Material Name: Flint (Silica)

Etymology:

“silica”
OED Latin: silex- their word for this mineral, or flint
French: silice
“flint”
OED Old English flint strong masculine = Middle Dutch vlint, related to Old High German flins (Middle High German vlins, modern German dialect flins), Danish flint strong masculine, Swedish flinta weak feminine; usually regarded as cognate with Greek πλίνθος tile.

Interesting early history with Flint:

Perhaps the most impressive story about flint is that of the ancient mining complexes that were built in what is now England during Neolithic times. These excavations began about 4000 BC and continued until the widespread use of metals about 2,000 years later.
One flint mining complex of particular note was Grime's Graves located near Brandon, England. Here ancient miners dug shafts down through 40 feet of Cretaceous chalk to a layer of high-quality flint below. Each shaft was several feet in diameter and required the removal of about 2,000 tonnes of chalk. Most of the digging was done without metal tools, using red deer antlers as picks. Each shaft required a team of workers and took several months to construct.
About 60 tons of flint could be removed from each of these pits and the short horizontal excavations that followed the high-quality flint layer at the base. Starting about 3000 BC until about 1900 BC, these miners built over 400 shafts over an area of about 100 acres and removed thousands of tons of flint.
Although these mining operations were amazing feats of engineering, just as impressive was the geological understanding of the workers. They knew that the flint was below the ground even though it did not outcrop anywhere in the immediate area. They also knew that the highest quality flint layer was below lower quality zones that were encountered during the early digging. (Geology.com)

Uses in studio ceramics:

Pure silica minerals (like quartz) have high melting points. In ceramic bodies and glazes other oxides are added to complement it, they form silicates with it or occupy the network between particles of quartz. In the latter case silica is considered a 'filler' (e.g. porcelain clay bodies). It is interesting that some special purpose (and expensive) clay bodies replace the silica filler with calcined alumina, this increases body strength and reduces thermal expansion.

High quartz bodies are usually unsuitable for ovenware and ware that must tolerate sudden temperature changes. However this behaviour is advantageous to glaze fit since it puts the 'squeeze' on the glaze to prevent crazing. At the same time silica in glazes tends to dissolve and form low expansion silicates that reduce glaze expansion and also prevent crazing. In both cases, silica powder of small grain size is advantageous.

High temperature traditional ceramic bodies tend to have up to 30% silica whereas low fire ones have much less or none (because of its refractory nature).

When limestone and silica are available in a body they can react to form wollastonite. This adds mechanical strength and is exploited in tile bodies. For optimal results the relative percentages must be in balance and the forming and firing methods tuned to optimize the effect. (DigitalFire, “Silica”)

Other Uses:

Glass production, abrasives, building stones (concrete). Quartz used in jewelry and test tubes, flint as a fire starter.
California State, Los Angeles

Dozens of other applications, ranging from sand for golf courses and volleyball courts to proppant for fracking. Proppant is essentially a sand-water mix that keeps fissures in the ground open during the fracking process

Proppant: The Greatest Oilfield Innovation of the 21st Century

Health Risks

Industrial sand used in certain operations, such as foundry work and hydraulic fracturing (fracking), is also a source of respirable crystalline silica exposure. About 2.3 million people in the U.S. are exposed to silica at work. (OSHA)

Silicosis: Silicosis is a type of pulmonary fibrosis, a lung disease caused by breathing in tiny bits of silica, a common mineral found in sand, quartz and many other types of rock. Silicosis mainly affects workers exposed to silica dust in jobs such as construction and mining. Over time, exposure to silica particles causes scarring in the lungs, which can harm your ability to breathe. (American Lung Association)

Source Location and Extraction Process/Conditions:

US Silica Company supplies Rocky Mountain Clay, according to email, although specifically what and how much RMC is buying from US Silica they will not share.

US Silica mines silica in many forms all over the country. Their website shows that they have several different silica products, each with multiple source mines. Some products (such as Sil-Co-Sil or Q-Rok) seem better suited for ceramic applications than others (such as ASTM Sands or Pro White, which is specifically processed for use in golf courses).

Without RMC's information as to what specific product they are buying, we're left to infer where this material is coming from based on which of their products are suited for ceramics applications and then which of those source locations are best situated for transportation. Ceramics appear to be a negligible portion of their market, but with the interactive map of their locations its possible to make educated guesses.

Four of US Silica's locations are economically situated to serve RMC:

4800 Oklahoma Highway 1 North
Mill Creek, OK 74856 (produces Sil-Co-Sil and 100 Mesh)

819 East Osage Street Pacific, MO 63069 (produces Sil-Co-Sil and 100 Mesh)

701 Boyce Memorial Drive Ottawa, IL 61350 (produces Sil-Co-Sil and 100 Mesh)

105 Burkett Switch Road Jackson, TN 38301 (produces Sil-Co-Sil and explicitly mentions ceramics)

Each of these locations mentions surface mining. The Missouri and Illinois locations mention "a variety of mining methods, including hard rock and hydraulic mining" and "mechanical mining" for Illinois. They all use natural gas and electricity in their mining.

Refinement Process:

"various processing methods, including hydraulic sizing, fluid bed drying, grinding and air sizing….rotary drying, screening and grinding."

US Silica appears to locate their processing facilities at or very near the mining locations.

Distribution Journey:

From a number of locations, likely a combination of all of them. The Oklahoma location is the closest (740 miles from RMC) and the Tennessee location is the farthest (1,090 miles from RMC). We can say that CSU's silica materials, as supplied by US Silica, travel anywhere from 810 to 1,160 miles from mine to University.

Geologic Origins:

The geologic origins of this material will vary greatly depending on where it's coming from. For instance, Missouri's St. Peter Formation has a hugely different and older history than Oklahoma's Oil Creek Formation.

Generally, though, silica is everywhere because silicon is crazy about bonds.

“The variety and abundance of the silicate minerals is a result of the nature of the silicon atom, and even more specifically, the versatility and stability of silicon when it bonds with oxygen…The Si-O bonds within this tetrahedral structure are partially ionic and partially covalent, and they are very strong…Therefore, by understanding how these silica tetrahedra form minerals, you will be able to name and identify 95% of the rocks you encounter on Earth's surface…

The silica tetrahedra can polymerize, or form chain-like compounds, by sharing an oxygen atom with a neighboring silica tetrahedron. The silicates are, in fact, subdivided based on the shape and bonding pattern of these polymers, because the shape influences the external crystal form, the hardness and cleavage of the mineral, the melting temperature, and the resistance to weathering….

Quartz only makes up an estimated 12% of the entire crust, but it is by far the most common mineral we see on the surface because of its resistance to weathering.

(Anne Egger, VisionLearning.com)

Synopsis:

The word silica comes from the Latin word “silex,” which referred to the mineral flint, a very common naturally-occuring form of silica. Silicate minerals such as flint and quartz are one of the most common and abundant materials found in Earth’s crust thanks to the silicon atom’s ability to form strong, long-lasting, and versatile bonds with oxygen.

Humans have been mining and using flint to make tools and weapons for longer than recorded history. A fascinating example comes from an area known as Grimes Graves in eastern England. Between roughly 4000 and 2000 BC, people dug 40-ft deep conical shafts using deer antlers to extract thousands of tons of high-quality flint.

In studio ceramics, silica is used as a filler in clay bodies and also in glazes to reduce expansion and crazing. When combined with limestone, the silica can form wollastonite and increase a body’s mechanical strength, which is used in the production of tiles.

Beyond ceramics, silica is used in the production of glass, abrasives, and concrete. Quartz is a popular jewelry item and goes into the production of laboratory test tubes, and flint is commonly used as a fire-starter. Silica also comes in the form of high-quality sands, which go into golf courses, volleyball courts, and many other recreational activities. Silica sand is also used in the fracking process as a proppant, essentially a sand-water mixture that holds tiny cracks and fissures open underground so that all of the oil and gas within them can be extracted.

Silicosis is a lung disease caused by breathing in microscopic bits of crystalline silica over long periods of time. This is a common problem for people who work regularly in close proximity to fine silicate materials.

U.S. Silica is a global industrial minerals producer with numerous silica mines across the United States. Similar to dolomite, we don’t know the precise mines supplying Rocky Mountain Clay with ground silica, but it’s reasonable to assume that U.S. Silica’s closest mines are the ultimate sources. There are four such mines that produce the grades of ground silica appropriate for ceramic purposes, and these are in Oklahoma, Missouri, Illinois, and Tennessee.

The Oklahoma mine is closest to Denver, and Tennessee is the farthest. Silica is most likely coming from any combination of these four mines at any given time, and so we can say that the material travels anywhere between 810 and 1,160 miles from mine to studio.

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