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CHALCOALUMITE, A NEW MINERAL FROM BISBEE, ARIZONA

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INTRODUCTION

Among a number of specimens from Bisbee, Arizona, sent to the authors for identification by Mr. English of Ward's Natural Science Establishment, three contained a crust of a delicate blue-green material that proved to be homogeneous on microscopic examination and had optical properties that did not agree with those of any known mineral. Mr. English and Ward's Natural Science Establishment generously presented us with the specimen that seemed most suitable for further study, and we acknowledge our indebtedness to them.

A chemical analysis and further study showed that the mineral is a new hydrous aluminum copper sulphate and we propose the name *chalcoalumite* for it.

We have since identified the mineral in two other specimens from Ward's collections; and Professor Palache has identified it on two specimens in the collection of Mr. Vaux of Philadelphia. Several specimens in the collection at Harvard University, called to our attention by Professor Palache, are with little doubt an alteration product of chalcoalumite. No doubt the mineral will be found in other collections. The specimens we have identified have been labelled either chrysocolla or allophane.

OCCURRENCE

Chalcoalumite forms crusts from one to ten millimeters thick on a brown limonite-like material. More or less malachite and azurite were deposited on the limonite before the chalcoalumite. Some of the specimens are clearly stalactites of limonite completely covered with a layer of chalcoalumite. From the number of specimens that have been found, the abundance of the mineral on the specimens, and the fact that it seems to have completely coated the limonite surfaces in the cavities, it is probable the chalcoalumite occurred in considerable quantity.

Physical Properties

Chalcoalumite forms botryoidal crusts which are made up of fibers approximately normal to the surface to which they are attached. The color is turquois green (Ridgway 41. d),[1] or nile blue (Ridgway 41′. d).[1] The main crust is dull, rather porous, and made up of very minute, matted fibers, while a thin outer layer is dense, vitreous, somewhat darker colored and more coarsely crystalline. None of the crystals are large enough for measurement on the goniometer. On one of the specimens the mineral is more coarsely crystalline and good interference figures were obtained.

Chalcoalumite has a specific gravity of 2.29[2] measured with a pycnometer. It has a hardness of 2 ½ and fusibility of 5.

The mineral is optically +, the axial angle is rather small, and the dispersion of the axial angle is strong, $\rho > \nu$. The indices of refraction are: $\alpha = 1.523$, $\beta = 1.525$, $\gamma = 1.532$.

The material is not satisfactory for accurate determination of the optical orientation or for good crystal data. The best crystals or cleavages are lath shaped in outline with the terminal edge making an angle of about 60° with the length. Some are equilateral triangles. The acute bisectrix, Z, makes a large angle with the normal to the laths. Crystals lying on this flat face do not give sharp extinction in white light due to the strong dispersion. They have negative elongation and one extinction position makes an angle of about 32° with the long edge and lies in the acute angle between the long edge and the terminal edge. Some of the laths are twinned with the twinning and composition plane parallel to the long edge and nearly normal to the flat face. Such laths have reentrant angles, and symmetrical faces and extinction.

Turned on edge the laths have an extinction angle of about 40° and negative elongation. An interference figure on this face shows

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[1] Ridgway, Robert. Color Standards and Nomenclature. Washington, D. C., **1912**.

[2] The specific gravity, calculated by the law of Gladstone and Dale using the mean index of refraction and the values of k given by Larsen, is 2.25, a very close check. See Larsen, E. S. Microscopic Determination of the non-opaque minerals, *U. S. Geological Survey, Bull.* **679,** pp. 30-31, (1921).

the emergence of the acute bisectrix, Z, just out of the field of the microscope and the plane of the optic axis across the length.

The matted fibers are so minute and intergrown that they give aggregate effects and appear to have parallel extinction, +elongation, and abnormal blue interference colors. The coarser fibers give sharp parallel extinction for some orientations and large extinction angles and strong dispersion for others.

The data are not entirely satisfactory, but the mineral is probably triclinic. There are believed to be several perfect cleavages but it was not possible to distinguish between cleavages and crystal faces.

CHEMICAL PROPERTIES

Chalcoalumite is not readily soluble in cold dilute acid but it is readily soluble in hot concentrated acid. Two chemical analyses, by Miss Vassar, on samples fom two separate specimens are given below together with the ratios and the theoretical composition corresponding to the formula. The material selected for analyses was carefully hand-picked and, examined under the microscope, was found to contain only traces of impurities. It was made up of both the fine porous inner layer of submicroscopic fibers and the denser, more coarsely crystalline outer layer. The first analysis was from the specimen that had the thickest crust—about five millimeters thick—and the second from a large specimen with a much thinner crust.

ANALYSES AND THEORETICAL COMPOSITION OF CHALCOALUMITE.

	Specimen 1	Specimen 2	Theoretical
Insol.	0.09	0.28	
Al_2O_3	38.71	38.88	38.81
MgO	0.05	(1.01)*	
CaO	0.01		
Na_2O K_2O	0.50		
H_2O-	28.95	30.60	30.82
H_2O+	1.90		
SO_3	14.80	14.67	15.22
CuO	14.78	14.56	15.15
	99.79	100.00	100.00

* Impurities by difference.

Water was determined by the absorption tube method with previously ignited CaO in the combustion tube to retain any SO_3.

Copper was determined gravimetrically, first precipitating the copper as CuS and then roasting it over to CuO. That method was checked on a separate sample by the volumetric KI method.

The analyses made on the mineral from the different specimens show a very close similarity. They agree very closely with the theoretical composition, $CuO.2Al_2O_3.SO_3.9H_2O$, although the SO_3 and CuO are a trifle low. If the alkali is added to the CuO the agreement for the CuO is very close. The formula may be interpreted as $CuSO_4.4Al(OH)_3+3H_2O$.

ALTERATION

Several specimens in the collections of Harvard University called to our attention by Professor Palache, are much paler colored than the chalcoalumite but are otherwise very similar, both in their mode of occurrence and structure. Microscopic examination showed that they are not all alike. They are almost certainly pseudomorphs after chalcoalumite. The crust on one sample is made up of minute fibers and plates that are biaxial +, have a small axial angle, *Z* normal to the fibers, and *X* parallel to the elongation. They tend to be on a perfect cleavage normal to *Z*. α and $\beta=1.571$. Birefringence about 0.02. A partial analysis gave

SiO_2	2.5
Al_2O_3	57.8
H_2O	35.0
CuO	2.6
Insol.	0.7
	98.6

The composition and optical properties agree with those of gibbsite and the material is no doubt an impure gibbsite.

The crust on another specimen is very finely crystalline, has a mean index of refraction of 1.558, and a birefringence of about 0.02. A partial analysis showed

SiO_2	20.12
Al_2O_3	50.67
Fe_2O_3	.26
H_2O	27.11
CuO	1.41
	99.57

This agrees rather closely with the formula $3Al_2O_3.2SiO_2.9H_2O$, but the sample is so fine grained that its homogeneity cannot be vouched for and it may be a mixture of silica and gibbsite.

SUMMARY

Chalcoalumite from Bisbee, Arizona, occurs as turquois green crusts up to several millimeters thick completely coating stalactites and related deposits of limonite and copper carbonates. It has a hardness of about 2 ½, a specific gravity of 2.29, and a fusibility of 5. It is made up of matted fibers. It is probably triclinic, has several perfect cleavages, and the more coarsely crystalline outer crust if powdered is partly in laths that have terminal faces making angles of about 60° with the length. Twins with the twinning plane parallel to the long edge of the laths and nearly normal to the laths are rather common. The mineral is optically +, $2V$ is rather small, $\rho > \nu$ is strong, $\alpha = 1.523$, $\beta = 1.525$, $\gamma = 1.532$. The laths give no sharp extinction in white light but they have negative elongation and extinguish at about 40° to the length. Turned on the long edge they show negative elongation and strong dispersion with extinction at an angle of about 32° to the length. The mineral has the composition $CuO.2Al_2O_3.SO_3.9H_2O$ or $CuSO_4.4Al(OH)_3.3H_2O$.

XONOTLITE AND PECTOLITE IN A DIABASE PEGMATITE FROM MINNESOTA*

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INTRODUCTION

A discovery of considerable amounts of xonotlite in the Pigeon Point region of Cook County, Minnesota, was described in a recent number of The American Mineralogist.[1] An additional occurrence was found during the summer of 1924 over a hundred miles from the first. Pectolite, an associated mineral, is new to the state of Minnesota. This deposit has certain similarities and also

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[1] Schwartz, G. M., An occurrence of xonotlite in Minnesota: *Am. Min.*, **9**, 32-33 (1924).