Petrology Report on Two Samples from Northland for VSG Consulting Group and Hutton & Cameron

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1.0 Introduction

Two samples from Northland were submitted in November 1994 with a request for petrological analysis. These samples were of crushed rock from quarries at Taheke and Kerikeri, which were being assessed for suitability as sand blasting material. It was specifically asked that we determine the proportion of free silica and comment on the hardness of this material, to establish its suitability for sand blasting.

Both samples were prepared as standard epoxy impregnated thin sections and examined in transmitted light using a standard petrographic microscope.

2.0 Results

The results of petrographic analysis are summarised in Table 1. Mineral abundances have been visually estimated, which is sufficiently accurate for the purposes of this study.

Both samples are very similar in appearance, and consist entirely of volcanic rock fragments, with no contaminants. The volcanic rock is dominantly (over 90%) composed of just two minerals, plagioclase feldspar, and clinopyroxene (augite). Opaque grains of titanomagnetite are a minor component. Little or no volcanic glass, and no olivine were distinguished in these samples. The lack of olivine suggests that strictly speaking, these samples are not basalts. They are probably hawaiites, a volcanic rock of "intermediate" composition. Secondary minerals, formed during weathering and/or low-temperature alteration, include minor carbonate and clay in the Kerikeri sample, and iron oxides in both. The carbonate appears to be an iron and magnesium-bearing variety, possibly siderite or ankerite, rather than calcite.

Both samples exhibit typical volcanic textures, in which some large crystals (phenocrysts) are set in a groundmass of finer crystals. In both samples, the phenocrysts are commonly 0.5 to over 1 millimetre in length. The groundmass consists of much smaller crystals (mostly less than 0.1 mm) and rare volcanic glass (Taheke).

No quartz or other varieties of "free silica" were found in either sample.

Each sample was weighed, seived, and the fraction which passed through a 0.150 mm seive weighed, to determine the percentage of fine material. The results are included in Table 1.

Sample Number (Location)	4968 (Taheke)	4969 (Kerikeri)
Plagioclase	55	55
Clinopyroxene	42	38
Titanomagnetite	2	2
Olivine	0	0
Glass	1	0
Carbonate	0	3
Clay	0	0.5
Iron oxides	0.1	0.5
Free silica	0.0	0.0
Percent Fines	0.01	0.03

3.0 Discussion

3.1 Safety Considerations

The two main requirements of sand-blasting abrasives are that the free silica (quartz) content is low (less than 5% by weight), and that there is minimal fine material (less than 2% finer than 0.15 mm). Both of the samples examined, from quarries at Taheke and Kerikeri, contain no (0%) free silica, and less than 2% of fine material (< 0.1%). Therefore both samples exceed the safety standards for abrasives.

3.2 Abrasive Properties

Determining the abrasive properties of a material is best determined by practical trials, but preliminary comments can be made based on the results of petrographic examination. Plagioclase has a density of 2.6 - 2.8, and a hardness of 6 - 6.5, while augite has a density of 3.0 - 3.5 and a hardness of 5 - 6. These are similar to quartz (density 2.65, hardness 7), though less than garnet (density 3.5 - 4.3, hardness 6 - 7.5).

Since plagioclase and augite make up over 90% of both samples, these rocks might be expected to have similar abrasive properties to quartz. However, a volcanic rock can be expected to behave differently from single crystals, because the contacts between individual crystals will present planes of weakness. Because most of the particles consist of intergrown fine (< 0.1 mm) plagioclase and augite grains, with few large crystals, the material may possess suitable abrasive properties, but particles will tend to break down more rapidly than quartz or garnet.

3.3 Other Possible Sources

Few volcanic rocks have a groundmass coarser than 0.15 mm, so most will give problems with relatively rapid breakdown. A basalt source with a significant proportion of olivine (density 3.2 - 4.4, hardness 6.5 - 7) and a coarse grain size would yield a product with better abrasive properties. A rock with a high proportion of volcanic glass may also give improved abrasive properties over one where the groundmass consists only of fine crystals. Finding a more suitable rock than those examined in this study may entail an extensive search, however.