FROM BERYL TO BERYLLIUM

Mentioning beryl [beryllium aluminum silicate, $Be_3Al_2Si_6O_{18}$] to most mineral collectors will evoke images well-developed, hexagonal crystals and beautiful gemstones. That's not surprising, for the colors of the different beryl varieties are among the most beautiful of all gemstones and include green emerald, blue aquamarine, pink morganite, golden heliodor, and colorless goshenite.

The essential element beryllium is another aspect of beryl that is no less interesting. With an atomic weight of just 9.01, beryllium is the second lightest metal. It also has great strength; with only one-third the density of aluminum, it has a stiffness greater than that of carbon steel and is nearly as strong.

Ranking 51st in crustal abundance, beryllium is about as common as tin. Despite being widely distributed, it rarely occurs in concentrations rich enough to mine. Although beryllium was discovered in 1798 and isolated in 1828, it remained a laboratory curiosity until the 1930s, when rapidly advancing X-ray and nuclear technologies created demand for the metal. Because of its transparency to X-rays, beryllium was first used in X-ray-tube windows, while its neutron-absorbing properties made it ideal for neutron shields in nuclear applications.

Beryl was then the only known source of beryllium. When beryllium prices soared during World War II, mining beryl-rich granite pegmatites became quite profitable, especially when miners encountered huge crystals of opaque, common beryl. Containing about 15 percent beryllium by weight, these enormous crystals, some 12 feet long and weighing four tons, were worth tens of thousands of dollars each. For several decades, small, domestic pegmatite mines provided an ample supply of beryllium for industry, and also a plentiful supply of beryl specimens and gemstones for mineral collectors.

But by the late 1950s, the relatively few beryl-rich pegmatites in the United States were rapidly depleting. When they could no longer meet the growing demand for beryllium for use in lightweight, aerospace alloys, industry turned to imported beryl from Brazilian pegmatites.

Meanwhile, soaring prices for beryllium encouraged prospectors in the United States to search for new sources. Prospectors focused most of their attention on western Utah's Spor Mountain region that had previously produced uranium and fluorspar and was a well-known collecting area for beryl, topaz [basic aluminum fluorosilicate, $Al_2SiO_4(F,OH)_2$], garnet (a group of complex aluminum silicates), and fluorite [calcium fluoride, CaF_2]. For the first time, exploration geologists employed newly developed, X-ray-emitting beryllometers, forerunners of the portable X-ray-fluorescence analyzers that are now standard in field mineral identification. But these crude instruments could identify only beryllium and, apart from confirming the identity of obvious beryl-containing samples, were of little help.

The search for new beryllium sources came up empty until 1959, when a geologist accidentally subjected samples of tuff, an earthy volcanic rock, to a beryllometer's X-rays. The instrument unexpectedly revealed a relatively high beryllium content. Later analysis showed that the tuff didn't contain beryl at all, but very small, yellowish, orthorhombic crystals of bertrandite [basic beryllium silicate, $Be_2Si_4O_7(OH)_2$], a mineral previously thought to be rare.

Geologists learned that groundwater had leached beryllium from nearby rhyolite formations, then redeposited it as tiny, disseminated crystals of bertrandite within the porous tuff. Although the beryllium-rich tuff contained only 0.5 percent bertrandite, it occurred in an extensive, shallow formation that could be mined with inexpensive, open-pit methods.

After mining began at Spor Mountain in 1969, the United States became self-sufficient in beryllium. Today, Spor Mountain is still the world's largest known beryllium deposit and yields most of the 150 tons of the elemental metal that are produced worldwide each year.

Beryllium now has a broad range of scientific and industrial applications that extends far beyond its early uses as X-ray-tube windows and nuclear shields. Beryllium-based, exotic alloys are vital to the aviation and aerospace industries. Aircraft and space-vehicle masts weighing just 6 pounds are stiff enough to support 95 pounds of instrumentation. Because highly polished beryllium reflects nearly as much visible light as polished silver and is even more reflective in the infrared wavelengths, it is widely used in space telescopes and optical guidance systems.

Beryllium is also employed in automotive air-bag impact sensors, retail checkout scanners, computer disk drives, and even racing bicycles that cost $10,000 each. Racing-bicycle frames made from beryllium alloys are nearly as strong as steel, yet weigh only a pound and a half. Reflecting high industrial demand, a single pound of refined, elemental beryllium now costs about $400.

So beryllium, whether in the form of beryl gemstones or the elemental metal, is truly a remarkable element.

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Steve has worked with the Mineral of the Month Club since 2002. As a former hardrock miner, he has mined Colorado molybdenum, Alaska gold, Arizona copper, and Wyoming uranium. Eight of his ten books deal with topics of minerals, mineral collecting, mining, and gemstones. He has written more than 1,000 articles and is a contributing editor and science columnist with *Rock & Gem* magazine. His work has also appeared in *The Mineralogical Record* and *Lapidary Journal*. He is a former member of the board of directors of the National Mining Hall of Fame & Museum