SOUTH AFRICA'S AMETHYST CACTUS QUARTZ

Quartz is a mineral with many faces. It occurs in both macrocrystalline and microcrystalline forms, has colors ranging from near-blacks to bright pinks, and is found in association with an extraordinarily large number of other minerals. With credentials like that, it is not surprising that quartz is among the most widely collected of all minerals.

For many collectors, the most desirable and interesting quartz specimens are those that combine rarity with attractive colors and unusual crystal forms. One type that incorporates all these criteria is South Africa's amethyst cactus quartz, a strikingly beautiful form that mineralogists described as "quartz, variety amethyst, subvariety cactus."

Amethyst cactus quartz combines the delicate, purple-violet hues of amethyst with a complex, "cactus"-like structure that results from two separate and distinct phases of crystallization. Adding to the appeal of amethyst cactus quartz is the fact that it has only one significant collecting locality—the Boekenhoutshoek area in the Mkobola District, Mpumalanga Province, South Africa.

Understanding and appreciating the origin, color, and structural complexity of amethyst cactus quartz requires a knowledge of quartz itself. Quartz [silicon dioxide, SiO_2] consists of 46.74 percent silicon and 53.26 percent oxygen. It is a member of the silicates, the largest of all mineral classes. While more than 2,000 silicate minerals account for 75 percent of the total weight of the Earth's crust, quartz alone makes up 12 percent of that crustal weight.

The silicate crystal structure is based on the silica tetrahedron $(SiO_4)^{4-}$, in which a silicon ion is surrounded by four equally spaced oxygen ions positioned at the corners of a tetrahedron (a four-faced polyhedron). Quartz crystallizes in the hexagonal system with four crystal axes, three being of equal length and lying in a common plane. The fourth axis is of variable length and perpendicular to the common plane of the other three.

The dominant habit of macrocrystalline quartz is the hexagonal or six-sided prism, in which six prismatic faces are parallel to the unique axis. Terminations usually appear as hexagonal pyramids or as dihexagonal (12-sided) pyramids. Quartz is transparent to translucent, and has a conchoidal fracture and a vitreous luster; its specific gravity is 2.65 and its Mohs hardness is 7.0.

As an allochromatic (other-colored) mineral, the colors of quartz are not caused by its essential, elemental components or the nature of its crystal lattice. Quartz colors are instead created by traces of nonessential, color-producing elements called chromophores, the effects of geophysical radiation, or lattice defects called "color centers." Although pure quartz is colorless, its many color varieties include purple amethyst, gray-brown smoky quartz, white milky quartz, yellow citrine, rose quartz, and rare pink quartz.

The purple coloration of amethyst is created mainly by traces of ferric iron (Fe^{+3}). These ferric-iron ions substitute for silicon ions and under certain conditions will free electrons to produce Fe^{4+} ions. These freed electrons migrate to vacant lattice sites called "electron traps" or color centers, which impart a local, negative charge to the crystal lattice that alters the absorption of visible light. The electron traps transmit and reflect both red and blue wavelengths to create colors ranging from pale lilac, lavender, and violet to intense purples. The subtle, but eye-catching, reddish hues and highlights seen in some top-quality amethyst crystals are caused by traces of manganese ions.

"Color zoning," or variations in color intensity, is common in amethyst, with the most intense hues concentrated in the crystal terminations. Color zoning results when the iron content of the silica solutions changes during the crystallization process. Intensely colored sections of amethyst crystals form when growth solutions are rich in ferric iron; pale or nearly colorless sections are created when solutions are deficient in ferric iron. The repetitive color banding seen in some amethyst is caused by a repetitive enrichment and depletion of iron in the silica solutions during crystal growth.

Amethyst forms mainly on granite pegmatites and hydrothermal-emplacement veins. Although it is relatively common and widely distributed, gem-quality crystals are rare. Mexico, Russia, Brazil, Uruguay, Bolivia, Canada, Zambia, and Namibia all have notable amethyst-collecting localities. In the United States, non-cactus amethyst is collected in North Carolina, Maine, Arizona, Rhode Island, Connecticut, Pennsylvania, Colorado, and Montana. The cactus subvariety of amethyst, however, is rare and found only in South Africa.

Amethyst has been known since antiquity and has the richest lore of all quartz varieties. Because of its wine-like color, the ancient Greeks associated it with the intoxicating effects of wine. The word "amethyst" actually stems from the Greek *amethystos*, meaning "remedy against drunkenness." The ancient Greeks and Romans both believed that wearing amethyst jewelry or amulets while drinking wine could prevent intoxication.

During the medieval period, physicians prescribed amethyst to reduce arthritic pain, treat digestive and circulatory ailments, and detoxify the body. Because amethyst symbolized piety and was thought to encourage celibacy, it was worn by Catholic clergymen, a tradition that continues in the modern church.

Amethyst remains a very popular gemstone. With a substantial hardness of Mohs 7.0, amethyst gems are suitable for all types of jewelry. The most attractive and valuable amethyst gems have an intense, even, "royal-purple" color. Amethyst is frequently faceted into square-, emerald-, or rectangular-cut gems that can weigh ten or more carats. Translucent, massive forms of amethyst are cut into cabochons.

Because large, gem-quality amethyst crystals are readily available, sizeable collectors' gems are surprising affordable. Amethyst gems in the 100-to-200-carat range usually sell for less than $1,000. Many museums display very large amethyst gems, some weighing more than 1,000 carats.

Amethyst cactus quartz is the rarest form of amethyst. This combination of amethyst coloration and "cactus"-like structure is rare because its formation depends upon two sets of specific chemical and physical conditions. First, the crystallizing solutions must have the proper chemistry to create amethystine quartz. Second, the physical conditions must include an unusual, secondary crystallizing event to create the "cactus" structure.

The world's only source of top-quality amethyst cactus quartz is the Boekenhoutshoek area in the Mkobola District, Mpumalanga Province, South Africa. The Republic of South Africa is the southernmost nation on the African continent. Mpumalanga Province is in the northeastern part of the country. Mpumalanga is topographically and climatologically divided into two regions. The low-elevation, semitropical Lowveld (or Bushveld) is in the south, while the Highveld grasslands is located in the higher elevations of the north. Boekenhoutshoek is located in the Highveld, about 40 miles northeast of the city and national administrative capital of Pretoria.

The geology of Mpumalanga Province is especially interesting because of the extreme age of many of its rocks. Most notable are a series of Precambrian granites and metamorphic rocks

that have been radiometrically dated to 2.3 billion years. At Boekenhoutshoek, amethyst cactus quartz formed when crevices within this Precambrian granite filled with silica-rich, hydrothermal solutions in two separate phases.

The initial crystallization phase began when minute crystals, called seed crystals, formed from solution. With continued cooling, additional silica precipitated on the surfaces of the growing quartz crystals. With slow cooling and an environment that provided space for free growth and a supply of silica-rich fluids, this quartz developed normally as hexagonal prisms in which traces of iron produced amethyst coloration.

This first-phase growth ended, however, when the silica solutions withdrew following a radical change in the mineralogical environment that could have been caused by nearby volcanic activity, igneous intrusions, tectonic stresses, or fault movements. At this point, the seams within the ancient granite were partially filled by large, hexagonal quartz prisms with smooth faces and amethyst coloration.

Much later, another geological event caused the seams to refill with silica-rich solutions. In different conditions of temperature and pressure, a second crystallization phase began that covered the original, primary crystals with much smaller, secondary, quartz crystals to create the distinctive, "cactus"-like appearance. As with the primary crystals, these secondary crystals were also of the amethyst variety.

After this ancient granite with its veins of amethyst cactus quartz was exposed by erosion, it underwent slow, in-place weathering and decomposition. The feldspar within the granite weathered into an iron-rich, reddish clay that became a major component of the regional soil. But while the granite decomposed, the more resistant veins of amethyst cactus quartz remained in place and intact, buried under thick layers of reddish clay.

In 1986, a resident of a communal village on the sprawling Boekenhoutshoek Farm discovered amethyst cactus quartz crystals while digging a foundation for a house. Impressed with the beauty of the specimens, he showed them to members of a Pretoria gem-and-mineral club. Word of the discovery soon reached commercial collectors, who traveled to Boekenhoutshoek to acquire specimens.

But the communal regulations of the Boekenhoutshoek Farm authorized excavations only for building or agricultural purposes. Nevertheless, commercial diggers managed to illegally recover small quantities of amethyst cactus quartz that they then sold within South Africa at a good profit.

To keep the source of the crystals secret and to protect themselves from possible prosecution, these commercial diggers falsely stated the locality as the Magaliesberg Mountains, a low mountain range 70 miles to the southeast. Because Magaliesberg is among South Africa's most popular scenic, trekking, and tourism areas, its name also added an element of romance that aided in the marketing of "Magaliesberg quartz."

After diggers uncovered massive veins of crystals in 2002, large quantities of specimens of amethyst cactus quartz finally reached international markets the following year and were widely acclaimed at major gem-and-mineral shows.

As prices and demand for amethyst cactus quartz soared, Boekenhoutshoek Farm managers lifted the excavation ban to enable villagers to share in the profits. By this time, it was obvious that "Magaliesberg quartz" hadn't originated in the Magaliesberg Mountains at all. Nevertheless, despite subsequent efforts by various mineralogists, dealers, and mineral publications to set the locality record straight, the erroneous "Magaliesberg" appellation endures.

Most Boekenhoutshoek amethyst cactus quartz sold today is still mislabeled as “Magaliesberg quartz.”

Amethyst cactus quartz is also known as “African cactus quartz,” “cactus crystals,” “porcupine quartz,” “hedgehog quartz,” “faerie quartz,” and “spirit quartz,” the latter name assigned by metaphysical practitioners who believe that the many smaller, secondary crystals amplify the metaphysical energy of the primary crystals. But some dealers were already using the term “spirit quartz,” claiming without evidence that African tribal shamans employed these crystals in their rituals. Another reported origin of the term “sprit quartz” is more mundane: Villagers who uncovered the crystals compared their amethystine color to that of “methylated spirits,” a hydrocarbon liquid used locally as a heating and cooking fuel.

In Boekenhoutshoek and surrounding areas, digging for amethyst cactus quartz is now a local mini-industry. Villagers manually dig trenches up to 20 feet deep through layers of decomposed granite and red clay to locate residual quartz veins. They then follow the veins laterally in search of amethyst cactus quartz. After excavation, they clean the heavy coating of reddish clay from the specimens. The diggers then receive top prices from dealers from Pretoria and Johannesburg who regularly visit Boekenhoutshoek to purchase specimens.

Amethyst cactus quartz has both wonderful visual appeal and unusual metaphysical significance. According to traditional metaphysical beliefs, regular amethyst crystals promote serenity and calmness, enhance the ability to assimilate new ideas, provide mental strength and stability, and balance physical, intellectual, and emotional states.

But practitioners also believe that amethyst cactus quartz has its own metaphysical properties that are distinct from, and greater than those, of regular amethyst. First, amethyst cactus quartz is specifically thought to bring freedom from fears, discourage negative thinking, and help communicate with the spirit world. Even more importantly, the energy of the large, primary crystals is greatly amplified in proportion to the number of small, secondary crystals. The most desirable specimens for metaphysical uses therefore have large primary crystals that are covered by thousands of small, secondary crystals.

The unique combination of amethyst color, complex “cactus”-like structure, great visual appeal, unusual geological origin, rarity, and interesting history make amethyst cactus quartz one of the most collectible of the many forms of quartz.