

## INTERPRETATION OF CONCENTRIC TEXTURES AT COLQUIJRCA, PERU

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Apropos of recent publications on the interpretation of micro-textures in terms of the sequence of minerals<sup>1</sup> it may be of interest to describe an unusual case of concentric arrangement of sulphides. The illustrations show stromeyerite, galena, sphalerite and chalcopyrite in textures which might be (and by a very able investigator were) interpreted as meaning that stromeyerite was deposited both before and after galena and the other minerals, hence was of the same general age as the galena and consequently hypogene. The writer, who collected the specimens at Colquijirca, Peru, suspected from field evidence that the stromeyerite was supergene and later had the privilege of studying the material in detail in the Harvard Laboratory. In polished sections the texture was very perplexing and it was not until hand specimens were studied under the binocular microscope that the proper interpretation suggested itself.

In a number of specimens, galena was found to be deposited on tennantite crystals, partly replacing the tennantite and partly growing upon it. Sphalerite forms botryoidal crusts upon the galena and at times there is still another crust of galena upon the sphalerite (Fig. 1 (1) ). Chalcopyrite is later than all of these minerals, replacing them and forming crusts upon them but is particularly active in its replacement of galena. Not infrequently chalcopyrite is seen to have broken through the band of sphalerite and attacked the underlying galena as shown graphically in Fig. 1, (2).

The latest sulphide is stromeyerite. It fills the vugs which were lined by chalcopyrite but in replacing shows a strong preference for tennantite. Some specimens show tennantite cut by veinlets of stromeyerite and others contain remnants in all stages of replacement. Frequently stromeyerite leaves the outer crust of chalcopyrite and the other minerals almost untouched and passes inward to replace the core of tennantite (see Fig. 1, (3) ).

Wherever stromeyerite is abundant it is accompanied by evidence of etching and corrosion of the other sulphides as if by acid.

<sup>1</sup> Fairbanks E. E., *The Laboratory Investigation of Ores*; McGraw-Hill Book Co., *New York* 1928, p. 132 (Colony); p. 147 (Newhouse).

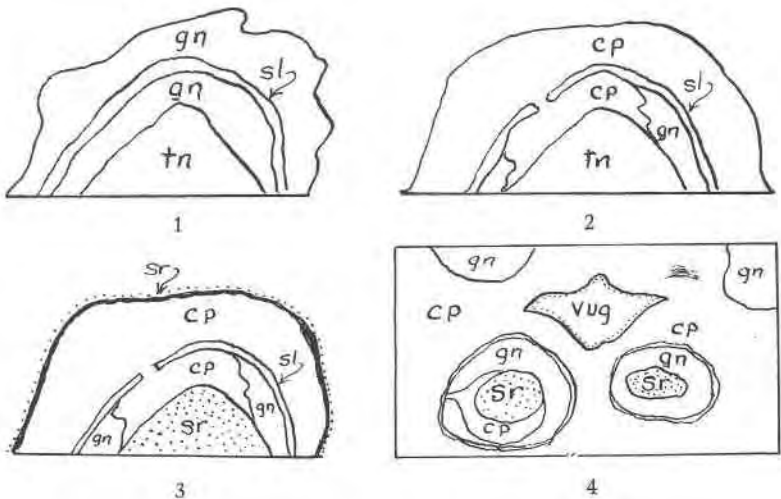


FIG. 1. Successive stages in the development of inherited concentric textures.

(1) Crystal of tennantite (tn) protruding into vug coated by alternate depositions of galena (gn) and sphalerite (sl).

(2) Selective replacement of galena by chalcopyrite (cp).

(3) Deposition of stromeyerite (sr) upon chalcopyrite and also replacing cores of tennantite.

(4) A group of such coated and replaced crystals as they would appear in polished section.

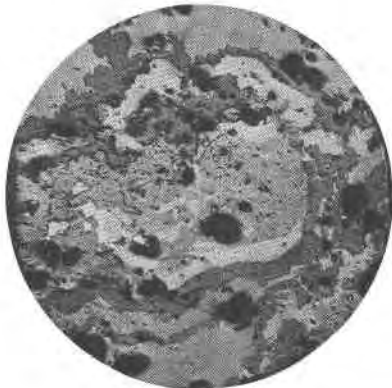


FIG. 2. In the center are tennantite and galena (in part intergrown with pierceite?) surrounded by a white rim of galena. Outside this are two somewhat discontinuous rims of sphalerite (dark gray). The space between the two sphalerite rims is occupied in part by galena and in part by chalcopyrite, the space outside the outer rim being occupied by chalcopyrite.

x60 (Photo by M. N. Short and R. W. Goranson).

With the stromeyerite, native silver is almost universally associated, cutting it in veinlets and growing from it in wires within the vugs. The attack by the corrosion which accompanies the development of stromeyerite may be likened, to use an unpleasant analogy, to the decay of a tooth where the enamel is left mainly intact but the core of less resistant material succumbs.



FIG. 3. Cores of stromeyerite (which has totally replaced tennantite) and native silver, surrounded first by galena and then by chalcopyrite. Vugs like the one represented by a black spot on the right ordinarily contain stromeyerite and silver.  $\times 60$  (Photo by M. N. Short and R. W. Goranson).

While all of the stages described are not necessarily found in any one specimen and hence cannot well be shown in any one illustration, examples of all stages of the process have been observed. The facts that stromeyerite is the latest of the sulphides, is accompanied by etching suggesting acid attack and is always associated with native silver, are perfectly in accord with the true field observation that the stromeyerite stage of deposition is absent in those parts of the mine which are least favorably located with respect to supergene enrichment and which show correspondingly lower content in silver.

#### SUMMARY

In this particular case, an example of concentric texture was shown to have originated not from simple rhythmic precipitation in a gel nor by simple successive stages of deposition but involved highly selective replacement at two stages, the last of which, at least, was supergene.