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Structural evolution of the Currawong Pb-Zn-Cu deposit (Victoria, Australia) - new insights from 3D implicit modelling linked to structural observations

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Structurally controlled mineralisation commonly shows distinctive geometries, orientations and spatial distributions that derive from associated structures. These structures have the ability to effectively transport, trap and focus fluids. Moreover, structures such as faults and shear zones can offset, truncate and spatially redistribute earlier mineralisation. We present a workflow that combines structural fieldwork with state-of-the-art 3D modelling to assess the structural framework of an ore deposit. Traditional 3D models of ore deposits rely on manual digitisation of cross sections and their subsequent linkage to form 3D objects. Consequently, the geological interpretation associated with each section will be reflected in the resulting 3D models. Such models are therefore biased and should be viewed and interpreted with caution. Conversely, 3D implicit modelling minimises the modelling bias by using an implicit function that is fitted to spatial data such as drillhole data. This function defines a scalar field, from which 3D isosurfaces can be extracted. Assay data can be visualised as 3D grade shells at various threshold grade values and used to analyse and measure the shape, distribution and orientation of mineralisation. Additionally, lithology codes from drillholes can be used to extract lithological boundaries in 3D without the need for manual digitisation.

In our case study at the Palaeozoic Currawong Pb-Zn-Cu deposit (Victoria, Australia), orientations extracted from ore bodies within a 3D implicit model have been compared to structural field data collected around the deposit. The data and model suggest that Currawong's massive sulfide lenses have been structurally modified. Mineralisation trends are parallel to a dominant NW dipping foliation mapped in the field. This foliation overprints earlier bedding in the host metasediments that has been deformed into upright folds. Several sets of steep faults further increase the structural complexity of the deposit and offset mineralisation. Previously suggested conceptual models for Currawong do not adequately explain the spatial geometry and distribution of the mineralisation that is apparent in the 3D implicit model. We present a new structural history for the Currawong deposit, which explains the structural evolution (folding & faulting) of the massive sulfide lenses in 3D.