May 2011 Mineral of the Month: Rhodonite

This month's mineral is rhodonite, a manganese silicate from a classic locality in Peru. Our write-up explains the mineralogy of rhodonite and its many uses as a decorative stone, and also describes certain other minerals and rocks that serve as decorative stones.

OVERVIEW

PHYSICAL PROPERTIES

Chemistry: $CaMn_4Si_5O_{15}$ Calcium Manganese Silicate, usually containing significant amounts of iron and magnesium.
Class: Silicates
Subclass: Inosilicates (Single-chain Silicates)
Group: Rhodonite
Crystal System: Triclinic
Crystal Habits: Usually in compact or massive form or coarse-to-fine granular aggregates. Crystals, which are rare, occur in bladed and flat-prismatic forms, and less commonly in blocky or square-prismatic forms, all with longitudinal striations.
Color: Brownish-red, flesh-red, pinkish-red, or pink; rarely yellowish or greenish, occasionally black; massive forms often exhibit black veining; may tarnish to brown or black with long-term atmospheric exposure.
Luster: Vitreous, sometimes pearly on polished surfaces
Transparency: Usually translucent; occasionally transparent or opaque.
Streak: Colorless to white
Refractive Index: 1.71-1.74
Cleavage: Good in two directions at nearly right angles
Fracture: Subconchoidal to uneven
Hardness: 5.5-6.5
Specific Gravity: 3.5-3.7
Luminescence: Occasionally fluorescent
Distinctive Features and Tests: Characteristic brownish-red, flesh-red, pinkish-red, or pink color; frequent, distinctive black veining in massive forms; fuses easily into a brownish-red, glass-like material. Can be confused with rhodochrosite [$MnCO_3$], which is softer, and with pink forms of microcline [feldspar group, $KAlSi_3O_8$], which is harder. Laboratory tests are necessary to distinguish rhodonite from pyroxmangite [$Mn(Mn,Fe)_6(Si_7O_{21})$], pyroxferroite [$(Ca,Fe)(Fe,Mn)_6(Si_7O_{21})$], and tephroite [$Mn_2SiO_4$].
Dana Classification Number: 65.4.1.1

NAME The name "rhodonite," pronounced ROW-(as in "go")-duh-nite, stems from the Greek *rhodon,* or "rose," alluding to the mineral's reddish color. Rhodonite is also known as "manganese spar," "rose spar," "angel blush," "pink marble," "mangan-amphibole," "mangankiesel," "kiesel-mangan," "manganolite," "hermannite," and "hydropite." When veined with black manganese oxide, the massive variety is called "spiderweb rhodonite." Other names include "fowlerite," a brownish or yellowish, zinc- and calcium-rich variety; "keatingine," a pink, manganese-rich variety; "hsihutsunite," a purple-red, calcium-rich variety; and "orlets," a fine-grained, manganese-rich variety.

COMPOSITION: Rhodonite consists of 6.26 percent calcium (Ca), 34.33 percent manganese (Mn), 21.93 percent silicon (Si), and 37.48 percent oxygen (O). Rhodonite usually contains significant amounts of iron and magnesium. Rhodonite is a member of the silicate class of minerals and is sub-classified as a single-chain inosilicate. It crystallizes in the triclinic system with three axes of different lengths, none of which are

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perpendicular to the others. Rhodonite most often occurs in massive forms consisting of tiny, tightly interlocked, individual crystals; well-developed crystals are rare. As an idiochromatic (self-colored) mineral, rhodonite's characteristic pinkish-to-reddish colors are caused by its essential elemental components and the nature of its crystal lattice. The essential element manganese is a powerful red chromophore (color-causing agent). Rhodonite colors vary considerably with the amount of iron and magnesium that replaces calcium and manganese. An excess of iron shifts the color toward intense brownish-red. Rhodonite forms in both metamorphic rocks and in hydrothermal replacement deposits that contain manganese mineralization.

COLLECTING LOCALITIES: Notable rhodonite localities include Bolognesi and Yauli provinces in Peru; Minas Gerais, Brazil; Corangas Province, Bolivia; British Columbia, Canada; and Ekaterinburg in the Urals Region of Russia. Rhodonite also occurs in Mexico, Sweden, Bulgaria, Italy, England, Japan, India, Namibia, South Africa, New Zealand, and Australia. In the United States, rhodonite is found in Massachusetts, New Jersey, Colorado, Michigan, Montana, New Hampshire, North Carolina, Vermont, Virginia, and California.

HISTORY, LORE, & GEMSTONE/TECHNOLOGICAL USES: Rhodonite was first described in 1783 and formally named in 1819. As a gemstone and decorative stone, it was first used extensively in Russia in the mid-1800s when production of high-grade material began at the huge rhodonite deposit at Ekaterinburg in the Ural Mountains. Later, other important rhodonite deposits were mined in Australia, Massachusetts, and Canada's Vancouver Island. Massive rhodonite, in bright-pink colors mottled with dendritic patterns of black manganese dioxide and white calcite are fashioned into cabochons, beads, inlay pieces for mosaics, and a variety of decorative items. Transparent rhodonite crystals are occasionally faceted into beautiful, distinctive, and costly collector's gems. Rhodonite crystals are rare and highly valued by mineral collectors as both individual and composite specimens for their color, rarity, and mineralogical associations. According to metaphysical practitioners, rhodonite strengthens resolve and builds self-confidence, enables wearers to assess and respond to chaotic situations, and aids in physical and emotional healing after traumatic accidents or events. Rhodonite occasionally serves as a minor ore of manganese.

ABOUT OUR SPECIMENS: Our rhodonite specimens were collected at the San Martín Mine at Chiurucu, Huallanca District, Bolognesi Province, Ancash Department, Peru. Huallanca District, with an average elevation of 6,000 feet and covering 337 square miles, is 80 miles east of the Pacific Coast and 125 miles north-northeast of the national capital of Lima. Local mineralization was emplaced following the crustal fracturing that accompanied the uplift of the Andes some 60 million years ago. Mineral-rich, hydrothermal solutions surged upward in multiple phases into fractures within quartz-monzonite and granitic country rock to precipitate an array of minerals in complex vein systems. Both the Incas and the colonial Spanish mined silver at Huallanca. Zinc mining became prominent at Huallanca in the 1960s when several underground mines were developed, including the San Martín Mine, a small, multi-metal operation that produces zinc and lesser amounts of silver, lead, and copper. Crystals of rhodonite, a gangue mineral at the San Martín Mine, gained popularity with collectors in the early 1990s. Miners found major rhodonite pockets in 1991, 1995, and 1997, and again in 2007 when our specimens were collected. The San Martín Mine has since closed and is unlikely to reopen.

10 YEARS AGO IN OUR CLUB: Gypsum, Red River Floodway, Winnipeg, Manitoba, Canada. "Blond balls," our supplier called these spherical clusters of light yellow crystals radiating out from a clay core. Truly unique and stunningly beautiful, these are still available and command high prices! They were discovered accidentally after the Red River overflowed its bank and flooded about one eighth of urban Manitoba in 1950. A 30-mile canal was dug, which led to the discovery of these amazing specimens!

May 2011 Mineral of the Month: Rhodonite

COMPREHENSIVE WRITE-UP

COMPOSITION

This is now the second time we have featured rhodonite. The first was in July 2003, when we sent Club members lovely crystals of pinkish-red rhodonite from a new find near Conselhierro Lafaiete, Minas Gerais, Brazil. Some years later, our Brazilian source informed us that they may have been crystals of a new mineral, structurally related to rhodonite, and that testing was ongoing; recently, we Emailed him to see if a conclusion had been reached, and will let you know his response. How amazing it would be if it did turn out to be a new mineral!

Rhodonite, chemical formula $CaMn_4Si_5O_{15}$, contains the elements calcium (Ca), manganese (Mn), silicon (Si), and oxygen (O) in the proportions of 6.26 percent calcium, 34.33 percent manganese, 21.93 percent silicon, and 37.48 percent oxygen. Like all molecules, those of rhodonite are composed of positively charged cations and negatively charged anions. Rhodonite's compound cation consists of a divalent calcium ion Ca^{2+} with its +2 charge and four divalent manganese ions $4Mn^{2+}$, each with a +2 charge, for a total cationic charge of +10. The rhodonite anion is a radical, a bonded group of ions of different atoms that behaves as an entity in chemical reactions. The rhodonite anion is the silica radical $(Si_5O_{15})^{10-}$, in which the silicon ions $5Si^{4+}$ have a collective +20 charge and the 15 oxygen ions $15O^{2-}$ have a collective -30 charge. This results in a total anionic charge of -10 to balance the total cationic charge of +10, thus imparting electrical stability to the rhodonite molecule.

Rhodonite is a member of the silicates, the largest mineral class, in which silicon and oxygen combine with one or more metals. The basic silicate structural unit is the silica tetrahedron $(SiO_4)^{4-}$, in which a silicon ion is surrounded by four equally spaced oxygen ions that are positioned at the four corners of a tetrahedron (a four-faced polyhedron). In the silicates, silica anions and metal cations join together in repeating chains to form seven types of structures: independent tetrahedral silicates (nesosilicates); double tetrahedral silicates (sorosilicates); ring silicates (cyclosilicates); sheet silicates (phyllosilicates); framework silicates (tectosilicates); and single- and double-chain silicates (inosilicates).

Rhodonite is a member of the single-chain inosilicates, a major group of rock-forming minerals that consists of single chains of silica tetrahedra. Within these chains, tetrahedra bond together by sharing two of their oxygen ions with adjacent tetrahedra. This reduces the number of oxygen ions per tetrahedron by one, resulting in a series of $(SiO_3)^{2-}$ units. Although these single chains are often diagramed as straight, they are actually twisted or helical in a manner that accommodates other ions between them. The two negative charges on each unit are carried by the two unshared oxygen ions and must be balanced by positive ions. In rhodonite, these positive ions are divalent calcium ions Ca^{2+} and divalent manganese ions Mn^{2+}, which bond ionically to the negatively charged oxygen ions. Rhodonite forms single-width, unbranched chains that consist of rhodonite molecules bonded together in units of five, an arrangement that is reflected in its chemical formula $CaMn_4Si_5O_{15}$. Note that the $(Si_5O_{15})^{10-}$ silica radical is actually a five-time multiple of the basic $(SiO_3)^{2-}$ silica radical—the reason that rhodonite's formula is sometimes expressed as $CaMn_4(SiO_3)_5$.

Within the rhodonite lattice, these individual, five-unit chains form planes of closely packed oxygen ions that alternate with planes of calcium and manganese ions and planes of silicon ions. Because the ionic bonds in the two directions *between* the chains are much weaker than the covalent oxygen-oxygen bonds *within* the chains, cleavage planes exist in two directions nearly perpendicular to the long axes of the chains. Because part of its bonding is ionic, rhodonite has a hardness of Mohs 5.5-6.5, substantially less than that of quartz (Mohs 7.0). Rhodonite crystallizes in the triclinic system, which is characterized by three axes of different lengths, none perpendicular to the others. This lack of symmetry is often reflected in knife-edged, wafer-like crystals, with no right angles. Coincidentally, this is our third month in a row featuring a mineral from the triclinic system–March was Axinite-(Fe), which typically forms axehead-shaped crystals, and from which habit its named is derived; and April was kyanite, which typically forms long thin bladed crystals with few terminations. Well-developed rhodonite crystals are rare; rhodonite usually occurs in a massive form consisting of tiny, tightly interlocked, individual crystals.

Because of their mutual divalent charges and similar ionic radii, iron and magnesium ions partially substitute for rhodonite's calcium and manganese ions. Until the 1990s, rhodonite's chemical formula was variously written as $Mn_5Si_5O_{15}$ to indicate essentially pure manganese silicate and to discount any significant cationic substitution, or as $(Mn,Ca,Fe,Mg)_5Si_5O_{15}$ to indicate prominent cationic substitution. This led to confusion with the following chemically similar mineral species:

Pyroxmangite [manganese iron silicate, $Mn(Mn,Fe)_6(Si_7O_{21})$, triclinic]
Pyroxferroite [calcium iron manganese silicate, $(Ca,Fe)(Fe,Mn)_6(Si_7O_{21})$, triclinic]
Tephroite [manganese silicate, Mn_2SiO_4, orthorhombic]

To eliminate this confusion, the rhodonite formula is now formally stated as $CaMn_4Si_5O_{15}$. Rhodonite, pyroxmangite, pyroxferroite, and tephroite are all similar in appearance and positive differentiation often requires X-ray diffraction analysis.

Rhodonite forms in both contact metamorphic rocks and in hydrothermal replacement deposits that have elevated concentrations of manganese. In contact metamorphic rocks, rhodonite occurs with willemite [zinc silicate, Zn_2SiO_4] and calcite [calcium carbonate, $CaCO_3$]. In hydrothermal replacement deposits, rhodonite is found with tephroite and spessartine [garnet group, manganese aluminum silicate, $Mn_3Al_2(SiO_4)_3$].

As an idiochromatic (self-colored) mineral, rhodonite's characteristic pinkish-to-reddish color is caused by the essential element manganese and the nature of its crystal lattice. The divalent manganese ion Mn^{2+} is a powerful red chromophore (color-causing agent) in such non-oxide minerals as rhodonite and rhodochrosite [manganese carbonate, $MnCO_3$]. Rhodonite colors vary considerably with the amount of iron and magnesium that has replaced calcium and manganese. An excess of iron shifts the color toward intense brownish-red, while an excess of magnesium and calcium, which are not chromophoric elements, produce lighter, more delicate pink hues. Massive rhodonite often occurs intermixed with white calcite and black pyrolusite [manganese dioxide, MnO_2] in contrasting and attractive patterns that increase rhodonite's value as a gemstone and decorative stone.

The Dana mineral-classification number 65.4.1.1 first identifies rhodonite as an inosilicate with single-width, unbranched chains (65). The subclassification (4) defines it structurally as consisting of chains of five-molecule units. Rhodonite is then assigned to the rhodonite group (1) as the first (1) and most abundant of eight uncommon or rare members.

COLLECTING LOCALITIES

Our rhodonite specimens were collected at the San Martín Mine at Chiurucu, Huallanca District, Bolognesi Province, Ancash Department, Peru. Peruvian rhodonite is also found in silver-lead mines of the Morococha District, Yauli Province, Junín Department. Other South American localities are the Piquiri and Morro da Mina mines in the Conselhierro Lafaiete iron-manganese district, Minas Gerais, Brazil, source of the specimens we sent out in July 2003; and the Negrillos Mine, Todos Santos District, Corangas

Province, Oruro Department, Bolivia. Mexican specimens come from the San Ignacio, Santa Inéz, and Carretera mines at Mineral del Monte, Hidalgo; and the Santa Lucia and Carillos mines at Angangueo, Michoacán.

In Europe, rhodonite is collected at the Gåsborn and Långban mines in the Gåsborn district near Filipstad, Värmland, Sweden; the Madan manganese field in the Rhodope Mountains, Smolyan Oblast', Bulgaria; the Valgraveglia Mine at Reppia in the Graveglia Valley, Genova Province, Liguria, Italy; and the Treburland manganese mine in the Liskeard district in Cornwall and the Exeter Mine at East Devon in Devon, both in England. Russian specimens come from the Malosedel'nikovskoe and Kurganovo manganese deposits at Ekaterinburg, Ekaterinburgskaya Oblast', Urals Region.

Other localities include the Iwato manganese mine in Miyazaki Prefecture, Kyushu Region, Japan; the Gowari Wadhona Mine, Bhrandara district, Madhya Pradesh, India; the Kombat Mine at Kombat, Grootfontein District, Otjozondjupa Region, Namibia; the Wessels Mine at Hotazel in the Kalahari manganese fields, Northern Cape Province, South Africa; and Dunedin on the Otago Peninsula, South Island, New Zealand. Australian localities include the Broken Hill mining district, Yancowinna County, New South Wales; and the Cannington lead-zinc deposit at Cannington, Queensland. Canadian specimens come from the Evelyn Creek area in the Yukon Territory, and from Duncan and Salt Spring Island on British Columbia's Vancouver Island.

Important sources in the United States include the Cummington rhodonite locality at Cummington, Hampshire County, Massachusetts; the Franklin and Ogdensburg zinc deposits in Sussex County, New Jersey; and the Sunnyside Mine at Howardsville in the Silverton district of San Juan County, the Camp Bird Mine at Ouray in the Sneffels district of Ouray County, and the Smuggler Vein in the Telluride district in San Miguel County, all in Colorado. Other sources are the Champion Mine at Champion in the Marquette Iron Range, Marquette County, Michigan; the Star West Mine at Butte in the Butte district, Silver Bow County, Montana; the Keene rhodonite locality at Keene, Cheshire County, New Hampshire; the Cowee Creek district near Franklin in Macon County and the Bald Knob deposit at Sparta in Alleghany County, both in North Carolina; the Berkshire manganese deposit at Berkshire, Franklin County, Vermont; the Fort Union rhodonite prospect at Fort Union, Fluvanna County, Virginia; and the Manganese Queen Mine at Randsburg in the Rand District in Kern County and Indian Creek at Happy Camp in Siskiyou County, both in California.

JEWELRY & DECORATIVE USES

Massive rhodonite has a rich history as a gemstone and decorative stone. Easy to cut and polish, high-quality, massive rhodonite is available in attractive colors ranging from rose-red and pink to brownish-pink. For gem and decorative purposes, the most desirable colors are bright pinks mottled with dense, dendritic patterns of black manganese dioxide and occasionally white calcite. Generally, translucent rhodonite is used for cabochons and beads, while opaque material is best suited for inlay work and carving. The toughness of massive rhodonite and its pleasing color patterns make it a superb carving medium.

As a gemstone and decorative stone, rhodonite was first used extensively in Russia in the mid-1800s, when large quantities of high-grade material became available from the huge rhodonite deposit at Ekaterinburg in the Ural Mountains. The distinctive, pink-and-black appearance of rhodonite gems and decorative items appealed to both Russian royalty and to the peasantry. The sarcophagus for Russia's Emperor Alexander II (1818-1881) was fashioned from a 47-ton block of rough rhodonite from Ekaterinburg. Peter Carl Fabergé (1846-1920), jeweler to the Russian imperial court, used rhodonite extensively in his exquisite, gold, enameled and jeweled Easter eggs. For the Paris Universal Exposition of 1900, Fabergé was authorized to create a jeweled replica of the Imperial Regalia that was exhibited on a silver plate mounted atop a polished rhodonite column. The original Imperial Regalia, the royal collection of ceremonial crowns and scepters used by Russian royalty, consisted of polished rhodonite inlay accompanied by diamonds and precious metals.

Russia was the world's leading source of rhodonite until the 1880s, when a new supply became available from a deposit in Cummington, Massachusetts. In 1891, George Frederick Kunz (1856-1932), America's first gemologist, who was then working with the United States Geological Survey, wrote of Cummington rhodonite: "Blocks were taken out weighing some hundreds of pounds each, having a rich pink-and-red color . . . and equal in quality and beauty to the Russian rhodonite, which is made into vases and also table-tops and mantels." In 1919, miners opened a major deposit at Duncan on Canada's Vancouver Island. During the 1920s, they removed several thousand tons of massive rhodonite. In the United States in the late 1950s, a time when pink and black became popular colors for clothing, cars, and interior décor, pink-and-black rhodonite jewelry enjoyed great popularity that also spread to Europe and Japan. Cabochons and polished "flats" of pink-and-black rhodonite were frequently used in necklaces, brooches, bracelets, cuff links, and tie clasps. To meet rhodonite demand, Canada's Duncan mine, which had been closed since the late 1930s, reopened in 1980 to supply cutters in China.

In 1991, Russia regained the lead in rhodonite production with the expansion of the Ekaterinburg stone-cutting facility, which has since supplied most of the world's rhodonite for such decorative objects as candlesticks, jewelry boxes, vases, sculptures, desk accessories, mantels, and tabletops. Rhodonite from Ekaterinburg is one of dozens of decorative stones that adorn the Moscow Metro Subway stations in Russia. At the Mayakovskaya Station, 80 square meters of polished rhodonite slabs decorate structural columns. At the Chekhovskaya Station, wall mosaics contain thousands of rhodonite inlay pieces.

Transparent rhodonite crystals are occasionally faceted into collector's gems. When properly faceted, transparent rhodonite makes very attractive gems because of its distinctive reddish colors and relatively high refractive index (1.71-1.74). Faceted rhodonite gems are very costly because of the rarity of transparent crystals large enough to cut into gems larger than five carats and also because of rhodonite's two cleavage planes that intersect at nearly 90 degrees, making cutting extremely difficult. Top-quality, six-carat rhodonite gems cost about $4,500; nine-carat gems about $6,000.

Rhodonite crystals are rare and in demand by mineral collectors who value both individual and composite specimens for their color, rarity, and often unusual mineralogical associations.

HISTORY & LORE

Johann B. Ruprecht, a Hungarian mine inspector and later a chemist at the Schemnitz Academy of Mining (now the University of Miscolk in Banská Ŝtiavnica, Slovakia), first described rhodonite in 1783. German chemist Christoph Friedrich Jascha (1781-1871) confirmed Ruprecht's findings in 1819 and named the new mineral "rhodonite," from the Greek *rhodon,* or "rose," in reference to the mineral's rose-like color. Mineralogists initially considered all forms of manganese silicate, including those consisting of nearly pure manganese silicate and those with significant cationic substitution, as rhodonite. But in 1823, mineralogists recognized a nearly pure form of manganese silicate with an orthorhombic structure as a new mineral, which they named tephroite [manganese silicate, Mn_2SiO_4]. Then in 1913, pyroxmangite [manganese iron silicate, $Mn(Mn,Fe)_6Si_7O_{21}$], an iron-rich variety of rhodonite with a fixed chemical composition was recognized as a separate species. Mineralogists defined the atomic structure of rhodonite in 1923 using X-ray diffraction methods. Finally, in 1969, pyroxferroite [$(Ca,Fe)(Fe,Mn)_6(Si_7O_{21})$], another mineral very closely related to rhodonite, was recognized as a new species. Astronauts first discovered pyroxferroite on the lunar surface; it was later found to also exist on Earth.

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Rhodonite was once informally considered to be the national gemstone of the Soviet Union and later of Russia. A movement is now underway to formalize this recognition, but many Russians favor alexandrite [a variety of chrysoberyl, beryllium aluminum oxide, $BeAl_2O_4$], which is also mined in Russia. In the United States, rhodonite is the official gemstone of Massachusetts. In 1979, the Massachusetts legislature formally declared rhodonite the state's gem in recognition of the massive rhodonite deposit at Cummington in Hampshire County.

Rhodonite has been featured on the 12-kopek postage stamp of the Soviet Union in 1963 and the 9-cent stamp of Australia in 1973, two nations that at various times have been important commercial rhodonite sources. According to metaphysical practitioners, rhodonite strengthens resolve and builds self-confidence, enables its wearer to process chaotic situations and assess options, and aids in physical and emotional healing after traumatic accidents or events.

TECHNOLOGICAL USES

Rhodonite occasionally serves as a minor ore of manganese. Small quantities of rhodonite are recovered along with such primary manganese ore minerals as pyrolusite [manganese dioxide, MnO_2], notably in South Africa's Kalahari manganese fields.

DECORATIVE STONES

Our write-ups always include a "Jewelry & Decorative Uses" section in which we explain the gem or decorative uses of our current Mineral of the Month. Gemstones, of course, are precious or semiprecious stones that are cut and polished for wear in jewelry for personal adornment or, in the case of collector's gems, for collection and display. The term "decorative stone," however, is less familiar and has a much broader meaning. Decorative stones are minerals or rocks that are cut and polished for a wide array of ornamental or decorative purposes. Rhodonite is an example of a mineral that serves both as a gemstone and a decorative stone. In its decorative uses, rhodonite is fashioned into everything from mosaic-inlay pieces, architectural facades and tabletops to objects ranging from statues and figurines to bookends, ashtrays, panels for Tiffany-style lamps, jewelry boxes, paperweights, candlesticks, bowls, vases, and spheres.

Gemstones, decorative stones, and mineral specimens are the only types of mineral resources that are valued for their visual appearance. All other mineral resources are mined either for their chemical content (metal ores, limestone, etc.), weight or volume (sand and gravel, crushed rock), or structural properties (granite, sandstone, etc.), and their physical appearance is irrelevant. Decorative stones come in an endless variety of colors, patterns, and textures and include a surprisingly broad variety of rocks and minerals. These are some of the more widely used decorative stones:

***Onyx** is a general term for two types of banded or patterned, translucent materials that differ greatly in composition and properties. **Chalcedonic onyx**, as its name implies, is a form of chalcedony, the microcrystalline variety of quartz [silicon dioxide, SiO_2]. It exhibits alternating, light–and-dark parallel bands and has a hardness of Mohs 7.0. **Onyx marble**, also called "oriental alabaster," consists primarily of calcite or aragonite [both calcium carbonate, $CaCO_3$]. With a hardness of only about Mohs 3.0, it is very easy to cut and polish. Its bands or flow patterns reflect its origin as a calcareous precipitate in hot-springs environments. Both chalcedonic onyx and onyx marble occur in a range of subtle colors and are fashioned into a broad variety of decorative objects.*

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Jade *(our July 2000 featured mineral) is a general term for two visually similar minerals—jadeite [sodium aluminum iron silicate, $Na(Al,Fe)Si_2O_6$] and nephrite [basic calcium magnesium iron silicate, $Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$]. Because of their hardness of Mohs 6.0-7.0 and their remarkable toughness, they can be intricately worked without fracturing. Both types of jade are superb mediums for detailed carvings. Jade is also a popular gemstone.*

Marble *is an intensely metamorphosed high-grade limestone, a sedimentary rock that consists mainly of calcite or dolomite [calcium magnesium carbonate, $CaMg(CO_3)_2$]. The finest marble has a soft white glow that makes it a popular medium for sculpting. When cut in thin slabs and polished, marble provides an attractive surface to cover rough, structural rock or block. Marble has also been used as a structural stone for buildings.*

Rhodochrosite *[manganese carbonate, $MnCO_3$, our October 1997 and June 2004 featured mineral] has an attractive, pink-to-red color somewhat similar to that of rhodonite. Massive rhodochrosite is fashioned into an array of decorative objects and also serves as a gemstone.*

Malachite *[basic copper carbonate, $Cu_2CO_3(OH)$, our February 2002 featured mineral], with its banded, massive forms and bright-green color, is a popular decorative stone that is fashioned into boxes, bookends, and figurines. As a gemstone, it is cut and polished into beads and cabochons.*

Alabaster*, a fine-grained form of gypsum [hydrous calcium sulfate, $CaSO_4 \cdot 2H_2O$], has a Mohs hardness of only 2.0 and is easily carved. With colors ranging from snow-white to an array of pastel hues, it is a popular medium for carving and sculpting.*

Fluorite *[calcium fluoride, CaF_2 , our featured mineral in June 1996, March 2002, October 2007, and January 2010] occurs in a wide range of pale colors, most notably pinks and greens. Easily cut and polished, it is worked into a variety of decorative objects including ashtrays, bookends, figurines, and vases that resemble those made of jade.*

Lapis lazuli *is a rock with a distinctive dark-blue color caused by its chief mineral component lazurite [basic sodium calcium aluminum sulfate chlorosilicate, $(Na,Ca)_8Si_6Al_6O_{24}[(SO_4),S,Cl,(OH)]_2$, our December 2009 featured mineral]. Lapis lazuli is most familiar as a gemstone; as a decorative stone, it is fashioned into mosaic-inlay pieces and figurines.*

Amazonite*, the blue-green variety of the feldspar-group mineral microcline [potassium aluminum silicate, $KAlSi_3O_8$, our March 2007 featured mineral] is both a gemstone and a decorative stone. Its latter uses include mosaic-inlay pieces and carved objects.*

ABOUT OUR SPECIMENS

Our rhodonite specimens were collected at the San Martín Mine at Chiurucu, Huallanca District, Bolognesi Province, Ancash Department, Peru. Ancash, one of Peru's 21 departments (political divisions comparable to American states), is located in northwestern Peru and extends from the Pacific coast eastward into the high elevations of the Andes. Covering 13,866 square miles, Ancash is about as large as the combined states of Massachusetts, Rhode Island, and Connecticut. Ancash Department is administratively divided into 20 provinces (comparable to American counties). Located in southeastern Ancash, sparsely populated Bolognesi

Province has a rugged mountain topography that is part of the Cordillera Blanca, a sub-range of the Andes. Bolognesi Province is divided into 15 administrative districts (comparable to American townships). Huallanca District, which covers 337 square miles and has an average elevation of 6,000 feet, is 80 miles east of the Pacific Coast and 125 miles north-northeast of Peru's capital city of Lima. The approximate map coordinates of the Huallanca District are 8˚49' south latitude and 77˚52' west longitude.

Because the names of many Peruvian towns and administrative areas are anglicized spellings of Spanish interpretations of Quechan and Incan words, Peru has many confusing place names, and "Huallanca" is a good example. The name "Huallanca" refers to separate administrative districts in Bolognesi and Dos de Mayo provinces, along with two individual towns, two mining areas, a mountain sub-range, and a river. This redundancy has sometimes resulted in errors in mineral-specimen source information. Specimens from Huallanca District in Bolognesi Province (the source of our specimens) have been erroneously attributed to Huallanca District in Dos de Mayo Province, and vice versa.

Mineralization in the Huallanca District was emplaced following the crustal fracturing that accompanied the Andean Orogeny (mountain-building episode) some 60 million years ago. Mineral-rich, hydrothermal solutions surged upward in multiple phases into fractures within quartz-monzonite and granitic country rock to precipitate an array of minerals in complex vein systems. These veins are multi-metal deposits containing minerals of zinc, silver, lead, molybdenum, copper, and manganese; although small and erratic, they can be extraordinarily rich. Gases accompanying the late deposition phases created vugs or cavities within the veins that provided space for unrestricted crystal growth. Much later, erosion exposed parts of these veins as mineralized outcrops.

Archaeological evidence suggests that the Incas, the dominant culture in Peru when the Spanish arrived in 1532, obtained small amounts of silver from outcrops in what is now the Huallanca District. After conquering the Incan Empire and looting vast quantities of gold, Spanish prospectors made a series of silver discoveries at Huallanca, Potosí, Huancavelica, Hualgoyoc, Castrovirreyna, Huancapeti, and Cerro de Pasco. By 1630, Spain's mines in the Viceroyalty of Peru were turning out five million troy ounces of silver per year. Although Huallanca was a relatively small mining district, it nevertheless contributed to overall Spanish silver production. After Peru attained independence in 1821, silver mining declined at Huallanca when government instability and incessant warfare compounded the difficulties of mining in the rugged Andes. Mine production recovered at Huallanca, for silver as well as lead, after Peru legalized foreign mine ownership in the 1890s. Zinc mining began at Huallanca in the 1960s when several underground mines were developed. Today, one of Huallanca's two mining areas is Chiurucu, a small town that serves the miners at the nearby San Martín, La Gringa, and Chiurucu mines—small, multi-metal mines that produce zinc and lesser amounts of silver, lead, and copper. The ores are hand-cobbed (manually concentrated) and trucked to concentrating mills in other districts. In recent decades, the operation of the Chiurucu mines has been sporadic and dependent upon zinc prices.

The primary ores at the San Martín Mine are sphalerite [zinc sulfide, ZnS] and galena [lead sulfide, PbS], both of which contain significant amounts of silver. Other economic minerals are molybdenite [molybdenum disulfide, MoS_2]; tetrahedrite [copper iron zinc antimony arsenic sulfide, $Cu_6Cu_4(Fe,Zn)_2(Sb,As)_4S_{13}$]; chalcopyrite [copper iron sulfide, $CuFeS_2$]; hübnerite [manganese tungstate, $MnWO_4$]; and tennantite [copper iron zinc arsenic antimony sulfide, $Cu_6Cu_4(Fe,Zn)_2(As,Sb,)_4S_{13}$]. Gangue minerals include pyrite [iron disulfide, FeS_2]; quartz, calcite, and small amounts of rhodochrosite and rhodonite, the latter as unusually well-developed crystals and with rich, pinkish-red colors. Until the 1980s, the rhodonite was discarded as a worthless gangue mineral. By then, however, Peruvian mineral specimens had begun to attract attention on international markets (see "Peru: A Mineral-Collecting History" in our June 2007 write-up on epidote). Among the Peruvian mineral specimens suddenly in demand was rhodonite from the San Martín Mine. As specimen prices rose sharply, San Martín miners began collecting rhodonite crystals as a source of secondary income and selling the specimens to buyers from Lima.

May 2011 Mineral of the Month: Rhodonite

Rhodonite is not common in the San Martín ore veins. It occurs only in occasional pockets, but these can be completely lined with rhodonite crystals. Pockets range from one foot to eight feet in length. Although recovering undamaged crystals is difficult, San Martín miners have become quite proficient at specimen extraction. San Martín miners discovered the first major rhodonite pocket in 1991. In 1995, a second pocket yielded hundreds of fine specimens that were widely acclaimed at major gem-and-mineral shows in the United States and Europe. San Martín rhodonite crystals were described in the prestigious *Mineralogical Record* in 1997, the same year that miners found yet another major pocket. By then, the San Martín Mine had earned recognition as one of the world's few classic localities for rhodonite crystals. The next major pocket—the source of our specimens—was not discovered until 2007. The 2007 *Mineralogical Record* described these as "gorgeously deep pink aggregates of bladed rhodonite crystals." It further described the specimens offered in 2007 as "loose, delicate, rosette-shaped aggregates of small crystals, thumbnail and small miniature-size, pale to medium-pink, looking like roses freshly plucked from their stems. These are priced at $50 to $150. These new rhodonites, from the Chiurucu (that is to say, the San Martin) mine, were a major hit of Tucson 2007." How delighted we are to be sending a similar specimen to you this month!

Unfortunately, the San Martín Mine closed shortly thereafter and recent reports from the Peruvian government indicate that it is unlikely to reopen. Prices for specimens of San Martín Mine rhodonite crystals have since increased sharply, with one-inch clusters of rhodonite crystals now selling for as much as $200! Cabinet-sized specimens cost thousands of dollars each. Only because we purchase our specimens in volume are we able to offer San Martín rhodonite crystals as our Mineral of the Month.

As you examine your specimen, note first the distinctive pinkish-red color that is typical of rhodonite and caused by its manganese content. These sharp, bladed crystals have developed in radial or "spray" forms known as "rosettes," a rhodonite habit that is rare in localities other than the San Martín Mine. Also note the longitudinal striations on the crystal faces, which are a diagnostic feature of rhodonite. These crystal clusters seem translucent, but when viewed against intense backlighting, many of the individual crystals are actually transparent—a quality uncommon in rhodonite. Our specimens consist mostly of rhodonite with traces of such associated minerals as small, white, trapezoidal crystals of calcite, hexagonal prisms of white quartz, cubic crystals of brassy pyrite, and dark specks of sphalerite.

Our rhodonite specimens from Peru's San Martín Mine are another reminder of the ties between mineral specimens and mining. The vast bulk of all mineral specimens come from commercial mining. The relationship between miners, especially those in developing nations, and mineral collectors around the world is mutually beneficial. Mineral collectors are able to appreciate the rarity and beauty of mineral specimens, while miners benefit from a welcome source of secondary income. And as a result, we have the opportunity to add to our collection a gorgeous specimen from a classic locality!

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