Parks and Open Space Update *by Lisa (Rusty) Goetz*

Rock'n with Rusty

Now that warm weather is here, many of us are out walking about Four Hills Village (FHV) admiring the colors of the newly emergent flowers. Look alongside these beautiful blooms and you can see colors of another sort. Many of the homes in FHV were built with stone facia decoration of unusually colored rocks. Also, many folks have placed rocks with interesting colors in their gardens. Here is a summary of the mineralogy of some of the more uniquely colored rocks and a stab at possible quarry locations for these stones. Please take the mineral and rock summaries listed below with a grain of salt (another mineral), as I have not crossed into anyone's yard to examine closely the rocks or collect samples for analysis.

Rocks are a little like chocolate chip cookies. "Rocks" (the finished cookie) are made up of "minerals" which are the ingredients. The "host rock" is often made up of a mixture of very fine crystalline minerals that sometimes intergrow with each other and, at other times, may become cemented together by yet other minerals (like the ingredients in cookie dough). Sometimes certain individual minerals will grow to larger sizes and can be seen by the naked eye (like chocolate chips) or they will form layers that fill up fractures within the host rock (like Oreo cookie filling). These layers are frequently weak zones within the rock. When they are quarried, the host rocks will break along these zones leaving the mineralized layer exposed (like icing on a cookie). Just like cookies, almost all rocks need to be "baked" by nature. Unlike cookies, the formation of a rock may also take lots of pressure which is usually produced by deep burial in the earth.

Chrysocolla

Some homes in FHV have walls made up rocks coated with a mineral that is a powdery-looking blue-green. Most probably these rocks contain "chrysocolla" which is a very common minor ore of copper. Chemically, it is a trash basket mixture of elements including copper, phosphates, silica, and a whole bunch of other minerals tossed in, in various amounts. It has wide range of hardness and copper content. It ranges in color from dark blue green to bright turquoise blue to very pale blue green. In general, chrysocolla has a chalky texture and forms fracture coatings or veins, within a darker host rock.

There are numerous places where these rocks could have been quarried. The closest is probably in the Cerrillos Hills, northeast of the Sandia Mountains, where it would have been associated with the volcanic rocks that contain the turquoise and the local copper/gold deposits. Another area known to have produced chrysocolla is in the Kelly Mining District on the west side of the Magdalena Mountains, west of Socorro. However, that district has been closed for more than 50 years. The most prolific source for chrysocolla would be in and about the giant open pit copper mines in the Silver City area of southwestern New Mexico or those in southeastern Arizona. It could also have been imported from the copper districts in northwestern Mexico.

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Turquoise
Turquoise is defined as an opaque, soft blue-to-green mineral that is actually a hydrated phosphate of copper and aluminum, with the chemical formula $CuAl_6(PO_4)_4(OH)_8 \cdot 4H_2O$. New Mexicans know it is a gem with historic and religious value. As far as I know, only the residents of FHV are decorated with turquoise, but here are a couple of fun facts about our local turquoise mine in the Cerrillos Hills.

Starting around 600 B.C.E., the Cerrillos turquoise deposits were worked and widely traded by the local Pueblo tribes. Cerrillos turquoise has now been identified by chemical "fingerprinting" in both Aztec and Mayan ceremonial objects. Surprisingly, the local turquoise was deemed to be of little value by the European settlers. However, a turquoise jewelry fashion craze in the 1880's drove up the price and mining at Cerillos then became economic. When turquoise prices rose to a peak in the mid 1880's, Tiffany & Co. contracted for all the turquoise the America Turquoise Company could mine from their Cerrillos claims. Between the mid 1880's and 1900, Tiffany & Co. supposedly sold over $2 million dollars' worth of Cerrillos turquoise jewelry and had such success with the Cerrillos turquoise jewelry that they patented its color as "Tiffany Blue" and ever since have used it on their signature boxes. The mine is now largely worked out but some local artisans continue to mine turquoise using hand tools.

Green Phyllite Schists
Another green/blue green facia stone used in FHV is a "phyllite" or "phyllite schist". It is a low-grade metamorphic rock formed when shaley sandstones are buried and placed under geologically moderate heat and pressure. The original minerals are reformed (metamorphosed) into new minerals. Within the rock, these new minerals tend to line up in sheets which form very fine layers called "foliation". Most often phyllite or phyllite schist will break (fracture) along these zones. The green color comes from the color of tiny crystals of the minerals "chlorite" and "epidote". Typically, phyllite and phyllite schist have a silvery-shiny look that is due to two other minerals, "mica" and "sericite", which are very reflective and are also aligned within the foliation zones. The rock, phyllite, is made up of mineral crystals that are too small to be seen with the naked eye. The mineral crystals in phyllite schists are much larger than in phyllite and can been seen as individual crystals without any magnification.

In New Mexico, these phyllites and green phyllite schists are usually associated with Precambrian age granites (greater than 600 million years old). They can be found in the mountains up and down the Rio Grande Rift System (today's Rio Grande valley) wherever the ancient granites are layered next to the metamorphosed former sandstone beds. I suspect the rocks used in FHV were taken from very small quarries located on private lands that may no longer be in business. The most likely areas to quarry this building stone would have been in the Manzano and Los Pinos Mountains. Possibly some of the stone could have come from the Tijeras area.

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Greenstone

Many homes here have a dull or matte green-gray to dark green rock with rough edges in their gardens. This is probably a type of rock called "greenstone". Most of the time the minerals making up this rock are too small to be seen with the naked eye. These minerals include: "quartz", "feldspars", "epidote", "actinolite", "hornblende", "chlorite", "biotite mica", "calcite", and derivatives of eroded volcanic rock and phyllites. The greenstone in our area is thought to have been formed from metamorphosed basalts (an iron-rich volcanic rock type), possibly interlayered with both rhyolites (a quartz rich-volcanic rock type) and sandy shales. These original rocks were both erupted and laid down underwater in rift valleys that formed beneath an ocean during Middle Phanerozoic time, more than 1.7 billion years ago. These rocks were later buried very deeply (producing geologically very high pressure but only moderate temperature) and were later uplifted and crushed when the Tijeras Fault Zone was activated more than a billion years ago.

Massive outcrops of "Tijeras Greenstone" can be found on the south side of Tijeras Canyon and southeast of Carnuel. It usually as forms dark green-grey cliffs and slopes where it outcrops. Another greenstone occurrence, known as the "Hell Canyon Formation", can be found in a layer that is about 5,000 feet thick in and about the Hell Canyon area of the central Manzano Mountains.

Milky Quartz

Many of us have seen the almost pure white, glassy-looking boulders and cobbles both in gardens and along the Open Space trails. This is variety of the very common mineral, "quartz". The opaque white form is called "milky quartz". Quartz is nature's answer to glass. It has basically the same chemical formula as clear glass (SiO_2) but differs in that it is crystalline substance. Like glass, if you chip quartz, it will form conchoidal fractures that are very similar to fractures seen on broken glass. Milky quartz is the same as pure quartz (sometimes called "rock crystal") which is colorless and transparent. The difference between them is that during the formation of milky quartz, tiny inclusions, similar to bubbles, of liquid SiO_2, or gas and/or water, are trapped within the quartz mass. These inclusions diffuse light and give milky quartz its wonderful glowing white color.

The milky quartz boulders we have in our yards were probably broken out of the quartz veins that crisscross the Sandia and Manzano Mountains. These veins are younger than the granite, which is about 1.2-billion years old, and can be on the order of over a half-mile long and tens of feet in width. Typically, quartz fills in preexisting fractures or faults. The old-time prospector searched for these quartz veins because the same fluids that emplaced the quartz often carried gold, silver, iron, and other precious metals in small quantities. These precious metals could be deposited in mostly pure bands within the quartz or as finely disseminated, nearly invisible inclusions within the quartz. When the miners found an economic deposit of this thick vein quartz with metals, they called them "reefs".