Genesis of Late Tournaisian lead + zinc + copper + baryte deposits in Ireland and Nova Scotia

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Cryptocrystalline baryte passes down dip (basinwards) into fine-grained pyritic zinc + lead + baryte ores at Silvermines, Ireland and Walton, Nova Scotia. At Silvermines the ores are demonstrably exhalative sedimentary, occur near the base of fault related depressions and are associated with submarine debris flows. Upward vertical zonation, Mn→Mn+Zn→Mn+Zn+Fe + Pb → Mn + Zn + Fe + Pb + minor Cu, reflects an increase in temperature of hydrothermal fluids with time up to at least 265°C. Chalcopyrite is also paragenetically late at Walton and Tynagh, a contrast with deposits of volcanic association.

Walton and the Irish deposits, Silvermines, Tynagh, Keel, Ballinalack and Navan, share a common basement, the Appalachian-Caledonian orogenic pile and, remarkably are coeval although separated by a predrift 20° of Earth circumference. Their features are accounted for by deriving the ore solutions from subsurface convective circulation of modified highly saline Early Carboniferous seawater. The circulation was initiated during rifting and driven by the high geothermal gradient (Appalachian-Caledonian granites froze between 420-360 Ma). As a result of continued extensional strain and cooling of the rock column the brittle to ductile transition zone is depressed and the circulating fluids penetrate to greater depths with time. Of the ore metals the downward-penetrating convecting fluids first leach and transport zinc and lead, but where the temperature of the fluids increase sufficiently with time, are later able to leach and transport copper. The minimum distance (≈18 km) separating ore deposits of this type is a function of the size of the convective systems.