AZURITE “SUNS”

Beautiful Blue Nodules-in-Matrix from Australia

Azurite ranks high among the most collectible minerals for good reasons. Its attractive forms include bladed crystals and massive and botryoidal forms. But azurite’s greatest appeal is its distinctive color, which ranges from a deep, saturated, midnight-blue to lighter and brighter sky-blue hues. In addition, azurite, whcih is a popular gemstone and ornamental stone, also has a rich history as one of the first ores of copper.

As a fairly abundant and widespread mineral, azurite has many occurrences worldwide. Notable azurite sources include Namibia, the western United States, Mexico, China, Morocco, Democratic Republic of Congo, and Australia.

In recent years, Australia has produced some of the most interesting forms of azurite. Among the most unusual specimens from “Down Under” are the azurite “suns” from the remote Malbunka Copper Mine near Areyonga, MacDonnellshire, Northern Territory. These “suns” are nodules that consist of aggregates of bright-blue, bladed azurite crystals in a matrix of off-white kaolin clay. With their rarity and striking color contrast, Malbunka “suns” are without question one of the most desirable and eye-catching forms of azurite.

The name “azurite,” pronounced “AZH-ur-ite,” is derived from the word “azure,” which stems from the Persian *lāzhuward,* meaning “blue of the sky” heaven and alluding to the mineral’s striking color. Azurite’s alternative names include “azure copper ore,” “blue copper ore,” and “blue malachite.”

Azurite, chemical formula $Cu_3(CO_3)_2(OH)_2$, is a basic copper carbonate containing the elements copper, carbon, oxygen, and hydrogen. Azurite’s molecular weight consists of 55.31 percent copper, 37.14 percent oxygen, 6.97 percent carbon, and 0.58 percent hydrogen. Azurite is one of the nearly 100 members of the carbonate class of minerals, in which one or more metallic elements are combined with the carbonate radical $(CO_3)^{2-}$.

Azurite crystallizes in the monoclinic system, which is characterized by three axes of unequal length, two of which are mutually perpendicular. Azurite occurs as prismatic crystals in tabular or bladed habits that are typically thin in one direction and exhibit crystal faces that are sometimes faintly wavy or striated. It also occurs in earthy, massive, stalactitic, stalagmitic, radiating, fibrous, crusty, and botryoidal forms.

Because azurite’s bonding strength varies significantly along its three lattice planes, its cleavage is perfect-to-good in one direction, good in a second, and fair in a third. Azurite’s brittleness and relatively low Mohs hardness of 3.5-4.0 is due to the weak ionic bonding that joins the copper, carbonate, and hydroxyl radicals. It has a brilliant, vitreous luster, and can be transparent, translucent, or opaque. Azurite has a light-blue streak and a conchoidal fracture. Because copper accounts for more than half of its molecular weight, azurite has a relatively high specific gravity of 3.7-3.8.

Most carbonates are colorless, white, or only lightly colored, but azurite is an exception. As an idiochromatic (self-colored) mineral, azurite’s blue color is due to its essential chemical composition and the nature of its crystal structure. Copper, azurite’s essential metal, is a powerful pigmenting agent for the colors blue and green. Copper ions cause the azurite crystal lattice to absorb all the visible wavelengths of white light except those within a narrow band of blue, which it reflects as its diagnostic, azure-blue color.

Azurite is a secondary mineral that occurs in the shallow, oxidized portions of copper deposits. It forms both from the reaction of carbonic acid with copper-sulfide minerals and from the reaction of copper-bearing solutions with calcite [calcium carbonate, $CaCO_3$]. Azurite occurs with malachite [basic copper carbonate, $Cu_2(CO_3)(OH)_2$], cuprite (cuprous oxide), chalcopyrite (copper iron sulfide), calcite, chalcocite (copper sulfide), native copper, chrysocolla (hydrous basic copper aluminum silicate), and linarite (basic lead copper sulfate).

Azurite is easily identified because of its diagnostic, azure-blue color, light-blue streak, and frequent association with malachite. Azurite is softer than most other blue minerals and, like many carbonates, effervesces readily in dilute hydrochloric acid.

Azurite is closely related chemically and structurally to malachite. Both crystallize in the monoclinic system and occur in the same mineralogical environments. Azurite specimens often contain malachite and vice versa.

As the less oxidized mineral, azurite occupies an earlier stage in the oxidation process than does malachite. Both crystallize directly from aqueous solutions. Because azurite requires less oxidation energy to form in an aqueous mineralogical environment, it usually precipitates out of solution before malachite. However, when greater amounts of oxidation energy are available, malachite can crystallize before azurite.

Azurite has less chemical stability than malachite. When exposed to water, azurite will slowly oxidize into malachite. The oxidation of azurite into malachite is a very slow, gradual process that is often reflected in color gradations between blue and green.

Because of its bright, blue color and occurrence in shallow, oxidized copper deposits, azurite has been well-known since antiquity. Powdered azurite has been used as a blue pigment and a green pottery glaze since about 3500 B.C. Both azurite and malachite were among the first ores of copper utilized at the start of the Bronze Age, and anthropologists believe that the association of native copper, azurite, and malachite helped early metallurgists to understand the relationship between metals and metal ores.

Medieval physicians prescribed powdered azurite to treat throat, spleen, and spine ailments, and suggested wearing azurite necklaces to ease pulmonary and bronchial congestion. Among several Native American cultures of the Southwest, azurite was a sacred stone that connected its wearers with spirit guides.

During both the Middle Ages and the Renaissance, powdered azurite was the primary blue pigment used in the paints of European artists. Finely ground azurite provided a lighter blue color while coarse azurite particles produced more intense blues. Italian artists referred to azurite pigment as *azurro della magna*, literally meaning “great blue.” Azurite-based paints were used in many classic works of art until the mid-1600s, when artists realized that the blue colors of older works were slowly turning green. Centuries later, scientists learned that this discoloration was due to the slow oxidation of azurite into malachite.

By 1800, scientists had recognized azurite as a carbonate mineral, but were unable to chemically distinguish it from malachite. Because smelted azurite and malachite yielded almost the same amount of copper, azurite was initially thought to be a color phase of malachite. The two minerals were chemically differentiated in 1824 by the French mineralogist and geologist François Sulpice Beudant (1787-1850). Working with specimens collected from the Chessy-les-Mines copper deposit at Chessy, Rhône, Rhône-Alpes, France, Beudant demonstrated the compositional difference between the two basic copper carbonates and assigned the name "azurite" to the blue mineral.

In the late 1800s, outcrops with blue azurite stains and green malachite stains led prospectors to the great copper deposits of the western United States. Both azurite and malachite were the primary ores of copper until the early 1900s, when miners turned their attention to massive deposits of low-grade sulfide ores.

Notable azurite sources in the United States include those in Greenlee, Cochise, Gila, and Yavapai counties in Arizona. Azurite is also collected in Colorado, California, Montana, Nevada, New Mexico, Utah, Idaho, Michigan, Arkansas, Pennsylvania, and New Jersey. Other localities are in China, Russia, Namibia, Morocco, Democratic Republic of Congo, Zambia, South Africa, France, Australia, Mexico, and Chile.

Because of its relative softness (Mohs 3.5-4.0) and brittleness, azurite's use in jewelry is limited to beads and cabochons for wear as necklaces and pendants. Although azurite takes a high polish, scratching dulls it quickly. Azurite crystals are sometimes faceted into collectors' gems, but because large crystals can appear almost black, azurite collector gems are rarely larger than one carat. Nevertheless, properly faceted, intensely colored, transparent azurite can make very attractive gems.

Massive azurite, which is often banded, is a popular ornamental stone that is fashioned into trinket boxes, ashtrays, figurines, paperweights, and inlay pieces. With its vivid, azure-blue color, unusual crystal habits, interesting mineralogical associations, and availability and affordability, azurite, as both individual and composite specimens, is one of the most collectible of all mineral species.

Metaphysical practitioners use azurite to identify, and dispense with, unwanted past beliefs to enable the mind to achieve higher levels of consciousness and intellectual receptivity. When worn on the body, azurite is thought to ease rheumatic pain and discomfort, a benefit that some traditional medical practitioners attribute to the mineral's copper content.

The distinctive form of azurite known as "suns" are collected at the Malbunka Copper Mine near Areyonga, MacDonnellshire, Northern Territory, Australia. The Northern Territory, which is roughly twice the size of the state of Texas, is located in north-central Australia. With just 230,000 residents, it is one of the world's most sparsely populated, non-polar regions. The Malbunka Copper Mine is 90 miles west of Alice Springs, an isolated city of 26,000 that is the economic, cultural, and transportation hub of central Australia.

From Alice Springs, the Malbunka Copper Mine is reached by a 60-mile-long, paved, one-lane road that leads west to the tiny town of Hermansburg. An unpaved track continues west for another 30 miles to the remote mine site. The mine is located in the low, rugged hills of the Gardiner Range, a geological remnant of a once-much-higher, billion-year-old mountain system. The regional elevation is about 1,700 feet; the climate is very arid and the low hills are covered only by sparse desert vegetation.

The Malbunka Copper Mine is a minor deposit that yields only mineral specimens. Aboriginal prospector Albert Namatjira discovered the deposit in the late 1940s. Originally known as "Namatjira's Copper Prospect," it was first described in Australian geological reports in 1953. But because of its remoteness, small size, low grades, and erratic mineralization, it never became a commercial copper source.

The Malbunka copper deposit is part of the Namatjira Formation, a 600-million-year-old, sedimentary formation that includes mixed strata of brown sandstone, gray oolitic siltstone, buffto-cream-colored mudstone and shale, and white kaolin clay, the latter consisting largely of the mineral kaolinite [basic aluminum silicate, $Al_2Si_2O_5(OH)_4$].

Geologists trace Malbunka's copper mineralization to sulfides that were originally emplaced at depth. As erosion eventually reduced the surface, the copper sulfides were exposed to the oxidizing effects of atmospheric oxygen and acidic groundwater. Groundwater eventually dissolved these sulfides, transporting and redepositing the copper in the form of the colorful, oxidized copper minerals azurite, malachite, atacamite, and chrysocolla.

While many oxidized copper minerals at Malbunka were deposited as disseminated particles, the azurite formed as nodules in a stratigraphically controlled deposition sequence within layers of kaolin clay that are impervious to water. Rather than penetrating this clay, water flows horizontally atop, between, or beneath the layers. When acidic, copper-rich groundwater circulated through the Namatjira Formation, it migrated horizontally through seams where conditions of temperature and chemistry caused the copper to precipitate as azurite. Because of limited space within the clay seams, this azurite developed as flat, disk-like "suns" or semi-spherical nodules.

When the Malbunka azurite "suns" were first collected in 1982, they immediately attracted attention on international specimen markets. But the site then became inactive until Australian miner and mineral dealer Dehne McLaughlin reopened it in 2005. Before McLaughlin could obtain the required lease, however, he faced a legal question about the site's name. Under Australian law, sites within an Aboriginal clan's "country" can be named only for members of that particular clan. But the copper site, which was on Malbunka land, was already named for Albert Namatjira, who was not a clan member. After Malbunka attorneys filed suit to change the name, the Northern Territory government disallowed all previous names and formally assigned the site its current, legal name—the "Malbunka Copper Mine."

The Malbunka Copper Mine is currently leased and operated by Dehne McLaughlin under terms of the Northern Territory Aboriginal Land Rights Act of 1976. McLaughlin pays annual rental and royalty fees to the Malbunka Clan and an annual administration fee to the Northern Territory Central Land Council. Together with his wife Maureen, he operates the mine during the cooler months of the Australian winter.

The Malbunka Copper Mine is an underground operation in which a shallow decline accesses short, horizontal drifts within a kaolin-clay layer. The soft clay is removed manually to prevent damage to the enclosed azurite "suns." The McLaughlins then use a water spray to carefully remove part of the clay matrix to better expose the azurite "suns" in each specimen.

Malbunka azurite "suns" consist of bladed or tabular azurite crystals with a deep-blue color. The shape of the "suns" reflects the shape of the voids within the clay layer in which the azurite crystallized. This off-white, fine-grained, clay matrix creates a striking contrast to show off the blue azurite "suns" in the superb Malbunka specimens.