Crustal Architecture and Under Cover Exploration: The Granites-Tanami Orogen Example

David B. Stevenson,[1,*] Linda M. Iaccheri,[1] Leon Bagas,[1] T. Campbell McCuaig,[1] and Alan R.A. Aitken[2]

[1]Centre for Exploration Targeting and ARC Centre for Excellence for Core to Crust Fluid Systems (CCFS), School of Earth and Environment, University of Western Australia, 35 Stirling Highway, Crawley, WA 6009, Australia
[2]Centre for Exploration Targeting, School of Earth and Environment, University of Western Australia, 35 Stirling Highway, Crawley, WA 6009, Australia

*E-mail, david.stevenson@research.uwa.edu.au

Understanding the nature of the lithosphere and its crustal architecture is vital in the successful execution of regional mineral exploration under cover. Mapping of crustal architecture is achieved by integrating regional-scale geophysical datasets with geological knowledge. In this study, we use the Paleoproterozoic Granites-Tanami Orogen of central Australia as a natural laboratory to test the relationship between mineral systems and crustal architecture, and illustrate how these associations aid vectoring in on undiscovered resources under cover.

The Granites-Tanami Orogen is a significant gold-producing province. Gold mineralization is hosted within the mid-Paleoproterozoic stratigraphy of the Tanami Group and is associated with late Paleoproterozoic deformation. Deep weathering profiles and cover sequences from Neoproterozoic to Paleozoic obscure much of the Tanami Group within the Granites-Tanami Orogen. Consequently, the majority of gold discoveries within the orogen occur in or near surface exposures of the Tanami Group. The interpretation of crustal-scale 2-D reflection seismic data identifies inverted basin architecture within the orogen, although the sparsity of seismic sections does not allow for the 3-D mapping of this basin architecture at a regional scale. In this study we couple gravity, magnetic, and seismic interpretation with geophysically constrained forward modeling to map out the Granites-Tanami Orogen's crustal architecture and place its mineral systems within this architectural framework. We display how this integrated geological and geophysical approach to map crustal architecture is a cost-effective technique to improve success in under cover mineral exploration.