

THE MICROGRAPHY OF THE LEAD AND ZINC ORES  
OF THE UPPER MISSISSIPPI VALLEY

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## ABSTRACT

Study of the Upper Mississippi Valley lead and zinc ores by means of the reflecting polarizing microscope leads to the following conclusions regarding their paragenesis.

The ore minerals—barite, calcite, galena, marcasite, pyrite and sphalerite—indicate deposition under low pressures and at temperatures less than the boiling point of water. No diagnostic minerals occur which prove or disprove any of the known theories of origin, but the association of marcasite and pyrite indicates that the ore solutions varied from acid to alkaline or neutral, for pyrite is generally deposited from alkaline or neutral solutions at all temperatures while marcasite is deposited from acid solutions and at low temperatures. Paragenesis of the ore minerals is as follows: (1) Pyrite was deposited first, in considerable abundance and over a long period of time. While marcasite has been considered the common iron sulphide in the past, pyrite being thought quite rare, the author's studies show that pyrite is almost as abundant as marcasite, solution and dolomitization of the Galena dolomite, which preceded ore deposition, made the country rock porous and enabled ore solutions to percolate through it and deposit pyrite, mainly by replacement, as small isolated crystals. The amount of pyrite so disseminated decreases gradually away from the fractures along which ore solutions traveled. At the point of pyrite deposition the ore solutions must have been alkaline or neutral although they may originally have been acid, the acidity being reduced by their reaction with the calcareous country rock. (2) Marcasite was deposited next as a thin band lining fractures. Its contact with pyrite forms a sharp line of demarkation while its upper surface consists almost entirely of crystal faces. The change from pyrite deposition to marcasite deposition was caused either by increased acidity of the ore solutions, or by their reaction with the wall rock being prevented by the coating of pyrite. (3) Sphalerite was deposited on the well defined crystal terminations of marcasite. Near the end of its deposition sphalerite was accompanied by galena, calcite, and soft, greenish botryoidal masses of pyrite and marcasite. (4) Galena was deposited with and after sphalerite, erratically in the flats and pitches and abundantly in the crevices. (5) Calcite commonly occupies the center of flats and pitches and hence is younger than the above minerals. It occurs in two forms—an older rhombohedral and a younger scalenohedral. (6) Barite is rare but where seen is apparently the last mineral deposited.

Summary. The ore minerals of the Upper Mississippi Valley lead and zinc deposits were laid down in the following order: (1) pyrite disseminated in country rock; (2) pyrite along fractures; (3) marcasite along fractures and to a much lesser extent disseminated in the country rock; (4) sphalerite alone; (5) sphalerite with soft greenish botryoidal iron sulphides, galena and calcite; (6) galena; (7) calcite in rare early rhombohedral forms and abundant later scalenohedral forms; (8) barite. The relation between stages 5, 6, and 7 is gradational.