

heavy solution for separations of hydrous silicates readily decomposed by acids. Possibly other analyses of zeolites exhibit irregularities due to similar substitutions.

DELAFOSSITE FROM KIMBERLY, NEVADA

AUSTIN F. ROGERS, *Stanford University*

Of the numerous copper minerals, one of the rarest and most interesting is delafossite, a cuprous metaferriite, with the formula, CuFeO_2 or $\text{Cu}_2\text{O} \cdot \text{Fe}_2\text{O}_3$. Delafossite was first described from the region of Ekaterinburg, Siberia, by Friedel in 1873.¹ No further mention of the mineral was made until 1913, when the writer² called attention to its occurrence at Bisbee, Arizona, and was able to establish it as a valid mineral species.

The object of this note is to place on record the discovery of delafossite at a second American locality. A specimen of the mineral in question was sent to my colleague, Professor W. F. Dietrich, by Mr. M. L. Crandall, Chief Engineer of the Consolidated Coppermines Company. The specimen was found on the 1200 ft. level of the Alpha mine (formerly called the Giroux) at Kimberly, Nevada. According to Mr. Crandall, "It was found in a body of clay containing some oxidized copper ore, occurring in oxidized jasperoid, near its contact with limestone."

DESCRIPTION OF THE DELAFOSSITE: The Kimberly delafossite is a black metallic mineral and occurs in spherical aggregates from 1 to 3 mm. in diameter which are disseminated through a white to pale gray clay. (The clay is probably halloysite, the amorphous equivalent of crystalline kaolinite, as it is optically isotropic and has an index of refraction of $1.543 \pm .003$.) The spherulitic aggregates have a fairly well defined radial structure and hence may be called spherulites. Spherulites of minerals with metallic luster seem to be very rare. The individual crystals of the spherulites have an imperfect cleavage parallel to their length. On the exterior of the spherulites the delafossite shows imperfectly developed crystals of triangular outline, which recalls the fact that delafossite is hexagonal in crystallization. The mineral has a hardness of about $5\frac{1}{2}$ and is very slightly magnetic. It has a black streak.

¹ *Compt. Rend.*, 77, 211.

² *Amer. Jour. Sci.*, [4] 35, 290.

In general appearance the specimen suggests a manganese mineral such as manganite, but chemical tests prove its identity with delafossite.

CHEMICAL TESTS FOR DELAFOSSITE: The delafossite is readily soluble in hydrochloric acid and aqua regia, but is only slightly soluble in nitric acid. Ammonium hydroxide added to an aqua regia solution of the mineral gives a red-brown precipitate of ferric hydroxide and a blue coloration to the filtrate. The hydrochloric acid solution gives tests for ferrous and ferric iron with solutions of potassium ferrocyanide and ferricyanide respectively. The ferrous iron test indicates that a change in the valence of some of the iron has taken place during solution, for in the original mineral all the iron is in the ferric condition.

Stokes³ has established the reversibility of the following reaction between cuprous, cupric, ferrous, and ferric ions: $\text{Cu}'' + \text{Fe}'' \rightleftharpoons \text{Cu}' + \text{Fe}'''$.

CHEMICAL FORMULA OF DELAFOSSITE: The chemical formula of delafossite, $\text{Cu}_2\text{O} \cdot \text{Fe}_2\text{O}_3$, given by Friedel for the original Siberian mineral was confirmed by an analysis of the Bisbee mineral made under the writer's direction by Mr. G. S. Bohart. The formula may be written in the form, CuFeO_2 , which is interpreted as cuprous metaferriite, a salt of the hypothetical acid, HFeO_2 , which is derived from ferrous acid (H_3FeO_3) thus: $\text{H}_3\text{FeO}_3 - \text{H}_2\text{O} = \text{HFeO}_2$.

With the exception of minerals of the magnetite group (magnetite, franklinite, magnesioferriite, and jacobsite), delafossite is the only known metaferriite.

VALIDITY OF DELAFOSSITE AS A MINERAL SPECIES: Delafossite has not been recognized as a distinct species in the mineralogical treatises; in both Dana's *System* and Hintze's *Handbuch* it is included in the Appendix to Oxides. The occurrence of a well-crystallized mineral from Bisbee, Arizona, which gave on analysis percentages for iron and copper almost identical with the theoretical for CuFeO_2 , established delafossite as a definite mineral. It is interesting to find delafossite at a third locality.

CHARACTERISTIC OCCURRENCE OF DELAFOSSITE: Its occurrence at Kimberly, Nevada, is similar to that at Bisbee, Arizona. In both localities it occurs in the lower part of the oxidized zone. It probably occurs in other copper mines and has been overlooked.

³ *U. S. Geol. Surv. Bull.* 186, 44, 1906.