Rocks and Minerals Make up Your World

Rock and Mineral 10-Specimen Kit Companion Book

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INTRODUCTION

The effect rocks and minerals have on our daily lives is not always obvious, but this book will help explain how essential they really are. If you don't think you come in contact with minerals every day, think about these facts below and see if you change your mind.

- Every American (including you!) uses an average of 43,000 pounds of newly mined materials each year.
- Coal produces over half of U.S. electricity, and every year you use 3.7 tons of coal.
- When you talk on a land-line telephone you're holding as many as 42 different minerals, including aluminum, beryllium, coal, copper, gold, iron, limestone, silica, silver, talc, and wollastonite.
- When you reach for a cell phone to send a text, know that you have at least nine different minerals in your hand, including copper, silver, gold, palladium, and platinum.
- The digital alarm clock you rely to wake you up every morning relies on boron, copper, gold, and quartz to work.
- Computers are made from more than 30 different minerals, including silver, gold, aluminum, and copper in the monitors; quartz in the glass; and calcite and gypsum in the keyboards.
- Next time you get a in car, think of the many, many different minerals it took to make it, including iron, aluminum, carbon, copper, silicon, lead, zinc, manganese, chromium, nickel, magnesium, sulfur, platinum, gold, silver, and tin.
- When you look out a window, appreciate the view, along with the silica and trona that make up the glass.
- Make a mistake on your homework? Be thankful for the graphite, kaolin, and pumice that make the erasers that help you fix it.
- Do you brush your teeth twice a day? Did you know that your toothpaste is made of calcium carbonate, zeolites, trona, clays, and silica?

There are hundreds of minerals used regularly in the United States for defense, industrial, agricultural, residential, medical, and cosmetic purposes. The minerals provided in this kit are a small sample of the minerals that Americans likely encounter but take for granted each day.

It is convenient when we discuss minerals to place them in different categories. The mineral information in this book has been grouped in the following four categories:

- Fuels
- Base Metals
- Precious Metals
- Industrial Rocks and Minerals

There is a section in the kit for each of these categories. Within each category, you will find information on the specific minerals in your kit. Maps are included to show where these minerals are found in the U.S.

Please Note:
This companion book is designed to be a complement to the 10 rock and mineral samples found in your kit. However, some kits could be different if a particular rock or mineral sample was not available.

MINERAL IDENTIFICATION

First, let's go over the difference between a rock and a mineral. Rocks are essential building materials that make up the earth, while minerals are individual substances that make up rocks. Therefore, most rocks are aggregates, meaning they are made up of two or more minerals. Ore, for example, is an aggregate containing precious or useful metal along with other minerals that must be separated out before the metal can be used. Three of the samples in your kit are ore samples: iron, copper, and gold.

There are three main types of rock found on earth: igneous, sedimentary, and metamorphic.

> *Igneous*—These rocks are made when magma (melted rock below the earth's surface) or lava (the melted rock that flows from volcanoes above the surface) cools and hardens. Most of the earth's crust is made of igneous rock. Granite is one example of igneous rock.
>
> *Sedimentary*—These rocks are made up of tiny pieces of rocks and minerals that have been worn away from larger rocks by wind and water. The small pieces settle somewhere and start piling up, layer after layer, and eventually the lower layers turn into rock. Sandstone is one example of sedimentary rock.
>
> *Metamorphic*—These rocks are formed when the heat and pressure found deep under the earth's crust cause existing rocks—igneous, sedimentary, or metamorphic—to change into a different rock. Marble is one example of metamorphic rock.

More than 3,500 minerals have been identified in the earth's crust. Each mineral can be identified by its distinctive physical and chemical properties.

Physical Properties:

- Luster
- Hardness
- Color
- Streak
- Cleavage (the way is splits)
- Fracture (the way it breaks)
- Specific gravity
- Other mineral properties

Chemical Properties:

- Atomic structure
- Chemical composition

PHYSICAL PROPERTIES

Most minerals can be identified by examining the physical properties described below.

Luster

Luster is determined by the way light is reflected from a rock or mineral. Luster describes how glossy, or shiny, the surface is. The general appearance of the surface, how it reflects light, the scattering of light by tiny, microscopic flaws (called inclusions), and how much light passes through the mineral—these and many other features are responsible for luster. Here are a few examples of luster:

> *Metallic*—The surface is opaque, meaning light does not pass through. It reflects light and looks like a typical metal, such as gold, silver, lead, copper, or aluminum.
>
> *Vitreous*—The surface reflects light like glass does; vitreous rocks and minerals, like the anthracite coal in your kit, are often called glassy.
>
> *Greasy*—The surface looks as if it has been coated in grease, like the salt in your kit.

Other terms used to describe luster include silky, pearly, waxy, and dull.

Hardness

Hardness is one of the most useful properties for identifying a mineral. Hardness can be defined as a measure of the mineral's resistance to a force. There are several ways to apply force (scratching, indentation, and grinding), but testing resistance to scratching is a popular way of determining hardness because it requires no special equipment. Hardness based on scratch testing was given a precise definition in 1822 by the Austrian mineralogist Friedrich Mohs, who proposed the following scale:

Mohs Scale of Hardness

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

Each of these minerals will scratch those minerals lower in the scale, and will in turn, be scratched by those higher in the scale. So, gypsum can scratch talc (or any mineral lower than a 2) and it will be scratched by calcite (or any mineral higher than a 2). To give a real-world example, minerals softer than 2 ½ will leave a mark when scratched across paper; here are some more hardness values for familiar objects:

2 ½ = Fingernail
3 = Copper coin
5 ½ = Knife blade, Window glass

Given those values, we can see that minerals under a hardness of 2 ½ can be scratched by your fingernail. Minerals under a hardness of 5 ½ can be scratched by a knife or piece of window glass. Minerals over a hardness of 5 ½ will scratch a knife or piece of glass.

Keep in mind that the minerals on the scale are just examples; they are not the only minerals with those hardness levels. Also, as you can see, some minerals fall between numbers on the scale and have hardness levels such as 3 ½ or 5 ¾.

Color

The same mineral can come in a variety of colors, so we don't usually rely on color to recognize them. Some minerals are almost always found in the same color, such as sulfur (yellow), gold, and silver, but many minerals have minor impurities, or flaws, that can cause color change. For example, quartz occurs in almost every color imaginable. When determining color, it should always be observed on a freshly broken piece of the mineral, because an older surface may be stained or worn down.

Streak

Streak is an important, simple test that can be used to identify some minerals. The color of a powdered mineral is called its streak, and it is usually obtained by rubbing the mineral against a piece of unglazed porcelain called a streak plate. Keep in mind that the color of a mineral's streak may be different than the mineral itself. For example, hematite is black, but its streak is Indian red, earning it the nickname "bloodstone."

Cleavage

Minerals that form in crystals are said to cleave or have cleavage when they break in a defined direction along a smooth surface. This property is the result of a precise pattern of atoms in regular layers that have weak connections in certain directions. Minerals may have cleavage in more than one direction if the atoms have a weak connection in multiple directions. For example, mica will flake into thin sheets because in has cleavage in a single direction. However, diamonds have cleavage in eight directions, allowing them to naturally form into the traditional diamond shape; this property is used by diamond cutters to shape the diamond and remove flaws or impurities.

Fracture

Minerals that break in irregular directions are said to fracture. Fracture is described based on a freshly broken pattern. For example, fracturing quartz has a series of arcs, similar to patterns seen in sea shells, called "conchoidal" fractures. This same pattern is found on chipped glass. Metals, however, have a "hackly" fracture, which results in a jagged surface that is uncomfortable to the touch. Common words used to describe mineral fractures include uneven, splintery, and blocky.

Specific gravity

Specific gravity is the relative weight of a mineral compared to the weight of an equal amount of water. Water is given a specific gravity of 1 and the specific gravity of a mineral is compared to it. So, if you have exactly one cup of water and one cup of a mineral, and the mineral weighs more, it has a higher specific gravity than water. Minerals vary in specific gravity. Some minerals are heavy for their size while others are light for their size. For example, lead (galena) and granite are very heavy for their sizes, while salt and talc are light for their sizes. Experience and judgment on handling minerals can help you make a good guess at the specific gravity for a mineral.

Other mineral properties
Some minerals have unusual physical properties that can be useful for recognizing minerals.

Fizz—Some minerals fizz, or react, when they come in contact with an acid or household vinegar. The fizz is carbon dioxide gas escaping from the mineral. Calcite is an example of a mineral that fizzes.

Striated—Some minerals, such as pyrite, have parallel, straight lines called striations on their smooth surfaces.

Flexible—Some minerals, such as chlorite, can be bent and remain bent.

Elastic—Some minerals will snap back to their original position if they are stretched (not broken). Mica has elastic properties.

Malleable—Malleable means the mineral can be hammered flat without falling to powder. Most metal minerals have malleable properties.

Magnetic—Some minerals, such as magnetite and pyrrhotite, are attracted by a magnet.

Fluorescent—Some minerals, such as fluorite, glow in the dark when they are exposed to ultraviolet light. The term fluorescent actually comes from the name for the mineral fluorite, but fluorite is not the only fluorescent mineral; many diamonds are also fluorescent. This property is similar to phosphorescence, which also involves a mineral glowing in the dark. Phosphorescent minerals release light slower and for longer periods of time than florescent ones. Phosphorescence is similar to the glow-in-the-dark effect found in toys and other objects.

Radioactive—A mineral is radioactive when the mineral’s atoms give off energy as they break down. Pitchblende (uraninite) and carnotite are two of the more common types of radioactive minerals.

Table 1 provides a quick summary of the physical properties of the minerals in this kit, but each mineral is also explained in detail on the following pages.

Hardness, streak, cleavage, and specific gravity are properties that typically belong to minerals, so four rocks in your kit—the two coals, limestone, and marble—don't have information in some of those areas of the table. Your kit also contains three more rocks: iron ore, copper ore, and gold ore, but on this table the pure metals are described so you can learn their physical properties.

Table 1. Summary of the Physical Properties of the Rocks and Minerals in Your Kit

Rock or Mineral	Luster	Hardness	Color	Streak	Cleavage	Fracture	Specific Gravity	Other
Bituminous Coal	Dull to Greasy	Varies	Black	Varies	Varies	Cleats	Varies	Rock
Anthracite Coal	Vitreous	Varies	Jet Black	Varies	Varies	Conchoidal	Varies	Rock
Iron	Metallic	4.0–5.0	Gray Black	Gray	None	Hackly	7.3–7.8	Magnetic
Copper	Metallic	2.5–3.0	Reddish Orange	Reddish Orange	None	Hackly	8.95	Ductile & Malleable
Gold	Metallic	2.5–3.0	Gold Yellow	Yellow	None	Hackly	19.3	Very ductile & malleable
Gypsum	Vitreous	2.0	Colorless	White	Perfect	None	2.3	Soluble
Limestone	Dull to Pearly (polished)	3.0	Varies	Varies	Varies	Irregular to Subconchoidal	1.8–2.7	Rock
Marble	Dull to Pearly	3.0–4.0	Varies	Varies	Varies	Irregular	1.8–2.9	Rock
Salt	Greasy	2.5	Colorless	White	Good	None	2.1	Taste
Zeolite	Vitreous	4.0–5.0	Colorless	White	Perfect	None	2.2	Light & Fragile

FUELS

The fuel-type minerals included in your kit are bituminous and anthracite coal. Coal is a fossil fuel composed mostly of carbon, with traces of hydrogen, nitrogen, sulfur, and other elements. Coal is far more plentiful than U.S. oil or natural gas, and it is removed from the earth by a process called mining. Mining occurs in both surface and underground operations. In 2007, there were 2,030 coal mines operating in the United States. Approximately 93,000 coal miners produce over 1 billion tons of coal per year and create jobs in transportation, management, manufacturing and support industries.

The map below shows where the mines are located.

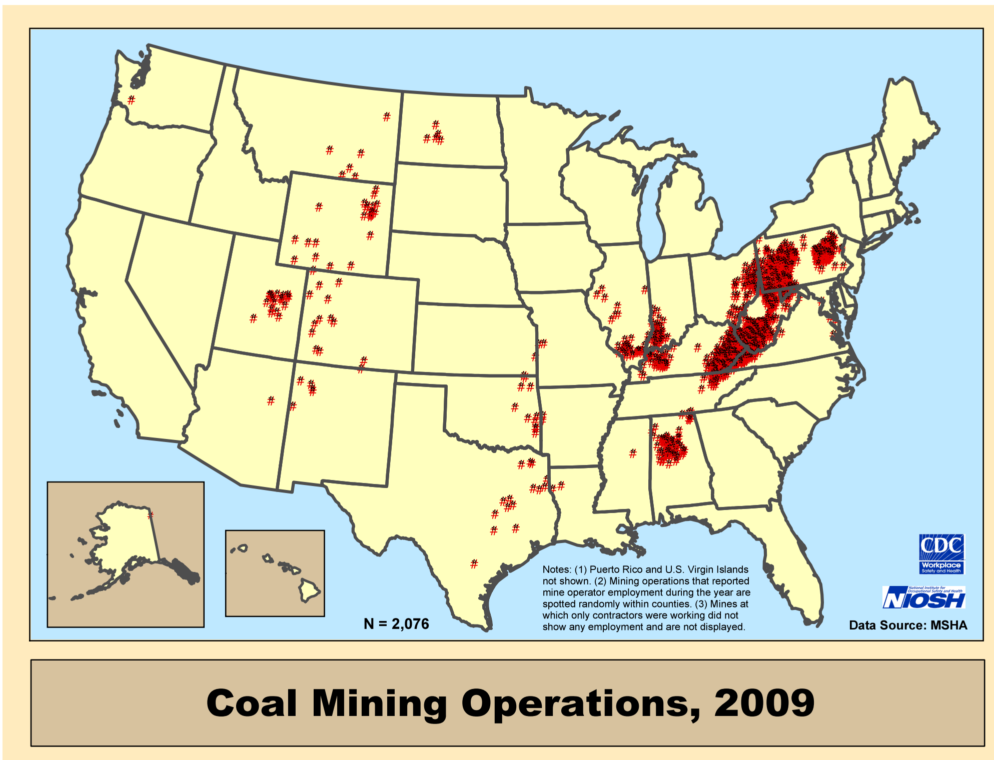

Figure 1. Location of coal mines (includes surface and underground mines).

Coal is a sedimentary rock deposited in layers, or beds, with other sedimentary rock. The oldest coal-forming period, the Carboniferous Period (also called Mississippi & Pennsylvania periods), occurred 300 to 360 million years ago and produced some of the world's major coal deposits. Three thousand different species of plant life were alive during at that time; some ferns were the size of today's trees, and some bushes were nearly 90 feet tall.

All coal once existed as growing plants. When the plants died they started to break down, but being buried by other plants kept them from decaying entirely. The dead plants were then transformed into coal by a process called "coalification." During coalification, the decaying plants are exposed to pressure and heat from being deeply buried. The pressure and heat bring on chemical changes in the plants: they first change into peat; then as more pressure and heat is applied, moisture and gases are forced out, and the remaining buried material consists mostly of carbon, the main element in coal.

There are five stages of coalification, and each stage results in different physical and chemical properties.

1. *Peat*—Partly-decomposed plants; about 50% carbon.
2. *Lignite*—Light-brown, soft coal; about 70% carbon.
3. *Sub-bituminous*—Low-luster, soft coal; about 80% carbon.
4. *Bituminous*—Brittle, well-jointed, and blocky black coal; about 88% carbon.
5. *Anthracite*—Hard, high-luster, jet-black coal exhibiting conchoidal fractures; about 92% carbon.

Coal is classified into different ranks by its behavior during heating; anthracite is the highest-ranked coal, and lignite is the lowest. This classification relies on measurements of moisture, volatile matter (parts of the coal given off during heating), and fixed carbon (the amount of carbon left after the volatile material is burned off). Coal with lower fixed carbon content and a higher volatile matter and moisture content is a low rank coal. Coal with higher fixed carbon content and lower volatile matter and moisture content is a high rank coal. High rank coals provide more heat when they are burned. Coal is used for different purposes based on its ranking and on the mineral impurities it contains that could pollute the environment.

In the U.S., coal provides over half of the electricity nationwide, meaning that it provides almost as much energy as gas, oil, hydroelectric, and nuclear power provide combined. It is relatively cheap to use coal to produce electricity, so it helps keep costs down as we power the air conditioners, televisions, computers, and so many other things we need electricity to use.

Bituminous Coal

GENERAL
Bituminous coal is an intermediate ranking coal, meaning it contains more carbon and gives off more heat than sub-bituminous and lignite coal, but it does not contain as much carbon or give off as much heat as anthracite coal. Most of the coal mined in the U.S. is bituminous.

PHYSICAL PROPERTIES*
Bituminous coal is a rock that is usually identified by how much carbon it contains rather than its physical properties, but knowing the physical properties can still be helpful.

Color—Black
Luster—Dull to greasy
Fracture—It breaks easily into irregular blocks; vertical fractures (called cleats) down two sides of the blocks.
Other—It is usually stratified, or banded, with thin, alternating shiny and dull layers.

Origin
Eastern U.S. coal formed from the remains of plant life that existed about 300 million years ago. The ideal environment for coal formation is a swamp. As the plants die and fall into the swamp environment, they become waterlogged and sink. Bacteria decay the dead plant material, and it turns into peat. Through time, oxygen supplies in the water are used up, and eventually the bacteria can no longer continue to decay the plant matter, but the pressure and heat from being buried under layers of plants and dirt continue the coal-making process. Valuable coal deposits only occur if the swamp basin slowly sinks and mud or similar material buries the dead plants. Bituminous coal is the fourth stage of the coal-forming process.

USAGE
- Fuel source to generate electricity
- Fuel source for industries
- Chemicals
  - perfume
  - billiard balls
  - saccharin (a sweetener that is much sweeter than sugar)

[Physical properties presented above are based on averages and/or purer minerals than in your kit.]*

Anthracite Coal

GENERAL
Anthracite coal, or hard coal, is the highest ranking coal. It is an ideal fuel because its high carbon content allows it to burn slowly and cleanly (smoke free and odorless), maximizing heat output.

PHYSICAL PROPERTIES*
Anthracite coal is a rock that is usually identified by how much carbon in contains rather than its physical properties, but knowing the physical properties can still be helpful.

Color—Jet black
Luster—Vitreous (Glassy)
Fracture—Curved or irregular conchoidal
Other—It is very hard and does not break easily. It also does not have the stratified, or banded, look that bituminous coal has.

ORIGIN
Eastern U.S. coal formed from the remains of plant life that existed about 300 million years ago. The ideal environment for coal formation is a swamp. As the plants die and fall into the swamp environment, they become waterlogged and sink. Bacteria decay the dead plant material, and it turns into peat. Through time, oxygen supplies in the water are used up, and eventually the bacteria can no longer continue to decay the plant matter, but the pressure and heat from being buried under layers of plants and dirt continue the coal-making process. Valuable coal deposits only occur if the swamp basin slowly sinks and mud or similar material buries the dead plants. Anthracite coal forms in the last stage of the coal-forming process.

USAGE
- Fuel source
- Mixed with other coals
- Purifier for water

[Physical properties presented above are based on averages and/or purer minerals than in your kit.]*

BASE METAL ORES

Metals are versatile, meaning they have many different uses, which makes them very valuable for use in technology. Metals are malleable, meaning they can be bent and shaped without cracking, and ductile, meaning they can be stretched out into a thin wire. They are very good at conducting heat and electricity. Metals directly impact radio and television communication, aeronautics, rocketry, nuclear power, and the distribution of electricity.

All the metals included in your kit (except for iron) are scarce, which means they make up less than 0.1% of the earth's crust. Many experts believe that these resources will be the first to develop shortages in the future, which will make developing new technology difficult.

Iron, on the other hand, is the second most abundant metal on earth (aluminum is the first). Iron makes up approximately 5% of the earth's crust, and it accounts for approximately 90% of all metal consumed.

The map shows where base and precious metals deposits are mined in the U.S.

Figure 2. U.S. Base and Precious Metal Producing areas. Includes gold (lode and placer), copper ore, iron ore, lead and/or zinc ore, uranium, silver ore, alumina (mill), aluminum ore, manganese, molybdenum, rare earths, titanium, nickel, uranium-vanadium ores, platinum group, zircon, tungsten, vanadium, beryl, and tin ore.

Iron Ore

GENERAL

Iron is mainly found in the ores magnetite, hematite, and taconite. In the U.S., taconite is the kind of iron ore most often mined. Remember that an ore is a rock containing valuable metal that must be separated out from the other minerals in the rock.

Iron is one of three naturally magnetic minerals on earth, along with cobalt and nickel. Magnetite, one of the main types of iron ore, was named for its magnetic properties. Though iron is useful for magnet making, over 99% of all iron mined is used to make steel. Iron is relatively weak on its own, but combined with carbon and other elements to make steel, it can be used to make buildings, cars, railroad tracks, and more.

PHYSICAL PROPERTIES*

Taconite

Luster—Metallic
Hardness—4.0–5.0
Color—Gray black
Streak—Gray
Cleavage—None
Fracture—Hackly
Specific Gravity—7.3–7.8
Other—Magnetic

Taconite deposits are generally distinguished into four types of deposits:

- *Cherty Taconite*—It is grayish to brownish—sometimes reddish—with a granular texture.
- *Silicate Taconite*—Silicate is like cherty taconite, but it is light grayish-green.
- *Slaty Taconite*—It has a banded or layered look. The bands may be very thin or reach one-inch thickness. The bands may be yellow, red, purple, green, gray, or black. It has sparkling grains of magnetite or hematite.
- *Mottled Taconite*—It has a spotted or mottled appearance. The spots are generally light in color and surrounded by gray or brownish iron oxides.

ORIGIN

Most iron deposits are found in igneous and sedimentary formations. They are also commonly found in banded sedimentary deposits. How they formed is not completely understood, but we do know that the banded sedimentary deposits came from iron settling on the bottom of shallow seas over one billion years ago.

USAGE

- Over 99% of iron ore makes iron and steel
- Magnets
- Vitamins

[Physical properties presented are based on averages and/or purer minerals than in your kit.]*

Copper Ore

GENERAL
Copper is man's oldest metal; it has been used for over 10,000 years. It's still widely used today, sometimes just as it was thousands of years ago. Copper plumbing, which is very popular in building today, was found in working condition in the 5,000-year-old Pyramid of Cheops in Egypt. From the beginning copper has been used for high-tech survival tools, like the axes of 10,000 years ago (high-tech for the time!), and today surgeons are using copper-coated scalpels to save lives.

PHYSICAL PROPERTIES*
Pure Copper

Luster—Metallic
Hardness—2.5–3.0
Color—Reddish orange (If the air around the copper is often damp, it will change to a reddish brown color. Eventually, it will develop a green coating, called a patina, that stops any further corrosion.)
Streak—Reddish orange
Cleavage—None
Fracture—Hackly
Specific Gravity—8.95
Other—Copper is malleable and ductile. Being ductile, combined with its excellent ability to conduct electricity, makes it a great material for making wire. (Silver is the only thing better at conducting electricity, but it's too expensive to use for wires.)

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ORIGIN
Copper occurs as a native metal (not as an ore) in only a few places, and the most likely place to find it is in the Keweenaw Peninsula of Michigan. Large deposits of copper ore are located in the United States, Chile, Zambia, the Democratic Republic of the Congo, Peru, and Canada. Most of the world's copper is mined from large copper sulfide deposits. After it is mined it's purified to remove the other parts of the ore and forms 99.999% pure copper.

USAGE
- Wire for electrical industry
- Plumbing
- Cookware
- Jewelry
- Coins (Though U.S. pennies are now only copper-covered zinc)
- Pesticides

[Physical properties presented are based on averages and/or purer minerals than in your kit.]*

PRECIOUS METALS

Precious metals are most commonly used to make money and jewelry. However, they are being used more and more in other industries. Similar to the base metals, silver and gold are malleable, ductile, and good conductors of heat and electricity.

Silver is in demand in photography as well as the electrical industry (mentioned in the section on copper). Silver crystals are a part of camera film and picture paper, and they allow clear, highly accurate pictures to develop. However, digital cameras have cut down on some of the silver use in photography. Gold is another useful metal because it is so resistant to corrosion that it is almost indestructible, but it is so scarce and expensive that it is not used in industry as much as silver.

The map (the same one presented in the base metal section) shows where base and precious metals are mined in the U.S.

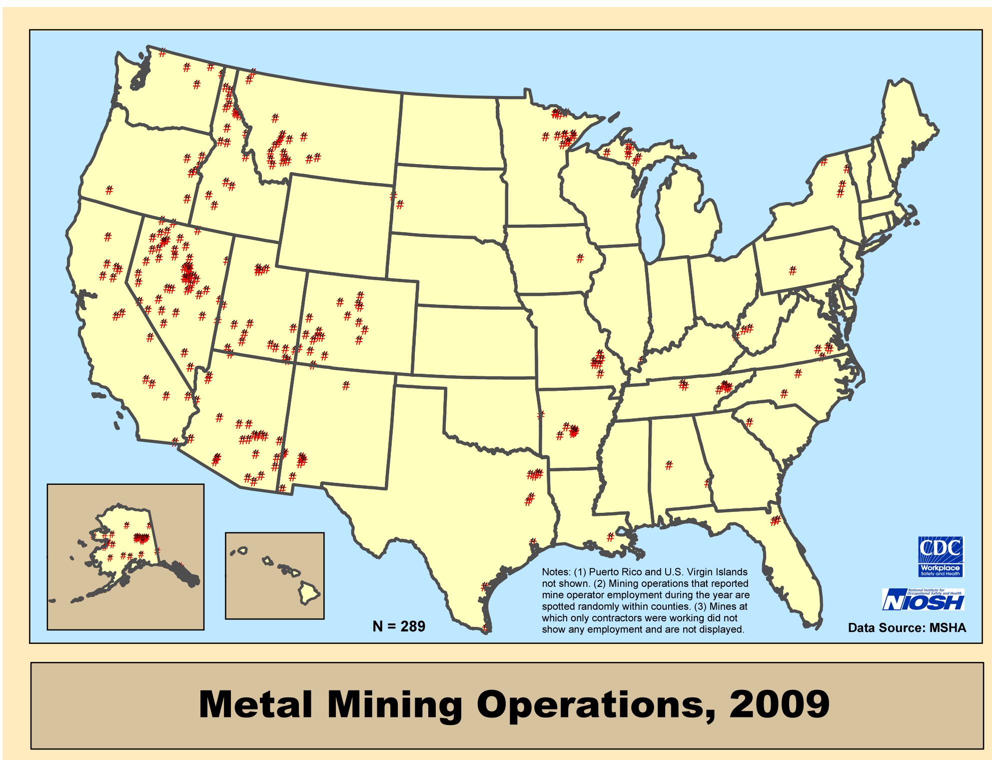

Figure 2. U.S. Base and Precious Metal Producing areas. Includes gold (lode and placer), copper ore, iron ore, lead and/or zinc ore, uranium, silver ore, alumina (mill), aluminum ore, manganese, molybdenum, rare earths, titanium, nickel, uranium-vanadium ores, platinum group, zircon, tungsten, vanadium, beryl, and tin ore.

Gold Ore

GENERAL
Man's quest for gold has been going on since ancient times. Gold has been prized as an ornament, a display of wealth, and as a bartering tool. The search for gold has also played a major role in exploration and discovery, because European explorers were often searching for gold when they first arrived in North and South America. Today gold is still very popular in jewelry-making.

PHYSICAL PROPERTIES*
The gold ore sample in your kit could be basalt, latite, shale/siltstone, or breccia. Basalt is a dark black rock with many small, light-colored crystals, which are made of the mineral feldspar, or green crystals, which are made of the mineral olivine. Latite is a light white rock with feldspar crystals surrounded by gray rock. Shale/siltstone is a gray rock with hematite (a black to brick red mineral) stains on the fractures. Breccia is a mixture of latite, shale, and sometimes sandstone.

The physical properties of pure gold are
Luster—Metallic
Hardness—2.5–3.0
Color—Gold Yellow
Streak—Yellow
Cleavage—None
Fracture—Hackly
Specific Gravity—19.3
Other—Gold is very malleable and ductile.

ORIGIN
Gold reserves are found in rock veins and placer deposits. Rock veins are a sheet of a separate mineral within a rock. They form when water flows through cracks in the rock. In the case of gold, water carries small pieces of gold in the rock and leaves them there to build up. Placer deposits form when gold is separated from other minerals by weathering or erosion and it flows down streams or rivers. The small flecks of gold build up in river bends, under waterfalls, or in other natural collection places.

USAGE
- Mostly jewelry and money
- Computers
- Communication equipment
- Spacecraft
- Jet aircraft engines
- Art

[Physical properties presented are based on averages and/or purer minerals than in your kit.]*

ROCKS AND INDUSTRIAL MINERALS

Your kit contains the following rocks and industrial minerals: gypsum, limestone, marble, salt, and zeolite.

These rocks and minerals are often used as building materials. Building materials are the largest crop that we reap from the earth; we extract about 3 billion tons per year. Furthermore, building materials are the second most valuable mineral commodity after fossil fuels. (Fossil fuels include coal, petroleum (oil), and natural gas.)

Because most building materials are not scarce like metals, they have little value as they are found in the ground, but when they are removed and processed to a useful form, they increase in value enormously.

When attractive building stone deposits are discovered, the main concern is how to get the rock without destroying it. Other types of mining use aggressive methods, like blasting, which usually shatters the mineral or rock. However, with building stones, it is better to remove the stone at places where it naturally cracks or joins with another stone.

The maps below show where nonmetal mining operations are located in the U.S

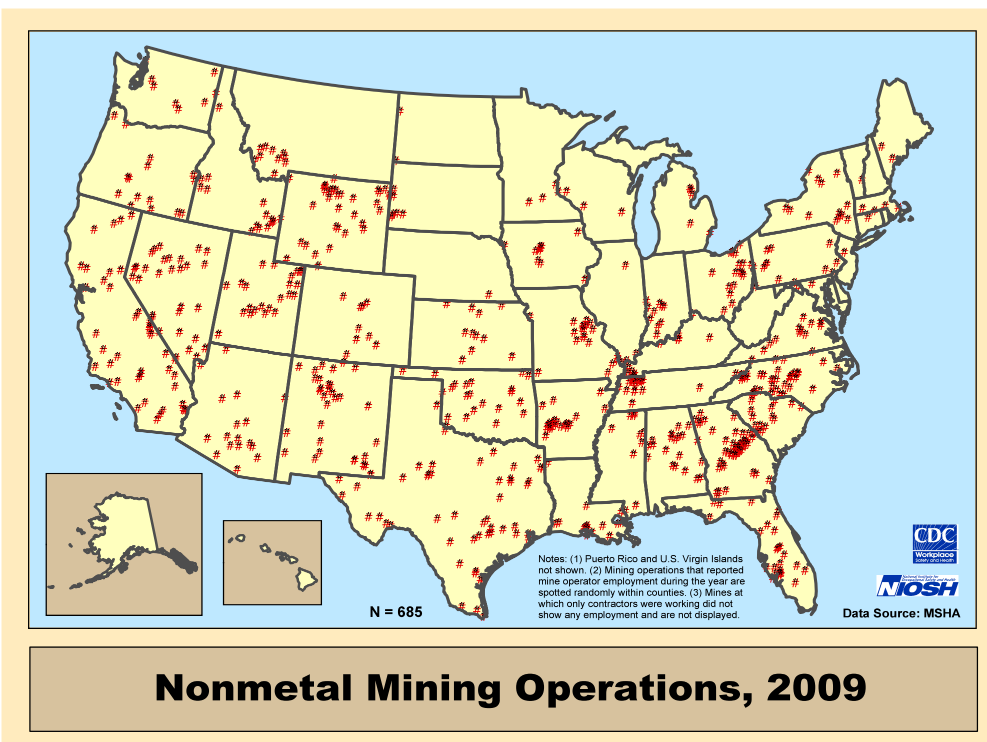

Figure 3. U.S. nonmetal mining operations (includes clay, gypsum, shale, pumice, talc, soapstone and pyrophylite, barite, phosphate, perlite, feldspar, salt, mica, trona, potash, boron materials, vermiculite, leonardite, kyanite, magnesite, gilsonite, fluorspar, asbestos, oil sand, aplite, borate minerals, and lithium).

Figure 4. U.S. stone mining operations (includes limestone, granite, traprock, sandstone, stone, dimension, lime, slate, and marble).

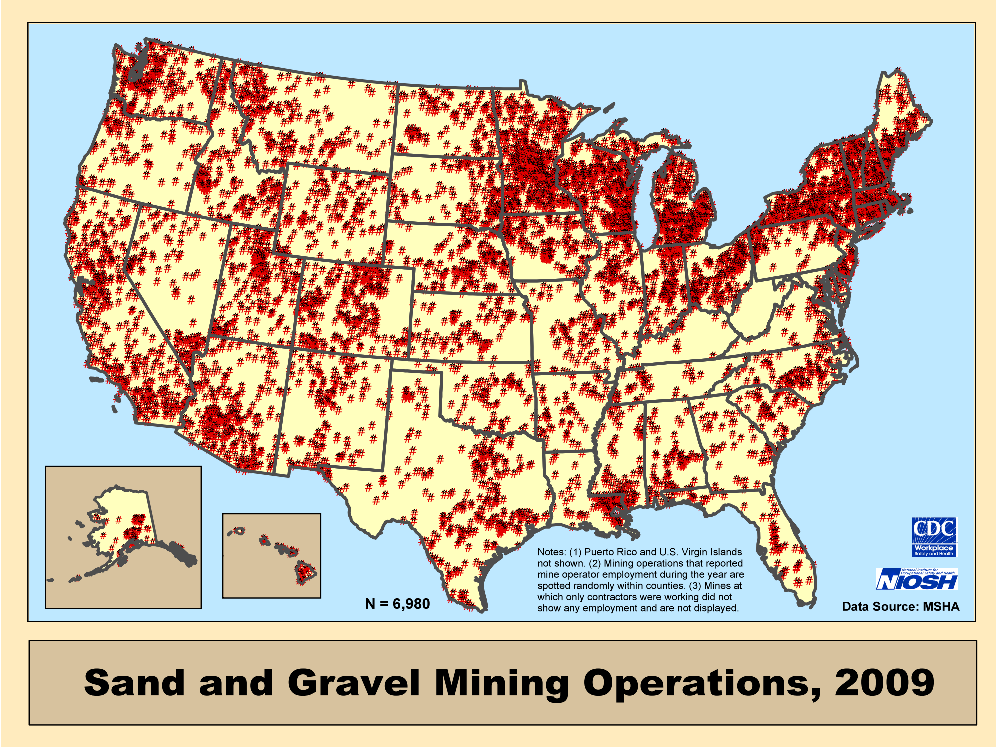

Figure 5. U.S. sand and gravel operations.

Gypsum

GENERAL

Gypsum is extensively mined in many parts of the world and consists of 79% calcium sulfate and 21% water. Gypsum is the raw material for making plaster of Paris, which, in the past, was often used to make the inside walls of houses. Plaster of Paris got its name from the gypsum deposit in the Paris Basin in France. Now a material called drywall is typically used in building, but it is still made of gypsum. Plaster of Paris is still used today to make casts for broken bones, though fiberglass casts are also very common.

PHYSICAL PROPERTIES*

Luster—Vitreous (glassy), pearly, silky
Hardness—2.0
Color—Colorless to transparent, white, gray, yellowish, or brown
Streak—White
Cleavage—Perfect to very good
Fracture—None
Specific Gravity—2.3
Other—Dissolves in hydrochloric acid and water. Can be fluorescent (meaning the sample glows in ultraviolet light).

ORIGIN

Gypsum is found in sedimentary rocks where seawater has evaporated.

USAGE

- Plaster, wall board
- Some cements
- Fertilizer
- Paint filler
- Ornamental stone
- Brewing industry
- Flux in pottery making

[Physical properties presented above are based on averages and/or purer minerals than in your kit.]*

Limestone

GENERAL
Limestone usage is so widespread that we use it every day and we may not even be aware of it. For example, most roads today have limestone beneath them as part of their beds. Also, limestone has made a major impact on almost everyone's education: blackboard chalk is limestone. When that fine white power is viewed under a microscope you can see the remains of single-celled animals called foraminifera that helped form the limestone.

PHYSICAL PROPERTIES*

Luster—Dull to pearly (when polished)
Hardness—3.0
Color—Varies. Deposits in southwestern Pennsylvania are usually gray-white
Fracture—Irregular to subconchoidal
Specific Gravity—1.8–2.7
Other—Fizzes under hydrochloric acid

Limestone consists mainly or entirely of calcite and calcium carbonate, but calcite is about the only thing common to all limestone. Limestone differs widely in texture, color, content, structure, and origin. Most of their diversity is the result of the physical and chemical properties of calcite.

ORIGIN
Limestone is a sedimentary rock that forms under an ocean or sea. Sea water contains less acid than fresh water (lakes and rivers). Since acid can dissolve calcium, and calcium is necessary for limestone accumulation, fresh water is not a likely place for limestone development.

A wide range of sea life—from one-cell plants such as algae to specialized animals, such as corals—can contribute to limestone formation. The plants and animals extract calcium carbonate from the sea water and use it to build skeletons and shells. When these plants and animals die, their shells and skeletons sink to the ocean floor and make a large contribution to limestone deposits.

USAGE
- Portland cement and aggregate (used to make concrete)
- Crushed stone for roads
- Soil stabilizer
- Paper, glass, fiberglass, porcelain, petrochemicals, insecticides
- Chewing gum, Toothpaste
- Antacids (heartburn medication)
- Food products—cereals and bakery items
- Source of calcium essential to healthy bone and muscle development.

[Physical properties presented above are based on averages and/or purer minerals than in your kit.]*

Marble

GENERAL

Marble is well-known for its use in building and sculpture. Many dignified buildings, such as banks, use marble to create an impressive look of strength and wealth. Sculptors value marble as well because it is easy to carve and looks good when sculpted. Many of the Italian Renaissance sculptors, like Michelangelo, used marble for their statues.

PHYSICAL PROPERTIES*

Luster—Dull to pearly
Hardness—3.0–4.0
Color—Varies.
Fracture—Irregular
Specific Gravity—1.8–2.9

Marble is known for its colorful swirls, but it can be solid white, as seen in sculptures. If there were impurities in the original rock or impurities were introduced while the rock was being changed into marble, they tend to group together in knots or spread into wavy streaks, giving the multicolored patterns for which marble is known. Also, the same process that changed the parent rock (limestone or dolomite) to marble causes the grains in the limestone and dolomite to grow, become visible crystals, and give the surface a lively sparkle.

ORIGIN

Marble is a metamorphic rock. It is formed as the result of deep burial and an increase in temperature and pressure, possibly resulting from tectonic activity (mountain building), or hydrothermal activity (the movement of hot water). Most marble deposits result when the rocks limestone or dolomite are subjected to increases in temperature and pressure.

USAGE

- Dignified buildings
- Monuments (Tomb of the Unknown Soldier)
- Decoration (Clocks, pen holders, etc.)

[Physical properties presented above are based on averages and/or purer minerals than in your kit.]*

Salt

GENERAL

Salt has had a profound impact on the history of man. It has promoted exploration, warfare, conquest, and trade. Salt has been used as basis for government taxation and payment for services. Salt was also used to pay soldiers of the Roman Empire in a payment called “Salarium argemtum.” The English word “salary” is derived from this Latin term.

In addition to its historical importance, salt is an essential nutrient for the existence of life. Because you lose salt in sweat, tears, and other body functions, you need to eat salt to keep your hydration in check. In a year, you consume approximately 12 pounds of salt.

PHYSICAL PROPERTIES*

Luster—Greasy
Hardness—2.5
Color—Colorless, white to blue
Streak—White
Cleavage—Good cleavage
Fracture—None
Specific Gravity—2.1
Other—Dissolves easily in water, and tastes salty

ORIGIN

Common salt is the mineral halite. Salt deposits are basically derived from evaporation of salt water, which is also called a brine solution. When the water evaporates, the salt separates and stays behind. The more common brine solutions include ocean water, salt lake water, and those found under the earth’s surface. The salt in your kit is called “extra coarse solar salt,” which means it was obtained by evaporation of a brine solution.

Salt can also be obtained from solid deposits. The most common solid deposits are sedimentary beds, salt domes (a dome-shaped formation of salt within a rock), or playa deposits (collections of salt that form where lakes have dried).

USAGE

- Plastic products for building and construction
- Soaps and detergents
- Home furnishings
- De-icing on highways
- Canning
- Water and sewage treatment
- Table salt

[Physical properties presented above are based on averages and/or purer minerals than in your kit.]*

Zeolite

GENERAL

The name zeolite comes from two Greek words meaning “to boil” and “stone.” It refers to the swelling-up and apparent boiling that occurs when this mineral is heated and water is driven off. Zeolites have the unique ability to not only lose water, but absorb water and other compounds, such as methane and carbon dioxide. Zeolites were first identified in 1756. They were considered geologic oddities and were collectable items.

Zeolite is actually referred to as a family of minerals that are aluminum silicates. Some of the more common zeolite minerals include: chabazite, clinoptilolite, erionite, and mordenice. The sample in your kit is one of these minerals. Zeolite deposits are abundant and can be mined at a low cost.

PHYSICAL PROPERTIES*

Luster—Vitreous to pearly
Hardness—4.0–5.0
Color—Colorless, white, sometimes red stains
Streak—White
Cleavage—Perfect
Fracture—None
Specific Gravity—2.2
Other—It gives off water when heated and is very light and fragile.

ORIGIN

Zeolite deposits are formed from reactions between volcanic rock and water. For the most part, zeolites occur in the cavities and veins of igneous and sedimentary rocks.

USAGE

- Ionic exchanger in environmental cleanup and water purification.
- Dimension stone
- Insulation
- Food supplement
- Soil conditioner
- Detergent
- Medical
- Filler in paper

[Physical properties presented are based on averages and/or purer minerals than in your kit.]*