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Albrittonite, a new cobalt chloride hydrate from Oxford, Llano County, Texas[1]

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Abstract

Albrittonite, $CoCl_2 \cdot 6H_2O$, occurs as a supergene alteration product of primary cobalt minerals at the Oxford serpentine quarry, Llano County, Texas. Associated minerals include cobaltite, linnaeite, siegenite, niccolite, erythrite, annabergite, and zaratite. Crystals are euhedral (0.5–20 mm), translucent, and magenta to reddish-violet in color. It is monoclinic, space group $C2/m$. The unit-cell constants are $a = 8.899(1)$, $b = 7.065(2)$, $c = 6.644(1)$A, $\beta = 97.25(3)°$, $Z = 2$. The strongest lines in the X-ray powder pattern are 5.637(10)($\bar{1}01$), 5.521(6)(110), 4.827(8)(011), 2.934(5)($\bar{1}12$), 2.758(3)(220), 2.411(3)(022), 2.219(3)(031), and 2.206(3)(400,$\bar{3}21$). These are essentially identical with those of synthetic $CoCl_2 \cdot 6H_2O$. Albrittonite is biaxial (+), $2V = 53°$, with refractive indices $\alpha = 1.525(2)$, $\beta = 1.550(2)$, $\gamma = 1.576(2)$. G (meas) is 1.897(5), G (calc) is 1.906. The name is in honor of Dr. Claude C. Albritton, Hamilton Professor of Geology and member of the Department of Geology, Southern Methodist University.

Introduction

In 1976 the writer (wwc) found a supergene alteration halo above a veinlet of primary cobalt and nickel minerals in an abandoned serpentine quarry near Oxford, Llano County, Texas. Primary minerals include cobaltite, linnaeite, siegenite, and niccolite. Associated minerals in the alteration assemblage include erythrite, annabergite, and zaratite. In the alteration halo several small magenta crystals of an unknown species were found intimately associated with erythrite. Further investigation of this mineral indicated that it was a new cobalt chloride hydrate.

The name, albrittonite, is in honor of Dr. Claude C. Albritton, Hamilton Professor of Geology and faculty member of the Department of Geology, Southern Methodist University. The name and the mineral have been approved by the Commission on New Minerals and Mineral Names, IMA. Single specimens of type material have been deposited in the collections of the Department of Geology and Mineralogy, The University of Michigan and the National Museum of Natural History (Smithsonian Institution).

Occurrence

Albrittonite occurs as 0.5–20 mm crystals and powdery coatings at the Oxford serpentine quarry, 9 miles south of Llano, Llano County, Texas (30°37′N, 98°42′W). The Oxford quarry was mined for serpentine which was used as road material and terrazzo chips (Barnes *et al.*, 1950). The serpentine is situated in a discontinuous band along the Valley Springs Formation–Packsaddle Schist contact but mostly in the Valley Springs Formation. Small amounts of chromite, talc, tremolite, anthophyllite, chlorite, and magnetite can be seen in the 200′ × 600′ quarry. The area has received attention from prospectors for chrome, nickel, and asbestos, but no large-scale economic deposit has been discovered. On the north side of the quarry a small veinlet of cobaltite, linnaeite, siegenite, and niccolite was discovered by the author in May, 1976. A narrow oxidized zone was present above the primary minerals containing erythrite, annabergite, zaratite, and albrittonite.

Physical properties

Albrittonite occurs as well-formed monoclinic crystals with principal forms {010}, {110}, {011}, {100}, and {001} (Fig. 1). Indices were obtained by goniometric measurements. The crystals are brittle with a

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subconchoidal fracture. A well-developed cleavage is parallel to {010} with an indistinct cleavage along {110}. Crystals have a vitreous luster, are translucent, and magenta to reddish-violet in color. Mohs hardness is approximately 1½. The streak is pale pink.

Optically it is biaxial (+), refractive indices for Na*D* are $\alpha = 1.525(2)$, $\beta = 1.550(2)$, $\gamma = 1.576(2)$, $2V = 53°$. It is pleochroic and axial colors are α = pink, β = pale red, γ = reddish-violet. The pleochroic formula is $\alpha > \beta > \gamma$. Optic orientation is $b = Y$, $a{:}Z = -3°$.

Specific gravity was determined in toluene on a Berman balance by averaged repeated measurements on single crystals weighing 14 mg; G (meas) is 1.897(5), G (calc) is 1.906. Calculation of the specific gravity was determined using a value of $Z = 2$, known from the structure analysis of synthetic $CoCl_2 \cdot 6H_2O$ (Mizuno *et al.*, 1959; Mizuno, 1960). Neither natural nor synthetic material fluoresces under ultraviolet radiation.

X-ray crystallography

Unit-cell parameters from Weissenberg and precession photographs using Cu*K*α (1.54051A) radiation with estimated standard deviations in parentheses are $a = 8.899(1)$, $b = 7.065(2)$, $c = 6.644(1)$A, $\beta = 97.25(3)°$, $Z = 2$, $V = 414.4$A^3. Lattice parameters were obtained by a least-squares refinement. The unit-cell data for albrittonite are in excellent agreement with data obtained for synthetic $CoCl_2 \cdot 6H_2O$ [$a = 8.898(2)$, $b = 7.066(1)$, $c = 6.644(1)$A, $\beta = 97.25(1)°$, $Z = 2$; JCPDS card No. 25-1039]. The space group is $C2/m$. The only extinctions observed were those corresponding to the *C*-centered lattice, $h + k = 2n$. The powder data are essentially identical to those of synthetic $CoCl_2 \cdot 6H_2O$.

Chemical analysis

An electron microprobe analysis (Table 1) was used in the identification of albrittonite, due in part to the lack of sufficient material for a standard chemical analysis. The analysis was conducted with 150 nA specimen current and 12 kV excitation voltage. Microprobe standards used for the following elements are: Co (cobalt metal); Cu,Ni (analyzed Cu–Ni–Fe alloy); Cr (chrome spinel); and Cl (halite). Water was measured by measuring total weight loss on ignition minus the chlorine content obtained from the probe analysis. Corrections were made using the EMPADR VII program (J. Rucklidge and E. L. Gasparrini, Department of Geology, University of Toronto, written communication, 1969). Tests for fluorine, iron, and titanium were negative. Albrittonite is extremely soluble in water and many mineral acids.

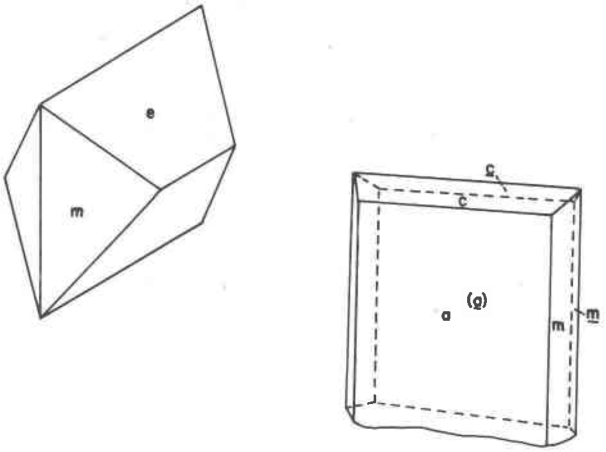

Fig. 1. Typical morphological development of albrittonite. A = common habit, B = occasionally developed form. Forms are a = {100}, c = {001}, e = {011}, m = {110}.

Discussion

The structure of $CoCl_2 \cdot 6H_2O$ as described by Mizuno (1960) is that of $2Cl^-$ and $4H_2O$ molecules coordinated to one Co^{2+} ion to form $CoCl_2 \cdot 4H_2O$. The remaining two water molecules are located far from the cobalt ion and are relatively free, being held together parallel to the *b* axis by hydrogen bonds. This creates a layer structure parallel to {010}, resulting in perfect cleavage along that direction.

The extreme solubility of albrittonite leads to a unique and unstable paragenesis. The authors believe

Table 1. Chemical analyses of albrittonite

	1	2	3
Co	24.17	24.25	24.17
Cu	0.66	0.71	-----
Ni	0.29	0.36	-----
Cr	0.08	0.13	-----
Cl	30.03	30.44	29.80
H_2O^*	45.61	45.16	45.43
TOTAL	100.84	101.05	100.00

1,2) Oxford, Llano County, Texas

3) Ideal $CoCl_2 \cdot 6\ H_2O$

* H_2O measured by total weight loss on ignition minus chlorine content from the probe analysis.

that albrittonite forms as a result of the alteration of secondary cobalt minerals (erythrite). The relative arid conditions of the region preserve the mineral from alteration. However, the influx of water through ground water, rain, *etc.* causes albrittonite to dissolve readily and to be reprecipitated upon the resumption of arid conditions. The constant dissolution and precipitation of albrittonite causes the halo of powdery surface stains seen above the oxidized zone of erythrite.

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