



SEDIMENTS AND SEDIMENTARY ROCKS OF SOUTH DAKOTA

What Are Sediments?

Sediments are accumulations of *clasts* (particles or fragments). The particles may include sand on a beach, sea shells piling up on the ocean floor, or even dust settling out of the air onto the furniture in your home. These particles accumulate in layers on the earth's surface. In sediments, each individual particle is separate from the others, they are not cemented together.

What Are Sedimentary Rocks?

Most sedimentary rocks form by the cementation of sediment into one rock layer. Some sedimentary rocks form by the consolidation of plant (i.e., coal) or animal remains (i.e., some limestones). Other sedimentary rocks form by precipitation from a solution (i.e., salt). There are three main types of sedimentary rocks; clastic, *organic*, and chemical.

How Are Clastic Sedimentary Rocks Formed?

Clastic sedimentary rocks are formed from the *erosion* and redeposition of particles of older rocks in water, ice, or air. These *clasts* may be of any rock type, even older clastic sediments. *Clasts* are found in many different sizes, some being

too small to see without the help of a microscope. Very small *clasts* (*clay-* and *silt-sized* particles) make up the black *shale* hills near Chamberlain and Pierre (Fig. 1). Clastic fragments may also be very large, up to several inches across. Rocks containing large fragments can be seen along the Fall River near Hot Springs and other places in the Black Hills.

Clastic fragments that have been churned or moved around by water for a long time are usually smooth, round, and similar in size. The sand that makes up the *sandstone* in many of the steep ridges in and near Rapid City are examples of these types of clastic sediments. A similar *sandstone* with well-rounded and smooth clasts can be found in the banks of Firesteel Creek near the city of Mitchell.

Other clastic sedimentary rocks may contain particles that have been moved around very little by moving water. These rocks would be characterized by particles of many different sizes and angular shapes. Some streams in the Black Hills have stream beds composed largely of angular and poorly-sorted clasts.

Sediments that have been moved by the wind are composed of small particles

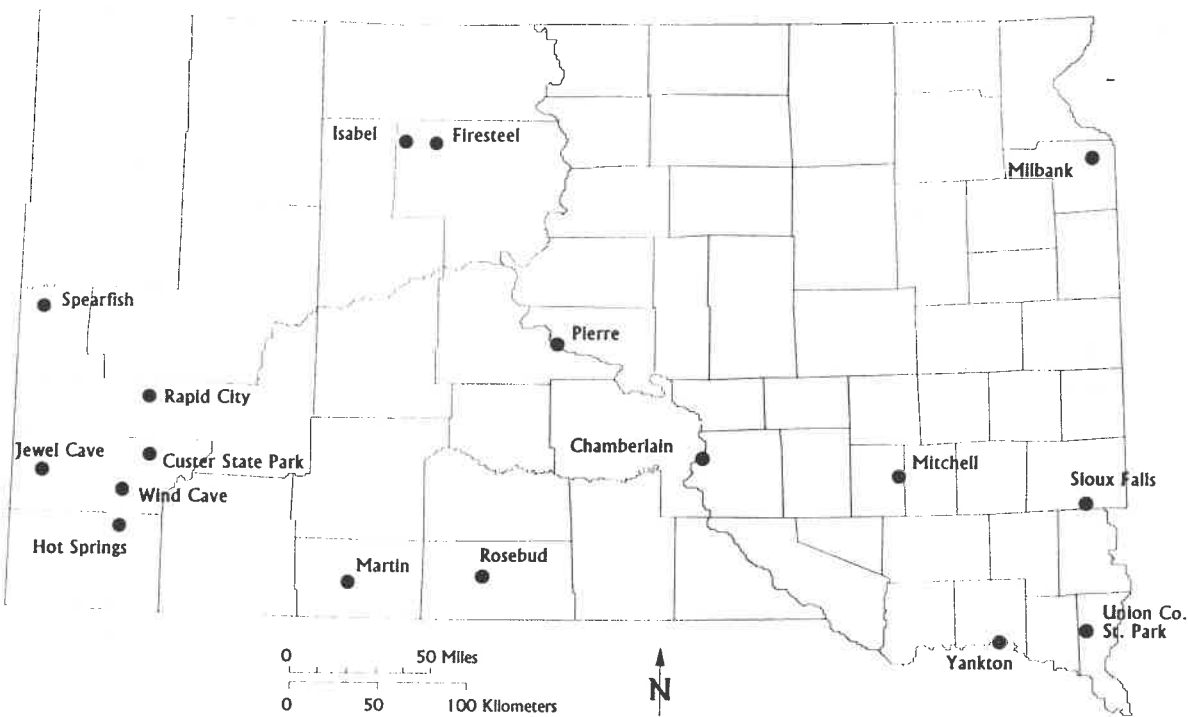


Figure 1. Location of rock outcrops mentioned in text.

(sand, *silt*, or *clay*) and are very uniform in size. The sand hills south of Martin and Rosebud are composed mainly of windblown sandy sediments. Many of the hills north of Sioux Falls are capped by windblown *silt*, called *loess*.

Sediments deposited directly from glacial ice produce a mixture of *clay*, *silt*, sand, and boulders, called *till*. Many road cuts and freshly cultivated fields in eastern South Dakota display glacial *till*.

How Are Organic Sedimentary Rocks Formed?

Organic sedimentary rocks are composed of the remains or products of plants or animals. Many limestones are composed mainly of the fossil shells of relatives of the oysters, clams, and other shellfish common in today's oceans. These shells range in size from microscopic size to more than 3 feet (0.9 meters) across. Although some limestones in South Dakota were formed in lakes, most of the state's limestones were formed during times when large inland seas covered the region. In fact, most of South Dakota's sedimentary rocks are marine in origin, that is, they were deposited from sea water.

Some *organic* sedimentary rocks, such as coal, were formed on land. Coal forms black layers in the hillsides of northwestern South Dakota, near Firesteel and Isabel. Careful examination of fist-sized lumps of these rocks will often reveal stems, leaves, and wood from trees and other plants that once grew in low-lying forests and swamps.

How Are Chemical Sedimentary Rocks Formed?

Chemical sedimentary rocks are formed by natural chemical reactions in nature. These reactions take place mainly through the process of chemical precipitation. Precipitation is the process in which dissolved minerals separate from a body of water and accumulate as a solid on the sea or lake bottom. To better visualize this process, dissolve some table salt in a pan of water. After the water has evaporated (this may take a few days), salt *crystals* will reappear as it precipitates from the water.

Gypsum is a very common type of chemical sedimentary rock in South Dakota. It is a soft rock that is used as a soil additive and to make plaster of Paris. Some of the gypsum in South Dakota formed from the evaporation of shallow

seas millions of years ago. Gypsum exists as white beds within the red rocks near Spearfish and in the eastern rolling hills in Custer State Park. Other types of gypsum are found in parts of eastern South Dakota. Clear gypsum *crystals* up to 3 inches (7.6 cm) long can be found in the rock cliffs near Yankton and along the creek bed in Union County State Park. These gypsum *crystals* were formed by a chemical process that separated the gypsum from the surrounding *shales* after they were buried within the earth.

Some of South Dakota's most interesting rocks are still forming by chemical precipitation. The strange and beautiful "flowstone," the *crystal* linings, and most of the graceful columns within Wind Cave, Jewel Cave and other caves in the southern Black Hills, are the products of chemical precipitation.

Why Are Sedimentary Rocks Important?

Almost all of the state's ground water is contained in sediments or sedimentary rocks. Well drillers look for certain types

of sediments and sedimentary rocks to find ground water resources. These sediments include sand, gravel, sandstone, fractured limestone, and *chalk*.

Sedimentary rocks contain some deposits that are economically important. Though other types of rocks in the Black Hills contain most of the state's gold, silver, and other metals, about 10 percent of the state's mineral resources come from sedimentary rocks. These include lime, *clay*, gypsum, uranium, gold, silver, lead, tungsten, sand, and gravel. South Dakota's sedimentary rocks also contain oil, gas, and coal deposits.

Where Are Sedimentary Rocks Found In S. D.?

Sedimentary rocks make up nearly the entire land surface of South Dakota. Other rock types make up the land surface only in the center part of the Black Hills and a small area near Milbank in the northeastern part of the state. Figure 2 shows the extent of sedimentary rocks in South Dakota.

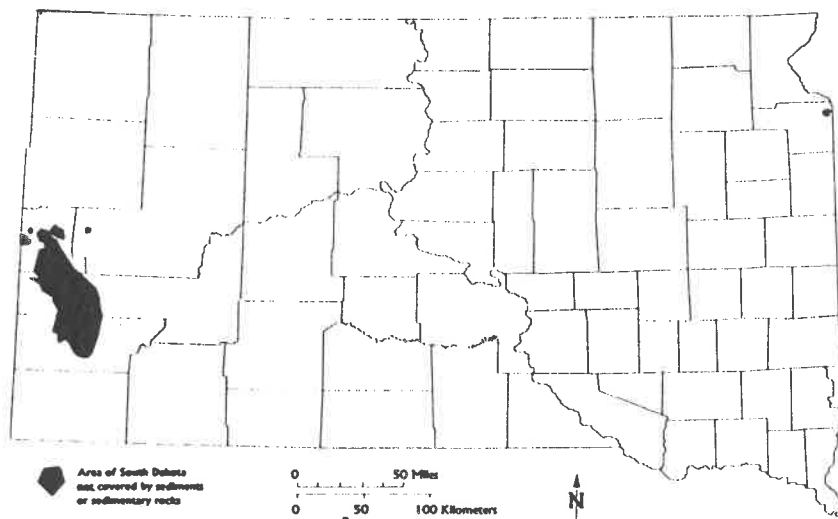


Figure 2. Area of South Dakota not covered by sediments or sedimentary rocks.

Glossary

Glossary terms are adapted from Bates, R.L., and Jackson, J.A., 1987, Glossary of Geology, American Geological Institute, Alexandria, Virginia.

Cementation - the process of becoming cemented or stuck together.

Chalk - a soft, powdery, light-colored limestone that was deposited from sea water.

Clasts - fragments of older rock.

Clay - a rock or mineral fragment being smaller than 0.00016 inches (1/256 millimeters) in diameter.

Crystals - a uniform solid body of a chemical element, compound, or mixture having a characteristic set of planar surfaces or faces; some common crystals may be cubes, rectangular, or blade shaped.

Erosion - the processes in which the materials of the Earth's surface are loosened, dissolved, or worn away, and moved from one place to another.

Limestone - a sedimentary rock made chiefly of calcium carbonate, mostly in the form of calcite.

Loess - a widespread windblown deposit of dust, usually of silt-sized rock or mineral fragments. The fragments are usually held together weakly by a limy cement.

Organic - materials that were produced by living things or were originally parts of the skeleton or tissues of living plants or animals.

Sandstone - a clastic rock composed mainly of fragments between 0.0025 inches (1/16 mm) and 0.08 inches (2 mm) in diameter, more or less firmly bonded by some cementing material.

Shale - a fine-grained clastic sedimentary rock formed by the cementation of clay and/or silt.

Silt - a rock or mineral fragment larger than 0.00016 inches (1/256 millimeters) and smaller than 0.0025 inches (1/16 millimeters) in diameter.

Till - a mixture of clay, silt, sand and rocks deposited directly by glaciers.

Selected Resources for Teachers

Minerals and Rocks of South Dakota by B.C.Petsch and McGregor, D.J., 1973. South Dakota Geological Survey Educational Series no. 5. A non-technical guide to minerals and rocks found in South Dakota.

Mineral and Water Resources of South Dakota by the South Dakota Geological Survey, 1964. S.D. Geological Survey Bulletin 16, 295 pp. An overview of South Dakota's geology, water, and mineral resources.

Physical Geology by C.C.Plummer and McGeary, D., 1985. Wm. C. Brown Publ., Dubuque, Iowa.

Record of Life by D.J. McGregor and Petsch, B.C., 1968. South Dakota Geological Survey Educational Series no. 2, 38 pp. Non-technical description of South Dakota's fossil resources. Contains numerous original drawings and pictures.

South Dakota's Rock History by B.C. Petsch and McGregor, D.J., 1969. South Dakota Educational Series no. 3, 39 pp. Booklet describing the history recorded in South Dakota's rocks. Contains numerous original drawings.

The Geology of Wind Cave by A. N. Palmer, 1981. 42 pp. Booklet rich with pictures and drawings showing and describing the geology and scenic wonders of Wind Cave, S.D.

Outreach (Resource Agency Personnel)

(See Natural Source directory for phone numbers.)

Earth Sciences Department, University of South Dakota, Vermillion, SD 57069.

Geology Department, S.D. School of Mines and Tech., 501 E. St. Joseph, Rapid City, SD 57701.

Museum of Geology, S.D. School of Mines and Tech., 501 E. St. Joseph, Rapid City, SD 57701.

South Dakota Geological Survey, Akeley Science Center, USD, Vermillion, SD 57069.

U.S. Geological Survey, Rm. 408 Federal Bldg., 200 4th Street SW, Huron, SD 57350.

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