DEPARTMENT OF MINES
SOUTH AUSTRALIA

R\B 65/82.

BASALT DEPOSIT

Secs. 3 & 4, Parish Roseneath, Co. Follett, Victoria

Client: Highways and Local Government Department

by

R.K. TARVYDAS
GEOLOGIST
NON-METALLIC MINERALS SECTION

CONTENTS PAGE

MAPS

Plan No.	Title	Scale
67-631	Basalt Deposits Dergholm, Victoria, Locality Map	1:250,000
67-650	Basalt Deposit, Glenelg River, Dergholm; Secs. 3 & 4 Parish Roseneath, Co. Follett, Victoria; Geological Plan and Cross-sections	1in. = ¼ m. and 1in. = 100ft.

Rept.Bk.No. 65/82
G.S. No. 3819
D.M. 71/66

26th October, 1967

DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept.Bk.No. 63/82
G.S. No. 3819
D.M. 71/66

BASALT DEPOSIT

Secs. 3 & 4, Parish Roseneath, Co. Follett, Victoria

Client: Highways and Local Government Department

ABSTRACT

Olivine basalt occurring three miles E.S.E. of Dergholm has been investigated by drilling and laboratory testing. Float and a single exposure are weathered, but fresh basalt occurs under an overburden of 5-20ft. (average 11.9ft.). Olivine phenocrysts and olivine-rich xenoliths comprise 10-20% of the rock; siderite, dolomite and calcite, 5-15%; groundmass glass and segregated glass about 25%; iddingsite and other iron minerals, up to 15%; pyroxene and plagioclase phenocrysts, serpentinite, opal, and chalcedony are minor constituents; crystalline groundmass comprises the remainder.

Twelve diamond drillholes have defined 312,000 cu.yd. of fresh basalt below 144,000 cu.yd. of moderately weathered basalt and clay. Los Angeles abrasion values range 16-21; Sulphate Soundness losses are 3.0 and 3.8, obtained from two samples. Limited petrographic data suggest that secondary clay and iron-oxide minerals in the fresh basalt are not present in sufficient quantity to have an adverse effect on the stability of paving surfaces. Further work is recommended before a satisfactory source of screenings can be assured.

INTRODUCTION

The Highways and Local Government Department require a source of screenings for bituminous surface treatment for use in the Penola area of South Australia.

Four deposits of basalt were located along the Glenelg River in Victoria by Highways Department personnel and assistance was requested of the Mines Department to investigate their suitability. A deposit of diabase near Dergholm (see plan 67-651) is also being investigated.

A preliminary inspection was made in March, 1966 by R.K. Johns (Supervising Geologist) and M.N. Hiern (Senior Geologist) in company with Highways Department personnel when two deposits were selected for detailed investigation. This report describes the site in the Parish of Roseneath. Investigation of the other site (Section 42, Parish Dergholm) was completed in April, 1967 and is described in a report by M.G. Mason and R.K. Tarvydas (Rept.Bk.No. 64/61 - unpublished).

Geological investigation of the Roseneath site, including a plane-table survey, was carried out by M.G. Mason and the author between 13th November and 13th December, 1966.

The deposit was drilled in two stages; auger drilling with Proline plant No. 90 totalled 255ft. for 33 holes, the work being carried out on 15th and 16th November, 1966. Diamond drilling commenced on 19th November, 1966 and was completed on 1st March, 1967 after drilling 12 holes for a total of 452.9ft.

The deposit is on Sections 3 and 4, Parish Roseneath, County Follett, 3 miles E.S.E. of the township of Dergholm which is about 22 miles due East of Penola (see plan 67-651). It lies on a plateau overlooking the Glenelg River. The land is privately owned; no other information on mineral tenure is known, such matters having been handled by the Highways and Local Government Department. Access is via Jones Bridge and a track following the river, or via a higher track that leaves the main road about 3½ road miles from Dergholm (see plan 67-651).

GEOLOGIC SETTING

Within ten miles of Dergholm the geological succession is as follows:

(Caldwell, 1941; Kenley, 1961; Kenley et al, 1965)

Sedimentary Rocks

Recent	—	River alluvium and swamp deposits, siliceous sand sheets, clayey soils
Pliocene	—	Laterite on rocks of all ages
Pliocene	Dorodong Sands	Ferruginous sands, sandstones and grits
Miocene-Oligocene	Glenelg Group	Polyzoal marl and limestone, limey marl
Lower Cretaceous-Jurassic	Merino Group	Mudstones and feldspathic sandstones
Cambro-Ordovician	Glenelg River Complex	Indurated slates and sandstones

Igneous Rocks

?Eocene	Older Volcanic	Olivine Basalt
Post-Ordovician	Dergholm Granite	Granite
Cambrian	—	Diabase

In addition to the "Older Volcanic" basalt noted above, basalts referred to as "Newer Volcanic", and of Pliocene to Recent in age, occur extensively in western Victoria. These do not outcrop in the Dergholm district, the closest exposure being near Coleraine, 28 miles to the southeast. The basalt described in this report is equated with the "Older Volcanic" division, after Kenley et al., 1965.

The stratigraphic relations of the basalt are not exposed at the site, and none of the diamond-drill holes penetrated the deposit fully. Weathered argillaceous and arenaceous rocks of a schistose nature are exposed in a gully to the S.E. of the deposit; these were mapped by Caldwell as equivalents of the Glenelg River Complex. They do not constitute a source of road-metal. None of the post Glenelg River Complex rocks crop out at the site, but some of the drill holes (GRD 8 & 9) intersected pockets of iron-oxide within the soil horizon.

SITE GEOLOGY

General

The site investigated is on a small plateau about 150ft. above the Glenelg River which slopes towards the river at about 5°. The only exposure on the site is a small outcrop of weathered basalt. In addition, there are several areas of persistent float, but they do not mark the limit of hard basalt at depth as defined by the drilling. The basalt was not fully penetrated in drilling, but in two holes (GRD 11 & 12) highly weathered basalt was found underlying fresh basalt, suggesting that the deposit may be a composite flow or a single flow with lobes.

Fresh basalt is seen only in drill core and is a porphyritic rock with a dark grey to near black glassy groundmass. Phenocrysts of olivine and xenoliths of olivine-rich peridotite are pale green in colour; in places these show slight alteration. Other sections of core show more heavily weathered rock, both in the phenocrysts and the groundmass. In the drill-core four classes of rock have been recognised, based on the degree of weathering.

.... Decomposed basalt - completely weathered to clay

.... Highly to moderately weathered basalt - rock weathered to such an extent that 2-inch diameter core can be broken readily by hand; olivine crystals completely weathered to goethite and clays.

.... Moderately weathered basalt - 2-inch diameter core cannot usually be broken by hand; olivine crystals at least partly weathered to goethite;

.... Fresh to slightly weathered basalt - groundmass dark grey, olivine crystals fresh or only slightly weathered; only this class constitutes a source of bitumen screenings.

These variations are illustrated in selected photographs of drill core (Figs. 1 & 2).

The cross-sections on the accompanying plan (67-650) show the subsurface distribution of the recognised basalt types. A mass of slightly weathered to fresh basalt occurs near the boundary of Sections 3 and 4 and its extent is shown on the surface plan. It reaches a maximum thickness of 40ft. in drillhole GRD 11. The lens of fresh basalt passes laterally and vertically into more weathered rock, and the possibility of highly weathered patches occurring within the unweathered zone is real and should be further investigated.

The basalt is extensively jointed as shown by the fracture logs in the accompanying bore logs (Appendix II). No statistical work has been done, but there appear to be two groups of joints:-

(1) planar joints, lying at 0 - 20° to the horizontal often filled with a few mm of clay.

(2) joints at 45° - 90° to the horizontal - the very steep variety having irregular surfaces coated with white to pale green minerals, and often with a film of yellow clay. It is possible that these high-angle

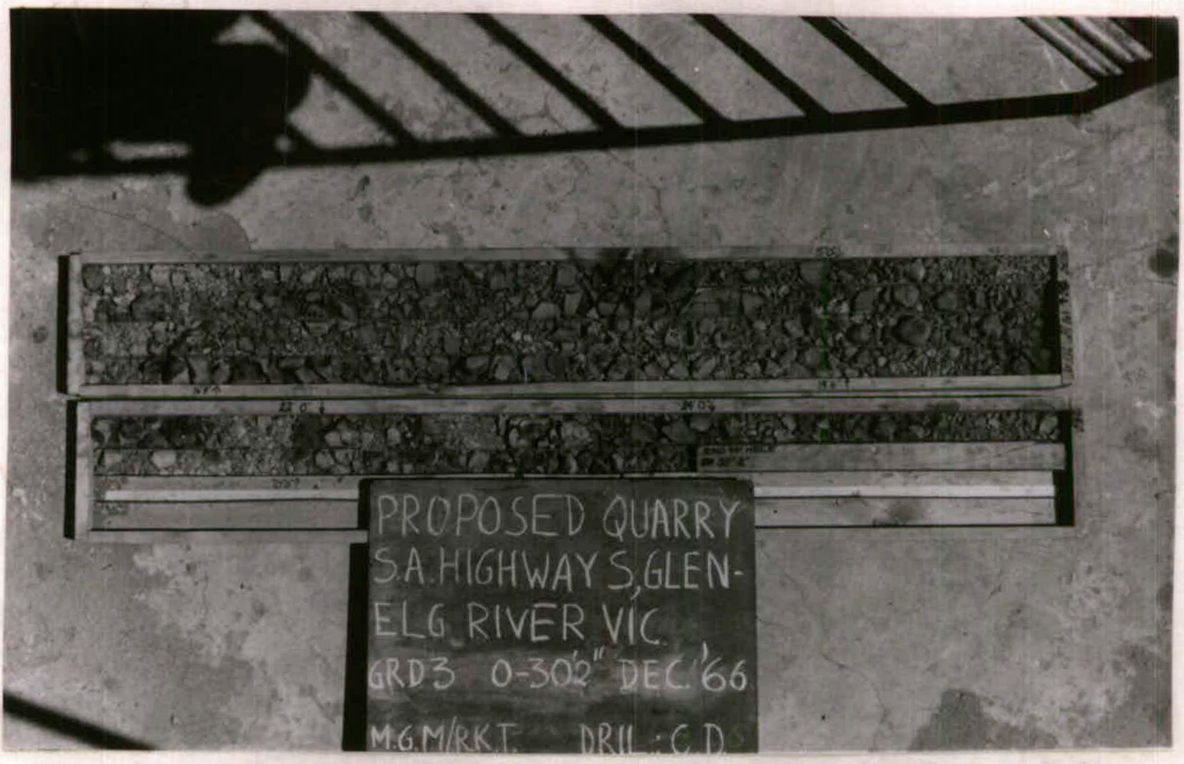


Fig. 1 Core from diamond drillhole GRD3 showing mainly highly weathered basalt. Scale 1 in. = 1ft.

VIC.

16926

Fig. 2 Core from diamond drillhole GRD 12 showing all degrees of weathering - clay at top and bottom, fresh basalt in the middle. Scale 1 in. = 1ft.

VIC

16927.

joints represent columnar jointing which commonly develops during the cooling of lava sheets.

Petrography

Petrographic work carried out by the Australian Mineral Development Laboratories included the examination of six thin-sections for the purpose of identifying certain minerals and determining their abundance. The reports are presented in Appendix I. (AMDEL Reports MP1474-67, MP2563-67, MP442-68).

The olivine phenocrysts range in size from a fraction of a mm to about 5 mm. Unweathered they are pale green in colour, but even in fresh-looking rock the grain boundaries are often altered to the brownish-red, iron-oxide mineral iddingsite. There is a lack of crystal outline, the larger phenocrysts being difficult to distinguish from smaller olivine-rick xenoliths, which reach a maximum width of 5 cm., but are usually in the range 0.5 - 2.0 cm. One xenolith has been microscopically identified as an orthopyroxene peridotite (see AMDEL report MP1474-67, Appendix I).

Besides olivine, there are phenocrysts of augite and plagioclase, but these constitute only a few percent of the total rock, whereas crystalline olivine comprises 10 - 15% of the total.

The dark green volcanic glass occurs as irregular bulbous segregations 0.5 - 2.0 cm across. In this form, it constitutes about 5% of the total rock, but the dark grey groundmass also contains considerable amounts - up to about 25% - of glass, (this form is being identifiable only only under the microscope..

In most sections of unweathered core there are conspicuous segregations of white to pale green minerals making up 5 - 15% of the total rock. These minerals are secondary, in that they have formed after the original molten lava had solidified. They are concentrated in open joints where they may reach a thickness of a few mm., or in vesicles which are a few mm wide. To the naked eye the minerals appear amorphous; their hardness varies from abut 3 to 4. Petrographic and X-ray analysis has shown that they consist of siderite with minor dolomite and calcite. Goethite and minor chalcedony, opal, montmorillonite, and ?nickel serpentine also occur in joints and vesicles.

The secondary minerals were probably formed in two ways. The final differentiate of the liquid melt was probably a hot fluid, which, being under considerable pressure, migrated through the rock. On reaching an opening such as a joint or a vesicle, the pressure and perhaps temperature dropped sufficiently for carbonates and silica to be deposited. It is also likely that such hydrothermal fluids attacked the early formed olivine crystals, producing the reddish iddingsite, which, on subsequent exposure to groundwater and air, weathered to the yellow-brown iron-oxide mineral goethite. Some of the olivine has also altered/to the minerals montmorillonite and serpentine.

PHYSICAL PROPERTIES

General

In recent literature dealing with highway construction much emphasis has been placed on the effects that secondary minerals have on the stability of roads. These studies have usually followed failure of highways constructed from material which appeared sound in hand specimens. In each case the trouble was traced to the presence of unstable secondary minerals which broke down soon after the roads were opened to traffic.

Scott (1955) examined the reasons for failures at 13 localities on basalt-paved highways in the State of Oregon, U.S.A. He found that within the -¼ inch size-grading of aggregate the amount of secondary minerals was important. He concluded that

(1) the worst of complete failures had rock with more than 35% secondary minerals

(2) rock with 20 - 35% secondary minerals produced borderline results

(3) rock with less than 20% secondary minerals produced little adverse effect

According to Scott, base or oiling aggregates fail in two ways. Most common is the dissolution or disintegration of fines containing secondary minerals; less commonly, badly altered rock is subject to crushing by wheel-load pressure. Field evidence suggests that water present in base material, either as initial moisture in the aggregate or derived from rain, removes the finest particles from the aggregate. This allows the remaining hydrophyllic clay fines to attract more water, thus causing further breakdown. Within a short time, this process of progressive dissolution produces clay pockets, and the kneeding set up by wheel-loading finally allows the surface to collapse.

Similar breakdown occurs in oil mats and pavements. Moisture present within or on a piece of aggregate tends to cause deterioration in or near the surface. The formation of even a minute film of clay between the surface of the rock and the asphalt binder destroys the cohesion between the two at that place. A progressive formation of such a film soom produces enough separation to allow for the easy dislodging of such a piece by passing traffic.

With the above facts in mind, the Australian Mineral Development Laboratories (AMDEL) were asked to provide some data on the secondary minerals in the Roseneath basalt. Results of this work are discussed in the following section, and the AMDEL reports are attached in full in Appendix I.

Laboratory Testing

To determine the suitability of the rock for use as road aggregate, various tests were performed. Drill-cores were submitted to the Highways and Local Government Laboratories for routine physical testing. AMDEL examined several thin sections in order to determine the amount of harmful secondary minerals.

The Highways Laboratories carried out the following tests: Los Angles abrasion (Fig. 3), Sulphate Soundness (Fig. 3) and the determination of Soil Constants (Figs. 4, 5 & 6).

Hole	Footage	Los Angles	Sulphate Soundness
1	10-39	16	3.0
2	9-52.9	17	3.8
3	0-30.8	21	-
4	4-50	17	-
5	0-30.5	19	-
6	0-30	17	-
7	-	-	-
8	4-26	18	-
9	8-41.25	18	-
10	-	-	-
11	3-50.5	16	-
12	-	-	-

Fig. 3 results of Los Angeles and Sulphate Soundness tests on $+\frac{3}{4}$ inch and $-\frac{3}{4}$ +3/8 inch fractions respectively.

Although the sulphate-soundness losses are low, the results should be viewed with caution. Firstly, there is considerable doubt about the usefulness of the test itself (e.g. McLaughlin et al. in Woods et al. 1960; Clelland, 1967). Secondly, in the present investigation the core was tested from two holes only.

In the following tables, the Soil Constants, consisting of Liquid Limit, Plastic Limit, Plasticity Index and Linear Shrinkage, are presented for material passing 36 mesh.

Hole GRD	Footage	Liquid Limit	Plastic Limit	Plasticity Index	Linear Shrinkage	Remarks
1	3-10	60	28	32	15.7	Clay
	39-47	64	29	35	16.6	Clay
2	0- 9	68	26	42	19.2	Clay
4	0- 4	72	27	45	22.0	Soil and Clay
8	0- 4	41	16	25	14.7	Fe pisolites and weathered basalt
9	0- 8	46	23	23	12.1	Fe pisolites and clay
11	0- 3	49	19	30	16.0	Soil

Fig. 4: Soil Constants for overburden

Hole GRD	Footage	Liquid Limit	Plastic Limit	Plasticity Index	Linear Shrinkage	Degree of Weathering
2	9-52.9	20	18	2	1.0	mainly fresh
3	0-30.2	30	25	5	2.9	moderate to high
5	0-30.5	26	21	5	2.7	moderate
6	0-30.0	25	21	4	1.9	moderate to high

Fig. 5: Soil Constants for basalt fines resulting from L.A. abrasion tests

Hole GRD	Footage	Liquid Limit	Plastic Limit	Plasticity Index	Linear Shrinkage	Degree of Weathering
3	0-30.2	43	27	16	7.8	see above
5	0-30.5	47	24	23	11.1	
6	0-30.0	33	23	10	4.9	

Fig. 6 Soil Constants for basalt in the -¾ in. fraction

In Fig. 4 the results represent the soft overburden of soil and completely weathered basalt; similar material was intersected in Hole 1 over the interval 39-47ft. This material is unlikely to be of use in road construction. The core used for results in Figures 5 & 6 is mainly moderately weathered basalt which may be usable as base or sub-base course. Core from bores 3, 5 & 6 was split into two fractions of ±¾in. The +¾ fraction was used for the Los Angeles test (see Fig. 3) and the soil constants were obtained from the resulting fines (Fig. 5). The -¾ fraction of the original material was used to provide another set of soil constants (Fig. 6). Comparing the two sets of results in Figs. 5 & 6, it may be deduced that naturally weathered basalt has a greater clay content than the fines collected from the Los Angeles abrasion test.

Three thin-sections were prepared from various parts of the fresh to slightly weathered basalt and the amounts of secondary minerals were estimated using point-counting and line-integrating. Fig. 7 is a summary of AMDEL Report MP442-68, which is appended. The data obtained cannot be regarded as ~~satistically~~ statistically representative because of the low number of samples. However, it at least gives an indication of the engineering properties of the basalt.

Hole	Depth	% Clays	% iddingsite & iron oxide	% carbonates	% total secondary minerals	% glass	Report No.	Remarks
2	22ft.	2-3.5	present	present	5-7.5	12 (Visual estim.)	MP1474-67 442-68	
8	22ft.	0-0.6		9.2-14.0			MP442-68	carbonate area
8	22ft.	0.4	12.5	7.2			MP442-68	iddingsitised area
9	28.5ft.				3.7-8.5	26.5-29	MP442-68	

Fig. 7 Results of petrographic analysis of basalt from the Roseneath site

Clays, including nickel serpentinite and montmorillonite (identified by X-ray analysis), form a very small volume of the total rock. However, even in a rock that looks fresh in hand-specimen, there can be patches of altered olivines where the amount of iddingsite is as high as 12.5%.

The limited data therefore suggests that harmful clay and iron-oxide minerals are within the tolerable limit of 20% set by Scott (op. cit).

The amount of carbonate can be fairly high (e.g. 14% in one section), but is not thought to present a major threat. It dissolves in water only slowly, does not swell and is not hydrophyllic.

The percentage of glass as given is very high. According to some writers (e.g. Myoeger, 1964) palagonite (water-rich volcanic glass) is a harmful constituent because it devitrifies quickly. However, the glass in all the six thin-sections observed is apparently not palagonite, and, furthermore, does not show any alteration. (AMDEL Report MP442-68; cf. iddingsite, which apparently formed at about the same time but has significantly altered to goethite). The glass seems to be sound chemically, judging by the lack of alteration, but under impact will shatter more easily than crystalline material.

The glass is apparently some

RESULTS OF DRILLING AND RESERVES

The purpose of the auger drilling with the Proline plant was two-fold: firstly, to find an area underlain by solid basalt; secondly to determine the depth of overburden. The results were not entirely satisfactory, as the drill stopped in material too weathered for aggregate use. For example, auger drill hole GR47 indicated an overburden thickness of 2ft., whereas diamond-drilling at the same point (Hole GRD6) encountered fresh basalt at 9.5ft. Depths of overburden indicated by the auger drill (plan 67-650) are thus less than true depths.

Thirty-three auger holes were drilled on a 250ft. grid. The thickness of overburden so obtained ranged from 1 - 20ft. with an average of 7 - 8ft. (cf. an average of 11.9ft. slightly weathered to fresh basalt, as obtained from diamond drilling at the site).

The auger drilling disclosed an area of least overburden near the boundary of Sections 3 & 4. Using a 200ft. grid, twelve diamond drill holes were put down to a total depth of 452.9ft. Despite the poor nature of part of the rock, 90% of the core was recovered.

Reserves have been calculated for the fresh to slightly weathered basalt; they are based entirely on measurement of cross-sections which in themselves are an interpolation of the diamond-drilling results. Two assumptions have been made in the calculations; (1) that usable basalt is continuous between holes; (2) that it is uneconomical to work a seam less than 10ft. thick. The first assumption should be checked by costeaning or further drilling between the existing holes, as the weathering pattern within basalts is unpredictable. As a consequence of the second assumption, only usable basalt thicker than 10ft. has been included in the calculations.

Within the 10ft. isopach shown on plan 67-650 there are 312,000 cu. yds. of fresh to slightly weathered basalt overlain by 97,000 cu. yds. of soil, clay and highly weathered basalt, the latter containing no usable rock. In addition, bores 4, 5, 9 and 12 intersected moderately weathered basalt before encountering fresh rock. There are 47,000 cu. yds. of this material within the defined area; its properties are shown in the logs, in the Los Angeles tests (Fig. 3) and in the Soil Constants (Fig. 6). It is thought that the material is unsuitable for bitumen screenings.

On the basis of diamond drilling, overburden plus moderately weathered rock over the area available for quarrying ranges in depth from 5 - 20ft. and averages 11.9ft. On the same basis the average thickness of quarriable basalt is 27.9ft.

SUMMARY AND CONCLUSIONS

(1) Basalt weathered to varying degrees underlies the area studied.

(2) Drilling on a 200ft. grid shows a zone of fresh to slightly weathered basalt which is calculated to contain over 300,000 cu. yds. in a layer +10ft. thick. This passes both laterally and vertically into highly weathered rock.

(3) Losses in the Los Angeles Abrasion test and the Sulphate Soundness test are within the range generally accepted for bitumen screenings.

(4) Petrographic investigation has revealed the presence of secondary minerals. Preliminary work suggests that these are not in sufficient quantity to be harmful.

(5) Further investigation is recommended to

a. prove continuity of hard rock within the area by costeaning or further drilling;

b. obtain more representative samples for determining effects of secondary minerals on rock properties. Petrographic investigation of laboratory-crushed samples from a. (above) should provide suitable material.

REFERENCES

CALDWELL, T.T., 1941. Geological Map, Parish Rosemeath, County Follett, Vic. scale 1:31,680 Department of Mines, Victoria.

CLELLAND, J.1967. An Artificial Weathering Test for Roading Aggregates. N.Z. National Roads Board, Proceedings Session L, Roading Symposium, 1967, p. 67-87.

KENLEY, P.R. et al, 1965. Geological Map, Sheet Hamilton, Provisional scale 1:250,000 Department of Mines, Victoria.

KENLEY, P.R., 1961. Stratigraphic Relationships of the Basalts near the Mouth of Salt Creek, Parishes of Dergholm and Youpayang. Unpublished map Y2228/G/2, Scale 1in. = 20ch., Department of Mines, Victoria.

MASON, M.G. & TARVYDAS, R.K., 1967. Report on Basalt Deposit Salt Creek, Section 42, Parish Dergholm, Co. Follett, Victoria. Rept.Bk.No. 64/61, unpublished, Department of Mines, South Australia.

SCOTT, L.E., 1955. Secondary Minerals in Rock as a Cause of Pavement and Base Failure, Highways Research Board Proceedings 34th Annual Meeting. p. 412-417

WOODS, K.B., BERRY, D.S. and GOETZ, W.H., 1960. Highway Engineering Handbook, 1st ed. McGraw-Hill.

R. Tarvydas

RKT:CM
26.10.1967

R.K. TARVYDAS
GEOLOGIST
NON-METALLIC MINERALS SECTION

APPENDIX I

Petrographic and X-ray Analyses by the Australian Mineral Development Laboratories (AMDEL)

Report	MP1474-67	The petrography of an olivine basalt
"	MP2563-67	Basalt cores from S.W. Victoria
"	MP 442-68	Basalt from Victoria

REPORT MP1474-67

THE PETROGRAPHY OF AN OLIVINE BASALT

Sample P1228/66: TS18717 Hole GRD2, depth 22.0ft.

Rock Name: Porphyritic, olivine-basalt

Hand Specimen:

A black porphyritic rock, containing phenocrysts of olivine, and xenoliths, set in an aphanitic groundmass.

Thin Section:

A visual estimate of the constituents gives the following:

	%
Olivine	25
Clinopyroxene (titanaugite)	37
Plagioclase	16
Carbonate (not calcite)	5
Opaques	5
Glass (brown basaltic)	12

Olivine occurs as phenocrysts ranging in size from 5 mm to 0.1 mm. The crystal form is generally well developed. Clinopyroxene phenocrysts are rare, and have an average size of 0.3 mm. Zoned titanaugite is the dominant pyroxene. A few crystals of a colourless clinopyroxene (? augite) occur as microphenocrysts. Calcic plagioclase, though generally confined to the groundmass as laths 0.09 mm in length, are found as very rare phenocrysts 0.3 mm in size, and these are strongly zoned.

The groundmass is composed mainly of small granules of titanaugite 0.04 mm in size, feldspar laths, and octahedra of an opaque mineral 0.03 mm in size. Devitrified glass is present.

Late stage activity is evident by the abundance of carbonate (?siderite), which sometimes replaces olivine.

Special Features:

The xenolith is an orthopyroxene-peridotite, consisting of olivine 50%, orthopyroxene 40%, clinopyroxene 5%, spinel 5%. A quartz xenocryst also occurs, surrounded by a reaction rim of closely packed prisms of pyroxene enclosed in glass.

History:

Igneous, with late stage deuteric activity, sometimes resulting in replacement of olivine.

REPORT MP2563-67

BASALT CORES FROM S.W. VICTORIA

Samples P175/67, P180/67, P181/67 (TS19179, 19180, 19181, 19182)

Location:

Glenelg River Area, Victoria

Rock Name:

Basalt

Hand Specimen:

Black, fine-grained, basic igneous rock containing numerous secondary minerals and phenocrysts.

Thin Section:

All rocks are olivine basalts containing up to 20% brown glass and ranging in texture from intersertal (glass interstitial) to hyalo-ophitic (glass groundmass). Occasional phenocrysts of olivine and pyroxene are present but usually the former is in a very altered condition. Alteration products include a yellow-green serpentine-like mineral, a grass-green mineral of similar form and carbonates (mainly sidertie and calcite). Some larger grains also are altered to a light green clay (?montmorillonite) mineral and secondary opal is also present.

Opal carbonates, goethite and clay minerals are very common in cavities. The rock contains approximately 10 to

15% of these secondary minerals. The rock fragment in TS19182 (P181/67) consists of olivine, clinopyroxene, and dark yellow-brown coloured ?spinel. Carbonate and serpentine alteration (in olivine) are both present in this fragment of peridotite.

Comments on Effect of Secondary Minerals in Road Aggregate

The alteration products of olivine (clay and serpentine) will be the most troublesome if the rock material is to be used as rud metal. These minerals are likely to break down or change their physical form with wetting and drying as well as with heating and cooling.

Other secondary minerals, although more stable are still undesirable. Apart from affecting the strength of the rock they could be affected by reactive groundwater in wet regions.

The glass content of the rock itself, because of its metastable form is liable to alter more quickly than other components. However, this alteration would take some time and it would probably be the brittleness of the glass which would be more of a problem especially with strength properties. Standard sulphate soundness tests, Los Angeles abraison tests and strength tests should be carried out for more quantitative information on the rock properties.

Secondary Minerals

Identification of various primary and secondary minerals was carried out by X-ray diffraction.

The minerals in Table 1 were present in the basalt.

TABLE 1: MINERALS FROM THREE BASALT CORES

Bore Hole	Depth Feet	Minerals
8	22	glassy mineral - glass spherules in glass - siderite brown altered mineral (phenocryst) - olivine green (core) mineral in cavity - 7Å serpentine WHITE (rim) mineral in cavity - siderite
8	24	glassy mineral - glass spherules in glass - goethite and minor siderite light green crystalline phenocrysts - olivine dull green (rim) mineral in cavity - siderite white (core) mineral in cavity - dolomite
8	13	white (rim) mineral in cavity - siderite green (core) mineral in cavity - montmorillonite and siderite
9	12	radial brown needles - calcite brown botryoidal growths (rim) in cavity - goethite white (core) mineral in cavity - 7Å serpentine
9	28.25	brown botryoidal growths - goethite
9	28.5	(See TS19180)
9	30	white mineral in cavity - calcite green-black secondary mineral - montmorillonite grass green surface staining (See TS19181, TS19182)
12	27.5	glassy mineral - glass spherulites - siderite

REPORT MP442-68

BASALT FROM VICTORIA

P1220/66: TS18717: Hole GRD2 22.0ft.

Both point counting and integrating stage methods were carried out on this sample. Some variation in the results could be statistical error or an error incurred by one or the other method.

The results are:

1. Integrating stage (210 mm): 5% secondary minerals
   (error uncertain but probably as good as 500 points)
2. Point counting (600 points); 7.5% secondary minerals
   (error ± 2%)
   (nearly 1/3 of which is clay)

3. Point counting (1000 points): (error ± 2%) — 7.2% secondary minerals (nearly 1/3 of which is clay)

Secondary minerals are clay, carbonate and iron oxides.

P180/67: TS19326: Hole GRD9 at 28.5ft.

Point counting and integrating stage measurements were also carried out on this sample. The results are:

1. Integrating Stage (40 mm): 8.9% secondary minerals 29% glass
2. Integrating Stage (60 mm): 6.6% secondary minerals 29% glass
3. Point counting (400 points): 3.68% secondary minerals 26.5% glass

P363/67: Hole GRD2, 42.0ft.

The refractive index of the volcanic glass in sample P363/67 (GRD2, 42ft.) was 1.555 to 1.56.

According to Williams, Turner and Gilbert[1] to RI of palagonite is usually much less than 1.54 and that of unhydrated glasses much higher than 1.54 (p. 39).

The glass in this rok, and indeed in all thin sections examined, is unaltered and therefore the RI of 1.56 is in order when it is considered that the graphs on p. 28 are for glass samples while these rocks are composed of glass and crystals. As crystals form, the residual glass becomes more acid (normal differentiation) and thus the RI observed in this case is lower than would be expected for a rock completely made up of unhydrated glass.

Therefore the glass is not thought to be palagonite.

---

[1] WILLIAMS, H., TURNER, F.J., GILBERT, C.M., 1958, Petrography. W.H. Freeman and Co., San Francisco. pp. 28, 39.

P175/67; TS19179; Hole 8. 22ft.

This rock when examined in hand specimen thin section shows a clear colour difference between the red-brown-grey iddingsite areas and the "normal" grey carbonate areas. TS19739 from Hole 2 at 42ft. exhibited this same distinct difference between altered olivine areas and unaltered areas but because the alteration is to green serpentine or clay minerals it is not as readily distinguishable (in hand specimen) as the red iddingsite alteration.

Point counting was carried out on selected areas of TS19179 so that the iddingsite-rich areas could be compared with the carbonate-rich areas.

Three counts of 500 points each on the carbonate areas gave:

1. 0.6% clays; 14% carbonate
2. 0% clays; 14% carbonate
3. 0% clays; 9.2% carbonate
   (Average 123% carbonate; error ± 2%)

A point count of 500 points on the iddingsite area gave:

1. 0.4% clays; 7.2% carbonate; 12.5% iddingsite.
   (error ± 3%)

Comments

Carbonates, although classed as secondary minerals, are not as deleterious in road aggregate as clays, serpentine, iddingsite and the like because of their more stable chemical and physical nature. However, the fact that they are secondary infers that the rock must be weaker, physically, than any rock not containing these minerals.

As far as can be ascertained the results obtained from point counting and from integrating stage measurements are both of the same order of accuracy but, as little is known of the statistics of line integrating, it is probably best to use point counting results. Much work has been done on this aspect and errors can be quoted on values given.

APPENDIX II

Logs of Diamond Drillholes

GRD 1 - 12

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE No. GRD1
SERIAL No 673 /67

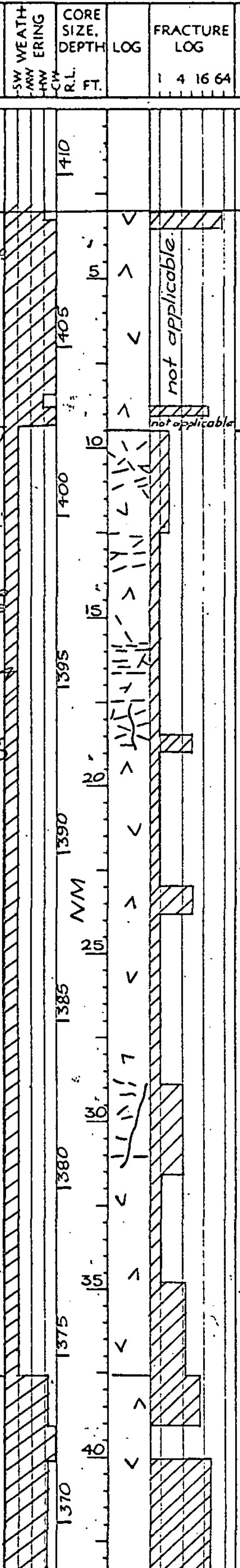
PROJECT H&L.G. DEPT. PROPOSED BASALT QUARRY.
FEATURE GLENELG RIVER
LOCATION. 3 MI E.S.E. DERGHOLM, VIC.

SECTIONS 3. & 4. PARISH ROSENEATH
CO-ORDINATES LAT. 37°23′ LONG 141°17′
ANGLE FROM HORIZONTAL 90°
DIRECTION —

R.L. Surface c 412 FT.
R.L. Collar c 412 FT.
Datum ARBITRARY

DESCRIPTION OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES
	END OF AUGER HOLE GRA 15 at 3·0 ft.
CLAY - pale grey, of low plasticity; undisturbed but rock structure difficult to discern; origin weathered basalt.	A few near-horizontal bands of more-plastic yellow clay 10 m.m thick along joint planes.
BASALT - dark grey, hard rock with porphyritic texture, phenocrysts not aligned. Groundmass: dark grey, microcrystalline phenocrysts: olivine pale green, anhedral, 1·5 m.m. dia. c 5% of rock. ferromagnesians - rare ? feldspar; a few laths c1·0 x 0·1 m.m. white. Amygdules: - 1·8 m.m. diam. with white to pale green minerals, H:3-4 c 2% of rock. Xenoliths: 1-6 c.m. dia olivine - rich Glass - green to black irregular blobs 0·5-2·0 c.m. dia < 2% of rock	Joints 10°-60° to horizontal, planar accounting for c 70%; rest sub-vertical, with irregular surfaces. All open with coatings of yellow and brown clay, to ½ m.m. thick, especially in near horizontal joints.
CLAY - pale grey, low plasticity, in parts retains basalt texture.	A few yellow clay bands, near horizontal up to 10 m.m. thick, originally joints.
	END OF HOLE 47·0 FT.

BASALT - OLDER VOLCANIC - EOCENE?



LIFT, CORE LOSS % 5 50 10 | WATER LEVEL DATE | CASING | DRILL WATER LOSS % 0-100 | LAB. TESTS: L.A. | SULPH. SOUND | SOIL CONSTS.

NX

NO WATER ENCOUNTERED

L.A. 16 — SULPH. SOUND 3

see report.

see report.

WEATHERING
- FR – Fresh
- SW – Slightly weathered
- MW – Moderately "
- HW – Highly "
- CW – Completely "

FRACTURE LOG

1	4	16	64	— Natural fractures per foot. of core
12	3	¾	³⁄₁₆	— Equivalent diameter in inches

→ Core lift.

╳ Joints.

c. Approximately

NON-METALLIC MINERALS DIVISION.

DRILL No. 5.
TYPE E.1000
DRILLER DAVIDSON
START 19. NOV. 1966.
FINISH 25. NOV 1966

LOGGED BY R. TARVYDAS
DATE 3 DEC 1966
TRACED J.M.W.
CHECKED C.W.F.

SHEET 1 OF 1 DRG. No. S 6032 9545

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE No. GRD2
SERIAL No. 680/67

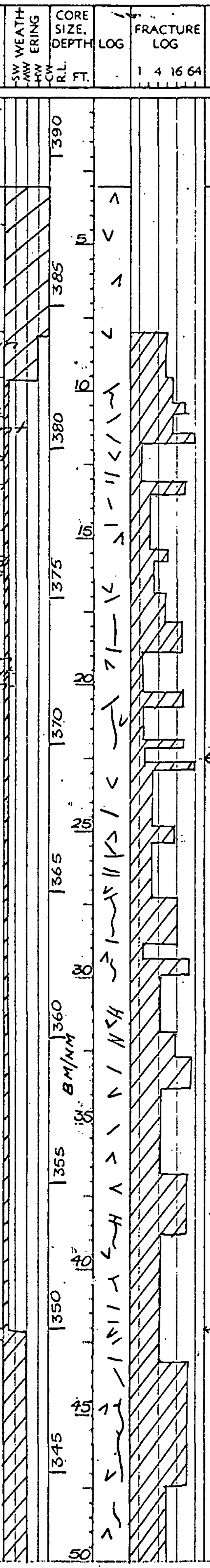
PROJECT H&LG DEPT PROPOSED BASALT QUARRY
FEATURE GLENELG RIVER
LOCATION 3 MI. ESE DERGHOLM VIC.

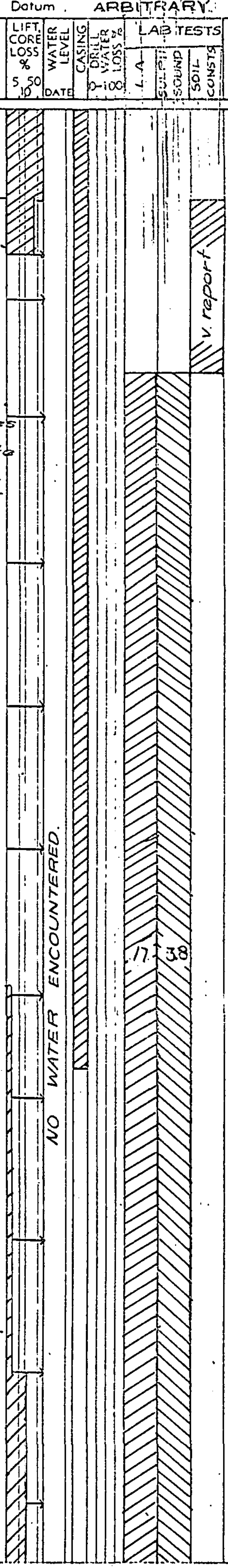
SECTION 3, 4 PARISH ROSENEATH
CO-ORDINATES LAT. 37°23' LONG. 141°17'
ANGLE FROM HORIZONTAL 90°
DIRECTION -

R.L. Surface c 492 FT.
R.L. Collar c 492 FT.
Datum ARBITRARY

DESCRIPTION OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES
SOIL - no core recovered.	
CLAY pale grey to brown with partial preservation of basalt texture.	
BASALT greenish brown to pale grey weathered rock	JOINTS 10-45° to horizontal, planar, coated with bluish black film or dendrites of MnO2; >45° to horizontal - surfaces irregular with ± m.m. thick coatings of white amorphous mineral similar to that in the depressions; near vertical fractures with irregular surfaces and MnO2 and clay coatings
BASALT - hard, dense, dark grey porphyritic rock; no alignment of phenocrysts. partially weathered anhedral phenocrysts of pale green olivine ± - 4 m.m. diam. apparently grading into olivine-rich xenoliths up to 2 Cm. dia. together accounting for about 15% of the rock. Glass, dark green blobs 1-2 cm across c. 1% of rock Spherical depressions 0.1-2 m.m. dia. filled with pale green to white opaque material of H=3, concentric layering sometimes visible.	←Petrological sample P1228/66. Petrological sample P363/67
BASALT - grey-brown broken rock; phenocrysts as above. partially to wholly altered.	JOINTS & FRACTURES irregular in surface and attitude.

BASALT - OLDER VOLCANIC - EOCENE ?





WEATHERING
FR - Fresh
SW - Slightly weathered
MW - Moderately ''
HW - Highly ''
CW - Completely ''

FRACTURE LOG
1 4 16 64 — Natural fractures per foot of core
12 3 ¾ 3/16 — Equivalent diameter in inches

→ Core lift
/~ Joints
c Approximately

NON-METALLIC MINERALS SECTION

DRILL No. 5
TYPE E 1000
DRILLER DAVIDSON
START 26 NOV. 1966
FINISH 29 NOV 1966

LOGGED BY R. TARVYDAS
DATE 7 FEB. '67
TRACED J.M.W.
CHECKED C.W.F.

SHEET . OF .
DRG. No. S6033a 9945

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE No. GRD2
SERIAL No. 680/67

PROJECT H&LG DEPT. PROPOSED
BASALT QUARRY.
FEATURE GLENELG RIVER.
LOCATION. 3 MI ESE DERGHOLM, VIC.

SECTIONS 3 & 4. PARISH ROSENEATH
CO-ORDINATES LAT. 37°23′ LONG. 141°17′
ANGLE FROM HORIZONTAL 90°
DIRECTION —

R.L. Surface c 392 FT.
R.L. Collar c 392 FT.
Datum ARBITRARY.

DESCRIPTION OF CORE	SW MW HW CW WEATHERING	CORE SIZE. DEPTH R.L. FT.	LOG	FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS. VEINS. SEAMS. SHEARED ZONES. CRUSHED ZONES	LIFT. CORE LOSS % 5 10 50	WATER LEVEL DATE	CASING	DRILL WATER LOSS % 0-100	LAB. TESTS L.A.	SULPH SOUND	SOIL CONSTS
As above.		1340			JOINTS near-horizontal with iron oxide staining 1in. either side.					17	38	
		55			END OF HOLE 52·9 FT.							

WEATHERING
FR – Fresh
SW – Slightly weathered
MW – Moderately ''
HW – Highly ''
CW – Completely ''

FRACTURE LOG
1 4 16 64 — Natural fractures per foot of core
12 3 ¾ ³⁄₁₆ — Equivalent diameter in inches

NON-METALLIC MINERALS SECTION.

DRILL No 5	LOGGED BY R. TARVYDAS
TYPE E 1000	DATE 7 FEB. '67
DRILLER DAVIDSON	TRACED J.M.W.
START. 26 NOV. 1966	CHECKED C.W.F.
FINISH 29 NOV. 1966	
SHEET 2 OF 2	DRG. No. S 6033b 9945

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE No. GRD3

SERIAL No. 681 / 67.

PROJECT H & LG. DEPT. PROPOSED BASALT QUARRY.

FEATURE GLENELG RIVER

LOCATION 3 MI. ESE DERGHOLM, VIC.

SECTION 3 & 4. PARISH ROSENEATH

CO-ORDINATES LAT. 37°23′ LONG. 141°17

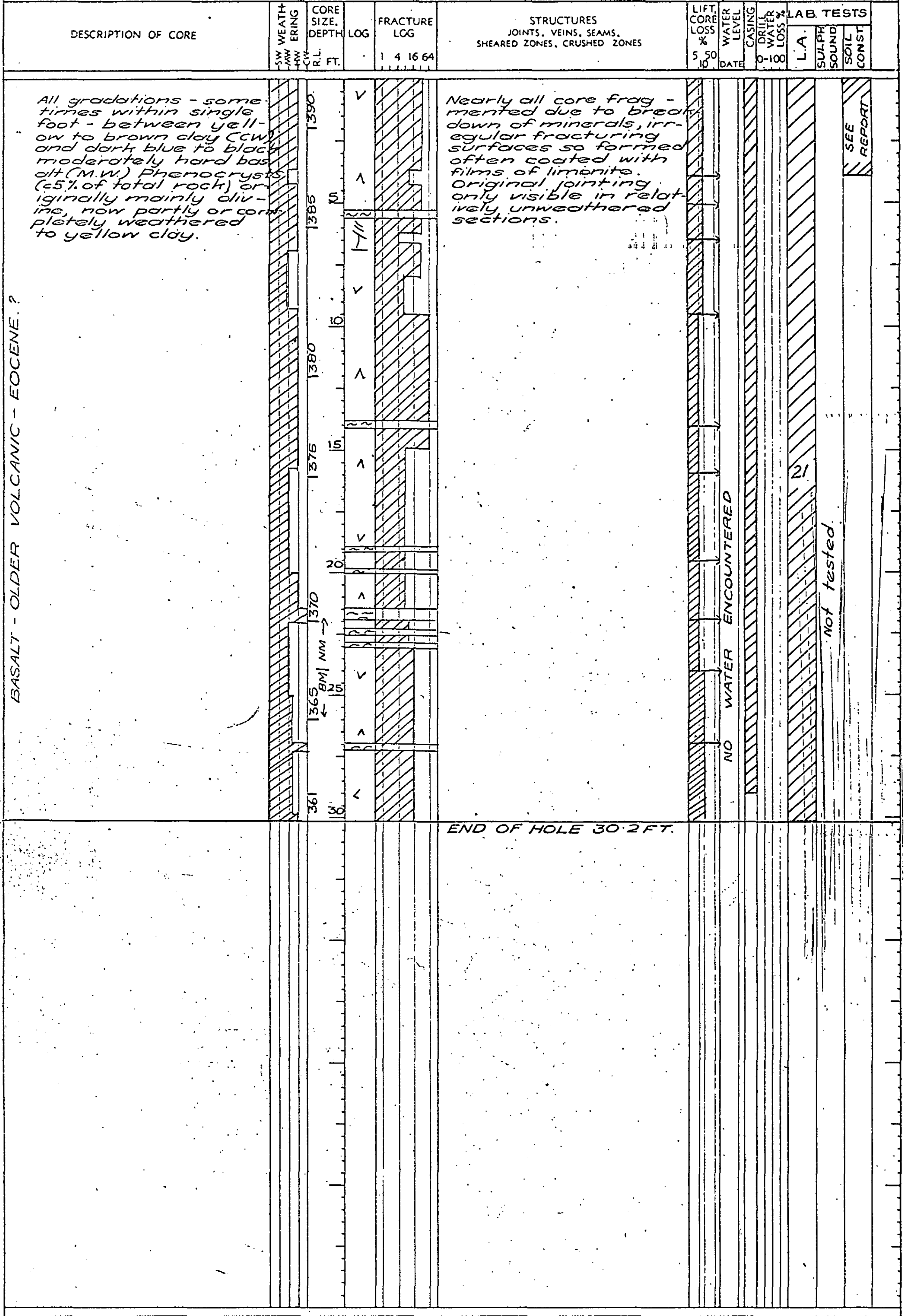
ANGLE FROM HORIZONTAL 90°

DIRECTION —

R.L. Surface c 392 FT.

R.L. Collar c 392 FT.

Datum ARBITRARY.



All gradations - sometimes within single foot - between yellow to brown clay (CW) and dark blue to black moderately hard basalt (M.W.) Phenocrysts (c5% of total rock) originally mainly olivine, now partly or completely weathered to yellow clay.

Nearly all core fragmented due to breakdown of minerals, irregular fracturing surfaces so formed often coated with films of limonite. Original jointing only visible in relatively unweathered sections.

END OF HOLE 30·2 FT.

WEATHERING

FR — Fresh
SW — Slightly weathered
MW — Moderately ··
HW — Highly ··
CW — Completely ··

FRACTURE LOG

1 4 16 64	Natural fractures per foot of core
12 3 ¾ 3/16	Equivalent diameter in inches

→ Core lift

▭ Clay seam

\ Joint

c. Approximately

NON-METALIC MINERALS SECTION

DRILL No. 5
TYPE E1000.
DRILLER DAVIDSON.
START 30 NOV. '66
FINISH 2 DEC '66.

LOGGED BY R. TARVYDAS
DATE 7 FEB. '67
TRACED J.M.W.
CHECKED C.W.E.

SHEET 1 OF 1. DRG. No. S 6034 9945

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE No. GRD4
SERIAL No. 692/67

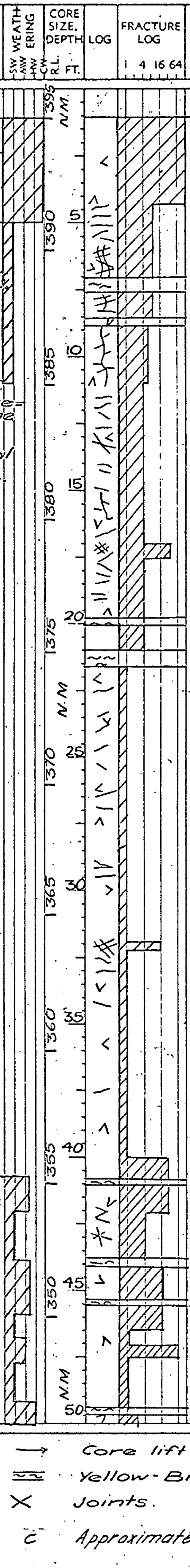
PROJECT H & L.G. PROPOSED BASALT QUARRY
FEATURE GLENELG RIVER
LOCATION 3 MI. ESE DERGHOLM, VIC.

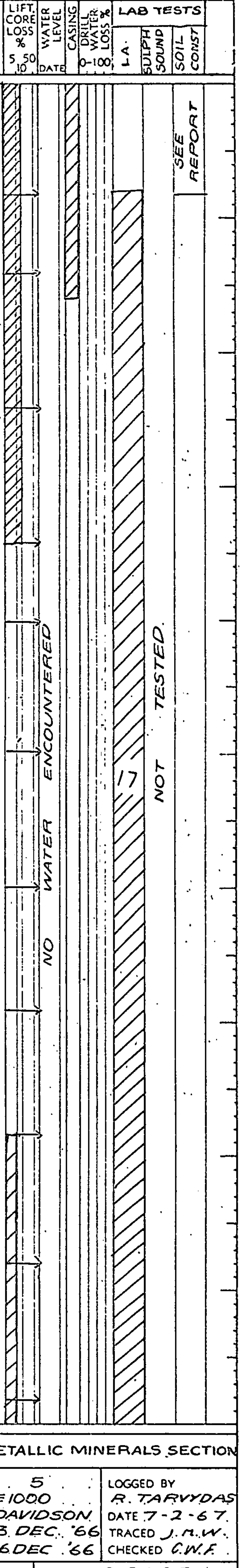
SECTION 3-4 PARISH ROSENEATH
CO-ORDINATES LAT 37°23' LONG. 141°17'
ANGLE FROM HORIZONTAL 90°
DIRECTION —

R.L. Surface c396 FT.
R.L. Collar c396 FT.
Datum ARBITRARY

DESCRIPTION OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES
SOIL - brown loam.	
Yellow-brown to grey brown crumbly rock no recognizable minerals; grades in to fresh basalt below.	
Hard, dark blue-grey porphyritic rock with partly to completely weathered 1-5 m.m. olivine crystals which c5% of total rock	Joints and fractures stained with brown Fe oxides.
Hard porphyritic rock groundmass - dark blue-grey, cryptocrystalline Phenocrysts; anhedral, olivine, 1-5m.m. across 10-15 % of total rock: glass, dark green, bulbous masses to 2 cm. across 1-2% total rock. White to pale green, moderately to hard minerals.	Some joints, including vertical, coated with pale green minerals.
Similar to above, but phenocrysts at least partly weathered to clays; groundmass light grey to brown.	
	END OF HOLE 50·0 FT.

BASALT - OLDER VOLCANIC - EOCENE?





WEATHERING
FR — Fresh
SW — Slightly weathered
MW — Moderately "
HW — Highly "
CW — Completely "

FRACTURE LOG
1 4 16 64 — Natural fractures per foot of core
12 3 3/4 3/16 — Equivalent diameter in inches

→ Core lift
≈ Yellow-Brown clay seam
X Joints.
c Approximately

NON-METALLIC MINERALS SECTION

DRILL No. 5
TYPE E1000
DRILLER DAVIDSON
START 3. DEC. '66
FINISH 6 DEC. '66

LOGGED BY R. TARVYDAS
DATE 7-2-67
TRACED J.M.W.
CHECKED C.W.F.

SHEET 1 OF 1
DRG. No. S6035 994-5

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE No. GRD 5
SERIAL No. 693/67

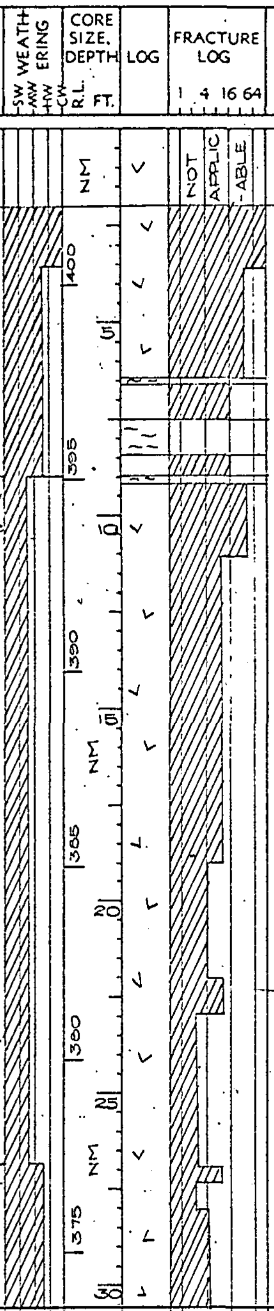
PROJECT HAND L.G. PROPOSED BASALT QUARRY
FEATURE GLENELG RIVER
LOCATION 3M. ESE DERGHOLM, VICTORIA

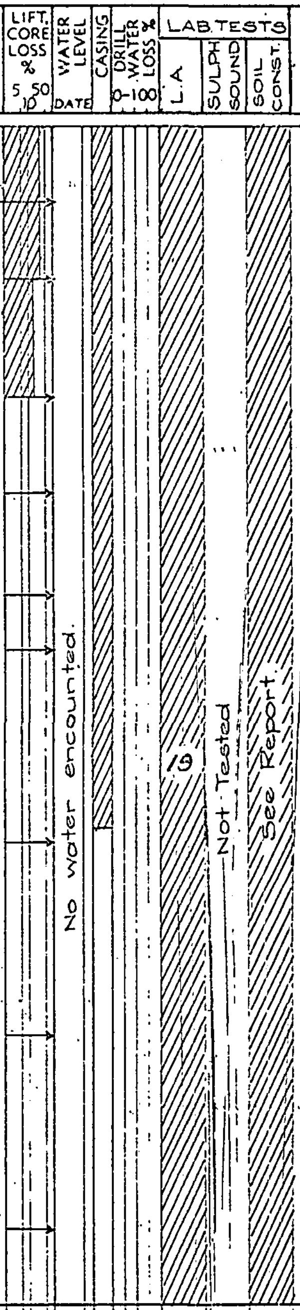
SECTION 3 AND 4 . PARISH ROSENEATH
CO-ORDINATES Lat. 37°23′ long. 141°17′
ANGLE FROM HORIZONTAL 90°
DIRECTION —

R.L. Surface c.404 FT.
R.L. Collar c.404 FT.
Datum arbitrary

DESCRIPTION OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES
SOIL, black-brown, loamy, some rock texture preserved.	
Grey to grey-brown rock with 1-5mm. "inclusions" of white to pale yellow and pale green, soft, weathered material.	Whole core broken up into equant 'pebbles' ½-1in. across, break up due to subaerial weathering no apparent pattern in the fracturing; original, planar joints often obliterated
Hard, dark blue-grey porphy-ritic rock. groundmass cryptocrystalline olivine, c 5% of total, as phenocrysts + inclusions 1-18mm across, anhedral non-aligned; some partly to completely weathered to pale yellow clay glass a few blubs, 1-2·cm. across. White to pale green minerals, on original joints, to 1mm. thicknoss.	
Similar above, but groundmass weathered brown and phenocrysts to yellow clay.	
	END OF HOLE 30·5 ft.

BASALT - OLDER VOLCANIC - EOCENE ?





WEATHERING
- FR – Fresh
- SW – Slightly weathered
- MW – Moderately ״
- HW – Highly ״
- CW – Completely ״

FRACTURE LOG
1 4 16 64 — Natural fractures per foot of core
12 3 ¾ 3/16 — Equivalent diameter in inches

→ Core lift.
☰ Clay seam
c. approximately.

NON-METALLIC MINERALS SECTION

DRILL No. 5
TYPE E1000
DRILLER DAVIDSON
START 6 Nov.'66
FINISH 8 Nov.'66

LOGGED BY TARVYDAS.
DATE 8 Feb.'67
TRACED AMcD
CHECKED C.F.

SHEET 1 OF 1 DRG. No. S 6028 994·5

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE No. GRD 6

SERIAL No. 694/67

PROJECT H. AND L.G. PROPOSED BASALT QUARRY

FEATURE GLENELG RIVER

LOCATION 3M. ESE DERGHOLM, VICTORIA

SECTION 3 AND 4 PARISH ROSENEATH

CO-ORDINATES Lat. 37° 23', Long. 141° 17'

ANGLE FROM HORIZONTAL 90°

DIRECTION —

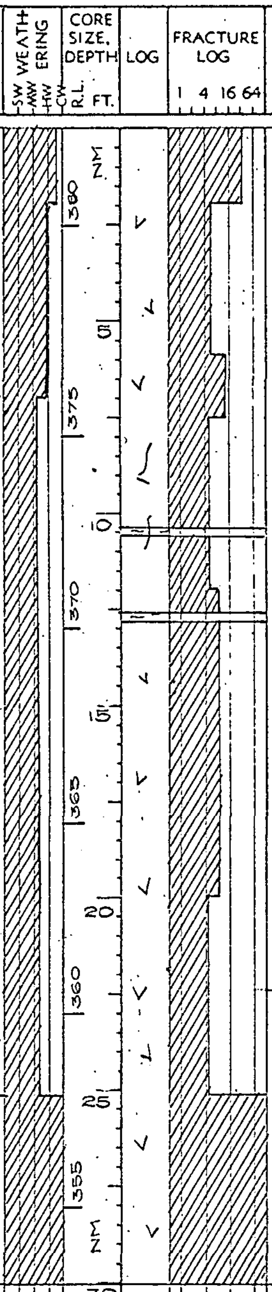
R.L. Surface c. 383 FT.

R.L. Collar c. 383 FT.

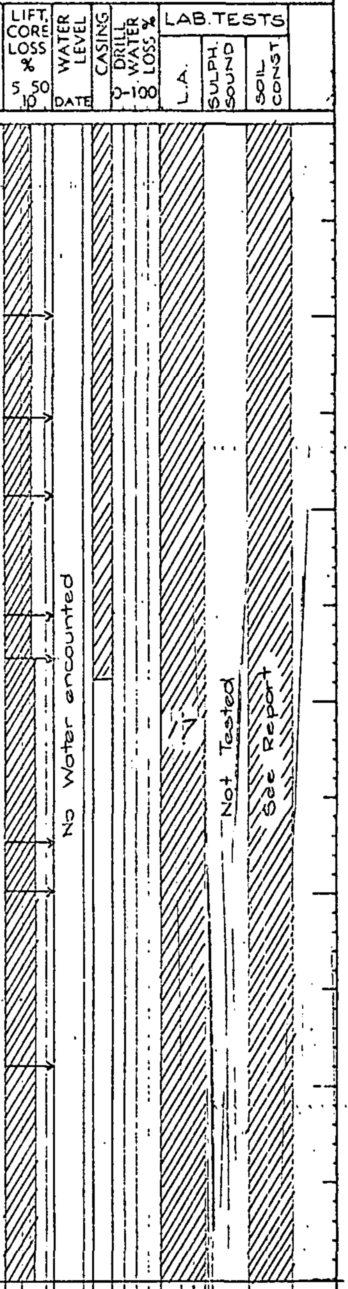
Datum ARBITRARY

BASALT - OLDER VOLCANIC - EOCENE?

DESCRIPTION OF CORE	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES
Brown clayey soil with small pieces of very weathered basalt.	
Black rock, moderately hard, with 1-3mm.-wide inclusions of yellow-brown clay, which are about 5% of total rock.	All core very fragmented, fracturing the result of subaerial weathering. Some tectonic joints: coated with films of black and brown iron oxides.
Dark grey to black, moderately hard, porphyritic rock; phenocrysts and or xenoliths of fresh (pale green) to weathered (yellow-brown) anhedral olivine; max. width 13mm, usually 2-3mm, c 5% of total rock.	
Above material nearly completely weathered to brown soil.	



END OF HOLE 30.0 FT.



WEATHERING

- FR — Fresh
- SW — Slightly weathered
- MW — Moderately "
- HW — Highly "
- CW — Completely "

FRACTURE LOG

1 4 16 64 — Natural fractures per foot of core

12 3 ¾ 3/16 — Equivalent diameter in inches

→ core lift.

═ Clay seam

c Approximately

X Joints

NON-METALLIC MINERALS SECTION

DRILL No 5

TYPE E1000

DRILLER DAVIDSON

START 8 Nov '66

FINISH 9 Nov '66

LOGGED BY TARVYDAS

DATE 8 Feb '67

TRACED AMcD.

CHECKED C.F.

SHEET 1 OF 1

DRG. No. S 6029
9945

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

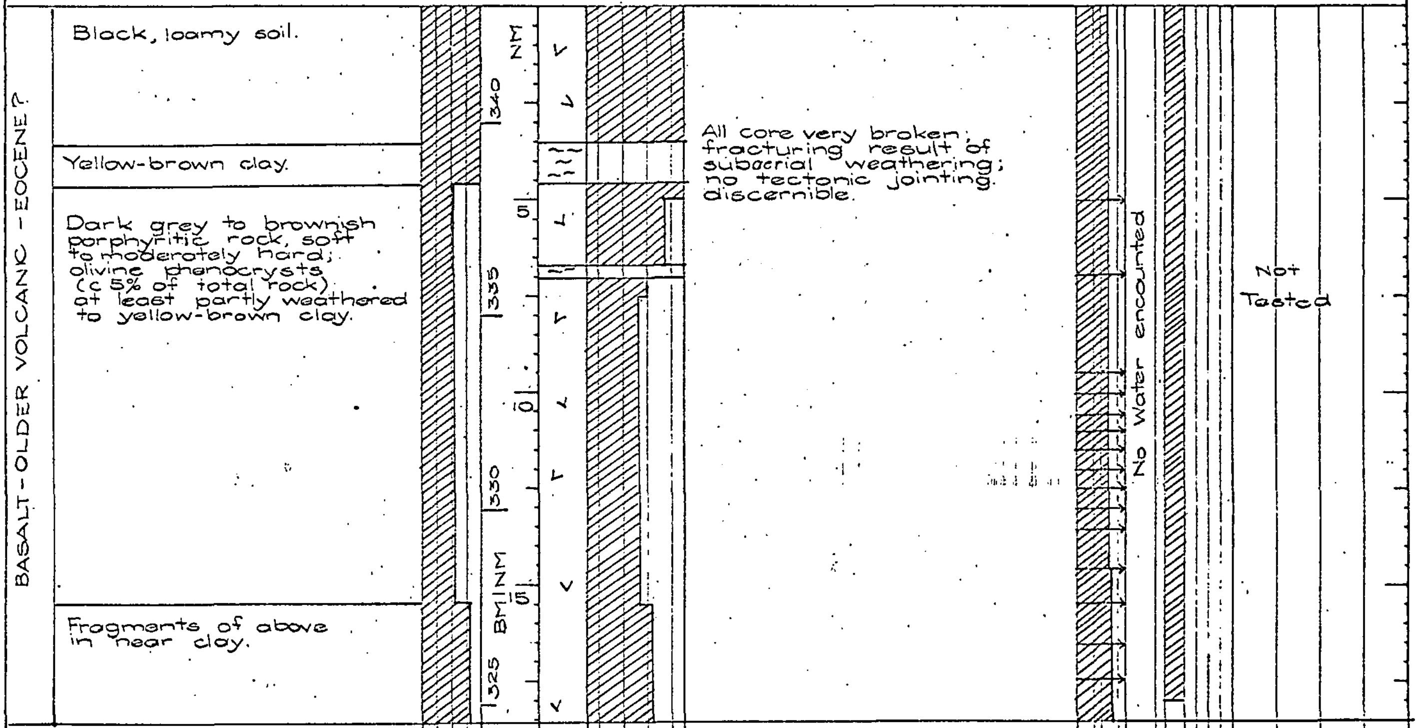
HOLE No. GRD7
SERIAL No. 698/67

PROJECT H. AND L.G. PROPOSED
BASALT QUARRY
FEATURE GLENELG RIVER
LOCATION 3 M. ESE DERGHOLM, VICTORIA

SECTION 3 AND 4 PARISH ROSENEATH
CO-ORDINATES Lat. 37°23' Long. 141°17'
ANGLE FROM HORIZONTAL 90°
DIRECTION —

R.L. Surface c. 343 FT.
R.L. Collar c343 FT.
Datum ARBITRARY

DESCRIPTION OF CORE	WEATHERING SW MW HW CW	CORE SIZE, DEPTH R.L. FT.	LOG	FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT. CORE LOSS % 5 10 50	WATER LEVEL DATE	CASING	DRILL WATER LOSS % 0-100	LAB TESTS L.A.	SULPH SOUND	SOIL CONST.



Black, loamy soil.

Yellow-brown clay.

Dark grey to brownish porphyritic rock, soft to moderately hard; olivine phenocrysts (c 5% of total rock) at least partly weathered to yellow-brown clay.

Fragments of above in near clay.

All core very broken; fracturing result of subaerial weathering; no tectonic jointing discernible.

END OF HOLE 18.5 FT.

WEATHERING
FR — Fresh
SW — Slightly weathered
MW — Moderately ,,
HW — Highly ,,
CW — Completely ,,

FRACTURE LOG
1 4 16 64 — Natural fractures per foot of core
12 3 ¾ 3/16 — Equivalent diameter in inches

→ Core lift
≡ Clay seam
c. Approximately

NON-METALLIC MINERALS SECTION

DRILL No. 5
TYPE E 1000
DRILLER DAVIDSON
START 16 Nov '66
FINISH 18 Nov '66

LOGGED BY TARVYDAS
DATE 7 Feb '67
TRACED A McD
CHECKED C.F.

SHEET 1 OF 1
DRG. No. S 6030 994.5

P.F. No. S5027A MB

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

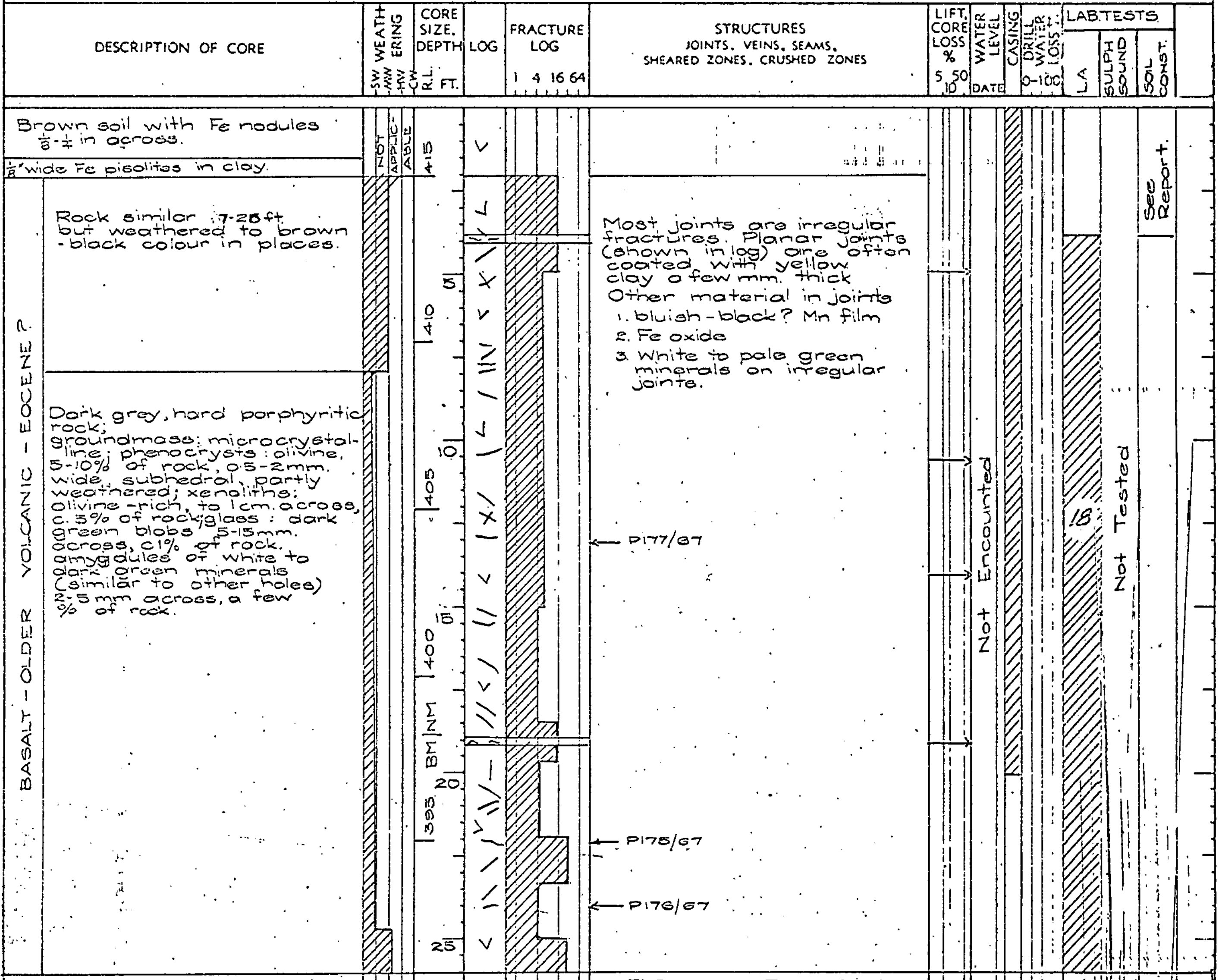
HOLE No. GRD 8
SERIAL No. 733/67

PROJECT H. AND L.G. PROPOSED BASALT QUARRY
FEATURE GLENELG RIVER
LOCATION 3 M. ESE DERGHOLM, VICTORIA

SECTION 3 AND 4. PARISH ROSENEATH
CO-ORDINATES Lat. 37°23′ Long 141° 17′
ANGLE FROM HORIZONTAL 90°
DIRECTION —

R.L. Surface c 417 FT.
R.L. Collar c 417 FT.
Datum ARBITRARY

DESCRIPTION OF CORE	WEATHERING SW MW HW CW	CORE SIZE. DEPTH R.L. FT.	LOG	FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT, CORE LOSS % 5 10 50	WATER LEVEL DATE	CASING	DRILL WATER LOSS 0-100	LAB TESTS LA	SULPH SOUND	SOIL CONST.



Brown soil with Fe nodules ⅛-¼ in across.

⅛″wide Fe pisolites in clay.

BASALT - OLDER VOLCANIC - EOCENE ?

Rock similar 7-25 ft but weathered to brown-black colour in places.

Dark grey, hard porphyritic rock; groundmass: microcrystalline; phenocrysts: olivine, 5-10% of rock, 0.5-2mm. wide, subhedral, partly weathered; xenoliths: olivine-rich, to 1cm. across, c. 5% of rock; glass: dark green blobs 5-15mm. across, c1% of rock. amygdules of white to dark green minerals (similar to other holes) 2-5 mm across, a few % of rock.

Most joints are irregular fractures. Planar joints (shown in log) are often coated with yellow clay a few mm. thick
Other material in joints
1. bluish-black ? Mn film
2. Fe oxide
3. White to pale green minerals on irregular joints.

← P177/67

← P175/67

← P176/67

END OF HOLE 26.0 FT.

WEATHERING
FR — Fresh
SW — Slightly weathered
MW — Moderately ”
HW — Highly ”
CW — Completely ”

FRACTURE LOG
1 4 16 64 — Natural fractures per foot of core
12 3 ¾ 3/16 — Equivalent diameter in inches

→ Core lift
~≡ Clay seam
Fe Iron
c. Approximately
Mn. Manganese
P177/67 Petrological sample joint.

NON-METALLIC MINERALS SECTION

DRILL No. 5.
TYPE E1000
DRILLER DAVIDSON
START 15 Feb '67
FINISH 17 Feb '67

LOGGED BY TARVYDAS
DATE 28 Mar. '67
TRACED AMcD
CHECKED C.F.

SHEET 1 OF 1 DRG. No. S 6031
994·5

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE No. GRD 9
SERIAL No. 738/67

PROJECT H.& L.G. DEPT. PROPOSED BASALT QUARRY.
FEATURE GLENELG RIVER.
LOCATION 3M. E.SE. DERGHOLM VIC.

SECTION 3 & 4 PARISH ROSENEATH
CO-ORDINATES LAT. 37° 23 , LONG. 141° 17'
ANGLE FROM HORIZONTAL 90°
DIRECTION —

R.L. Surface c 398 FT.
R.L. Collar c 398 FT.
Datum arbitrary

DESCRIPTION OF CORE	SW MW HW CW WEATHERING	CORE SIZE, DEPTH R.L. FT.	LOG	FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT. CORE LOSS % 5 50 10	WATER LEVEL DATE	CASING	DRILL WATER LOSS % 0-100	LAB. TESTS L.A.	SULPH SOUND	SOIL CONST

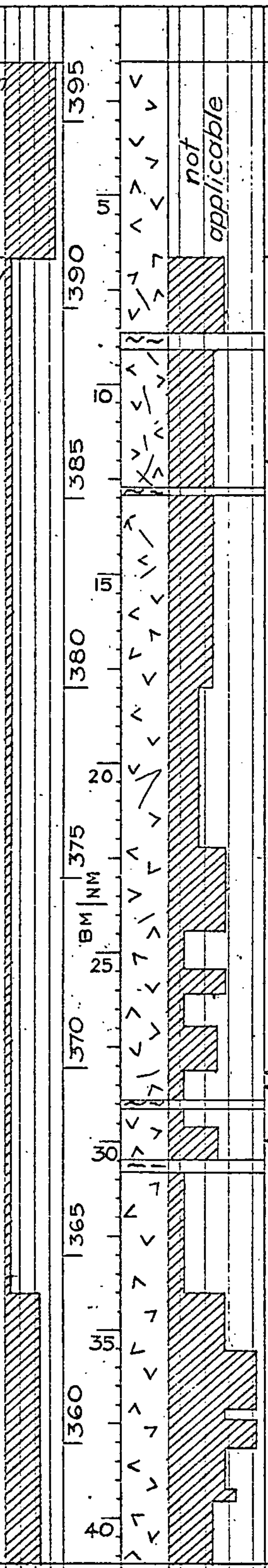
SOIL, brown, with Fe-rich nodules 3mm across

BASALT - OLDER VOLCANIC - EOCENE ?

greenish yellow to brown clay, weathered equivalent of basalt, as below.

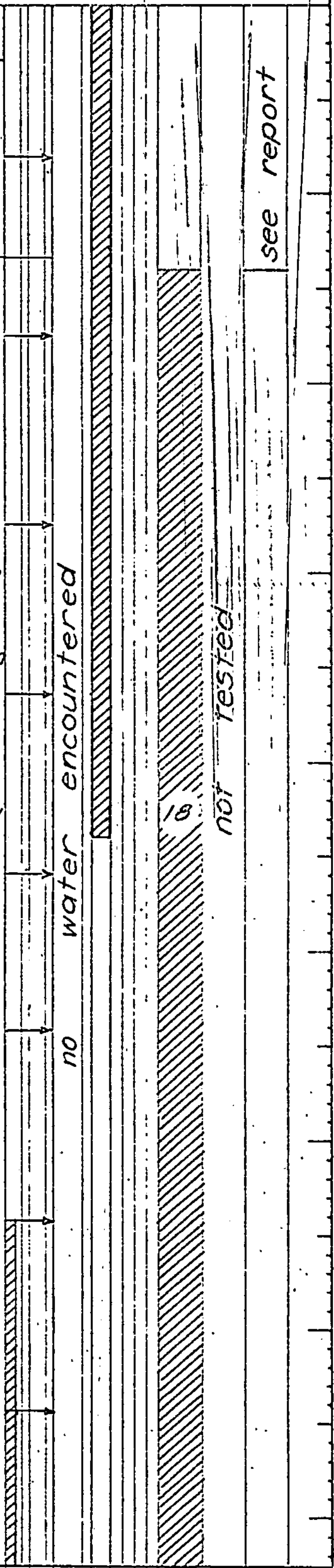
remnants of pale green crystals.

dark grey, hard, porphy-ritic rock.
groundmass: dark grey, finely crystalline to cryptocrystalline.
phenocrysts: non-aligned olivine c. 10% of rock 0·2-3 mm. across.
xenoliths: olivine-rich, c. 5% of rock, to 2 cm. long; these phenocrysts weather brown near joints. green minerals: pale to dark green, as amygdules and lensoid patches to 2 cm. long, c. 10% of rock.



P178/67 Joints
mostly with irregular surfaces (planar shown in log); all coated with one or more of following
1) Fe oxides-yellow to brown
2) Clay- white to yellow-brown, usually a few mm but sometimes a few in. thick.
3) ? Mn film, blue-black, in conjunction with 4.
4) White to pale green minerals, often stained brown and in botryoidal spheres c 1mm. across; seams a few mm. thick.

P179/67
P180/67
P181/67



End of hole 41·25 ft.

WEATHERING
FR - Fresh
SW - Slightly weathered
MW - Moderately ''
HW - Highly ''
CW - Completely ''

FRACTURE LOG
1 4 16 64 — Natural fractures per foot of core
12 3 ¾ 3/16 — Equivalent diameter in inches

→ core lift.
▭ clay seam
c approximately
Fe iron
Mn manganese
⨯ joints

NON-METALLIC MINERALS SECTION

DRILL No. 5
TYPE E 1000
DRILLER DAVIDSON
START 17 FEB. '67
FINISH 21 FEB. '67

LOGGED BY R. TARVYDAS.
DATE 29 MAR. '67
TRACED R.A.J.
CHECKED C.F.

SHEET 1 OF 1 DRG. No. S6036 994-5

DEPARTMENT OF MINES — SOUTH AUSTRALIA

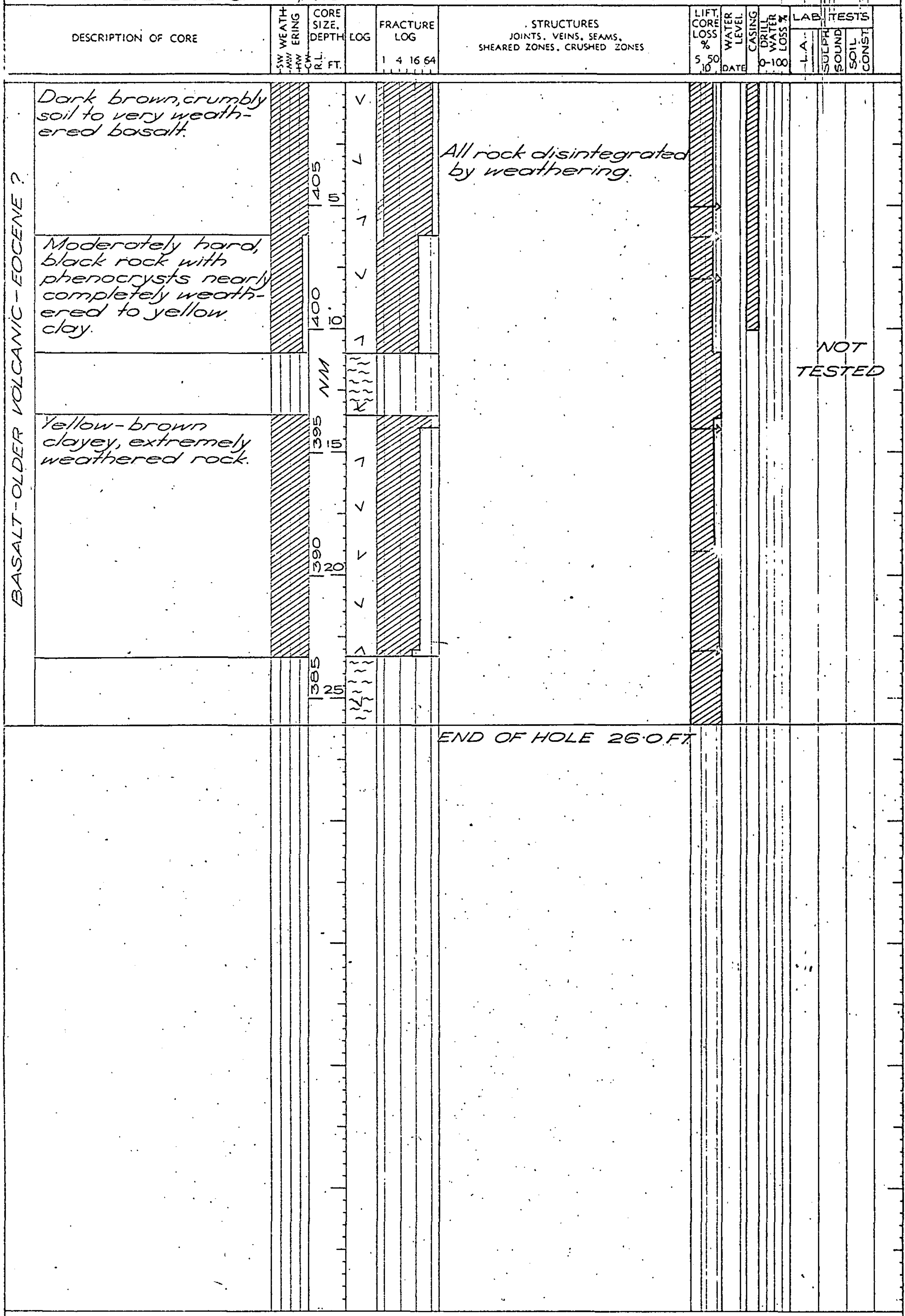
LOG OF DIAMOND DRILL HOLE

HOLE No. GRD 10
SERIAL No. 697/67

PROJECT H.&L.G. DEPT. PROPOSED BASALT QUARRY
FEATURE GLENELG RIVER
LOCATION 3 ML. E.S.E. DERGHOLM, VIC.

SECTION 3 & 4. PARISH ROSENEATH
CO-ORDINATES LAT. 37°23', LONG. 141°17'
ANGLE FROM HORIZONTAL 90°
DIRECTION —

R.L. Surface C410 FT.
R.L. Collar C410 FT.
Datum ARBITRARY.



Dark brown, crumbly soil to very weathered basalt.

Moderately hard, black rock with phenocrysts nearly completely weathered to yellow clay.

Yellow-brown clayey, extremely weathered rock.

All rock disintegrated by weathering.

END OF HOLE 26·0 FT.

WEATHERING
FR – Fresh
SW – Slightly weathered
MW – Moderately "
HW – Highly "
CW – Completely "

FRACTURE LOG
1 4 16 64 — Natural fractures per foot of core
12 3 ¾ 3/16 — Equivalent diameter in inches

→ Core lift.
~~~ Clay seam
c Approximately
// Joints

NON-METALLIC MINERALS SECTION

DRILL No. 5
TYPE E 1000
DRILLER Davidson
START 14 Dec. 1967
FINISH 15 Dec. 1967

LOGGED BY R. Tarvydas
DATE 9 Feb. '67
TRACED T.P.S.
CHECKED C.F.

SHEET 1 OF 1 DRG. No. S 6037
~~~

DEPARTMENT OF MINES — SOUTH AUSTRALIA

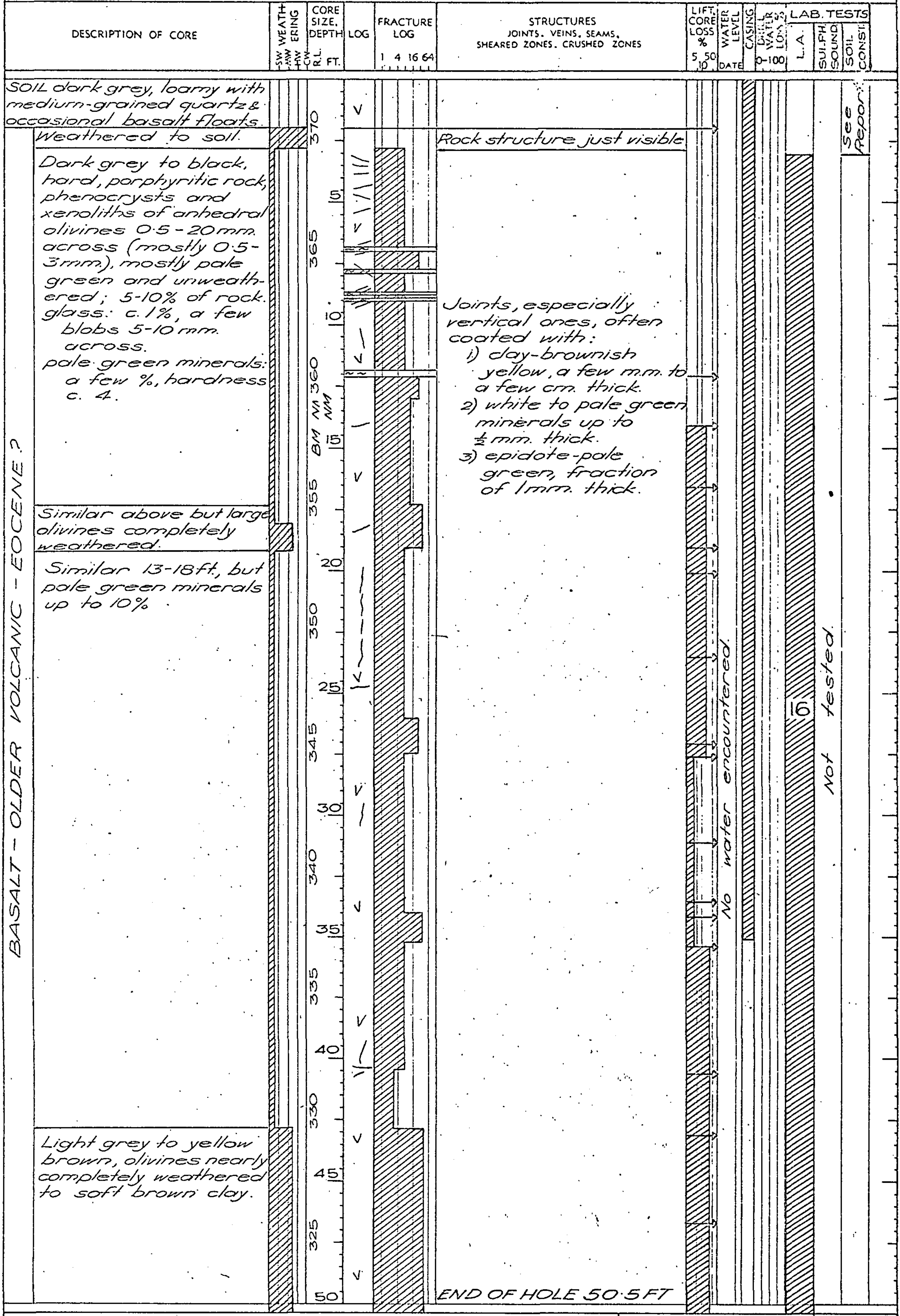
LOG OF DIAMOND DRILL HOLE

HOLE No. GRD 11
SERIAL No. 739/67

PROJECT H&L.G. DEPT. PROPOSED BASALT QUARRY
FEATURE GLENELG RIVER
LOCATION 3 ML. E.S.E. DERGHOLM, VIC.

SECTION 3&4. PARISH ROSENEATH
CO-ORDINATES LAT. 37°23', LONG. 141°17'
ANGLE FROM HORIZONTAL 90°
DIRECTION —

R.L. Surface c. 373 FT.
R.L. Collar c. 373 FT.
Datum ARBITRARY.



SOIL dark grey, loamy with medium-grained quartz & occasional basalt floats.

Weathered to soil. — Rock structure just visible

Dark grey to black, hard, porphyritic rock, phenocrysts and xenoliths of anhedral olivines 0·5 - 20 mm. across (mostly 0·5-3 mm), mostly pale green and unweathered; 5-10% of rock. glass: c. 1%, a few blobs 5-10 mm. across. pale green minerals: a few %, hardness c. 4.

Joints, especially vertical ones, often coated with:
1) clay-brownish yellow, a few m.m. to a few cm. thick.
2) white to pale green minerals up to ½ mm. thick.
3) epidote-pale green, fraction of 1 mm. thick.

Similar above but large olivines completely weathered.

Similar 13-18 ft, but pale green minerals up to 10%

Light grey to yellow brown, olivines nearly completely weathered to soft brown clay.

END OF HOLE 50·5 FT

WEATHERING
FR - Fresh
SW - Slightly weathered
MW - Moderately "
HW - Highly "
CW - Completely "

FRACTURE LOG
1 4 16 64 — Natural fractures per foot of core
12 3 ¾ 5/16 — Equivalent diameter in inches

→ Core lift.
≈ Clay seam.
// Joints.
c. Approximately

NON-METALLIC MINERALS SECTION

DRILL No. 5.
TYPE E1000
DRILLER Davidson
START 22 Feb. 1967
FINISH 27 Feb. 1967

LOGGED BY R. Tarvydas.
DATE 28 Mar. 67
TRACED T.P.S.
CHECKED C.F.

SHEET 1 OF 1
DRG. No. S 6038

DEPARTMENT OF MINES — SOUTH AUSTRALIA

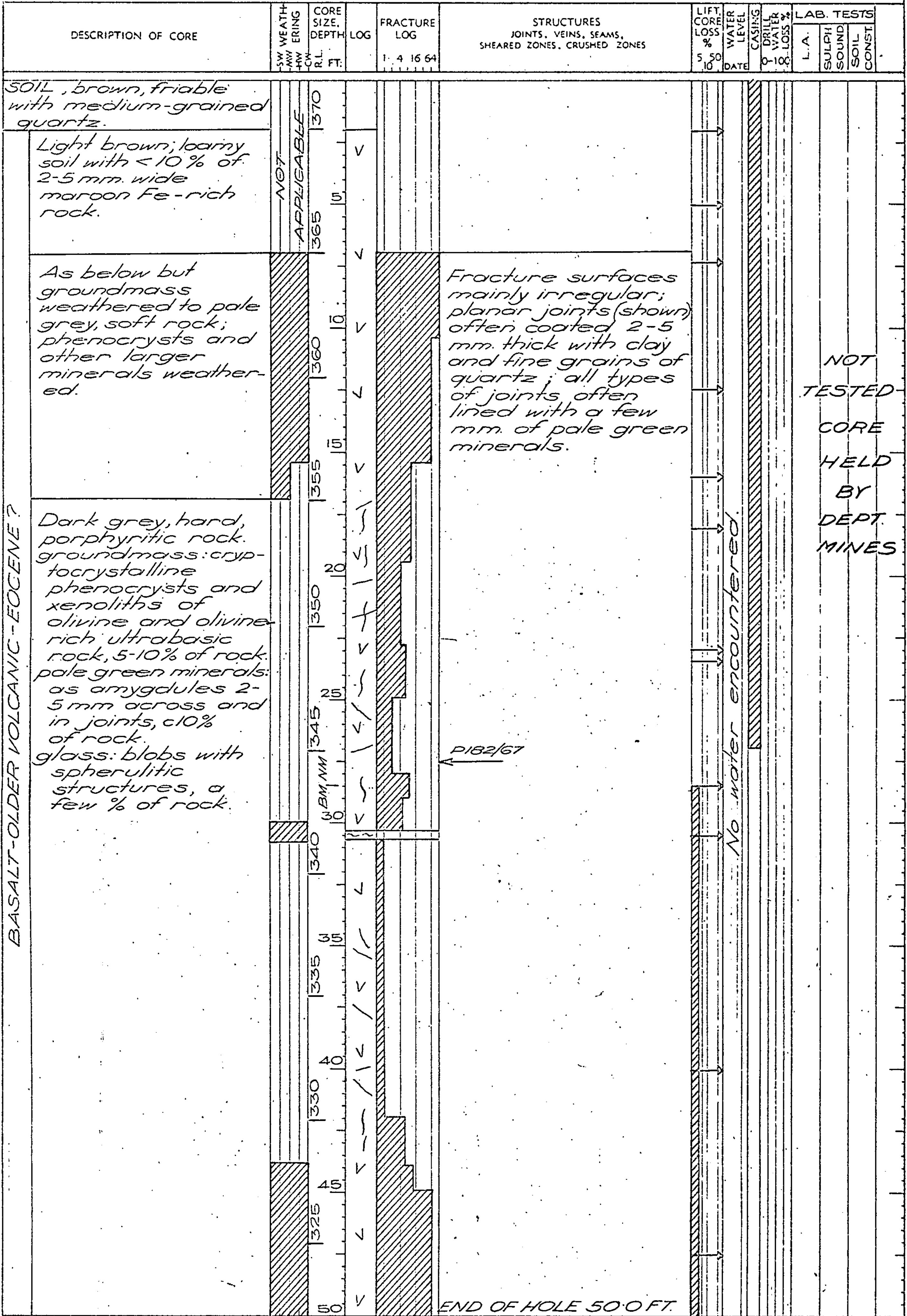
LOG OF DIAMOND DRILL HOLE

HOLE No. GRD 12
SERIAL No. 745/67

PROJECT H&L.G. DEPT. PROPOSED BASALT QUARRY
FEATURE GLENELG RIVER
LOCATION 3 ML. E.S.E. DERGHOLM, VIC.

SECTION 3&4 PARISH ROSENEATH
CO-ORDINATES LAT. 37°23', LONG. 141°17'
ANGLE FROM HORIZONTAL 90°
DIRECTION —

R.L. Surface c. 372 FT.
R.L. Collar c. 372 FT.
Datum ARBITRARY



SOIL, brown, friable with medium-grained quartz.

Light brown; loamy soil with <10% of 2-5 mm. wide maroon Fe-rich rock.

As below but groundmass weathered to pale grey, soft rock; phenocrysts and other larger minerals weathered.

Dark grey, hard, porphyritic rock. groundmass: cryptocrystalline phenocrysts and xenoliths of olivine and olivine-rich ultrabasic rock, 5-10% of rock. pale green minerals: as amygdules 2-5 mm across and in joints, c10% of rock. glass: blobs with spherulitic structures, a few % of rock.

Fracture surfaces mainly irregular; planar joints (shown) often coated 2-5 mm. thick with clay and fine grains of quartz; all types of joints often lined with a few mm. of pale green minerals.

END OF HOLE 50·0 FT.

WEATHERING
FR — Fresh
SW — Slightly weathered
MW — Moderately "
HW — Highly "
CW — Completely "

FRACTURE LOG
1 4 16 64 — Natural fractures per foot of core
12 3 ¾ 3/16 — Equivalent diameter in inches

→ Core lift.
≈≈ Clay seam.
Fe. Iron.
P182/67. Petrological sample.
c. Approximately

NON-METALLIC MINERALS SECTION

DRILL No. 5.
TYPE E1000
DRILLER Davidson
START 18 Feb. 1967
FINISH 1 Mar. 1967

LOGGED BY R. Taryydas
DATE 28 Apr. '67
TRACED T.P.S.
CHECKED C.F.

SHEET 1 OF 1 DRG. No. S 6039