

October 2011 Mineral of the Month: Barite

This month we are pleased to feature barite from a recent find in Peru. Our write-up details barite's mineralogy and many uses, the properties of the heavy metal barium, and how the procedure of naming of minerals has evolved from antiquity to the present.

OVERVIEW

PHYSICAL PROPERTIES

Chemistry: BaSO_4 Barium Sulfate, usually containing some strontium or lead, sometimes containing calcium and iron.

Class: Sulfates

Subclass: Anhydrous Sulfates

Group: Barite

Crystal System: Orthorhombic

Crystal Habits: Usually thin-to-thick, tabular crystals in intergrown clusters, sometimes with sharp, beveled edges; less commonly prismatic; also granular, massive, fibrous, stalactitic, radiating, and earthy, and as rosette, laminated, and globular-concretion forms; occasionally as crossed twins.

Color: White, gray, colorless, or pale hues of yellow, gold, amber, brown, red, or blue

Luster: Vitreous, pearly

Transparency: Transparent to translucent

Streak: White

Cleavage: Perfect in one direction, good in a second, and distinct in a third

Fracture: Uneven, brittle

Hardness: Mohs 3.0-3.5

Specific Gravity: 4.3-4.6

Luminescence: Often fluoresces yellow or orange under long-wave ultraviolet light; sometimes phosphoresces greenish-white or bluish-white.

Refractive Index: 1.634-1.648

Distinctive Features and Tests: Best field indicators are tabular crystal form and unusually high density for a light-colored, transparent-to-translucent mineral.

Dana Classification Number: 28.3.1.1

NAME The name "barite," pronounced BARE-ite, stems from the Greek *barytēs*, meaning "weight," in allusion to its considerable density. The United Kingdom, Canada, and Australia use the spelling "baryte." Barite has acquired such alternative and regional names as "astapia," "baryntine," "barytite," "barytes," "boulonite," "calk," "calstronbarite," "dreelite," "schoharite," "tiff," "yellow spar," "blue spar," "golden spar," "heavy spar," and "barium spar." "Golden barite" is a golden, yellow, or amber variety. The terms "Bologna stone" and "Bolognian spar" refer to a radiating, phosphorescent variety. Strontium-rich barite is known as "barian celestine," "celestobarite," and "barytocelestine." Lead-rich barite is called "plumbobarite," while "calcareobarite" is a calcium-rich variety. In European mineralogical literature, barite appears as *barit*, *barita*, and the British "baryte."

COMPOSITION: Barite, which consists of 58.84 percent barium (Ba), 13.74 percent sulfur (S), and 27.42 percent oxygen (O), is a member of the sulfates, a complex class of minerals with nearly 200 members. Sulfates consist of one or more metallic elements bound to one or more sulfate radicals. In the sulfate radical (SO_4)²⁻, a single sulfur ion is surrounded by four oxygen atoms positioned at the corners of a tetrahedron. The physical properties of sulfates vary widely, but most are light in color, transparent to translucent, fragile, and relatively soft. As an allochromatic (other-colored) mineral, barite's color is due to traces of nonessential elements or defects in crystal structure, rather than to essential elements or the

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nature of the crystal lattice. Pure barite is colorless, but impurities such as iron and calcium distort the lattice in a manner that alters its light-absorption characteristics. Barite has a wide range of pale colors. Blue colors are due to imperfections in the crystal lattice called "color centers" that occur when natural geophysical radiation displaces electrons from their normal orbital positions. The most abundant of all barium-bearing minerals, barite occurs in carbonatites (carbonate-containing igneous and metamorphic rocks); in mesothermal and epithermal vein deposits; and in massive hydrothermal replacement deposits. Barite also occurs as intergranular and crystalline precipitates in seam fillings in limestone and sandstone. Barite-impregnated sandstones contain as much as 50 percent barite by weight and are the only barite ore.

COLLECTING LOCALITIES: Barite is a common, widely distributed mineral with many collecting localities worldwide. Important occurrences are located in Peru, Brazil, China, Germany, Greece, Sweden, Switzerland, Italy, England, France, Russia, South Africa, Namibia, Australia, and Canada. In the United States, barite is collected in Arizona, Colorado, Nevada, California, Illinois, Arkansas, Missouri, Texas, and Tennessee.

HISTORY, LORE, & GEMSTONE/TECHNOLOGICAL USES: Barite was described as a mineral species and named in 1837. It has little use in jewelry because of its softness and brittleness. Barite crystals, usually in hues of gold or blue, are sometimes wrapped in silver wire for wear as pendants, usually for metaphysical purposes. Barite has a wide array of applications in industry and the manufacture of consumer products. More than 6.2 million metric tons of barite are mined worldwide each year by open-pit operations that exploit sedimentary deposits. Ninety percent of world barite production goes into drilling fluids or "muds" that are vital to oil- and natural-gas-drilling operations. Barite is also the feedstock for the production of barium chemicals and barium metal. Because of its large size and the mass of its molecule, barite is an excellent absorber of X-rays and gamma rays and has important uses in the medical and nuclear fields. Modern metaphysical practitioners believe that barite helps heal the Earth, creates the initiative to pursue dreams, facilitates independence, and enhances friendship, harmony, and love.

ABOUT OUR SPECIMENS: Our barite specimens were collected at Cerro Huarihuyn (also spelled Warihuayin) in the Miraflores District, Huamalíes Province, Huánuco Department, Peru. Located in central Peru, the remote Miraflores District covers 1,214 square miles and has 3,700 residents and an average elevation of 8,000 feet. It is 200 air miles north-northeast of the national capital of Lima and 125 air miles east of the Pacific coast. Miraflores is not a major mining district, but is rather one of many lesser-mineralized areas of the greater Andes region. Spanish prospectors first visited what is now the Miraflores District in the late 1500s, discovering mineralized outcrops that were of insufficient size and richness to warrant mining. Our barite specimens were collected at Cerro Huarihuyn (Huarihuyn Mountain), an 8,835-foot-high mountain that is really a "hill" by Andean standards. Barite specimens from Cerro Huarihuyn first reached international markets in the late 1990s, but attracted little interest. Then in spring 2005, barite specimens (including ours) with water-clear transparency and superb crystal development were collected in quantity. Many geologists believe that comprehensive core-drilling programs will soon determine whether or not the Miraflores District has economic multi-metal deposits.

10 YEARS AGO IN OUR CLUB: Ocean Jasper, Marovato, Ambolobozo, Analalava District, Sofia Region, Mahajanga (Majunga) Province, Madagascar. Here's how we described it then: "This new material was outstanding in several ways: the pretty pastel pink and blue colors mixed in with the solid white, green, yellow and red; the small vugs with drusy quartz and prase (green quartz) crystals, and the seemingly infinite numbers of spherical nodules or orbs, (round inclusions of contrasting color and composition.) Words really fail to adequately describe the marvelous beauty of this new find!" Now you see very little of this stone around, almost nothing with the kind of amazing colors and patterns available then.

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COMPREHENSIVE WRITE-UP

COMPOSITION

Barite, chemical formula BaSO_4 , contains the elements barium (Ba), sulfur (S), and oxygen (O). Barite's molecular weight is made up of 58.84 percent barium, 13.74 percent sulfur, and 27.42 percent oxygen. The simple barite molecule consists of a single cation (positively charged ion) and a single anion (negatively charged ion). Barite's cation is the barium ion Ba^{2+} with its +2 charge. Its anion is a radical, a group of ions of different atoms that acts as an entity in chemical reactions. Barite's anion is the sulfate radical $(\text{SO}_4)^{2-}$, in which a single sulfur ion is surrounded by four oxygen ions positioned at the corners of a tetrahedron. Each of the four oxygen ions has a -2 charge, while the sulfur ion has a +6 charge. This produces a collective, anionic -2 charge to balance the +2 cationic charge and provide the barite molecule with electrical stability.

Barite is a member of the sulfates, a large and complex class of minerals with nearly 200 members. Sulfates consist of one or more metallic elements bound to one or more sulfate radicals. In the sulfate radical $(\text{SO}_4)^{2-}$, the two negative charges are distributed evenly across the four oxygen ions. This enables the sulfate radical to bond to many different metal cations in a variety of lattice configurations that can accommodate such anions as hydrogen and halogen ions and hydroxyl $(\text{OH})^{1-}$, carbonate $(\text{CO}_3)^{2-}$, and nitrate $(\text{NO}_3)^{1-}$ radicals. Many sulfates are hydrous and have attached molecules of water (H_2O); many are also rare. Although the physical properties of sulfates vary widely, most are light in color, transparent to translucent, fragile, and relatively soft.

Within its closely packed crystal lattice, ten oxygen ions surround and completely shield each barium ion so that barite exhibits no metallic properties. The barite lattice has both covalent and ionic bonding. The strong covalent bonding with shared electrons occurs primarily between the sulfur and oxygen ions within the sulfate radical. Most inter-molecular bonding, however, is ionic. Ionic bonding is the force that holds positively charged, metallic ions together with negatively charged, nonmetallic ions or radicals. In barite, the positively charged, divalent barium ion Ba^{2+} is attracted to the negatively charged, divalent sulfate radical $(\text{SO}_4)^{2-}$. Because of their weak ionic bonding, most sulfates have varying degrees of solubility in water. But barite's close atomic packing creates unusually strong ionic bonding that makes it insoluble in water, resistant to alteration, and substantially harder (Mohs 3.0-3.5) than most other sulfates. Ionic bonding usually has omnidirectional strength, but in barite this is modified by the orthorhombic crystal structure. The orthorhombic system is characterized by three mutually perpendicular axes of different lengths, an arrangement that is reflected in barite's tabular habit. Because its ionic-bonding strength varies directionally with the unequal axial lengths of its orthorhombic structure, barite exhibits perfect cleavage in one direction, good cleavage in another, and distinct in a third.

As an allochromatic (other-colored) mineral, barite's color is due to traces of nonessential elements or defects in crystal structure, and not to essential elements or the nature of the crystal lattice. Pure barite is colorless, but impurities such as iron and calcium distort the crystal lattice in a manner that alters its light-absorption characteristics. Barite has a wide range of pale colors. Its blue colors are caused by "color centers," which are imperfections in the crystal lattice that form when natural geophysical radiation energizes electrons, displacing them from their normal positions in atomic orbits. These energized electrons come to rest in vacant lattice positions called "traps" and absorb only certain wavelengths of visible light while reflecting others. Many barite varieties are fluorescent; some are phosphorescent, continuing to emit visible light even after an incident light source has been removed. Phosphorescence occurs when electrons are energized by visible light and release their excess energy very slowly in the blue or blue-green wavelengths of visible light.

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The Dana classification number 28.3.1.1 first identifies barite as an anhydrous sulfate or anhydrous acid sulfate (28). Anhydrous sulfates have no attached water molecules (H_2O). Anhydrous acid sulfates also have no attached water molecules, but contain a single hydrogen ion (H^+). The subclassification (3) next defines barite by the general formula $(\text{A}^{2+})\text{XO}_4$, in which "A" can be divalent ions of barium, strontium (Sr^{2+}), or lead (Pb^{2+}), and "X" is the sulfur ion S^{6+} . Barite is then classified as a member of the barite group (1) as the first (1) of three members. The other members are celestine [strontium sulfate, SrSO_4] and anglesite [lead sulfate, PbSO_4]. All barite-group members crystallize in the orthorhombic system and differ only in their metal cations. With similar electrical charges and ionic radii, strontium and lead readily substitute for barium, explaining why barite often contains some strontium and lead. Substitution between barium and strontium occurs so readily that barite and celestine form a complete, graded, solid-solution series, with the intermediate phases known as bariar celestine, celestobarite, or barytocelestine. Barite also forms a partial, graded, solid-solution series with anglesite, with intermediate phases known as plumbobarite.

By far the most abundant of all barium-bearing minerals, barite occurs with anhydrite [calcium sulfate, CaSO_4], fluorapatite [calcium fluorophosphate, $\text{Ca}_5(\text{PO}_4)_3\text{F}$], and calcite [calcium carbonate, CaCO_3] in carbonatites (carbonate-containing igneous and metamorphic rocks); with calcite, quartz [silicon dioxide, SiO_2], and fluorite [calcium fluoride, CaF_2] in mesothermal and epithermal vein deposits; and with gypsum [hydrous calcium sulfate, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$], dolomite [calcium magnesium carbonate, $\text{CaMg}(\text{CO}_3)_2$], and cerussite [lead carbonate, PbCO_3] in massive, hydrothermal replacement deposits. It also occurs as intergranular and crystalline precipitates in seam fillings in limestone and sandstone. Barite-impregnated sandstones containing as much as 50 percent barite by weight are the only ore of barite.

COLLECTING LOCALITIES

Barite is a common, widely distributed mineral with many collecting localities worldwide. Our specimens were collected at Cerro Huarihuyn in the Miraflores District, Huamalíes Province, Huánuco Department, Peru. Other Peruvian sources are the Casapalca Mine at Casapalca in Huarochiri Province, Lima Department; and the Herminia Mine in the Julcaní district, Angaraes Province, Huancavalica Department. Another South American source is the Jacupiranga Mine at Cajati near the city of São Paulo in São Paulo state, Brazil.

Barite localities in China include the Wenyuhe barite deposit in Zhushan County, Shiyan Prefecture, Hubei Province; the Danegou and Lushi mines in the Xiaoqinling Ore Belt, Sanmenxia Prefecture, Henan Province; the Gangxi barite deposit in Xinhaung County, Huaihua Prefecture, Hunan Province; the Tuchengzi mine in the Jinzhou district, Dalian Prefecture, Liaoning Province; and the Huangboshuwan deposit in Zyang County, Ankang Prefecture, Shaanxi Province.

European specimens come from the Clara Mine at Oberwolfach in the Black Forest Region, Baden-Württemberg, Germany; the Milos Mine on Milos Island, Kykládes district, Aegean Islands, Greece; the Muscadroxius-Tres Montes Mine at Silius, Sardinia, Italy; the Garpenberg Nora Mine, Garpenberg, Hedemora, Sweden; the Serpiano Mine at Serpiano near Lugano Lake, Ticino, Switzerland; Bromley Hill at Nenthead, Alston-Moor district, North Pennines, Cumbria, England; and the Les Farges Mine at Ussel near Corrèze, Limousin, France.

Other localities include Dalnegorsk at Primoskiy Kray, Far Eastern Region, Russia; the Elandsrand Mine at West Rand in the Wittersrand Goldfield, Mpumalanga Province, South Africa; the Naica Mine at Naica, Chihuahua, Mexico, where last month's Anhydrite was collected—interestingly, we have never seen any barite from this locality; the Rosh Pina Mine in the Lüderlitz District, Karas Region and the Tsumeb Mine at Tsumeb, Otjikoto Region, both in Namibia; and the Kintore Mine at Broken Hill, Yancowinna County, New

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South Wales, and Big Spring at Fitzroy Crossing, Ashburton Down, Western Australia, both in Australia. Canadian localities include the Bailey Mine at Madoc, Madoc Township, Hastings County, Ontario; Mont Saint-Hilaire, Rouville County, Québec; and the Rock Candy Mine at Grand Forks, Greenwood Mining District, British Columbia.

We have featured barite twice in the past in two completely different crystal habits and colors from two classic American localities. In January 2002, we sent specimens consisting of clusters of small, blond-colored crystals with a smattering of sugary-white crystals on top, from the Palos Verdes Hills (Palos Verdes Cliffs), Palos Verdes peninsula, Los Angeles County, California; and in January 2008, we had long thin single crystals and a few groups of lovely light blue barite from Stoneham, Weld County, Colorado!

Other Colorado localities include the Book Cliffs near Grand Junction, Mesa County; the Black Cloud Mine in the Leadville Mining District, Lake County; the Rico Argentine Mine at Rico, Dolores County; the Wagon Wheel Gap Mine at Wagon Wheel Gap in Mineral County; and the Sunnyside Mine in the Silverton district, San Juan County. Arizona specimens come from the Blue Ball Mine in the Globe-Miami Mining District, Gila County; the Grandview Mine at Horseshoe Point, Grand Canyon National Park, Coconino County; the Mammoth Mine in the Mammoth district, Pinal County; and the Weldon Mine in the Osborn district, Pima County. Nevada specimens are found in Elko County at the Seventy-Six Mine in the Charleston district, the Judy Barite Mine in the Cave Creek district, and the Big Bird and Barite claims in the Merrimac district. Other U.S. localities are the Cargo Muchacho district mines in Imperial County and the Lalkar Quarry at Santa Cruz in Santa Cruz County, both in California; the Cave-in-Rock mines in the Illinois-Kentucky Fluorite District, Hardin County, Illinois; the McKnight, Henderson, and Gap Mountain mines in the Fancy Hill Mining District, Montgomery County, Arkansas; the lead mines of Morgan, Texas, St. Louis, and Washington counties mines in Missouri; and the Sweetwater district mines in Roane County and the Falls Branch-Greeneville district mines in Sullivan County, all in Tennessee.

JEWELRY & DECORATIVE USES

Due to its softness and brittleness, barite has little use in jewelry. Barite crystals, usually in blue or golden hues, are sometimes wrapped in silver wire for wear as pendants, especially for metaphysical purposes. Barite is faceted into collectors' gems in various cuts and in sizes of up to 12 carats. In desirable or unusual colors, flawless barite collectors' gems of about 10 carats, which are rare, cost about \$700.

Both as individual crystals and composite specimens, barite is popular among mineral collectors for its range of colors, various crystal habits, and affordability.

HISTORY & LORE

Although known since antiquity, barite attracted little attention until 1603, when Italian cobbler and alchemist Vincenzo Casciarolo (vita uncertain) began studying white, unusually heavy, translucent stones from Monte Paderno near Bologna in northern Italy. Casciarolo ground these stones to a powder, which he then mixed with charcoal and heated. In darkness, the powdered stone emitted an eerie, bluish glow, leading Casciarolo to believe he had discovered the "philosopher's stone" capable of transmuting common metals into gold. Casciarolo named his discovery *lapis solaris*, or "sun stone" and showed it to the Italian astronomer and physicist Galileo Galilei (1564-1642). One of Galileo's contemporaries, Giulio Cesare La Galla (1576-1624), wrote in his journal how *lapis solaris* "trapped" sunlight and firelight, then released it slowly in darkness—the first recorded observation of mineral phosphorescence. The mysterious *lapis solaris*, which became known as "Bologna stone," attracted great attention throughout Europe.

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Scientists learned the composition of Bologna stone only after barium had been recognized as an element. In 1774, Swedish chemist Carl Wilhelm Scheele (1742-1786) concluded that a heavy oxide in calcined lime [calcium oxide, CaO] contained an unidentified metallic element. French chemist Louis-Bernard Guyton de Morveau (1737-1816) named this oxide “barote,” after the Greek *barytēs*, meaning “weight.” De Morveau’s colleague, French chemist Antoine-Laurent Lavoisier (1743-1794), the father of modern chemistry, changed this name to “baryta.” Finally, in 1803, British chemist and physicist Sir Humphry Davy (1778-1829) electrolytically reduced the molten oxide to isolate a new metal, which he named “barium,” after “baryta.” In 1837, chemists identified Bologna stone as barium sulfate and assigned the name “baryte.” Britain, Canada, and Australia still use this spelling today, although the United States uses “barite.” In 1922, physicists used newly developed X-ray diffraction techniques to reveal barite’s atomic structure.

“Rose rock”—intergrowths of rosette-shaped barite crystals colored by inclusions of iron-stained, reddish quartz grains—is the official state rock of Oklahoma. Modern metaphysical practitioners believe that barite helps heal the Earth, creates the initiative to pursue dreams without restraint, facilitates independence, and enhances friendship, harmony, and love. Barite crystals have been featured on the 7.60-ron stamp of Romania in 2010, the 7,000-dobra stamp of São Tomé e Príncipe in 2006, the 132-metacal stamp of Mozambique in 2002, and the 0.49-Belgian-franc stamp of Belgium in 1997.

TECHNOLOGICAL USES

Despite having no uses until the early 1900s, barite now has many applications in industry and in the manufacture of consumer products. Some 6.2 million metric tons of barite are mined worldwide each year by open-pit operations that exploit sedimentary deposits. Because of barite’s considerable density (specific gravity 4.3-4.6), crudely crushed ore is easily concentrated by simple gravitational-separation methods such as washing and jigging to yield “primary barite,” a concentrate containing 95 percent barite that is currently valued at \$52 per metric ton. China accounts for 67 percent of world production and is followed by India and Morocco. The United States ranks fourth, producing 383,000 metric tons of barite annually from four mines in Nevada and one in Georgia.

Ninety percent of all barite goes into drilling fluids or “muds” for use in oil and natural-gas drilling operations. Drilling muds were developed about 1920 to alleviate many problems associated with rotary drilling, especially the violent “blowouts” that occurred when drills penetrated deep, high-pressure gas and oil formations. Engineers had learned that drill holes filled with a relatively dense, thick liquid exerted sufficient downward, hydrostatic pressure to counter deep-formation pressures. Barite was an ideal “weighting agent” in drilling mud because of its density, inertness, non-toxicity (barite is insoluble in water), and availability. Drilling mud not only ended the blowout problem, but improved formulations consisting primarily of finely ground barite and bentonite clay also maintain drill-hole stability, cool and lubricate drill bits, and remove cuttings from drill holes.

In addition, barite is the feedstock for producing barium metal and barium chemicals. Barium is a soft, heavy, silvery, alkaline-earth metal that does not occur free in nature. Its high atomic weight of 137.33 is 2.5 times greater than that of iron. The alkaline-earth metals (group IIA on the periodic table of elements) include barium, beryllium (Be), magnesium (Mg), calcium (Ca), strontium (Sr), and radium (Ra), all of which burn when heated in air. Because it oxidizes readily in air and reacts violently with water, elemental barium must be stored under petroleum or other oxygen-free liquids. The most important of elemental barium’s few uses is as a “getter” in electronic vacuum tubes. Because highly reactive elemental barium bonds quickly with free oxygen, a trace of the metal placed within vacuum tubes eliminates virtually all residual free oxygen to greatly extend the life of the tube. Small amounts of barium are alloyed with lead to

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improve the performance of acid storage batteries and with iron to produce ductile ferric alloys. Elemental barium also serves as a “carrier” when working with the radioactive element radium.

Barium compounds, especially barium sulfate (barite), have many uses. Its large size and mass gives the barite molecule high radio-opacity, which is the ability to absorb X-rays and gamma rays, making it useful in the medical and nuclear fields. Finely ground, non-toxic barite is the key ingredient in the “barium milkshakes” used in X-ray diagnosis of the gastrointestinal tract. X-rays pass through soft tissue, but are completely absorbed by the barite fluid to produce clearly defined, gastrointestinal-tract images. Ground barite is an additive in the radiation-shielding “heavy cements” used in radioactive-waste containers, and in the radiation-absorbing glass of computer and television screens. When added to glass mixtures, barite produces high-refraction, nontoxic “leaded” crystal. In paints, enamels, plastics, and paper, powdered barite serves as a filler and a glossing and weighting agent. Playing cards owe their substantial weight to barite additives.

THE NAMING OF MINERALS

When barite was assigned its name in 1837, mineralogists were naming most new minerals for their physical properties or for prominent scientists. At that time, when only a few hundred minerals had been described as distinct species, naming was an informal process. Today, with more than 4,400 minerals and dozens of new species being described each year, naming has evolved into a formal, regulated process. Over the centuries, the practice of naming minerals has fallen into three distinct ages: Antiquity, Tradition and Science, and Modern Science.

Antiquity (before 1750): Minerals that were named in antiquity were usually readily available, common species that occurred in shallow or surface mineralogical environments. When new minerals were identified, discoverers assigned a name that was usually based on obvious physical properties, uses, or sources. These early mineral names had nothing to do with science, the various disciplines of which did not yet exist. Names were considered “formalized” if they appeared in a scholarly work or became popular in general use. In this non-scientific age, the naming of minerals was far from precise and, in fact, a practice that was filled with errors. Many names referred not to species, but to varieties of species. As an example, the various crystal habits of pyrite [FeS₂] were once considered to be individual minerals. And the name “quartz” was assigned to a wide variety of hard, transparent crystals and gemstones that were unrelated to true quartz. Nevertheless, a surprising number of mineral names assigned in antiquity, often with modifications in both etymology and specific meaning, have survived to the present.

Tradition and Science (1750 to 1958): As science replaced alchemy, the emergence of analytical chemistry and crystallography, together with the identification of chemical elements, greatly accelerated the recognition of new mineral species. The process of naming new minerals became somewhat more formal and orderly, with researchers publishing descriptions of new minerals in scientific journals for international review, proposing names, and soliciting comments from their peers. But naming minerals also became competitive, with scientists often rejecting proposed names in favor of their own preferences. Nevertheless, many previous naming errors from antiquity were corrected, such as that of “calamine.” In the mid-1800s, accurate chemical analyses revealed that two totally different minerals shared the traditional name “calamine.” To avoid further confusion, scientists dropped the name “calamine” entirely and assigned the two “calamine” minerals their current names—smithsonite [zinc carbonate, ZnCO₃] and hemimorphite [zinc silicate, ZnSiO₄]. Meanwhile, many assumed “minerals” that had been given various names over the centuries were determined to be varieties of a single species and assigned a single name.

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During this period, most new minerals were named for their chemical compositions, physical properties, type localities or major occurrences. When Greek terms for physical properties were used in mineral names, it led to the long, difficult-to-pronounce names we are in many cases stuck with today, such as:

Apophyllite (A-POF-fill-lite), from “Apos” meaning “off” and “Phyllon” meaning “leaf”, because when heated in a flame the crystals would flake or “leaf” off

Astrophyllite (a-STROF-fill-lite), from “Astro” meaning “star” and “Phyllon” meaning “leaf”, because it often forms as clusters that are star- or leaf-shaped

Eudialyte (u-DIE-a-lite), from “Eu” meaning “well” and “Dialytos” meaning “dissolves”, because it dissolved quickly in acid

Rhodochrosite, (RO-do-kro-site), from “Rhodo” meaning “Rose” and “Chrosis” meaning “a coloring”, in allusion to its typical rose-pink hue

Then in 1789, the new mineral prehnite [$\text{Ca}_2\text{Al}_2\text{Si}_3\text{O}_{10}(\text{OH})_2$] was named for a person—Hendrick von Prehn (1733-1785), the Dutch governor of South Africa. That began a trend of naming new minerals for scientists and other individuals. In the early and mid-1800s, the convention evolved of ending most new mineral names in “ite,” which derives from the Greek lithos, meaning “stone.” Between 1800 and 1900, the number of recognized minerals increased from about 200 to more than 1,000. In the early 20th century, the emergence of atomic theory, advanced analytical techniques, and X-ray diffraction analysis greatly accelerated the rate at which scientists described new minerals. By the 1950s, nearly 2,000 minerals had been identified, yet no central authority existed to regulate and approve their names or to eliminate confusion and redundancy in the rapidly growing list of recognized minerals.

Modern Science (1959 to present): *By 1959, the naming of new species had grown so chaotic that the mineralogical societies of 16 nations joined together to establish the International Mineralogical Association (IMA). The IMA created the Committee on New Minerals and Mineral Names (CNMMN). In 2006, the name of this committee was changed to the Commission on New Minerals, Nomenclature and Classification (CNMNC). Since 1959, formal guidelines and a review process have regulated the naming of all new minerals. Earlier names of clearly recognized species were “grandfathered” into this new nomenclature system.*

Now, when researchers are confident that they have identified a new mineral and that their chemical and physical data are correct, they may propose a name. But until the CNMNC determines the chemical and physical validity of the new species and approves the proposed name, it is identified only by a number. The CNMNC specifies that new mineral names end in “ite” and be based upon their chemical composition or physical properties, relationship to other recognized species, type localities where the type specimens were collected, or some deserving person or organization. If the proposed name honors a person, the CNMNC prefers that the individual be someone with significant achievements in the fields of mineralogy, geology, or related sciences. That being said, however, minerals have also been named for famous people, well-known mineral collectors and dealers, and museum curators. Once the CNMNC has decided that a new mineral is indeed valid and that its proposed name does not conflict with those of any of the more than 4,400 currently recognized mineral, the name becomes official.

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Today, about 45 percent of all recognized mineral species are named for individuals. Examples, using our previous Minerals of the Month, include smithsonite [ZnCO_3], named for James Smithson (1765-1829), founder of the Smithsonian Institution; and adamite [$\text{Zn}_2(\text{AsO}_4)(\text{OH})$], named for French mineralogist Gilbert-Joseph Adam (1795-1881). About 23 percent of mineral names are based on discovery localities, such as aragonite [CaCO_3], named after its type locality in Aragon, Spain; and vesuvianite [$\text{Ca}_{19}(\text{Al,Mg,Fe})_{13}\text{Si}_{18}\text{O}_{68}(\text{O,OH,F})_{10}$], named for its type locality at Mt. Vesuvius, Italy. Another 14 percent of all minerals are named for their chemical composition, such as stibnite [Sb_2S_3], named after the Greek word for antimony; and vanadinite [$\text{Pb}_5(\text{VO}_4)_3\text{Cl}$], named after the essential element vanadium. About eight percent of mineral names are based on physical properties, such as azurite [$\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$], named for its azure color; and this month's mineral, barite, which takes its name from the Greek word for "weight."

Most of the remaining 12 percent of mineral names were assigned in antiquity, such as silver [Ag], of unknown origin; and quartz, from the Old German Quarz, also of uncertain origin. Some mineral names are in a class of their own, including romarchite [SnO], named after Canada's Royal Ontario Museum of Archaeology; and minrecordite [$\text{CaZn}(\text{CO}_3)_2$], named after The Mineralogical Record magazine.

Yet for all the refinement in mineral-naming procedures, some old habits just won't go away—and that's the reason that barite, our Mineral of the Month, is "barite" in the United States, and "baryte" in Britain, Canada, and Australia.

ABOUT OUR SPECIMENS

Our specimens were collected at Cerro Huarihuyn (also spelled Warihuayin) in the Miraflores District, Huamalíes Province, Huánuco Department, Peru. Huánuco Department, one of Peru's 21 departments (political divisions comparable to American states), is located in central Peru. Most of Huánuco is in the high Andes, with only its extreme eastern section extending to the lower foothill jungles of the Amazon River drainage. Covering 14,227 square miles, Huánuco has an area roughly equal to that of the combined states of Vermont and New Hampshire. Huánuco is administratively divided into 11 provinces (comparable to American counties). Located in western Huánuco, Huamalíes Province is in the Cordillera Blanca, an Andean sub-range, and has a rugged mountain topography. Huamalíes Province is subdivided into 11 administrative districts (comparable to American townships). The Miraflores District covers 1,214 square miles and has 3,700 residents and an average elevation of 8,000 feet. It is 200 air miles north-northeast of the national capital of Lima and 125 air miles east of the Pacific coast. The approximate map coordinates of the remote Miraflores District are 9°12' south latitude and 76°40' west longitude.

Miraflores is not a major mining district, but rather one of the many lesser-mineralized areas that are scattered across the greater Andes region. Its mineralization 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 into fractures within quartz-monzonite and granitic country rock to precipitate an array of metal minerals in erratic vein systems. Gases accompanying the late deposition phases created vugs or cavities within some veins to provide space for unrestricted crystal growth. Much later, erosion exposed parts of these veins as mineralized outcrops.

Spanish prospectors first visited what is now the Miraflores District in the late 1500s, discovering mineralized outcrops, although none were large or rich enough to warrant mining. Prospectors searched the Miraflores District again in the 1890s, after foreign mine ownership became legal and mining boomed throughout Peru. In the 1970s, as many American, Canadian, and Australian mining companies directed their exploration efforts to South America, geologists classified the Miraflores District as one with "sub-economic mineralization," meaning, as Spanish prospectors had found 400 years earlier, that its known

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metal mineralization was of insufficient grade and size to be mined profitably. Since the mid-1990s, rising silver and base-metal prices have again lured exploration geologists to the district to search for silver, zinc, and lead. To date, the Miraflores District has not been thoroughly core-drilled, but several companies have driven exploration tunnels with mixed results. Occasional loads of hand-cobbed silver-lead-zinc ore have been trucked to concentrating mills and smelters at Cerro de Pasco, 80 miles to the south. Soaring silver prices have again spurred geological exploration in the Miraflores District. Some geologists believe that the erratic surface outcrops of multi-metal mineralization indicate the existence of massive vein systems at depth. Should metal prices remain high or rise further, it is likely that core-drilling programs will finally determine whether or not economic multi-metal deposits actually exist within the Miraflores District.

Our barite specimens were collected at Cerro Huarihuyn (also spelled Warihuayin), an 8,835-foot-high mountain that is really a “hill” by Andean standards. Its slopes are pockmarked with prospect holes and exploration tunnels, as you can see in the photo to the right. Although little silver-lead-zinc mineralization has been found in the district, wide distribution of pyrite and barite indicates that greater concentrations of multi-metal mineralization may exist at depth. Along with small amounts of silver, lead, and zinc sulfides, other minerals at Cerro Huarihuyn are barite, pyrite and marcasite, calcite, and dolomite. To date, barite is the only collectible mineral of interest. Barite specimens from Cerro Huarihuyn first reached international markets in the late 1990s, but attracted little attention. Then in spring 2005, barite specimens of water-clear transparency and superb crystal development were collected in quantity. These specimens were widely acclaimed at the Tucson Gem and Mineral Show in 2006 and were subsequently mentioned in the March-April issue of *The Mineralogical Record* later that year. Our barite specimens were selected from several lots that were collected in 2005.



We were fortunate to obtain these specimens, many of which would typically sell for much more than they cost through our Club. Note that the crystal habit is tabular and that the crystal edges are sharply beveled (wedge-shaped). The superb development of these delicate, tabular crystals is an indication of high chemical purity and minimal distortion of the crystal lattice. The specimens we sent ranged from colorless to shades of translucent gray to butterscotch yellow to amber, each beautiful in its own way. Many are on a matrix of dolomite. Knowing that barite often fluoresces under ultraviolet (UV) light, we were disappointed to notice only a smattering of yellow fluorescence on a few specimens in short wave UV light, and none under long wave. We are very much aware of the significant heft of these specimens, a reflection of barium's high atomic weight of 137.33, 2.5 times greater than that of iron. Whether you spell it “barite” or “baryte,” we hope you'll find this month's mineral as fascinating and beautiful as we do!

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