EESC 2100: Mineralogy

LAB 6: COMMON MINERALS IN IGNEOUS ROCKS

Part 2: Minerals in Gabbroic Rocks

Learning Objectives:

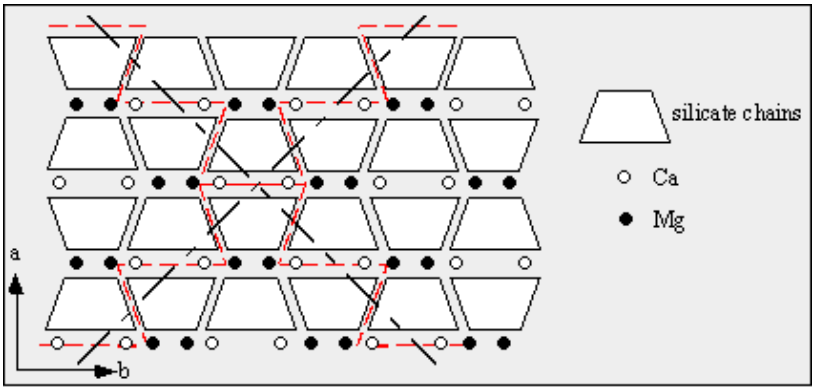
- Students will be able to identify the most common silicate minerals in gabbroic rocks in thin-section and hand-sample
- Students will be able to identify the most common oxide minerals gabbroic rocks in hand-sample
- Students will be able to classify gabbroic rocks based on mineral content

New Minerals: Orthopyroxene*, Clinopyroxene*, Olivine*, Magnetite, Ilmenite, Chromite

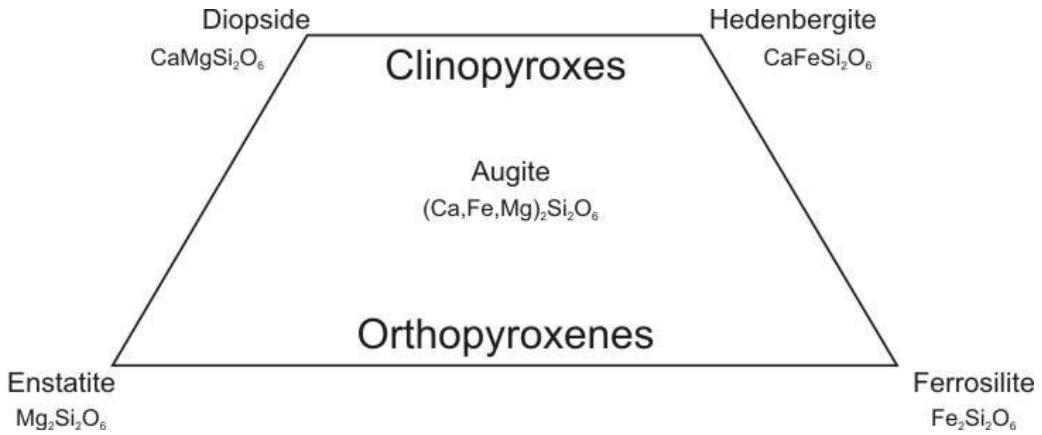
Review Minerals: Plagioclase, Biotite, Hornblende

COMMON MINERALS IN GABBROIC ROCKS

The **pyroxenes** are an important group of single chained inosilicates, and are common in igneous and high-grade metamorphic rocks. The single-chain structure leads to the prismatic to fibrous character of pyroxenes, and the characteristic cleavage angle of the pyroxenes at nearly 90° degrees (actually 93° and 87°). Pyroxenes and amphiboles are in structure (chain silicates), composition and general appearance. Cleavage angle is the most reliable property to distinguish pyroxenes from amphiboles; luster and crystal form may also help to differentiate these mineral groups.



Pyroxenes fall into two groups based on their composition and resulting optical properties: the monoclinic clinopyroxenes and the orthorhombic orthopyroxenes.
Clinopyroxenes contain Ca, and in igneous rocks can be thought of as $(Ca,Mg,Fe)_2Si_2O_6$, with small amounts of Al, Mn and Na substituting for other elements. Clinopyroxenes The most common clinopyroxene in igneous rocks is **augite** which has a variable composition $(Ca,Mg,Fe,Na)(Mg,Fe,Al)(Si,Al)_2O_6$.
Orthopyroxenes lack Ca, and their natural compositions are dominated by two major end member components: **enstatite**, $Mg_2Si_2O_6$, and **ferrosilite**, $Fe_2Si_2O_6$



Examine the hand samples of CLINOPYROXENE (Augite, Diopside) and ORTHOPYROXENE (Enstatite) and document their physical properties. What properties do pyroxenes have in common? How can they be differentiated from hornblende?

Examine thin-sections DIOPSIDE and ENSTATITE and document their optical properties.

Olivine is not an official mineral name itself, but is the name for a Fe-Mg solid-solution series; **fayalite** (Fe_2SiO_4) is the iron end member, and **forsterite** (Mg_2SiO_4) is the magnesium end member. Fayalite has a higher index of refraction, is heavier and has a darker color compared to forsterite. livine is a common component of mafic (e.g., basalt and gabbro) and ultramafic igneous rocks (e.g, dunite).

Examine the hand sample OLIVINE and document this mineral's physical properties.

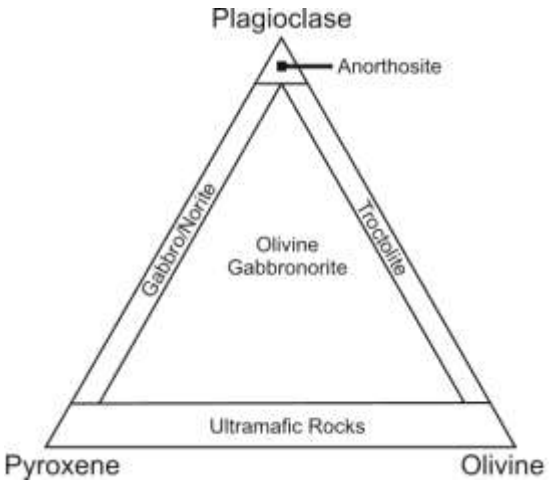
Examine the thin-section of OLIVINE and document this mineral's optical properties. Using the data in your textbook, determine if this is olivine is richer in Fe or Mg.

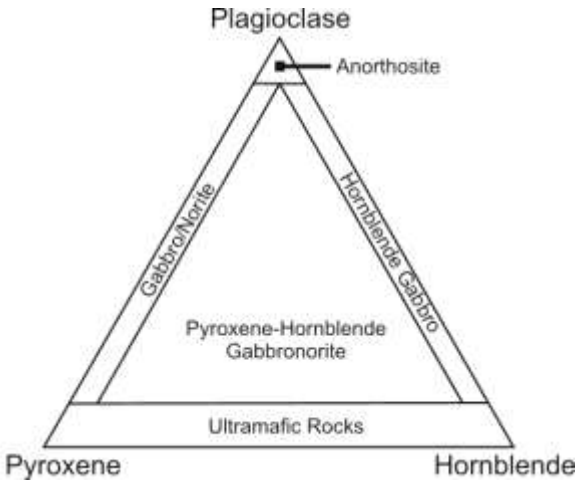
Iron-bearing oxides are a common component of mafic igneous rocks. Three of the most common igneous oxide minerals are **magnetite** (Fe_3O_4), **ilmenite** ($FeTiO_3$), and **chromite** ($FeCr_2O_4$). These potential ore minerals crystallize early from the magma.

Examine the hand samples MAGNETITE, ILMENITE and CHROMITE, and document their physical properties.

CLASSIFYING GABBROIC ROCKS

Rocks with less than 5% ferromagnesian minerals (i.e., mostly made of plagioclase) are termed **anorthosite**. Rocks with 5-40% ferromagnesian minerals are termed **diorite** if their feldspar composition is less than 50% anorthite, or leucogabbro if their feldspar composition is more than 50% anorthite. Rocks with over 40% ferromagnesian minerals are generally termed **gabbro**. The relative abundance of ferromagnesian minerals (hornblende, pyroxene, olivine) can be used to further categorize the gabbroic rocks. Note that a norite is a gabbro that contains more orthopyroxene than clinopyroxene.





Review the optical properties of plagioclase, hornblende, and biotite. Examine thin-sections GABBROID 1, and GABBROID 2. Identify the minerals in each of these rocks and estimate the percentage plagioclase, hornblende, orthopyroxene, clinopyroxene, and olivine. Determine the composition of plagioclase in each sample using the Michel-Levy method. Use this data along with the classification schemes described above to name these rocks.

GABBROID 1

% Pyroxene: ____ % Plagioclase: ____ % Olivine: ____ % Hornblende: ____

Which classification diagram do you need to use? Pl-Px-Ol Pl-Px-Hb

Total = (Plagioclase + Pyroxene + _____ [Ol or Hb]) = _____

% Plagioclase/Total = _____ Plagioclase Composition: _____

% Pyroxene/Total = _____

% _____ [Ol or Hb]/Total = _____

Other Major Minerals Present: _____

Accessory Minerals Present: _____

Rock Name: _____

GABBROID 2

% Pyroxene: ____ % Plagioclase: ____ % Olivine: ____ % Hornblende: ____

Which classification diagram do you need to use? Pl-Px-Ol Pl-Px-Hb

Total = (Plagioclase + Pyroxene + _____ [Ol or Hb]) = _____

% Plagioclase/Total = _____ Plagioclase Composition: _____

% Pyroxene/Total = _____

% _____ [Ol or Hb]/Total = _____

Other Major Minerals Present: _____

Accessory Minerals Present: _____

Rock Name: _____

Review the physical properties of plagioclase and hornblende. Examine hand-sample GABBROID A. Identify the minerals in each of these rocks and estimate the percentage plagioclase, hornblende, pyroxene, and olivine. Use this data along with the classification schemes described above to name this rock.

GABBROID A

% Pyroxene: ____ % Plagioclase: ____ % Olivine: ____ % Hornblende: ____

Which classification diagram do you need to use? Pl-Px-Ol Pl-Px-Hb

Total = (Plagioclase + Pyroxene + _____ [Ol or Hb]) = _____

% Plagioclase/Total = _____ Plagioclase Composition: _____

% Pyroxene/Total = _____

% _____ [Ol or Hb]/Total = _____

Rock Name: _____

Describe how you were able to differentiate plagioclase from the Fe-bearing minerals in this rock.

_____

_____

_____

_____

_____

Describe how you were able to differentiate the Fe-bearing minerals from each other in this rock.

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