

Cleavage & Fracture

Overview: Geologists use a number of tests to identify minerals. One of their best friends in these tests is a trusty hammer, used to smash a sample to bits. The way a mineral breaks reveals important details about it that we might not be able to notice otherwise.

What to Learn: Today, you'll learn what to look for in a broken mineral. There are different names for the types of breaks that a mineral can experience. You'll need to ask a few important questions during your investigation, like, "What is the difference between mineral cleavage and fracture?"

Materials

- Mineral samples
- Hand lens
- Good lighting

Experiment

1. You will begin by labeling each of the mineral samples, starting with 1. Make sure to keep track of these samples throughout the entire lab.
2. Take the mineral samples and note which number it is on your observation data sheet.
3. Using your hand lens, look carefully for little sparkles of surfaces that reflect light. These are the cleavage surfaces.
4. In the space marked cleavage on your worksheet, label the cleavage as *perfect*, *good*, or *poor*. If there are no flat surfaces that are broken, write "none." Some of your samples may have more than one cleavage. Make a note if this is the case.
5. Now look for broken surfaces that are not flat. Place a check below the best category of fracture that the mineral shows. If there are no surfaces like this, mark "none." If you are uncertain about either category, leave the section blank. It is better to record no information than to mark something that can mess up your data.

Cleavage & Fracture Data Table

Sample	Color	Cleavage <i>(Perfect, Good, Poor, None) and Number of Planes (0, 1, 2, 3)</i>	Fracture <i>(Conchoidal, Earthy, Hackly, Splintery, Uneven, etc...)</i>

Reading

Cleavage and fractures are two properties that geologists test at the same time, both by observations. Using a hammer, geologists will break a mineral by studying how the mineral broke. They describe the way the surfaces look. Sometimes minerals break apart like they were stacked together in thin sheets. Other times they break off in large chunks, and the sides of each chunk are always at right angles. The way that they break into planes is called “cleavage.” Minerals can have cleavage in one direction, like mica, or two or three directions (like halite). The type of cleavage is also described using geometric terms. Halite has cubic cleavage because when it breaks, it looks like it’s made up of tiny cubes, while calcite has rhombic cleavage because it never breaks into right angles, but always in a rhombus, or diamond shape.

Fracture describes the surfaces that are broken but don’t break along plane lines. A mineral can have both cleavage and fracture, and some have either one or the other. Quartz has no cleavage, only fracture. Calcite has no fracture, only cleavage. Feldspar has both.

Geologist look for smooth surfaces, which can be (when viewed up close) cubes, triangles, or simple, flat plane surfaces. Always look for cleavage first, then fracture when making your data observations.

An easy way to look for cleavage is to hold the sample in sunlight and look for surfaces that reflect light and describe the surface in one of three ways for cleavage:

- Perfect – the mineral breaks to reflect a clear, glass, or mirror-smooth surface.
- Good – the mineral breaks to reveal a surface that reflects light, but may be dull in places.
- Poor – the mineral breaks along clear planes and flat spaces are visible, but these are dull and could be ragged, and not very reflective.

Remember, a mineral can have more than one cleavage plane. For example, feldspar has two cleavages, one which is perfect and one which ranges from poor to good, depending on the sample. At first glance, you might not be able to tell feldspar from quartz, but if you look for cleavage, you'll find feldspar has two planes of cleavage whereas quartz has none. Quartz will look like lots of broken surfaces that are not flat planes.

The way a mineral breaks depends on what the crystalline structure looks like. Here are some forms of cleavage:

- Basal cleavage is cleavage on the horizontal plane, like mica. Basal cleavage samples can sometimes have their layers peeled away.
- Cubic cleavage is found in mineral that have crystals that look like cubes., like with galena or halite.
- Octahedral cleavage is found on crystals that have eight-sided crystals, like two pyramids with their bases stuck together. Look for flat, triangular wedges that peel off an octahedron, like in the mineral fluorite.
- Prismatic cleavage is found in minerals that have four or more sides and are long in one direction, like aegirine, where the crystal cleaves on the vertical plane.
- Rhombohedral cleavage is really my favorite, because it shows up in calcite so well due to its internal crystal structure, which is made up of hexagonal crystals. No matter where you look, there are no right angles to this cleavage – everything is at an angle.

Fracture can be described like this:

- Conchoidal (like a shell, for example: obsidian)
- Earthy (looks like freshly broken soil, like limonite)
- Hackly or jagged (when a mineral is torn, like with naturally occurring silver or copper)
- Splintery (looks like sharp, long fibrous points, like chrysolite)
- Uneven (rough surface with random irregularities, like pyrite and magnetite)
- Even or smooth (the fracture forms a smooth surface)

Exercises

1. Which properties do geologists look for when they try to categorize a mineral? Circle all that apply.
 - a. Color
 - b. Shine
 - c. Smell
 - d. How it breaks
2. If you break a sample of quartz and find that it has no clean surfaces of separation, what kind of cleavage does it show?
3. True or false: A mineral can show more than one type of cleavage or fracture.
4. What is a fracture called that is similar to glass?

Answers to Exercises: Cleavage & Fracture

1. Which properties do geologists look for when they try to categorize a mineral? Circle all that apply. (color, shine, how they break)
2. If you break a sample of quartz and find that it has no clean surfaces of separation, what kind of cleavage does it show? (None)
3. True or false: A mineral can show more than one type of cleavage or fracture. (True)
4. What is a fracture called that is similar to glass? (Perfect)