December 2000 Mineral of the Month: Celestite

"Celestine . . . is very popular with collectors. It occurs in a variety of geological environments, often in large, pleasingly colored, well-developed crystals that offer a relatively inexpensive opportunity to add depth to a growing collection."– Robert B. Cook, Connoisseur's Choice, Rocks & Minerals, April 1996

PHYSICAL PROPERTIES

Chemistry: $SrSO_4$ Strontium Sulfate
Class: Sulfates Group: Barite
Dana's: Anhydrous Acids and Sulfates
Crystal System: Orthorhombic
Crystal Habits: Crystals tabular, commonly with large {210}, or lathlike elongated {100}, or with equant cross section. Also massive, as fibrous veinlets or nodules, granular, earthy
Color: Pale blue or colorless, also white, light red, green, or brown
Luster: Vitreous; Pearly on cleavage
Transparency: Transparent to translucent
Streak: White
Cleavage: Perfect in one direction *c* {001}, good in another *m* {210}
Fracture: Uneven; Very brittle
Hardness: 3-3.5
Specific Gravity: 3.97
Refractive Index: 1.622-1.631; Pleochroic in colored crystals
Luminescence: Some celestite fluoresces white under longwave ultraviolet light, and to a lesser extent under shortwave
Distinctive Features and Tests: Heavy, tabular crystals similar to barite but predominantly blue in color; Fuses at 3.5-4; Slowly soluble in concentrated acids; Very slightly soluble in water (See information under *Composition* regarding flame test)
Dana Classification Number: 28.3.1.2

NAME

In the late 1700's, a fibrous, vein-filling mineral was discovered at Bellwood, Blair County, Pennsylvania. Analysis by German chemist Martin Heinrich Klaproth (1743-1817) proved it to be rich in the element strontium, and he called it "sulfurous strontianite." This scientifically accurate but not-so-aesthectically pleasing designation was superseded in 1791 by German mineralogist Abraham Gottlob Werner (1749-1817) who named it "coelestine," from the Latin *caelestis*, meaning "of the sky" or "heavenly," in allusion to the sky blue color of the crystals found at Bellwood. Coincidentally, this is the third mineral we have featured this year that was named by Werner, the others being aragonite (June) in 1790, and vesuvianite (March) in 1795.

Throughout the American reference books, this month's mineral is uniformly called celestite (pronounced se-less´-tīt), however, the official name approved by the CNMMN and found in the *Glossary of Mineral Species* is celestine (pronounced se-less´-teen.)

COMPOSITION

Celestite is our first featured mineral containing the element strontium (Sr), which is about fifteenth in abundance in the earth's crust, being widely distributed in small amounts. Celestite is placed in the barite mineral group, which we will delve into more deeply when we feature the mineral barite, and is

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isostructural with the six other minerals in the group: avogadrite [$(K,Cs)BF_4$], barite [$BaSO_4$], anglesite [$PbSO_4$], itoite [$Pb_3[GeO_2(OH)_2](SO_4)_2$], olsacherite [$Pb_2(SO_4)(SeO_4)$], and hashemite [$Ba(Cr,S)O_4$]. Barium (Ba) often substitutes for strontium and a complete series probably exists between barite and celestite. In fact, barite and celestite are so similar in crystal form that they are often difficult to distinguish. Though barite is slightly heavier, with a specific gravity of 4.50, the easiest way to distinguish between the two is to heat a small fragment with a blowpipe. Barium gives off a green color, while strontium burns red, making identification simple. Calcium also partially substitutes for strontium in celestite.

COLLECTING LOCALITIES

Celestite is widespread, and its localities are "endless," as one reference puts it, as its three elemental components rank high in abundance in the crust of the earth: oxygen is first, strontium fifteenth, and sulfur sixteenth, and both strontium and sulfate (SO_4) are relatively abundant in sea water. (In fact, in some areas, strontium is mined from the sea.) As a result, celestite usually occurs in various kinds of sedimentary rocks. It is found in bedded deposits with gypsum, anhydrite, and halite (see the June 1998 anhydrite write-up under *Composition* for more information;) in salt-dome caprock, which refers to a body of anhydrite and gypsum that overlies a body of salt; in masses of marine carbonate rock, such as limestone; in shales and sandstones (see the May 2000 staurolite write-up under *Composition*;) and is often found in deposits rich in potash, (potassium carbonate [$K_2(CO_3)$],) or borates (minerals containing the borate radical [BO_3]). Occasionally, celestite is found in hydrothermal ore deposits or in iron and magnesium-rich igneous rocks.

In addition to its initial discovery in Pennsylvania, many fine quality celestite producing localities are in the Great Lake states of Ohio, Michigan, Illinois, and Indiana. Space limitations will allow us to mention just a few of the notable localities, including Clay Center and the White Rock Quarry, both in Ottawa County, Ohio; Portage, Wood County, Ohio, where crystals up to fifteen inches have been found; the Ottawa Silica Company quarry near Rockwood, Wayne County, Michigan, where single celestite crystals weighing up to eleven pounds have come to light; Indiana localities include the Hoosier Stone Quarry in Washington County, and the Lehigh Portland Cement Company quarry in Lawrence County; fine celestite crystals have also come from the Annabel Lee and Denton mines in Hardin County, Illinois. Other U.S. localities include Texas, Virginia, Tennessee, Utah, Colorado, California, Arizona, and New Mexico. Worldwide localities include Ontario, Canada; San Luis Potosi, Mexico; and England, France, Germany, Spain, the Netherlands, Sicily, Poland, Libya, Egypt, Tunisia, Turkmenistan, Tajikistan, Turkestan, Kyrgyzstan, Siberia, and Australia. Widespread indeed!

One of the most outstanding celestite occurrences was discovered on the island of Put-in-Bay, Ohio, in Lake Erie in 1897. A farmer was busy drilling a well when his drilling bit suddenly dropped into an underground cavern at the seventeen feet level. He dug into the cave to recover his bit, and was absolutely amazed at finding a cavern twenty-five feet long, fifteen feet wide, and twelve feet high, completely lined with gorgeous pale blue celestite crystals, some of then up to eighteen inches long! Tours of what is called the "World's Largest Geode" are available through the nearby Heinemen Winery.

Much of the celestite mined at many of the above localities was colorless or a color that did not seem to inspire passion in most collectors. As a result, celestite was primarily regarded as of little value. But all this changed with the discovery of the highly lustrous sky-blue crystals in Madagascar that we are featuring this month. As one reference said regarding this find: "Celestite has now been hyped into the deserved attention it could earlier never earn."

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Our April 1997 Labradorite write-up under *Collecting Localities* has some good information on the island nation of Madagascar. Our celestite comes from a small town named Sakoany, southwest of the large city of Majunga, near Bombetoka Bay on the northeastern shore of Madagascar. We have seen the locality noted as “Sakoany Mine” and as “Sakoany Mines.” The trip to this small town of fifty families who make their living from fishing, farming, and celestite mining is most difficult, but well worth the effort! Evidently, the deposit became known as far back as 1967, but conditions there, particularly the heavy rainfall, preclude the use of heavy equipment to do wide scale mining. The German mineral magazine Lapis shows a photograph of two men equipped with shovels digging straight down into the soft rock to unearth the crystal-lined geodes.

The first references to the outstanding beauty of Madagascar celestite are in the Mineralogical Record of 1987 and 1988, and in the 1989 Lapidary Journal. The German magazine mentioned earlier puts the annual yield at about fifteen tons.

JEWELRY & DECORATIVE USES

Perhaps you noted from the Physical Properties section that celestite has two major obstacles against its use as a gemstone: its low hardness, meaning it would easily scratch during wear, and its two cleavages, which means it tends to come apart when being cut. As a result, it is almost exclusively a collector stone. We read of a faceted orange celestite weighing just 3.11 carats from Forks of Credit, Caledon Township, Peel County, Ontario, Canada, that now resides in the Canadian Museum of Nature, and some catseye celestite stones from 2.17 to 3.85 carats cut from parallel-fibrous pale blue celestite from below Chittenango Falls, Madison County, New York, that are now on display in the New York State Museum, Albany, NY. Faceted stones have been cut from blue celestite crystals from Ohio and from near Austin, Texas, and from Tsumeb, Nigeria. With its brilliant lustrous blue color, Madagascar celestite would be ideal for gemstone use were it not for the reasons mentioned above, and yet, it occasionally is, resulting in some spectacular gems, such as a scintillating 32.7-carat faceted stone mentioned in *Gem and Lapidary Materials* that we would love to see!

We have had the privilege to handle some larger, absolutely breathtaking celestite geodes over the years that are now gracing the private homes and offices of individuals in California and elsewhere. No doubt many lovers of natural art around the world display with pride such specimens!

HISTORY & LORE

As noted previously, the history of celestite dates back just a couple of hundred years, and is still being written. As far as alleged healing properties, celestite is said to bring clarity of mind, assist in communicating clearly, balance energies, and to bring calm and harmony. It is said to be useful in recalling dreams, and to replace pain with loving light.

TECHNOLOGICAL USES

The element strontium was first isolated in 1808 by British chemist Sir Humphry Davy. This chemically reactive, malleable, ductile metallic element is never found in the native state. When isolated in the laboratory, it has a silvery color when freshly cut and quickly oxidizes upon exposure to air. It melts at 1416° F, boils at 2523° F, has a specific gravity of 2.60, and an atomic weight of 87.62. The two primary sources of the element strontium are the minerals celestite and strontianite [$SrCO_3$].

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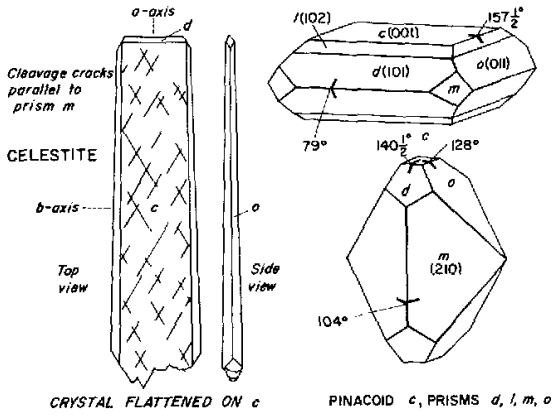
Strontium, along with beryllium (Be), magnesium (Mg), calcium (Ca), barium (Ba), and radium (Ra), make up group 2 or IIA of the Periodic Table of the Elements, a group called the Alkaline Earth Metals. Members of this group react fairly easily are not found free in nature, are brittle, malleable, and extrudable, conduct electricity well, and burn easily.

Because strontium burns a brilliant red, it is used in fireworks and signal flares. In the form of strontia, or strontium oxide (SrO), it is also used in recovering sugar from beet-sugar molasses. Strontium-85 is a radioactive isotope used in the detection of bone cancer, while strontium-90 is a dangerous radioactive isotope found in the fallout caused by the detonation of some types of nuclear weapons.

ABOUT OUR SPECIMENS

No doubt the most remarkable properties of celestite were apparent the first time you examined it. Though there are quite a few minerals which have higher specific gravity and are heavier, celestite is heavier than most. The crumbly matrix is an interesting mix of clay and calcium carbonate called marl, typically formed under marine conditions, and is believed to be of the Tertiary period (sixty-five million to two million years ago.) But of course it is the lustrous blue color along with the fascinating forms of the crystals that most rivets our attention. The color of the Madagascar celestite grades from a very light, almost translucent blue through the sky-blue color that gives celestite its name to a grayish blue color that is striking but not nearly as pretty.

Perhaps because the crystals are growing inwardly inside a geode, they seem to often block each other, preventing the formation of large crystals. As mentioned earlier, we have seen some geodes one and a half and two feet across with brilliant crystals up to perhaps four inches or more in length, but these are rare. Some of the almost-complete geodes have crystals that grow into and penetrate each other in the center of the geode in an awe-inspiring way! Most of the crystals are variations of the two forms on the right side of the drawing, while occasionally, a long pointed crystal is seen.



Celestite crystal forms. Image courtesy of *Mineralogy* by John Sinkankas. Used by permission.

References point to color zoning in celestite crystals, a phenomenon we have not observed in Madagascar specimens. They also state that twinned crystals are rare in celestite. Also, the fluorescence mentioned under *Physical Properties* was not noticed under shortwave ultraviolet light at our home. Some have written that the color of celestite may fade in bright sunlight, and while we have not observed this taking place, we thought it is worth passing along.

Knowing all this about celestite makes it easy to understand why celestite is so popular with collectors. And no doubt we are all delighted to add its distinctive beauty to our own collections!

References: Mineralogy, John Sinkankas, Van Nostrand Reinhold Company; Dana's New Mineralogy, Richard V. Gaines, et al, John Wiley & Sons, Inc.; Fleischer's 1999 Glossary of Mineral Species, Joseph A. Mandarino, The Mineralogical Record, Inc.; Minerals and Man, Cornelius S. Hurlbut, Random House; Gem & Lapidary Materials, June Culp Zeitner, Geoscience Press; Gemstones of North America Volume III, John Sinkankas, Geoscience Press;Lapis No 17: Madagascar, 1999; Connoisseur's Choice: Celestine, Robert B. Cook, Rocks & Minerals March-April 1996; Mineral Notes: Celestite, Frederick H. Pough, Ph.D., Lapidary Journal, August 1989; Special thanks to Carey Thoms.

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