1984/67. Investigation of a basalt quarry, West Mooreville Road, Burnie

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Abstract

Seismic refraction methods with back-up reconnaissance drilling have shown much of the area investigated to have at least 8-10 m and up to 20 m of overburden material. In addition, the overburden/bedrock interface is highly irregular and unpredictable, even over short distances. The area immediately to the east of the quarry face shows most potential for further quarrying and a 2.5 ha area was delineated as suitable for extension of the existing quarry.

INTRODUCTION

Brambles Industrial Services requested geological advice on their West Mooreville Road basalt quarry site [DQ015488]. Advice was sought on the attitude and depth of the rock/overburden interface beyond the existing southern quarry face. During the recent removal of overburden, it was found that the bedrock surface fell away rapidly and the depth of overburden increased from about two metres at the quarry face to several metres a short distance beyond.

The investigation involved a seismic refraction survey supplemented by selected drilling to confirm the geophysical results. This report describes the results of the investigation which covered a 9.5 ha area near the south-east corner of lease 857P/M (fig. 2).

GEOLOGY

The lease area is underlain, for the greater part, by Tertiary basalt (Gee *et al.*, 1968). The basalt lies unconformably on rocks of the Precambrian age Burnie Formation which have been complexly and closely folded into a sequence of alternating slaty mudstone with siltstone and mudstone. These rocks crop out close to the lease boundaries to the south and west.

Basalt outcrop is rare in the unquarried portion of the lease area; the land is flattish and the surface comprises a red-brown high plasticity residual basalt clay (CH). The basalt exposed in the quarry is highly variable, ranging from fresh, extremely high strength, widely jointed rock as occurs on the floor of the main quarry, to slightly-highly weathered, variable strength, contorted, columnar and closely fractured rock exposed in parts of the face. It would appear that there is more than one flow present at this site.

Basalt crops out near the southern boundary of the area under investigation (fig. 3).

SEISMIC REFRACTION SURVEY

Survey details

Fifteen seismic spreads were fired using a twelve-channel Nimbus seismograph. Both hammer and electrical (gelignite with electrical detonators) firing methods were employed. All spreads were fired from both ends and in the middle; some extension shots were used. Geophone

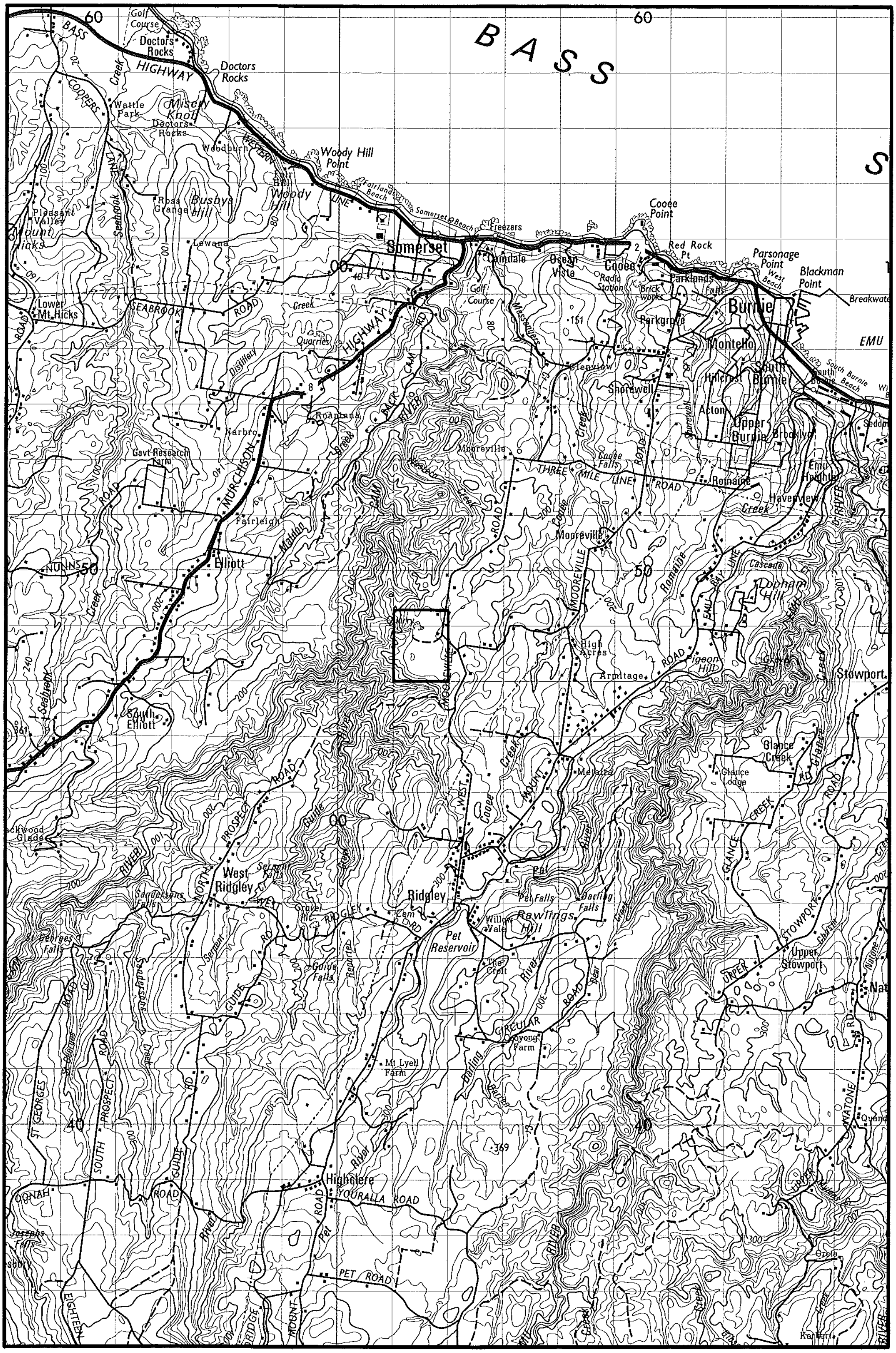


Figure 1. *Location of quarry*

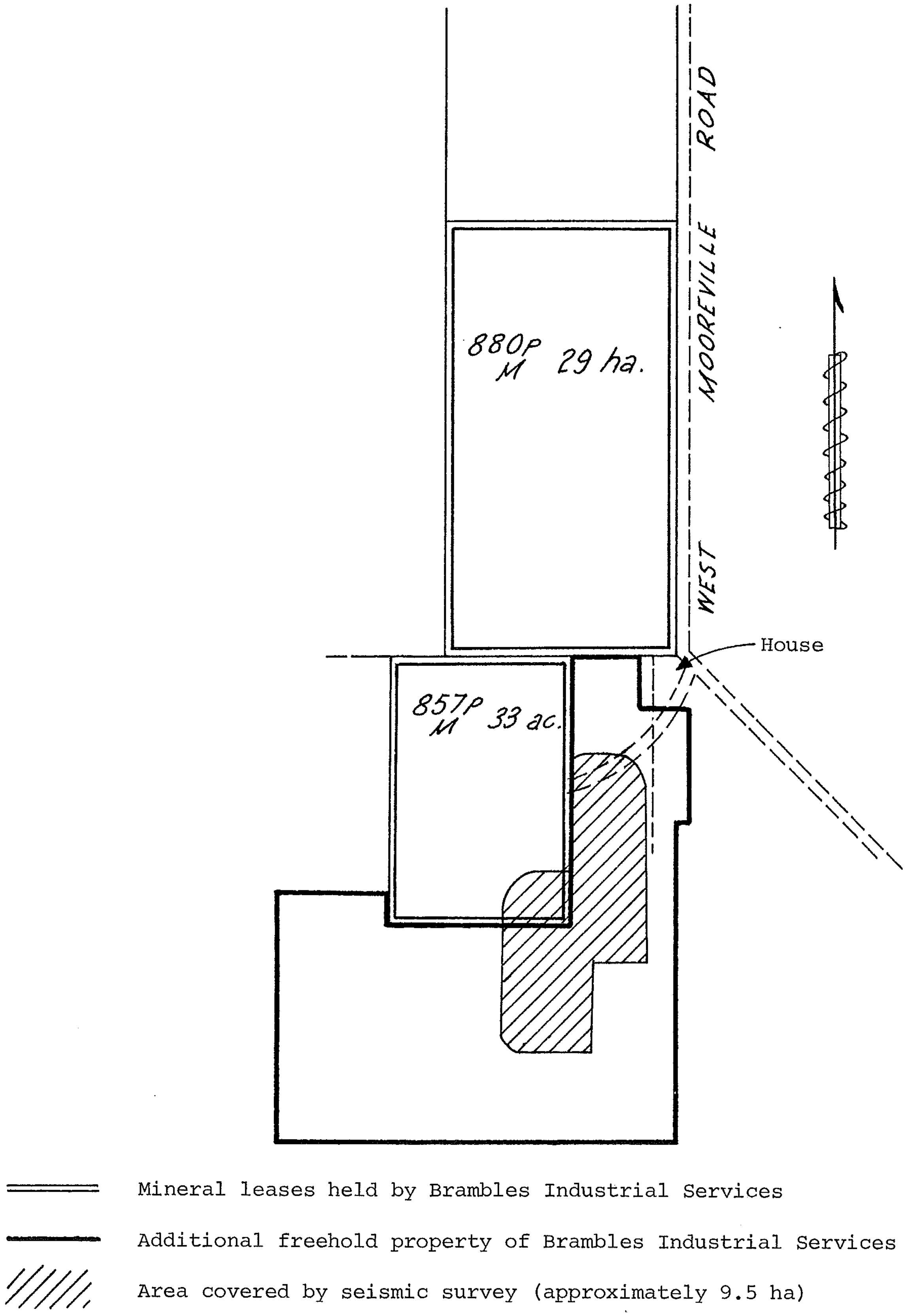


Figure 2. *Location of area of investigation*

spacing was set at 10 m or 15 m when using explosives, and 3 m for the hammer spreads. The locations of the spreads are shown on Figure 3.

Survey constraints

A major constraint during the first phase of the survey was the limitation on the amount of explosive charge that could be used effectively in a 1.0 m deep shot hole, yet act as a sufficiently large energy source to penetrate the surprisingly thick, high energy absorbing surface layer in order to obtain a good seismic record.

This problem was largely overcome for the second phase of the survey. However, to traverse more ground, some spread lengths were increased (15 m spacings) thus losing some of the detail of the near-surface velocity layers. Any survey of this nature is a compromise; a trade-off between various parameters.

Depth determinations of velocity layers were calculated using a combination of critical distance, reciprocal and time intercept methods. Due to the stepped nature and asymmetry of several of the velocity plots, there was a degree of variation in depth calculated at a particular point, depending upon the interpretation method used. Thus depth determinations should be regarded as approximate only and used as a general guide to the depth to bedrock.

Interpretation of seismic velocities

With the exception of the quarry floor spreads (3 m geophone spacings), three velocity layers were distinguished in all spreads. The time-distance (velocity) plots range from the highly asymmetrical case with stepped and inverted slope segments in the higher velocity layer, to basically symmetrical plots. The asymmetry of several of the plots, with their corresponding apparent velocity differences in the faster velocity layer, is due to the sloping and irregular interface of the bottom (hard rock) refractor. A summary of the results of the survey is given in Table 1.

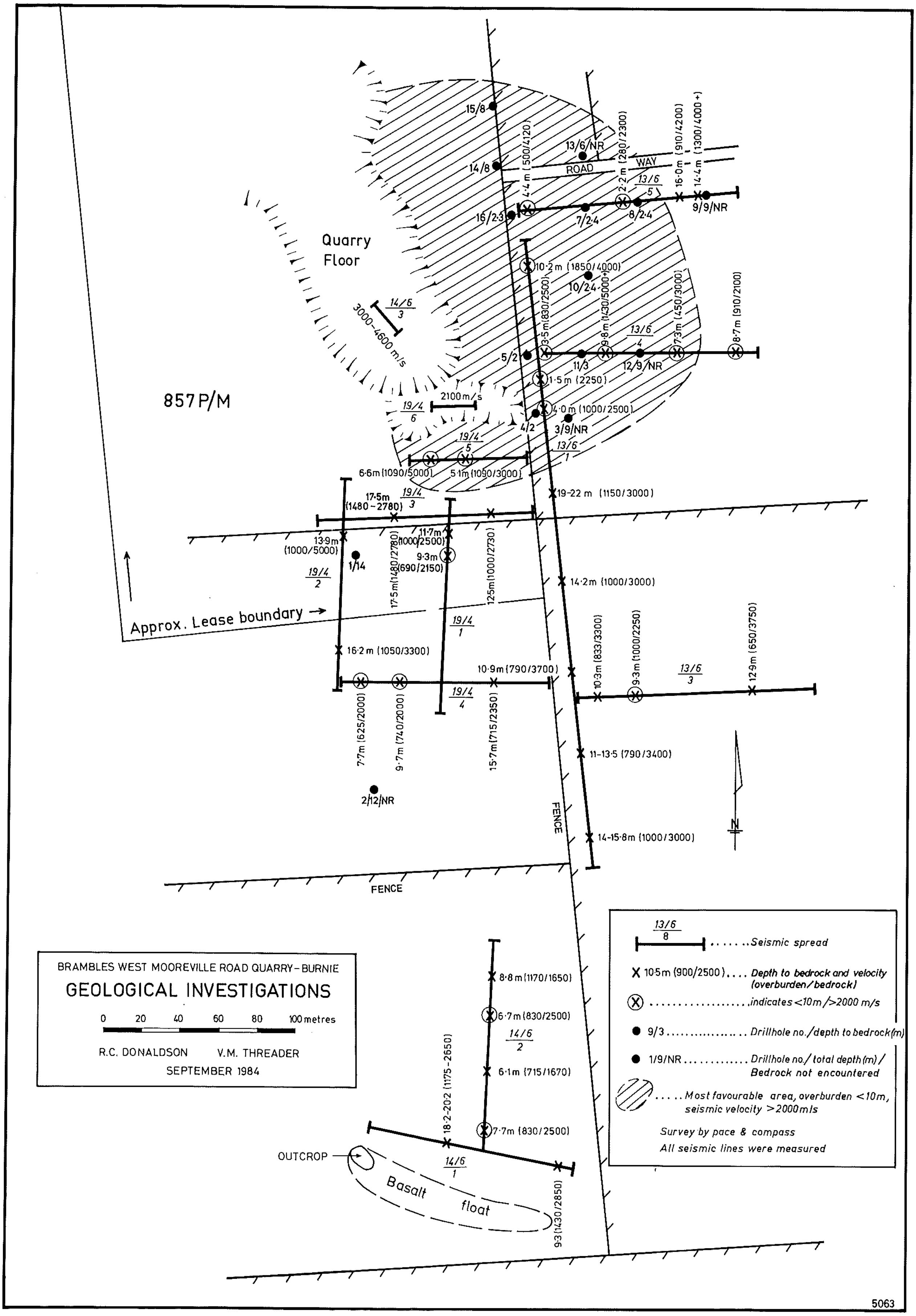
Table 1. SEISMIC VELOCITIES AND INTERPRETED MATERIALS

	Seismic velocity (m/sec)	*Layer thickness (m)*	*Interpreted material*
V_1	* 360-515 † (350-650)	1.5-5.0	Unconsolidated surface layer (topsoil). High plasticity clay and weathered rock fragments.
V_2	850-1220 (700-1600)	0 -15.5	Consolidated residual clay deposits grading into an EW-HW, low strength rock (basalt). Water table absent.
V_3	2310-3360 (2000-4000+)	Not known	SW-FR, high strength bedrock (basalt). Discontinuities (joints) generally closed.

* Mean values

† Extreme values

For all practical purposes, both the V_1 and V_2 velocity layers can be regarded as overburden material which would need to be stripped off prior to quarrying.



BRAMBLES WEST MOOREVILLE ROAD QUARRY – BURNIE
GEOLOGICAL INVESTIGATIONS
0 20 40 60 80 100 metres
R.C. DONALDSON V.M. THREADER
SEPTEMBER 1984
Quarry Floor
857 P/M
Approx. Lease boundary
ROAD WAY
FENCE
OUTCROP
Basalt float
3000–4600 m/s
2100 m/s
13/6 8 ......Seismic spread
X 10·5 m (900/2500).... Depth to bedrock and velocity (overburden/bedrock)
(X) ....indicates <10 m/>2000 m/s
● 9/3 .... Drillhole no./depth to bedrock (m)
● 1/9/NR .... Drillhole no./ total depth (m)/ Bedrock not encountered
..... Most favourable area, overburden <10 m, seismic velocity >2000 m/s
Survey by pace & compass
All seismic lines were measured
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Figure 3.

The depth to bedrock (V_3), as determined from the seismic refraction survey, is shown in Figure 3. No attempt has been made to give a complete depth profile along each spread due to the complexity of the plots. Nevertheless the figures, as shown, do indicate the anticipated depth to bedrock at those specific locations. There are sufficient figures to show the variability in depth to bedrock over relatively short distances.

Two spreads were fired on the main quarry floor to compare the survey results with the material being quarried. Velocities in the order of 2000-4000 m/sec were recorded which agrees well with the fast velocity refractor (V_3) observed in the spreads beyond the quarry face.

DISCUSSION

The thickness of basalt in the area, as deduced from the regional geological map, is about 30 m but the greatest thickness of quarriable stone worked so far is 12 m. Below this depth the stone is so tough that it is too difficult to extract and crush. This stone is presumably a separate, earlier basalt flow and probably corresponds with the top value of the fast velocity layer (V_3). It is assumed that this level is the economic limit of the quarry.

The overburden thickness is least in the north-east corner of the area investigated. Test drilling with the company-owned "Airtrack" percussion drill was carried out in this area as a check on the seismic interpretation (fig. 3). There was good general agreement between drilling and seismic results, and the mean thickness of overburden from 13 holes in an area of 2.3 hectares was five metres. This represents 115 000 m^3 of overburden to be stripped if this area is quarried.

The geophysical technique used was designed to locate the interface between overburden and bedrock. The thickness of basalt would best be determined by drilling.

The shaded area on Figure 3 represents the most favourable conditions with overburden less than 10 m and seismic velocity of bedrock greater than 2000 m/sec. This area would contain 69 000 t/metre depth (23 000 m^3 and RD = 3.0).

It is unlikely that more than 10 m of quarriable stone will underly this area which would limit the reserve to 690 000 t (*in situ*). At a production rate of 150 000 t of crushed stone per annum, it is estimated that, allowing for quarrying and crushing losses, this would represent a 3-4 years reserve.

RECOMMENDATIONS

1. Test drill the reserve area (shaded) for basalt thickness to ensure sufficient reserves to warrant stripping.

2. Examine the remainder of the untested freehold land in the south and south-west.

3. Initiate a wider search for a new quarry site to allow development time before the present property is worked out.

REFERENCE

GEE, R.D.; GULLINE, A.B.; BRAVO, A.P. 1968. Geological atlas 1 mile series. Zone 7 sheet 28 (8015N). Burnie. *Department of Mines, Tasmania.*

[11 October 1984]

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