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1962/137

GEOCHEMICAL INVESTIGATIONS AT McARTHUR RIVER NORTHERN TERRITORY.

by

A.G. Fricker.

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GEOCHEMICAL INVESTIGATIONS AT McARTHUR RIVER

NORTHERN TERRITORY

SUMMARY

Previous geochemical work in the area surrounding the H.Y.C. zinc-lead-silver prospect at McArthur River, Northern Territory, was mostly unsuccessful. It was considered that this may have been due to the fact that the samples were taken from too shallow a depth and in 1961 the Bureau of Mineral Resources undertook further geochemical studies in the area in an attempt to improve on the previous chemical and sampling techniques.

This work was successful and the results were applied elsewhere in the area to delineate probable recurrences of the mineralised pyritic shale in which the H.Y.C. prospect occurs.

A useful exploration tool, suited to the locality, was found in the study of creek sediments.

INTRODUCTION

Location

The McArthur River flows from the Barkly Tablelands into the south-western section of the Gulf of Carpentaria. It is tidal up to Borroloola, about 20 miles from the coast. McArthur River Homestead, now derelict, is 43 road miles south-south-west of Borroloola and 550 miles from Mt. Isa. The approximate position of the homestead is - Latitude $16\frac{1}{2}^{o}$S, Longitude 136^{o}E (Plate VI). Access is by formed gravel road off the Stuart Highway at Daly Waters, or by station track off the Barclay Highway through Brunette Downs, Anthony Lagoon and Malapunyah stations.

Soils, Topography and Vegetation.

The general term "soil" here means one or more subdivisions of alluvium, eluvium or residuum, which are defined as follows :

Alluvium - detrital matter deposited by large modern rivers, and including the sediments laid down in river beds, flood plains, lakes, fans at the foot of mountain slopes, and estuaries (Holmes 1928). Alluvium in the McArthur River area is the deep widespread detritus on the McArthur River and Barney's Creek flood plains (Plate IV). It is grey to grey-brown, is commonly fine-grained sand, in places clayey and commonly carries travertine and gypsum.

Eluvium - detrital deposits resulting from small surface waters and wind, including hill wash, soil creep and wind drift. Eluvium is of local origin. Eluvium in the area is the thin and patchy detritus outside the flood plains of the McArthur River and Barney's Creek. It is grey-brown and is more variable in grain size, and more clayey then the alluvium.

Residuum - the material resulting from the decomposition of rocks in situ and consisting of the material left after removal of more readily soluble constituents (Fay, 1920). Residuum in the area is brown to red-brown, carries much float material, and is commonly overlain by alluvium or eluvium.

Between the Reward prospect and the Emu Fault to the east (Plate VI) the country is mostly flat with low rounded hills. The permanent watercourse of the McArthur River is lined by dense undergrowth and tall timber, whereas the seasonally dry country is savannah woodland. Mitchell grass grows profusely on open alluvium, but is replaced by "spear" grass and small shrubs in the timbered areas.

Geology and Mineralization

The required geology of the Bauhinia Downs 1:250,000 Sheet area, which includes the McArthur River district, is described by Smith (Rec. 1962/111) and by Dunn, Smith and Roberts (in preparation). The work of Mt. Isa Mines Ltd. (M.I.M.) and Carpentaria Exploration Co. (C.E.C.) in the McArthur River area is described by Kriewaldt (1957), Beresford (1957) and Cotton (in preparation).

Lead is found throughout the Amelia Dolomite, and Barney's Creek Member (called the H.Y.C. sequence by the Company Geologists) around McArthur River. Mineralization at the H.Y.C., W-Fold, and Teena prospects (Plate VI) is in the Barney's Creek Member, and shows a marked stratigraphic, but no apparent structural control. The Member consists of - bottom to top-laminated dolomite, green vitric tuff, lower barren shale, pyritic shale, upper barren shale, and dolomite breccia. Mineralisation is strongest in the pyritic shale. The Bald Hills, Barney's and Cooley's lead prospects are in underlying formations.

History

The history of mining in the area is described by Beresford (1957) and Kriewaldt (1957). Lead mineralisation was discovered near McArthur River Homestead in 1887 by T.C. Lynott. The first official investigation was three years later by Parkes (1891), who examined some of the copper and lead leases, but recommended that they be abandoned with the exception of Cook's prospect, in the Coxco valley, 8 miles south-east of the homestead. In 1912 Cook's prospect was drilled by the McArthur River Company, but results were not encouraging and the prospect was abandoned. No further interest was shown in the area until 1953 when Australian Mining and Smelting Company (1953) drilled the Bald Hills (Bulburra) lead prospect; results were discouraging.

In 1955 M.I.M. applied for an Authority to Prospect in the McArthur River area and began a programme of regional mapping and prospecting which resulted in the discovery of the Reward, Teena, W-Fold and H.Y.C. prospects. Since then M.I.M. has carried on geological, geophysical and geochemical investigations and diamond drilling. Early in 1961, C.E.C. was formed as a subsidiary of M.I.M. and the new Company continued the work in the area.

Previous Geochemical Prospecting

Crabb (1956) carried out reconnaissance geochemical prospecting over large areas of the Coxco valley, and between the Reward and H.Y.C. prospects. The method successfully delineated areas of known outcropping mineralization, and outlined some previously unknown mineralised areas. However the strength of the anomaly at the strongly mineralised H.Y.C. prospect was surprisingly low and no greater than that of anomalies from much weaker mineralization elsewhere.

General

The possibility of a recurrence of mineralization similar to the H.Y.C. and the limitations of the previous geochemical survey made it desirable to carry out further geochemical investigations and to try and improve the techniques and to see if the reason for the lack of definition in the H.Y.C. results could be found.

This work was undertaken by the Bureau, a chemist and two assistants, worked in the area from May to September, 1961. A Proline power auger and operator were provided by the Company. The H.Y.C. prospect was chosen initially as a study area in order to establish suitable analytical and sampling techniques, which could then be applied in areas covered by deep alluvium where the Barney's Creek member was expected to be present. Prospects selected by the Company geologist in non-alluvial areas, as possible repetitions of the Barney's Creek Member, were also studied. Later because of drilling difficulties, the Proline was removed from service, and the study was confined to non-alluvial areas.

SAMPLING PROCEDURE

The Proline drill was used to sample deep soils in the alluvial areas. A hand auger was used at places inaccessible to the Proline, and in those areas where the soils were shallow. A sampling depth of one foot, which Crabb (1956) had found satisfactory, was adopted in non-alluvial areas.

Creek sediments and bank soils (about 2 feet above the bed) were sampled at the surface and at a penetration of one foot.

ANALYTICAL PROCEDURE.

Samples were dried, crushed, and the minus 40 mesh fraction taken for analysis. Various chemical attacks to digest the sample were studied. The potassium bisulphate fusion was finally chosen as achieving the greatest digestion (desirable for alluvium) even though less rapid. Colourimetric determinations were made, using dithizone for zinc and lead, and biquinoline for copper (U.S. Geol. Survey 1953).

The method of Bloom (1955) for extracting the citrate-soluble heavy metals was employed in the creek sediment study.

Blank runs were made with each batch and demineralisation of the river water was not found to be necessary.

AREAS OF STUDY.

H.Y.C. PROSPECT

The outcrop of the H.Y.C. prospect is 1¼ miles downstream from the McArthur River Homestead and consists of a secondary enrichment of hemimorphite in dolomitic breccia.

The source of the secondary mineralisation is the ore bearing shale which underlies the breccia. The breccia and shale are part of the Barney's Creek Member, which crops out through deep widespread alluvium to the west of the river and forms the Barney's Hill Anticline. The H.Y.C. prospect is on the eastern limb of the anticline. Mineralisation in the shale follows the bedding planes and consists principally of fine-grained pyrite, sphalerite and galena. Sphalerite occurs throughout the groundmass and minute, cross-cutting veins of galena are present. The mineralised beds at the H.Y.C. have a strike length of several thousand feet. Drilling is in progress to determine the full extent of the mineralised zone. The highly leached outcropping shale carries some lead and traces of zinc. Lead is not visibly enriched in the dolomite breccia. Plate 1A illustrates the traverses where the vertical zinc and lead distribution profiles were studied, and these are shown as block diagrams on Plate IB.

Discussion

The alkalinity of the alluvium greatly reduces the dispersion of zinc and lead which have vertical dispersions of 12 to 15 foot and 8 to 10 foot respectively. The distribution profiles in hole A3 (Plate I-B) is typical in that the lead and zinc initially increase with depth but later decrease. Otherwise the zinc and lead content of the alluvium increases exponentially with depth. The profiles shown on Plate I-B illustrates a general high zinc and lead content in soils above the breccia, and a lower content above the shales. Proportionately, zinc is more enriched than lead in the breccia, and has been more extensively leached from the shale.

2 MITCHELL YARD

At Mitchell Yard the Barney's Creek Member crops out in a south west plunging synclinal nose, on the eastern side of the river 2 miles south-south-east of the McArthur River Homestead. Across the river the syncline is buried beneath deep alluvium (Plate II-A). Significant zinc values were found in the soil above the shale on the eastern side of the river as shown by Proline drill holes Nos.1 and 4 (Fig.1.)

Depth	No.1		No.2		No.3		No.4	
	Zn	Pb	Zn	Pb	Zn	Pb	Zn	Pb
0-			20-	10	20-	10		
	25-	10	20-	15				
10'-			20-	10				
	20-	10			50-	15	5000-	560
	20-	10						
20'-	380-	30	(all values in p.p.m.)					

Figure 1: Distribution of zinc and lead in soils from Proline drill holes Nos.1 to 4. (Plate II-A).

The presence of zinc encouraged the Company to drill D.D.Hs. Nos. 1 and 2 on the western side of the river. Both of these intersected pyritic shale with low grade lead and zinc mineralisation (Table 1). The distribution of zinc in the soil profile of traverses A,B and C (Plate II-A) was then determined. The results are represented as block diagrams on Plate II-B. The geochemical work was followed by the D.D.Hs. Nos. 3 to 6 which penetrated the alluvium and cored five feet of bedrock (Table 1) and proved a closed syncline.

	D.D.H.1	D.D.H.2	D.D.H.3	D.D.H.4	D.D.H.5	D.D.H.6
Declination	60°	70°	Vertical	Vertical	Vertical	Vertical
Depth to bedrock.	80'	70'	45'	55'	76'	72'
Nature of bedrock	pyritic shale with specks of galena and sphalerite 0.7 to 1.1% Zn		green tuff			

Analyses on soils collected in drill	D.D.H.4	D.D.H.5	D.D.H.6
Depth	8-10' light red brown	8-10' light brown	8-10' grey
Zinc in p.p.m.	25	55	25
Lead in p.p.m.	10	25	15

Table 1. Information from D.D.Hs. Nos. 1 to 6.

Discussion

Diamond drill holes Nos, 1 to 6, show a deep alluvial cover, in which gypsum and travertine are present and low dispersion of metal ions can be expected. High zinc values are recorded in the profiles of holes 7 and 10 of traverse B (Plate II-B). These holes penetrated near to bedrock and are near to outcropping dolomite, which carries visible galena. Galena in these dolomites is known to carry very significant, if not visible, zinc. Hence the high zinc values may be related to the dolomite, and the significant zinc values in the profile of holes 1 and 9 of traverse C (Plate II-B) could trace the dolomite closing the syncline. Mineralised shale would not have been detected except where overlain by less than 30 feet of soil cover. The generally low values found by the geochemical work are in agreement with the information from the diamond drillings, which shows Mitchell Yard as uneconomic.

(3) TEENA

The Teena prospect is at an isolated hill about 6½ miles west of the McArthur River Homestead. The mineralised beds, belong to the Barney Creek Member, which is silicified on the surface.

Cerussite and anglesite are rarely visible in hand specimens but field tests by the Company indicated the presence of lead in the silicified shales. Costeaning revealed 4 percent lead over a 200 ft. width. Previous geochemical work had outlined the outcrop as a very low order anomaly.

The surrounding plain has slight drainage to the south. There is little undergrowth beneath the general light timber, but there is some grass cover where thin patchy eluvium overlies residuum.

Soils were sampled as near as possible at a depth of 1 ft., at intervals of 100 ft. on traverses 150 ft. apart in an area 1650 ft. by 1200ft.. The zinc and lead analyses are shown on Plates IIIA and IIIB and their distributions illustrated by contour isograds. The background values of 350 p.p.m. for zinc and 25 p.p.m. for lead were selected as the most common of the lower values within the grid. The relationship of the geochemical centres and geology is shown on Plate III-C. Samples of the dumps at the eastern ends of the two larger costeans did not show any exceptional differences from the surrounding soil.

Discussion.

The zinc anomaly shows two zones of zinc mineralization. The western zone is coincident with the green vitric tuff, and the eastern zone is in soil overlying the shales. The zinc "low" over the silicified shales may reflect the loss of zinc prior to and during silicification.

The lower isograds of the lead anomaly approximately follow the base of the hill. The area of greater than 24 times background overlies the green tuff and lower barren shale. The laminated dolomite, which elsewhere carries galena, is not reflected in the anomaly. The southern swing of the lead anomaly to the west, off the outcrop, corresponds to an apparent dispersion channel.

Because of its high mobility zinc disperses readily giving rise to large areas of anomalous zinc content. Where the area being surveyed is restricted the apparent background value will be high, consequently lowering the contrast of any anomaly within the survey area. Lead however is considerably less mobile than zinc, and the restricted dispersion commonly allows the true background to be determined even in small survey areas. Thus the lead anomaly shows a high contrast to the zinc anomaly. These considerations of course do not apply where dispersion is purely mechanical. However, in my opinion the difference of mobilities is not considered sufficient to account for the contrast between the lead and zinc anomalies. I consider this contrast infers a predominance of lead, at least on the surface, in the shales and tuff. As the sampling conditions were very good, the geochemical anomalies are not of sufficient magnitude to warrant further investigation.

Diamond Drill Information.

The Company drilled the prospect shortly after the geochemical survey was completed.

The drill site and section are shown on Plate III-C. Residuum was encountered to bedrock at 20 feet. The pyritic shale, intersected by the drilling, was poorly mineralised, and the best assays recorded were 1.9 percent zinc and 0.4 percent lead.

4 REWARD CROSSING

The Reward Crossing area is where the road to Reward prospect crosses Barney's Creek, 1.6 miles north of the McArthur River Homestead (Plate IV). The western limb of the Barney's Hill anticline disappears beneath soil cover just south of the Crossing. Where the limb disappears, Barney's lead prospect occurs in the "chocolate" dolomite which underlies the Barney's Creek Member.

Geochemical prospecting was used in an attempt to prove a continuation of the Barney's Creek Member in this area. An area 2000 ft. by 9000 ft. was gridded and is outlined on Plate IV. The major axis of the grid follows a very gentle ridge which runs south-west from Barney's prospect and disappears at the western end of the grid. Moderate timber and quite dense undergrowth grow on the residuum along the ridge. The timber thins out on the flanks of the ridge, and there is thick grass on the eluvium and alluvium below the ridge. On the edges of the grid the alluvium deepens and is potted with soaks.

The grid was sampled at a depth of 1 ft. at intervals of 100 ft. by 400 ft. in the western section and 200 ft. by 400 ft. in the eastern section. Zinc determinations only were made. Individual analyses are not given here as values were generally low. However the distribution of zinc is illustrated by the contour isograds, which are multiples of the background (40 p.p.m.). Zinc was chosen as the most suitable pathfinder of the mineralised shale, as the zinc to lead ratio is generally greater in the pyritic shale than in the dolomites. Concurrently with the geochemical survey D.D.H. R.C. No.1 was drilled and intersected the "chocolate" dolomites in which Barney's prospect is found. The core carried patchy galena and some sphalerite.

Discussion

The alluvium is deeper to the west of the grid, and hence the low-order western anomaly may have greater significance than is apparent from its magnitude. The displacement in the north-east section of the western anomaly may represent a fault. The eastern anomaly is formed in residuum, but the south-east part is in deepening alluvium, and thus may have been reduced in extent. The trend of the anomaly follows the line of strike of the "chocolate" coloured dolomites.

Only a small part of the area overlying the inferred continuity could be examined as the remainder would involve deep sampling.

Further geochemical work with deeper sampling is required in this area before it can be completely evaluated. This is clearly illustrated by the values for zinc (1200 - 3000 ppm) and lead (400 - 600 ppm) found in the sub-soil in D.D.Hs, RC 4, RC 5 and RC 8 (Table 2) all in an area showing less than 80 ppm Zn at the surface.

Diamond Drill Information.

Subsequent to the geochemical survey the Company investigated the underlying bedrock by drilling a number of holes through the overburden and coring five feet of bedrock. A few of the holes are illustrated on Plate IV and Table 2 records the depth and type of bedrock beneath the overburden. A few analyses were made on soils obtained during drilling.

	RC.No.1.	RC.No.2.	RC.No.3.	RC.No.4	RC.No.5.	RC.No.6.	RC.No.7.	RC.No.8.
Depth to bedrock	12'	16-30'	17-24'	15-38'	50-76'	63-76'	50-66'	48-56'
Nature of bedrock	green tuff				pyritic shale		dolomite and siltstone	

Analyses on soils obtained during drilling.

Depth	15-16'	8-12'	7-9'	18-23'
Colour	grey-buff	red-brown	orange-red	buff
Zinc in ppm	180	3000	1200	1500
Lead in ppm	90	600	400	500

Table 2 - information from diamond drill holes at Reward Crossing.

W-FOLD

W-Fold is a much faulted and folded outcrop, 3.3 miles west-north-west of the McArthur River Homestead. Silicified rocks of the Barney's Creek member are exposed in two synclines (Plate V-D). Traces of cerussite, minium, hydrozincite and ankerite can be seen in hand specimens of the silicified shale. The Company identified a lead manganate in a ferruginised gravel, that forms a mound west of D.D.H. W-Fold No.1 (Plate V-D).

W-FOLD NORTH

The eastern syncline disappears beneath the soil cover, and is thought to be linked with the western limb of the Barney Hill anticline, 3 miles to the east. Shale, with traces of sphalerite and galena was obtained in the core of D.D.Hs. W-Fold Nos. 1 and 2 (Plate V-D) which encountered much cross-faulting and shearing, and were abandoned. Residuum is overlain by thin eluvium north-east of W-Fold. Outcrop, in most places unidentifiable, commonly just breaks the surface.

A grid 3000 ft. by 2000 ft. was chosen to traverse the continuation of the Barney's Creek Member inferred from geological mapping and photo-interpretation. Samples at 1 ft. depth were taken at 200 ft. intervals on traverses 400 ft. apart and analysed for zinc only.

Discussion

The anomaly does not appear to follow the known trend of the rocks. (Plate V-D). The 150 and 300 ppm isograds in the south-east corner of the grid (Plate V-A) have a topographical, and probably lithological significance.

Siltstone float and higher ground are to the east and dolomite float to the west. Bedrock in drill holes W-Fold Nos. 6 and 7 is oxidised yellow and light grey shale. The anomaly centre lies to the south, towards D.D.Hs. Nos. 1 and 2 as shown by traverses A', A_0' and B' (Plate V-A). The creek to the south of the grid precludes the anomaly being derived by drainage of the mineralisation around D.D.Hs. Nos. 1 and 2. Under the favourable sampling conditions around D.D.Hs. Nos. 1 and 2 the medium to low order geochemical anomaly is not indicative of strong mineralisation.

(6)

W-FOLD WEST

The western syncline broadens and disappears beneath soil cover. The northern limb probably terminates at a fault west of Bald Hills and the southern limb swings south (Plate V-D). The pyritic shale of the Barney's Creek Member is soil covered. Travertinised upper barren shale just crops out west of the syncline. The Bald Hills prospect in the northern part of the grid (Plate V-D) carries galena in "chocolate" dolomite, with minor sphalerite, barytes and malachite, and like the outcrop of W-Fold, forms a small hill.

Light timber and undergrowth occur around the sparsely covered prominent outcrops. The residuum is partly covered by eluvium, except to the south-west of the grid, where deeper alluvium, potted with soaks, is present. Drainage within the grid is from the north to the south-east corner.

An area 7000 ft. by 2500 ft. was sampled at intervals of 200 ft. on traverses 400 ft. apart, and zinc and lead determinations were made. Background values of 200 and 50 ppm for zinc and lead respectively, were selected as the most abundant of low values within the grid.

Discussion

The lead distribution (Plate VC) shows distinct dispersions from the Bald Hills prospect and from the northern synclinal limb. The superimposed zinc dispersions (Plate VB) are most probably due to the greater mobility of zinc. Both distribution patterns have similar outlines and are coincident with the southern limb. The anomalies cut out and reappear in the south-west corner where the alluvium reduces the intensity of the anomaly. The small zinc and lead anomaly centres near co-ordinates, D31 (Plates VB and C) are coincident with outcrops of steeply dipping shale and tuff. The anomalies definitely reflect the lithologies, even though partly formed in the drainage path from Bald Hill. The low mobility of lead and the swing of the anomalies to the south-west discount drainage as the causative agent.

The anomalies indicate mineralization in the northern synclinal limb similar to that at Bald Hills. Mineralization is not visible in the weathered shale of the syncline but, as at the H.Y.C., could exist at depth. The anomaly centres record values of 16 times background and are indicative of strong mineralisation.

(7)

BULL CREEK

The Barneys Creek Member crops out in Bull Creek, one mile east of the H.Y.C. prospect, and is probably synclinal between the two localities (Plate VI).

Cooley's prospect (galena, with minor malachite and barytes) is east of Bull Creek, in the Ngarijinma limestone which lies below the Barney's Creek Member. Traces of malachite are present in the dolomite breccia of the Barney's Creek Member. The syncline is displaced by the Bull Creek Fault and is covered in part by thick alluvium. Deep channels have been cut in the alluvium by the creeks, the beds of which give closer access to the underlying rock. Because of the desirability of sampling close to bedrock and the reconnaissance nature of the work in this area, the distribution of zinc in the soil of the creek beds was chosen for study. The two small creeks near D.D.H. F.T.1 where the southern continuation of the shales of the H.Y.C. crosses the McArthur River; and the creeks near D.D.H. F.T.S.2 where shale is exposed in Bull Creek (see Plate VI) were investigated.

Silicified shale crops out in the small creek immediately south of D.D.N. F.T. No.1. The outcrop occurs a little above the confluence with the McArthur River, and samples near to the outcrop showed the presence of zinc mineralisation. Evidence of mineralization was not obtained in the small creek immediately south of that just described and where the continuation of the shale again crops out.

Several small creeks of the Bull Creek system traverse the Barney's Creek Member. The creeks investigated did not reveal evidence of mineralisation.

Discussion.

F.T. No.1 intersected shale carrying visible galena and sphalerite, which is reflected in distribution of zinc in the soil of the nearby creek bed. The silicified shale in the next creek south was traversed, but the results obtained from the creek bed soils indicate that the shale here does not carry zinc minerals.

The absence of zinc in the creek bed soils of the small creeks at Bull Creek, where sampling conditions are relatively better, infer barren shales. F.T. No.2 intersected barren shale and proved the Member to be unmineralised.

CREEK SEDIMENT STUDY.

Towards the end of the survey, a rapid but incomplete study of the creek sediments was made. The order of mineralisation in the sediments of Barney's Creek and tributaries, and the small creek draining into the McArthur River immediately south of diamond drill hole F.T. No.1, is illustrated on Plate VI. The study has shown the W-Fold area as potentially mineralised and indicated mineralization near the silicified shale outcropping in the creek by F.T. No.1 (see Bull Creek area). It also suggests mineralization in or near to the Reward Crossing area.

The results are in agreement with the other studies made, and indicate that effective reconnaissance surveys could be carried out under these climatic conditions using Bloom's citrate extraction method.

CONCLUSIONS.

The results were statistically analysed in the manner suggested by Tennant and White (1959). Logarithmic and arithmetric probability plots show the number of populations in each area. Background mineralisation, significant mineralisation and potential ore would show as three populations, in an area in which a sufficient number of observations has been made. Hence in a geochemical distribution a third population may be indicative of potential ore. However change of sampling conditions (e.g. from soil flats to outcrop), soil type, vegetation etc. provide their own populations and must be considered in the interpretation of plots. A third population was obtained in some of the areas, namely those of the H.Y.C., Reward Crossing and W-Fold West Prospect, but from an insufficient number of observations to give full weight to the result. A more detailed study of the results could lead to an improved interpretation.

The geochemical investigations delineated areas of mineralization, some of which were previously known and subsequently found to be uneconomic. The full potential of the W-Fold area is unknown. Continued geochemical prospecting would be profitable if further drilling is envisaged in the area south-east of the W-Fold North grid. The extension of the W-Fold West grid would provide more information on the mineralisation of the southern limb. The whole area around W-Fold including the extension to Reward Crossing is worthy of continued exploration. The creek sediment study would be a useful exploration tool in neighbouring areas.

ACKNOWLEDGEMENTS

The use of the Proline auger drill and operator, co-operation and assistance on geological matters from the geologists of Carpentaria Exploration Co.Pty.Ltd. is gratefully acknowldeged. The facilities of the camp at McArthur River, and provision of maps by the Company are also appreciated.

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Plate IA

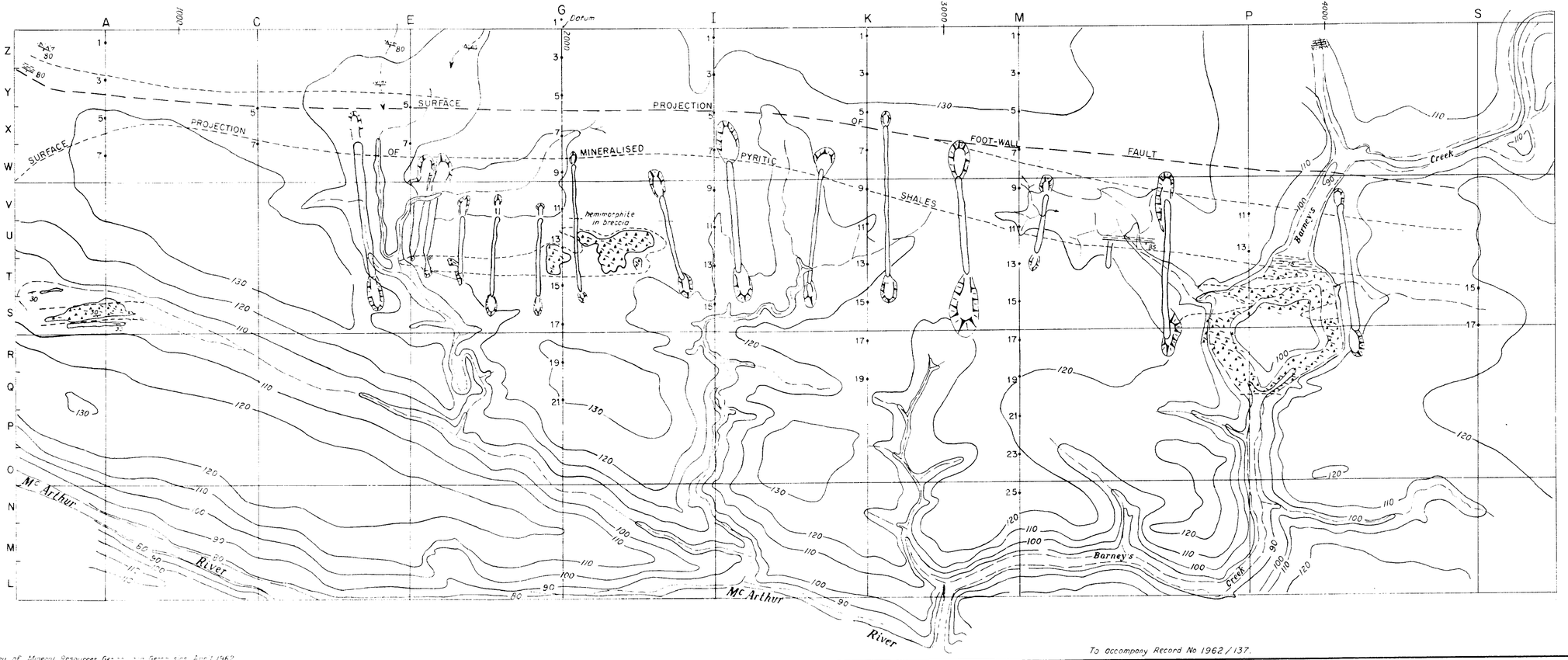
GEOLOGICAL MAP OF H.Y.C. SILVER-LEAD-ZINC PROSPECT

Mc ARTHUR RIVER N.T.

Geology and cartography by Carpentaria Exploration Co. Pty Ltd

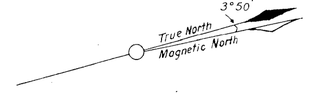
Scale

200 0 200 400 Feet



Reference

- slump breccia and "collenia" lenses
- mineralised pyritic shale
- green vitric tuff and siltstone
- laminated dolomite
- costeans
- A 1 / 3 — geochemical sample stations on existing grid
- 120 — topographical contours (datum unknown)



To accompany Record No 1962/137.

E53/3/8 Kc

Bureau of Mineral Resources Geology & Geophysics April 1962

GD 190

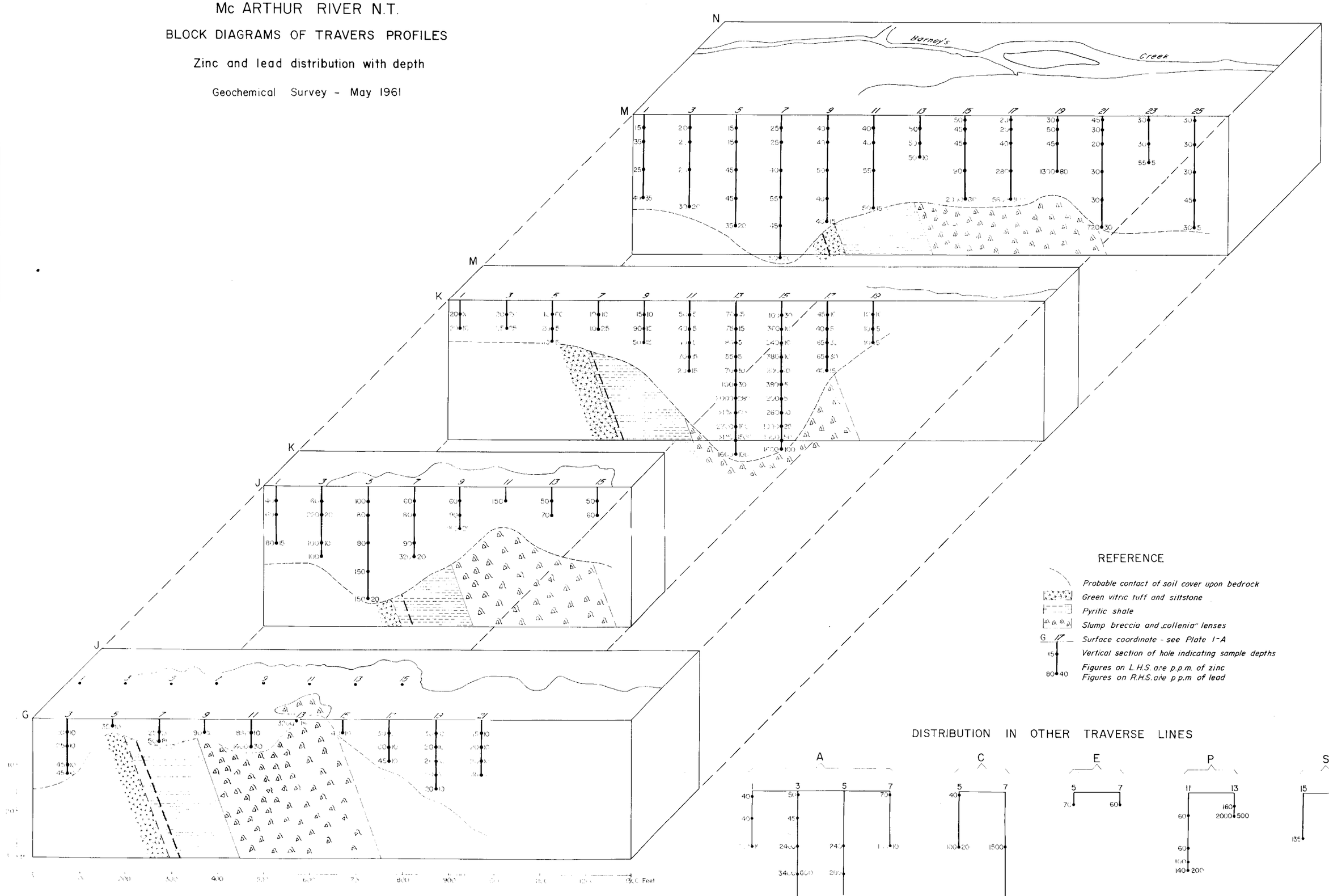
H.Y.C. PROSPECT

Mc ARTHUR RIVER N.T.

BLOCK DIAGRAMS OF TRAVERS PROFILES

Zinc and lead distribution with depth

Geochemical Survey - May 1961



REFERENCE

- Probable contact of soil cover upon bedrock
- Green vitric tuff and siltstone
- Pyritic shale
- Slump breccia and „collenia" lenses
- G 17 — Surface coordinate - see Plate I-A
- Vertical section of hole indicating sample depths
- Figures on L.H.S. are p.p.m. of zinc
  Figures on R.H.S. are p.p.m of lead

DISTRIBUTION IN OTHER TRAVERSE LINES

Bureau of Mineral Resources, Geology and Geophysics April 1962

To accompany Record No 1962/137.

E 53/3/12 JK

PLATE II-A

GEOLOGICAL MAP OF MITCHELL YARD PROSPECT

Mc ARTHUR RIVER, N.T.

Geology after Carpentaria Exploration Co. Pty. Ltd.

Scale

200 0 200 400 800 Feet

R E F E R E N C E

- Pyritic shale
- Green vitric tuff
- Interbedded siltstone and green vitric tuff
- Laminated dolomite
- Chocolate brown dolomite
- Geological boundary, position accurate
- " " , " approximate
- " " , " concealed
- Strike and dip of beds
- Trend of bedding
- Syncline, position accurate
- " , " concealed
- D.D.H 2 / D.D.H 4 — Diamond drill hole
- Road
- Proline drill hole sites (traverse profiles shown as Block Diagrams on Plate II-B)
- Pb Lead
- Cu Copper

Bureau of Mineral Resources, Geology and Geophysics. April 1962. To accompany Record 1962/137.

E 53/3/9 EJ

PLATE II-B

MITCHELL YARD PROSPECT

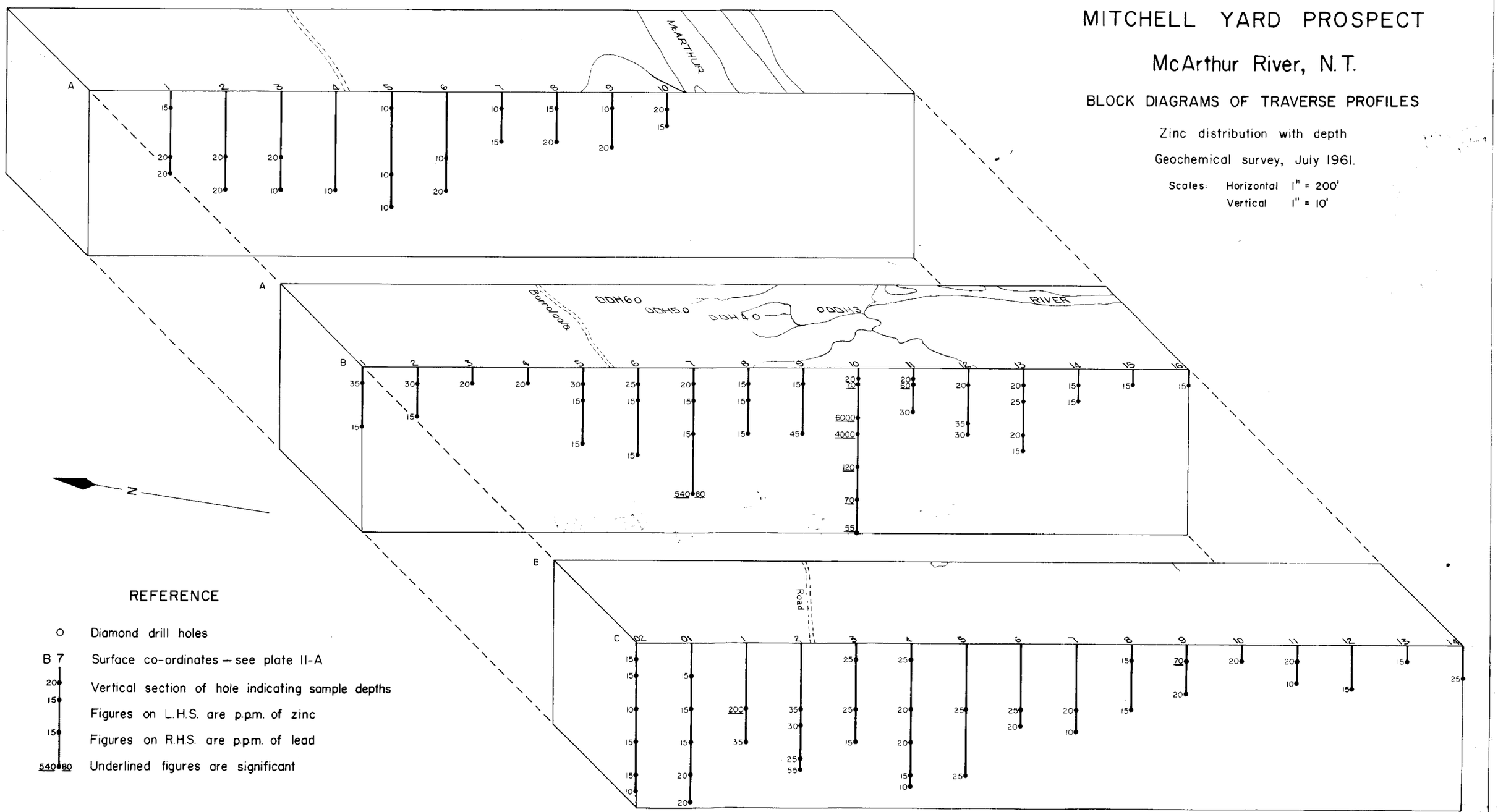
McArthur River, N.T.

BLOCK DIAGRAMS OF TRAVERSE PROFILES

Zinc distribution with depth

Geochemical survey, July 1961.

Scales: Horizontal 1" = 200'
Vertical 1" = 10'



REFERENCE

- O — Diamond drill holes
- B 7 — Surface co-ordinates — see plate II-A
- 20 / 15 — Vertical section of hole indicating sample depths
- Figures on L.H.S. are p.p.m. of zinc
- Figures on R.H.S. are p.p.m. of lead
- 540 / 80 — Underlined figures are significant

Bureau of Mineral Resources, Geology and Geophysics. April 1962.

To accompany Record 1962/137.

E53/3/13 RGW

PLATE III-A

GEOCHEMICAL SKETCH MAP OF TEENA PROSPECT

DISTRIBUTION OF ZINC IN SOILS AT A DEPTH OF 1 ft.

Mc ARTHUR RIVER AREA, N.T.

Background - 350 p.p.m.

Geochemical Survey - 1961

Scale

100 0 100 200 300 Feet

REFERENCE

680 — *Sample site and p.p.m. of zinc in soil at a depth of 1 ft.*

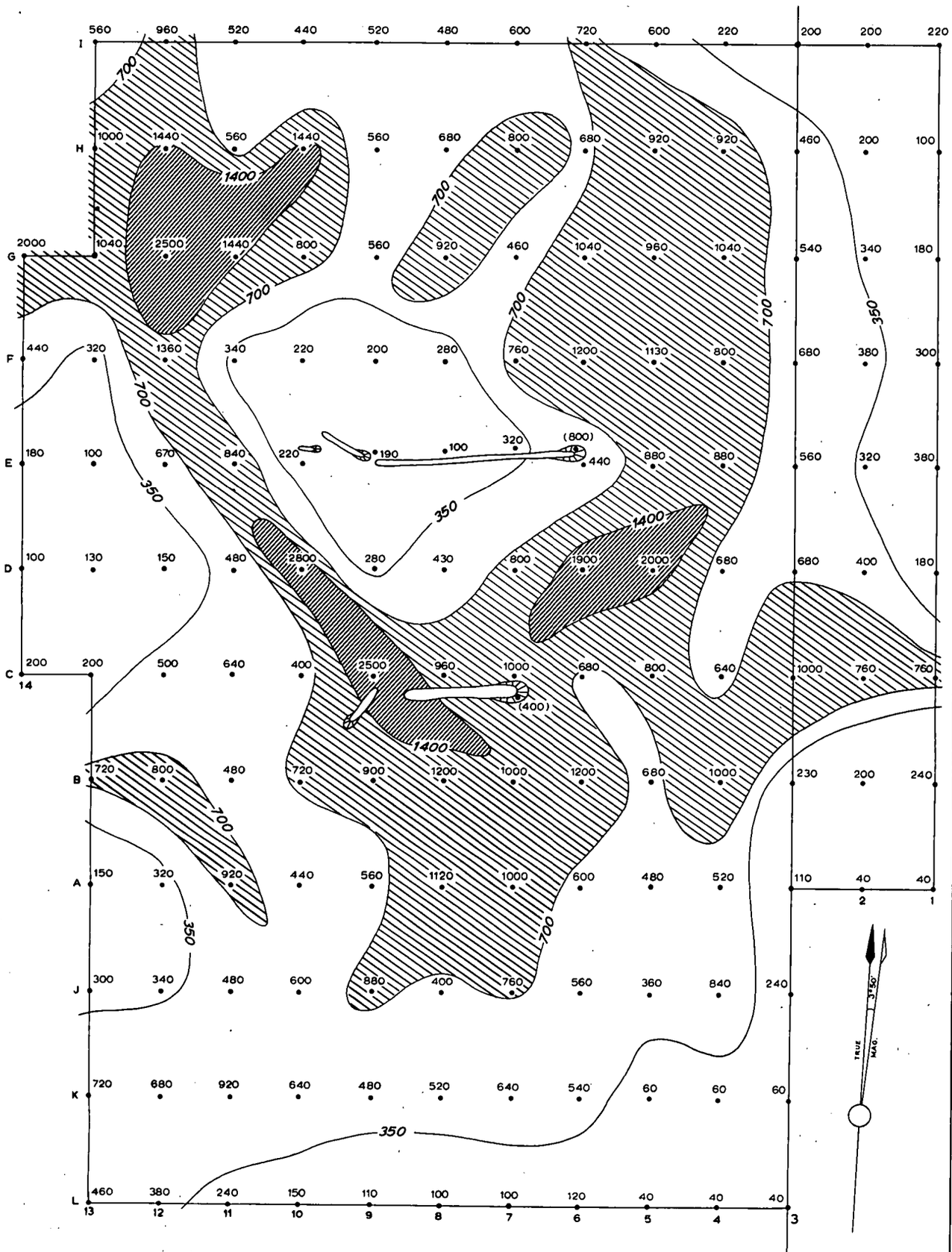
700 to 1399 p.p.m. zone (2-4 x background)

1400 p.p.m. and above zone (>4 x background)

(800) — *Costean, with p.p.m. of zinc in sample from dump*

Geochemical grid boundary

700 — *Zinc isograds in p.p.m.*



Bureau of Mineral Resources, Geology and Geophysics. March 1962.

To accompany Record 1962/137.

E 53/3/1 EJ

GD135

PLATE III-B

GEOCHEMICAL SKETCH MAP OF TEENA PROSPECT

DISTRIBUTION OF LEAD IN SOILS AT A DEPTH OF 1 ft.

Mc ARTHUR RIVER AREA, N.T.

Background - 25 p.p.m.

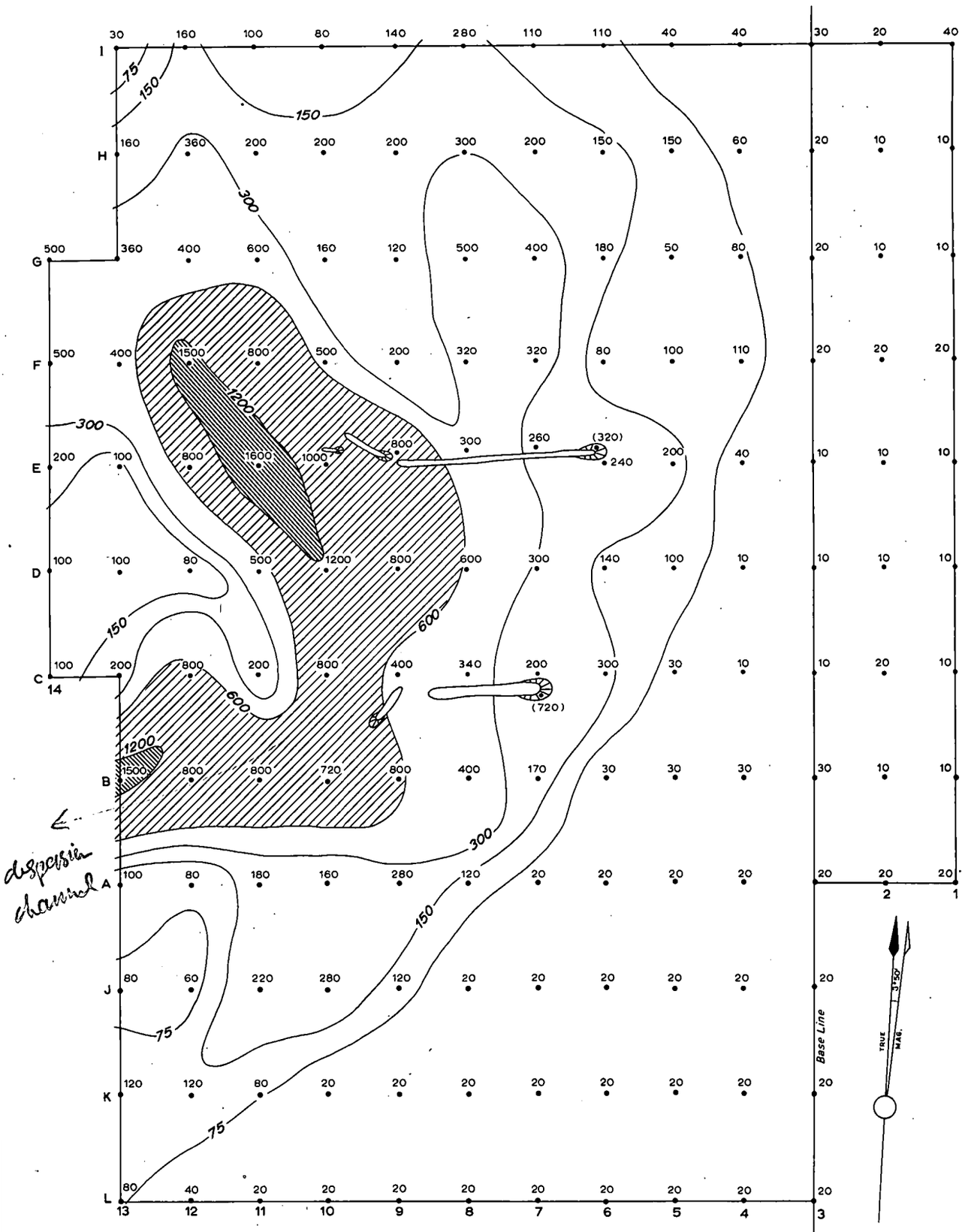
Geochemical Survey - 1961

Scale

100 0 100 200 300 Feet

REFERENCE

- 110 — Sample site and p.p.m. of lead in soil at a depth of 1 ft.
- 75 — Lead isogards in p.p.m.
- 600-1199 p.p.m. zone (24-48 x background)
- 1200 p.p.m. and above zone (> 48 x background)
- (320) — Costean, with p.p.m. of lead in sample from dump
- Boundary of geochemical grid.



Bureau of Mineral Resources, Geology and Geophysics. March 1962.

To accompany Record 1962/137.

E 53/3/2 EJ

GD 136

PLATE III-C

SKETCH MAP OF TEENA PROSPECT

Mc ARTHUR RIVER AREA, N.T.

Geochemical Anomaly Centres and Geology

Geology and D.D.H. Information after

Carpentaria Exploration Co.Pty.Ltd.

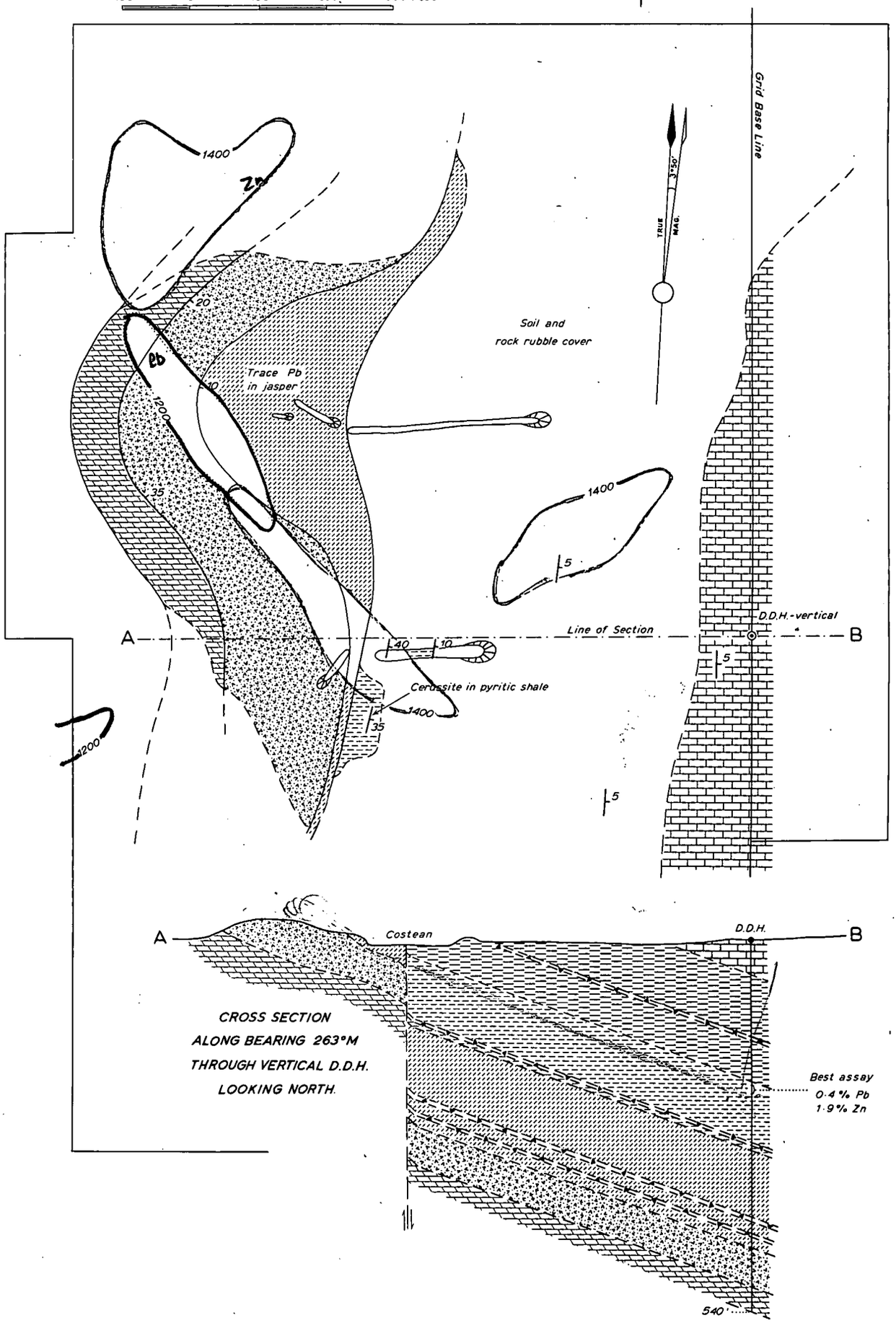
Geochemical Survey - 1961

Scale

100 0 100 200 300 Feet

REFERENCE

- Deep Creek limestone
- Barren shale
- Sedimentary breccia
- Pyritic shale
- Lower barren shale
- Green vitric tuffs and siltstone
- Laminated dolomite
- Costean
- 1400 Geochemical Anomaly Centres p.p.m. Zinc
- 1200 Geochemical Anomaly Centres p.p.m. Lead
- Geochemical Grid Boundary

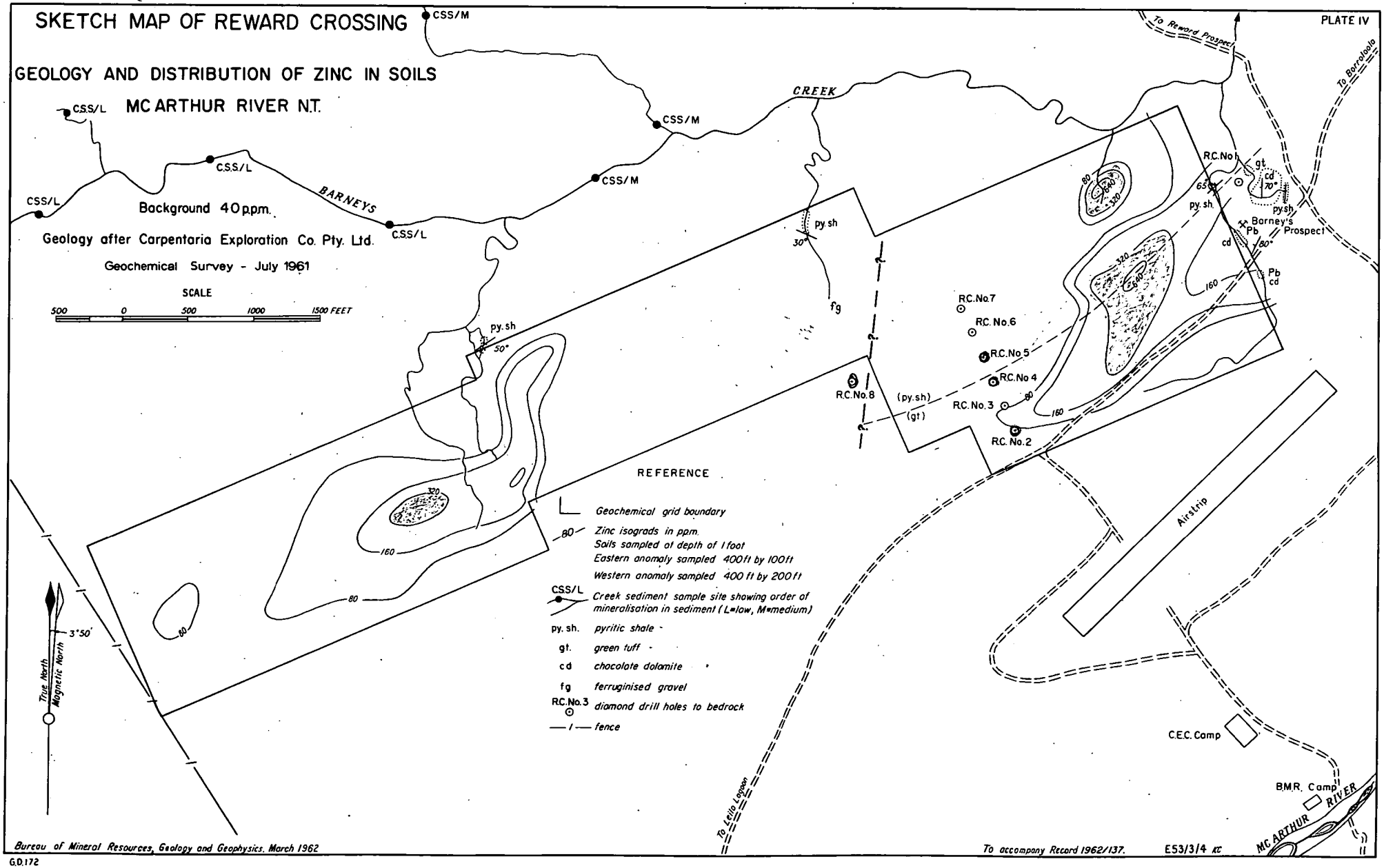


Bureau of Mineral Resources, Geology and Geophysics. March 1962.

To accompany Record 1962/137.

E 53/3/3 EJ

GD137



Bureau of Mineral Resources, Geology and Geophysics. March 1962

To accompany Record 1962/137. E53/3/4 KC

G.D.172

PLATE V-A

SKETCH MAP OF W - FOLD NORTH

DISTRIBUTION OF ZINC IN SOILS AT A DEPTH OF 1 ft.

Mc ARTHUR RIVER AREA, N.T.

Background - 150 p.p.m.

Geochemical Survey - July 1961

Scale

200 0 200 400 600 Feet

REFERENCE

- 230 — *Sample site and p.p.m. of zinc in soil at a depth of 1 ft.*
- 300 — *Zinc isograds in p.p.m. - 2 x background*
- C.S.S./H — *Creek sediment simple site showing high / medium / low order mineralisation*
- W-F N°6 18' — *Diamond drill hole site showing depth of bedrock. Information from Carpentaria Exploration Co*
- fg — *Ferruginised gravel*
- *600 p.p.m and above zone (> 4 x background)*

A B C D E F G H I K

29 25 21 17 13 9 5 1

W-F N°5 29'

W-F N°6 18'

W-F N°7 19'

fence

TRUE 3°50' MAG.

To Reward Prospect

To Mc Arthur River

A' A'o B' C' D' E'

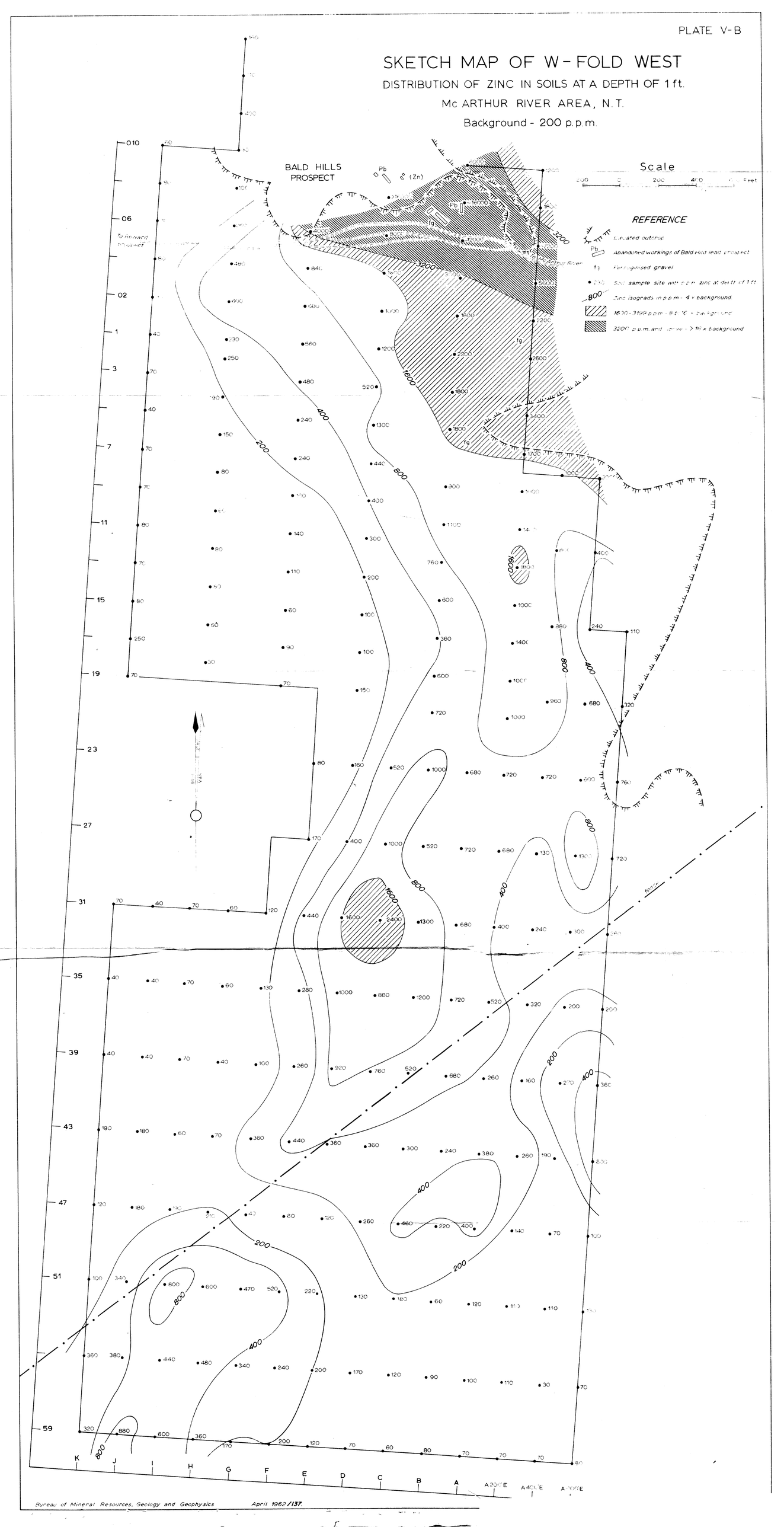
PLATE V-B

SKETCH MAP OF W-FOLD WEST

DISTRIBUTION OF ZINC IN SOILS AT A DEPTH OF 1 ft.

Mc ARTHUR RIVER AREA, N.T.

Background - 200 p.p.m.



Bureau of Mineral Resources, Geology and Geophysics April 1962/137.

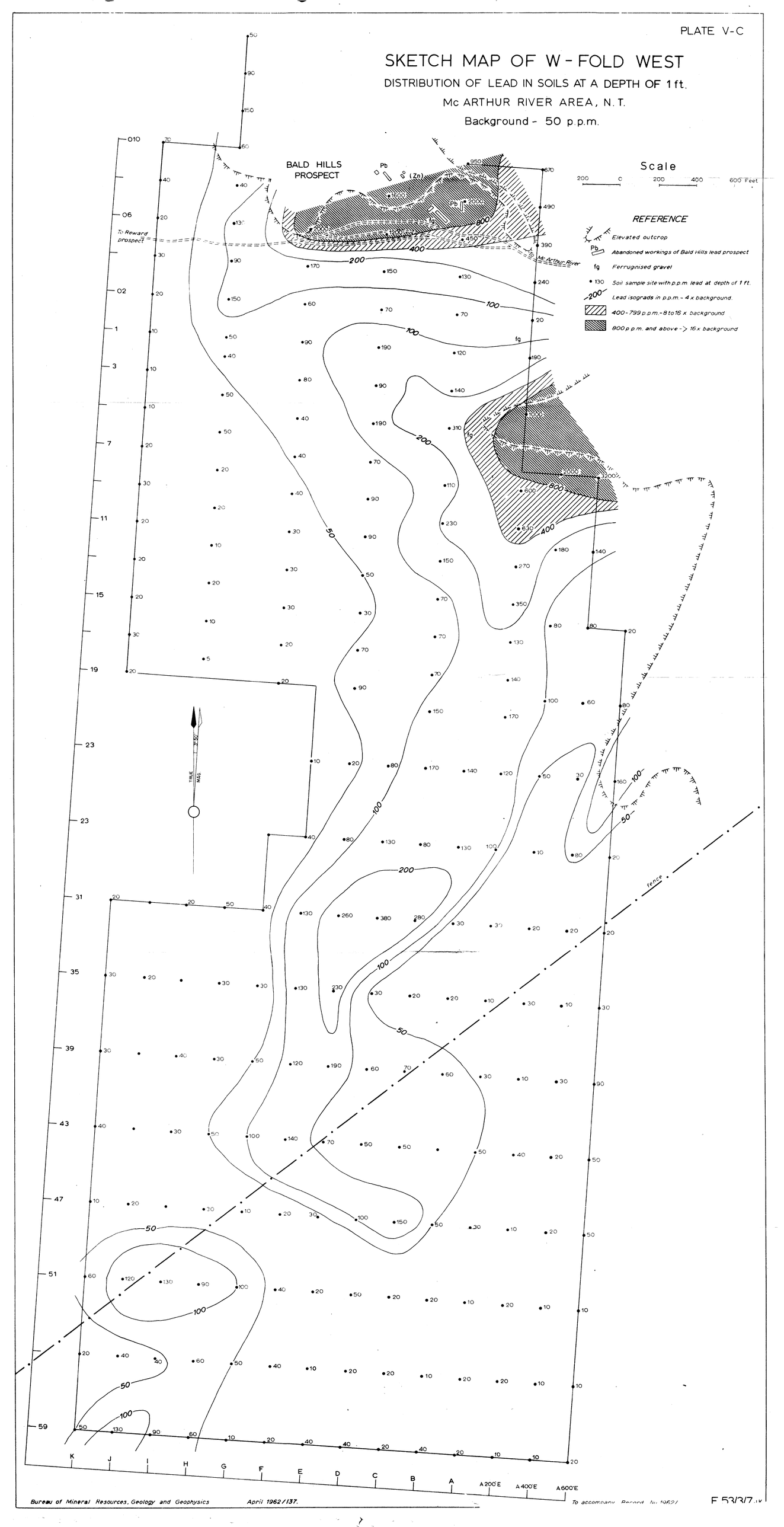
PLATE V-C

SKETCH MAP OF W - FOLD WEST

DISTRIBUTION OF LEAD IN SOILS AT A DEPTH OF 1 ft.

Mc ARTHUR RIVER AREA, N.T.

Background - 50 p.p.m.



Bureau of Mineral Resources, Geology and Geophysics April 1962/137.

To accompany Record No. 1962/

F 53/3/7.IV

GEOLOGICAL MAP

W-FOLD AREA

McARTHUR RIVER N.T.

Geology after Carpentaria Exploration Co. Pty. Ltd.
Geochemical Survey by A.G. Fricker.
August, 1961

SCALE

400 0 400 800 1200 feet

W-FOLD NORTH

W-FOLD WEST

Bald Hills Prospect

W-Fold

Scattered Outcrop

Outcrop

⊙W-Fold No.1
⊙W-Fold No.2
⊙W-Fold No.6
⊙W-Fold No.7
⊙W-Fold No.8

To Reward

To McArthur River

3°50' True Mag.

C.S.S./H
C.S.S./M
C.S.S./L

Barney's Creek

REFERENCE

- "H.Y.C." upper barren shale
- "H.Y.C." stylolite marker
- Pyritic shale
- Green vitric tuff
- Laminated dolomite
- Sedimentary breccia
- Chocolate dolomite
- Ngarajinma (Kilgour) limestone
- fg Ferruginised gravel
- ⊙18' D.D. holes with depth to bedrock
- 50 Zinc isograds in p.p.m.
- 100 Lead isograds in p.p.m.
- Boundaries of geochemical grids
- Fence
- A' Geochemical traverses
- C.S.S./M Creek sediment sample site Showing High Medium Low order mineralisation
- Sampling interval of 400' & 200'

Bureau of Mineral Resources, Geology and Geophysics
G.D.178

April, 1962

To accompany Record No. 1962/137

E53/3/6

M.F.

Plate V

Mc ARTHUR RIVER AREA NT

GEOLOGY OF THE H.Y.C. SEQUENCE

after Carpentaria Exploration Company Pty Ltd

GEOCHEMICAL SURVEY AREAS

Scale

2000 0 2000 4000 6000 FEET

REFERENCE

H.Y.C. SEQUENCE
- pyritic shale
- green vitric tuff
- laminated dolomite
- chocolate dolomite
- Vgarijiluna Kilgour limestones
- chert breccia
- Mara Eagles Nest dolomite
- geochemical survey areas

- Geological boundary, position accurate
- " " " approximate
- fault (approximate position shown in dashes)
- Strike and dip of beds
- Trends of bedding
- Fold axis, position approximated
- CS/M Creek sediment sample site and order of mineralisation in sediment
- CS/L H=high M=medium L=low
- Pb Minor mineral occurences
- Prospect little or no production
- DD/FT1 Diamond drill hole site
- Road
- Fence

Surprise Creek

W FOLD NORTH

W-FOLD

W FOLD WEST

BALD HILLS

REWARD

Pb, Cu

TEENA

REWARD CROSSING

BARNEY'S HILL

BARNEY'S

HYC

Pb

COOLEY'S

Airstrip

U.E.C. Camp

BMR Camp

DD/FT1

DD/FT2

Bull Creek Fault

Bull Creek

Barrie's Creek

RIVER

Mc Arthur River H.S.

Airstrip

Mc ARTHUR

MITCHELL YARD

Track to Seigals 12 mls

Mitchell Yard 3 mls

3°50'

True North 1963 A.D.

NORTHERN TERRITORY

LOCALITY MAP

15°S 135°E 18°S

GULF

SIR EDWARD PELLEW GROUP

CARPENTARIA

Lynman Bight River

Borroloola

Mc Arthur River

Mc Arthur River H.S.

Robinson River

Calvert

Calvert Hills

Wollogorang

Seigals Ck

OT Downs

Mallapunyah

BARKLY TABLELAND

Scale 20 0 20 40 Miles

Department of Mineral Resources, Geology and Geophysics Canberra A.C.T. 1962

To accompany Record No. 1962/137.

E53/3/11