THE OCCURRENCE OF STRONTIANITE AT SIERRA MOJADA, MEXICO

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Abstract

Strontianite is found in unusual abundance as a gangue mineral associated with lead and silver ores at Sierra Mojada, Mexico. The occurrence differs in several respects from other mineralization in this district. So far as known, strontianite has not been observed as a gangue mineral, even in minor amounts, in any of the ore bodies previously mined. In the Suiza ore body, however, it is sufficiently common as a gangue mineral to require hand sorting in order to separate it from the lead and silver ores. The strontianite is distinctly secondary in its occurrence and is believed to have been formed as an alteration product of celestite, the strontium sulphate. In the case of the celestite, however, the evidence appears to indicate that it was deposited by ascending hydrothermal solutions associated with ore deposition in the Suiza area.

Introduction

Sierra Mojada is located in the extreme western part of the State of Coahuila just a few miles east of the Chihuahua boundary. It is accessible by railroad over the Mexican Northern Railway, a branch line connecting with the Mexican National Railway at Escalon.

The district was first discovered in June 1878.[1] Since then the mines in the vicinity have been worked almost continuously and the district has been credited with having produced approximately five million tons of ore.[2] The ores consist chiefly of oxidized lead, silver and zinc minerals with some siliceous copper ores carrying rather high values in silver. The deposits are of the manto type* occurring in limestone and dolomite. Ore deposition appears to have been controlled largely by nearly east-west shear planes and fissures as well as certain favorable horizons in the limestone.

Sincere appreciation is extended to Mr. Henry Holcombe, superintendent, and Mr. F. L. Wingfield, geologist, for the many courtesies extended the author while visiting the property and for valuable information concerning the geology of the district. Mr. Van

[1] Chism, Richard E., Sierra Mojada, Mexico: *Trans. Am. Inst. Min. Eng.*, vol. **15**, pp. 542–587, 1886–87.

[2] Hayward, M. W., and Triplett, W. H., The Occurrence of Lead-Zinc Ores in Dolomitic Limestone in Northern Mexico: *Trans. Am. Inst. Min. Eng.*, Technical Publication No. **42**, 1931.

* The nearly flat-lying limestone replacement deposits of northern Mexico containing oxidized ores are usually referred to as "manto" deposits.

Dyne Howbert, of the American Metal Company, kindly gave his permission to publish the results of this study. Acknowledgment is also made to Professor R. J. Colony, of Columbia University, for helpful suggestions in the interpretation of criteria observed in thin sections.

General Geology

The earliest account of the geology of the Sierra Mojada district is by Chism,[3] who apparently visited the camp shortly after its discovery. Later, Malcomson[4] gave a comprehensive description of its history and development and the character of the ore deposits. Van Horn[5] described the silver, copper and lead ores of the Veta Rica Mine and has noted the occurrence of several rare minerals in the district. The most recent work has been done by Hayward and Triplett[6] who discuss the influence of dolomitic horizons in the limestone with relation to ore deposition.

The rocks making up the Sierra Mojada Range consist of a series of Lower Cretaceous limestone and dolomite beds dipping gently to the southeast and having a total thickness of approximately 3000 feet. The valley on the north side of the range has been partially filled with a flow of volcanic agglomerate over which has been deposited a considerable thickness of alluvial material. Strong thrust faulting, striking nearly due east and west and dipping about thirty degrees to the north, has forced the agglomerate against the limestone in a number of places along the north side of the range. Probably as a result of this faulting parallel shear planes were developed in the limestone, and where these intersect certain favorable horizons they have usually made important ore bodies which also have a general east-west trend.

Previous to the discovery of the Suiza ore body, most of the ore had been derived from these nearly east-west mantos. They have produced a variety of minerals, some of which are unusual in deposits of this type. Among these are such minerals as erythrite,

[3] *Op. cit.*

[4] Malcomson, J. W., The Sierra Mojada, Coahuila, Mexico, and its Ore Deposits: *Trans. Am. Inst. Min. Eng.*, vol. **32**, pp. 100–139, 1902.

[5] Van Horn, Frank R., The Occurrence of Silver, Copper and Lead Ores at the Veta Rica Mine, Sierra Mojada, Coahuila, Mexico: *Trans. A.I.M.E.*, vol. **43**, pp. 219–233, 1912; A New Occurrence of Pearceite, *Amer. Jour. Sci.*, vol. **31**, pp. 518–524, 1911; A New Occurrence of Silver, Copper and Cobalt Minerals in Mexico: *Amer. Jour. Sci.*, vol. **35**, pp. 23–30, 1913.

[6] *Op. cit.*

pearceite, descloizite, wulfenite and covellite, in addition to the many normal oxidation products of lead, silver, zinc and copper. Most of these have been described and can be found in the literature. Gangue minerals commonly associated with the ores consist of calcite, quartz, limonite, dolomite, gypsum and sulphur, and in some areas fairly large quantities of barite have been noted. So far as known, however, nowhere in any of these east-west mantos have strontianite and celestite been observed as a gangue mineral.

Occurrence of the Strontianite

Strontianite is found in considerable abundance throughout the length of the Suiza ore body, a distance of approximately 3500 feet.

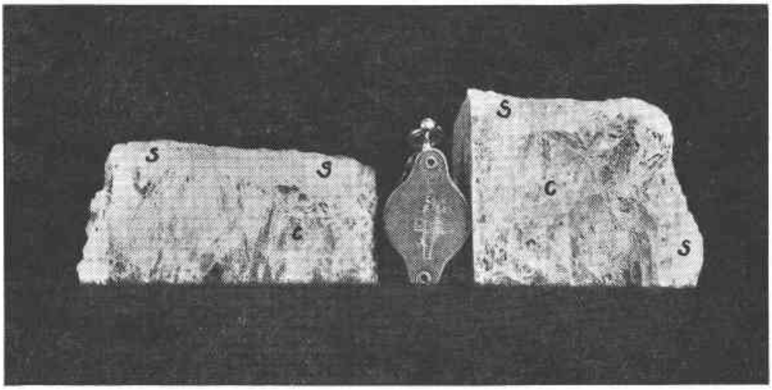

Fig. 1. Specimens showing the alteration of celestite (c) to strontianite (s). The strontianite forms a crust over the celestite and also penetrates between celestite crystals.

The mineral is also found in the Upper Atalaya ore body, a small area lying above and slightly to the east of the Suiza ore body. According to Mr. F. L. Wingfield, geologist at Sierra Mojada, recent development work appears to indicate that these two ore bodies will eventually connect with each other, so that they can be considered essentially as one ore body. The strontianite occurs in fairly large masses made up of innumerable fine crystals which rarely exceed five or six millimeters in length, and may sometimes resemble a white powdery mass. The mineral is distinctly secondary in its occurrence and is often associated with anglesite and cerussite, usually filling interstitial spaces between these oxidation products. Chert nodules showing replacement by strontianite are frequently found included within large masses of the latter mineral. These probably represent residual chert, the surrounding limestone having been completely replaced by later strontianite.

The strontianite appears to have been formed by the alteration of celestite, the strontium sulphate, and perhaps to some extent as an alteration product of calcite. This alteration is well shown by the specimens in Fig. 1, the bulk of which consists of thin, tabular crystals of celestite having the characteristic bluish tinge and responding to the optical and chemical tests for this mineral. Strontianite forms a white, cloudy and somewhat botryoidal crust over

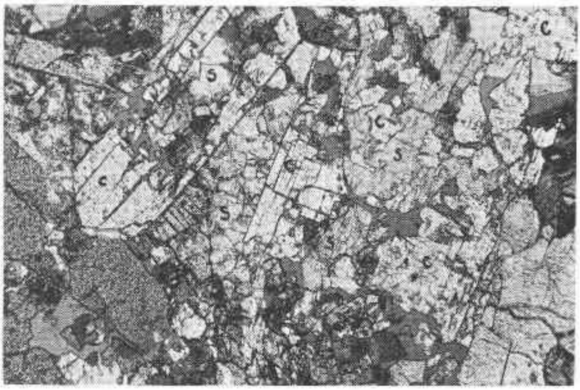

FIG. 2. Photomicrograph showing celestite (c) being replaced by strontianite (s). Strontianite also fills areas between celestite crystals. Nicols partially crossed. ×22.

the celestite as well as penetrating through and between the celestite crystals. The same process can be seen in thin sections showing well formed euhedral crystals of celestite which have been partially replaced by strontianite, with the latter mineral also filling areas between celestite crystals.

The presence of such a large quantity of strontianite, and its apparent confinement to the one ore body in this district, presents a rather interesting problem in limestone replacement deposits. The general nature and occurrence of the strontianite indicate that it is undoubtedly a secondary mineral and there is sufficient evidence to show that most of it, at least, was formed by the alteration of celestite. In the case of the celestite, however, the evidence appears to favor a hydrothermal origin. This brings up the question of primary sulphate minerals associated with ore deposits that was discussed by Butler[7] some years ago. He cites numerous occurrences with conclusive evidence that such minerals as barite, alunite and anhydrite are undoubtedly primary constituents in some mineral deposits. Landes[8] and Spence[9] have both recorded the occurrence of celestite which they believe to be of hydrothermal origin rather than concentrated by the action of meteoric waters. The occurrence of primary celestite, however, is not nearly so common as in the case of barite or alunite. On the other hand, celestite formed by

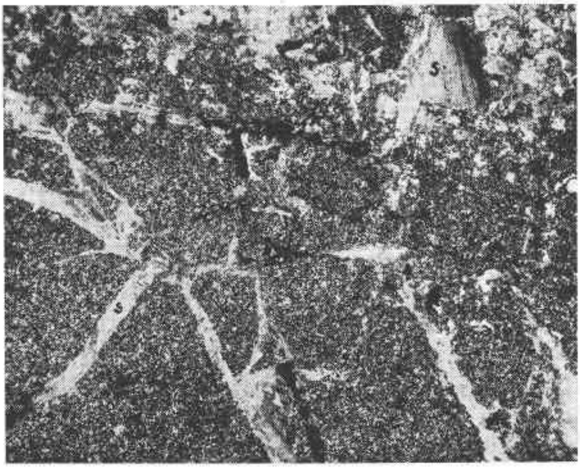

FIG. 3. Photomicrograph showing strontianite (s) filling fractures in and replacing a chert nodule. Crossed nicols. ×22

the action of meteoric waters or other surface agencies has been noted by a number of writers.[10]

In the case of the Suiza ore body at Sierra Mojada it appears that strontium solutions were an important constituent of the same

[7] Butler, B. S., Primary Sulphate Minerals in Ore Deposits: *Econ. Geol.*, vol. **14**, pp. 581–609, 1919.

[8] Landes, Kenneth K., The Strontium Occurrence Near La Conner, Wash.: *Amer. Min.*, vol. **14**, pp. 408–415, 1929.

[9] Spence, H. S., Barium Deposits of Canada: *Canada Mines Rept.*, p. 100, **1922.**

[10] Kraus, E. H., Occurrence of Celestite Near Syracuse, N. Y.: *Amer. Jour. Sci.*, 4th ser., vol. **18**, pp. 30–39, 1904; Occurrence and Distribution of Celestite-bearing Rocks: *Amer. Jour. Sci.*, 4th ser., vol. **19**, pp. 286–293, 1905; Kraus, E. H., and Hunt, W. F., The Occurrence of Sulphur and Celestite at Maybee, Mich.: *Amer. Jour. Sci.*, 4th ser., vol. **21**, pp. 237–244, 1906.

solutions responsible for primary ore deposition, and that celestite was quite likely a primary mineral deposited from these solutions. The evidence upon which this conclusion is based is as follows: (1) The confinement of both strontianite and celestite to the Suiza ore body and the absence of these minerals in other ore bodies of the district. If either strontianite or celestite were originally contained in the surrounding limestone and concentrated by meteoric waters, they would be expected to occur in other ore bodies of the district which have had a similar history as regards supergene processes. (2) Celestite is one of the early minerals of the deposit. No evidence was found which indicated that celestite replaces any of the older minerals. On the other hand, there is abundant evidence showing celestite being replaced by such oxidation products as anglesite and cerussite as well as by strontianite. (3) The celestite occurs in greater abundance associated with residual masses of primary ore, such as galena which has been but partially oxidized to anglesite and cerussite, and with such gangue minerals as quartz and barite. Where oxidation has been more prominent and the primary sulphide ores have been altered to anglesite and cerussite, the celestite has also been destroyed and its place taken by strontianite. This evidence is more easily interpreted as being due to ascending hydrothermal solutions associated with the late stages of metallic mineral deposition.

If both strontianite and celestite were secondary minerals, they would be expected to occur in a similar manner. The strontianite, however, is distinctly secondary, much of it having been formed even after the oxidation of galena to anglesite and cerussite had been accomplished, whereas the celestite is obviously earlier than the period of oxidation.