October 2006 Mineral of the Month: Crocoite

> "Specimens of the rare mineral Crocoite from Tasmania are displayed in Museums and Educational establishments throughout the world. Specimens of the mineral are regarded by most mineral collectors as being amongst the most beautiful objects to originate underground, and to be amongst nature's most brilliant creations." --from the official proclamation declaring crocoite to be the Mineral Emblem of the State of Tasmania, *Tasmanian Government Gazette,* December 6, 2000

PHYSICAL PROPERTIES

Chemistry: $PbCrO_4$ Lead Chromate, sometimes with small amounts of zinc and sulfur
Class: Phosphates, Chromates, Arsenates, and Vanadates
Sub-Class: Chromates
Group: Crocoite
Crystal System: Monoclinic
Crystal Habits: Prismatic, striated lengthwise, and generally square in cross-section; crystals are usually small, thin, elongated needles that form reticulated aggregates, acicular (jackstraw) clusters, radial sprays, and disorganized groupings; crystals are sometimes partially hollow with poorly developed, uneven, or pitted terminations; also granular, columnar, and incrusting forms.
Color: Usually bright orange-red, also yellow-orange, orange, and red.
Luster: Adamantine
Transparency: Translucent to transparent
Streak: Yellow-orange
Cleavage: Distinct in one direction, poor in two others.
Fracture: Conchoidal to uneven, brittle and sectile.
Hardness: 2.5-3.0
Specific Gravity: 5.9-6.1
Luminescence: None
Refractive Index: 2.31-2.66
Distinctive Features and Tests: Best field indicators are orange-red color, long prisms with generally squared cross-sections, unusually high density, and adamantine luster. May be confused with such minerals of similar color as wulfenite [lead molybdate, $PbMoO_4$], vanadinite [lead chlorovanadate, $Pb_5(VO_4)_3Cl$], and realgar [arsenic sulfide, AsS], but wulfenite does not form long prismatic crystals, vanadinite forms six-sided prisms, and realgar is softer and much less dense.
Dana Classification Number: 35.3.1.1

NAME

This month's mineral is pronounced CROAK-eh-ite. The name derives from the Greek *krokos*, meaning "saffron," a reference to the saffron-like color of the mineral's streak or powder. Crocoite has also been known as "Siberian red lead," "red lead," "red lead ore," "chrome lead," "red chrome ore," "lehmannite," "beresofite," "beresewite," "crocosite," "crocoise," "crocoit," "crocoita," "crocoisite," and "callochrome."

COMPOSITION

It was not too difficult for us to obtain fifty-eight crocoite specimens back in October 1996, when we first sent specimens of this vividly colored mineral to eager Club members. As our tenth anniversary was approaching and we were considering featuring again some of the minerals from our first year, we ruled crocoite out, assuming we would never have access to a lot containing the 550 to 600 pieces we now require. But that changed when we checking out the Tucson Gem & Mineral show earlier this year, and made contact with an Australian miner/collector who had lots of stunning pieces for us to send to you!

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Crocoite is the most abundant and familiar member of the chromates, a small subclass of very rare minerals with only 14 species. Chromates consist of a metal bonded to the chromate radical. (A radical is a group of bonded atoms of different elements that acts as an entity in chemical reactions.) The chromate radical consists of a chromium ion surrounded by four oxygen ions. The element chromium is a steel-gray, lustrous, hard metal that takes a high polish, and has a high melting point. It ranks about twenty-first in elemental abundance in the Earth's crust. Chromium exists in several different oxidation or valence states, the most common of which are +2, +3, and +6. In crocoite, chromium is present as the hexavalent chromium ion Cr^{6+}. Within the chromate radical, this hexavalent chromium ion is covalently bonded to and shares electrons with four oxygen ions (O^{2-}). Because the collective -2 charge is distributed evenly over the four oxygen ions, the chromate radical $(CrO_4)^{2-}$ can bond with positively charged, divalent metal cations. In crocoite, this divalent metal ion is lead (Pb^{2+}).

Crocoite's chemical formula $PbCrO_4$ identifies its elemental components as lead (Pb), chromium (Cr), and oxygen (O). Lead comprises 64.11 percent of the molecular weight of crocoite, chromium 16.09 percent, and oxygen 19.80 percent. Within the crocoite molecule, the lead ion Pb^{2+} is bound ionically to a single chromate ion $(CrO_4)^{2-}$. The +2 cationic and -2 anionic charges balance to provide the molecule with electrical stability. The crocoite molecules within the crystal lattice are joined by both ionic and covalent bonds. Lead ions form weak, directional ionic bonds with the oxygen ions of the chromate radicals. The oxygen ions of chromate radicals in adjacent molecules share electrons to form strong, omni-directional covalent bonds. The weaker, lead-oxygen ionic bonding explains crocoite's relative softness of Mohs 2.5-3.0, while the omnidirectional, covalent, oxygen-oxygen bonding accounts for crocoite's lack of pronounced cleavage.

Crocoite crystallizes in the monoclinic system, which is characterized by crystals with three axes of different lengths, two of which are perpendicular. Like crocoite, many monoclinic minerals form long prisms. Also, minerals like crocoite with complex chemical compositions and different types of atomic bonding frequently crystallize in either the monoclinic or orthorhombic systems. As the largest of the seven crystal-symmetry systems, the monoclinic system includes more than 1,300 species—approximately one-third of all minerals.

It was not until 1964 that mineralogists succeeded in using X-ray diffraction to definitively determine the precise positions of atoms and molecules within the crocoite lattice. Each chromium ion is surrounded by four oxygen ions within its chromate radical. Within the lattice, each lead ion is surrounded by ten oxygen ions of adjacent chromate radicals. This high degree of atomic shielding explains why crocoite, even with lead and chromium accounting for nearly three-quarters of its molecular weight, exhibits no metallic properties.

With its high specific gravity of 5.9-6.1, crocoite is among the densest of all translucent minerals, as most minerals with a specific gravity greater than 5.0 are opaque. Crocoite's density is due partly to close atomic packing within the crystal lattice, but primarily to the very high atomic weight (202.7) of lead, its primary elemental component. In translucent or transparent minerals, high density is often related to a high index of refraction—the reason that lead is used to create the brilliance in fine lead-crystal glass. Because of its high lead content, crocoite's index of refraction ranges between 2.31-2.66, an unusually high index that approximates that of diamond (2.42). Diamond's high index of refraction, however, is due to very dense atomic packing, rather than to the atomic weight of its elemental component (carbon).

The Dana mineral classification number 35.3.1.1 first establishes crocoite as an anhydrous chromate (35). Crocoite is subclassified (3) by the general formula AXO_4, in which "A" is a divalent ion of lead, barium, or calcium, and "X" is a chromium ion in the hexavalent oxidation state (Cr^{6+}). Next, crocoite is a member of the crocoite group (1), in which it is the first and only member (1).

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Although crocoite itself is quite rare, it is nevertheless the most abundant of the chromate minerals. As a secondary mineral, it forms in the oxidation (alteration) zone of massive hydrothermal replacement deposits. Crocoite derives specifically from the oxidation of galena (lead sulfide, PbS) in a basic chemical environment in the presence of chromium-rich rocks. Crocoite is commonly associated with such other secondary minerals as wulfenite [lead molybdate, $PbMoO_4$], pyromorphite [lead chlorophosphate, $Pb_5(PO_4)_3Cl$], cerussite (lead carbonate, $PbCO_3$), limonite [an indefinite mixture of basic hydrous iron oxides with the general formula $FeO(OH)\cdot nH_20$], and vanadinite [lead chlorovanadate, $Pb_5(VO_4)_3Cl$]. Other associated minerals are the rare and chemically related species phoenicochroite [lead oxychromate, $Pb_2(CrO_4)O$] and vauquelinite [basic lead copper chromophosphate, $Pb_2Cu(CrO_4)(PO_4)(OH)$].

As an idiochromatic mineral, crocoite derives its basic color not from accessory elements and impurities, but from essential chemical components and/or crystal structure. Chromium is a powerful chromophoric (color-causing) agent. In its hexavalent oxidation state (Cr^{6+}), it imparts pronounced orange and red colors. But in its trivalent state (Cr^{3+}), chromium imparts a green color and is the chromophore in the emerald variety of beryl. Other minerals whose brilliant colors are due to the presence of chromium include kammererite, the beautiful purple variety of clinochlore (our December 2005 featured mineral); uvarovite [$Ca_3Cr_2(SiO_4)_3$], the exquisitely green garnet we featured in February 2001; and the lovely chrome-containing variety of diopside [$CaMgSi_2O_6$] from Russia marketed as "Siberian Emerald."

Crocoite's distinctive orange-red color is caused by a metal-nonmetal charge transfer within its crystal lattice. Crocoite's chromate ions are covalently bonded by shared electrons which are not restricted to specific chromate radicals, but occupy "molecular orbitals" over the entire lattice. When white light strikes crocoite, these common electrons become energized or "excited." As their higher energy levels displace them from their normal molecular orbitals, they migrate toward a positive charge, which in crocoite is the hexavalent chromium ion Cr^{6+}. This causes the lattice to broadly absorb color from the blue end of the visible spectrum and to reflect or transmit the red end of the spectrum. Accordingly, we perceive the color of crocoite as orange-red. The reason that crocoite varies somewhat in color from yellow-orange to red is because of the presence of small amounts of such chemical impurities as sulfur and zinc.

COLLECTING LOCALITIES

Crocoite's classic locality is the Dundas subdistrict of the Zeehan Mining District in Tasmania, Australia, where a group of small mines has provided most of the crocoite to reach world markets since the 1890s. Other Tasmanian crocoite sources are the Heazlewood Mine in the Heazlewood district, the Mt. Cleveland tin mine in the Luina district, the Magnet Mine in the Waratah district, and the Whyte River Mine in the Whyte River district. After Dundas, Tasmania, Australia, the most notable crocoite source is the type locality, the Tsvetnoi Mine in the Berezovski gold district near Sverdlowsk (formerly Ekaterinburg) in the Ural Mountains of Russia.

Although rare, crocoite is found in a surprising number of localities, very few of which are significant in terms of abundance or specimen quality. It occurs at Heiterwand Mountain in the Nassereith district of Tyrol, Austria; the Callenburg North Pit at Glauchau, Saxony, Germany; the Le Cantonnier Mine at Nontron, Aquitaine, France; the High Pirn Mine in the Leadhills district, Dumfries, Scotland; and the Graystones Quarry in the Callington District, Cornwall, England. In South Africa, crocoite occurs at the Transvaal, Shimwell, and Argent mines at Argent in Gauteng Province. In Chile, micromount specimens are collected at the San Francisco Mine, Sierra Gorda district, Antofagosta. In Canada, crocoite occurs at the Francon Quarry in the St. Michael district near Montréal, Québec. Small specimens of crocoite have also been collected at the Verde, Santa Fé, Pichardo, and Iguana mines at Bolaño, Jalisco, Mexico.

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In the United States, crocoite specimens, rarely in larger-than-micromount sizes, are found only in California and Arizona. California sources include the El Dorado Mine near Indio in Riverside County and the Darwin Mine in the Darwin district in Inyo County. In Arizona, crocoite occurs in the Moon Anchor, Aggravation, Blue Jay, and Chromate mines in the Osborn district and in the Potter-Cramer and Phoenix mines in the Vulture district of Maricopa County; the Steppe and Mildren mines in the Cababi district of the Tohono O'odham (Papago) Reservation in Pima County; and at the Constellation Mine in the Black Rock district of Yavapai County.

JEWELRY & DECORATIVE USES

Crocoite is too soft (Mohs 2.5-3.0) for jewelry use. Although it is difficult to cut and polish, large crystals, which tend to have greater transparency, are occasionally faceted into collector's gems, usually in rectangular styles that maximize cutting retention in the long prisms. Typically, one-carat crocoite gems, depending on cut and degree of transparency, cost about $500. With their high index of refraction and bright orange-red color, crocoite collectors' gems make eye-catching display pieces.

Because of its rarity, color, and distinctive crystal habit, both singular and composite specimens of crocoite have long been popular among mineral collectors. Mineral exhibits in many of the world's leading museums feature cabinet specimens of Tasmanian crocoite with crystals as long as four or five inches!

HISTORY & LORE

The German physician, mineralogist, and geologist Johann Gottlob Lehmann (1719-1767) identified crocoite as a new mineral in 1761 after studying samples from what is now the mineral's type locality, the Tsvetnoi Mine, Berezovski gold-mining district near Sverdlowsk (formerly Ekaterinburg) in the Russian Urals. Lehmann initially believed—incorrectly—that the new mineral, which he named "Siberian red lead," consisted of lead, selenium, and iron. In 1770, Peter Simon Pallas (1741-1811), a German biologist and zoologist working in Russia, collected specimens from the same site. Pallas ground the mineral into a fine, bright-yellow powder that made a superb paint pigment and fabric dye. Crocoite-based paints and crocoite-dyed, saffron-yellow fabrics and paints quickly gained great popularity in Russia and Europe.

But the true composition of crocoite remained a mystery until 1797, when French chemist Louis-Nicolas Vauquelin (1763-1829) studied samples of "Siberian red lead." Vauquelin treated the mineral with hydrochloric acid (HCl), producing an oxide which he then reduced to a previously undiscovered element—a lustrous, hard, steel-gray metal with a high melting point and a density similar to that of iron. Vauquelin named the new element chromium, after the Greek word *chrôma*, meaning "color," a reference to the bright colors of many of its compounds. He also determined that "Siberian red lead" was actually lead chromate ($PbCrO_4$).

Then in 1832, French mineralogist and geologist François-Sulpice Beaudant (1787-1850) gave "Siberian red lead" its first formal mineral name—"crocoise," from the Greek *krokos*, or "saffron," a reference to the color of its powdered (streak) form. This name was later changed to "crocoisite" and, by 1900, to the present crocoite. In the early 1800s, "Siberian red lead" was the only source of chromium, compounds of which served as paint pigments and leather-tanning salts. Crocoite's value as a chromium ore ended in the 1850s, following discovery of large deposits of chromite (ferrous chromic oxide, $Fe^{2+}Cr_2O_4$) ores.

Interestingly, some historians suggest that crocoite-based yellow paints are the origin of today's "yellow cabs." In the early 1800s, some prominent London citizens painted their private carriages with bright-yellow, crocoite-based paints, an idea soon copied by operators of carriages-for-hire. When taxis in the

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United States became motorized in the early 1900s, many vehicle operators in New York City painted their vehicles the same bright, highly visible color of the old London carriages-for-hire. By then, however, the yellow paint was colored with a synthetic lead-chromate pigment.

In 2000, a little over a century after crocoite was first found in Tasmania, the Hon. John Bestwick, minister of mines of the Australian State of Tasmania, speaking at a special meeting of the Australian Gemboree and National Gem & Mineral Show at Launceston, Tasmania, declared crocoite to be Tasmania's mineral emblem (official state mineral), uttering the quote that introduced our write-up.

According to modern metaphysical beliefs, crocoite enhances intuition, creativity, charisma, vitality, strength, and spirituality. It also helps one to adapt to changing situations and to overcome emotional and mental distress.

TECHNOLOGICAL USES

From 1780 until 1850, Russian crocoite and smaller amounts of German crocoite were the only ores of chromium and thus the only source of lead-chromate yellow pigment for paints and dyes. From 1895 until 1910, Tasmanian crocoite served as a flux in metal-ore smelting. Since 1850, the mineral chromite [$Fe^{2+}Cr_2O_4$] has served as the only ore of chromium. Today, chromium is used primarily as an alloying agent in stainless steels and to plate non-chromium steels, particularly for use in the automotive field. When alloyed with iron, nickel, or cobalt, it imparts hardness, strength, and corrosion resistance. Chromium compounds are widely employed in chemicals, dyes, magnetic recording tapes, and leather-tanning and electroplating solutions. Synthetic lead chromate (the chemistry is identical to that of crocoite) is an important commercial yellow pigment. The only current technological use of crocoite is as a pigment called "chrome yellow" in certain specialty oil paints for the graphic arts.

Small amounts of chromium are necessary to the human body for proper carbohydrate metabolism. Foods rich in chromium include raw onions, broccoli, raw tomatoes, Romaine lettuce, and grape juice.

ABOUT OUR SPECIMENS

Our crocoite specimens come from the classic locality at the Dundas subdistrict of the Zeehan Mining District of Tasmania, Australia. Tasmania, Australia's "island state," is located some 120 miles south of the mainland state of Victoria. With an area of 26,100 square miles, it is bit smaller than West Virginia. Tasmania has a population of just 490,000, and much of the island is protected in its natural state in parks and wildlife refuges.

Tasmania is named in honor of Dutch sea captain and explorer Abel Tasman who, in 1642, was the first European to visit the island. Tasmania was settled in the early 1800s as a British penal colony. In 1871, the discovery of tin ore lured hundreds of miners into the rugged hills of northwestern Tasmania. Although miners found relatively little tin, a decade later they discovered rich silver-lead mineralization near the present site of the town of Zeehan. A major silver rush ensued and within five years Zeehan had a population of 10,000 and was known as Tasmania's "Silver City of the West." When Tasmania's silver boom peaked in 1890, 160 mining companies were working silver-lead ores that graded as high as 70 troy ounces of silver per ton. The value of their annual metal output topped $1 million. With banks, theaters, dozens of saloons, 26 hotels, and even a stock exchange, Zeehan was similar to the large mining boomtowns like Bisbee, Arizona in the American West of the same time period. In 1892, the town became home to the Zeehan School of Mines and Metallurgy, which taught surveying, assaying, geology, and mining and milling methods.

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The sedimentary, metamorphic, and igneous rocks of the Zeehan district testify to a complex geology. The oldest rocks are one-billion-year-old Proterozoic schists, which underlie mixed strata of lava and sediments. Some 600 million years ago, these existing formations were intruded by olivine-rich magmas that formed peridotite, a coarse-grained plutonic rock composed chiefly of olivine and containing little or no feldspar. Then, 400 million years ago, tectonic collisions generated stresses that uplifted mountains while severely deforming, folding, faulting, and fracturing the existing strata. Mineral-rich hydrothermal solutions surged into the fractures and faults to form veins and replacement deposits. Subsequent erosion wore down these mountains to expose the mineralized veins with their concentrations of silver, lead, zinc, copper, tin, and gold. The uppermost veins weathered into gossan (shallow mineralization characterized by rusty or reddish iron oxidation products of pyrite).

Miners first encountered crocoite in the late 1880s in the Heazlewood district some 20 miles from Zeehan. The prominent Tasmanian amateur mineralogist William Frederick Petterd (1849-1910) writes: "The first discovery of the mineral was made by Mssrs. Smith and Bell at the Heazlewood silver-lead mine. It occurs there in bright, shining hyacinth-red crystals, small as we now know them from other portions of the island, arranged in acicular bunches, penetrating and attached to a very friable clayey gossan, intermixed with a little cerussite [lead carbonate, $PbCO_3$], and more rarely pyromorphite [lead chlorophosphate, $Pb_5(PO_4)_3Cl$]." By 1895, when mineralogists had positively identified the orange-red mineral as crocoite, miners had also encountered it in the mines of the Luina, Waratah, Whyte River, and Zeehan districts.

The greatest abundance of crocoite occurred in Zeehan district, specifically in the Dundas subdistrict some five miles east of Zeehan at the Adelaide, Adelaide Proprietary, Comet Maestries, Dundas Extended (later renamed the Red Lead), West Comet, Platt, and Kosminsky mines, all located along a mile-long, mineralized fault line. Another crocoite source was the Kapi Mine, 10 miles away on an outlier of the same fault in the North Dundas subdistrict. The size and quality of these crystals—some five inches long with brilliant color, excellent transparency, and perfect terminations—far exceeded any crocoite specimens ever collected before. Dundas immediately became the classic locality for crocoite and its remarkable specimens amazed the mineralogical world. As demand for crocoite specimens soared, the Foote Mineral Company of New York City, then the world's leading commercial source of mineral specimens, sent a field collector to Tasmania to secure a supply.

But the collector had his work cut out for him. By the time he arrived, many mines had already driven through the shallow, crocoite-rich gossan into deeper, unoxidized ore bodies, while others had shut down entirely and allowed their workings to flood. Nevertheless, the Foote Mineral Company collector obtained leases and hired local miners who drove several hundred feet of new workings in the Adelaide Mine to expose several pockets of superb crystals. The 1899 Foote Mineral Company catalogue, which was filled with wonderful Dundas crocoite specimens, noted: "The discovery of new forms of this wonderful mineral is the result of over a year's work by our collector, in which the old Siberian specimens were totally outclassed. . . . our collector was fortunate to strike a patch of loose prisms 3 to 9 centimeters [1.2 to 3.6 inches] in length, superbly terminated, and of a most gorgeous translucent to transparent scarlet-red." The catalogue also pointed out that the collector's work, performed at a depth of 232 feet, was "the most extensive mining ever done solely for scientific mineral specimens."

The crocoite actually collected by the Foote Mineral Company amounted to only a small part of the crystals found by Dundas miners in the course of production. And although crocoite was no longer valuable as chromium ore, it made an excellent flux for the Zeehan silver-lead smelters. Added to ore concentrates, it supplemented lead recovery to a small degree. Much more importantly, crocoite's chromium component combined with impurities in the lead-silver concentrates to form an easily separable slag. Accordingly, most of the Dundas crocoite ever mined, including countless beautiful specimens, ended up in smelting furnaces. If only one forward-thinking person had been there to save them!

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When ore grades declined after 1900, only a handful of Zeehan's silver-lead mines survived. The biggest was the Adelaide Mine at Dundas where, during the 1920s, miners recovered an exceptional crocoite specimen which later earned a prestigious distinction: Its photograph appeared in Peter Bancroft's 1973 classic *The World's Finest Minerals and Crystals,* a collection of 78 of the finest mineral and gemstone specimens ever photographed.

The end of silver-lead production at Zeehan in the early 1960s also temporarily halted the commercial supply of crocoite specimens. But a decade later, rapidly growing interest in mineral collecting together with soaring prices for crocoite specimens began luring miners back to the old Dundas mines. This time, they were not looking for silver-lead ore, but for crocoite. Specimen miners at the Adelaide Mine opened a nine-foot-wide cavity filled with thousands of brilliant, terminated crocoite crystals as long as 3.5 inches. These specimens, which included both single crystals and crystal clusters, attracted great attention at mineral and gem shows in the mid-1970s. Since then, several old Dundas mines have reopened to provide a small supply of crocoite specimens.

Figure 1. Open cut at Red Lead mine. Photos courtesy of Shane Dohnt.

Prominent among these is the aforementioned Red Lead mine, which is where most of our featured specimens originated. This mine was formerly known as the Dundas Extended mine, which can lead to confusion. Red Lead's history dates back to the discovery of its gossan outcrop in 1890, and it has the distinction of possibly being the first recorded crocoite find in the district. Happily, it was not worked on a large scale until the 1920's, after the period where gorgeous crocoite specimens were being crushed for use as flux. Commercial mining stopped at Red Lead in the 1920's, and it lay dormant until crocoite-specimen recovery operations began in the 1970's. Many suberb specimens have been unearthed there in the years since. Other minerals found here include anglesite [$PbSO_4$], bournonite [$PbCuSbS_3$], chalcophanite [$(Zn,Fe^{2+},Mn^{2+})Mn^{4+}{}_3O_7 \cdot 3H_2O$], chalcopyrite [$CuFeS_2$], coronadite [$Pb(Mn^{4+},Mn^{2+})_8O_{16}$], covellite [CuS], dundasite [$PbAl2(CO3)_2(OH)_4 \cdot H_2O$, first discovered at the Adelaide Proprietary mine], fuchsite [the the green chromium-rich variety of muscovite], galena [PbS], pyrolusite [$Mn^{4+}O_2$], quartz [SiO2], sulphur [S], philipsbornite [$PbAl3(AsO4)_2(OH,H_2O)_6$, also first discovered in the Dundas district], and petterdite [$PbCr2(CO3)_2(OH)_4\ 3H_2O$], whose type locality is Red Lead. As we might expect, many of these minerals contain the lead and chromium so abundant in the district.

We received as part of our lot about fifty specimens from the Adelaide mine, formerly known as the Adelaide Proprietary mine, as mentioned in the paragraph above. Adelaide has the distinction of being the world's major producer of crocoite specimens, and one of the world's earliest specimen mines, its first specimens coming to light in 1899! Sad to say, many of its early glory specimens died an untimely death feeding the needs of the smelter. Since 1957, it has produced many more fine specimens, particularly when large pockets were opened in 1971 and 1993.

And we also obtained a few specimens from the Dundas Extended mine. This is a distinct mine, and we hope you won't confuse it with the previous name for the Red Lead mine mentioned above. Though not

Figure 2. Looking east from open cut, toward Mt. Dundas.

achieving the renown of the Red Lead and Adelaide mines, Dundas Extended has produced its share of excellent crocoite and cerussite [PbCO3], including a chromium-rich variety of cerussite with a pale to deep yellow or greenish yellow hue, and on occasion, doubly terminated crocoite crystals up to 2 cm.

Each of the district's mines produces crocoite of a slightly different nature. Red Lead and Adelaide both produce crocoite of a brilliant red color, not surprising since they are side by side. But Red Lead's crocoite tends to be more commonly transparent, more commonly terminated, and less commonly hollow than Adelaide's. Crocoite groups from Adelaide are commonly described as "jackstraw aggregates," an allusion to the tendency of the crocoite crystals here to be hollow tubes. Why are they hollow? They may have crystallized so (relatively) quickly that the inner portion of the crystal could not keep up (a habit known as hopper crystals), or they may have crystallized as a coating around another crystal that later dissoved.

Museums around the world display fine specimens of Dundas crocoite, but the premier display is fittingly located right in Zeehan. The old Zeehan School of Mines and Metallurgy building that was built in 1892 during the Tasmanian silver-mining boom has been converted into the Zeehan Mining Museum. A highlight of the museum is the Mihajlowits Room, named in honor of Frank Mihajlowits, a 30-year-veteran of local crocoite-specimen mining. The Mihajlowits Room is filled with hundreds of fine specimens that represent the best of Dundas crocoite.

The inclusion of crocoite in Peter Bancroft's 1973 *The World's Finest Minerals and Crystals* confirms its place among the most aesthetic of minerals. At shows and museums, the bright red-orange color appeals even to those who are not moved by an appreciation for Earth's treasures. Viewed under magnification, we can appreciate the unique crystal properties–the hopper crystals, the terminations, the vertical striations, the seemingly random orientation of the crystals. What more could we ask for?

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