Minerals Lab

Minerals are the principal building blocks of the earth. All rocks are made up of minerals and minerals are a critical source of raw materials for our industrial society. Though there are thousands of minerals, only a few dozen are important rock forming minerals. The purpose of this lab is to teach you how to recognize some of these important rock−forming minerals.

Materials and Preparation

Bring pencils and your text to lab with you. Before coming to lab look through Chapter 2 of Press and Siever. You should also have carefully read through this lab description.

Method

This lab has two parts:

1. **Physical properties of minerals:**
   What are the characteristics that can be used to identify minerals? Descriptions of important properties are given in this handout. Class discussion and examples will teach you how to recognize and describe mineral properties.

2. **Identifying unknown minerals:**
   You will be given a mineral key for the identification of 19 common minerals and we will discuss how to use it to identify unknown minerals. When you are confident in using this key you will have to use it to identify some unknowns on your own.

When you have demonstrated your ability to use the mineral key to identify unknown minerals, you are finished with this lab. Your grade for this lab will be determined next week when you will have to take a mineral identification quiz. Your grade on this quiz will count as your grade on this lab.

Part 1. Physical Properties of Minerals

Because minerals have definite chemical compositions and internal ordering, their physical properties are usually consistent from sample to sample and can be used as identifying characteristics. This section is designed to introduce you to the important physical properties that can be used to identify minerals. The important types of physical properties and the terminology for describing them appear below. Examples of the relevant properties and terms will be provided in reference collections which you can study during lab. Go through the various descriptions and examples carefully, taking notes as needed.

a. Sample type

Before you can determine a mineral sample's physical properties you must know what kind of sample it is. A particular mineral may be a single crystal, a crystal fragment, or an aggregate of several crystals. Note that in this context "crystal" means simply a solid with a regularly repeated, internal order. Deciding whether you are looking at a crystal (or crystal fragment) or an aggregate of crystals is critical because crystal aggregates often have physical properties that depend more on how the aggregate is put together than on the minerals it is made up of. Mineral properties always pertain to crystals or crystal fragments, **not** aggregates. When determining mineral properties also be careful not to use weathered surfaces as these may have been chemically and physically altered.

Describe sample types as:

Crystal

Crystal Fragment

Crystal Aggregate

b. Color

Color is a reliable criteria for the recognition of many minerals that have metallic luster, but it is much less reliable for the identification of minerals with nonmetallic luster.

c. Luster

Luster is the intensity and quality of light reflected from a mineral surface. The categories we will use are:

Metallic

Vitreous

Nonvitreous

d. Cleavage and Fracture

Cleavage and fracture are ways in which a single mineral grain, a crystal or crystal fragment, may break. If a mineral's internal structure has distinct planes of weakness, the mineral may break along smooth planes. This is cleavage. The smooth planes are called cleavage planes, and the orientation of the planes is called a cleavage direction. Because the cleavage direction is controlled by the internal structure of the mineral, cleavage is a diagnostic feature of those minerals in which it occurs. A mineral may have one, two, or several cleavage directions. Each direction may manifest itself in several parallel planes within a single crystal fragment.

Cleavage is described by noting the number of nonparallel cleavage directions and the approximate angles between these directions.

Breakage that does not occur along a cleavage plane can produce distinctive types of fracture surfaces. Fracture is described as being:

Conchoidal

Irregular

e. Hardness

Hardness is a measure of the resistance to scratching. Hardness is measured relative to a standard group of ten minerals that have a range of hardnesses, the Mohs scale. These standard minerals are assigned hardness values of 1 (the softest, talc) to 10 (the hardest, diamond). If an unknown mineral scratches the mineral of hardness 3, but is scratched by the mineral of hardness 4, the unknown mineral has a hardness of 3.5. Hardness kits with the standard Mohs hardness minerals are provided at each lab table. When looking at minerals in the field, however, it is more convenient to compare unknown mineral hardnesses to handier objects. Use the Mohs hardness kit to determine the hardness of the following objects:

Fingernail: _____

Penny: _____

Nail or Knife: _____

In testing hardness be certain to test fresh crystal or crystal fragment surfaces and not aggregates!

f. Streak

Streak is the color of the mineral when powdered. Streak is tested by dragging the mineral across an unglazed ceramic tile, powdering the mineral in the process and leaving a "streak". Minerals with metallic luster generally have a consistent streak color. Minerals with nonmetallic luster generally have a white or weakly colored streak. Minerals with hardness greater than 7 cause the tile to powder and so cannot be tested.

g. Magnetic Response

The mineral Magnetite is the only strongly magnetic mineral. A few other minerals are weakly magnetic. Minerals with nonmetallic luster are all nonmagnetic.

h. Acid Reactivity

The minerals Calcite and Dolomite react with cold, dilute hydrochloric acid by fizzing. Calcite reacts very readily, but Dolomite must be powdered for the reaction to be visible.

i. Tenacity

Related to fracture and cleavage is a mineral's resistance to breakage, its tenacity. Tenacity can be:

Brittle

Elastic

Flexible

j. Other Properties

There are many other properties that can be very useful in the identification of minerals. Some of the most useful are subtle properties that distinguish two otherwise similar minerals. Some of these are described below.

Striations: Striations, fine "scratches", appear on the cleavage planes of most plagioclase feldspars, but are not present on orthoclase feldspar cleavage planes.

Intergrowths: Very fine wispy zones of one type of mineral in another. Plagioclase intergrowths, for example, often occur within orthoclase. A lack of striations and the presence of intergrowths is thus good evidence for identifying a feldspar as orthoclase.

Density: Though hard to measure without special equipment, some minerals, such as Galena, the lead sulfide, are noticeably dense when handled. This high density can be an important identifying property.

Which properties are most important? Different properties are important for different minerals so it is hard to generalize. However, you should always determine and consider sample type, color, luster, cleavage and hardness. For some minerals you will need to examine one or two other specific properties as well.

A last, but extremely important, identifying characteristic of minerals is the type of rocks in which an unknown mineral is found. Certain minerals are typical of certain rocks, others are never found in some kinds of rocks. In the next few weeks many of these common mineral associations will become familiar to you and make mineral recognition easier.

Part 2: Mineral Identification

Each lab table has a tray containing nineteen common minerals that you must learn how to identify. These minerals and their chemical families are:

Oxides

Magnetite	Fe_3O_4
Ilmenite	$FeTiO_3$
Hematite	Fe_2O_3

Sulfides

Pyrite	FeS_2
Galena	PbS

Sulfates

Gypsum	$CaSO_4(H_2O)_2$

Carbonates

Calcite	$CaCO_3$
Dolomite	$CaMg(CO_3)_2$

Silicates

Olivine	$(Mg,Fe)SiO_4$
Garnet	Complex Ca,Fe,Mg,Al silicate
Hornblende	Complex Na,Ca,Fe,Mg,Al silicate
Pyroxene	$Ca(Mg,Fe)Si_2O_6$
Talc	$Mg_3Si_4O_{10}(OH)_2$
Biotite	$K(Mg,Fe)_3AlSi_3O_{10}(OH)_2$
Muscovite	$KAl_3Si_3O_{10}(OH)_2$
Chlorite	$(Mg,Fe)_5Al_2Si_3O_{10}(OH)_8$
Quartz	SiO_2
Plagioclase	$(Na,Ca)Al_{1-2}Si_{2-3}O_8$
Orthoclase	$KAlSi_3O_8$

We will go through each of these minerals in some detail and discuss their physical properties. As we do so you will see that there are broad similarities between minerals in similar anionic groups, and that it is not necessary to describe all of a particular mineral's physical properties in order to identify it. This approach is used in the unknown mineral key that will be given to you during lab. Try using the key to "identify" some of the known minerals in the tray to make sure that you understand how it works.

The problem with the mineral key is that it can only be used to identify the nineteen minerals for which it was constructed. Thus mineral identifications made using this key should be considered as **hypotheses that require confirmation**. Confirmation means checking the hypothesized mineral identification against all of the known properties for that mineral as listed in Appendix 3 in the back of your text. If there are major discrepancies between the description of an hypothesized mineral and its actual properties, then the mineral may be one of the more than three thousand less common

minerals that are not covered by the key. The key cannot be used blindly! All identifications should be checked against the more complete description of mineral properties in your textbook.

When you are confident in your ability to use the key, you will take a quiz to demonstrate that you can identify the minerals in the key. This quiz will not be graded, but you must pass it before you can leave lab.

For Next Week: A Quiz!

Part of your grade for this lab will depend upon a mineral identification quiz. This quiz will ask you to apply some of the terminology that we discussed today and to identify several unknown minerals. You will take the quiz outside of lab; sign−up sheets will be posted in lab. To help you study for the quiz, the mineral samples used in lab will be left out where you may examine them.

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