

saturation controlled. This is evidently regulated by the amount of boron oxide in the flux which influences certain growing faces depending on its concentration. It has also been observed that the viscosity increases as Na/B decreases. While high viscosity is usually associated with a low diffusion rate, it would not necessarily decrease it preferentially for a particular crystal direction. It does not seem likely therefore that viscosity could control the morphology especially since Newkirk and Smith (1965) observe changes in morphology in lithium molybdate flux with boron oxide additions which are far too small to significantly affect viscosity.

It is not clear why the hollow rods form, however, this shape has a high surface area which can use the large amount of BeO available for deposit. It would appear that at higher cooling rates (50°C/hr.), the supersaturation is so high that even the hollow geometry cannot accommodate all the material available for deposition, and the walls begin to break up, thereby further increasing their surface area. At still higher rates (100°C/hr.) this break-up is complete and crystals grow as individual filaments.

ACKNOWLEDGMENTS

The author would like to thank J. B. Schroeder and J. F. Nester for many valuable discussions during the course of this study.

REFERENCES

- AUSTERMAN, S. B. (1963) Growth of beryllia single crystals. *J. Amer. Ceram. Soc.*, **46**, 6-10.
LINARES, R. C. (1962) Growth of refractory oxide single crystals. *J. Appl. Phys.* **33**, 1747-1749.
NEWKIRK, HERBERT W., AND DEANE K. SMITH (1965) Studies on the formation of crystal-line synthetic bromellite. II Macrocrystals. *Amer. Mineral.* **50**, 42-72.

THE AMERICAN MINERALOGIST, VOL. 52, JULY-AUGUST, 1967

COCINERITE DISCREDITED¹

BRIAN J. SKINNER, *U. S. Geological Survey, Washington, D. C.*

In 1901, during a brief reopening of the centuries-old Cocinera Mine, at Ramos, San Luis Potosi, Mexico, a large pocket of oxidized ore was encountered near the bottom of the mine, at a depth of 1100 feet. This ore was reported to have been a complex mixture of "the red and black oxides of copper, some carbonates and some metallic copper and metallic silver" (Hough, 1919), and to contain a few pounds of an unknown metallic mineral. Pieces of this unknown mineral were analyzed by the chemist of the Mexican Copper Company, owners of the mine at the time of the

¹ Publication is authorized by the Director, U. S. Geological Survey.

reopening. The results of the analysis remained unreported for some years, until the analyst, George J. Hough, mentioned the mineral formula, AgCu_4S , derived from them, in a short romantic historical discussion of Ramos, titled "An old Treasure Town" (Hough, 1911).

The first and only description of the mineral cocinerite appeared in 1919, when Hough published his analysis of 1901, and proposed the name cocinerite. The mineral was stated to be homogeneous on a microscopic scale, to have a hardness of 2.5, specific gravity of 6.14, a silver-gray color with the appearance of an alloy, a lead gray streak and to slowly tarnish and blacken.

The formula proposed by Hough, AgCu_4S , has remained the accepted formula to the present day. No further examinations or studies of the

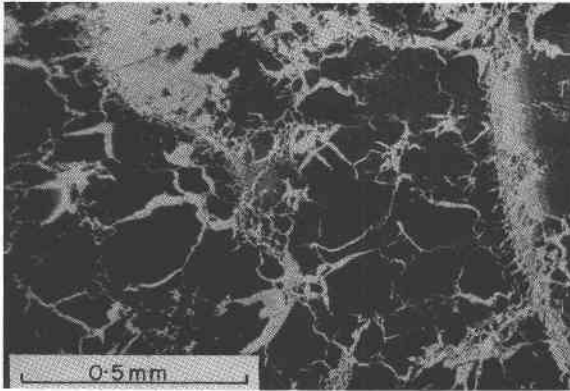


FIG. 1. Complex intergrowth of chalcocite (gray) and native silver (white) forming the bulk of the type sample of cocinerite.

mineral have been reported. During a recent study of the system Cu-Ag-S (Skinner, 1966), no compounds, either natural or synthetic were found to have metal to sulfur ratios greater than 2:1, save the metals copper, silver, and their alloys. The composition ascribed to cocinerite fell in the three-phase field chalcocite+silver+copper and the doubts so raised led to a search for a specimen of the original cocinerite.

Hough (1919) clearly stated that no more than a few pounds of cocinerite were ever mined, and that only a few fragments were preserved by the time it was recognized as a possibly new mineral in 1901. Apparently the only specimens identified as cocinerite were those in Hough's possession. Fortunately, in 1927, Hough presented a fragment of cocinerite to the U. S. National Museum (catalogue no. 95665). Although not specifically identified as a split of the analyzed sample of 1901, Hough's published descriptions of the material and its history leave no room for

doubt that the U. S. National Museum sample was considered as the type sample by him.

Microscopic and X-ray diffraction examinations of the type specimen show it to be an exceedingly complex intergrowth of minerals, principally chalcocite and native silver (Fig. 1), but with lesser amounts of native copper and a trace of cuprite. The native silver is so intergrown with the chalcocite, and on such a fine scale, as to preclude any possibility of mineral separation. The state of the microscopic art in 1901, and the equipment available to Hough at the time, were possibly too crude to reveal the complex mineral intergrowths in the material being analyzed. It is quite apparent that cocinerite is such a mixture, that the proposed formula is spurious, and that the name should be discarded.

REFERENCES

- HOUGH, G. J. (1911) An old treasure town. *Mining Sci. Press*, **103**, 836-837.
——— (1919) Notes on a unlisted mineral. *Amer. J. Sci.* **48**, 206.
SKINNER, B. J. (1966) The system Cu-Ag-S. *Econ. Geol.*, **61** 1-26.

THE AMERICAN MINERALOGIST, VOL. 52, JULY-AUGUST, 1967

DAWSONITE IN THE GRETA COAL MEASURES AT MUSWELLBROOK,
NEW SOUTH WALES

F. C. LOUGHNAN AND G. T. SEE, *School of Applied Geology, University of New South Wales, Kensington, Sydney, Australia.*

Dawsonite is a relatively rare, basic carbonate of sodium and aluminum ($\text{NaAlCO}_3(\text{OH})_2$) which, according to Smith and Milton (1966), has been found in only seven localities in the world. Palache *et al.*, (1960) considered the mineral to be of low temperature hydrothermal origin but the recent work of Hay (1964) and Smith and Milton (1966) indicates that it may also form by sedimentary diagenesis. Hay found dawsonite altering from nepheline in arid, saline soils at Olduvai Gorge, Tanganyika, and Smith and Milton described the occurrence of the mineral in fissures, vugs, and generally disseminated in beds of the Green River Formation in Colorado. In both cases carbonates and authigenic silicates, including zeolites, are associated with the dawsonite and the origin was attributed to the influence of a high soda-concentration in the environmental waters.

The discovery of dawsonite in the Permian Coal Measures of the Sydney Basin was made during an X-ray examination of core samples obtained from the Joint Coal Board's B.C. 20 diamond drill bore, put down in the Balmoral area near Muswellbrook on Portion 179, Parish Wynn,