MINERAL INFORMATION INSTITUTE

ROCKS ARE MADE OF MINERALS

Rocks, to begin with, are made of minerals. What is a mineral? The definition may sound difficult— a *mineral* is a chemical element or compound (combination of elements) occurring naturally as the result of inorganic processes.

The world contains more than 1,100 kinds of minerals. These can be grouped in three general classes.

1. **Metallic minerals.** These include minerals most of us would think of if we were asked to name some. Examples are copper, silver, mercury, iron, nickel, and cobalt. Most of them are found in combination with other minerals—such as ores. We get lead from galena, or lead sulfide. Tin comes from the ore cassiterite; zinc from sphalerite and zincblende, or blackjack. Chromium that makes the family car flashy comes from chromite. Many minerals yield aluminum. Uranium occurs in about 50 minerals, nearly all rare. Twenty-four carat gold is a metallic mineral. A 14 carat gold ring is 14/24 (or 58%) gold.

One thing to remember is that some minerals like to be together—lead and zinc, tungsten and tin, molybdenum and copper, and so on. There are also ores called "massive sulfides" that contain copper, lead, zinc, gold, and silver (often there are other minerals also identified). Such a find usually shows that the ore can be mined economically and can yield a profit. Of course, all depends on *where* it is found and its relationship to transportation.

An average sample of earth contains 9% aluminum, 5.5% iron, .01% zinc, .008% copper, .004% tin, .002% lead, .0005% uranium, and .0000006% gold or platinum. It would be hopelessly expensive to recover such metals from an average ton of earth. That is why metallic minerals are taken from concentrated deposits in mines.

Many valuable minerals are found in veins running through rock. Veins can be formed when: (a) mineral-laden ground water seeps into cracks, evaporates, and leaves mineral grains that build up into a vein; (b) hot water from deep within the earth fills cracks, then cools and deposits much of the material in solution as mineral in a vein—sometimes including metals such as gold and silver; (c) molten gaseous material squeezes into cracks near the earth's surface, then slowly hardens into a vein.

2. **Nonmetallic minerals**. These are of great importance to certain industries. You will find them in insulation and filters. They are used extensively in the ceramic and chemical industries. They include sulfur, graphite (the "lead" in pencils), gypsum, halite (rock salt), borax, talc, asbestos, and quartz. You probably have some nonmetallic minerals in your collection. Rocks containing asbestos are especially handsome and varied.

3. **Rock-forming minerals**. These are the building materials of the earth. They make mountains and valleys. They furnish the ingredients of soil and the salt of the sea. They are largely silicates—that is, they contain silicon and oxygen. (Silicon is a nonmetallic element, always found in combination with something else. It is second only to oxygen as the chief elementary constituent of the earth's crust.)

Other rock-forming minerals are the large family of micas, with names like muscovite, biotite, and phlogopite. There are the feldspars, including albite and orthoclase. Others are amphiboles, pyroxenes, zeolites, garnets, and many others you may never find or hear about unless you become a true mineralogist.

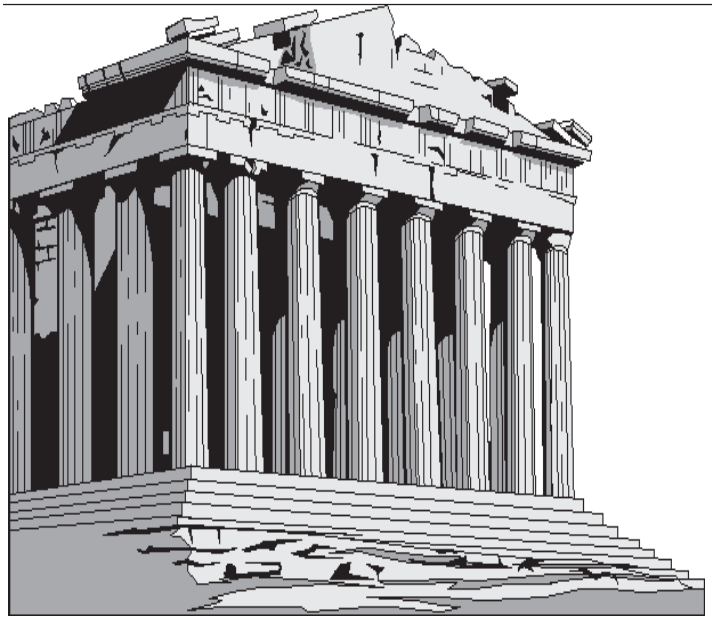
A rock may be made almost entirely of one mineral or of more than one mineral. Rocks containing different combinations of the same minerals are different. Even two things made of the same single mineral can be quite different. Carbon may be found as a lump of coal or as a diamond. Quite a difference, wouldn't you say!

HOW MINERALS GOT THEIR NAMES

Names of most minerals end in "ite" — apatite, calcite, dolomite, fluorite, molybdenite. But many do not: amphibole, copper (the most common pure metal in rocks), feldspar, galena, gypsum, hornblende, mica, and quartz.

Many minerals take their names from a Greek word referring to some outstanding property of the mineral. For example, *hematite*, an oxide of iron, was named about 325 BC from the Greek *haima*, or blood, because of the color of its powder. Sphalerite got its name from the Greek word meaning to *deceive* — being mistaken for other ores.

Some minerals are named for the locality in which they were first discovered. Coloradoite was found in Colorado. Bentonite, a clay, was found at Fort Benton in Montana. And so with labradorite and brazilite.



The Parthenon, the Doric temple of Athena, was built in the 5th century, B.C. on the Acropolis in Athens. It was built with marble, the metamorphic form of limestone.

Other minerals got their names from famous people. Willemite was named in honor of Willem I, King of the Netherlands. The great German poet-philosopher, Goethe, could turn up in your collection as goethite. And there's smithsonite, named for James Smithson, founder of the Smithsonian Institution.

OUT OF THIS WORLD

Some minerals come from outer space. They are meteorites, which are rock fragments. Every day, hundreds of millions of them enter the earth's atmosphere. Most of them, however, are burned up by the heat from air friction and never reach the ground. Meteors large enough to reach the earth are called meteorites. Most minerals found in meteorites are the same as those we have on earth. But, there are some rare minerals known only in meteorite—two of them are cohenite and schreibersite.

MAIN KINDS OF ROCKS

Rocks are the building blocks of the earth's crust. They may be massive, as in granite ledges, or tiny. Soil, gravel, sand, and clay are rocks. There are three main types of rocks.

1. **Igneous** rocks are those formed at very high temperatures or from molten materials. They come from magmas—molten mixtures of minerals, often containing gases. They come from deep below the surface of the earth. If they cool off while below the surface, they form intrusive rocks, which may later be revealed by erosion. When magmas reach the surface red hot, they form extrusive rocks, such as volcanic rocks. Thus, granite is an igneous, intrusive rock; lava is an igneous, extrusive rock.

2. **Sedimentary** rocks are formed by the action of wind, water, snow, or organisms. They cover about three quarters of the Earth's surface. Most are laid down—as sediments—on the bottom of rivers, lakes, and seas. Many have been moved by water, wind, waves, currents, ice, or gravity. The most common sedimentary rocks are sandstones, limestones, conglomerates and shales. Oil and natural gas are found in sedimentary formations.

3, **Metamorphic** rocks are those that have been changed from what they were at first into something else—by heat, pressure or chemical action. All kids of rocks can be changed. The result is a new crystalline structure, the formation of new minerals, or a change in the rock's texture. Slate was once shale. Marble came from limestone. Granite is changed into gneiss.

COLLECTING

If you want to collect rocks and minerals just for the sake of having them, you can buy specimens. Many can be purchased for 25¢ to $5.00 each, while rare specimens can cost hundreds of dollars or more.

The real fun is in finding your own samples. Later, when you have a good-sized collection, you can fill gaps by buying specimens or swapping with other collectors. You'll be amazed at the number of amateur collectors. Check your library for a listing of rock and mineral/gem clubs in your area. You will learn a great deal from their membership. Most have annual shows where they gather to sell and swap minerals and gems.

Where to Look

Look for rocks and pebbles by the roadside, in stream beds and river banks. Go to the country for ledges on hillsides. Every road cut, cliff, bank, excavation, or quarry shows rocks and minerals. Railroad cuts, rock pits, dump piles around mines, building sites—all yield specimens. Some of the best mineral specimens collected in New York City came from skyscraper and subway excavations. Help a New England farmer clear his field and you'll have more rocks than you know what to do with.

As for reference books, many states publish guides to mineral deposits. Check your State Geologist for books and maps available.

Mineralogical magazines list mineral localities. At your library, ask to see the *Subject Guide to Books in Print*—there are wonderful books that will answer all your questions. If your library doesn't have the books you'd like to see, ask the librarian to borrow the books through "Inter-library Loan."

Tips for the Field

Don't try to collect too much at once. Work early in the day or late in the afternoon. A hot sun on bare rock can make you sizzle—especially if you are loaded with equipment and samples. Here's the equipment to take: A backpack to carry your samples and equipment; zip-lock bags for your samples; notebook and pencil; geologist's pick; cold chisel, magnifying glass, compass, heavy gloves, and a knife. Don't forget to take water—for YOU! Later on, you may want a Geiger counter for spotting radioactive rocks.

Be selective. Hand-sized specimens are best. When you place your sample in the zip-lock bag, include a note telling when and where you found it. Don't forget the "year" ...it is awful to look back and see "Found May 19th on Spook Spider Hill"—when after a few years go by, the year it happened is long forgotten. This practice is important for many reasons, but the most important is that you may find a specimen that no one has ever seen and the date are year may help an "ite" to be named after you! Later, this information will be transcribed to a filing card or recorded in your computer when you add the specimen to your display.

When you get home, clean each specimen with soapy warm water, applied with a soft brush. Soluble minerals like halite can't be washed, but should be rinsed with alcohol.

Arranging Your Collection

Just like all geologists do, put a spot of enamel on the specimen. When it is dry, write on the spot—in India ink—a catalog number and have this number refer to the card in your file drawer or computer. The card should list date, place found, identification of specimen, etc. Also, if you know what the rock or mineral is used for (used by man) make that note also. Example: Hematite is the ore of iron, used in making steel, which is used in buildings, shipbuilding, car manufacture, aerospace and airplanes, farm equipment, dishwashers, and endless other material goods.

Group your samples: metallic minerals, semiprecious stones, nonmetallic minerals. Display them on a shelf, or buy or build a mineral cabinet with partitioned sections. Egg cartons work well.

WHAT DO I HAVE

How do you identify specimens?

Get books and magazines on rocks and minerals. Many have colored pictures that help.

Identification is best made by noting the physical characteristics of the rock or mineral. For minerals, there is a hardness scale in which a mineral of the higher number can scratch a mineral of the lower number but not be scratched by it. The scale, known as Moh's Hardness Scale, is: 1) talc; 2) gypsum; 3) calcite; 4) fluorite; 5) apatite; 6) orthoclase; 7) quartz; 8) topaz; 9) corundum; 10) diamond.

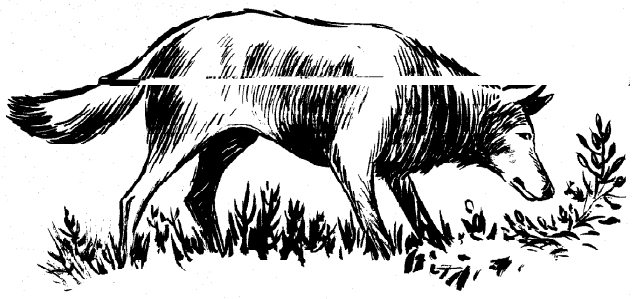
Remember that a fingernail has a hardness of 2.5; a penny, 3; a knife blade, 5.5; and a steel file, 6.5. Use these to scratch your sample and you can get an approximate idea of its hardness.

Other tests for identifying minerals include specific gravity (weight of mineral compared to the weight of an equal volume of water), optical properties and crystal form, color and luster. Minerals differ in cleavage and fracture (how they come apart when cut). They leave distinctive streaks on unglazed porcelain. Some are magnetic, some have electrical properties, some glow under ultraviolet or black light, some are radioactive, some fuse under a low flame while others are unaffected. Many studies with the dissolved mineral can identify it beyond doubt.

But most of these are too complicated for the beginner. As you read, look at pictures and samples and talk with other rock hounds or leaders of mineralogy clubs, you will get better at identifying rocks. Museum experts and your state's geologist can help, too.

Rock collecting is a hobby you can tailor to your taste. But, whether you concentrate on an area close to home or travel across whole continents, you will find that the pleasure and knowledge you gain from your collection are matched by the fun and adventure of the search.

Adapted from "Let's Collect Rocks & Shells," *Shell Oil Company.*



Dogs are used by Canadian geologists to sniff out sulfide rocks.

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