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Guide to

ROCKS AND MINERALS OF ILLINOIS

Illinois State Geological Survey

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Guide to

ROCKS AND MINERALS OF ILLINOIS

ILLINOIS has so long been known as the Prairie State that at first glance it seems a most unlikely place in which to collect rock and mineral specimens.

But Illinois has a surprising wealth of rock and mineral resources, not only to be collected as interesting specimens but to be put to practical and profitable use.

The rich prairies that gave the state its nickname are themselves derived from ancient rocks, worn and changed by millions of years of action by weather, water, wind, plants, and animals. Unmeasured depths of rock underlie the prairies, hills, and valleys, and in some parts of the state are exposed in outcrops, canyons, and river valleys. Boulders and gravel brought in by the glaciers thousands of years ago are strewn over many parts of the state.

These resources are of great value. Besides the rich agriculture based on the rock-derived soil, much of our industry, manufacturing, and transportation is dependent on rock and mineral materials. Every county in Illinois possesses some rocks and minerals that either are being used or have potential future value.

The Illinois State Geological Survey several years ago began to prepare sets of typical rocks and minerals of Illinois for use by the schools and other educational groups in Illinois. This booklet is designed to furnish a brief geological background and explanation of these common Illinois rocks and minerals. It also should be useful to the student or amateur interested in making his own collection.

Even though Illinois has no mountain ranges or deep canyons, the geology of the state has many complexities. In fact, the very flatness of our topography is a complicating factor because in order to study the geology at many places in the state it is necessary to use information from mines and descriptions (logs) and samples (cores) of the rock penetrated during drilling of deep wells. There are also geophysical methods of learning something about the rocks beneath the surface.

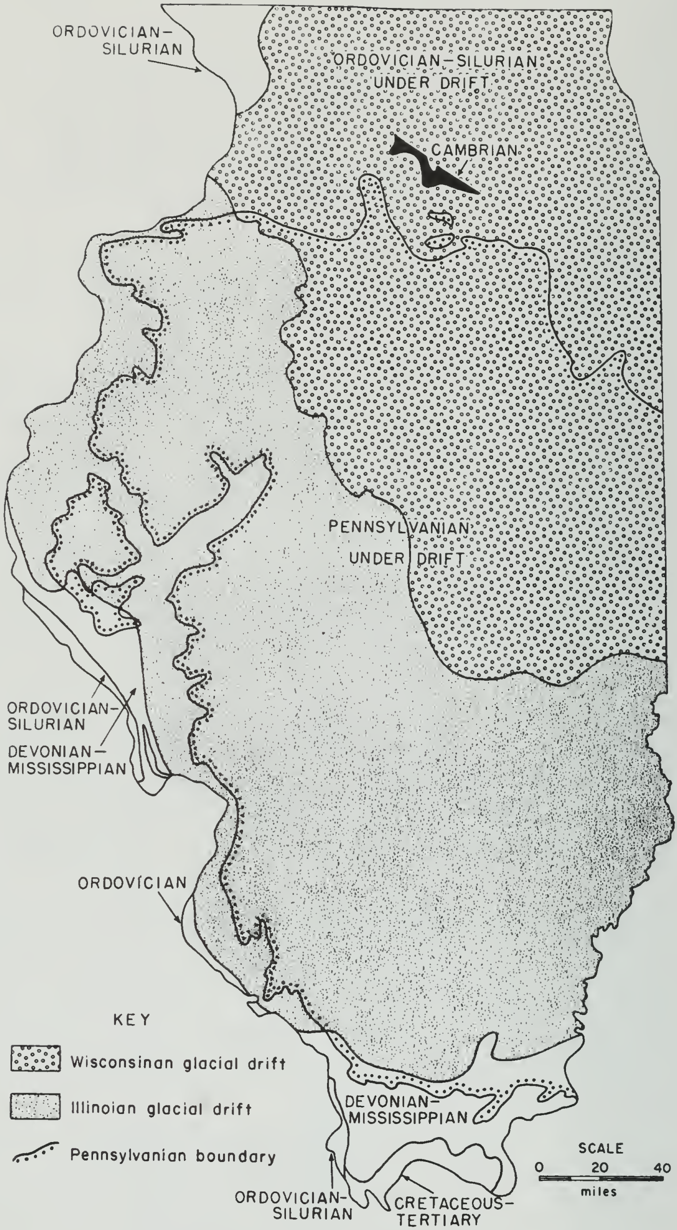


Fig. 1.- Geologic map of Illinois.

The complexity of Illinois geology is not produced by the upturning and sharp folding of rock layers such as can be seen in the Rocky Mountains, but rather by the changes in composition, thickness, and character of the rock layers that are only gently warped or relatively flat. At several places in the state, especially in the southern part, faults, or breaks, in the rock layers do occur, but over much of our area this is not common.

The presence of usable minerals at considerable depth is known at many places; coal is mined from depths greater than 800 feet, and oil is produced from saturated rock layers, called pay zones, several thousand feet below the surface. Lead and zinc ores, fluorspar, silica sand, limestone, sand, gravel, clay, and shale are all produced at shallower depths. However, the student can see only those rocks and minerals that are to be found at or near the surface. For that reason the following paragraphs describing their geologic occurrence deal only with surface geology.

The youngest of the major geologic divisions of our rocks is called the Pleistocene, which is the scientific name for the "Ice Age" deposits. During this relatively recent period of geologic time, which began about a million years ago, glaciers flowed southward from Canada and spread a layer of "glacial drift" over all of the state except the northwest corner, the southwest edge of the state along the Mississippi River, and extreme southern Illinois (fig. 1).

Most of the glacial deposits that we see were formed by the last two of the four major periods of glacial advance, the Illinoian and the Wisconsin. The Illinoian was the most extensive, reaching as far south as Carbondale and Harrisburg. The Wisconsin, so called because its deposits are so widely spread in that state, reached only to Mattoon and Peoria.

The glacial drift is the youngest and uppermost of the divisions of the rock column (fig. 2). Within the drift can be found the widest diversity of rock and mineral types - quartzite, schist, and other metamorphic rocks; granite, gabbro, and other igneous rocks; and of course the sedimentary rocks, limestone, dolomite, sandstone, shale, and even pieces of coal, which occur in bedded layers of the older rocks in Illinois.

Sand and gravel were carried and deposited by flowing streams before, during, and after glaciation, but the major deposits were made while the glaciers were melting. They contain a wide variety of rock and mineral types.

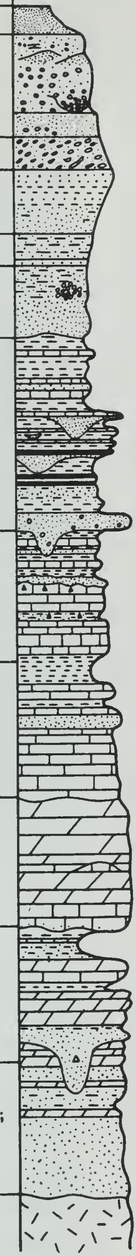
Era		Period or System and Thickness	Epoch	General Types of Rocks	
CENOZOIC "Recent Life"	Age of Mammals	Quaternary 0-500'	Pleistocene or Glacial Age	Recent—alluvium in river valleys	
				Glacial till, glacial outwash, gravel, sand, silt, lake deposits of clay and silt, loess and sand dunes; covers nearly all of state except northwest corner and southern tip	
		Tertiary 0-500'	Pliocene	Chert gravel; present in northern, southern, and western Illinois	
			Eocene	Mostly micaceous sand with some silt and clay; present only in southern Illinois	
			Paleocene	Mostly clay, little sand; present only in southern Illinois	
MESOZOIC "Middle Life"	Age of Reptiles	Cretaceous 0-300'		Mostly sand, some thin beds of clay and, locally, gravel; present only in southern Illinois	
PALEOZOIC "Ancient Life"	Age of Amphibians and Early Plants	Pennsylvanian 0-3,000' ("Coal Measures")		Largely shale and sandstone with beds of coal, limestone, and clay	
		Mississippian 0-3,500'		Black and gray shale at base; middle zone of thick limestone that grades to siltstone, chert, and shale; upper zone of interbedded sandstone, shale, and limestone	
	Age of Fishes	Devonian 0-1,500'		Thick limestone, minor sandstones and shales; largely chert and cherty limestone in southern Illinois	
	Age of Invertebrates	Silurian 0-1,000'		Principally dolomite and limestone	
		Ordovician 500-2,000'		Largely dolomite and limestone but contains sandstone, shale, and siltstone formations	
		Cambrian 1,500-3,000'		Chiefly sandstones with some dolomite and shale; exposed only in small areas in north-central Illinois	
ARCHEOZOIC and PROTEROZOIC				Igneous and metamorphic rocks; known in Illinois only from deep wells	

Fig. 2.- Geologic column showing succession of rocks in Illinois.

As shown by the diagrammatic rock column (fig. 2), rocks placed in the divisions called early Cenozoic and Mesozoic are next in age to the Pleistocene. The map (fig. 1) shows that the Cenozoic and Mesozoic rocks occur only in the extreme southern tip of Illinois because only that part of Illinois was covered by a northward extension of the forerunner of the Gulf of Mexico in which the deposits of sand, gravel, and clay were laid down.

The next older division of Illinois rocks is called Pennsylvanian - or "Coal Measures" - because during the last century they were first extensively described by geologists working in Pennsylvania.

The Pennsylvanian is one of our most important groups of rock strata because it contains all of our minable coal beds, as well as important deposits of limestone, shale, clay, sandstone, and some oil and gas. The Pennsylvanian rocks are very widespread in Illinois, occurring under the glacial drift from depths of a few feet to several hundred feet throughout about two-thirds of the glaciated area (fig. 1).

Next below the Pennsylvanian are the Mississippian rocks. We in Illinois are particularly interested in this division of rocks because they take their name from the excellent exposures along the Mississippi River valley in western Illinois, southeastern Iowa, and eastern Missouri. They are composed of extensive beds of limestone and cherty limestone, sandstone, and shale.

Mississippian rocks are of great economic importance in the structural area known as the Illinois Basin, where they are the most important oil producing rocks. They also contain our fluorspar deposits and along the valley bluffs are an excellent source of limestone for quarrying.

Rocks older than the Mississippian - except for small areas along the Mississippi and Illinois River valleys - are found at the surface only in the northern quarter of the state and locally in Hardin County near the southern tip of the state. They are nonetheless economically important because from these older rocks are produced lead and zinc, some oil and gas, silica sand, limestone, dolomite, and shale.

On the generalized rock column (fig. 2) these older rocks are grouped into two units. The uppermost contains the Devonian and Silurian and the lower contains the Ordovician and Cambrian. In general they include dolomite, limestone, and shale, with sandstone at several places, especially in the lower unit.

DESCRIPTION OF ROCKS AND MINERALS

The terms *mineral* and *rock* are often confused. They are frequently used together and the materials they describe are closely related. In general, a mineral is a naturally occurring chemical element or compound formed by inorganic processes, whereas a rock is a mixture of particles or grains of several minerals.

However, when we refer to mineral resources or industrial minerals, we generally include materials that are technically rocks - such as limestone, dolomite, shale - and also coal and oil that are in fact organic substances. On the other hand, we include in the rock category high purity sandstone that is composed almost entirely of one mineral (quartz) and high purity limestone that is composed largely of the mineral calcite.

MINERALS

A few minerals are composed of only one element, such as diamond (carbon) and native copper, but most minerals are chemical compounds that contain several elements.

Most minerals grow into distinctive shapes if they are free to grow. A familiar example is the formation of salt crystals that grow on a saucer of evaporating salt water. The distinctive shapes of crystals are called their *habits*, and the flat surfaces that develop are called *crystal faces*, the angles of which may be used to identify the mineral.

The individual atoms of a crystal always arrange themselves in the same way, so that each mineral breaks characteristically. Some minerals break more easily in particular directions and present a flat, smooth surface. This characteristic is called *cleavage* and the cleavage surfaces, although sometimes confused with crystal faces, may be useful for identifying a particular mineral. The manner in which a mineral breaks when the broken surface does not include cleavage surfaces is called its *fracture*, and this too may give a clue to the identification of the mineral.

There are other physical features useful in identifying minerals. Some of them, such as *color*, are quite obvious. The color of the powder left when a mineral is scraped on a rough, white surface, such as unglazed porcelain or tile, is called *streak*. *Luster* refers to the brightness of light reflected from the mineral's surface. *Transparency* and *translucency* refer to the mineral's ability to transmit light, and *tenacity* is a measure of its toughness.

Two special physical characteristics of minerals are important to their identification - specific gravity and hardness. *Specific gravity* simply means the ratio of the weight of the mineral to an equivalent volume of water. For example, if a mineral has a specific gravity of 4, then a cubic inch of the mineral weighs as much as 4 cubic inches of water.

Hardness is measured by the ability of one mineral to scratch another, and a set of ten standard minerals has been selected for determining this characteristic. The listing below, from soft to hard, is known as Mohs scale.

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

A rough measure of hardness can be made by using handy objects. Your fingernail has a hardness ranging from 2 to 3, a penny is a little harder than 3, window glass ranges from less than 5 to approximately 6 in hardness, and a knife blade is generally in the range of 5 to 6.

ROCKS

Rocks, being mixtures of minerals, are more complex than minerals and are therefore classified in a more complicated way. The broadest grouping of rocks is based on the origin of the rock rather than on the minerals that compose it. In this scheme all rocks are divided into three general groups, *igneous*, *sedimentary*, and *metamorphic*.

The igneous rocks are mentioned first because they are produced directly from hot liquids that come from deep within the earth. These hot liquids are essentially molten rock and are called *magmas*. When they cool, the elements of the individual minerals come together and crystallize, as water crystallizes into ice on a winter day.

Different minerals crystallize, or "freeze", at different temperatures so that if the magma cools slowly some individual grains have opportunity to grow larger than others. If the magma cools quickly, as does lava or basalt, the separate mineral grains will be small. Igneous rocks are classified on the basis of the size and arrangement of the individual crystals and the kinds of minerals present.

The glacial drift in Illinois contains many pieces of igneous and metamorphic rocks, but most of the rocks native to Illinois are sedimentary.

Some sedimentary rocks are made up of weathered fragments of other rocks that have been moved by rivers, waves, winds, or glaciers. These sediments have been deposited and later compacted or cemented by the mineral matter carried in water moving through them. Such sedimentary rocks are called *clastic* (meaning broken pieces) rocks, as opposed to those formed by chemical precipitation from water and those that consist of fossil remains.

Clastic sedimentary rocks are classified first on the basis of the size of the grains of gravel, sand, silt, and clay of which they are composed; on the type of deposition, such as glacial drift and wind-blown silt or loess, that produced them; and then on the basis of their mineral composition. Rocks such as gypsum and some of our limestones were formed by chemical precipitation from sea water.

Metamorphic rock literally means rock that has changed form. The change of form has been caused by heat and pressures that occur below the surface of the earth or by heat from upward moving hot magmas or melted rocks. Examples of metamorphic rocks are found in Illinois as boulders and pebbles in the glacial drift.

Descriptions of the rocks and minerals represented by specimens in the Geological Survey's rock and mineral sets follow. The numbers preceding the descriptions correspond to the numbers on the specimens in the sets.

Although the set includes the rocks and minerals that are most commonly found in Illinois, many others can be collected. For that reason, following the descriptions is a key for identifying other Illinois minerals and rocks.

As a further aid to the beginner and the amateur, a list of equipment useful in making a rock and mineral collection is given at the end of the book.

GRANITE (1)

GRANITE is one of the most widespread intrusive (originating deep within the earth) igneous rocks. It consists chiefly of feldspar and quartz with small amounts of biotite, muscovite, or hornblende. Most granite is light colored, but it can be white, gray, yellow, pink, or deep red. The texture ranges from medium grained to coarse grained.

Granite pebbles or boulders are the most common igneous rocks found in glacial deposits in Illinois. They are not native to the state but were brought here by the great ice sheets or glaciers that advanced from southern Canada to cover much of northern United States during Pleistocene time.

Native granitic rock probably lies very deep beneath the entire state. It has been found in deep oil-test drillings along the western and northern margins of Illinois.

GABBRO (2)

GABBRO is another intrusive igneous rock, but it is heavier and darker than granite. It is composed mainly of feldspar and dark iron-bearing minerals that give the rock a dark color. It is coarse grained and contains little or no quartz.

Mineral crystals of gabbro are especially tightly interlocked, making the rock very difficult to break. Weathered gabbro is a rusty color on the surface, because the iron in gabbro changes color just as a piece of metallic iron becomes coated with rust when left out of doors.

Like other igneous rocks found near the surface in Illinois, gabbro was carried into Illinois by the glaciers and deposited as glacial debris.

PORPHYRY (3)

PORPHYRY is an igneous rock identified by its texture rather than its mineral content, which is variable. Distinct crystals (phenocrysts) of minerals are embedded in a matrix of fine-grained rock. The phenocrysts formed before the main mass of the rock hardened.

Any igneous rock may have a porphyritic variety, such as granite porphyry and rhyolite porphyry, although porphyries are most likely to form in association with fine-grained igneous rocks.

Porphyry is found in Illinois only in glacial drift.

BASALT (4)

BASALT is the most widely distributed volcanic rock. Pyroxene, feldspar, magnetite (an iron ore), and in some instances olivine, biotite, and hornblende, compose this rock. The dark green, gray, or black color is due to the dark-colored minerals that make up much of the rock. The minerals in basalt are fine grained and are packed closely together. Phenocrysts of olivine, pyroxene, and hornblende may be present. Basalt is easily identified by its color and fine-grained texture.

The glaciers brought basalt into Illinois along with other igneous rocks.

PERIDOTITE (5)

PERIDOTITE is the only igneous rock native to Illinois that crops out at the surface. It is found as dikes (irregular veins) or sills (thin sheets) that were formed when molten rock from deeper in the earth intruded into cracks and fissures in the bedrock of southeastern Illinois (Hardin, Pope, Gallatin, and Saline Counties). Peridotite pebbles and boulders also may be found in the glacial drift.

Peridotite ranges from very fine grained to medium grained and has an even texture. It is dark gray to greenish gray, depending on the minerals present. In general it is composed of olivine, hornblende, pyroxene, and mica, with little or no feldspar or quartz.

GNEISS AND SCHIST (6)

GNEISS is a metamorphic rock composed of roughly parallel bands of minerals. It is medium grained to coarse grained and is generally light in color. The names given to gneiss emphasize a distinctive texture or mineral or indicate composition. For example, biotite gneiss emphasizes a mineral, and granite gneiss indicates the composition of the rock.

SCHIST is much like gneiss but is fine grained and has a thinly layered structure that makes the rock break with a wavy surface. Some common types of schistose rocks are talc schist, chlorite schist, and hornblende schist. As the names indicate, they are characterized by their dominant mineral. Mica schist may be formed by the metamorphism of either sedimentary or igneous rocks.

Gneiss and schist are not native to Illinois but are found in the glacial drift.

CONGLOMERATE (7)

CONGLOMERATE is a sedimentary rock made up of pebbles or other rock fragments cemented in a background or matrix of finer material, generally silica, calcium carbonate, clay, iron oxide, or a mixture of these substances. The rounded rock fragments have been worn by being rolled in streams and along beaches.

If the pebbles embedded in the matrix are sharp and angular, freshly broken and not worn, the rock is called *breccia* and is generally found near the place where the fragments originated. Conglomerate or breccia may be made up of any type of rock or mineral, most commonly durable material such as chert, quartz, quartzite, granite, and gneiss.

In Illinois, conglomerates commonly are found at the base of sandstone formations and as beds in the lower "Coal Measures." They also are found in some gravel deposits.

SANDSTONE (8)

SANDSTONE is a clastic sedimentary rock consisting of sand-sized grains (one sixty-fourth to one-sixteenth inch in diameter) held together by a cementing material. As sandstones become finer grained they grade into siltstones; as they become coarser grained they grade into conglomerate. The shape of sand grains in sandstones ranges from rounded to angular.

Quartz is the dominant mineral in sandstone, but other rock grains and mineral grains (especially chalcedony, feldspar, muscovite, hornblende, magnetite, or garnet) generally are present.

Sandstones are commonly cemented by carbonates, silica, iron oxides, or clays. Most sandstones are a shade of gray or brown, but the color may vary from gray or white to yellow, brown, or red. The color probably depends on the type of cement, the amount of organic material present, and the amount and degree of oxidation of iron in the rock.

Durability of sandstones depends largely on the character of the cement. Some sandstones crumble easily, but others, especially those cemented by iron oxides or silica, are tough and durable. Sandstones break around the grains, giving the broken surface a granular appearance.

Sandstone crops out in many places throughout much of the state. In LaSalle and Ogle Counties, large tonnages of sand are mined from the St. Peter Sandstone and sold for a variety of uses, including abrasive sand, molding sand, and sand for making glass. In extreme southern Illinois attractively colored sandstones have been quarried for building stone.

QUARTZITE (9)

QUARTZITE is a metamorphic rock that originally was quartz sandstone. Quartzites are produced by intense heat and/or pressure, probably aided by hot silica-bearing solutions. The quartz grains may be so closely interlocked that individual grains are no longer recognizable. The rock fractures conchoidally through both the grains and cement, so the broken surface, unlike that of sandstone, is smooth and may even be glassy like quartz.

Color depends upon the amount and kind of impurities present. A quartzite that is all quartz is white or gray, but iron or other elements may change the color to shades of purple, yellow, brown, or red. Quartzite is a very resistant, hard rock and cannot be scratched by a knife.

Quartzite is abundant as boulders and pebbles in glacial drift of Illinois, having been brought into the state during the "Ice Age."

SHALE (10)

SHALE is a common and important sedimentary rock composed of compacted clay or mud. It is so fine grained that the minerals forming it generally cannot be identified without the aid of X-ray.

Shales are composed mainly of clay minerals but, like other sedimentary rocks, generally include other minerals. Shales containing calcium carbonate are called *calcareous shales*. Most shales contain silt or sand particles; if silt or sand is present in large quantity, the rock is called *silty shale* or *sandy shale*. If mica minerals are present in quantity in a shale it is called *micaceous shale*.

The particles of most clay minerals are thin and flat and overlap each other.

Shales have a wide range of colors but most of those in Illinois are gray. A gray, black, or blue-gray color is caused by organic matter in the shale; shades of red, brown, yellow, or green are caused by iron compounds.

Shale is widely distributed in Illinois, especially in "Coal Measures" rocks, and is used in manufacturing bricks, drain tile, building tile, and lightweight aggregate.

CLAY (11)

CLAY is an unconsolidated rock made up of a group of hydrous aluminum silicate minerals, of which chlorite, montmorillonite, kaolinite, and illite are the most abundant. These minerals are formed by the weathering or alteration of other rocks and minerals.

Clays are very fine grained and their minerals have tiny, flat crystals that can be distinguished from each other only by laboratory methods. Although clays may appear to be similar, their compositions vary greatly.

Some clays are white, but most are colored by iron compounds and organic matter. Wet clays have an earthy odor and generally are slick and plastic, but dry clays are relatively hard and are greasy to the touch.

Clays are abundant in Illinois, especially in soils, in shales, and as clay deposits. In Illinois the underclays that occur beneath coal beds are particularly well suited to the manufacture of bricks, pottery, stoneware, and drain tile.

LIMESTONE (12)

LIMESTONE is a sedimentary rock composed of particles of calcite (calcium carbonate). The crystals may range from fine to coarse. Many limestones contain other minerals, such as chert, clay, or sand, and in some places they grade into dolomite (calcium magnesium carbonate).

Many limestones are white or gray. Yellow or brown shades are caused by iron oxide impurities and dark gray to black colors by organic matter.

Limestones form in various ways. Some are deposited when calcium carbonate precipitates from solution; others are formed when the shells or skeletons of organisms such as brachiopods, clams, and corals accumulate on a sea floor. If such fossils are very abundant, the rock is called fossiliferous limestone.

Limestone composed of tiny, rounded concretions is called *oolite* or oolitic limestone.

Limestone effervesces freely in dilute hydrochloric acid, but dolomite must be powdered before it will effervesce. In nature, limestones may be dissolved by percolating water containing weak acid (such as carbonic acid, composed of water and carbon dioxide). At many places in southern and southwestern Illinois such solution of limestones has produced caves and caverns.

Limestone outcrops are abundant in Illinois, especially along the bluffs of the Mississippi, Ohio, and Illinois Rivers.

Limestone has many uses. It is used for building stone, road surfacing, railroad ballast, in the manufacture of portland cement, and, if of high purity, for making lime and chemicals and as a flux in smelting metals. It also is used, as agricultural limestone, to add calcium to the soil.

PEAT (13)

PEAT is produced by the partial decomposition of plants that accumulate, with varying amounts of mineral matter, in old ponds, swamps, and lakes, and in abandoned channels in valley bottoms along many rivers and streams. Peat may be an early stage in the formation of coal.

Peat ranges from light to dark brown, the color, decomposition, and compaction increasing with depth in the deposit. Some of the plant remains are clearly distinguishable and appear as fibrous fragments held together by the fine peat particles. The type of peat common in Illinois has a high water content. Before it is dried it is soft and spongy to the touch; upon drying, it loses much water and becomes harder.

Peat is used as a fuel in some parts of the world, but its heating value is low compared to that of coal. It burns with a long flame and leaves a great deal of ash because of the silt and sand that were buried with the vegetation. Peat and peat moss are used chiefly as an absorbent, as stable litter, as insulating and packing material, and by gardeners to increase the water-holding capacity of soils.

Peat is found in many places in Illinois but the largest deposits are in northeastern Illinois.

COAL (14)

COAL, an organic stratified rock, is formed from accumulated plant material and partially decayed plants that were buried during the "Coal Measures" period in Illinois more than 200 million years ago.

Sediments deposited over the peat-like organic material compacted it. Chemical changes gradually took place and resulted in the loss of water and gases, leaving a higher percentage of carbon than the original material contained.

The amount of such change that has taken place determines the rank of the coal. The lowest ranks are called *lignite*, the intermediate group is called *bituminous* (soft) coal, and coals of the highest rank, with the highest carbon content, are called *anthracite* (hard coal). Mineral matter, such as shale, clay, or pyrite, generally is present in the coal and becomes ash when the coal is burned.

Most coal mined in the United States is bituminous coal. It is black, brittle, breaks into angular blocks, has a shiny luster, and generally shows a banded structure.

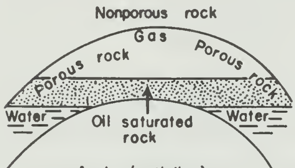
Coal mining is an important industry in Illinois, and the state contains the largest known reserves of bituminous coal in the United States. Minable coal beds underlie about two-thirds of the state. As many as 20 different coal beds have been mined in Illinois, the most important being the Herrin (No. 6) and the Springfield (No. 5) or Harrisburg (No. 5). The coal in most mining areas averages 5 to 7 feet thick and in places attains a thickness of 15 feet.

In underground mines the coal is approached by vertical or inclined shafts. In open cut, or strip, mines all of the overlying material (overburden) is removed, leaving the coal exposed. Coal as much as 100 feet deep is now being strip mined in Illinois.

Illinois coal is now used mainly for generating electric power, for industrial purposes, and for heating. In industry, coal is used extensively for power, heating, burning cement, firing clay products such as brick, tile, pottery, porcelain, and china, and making coke.

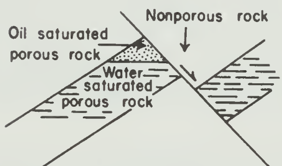
Certain Illinois coals when mixed with coal from the eastern part of the United States, produce metallurgical coke for making steel. Gases, oils, and tars derived in processing coal for coke have been used for making many chemical products, including dyes, perfumes, explosives, medicines, insecticides, plastics, and road tar.

PETROLEUM (crude oil) is classed as a mineral resource although it is a liquid hydrocarbon and not technically a mineral or rock. It is, however, found in the pores and fractures of rocks. The color of crude oil ranges from yellow through green and brown to black.



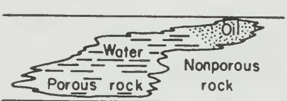
Arch (anticline)

Petroleum had its origin in the plants and animals buried in ancient sediments. The organic matter changed slowly into the complex mixture of hydrogen and carbon compounds that is petroleum.



Break (fault)

Because gas is lighter than oil, and oil in turn lighter than water, gas and oil move upward in a porous rock containing all three. Gas moves to the highest position with oil next below and water in the lowest part of the rock. Oil pools exist where geologic barriers have stopped the movement of gas and oil.



Trap formed by change in character of rock

Arches (upward folds or anticlines), breaks (faults), and lateral changes from porous to nonporous rock are geologic features that serve to localize oil pools within the reservoir rock.

Petroleum is obtained by drilling wells into the reservoir rock. Gas that is free or dissolved in the petroleum expands as pressure is released when the well is drilled and drives the oil to the well. Water in the reservoir rock also acts as a driving force. When this natural pressure is no longer effective, other methods (secondary recovery) are used to recover the oil remaining in the reservoir.

Porous sandstones and limestones are the oil bearing rocks. Illinois also has deposits of oil shale from which petroleum may be produced in the future.

Thousands of products are derived from petroleum, including gasoline, kerosene, naphtha, lubricating oils and waxes, medicinal oils, salves, heavy fuels, road oils, tar, and asphalt.

GLACIATED PEBBLES (16)

GLACIATED PEBBLES are small stones whose shapes have been altered by the grinding action of a glacier. Such pebbles commonly have at least one flattened side that shows scratches (called striae). The striae were produced when the pebbles were pushed over bedrock or ground against other pieces of rock.

Glaciers tore fragments from the bedrock over which they moved and the fragments accumulated in, on, and under the mass of ice. The rock fragments were transported, some of them far from their source, and were deposited as the glacier moved along or when the ice melted.

Soft rocks like limestone and dolomite are easily scratched, but soft rocks cannot make grooves in hard igneous and metamorphic rocks. Therefore soft rocks have more striae.

Glaciated pebbles can be found in deposits in many parts of the state, especially in northeastern and east-central Illinois. However, many deposits near the surface have been weathered and striae have been destroyed. An especially good place to look for striated pebbles is in quarries and strip mines where glacial drift overburden has been removed. Pebbles found in such deposits show good striae for they are but little weathered.

SILICA SAND (17)

SILICA SAND is the commercial name for sand composed almost entirely of grains of quartz. Sand of this kind is mined in Illinois from the St. Peter Sandstone in LaSalle and Ogle Counties. The coarser grains of the sand are characteristically rounded and frosted. The frosting causes the sand to look white.

Illinois silica sand has many uses. It is used just as it is mined for molding sand in which metal castings are made, for lining industrial furnaces, and for many other purposes. Some of the sand is washed to remove the small amount of impurities present. The washed sand is used for such purposes as making glass, for grinding plate glass smooth, for sand blasting, for molding metal, as fracturing sand to increase the production of oil wells. Some silica sand is ground to a fine powder and used as a fine abrasive, as a filler in paint, and as an ingredient in pottery, glazes, and enamel.

A specially prepared St. Peter sand, known throughout the world as Standard Ottawa Testing Sand, is used to test the strength of cements and as a laboratory standard in physical tests of other sands.

MOLDING SAND (18)

MOLDING SAND is a mixture of sand and clay or other bonding material and is used to make molds in which metal is cast into various useful shapes. There are two kinds of molding sands, synthetic and natural bonded. The first is an artificial mixture of silica sand and clay; the second is a naturally occurring mixture of sand and a bonding material.

For casting, molding sand is first moistened with water and shaped into a mold of the metal part to be reproduced. The mold is then allowed to dry and the molten metal poured into it. The bonding material in the sand must be strong enough to keep the mold in shape during these operations.

Natural bonded molding sand is produced in Fayette, Bond, Bureau, Carroll, Kankakee, and Rock Island Counties, Illinois.

TRIPOLI (19)

TRIPOLI, called amorphous silica in southern Illinois, is a white or light brown, powdery substance that rubs off on the hands like chalk. It consists mostly of very small particles of quartz that result from the weathering of calcareous chert or highly siliceous limestone.

It is finely ground and used as "white rouge" for polishing optical lenses, as a filler in paints, in making ceramic products, as a component of buffing compounds, and as a fine abrasive.

Tripoli occurs in Alexander and Union Counties and is milled at Elco and Tamms in Alexander County.

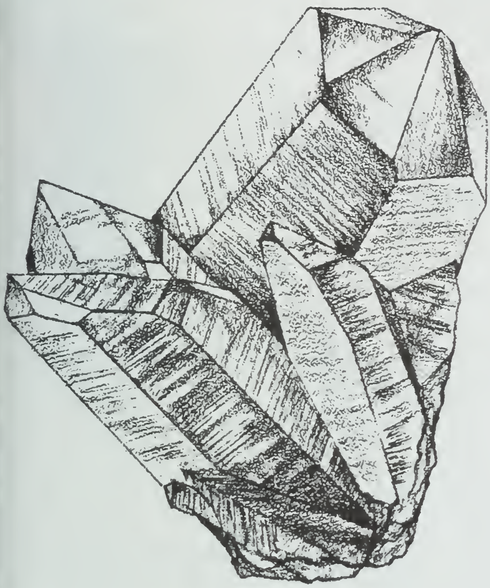
FULLER'S EARTH (20)

FULLER'S EARTH is clay or silty clay material that contains very fine silica. It is soft, nonplastic, opaque, has a greasy feel when wet, and does not readily break up in water. Its color varies from blue-gray to yellow or buff.

Fuller's earth is valuable for its unique property of absorbing and decolorizing substances. The material was first used to "full" or remove grease from woolen cloth, hence its name. It also has been used to filter and bleach mineral and vegetable oils by absorbing dark organic matter.

In Pulaski County in extreme southern Illinois the Porter's Creek Formation contains deposits of clay that were at one time the source of fuller's earth and still afford clay whose absorbent properties make it useful as litter and as sweeping and cleaning compound.

QUARTZ is the most common of all minerals, making up about 12 percent of the earth's crust. There are two main types of quartz - crystalline quartz and dense, crypto-crystalline (submicroscopic) quartz. Many dense varieties occur in Illinois, probably the most common are chert or flint.



Crystals of quartz are typically six-sided, elongated, have sharply pointed pyramid-like ends, and are apt to grow together forming twins. Good crystals are rare in Illinois, and the crystal structure is not apparent in the commonly occurring grains and masses.

Quartz is brittle and hard. It may be colorless or tinted, transparent or translucent, but more commonly it is white and nearly opaque. Transparent quartz looks much like ordinary glass, but it scratches glass easily. It has a glassy to brilliant luster and breaks irregularly or with a good conchoidal fracture.

Some varieties of quartz that are used for semiprecious gems are chalcedony, agate, onyx, and jasper. Chalcedony is waxy, smooth, generally translucent, white to gray, blue, brown, or black. Agate is a form of chalcedony that has a mottled or variegated banded appearance and may be yellow, green, red, brown, blue, gray, or black. Onyx is agate with parallel bands that as a rule are brown and white or black and white. Jasper, an impure opaque quartz, generally is red.

Quartz occurs as rock crystal (colorless, transparent), milky quartz (white, nearly opaque), and smoky quartz (smoky yellow to gray or brown) in geodes from the Warsaw and Keokuk Limestones of the Nauvoo-Hamilton-Warsaw area and as vein and cavity fillings associated locally with fluorite, sphalerite, and galena in extreme southern Illinois. It also occurs as vug (cavity) fillings in limestones and sandstones.

FELDSPAR (22)

FELDSPAR is the name applied to a group of minerals that are the second most common of all the earth's minerals. All feldspars are composed of aluminum, silicon, and oxygen, combined with varying amounts of one or more metals, particularly potassium, sodium, calcium, and lithium.

The minerals are hard, have a smooth glassy or pearly luster, and cleave along two planes nearly at right angles to each other. Feldspars are fairly light weight. The streak is white, but the color of the mineral is highly variable, although potassium and sodium-bearing feldspar are commonly white or pink and most plagioclase feldspar is gray.

Feldspars are essential parts of the crystalline igneous rocks. Their decomposition products are present in most soils. In Illinois relatively small feldspar crystals can be found associated with quartz and other minerals in granite and gneiss boulders and pebbles in glacial drift.

MICA (23)

MICA is the name of a family of complex aluminum silicate minerals that can be split easily into paper-thin, flexible sheets. If broken across the grain at right angles to the flat, smooth surface they fracture raggedly. In a single mica crystal the sheets range from more or less transparent to translucent and are arranged one on top of another like a deck of cards.

Micas are tough and somewhat elastic, soft enough to be split and scratched by a fingernail, and are light weight. They have a nonmetallic, glassy or pearly luster, although yellow mica may appear to be metallic. Color and streak depend upon the chemical composition of the mineral. Muscovite, or white mica, contains potassium and makes a colorless or white streak. Biotite, or black mica, contains iron and magnesium and is commonly dark green or black, although it may be shades of yellow or brown; its streak is uncolored.

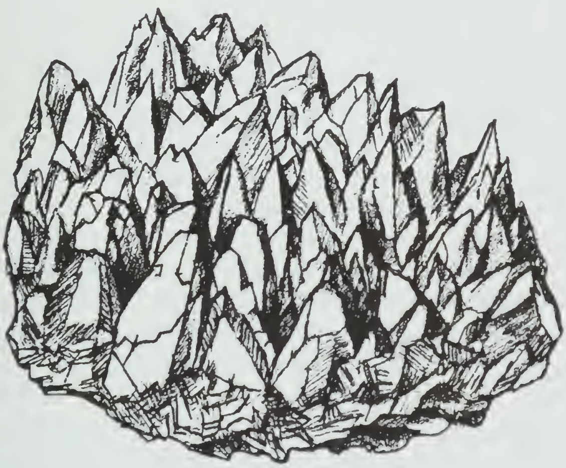
Mica is abundant as tiny, shimmering flakes in Illinois sands, sandstones, and shales (which are then said to be micaceous). It also is common in many varieties of igneous and metamorphic rocks. White or yellow flakes may show a brilliant luster and may be mistaken for silver, platinum, or gold, but those minerals are heavy and malleable whereas mica is not.

CALCITE (24)

CALCITE, a common rock-forming mineral, consists of calcium carbonate. The mineral is white or colorless, but impurities may tint it shades of yellow or gray. Transparent calcite is more rare than the tinted varieties.

Transparent calcite possesses the property of double refraction; an image appears double when viewed through a calcite cleavage block.

Calcite has a glassy luster, its streak is white or colorless. The mineral is of medium hardness and can be scratched by a penny or a piece of window glass but not by the fingernail. It is fairly light weight and effervesces freely in cold dilute hydrochloric acid.



Calcite has a variety of crystal forms but in Illinois flattened block-shaped crystals and elongate crystals with tapering points ("dogtooth spar") are the most common. When broken, calcite cleaves into six-sided blocks called rhombs.

Crystals of calcite are found in Illinois as linings in geodes in certain limestones and shales, especially in the Nauvoo-Hamilton-Warsaw area, and as crystalline masses in limestone and dolomite. Small amounts of clear crystalline calcite are associated with various ores in northwestern and extreme southern Illinois.

Calcite is the principal mineral in limestones and occurs as a component of many concretions.

FLUORITE (25)

FLUORITE, or fluorspar, is made up of the elements calcium and fluorine. The mineral is easily identified by its perfect cleavage, color, and hardness.

It occurs in cubic crystals that may be twinned but is more often found as irregular masses. It can be split into diamond-shaped, eight-sided forms (octahedrons). Fluorite is commonly gray, white, or colorless, but it may be green, blue, purple, pink, or yellow. The streak is colorless and the luster glassy. It can be scratched by a knife or a piece of window glass, is fairly light weight, and is transparent to translucent.

Extensive deposits of fluorite, one of Illinois' important commercial minerals, occur in Hardin and Pope Counties in extreme southern Illinois, where it is associated with galena, sphalerite, calcite, barite, and other less abundant minerals.

Fluorite is used to make hydrofluoric acid, to form a fluid slag in the production of iron and steel, in the manufacture of aluminum, to make many chemical products, and in the ceramic industry, in which it is used to make colored glass, enamels, and glazes.

GYPSUM (26)

GYPSUM, hydrous calcium sulfate, is a colorless, transparent to translucent mineral when pure, but it often is stained yellow by impurities. It has a white streak, is soft enough to be scratched by a fingernail, and is light weight.

Gypsum occurs in several forms. *Selenite* is a coarsely crystalline, transparent variety, composed of flat, nearly diamond-shaped crystals that can be split easily into thin sheets, have a glassy luster, and often grow together to form "fishtail twins." Crystals of selenite occur in shales of the "Coal Measures" of southern, north-central, and western Illinois, and can be picked up at the surface.

Satin spar has crystals like silky threads closely packed together, splits parallel to the fibers, and is found as fillings in rock cracks and as thin layers in shales. *Massive gypsum* is granular.

Gypsum deposits occur deep underground in Illinois but thus far have not been mined.

CHERT (27)

CHERT, one of the main forms of silicon dioxide, is cryptocrystalline (submicroscopic) quartz. Most of the chert in Illinois is white or gray, but impurities stain many deposits yellow, brown, or even pink. Chert is so hard that it can scratch glass and ordinary steel. It is fairly light weight, dense, opaque, and brittle; the luster is dull.

Flint, a variety of chert, is generally dark colored, more dense, may have a glassy luster and be transparent in thin flakes. Both chert and flint have a smooth, curved (conchoidal) fracture, but flint tends to break with thinner, sharper edges. Indians used flint and chert to make arrow points and spearheads.

Chert occurs as rounded masses (nodules and concretions) or as irregular layers in limestones and dolomites in northern, western, southwestern, and southern Illinois. Because chert is hard and more resistant to weathering than limestone or dolomite, it often remains after the rest of the rock has weathered away.

Chert also is abundant in many glacial deposits because it is hard and resists solution. Streams that flow through cherty bedrock or glacial deposits carry pebbles along and concentrate them as gravel in stream channels. Cherty stream gravels are especially abundant in western and southern Illinois.

Brown chert gravels in the southern part of the state are used for road gravel. Other deposits in extreme southern Illinois, consisting of angular fragments of chert and a small amount of clay (known locally as novaculite gravel) also are used for road surfacing.

White and gray chert occur as massive bedrock deposits several hundred feet thick in Union and Alexander Counties.

PYRITE AND MARCASITE (28)

PYRITE and MARCASITE are iron disulfide compounds. They look much alike but have different crystal forms. Both are brittle, hard, brassy yellow with metallic luster, and opaque. The best distinguishing feature is crystal shape. The pyrite crystals are cubes, but the marcasite crystals are blade- or needle-shaped.

Pyrite and marcasite have been mistaken for gold because they are yellow and metallic and hence are sometimes referred to as "fool's gold". They, however, are harder than gold, tarnish, and leave a dark streak, whereas gold is soft, very heavy, does not tarnish, and leaves a yellow streak. Gold is malleable, but pyrite or marcasite are reduced to powder if they are pounded and give off a noticeable odor of sulfur dioxide gas if they are heated.

Pyrite and marcasite are found in many deposits in Illinois. They occur as grains or larger masses in some clays, shales, and limestones. They also occur with the lead and zinc ores of northwestern Illinois and, in small amounts, with the fluorite and associated minerals in the extreme southern part of the state.

Both pyrite and marcasite are common as surface coatings, veins, and concretionary structures in coal and in dark shales associated with coal. They are referred to as "coal brasses" or "sulfur" when found as impurities in coal.

A potential use for pyrite and marcasite is in the manufacture of sulfuric acid for industrial use. Coal brasses recovered from Illinois coal have been so used.

LIMONITE (29)

LIMONITE is an iron oxide containing water and has a complex chemical composition. The limonite found in Illinois may be yellow, orange, red, brown, or black, but its streak is always yellowish brown. The mineral may have a glassy or an earthy luster. It may be too hard to be scratched by a knife. It is of medium weight.

Limonite is common and occurs as concretions and cavity fillings in sedimentary rocks, and as coatings on them, especially sandstone. It also occurs as iron rust, as scum on stagnant water, and it accumulates around rootlets in soils. Small amounts color limestone, dolomite, clay, shale, sandstone, and gravel. Some sands are firmly cemented by brown or black limonite and look much like iron ore. Clays containing a high percentage of limonite are called ocher.

In some states limonite is mined as an iron ore, and in Illinois it was so used in Hardin County in the middle 1800's, but deposits are not large enough for profitable use now.

SPHALERITE (30)

SPHALERITE, zinc sulfide, is a major ore of zinc. It has a resinous luster and a white, yellow, or brown streak. Illinois sphalerite is generally yellow, yellowish brown, reddish brown, or brownish black. It is of medium weight, brittle, can be scratched by a piece of window glass but not by a penny. It is commonly opaque but may be translucent on thin edges.

Sphalerite is mined with galena in northwestern Illinois and in extreme southern Illinois with galena and fluorite. Small crystals occasionally are found in limestones and as crystalline masses in clay-ironstone concretions.

GALENA (31)

GALENA, lead sulfide, is the principal ore of lead. It is steel gray, heavy, opaque, and has a bright metallic luster, though the shiny surface may be dulled by a coating of lead carbonate. It has a gray or black streak, is soft enough to mark paper, and can be scratched by a penny. The cube-shaped crystals readily break into cubic, right-angled fragments. Probably the most obvious features of the mineral are its bright metallic luster on fresh surfaces, high specific gravity, and cubic cleavage.

At many places galena is argentiferous (silver-bearing), but Illinois galena is relatively unimportant for its silver content. As a source of lead, however, it is an important commercial product of the state.

Scattered pieces of galena are found at many places in Illinois. Some occur in the glacial deposits, others occur as small pockets and as crystals in limestones and geodes. In only two areas of the state are deposits of commercial value. In northwestern Illinois galena occurs in association with sphalerite; in extreme southern Illinois it occurs in association with fluorite and sphalerite.

CONCRETIONS (32)

CONCRETIONS are concentrations of inorganic sedimentary material within other sediments. Minerals that commonly form concretions are silica (in the form of opal, chert, chalcedony, and quartz), calcite, siderite, pyrite, marcasite, and limonite.

Concretions may form either as the sediment around them is forming or after the sediment around them has hardened. They may be formed when water containing dissolved minerals seeps through the sediment or rock and leaves a concentration of mineral matter in a cavity or around a central particle (nucleus) such as the remains of a plant or animal. Portions of rock may also become firmly cemented by such mineral matter.

Concretions range in size from minute particles to objects several feet in diameter. Shapes range from spheres to tubes. Many are globular or lumpy-surfaced, some are smooth. Because concretions generally are harder than the surrounding rock in which they have formed, they do not weather away as readily and may remain after the surrounding material has been eroded.

Concentrations of calcite are found in loess deposits. They may look like bizarre, knobby figurines, and the Germans called them loess kindchen (little children of the loess).

Ironstone concretions, especially common in many Illinois shales, are formed by a local concentration of the mineral siderite (iron carbonate) in the rock. The concretions found in weathered outcrops commonly are partly or entirely weathered to limonite. Some ironstone concretions grow together into odd shapes. Mazon Creek ironstone concretions of northeastern Illinois, world famous for their fossils, are sideritic. The concretions are commonly covered with limonite, the result of oxidation.

Limonite concretions, generally with a high content of clay, silt, or sand, occur in loess, shale, and sandstone.

Concretions of chert and other forms of silica are common in limestones. In many places, because of their greater resistance to weathering, lenses and nodules of chert protrude from the beds.

Pyrite or marcasite occur as concretions or concretion-like masses in some coal beds and in the black shales, sometimes popularly called "slates," above coal beds. Some other Pennsylvanian clays and shales also contain concretions or coarsely crystalline aggregates of these minerals.

GEODES (33)

GEODES are roughly spherical bodies that may be filled with layers of minerals, lined with crystals, or both. The outer layer of geodes found in Illinois as a rule is composed of chalcedony, a form of finely crystalline silica.

Geodes differ from concretions in that they form inward from the outer shell, whereas concretions develop outward from a center. Even if geodes have been completely filled by mineral matter, their inward-projecting crystals prove that they formed within a cavity.

In a partly filled cavity, crystals generally are well formed because they grew without being crowded. Some of the best mineral specimens known in Illinois are found as crystal linings in geodes.

Quartz is the most common mineral deposited in geodes, but calcite, aragonite, dolomite, siderite, pyrite, galena, fluorite, and sphalerite also are found.

Geodes ranging in size from less than one inch to a foot or more in diameter can be gathered from streams where they have accumulated as residual boulders after the rock in which they were enclosed has been eroded.

Hollow geodes are the most desirable because they have better crystals. They can be distinguished from solid ones by their comparative lightness of weight.

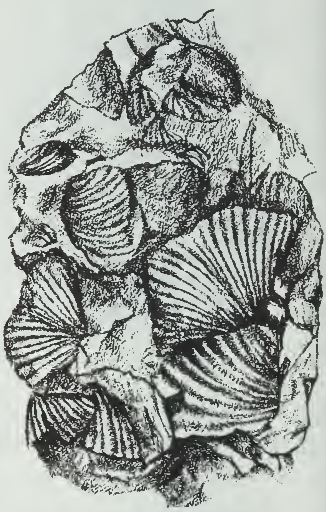
Geodes are commonly associated with limestone and dolomite, at some places with shale. In Illinois they can be found most easily in the Warsaw Formation in the area of Nauvoo, Hamilton, and Warsaw, but they also occur in other areas and other formations.

ANIMAL FOSSILS (34)

Prehistoric animals lived in water, on land, and in the air, and left both direct and indirect evidence of their existence, evidence we now call fossils.

Millions of ancient animals died without leaving a trace, but some, especially those that had hard parts such as shells, bones, or teeth, may be found preserved in rocks much as they were when buried beneath sediment on the floor of an ancient sea. Sometimes only imprints of the outside or fillings of the inside of the shells remain, the original material having been completely dissolved. Footprints of land or amphibious animals, burrows made by clams, or holes made by worms also are fossils.

The animals whose remains are fossilized lived and died while the sediments that contained them were being deposited, and they provide clues to the types of life and climate then existing. Fossils of animals characteristic of a certain time are an index to the age of formations where they occur. For example, if a certain trilobite (an ancient relative of the crayfish and lobster) is known to have lived only during a definite time, then all rocks in which it is found are the same age.



Fossils of animals that lived in the sea are exposed in rocks in many parts of Illinois, especially in quarries, river bluffs, and road cuts.

The oldest fossils found in Illinois are shells of marine animals — snails, corals, crinoids, brachiopods, trilobites, pelecypods (clams), cephalopods, bryozoa, arthropods, and others. The youngest fossils are teeth and bones of prehistoric bison, giant beavers, deer, mammoths and mastodons of the "Ice Age," and snails found in glacial loess.

PLANT FOSSILS (35)

PLANT FOSSILS are the remains of prehistoric plants. Woody structures of plants aid preservation just as hard parts of animals do. Leaves and plants without much woody material generally were well preserved only if they were buried quickly in fine, soft sediment.

The most famous Illinois plant fossils are those from the Mazon Creek area in Grundy and Will Counties of northeastern Illinois. The plant material acted as a nucleus around which iron minerals accumulated to form concretions. Many good fossils - of trunks, branches, leaves, and seeds - are found in coals and in shale directly overlying coals. Descendants of "Coal Measures" plants, such as ferns, mosses, and rushes, are still living today, but they no longer thrive as they did in the warm, moist climate of the Pennsylvanian forests.

Some plants of Pennsylvanian age are petrified, and occasionally such trees or stumps are found. Petrified trees are found also in the upper Mesozoic deposits of southern Illinois. Fossils of "Ice Age" plants closely related to forms living at the present time are occasionally found in peat bogs or scattered throughout glacial deposits.

KEYS FOR IDENTIFICATION OF COMMON ILLINOIS ROCKS AND MINERALS

Two keys, one for minerals and one for rocks, briefly present clues that may aid the collector in identifying rocks and minerals found in Illinois. In outline form, the keys are a guide to some of the easily observable properties that various rocks and minerals display.

The rocks and minerals in the school set of "Typical Rocks and Minerals of Illinois" are included, plus other relatively common ones you might find in Illinois. Because of the great diversity of rocks and minerals in this state, the keys are not conclusive. It is therefore suggested you consult other more complete keys (such as that in Dana's *Manual of Mineralogy*) when identifying rocks and minerals that are either from other states or are difficult to identify.

The minerals (p. 30-35) are arranged in two groups: 1) those with a metallic luster, and 2) those with a nonmetallic luster. Each group is arranged according to increasing hardness. Other characteristics such as color, streak, cleavage, fracture, and composition are listed.

The rocks (p. 36-39) are arranged according to their reaction to dilute hydrochloric acid applied to a scratched surface. (The acid reacts more readily to powdered material produced by scratching the rock.) After the reaction to acid has been determined, the texture and components of the rock should be noted. Because rocks grade into one another, clear distinctions are not always possible.

MINERAL IDENTIFICATION KEY

I. METALLIC LUSTER, STREAK COLORED

C - color S - streak	H - hardness Cl - cleavage F - fracture	Remarks	Name and composition
A. Hardness not more than 2.5			
C - lead gray S - black	H - 2.5 Cl - cubic; perfect in 3 directions F - subconchoidal or even	Very heavy; occurs as crystals, grains, or masses; easily identified by color and cleavage	Galena (31) PbS
C - copper red S - metallic, shiny	H - 2.5 Cl - none F - jagged	Very heavy; apt to have green coating; distorted or wirelike forms; malleable	Native copper Cu

C - color S - streak	H - hardness Cl - cleavage F - fracture	Remarks	Name and composition

B. Hardness greater than 2.5 but not greater than 6.5

C - yellow-brown to black S - yellow-brown	H - 5.5 (may be as low as 1) Cl - none F - uneven	In earthy masses; coloring material in many sandstones, conglomerates, and soils; often mixed with and difficult to distinguish from goethite and other iron minerals	Limonite (29) $FeO(OH) \cdot H_2O$
C - brassy yellow S - greenish black	H - 6 Cl - poor F - conchoidal to uneven	As compact masses, grains, cubes, and in 8- and 12-sided crystals; commonly associated with coal, and with lead-zinc ores of northwestern Illinois	Pyrite (28) FeS_2
C - pale brassy yellow to silver white S - greenish gray	H - 6 Cl - poor F - uneven	As fibrous, radiating, tabular, and cockscomb crystals or compact masses; usually lighter colored than pyrite, but difficult to distinguish from pyrite; associated with coal, and with lead-zinc ores of northwestern Illinois	Marcasite FeS_2 (28)

II. NONMETALLIC LUSTER, STREAK WHITE

A. Hardness not greater than 2 (can be scratched by fingernail)

C - usually white but may be almost any color	H - 2 Cl - perfect in one direction, less perfect in two others	Commonly found in Illinois as twinned or needle-shaped crystals in weathered shales containing pyrite and calcium carbonate	Gypsum (26) $CaSO_4 \cdot 2H_2O$

C - color	H - hardness Cl - cleavage F - fracture	Remarks	Name and composition
C - white or a shade of green	H - 2	As needle-shaped crystals or powdery coating on pyrite or marcasite; has an astringent taste	Melanterite $FeSO_4 \cdot 7H_2O$

B. Hardness greater than 2 but not greater than 3
(Can be scratched by a penny)

C - color	H - hardness Cl - cleavage F - fracture	Remarks	Name and composition
C - colorless, silver white, gray, brown	H - 2 - 2.5 Cl - perfect in one direction	In scales or "books"; splits into thin sheets; common in sandstones, shales, and in igneous and metamorphic rocks	Muscovite (white mica) (23) $(OH)_2KAl_2 AlSi_3O_8$
C - brown or black	H - 2.5 - 3 Cl - perfect in one direction	As scales or "books"; splits into thin sheets; common in igneous and metamorphic rocks but not in sedimentary rocks such as sandstone or shale	Biotite (23) (black mica) $(OH)_2K(Mg,Fe) AlSi_3O_8$
C - colorless, white, gray, and various tints.	H - 3 Cl - perfect in three directions, not at right angles (rhombohedral)	Common mineral; effervesces vigorously in cold acid; occurs in many crystal forms and as fibrous, banded, and compact masses; chief mineral in limestones	Calcite (24) $CaCO_3$
C - white, gray, red, or almost any color	H - 3 Cl - perfect in one direction, less perfect in two other directions	Very heavy; commonly in tabular crystals united in diverging groups, as laminated or granular masses; associated with fluorite in southern Illinois	Barite $BaSO_4$

C - color S - streak	H - hardness Cl - cleavage F - fracture	Remarks	Name and composition
C. Hardness greater than 3 but not greater than 5 (Cannot be scratched by penny; can be scratched by knife)			
C - white, gray, light yellow	H - 3.5 Cl - in one direction F - uneven	Relatively heavy; effervesces in acid; associated with fluorite and barite in southern Illinois but is not abundant	Witherite $BaCO_3$
C - white, pink, gray, or light brown	H - 3.5 Cl - perfect in three directions, not at right angles (rhombohedral)	In grains, rhombohedral crystals and cleavable or granular masses; effervesces slowly in cold acid when powdered, more vigorously in warm acid; principal mineral in rock called dolomite	Dolomite $CaMg(CO_3)_2$
C - colorless, white, gray, grayish black	H - 3.5	In fibrous or compact masses or may be in orthorhombic crystals as a coating on galena; very heavy; effervesces in acid; formed by alteration of galena	Cerussite $PbCO_3$
C - brown to gray S - usually white but may tend toward brown when weathered	H - 3.5 Cl - in three directions not at right angles (rhombohedral) slightly curved surfaces	In fibrous or botryoidal masses or rhombohedral crystals; effervesces in hot acid	Siderite $FeCO_3$
C - yellow, yellow-brown to almost black S - light yellow to brown	H - 3.5 Cl - parallel to dodecahedral faces; in six directions	In crystals, in fibrous or layered masses; associated with galena in northwestern Illinois, with fluorite and galena in southern Illinois	Sphalerite ZnS (30)

C - color	H - hardness Cl - cleavage F - fracture	Remarks	Name and composition
C - colorless, white, yellow, purple, green, blue	H - 4 Cl - perfect, parallel to octahedral faces; in four directions	In cubes and cleavable masses; many colors; mined in Hardin and Pope counties	Fluorite (25) (Fluorspar) CaF_2
C - white, tinted yellow, blue, or green	H - 5	As crystalline incrustations or in earthy or compact masses; associated with fluorite-sphalerite ores in southern Illinois, with galena and sphalerite in northwestern Illinois	Smithsonite $ZnCO_3$

D. Hardness greater than 5 but not greater than 7

C - white, green, brown, black	H - 5 - 6 Cl - in two directions intersecting at about 60° and 120°	In long, slender 6-sided crystals; cleavage angle important in differentiating from pyroxenes; common in metamorphic and some igneous rocks	Amphibole Group $(Mg,Fe,Ca)_7$ $(Si_8O_{22})(OH)_2$ (may also contain Na or Al)
C - gray, dark green, black, dark brown, bronze	H - 5 - 6 Cl - in two directions intersecting at about 90°	Crystals short, stout, and 8-sided; cleavage angle important in differentiating from amphiboles; common in igneous and some metamorphic rocks	Pyroxene Group $(Mg,Ca,Fe)_2$ (Si_2O_6)
C - white, gray, pink, light blue, green	H - 6 Cl - in two directions nearly at right angles	As crystals, cleavable masses and grains; common in igneous and metamorphic rocks, also in stream gravel and sand; many varieties	Feldspar Group (22) K, Na, Ca, Ba $(Al,Si)_4O_8$
C - white when pure; may be colored by impurities	H - 7 Cl - none F - conchoidal	Finely crystalline variety of quartz; botryoidal or concretionary masses; lining in geodes	Chalcedony SiO_2

C - color	H - hardness Cl - cleavage F - fracture	Remarks	Name and composition
C - colorless, white, or almost any color	H - 7 F - conchoidal	Most abundant mineral; occurs in 6-sided crystals capped by pyramids, in grains or masses; principal mineral in sandstone, also abundant in igneous and metamorphic rocks; is a variety of silica	Quartz (21) SiO_2
C - red	H - 7 F - conchoidal	A variety of quartz usually colored red by hematite inclusions; common in glacial and river sand and gravel found along Lake Michigan shores and in the Mississippi River	Jasper SiO_2
C - many· arranged in bands	H - 7 F - conchoidal	Cloudy banded variety of silica; widely used as semi-precious stones. Onyx and silicified wood are forms of agate; found in glacial gravels and upper Mesozoic sediments in southern Illinois	Agate SiO_2

E. Hardness greater than 7 (cannot be scratched by quartz)

C - red, brown, yellow, green, black, white	H - 7.5 Cl - poor F - even	Irregular grains or masses; sometimes as 12-, 24-, and 36-sided crystals; abundant in glacial sands and Lake Michigan beach sands; common in metamorphic rocks	Garnet Group $(Ca, Mn, Fe, Mg)_3 (Al, Cr)_2 (SiO_4)_3$

ROCK IDENTIFICATION KEY

SAMPLE

Scratch with a knife and apply dilute acid (HCl)
If rock does not scratch, go directly to I, II, or III

- No effervescence or very slight effervescence
  - I Coarse-grained (p. 37)
  - II Fine-grained (p. 38)
  - III Organic (p. 39)
- Vigorous effervescence
  - Composed of pebbles that effervesce
    - Rounded pebbles
      - Limestone conglomerate
    - Angular pebbles
      - Limestone breccia
  - Large amount of insoluble residue left on acid-treated surface
    - Individual grains seen with unaided eye
      - Calcareous sandstone
    - Individual grains not seen with unaided eye
      - Calcareous shale
  - Composed of crystals of calcite, fossil shells, or oolites
    - Limestone
  - Composed of porous or cellular mass of calcite; commonly found near springs and waterfalls
    - Tufa
  - Composed of banded layers of crystalline calcite; commonly found in caves, forming stalactites and stalagmites
    - Travertine
- Slight effervescence
  - gray, light gray, white, or brown
    - Dolomite

I COARSE-GRAINED ROCKS

A. Rock consists of interlocking grains or crystals, easily seen; too hard to scratch with a knife

1. Crystals aligned in one direction

a) Crystals in parallel bands with layers of quartz and feldspar separated by mica and other minerals — Gneiss (6)

b) Crystals in thin parallel bands; tends to split into thin sheets parallel to banding; some varieties may be scratched with a knife — Schist (6)

2. Crystals not aligned in any particular direction

a) Light gray, pink, red, or tan with only a few dark minerals; feldspar and quartz principal minerals — Granite (1)

b) Dark to medium gray; composed of feldspar and dark minerals with little quartz — Gabbro (2)

c) Dark green to black; essentially dark minerals, may have some feldspar; quartz generally lacking — Peridotite (5)

d) Light color; similar to granite in texture but lacks quartz; composed of feldspar and some dark minerals — Syenite

e) Large, easily seen crystals set in a fine- to extremely fine-grained background; any color — Porphyry (3)

f) Essentially quartz; grains may be identifiable; specimens break through rather than around grains — Quartzite (9)

B. Rock composed of individual rock particles or fragments, non-interlocking crystals, cemented or not cemented together; may or may not be scratched with a knife

1. Particles or fragments not uniform in size; a mixture of pebbles, sand, and smaller materials

a) Solid rock consisting of particles or fragments generally rounded and cemented together — Conglomerate (7)

b) Solid rock consisting of particles or fragments, generally angular and cemented together — Breccia

c) Fragments ranging in size from clay to large boulders; may be compacted, but not cemented; much clay generally present; may effervesce — Glacial till

d) Loose particles of many sizes, not cemented together; some particles may effervesce — Gravel

2. Rock particles or fragments, about the size of grains of sugar (2 to .05 mm)

a) Loose particles consisting largely of quartz — Sand (17, 18)

b) Solid rock consisting largely of quartz; can be separated easily into individual particles; granular; breaks around rather than through grains — Sandstone (8)

II FINE-GRAINED ROCKS

A. Cannot be scratched easily with a knife; crystals or particles not easily seen with the unaided eye; very hard; difficult to break; may contain a few crystals or particles large enough to see; granular

1) Dense; brittle; splintery or conchoidal fracture; sharp edges and corners when broken; often associated with limestone; usually white or gray; very dense, dull varieties called flint — Chert (27)

2) Light gray, pink, red, or tan varieties common; boulders or fragments in the glacial drift — Felsite

3) Dark gray, greenish, black, or maroon varieties common; may have small mineral-filled cavities; occurs as boulders or fragments in the glacial drift — Basalt (4)

4) Essentially quartz; grains may be identifiable; specimens break through rather than around grains — Quartzite (9)

B. May or may not be scratched with a knife; fairly uniformly fine grained

1) Soft; feels slippery or soapy when wet; may disintegrate in water; gives off an earthy odor when breathed upon	Clay (11, 20)
2) Loose; gritty; particles smaller than table salt	Silt
3) Solid rock; often in thin beds or sheets; separates into silt; mica flakes may be present; may contain fossils; may effervesce slightly	Siltstone
4) Solid rock; breaks into thin platy sheets; may feel slippery when wet; black to gray; may contain fossils; shows thin laminations; may effervesce	Shale (10)
5) Solid rock; does not break into thin platy fragments; may effervesce slightly	Mudstone
6) Solid rock; usually gray or black; splits into platy sheets or slabs; harder than shale	Slate
7) Powdery; white or light brown; commonly associated with chert and quartz from which it forms	Tripoli (19)

III ORGANIC ROCKS (DARK COLORED)

A. Soft; spongy when wet; very lightweight when dry; forms in swampy places

1) Fine mass with coarse plant fragments; dark gray to black	Peat (13)
2) Plant fragments small and not easily recognized; fine-grained; black to dark gray; earthy	Muck

B. Hard but can be scratched with a knife

1) Black; contains bands of shiny and dull material; burns well	Coal (14)
2) Dark gray to black; does not contain shiny bands; splits into thin sheets; burns poorly or not at all	Bituminous shale (10)

EQUIPMENT FOR COLLECTING

1. Hammer (bricklayer's) with one chisel or pick head.
2. Cold chisel about 6 inches long with an edge about $\frac{1}{2}$-inch wide.
3. Dilute hydrochloric (muriatic) acid (10 percent solution) in a dropper bottle for testing the presence of carbonate minerals. Mark the bottle POISON. If acid is spilled on skin or clothing, wipe immediately and, if possible, rinse with water.
4. Magnifying glass or hand lens - 10 power is probably most useful.
5. Hardness testers - penny, square of window glass, pocket knife, or nail.
6. Streak plate - piece of unglazed white porcelain (such as the back of a tile) for testing the color of the streak of minerals.
7. Notebook and pencil for keeping records of the locality and bed from which specimens are collected.
8. Collecting bag - a musette bag, a knapsack, or similar bag of strong material.
9. Heavy gloves and goggles to protect hands and eyes.
10. Labels and wrappings. Field identification of specimens may be written on adhesive tape and attached to the specimen or on a slip of paper enclosed in the wrapping. Newspaper, brown paper, or paper bags can be used for wrapping specimens. Label the outside of the wrapped specimen too. Take only the best specimens home with you. Trim specimens to hand size (about 2 by 3 inches).

All specimens should be labeled with the following information: name of mineral or rock type, where found, collector's name, and date. As your collection grows, you may want to set up a system of cataloging. List specimens and assign a number to each one. Place a small amount of white enamel on a corner of each specimen; when the enamel dries, number the sample with India ink; coat number with lacquer. Corresponding numbers should be entered on your list of specimens.

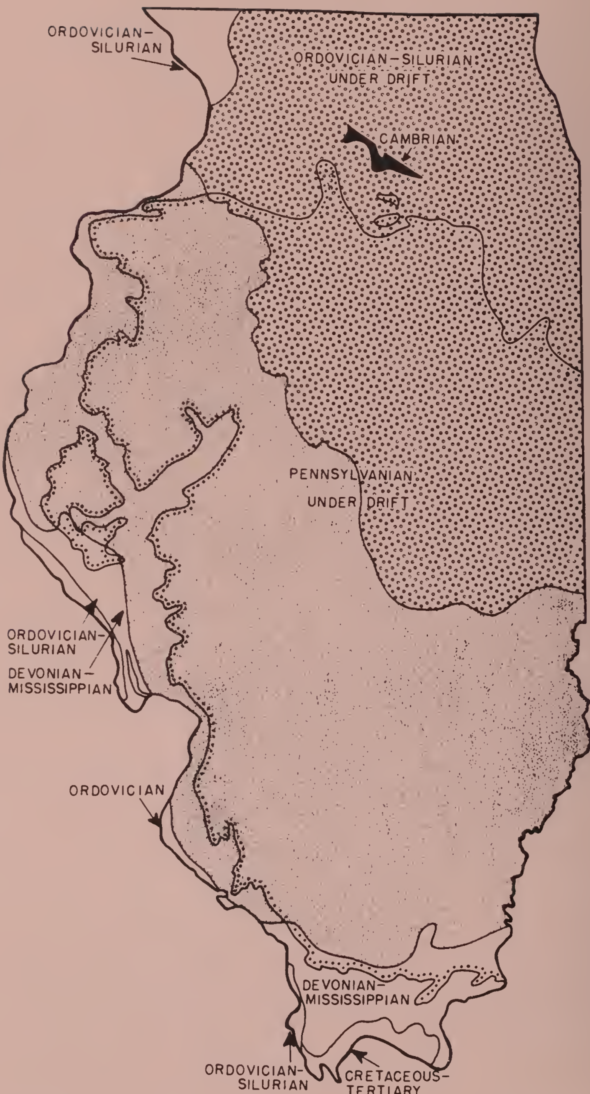
Geoscience Education and Outreach

The Geoscience Education and Outreach Unit of the Illinois State Geological Survey uses many channels to inform the public about the geology and mineral resources of the state and the results of the Geological Survey's research. The unit distributes nontechnical publications, offers sets of rock and mineral specimens to Illinois schools and educational groups, presents lectures and exhibits, responds to inquiries, conducts workshops for teachers, and leads field trips. The unit's four full-day field trips, each conducted in a different area of the state, offer teachers, students, and the general public the opportunity to learn about the geologic processes that shaped the land and formed the rocks.

The unit's work is specifically designed to assist in the teaching of earth sciences and help citizens understand how the research programs of the Geological Survey help to protect the envrionment and strengthen the economy of Illinois.

This book was originally prepared in 1959 by Betty Jean Hanagan, I. Edgar Odom, and Shirley J. Trueblood, under the direction of George M. Wilson. They were assisted by other members of the Geological Survey staff, especially J.E. Lamar and J.C. Bradbury of the Industrial Minerals Section.

Illinois State Geological Survey
Champaign, Illinois



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