Lecture-12

Six Common Rock-Forming Minerals

The six minerals **amphibole, feldspar, mica, olivine, pyroxene, and quartz** are the most common rock-forming minerals and are used as important tools in classifying rocks, particularly igneous rocks.

Except for quartz, all the minerals listed are actually mineral groups.

However, instead of trying to separate all the minerals which make up a group, which is often not possible in the field, they are dealt with here as a single mineral with common characteristics.

Quartz and feldspar are light-coloured minerals; mica, pyroxene, amphibole and olivine are dark-coloured. The colour of a rock will be determined by the proportions of light and dark-coloured minerals present.

If most of the grains are quartz and feldspar then the overall appearance of the rock will be light, while the opposite will be true if the minerals are mainly mica, pyroxene, amphibole or olivine.

The colour of a rock with between 25 and 50% dark minerals is intermediate.

Common Rock-forming Minerals

Quartz

- Quartz (Figure 2), which is usually called silica, is one of the most common minerals in the Earth's crust.
- Quartz is made up of silicon dioxide (SiO_2)
- Quartz crystals are usually hexagonal and prismatic in shape.
- Pure quartz is colourless, although the presence of impurities may give a range of colours, such as violet, pink and orange.
- Quartz is the raw material for making glass

Figure 1 Quartz

Plagioclase Feldspar

- Plagioclase feldspar (Figure 2) is sodium- or calcium-rich feldspar. The chemical composition ranges from sodium aluminium silicate, $NaAlSi_3O_8$ to calcium aluminium silicate, $CaAl_2S_{i2}O_8$.
- Plagioclase feldspar crystals usually occur as stubby prisms.
- Plagioclase feldspar is generally white to grey and has vitreous lustre.
- Plagioclase feldspar is an important industrial mineral used in ceramics

Figure 2 Plagioclase Feldspar

Alkali Feldspar

- Alkali feldspar (Figure 3) is another member of the family of feldspar minerals.
- Alkali feldspar (Potassium aluminium silicate $(K,Na)AlSi_3O_8$) are rich in alkali metal ions.
- Alkali feldspar crystals usually occur as stubby prisms.
- Alkali feldspar is commonly pink to white.
- Alkali feldspar is used as raw material to make porcelain.

Figure 3 Alkali Feldspar

Micas

- Micas are a family of silicate minerals.
- Micas are made up of varying amounts of potassium, magnesium, iron, as well as aluminium, silicon and water.
- Micas form flat, book-like crystals that split into individual sheets, separating into smooth flakes along the cleavage planes.
- They are common minerals in intrusive igneous rocks, and can also be found in sedimentary and metamorphic rocks.
- Biotite (Figure 4) is dark, black or brown mica; muscovite (Figure 5) is light-coloured or clear mica (next page).

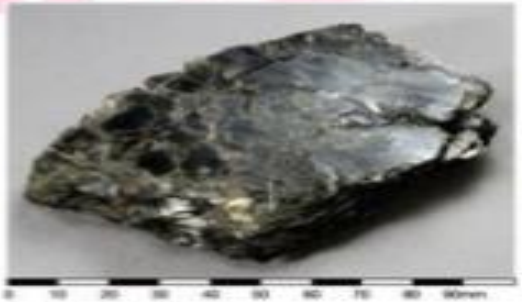

Figure 4 Biotite

Figure 5 Muscovite

Amphiboles

- Amphiboles are a family of silicate minerals.
- Amphibole minerals generally contain iron, magnesium, calcium and aluminium as well as silicon, oxygen, and water.
- Amphiboles form prismatic or needle-like crystals.
- Amphibole is a component of many igneous and metamorphic rocks.
- Hornblende (Figure 6) is a common member of the amphibole group of rock-forming minerals.

Figure 6 Hornblende

Pyroxene

- Pyroxenes (Figure 7) are a family of silicate minerals.
- Pyroxene minerals generally contain magnesium, iron, calcium and aluminium as well as silicon and oxygen.
- Pyroxenes form short or columnar prismatic crystals.
- Pyroxene is a component in many igneous and metamorphic rocks.
- Pyroxene crystals are commonly faceted as gemstones. For instance, precious jade (jadeite) is a pyroxene.

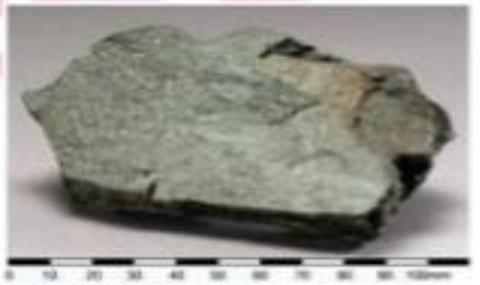

Figure 7 Pyroxene

Olivine

- Olivine (Figure 7) is a silicate mineral.
- Olivine ($(Mg,Fe)_2SiO_4$) contains iron and magnesium.
- Olivine is a green, glassy mineral.
- Olivine is common in mafic and ultramafic rocks.
- Clear and transparent olivine crystals are commonly faceted as gemstones

Figure 8 Olivine

Calcite

- Calcite (Figure 9) is a carbonate mineral.
- Calcite is made up of calcium carbonate ($CaCO_3$).
- Calcite is generally white to clear, and is easily scratched with knife.
- Calcite is a common sedimentary mineral that is the major component of calcareous sedimentary rocks such as limestone. Metamorphism of limestone produces marble.

Figure 9 Calcite

Common Rock Forming Minerals

The vast majority of the common igneous rock-forming minerals belong to the silicate group, which means that they are based on silicon and oxygen for their basic elemental components. The silicates can be further divided into mafic and felsic - 2 very broad categories that relate to the other elements which occur along with the ever-present SiO_2. In any event, from mafic to felsic, the common igneous rock forming minerals would include the following:

Common Rock Forming Minerals

Olivine:
olive green to black, translucent, with a conchoidal fracture. Olivine phenocrysts are relatively common in some basaltic rocks (like those found in Hawaii), and make an extremely pretty contrast with the black groundmass of the basalt. A semi-precious variety occurs (peridot), which can be cut and faceted like any other gemstone.

Common Rock Forming Minerals

Pyroxene:
green to black, nearly opaque, 2 cleavages at approx. 90˚. Enstatite is a common member of the pyroxene family, and can be found in gabbro and mafic diorites. Pyroxenite, an igneous rock composed totally of pyroxene minerals, is related to ultramafic terrains and is therefore relatively rare at the surface of the earth's crust. Example: Enstatite, Hypersthene, Augite etc.

Common Rock Forming Minerals

Amphibole:
mostly black, forms long, slender crystals with 2 cleavages at 60° and 120° . The most common member of the amphibole family is hornblende, which is easy to identify in diorite, granodiorite, and some granites. Amphibolite is a metamorphic equivalent of basalt, and can contain extremely coarse grained specimens of hornblende. Example: Tremolite, Actinolite etc.

Common Rock Forming Minerals

Feldspar: all have 2 cleavages at approx. 90˚ and a hardness of 6. Approximately 60% of the earth's crust is composed of feldspar, and I tell my Geology 101 students that it's probably a pretty good idea to be able to identify the various members of the family. The mafic variety (plagioclase) may have striations (very fine "razor-cut" grooves on selected cleavage faces), but not always. The felsic variety (orthoclase) can often be pink and has no striations. Both can be white, which can make a specific determination of which feldspar a bit awkward (especially if there are no visible striations). Microcline is another example.

Common Rock Forming Minerals

Mica:
translucent to black (felsic to mafic), with one (1) perfect cleavage, causing it to easily break into thin sheets. The mafic mica is called biotite, with the more felsic member of the family affectionately referred to as muscovite.

Common Rock Forming Minerals

Quartz:
hard, durable, relatively inert, and no cleavage (but a great conchoidal fracture). Quartz is the last mineral to form in a felsic (granitic) rock, and can generally be found filling in between all of the other minerals. When allowed to cool and crystallize in open space, quartz commonly forms 6-sided (hexagonal) crystals which are highly prized and sought after by many people for a variety of natural (and super-natural) uses.