

April 2001 Mineral of the Month: Smithsonite

We are delighted to present another mineral, beautiful in appearance, significant to modern man and to our ancestors, and whose name honors a man who never saw America, but made a most significant contribution to its national education!

PHYSICAL PROPERTIES

Chemistry: $ZnCO_3$ Zinc Carbonate
Class: Carbonates
 Dana's: Anhydrous Carbonates
Crystal System: Hexagonal-Trigonal
Crystal Habits: Crystals are rare, usually as rhombohedrons, often curved and rough, or more rarely, as scalenohedrons; Usually as crusts; Botryoidal, stalactitic, reniform; Massive, granular, earthy
Color: Grayish white to dark gray, greenish or brownish white, also green to apple-green, blue, green-blue, yellow, pink, brown, or white; rarely, colorless and transparent
Luster: Greasy to vitreous
Transparency: Transparent to translucent
Streak: White
Refractive Index: 1.848, 1.621
Cleavage: Perfect in one direction
Fracture: Uneven to conchoidal; brittle
Hardness: 4.5
Specific Gravity: 4.2
Luminescence: Often fluoresces white, vivid blue, pink, red, yellow, and orange under shortwave and longwave ultraviolet light
Distinctive Features and Tests: Specific gravity and hardness higher than other carbonates; Infusible
Dana Classification Number: 14.1.1.6

NAME

Our featured mineral is pronounced smith'-sun-ĭt, and was named in 1832 in honor of British mineralogist and chemist James Smithson (1765-1829), whose legacy provided for the foundation of the Smithsonian Institute, and who did much research into zinc and zinc minerals. See *History and Lore* for more information on the man and the institution.

COMPOSITION

Smithsonite is the sixth member of the carbonates class to be our featured mineral, after azurite (September 1996), calcite (November 1996), rhodochrosite (October 1997), aragonite (June 2000) and dolomite (January 2001). All in all, this class contains about two hundred species, all containing the carbonate radical (CO_3).

Our featured mineral is another gorgeous product caused by the weathering of an ore mineral, in this case, sphalerite $[(Zn,Fe)S]$. Our September 1996 write-up explained it this way: "When mineral rich water (containing dissolved oxygen and carbon dioxide) comes into contact with these sulfide minerals (such as sphalerite) under the right conditions, a chemical reaction can take place causing the loss of the sulfur molecules and a recombining of the zinc atoms with the newly introduced atoms of hydrogen, oxygen and carbon (and whatever other elements may be dissolved in the water) causing the formation

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of new and different molecules in new and different crystal structures resulting in the formation of a new and different minerals! An area where this takes place is called an **oxidation zone** (also known as an oxide zone or oxidized zone.)” Mineral collectors rejoice upon discovery of such a zone, as many of the world’s most colorful and best crystallized minerals, such as smithsonite, wulfenite, azurite, and many others are found in such.

Smithsonite belongs to the calcite group of minerals, as described in the box:

Calcite Group Members		
Trigonal carbonates of general formula $A^{2+}(CO_3)$, where $A^{2+} = Ca, Cd, Co, Fe, Mg, Mn, Ni, Zn$		
Species	Chemical Formula	Source of Name, Year of Acceptance
Calcite	$CaCO_3$	From the Greek <i>chalx</i> , “burnt lime,” from a root meaning “to reduce to powder by heat” (1845)
Gaspéite	$(Ni, Mg, Fe^{2+})CO_3$	For the locality, Gaspé Peninsula, Quebec, Canada (1966)
Magnesite	$MgCO_3$	For the composition (1807)
Otavite	$CdCO_3$	For the Otavi District, Namibia, where the Tsumeb Mine is located (1906)
Rhodochrosite	$Mn^{2+}CO_3$	From the Greek <i>rhodo</i> , “rose,” and <i>chrosis</i> , a coloring, for its color (1800)
Siderite	$Fe^{2+}CO_3$	From the Greek <i>sideros</i> , meaning “iron” (1845)
Smithsonite	$ZnCO_3$	See <i>Name</i> (1832)
Sphaerocobaltite	$CoCO_3$	For the composition and form; also called cobaltocalcite (1877)

There is at least partial solid solution among all members of the group. In smithsonite, small amounts of iron, cobalt, copper, manganese, cadmium, magnesium, and lead are commonly found, causing some of the colors mentioned under *Collecting Localities*. As you noted from the Physical Properties section, individual smithsonite crystals are rare. When crystals are found, they are usually rhombohedral, looking like a slanted box, or scalenohedral, the sharp, dog-tooth shape common to calcite. The other descriptions refer to masses of small crystals that are intergrown, and refer to the shapes of the mass of crystals. **Botryoidal** means “grape-like,” denoting a shape like a cluster of grapes; **reniform** indicates a kidney-like shape, and **mamillary**, a breast-like one. These three terms basically describe the same form, a common one for smithsonite, also for minerals like malachite and hematite. **Massive** indicates

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fine, interlocking crystals forming a mass of considerable size, and **compact** is used to describe such a mass that has no openings or voids. **Granular** implies that we can see individual crystals without visible faces as grains, from small to large, as we often do in granite and marble.

COLLECTING LOCALITIES

Our featured mineral has been known by several names according to its color and form. Another crystal habit common to smithsonite is **earthy**, signifying a mass that crumbles like dried mud and seems to have no crystalline character. When found in earthy masses, it is often dull in color and looks like it has a cellular structure, so miners called it "dry-bone ore." Pure smithsonite is an unremarkable white-to-gray color. How thankful we are that its crystal structure allows impurities in the form of other elements to give it many dynamic colors! For example, a brilliant yellow smithsonite called "turkey-fat" has been found at several localities, including the Laurium mine, Greece, where our November 2001 jarosite specimens were found; Sardinia, Italy, where "turkey-fat" banded stalactites have been found, and cut into thin slices that look stunning when light passes through; also, the Rush Creek district, Marion County, Arkansas, and Orongo, Missouri. The brilliant yellow color is caused by cadmium sulfide. Laurium also produced fine green and blue-green mamillary masses, stalactites, and smithsonite after calcite crystals. Bright pink smithsonite colored by cobalt comes from Choix, Sinaloa, Mexico. One of the most famous occurrences of smithsonite is the gorgeous blue-green color caused by copper from the Kelly mine, Magdalena County, New Mexico. This mine has also produced perfect smithsonite fossils of crinoids and mollusk shells! Smithsonite was found so plentifully at the Kelly Mine that miners used it for tombstones! When iron impurities abound, smithsonite takes on a dull to lustrous brown color and is sometimes called monheimite. Scientists would call these varieties cadmian-, cobaltian-, cuprian-, and ferroan-smithsonite.

Outstanding smithsonite localities are too numerous to detail, but include Arizona, California, Colorado, Idaho, Massachusetts, Nevada, New Jersey, Pennsylvania, and Utah, while worldwide localities include Austria, Brazil, Canada, England, Morocco, New Zealand, and Broken Hill, Australia (among other Australian localities), and Broken Hill, Zambia. Yes, if we so desire, we can add many different smithsonite specimens to our collections!

For crystals, the most outstanding location is the famous copper mine in Tsumeb, Namibia. Here were found large sharp smithsonite crystals up to four inches long and two inches across in many colors, some suitable for faceting! Scalenohedral crystals approaching one inch have been found here. A new book devoted entirely to this producer of world-class minerals, both common and rare, is now available with glorious photos of smithsonite (and many, many other) crystals, which have been coming out since the 1920's. Another fabulous locality for fine, colorful smithsonite is the San Antonio mine in the famous Santa Eulalia district of Chihuahua, Mexico, home of our specimens, as described in *About Our Specimens*.

JEWELRY & DECORATIVE USES

Bright, vibrantly colored smithsonite would be ideal for gem use were it greater in hardness. Though its hardness of 4.5 makes it one of the hardest carbonate minerals, it is not practical for everyday wear in rings. The brightly colored massive material is usually cut into lovely cabochons or used for carving, and occasionally faceted into gems of less than ten carats. As mentioned, crystals from Tsumeb are also cut into gorgeous stones. Massive smithsonite is occasionally available to lapidaries in all its vibrant colors, including a green that rivals jade.

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HISTORY & LORE, TECHNOLOGICAL USES

Although brass, the alloy of copper and zinc, did not come into common usage until the sixteenth century, during the time of Caesar Augustus (63 BC-14 AD), the Romans had learned to add smithsonite to copper, producing a metal that was harder than copper and more yellow than bronze. (For more information on brass, bronze, and copper smelting, see the September 1998 Copper write-up under *Technological Uses*.) A Roman coin dated about 20 B.C. contained about 17% zinc and 83% copper. Ancient relics containing zinc have been found in Iran, Transylvania, Cameros, and Pompei. Whether the zinc was added purposefully or accidentally has not been determined. Zinc oxide was used by the Romans as an astringent and a pain killer; we still use it today in calamine lotion.

A discussion of the history and the technological and medicinal uses of zinc can be found in our December 1999 Sphalerite write-up, continued in our October 2000 Hemimorphite write-up, both under *Technological Uses*. In the Hemimorphite write-up under History & Lore, you will also find interesting information about the historical confusion of hemimorphite and smithsonite.

Did you realize that the man whose contribution made possible the founding of the National Museum never saw America? James Smithson was a mineralogist and chemist, born in France and educated at Oxford University in England, and published many scientific studies. When he died childless in 1829, his estate was passed on to a nephew. Smithson's will provided that, should the nephew die without children, the estate was then to go to the United States "to found, at Washington, under the name of the Smithsonian Institution, an Establishment for the increase and diffusion of knowledge." The nephew did not produce children, so the sum of \$508,318.46 was bequeathed to the United States. After years of debate, Congress accepted the gift, and in 1846, authorized the formation of the Smithsonian Institute, which has expanded to become the largest museum complex in the world, and a major research center. The Smithsonian currently consists of sixteen museums, several research centers, and the National Zoo. Most of the museums, as you see in the map, are located with the Institute headquarters in Washington, D.C., on the National Mall between the Capitol Building and the Washington Monument. Museums are open every day except December 25, and admission is free. As mentioned, James Smithson never saw America, but in the early 1900's his remains were interred at the original Smithsonian building, now known as the Smithsonian Castle. (See map.)

The breadth of the Smithsonian collection is staggering, numbering more than 140 million items in all its collections! But of course, the museum most of us would head to first is the Natural History Museum. Here we would thrill to visit the recently opened (September 1997) Janet Annenberg Hooker Hall of Geology, Gems and Minerals. The first thing we might see, of course, is the world's most famous blue diamond, the Hope Diamond. Galleries are devoted to geology, meteorites, gems, and minerals. Among the fabulous displays, we might expect to see the Case emerald necklace, as described in our Tucson Report, and some of the world's most outstanding gems and minerals, all beautifully displayed and lit, to show off their natural grandeur! Some of the mineral exhibits include: Multicolored Minerals, The Many Faces of Crystals, One Mineral/Many Shapes (focusing on pyrite, calcite, and wulfenite), Colored By Copper, Colored By Impurities, One Mineral/Different Impurities (focusing on beryl and fluorite), and one Family Many Colors, focusing on garnets. Of course, this is merely a hint of the treasures to be seen and admired here, and we owe it to ourselves and our families to see these stunning minerals stunningly displayed. Prominently featured, too, are several world-class, drop-dead, large, colorful specimens of the mineral named for the one whose contribution made the Institute possible.

And of course, what is on display is only a small portion of the Smithsonian mineral, gem, meteorite,

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rock, and ore collection. The gem and mineral collection alone contains more than 375,000 specimens! A number of well-known collectors have left their collections to the Smithsonian over the years. We spoke with Paul Pohwat, one of the mineral curators, who seemed overwhelmed by the volume of cataloging the staff had ahead of them. Mr. Pohwat indicated that there are collections received years ago still waiting to be cataloged. Anyone want to volunteer their assistance?

Crystal power advocates believe that smithsonite provides energies conducive to pleasantness, charm, kindness, and favorable outcomes, provides for leadership abilities, and tends to build "bridges over troubled waters" by which one can remedy uncomfortable situations. They also believe it promotes the dynamic celebrations of new beginnings.

ABOUT OUR SPECIMENS

As mentioned, our specimens come from the eighth level of the San Antonio Mine in the East Camp of the Santa Eulalia district. (See the October 2000 Hemimorphite write-up under *Collecting Localities* for more details about this fabulous mineral-producing area.) In the early 1980's, large masses of botryoidal smithsonite were found here in shades of gray, green, yellow, orange, and rose red, colored by the impurities mentioned earlier. These were centered around the 8th level of the mine, signifying a depth of 800 meters, or about a half a mile.

The smithsonite formed here in the manner described earlier. Circulating groundwater leached zinc from the ore body above, carrying it in solution to the eighth level, where it was precipitated as sphalerite and predominantly as smithsonite. Most of the smithsonite is found as gray stalactitic formations in openings that were created in the rock by oxidation, while some replaces scalenohedral calcite crystals.

Smithsonite specimen collecting on the 8th level has been sporadic over the years. The mining company prefers not to extract ores on this level, as the ores found here are difficult to process. It is only when deeper mining operations blast into an underground water source that floods the lower levels of the mine (with water gushing at 90,000 gallons per minute) that the company is forced to work on the 8th level until the lower levels are pumped out and rebuilt. Unfortunately for the mine owners but fortunately for us, in the spring of 1999, the lower levels were again flooded, and mining moved to the 8th level. Soon, brilliant green translucent smithsonite knobs and stalactites like ours were coming out! Mining operations later moved back downward, but specimens continued to come out.

In late November 1999, a zone of blue smithsonite was uncovered, ranging in color from a greenish- to grayish-blue to the electric blue made famous by the Kelly Mine in New Mexico! This find in particular set off a wave of interest, and dealers stormed the area looking to buy blue material, which sent miners scurrying and prices skyrocketing.

We were delighted to be able to obtain a large lot from this find, and to closely examine many of them. Under shortwave fluorescent light, many gave off a neon green color. Others have a few small knobs on the brown matrix, which under magnification looked like seedlings pushing out of the ground! On a very few, the light green smithsonite had a powdery appearance, and many pieces had small, clear to gray hemimorphite crystals as well.

References: Mineralogy, John Sinkankas, Van Nostrand Reinhold Company; Dana's Manual of Mineralogy, 18th Edition, Cornelius S. Hurlbut, John Wiley & Sons, Inc.; Fleischer's 1999 Glossary of Mineral Species, Joseph A. Mandarino, The Mineralogical Record, Inc.; Manual of Mineralogy, 21st Edition, Cornelia Klein & Cornelius S. Hurlbut, Jr., John Wiley & Sons; Getting Acquainted with Minerals, George Letchworth English, McGraw-Hill; Minerals and Man, Cornelius S. Hurlbut, Random House; Gem & Lapidary Materials, June Culp Zeitner, Geoscience Press; Rare & Beautiful Minerals, Fritz Hofmann, Exeter Books; The Mineral Kingdom, Paul DeSautels, Madison Square Press; 1001 Questions Answered About the Mineral Kingdom, Richard M. Pearl, Dover Publications, Inc.; News from Mexico: Peter Megaw, Mineral News, March 2000; Smithsonite, Robert W. Jones, Rock & Gem, Nov 1972; Gallery Reviews: The Smithsonian's Janet Annenberg Hooker Hall of Geology, Gems and Minerals, John S. White, Mineralogical Record, May-June 2000; The Elusive Element, Bob Jones, Rock & Gem, June 2001.

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