Mineral of the Month Club May 2015

Quartz (var. Rock Crystal)

Our featured mineral for May is the rock-crystal variety of quartz from a classic locality—the Ouachita Mountains of Arkansas. Our write-up explains the formation of rock crystal, describes its applications in modern electronics, and recounts the rich history of quartz mining in Arkansas.

PHYSICAL PROPERTIES:
Chemistry: SiO_2 Silicon Dioxide
Class: Silicates
Subclass: Tectosilicates
Group: Quartz
Crystal System: Hexagonal
Crystal Habits: Usually as long, hexagonal, prismatic crystals striated crosswise and terminated by hexagonal pyramids or dihexagonal (12-sided) pyramids; less often as short to nearly bipyramidal prisms; sometimes distorted, skeletal, and drusy. Twinning common.
Color: Colorless
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 create a weak, greenish-white fluorescence.
Distinctive Features and Tests: Best field marks are hardness; vitreous-to-greasy luster; distinct conchoidal fracture; and hexagonal crystal form with crosswise striations and pyramidal terminations.
Dana Classification Number: 75.1.3.1

NAME: The word "quartz," pronounced KWORTZ, is derived from the German *Quarz*, which is believed to stem from the Slavic *kwardy*, meaning "hard." The word "crystal" comes from the Greek *krystallos*, meaning "ice," a reference to the visual similarity between colorless, transparent quartz crystals and ice. Rock crystal is the transparent, colorless variety of quartz. Other names for rock crystal include "unripe diamond," "diamond quartz," "ice quartz," "mountain crystal," "mountain diamond," "beach diamond," and "clear quartz." In European mineralogical literature, quartz appears as *Quarz*, *kwartz*, and *cuarzo*; rock crystal appears as *Bergkristal* and *cristollo de rocco*.

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 make up 75 percent of the crust's total weight. The basic building block of all silicate minerals 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, a framework silicate or tectosilicate, occurs in both macrocrystalline and microcrystalline forms. As an allochromatic (other-colored) mineral, quartz colors are caused by traces of nonessential, color-producing elements called chromophores. The rock crystal variety of quartz is colorless.

Quartz, including the rock-crystal variety, is a component of most igneous, metamorphic, and sedimentary rocks. It can form as a component of crystallized magma in intrusive and extrusive (volcanic) rocks, and by the crystallization of silica-rich, hydrothermal fluids and silica-rich groundwater.

COLLECTING LOCALITIES: The rock-crystal variety of quartz is collected in Argentina, Brazil, Peru, Canada, Mexico, Austria, Belgium, England, Germany, Switzerland, France, Russia, Namibia, Pakistan, China, Portugal, Romania, Norway, Greece, and Sri Lanka. In the United States, rock crystal occurs in Arkansas, Arizona, Colorado, Connecticut, Maine, New Hampshire, New Jersey, North Carolina, Virginia, California, Massachusetts, and New York.

HISTORY, LORE & GEMSTONE/TECHNOLOGICAL USES: Rock crystal has been collected since antiquity. Much of its early history and value was based on its visual similarity to diamond and its use as a diamond substitute. During the Middle Ages and the Renaissance, stoneworkers fashioned beautifully engraved drinking glasses, vases, and other objects from rock crystal. Metaphysical practitioners have long used spherical "crystal balls" fashioned from rock crystal for divining purposes. Medieval physicians prescribed the ingestion of powdered rock crystal generally to relieve pain and specifically to alleviate renal and intestinal ailments. Modern metaphysical practitioners consider rock crystal to be the "universal crystal" because of its purported abilities to sharpen insight, enhance spiritual development, improve concentration, refine focus, energize the mind, and facilitate channeling and astral travel. Researchers discovered quartz's unusual piezoelectrical properties in the late 1800s. Until the 1960s when quartz was synthesized commercially, electronic-grade rock crystal was employed in many optical and electronic uses. Today, thin wafers of synthetic quartz are standard in electronic filters, frequency controls, and timers for watches, computers, cellular phones, digital games, and televisions. Natural rock crystal is still mined and ground into a powder called "lascas" for use as a silica feedstock in the manufacture of synthetic quartz. More than 200 tons of synthetic quartz are now manufactured each year.

ABOUT OUR SPECIMENS: Our specimens of the rock-crystal variety of quartz were collected at Mount Ida in Montgomery County in west-central Arkansas. Mount Ida is surrounded by Ouachita (WASH-eh-tah) National Forest, an expanse of forest, rolling hills, and the long ridges of the Ouachita Mountains. The Ouachitas began forming some 600 million years ago with deposits of silica-rich, marine sediments that later lithified into massive formations of sandstone and shale. Some 245 million years ago, silica-rich solutions filled fissures and fractures in the sandstone and shale formations. When these solutions cooled, quartz precipitated to fill the fractures and form complex vein systems. Most of these quartz-filled veins are concentrated in a 30-to-40-mile-wide zone that begins southwest of Little Rock and extends some 170 miles west past the Oklahoma line. Eons of erosion eventually reduced the surface of the Ouachita Mountains to expose many quartz-crystal-filled veins. Early settlers in the Ouachitas reported places where quartz crystals covered the ground. Systematic quartz mining in the Ouachitas has been conducted for more than 160 years. Thousands of rockhounds, mineral collectors, and metaphysical practitioners visit the Mount Ida area each year to purchase or collect rock crystal. Our rock-crystal specimens were gathered by commercial collectors.

COMPREHENSIVE WRITE-UP

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COMPOSITION & STRUCTURE

The chemical formula SiO_2 shows that quartz contains two elements: the semimetal silicon (Si) and oxygen (O). Its molecular weight is made up of 46.74 percent silicon and 53.26 percent oxygen. All molecules consist of positively charged cations and negatively charged anions. The cation in the quartz molecule is the silicon ion Si^{4+} with its +4 charge. The 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.

Chemically, quartz is an oxide, a mineral in which metals or semimetals combine with oxygen. But in terms of structure, the basis of modern mineral-classification systems, quartz is classified as a silicate, a mineral in which the basic building block is the silica tetrahedron $(SiO_4)^{4-}$. The silica tetrahedron $(SiO_4)^{4-}$ 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. In this configuration, four oxygen ions surround each silicon ion, and two silicon ions surround each oxygen ion. 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 quartz's infinite, three-dimensional structure, in which each electrically balanced molecular unit is described by the formula SiO_2.

Repeating chains of silicate molecules 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 (chalcedony) is a compact or massive form that consists of interlocked, microscopic silica grains and includes such varieties as chert, jasper, and agate. Quartz, a component of virtually all igneous, metamorphic, and sedimentary rocks, can form as a component of crystallized magma in both intrusive and extrusive (volcanic) rocks; by crystallization of silica-rich, hydrothermal fluids; or, in the case of our specimens, by the crystallization of silica-rich groundwater.

Quartz crystallizes in the hexagonal system and has four axes. Three are of equal length and lie on a plane; the fourth, which is unique to the hexagonal system, is perpendicular to the plane of the other three axes and is of variable length. 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. Atomic bonding within the quartz lattice is exclusively covalent. Because covalent bonding exerts omnidirectional strength, quartz crystals exhibit no cleavage. This lack of cleavage and the high bonding strength resulting from close atomic packing account for quartz's substantial durability and hardness of Mohs 7.0. Despite close atomic packing, the low atomic weights of the essential elements silicon (28.09) and oxygen (16.00) produce a relatively low specific gravity of 2.65. Although most minerals eventually abrade into fine particles and chemically weather, huge quantities of hard, durable quartz sand accumulate as beaches, sea bottoms, desert soils, and dune fields. These granular silica deposits often lithify into sandstone, a common sedimentary rock that often subsequently metamorphoses into quartzite, a tough, hard, compact rock that can survive most weathering and erosion processes to form large geological features.

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Quartz is an allochromatic (other-colored) mineral, meaning its colors are caused by traces of nonessential, color-producing elements called chromophores. Pure or nearly pure quartz, which includes rock crystal, is colorless and often exhibits a high degree of transparency.

The Dana mineral classification number 75.1.3.1 first identifies quartz as a tectosilicate or framework silicate (75). The subclassification (1) next defines quartz by the chemical formula SiO_2 and by its four-oxygen coordination, in which four oxygen ions (in the lattice configuration) are bound to each silicon ion. Quartz is then assigned to the quartz group (3) as the first (1) and only member. The subclassification includes several quartz polymorphs which share identical chemistries but have different crystal structures. These minerals are cristobalite (tetragonal), tridymite (triclinic), coesite (monoclinic), and stishovite (tetragonal).

COLLECTING LOCALITIES

Our specimens of the rock-crystal variety of quartz were collected near Mount Ida in Montgomery County, Arkansas. Rock-crystal sources near Mt. Ida include the Kimes crystal area and the Blue Phantom, Ocus Stanley, Fisher Spur, Wheeler, Wegner Quartz Crystal, Mount Ida Mountain, Monroe-Robbins, and Howard Sheffield mines. Montgomery County sources also include the de Linde and High Peak mines at Norman, and the Pigeon Roost prospect at Glenwood. Other Arkansas localities are the Young-Merriot, Wylie, Show, Miller Mountain, McEarle Ridge, Foyill, Elison, Dierks No. 3, Monte Cristo, East Coleman, Chance, and Hamilton Hill mines in Garland County; the Game Preserve and Iron Springs mines in Perry County; and the Lake Sylvia, Marler, Drennon, Fairchild, Goodwin, Hogan-Greene, Williams, and Willis mines in Saline County.

Other United States localities include Crystal Peak in the Kofa Game Range, Plomoso Mountains, La Paz County, Arizona; the Calumet Mine in the Turret District and Mount Antero, both in Chaffee County, Colorado; the Strickland and Schoonmaker quarries at Collins Hill, Portland, Middlesex County, Connecticut; the Noyes Mountain Quarry and the Diamond Ledge locality at Greenwood, Oxford County, Maine; the Black Mountain Quarry at Benton and the Palermo No. 1 Quarry at Groton, both in Grafton County, New Hampshire; the Chimney Rock Quarry in Bridgewater Township, Somerset County, New Jersey; the Jamestown Quarry at Jamestown, Guilford County, North Carolina; and the Enterprise Mine at Beckham, Appomattox County, and the Morefield Mine at Winterham, Amelia County, both in Virginia. In California, rock crystal occurs at the Rough Diamond and Green Mountain mines in Chili Gulch, Mokelumne Hill, Mokelumne district, Calaveras County, and at the Himalaya Mine at Gem Hill, Mesa Grande district, San Diego County. Massachusetts localities include the Blueberry Hill Quarry at Wobrun, Middlesex County, and at Andover and Nahant in Essex County. The best-known sources in New York are the “Herkimer diamond” localities in Herkimer, Fulton, and Montgomery counties.

Other sources in the Western Hemisphere are the Incahuasi Mine at Solar de Hombre Muerto, Antofagosta de la Sierra Department, Catamarca, Argentina; the Sopa area in the Jequitinhona Valley, Minas Gerais, Brazil; the Rosario Mine at Casapalca, Huarochiri Province, Lima Department, Peru; and the Porcupine Mine in Gillies Township, Thunder Bay, Ontario, Canada. Mexican localities include the Santa Rita Mine at Guanajuato in the state of Guanajuato; the

Bilbao Mine at Ojo Caliente, Zacatecas; the Doloras Mine at Mineral de Monte, Hidalgo; and the San Bartolo Mine at Charcas, San Luis Potosí.

In Europe, the rock crystal variety of occurs in Austria at Lassach Glacier on Kleiner Ankogel Mountain, Plattenkogel Mountain in the Hohe Tauern Mountains, and the Althaus Mine at St. Martin am Silberberg, all in Carinthia; Wolfsbach at Drosendorf, Waldviertel, Lower Austria; the Keotsen gold mines at Brennkogel, Fusch Valley, Salzburg; the Hartner Quarry at Schwannberg, Koralpe, Styria; and Hoher Eicham at Prägraten, Tyrol. Other European sources are Marvie and Wardin near Bastogne, Luxembourg Province, Belgium; the Spearn Moor and Wheal Diamond mines at St. Just, St. Just District, Cornwall, England; and the Büchlberg rock-crystal quarry at Hausenberg, Lower Bavaria, Bavaria, and the Trechtingshausen Quarry at Bingen in the Hunsrüch Mountains, Rhineland-Palatinate, both in Germany. Swiss sources include the Vals Quarry in the Vals Valley at Grischun near Tiefenbach in Uri, and Alpsjuhorn Mountain at Visp, Wallis. French specimens come from the La Gardette Mine at Bourg d'Oisans, Isère, Rhône-Alpes.

Russian specimens are collected at the Zhelannoe quartz deposit at Prepolar Ural in the Komi Republic, and the Natalka gold mines in the Kolyma River Basin, Magadanskaya Oblast', both in the Far-Eastern Region. Other localities worldwide include the Tsumeb Mine at Tsumeb, Otjikoto Region, Namibia; the Gilgit and Skardu pegmatite districts, Northern Areas, Pakistan; the Yanganxian Mine in Yizhang County, Chenzou Prefecture, Hunan Province, China; the Góis ore field at Góis, Coimbra District, Portugal; Şurdeşti, Baia Sprie, Maramureş County, Romania; Ljoslandsknipen, Ljosland, Aust-Adger, Norway; the Madem-Lakko Mine in the Cassandra ore field, Chalkidiki Prefecture, Macedonia Province, Greece; and the Ratnapura gem gravels, Ratnapura District, Sabaragamuwa Province, Sri Lanka.

JEWELRY & DECORATIVE USES

Prior to the early 1700s, diamonds were in very short supply and exorbitantly, making the rock crystal variety of quartz a popular diamond substitute throughout Europe. Even after diamonds became more available and affordable, rock crystal continued to serve as a traditional diamond substitute until the 1950s, when the manufacture of synthetic, colorless gemstones with much higher indices of refraction was commercialized. Faceted rock crystal served continued to be used in costume jewelry until the 1960s, when it was replaced by faceted, high-refraction, leaded glass. Today, collector's gems are cut from flawless rock crystal, often in sizes exceeding 100 carats and usually in round-brilliant styles. Faceted, 100-carat, rock-crystal gems are now priced at about $100.

Over the centuries, rock crystal has been cut into such decorative objects as goblets, engraved medallions, scepter tips, candleholders, paperweights, figurines, and spheres, the latter for both decorative and metaphysical purposes (see "History & Lore"). The largest-known, flawless rock-crystal sphere, which is 12.9 inches in diameter and weighs 106.75 pounds, is displayed at the National Museum of Natural History (Smithsonian Institution) in Washington, D. C. Three-inch-diameter, nearly flawless rock-crystal spheres sell for about $250.

Because of its transparency, brilliance, well-developed crystal form, affordability, and frequent association with other interesting and colorful species, the rock-crystal variety of quartz is one of the most widely collected minerals.

HISTORY & LORE

The rock-crystal variety of quartz was among the first mineral crystals collected in Paleolithic times. In early attempts to differentiate rock crystal from diamond, ancient naturalists and alchemists divided colorless gemstones into two groups based generally on hardness. Such gemstones as diamond [carbon, C], beryl [beryllium aluminum silicate, $Be_3Al_2Si_6O_{18}$], and colorless sapphire [corundum, aluminum oxide, Al_2O_3] were known as *adamas*, the Latin word for "hardest," while much softer rock crystal was called *krystallos*, the Greek word for "ice." In *A History of Stones*, the first treatise on gems written in 315 B.C., Greek philosopher and naturalist Theophrastus (ca 372-ca 287 B.C.) described rock crystal as a type of ice. The Roman scholar Pliny the Elder (Gaius Plinius Secundus, A.D. 23-79) later described rock crystal as ice that had frozen so solidly and completely that it could never thaw. Other naturalists of that period classified colorless gems as "ripe" or "unripe," diamond being "ripe" and rock crystal "unripe." Diamond, then obtained almost exclusively from India, was thought to have "ripened" in the warmer Indian climate, while rock crystal, which was abundant in cooler European regions, was thought to have lacked sufficient heat to "ripen."

Rock crystal was long considered both the "poor man's diamond" and the "rich man's glass." Until the discovery of Brazil's alluvial diamond deposits in the early 1700s, most European "diamonds" were actually rock crystal that was known as "quartz diamond." When the great popularity of affordable "quartz diamond" began eroding the value of genuine diamonds, the rulers of Austria's Hapsburg Dynasty, which controlled parts of western Europe in the late 18^{th}-century, banned rock-crystal mining to boost diamond prices. Much European "quartz diamond" came from the Rhine River sediments, which contained rock-crystal fragments that had washed down from the Alps. These became known as "Rhine stones," a name that survives today in the glass "rhinestones" popular in costume jewelry. During the Middle Ages and the Renaissance, stoneworkers fashioned elaborately engraved drinking glasses, vases, and other objects from rock crystal. Rock crystal remained the "rich man's glass" until the mid-1800s, when it was finally replaced by improved types of glass, which were equally transparent, but softer and much more workable.

Rock crystal has always been the preferred medium for metaphysical "crystal balls." About 2000 B.C., the Druids in what is now England began using mineral crystals to divine or "see" the future. By the 15^{th} century A.D., divination or "scrying" with crystal balls cut from rock crystal had gained great popularity. Of the many prominent alchemists, seers, psychics, and philosophers who used crystal balls, the best-known is perhaps the learned astronomer, mathematician and astrologer John Dee (1527-1608), a leading advisor to England's Queen Elizabeth I (1533-1603). The British Museum in London now displays the crystal ball with which Dee divined much of his advice for his queen. The crystal ball's role in divination has always been controversial. Some seers claim that the inclusions and play of light within rock-crystal spheres actually form clairvoyant images, while others believe that the featureless, seemingly infinite interior of the spheres helps to clear the mind in preparation for the emergence of futuristic visions.

Medieval physicians prescribed the ingestion of powdered rock crystal to relieve pain in general and to specifically alleviate the symptoms of renal and intestinal ailments. Modern metaphysical practitioners call rock crystal the "universal crystal" because of its purported abilities to sharpen insight, enhance spiritual development, improve concentration, refine focus, energize the mind, and facilitate channeling and astral travel. Rock crystal has appeared on the 40-centime stamp of Switzerland in 1958, the 400-sucre stamp of Ecuador in 1997, the 1.00-franc stamp of the French Southern & Antarctic Territories in 1998, the 1-cent stamp of Canada in 1963, the 6.00-franc stamp of Monaco in 1990, the 4-bhat stamp of Thailand in 1972, and the 10-cent stamp of the United States in 1974. Rock crystal is the state gemstone of Georgia and the state mineral of Arkansas.

ARKANSAS' QUARTZ LEGACY

Based on the accessibility and size of its quartz deposits, along with degrees of transparency and crystal development seen in many specimens, the area in the Ouachita (WASH-eh-tah) Mountains around Mount Ida, Arkansas, is one of the world's premier sources of rock crystal. While other great sources exist, notably those in Brazil and Europe, along with the "Herkimer diamond" sites in New York, none can match the Arkansas localities in terms of economic impact, colorful history, and public attention.

Archaeologists have contextually dated the oldest known artifact made from Arkansas quartz, an arrowhead, to 9000 B.C. When the Spanish conquistador Hernando de Soto arrived in what is now central Arkansas in 1541, he saw many Native Americans using projectile points fashioned from quartz crystals. These Native Americans probably collected most of their quartz from the surface. However, many archaeologists believe that Native Americans also systematically mined rock crystal and continue to search for evidence to prove this assertion.

The American geographer and geologist Henry Rowe Schoolcraft (1793-1864) made the first written report of Arkansas rock crystal in 1819, stating, "One of the most noted localities of this mineral west of the Mississippi River is the Hot Springs of Ouachita in Arkansaw [sic] Territory. At this place numerous pieces of quartz have been found, very pure and transparent, and beautifully crystallized in six-sided prisms, terminated by six-sided pyramids." Early settlers in the Ouachita Mountains were interest in the crystals which, in places, covered the ground. In 1859, a number of settlers collected and marketed crystals valued at $1,000—an appreciable sum for the time. By the 1890s, crystal sales in the region had risen to $5,000 per year. Production soared in the 1920s, when the first paved roads through the Ouachitas triggered a wave of tourism and a huge demand for crystals.

World War II brought unprecedented attention to Arkansas rock crystal, thanks to the urgent wartime need for electronic-grade quartz crystals for use in chronometers, radios, radars, and bombsights (see "Technological Uses"). At the time, Brazil was the only source of electronic-grade quartz crystals. In 1939, the United States War Department classified electronic-grade quartz crystal as a strategic material. Two years later, it established the Quartz Crystal Section of the Army's Office of the Chief Signal Officer to manage the acquisition of electronic-grade quartz crystals from Brazil. But when German U-boats cut off the maritime supply of Brazilian quartz and air transport proved costly, the government turned its attention to a secure domestic source of quartz—Arkansas. Backed by government subsidies, miners and prospectors rushed into the Ouachitas. In 1943, the quasi-governmental Metals Reserve Company set up an electronic quartz-testing and quartz-buying office in Hot Springs, Arkansas. That year alone, the office purchased 212,000 pounds (106 tons) of rock crystal valued at $35,000. Although only part of this production consisted of electronic-grade quartz, the remainder went to optical uses. Although Brazil continued to supply most electronic-grade quartz, Arkansas' quartz mines nevertheless made a major contribution to the war effort.

Commercial mining of electronic-grade quartz in Arkansas ceased after the war, but a new era opened in the 1950s with increased automobile travel and growing interest in both mineral collecting and the metaphysical aspects of crystals. Crystal mining also increased sharply to satisfy demand from tourists, mineral collectors, museum curators, and metaphysical practitioners. During this decade, many rock shops and fee-collecting areas opened in and near Mount Ida. The fee-collecting sites were tracts of land with occurrences of in situ quartz veins or layers of quartz-rich surface gravels. The owners and operators used mechanical equipment to expose bedrock or "turn over" gravels, then charged customers an hourly fee to search for crystals—an approach that became widely popular among both tourists and rockhounds.

By the mid-1980s, global metaphysical interest in mineral crystals, especially rock crystal, had skyrocketed. And the most desirable and affordable rock crystal came from Arkansas. Major news magazines and network television documentaries reported on the "crystal power" phenomenon and on the place where most of these crystals came from—Mount Ida, Arkansas. As crystal prices continued to soar, prospectors and miners again flocked into the Ouachitas. In the early 1980s, Ouachita National Forest had reported about 20 crystal claims operating each year, with top-quality crystals selling for about $30 per pound. By 1987, the number of national forest claims had quadrupled, and top-quality crystals were bringing $100 per pound.

Today, the Ouachita National Forest, which manages hundreds of rock-crystal claims and leases, recognizes two types of quartz products: industrial-grade quartz and natural quartz crystal. Industrial-grade quartz is a massive form of translucent, milky quartz. Known among Arkansas miners as "bull quartz," it has a very high chemical purity and is ground to a powder as a silica feedstock for the manufacture of synthetic quartz (see "Technological Uses"). Most Arkansas miners, however, are after natural quartz crystal, which is valued for its water-clear transparency, exceptional crystal form, and overall aesthetic quality. Natural quartz crystal is sold in large quantities in the Mt. Ida area and is also distributed to mineral-specimen dealers, rock shops, and metaphysical shops worldwide.

Quartz-crystal production from the Ouachita National Forest from 1920 through 1981 is estimated at 1.7 million pounds (850 tons), much of it mined during World War II. A substantial, but unknown, quantity has also been mined on private land adjacent to the national forest. Current production on federal lands is about 20,000 pounds (10 tons) per year. About 250 people now work in crystal exploration or mining, with another 250 employed in crystal sales in the Ouachita Mountains region. As for the future of Arkansas rock crystal, old-timers believe that only three or four percent of all the crystals that exist at or near the surface in the Ouachitas have been collected or mined. Much interest in quartz prospecting and mining remain apparent today, especially with top-quality, cabinet-sized clusters of rock crystal now selling for more than $10,000 each.

TECHNOLOGICAL USES

Quartz served as the model for its own laboratory synthesis in 1845. Although quartz synthesis was a major scientific achievement, the first synthetic quartz crystals were poorly developed and had no technological uses. French physicists discovered the remarkable electrical properties of quartz in the 1880s. While applying mechanical stress, they detected an electrical potential (voltage) across the crystal faces, an effect called “piezoelectricity,” after the Greek *piezein*, meaning “to press.” French researchers then learned that applying electrical current to quartz would physically deform the crystal by changing the crystal-face angles and, in 1918, found that electrical current applied to thinly sliced quartz caused these “wafers” to vibrate mechanically at a natural resonance frequency later measured at precisely 32,768 cycles per second. Scientists subsequently designed a quartz oscillator to control clocks with unprecedented accuracy, triggering a rush for “electronic-grade” quartz crystals—single (untwinned) crystals with nearly perfect, undistorted crystal lattices large enough to be cut into wafers. Although rare, electronic-grade, natural quartz was obtainable in commercial quantities from sources in Brazil and Arkansas (see “Arkansas’ Quartz Legacy”). Natural-quartz wafers were soon regulating time and electrical frequencies in chronometers, radios, radars, bombsights, and many other instruments.

By the 1960s, researchers had synthesized electronic-grade quartz by developing a hydrothermal technique that replicated the formation of natural quartz. In a synthesis process that is still used today, powdered, high-quality (but nonelectronic grade), natural quartz called “lascas” is mixed with an aqueous solution of basic sodium carbonate, then placed in steel autoclaves under high temperature and high pressure to form a silica gel. Tiny “seed” crystals of electronic-grade, natural quartz are added to initiate the crystallization of synthetic quartz. Today, laboratories worldwide annually manufacture more than 200 tons of synthetic quartz, cutting it into wafers that are standard in electronic filters, frequency controls, and timers for watches, computers, cellular phones, digital games, televisions, and many other electronic devices.

ABOUT OUR SPECIMENS

Our specimens of the rock crystal variety of quartz were collected at Mount Ida in Montgomery County, Arkansas. Mount Ida, population 1,100, is located in west-central Arkansas on U.S. Highway 270, about 35 miles west of the city of Hot Springs, 70 miles west of the state capitol of Little Rock, and 40 miles east of the Oklahoma line. Mount Ida is surrounded by Ouachita National Forest, an expanse of forest, rolling hills, and the long ridges of the Ouachita Mountains.

The Ouachita Mountains consist of a series of ridges with elevations as high as 2,000 feet that trend in an east-west direction across west-central Arkansas and part of eastern Oklahoma. The Ouachitas began forming 600 million years ago in Paleozoic time when a rift developed along the southern edge of the North American tectonic plate. As the Earth’s crust stretched and subsided, a section separated and drifted south, leaving behind marine basins that extended inland. For the next 150 million years, massive deposits of silica-rich marine sediments accumulated on the basin floors, later lithifying into formations of sandstone and shale. During the Mississippian Period some 360 million years ago, distant tectonic collisions thrust the separated section of crust back toward the north, forcing it beneath the North American Plate.

This buckled the overlying sedimentary formations, uplifting them as much as 10,000 vertical feet to form the original Ouachita Massif, a range of intensely deformed, fold-type mountains that is structurally similar to the Appalachians.

Some 245 million years ago during the late Permian Period, silica-rich solutions began to circulate through fissures and fractures in the sandstone and shale formations. Upon cooling, large amounts of quartz precipitated within these fractures to form complex vein systems. Most of this quartz is of the massive, translucent, milky variety, which has a white color caused by included, microscopic, gas- and fluid-filled bubbles that reflect and refract light. A smaller portion consists of the colorless, transparent rock-crystal variety. Most quartz-filled veins are concentrated in a 30-to-40-mile-wide zone extending from a point southwest of Little Rock some 170 miles west into Oklahoma—an area that represents the geological core of the Ouachita Mountains. Erosion eventually reduced the surface of the Ouachita Mountains to expose many of these quartz-crystal-filled veins. Early settlers in the Ouachitas reported places where the crystals literally covered the ground (see "Arkansas' Quartz Legacy"). Most quartz crystals are found in Montgomery, Garland, Saline, and Perry counties, which have dozens of quartz mines (see "Collecting Localities"). Mount Ida in Montgomery County is the approximate center of this quartz-rich area.

Our rock-crystal specimens were gathered by commercial collectors who extract the crystals from in situ veins and crevices. After mechanical equipment exposes these bedrock veins, crystals are then manually removed from the crevices. The width of these quartz-filled crevices ranges from only several inches to about 40 feet; most are just a few feet wide. The crystals project from the walls toward the center of the crevices, which are partially filled with a sand-like material and a reddish, iron-rich clay.

As you examine your specimen, note first its distinctive hexagonal shape, in which the prism exhibits six longitudinal faces. These crystals have a single termination which forms a six-sided pyramid. Because terminations are often modified and lack perfect symmetry, some crystals may appear to have fewer than six termination faces, but close study will reveal all six modified faces. Detailed inspection of the prism faces will also reveal crosswise, parallel striations. The bright, vitreous luster of the prism and termination faces is another diagnostic feature of quartz. These specimens are colorless and exceptionally transparent, with the greatest transparency near the termination. Closer to the base, many crystals have gas-filled or fluid-filled, microscopic inclusions that reduce transparency and produce a milky-white coloration. Your specimen of rock crystal is an example of one of the most widely collected minerals and a souvenir of the great quartz locality in Arkansas' Ouachita Mountains.

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