April 2013 Mineral of the Month: Cactus Quartz

QUARTZ (var. AMETHYST, subvariety "CACTUS")

This month we are featuring a rare form of quartz from South Africa—variety amethyst, subvariety "cactus." Our write-up explains its two-phase crystallization, the origin of its amethyst color, and why quartz occurs in more varieties and subvarieties than any other mineral.

PHYSICAL PROPERTIES

Chemistry: SiO_2 Silicon Dioxide (The amethyst variety always contains traces of iron and sometimes manganese.)
Class: Silicates
Subclass: Tectosilicates
Group: Quartz
Crystal System: Hexagonal
Crystal Habits: Usually as long, prismatic crystals striated crosswise and terminated by hexagonal pyramids (double rhombohedrons) or dihexagonal (12-sided) pyramids; less often as short or nearly bipyramidal prisms; also granular, disseminated, stalactitic, and massive (microcrystalline); sometimes distorted, skeletal, and drusy. Twinning common.
Color: The amethyst variety of quartz is light-to-dark purple, lavender, violet, or lilac, sometimes with pink, red, or blue tints and highlights. Color intensity varies greatly and color zoning is prominent.
Luster: Vitreous to greasy
Transparency: Transparent to translucent
Streak: White
Refractive Index: 1.544-1.553
Cleavage: None
Fracture: Conchoidal; brittle to tough.
Hardness: Mohs 7.0
Specific Gravity: 2.65
Luminescence: Impurities sometimes produce a greenish-white fluorescence.
Distinctive Features and Tests: Best field marks are vitreous-to-greasy luster, distinct conchoidal fracture, hexagonal cross sections of crystals, crosswise striations, and hardness. The amethyst variety of quartz has diagnostic, light-to-dark purple, lavender, violet, or lilac colors.
Dana Classification Number: 75.1.3.1

NAME: The word "quartz," pronounced KWORTZ, stems from the German *Quarz*, which comes from the Slavic word *kwardy*, meaning "hard." In European mineralogical literature, quartz appears as *Quarz*, *kwartz*, and *cuarzo*. Amethyst, pronounced AM-eh-thist, stems from the Greek *amethystos*, literally meaning "remedy against drunkenness" and alluding to the ancient belief that amethyst prevented inebriation. "Cactus" quartz is named for its resemblance in shape to certain cacti. Amethyst cactus quartz is named for its crystal habit, in which tiny,

secondary amethyst crystals partially cover primary amethyst crystals. Amethyst cactus quartz is also known as "African cactus quartz," "cactus crystals," "spirit quartz," "porcupine quartz," "hedgehog quartz," and "faerie quartz." Other names such as "Magaliesberg quartz" and "Magaliesberg crystals" are based on erroneous locality information.

COMPOSITION: Quartz consists of 46.74 percent silicon (Si) and 53.26 percent oxygen (O). Silicon and oxygen are the most abundant elements in the Earth's crust. More than 2,000 silicate minerals account for 75 percent of the total crustal weight. The basic building block of all silicates is 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 is a framework silicate or tectosilicate that occurs in both macrocrystalline and microcrystalline forms. As an allochromatic (other-colored) mineral, the colors of quartz are caused by traces of nonessential, color-producing elements called chromophores. Pure quartz, or rock crystal, is colorless, but traces of impurities and the effects of natural geophysical radiation can impart a wide range of colors. The purple-to-lilac color of the amethyst variety is due to traces of iron and sometimes of manganese that disrupt the crystal lattice to create "color centers" that alter light absorption. Quartz, a component of most igneous, metamorphic, and sedimentary rocks, forms as a component of solidified magma in intrusive and extrusive (volcanic) rocks and by the crystallization of silica-rich, hydrothermal fluids and groundwater.

COLLECTING LOCALITIES: Amethyst cactus quartz is rare and has only one significant collecting locality—the Boekenhoutshoek area in the Mkobola District, Mpumalanga Province, South Africa. Non-cactus amethyst is collected in Russia, Brazil, Uruguay, Bolivia, Mexico, Canada, Zambia and Namibia. In the United States, amethyst occurs in Maine, Rhode Island, Connecticut, North Carolina, Pennsylvania, Arizona, Colorado, and Montana.

HISTORY, LORE & GEMSTONE/TECHNOLOGICAL USES: The ancient Greeks associated amethyst with the color of wine and believed that it protected against inebriation. Amethyst was one of the 12 stones in the jeweled breastplate of Aaron, the first high priest of the Hebrews. Medieval physicians believed that amethyst helped to remove toxins from the body, ease arthritic pain, and alleviate disorders of the digestive and circulatory systems. Because amethyst symbolized piety and was thought to encourage celibacy, it was worn by Catholic clergymen during the Middle Ages. Amethyst has served as a gemstone since antiquity and is the most valuable of all quartz gemstones. Transparent amethyst is usually faceted into square, emerald, or rectangular cuts in sizes ranging from two to six carats. Sub-transparent and translucent amethyst is cut into cabochons. Modern metaphysical practitioners believe that amethyst promotes serenity and calmness, enhances the assimilation of new ideas, provides mental strength and stability, and balances physical, intellectual, and emotional states. Amethyst cactus quartz is thought to have extraordinary metaphysical energy levels that increase proportionally with the number of small, secondary crystals that cover the primary crystals.

ABOUT OUR SPECIMENS: Our specimens of amethyst cactus quartz were collected at Boekenhoutshoek in the Mkobola District, Mpumalanga Province, South Africa, an area about 40 miles northeast of the city and national administrative capital of Pretoria. Amethyst cactus quartz is the result of two separate phases of crystal growth. Large, hexagonal quartz prisms developed first within fissures of ancient granite to form veins. In a second crystallization phase,

smaller, secondary crystals developed over the primary crystals to create the distinctive "cactus" appearance. After the host granite eventually weathered and decomposed, the resistant veins of amethyst cactus quartz remained in place within thick layers of reddish clay. These veins of crystals were discovered in 1986 on the Boekenhoutshoek communal farm, but to keep the source secret the locality was announced as the Magaliesberg Mountains 70 miles to the southeast. The operating regulations of the Boekenhoutshoek Farm initially prohibited digging for non-agricultural purposes. But after a major discovery on the farm in September 2002, large quantities of "Magaliesberg quartz" began appearing on international specimen markets and were widely acclaimed at the 2003 Tucson Gem & Mineral Show. The ban against digging on the Boekenhoutshoek Farm was then lifted and recovering crystals has since become a local industry. To recover amethyst cactus quartz crystals, villagers manually dig pits and trenches up to 20 feet deep through compacted layers of decomposed granite and red clay.

COMPREHENSIVE WRITE-UP

COMPOSITION

Quartz is a very abundant mineral and occurs in many forms, some of which are quite rare. Our featured mineral this month—amethyst cactus quartz—is an excellent example of a rare variety. Our quartz specimens are properly described as variety amethyst, subvariety "cactus." This combination of amethyst and cactus features is rare because its formation depends on two sets of specific chemical and physical conditions. First, the chemistry of the crystallizing solutions must create an amethyst color in the quartz. Then the physical conditions must include a secondary crystallizing event to create the "cactus" structure.

Quartz is a member of the silicates, the largest of all mineral groups. Silicon and oxygen, two of the essential elements of all silicate minerals, are the most abundant elements in the Earth's crust. More than 2,000 silicate minerals make up 75 percent of the total crustal weight. The chemical formula SiO_2 shows that quartz contains oxygen (O) and the semimetal silicon (Si). Its molecular weight consists of 46.74 percent silicon and 53.26 percent oxygen. All molecules are made up of positively charged cations and negatively charged anions. In quartz, the cation is the silicon ion (Si^{4+}) with its +4 charge. The quartz anion consists of two oxygen ions ($2O^{2-}$) with a collective -4 charge. The balance of the +4 cationic and -4 anionic charges provides the quartz molecule with electrical stability.

The basic building block of quartz and all silicates is the silica tetrahedron $(SiO_4)^{4-}$, which consists of a silicon ion surrounded by four equally spaced oxygen ions positioned at the corners of a tetrahedron (a four-faced polyhedron). In the quartz-crystal lattice, all four oxygen ions in each silica tetrahedron bond covalently with the silicon ions of adjacent tetrahedra, leaving each silicon ion surrounded by four oxygen ions and each oxygen ion surrounded by two silicon ions. Because this "four-oxygen-coordination" arrangement satisfies the -4 charge of each individual tetrahedron, no other ions are needed for electrical stability. The result is the infinite, three-dimensional structure of quartz, in which each electrically balanced, molecular unit within the lattice is described by the formula SiO_2.

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In all silicates (except for quartz itself), silica anions bond with metallic cations in repeating chains to form seven types of structures: independent tetrahedral silicates (nesosilicates); double tetrahedral silicates (sorosilicates); single- and double-chain silicates (inosilicates); ring silicates (cyclosilicates); sheet silicates (phyllosilicates); and framework silicates (tectosilicates). Quartz is a framework silicate or tectosilicate that occurs in two distinct forms: macrocrystalline and microcrystalline. Macrocrystalline quartz forms large, individual, transparent-to-translucent crystals or groups of crystals. Microcrystalline quartz or chalcedony is a compact or massive form that consists of interlocked grains of microscopic silica and includes such varieties as chert, jasper, and agate (see "The Many Forms of Quartz").

Quartz, which is present in virtually all igneous, metamorphic, and sedimentary rocks, forms as a component of solidified 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. Macrocrystalline quartz most often occurs in granite pegmatites and hydrothermal-emplacement veins. Microcrystalline quartz usually forms through the crystallization of silica-rich groundwater in shallow environments under conditions of low temperature and pressure.

Quartz crystallizes in the hexagonal system and has four axes, three of equal length and lying in a common plane. The fourth axis, unique to the hexagonal system, is of variable length and perpendicular to the plane of the other three. The dominant quartz habit is the hexagonal or six-sided prism in which all six prismatic faces are parallel to the unique axis. Quartz crystals are usually terminated by hexagonal pyramids or dihexagonal (12-sided) pyramids. Atomic bonding within the quartz lattice is exclusively covalent. Because covalent bonding exerts omnidirectional strength, quartz crystals have no cleavage planes. This lack of cleavage and the high bonding strength derived from close atomic packing account for quartz's substantial durability and hardness of Mohs 7.0. Despite close atomic packing, the light atomic weights of its essential elements silicon (28.09) and oxygen (16.00) give quartz a relatively low specific gravity of 2.65.

As an allochromatic (other-colored) mineral, the colors of quartz are caused by traces of nonessential, color-producing elements called chromophores. Pure quartz, or rock crystal, is colorless. But traces of chromophoric impurities and the effects of natural geophysical radiation can disrupt the symmetry of the crystal lattice to impart a wide range of colors. The primary chromophore that creates the purple color of amethyst is ferric iron (Fe^{+3}). Very small quantities of ferric iron—only about 40 parts per million—are distributed in layers parallel to the interfaces. These form "color centers," which are imperfections in the crystal lattice that alter its light-absorption characteristics. The ferric iron ions substitute for silicon ions and under certain conditions can give up another electron, thus producing Fe^{4+} ions. The free electrons then migrate to vacant sites in the lattice called "electron traps," where they impart a local, negative charge that alters the absorption of visible light. In amethyst, these electron traps absorb the yellow and green portions of the visible spectrum, thus transmitting and reflecting the combined red and blue wavelengths to create a purple color. Manganese ions Mn^{2+} can also contribute to amethyst color by introducing reddish hues and highlights.

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Amethyst always exhibits prominent color zoning, with the purple color concentrated in certain sections of the crystal. Color zoning reflects changes in the chemical composition of the silica solutions during crystallization. Intensely colored sections of amethyst crystals result from growth solutions that were relatively rich in ferric iron, while paler or nearly colorless sections developed from solutions that were deficient in ferric iron. Many amethyst crystals have a repetitive color banding which indicates a sequential enrichment and depletion of the ferric iron content in the silica solutions during the growth process.

The Dana mineral classification number 75.1.3.1 first identifies quartz as a tectosilicate or framework silicate (75). The subclassification (1) defines it by the chemical formula SiO_2 and by its four-oxygen coordination in which four oxygen ions are bound to each silicon ion. Quartz is then assigned to the quartz group (3) as the first (1) and only member.

COLLECTING LOCALITIES

Amethyst cactus quartz has only one significant collecting locality—the Boekenhoutshoek area in the Mkobola District, Mpumalanga Province, South Africa. Non-cactus amethyst occurs worldwide, with important sources located in Russia, Brazil, Uruguay, Bolivia, Mexico, Canada, Zambia, and Namibia. In the United States, amethyst is collected in Maine, Rhode Island, Connecticut, North Carolina, Pennsylvania, Arizona, Colorado, and Montana.

JEWELRY & DECORATIVE USES

Amethyst has served as a gemstone since antiquity and has always been the most valuable quartz gem variety. Stones with deep, even coloration, often called “royal purple,” are the most valuable, although the paler, “rose de France” lilac shades that were once popular in Victorian-era jewelry are seen in jewelry today. With a substantial hardness of Mohs 7.0, amethyst gems are suited for all types of jewelry, including rings. Amethyst is usually faceted into square, emerald, or rectangular cuts. Most amethyst gems weigh between 2 and 6 carats, although gems larger than 10 carats are not unusual. Amethyst’s pronounced color zoning tends to limit gem size, since stones must be cut in a manner that conceals the uneven coloration. Sub-transparent and translucent amethyst is cut into cabochons. Most amethyst gems on today’s market have been heat-treated to intensify their color and reduce color zoning. Intensive and lengthy heat-treating will, however, turn the purple-lilac color into a golden-yellow very similar to the color of the citrine variety of quartz. Most citrine gems sold today were originally amethyst.

Among the largest and finest amethyst gems are a superb, 343-carat gem at the British Museum in London, and a 1,362-carat gem from Brazil and a 202.5-carat gem from North Carolina, both on display at the National Museum of Natural History (Smithsonian Institution) in Washington, D.C. Amethyst is often cut into collectors’ gems. Because large amethyst crystals are fairly common, large collectors’ gems are surprisingly affordable. Amethyst gems in the 100-to-200-carat range are available for less than $1,000. Amethyst exhibits at many major museums feature large collectors’ gems side-by-side with uncut crystals.

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Massive amethyst is carved into various decorative items, especially miniature wine goblets that reflect the stone's significance in Greek mythology (see "History & Lore"). Amethyst crystal clusters, which are often large sections of geode walls, are valuable both as specimens and as display pieces for interior decoration.

HISTORY & LORE

Because of its beauty, abundance, availability, and worldwide distribution, amethyst has accumulated a rich history and lore. Due to their similarity of color, the ancient Greeks associated amethyst with wine and, by extension, the intoxicating effects of wine. The word "amethyst" is derived from the Greek *amethystos*, literally meaning "remedy against drunkenness," a reference to the belief that amethyst prevented inebriation. A Greek myth about the origin of amethyst involves Dionysus, the Greek god of wine and joviality (the Roman equivalent is Bacchus), and Artemis, the Greek goddess of the moon and the hunt (Roman equivalent: Diana). Insulted by a mortal, Dionysus swore revenge on the next mortal he met and created fierce tigers to carry out his wish. The unlucky mortal who crossed his path was a young maiden named Amethyst, who was on her way to pay homage to the goddess Artemis. Attacked by Dionysus' tigers, Amethyst cried out to Artemis for help. To protect the maiden, Artemis turned her into a statue of pure, colorless quartz. Dionysus, awed by the statue's beauty and shamed by his own ruthlessness, remorsefully wept tears of wine that colored the quartz purple. Ancient Greeks and Romans alike often wore amethyst jewelry or amulets while drinking wine to protect them from intoxication. Some also drank wine from amethyst goblets, believing that because these goblets retained their purple color after the wine had been consumed, the intoxicating effects remained within the goblet.

Amethyst was one of the 12 gems in the jeweled breastplate of Aaron, the first high priest of the Hebrews. In the first century A.D., the Roman scholar Pliny the Elder (Gaius Plinius Secundus, A.D. 23-79) recounted the legend of amethyst being named for its wine-like color. By then, amethyst was also thought to aid in hunting, to protect soldiers from harm in battle, and to protect wearers from the intoxication of love. Medieval physicians believed that amethyst removed toxins from the body, eased the pain of arthritis, and alleviated disorders of the digestive and circulatory systems. Because amethyst symbolized piety and was thought to encourage celibacy, it was worn by Catholic clergymen during the Middle Ages, a tradition continues today in the amethyst rings worn by Catholic bishops. Amethyst is also found in the British crown jewels, which include gemstones of far greater rarity and monetary value.

Amethyst is the birthstone for February, the symbolic gift for the 17th wedding anniversary, and the official gemstone of both North Carolina and the Canadian province of Ontario. Amethyst crystals and gems have been featured on Austria's seven-schilling stamp of 1990; the 20-manat stamp of Azerbaijan in 1994; Brazil's 1.5-cruzado stamp of 1989; Bulgaria's seven-leva stamp of 1995; the one-franc stamp of the French Southern and Antarctic Territories in 1997; the German 25-pfennige stamps of 1972 and 1974; Kenya's one-shilling stamp of 1977; the 20-chon stamp of the Democratic People's Republic of Korea (North Korea) in 1995; New Zealand's four-cent stamp of 1982; Russia's six-kopeck stamp of 1963; the Swiss 30-centimes stamp of 1979;

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Uruguay's five-peso stamp of 1997; the 10-cent stamp of the United States in 1974; and Zimbabwe's 17-cent stamp of 1974.

Metaphysical practitioners believe that amethyst promotes serenity and calmness, enhances the ability to assimilate new ideas, provides mental strength and stability, and balances physical, intellectual, and emotional states. Metaphysical practitioners place great value on amethyst cactus quartz, believing that its extraordinary energy levels are proportional to the number of small, secondary crystals that cover the primary crystals. Amethyst cactus quartz is specifically thought to bring freedom from fears, discourage negative thinking, and help communicate with the spirit world. Its many secondary crystals also enable amethyst cactus quartz to amplify the energies of other types of crystals.

THE MANY FORMS OF QUARTZ

The most abundant mineral in the Earth's crust, quartz accounts for 12 percent of its total weight. Widely distributed, it occurs in an unusually broad array of interesting and often beautiful varieties, so many, in fact, that we have featured quartz as our Mineral of the Month more often than any other mineral—about once each year for the past 16 years. Our Mineral of the Month quartz specimens have included amethyst, quartz scepters, twinned quartz crystals, quartz geodes, "ocean" jasper, Mookaite jasper, chrysoprase, Soledade agate, jasper-after-aragonite, carnelian, quartz stalactites, rock crystal, silicified (petrified) wood, and amethyst cactus quartz.

The main reason that quartz has so many varieties is that is crystallizes in two radically different forms: macrocrystalline and microcrystalline. Another reason is that quartz occurs in many different habits that are modifications of its basic hexagonal system. Also, quartz readily accepts many chromophores (coloring agents) that impart all the colors of the rainbow. Amethyst cactus quartz is a textbook example of the complexity of quartz varieties: It is the cactus subvariety of the amethyst variety of the macrocrystalline form of quartz.

Macrocrystalline quartz occurs as transparent-to-translucent, individual crystals or crystal groups. Macrocrystalline quartz develops by adding molecules of silica to new layers on a crystal's surface. Conversely, microcrystalline quartz, or chalcedony, consists of compact, interlocked, microscopic silica grains or fibrous silica crystals in such varieties as agate and jasper. Chalcedony forms from the solidification of silica solutions in a process that begins when silica weathers free from silicate minerals and is transported by groundwater as microscopic particles in colloidal suspensions called silica gels. In the low temperatures and low pressures of shallow mineralogical environments, silica gels crystallize into solid masses of chalcedony.

The following color varieties of macrocrystalline quartz all serve as gemstones:

Rock crystal: colorless and transparent, consists essentially of pure silica
Amethyst: purple-to-lilac color due to traces of iron and sometimes manganese, transparent to translucent, occurs in both crystalline and massive forms
Citrine: yellow to golden-yellow color is due traces of iron, transparent
Rose quartz: pink color is caused by traces of titanium, transparent to translucent
Smoky quartz: brown, gray, or near-black colors are caused primarily by exposure

to natural geophysical radiation, transparent to translucent

Inclusions can create subvarieties of these basic color varieties with unusual visual effects:

Milky quartz: white color is caused by tiny inclusions of gases and liquids, translucent

Cat's-eye quartz: range of pale colors is caused by various inclusions that sometimes create chatoyancy, usually sub-transparent

Tiger's-eye quartz: opacity is due to dense inclusions of fibrous crystals of asbestos-group minerals that create a banded chatoyancy and a silky luster

Macrocrystalline quartz also has many unusual crystal habits and forms.

Drusy: coatings of numerous tiny, individual quartz prisms

Stalactitic: compact clusters of quartz crystals that develop downward in fluid environments to create icicle-like shapes

Cactus: primary crystals are covered with growths of smaller, secondary crystals in cactus-like shapes

Scepter: individual quartz crystals with thin bases or prisms that are overgrown by larger terminations

Gwindel: quartz crystals with unusual parallel or "stacked" structures that result from opposing electrical charges reforming crystal faces during development

Floaters: distorted, "free-form" quartz crystals that grow in fluid environments while not attached to any base or matrix

The many forms of microcrystalline quartz include:

Agate: banded or layered, translucent to opaque, occurs in all colors, multi-coloration common, many subvarieties are based on colors and patterns

Jasper: opaque, usually singular in color, most often brown or red, striped or spotted patterns common, has many subvarieties

Chrysoprase: distinctive, apple-green color caused by traces of nickel, sub-transparent to translucent

Carnelian: brownish-red to orange-red colors are due to small amounts of hematite, sub-transparent to translucent

These major varieties and subvarieties of quartz are based on crystal type and habit, color, color patterns, and degree of transparency. Because of the large number of possible combinations of these features, we will continue to feature new and unusual forms of quartz as our Minerals of the Month for many years to come.

TECHNOLOGICAL USES

Amethyst has no technological uses.

ABOUT OUR SPECIMENS

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Our specimens of amethyst cactus quartz were collected in the Boekenhoutshoek area in the Mkobola District, Mpumalanga Province, South Africa. The Republic of South Africa, the southernmost nation on the African continent, has a population of 50 million. At 471,444 square miles, it covers an area nearly twice that of the state of Texas. South Africa is bounded by the Indian Ocean on the east, the Atlantic Ocean on the west, Namibia on the northwest, Botswana and Zimbabwe on the north, and Swaziland on the northeast. Mpumalanga Province, one of nine provinces, is in the northeastern part of South Africa. Covering 26,535 square miles, Mpumalanga is roughly the size of the state of South Carolina and has six million residents. Mpumalanga is topographically and climatologically divided into two regions: the low-elevation, semitropical Lowveld (or Bushveld) in the south; and the Highveld grasslands in the higher elevations of the north. Boekenhoutshoek is in the Highveld, about 40 miles northeast of the city and national administrative capital of Pretoria.

Mpumalanga Province has some of the world's oldest rocks—Precambrian Era granites and metamorphic rocks more than 2.3 billion years old. Our specimens of amethyst cactus quartz formed within this Precambrian granite when crevices filled with silica-rich, hydrothermal solutions that precipitated quartz in two separate phases. The initial phase began when minute crystals, called seed crystals, formed from solution. Continued cooling caused more silica to precipitate on the growing quartz crystals. With slow cooling, space for free growth, and a supply of silica-rich fluids, the quartz developed normally as hexagonal prisms. This first-phase growth ended, however, when the silica solutions withdrew following a dramatic change in the mineral environment that may have been caused by nearby volcanic activity or igneous intrusions, tectonic stresses, or fault movements. At this point, the seams within the ancient granite were partially filled with normal, hexagonal quartz prisms with distinct amethyst coloration.

Much later, another geological event or series of events caused the seams to refill with silica-rich solutions. In different conditions of temperature, pressure, and chemistry, a second crystallization phase deposited much smaller, secondary quartz crystals atop the original, primary crystals to create a distinctive, "cactus" appearance. Like the primary crystals, these secondary crystals were of the amethyst variety, but with somewhat different coloration.

Over eons of geologic time, the ancient granite with its veins of amethyst cactus quartz was exposed by erosion to undergo slow, in-place weathering and decomposition. The feldspar component of the granite eventually weathered into an iron-rich, red clay that now makes up the regional soil base. But while the granite decomposed and its feldspar component weathered into clay, the more resistant veins of amethyst cactus quartz remained in place, buried under thick layers of reddish clay.

The amethyst cactus quartz crystals were discovered in 1986 by a resident digging a house foundation at Boekenhoutshoek, a communal village on the sprawling Boekenhoutshoek Farm. The resident took specimens to a gem–and-mineral club in Pretoria where they attracted considerable attention. Two commercial collectors soon visited Boekenhoutshoek to acquire specimens. But the operating regulations of the Boekenhoutshoek Farm authorized excavations only for building or agricultural purposes. Nevertheless, diggers continued to illegally recover small numbers of crystals that were sold within South Africa. To keep the source of the crystals

secret, the locality was said to be the Magaliesberg Mountains, a range 70 miles to the southeast that is one of South Africa's most popular scenic, trekking, and tourism areas. The Magaliesberg name also imparted a certain element of romance that doubtlessly aided in the marketing of "Magaliesberg quartz."

In September 2002, after Boekenhoutshoek diggers illegally uncovered large veins of "Magaliesberg quartz," large numbers of specimens began reaching international markets. These specimens were widely acclaimed at the gem-and-mineral shows at Tucson, Arizona, in 2003. As prices and demand for amethyst cactus quartz increased, managers at the Boekenhoutshoek Farm lifted the excavation ban to enable villagers to legally dig through the red clay. Unfortunately, a few ruthless dealers employed such strong-arm tactics as the intimidation of diggers and legitimate dealers along with specimen theft in an attempt to control specimen supply. At this point, it finally became clear that "Magaliesberg quartz" didn't come from the Magaliesberg Mountains at all. Nevertheless, despite subsequent efforts by various mineralogists, dealers, and publications to set the locality record straight, the erroneous "Magaliesberg" appellation has endured. Most of the Boekenhoutshoek amethyst cactus quartz on the market today is still mislabeled as "Magaliesberg quartz."

Amethyst cactus quartz has also acquired such names as "African cactus quartz," "cactus crystals," "porcupine quartz," "hedgehog quartz," "faerie quartz" and, perhaps most interestingly, "spirit quartz." The latter name came from metaphysical practitioners at the 2003 Tucson gem-and-mineral show who believed that the many smaller, secondary crystals on amethyst cactus quartz amplified the energy of the primary crystals and assigned the name "spirit quartz." But some dealers had ready been using the name "spirit quartz," claiming—without evidence—that African tribal shamans employed the crystals in their rituals. Another purported origin of the name "sprit quartz" is a bit more mundane: Villagers who uncovered the crystals likened their amethystine color to that of "methylated spirits," a commercial, hydrocarbon liquid that is a popular heating and cooking fuel in the South African bush.

Today in Boekenhoutshoek and the nearby villages of Mathys Zin Loop and Kwaggafontein (formerly the apartheid-era homeland village of Kwandebele), digging for amethyst cactus quartz has become a local industry. Villagers manually dig pits and trenches up to 20 feet deep through layers of decomposed granite and red clay to locate residual quartz veins, then follow the veins laterally to hopefully find amethyst cactus quartz. All specimens are heavily coated with reddish-orange hematite [iron oxide, Fe_2O_3] and must be cleaned. Digging and cleaning is difficult, but worth the effort when dealers from Pretoria and Johannesburg arrive eager to pay cash for well-cleaned specimens. Most private properties in Boekenhoutshoek, Mathys Zin Loop, and Kwaggafontein have now been extensively excavated. But while prices and demand for amethyst cactus quartz continue to remain strong, the pits and trenches only become deeper. Some of the more extensive workings are now supported by timbers. And many property owners who initially did their own digging and profited handsomely now hire laborers to do the manual work.

As you examine your specimen of amethyst cactus quartz, note that it consists of large, primary quartz crystals partially overgrown with smaller, secondary crystals, an arrangement that clearly reflects two separate phases of crystal growth. Both the primary and secondary crystals show

such diagnostic quartz features as hexagonal prisms and terminations, crosswise striations on prism faces, and a vitreous luster. These primary and secondary crystals also have the characteristic purple-to-lilac coloration of amethyst, although their shade, intensity, and zoning may vary. Color-zoning is especially prominent, with the most intense colors concentrated near the crystal terminations.

Our specimens are of two types. In one, the primary amethyst crystals have a soft, lilac color and are partially overgrown by very small, secondary amethyst crystals with similar pale, lilac colors. These crystals rest on a matrix of grayish-white, massive quartz. In the other specimen type, intensely colored, primary amethyst crystals are partially overgrown by medium-sized, secondary amethyst crystals. Both the primary and secondary amethyst crystals have very prominent and sharply delineated color zoning. These crystals rest on a matrix of massive and crystalline quartz that is heavily stained with orange-brown hematite. In both specimen types, some secondary quartz crystals may appear to have a yellow color similar to that of citrine, the yellowish-gold, gem variety of quartz. These crystals are not citrine. Their citrine-like coloration is due to coatings and inclusions of orange-brown hematite. Whichever specimen type you have is a fine example of amethyst cactus quartz that comes from only one source in the world—Boekenhoutshoek, South Africa.

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