EESC 2100: Mineralogy

LAB 5: COMMON MINERALS IN IGNEOUS ROCKS

Part 1: Minerals in Granitic Rocks

Learning Objectives:

- Students will be able to identify the most common minerals in granitoids
- Students will be able to identify the most common accessory minerals in granitoids
- Students will be able to classify granitoid rocks based on mineral content

New Minerals: Muscovite*, Biotite*, Hornblende*, Tourmaline*, Apatite*, Rutile*, Corundum

Review Minerals: Quartz, Plagioclase, Microcline

MINERALS IN GRANITIC ROCKS

Granitic rocks (felsic to intermediate intrusive rocks) are composed mainly of the three minerals **quartz, plagioclase, and potassium feldspar** and their classification is based upon the relative proportions of these three minerals that you examined in previous labs. Additional major minerals (>5% of the rock) in granitic rocks may include micas (muscovite and biotite) and the amphibole hornblende. Common accessory minerals (<2% of the rock) include apatite ($Ca_5[PO_4]_3[OH,F,Cl]$), tourmaline ($Na[Al,Fe,Li,Mg,Mn]_3Al_6[Si_6O_{18}][BO_3][OH,F]_4$), and rutile ($TiO_2$).

Micas are a group of hydrated aluminosilicate minerals. They are sheet silicates and exhibit perfect basal cleavage. Although they are monoclinic minerals, micas commonly form hexagon-shaped crystals. **Muscovite** ($KAl_2Si_3AlO_{10}[OH,F]_2$) and **biotite** ($K[Mg,Fe^{2+}]_3AlSi_3O_{10}[OH,F]_2$) are the two most common micas.

Examine the hand samples MUSCOVITE (Muscovite and Psuedo-Hexagonal Crystals) and BIOTITE, and document their physical properties. What is the main physical property that allows you to distinguish these two micas?

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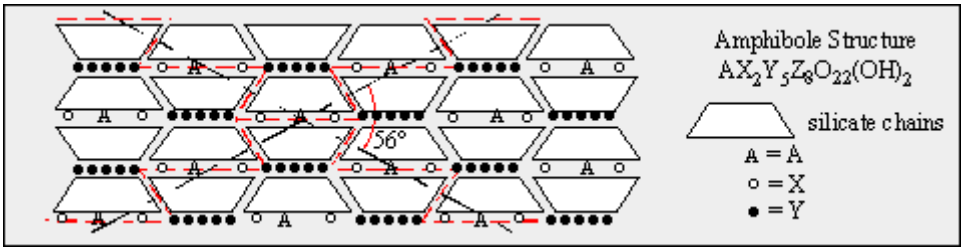
Examine thin-section of MUSCOVITE and BIOTITE and document the optical properties of these minerals. Note the pleochroic halos in biotite, a shell of more intense color surrounding, and caused by, radioactive mineral grains (e.g., zircon, titanite, xenotime).

Amphiboles are a diverse group of rock-forming inosilicate minerals that are composed of double chain SiO_4 tetrahedra. Amphiboles are hydrous minerals, contain Fe and/or Mg, and most amphiboles contain Ca, Na or K as well. Amphiboles have two cleavage distinct planes at 124°/56°. **Hornblende** ($Ca_2[Mg,Fe,Al]_5[Al,Si]_8O_{22}[OH]_2$) is the most common amphibole, and is a common constituent of both igneous and high-grade metamorphic rocks.



Examine the hand sample HORNBLENDE, and document this mineral's physical properties. Note the well-developed amphibole cleavage on cross-sections.

Examine the thin-section HORNBLENDE and document this mineral's optical properties.

Felsic igneous rocks commonly contain small amounts of minerals that accommodate the ions from the magma that do not fit into the structure of the common silicate minerals. For example, titanium is commonly incorporated in to rutile (TiO_2), phosphorus into apatite ($Ca_5[PO_4]_3[OH,F,Cl]$), and boron into tourmaline ($Na(Al,Fe,Li,Mg,Mn)_3Al_6(Si_6O_{18})(BO_3)_3(OH,F)_4$).

Rutile is a high relief, golden-brown colored mineral that typically forms small prismatic or needle-like crystals. **Apatite** is a colorless, uniaxial mineral with low interference colors, and so may be confused with quartz. However, apatite commonly displays well-developed hexagonal cross-sections, has a negative optic sign, and higher relief than quartz. **Tourmaline** occurs as prismatic crystals that commonly have a roughly triangular cross-section. One distinctive optical property of tourmaline is that it is pleochroic and displays its strongest colors when oriented north-south on the stage.

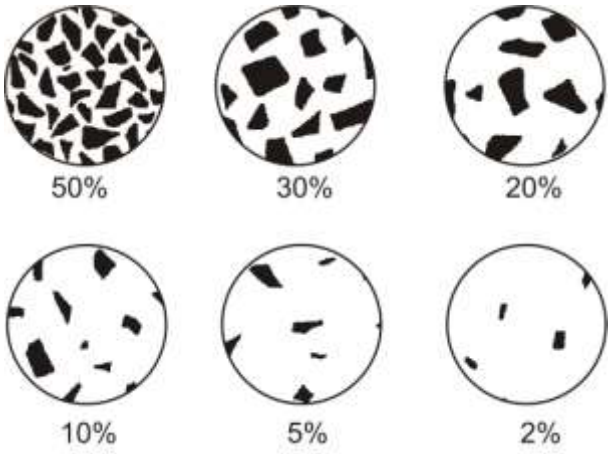
Examine the hand samples APATITE, TOURMALINE (var. Uvite, var. Rubellite), and CORUNDUM, and document their physical properties.

Examine thin-sections RUTILE, APATITE, and TOURMALINE and document the optical properties of these minerals.

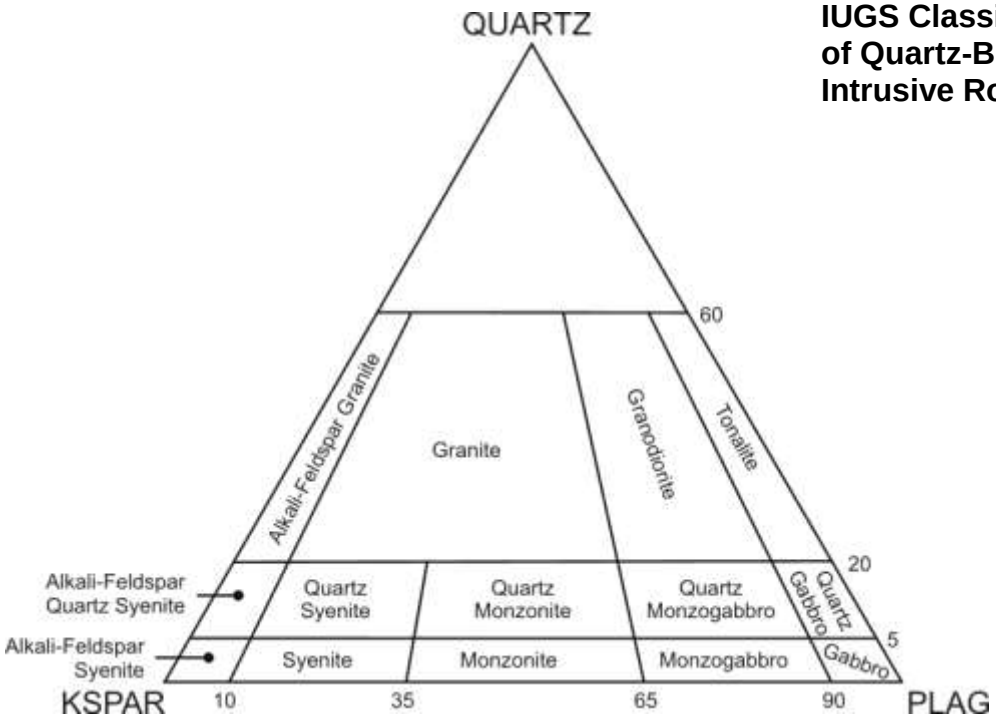
CLASSIFYING QUARTZ-BEARING PLUTONIC ROCKS (GRANITOIDS)

The IUGS classification scheme for igneous rocks is used commonly and is based upon the relative proportion of three components: quartz, K-feldspar, and plagioclase. The major additional mineral that is present (muscovite, biotite, hornblende, etc) are used as modifiers to the rock name (e.g., biotite granite, hornblende syenite).

Review the optical properties of quartz, K-feldspar and plagioclase. Examine samples GRANITOID 1 and GRANITOID 2, and estimate the percentage of these minerals in each sample. Use the figure to the right to help you to estimate the percentage of each of these three mineral components. Recast these percentages relative to the total of these three components. Use this information to classify the granitoids using the IUGS classification diagram for quartz-bearing intrusive rocks.



IUGS Classification of Quartz-Bearing Intrusive Rocks



GRANITOID 1

% Quartz: _____ % K-Feldspar: _____ % Plagioclase: _____

Total = (Quartz + K-Feldspar + Plagioclase) = _____

% Quartz/Total = _____

% K-Feldspar/Total = _____

% Plagioclase/Total = _____

Other Major Minerals Present: _____

Accessory Minerals Present: _____

Rock Name: _____

GRANITOID 2

% Quartz: _____ % K-Feldspar: _____ % Plagioclase: _____

Total = (Quartz + K-Feldspar + Plagioclase) = _____

% Quartz/Total = _____

% K-Feldspar/Total = _____

% Plagioclase/Total = _____

Other Major Minerals Present: _____

Accessory Minerals Present: _____

Rock Name: _____

Review the physical properties of quartz, microcline and plagioclase. Examine hand-samples GRANITOID A and GRANITOID B, and estimate the percentage of these minerals in each sample. Recast these percentages relative to the total of these three components. Use this information to classify the granitoids using the IUGS classification diagram for quartz-bearing intrusive rocks.

GRANITOID A

% Quartz: _____ % K-Feldspar: _____ % Plagioclase: _____

Total = (Quartz + K-Feldspar + Plagioclase) = _____

% Quartz/Total = _____

% K-Feldspar/Total = _____

% Plagioclase/Total = _____

Other Major Minerals Present: _____

Accessory Minerals Present: _____

Rock Name: _____

GRANITOID B

% Quartz: _____ % K-Feldspar: _____ % Plagioclase: _____

Total = (Quartz + K-Feldspar + Plagioclase) = _____

% Quartz/Total = _____

% K-Feldspar/Total = _____

% Plagioclase/Total = _____

Other Major Minerals Present: _____

Accessory Minerals Present: _____

Rock Name: _____

Describe how you were able to differentiate quartz, microcline, and plagioclase in these rocks.

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