This is a chapter from my book about identifying minerals and then rocks. Most field guides are fairly useless, with a lot of information you will never need, and a lot of pictures that are only useful if you are allowed to collect in a museum. This chapter is the basic guide to mineral properties.
-Chris Tacker, Ph.D. P.G.

Identifying Minerals

There's a traditional dialog in Mineralogy Lab, which is usually the first class a Geology major takes in college. It goes something like this:

> Undergraduate mineralogy student: What's this mineral?
> New Graduate Laboratory Assistant: Nepheline.
> Undergraduate: How do you know it's nepheline?
> New Lab Assistant: Looks like nepheline to me.

This leaves the undergraduate frustrated and the graduate student confused. (Answer at the end of the chapter.)

Identifying minerals is a highly visual skill. The grad student told the truth, but what the undergrad wanted to know was, *What is it the grad student sees that tells him the mineral is nepheline?* The grad student is summing up his observations as *Looks like nepheline*.

Mineral properties

All the mineral field guides list similar sets of properties for each mineral or mineral group. Unfortunately, not all of this information is useful. Presented in the form of a list, it's pretty hard to narrow things down to what is distinctive for each mineral. So we'll start with the most useful ones and end up with the least.

You can take my word for it that minerals are made up of chemical elements (like silicon, aluminum, calcium, iron, lots of oxygen) that are bonded to each other. The elements are arranged in very specific ways that are distinctive for each different mineral group. The end result is that minerals have a very definite internal atomic structure.

Crystal Habit

If a mineral is growing in an environment with plenty of room, it will grow into a crystal. You can think of a crystal as a nice geometric form. If the space is too cramped, it will form a partial or incomplete crystal. ***Habit*** refers to the external shape that results from the orderly internal structure of a crystal. Mineralogists of old spent a lot of time collecting crystals and measuring the angles between crystal faces, and developing a language to describe the common shapes. We'll stick to the shape names we learned in elementary school, with a few exceptions.

A good example of crystal habit is quartz crystals- an elongated crystal with six sides (a hexagon) that often comes to a point at one end. This is true no matter how large or small the crystal is. Quartz is simply silicon dioxide (SiO_2), so the internal structure of the crystal is the same no matter what the exterior looks like.

This is the first clue to identifying a mineral. [photo- crystal habit of quartz, pyrite and tourmaline]

Cleavage

One of the fathers of mineralogy was Frenchman René Just Haüy (pronounced Ow-ee, like a boo-boo on your shin). He discovered that there was a particular rhombohedron [photo] existing inside calcite crystals. No matter what the external form of the calcite crystal (and there are many), when you whacked it with a hammer,

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you eventually ended up with the same shape. This really bent Haüy's mind. I imagine him in his lab collecting a lot of different crystals and happily whacking them to pieces.

Haüy was observing cleavage, the distinctive way that some minerals break. Cleavage is the result of the orderly atomic structure of minerals: some atomic bonds are stronger than others, so when you whack it with a hammer, it tends to break along the weaker bonds. Cleavage is the geometric form taken when the mineral breaks. That's a powerful clue, because geometric forms in nature tend to be uncommon.

Here's where your high school geometry classes are finally useful. Cleavage in one direction is a flat plane. Cleavage in two directions is an angle. Cleavage in three directions is a couple of angles.

In some minerals, and in glasses, atomic bonds are too strong to break, or too equal to have a preferred way to break. In these, a conchoidal fracture is the result [photo conchoidal fracture]. Conchoidal fracture is the circular chip with a sharp edge you get when you break a bottle or make an arrowhead. Primitive man was a master at making conchoidal fractures on arrowheads and stone implements [photo of arrowhead] . We owe our survival as a species to the way quartz and volcanic glass breaks.

The kings and queens of cleavage are the diamond cutters. Inside any raw gemstone is a beautiful faceted gem waiting to emerge. The right tap on the stone will break it correctly and free that gem. The wrong tap will leave you with a pile of worthless chips. Diamond cutters tend to be stressed.

Hardness

Hardness is another function of the strength of the atomic bonds in a mineral. Some minerals scratch easily and some don't. Gemstones generally don't scratch easily, and the ultimate gemstone is diamond, the hardest mineral.

This test is easy. Scratch one mineral with the other. Which is the hardest? Be careful! Minerals of the same hardness will scratch each other. Also, a soft mineral may rub off on a harder one, giving the appearance of a scratch. Use your hand lens to check closely.

Moh's scale of hardness is a way of testing common minerals against each other. This provides the most useful method of telling one mineral from another in the field. It's easy to carry a knife and a piece of quartz.

The scale is:

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

The traditional mnemonic device for remembering this is Tall Girls Can Flutter And Other Queenly Types Can Dance. A knife blade is about 5.5. A pre-1987 penny will be copper, a hardness of about 3.5. If you need reference, you can pick up a cheap quartz crystal, apatite crystal or calcite rhomb at a gem and mineral show.

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Luster

Luster is the way that light interacts with the mineral. We'll break things down at first into metallic and non-metallic. This is pretty self-explanatory. Chalcopyrite (CAL-coe pie rite) looks brassy, galena looks like lead metal, and so on.

In the non-metallic category, we have pearly, adamantine, resinous, vitreous, greasy, etc. These are best dealt with as you have an example in front of you. Luster is a clue, not a clincher.

Specific gravity

Specific gravity is related to density. Some newbies read the field guides and try to measure this, but it really can't be measured at home with enough precision to matter. Its greatest utility is as a subjective term. Lead ore (galena) and iron ore (hematite or magnetite) feel "heavy" for their size. Bauxite or aluminum ore feels "light".

Color

Color is deceiving, a mineralogy professor's favorite trick on a test. Mineral color is a good clue, but it should be treated as one clue among others. Micas come in white, silvery, black, green and golden hues, but will always cleave as flakes or sheets. Fluorite is usually purple, but also comes in yellow and green. Fluorite is always a hardness of 4, so you can scratch it with a knife, whereas you can't scratch amethyst, which is a variety of quartz.

Streak

Taking a streak is pretty easy. You rub the mineral on a piece of unfinished porcelain, and look at the color. Unfortunately, most minerals you will find are too small for this. Usually the streak is either black or white. The only time streak is useful is in identifying hematite, iron oxide, Fe_2O_3. Hematite can be red (it is rust, after all) or metallic silver. In either case, the streak is red.

Putting this into practice

When you are faced with a new mineral to identify, the first thing to do is look at it with your handlens. Look at several different examples of the same mineral. What colors are there? What shapes do you see? If you can, next break the rock so that you have a fresh surface to examine. Scratch the mineral with your knife blade, fingernail, or a piece of quartz. Keep a mental note of your observations.

Now you're ready to start figuring out what it is. My advice is, look carefully, and trust your eyes. You may not have the vocabulary for what you see, but you can tell differences among minerals.

The answer to the story at the beginning of this chapter is fairly simple. Nepheline is not very common, but when you find it, it is usually gray with a greasy kind of luster. It cleaves in only one direction, so you will find a nice flat plane where it breaks. It's harder than a knife blade (About 5.5 on the Moh's scale), but softer than quartz (hardness of 7). It's very important in the study of igneous rocks, which is why it ends up on the Mineralogy exam.

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