

## Economic Minerals and Rocks

This set consists of samples of minerals (and a few rocks) that are important economically in our society. There are samples of common metal ores and also non-metallic ore minerals that are important in many ways. An ore is anything that can be mined from the Earth at a profit. Generally this means the quantity or quality of the ore or both are sufficiently high to make it worth the effort to extract it, either by shaft or open pit mining. Ores are created when physical processes within the earth or on the earth's surface concentrate low-abundance elements. Most of these important economic elements are less than 1% of all the rock in the earth and are not economic unless they are concentrated.

Most ore minerals belong to three non-silicate Mineral Groups:

Native elements (gold, silver, copper, sulfur for example)

Sulfides (galena, pyrite, chalcopyrite, and stibnite for example)

Oxides (hematite, magnetite, rutile, cuprite, and corundum for example)

**1. Galena – Lead Sulfide:** This is the most important ore mineral of Lead (Pb). Notice the lead-gray color, the high specific gravity (the “hefty” feel in your hand), and the metallic luster on broken surfaces. It has a gray streak. Lead was used in making paint, leaded gasoline, and is still used in car and other types of batteries and lead crystal glass. Lead aprons keep us safe from stray x-rays at the dentist's office or in the hospital. Lead pollution is documented as the cause of learning disabilities in children. Your sample is from the Tri-State area of OK-MO-KS, site of the largest lead zinc mining operation in the US for 100 years.

**2. Copper – Element:** This is a sample of “native copper” which is commonly deposited near the contact of basalt flows and underlying rocks containing distributed copper. The sample is from the Keweenaw Peninsula of northern Michigan, the greatest deposit of native copper in the world. Copper is used in many industries. The electrical power industry relies on copper wires to conduct electricity. Copper was formerly used for the US penny coin. It is often alloyed with other metals to produce harder composites such as brass and bronze. It is widely used in analytical chemistry. Copper today is mined from many open pit mines where disseminated copper is present in low concentrations.

**3. Sphalerite – Zinc Sulfide:** This is the most important ore mineral of zinc. It has a resinous luster and a black or yellow streak. It does not look metallic. It has many perfect cleavages (7), so it tends to have a reflective sparkle. Zinc is used in the galvanizing process, which protects steel and iron from rust and corrosion. It is now commonly used for coins as in the US penny. As an oxide, zinc is used as a paint pigment. As a chloride, zinc is used in making wood preservatives. It is frequently used for medical purposes. Your sample is from the Tri-State area of OK-MO-KS, site of the largest lead zinc mining operation in the US for 100 years.

**4. Chalcopyrite – Copper Iron Sulfide:** This is the most important ore mineral of copper. It has a tarnished brassy-yellow color and a greenish-black streak on the plate. Copper is used in many industries. The electrical power industry relies on copper wires to conduct electricity. Copper was formerly used for the US penny coin. It is often alloyed with other metals to produce harder composites such as brass and bronze. It is widely used in analytical chemistry. Your sample is from a copper mine in Montana.

**5. Halite – Sodium Chloride:** Salt is found in certain sedimentary environments, and can accumulate in large beds that can be mined commercially. It is also extracted from seawater in many places around the world. Salt is essential to human diets. It is used commercially as a preservative of meat and for tanning leather. It is also used in the production of ceramics and glass. The biggest industrial use of salt is in the chemical industry, to produce chlorine for chemical processes and also soda ash (sodium). In northern climates “rock salt” is used to melt ice and snow on highways. Your halite sample comes from Hockley, in Waller Co., where an underground operation mines a salt dome near the surface.

**6. Gypsum – hydrated calcium sulfate:** This common sedimentary mineral, which occurs in large beds deposited in restricted marine environments, has many uses in our society and large, easily mined deposits are exploited world-wide. Texas has many large gypsum mines in West Texas. It is used in the manufacture of plasterboard for house and building construction. It has a lot of use as a fertilizer and soil conditioner in the agricultural industry. Plaster of Paris, made from ground gypsum, is used for surgical splints to restrict the movement of broken limbs and also for casting moulds. Two specimens are included, white “satin spar” and crystalline “Selenite.” The first is from a gypsum mine in Highland, AR, and the second is from Matagorda Bay, where the crystals form in the mud.

**7. Sulfur – Element:** This element is found near volcanic vents, where it is deposited from gases arising from deep underground. It is also found in salt domes where the action of anaerobic bacteria has changed oil and released sulfur as a byproduct. Most sulfur is obtained now from the scrubbing of “sour” oil and gas and from oil refineries as a by-product. Sulfur is an essential component of the anti-microbial medicines developed in the early 20<sup>th</sup> century called sulfa drugs. It is primarily used in the production of sulfuric acid, a chemical of great importance to the fertilizer industry and the chemical industry. It is also used as a bleaching agent and in food preservation. Your sulfur sample is from Boling Dome in New Gulf, TX, site of the largest Frasch sulfur operation in the world for many years, but now closed.

**8. Hematite – Ferric Iron Oxide:** hematite is found in large sedimentary beds of Precambrian age, where it is mined by open pit methods. It also occurs in other environments, but not usually in quantities large enough for commercial mining. It can be reddish and earthy in appearance or have silver-like reflective crystals, but all give a reddish-brown streak on a ceramic plate. Hematite is one of the primary ores of iron, used in the manufacture of wrought iron and steel. Steel is used in our economy for many essential tasks, from structural supports in buildings to ships and automobiles, furniture, and household tools.

**9. Garnet Group – Aluminum Silicates with Calcium, Magnesium, Iron, or Manganese to determine the principal species:** Found in metamorphic deposits of various kinds, but usually not concentrated enough to be economic. Alluvial garnet sands are mined in some parts of the world. An Almandite (iron-aluminum garnet) deposit in upstate New York is the principal supplier of crushed garnet for the abrasive industry and for the optical and plate glass grinding industries in the US and around the world. The red garnet samples are from there.

**10. Magnetite – Ferrous Ferric Iron Oxide:** Magnetite occurs in all types of depositional environments in the earth, from igneous to metamorphic. It is one mineral in a series, but the most common of those minerals that make up the series. Its distinguishing characteristic is an attraction to a magnet. Magnetite is used as an ore of iron, with all the products of wrought iron and steel mentioned under hematite. It is also used as an abrasive, as a pigment in paints and as heavy media in specific gravity operations.

**11. Fluorite – Calcium Fluoride:** Fluorspar, the miner's name for fluorite, is found in deposits in sedimentary rocks around the world. The US and England had considerable reserves, but most world production comes now from enormous Chinese deposits. It has a very important commercial use as a flux in the making of steel and aluminum. This consumes the majority of world production. The remainder is used in the chemical industry to produce fluorine, which is then used to produce HF, hydrofluoric acid, and also to produce fluoridated water, which prevents cavity formation in teeth. Most of the samples come from southern Illinois, once the hub of the US fluorspar industry. Samples can also be from China (light transparent green) and northern Mexico (purple).

**12. Pyrite – Iron Sulfide:** this mineral is common in all environments—sedimentary, igneous, and metamorphic—and is a common constituent of ore deposits. When it is shiny and brass-yellow, it can be mistaken for gold, and it has the common name of fool's gold. It is rarely mined for its iron content because the sulfur in the mineral is a contaminant that makes the resulting iron weak and brittle. It is mainly used today for the production of sulfur dioxide, used in the paper industry as a whitener, and for the production of sulfuric acid, which has a great many uses in the chemical industry. Your pyrite samples came from sulfide mines in Chihuahua, Mexico and Pasto Bueno, Peru.

**13. Barite – Barium Sulfate:** It occurs in sedimentary rocks as veins or lenses, and when these are large enough, they are mined commercially. It is also a by-product of metal ore mining, since it is a common gangue mineral in sulfide veins (see galena, sphalerite, chalcopyrite). It is primarily used in industry as a weighting agent in drilling mud for oil and gas drilling. It is extremely useful there to control the great pressures found in underground reservoirs. Other uses are as a pigment in paints and as weighted filler for paper and cloth. Since it is impervious to X-rays, it is used in the medical field in enemas, etc to picture the digestive system. The barite samples are from several locations, including eastern Missouri, formerly the largest deposit in the world.

**14. Limestone – calcium carbonate with impurities:** This rock is one of the most important economic materials obtained by quarrying in the US. The limestone is ground to powder and used in the production of cement, which is essential in any building for the foundation or above, and for roadbeds and airport runways. Many quarries are opened solely for rock to use in cement manufacture. It is also used as road gravel, and for the production of lime to be used in mortar. It can also be quarried as a building stone and many important buildings have facings of limestone (Empire State Building). Your limestone sample came from one of the Cretaceous formations in Texas.

**15. Granite – quartz, potassium feldspar, and muscovite mica in varying percentages:**

Granite is a hard igneous rock that formed beneath the surface of the earth and is now exposed due to mountain building and continental drift. Where found in sufficient quantity and quality, it is quarried as a dimension stone with many uses—riprap to protect coastlines (Galveston jetties), monuments for cemeteries and public places, building facing, and most recently, countertops and tables in homes and restaurants. Crushed granite gravel is often used on trails in the Houston area. Most of the samples in the sets come from Marble Falls, TX, where there are a number of granite quarries.

**16. Basalt – plagioclase feldspars and hornblende series minerals, in varying percentages:**

Basalt is a hard, tough extrusive igneous rock formed when lava was extruded on the surface of the ground in an eruption. Basalt flows are common in some parts of the country, and where they can be accessed, are quarried for the superior gravel they make when crushed to various sizes. This gravel is used in asphalt road construction, concrete road construction, and in gravel roads. Occasionally large pieces are used as riprap along coastlines to protect from erosion. The basalt sample here came from a quarry west of Uvalde, TX where an extinct volcano is being quarried.

**17. Potassium Feldspar – Potassium Aluminum Silicate:** A primary constituent of light-colored igneous rocks, such as granite and rhyolite, it occasionally occurs in pegmatite masses large enough to be commercially exploitable. It is used in the manufacture of ceramics, primarily porcelain, which is used to cover bathroom vanities, sinks, and toilets. It is also used in the manufacture of Fiberglas. Most of the samples of microcline come from the hill country of Central Texas.