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SML 143

THIRD PLAIN

TECHNICAL AND FINAL REPORTS TO LICENCE SURRENDER, FOR THE PERIOD 1/1/1967 TO 30/9/1967

Submitted by
Kennecott Explorations (Australia) Pty Ltd
1968

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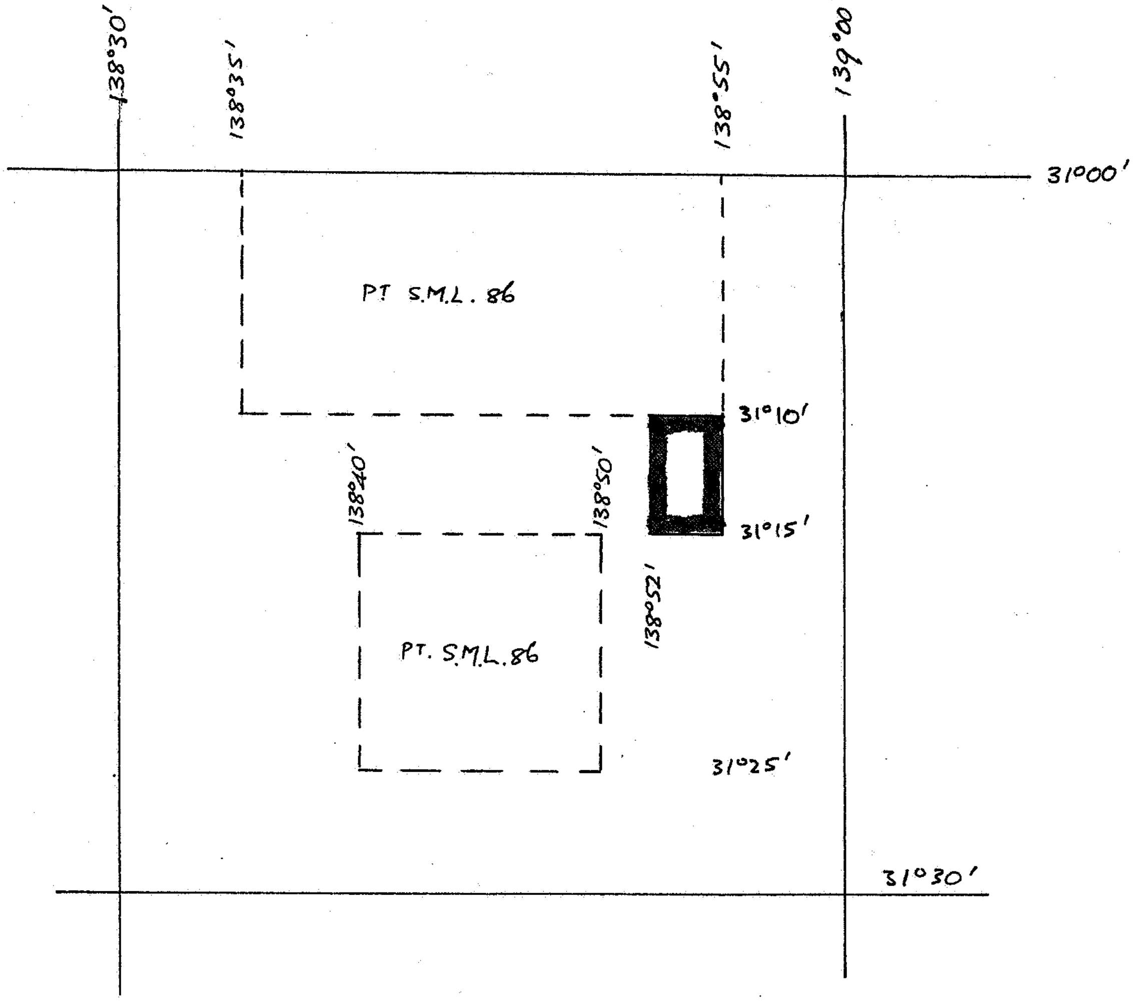
Primary Industries and Resources SA



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D.M. 1961/66 S.M.L. 143

CONTENTS ENVELOPE 800 DM 1961/66

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REPORTS:

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KENNECOTT EXPLORATIONS (AUSTRALIA) PTY. LTD.

FINAL REPORT ON THIRD PLAIN (S.M.L. 149)

FLINDERS RANGES. S.A.

By R.E. Besley
Adelaide Office
September, 1967

SUMMARY

The anomalous values found in the initial Flinders Ranges reconnaissance stream sediment programme were investigated by a follow up ground survey consisting of closer spaced stream sediment sampling and reconnaissance mapping to further define the anomalies and to determine their source.

As a result of this survey a small high grade zinc outcrop was discovered in the Third Plain area. This was then mapped in detail and sampled on close spaced chip lines to determine the surface grades and areal extent of mineralization. The results indicated a broad area of limestone containing anomalous zinc values but few greater than one per cent. Four very small areas of high grade zinc mineralization, mainly as willemite (Zn_2SiO_4) were found. However, the overall size and grade of mineralization is considered insufficient to warrant further investigation.

CONTENTS

PLATES

1. Locality Map

2. Regional Stream Sediment Sampling (Zn values in p.p.m.)

3. Reconnaissance Geology and follow up Stream Sediment Sampling

4. Detailed Geology and rock chip sampling

PLATE 1

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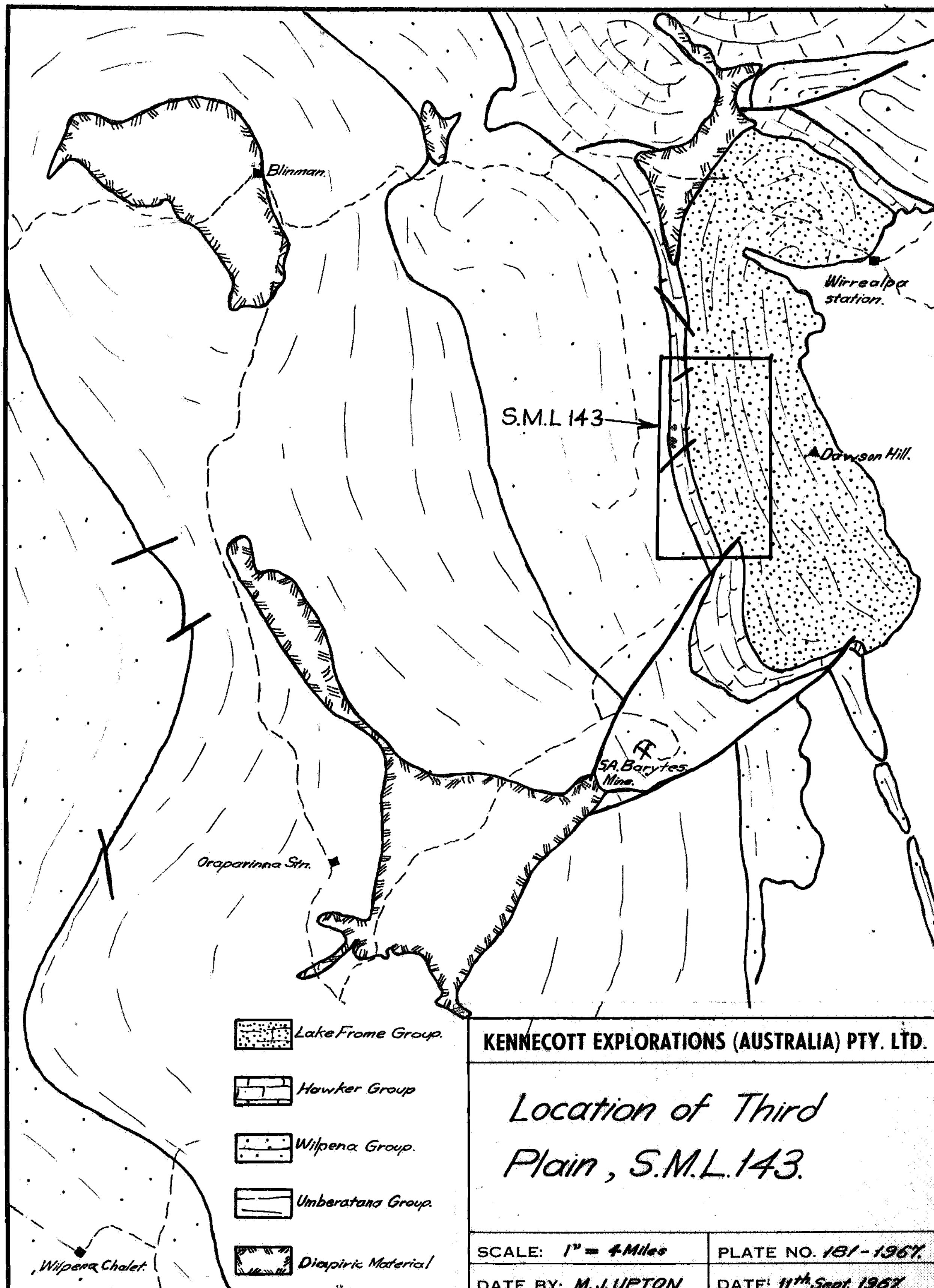

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Location of Third Plain, S.M.L.143.

SCALE: 1" = 4 Miles	PLATE NO. 181-1967.
DATE BY: M. J. UPTON	DATE: 11th Sept. 1967.

INTRODUCTION

This report is submitted as a summarised account of the results and work carried out on the Third Plain, Special Mining Lease No. 143. The lease was taken up to evaluate small outcrops of high grade zinc mineralization discovered as a result of our regional stream sediment survey of the central Flinders Ranges.

LOCATION

The Third Plain area is situated in the Bunkers Ranges to the immediate east of Third Plain Creek (see plate 1). The area is best reached via a rough track that turns off the Blinman - Wirrealpa Station road approximately ten miles from Blinman.

REGIONAL GEOLOGY

The Flinders Ranges are essentially made up of Proterozoic sediments of the Adelaide System overlain by sediments of Lower and Middle Cambrian in age. It totals over 50,000 ft. of unmetamorphosed sediment of essentially continuous deposition. The regional geology has best been described by Dalgarno and Johnson (1966). Much of the stratigraphy and type sections were originally described by Daily (1956) and later by Dalgarno (1964).

(a) **Stratigraphy** (See plate 3)

The sequence given for the central Flinders Ranges by Dalgarno and Johnson (op. cit.) is as follows:-

MIDDLE CAMBRIAN	Billy Creek Formation	HAWKER GROUP
LOWER CAMBRIAN	Narina Greywacke	HAWKER GROUP
	Oraparinna Shale	
	Bunkers Sandstone	
	Parara Limestone	
	Wilkawillina Limestone	
	Parachilna Formation	
ADELAIDE SYSTEM	Pound Quartzite	WILPENA GROUP
	Wonoka Formation	

(a) Stratigraphy (cont'd.)

The Pre-Cambrian sequence in the area under consideration is continuous through the calcareous shales and flaggy dolomites of the Wonoka Formation to the top of the Pound Quartzite. In this region only the lower member (unnamed) of the Pound Quartzite is present. The upper massive clean sandstone portion that forms prominent ridges elsewhere in the Flinders Ranges is absent.

The Parachilna Formation that usually forms a transition between the Pound and overlying limestones is generally absent in this region.

The Lower Cambrian sedimentation was influenced by tectonic activity. In the Third Plain area the formations are much thinner compared with their development in both north and south directions. In the Wilkawillina Gorge area to the south contemporaneous subsidence of a graben structure caused the development of a greater thickness of sediment with associated intertonguing of facies. Here the complete sequence of Wilkawillina Limestone, Parara Limestone, Bunker Sandstone and Oraparinna Shale of the Hawker Group is represented. The sequence above the Wilkawillina Limestone thins rapidly to the north in lenticular fashion and in places is completely absent.

The Billy Creek Formation overlies the Hawker Group uniformly throughout the region.

(b) Structure

The Proterozoic and Lower Cambrian sediments of the region occupy the eastern limb of a large anticlinal structure. Transverse faulting with only minor displacement on a regional scale is relatively common. Major faulting to the south was associated with the development of the Oraparinna diapir that commenced during sedimentation of the early Proterozoic and continued after sedimentation in the Adelaide Geosyncline had ceased. Similarly faulting to the north shows some control by the Wirrealpa diapir.

STREAM SEDIMENT SAMPLING

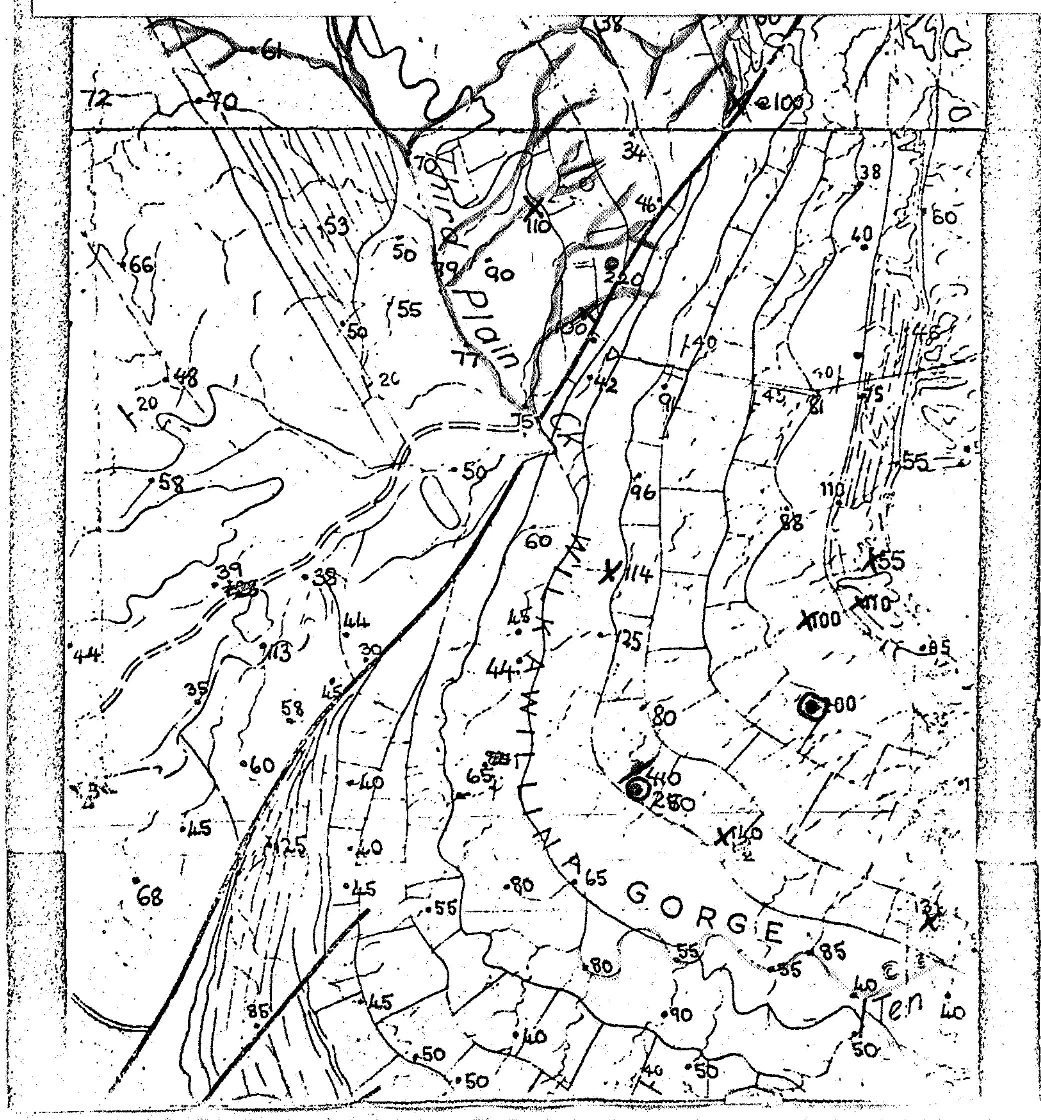
The results of the regional stream sediment sampling for zinc are given in plate 2. Two values of 400 p.p.m. and 500 p.p.m. were obtained in the creeks draining the Wilkawillina Limestone about one mile south of Balcoracana Creek.

A follow up programme to define the anomalies was carried out by sampling every major stream junction and taking a sample every 500 feet in the various creeks. The results are shown in plate 3. A train of anomalous values (up to 400 p.p.m.) was obtained in the creeks draining north from the Third Plain area. This led to the discovery of zinc mineralization in outcrop.

PLATE 2

011

REGIONAL STREAM SEDIMENT VALUES (ZINC in p.p.m.)

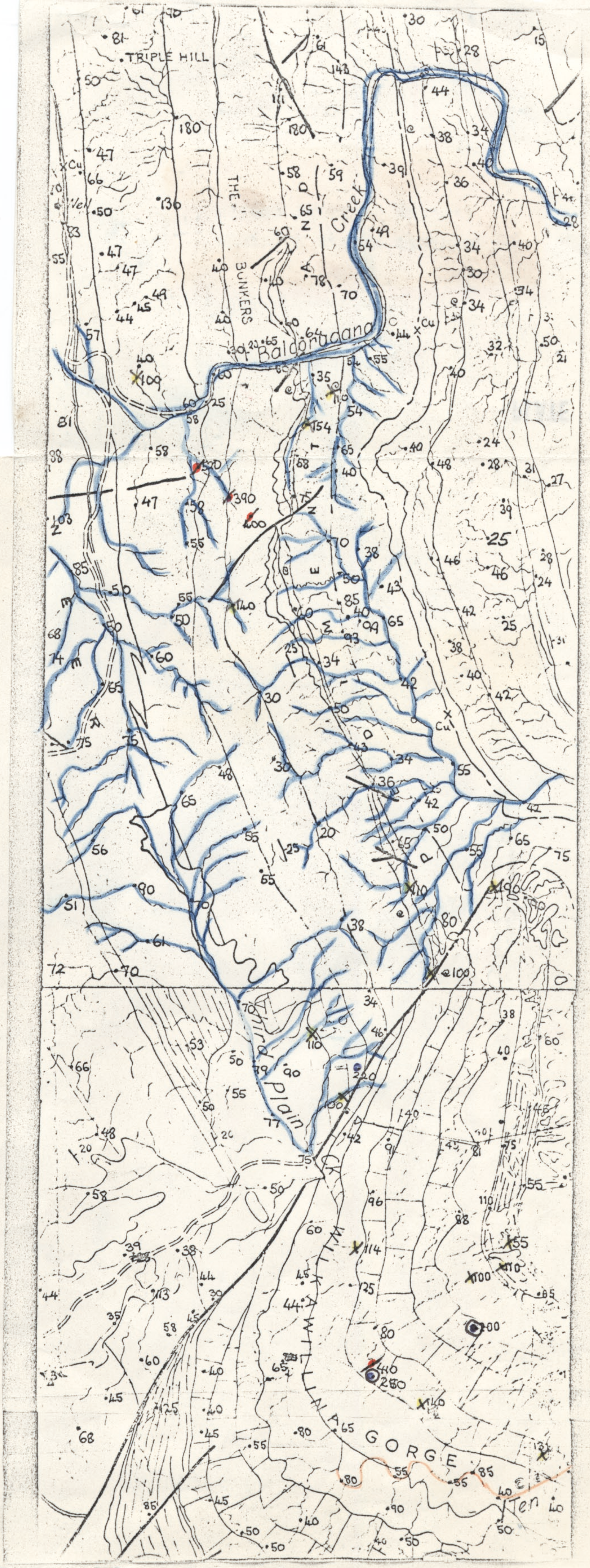


> 300

200-300

100-200

Zn ppm in streams



> 300

200-300

100-200

Zn ppm in streams

DETAILED GEOLOGY

In order to gain a better understanding of the mineralization and its associations at Third Plain, the area was mapped in detail on a scale of 1" represents 110' (see plate 4). This mapping covered the Pound Quartzite and Wilkawillina Limestone formations for approximately one mile along strike, the mineralization occurring at the base of the Wilkawillina Limestone.

The bulk of the Pound Quartzite in this area is composed of red to chocolate coloured micaceous siltstones and micaceous feldspathic sandstones. Cross-bedding is dominant throughout and ripple marks, clay galls and slumping are common features. There are two thin greyish-white quartzite bands that are useful markers within this formation. They exhibit cross-bedding of a much greater amplitude than the finer grained portions. Mud cracks were found in a number of horizons indicating subaerial conditions for at least part of the depositional cycle. The absence of the upper massive, white quartzite (present elsewhere in the Flinders Ranges) has been used as part of the evidence to infer a disconformity between the Pound and overlying Wilkawillina but as the Pound lack fossils this cannot be satisfactorily established. Thin lenses of only a few feet of kaolinitic sands and shales are present at the top of the Pound Quartzite possibly representing the Parachilna Formation.

Conformably overlying that sequence is the massive Wilkawillina Limestone representing an abrupt change in sedimentary conditions. This formation can be divided into two members, a lower poorly fossiliferous, grey to buff coloured dolomitic limestone and an upper clean massive fossiliferous limestone. Bedding is rarely seen in either member. The lower member varies from 400 - 500 feet in thickness and contains occasional isolated large archeocyatha to within 50 feet of the base. The mineralization occurs within this facies. For some distance surrounding the mineralization the limestones are stained a reddish colour by haematite. The upper member varies from 500 to 600 feet in thickness and contains beds of abundant archeocyatha and brachiopod fragments. This is a clean fossiliferous limestone throughout and contains no evidence of any mineralization.

Major transverse faults cross the strata at angles of approximately 50° to the strike with apparent horizontal displacements of the order of 50 to 100 feet, varying according to the competency of the rock types involved. A system of associated minor faults and bedding plane slips is present within the more competent sandstones but no such evidence of structural disturbance could be detected in the incompetent limestones. The area is situated on the hinge of a regional strike change of 15° - 20° and the transverse faulting appears to be associated with this hinge region. The zinc mineralization is localized in the area of one of these transverse faults.

MINERALIZATION

Several outcrops of zinc rich rock are scattered over an area of 800 feet by 300 feet. Isolated rock chip samples of these outcrops assayed up to 55% zinc (see appendix 1). The high grade outcrops themselves cover only a small area (see plate 4) and are separated by area of haematite stained dolomitic limestone containing 0.1 - 1.0% zinc. The zinc occurs mainly as the white zinc silicate willemite, identified by optical properties and x-ray diffraction pattern. It is mainly in the form of radiating spherulitic aggregates or colloform bands, the rock varying from a complete mass of willemite spherules to spherules in a matrix of dolomite and colloform bands cutting the dolomite at a variety of angles. Very minor amounts of smithsonite occur with manganese oxides irregularly distributed amongst the willemite. A few cavities lined with small quartz crystals contain a bright red-orange mineral that is most probably zincite (ZnO) but which is too intimately intergrown with the quartz to obtain an x-ray diffraction pattern.

The relationship between this supergene surface outcrop of zinc mineralization and the primary mineralization is obscure. Well documented examples of this type of mineralization and its relationship to the primary source elsewhere in the world are virtually non-existent. The conditions of weathering are those of an arid environment in limestone. Thus acid solutions formed by the oxidation of primary sulphides would be readily neutralized by the slightly alkaline conditions present in the limestone and smithsonite would be the stable phase formed from sphalerite. In a dry environment the partial pressure of CO_2 in the limestones near the surface is very low as it can easily escape to the atmosphere. Under these conditions and in the presence of silica in solution it is possible that zinc carbonate is less stable than the silicate leading to the formation of willemite or hemimorphite. Open circulation of ground waters through fault zones and fractures would facilitate the build up of insoluble silicates forming near-surface concentrations.

In this way supergene enrichment rather than depletion would be expected and the outcrops of massive willemite could most likely be derived from a lower grade carbonate body which in turn could be derived from primary low grade zinc sulphides.

GEOCHEMICAL ROCK CHIP SAMPLING

In order to determine the surface grades and extent of mineralization six rock chip lines 200 feet apart were run east-west, approximately perpendicular to the strike of the sediments. Samples on the four central lines were taken at 10 feet intervals and on the two end lines at 25 feet intervals. Assayed values are given in appendix 2 and averaged values are plotted on plate 4.

The main concentration of zinc mineralization occurs in the small isolated outcrops that were detected in the initial ground survey. There is a marked contrast between these high grade outcrops and the surrounding limestones. For example there is 40 feet averaging 33.0% zinc on line zero but either side of this outcrop values are less than 1%. The overall area containing anomalous zinc (> 1,000 p.p.m.) extends over 1,000 feet by 400 feet. The limits of this value along strike were not reached. Spectrographic analysis of randomly selected outcrops of high grade mineralization and the adjacent limestones (see appendix 1) indicated that arsenic is very high in a number of the samples (> 1% in one case). Lead is also anomalous with one sample having 3 - 3.5% lead. Manganese is low particularly in the high grade samples.

If it is assumed that the high grade zinc silicate outcrops extend for no more than 100 feet in depth then the following ore reserves can be calculated;

(a) Main willemite outcrop extends for 150' x 40'

Volume = 60,000 cubic feet

(b) Southern area outcrop extends for 150' x 20'

Volume = 30,000 cubic feet

Total volume is 90,000 cubic feet.

Assuming 12 cubic feet of ore per ton of rock then;

Total tonnage is 7,500 tons

REFERENCES

Daily 1956:	'The Cambrian in South Australia' xx Congreso Geologico Internacional
Dalgarno 1964:	'Lower Cambrian Stratigraphy of the Flinders Ranges' Trans. Roy. Soc. S.A. Vol. 88
Dalgarno and Johnson 1965:	'Diapiric Structures and Late Pre-Cambrian to early Cambrian Sedimentation in the Flinders Ranges' S.A. Dept. of Mine, Report (unpublished)
Dalgarno and Johnson 1966:	S.A. Dept. of Mines Geological Atlas 4 mile series. Parachilna Sheet

APPENDIX I.

Spectrographic analysis of selected samples from zinc mineralisation.

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

REPORT AN 1670/67

SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSIS

Sample No.	Co	Ni	Sn	Cd.	Bi	Cr.	V.	Mo.
43025	60	80	3	5	1	15	20	30
6	< 1	< 1	< 1	< 3	< 1	12	20	2
7	12	7	2	10	"	4	2	< 1
8	10	100	1	< 3	2	100	50	6
9	< 1	< 1	< 1	"	< 1	400	12	< 1
30	4	2	"	"	"	4	10	"
43031	1	< 1	"	"	"	4	3	1

Sample No.	Ga	Ge	As.	Mn.	Ba.	Sr.	B.	P
43025	5	5	6000	>10000	250	5	8	400
6	< 1	150*	5000	250	80	< 1	300	500
7	1	< 1	120	>10000	40	30	1	< 100
8	7	200*	>10000	5000	100	150	7	250
9	1	< 1	< 50	25	3	< 1	3	120
30	1	3	150	3000	150	20	4	< 100
43031	< 1	70*	200	50	10	< 1	300	150

* Note, high Ge values corresponding to high zinc values

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

REPORT AN 1670/67

SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSIS

Sample No.	Se	Hg	Li	Zn%	Pb%
43025	< 1	< 0.15	<3	.9	3.-3.5
6	"	"	10	55.5	.3
7	"	"	<3	2.3	.05
8	12	"	15	41.5	.55
9	< 1	"	25	.2	< .05
30	"	0.15	< 3	16.0	.1
43031	"	< 0.15	"	52.5	.2

ELEMENTS NOT DETECTED

Zr. La. Y. Ag. Au. W. Be In. Pd. Sb.

Pt. Os. Ir. Rh. Ru. Ta. Nb. Te. Tl. Rb. Cs.

APPENDIX 2.

Third Plain Line Chip Samples

Analysis by Aust. Mineral Development Labs.

Report AN 3386/67

ROCK CHIP LINE O

Sample No.	Zn (in p.p.m.)	Footage
35001	300	0' - 10'
5	7200	40' - 50'
6	3100	50' - 60'
7	6.7%	60' - 70'
8	50.0%	70' - 80'
9	43.8%	80' - 90'
10	32.5%	90' - 100'
11	10000	100' - 110'
12	5800	110' - 120'
13	3900	120' - 130'
14	3000	130' - 140'
15	2800	140' - 150'
16	1600	150' - 160'
17	2000	160' - 170'
18	3000	170' - 180'
19	1100	180' - 190'
20	5400	190' - 200'
21	560	200' - 210'
22	880	210' - 220'
23	580	220' - 230'
24	770	230' - 240'
25	1800	240' - 250'
26	3300	250' - 260'

Sample No.	Zn (in p.p.m.)	Footage
35027	4000	350' - 360'
28	270	360' - 370'
29	1000	390' - 400'
30	95	400' - 450'
31	420	450' - 500'

ROCK CHIP LINE 2N

Sample No.	Zn (in p.p.m.)	Footage
35032	4500	0' - 10'
33	1750	10' - 20'
34	5300	20' - 30'
35	7700	30' - 40'
36	3400	40' - 50'
37	2200	50' - 60'
38	6200	60' - 70'
39	2100	70' - 80'
40	2300	80' - 90'
41	1500	90' - 100'
42	3000	100' - 110'
43	3300	110' - 120'
44	4600	120' - 130'
45	6000	130' - 140'

Sample No.	Zn (in p.p.m.)	Footage
35046	7200	140' - 150'
47	3200	150' - 160'
48	3000	160' - 170'
49	3200	278' - 290'
50	1.55%	290' - 300'
51	4.45%	310' - 320'
52	6.12%	320' - 330'
53	7.38%	330' - 340'
54	7700	340' - 350'
55	10000	350' - 360'
56	2500	360' - 370'
57	1400	370' - 380'
58	1700	380' - 390'
59	2000	390' - 400'
60	950	400' - 450'
61	530	450' - 500'

ROCK CHIP LINE 2S

Sample No.	Zn (in p.p.m.)	Footage
35062	260	0' - 10'
63	390	10' - 20'
64	200	20' - 30'

Sample No.	Zn (in p.p.m.)	Footage
35065	5600	30' - 40'
66	5000	40' - 50'
67	3500	50' - 60'
68	3000	60' - 70'
69	2700	70' - 80'
70	2200	80' - 90'
71	1900	90' - 100'
72	1300	100' - 110'
73	1400	110' - 120'
74	1250	120' - 130'
75	1500	130' - 140'
76	800	140' - 150'
77	830	150' - 156'
78	960	160' - 170'
79	670	170' - 180'
80	640	180' - 190'
81	440	190' - 200'
82	620	225' - 240'
83	480	240' - 250'

ROCK CHIP LINE 4S

Sample No.	Zn (in p.p.m.)	Footage
35084	1100	0' - 10'
85	1250	10' - 20'
86	1150	20' - 30'
87	2200	30' - 40'
88	1300	40' - 50'
89	5800	50' - 60'
90	3100	60' - 70'
91	900	70' - 80'
92	1400	80' - 90'
93	17.5%	90' - 100'
94	30.5%	100' - 107'
95	450	115' - 120'
96	1700	120' - 130'
97	2000	130' - 140'
98	1400	140' - 150'
99	1600	150' - 160'
35100	2700	160' - 170'
1	3000	170' - 180'
2	6000	180' - 190'
3	6800	190' - 200'
4	7500	200' - 210'
5	6600	210' - 220'

ROCK CHIP LINE 6S

Sample No.	Zn (in p.p.m.)	Footage
35131	520	0' - 25'
32	710	25' - 50'
33	540	50' - 75'
34	1300	75' - 100'
35	680	100' - 125'
36	1100	125' - 150'
37	3700	150' - 175'
38	5200	175' - 200'
39	3100	200' - 225'
40	1400	225' - 250'
41	1300	250' - 275'
42	1150	275' - 300'
43	6600	300' - 325'
44	Missing	325' - 350'
45	600	350' - 375'
46	1700	375' - 400'

ROCK CHIP LINE 4N

35047	1600	-25' - 0'
48	1650	0' - 25'
49	1.07%	25' - 50'

Sample No.	Zn (in p.p.m.)	Footage
35106	1800	220' - 230'
7	2700	230' - 240'
8	1300	240' - 250'
9	1600	250' - 260'
10	1500	260' - 270'
11	780	270' - 280'
12	470	280' - 290'
13	700	290' - 300'
14	900	300' - 310'
15	690	310' - 320'
16	700	320' - 330'
17	640	330' - 340'
18	550	340' - 350'
19	1200	350' - 360'
20	1350	360' - 370'
21	1800	370' - 380'
22	1000	380' - 390'
23	6500	390' - 400'
24	1450	400' - 410'
25	770	410' - 420'
26	1600	420' - 430'
27	710	430' - 440'
28	900	440' - 450'
29	730	450' - 475
30	520	475' - 500'

Sample No.	Zn (in p.p.m.)	Footage
35050	7300	50' - 75'
51	1400	75' - 100'
52	1400	100' - 125'
53	1350	125' - 150'
54	2700	150' - 175'
55	2100	350' - 375'
56	5400	375' - 400'
57	950	400' - 425'
58	500	425' - 450'
59	1400	450' - 475'
60	2800	475' - 500'

ROCK CHIP LINE IN

Sample No.	Zn (in p.p.m.)	Footage
35161	24.5%	0' - 10'
62	43.8%	10' - 20'
63	37.0%	20' - 30'
64	33.0%	30' - 40'

ROCK CHIP LINE MISCELLANEOUS SOUTH 1

Sample No.	Zn (in p.p.m.)	Footage
35166	3100	Limestone
67	26.3%	Gossan

ROCK CHIP LINE MISCELLANEOUS SOUTH 2

Sample No.	Zn (in p.p.m.)	Footage
35168	5400	Limestone
69	41.3%	Gossan

ENV 800

ENV 800-1

GEOLOGY BY : R. E. BESLEY.

LEGEND

Recent

CREEK ALLUVIUM & OUTWASH

HIGH LEVEL OUTWASH GRAVELS

Lower Cambrian

WILKAWILLINA LIMESTONE *Clean limestone with abundant Archaeocyatha and brachiopods in upper part. Buff coloured dolomitic limestone in lower part.*

PARACHILNA FORMATION (?) *White kaolinitic sands and silts.*

Upper Proterozoic

POUND QUARTZITE *Red micaceous siltstones and micaceous feldspathic sandstones with two major white quartzite bands.*

Dolomitic lenses near the base.

FAULT.
observed.
inferred.

40° ATTITUDE OF BEDDING

AREA OF HIGH GRADE WILLEMITE OUTCROP

BOUNDARY OF HEMATITE STAINED RED DOLOMITE LIMESTONE.

4S CHIP SAMPLE LINES, AVERAGED Zn PERCENTAGE.

CREEK

SCALE

feet 110 55 0 110 220 330 440 550 660 770 feet

Env 800-2

KENNECOTT EXPLORATIONS (AUSTRALIA) PTY. LTD.	
GEOLOGY & CHIP SAMPLING THIRD PLAIN PROSPECT	
SCALE:	PLATE NO. 182 - 1967.
DATE BY: M.J. Upton	DATE: 21st September 1967.

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Fa
Env800

PLATE 4

ENV. ~~[illegible]~~

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KENNECOTT EXPLORATIONS (AUSTRALIA) PTY. LTD.

WESTERN DISTRICT

REPORT ON EVALUATION OF ZINC MINERALISATION

THIRD PLAIN CENTRAL FLINDERS RANGES

R.E. BEALEY
Adelaide Office

November, 1968.

1. SUMMARY

The zinc mineralisation found by K.E.A. in 1966 at the base of a Cambrian limestone sequence at Third Plain was evaluated by trenching and shallow percussion drilling in 1968.

The drilling proved that the zinc silicate mineralisation extends to at least 36 feet vertical depth. It was proposed to completely test the deposit to 100 feet depth but, due to difficult drilling conditions, holes aimed at this depth of intersection did not reach the ore horizon. However, sufficient information was obtained from shallower intersections to indicate that the deposit is small, and that deeper drilling by K.E.A. is not warranted at this stage.

The ore potential indicated is of the order of 350 tons of 28% zinc per vertical foot, and the total ore reserves based on drill intersections are 13,400 tons of 28.5% zinc to an average vertical depth of 38 feet.

CONTENTS

2. LOCATION

The Third Plain Prospect is situated to the east of Third Plain Creek in the Bunker Range in the Central Flinders Ranges of South Australia, Latitude 31°12'S, Longitude 138°52'30"E. It is 40 miles by gravel road to the south-south-east from Parachilna, the nearest siding on the main north-south standard gauge railway line, and 20 miles to the south-east from Blinman, the closest town. The nearest sea port is Port Augusta, some 100 miles to the south by rail from Parachilna. (Refer Location Map, Plate 1)

3. ACCESS

The site can best be reached by travelling ten miles east from Blinman along the Blinman-Wirrealpa Station road, thence a further ten miles south along a rough track negotiable by heavy vehicles. An alternative route from the south can be traversed with difficulty in four wheel drive vehicles.

4. LEASING

The mineralised area is held by K.N.A. in one thirty-seven acre mineral claim (No. 5158). The surrounding ground is held by Asarco (Aust.) Pty. Ltd. in S.M.L. 166. Suspension of the labour conditions pertaining to this claim has been obtained and requires renewal with justification every three months.

5. INTRODUCTION

The high grade zinc silicate mineralisation initially found during follow-up of a reconnaissance stream sediment programme in 1966, was investigated by mapping the surface geology and by sampling by the writer in 1967 (see Besley, 1967, Final Report Third Plain S.M.L. 143). This survey indicated a small high grade deposit of the order of 10,000 to 20,000 tons near the surface. At that time this tonnage was not considered sufficient to warrant further investigation. S.M.L. 143 was allowed to expire but shortly afterwards the mineralised area was covered by a 37 acre mineral claim with a view to selling the title to any interested party that could mine it on a small scale.

During 1966 and 1967 an apparently similar high grade deposit at Puttapa (now referred to as Beltana) some fifty miles to the north-west was under investigation by Electrolytic Zinc Industries Limited. In February of this year reserves of 250,000 tons of 40% zinc were announced and an economic appraisal by C.C. Brooks of K.E.A. indicated a possible 800,000 tons. In September E.Z. announced reserves of 750,000 tons of 37% Zn and 3% Pb and a further 97,000 tons of 24% Zn and 12% Pb to a depth of 300 feet.

If the surface high-grade mineralisation at Third Plain were to continue to only 100 feet in depth an orebody of up to 100,000 tons would be indicated. Because of the high profitability of the Beltana deposit, it was decided to test our mineralisation by trenching and shallow percussion drilling.

6. REGIONAL GEOLOGY

The Central Flinders Ranges are composed of Proterozoic sediments of Adelaide System, overlain by sediments of Lower and Middle Cambrian. In total there are over 80,000 feet of essentially unmetamorphosed sediments of an almost continuous deposition sequence.

The regional setting and stratigraphy are shown on Plate 2.

The oldest rocks are exposed in diapirs that often form the cores of anticlinal structures. The major rock types are dolomites and siltstones with lesser rafts of volcanics, tuffs, granites and dolorites.

The Umberatana Group is composed of dolomites, dolomitic siltstones and sandstones.

The Wilpena Group is composed of siltstones, shales, dolomites and quartzites. The uppermost formation is the Pound Quartzite, the top of which defines the boundary between the Wilpena Group and overlying Hawker Group. This boundary also defines the upper limit of Proterozoic sedimentation and the commencement of Lower Cambrian sedimentation. It is a lithologically defined plane due to the lack of fossils in the sediments below the Hawker Group.

The lowest member of the Hawker Group is the Parachilna formation, composed of calcareous and kaolinitic sandstone and oolitic beds containing worm burrows. This formation is absent in the Third Plain area. The Wilkawillina limestone grades up from the Parachilna Formation or lies directly on the Pound

Quartzite. It is a fossiliferous blue-grey dolomitic limestone. The mineralisation at Third Plain occurs at the base of this limestone. This stratigraphic position hosts numerous other occurences of lead-zinc mineralisation throughout the Flinders Ranges including Beltana. The complete Lower Cambrian Hawker Group sequence above the Wilkawillina Limestone is Parara Limestone, Bunker Sandstone, Oraparinna Shale and Narina Greywacke.

The Lower Cambrian sedimentation was influenced by tectonic activity. In the Third Plain area these sediments are much thinner compared with their development in both north and south directions, indicating a structural high during deposition.

The Central Flinders Ranges are characterised by open style concentric folding on north-south axes with broad cross folding on east-west axes. Diapirs are often formed in the cores of anticlinal structures. Transverse faulting with only minor displacement on a regional scale is relatively common. In the vicinity of the diapirs faulting was controlled by the diapiric action.

Deep weathering from 100 to 800 feet is characteristic of the Flinders Ranges.

7. LOCAL GEOLOGY

Geological mapping of the mineralised area on a scale of approximately 1 inch to 110 feet was completed during the 1967 investigation (op. cit), refer Plate 4 of this report. Detailed mapping of the mineralisation on a scale of 1 inch to 40 feet was completed during the trenching and drilling programme (refer Plate 3).

7.1. Stratigraphy

The mineralisation occurs in the Lower Cambrian, Wilkawillina Limestone within 100 feet of the contact with the underlying Pound Quartzite (Proterozoic).

Extensive regional mapping by the S.A. Department of Mines and others in the Flinders Ranges has suggested a disconformity or slight unconformity between the Pound Quartzite and Wilkawillina Limestone. However, during the drilling and trenching programme sand lenses and oolitic beds up to 20 feet thick were found up to 150 feet above the base of the limestone. These could not be detected in surface outcrop. This indicates an inter-relation of facies between the Pound Quartzite (actually a sandstone at Third Plain) and overlying limestone, and is of importance in interpretation of environment of deposition. Lenses of calcareous siltstone occur adjacent to mineralisation in faulted areas but their stratigraphic position is uncertain.

7.2. Structure

The sediments of the Third Plain area occupy the eastern limb of a large anticlinal structure (see Plate 2). Steep transverse faults cross the strata at angles from 50° to 80°

to the strike with displacements of the order of 50 to 100 feet. The area is situated on the hinge of a regional strike change of 15° - 20° and the transverse faulting appears to be associated with this hinge area.

The zinc mineralisation occurs in an area displaced by a transverse fault (see Plate 4). The fault plane trace can be followed through the Pound Quartzite to the offset in the Pound-Wilkawillina Limestone boundary but is not traceable within the limestone, due partially to the incompetent nature of the limestone and to the fact that there are no marker horizons within the limestone to indicate displacements.

It appears that a later thrust fault developed along the sandstone-limestone boundary offsetting the transverse fault and producing the isolated block of limestone with associated clay zones to the south of the main willemite outcrop (refer Plate 5).

7.3. Mineralisation

There are two distinct mineralised areas. The northern area where the zinc occurs as willemite (Zn_2SiO_4) and which contains the only important reserves and the southern faulted block where massive goethitic zinc mineralisation at the surface was revealed by the trenching to be a surface concentration only a few feet thick, possibly derived from goethitic clays containing only minor zinc.

The willemite was found to occur on two horizons, one outcropping and intersected in trenches 6, 7 and 8 and in drill holes 3, 5 and 17, the other hidden by a thin soil vein only a few inches thick was observed near drill hole 14 but was not traced in the trenching or drilling.

The development of willemite is not consistent along strike but lenses rapidly and sporadically within the mineralised zone. It either forms irregular veins from less than one inch up to several inches thick in haematite stained dolomite and clays or is massive.

7.3.1. Origin: It would appear that the willemite may be either primary or formed by supergene processes. In arid climate under low CO_2 partial pressure and in the presence of silica it seems feasible to form willemite from a low (?) grade carbonate or sulphide orebody at depth. It is equally feasible that during faulting of the limestone-sandstone sequence sufficient silica was mobilised from the sandstone to react with mobilised zinc to form primary willemite concentrations.

If the willemite were formed by supergene enrichment then the high grade orebody should extend to only a few hundred feet depth and would not be likely to increase in size with depth. However, if it is of primary origin the orebody is most likely controlled by structure and could increase or decrease in size with depth. The zinc silicate mineralisation at Beltana is known to extend to at least 300 feet vertical depth.

8. TRENCH SAMPLING

Eleven trenches were cut to a depth of between 3 and 8 feet and sampled on 5 feet intervals by cutting a continuous channel in the trench floor. Trench locations are shown on plate 3.

The trenching was effected by a D7E bulldozer with hydraulic ripper.

The Zn results of all trenches are given in Appendix I. The Pb values were all less than 1% (analysis by atomic absorption spectrometer, A.M.D.L. reports 994/69 and 1124/69).

A close relationship between mineralisation and clay zones was revealed by the trenching. Massive willemite outcrops continued into the trenches. However, high grade outcrops of goethitic zinc mineralisation were shown to be only a surface effect and are possibly represented by low grade goethitic clays within a few feet of the surface. This may be due to mechanical removal of clays to leave upgraded willemite patches at the surface.

9. DRILLING

Twenty-three shallow rotary percussion holes were drilled totalling 993 feet. The drilling was carried out by the South Australian Department of Mines. The hole locations are shown on Plate 3. The results of 12 holes are shown on Sections on Plate 5, the remaining results are given in Appendix II. Total cuttings were taken over each 6 foot interval and split to obtain a representative sampling weighing 4 to 5 pounds and submitted for zinc analysis (A.M.D.L. report nos. 1616/69 and 1391/69). Nineteen of the high grade samples were analysed for arsenic and germanium (A.M.D.L. report 1712/69). Of these one sample assayed 100 p.p.m. Ge and 1200 p.p.m. As, two assayed 80 p.p.m. Ge and two 60 p.p.m. Ge. The remainder all assayed less than 15 p.p.m. Ge and less than 800 p.p.m. As.

The initial objective of this drilling programme was to completely test the high grade zinc deposit to 100 feet in depth, but due to caving ground conditions, ore intersections were not made below 36 feet vertical depth. Holes aimed at deeper intersections were not able to reach the ore zone. Because of the difficult drilling conditions a pattern of short holes was drilled to determine possible ore positions to approximately 30 feet in depth.

Although there was a lack of systematic ore horizon intersections, it was considered that the combined results of the trenching and drilling were sufficient to outline the near surface ore potential and that deeper drilling was not warranted at this stage of evaluation.

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10. ORE RESERVES

The following potential ore reserves are calculated on a 20% Zn cut off grade by extending envelopes in tabular form from trenching and drilling results. The three sections A, B-C and D are those shown on Plate 8.

Section A

Volume: 8 ft. wide by 100 ft. down dip by 50 ft. long = 40,000 cu. ft.

Average Grade = 20% Zn.

Section B-C

Volume: 9 ft. wide by 30 ft. down dip by 100 ft. long = 27,000 cu. ft.

Average Grade = 25% Zn.

Section D

Volume: 12 ft. wide by 80 ft. down dip by 70 ft. long = 67,000 cu. ft.

Average Grade = 35% Zn.

Total Volume = 134,000 Cu. Ft.

Average Grade = 30% Zn.

Assuming 10 cubic feet of ore/ton

Total reserve= 13,400 tons of 28.5% Zn.

The vertical depth extensions of these envelopes are 45 ft. in Section A, 20 ft. in Section B-C and 50 ft. in Section D, the average being 38 ft.

The corresponding tonnage potential is 350 tons of less than 30% zinc per vertical foot. This figure is less than half that indicated by the initial surface appraisal in 1967 (op. cit.)

This is due to two factors. Firstly, the high grade goethitic mineralisation in the southern faulted block did not extend in depth and does not contribute to the present tonnage potential. Secondly, the main zinc silicate mineralisation forms a prominent outcrop and large boulders that have spread out a few feet either side of the true surface extent were taken as outcrop in the initial survey.

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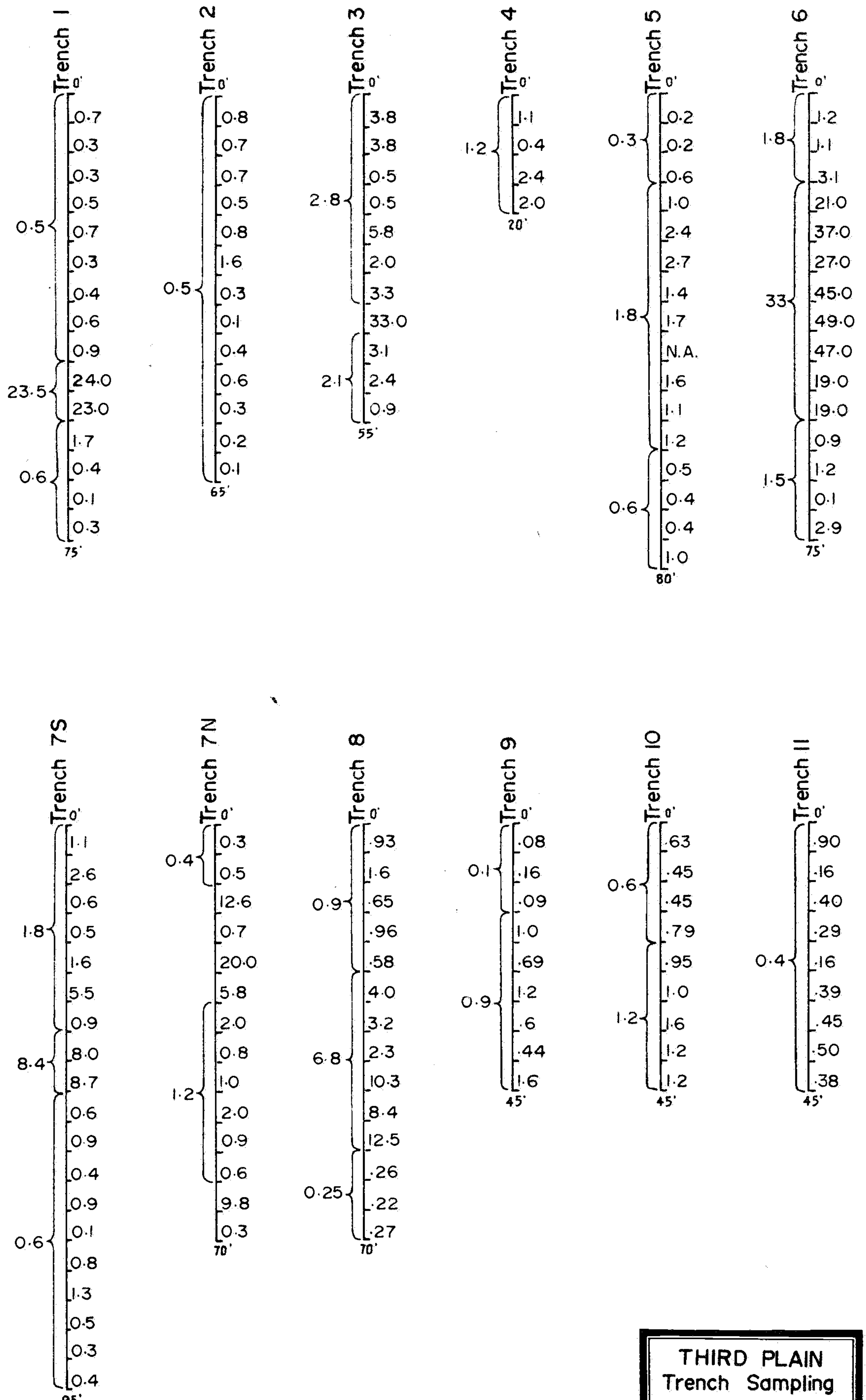


THIRD PLAIN
Trench Sampling

Total 5,759,904 ppm.

Hole 4 70° W	Hole 10 Vert.	Hole 11 Vert.	Hole 12 Vert.	Hole 13 Vert.	Hole 14 Vert.
0.5	1.4	1.1	0.7	0.4	1.7
0.8	0.7	1.2	1.3	0.4	6.5
0.6	0.7	0.8	1.5	0.3	2.3
0.8	0.7	0.5	1.3	0.4	1.5
	1.3	0.4		1.2	0.6
	0.9	0.5		5.2	0.6
		0.4		3.4	0.4
		0.3		3.0	1.7
					1.5
					1.1
					0.1
					0.4
					0.1
					0.3
					0.4
					0.8
					0.7
					0.8
					1.2

Hole 15 Vert.	Hole 16 Vert.	Hole 21 Vert.	Hole 22 Vert.	Hole 23 Vert.
0.4	0.2	0.1	0.2	0.2
0.3	0.6	0.02	0.2	0.1
0.4	0.5	0.1		0.1
0.5	0.4	0.1		0.1
	0.8	0.3		0.1
	0.7	0.2		
	0.9	0.1		
		0.1		
		0.1		
		0.04		
		0.1		
		0.1		

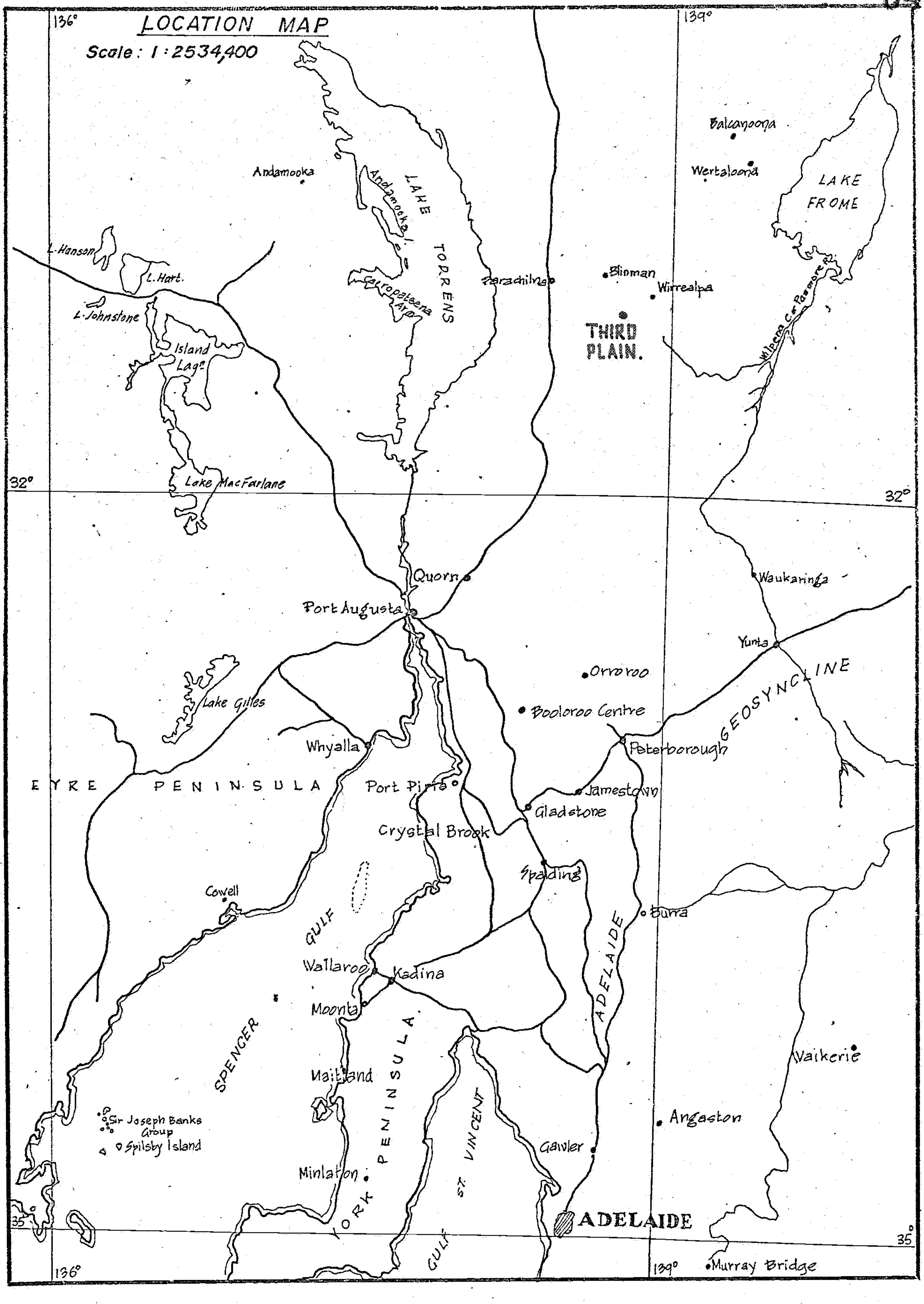
SCALE: 1" = 30 feet

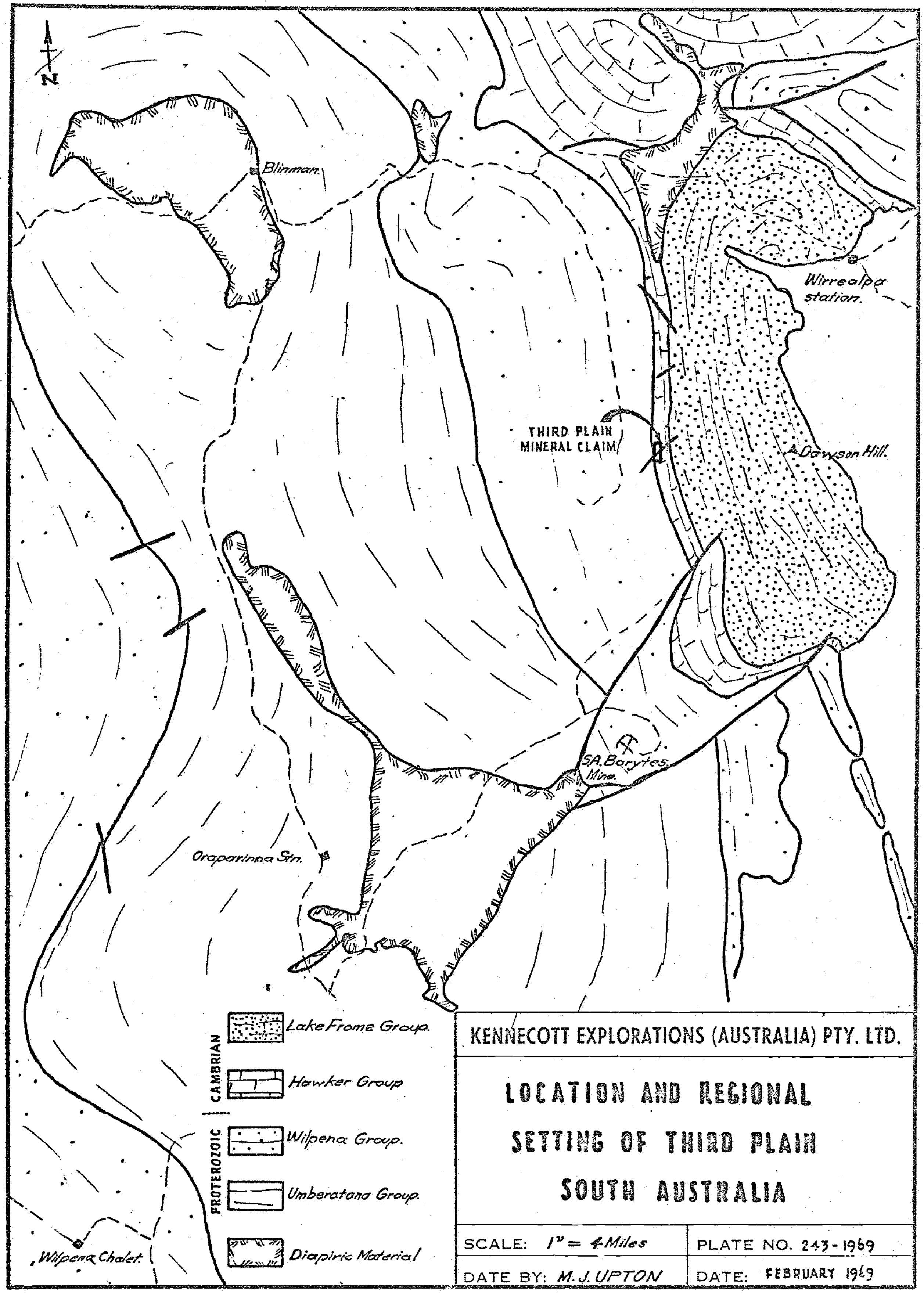
THIRD PLAIN
Drilling Results

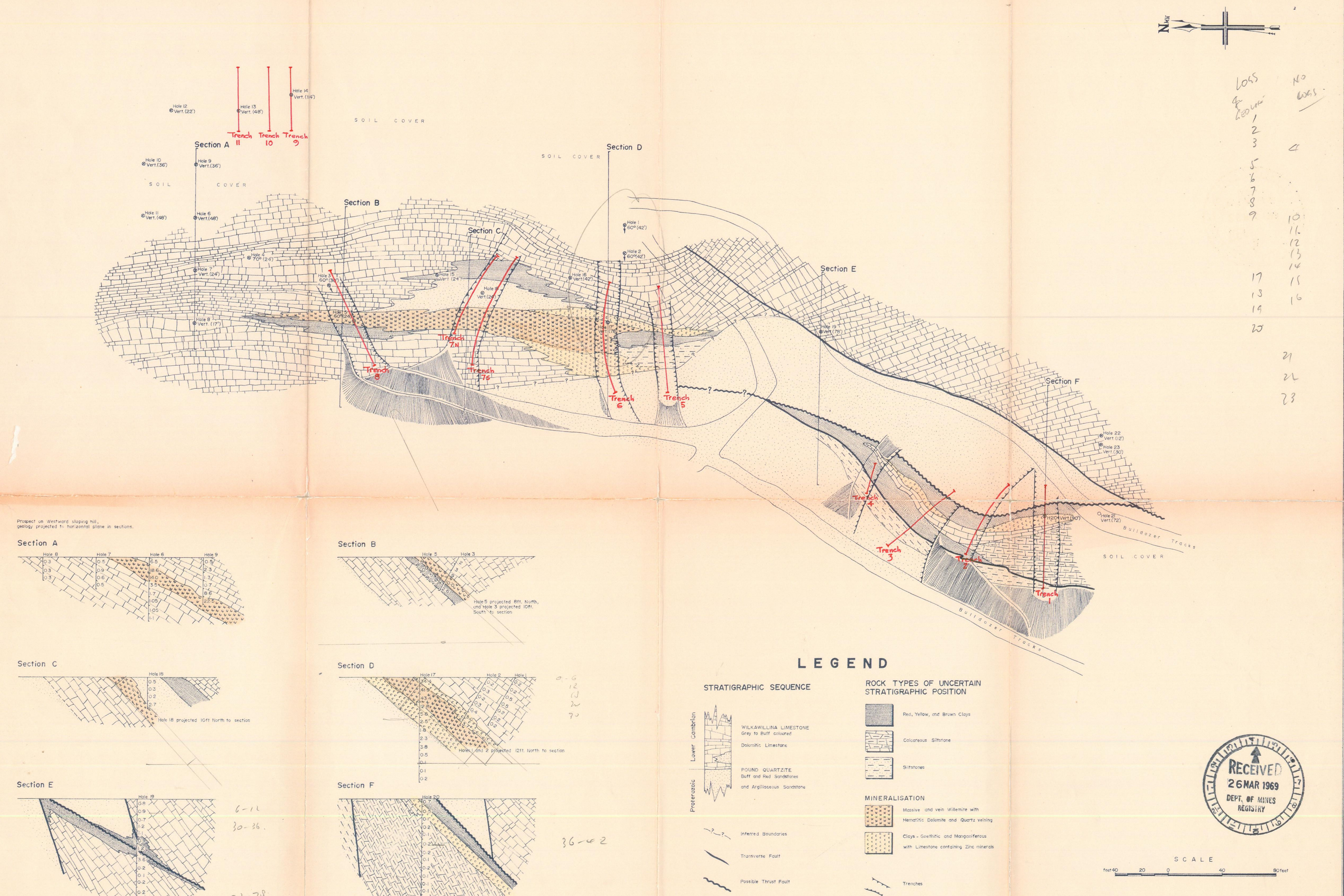
RESULTS IN % Zn

PLATE 1

045


LOCATION MAP
Scale: 1:2534,400
136°
139°
32°
35°
Andamooka
Andamooka I.
LAKE TORRENS
Parachilna
Blinman
Wirrealpa
THIRD PLAIN.
Balcanoona
Wertaloona
LAKE FROME
Wilpena Cr.
L. Hanson
L. Hart.
L. Johnstone
Island Lagn
Lake MacFarlane
Quorn
Port Augusta
Waukaringa
Yunta
GEOSYNCLINE
Orroroo
Booloroo Centre
Peterborough
Lake Gilles
Whyalla
EYRE PENINSULA
Port Pirie
Jamestown
Gladstone
Crystal Brook
Spalding
Burra
ADELAIDE
Cowell
GULF
Wallaroo
Kadina
Moonta
SPENCER
Maitland
YORK PENINSULA
Sir Joseph Banks Group
Spilsby Island
ST. VINCENT
GULF
Minlaton
Gawler
Angaston
Waikerie
ADELAIDE
Murray Bridge


N
Blinman
Wirrealpa station.
THIRD PLAIN MINERAL CLAIM
Dawson Hill.
S.A. Barytes Mine.
Oraparinna Stn.
Wilpena Chalet.
CAMBRIAN
Lake Frome Group.
Hawker Group
PROTEROZOIC
Wilpena Group.
Umberatana Group.
Diapiric Material
KENNECOTT EXPLORATIONS (AUSTRALIA) PTY. LTD.
LOCATION AND REGIONAL SETTING OF THIRD PLAIN SOUTH AUSTRALIA
SCALE: 1" = 4 Miles
PLATE NO. 243-1969
DATE BY: M.J. UPTON
DATE: FEBRUARY 1969



KENNECOTT EXPLORATIONS (AUSTRALIA) PTY. LTD.

THIRD PLAIN
Drilling and Trenching

BY R.E.B. 1st November 1968

SCALE: 1" = 40 feet	PLATE NO. 234-1968
DATE BY: J.R. Stevens	DATE: 31st October 1968