Box 3-1. Physical Properties of Minerals

Crystal Form

When allowed to grow unobstructed, crystals will form into smooth, planar faces with perfect geometric form. The internal arrangement of atoms in a mineral determines the shape of its crystal. Certain minerals commonly grow into well-developed crystals, and their crystal forms are diagnostic. Some of the common minerals in which crystal form is especially diagnostic are quartz, garnet, fluorite, pyrite, and galena.

Cleavage

Cleavage is the tendency of a mineral to break along definite planes of weakness that exist in the internal (atomic) structure of the mineral. The bonds that hold the atoms together in a crystalline structure are not equally strong in all directions. If definite planes of weakness exist, the mineral will cleave, or break, along the planes of weakness much more easily than in other directions.

Crystals may cleave in one, two, three, four, or six directions. Perfect cleavage displays a smooth, even surface that reflects light. Cleavage planes, however, can occur in small segments arranged in a step-like manner. This step-like arrangement may appear initially as an irregular fracture, but if the sample is rotated, light will reflect just as it would on single large, smooth cleavage surfaces. If the surface were an irregular fracture, the light would not concentrate in any particular direction.

Cleavage surfaces may be confused with natural crystal faces, but there are several ways to distinguish them: (1) although crystal faces and cleavage planes are both normally smooth, cleavage planes commonly are broken in a step-like fashion; (2) some crystal faces have fine grooves or ridges on their surfaces; most cleavage planes do not; and (3) unless crystal faces happen to correspond with cleavage planes, the mineral will not break parallel to them. Cleavage results from planes of weakness within the crystal structure along which the crystal breaks. Crystal faces reflect the geometry of the crystal's growth.

Fracture

When a mineral breaks along random, irregular surfaces, it is called fracture. Some minerals break only by fracturing, while others both cleave and fracture. The best everyday example of fracture is broken glass, which fractures into smoothly curved fracture surfaces, called *conchoidal* fracture. Because fractures are random, they will not concentrate light reflections in any particular direction. Fracture surfaces, like cleavage surfaces, are only produced as a result of breaking the mineral.

Hardness

The hardness of a mineral is its resistance to abrasion. Hardness is measured according to Mohs scale of hardness, where 1 is the softest mineral (talc) and 10 is the hardest mineral (diamond). All other minerals have a hardness between 1 and 10. Each number in the Mohs hardness scale is represented by one mineral (calcite is 3 and quartz is 7). Because it is not practical to have a set of Mohs index minerals with you at all times, a scratch test is used to determine a mineral's hardness using several common objects in place of index minerals. Common objects used in this lab, and their relative hardnesses, include your fingernail (2-2.5 for real fingernails), a copper penny (3.5), a glass plate (5-5.5), a steel nail (5.5), and a streak plate (6.5-7).

Hardness is generally a reliable diagnostic physical property of a mineral, but be aware that variations in composition may make some minerals harder or softer than normal. Weathering can also affect hardness, so make sure to test your sample on a fresh mineral surface.

Box 3-1 (continued).

Color

Color is the most obvious physical property of a mineral, and for some minerals, such as galena (gray), azurite (blue), and olivine (green), it is diagnostic. Other minerals, however, may contain slight impurities or defects within the crystal structure that give the mineral a variety of colors. Quartz, for example, can be a colorless, clear crystal or white, pink, green, purple, red, and black. Although color may be diagnostic for a few minerals, especially minerals with a metallic luster, it is almost without diagnostic significance in minerals of nonmetallic luster. Color should be considered in mineral identification, but other properties should also be considered before making identification.

Streak

Streak is the color of the mineral when powdered, and the color of the streak may differ considerably from the color of the mineral. Streak is obtained by rubbing the mineral across an unglazed porcelain plate. Streak is more helpful for identifying minerals with a metallic luster because minerals with a nonmetallic luster will usually have a light-colored streak or no streak at all. Minerals with hardness greater than that of porcelain will scratch the plate and will not produce streak. Because the streak of a mineral is usually the same, no matter what color the mineral, streak is generally more diagnostic than color. Hint – place the streak plate on the table, rather than holding it in your hand where it can break under the pressure.

Luster

Luster describes the general appearance of a mineral surface in reflected light. Most minerals are either metallic or nonmetallic. Minerals, such as pyrite or galena, that have a metallic luster look like metal. There are a variety of nonmetallic lusters, including glassy, silky, dull or earthy (not bright or shiny). Also, minerals can be transparent (you can see through them, like window glass), translucent (they transmit light but no clear image, like frosted glass), or opaque (don't let any light pass through them, like a brick wall).

Other Properties

Specific Gravity. The specific gravity of a mineral is a number that represents the ratio of a mineral's weight to the weight of an equal volume of water. For purposes of general laboratory work, you can estimate specific gravity simply by lifting a mineral specimen in your hand and making an estimate: relatively heavy or relatively light.

Chemical Reaction. Some minerals, especially carbonate minerals, react vigorously with dilute hydrochloric acid (HCl) by effervescing (bubbling) to release carbon dioxide. Calcite, a common carbonate mineral, will readily bubble when HCl is applied. This simple chemical test is very diagnostic and can be used to distinguish calcite from most of the other common minerals.

Magnetism. Some minerals are magnetic, to varying degrees. The test for magnetism requires a common magnet. Magnetite is the only common mineral actually attracted by a small magnet.

Double Refraction. If an object appears to be double when viewed through a transparent material, the material is said to have double refraction. Calcite is the best common example.

Taste and Odor. Some minerals have a distinctive taste or odor. The salty taste of halite is a definite and unmistakable property of that mineral. We do not recommend tasting minerals in this laboratory.

Lines on Feldspar. Plagioclase feldspar contains distinctive tiny, straight, parallel lines, called striations, that appear on some of the cleavage surfaces. Potassium feldspar may have crooked lines, which help distinguish it from plagioclase feldspar.