TECTONIC DISCRIMINATION OF VOLCANIC ROCKS OF THE CRY LAKE MAP AREA, NORTHERN BRITISH COLUMBIA BY MAJOR AND TRACE ELEMENT GEOCHEMISTRY

This lab will do two things - it will allow you to practice using geochemistry to investigate the tectonic setting in which mafic extrusive rocks may have formed – and it will familiarize you with "igpet2006", a useful geochemical analysis program. You will be using a major and trace element database determined by XRF from five different suites of samples. Each suite is gathered over a broad area (approximately 75 x 25 km bands) in a single (but complex) rock unit. The five units are: the Sylvester Assemblage, the French Range volcanics, the Shonektaw volcanics, volcanics of the Nazcha Formation, and the Stuhini Group. The origin of each of these units is unclear. Each is late Paleozoic and or Mesozoic. All lie outboard of demonstrable continental margin rocks of ancestral North America.

You should analyze the geochemistry of each unit in any way that seems fruitful to you. I recommend that you start with the following analyses and answer the following questions. It is very likely, however, that these results will prompt you to ask other, better-constrained questions. Go ahead and investigate them too. You may wish to consider subsets of the database to sharpen your analysis. You will find that igpet makes it very easy to explore the ramifications of geochemistry. If you have any difficulty using igpet, you might want to refer to the manual, which is also in the igpet folder. There is an abbreviated set of instructions attached to this lab.

Be sure to document your interpretations with printed diagrams (in B&W) and cogent written arguments.

INVESTIGATE THE MAJOR ELEMENT GEOCHEMISTRY OF THE ROCK SUITES:

Plot a Total Alkalies/Silica (TAS) diagram. What kind of igneous rocks are represented in the sample suite? Are the rocks alkalic or subalkalic?

Plot an AFM diagram. Does the suite represent a tholeiitic or calc-alkaline trend?

Explore the suite of rocks using Fenner and/or Harker diagrams. I recommend you try SiO_2 versus MgO; MgO versus Al_2O_3, TiO, K_2O, and Na_2O; and SiO_2 versus the same oxides. Next, plot some Harker diagrams based on immobile trace elements like Zr and Ni. (Harker and Fenner diagrams are typically presented on one page, with all matching x-axes lined up vertically. Igpet should allow you to produce such a figure.) Is it reasonable to consider that each suite of volcanic rocks - collected over several 100 sq km - is cogenetic? Do the rocks have a problem with major element mobility? Do you think the TAS diagram you developed is a reliable determinant of the classification of these rocks?

ANALYZE THE TRACE ELEMENT GEOCHEMISTRY OF THE ROCK SUITES AND ASSESS THE TECTONIC SETTING IN WHICH THEY FORMED:

Try to develop an understanding of the most likely tectonic setting for the formation of these extrusive rocks. Use discriminant diagrams to start your analysis. igpet offers a long list of such plots. Look them over to see which use the trace elements that you have analyses for. Try several (3 to 6) such diagrams.

igpet also allows you to plot your own XY or ternary diagrams. Use this feature to plot a V(ppm) versus Ti (ppm)/100 diagram as is shown below. (Be sure to convert your Ti data – given in wt % oxide to ppm form. igpet will do this for you.)

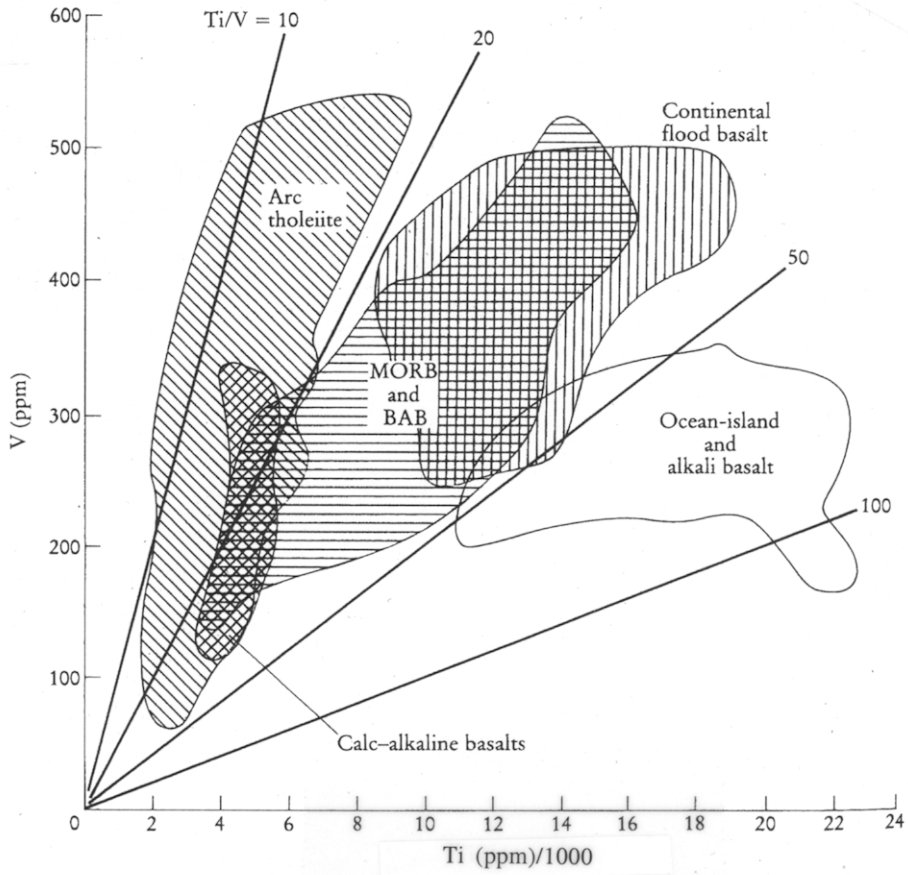

Figure 5.10 The Ti–V discrimination diagram for basalts (compiled from Shervais, 1982). The fields of arc tholeiite (diagonal hatching), MORB and back-arc basin basalts (BAB) (horizontal hatching), continental flood basalts (vertical hatching) and ocean-island and alkali basalt (unshaded) are recognized by their Ti/V ratio as shown. Calc–alkaline basalts (shaded) plot with low Ti concentrations with a wide range of Ti/V ratios.

ANALYZE THE TRACE ELEMENT GEOCHEMISTRY OF THE ROCK SUITES AND ASSESS THE TECTONIC SETTING IN WHICH THEY FORMED: (cont'd)

Now try plotting some Spider diagrams. igpet will give you a long list of normalization schemes from which to choose. I recommend that you try out Sun+McDon. Chondrites and Pearce MORB for starters. (These diagram titles give the author and date of the reference in which this particular spider diagram was first introduced, and the normalization basis used.) What do these Spider diagrams suggest?

FINAL INTERPRETATIONS:

Do the various geochemical analyses you have undertaken form a consistent picture for the formation of each of the five rock suites? If so, what is that picture? Are there inconsistencies and if so what are they? Summarize your findings as clearly and persuasively as possible.