August 2002 Mineral of the Month: Cobaltoan Dolomite

Cobaltocalcite? Sphaerocobaltite? Cobaltian calcite? Cobaltoan calcite? Colbaltoan dolomite? Recently, at the booth of a highly regarded mineral dealer, we examined a wonderful specimen with small, electric-pink crystals on matrix from the Democratic Republic of the Congo. When we asked him why he labeled it as "Cobaltoan Dolomite," we expected a highly erudite and scientific explanation. He simply shrugged his shoulders while giving us a quizzical look.

PHYSICAL PROPERTIES

Chemistry: $CaMg(CO_3)_2$ Calcium Magnesium Carbonate with Trace Cobalt
Class: Carbonates Group: Dolomite Variety of Dolomite
Dana's: Anhydrous Carbonates
Crystal System: Trigonal
Crystal Habits: Commonly rhombohedral; Rarely, prismatic terminated by rhombohedrons or tabular
Color: Bright pink to electric pink
Luster: Vitreous to pearly, sometimes porcelainous or opaline
Transparency: Transparent to translucent
Streak: White
Refractive Index: 1.50 and 1.68, strongly birefringent, like calcite
Cleavage: Perfect in one direction
Fracture: Conchoidal; Brittle
Hardness: 3.5-4
Specific Gravity: 2.85
Luminescence: None
Distinctive Features and Tests: Far less effervescence in cold hydrochloric acid but dissolves readily in warm acid; Infusible, glowing brightly
Dana Classification Number: 14.2.1.1– variety of dolomite

NAME

Cobaltoan dolomite refers to dolomite with cobalt partially substituting for calcium in the crystal lattice. Though the term "cobaltoan" is preferred, "cobaltian" is also commonly used, with the same meaning. The term "cobaltocalcite" is commonly misused to refer to both cobaltoan dolomite and cobaltoan calcite, as we will see.

COMPOSITION

This month's mineral is almost always referred to and labeled as "cobaltocalcite." However, since "cobaltocalcite" was for a period of years also accepted as the name of another mineral, as we will see, it should not be used for our mineral, so as to avoid confusion. And of course, many specimens labeled "cobaltocalcite" are not really calcite! Let's look at the history of our mineral, to shed light on this.

In the early and mid 1980's, when large, gorgeous pink crystals began coming out of what was then known as Shaba Province, Zaire (now Katanga Province, Democratic Republic of Congo), they were called in the *Mineralogical Record* "cobaltian calcite." Most were calcite colored pink by trace amounts of cobalt in the crystal lattice, so this name was fitting for this unique variety. (Other metallic elements can be incorporated in calcite, producing varieties known as manganoan, ferroan, plumbian, barian, strontian, and magnesian.) In 1921, an earlier mineralogist had suggested calling this variety "cobaltocalcite," but this varietal name had to be rejected, as it was later used as the name of a distinct

mineral. In fact, the 1986 MR stated: "Although some early authors use the term *cobaltocalcite* for cobaltian calcite, that term was used in the last edition of *Dana's System* for the now-preferred term *sphaerocobaltite*. Neither of these names should be used for the Zaire specimens." A few years later, it was decided that these should more properly be called cobaltoan calcite rather than cobaltian calcite.

What is sphaerocobaltite? A rare mineral with the chemical formula of $CoCO_3$ that was first described in 1877, after crystals were discovered in cobalt- and nickel- rich veins at Schneeberg, Saxony, Germany. This rare mineral belongs to the calcite group, along with calcite [$CaCO_3$], gaspéite [$(Ni,Mg,Fe^{2+})CO_3$], magnesite [$MgCO_3$], otavite [$CdCO_3$], rhodochrosite [$Mn^{2+}CO_3$], siderite [$Fe^{2+}CO_3$], and smithsonite [$ZnCO_3$]. In the *Seventh Edition of The System of Mineralogy of James Dwight Dana*, published in 1951, it was designated "cobaltocalcite," but when the *Glossary of Mineral Species* was published, the original name was used. It is quite a rare mineral, usually found as small spherical masses or as crusts with a concentric and radiating structure, of a rose-red to cranberry-red color. Crystals more than a couple of millimeters in size are very rare and highly treasured. Its name reflects its common spherical crystal form (sphaero-, or sphere-like) and its cobalt composition.

In the early 1990's, a professor at U.C.L.A., who was particularly fond of the pink color of both cobaltoan calcite and sphaerocobaltite, began to wonder how much cobalt was present to give cobaltoan calcite its lovely pink color, and if there really was much difference between the two minerals. Using X-ray diffraction, he sought to determine the percentage of elements in the crystals. Since calcite is made up of calcium carbonate, he expected to find each specimen to have a large proportion of calcium ions and wanted to see how much cobalt would be in each one. (This technique cannot measure carbon or oxygen.) He knew, as we mentioned earlier, that several other elements can substitute for calcium in calcite, so he expected he might find small amounts of manganese, iron, and the other metals previously mentioned. In testing his eight specimens, he made two unexpected discoveries: first, that many of the specimens contained a higher percentage of magnesium than calcium, and second, that cobalt was present in only very small percentages!

What did the tests prove? They confirmed that cobalt is a powerful coloring agent, and can affect the color in a mineral, even in small amounts, sometimes so minute that the presence is undetectable. And more importantly, because many of the specimens contained a greater percentage of magnesium than calcium, they more accurately fit the chemistry of dolomite, which is $CaMg(CO_3)_2$, and should be called cobaltoan dolomite rather than cobaltoan calcite.

From additional testing performed through the 1990's, it was concluded that most of the pink-hued specimens coming from the D.R.C. were dolomite rather than calcite. It was found that, in general, cobaltoan dolomite has a more vivid pink color, and usually forms as a druse or a botryoidal crust, while cobaltoan calcite is usually a duller, more subtle pink, and forms as larger crystals. This would be a good rule of thumb to assist in making an accurate distinction between the two, though of course there would be exceptions, and the only way to know with absolute certainty would be to test each specimen. Only a minute amount of cobalt can make dolomite and calcite pink. It is thought to be only on the crystal's surface layers, as some cobalt is trapped in the crystal lattice during the crystal's last growth stage.

To sum up: the term "cobaltocalcite" should be used only as a synonym for the rare mineral sphaerocobaltite. Most pink specimens now coming from the D.R.C. are dolomite rather than calcite, and should be called cobaltoan dolomite, though cobaltian is still acceptable. A simple way to make a distinction is by the color and crystal size– cobaltoan dolomite crystals are usually druses and coatings with a bright to electric pink color, while cobaltoan calcite crystals are larger and pale pink.

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COLLECTING LOCALITIES

Cobaltoan calcite of a lovely berry color is known from a cavern wall in Peremoea, Spain. We have also seen pretty specimens from Bou Azzer, Morocco. Cobaltoan dolomite is also found at the famous Tsumeb Mine, Namibia, as are Mn, Pb, and Zn varieties. A number of localities in the D.R.C. produce wonderful specimens of cobaltoan dolomite and calcite, including the Mashamba West mine, the Mupine mine, and the Kakanda mine, where ours were dug. Sphaerocobaltite crystals come from Boleo, Baja California Sur, Mexico; Schneeburg, Saxony, Germany; Jervois Range, Northwest Territories, Australia; and mines of the Shaba Crescent, D.R.C.

JEWELRY & DECORATIVE USES

Although cobaltoan calcite from the Spanish locality is occasionally seen as small faceted stones, cobaltoan calcite and dolomite are rarely cut into gemstones, and only as collector stones. The brittleness, perfect cleavage, and low hardness of both minerals make them impractical for jewelry use. However, drusy cobaltoan dolomite on matrix is ideal for use in pendants, earrings, and brooches, and is eagerly sought by jewelry designers and wire artists. In fact, our African specimen supplier told us that most of the cobaltoan dolomite he imports is sold to cutters for jewelry use!

HISTORY & LORE

As mentioned, cobalt is a powerful coloring agent, and has been used as such for millennia, especially in the Middle East, Egypt, and China. Cobalt oxides were added to pottery, earthenware, glass, enamelware, and pearls, and also used in paints, imparting every shade of blue. Cobalt ore for pigment came from Persia and Burma, and was roasted at red heat and ground up for use as a pigment. As one author puts it, the “Egyptian blue” and the “China blue,” of those times were simply “cobalt blue.” It is used much the same way in our day.

We could not find any metaphysical powers attributed to cobaltoan dolomite. One reference to cobaltocalcite gives it the ability to expand the creative influence and the ability to use the higher emotions and the heart, to resolve emotional imbalance, to stimulate the flow of love between individuals, and to make communication a positive experience. What happens if a believer is using a cobaltoan dolomite improperly labeled as cobaltocalcite? To the modern day crystal power believer, regular dolomite crystals encourage charitable actions, relieve sorrow, encourage energetic and impulsive original thinking, and produce stamina when one is dealing with hyperactive people.

TECHNOLOGICAL USES

Cobalt (symbol Co, atomic weight 58.933, number 27 on the Periodic table) is a silver-white, magnetic, metallic element, one of the transition elements. It ranks about thirtieth among elements in the Earth’s crust. About 50 cobalt minerals are known, with the best-known being cobaltite [CoAsS], skutterudite [$CoAs_{2-3}$], carrollite [$Cu(Co,Ni)_2S_4$], linnaeite [$Co^{2+}Co^{3+}{}_2S_4$] and erythrite [$Co_3(AsO_4)_2 \cdot 8H_2O$]. Cobalt in small amounts is also a common component of metallic meteorites. Cobalt is ductile at high temperatures, with a melting point of about 2723° F and a boiling point of about 5198° F.

Cobalt was isolated and identified as an element by Swedish chemist George Brandt in 1735, although its ores were known long before that. During the Middle Ages, European miners regarded cobalt ore as a divine curse, as they had no use for it, and had a difficult time separating it from the copper and other metallic ores they were seeking. This may explain the origin of the English word “cobalt,” which comes

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from the German word “Kobold,” meaning “demon,” or the ‘evil-minded gnome-like spirits of the mines.’ It is also possible that this meaning relates to the stature of the old German miners, as the shafts and opening were much more easily navigated by small men.

Though its value was not appreciated by those early miners, by the early 19th century, cobalt for industrial applications was being mined all over the world, especially in Germany, Norway, Sweden, Transylvania, France, Spain, England, Chile, Argentina, Tasmania, and later, Canada, Zaire, Zambia, and the United States. The U.S. remains as the chief user of cobalt. Cobalt is alloyed with iron and nickel to form an alloy of unusual and strong magnetic properites. With steel, cobalt is alloyed to make heat resistant materials known as **superalloys**, which are used in the making of jet and gas turbine engines. Carboloy is an alloy of cobalt and tungsten carbide used for cutting and machining steel, and Stellite is an alloy of cobalt and chromium used for the same applications. Cobalt is also used in small amounts as a pigment to impart a brilliant, deep blue color to glass, porcelain, enamels, and pottery. It also has some medical applications.

As mentioned, cobalt is a powerful pigmenting agent. Like the element chromium, which puts the red in ruby and the green in beryl, cobalt imparts two distinct colors: the blue in andalusite and synthetic spinel, and the pink in cobaltoan dolomite and calcite and sometimes in smithsonite.

ABOUT OUR SPECIMENS

For nearly a century, the Democratic Republic of the Congo has been a primary producer of cobalt for industrial uses, along with its neighbor, Zambia, and the cobalt-rich region of Ontario, Canada. Other current cobalt-producing areas include Morocco, Kazakhstan, and Azerbaijan. Please refer to your February 2002 Malachite write-up for much information and a map on the cobalt, uranium, copper and other rich deposits of the Shaba Crescent, Katanga Province, D.R.C.

Most of the specimens we received show the bright pink, drusy crystals we now know are most likely cobaltoan dolomite. A few pieces had somewhat larger, though still small crystals with a more magenta-pink color and crystal faces visible under the 10x jeweler’s loupe. A number of our specimens had areas of green to almost-black malachite, with cobalt substitution in malachite accounting for the dark color. Cobalt oxides of a black color were also visible on some pieces. Some red fluorescence was noted on the matrix of a few pieces, perhaps indicative of calcite. It is possible that some of our specimens have sphaerocobaltite crystals as well, as minute, more deeply colored particles on the cobaltoan dolomite.

The one question we were unable to answer by means of our research: If much of this material coming from the D.R.C. is dolomite rather than calcite, and the use of the term “cobaltocalcite” is being discouraged due to its connection to another mineral, why do we see this pretty pink consistently being called, labeled, and sold as “cobaltocalcite?” As a prominent writer once said: “A rose by any other name would smell as sweet.”

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