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3D modelling of the Leonora district, Yilgarn Craton (Western Australia) Implication for the tectonostratigraphic evolution and Au - mineralisation

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We present the results of a recent investigation of the tectonostratigraphic evolution of the Leonora gold district in the Yilgarn Craton of Western Australia. Our approach relies on a combination of field based structural investigation, the compilation of existing and recently acquired U-Pb SHRIMP data and digital 3D modelling. Our research strategy rigorously tests the geological model(s) generated through the field based study and lithostratigraphic correlation by using 3DGeoModeller geological modelling software. 3DGeoModeller implicitly models the geometry of rock units in 3D constrain by the geological and potential field (gravity and magnetic) data.

The results of our research indicate a structural evolution for the Leonora district that can be divided in 3 principal stages. The first stage is associated with the deposition of mafic/ultramafic sequence prior to ca. ca. 2751Ma. Lateral thickness variation of the lithostratigraphic units bounded by cross-structure delineated on potential field images are interpreted as remains of an early basin architecture active prior to or during the time of the greenstone deposition. This early architecture was then affected by at least two major penetrative ductile deformations. D1 is associated with a phase of regional granitic doming dated at ca. 2751 Ma generated through a combination of gravitational tectonic and far-field extension. During this deformation stage the early basin architecture defined during the deposition of the supracrustal cover may have controlled the dome geometry and early fault may have been reactivated to accommodate the deformation. Followed by the deposition of felsic volcanics and metasediments in the greenstone belts, D1 structures are overprinted by a second ductile deformation event D2. D2 is characterized by steep NW-SE- to N-S trending foliations and upright folds. D2 strain is strongly partitioned over the area with granitoid plutons emplaced during D1 acting as rigid block and providing D2 strain shadows. Gold mineralisation is closely associated with D2 and was dated at Sons of Gwalia at ca. 2640 Ma [1]. However, structural relationship together with the mineralisation style documented in the Leonora district support a protracted mineralization history during which gold was deposited from D1 to D2.

In conclusion, we argue that the early basin architecture developed prior to D1 was successively reactivated throughout the protracted tectonic history of the Leonora district and largely contributed to its present geometry. Furthermore, we suggest that the structures bounding the early greenstone basin architecture and successively reactivated played a key role in fluids focusing throughout the crust and the formation of gold deposit in the Leonora district.

[1] M.S. Baggot, A Refined Model for the Magmatic, Tectonometamorphic and Hydrothermal Evolution of Leonora District, Eastern Goldfields Province, Yilgarn Craton, Western Australia, University of Western Australia, 2006.