Earth Science Lab
Physical Geology Lab
Minerals

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Minerals offer us a view into the atomic world. Their structure, the way that they can resist scratching, and the way that they break apart all reflect the way that the atoms themselves are put together. Further, some minerals have an intrinsic beauty that makes them pleasing to look at, and in some cases quite valuable. Lastly, in order to identify the 31 samples you get to work with, you will have to develop some keen observations skills that will help you in any similar endeavor in the future.

The definition of a mineral is very specific. A mineral must be a **naturally occurring** (not man made), **crystalline** (made of an orderly array of atoms), **inorganic** (not made from by living process), **solid** (not liquid, not gas), with a consistent **chemical formula**.

The crystalline part of the definition lends itself to several properties you will use in your identifications. **Crystal form** is the shape of the crystals and reflects the way that the mineral has grown, atom by atom. Where they have had a chance to grow, many mineral crystals have a distinctive shape such as hexagonal, cubic, octahedral, or tabular.

Cleavage also reflects the mineral structure, but instead how the mineral grows, cleavage is a weakness in the structure that allows the mineral to break evenly along a planar (flat) surface. Where the atoms are aligned to allow a break, the mineral will repeatedly fail and this can be an important diagnostic feature. We measure cleavage in a couple of ways. First how many surfaces are there and what is there relation to each other. For example halite (rock salt) has three surfaces of weakness and they are arranged at 90° to each other, forming a perfect cube. Each time some halite breaks it will be along one of these surfaces, all the way down to the atomic level. Calcite also has three planes, but these are at 60° or 120° to each other, and the mineral will form rhombohedrons. Fluorite has octahedral cleavage where four planes form a double ended pyramid. The micas have a single plane. We also describe cleavage in terms of how well it is developed. In some minerals (halite, biotite) the cleavage is described as perfect meaning that it will be present in virtually all samples.

Another property that reflects the atomic structure is **fracture**, or the way a mineral breaks other than on a cleavage plane. Some minerals have no cleavage but have distinctive fractures and some have both. Common fractures are **uneven** (just a rough surface, like the feldspars), and **conchoidal** (chips off like the inside of a giant snail shell, or glass hit with a BB, quartz is a good example).

Other Mineral Properties

Probably the first thing we notice about a sample is its **color**. Unfortunately, because many minerals can have several colors, it is not a very reliable property. For example, samples of the common mineral calcite can have just about any color or none at all (some examples are so clear they were used in the manufacture of bombsights for WW II aircraft). By the time you know you can trust color, you have probably already identified the mineral. Another way to look at color that has less variability is the color of a ground up sample, or the **streak**. We use unglazed tile plates to check for streak, and it will not always be the same as the color. If you rub a harder mineral on the streak plate, you will see the color of the ground tile rather than the mineral.

We also look at the way the mineral reflects light, or its **luster**. Some look like they are made of metal and this is a metallic luster. Some reflect no light at all and are dull or earthly. Some look like they have a sheen at depth and we describe this as pearly. Others look like they are made of wax (waxy luster), or resin (resinous, like sap or amber). A common luster is vitreous which looks like the material is made of glass.

Density is the measure of how tightly packed stuff is. It is the mass/volume of a substance, and you already have an innate sense for it. When you pick up some of the minerals you will note that they feel very heavy, while some will feel very light. Generally the minerals that have metal in them will feel heavy.

Effervescence in cold HCl (hydrochloric acid). The minerals in the carbonate family will break down when exposed to HCl and they actually bubble as CO_2 (carbon dioxide) gas is released. This test will help you to identify the family. Although the acid used in this lab if very dilute, it is still acid, and your instructor will provide directions on how to handle it safely.

Feel. Some minerals have a distinctive feel, for example one feels like touching bar soap, and another fees greasy.

Magnetism, **odor**, and **taste**. Some minerals are weakly magnetic and a magnet will stick to them. One mineral has a distinctive smell, and another a distinctive taste. These properties can help you pin the identification down.

Hardness is the property of scratch resistance. Soft minerals can easily be scratched with your thumbnail, while those in the very common quartz family will cut glass. Of course, diamonds are significantly harder than anything else. In geology we use the Mohs Hardness scale that was developed by Friedrich Mohs who took ten minerals with consistent hardness and ranked them 1 to 10, from talc to diamond. We have hardness kits in the lab with samples of these minerals to check against. This is a good place to start as you will note that the minerals are arranged by hardness, and if you can identify the hardness you will only have a few choices left.

Mohs Hardness Scale

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

Other classifications. We might lump minerals into those that are mined to produce something. These are the ore minerals (iron or copper ores for example). Some are sought after as gems (diamonds, sapphires, and gold). And some simply hold the Earth together – the rock forming minerals.

We can also class them by their chemical makeup as follows: Native Elements (NE), Oxides (O), Halides (H), Sulfides (S), Borates (B), Sulphates (SO4), Phosphates (PO4), the common Carbonates (CO3), and the most common by far, the Silicates (Si).