 5 | 155 | 2160 | 1 |
| A1926/84 | 3 | 12 | 445 | 2800 | 3 |
| A1927/84 | 3 | 7 | 145 | 2500 | 1 |
| A1928/84 | 5 | 5 | 74 | 2440 | <1 |
| A1929/84 | 7 | 60 | 54 | 660 | 1 |
| A1930/84 | 4 | 52 | 52 | 475 | <1 |
| A1931/84 | 4 | 54 | 50 | 780 | 1 |
| A1932/84 | 7 | 135 | 62 | 425 | 1 |
| A1933/84 | 4 | 88 | 50 | 460 | <1 |
| A1934/84 | 4 | 110 | 170 | 970 | 1 |
| A1935/84 | 4 | 145 | 155 | 830 | 1 |
| A1936/84 | 3 | 135 | 205 | 1180 | 1 |
| A1937/84 | 6 | 21 | 82 | 1780 | <1 |
| A1938/84 | 10 | 170 | 310 | 2380 | 1 |
| A1939/84 | 7 | 82 | 110 | 1620 | 1 |
| A1940/84 | 5 | 27 | 82 | 2000 | 1 |
| A1941/84 | 7 | 105 | 48 | 420 | <1 |
| A1942/84 | 4 | 52 | 66 | 455 | 1 |
| A1943/84 | 3 | 62 | 56 | 520 | 2 |
| A1944/84 | 3 | 90 | 40 | 820 | 5 |
| A1945/84 | 5 | 19 | 130 | 2300 | 1 |
| A1946/84 | 4 | 9 | 245 | 2180 | 3 |
| A1947/84 | 3 | 19 | 490 | 2800 | 5 |
| A1948/84 | 4 | 21 | 335 | 2880 | 2 |
| A1949/84 | 3 | 13 | 360 | 3220 | 4 |
| A1950/84 | 3 | 10 | 355 | 3520 | 2 |
| A1951/84 | 4 | 35 | 870 | 5250 | 8 |
| Detn limit | (2) | (2) | (5) | (5) | (1) |

amdel

Analysis code A1/1 Report AC 1429/85 Page 4

NATA Certificate Order No. EX-242 Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A1952/84 | 3 | 17 | 120 | 3300 | 1 |
| A1953/84 | 7 | 20 | 330 | 4780 | 2 |
| A1954/84 | 4 | 7 | 175 | 4400 | 1 |
| A1955/84 | 7 | 42 | 230 | 5650 | 2 |
| A1956/84 | 13 | 62 | 720 | 1.32% | 2 |
| A1957/84 | 10 | 16 | 125 | 7950 | <1 |
| A1958/84 | 6 | 11 | 155 | 4220 | 1 |
| A1959/84 | 6 | 8 | 150 | 4080 | 1 |
| A1960/84 | 4 | 10 | 415 | 1.18% | 1 |
| A1961/84 | 255 | 580 | 4840 | 26.3% | 12 |
| A1962/84 | 205 | 305 | 1.07% | 8.80% | 32 |
| A1963/84 | 90 | 105 | 4860 | 7600 | 10 |
| A1964/84 | 54 | 165 | 4940 | 4.22% | 7 |
| A1965/84 | 115 | 650 | 6650 | 9.12% | 11 |
| A1966/84 | 15 | 54 | 1680 | 2.45% | 3 |
| A1967/84 | 4 | 10 | 195 | 5800 | <1 |
| A1968/84 | 6 | 8 | 370 | 6250 | <1 |
| A1969/84 | 6 | 18 | 560 | 5700 | 2 |
| A1970/84 | 4 | 13 | 450 | 5550 | 1 |
| A1971/84 | 4 | 12 | 335 | 5600 | 1 |
| A1972/84 | 3 | 15 | 520 | 7350 | 2 |
| A1973/84 | 2 | 3 | 115 | 4920 | <1 |
| A1974/84 | 6 | 14 | 410 | 4840 | 1 |
| A1975/84 | 2 | 18 | 350 | 3720 | 2 |
| A1976/84 | 3 | 2 | 215 | 3360 | 1 |
| A1977/84 | 3 | 8 | 86 | 1880 | <1 |
| A1978/84 | 3 | <2 | 56 | 1160 | <1 |
| A1979/84 | 6 | 6 | 350 | 3000 | 1 |
| A1980/84 | 4 | <2 | 120 | 1940 | 1 |
| A1981/84 | 3 | 52 | 64 | 1500 | 2 |
| A1982/84 | 5 | 62 | 46 | 450 | 2 |
| A1983/84 | 2 | 64 | 60 | 620 | 2 |
| A1984/84 | 2 | 44 | 110 | 740 | 1 |
| A1985/84 | 25 | 38 | 46 | 340 | 1 |
| A1986/84 | 5 | 28 | 115 | 650 | 1 |
| A1987/84 | 3 | 44 | 82 | 480 | 4 |
| A1988/84 | 3 | 36 | 28 | 240 | 1 |
| A1989/84 | 5 | 80 | 40 | 640 | 7 |
| A1990/84 | 4 | 40 | 92 | 1600 | 2 |
| A1991/84 | 4 | 10 | 140 | 1840 | 1 |
| Detn limit | (2) | (2) | (5) | (5) | (1) |

Analysis code Al/1 Report AC 1429/85 

NATA Certificate Order No. EX-242 Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A1992/84 | 4 | 9 | 245 | 2240 | 1 |
| A1993/84 | 16 | 6 | 220 | 2660 | 1 |
| A1994/84 | 6 | 6 | 130 | 2720 | 1 |
| A1995/84 | 5 | 10 | 230 | 3660 | 1 |
| A1996/84 | 10 | 33 | 435 | 7950 | 4 |
| A1997/84 | 6 | 8 | 355 | 6000 | 1 |
| A1998/84 | 4 | <2 | 135 | 3760 | <1 |
| A1999/84 | 6 | <2 | 105 | 4040 | <1 |
| A2000/84 | 4 | <2 | 170 | 4840 | <1 |
| A2001/84 | 7 | 10 | 810 | 7200 | 2 |
| A2002/84 | 5 | <2 | 205 | 6300 | <1 |
| A2003/84 | 5 | 2 | 660 | 1.27% | <1 |
| A2004/84 | 17 | 30 | 6000 | 7.12% | 16 |
| A2005/84 | 200 | 225 | 4060 | 1.74% | 7 |
| A2006/84 | 195 | 68 | 5250 | 20.3% | 39 |
| A2007/84 | 37 | 68 | 2960 | 4.20% | 9 |
| A2008/84 | 7 | 14 | 1920 | 3.49% | 3 |
| A2009/84 | 5 | 4 | 220 | 6900 | <1 |
| A2010/84 | 4 | 3 | 270 | 1300 | <1 |
| A2011/84 | 4 | 2 | 245 | 6900 | 1 |
| A2012/84 | 3 | 6 | 220 | 4240 | 1 |
| A2013/84 | 4 | 3 | 185 | 3260 | 1 |
| A2014/84 | 5 | 3 | 240 | 3420 | 1 |
| A2015/84 | 4 | 115 | 64 | 740 | 1 |
| A2016/84 | 7 | 56 | 90 | 740 | 2 |
| A2017/84 | 7 | 88 | 115 | 1000 | 3 |
| A2018/84 | 4 | 43 | 94 | 710 | 1 |
| A2019/84 | 7 | 165 | 345 | 3020 | 3 |
| A2020/84 | 5 | 105 | 100 | 435 | 1 |
| A2021/84 | 3 | 90 | 105 | 610 | 1 |
| A2022/84 | 6 | 28 | 990 | 4140 | 3 |
| A2023/84 | 4 | 10 | 180 | 4080 | <1 |
| A2024/84 | 7 | 18 | 860 | 5200 | 2 |
| A2025/84 | 6 | 16 | 800 | 6200 | 1 |
| A2026/84 | 5 | 11 | 1280 | 1.40% | 1 |
| A2027/84 | 25 | 38 | 2560 | 6.56% | 9 |
| A2028/84 | 45 | 150 | 5300 | 13.7% | 19 |
| A2029/84 | 58 | 115 | 5350 | 8.56% | 17 |
| A2030/84 | 6 | 11 | 120 | 2020 | 1 |
| A2031/84 | 4 | 8 | 38 | 560 | 1 |
| | | | | | |
| Detn limit | (2) | (2) | (5) | (5) | (1) |

amdel

Analysis code A1/1 Report AC 1429/85 Page 6

NATA Certificate Order No. EX-242 Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A2032/84 | 5 | 13 | 24 | 295 | 1 |
| A2033/84 | 180 | 470 | 1980 | 11.1% | 12 |
| A2034/84 | 60 | 68 | 3300 | 21.6% | 8 |
| A2035/84 | 11 | 14 | 660 | 1.71% | 1 |
| A2036/84 | 7 | 125 | 740 | 8850 | 2 |
| A2037/84 | 3 | 9 | 440 | 3380 | 1 |
| A2038/84 | 7 | 11 | 195 | 1900 | <1 |
| A2039/84 | 4 | 24 | 66 | 2240 | 1 |
| A2040/84 | 3 | 46 | 96 | 1940 | 2 |
| A2041/84 | 3 | 5 | 14 | 295 | <1 |
| A2042/84 | 5 | 8 | 325 | 1540 | 1 |
| A2043/84 | 5 | 28 | 94 | 3800 | 1 |
| A2044/84 | 12 | 11 | 145 | 8650 | 1 |
| A2045/84 | 12 | 30 | 285 | 5800 | 1 |
| A2046/84 | 10 | 64 | 330 | 6450 | 1 |
| A2047/84 | 18 | 135 | 940 | 1.18% | 1 |
| A2048/84 | 9 | 20 | 650 | 6750 | 1 |
| A2049/84 | 8 | 10 | 970 | 7550 | 1 |
| A2050/84 | 34 | 185 | 1.26% | 25.5% | 74 |
| A2051/84 | 3 | 14 | 180 | 2800 | 1 |
| A2052/84 | 3 | 7 | 36 | 570 | <1 |
| A2053/84 | 5 | 8 | 84 | 1180 | <1 |
| A2054/84 | 9 | 14 | 760 | 3040 | 1 |
| A2055/84 | 15 | 12 | 165 | 3280 | <1 |
| A2056/84 | 8 | 17 | 195 | 5550 | <1 |
| A2057/84 | 12 | 27 | 270 | 5450 | <1 |
| A2058/84 | 6 | 14 | 215 | 3560 | <1 |
| A2059/84 | 9 | 17 | 120 | 4120 | <1 |
| A2060/84 | 9 | 23 | 170 | 2520 | <1 |
| A2061/84 | 7 | 90 | 72 | 1680 | <1 |
| A2062/84 | 7 | 70 | 74 | 1740 | <1 |
| A2063/84 | 9 | 39 | 46 | 1420 | <1 |
| A2064/84 | 19 | 350 | 110 | 1140 | <1 |
| A2065/84 | 6 | 35 | 86 | 800 | <1 |
| A2066/84 | 5 | 26 | 48 | 830 | <1 |
| A2067/84 | 6 | 24 | 96 | 890 | 1 |
| A2068/84 | 12 | 34 | 36 | 1880 | <1 |
| A2069/84 | 15 | 6 | 24 | 2420 | <1 |
| A2070/84 | 6 | 8 | 50 | 2060 | 1 |
| A2071/84 | 8 | 7 | 110 | 1920 | <1 |
| A2072/84 | 5 | 10 | 8 | 145 | <1 |
| A2073/84 | 8 | 5 | 8 | 110 | <1 |
| A2074/84 | 5 | 7 | 6 | 70 | <1 |
| A2075/84 | 6 | 11 | 6 | 94 | <1 |
| A2076/84 | 4 | 9 | 8 | 82 | <1 |
| Detn limit | (2) | (2) | (5) | (5) | (1) |

amdel

Analysis code A1/1,2 Report AC 5301/85 Page G1

NATA Certificate Order No. 12/03/178 Results in ppm

| Sample | Cu | Pb | Zn | As | Mn | Cd |
|---|---|---|---|---|---|---|
| A 350/85 | 9 | 14 | 29 | <2 | 320 | <1 |
| A 351/85 | 9 | 12 | 34 | <2 | 600 | <1 |
| A 352/85 | 12 | 48 | 21 | <2 | 260 | <1 |
| A 353/85 | 4 | 28 | 18 | 2 | 410 | <1 |
| A 354/85 | 3 | 9 | 32 | 3 | 325 | <1 |
| A 355/85 | No sample received. | | | | | |
| A 356/85 | 7 | 48 | 115 | 7 | 890 | <1 |
| A 357/85 | 47 | 375 | 335 | 50 | 1880 | <1 |
| A 358/85 | 10 | 37 | 58 | <2 | 680 | <1 |
| A 359/85 | 6 | 41 | 115 | <2 | 820 | <1 |
| A 360/85 | 6 | 43 | 48 | <2 | 550 | <1 |
| A 361/85 | 6 | 45 | 110 | <2 | 690 | <1 |
| A 362/85 | 7 | 13 | 110 | <2 | 990 | <1 |
| A 363/85 | 3 | 3 | 9 | 2 | 190 | <1 |
| A 364/85 | 8 | 15 | 64 | <2 | 540 | <1 |
| A 365/85 | 7 | 82 | 30 | 2 | 640 | <1 |
| A 366/85 | 4 | 23 | 32 | <2 | 415 | <1 |
| A 367/85 | 3 | 15 | 29 | <2 | 490 | <1 |
| A 368/85 | 3 | 15 | 76 | 2 | 540 | <1 |
| A 369/85 | 5 | 30 | 110 | <2 | 930 | <1 |
| A 370/85 | 2 | 28 | 27 | <2 | 990 | <1 |
| A 371/85 | <2 | 48 | 22 | <2 | 1260 | <1 |
| A 372/85 | 2 | 12 | 16 | <2 | 1060 | <1 |
| A 373/85 | <2 | 18 | 19 | 2 | 990 | <1 |
| A 374/85 | 3 | 48 | 70 | 4 | 960 | <1 |
| A 375/85 | 180 | 170 | 100 | 3 | 910 | <1 |
| A 376/85 | 4 | 74 | 64 | <2 | 1340 | <1 |
| A 377/85 | 5 | 375 | 45 | <2 | 710 | <1 |
| A 378/85 | 4 | 570 | 365 | 4 | 690 | <1 |
| A 379/85 | 10 | 980 | 88 | 15 | 830 | <1 |
| A 380/85 | 6 | 640 | 86 | 10 | 670 | <1 |
| A 381/85 | 5 | 550 | 60 | 12 | 590 | <1 |
| A 382/85 | 3 | 215 | 125 | <2 | 570 | <1 |
| A 383/85 | 5 | 480 | 315 | 3 | 640 | <1 |
| A 384/85 | 3 | 255 | 175 | 2 | 640 | <1 |
| A 385/85 | 8 | 1440 | 310 | 11 | 1280 | <1 |
| A 386/85 | 7 | 210 | 35 | <2 | 620 | <1 |
| A 387/85 | 20 | 870 | 125 | 6 | 1140 | <1 |
| A 388/85 | 21 | 1060 | 86 | 15 | 960 | <1 |
| A 389/85 | 58 | 590 | 120 | 6 | 1340 | <1 |
| A 390/85 | 3 | 4 | 32 | <2 | 1580 | <1 |
| | | | | | | |
| Detn limit | (2) | (2) | (2) | (2) | (5) | (1) |

amdel

Analysis code A1/1.2 Report AC 5301/85 Page G2

NATA Certificate Order No. 12/03/178 Results in ppm

| Sample | Cu | Pb | Zn | As | Mn | Cd |
|---|---|---|---|---|---|---|
| A 391/85 | 66 | 12 | 105 | 4 | 1740 | <1 |
| A 392/85 | 47 | 6350 | 1420 | 13 | 1320 | 3 |
| A 393/85 | 16 | 1040 | 230 | 12 | 1800 | <1 |
| A 394/85 | 13 | 1020 | 325 | 19 | 950 | <1 |
| A 395/85 | 9 | 185 | 155 | 4 | 710 | <1 |
| A 396/85 | 7 | 300 | 600 | <2 | 760 | <1 |
| A 397/85 | 3 | 365 | 48 | 2 | 465 | <1 |
| A 398/85 | 7 | 410 | 225 | <2 | 620 | <1 |
| A 399/85 | 6 | 165 | 180 | <2 | 580 | <1 |
| A 400/85 | 5 | 380 | 110 | <2 | 640 | <1 |
| A 401/85 | 4 | 250 | 195 | <2 | 415 | <1 |
| A 402/85 | 5 | 285 | 190 | <2 | 410 | <1 |
| A 403/85 | 12 | 1000 | 150 | 17 | 1000 | <1 |
| A 404/85 | 3 | 230 | 23 | <2 | 1320 | <1 |
| A 405/85 | 3 | 125 | 62 | <2 | 1260 | <1 |
| A 406/85 | 4 | 76 | 21 | <2 | 880 | <1 |
| A 407/85 | 4 | 155 | 70 | 4 | 980 | <1 |
| A 408/85 | 3 | 50 | 37 | 3 | 870 | <1 |
| A 409/85 | 2 | 22 | 28 | <2 | 900 | <1 |
| A 410/85 | 2 | 28 | 33 | <2 | 1140 | <1 |
| A 411/85 | 3 | 110 | 15 | <2 | 385 | <1 |
| A 412/85 | 4 | 29 | 12 | <2 | 275 | <1 |
| A 413/85 | 4 | 11 | 31 | <2 | 650 | <1 |
| A 414/85 | 4 | 33 | 22 | 2 | 300 | <1 |
| A 415/85 | 45 | 6 | 28 | 2 | 435 | <1 |
| A 416/85 | 4 | 12 | 30 | 2 | 500 | <1 |
| A 417/85 | 5 | 27 | 29 | 2 | 620 | <1 |
| A 418/85 | 3 | 30 | 20 | <2 | 300 | <1 |
| A 419/85 | 3 | 4 | 16 | 5 | 250 | <1 |
| A 420/85 | 3 | 52 | 18 | <2 | 265 | <1 |
| A 421/85 | 5 | 90 | 56 | <2 | 630 | <1 |
| A 422/85 | 5 | 29 | 45 | <2 | 425 | <1 |
| A 423/85 | 5 | 45 | 84 | 2 | 500 | <1 |
| A 424/85 | 3 | 72 | 30 | <2 | 485 | 2 |
| A 425/85 | 13 | 205 | 130 | <2 | 700 | <1 |
| A 426/85 | 15 | 82 | 74 | <2 | 700 | <1 |
| A 427/85 | 8 | 96 | 88 | <2 | 710 | <1 |
| A 428/85 | 7 | 72 | 105 | <2 | 790 | <1 |
| A 429/85 | 6 | 190 | 34 | <2 | 450 | <1 |
| A 430/85 | 10 | 315 | 32 | <2 | 820 | <1 |
| A 431/85 | No sample received. | | | | | |
| Detn limit | (2) | (2) | (2) | (2) | (5) | (1) |

amdel

Analysis code A1/1.2 Report AC 5301/85 Page G3

NATA Certificate Order No. 12/03/178 Results in ppm

| Sample | Cu | Pb | Zn | As | Mn | Cd |
|---|---|---|---|---|---|---|
| A 432/85 | 4 | 88 | 32 | <2 | 495 | <1 |
| A 433/85 | 4 | 34 | 17 | <2 | 260 | <1 |
| A 434/85 | 2 | 10 | 8 | <2 | 240 | <1 |
| A 435/85 | 10 | 14 | 9 | <2 | 255 | <1 |
| A 436/85 | 5 | <2 | 13 | <2 | 800 | <1 |
| A 437/85 | 6 | 76 | 27 | <2 | 560 | <1 |
| A 438/85 | 5 | 375 | 43 | <2 | 680 | <1 |
| A 439/85 | 7 | 145 | 16 | <2 | 700 | <1 |
| A 440/85 | 5 | 270 | 23 | <2 | 720 | <1 |
| A 441/85 | 11 | 250 | 21 | 4 | 750 | <1 |
| A 442/85 | 5 | 195 | 27 | 4 | 660 | <1 |
| A 443/85 | 14 | 165 | 72 | 5 | 900 | <1 |
| A 444/85 | 10 | 135 | 37 | <2 | 1040 | <1 |
| A 445/85 | 5 | 66 | 26 | <2 | 680 | <1 |
| A 446/85 | 4 | 110 | 32 | <2 | 770 | 1 |
| A 447/85 | 8 | 170 | 34 | 5 | 780 | <1 |
| A 448/85 | 4 | 74 | 29 | <2 | 780 | <1 |
| A 449/85 | 3 | 56 | 42 | <2 | 970 | <1 |
| A 450/85 | 9 | 30 | 38 | 2 | 870 | <1 |
| A 451/85 | 4 | 70 | 27 | 2 | 1340 | <1 |
| A 452/85 | 17 | 96 | 38 | 3 | 1060 | <1 |
| A 453/85 | 5 | 205 | 28 | <2 | 650 | <1 |
| A 454/85 | 2 | 29 | 18 | <2 | 315 | <1 |
| A 455/85 | 3 | 10 | 10 | <2 | 220 | <1 |
| A 456/85 | 4 | 8 | 43 | <2 | 680 | <1 |
| A 457/85 | 5 | 12 | 22 | <2 | 410 | <1 |
| A 458/85 | 2 | 28 | 13 | <2 | 255 | <1 |
| A 459/85 | 4 | 5 | 17 | 2 | 295 | <1 |
| A 460/85 | 80 | 230 | 450 | 26 | 255 | <1 |
| A 461/85 | 5 | 36 | 8 | <2 | 220 | 1 |
| A 462/85 | 8 | 64 | 34 | <2 | 510 | <1 |
| A 463/85 | 21 | 100 | 48 | 4 | 255 | <1 |
| A 464/85 | 105 | 145 | 115 | 12 | 530 | <1 |
| A 465/85 | 16 | 110 | 49 | <2 | 340 | <1 |
| A 466/85 | 20 | 185 | 94 | 7 | 430 | <1 |
| A 467/85 | 5 | 3040 | 25 | 8 | 690 | <1 |
| A 468/85 | 5 | 125 | 35 | <2 | 610 | <1 |
| A 469/85 | 2 | 105 | 4 | <2 | 250 | <1 |
| A 470/85 | 5 | 220 | 15 | 3 | 425 | <1 |
| A 471/85 | 11 | 570 | 19 | 18 | 960 | <1 |
| Detn limit | (2) | (2) | (2) | (2) | (5) | (1) |

amdel

Analysis code A1/1,2 Report AC 5301/85 Page G4

NATA Certificate Order No. 12/03/178 Results in ppm

| Sample | Cu | Pb | Zn | As | Mn | Cd |
|---|---|---|---|---|---|---|
| A 472/85 | 4 | 32 | 6 | <2 | 425 | <1 |
| A 473/85 | 3 | 68 | 9 | 2 | 390 | <1 |
| A 474/85 | <2 | 13 | 13 | <2 | 250 | <1 |
| A 475/85 | 6 | 34 | 26 | <2 | 305 | <1 |
| A 476/85 | <2 | 6 | <2 | <2 | 165 | <1 |
| A 477/85 | 2 | <2 | <2 | 2 | 185 | <1 |
| A 478/85 | 3 | <2 | 6 | <2 | 145 | <1 |
| A 479/85 | <2 | <2 | 6 | <2 | 250 | <1 |
| A 480/85 | 2 | 3 | 8 | <2 | 215 | <1 |
| A 481/85 | 2 | <2 | 3 | <2 | 185 | <1 |
| A 482/85 | 2 | <2 | 9 | <2 | 285 | <1 |
| A 483/85 | 3 | 3 | 10 | 3 | 630 | <1 |
| A 484/85 | 31 | 58 | 11 | <2 | 750 | <1 |
| A 485/85 | 6 | 7 | 12 | 2 | 520 | <1 |
| A 486/85 | 3 | 5 | 18 | <2 | 1040 | <1 |
| A 487/85 | 6 | 3 | 36 | <2 | 600 | <1 |
| A 488/85 | 4 | <2 | 31 | <2 | 640 | <1 |
| A 489/85 | 27 | 5 | 115 | <2 | 1320 | 1 |
| A 490/85 | 23 | 17 | 68 | 3 | 1040 | <1 |
| A 491/85 | 13 | 10 | 35 | <2 | 475 | 1 |
| A 492/85 | 5 | <2 | 45 | <2 | 790 | <1 |
| A 493/85 | 4 | <2 | 15 | 2 | 415 | <1 |
| A 494/85 | 8 | 11 | 31 | <2 | 510 | <1 |
| A 495/85 | 8 | 13 | 21 | 2 | 295 | 1 |
| A 496/85 | 3 | 8 | 34 | 2 | 345 | <1 |
| A 497/85 | 3 | 26 | 54 | <2 | 445 | <1 |
| A 498/85 | <2 | <2 | 6 | 3 | 105 | <1 |
| A 499/85 | 2 | 5 | 50 | <2 | 445 | <1 |
| A 500/85 | <2 | 6 | 66 | 2 | 590 | <1 |
| A 501/85 | 3 | 33 | 50 | <2 | 530 | <1 |
| A 502/85 | 5 | 33 | 52 | 6 | 510 | <1 |
| A 503/85 | 3 | 30 | 125 | <2 | 550 | <1 |
| A 504/85 | <2 | 24 | 56 | <2 | 600 | <1 |
| A 505/85 | 10 | 175 | 47 | 3 | 445 | <1 |
| A 506/85 | 4 | 27 | 26 | <2 | 430 | <1 |
| A 507/85 | 11 | 100 | 27 | <2 | 570 | <1 |
| A 508/85 | 3 | 66 | 22 | <2 | 580 | <1 |
| A 509/85 | 4 | 130 | 36 | 2 | 510 | <1 |
| A 510/85 | <2 | <2 | 27 | <2 | 910 | <1 |
| A 511/85 | 4 | <2 | 15 | <2 | 1500 | <1 |
| Detn limit | (2) | (2) | (2) | (2) | (5) | (1) |

amdel

Analysis code A1/1,2    Report AC 5301/85    Page G5

NATA Certificate    Order No. 12/03/178    Results in ppm

| Sample | Cu | Pb | Zn | As | Mn | Cd |
|---|---|---|---|---|---|---|
| A 512/85 | 2 | 86 | 27 | <2 | 740 | <1 |
| A 513/85 | <2 | 56 | 8 | <2 | 165 | <1 |
| A 514/85 | <2 | 7 | <2 | <2 | 470 | <1 |
| A 515/85 | 2 | 10 | 13 | <2 | 285 | <1 |
| A 516/85 | 170 | 155 | 17 | <2 | 360 | <1 |
| A 517/85 | 3 | 13 | 25 | <2 | 185 | <1 |
| A 518/85 | 2 | <2 | 6 | <2 | 140 | <1 |
| A 519/85 | 2 | <2 | 15 | 3 | 185 | <1 |
| A 520/85 | <2 | <2 | 8 | <2 | 160 | <1 |
| A 521/85 | 4 | 12 | 22 | <2 | 165 | <1 |
| A 522/85 | 2 | 43 | 23 | <2 | 250 | <1 |
| A 523/85 | 4 | 100 | 74 | <2 | 540 | <1 |
| A 524/85 | 16 | 130 | 165 | 2 | 1460 | <1 |
| A 525/85 | 9 | 70 | 165 | 5 | 590 | <1 |
| A 526/85 | 5 | 28 | 45 | <2 | 465 | <1 |
| A 527/85 | 6 | 34 | 130 | <2 | 730 | <1 |
| A 528/85 | 14 | 105 | 280 | <2 | 2160 | <1 |
| A 529/85 | 4 | 30 | 210 | <2 | 2040 | <1 |
| A 530/85 | 2 | 36 | 42 | <2 | 330 | <1 |
| A 531/85 | 5 | 10 | 29 | 3 | 480 | <1 |
| A 532/85 | 5 | 33 | 680 | 6 | 1720 | <1 |
| A 533/85 | 2 | <2 | 110 | <2 | 840 | <1 |
| A 534/85 | 3 | <2 | 27 | 2 | 365 | <1 |
| A 535/85 | 4 | 14 | 45 | 2 | 520 | <1 |
| A 536/85 | 2 | <2 | 72 | <2 | 660 | <1 |
| A 537/85 | 2 | 13 | 13 | <2 | 195 | <1 |
| A 538/85 | 11 | 18 | 100 | <2 | 480 | <1 |
| A 539/85 | 16 | 80 | 170 | 2 | 530 | <1 |
| A 540/85 | 7 | 3 | 56 | 2 | 325 | <1 |
| A 541/85 | 5 | 13 | 34 | 4 | 340 | <1 |
| A 542/85 | 7 | 45 | 115 | <2 | 720 | <1 |
| A 543/85 | 7 | 24 | 96 | <2 | 660 | <1 |
| A 544/85 | 9 | 45 | 60 | 2 | 760 | <1 |
| A 545/85 | 19 | 43 | 90 | 2 | 1180 | <1 |
| A 546/85 | 3 | 27 | 27 | 2 | 580 | <1 |
| A 547/85 | 8 | 62 | 23 | <2 | 465 | <1 |
| A 548/85 | 7 | 96 | 27 | <2 | 610 | <1 |
| A 549/85 | 13 | 195 | 39 | <2 | 1120 | <1 |
| A 550/85 | 5 | 42 | 14 | 3 | 1640 | <1 |
| A 1000/85 | 4 | 12 | 21 | <2 | 345 | <1 |
| Detn limit | (2) | (2) | (2) | (2) | (5) | (1) |

amdel

Analysis code A1/1,2 Report AC 5301/85 

NATA Certificate Order No. 12/03/178 Results in ppm

| Sample | Cu | Pb | Zn | As | Mn | Cd |
|---|---|---|---|---|---|---|
| A 1001/85 | 9 | 225 | 27 | 3 | 920 | <1 |
| A 1002/85 | 15 | 72 | 15 | <2 | 490 | <1 |
| A 1003/85 | 4 | 70 | 17 | <2 | 310 | <1 |
| A 1004/85 | 5 | 15 | 47 | 2 | 560 | <1 |
| A 1005/85 | 22 | 29 | 34 | <2 | 610 | <1 |
| A 1006/85 | 3 | 26 | 35 | <2 | 370 | <1 |
| A 1007/85 | 7 | 32 | 31 | 3 | 410 | <1 |
| A 1008/85 | 5 | 82 | 25 | <2 | 440 | <1 |
| A 1009/85 | 38 | 52 | 22 | <2 | 1400 | <1 |
| A 1010/85 | 3 | 56 | 37 | 2 | 830 | <1 |
| A 1011/85 | 3 | 38 | 42 | 4 | 620 | <1 |
| A 1012/85 | 7 | 14 | 33 | <2 | 800 | <1 |
| A 1013/85 | 9 | 29 | 66 | <2 | 1120 | <1 |
| A 1014/85 | 10 | 44 | 54 | <2 | 590 | <1 |
| A 1015/85 | 4 | 68 | 28 | <2 | 440 | <1 |
| A 1016/85 | 5 | 23 | 45 | <2 | 520 | <1 |
| A 1017/85 | 4 | 29 | 40 | <2 | 610 | <1 |
| A 1018/85 | 5 | 5 | 36 | <2 | 425 | <1 |
| A 1019/85 | 3 | 7 | 37 | <2 | 350 | <1 |
| A 1020/85 | 4 | <2 | 47 | <2 | 485 | <1 |
| A 1021/85 | 3 | 19 | 18 | 3 | 315 | <1 |
| A 1022/85 | 4 | 23 | 16 | <2 | 205 | <1 |
| A 1023/85 | 2 | 2 | 12 | <2 | 180 | <1 |
| A 1024/85 | 2 | 3 | 14 | 2 | 205 | <1 |
| A 1025/85 | 3 | 16 | 14 | <2 | 275 | <1 |
| A 1026/85 | 2 | 11 | 18 | <2 | 235 | <1 |
| A 1027/85 | 3 | 25 | 30 | <2 | 270 | <1 |
| A 1028/85 | 5 | 82 | 26 | <2 | 390 | <1 |
| A 1029/85 | 5 | 9 | 37 | <2 | 770 | <1 |
| A 1030/85 | <2 | <2 | 22 | <2 | 970 | <1 |
| A 1031/85 | <2 | <2 | 15 | <2 | 460 | <1 |
| A 1032/85 | 4 | 6 | 35 | 4 | 1200 | <1 |
| A 1033/85 | 2 | 6 | 11 | <2 | 1020 | <1 |
| A 1034/85 | 2 | <2 | 22 | 2 | 1020 | <1 |
| A 1035/85 | 2 | <2 | 7 | <2 | 980 | <1 |
| A 1036/85 | 2 | <2 | 10 | 2 | 960 | <1 |
| A 1037/85 | 2 | <2 | 4 | <2 | 1160 | <1 |
| A 1038/85 | 2 | <2 | 6 | <2 | 640 | <1 |
| A 1039/85 | 2 | 18 | 18 | 3 | 910 | <1 |
| A 1040/85 | 3 | 5 | 23 | 2 | 990 | <1 |
| Detn limit | (2) | (2) | (2) | (2) | (5) | (1) |

amdel

Analysis code A1/1,2 Report AC 5301/85 Page G7

NATA Certificate Order No. 12/03/178 Results in ppm

| Sample | Cu | Pb | Zn | As | Mn | Cd |
|---|---|---|---|---|---|---|
| A 1041/85 | 5 | 41 | 18 | <2 | 900 | <1 |
| A 1042/85 | 4 | 68 | 24 | 3 | 820 | <1 |
| A 1043/85 | 5 | 175 | 33 | 4 | 710 | <1 |
| A 1044/85 | 4 | 160 | 46 | <2 | 820 | <1 |
| A 1045/85 | 2 | 27 | 26 | <2 | 750 | <1 |
| A 1046/85 | 4 | 40 | 45 | 3 | 1300 | <1 |
| A 1047/85 | 3 | 32 | 38 | <2 | 830 | <1 |
| A 1048/85 | 9 | 10 | 28 | <2 | 610 | <1 |
| A 1049/85 | 3 | <2 | 33 | <2 | 990 | <1 |
| A 1050/85 | 4 | 36 | 54 | <2 | 950 | <1 |
| A 1051/85 | 3 | 34 | 49 | <2 | 490 | <1 |
| A 1052/85 | 4 | 19 | 31 | 3 | 500 | <1 |
| A 1053/85 | 2 | 11 | 6 | 2 | 270 | <1 |
| A 1054/85 | 2 | 7 | 32 | <2 | 550 | <1 |
| A 1055/85 | 3 | 20 | 29 | <2 | 415 | <1 |
| A 1056/85 | 4 | 13 | 26 | 2 | 395 | <1 |
| A 1057/85 | 4 | 36 | 32 | <2 | 370 | <1 |
| A 1058/85 | 24 | 205 | 20 | <2 | 290 | 1 |
| A 1059/85 | 3 | 10 | 23 | 5 | 355 | <1 |
| A 1060/85 | 10 | 54 | 52 | <2 | 335 | <1 |
| A 1061/85 | 4 | 50 | 31 | 2 | 295 | <1 |
| A 1062/85 | 8 | 52 | 45 | 3 | 430 | <1 |
| A 1063/85 | 4 | 64 | 21 | 2 | 240 | <1 |
| A 1064/85 | 4 | 37 | 78 | <2 | 830 | <1 |
| A 1065/85 | 12 | 135 | 82 | 6 | 820 | <1 |
| A 1066/85 | 9 | 72 | 94 | <2 | 730 | <1 |
| A 1067/85 | 14 | 88 | 100 | 2 | 670 | <1 |
| A 1068/85 | 9 | 110 | 50 | <2 | 445 | <1 |
| A 1069/85 | 7 | 66 | 33 | <2 | 510 | <1 |
| A 1070/85 | 13 | 62 | 44 | 3 | 1060 | <1 |
| A 1071/85 | 120 | 370 | 4000 | 5 | 7.88% | 3 |
| Detn limit | (2) | (2) | (2) | (2) | (5) | (1) |

amdel

Analysis code A1/1.2 | Report AC 443/86 | Page G2

NATA Certificate | Order No. 12/03/185 | Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A 551/85 | 9 | 345 | 42 | 1420 | <1 | <2 |
| A 552/85 | 7 | 195 | 34 | 1460 | <1 | <2 |
| A 553/85 | 6 | 155 | 52 | 1580 | <1 | 2 |
| A 554/85 | 5 | 4 | 18 | .620 | <1 | 4 |
| A 555/85 | 5 | <4 | 27 | 1360 | <1 | 5 |
| A 556/85 | 3 | <4 | 16 | 520 | <1 | 3 |
| A 557/85 | 3 | 4 | 19 | 440 | <1 | <2 |
| A 558/85 | 2 | <4 | 9 | 170 | <1 | 2 |
| A 559/85 | 2 | <4 | 12 | 160 | <1 | <2 |
| A 560/85 | 6 | 8 | 24 | 200 | <1 | <2 |
| A 561/85 | 3 | 6 | 15 | 195 | <1 | 3 |
| A 562/85 | <2 | 10 | 11 | 245 | <1 | <2 |
| A 563/85 | 6 | 14 | 26 | 260 | <1 | 3 |
| A 564/85 | 3 | 14 | 12 | 205 | <1 | <2 |
| A 565/85 | 4 | 24 | 28 | 225 | <1 | 4 |
| A 566/85 | 5 | 34 | 20 | 265 | <1 | <2 |
| A 567/85 | 5 | 74 | 78 | 570 | <1 | <2 |
| A 568/85 | 5 | 32 | 41 | 510 | <1 | <2 |
| A 569/85 | 5 | 24 | 27 | 410 | <1 | 2 |
| A 570/85 | 4 | 26 | 21 | 620 | <1 | 2 |
| A 571/85 | 5 | 10 | 25 | 420 | <1 | <2 |
| A 572/85 | 6 | 62 | 28 | 600 | <1 | <2 |
| A 573/85 | 6 | 18 | 16 | 355 | <1 | <2 |
| A 574/85 | 4 | 8 | 13 | 285 | <1 | <2 |
| A 575/85 | 7 | 10 | 21 | 370 | <1 | 3 |
| A 576/85 | 2 | <4 | 13 | 165 | <1 | 4 |
| A 577/85 | 16 | 115 | 60 | 380 | <1 | 7 |
| A 578/85 | 8 | 42 | 28 | 295 | <1 | <2 |
| A 579/85 | 5 | 40 | 35 | 370 | <1 | 4 |
| A 580/85 | 5 | 12 | 40 | 610 | <1 | 3 |
| A 581/85 | 15 | 34 | 64 | 435 | <1 | 2 |
| A 582/85 | 14 | 22 | 52 | 340 | <1 | 4 |
| A 583/85 | 9 | 40 | 45 | 590 | <1 | <2 |
| A 584/85 | 160 | 260 | 335 | 365 | <1 | 33 |
| A 585/85 | 11 | 225 | 34 | 415 | <1 | 4 |
| A 586/85 | 9 | 105 | 33 | 415 | <1 | <2 |
| A 587/85 | 15 | 155 | 40 | 420 | <1 | <2 |
| A 588/85 | 8 | 160 | 24 | 285 | <1 | <2 |
| A 589/85 | 8 | 115 | 42 | 700 | <1 | <2 |
| A 590/85 | 5 | 32 | 30 | 990 | <1 | <2 |
| Detn limit | (2) | (4) | (2) | (5) | (1) | (2) |

amdel

Analysis code A1/1,2 Report AC 443/86 

NATA Certificate Order No. 12/03/185 Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A 591/85 | 39 | 105 | 140 | 830 | <1 | 80 |
| A 592/85 | 6 | 4 | 40 | 1080 | <1 | <2 |
| A 593/85 | 9 | 4 | 33 | 1420 | <1 | <2 |
| A 594/85 | 5 | <4 | 60 | 1520 | <1 | <2 |
| A 595/85 | 44 | 8 | 205 | 1880 | <1 | <2 |
| A 596/85 | 8 | 12 | 36 | 1140 | <1 | <2 |
| A 597/85 | 6 | 70 | 36 | 380 | <1 | 6 |
| A 598/85 | 4 | 8 | 11 | 250 | <1 | 3 |
| A 599/85 | 7 | 24 | 22 | 240 | <1 | <2 |
| A 600/85 | 5 | <4 | 49 | 435 | <1 | 3 |
| A 601/85 | 6 | 22 | 24 | 305 | <1 | <2 |
| A 602/85 | 5 | 18 | 18 | 210 | <1 | <2 |
| A 603/85 | 17 | 235 | 6.10% | 1260 | 2 | 305 |
| A 604/85 | 30 | 295 | 800 | 1300 | 4 | 12 |
| A 605/85 | 4 | 12 | 220 | 385 | <1 | <2 |
| A 606/85 | 8 | 34 | 88 | 560 | <1 | <2 |
| A 607/85 | 2 | 20 | 165 | 520 | <1 | <2 |
| A 608/85 | 2 | 14 | 160 | 980 | <1 | <2 |
| A 609/85 | 6 | 125 | 62 | 425 | <1 | <2 |
| A 610/85 | 5 | 62 | 96 | 810 | <1 | 3 |
| A 611/85 | 4 | 110 | 76 | 760 | <1 | <2 |
| A 612/85 | <2 | <4 | 19 | 320 | <1 | <2 |
| A 613/85 | 7 | 14 | 41 | 375 | <1 | 2 |
| A 614/85 | 135 | 235 | 200 | 180 | <1 | 12 |
| A 615/85 | 3 | 42 | 26 | 240 | <1 | 2 |
| A 616/85 | 12 | 92 | 32 | 260 | <1 | <2 |
| A 617/85 | 5 | 46 | 26 | 290 | <1 | <2 |
| A 618/85 | 9 | 54 | 68 | 1020 | <1 | <2 |
| A 619/85 | 10 | 40 | 135 | 860 | <1 | <2 |
| A 620/85 | 5 | 20 | 44 | 360 | <1 | <2 |
| A 621/85 | 20 | 80 | 120 | 1300 | <1 | <2 |
| A 622/85 | 11 | 175 | 180 | 610 | <1 | <2 |
| A 623/85 | 12 | 245 | 135 | 1080 | <1 | <2 |
| A 624/85 | 10 | 205 | 47 | 445 | <1 | <2 |
| A 625/85 | 10 | 325 | 50 | 330 | <1 | <2 |
| A 626/85 | 15 | 235 | 66 | 340 | <1 | <2 |
| A 627/85 | 24 | 98 | 110 | 1080 | <1 | 7 |
| A 628/85 | 56 | 495 | 170 | 1620 | <1 | 35 |
| A 629/85 | 13 | <4 | 56 | 1020 | <1 | 2 |
| A 630/85 | 92 | 38 | 230 | 1660 | <1 | 4 |
| Detn limit | (2) | (4) | (2) | (5) | (1) | (2) |

amdel

Analysis code A1/1,2 Report AC 443/86 Page G4

NATA Certificate Order No. 12/03/185 Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A 631/85 | 10 | 8 | 265 | 1640 | <1 | <2 |
| A 632/85 | 7 | 38 | 620 | 2320 | <1 | <2 |
| A 633/85 | 4 | 20 | 54 | 360 | <1 | <2 |
| A 634/85 | 5 | 20 | 23 | 190 | <1 | 2 |
| A 635/85 | 4 | 4 | 28 | 220 | <1 | <2 |
| A 636/85 | 3 | 16 | 27 | 180 | <1 | <2 |
| A 637/85 | 6 | 28 | 365 | 495 | <1 | <2 |
| A 638/85 | 4 | 12 | 94 | 310 | <1 | <2 |
| A 639/85 | 4 | 8 | 33 | 180 | <1 | <2 |
| A 640/85 | 3 | 280 | 38 | 370 | <1 | 64 |
| A 641/85 | 5 | 20 | 30 | 250 | <1 | <2 |
| A 642/85 | 4 | 12 | 26 | 205 | <1 | 4 |
| A 643/85 | 5 | 12 | 58 | 355 | <1 | 3 |
| A 644/85 | 4 | 14 | 72 | 460 | <1 | 41 |
| A 645/85 | 4 | 42 | 70 | 700 | <1 | 4 |
| A 646/85 | 4 | 24 | 105 | 740 | <1 | 2 |
| A 647/85 | 6 | 46 | 125 | 970 | <1 | 4 |
| A 648/85 | 3 | 30 | 68 | 1340 | 3 | 5 |
| A 649/85 | 3 | 22 | 50 | 445 | <1 | <2 |
| A 650/85 | 15 | 40 | 68 | 650 | <1 | <2 |
| A 651/85 | 19 | 170 | 84 | 520 | <1 | 35 |
| A 652/85 | 7 | 40 | 62 | 530 | <1 | <2 |
| A 653/85 | 6 | 10 | 46 | 400 | <1 | 4 |
| A 654/85 | 8 | 40 | 66 | 730 | <1 | <2 |
| A 655/85 | 52 | 90 | 110 | 810 | <1 | <2 |
| A 656/85 | 5 | <4 | 31 | 360 | <1 | 5 |
| A 657/85 | 1.04% | 96 | 520 | 1240 | <1 | 7 |
| A 658/85 | 21 | 14 | 44 | 205 | <1 | 2 |
| A 659/85 | 4 | 10 | 30 | 375 | <1 | <2 |
| A 660/85 | 6 | 18 | 60 | 300 | <1 | 4 |
| A 661/85 | 6 | 8 | 56 | 390 | <1 | 2 |
| A 662/85 | 8 | 24 | 96 | 290 | <1 | <2 |
| A 663/85 | 24 | 445 | 830 | 1.02% | 4 | <2 |
| A 664/85 | 7 | 50 | 110 | 455 | 1 | <2 |
| A 665/85 | 8 | 44 | 58 | 245 | <1 | <2 |
| A 666/85 | 10 | 36 | 78 | 550 | <1 | <2 |
| A 667/85 | 4 | 20 | 25 | 230 | <1 | 6 |
| A 668/85 | 2 | 4 | 23 | 205 | <1 | 2 |
| A 669/85 | 2 | 22 | 38 | 690 | 1 | 2 |
| A 670/85 | <2 | 12 | 44 | 475 | <1 | <2 |
| Detn limit | (2) | (4) | (2) | (5) | (1) | (2) |

amdel

Analysis code A1/1,2. Report AC 443/86 Page G5

NATA Certificate Order No. 12/03/185 Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A 671/85 | 7 | 26 | 37 | 540 | <1 | <2 |
| A 672/85 | 6 | 24 | 165 | 600 | <1 | 2 |
| A 673/85 | 5 | 28 | 690 | 1800 | <1 | 2 |
| A 674/85 | 7 | 14 | 270 | 1980 | <1 | 4 |
| A 675/85 | 6 | 6 | 230 | 1180 | <1 | <2 |
| A 676/85 | 8 | 12 | 150 | 1000 | <1 | 2 |
| A 677/85 | 24 | 135 | 96 | 680 | <1 | 6 |
| A 678/85 | 16 | 345 | 115 | 1240 | <1 | <2 |
| A 679/85 | 10 | 260 | 180 | 1220 | <1 | <2 |
| A 680/85 | 6 | 74 | 530 | 2360 | <1 | <2 |
| A 681/85 | 17 | 115 | 92 | 510 | <1 | 7 |
| A 682/85 | 3 | 345 | 60 | 660 | <1 | 52 |
| A 683/85 | 3 | 16 | 550 | 2060 | <1 | <2 |
| A 684/85 | 10 | 74 | 990 | 1180 | 6 | 4 |
| A 685/85 | 7 | 34 | 420 | 1980 | <1 | 2 |
| A 686/85 | 11 | 38 | 360 | 1840 | <1 | 3 |
| A 687/85 | 5 | 16 | 480 | 2060 | <1 | 3 |
| A 688/85 | 3 | 6 | 500 | 3080 | 1 | 2 |
| A 689/85 | 2 | 40 | 400 | 3460 | <1 | 6 |
| A 690/85 | 5 | 58 | 410 | 1480 | <1 | 4 |
| A 691/85 | 3 | 50 | 265 | 1140 | 1 | 7 |
| A 692/85 | 9 | 42 | 78 | 530 | <1 | 4 |
| A 693/85 | 4 | 8 | 54 | 320 | <1 | <2 |
| A 694/85 | 3 | 16 | 17 | 140 | <1 | 4 |
| A 695/85 | 4 | 8 | 18 | 210 | <1 | <2 |
| A 696/85 | 15 | 86 | 130 | 355 | <1 | 5 |
| A 697/85 | 3 | 8 | 125 | 475 | <1 | <2 |
| A 698/85 | 94 | 4 | 30 | 190 | <1 | 2 |
| A 699/85 | 5 | 20 | 48 | 325 | <1 | <2 |
| A 700/85 | 3 | 10 | 175 | 690 | <1 | 3 |
| A 701/85 | 13 | 16 | 120 | 640 | <1 | 6 |
| A 702/85 | 5 | 10 | 35 | 255 | <1 | <2 |
| A 703/85 | 6 | 16 | 50 | 435 | <1 | 2 |
| A 704/85 | 4 | 8 | 54 | 550 | <1 | 3 |
| A 705/85 | 25 | 10 | 82 | 1560 | <1 | 2 |
| A 706/85 | 16 | 115 | 340 | 1980 | <1 | 5 |
| A 707/85 | 31 | 26 | 195 | 1140 | <1 | <2 |
| A 708/85 | 21 | 32 | 180 | 780 | <1 | <2 |
| A 709/85 | 5 | 50 | 100 | 510 | <1 | 2 |
| A 710/85 | 4 | 22 | 33 | 200 | <1 | <2 |
| Detn limit | (2) | (4) | (2) | (5) | (1) | (2) |

Analysis code A1/1,2 Report AC 443/86 

NATA Certificate Order No. 12/03/185 Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A 711/85 | 4 | 32 | 110 | 750 | <1 | 2 |
| A 712/85 | 7 | 78 | 110 | 1180 | 5 | 3 |
| A 713/85 | 7 | 84 | 86 | 1000 | 5 | <2 |
| A 714/85 | 37 | 24 | 37 | 345 | 1 | 5 |
| A 715/85 | 10 | 120 | 37 | 1520 | 11 | <2 |
| A 716/85 | 6 | 26 | 39 | 335 | <1 | <2 |
| A 717/85 | 4 | 60 | 94 | 810 | 4 | 2 |
| A 718/85 | 6 | 36 | 235 | 1520 | <1 | 3 |
| A 719/85 | 5 | 4 | 96 | 455 | 1 | <2 |
| A 720/85 | 6 | 12 | 105 | 1300 | <1 | <2 |
| A 721/85 | 6 | 16 | 300 | 820 | <1 | 2 |
| A 722/85 | 3 | 26 | 160 | 2100 | 1 | <2 |
| A 723/85 | 5 | 34 | 225 | 2280 | 2 | 3 |
| A 724/85 | 5 | 22 | 410 | 1800 | 1 | 7 |
| A 725/85 | 22 | 36 | 495 | 3860 | 2 | 3 |
| A 726/85 | 5 | 22 | 920 | 1800 | <1 | 4 |
| A 727/85 | 5 | 4 | 340 | 1000 | <1 | 3 |
| A 728/85 | 12 | 165 | 155 | 1160 | <1 | 4 |
| A 729/85 | 5 | 20 | 96 | 560 | <1 | <2 |
| A 730/85 | 6 | 24 | 630 | 1660 | <1 | <2 |
| A 731/85 | 4 | 22 | 270 | 1120 | <1 | <2 |
| A 732/85 | <2 | <4 | 400 | 1900 | <1 | 2 |
| A 733/85 | <2 | 20 | 480 | 2500 | 1 | 3 |
| A 734/85 | 5 | 98 | 410 | 1540 | 1 | <2 |
| A 735/85 | 3 | 50 | 68 | 405 | <1 | <2 |
| A 736/85 | <2 | <4 | 21 | 295 | <1 | 5 |
| A 737/85 | 3 | 8 | 21 | 300 | <1 | <2 |
| A 738/85 | 5 | 22 | 92 | 430 | <1 | <2 |
| A 739/85 | 7 | 20 | 36 | 290 | <1 | <2 |
| A 740/85 | 4 | 42 | 68 | 740 | 2 | 3 |
| A 741/85 | 2 | 6 | 33 | 225 | <1 | 3 |
| A 742/85 | 2 | <4 | 23 | 105 | 1 | 2 |
| A 743/85 | 6 | 12 | 50 | 285 | <1 | <2 |
| A 744/85 | 8 | 36 | 145 | 950 | 1 | <2 |
| A 745/85 | 4 | 8 | 46 | 420 | <1 | <2 |
| A 746/85 | 3 | 12 | 86 | 730 | <1 | 2 |
| A 747/85 | 4 | 12 | 78 | 790 | <1 | <2 |
| A 748/85 | 3 | 18 | 76 | 560 | <1 | <2 |
| A 749/85 | 7 | 4 | 62 | 415 | <1 | <2 |
| A 750/85 | 15 | 46 | 80 | 510 | <1 | <2 |
| Detn limit | (2) | (4) | (2) | (5) | (1) | (2) |

amdel

Analysis code A1/1,2 Report AC 443/86 Page G7

NATA Certificate Order No. 12/03/185 Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A 751/85 | 11 | 100 | 60 | 480 | <1 | <2 |
| A 752/85 | 6 | 28 | 35 | 340 | <1 | <2 |
| A 753/85 | 11 | 72 | 105 | 530 | <1 | <2 |
| A 754/85 | 21 | 60 | 100 | 530 | <1 | 4 |
| A 755/85 | 7 | 50 | 94 | 425 | <1 | <2 |
| A 756/85 | 8 | 60 | 140 | 590 | <1 | 4 |
| A 757/85 | 8 | 62 | 130 | 820 | 3 | 5 |
| A 758/85 | 5 | 220 | 160 | 1200 | 2 | 86 |
| A 759/85 | 6 | 70 | 135 | 780 | <1 | 3 |
| A 760/85 | 5 | 46 | 92 | 225 | <1 | <2 |
| A 761/85 | <2 | 16 | 38 | 155 | <1 | <2 |
| A 762/85 | <2 | 16 | 32 | 205 | <1 | <2 |
| A 763/85 | 8 | 46 | 170 | 200 | 1 | 4 |
| A 764/85 | 3 | 12 | 230 | 570 | <1 | 5 |
| A 765/85 | 2 | 32 | 165 | 385 | 1 | 2 |
| A 766/85 | 17 | 255 | 1020 | 1740 | <1 | <2 |
| A 767/85 | 6 | 54 | 2980 | 4040 | 4 | 4 |
| A 768/85 | 3 | 14 | 730 | 1540 | 2 | <2 |
| A 769/85 | 2 | <4 | 82 | 660 | 1 | <2 |
| A 770/85 | 3 | <4 | 68 | 720 | <1 | 3 |
| A 771/85 | 8 | 50 | 50 | 600 | <1 | <2 |
| A 772/85 | 8 | 385 | 52 | 730 | <1 | 4 |
| A 773/85 | 5 | 580 | 74 | 700 | <1 | <2 |
| A 774/85 | 3 | 36 | 140 | 780 | <1 | 2 |
| A 775/85 | <2 | 24 | 90 | 870 | <1 | 4 |
| A 776/85 | <2 | <4 | 110 | 1140 | <1 | 2 |
| A 777/85 | <2 | <4 | 48 | 840 | <1 | <2 |
| A 778/85 | 3 | <4 | 52 | 870 | <1 | 4 |
| A 779/85 | 2 | 20 | 44 | 485 | <1 | <2 |
| A 780/85 | 3 | <4 | 24 | 230 | <1 | <2 |
| A 781/85 | 14 | 30 | 610 | 450 | <1 | 54 |
| A 782/85 | 2 | 18 | 62 | 110 | <1 | <2 |
| A 783/85 | 2 | 8 | 18 | 130 | <1 | <2 |
| A 784/85 | 2 | <4 | 10 | 160 | <1 | <2 |
| A 785/85 | 6 | 6 | 14 | 130 | <1 | 2 |
| A 786/85 | 8 | 4 | 34 | 130 | <1 | 4 |
| A 787/85 | 6 | 28 | 30 | 280 | <1 | <2 |
| A 788/85 | 12 | 48 | 54 | 370 | <1 | <2 |
| A 789/85 | 6 | 22 | 35 | 210 | <1 | <2 |
| A 790/85 | 6 | 18 | 56 | 405 | <1 | <2 |
| Detn limit | (2) | (4) | (2) | (5) | (1) | (2) |

amdel

Analysis code A1/1,2 Report AC 443/86 Page G8

NATA Certificate Order No. 12/03/185 Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A 791/85 | 6 | 14 | 36 | 320 | <1 | 2 |
| A 792/85 | 6 | 20 | 56 | 420 | <1 | <2 |
| A 793/85 | 11 | 24 | 49 | 435 | <1 | 2 |
| A 794/85 | 6 | 48 | 56 | 465 | <1 | 2 |
| A 795/85 | 18 | 58 | 140 | 910 | <1 | 3 |
| A 796/85 | 46 | 62 | 165 | 640 | <1 | <2 |
| A 797/85 | 9 | 24 | 90 | 435 | <1 | <2 |
| A 798/85 | 15 | 60 | 180 | 750 | <1 | <2 |
| A 799/85 | 280 | 790 | 4880 | 9350 | 2 | 33 |
| A 800/85 | 14 | 66 | 78 | 470 | <1 | <2 |
| A 801/85 | 16 | 78 | 120 | 2020 | <1 | 6 |
| A 802/85 | 11 | 8 | 80 | 420 | <1 | <2 |
| A 803/85 | 7 | 14 | 14 | 175 | <1 | <2 |
| A 804/85 | 4 | 6 | 15 | 155 | <1 | <2 |
| A 805/85 | 4 | <4 | 16 | 210 | <1 | <2 |
| A 806/85 | 3 | <4 | 16 | 150 | <1 | 4 |
| A 807/85 | 26 | 10 | 135 | 200 | <1 | 13 |
| A 808/85 | 6 | 24 | 840 | 1000 | 3 | <2 |
| A 809/85 | 8 | 76 | 2400 | 2600 | 4 | 5 |
| A 810/85 | 4 | <4 | 135 | 1280 | <1 | <2 |
| A 811/85 | 6 | <4 | 105 | 1100 | <1 | <2 |
| A 812/85 | 5 | <4 | 54 | 1060 | <1 | <2 |
| A 813/85 | 13 | 125 | 60 | 680 | <1 | 4 |
| A 814/85 | 13 | 115 | 110 | 650 | <1 | <2 |
| A 815/85 | 6 | <4 | 96 | 1080 | <1 | 2 |
| A 816/85 | 6 | <4 | 74 | 920 | <1 | <2 |
| A 1110/85 | 7 | 400 | 26 | 870 | <1 | <2 |
| A 1111/85 | 7 | 230 | 33 | 1700 | <1 | 4 |
| A 1112/85 | 4 | <4 | 29 | 1120 | <1 | 2 |
| A 1113/85 | 3 | <4 | 31 | 1260 | <1 | 2 |
| A 1114/85 | 3 | 14 | 13 | 395 | <1 | <2 |
| A 1115/85 | 3 | 20 | 12 | 305 | <1 | 3 |
| A 1116/85 | 4 | 54 | 13 | 280 | <1 | 2 |
| A 1117/85 | 5 | <4 | 20 | 325 | 1 | 5 |
| A 1118/85 | 3 | <4 | 12 | 175 | <1 | <2 |
| A 1119/85 | 3 | <4 | 13 | 220 | <1 | <2 |
| A 1120/85 | 3 | 8 | 17 | 265 | <1 | <2 |
| A 1121/85 | 3 | <4 | 19 | 195 | <1 | <2 |
| A 1122/85 | 6 | 38 | 29 | 425 | <1 | <2 |
| A 1123/85 | 10 | 58 | 49 | 415 | <1 | 3 |
| Detn limit | (2) | (4) | (2) | (5) | (1) | (2) |

amdel

Analysis code A1/1,2     Report AC 443/86     

NATA Certificate     Order No. 12/03/185     Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A 1124/85 | 31 | 135 | 180 | 1460 | <1 | <2 |
| A 1125/85 | 14 | 48 | 90 | 340 | <1 | <2 |
| A 1126/85 | 7 | 110 | 74 | 810 | <1 | <2 |
| A 1127/85 | 10 | 46 | 160 | 1020 | 1 | <2 |
| A 1128/85 | 11 | 62 | 60 | 550 | 1 | <2 |
| A 1129/85 | 29 | 120 | 66 | 970 | <1 | 6 |
| A 1130/85 | 7 | 40 | 56 | 650 | 1 | <2 |
| A 1131/85 | 4 | 24 | 80 | 510 | <1 | 2 |
| A 1132/85 | 5 | 24 | 43 | 430 | <1 | 3 |
| A 1133/85 | 6 | 12 | 33 | 425 | <1 | 2 |
| A 1134/85 | 3 | 6 | 62 | 550 | <1 | <2 |
| A 1135/85 | <2 | 4 | 31 | 435 | <1 | <2 |
| A 1136/85 | <2 | 12 | 30 | 330 | <1 | 4 |
| A 1137/85 | 4 | 78 | 41 | 440 | <1 | <2 |
| A 1138/85 | 4 | 14 | 50 | 500 | <1 | 4 |
| A 1139/85 | 4 | 12 | 54 | 990 | <1 | <2 |
| A 1140/85 | 4 | 36 | 88 | 770 | <1 | 2 |
| A 1141/85 | 5 | 26 | 54 | 690 | <1 | 2 |
| A 1142/85 | 92 | 240 | 315 | 1020 | <1 | 21 |
| A 1143/85 | 13 | 98 | 42 | 530 | <1 | <2 |
| A 1144/85 | 9 | 28 | 30 | 490 | <1 | 3 |
| A 1145/85 | 9 | 135 | 42 | 350 | <1 | 2 |
| A 1146/85 | 5 | 62 | 29 | 360 | <1 | <2 |
| A 1147/85 | 6 | 120 | 39 | 375 | <1 | <2 |
| A 1148/85 | 16 | 110 | 205 | 1120 | <1 | 3 |
| A 1149/85 | 18 | 52 | 68 | 970 | <1 | <2 |
| A 1150/85 | 9 | 18 | 92 | 800 | <1 | <2 |
| A 1151/85 | 13 | <4 | 305 | 1380 | <1 | 3 |
| A 1152/85 | 9 | <4 | 54 | 910 | <1 | <2 |
| A 1153/85 | 8 | <4 | 43 | 920 | <1 | <2 |
| A 1154/85 | 17 | 8 | 230 | 1780 | <1 | <2 |
| A 1155/85 | 11 | 78 | 47 | 960 | <1 | 4 |
| A 1156/85 | 5 | 20 | 17 | 345 | <1 | <2 |
| A 1157/85 | 4 | 8 | 18 | 200 | <1 | <2 |
| A 1158/85 | 9 | 18 | 33 | 260 | <1 | 2 |
| A 1159/85 | 4 | 14 | 21 | 195 | <1 | 2 |
| A 1160/85 | 5 | 14 | 17 | 305 | <1 | <2 |
| A 1161/85 | 4 | 10 | 25 | 330 | <1 | <2 |
| A 1162/85 | 5 | 8 | 36 | 375 | <1 | <2 |
| A 1163/85 | 7 | 16 | 96 | 880 | <1 | <2 |
| Detn limit | (2) | (4) | (2) | (5) | (1) | (2) |

Analysis code A1/1,2 Report AC 443/86 Page G10

NATA Certificate Order No. 12/03/185 Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A 1164/85 | 7 | 14 | 84 | 710 | <1 | <2 |
| A 1165/85 | 5 | 14 | 60 | 630 | <1 | <2 |
| A 1166/85 | 4 | 10 | 58 | 600 | <1 | 3 |
| A 1167/85 | 43 | 2660 | 3600 | 550 | 1 | <2 |
| A 1168/85 | 7 | 120 | 86 | 580 | <1 | <2 |
| A 1169/85 | 3 | 24 | 76 | 570 | <1 | <2 |
| A 1170/85 | <2 | 6 | 24 | 270 | <1 | <2 |
| A 1171/85 | 2 | 4 | 27 | 470 | <1 | <2 |
| A 1172/85 | <2 | <4 | 13 | 205 | <1 | <2 |
| A 1173/85 | 5 | 10 | 25 | 355 | <1 | <2 |
| A 1174/85 | 29 | 20 | 39 | 295 | <1 | <2 |
| A 1175/85 | 16 | 86 | 76 | 680 | <1 | 5 |
| A 1176/85 | 6 | 72 | 31 | 600 | <1 | <2 |
| A 1177/85 | 8 | 110 | 37 | 560 | <1 | 2 |
| A 1178/85 | 11 | 165 | 54 | 380 | <1 | <2 |
| A 1179/85 | 11 | 165 | 42 | 375 | <1 | <2 |
| A 1180/85 | 13 | 260 | 56 | 820 | <1 | <2 |
| A 1181/85 | 16 | 76 | 105 | 1040 | <1 | 11 |
| A 1182/85 | 9 | <4 | 74 | 740 | <1 | 3 |
| A 1183/85 | <2 | <4 | 225 | 1720 | <1 | <2 |
| A 1184/85 | 3 | <4 | 135 | 1280 | <1 | <2 |
| A 1185/85 | 4 | 4 | 165 | 1400 | <1 | <2 |
| A 1186/85 | <2 | <4 | 96 | 820 | <1 | <2 |
| A 1187/85 | 2 | 6 | 34 | 570 | <1 | <2 |
| A 1188/85 | 2 | 12 | 26 | 230 | <1 | 2 |
| A 1189/85 | 3 | <4 | 25 | 245 | <1 | 2 |
| A 1190/85 | 7 | 28 | 27 | 235 | <1 | 2 |
| A 1191/85 | 2 | <4 | 37 | 200 | <1 | <2 |
| A 1192/85 | 5 | 18 | 70 | 355 | <1 | <2 |
| A 1193/85 | <2 | 4 | 19 | 315 | <1 | <2 |
| A 1194/85 | 4 | 26 | 45 | 410 | <1 | <2 |
| A 1195/85 | 5 | 24 | 49 | 285 | <1 | <2 |
| A 1196/85 | 4 | 38 | 62 | 435 | <1 | <2 |
| A 1197/85 | 7 | 26 | 66 | 540 | <1 | <2 |
| A 1198/85 | 4 | 34 | 98 | 600 | <1 | <2 |
| A 1199/85 | 7 | 24 | 58 | 470 | <1 | 3 |
| A 1200/85 | 4 | 16 | 105 | 750 | <1 | <2 |
| A 1201/85 | 4 | 44 | 115 | 880 | <1 | 3 |
| A 1202/85 | 5 | 50 | 385 | 880 | <1 | 5 |
| A 1203/85 | 4 | 12 | 35 | 475 | <1 | <2 |
| Detn limit | (2) | (4) | (2) | (5) | (1) | (2) |

Analysis code A1/1.2 Report AC 443/86 Page G11

NATA Certificate Order No. 12/03/185 Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A 1204/85 | <2 | 10 | 47 | 475 | <1 | <2 |
| A 1205/85 | 3 | 26 | 58 | 810 | <1 | 4 |
| A 1206/85 | 7 | 20 | 84 | 690 | <1 | 2 |
| A 1207/85 | 9 | 46 | 120 | 1160 | <1 | 4 |
| A 1208/85 | 3 | 44 | 52 | 670 | <1 | <2 |
| A 1209/85 | 9 | 72 | 82 | 800 | <1 | <2 |
| A 1210/85 | 6 | 36 | 14 | 295 | <1 | <2 |
| A 1211/85 | 5 | 16 | 210 | 350 | <1 | <2 |
| A 1212/85 | 4 | 44 | 24 | 205 | <1 | <2 |
| A 1213/85 | 3 | 16 | 60 | 540 | 1 | <2 |
| A 1214/85 | 5 | 16 | 14 | 275 | <1 | <2 |
| A 1215/85 | 8 | 40 | 33 | 520 | <1 | <2 |
| A 1216/85 | 6 | 14 | 50 | 495 | <1 | 3 |
| A 1217/85 | 6 | 64 | 32 | 940 | <1 | <2 |
| A 1218/85 | 5 | 20 | 22 | 350 | <1 | <2 |
| A 1219/85 | 5 | 16 | 66 | 370 | <1 | <2 |
| A 1220/85 | 4 | <4 | 25 | 205 | <1 | 2 |
| A 1221/85 | 3 | 10 | 60 | 290 | <1 | <2 |
| A 1222/85 | 3 | 14 | 30 | 265 | <1 | <2 |
| A 1223/85 | 2 | 8 | 22 | 330 | <1 | <2 |
| A 1224/85 | 4 | 32 | 30 | 630 | <1 | 2 |
| A 1225/85 | 3 | 24 | 36 | 380 | <1 | <2 |
| A 1226/85 | <2 | 20 | 88 | 730 | <1 | <2 |
| A 1227/85 | 3 | 18 | 120 | 850 | <1 | <2 |
| A 1228/85 | 3 | 28 | 58 | 780 | <1 | <2 |
| A 1229/85 | <2 | 20 | 110 | 1120 | <1 | <2 |
| A 1230/85 | <2 | 18 | 52 | 610 | <1 | <2 |
| A 1231/85 | <2 | 16 | 56 | 600 | <1 | <2 |
| A 1232/85 | <2 | 18 | 66 | 770 | <1 | <2 |
| A 1233/85 | 2 | 16 | 38 | 510 | <1 | <2 |
| A 1234/85 | 3 | 34 | 56 | 640 | <1 | <2 |
| A 1235/85 | 3 | 76 | 40 | 590 | <1 | <2 |
| A 1236/85 | 11 | 215 | 76 | 580 | <1 | 2 |
| A 1237/85 | 52 | 26 | 165 | 2120 | <1 | 4 |
| A 1238/85 | 6 | 66 | 190 | 700 | <1 | <2 |
| A 1239/85 | 2 | 30 | 140 | 660 | <1 | <2 |
| A 1240/85 | 2 | 18 | 145 | 830 | <1 | <2 |
| A 1241/85 | 4 | 20 | 64 | 405 | <1 | 5 |
| A 1242/85 | 2 | 22 | 45 | 290 | <1 | <2 |
| A 1243/85 | 3 | 18 | 36 | 315 | <1 | <2 |
| Detn limit | (2) | (4) | (2) | (5) | (1) | (2) |

amdel

Analysis code A1/1,2 | Report AC 443/86 | Page G12

NATA Certificate | Order No. 12/03/185 | Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A 1244/85 | 2 | 10 | 17 | 290 | <1 | <2 |
| A 1245/85 | 6 | 10 | 125 | 260 | <1 | 2 |
| A 1246/85 | <2 | 26 | 86 | 620 | <1 | <2 |
| A 1247/85 | 3 | 10 | 70 | 215 | <1 | 2 |
| A 1248/85 | 2 | 20 | 66 | 210 | <1 | <2 |
| A 1249/85 | 3 | 74 | 3.70% | 320 | <1 | 8 |
| A 1250/85 | 2 | 24 | 230 | 510 | <1 | 4 |
| A 1251/85 | 3 | 8 | 215 | 500 | <1 | <2 |
| A 1252/85 | <2 | 28 | 365 | 1980 | 1 | 4 |
| A 1253/85 | <2 | 42 | 280 | 2140 | <1 | 7 |
| A 1254/85 | 5 | 52 | 475 | 2500 | <1 | 19 |
| A 1255/85 | <2 | 18 | 74 | 2360 | <1 | 9 |
| A 1256/85 | 6 | 26 | 640 | 3620 | <1 | 18 |
| A 1257/85 | 52 | 18 | 640 | 2080 | <1 | <2 |
| A 1258/85 | 260 | 36 | 180 | 860 | <1 | <2 |
| A 1259/85 | 5 | 20 | 120 | 860 | <1 | <2 |
| A 1260/85 | 10 | 22 | 150 | 960 | <1 | <2 |
| A 1261/85 | 19 | 70 | 98 | 660 | <1 | 3 |
| A 1262/85 | 12 | 28 | 510 | 1220 | <1 | 2 |
| A 1263/85 | 7 | 18 | 265 | 1140 | <1 | 2 |
| A 1264/85 | 2 | 12 | 640 | 1760 | <1 | <2 |
| A 1265/85 | 2 | 42 | 660 | 3600 | <1 | 4 |
| A 1266/85 | 2 | 68 | 365 | 4140 | <1 | 7 |
| A 1267/85 | 4 | 165 | 690 | 4040 | <1 | 8 |
| A 1268/85 | 5 | 52 | 440 | 2680 | <1 | 5 |
| A 1269/85 | 4 | 50 | 135 | 1060 | <1 | 3 |
| A 1270/85 | 6 | 26 | 78 | 560 | <1 | 2 |
| A 1271/85 | 7 | 20 | 54 | 310 | <1 | <2 |
| A 1272/85 | 4 | 16 | 28 | 235 | <1 | <2 |
| A 1273/85 | 9 | 26 | 50 | 325 | <1 | 3 |
| A 1274/85 | 6 | 62 | 37 | 405 | <1 | <2 |
| A 1275/85 | 4 | 28 | 64 | 405 | <1 | <2 |
| A 1276/85 | 3 | 20 | 22 | 235 | <1 | 5 |
| A 1277/85 | 3 | 24 | 27 | 235 | <1 | <2 |
| A 1278/85 | 4 | 36 | 62 | 425 | <1 | <2 |
| A 1279/85 | 7 | 12 | 110 | 640 | <1 | 5 |
| A 1280/85 | 5 | 30 | 105 | 660 | <1 | 3 |
| A 1281/85 | 4 | 10 | 105 | 365 | <1 | 2 |
| A 1282/85 | 3 | 22 | 80 | 495 | <1 | 2 |
| A 1283/85 | 5 | 32 | 98 | 710 | <1 | <2 |
| Detn limit | (2) | (4) | (2) | (5) | (1) | (2) |

amdel

Analysis code A1/1.2 Report AC 443/86 

NATA Certificate Order No. 12/03/185 Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A 1284/85 | <2 | 20 | 31 | 450 | <1 | <2 |
| A 1285/85 | 3 | 12 | 92 | 630 | <1 | 2 |
| A 1286/85 | 2 | 16 | 62 | 440 | <1 | 2 |
| A 1287/85 | 3 | 10 | 34 | 305 | <1 | 2 |
| A 1288/85 | 4 | 18 | 60 | 510 | <1 | <2 |
| A 1289/85 | <2 | 42 | 24 | 155 | <1 | <2 |
| A 1290/85 | 4 | 16 | 52 | 300 | <1 | 3 |
| A 1291/85 | 3 | 10 | 30 | 320 | <1 | <2 |
| A 1292/85 | 21 | 68 | 105 | 490 | <1 | 3 |
| A 1293/85 | 7 | 40 | 76 | 550 | <1 | <2 |
| A 1294/85 | 16 | 96 | 145 | 860 | <1 | <2 |
| A 1295/85 | 10 | 70 | 82 | 340 | <1 | 3 |
| A 1296/85 | 7 | 74 | 135 | 530 | <1 | <2 |
| A 1297/85 | 3 | 42 | 150 | 790 | <1 | <2 |
| A 1298/85 | 5 | 12 | 170 | 1160 | <1 | <2 |
| A 1299/85 | 21 | 130 | 195 | 1880 | 2 | 3 |
| A 1300/85 | 4 | 46 | 1640 | 2160 | 1 | 7 |
| A 1301/85 | 4 | 30 | 620 | 1640 | <1 | 2 |
| A 1302/85 | 4 | 60 | 200 | 1260 | <1 | <2 |
| A 1303/85 | 3 | 54 | 150 | 1240 | <1 | <2 |
| A 1304/85 | 4 | 145 | 140 | 860 | <1 | <2 |
| A 1305/85 | 2 | 12 | 115 | 830 | <1 | 2 |
| A 1306/85 | 3 | 6 | 140 | 910 | <1 | 3 |
| A 1307/85 | 2 | 12 | 98 | 1080 | <1 | <2 |
| A 1308/85 | 3 | 4 | 76 | 1120 | <1 | 3 |
| A 1309/85 | 2 | 4 | 160 | 1280 | <1 | 3 |
| A 1310/85 | <2 | 8 | 325 | 1500 | <1 | 6 |
| A 1311/85 | 2 | 22 | 24 | 285 | <1 | <2 |
| A 1312/85 | 2 | 30 | 24 | 285 | <1 | <2 |
| A 1313/85 | 3 | 88 | 28 | 265 | <1 | <2 |
| A 1314/85 | 3 | 10 | 18 | 210 | <1 | 4 |
| A 1315/85 | 2 | 16 | 11 | 170 | <1 | <2 |
| A 1316/85 | 2 | 18 | 24 | 265 | <1 | <2 |
| A 1317/85 | 4 | 36 | 155 | 1300 | <1 | 2 |
| A 1318/85 | 4 | 50 | 64 | 350 | <1 | <2 |
| A 1319/85 | 7 | 56 | 56 | 370 | <1 | <2 |
| A 1320/85 | 12 | 64 | 72 | 650 | <1 | <2 |
| A 1321/85 | 24 | 48 | 82 | 490 | <1 | <2 |
| A 1322/85 | 7 | 62 | 160 | 730 | <1 | 2 |
| A 1323/85 | 4 | 40 | 125 | 680 | <1 | 2 |
| Detn limit | (2) | (4) | (2) | (5) | (1) | (2) |

amdel

Analysis code A1/1,2 Report AC 443/86 Page G14

NATA Certificate Order No. 12/03/185 Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A 1324/85 | 11 | 52 | 125 | 790 | <1 | 2 |
| A 1325/85 | 7 | 48 | 115 | 610 | <1 | <2 |
| A 1326/85 | 9 | 60 | 265 | 560 | <1 | <2 |
| A 1327/85 | 14 | 390 | 8.60% | 680 | <1 | 98 |
| A 1328/85 | 12 | 52 | 680 | 830 | <1 | 4 |
| A 1329/85 | 11 | 20 | 370 | 700 | <1 | 2 |
| A 1330/85 | 7 | 44 | 76 | 230 | <1 | <2 |
| A 1331/85 | 6 | 20 | 50 | 205 | <1 | <2 |
| A 1332/85 | 2 | 8 | 13 | 160 | <1 | <2 |
| A 1333/85 | 3 | 6 | 19 | 145 | <1 | <2 |
| A 1334/85 | 3 | 6 | 25 | 205 | <1 | 2 |
| A 1335/85 | 3 | 6 | 23 | 180 | <1 | <2 |
| A 1336/85 | 2 | 8 | 37 | 250 | <1 | <2 |
| A 1337/85 | 6 | 14 | 165 | 185 | <1 | 7 |
| A 1338/85 | <2 | 6 | 125 | 760 | <1 | <2 |
| A 1339/85 | <2 | 10 | 345 | 1540 | <1 | <2 |
| A 1340/85 | <2 | 4 | 100 | 640 | <1 | <2 |
| A 1341/85 | 4 | <4 | 70 | 750 | <1 | <2 |
| A 1342/85 | 46 | 66 | 710 | 1640 | <1 | 25 |
| A 1343/85 | 4 | 260 | 185 | 1040 | <1 | <2 |
| | | | | | | |
| Detn limit | (2) | (4) | (2) | (5) | (1) | (2) |

amdel

Analysis code A1/1,2 Report AC 1037/86 

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A817/85 | 11 | 105 | 49 | 930 | <1 | <40 |
| A818/85 | 9 | 46 | 125 | 460 | <1 | <40 |
| A819/85 | 2 | 44 | 105 | 345 | 2 | <40 |
| A820/85 | 2 | 26 | 31 | 280 | <1 | <40 |
| A821/85 | <2 | 24 | 21 | 220 | <1 | <40 |
| A822/85 | <2 | 22 | 32 | 375 | <1 | <40 |
| A823/85 | <2 | 22 | 26 | 200 | <1 | <40 |
| A824/85 | <2 | 28 | 39 | 150 | <1 | <40 |
| A825/85 | <2 | 30 | 41 | 200 | <1 | <40 |
| A826/85 | <2 | 18 | 26 | 215 | <1 | <40 |
| A827/85 | <2 | 145 | 210 | 700 | 3 | <40 |
| A828/85 | <2 | 22 | 45 | 225 | <1 | <40 |
| A829/85 | <2 | 38 | 46 | 195 | <1 | 50 |
| A830/85 | <2 | 20 | 35 | 160 | <1 | <40 |
| A831/85 | <2 | 22 | 30 | 145 | <1 | <40 |
| A832/85 | <2 | 18 | 24 | 160 | <1 | <40 |
| A833/85 | <2 | 16 | 16 | 115 | <1 | <40 |
| A834/85 | <2 | 24 | 27 | 175 | <1 | <40 |
| A835/85 | <2 | 24 | 21 | 210 | <1 | <40 |
| A836/85 | <2 | 38 | 26 | 385 | <1 | 40 |
| A837/85 | <2 | 38 | 62 | 510 | <1 | <40 |
| A838/85 | <2 | 24 | 21 | 215 | <1 | <40 |
| A839/85 | <2 | 20 | 49 | 290 | <1 | <40 |
| A840/85 | 2 | 36 | 38 | 285 | <1 | <40 |
| A841/85 | 2 | 54 | 40 | 450 | <1 | <40 |
| A842/85 | <2 | 28 | 54 | 375 | <1 | <40 |
| A843/85 | <2 | 28 | 44 | 310 | <1 | <40 |
| A844/85 | <2 | 28 | 58 | 550 | <1 | <40 |
| A845/85 | <2 | 38 | 96 | 315 | <1 | <40 |
| A846/85 | 2 | 42 | 94 | 410 | <1 | <40 |
| A847/85 | 2 | 20 | 29 | 275 | <1 | <40 |
| A848/85 | 12 | 26 | 20 | 165 | <1 | <40 |
| A849/85 | <2 | 30 | 25 | 170 | <1 | <40 |
| A850/85 | <2 | 26 | 9 | 100 | <1 | <40 |
| A851/85 | 2 | 60 | 62 | 345 | <1 | <40 |
| A852/85 | <2 | 32 | 52 | 265 | <1 | <40 |
| A853/85 | 3 | 18 | 50 | 570 | <1 | <40 |
| A854/85 | 2 | 18 | 36 | 400 | <1 | <40 |
| A855/85 | <2 | 68 | 60 | 425 | <1 | <40 |
| A856/85 | 2 | 20 | 22 | 220 | <1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

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Analysis code A1/1,2 Report AC 1037/86 Page G2

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A857/85 | 2 | 30 | 41 | 335 | <1 | 40 |
| A858/85 | 3 | 36 | 47 | 550 | <1 | <40 |
| A859/85 | 4 | 38 | 86 | 475 | <1 | <40 |
| A860/85 | 11 | 100 | 225 | 1940 | <1 | <40 |
| A861/85 | <2 | 32 | 70 | 365 | <1 | <40 |
| A862/85 | <2 | 24 | 70 | 375 | <1 | <40 |
| A863/85 | 3 | 42 | 135 | 550 | <1 | <40 |
| A864/85 | 4 | 68 | 92 | 490 | <1 | <40 |
| A865/85 | <2 | 16 | 19 | 2240 | <1 | <40 |
| A866/85 | <2 | 44 | 25 | 430 | <1 | <40 |
| A867/85 | <2 | 30 | 66 | 255 | <1 | <40 |
| A868/85 | 2 | 44 | 35 | 290 | <1 | <40 |
| A869/85 | 11 | 28 | 33 | 410 | <1 | <40 |
| A870/85 | 5 | 48 | 125 | 245 | <1 | <40 |
| A871/85 | <2 | 30 | 46 | 280 | <1 | <40 |
| A872/85 | <2 | 26 | 31 | 225 | <1 | <40 |
| A873/85 | <2 | 14 | 10 | 64 | <1 | <40 |
| A874/85 | <2 | 22 | 24 | 165 | <1 | <40 |
| A875/85 | <2 | 24 | 22 | 140 | <1 | <40 |
| A876/85 | <2 | 22 | 40 | 195 | <1 | <40 |
| A877/85 | 2 | 88 | 48 | 275 | 1 | <40 |
| A878/85 | 2 | 42 | 56 | 160 | <1 | <40 |
| A879/85 | <2 | 40 | 45 | 160 | <1 | <40 |
| A880/85 | 2 | 26 | 31 | 130 | <1 | <40 |
| A881/85 | 3 | 40 | 440 | 1380 | 3 | <40 |
| A882/85 | 14 | 96 | 530 | 560 | <1 | 70 |
| A883/85 | <2 | 26 | 33 | 255 | <1 | <40 |
| A884/85 | 13 | 90 | 90 | 375 | <1 | <40 |
| A885/85 | <2 | 38 | 29 | 380 | <1 | <40 |
| A886/85 | 2 | 42 | 34 | 325 | <1 | <40 |
| A887/85 | 2 | 26 | 31 | 365 | <1 | <40 |
| A888/85 | <2 | 18 | 17 | 530 | <1 | <40 |
| A889/85 | 3 | 52 | 66 | 440 | <1 | <40 |
| A890/85 | <2 | 32 | 41 | 345 | <1 | <40 |
| A891/85 | 10 | 84 | 265 | 410 | <1 | 50 |
| A892/85 | 4 | 54 | 74 | 310 | <1 | <40 |
| A893/85 | <2 | 38 | 30 | 245 | <1 | 40 |
| A894/85 | 8 | 105 | 280 | 330 | <1 | <40 |
| A895/85 | 4 | 38 | 80 | 480 | <1 | <40 |
| A896/85 | <2 | 24 | 82 | 265 | <1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

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NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A897/85 | <2 | 26 | 19 | 190 | <1 | <40 |
| A898/85 | <2 | 18 | 80 | 215 | <1 | <40 |
| A899/85 | <2 | 24 | 20 | 135 | <1 | <40 |
| A900/85 | 4 | 120 | 54 | 450 | 5 | <40 |
| A901/85 | <2 | 38 | 36 | 140 | 1 | <40 |
| A902/85 | 2 | 48 | 68 | 225 | <1 | <40 |
| A903/85 | <2 | 30 | 46 | 215 | <1 | <40 |
| A904/85 | <2 | 24 | 25 | 240 | <1 | <40 |
| A905/85 | <2 | 30 | 15 | 140 | <1 | <40 |
| A906/85 | <2 | 40 | 39 | 265 | <1 | <40 |
| A907/85 | 2 | 40 | 43 | 360 | <1 | <40 |
| A908/85 | <2 | 62 | 58 | 560 | <1 | <40 |
| A909/85 | <2 | 70 | 66 | 450 | <1 | <40 |
| A910/85 | 4 | 40 | 135 | 225 | <1 | 100 |
| A1362/85 | 3 | 26 | 960 | 5500 | 2 | <40 |
| A1363/85 | 16 | 86 | 3740 | 2.21% | 5 | <40 |
| A1364/85 | 2 | 30 | 475 | 4720 | 1 | 50 |
| A1365/85 | <2 | 20 | 390 | 3820 | 1 | 40 |
| A1366/85 | 39 | 12 | 150 | 3140 | <1 | <40 |
| A1367/85 | 4 | 20 | 375 | 3480 | 1 | <40 |
| A1368/85 | 4 | 44 | 910 | 3120 | 5 | 40 |
| A1369/85 | <2 | 12 | 185 | 2880 | <1 | 40 |
| A1370/85 | <2 | 12 | 170 | 1640 | <1 | 40 |
| A1371/85 | 4 | 18 | 500 | 1500 | 1 | <40 |
| A1372/85 | 2 | 24 | 345 | 1420 | 2 | <40 |
| A1373/85 | <2 | 88 | 145 | 840 | 4 | <40 |
| A1374/85 | <2 | 12 | 230 | 2220 | <1 | <40 |
| A1375/85 | 3 | 16 | 390 | 2860 | 2 | <40 |
| A1376/85 | 2 | 16 | 215 | 1420 | 2 | <40 |
| A1377/85 | 3 | 22 | 485 | 2640 | 3 | <40 |
| A1378/85 | 3 | 62 | 1460 | 3900 | 14 | <40 |
| A1379/85 | 4 | 50 | 1360 | 4800 | 8 | <40 |
| A1380/85 | 2 | 34 | 710 | 3720 | 5 | <40 |
| A1381/85 | 2 | 14 | 265 | 3240 | <1 | <40 |
| A1382/85 | 5 | 16 | 255 | 3860 | <1 | <40 |
| A1383/85 | 3 | 20 | 285 | 4000 | <1 | <40 |
| A1384/85 | 11 | 140 | 230 | 3500 | 3 | <40 |
| A1385/85 | 11 | 92 | 405 | 4200 | 2 | <40 |
| A1386/85 | 5 | 125 | 280 | 6400 | 1 | <40 |
| A1387/85 | 4 | 36 | 465 | 4980 | <1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

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Analysis code A1/1,2 Report AC 1037/86 

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A1388/85 | 9 | 32 | 340 | 4880 | 1 | <40 |
| A1389/85 | 2 | 22 | 400 | 4580 | <1 | 80 |
| A1390/85 | 3 | 60 | 115 | 1400 | 1 | <40 |
| A1391/85 | 4 | 38 | 76 | 770 | 1 | <40 |
| A1392/85 | 4 | 42 | 405 | 2880 | 3 | <40 |
| A1393/85 | 3 | 28 | 200 | 1220 | 1 | <40 |
| A1394/85 | 5 | 26 | 230 | 2880 | 1 | <40 |
| A1395/85 | 5 | 28 | 165 | 2800 | <1 | <40 |
| A1396/85 | <2 | 18 | 190 | 1320 | 1 | <40 |
| A1397/85 | 3 | 18 | 155 | 1520 | 1 | <40 |
| A1398/85 | 6 | 28 | 76 | 1520 | <1 | <40 |
| A1399/85 | 9 | 28 | 60 | 1720 | 6 | <40 |
| A1400/85 | 7 | 44 | 72 | 2020 | <1 | <40 |
| A1401/85 | 12 | 110 | 90 | 2700 | <1 | <40 |
| A1402/85 | 17 | 155 | 760 | 9600 | 2 | <40 |
| A1403/85 | 5 | 20 | 195 | 3640 | <1 | <40 |
| A1404/85 | 3 | 16 | 110 | 3160 | <1 | <40 |
| A1405/85 | 3 | 20 | 115 | 3160 | <1 | <40 |
| A1406/85 | 2 | 22 | 125 | 2880 | <1 | <40 |
| A1407/85 | 4 | 36 | 350 | 2760 | 1 | <40 |
| A1408/85 | 2 | 24 | 165 | 2200 | <1 | <40 |
| A1409/85 | 4 | 20 | 155 | 1920 | <1 | <40 |
| A1410/85 | 4 | 18 | 140 | 1680 | <1 | 50 |
| A1411/85 | 2 | 20 | 165 | 2280 | <1 | <40 |
| A1412/85 | 5 | 32 | 165 | 2340 | <1 | <40 |
| A1413/85 | 8 | 52 | 135 | 1520 | 1 | <40 |
| A1414/85 | 5 | 30 | 82 | 2700 | <1 | 50 |
| A1415/85 | 4 | 34 | 135 | 2400 | <1 | 50 |
| A1416/85 | 3 | 40 | 115 | 1720 | <1 | <40 |
| A1417/85 | 6 | 48 | 205 | 2820 | <1 | <40 |
| A1418/85 | 72 | 96 | 230 | 7800 | <1 | 230 |
| A1419/85 | 11 | 185 | 180 | 2640 | <1 | <40 |
| A1420/85 | 17 | 50 | 225 | 9300 | <1 | 50 |
| A1421/85 | 17 | 76 | 245 | 8250 | <1 | 50 |
| A1422/85 | 10 | 34 | 33 | 770 | <1 | 50 |
| A1423/85 | 2 | 50 | 56 | 840 | <1 | <40 |
| A1424/85 | 2 | 32 | 46 | 680 | <1 | <40 |
| A1425/85 | 2 | 34 | 24 | 420 | <1 | 40 |
| A1426/85 | 4 | 20 | 58 | 1380 | <1 | <40 |
| A1427/85 | 5 | 22 | 125 | 2540 | <1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

Analysis code A1/1,2 Report AC 1037/86 

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A1428/85 | 3 | 18 | 45 | 2000 | <1 | <40 |
| A1429/85 | 5 | 16 | 76 | 1240 | <1 | <40 |
| A1430/85 | 24 | 92 | 205 | 5.68% | <1 | 140 |
| A1431/85 | 36 | 42 | 38 | 1620 | <1 | <40 |
| A1432/85 | 16 | 140 | 66 | 2640 | <1 | 40 |
| A1433/85 | 11 | 46 | 33 | 1640 | <1 | <40 |
| A1434/85 | 165 | 105 | 220 | 3940 | <1 | <40 |
| A1435/85 | 3 | 24 | 15 | 350 | <1 | 40 |
| A1436/85 | 9 | 26 | 32 | 550 | <1 | 50 |
| A1437/85 | 5 | 18 | 105 | 2460 | <1 | 40 |
| A1438/85 | 3 | 24 | 98 | 1940 | <1 | <40 |
| A1439/85 | 3 | 18 | 50 | 1180 | <1 | <40 |
| A1440/85 | 3 | 20 | 49 | 1120 | <1 | <40 |
| A1441/85 | <2 | 36 | 110 | 1360 | <1 | <40 |
| A1442/85 | 3 | 20 | 64 | 1040 | <1 | <40 |
| A1443/85 | 3 | 18 | 72 | 1320 | <1 | <40 |
| A1444/85 | 3 | 32 | 66 | 1240 | <1 | <40 |
| A1445/85 | 5 | 20 | 50 | 1740 | <1 | <40 |
| A1446/85 | 16 | 24 | 160 | 3260 | <1 | <40 |
| A1447/85 | 8 | 56 | 72 | 1300 | <1 | <40 |
| A1448/85 | 50 | 240 | 155 | 3280 | <1 | <40 |
| A1449/85 | 115 | 285 | 76 | 2520 | <1 | <40 |
| A1450/85 | 700 | 2820 | 230 | 5750 | 1 | 120 |
| A1451/85 | 20 | 96 | 74 | 3720 | <1 | 40 |
| A1452/85 | 21 | 155 | 165 | 4.47% | <1 | 40 |
| A1453/85 | 21 | 54 | 48 | 4.14% | <1 | 60 |
| A1454/85 | 90 | 365 | 255 | 6050 | <1 | <40 |
| A1455/85 | 240 | 360 | 200 | 3280 | <1 | <40 |
| A1456/85 | 92 | 430 | 98 | 2860 | <1 | <40 |
| A1457/85 | 19 | 110 | 84 | 2140 | <1 | <40 |
| A1458/85 | 13 | 62 | 80 | 2380 | <1 | <40 |
| A1459/85 | 5 | 24 | 60 | 1620 | <1 | <40 |
| A1460/85 | 3 | 16 | 78 | 1800 | <1 | <40 |
| A1461/85 | 11 | 34 | 50 | 1400 | <1 | <40 |
| A1462/85 | 5 | 32 | 45 | 1180 | <1 | <40 |
| A1463/85 | 5 | 22 | 60 | 1220 | <1 | <40 |
| A1464/85 | 3 | 20 | 74 | 1100 | <1 | <40 |
| A1465/85 | 5 | 22 | 110 | 920 | <1 | <40 |
| A1466/85 | 3 | 20 | 100 | 1080 | <1 | <40 |
| A1467/85 | 4 | 22 | 60 | 1320 | <1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

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NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A1468/85 | 3 | 24 | 43 | 1180 | <1 | <40 |
| A1469/85 | 7 | 22 | 66 | 2240 | <1 | 40 |
| A1470/85 | 5 | 28 | 66 | 3060 | <1 | <40 |
| A1471/85 | 6 | 40 | 42 | 1700 | <1 | <40 |
| A1472/85 | 6 | 86 | 36 | 710 | <1 | <40 |
| A1473/85 | 6 | 62 | 56 | 1100 | <1 | <40 |
| A1474/85 | 4 | 38 | 44 | 920 | <1 | <40 |
| A1475/85 | 7 | 30 | 36 | 2780 | <1 | <40 |
| A1476/85 | 17 | 44 | 39 | 1.77% | <1 | <40 |
| A1477/85 | 10 | 54 | 100 | 2600 | <1 | 60 |
| A1478/85 | 6 | 38 | 56 | 1040 | <1 | <40 |
| A1479/85 | 13 | 58 | 60 | 2160 | <1 | <40 |
| A1480/85 | 3 | 24 | 27 | 510 | <1 | <40 |
| A1481/85 | 6 | 30 | 58 | 1820 | <1 | <40 |
| A1482/85 | 8 | 28 | 62 | 2520 | <1 | <40 |
| A1483/85 | 8 | 22 | 30 | 1560 | <1 | <40 |
| A1484/85 | 6 | 26 | 66 | 1700 | <1 | 40 |
| A1485/85 | 4 | 18 | 38 | 1080 | <1 | <40 |
| A1486/85 | 3 | 22 | 105 | 1460 | <1 | <40 |
| A1487/85 | 4 | 28 | 145 | 2220 | <1 | <40 |
| A1488/85 | 8 | 20 | 76 | 1100 | <1 | <40 |
| A1489/85 | 15 | 28 | 48 | 1740 | <1 | <40 |
| A1490/85 | 6 | 20 | 46 | 2740 | <1 | <40 |
| A1491/85 | 11 | 50 | 60 | 3840 | <1 | <40 |
| A1492/85 | 5 | 28 | 22 | 550 | <1 | <40 |
| A1493/85 | 5 | 24 | 16 | 260 | <1 | <40 |
| A1494/85 | 4 | 32 | 14 | 600 | <1 | <40 |
| A1495/85 | 4 | 28 | 23 | 1000 | <1 | <40 |
| A1496/85 | <2 | 30 | 35 | 1.41% | <1 | 40 |
| A1497/85 | <2 | 22 | 26 | 2.04% | <1 | <40 |
| A1498/85 | 6 | 22 | 20 | 9050 | <1 | <40 |
| A1499/85 | 4 | 20 | 11 | 2260 | <1 | <40 |
| A1500/85 | 2 | 20 | 11 | 1180 | <1 | <40 |
| A1501/85 | 3 | 26 | 20 | 325 | <1 | <40 |
| A1502/85 | 5 | 24 | 41 | 370 | <1 | <40 |
| A1503/85 | 5 | 345 | 680 | 690 | 7 | <40 |
| A1504/85 | 7 | 270 | 560 | 730 | 5 | <40 |
| A1505/85 | 4 | 135 | 235 | 780 | <1 | <40 |
| A1506/85 | 3 | 74 | 70 | 870 | <1 | <40 |
| A1507/85 | 2 | 62 | 35 | 720 | <1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

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NATA Certificate

Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A1508/85 | 2 | 76 | 84 | 640 | <1 | <40 |
| A1509/85 | 2 | 40 | 33 | 190 | <1 | <40 |
| A1510/85 | 2 | 42 | 42 | 175 | <1 | <40 |
| A1511/85 | 2 | 38 | 39 | 170 | <1 | <40 |
| A1512/85 | 2 | 56 | 105 | 175 | <1 | <40 |
| A1513/85 | 2 | 22 | 19 | 155 | <1 | <40 |
| A1514/85 | 3 | 200 | 155 | 1020 | <1 | <40 |
| A1515/85 | 2 | 66 | 70 | 720 | <1 | <40 |
| A1516/85 | 2 | 105 | 46 | 770 | <1 | <40 |
| A1517/85 | 8 | 290 | 550 | 680 | 4 | <40 |
| A1518/85 | 3 | 60 | 94 | 510 | <1 | <40 |
| A1519/85 | 4 | 22 | 24 | 210 | <1 | <40 |
| A1520/85 | 3 | 30 | 31 | 375 | <1 | <40 |
| A1521/85 | 2 | 24 | 24 | 560 | <1 | <40 |
| A1522/85 | 4 | 22 | 18 | 870 | <1 | <40 |
| A1523/85 | 4 | 24 | 12 | 490 | <1 | <40 |
| A1524/85 | 10 | 22 | 30 | 1.84% | <1 | <40 |
| A1525/85 | 11 | 40 | 38 | 9750 | <1 | <40 |
| A1526/85 | 7 | 18 | 47 | 4540 | <1 | <40 |
| A1527/85 | 10 | 28 | 18 | 2180 | <1 | 90 |
| A1528/85 | 6 | 28 | 46 | 2460 | <1 | 50 |
| A1529/85 | 5 | 26 | 43 | 670 | <1 | 50 |
| A1530/85 | 5 | 30 | 54 | 900 | <1 | 60 |
| A1531/85 | 5 | 72 | 120 | 420 | <1 | <40 |
| A1532/85 | 3 | 120 | 105 | 630 | 1 | 40 |
| A1533/85 | 5 | 215 | 205 | 800 | 1 | <40 |
| A1534/85 | 3 | 200 | 245 | 870 | <1 | <40 |
| A1535/85 | 2 | 70 | 92 | 570 | <1 | <40 |
| A1536/85 | 3 | 28 | 36 | 150 | <1 | <40 |
| A1537/85 | 6 | 32 | 39 | 180 | <1 | <40 |
| A1538/85 | 3 | 48 | 64 | 205 | <1 | <40 |
| A1539/85 | 3 | 76 | 74 | 475 | 1 | <40 |
| A1540/85 | 5 | 84 | 200 | 750 | <1 | <40 |
| A1541/85 | 2 | 88 | 58 | 800 | <1 | <40 |
| A1542/85 | 3 | 120 | 115 | 900 | <1 | <40 |
| A1543/85 | 3 | 74 | 82 | 640 | <1 | <40 |
| A1544/85 | 2 | 105 | 72 | 830 | <1 | <40 |
| A1545/85 | 3 | 94 | 54 | 800 | <1 | <40 |
| A1546/85 | 3 | 34 | 66 | 310 | <1 | 40 |
| A1547/85 | 4 | 24 | 25 | 560 | <1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

amdel

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NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A1548/85 | 2 | 20 | 26 | 520 | <1 | <40 |
| A1549/85 | 2 | 22 | 32 | 970 | <1 | <40 |
| A1550/85 | 10 | 60 | 150 | 2.16% | <1 | <40 |
| A1551/85 | 6 | 24 | 34 | 1.16% | <1 | <40 |
| A1552/85 | 5 | 60 | 31 | 2380 | <1 | 60 |
| A1553/85 | 4 | 30 | 43 | 1240 | <1 | <40 |
| A1554/85 | 72 | 74 | 260 | 3760 | <1 | 40 |
| A1555/85 | 3 | 32 | 60 | 1180 | <1 | <40 |
| A1556/85 | 3 | 22 | 24 | 770 | <1 | <40 |
| A1557/85 | 3 | 26 | 21 | 350 | <1 | <40 |
| A1558/85 | 5 | 22 | 18 | 285 | <1 | <40 |
| A1559/85 | 7 | 110 | 36 | 1100 | <1 | <40 |
| A1560/85 | 4 | 105 | 36 | 1100 | <1 | <40 |
| A1561/85 | 4 | 90 | 40 | 930 | <1 | <40 |
| A1562/85 | 3 | 105 | 45 | 910 | <1 | <40 |
| A1563/85 | 3 | 110 | 47 | 650 | <1 | <40 |
| A1564/85 | 4 | 30 | 26 | 235 | <1 | <40 |
| A1565/85 | 5 | 155 | 39 | 220 | <1 | <40 |
| A1566/85 | 4 | 78 | 68 | 240 | <1 | <40 |
| A1567/85 | 3 | 46 | 54 | 245 | <1 | <40 |
| A1568/85 | 5 | 185 | 225 | 1880 | <1 | <40 |
| A1569/85 | 5 | 125 | 66 | 1180 | <1 | <40 |
| A1570/85 | 2 | 76 | 27 | 980 | <1 | <40 |
| A1571/85 | 4 | 68 | 23 | 890 | <1 | <40 |
| A1572/85 | 6 | 135 | 60 | 1080 | <1 | <40 |
| A1573/85 | 6 | 120 | 105 | 1080 | <1 | <40 |
| A1574/85 | 3 | 82 | 37 | 1440 | <1 | <40 |
| A1575/85 | 3 | 42 | 50 | 640 | <1 | <40 |
| A1576/85 | 2 | 32 | 25 | 470 | <1 | <40 |
| A1577/85 | 4 | 26 | 20 | 760 | <1 | <40 |
| A1578/85 | 3 | 24 | 23 | 820 | <1 | <40 |
| A1579/85 | 4 | 30 | 31 | 1780 | <1 | <40 |
| A1580/85 | 5 | 24 | 48 | 3740 | <1 | <40 |
| A1581/85 | 3 | 22 | 78 | 7200 | <1 | <40 |
| A1582/85 | 4 | 30 | 14 | 1240 | <1 | <40 |
| A1583/85 | 3 | 26 | 11 | 490 | <1 | <40 |
| A1584/85 | 3 | 22 | 9 | 380 | <1 | <40 |
| A1585/85 | 7 | 94 | 20 | 1140 | <1 | <40 |
| A1586/85 | 3 | 120 | 170 | 1160 | <1 | <40 |
| A1587/85 | 4 | 94 | 125 | 1160 | <1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

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NATA Certificate    Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A1588/85 | 4 | 44 | 50 | 1240 | <1 | <40 |
| A1589/85 | 3 | 78 | 90 | 1640 | <1 | <40 |
| A1590/85 | 2 | 170 | 56 | 750 | <1 | <40 |
| A1591/85 | <2 | 105 | 46 | 250 | <1 | <40 |
| A1606/85 | 4 | 22 | 17 | 870 | <1 | <40 |
| A1607/85 | 3 | 22 | 12 | 760 | <1 | 50 |
| A1608/85 | 6 | 22 | 24 | 840 | <1 | 40 |
| A1609/85 | 5 | 36 | 20 | 1200 | <1 | 40 |
| A1610/85 | 4 | 42 | 42 | 1400 | <1 | 40 |
| A1611/85 | 3 | 44 | 29 | 840 | <1 | 40 |
| A1612/85 | 6 | 34 | 24 | 1940 | <1 | 50 |
| A1613/85 | 4 | 22 | 21 | 1920 | <1 | <40 |
| A1614/85 | 7 | 22 | 56 | 3120 | <1 | <40 |
| A1615/85 | 5 | 48 | 86 | 2160 | <1 | <40 |
| A1616/85 | 4 | 54 | 56 | 1040 | <1 | 50 |
| A1617/85 | 4 | 86 | 46 | 690 | <1 | 40 |
| A1618/85 | 9 | 98 | 88 | 750 | <1 | <40 |
| A1619/85 | 3 | 52 | 50 | 750 | <1 | <40 |
| A1620/85 | 4 | 34 | 62 | 1760 | <1 | 40 |
| A1621/85 | 4 | 24 | 29 | 1860 | <1 | <40 |
| A1622/85 | 5 | 42 | 58 | 2120 | <1 | <40 |
| A1623/85 | 6 | 38 | 49 | 2140 | <1 | 60 |
| A1624/85 | 4 | 40 | 26 | 630 | <1 | <40 |
| A1625/85 | 5 | 36 | 22 | 370 | <1 | <40 |
| A1626/85 | 4 | 30 | 30 | 840 | <1 | <40 |
| A1627/85 | 8 | 34 | 44 | 570 | <1 | 50 |
| A1628/85 | 4 | 28 | 34 | 1440 | <1 | 50 |
| A1629/85 | 9 | 64 | 16 | 8700 | <1 | <40 |
| A1630/85 | 6 | 38 | 52 | 6550 | <1 | 40 |
| A1631/85 | 4 | 28 | 38 | 2300 | <1 | 40 |
| A1632/85 | 3 | 20 | 19 | 490 | <1 | <40 |
| A1633/85 | 5 | 36 | 39 | 670 | <1 | <40 |
| A1634/85 | 7 | 36 | 34 | 500 | <1 | <40 |
| A1635/85 | 3 | 30 | 50 | 1100 | <1 | <40 |
| A1636/85 | 115 | 60 | 830 | 8.78% | <1 | 80 |
| A1637/85 | 17 | 30 | 120 | 3760 | <1 | <40 |
| A1638/85 | 9 | 30 | 110 | 3920 | <1 | <40 |
| A1639/85 | 6 | 34 | 92 | 2320 | <1 | <40 |
| A1640/85 | 7 | 26 | 54 | 2540 | <1 | <40 |
| A1641/85 | 7 | 30 | 68 | 1940 | <1 | 50 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

Analysis code A1/1,2 Report AC 1037/86 

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A1642/85 | 6 | 34 | 44 | 790 | <1 | <40 |
| A1643/85 | 4 | 40 | 38 | 480 | <1 | <40 |
| A1644/85 | 4 | 32 | 82 | 1220 | <1 | <40 |
| A1645/85 | 6 | 26 | 115 | 3420 | <1 | <40 |
| A1646/85 | 6 | 22 | 90 | 2520 | <1 | <40 |
| A1647/85 | 9 | 20 | 74 | 2040 | <1 | <40 |
| A1648/85 | 10 | 58 | 190 | 3100 | <1 | 40 |
| A1649/85 | 6 | 36 | 38 | 720 | <1 | <40 |
| A1650/85 | 8 | 28 | 41 | 510 | <1 | <40 |
| A1651/85 | 5 | 40 | 36 | 630 | <1 | <40 |
| A1652/85 | 13 | 24 | 31 | 500 | <1 | <40 |
| A1653/85 | 12 | 58 | 62 | 5050 | <1 | 50 |
| A1654/85 | 18 | 42 | 125 | 3.63% | <1 | 40 |
| A1655/85 | 19 | 30 | 62 | 4.06% | <1 | <40 |
| A1656/85 | 11 | 54 | 145 | 3.27% | <1 | 80 |
| A1657/85 | 3 | 24 | 32 | 1040 | <1 | <40 |
| A1658/85 | 3 | 24 | 28 | 680 | <1 | <40 |
| A1659/85 | <2 | 24 | 31 | 375 | <1 | <40 |
| A1660/85 | 4 | 28 | 35 | 450 | <1 | <40 |
| A1661/85 | 3 | 36 | 66 | 1080 | <1 | <40 |
| A1662/85 | 7 | 28 | 90 | 2600 | <1 | <40 |
| A1663/85 | 11 | 30 | 92 | 2460 | <1 | <40 |
| A1664/85 | 9 | 26 | 88 | 2700 | <1 | <40 |
| A1665/85 | 4 | 36 | 54 | 870 | <1 | <40 |
| A1666/85 | 7 | 62 | 68 | 550 | <1 | <40 |
| A1667/85 | 5 | 100 | 52 | 1580 | 2 | <40 |
| A1668/85 | 6 | 22 | 100 | 3280 | <1 | <40 |
| A1669/85 | 11 | 20 | 76 | 2340 | <1 | <40 |
| A1670/85 | 7 | 24 | 60 | 1480 | <1 | <40 |
| A1671/85 | 4 | 34 | 48 | 1200 | <1 | <40 |
| A1672/85 | 4 | 36 | 18 | 340 | <1 | <40 |
| A1673/85 | 5 | 30 | 40 | 720 | <1 | <40 |
| A1674/85 | 84 | 1140 | 2460 | 21.9% | 2 | 60 |
| A1675/85 | 5 | 30 | 34 | 1840 | <1 | <40 |
| A1676/85 | 8 | 30 | 58 | 2400 | <1 | <40 |
| A1677/85 | 10 | 105 | 210 | 4.92% | 1 | <40 |
| A1678/85 | 21 | 70 | 630 | 20.4% | 2 | 60 |
| A1679/85 | 5 | 42 | 86 | 4160 | <1 | <40 |
| A1680/85 | 12 | 28 | 27 | 1.80% | <1 | <40 |
| A1681/85 | 9 | 52 | 60 | 740 | <1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

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NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A1682/85 | 4 | 20 | 130 | 870 | <1 | <40 |
| A1683/85 | 3 | 24 | 185 | 1600 | <1 | <40 |
| A1684/85 | 12 | 82 | 110 | 1480 | <1 | <40 |
| A1685/85 | 18 | 88 | 135 | 900 | <1 | <40 |
| A1686/85 | 12 | 54 | 82 | 780 | <1 | <40 |
| A1687/85 | 13 | 48 | 130 | 1400 | <1 | <40 |
| A1688/85 | 52 | 68 | 200 | 3560 | <1 | <40 |
| A1689/85 | 20 | 125 | 80 | 2960 | <1 | <40 |
| A1690/85 | 12 | 355 | 110 | 710 | <1 | <40 |
| A1691/85 | 7 | 58 | 68 | 1680 | <1 | <40 |
| A1692/85 | 10 | 115 | 155 | 600 | <1 | <40 |
| A1693/85 | 19 | 150 | 50 | 600 | <1 | <40 |
| A1694/85 | 4 | 62 | 35 | 520 | <1 | <40 |
| A1695/85 | 3 | 165 | 415 | 1900 | 5 | <40 |
| A1696/85 | 23 | 88 | 550 | 1760 | 3 | <40 |
| A1697/85 | 3 | 46 | 84 | 920 | <1 | <40 |
| A1698/85 | 4 | 34 | 105 | 690 | <1 | <40 |
| A1699/85 | 5 | 92 | 78 | 610 | <1 | <40 |
| A1700/85 | 2 | 46 | 41 | 780 | <1 | <40 |
| A1701/85 | <2 | 26 | 25 | 590 | <1 | <40 |
| A1702/85 | <2 | 28 | 66 | 195 | <1 | <40 |
| A1703/85 | <2 | 26 | 18 | 230 | <1 | <40 |
| A1704/85 | <2 | 22 | 30 | 540 | <1 | <40 |
| A1705/85 | <2 | 24 | 13 | 170 | <1 | <40 |
| A1706/85 | <2 | 38 | 36 | 470 | <1 | <40 |
| A1707/85 | 2 | 30 | 23 | 145 | <1 | <40 |
| A1708/85 | 6 | 62 | 20 | 180 | 1 | <40 |
| A1709/85 | <2 | 34 | 155 | 250 | <1 | <40 |
| A1710/85 | <2 | 190 | 390 | 1700 | 4 | <40 |
| A1711/85 | 3 | 115 | 1580 | 405 | 5 | 60 |
| A1712/85 | <2 | 60 | 1380 | 1460 | 2 | <40 |
| A1713/85 | <2 | 30 | 500 | 1080 | <1 | <40 |
| A1714/85 | 5 | 28 | 400 | 1520 | <1 | <40 |
| A1715/85 | 2 | 26 | 345 | 1120 | <1 | <40 |
| A1716/85 | 2 | 18 | 165 | 720 | <1 | 40 |
| A1717/85 | 4 | 32 | 165 | 1040 | <1 | <40 |
| A1718/85 | 2 | 22 | 185 | 820 | <1 | <40 |
| A1719/85 | 8 | 72 | 50 | 1260 | <1 | <40 |
| A1720/85 | 25 | 56 | 66 | 1260 | <1 | <40 |
| A1721/85 | 13 | 30 | 125 | 1060 | <1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

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NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A1722/85 | 5 | 18 | 120 | 1040 | <1 | <40 |
| A1723/85 | 8 | 46 | 84 | 1120 | <1 | <40 |
| A1724/85 | 3 | 24 | 78 | 1100 | <1 | <40 |
| A1725/85 | 19 | 30 | 150 | 1560 | <1 | <40 |
| A1726/85 | 11 | 485 | 54 | 510 | <1 | <40 |
| A1727/85 | 6 | 100 | 62 | 1040 | <1 | <40 |
| A1728/85 | <2 | 26 | 130 | 1120 | <1 | <40 |
| A1729/85 | 9 | 28 | 115 | 670 | <1 | <40 |
| A1730/85 | 2 | 80 | 980 | 1400 | 2 | <40 |
| A1731/85 | <2 | 86 | 295 | 1220 | 1 | <40 |
| A1732/85 | <2 | 150 | 70 | 580 | 2 | <40 |
| A1733/85 | <2 | 120 | 34 | 650 | 1 | <40 |
| A1734/85 | 3 | 60 | 38 | 580 | <1 | <40 |
| A1735/85 | 3 | 48 | 30 | 330 | <1 | <40 |
| A1736/85 | 2 | 34 | 110 | 560 | <1 | <40 |
| A1737/85 | <2 | 26 | 40 | 435 | <1 | <40 |
| A1738/85 | 2 | 36 | 40 | 365 | <1 | <40 |
| A1739/85 | 2 | 48 | 70 | 285 | 1 | <40 |
| A1740/85 | <2 | 34 | 66 | 510 | <1 | <40 |
| A1741/85 | 3 | 42 | 23 | 280 | <1 | <40 |
| A1742/85 | 4 | 40 | 30 | 360 | <1 | <40 |
| A1743/85 | 2 | 26 | 9 | 150 | <1 | <40 |
| A1744/85 | <2 | 24 | 56 | 410 | <1 | <40 |
| A1745/85 | 2 | 26 | 54 | 700 | <1 | <40 |
| A1746/85 | <2 | 32 | 27 | 290 | <1 | <40 |
| A1747/85 | <2 | 24 | 10 | 250 | <1 | <40 |
| A1748/85 | <2 | 28 | 76 | 285 | <1 | <40 |
| A1749/85 | 3 | 78 | 130 | 445 | 2 | <40 |
| A1750/85 | 4 | 105 | 475 | 740 | 3 | <40 |
| A1751/85 | 4 | 86 | 460 | 430 | 4 | <40 |
| A1752/85 | 2 | 66 | 1040 | 1480 | 4 | <40 |
| A1753/85 | 2 | 32 | 530 | 1440 | <1 | <40 |
| A1754/85 | <2 | 22 | 360 | 1120 | <1 | <40 |
| A1755/85 | <2 | 16 | 115 | 720 | <1 | <40 |
| A1756/85 | 2 | 40 | 820 | 1140 | 1 | <40 |
| A1757/85 | <2 | 26 | 470 | 1060 | <1 | <40 |
| A1758/85 | 4 | 62 | 2520 | 2260 | 3 | <40 |
| A1759/85 | 3 | 52 | 130 | 630 | 2 | <40 |
| A1760/85 | <2 | 46 | 105 | 270 | 1 | <40 |
| A1761/85 | 4 | 24 | 46 | 1000 | <1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

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NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A1762/85 | <2 | 18 | 29 | 255 | <1 | <40 |
| A1763/85 | <2 | 18 | 25 | 210 | <1 | <40 |
| A1764/85 | 5 | 26 | 28 | 295 | <1 | <40 |
| A1765/85 | <2 | 26 | 20 | 330 | <1 | <40 |
| A1766/85 | <2 | 20 | 20 | 205 | <1 | <40 |
| A1767/85 | 2 | 24 | 24 | 580 | <1 | <40 |
| A1768/85 | 4 | 22 | 28 | 410 | <1 | <40 |
| A1769/85 | <2 | 26 | 46 | 350 | <1 | <40 |
| A1770/85 | <2 | 24 | 21 | 240 | <1 | <40 |
| A1771/85 | 18 | 32 | 35 | 335 | <1 | <40 |
| A1772/85 | <2 | 26 | 19 | 245 | <1 | <40 |
| A1773/85 | 10 | 58 | 29 | 375 | <1 | <40 |
| A1774/85 | 25 | 54 | 52 | 365 | <1 | <40 |
| A1775/85 | 4 | 140 | 45 | 335 | <1 | <40 |
| A1776/85 | 2 | 48 | 26 | 370 | <1 | <40 |
| A1777/85 | 5 | 46 | 22 | 500 | <1 | <40 |
| A1778/85 | 3 | 56 | 76 | 220 | <1 | <40 |
| A1779/85 | 2 | 38 | 40 | 690 | <1 | <40 |
| A1780/85 | 2 | 38 | 20 | 420 | <1 | <40 |
| A1781/85 | 2 | 26 | 24 | 280 | <1 | <40 |
| A1782/85 | 6 | 20 | 50 | 320 | <1 | <40 |
| A1783/85 | 3 | 44 | 58 | 430 | <1 | <40 |
| A1784/85 | 7 | 150 | 265 | 900 | 3 | <40 |
| A1785/85 | 3 | 320 | 150 | 700 | 8 | <40 |
| A1786/85 | 4 | 270 | 300 | 730 | 7 | <40 |
| A1787/85 | 4 | 140 | 390 | 750 | 5 | <40 |
| A1788/85 | 9 | 88 | 200 | 760 | 3 | <40 |
| A1789/85 | 3 | 150 | 355 | 1000 | 4 | <40 |
| A1790/85 | 6 | 115 | 68 | 1120 | 3 | <40 |
| A1791/85 | 4 | 250 | 2300 | 2900 | 11 | <40 |
| A1792/85 | 25 | 88 | 260 | 840 | <1 | <40 |
| A1793/85 | 3 | 68 | 62 | 295 | <1 | <40 |
| A1794/85 | 4 | 70 | 66 | 305 | <1 | <40 |
| A1795/85 | 3 | 32 | 48 | 640 | <1 | <40 |
| A1796/85 | 3 | 40 | 31 | 365 | <1 | <40 |
| A1797/85 | 3 | 44 | 26 | 175 | <1 | <40 |
| A1798/85 | 3 | 90 | 39 | 580 | <1 | <40 |
| A1799/85 | 3 | 56 | 31 | 325 | <1 | <40 |
| A1800/85 | <2 | 22 | 49 | 345 | <1 | <40 |
| A1801/85 | 2 | 36 | 50 | 640 | <1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

Analysis code A1/1,2 Report AC 1037/86 

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A1802/85 | <2 | 18 | 28 | 270 | <1 | <40 |
| A1803/85 | 2 | 18 | 12 | 92 | <1 | <40 |
| A1804/85 | 2 | 24 | 42 | 285 | <1 | <40 |
| A1805/85 | 2 | 20 | 24 | 175 | <1 | <40 |
| A1806/85 | 3 | 18 | 36 | 155 | <1 | <40 |
| A1807/85 | 3 | 18 | 32 | 120 | <1 | <40 |
| A1808/85 | 2 | 24 | 24 | 205 | <1 | <40 |
| A1809/85 | 3 | 24 | 25 | 130 | <1 | <40 |
| A1810/85 | 2 | 18 | 22 | 145 | <1 | <40 |
| A1811/85 | 3 | 18 | 60 | 345 | <1 | <40 |
| A1812/85 | <2 | 16 | 155 | 870 | <1 | <40 |
| A1813/85 | <2 | 16 | 195 | 970 | <1 | <40 |
| A1814/85 | 3 | 16 | 185 | 750 | <1 | <40 |
| A1815/85 | 3 | 16 | 265 | 780 | <1 | <40 |
| A1816/85 | <2 | 14 | 150 | 580 | <1 | <40 |
| A1817/85 | 3 | 12 | 150 | 730 | <1 | <40 |
| A1818/85 | 3 | 58 | 1540 | 1500 | 3 | <40 |
| A1819/85 | 3 | 42 | 750 | 1160 | 2 | <40 |
| A1820/85 | 3 | 22 | 155 | 510 | <1 | <40 |
| A1821/85 | <2 | 16 | 29 | 150 | <1 | <40 |
| A1822/85 | <2 | 18 | 27 | 175 | <1 | <40 |
| A1823/85 | 2 | 20 | 24 | 130 | <1 | 40 |
| A1824/85 | <2 | 18 | 11 | 105 | <1 | <40 |
| A1825/85 | 2 | 20 | 47 | 120 | <1 | <40 |
| A1826/85 | <2 | 20 | 20 | 160 | <1 | <40 |
| A1827/85 | 5 | 34 | 145 | 1560 | <1 | <40 |
| A1828/85 | 2 | 20 | 13 | 210 | <1 | <40 |
| A1829/85 | <2 | 20 | 20 | 445 | <1 | <40 |
| A1830/85 | <2 | 32 | 27 | 285 | <1 | <40 |
| A1831/85 | 37 | 34 | 60 | 205 | <1 | <40 |
| A1832/85 | <2 | 36 | 265 | 520 | <1 | <40 |
| A1833/85 | 2 | 40 | 230 | 720 | <1 | <40 |
| A1834/85 | 3 | 44 | 56 | 510 | <1 | <40 |
| A1835/85 | 2 | 52 | 21 | 245 | <1 | <40 |
| A1836/85 | 7 | 92 | 275 | 4580 | <1 | 240 |
| A1837/85 | 11 | 135 | 245 | 490 | <1 | 120 |
| A1838/85 | 2 | 60 | 72 | 850 | <1 | 40 |
| A1839/85 | 2 | 52 | 52 | 410 | <1 | 40 |
| A1840/85 | 4 | 170 | 790 | 1780 | <1 | 40 |
| A1841/85 | 2 | 42 | 40 | 380 | <1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

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NATA Certificate

Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A1842/85 | <2 | 24 | 11 | 98 | <1 | <40 |
| A1843/85 | 2 | 26 | 25 | 225 | <1 | <40 |
| A1844/85 | 3 | 36 | 22 | 400 | <1 | <40 |
| A1845/85 | <2 | 24 | 20 | 245 | <1 | <40 |
| A1846/85 | 7 | 44 | 31 | 465 | <1 | <40 |
| A1847/85 | 2 | 28 | 23 | 240 | <1 | <40 |
| A1848/85 | 3 | 48 | 23 | 200 | <1 | <40 |
| A1849/85 | 66 | 36 | 34 | 345 | <1 | <40 |
| A1850/85 | 3 | 50 | 39 | 325 | <1 | <40 |
| A1851/85 | 4 | 26 | 25 | 190 | <1 | <40 |
| A1852/85 | 2 | 22 | 31 | 205 | <1 | <40 |
| A1853/85 | 2 | 20 | 8 | 84 | <1 | <40 |
| A1854/85 | 2 | 26 | 14 | 130 | <1 | <40 |
| A1855/85 | 3 | 20 | 24 | 120 | 1 | <40 |
| A1856/85 | 3 | 22 | 60 | 265 | <1 | <40 |
| A1857/85 | 3 | 26 | 150 | 920 | <1 | <40 |
| A1858/85 | 2 | 22 | 145 | 295 | <1 | <40 |
| A1859/85 | <2 | 30 | 710 | 1200 | 2 | <40 |
| A1860/85 | 3 | 60 | 1100 | 1380 | 4 | <40 |
| A1861/85 | 3 | 24 | 630 | 1040 | <1 | <40 |
| A1862/85 | 2 | 18 | 240 | 760 | <1 | <40 |
| A1863/85 | 3 | 26 | 350 | 780 | <1 | <40 |
| A1864/85 | 4 | 14 | 130 | 740 | <1 | <40 |
| A1865/85 | 3 | 20 | 175 | 770 | <1 | <40 |
| A1866/85 | 2 | 50 | 1340 | 1680 | 3 | <40 |
| A1867/85 | 3 | 36 | 115 | 265 | 1 | <40 |
| A1868/85 | 9 | 34 | 76 | 165 | 2 | <40 |
| A1869/85 | 3 | 26 | 23 | 82 | 1 | <40 |
| A1870/85 | 3 | 50 | 31 | 135 | 2 | <40 |
| A1871/85 | 2 | 92 | 98 | 295 | 6 | <40 |
| A1872/85 | 3 | 86 | 235 | 350 | 4 | <40 |
| A1873/85 | 3 | 145 | 345 | 345 | 5 | <40 |
| A1874/85 | 2 | 28 | 58 | 180 | 1 | <40 |
| A1875/85 | 2 | 22 | 38 | 330 | <1 | <40 |
| A1876/85 | <2 | 24 | 22 | 130 | <1 | <40 |
| A1877/85 | <2 | 26 | 24 | 175 | <1 | <40 |
| A1878/85 | <2 | 40 | 35 | 295 | <1 | <40 |
| A1879/85 | <2 | 32 | 39 | 315 | 1 | <40 |
| A1880/85 | <2 | 52 | 125 | 345 | 1 | <40 |
| A1881/85 | 2 | 26 | 17 | 265 | <1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

amdel

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NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A1882/85 | <2 | 28 | 37 | 330 | <1 | <40 |
| A1883/85 | <2 | 22 | 46 | 300 | <1 | <40 |
| A1884/85 | <2 | 40 | 105 | 415 | 1 | <40 |
| A1885/85 | <2 | 32 | 56 | 465 | <1 | <40 |
| A1886/85 | 7 | 32 | 270 | 1.04% | <1 | <40 |
| A1887/85 | 2 | 34 | 43 | 770 | <1 | <40 |
| A1888/85 | <2 | 38 | 27 | 435 | <1 | <40 |
| A1889/85 | <2 | 28 | 17 | 490 | <1 | <40 |
| A1890/85 | 3 | 22 | 28 | 455 | <1 | <40 |
| A1891/85 | <2 | 28 | 16 | 170 | <1 | <40 |
| A1892/85 | 2 | 22 | 28 | 265 | <1 | <40 |
| A1893/85 | <2 | 38 | 36 | 335 | <1 | <40 |
| A1894/85 | 3 | 32 | 54 | 310 | <1 | <40 |
| A1895/85 | 2 | 74 | 86 | 325 | <1 | <40 |
| A1896/85 | 2 | 54 | 140 | 470 | <1 | <40 |
| A1897/85 | <2 | 30 | 76 | 325 | <1 | <40 |
| A1898/85 | <2 | 170 | 170 | 460 | 7 | <40 |
| A1899/85 | 2 | 94 | 265 | 390 | 3 | <40 |
| A1900/85 | 3 | 66 | 115 | 345 | 4 | <40 |
| A1901/85 | 2 | 170 | 78 | 350 | 9 | <40 |
| A1902/85 | 3 | 36 | 730 | 940 | 2 | <40 |
| A1903/85 | 3 | 24 | 430 | 1020 | <1 | <40 |
| A1904/85 | 3 | 28 | 435 | 860 | 1 | <40 |
| A1905/85 | 3 | 28 | 340 | 830 | <1 | <40 |
| A1906/85 | <2 | 18 | 250 | 820 | <1 | <40 |
| A1907/85 | 2 | 34 | 225 | 540 | <1 | <40 |
| A1908/85 | 3 | 32 | 325 | 860 | <1 | <40 |
| A1909/85 | 6 | 50 | 630 | 950 | 1 | <40 |
| A1910/85 | 4 | 60 | 1420 | 1360 | 3 | <40 |
| A1911/85 | 5 | 52 | 1480 | 1620 | 3 | <40 |
| A1912/85 | <2 | 56 | 260 | 365 | 1 | <40 |
| A1913/85 | <2 | 88 | 1980 | 880 | 4 | <40 |
| A1914/85 | <2 | 100 | 72 | 300 | 7 | <40 |
| A1915/85 | <2 | 375 | 150 | 2860 | 2 | <40 |
| A1916/85 | 3 | 150 | 29 | 130 | 1 | <40 |
| A1917/85 | 2 | 24 | 23 | 145 | 1 | <40 |
| A1918/85 | <2 | 24 | 46 | 220 | <1 | 40 |
| A1919/85 | <2 | 26 | 21 | 245 | <1 | <40 |
| A1920/85 | <2 | 24 | 22 | 255 | <1 | <40 |
| A1921/85 | <2 | 24 | 42 | 450 | 1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

amdel

Analysis code A1/1.2 Report AC 1037/86 

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A1922/85 | 2 | 44 | 20 | 405 | <1 | <40 |
| A1923/85 | 2 | 22 | 14 | 245 | <1 | <40 |
| A1924/85 | <2 | 22 | 16 | 370 | <1 | <40 |
| A1925/85 | 2 | 22 | 14 | 245 | <1 | <40 |
| A1926/85 | 2 | 20 | 20 | 540 | <1 | <40 |
| A1927/85 | 2 | 220 | 21 | 220 | 1 | <40 |
| A1928/85 | 7 | 105 | 370 | 2620 | <1 | 130 |
| A1929/85 | <2 | 26 | 22 | 350 | <1 | <40 |
| A1930/85 | 7 | 155 | 22 | 270 | <1 | <40 |
| A1931/85 | 4 | 46 | 14 | 300 | <1 | <40 |
| A1932/85 | 52 | 38 | 22 | 430 | <1 | <40 |
| A1933/85 | 4 | 22 | 30 | 245 | <1 | <40 |
| A1934/85 | 3 | 24 | 21 | 345 | <1 | <40 |
| A1935/85 | 31 | 260 | 17 | 395 | 1 | <40 |
| A1936/85 | 3 | 56 | 19 | 325 | <1 | <40 |
| A1937/85 | 58 | 26 | 20 | 170 | <1 | <40 |
| A1938/85 | 13 | 32 | 25 | 98 | <1 | <40 |
| A1939/85 | 4 | 46 | 40 | 130 | 1 | <40 |
| A1940/85 | 7 | 40 | 21 | 110 | <1 | <40 |
| A1941/85 | 24 | 40 | 18 | 120 | <1 | <40 |
| A1942/85 | 3 | 26 | 62 | 365 | <1 | <40 |
| A1943/85 | 5 | 185 | 3580 | 1840 | 10 | <40 |
| A1944/85 | 4 | 70 | 720 | 1120 | 1 | <40 |
| A1945/85 | 2 | 76 | 1120 | 1160 | 2 | <40 |
| A1946/85 | 5 | 72 | 690 | 1260 | 2 | <40 |
| A1947/85 | 3 | 70 | 470 | 810 | 1 | <40 |
| A1948/85 | 11 | 68 | 740 | 970 | 2 | <40 |
| A1949/85 | 7 | 58 | 790 | 990 | 2 | <40 |
| A1950/85 | 5 | 58 | 1380 | 1060 | 3 | <40 |
| A1951/85 | 3 | 48 | 650 | 1260 | 2 | <40 |
| A1952/85 | 3 | 46 | 600 | 870 | 3 | <40 |
| A1953/85 | 15 | 52 | 880 | 1020 | 2 | <40 |
| A1954/85 | 7 | 94 | 2040 | 1640 | 4 | <40 |
| A1955/85 | 26 | 70 | 980 | 1300 | 2 | <40 |
| A1956/85 | 13 | 190 | 3100 | 1840 | 5 | <40 |
| A1957/85 | 17 | 165 | 4760 | 2500 | 10 | <40 |
| A1958/85 | 7 | 38 | 435 | 590 | 1 | <40 |
| A1959/85 | 8 | 78 | 68 | 205 | 1 | <40 |
| A1960/85 | 3 | 32 | 70 | 190 | <1 | <40 |
| A1961/85 | 8 | 30 | 33 | 180 | <1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

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Analysis code A1/1.2 Report AC 1037/86 

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A1962/85 | 4 | 30 | 22 | 86 | <1 | <40 |
| A1963/85 | 3 | 30 | 12 | 170 | <1 | <40 |
| A1964/85 | 2 | 24 | 27 | 310 | <1 | <40 |
| A1965/85 | 2 | 26 | 18 | 235 | <1 | <40 |
| A1966/85 | 5 | 32 | 36 | 425 | <1 | <40 |
| A1967/85 | 7 | 34 | 28 | 410 | <1 | 40 |
| A1968/85 | 13 | 30 | 19 | 300 | <1 | <40 |
| A1969/85 | 6 | 24 | 17 | 260 | <1 | <40 |
| A1970/85 | 11 | 28 | 23 | 400 | <1 | <40 |
| A1971/85 | 10 | 78 | 880 | 1280 | 2 | <40 |
| A1972/85 | 3 | 64 | 640 | 970 | <1 | <40 |
| A1973/85 | 3 | 46 | 810 | 1300 | 1 | <40 |
| A1974/85 | 15 | 54 | 1140 | 1460 | 2 | <40 |
| A1975/85 | 5 | 56 | 680 | 1520 | 2 | <40 |
| A1976/85 | 9 | 50 | 58 | 305 | 1 | <40 |
| A1977/85 | 5 | 30 | 26 | 310 | <1 | <40 |
| A1978/85 | 16 | 32 | 42 | 350 | <1 | <40 |
| A1979/85 | 4 | 220 | 23 | 210 | 1 | <40 |
| A1980/85 | 6 | 60 | 14 | 145 | <1 | <40 |
| A1981/85 | 6 | 22 | 20 | 195 | 1 | <40 |
| A1982/85 | 7 | 42 | 56 | 375 | 1 | <40 |
| A1983/85 | 11 | 42 | 24 | 210 | <1 | <40 |
| A1984/85 | 4 | 100 | 14 | 98 | <1 | <40 |
| A1985/85 | 11 | 24 | 15 | 150 | <1 | <40 |
| A1986/85 | 6 | 64 | 17 | 205 | <1 | <40 |
| A1987/85 | 5 | 26 | 20 | 365 | <1 | <40 |
| A1988/85 | 6 | 26 | 24 | 390 | <1 | <40 |
| A1989/85 | 8 | 28 | 21 | 310 | <1 | <40 |
| A1990/85 | 6 | 24 | 26 | 360 | <1 | <40 |
| A1991/85 | 4 | 22 | 17 | 360 | <1 | <40 |
| A1992/85 | 5 | 36 | 28 | 275 | <1 | <40 |
| A1993/85 | 5 | 36 | 36 | 620 | <1 | <40 |
| A2012/85 | 8 | 105 | 47 | 445 | <1 | <40 |
| A2013/85 | 11 | 90 | 78 | 325 | <1 | <40 |
| A2014/85 | 9 | 62 | 32 | 245 | <1 | <40 |
| A2015/85 | 14 | 185 | 78 | 500 | 1 | <40 |
| A2016/85 | 28 | 320 | 80 | 485 | 2 | <40 |
| A2017/85 | 13 | 68 | 70 | 400 | <1 | <40 |
| A2018/85 | 265 | 110 | 62 | 430 | <1 | <40 |
| A2019/85 | 8 | 54 | 60 | 390 | <1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

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Analysis code A1/1,2 Report AC 1037/86 

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A2020/85 | 5 | 48 | 40 | 220 | <1 | <40 |
| A2021/85 | 5 | 42 | 145 | 315 | <1 | <40 |
| A2022/85 | 4 | 34 | 62 | 300 | <1 | <40 |
| A2023/85 | 6 | 52 | 155 | 930 | 1 | 40 |
| A2024/85 | 9 | 76 | 86 | 490 | <1 | <40 |
| A2025/85 | 25 | 105 | 84 | 405 | 1 | <40 |
| A2026/85 | 9 | 220 | 64 | 970 | 2 | <40 |
| A2027/85 | 10 | 520 | 64 | 425 | <1 | <40 |
| A2028/85 | 13 | 170 | 130 | 495 | 1 | <40 |
| A2029/85 | 6 | 26 | 105 | 800 | <1 | <40 |
| A2030/85 | 5 | 20 | 76 | 910 | <1 | <40 |
| A2031/85 | 7 | 28 | 96 | 700 | <1 | <40 |
| A2032/85 | 4 | 24 | 125 | 1160 | <1 | <40 |
| A2033/85 | 4 | 26 | 56 | 590 | <1 | <40 |
| A2034/85 | 8 | 38 | 175 | 840 | <1 | <40 |
| A2035/85 | 6 | 58 | 72 | 145 | <1 | <40 |
| A2036/85 | 5 | 56 | 33 | 110 | <1 | <40 |
| A2037/85 | 6 | 66 | 39 | 165 | <1 | <40 |
| A2038/85 | 10 | 66 | 43 | 180 | 1 | <40 |
| A2039/85 | 9 | 60 | 23 | 160 | <1 | <40 |
| A2040/85 | 6 | 30 | 32 | 205 | <1 | <40 |
| A2041/85 | 7 | 42 | 38 | 590 | 1 | <40 |
| A2042/85 | 12 | 44 | 48 | 355 | <1 | <40 |
| A2043/85 | 7 | 36 | 50 | 470 | <1 | <40 |
| A2044/85 | 8 | 48 | 42 | 265 | <1 | <40 |
| A2045/85 | 7 | 30 | 78 | 450 | <1 | <40 |
| A2046/85 | 5 | 28 | 56 | 415 | <1 | <40 |
| A2047/85 | 5 | 36 | 54 | 820 | <1 | <40 |
| A2048/85 | 11 | 60 | 36 | 310 | <1 | <40 |
| A2049/85 | 19 | 275 | 195 | 870 | 1 | <40 |
| A2050/85 | 6 | 68 | 98 | 920 | <1 | <40 |
| A2051/85 | 11 | 40 | 49 | 480 | <1 | <40 |
| A2052/85 | 13 | 80 | 50 | 550 | <1 | <40 |
| A2053/85 | 10 | 36 | 19 | 660 | <1 | <40 |
| A2054/85 | 8 | 130 | 31 | 620 | <1 | <40 |
| A2055/85 | 8 | 78 | 26 | 1860 | <1 | <40 |
| A2056/85 | 1560 | 94 | 38 | 1060 | <1 | <40 |
| A2057/85 | 41 | 62 | 31 | 800 | <1 | <40 |
| A2058/85 | 25 | 82 | 34 | 1640 | <1 | <40 |
| A2059/85 | 7 | 44 | 18 | 435 | <1 | <40 |
| A2060/85 | 5 | 350 | 9 | 225 | <1 | <40 |
| A2061/85 | 62 | 1520 | 56 | 1420 | <1 | <40 |
| A2062/85 | 8 | 160 | 86 | 640 | <1 | <40 |
| A2063/85 | 11 | 170 | 66 | 400 | 1 | <40 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (40) |

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Analysis code A1/1,2 Report AC 1058/86 

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A911/85 | 14 | 36 | 33 | 1960 | <1 | <20 |
| A912/85 | 6 | 26 | 45 | 1100 | <1 | <20 |
| A913/85 | 3 | 30 | 32 | 495 | <1 | <20 |
| A914/85 | 3 | 24 | 35 | 420 | <1 | <20 |
| A915/85 | 4 | 32 | 54 | 420 | <1 | <20 |
| A916/85 | 6 | 125 | 120 | 860 | 1 | <20 |
| A917/85 | 4 | 40 | 29 | 160 | <1 | <20 |
| A918/85 | 4 | 20 | 21 | 235 | <1 | <20 |
| A919/85 | 2 | 46 | 24 | 220 | <1 | <20 |
| A920/85 | 4 | 54 | 36 | 225 | <1 | <20 |
| A921/85 | 2 | 12 | 17 | 92 | <1 | <20 |
| A922/85 | <2 | 10 | 11 | 70 | <1 | <20 |
| A923/85 | <2 | 34 | 52 | 185 | <1 | <20 |
| A924/85 | 2 | 22 | 74 | 205 | <1 | <20 |
| A925/85 | <2 | 22 | 42 | 145 | <1 | <20 |
| A926/85 | 2 | 84 | 135 | 355 | <1 | <20 |
| A927/85 | 2 | 48 | 56 | 305 | <1 | <20 |
| A928/85 | 2 | 26 | 34 | 285 | <1 | <20 |
| A929/85 | 2 | 26 | 42 | 530 | <1 | <20 |
| A930/85 | 2 | 22 | 47 | 225 | <1 | <20 |
| A931/85 | 5 | 78 | 80 | 730 | <1 | <20 |
| A932/85 | 4 | 38 | 74 | 510 | <1 | <20 |
| A933/85 | 23 | 44 | 105 | 1720 | <1 | <20 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (20) |

amdel

Analysis code A1/1,2 Report AC 2198/86 Page G1

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A2064/85 | 20 | 105 | 130 | 660 | <1 | 7 |
| A2065/85 | 4 | 42 | 62 | 365 | 1 | 4 |
| A2066/85 | 8 | 185 | 215 | 670 | 3 | <2 |
| A2067/85 | 4 | 72 | 280 | 510 | 2 | 2 |
| A2068/85 | 4 | 18 | 76 | 265 | <1 | 2 |
| A2069/85 | 3 | 44 | 41 | 195 | <1 | 2 |
| A2070/85 | 4 | 60 | 24 | 355 | <1 | <2 |
| A2071/85 | 4 | 72 | 70 | 460 | 1 | <2 |
| A2072/85 | <2 | 10 | 54 | 620 | <1 | <2 |
| A2073/85 | 6 | 550 | 2.41% | 1200 | <1 | 5 |
| A2074/85 | 6 | 125 | 155 | 550 | <1 | 5 |
| A2075/85 | 4 | 46 | 145 | 540 | <1 | 5 |
| A2076/85 | 68 | 370 | 52 | 495 | 1 | 12 |
| A2077/85 | 15 | 155 | 335 | 750 | 2 | <2 |
| A2078/85 | 13 | 200 | 1160 | 990 | 3 | <2 |
| A2079/85 | 11 | 125 | 78 | 560 | <1 | 3 |
| A2080/85 | 11 | 235 | 175 | 870 | 5 | 2 |
| A2081/85 | 9 | 86 | 210 | 640 | <1 | 3 |
| A2082/85 | 7 | 120 | 84 | 570 | 2 | <2 |
| A2083/85 | 3 | 48 | 76 | 570 | 1 | <2 |
| A2084/85 | 7 | 66 | 54 | 475 | 1 | <2 |
| A2085/85 | 3 | 34 | 60 | 485 | 1 | <2 |
| A2086/85 | 8 | 105 | 52 | 620 | 1 | <2 |
| A2087/85 | 10 | 235 | 37 | 480 | 1 | 10 |
| A2088/85 | 18 | 270 | 60 | 600 | 1 | <2 |
| A2089/85 | 14 | 315 | 31 | 690 | 2 | 2 |
| A2090/85 | 13 | 490 | 98 | 485 | 2 | <2 |
| A2091/85 | 14 | 190 | 52 | 405 | 1 | 3 |
| A2092/85 | 3 | 36 | 12 | 200 | 1 | <2 |
| A2093/85 | 2 | 26 | 13 | 175 | 2 | 2 |
| A2094/85 | 3 | 12 | 12 | 155 | 1 | <2 |
| A2095/85 | 4 | 12 | 14 | 180 | 2 | 4 |
| A2096/85 | 3 | 6 | 13 | 215 | 3 | 3 |
| A2097/85 | 8 | 10 | 40 | 420 | 2 | 3 |
| A2098/85 | 5 | 18 | 30 | 255 | 1 | <2 |
| A2099/85 | 4 | 10 | 33 | 190 | 2 | <2 |
| A2100/85 | 5 | 32 | 48 | 285 | <1 | 5 |
| A2101/85 | 7 | 28 | 45 | 315 | 2 | 5 |
| A2102/85 | 3 | 8 | 30 | 270 | 1 | <2 |
| A2103/85 | 2 | 16 | 86 | 480 | 1 | 7 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (2) |

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Analysis code A1/1,2 Report AC 2198/86 

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A2104/85 | 14 | 105 | 4600 | 1660 | 11 | 5 |
| A2105/85 | 4 | 8 | 155 | 1040 | 2 | <2 |
| A2106/85 | 4 | 6 | 120 | 1140 | 1 | 3 |
| A2107/85 | 3 | <5 | 125 | 950 | 1 | <2 |
| A2108/85 | 8 | 10 | 125 | 680 | <1 | <2 |
| A2109/85 | 5 | 16 | 74 | 740 | 1 | 3 |
| A2110/85 | 7 | 52 | 78 | 540 | 1 | 2 |
| A2111/85 | 22 | 110 | 64 | 690 | <1 | <2 |
| A2112/85 | 11 | 195 | 50 | 630 | <1 | 2 |
| A2113/85 | 6 | 88 | 90 | 670 | <1 | 2 |
| A2114/85 | 9 | 98 | 72 | 640 | 1 | 10 |
| A2115/85 | 17 | 145 | 70 | 720 | <1 | 7 |
| A2116/85 | 20 | 74 | 49 | 660 | 1 | <2 |
| A2117/85 | 5 | 26 | 58 | 600 | 2 | <2 |
| A2118/85 | 3 | 10 | 48 | 740 | 1 | <2 |
| A2119/85 | 2 | <5 | 54 | 860 | 1 | 2 |
| A2120/85 | <2 | <5 | 74 | 980 | <1 | 2 |
| A2121/85 | 8 | <5 | 58 | 1020 | <1 | 4 |
| A2122/85 | 3 | 6 | 110 | 1100 | 2 | 8 |
| A2123/85 | 2 | <5 | 175 | 920 | 1 | 2 |
| A2124/85 | <2 | 12 | 47 | 445 | <1 | <2 |
| A2125/85 | 2 | 12 | 52 | 455 | 2 | 2 |
| A2126/85 | 2 | 14 | 24 | 255 | 1 | 4 |
| A2127/85 | 3 | 76 | 45 | 220 | 1 | 3 |
| A2128/85 | 2 | <5 | 28 | 230 | 2 | 4 |
| A2129/85 | 2 | 8 | 22 | 205 | 1 | <2 |
| A2130/85 | 3 | <5 | 25 | 210 | 2 | 7 |
| A2131/85 | 2 | <5 | 15 | 235 | 2 | 6 |
| A2132/85 | 5 | 180 | 145 | 415 | 1 | <2 |
| A2133/85 | 3 | 425 | 265 | 335 | 3 | <2 |
| A2134/85 | 5 | 24 | 27 | 530 | 2 | <2 |
| A2135/85 | 7 | 8 | 19 | 790 | 1 | 8 |
| A2136/85 | 3 | <5 | 13 | 500 | 2 | <2 |
| A2137/85 | 3 | 6 | 29 | 395 | <1 | 4 |
| A2138/85 | 3 | 8 | 41 | 255 | 1 | 3 |
| A2139/85 | 3 | 12 | 40 | 245 | <1 | <2 |
| A2140/85 | 3 | 10 | 56 | 385 | 1 | <2 |
| A2141/85 | 5 | 18 | 52 | 305 | <1 | 8 |
| A2142/85 | 4 | 14 | 60 | 270 | 1 | 3 |
| A2143/85 | 4 | 20 | 40 | 240 | 1 | <2 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (2) |

Analysis code A1/1,2 Report AC 2198/86 Page G3

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A2144/85 | 3 | 14 | 42 | 225 | 2 | 7 |
| A2145/85 | 2 | 16 | 15 | 115 | <1 | <2 |
| A2146/85 | 2 | 24 | 16 | 140 | <1 | 2 |
| A2147/85 | 3 | 36 | 24 | 165 | <1 | 5 |
| A2148/85 | 6 | 40 | 35 | 165 | <1 | 2 |
| A2149/85 | 3 | 16 | 32 | 150 | 1 | 3 |
| A2150/85 | <2 | 48 | 66 | 145 | 1 | <2 |
| A2151/85 | 3 | 10 | 54 | 155 | 1 | 9 |
| A2152/85 | 4 | 8 | 215 | 940 | 1 | 5 |
| A2153/85 | 5 | <5 | 68 | 960 | <1 | <2 |
| A2154/85 | 3 | <5 | 78 | 890 | <1 | 3 |
| A2155/85 | 2 | 8 | 96 | 790 | <1 | 6 |
| A2156/85 | 9 | 58 | 160 | 700 | <1 | 3 |
| A2157/85 | 4 | <5 | 84 | 1160 | <1 | 3 |
| A2158/85 | 23 | 110 | 58 | 740 | 1 | 3 |
| A2159/85 | 40 | 210 | 70 | 600 | <1 | 3 |
| A2160/85 | 52 | 150 | 110 | 670 | <1 | <2 |
| A2161/85 | 7 | 10 | 41 | 560 | <1 | <2 |
| A2162/85 | 7 | <5 | 105 | 850 | <1 | <2 |
| A2163/85 | 2 | <5 | 78 | 980 | <1 | 4 |
| A2164/85 | 2 | <5 | 105 | 840 | <1 | <2 |
| A2165/85 | 2 | <5 | 82 | 1000 | 2 | 2 |
| A2166/85 | <2 | <5 | 78 | 1100 | <1 | 3 |
| A2167/85 | <2 | 8 | 28 | 330 | <1 | <2 |
| A2168/85 | <2 | 10 | 14 | 170 | 1 | 3 |
| A2169/85 | <2 | <5 | 19 | 155 | 1 | <2 |
| A2170/85 | <2 | 16 | 34 | 245 | <1 | <2 |
| A2171/85 | 6 | 12 | 84 | 1320 | <1 | 3 |
| A2172/85 | 24 | 36 | 190 | 1520 | 1 | 4 |
| A2173/85 | 13 | 42 | 86 | 670 | <1 | 5 |
| A2174/85 | 6 | 10 | 44 | 980 | 1 | <2 |
| A2175/85 | 6 | <5 | 62 | 860 | <1 | 2 |
| A2176/85 | 9 | 76 | 1940 | 3260 | 3 | 11 |
| A2177/85 | 4 | 36 | 52 | 330 | 2 | 6 |
| A2178/85 | 5 | 58 | 66 | 530 | 1 | <2 |
| A2179/85 | 9 | 115 | 72 | 530 | 2 | 5 |
| A2180/85 | 4 | 28 | 100 | 560 | 2 | <2 |
| A2181/85 | 5 | 34 | 64 | 415 | 2 | <2 |
| A2182/85 | 5 | 44 | 66 | 490 | 1 | <2 |
| A2183/85 | <2 | <5 | 26 | 155 | 2 | <2 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (2) |

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Analysis code A1/1.2 Report AC 2198/86 Page G4

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A2184/85 | <2 | <5 | 19 | 175 | 2 | 5 |
| A2185/85 | 3 | <5 | 20 | 165 | 1 | <2 |
| A2186/85 | 4 | <5 | 9 | 155 | <1 | 4 |
| A2187/85 | 3 | <5 | 52 | 650 | <1 | 3 |
| A2188/85 | 2 | <5 | 120 | 870 | 1 | 2 |
| A2189/85 | 3 | <5 | 150 | 810 | 1 | 2 |
| A2190/85 | 6 | 8 | 240 | 770 | 1 | 3 |
| A2191/85 | 6 | 42 | 185 | 750 | 1 | <2 |
| A2192/85 | 7 | 26 | 400 | 810 | <1 | 6 |
| A2193/85 | 5 | 18 | 320 | 680 | <1 | <2 |
| A2194/85 | 4 | 22 | 660 | 860 | 3 | <2 |
| A2195/85 | 4 | 6 | 230 | 770 | 1 | <2 |
| A2196/85 | 4 | 12 | 170 | 740 | 1 | 6 |
| A2197/85 | 5 | 8 | 175 | 750 | 1 | <2 |
| A2198/85 | 4 | <5 | 125 | 920 | 1 | <2 |
| A2199/85 | 4 | <5 | 170 | 990 | <1 | <2 |
| A2200/85 | 2 | <5 | 190 | 600 | <1 | 5 |
| A2201/85 | 2 | 6 | 19 | 155 | 2 | 3 |
| A2202/85 | 2 | 6 | 9 | 175 | <1 | 4 |
| A2203/85 | 4 | 38 | 560 | 920 | 2 | <2 |
| A2204/85 | 5 | 66 | 800 | 1000 | 3 | 4 |
| A2205/85 | 3 | 40 | 485 | 850 | 2 | 3 |
| A2206/85 | 4 | 145 | 1800 | 1460 | 5 | <2 |
| A2207/85 | 4 | 46 | 570 | 890 | 3 | <2 |
| A2208/85 | 7 | 76 | 1540 | 1320 | 5 | <2 |
| A2209/85 | 5 | 30 | 520 | 800 | 1 | <2 |
| A2210/85 | 9 | <5 | 290 | 880 | <1 | 4 |
| A2211/85 | 4 | 12 | 240 | 720 | 1 | 2 |
| A2212/85 | 3 | 22 | 235 | 660 | 1 | <2 |
| A2213/85 | 4 | 6 | 160 | 720 | 1 | 4 |
| A2214/85 | 4 | 6 | 175 | 720 | 1 | 5 |
| A2215/85 | 4 | 6 | 210 | 720 | 3 | <2 |
| A2216/85 | 3 | <5 | 170 | 790 | 1 | 5 |
| A2217/85 | 3 | 6 | 230 | 720 | <1 | 7 |
| A2218/85 | 3 | 6 | 210 | 680 | 3 | <2 |
| A2219/85 | 3 | 8 | 300 | 840 | 1 | <2 |
| A2220/85 | 3 | 8 | 245 | 950 | 1 | 4 |
| A2221/85 | 5 | 20 | 275 | 870 | 1 | 3 |
| A2222/85 | 4 | 28 | 475 | 780 | 2 | <2 |
| A2223/85 | 3 | 6 | 240 | 650 | 1 | 4 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (2) |

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Analysis code A1/1,2 Report AC 2198/86 Page G5

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A2224/85 | 4 | 16 | 520 | 960 | 3 | <2 |
| A2225/85 | 5 | 60 | 620 | 1100 | 1 | 2 |
| A1602/85 | 46 | 405 | 2940 | 960 | 1 | 170 |
| A1603/85 | 19 | 1.09% | 62 | 1700 | <1 | <2 |
| A1604/85 | 7 | 205 | 5200 | 3120 | 7 | 9 |
| A1605/85 | 6 | 450 | 590 | 720 | 22 | 25 |
| | | | | | | |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (2) |

# APPENDIX E

## Concert Prospect, Soil Sample Assay Results

AMDEL Reports: AC 1431/85
AC 1038/86

amdel

Analysis code A1/1 | Report AC 1431/85 | Page 1

NATA Certificate | Order No. EX-243 | Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A2077/84 | 31 | 78 | 215 | 1700 | <1 |
| A2078/84 | 52 | 94 | 335 | 2760 | <1 |
| A2079/84 | 47 | 140 | 450 | 2680 | <1 |
| A2080/84 | 40 | 110 | 375 | 2120 | <1 |
| A2081/84 | 25 | 48 | 155 | 930 | <1 |
| A2082/84 | 29 | 80 | 170 | 1100 | <1 |
| A2083/84 | 28 | 70 | 165 | 1040 | <1 |
| A2084/84 | 25 | 72 | 115 | 880 | <1 |
| A2085/84 | 27 | 52 | 105 | 660 | <1 |
| A2086/84 | 42 | 80 | 185 | 570 | <1 |
| A2087/84 | 62 | 160 | 310 | 1120 | <1 |
| A2088/84 | 36 | 82 | 200 | 730 | <1 |
| A2089/84 | 25 | 58 | 130 | 700 | <1 |
| A2090/84 | 31 | 92 | 155 | 790 | <1 |
| A2091/84 | 28 | 72 | 145 | 710 | <1 |
| A2092/84 | 20 | 34 | 68 | 385 | <1 |
| A2093/84 | 22 | 30 | 74 | 480 | <1 |
| A2094/84 | 23 | 52 | 98 | 570 | <1 |
| A2095/84 | 19 | 50 | 105 | 550 | <1 |
| A2096/84 | 18 | 24 | 58 | 425 | <1 |
| A2097/84 | 18 | 36 | 82 | 590 | <1 |
| A2098/84 | 20 | 46 | 100 | 670 | <1 |
| A2099/84 | 18 | 44 | 88 | 800 | <1 |
| A2100/84 | 19 | 38 | 80 | 560 | <1 |
| A2101/84 | 27 | 76 | 110 | 860 | <1 |
| A2102/84 | 39 | 68 | 135 | 590 | <1 |
| A2103/84 | 25 | 40 | 84 | 610 | <1 |
| A2104/84 | 29 | 50 | 96 | 700 | <1 |
| A2105/84 | 31 | 48 | 120 | 770 | <1 |
| A2106/84 | 23 | 32 | 86 | 650 | <1 |
| A2107/84 | 20 | 34 | 78 | 660 | <1 |
| A2108/84 | 21 | 40 | 105 | 780 | <1 |
| A2109/84 | 20 | 30 | 88 | 660 | <1 |
| A2110/84 | 23 | 42 | 94 | 680 | <1 |
| A2111/84 | 35 | 88 | 155 | 580 | <1 |
| A2112/84 | 39 | 94 | 190 | 760 | <1 |
| A2113/84 | 86 | 225 | 295 | 1360 | <1 |
| A2114/84 | 52 | 135 | 310 | 1100 | <1 |
| A2115/84 | 28 | 82 | 160 | 850 | <1 |
| A2116/84 | 30 | 125 | 205 | 1280 | <1 |
| | | | | | |
| Detn limit | (2) | (5) | (2) | (5) | (1) |

amdel

Analysis code A1/1 | Report AC 1431/85 | 

NATA Certificate | Order No. EX-243 | Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd |
|---|---|---|---|---|---|
| A2117/84 | 33 | 80 | 170 | 960 | <1 |
| A2118/84 | 56 | 165 | 265 | 1200 | <1 |
| A2119/84 | 94 | 255 | 610 | 1500 | <1 |
| A2120/84 | 43 | 155 | 235 | 1200 | <1 |
| A2121/84 | 60 | 210 | 390 | 1720 | <1 |
| A2122/84 | 52 | 225 | 325 | 1620 | <1 |
| A2123/84 | 70 | 305 | 500 | 1800 | <1 |
| A2124/84 | 68 | 335 | 440 | 2540 | <1 |
| A2125/84 | 58 | 240 | 370 | 1820 | <1 |
| A2126/84 | 37 | 145 | 250 | 1180 | <1 |
| A2127/84 | 50 | 195 | 365 | 1560 | <1 |
| A2128/84 | 31 | 96 | 215 | 1040 | <1 |
| A2129/84 | 29 | 84 | 190 | 910 | <1 |
| A2130/84 | 23 | 66 | 185 | 700 | <1 |
| | | | | | |
| Detn limit | (2) | (5) | (2) | (5) | (1) |

amdel

Analysis code A1/1,2 Report AC 1038/86 Page G1

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A934/85 | 24 | 42 | 98 | 640 | <1 | <20 |
| A935/85 | 24 | 44 | 98 | 680 | <1 | <20 |
| A936/85 | 23 | 66 | 120 | 890 | <1 | <20 |
| A937/85 | 22 | 50 | 110 | 700 | <1 | <20 |
| A938/85 | 31 | 150 | 240 | 1280 | <1 | <20 |
| A939/85 | 24 | 88 | 185 | 940 | <1 | <20 |
| A940/85 | 28 | 105 | 205 | 880 | <1 | <20 |
| A941/85 | 37 | 96 | 210 | 810 | <1 | <20 |
| A942/85 | 42 | 160 | 300 | 1220 | 1 | <20 |
| A943/85 | 37 | 135 | 340 | 1240 | <1 | <20 |
| A944/85 | 31 | 90 | 215 | 930 | <1 | <20 |
| A945/85 | 28 | 90 | 175 | 970 | <1 | <20 |
| A946/85 | 32 | 130 | 255 | 910 | <1 | <20 |
| A947/85 | 28 | 84 | 200 | 1020 | <1 | <20 |
| A948/85 | 25 | 52 | 140 | 650 | <1 | <20 |
| A949/85 | 24 | 78 | 140 | 580 | <1 | <20 |
| A950/85 | 26 | 82 | 155 | 710 | <1 | <20 |
| A951/85 | 26 | 90 | 165 | 750 | <1 | <20 |
| A952/85 | 26 | 84 | 160 | 580 | <1 | <20 |
| A953/85 | 22 | 60 | 140 | 465 | <1 | <20 |
| A954/85 | 20 | 46 | 110 | 425 | <1 | <20 |
| A955/85 | 21 | 50 | 115 | 440 | <1 | <20 |
| A956/85 | 30 | 76 | 175 | 640 | 1 | <20 |
| A957/85 | 40 | 105 | 255 | 840 | <1 | <20 |
| A958/85 | 39 | 84 | 250 | 710 | <1 | <20 |
| A959/85 | 25 | 54 | 155 | 870 | <1 | <20 |
| A960/85 | 22 | 48 | 130 | 900 | 1 | <20 |
| A961/85 | 25 | 46 | 110 | 840 | <1 | <20 |
| A962/85 | 30 | 52 | 120 | 940 | <1 | <20 |
| A963/85 | 22 | 44 | 98 | 760 | <1 | <20 |
| A964/85 | 25 | 58 | 170 | 850 | 1 | <20 |
| A965/85 | 26 | 70 | 250 | 900 | 1 | <20 |
| A966/85 | 30 | 140 | 225 | 1440 | 4 | <20 |
| A967/85 | 24 | 100 | 150 | 1160 | 3 | <20 |
| A968/85 | 23 | 115 | 160 | 1580 | 5 | <20 |
| A969/85 | 31 | 84 | 150 | 980 | 1 | <20 |
| A970/85 | 28 | 180 | 150 | 1520 | 3 | <20 |
| A971/85 | 29 | 285 | 160 | 1760 | 3 | <20 |
| A972/85 | 33 | 250 | 145 | 1200 | 3 | <20 |
| A973/85 | 30 | 215 | 115 | 780 | 1 | <20 |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (20) |

amdel

Analysis code A1/1,2 Report AC 1038/86 Page G2

NATA Certificate Results in ppm

| Sample | Cu | Pb | Zn | Mn | Cd | As |
|---|---|---|---|---|---|---|
| A974/85 | 28 | 92 | 155 | 670 | <1 | <20 |
| A975/85 | 35 | 115 | 240 | 740 | <1 | <20 |
| A976/85 | 52 | 190 | 360 | 1720 | <1 | <20 |
| A977/85 | 37 | 120 | 275 | 990 | 2 | <20 |
| A978/85 | 24 | 96 | 170 | 790 | 2 | <20 |
| A979/85 | 22 | 36 | 98 | 520 | <1 | <20 |
| A980/85 | 17 | 50 | 110 | 610 | <1 | <20 |
| A981/85 | 20 | 62 | 160 | 650 | <1 | <20 |
| A982/85 | 20 | 46 | 125 | 620 | <1 | <20 |
| A983/85 | 24 | 80 | 185 | 830 | 1 | <20 |
| A984/85 | 21 | 48 | 130 | 730 | <1 | <20 |
| A985/85 | 18 | 32 | 88 | 660 | <1 | <20 |
| A986/85 | 19 | 44 | 105 | 750 | <1 | <20 |
| A987/85 | 19 | 54 | 105 | 790 | <1 | <20 |
| | | | | | | |
| Detn limit | (2) | (5) | (2) | (5) | (1) | (20) |

PLATE 1. Heysen Range northwards from Brachina Gorge. Wilkawillina Limestone forms lower range and Rawnsley Quartzite forms main range in background. October 1983.

Slide No. 24348

PLATE 2. Easterly view of abandoned manganese mine area (Manga Prospect), showing Rawnsley Quartzite (foreground), massive manganese concentrations (centre) and dolomitized Wilkawillina Limestone (middle right). September 1984.

Slide No. 24966

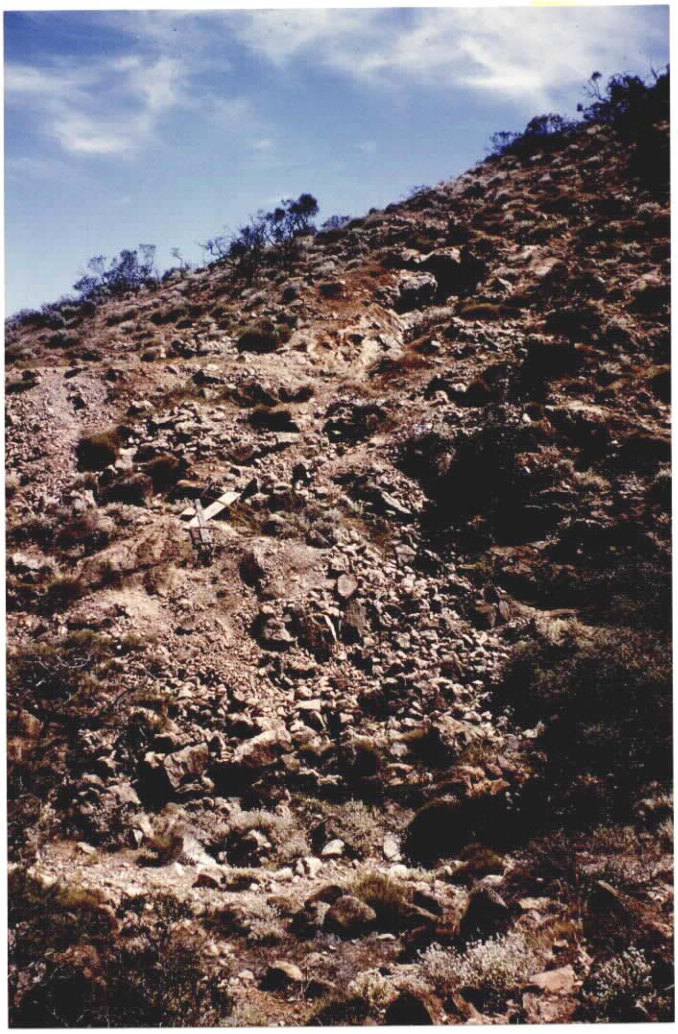


PLATE 3. Northerly view of Galena Creek Lead Prospect immediately below palaeo-surface. November 1985.

Slide No. 35066.

PLATE 4. Southerly view of Wilkawillina Limestone. Lower member bedded dolomite in centre, upper member massive limestone to right and Parachilna Formation overlying Rawnsley Quartzite to left. November 1983.
Slide No. 24349

PLATE 5. Archaeocyathid-rich limestone of upper light grey massive Wilkawillina Limestone. Note sparry calcite filling open spaces. November 1983.
Slide No. 24350

PLATE 6.

Red-brown recrystallized calcrete crust defines irregular palaeo-surface at top of Wilkawillina Limestone. November 1983.
Slide No. 24352.

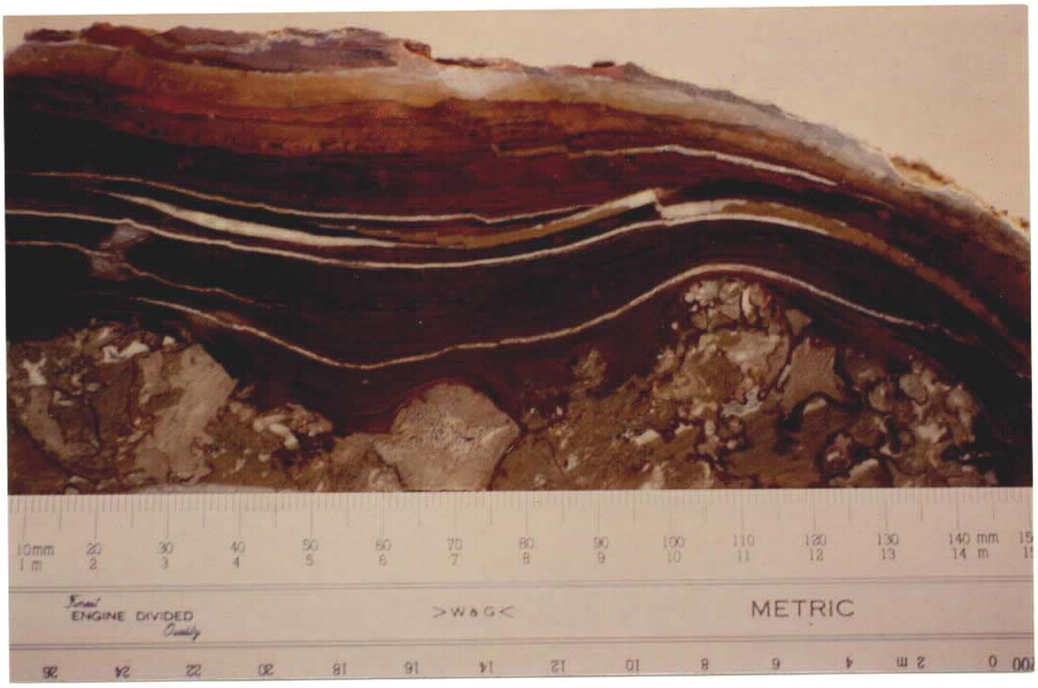



PLATE 7. Hand specimen of red-brown recrystallized calcrete crust showing its laminar nature.
November 1983. Slide No. 24353.

PLATE 8. Nodular limestone upper member, Wilkawillina Limestone south of Bunyeroo Gorge. Nodules are grey limestone and matrix is dolomitized. September 1984.
Slide No. 24967.

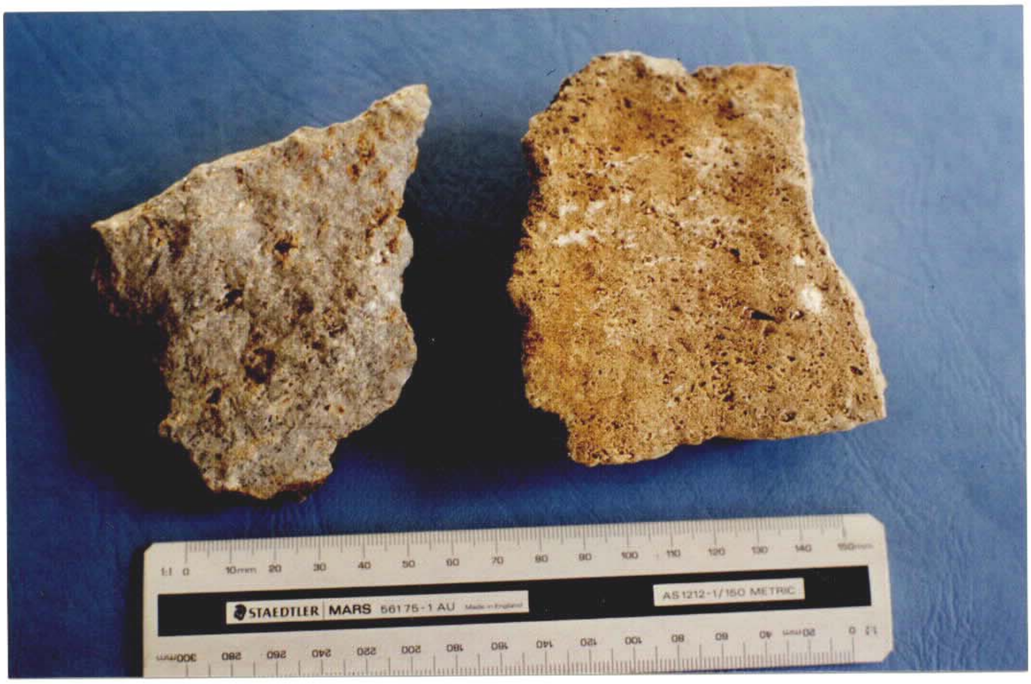



PLATE 9. Vuggy calc-dolomite near base of upper member, Wilkawillina Limestone.
November 1983. Slide No. 24354.

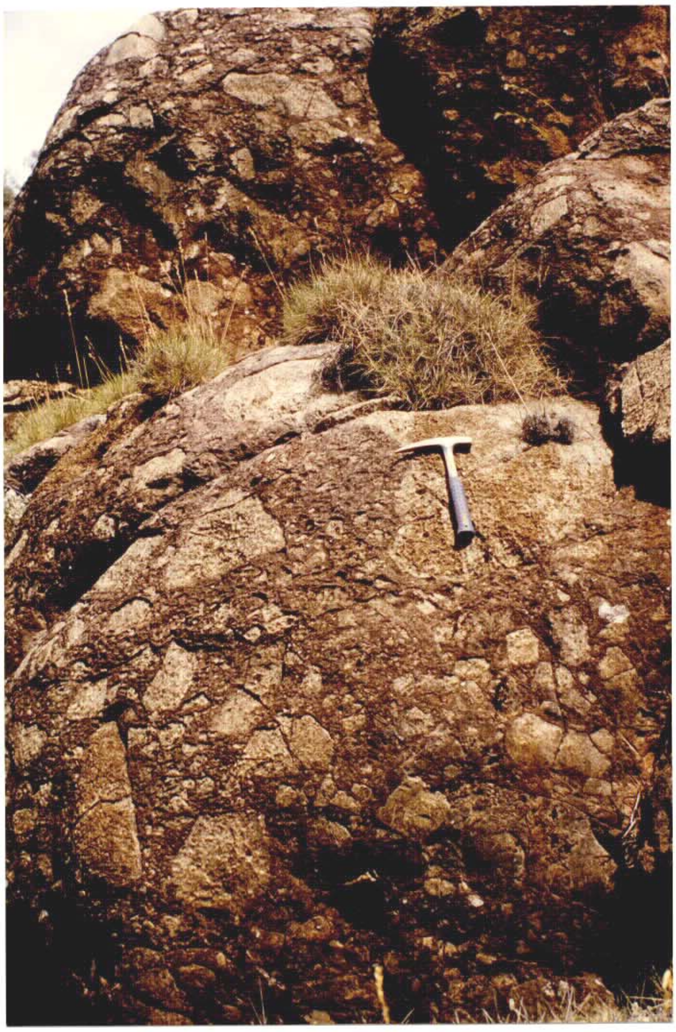


PLATE 10.

Solution collapse breccia. Blocks of archaeocyathid limestone in hematitic matrix. Willa Prospect.
October 1983.
Slide No. 24355.

PLATE 11. View south from Bunyeroo Gorge. Massive calc-dolomite to left overlain by bedded nodular limestone. October 1983. Slide No. 24968.


PLATE 12. Concert Prospect, aerial photograph of eroded collapse karst, 200 m across, 5.5 km north of Brachina Gorge. March 1981 Photo No. 34416

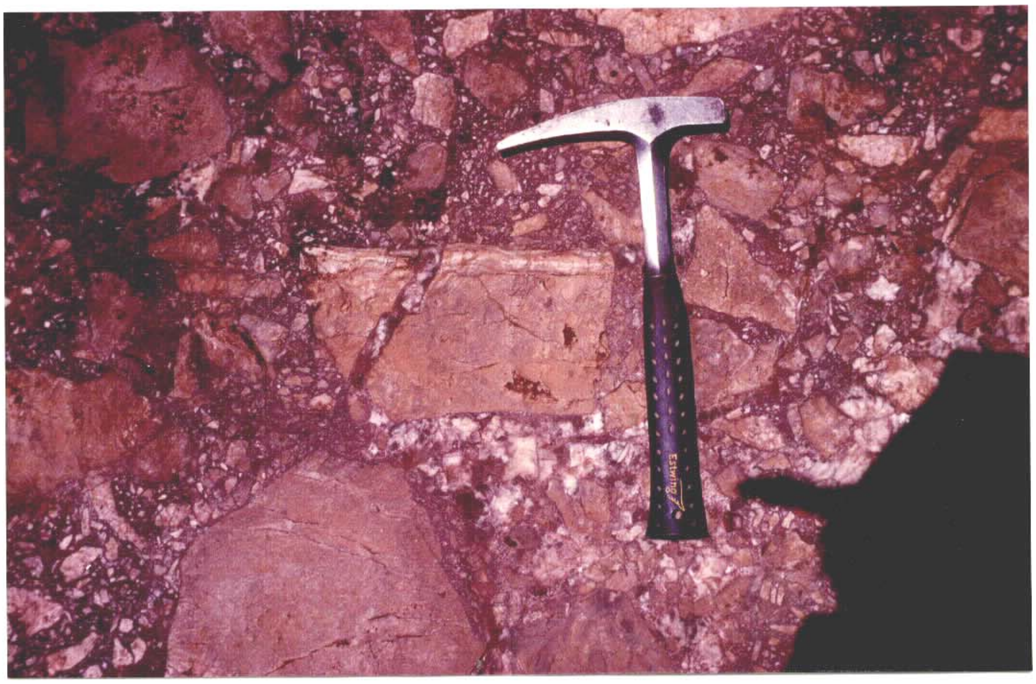


PLATE 13. Willa Prospect. Block of archaeocyathid limestone with laminar calcite along margin in solution collapse breccia. September 1984. Slide No. 24969.

PLATE 14. Willa Prospect, laminar calcrete filling karst feature. November 1985.

Slide No. 35067

PLATE 15. Southern Prospect, smithsonite replacing calc-dolomite along fracture. October 1983.
Slide No. 24970.

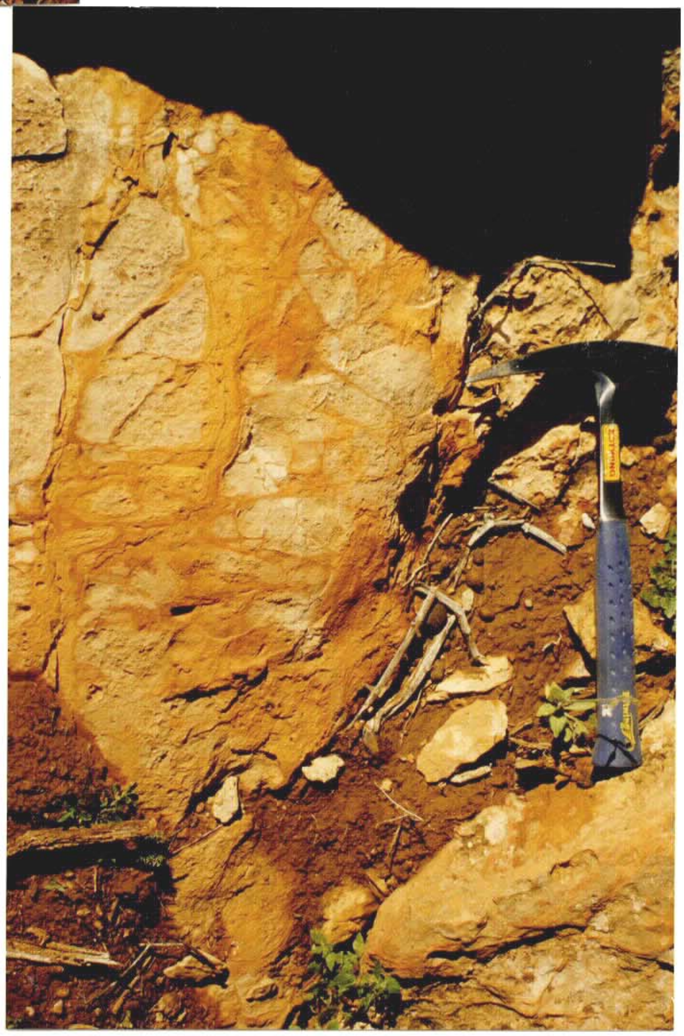


PLATE 16. Southern Prospect, smithsonite replacing calc-dolomite. October 1983.
Slide No. 24971

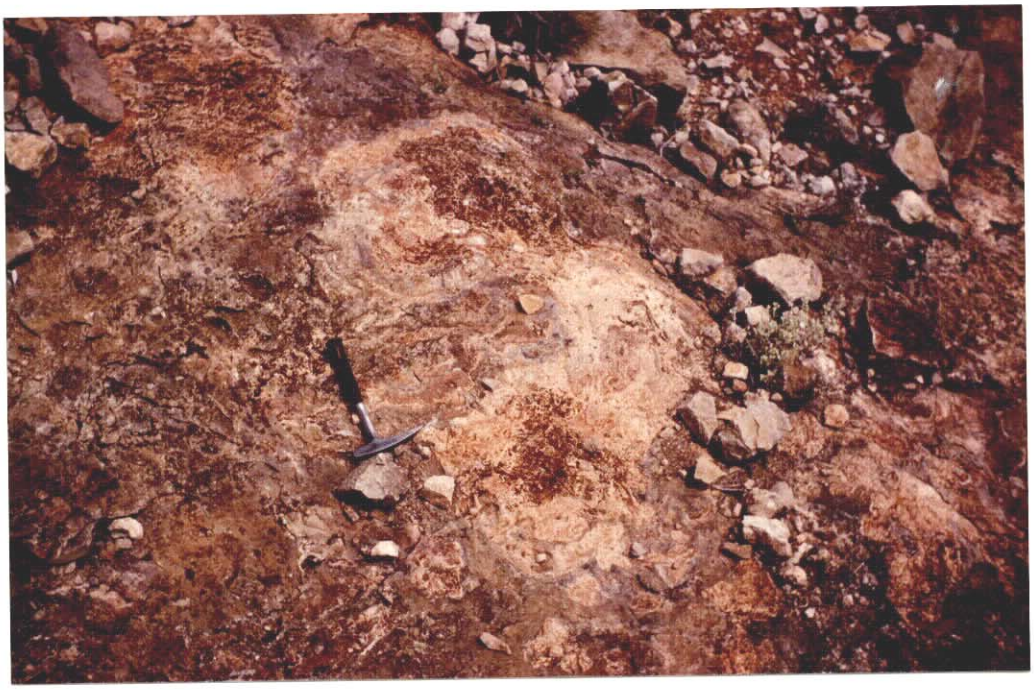


PLATE 17. Willa Prospect, willemite filling karst feature immediately below palaeo-surface. November 1985. Slide No. 35068.

PLATE 18.

Stream sediment sampling. July 1985. Slide No. 35064.

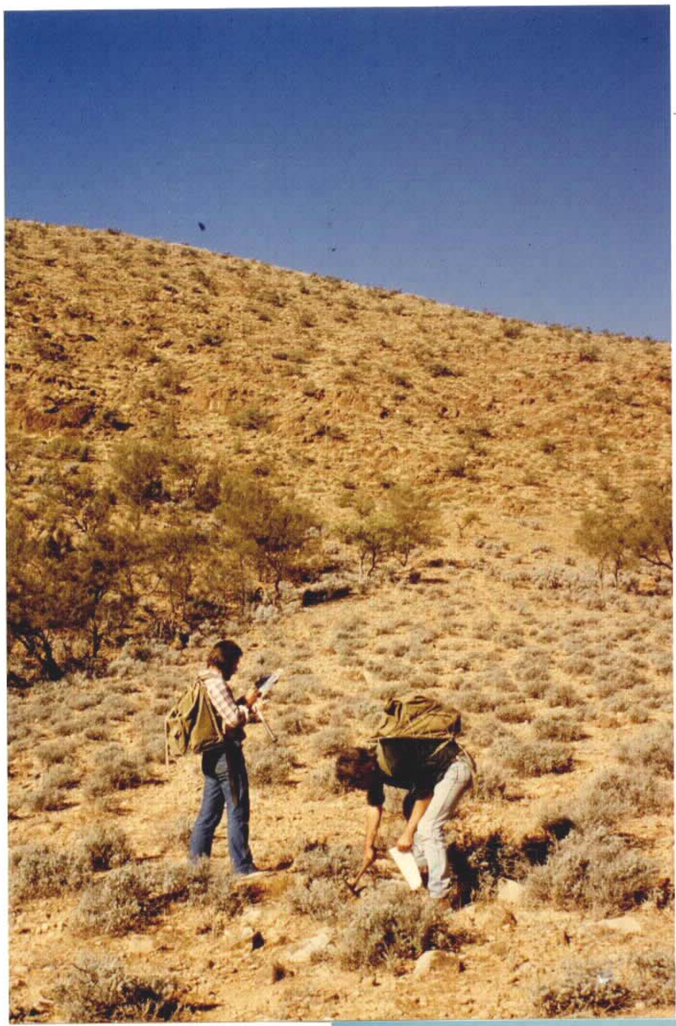
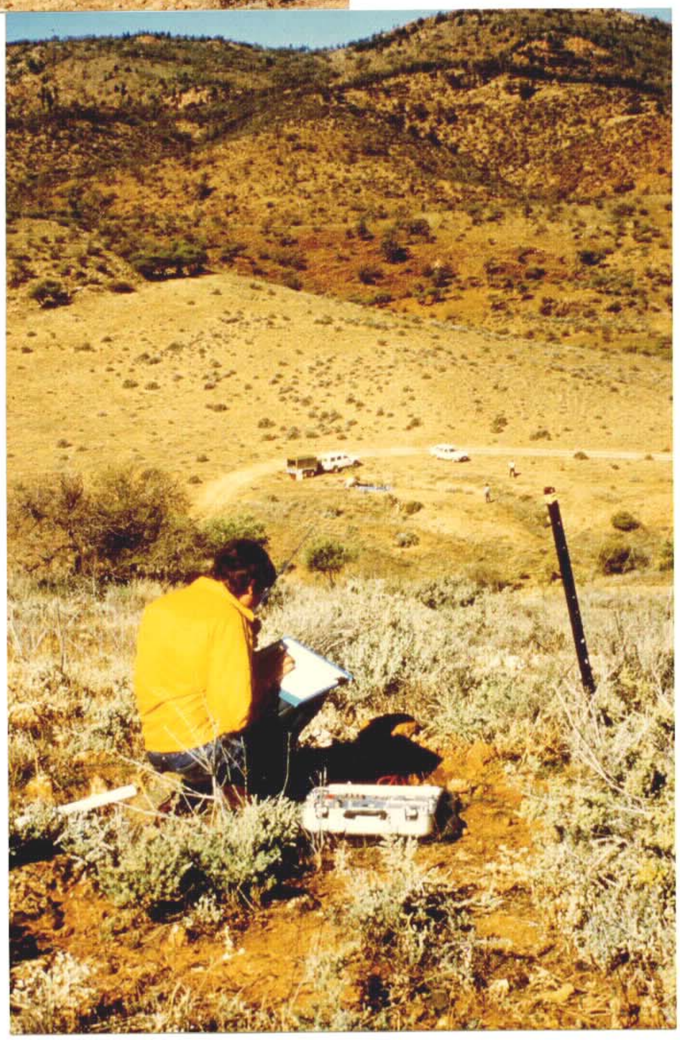


PLATE 19. Rock chip sampling. July 1985.

Slide No. 35065.

PLATE 20.

Easterly view across Manga Prospect showing I.P. survey.
September 1984.
Slide No. 24972.



## VOLUME 2

## FIGURES

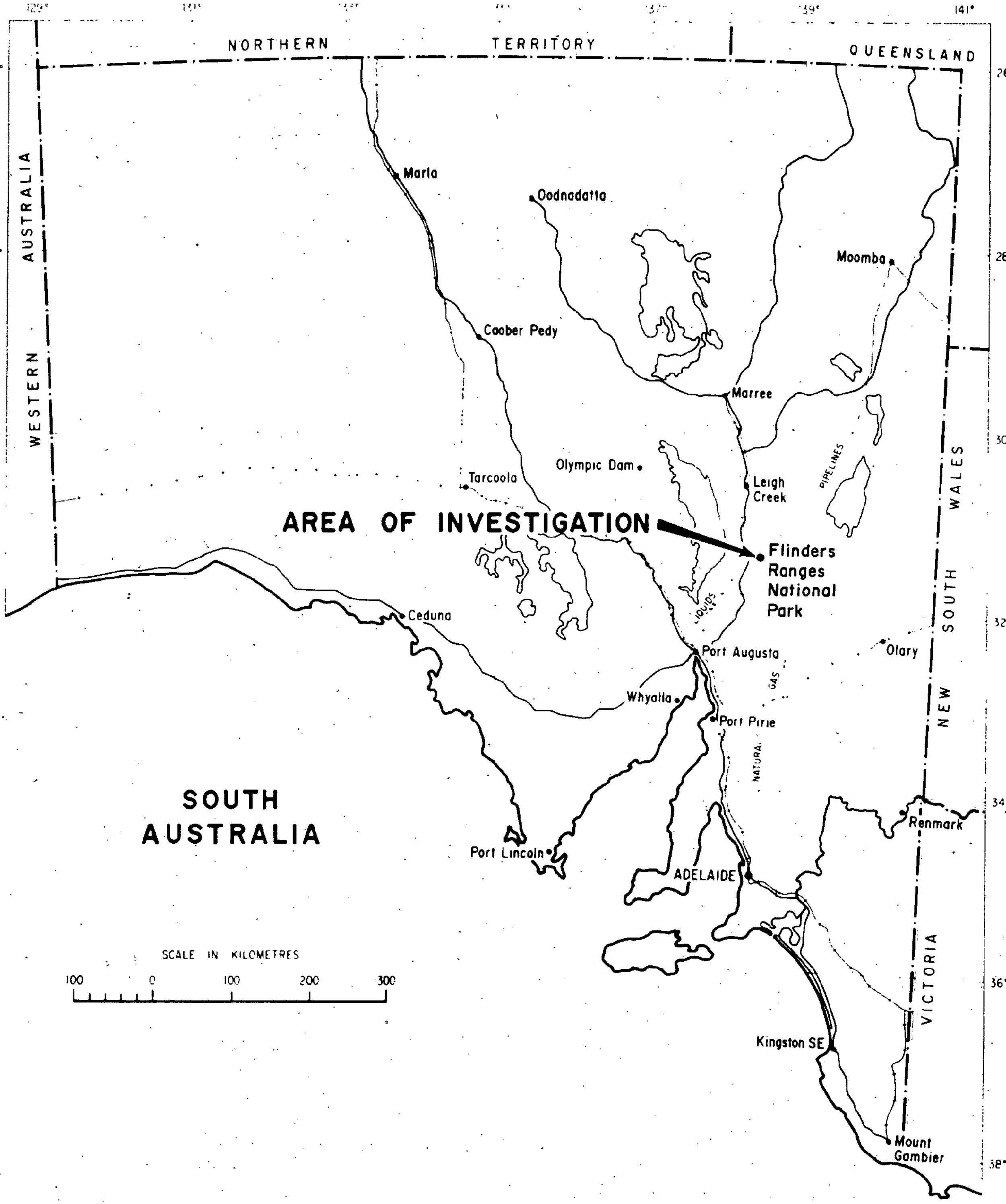



FIG. 1

| | | |
|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED D. Ivic | C.D.O. 10·12·85 DATE |
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK LOCALITY PLAN | DRAWN E. Calabio | SCALE 1: 7 500 000 |
| | DATE Feb.'85 | PLAN NUMBER S 18318 |
| | CHECKED | |

3406

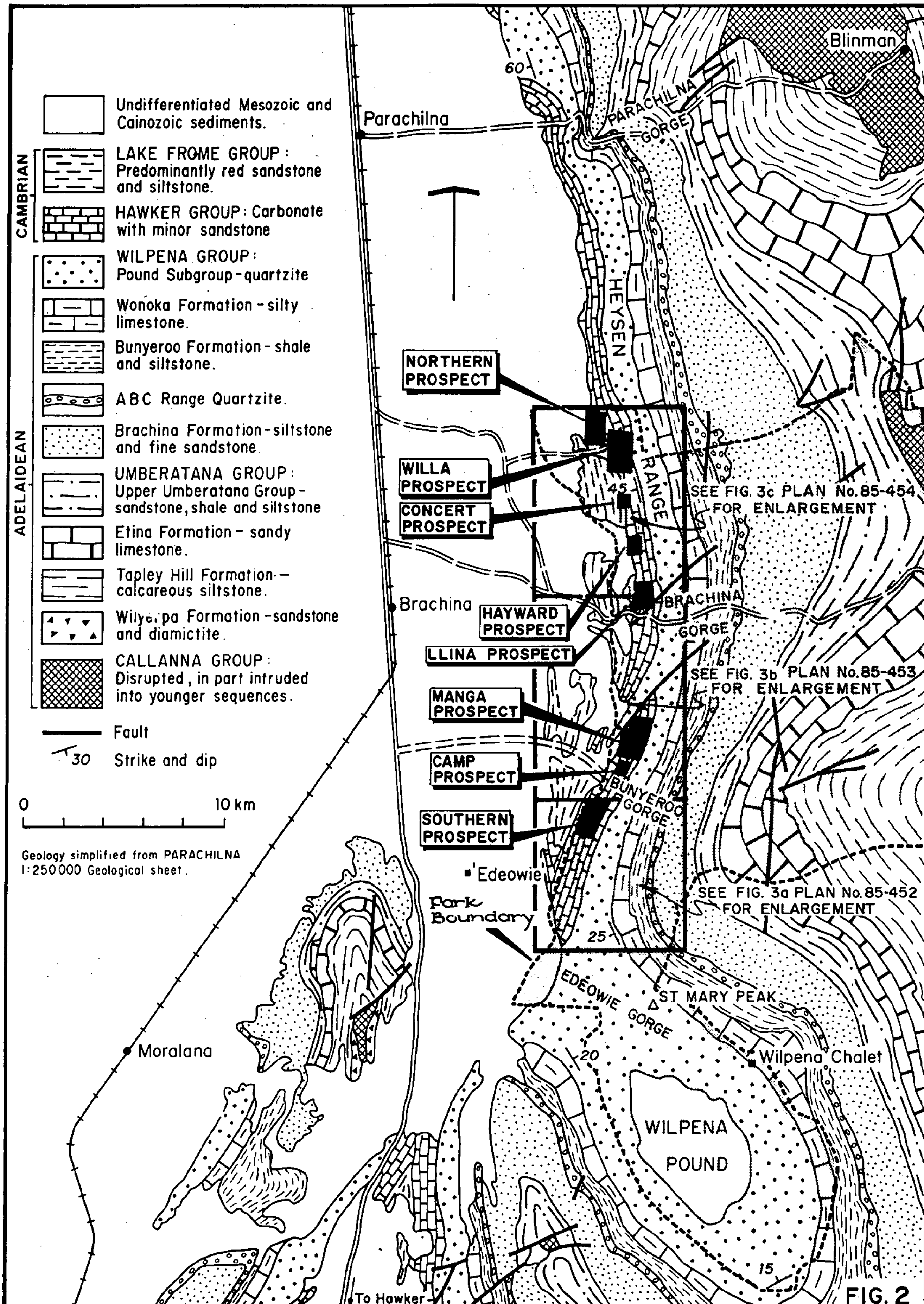
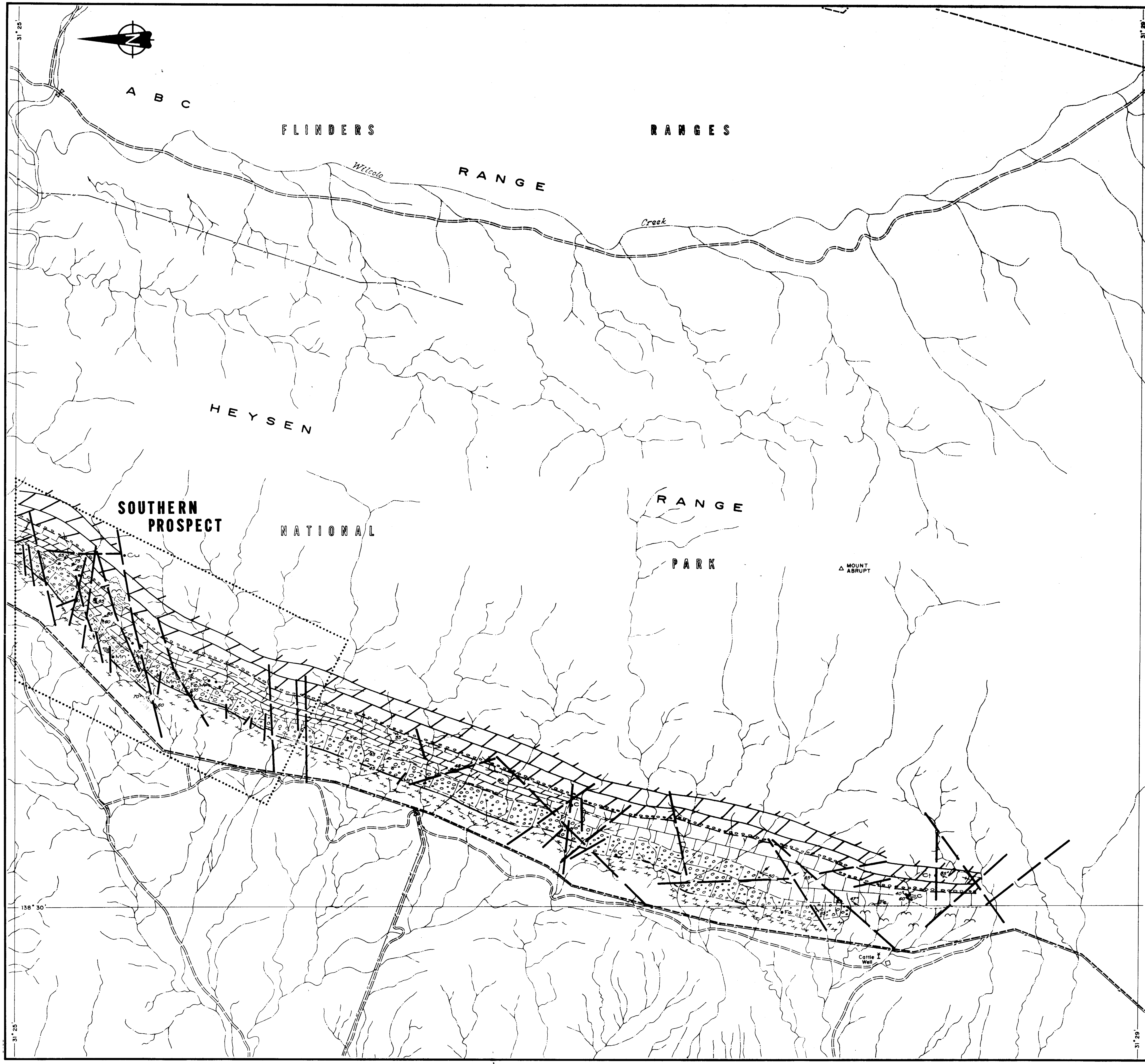


FIG. 2

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED J.K. | C.D.O. 10·12·85 DATE |
|---|---|---|
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK **REGIONAL GEOLOGY AND LOCATION OF PROSPECTS** | DRAWN A.F. | SCALE 1:250000 |
| | DATE 29-8-84 | PLAN NUMBER |
| | CHECKED | S 18319 |




**REFERENCE**

**QUATERNARY**
Alluvial and colluvial deposits.

**TERTIARY**
Silcrete

**CAMBRIAN**
BILLY CREEK FORMATION: Basal dolomite and flaggy limestone followed by red and green shale.
Hawker Group
PARARA LIMESTONE: Dark flaggy and silty limestone with interbedded shale.
WILKAWILLINA LIMESTONE:
Upper Member: Massive, commonly recrystallized, light grey biostromal limestone with palaeo-surface at top marked by laminated, red-brown, recrystallized calcrete crust up to 10cm thick. Abundant archaeocyathids with brachiopods in upper half grading southwards from near Bunyeroo Gorge to non-fossiliferous nodular limestone with massive recrystallized limestone interbeds. Off-white porous calc-dolomite occurs near base often with thin dolomite bed above.

Lower Member: Dark grey-brown bedded sandy dolomite with algal and oolitic beds. Dark grey nodular limestone at top southwards from near Bunyeroo Gorge.

**ADELAIDE SYSTEM**
Wilpena Group
POUND SUB-GROUP: Massive clean white Rawnsley Quartzite.

Breccia

Dolomitization

Massive manganese oxides

Red-brown hematitic ochre

| | |
|---|---|
| Galena | Gn |
| Hydrozincite, smithsonite | Zn |
| Magnesite | Mg |
| Coarse calcite crystals | Ct |
| Laminar calcrete and calcite | Lc |
| Iron and manganese oxide | Fe/Mn |
| Quartz | qtz |
| Willemite | W |
| Malachite and chalcocite | Cu |
| Strike and dip of bedding | 45 |
| Strike and dip of jointing and/or fracturing | 70 |
| Geological boundary | |
| Boundary between bedrock and alluvium or colluvium | |
| Fault | |
| Graded road or track | |
| Drainage lines | |
| Fence | |
| National Park boundary | |

Diamond Drill Holes:

| | |
|---|---|
| SADME (Cramsie, 1967) | DDH 1 |
| MEPL (Roberts, 1968) | LT 1 |
| EZ (Horn, 1972) | T 1 |

SCALE
200 0 200 400 600 800 1000
METRES

Figure 3a

**DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA**

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

GEOLOGICAL PLAN

| | |
|---|---|
| COMPILED | B. Morris |
| DRAWN | M.R. |
| DATE | Jan '85 |
| CHECKED | 10.17.85 |
| SCALE | 1:10,000 |
| PLAN NUMBER | 85-452 |


Figure 3b

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

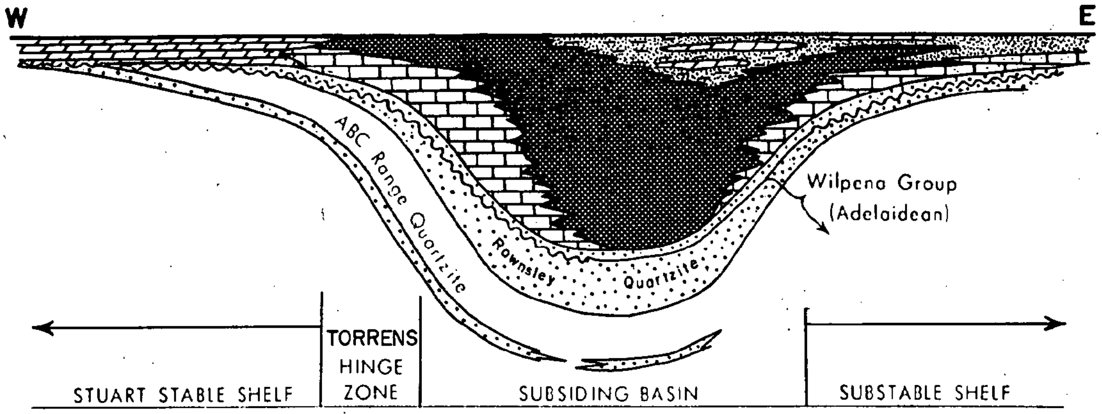
BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

GEOLOGICAL PLAN

| | |
|---|---|
| COMPILED | B. Morris |
| DRAWN | M.R. |
| DATE | Jan '85 |
| CHECKED | |
| C.D.O. | 10.12.85 (DATE) |
| SCALE | 1:10,000 |
| PLAN NUMBER | 85-453 |


Figure 3c

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris |
| --- | --- |
| | DRAWN M.R. |
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DATE Jan '85 |
| | CHECKED 10.12.85 |
| GEOLOGICAL PLAN | SCALE 1:10,000 |
| | PLAN NUMBER 85-454 |




## LEGEND

- NARINA GREYWACKE AND BUNKERS SANDSTONE
- PARARA LIMESTONE AND ORAPARINNA SHALE
- WILKAWILLINA LIMESTONE
- CHERT AND DOLOMITE SHELF – FACIES (ANDAMOOKA LST)
- PARACHILNA FORMATION (TRANSGRESSIVE FACIES)

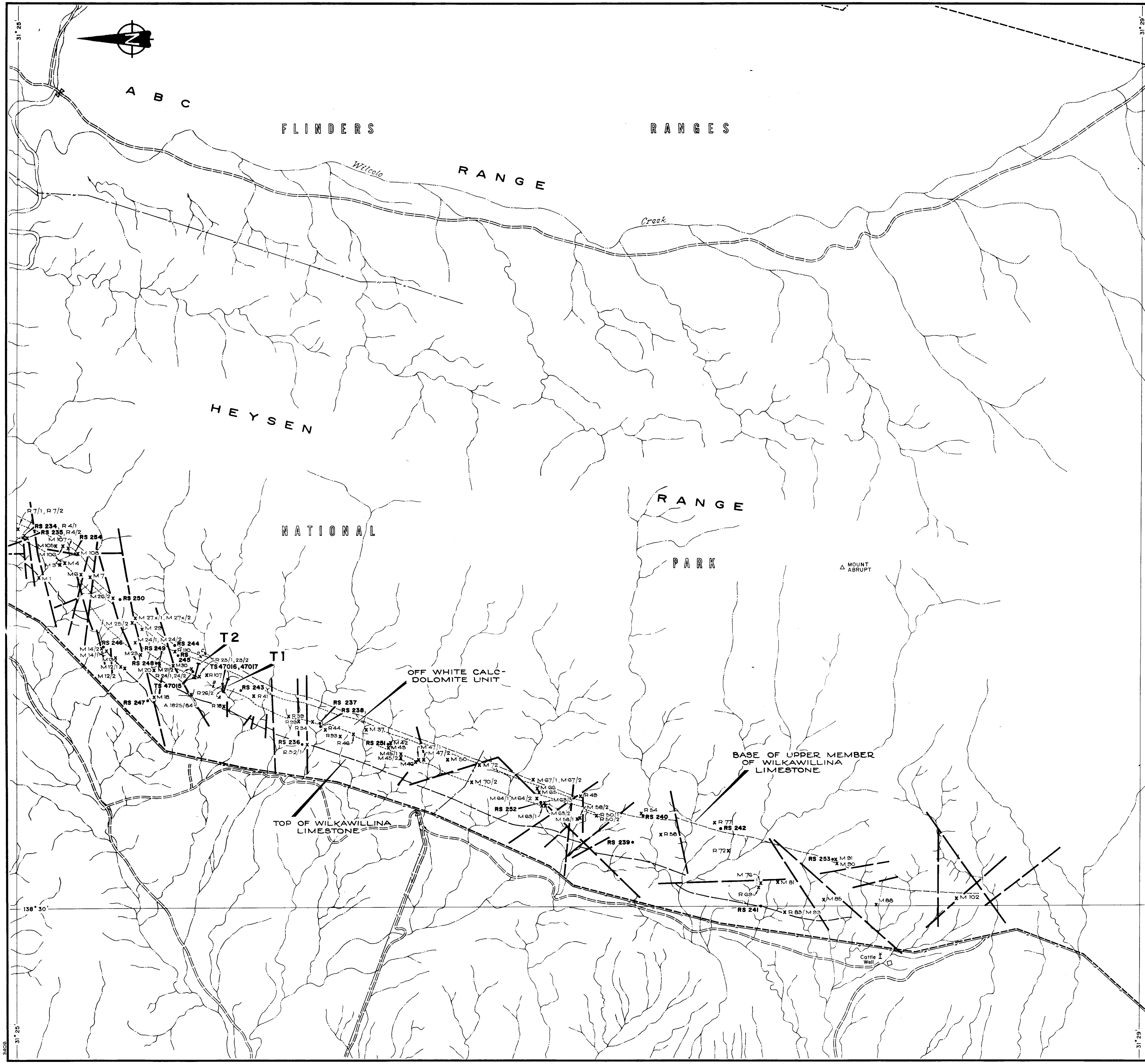
*(NOT TO SCALE AND VERTICALLY MUCH EXAGGERATED)*

(after Wopfner, 1969)

**FIG. 4**

| | | |
|---|---|---|
| **DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA** | COMPILED B. Morris | C.D.O. 10·12·84 DATE |
| **BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK SCHEMATIC CROSS SECTION** | DRAWN E. Calabio | SCALE As shown |
| | DATE May '85 | PLAN NUMBER |
| | CHECKED | S 18320 |

3406




# REFERENCE

| | |
|---|---|
| • RS 240 | Location and number of petrological sample (AMDEL) - prefix with 6536. |
| • TS 47016 | Location and number of petrological sample (CMS). |
| x M 72, x R 72, x A 1078/84 | Location and assay number of rock chip sample. |
| | ORIENTATION GEOCHEMISTRY Stream sediment sample point. |
| T1 | Rock chip and soil sample traverse. |
| | Top of Wikawillina Limestone. |
| | Off white calc-dolomite unit. |
| | Base of upper member of Wilkawillina Limestone. |
| | Fault. |
| | Flinders Ranges National Park boundary. |
| | Graded road or track. |
| | Fence and gate. |
| | Creek. |

SCALE

200 0 200 400 600 800 1000

METRES

Figure 5a

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

**REGIONAL ROCK CHIP PETROLOGICAL AND ORIENTATION GEOCHEMICAL SAMPLE LOCATIONS**

| | |
|---|---|
| COMPILED | B. Morris |
| DRAWN | M.R. |
| DATE | Jan '85 |
| CHECKED | 10.12.85 C.D.O. |
| SCALE | 1 : 10,000 |
| PLAN NUMBER | 85-455 |


Figure 5b

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

REGIONAL ROCK CHIP
PETROLOGICAL AND ORIENTATION
GEOCHEMICAL SAMPLE LOCATIONS

| | |
|---|---|
| COMPILED | B. Morris |
| DRAWN | M.R. |
| DATE | Jan '85 |
| CHECKED | |
| C.D.O. DATE | 10.12.85 |
| SCALE | 1:10,000 |
| PLAN NUMBER | 85-456 |

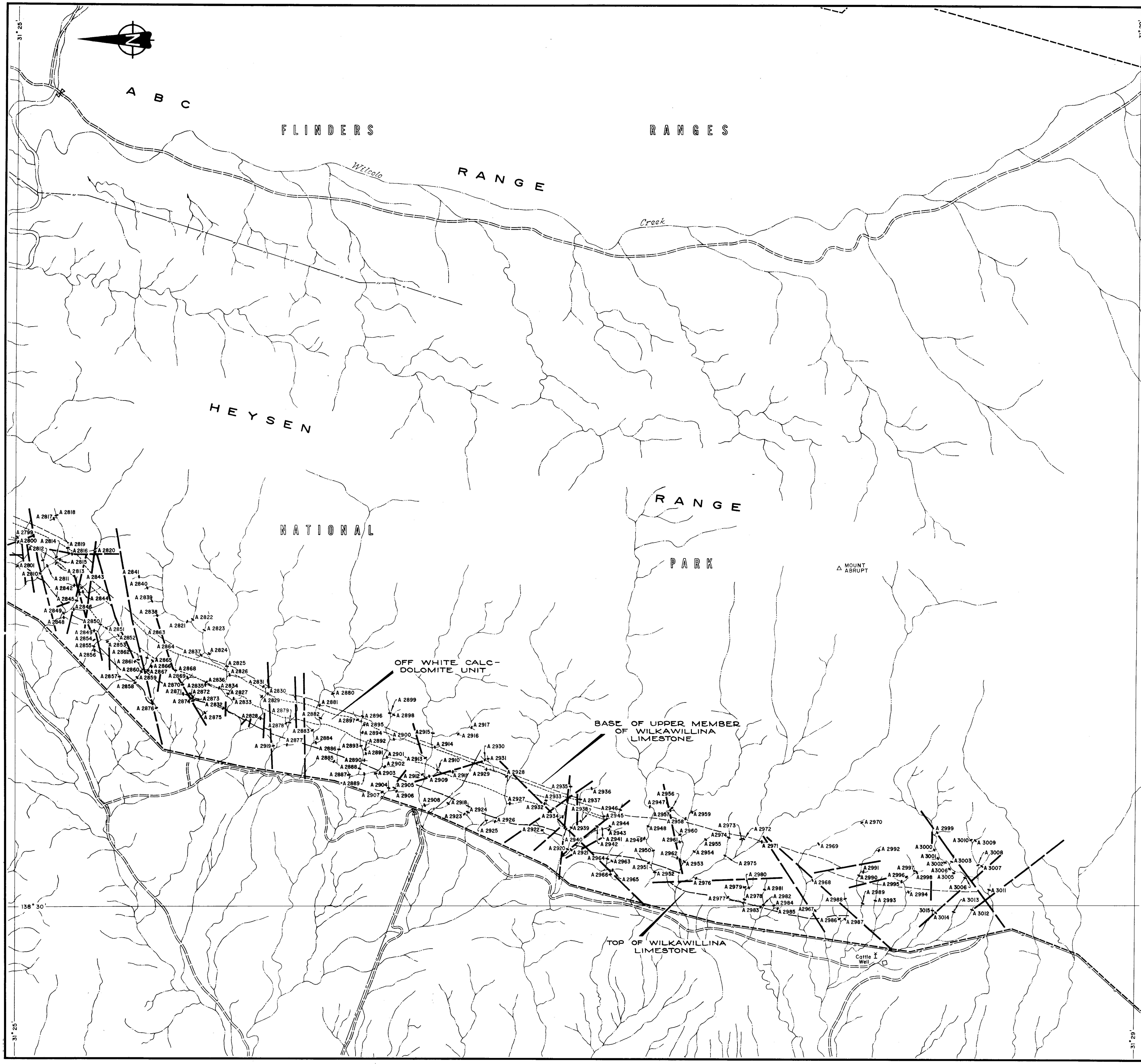

Figure 5c

**DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA**

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

**REGIONAL ROCK CHIP PETROLOGICAL AND ORIENTATION GEOCHEMICAL SAMPLE LOCATIONS**

| | |
|---|---|
| COMPILED | B. Morris |
| DRAWN | M.R. |
| DATE | Jan '85 |
| CHECKED | |
| SCALE | 1:10,000 |
| PLAN NUMBER | 85-457 |




## REFERENCE

A 3013 ........ Location of stream sediment sample with assay number. Assay numbers are 1983 unless otherwise stated.

........ Top of Wilkawillina Limestone.

........ Off white calc-dolomite unit.

........ Base of upper member of Wilkawillina Limestone.

........ Fault.

........ Flinders Ranges National Park Boundary.

........ Graded road or track.

........ Fence or gate.

........ Creek.

SCALE

200 0 200 400 600 800 1000

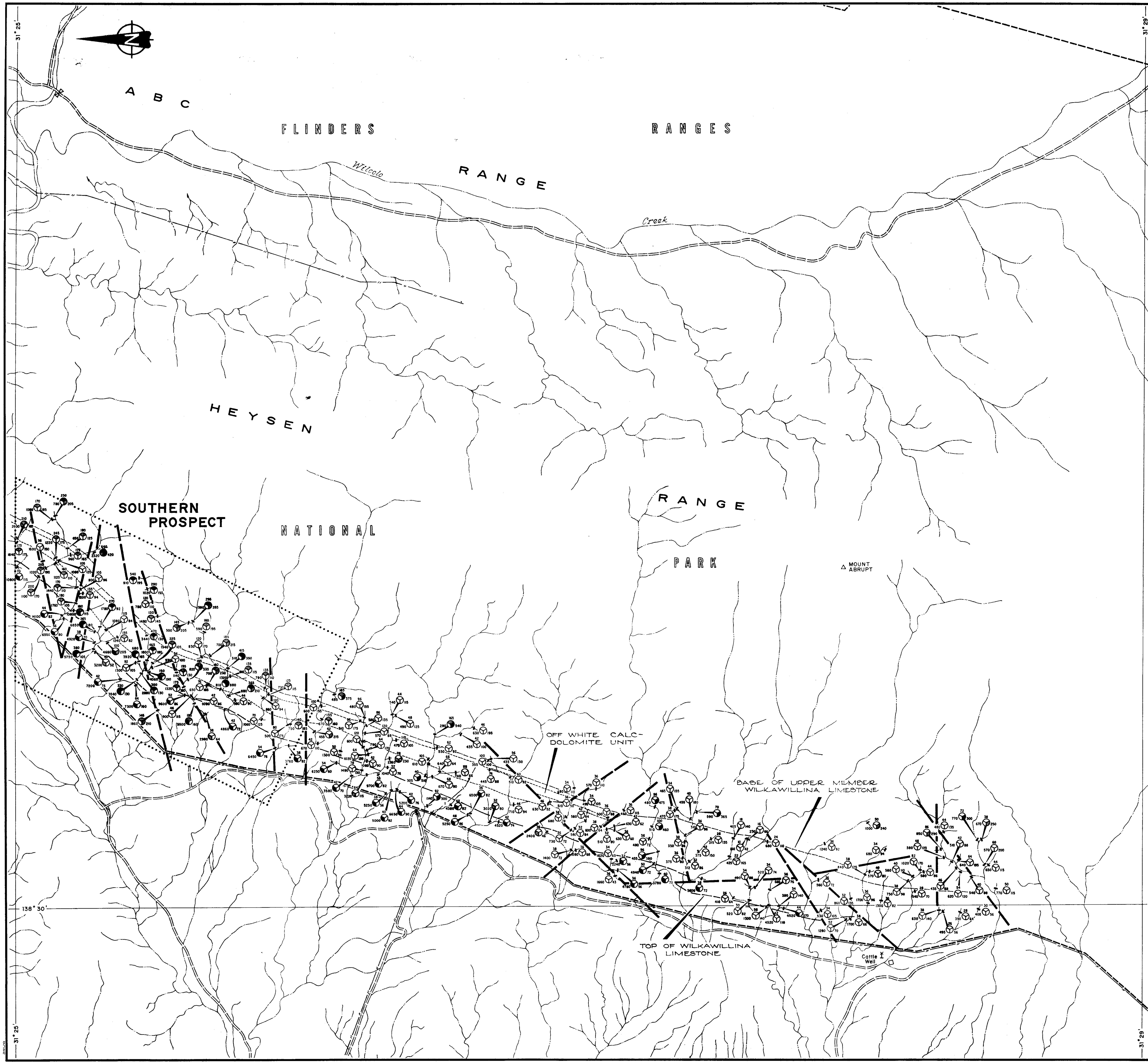
METRES

Figure 6a

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris |
|---|---|
| | DRAWN M.R. |
| | DATE Jan '85 |
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | CHECKED |
| STREAM SEDIMENT SURVEY | C.D.O. 10.12.85 |
| | SCALE 1:10,000 |
| SAMPLE LOCATION PLAN | PLAN NUMBER 85-458 |

HEYSEN RANGE
FLINDERS RANGES NATIONAL PARK
THE GUARDIAN
MOUNT RUPERT
BRACHINA GORGE
BUNYEROO GORGE
OFF WHITE CALC-DOLOMITE UNIT
BASE OF UPPER MEMBER OF WILKAWILLINA LIMESTONE
TOP OF WILKAWILLINA LIMESTONE
Brachina Creek
Bunyeroo Creek
BRACHINA GORGE ROAD
Yards
New Brachina Well
31° 20'
31° 25'
138° 30'
SCALE
200 0 200 400 600 800 1000
METRES
Figure 6b
DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA
BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
STREAM SEDIMENT SURVEY
SAMPLE LOCATION PLAN
COMPILED B. Morris
DRAWN M.R.
DATE Jan '85
CHECKED
SCALE 1:10,000
PLAN NUMBER 85-459

SOUTH MOUNT HAYWARD
MOUNT HAYWARD
WALKANDI PEAK
MOUNT BARBARA
MOUNT BARLOO
HEYSEN RANGE
FLINDERS RANGES
NATIONAL PARK
ABORIGINAL HISTORIC RESERVE
BASE OF UPPER MEMBER OF WILKAWILLINA LIMESTONE
OFF WHITE CALC-DOLOMITE UNIT
TOP OF WILKAWILLINA LIMESTONE
Bunduilla
Walkandi Creek
Hayward Creek
Etina Creek
North
South
31° 15'
31° 20'
138° 30'
SCALE
200 0 200 400 600 800 1000
METRES
Figure 6c
DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA
BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
STREAM SEDIMENT SURVEY
SAMPLE LOCATION PLAN
COMPILED B. Morris
DRAWN M.R.
DATE Jan '85
CHECKED
SCALE 1:10,000
PLAN NUMBER 85-460




## REFERENCE

Stream sediment sample location.

Pb 60, Mn 570, Zn 180 — Sample analyses in ppm.

Value < arithmetic mean

Value ≥ arithmetic mean and < threshold.

Value ≥ threshold.

| | Pb | Zn | Mn |
|---|---|---|---|
| Arithmetic Mean (ppm) | 120 | 200 | 2170 |
| Threshold (ppm) | 250 | 300 | 3500 |

Top of Wilkawillina Limestone.

Off white calc-dolomite unit.

Base of Upper Member – Wilkawillina Limestone

Fault

Flinders Range National Park boundary.

Graded road or track.

Fence and gate.

Creek.

SCALE

200 0 200 400 600 800 1000

METRES

Figure 7a

**DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA**

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

**STREAM SEDIMENT SURVEY**

**SAMPLE ANALYSES**

COMPILED B. Morris
DRAWN M.R.
DATE Jan '85
CHECKED
C.D.O. 10·9·85 DATE
SCALE 1 : 10,000
PLAN NUMBER 85-46


Figure 7b

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

STREAM SEDIMENT SURVEY

**SAMPLE ANALYSES**

COMPILED B. Morris
DRAWN M.R.
DATE Jan '85
CHECKED
SCALE 1:10,000
PLAN NUMBER 85-462


Figure 7c

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

STREAM SEDIMENT SURVEY

**SAMPLE ANALYSES**

| | |
|---|---|
| COMPILED | B. Morris |
| DRAWN | M.R. |
| DATE | Jan '85 |
| CHECKED | |
| C.O.G. DATE | 10-9-85 |
| SCALE | 1:10,000 |
| PLAN NUMBER | 85-463 |

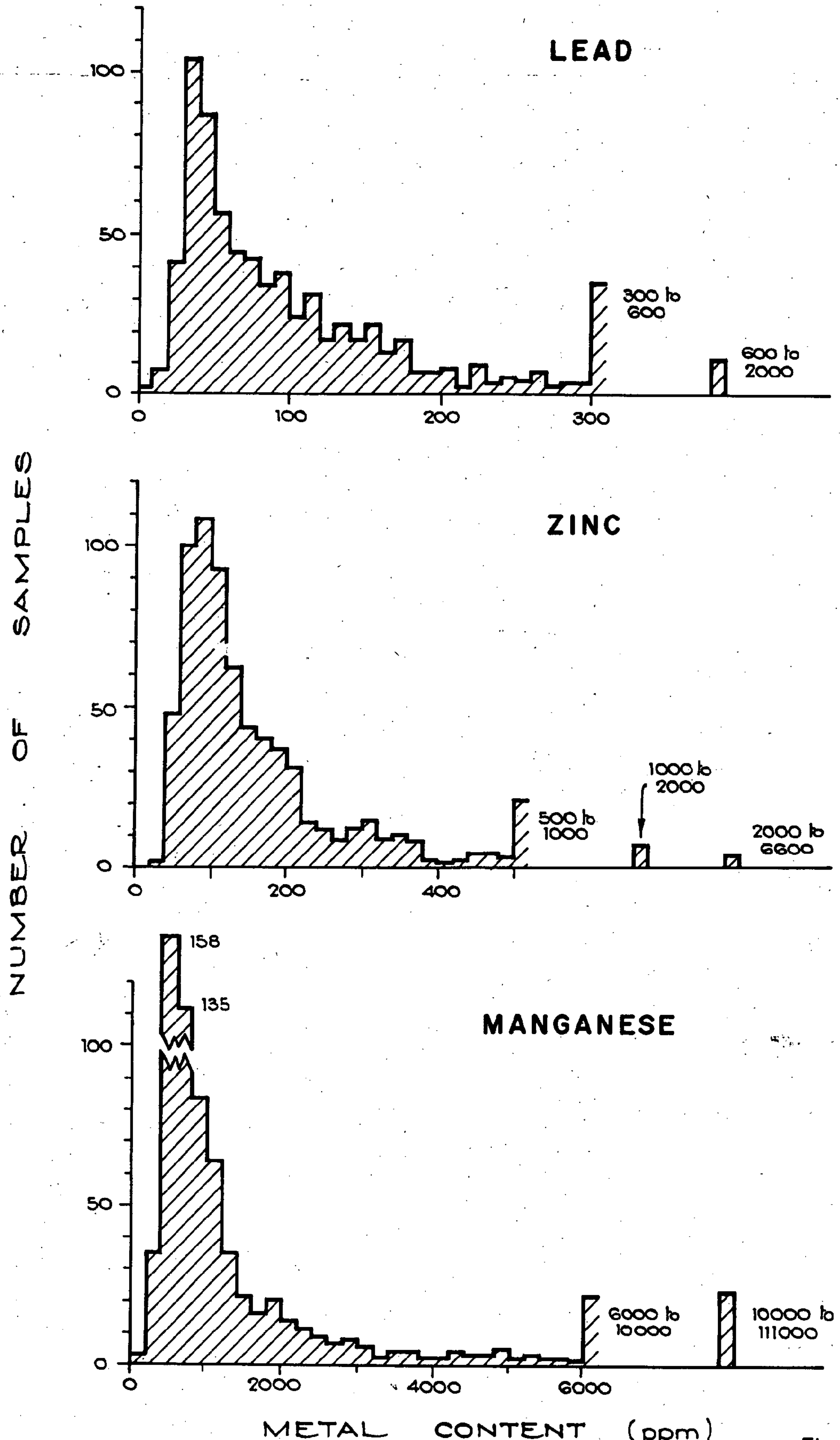



Figure ..... 8

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

## STREAM SEDIMENT SURVEY

FREQUENCY DISTRIBUTION GRAPHS OF METAL CONTENT

| | |
|---|---|
| COMPILED B. Morris | C.D.O. 26·6·86 DATE |
| DRAWN M.R. | SCALE — |
| DATE May '86 | PLAN NUMBER |
| CHECKED | S 18708 |

4019

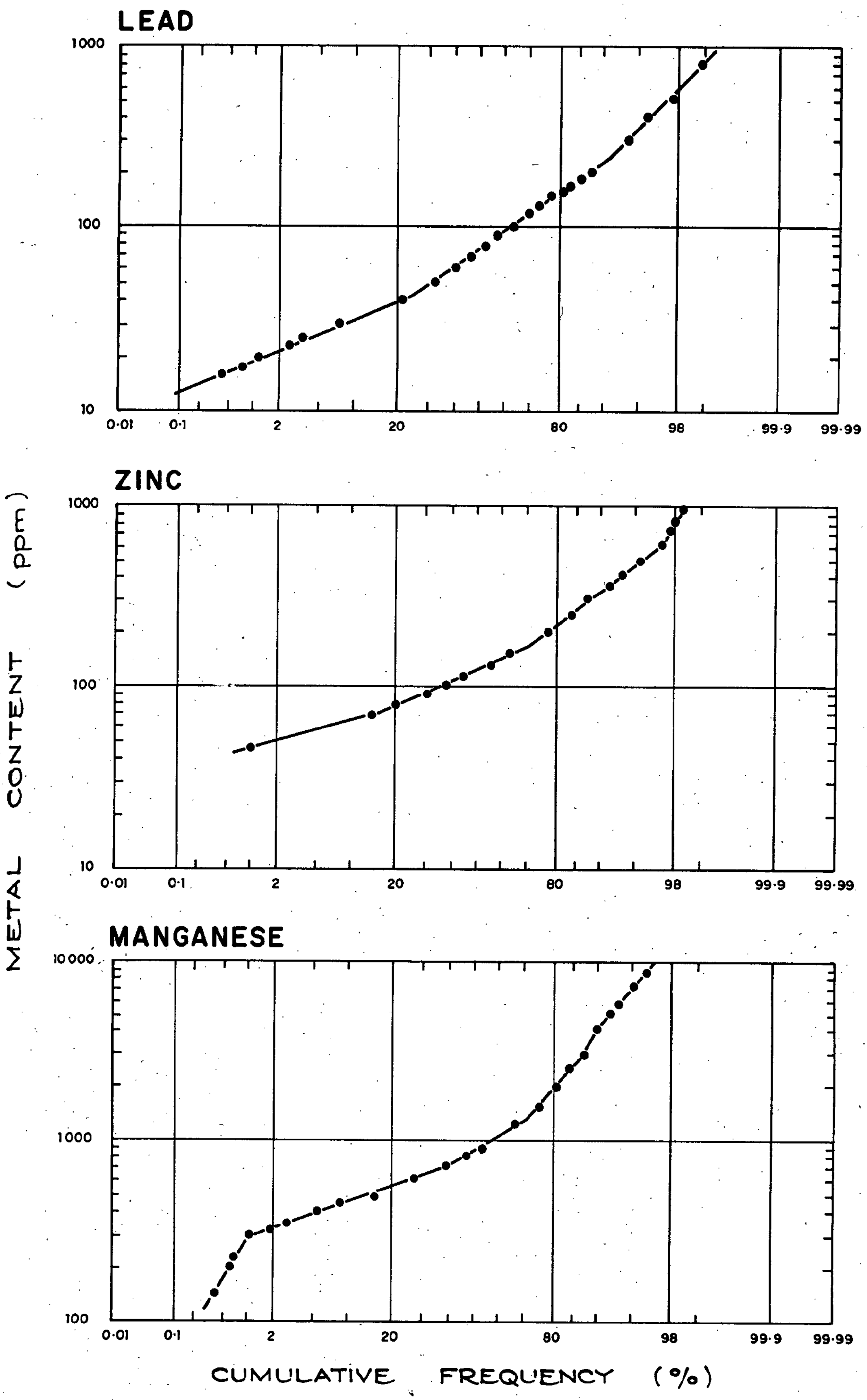



Figure......9

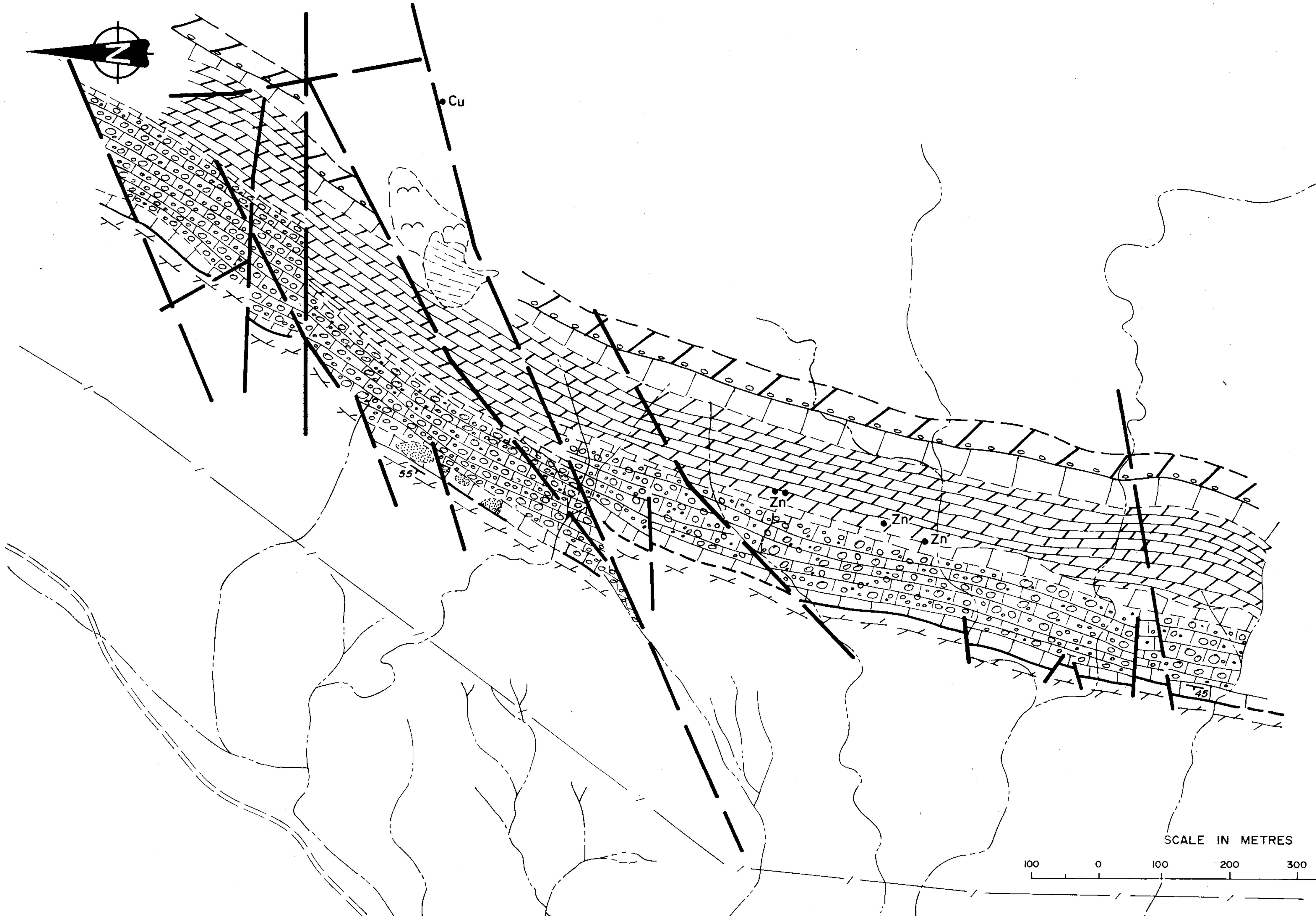
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

## STREAM SEDIMENT SURVEY

LOG PROBABILITY GRAPHS OF METAL CONTENT

| | |
|---|---|
| COMPILED B. Morris | C.D.O. 26·6·86 DATE |
| DRAWN M.R. | SCALE — |
| DATE May '86 | PLAN NUMBER |
| CHECKED | S 18709 |




## REFERENCE

**QUATERNARY**
Colluvium

**TERTIARY**
Silcrete

**CAMBRIAN**
Hawker Group
PARARA LIMESTONE: Dark grey flaggy and silty limestone with interbedded shale.
WILKAWILLINA LIMESTONE:
Upper Member: Palaeosurface at top marked by laminated red-brown recrystallized calcrete crust on nodular limestone with massive recrystallized limestone interbeds, then off-white porous calc-dolomite with grey fine grained limestone.

Lower Member: Dark grey nodular limestone then dark grey-brown bedded sandy dolomite with algal and oolitic beds.

Manganese and iron oxides

Fault

Drainage Lines

Fence

Track

Strike and dip of bedding — 45

Smithsonite and hydrozincite occurrence — • Zn

Malachite and chalcocite occurrence — • Cu

Note: For location of area see FIG. 2, PLAN No. S18319

FIG. 10

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | C.D.O. 10 12 85 DATE |
|---|---|---|
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK **SOUTHERN PROSPECT** GEOLOGICAL PLAN | DRAWN E. Calabio | SCALE 1:5000 |
| | DATE May '85 | PLAN NUMBER |
| | CHECKED | **85-464** |

3406

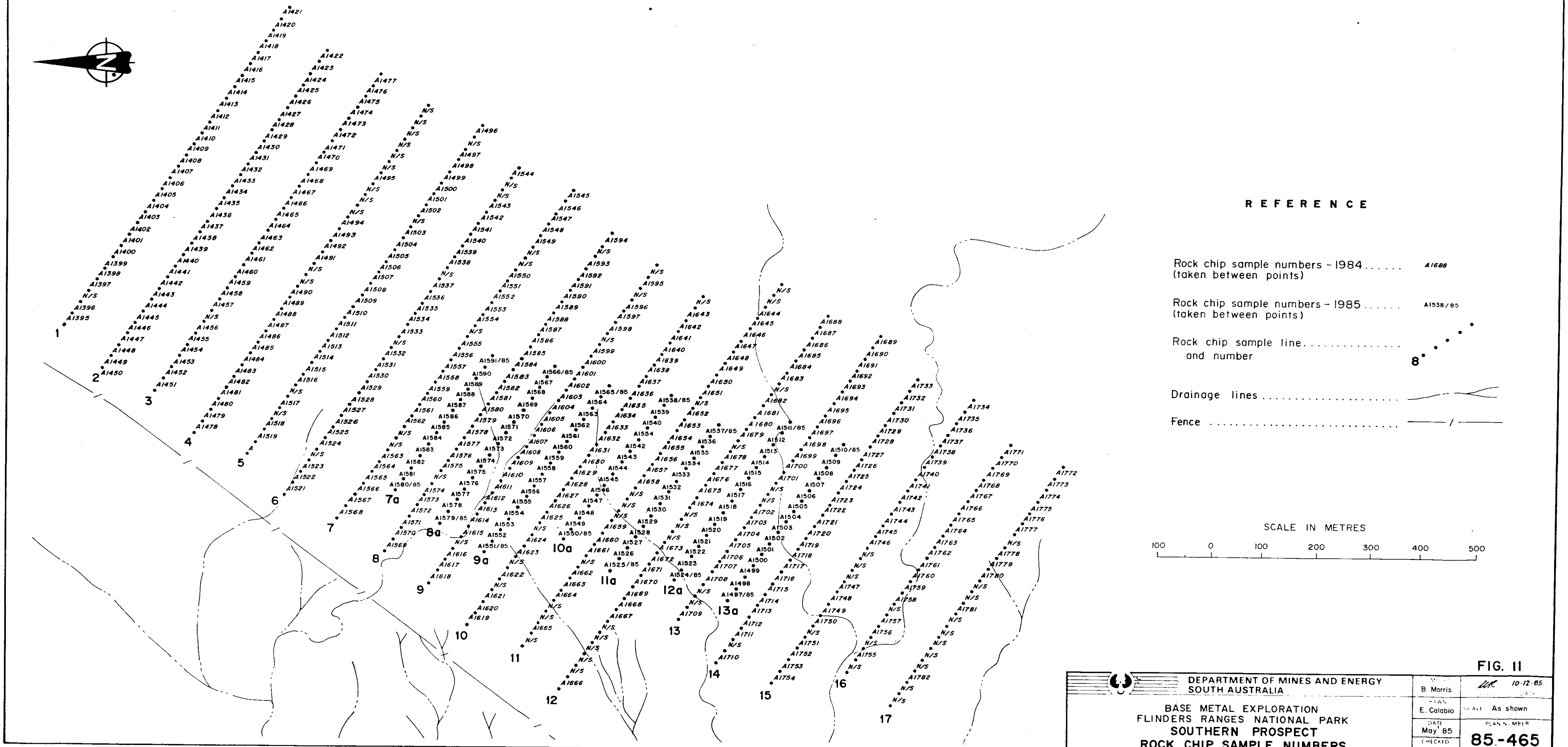
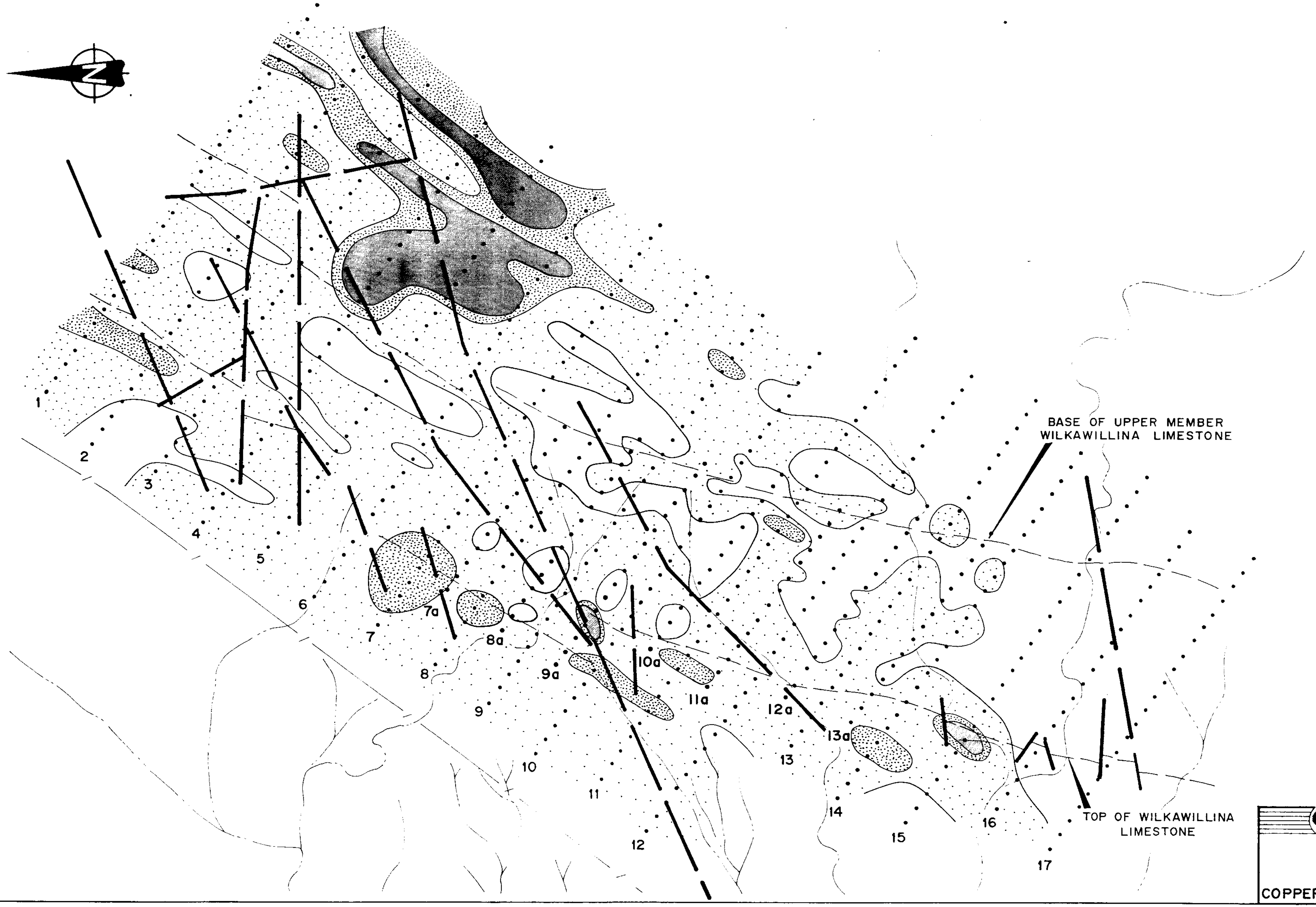



FIG. 11

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | B. Morris | 10.12.85 |
|---|---|---|
| BASE METAL EXPLORATION<br>FLINDERS RANGES NATIONAL PARK<br>**SOUTHERN PROSPECT**<br>**ROCK CHIP SAMPLE NUMBERS** | E. Calabio | SCALE As shown |
| | DATE May '85 | PLAN NUMBER 85-465 |

3406




**REFERENCE**

Copper content (ppm) of rock chip samples.

MEDIAN VALUE — 4
12
THRESHOLD VALUE — 20

Drainage lines ....................

Fence ....................

Rock chip sample line and number..... 15 • • • • • •

Fault ....................

SCALE IN METRES

100 0 100 200 300 400 500

FIG. 12

| | | |
|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B Morris | CDO DATE |
| BASE METAL EXPLORATION<br>FLINDERS RANGES NATIONAL PARK<br>SOUTHERN PROSPECT<br>COPPER CONTOURS – ROCK CHIP SAMPLE RESULTS | DRAWN E Calabio | SCALE As shown |
| | DATE May 85 | PLAN NUMBER |
| | CHECKED | 85-466 |

3733

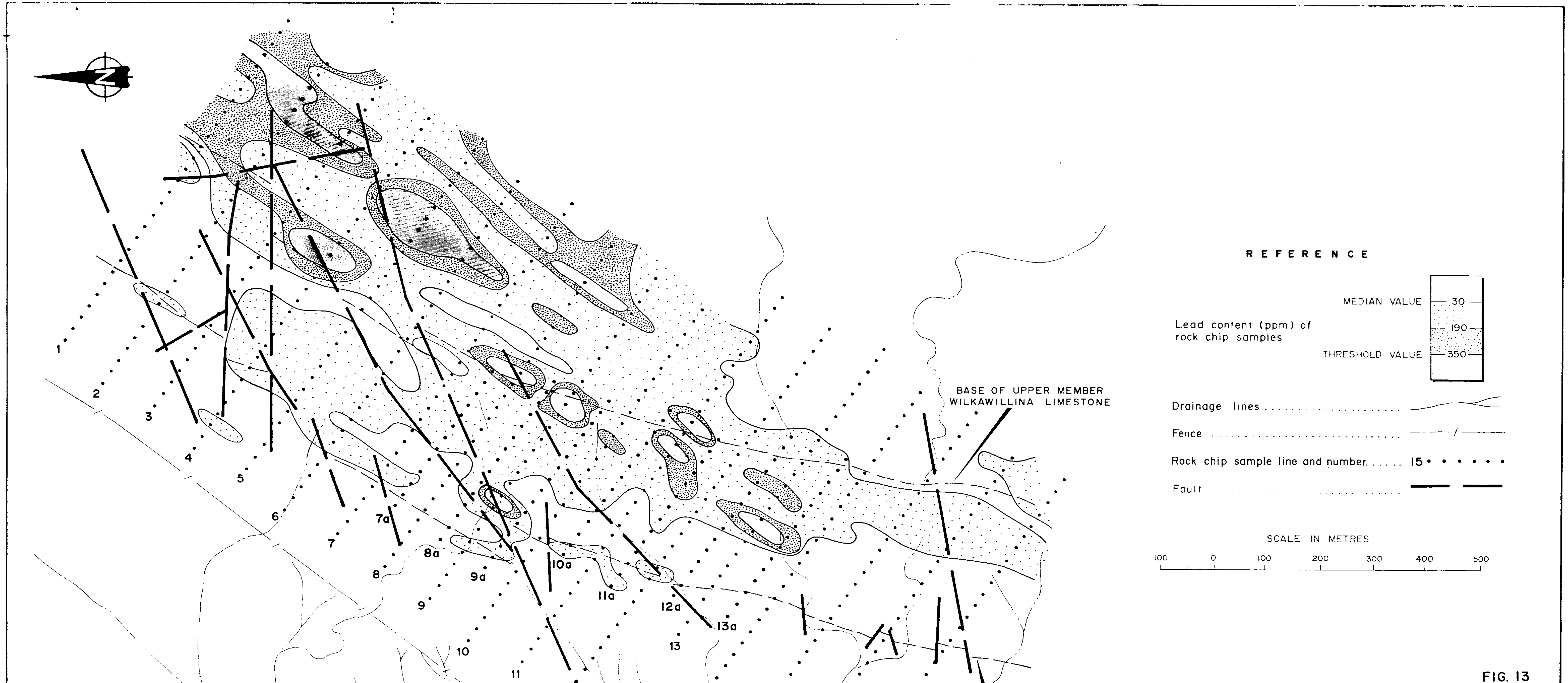



FIG. 13

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | CDO DATE |
|---|---|---|
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN E. Calabio | SCALE As shown |
| SOUTHERN PROSPECT | DATE May 85 | PLAN NUMBER |
| LEAD CONTOURS - ROCK CHIP SAMPLE RESULTS | CHECKED | 85-467 |

3733

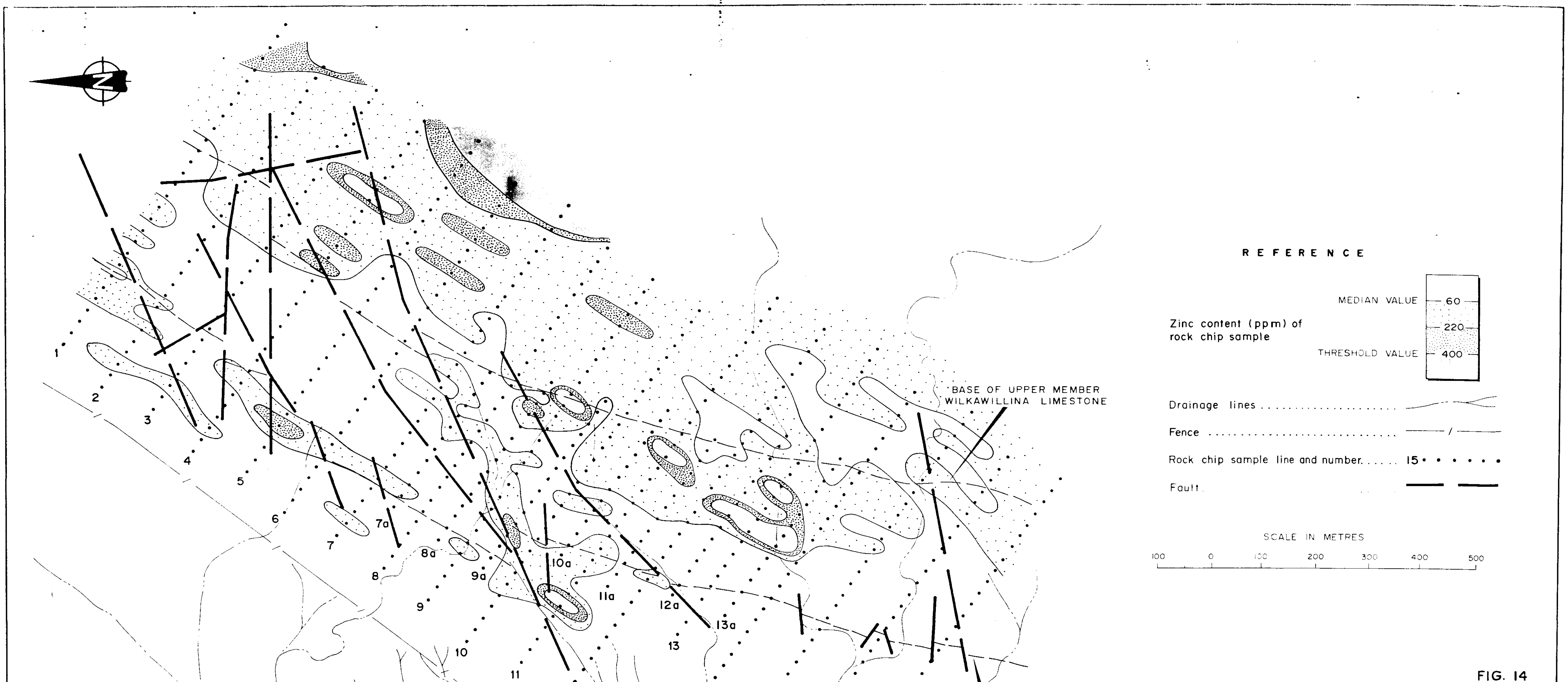



FIG. 14

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
SOUTHERN PROSPECT
ZINC CONTOURS – ROCK CHIP SAMPLE RESULTS

B. Morris
E. Calabio
May '85
As shown
85.-468

3733

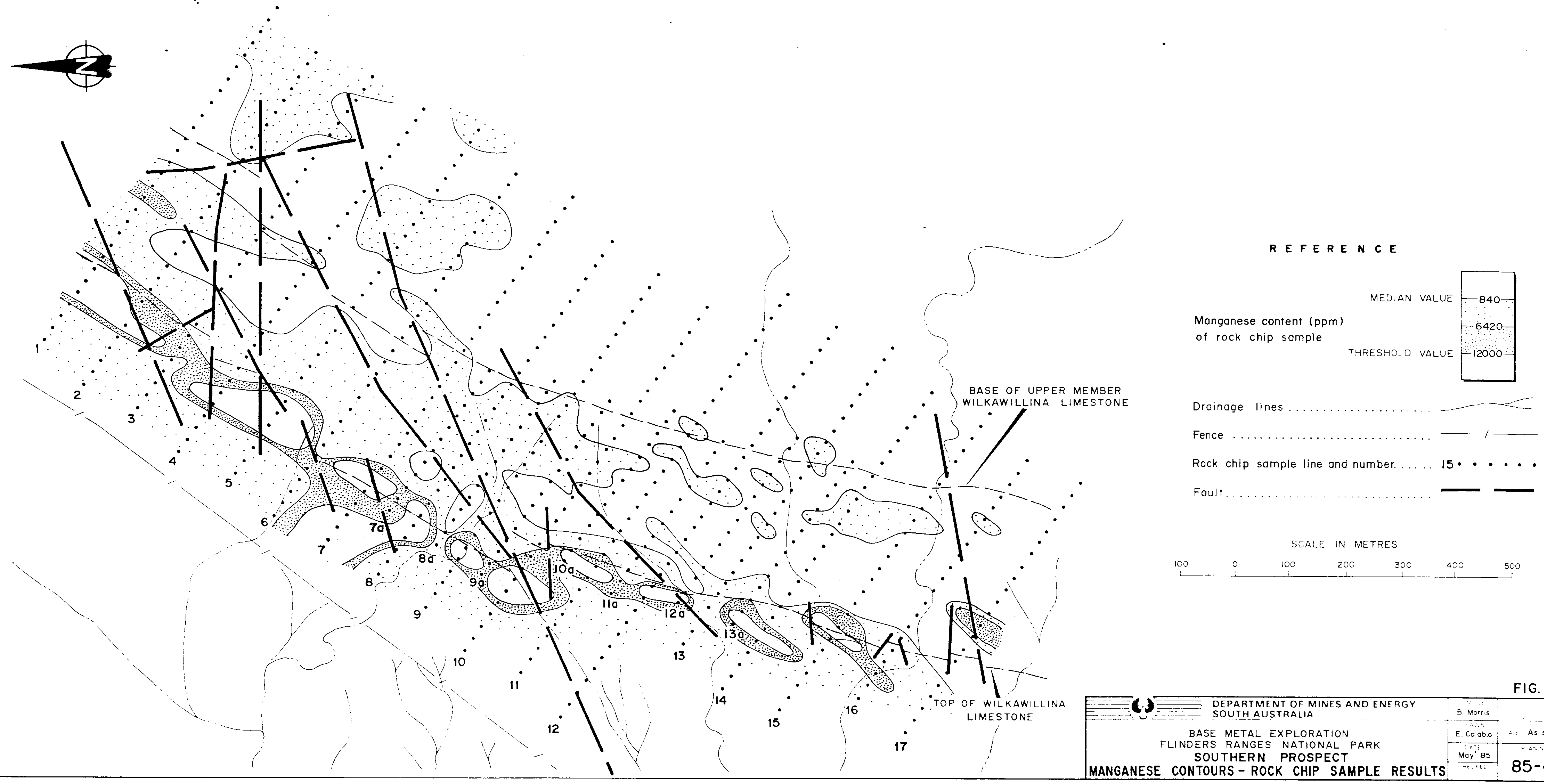



FIG. 15

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
SOUTHERN PROSPECT
MANGANESE CONTOURS - ROCK CHIP SAMPLE RESULTS

| | |
|---|---|
| B Morris | |
| E. Calabio | As shown |
| May '85 | 85-469 |

3733

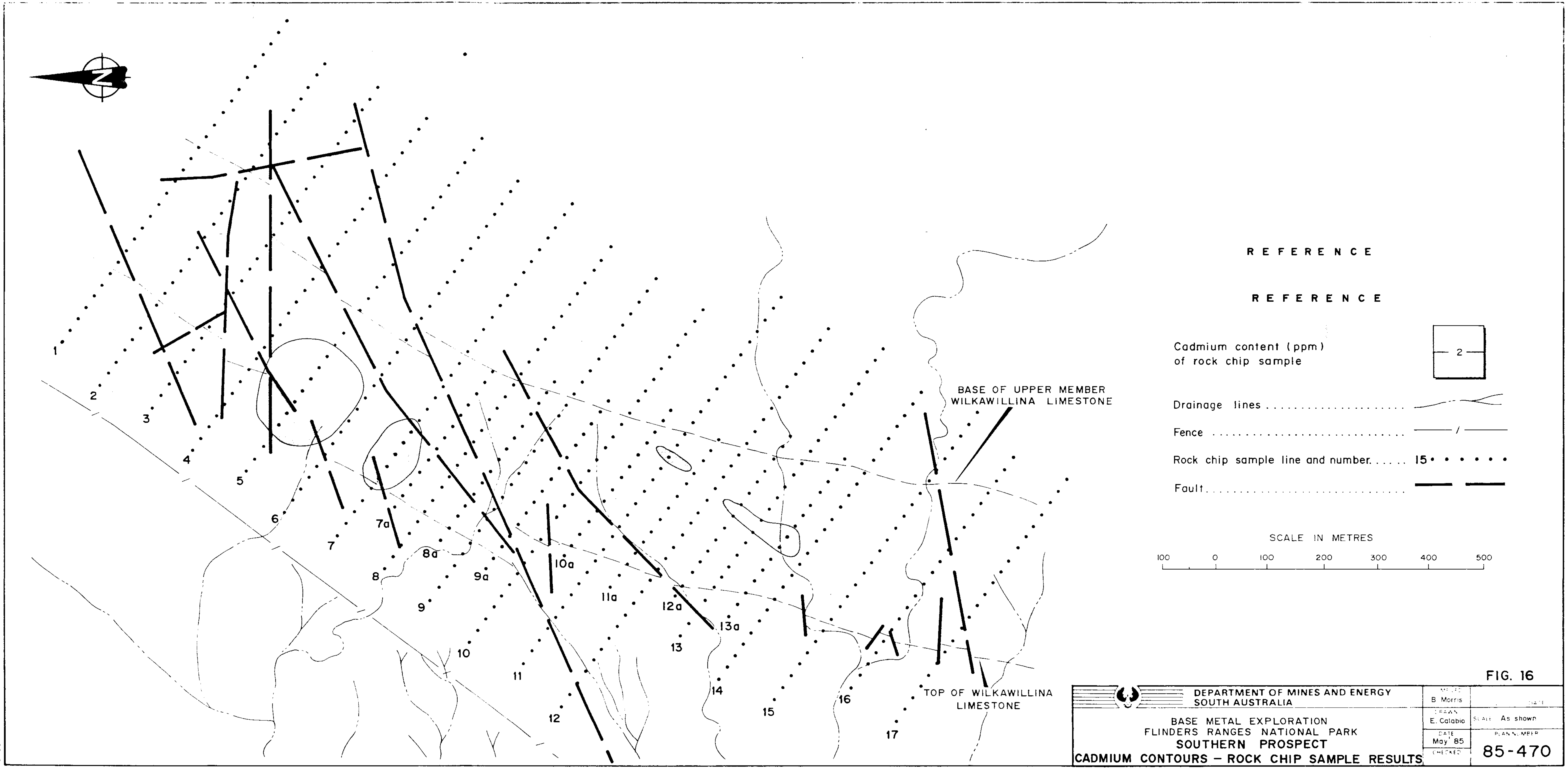



FIG. 16

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
SOUTHERN PROSPECT
CADMIUM CONTOURS – ROCK CHIP SAMPLE RESULTS

B. Morris
DRAWN E. Calabio
DATE May '85
SCALE As shown
PLAN NUMBER 85-470

3733

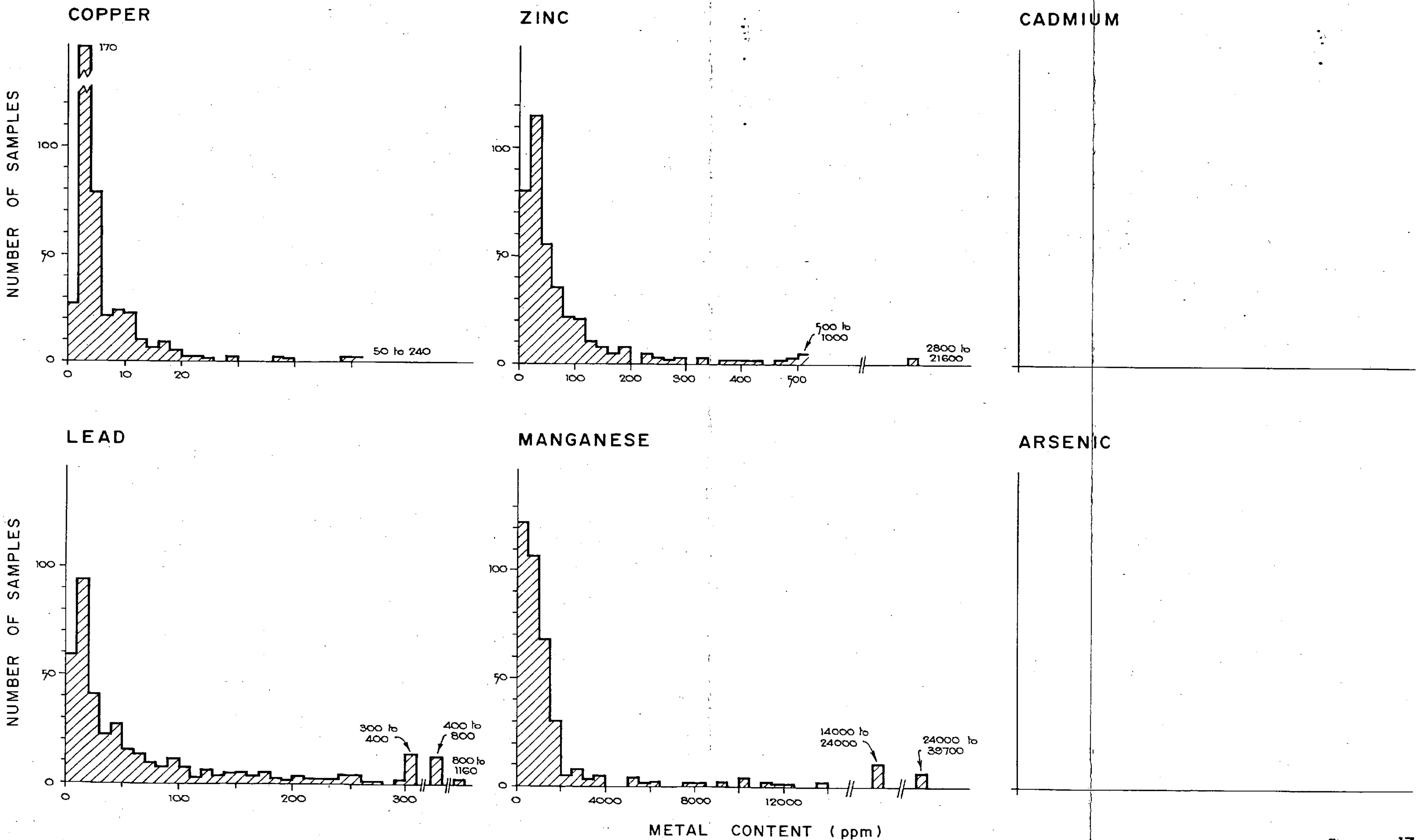



Figure 17

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | C.D.O. 26-6-86 DATE |
|---|---|---|
| BASE METAL EXPLORATION<br>FLINDERS RANGES NATIONAL PARK<br>**SOUTHERN PROSPECT** – Rock chip samples<br>FREQUENCY DISTRIBUTION GRAPHS OF METAL CONTENT | DRAWN M.R. | SCALE Graph |
| | DATE March '86 | PLAN NUMBER |
| | CHECKED | 86 - 251 |

3406

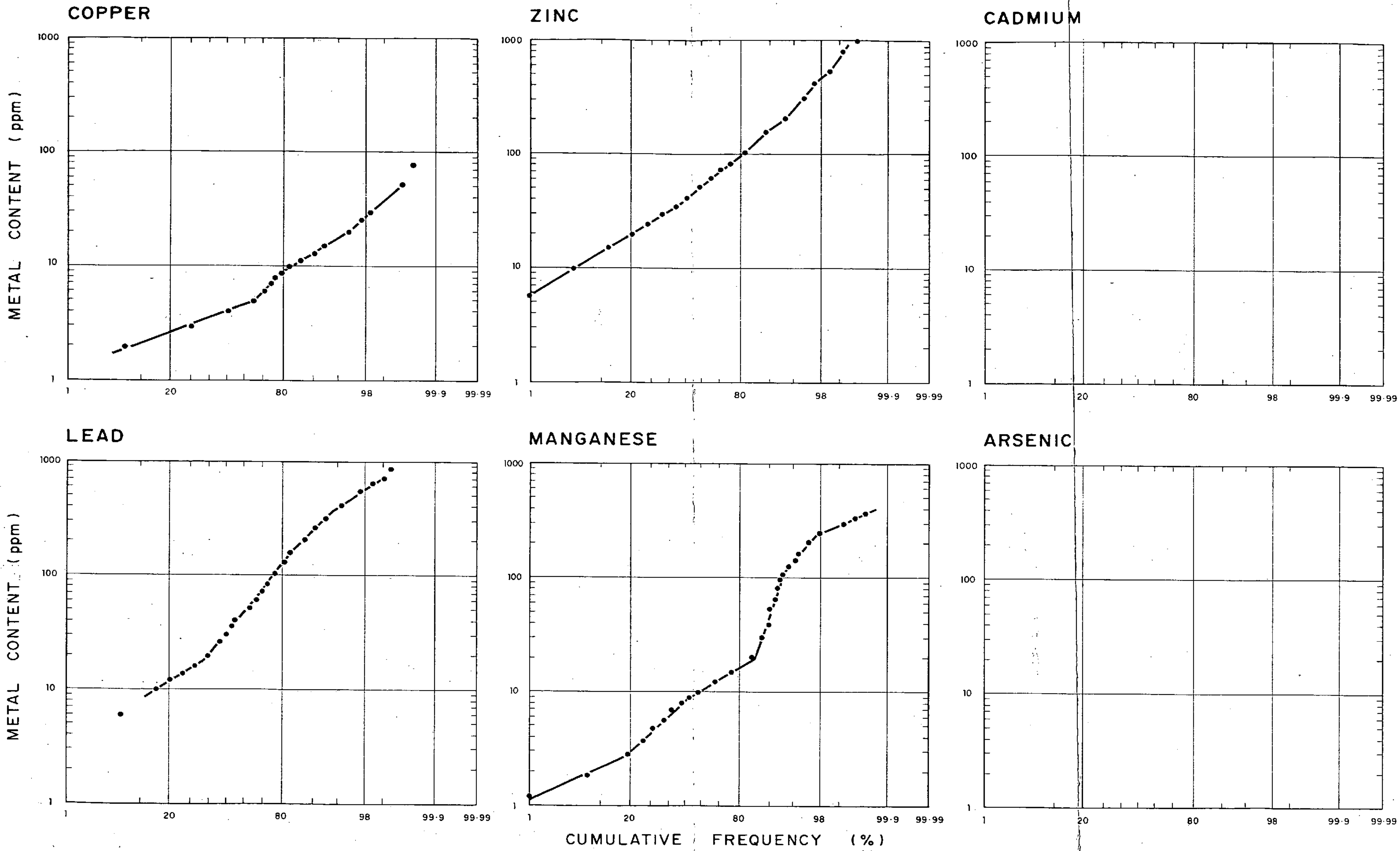



Figure ...... 18

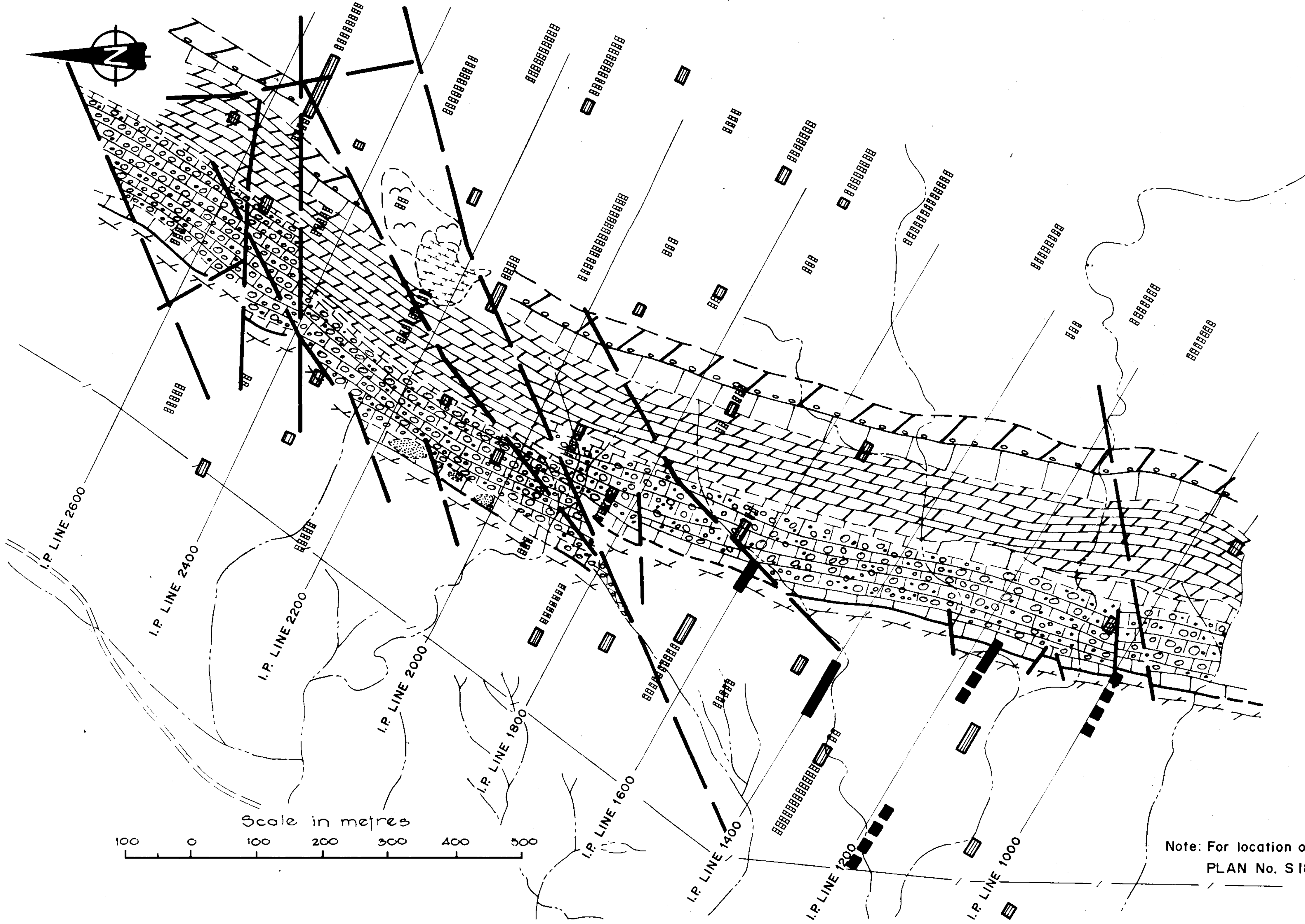
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

**SOUTHERN PROSPECT – Rock chip samples**

LOG PROBABILITY GRAPHS OF METAL CONTENT

| | | | |
|---|---|---|---|
| COMPILED B. Morris | C D·O | DATE 26·6·86 | |
| DRAWN M.R. | SCALE Graph | | |
| DATE March '86 | PLAN NUMBER 86 - 252 | | |
| CHECKED | | | |




Note: For location of area see FIG. 2, PLAN No. S18319

## REFERENCE

**QUATERNARY**
Colluvium

**TERTIARY**
Silcrete

**CAMBRIAN**
Hawker Group
PARARA LIMESTONE: Dark grey flaggy and silty limestone with interbedded shale.
WILKAWILLINA LIMESTONE:
Upper Member: Palaeosurface at top marked by laminated red-brown recrystallized calcrete crust on nodular limestone with massive recrystallized limestone interbeds, then buff coloured porous calc-dolomite with grey fine grained limestone.
Lower Member: Dark grey nodular limestone then dark grey-brown bedded sandy dolomite with algal and oolitic beds.

Manganese and iron oxides

Fault

Drainage Lines

Fence

Track

Definite I.P. anomaly

Probable I.P. anomaly

Possible I.P. anomaly

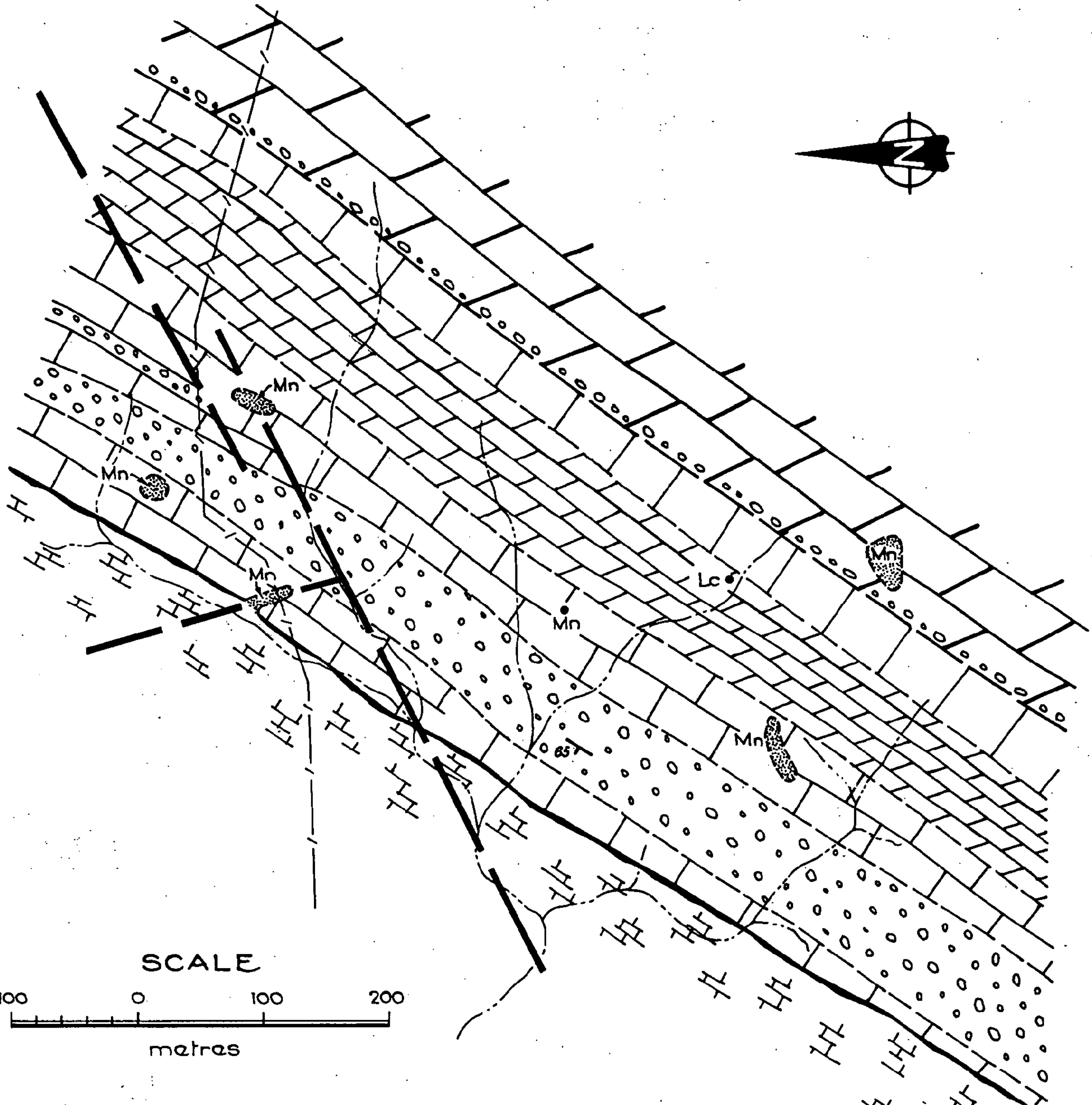
Strong sirotem anomaly

Weak sirotem anomaly

FIG. 19

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED D. Ivic | [signature] C D O | 10.12.85 DATE |
|---|---|---|---|
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN E. Calabio | SCALE As shown | |
| SOUTHERN PROSPECT GEOPHYSICAL RESULTS | DATE Mar.'85 | PLAN NUMBER 85-471 | |
| | CHECKED | | |

3406




**CAMBRIAN**

Hawker Group

PARARA LIMESTONE - Dark grey flaggy and silty limestone with interbedded shales.

WILKAWILLINA LIMESTONE -

Upper Member - Palaeosurface at top marked by laminated red-brown recrystallized calcrete crust, then massive light grey limestone with archaeocyathans and brachiopods, also nodular limestone bed and buff coloured porous calc-dolomite near base.

Lower Member - Dark grey nodular limestone then dark grey-brown bedded sandy dolomite with algal and oolitic beds.

Mn — Manganese oxides, probably filling karsitic feature.

65 ..........Strike and dip of bedding

• Lc ..........Laminar calcite or calcrete

• Mn ..........Manganese

..........Fault

..........Drainage line

..........Fence

NOTE: For location of prospect see plan no. S 18319 (Fig. 2)

Figure 20

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

**CAMP PROSPECT**

GEOLOGICAL PLAN

| | | |
|---|---|---|
| COMPILED B. Morris | CDO | DATE 25 · 6 · 86 |
| DRAWN M.R. | SCALE 1 : 5000 | |
| DATE May '86 | PLAN NUMBER | |
| CHECKED | S 18700 | |

4015

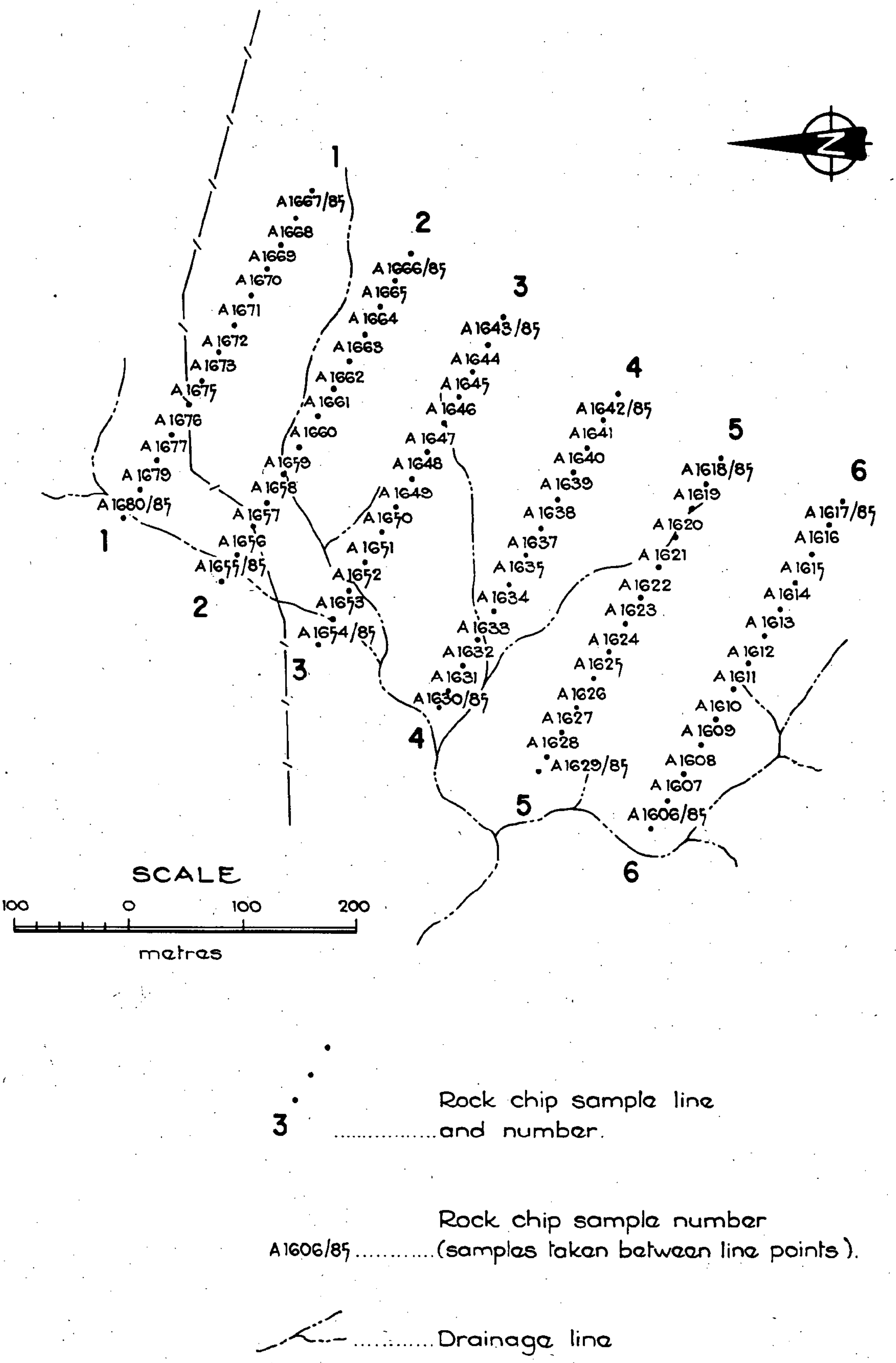



Figure..... **21**

| | | |
|---|---|---|
| **DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA** | COMPILED B. Morris | CDO DATE 25·6·86 |
| BASE METAL EXPLORATION<br>FLINDERS RANGES NATIONAL PARK | DRAWN M.R. | SCALE 1 : 5000 |
| **CAMP PROSPECT** | DATE May '86 | PLAN NUMBER |
| ROCK CHIP SAMPLE LOCATIONS | CHECKED | **S 18701** |

4015

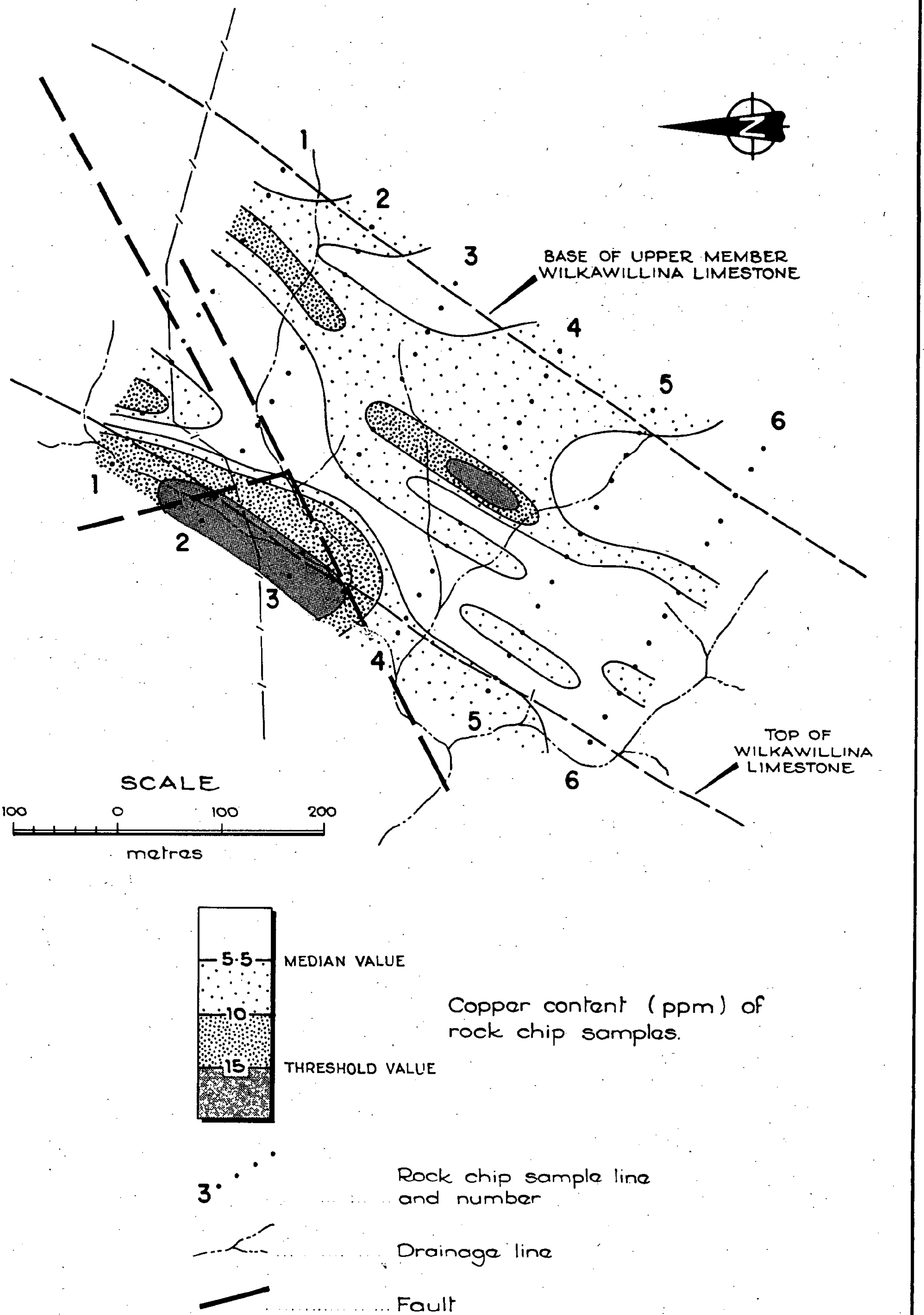



Figure 22

**DEPARTMENT OF MINES AND ENERGY**
**SOUTH AUSTRALIA**

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

## CAMP PROSPECT

## COPPER CONTOURS - ROCK CHIP SAMPLE RESULTS

| | | |
|---|---|---|
| COMPILED B. Morris | CDO 26·6·86 | DATE |
| DRAWN M.R. | SCALE 1 : 5000 | |
| DATE May '86 | PLAN NUMBER | |
| CHECKED | S 18702 | |

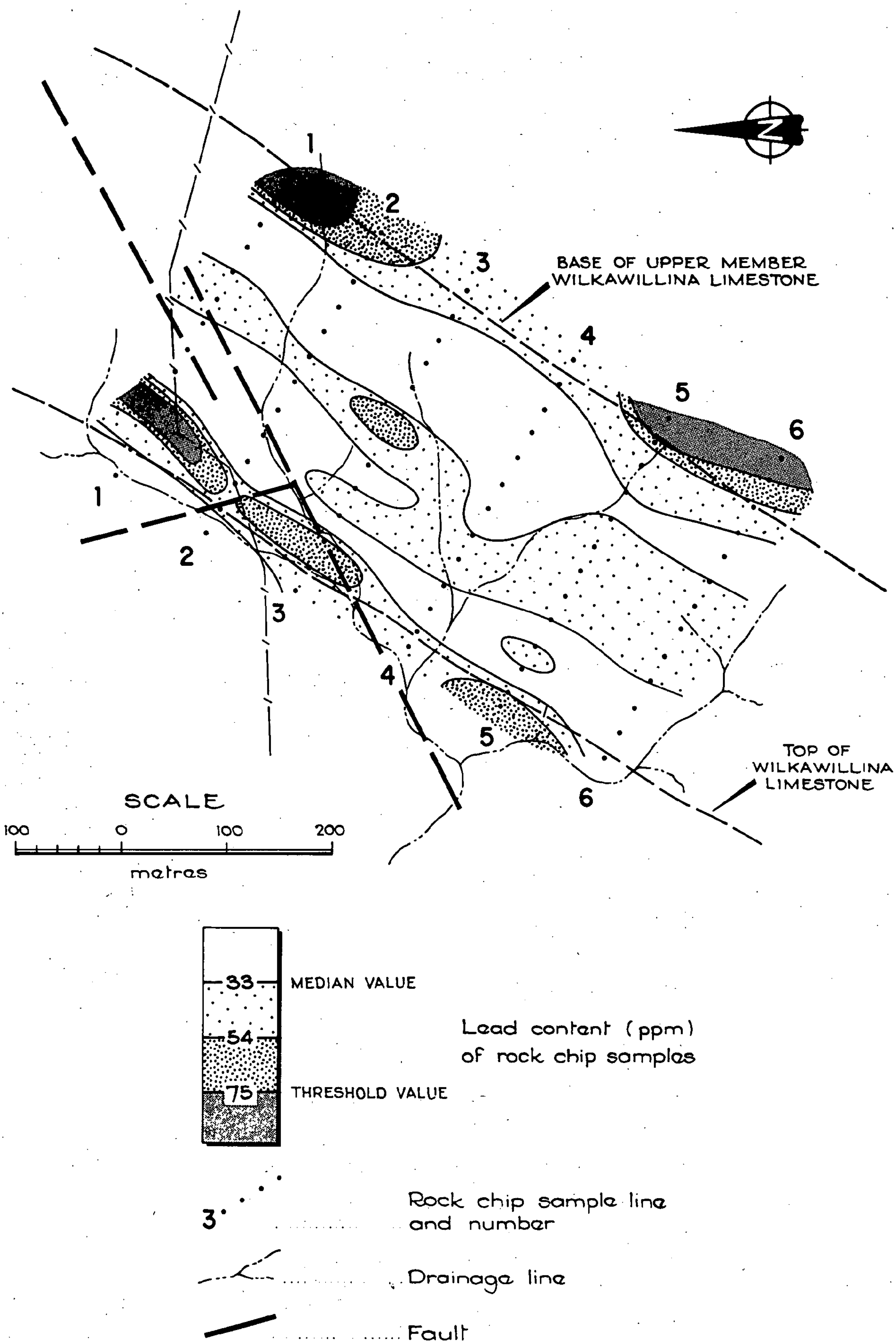



Figure 23

| DEPARTMENT OF MINES AND ENERGY<br>SOUTH AUSTRALIA | COMPILED<br>B. Morris | CDO · DATE 26·6·86 |
|---|---|---|
| BASE METAL EXPLORATION<br>FLINDERS RANGES NATIONAL PARK | DRAWN<br>M.R. | SCALE 1 : 5000 |
| CAMP PROSPECT | DATE<br>May '86 | PLAN NUMBER |
| LEAD CONTOURS - ROCK CHIP SAMPLE RESULTS | CHECKED | S 18703 |

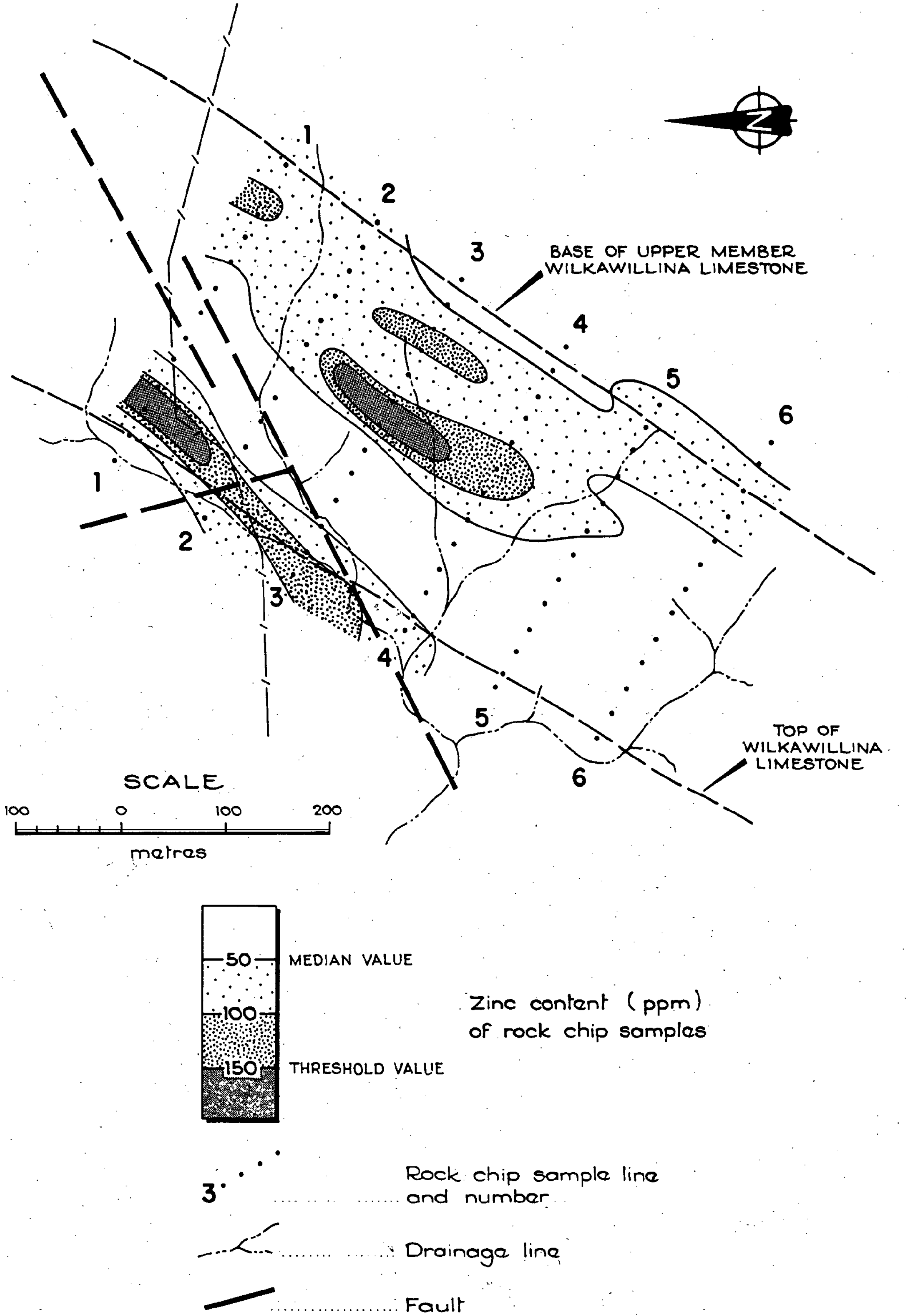



Figure 24

| | | |
|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | CDO 26·6·86 DATE |
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M.R. | SCALE 1 : 5000 |
| CAMP PROSPECT | DATE May '86 | PLAN NUMBER |
| ZINC CONTOURS - ROCK CHIP SAMPLE RESULTS | CHECKED | S 18704 |

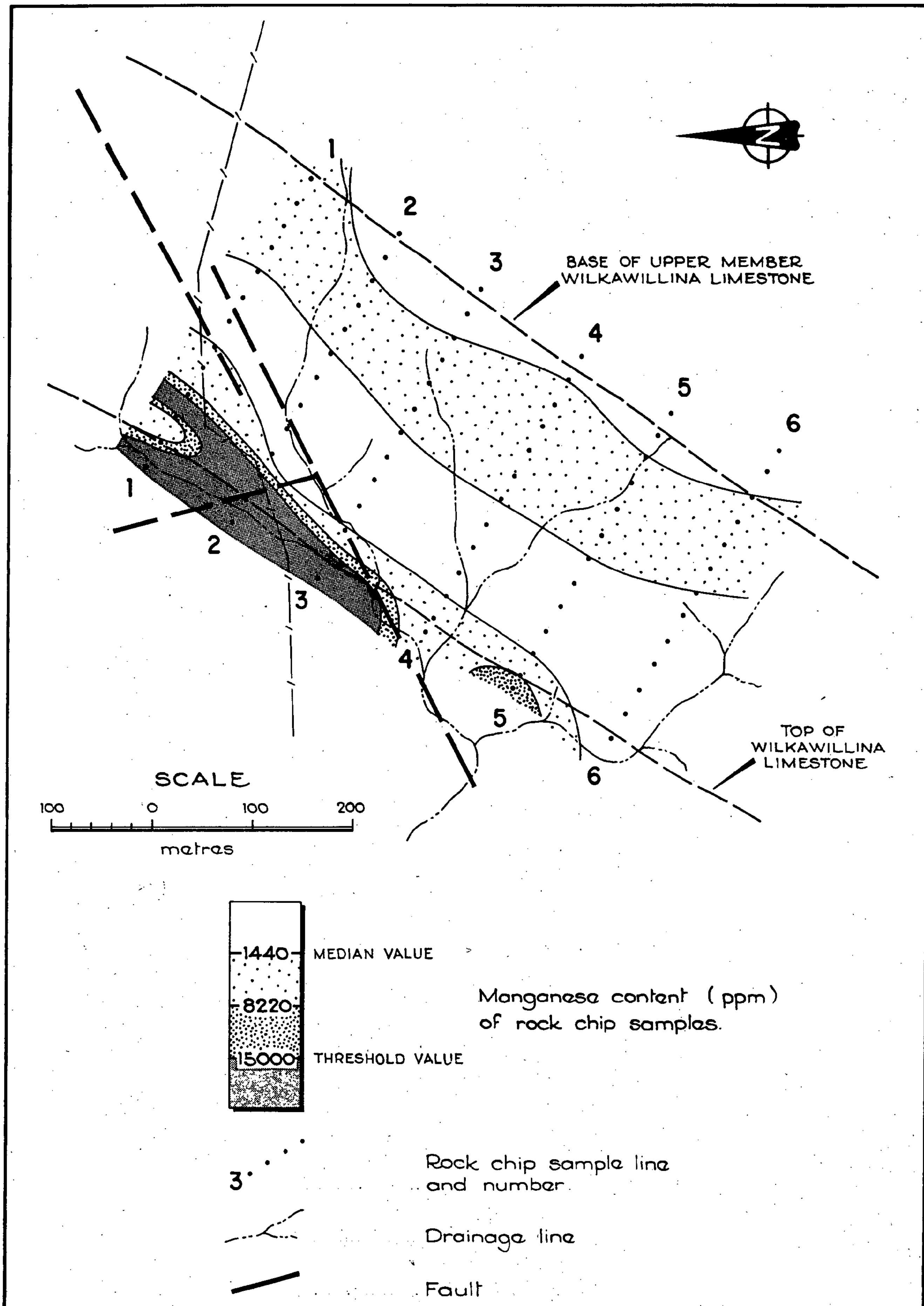



Figure..... 25

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

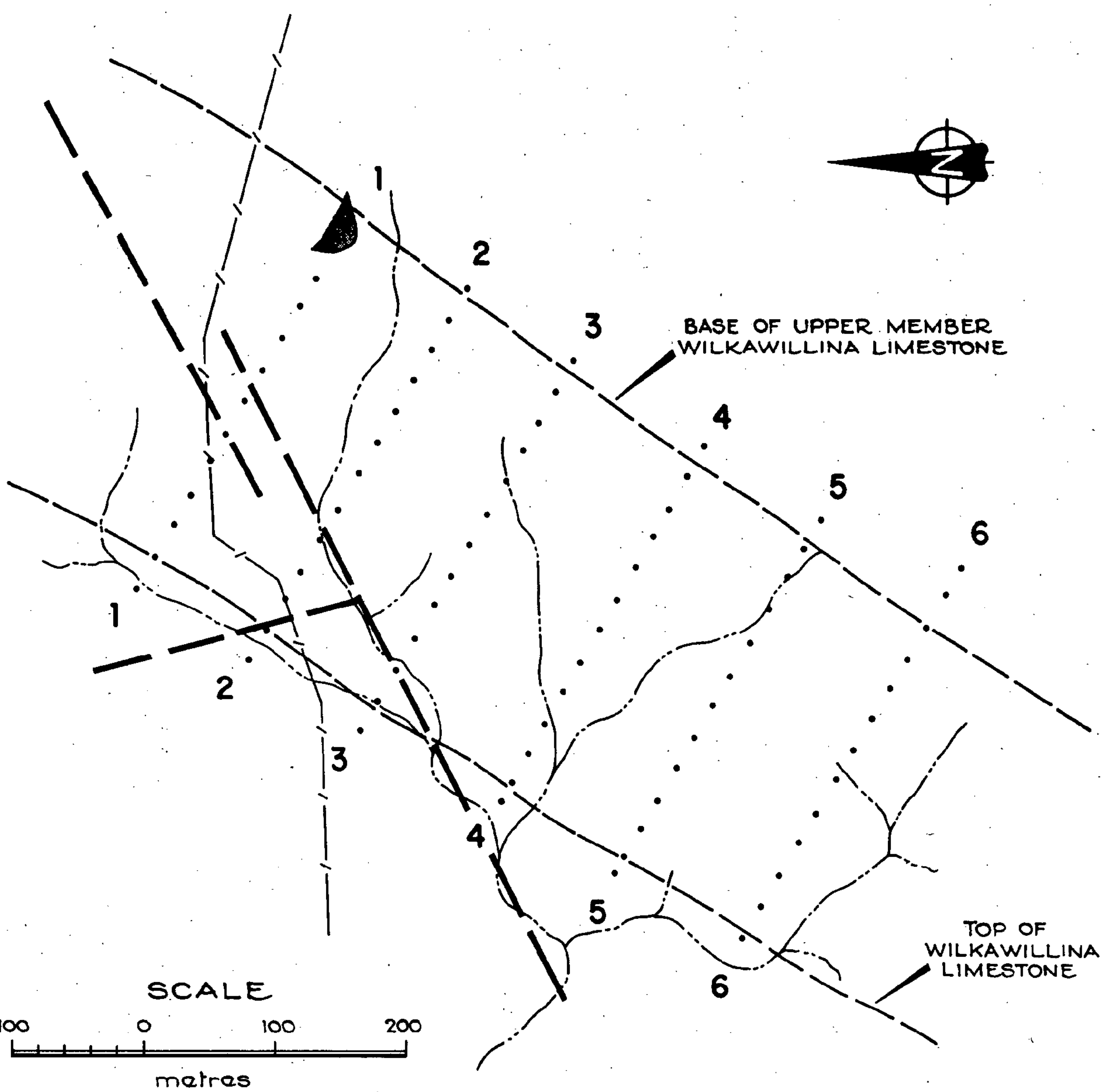
BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

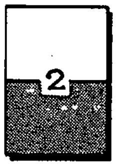
# CAMP PROSPECT

## MANGANESE CONTOURS - ROCK CHIP SAMPLE RESULTS

| | | | |
|---|---|---|---|
| COMPILED | B. Morris | CDO | DATE 26·6·86 |
| DRAWN | M.R. | SCALE | 1 : 5000 |
| DATE | May '86 | PLAN NUMBER | S 18705 |
| CHECKED | | | |

40113




Cadmium content (ppm) of rock chip samples.

3 ........ Rock chip sample line and number.

........ Drainage line

........ Fault

Figure..... 26

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

CAMP PROSPECT

CADMIUM CONTOURS - ROCK CHIP SAMPLE RESULTS

| | | |
|---|---|---|
| COMPILED B. Morris | CDO | 26·6·86 DATE |
| DRAWN M.R. | SCALE 1 : 5000 | |
| DATE May '86 | PLAN NUMBER | |
| CHECKED | S 18706 | |

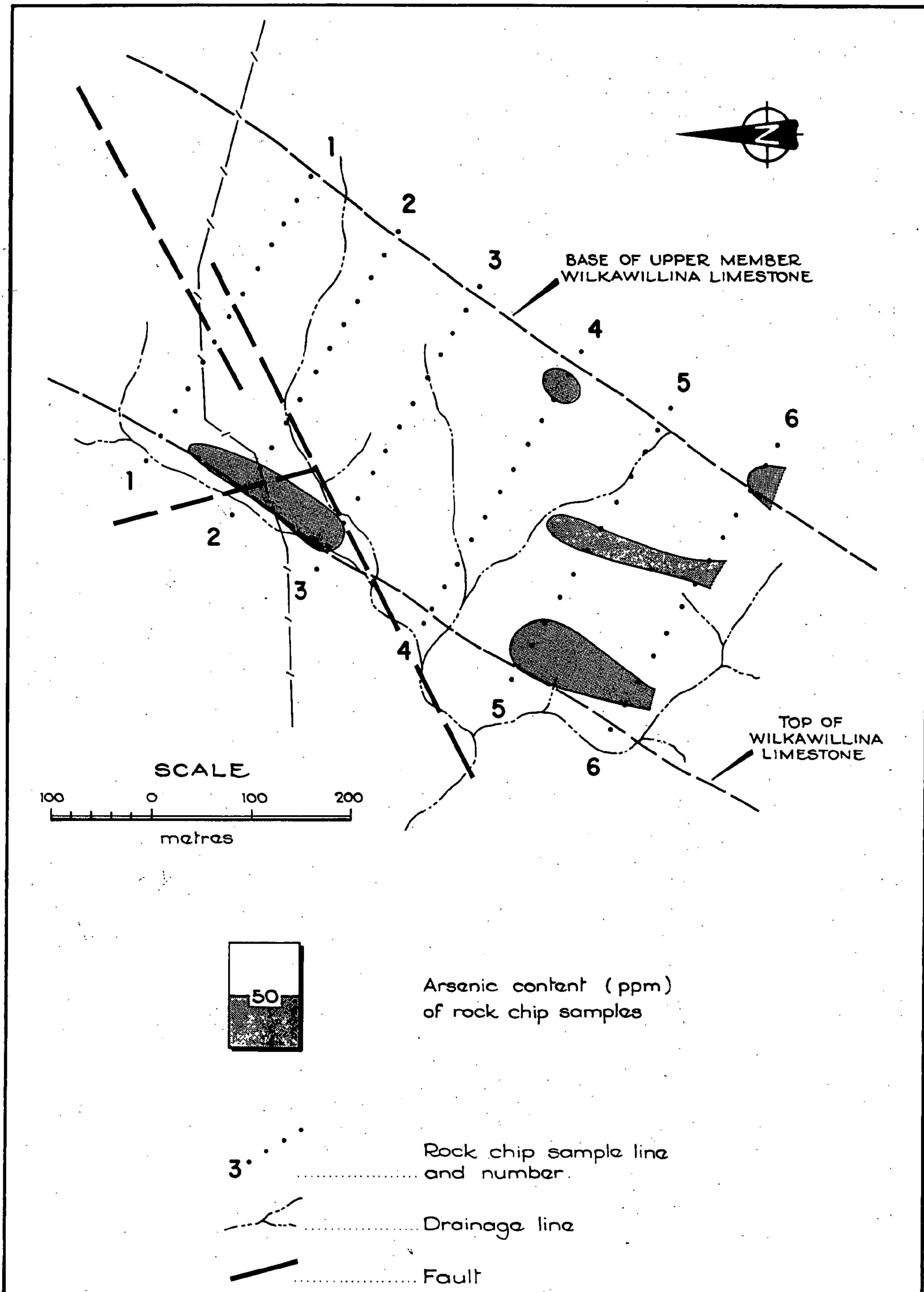



Figure ..... 27

| DEPARTMENT OF MINES AND ENERGY<br>SOUTH AUSTRALIA | COMPILED<br>B. Morris | [illegible] CDO   26·6·86 DATE |
|---|---|---|
| BASE METAL EXPLORATION<br>FLINDERS RANGES NATIONAL PARK | DRAWN<br>M. R. | SCALE 1 : 5000 |
| **CAMP PROSPECT** | DATE<br>May '86 | PLAN NUMBER |
| **ARSENIC CONTOURS - ROCK CHIP SAMPLE RESULTS** | CHECKED | **S 18707** |

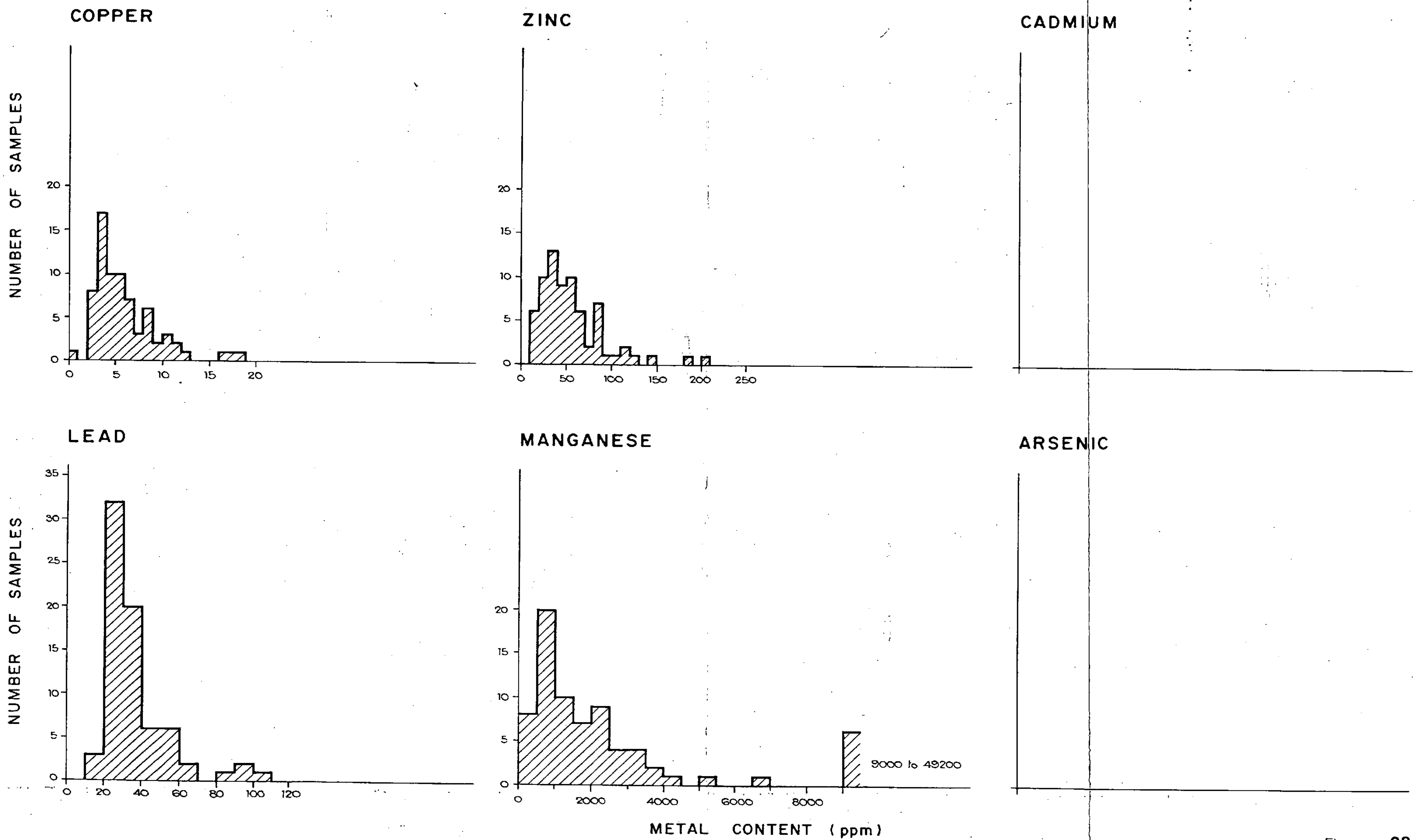



Figure ...... 28

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

CAMP PROSPECT - Rock chip samples
FREQUENCY DISTRIBUTION GRAPHS OF METAL CONTENT

| | |
|---|---|
| COMPILED B. Morris | C.D.O. 26-6-86 DATE |
| DRAWN M.R. | SCALE Graph |
| DATE March '86 | PLAN NUMBER 86 - 247 |
| CHECKED | |

4018

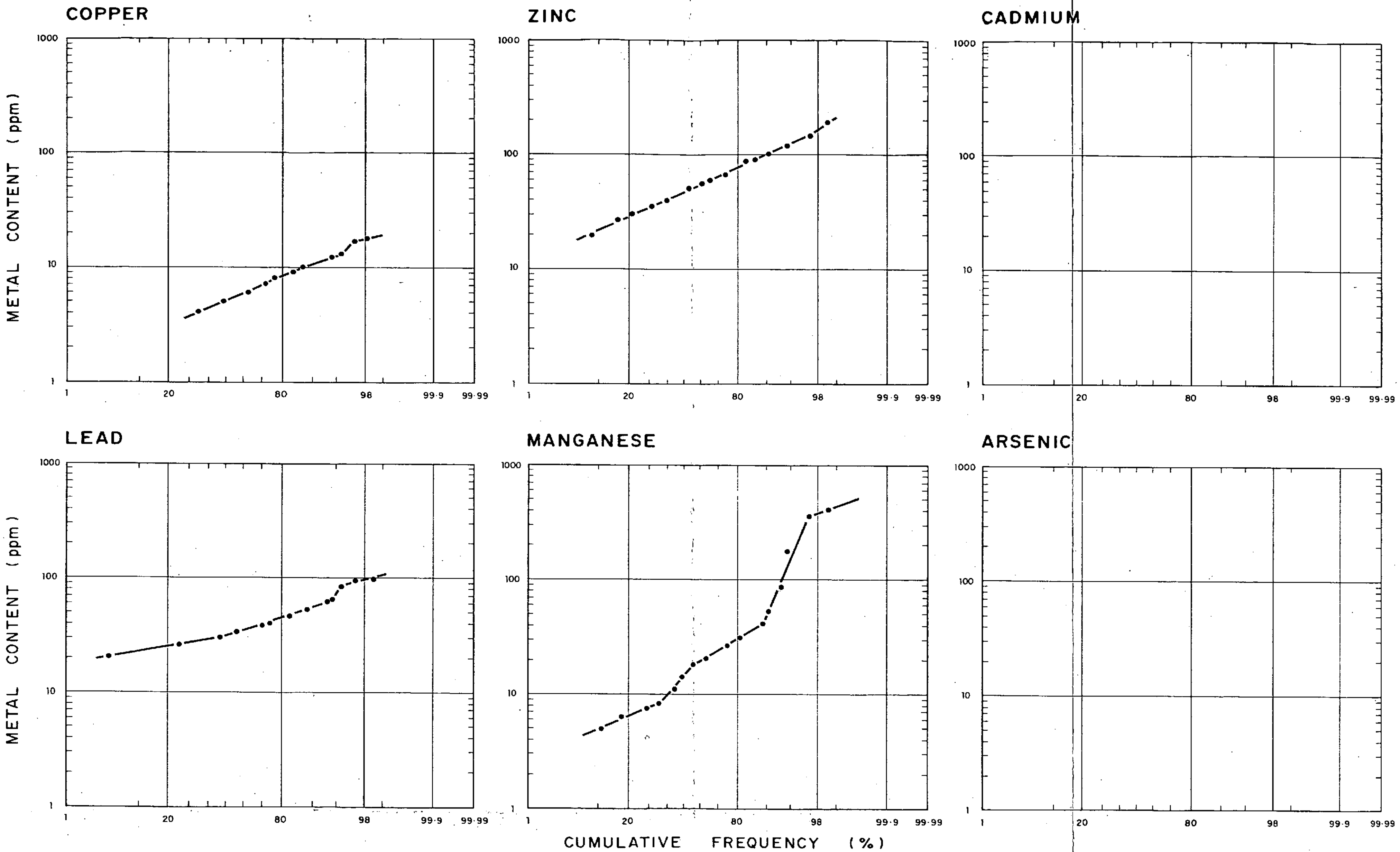



Figure...... 29

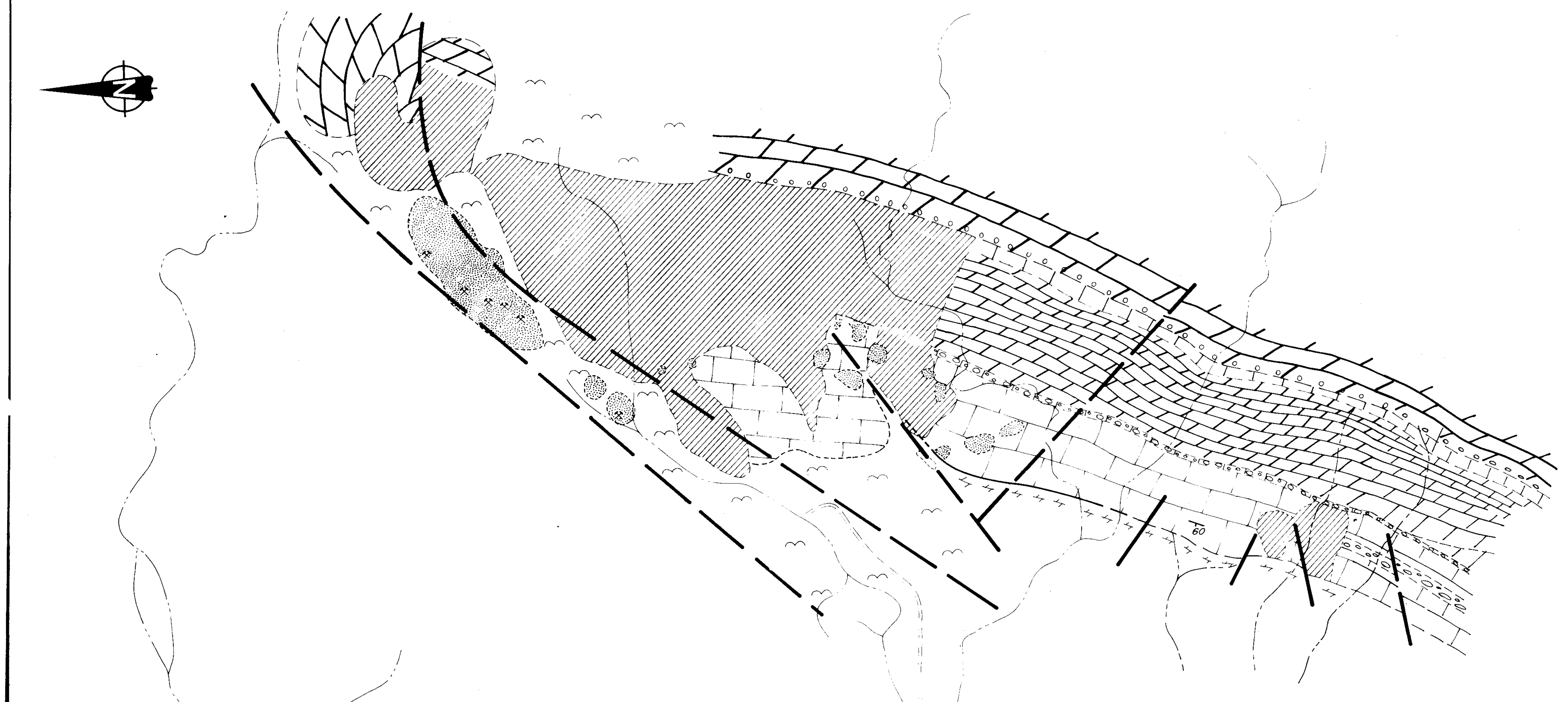
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

**CAMP PROSPECT – Rock chip samples**

**LOG PROBABILITY GRAPHS OF METAL CONTENT**

| | | | |
|---|---|---|---|
| COMPILED B. Morris | C.D.O. | 26·6·86 DATE | |
| DRAWN M.R. | SCALE Graph | | |
| DATE March '86 | PLAN NUMBER | | |
| CHECKED | 86 - 248 | | |




REFERENCE

**QUATERNARY**
Alluvial and colluvial deposits.

**CAMBRIAN**
Hawker Group
PARARA LIMESTONE: Dark grey flaggy and silty limestone with interbedded shale.
WILKAWILLINA LIMESTONE:
Upper Member: Palaeosurface at top marked by laminated red-brown recrystallized calcrete crust, then massive light grey limestone with archaeocyathids and brachiopods, also nodular limestone bed and off-white porous calc-dolomite and massive light grey limestone at base.
Lower Member: Dark grey nodular limestone then dark grey-brown bedded sandy dolomite with algal and oolitic beds.

Dolomitisation

Manganese oxides

Fault

Drainage Lines

Track

Manganese pit, open cut

Strike and dip of bedding 60

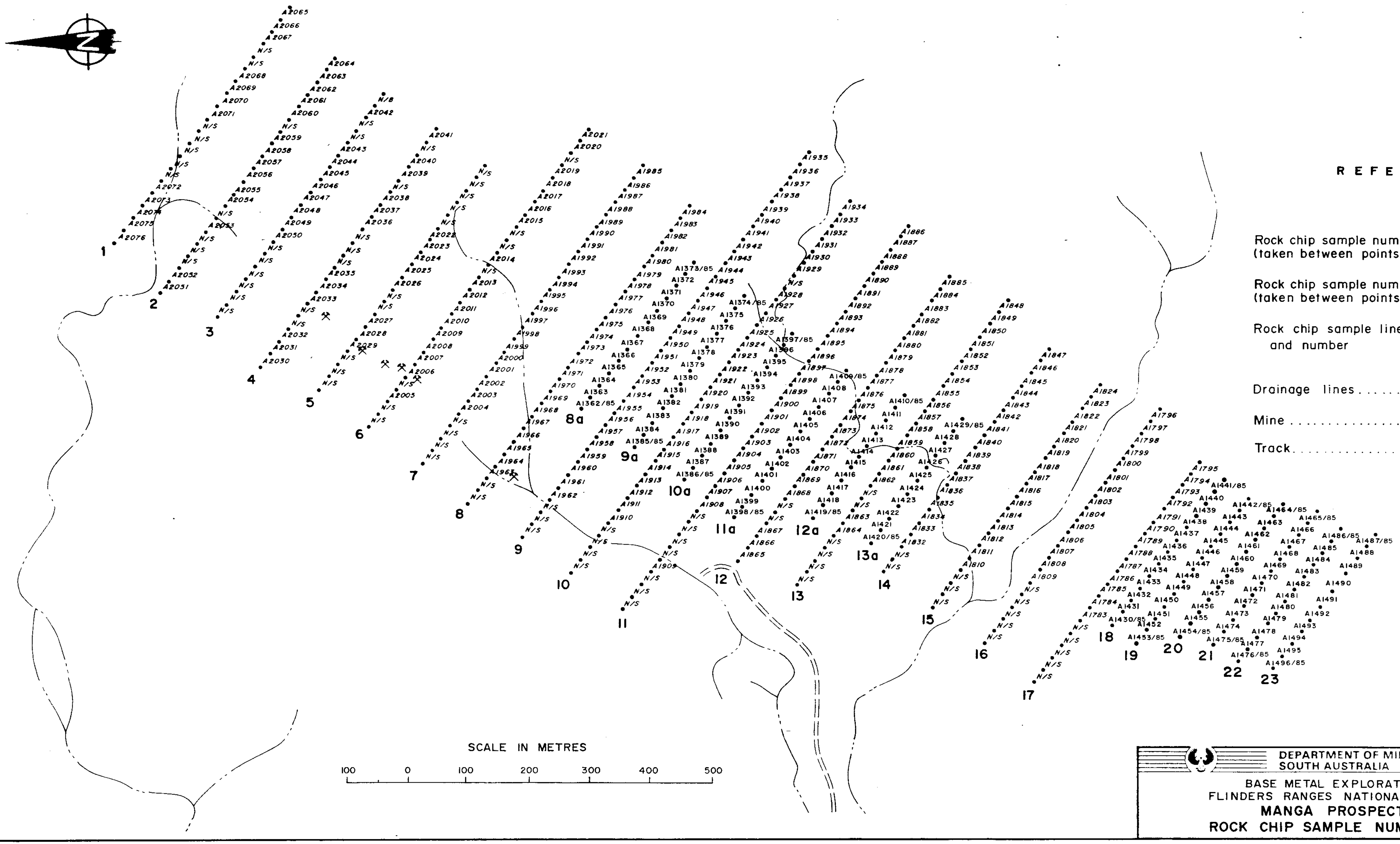
SCALE IN METRES

100 0 100 200 300 400 500

Note: For location of area see FIG. 2, PLAN No. S18319

FIG. 30

| | | |
|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | C.D.O. 10-12-85 DATE |
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK **MANGA PROSPECT** GEOLOGICAL PLAN | DRAWN E. Calabio | SCALE 1:5000 |
| | DATE May '85 | PLAN NUMBER |
| | CHECKED | **85-472** |




## REFERENCE

| | |
|---|---|
| Rock chip sample numbers - 1984 (taken between points) | A1963 |
| Rock chip sample numbers - 1985 (taken between points) | A1386/85 |
| Rock chip sample line and number | 8 |
| Drainage lines | |
| Mine | |
| Track | ⚒ |

FIG. 31

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
**MANGA PROSPECT**
**ROCK CHIP SAMPLE NUMBERS**

| | |
|---|---|
| COMPILED B. Morris | C.D.O. DATE |
| DRAWN E. Calabio | SCALE 1: 5000 |
| DATE May '85 | PLAN NUMBER |
| CHECKED | 85-473 |

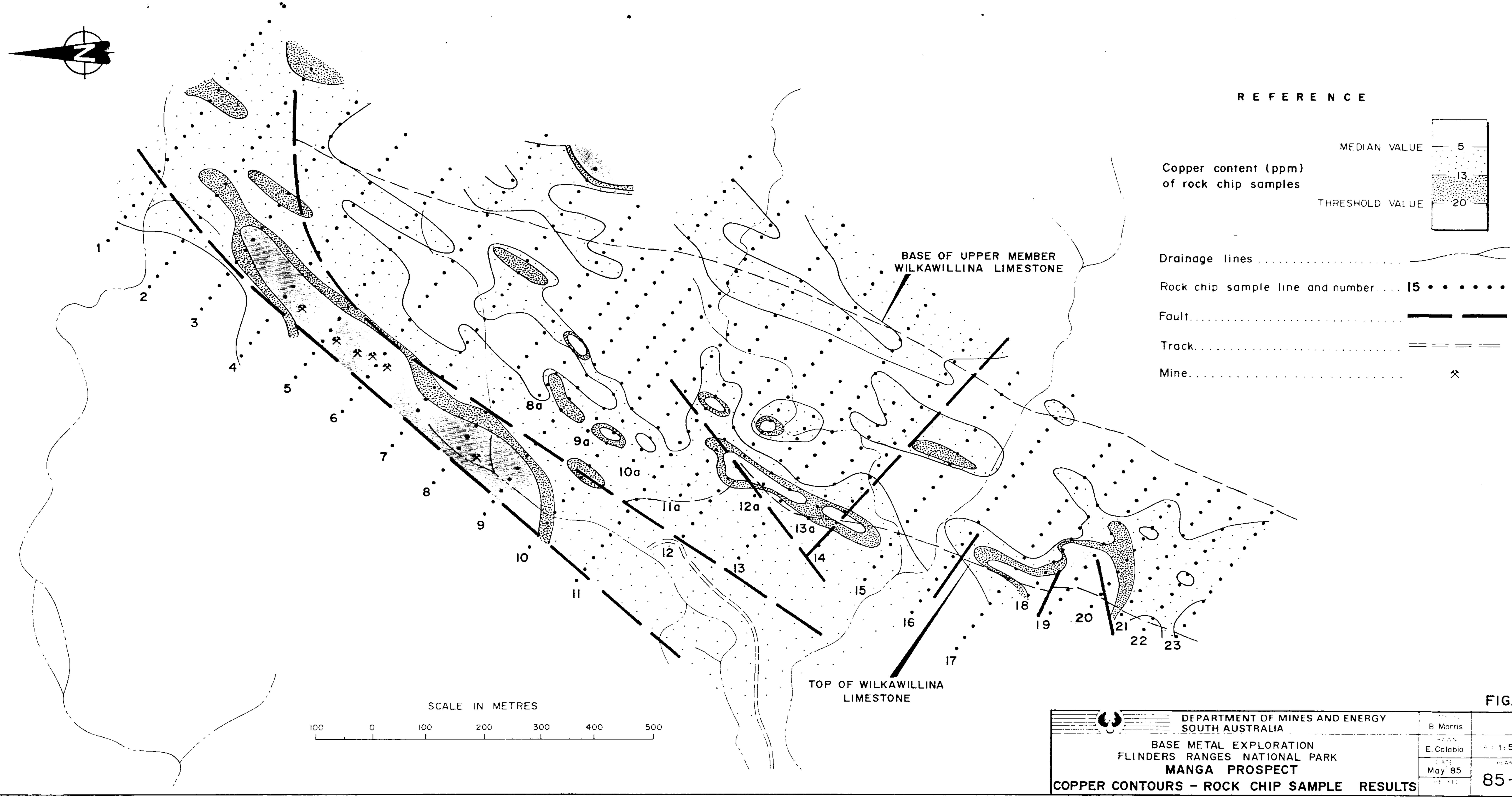



FIG. 32

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
**MANGA PROSPECT**
**COPPER CONTOURS – ROCK CHIP SAMPLE RESULTS**

B Morris | E. Calabio | May '85 | 1:5000 | 85-474

3733

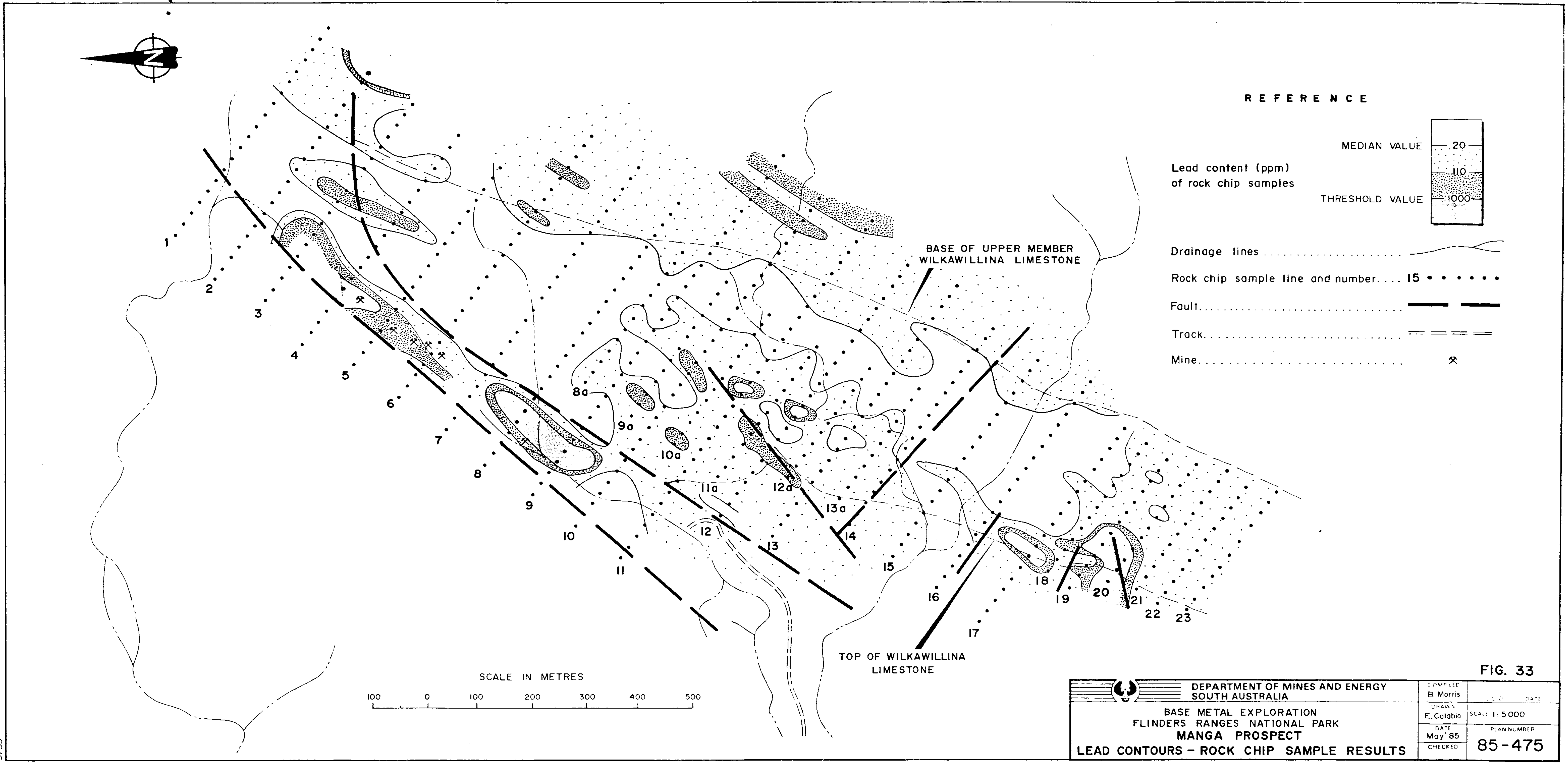



FIG. 33

| | | |
|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | DATE |
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN E. Calabio | SCALE 1:5000 |
| MANGA PROSPECT | DATE May '85 | PLAN NUMBER |
| LEAD CONTOURS – ROCK CHIP SAMPLE RESULTS | CHECKED | 85-475 |

3733

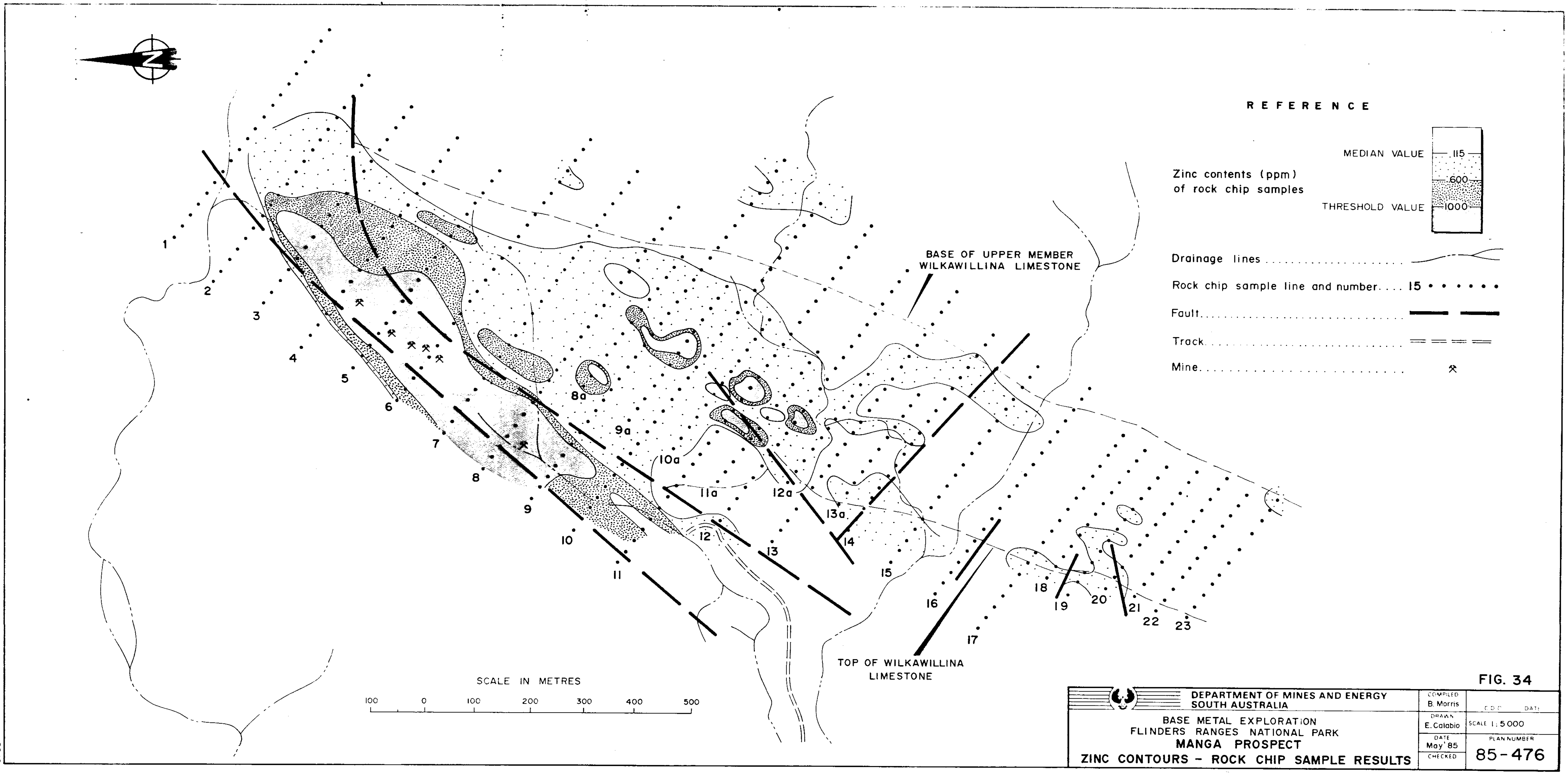



FIG. 34

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
**MANGA PROSPECT**
**ZINC CONTOURS - ROCK CHIP SAMPLE RESULTS**

| | | |
|---|---|---|
| COMPILED B. Morris | | |
| DRAWN E. Calabio | SCALE 1:5000 | |
| DATE May '85 | PLAN NUMBER | |
| CHECKED | 85-476 | |

3733

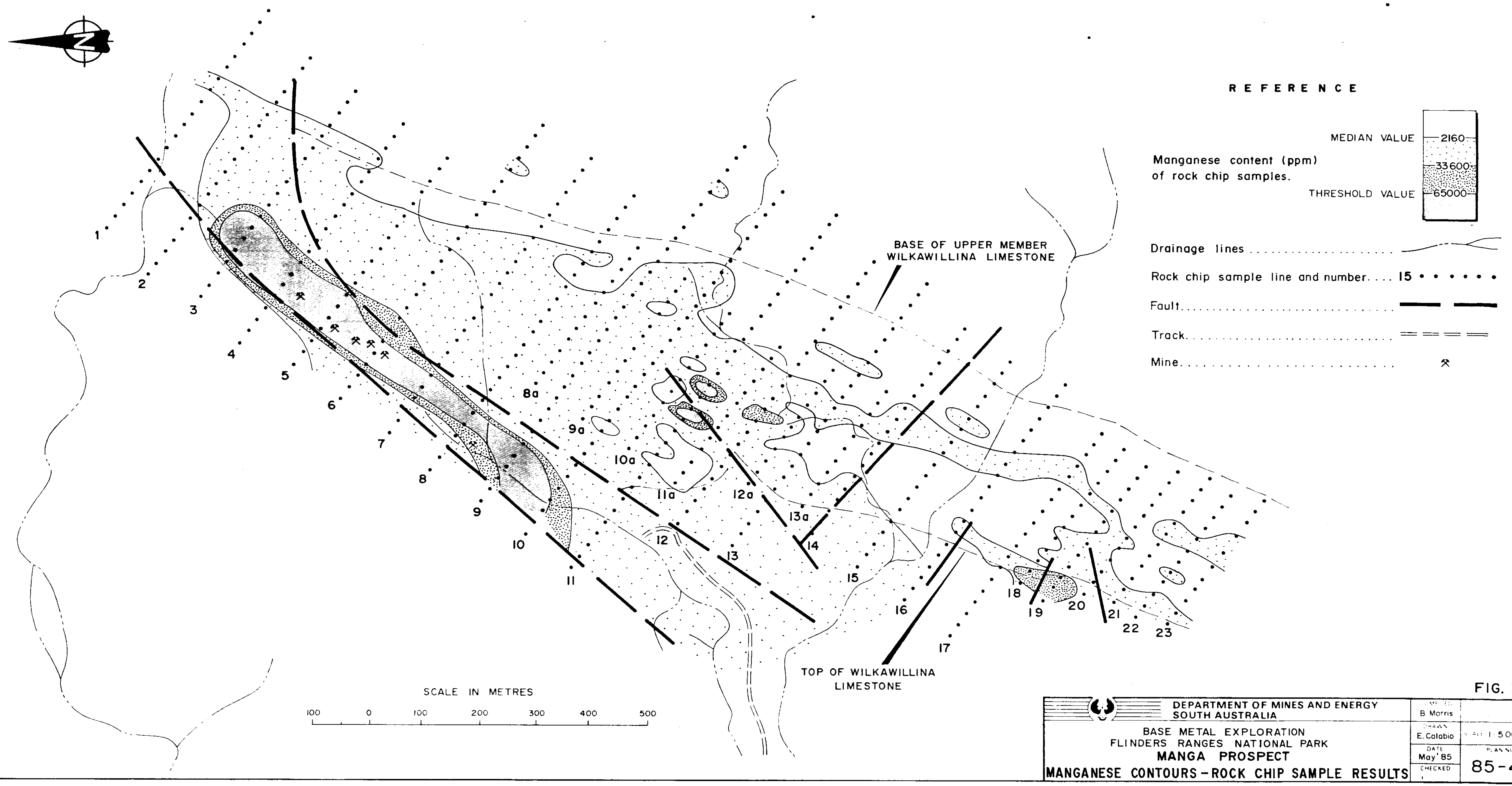



FIG. 35

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
**MANGA PROSPECT**
**MANGANESE CONTOURS - ROCK CHIP SAMPLE RESULTS**

| | |
|---|---|
| COMPILED B. Morris | |
| DRAWN E. Calabio | SCALE 1:5000 |
| DATE May '85 | PLAN NUMBER |
| CHECKED | 85-477 |

3733

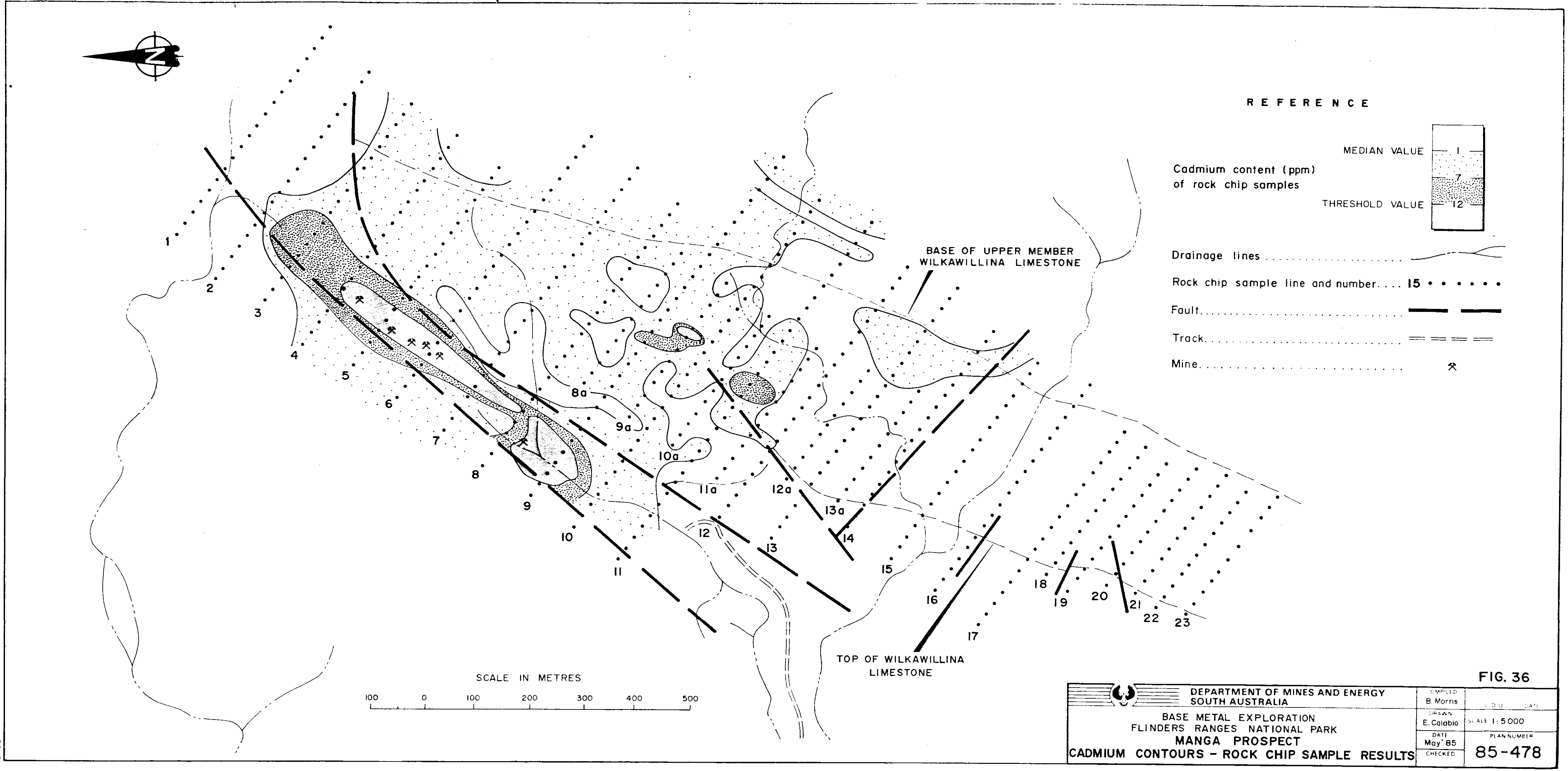



FIG. 36

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | |
|---|---|---|
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN E. Calabio | SCALE 1:5000 |
| MANGA PROSPECT CADMIUM CONTOURS - ROCK CHIP SAMPLE RESULTS | DATE May '85 | PLAN NUMBER 85-478 |
| | CHECKED | |

3733

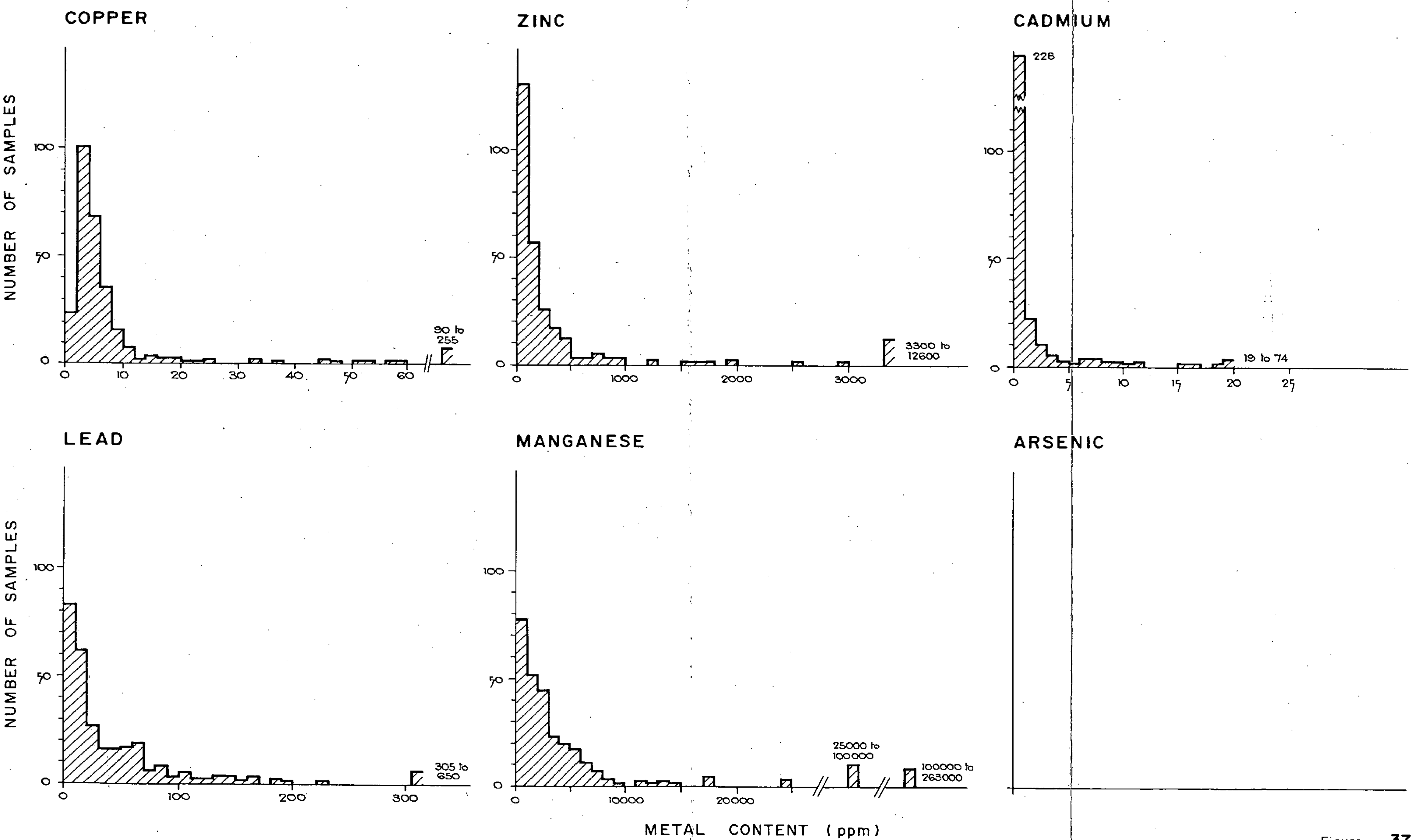



Figure ...... 37

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
**MANGA PROSPECT** – Rock chip samples
FREQUENCY DISTRIBUTION GRAPHS OF METAL CONTENT

| | | |
|---|---|---|
| COMPILED B. Morris | C.D.O. | DATE 26·6·86 |
| DRAWN M.R. | SCALE Graph | |
| DATE March '86 | PLAN NUMBER | 86 - 249 |
| CHECKED | | |

3408

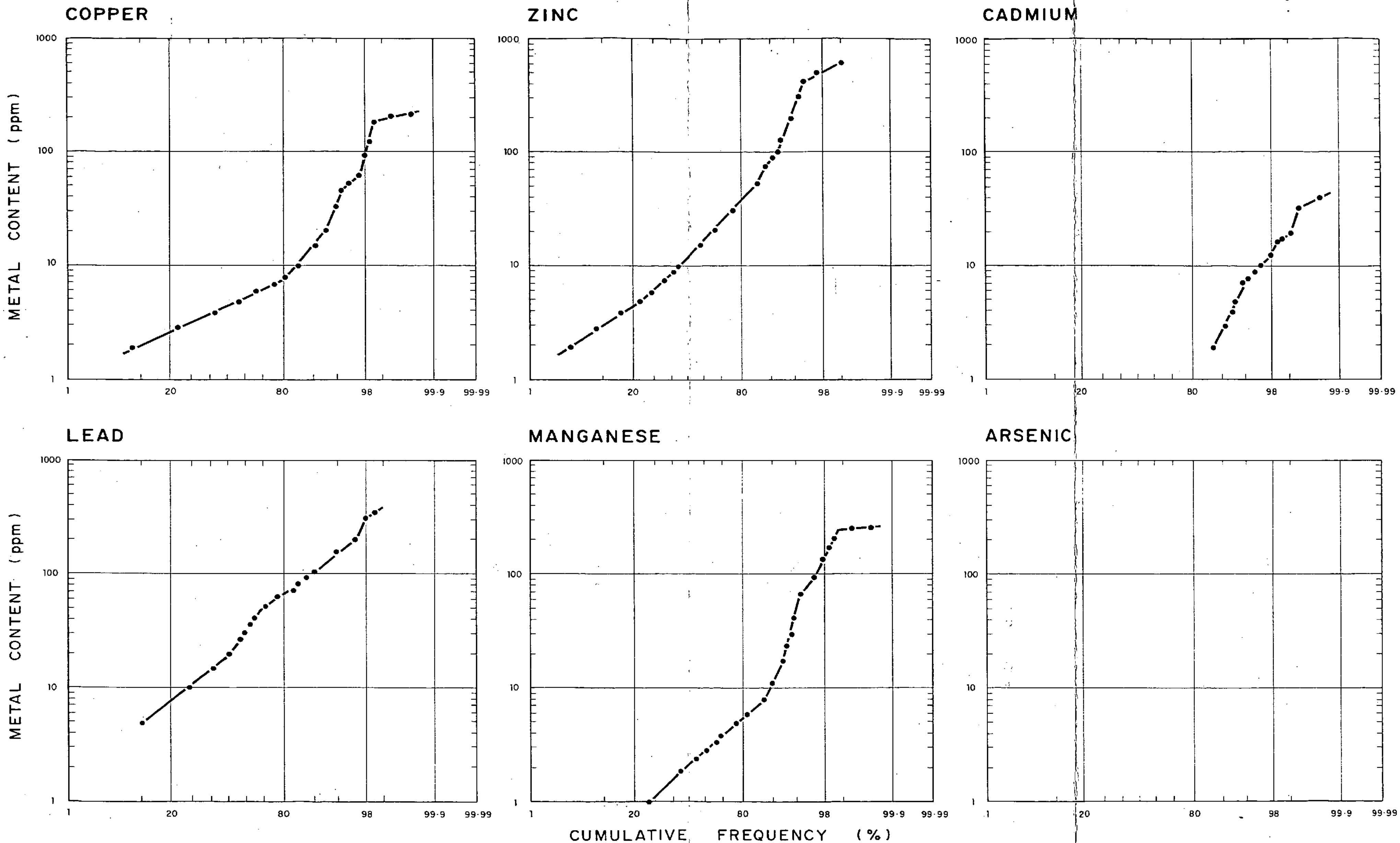
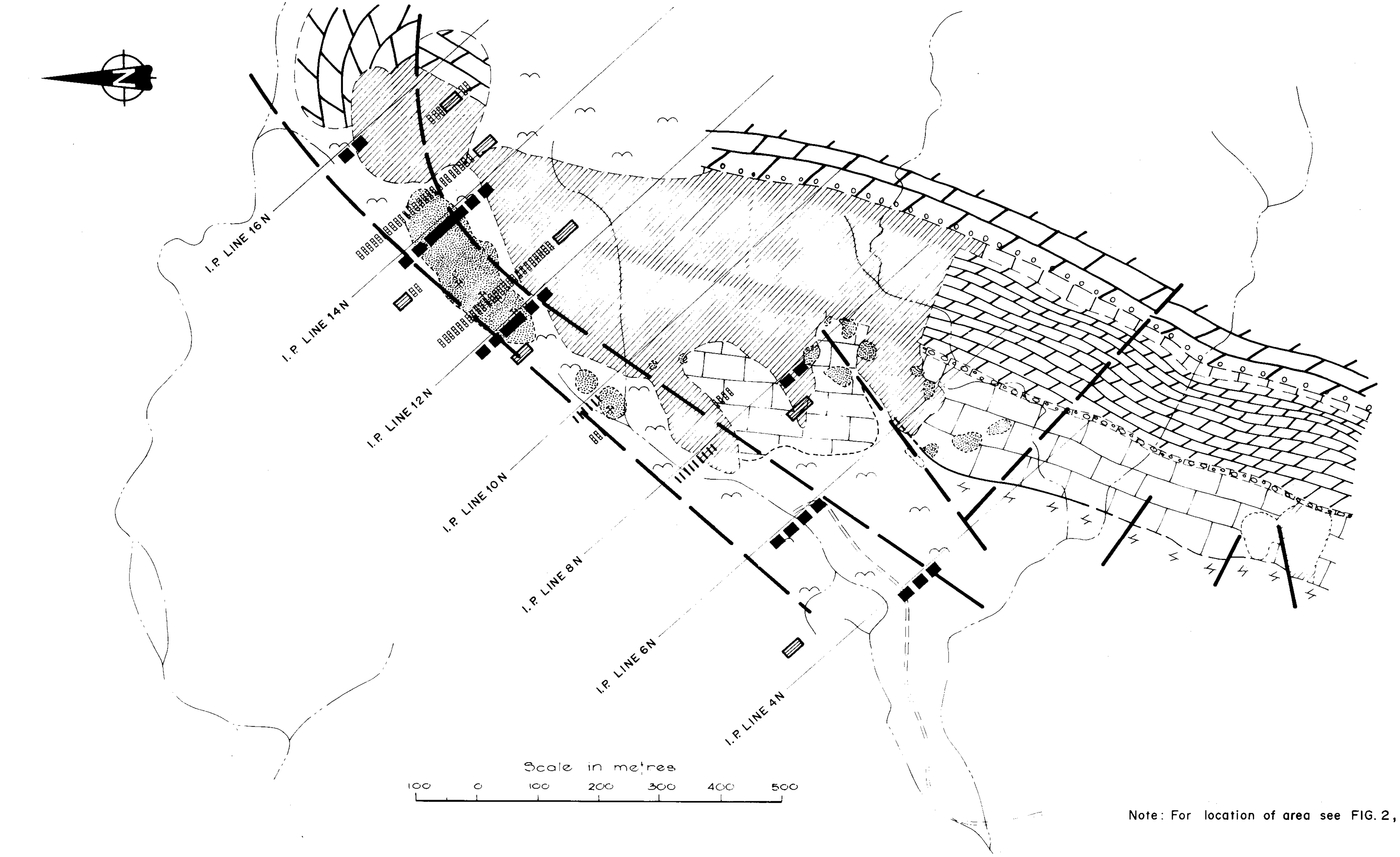



Figure 38

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | C D*O 26·6·86 DATE |
|---|---|---|
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M.R. | SCALE Graph |
| MANGA PROSPECT - Rock chip samples LOG PROBABILITY GRAPHS OF METAL CONTENT | DATE March '86 | PLAN NUMBER 86 - 250 |
| | CHECKED | |




**REFERENCE**

**QUATERNARY**
Alluvial and colluvial deposits.

**CAMBRIAN**
Hawker Group
PARARA LIMESTONE: Dark grey flaggy and silty limestone with interbedded shale.
WILKAWILLINA LIMESTONE:
Upper Member: Palaeosurface at top marked by laminated red-brown recrystallized calcrete crust, then massive light grey limestone with archaeocyathids and brachiopods, also nodular limestone bed and off-white porous calc-dolomite and massive light grey limestone at base.
Lower Member: Dark grey nodular limestone then dark grey-brown bedded sandy dolomite with algal and oolitic beds.

Dolomitisation

Manganese oxides

Fault

Drainage Lines

Track

Definite I.P anomaly

Probable I.P anomaly

Possible I.P anomaly

Strong sirotem anomaly

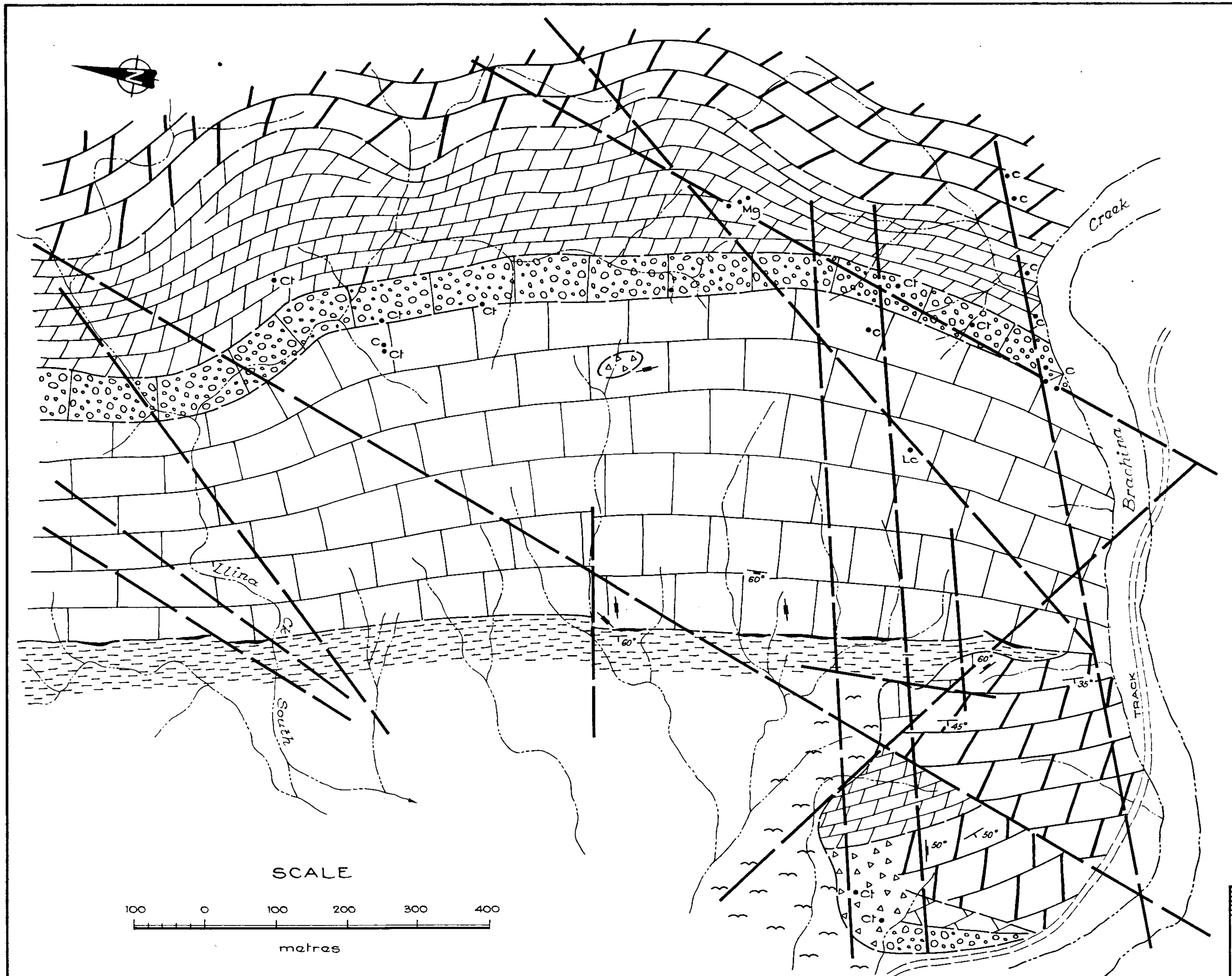
Weak sirotem anomaly

Note: For location of area see FIG. 2, PLAN No. S18319

FIG. 39

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED D. Ivic | C.D.O. 10.12.85 DATE |
|---|---|---|
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK **MANGA PROSPECT** GEOPHYSICAL RESULTS | DRAWN E. Calabio | SCALE As shown |
| | DATE May '85 | PLAN NUMBER |
| | CHECKED | 85-479 |

340G




**QUATERNARY**
Alluvial and colluvial deposits.

**CAMBRIAN**
BILLY CREEK FORMATION: Basal dolomite and flaggy limestone followed by red and green shales.

Hawker Group
WILKAWILLINA LIMESTONE:
Upper Member - Palaeosurface at top marked by laminated red-brown recrystallized calcrete crust, then massive light grey limestone with archaeocyathans and brachiopods, nodular limestone and off-white coloured porous calc-dolomite near base.
Lower Member - Dark grey-brown bedded sandy dolomite with algal and oolitic beds.

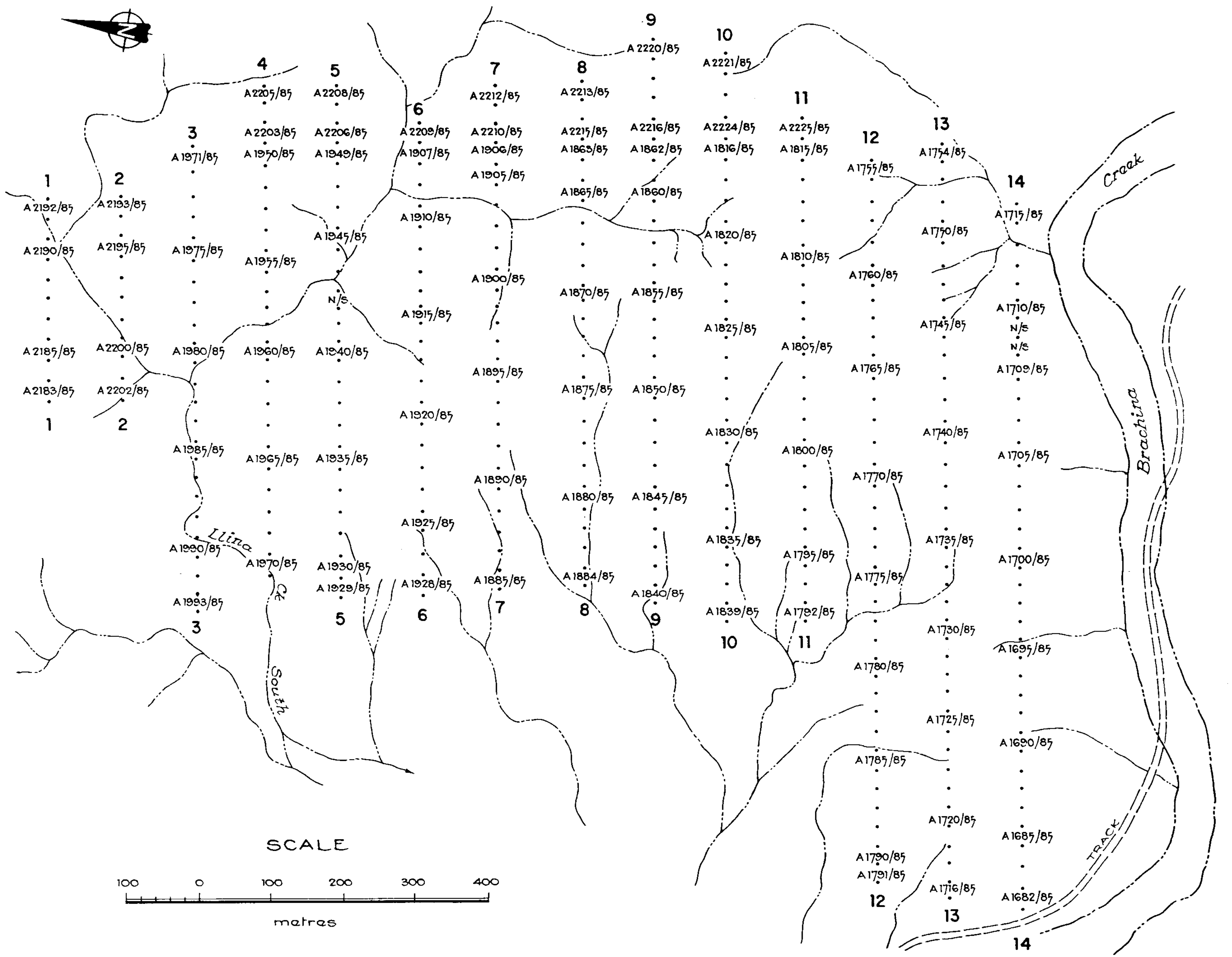
Breccia

Strike and dip of bedding ........ 50°
Inclined jointing ........ 60°
Vertical jointing ........
Fault ........
Laminar calcrete and calcite ........ • Lc
Coarse calcite crystals ........ • Ct
Magnesite ........ • Mg
Cave ........ • C
Drainage lines ........

NOTE: For location of prospect see plan no. S 18319 (Fig. 2)

Figure.... 40

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | C.D.O. 26.6.86 DATE |
|---|---|---|
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M.R. | SCALE 1 : 5000 |
| LLINA PROSPECT GEOLOGICAL PLAN | DATE March '86 | PLAN NUMBER 86 - 207 |
| | CHECKED | |




## REFERENCE

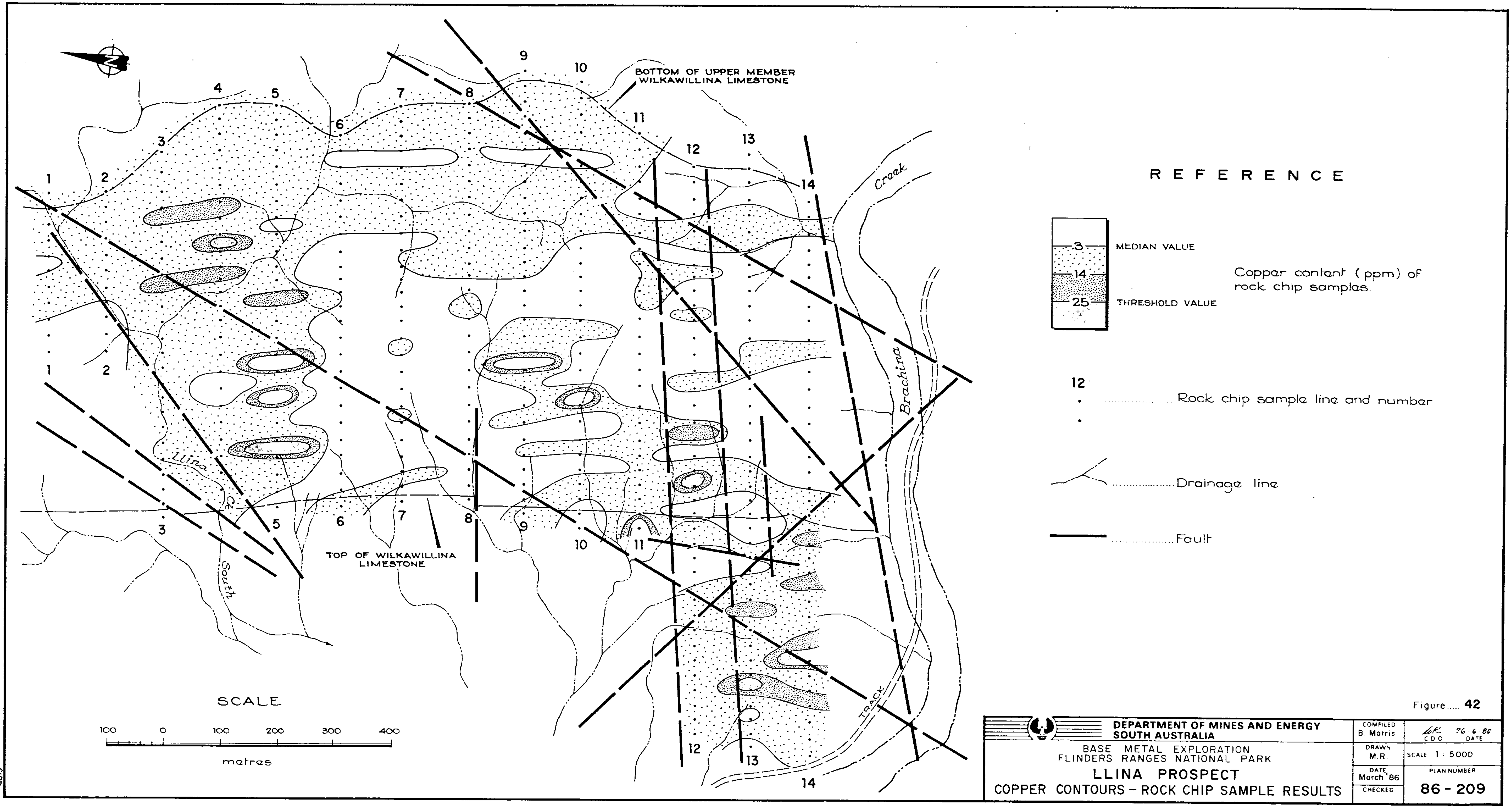
12 — Rock chip sample line and number

A1710/85 ............ Rock chip sample number (samples taken between line points).

............ Drainage line.

Figure 41

| | | | |
|---|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | CDO 26·6·86 DATE | |
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M.R. | SCALE 1 : 5000 | |
| **LLINA PROSPECT** ROCK CHIP SAMPLE LOCATIONS | DATE March '86 | PLAN NUMBER 86 - 208 | |
| | CHECKED | | |


BOTTOM OF UPPER MEMBER
WILKAWILLINA LIMESTONE
TOP OF WILKAWILLINA
LIMESTONE
Llina
South
Creek
Brachina
TRACK
1 2 3 4 5 6 7 8 9 10 11 12 13 14
SCALE
100 0 100 200 300 400
metres
REFERENCE
3 MEDIAN VALUE
14
25 THRESHOLD VALUE
Copper content (ppm) of rock chip samples.
12 Rock chip sample line and number
Drainage line
Fault
Figure 42
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA
BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
LLINA PROSPECT
COPPER CONTOURS – ROCK CHIP SAMPLE RESULTS
COMPILED B. Morris
DRAWN M.R.
DATE March '86
CHECKED
CDO 26·6·86 DATE
SCALE 1 : 5000
PLAN NUMBER
86 - 209
4013

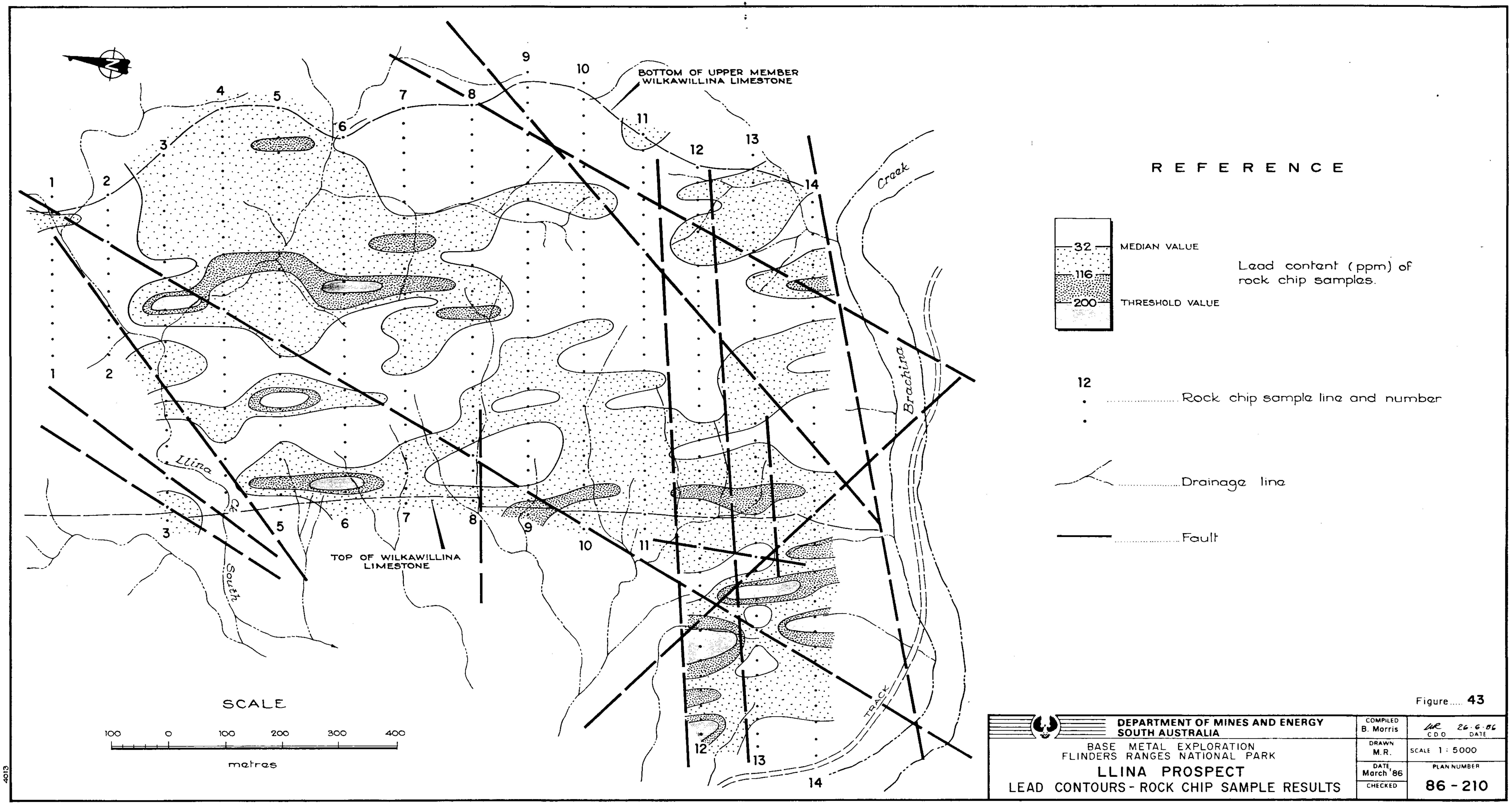



Figure 43

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

**LLINA PROSPECT**

**LEAD CONTOURS - ROCK CHIP SAMPLE RESULTS**

| | | | |
|---|---|---|---|
| COMPILED | B. Morris | WR C.D.O. | 26·6·86 DATE |
| DRAWN | M.R. | SCALE 1 : 5000 | |
| DATE | March '86 | PLAN NUMBER | |
| CHECKED | | 86 - 210 | |

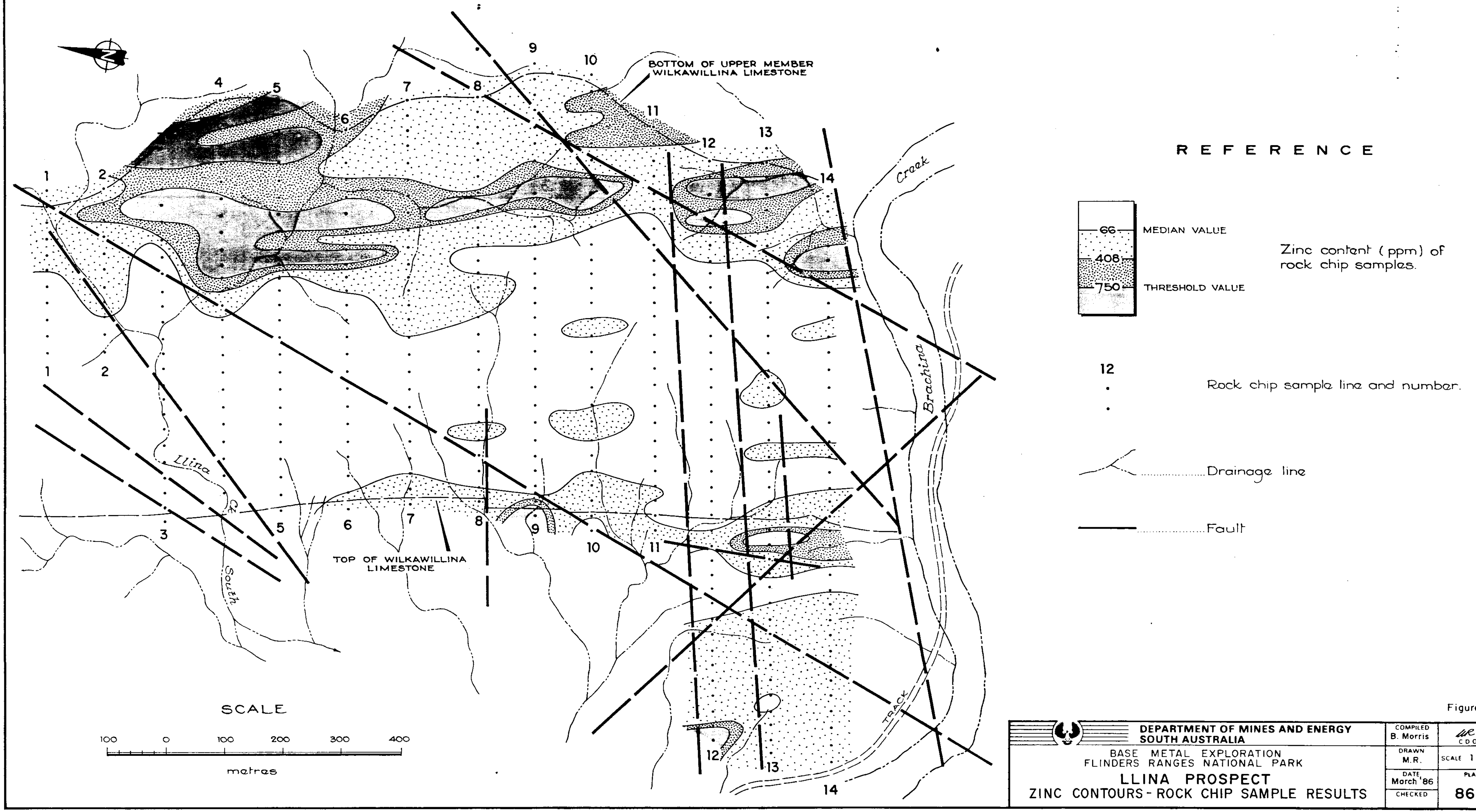



Figure 44

| | | |
|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | CDO 26·6·86 DATE |
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M.R. | SCALE 1 : 5000 |
| LLINA PROSPECT | DATE March '86 | PLAN NUMBER |
| ZINC CONTOURS - ROCK CHIP SAMPLE RESULTS | CHECKED | 86 - 211 |

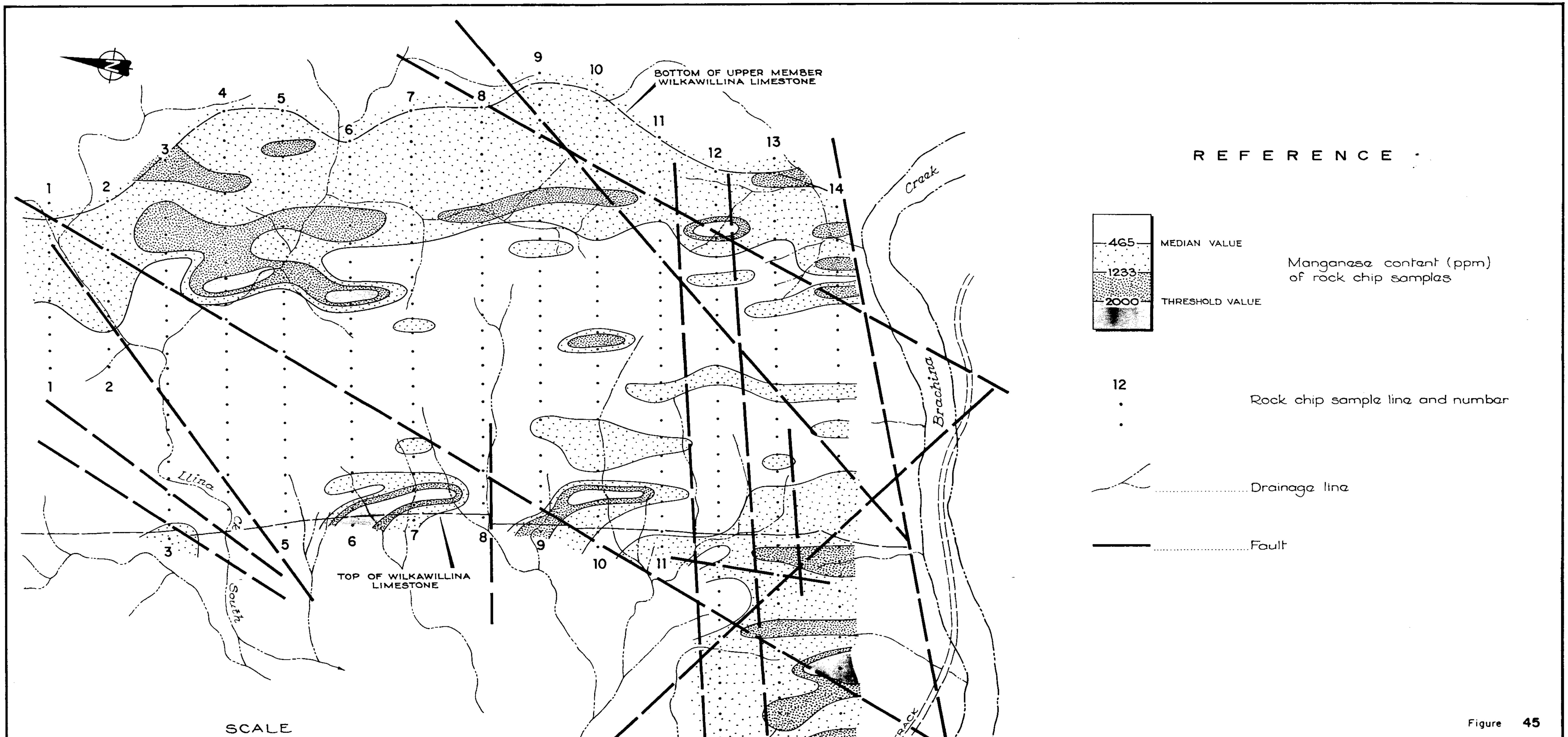



Figure 45

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

LLINA PROSPECT
MANGANESE CONTOURS - ROCK CHIP SAMPLE RESULTS

| | |
|---|---|
| COMPILED B. Morris | C.D.O. 26.6.86 DATE |
| DRAWN M.R | SCALE 1 : 5000 |
| DATE March '86 | PLAN NUMBER 86 - 212 |
| CHECKED | |

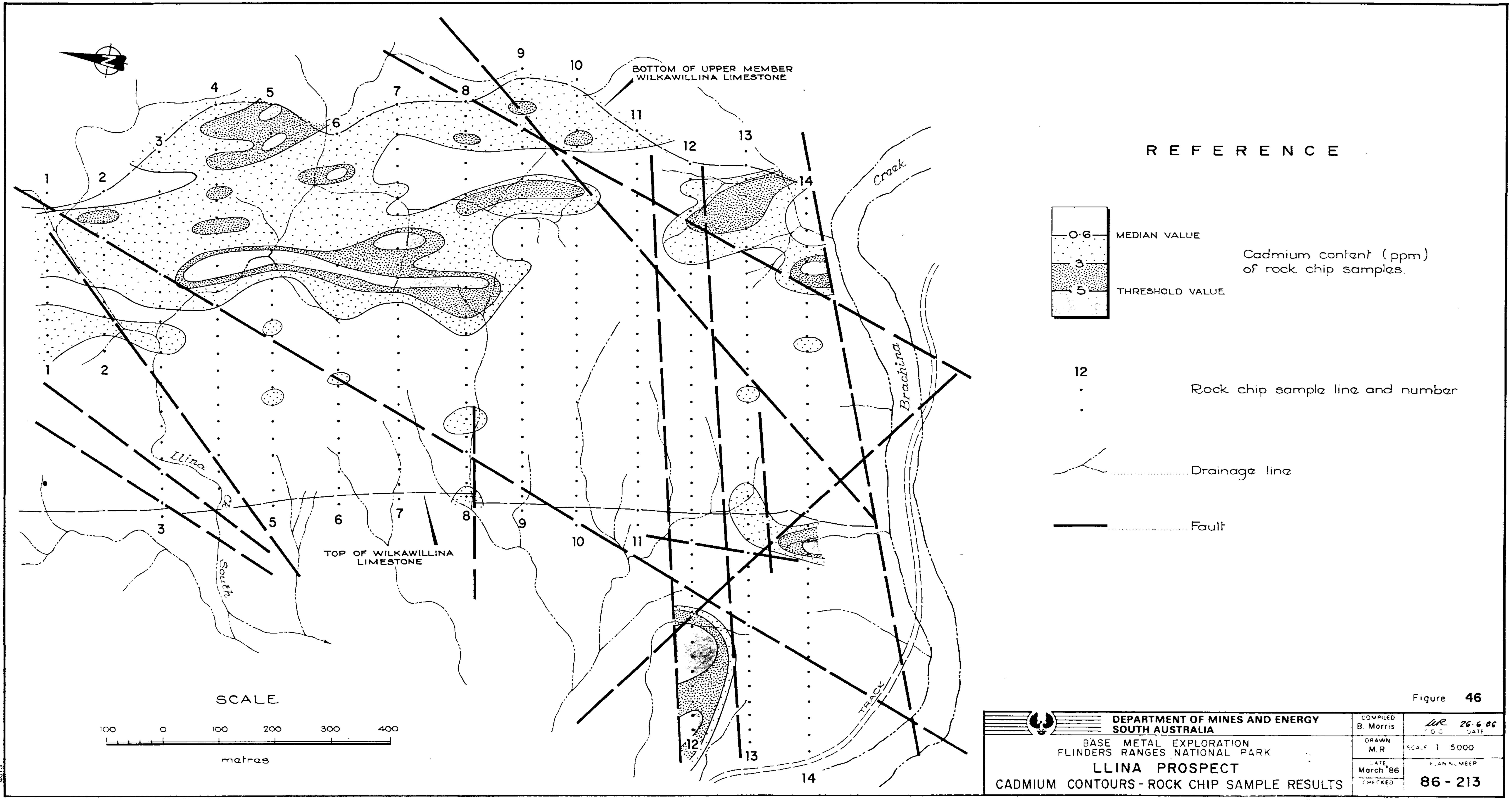

BOTTOM OF UPPER MEMBER
WILKAWILLINA LIMESTONE
TOP OF WILKAWILLINA
LIMESTONE
Llina
South
Creek
Brachina
TRACK
REFERENCE
0·6 MEDIAN VALUE
3
5 THRESHOLD VALUE
Cadmium content (ppm) of rock chip samples.
12
Rock chip sample line and number
Drainage line
Fault
SCALE
100 0 100 200 300 400
metres
4013
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA
BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
LLINA PROSPECT
CADMIUM CONTOURS - ROCK CHIP SAMPLE RESULTS
COMPILED B. Morris
DRAWN M.R
DATE March '86
CHECKED
26·6·86
SCALE 1 5000
PLAN NUMBER 86 - 213

Figure 46

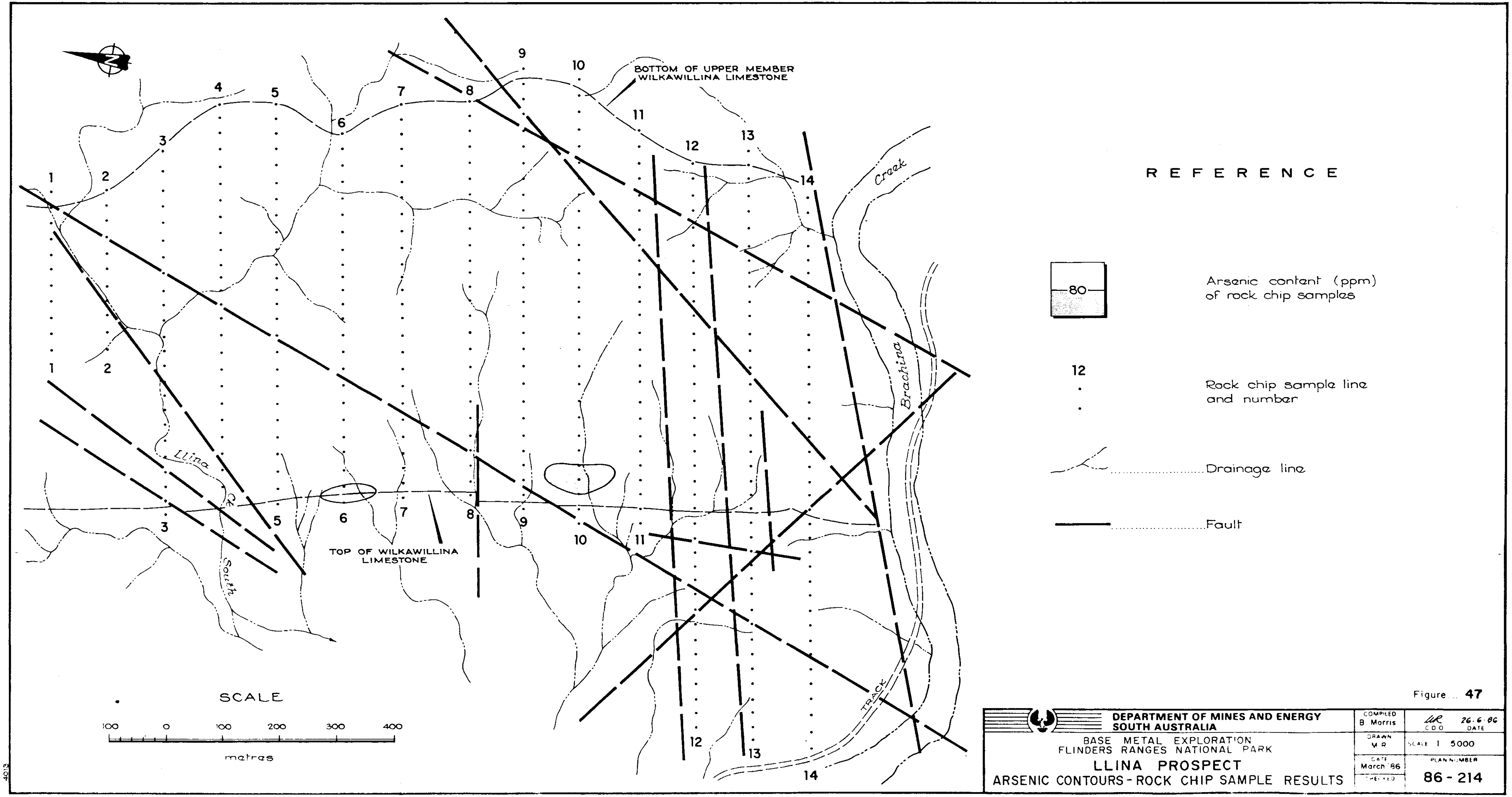

BOTTOM OF UPPER MEMBER WILKAWILLINA LIMESTONE
TOP OF WILKAWILLINA LIMESTONE
Llina Ck
South
Brachina Creek
TRACK
1 2 3 4 5 6 7 8 9 10 11 12 13 14
SCALE
100 0 100 200 300 400
metres
REFERENCE
80
Arsenic content (ppm) of rock chip samples
12
Rock chip sample line and number
Drainage line
Fault
DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA
BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
LLINA PROSPECT
ARSENIC CONTOURS - ROCK CHIP SAMPLE RESULTS
COMPILED B Morris
DRAWN M R
DATE March '86
CHECKED
C D O
26·6·86
DATE
SCALE 1 : 5000
PLAN NUMBER
86 - 214
4013

Figure 47

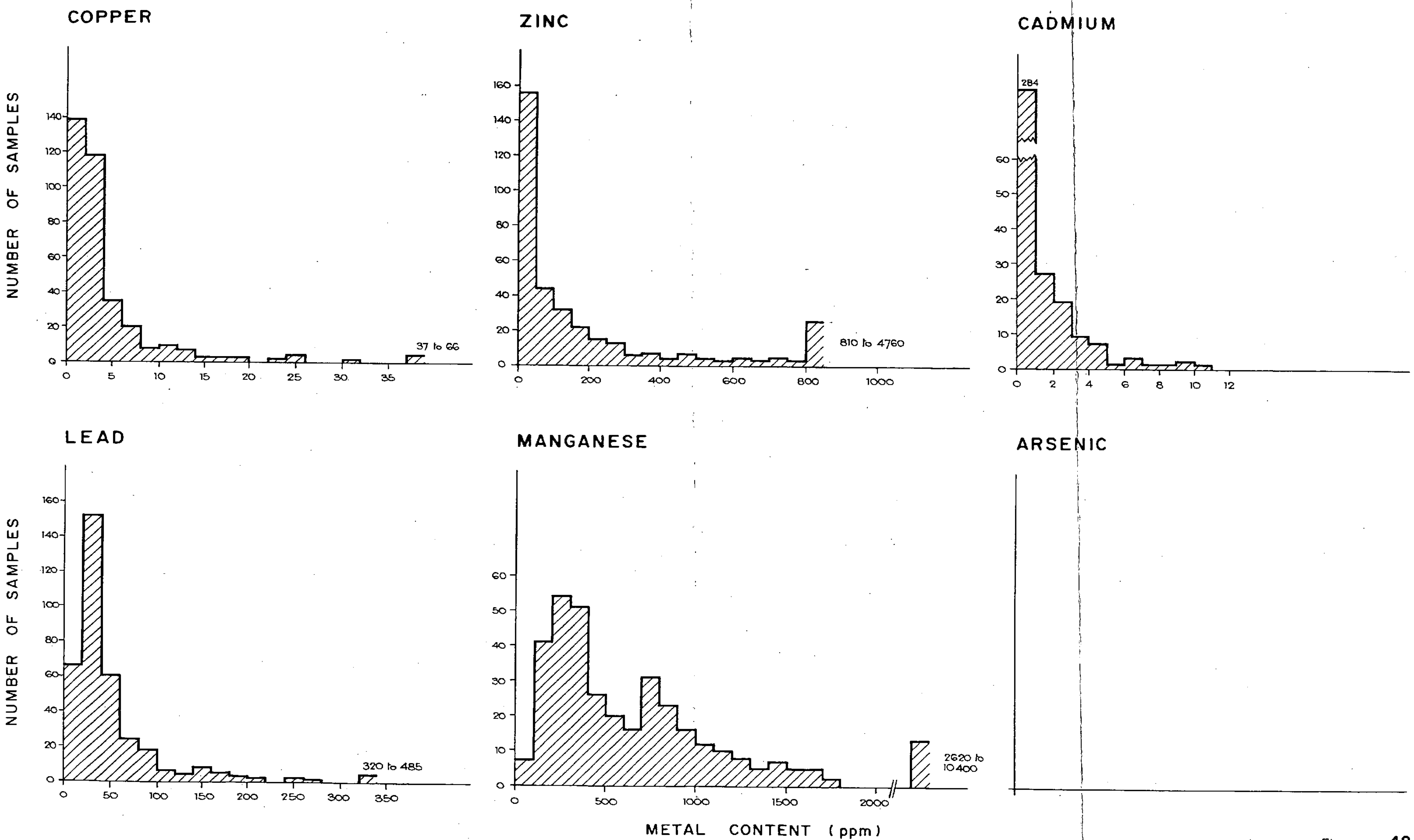



Figure ...... 48

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

**LLINA PROSPECT - Rock chip samples**
FREQUENCY DISTRIBUTION GRAPHS OF METAL CONTENT

| | | |
|---|---|---|
| COMPILED B. Morris | CDO 26.6.86 DATE | |
| DRAWN M.R. | SCALE Graph | |
| DATE March '86 | PLAN NUMBER 86 - 215 | |
| CHECKED | | |

4013

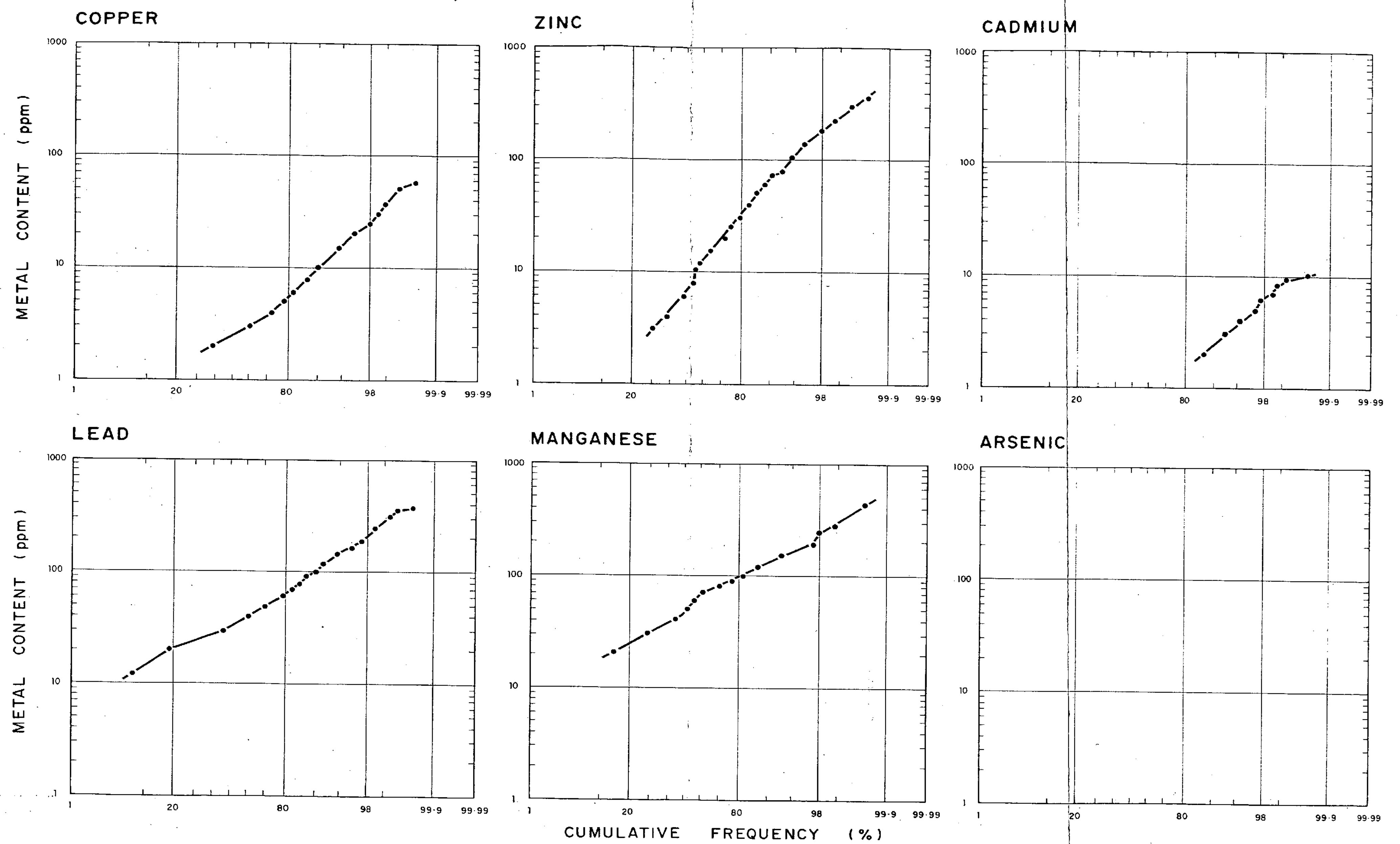



Figure 49

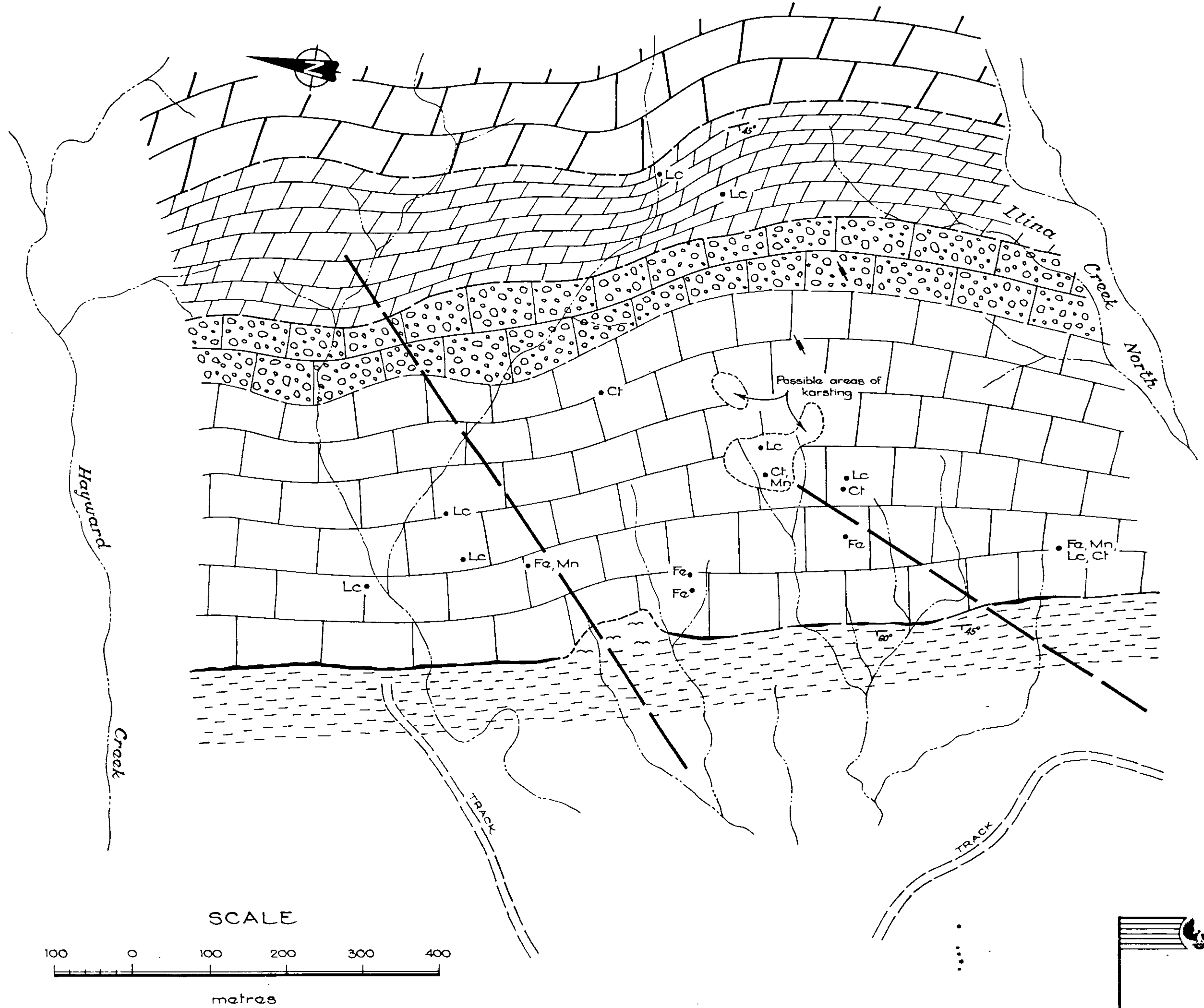
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

**LLINA PROSPECT - Rock chip samples**
LOG PROBABILITY GRAPHS OF METAL CONTENT

| | |
|---|---|
| COMPILED B. Morris | C.D.O. 26·6·86 DATE |
| DRAWN M.R. | SCALE Graph |
| DATE March '86 | PLAN NUMBER |
| CHECKED | 86 - 216 |

4013




**QUATERNARY**
Alluvial and colluvial deposits.

**CAMBRIAN**
BILLY CREEK FORMATION: Basal dolomite and flaggy limestone followed by red and green shales.

Hawker Group
WILKAWILLINA LIMESTONE:
Upper Member - Palaeosurface at top marked by laminated red-brown recrystallized calcrete crust, then massive light grey limestone with archaeocyathans and brachiopods, nodular limestone and off-white coloured porous calc-dolomite near base.
Lower Member - Dark grey-brown bedded sandy dolomite with algal and oolitic beds.

Strike and dip of bedding ........ 45°
Vertical jointing ........
Fault ........
Laminar calcrete and calcite ........ • Lc
Coarse calcite crystals ........ • Ct
Iron oxides ........ • Fe
Manganese oxides ........ • Mn
Drainage lines ........

NOTE: For location of prospect see plan no. S 18319 (Fig. 2)

Figure 50

| | | |
|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | MR C.O.O. 26·6·86 DATE |
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M.R. | SCALE 1:5000 |
| HAYWARD PROSPECT GEOLOGICAL PLAN | DATE March '86 | PLAN NUMBER 86-217 |

4013

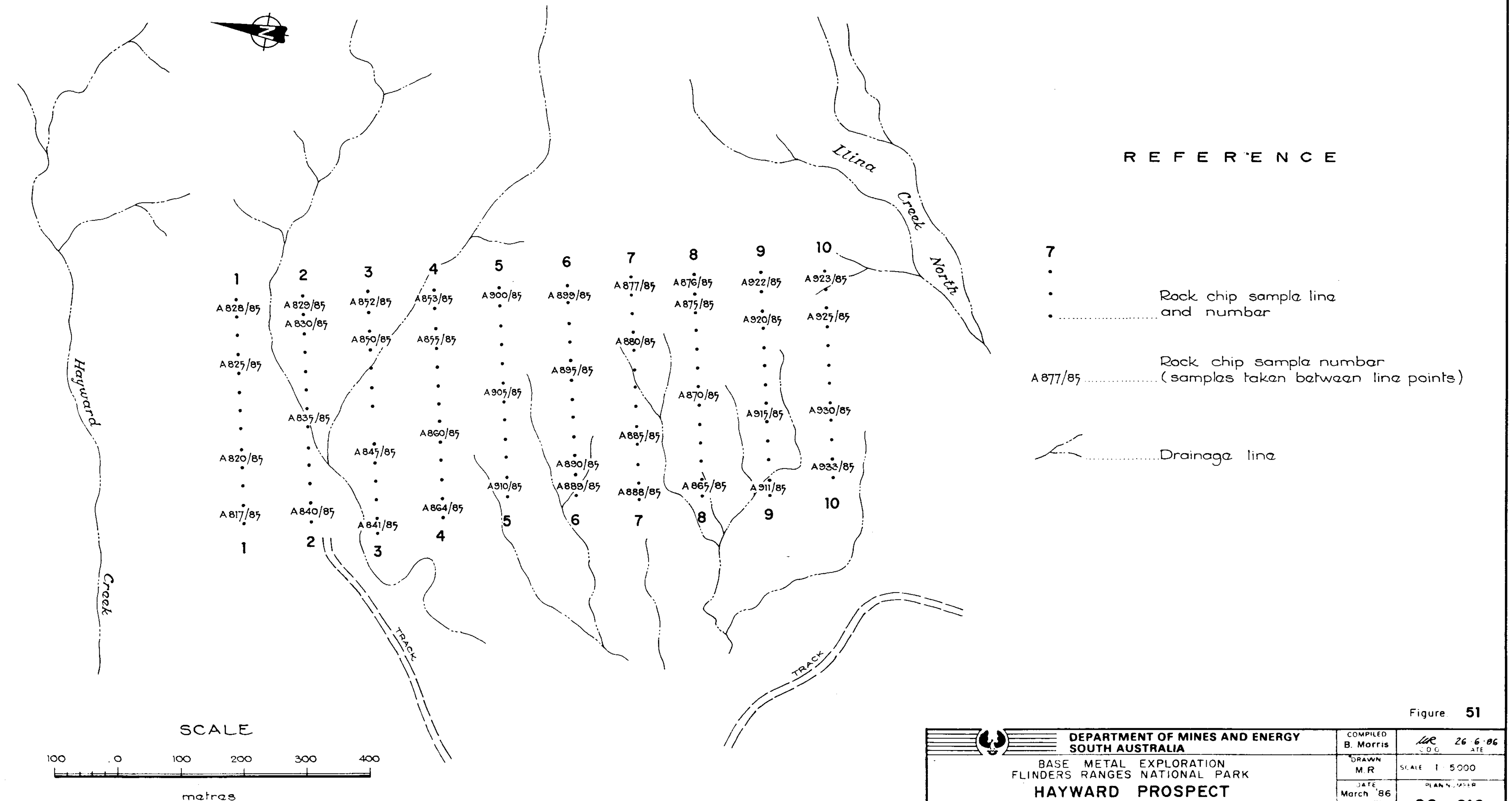



Figure 51

| | | |
|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | 26·6·86 |
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M.R | SCALE 1:5000 |
| HAYWARD PROSPECT ROCK CHIP SAMPLE LOCATIONS | DATE March '86 | PLAN NUMBER 86 - 218 |

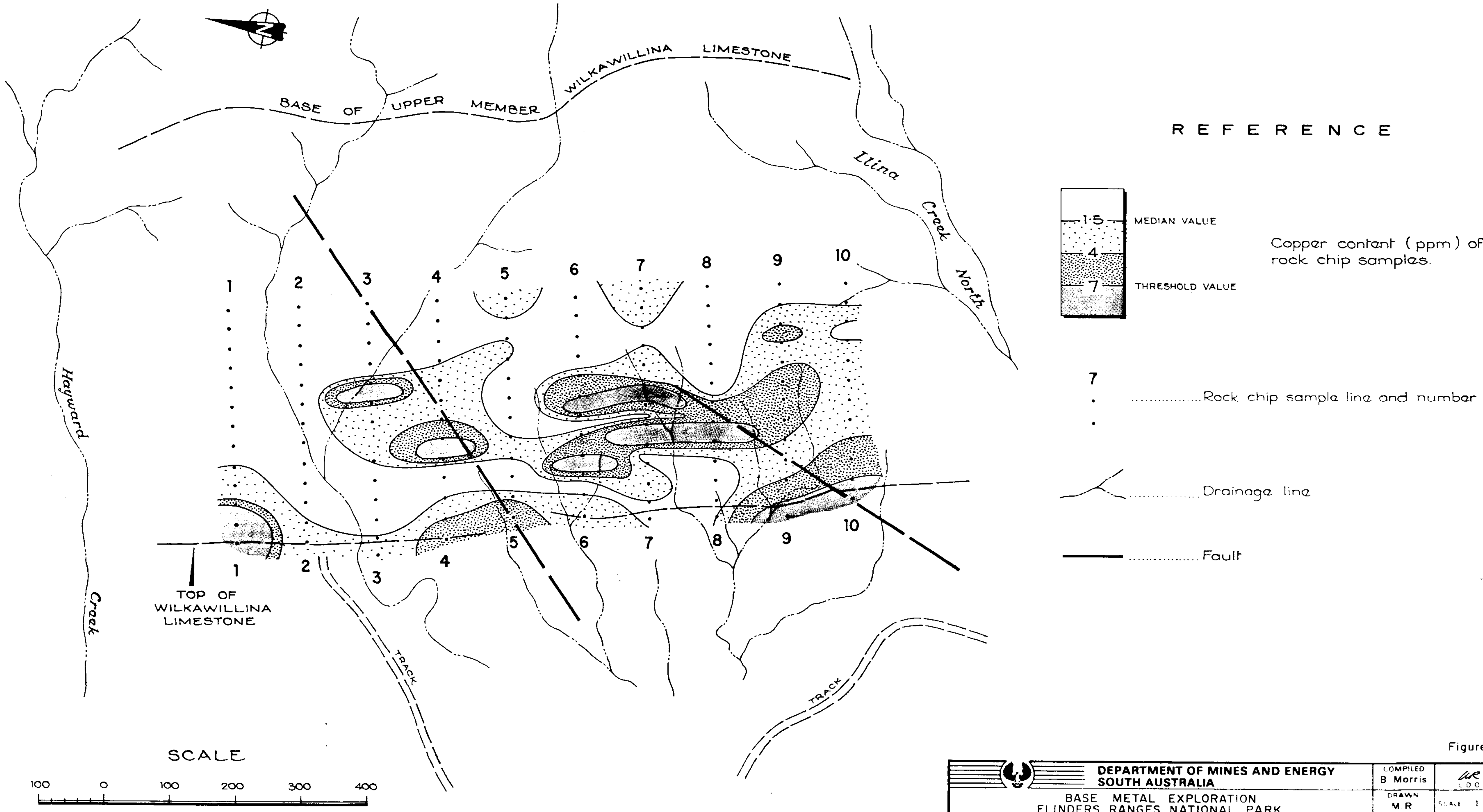



Figure 52

**DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA**

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

**HAYWARD PROSPECT**

COPPER CONTOURS - ROCK CHIP SAMPLE RESULTS

| | | |
|---|---|---|
| COMPILED B. Morris | 26·6·86 DATE | |
| DRAWN M.R | SCALE 1 : 5000 | |
| DATE March '86 | PLAN NUMBER 86 - 219 | |

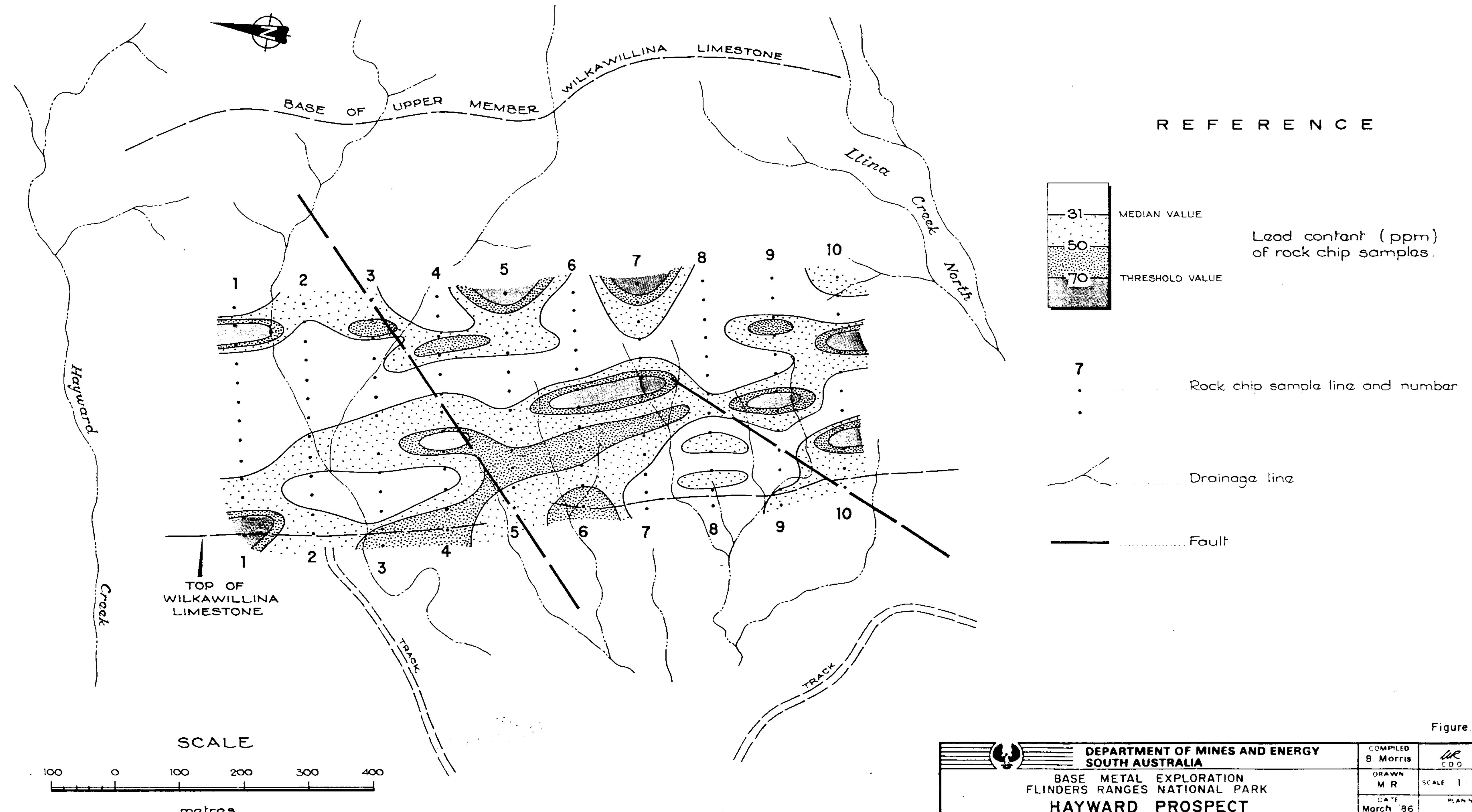



Figure 53

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | CDO 26·6·86 DATE |
|---|---|---|
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M R | SCALE 1 : 5000 |
| HAYWARD PROSPECT | DATE March '86 | PLAN NUMBER |
| LEAD CONTOURS - ROCK CHIP SAMPLE RESULTS | CHECKED | 86 - 220 |

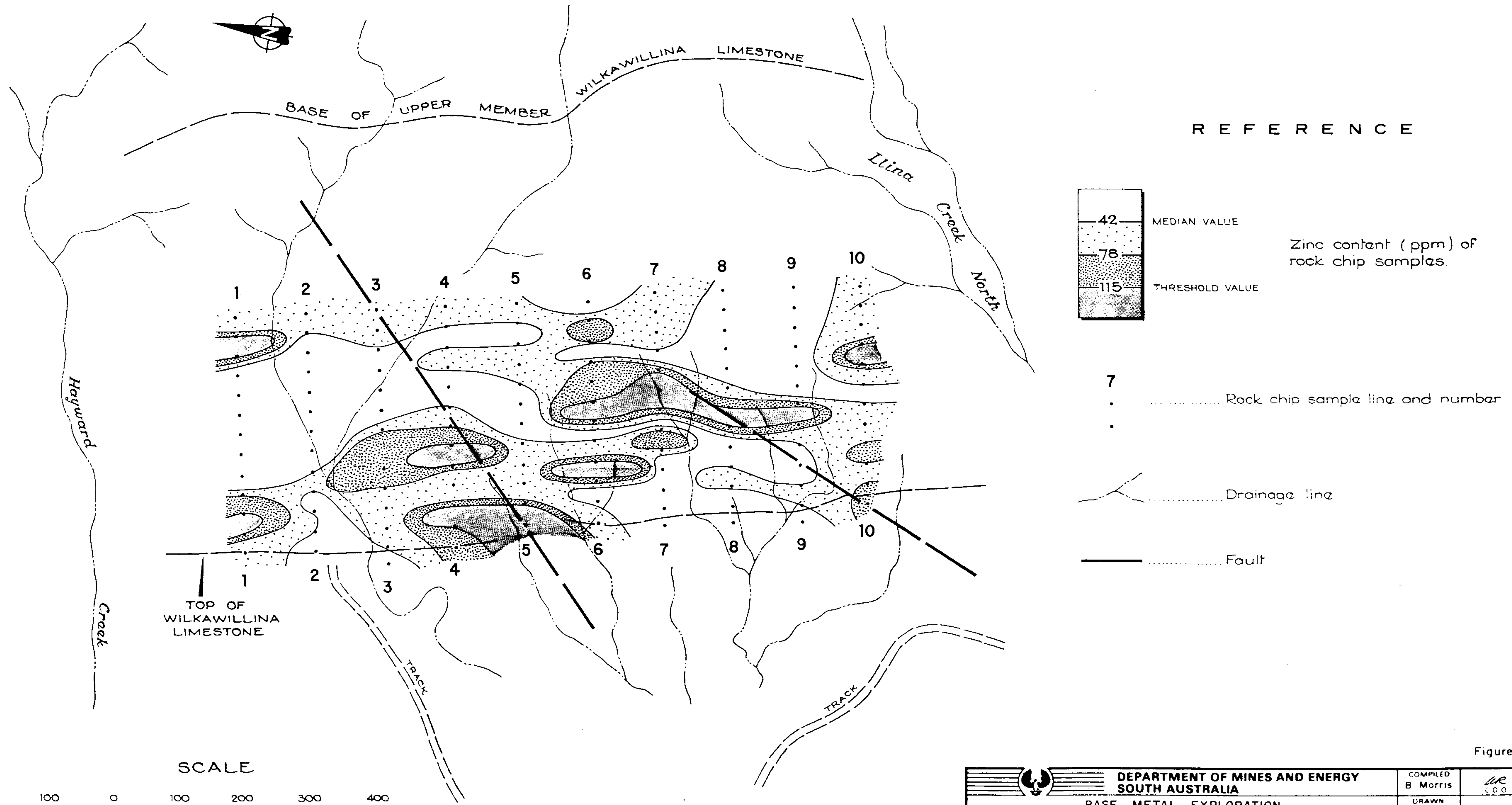



Figure 54

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B Morris | 26-6-86 |
|---|---|---|
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M R | SCALE 1 5000 |
| HAYWARD PROSPECT | DATE March '86 | PLAN NUMBER |
| ZINC CONTOURS - ROCK CHIP SAMPLE RESULTS | CHECKED | 86 - 221 |

4013

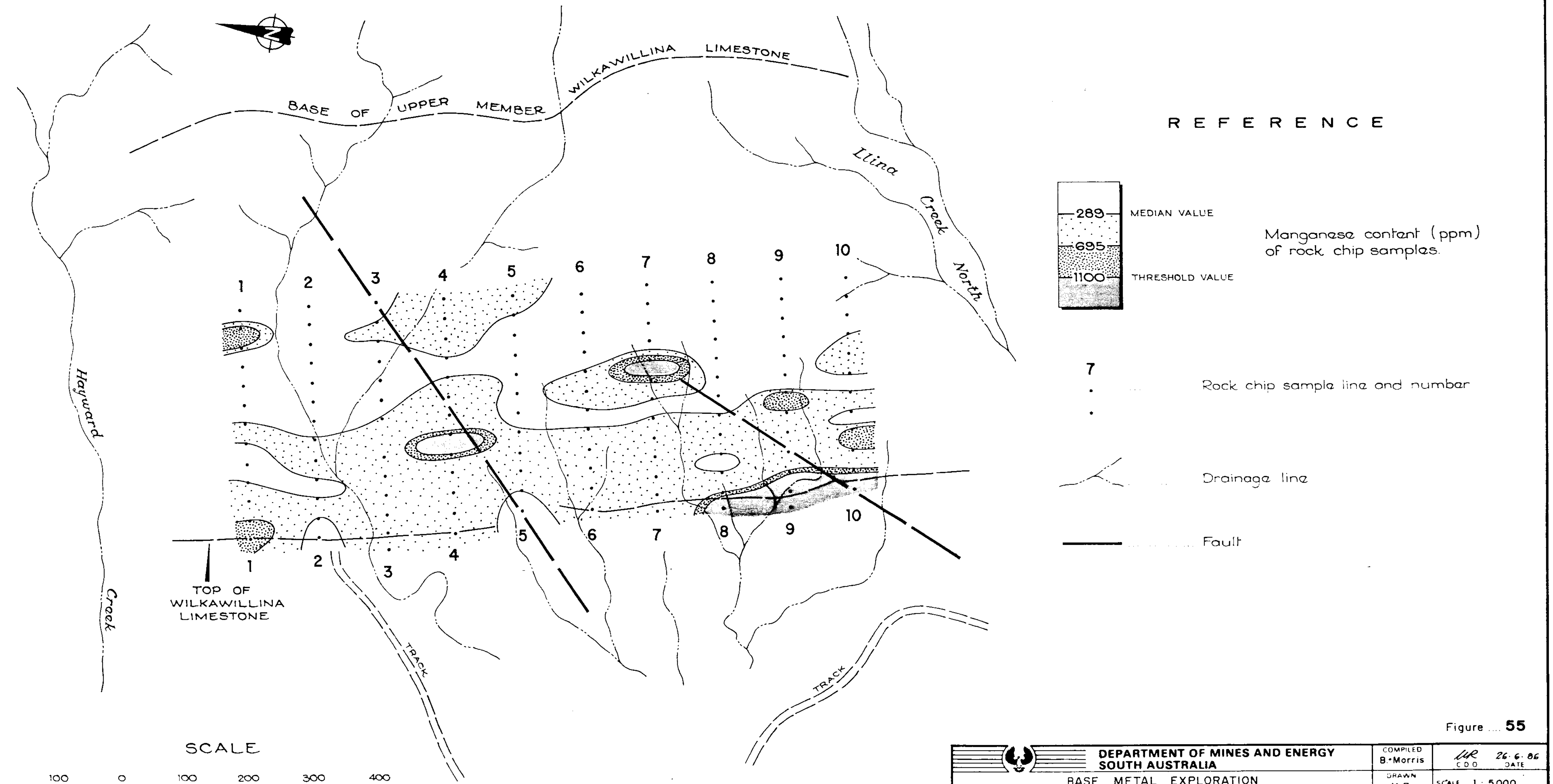



Figure 55

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

**HAYWARD PROSPECT**

MANGANESE CONTOURS - ROCK CHIP SAMPLE RESULTS

| | |
|---|---|
| COMPILED B. Morris | C.D.O. 26.6.86 DATE |
| DRAWN M R | SCALE 1 : 5000 |
| DATE March '86 | PLAN NUMBER 86 - 222 |

4013

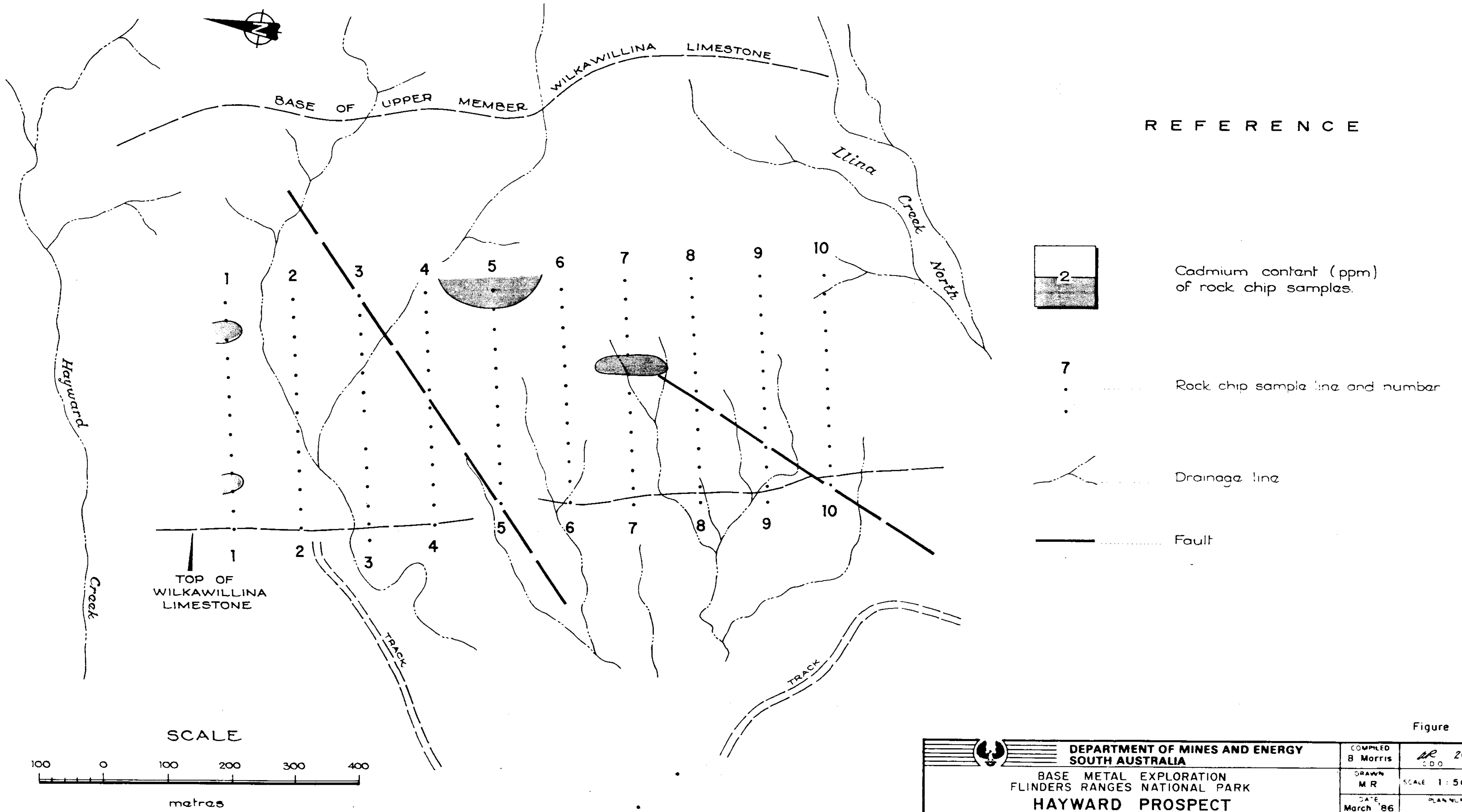



Figure 56

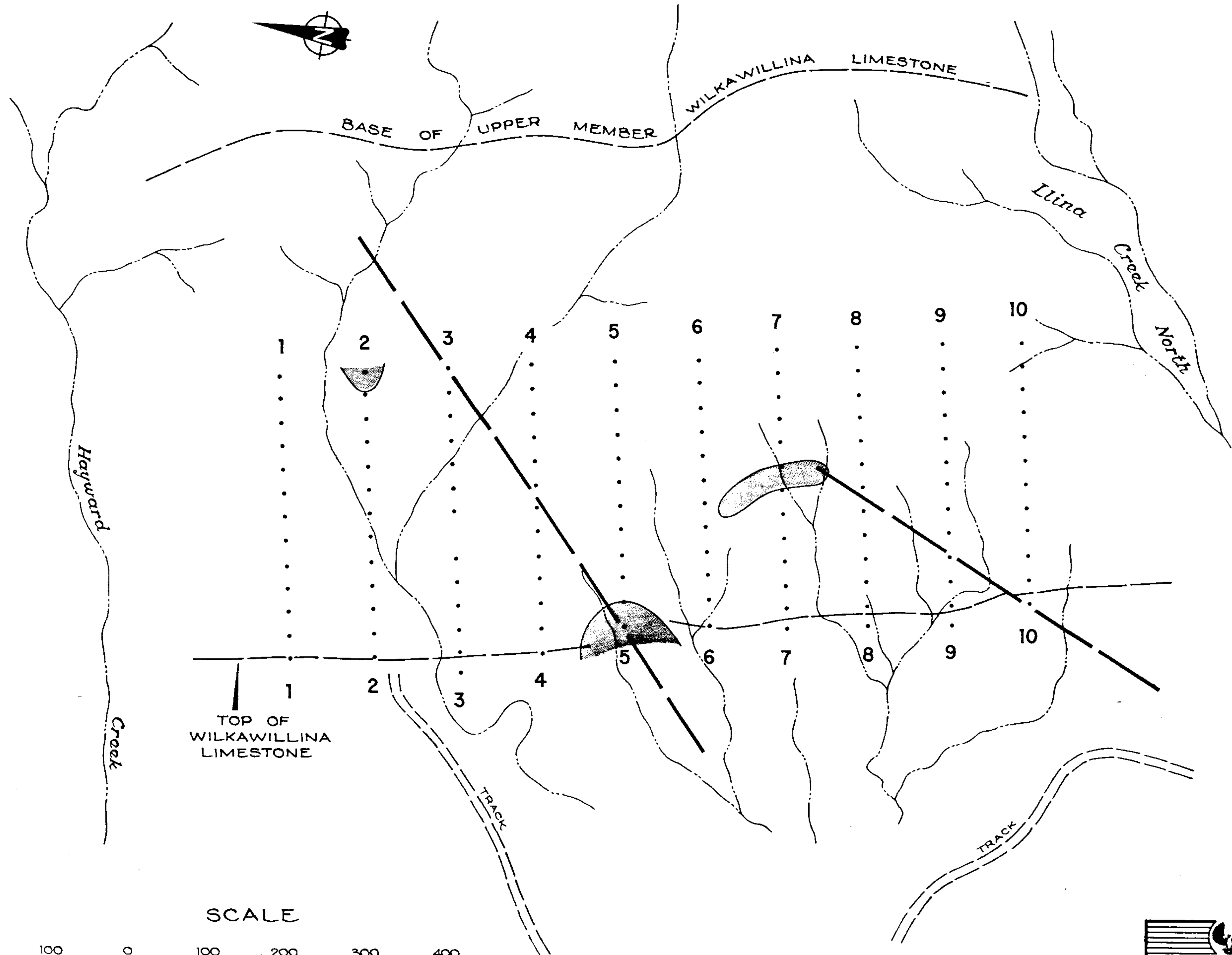
DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

**HAYWARD PROSPECT**

CADMIUM CONTOURS - ROCK CHIP SAMPLE RESULTS

| | |
|---|---|
| COMPILED | B Morris |
| DRAWN | M R |
| DATE | March '86 |
| CHECKED | |
| DATE | 26-6-86 |
| SCALE | 1 : 5000 |
| PLAN NUMBER | 86 - 223 |




REFERENCE

50 Arsenic content (ppm) of rock chip samples.

7 Rock chip sample line and number

Drainage line

Fault

Figure 57

| | | | |
|---|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | CDO 26·6·86 DATE | |
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M R | SCALE 1 : 5000 | |
| HAYWARD PROSPECT | DATE March '86 | PLAN NUMBER | |
| ARSENIC CONTOURS - ROCK CHIP SAMPLE RESULTS | CHECKED | 86-224 | |

4013

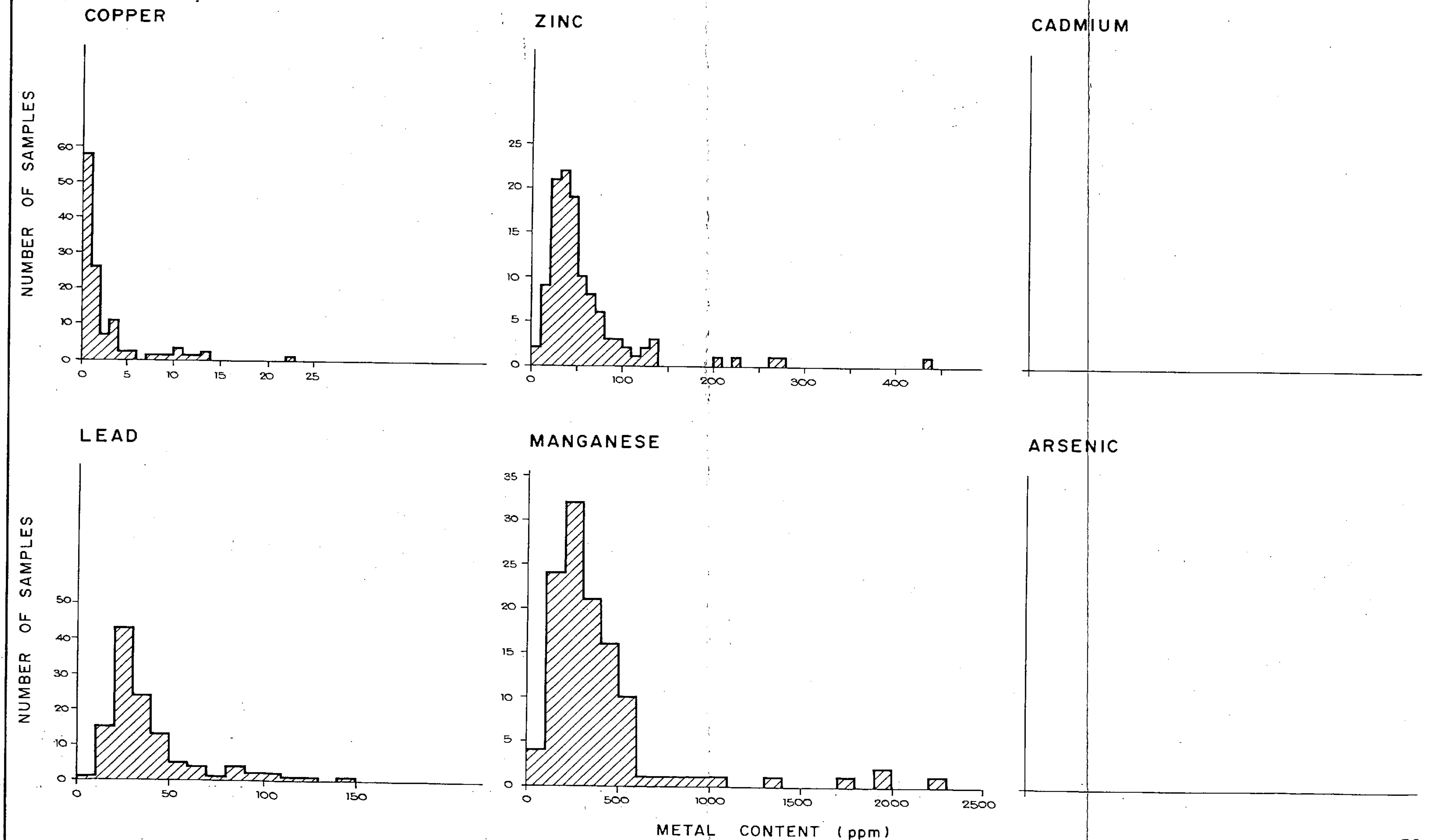



Figure ...... 58

| | | | |
|---|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | CDO DATE 26·6·86 | |
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M.R. | SCALE Graph | |
| **HAYWARD PROSPECT - Rock chip samples.** | DATE March '86 | PLAN NUMBER | |
| FREQUENCY DISTRIBUTION GRAPHS OF METAL CONTENT | CHECKED | **86 - 225** | |

4013

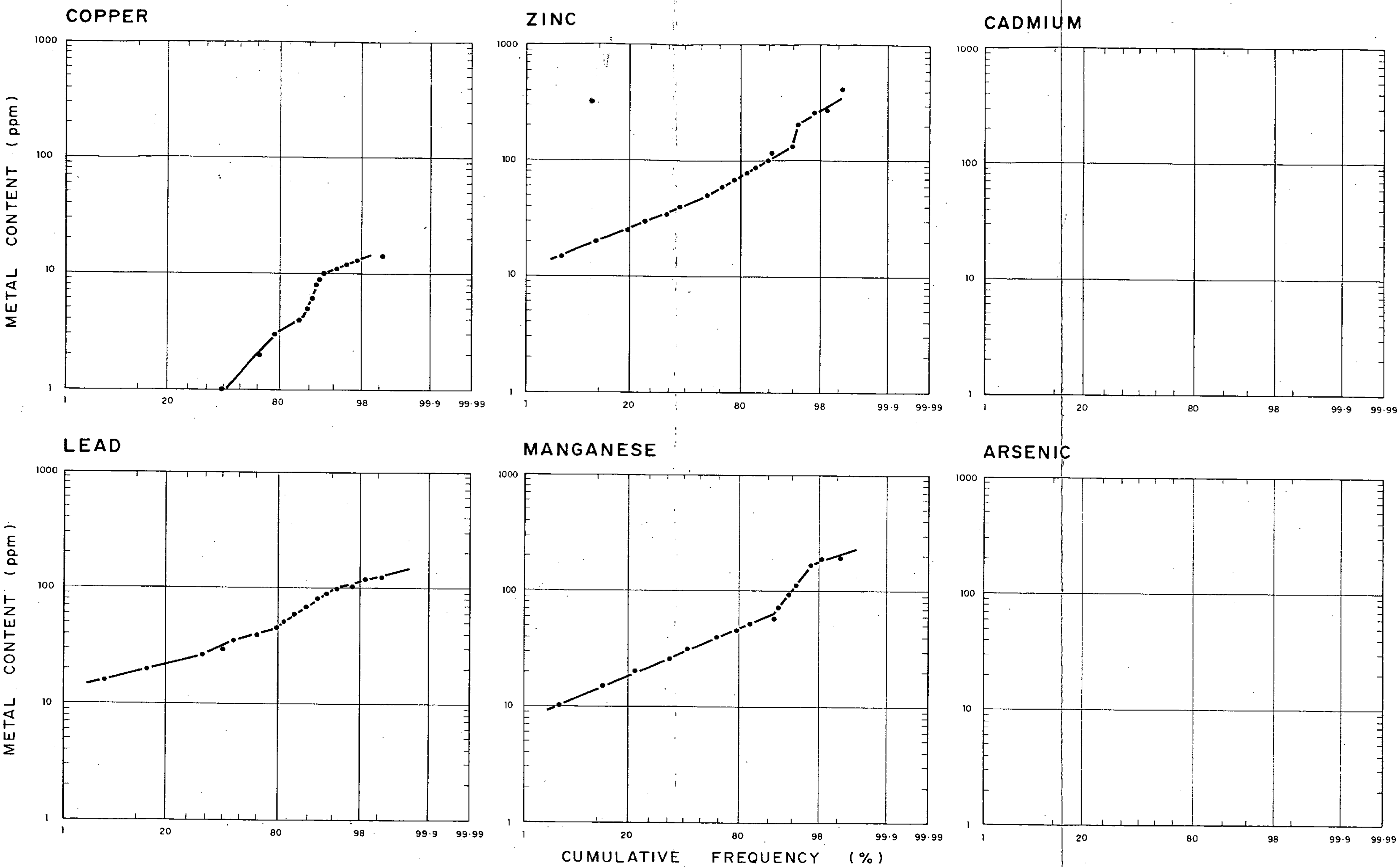



Figure...... **59**

| | | |
|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | *WR* CDO 26·6·86 DATE |
| BASE METAL EXPLORATION<br>FLINDERS RANGES NATIONAL PARK | DRAWN M.R. | SCALE Graph |
| **HAYWARD PROSPECT** - Rock chip samples<br>LOG PROBABILITY GRAPHS OF METAL CONTENT | DATE March '86<br>CHECKED | PLAN NUMBER **86 - 226** |

4013

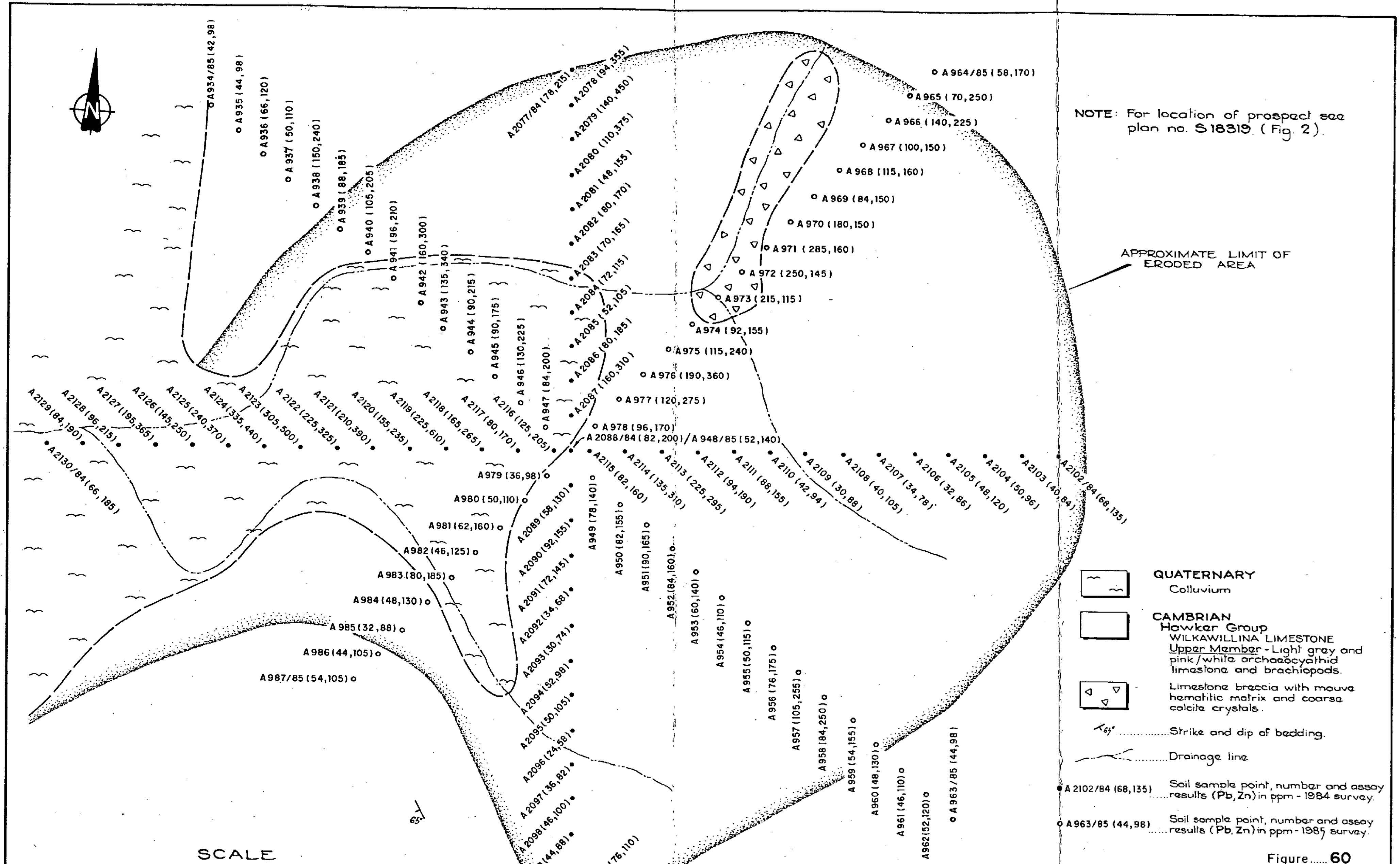
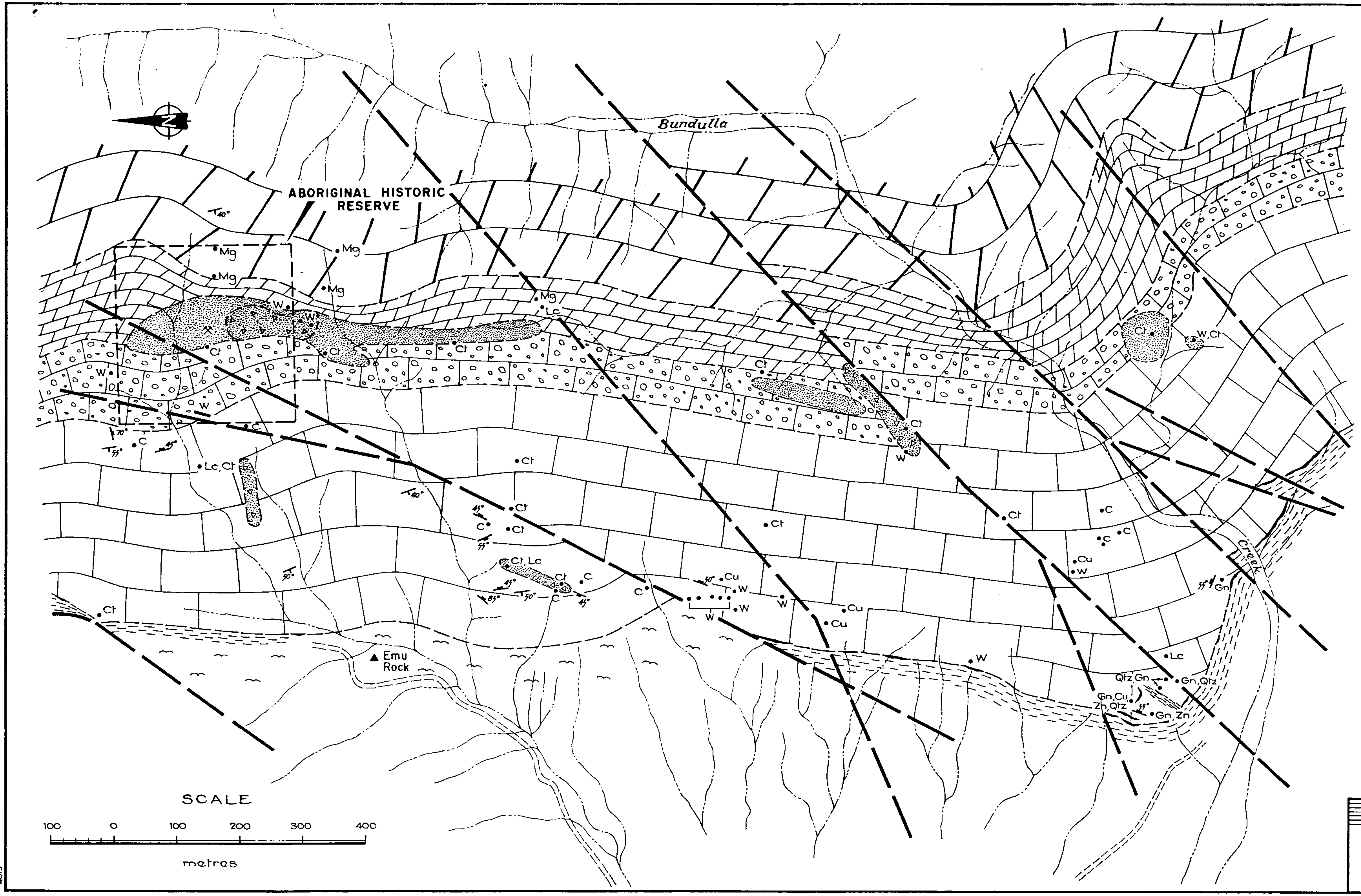



Figure 60

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | C.D.O. DATE |
|---|---|---|
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M.R. | SCALE 1 : 1000 |
| CONCERT PROSPECT | DATE May '86 | PLAN NUMBER |
| SOIL SAMPLE LOCATIONS AND ASSAY RESULTS | CHECKED | 85 - 480 |




**QUATERNARY**
Alluvial and colluvial deposits.

**CAMBRIAN**
BILLY CREEK FORMATION: Basal dolomite and flaggy limestone followed by red and green shales.

Hawker Group
WILKAWILLINA LIMESTONE:
Upper Member - Palaeosurface at top marked by laminated red-brown recrystallized calcrete crust, then massive light grey limestone with archaeocyathans and brachiopods, nodular limestone and off-white coloured porous calc-dolomite near base.
Lower Member - Dark grey-brown bedded sandy dolomite with algal and oolitic beds.

Breccia

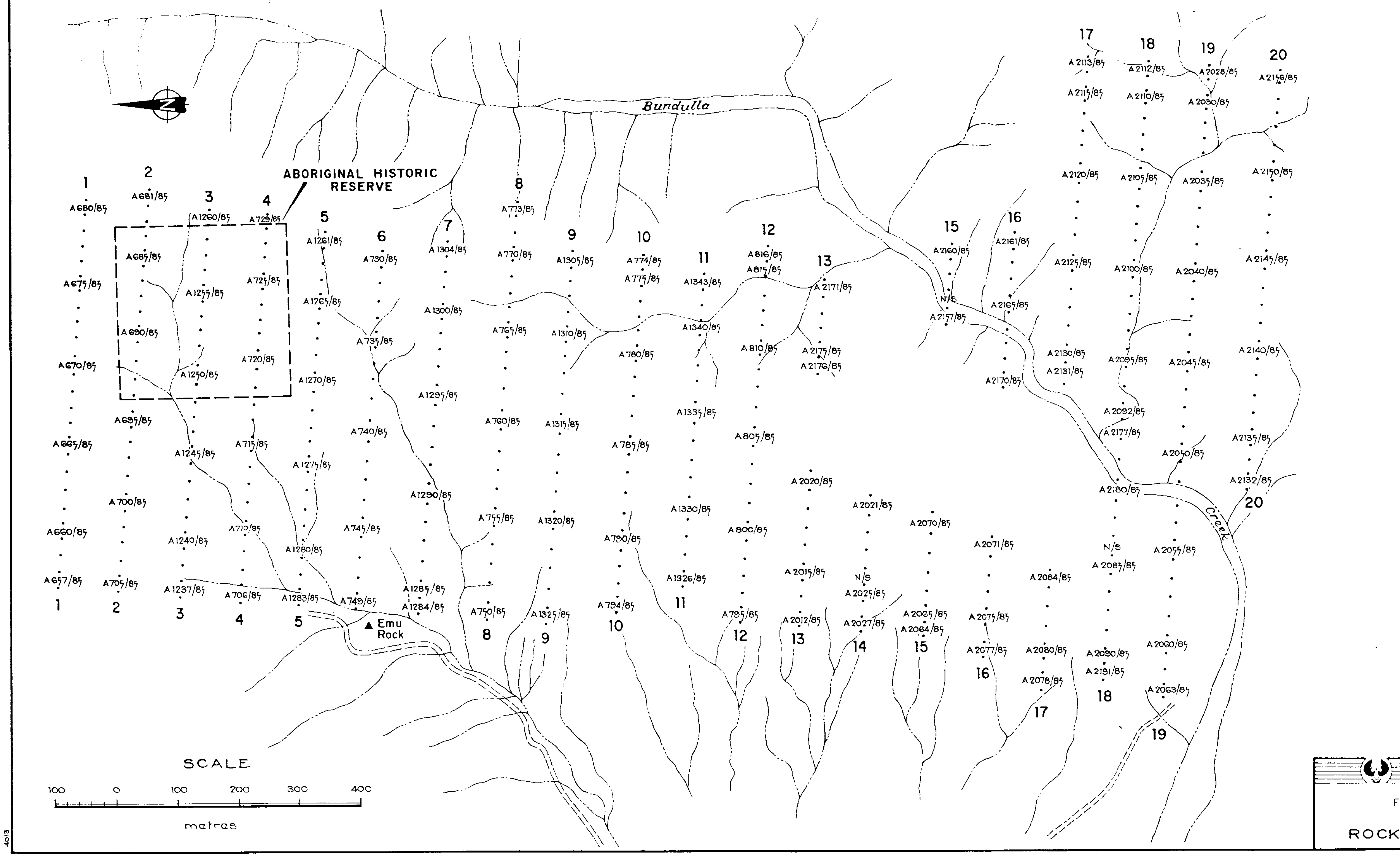
Red-brown hematitic ochre

| | |
|---|---|
| Strike and dip of bedding | 50° |
| Inclined jointing | 60° |
| Fault | |
| Laminar calcrete and calcite | • Lc |
| Coarse calcite crystals | • Ct |
| Malachite, chalcocite | • Cu |
| Magnesite | • Mg |
| Willemite | • W |
| Hydrozincite | • Zn |
| Galena | • Gn |
| Quartz | • Qtz |
| Cave | • C |
| Ochre diggings | |
| Drainage line | |

NOTE: For location of prospect see plan no. S18319 (Fig. 2)

Figure 61

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B Morris | C D O 26.6.86 DATE |
|---|---|---|
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M.R. | SCALE 1:5000 |
| WILLA PROSPECT GEOLOGICAL PLAN | DATE May '86 / CHECKED | PLAN NUMBER 86-227 |




## REFERENCE

9

Rock chip sample line and number

A2130/85 Rock chip sample number (samples taken between line points).

Drainage line

Figure 62

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

**WILLA PROSPECT**
**ROCK CHIP SAMPLE LOCATIONS**

| | | | |
|---|---|---|---|
| COMPILED | B Morris | C.D.O. | DATE 26·6·86 |
| DRAWN | M.R. | SCALE | 1:5000 |
| DATE | May '86 | PLAN NUMBER | 86 - 228 |
| CHECKED | | | |

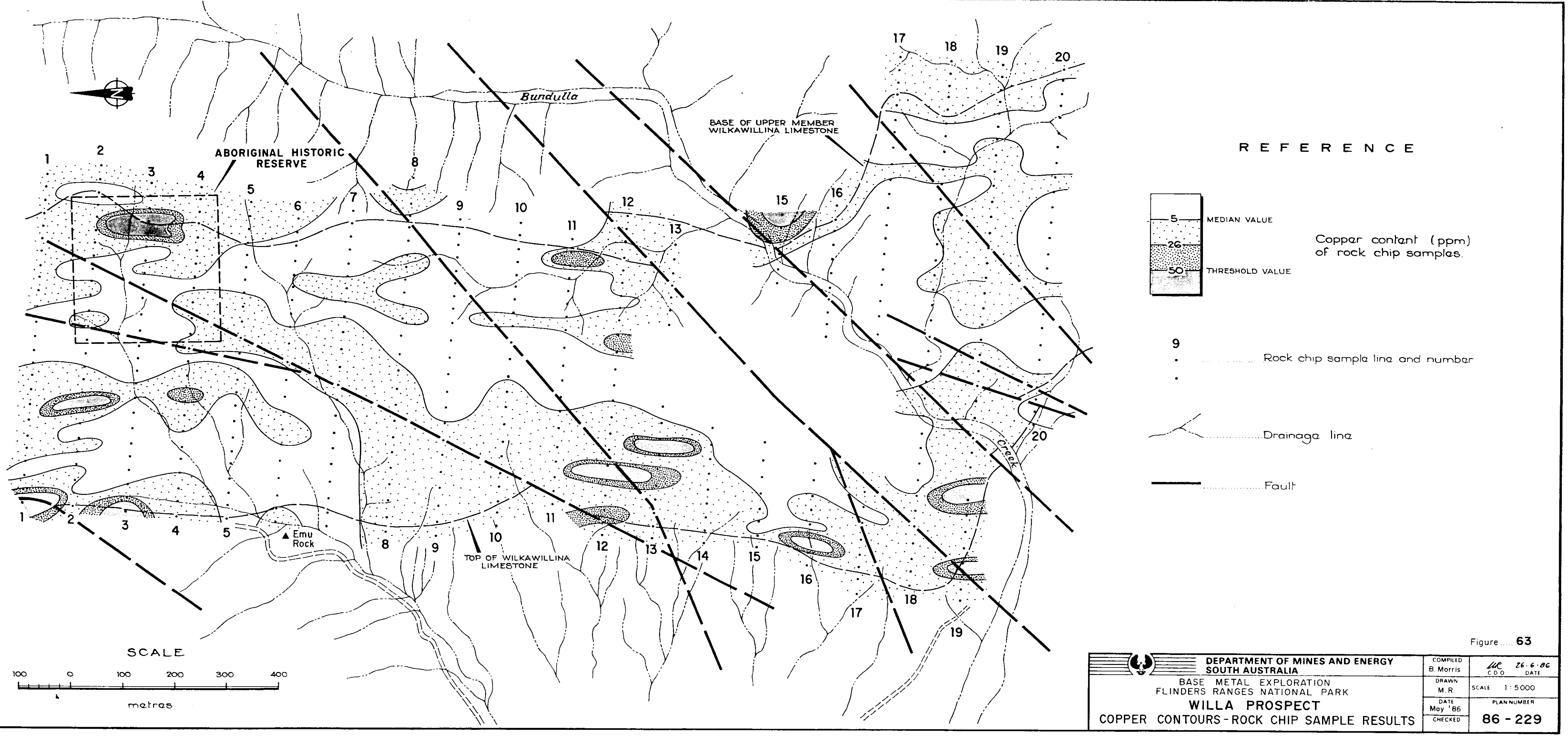
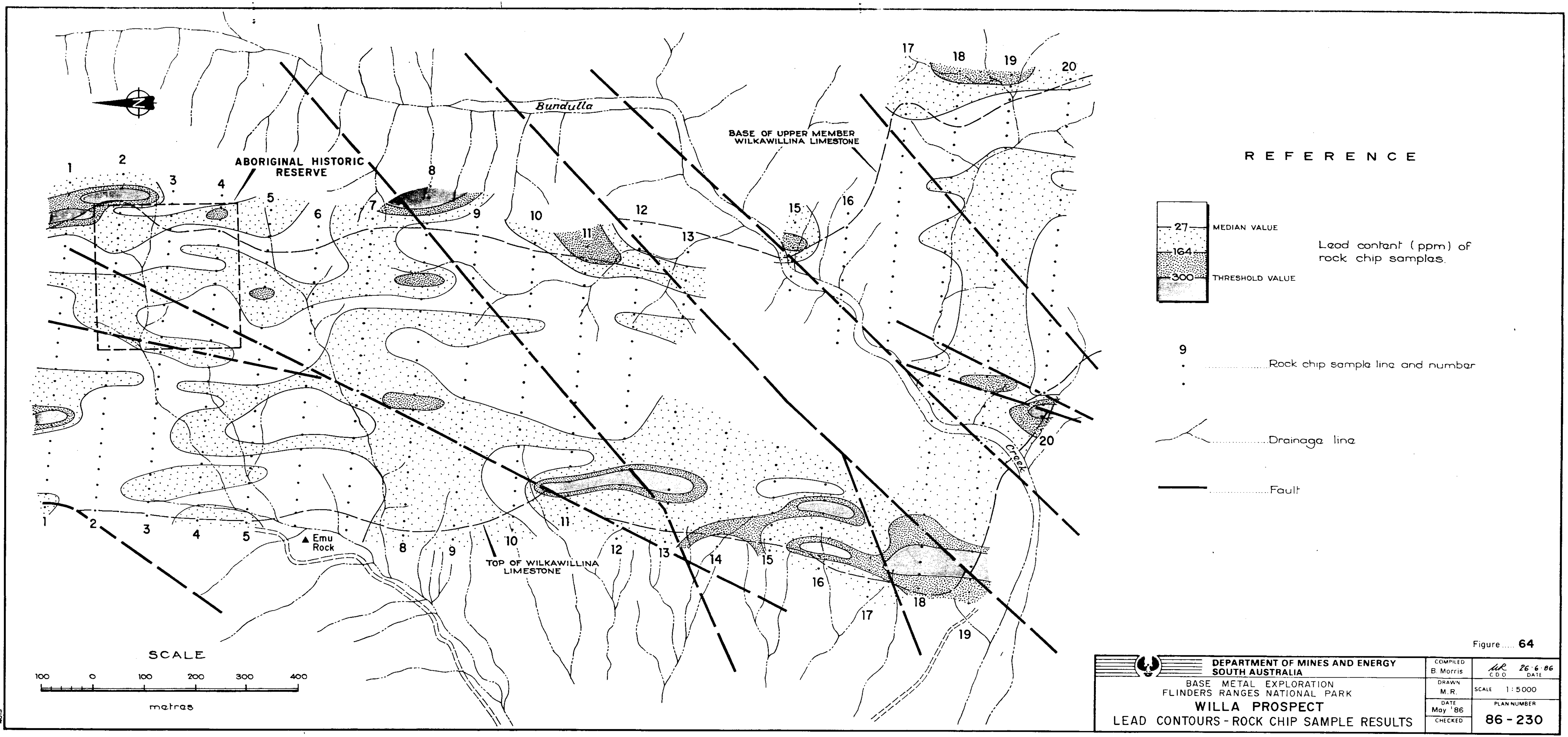



Figure 63

| | | |
|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | 26.6.86 C.D.O. DATE |
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M.R. | SCALE 1:5000 |
| WILLA PROSPECT | DATE May '86 | PLAN NUMBER |
| COPPER CONTOURS - ROCK CHIP SAMPLE RESULTS | CHECKED | 86 - 229 |


Bundulla
BASE OF UPPER MEMBER WILKAWILLINA LIMESTONE
ABORIGINAL HISTORIC RESERVE
TOP OF WILKAWILLINA LIMESTONE
Emu Rock
Creek
SCALE
100 0 100 200 300 400
metres
REFERENCE
27 MEDIAN VALUE
164
300 THRESHOLD VALUE
Lead content (ppm) of rock chip samples.
9
Rock chip sample line and number
Drainage line
Fault
Figure 64
DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA
BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
WILLA PROSPECT
LEAD CONTOURS - ROCK CHIP SAMPLE RESULTS
COMPILED B. Morris
DRAWN M.R.
DATE May '86
CHECKED
C.D.O. 26·6·86 DATE
SCALE 1:5000
PLAN NUMBER 86-230

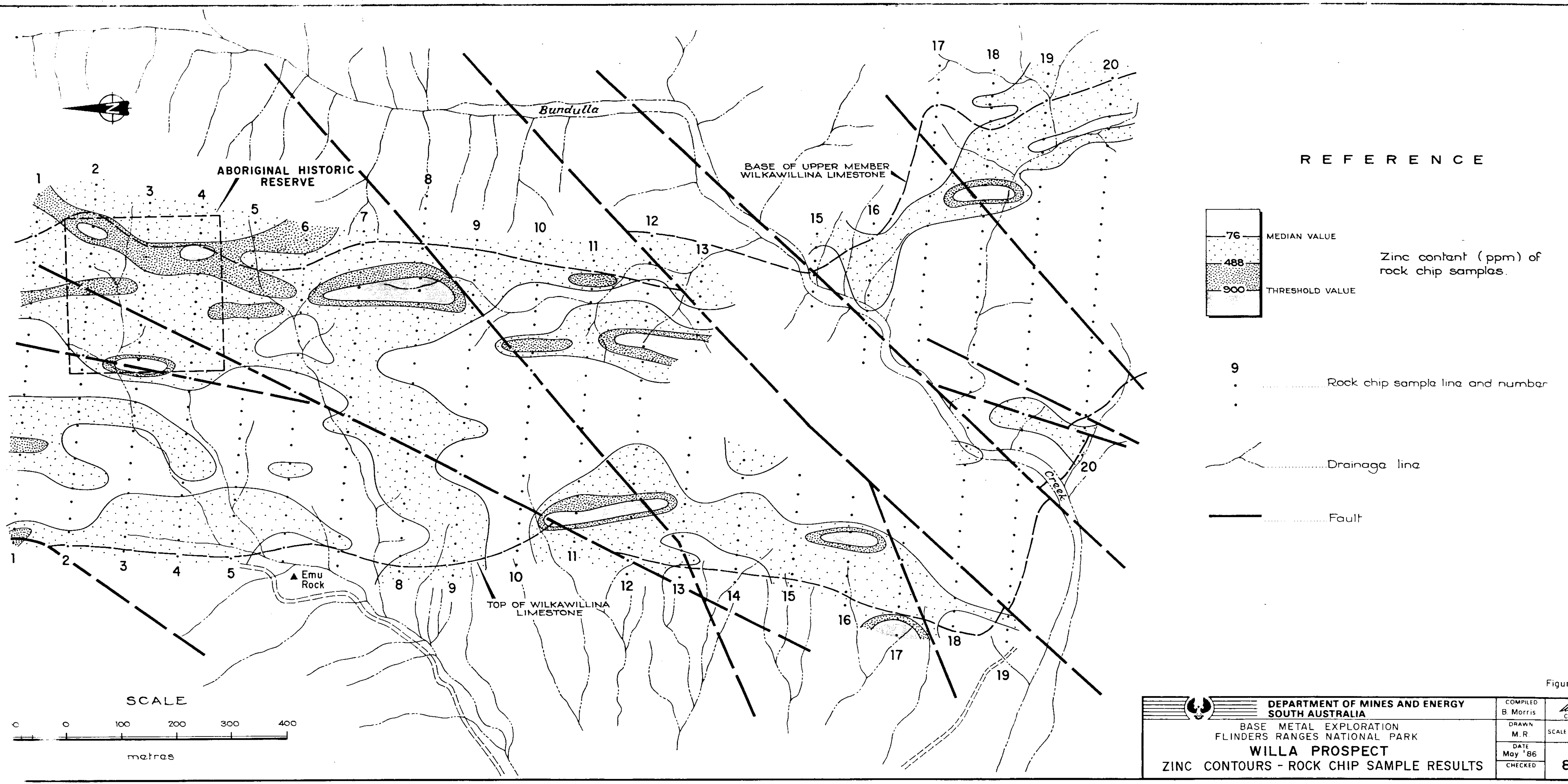



Figure 65

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | 26. 6. 86 CDO DATE |
|---|---|---|
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M.R | SCALE 1:5000 |
| WILLA PROSPECT | DATE May '86 | PLAN NUMBER |
| ZINC CONTOURS - ROCK CHIP SAMPLE RESULTS | CHECKED | 86 - 231 |

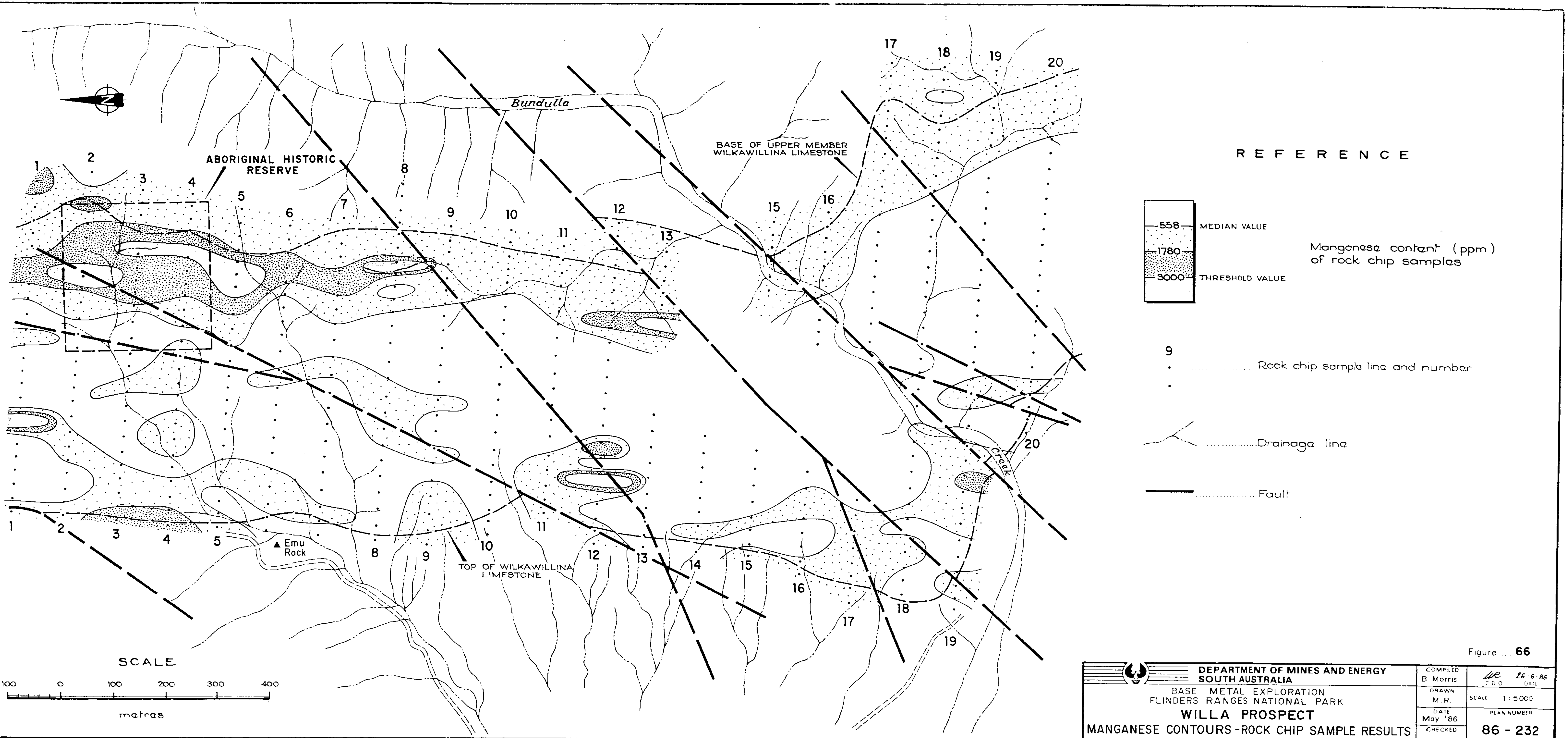



Figure 66

| | | |
|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | C.D.O. 26·6·86 DATE |
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M.R | SCALE 1:5000 |
| WILLA PROSPECT | DATE May '86 | PLAN NUMBER |
| MANGANESE CONTOURS - ROCK CHIP SAMPLE RESULTS | CHECKED | 86 - 232 |

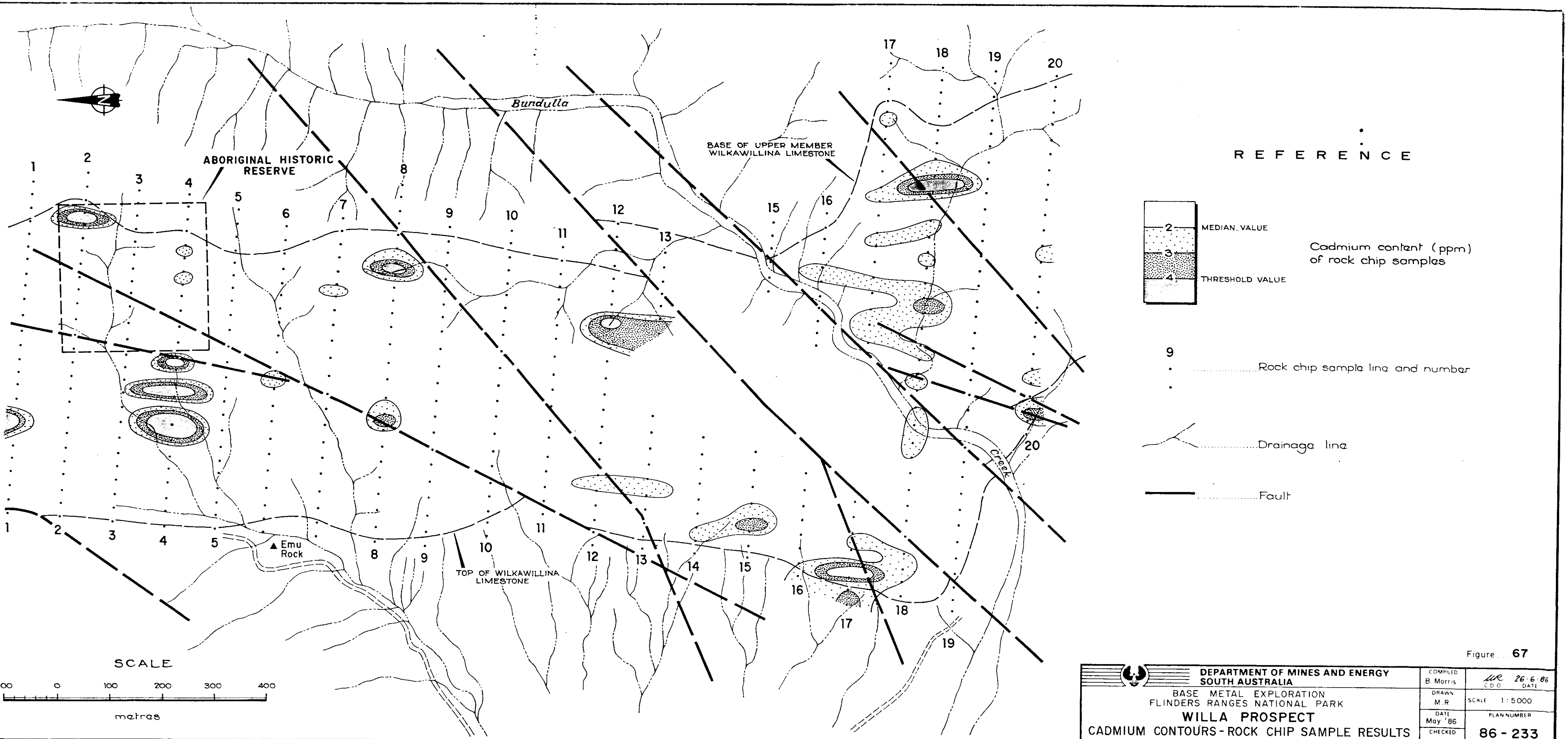
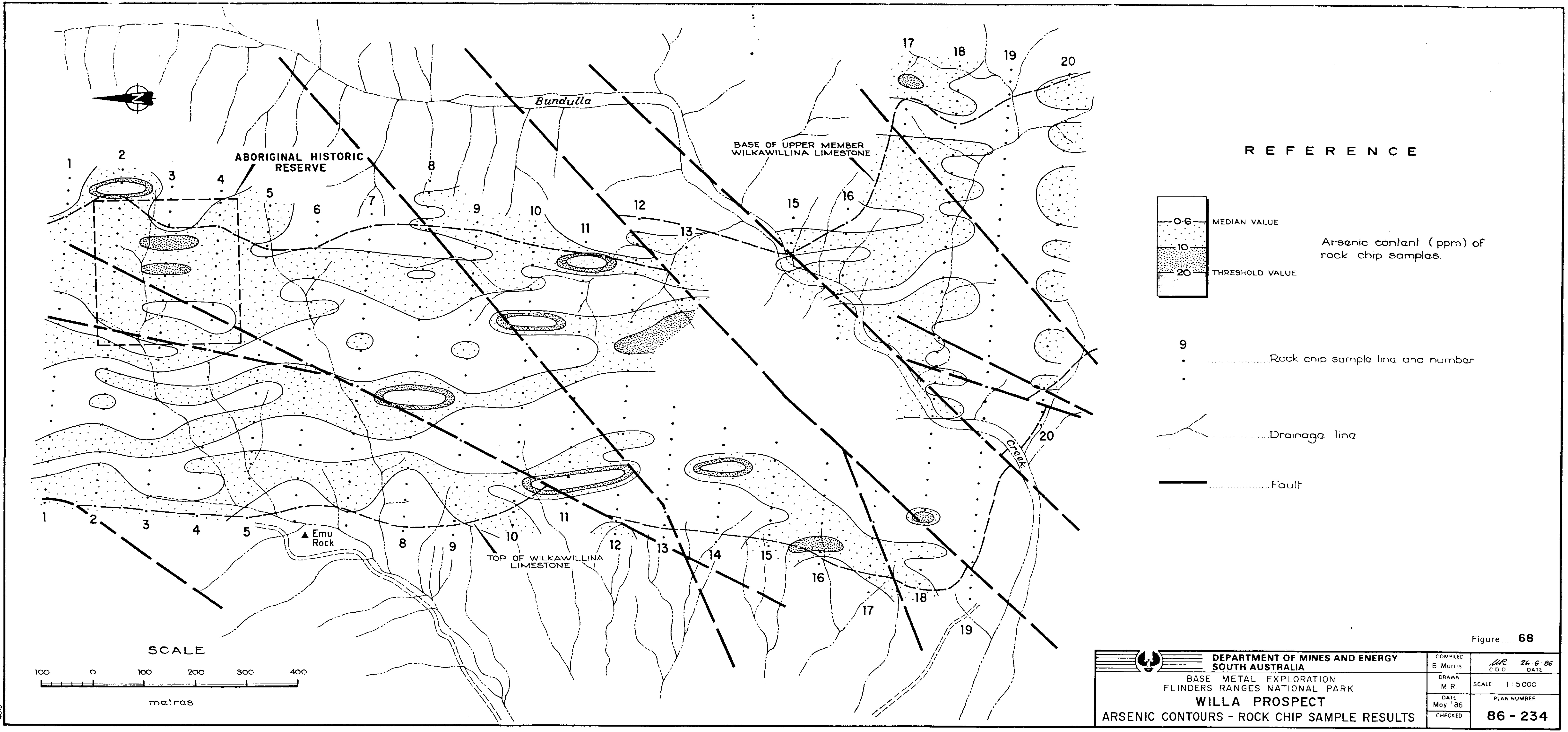



Figure 67

| | | | |
|---|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | C.D.O. 26·6·86 DATE | |
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M.R | SCALE 1:5000 | |
| WILLA PROSPECT | DATE May '86 | PLAN NUMBER | |
| CADMIUM CONTOURS - ROCK CHIP SAMPLE RESULTS | CHECKED | 86 - 233 | |

4015



ABORIGINAL HISTORIC RESERVE
Bundulla
Creek
BASE OF UPPER MEMBER WILKAWILLINA LIMESTONE
TOP OF WILKAWILLINA LIMESTONE
Emu Rock
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
SCALE
100 0 100 200 300 400
metres
REFERENCE
0·6 MEDIAN VALUE
10
20 THRESHOLD VALUE
Arsenic content (ppm) of rock chip samples.
9
Rock chip sample line and number
Drainage line
Fault
Figure 68
DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA
BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
WILLA PROSPECT
ARSENIC CONTOURS - ROCK CHIP SAMPLE RESULTS
COMPILED B Morris
CDO 26·6·86 DATE
DRAWN M R
SCALE 1:5000
DATE May '86
PLAN NUMBER
CHECKED
86 - 234

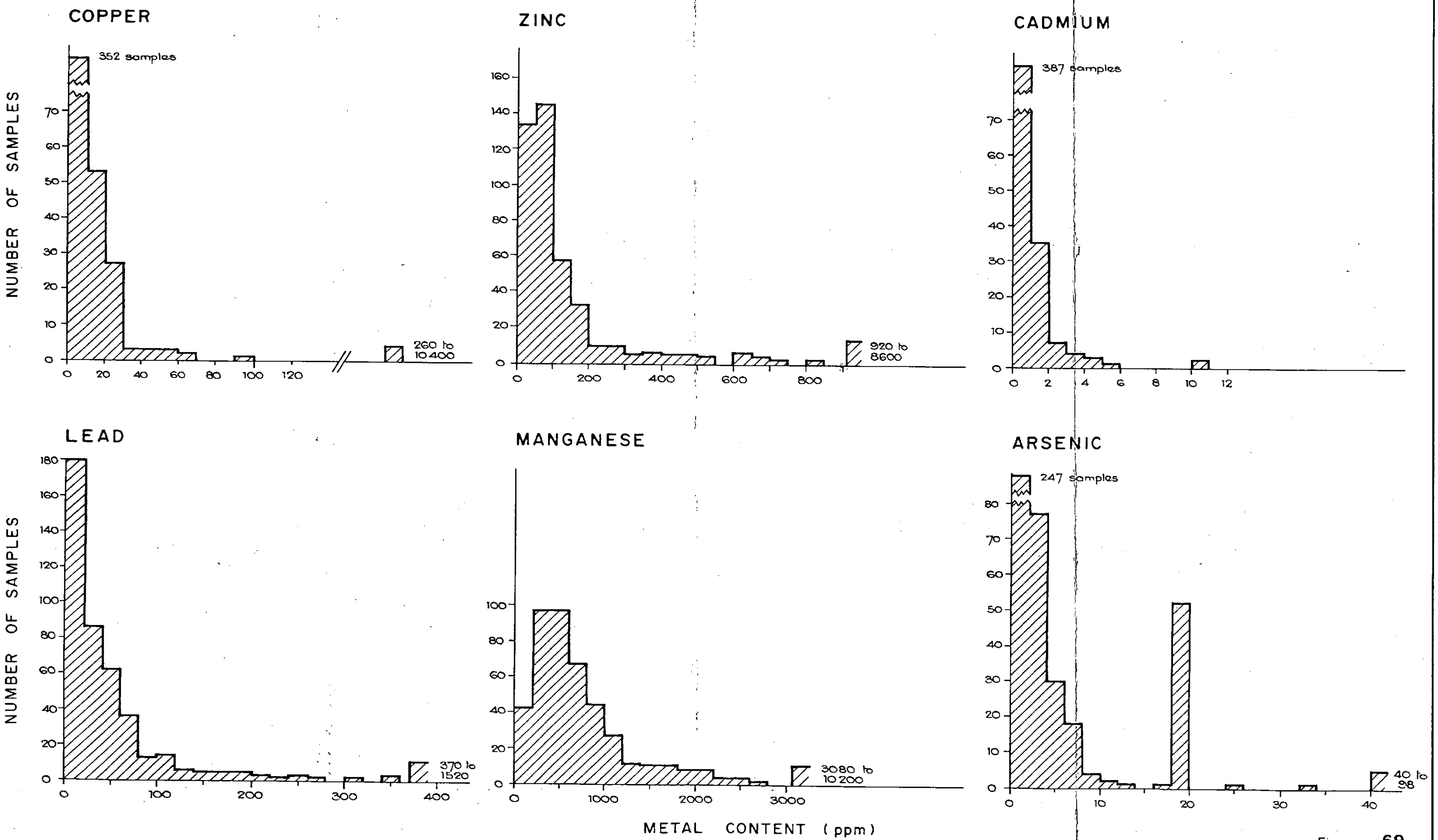



Figure 69

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

**WILLA PROSPECT - Rock chip samples**
**FREQUENCY DISTRIBUTION GRAPHS OF METAL CONTENT**

| | | | |
|---|---|---|---|
| COMPILED B. Morris | C D O | DATE 26·6·86 |
| DRAWN M.R. | SCALE Graph | |
| DATE March '86 | PLAN NUMBER | 86-235 |
| CHECKED | | |

4018

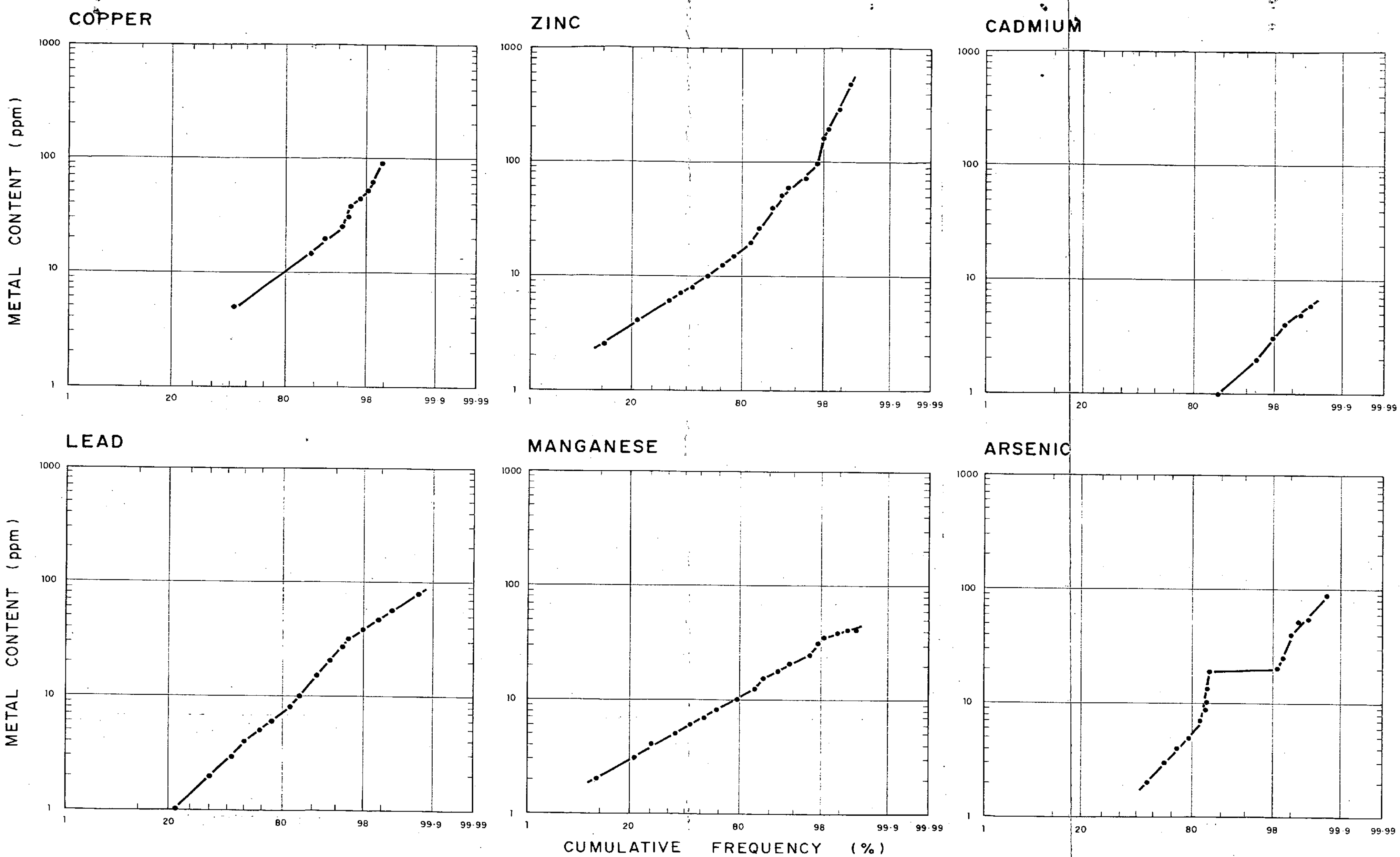



Figure...... 70

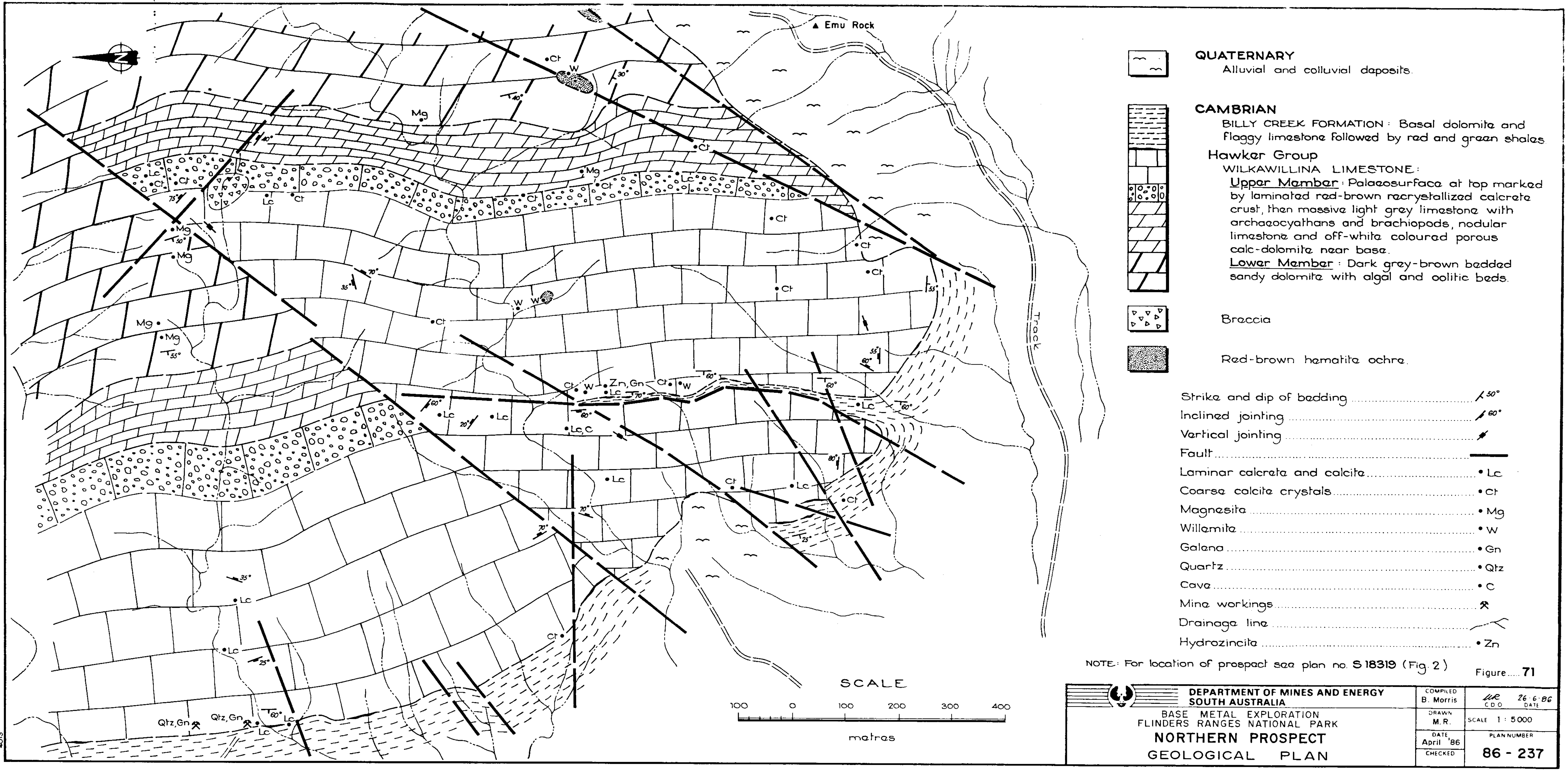
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

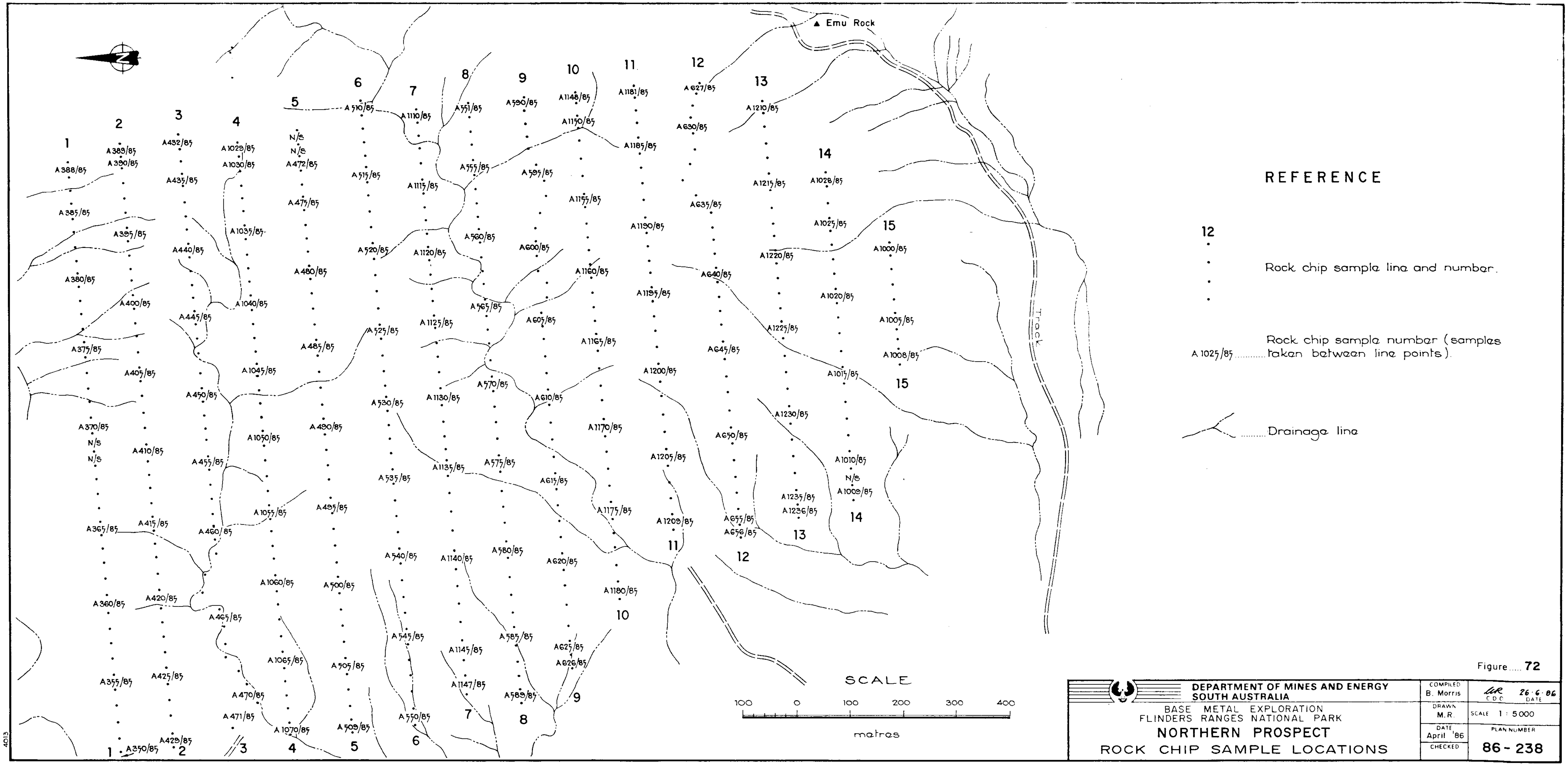
**WILLA PROSPECT - Rock chip samples**
LOG PROBABILITY GRAPHS OF METAL CONTENT

| | | |
|---|---|---|
| COMPILED B. Morris | MR C D O | 26-6-86 DATE |
| DRAWN M.R. | SCALE Graph | |
| DATE March '86 | PLAN NUMBER | |
| CHECKED | 86 - 236 | |

4013



Emu Rock
Track
QUATERNARY
Alluvial and colluvial deposits.
CAMBRIAN
BILLY CREEK FORMATION: Basal dolomite and flaggy limestone followed by red and green shales.
Hawker Group
WILKAWILLINA LIMESTONE:
Upper Member: Palaeosurface at top marked by laminated red-brown recrystallized calcrete crust, then massive light grey limestone with archaeocyathans and brachiopods, nodular limestone and off-white coloured porous calc-dolomite near base.
Lower Member: Dark grey-brown bedded sandy dolomite with algal and oolitic beds.
Breccia
Red-brown hematite ochre.
Strike and dip of bedding
Inclined jointing
Vertical jointing
Fault
Laminar calcrete and calcite • Lc
Coarse calcite crystals • Ct
Magnesite • Mg
Willemite • W
Galena • Gn
Quartz • Qtz
Cave • C
Mine workings
Drainage line
Hydrozincite • Zn
NOTE: For location of prospect see plan no. S 18319 (Fig. 2)
Figure 71
SCALE
100 0 100 200 300 400
metres
DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA
BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
NORTHERN PROSPECT
GEOLOGICAL PLAN
COMPILED B. Morris
DRAWN M.R.
DATE April '86
CHECKED
C.D.O. 26·6·86
SCALE 1 : 5000
PLAN NUMBER 86 - 237


Emu Rock
REFERENCE
12
Rock chip sample line and number.
A 1025/85 ........ Rock chip sample number (samples taken between line points).
........ Drainage line
Track
SCALE
100 0 100 200 300 400
metres
Figure ..... 72
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA
BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
NORTHERN PROSPECT
ROCK CHIP SAMPLE LOCATIONS
COMPILED B. Morris
C.D.C. 26·6·86 DATE
DRAWN M.R.
SCALE 1 : 5000
DATE April '86
PLAN NUMBER 86 - 238
CHECKED
4013

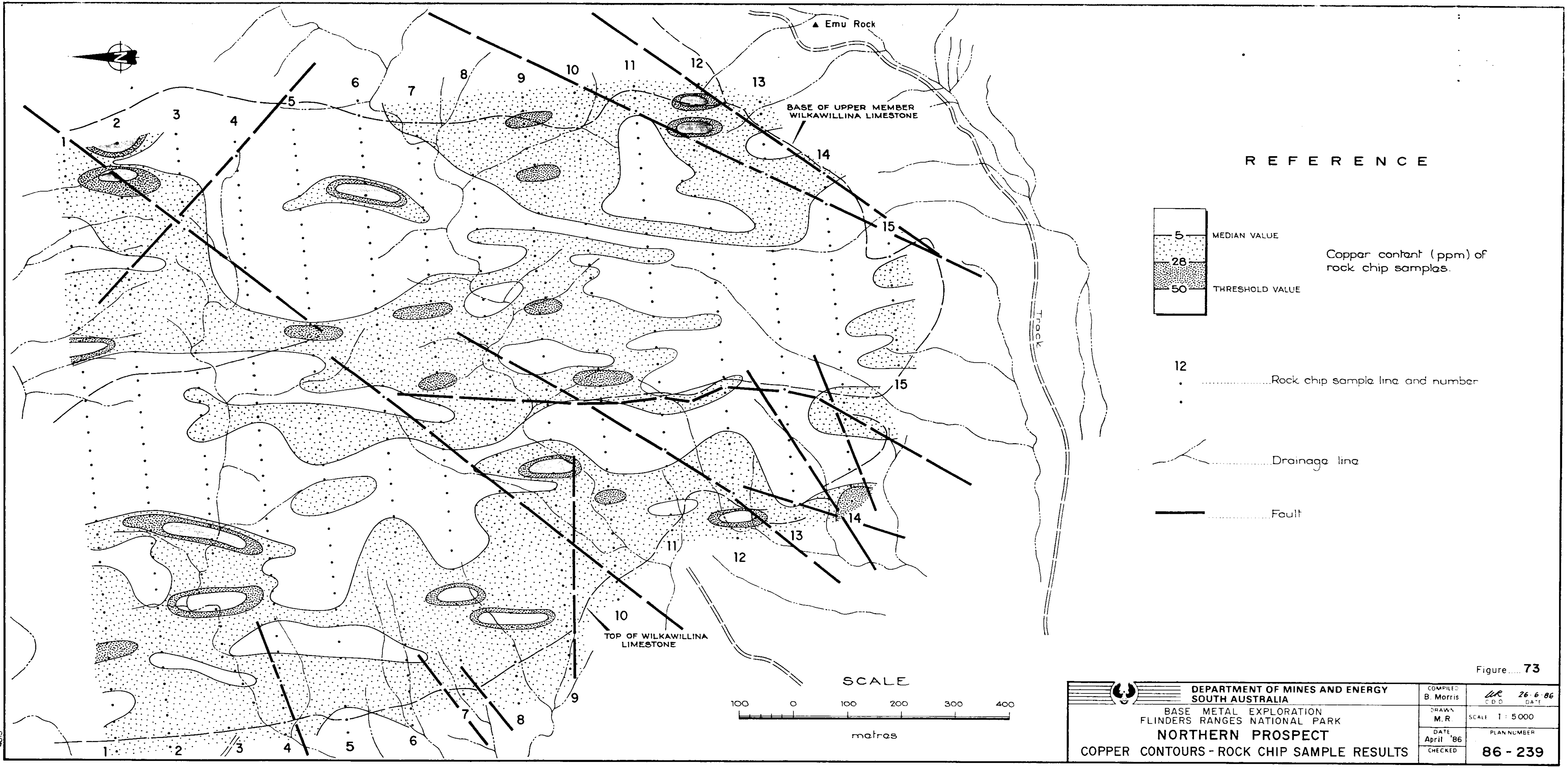
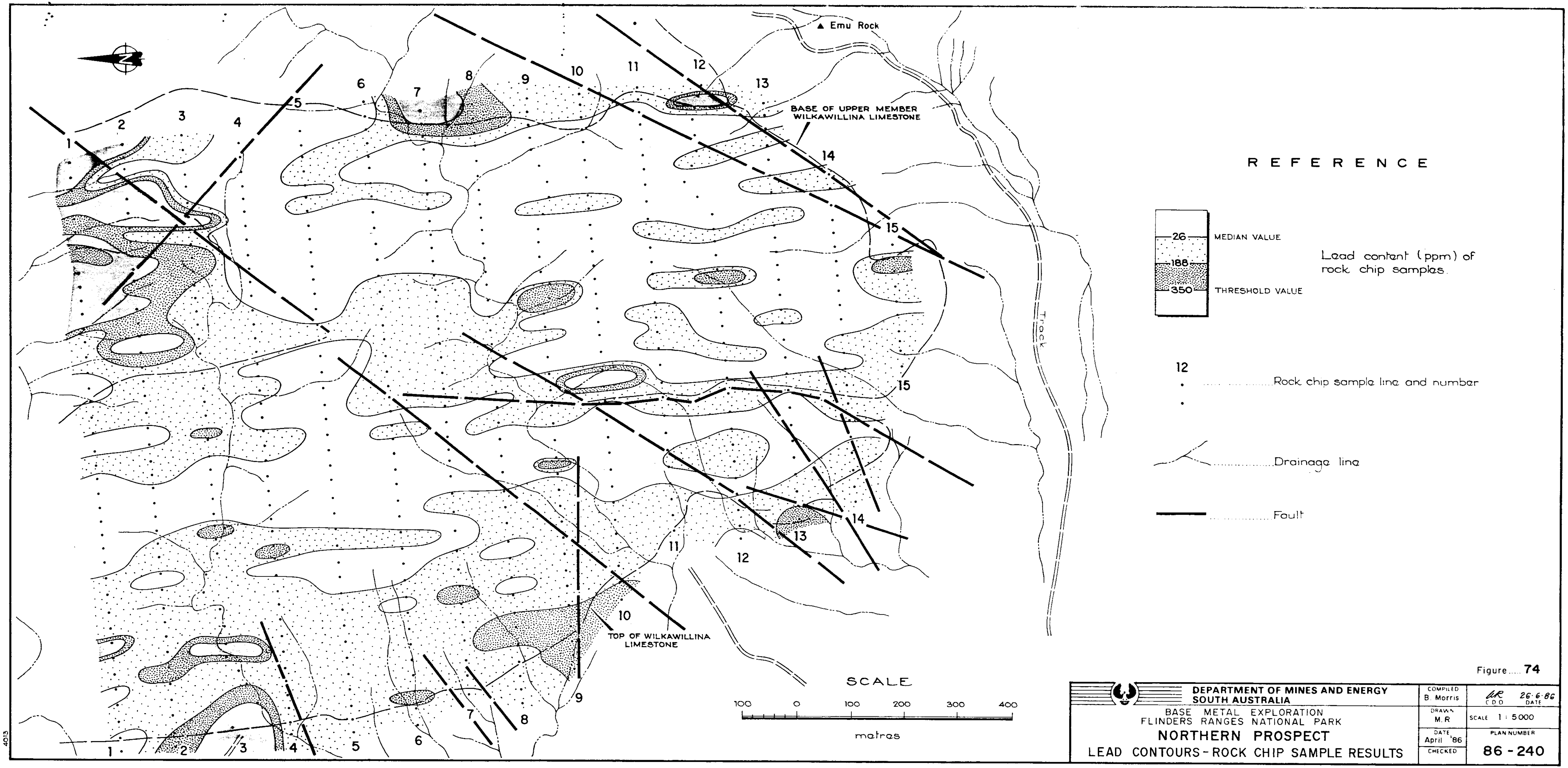



Figure 73

| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | C.D.O. 26.6.86 DATE |
|---|---|---|
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M.R | SCALE 1 : 5000 |
| NORTHERN PROSPECT | DATE April '86 | PLAN NUMBER |
| COPPER CONTOURS - ROCK CHIP SAMPLE RESULTS | CHECKED | 86 - 239 |

4013


Emu Rock
BASE OF UPPER MEMBER WILKAWILLINA LIMESTONE
TOP OF WILKAWILLINA LIMESTONE
Track
REFERENCE
26 MEDIAN VALUE
188
350 THRESHOLD VALUE
Lead content (ppm) of rock chip samples.
12
Rock chip sample line and number
Drainage line
Fault
SCALE
100 0 100 200 300 400
metres
Figure 74
DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA
BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
NORTHERN PROSPECT
LEAD CONTOURS - ROCK CHIP SAMPLE RESULTS
COMPILED B. Morris
DRAWN M.R
DATE April '86
CHECKED
C.D.O. 26.6.86 DATE
SCALE 1 : 5000
PLAN NUMBER 86-240
4013

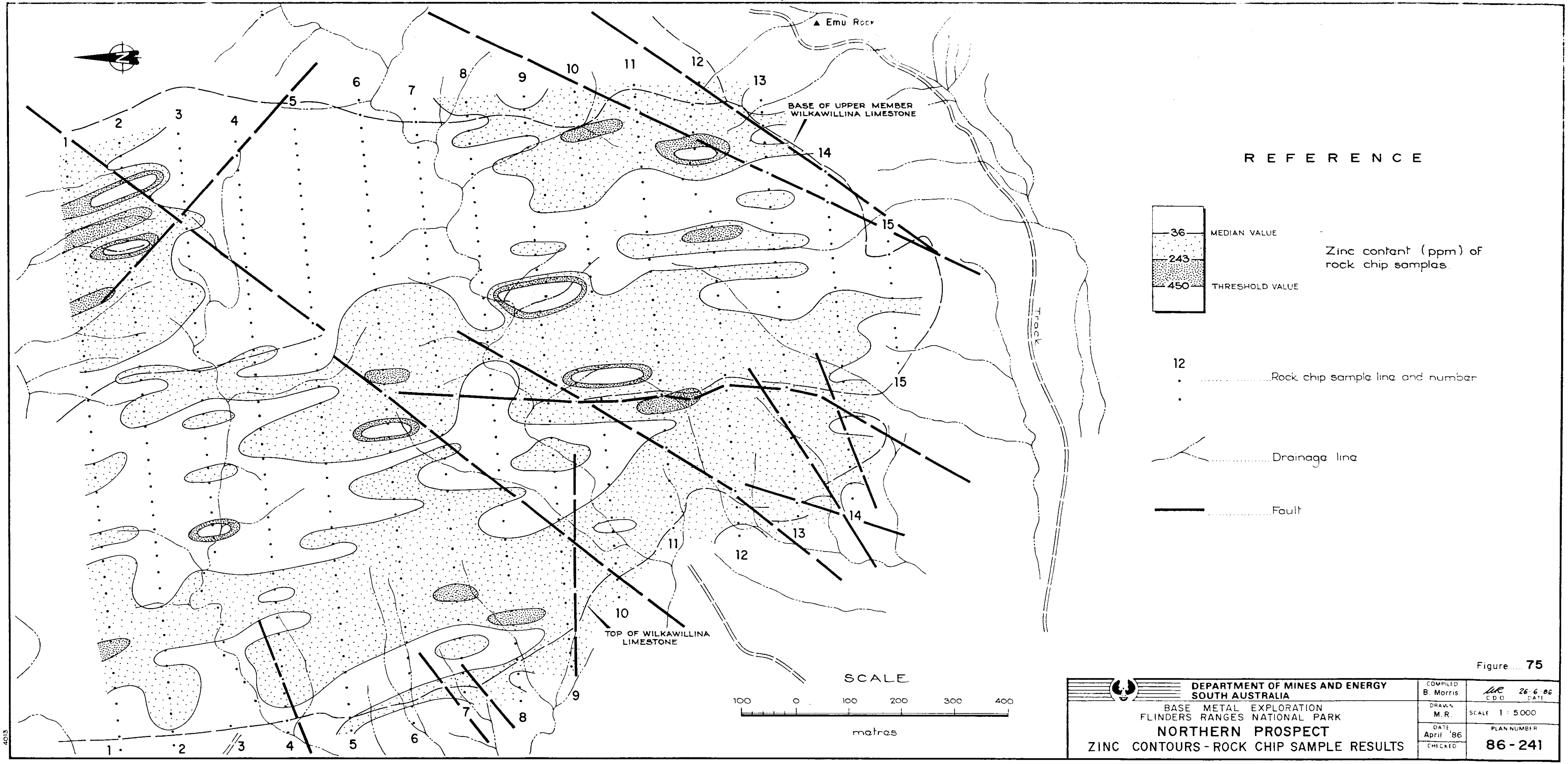


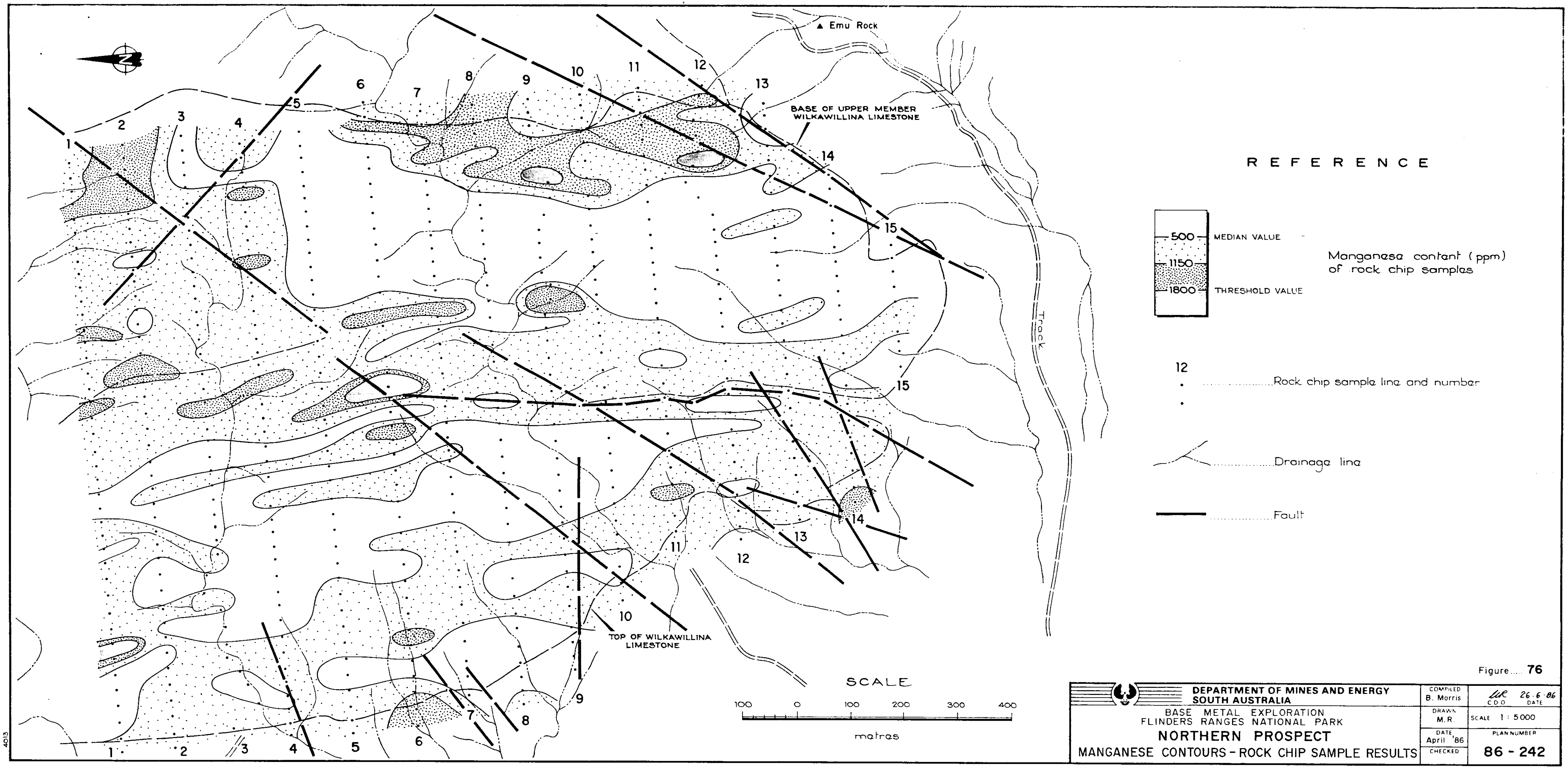

Figure 75

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

NORTHERN PROSPECT
ZINC CONTOURS - ROCK CHIP SAMPLE RESULTS

| | | |
|---|---|---|
| COMPILED B. Morris | CDO | DATE 26.6.86 |
| DRAWN M.R. | SCALE 1 : 5000 | |
| DATE April '86 | PLAN NUMBER | |
| CHECKED | 86-241 | |



Emu Rock
BASE OF UPPER MEMBER WILKAWILLINA LIMESTONE
TOP OF WILKAWILLINA LIMESTONE
Track
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
REFERENCE
500 MEDIAN VALUE
1150
1800 THRESHOLD VALUE
Manganese content (ppm) of rock chip samples
12 Rock chip sample line and number
Drainage line
Fault
SCALE
100 0 100 200 300 400
metres
DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA
BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
NORTHERN PROSPECT
MANGANESE CONTOURS - ROCK CHIP SAMPLE RESULTS
COMPILED B. Morris
DRAWN M.R.
DATE April '86
CHECKED
CDO 26.6.86 DATE
SCALE 1 : 5000
PLAN NUMBER 86 - 242
4013


Figure 76

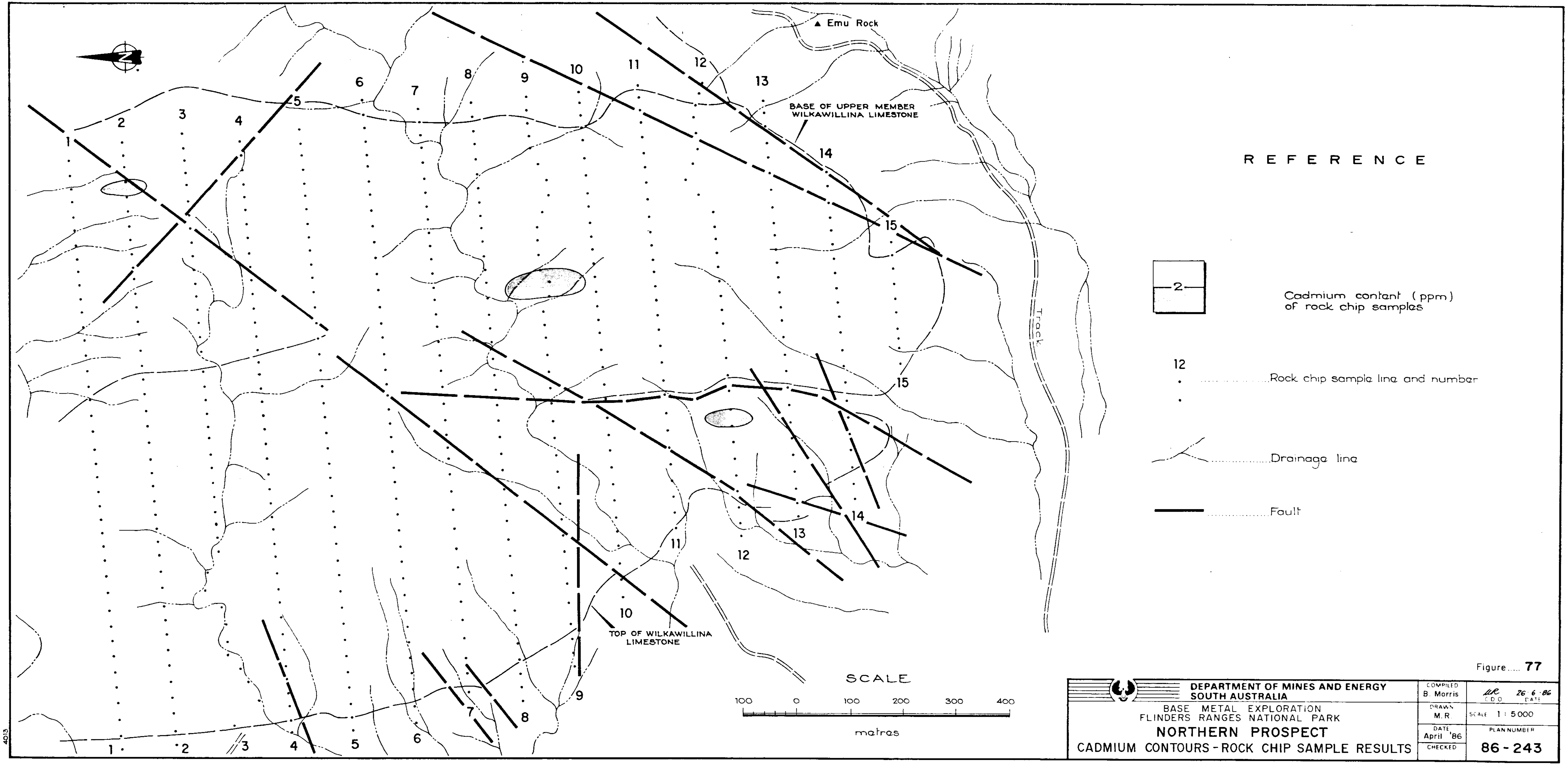



Figure 77

| | | |
|---|---|---|
| DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | COMPILED B. Morris | C.D.O. 26-6-86 DATE |
| BASE METAL EXPLORATION FLINDERS RANGES NATIONAL PARK | DRAWN M.R | SCALE 1 : 5000 |
| NORTHERN PROSPECT | DATE April '86 | PLAN NUMBER |
| CADMIUM CONTOURS - ROCK CHIP SAMPLE RESULTS | CHECKED | 86-243 |

4013

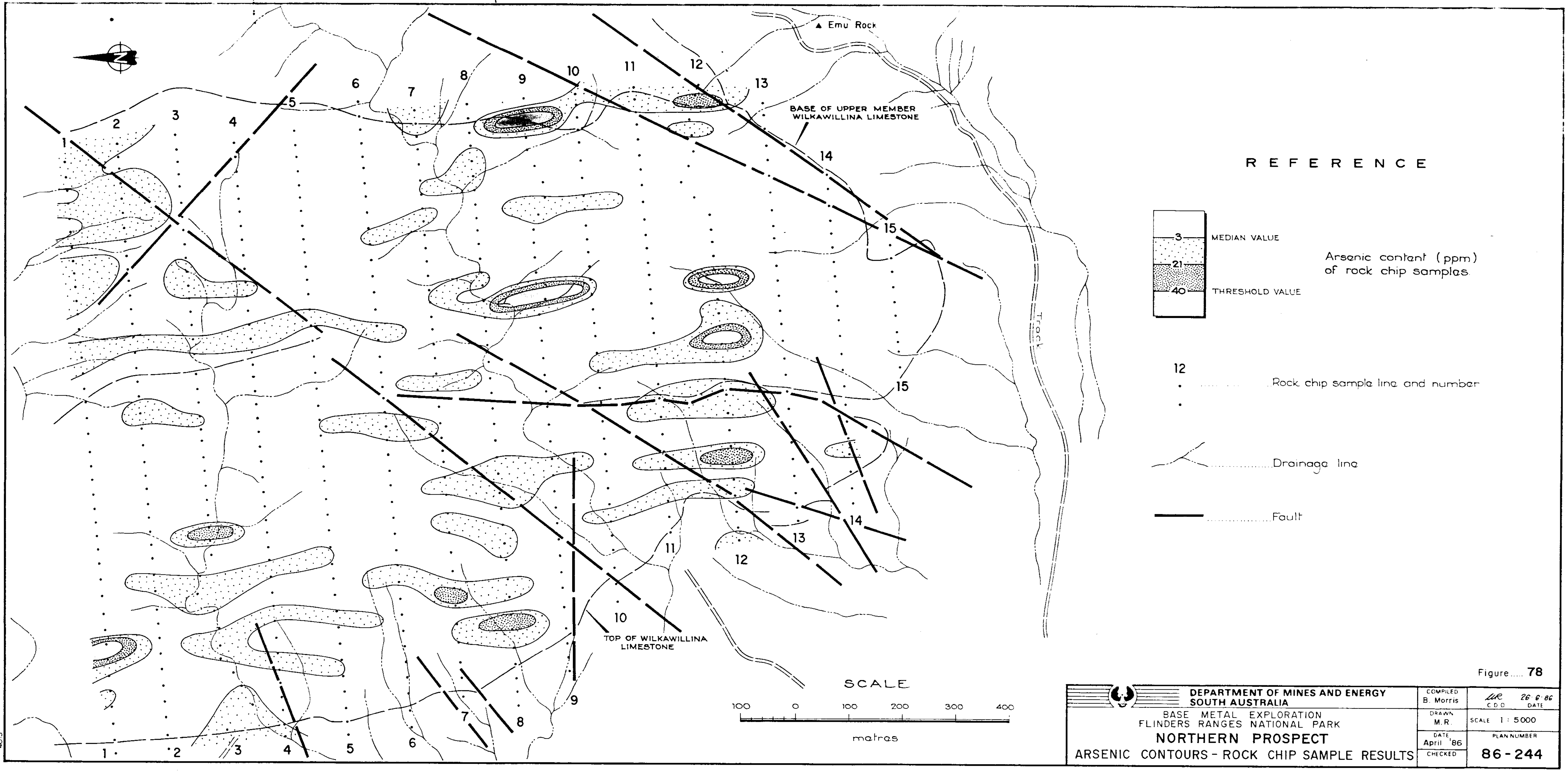



Figure 78

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

NORTHERN PROSPECT

ARSENIC CONTOURS - ROCK CHIP SAMPLE RESULTS

| | |
|---|---|
| COMPILED B. Morris | C.D.O. 26.6.86 DATE |
| DRAWN M.R. | SCALE 1 : 5000 |
| DATE April '86 | PLAN NUMBER |
| CHECKED | 86-244 |

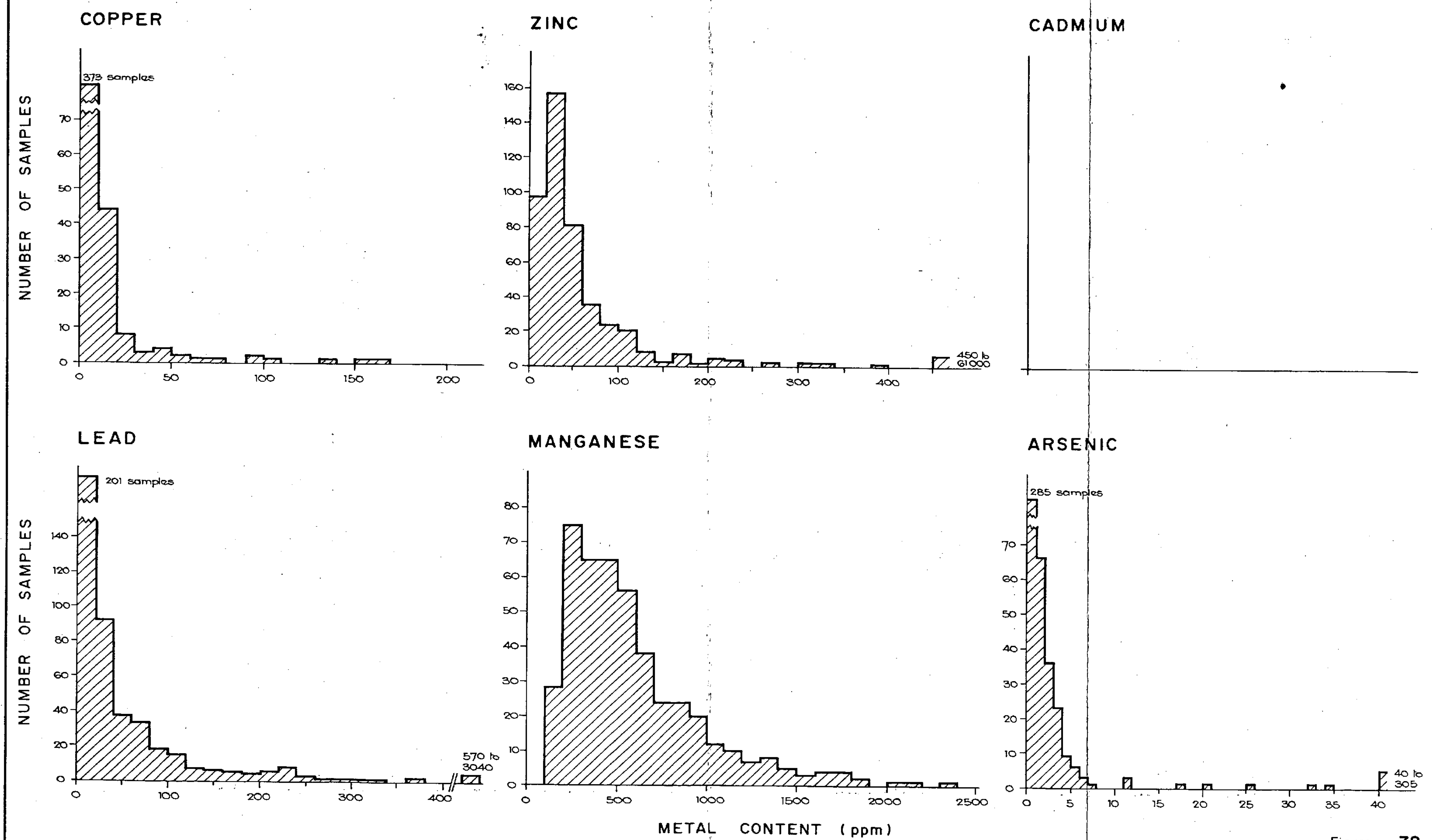



Figure ...... 79

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK
**NORTHERN PROSPECT - Rock chip samples**
FREQUENCY DISTRIBUTION GRAPHS OF METAL CONTENT

| | | |
|---|---|---|
| COMPILED B. Morris | C.D.O. | DATE 26·6·86 |
| DRAWN M.R. | SCALE Graph | |
| DATE March '86 | PLAN NUMBER | |
| CHECKED | 86 - 245 | |

4013

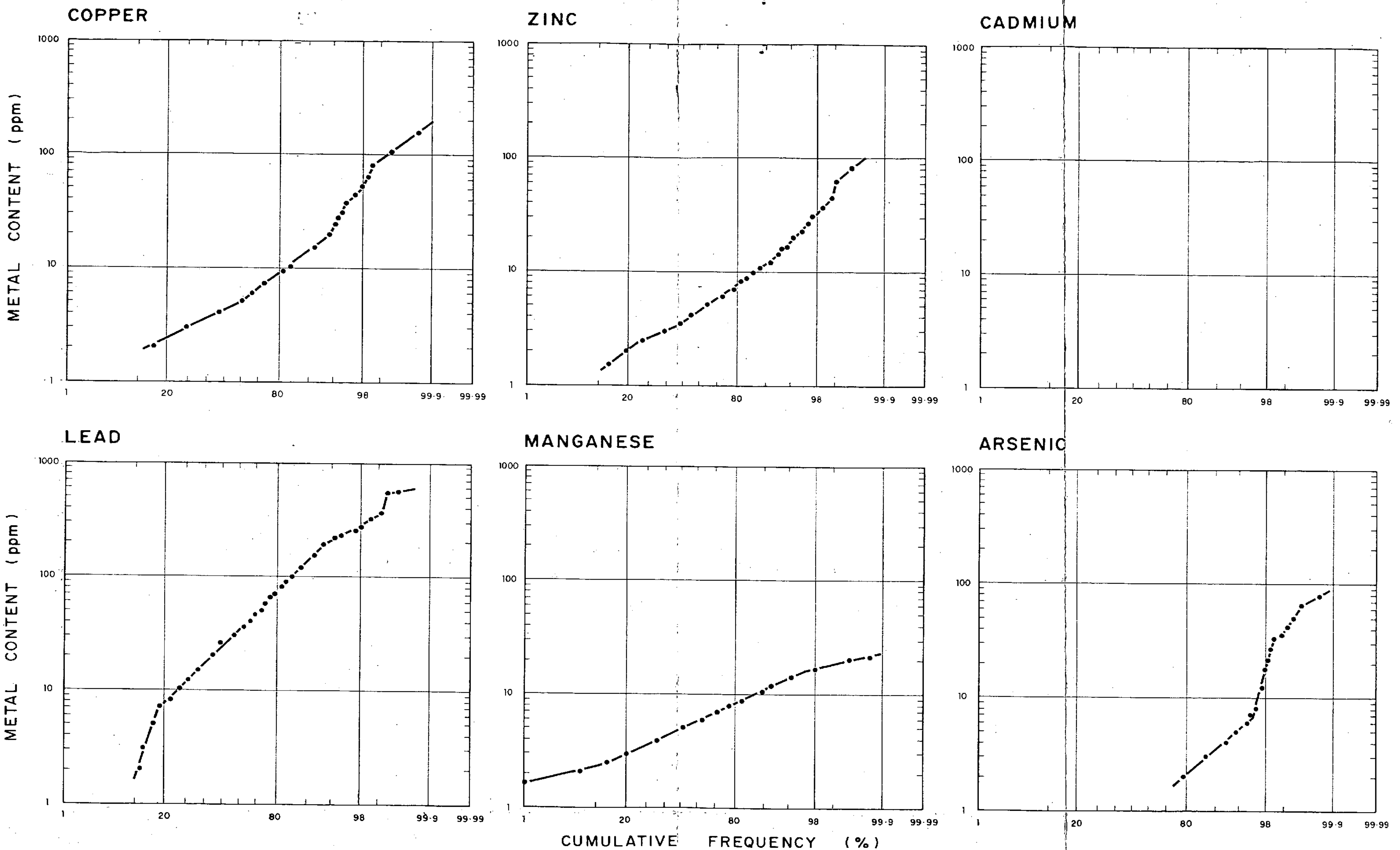



Figure 80

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

BASE METAL EXPLORATION
FLINDERS RANGES NATIONAL PARK

**NORTHERN PROSPECT - Rock chip samples**
**LOG PROBABILITY GRAPHS OF METAL CONTENT**

| | | | |
|---|---|---|---|
| COMPILED | B. Morris | C.D.O. | DATE 26·6·86 |
| DRAWN | M.R. | SCALE | Graph |
| DATE | March '86 | PLAN NUMBER | 86 - 246 |
| CHECKED | | | |