Fault-controlled stratiform Zn-Pb mineralization in the Irish Midlands: a structural study of the Galmoy orebodies

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In recent decades a variety of models have been advanced for the origin and evolution of Irish Zn-Pb deposits, all of which acknowledge the important role of faults, which act as the main conduits for transporting ore fluids and form the main bounding structures to the deposits. Here we present a study of the structure of the Galmoy deposit, in the Irish Midlands, which examines the role of the specific fault geometries responsible for focusing ore fluids within the bounding fault systems and the effect of minor faults on ore distribution within the deposit.

The Galmoy Zn-Pb orebodies are situated within the *Rathdowney Trend* of the south-central Irish Midlands: a *ca* 80 km long NE-SW-trending belt of Lower Carboniferous carbonate rocks noted for its abundance of mineral occurrences. Mineralization occurs in the hangingwall of a regionally-extensive, segmented normal fault array, is hosted by a 1-30m thick package of stratiform black dolomite-matrix breccias, developed at the stratigraphic contact between two formations with strongly contrasting lithological and rheological properties, namely: (1) pervasively dolomitised massive Waulsortian micritic limestones, and (2) well-bedded argillaceous bioclastic limestones (ABL) of the Ballysteen Formation, underlying the Waulsortian.

The Galmoy fault system bounds the orebodies to the south and consists of a series of ENE-trending segments which dip towards the north and collectively accommodate a maximum net throw of *ca* 200m. The fault system is segmented on a range of scales and exhibits structures reflecting the progressive stages of linkage of the fault segments. Two overlapping fault segments bound a 600m wide, gently (5°) E-dipping ramp, interpreted as a breached relay zone which hosts the G orebody. These large-scale fault segments are themselves segmented on smaller scales: the presence of breached relay zones, splays and bends are attributed to the coalescence of small-scale fault segments with strike-perpendicular dimensions of a few tens of metres at a relatively early stage in the fault displacement history. In addition to the large bounding faults, minor normal faults and extensional monoclines with displacements of *ca* 1-10m, termed 'rolls', are found throughout the mined area. Rolls are relatively discontinuous, being traceable for distances of *ca* 5-50m along strike.

The thickness of the orebodies increases towards the main ENE-WNW trending bounding faults. Critically, maximum ore thickness occurs within and adjacent to fault segment linkage structures along the principal normal fault zone (e.g. breached relay zones and the branch-line of a splay), consistent with the notion that the faults acted as the principal up-fault flow conduits for the mineralizing fluids. This model is supported by the general correspondence in metal distributions within the deposit: highest Pb:Zn values coincide with areas of thickest ore and decrease with distance away from the faults. The zonation in ore thickness and Pb:Zn ratio is interpreted to show that the fault segment linkage structures provided the principal vertical conduits which transported ore fluids to the brecciated interval, which subsequently cooled with distance away from these structures as they percolated through the breccia. Migration of the ore fluids within the stratiform breccias appears to have been affected by minor structures. Sulphide mineralization sits directly on, or close to, the base of the breccias and fills *topographic* lows, but normally does not entirely fill the brecciated column. Marked thickness changes of sulphide occurs across some roll structures and the apparent 'banking' of ore adjacent to the rolls suggests that, rather than acting as discrete feeder structures, the *topography* associated with the rolls may have exerted a strong control on the lateral flow of ore fluids within the stratiform breccia layer.

Although it is clear that normal faults and rolls were fundamental controls on the distribution of ore within the Galmoy deposit, the absence of evidence either of post-ore normal faulting or of textures indicative of fault-related fluid pressure cycling supports the notion that ore mineralization took place after normal faulting had ceased.