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CONICALCITE FROM THE BRISTOL MINE, LINCOLN COUNTY, NEVADA*

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ABSTRACT

A fibrous mineral which was shown by quantitative chemical analysis to be identical with conicalcrite was found on the dump of a small prospect on the property of the Bristol Silver Mine, Lincoln County, Nevada. Among the specimens collected was one small piece on which occurred a very small quantity of larger crystals. These yielded interference figures giving an optically negative sign. Conicalcrite is given as optically positive. The indices of refraction are lower than those given by several varieties of conicalcrite. Since the optical sign of the typical fibrous conicalcrite is very difficult to determine, it is possible that conicalcrite is in reality negative. If not, this mineral from the Bristol Mine is a new species.

OCCURRENCE

The crystals were collected on the dump of the "Inman" prospect on the property of the Bristol Silver Mines Company, Lincoln County, Nevada. The prospect is an opening on one of the locally called "Tempest" fissures at an elevation of about 7500 feet, on the west slope of the Bristol Range about one quarter of a mile east of the collar of the Snyder shaft of the Bristol mine. The position may be found on the Bristol Range, Nevada, topographic sheet of the U. S. Geological Survey at a latitude of about $38^{\circ} 4' 42''$ and longitude of about $114^{\circ} 36' 57''$.

The specimens were collected in the summer of 1924, during the field study of the Pioche, Nevada district, by Messrs. Westgate and Gillson, of the U. S. Geological Survey.

The ore in the Tempest fissures is an oxidized copper lead ore in which the most conspicuous minerals are jarosite, malachite, chrysocolla and copper pitch (melanoconicalcrite). Although the ore in the Inman prospect is very similar to the ore in the Tempest fissures in the Bristol mine itself, and in other openings on the fissures, none of the arsenate mineral was found elsewhere.

PHYSICAL PROPERTIES

The arsenate mineral occurring on all but one unique specimen consisted of the typically green crustiform aggregates of very

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OPTICAL CONSTANTS OF CONICALCITE FROM VARIOUS LOCALITIES

| Analyzed fibers, Bristol Mine, Nevada | Larger crystals, Bristol Mine, Nev., unanalyzed | | American Eagle Mine, Tintic District ¹ | | Locality Unknown ² | | Tintic District ³ Nevada ⁴ | | Simon Mine, Mineral Co., Nevada ⁵ | | Good Springs, Nevada ⁵ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\gamma = 1.770 \pm .003$ $\alpha = 1.730 \pm .003$ Variable in different crusts | $\gamma = 1.771 \pm .003$ $\alpha = 1.730 \pm .003$ Indices differ in different crusts | $\gamma = 1.801 \pm .003$ $\alpha = 1.778 \pm .003$ Indices differ in different crusts | $\gamma = 1.790 \pm .005$ $\alpha = 1.765 \pm .005$ Indices differ in different crusts | $\gamma = 1.790 \pm .005$ $\alpha = 1.765 \pm .005$ Indices differ in different crusts | $\gamma = 1.810 \pm .005$ $\alpha = 1.790 \pm .005$ Indices differ in different crusts | $\gamma = 1.790 \pm .005$ $\alpha = 1.765 \pm .005$ Indices differ in different crusts | $\gamma = 1.790 \pm .005$ $\alpha = 1.765 \pm .005$ Indices differ in different crusts | $\gamma = 1.795 \pm .003$ $\alpha = 1.770 \pm .005$ Variable in different crusts | $\gamma = 1.795 \pm .003$ $\alpha = 1.770 \pm .005$ Variable in different crusts | $\gamma = 1.795 \pm .003$ $\alpha = 1.770 \pm .005$ Variable in different crusts | $\gamma = 1.795 \pm .003$ $\alpha = 1.770 \pm .005$ Variable in different crusts |
| Optically? $\alpha = \text{yellowish to colorless}$ $\gamma = \text{pale bluish green}$ | 2V about 25 degrees Optically negative | Nearly or quite uniaxial Optically positive | 2V very small Optically positive | Optically positive | Optically positive | Optically positive | Optically positive | Optically positive | Optically positive | Optically positive | Optically positive | Optically positive |
| Dispersion very strong $\rho > \nu$ | No dispersion noticed | No dispersion noticed | No dispersion noticed | No dispersion noticed | No dispersion noticed | No dispersion noticed | No dispersion noticed | No dispersion noticed | No dispersion noticed | No dispersion noticed | No dispersion noticed | No dispersion noticed |
| Parallel extinction | Parallel extinction | Parallel extinction | Parallel extinction | Parallel extinction | Parallel extinction | Parallel extinction | Parallel extinction | Parallel extinction | Parallel extinction | Parallel extinction | Parallel extinction | Parallel extinction |
| Positive elongation | Positive elongation | Positive elongation | Positive elongation | Positive elongation | Positive elongation | Positive elongation | Positive elongation | Positive elongation | Positive elongation | Positive elongation | Positive elongation | Positive elongation |
| Gravity 3.9 ⁶ | Gravity 3.9 ⁶ | Gravity 4.15 | Gravity 4.15 | Gravity 4.15 | Gravity 4.15 | Gravity 4.15 | Gravity 4.15 | Gravity 4.15 | Gravity 4.15 | Gravity 4.15 | Gravity 4.15 | Gravity 4.15 |

¹ Larsen, E. S. Microscopic determination of the non-opaque minerals: *U.S.G.S. Bull.* 679, p. 60.

² Larsen, E. S. *Loc. cit.*, page 60.

³ Determined by the writer on a specimen loaned from Harvard Univ., no catalog number.

⁴ Determined by the writer on a specimen loaned from Harvard Univ., their catalog no. 86387.

⁵ Determined by the writer on a specimen furnished by R. M. Wilke, Palo Alto, Calif.

⁶ Determined by floating in Clerici's solution.

minute fibers very similar to the conichalcite from the American Eagle Mine, Tintic district, Utah. On such material the maximum and minimum indices of refraction are the only optical constants readily obtainable. Since these indices were appreciably lower than those recorded for conichalcite in standard mineralogy references, the identity of the fibers was in doubt until the quantitative analysis was made by Mr. E. V. Shannon of the U. S. National Museum.

The one unique specimen consisted mainly of yellowish jarosite, and contained aggregates of green crystals, individuals of which were sufficiently large to yield optical interference figures. Although these crystalline aggregates were mixtures of three minerals, the one that agreed in indices of refraction and pleochroism with the fibers of the other specimens was shown by repeated microchemical analysis to contain lime, copper and arsenic, the constituents of conichalcite.

The optical constants were determined as follows, and they are compared with those of several varieties of conichalcite.

THE CHEMICAL COMPOSITION

The fibrous conichalcite of usual habit was analyzed by Mr. E. V. Shannon of the U. S. National Museum. The mineral was very intimately mixed with "copper pitch" and all attempts to separate the two minerals by means of heavy solutions and with the electromagnet failed. Accordingly, the material for analysis was handpicked as carefully as possible under the binocular microscope and about three-tenths of a gram was so obtained in which probably about 10 per cent of "copper pitch" remained. The analysis by Mr. Shannon is as follows:

ANALYSIS OF CONICALCITE FROM THE BRISTOL MINE, NEVADA,

| | |
|--------------------------------|-------|
| CaO | 18.34 |
| CuO | 29.23 |
| As ₂ O ₅ | 38.11 |
| Al ₂ O ₃ | 0.85 |
| Fe ₂ O ₃ | 0.20 |
| H ₂ O above 110° | 6.45 |
| H ₂ O below 110° | 0.99 |
| SiO ₂ | 1.32 |
| MnO ₂ | 1.28 |
| CO ₂ | 1.95 |
| | <hr/> |
| | 98.72 |

The mineral was proven free of nitrates, chlorides and sulphates. The "copper pitch" was shown by qualitative analysis to contain a considerable quantity of copper, manganese, iron, alumina, silica, carbon dioxide, and water. Hence all of these oxides, foreign to conichalcite, can probably safely be considered as impurities in the analysis. The composition of "copper pitch" (melano-chalcite) is, as Hunt and Kraus,¹ and Rogers² have shown, very uncertain. However, considering about 10 per cent of the "copper pitch" to have been present in the analyzed material, and considering that the amounts of alumina, ferric oxide, manganese oxide, carbon dioxide and silica shown in the analysis belong with the "copper pitch," an analysis of that mineral may be assumed, and these quantities deducted from the total analysis of the conichalcite. This analysis can then be recalculated to 100 per cent.

ESTIMATE OF IMPURITIES IN THE ANALYZED CONICALCITE

| | |
|--------------------------------|-------|
| CuO | 3.00 |
| MnO ₂ | 1.28 |
| SiO ₂ | 1.32 |
| Al ₂ O ₃ | 0.85 |
| Fe ₂ O ₃ | 0.20 |
| CO ₂ | 1.95 |
| H ₂ O | 2.00 |
| | <hr/> |
| | 10.60 |

Recalculating the conichalcite analysis on this basis gave the following values which are compared with the interpretation of the analyses given by Dana.³

| Recalculation of analysis of conichalcite from the Bristol Mine with impurities eliminated. | | Recalculation of analysis of conichalcite given by Dana. |
|---|-------|---|
| CaO | 21.4 | 21.2 |
| CuO | 30.0 | 30.1 |
| As ₂ O ₅ | 43.6 | 43.6 |
| H ₂ O | 5.0 | 5.1 |
| | <hr/> | <hr/> |
| | 100.0 | 100.0 |

¹ Hunt, W. F., and Kraus, E. H. Note on the variable composition of melano-chalcite: *Amer. Jour. Sci.*, (4) **41**, pp. 211-214 (1916).

² Rogers, A. F., A review of the amorphous minerals: *J. Geology*, **25**, 527-8, (1917).

³ Dana, E. S. A system of mineralogy: 6th Edition, p. 836, 1892.

These figures indicate identical ratios in the two analyses. The molecular ratios are as follows:

$$\begin{aligned} \text{CaO} &= .382 = .191 \times 2 \\ \text{CuO} &= .378 = .189 \times 2 \\ \text{As}_2\text{O}_5 &= .181 = .181 \times 1 \\ \text{H}_2\text{O} &= .240 = .180 \times 1\frac{1}{2} \end{aligned}$$

Conichalcite seems to be definitely a double salt, for the copper oxide and the lime do not vary reciprocally and are not isomorphous. It, therefore, seems to the writer that the formula should be written: $2\text{CuO} \cdot 2\text{CaO} \cdot \text{As}_2\text{O}_5 \cdot 1\frac{1}{2}\text{H}_2\text{O}$, instead of $4(\text{Cu}, \text{Ca})\text{O} \cdot \text{As}_2\text{O}_5 \cdot 1\frac{1}{2}\text{H}_2\text{O}$.

The larger crystals on which interference figures were obtained and which gave a negative optic sign were not analyzed quantitatively. The amount available was much too small and the crystals were so mixed with two other green minerals that only very minute grains could be separated. These other two minerals were identified in order to make certain that the qualitative tests for lime and arsenic were not being given by them. One is certainly brochantite, the other very probably langite, $4\text{CuO} \cdot \text{SO}_3 \cdot \text{H}_2\text{O}$. Of course, a confirmatory test for sulphate on the latter was not diagnostic in the presence of brochantite. The absence of phosphate served to eliminate libethenite, a mineral with similar properties.

Repeated qualitative analyses were made on the arsenate crystals examined optically by drying off the immersion medium used in the identification of the material, and by then dissolving the fragments on the glass slide in a drop of nitric acid. Ammonium molybdate solution was added and the solution boiled, previously noting that no precipitate formed in the cold liquid. Upon boiling a yellow precipitate indicated a test for arsenic. A test for calcium was made with ammonium oxalate solution separately when sufficient material was available for making two fractions, or in the same solution by adding ammonium hydroxide which dissolved the yellow precipitate of ammonium arseno-molybdate.

These qualitative tests on material of the same indices of refraction and pleochroism as the analyzed fibers seem to indicate with reasonable certainty that the larger crystals and the analyzed fibers collected from the same place are varieties of the same mineral.

DISCUSSION OF THE RESULTS

The chemical analysis shows that the fibrous material is identical with conichalcite in composition. The lower indices of refraction, and the pleochroism, throw some doubt, however, on its being the same species.

The larger crystals are optically negative, conichalcite has been determined as positive. Professor E. S. Larsen, who determined the optical constants on two varieties of conichalcite says⁴ that the interference figure with positive sign that he obtained may have been caused by a spherical aggregation of fibers of positive elongation and may not have been true figures. The writer attempted to obtain interference figures from the minute fibers so characteristic of the material from the Simon Mine, Nevada, and from the Tintic district, Utah, but without success. The spherical aggregates do, however, give a figure resembling a uniaxial cross, which appears optically positive.

These results indicate, therefore, either that the optical character of conichalcite has been incorrectly given as positive, or they indicate that another mineral similar to conichalcite exists, hitherto unknown. In order to settle the question it seems necessary to wait the discovery of other crystals of conichalcite large enough to yield satisfactory interference figures.

The writer wishes to thank Mr. E. V. Shannon for making the analysis, Professor E. S. Larsen for assistance in checking over the optical determinations, and Professor Charles Palache for the loan of the specimens of conichalcite from the Harvard Mineralogical collection.

⁴ Larsen, E. S. Personal communication.