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Facies Architecture and Diagenesis of the Lower Carboniferous Shallow Marine Carbonate Rocks of the Irish Midlands: Implications for the Fluid-Flow System and Mineralization

Platform carbonates were deposited in tilted half-graben basins in the Irish Midlands during the Lower Carboniferous. The Chadian-Arundian proximal sediments, adjacent to the Leinster Granite, include very shallow, tidal flat environments with dolomites, oolites, fenestral mudstones, and stromatolites with associated evaporites. The laterally equivalent distal facies, including the Rathdowney Trend mineral district, consist of skeletal wacke-packstones and dolomites. The Holkerian-Brigantian sequences in both areas are open marine and built up by fossiliferous wacke-pack-grainstones.

The tidal flat sediments were affected by early diagenetic processes that include the replacement of the evaporites and dolomitization. The subsurface migration of brines caused dolomitization of the underlying units (y^{13}C and y^{18}O values of –0.4 to 3.0‰ and –0.2 to –2.6‰) and precipitation of anhydrite in solution cavities. In the distal facies, however, the dolomite was precipitated from a slightly modified seawater as opposed to highly evaporated seawater (3.3 to 4.5‰ and –6.1 to –7.1‰). Late diagenetic dolomites are associated with complex regional fracture systems and fluid inclusion analyses indicate at least three distinct fluids. Halogen chemistry of brine inclusions (Cl:Br ratios) is consistent with genesis of hydrothermal fluids from evaporated seawater. Dissolution of halite along flowpaths provides a plausible explanation of Cl enrichment in mineralizing brines.

This study shows the importance of the complex interaction between depositional environment and fluid migration. It is the first time that a link between a possible source of migrating evaporite brines and base metal mineralization has been established in the Irish Midlands.