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SML 536

WARRAWEENA

PROGRESS AND TECHNICAL REPORTS TO LICENCE EXPIRY/RENEWAL, FOR THE PERIOD 20/1/1971 TO 19/1/1973

Submitted by
Endeavour Oil Co. NL
1973

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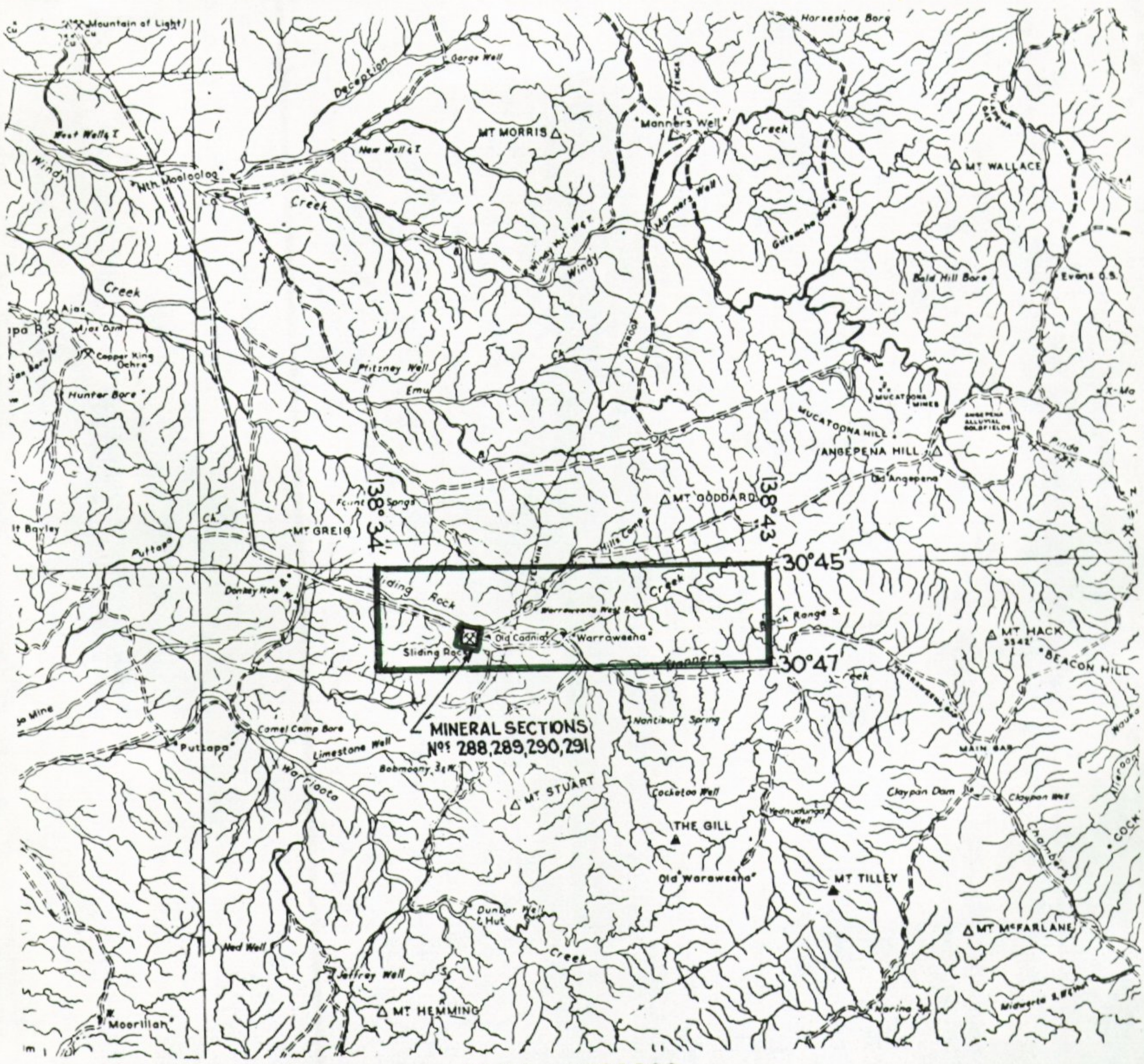

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TENEMENT: S.M.L. 536 - Warraweena.

TENEMENT HOLDER: Endeavour Oil Co. N.L.

ENDEAVOUR OIL COMPANY N.L.

QUARTERLY REPORT No. 1

For period ending 21st April, 1971

S.M.L. 536, WARRAWEENA AREA

FLINDERS RANGES, SOUTH AUSTRALIA

by

L.G. NIXON

B.Sc., M.Aust. Inst. M.M., M.A.I.M.E., M.Sc.Ec.G

S.A. 2/71

ENDEAVOUR OIL COMPANY N.L.

QUARTERLY REPORT No. 1

For period ending 21st April, 1971

S.M.L. 536, WARRAWEENA AREA

FLINDERS RANGES, SOUTH AUSTRALIA

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AND THE RESULTS OF GEOCHEMICAL SAMPLING

ENDEAVOUR OIL COMPANY N.L.

QUARTERLY REPORT No. 1

For period ending 21st April, 1971

S.M.L. 536 WARRAWEENA AREA

FLINDERS RANGES, SOUTH AUSTRALIA

INTRODUCTION

During the period under review the company carried out a programme of geological mapping and geochemical prospecting including stream, soil sampling.

A number of geochemically anomalous zones were located as a result of the work done.

WORK DONE

One geologist and two field assistants worked within the concession continuously from 20th January to 5th February. Work included geological mapping of the lease, setting out a grid for geochemical soil sampling, clearing the grid lines and collecting samples. A total of 181 samples or rock, soil and stream sediment were collected and 177 analysed for copper, lead, zinc and cobalt.

SUMMARY OF RESULTS

Zinc content in the Ajax Limestone was found to be unusually high at a number of localities. These include anomalies on soil-sample traverse 130, the ironstone one mile west- northwest of the Sliding Rock Mine, and the limestone exposed beneath the thrust fault on the western boundary of the lease.

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ENDEAVOUR OIL COMPANY, N.L.

THE GEOLOGY OF SPECIAL MINING LEASE 536, WARRAWEENA, SOUTH AUSTRALIA, AND THE RESULTS OF GEOCHEMICAL SAMPLING

BY

L.G.B. NIXON and ASSOCIATES

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ENDEAVOUR OIL COMPANY, N.L.

THE GEOLOGY OF SPECIAL MINING LEASE 536, WARRAWEENA, SOUTH AUSTRALIA, AND THE RESULTS OF GEOCHEMICAL SAMPLING

SUMMARY

Special Mining Lease 536 is located in the Flinders Ranges, South Australia, about 15 miles east of Beltana. The lease covers about 20 square miles and was mapped at 2,000 feet to the inch for the Endeavour Oil Company, N.L. Soil samples were systematically collected around the abandoned copper mine at Sliding Rock. The lease is mostly occupied by the uppermost Adelaidean Pound Quartzite and the Lower Cambrian Parachilna Formation and Ajax Limestone. In the northeast a sequence of Sturtian and older Marinoan tillite and shale is thrust against the limestone and quartzite. Small bodies of diapiric rock have been intruded along some faults.

The Sliding Rock Mine produced about 1,000 tons of copper matte and copper ore between 1871 and 1877, but was closed by water. Native copper, copper oxide and copper carbonate were mined in clay in a fault zone between quartzite and limestone. Several other test pits and shafts are sunk in the Parachilna Formation and Ajax Limestone. The Green Rock Copper Mine is located on cross-cutting lodes in older Marinoan sediments; another shaft is sunk in copper-bearing diapiric rocks.

Soil sampling around the Sliding Rock Mine revealed anomalous quantities of copper southwest of the mine along the contact of the Parachilna Formation and the Ajax Limestone, in a zone within the limestone possibly parallel to the Sliding Rock fault, and low in the Ajax Limestone near the southern boundary of the Lease. Zinc values reflect these copper anomalies, but are even greater at higher horizons within the Ajax Limestone.

Lead and cobalt values show lessvariation but appear to follow the distribution of the zinc.

Stream-sediment samples taken by Electrolytic Zinc reveal high copper values near the southwest extension of the Sliding Rock lode, around the Green RockMine, and in the older sediments in the northeast. Zinc values again reflect these anomalies but are highest in the Ajax Limestone at the eastern boundary of the lease, and are generally high in the limestone north and east of Warraweena. Lead values appear to follow the zinc pattern.

The high content of zinc in the Ajax Limestone should be further investigated. Ironstone capping the Cambrian sediments should be tested for metals. The base metal content of the older sediments in the northeast should also be examined and the diapiric rocks should be tested. Copper and zinc anomalies near the Sliding Rock Mine should be investigated also; in searching for the southwest extension of the Sliding Rock lode, both the fault and the contact of the Parachilna Formation and the Ajax Limestone should be examined and the Ajax Limestone should be examined for parallel lodes.

INTRODUCTION

Special Mining Lease 536 was granted to Endeavour Oil Company N.L. by the government of South Australia with tenure commencing on 21st January, 1971. The lease is located in the Flinders Ranges about 300 miles north of Adelaide and extends from longitude 138°34'E. eastwards to 138°43'E.,and from latitude 30°45'S. southwards to 30°47'S. Warraweena Homestead lies roughly in the centre of the lease, and is about 17 mileseast of Beltana township, which is 26 miles south of Leigh Creek on the Leigh Creek/Adelaide road. The lease extends for about 8.5 miles from east to west and about 2.3 miles north to south/and is just under 20 square miles in area.

The geological map accompanying this report (Fig. 1) has been based on an uncorrected enlargment of air photographs and is almost certainly distorted, particularly towards its eastern boundary. The eastern boundary of this geological map appears to lie between 500 and 800 feet to the west of longitude 138°43' as shown on the preliminary print of the Cadnia 1-mile sheet, printed at the scale of 60 chains to the inch, obtained from the Geological Survey. However, the position of longitude 138°43' on this preliminary print lies nearly 3,000 feet to the west of the position of this meridian shown on the geochemistry maps produced by the Electrolytic Zinc Company. There are other discrepancies between the preliminary print of the Cadnia sheet and the maps of the Electrolytic Zinc Company, for example the Green Rock Mine lies outside the lease according to the latter, and it is recommended that future exploration should be carried beyond the limits of the accompanying geological map, the boundaries should be determined from accurate topographic maps, and a surveyor should be called in if promising results are obtained close to the boundaries of the lease.

The lease contains the abandoned Sliding Rock Copper Mine and the abandoned Green RockCopper Mine as well as several old copper prospects, and was taken up with a view to examining the Cambrian Parachilna Formation and Ajax Limestone for Mississippi-type ore deposits.

One geologist and two field assistants employed by L.G.B. Nixon and Associates worked within the lease from 20 th January to 5th February, and Mr.Nixon and Mr. Woolf, Chief Geologist (Mining) of the Endeavour Oil Company visited the party from 3rd to 5th February. The geologist spent about 10 days on the geological mapping of the lease, and about two and a half days in setting out the grid for soil sampling and in airphoto interpretation. The remainder of the time was spent accompanying Messrs.

Woolf and Nixon on their visit to the lease. The bulk of the field assistants' time was occupied in laying out and clearing the soil sample grid and in collecting the samples; occasionally one of them accompanied the geologist to facilitate transportation - the assistant driving while the geologist walked.

The soil samples were collected on grid lines spaced 500 feet apart over the Ajax Limestone and the Parachilna Formation in the vicinity of the Sliding Rock Mine (Fig.2). The copper, zinc, lead, and cobalt contents of the soil samples were determined by McPhar in Adelaide by atomic absorption spectroscopy.

Access is provided by a dirt road from Beltana; within the lease rough tracks run from Warraweena Homestead along the broader valleys within easy walking distance of all parts of the area, except parts of the rugged outcrop of the Pound Quartzite.

Throughout the greater part of the lease, high steep ridges formed by the Pound Quartzite rise above broad undulating depressions floored by the Ajax Limestone or the limestone and siltstone of the Wonoka Formation. In the northeastern part of the lease a sequence of older tillite, shale, and siltstone thrust against low steep hills and narrow valleys.

There is a remarkable absence of karst topography on the limestones. Soils on these rocks are also generally very thin, and the outcrop of the Ajax Limestone in many places carries a black crust of ferruginous and manganiferous material.

Acknowledgments

The Geological Survey of South Australia kindly supplied a preliminary print of the Cadnia 1-mile sheet and lent air photographs covering the lease; both of these were essential and provided the frame-

work of the geological map which accompanies this report. The Geological Survey also supplied copies of geochemical maps made by the Electrolytic Zinc Company. The writer benefited greatly from discussions in the field with Mr. Nixon and Mr. Woolf. Mr.Nichols of Warraweena provided information on the area.

STRATIGRAPHY

The stratigraphy is summarised in Table 1. The greater part of the lease is occupied by a more or less continuous sequence of younger Marinoan and Lower Cambrian rocks; inthe northeast corner an attenuated sequence of older Marinoan and Sturtian sediments has been thrust against the younger rocks.

The rock units are described in stratigraphic order beginning with the oldest member of the exotic, attenuated sequence.

Adelaidean

UMBERATANA GROUP

In the northeast corner of the lease thick boulder beds succeeded northwards by shale and siltstone are thrust against Marinoan Pound Quartzite and Lower Cambrian sediments. The sequence overlying the thrust plane appears to contain attenuated representatives of both the Umberatana Group and the Wilpena Group. However, much of the upper part of the Umberatana Group present in the Beltana 1:63,360 map area (Leeson, 1970) about 20 miles to the west, is missing from the sequence within the lease, whether this is the result of depositional or tectonic causes is unknown.

Appila? Tillite

The boulder beds which lie directly on the thrust plane have been tentatively identified with the Appila Tillite, as described by Thomson (in Parkin, 1969).

The tillite is well exposed near Sliding Rock Creek. It is a greyish-green, tough rock composed of scattered sub-round pebbles of quartzite, white quartz, and granitic rocks in a matrix of subangular quartz grains ranging, from silt-size to granules, together with grains of feldspar and green chloritic (?) material. The tillite is generally a massive rock in which it is difficult to distinguish bedding planes; near the sole of the thrust it is intensely cleaved in places and resembles the younger green shale described below, though it has the texture of a poorly sorted sandstone.

In several exposures the tillite is dark grey and contains black angular pebbles of ferruginous siltstone and hard greenish-grey mudstone, as well as of quartzite. A few hundred feet stratigraphically below the contact of the tillite with the overlying shale, the tillite contains one massive prominent bed of feldspathic quartzite a few feet thick, and other thinner beds of this rock.

At its contact with the overlying shale the tillite contains a few beds, up to 2 feet thick, crowded with large rounded pebbles and cobbles of resistant rocks, interlayered with beds of cleaved green siltstone and shale up to one foot thick.

The tillite appears to be about 2,000 feet thick at the eastern margin of the lease. However, as the sedimentary sequence is inverted and lies on a thrust plane, and as tight small-scale folds are evident in the fine-grained sediments adjacent to the tillite some repetition probably occurs within the tillite, and since this unit is cut by the thrust fault an unknown thickness is missing.

TABLE I SUMMARY OF STRATIGRAPHY

AGE		FORMATION & THICKNESS	ROCK TYPE	RELATIONSHIP	ECONOMIC GEOLOGY -
			Scree Sand & gravel Calcareous conglom.	Shed from Pound Qtst. in Creek Beds On Ajax Lmst.	
LOWER CAMBRIAN		HAWKER GROUP Ajax Lst. 800ft.?	Massv.lmst. & dolmt. *Collenia* lmst. oolitic dolmt.	Conformable on Parachilna Fm.	High Zn content Cu near base?
		Parachilna Fm. 200ft.?	Clayey & fergns. sst. & slst; shale, mdst.	Unconformable on Pound Qtzt. & Uratanna Fm.	Cu at Sliding Rock
ADELAIDEAN	MARINOAN	WILPENA GROUP Uratanna Fm. 100ft.?	Mdst.shale, slst; some sst.at top	Unconformable? on Pound Qtzt.	
		Pound Qtzt. 5000ft.	Well sorted qtzt; sst. & slst. near base	Conformable on Wonoka Fm.	
		Wonoka Fm. 1500ft.	lmst. & slst.	Conformable on Bunyeroo Fm.	
		Bunyeroo Fm. 500-700ft.?	Red slst. & mdst.	Conformable on Brachina Fm.	Cu in green shale near Beltana
		Brachina & Nuccaleena Fms. 1000ft.?	Mdst. slst. shale, dolmt.	Unconformable? on Elatina Fm.	Contain green Rock Cu Mine
		UMBERATANA GROUP Elatina Fm.	Sandstone?	not observed	
	STURTIAN	Tapley Hill Fm. 1500 feet?	Shale; some mdst.slst. dolmt.	Conformable? on Appila? Tillite	
		Appila? Tillite 2000 feet?	Tillite; some qtzt.	Thrust against younger sediments	

Only the granitic clasts are exotic to the area, but the presence of these confirms that the rock is a glacial sediment composed of pebbles and cobbles dropped from melting icebergs or from the base of a floating ice shelf into a sediment predominantly composed of rock flour. If there were no true erratics in the tillite, then its structural position in the core of an almost recumbent anticline with a sheared-out lower limb could suggest a tectonic origin for the boulder beds, as almost all the rock types which form clasts within it are also exposed nearby.

Tapley Hill Formation

A unit composed predominantly of green and grey shale dips under the tillite along the northern margin of its outcrop. This has been mapped as the Tapley Hill Formation by the South Australian Geological Survey on the preliminary print of the Cadnia 1:63,360 sheet. The Tapley Hill Formation crops out as a belt about 2,000 feet wide, which narrows progressively westwards from the northeast corner of the lease to cut out completely between the tillite and the succeeding unit close to the thrust fault separating these rocks from the Pound Quartzite two miles northeast of Warraweena Homestead.

The Tapley Hill Formation is predominantly composed of green or grey very fine-grained and even-grained shale. Beds of mudstone and siltstone, generally several inches thick, are common in the Formation and a few beds of sandy dolomite(?) occur sporadically in the lower part of the Formation. A large mass of white calcareous rock, about 50 feet thick, near the contact of the Tapley Hill Formation and the tillite three miles eastnortheast of Warraweena Homestead, is generally structureless with a few faint remnants of bedding and may be an isolated mass of diapiric rock.

In several exposures the shale exhibits tight drag folds, strain-slip cleavage oblique to fissility, and cleavage broadly parallel to bedding, in otherwise massive siltstone or mudstone. Although the contact of the formation with the tillite appears to be not only conformable but gradational, the presence of diapiric (?) rock near this contact and the intense deformation evident on both large and small scales suggest that the eastward thinning of the formation is produced bythrust faults within the formation and parallel to the main thrust separating the tillite from the younger rocks.

In one exposure of massive mudstone near the contact with the tillite black bands, 1 or 2mm thick, alternate with light greyish-green bands about 5 mm thick, and probably represent varves, although no pebbles were seen in the rock. The presence of sandy dolomite (?) beds suggests that the Tapley Hill Formation is a marine sediment.

The Tapley Hill Formation appears to be about 1500 feet thick at the eastern margin of the lease, but thins abruptly westwards towards the thrust fault.

The contact of the Tapley Hill Formation with the succeeding formation was not seen, and indeed only the sub-division shown on a preliminary print of the Cadnia 1-mile sheet together with the boundaries of the Elatina Formation drawn on air photographs lent by the Geological Survey, enabled the writer to subdivide the predominantly shaly rocks which lie between the tillite and the ferruginous siltstone of the Bunyeroo Formation.

Elatina Formation

The trace of the Elatina Formation shown by the Geological Survey of South Australia on a preliminary print of the Cadnia 1:63,360 sheet follows a prominent white band on the air photographs in the position shown on the geological mp accompanying this report. The formation was not identified on the single traverse undertaken across it during the mapping.

The Elatina Formation is described by Leeson (1970) from the neighbouring Beltana 1:63,360 sheet area, about 20 miles to the west, as a reddish, coarse-grained well sorted sandstone composed mainly of quartz but with distinctive granules of red chert. This formation is also present at Mount Stuart, only four miles south of Warraweena Homestead, together with considerable thicknesses of the other formations forming the upper part of the Umberatana Group, such as the Etina Formation, the Enorama Shale, and the Trezona Formation, none of which has been mapped within the lease either by the Geological Survey or by the writer.

The apparent constancy of the Elatina Formation suggests that the thinning of the Umberatana Group may be a depositional effect, but in view of the intense deformation evident, this seems unlikely.

WILPENA GROUP

The base of the Wilpena Group is defined in the northern Flinders Ranges by the Nuccaleena Formation, which consists of a persistent pink flaggy dolomite 30 feet thick, overlain by 200 feet of purple shale (Parkin, 1969). This formation is normally succeeded by the Brachina Formation, composed of red and green shale or green siltstone, and both these formations have been distinguished in the northeastern part of the lease by the Geological Survey in mapping the Cadnia 1-mile sheet. Although the traces of these shaly formations as mapped by the survey are clearly visible on air photographs, in the field they could not be distinguished lithologically from each other or from the shales of the Tapley Hill Formation. Indeed the first clear lithological break seen above the contact of the tillite with the Tapley Hill Formation is the dark red massive ferruginous siltstone which caps the hills north of the Green Rock Mine and which has been mapped as Bunyeroo Formation on the Cadnia 1-mile sheet.

Brachina & Nuccaleena Formation

The Nuccaleena Formation in the lease is made up of slaty mudstone, siltstone, and shale with scattered beds of dolomite, commonly about six inches thick. The clastic sediments are greenish, reddish, or brownish grey; scattered rusty casts of pyrite (?) crystals occur in some beds. A tight syncline a few hundred feet across is exposed in one hill, indicating that sediments are repeated by intra-formational folding.

The Brachina Formation is evidently represented by the greenish-grey shale, mudstone, and siltstone which crop out around the Green Rock Mine. Mr. Woolf pointed out purple sediments south of the mine close to the boundary of the Brachina Formation with the Nuccaleena Formation on the Cadnia 1-mile sheet, but the two formations could not otherwise be separated and probably represent the continuous deposition of fine-grained sediments far from shore.

The two formations together form a belt about 1500 feet across at the northern margin of the lease, which tapers westwards towards the thrust plane in a manner similar to the outcrop of the Tapley Hill Formation. Again because the rocks are thinly bedded, fissile, and commonly cleaved this thinning may be the result of deformation. The combined thickness of the two formations appears to be about 1000 or 1200 feet in the vicinity of the Green Rock Mine, but the presence of a tight syncline a few hundred feet across in the sediments about half a mile southeast of the mine suggests that they are thickened by intraformational folding.

The occurrence of reddish brown shale and siltstone in greenish grey sediments on the ridge north of the Green Rock Mine suggests that the Brachina Formation grades upwards into the dark red siltstone of the

Bunyeroo Formation. Both on the neighbouring Beltana 1-mile sheet, and on the Cadnia 1-mile sheet about two and a half miles south of the mine, the ABC Range Quartzite is present between the Brachina Formation and the Bunyeroo Formation, but as this quartzite thins progressively eastwards and cuts out due south of the mine it was probably not deposited in the sequence represented near the mine. Thomson's diagram(in Parkin, 1969) suggests that the quartzite is absent deeper in the trough of sedimentation and is replaced by fine-grained sediments deposited continuously across the boundary of the Brachina and Bunyeroo Formations.

Bunyeroo Formation

In the southeast corner of the lease the Bunyeroo Formation forms part of a relatively undisturbed sequence which extends from tillite and Tapley Hill Formation exposed in the core of the dome forming Mount Stuart, 4 miles south of the lease, up to the Lower Cambrian Ajax Limestone in the central part of the lease. The Bunyeroo Formation is also exposed in the sequence overlying the thrust in the northeast quarter of the lease, but is thinner than the formation in the southeast corner.

The Bunyeroo Formation in the northeastern part of the lease is predominantly a dark purplish red or black siltstone, a massive or flaggy rock consisting of silt-size and smaller grains of quartz in avery fine-grained ferruginous matrix. Flakes of muscovite are scattered through the siltstone, and layers of iron-oxide minerals a few millimetres thick parallel the bedding. The black siltstone contains several light-coloured beds of limestone or dolomite, generally about one foot thick, and these limestone beds increase in abundance upwards through a transition into the overlying Wonoka Formation.

Ferruginous siltstone, with layers of iron-oxide minerals up to 4 inches thick, is interbedded with limestone and green shale on the west side of the body of diapiric rock 2 miles northeast of Warraweena Homestead, and these rocks have been mapped as Bunyeroo Formation since they resemble closely the upper part of the Bunyeroo Formation east of the diapiric rocks. About 1 mile west of the diapir a caved shaft is sunk in malachite-bearing shattered red and brown mudstone and siltstone close to the thrust fault which separates these sediments from the Pound Quartzite, and similar red mudstone is exposed a quarter of a mile west of the shaft between Pound Quartzite and Wonoka Formation. All these red sediments have also been mapped as Bunyeroo Formation, as they resemble the rocks described by Leeson (1970) from the neighbouring Beltana 1-mile sheet in that category. However, similar red sediments have been described by Leeson and others (Parkin, 1969) from diapirs in the Flinders Ranges, and the selvedge of red sediments north of the Pound Quartzite here may have been emplaced by diapiric action from an older and lower horizon.

The Bunyeroo Formation in the southeast corner of the lease has not been closely examined, as before the orientation of the air photographs was corrected it was thought to lie outside the lease. However, the lower part of the Bunyeroo Formation in this vicinity consists of red mudstone and shale, which become sandy towards their contact with the underlying ABC Range Quartzite south of the lease. Within the lease the boundary of the Bunyeroo Formation with the Wonoka Formation has been moved about 100 yards south of the position given this boundary by the Geological Survey on the Cadnia 1-mile sheet, because the rocks in this 100-yard zone appear to correspond more closely with the description given by Leeson (1970) and in Parkin (1969) for the Wonoka Formation. They are greenish-grey shale and siliceous siltstone with thin beds of calcareous mudstone or muddy limestone, the silty layers are commonly crowded with cylindrical bodies or rolls only about half an inch in diameter.

Since sequences of green sediments occur elsewhere within the

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Bunyeroo Formation (Leeson, 1970) it may be that they should be included in the Bunyeroo Formation, and they almost certainly represent a gradation between this formation and the Wonoka Formation.

In the northeast corner the maximum thickness of Bunyeroo Formation is only about 500 feet and, like the other sediments, it thins abruptly against the thrust fault separating them from the Pound Quartzite. In the southeast corner the Bunyeroo Formation appears to be about 700 feet thick, though its base is not exposed within the lease.

The rolls in the rocks transitional between Bunyeroo and Wonoka Formations suggest that they were deposited in an unstable situation, perhaps on quite a steep slope on the edge of a trough. However, Parkin (1969) suggest that mild tectonism occurred during the deposition of the Bunyeroo Formation, and Coats believes that the erosion of activelyrising diapirs in Bunyeroo times may have provided the copper for the syngenetic deposits known in the Bunyeroo Formation nearby (Leeson, 1969). These events mayalso have disturbed the soft sediments. Both Parkin and Leeson describe mud cracks in the formation near Beltana as indicating a shallow-waterorigin.

<u>Wonoka Formation</u>

The most extensive area of the Wonoka Formation within the lease forms low rough hills in the southeastern quarter. This formation also crops out in the core of a large anticline on the northern margin of the lease one and half miles northeast of the Sliding Rock Mine, and the southern margin of another extensive belt of Wonoka Formation lies close to the northern boundary of the lease about one and a half miles northeast of Warraweena Homestead.

In all these outcrops the formation is composed of beds of light greenish-grey fine-grained limestone alternating with beds of greenish-grey siltstone or silty shale in which rolls or sub-cylindrical bodies up to a few inches in diameter and several inches long are common. Irregular minor folds and slumps are also common in the formation. The beds of limestone range from a few inches to several feet in thickness, and some masses of limestone about 100 feet thick occur high in the formation close to its boundary with the Pound Quartzite. A few hundred feet below the top of the Wonoka Formation, in Warraweena Creek, it contains asequence of white and brown quartzite beds several feet thick, alternating with fissile dark red fine sandstone, siltstone, and shale; they display asymetrical ripple marks and other sole casts broadly parallel to the strike, and some of the quartzite appears to contain worm burrows. This sequence of clastic sediments about 100 feet thick is either an unusual member of the Wonoka Formation, or a representative of the Pound Quartzite folded or faulted within it.

The top of the Wonoka Formation in the southeasternquarter of the lease is greenish-grey shale between 50 and 100 feet thick containing a few beds of sandy limestone, dark red ferruginous fine-grained sandstone, and fissile siltstone, all ranging up to several feet inthickness. The shale passes upwards into the Pound Quartzite through a transition zone about 10 or 15 feet thick of flaggy and fissile fine-grained quartzite and quartzose siltstone.

In the northwestern quarter of the lease this contact was not observed; the lowest beds seen inthe Pound Quartzite were clayey yellow-brown fine-grained sandstone overlying dark red, weathered ferruginous siltstone. Along the northern margin of the lease in its east-central part, the Wonoka Formation is separated from the Pound Quartzite along a thrust fault by diapiric rock and by crushed red shale and mudstone which may belong to the Bunyeroo Formation.

In the southeastern part of the lease, the Wonoka Formation is about 1500 feet thick; in its other outcrops either the top or the base of the formation is not exposed.

The abundance of limestone or dolomite in the Wonoka Formation as well as fine-grained clastic sediment indicates that it was deposited in the sea. The common occurrence of sole marks, rolls, and depositional folds in the siltstone of the formation, both here and throughout the Flinders Ranges, suggests that it was deposited in an unstable environment, on the continental slope or on the margins of a steep-sided trough. It may be that the source material of the Pound Quartzite was uplifted by tectonic activity initiated during the deposition of the Wonoka Formation and reflected inthe sedimentary structures developed in it.

<u>Pound Quartzite</u>

The Pound Quartzite forms high abrupt ridges and massifs, rising several hundred feet above the valleys throughout the lease. The displacements of the prominent masses of Pound Quartzite pick out the major faults in the area, although this very competent unit is generally less affected by folding than almost all the other rock types. One broad belt of Pound Quartzite runs eastwards along the southern boundary of the lease, swinging northwards into the lease in its eastern half. Another forms the northern limit of the lease in the west, but is truncated by a major fault north of the Sliding Rock Mine and re-appears two miles to the northeast where it forms a southeast-trending ridge converging on the southern belt of quartzite, and overridden by older rocks south of the Green Rock Mine.

The Pound Quartzite is a very thick and remarkably uniform accumulation of massive medium-grained, well sorted quartz sandstone. The upper part of the formation is composed almost exclusively of massive white medium-grained quartzite. The lower part contains both white quartzite beds and many beds of red and brown medium and fine-grained sandstone and siltstone. The brown sandstone commonly contains a small quantity clayey matrix. Asymetrical ripple marks were noted in a few exposures of the upper part, and cross-bedding inthe lower red horizons. The grain-size of the quartzite varies little, and coarse-grained or conglomeratic rocks are rare.

The Pound Quartzite is about 5000 feet thick in the northwestern quarter of the lease; elsewhere the thickness of the formation is masked by faulting.

Nixon (1963), in mapping the Ediacara Mineral Field east of Beltana, used the worm-burrow beds at the top of the Pound Quartzite as a marker horizon defining the base of the Cambrian rocks and hence the base of the Parachilna Formation. Leeson (1970) found that this held true in all parts of the Beltana 1-mile sheet.

However, within the lease, the top of the Pound Quartzite is commonly marked by a thin sequence of brown shale, mudstone, and siltstone for which the name Uratanna Formation has recently been suggested. (L.G.B. Nixon, pers.comm.). The change from white quartzite to brown fine-grained sediments is quite abrupt though the contact itself was not seen, and there may be a disconformity between the two formations.

In the south-central and western parts of the lease, the white quartzite is directly overlain in places by red fine-grained sandstone and siltstone and white clayey sandstone referred to the Lower Cambrian Parachilna Formation.

The remarkable absence of fine-grained sediment, particularly in the upper part of the Pound Quartzite indicates that the quartz sand was deposited in a high energy environment, possilby along a coast subject to strong wave action, and the presenceof heavy mineral bands, recorded in Parkin (1969), suggests deposition on beaches.

Uratanna Formation

The Uratanna Formation has only recently beensuggested and the name has not yet been published. The formation is represented on the preliminary print of the Cadnia 1:63,360 sheet and on the map accompanying this report by the symbol € - 1; however L.G.B. Nixon demonstrated in the field that it lies below the worm-burrow marking the base of the Cambrian and is hence of Proterozoic age.

Exposures of this formation are few and poor because it crops out below steep slopes of Pound Quartzite and is almost everywhere mantled by scree. The best exposure seen is located in a creekbed a little over one mile north-northeast of Warraweena Homestead. Here the formation is composed of beds of slightly fissile brown mudstone up to 2 feet thick, alternating with beds of finely fissile brown shale up to 6 inches thick and beds of banded, micaceous and siliceous siltstone a fewinches thick. This sequence is about 50 feet thick, and is overlain by about 5 feet of reddish brown feldspathic sandstone, followed by about 10 feet of reddish brown silty mudstone and 8 feet of white calcareous sandstone or sandy limestone. The calcareous rock is overlain by a dark red sandstone with worm burrows, which is the base of the LowerCambrian Parachilna Formation. Elsewhere, the Uratanna Formation is exposed as isolated patches of brown shale, mudstone, and siltstone, and its relationship with the formation above and below are concealed. In a steep gully about half a mile south of Warraweena Homestead about 40 feet of weathered and leached shale and mudstone occurs beneath sandstone with worm burrows at the base of the Parachilna Formation.

Where best exposed, the Uratanna Formation is at least 75 feet thick and may be as much as 100 feet thick. The thickest development of the Uratanna Formation shown on the preliminary print of the Cadnia sheet, probably occurs between 2 and 4 miles east of Warraweena Homestead, but the formation was not observed in the single traverse undertaken across this area.

The Uratanna Formation appears to be absent in places in the central and western parts of the lease. In the creek below the smelter at the Sliding Rock Mine only a small unexposed interval separates Pound Quartzite from clayey sandstone of the Parachilna Formation, and about a mile and a half west-southwest of Warraweena Homestead near a copper prospect in leached sandstone of the Parachilna Formation the worm burrow beds appear to overlie white quartzite.

The absence of coarse sediment in the major and lower part of the Uratanna Formation indicates either a rapid reduction in the relief of the source area of the Pound Quartzite, or a deepening of the sea in which it was deposited.

Lower Cambrian

HAWKER GROUP

The sediments of the Hawker Group comprises a thin sequence of sandstone and siltstone overlain by a thicker unit almost entirely composed of limestone or dolomite. These formations contain the important mineralisation at Ediacara (Nixon, 1963) and at the Sliding Rock Mine, within the lease.

Parachilna Formation

Like the Uratanna Formation, the Parachilna Formation crops out in most places below a slope of Pound Quartzite, and is commonly obscured by scree. However, it appears to be present everywhere between the Pound Quartzite and the overlying Ajax Limestone, even where the Uratanna Formation is absent.

The Parachilna Formation appears to be composed predominantly of white clayey sandstone and red ferruginous fine sandstone and siltstone, but a considerable thickness of shale or mudstone in the top part of the formation is commonly not exposed.

Following Nixon (1963) the base of the Parachilna Formation and the base of the Cambrian is taken to be the first appearance of worm-burrow beds in the sediments overlying the Pound Quartzite. This occurs among sandy sediments up to 25 feet above the top of the shale, mudstone, and siltstone which form the bulk of the Uratanna Formation. The worm-burrow beds are generally red sandstone, and are succeeded by 20 to 40 feet or more of brown clayey or calcareous sandstone, commonly leached and intensely sheared in some of the best exposures. This is followed by 100 feet or so of red ferruginous sandstone and siltstone and thin beds of sandy limestone. A few exposures of these sediments contain beds almost entirely composed of black ferruginous and earthy manganiferous material up to 1 foot in thickness; this may be a product of surface enrichment.

At the contact of the Parachilna Formation with the Ajax Limestone in Warraweena Creek close to its junction with Sliding Rock Creek, shattered yellow-brown calcareous mudstone with a few beds of dark red ferruginous silty shale, passes upwards into cleaved and rodded limestone. About 1 mile east of this a similar brown mudstone underlies silty brown limestone, and sheared mudstone exposed below Ajax Limestone in the creek running down from the smelter at Sliding Rock Mine is probably the same rock type. Thomson (1962) notes that lead values are unusually high in this sediment.

The thickness of the Parachilna Formation may be as much as 200 feet, but no complete section through the formation was found and a large part of it is generally concealed. The thickness of the formation almost certainly changes from place to place.

The lower part of the Parachilna Formation reflects a brief renewal of sandstone deposition, though the extreme conditions which produced the well sorted Pound Quartzite did not prevail. The shale at the top of the formation signals drastic reduction of the sediment supply leading to the sediment-free sea in which the Ajax Limestone was deposited.

Ajax Limestone

The Ajax Limestone crops out within a synclinal structure running from the southwest corner to the centre of the lease. A ridgeof limestone continues into the northeastern quarter of the lease, where it is truncated by a thrust plane. The limestone generally forms low rounded hills with little soil on them. There is a remarkable absence of karst topography on the limstone. No sink holes or caves are evident, and creeks flow over its outcrop without interruption.

Leeson (1970) in the Beltana Sheet area, follows Nixon's (1963) threefold division of the Ajax Limestone into a lower cross-bedded sandy dolomitic unit, a middle unit of algal dolomites, and an upper unit of cherty dolomites with Archaeocyatha. Within the lease the basal unit of the limestone contains several sandy beds of detrital oolitic dolomite up to 3 feet thick, alternating with beds of massive limestone or dolomite. The basal part is also very commonly heavily stained by iron, and black ferruginous and manganiferous material caps many exposures.

The sandy dolomite is yellow-brown and is generally medium-grained or coarse-grained and well-sorted. The massive limestone weathers brown but is dark grey or black where fresh; it is an even-grained fine-grained or medium-grained aggregate of calcite or dolomite crystals. Bedding is clearly picked out by the sandy dolomite beds, but is difficult to discern in the massive limstone, and in many places where steep dips have been recorded, iron-stained joints or cleavage planes may havebeen mistakenly identified as bedding. Collenia colonies are common in places in the massive limestone.

In the vicinity of Warraweena Homestead the limestone is intensely cleaved in several exposures, and trend lines on air photographs indicate that the broad expanse of Ajax Limestone north of Warraweena may be tightly folded.

The limestone appears to be at least 800 feet thick in a section drawn through the syncline south of the Sliding Rock Mine. However, the appearance of the basal sandy dolomite unit and of the upper part of the Parachilna Formation in the south bank of Sliding Rock Creek between points half a mile west and a quarter of a mile south of Warraweena Homestead and in a pit one and a half miles eastnortheast of the Sliding Rock Mine, indicates that intraformation folding may give a deceptive appearance of thickness to the Ajax Limestone. Daily (1956) records a thickness of 725 feet for the Ajax Limestone inthe Scott Range, about 20 miles north of Beltana, and Nixon (1963) estimates that the total thickness of the Cambrian sediments (Ajax Limestone and Parachilna Formation) at Ediacara, about 30 miles west of the lease, is about 1000 feet.

The Ajax Limestone was deposited in a shallow sea receiving very little detrial sediment. The oolitic dolomite formed in very shallow water influenced by waves and tidal currents; slight deepening of the sea probably led to the growth of Collenia algae and the deposition of calcitic or dolomitic mud to form the massive limestone.

Diapiric Rocks

Three occurrences of diapiric rocks are known within the lease. Two of these were recognised from the preliminary print of the Cadnia 1-mile sheet.

The occurrence located along the thrust fault at the eastern margin of the lease is overlain at its western end by a conglomeratic rock composed of scattered pebbles of a variety of rock types in an abundant white limy matrix, which appears to be a calcareous spring deposit. Poorly exposed limestone close to the diapir contains large masses of black ironstone and is disturbed by faulting.

Another occurrence of diapiric rock is located on the thrust plane near the northern margin of the lease, about 2 miles northwest of Warraweena Homestead. On the western side of this diapiric structure dark red siltstone in masses from 30 to 100 feet thick is interlayered with brecciated limestone intensely veined by calcite. The ferruginous siltstone contains layers of iron oxide minerals, partly formed by specular hematite, up to severalinches thick. These rocks strike at right angles to the Wonoka Formation close to the north, but some nearby representatives of the Wonoka Formation are deformed and probably inverted, as shown by load casts. As explained above these rocks have been mapped as Bunyeroo Formation. However, the red fine-grained sediments and the brecciated limestone associated with them may be diapiric material as they are similar to rocks described by Leeson (1970) from the core of the Beltana diapir.

The largest mass of diapiric material in the lease lies about 1 mile north-northwest of Warraweena Homestead, across a large northern tributary of Sliding Rock Creek. Exposed in the creek is a disturbed sequence of silicified limestone and chert, a pseudoconglomerate of quartzite and mudstone fragments in a calcareous matrix, blocks of shattered purple mudstone, and weathered feldspathic quartzite. A dark greenish-grey crystalline rock was found by Mr. Woolf in mullock at an abandoned shaft on the east bank of this creek and a similar rock occurs at the southeast margin of the diapir. The rock has a fine-grained greenish-grey matrix studded with small crystals of a yellow-brown mineral and other soft blackcrystals; it also contains small irregular bodies of quartz up to 5 mm across. A spectrographic analysis of this rock indicates that it may be an altered basalt. At both the shaft and the diapir margin this crystalline rock is associated with brown marble, brecciated in places, and at the margin it occurs close to a mass of milky quartz and black ironstone.

A low ridge of patchily recrystallised weathered granular arkose occurs east of the creek north of the abandoned shaft, and at the road crossing of the creek southwest of the shaft a ridge of silicified or cherty limestone breccia, containing scattered veins of barytes and partly capped by ironstone, is paralleled by a zone of red banded mudstone. A short distance to the south, the west bank of the creek is formed by cleaved and irregularly folded dark grey mudstone, siltstone, and limestone attributed to the Wonoka Formation, and these beds are cut in places by veins and apophyses of brown sideritic or calcitic material.

Diapirs are common in the north Flinders Ranges (Coats, 1965; Parkin, 1969) and are generally located on faults or in anticlines. The diapiric material is believed to originate in the Callanna Beds at the base of the sedimentary sequence in the Adelaide Geosyncline.

Cainozoic

The age of the black ferruginous and manganiferous material common as a capping on exposures of Ajax Limestone and some other sediments and diapiric rocks is probably late Tertiary or Quaternary, but whether it marks a particular climatic phase or is in the process of forming today is not known.

The bulk of the material mapped as Quaternary alluvial gravel and sand is found along the courses of the larger creeks, and the scree accumulates below steep faces of Pound Quartzite. The plain which extends eastwards from the Sliding Rock Mine to Warraweena Homestead, over the Ajax Limestone, is partly floored by a conglomerate composed of sub-round cobbles and pebbles of limestone, quartzite, ferruginous sandstone, siltstone, and mudstone in a massive calcareous matrix.

GEOLOGICAL HISTORY

The oldest unit exposed in the lease is the Appila Tillite which is probably no greater than 700 m.y. old, according to Compston, Crawford and Bofinger (1966), as it is part of the Sturtian division. This was probably deposited on the continental shelf under a vast sheet of floating ice originating in a land to the west. Horizons of varves identify periods when the ice sheet was absent, and summer melting alternated with winter freeze-up. After the ice had melted completely a thick sequence of shales with beds of dolomite was deposited into late Marinoan times suggesting a long interval of crustal stability and low relief, as the fine-grained sediments of the Bunyeroo Formation were deposited in shallow water probably close to land.

Copper-bearing shale within the Bunyeroo Formation may have been derived from the erosion or solution of rising diapirs, and some of the carbonate in the dolomites may have the same origin. Rolls and slumps in the siltstone of the Wonoka Formation probably indicate deepening sea and rising land with a consequent steepening of the depositional slope, culminating in the deposition of a great thickness of Pound Quartzite along a coast subject to strong wave action.

The Uratanna Formation may mark the spreading of coastal swamps before the deposition of clayey and ferruginous sandstone was renewed for a short time at the beginning of the Cambrian. This was followed by the deposition first of detrital dolomite and then by the formation of Collenia reefs and massive dolomite or limestone deposits in a sea free from terrigenous sediments. Nixon (1963) lists references suggesting that zinc and other metals may be selectively removed from seawater by marine organisms, and this may account for the high zinc content of the Ajax Limestone. No Palaeozoic sediments younger than Lower Cambrian are preserved in the lease, though Compston et al date the final metamorphism in the Flinders Ranges at 465 m.y. The deformation of the sediments probably began some time before this final spasm of the orogeny, though structural events represented within the lease probably occurred in a fairly short interval.

STRUCTURE

The structure of the lease is illustrated in Fig. 1 and in the sections accompanying the map. The dominant structural feature within the lease is the complicated syncline which extends along Sliding Rock Creek for three and a half miles west of Warraweena Homestead and for about two and a half miles east of it.

The older sediments of the Umberatana Group in the northeast corner of the lease form part of an overthrust fold the form of which is tentatively shown in section D-E. Since Campana (in Glaessner and Parkin, 1958) in a section drawn across the Flinders Ranges about 15 miles north of the lease, shows an almost vertical contact between tillite and Pound Quartzite in a similar situation, this thrust plane may be considerably steeper than shown in the section. However, the sinuous outcrop of the plane in the lease together with the opposing dips in units separated by the plane suggest that this structure is unlike the steep near isoclinal folds drawn by Campana.

Cleavage and lineation were observed in several exposures in less competent rocks, but they are not uniformly distributed in any unit and are more likely to be the results of intense local deformation on fault planes than of large-scale folding. The axes of folds observed within the lease generally trend between northeast and southeast, but they have no strongly preferred direction. With the exception of the folding affecting the older overthrust sediments, folding within the lease is open and, on a large scale, regular, presumably as a result of the competence of the Pound Quartzite. However, several faults trending between northeast and east-northeast disrupt the regular pattern of the folds, probably because the Pound Quartzite deformed in a brittle fashion during the fold movements with the result that tear and thrust faults were formed under the compressive forces.

The older sediments overlying the thrust fault appear to have moved into place after the folding and faulting which produced the present outcrop pattern of the Pound Quartzite and the Cambrian sediments, although the thrust fault has to a small extent been displaced by subsequent movement on some of these faults. All the deformation presumably occurred between the deposition of the Lower Cambrian sediments and the culmination of the orogeny in the Flinders Ranges dated by Compston, Crawford, and Bofinger (1966) at 465 m.y.

Intraformational folding is probably common in the less competent ore-bearing sediments such as the Bunyeroo Formation, the Parachilna Formation, and the Ajax Limestone, and has probably produced some concentration of ore minerals within them. However, the copper deposit mined at the Sliding Rock Mine is located on a major fault, and copper-bearing lodes at the Green RockMine evidently follow fractures parallel to minor north-northwest trending faults in the vicinity of the mine.

ECONOMIC GEOLOGY

Between 1871 and 1877 copper was mined from the Sliding Rock Mine. Shafts were sunk and some ore was raised at the Green Rock Mine and at an unnamed (?) location in the diapir in the centre of the lease, but no records of production from these have so far been found. Several small shafts or test pits were sunk in the Cambrian sediments, mainly near the Sliding Rock Mine.

Sliding Rock Mine

The Sliding Rock Mine is located on the south side of Sliding Rock Creek about 2 miles from the western boundary of the lease and about 14 miles from Beltana. The mine is sunk on a lode composed of clayey material containing copper carbonate, copper oxide, and native copper, which lies in a fault zone cutting the northern limb of an east-pitching anticline and separating Pound Quartzite on the west from Ajax Limestone on the east. Dickinson (1944) provides a comprehensive description of the mine and its surroundings. Inspectors' reports are also given in the 4th edition of the Record of Mines of South Australia (Gee, 1908).

The deposit was purchased by the Sliding Rock Company from its discoverers in 1871 and rich parcels of copper carbonates and native copper were profitably mined. Water was met at 30 feet and gave continual trouble until production ceased in 1877. Dickinson (1944) indicates that water caused the mine to close, but local opinion holds that the cause was the suicide of the manager when the price of copper fell, after he had over-committed either himself or the company by buying up numerous copper prospects inthis region.

Between 1871 and 1877 227½ tons of copper matte and 917 tons of copper ore were sold to the Australian Copper Company at Port Adelaide from Sliding Rock. The copper content of the matte ranged from 89 to 94$\frac{3}{8}$

per cent and the copper content of the ore ranged from 18¼ to 88⅜ per cent; between December 1874 and June, 1877 the copper content of the ore ranged between 55¼ and 79⅜ per cent. Presumably the low-grade ore was converted to copper matte in the smelter whose chimney still stands close to the mine.

In 1876 the lode had been stoped fromthe 150-foot level up through the 90-foot level to the surface over a width of 23 feet, from drives extending up to 212 feet southwest and 190 feet northeast of the main engine shaft. At the 210-foot level a drive extended 150 feet southwest and 180 feet northeast of this shaft through payable ore with an average width of 24 feet. Manager Mathews later reported that when he handed over to his successor in 1876, a year before the mine closed, very little stoping had been carried out between the 210-foot and the 150-foot levels.

Between 1899 and 1901 the Sliding Rock Proprietary sank a new shaft at the northeast end of the old workings to a depth of 361 feet and advanced a drive at 310 feet for 87 feet along the lode towards the old workings. At this stage the drive was flooded and the shaft partly destroyed by a flow of 1000 gallons of water per hour. In 1906 and 1907 the Tasmanian Copper Company dewatered the shaft to 250 feet with a Cornish pump capable of raising 30,000 gallons per hour, and at 235 feet a crosscut was begun to intersect the lode below the old workings. For safety 3 boreholes were driven 25 to 30 feet in advance, but at 72 feet the crosscut flooded from the boreholes. When the pump broke down in 1907, operations were terminated.

No other attempts were made to re-open the mine, but the 1899 shaft was tested in the 1940's as a potential water supply for the planned coal-mining town of Leigh Creek. During pumping tests the shaft collapsed below 198 feet and the silt level rose to 155 feet. Dickinson notes that the shaft is in hard dolomite to 150 feet and practically no water enters above that level. A sample of the silt in the shaft contained 0.56 per cent cupric oxide (CuO). In 1907 the old main shaft was reported to be caved below a depth of 70 feet.

Dickinson records that the copper minerals occur in a brown tenacious clay within a fault zone in friable calcareous clay and sandstone, in the Parachilna Formation, and probably near its top. Native copper is the predominant mineral, associated with malachite, cuprite, and chalcocite. Copper sulphide and black copper oxide were said to be present in the deeper workings, but production figures indicate that oxidised ore persists down to the 210-foot level. Dickinson attributes this to active circulation of groundwater in the lode channel.

Dickinson also notes that the outcrop of the lode is reported to have been rather poor in copper, but that rich values were encountered at 30 feet, at the water table. A report of 1907 quoted by Dickinson estimates that the lode, on re-openeing the mine, would yield 3 to 4 per cent copper. Inspector Ulrich in 1872 (in Gee, 1908), states that "the main ore deposit is a lode varying from 18 inches to 10 feet wide. Its course is tortuous, and has a mean strike of N.20.E with an east underlie of 3 feet in the fathom. It traverses the beds of thecountry which strike W.20 N. and dip south at an angle of about 60°." Another inspector, writing in 1899, stated that the main lode "which varies in size from 2 feet to 10 feet, is very erratic in its course, apparently following the base of the hills." He agrees on a strike of 20°, but states that the underlie is 2 in 6 easterly.

Ulrich records that the east wall of the ore deposit is a blackish aluminous shale resting against a hard bar of reef of impure brown iron ore which dams back a great accumulation of water, and the west wall is a soft sandy concretionary light-coloured shale thickly stained by copper carbonates and iron ore near the surface. The ore is carbonate at the surface but "changes in depth to an association of red oxide of copper, native copper, green and some blue carbonates in a soft, clayey partly ferruginous matrix. The red oxide occurs frequently in large crystalline, granular, and vein-like masses; the native copper in pure crystallised masses, occasionally several inches in size; and the carbonate- mostly malachite - forms veins and druses in connection with the former. Beneath the water level traces only have been discovered of black sulphide of copper ore."

Ulrich records that the middle of the length of lode then worked is traversed, without being fractured, by a cross course 13 feet wide striking W.17° N. (287°), which "carries ore similar to the main lode and has been followed for several fathoms towards the west."

An inspector's report of 1899 (in Gee, 1908) confirms that the lode was stoped from the 150-foot level to the surface and that the bottom level was reported intact (possibly by the Sliding Rock Proprietary then engaged in re-opening the mine). The crosscut put in at the 10-foot level in 1901 cut lode material composed of "fine-grained argillaceous sandstone, containing native copper, which occurs in small grains, thin streaks, and at times in more massive form. Eight bulk samples from various points of the crosscut along its length assayed from 1 per cent to 2¾ per cent copper." The inspector described the material as very friable and said that when thoroughly drained it would be inexpensive to work.

Dickinson (1944) suggests that 3 shallow drill holes to about 100 feet vertical depth should be put down "to test the gossan formations outcropping along the southern extension of the Sliding Rock lode."

These would determine whether or not further testing was justified. He believes that the scattered distribution of copper values makes it doubtful if a sufficient tonnage can be developed to make mining profitable, and that the exceedingly bad ground and copious water offer serious difficulties to any mining operation."

The friable clay in which the copper minerals are concentrated may be an altered member of the Parachilna Formation, or it may be a thick pug seam following a fault; One inspector records that the lode cuts the bedding at an angle of about 90°. The geochemical results suggest that the copper was derived either from the Parachilna Formation or from the basal part of the Ajax Limestone, and, as Dickinson infers, the incompetent Parachilna Formation may be dragged out along the fault to form the lode.

The results of the soil sampling around the mine in 1971 point to the southern extension of the fault as a target for further investigation in the search for copper, and since rich copper values were encountered at a depth of only 30 feet in the original deposit, aseries of shallow drill holes would be a suitable method of testing this particular prospect.

Dickinson shows two shafts, shafts C and D on his map as well as shaft A, the new shaft of 1899, and shaft B, the original main shaft of 1871. No description of shaft C and D has been seen, but shaft C appears to be sunk on the southern end of the workings as described in 1876, and shaft D. lies about 100 feet farther south, onthe southern extension of the lode. These shafts were probably sunk to test the southern extension, but the results are unknown.

During the visit of Messrs. Nixon and Woolf, a sample of a pink encrustation was taken from the southeast corner of the open cut at the Sliding Rock Mine. This was found to becobalt bloom, containing 18,000 ppm cobalt as well as 13,000 ppm copper 10,000 ppm zinc, and 700 ppm lead; a sample submitted by Mr. Woolf contained 1050 ppm nickel as well. Although this is an isolated sample, the possibility exists that nickel-cobalt minerals are associated with the copper mineralisation. In the history of the mine no reference has been found to the zinc content of the lode, but this also may have been considerable.

Mineralisation in Cambrian sediments

Eight sets of pits or shafts were found in the Parachilna Formation or the Ajax Limestone, seven of them within a mile of the Sliding Rock Mine. The shaft on the north side of the ruins of Cadnia township and about a quarter of a mile east of the mine, may have been dug and timbered to serve as a well. Four sets of pits or shafts lie between half a mile and one mile south and southwest of the mine; they were probably all dug to test ironstone exposures within the Ajax Limestone. One of them, half a mile south-southeast of the mine, is a shaft over 30 feet deep and exposes bands of hard ferruginous rock under a very extensive patch of ironstone rubble. The others are pits or small caved shafts with no sign of significant production.

A small shaft is located in ironstone in the Ajax Limestone slightly less than one mile west-northwest of the mine, again without signs of production; a sample from the ironstone contained 2000 ppm zinc and 270 ppm cobalt. A pit in ironstone capping the Parachilna Formation about a mile southeast of the mine exposes leached and sheared sandstone weakly stained by malachite, a sample of which contained 180 ppm copper and 120 ppm zinc. A shallow pit in ironstone on the Ajax Limestone about one and a half miles east-northeast of the Sliding Rock Mine exposes iron-stained sandstone or oolitic dolomite and is possibly located close to the base of the Ajax Limestone.

A few samples taken for geochemical analysis from ironstone overlying the Parachilna Formation and the Ajax Limestone contain anomalous quantities of metals. One sample from a prominent ironstone outcrop on the Parachilna Formation one mile east-southeast of Warraweena Homestead contains 1,900 ppm copper and 1,000 ppm zinc, as well as 95 ppm lead and 160 ppm cobalt. A sample of Ajax Limestone collected by L.G.B. Nixon about one mile east-southeast of the Sliding Rock Mine, because it was unusually heavy, contains 1,300 ppm zinc as well as 200 ppm cobalt, 70 ppm lead, and only 25 ppm copper.

Describing the distribution of lead in Cambrian sediments in South Australia. Thomson (1962) states that "stratigraphic control evidently favoursthe calcareous siltstone immediately below the lowest carbonate member, which is frequently oolitic dolomite" for the deposition of unusually high quantities of lead. The cacareous siltstone is probably part of the fine-grained sediment at the top of the Parachilna Formation, and he notes that values decline lower in this clastic basal Cambrian Formation. He also states that high lead values occur at Ediacara and Parachilna Gorge within higher members of the Ajax Limestone, and Nixon (1963) confirms that a substantial low-grade lead deposit occurs in a brecciated within the limestone at Ediacara. Thomson records that the analyses show a marked association of lead with copper, zinc, silver, manganese, barium and phosphorous.

Mineralisation in Adelaidean sediments

Leeson (1970) and Parkin (1969) note that green shale layers within the Bunyeroo Formation commonly contain copper. Of the copper occurrences in Adelaidean rocks within the lease the one at the Green Rock Mine consists of lodes cutting across green shale mapped by the Geological Survey as Brachina Formation close below its contact with the

Bunyeroo Formation. The other occurrence is in red shattered mudstone or shale close to the thrust plane separating older sediments fromthe Pound Quartzite near the northern boundary of the lease. The red sediments have been mapped as Bunyeroo Formation, but they may be diapiric material.

The Green Rock Mine consists of a shaft, at least 30 feet deep, and an inclined drive sunk on the largest of a series of parallel lodes composed of siliceous and ferruginous material. The lodes strike southeast and dip between 30 and 40 degrees southwest; they cut across the greenish-grey shales, which strike between north-northwest and east-northeast, and range in dip from 50 degrees north through vertical to 70° south.

The lodes are composed of a breccia of milky quartz and green shale fragments in a black ferruginous matrix. On weathering they turn rusty-brown and near the mine are patchily stained by malachite. Green shale up to 50 yards east of the mine is also stained by malachite though it contains no well defined lodes. The lode mined is about 8 feet thick and at least 5 parallel lodes, up to 2 feet in thickness crop out between 40 and 70 feet west and downstream of the main lode. Mr. Woolf pointed out that the lodes cut out on both sides of the small valley about 40 feet above the mine, which is only a few feet higher than the creek bed; he suggested that this may be related to a former level of the water table.

Mullock at the entrance to the inclined drive consisted of green shale fragments with malachite and azurite apparently filling cavities which may originally have been occupied by sulphide minerals. A sample of mullock collected by Mr.Nixon contains 10,000 ppm of copper and 18,000 ppm of lead, as well as 2,000 ppm of zinc and 140 ppm of cobalt.

The fractures followed by the lodes appear to parallel the faults evident on airphotos in the nearby Bunyeroo Formation, and it is possible that the copper migrated downwards along these fractures from the overlying Bunyeroo Formation, which elsewhere contains syngenetic copper deposits (Leeson, 1970; Parkin, 1969). A suggestion by Mawson and Segnit, cited by Glaessner and Parkin (1958) that the Bunyeroo Formation may be a deposit of fine volcanic ash, suggests a source for the metals.

A copper occurrence in the Bunyeroo (?) Formation is marked by a small caved shaft sunk in shattered red mudstone and siltstone near the centre of the northern margin of the lease and close to a thrust fault separating the mudstone and siltstone from the Pound Quartzite; small sets of malachite are the only trace of mineralisation on mullock heap at the shaft. A sample of mullock from the caved shaft in the red mudstone contains 3,200 ppm copper, but only 55 ppm lead, 25 ppm zinc, and 80 ppm cobalt. About a quarter of a mile west of the shaft a similar purplish red mudstone, sheared in places, crops out beneath limestone of the Wonoka Formation, and carries faint traces of malachite and azurite (?). The base of the limestone overlying this mudstone is formed by a layer about 5 feet thick of conglomerate or breccia containing small angular fragments of limestone, quartzite, quartz and ironstone, and as it is close to the thrust fault separating the Pound Quartzite from the older sediments, it perhaps indicates that both the breccia and the red and purple mudstone are diapiric rocks introduced along the thrust plane, and that the occurrence of these red fine-grained sediments in the stratigraphical position of the Bunyeroo Formation is coincidental.

Mineralisation in diapiric rocks

A shaft at least 30 feet deep surrounded by a considerable quantity of copper-stained mullock is located in the diapir near the centre of the northern margin of the lease. No record of production from it has yet been found. The mullock includes aquantity of fresh crystalline igneous or metamorphic rock described under diapiric rocks above, as well as a variety of sediments. Samples of rock from here have been identified by Pander as metasomatised basic vesicular igneous rock, metasomatised dolerite, and metasomatised Lamprophyre.

Brecciated limestone about 200 yards west of the shaft carries a few veins of barytes up to 6 inches thick. Ironstone, siltstone, limestone, and chert or silicified limestone close to the barytes occurrence were sampled. The highest metal content is recorded by the ironstone, which contains 190 ppm copper, 40 ppm lead, 900 ppm zinc, and 320 ppm cobalt. In the other rocks these elements range only from 15 to 55 ppm.

Other diapiric material sampled and analysed also gave disappointing results. Ironstone from the Bunyeroo Formation in contact with the diapiric rocks 2 miles northeast of Warraweena Homestead contained 85 ppm cobalt and 45 ppm lead, but only 10 and 20 ppm of copper and zinc respectively. Limestone from the diapiric material about 4 miles east of Warraweena Homestead contained 170 ppm copper and only between 35 and 50 ppm of lead, zinc, and cobalt separately.

GEOCHEMISTRY

To investigate the metal content of the Parachilna Formation and the Ajax Limestone, soil samples were taken selectively in these formations on a grid in the vicinity of the Sliding Rock Mine. Stream-sediment sample maps compiled by the Electrolytic Zinc Company for a large area including the lease were obtained from the Geological Survey of South Australia.

Soil Samples

Sample stations were set at 100-foot intervals on grid lines trending about south-southwest and spaced 500 feet apart. Not all the stations were occupied; samples were taken selectivelyover the Parachilna Formation and the lower part of the Ajax Limestone. Pound Quartzite, alluvium, and obviously contaminated ground around the mine and smelter were not sampled, (Fig. 2) and few samples were taken in the higher part of the Ajax Limestone (Fig.2).

The grid lines were laid out by compass and tape, and are only approximately located on the maps. Samples were taken between 3 and 6 inches below the surface. As many stations werenot sampled contouring the results obtained would not give a true picture of the metal content of soil in the area, but the main anomalies have been outlined for each element determined, in a manner felt to be in accord with the structure and the distribution of the rock types (Figs. 3-6).

Averaging the copper values (Fig. 3) of samples containing less than 100 ppm copper provides a background value of about 45 ppm for the Lower Cambrian sediments, on which almost all the samples are taken. A group of samples taken close east of the mine range from 350 to 570 ppm copper, and are probably contaminated by material from the mine.

Anomalously high amounts of copper occur close to the boundary between the Parachilna Formation and the Ajax Limestone which extends for a little over half a mile south and southeast of the mine; generally the copper values are not very much higher than background, but a few samples contain three or four times the background value. An extension of this anomaly is indicated by the samples containing more than 100 ppm copper which occupy a poorly defined zone about 1,000 feet southeast of the mine striking southwestwards more or less parallel to the Sliding Rock fault. Two other small but fairly well defined anomalies occur in the lower part of the Ajax Limestone near the southern boundary of the lease, with copper values between two and four and a half times the background value.

At higher stratigraphic levels in the Ajax Limestone copper values are generally lower than the chosen background vale.

The zinc values of the soil samples (Fig.4) are generally higher than the copper values and inspection suggests that 60 ppm is a suitable value for the background.

The zinc anomalies in the Parachilna Formation and the lower part of the Ajax Limestone to some extent reflect copper anomalies towards the southwestern end of the Sliding Rock fault. The small copper anomalies in the lower part of the Ajax Limestone near the southern boundary of the lease are also the sites of zinc anomalies rising to three or four times background.

Another notable and independent zinc anomaly is located along traverse 130, east and northeast of an abandoned shaft sunk in ironstone rubble which presumably covers Ajax Limestone, and the limestone in this location is likely to be at least a few hundred feet above the base of the formation. The zinc anomaly may of course result from contamination by galvanised iron, but it is well clear of the existing works and buildings associated with the Leigh Creek water supply and is spread out for 500 feet both north and south of the shaft. Zinc values in this anomaly rise to about seven times background.

Possible extensions of this anomaly run northwestwards to the Sliding Rock Mine and southwestwards to traverses 125 and 130 about 1,500 feet south of the shaft mentioned but significantly higher in the formation that the combined copper and zinc anomalies near its base; values in this anomaly rise to about four times background. High values of zinc are more widespread in, and perhaps more characteristic of the Ajax Limestone than are high values of copper.

Lead (Fig. 5) displays fewer sharp anomalies than copper or zinc in the soil samples, however it is difficult to set an average or background value for lead as it appears to increase broadly, though not in a steady fashion, eastwards across the area; the background value probably lies between 40 and 60 ppm. The only very high lead value, of 1,500 ppm, is located over the base of the Ajax Limestone almost half a mile southwest of the Sliding Rock Mine. Throughout the rest of the area the lead values are relatively even, and few of them exceed twice background. They tend to reflect the distribution pattern of zinc; values are generally higher along traverse 130; small anomalies occur near the southern margin of the lease; there is a faint reflection of the anomaly along the contact of Parachilna Formation and Ajax Limestone southeast of the mine.

For cobalt values in the soil (Fig. 6) 40 ppm appears to represent an average for the Lower Cambrian sediments. The cobalt anomalies generally reflect faintly the zinc distribution. A small anomaly exists the boundary of the Ajax Limestone and Parachilna Formation near the southeast end of the Sliding Rock fault. The two anomalies close to the base of the Ajax Limestone near the southern boundary of the lease, and the higher zinc anomaly on line 130 are faintly reflected in the cobalt results; the strong zinc anomaly east of the shaft half way along line 130 is also the site of the highest cobalt anomaly.

The distribution pattern of copper appears to be significantly different from the distribution patterns of the other metals in that it is generally concentrated only in the lower part of the Ajax Limestone and the Parachilna Formation, and that the concentrations of copper appear to be more sharply defined. Although zinc is concentrated in the same locations as the copper, independent concentrations of zinc also occur, notably at higher stratigraphic levels in the Ajax Limestone. Lead and cobalt generally seem to reflect the zinc anomalies but are more evenly distributed in the Lower Cambrian sediments.

At the request of Mr. Woolf pits were dug to between 2 and 3 feet at sample stations 25, 27 and 29 on traverse 105 and samples were taken at 6-inch intervals to find the distribution of metals with depth. The results are tabulated below:-

STATION & SAMPLE NUMBER	DEPTH (FEET & INCHES)	COPPER ppm	LEAD ppm	ZINC ppm	COBALT ppm
25/1	6"	60	70	80	20
25/2	1'0"	50	45	50	20
25/3	1'6"	50	50	40	15
25/4	2'	40	25	30	15
25/5	2'6"	40	60	40	15
27	3"	70	50	110	30
27/1	6"	100	85	160	55
27/2	1'	50	35	120	30
27/3	1'6"	40	35	50	20
27/4	2'	50	50	50	30
27/5	2'6"	40	30	45	30
29	3"	65	65	240	45
29/1	6"	60	60	140	40
29/2	1'	35	55	60	25
29/3	1'6"	40	45	65	25
29/4	2'	20	50	35	15
29/5	2'6"	20	30	30	10
29/6	3'	20	30	25	10

With few exceptions the metal content is greatest in the samples taken within 6 inches of the surface, and anomalous quantities of since in particular, do not persist in depth. This is probably a reflection of leaching as the pits bottomed in a layer of Kunka, which was not penetrated.

Stream sediments

On the maps prepared by the Electrolytic Zinc Company showing metal values in stream sediments samples, relatively high values of copper (Fig. 7) are located near the Sliding Rock Fault, and west of the Green Rock Mine. Copper values are higher than normal. in streams draining the outcrop of the older Sutrtian and Marinoan sediments extending for a few miles east of the Green Rock Mine, and probably originating in the Tapley Hill, Nuccaleena, and Brachina Formations, and possibly in the cupriferous Bunyeroo Formation.

Zinc values in stream sediments (Fig. 8) also point to the Sliding Rock Fault as a locus of mineralisation, and zinc values appear to be a little higher than normal on the broad expanse of Ajax Limestone north of Sliding Rock Creek and on the ridge of Ajax Limestone extending east of Warraweena Homestead. Zinc values are particularly high on the isolated body of Ajax Limestone exposed below the thrust plane at the eastern boundary of the lease; or on the diapiric rocks associated with it; in one stream close to the eastern boundary a zinc value of 550 ppm and another of 280 ppm are recorded, and relatively high values of 40, 60 and 80 ppm are spread over the limestone body. Zinc values are also relatively high near the Green Rock Mine. A rather high content of zinc is also recorded for sediment near the abandoned prospect about 1 mile west-northwest of the Sliding Rock Mine.

The Lead value (fig. 9) in the sediment from the above prospect is also high, and anomalous values of lead reflect the high values of zinc noted above on the Ajax Limestone or diapiric rocks at the eastern boundary of the lease.

D S TRAIL

(D.S.TRAIL.)

L. G. B. NIXON & ASSOCIATES
GEOLOGICAL CONSULTANTS

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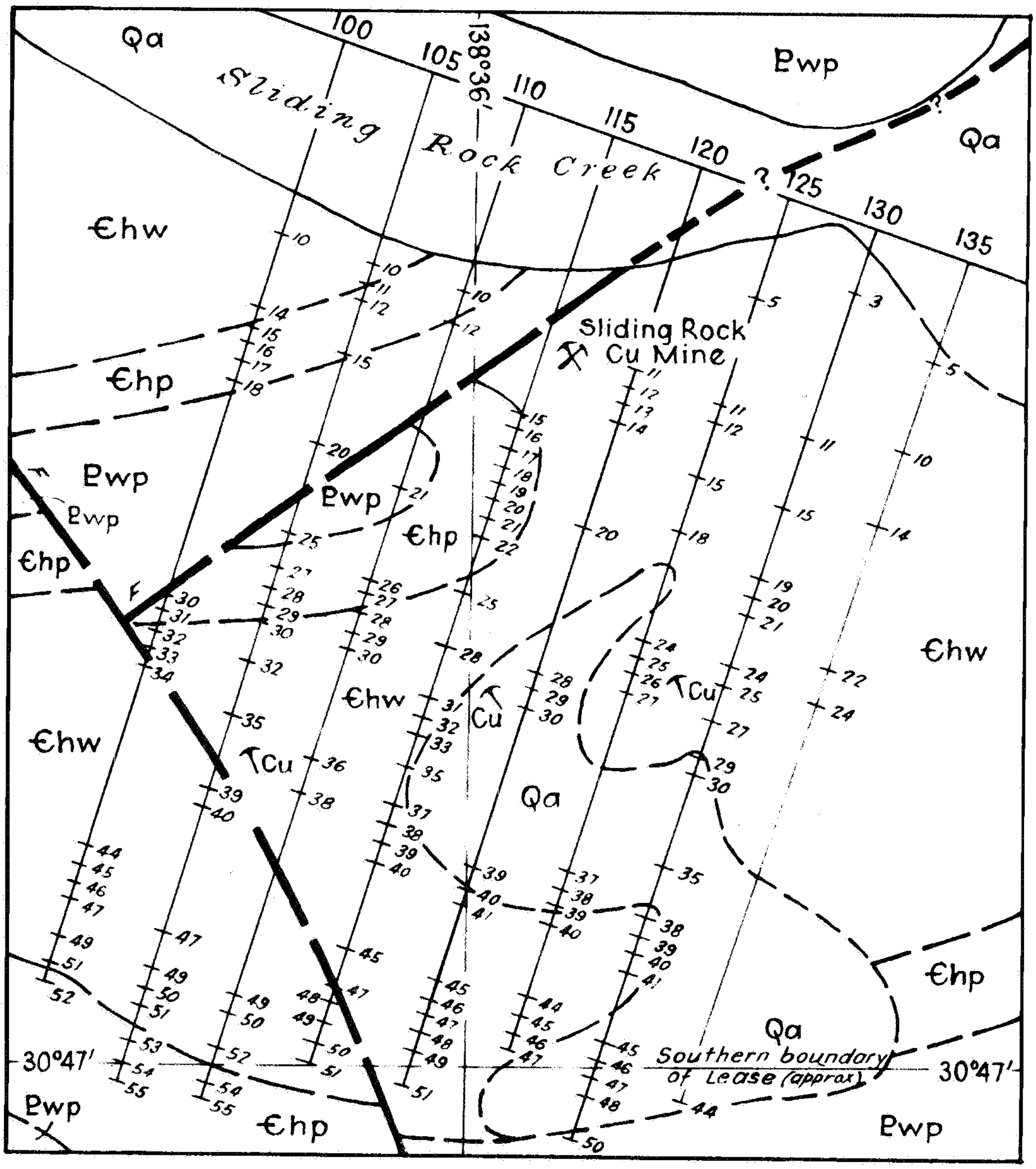
"D. S. TRAIL"

D.S. Trail
(D.S. TRAIL)

15th March, 1971



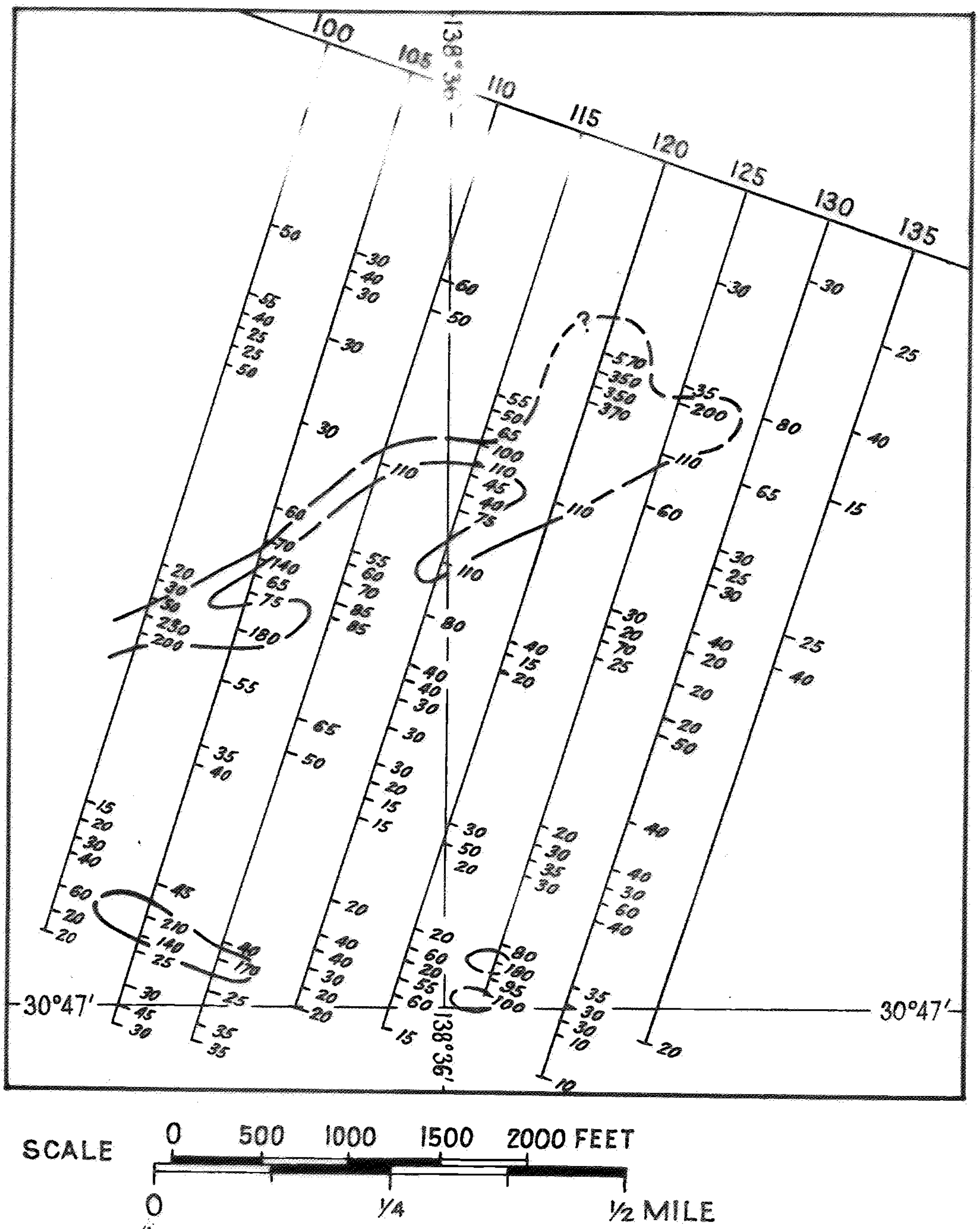
SCALE 0 500 1000 1500 2000 Feet

0 1/4 1/2 Mile

For letter symbols see Figure 1.

L. G. NIXON & ASSOCIATES	
Drawn D.S.Trail	MAP SHOWING LOCATIONS OF SOIL SAMPLES S.M.L.536 South Australia.
Traced MRT	
Revised	
Date	

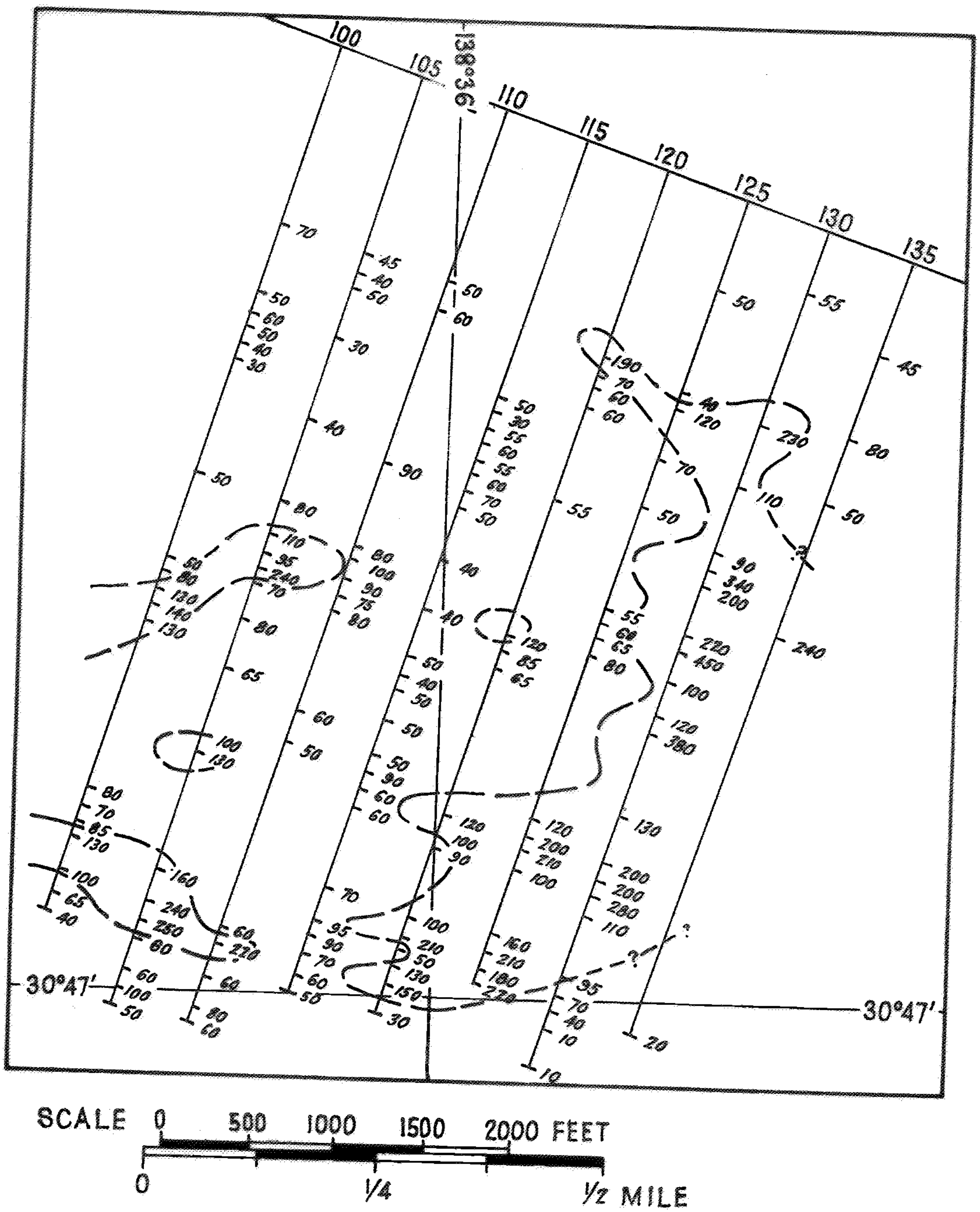
FIG. 2.



Values in excess of 100ppm outlined thus ....

L. G. NIXON & ASSOCIATES	
Drawn D.S.Trail Traced M.R.T. Revised Date	MAP SHOWING P.P.M. COPPER IN SOIL SAMPLES S.M.L. 536 South Australia.

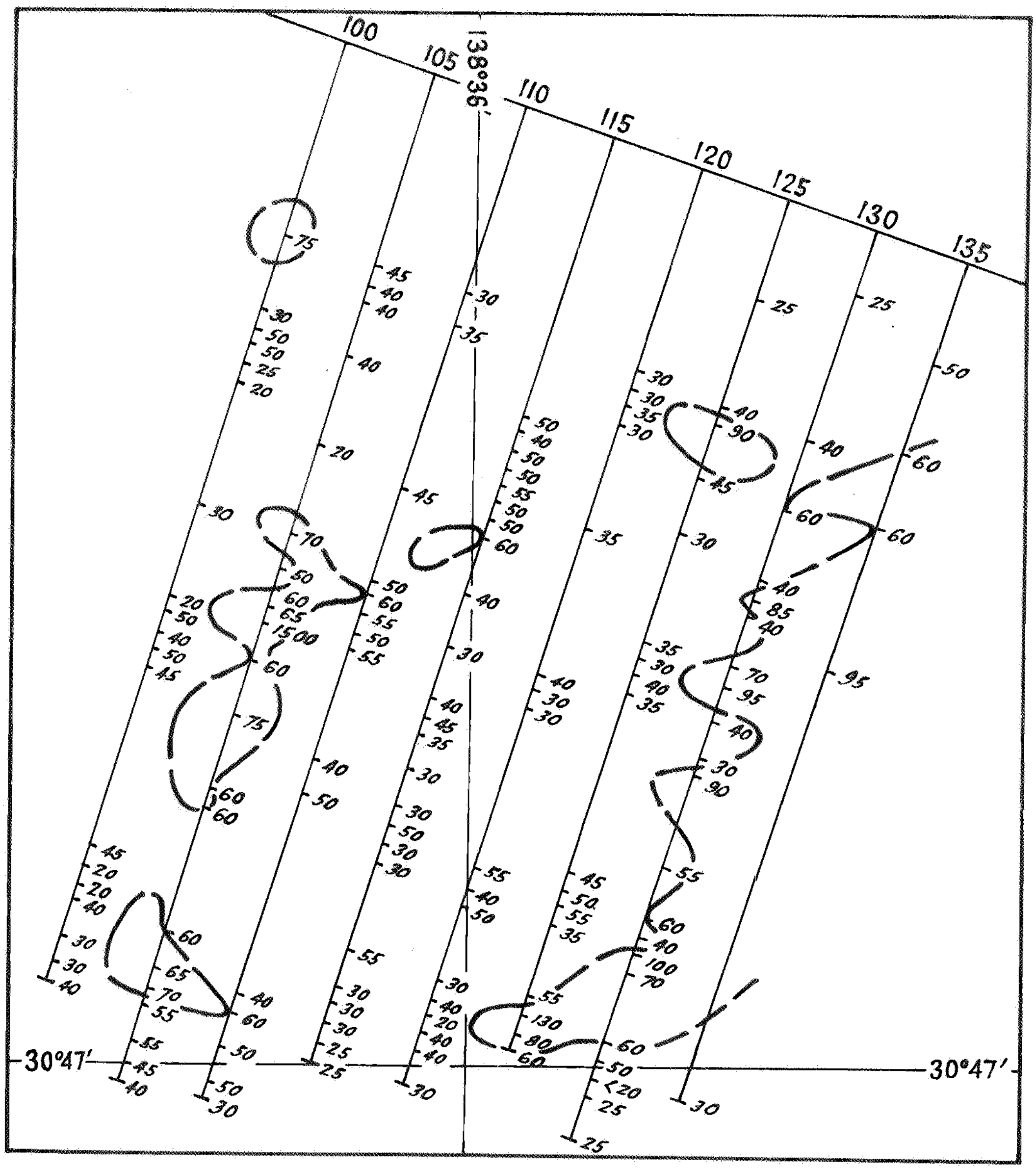
FIG. 3



Values in excess of 100 p.p.m. outlined thus ....

L. G. NIXON & ASSOCIATES	
Drawn: D.S.Trail	MAP SHOWING P.P.M. ZINC IN SOIL SAMPLES (Sliding Rock) S.M.L.536 South Australia
Traced: M.R.T.	
Revised	
Date:	

FIG. 4.



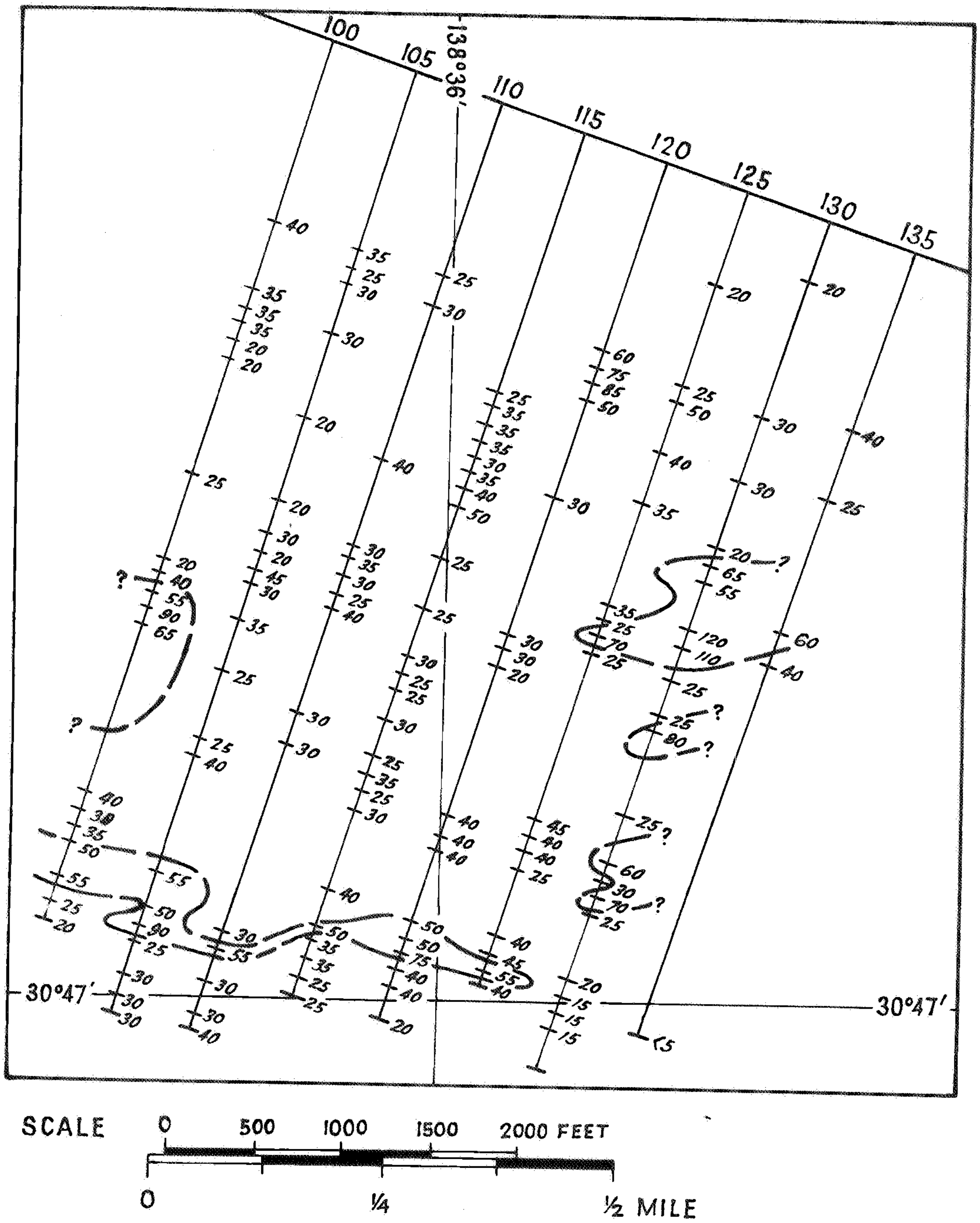
SCALE 0 500 1000 1500 2000 FEET

0 1/4 1/2 MILE

Values in excess of 60 p.p.m. outlined thus.....

L.G. NIXON & ASSOCIATES	
Drawn D.S.Trail Traced M.R.T Revised Date	MAP SHOWING P.P.M. LEAD IN SOIL SAMPLES S.M.L. 536 South Australia

FIG.5.



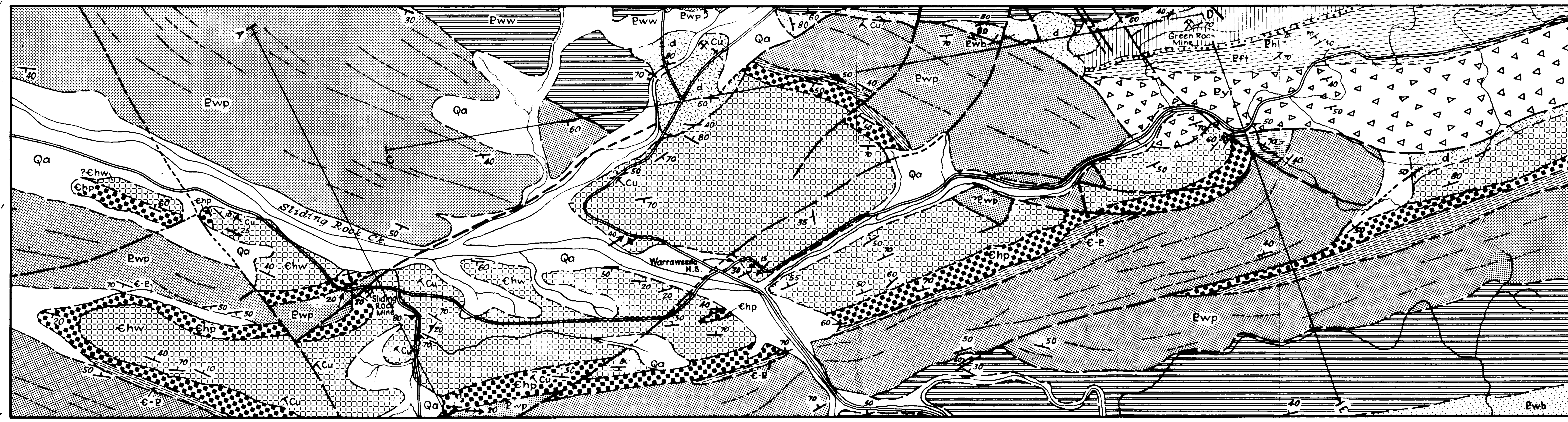
Values in excess of 50 p.p.m. outlined thus.....

L.G. NIXON & ASSOCIATES	
Drawn D.S.Trail	MAP SHOWING P.P.M. COBALT IN SOIL SAMPLES S.M.L.536 South Australia
Traced M.R.T.	
Revised Date:	

FIG. 6

138°34′ 30°45′

138°43′ 30°45′

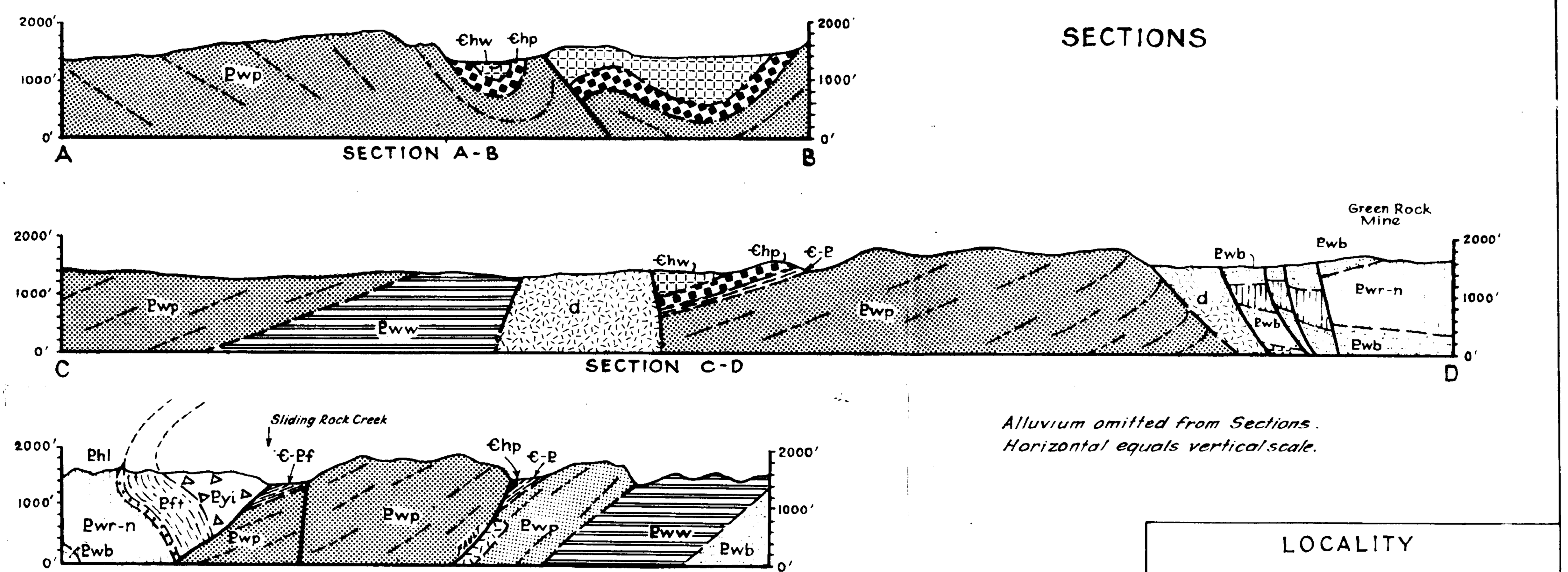


30°46′ 30°46′

30°47′ 138°34′

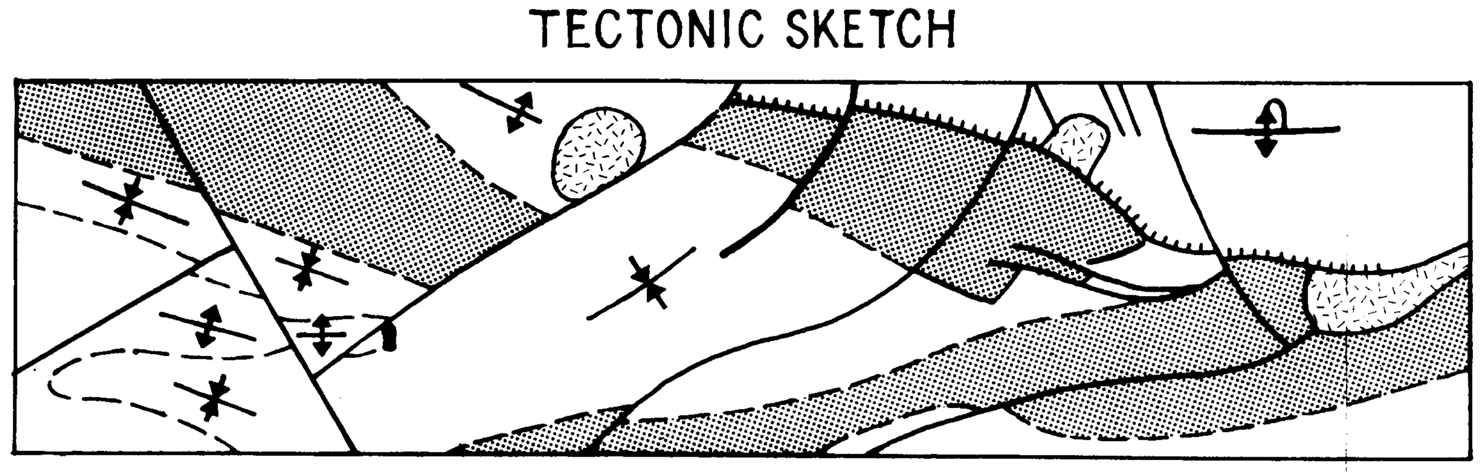
30°47′ 138°43′

SECTIONS



Alluvium omitted from Sections.
Horizontal equals vertical scale.

TECTONIC SKETCH

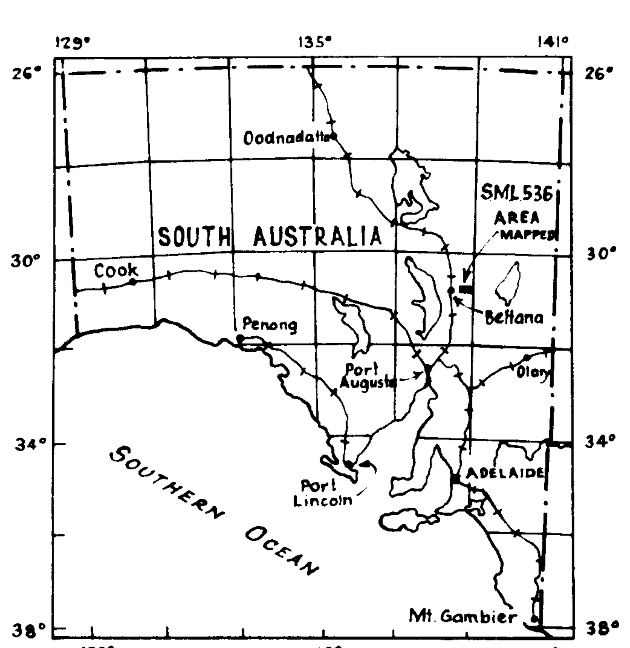


STRUCTURAL ELEMENTS

Approx Scale
Miles 0 1 2

Syncline · Anticline · Fault · Overturned Anticline · Thrust Fault · Conformable boundary · Diapiric rocks · Pound Quartzite

LOCALITY



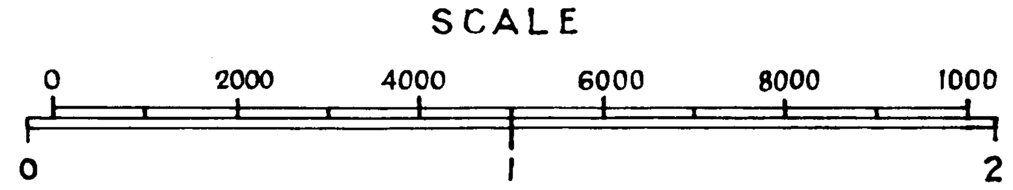
REFERENCE

Era	Period	Series	Group	Formation	Symbol	Description
CAINOZOIC					Qa	Alluvial gravel and sand, scree.
PALAEOZOIC	CAMBRIAN	LOWER CAMBRIAN	Hawker Group	Ajax (Wilkawillina) Limestone	Ꞓhw	Oolitic dolomitic limestone. Collenia limestone.
				Parachilna Formation	Ꞓhp	Clayey and ferruginous sandstone, worm-burrow beds, siltstone, sandy limestone.
				Uratanna Formation	Ꞓ-Ꞓ	Brown shale, mudstone, siltstone.
PROTEROZOIC	ADELAIDEAN	MARINOAN	Wilpena Group	Pound Quartzite	Ꞓwp	Quartzite, sandstone.
				Wonoka Formation	Ꞓww	Grey limestone and siltstone.
				Bunyeroo Formation	Ꞓwb	Red and green shale mudstone and siltstone.
				Brachina & Nucaleena Formations	Ꞓwr-n	Green and grey shale, siltstone, dolomite.
		STURTIAN	Umberatana Group	Elatina Formation	Ꞓhl	
				Tapley Hill Formation	Ꞓft	Green and grey shale
				Appila? Tillite	Ꞓyi	Massive boulder beds
					d	Diapiric rocks

SYMBOLS

Strike and dip of bedding
Vertical beds
Strike and dip of cleavage
Plunge of lineation, fold axis
Creeks
Road, track
Geological boundaries, accurate
" " " , approx.
Fault · Fault concealed.
Trend lines from air photos.
Copper mine, abandoned · Cu
Copper prospect, abandoned · Cu

SCALE



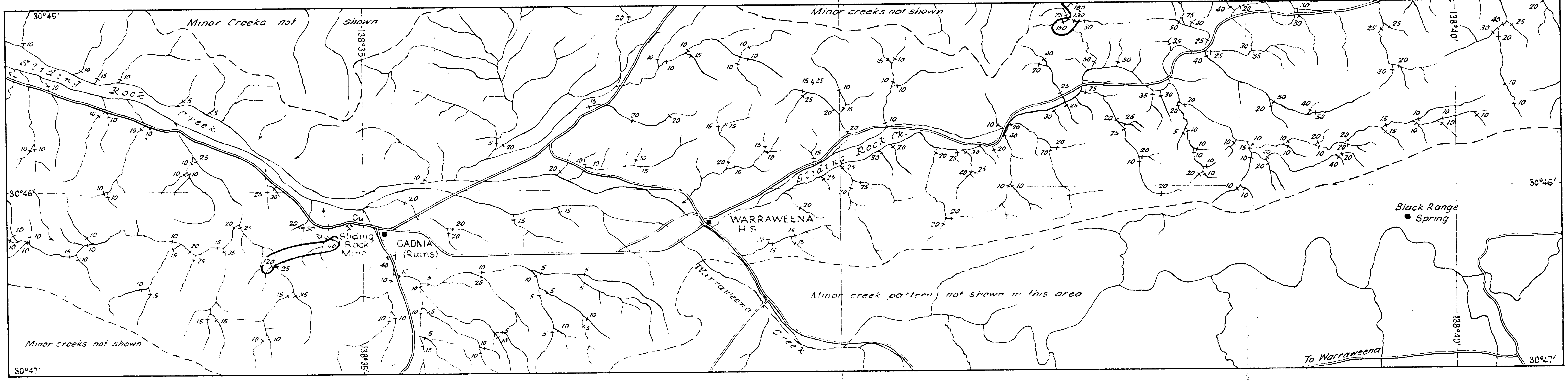
Note: Topographic detail from Aerial photograph

L. G. NIXON & ASSOCIATES.

DRAWN D.S.Trail	GEOLOGICAL MAP & SECTIONS, TECTONIC SKETCH & LOCALITY MAP S.M.L. 536 (SLIDING ROCK) South Australia.
TRACED M.R.T.	
REVISED	
Date:	

FIG. 1.

ENV 1585-4



Creeks
Tracks
Ppm copper in stream sediments 30
Values over 100 ppm outlined thus
Areas where minor creek pattern not shown

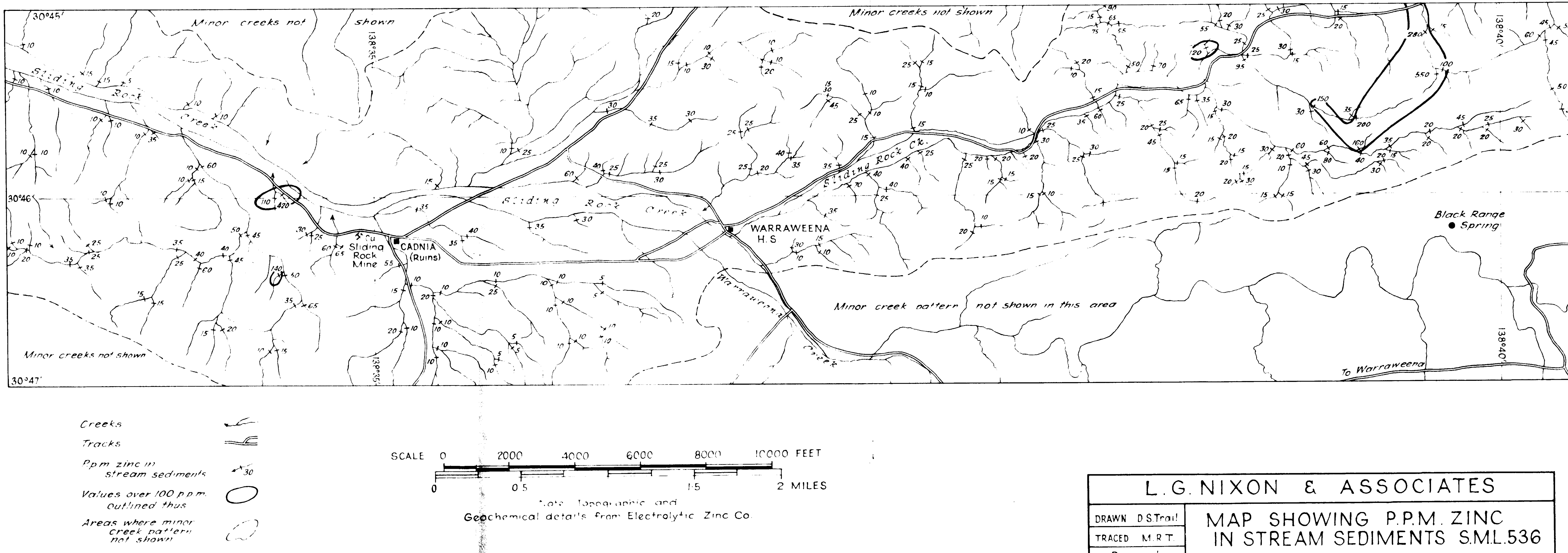
SCALE 0 2000 4000 6000 8000 10000 FEET
0 0·5 1 1·5 2 MILES

Note: Topographic and Geochemical details from Electrolytic Zinc Co.

L. G. NIXON & ASSOCIATES	
DRAWN D.S.Trail	MAP SHOWING P.P.M. COPPER — IN STREAM SEDIMENTS S.M.L. 536
TRACED M.R.T.	(DETAILS FROM ELECTROLYTIC ZINC Co.)
Revised Date	VALUES OVER 100 PPM OUTLINED

FIG. 7.

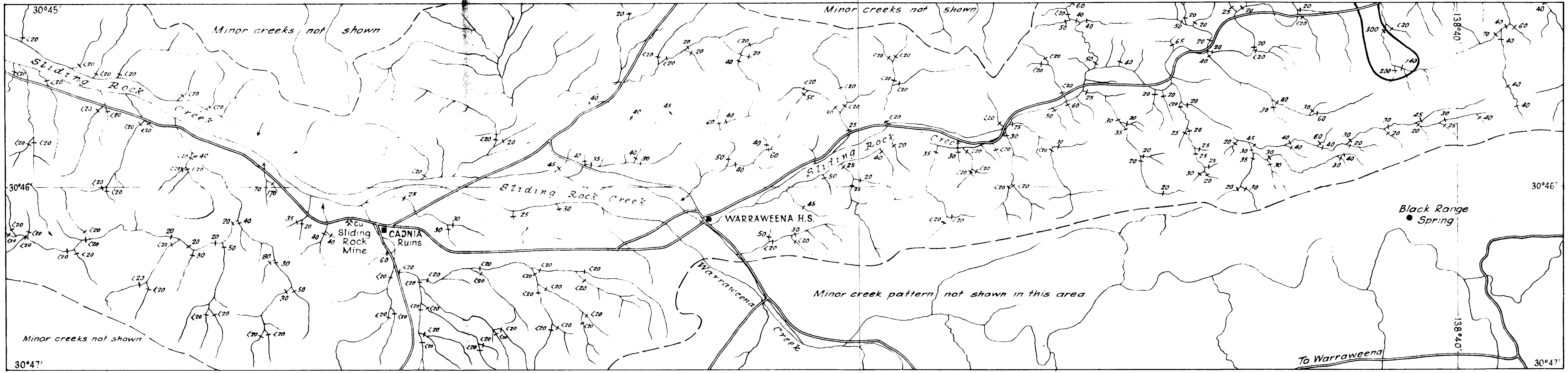
ENV 1585-1



L. G. NIXON & ASSOCIATES	
DRAWN D.S.Trail TRACED M.R.T. Revised Date	MAP SHOWING P.P.M. ZINC IN STREAM SEDIMENTS S.M.L.536 (DETAILS FROM ELECTROLYTIC ZINC CO.) VALUES OVER 100 P.P.M. OUTLINED

FIG. 8.

ENV 1585-2



Creeks

Tracks

P.p.m. lead in stream sediments

Values over 100 p.p.m outlined thus

Areas where minor creek pattern not shown

<20 Denotes "Less than 20 ppm"

SCALE 0 2000 4000 6000 8000 10000 FEET

0 0.5 1 1.5 2 MILES

Note: Topographic and Geochemical details from Electrolytic Zinc Co.

L. G. NIXON & ASSOCIATES	
DRAWN D.S. Trail	MAP SHOWING P.P.M. LEAD IN STREAM SEDIMENTS S.M.L. 536
TRACED M.R.T.	(DETAILS FROM ELECTROLYTIC ZINC Co)
Revised: Date:	VALUES OVER 100 P.P.M. OUTLINED

FIG. 9.

ENV 1585-3

ENDEAVOUR OIL COMPANY N.L.

QUARTERLY REPORT NO. 2

For the third quarter ending 21st October, 1971

S.M.L. 536 WARRAWEENA AREA

FLINDERS RANGES SOUTH AUSTRALIA

BY

L. G. NIXON

L. G. B. NIXON & ASSOCIATES

16.12.1971

ENDEAVOUR OIL COMPANY N.L.

QUARTERLY REPORT NO. 2

For the third quarter ending 21st October, 1971

S.M.L. 536 WARRAWEENA AREA

FLINDERS RANGES SOUTH AUSTRALIA

BY

L.G. NIXON
L.G.B. NIXON & ASSOCIATES

CONTENTS

ATTACHMENTS

16.12.1971

ENDEAVOUR OIL COMPANY N.L.

QUARTERLY REPORT NO. 2

For the third quarter ending 21st October, 1971

S.M.L. 536 WARRAWEENA AREA

FLINDERS RANGES SOUTH AUSTRALIA

INTRODUCTION

During the period 21st April - 21st October the company concentrated on geochemical prospecting over previously identified geochemically anomalous areas. Appended are Analytical Results with locality map and detailed grids of areas sampled.

WORK DONE

One geologist and one field assistant commenced work in the area on 30th July, 1971. These two worked together laying out grids over the areas to be sampled in detail between 1st August and 6th August. Between 6th August and 18th August two field assistants, two vehicles and two field hands were involved in geochemical sampling of the gridded area.

One geologist joined the field party between 16th August and 17th August in a supervisory capacity.

Five areas were sampled in detail. Most of the work was concerned with soil sampling but a few rock samples were also taken. Area 1 (see Fig. 10) was not sampled in detail as the area had been sampled earlier by

E.Z . Co with encouraging results. Altogether 364 soil and rock samples were collected and submitted for analysis. Results are shown on the appended analytical data sheets and on the plans of gridded areas.

SUMMARY OF RESULTS

Area 4:- This area covers the Sliding Rock Plain. Apart from a few relatively high copper and zinc values in the southeastern corner of the sampled area no significant geochemical values were found.

Area 6:- Most of this area is occupied by the Parachilna and Ajax Limestone formations. Copper and Lead values in this area were uniformly low. Zinc values were generally low except in the southeastern area where values ranged up to 750 ppm.

Area 7:- The Green Rock Mine area covers approximately 3500ft X 1800 feet. Except in the mine area, values of copper lead and zinc are not significant. Mineralisation occurs in a number of narrow north trending veins which cut across the beds at right angles. At this stage the area is not considered to be worth further investigation.

Area 8:- This area covers a diapir and part of the projected Sliding Rock Fault. Values for copper lead and zinc are generally low over the area except for relatively high copper values in the northwestern corner.

Area 9:- Values were generally low over the whole area. The grid covers a diapiric zone in which minor copper mineralisation was seen.

L.G. NIXON
L.G.B. NIXON & ASSOCIATES

16.12.1971

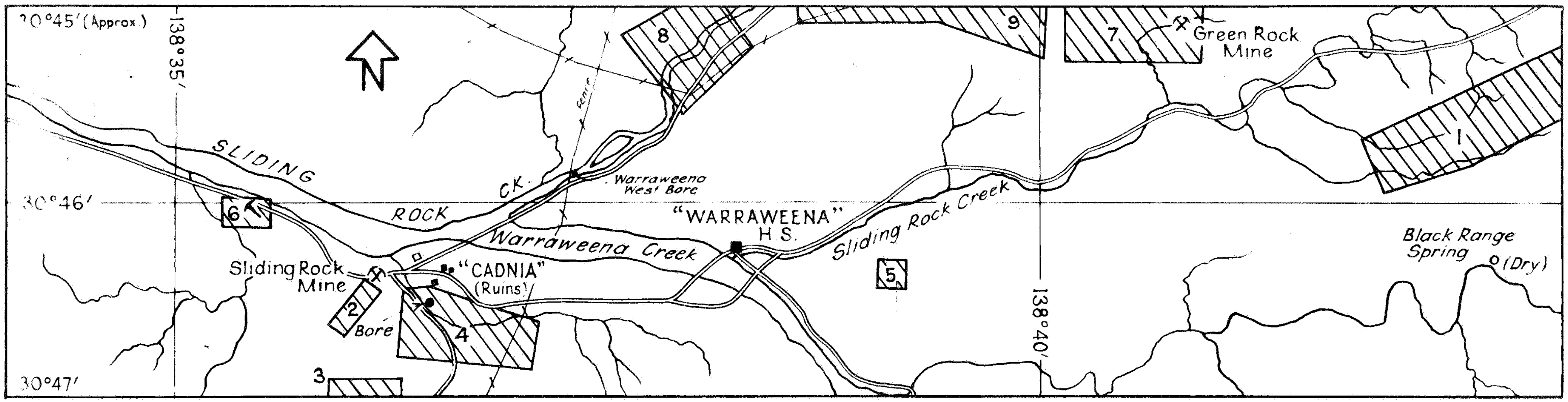


FIG. 10 AREAS RECOMMENDED FOR FURTHER INVESTIGATION IN S.M.L. 536

FIG. 10.

1. ZINC in Ajax Limestone and diapiric rocks
2. South east extension of Sliding Rock lode
3. COPPER anomalies near base of Ajax Limestone
4. ZINC at higher levels in Ajax Limestone
5. COPPER and ZINC bearing ironstone on Parachilna Formation
6. ZINC anomaly on Ajax Limestone
7. COPPER around Green Rock Mine
8. Diapiric rocks with COPPER prospect
9. Diapiric rocks or sheared Bunyeroo Formation

Prospect Mine Track Creeks

Areas for further investigation

SCALE 0 1 2 MILES

Note: Topographic detail from S.A. Dept. of Mines' 60 Chain' Cadnia base map

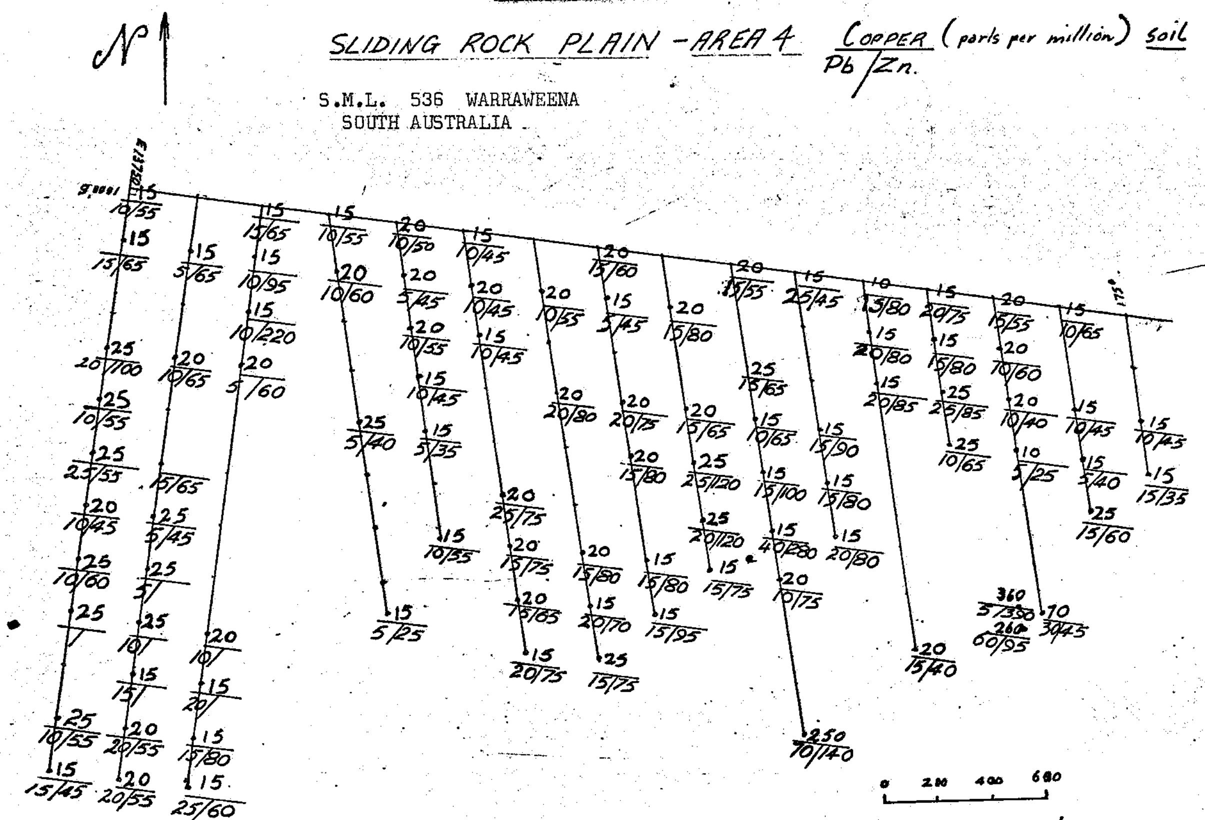
L. G. NIXON & ASSOCIATES.	
Drawn: D.S.Trail Traced: M.R.T Revised Date	AREAS RECOMMENDED FOR FURTHER INVESTIGATION IN S.M.L. 536

FIG. 10.

Endeavour Oil Company N.L.

SLIDING ROCK PLAIN - AREA 4 Copper (parts per million) soil assay results Pb/Zn.

S.M.L. 536 WARRAWEENA
SOUTH AUSTRALIA



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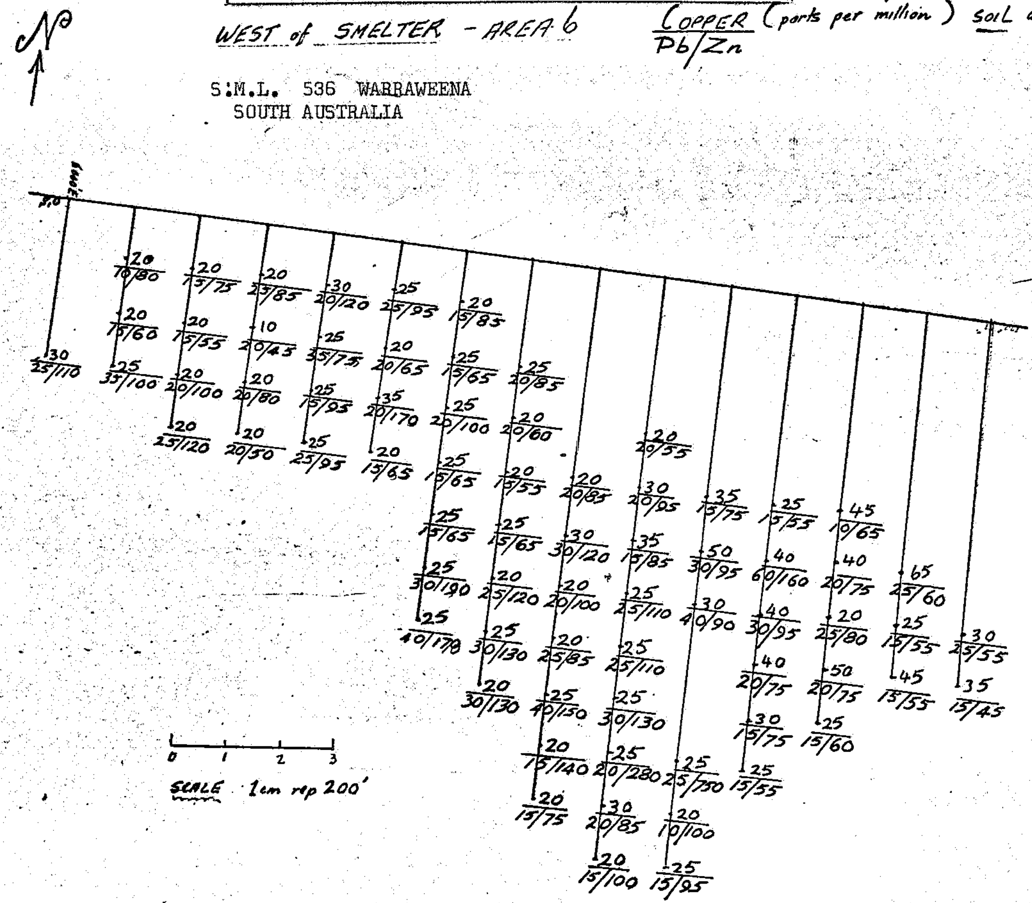
Endeavour Oil Company N.L.

0 63

WEST of SMELTER - AREA 6

COPPER (parts per million) soil assay results
Pb/Zn

S.M.L. 536 WARRAWEENA
SOUTH AUSTRALIA



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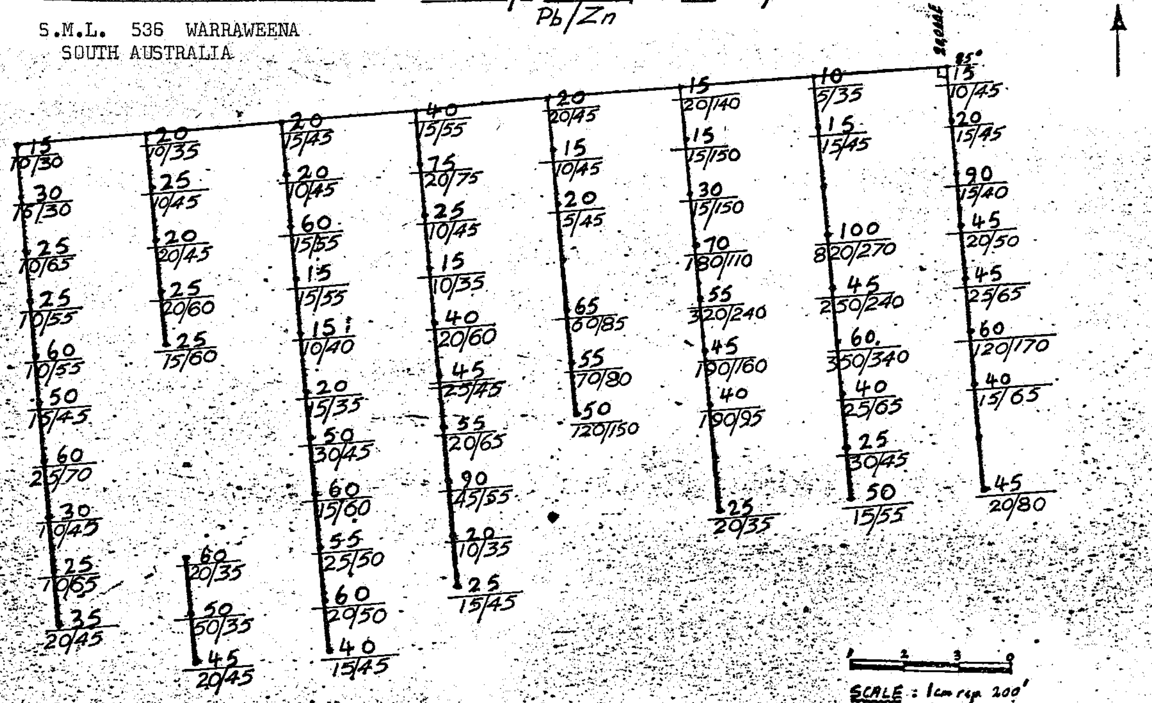
GREEN ROCK MINE AREA - AREA 7 - $\frac{Cu\ (p.p.m.)}{Pb/Zn}$ soil assay results

S.M.L. 536 WARRAWEENA
SOUTH AUSTRALIA

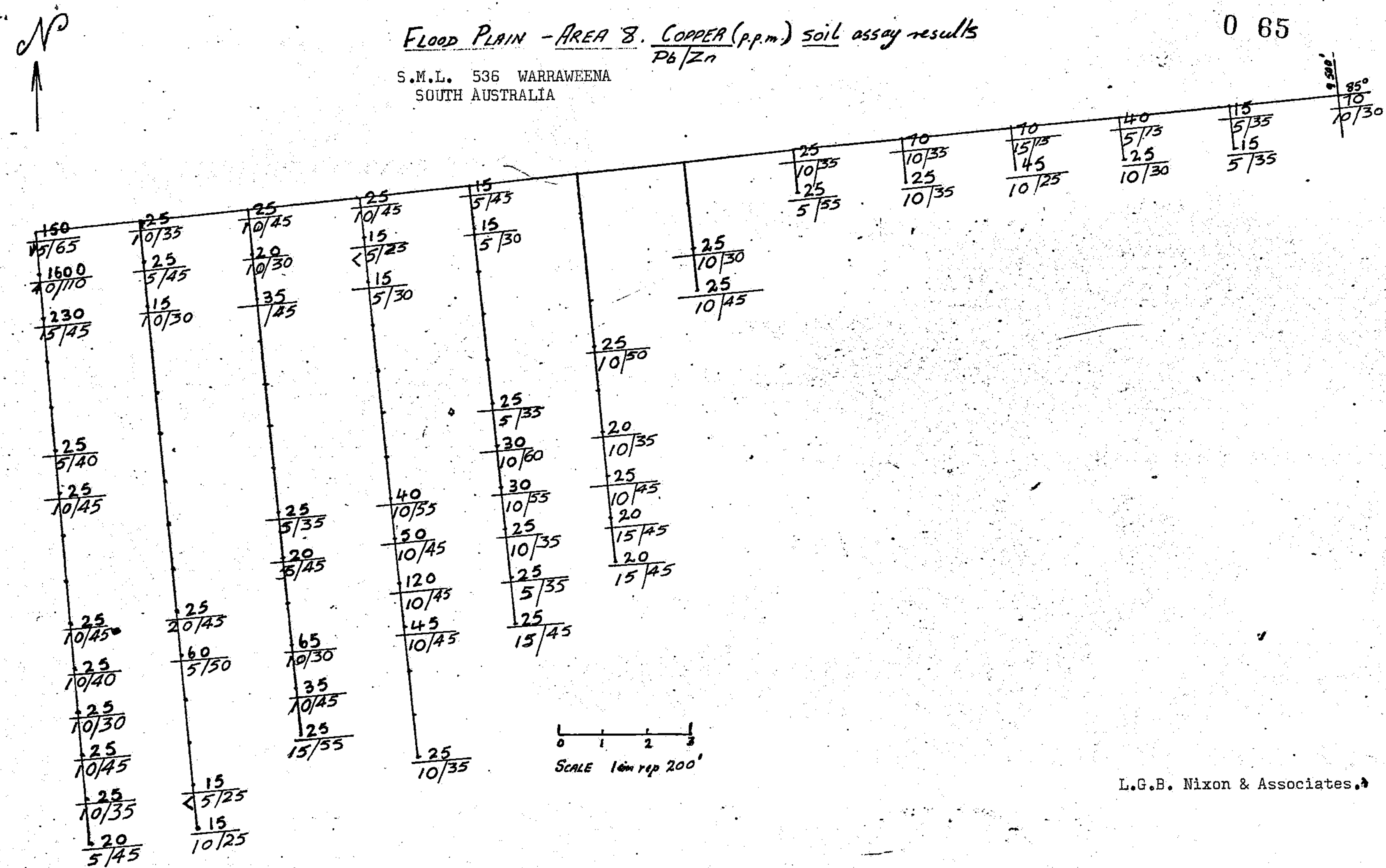


L.G.B. Nixon & Associates.

0 65

FLOOD PLAIN - AREA 8. COPPER (p.p.m.) / Pb/Zn soil assay results

S.M.L. 536 WARRAWEENA
SOUTH AUSTRALIA



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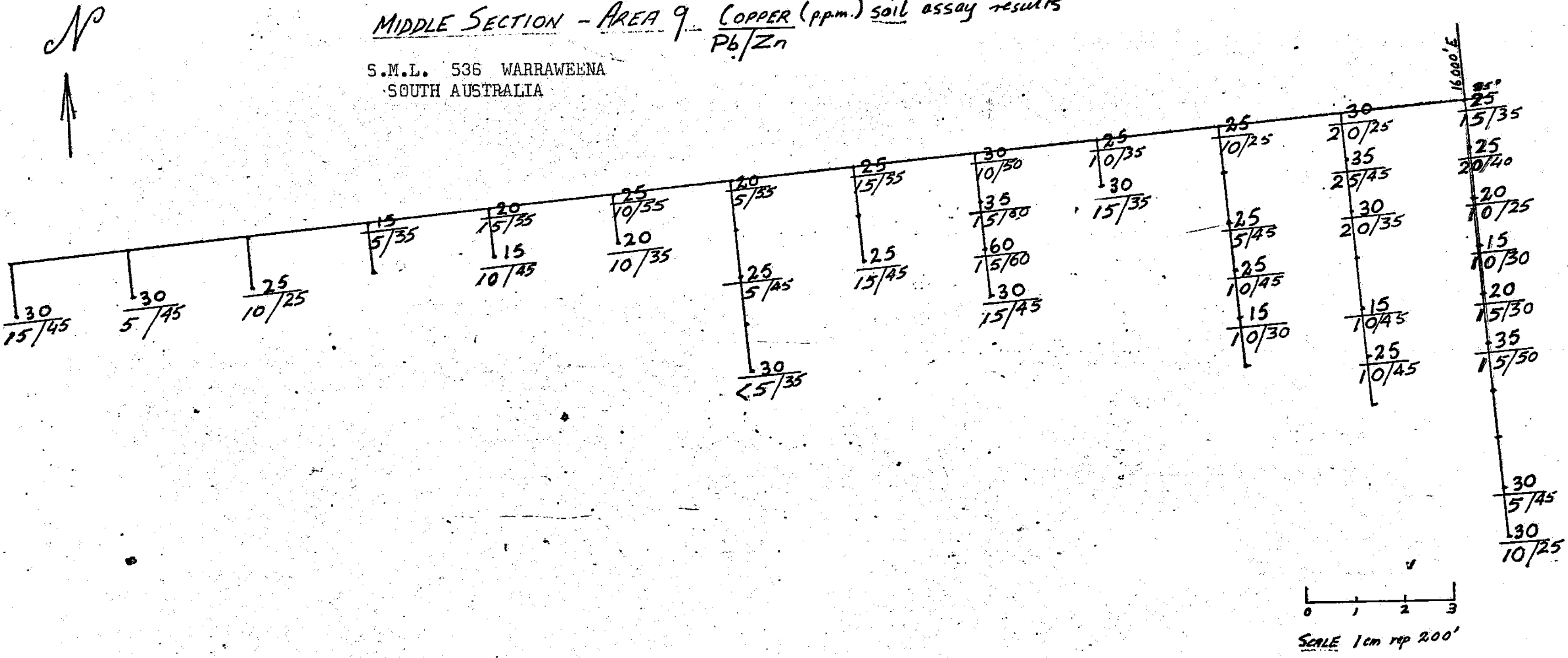
Endeavour Oil Company N.L.

MIDDLE SECTION - AREA 9 - Copper (ppm) / Pb/Zn soil assay results

S.M.L. 536 WARRAWEENA
SOUTH AUSTRALIA



L.G.B. Nixon & Associates.

0 67

AN3/495/2/0 - 933/72

7 September 1971

The Manager
Endeavour Oil Co N.L.
232 Victoria Parade
EAST MELBOURNE Vic 3002

REPORT AN933/72

YOUR REFERENCE: Application dated 19/8/71

MATERIAL: Rock and Soil

IDENTIFICATION: As listed

DATE RECEIVED: 19/8/71

Enquiries quoting AN933/72 to Officer in Charge please.

Analysis by: A.E. Francis

Officer in Charge, Analytical Section: A.B. Timms

for F.P. Hartley
Director

jw

c.c. Mr L.G. Nixon
85 Highland Drive
BELLEVUE HEIGHTS SA 5050

FORM 6 JOB 933/72 AMDEL ANALYTICAL SERVICE BATCH NO. 0 68

TT	Sample No.		Cu		Pb		Zn		
1	PW 1	Rock	400		160		450		
2	2	"	65		65		500		
3	3	"	35		110		65		
4	4	"	140		5		120		
5	5	"	140		140		350		
6	STD 52								
7	6	"	110		40		140		
8	PW 7	"	170		5		190		
9	EZ Wrw 1	"	15		50		110		
10	2	"	1000		15		1900		
11	Wrwr 3	"	5		15		15		
12	EZ W4	"	190		10		80		
13	GM 1 X	"	75		15		140		
14	G/170E/3S		10		10		60		
15	G/170E/9S		5		5		15		
16	G/165E/0S		10		10		75		
17	G/165E/14S		60		<5		45		
18	137.5/20	"	110		10		120		
19	140/20 Rock		45		5		830		
20	GM 1 X								

FORM 6 JOB 933/72 AMDEL ANALYTICAL SERVICE BATCH NO. 2 69

TT	Sample No.		Cu		Pb		Zn		
1	140/30	ROCK	20		15		45		
2	160/28A	"	1350		80		390		
3	28B	"	470		15		780		
4	164.5/10X	"	15		5		180		
5	167.5/16	"	35		5		620		
6	168.5/10	"	15		5		930		
7	170/22A	ROCK	110		40		95		
8	60/6	SOIL	30		25		110		
9	6.25/2	"	20		10		80		
10	6.25/4	"	20		15		60		
11	6.25/6	"	25		35		100		
12	6.50/2	"	20		15		75		
13	4	"	20		15		55		
14	6	"	20		20		100		
15	8	"	20		25		120		
16	STD52	"							
17	6.75/2	"	20		25		85		
18	4	"	10		20		45		
19	6.75/6	SOIL	20		20		80		
20	164.5/10X								

0 70

FORM 6 JOB 933/72 AMDEL ANALYTICAL SERVICE BATCH NO. 3

TT	Sample No.		Cu		Pb		Zn		
1	6.75/8	SOIL	20		20		50		
2	70/2		30		20		120		
3	4		25		35		75		
4	6		25		15		95		
5	8		25		25		95		
6	7.25/2		25		25		95		
7	4		20		20		65		
8	6		35		20		170		
9	8		20		15		65		
10	STD 52								
11	7.50/2		20		15		85		
12	4		25		15		65		
13	6		25		20		100		
14	8		25		15		65		
15	10		25		15		65		
16	12X		25		30		190		
17	14		25		40		170		
18	7.75/4		25		20		85		
19	7.75/6		20		20		60		
20	7.50/12X								

FORM 6 JOB 933/72 AMDEL ANALYTICAL SERVICE BATCH NO. 40 71

TT	Sample No.		Cu		Pb		Zn		
1	7.75/8		20		15		55		
2	10		25		15		65		
3	12		20		25		120		
4	14		25		30		130		
5	16		20		30		130		
6	80/8 X		20		20		85		
7	10		30		30		120		
8	12		20		20		100		
9	14		20		25		85		
10	16		25		40		150		
11	18		20		15		140		
12	20		20		15		75		
13	8.25/6		20		20		55		
14	8		30		20		95		
15	10		35		15		85		
16	12		25		25		110		
17	14		25		25		110		
18	STD52								
19	8.25/16		25		30		130		
20	80/8 X								

FORM 6 JOB 933/72 AMDEL ANALYTICAL SERVICE BATCH NO 82

TT	Sample No.		Cu		Pb		Zn	
1	8.25/18		25		20		280	
2	20		30		20		85	
3	22		20		15		100	
4	8.50/8		35		15		75	
5	10		50		30		95	
6	12		30		40		90	
7	18		25		25		750	
8	20		20		10		100	
9	STD52							
10	22		25		15		95	
11	8.75/8		25		15		55	
12	10		40		60		160	
13	12		40		30		95	
14	14		40		20		75	
15	16		30		15		75	
16	18		25		15		55	
17	90/8 X		45		10		65	
18	10		40		20		75	
19	90/12		20		25		80	
20	90/8x							

FORM 6 JOB 933/72

AMDEL ANALYTICAL SERVICE

BATCH NO. 6 0 73

TT	Sample No.		Cu		Pb		Zn		
1	90/14		50		20		75		
2	16 X		25		15		60		
3	9·25/10		65		25		60		
4	12		25		15		55		
5	14		45		15		55		
6	9·50/12		30		25		55		
7	14		35		15		45		
8	142·5/10		15		15		65		
9	12		15		10		95		
10	14		15		10		220		
11	16		20		5		60		
12	26		70		10		65		
13	STD52								
14	28		15		20		65		
15	30		15		15		80		
16	32		15		25		60		
17	145/10		15		10		55		
18	12		20		10		60		
19	145/18 NOT REC'D		—		—		—		
20	90/16x								

FORM 6 JOB 993/72 AMDEL ANALYTICAL SERVICE BATCH NO. 7

TT	Sample No.		Cu		Pb		Zn		
1	145/22 NOT	REC'D	—		—		—		
2	25 "	"	—		—		—		
3	147.5/10		20		10		50		
4	STD 52								
5	12		20		5		45		
6	14		20		10		55		
7	16		15		10		45		
8	18		15		5		35		
9	22		15		10		55		
10	150/10		15		10		45		
11	12		20		10		45		
12	14X		15		10		45		
13	20		20		25		75		
14	22		20		15		75		
15	24		20		15		65		
16	26		15		20		75		
17	152.5/10 NOT	REC'D	—		—		—		
18	152.5/12		20		10		55		
19	152.5/16		20		20		80		
20	150/14X								

FORM 6 JOB 933/72

AMDEL ANALYTICAL SERVICE

BATCH NO. 0 75

TT	Sample No.		Cu		Pb		Zn		
1	152.5/22		20		15		80		
2	24		15		20		70		
3	26		25		15		75		
4	155/10		20		15		60		
5	12		15		5		45		
6	16		20		20		75		
7	18		20		15		80		
8	22 X		15		15		80		
9	24		15		15		95		
10	157.5/10	NOT REC'D	—		—		—		
11	12		20		15		80		
12	16		20		15		65		
13	18		25		25		120		
14	STD 52								
15	20		25		20		120		
16	22		15		15		75		
17	160/10		20		15		55		
18	14		25		15		65		
19	160/16		15		10		65		
20	155/22x								

FORM 6 JQB 933/72 AMDEL ANALYTICAL SERVICE BATCH NO. 90 76

TT	Sample No.		Cu	Pb	Zn
1	160/18		15	15	100
2	STD S2				
3	20		15	40	280
4	22		20	10	75
5	162.5/10		15	25	45
6	16		15	15	90
7	18		15	15	80
8	20		15	20	80
9	162.5/22	Not Rec'd	—	—	—
10	165/10		10	15	80
11	12		15	20	80
12	14		15	20	85
13	24		20	15	40
14	167.5/10		15	20	75
15	12		15	15	60
16	14		25	25	85
17	16X		25	10	65
18	170/10		20	15	55
19	170/12		20	10	60
20	167.5/16X				

FORM 6 JOB 933/72 AMDEL ANALYTICAL SERVICE BATCH NO. 10 77

TT	Sample No.		Cu		Pb		Zn		
1	170/14		20		10		40		
2	16 X		10		5		25		
3	22		70		30		45		
4	22A		360		5		390		
5	22B		260		60		95		
6	172.5/10		15		10		65		
7	14		15		10		45		
8	16		15		5		40		
9	18		25		15		60		
10	175/10 NOT REC'D		—		—		—		
11	14		15		10		45		
12	16		15		15		35		
13	G/195E/0S		10		5		35		
14	STD52								
15	2s		15		15		45		
16	6s		100		820		270		
17	8s		45		250		240		
18	10s		60		350		340		
19	G/195/12s		40		25		65		
20	170/16x								

FORM 6 JOB 933/72 AMDEL ANALYTICAL SERVICE BATCH NO. A 78

TT	Sample No.		Cu		Pb		Zn		
1	G/195E/14S		25		30		45		
2	16S		50		15		55		
3	200E/0S		15		10		45		
4	2S		20		15		45		
5	4		90		15		40		
6	6		45		20		50		
7	STD 52								
8	8		45		25		65		
9	10		60		120		170		
10	200E/12S A		40		15		65	Two 200E/12S	
11	200E/12S B		20		20		35	Samples Received Marked A & B	
12	16S		45		20		80		
13	190E/0S		15		20		140		
14	2		15		15		150		
15	4		30		15		150		
16	6 x		70		180		110		
17	8		55		320		240		
18	10		45		190		160		
19	G/190E/12S		40		190		95		
20	190E/6S								
	G/200E/14S -	Not Received							

FORM 6 JOB 933/72

AMDEL ANALYTICAL SERVICE

BATCH NO. 12

~~0~~ 79

TT	Sample No.		Cu		Pb		Zn		
1	G/190E/16S		25		20		35		
2	185/0S		20		20		45		
3	2		15		10		45		
4	4X		20		5		45		
5	8		65		60		85		
6	10		55		70		80		
7	12		50		120		150		
8	180/0S		40		15		55		
9	2		75		20		75		
10	4		25		10		45		
11	6		15		10		35		
12	8		40		20		60		
13	10		45		25		45		
14	STD 52								
15	12		55		20		65		
16	14		90		45		55		
17	16		20		10		35		
18	18		25		15		45		
19	G/175E/0S		20		15		45		
20	185/4SX								

FORM 6 JOB 933/72 AMDEL ANALYTICAL SERVICE BATCH NO. 10 80

TT	Sample No.		Cu		Pb		Zn		
1	G/175E/2S		20		10		45		
2	4		60		15		55		
3	STD S2								
4	6		15		15		55		
5	8		15		10		40		
6	10		20		15		35		
7	12		50		30		45		
8	14		60		15		60		
9	16		55		25		50		
10	18		60		20		50		
11	20		40		15		45		
12	G/170E/0S		20		10		35		
13	2		25		10		45		
14	4		20		20		45		
15	6X		25		20		60		
16	8		25		15		60		
17	16		60		20		35		
18	18		50		50		35		
19	170E/20S		45		20		45		
20	170E/6S								

FORM 6 JOB 933/72 AMDEL ANALYTICAL SERVICE BATCH NO. 0 81 14

TT	Sample No.		Cu		Pb		Zn		
1	G/165E/0S		15		10		30		
2	2		30		15		30		
3	4X		25		10		65		
4	6		25		10		55		
5	8		60		10		55		
6	10		50		15		45		
7	12		60		25		70		
8	14		30		10		45		
9	16		25		10		65		
10	18		35		20		45		
11	G/165E/20	NOT REC'D	—		—		—		
12	G/160E/0S		25		15		35		
13	2		25		20		40		
14	4		20		10		25		
15	6		15		10		30		
16	8		20		15		30		
17	10		35		15		50		
18	STD S2								
19	G/160E/16S		30		5		45		
20	165E/4S								

FORM 6 JOB 933/72 AMDEL ANALYTICAL SERVICE BATCH NO. 15

TT	Sample No.		Cu		Pb		Zn		
1	G/160E/18S		30		10		25		
2	155E/0S		30		20		25		
3	2		35		25		45		
4	4		30		20		35		
5	8		15		10		45		
6	10		25		10		45		
7	150E/0S		25		10		25		
8	STD 52								
9	4		25		5		45		
10	6		25		10		45		
11	8		15		10		30		
12	145E/0S		25		10		35		
13	2S		30		15		35		
14	140E/0S		30		10		50		
15	2 X		35		15		60		
16	4		60		15		60		
17	6		30		15		45		
18	135E/0S		25		15		55		
19	135E/4S		25		15		45		
20	140E/2S X								

FORM 6 JOB 933/72 AMDEL ANALYTICAL SERVICE BATCH NO. 16 0 83

TT	Sample No.		Cu		Pb		Zn		
1	G/130E/0S		20		5		55		
2	4SX		25		5		45		
3	8S		30		<5		35		
4	125E/0S		25		10		55		
5	2S		20		10		35		
6	120E/0S		20		15		55		
7	2S		15		10		45		
8	115E/0S		15		5		35		
9	110E/2S		25		10		25		
10	105E/2S		30		5		45		
11	100E/2S		30		15		45		
12	95E/0S		70		10		30		
13	90E/0S		15		5		35		
14	2S		15		5		35		
15	85E/0S		40		5		15		
16	STD 52								
17	2S		25		10		30		
18	80E/0S		70		15		15		
19	G/80E/2S		45		10		25		
20	130E/4SX								

0 84

FORM 6 JOB 933/72 AMDEL ANALYTICAL SERVICE BATCH NO. 17

TT	Sample No.		Cu		Pb		Zn		
1	G 75E/0S		70		10		35		
2	2		25		10		35		
3	70E/0S		25		5		35		
4	2S		25		10		55		
5	65E/4S		25		10		30		
6	6S		25		10		45		
7	STD 52								
8	60E/8S		25		10		50		
9	12S		20		10		35		
10	14S		25		10		45		
11	16S		20		15		45		
12	18S		20		15		45		
13	55E/0S		15		5		45		
14	2S		15		5		30		
15	10S		25		5		35		
16	12S		30		10		60		
17	14S X		30		10		55		
18	16S		25		10		35		
19	55E/18S		25		5		35		
20	55E/14S X								

FORM 6 JOB 933/72 AMDEL ANALYTICAL SERVICE 0 85

BATCH NO. /18

TT	Sample No.		Cu		Pb		Zn		
1	G55E-20S		25		15		45		
2	50E-05S		25		10		45		
3	50E-25		15		<5		25		
4	50E-45		15		5		30		
5	50E-145		40		10		55		
6	50E-165		50		10		45		
7	50E-185		120		10		45		
8	50E-205		45		10		45		
9	50E-265		25		10		35		
10	45E-05		25		10		45		
11	25		20		10		30		
12	145		25		5		35		
13	165		20		5		45		
14	205		65		10		30		
15	235		35		10		45		
16	Sio 52								
17	45E 245		25		15		55		
18	40E 05		25		10		35		
19	G40E 25		25		5		45		
20	50E-05*								

0 86

FORM 6. JOB 432/72 AMDEL ANALYTICAL SERVICE BATCH NO. 19

TT	Sample No.		Cu		Pb		Zn	
1	40E – 4S		15		10		30	
2	18S		25		20		45	
3	20S		60		5		50	
4	26S		15		<5		25	
5	40E – 28S		15		10		25	
6	35E – 0S ×		150		15		65	
7	2S		1600		40		110	
8	4S		230		15		45	
9	10S		25		5		40	
10	12S		25		10		45	
11	18S		25		10		45	
12	20S		25		10		40	
13	22S		25		10		30	
14	24S		25		10		45	
15	26S		25		10		35	
16	35E – 28S		20		5		45	
17	Str 5A							
18	137.5 – 16	NOT LISTED	25		20		100	
19	145 – 2	NOT LISTED	25		10		55	
20	35E – 0S ×							

0 87

FORM 6 JOB 9/3/72 AMDEL ANALYTICAL SERVICE BATCH NO. 20

TT	Sample No.		Cu		Pb		Zn		
1	137.5 – 32	NOT LISTED	15		15		45		
2	137.5 – 18	" "	25		10		55		
3	140 – 32	" "	20		20		55		
4	140 – 12	" "	15		5		65		
5	140 – 16	" "	20		10		65		
6	Sm Str								
7	140 – 22	" "	25		5		45		
8	137.5 – 30	" "	20		10		55		
9	160 – 28	" "	250		70		140		
10	G 455 – 45	" "	35		5		45		
11	140 – 26	" "	25		10		55		
12	145 – 15	" "	15		<5		25		
13	140 – 28	" "	15		15		50		
14	137.5 – 20 x	" "	25		25		55		
15	137.5 – 22	" "	20		10		45		
16	140 – 24	" "	25		5		60		
17	137.5 – 24	" "	25		10		60		
18	137.5 – 10	" "	15		10		55		
19	145 – 8	NOT LISTED	25		5		40		
20	137.5 – 20 x	" "							

FORM JOB 133/72 AMDEL ANALYTICAL SERVICE BATCH NO. 21

TT	Sample No.		Cu		Pb		Zn		
1	131.5 – 12	NOT LISTED	15		15		65		
2	167.5 – 24	" "	110		35		65		
3	140 – 20	STREAM SEDIMENT NOT LISTED	25		15		65		
4	S 10 52								
5	140 – 30	STREAM SEDIMENT NOT LISTED	25		20		55		
6	BLANK		—		—		—		
7									
8									
9									
10									
11									
12									
13									
14									
15									
16								Code C1	
17									
18								Results in ppm	
19									
20									

ENDEAVOUR OIL COMPANY N.L.

QUARTERLY REPORT NO.3

For the fourth quarter ending 21st JANUARY 1972 ~~December, 1971~~

S.M.L. 536, WARRAWEENA AREA

FLINDERS RANGES, SOUTH AUSTRALIA

BY

L.G. NIXON

Geophysics by

G.JENKE.

0 90

ENDEAVOUR OIL COMPANY N.L.

QUARTERLY REPORT NO.3

For the fourth quarter ending 21st JANUARY 1972 ~~December, 1971~~

S.M.L. 536, WARRAWEENA AREA

FLINDERS RANGES, SOUTH AUSTRALIA

BY

L. G. NIXON

CONTENTS

ATTACHMENTS

i) FIG. 1. Locality plan of areas investigated using VFL-EM

ii) TWENTY SIX SHEETS OF GEOPHYSICAL PROFILES, CONTOURS AND PLACES.

24th January, 1972

ENDEAVOUR OIL COMPANY N.L.

QUARTERLY REPORT NO.3

For the fourth quarter ending 21st ~~December, 1971~~ January 1972

S.M.L. 536, WARRAWEENA AREA

FLINDERS RANGES, SOUTH AUSTRALIA

INTRODUCTION

During the period under review the company carried out a programme of geophysical exploration which was completed over areas 1, 2, 4, 6, 8 and 9. (See Fig. 1).

The instrument used was an EM16 Electromagnetic unit manufactured by GEONICS LIMITED of Canada.

The V.L.F. transmitting station used was N.W. Cape in Western Australia.

WORK DONE

One geophysicist and one field assistant were employed on the project in the field between 8th December, 1971 and 16th December, 1971. In addition one Geologist was engaged on the project for 3 days.

One geophysicist was employed in compilation of the data and report preparation between 18th December, 1971 and 10th January, 1972.

GEOPHYSICAL RESULTS

A VLF-EM survey was conducted in the Sliding Rock Mine area over a period of six days, using the EM16 VLF electromagnetic unit, manufactured by Geonics Limited, Canada. The only station received with sufficient strength to be used was North West Cape, Australia.

The instrument is designed to measure the in-phase and out of phase or quadrature components of the secondary field due to conductors within the ground, relative to the primary field. The measured values were found to be accurate to ± 1% in quiet areas and ± 3% in anomalous areas.

METHOD OF SURVEY

The spacings of the traverses varied from 200 to 1000 feet, and the reading interval was either 50 or 100 feet.

Measurements were taken of the in-phase and quadrature components of the secondary field.

The instrument was orientated perpendicular to the direction to N.W. Cape and faced north, unless otherwise indicated.

METHOD OF INTERPRETATION

Interpretation was made by a visual examination of the traverse profiles, and by filtering the in-phase data by a method proposed by Fraser (Geophysics, 1969).

The filter includes a difference operator to transform zero crossings into peaks, and a low-pass smoothing operator to reduce noise. Thus the data becomes less noisy and contourable.

Fraser recommends a reading interval of 50 feet rather than 100 feet, since anomalies from near-surface conductors will have poorly defined waveforms for a 100 foot station interval, and will alias as deeper conductors. However, this may be overcome by an examination of the traverse profile. Surface conductors are separated from those at depth by observing the negative quadrature signals compared to the usually positive or zero ones (quadrature follows the inphase polarity) from surface targets. Weak conductors in a fault or shear zone give a positive quadrature whereas better conductors produce a negative response.

An indication of the depth of the target is the horizontal distance between the maximum positive and negative readings, which is about the same as the actual depth from the ground surface to the centre of the effective area of the conductive body. This point is not the centre of the body, but somewhat closer to the upper edge.

RESULTS

BLACK RANGE SPRING AREA 1

The in-phase component has been filtered and a contour map produced. The anomalies trend approximately parallel to the grid baseline.

For the anomalies at 994N from 955E to 990E and at 992N from 1000E to 1010E, the quadrature is zero or positive indicating either that the source is shallow, or of a medium to poor conductivity.

On the other hand, the anomaly ranging from 1000N to 996N between 985E and 1010E shows a zero or negative quadrature on its profiles, indicating a deeper source or a better conductor.

From the distance between maximum positive and negative values on the profiles, depths to the conductors are of the order of 200 to 300 feet for the former anomalies, and 200 feet for the latter. These figures are by no means accurate.

AREA 2 (see map)

Relation of quadrature to inphase polarity.

	Position of anomaly	Quadrature
Line 105E	12 - 155 (telephone line ?)	negative
	17 - 205	negative
	27 - 315	zero
	36 - 315 (fault)	zero
	45 - 505	positive
Line 115E	9 - 115 (telephone line, fault)	negative
	22 - 285	positive
	31 - 335	positive
	37 - 415	positive
	48 - 505	negative
Line 125E	3 - 65	zero
	11 - 135 (telephone line ?)	negative
	19 - 215	zero
	29 - 325	negative
	39 - 41 S	negative
	44 - 46 S	negative

The negatives responses are usually of more interest than the positive or zero ones.

FAULT LINE GRID   AREA 2

The grid baseline was layed parallel to the fault as marked on the map of Area 2, using station 105 on line 115E as a reference point.

For all traverses from 2500 SW to 1000 SW crossing the anomaly in that region, the quadrature is negative or zero with respect to the in-phase component. This suggests that moderate conductors may be present.

The anomaly on lines 500 SW, 0, and 500 NE has its largest values near the telephone line. The negative quadrature, suggesting a good conductor, also suggests that the anomaly may be wholly or partly due to it. The presence of iron pipes in the vicinity of the mine may have influenced readings in that region.

On the north-west ends of 1500 NE and 2000 NE, the anomaly near the Pound quartzite has a positive quadrature with respect to the in-phase component, indicating shallow or poor conductors.

AREA 4

In this area, for which the profiles have not been drawn, anomalies are relatively small, and because of the wide traverse spacing, they are not easily correlated from one line to another. Quadratures are positive or zero for all anomalies.

AREA 6

As for area 4, no profiles have been drawn and the anomalies are difficult to contour. Some of the largest anomalies occur along the telephone line, and the quadratures for anomalies on or near it are strongly negative because of its high conductivity.

The remaining anomalies have positive or zero quadratures except for those on 6000E, 6500E, and 8000E.

AREA 8 AND AREA 9 (see map)

Grid 1

The quadrature is negative indicating a moderate conductor, and the order of depth in 50 to 150 feet.

Line 2

The anomaly at the southeast and is covered by Grid 3 which shows positive quadrature indicating a poor conductor.

Line 4

The anomaly at 0 is covered by Grid 5 which shows a variable quadrature.

Line 6

There are no significant anomalies.

Line 7

An anomaly with negative quadrature appears at 500N.

0 97

L.G. NIXON
L.G.B. NIXON & ASSOCIATES

24.1.1972

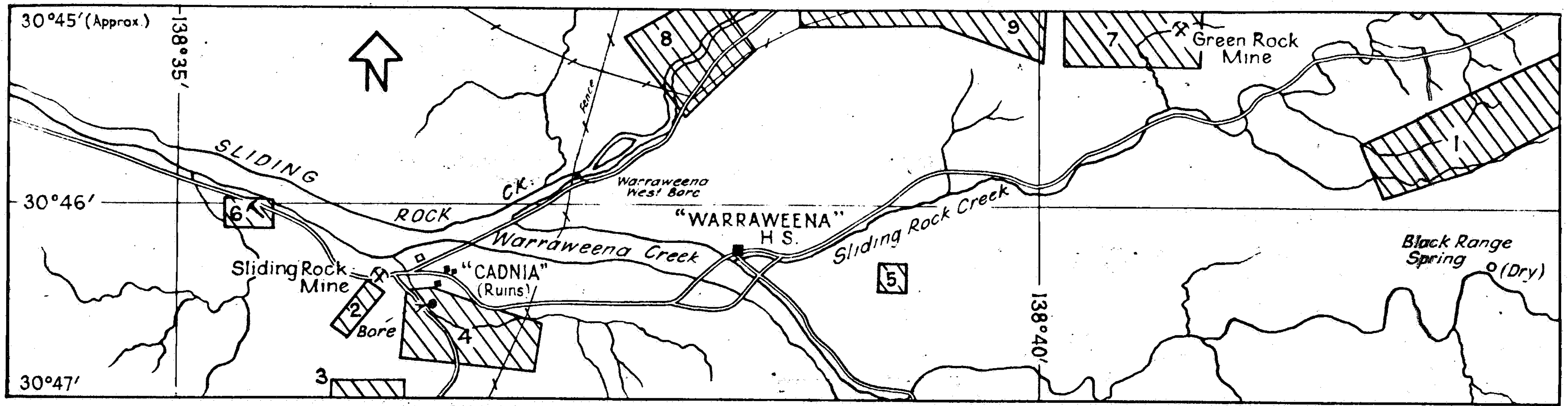


FIG. I LOCALITY PLAN OF AREAS INVESTIGATED USING V.L.P. - E.M. IN S.M.L. 436. WARRAWEENA S. AUST.

36

FIG. I.

1. ZINC in Ajax Limestone and diapiric rocks
2. South-east extension of Sliding Rock lode
3. COPPER anomalies near base of Ajax Limestone
4. ZINC at higher levels in Ajax Limestone
5. COPPER and ZINC bearing ironstone on Parachilna Formation
6. ZINC anomaly on Ajax Limestone
7. COPPER around Green Rock Mine
8. Diapiric rocks with COPPER prospect
9. Diapiric rocks or sheared Bunyeroo Formation

Prospect Mine Track Creeks

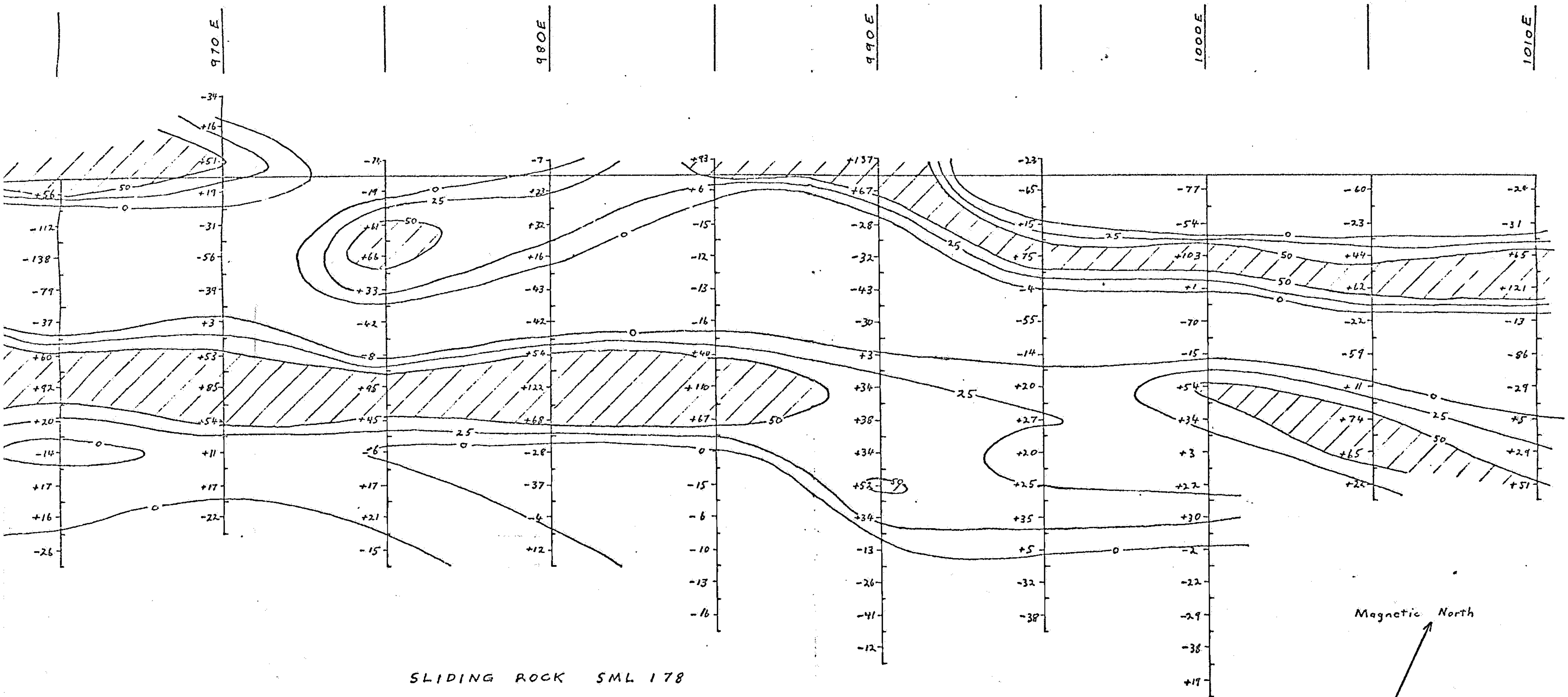
Areas for further investigation

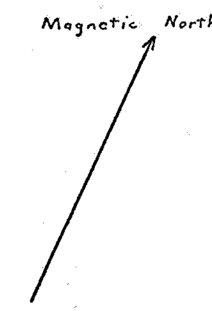
SCALE 0 1 2 MILES

Note: Topographic detail from S.A. Dept. of Mines '60 Chain' Cadnia base map

L.G. NIXON & ASSOCIATES.	
Drawn: D.S.Trail	LOCALITY PLAN OF AREAS INVESTIGATED USING V.L.P. - E.M. IN S.M.L. 436. WARRAWEENA S. AUST.
Traced: M.R.T	
Revised Date	

FIG. I



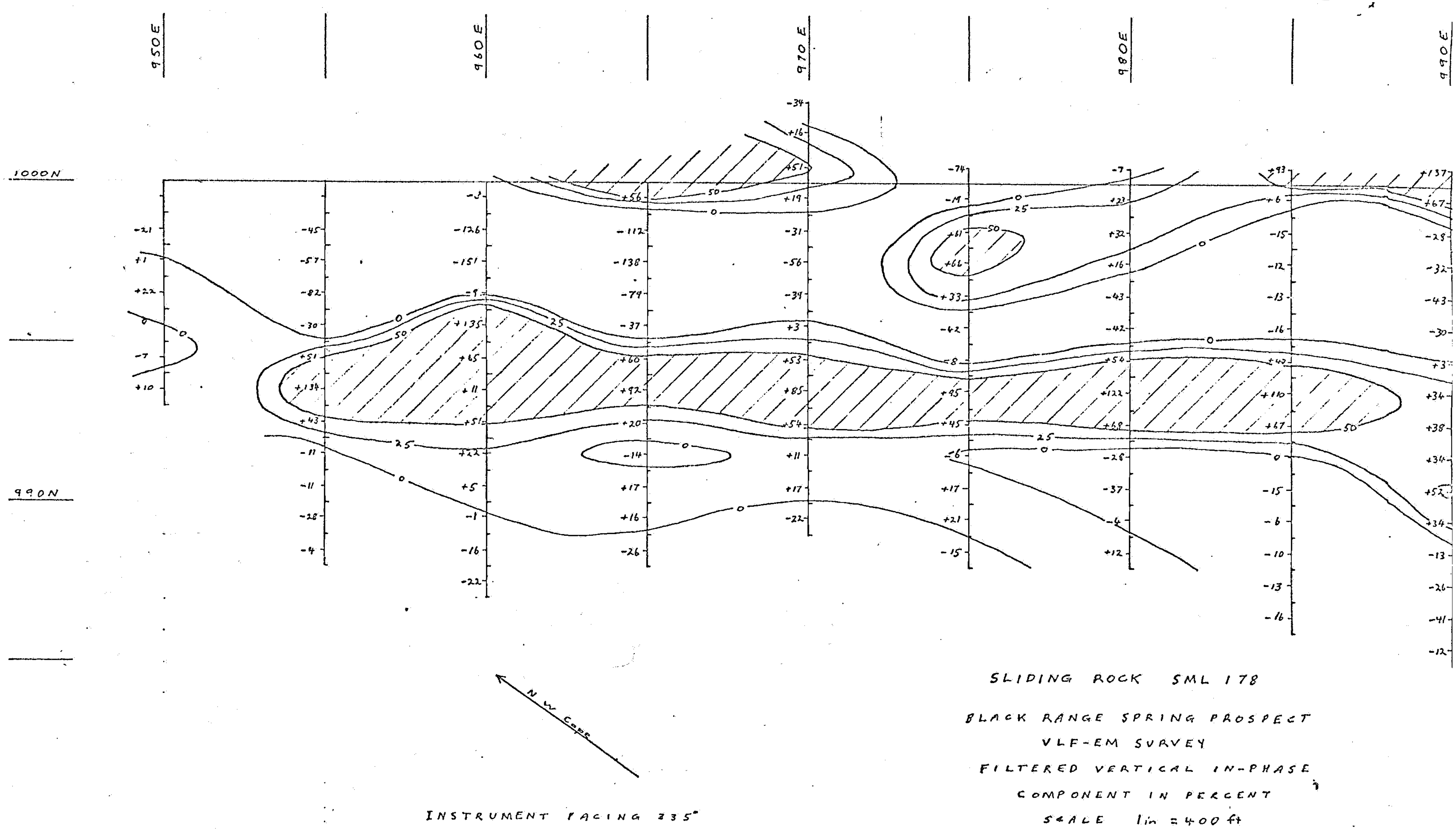


SLIDING ROCK SML 178

BLACK RANGE SPRING PROSPECT
VLF-EM SURVEY
FILTERED VERTICAL IN-PHASE
COMPONENT IN PERCENT
SCALE 1in = 400 ft

DECEMBER 1971

CING 335°

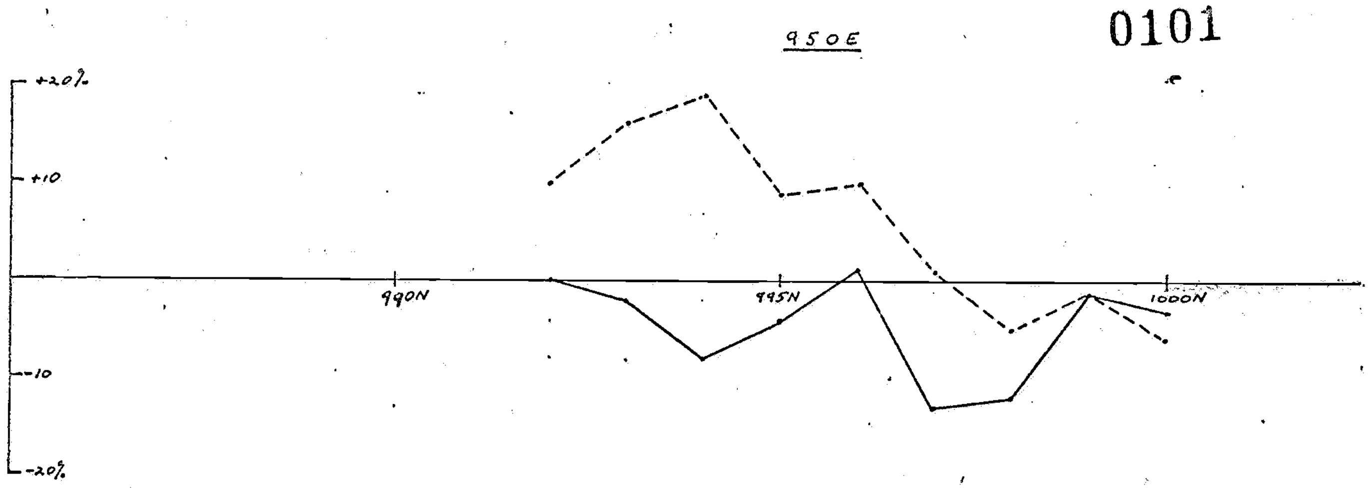


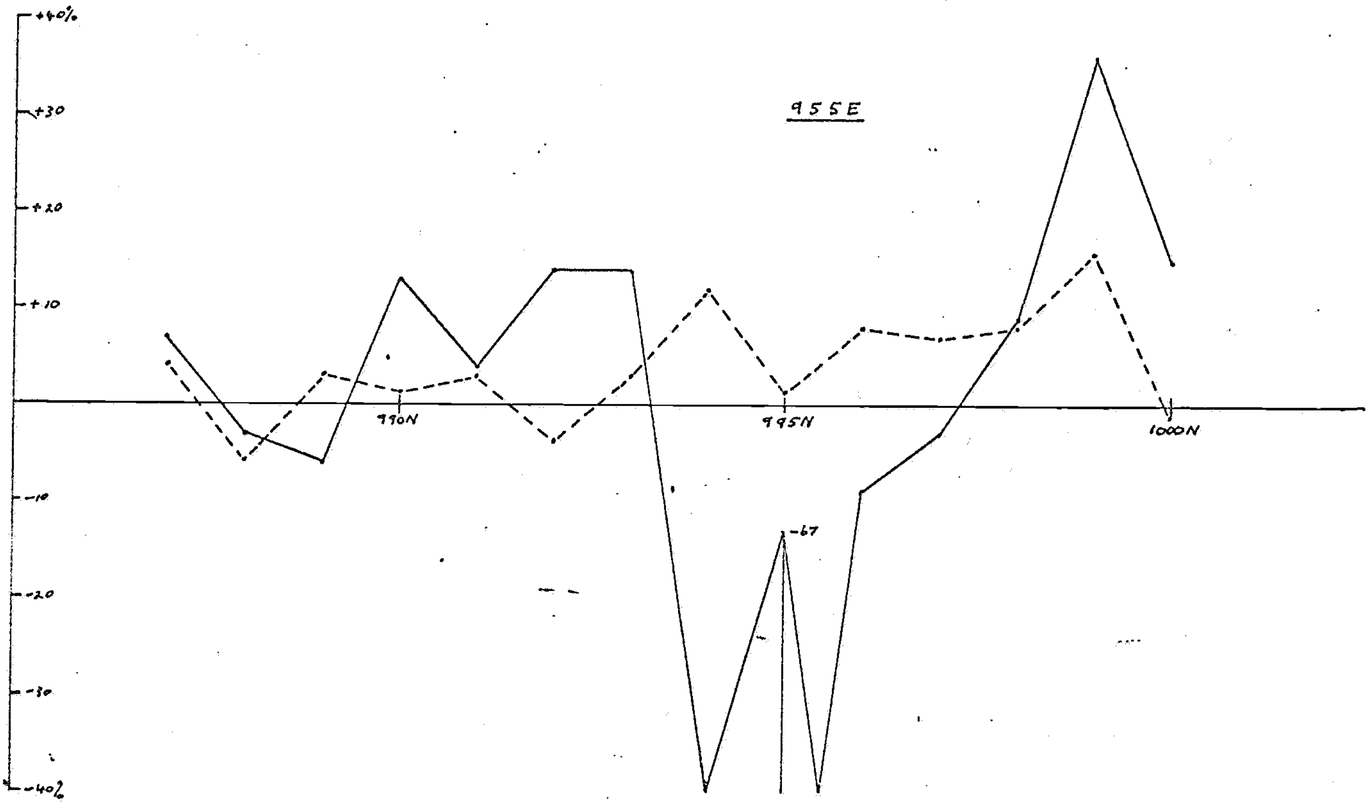
SLIDING ROCK SML 178

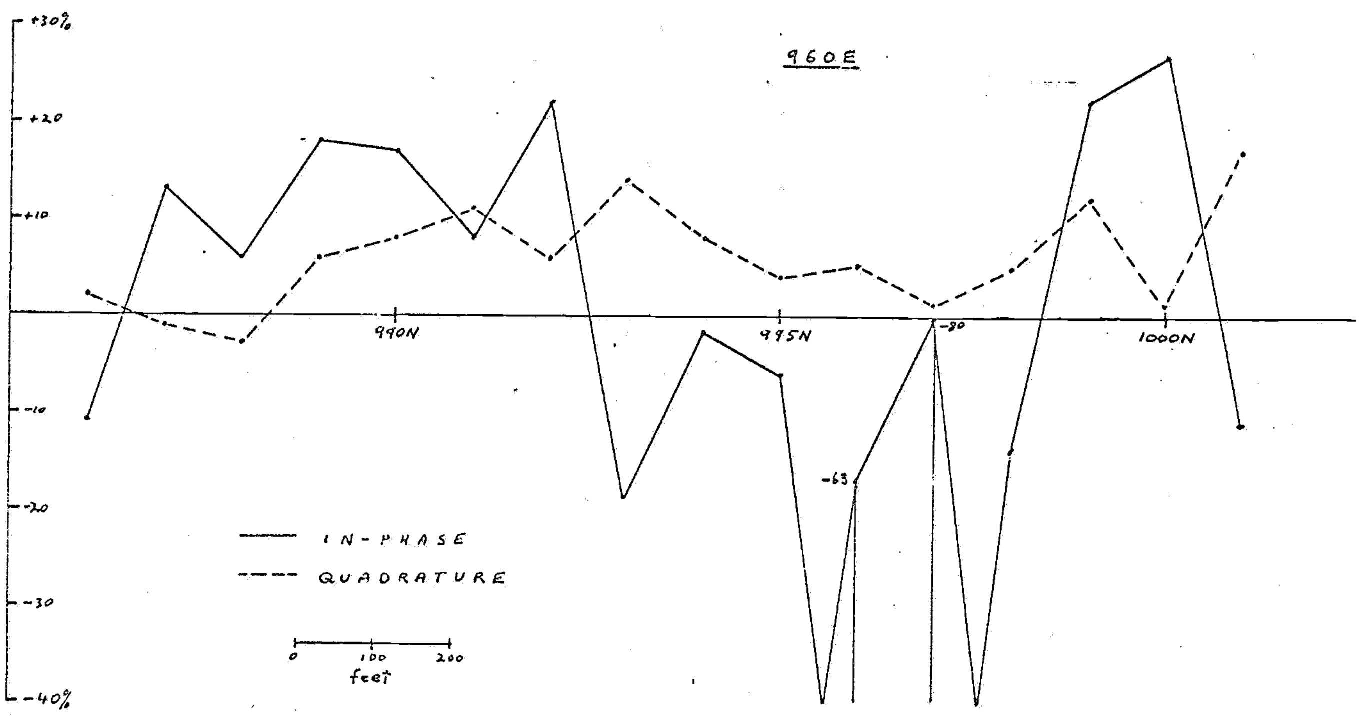
BLACK RANGE SPRING PROSPECT
VLF-EM SURVEY
FILTERED VERTICAL IN-PHASE
COMPONENT IN PERCENT
SCALE 1in = 400 ft

DECEMBER 1971

BLACK RANGE SPRING

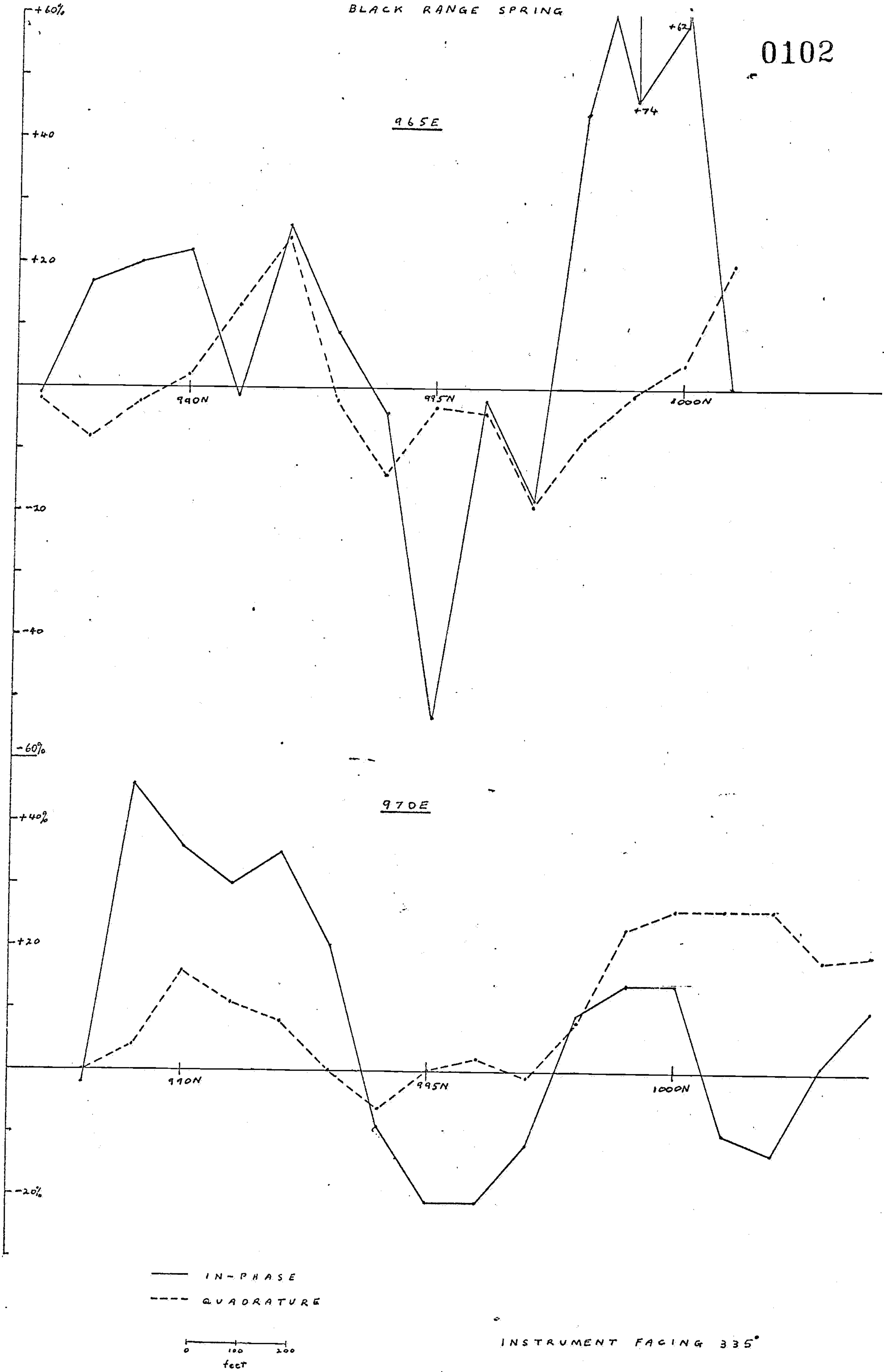






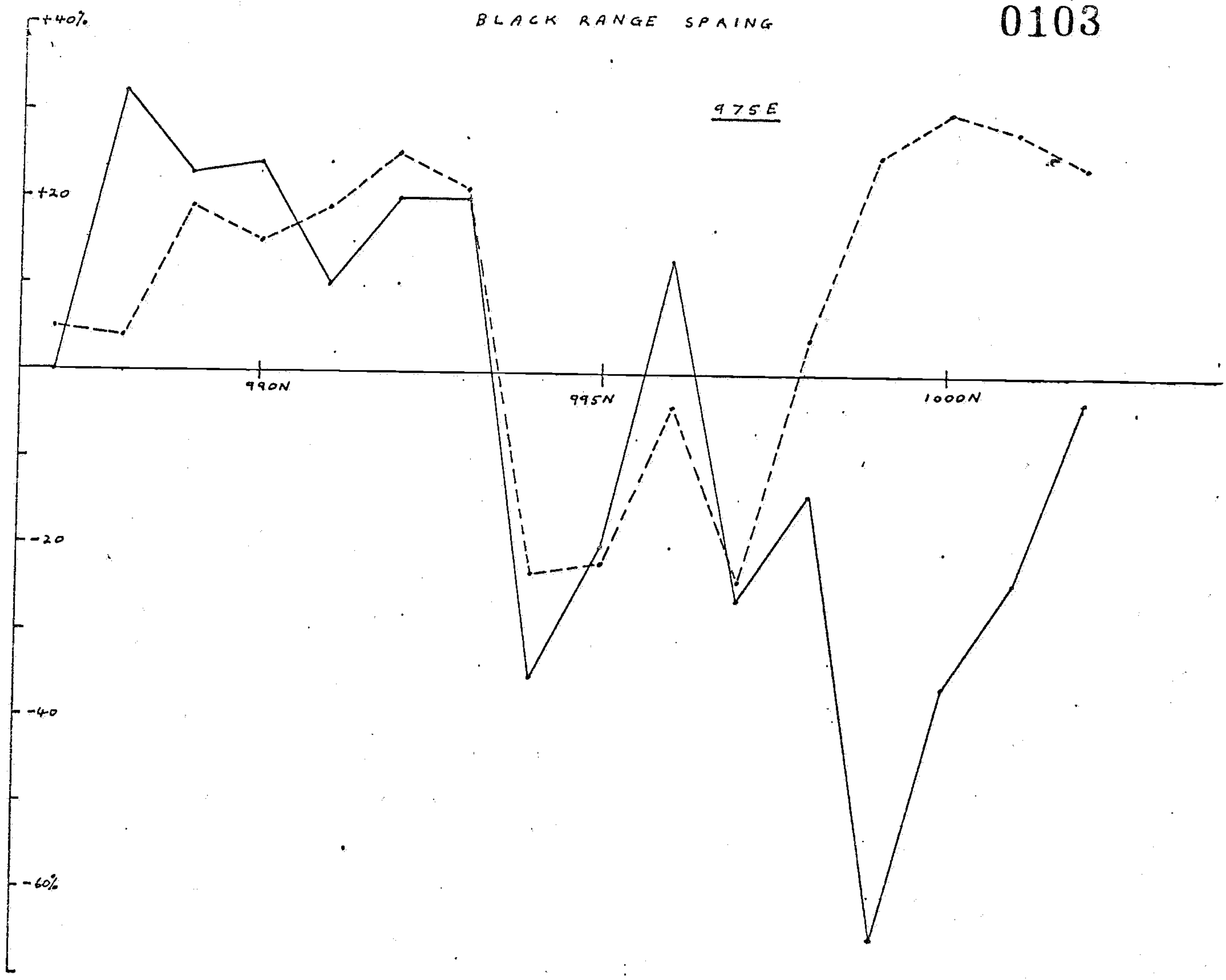
0102

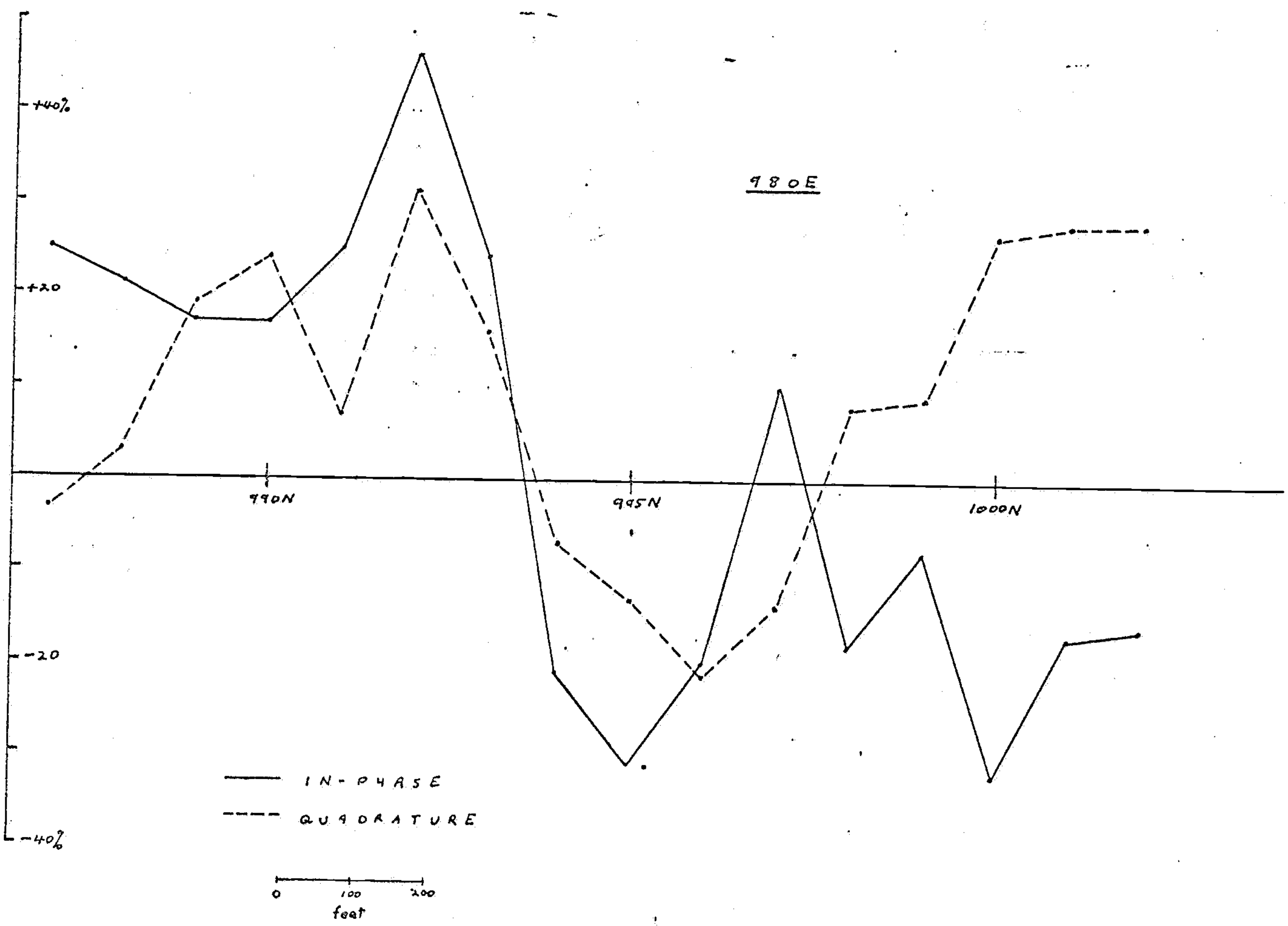
BLACK RANGE SPRING



INSTRUMENT FACING 335°

BLACK RANGE SPRING





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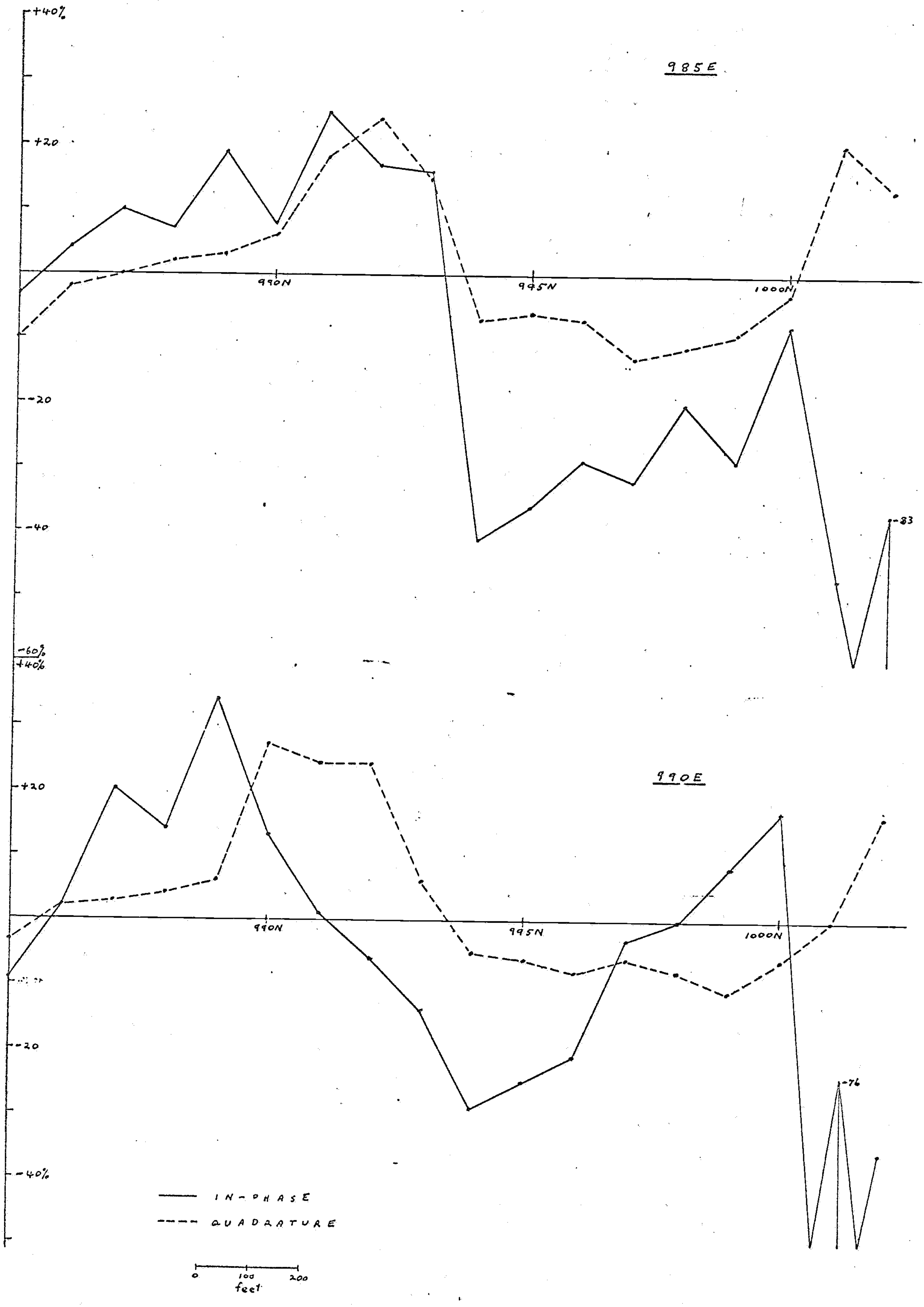

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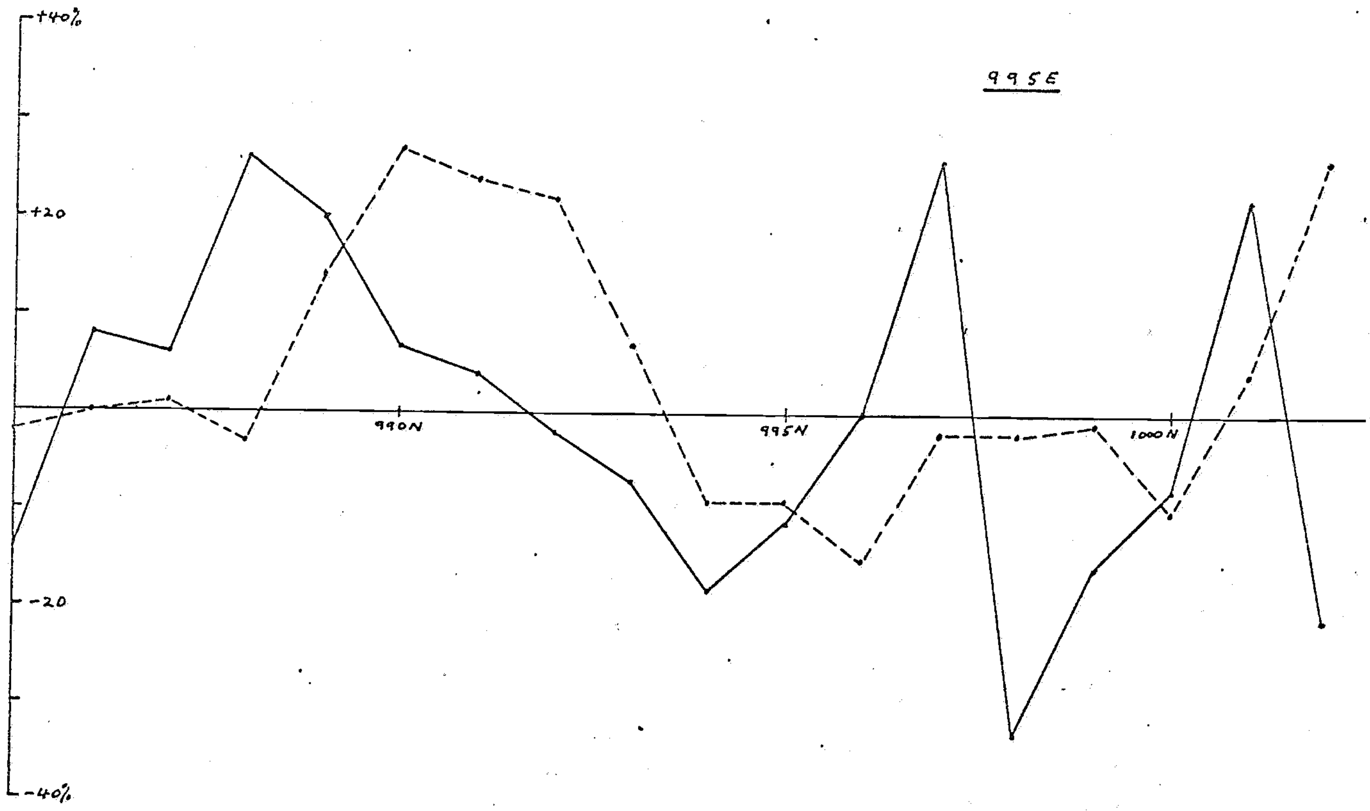
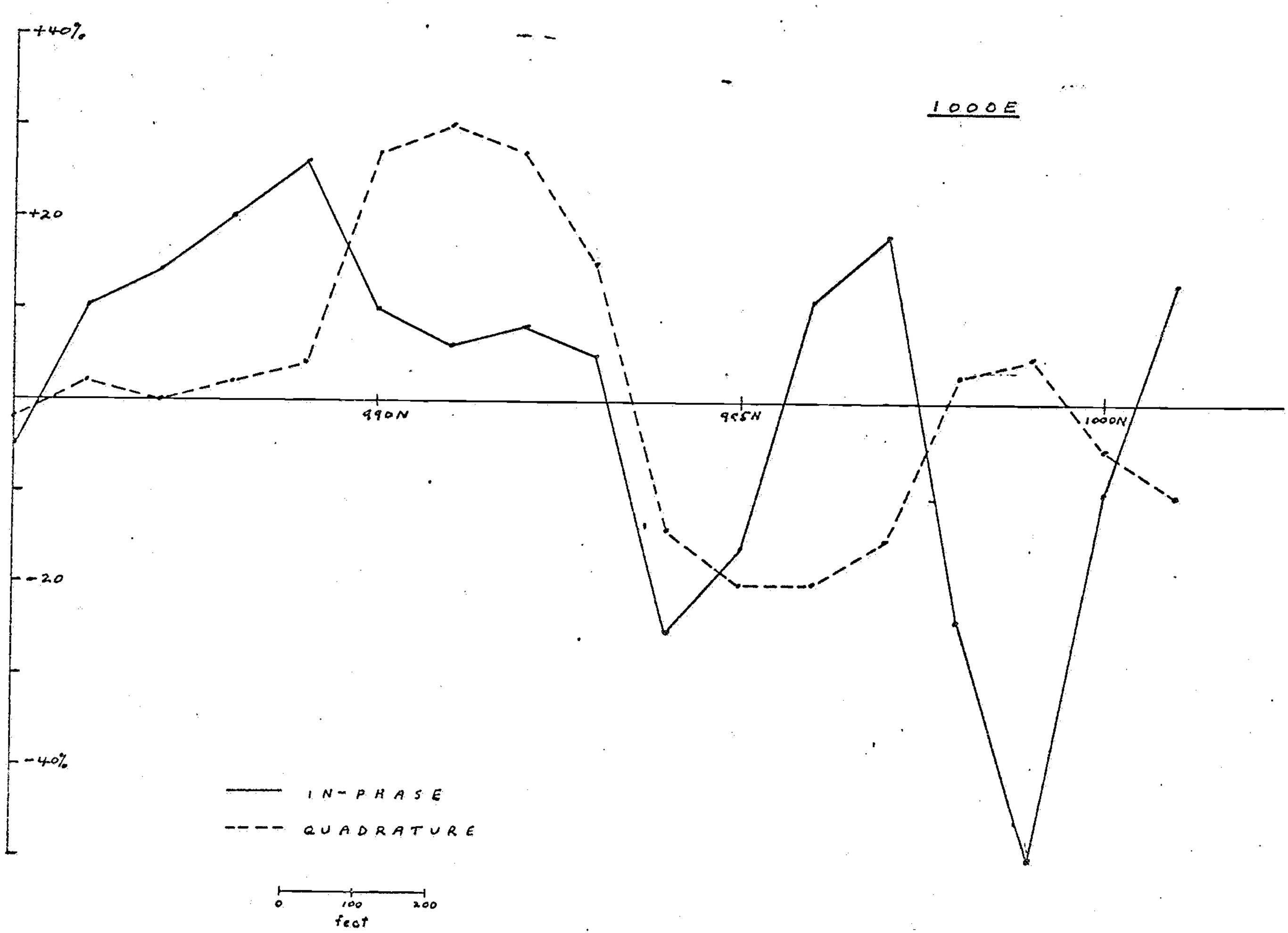
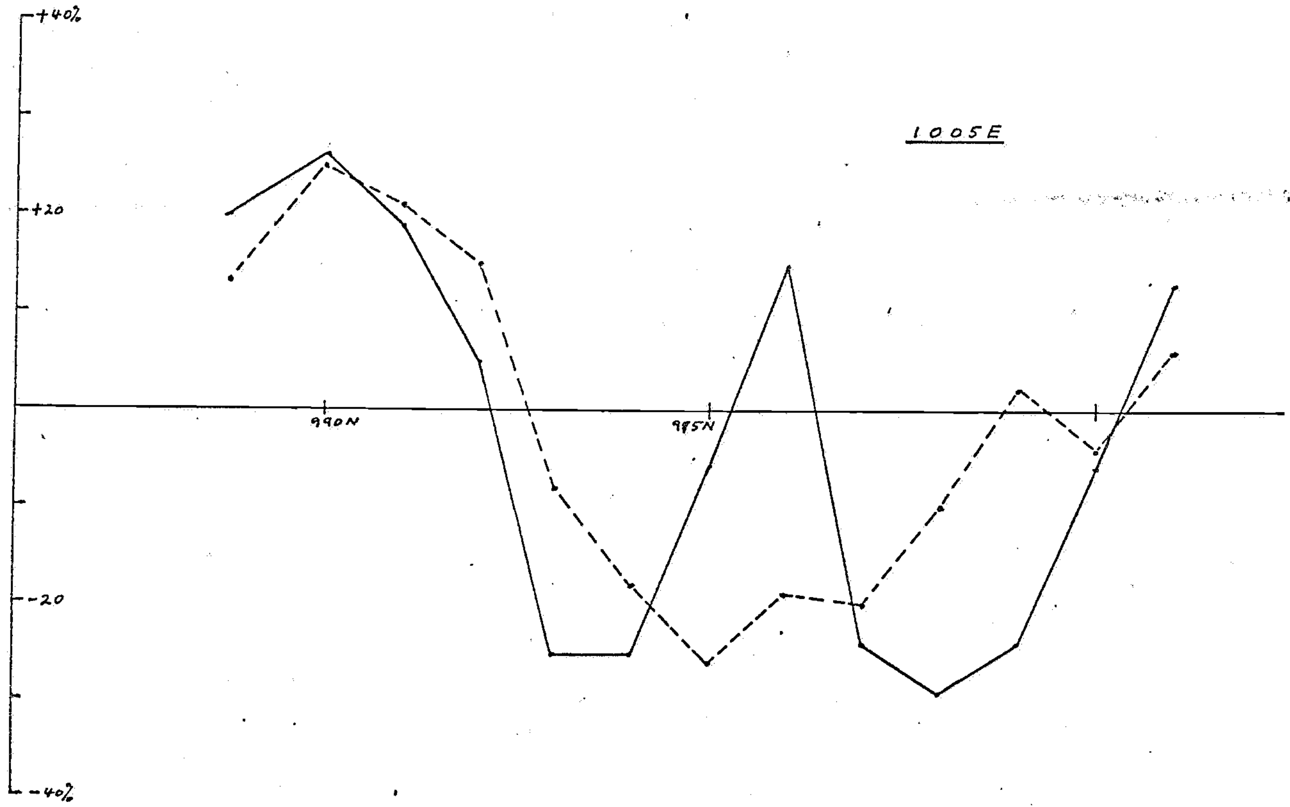
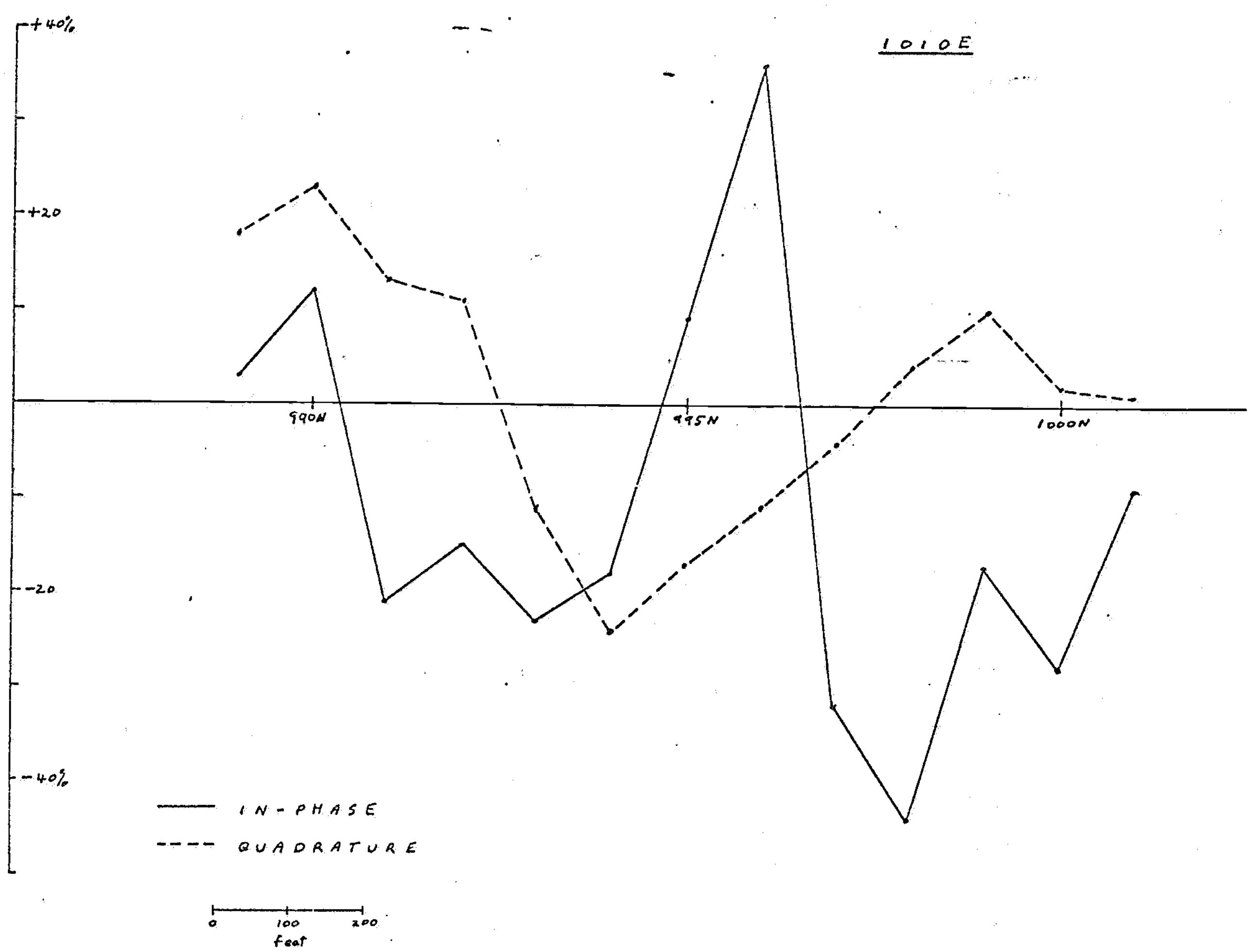




BLACK RANGE SPRING

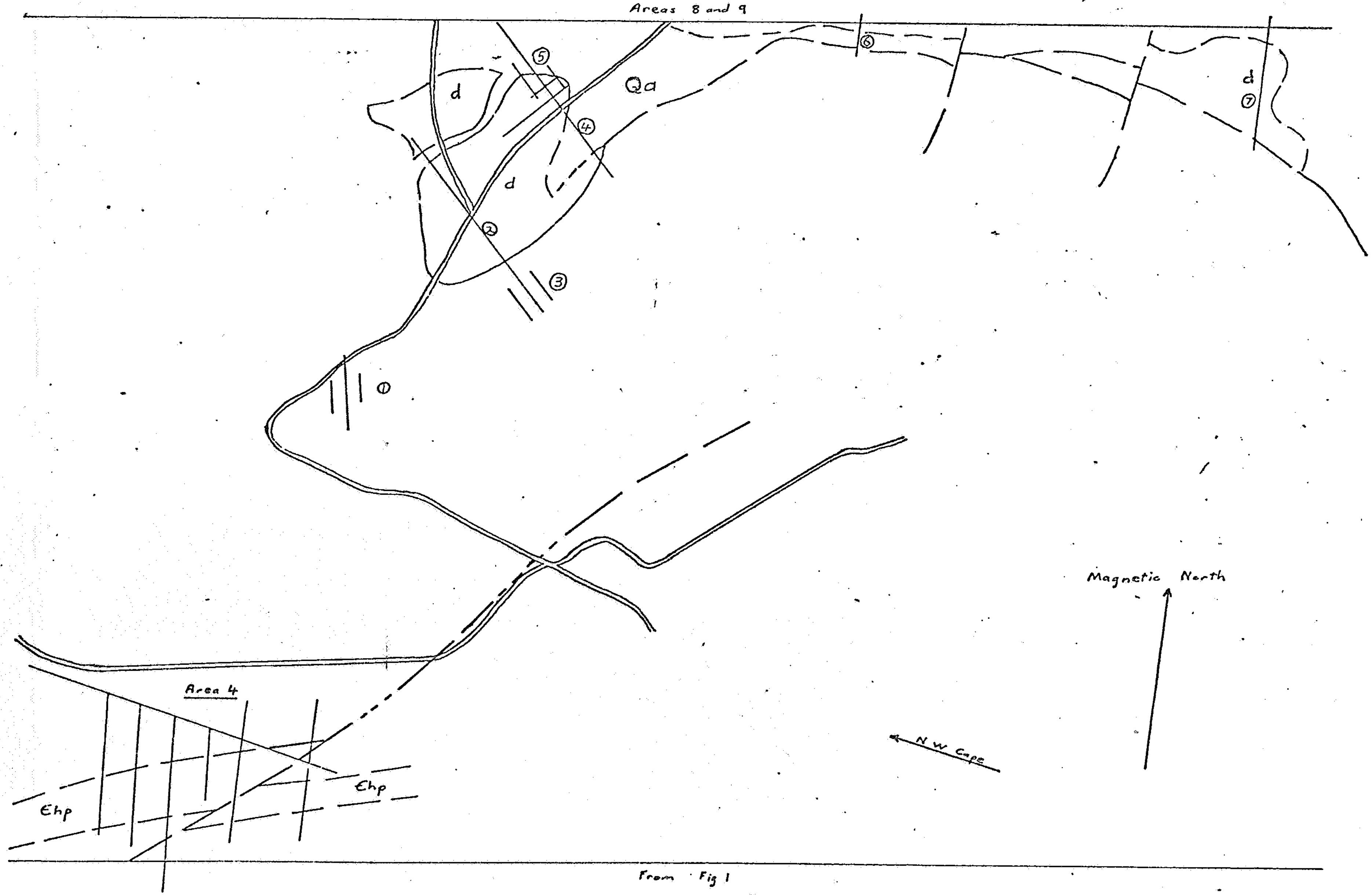
0106





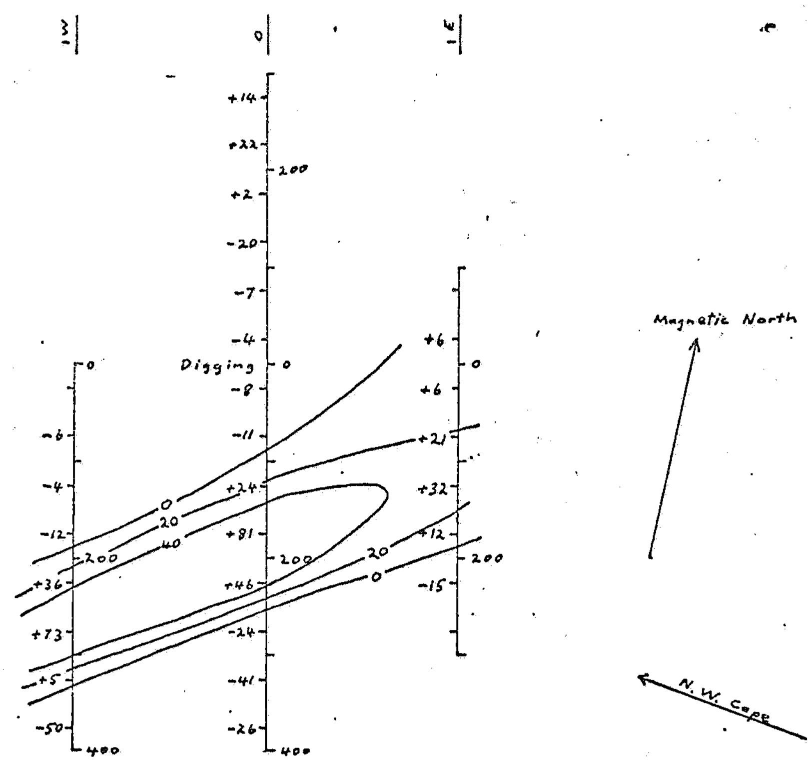
Location of lines and grids

Areas 8 and 9



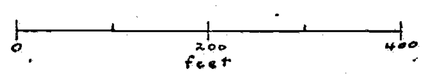
From Fig 1

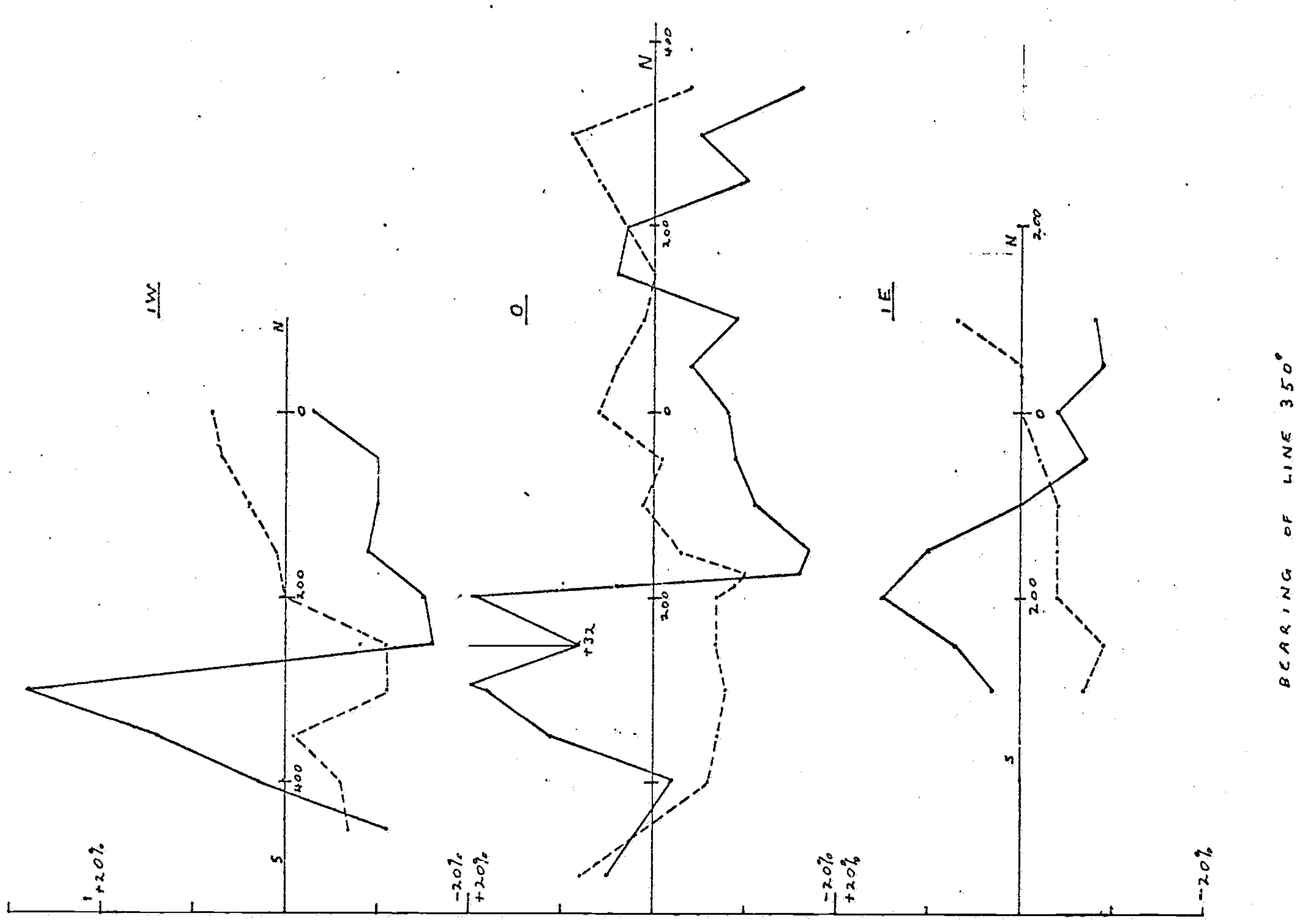
GRID ①

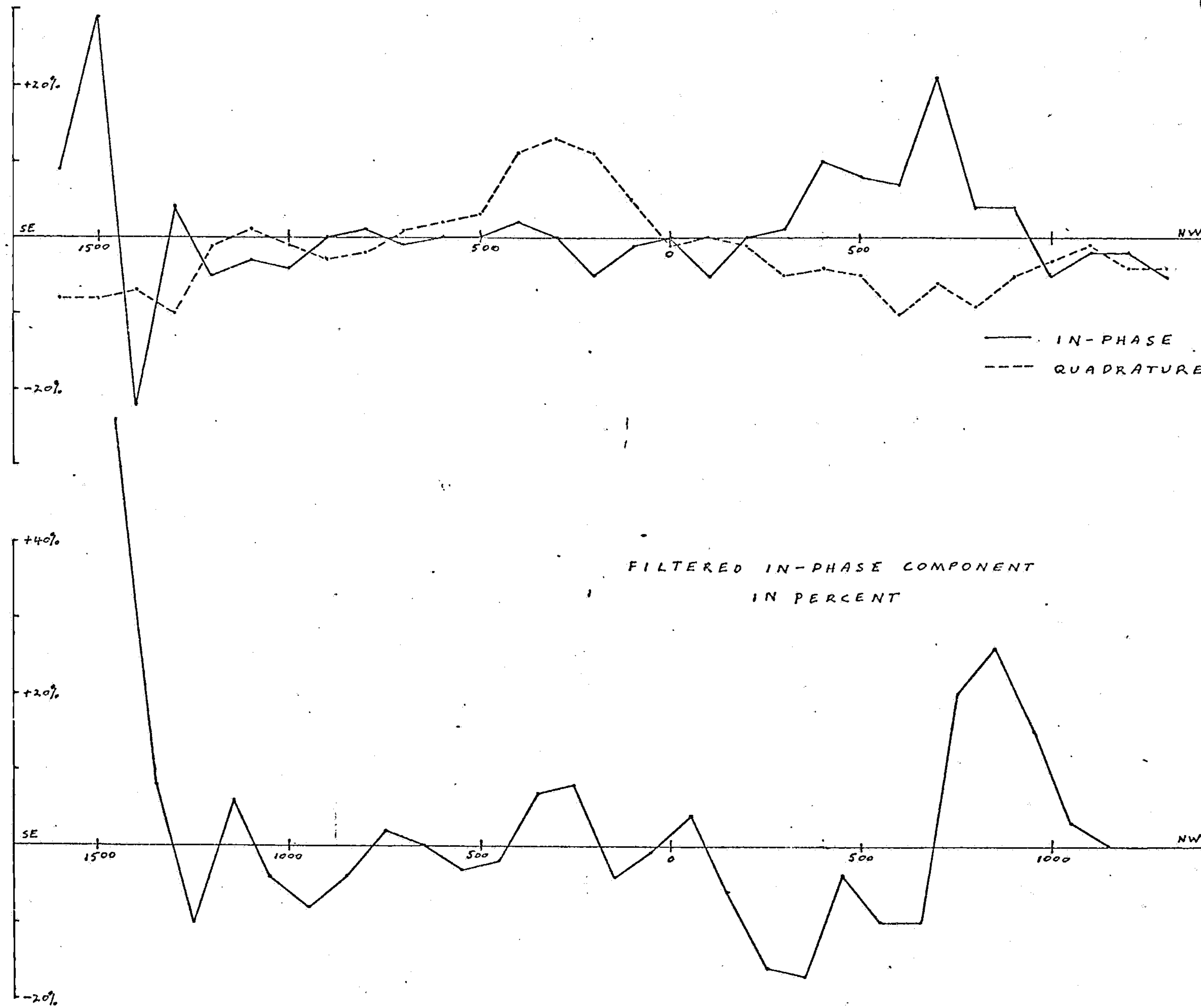


FILTERED IN-PHASE COMPONENT

IN PERCENT

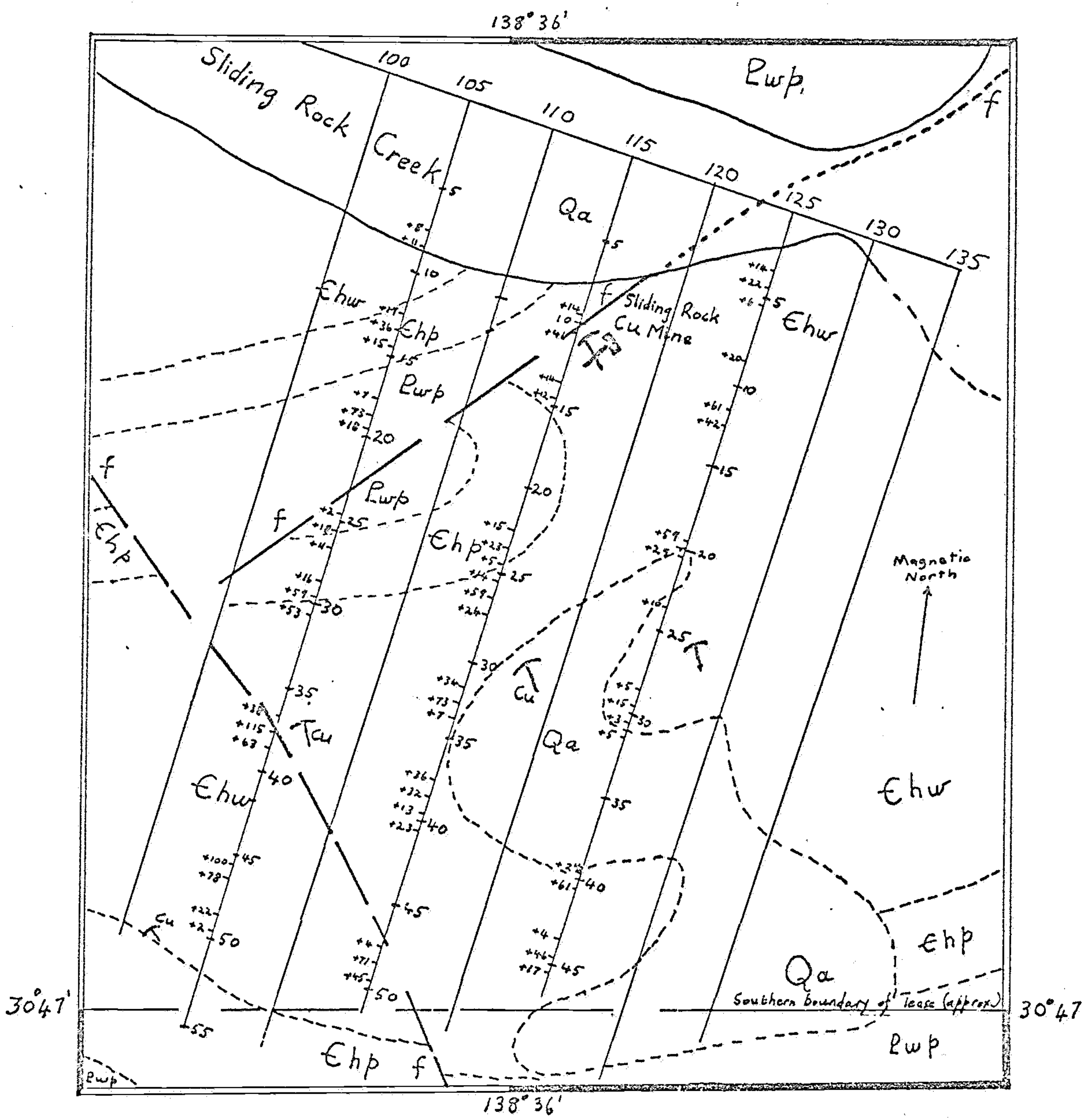






BEARING OF LINE 315°

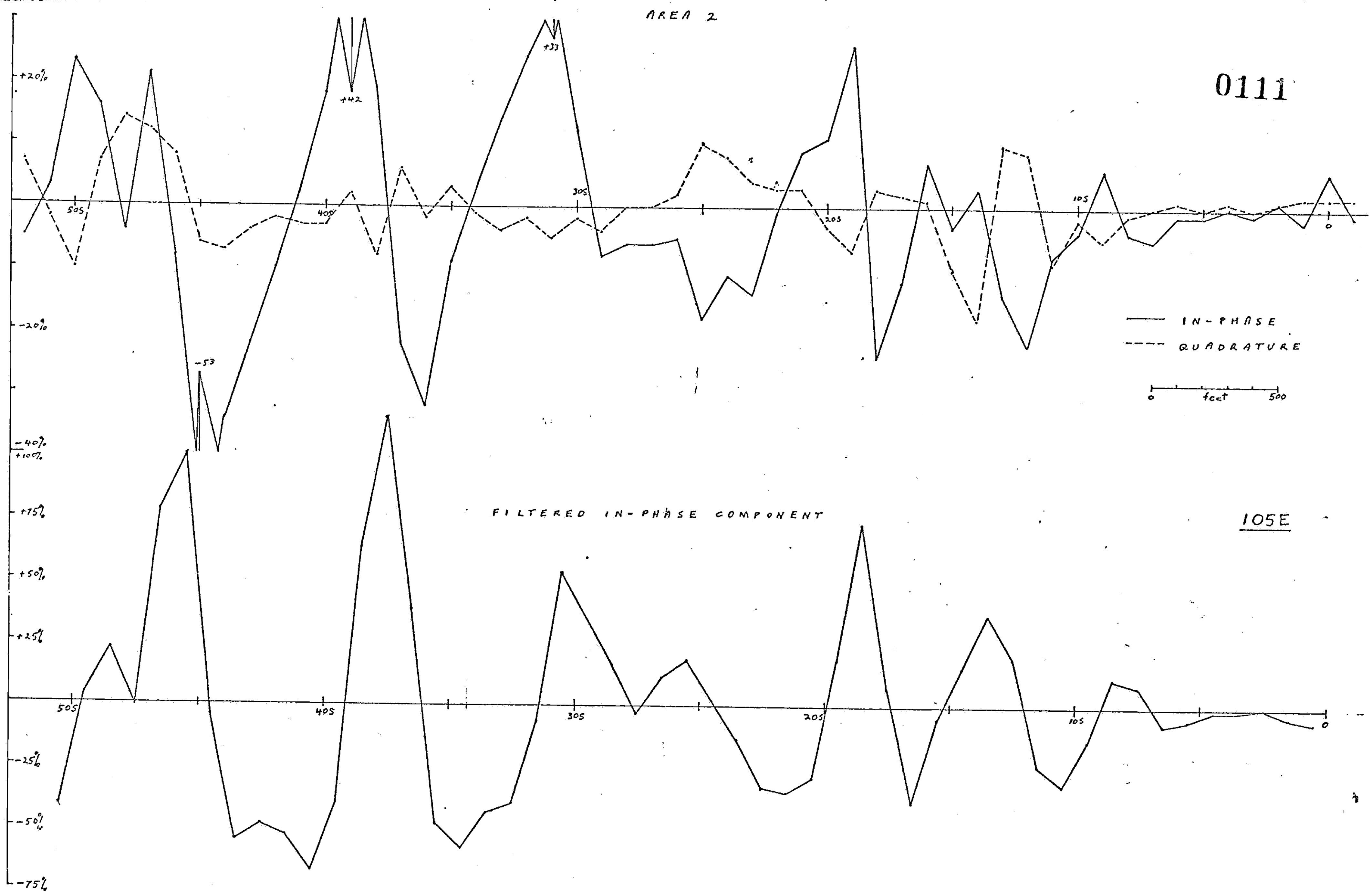
LINE ②

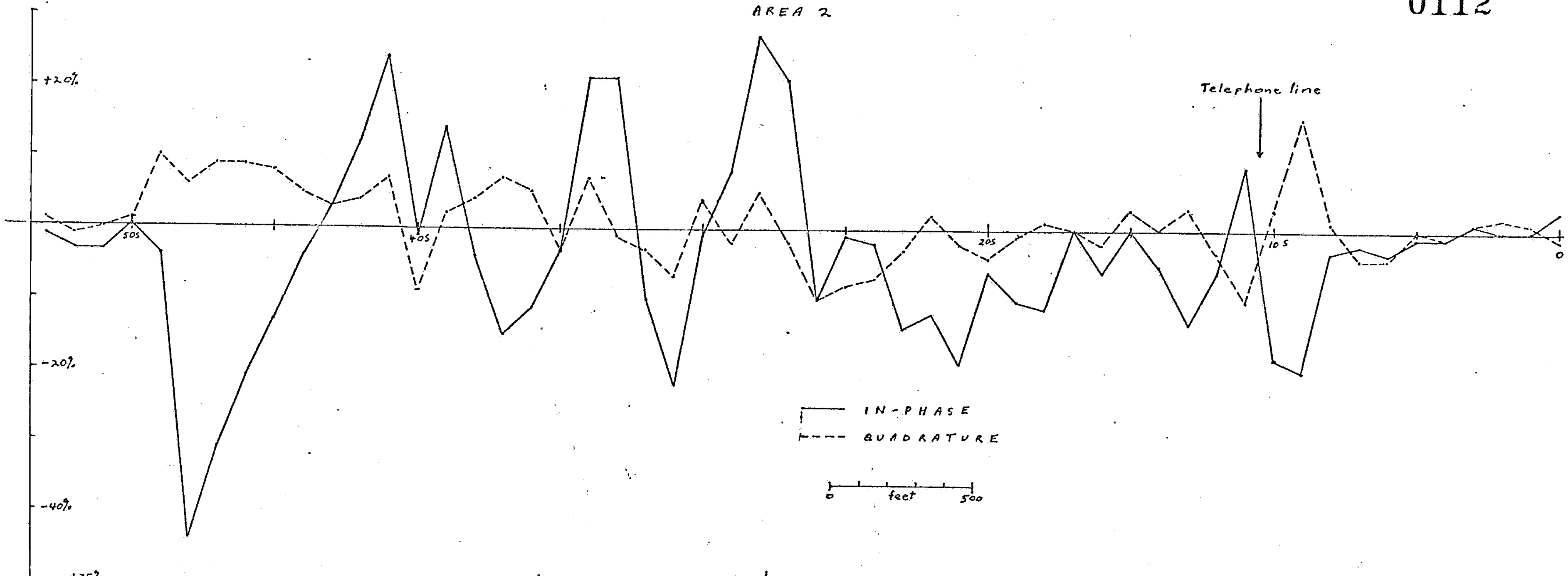


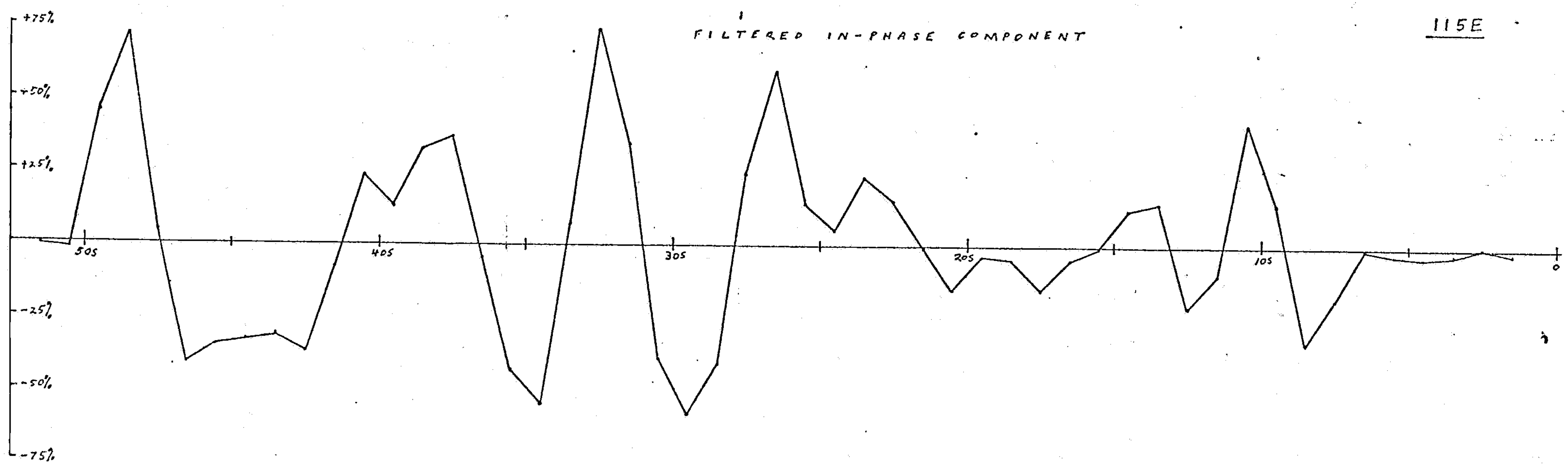
Location of grid in area 2 with positive values of the filtered data

Scale 1 inch = 1000 feet

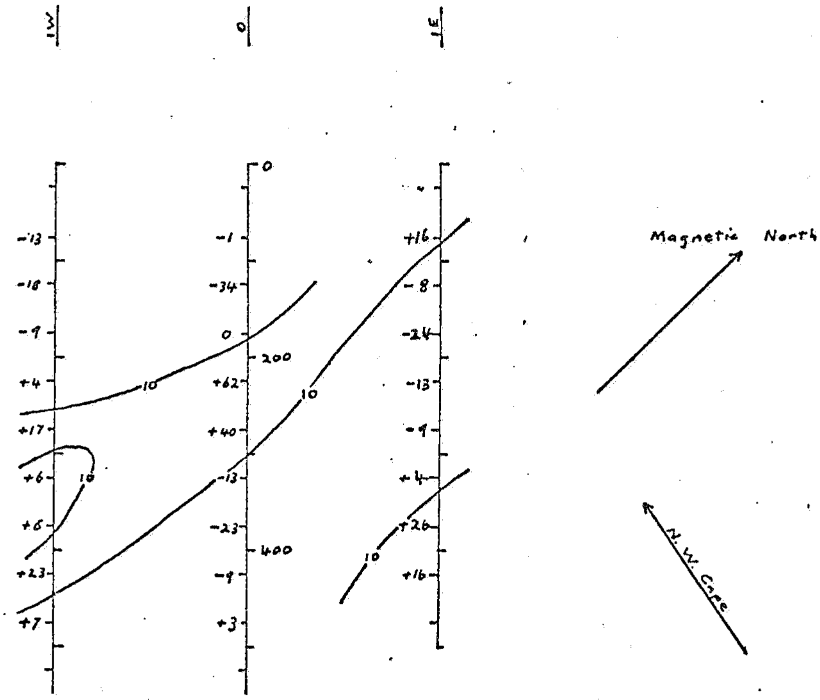
0111


AREA 2
+20%
-20%
-40%
+100%
+75%
+50%
+25%
-25%
-50%
-75%
+42
+33
-53
50S
40S
30S
20S
10S
0
IN-PHASE
QUADRATURE
0 feet 500
FILTERED IN-PHASE COMPONENT
105E

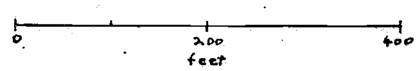

AREA 2
+20%
-20%
-40%
50S
40S
20S
10S
0
Telephone line
IN-PHASE
QUADRATURE
0
feet
500

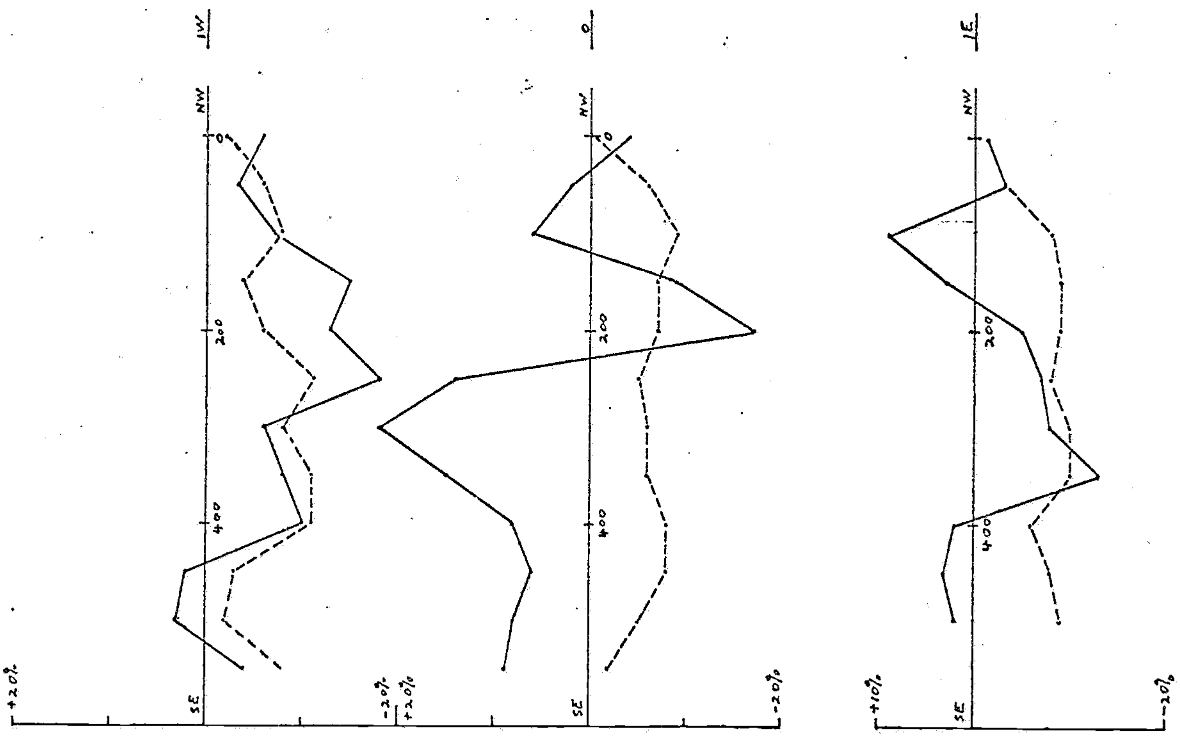

FILTERED IN-PHASE COMPONENT
115E
+75%
+50%
+25%
-25%
-50%
-75%
50S
40S
30S
20S
10S
0

GRID ③



FILTERED IN-PHASE COMPONENT
IN PERCENT



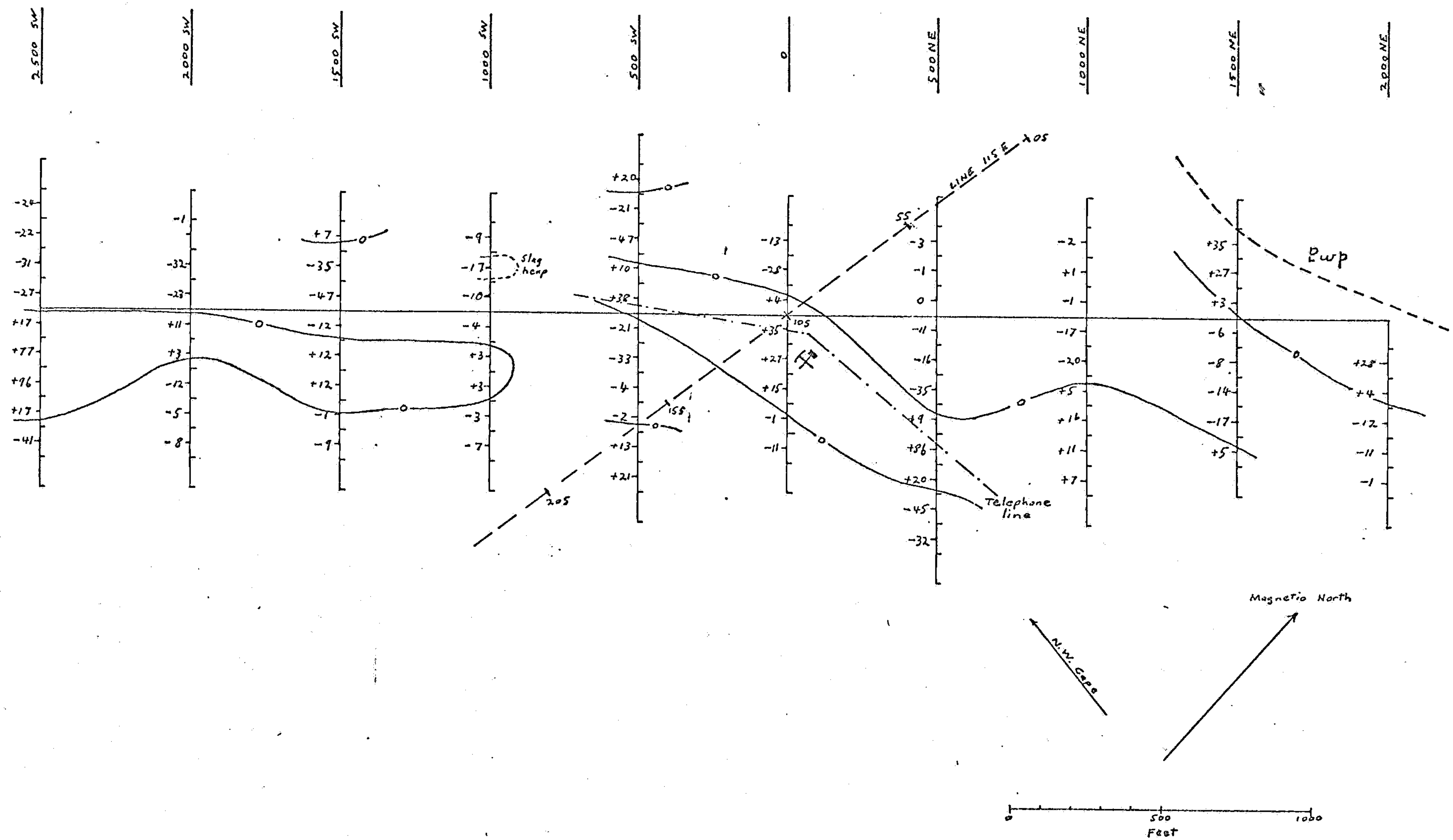


BEARING OF LINE 315°

FAULT LINE GRID

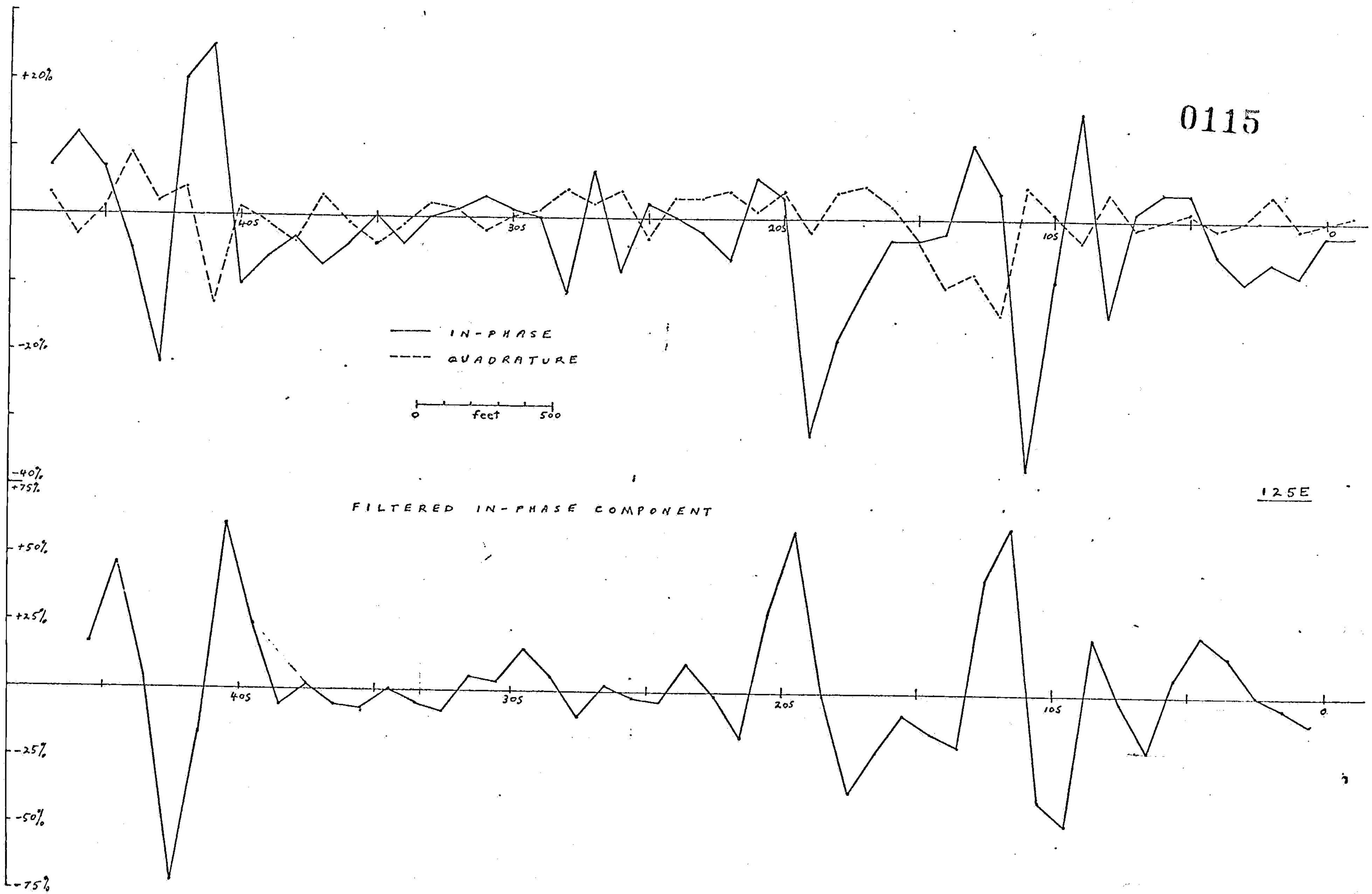
AREA 2

0114



AREA 2

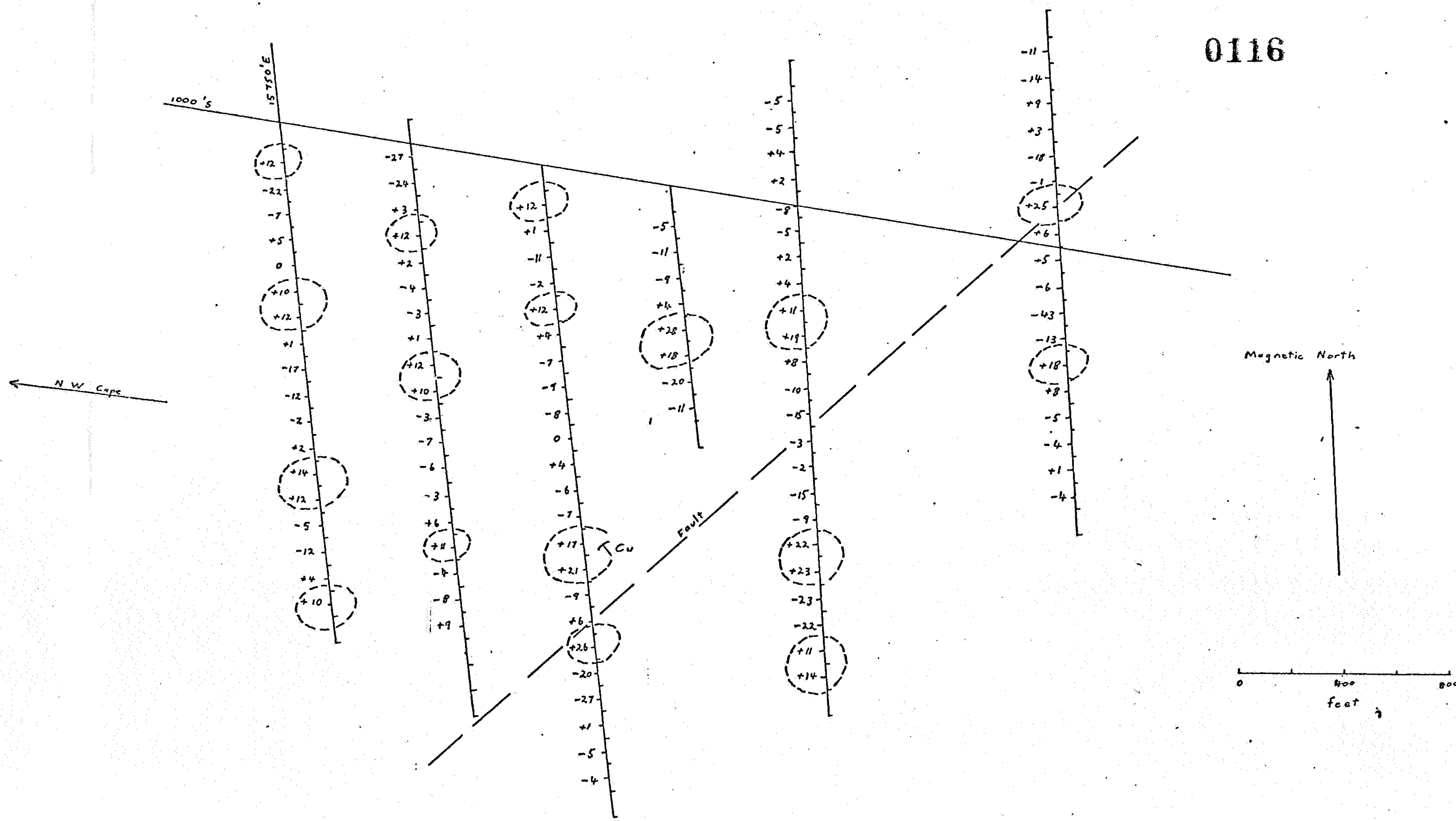
0115



+20%
-20%
-40%
+75%
40S
30S
20S
10S
0
IN-PHASE
QUADRATURE
0 feet 500
125E
FILTERED IN-PHASE COMPONENT
+50%
+25%
-25%
-50%
-75%
40S
30S
20S
10S
0

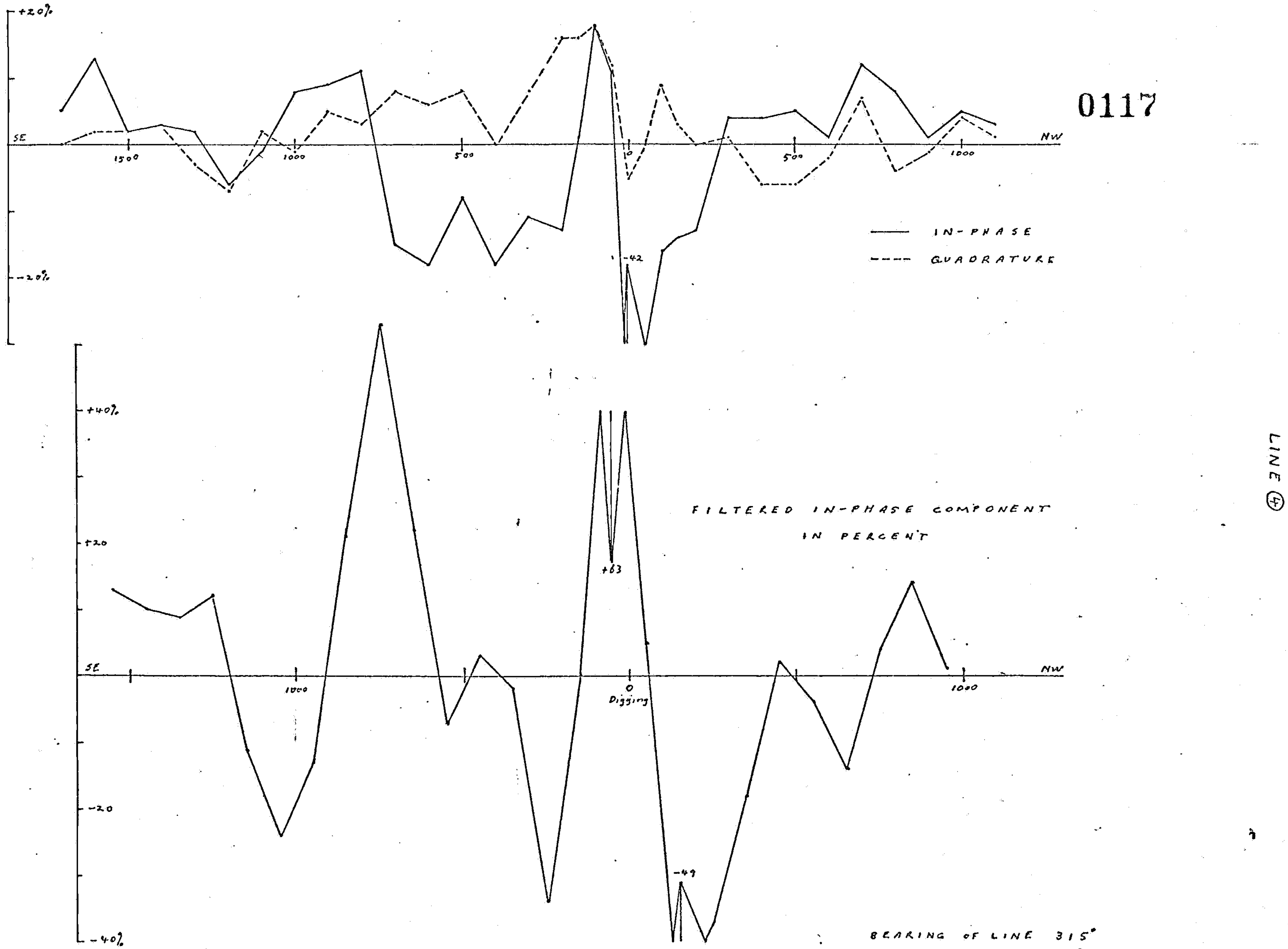
SLIDING ROCK PLAIN AREA 4

0116



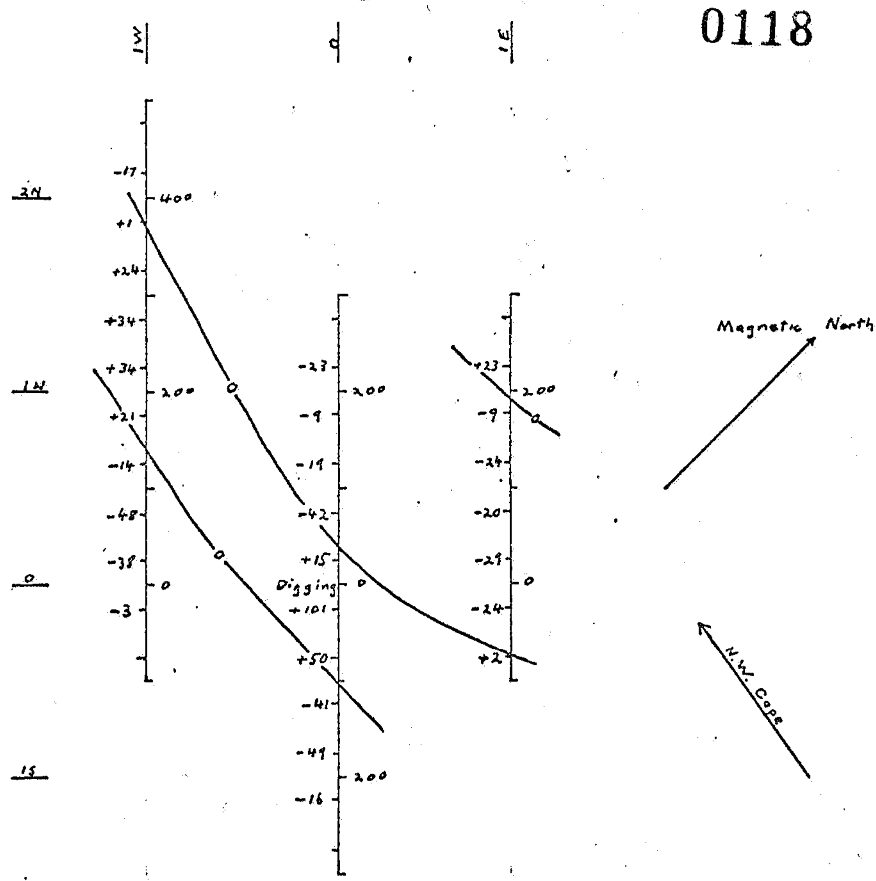
Filtered In-phase Component
Values greater than +10 are circled

0117

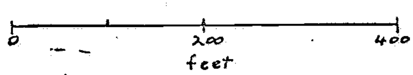

+20%
-20%
SE
NW
1500
1000
500
0
500
1000
-42
IN-PHASE
QUADRATURE
+40%
+20
-20
-40%
+63
-49
Digging
FILTERED IN-PHASE COMPONENT
IN PERCENT
BEARING OF LINE 315°
LINE 4

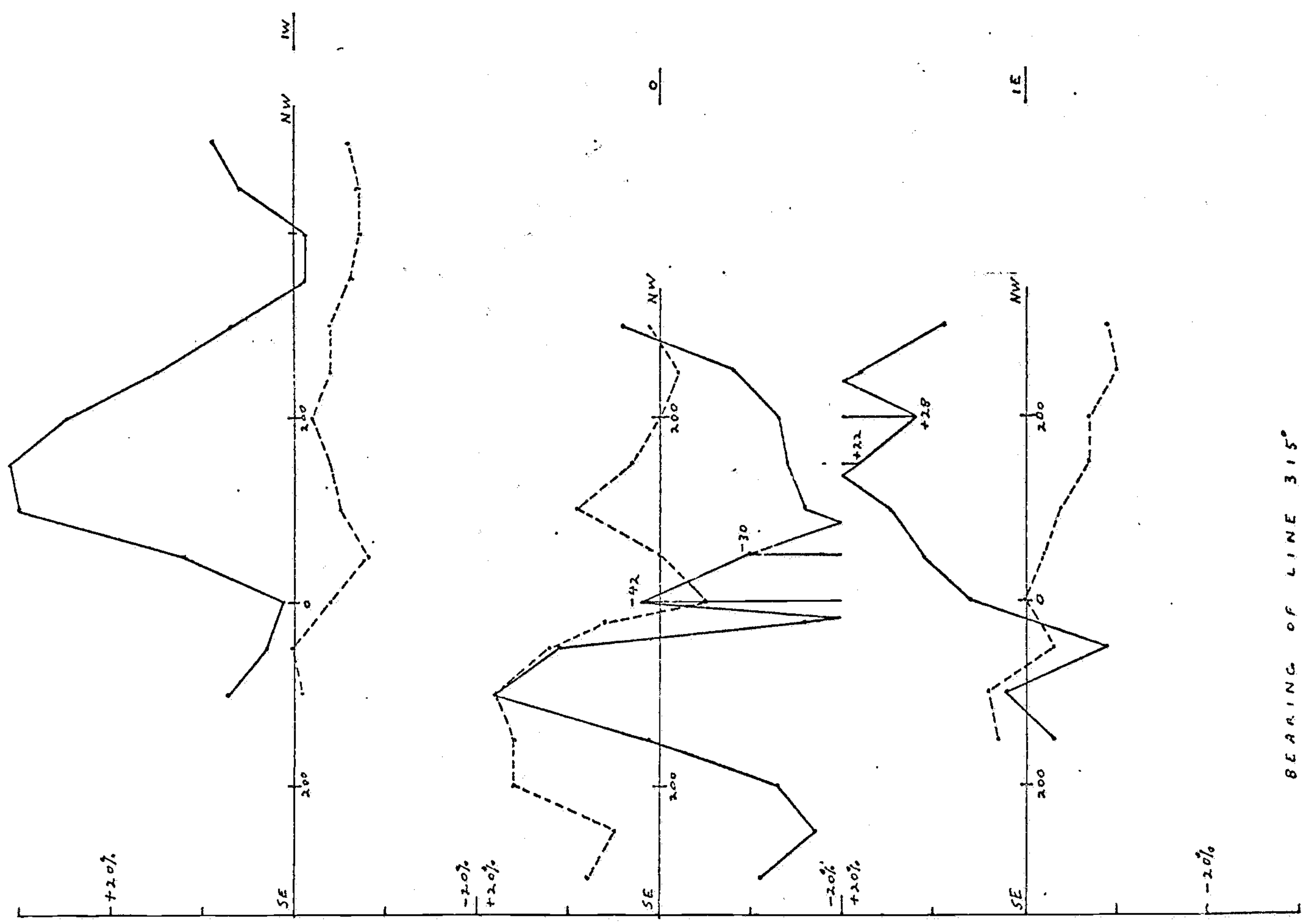
GRID ⑤

0118



FILTERED IN-PHASE COMPONENT
IN PERCENT

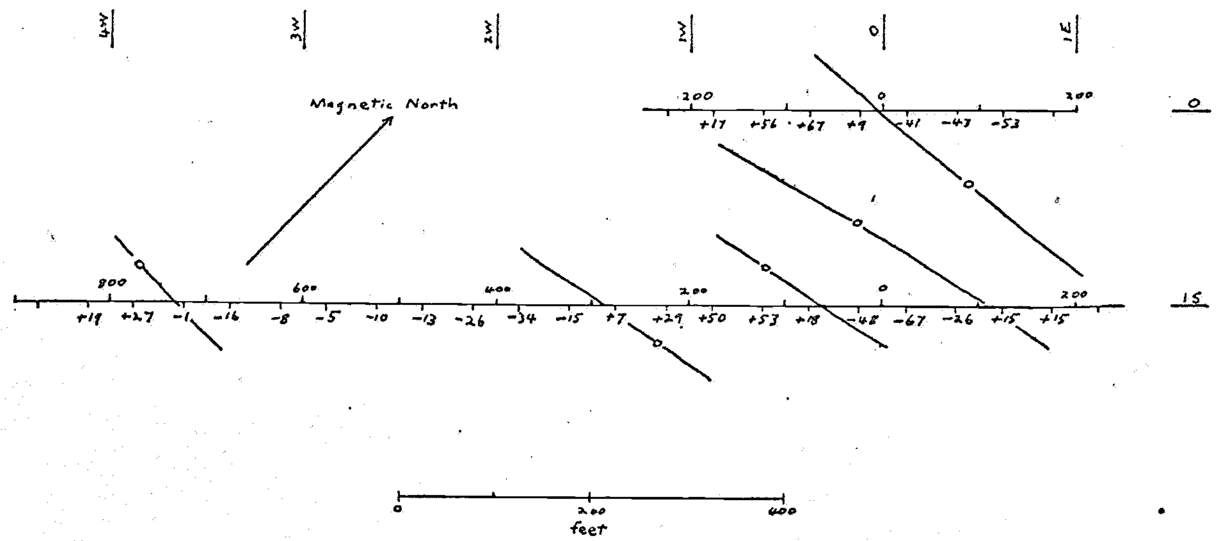


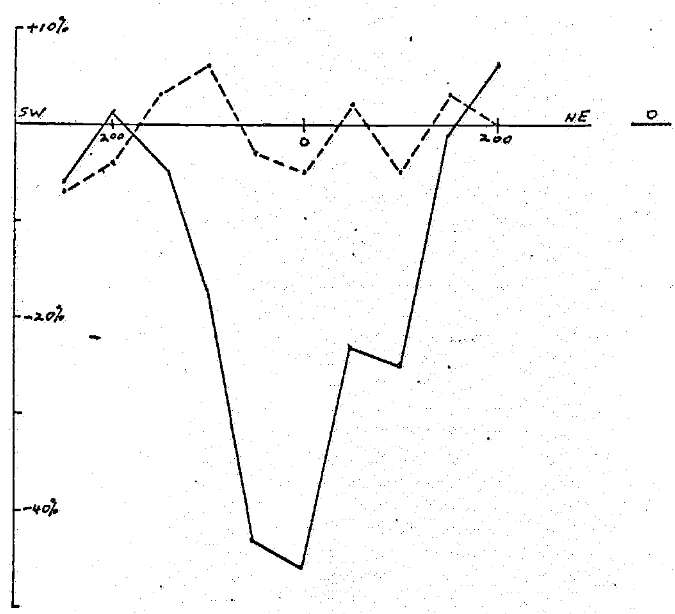


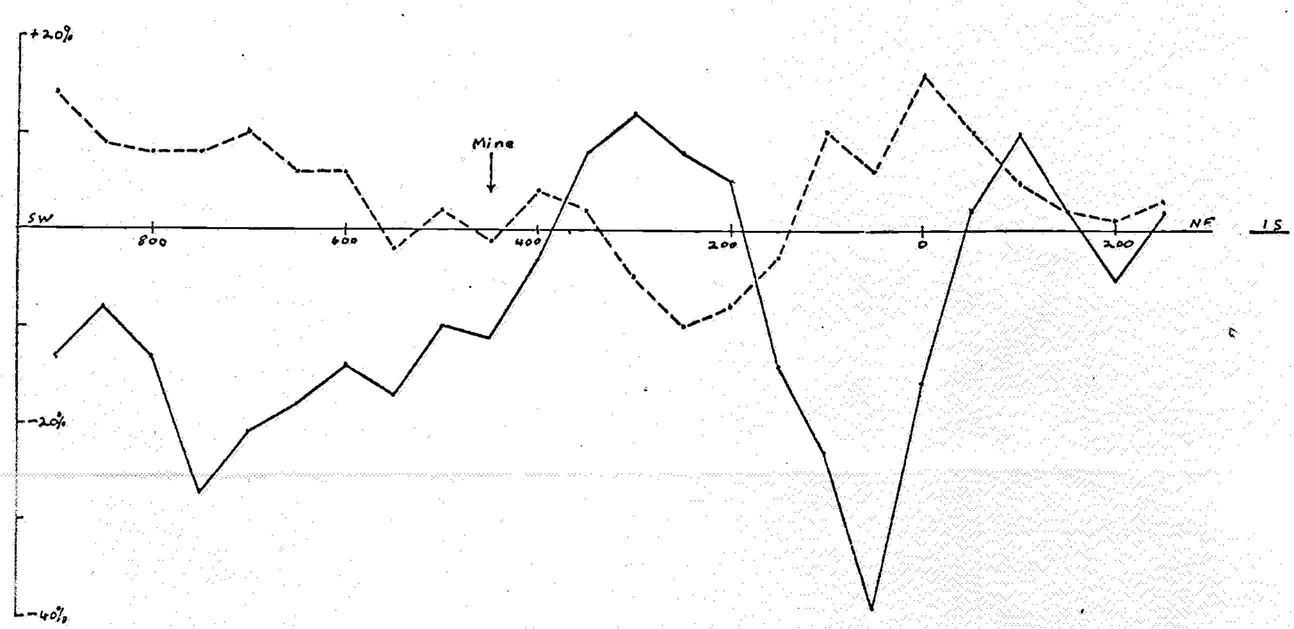
GRID ⑤

FILTERED IN-PHASE COMPONENT

IN PERCENT







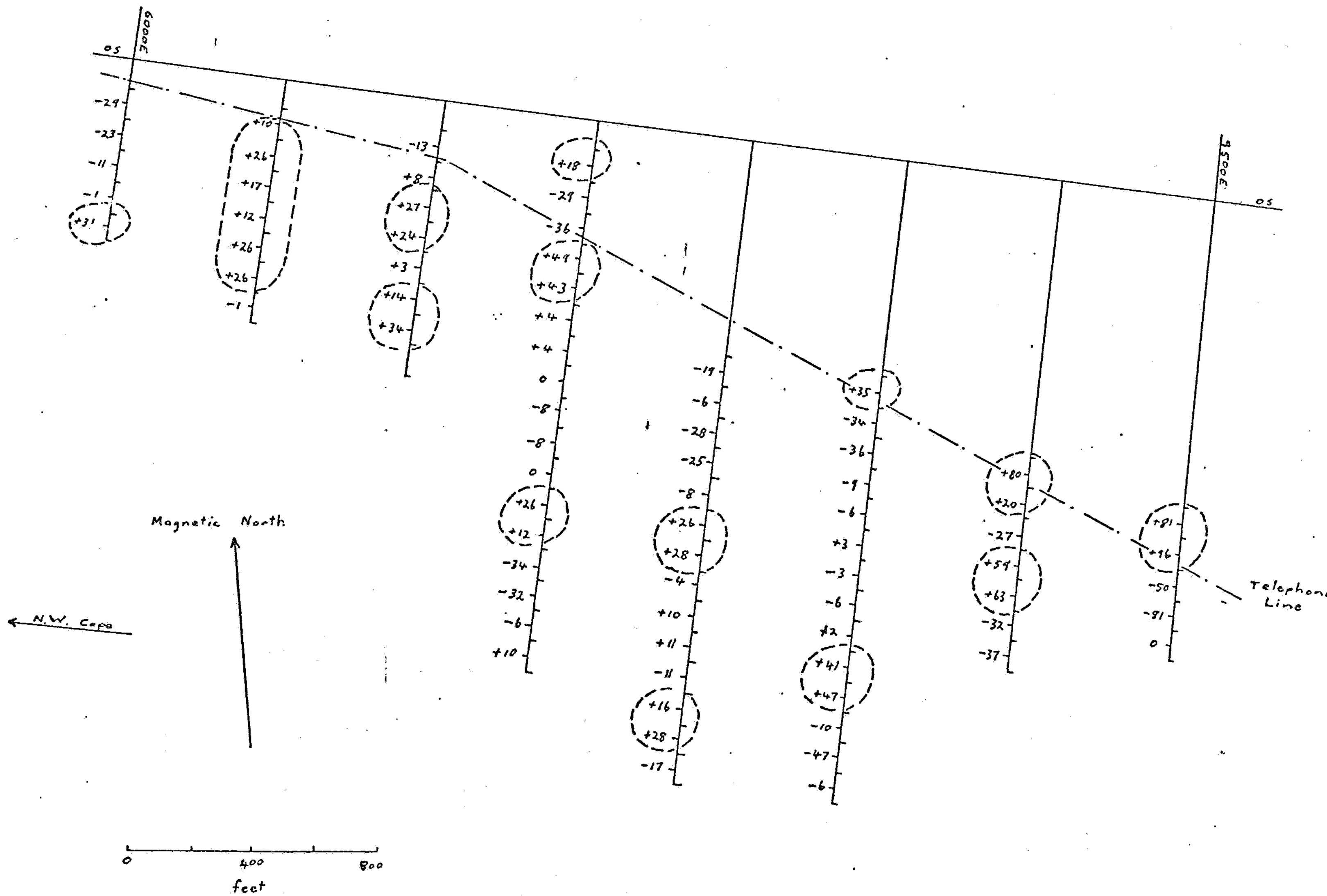
BEARING OF LINE 045°

AREA 6

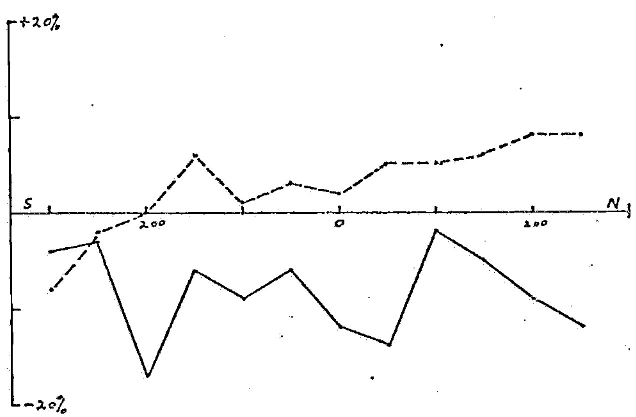
Filtered In-phase Component

Values greater than +10 are circled

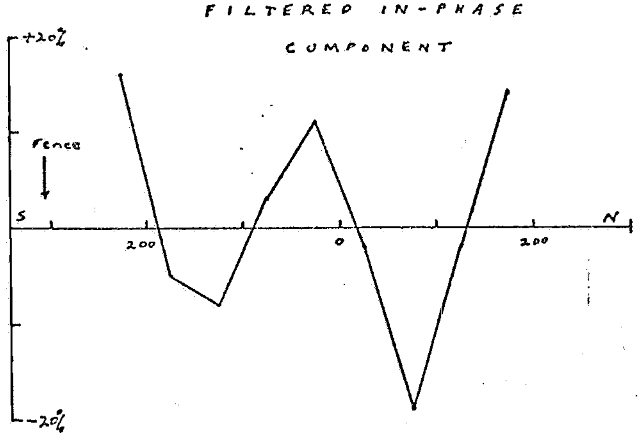
0120



LINE ⑥

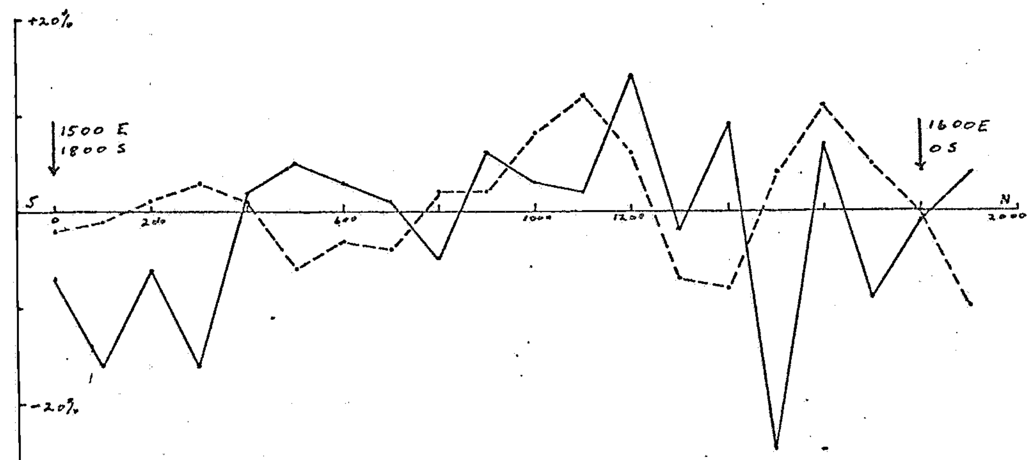


FILTERED IN-PHASE COMPONENT



BEARING OF LINE 360°

LINE ⑦



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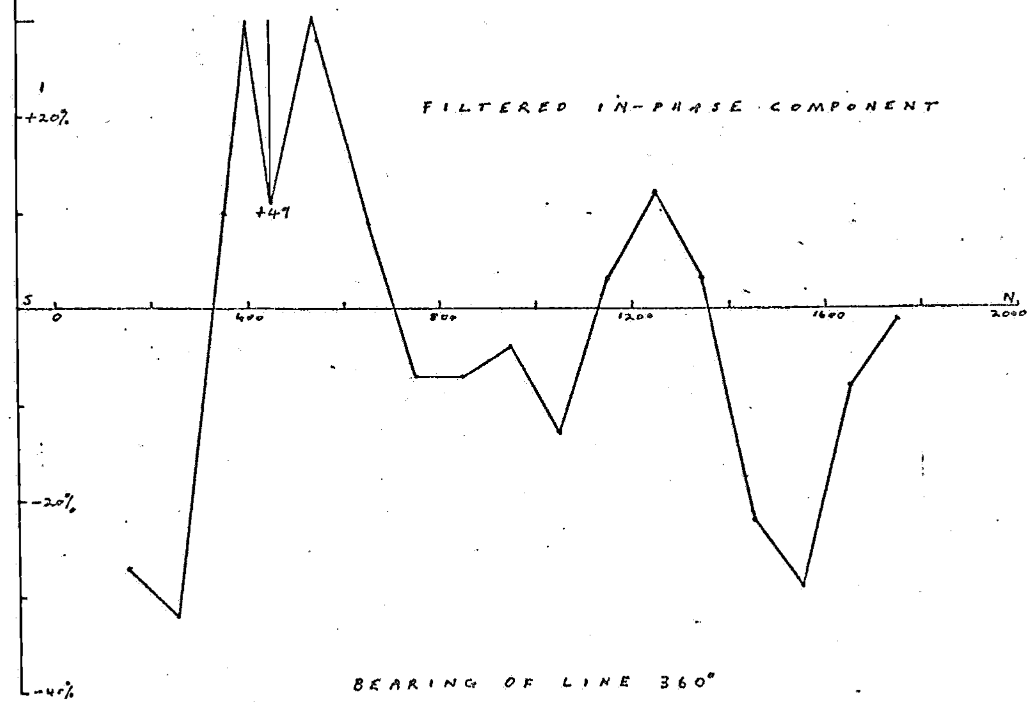
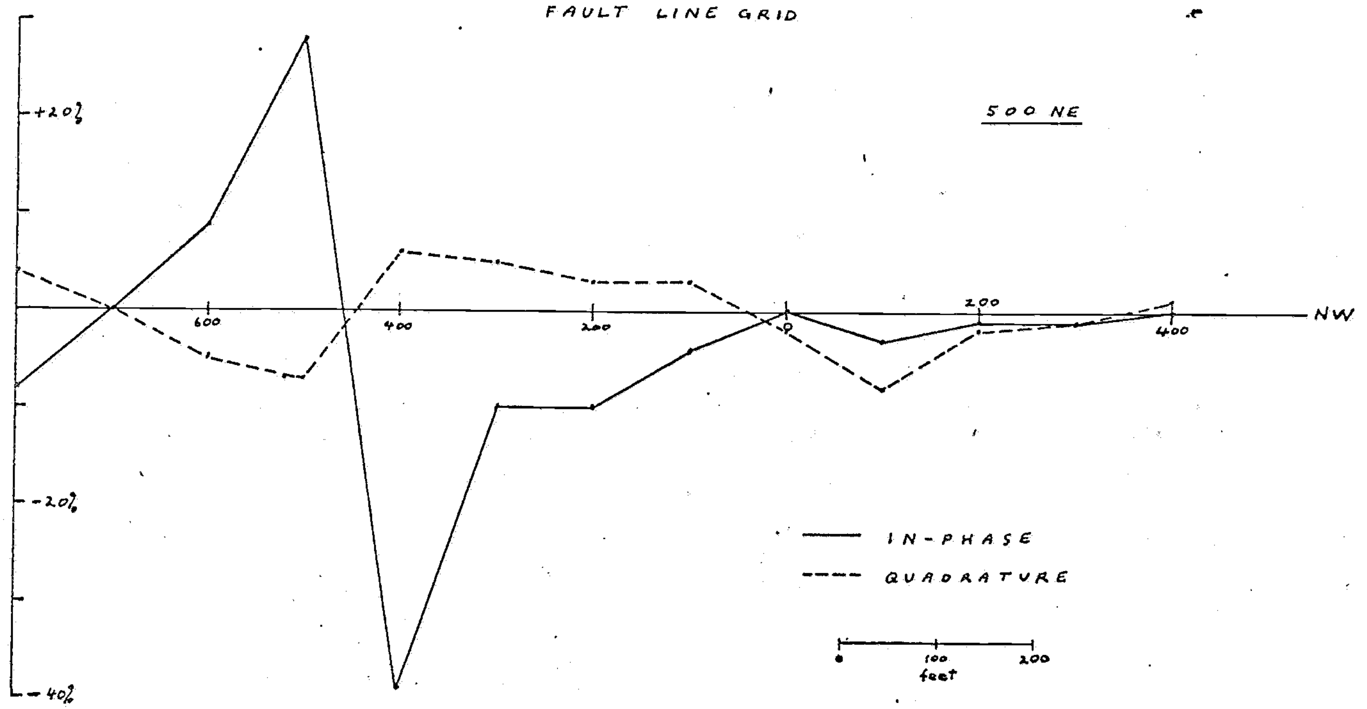
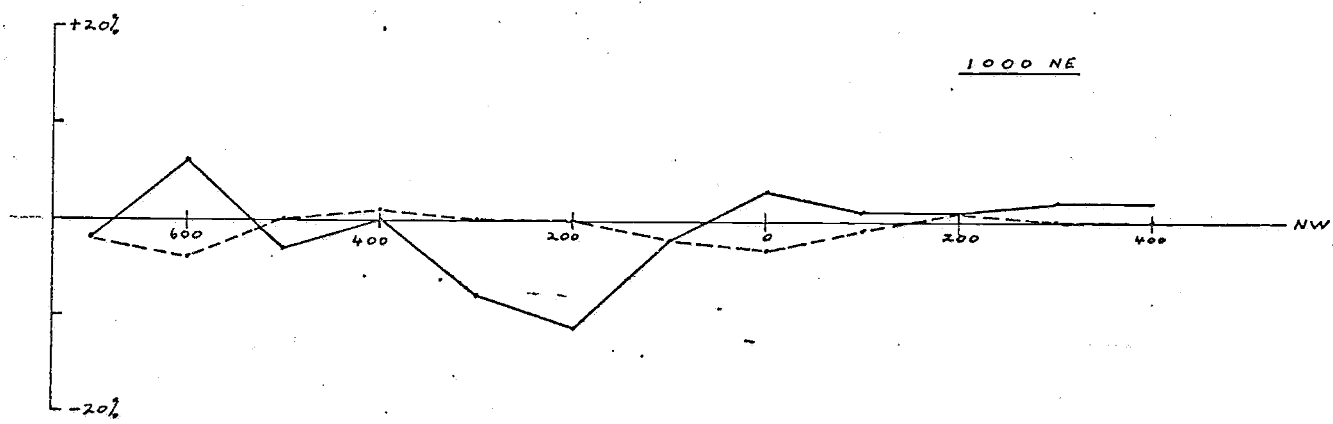
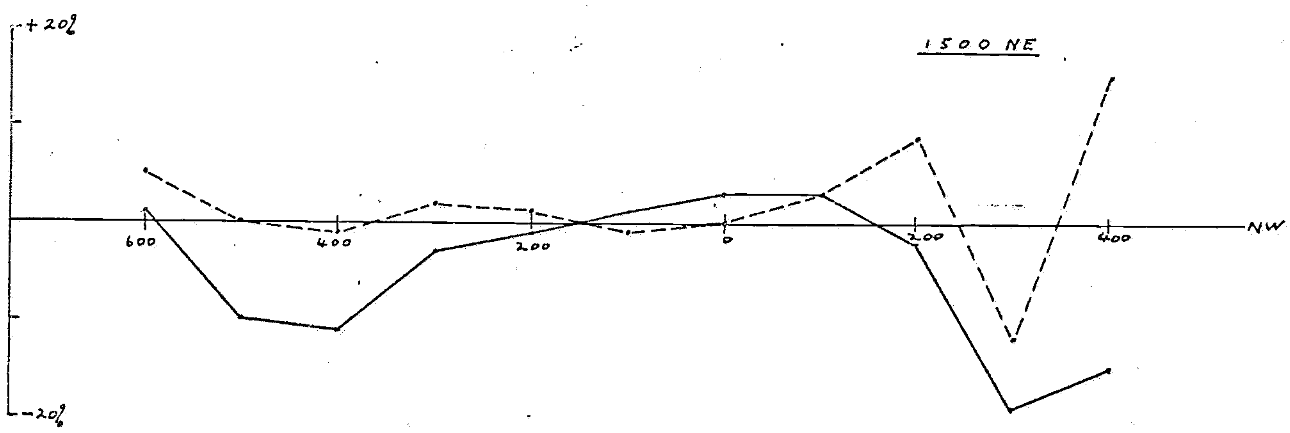


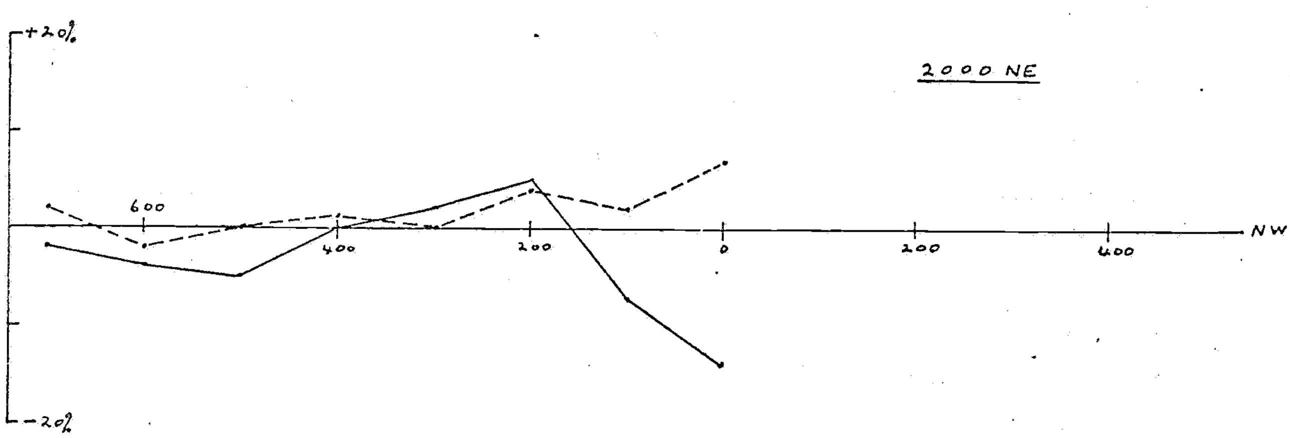
BEARING OF LINE 360°

FAULT LINE GRID

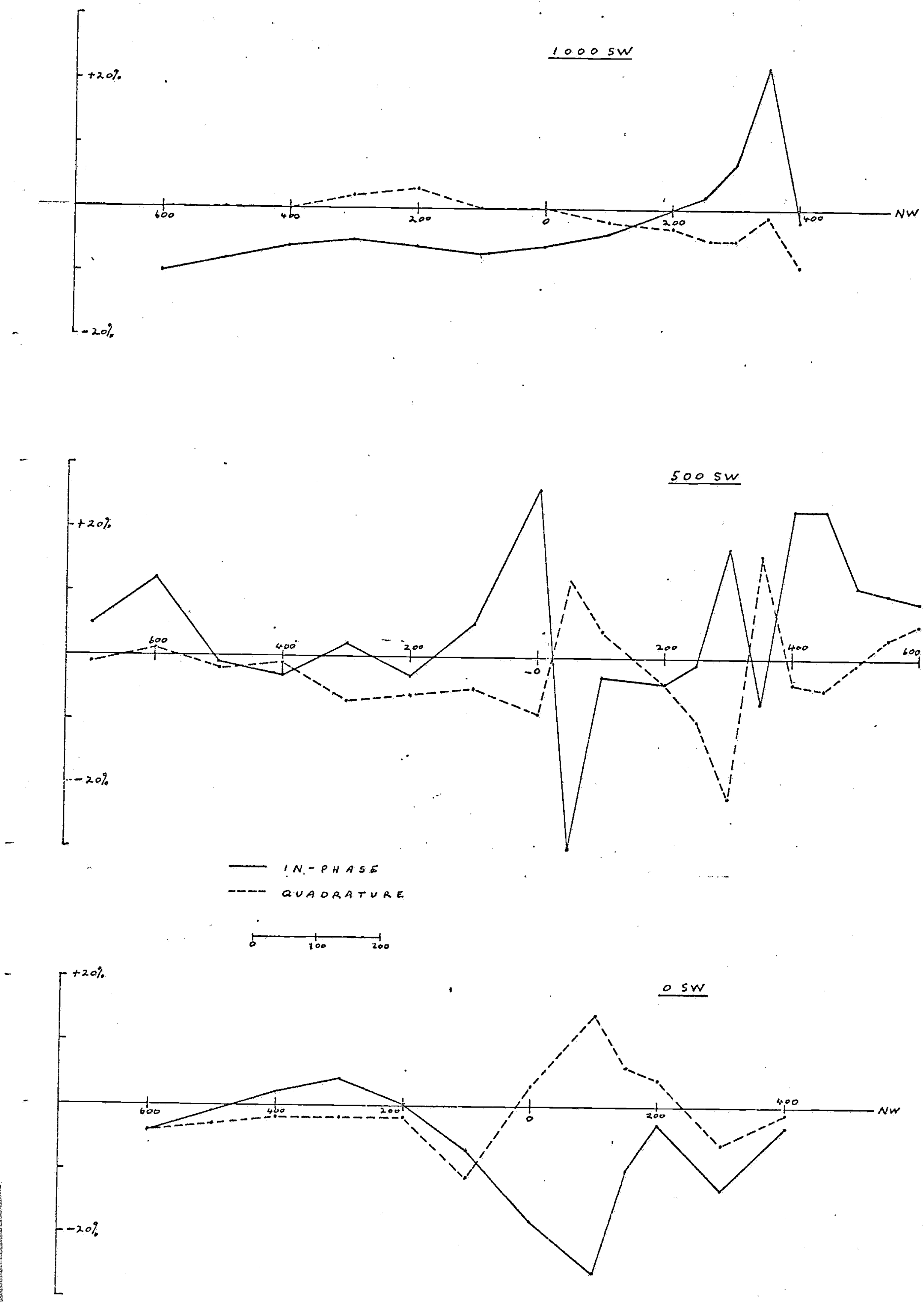




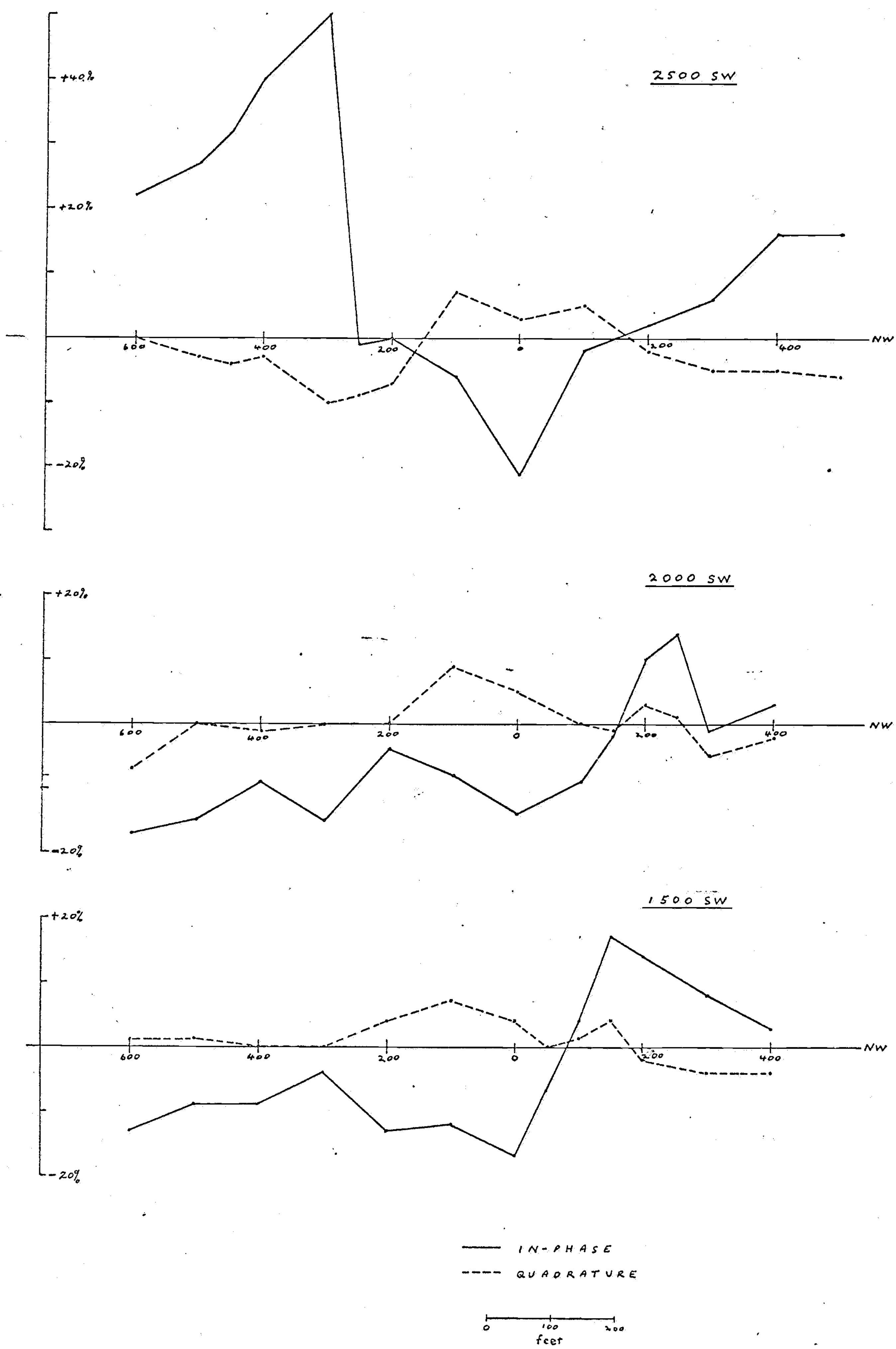




FAULT LINE GRID



FAULT LINE GRID



0125

ENDEAVOUR OIL COMPANY N.L.

REPORT ON RECONNAISSANCE DRILLING SEPTEMBER, 1972 SPECIAL MINING LEASE 536 WARRAWEENA SOUTH AUSTRALIA

Geologist: R.C. Donaldson

Date: October, 1972

Editor: D.L. Woolf

Date: November, 1972

CONTENTS

FIGURES

TABLES

SUMMARY

SML 536 has been investigated by Endeavour using geological, geophysical and geochemical surveys over selected areas of the lease. A percussion air drill programme of 6 holes totalling 765 feet was designed primarily to test the two most promising prospects. These were the extensions of the Sliding Rock copper lode and the Mississippi Valley type lead-zinc potential of the Black Springs area. The latter area ~~area~~ proved inaccessible for the available types of drill rig, and a substitute target of similar geology but lower potential was selected on the basis of available access.

One hole, PDSL 3, intersected mineralisation. The intersection in Parachilna mudstones, and which forms the north east extension of the Sliding Rock copper lode, assayed 0.42% Cu over 40 ft. with a best value of 0.82% Cu over 10 ft. Further drilling at the mine area was hindered by excess ground water, unsuitable equipment and lack of drilling supplies, and additional drill holes are required before the prospect is abandoned. The future intersections, however, would need to be considerably better in grade than the best obtained during the recent programme.

The Black Spring area lead-zinc potential has not altered. It is clear, however, that high manganese contents with the Ajax Limestones in the No. 6 area may be the cause of apparently anomalous zinc content in rocks, soils and stream sediments. Whilst this factor may affect the geochemical values, the geophysical anomalies at Black Springs Area need further explanation.

It is recommended that a further programme, using a diamond drill, should be attempted after additional detailed geological, geochemical and geophysical surveys have been completed at Black Springs. The use of a helicopter may be required to move equipment. The costs of this programme, plus some additional work on Sliding Rock copper lode, should be borne by an incoming partner in exchange for equity.

AUTHORITY

Special Mining Lease 536 was granted to Endeavour Minerals N.L., Adelaide, by the government of South Australia with tenure commencing on 21st January, 1971.

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1.00 INTRODUCTION

1.01 Location and Access

Special Mining Lease 536 is located approximately 300 miles north of Adelaide in the Flinders Ranges. Warraweena Homestead lies within the lease, 17 miles east of Beltana township. Beltana lies on the main Adelaide-Leigh Creek road. (Refer Fig. 1.)

Access to the lease is good as Leigh Creek is serviced by regular air services, and hire vehicles are also obtainable. Access within the lease is difficult due to the mountainous terrain. Rough tracks run along the broader valleys but much of the area is inaccessible for a conventional truck mounted rig, making it difficult to test all areas.

1.02 Leases

SML 536 extends from longitude 138°34"E eastwards to 138°43"E, and from latitude 30°45"S southwards to 30°47"S. It is just under 20 square miles in area with approximate dimensions of 8.5 miles from east to west and 2.3 miles north to south.

1.03 Geography and Climate

Throughout the lease, the Pound Quartzites form high abrupt ridges and massifs rising several hundred feet above the valleys. The lower areas appear to be associated with less competent limestones but there is an absence of karst topography in the area drilled.

There are extreme seasonal variations experienced in this area ranging from higher than 38°C in the summer months through to occasional snow drifts in the higher ranges in the winter season. Annual rainfall averages 5-6 inches, but is erratic in seasonal distribution.

1.04 Area History and Previous Work

The lease contains the abandoned Sliding Rock mine and the abandoned Green Rock copper mine as well as several old copper prospects.

The Sliding Rock mine produced about 1,000 tons of copper matte and copper ore between 1871 and 1877 but was closed by water flooding the mine. Production statistics of the Green Rock copper mine are unavailable.

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During 1942, the South Australian government placed a water reserve over the Sliding Rock mine area. This reserve is still current and serves as the auxiliary water supply to the Leigh Creek township. The area granted has dimensions 2,640 ft. by 2,640 ft. and includes the smelters, open cut, original shaft (1871), the main shaft (1899) and the immediate extensions of the Sliding Rock lode. The reserve extends northwards to the Sliding Rock creek. No mining is permitted within the boundaries of this water reserve. Exploration work is, however, permissable. For details of the extent of the reserve, refer to Figure 2.

During 1971, the lease was granted to Endeavour and was mapped geologically at a scale of 1 inch to 2,000 ft. by D.S. Trail (L.G. Nixon & Associates). This work was based on an interpretation of an uncorrected enlargement of air photographs with follow up field work. A comprehensive geological report accompanies this map.

Geochemical surveys, incorporating rock, soil and stream sediments have been completed in selected areas. Soil samples were taken adjacent to and within the Parachilna Formation and the Ajax Limestones and in the Sliding Rock mine area. Stream sediment surveys covering the lease area had been completed by E.Z. Industries prior to 1971 and these data were obtained from the Geological Survey of South Australia.

Geophysical surveys, using VLF.EM, have been completed over the more prospective areas by Endeavour, namely the Black Range Springs area at the eastern most end of the lease, and the Sliding Rock mine area during 1971-72. (L.G.B. Nixon & Associates Quarterly Report No. 3 1972.)

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2.00 GEOLOGY

2.01 Geology of the Prospect

The lease area is underlain principally by the uppermost Adelaidean Pound Quartzite Formation, the Lower Cambrian Parachilna mudstone/sandstones and the Ajax Limestone Formations. In the northeast corner of the lease a sequence of Sturtian and older Marinoan tillite and shale are thrust against the Ajax Limestone and Pound Quartzite. Small diapirs have intruded planes of weakness, including the thrusting of tillites over the younger Hawker Group.

The dominant structural feature within the lease is the complicated syncline which extends along Sliding Rock creek for three and a half miles west of Warraweena Homestead, and for about two and a half miles to the east. The fold axes within the lease trend usually between northeast and southeast, but have no strongly preferred direction.

A comprehensive report on the geology of the prospect including stratigraphy structure and geological history, from which the above notes have been summarised, has been compiled by L.G.B. Nixon & Associates (D.S. Trail 1971).

2.02 Economic Geology

The recently completed drilling programme was planned towards locating mineralised structures within the Cambrian sediments, notably the Parachilna and Ajax Limestone formations. Numerous pits and shafts had been excavated during the late 1800's within the Cambrian formations, most of which are located within a mile of the Sliding Rock mine.

The Sliding Rock mine was sunk on a mudstone-ironstone lode reportedly containing the oxidised minerals malachite, cuprite and native copper. The ore body lies in a fault zone cutting the northern limb of an easterly plunging anticline, thereby separating the Pound Quartzite on the west from the Ajax Limestone on the east (D.S. Trail 1971 p.28).

Geochemical soil surveys have indicated the zinc and copper contents of the Parachilna/Ajax Limestone contact to be anomalous at several localities. Zinc anomalies also occur at higher stratigraphic levels within the Ajax Limestone.

The extensions of the Sliding Rock mine lode, together with several other holes to test the Ajax Limestone/Parachilna formation, were programmed as drilling targets on the basis of geological, geochemical and geophysical data. The latter were selected as alternative targets in view of the lack of access to the Black Springs lead/zinc anomalies which had been selected as a higher priority target previously (L.G.B. Nixon & Associates Report No. 3).

3.00 DRILLING

3.01 Techniques Used

Between 22nd September and 27th September 1972, drilling was carried out with a Foxmobile top drive rotary rig designed to drill both vertical and angle holes. A Schramm compressor was used in conjunction with the rig. A cyclone hopper and collector box were used to trap all the cuttings.

Prior to bagging, the sample was split by a Jones Splitter sufficient times to result in an 8 to 10 pound (weight) composite sample being taken for assay. A sampling interval of 5 ft. was used throughout the programme. All holes, bar one, were drilled at an angle of minus 60^{o} to the horizontal, the remaining hole being depressed at an angle of minus 70^{o} to the horizontal due to terrain.

The holes were programmed to terminate at a depth of approximately 150 ft. in most cases. Prior to the commencement of the drilling programme, all drill hole collars were positioned according to eye and to the accessibility to the rig.

The original programme called for the drilling of seven holes, but two of these could not be drilled due to difficult terrain.

There was considerable difficulty in drilling all holes to their programmed depth. Briefly, some of the problems were:-

1. The country drilled was not fully suitable for air drilling due to water problems encountered at and below the local water table.
2. In some holes there was insufficient water in the hole to allow the return of samples to the surface.
3. There was little point in using mud down the hole with this particular rig as some rock formations were too hard for a blade bit to penetrate, and mud in the hole does not allow the use of the down hole hammer.

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4. Any future drilling programme should involve the use of a larger mud rig capable of drilling through the hard bands with a blade bit or some suitable mud bit.

3.02 Results of Drilling

A total of six holes was drilled with an aggregate footage of 765 ft. The following table (Table No. 1) sets out the actual drill hole numbering system used in the field as against the proposed numbering system detailed in the original work programme (12/9/1972). Unless indicated, all hole numbers refer to the current numbering system.

Table No. 1: Correlation of Drill Hole Numbering Systems

Drill Hole Numbering System (in order of drilling)	Original Numbering System (as set out in work programme 12/9/72)
P.D.S.L. 1	P.D.S.L. 6
2	4
3	1
4	2
5	Not programmed
6	Not programmed

For drill hole locations, refer to Figure 2. All holes were prefixed P.D.S.L. - percussion drill sliding lode.

As can be seen from Table No. 1, only four of seven holes originally programmed were drilled.

P.D.S.L. 3 (original numbering system) was not drilled as the hole 150 ft. to the NNE (P.D.S.L. 4) showed no signs of mineralisation. The steep terrain would have made the positioning of the hole extremely difficult. P.D.S.L. 5 and P.D.S.L. 7 (original numbering system) were not drilled due to poor access.

P.D.S.L. 1 is located approximately 4,000 ft. WNW from the Sliding Rock Mine. It was designed to test a zinc bearing ferruginous capping (15 ft. in width) in the Ajax Limestone. A vertical shaft was sunk into this ferruginous capping some years ago. The drill hole collar is situated 75 ft. south from this capping. Below the top few feet of limestone, clays containing varying proportions of manganese were intersected, possibly Parachilna formation. Although the hole was terminated at 130 ft. no sample was returned from 80 ft. so further drilling was not justified.

The penetration rate of the drill between 80 ft. and 130 ft. was quite rapid, suggesting clays between these depths.

The ironstone outcrop had a southerly dip and it is anticipated that the projected ironstone capping should have been intersected within the first 80 ft.

P.D.S.L. 2 is situated approximately ½ mile southwest of the Sliding Rock Mine, almost at the convergence of two faults. The hole had two main objectives. Firstly, to test the geophysical anomaly present on the 2,500 southwest line and, secondly, to test the Parachilna formation which may have been squeezed along the fault zones.

This hole was terminated at 75 ft. due to unsatisfactory sample returns. The hole commenced in limestones down to 25 ft. followed by a sequence of alternating hard quartzite bands and softer ferruginous clay material. At the time it appeared that the drill was possibly still in the Parachilna formation sequence at 75 ft., but further drilling was not justified as only the more resistent quartzite bands were being returned to the surface. The clays slurriedand remained in the hole. Any copper mineralisation present was likely to be associated with these soft puggy clay seams. The analyses from the 30-75' zone, however, would indicate that the section is unmineralised and possibly of Pound Quartzite origin.

Hole Nos. P.D.S.L. 3, 4 and 5 are situated in the Sliding Rock mine area and were designed to test the extensions of the Sliding Rock lode. The lode has a mean bearing of N20^{o}E with an easterly dip of approximately 60^{o} according to old records. For hole locations and drill logs, refer Appendix 8.01, Figure 2.

P.D.S.L. 3 is situated 150 ft. north of the northern extent of the old mine workings. It was positioned on a weak geophysical anomaly indicated by the VLF.EM survey on the 500 northeast line at the base line. It was also designed to test the northern extension of the lode. A sequence of Ajax Limestone, mudstones (Parachilna Formation) and finally quartzites (Pound Quartzites) was intersected. The hole was terminated at 150 ft. as planned with no mineralisation noted in the cuttings. Subsequent analysis has indicated the presence of copper mineralisation between 100 ft. and 140 ft. (Refer Section 8.02, Figure 5.)

P.D.S.L. 4 is situated 150 ft. south of the southern extent of the old mine workings. It was designed to test the immediate southern extension of the Sliding Rock lode. A sequence of limestone only was intersected to 130 ft., the depth at which the hole terminated. A combination of excessive water flow and caving of the hole made it impossible to drill to greater depths. Due to the difficulty of determining the lode extension, the drill may have been sited too far to the southeast in stratigraphically higher sections in the Ajax Limestone. The amount of limestone scree and recent alluvium on the surface made it difficult to determine formation changes.

It should be noted, however, that both holes P.D.S.L. 3 and 4 were sited by chain and compass method, using descriptions of previous mine workings as a basis for the surveying of drill hole collars.

P.D.S.L. 5 is situated 100 ft. to the east southeast of P.D.S.L. 3 and with the same attitude but a projected depth of 200 ft. Due to caving, the hole was terminated at 160 ft. With the exception of the top few feet, a mudstone/shale sequence was intersected. From 50 ft. to 80 ft., the mudstones contained minor amounts of finely disseminated sulphides in which only pyrite was identifiable.

P.D.S.L. 6, situated approximately 8,000 ft. east northeast from the Sliding Rock mine area was designed to test the extension of the Pound Quartzite/Ajax Limestone contact of the Sliding Rock mine fault. It was located 125 ft. south of a small ironstone outcrop in the Ajax Limestone, designated as a copper show on the geological map (D.S. Trail 1971). The drill intersected a few feet of limestone grading into clayey sandstones and intersected a hard ironstone formation at 108 ft. The hole was terminated at 120 ft. in ironstone as no sample was returned from 110 ft.

It should be noted that the 'copper show' as per D.S. Trail geological map is a relatively recent pit excavated by the Landowner's son twelve months ago in search of gold. The Pound Quartzite/Ajax Limestone contact was not intersected due to drilling difficulties.

3.03 Provisional Conclusions

1. The drilling programme was not altogether successful in reaching the full programmed depths, mainly because the country drilled was not fully suited to air drilling. Future drilling programmes should involve the use of a larger mud rig. Unfortunately, the terrain is unsuitable for the use of larger rigs, especially on the steeper slopes.

2. P.D.S.L. 3 was the only hole drilled to completion with sample return as laid out in the original programme. An acceptable depth, however, for sampling and assay purposes was reached in hole nos.

P.D.S.L. 1, 2, 3, 4 and 5 but not P.D.S.L. 6.

3. No visible copper mineralisation was noted in any of the holes, although this was probably to be expected considering the type of mineralisation sought, i.e. oxides of copper in a clay matrix.

4. Even from the drilling of the holes in the Sliding Rock mine area, viz. P.D.S.L. 2, 3, 4 and 5, the origin of mineralisation is not clear. Several factors are, however, apparent. The lode reportedly strikes at N20^{O}E and transverse to the regional strike. The fault located to the northwest of the mine has a mean strike of N40^{O}E. It is doubtful, therefore, whether the copper mineralisation is associated with the major fault zone. It is envisaged that secondary enrichment has taken place within a past water table along a shear (N20^{O}E) or tension fissure near the apex of the easterly plunging anticline into which the old mine workings were excavated. This shear zone may have intersected a sequence (portion of the Parachilna Formation?) containing copper mineralisation. Drilling, as evidenced in P.D.S.L. 4 and barren pits to the southwest of the mine area, suggests that mineralisation may be localised to the immediate mine area and, in fact, the richest sections were mined out during the nineteenth century.

4.00 ANALYSIS

4.01 Techniques Used

All samples were analysed by McPhar Geophysics Pty. Ltd. of Adelaide. Samples were assayed for the elements Cu, Zn and Co by A.A.S. method. Drill cuttings from the field were bagged in 5 ft. intervals but had to be coupled together into 10 ft. intervals prior to analysis. These 10 ft. samples were then dried, crushed, pulverised and finally subjected to analysis.

4.02 Results of Analysis (Section 8.02)

Assay results, together with drill hole profiles, are plotted together on Figure Nos. 5, 6, 7, 8 and 9. Background values vary for each hole but values of 20-70 ppm Cu, 40-200 ppm Zn and 40-60 ppm Co are frequent. They appear to represent unmineralised formations intersected.

In P.D.S.L. 1 (Figure 3) the Cu and Co values parallel each other. The Zn profile values are higher than background with values up to 980 ppm Zn recorded. Manganese coatings on chip returned were abundant in this hole.

In P.D.S.L. 2 (Figure 4) analytical values decrease rapidly from 30 ft. to 75 ft., indicating that this section is unmineralised and possibly of Pound Quartzite origin.

P.D.S.L. 3 (Figure 5) intersected 0.82% Cu between the 100 ft. and 110 ft. depth interval and 0.42% Cu over the 100 ft. to 140 ft. interval. Corresponding Zn and Co values over these depths are tabulated below (Refer Table 2).

Between 100 ft. and 105 ft., heavily ferruginised mudstones were described in which possible rich zones may be present. Significantly high cobalt and occasional zinc values were noted outside the main copper intersection in higher sections of the Parachilna Formation.

Table 2: Selected Assay Results from P.D.S.L. 3

Sample Description		Cu (ppm)	Zn (ppm)	Co (ppm)
P.D.S.L. 3	100-110'	8,200	60	20
	110-120'	1,600	145	80
	120-130'	5,000	290	310
	130-140'	2,000	260	310

These Cu values, although initially encouraging, appear to fall well below the average grade mined in the late 1800's. It should be kept in mind that P.D.S.L. 3 is only 150 ft. beyond the extent of the old workings.

P.D.S.L. 4 (Figure 6) drilled to the immediate south of the old mine workings, failed to intersect the lode as indicated by analysis.

P.D.S.L. 5 (Figure 5), 100 ft. to the east southeast of P.D.S.L. 3, showed no values of economic interest, the highest values being recorded at the 80 ft. to 90 ft. interval which are 110 ppm Cu, 200 ppm Zn and 45 ppm Co respectively. The minor sulphides noted between the 50 ft. to 80 ft. interval are not reflected in the assay results. This section reflects unmineralised Parachilna formation. The anomalous values recorded in P.D.S.L. 3 were not repeated in P.D.S.L. 5 as the hole was terminated before the projected lode was intersected.

P.D.S.L. 6 (Figure 7) failed to intersect any economically interesting zones. It should be noted that this hole was terminated prematurely due to lack of sample return.

4.03 Provisional Conclusions

1. With the exception of P.D.S.L. 3, the analytical results from the Sliding Rock mine area are not of economic interest. The assay results from P.D.S.L. 3 of 0.42% Cu over 40 ft. are less than those mined in the 19th Century. However, within the 10 ft. section of 0.82% Cu, there could be rich zones with values approaching 2% Cu.

2. P.D.S.L. 4, also stopped prematurely, has indicated that the Parachilna Formation has deviated towards NE-SW in strike and it is still not concluded whether the lode extends southwestwards.

3. The Sliding Rock lode is structurally controlled within the Parachilna Formation adjacent to the Sliding Rock fault, and possibly by the apex of an easterly plunging anticline. Ore grade is possibly controlled by the action of varying water table levels during recent geological time.

4. The present drilling programme has indicated that the Sliding Rock lode extends northeastwards at least 150 ft. beyond reported workings but may be dissipating in grade.

5. The zinc values encountered in P.D.S.L. 1 of Anomaly 6 area (Figure 8) have indicated that the ferruginous, part manganiferous, cappings occurring within the Ajax Limestone formation can yield seemingly anomalous base metal values without being related to economic mineralisation.

5.00 CONCLUSIONS

1. The drilling programme was not completely successful as the rig used proved inadequate. The country in this area is not fully suited to air drilling in view of the near surface water table. A smaller rig capable of coring would have been better suited to the terrain and difficulties encountered below the near surface water table would have been reduced.

2. The rugged Black Springs area (Figure 8) in the eastern flanks of the lease was designated number one priority for the original drilling programme. This area is a prospective target for lead/zinc mineralisation as evidenced by geochemical and geophysical surveys. Unfortunately, no drilling contractor contacted possessed the necessary drilling equipment for the Black Springs region at the programmed drilling period.

A substitute area, priority 6 (Figure 8) was drilled (P.D.S.L. 1) for prospective Mississippi Valley type zinc deposits because of better access. P.D.S.L. 1 was virtually a wildcat hole but yielded cuttings with zinc analyses higher than background up to 980 ppm Zn. It is uncertain, but probable, that the scavenging nature of manganese, noted in the cuttings, has a beneficial effect on the zinc content.

It is emphasised that this area is considerably less prospective than the Black Springs area with its potential lead/zinc Mississippi Valley type mineralisation.

3. The Sliding Rock Mine extensions were drilled (Figure 8) and indicated that the lode continued at least 150 ft. to the northeast of the old workings. Drilling failed to define the southwestern extension, but it may still be present.

0.82% Cu was analysed over a 10 ft. interval in P.D.S.L. 3 at Sliding Rock Mine, with possible rich zones within the 100 ft. to 105 ft. section in which heavily ferruginised mudstones were described. These grades are well below the ore grade worked during the nineteenth century.

The Sliding Rock lode appears to be associated with the intersection of a structural feature within a section of the Parachilna Formation. It is clear from P.D.S.L. 5 that the undisturbed mudstones (Parachilna Formation) are not mineralised.

The original objective of defining a lode structure with grades in excess of 5% copper has not been attained. Further drilling at Sliding Rock would be required, however, to negate the possibility of a southwestern extension of the lode.

4. Drill holes located on the southwest (P.D.S.L. 2) and northeast (P.D.S.L. 6) extensions of the Sliding Rock fault did not define mineralisation. At the P.D.S.L. 2 location, it is doubtful whether

Parachilna formation is represented. At the latter location, a further drill hole would be required to elucidate the section due to the termination of P.D.S.L. 6 before target depth was reached.

6.00 RECOMMENDATIONS

1. The mineral potential of the SML 536 area has not been changed substantially by the present programme.

The Black Springs area requires exploratory diamond drilling based on the most prospective geochemical and geophysical targets. It may be necessary to use a helicopter to assist the movement of drill and supplies. Before drilling takes place, however, it would be desirable to prepare a detailed geological map of the Ajax Limestone zone, using a closer grid interval than that available. Additional detailing of the geophysical anomalies and checking of sub-outcropping rock geochemical data should be applied. The cost of such a project has been estimated to be approximately $15,000.

2. If such a drill programme is approved at Black Springs, additional check diamond drilling should be used to clarify the potential of the Sliding Rock lode extensions. The cost of this work is estimated at $8,000.

3. Further checking by VLF.EM geophysics, roch geochemistry and geological mapping could be applied to areas 3 and 4 in particular by the geologist assigned to the project. This cost is estimated at $3,500.

4. It is recommended that the projects outlined in 1 to 3 above should be proposed as a joint venture to interested companies in return for equity.

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7.00 REFERENCES

L.G. Nixon & Associates Report Author D.S. Trail (1971) — The Geology of Special Mining Lease 536, Warraweena, South Australia, and the Results of Geochemical Sampling.

L.G. Nixon & Associates (1972) — Quarterly Report No. 3. For the Fourth Quarter ending 21st January, 1972. SML 536, Warraweena Area, Flinders Ranges, South Australia.

APPENDIX 8.01

DRILL HOLE LOGS

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Endeavour Oil Company N.L.

ROTARY/PERCUSSION SAMPLE LOG

Area WARRAWEENA - SLIDING ROCK
RIG ~~Claim No.~~ FOX MOBILE
Hole No. P.D.S.L. 1
Co-ordinates
Total Depth 130' 39.62
Date 22/9/1972
Logged by R.C. DONALDSON
Drillers W.L. SIDES & SON

Sample Depth	Assay No.	Rock Type	DESCRIPTION
			Hole collar: situated 75' bearing 195° from shaft.
			Hole declination: -60° to the horizontal.
			Hole altitude: N15°E
			Bit: 4 3/4" blade bit.
0-5'			Mottled brown-buff and light grey friable clays and limestone.
5-10'		Limestone	Buff coloured, sample intervals comprising mostly buff clay particles together with -30% hard light grey limestone chips.
10-15'		Limestone & Sandstone	Buff coloured sample interval - comprising buff friable clays exhibiting manganiferous staining; light grey limestone and hardened clayey sandstone particles.
15-20'		Ironstone Sandstone	Buff coloured sample intervals comprising massive hard ironstone, red/brown ferruginous sandstone, hardened clayey sandstone and a small %-age of limestone.
20-25'		Sandstone Limestone	Buff coloured sample interval comprising 40% light grey hard limestone 50% buff clayey hardened sandstone containing a small %-age of lime. Remainder of sample consists of ironstone.
25-30'		Clays	Buff coloured sample intervals comprising mostly friably brown and grey clays, small %-age (15%) of ironstone and hardened sandstones.
30-35'			Tan coloured sample intervals comprising mottled ferruginous friable yellow/brown/grey clay particles - balled returns.
35-45'		Clays	Sample intervals very similar to 30-35' interval.
45-50'			Chocolate brown clay returns comprising buff friable clays with thin seams of manganese.
50-55'			Dark brown to grey balled clay returns comprising mostly friable clays as above but

Endeavour Oil Company N.L.

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ROTARY/PERCUSSION SAMPLE LOG

Area WARREWEENA - SLIDING ROCK
Hole No. P.D.S.L. 1
Total Depth 130'
Logged by R.C. DONALDSON
Claim No.
Co-ordinates
Date 22/9/1972
Drillers W.L. SIDES & SON

Sample Depth	Assay No.	Rock Type	DESCRIPTION
			with abundant manganese staining in places.
			Also present is a small %-age (up to 15%)
			of ironstone with coatings of manganese.
55-60'			Similar to above.
60-65'			Dark brown sample intervals comprising friable
			buff and green grey clays with a few ironstone
			manganese coated chips.
65-80'			Balled clay returns similar to above.
			80' water table.
80-130'			No sample returns. Hole terminated at
			130'
			NOTES:
			1. Hole commenced 10.15am, terminated 5.30pm.
			2. Hole was not making sufficient water to
			flush returns to surface.
			3. Put 50 gallons water down hole - results
			negative.
			4. Mud required for chip returns.

Endeavour Oil Company N.L.

ROTARY/PERCUSSION SAMPLE LOG

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Area: WARRAWEENA - SLIDING ROCK
RIG ~~XXXXXXXX~~ FOX MOBILE
Hole No. P.D.S.L. 2
Co-ordinates
Total Depth 75' 22.86
Date 23/9/1972
Logged by R.C. DONALDSON
Drillers W.L. SIDES & SON

Sample Depth	Assay No.	Rock Type	DESCRIPTION
			Hole Collar: Situated 500 paces bearing 40° from Smelter Stack.
			Hole Declination: -60° to the horizontal.
			Hole Altitude: 300° mag.
			NOTE: Hole collar positioned 100 ft. southerly from quartzite outcrop.
			Bit: 4 3/4" blade. 4 3/4" hammer.
0-5'			Red brown top soils together with hard grey limestone chips.
5-10'		Limestone	Sample interval comprises hard grey crystalline limestone chips. 10' - change bit-blade to hammer.
10-15'		"	As above.
15-20'			Off white-buff coloured sample interval comprising cream coloured limestone chips - small angular quartz particles within a lime matrix.
20-25'		"	Similar to above.
25-30'		Clayey Sandstone	Mauve coloured sample interval comprising friable mottled ferruginous grey and brown manganiferous fine grained clayey sandstone. 30' - change bit to blade.
30-40'			Similar to above.
40-45'			Similar to above except for a few hard chips of quartzite amongst the ferruginous red/brown clays - possibly bands of quartzite within the Parachilna formation??
45-50'			Sample interval comprises mostly fine mauve powder with up to 30% quartzite chips.
50-55'			Similar to above - up to 30% quartzite chips amongst fine powder and mauve/red/brown clayey sandstone chips.
55-60'			Sample interval comprises mostly ferruginous clayey sandstone particles.
60-65'			Small return only comprising ochre red to brown

Endeavour Oil Company N.L.

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ROTARY/PERCUSSION SAMPLE LOG

Area WARRAWEENA - SLIDING ROCK
Hole No. P.D.S.L. 2
Total Depth 75'
Logged by R.C. DONALDSON

Claim No.
Co-ordinates
Date 23/9/1972.
Drillers W.L. SIDES & SON

Sample Depth	Assay No.	Rock Type	DESCRIPTION
			ferruginous clayey sandstones.
			68': Change bit to 4 3/8" diameter hammer.
65-7-'			Water at 68' wet sample comprising mostly
			chips of quartzite within a slurry of brown
			mauve mud returns.
70-75'			Rate of penetration of drill indicates
			alternate bands of hard quartzite with
			softer ferruginous material. Quartzite chips
			recovered only. Quartz particles typically
			sub-rounded and in places are cemented together
			by clay. No material from the softer bands
			recovered. Hard bands may be hardened
			sandstones or quartzites? Hole terminated
			at 75'.
			NOTES:
			1. Hole commenced 7.45am, terminated 3.00pm.
			2. Possibly still in Parachilna formation but
			further drilling not justified as only hard
			bands of sandstone or quartzite are
			returned. Any copper mineralisation is
			likely to be associated with the softer
			bands which material is not returned to the
			surface.

Endeavour Oil Company N.L.

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ROTARY/PERCUSSION SAMPLE LOG

Area WARRAWEENA - SLIDING ROCK
RIG ~~Claim No~~ FOX MOBILE
Hole No. P.D.S.L. 3
Co-ordinates
Total Depth 150' 45.72
Date 23/9/1972
Logged by R.C. DONALDSON
Drillers W.L. SIDES & SON

Sample Depth	Assay No.	Rock Type	DESCRIPTION
			Hole Collar: Situated 340 ft. bearing N20°E from original shaft, thence 115 ft. bearing 110°.
			Hole declination: -60° to the horizontal.
			Hole Altitude: 290° mag. or N70°W.
			Bit: 4 3/4" hammer.
0-5'			Red brown top soils and clays with light brown limestone chips.
5-10'		Limestone	Sample interval comprises grey crystalline hard limestone chips.
10-15'			As above.
15-20'		Mudstone Limestone	Change - sample interval comprises 80%-85% friable dark grey, green, brown claystone particles. Remainder of sample consists of limestone.
20-25'		Mudstone	Sample interval comprises almost entirely friable dark grey, brown & green/grey small claystone chips - chips very small. 25' - change bit to 4 3/4" blade.
25-30'		"	Medium grey coloured sample intervals comprising >95% friable grey claystone chips.
30-35'		"	As above. Chips are probably from a grey mudstone or shale.
35-40'		"	As above - a small %-age of chips are light green/brown/grey and brown.
40-45'			As above - dark grey with minor amount of olive green and brown clay or mudstone chips.
45-50'			Similar to above - dark grey mudstones.
50'55'		Mudstone	Formation becoming firmer. Comprises mostly dark grey friable mudstones with occasional chips of brown mudstone exhibiting very thin olive green structures or seams probably related to bedding planes.
55-60'		"	Similar to above - dark grey, brown and Khaki green mudstones.

Endeavour Oil Company N.L.

0148

ROTARY/PERCUSSION SAMPLE LOG

Area WARRAWEENA - SLIDING ROCK
Hole No. P.D.S.L. 3
Total Depth 150'
Logged by R.C. DONALDSON

Claim No.
Co-ordinates
Date 23/9/1972
Drillers W.L. SIDES & SON

Sample Depth	Assay No.	Rock Type	DESCRIPTION
60-65'			Grey coloured sample interval comprising similar material as above.
65-70'		Mudstone	Sample interval similar to above.
70-75'			Slight colour change. Sample interval olive green to grey chips comprise mostly grey mudstone - siltstone, with up to 30% buff-brown mudstone chips.
75-80'		"	Similar to previous interval.
80-85'		"	As above, except for a greater %-age of brown-buff-olive green mudstone siltstone chips.
85-90'		"	Similar to above.
90-95'		"	Colour change - buff coloured sample interval comprising buff, ochre red, brown and olive green mudstones exhibiting bedding.
95-100'		"	Similar to above.
100-105'			Colour change - red brown sample interval comprising heavily ferruginised mudstones similar to those described above.
105-110'		"	Green grey coloured sample interval comprising light grey, brown, olive green and ochre red mudstones exhibiting bedding.
110-115'		"	Brown to grey coloured sample interval comprising similar material to above. A few chips contain very thin seams of manganese?
115-120'		"	Brown coloured sample interval comprising chips similar to above.
120-125'		"	Similar to above - light grey, brown, olive green, ochre red mudstone chips.
125-130'		"	Similar to above.
130-135'			" " "
135-140'			" " "
			NOTE: 138' - Penetration rate of drill indicates a change of country - harder.
140-145'		Quartzite	Brown coloured sample interval comprising

Endeavour Oil Company N.L.

ROTARY/PERCUSSION SAMPLE LOG

0149

Area WARRAWEENA - SLIDING ROCK
Hole No. P.D.S.L. 3
Total Depth 150'
Logged by R.C. DONALDSON

Claim No.
Co-ordinates
Date 23/9/1972
Drillers W.L. SIDES & SON

Sample Depth	Assay No.	Rock Type	DESCRIPTION
			balled clay returns with 50% of chips being
			quartzite.
145-15-'			Sample interval comprises quartzite chips.
			Hole terminated at 150'.
			NOTES:
			1. Hole commenced 3.30pm, terminated 7.45pm.
			2. Water table 140' - lying on top of
			quartzite.
			3. No copper mineralisation noted although
			could be contained within the fines.
			4. Commenced in Ajax Limestone, drilled
			through the Parachilna into the Pound
			Quartzite.

Endeavour Oil Company N.L.

0150

ROTARY/PERCUSSION SAMPLE LOG

Area: WARRAWEENA - SLIDING ROCK
Claim No.:
Hole No.: P.D.S.L. 4
Co-ordinates:
Total Depth: 130' 39.62
Date: 24/9/1972-25/9/1972
Logged by: R.C. DONALDSON
Drillers: W.L. SIDES & SON

Sample Depth	Assay No.	Rock Type	DESCRIPTION
			Hole Collar: Situated 362 ft. bearing S20°W
			from original shaft, thence 100 ft. bearing
			110°.
			Hole Declination: -60° to the horizontal.
			Hole Attitude: 305° magnetic.
			Bit: 4 3/4" blade.
			NOTE: Ground surface sloping -15° to the NW.
0-5'		Limestone	Sample interval comprises minor amounts of
			red brown soils with light grey/cream/brown
			Limestone chips.
5-10'		Limestone	Light grey/cream limestone chips.
			NOTE: Hole not standing up - caving.
			Move rig 15 ft. bearing 305°. Angle of hole
			changed to -70° to the horizontal.
START NEW HOLE			
0-5'		Limestone	Sample interval comprises mostly grey
			crystalline limestone.
5-10'		"	Similar to above.
10-15'		"	Buff coloured sample interval comprising brown
			and grey crystalline limestone.
15-20'			Similar to above. ¼ to½" chips.
20-25'			" " " Manganese staining.
25-30'		"	" " " " "
30-35'			" " " " "
35-40'			" " " " "
40-45'		"	Olive green-gray sample interval 15% brown and
			grey limestone chips, 85% fine limestone
			powder - ground extremely hard.
			45': Change bit - hammer to blade.
45-50'		Limestone	80% of sample interval comprises powdered
			limestone; 20% small limestone chips - grey
			and brown.
50-55'		"	Similar to above. 55': Change bit - blade→
55-60'			tricone bit. Light grey and brown limestone
			chips, much of sample finely ground to

Endeavour Oil Company N.L.

0151

ROTARY/PERCUSSION SAMPLE LOG

Area WARRAWEENA - SLIDING ROCK
Hole No. P.D.S.L. 4
Total Depth 130'
Logged by R.C. DONALDSON

Claim No.
Co-ordinates
Date 24/9/72-25/9/72
Drillers W.L. SIDES & SON

Sample Depth	Assay No.	Rock Type	DESCRIPTION
			limestone powder.
60-65'		Limestone	Similar to above.
65-70'		"	68' - Slight change of penetration of drilling rate - faster. Slight colour change - sample interval mainly grey with minor amount of light brown powdered material. Sample consists essentially of grey limestone as above.
70-75'		"	Beige brown coloured sample interval comprising grey limestone chips amongst a brown powder.
75-80'		"	Drilling rate slower. Sample interval comprises grey limestone chips in a light grey powder.
80-85'		"	Similar to above.
85-90'		"	Beige coloured sample interval comprising small chips of grey crystalline limestone in a beige to grey powder.
90-95'			Slightly faster rate of penetration. Sample interval similar to above.
95-100'		"	Sample interval similar to above.
100-105'			Similar to above.
			106' - Water
105=110'		Limestone	Wet sample comprising dark grey fine grained-medium grained limestone chips. Thin veins of calcite noted in some chips.
110-115'		"	As above - water flow increasing - approx. 400 gallons/hr. - saline.
115-120'		"	As above.
120-125'		"	" "
125-130'		"	" "
			Hole terminated at 130' in dark grey crystalline limestone.
			NOTES:
			1. Hole commenced 4.00pm 24.9.72. Terminated

Endeavour Oil Company N.L.

0152

ROTARY/PERCUSSION SAMPLE LOG

Area WARRAWEENA - SLIDING
Hole No. P.D.S.L. 4
Total Depth 130'
Logged by R.C. DONDADSON

Claim No.
Co-ordinates
Date 24/9/72-25/9/72
Drillers W.L. SIDES & SON

Sample Depth	Assay No.	Rock Type	DESCRIPTION
			5.30pm 25/9/72.
			2. Water flow at 130' between 600 & 700 gallons per hour.
			3. Hole starting to cave due to water pressure and flow rate.
			4. No sign of mineralised zone.

Endeavour Oil Company N.L.

0153

ROTARY/PERCUSSION SAMPLE LOG

Area: WARRAWEENA - SLIDING ROCK
Hole No.: P.D.S.L. 5
Total Depth: 160' 48.77
Logged by: R.C. DONALDSON

RIG ~~Claim No.~~: FOX MOBILE
Co-ordinates:
Date: 26/9/1972
Drillers: W.L. SIDES & SON

Sample Depth	Assay No.	Rock Type	DESCRIPTION
			Hole Collar: Situated 100 ft. bearing 110^{o}
			magnetic from hole PDSL 3.
			Hole Declination: -60^{o} to the horizontal.
			Hole Altitude: 290^{o} mag. or N70^{o}W.
			Bit: 4 3/4" tricone.
0-5'		Topsoils	Sample interval comprises red/brown soils,
			ferruginous and olive green clays with up
			to half of sample containing brown limestone
			chips? - react slightly with car battery acid.
5-10'		Weathered	Buff coloured sample interval comprising
		mudstone	brown and red clays, light brown limestone?
		minor	chips and light grey mudstones exhibiting
		limestone	manganiferous staining.
10-15'		Weathered	Buff coloured sample interval comprising
		Mudstone	mostly olive green to grey and brown
		Shale	(weathered) hardened mudstone chips.
15-20'		"	Sample interval very similar to above.
20-25'		Mudstone	Colour, change - dark grey sample interval
			comprising fine grained grey mudstone or shale.
25-30'		"	As above. 30': Change bit to 4 3/4" blade.
30-35'			Sample interval comprises grey mudstone with
			occasional chips of weathered brown mudstone.
35-40'		"	As above. 40': Water intersected.
40-45'		Mudstone	Similar to above - dark grey to grey green
		Shale	mudstone - shale chips.
45-50'			Similar to above.
50-55'			Similar to above except occasional chips (dark
			grey only?) exhibit finely disseminated small
			pyrite crystals.
55-60'		"	Again minor amounts of finely disseminated
			pyrite crystals noted. They do not appear to
			be associated with any other common association
			minerals and may therefore be syngenetic pyrite.
60-65'		"	Similar to above, a few chips exhibit minor
			amounts of finely disseminated pyrite.

Endeavour Oil Company N.L.

ROTARY/PERCUSSION SAMPLE LOG

0154

Area WARRAWEENA - SLIDING ROCK
Claim No.
Hole No. P.D.S.L. 5
Co-ordinates
Total Depth 160'
Date 26/9/1972
Logged by R.C. DONALDSON
Drillers W.L. SIDES & SON

Sample Depth	Assay No.	Rock Type.	DESCRIPTION
65-70'			Similar to above interval. 3 to 4 chips contained minor quantities of pyrite.
70-75'		Mudstone	As above.
75-80'		Shale	As above.
80-85'			Sample interval comprises mostly light green grey mudstone (85%) showing partial weathering giving some chips a brown colouration, especially along bedding planes. Remainder of sample comprises dark grey mudstones. No sulphides noted.
85-90'			Similar to above.
90-95'		Mudstones	Sample interval comprises mostly green grey mudstone chips similar to previous interval.
95-100'			Similar to above.
100-105'			As above.
105-110'			As above.
110-115'			As above.
115-120'			Colour change in water - khaki green. Sample interval comprises mostly green with some brown (weathered or ferruginised) mudstone chips.
120-125'		"	As above.
125-130'			Similar to above.
130-135'			Similar to above - the %-age of brown and green brown chips increasing. Ferruginous thin seams noted throughout mudstones.
135-140'		"	Similar to above.
140-145'			Light brown and olive green mudstone chips ferruginised along bedding planes.
145-150'			Similar to above.
150-155'			Sample interval contains fall in material possibly from the 50-80' section. Sample comprises light brown and olive green mudstones with large chips of dark grey mudstone.

Endeavour Oil Company N.L.

ROTARY/PERCUSSION SAMPLE LOG

0155

Area: WARRAWEENA - SLIDING ROCK
Hole No.: P.D.S.L. 5
Total Depth: 160'
Logged by: R.C. DONALDSON

Claim No.:
Co-ordinates:
Date: 26/9/1972
Drillers: W.L. SIDES & SON

Sample Depth	Assay No.	Rock Type	DESCRIPTION
158-160'			Sample interval has more fall in material than previous sample.
			160': Hole caving in - drill pipes stuck in hole. Pulled back about 40 ft. to clear bit.
			Hole caving continued - could not get back to bottom.
			Hole terminated at 160'.

Endeavour Oil Company N.L.

ROTARY/PERCUSSION SAMPLE LOG

0156

Area: WARRAWEENA - SLIDING ROCK
Hole No. P.D.S.L. 6
Total Depth 120' 36.58
Logged by R.C. DONALDSON

RIG ~~Claim No.~~ FOX MOBILE
Co-ordinates
Date 26-27/9/1972
Drillers W.L. SIDES & SON

Sample Depth	Assay No.	Rock Type	DESCRIPTION
			Hole Collar: Situated approximately 8,000 ft. ENE from Sliding Rock Mine area near a shallow pit dug into ironstone capping. From pit drill hole collar is 125 ft. bearing 170^{o} magnetic.
			Hole declination: -60^{o} to the horizontal.
			Hole Altitude: 350^{o} magnetic.
			Bit: 4 3/4" blade.
0-5'			Brown calcareous topsoils and brown nodules of limestone.
5-10'		Limestone	Light brown to buff coloured sample interval comprising dark grey crystalline limestone.
10-15'		"	Very similar to above.
15-20'		Clay	Colour change - chocolate brown sample intervals comprising brown clay particles plus up to 20% limestone chips.
20-25'		"	Similar to above.
25-30'		Sandstone	Chocolate brown sample interval comprising mostly brown to olive green-brown friable clay fragments. Also present are thin bands of ironstone and one or two chips of opaline silica? Drill penetration rate suggests alternating hard and soft bands.
30-35'			Similar to above.
35-40'			Slight colour change - tan to buff coloured sample intervals comprising friable ochre red ferruginous (limonitic) brown, off white to grey, and olive green fine grained sandstone or mudstone chips. Bedding planes are accentuated by limonite.
40-45'		Sandstones	As above.
45-50'			Very similar in appearance to above.
50-55'			As above.
55-60'			As above.
60-65'			As above.

Endeavour Oil Company N.L.

ROTARY/PERCUSSION SAMPLE LOG

0157

Area WARRAWEENA - SLIDING ROCK
Claim No.
Hole No. P.D.S.L. 6
Co-ordinates
Total Depth 120'
Date 26-27/9/1972
Logged by R.C. DONALDSON
Drillers W.L. SIDES & SON

Sample Depth	Assay No.	Rock Type	DESCRIPTION
65-70'			Slight colour change - brown to ochre red coloured sample interval comprising essentially as above except for an increase in the amount of ochre red sandstone/mudstone friable chips.
70-75'		Sandstone	As for 65-70' interval.
75-80'			Slight colour change to buff coloured sample intervals comprising a greater %-age of chips being limonitic brown sandstones.
80-85'			Brown coloured sample interval similar to above.
85-90'			As above.
90-95'		"	Ochre red coloured sample interval comprising sandstones similar to above - the greater percentage being ochre red in colour.
95-100'			Very similar to above.
1-0-105'		"	Brown coloured sample interval comprising friable sandstones similar to those observed above.
105-110'		Ironstone	108': Drilling penetration rate virtually reduced to a standstill. Sample interval comprises sandstones as above (105-108') then very hard small ironstone chips similar to those observed on surface where pit is dug.
110-115'		"	Very slow (approx. 1 ft./50 minutes) penetration rate. No sample return due to a small quantity of water mudding the hole. Not sufficient water to blow chip returns to surface. 110': Change to tricone roller bit.
115-120'		"	Presumably still in ironstone - no sample returns - no increase in water content - small amount of light brown slurry only being returned to surface.
			Hole terminated at 120'.

APPENDIX 8.02

ANALYTICAL DATA - ASSAY RESULTS

McPHAR

GEOCHEMICAL RESULTS

50-52 MARY STREET
UNLEY, S.A. 5061
PHONE: 72 2133
CABLE: "PHARGEO" ADELAIDE
TELEX: "PHARGEO" AA82623

0159

Samples from: ENDEAVOUR OIL
Area:
Samples of: DRILL CUTTINGS
Batch No.: CH 4246

Sheet No.: 1
Date: 28.9.72

SAMPLES DISPOSED OF AFTER TWO MONTHS UNLESS WE ARE OTHERWISE ADVISED

Sample Description		Cu, ppm	Zn, ppm	Co, ppm			
PDSL 3	0-10	100	75	40			
	10-20	60	250	80			
	20-30	130	170	75			
	30-40	35	260	140			
	40-50	50	390	250			
	50-60	30	620	300			
	60-70	45	2200	320			
171452	70-80	40	640	40			
	80-90	65	760	240			
	90-100	360	75	25			
	100-110	8200	60	20			
	110-120	1600	145	80			
	120-130	5000	290	310			
	130-140	2000	260	310			
PDSL 3	140-150	700	120	70			
PDSL 4	0- 10	80	45	55			
	10- 20	20	45	65			
	20-30	40	40	75			
	30- 40	20	40	60			
	40- 50	20	50	45			
	50- 60	20	45	50			
171453	60- 70	10	40	50			
	70- 80	20	50	60			
	80 -90	15	45	45			
	90-100	15	60	40			
	100-110	10	40	25			
	110-120	10	40	30			
PDSL 4	120-130	15	60	130			
PDSL 2	0- 10	45	120	45			
	10- 20	30	110	30			
	20- 30	25	70	20			
171451	30- 40	10	20	5			
	40- 50	10	15	<5			
	50- 60	5	20	<5<			
	60- 70	5	20	<5			
PDSL 2	70- 75	10	15	<5			
PDSL 1	0- 10	10	30	10			
	10- 20	45	120	20			
	20- 30	10	20	<5			
171450	30- 40	40	300	40			
	40- 50	45	720	60			
	50- 60	35	980	55			
	60- 70	55	680	60			
PDSL 1	70- 80	65	450	45			
PDSL 5	0- 10	50	100	40			
	10- 20	30	85	40			
PDSL 5	20- 30	30	120	50			
171454							

ANALYTICAL METHODS: Cu, Zn, Co, by AAS following conc. $HClO_4$ leach for 1 hour on 0.25 g sample

PREPARATION : Dried and Pulverised

Signed: [signature]

*37907

McPHAR

GEOCHEMICAL RESULTS

0160

50-52 MARY STREET
UNLEY, S.A. 5061
PHONE: 72 2133
CABLE: "PHARGEO"
ADELAIDE
TELEX: "PHARGEO"
AA82623

Samples from: ENDEAVOUR OIL

Area:

Samples of: DRILL CUTTINGS

Batch No.: CH 4246

Sheet No.: 2

Date: 28.9.72

SAMPLES DISPOSED OF AFTER TWO MONTHS UNLESS WE ARE OTHERWISE ADVISED

Sample Description	Cu, ppm	Zn, ppm	Co, ppm				
PDSL 5 30- 40	40	130	60				
40- 50	55	170	45				
50- 60	50	160	60				
60- 70	65	190	80				
70- 80	30	200	100				
80- 90	110 ✓	200 ✓	45 ✓				
171454 90-100	75	210	55				
100-110	65	180	40				
110-120	85	210	45				
120-130	85	210	80				
130-140	50	190	75				
140-150	65	190	60				
PDSL 5 150-160	60	200	80				
PDSL 6 0- 10	15	35	35				
10- 20	25	95	60				
20- 30	40 ✓	140 ✓	100 ✓				
30- 40	50	85	100				
171455 40- 50	60	130	80				
50- 60	60	120	80				
60- 70	70	85	75				
70- 80	65	35	30				
80- 90	75	60	40				
90-100	85	45	35				
PDSL 6 100-110	120	100	60				

ANALYTICAL METHODS:

Signed: [signature]

★37907

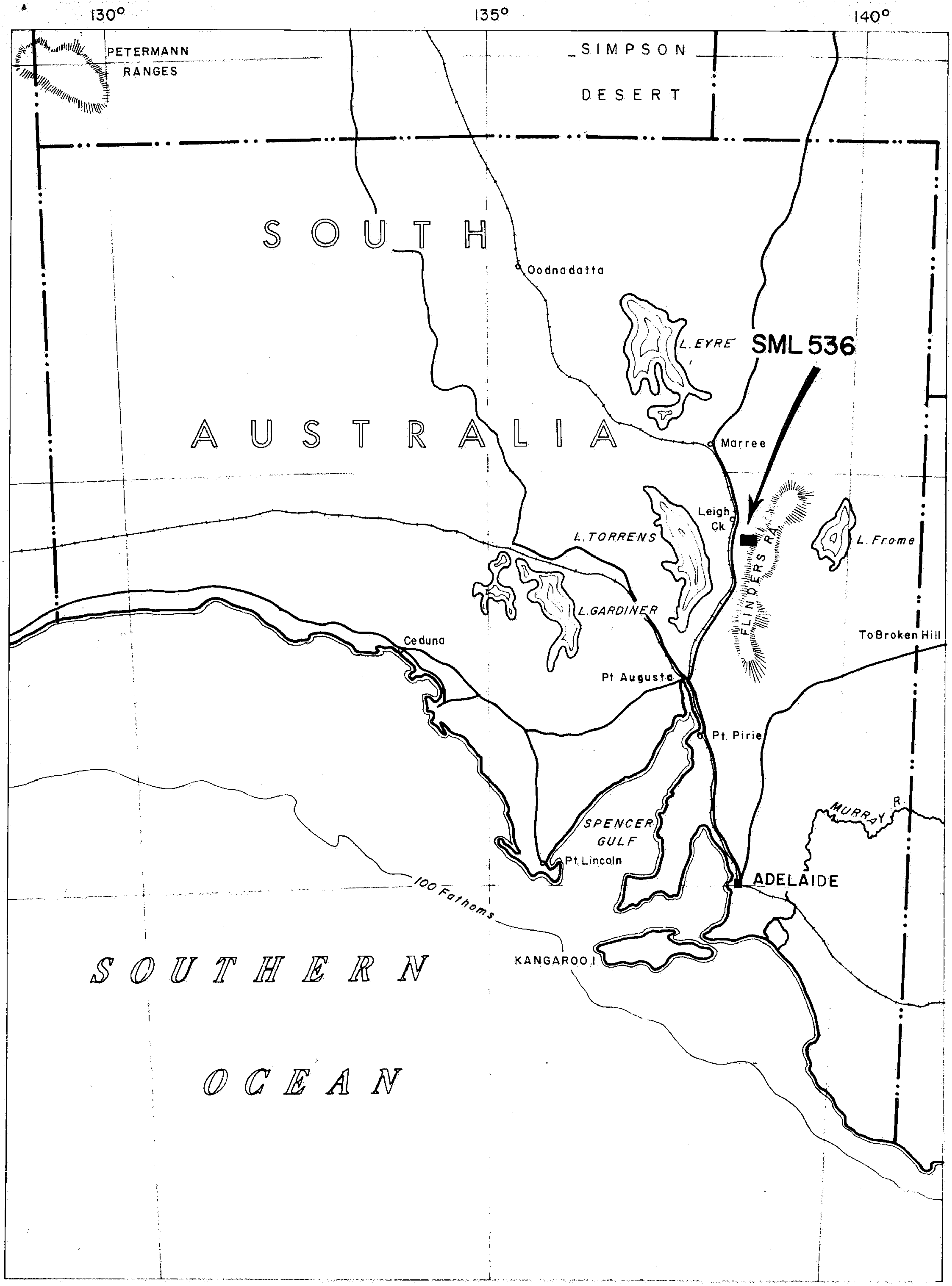


Figure 1

ENDEAVOUR OIL COMPANY N.L.

SOUTH AUSTRALIA
SML 536-WARRAWEENA AREA

LOCATION MAP

DATE: Nov., 1972 Drawing No: F 0441

0 20 40 60 80 100 150 200 250 Mls.
0 50 100 200 300 400 Km.

0162

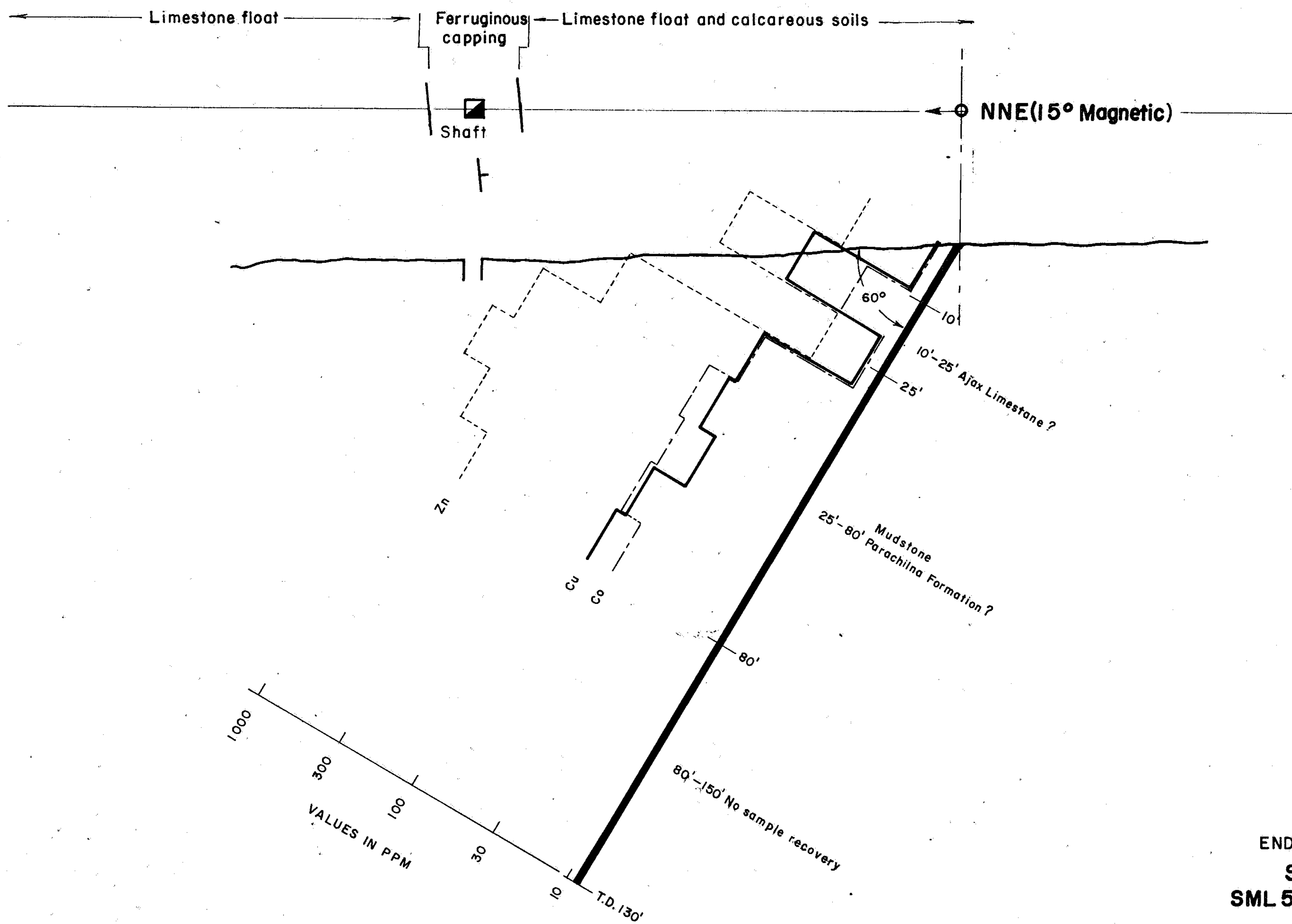


Figure 3

ENDEAVOUR OIL COMPANY N.L.

SOUTH AUSTRALIA

SML 536 WARRAWEENA AREA

DRILL HOLE PD SL I

PLAN & SECTION

AUTHOR: R.C.Donaldson November, 1972

SCALE: 1" = 25' Drawing Number: F0436

0163

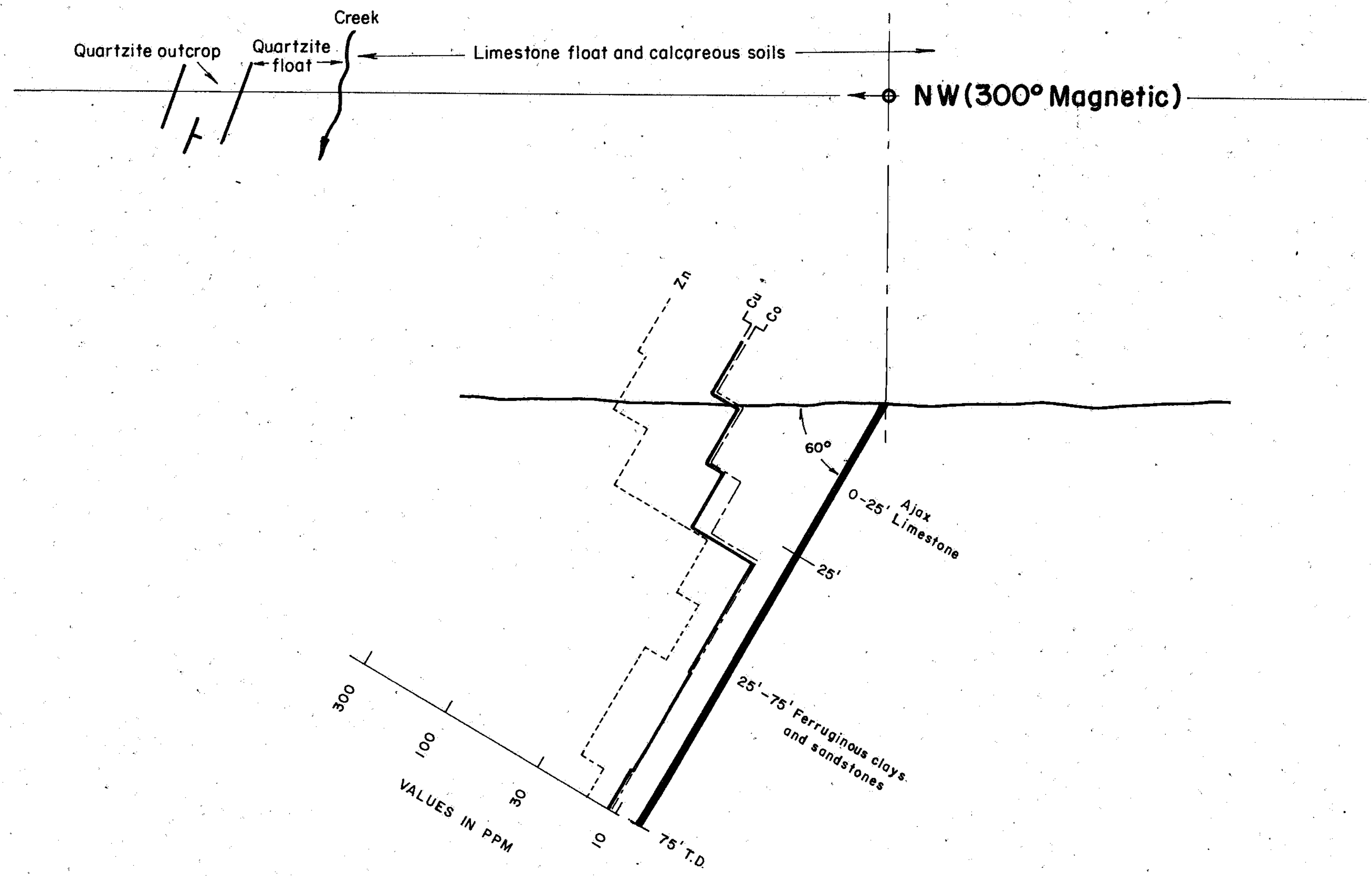


Figure 4
ENDEAVOUR OIL COMPANY N.L.
SOUTH AUSTRALIA
SML 536-WARRAWEENA AREA

DRILL HOLE PD SL 2
PLAN & SECTION

AUTHOR: R C Donaldson   November, 1972
SCALE: 1" = 25'   Drawing Number: F0437

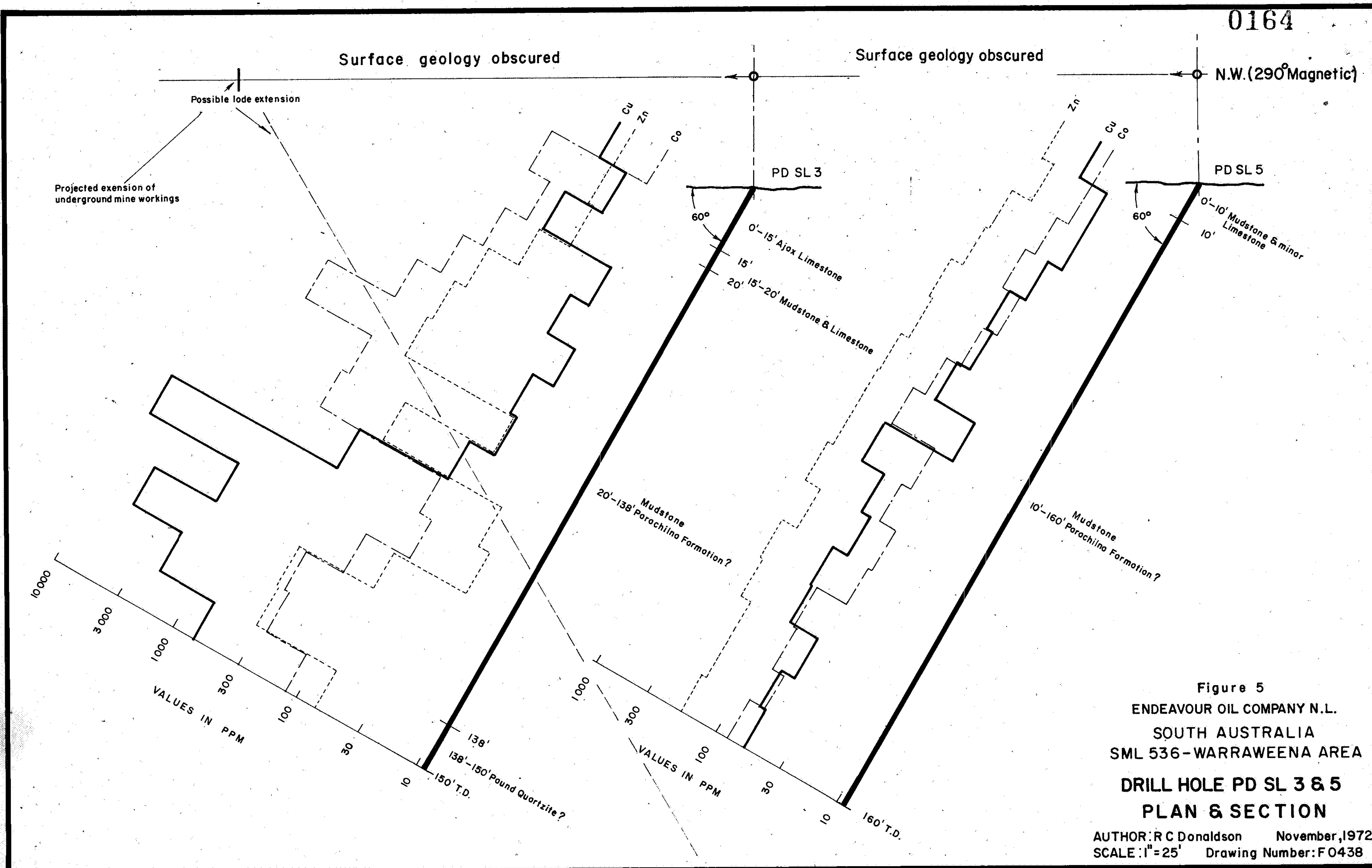


Figure 5
ENDEAVOUR OIL COMPANY N.L.
SOUTH AUSTRALIA
SML 536-WARRAWEENA AREA
DRILL HOLE PD SL 3 & 5
PLAN & SECTION
AUTHOR: R C Donaldson November, 1972
SCALE: 1" = 25' Drawing Number: F 0438

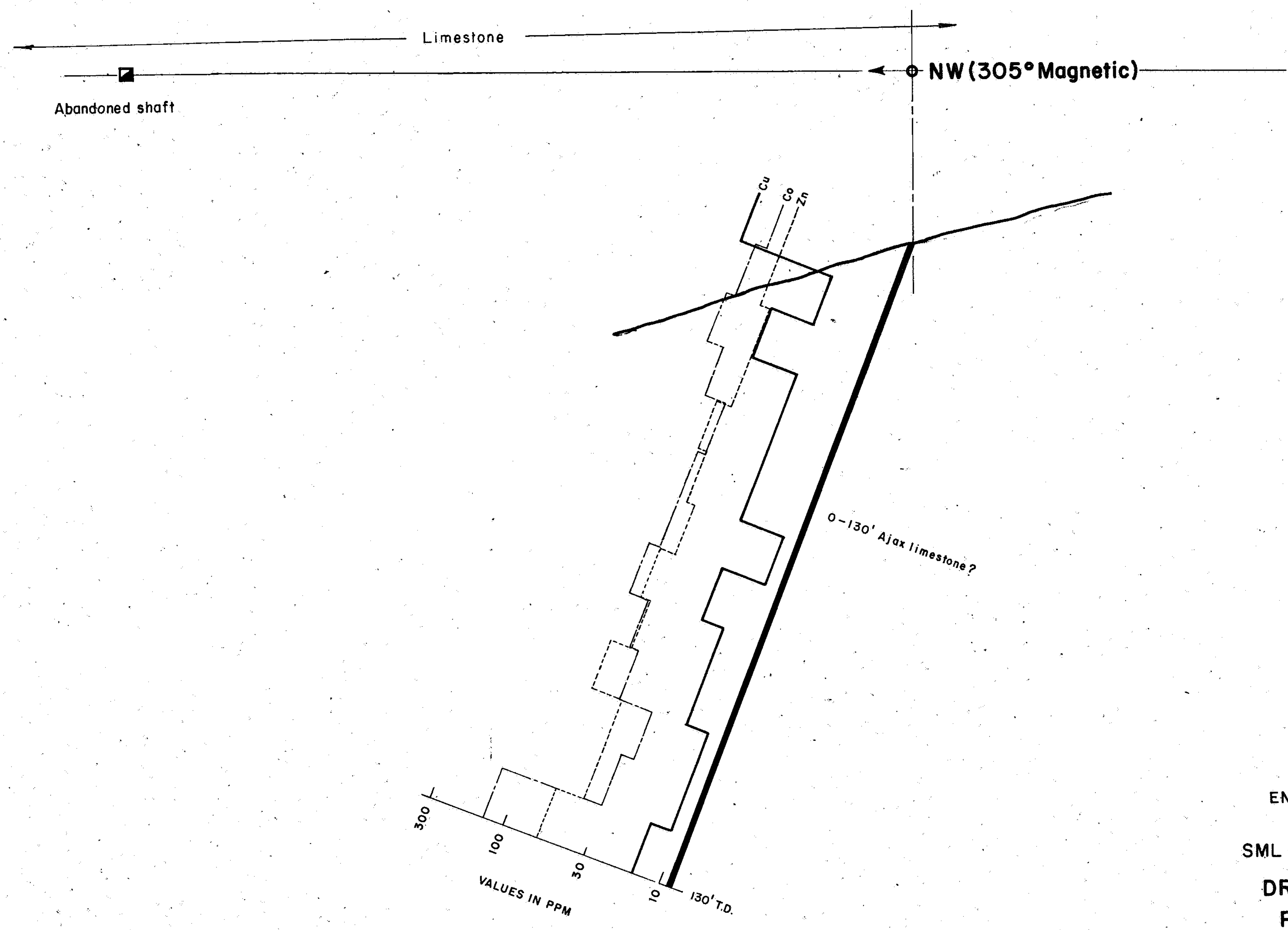


Figure 6
ENDEAVOUR OIL COMPANY N.L.
SOUTH AUSTRALIA
SML 536 - WARRAWEENA AREA

DRILL HOLE PD SL 4
PLAN & SECTION

AUTHOR: R C Donaldson November, 1972
SCALE: 1" = 25' Drawing Number: F0439

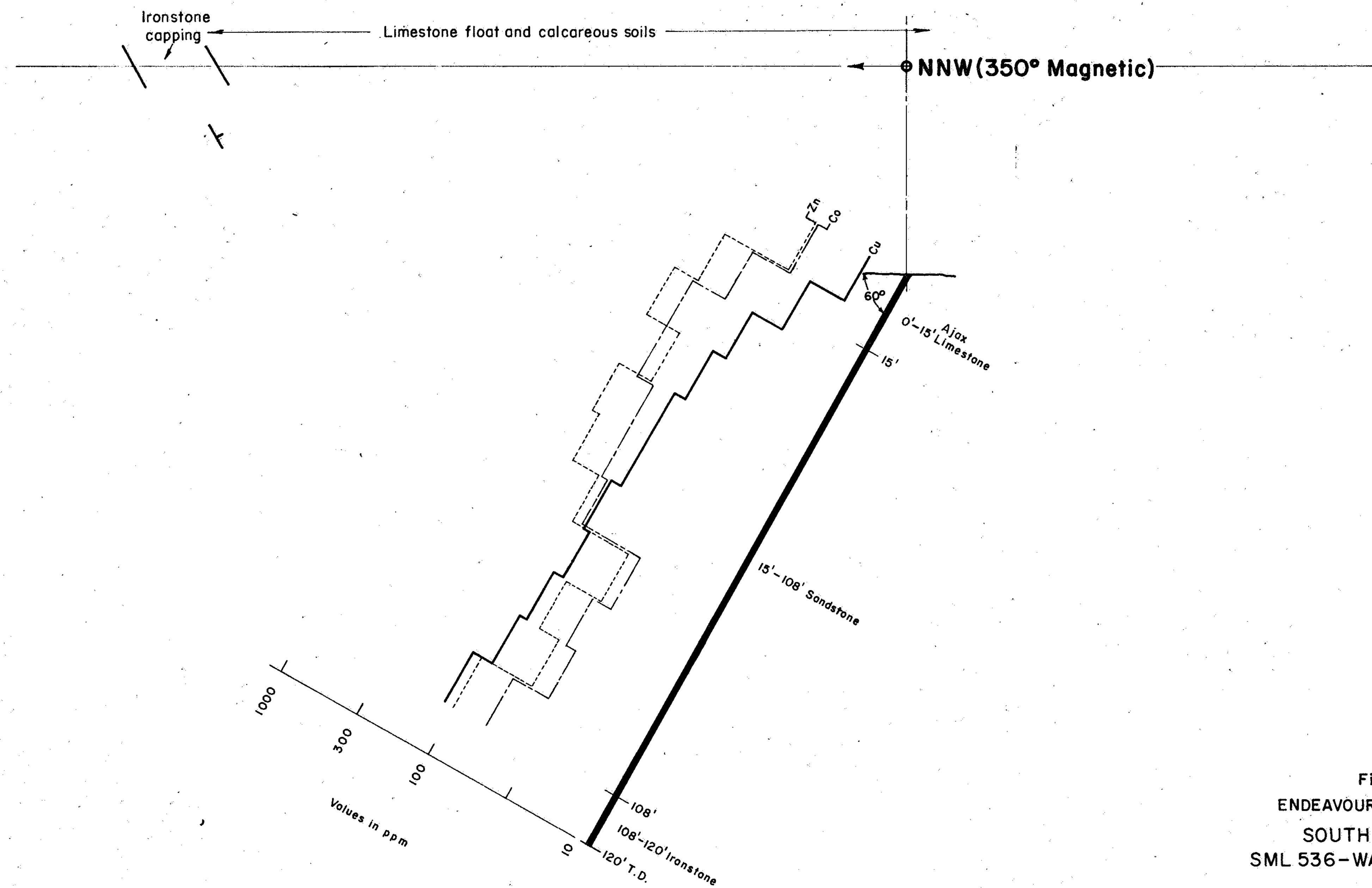


Figure 7

ENDEAVOUR OIL COMPANY N.L.

SOUTH AUSTRALIA

SML 536-WARRAWEENA AREA

DRILL HOLE PDSL 6

PLAN & SECTION

AUTHOR: R C Donaldson November, 1972

SCALE: 1" = 25' Drawing Number: F0440

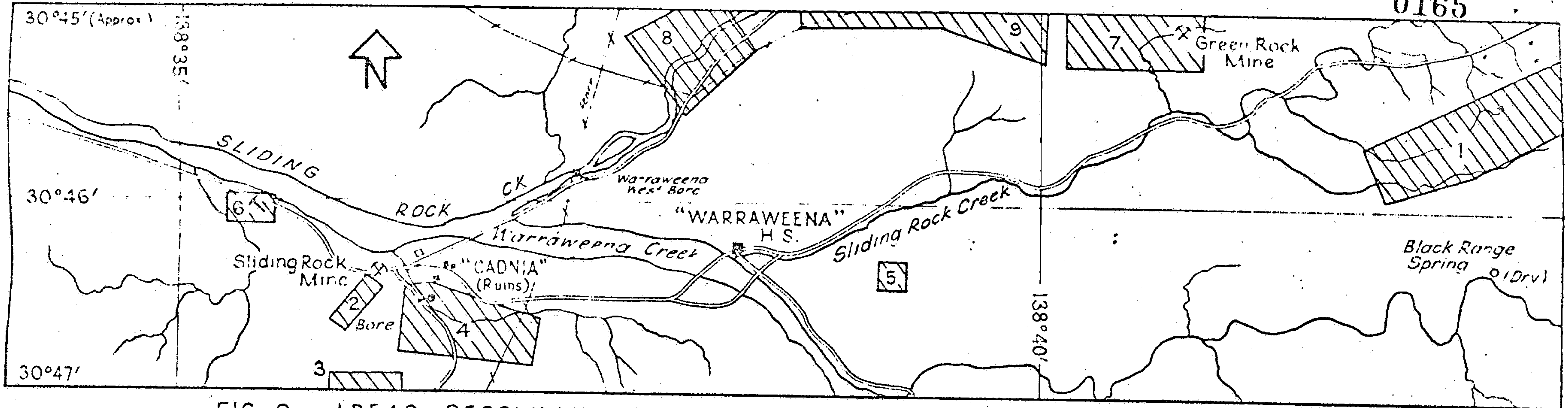


FIG. 8 AREAS RECOMMENDED FOR FURTHER INVESTIGATION IN S.M.L. 536

1. ZINC in Ajax Limestone and diapiric rocks
2. South-east extension of Sliding Rock lode
3. COPPER anomalies near base of Ajax Limestone
4. ZINC at higher levels in Ajax Limestone
5. COPPER and ZINC bearing ironstone on Parachilna Formation
6. ZINC anomaly on Ajax Limestone
7. COPPER around Green Rock Mine
8. Diapiric rocks with COPPER prospect
9. Diapiric rocks or sheared Bunyeroo Formation

Prospect Mine Track Creeks

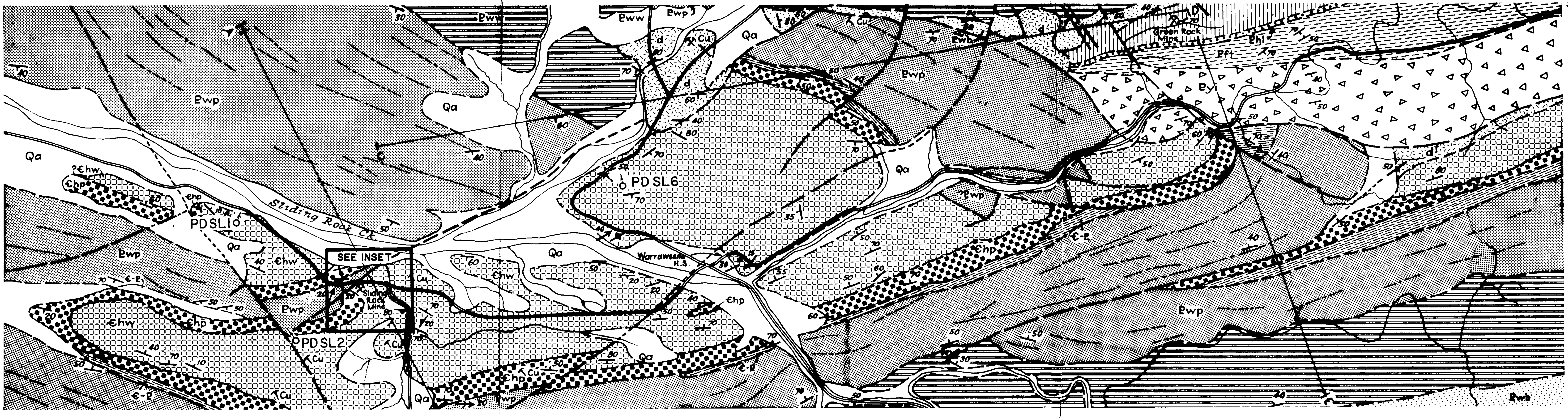
Areas for further investigation

SCALE 0 1 2 MILES

Note. Topographic detail from S.A. Dept. of Mines 60 Chain Cadnia base map

L.G. NIXON & ASSOCIATES.	
Drawn: D.S. Trail	AREAS RECOMMENDED FOR FURTHER INVESTIGATION IN S.M.L. 536
Traced: M.R.T.	
Revised	
Date	

138° 34' 138° 43'
30°45'



30°47

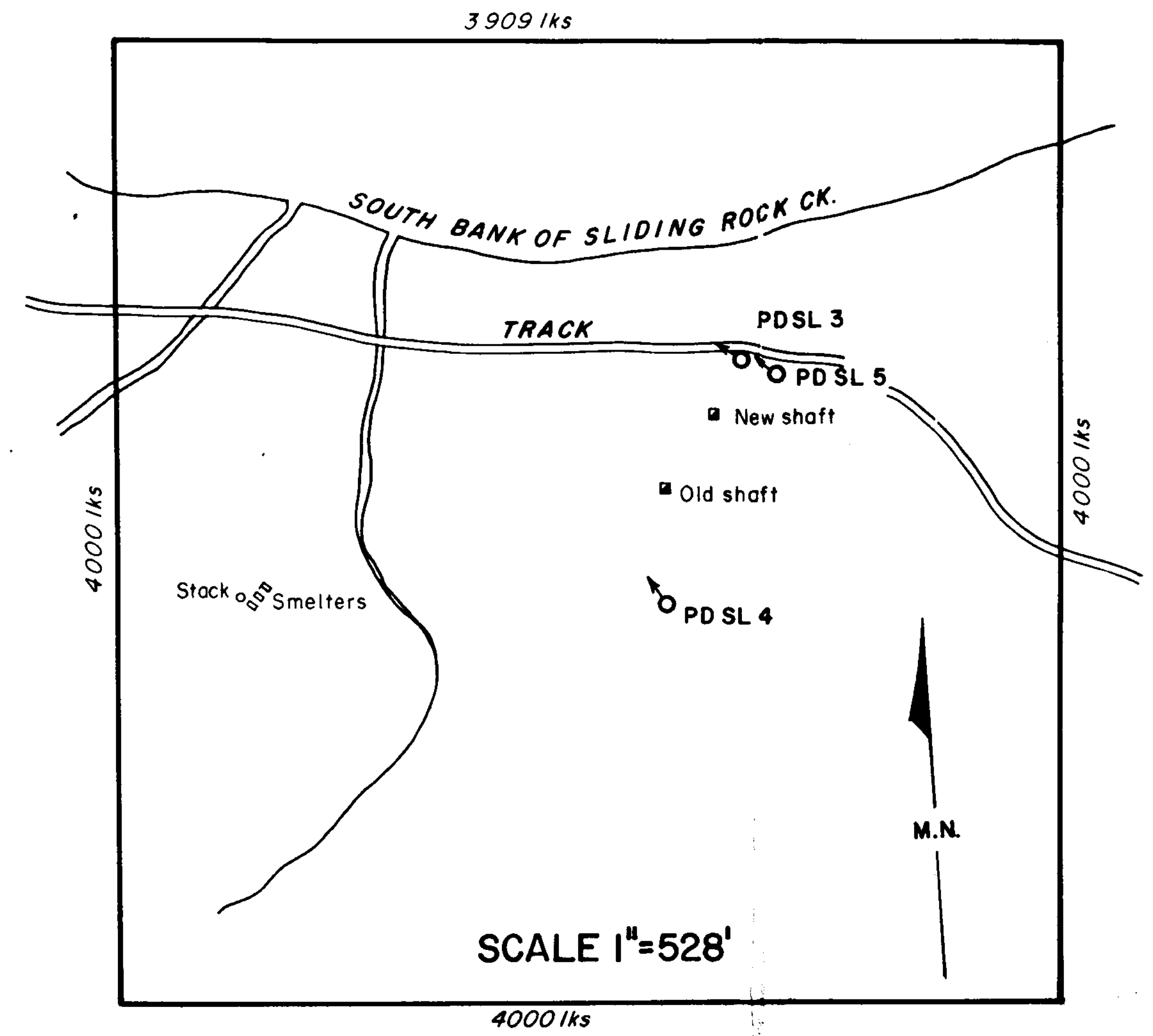
REFERENCE

CAINOZOIC				Qa	Alluvial gravel and sand, scree
PALAEOZOIC	CAMBRIAN	LOWER CAMBRIAN	Hawker Group	Ajax (Wilkawillina) Limestone — Ꞓhw	Oolitic dolomitic limestone, Collenia limestone
				Parachilna Formation — Ꞓhp	Clayey and ferruginous sandstone, worm-burrow beds, siltstone, sandy limestone
				Uratanna Formation — Є-Ꞓ	Brown shale, mudstone, siltstone
PROTEROZOIC	ADELAIDEAN	MARINOAN	Wilpena Group	Pound Quartzite — Ꞓwp	Quartzite, sandstone
				Wonoka Formation — Ꞓww	Grey limestone and siltstone
				Bunyeroo Formation — Ꞓwb	Red and green shale, mudstone and siltstone
				Brachina & Nucaleena Formations — Ꞓwn	Green and grey shale, siltstone, dolomite
		STURTIAN	Umberatana Group	Elatina Formation — Ꞓhl	Green and grey shale
				Tapley Hill Formation — Ꞓft	
				Appila Tillite — Ꞓy	Massive boulder beds
				d	Diapiric rocks

SYMBOLS

Strike and dip of bedding	60	Geological boundaries, accurate	
Vertical beds		" " , approx.	
Strike and dip of cleavage	20	Fault	Fault concealed
Plunge of lineation, fold axis		Trend lines from air photos	
Creeks		Copper mine abandoned	Cu
Road, track		Copper prospect abandoned	Cu
		Percussion Drill Hole	O PDSL1

INSET
SHOWING AREA RESERVED FROM MINING



LOCATION MAP

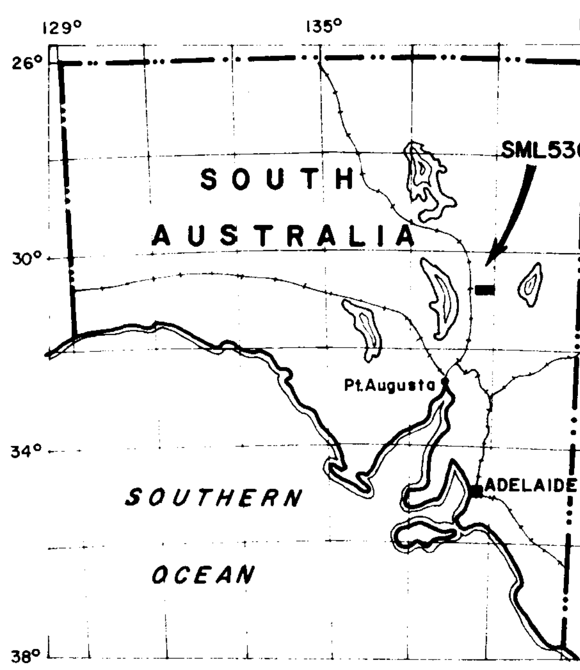


Figure 2
ENDEAVOUR OIL COMPANY N.L.

SOUTH AUSTRALIA
SML 536 - WARRAWEENA AREA

GEOLOGICAL MAP AND DRILL HOLE LOCATIONS

0 2000 4000 6000 8000 10000 Feet
0 50 100 200 300 Metres

AUTHOR: D.S.Trail June, 1971.
REVISED: November, 1972 Drawing Number: A0442

ENV 1383-3

125/70

0168

REGISTERED OFFICE:
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VICTORIA, AUSTRALIA, 3002
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CABLES: "COOKOIL" MELBOURNE
TELEX: 31859

Endeavour Oil Company N.L.

DLW/ajm

24th January, 1973

Director of Mines,
South Australian Department of Mines,
P.O. Box 38,
Rundel Street Post Office,
ADELAIDE. S.A. 5001.

Dear Sir,

SML536 Quarterly Report for period ending
21st January, 1973

No work was completed on the SML536 during the period ending 21.1.73. During 1973, a further drilling program to examine the main zinc prospect located at Black Springs within the licensed area is being considered at a cost of $13,000. It is not anticipated that such work would be started until the cooler months.

Yours faithfully,

Chief Geologist (Mining)

CHIEF CLERK
25 JAN 1973
DEPT. OF MINES
ADELAIDE

1585