

1984/74. Igneous rocks from Tasmanian Devil #1

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## Abstract

Tasmanian Devil #1 bottomed in Tertiary alkali olivine basalt and not granite basement. Detailed petrological and petrographic information is presented.

## INTRODUCTION

Tasmanian Devil #1, a hydrocarbon exploration well, was drilled in the Bass Basin on behalf of a consortium headed by Weaver Oil and Gas. The well was located at 40°44'16.209"S, 146°09'44.958"E and penetrated 863 m before being plugged and abandoned as a dry hole.

The Completion Report submitted by Triton Engineering Services Company Ltd indicates the following stratigraphy:

Pliocene/Miocene limestone	ML - 508 m
Pliocene/Miocene claystone	508 - 589 m
Eocene Shale (Demon's Bluff)	589 - 680 m
Sand	680 - 701 m
Claystone	701 - 720 m
Volcanic rocks	720 - 830 m
Granite basement	830 - 863 m

Preliminary examination of the wireline logs raised doubts as to whether granite basement had been penetrated, which resulted in a follow-up petrological analysis of ditch cuttings, these being the only material available to work with as no cores were cut nor side-wall cores shot.

## LOGGING RESULTS

Volcanic rocks were first detected by the mud-loggers at 736 m where they record the presence of - "Diorite - medium brown-black, fine-grained, very hard, crystalline (rock with) feldspar, hornblende, opaques, minor quartz". The same rock was reported over the interval 736-855 m.

From 855-863 m the mud-loggers recorded the presence of - "Granite - white-grey, very hard, coarse-grained, crystalline (rock with) feldspar, quartz, biotite, opaques".

It will be noted that there is a difference of 25 m between the initial recording of "granite" by the mud-loggers, and the depth of inter-section quoted by Triton in the Completion Report.

The following wireline logs were run:

DIL - SLS - CAL - GR - SP	Run 1 (251-561 m)
DIL - SLS - CAL - GR - SP	Run 2 (552-861 m)
LDL - CNL - GR	Run 1 (552-862 m)

Of relevance to this report is the section 700-863 m. All the logs show a pronounced change of character below 750 m, but are best observed on the resistivity (DIL) and sonic (SLS) logs. The velocity gradually increases from 150  $\mu$ s/ft at 750 m to 60  $\mu$ s/ft at 765 m. Velocity then very slowly increases to 50  $\mu$ s/ft at 852 m. A similar gradual, then slow

increase is shown by the three resistivity curves. This pattern is interpreted as either a weathered zone (750-760 m), or a highly fractured upper igneous contact, above a massive igneous body.

The possibility of the presence of a weathered zone is increased by the density log which shows an increase in density from 1.90 g/cc (750 m) to 2.80 g/cc (765 m) and then constant at 2.80 g/cc to 863 metres.

Because of the lengths of the various sondes it is not possible to confirm if there is a change in lithology at 855 m, although there is no obvious change from basalt to granite at 830 m, as suggested in the Triton Completion Report.

#### PETROGRAPHIC DESCRIPTIONS

Thin sections were prepared of cuttings samples from 815 m, 835 m, 850 m, 855 m, 860 m, 865 m (sic.). The thin sections were made from 275 mm diameter grain mounts, each thin section containing approximately 250 grains.

In all six thin sections at least 95% of the grains present are olivine-bearing basalt, similar to the Tertiary alkali olivine basalts found onshore in north-western Tasmania in the Burnie-Waratah basalt field. At the Waratah end of this tract the basalts are interbedded with sediments which have yielded an earliest Oligocene microflora (Brown and Forsyth, 1984).

##### *Thin section description*

865 m (sic.): Texture ophitic to intergranular, with titanite and opaque mineral grains interlocked by plagioclase laths. Clinopyroxene is a purplish pink (titaniferous) augite which occurs as discrete grains or grains enclosing an opaque mineral.

Also present in the slide are four grains of recrystallised carbonate and one grain of vesicular basaltic glass.

860 m: Texture dominantly intergranular, with plagioclase laths interlocking and surrounding olivine and opaque mineral grains.

In this slide is one grain of fossiliferous calcarenite and one grain of a quartz phyllite similar to phyllites from the Precambrian of north-western and western Tasmania.

This sample contains the highest degree of alteration observed in the six slides.

855 m: Medium-grained olivine-phyric basalt. Olivine grains are surrounded by interlocking plagioclase laths with an intergranular texture. Interstices are filled by anhedral titaniferous augite and a black opaque mineral (Fe-Ti oxide). A minor percentage of grains consist of plagioclase microlites in a black glass and olive-green to brown fibrous material replacing devitrified glass.

850 m: Texture more ophitic than intergranular. Minor grains are devitrified glass, some with feldspar microlites. One to two grains of pyritised basalt are present.

835 m: Similar to above, some alteration is present. Percentage of devitrified glass is higher than 850-865 m and the texture is dominantly intergranular.

815 m: Similar to above. Texture is variable from ophitic to intergranular. Two grains of phyllite have been largely replaced by carbonate.

### MINERAL CHEMISTRY

Polished thin sections were prepared from the 275 mm grain mounts prepared from material taken from the 815, 835, 850 and 855 m samples. For each sample, five areas were chosen that contained all four (or most of the four) mineral components of the basalt. Analysis of the mineral grains was carried out using the Jeol JXA-50A Electron Probe Microanalyzer at the Central Science Laboratory of the University of Tasmania.

The four mineral phases present are olivine, feldspar, clinopyroxene and Ti-Fe oxide. Each of the phases shows a similar compositional range between and within each sample, indicating that each sample represents a homogenous grouping of grains from a very similar source rock.

#### *Olivine*

The variation in composition of the olivine crystals does not reflect any gradation or differentiation and, with the exception of large olivine phenocrysts in sample TD 855, all ranges were recorded in each sample.

The larger olivine phenocrysts have an average composition of Fo<sub>71.5</sub> (4 grains) with the smaller olivine phenocrysts being Fo<sub>66.5</sub> (4 grains). Groundmass olivine averages Fo<sub>60.5</sub>.

These values are less magnesian than the lower-most alkali olivine basalts so far studied on the Tasmanian mainland, but only reflect a normal differentiation trend between alkali olivine basalt and olivine-bearing tholeiite.

#### *Clinopyroxene*

The clinopyroxene grains in all four samples are a titaniferous, high calcic augite [Ca; Mg; Fe; = 44.4; 42.6; 13.0] with an average of 1.36 wt% TiO<sub>2</sub> (20 grains). Some samples (3 grains) contained greater than 0.20 wt% Cr<sub>2</sub>O<sub>3</sub> (up to 0.39 wt%). In comparison with clinopyroxene from other Tasmanian alkali olivine basalt the variation in composition in (Ca, Mg, Fe) is insignificant, but the grain analyses have slightly lower TiO<sub>2</sub> and Cr<sub>2</sub>O<sub>3</sub> contents, again consistent with the olivine composition and due to a degree of differentiation of source magma.

#### *Plagioclase*

Although a range of feldspar compositions occur, the variations recorded occur in each of the four samples. The most calcic plagioclase is a calcic labradorite (An<sub>64.3</sub> - average of 7 grains). A second labradorite has a composition of An<sub>56.2</sub> (average of 7 grains), and a high-calcic andesine, An<sub>46.5</sub> (5 grains) is also present. The variation in composition is more likely to be due to alteration than original composition variations.

A second feldspar present displays diffuse albite twinning and has a larger grain size than the labradorite-andesine laths. The composition suggests that it is an intergrowth of plagioclase and K feldspar. Two compositional variations were recorded; one having a composition of [Ca; Na; K; = 14.2, 62.8, 23.0] (2 grains) occurred in TD 815 and TD 835, whereas in TD 835, 850 and 855 a second intergrowth with a composition of [Ca, Na, K = 3.9; 46.6; 49.6] occurs.

*Opaque minerals*

Analyses of the majority of opaque mineral grains (15 grains) were uniform throughout the four samples, and showed the mineral to be ilmenite. The minor opaque phase (5 grains) is a titaniferous magnetite. In comparison with other Tasmanian alkali olivine basalts the opaque phase is higher in TiO<sub>2</sub> content, and forms ilmenite at a higher temperature than titaniferous magnetite. The presence of ilmenite could also explain the low TiO<sub>2</sub> content of the clinopyroxene in these samples, as in most cases the ilmenite appears to crystallise before clinopyroxene.

DISCUSSION

Each of the four samples contains mineral grains which display a small compositional range, consistent with all the grains having come from a similar source. The nature of sampling precludes easy recognition of individual flows. Within onshore Tertiary basalt fields flows range in thickness from approximately one metre to about 10 m (Brown and Forsyth, 1984). Flows of alkali olivine basalt in excess of 50 m thick are not considered to be likely, given the low viscosity of alkali olivine basalt lava, grain size observed in the samples, and lack of chemical variation.

A possible flow top occurs at 822 m and is indicated by a one inch increase in hole size and a decrease in density from 2.9 g/cc to 2.6 g/cc. A corresponding decrease in resistivity indicates the presence of water, consistent with the top of a weathered flow.

Other possible flow tops are present at 841 m and in the zone 750-780 m.

CONCLUSION

The mineral chemistry, petrographic observations and comparison with Tertiary basalts exposed onshore in north-western Tasmania all support the conclusion that the samples from Tasmanian Devil #1 are alkali olivine basalts, transitional to olivine-bearing tholeiites, and probably of Oligocene age.

No evidence to support the presence of granite basement was observed.

REFERENCE

BROWN, A.V.; FORSYTH, S.M. 1984. Chemistry of Tertiary basalt, and palynology of interbedded sediments from B.H.P. drill holes, E.L. 33/79. *Unpubl.Rep.Dep.Mines Tasm.* 1984/39. (closed file report).

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