THE BROKEN HILL PROPRIETARY COMPANY LIMITED

RAW MATERIALS & EXPLORATION DEPARTMENT

GEOPHYSICAL SURVEYS

MONARCH TIN PROSPECT, TASMANIA

SPL 399

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Melbourne

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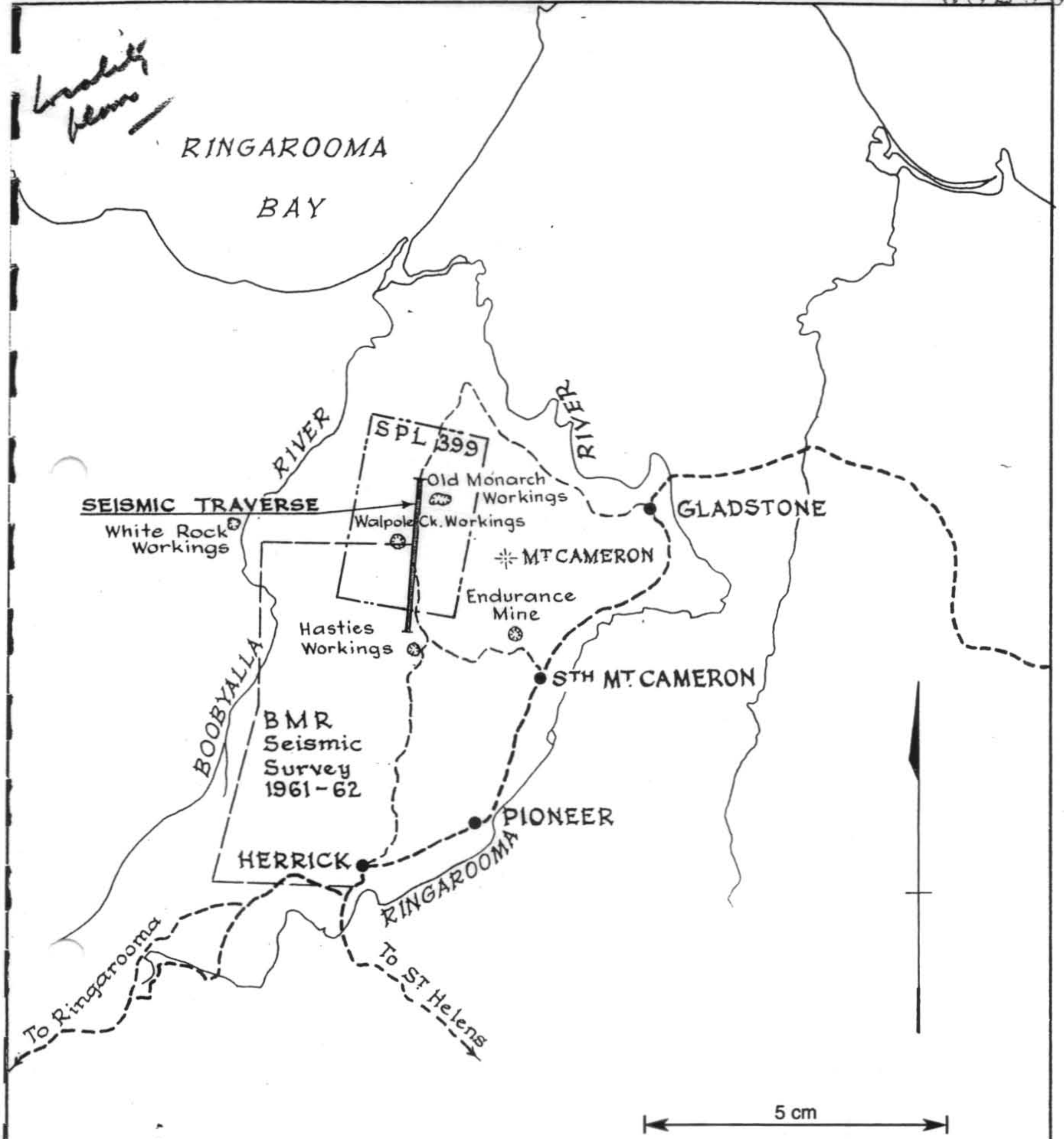

Locality Plan

Graphic Scale

LOCALITY MAP
SEISMIC REFRACTION TRAVERSE
MONARCH TIN PROSPECT - TAS.

SCALE: 1:250.000

Fig 1

H. N. 1-3-65

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INTRODUCTION.

The location of S.P.L. 399, which covers the alluvial tin prospect just west of Mt. Cameron, is shown on Fig. 1. Tin is being mined in the deep leads at the Endurance and Hasties mines, but not in the shallow lead of the old Monarch workings or in the deep leads of the Walpole Creek and White Rock workings.

The rich tin deposits of the Ringarooma Valley have been described by Nye (1925). They include those worked at the Pioneer and Arba mines and the Tertiary sub-basaltic alluvial deposits at Branxholm, Darby and Main Creek.

The former Ringarooma River flowed approximately parallel to, and about one mile west of, the western edge of S.P.L. 399. The tin deposits near Mount Cameron were formed in tributaries which flowed into this river, and they are shallow and generally narrow. Basalt covers many of the deposits of the Ringarooma Valley, although there is almost certainly none near the surveys described in this report.

Chesnut (unpublished Company report) discusses the geology of the Monarch tin prospect.

There is no known geophysical method which can be used to detect directly the small amounts of tin in a deep lead. However, if the deep lead corresponds to a channel in the bedrock, then geophysical methods might locate the deep lead indirectly by first determining the buried bedrock surface.

O'Connor (1964) reports that the B.M.R. successfully delineated channels in the unweathered bedrock at Emmaville, where there appeared to be only a thin zone of weathering. Here the deep leads which correspond to depressions in bedrock were defined.

The purpose of the seismic traverse was to define gutters in granite. These represent the deepest portion of the lead and correspond to the course of the stream before its valley began to be filled with sediments. The traverse was approximately at right angles to four known channels.

The northern section of the traverse had been closely drilled by bores 264 feet apart before the survey began and the aim of this part of the survey was to compare the seismic results with those obtained from drilling. On the southern part of the traverse bores were to be drilled at 1,056 feet spacing and the aim of the seismic survey here was to obtain information on the position of possible channels in advance of drilling. No readings were taken on the granite outcrop which separates these two parts of the traverse.

The main purpose of the magnetic survey was to determine if there was any basalt along the traverse. It might also assist defining the position of the lead for reasons given by O'Conner (1964).

The B.M.R. in 1961-62 made seismic, gravity and magnetic surveys, which were described by Sedmick (1964), over the area shown on Fig.1. They had difficulties due to the considerable thickness of weathering of the granite bedrock, although they were able to define possible channels for further testing.

The survey was the first made with the Company's seismic refraction equipment.

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SURVEY DETAILS.

The seismic refraction traverse was made from 18th December 1964 to 15th January 1965 by P.J. Gunn assisted by K.W. Hughes, R. Williams, R. Hagger and W. Hewitt at the location shown on Fig.1. It corresponded on the Monarch grid to line 15 from D.15 to Y.15, a distance of twenty one thousand feet.

Our ER-75-12 interval timer, with Vector cables and EV-20 subminiature geophones, was used. Stations were pegged every 50 feet along the traverse and levels taken with a Watts Autoset level. The Askania torsion magnetometer No. 582374 was used.

The reciprocal method as described by Hawkins (1961) was followed as this provides a convenient method for determining absolute depths to refractors and velocities in the refractors. Continuous profiling was employed. Geophones were spaced 50 ft. apart along the traverse and in line with the shots. Shots were exploded at the centre, ends and 250 feet and 750 feet from the end of a spread. This gave seven shots for each spread. After these shots were fired the whole spread was moved 500 feet along the traverse (see Fig.2).

Weathering spreads were made to obtain seismic velocities in the soil and near surface layers, and also to measure the thickness of the soil. Results showed that there is generally only a thin soil cover, if any, over the alluvium. Weathering spreads were made every 1,000 feet as shown on Fig.2. Four separate shots were used for each spread.

The seismic energy generated by dynamite charges in shallow (2 feet for short shots and 5 feet for long shots) drillholes travelled through the shallow layers of the earth by ray paths determined by refraction at the surfaces of these layers and was detected by geophones laid out as described previously. The first arrival times of the seismic waves were recorded on

Polaroid photographic film. The times and distances were graphed as indicated on Fig.2. From such graphs homogeneous layers in which the seismic energy travels at different horizontal velocities were differentiated and the depths to the layers computed. Time depths at each geophone were calculated and these multiplied by a composite depth factor to give the depths to the refracting layers beneath each geophone. No direct measurements of velocities was possible and all those used in depth calculations were obtained from time-distance graphs.

Shallow (average depth 3'0") shot holes were used and the shot corrections were negligible.

Depths to the main refractor, unweathered granite, were calculated at 50 intervals except between D.15 and L.15 where continuous profiling was not possible and depths were plotted every 500 feet.

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RESULTS

The results of the seismic survey are shown on Fig.3, which also gives bore results and topography along the section.

Three continuous seismic layers were differentiated. The horizontal seismic velocities in these layers and the probable geological equivalents as indicated from bore results are as follows:

Velocity (ft./sec)		Geological Unit
Range:	Average:	
1,600 - 3,500	2,500	Dry alluvium
3,800 - 7,200	5,500	Wet alluvium and weathered granite
12,500 -25,000	16,200	Unweathered granite

These three layers, which could generally be clearly distinguished, are shown on Fig.3. Continuous profiling (i.e. 50 ft. intervals) of the top of the unweathered granite was done. Depths to the other layers were calculated from the time/distance graphs which gave spot depths at 250 intervals for the intermediate layers.

The unweathered bedrock profile shown on Fig.3. has had irregularities smoothed out of it. Differences between the calculated depths and those shown on the profile are generally less than 20 feet which is the order of accuracy at this depth (200 ft.).

The boundary between the top and middle layers corresponded to the water table and the depths at which this was intersected in the percussion bores as taken from the drillers logs are given. The average difference between the depth to the water table from seismic and drilling results is zero confirming the correlation, but there are often large differences between the two, probably because:

(a) the depth to the water table is often difficult to determine exactly in drilling and this figure in the drillers log may be unreliable.

(b) the seismic arrangement was designed to test the depth to the deepest layer and calculations of the depths to the top of the middle layer are only approximate.

The alluvium and especially the drift was similar in physical appearance to weathered granite and seismic velocities in these were almost the same so that there was no refraction at the top of the weathered granite. Within the alluvium the clay, grits, sands and gravels were usually discontinuous and they transmitted seismic waves at similar velocities. They were not distinguished by the seismic method. Occasionally a discontinuous refractor was apparent in the alluvium. Drilling indicated that this was either a marcasite layer or the top surface of the weathered granite.

The velocity contrast of seismic waves in unweathered and weathered granite was large enough to produce a good refraction at the top of the unweathered granite and this was the main horizon plotted.

The apparent velocities along the top of the unweathered granite differed in the two directions of shooting, indicating a dip of the unweathered granite. This dip was generally very slight and was generally neglected in calculations.

There was little soil over the alluvium and both shot and detectors were taken as being on alluvium.

Chesnut (unpublished company report) has postulated from aerial photography and geological mapping that there are four fossil channels which cross line 15. These are shown on Fig.3, although the evidence for them is not sufficiently accurate to say that they are at precisely the locations given.

The seismic results indicate five possible channels in bedrocks as shown on Fig.3.

There appears to be a correlation, within the expected accuracy, between channels determined by the two methods on the southern part of the traverse. No definite correlation is indicated on the northern part. Drilling results did not confirm any of the channels on the southern part.

In general, as can be seen from Fig.3, there is no direct correlation between the surface of the unweathered granite obtained from drilling and the surface of the unweathered granite found from the seismic survey. A reason for this is the thickness of the weathered zone in the granite. It is up to 210 feet thick along the traverse and has an average thickness of 60 ft. This thick weathering zone limits the usefulness of the seismic method as was found by the B.M.R. survey at Winnaleah as described by Sedmik (1964).

An interesting feature along the traverse was the rise in the unweathered granite near G as shown by the seismic survey and the corresponding low on the magnetic profile. No satisfactory explanation of this can be given. A slab of residual basalt or a dyke in the granite could explain the geophysical results, but these possibilities are not supported by drilling results.

The magnetic profile along the traverse was comparatively flat, the only features being the one described above and some sharp variations near bores where there was casing.

The traverse along line 15 crossed gravity traverses M & L of the B.M.R. survey at Winnaleah. Results are in close agreement.

CONCLUSIONS & RECOMMENDATION

Technically the seismic refraction survey at the Monarch tin prospect was highly successful. The ER-75-12 interval timer and the cable units performed well, satisfactory field techniques were developed, and good records were obtained, enabling continuous profiles of two distinctive refractors to be made.

The survey was little assistance in tin prospecting in the area. Reasons for this include:

1. The weathered granite could not be distinguished from the overlying alluvium as the velocity of seismic waves in each was about the same.
2. Because of a thick zone of weathered granite, the top of the unweathered granite, which was distinguished by the seismic refraction method, was practically independent of the top of the weathered granite as determined from drilling results. However, at least three depressions in the unweathered granite corresponded approximately to possible channels determined from geology and correlation of these channels with the seismic results was better than with the drilling results.
3. Shallow tin, such as at the old Monarch workings, is high up in the alluvium and is independent of any channels in the surface of either the weathered or unweathered granite.

Although the survey did not help prospecting for tin, this was due to local geological conditions and not to any limitations of the seismic refraction method.

The survey clearly demonstrated the suitability of the seismic refraction method for detecting the depth to the water table.

The magnetic traverse confirmed that there is probably no basalt along line 15.

No further seismic surveys are warranted at the Monarch tin prospect.

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REFERENCES

HAWKINS, L.V.	1961	The Reciprocal Method of Routine Shallow Seismic Refraction Investigations. Geophysics, Dec.1961.
NYE, P.B.	1925	The Sub-Basaltic Tin Deposits of the Ringarooma Valley. Geol. Survey Bull. No.35. Tas. Dept. of Mines.
O'CONNOR, M.J.	1964	Graveyard Deep Lead Geophysical Surveys, Emmaville, N.S.W. B.M.R. Record No. 1964/148.
SEDMIK, E.C.E.	1964	Winnaleah Area Geophysical Surveys Tasmania 1961-62. B.M.R. Record No. 1964/54.

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