Fluid mixing during ore deposition at the Tynagh base-metal deposit, Ireland

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Abstract: The Tynagh base-metal deposit is hosted by upper Tournaissian to lower Visean age Waulsortian carbonates in the west of Ireland. Epigenetic galena, sphalerite and baryte are located in the hanging wall of a major normal fault. Fluid inclusions in quartz, sphalerite and baryte show that two distinct fluids were responsible for the mineralisation. A high temperature moderate salinity fluid (240 °C, 12 Wt. %), derived from convection of Carboniferous seawater in the crust, carried most of the ore metals. A low temperature high salinity fluid (< 70 °C, 21 Wt. %), residing on or close to the seafloor, provided most of the reduced sulphur and sulphate. These fluids mixed to a minor extent on the seafloor as well as in the epigenetic ore zones and the fault zone which acted as a major conduit for both ascending and descending fluids. Post-ore fluid inclusions in calcite show no evidence of the high temperature fluid but record that the high salinity was being progressively diluted by a low salinity (c. 1 Wt. %) SO$_4^{2-}$ or HCO$_3^-$ meteoric fluid. The results are similar to those from the Silvermines deposit and suggest that other Irish base-metal deposits may have been derived from similar fluids.

Key-words: fluid inclusions, sediment-hosted Pb-Zn mineralisation, Tynagh, Ireland.

Introduction

The discovery of the Tynagh Pb-Zn-Cu-Ag-BaSO$_4$ deposit, 45 km ESE of Galway in the west of Ireland, during the 1960’s provided the impetus for the exploration which resulted in the location of other major stratiform base-metal deposits at Silvermines and Navan (Schultz, 1971). All occur at approximately the same stratigraphic level in the Carboniferous shelf carbonates of Ireland together with numerous sub-economic deposits such as Keel, Harberton Bridge and Ballinalack (Andrew et al., 1986).

The initial work on the deposit was carried out by Derry et al. (1965) who, observing that an iron formation with interbedded tuff bands was closely associated with the sulphides, suggested that emanations of sulphateric solutions during periods of local vulcanicity were responsible for the mineralisation. Schultz (1966) disagreed, suggesting that the iron formation was derived from chemical weathering of newly emergent lower Dinantian sediments and that association with the sulphides was purely coincidental. A partly syn-genetic origin for the deposit was favoured by Russell (1974) who discovered a manganese halo in the host limestones centred on the iron formation. In addition, chemical analysis showed that it was similar to iron formations of known exhalative origin and that it contained high concentrations of Ba, Zn and Pb indicating the sulphide ore-body was derived from the same solution (Russell, 1975).

The formation of Tynagh, and other Irish deposits, is accepted as being associated with a new extensional stress regime at the end of the Tournaisian, which may have resulted in thinning and eventual failure of the crust at the end of the Carboniferous (Russell, 1973, 1976; Russell & Smythe, 1983; Hazeldine, 1984; Smythe, 1984). The stable carbonate shelf was broken up by syn-depositional faults creating numerous basins. The increased permeability then allowed the downward penetration of the saline Carbonifer-