QUARTZ (var. PINK)

Rare Crystals from Brazil's Pegmatites

Because of its availability, affordability, degree of crystal development, and the beauty of its many color varieties, quartz is among the most widely collected of all minerals. Among its many color varieties are water-clear rock crystal, gray-brown smoky quartz, white milky quartz, purple amethyst, yellow citrine, rose quartz, and pink quartz. All major color varieties of quartz serve as gemstones.

Until recently, all pinkish-colored quartz was known simply as "rose quartz." But mineralogists now recognize two distinct varieties that are properly called rose quartz and pink quartz. Despite their similarity of color, rose quartz and pink quartz differ greatly in structure, abundance, degree of transparency, mineralogical occurrence, origin of color, and cost. Of all the quartz color varieties, rose and pink quartz are the most confused among collectors.

Before considering the differences between rose quartz and pink quartz, let's look first at quartz itself. Its name stems from the German *Quarz*, which in turn comes from the Slavic word *kwardy*, meaning "hard." Quartz [silicon dioxide, SiO_2] consists of 46.74 percent silicon and 53.26 percent oxygen.

Quartz is a member of the silicates, the largest of all mineral groups. Silicon and oxygen, which are essential elements in all silicate minerals, are the most abundant elements in the Earth's crust. More than 2,000 silicate minerals collectively make up an estimated 75 percent of the weight of the Earth's crust. Quartz, the most abundant of these silicate minerals, comprises 12 percent of the total crustal weight.

Widely distributed, quartz has many interesting and unusual varieties and habits and occurs in virtually all igneous, metamorphic, and sedimentary rocks. It forms as a component of crystallized magma in both intrusive and extrusive (volcanic) rocks; by the crystallization of silica-rich, hydrothermal fluids; and by the downward percolation and crystallization of silica-rich groundwater.

Quartz occurs in both microcrystalline and macrocrystalline forms. Microcrystalline quartz is chalcedony, a compact or massive form consisting of interlocked grains of microscopic silica; varieties include chert, jasper, and agate. Macrocrystalline quartz occurs as large, individual, transparent-to-translucent crystals or crystal groups and includes rock crystal, amethyst, and smoky and milky quartz. Large, well-developed crystals of macrocrystalline quartz are most often found in granite pegmatites and hydrothermal veins.

Quartz crystallizes in the hexagonal system with four axes, three of which are of equal length and lying in a plane. The fourth axis, which is unique to the hexagonal system, is of variable length and perpendicular to the plane of the other three. The most common quartz habit is the hexagonal or six-sided prism, in which all six prismatic faces are parallel to the unique axis. Quartz crystals are terminated by hexagonal pyramids or dihexagonal (12-sided) pyramids. Because of strong covalent, omnidirectional bonding within the lattice, quartz crystals have neither cleavage planes nor centers of symmetry. The strong bonding and lack of cleavage account for quartz's great durability and substantial hardness of Mohs 7.0. The low atomic weights of silicon (28.09) and oxygen (16.00) account for quartz's low specific gravity of 2.65.

As an allochromatic or "other-colored" mineral, the colors of quartz are caused by factors other than essential elements or crystal structure. Pure quartz is colorless, but traces of chromophoric (color-causing) impurities can distort the symmetry of the crystal lattice to impart a wide range of colors. Quartz colors can also be caused by the effects of natural geophysical radiation and subsequent lattice defects called “color centers,” as is the case with pink quartz.

Transparent and colorless rock crystal consists essentially of pure silica. The purple-to-lilac color of the amethyst variety is due to traces of iron and manganese. The characteristic yellow to golden-yellow color of transparent citrine is due to traces of iron. Transparent-to-translucent smoky quartz has a grayish-brown to nearly black color that is caused by exposure to natural geophysical radiation. The white color of milky quartz is due to tiny, bubble-like inclusions of gases and liquids.

The cause of the colors in both the rose and pink varieties of quartz is more complex, however. Mineralogists have only recently offered satisfactory explanations of the origins of their colors.

Consider rose quartz, which is much more abundant than pink quartz. Rose quartz occurs only in massive form and does not exhibit crystal faces, edges, or terminations. It has a hazy translucency and is found exclusively in the core zones of granite pegmatites.

Known since antiquity, rose quartz is a popular gemstone and ornamental stone. Because of its translucency, it is not faceted, but is instead fashioned into cabochons and beads for use in jewelry. It is also carved into such decorative items as spheres, pyramids, figurines and, most commonly, heart-shaped objects. Because it occurs in large masses, it can be fashioned into decorative objects more than 12 inches in size. And because of its abundance, rose quartz is relatively inexpensive.

Rose quartz colors range from pale pink to pinkish-red and are caused by the trace presence of non-essential chromophores (color-causing agents). The primary chromophore in rose quartz is titanium, but mineralogists believe that iron and manganese also play a role. These chromophores distort the crystal lattice, causing it to absorb all white-light wavelengths except red, which it reflects and transmits only as subtle shades of pink.

Rose quartz sometimes exhibits asterism because of inclusions of aligned, microscopic needles of rutile [titanium oxide, TiO_2] or dumortierite [aluminum oxyborosilicate, $Al_7(BO_3)(SiO_4)_3O_3$]. In properly cut cabochons, light reflecting from aligned inclusions of needle-like crystals can produce cat’s-eye or six-pointed “star” effects. Star rose quartz can be cut into unusual and attractive cabochons.

Mineralogists had long wondered why rose quartz was the only color variety of macrocrystalline quartz that did not form crystals. Then in the 1930s, pink crystalline quartz was discovered in pegmatites near Rumford and Newry in Oxford County, Maine. Its occurrence and properties were described in journals in 1938. But because the Maine specimens were assumed to be a rare, aberrant form of rose quartz that occurred nowhere else, they attracted no further interest.

In 1959, miners in Brazil’s Minas Gerais pegmatite region discovered clusters of transparent, hexagonal quartz prisms with pyramidal terminations and an attractive pink color. This pink quartz was initially introduced to collectors as “rose-quartz crystals.”   The limited supply was snapped up by collectors seeking to acquire a rare form of quartz and by mineralogists eager to study “rose-quartz crystals” from a new locality.

Mineralogists subsequently discovered that these pink-quartz crystals occurred exclusively in phosphorus-rich pegmatites. But unlike massive rose quartz which occurred only in pegmatite core, the pink quartz was found in thin vein systems throughout the pegmatites. It often occurred in association with smoky quartz and had apparently formed through late-phase crystallization.

Unlike the color of massive rose quartz, the color of pink quartz is not caused by chromophores. It has instead a much more complex origin. Mineralogists have recently learned that trivalent aluminum ions Al^{3+} and pentavalent phosphorus ions P^{5+} have replaced some of the silicon ions Si^{4+} within pink quartz. Specifically, pairs of one aluminum oxide $(AlO_4)^{5-}$ ion and one phosphate $(PO_4)^{3-}$ ion with a combined -8 charge have replaced pairs of silicate ions $2(SiO_4)^{4-}$.

This arrangement makes the quartz lattice very susceptible to the energy of natural geophysical radiation, which can create lattice defects called "color centers." In pink, crystalline quartz, color centers form when radiation displaces phosphorus ions from their normal lattice positions. This displacement creates voids which then trap electrons. White light boosts these trapped electrons to higher energy levels, which return to their normal levels by releasing excess energy as visible pink light

In massive rose quartz, the presence of titanium, iron, and manganese chromophores seems to inhibit normal crystal development. But the color centers in pink quartz do not inhibit crystal development. Also, the color of pink quartz fades slowly with prolonged exposure to sunlight, while that of massive rose quartz does not fade.

The mineralogical environment necessary to create pink quartz must include: phosphorus-rich pegmatites; a chemistry that enables aluminum and phosphorus ions to replace those of silicon; relatively high levels of natural geophysical radiation; and vein space to permit crystal growth. Because all of these conditions rarely exist together, pink quartz itself is quite rare. Rose quartz has many collecting localities worldwide, but the only significant sources of pink quartz today are a few pegmatites in Brazil.

Because of its rarity, pink quartz is not used in jewelry. It is only occasionally faceted into collectors' gems. Virtually all of the very limited supply of pink quartz is sold as specimens.

Citing the differences in color origin, structure, and occurrence, mineralogists in the 1990s proposed that rose quartz and pink quartz be considered entirely different varieties of quartz.

Pink quartz is now obtained only from a few pegmatites in the Jequitinhonha Valley in Minas Gerais in northeastern Brazil, a region that is a legendary source of beautiful mineral specimens and gemstones. The Minas Gerais pegmatite belt, a geological zone of gemstone-rich, granite pegmatites, extends 170 miles east-west and 360 miles north-south. Granite pegmatites are bodies of very coarse-grained granite that originated as pockets of residual magma, which is often enriched with accessory or rare elements that can produce unusual minerals. This magma cooled slowly and crystallized on a fractional, or mineral-by-mineral, basis to form irregular pods, lenses, veins, and dikes. Gases within residual magma created mariolitic cavities that provided space for the growth of large, well-developed crystals.

The pegmatites of Minas Gerais have yielded many extraordinary specimens of the tourmaline group-mineral elbaite [basic sodium aluminum lithium borosilicate $Na(Al_{1.5},Li_{1.5})Al_6(BO_3)_3(Si_6O_{18})(OH)_4$]; topaz [basic aluminum fluorosilicate, $Al_2SiO_4(F,OH)_2$]; the cat's-eye variety of chrysoberyl [beryllium aluminum oxide, $BeAl_2O_4$]; beryl [beryllium aluminum silicate, $Be_3Al_2Si_6O_{18}$] and its many color varieties; the purple amethyst variety of quartz [silicon dioxide, SiO_2]; spodumene [lithium aluminum silicate, $LiAlSi_2O_6$]; spinel [magnesium aluminum oxide, $MgAl_2O_4$]; and brazilianite [basic sodium aluminum phosphate, $NaAl_3(PO_4)_2(OH)_4$].

The Minas Gerais pegmatites formed more than 490 million years ago during the early Paleozoic Era when the present-day surface was deeply buried. Granitic magma surged upward into a basement rock of highly metamorphosed gneiss, quartzite, and schist where slow cooling formed pegmatites. These pegmatites were eventually exposed by geological uplifting and subsequent erosion.

Our specimens of pink quartz were mined from pegmatites near Coronel Murta, a town of 10,000 residents in northeastern Minas Gerais. Miners first blast and remove the surrounding rock to expose the pegmatites. When pink quartz is found, the miners resort to slow, laborious, manual mining methods using hammers and chisels so as not to damage the rare specimens.

Metaphysical practitioners consider pink and rose quartz to be stones of universal love that restore trust and harmony in relationships; open the heart to love, friendship, and peace; provide comfort in times of grief; dispel negativity; and promote calmness and reassurance. In the physical realm, pink and rose quartz are said to provide strength and balance to the heart and circulatory system, reduce high blood pressure, and speed overall healing.

Collectors must not confuse common rose quartz and rare pink quartz. Despite their similar colors, there is a world of difference between these two varieties.