

EARTH AND SPACE SCIENCES 439

LAB 10: INTERMEDIATE TO FELSIC PLUTONIC ROCKS

This is the last lab of the quarter and it consists of eight samples, each represented by multiple thin sections. Rock types included are diorite, quartz diorite, tonalite, granodiorite as well as samples of alkali granites and syenite which come from a variety of tectonic settings [predominantly magmatic arcs on continents].

All of these rocks are coarse-grained so you should be able to identify all of the minerals present and then estimate a mode. In naming the rocks, use the IUGS classification scheme that is based on the relative proportions of quartz, plagioclase, and alkali feldspar. Classification diagram is shown in John Winter's textbook in Figure 2.2, p. 21. The names may be modified with textural terms (porphyritic, etc.) or with mineral names (hornblende-biotite quartz diorite, etc.)

Minerals you are likely to encounter in this week's lab include the following:

Plagioclase: Make note of zoning (patchy, oscillatory, normal, reversed), twinning, inclusions, alteration, synneusis, and determine the composition. Some of these samples contain sodic plagioclase so be certain to determine the sign of extinction when measuring extinction angles in a-normal determinations.

Alkali feldspar: May be either orthoclase or microcline and is commonly perthitic in slowly cooled plutonic rocks. Note any inclusions, alteration, twinning, etc.

Quartz: Look for evidence of deformation (undulose extinction) and resorption.

Amphibole: Several different types of amphibole are represented in the various thin sections. Use optical properties (especially the pleochroic formula) to estimate compositions. Also be on the lookout for pyroxene cores within amphiboles, magmatic overgrowths of biotite, and evidence of low temperature (including deuteritic) alteration.

Augite: Augite occurs in the more mafic members [diorites] and may also occur as cores within amphibole grains in more silicic members.

Biotite: Biotite abundances increase as the rocks become more felsic. In many samples biotite is the predominant mafic mineral. Biotites show a range of $Fe/(Fe+Mg)$ values. The most Fe-rich tend to be greenish in color.

Accessory minerals: Zircon, Apatite, Sphene, Topaz, Opaques [magnetite, ilmenite, sulfides], plus a host of secondary minerals, e.g. chlorite, epidote, sericite, etc.

CAPE ANN (MASS) This granite contains abundant microcline perthite. Note that there is only one feldspar (perthite) in this rock. Why is this and what does it tell you about the water content and depth of crystallization of this magma? What is the isotropic accessory mineral? The biotite in this rock is very dark, suggesting that it is relatively iron-rich. This is an A-type granitoid.

CATHEDRAL PEAK **Hand in a complete description of this rock.** This sample is from the Sierra Nevada batholith in California. Make sure you examine more than one thin section. There also is a polished section to help you identify the opaque minerals. Don't forget the accessory minerals and the alteration minerals. Look at the hand sample. This is an I-type granitoid

ADAMELLO-7 Sketch and determine the compositions of several plagioclase grains which show zoning and if possible determine the range of An content within an individual grain. Estimate the magnitude of any compositional gaps. Determine the 2V of the amphibole and try to estimate its composition. This is an excellent example of an I-type granitoid.

SILVER STAR This sample is from one of the early phases of the Golden Horn batholith in the Northern Cascades. This is another one-feldspar (hypersolvus) granite—some Golden Horn samples have two feldspars in a Rapakivi texture. The small amount of plagioclase which is present is interpreted to have exsolved from the alkali feldspar. What textural and/or compositional evidence can you find to support this hypothesis? What type of amphibole is present? The yellow-orange micaceous mineral is probably stilpnomelane. Based on its mineral assemblage, how do you think the composition of this granite differs from a typical I-type calc-alkaline granitoid from the North Cascades? This is also an A-type granitoid. Examine the large hand samples.

CASTLE PEAK This quartz diorite is typical of those found in the Cascades. What is the colorless mineral which occurs as relicts within some hornblendes? Draw a diagram of the crystallization sequence of this rock. How would you classify this granitoid (A, I, M, S-type?)

CUTTINGSVILLE (VT) What minerals are present in this rock? What is the average composition of the feldspar? Estimate a mode and name the rock.

JUDITH PEAK This alkali granite porphyry comes from central Montana. What is the green mafic mineral? The rock has many interesting textural features which you should note. In particular observe: (1) large bipyramidal quartz phenocrysts, (2) inclusion relationships between the feldspars (how did the inclusions get into the alkali feldspar phenocrysts?), and (3) crowding and crushing of the matrix plagioclases (note the strained and broken crystals).

Rock to be described: CATHEDRAL PEAK