

Appendix 3 – Geochemistry

Aim

The main purpose of geochemistry was to classify the Weldborough basalts much more accurately than before. Also, the unlikely option that the basalt is aluminous enough to crystallise corundum will be discussed.

Method

Thirteen least altered samples of basalt from Weldborough were selected and prepared for whole-rock geochemical analysis (for locations refer to sample map Figure 5 in main body of thesis). Also included in the analysis were basalts from Forest Lodge, Grey's Hill and Mutual Hill.

Special care was taken to avoid samples with:

- a) domains of veins of secondary alteration such as carbonate or iron oxide
- b) xenoliths and
- c) abundant amygdales.

The major element analyses were conducted using XRF by Phil Robinson at the University of Tasmania. The trace elements Y, U, Rb, Th, Pb, As, Zn, Cu, Ni, Nb, Zr, Sr, Cr, Ba, Sc, V, La, Cd and Nd were analysed for.

Before processing the major element data, volatiles were corrected for and totals of analysis were recalculated to 100%.

Results - For full results refer to attached spreadsheet.

Discussion

The Weldborough Sapphires are classified as alkali basalts and hawtiites (Figure 1; Cox, Bell and Pank, 1979).

The basalts contain between 12 wt % and 15 wt % Al_2O_3 and at these concentrations plagioclase dominates the crystallisation phase.

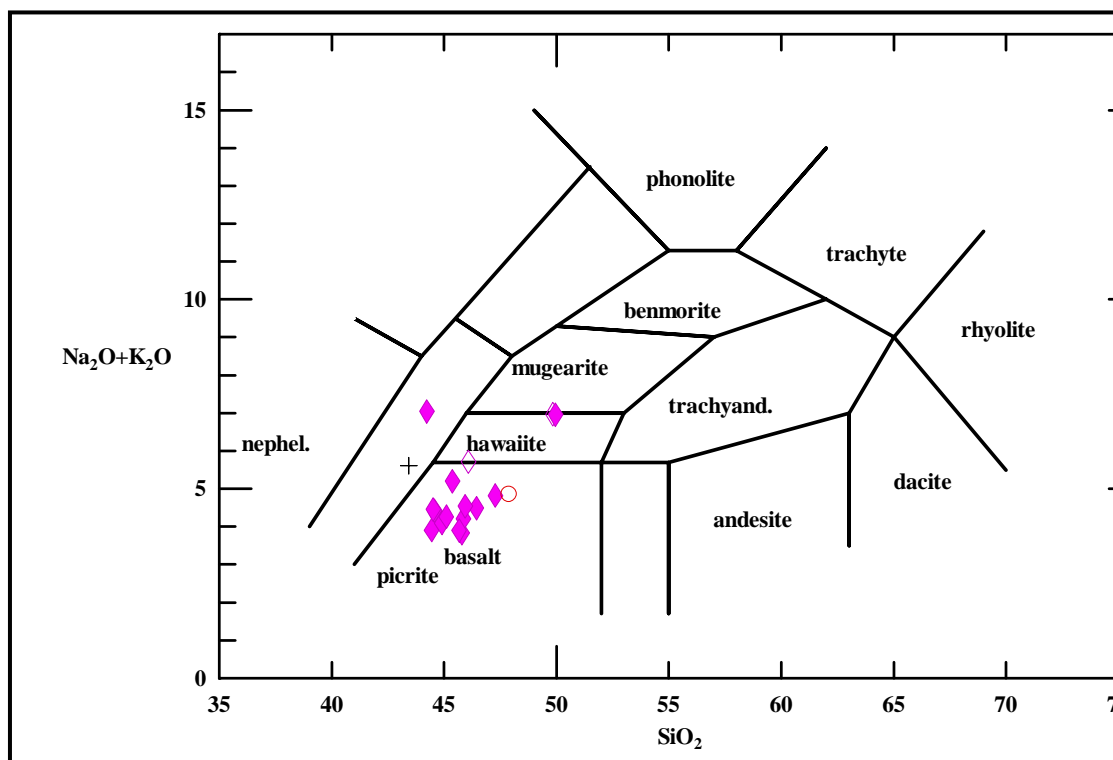


Figure 1. TAS Diagram - Cox, Bell and Pank (1979). Filled diamonds are Weldborough Basalts. Open diamond is Grey's Hill. Open circle is "swarm basalt" NW of Tower Hill. Cross is Mutual Hill Basalt.

Mg# : Primary magma considerations and contamination

The basalts have an Mg# ([molecular MgO/MgO+FeO]) of between 39 and 58 with an average on 49 (assuming 80% of iron is represented as FeO) and Ni and Cr contents of ~182 and ~305ppm respectively. A bulk rock with Mg# > 68 is necessary for primary magmas (ie. Magmas formed in equilibrium with peridotite mantle and unmodified by assimilation or fractional crystallisation processes (Irving & Green, 1976; Frey et al., 1978). Other criteria used to identify primary mantle-derived magmas are high Ni and Cr contents. Values for Ni and Cr in primary magmas of 298 - 496 and 310 – 540 ppm respectively have been suggested (McDonough et al., 1975). Samples from Mt Littlechild, Mutual Hill and Fieldwicks Quarry are the least contaminated. They have an Mg# of 56 to 58, Ni values between 300 and 350 ppm and Cr values of between 380 and 650 ppm.

Comparison

In figure 2, the Circular Head, Weldborough basalts and Ringarooma basalts are compared on a TAS diagram (Cox, Bell and Pank, 1979).

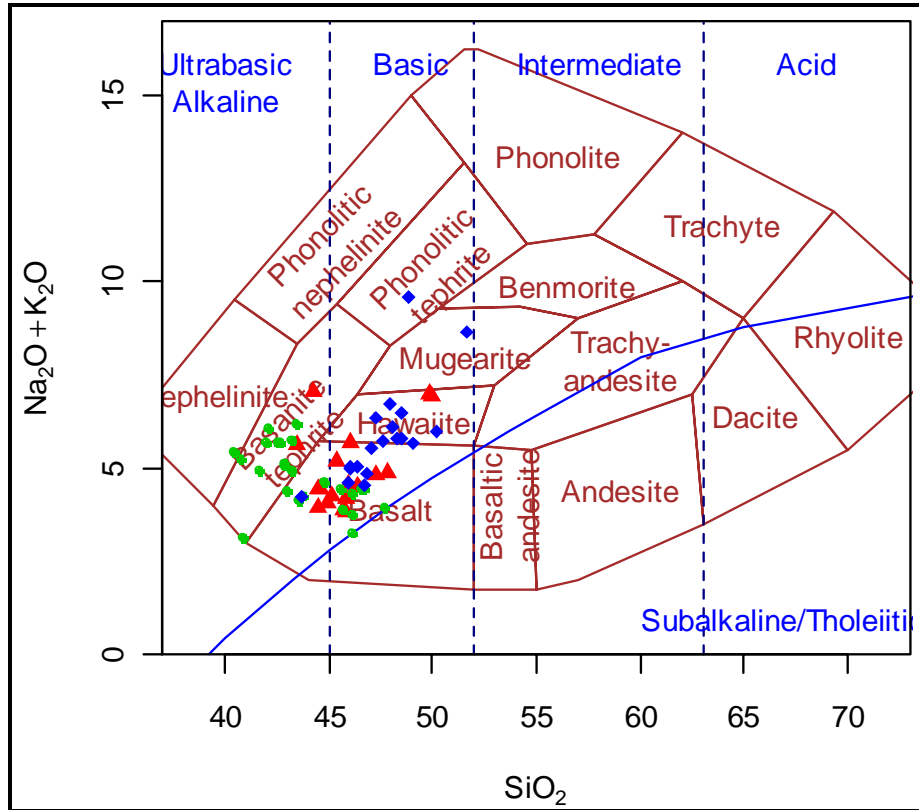
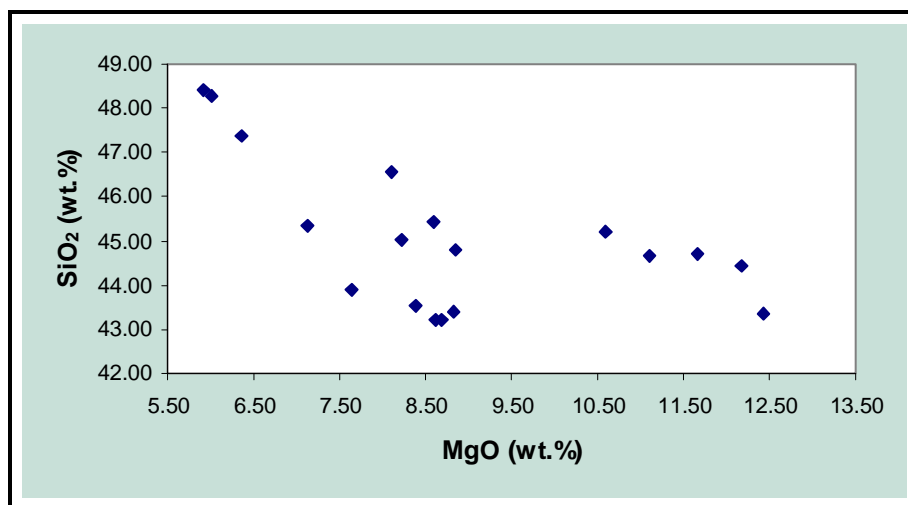
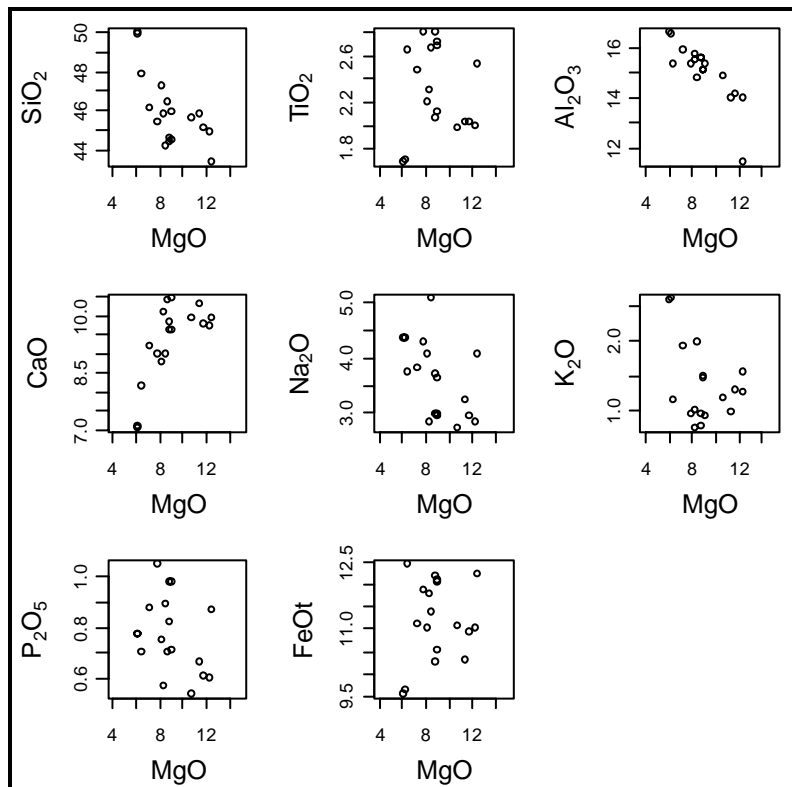


Figure 2. TAS Diagram (Cox, Bell and Pank, 1979). Red triangles are Weldborough basalts (This study). Blue circles are Ringarooma basalts and green circles are Circular Head basalts (Thanks to John Everard).

-----END-----

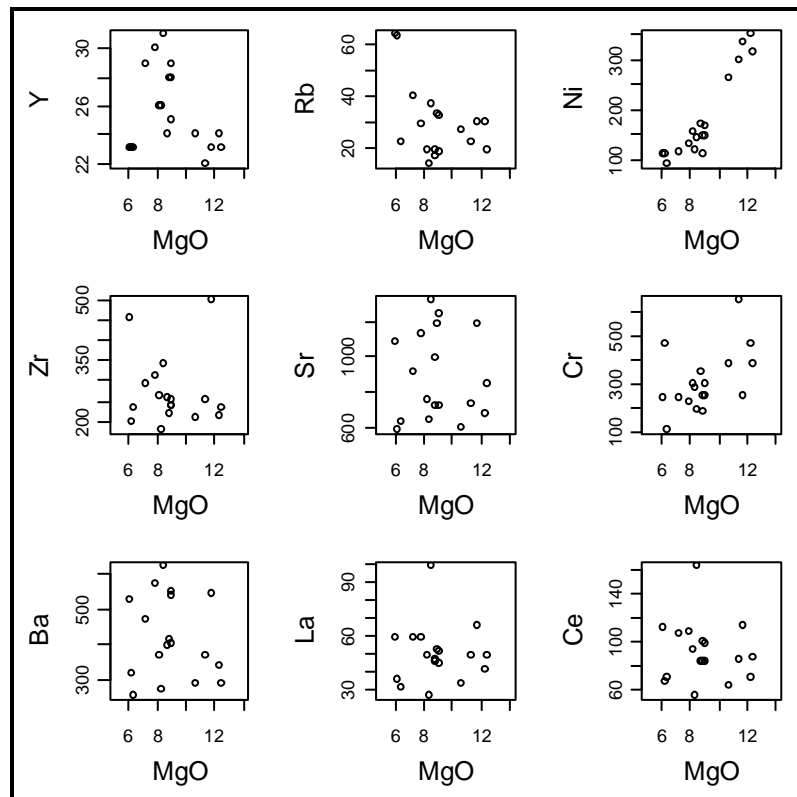


MgO vs other elements

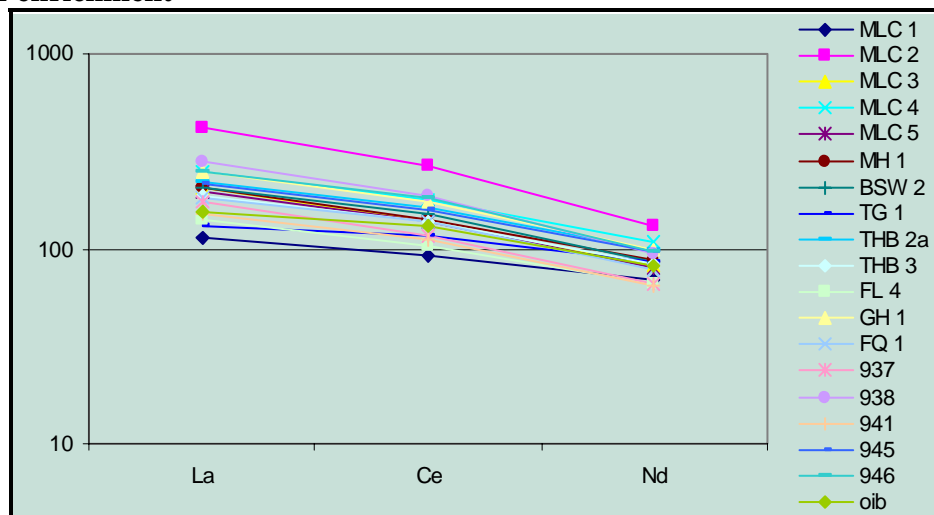


1.1.1

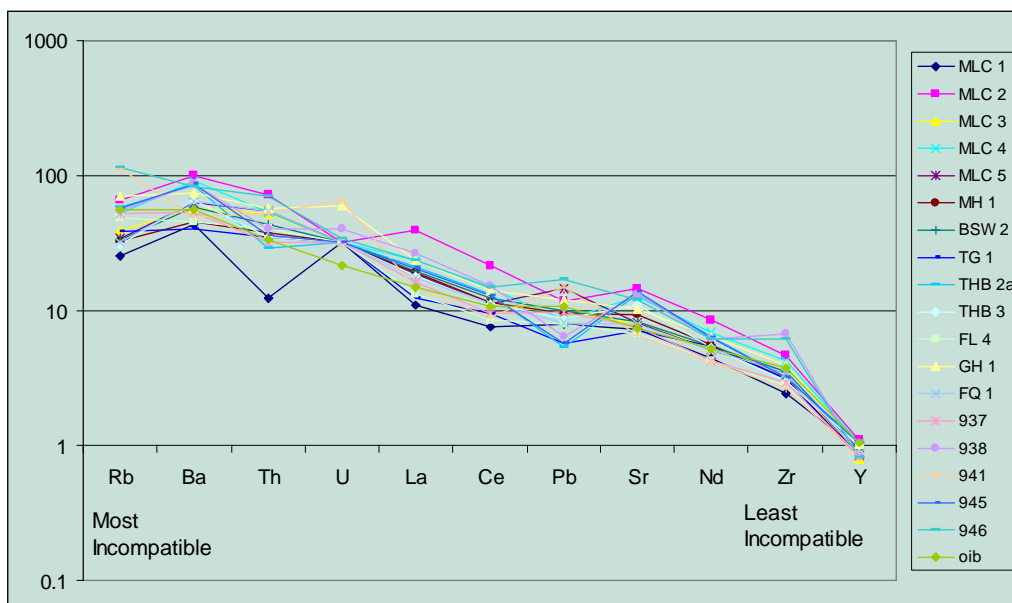
1.1.2 Trace element geochemistry



LREE enrichment



Spider diagrams



Harker Plots

