Earth and Space Sciences 439

LAB 9: INTERMEDIATE TO FELSIC VOLCANIC ROCKS

The samples in this week's lab include both **lava flows** and **ash flow tuffs**. Many are members of the ***calc-alkaline volcanic suite (basalt-andesite-dacite-rhyolite)*** that is typically developed in volcanic arcs. Many of the samples were collected locally. In examining these sections you should pay attention to the following:

(1) **Phenocrysts:** Identify and describe the phases present. Some samples may contain 5 or more different phenocryst minerals. Be sure to distinguish plagioclase from alkali feldspars (sanidine or anorthoclase) and, since these are volcanic rocks, remember to use the high-temperature curves when estimating plagioclase compositions. Note also the zoning patterns, resorption features, and melt inclusions which are preserved in many plagioclases. Quartz phenocrysts are present in some sections and may be rounded or embayed. Look for evidence (particularly a dipyramidal habit) which might indicate that the quartz phenocryst originally crystallized as ß-quartz. Ferromagnesian minerals occurring as phenocrysts include olivine, hypersthene, augite, aegerine-augite, hornblende, biotite, garnet [rare], magnetite, ilmenite. Less common are crystals of sphene, zircon, apatite, sulfides, and aenigmatite (very rare), etc.

(2) **Groundmass:** The groundmass in felsic to intermediate volcanics ranges from almost entirely glass to holocrystalline in these sections. In the case of pyroclastic rocks (tuffs), note the degree of compaction and/or welding that has taken place. Glassy samples may also show evidence for devitrification of the groundmass. Look for evidence of post-solidification hydration of glass--perlitic fractures.

(3) **Lithic and pumice Fragments**: The Fish Canyon and Breitenbush tuffs contain lithic fragments and/or pumice fragments. Attempt to identify the lithic fragments and estimate their abundance.

(4) **Textures:** Describe the textures and where possible use them to develop a history of the sample. In particular be on the lookout for evidence of magma mixing (e.g., bimodal phenocryst populations, textures indicative of resorption, zonally arranged melt inclusions, zoning reversals, reaction textures, etc.) which is present in several sections. Phenocrysts in siliceous volcanic rocks commonly contain melt inclusions. A common texture in ashflow tuffs is termed **eutaxitic**, i.e., flattened and aligned pumice fragments. In hand samples, this structure is called **fiamme** [Italian word meaning flame.]

IRAZU This basaltic andesite from Costa Rica shows textural evidence suggestive of magma mixing. Note in particular that there are two plagioclase populations (how do they differ in composition and texture?). In some sections there is evidence of a reaction relationship between hypersthene and augite, i.e., hypersthene rimmed by augite. Olivine phenocrysts and opaque microphenocrysts are also present in a fine-grained groundmass.

MT. BAKER **This week's petrographic description**. The sample was collected from an outcrop of a columnar jointed flow on the Mt. Baker highway approx 1-2 miles from the ski lodge. Some clues: There are six phenocryst minerals in this andesite from the North Cascades. Do they represent an equilibrium assemblage? If not, how might you be able to tell? What reactions are taking place? Note the zoning and corrosion of the plagioclase phenocrysts. Describe the textures and speculate on what processes might cause such textures to develop.

ROSS PASS What term would describe the crystallinity of this andesitic vitrophyre? What minerals are present as phenocrysts?

TREPCA Identify the phenocrysts. Many of the quartz crystals are rounded or embayed, but note the habit of the less affected grains. What does it indicate? Note the extensive alteration of the hornblende phenocrysts which, however, have retained their original morphology. What name would you give to this rock?

R-210 What minerals are present as phenocrysts? Note the embayed form of many of the felsic phenocrysts and the devitrification of the groundmass. Although you don't have a chemical analysis of this rock, the unusual phenocryst assemblage (especially aegerine) indicates that this is a peralkaline rock.

ST. HELENS (pumice) What phenocrysts are present in this highly vesicular rock? Note the cumulophyric texture that is locally developed.

CAPE ROYDS, [Ross Island] What is the composition of the large alkali feldspar phenocrysts in this section (you've seen them before)? Note the melt inclusions present within the feldspar phenocrysts. Would you classify this rock as alkaline or subalkaline?

HANSON LAKE This rhyolite vitrophyre (perhaps a welded tuff) is associated with the 50 Ma. Mt Pilchuck stock near Granite Falls, WA. The curved fractures in the matrix indicate the glass is altered to perlite (this primarily involves hydration). Note the presence of scarce garnet crystals, which are also found (along with cordierite) in the Mt. Pilchuck stock. Suggest a possible explanation for the presence of garnet [garnets are very rare in volcanic rocks].

JOHN DAY "A" This welded tuff is from the basal member of the 36-18 Ma John Day Formation of north-central Oregon. Note the foliation and flattening of the pumice fragments due to welding. What minerals are present as phenocrysts?

BREITENBUSH Notice the beautifully preserved glass shards in this relatively uncompacted ash-flow tuff. The green color reflects low temperature alteration of the glass. Lithic fragments are common - what types of rock are represented?

FISH CANYON This sample is from a voluminous (3000 km^3!) ash-flow in the San Juan Mountains of Colorado. Note that it is very crystal-rich in comparison to the other tuffs in this lab, and that many crystals were broken or deformed during eruption and/or welding.

SAMPLE TO BE DESCRIBED: MOUNT BAKER