Rept.Bk.No. 69/80
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DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY

EXPLORATION SERVICES DIVISION

REPORT ON SEISMIC REFRACTION INVESTIGATIONS OVER SML.315 NEAR PERNATTY LAGOON

Clinet: Stuart's Bluff Minerals Limited

by

I.S. ROWAN
GEOPHYSICIST
EXPLORATION GEOPHYSICS SECTION

DM.806/69

18th September, 1969

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REPORT ON SEISMIC REFRACTION INVESTIGATIONS OVER S.M.L. 315 NEAR PERNATTY LAGOON

Client: Stuart's Bluff Minerals Limited

ABSTRACT

Isolated seismic refraction probes over S.M.L. 315 east of Pernatty Lagoon revealed refractor velocities often quite different from thos obtained over the outcropping rock units near Woocalla siding.

However two areas adjacent to a subsurface ridge of presumed Pandurra Formation near the eastern shore of the Lagoon have been outlined as having possible economic interest due to the interpreted stratigraphic relationships. Drill holes are recommended to test this interpretation

INTRODUCTION

At the request of Stuart's Bluff Minerals Limited a seismic refraction survey was carried out over the northern part of SML.315, north and east of Pernatty Lagoon. The purpose of this survey was to try to ascertain the depths beneath cover and the stratigraphic relationships of the rock units which are the host rocks for copper and manganese mineralisation on the western edge of Pernatty Lagoon.

The survey was carried out between the 4th and 23rd August, 1969; 35 spreads were completed on an approximate 4 mile square grid pattern in an area of approximately 700 square miles bound by latitudes 31°15' and 32°00' and longitudes 137°15' and 137°30' (Plan S.7460).

PREVIOUS WORK

A comprehensive review of geological investigations in the area from 1899 to 1967 can be found in Bulletin No.41 of the Geological Survey of South Australia (Johns,1968).

The Mt.Gunson copper deposits on the western shore of Pernatty Lagoon were discovered in 1875 and the first mining operations were begun in 1898. This area has been investigated in detail due to its economic possibilities. SML.139 which includes Pernatty Lagoon has been taken over by the Colonial Sugar Refinery Pty. Ltd. and mining of the Mt.Gunson deposits may recommence in 1970.

Geophysics was first used in the area in 1949 when a ground magnetic survey was conducted over the manganese deposits east of Birthday siding. The results showed that a magnetic anomaly was associated with the manganese/limonite deposits (McPharlin, 1951).

Regional geological mapping began in 1959 and culminated in the publishing of TORRENS geological map in 1964 and PT.AUGUSTA in 1969.

In 1961 the Bureau of Mineral Resources flew east-west aeromagnetic traverses at an elevation of 500ft. over TORRENS AND ANDAMOOKA. Results were computed by the female computers of the Exploration Geophysics Section of this Department. Two interpretations of the aeromagnetics have been made (Young, 1964 and Webb, 1968).

In 1966, at the request of Austminex Pty. Ltd., the Exploration Geophysics Section tried a number of geophysical methods in an attempt to locate mineralization around the Mt.Gunson deposits. "Induced polarization, resistivity, gravity, magnetic, electromagnetic, self potential and radiometric methods showed no diagnostic relationships to the ore occurrence" due mainly to conditions and variations in the near surface layers (Milton, 1966). Induced polarization has also been attempted by Geoscience Inc. and McPhar Geophysics but with little result.

A geological and geochemical investigation of the area was made in 1967 by Noranda Aust. Ltd. (Tonkin, 1968).

In 1968 a regional gravity survey of TORRENS was made as part of a geophysical investigation of the "Torrens hinge zone". A helicopter was used and readings were taken on a 4-mile grid. This survey was extended to cover ANDAMOOKA and PT.AUGUSTA in 1969.

DESCRIPTION OF THE AREA

General

SML.315 includes approximately 840 square miles north and east of SML.139 which includes Pernatty Lagoon. The southern extent of SML.315 is latitude 32°10'S however the present survey only extended south to Beda Bore near latitude 32°00'.

The area occupies the physiographic division known as the Bookaloo Lowlands which comprises low alluvial plains, sand dunes and numerous playas at an elevation 250-300 ft. above sea level. In the northern and eastern extremities of the lease is the Arcoona Plateau which rises 600-800ft. above sea level.

Geology

The oldest rocks known to outcrop in the area are the reddish sandstones, quartzites and grits of the Pandurra Formation.which are equivalent to the Callanna Beds of the Willouran Series. This formation forms the low tableland along the western edge of Pernatty Lagoon.

Disconformably overlying the Pandurra Formation is the Woocalla Dolomite, which outcrops as a hard blue-grey often manganiferous dolomite. The Beda and Woomera bores passed through several hundred feet of black dolomitic shales which are thought to represent this Woocalla Dolomite.

Disconformably overlying the Dolomite is a white sandstone known as the Whyalla Sandstone which is the lowest

member of the Tent Hill Formation of the Marinoan Series. In the Pernatty Lagoon area the Woocalla Dolomite thins out and in places the sandstone lies disconformably on the Pandurra Formation. The Whyalla Sandstone outcrops over much of the Bookaloo Lowlands as low hills. East and north of the lease the shales and quartzites of the Tent Hill Formation overlie this sandstone with the quartzite forming the Arcoona Plateau.

Tertiary and Quaternary deposits in the form of silicified cappings and stream deposits, sand dunes, alluvium and numerous playa lakes form a veneer of cover up to 100ft. thick over most of the lease area.

Although not outcropping in the area, the Roopena Volcanics of Willouran age were intersected at a depth of 450ft. in the Beda bore. This bore was reported as passing through a white sandstone (Whyalla S.S?), black shale (Woocalla Dolomite?) and red sandstone (Pandurra Formation?) before reaching the volcanics (Tonkin , 1968).

The various units in the area are generally flat lying with small dips away from a culmination along the western edge of Pernatty Lagoon. It is expected that the Woocalla Dolomite and possibly the Whyalla Sandstone thicken away from this culmination.

Mineralisation

At the Mount Gunson deposits the copper and lead mineralisation is associated with the Woocalla Dolomite at the Pandurra - Tent Hill disconformity. Assays from the Woomera Bore have shown that there is a concentration of copper, lead, zinc and manganese in the shales of the Woocalla Dolomite member with a maximum metal content being recorded at the Woocalla Dolomite - Whyalla Sandstone disconformity.

Less research has been done on the occurrence of manganese. It is found at the base of the Woocalla Dolomite and its geochemical patterns do not follow those of copper, lead and zinc.

Assuming the above controls the purpose of the seismic survey was to try to map the Pandurra - Woocalla - Whyalla relationships under the covered areas east and north of Pernatty Lagoon.

SURVEY PROCEDURES

A Texas Instruments 7000B 24 channel recorder mounted in a Land Rover was used.

35 spreads were shot, the first 5 being over known outcrop near Woocalla Siding to obtain velocity characteristics of the Pandurra Formation, Woocalla Dolomite and Whyalla Sandstone. A 30ft. geophone spacing for the first five was used whereas 50ft. geophone spacing was used for the remainder theoretically giving depth penetration to 250-400ft. Five shots were fired per spread, one at the centre, two at either end and two 750ft. out from either end of the spread. Hand auger holes were used to bury the charges. The spreads were not levelled, however this presented no difficulties as in the majority of the areas the spreads could be laid out along interdunal clay pans and playas.

The spreads were positioned on an approximate 4 mile square grid pattern and where possible at easily located positions such as fence and track intersections (Plan S.7460). Two deeper depth probes were shot (Spread nos. 23 and 35) to try to find deeper refractors.

RESULTS AND INTERPRETATION

The records were generally of good quality except for some of those from the long shots in areas of thick sand cover.

The results of the five spreads over knwon outcrop can be summarised as follows:-

Whyalla Sandstone	5,000 - 7,000 fps.
Woocalla Dolomite	8,500 - 12,000 fps.
Pernatty Grit (Pandurra F.)	12,500 - 16,000 fps.

The velocity of the Woocalla Dolomite was lower than expected and this was thought to be due to the severely jointed nature of this unit as seen in outcrop. It was expected therefore that the velocity of this unit could vary considerably with depth even without considering the facies changes known to occur. This fact was born out by the results of a depth probe at Beda Bore (Spread 35) where the black shales of the Woocalla Dolomite coincided with a seismic velocity of 14,000 - 16,000 fps or equivalent to the velocity of the Pandurra Formation as measured in outcrop.

However until more is known about the geology of the area to enable more accurate correlations between the various rock units and the velocities measured to be made the recorded velocities have been grouped together as follows:-

Group	Velocity	Possible Correlations
I	1,000 - 5,000 fps.	Loose to compacted and saturated Cainozoic sediments.
II	5,000 - 9,000 fps.	Weathered to fresh Whyalla S.S.
III	9,000-12,500 fps.	Whyalla SS and/or Woocalla Dolomite.
IV	12,500-16,000 fps.	Silicified Whyalla S.A. and/or Woocalla Dolomite and/or Pandurra F. and/or Roopena Volcanics.

This grouping corresponds to the <u>minimum</u> measured outcrop velocities for each unit, but leaves the maximum velocity for each unit open to question.

The results have been plotted as isopach maps for groups II and III and depth below surface to group IV. A summary of the data for each spread is given in the

appendix of this report. Average values for each spread have been used as in most cases there were local irregularities and dips in the layers measured.

Plan S.7461 shows depth below surface to material with group IV velocities. Generally this layer deepens east and south-east of Pernatty Lagoon with the exception of two "highs", one immediately east of the centre of Pernatty Lagoon and the other coinciding with the position of outcropping Whyalla Sandstone around Whitata H.S. about 10 miles south-east of the Lagoon. Due to the position of this latter "high" the contours suggest a trough extending south towards Beda Bore. This high speed layer is known to correspond to shales of the Woocalla Dolomite at Beda Bore and not to the Pandurra Formation. In fact the depth probe did not reveal any higher velocity material within approximately 1500ft. of the surface even though it is known that the Roopena Volcanics are present at about 450ft.

Plan S.7463 is an isopach map of layers with a velocity of 9,000 - 12,5000 fps. The main fact shown on this plan indicate that where the high velocity material is close to the surface this intermediate layer is absent or very thin. This means that either this layer thins out over bedrock (Pandurra Formation) highs or that the high speed layer corresponds to rocks further up the sequence as is known to be the case at Beda bore.

Plan S.7462 is an isopach map layers with a velocity of 5,000 - 9,000 fps. which probably do correspond to the Whyalla Sandstone although the isopachs shown on this plan must be regarded as the minimum thickness of this unit. The pattern on this plan also shows increasing thickness away from Pernatty Lagoon and local bedrock "highs".

The areas of possible economic interest are defined as those where the Whyalla/Woocalla and to a lesser extent the Whyalla/Pandurra and Woocalla/Pandurra contacts are within 150ft. of the surface as it is at these contacts where a

concentration of mineralization is assumed to have occurred. Assuming those layers with group II, III and IV velocities to correspond to Whyalla Sandstone, Woocalla Dolomite and Pandurra Formation units respectively then the areas of possible economic interest have been plotted on Plan S.7464.

Area "A" which seems to have the greatest potential extends east from the Mt.Gunson copper deposits to the Pernatty-Whitata creek intersection. Within this area the thicknesses of the Whyalla S.S. and the Woocalla Dolomite vary from 0 to 100ft. and 0 to 150ft. respectively (Plans S.7462 and S.7463).

No spreads have been shot in area "B" which is north-west of Pernatty Lagoon however its extent has been arrived at by interpolation of the results of spreads 20, 21 and 22.

Area "C" is south of "A" but separated from it by a subsurface ridge of Pandurra Formation over which the Whyalla S.S. and the Woocalla Dolomite thin out and appear to be missing where it is closest to the surface.

Areas "D" and "E" are difficult to evaluate as the velocities measured seem from available information to correspond to a number of different lithologies. Area "D" extends westwards from a line south of Pernatty Lagoon and is based on the results of spreads 31 and 32 only. Area "E" includes the outcropping Whyalla S.S. around Whitata H.S.

CONCLUSION and RECOMMENDATIONS

The results of isolated seismic refraction spreads over part of SML.315 indicated refractor velocities in some cases quite different to those recorded over the outcropping rock units. There is a known change in lithology of some of these units but as it was not practicable to do continuous refraction profiling over the large distances necessary and as the data from bore holes is incomplete it is not known how

this change effects the seismic velocity.

Two areas "A" and "C" (Plan S.7464) adjacent to a subsurface ridge of presumed Pandurra Formation on the eastern side of Penatty Lagoon have been selected on the results of the seismic work to warrant further investigation.

It is recommended that holes be drilled in these areas to confirm the seismic results and assess the economic potential. Depending on the results of this exploratory drilling further seismic work may be recommended to reduce the areas to a convenient size for detailed work.

Seismic results, in a limited area, which were controlled by drilling would produce far more definite interpretations.

ISR:JB
18.9.1969

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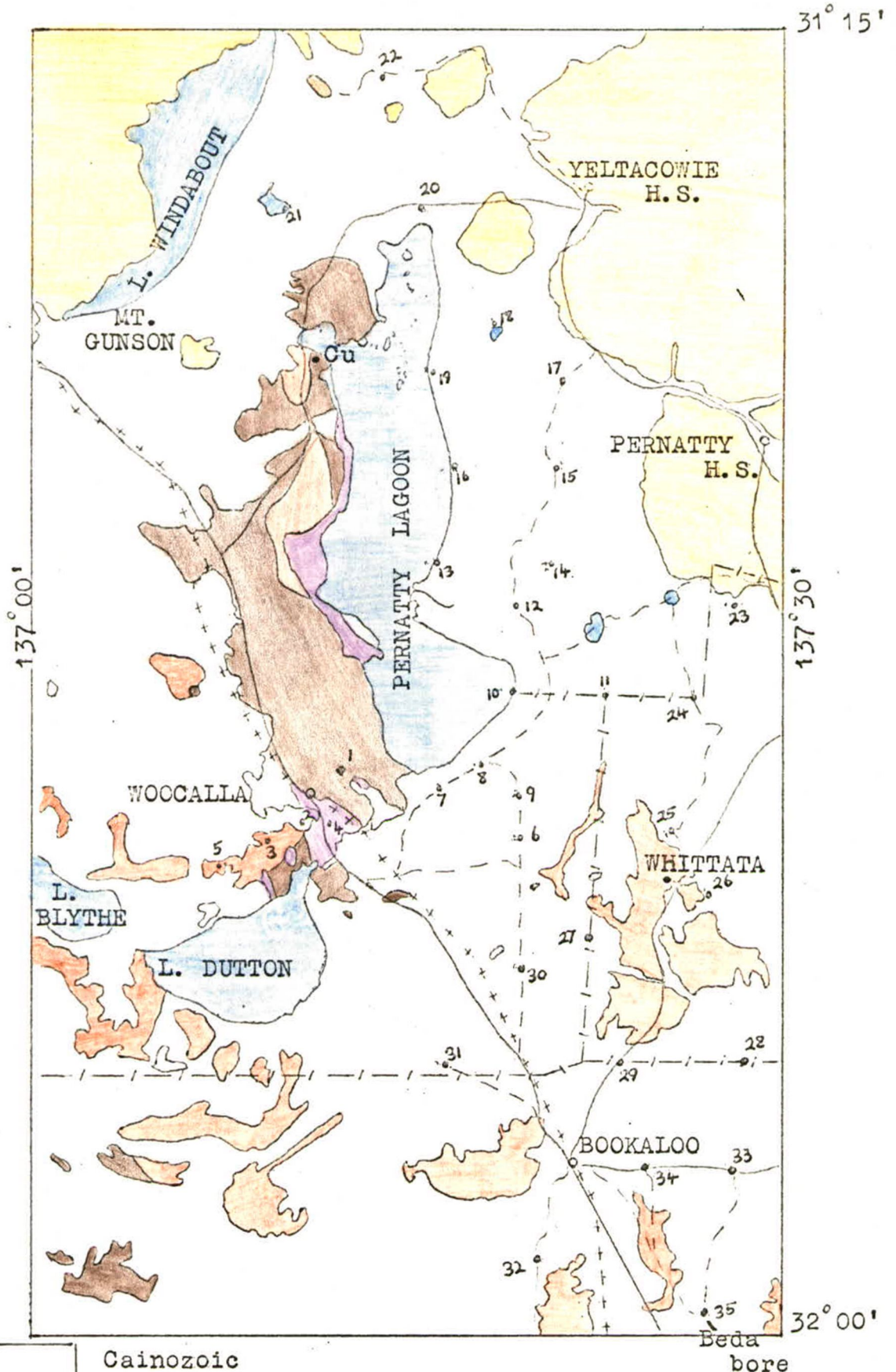
APPENDIX I

SUMMARY OF SEISMIC RESULTS

Spread	THICKNESS Group I	Group II	Group III	DEPTH TO and VELOCITY Group IV		Remarks
1	10	-	-	10	14,500	Pandurra o/c
2	15	-	100	115	14,500	Woocalla o/c
3	9	75	-	84	15,000	Whyalla o/c
4	10	-	45	55	12,750	Woocalla o/c
5	10	90	na	-	-	Whyalla o/c
6	32	33	-	65	13,750	
7	78	43	-	120	13,250	
8	120	110	-	230	15,500	
9	30	57	67	154	13,750	Bore 207
10	8	58	-	66	15,250	
11	20	167	-	187	14,000	
12	73	39	128	240	16,500	
13	21	-	78	99	15,250	
14	43	-	60	103	12,750	
15	20	81	-	101	13,500	
16	19	-	-	19	13,500	
17	22	100	162	284	14,000	
18	15	150	na	-	-	
19	22	41	134	197	15,250	
20	16	114	118	248	13,750	
21	24	-	-	24	15,000	
22	15	140	-	155	14,250	
23	17	106	120	243	15,250	Depth Probe
24	47	78	137	262	14,750	
25	26	-	-	26	14,000	
26	21	38	-	59	15,000	
27	23	64	102	189	16,250	
28	21	-	90	111	16,000	
29	19	45	-	64	14,000	
30	21	83	193	297	12,500	
31	19	28	67	114	13,250	
32	21	55	85	161	14,250	
33	19	93	-	112	15,250	
34	16	55	109	180	14,000	
35	20	24	200	244	15,000	Depth Probe Beda Bore



Cainozoic Sediments

Tent Hill Formation

Whyalla Sandstone
Woocalla Dolomite

Pandurra Formation

Seismic Spread 9

Road .....

Track .....

Railway .....

Lease Boundary (SML 315)

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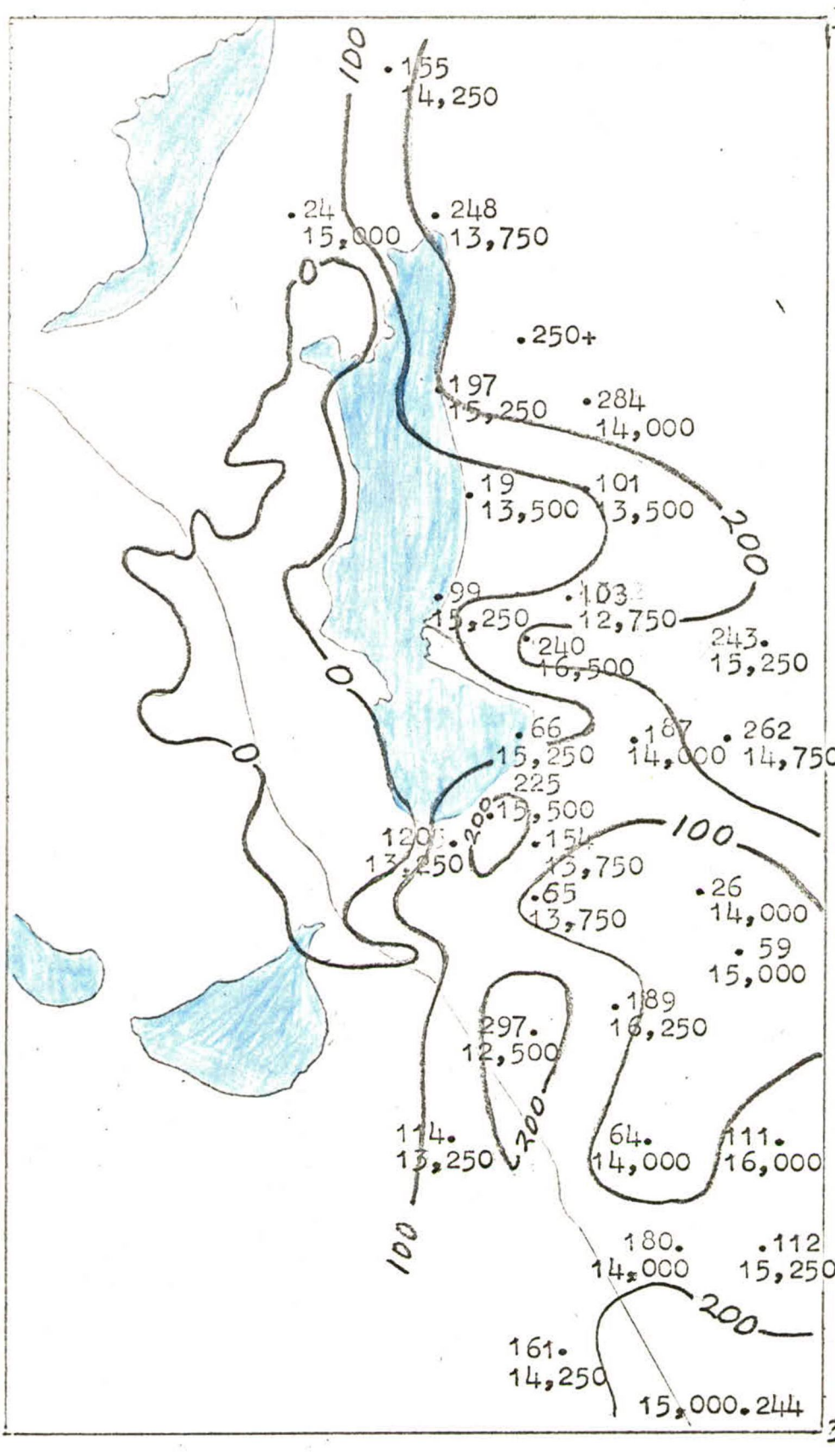
PERNATTY LAGOON AREA
SEISMIC SURVEY OVER SML 315
LOCALITY & GEOLOGICAL
SKETCH PLAN

SCALE: 1"=6 miles

S7460

EL

DATE: 5/9/69



Seismic spread position showing depth & velocity of high speed refractor
(Depth in feet, velocity in feet/second)

•187
14,000

Contour interval 100 feet

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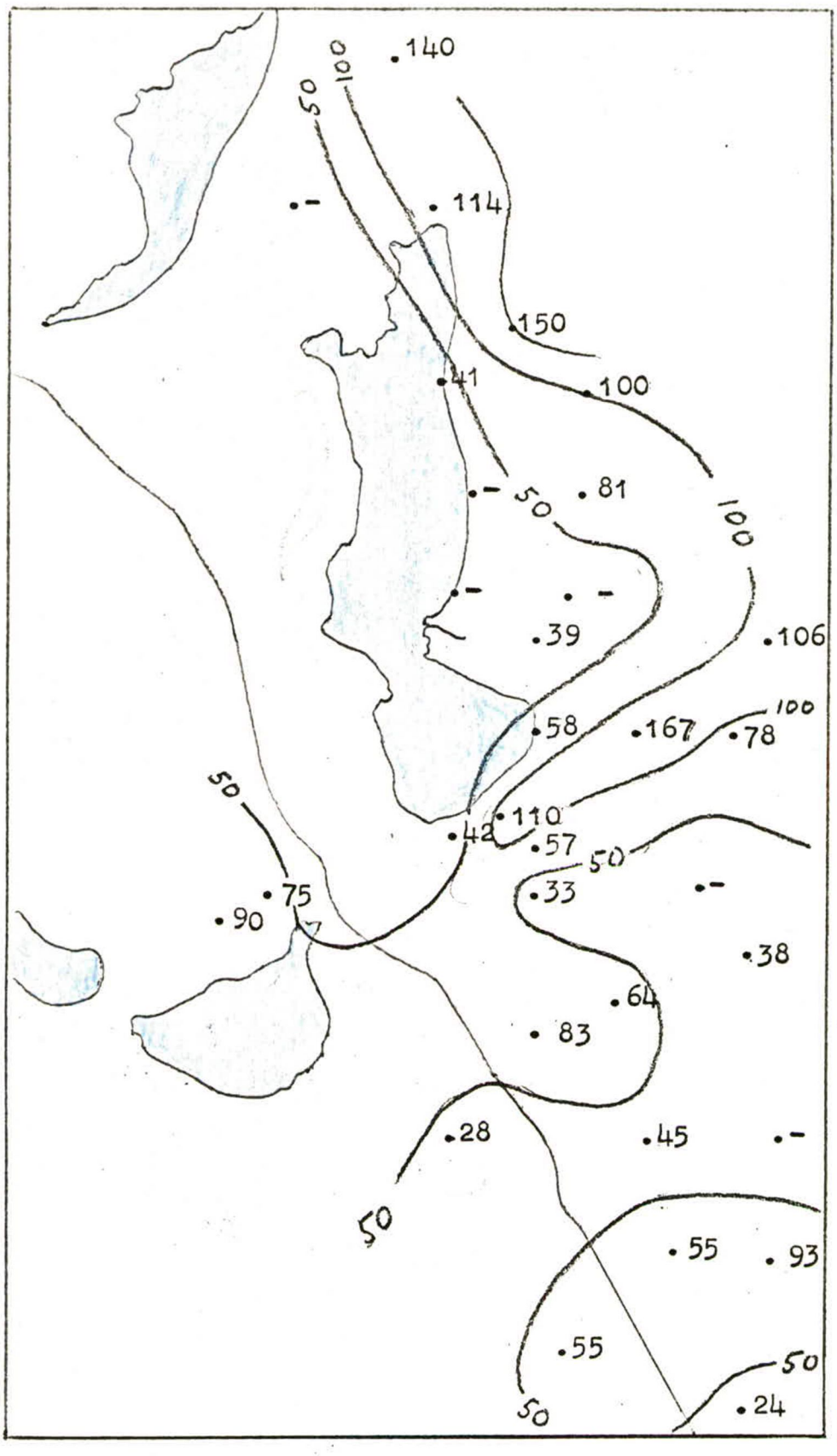
S.S. Rowan	Drn. IR	PERNATTY LAGOON AREA SEISMIC RESULTS OVER SML 315 CONTOUR PLAN OF DEPTH BELOW SURFACE TO HIGH SPEED REFRACTOR	SCALE: 1"=6 miles
	Tcd.		S 7461
	Ckd.		Eh
	Exd.		DATE: 5/9/69



Seismic spread position showing thickness of low velocity (5,000-9,000 fps.) refractor. Thickness in feet .45

Contour interval 50 feet.

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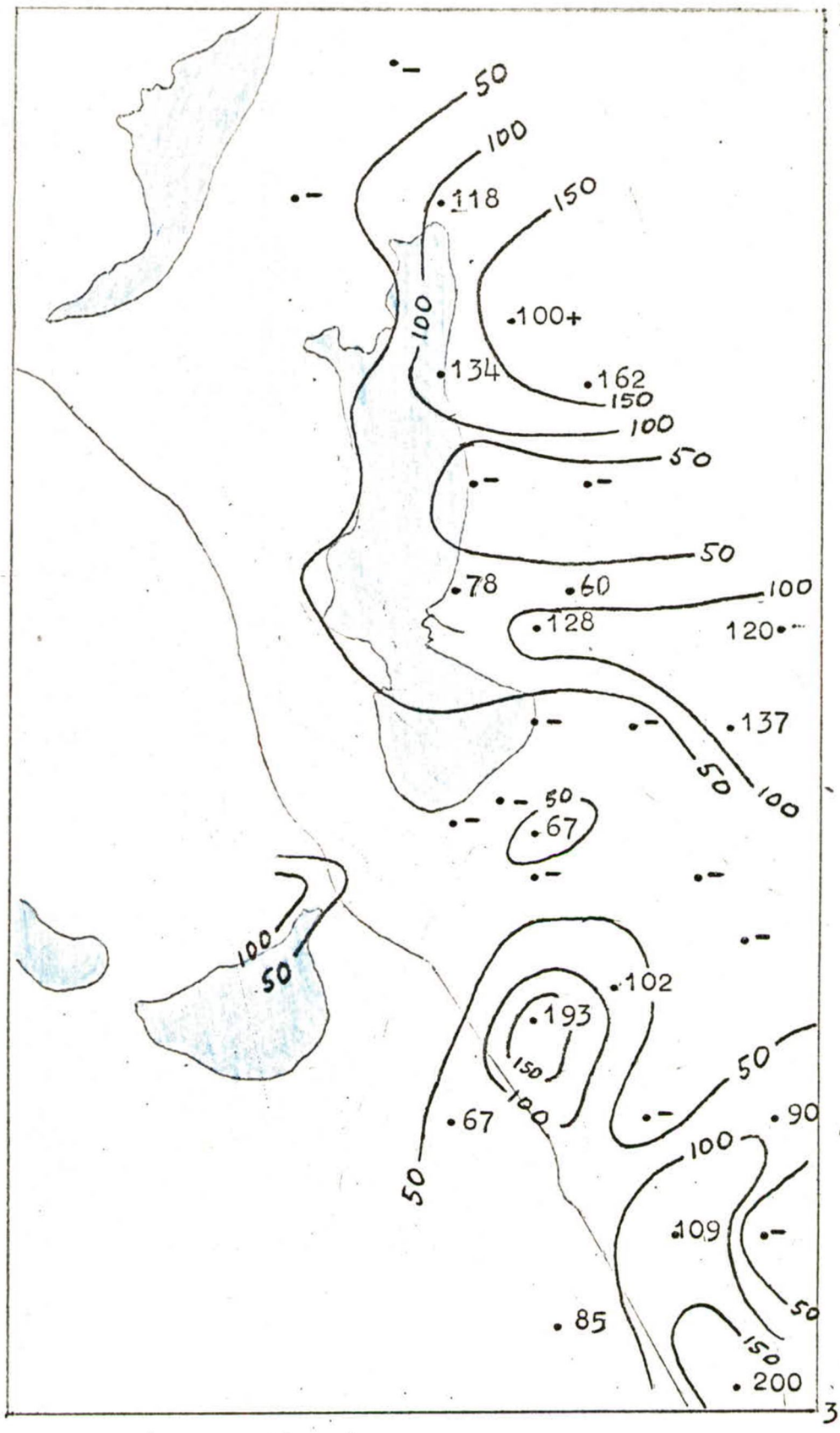
S.B. Rowan	Drn. IR	PERNATTY LAGOON AREA SEISMIC RESULTS OVER SML 315 ISOPACH MAP OF LOW VELOCITY REFRACTOR (5,000-9,000 fps.)	SCALE: 1"=6 miles.
	Tcd.		S7462
	Ckd.		Eb
	Exd.		DATE: 5/9/69



Seismic spread position showing thickness of intermediate velocity (9000-12500 fps.) refractor.
Thickness in feet .109

Contour interval 50 feet

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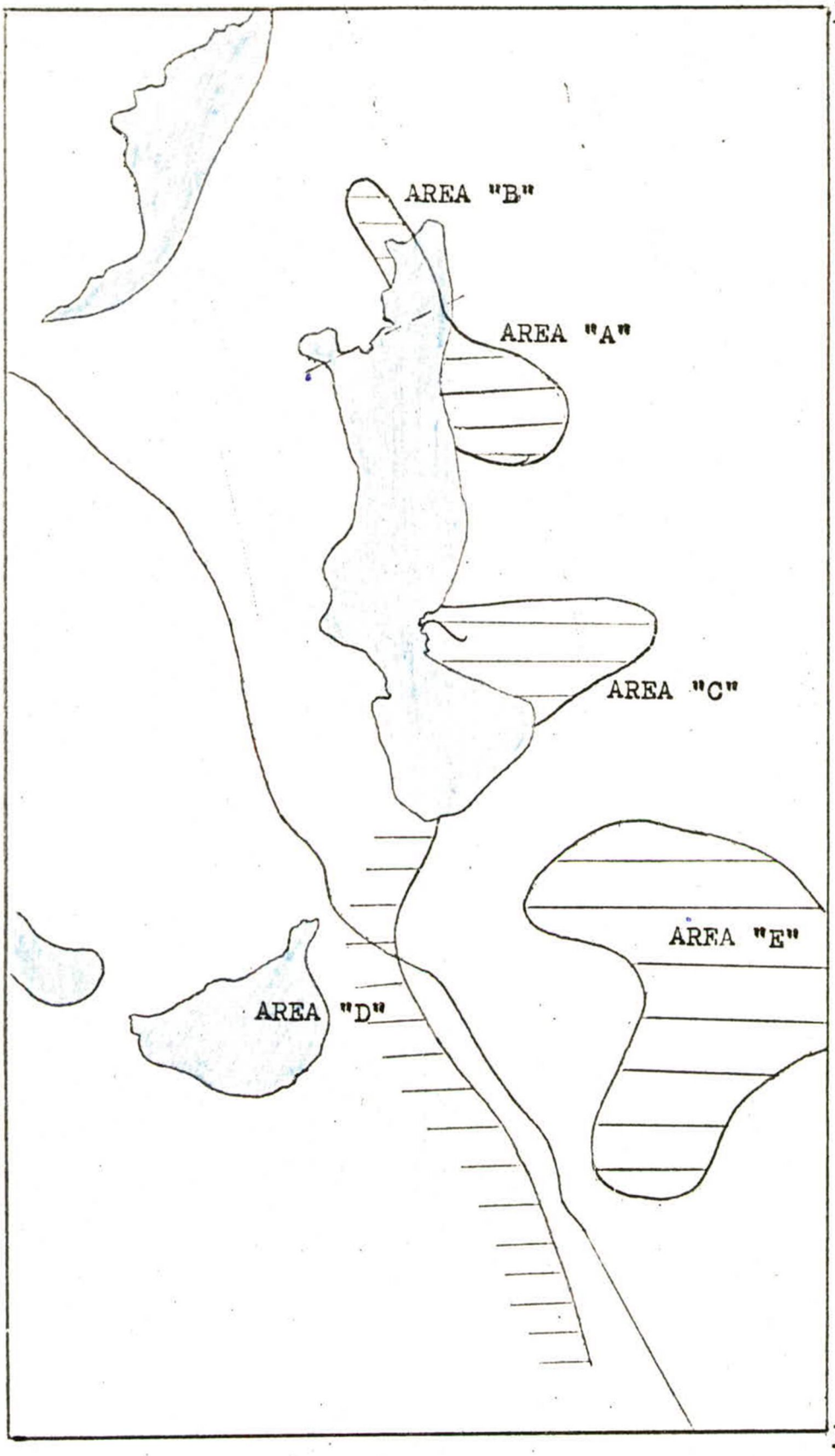
S S Rowan	Drn. IR	PERNATTY LAGOON AREA SEISMIC RESULTS OVER SML 315 ISOPACH MAP OF INTERMEDIATE VELOCITY REFRACTOR (9000-12500 fps.)	SCALE: 1"=6 miles
	Tcd.		S7463
	Ckd.		Eb
	Exd.		DATE: 5/9/69



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S.B. Rowan	Drn./R	PERNATTY LAGOON AREA SEISMIC RESULTS OVER SML 315 AREAS OF POSSIBLE ECONOMIC INTEREST	SCALE: 1" = 6 miles
	Tcd.		S7464
	Ckd.		Eb
	Exd.		DATE: 5/9/69