COLUSITE, A NEW MINERAL OF THE SPHALERITE GROUP

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INTRODUCTION

Small amounts of tin in ores shipped from the Leonard, West Colusa, Mountain View and Tramway Mines of the Anaconda Copper Mining Company at Butte, Montana, have been noted for a number of years. The tin-bearing mineral was provisionally named "colusite" by Mr. Reno H. Sales, Chief Geologist of the Anaconda Company. The mineral was first noted on the 1200 foot level of the Leonard Mine near the west end of the Piccolo claim, south of the Colusa claim. The latter was one of the earliest locations in the district, and therefore it seemed appropriate to name the new mineral "colusite."

Samples of colusite from the Leonard and Mountain View Mines gave the following partial analyses:

Mine	*Cu*	*Sn*	*Fe*	*As*	*Sb*	*Zn*	*S*	*Te*	*Bi*	*Total*
Leonard	48.0	6.9	?	6.8	2.6	0.0	27.5	3.0	0.0	94.8%
Mt. View	46.9	5.8	3.6	8.4	0.64	0.9	29.2	0.4	0.0	95.8%

In June 1930 the 2900 and 3000 levels of the Tramway Mine opened a copper ore body containing unusually high percentages of tin. At that time the writer collected a number of specimens from the Number Seven Vein on the 2900 level and later additional specimens were furnished by the Anaconda Copper Mining Company.

The only reference to colusite in the literature known to the writer is that of Schneiderhöhn[1] in which he says, "Apparently belonging to the tetrahedrite group is the tin-rich, but not yet thoroughly studied "colusite" from Butte, Montana."

ACKNOWLEDGMENTS

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[1] Schneiderhöhn, H., and Ramdohr, P., Lehrbuch der Erzmikroskopie, 2nd Edition, *Berlin*, 1931, p. 433.

conda Geological Staff for furnishing fresh material for study. To Mr. Reno H. Sales the writer is indebted for a critical reading of the manuscript. The writer is especially grateful to Drs. E. S. Bastin and D. J. Fisher of the University of Chicago for the use of a laboratory and microscope during the summer of 1931 when part of the study was carried on, and for helpful criticism of the paper.

Mineralogy of Colusite

Colusite is bronzy in color, rather brittle, and decidedly granular in structure. It has a hardness of 3 to 4 in the Mohs' scale. A small specimen of unusual purity had a specific gravity of 4.2. Colusite gives a black streak. It has no cleavage. According to a personal communication from Dr. D. J. Fisher at the University of Chicago, a small crystal fragment showed two faces which suggest the tris-octahedron (221) form. That colusite is isometric is shown conclusively in the following article of this journal.[2]

The following complete chemical analyses were made of material collected from the Number Seven Vein, 2900 level of the Tramway Mine at Butte:

Elements	No. 1	No. 2	Average
Tin	6.45%	6.83%	6.64%
Copper	35.82	35.82	35.82
Antimony	0.57	0.59	0.58
Arsenic	2.09	2.91	2.50
Chromium	tr.	tr.	tr.
Zinc	0.90	0.91	0.90
Manganese	none	none	none
Tellurium	3.04	2.91	2.97
Molybdenum	8.80	8.80	8.80
Tungsten	tr.	tr.	tr.
Iron	17.75	19.00	18.37
Sulphur	24.20	24.20	24.20
Total	99.62%	101.97%	100.78%

Analyses by S. T. Gross, Graduate student in chemistry at the California Institute of Technology, Pasadena, California.

The reader is referred to the article by Zachariasen cited above for a discussion of the chemical structure of colusite.

[2] Zachariasen, W. H., *X*-ray Examination of Colusite, $(Cu, Fe, Mo, Sn)_4(S, As, Te)_{3-4}$, a New Member of the Sphalerite Group, *Am. Mineral.*, Vol. **18**, pp. 534–537, 1933.

Observations on the Polished Surface

Optical Character—Isotropic.
Hardness—low.
Color—bronzy gray.
Reagents:
HNO_3—positive. Tarnishes brown. Etched to pitted surface.
HCl—same as HNO_3. Fumes tarnish.
KOH—negative.
KCN—positive. Solution colors pink. Slight tarnish which washes off.
$HgCl_2$—negative.
$FeCl_3$—negative.

Gives positive tests for tin and copper according to the methods prescribed by Short.[3] In making the tin tests cesium chloride rather than rubidium chloride was used.

Paragenetic Relations

Other minerals associated with colusite are pyrite, tetrahedrite, bornite, chalcocite, and quartz.

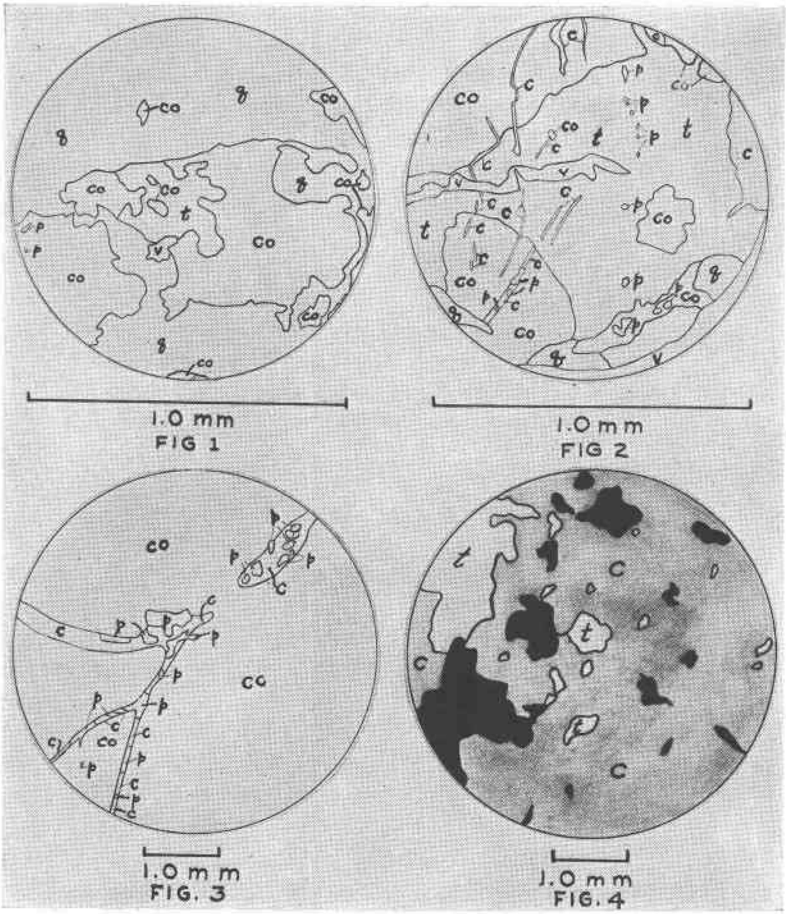
Pyrite appears as yellow specks in the hand-specimen. Under the microscope it occurs as irregular grains imbedded in other minerals. It shows no unusual features.

Colusite and tetrahedrite occur intimately associated in irregular areas having sharp curving boundaries and outlines. Colusite makes up the greater volume, and generally encloses the tetrahedrite, but in some places the tetrahedrite encloses the colusite. See Figs. 1, 2, and 4. The fact that even under the high power of the microscope the boundaries are still smoothly curving and clean-cut indicating no replacement of either mineral by the other, and the fact that both minerals contain areas of the other, suggest that the two minerals are essentially contemporaneous, and that their texture is the result of unmixing. Both minerals are at least partly later than the early generation of pyrite, small grains of which they enclose.

Mottled intergrowths of chalcocite and bornite, such as figured by Schwartz,[4] occur in small veinlets traversing colusite and tetra-

[3] Short, M. N., Microscopic Determination of the Ore Minerals: *U. S. Geol. Survey, Bull.* **825**, 1931.

[4] Schwartz, G. M., Bornite-Chalcocite Intergrowths: *Econ. Geol.*, Vol. **XXIII**, Fig. 1, p. 389, 1928.



Explanation Plate I.

FIG. 1. Camera lucida drawing showing unmixing texture of tetrahedrite and colusite. *t*, tetrahedrite; *co*, colusite; *q*, quartz; *p*, pyrite, and *v*, void.

FIG. 2. Camera lucida drawing showing relations of tetrahedrite, *t;* colusite, *co;* quartz, *q;* chalcocite (with some bornite), *c;* and pyrite, *p; v*, void.

FIG. 3. Camera lucida drawing showing detail relations of chalcocite and pyrite in veinlets traversing colusite. *co*, colusite; *p*, pyrite; and *c*, chalcocite. The chalcocite in these veinlets contains little or no bornite.

FIG. 4. Line drawing made by tracing a photomicrograph showing unmixing texture of tetrahedrite and colusite.

t, tetrahedrite; *c*, colusite. The black areas are quartz. The small light colored areas within the colusite are tetrahedrite.

hedrite. Chalcocite without bornite occurs in the smaller of these veinlets. Within the veinlets are small blebs of pyrite oriented in lines, suggesting that pyrite first filled the fractures and later bornite and chalcocite replaced the pyrite. See Figs. 2 and 3. Since the boundaries between colusite or tetrahedrite and bornite or chalcocite are sharp, and since these minerals occupy fractures once filled by pyrite, it seems certain that the pyrite did not replace colusite or tetrahedrite but merely filled the fractures.

Quartz is chiefly earlier than the sulphides, but also occurs in small veinlets cutting the sulphides, indicating that it formed in two generations, one very early, and one rather late. The early quartz in many places shows its crystal outlines against the sulphides. The later quartz occurring in veinlets tends to form irregular grains without definite crystal faces, although in some of the veinlets crystal faces of quartz are present.

The relations just described are represented graphically below:

early quartz

early pyrite

colusite & tetrahedrite

Time of fracturing

late pyrite

chalcocite & bornite

late quartz

The history of mineralization may be summarized as follows: (1) Early solutions precipitated quartz and pyrite. (2) Colusite and tetrahedrite followed, and in part, accompanied pyrite. These minerals may have replaced pyrite to some extent, but whether they did or did not is uncertain. (3) Following a period of fracturing more pyrite was introduced. This pyrite seems to have merely filled fractures in the earlier minerals. (4) Chalcocite and bornite, the last metallic minerals, replaced pyrite, but did not affect either colusite or tetrahedrite. Evidently the precipitation of pyrite had ceased before the chalcocite-bornite solutions arrived since no chalcopyrite is observed. Had copper been present while iron and sulphur were forming pyrite it no doubt would have entered into the reaction in the form of chalcopyrite. (5) The deposition of small amounts of quartz closed the sequence of mineralization.

Summary

Colusite is a new mineral species belonging to the sphalerite group. Chemically it is a sulphide of copper, iron, tin, molybdenum, and zinc which are isomorphous. Arsenic, tellurium and antimony are isomorphous with sulphur. Colusite is bronzy in color, has a hardness of 3 to 4, and a specific gravity of 4.2. It occurs as a primary mineral in various copper veins at Butte, Montana, together with chalcocite, pyrite, and other sulphides. Its relations to other primary minerals are described.