

## Fort Dodge Gypsum: A Salt from Iowa's Jurassic Sea

by Raymond R. Anderson

One of Iowa's most valuable mineral resources is found in a small area of central Webster County, in and around the town of Fort Dodge. The resource is gypsum, and this deposit, part of the Jurassic-age Fort Dodge Formation (about 145 million years old), comprises one of the most pure gypsum deposits known on Earth. The occurrence of this gypsum was first reported in the 1850s from natural exposures at the land surface, and it was mined as building stone by early settlers in the area. Today, gypsum is used primarily to produce wallboard (also called Sheetrock), which is valued for its versatility, fire-retarding properties, and ease of installation. The value of gypsum mined annually in the Fort Dodge area to feed this flourishing gypsum wallboard industry is about \$10 million.

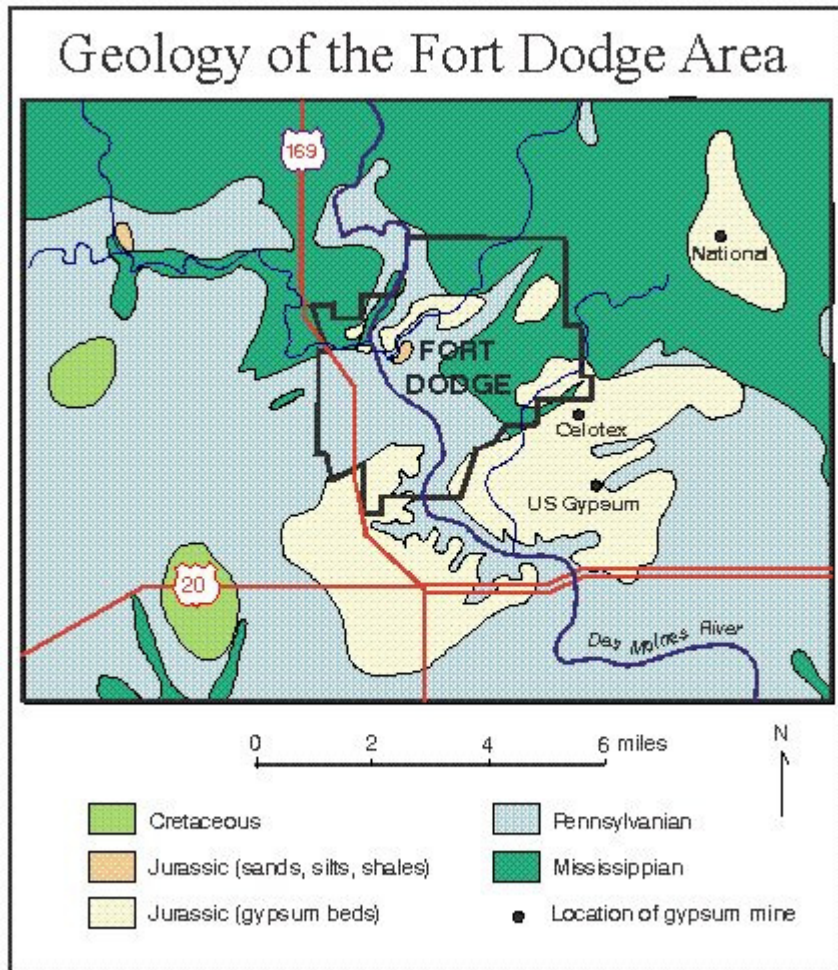


**Thin light and dark bands seen in this 30-inch high ledge of Fort Dodge gypsum may reflect seasonal variations in the evaporation and crystallization of the gypsum salt about 145 million years ago. *Photo by Ray Anderson.***

Gypsum is a soft, white to gray, "chalky" mineral (see photo above) composed of calcium sulfate and water ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ). The gypsum at Fort Dodge, like most commercial-scale deposits, had its origins in the evaporation of seawater from a restricted shallow basin. Water from the Jurassic-age Sundance Sea passed over a low-lying barrier into the basin, where the mineral salts became concentrated by evaporation in the hot semi-tropical sun. When the brine became sufficiently concentrated, gypsum crystals formed and settled to the floor of the basin. The gypsum beds at Fort Dodge average over 95% pure gypsum and contain no anhydrite (a common alteration mineral contaminant.) The extent of the original depositional basin is unknown, but it was certainly larger than the 15 square miles of gypsum remaining today.

As the Jurassic passed into the Cretaceous Epoch about 135 million years ago, the continent slowly drifted northward out of the dry latitudes where the gypsum formed, into wetter, more temperate latitudes closer to North America's present position. Great Cretaceous rivers flowed across Iowa, first eroding most of the original gypsum deposit, then reburying the region with river sediments. The remaining gypsum was buried for tens of millions of years until a new episode of erosion uncovered it, and again began to wear away the resource. Most recently, the gypsum bed was buried once again, this time by glacial materials carried by continental ice sheets that advanced into Iowa beginning about 2.5 million years ago.

In 1852, geologist David Dale Owen first reported the occurrence of gypsum in the area that is now Fort Dodge. In the first geological survey of the region, he reported a "supply {of gypsum that} may be considered as almost inexhaustible," exposed along the Des Moines River. In 1893, Iowa Geological Survey geologist C.R. Keyes described the gypsum deposit at Fort Dodge as "by far the most important bed of plaster-stone known west of the Appalachian chain if not in the United States." The success of the first gypsum mill in the region, the Fort Dodge Plaster Mill built in 1872, led to the construction of others. By 1902, seven mills were operating and producing a variety of products including building blocks, mortar, plaster, roofing and floor materials. During the 125 years of industry operations in Iowa, at least 30 different business entities have mined or processed Fort Dodge gypsum. Today three companies operate mines, running two shifts a day, and four companies process gypsum, operating their mills 24 hours a day. The most recent production data available (1994) indicates that a total of about 1.5 million tons of Fort Dodge gypsum are mined yearly, with a value of \$10 million. The Fort Dodge area accounts for about 75% of Iowa's total gypsum production, and the state, as a whole, is second only to Oklahoma in total production. Fort Dodge gypsum constitutes about 12-13% of the total U.S. production. Because of the limited extent of the gypsum resource at Fort Dodge, Owen's "inexhaustible" supply will be depleted within about 30 years at its current mining rate.



Although it was mined from underground in the past, gypsum is currently extracted by stripping in open pits (see photo below). After mining, the gypsum is processed into a variety of products, the most common of which are wallboard and plaster-of-Paris. To produce wallboard, the gypsum is "calcined," an industrial term for the process that includes the grinding of gypsum to a fine powder which is then heated for 2 to 3 hours. During the heating process, the powdered gypsum goes through a complex series of temperatures (as high as 204°C) that drives off some of the water to produce a material called  $\beta$ -hemihydrate. To manufacture the wallboard, the  $\beta$ -hemihydrate is combined with water to form a slurry that is poured onto a continuous strip of special paper. As the slurry crystallizes, forming tiny interlocking needles of gypsum, a top layer of paper is added with rollers that insure the proper thickness. The wallboard then goes through heaters that expel excess water as the board solidifies. It is then cut to size and stacked for shipping.





**The smooth, deeply creviced surface of the Fort Dodge gypsum beds results from groundwater movement along a series of intersecting vertical fractures in the soft gypsum. This surface is revealed during mining operations, when overlying glacial deposits are removed.**  
*Photo by Ray Anderson.*

Gypsum from the Fort Dodge area was used to create one of the great hoaxes in U.S. history. In the 1860s, New England native George Hull traveled to Fort Dodge and purchased one acre of land along Gypsum Creek. He engaged local quarrymen to excavate the largest block of gypsum possible (about 2 feet thick, 4 feet wide, and 12 feet long). The block was shipped to Chicago where sculptors carved it into the form of a giant man. Then they scoured the sculpture with a sandy sponge to remove the chisel marks and "aged" the figure by pitting it with needle-tipped hammers and discoloring it with sulfuric acid. The sculpture, now appearing very old, was shipped to New York and secretly buried on an up-state farm near Cardiff. A year later, while digging a well, the "petrified man" was "discovered" and proclaimed the "eighth wonder of the world." Despite being quickly identified as a hoax by eminent Yale paleontologist O.C. Marsh, the Cardiff Giant went on tour, earning Hull about \$20,000. The giant came home to Fort Dodge for display between 1913 and 1923, and then was returned to New York where it is currently on exhibit at the Farmers Museum in Cooperstown.

*For further information:*

*R.D. Cody, R.R. Anderson, and R.M. McKay, 1996, Geology of the Fort Dodge Formation (Upper Jurassic) Webster County, Iowa: Iowa Department of Natural Resources Geological Survey Bureau Guidebook No. 19, 74 pages.*

*Rodenborn, L.V., 1972, A History of the Gypsum Industry in Fort Dodge and Webster County, Iowa: privately printed, 127 pages.*

**Adapted from *Iowa Geology 1998*, Iowa Department of Natural Resources**