

Deformation and Stratigraphic Architecture of the Golden Grove Volcanogenic Massive Sulfide Deposits, Western Australia

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The Archean Gossan Hill and Scuddles volcanogenic massive sulfide (VMS) deposits at Golden Grove, Western Australia, share many characteristics with VMS systems across the globe. These include an extensional volcanic setting, association with felsic-dominated siliciclastic rocks, deposition of stratigraphically controlled massive to podiform sulfide bodies in a subseafloor environment, lower Cu-rich and upper Zn-rich ore lenses, and a silica-chlorite-pyrite-sericite-dominated alteration assemblage. Since the host stratigraphic units are mostly continuous along strike, the effects of pre- and postmineralization deformation have been largely overlooked. This study presents a deformation history for Golden Grove and uses this new information to improve our understanding of VMS mineralization processes and mine-scale resource targeting.

The dominant ductile deformation event is characterized by a moderate to pervasive, NNW-trending, steep W-dipping fabric associated with oblique sinistral-normal shearing. Predating this fabric were isolated, NNW-trending upright folds indicating E-W shortening and a spaced cleavage only observed in banded sedimentary sequences and interpreted to have formed during early extension of the host sequences. Importantly, evidence for syndepositional faulting has only been inferred from abrupt thickness variations in stratigraphic units, but, for the first time, drill core observations show that early extension structures are not only abundant, but played a pivotal role in fluid infiltration and VMS mineralization.

Important factors determining the distribution of high-grade mineralization at the mine scale are the plunge of lineations within the steep W-dipping fabric, the thickness variations in lithologies bounding the host sedimentary rocks, and proximity to postmineralization dacite and dolerite intrusions. By integrating these data in three-dimensional models, more specific drilling programs have been defined, maximizing the process of resource discovery and converting resources into reserves.