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## The Carbonate-Hosted Lisheen Zn-Pb-Ag Deposit, County Tipperary, Ireland

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### Abstract

The Lisheen Zn-Pb-Ag deposit, located in County Tipperary in southeast-central Ireland, consists of a group of strata-bound pyritic sulfide lenses containing 22 Mt of ore with an overall grade of 11.5 percent Zn, 1.9 percent Pb, 26 g/t Ag, and 16 percent Fe hosted in Lower Carboniferous (Early Mississippian) carbonate rocks.

Sulfide bodies at Lisheen are restricted to the Waulsortian mudbank complex and the Lisduff oolite unit of the Ballysteen limestone, which compose the stratigraphically lowest, nonargillaceous carbonate horizons in the local Lower Carboniferous succession. The deposit is located within a major right-stepping relay zone of a segmented normal fault system. Sulfide bodies occur adjacent to the normal faults; thickest development of sulfides generally occurs at points of maximum throw. Metal zoning is well developed relative to these structures.

The Waulsortian mudbank complex and portions of the overlying succession were subjected to an early, pre-mineralization, regional-scale dolomitizing event that increased permeability. The regional dolostone produced by this event is cut and replaced by hydrothermal dolomite, referred to as black matrix breccia and white matrix breccia, associated with mineralization. Hydrothermal dolomitization was most intense in the Waulsortian mudbank complex, though it locally affected rocks from the Silurian basement to more than 200 m above the level of major sulfide precipitation.

The majority of the Lisheen deposit consists of Fe-Zn-Pb-Ag sulfides hosted in the black matrix breccia, regional dolomite and, to a much lesser extent, undolomitized limestone of the Waulsortian complex. Sulfide bodies at Lisheen consist of pyrite-marcasite, sphalerite, and galena with subsidiary sulfosalt minerals, arsenopyrite, and copper sulfides. Sulfides replace carbonate minerals and infill dissolution cavities. Gangue minerals intergrown with sulfides include dolomite, calcite, barite, and quartz. Mineral textures indicate a regular paragenetic sequence of sulfide deposition from early precipitation of colloform iron sulfide containing minor sphalerite and galena through deposition of a complex assemblage of sphalerite, galena, iron sulfides, sulfosalt minerals, and copper sulfides. Distribution of alteration and sulfide zones indicates that the Lisheen deposit formed as a prograding hydrothermal system. Textural and mineralogic evidence suggests that the hydrothermal fluids were relatively acidic and that reaction with the carbonate host rocks was a primary reason for sulfide precipitation.

On the basis of the probable age of faulting and crosscutting relationships of the regional and hydrothermal dolomite, the maximum age of mineralization at Lisheen was at least 10 m.y. after host-rock deposition.

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