GL 211 Mineralogy

Lab 1: Physical properties of minerals

Since minerals are the building blocks of rocks, geologists who study rocks, sediments, or soils in the field need to be able to quickly and accurately identify minerals. The purpose of this lab is to introduce you to the most important physical properties used to identify minerals. You will be using these physical properties throughout the term during the mineral ID quizzes.

The **first** portion of this lab deals with using physical properties to identify minerals. You should complete this portion during the lab period. For the **second** part of the lab, you are given a set of several common rock-forming minerals. Using the physical properties and the determinative tables in your and in the back of Klein and Hurlbut, identify five minerals.

1. Color

Color is one of the most obvious characteristics of minerals to most people, but it is not one of the most useful properties in mineral identification. One reason is that the majority of minerals, in particular the common rock-forming minerals, allow substitution of different ions into the mineral structure, causing the color to vary depending on the exact composition. Other minerals can have a range of colors due to impurities or defects in the crystal.

The samples labeled "quartz" are all crystals of the mineral quartz (SiO_2). What color is each crystal? What causes the color in each (Hurlbut and Klein's description of quartz will tell you)?

Variety	Color	Cause of color
Amethyst		
Rose quartz		
Smoky quartz		
Milky quartz		
Jasper		

2. Streak

The streak of a mineral is the color of its powder, seen when the mineral is scratched on a ceramic plate. Streak is most useful for identifying opaque minerals, because the color of an opaque mineral can be affected by tarnish on the surface or by the luster of the mineral. Test the streak of each of the following minerals.

Mineral	**Color of hand specimen**	**Color of streak**
Hematite		
Magnetite		
Chalcopyrite		
Pyrite		
Sphalerite		

3. Luster and transparency

Luster refers to the manner in which light is reflected from the surface of a mineral, whereas transparency deals with how well light passes through a substance. Minerals that reflect light well and are opaque are said to have a metallic luster. All other lusters are said to be non-metallic. The subdivision of minerals into metallic and non-metallic is one of the easiest to determine, and is often the first property used in a mineral identification key. Minerals like quartz that transmit light yet also reflect light from their surface in the way glass does are said to have a vitreous (or glassy) luster. Other common terms for luster include resinous, greasy, pearly, earthy, and dull.

Although most opaque minerals also display a metallic luster, some do not. For the following opaque minerals, indicate whether the luster is metallic, nonmetallic, or either (depending on the specimen).

Mineral	**Luster**
Cinnabar	
Galena	
Hematite	
Limonite	

4. Hardness

Hardness is a relative property: harder minerals can scratch softer minerals. Minerals can be assigned a semiquantitative hardness by comparing them to the minerals of the Mohs hardness scale:

1.....Talc
2.....Gypsum
3.....Calcite
4.....Fluorite
5.....Apatite
6.....Orthoclase feldspar
7 .....Quartz
8.....Topaz
9.....Corundum
10.....Diamond

In practice, hardness is usually measured with respect to a few everyday objects rather than to a reference set of minerals. Most fingernails have a hardness a little over 2, copper pennies have a hardness slightly greater than 3, a pocket knife has a hardness around 5.5, and a steel file has a hardness around 6.5.

The hardness test has several weaknesses:
1) Weathering will make a mineral softer than when it is fresh.
2) Many minerals have variable hardness as a result of variable bond strength from substitution of different ions.
3) Granular mineral aggregates may appear to be scratched, but really are only disaggregated when tested.
4) Accurate hardness testing is difficult for minerals harder than 6 on the Mohs hardness scale.

Determine the relative and Mohs hardness of each of the following minerals and then check your results with your text: barite, beryl, graphite, halite, corundum.

Mineral	Your determination	Expected hardness (from text)
Softest		
1.		
2.		
3.		
4.		
5.		
Hardest		

Determine the hardness of kyanite parallel and perpendicular to the length of the crystal.

Hardness parallel to length:_____

Hardness perpendicular to length:_____

5. Cleavage

Most minerals have lattice planes along which chemical bonds are weaker than elsewhere in the crystal. When minerals break, they usually do so preferentially along these planes. The number of planes along which a mineral breaks depends on the structure of the mineral, and may range from one (like micas) to six (like sphalerite). Furthermore, the weakness of bonds along cleavage planes compared to other bonds varies from mineral to mineral, resulting in a wide range of "perfection" of mineral cleavage. Since cleavage planes are related to the crystal structure, their symmetry is restricted in the same way that the symmetry of their crystal faces is. Cleavage and crystal faces are very different, however, and it is important not to confuse them: crystal faces are growth planes, whereas cleavage planes are planes of breakage or weakness.

Describe the cleavage of the minerals listed below using the following terms:
1. Degree of development: perfect or excellent, good, fair, poor, absent
2. Number of directions: any number from 1 to 6
3. Angle between cleavage planes: 2 @ right angles, 2 not at right angles, 3 at right angles, 3 not at right angles

Mineral	Cleavage description
Biotite:	
Fluorite:	
Galena:	
Gypsum:	
Potassium feldspar:	
Hornblende:	
Pyroxene:	

6. Tenacity

Tenacity is the resistance that a mineral offers to breaking, crushing, bending, or tearing. Minerals are characterized as brittle (breaks easily), malleable (can be hammered into thin sheets), sectile (can be cut into thin shavings with a knife), ductile (can be drawn into a wire), flexible (can be bent, but does not resume its original shape when the stress is released), and elastic (can be bent, but resumes its original shape when the pressure is released).

Describe the tenacity of each of the following minerals:

1. Muscovite

2. Chlorite

3. Calcite

4. Copper

7. Other properties

Specific gravity is the ratio between the weight of a substance and the weight of an equal volume of water at 4 °C. This can be measured precisely, but in practice it is usually used as a quick relative test. Galena, for example, feels unusually heavy for its size.

Other properties are useful for the identification of specific minerals. For example, most carbonates react with HCl; magnetite is attracted to a magnet, and halite has a distinctive taste.

Turn in this part of the assignment before leaving.