Silicon

Lisa Corathers, the Silicon Commodity Specialist for the U.S. Geological Survey, has compiled the following information about silicon, an extremely versatile mineral with many applications in the manufacture of iron and steel, aluminum alloys, chemicals, and electronic microchips.

In the industrialized world, silicon is as ubiquitous in the objects people use every day as it is in nature. The second most abundant element in Earth's crust and more than 25 percent of the crust by weight, silicon is one of the most useful elements to humans.

Perhaps the most commonly known use of silicon is the microchip or the integrated circuit — thus its namesake, Silicon Valley. With the advent of the microchip in 1962, the high-purity grade of silicon metal (containing greater than 99.99 percent silicon) helped usher in the modern electronic age. While its importance in electronics is undeniable, this use of silicon accounts for only about 5 percent of total silicon metal consumption.

Silica (SiO2) as quartz or quartzite is used to produce silicon ferroalloys for the iron and steel industries, and silicon metal for the aluminum and chemical industries. More than half of the silicon consumed yearly in the United States is used as ferrosilicon.

Silicon carbide (SiC, the only chemical compound of carbon and silicon) is one of the hardest substances known, and is used as an industrial abrasive and as a substitute for ferrosilicon in iron-making. Steelmaking consumes some silicon metal, and the semiconductor industry refines some for use. Microsilica (silica fume) is a byproduct from furnaces that make silicon metal or ferrosilicon with a silicon content of at least 75 percent. It is used as binder and filler in cement. In the form of sand and clay, silica is a component of concrete and brick. And as sand, it is a principal ingredient of glass.

Only oxygen is more prevalent in Earth's crust, and silica itself is not found free in nature. It occurs chiefly in oxide and silicate minerals. Sand, quartz (silica), agate, flint, jasper and opal are some of the oxide minerals in which silicon is found. Granite, hornblende, serpentine, feldspar, clay and mica are but a few of the many silicates comprised of silicon, as the name indicates.

For the past five years, ferrosilicon and silicon metal production in the United States has been from locally mined silica at the average rate of 256,000 and 158,000 metric tons per year, respectively. U.S. consumption of ferrosilicon averaged 329,000 metric tons per year, and silicon metal averaged 165,000 metric tons. Even with significant domestic resources and production, the United States annually imports silicon materials to meet demand. The reliance on imports has averaged about 42 percent for ferrosilicon and 39 percent for silicon metal. The reliance for silicon metal imports has increased steadily from 29 percent in 1999 to 55 percent in 2002; U.S. production has decreased because domestic producers have been unable to compete with imports.

World production of ferrosilicon has been approximately 4 million metric tons (gross weight) per year over the past five years. Production of silicon metal in the world, with the exclusion of China, has been about 645,000 metric tons per year. Although firm data are lacking, China's

production of silicon metal is believed to be the world's largest. China's annual output of silicon metal was estimated at about 300,000 metric tons in 2002.

On a silicon content basis, Western world consumption of ferrosilicon averages about 1.7 million metric tons per year, and silicon metal averages about 968,000 metric tons per year. Because of its abundance in Earth's crust, silica reserves around the world are more than adequate to sustain silicon production levels indefinitely.

Originally published as *Geotimes* Mineral Resource of the Month, November 2003
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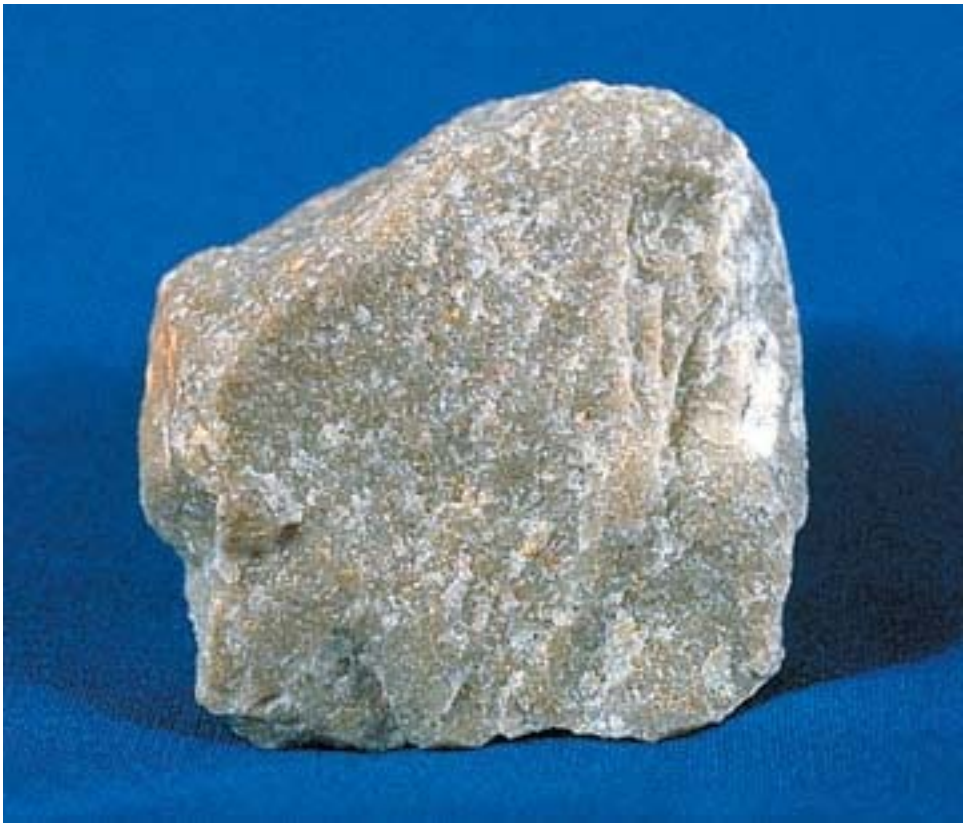

Silica (SiO2) as quartz or quartzite (shown here) is used to produce silicon ferroalloys for the iron and steel industries, and silicon metal for the aluminum and chemical industries. Image from *Minerals in Your World*.