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Topology of a mineralised stockwork: Sunrise Dam Gold Mine, W. Australia

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Stockworks are a common structural setting in epithermal and some mesothermal gold deposits. Connectivity of a fracture/vein network is critical for their formation, and for their contained resource. However, connectivity is difficult to assess by conventional geometrical parameters in the restricted confines of mines. A topological approach offers many advantages [1], which we apply for the first time to a stockwork ore body at Sunrise Dam Gold Mine, Western Australia.

Sunrise Dam is one of Australia's premier gold mines, having produced in excess of 8.5Moz of gold since 1989, with current Mineral Resources and Ore Reserves at 58.96Mt@2.41g/t Au (4.55Moz) and 21.45Mt@1.87g/t Au (1.29Moz), respectively [2]. The mine is situated in the Laverton greenstone belt on the Yilgarn craton, and hosted in andesitic to basaltic volcaniclastic rocks, iron formation, turbidites and porphyry sills and dykes. As typical for a world-class resource, there are several styles of mineralization and important variations through the mine between shear zone-, stockwork-, breccia-, and vein-hosted mineralization. There was a complex structural sequence with mineralization occurring under greenschist facies in the Late Archean [3]. In several respects sunrise Dam Gold Mine is a typical greenstone-hosted, late Archean lode gold deposit.

Part of the Astro Lode is a stockwork of quartz-carbonate veins hosted in volcanics. Veins are typically cm thick, and have wider sericite alteration haloes. The veins can be divided into four sets that have mutually cross-cutting relationships and similar mineralogy. Veins are dominantly extensional as judged from their blocky fillings, but one set of veins has consistent indicators of shear in the form of laminations. These characteristics are compatible with gold mineralisation in a stockwork created by a fluctuating stress and fluid pressure regime.

Detailed face maps show a network of I (isolated tips), X (crossing) and Y (abutting) nodes at vein terminations and junctions, giving basic topological measurements that indicate a highly connected topology compared to fault networks in the literature. In order to characterise vein intensity, the 3D vein orientations need to be taken into account. It was not possible to measure every vein when mapping, so that veins have been assigned to one of four sets based on their apparent dip and dip direction in the face (Fig. 1). This is justified because–the face was at a high angle to the majority of veins (Fig. 1). Terzaghi corrections could then be derived on the basis of each separate vein set. True vein intensities can be calculated from the sum of the separate vein sets. The topological approach also allows the effect of a finite sampling area to be accounted for. It may allow stockworks to be characterised more effectively for resource evaluation.

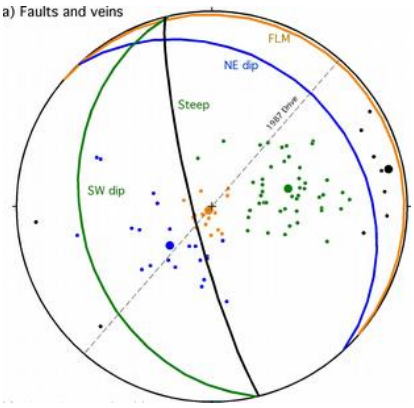

Figure 1: Lower hemisphere, equal area stereoplot of poles to fracture sets in the Astro Stockwork Great circles show best fit to each of the four sets. Dashed line shows orientation of mapped drive.

References:

[1] Sanderson D and Nixon C (2015) J Struct Geol 72: 55-66

[2] AngloGold Ashanti (2014) Mineral resource and ore reserve report; 116-117

[3] Baker et al. (2010) Econ Geol 105:873-894