BARITE FROM CERRO HUARIHUYN, PERU

When assessing the quality of barite specimens, most collectors agree on the basic, requisite features: Specimens should have well-developed, sharp-edged, thin, tabular, transparent barite crystals that project in three-dimensional clusters from attractive matrices. While barite is a relatively common mineral with many collecting localities, only a few sources provide specimens that meet these criteria.

One such locality is Cerro Huarihuyn in the Miraflores mining district, Huamalíes Province, Huánuco Province, Peru. For the past ten years, Miraflores has yielded unusually fine barite specimens—a considerable achievement for a rather obscure, multimetal mining district hidden high in the Andes of central Peru.

Barite [barium sulfate, $BaSO_4$] is a member of the sulfates, a complex class of minerals with nearly 200 members. Sulfates contain 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. Although the physical properties of sulfates vary widely, most are fragile, light in color, transparent to translucent, and relatively soft.

Barite consists of 58.84 percent barium, 13.74 percent sulfur, and 27.42 percent oxygen. Most specimens also contain variable amounts of strontium, lead, iron, or calcium. Barite is transparent to translucent and has a Mohs hardness of 3.0-3.5, an uneven fracture, a vitreous-to-pearly luster, and perfect, one-directional cleavage.

With a substantial specific gravity of 4.3-4.6, barite is one of the densest of all transparent-to-translucent, light-colored minerals. Its unusual density, which is readily apparent when handling barite specimens, is due to its primary elemental component—barium, a soft, heavy, silvery, alkaline-earth metal with an atomic weight 2.5 times greater than that of iron.

Barite crystallizes in the orthorhombic system, which is defined by three mutually perpendicular axes of different lengths, an arrangement that is reflected in barite's dominant, tabular habit of intergrown clusters of thin-to-thick "tabs" with sharp, beveled edges. Less frequently, barite will form prismatic crystals. It also occurs in granular, massive, radiating, earthy, rosette, and globular-concretion forms.

Due to their weak ionic bonding, most sulfate minerals have varying degrees of solubility in water. But in barite, close atomic packing within the crystal lattice strengthens the ionic bonding to make barite insoluble in water, resistant to alteration, and substantially harder than most other sulfates.

As an allochromatic (other-colored) mineral, barite's color is due to traces of nonessential elements or structural defects, not to its essential elements or the nature of its 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 and creates a range of pale colors from white, gray, yellow and amber to brown, red, and blue. Blue colors in barite can also be due to "color centers," which are distortions in the crystal lattice that form when natural geophysical radiation energizes electrons and displaces them from their normal atomic orbits. The energized electrons come to rest in vacant lattice positions and absorb and transmit only certain wavelengths of visible light.

Under long-wave ultraviolet light, most barite specimens exhibit a yellow-to-orange fluorescence. Barite can also be phosphorescent and continue to emit a soft, blue or blue-green light even after incident light sources have been removed.

Barite is closely related to celestine [strontium sulfate, $SrSO_4$] and anglesite [lead sulfate, $PbSO_4$]. Mutual substitution of barium and strontium ions occurs so readily that barite and celestine form a complete, graded, solid-solution series. Barite also participates in a partial solid-solution series with anglesite.

By far the most abundant of all barium-bearing minerals, barite occurs with anhydrite, apatite-CaF, and calcite in carbonatites (carbonate-containing igneous and metamorphic rocks); with calcite, quartz, and fluorite in mesothermal and epithermal vein deposits; and with gypsum, dolomite, and cerussite in massive, hydrothermal replacement deposits. It also occurs as intergranular precipitates and seam fillings in limestone and sandstone. Barite-impregnated sandstone containing more than 50 percent barite is the only ore of barite.

Peru, Brazil, China, Switzerland, Italy, England, France, Russia, South Africa, Namibia, Australia, and Canada have notable barite collecting localities. In the United States, barite is collected in Arizona, Colorado, Nevada, California, Illinois, Texas, and Tennessee.

Although known since antiquity, barite received little attention until 1603 when Italian alchemist Vincenzo Casciarolo began studying unusually heavy, translucent, white stones collected from a site near Bologna, Italy. When heated, these stones emitted an eerie, blue glow, leading Casciarolo to believe that he had discovered the long-sought-after “philosopher’s stone” that could transmute common metals into gold. Casciarolo named his discovery *lapis solaris*, or “sun stone.” Another naturalist of the era, Giulio Cesare La Galla, theorized that *lapis solaris* somehow “trapped” sunlight, then released it slowly in darkness—the first recorded observation and attempted explanation of the phenomenon of mineral phosphorescence.

Lapis solaris became known as “Bologna stone” and was the subject of attention throughout Europe for the next century. Scientists learned the chemical composition of Bologna stone only after barium had been recognized as an element in 1774. Barium oxide was named “baryta” after the Greek *barytēs* meaning “weight” and alluding to its unusual density. In 1803, British chemist Sir Humphry Davy isolated the heavy metal in “baryta” and named it “barium.” In 1837, chemists identified Bologna stone as barium sulfate and named it “baryte.”

“Baryte” is the formal name for the mineral form of barium sulfate. It is used in all English speaking nations except the United States, which still prefers “barite,” but is slowly adopting the internationally accepted “baryte” spelling.

Barite is too soft for 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 as large as 12 carats. When flawless and attractively colored, barite gems of this size 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.

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 is a major industrial mineral and the source of all barium and barium compounds. Some eight million metric tons of barite are recovered worldwide each year by open-pit mining of barite-rich sandstone. Because of barite’s substantial density, crushed ore is easily concentrated by hydraulic, gravitational-separation methods. China is the leading producer, followed by India and Morocco. The United States ranks fourth, producing 400,000 metric tons of barite annually from four mines in Nevada and one in Georgia. Concentrated barite is relatively inexpensive, currently costing about $36 per ton.

Ninety percent of all barite goes into the preparation of heavy drilling fluids or "muds" that are used in large volumes in oil and natural-gas drilling operations to contain formation pressures, prevent well "blowouts," maintain drill-hole stability, cool and lubricate drill bits, and remove cuttings from drill holes.

Refined barite is the feedstock for the production of barium metal and barium chemicals. Although elemental barium has few uses, barium compounds, especially barium sulfate, have many. Because of its large size and mass, the barite molecule has very high radio-opacity. This ability to absorb X-rays and gamma rays gives it numerous applications in the medical and nuclear fields. When added to glass mixtures, barite produces high-refraction, nontoxic, "leaded" crystal. Finely powdered barite serves variously as a glossing compound, filler, and weighting agent in the manufacture of paints, enamels, plastics, paper, and cardboard.

During the last decade, fine barite specimens have come from Cerro Huarihuyn (Huarihuyn Mountain) in the Miraflores District, Huamalíes Province, Huánuco Department, Peru. Because of inconsistencies in anglicizing the native Quechuan word "Huarihuyn," the name appears variously in mineralogical literature and on mineral locality labels as "Huarihuayin," "Huari Huayin," "Warihuayin," and other similar spellings.

The Miraflores District is located in central Peru in the Cordillera Blanca, an Andean sub-range with a rugged mountain topography. The district has a populaton of 3,700, covers 1,214 square miles, and has 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 one of the many lesser-mineralized districts that are scattered across the greater Andes region. Its 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 into fractures within quartz-monzonite and granite country rock where they precipitated 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 discovered these mineralized outcrops in the late 1500, but 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, when many American, Canadian, and Australian mining companies were focusing their exploration efforts on South America, geologists classified the Miraflores District as one of "sub-economic mineralization," meaning, as Spanish prospectors found 400 years earlier, that its known metal mineralization was of insufficient grade and size to be mined profitably. But when silver and base-metal prices soared in the 1990s, exploration geologists returned to Miraflores to search for silver, zinc, and lead. Although the district has not yet been thoroughly core-drilled, several companies have driven exploration tunnels and developed small underground mines. Hand-cobbed, high-grade, silver-lead-zinc ore is trucked from Miraflores to concentrating mills and smelters at Cerro de Pasco, 80 miles to the south.

The slopes of Cerro Huarihuyn, an 8,835-foot-high mountain that is a "hill" by Andean standards, are marked with prospect holes and exploration tunnels. Although the veins of silver-lead-zinc mineralization found to date have been erratic and small, the abundance of pyrite and barite indicates that greater concentrations of multimetal mineralization may exist at depth.

Along with pyrite, barite, and silver-lead-zinc sulfides, other minerals present include marcasite, calcite, and dolomite.

Barite is the district's only collectible mineral. When barite specimens from Cerro Huarihuyn first reached the international markets in the late 1990s, they attracted little attention. But quantities of finer barite specimens with water-clear transparency and superb crystal development were found in 2005 and widely acclaimed at international gem-and-mineral shows. Cerro Huarihuyn miners made another major recovery of barite specimens in 2008.

The Miraflores district continues to yield small lots of fine barite specimens. Since barite is the only collectible mineral at Miraflores, dealers rarely visit the remote district. Instead, Miraflores miners must transport the specimens to the mill-and-smelter town of Cerro de Pasco to sell to dealers there. Given the rough roads, lack of suitable packing materials to protect the specimens, and the need to transport specimens on heavy ore trucks, dealers are often pleasantly surprised when Miraflores specimens arrive in Cerro de Pasco undamaged.

Barite specimens from the small mines on Cerro Huarihuyn have a bright, vitreous luster; some are colorless, while others are shades of blue or golden-yellow. When viewed with backlighting, these thin, tabular barite crystals often have a water-clear transparency. Crystal development is excellent with sharp, beveled edges. The clustered barite crystals usually rest on a matrix of pink dolomite. These are the features that collectors seek in fine barite specimens.