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DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
EXPLORATION SERVICES DIVISION

FIRST GEOLOGICAL & GEOCHEMICAL REPORT
ON THE SELLICK HILL AREA
FOR THE PERIOD JANUARY TO MAY, 1967

by

R.G. WRIGHT
GEOLOGIST
GEOCHEMICAL EXPLORATION SECTION

D.M.77/67

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ABSTRACT

The Lower Cambrian rocks of South Australia contain a number of stratiform lead, zinc and copper deposits. Work at Sellick Hill has indicated that a massive Archaeocyatha-bearing limestone carries anomalous amounts of lead and zinc.

Basal arkose-siltstone beds also contain high lead concentrations. Geochemical exploration techniques are being used to assess the economic potential of the area.

INTRODUCTION

The first reference to mineralization in the Cambrian sequence at Sellick Hill is given by H.Y.L. Brown (1908) in the Record of Mines. Brief mention is made of a small silver-lead prospect south of Aldinga and the Barritt's Mine and Queen Mary Mine north of Normanville. R. Rowley (1955) reported on the lead mine, now called Pipeline Prospect, situated west of the Myponga Reservoir pipeline, two miles south of Sellicks Beach. J.E. Johnson (1962) focused interest on the Sellick Hill region by discovering anomalous lead values in the basal arkose-siltstone members of the Mt. Terrible Formation. This discovery resulted from systematic rock sampling through the State's Cambrian sections. J. Verhofstad (1963) reported in detail the local geology of the area and B.J. Taylor (1964) carried out local geophysical investigations.

The regional geology of the area was first published by R.B. Wilson and A.W.G. Whittle (1953) in their mapping of the

Yankalilla and Jervis one mile sheets. More detailed mapping of the Cambrian exposures was carried out by C. Abele and B. McGowran (1958). R.C. Horwitz and B.P. Thomson (1960) mapped the northward extension of the Cambrian on the Milang one mile sheet.

The present exploration programme was begun in January, 1967 to fully investigate the whole Cambrian sequence exposed from south of Willunga to Normanville, a strike length of over 15 miles with a width of 1 to 1½ miles.

The work to date is in the orientation stage, gathering basic data. At this stage it is difficult to give any opinions on the economic potential of the area.

LOCATION AND ACCESS

The area lies about 35 miles south of Adelaide and is easily reached by bitumen and gravel roads from the coast road south to Cape Jervis. (see Locality Map S5900). Most parts of the area are accessible to Landrovers but walking is required in the more rugged regions near the coast and in the larger creeks.

CLIMATE AND PHYSIOGRAPHY

The climatic conditions at Sellick Hill are much the same as those experienced in the Adelaide region. Rainfall is lower, being of the order of 20 inches per annum on the western relatively barren side of the ranges. To the east of the coastal ranges, in the region of Myponga, the rainfall is much higher producing a dense scrubby vegetation cover.

The area is part of an uplifted Pre-Tertiary peneplain consisting of highly folded Archaean, Proterozoic and Palaeozoic formations dissected by subsequent cycles of erosion. The northwest boundary of the region is marked by the northeast trending Willunga Fault scarp with the Willunga Basin containing Tertiary and Quaternary rocks to the northwest. (see Drawing 67-400). Rugged relief predominates, with steep-sided hills reaching 1,000 to 1,400 feet above sea level. Deeply incised streams have cut into the Proterozoic and Cambrian rocks and Recent alluvium producing numerous waterfalls and remnant stream terraces. Wherever the Cambrian rocks reach the sea, cliffs some 200 foot high have formed. Drainage trends in a northwest direction across strike towards the sea.

GEOLOGY

The following brief description of the geology of the area is based largely on the work by C. Abele and B. McGowran and on B. Daily's later revision of the stratigraphy. (see Drawings 67-400 and 67-407)

Stratigraphy

The stratigraphic sequence is shown below.

QUATERNARY	Clay and gravel alluvium	
TERTIARY	Bryozoal Miocene limestones	
PERMIAN	Unconsolidated glacial sand and boulder clays	
LOWER CAMBRIAN	Carrickalinga Head Formation 450ft.	
	Heatherdale Shales 950ft.	
	Fork Tree Limestone	mottled upper limestone 50ft. massive Archaeocyatha limestone 800ft.
	Sellick Hill Limestone 700 - 1,200ft.	
	Wangkonda Limestone 400ft.	
	Mt. Terrible Formation	ferruginous sandstone 50ft. siltstone 200ft. arkose 40ft.
UPPER PROTEROZOIC	Wilpena Group	- shales and flaggy quartzites

Upper Proterozoic

Wilpena Group

These rocks consist dominantly of light brown to green siltstones, shales and flaggy quartzites. Massive, 50 foot thick quartzites with a tendency to lense occur in the sequence. The rocks are laminated with the coarser quartzites showing frequent cross bedding. Towards the southwest the beds become more calcareous.

Lower Cambrian

The onset of a new sedimentary cycle is marked by the appearance of a thin arkose unit which begins the deposition of the dominantly carbonate-rich Cambrian sequence. Daily (1963) believes that this arkose is a transgressive unit deposited under full marine conditions over the muds and sands of the Wilpena Group. Thomson and Horwitz (1961) suggest that there is a disconformity between the Proterozoic and the Cambrian in this region.

Mt. Terrible Formation

This formation consists of three separate units. The basal part of lowest member is a 40 foot thick, cross-bedded arkosic grit with thin silty partings. The upper part of this lowest member grades into sandy siltstone with thin beds of coarse sandstone. This position was found to contain anomalous lead values at Sellick Hill by J.E. Johnson.

Overlying the arkose member is about 200 feet of dark grey (yellow weathering) siltstone which in turn is followed by 50foot of cavernous and ferruginous siltstone (The Hyolithes sandstone of Abele and McGowran (1959)).

Wangkonda Limestone

This is a 400ft. thick,massive, mainly blue-grey recrystallized limestone with a median calcareous sandstone band. Towards the top it grades into a calcareous sandstone. Daily (1963) states that the contact between the Wangkonda Limestone and the Sellick Hill Limestone is a cut and fill contact.

Sellick Hill Limestone

This is a very persistent formation which is easily traced over the entire area. It consists of alternating bands of pale or dark grey crystalline limestone with buff shaly bands. These bands vary in thickness but average about 2 - 3cms. with some extending to 10cms. The calcareous layers are variable in thickness and show pinching and swelling, probably due to their growth from the amalgamation of concretions in fine muds. The base of the formation is sandy becoming more calcareous upwards. Weathering produces a characteristic serrated surface. The thickness is variable but is between 700 to 1,200 feet at Sellick Hill.

<u>Fork Tree Limestone</u>

This limestone occupies the largest proportion of the outcrops of Cambrian rocks in the region. This is of economic importance because of the apparent association of lead-zinc mineralization with the upper part of the formation. The lower member of the Fork Tree Limestone is commonly massive, light grey to moderately dark blue on fresh surfaces. The rock weathers to a pale grey or brownish colour and often has a thick overlying crust of calcrete. Generally the limestone is very pure, finely crystalline with greater than 90% carbonate minerals. Abundant Archaeocyatha fossils characterize this member which is about 800 feet thick at Sellick Hill.

The mottled upper limestone member consists of dark blue-black angular lumps of limestone surrounded by yellow-brown calcareous shaly material. The rock appears to be an intraformational breccia or conglomerate. Thickness varies from 50 to 100 feet. This member is very characteristic in the field and is important in mapping. The two largest lead deposits; Barrit's Mine and the Pipeline Prospect occur in fractures or shears in this rock.

<u>Heatherdale Shale</u>

This formation was divided into two members by C. Abele and B. McGowran but has been treated as a single unit in this report. The base is normally sharply defined from the top mottled limestone member of the Fork Tree Limestone by changes due to weathering.

soft,

The Heatherdale shales consist of [redacted]./highly weathered, brightly coloured red, pink, yellow and orange shales with the lower 10 to 15 feet composed of fine-laminated flaggy limestone bands. Towards the middle of the formation, there are large nodules of dark blue limestone. Small black phosphatic nodules occur in the upper parts of the formation. Exposures in the new road cuttings show that the unweathered rock is carbonaceous and pyritic.

Carrickalinga Head Formation

This name was given by B. Daily (1963) to a sequence of olive-coloured, alternating greywackes and shales exposed at Carrickalinga Head and at Myponga Beach.

Permian

Flat-lying sand and boulder clay of glacial origin covers various parts of the area, especially the central and southern portions.

Tertiary

Cambrian rocks on the south-eastern edge of the Willunga Basin are unconformably overlain by thin Miocene bryozoal limestones.

Quaternary

These deposits include the coastal sands and dunes, alluvial clays and gravels and calcrete horizons

Structure

The fossiliferous Cambrian formations lie on the western flank of the Myponga Hill-Little Gorge Anticline, shown by Campana and Wilson to dominate the structure of the region. The Cambrian is separated from the older rocks by the Black Hill Fault, except in the area north of the main road. The attitude of the beds is controlled mainly by the development of a series of southwest-northeast trending folds extending from the S.W. of Carrickalinga Hill to north of Black Hill. South-westwards along strike, the area is structurally very complex.

The beds at Sellick Hill are overturned to the west.

Towards the southwest the beds become steeper and dip westwards with the beginnings of a large anticline which plunges shallowly to the southwest. This anticline continues until it is broken by a transverse fault, roughly at right angles to the Black Hill Fault, one mile east of Myponga Beach. The coastal section northeast of this transverse fault is very complicated.Abele and McGowran record the upper mottled limestone of the Fork Tree Limestone being repeated by faulting here at least three times.

The northern portion of the region,between Myponga Beach and Sellick Hill has so far received the most attention in the current survey. The area to the south, between Myponga Beach and Normanville is at present being investigated via stream sampling. Thus the general structural picture is that the rocks of the region have been tightly folded along southwest-northeast, trending axis and overturned towards the northwest. There has probably been much thrusting of the Wilpena Group rocks towards the northwest along the Black Hill Fault.

Campana, Wilson and Whittle (1955) discuss the tectonics of the whole area. The tight folding of the Proterozoic Cambrian and Ordovician formations is thought to be the result of an early Palaeozoic orogeny. The longitudinal Black Hill Fault is probably of Palaeozoic age. During the Mesozoic Era, after the Permian glacial period, the relief of the area was reduced to a peneplain. Numerous periods of tectonism in the Tertiary, uplifted the old peneplain by some 1,500 feet. The thrusting and uplift of the various blocks along earlier fault lines resulted in the present day topography.

Mineralization

There are five localities where mining has been attempted. From north to south, these are as follows:

1. The first deposit is situated about half a mile east of the Sellick Hill HOtel and consists of a 60 foot shaft and a shallow underlie shaft sunk on a

ferruginous breccia? zone in Wangkonda limestone. To the north a long adit has been driven into the south side of a gully. This mines is probably the gold discovery reported by H.Y.L. Brown in the Record of Mines 1908, page 268. A sample of the ore has been sent for analysis.

2. Sellick Hill Prospect.

Two shallow shafts and several pits have been put into a 15 to 60 foot wide, recrystallized calcite zone in the upper part of the massive Archaeocyatha limestone member of the Fork Tree Limestone. This prospect is located about ¾ mile south of the Sellick Hill Hotel. The recrystallized calcite carries disseminations and small veinlets of sphalerite and galena. The deposit was rediscovered when the first geochemical soil sampling line (line 1) was run through the Cambrian section at Sellick Hill. The soil overlying the recrystallized material contains up to 400 p.p.m. lead and 200 p.p.m. zinc. Local background is about 20-30 p.p.m. lead and 25-35 p.p.m. zinc. This unusual material could be followed along strike for over a mile and appeared to be located in a definite stratigraphic position. Later, during stream sampling, similar material was discovered in the same stratigraphic position in the large creek northeast of the Pipeline Prospect (see Drawing 67-400), about two miles southwest of the Sellick Hill Prospect. Rock samples of this material from Sellick Hill, contain up to 300 p.p.m. lead and 1,400 p.p.m. zinc. This deposit is probably that described as in the Record of Mines 1908, page 189.

3. Pipeline Prospect

R. Rowley (1955) reported on this lead deposit which is located nearly two miles south of Sellick Beach and ¼ mile inland from the sea, close to the Myponga

Reservoir pipeline. Galena-calcite lenses occur in a joint or shear zone in the mottled upper limestone member of the Fork Tree Limestone. The mineral veins vary from $\frac{1}{4}$ inch to 12 inches in width, strike at 030° and dip vertical to steep east. At creek level on the western bank, a small drive discloses a two to three foot wide, ferruginous, shale-filled shear zone carrying angular fragments of galena. Rowley reports that a grab sample from the dump assayed 39.8% lead, 2ozs. 2 dwts/ton of silver, a trace of gold, less than 0.001% bismuth and no zinc. No sphalerite was found at this deposit. The other two deposits occur in the area between Myponga Beach and Normanville which is now being explored. Their exact location will be recorded on a later map.

4. Queen Mary Mine

This mine is situated $3\frac{1}{2}$ miles north of Normanville. Four shafts have been sunk on one to two foot thick coarsely-crystallized calcite veins in Fork Tree Limestone. No ore minerals could be found in the waste dumps. The mine was probably a prospecting venture (Record of Mines 1908, page 192.)

5. Barritt's Mine.

The mine is the largest of the three known lead deposi[ts]. It is situated on the northern bank of a creek $2\frac{1}{2}$ mile[s] north of Normanville. The lode is about one to three foot wide, strikes 035°N and dips 80° northwest. The lode consists of a shear or fracture zone filled with yellow shale breccia containing angular limestone fragments and nodules and blocks of up to 2cwt. of galena. The deposit is of much the same type as the Pipeline Prospect and similarly occurs in the upper mottled limestone members of the Fork Tree Limestone. The dressed ore assayed 60% lead and three to five ounces of silver per ton. Unlike the

Pipeline Prospect, a small amount of sphalerite is associated with the galena (Record of Mines 1908, page 165).

Lead mineralization occurs as small disseminations of galena and sphalerite in limestones at Carrickalinga Head. (Wilson and Campana). J.E. Johnson (pers. comm.) has found lead and zinc sulphides in limestone some half mile northwest of the Carrickalinga Hill.

GEOCHEMISTRY

Sample Preparation and Analysis

Rock samples are crushed and soil and stream samples seived through the -80 mesh seive and this fraction submitted for analysis to AMDEL. The samples are treated with perchloric acid and the metal content determined by the atomic absorption spectrophotometer. Initially the orientation soil, stream and rock samples were tested for copper, lead, zinc, cobalt and nickel. The results indicated little variation in cobalt and nickel values through the Cambrian sections (see Drawing 67-407). Subsequent samples have been tested for copper, lead and zinc only. To date 431 stream sediment samples, 571 soil samples and 51 rocks samples have been collected and the results received.

Rock Sampling

The geochemical investigation at Sellick Hill began with close rock sampling at 5 foot intervals over the best lead anomaly discovered by J.E. Johnson (Anomaly C). This anomaly occurs at the contact of the basal arkose with the overlying siltstone of the Mt. Terrible Formation. At this position anomalous lead values (460 p.p.m. lead) occur in $\frac{1}{8}$ inch thick, ferruginous veinlets developed in a 2 to 3 foot wide, shaly fracture zone. The overlying siltstones, for a thickness of 20 feet, carries an average of 85 p.p.m. lead and 70 p.p.m. zinc. One 5 foot section of the siltstone gave 5,600 p.p.m. lead and 350 p.p.m. zinc. This horizon wherever sampled northeast of the main road invariably contains anomalous lead values. Samples of the ferruginous veins and the siltstone have been submitted to AMDEL for petrological description.

A rock sampling line, 120 foot long, was carried across strike of the recrystallized zone at the Sellick Hill Prospect. Chip samples were taken at 5 foot intervals. The average rock background values for the massive Fork Tree Limestone was 10 p.p.m. lead and 20 p.p.m. zinc. The 15 foot wide recrystallized zone contained up to 300 p.p.m. lead and 1400 p.p.m. zinc. The soils overlying this deposit contain up to 400 p.p.m. lead and 200 p.p.m. zinc. The results of rock sampling carried out concurrently with the initial soil sampling on lines 1 and 2 is shown in Drawing 67-407. Generally the soil overlying a particular bedrock shows a similar lead content as the bedrock.

The mobility of zinc is shown by the wider variation between bedrock and overlying soil analyses. Soil line 2, however, shows much less lead in the soils overlying some bedrock samples. Both the Wangkonda and Fork Tree limestones show anomalous lead and zinc values. Anomalous lead values occur in the Mt. Terrible Formation.

Soil Sampling

The soils sampled at Sellick Hill on ridge crests are dominantly zonal; i.e. residual and controlled in their development by the nature of the climate and the type of vegetation cover. In areas of steeper gradient the soils are more colluvial in type. The zonal soils developed are typical of a moderate climate with rainfall less than 30 inches per year. Chemical weathering and leaching proceed slowly and the development of a differentiated soil profile is rarely complete. The calcrete present in the region is characteristic of soils developed under these conditions.

Orientation soil sampling (Lines 1 and 2) was carried out on hill crests north and south of the stream draining J.E. Johnson's lead anomaly. These lines, sampled every 100 feet, were run east from the main road across the strike of the Cambrian rocks and carried 1000 feet into the Proterozoic rocks. This survey provided the necessary data to design a full scale soil sampling survey. Where possible five samples were taken at each sample point.

These samples were

0 - 1 inch	soils
1 - 12 inches	soils
below 12 inches	soils
calcrete	rocks
bedrock	rocks

As a result it was found that in most cases the soil overlying bedrock reflected the metal values of the bedrock. Sampling on Line 2 especially showed that the deeper sampling (1-12 inches) was preferable because of the increase in metal content with depth. These facts substantiate the idea of the soils being dominantly residual when sampled on the hill crests. The -80 mesh fraction of the soils was analysed because this size is believed to provide the best contrast between anomalous and background values in most environments. The results from test soil lines over mineralized areas have shown this to be correct for the Sellick Hill region.

Some of the more calcareous formations have a one to two foot thick cover of calcrete. Of 18 calcrete-bedrock pairs analysed, 16 showed that the calcrete contains much the same amount of lead as the underlying bedrock. The distribution of zinc, as expected, is more erratic.

The soil overlying this calcrete cover contains lesser but similar lead values as the calcrete. The zinc and copper values are enhanced in the overlying soil. Two examples are shown below

Sample 2/14		Cu	Pb	Zn	p.p.m.
	0 - 1"	15	30	50	G1242/67
	1 - 12"	15	30	45	
	calcrete	*< 5	95	10	
	bedrock	< 5	95	15	G1245/67

Sample 2/17		Cu	Pb	Zn	p.p.m.
	0 - 1"	15	70	50	G1254/67
	1 - 12"	15	75	50	
	calcrete	< 5	95	12	
	bedrock	< 5	105	10	G1257/67

*< = less than

The basic soil data obtained in this survey is shown in the table below.

Sellick Hill Soils	Pb	Zn	Cu	Co	Ni p.p.m.
Background	20-30	25-35	10-15	10-20	15-25
Threshold	50-60	60-70			
Anomalous	* >60	>70			

* > = greater than

An interesting feature of this study is the sharp geochemical change at the disputed base of the Cambrian. The Upper Proterozoic rocks are low in trace elements compared with the overlying Cambrian rocks, the division being in the region of the base of the arkose member.

Stream Sediments

In the initial survey, bed gravel samples were collected at approximately 400 foot intervals in the stream draining the original lead anomaly and the stream north of the Old Sellicks Hill Road. The sample interval was cut to 100 feet downstream from the outcrop of the Mt. Terrible arkose-siltstone and the top of the Fork Tree Limestone. The samples from the stream draining Johnson's lead anomaly were split into six size fractions.

-9	+	16 Mesh
-16	+	32
-32	+	60
-60	+	115
-115	+	250
-250		

Each of the three coarser fractions was ground and seived through a -80 mesh seive and then sent for analysis with the three finer fractions. Half of the sample points in this creek were double sampled in two closely-spaced places (A & B) to determine repeatability of the various fractions.

The results show that the coarser fractions contain slightly more lead than the fines (see examples below). Zinc increases with the coarseness of the fractions.

<u>Sellick Hill Stream Sediments</u>

Sample Point 72 G1584-1595					Sample Point 73 G1596-1607			
Pb		Zn			Pb		Zn	
A	B	A	B	<u>FRACTION SIZE</u>	A	B	A	B
60	90	40	30	-9 + 16	90	60	15	12
60	70	35	20	-16 + 32	75	55	12	10
70	50	35	18	-32 + 60	80	55	10	10
70	55	25	12	-60 + 115	70	70	8	8
70	55	18	10	-115 + 250	70	60	8	8
60	50	18	12	-250	60	60	10	10

Analysis repeatability of the finer material was better than that of the coarse fractions. As a result it was decided to use the -80 mesh fraction for further stream sampling work. The lengths of the dispersion trains for lead and zinc in the creeks are about ¼ mile. In this geochemical environment, in contrast to the Lyndhurst region, chemical mobility appears to be more important in the dispersion of metals than mechanical movement.

To determine the extent of mechanical mobility, bulk gravel samples of 2-3lb. weight were collected downstream from the outcrop of the top of the Fork Tree Limestone. The samples were concentrated by panning and the concentrates examined, crushed to -80 mesh and then sent for analysis. A normal -80 mesh sample of the bed gravel was also submitted. The results are plotted in Diagrams one and two (S5891 & S5890). The panned concentrates show an increase in lead content in all cases possibly indicating that the lead travels as grains of galena or as adsorbed ions on hydrated iron or manganese oxide grains in the bed gravels. Samples 56 and 113 are from streams draining known mineralization. (56 down from the Sellick Hill Prospect, 113 downstream from Pipeline Prospect). Panning of the bed gravel of these streams has concentrated the heavier mineral grains. Both lead and zinc values are magnified. The zinc values however, do not show the effect as well as the lead, probably because much of the zinc is presently absorbed on the lighter clays and organic materials which are lost in panning. Only the zinc adsorbed on hydrated iron or manganese oxide grains is retained.

Visual examination of the concentrates showed that six of the 22 treated contained small fragments of metallic lead probably derived from shooting in the area. Diagram one shows the samples which contained this lead. Samples 60 contained some 10 to 15 fragments.

From the plotted values it can be seen that there is a marked increase in the lead content of sample 60 but in the other cases, where only one or two fragments of lead were noted, the effect is negligeable. Sample preparation will probably remove much of this lead, because most of the fragments seen were coarser than -80 mesh. It will also be noted that high lead values from mineralized stream gravels are matched with high zinc values. Thus a high lead with low normal zinc would be a suspect sample and possibly contaminated. Sample 223 contains both lead and zinc high values and probably drains through a mineralized area. The sample was taken in the fourth creek east from Myponga Beach.

Plans 67-330 and 67-331 show the distribution of lead and zinc in streams draining the Proterozoic and Cambrian rocks between Willunga and Myponga Beach. Streams draining past the Sellick Hill and Pipeline Prospects carry anomalous lead and zinc values.

An interesting feature is the high values upstream from the Pipeline Prospect. Soil sampling here indicates another lead-zinc anomaly uphill from the small anomaly over the actual prospect. Further work will be done here to delineate this new anomaly.

So far the area between the main road and Myponga Beach is geochemically and structurally the most interesting. North of the Sellick Hill Prospect the main feature of interest is the high zinc values in streams draining off the Proterozoic rocks north of Mt. Terrible. The next stage of the investigation will be to run soil sampling lines along the ridge crests in these areas so as to narrow down the anomalous areas.

From the stream sampling done so far, the background values for lead and zinc in bed gravels is 40 p.p.m. for both. Threshold values are 61-90 p.p.m. for lead and 71-100 for zinc. Anomalous values for lead are greater than 90 p.p.m. and zinc are greater than 100 p.p.m. zinc.

The geochemistry of the area is complicated by the aerial application of superphosphate, a sample of which contained 15 p.p.m. lead and 350 p.p.m. zinc. Roadside rubbish-dumps are another source of contamination.

GEOPHYSICS

Results from the five geochemical soil lines put over the Sellick Hill Prospect proved that the soil over the recrystallized zone carried up to 400 p.p.m. lead and 200 p.p.m. zinc for well over 3,000 feet along strike. Two short geophysical lines were carried out along geochemical soil lines nine and eleven to investigate this zone. Line nine passed through the centre of the geochemical lead high and line eleven passed across the thickest part of the recrystallized zone. Appended is the minute by B.J. Taylor (Geophysical Assistant) on the results obtained. The geochemical soil sampling indicated that lead was present in greater concentrations than zinc. Later rock sampling however, showed that zinc as sphalerite, is more important (i.e. rock samples contained up to 1,400 p.p.m. zinc). Cheap wagon drilling will be necessary to further investigate this zone as geophysical methods are limited in case of sphalerite mineralization.

The geophysical results are illustrated in Drawings 67-162 and 67-163.

CONCLUSIONS AND RECOMMENDATIONS

At this stage the work carried out at Sellick Hill is insufficient for any estimation of the economic potential of the area. Certain pertinent facts, however, have emerged from the study. The work has verified and extended the strike length of the anomalous lead values occuring at the arkose-siltstone contact of the Mt. Terrible Formation. The work has also indicated the presence of anomalous lead and zinc concentrations in certain parts of the Fork Tree Limestone and to a lesser extent in the Wangkonda Limestone.

The unusual recrystallized calcite bed? in the massive Fork Tree Archaeocyatha limestone member carries disseminated lead, zinc and iron sulphides. The physical and chemical nature of this bed may have helped in its easy crystallization during the folding of the early Palaeozoic orogeny. During this folding some of the lead and lesser amounts of the zinc were probably channeled off into joints or shears available in the overlying mottled limestone member. Thus regions of extreme folding and shearing of the limestone would be the best areas for the formation of economic ore bodies. The fact that the structurally complex region to the southwest of the new road has several

APPENDIX 1.

TO THE SENIOR GEOPHYSICIST, EXPLORATION GEOPHYSICS SECTION:

Geophysical Investigations of Geochemical Anomaly - Sellicks

Induced Polarization, Self Potential and Magnetic methods were used between the 5th and 7th April on two lines on which geochemical investigations had been carried out in the vicinity of Sellicks Hill ([redacted]). The geochemical samples exhibited an anomalous amount of lead associated with a recrystallized section of the Forked Tree Limestone bed and geophysical work was requested to determine whether these methods would delineate the amount and extent of mineralization.

The accompanying drawings Nos. 67-162 and 67-163 display results of the geophysical surveys together with a geological cross section. The lines were centred near the centre of the geochemical anomaly and positioned in a general eastwest direction approximately at right angles to the strike of the beds.

From the I.P. contours it can be seen that the area near the recrystallized limestone is of a very high resistivity, while on line 9/3 there is a slight increase in percentage frequency effect. The resistivity is extremely high (reaching > 5000 ohm-metres) suggesting that the recrystallized rock has an extremely low porosity and that there is no continuity between centres of mineralization sufficient to increase the conductivity to any extent. Disseminated sulphide mineralisation may be present but the rock acting as an electrical insulator would prevent the over-voltage phenomenon on which the I.P. effect presumably depends. The frequencey effect values show a considerable increase to the west, which is probably caused by the Heatherdale Shale bed containing pyrite and graphite.

The Self Potential profiles show a steady negative gradient towards the shale bed. This is also probably caused by the presence of pyrite in the shale.

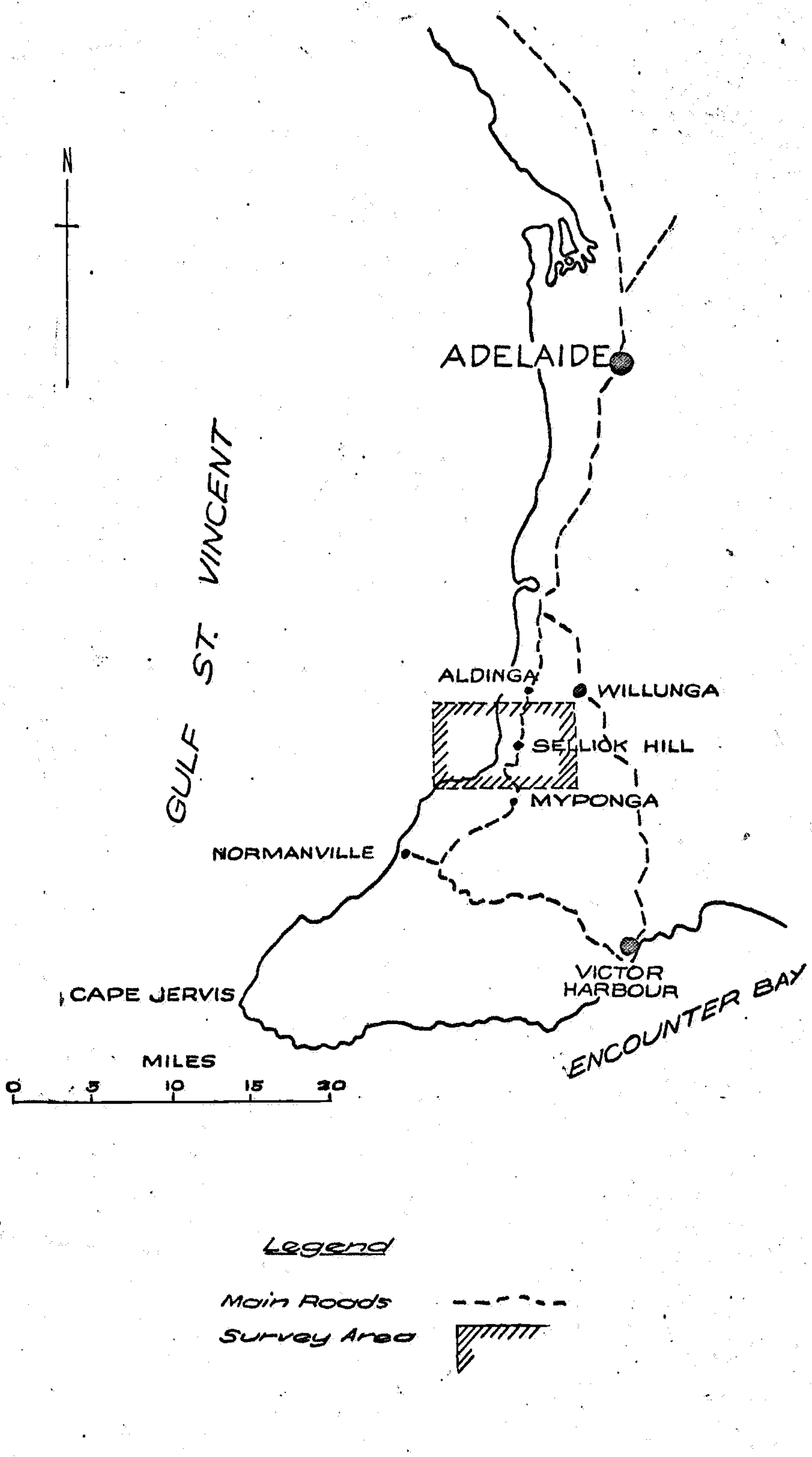
Magnetic profiles display variations of up to 200 gammas, but the variations cannot be related directly to the geology as mapped, and are probably caused by small variations of magnetic minerals within the rocks.

It is concluded that the I.P. method could be used to locate the recrystallized material of the Forked Tree Limestone bed if this is concealed by overburden, but that disseminated mineralisation cannot be detected within this material because of its physical nature.

B Taylor

BJT:PAL
12/4/67

B.J. TAYLOR
Geophysical Assistant



DEPARTMENT OF MINES — SOUTH AUSTRALIA

	Drn. R.G.W.	SELLICK HILL LOCALITY MAP	SCALE: AS SHOWN
	Tcd. J.M.W.		S5900 Hatc
	Ckd. L.V.W.		
	Exd.		DATE:

DEPARTMENT OF MINES – SOUTH AUSTRALIA

SELLICK HILL
LEAD VALUES
PLOT OF -80 MESH SAMPLE COMPARED WITH PANNED CONCENTRATE

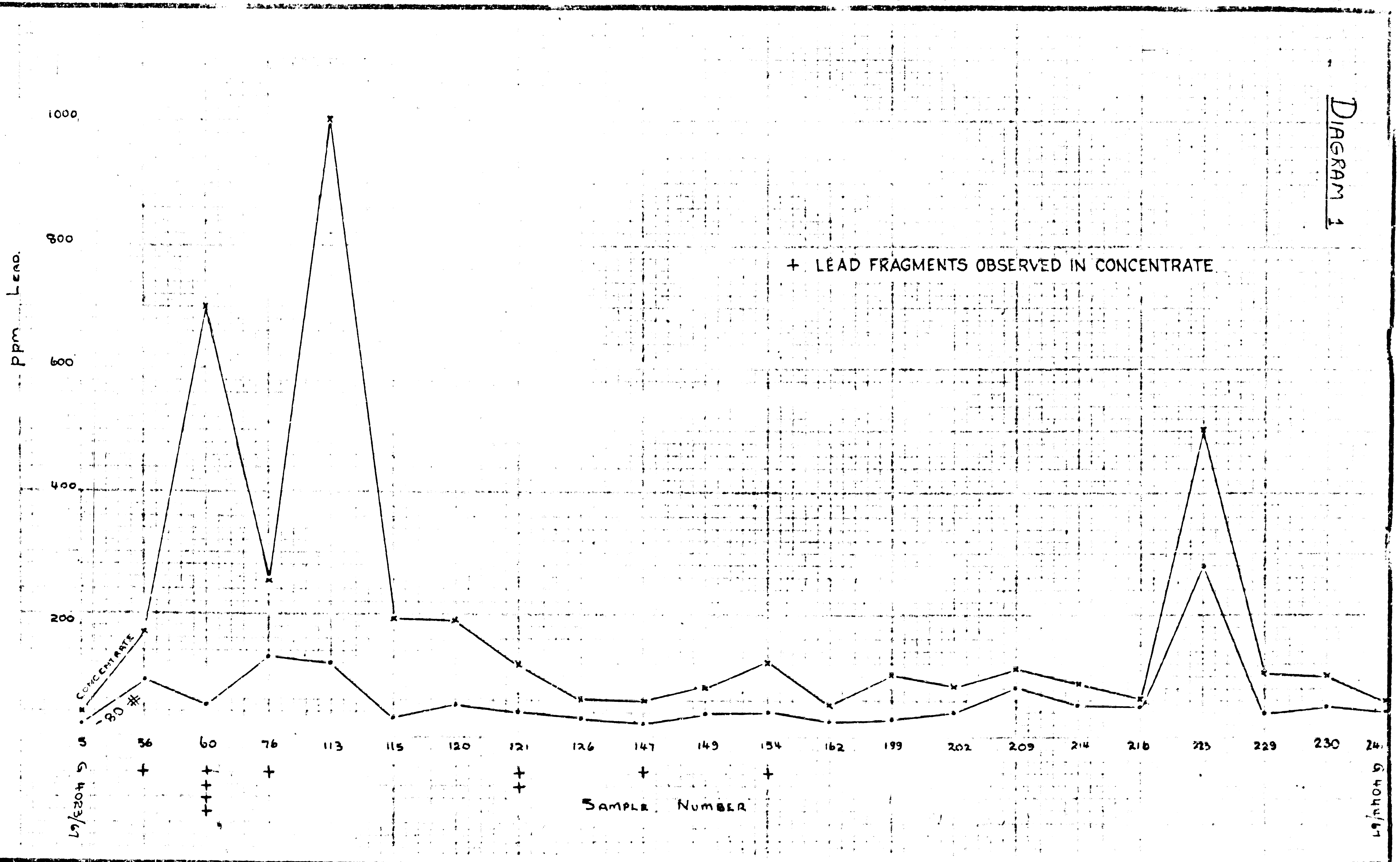
Drn. RGW
Tcd. -
Ckd. LVW
Exd.

SCALE:

S5891

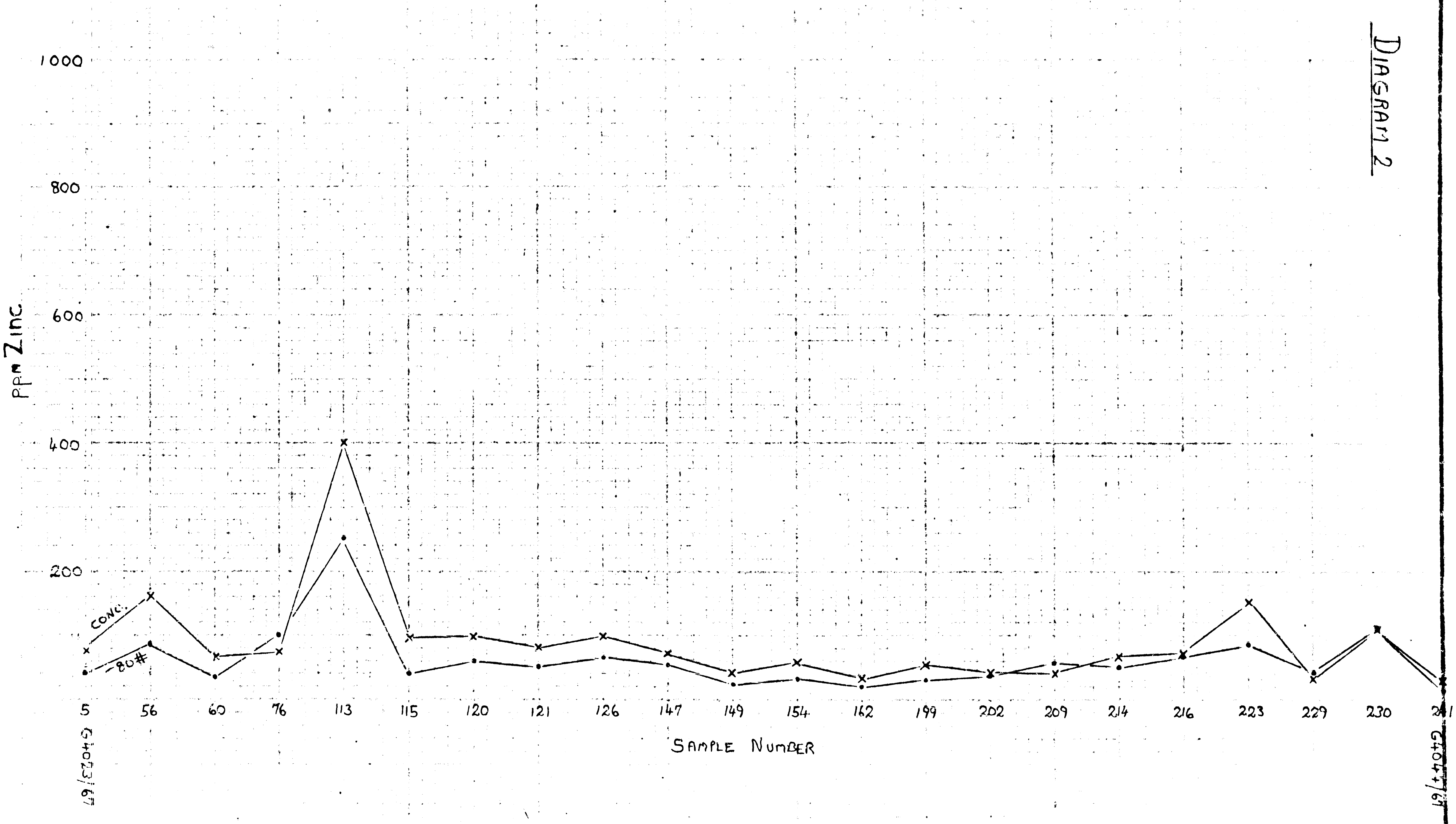
Ha+C

DATE: 9 JUN 1967



ORIGINAL

DIAGRAM 2



DEPARTMENT OF MINES — SOUTH AUSTRALIA

SELLICK HILL
ZINC VALUES
PLOT OF -80 MESH SAMPLE COMPARED WITH PANNED CONCENTRATE

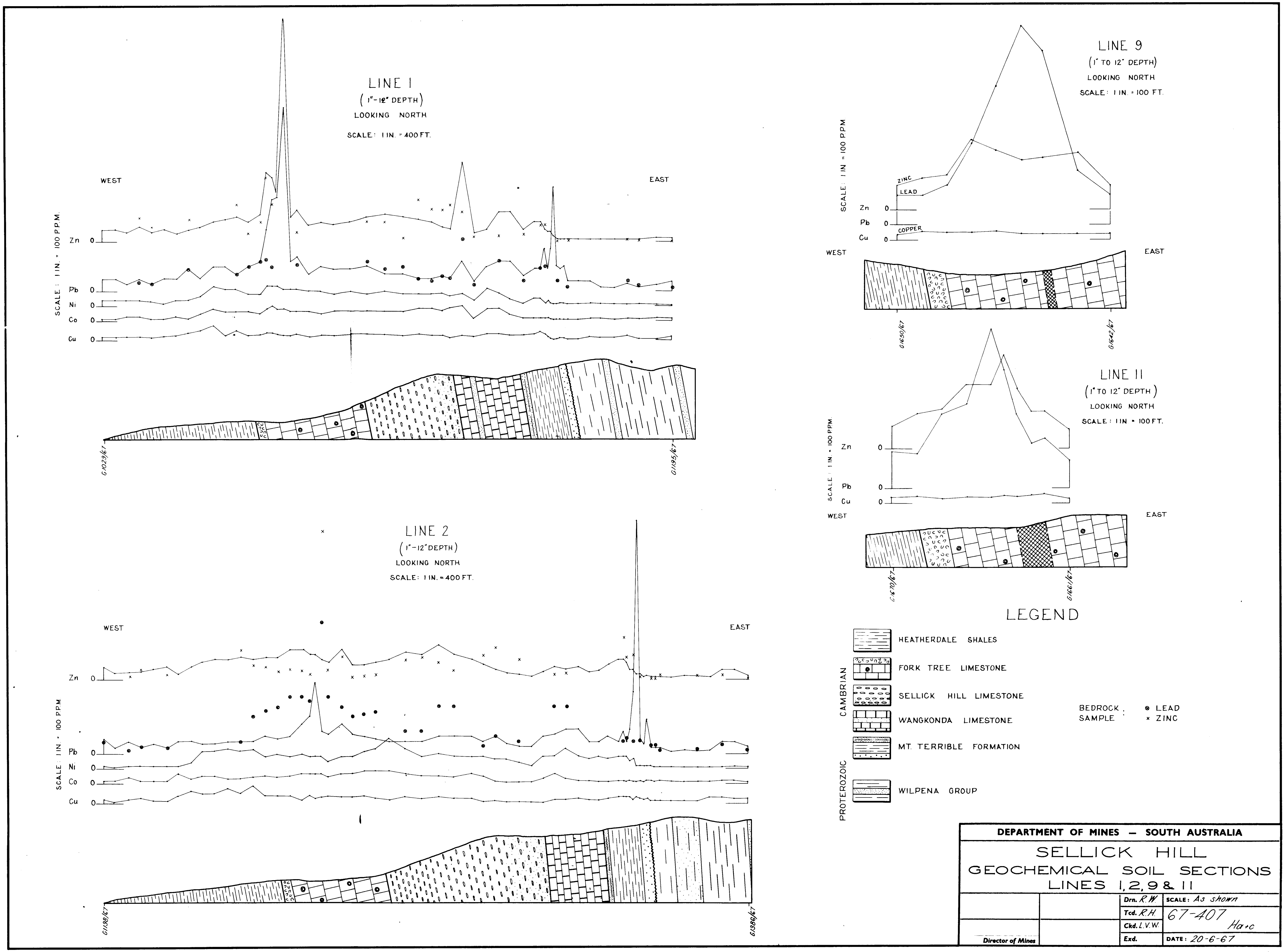
Drn. RGW.	SCALE:
Tcd. -	S 5890
Ckd. LVW.	Ha+C
Exd.	DATE: 9 JUN. 1967

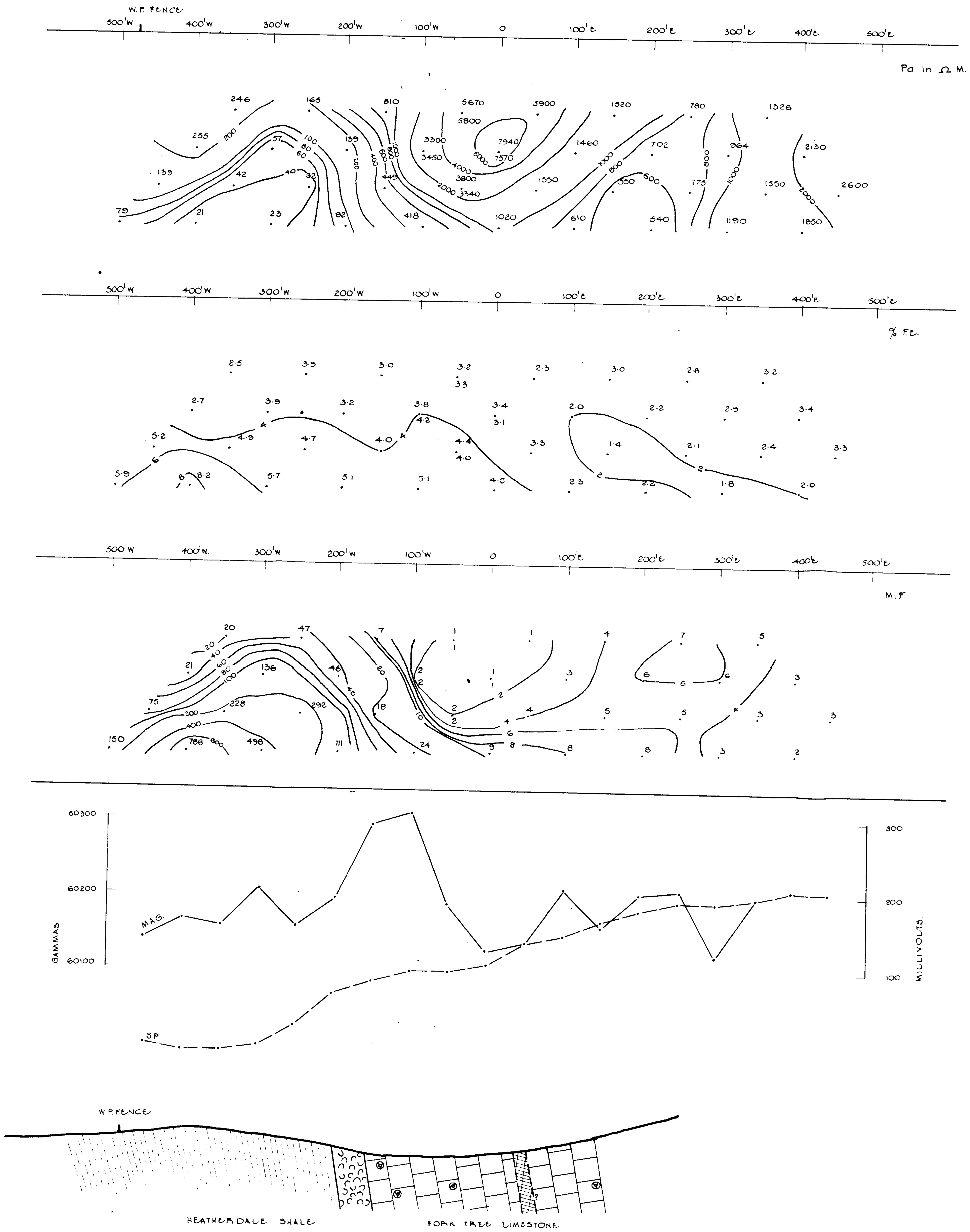
ORIGINAL


TN MN
SCALE
CHAINS 80 60 40 20 0 1/2 1 MILES
ST VINCENT
GULF
SELLICK BEACH
MYPONGA BEACH
SELLICK HILL
HOTEL
MT TERRIBLE 1267
Mt. Terrible Gully
WILLUNGA
FAULT
SCARP
SELLICK HILL PROSPECT
PIPELINE PROSPECT
JOHNSONS LEAD ANOMALY
Confused Area
Cover of Soil and Alluvium
BLACK HILL
HEATHERDALE 1156
Heatherdale Pastoral Pty Ltd
MYPONGA RIVER
To Myponga
To Willunga
OLD
SELLICKS HILL ROAD
LEGEND
QUATERNARY
ALLUVIAL CLAYS & GRAVELS
TERTIARY
BRYOZOAL LIMESTONE
PERMIAN
UNCONSOLIDATED GLACIAL SANDS & BOULDER CLAYS
CARRICKALINGA HEAD FORMATION
HEATHERDALE SHALES
CAMBRIAN
MOTTLED LIMESTONE
MASSIVE ARCHAEOCYATHA LIMESTONE
FORK TREE LST.
SELLICK HILL LIMESTONE
WANGKONDA LIMESTONE
FERRUGINOUS SANDSTONE SILTSTONE ARKOSE
MT TERRIBLE FORMATION
PROTEROZOIC
WILPENA GROUP
Geological Boundaries
Observed
Inferred
Fault
Bedding
Strike and dip
Vertical
Geochemical Soil Sampling Line
LINE 4
Main road
Secondary road
Track
Creek
Triangulation station
Quarry
Mine
Lead.....Pb
Zinc.....Zn
Silver....Ag
Phosphate....P
DEPARTMENT OF MINES – SOUTH AUSTRALIA
SELLICK HILL
GEOLOGICAL PLAN
Drn. R.W.
Tcd. R.H.
Ckd. L.V.W.
Exd.
Director of Mines
SCALE: As shown
67-400
Ha+c
DATE: 28-6-67
Geology after C. Abele and B. McGowran (1959), B. Campana and B. Wilson (1954), R.C. Horwitz and B.P. Thomson (1961)


T.N.
M.N
GULF St VINCENT
SCALE
CHAINS 80 60 40 20 0 1/4 1/2 1 MILES
To Aldinga
LOUD HILL
SELLICK HILL
SELLICK BEACH
MT. TERRIBLE ▲ 1267'
Pb, Zn
SELLICK HILL PROSPECT
OLD SELLICKS HILL ROAD
MT TERRIBLE GULLY
PIPELINE PROSPECT Pb, Ag
BLACK HILL
HEATHERDALE ▲ 1156'
HEATHERDALE PASTORAL PTY. LTD
MYPONGA BEACH
RIVER
MYPONGA
To Willunga
To Myponga
Metal Content in parts per million of -80 Mesh Fraction of stream bed gravels listed in the order; Lead Zinc
75 – Lead p.p.m
25 – Zinc p.p.m
LEAD CONTENTS
≤ 20 p.p.m.
21 – 40 p.p.m
41 – 60 p.p.m
61 – 90 p.p.m.
>90 p.p.m.
Base compiled from Aerial Photos
DEPARTMENT OF MINES – SOUTH AUSTRALIA
SELLICK HILL
LEAD IN STREAM BED GRAVEL
Drn. R.W.
Tcd. R.H.
Ckd. L.V.W.
Exd.
Director of Mines
SCALE: As shown
67-330
Ha+c
DATE: 2-6-67

DEPARTMENT OF MINES – SOUTH AUSTRALIA
SELLICK HILL
ZINC IN STREAM BED GRAVEL
Drn. R.W.
Tcd. R.H.
Ckd. L.V.W.
Exd.
Director of Mines
SCALE: As shown
67-331
Ha+c
DATE: 2-6-67
Base compiled from Aerial Photos
Metal Content in parts per million of -80 Mesh Fraction of stream bed gravels listed in the order, Lead Zinc
75 – Lead p.p.m.
25 – Zinc p.p.m.
ZINC CONTENTS
≤ 20 p.p.m.
21 – 40 p.p.m.
41 – 70 p.p.m.
71 – 100 p.p.m.
>100 p.p.m.
SCALE
CHAINS 80 60 40 20 0 1/4 1/2 1 MILES
T.N.
M.N.
GULF ST VINCENT
SELLICK BEACH
SELLICK HILL
SELLICK HILL PROSPECT
OLD SELLICKS HILL ROAD
MT TERRIBLE GULLY
MT TERRIBLE ▲ 1267'
LOUD HILL
PIPELINE PROSPECT
BLACK HILL
HEATHERDALE ▲ 1156'
HEATHERDALE PASTORAL PTY. LTD.
MYPONGA BEACH
MYPONGA RIVER
To Aldinga
To Willunga
To Myponga


LINE 1
(1"-12" DEPTH)
LOOKING NORTH
SCALE: 1 IN. = 400 FT.
WEST
EAST
SCALE: 1 IN. = 100 P.P.M.
Zn 0
Pb 0
Ni 0
Co 0
Cu 0
G1029/67
G1195/67
LINE 2
(1"-12" DEPTH)
LOOKING NORTH
SCALE: 1 IN. = 400 FT.
WEST
EAST
SCALE 1 IN. = 100 PPM
Zn 0
Pb 0
Ni 0
Co 0
Cu 0
G1138/67
G1386/67
LINE 9
(1" TO 12" DEPTH)
LOOKING NORTH
SCALE: 1 IN. = 100 FT.
SCALE: 1 IN = 100 PPM
ZINC
LEAD
COPPER
Zn 0
Pb 0
Cu 0
WEST
EAST
G1630/67
G1642/67
LINE 11
(1" TO 12" DEPTH)
LOOKING NORTH
SCALE: 1 IN = 100 FT.
SCALE: 1 IN = 100 PPM.
Zn 0
Pb 0
Cu 0
WEST
EAST
G1670/67
G1661/67
LEGEND
CAMBRIAN
HEATHERDALE SHALES
FORK TREE LIMESTONE
SELLICK HILL LIMESTONE
WANGKONDA LIMESTONE
MT. TERRIBLE FORMATION
PROTEROZOIC
WILPENA GROUP
BEDROCK SAMPLE: ⊙ LEAD × ZINC
DEPARTMENT OF MINES – SOUTH AUSTRALIA
SELLICK HILL
GEOCHEMICAL SOIL SECTIONS
LINES 1, 2, 9 & 11
Drn. R.W.
Tcd. R.H.
Ckd. L.V.W.
Exd.
Director of Mines
SCALE: As shown
67-407
Ha+c
DATE: 20-6-67



LEGEND

- RECRYSTALISED ZONE.
- H. SHALE (CARBONACEOUS AND PYRITIC)
- MOTTLED SHALEY LIMESTONE } FORK TREE LIMESTONE.
- MASSIVE ARCHAEOCYATHA LIMESTONE } FORK TREE LIMESTONE.

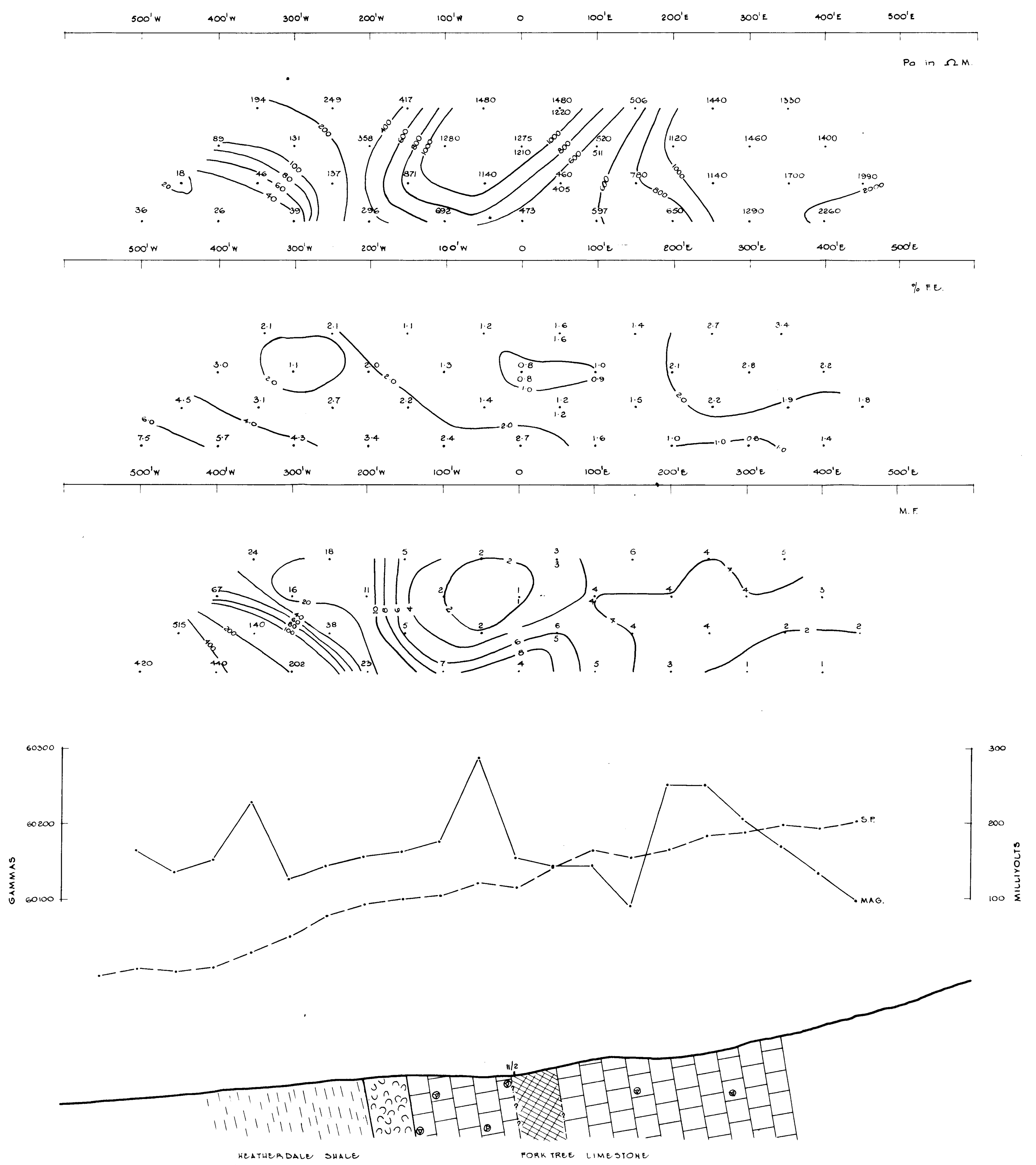
DEPARTMENT OF MINES — SOUTH AUSTRALIA

SELLICKS HILL GEOCHEMICAL ANOMALY

E-W LINE CENTRED AT 9/3

GEOPHYSICAL DATA AND GEOLOGICAL CROSS SECTION

		Drn. B.T.T.	SCALE: ONE INCH REPS. 100 FEET.
		Tcd. S.C.W.	67-162
		Ckd.	Ha II.
Director of Mines		Exd.	DATE: 24th APRIL, 1967.



LEGEND

- RECRYSTALISED ZONE
- H. SHALE (CARBONACEOUS AND PYRITIC)
- MOTTLED SHALEY LIMESTONE } FORK TREE LIMESTONE
- MASSIVE ARCHAEOCYATHA LIMESTONE } FORK TREE LIMESTONE

DEPARTMENT OF MINES — SOUTH AUSTRALIA		
SELLICKS HILL GEOCHEMICAL ANOMALY E-W LINE CENTRED AT 11/2 GEOPHYSICAL DATA AND GEOLOGICAL CROSS SECTION		
	Drn. D.J.T.	SCALE: ONE INCH REPS. 100 FEET
	Tcd. S.C.W.	67-163
	Ckd.	Ha II
Director of Mines	Exd.	DATE: 21ST APRIL, 1967