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Fracture, fluid flow and paleostress at Sunrise Dam Gold Mine, W. Australia

Thomas Blenkinsop (1), David Sanderson (2), and Michael Nugus (3)

(1) Cardiff University, School of Earth and Ocean Science, Cardiff, United Kingdom (blenkinsopt@cardiff.ac.uk), (2) Faculty of Engineering and the Environment, University of Southampton, Southampton SO17 1BJ, (3) AngloGold Ashanti, Strategic Technical Group. Perth, WA. 6000

Some of the clearest examples of Interactions between fracture, fluid flow, pore fluid pressure and differential stress can be inferred from underground observations in mines. This study examines the inferred stress conditions and resulting fracture network that constitutes a stockwork type ore body at Sunrise Dam gold mine, Western Australia. Stockworks in mine workings are particularly instructive for such analyses, because the abundance of veins allows cross-cutting relationships to be observed, which are commonly hard to see in situations of lower fracture intensity or incomplete outcrop. Sunrise Dam has 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. The stockwork examined is in the Astro ore body, and consists of three sets of extensional veins and one set of low-angle strike-slip shear veins. Cross-cutting relationships suggest broadly contemporaneous formation of all fracture sets, which are also related by a common quartz-carbonate mineralogy. The extensional veins intersect the shear veins along the direction of shear, a geometry that can be predicted for certain stress ratios. Combined with observations and paleostress inferences from other parts of the mine, the veining and gold mineralisation can be associated with a D4 strike-slip shearing event, which had a maximum compressive stress plunging gently NE. Fracture intensity varies by 50% on a scale of 10s of metres. The stockwork formed by repeated extensional and shear failure events, showing fluctuations in pore fluid pressure and stress conditions, which would have required fracture healing/sealing in order for the deformation to spread throughout the stockwork volume.