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Lithostratigraphic Controls on the Mineralizing System at the Stonepark Zn-Pb Deposit, SW Ireland

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Base metal demand is projected to increase significantly to sustain the energy transition. Zinc is an essential element for building the infrastructure for renewable energy production. A large proportion of global Zn resources are hosted in sedimentary basins, and to meet the future Zn demand, current mineral system models need to be refined in order to aid exploration programs. The Lower Carboniferous basin in Ireland (“Irish Orefield”) is one of the most prospective sedimentary basins for Zn-Pb mineralization. Irish-type Zn-Pb deposits are typically associated with normal faults and form stratabound bodies within fine-grained limestones. Pre- and syn-ore dissolution/brecciation of the host limestones (i.e., Waulsortian Limestone Fm) is a common feature in many Irish-type deposits. The Stonepark and neighbouring Pallas Green deposits share many characteristics with other Irish-type mineralization, but previous studies have noted two major differences: (1) the apparent absence of faults controlling the location of zones of mineralization; and (2) the close spatial association of zones of mineralization and brecciation with igneous rocks (dykes, sills, diatremes). To better constrain the mineral system at Stonepark, we present a 3D model that integrates drill core logging, exploration drilling data, and regional seismic interpretation. There are considerable differences in Waulsortian limestone facies (mudmound micrites, mudmound-flank wackestones, off-mudmound argillaceous wackestones). Our 3D modelling suggests that this initial facies architecture of the Waulsortian limestones had a strong control on the spatial distribution of zones of alteration/mineralisation due to the lithological contrasts (e.g., permeability, reactivity) between the different facies. The 3D distribution of Waulsortian limestone facies may also be a proxy for identifying initial, now blind or obscured, normal faults at the Stonepark deposit. This study highlights how comprehensive 3D geological modelling utilizing multiple data sets can be used to identify controls on the formation of Zn-Pb deposits in highly complex basin-hosted mineral systems.