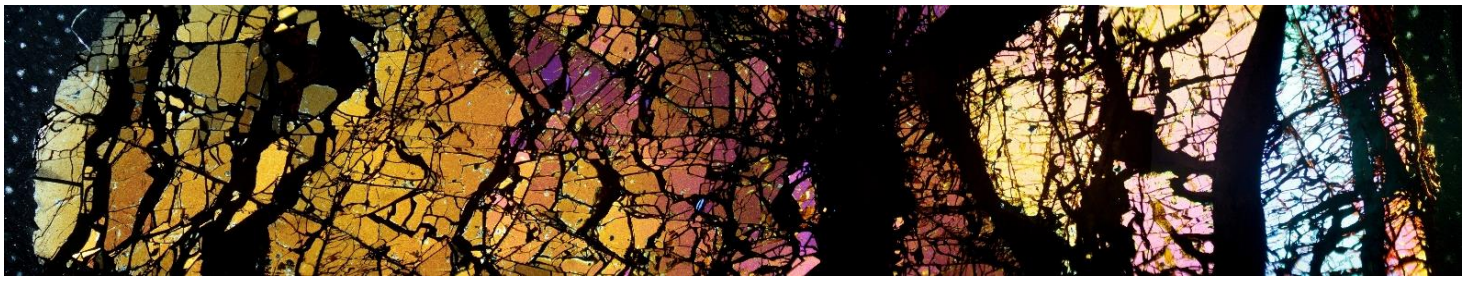

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PETROGRAPHIC REPORT ON A ROCK SPALL SAMPLE FROM YERRA QUARRY BLACK PIT

Prepared for

HARD ROCK QUARRIES MARYBOROUGH

Purchase Order:
Invoice Number: 00008018
Client Ref: Richard Kingston

Issued by

T. F. D. Spring BAppSc. MAppSc.
30 January 2018

Sample Label: HRQ Black Pit **Date Sampled**: Unknown

Sample Type: Rock Spalls **Date Supplied**: 11/01/2018

Source: Yerra Quarry **Client**: Hard Rock Quarries

Work Requested Petrographic analysis in relation to suitability for use as a source of concrete aggregate, road base, rail ballast, marine armour rock, dimension stone, sealing aggregate, in asphalt and rip rap; petrographic assessment of potential for alkali-silica reactivity and 4 PH Environment Suitability

Methods Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete*, the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B),* the AS1141 Standard Guide for the *Method for sampling and testing aggregates*, of the content of the 2002 joint publication of the Cement and Concrete Association of Australia and Standards Australia, (HB 79-2015) entitled *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*, and in accordance with ASTM C 294 Standard Guide for *Petrographic Assessment of Railway Ballast* and to the content of the 2015 publication of Standards Australia *(AS 2758.7 – Appendix B),* entitled *Aggregates and Rock for Engineering Purposes- Part 7: Railway Ballast*, and in accordance with ASTM C1721-15 *Standard Guide for Petrographic Assessment of Dimension Stone*, and in accordance with ASTM D4992-14 *Standard Guide for Evaluation of Rock to be used for Erosion Control.*

Identification Trachyte

Description

The sample consists of rock spalls being essentially unweathered to superficially weathered on joint surfaces, hard, robust, broadly dark grey, finely crystalline igneous rock. The rock can be lightly but easily scratched by a steel tool.

Plate 1. Photograph of three selected spalls from the supplied sample.

A thin section was prepared to permit detailed microscopic examination in transmitted polarised light of the three spalls. An average composition of the rock, expressed in volume percent and based on a brief count of 100 widely spaced points falling within the thin section, is:

Primary Minerals

69%	sanidine feldspar
6%	pyroxene
<1%	opaque oxides (ilmenite and/or magnetite)
<1%	apatite

Secondary Minerals

19%	green to brown smectite clay
5%	calcite
1%	pyrite
<1%	limonite
<1%	zeolite

Microscopically the essentially uniform fragments display sparsely porphyritic, hypidiomorphic, moderately to strongly flow-aligned textures of finely crystalline intermediate volcanic style. Sparse blocky and randomly-orientated phenocrysts are set in a moderately well flow-aligned groundmass with mainly interstitial smaller granules and prisms, mainly around 0.05 to 0.3 mm.

The sparse phenocrysts are sanidine with smaller phenocrysts of clear pyroxene and equant opaque oxide. Within the bimodal groundmass, prisms of sanidine constitute the coarser grains, whilst additional prisms of sanidine, augite, opaque oxides, apatite and possibly olivine (completely-altered to brown smectite clay) constitute the finer grains. There are scattered small, interstitial patches of brown to brownish-green smectite clay which form a vaguely cellular pattern in the groundmass (probably after incipient glassy mesostasis) and minor calcite in vuggy patches and disrupted veins; some seem to be carbonating feldspar phenocrysts in more altered areas. A few small patches appear to consist of aggregates of anisotropic zeolite. One fragments had small euhedral pyrites disseminated throughout.

In the weathered and more altered example, there are a few fractures healed by limonite and smectite clay and the interstitial brown smectite clay is more developed with a better connected cellular pattern in the groundmass.

Comments and Interpretations

The supplied rock spall sample (labelled Black Pit) ex Yerra Quarry is considered to be unweathered and superficially weathered trachyte. The constituent minerals and textures are consistent with an intermediate igneous rock of volcanic origin.

For engineering purposes, the rock in the supplied sample may be summarised as:

- **trachyte** (in this case volcanic intermediate igneous rock)
- finely holocrystalline
- non-porous

- consist of unweathered and superficially weathered spalls
- moderately altered
- having a secondary mineral content of 25%, comprising 19% green to brown smectite clay, 5% moderately robust calcite, 1% oxidisable pyrite, <1% limonite and <1% zeolite
- soft, weak minerals are composed mainly of 19% smectite clay
- **hard**
- **strong**

The rock is predicted to be **durable**, although the secondary minerals are somewhat elevated, they are enclosed in robust minerals so the rock is expected to remain durable. A secondary mineral content of less than 20-25% is commonly specified for durable products, but it is noted that the unevenly distributed nature and on average somewhat elevated abundance of the smectite clay may detract slightly from its suitability.

The rock seems to lack free silica: consequently, it is predicted to be **innocuous in relation to alkali reactivity in concrete**.

The rock is predicted to be **suitable as a source of road base, concrete aggregate, asphaltic/sealing aggregate, rip rap and rail ballast** (subject to compliance with the Durability Criteria of CT147/AS2758.7). The wet/dry strength should be carefully tested to determine the effect of the content of secondary minerals (swelling smectite clay).

Fresh rock equivalent to the supplied sample is predicted to be **suitable for use as marine armour rock and dimension stone** assuming quarry inspection reveals blocks of sufficient size which are free of defects (as the secondary minerals are somewhat elevated) are available. The wet/dry strength and sodium soundness should be carefully tested to determine the effect of the content of secondary minerals (swelling smectite clay).

Thus, fresh rock of the type represented by the supplied sample is predicted to be **physically suitable for use as a source of drainage material in an acidic environment**. The carbonate content of the product is about 5%: calcite is a mineral which is soluble in even dilute or weak natural or synthetic acids which may limit its suitability for this purpose but it is enclosed within robust minerals.

Free Silica Content

Apparently nil.

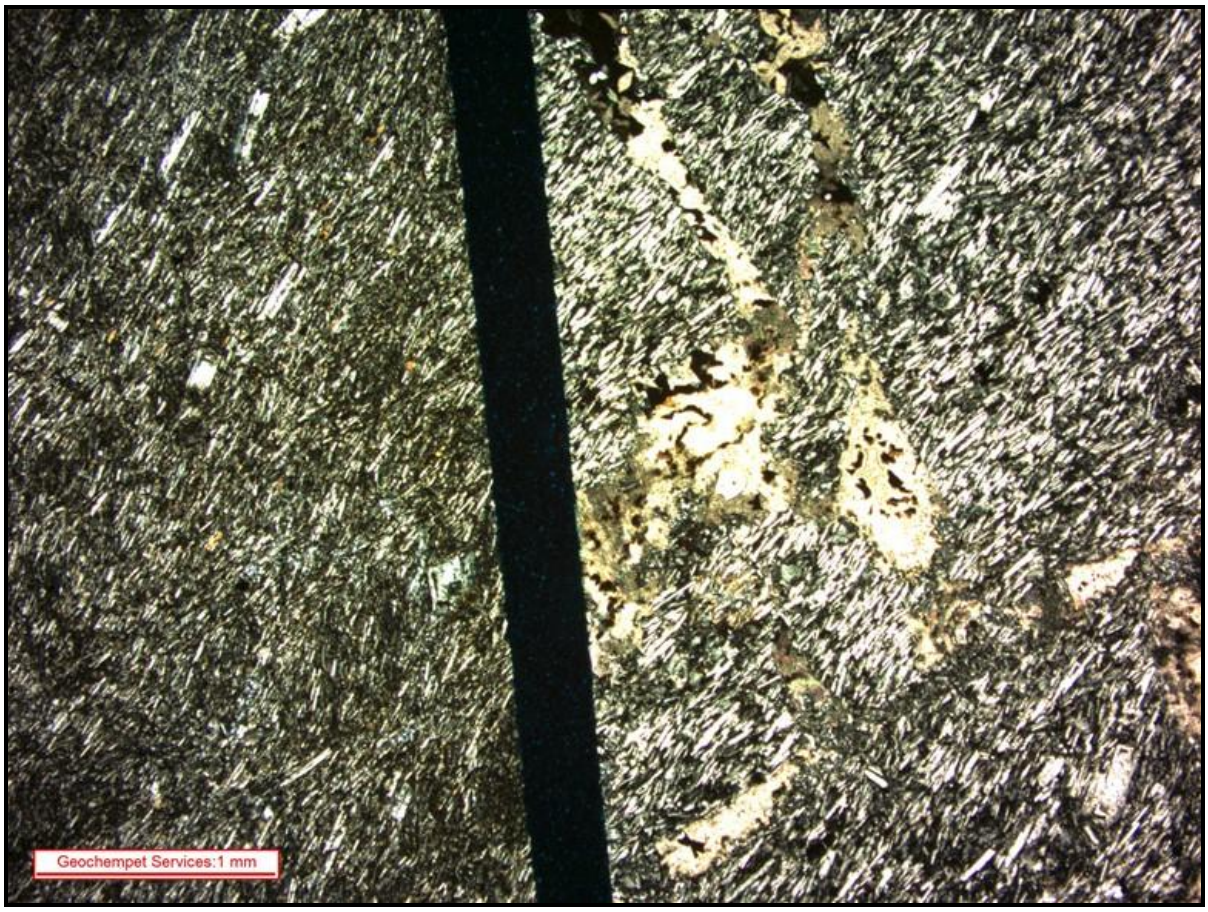

Plate 2: Micrograph taken at low magnification, cross polarised transmitted light image of part of trachyte which shows flow-aligned groundmass of feldspar laths with a partly connected network of smectite clay. It shows unaltered feldspar phenocrysts in the left fragment which are completely altered to calcite in the right fragment.