



The regolith expression of gold mineralisation in the Central Gawler Craton, South Australia: examples from the Tunkillia Gold Prospect and the surrounding region

BENJAMIN G. VAN DER HOEK

University of Adelaide
School of Earth and Environmental Sciences
Department of Geology and Geophysics

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Abstract

Transported and typically weathered material that covers much of Australia presents a challenge to the successful application of surficial geochemical exploration methods. The Gawler Craton of South Australia is host to world-class IOCG-U style (viz. Olympic Dam and Prominent Hill) and Au (Challenger) deposits. Exploration in this region is a challenging enterprise, where 90% of the crystalline basement is under sedimentary cover. Geochemical sampling of regolith materials, such as pedogenic carbonate, has been attempted across the Gawler Craton to target buried mineralisation. However, results have been equivocal because the calcrete is potentially transported, poorly developed, or absent. Plant biogeochemistry has also emerged as a tool for mineral exploration, as it has been attributed to the discovery of mineralisation in regional-scale surveys in Canada, however, Australian applications have been limited.

The Tunkillia Au Prospect (*Mungana Goldmines Ltd.*), in the central Gawler Craton, was first recognised on a 50 km² area of elevated Au-in-calcrete (> 10 ppb). The Prospect has a challenging exploration context: pervasive sand dunes and leached saprolite cover mineralisation that is at depths greater than 50 m. Gold content in the surface materials does not always represent underlying mineralisation, and this has misled previous exploration targeting in the area.

In this thesis I show that a detailed analysis of the transported and residual regolith in three profiles to a depth of 50 m indicates that despite deep weathering, geochemical and mineralogical indicators of mineralisation are retained. The saprolite is predominantly kaolinite with relic feldspar in each of the profiles. White mica (muscovite and phengite) is abundant in the saprolite from the site of main mineralisation (Area-223). The white mica is distinguished using Hylogger™ and/or X-ray diffraction, and is characterised by Rb concentrations > 175 ppm using portable XRF instruments. Results from biogeochemical and calcrete sampling conducted across parts of the Tunkillia Au Prospect are interpreted in the context of landscape setting. Plant and calcrete Au results are similar at the prospect scale that suggests that the plants are accessing the Au from calcrete. The Au-in-calcrete anomaly is controlled by palaeo-drainage. Gold within calcrete is restricted to detrital sand pods, indicating the Au is transported within sediments from an upslope source. Silver and Te in plant leaves also indicate upslope mineralisation, highlighting areas of the Prospect that warrant further investigation.

Biogeochemical pathfinders of metre-scale mineralised veins in the Glenloth and Earea Dam goldfields west of Lake Harris I found were Au, Ag, Bi, Cu, Sn, Te and U. Biogeochemical sampling was implemented in regional surveys (20 – 200 km²) alongside regolith geochemical sampling. Calcrete development is generally irregular, whereas plant samples could be collected at regular intervals. Biogeochemical sampling was able to delineate underlying geology, particularly the Gawler Range Volcanics (high Pb) and Deception Hill basalt (high Re). Biogeochemical results were also found to be influenced by landscape processes such as mechanical and hydromorphic element mobility along drainage and aeolian contamination in open chenopod shrublands and near unsealed roads.

Keywords: *Tunkillia, Gawler Craton, biogeochemistry, calcrete geochemistry, Yellabinna, Glenloth, Earea Dam.*

Statement of originality

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Publications and conference proceedings derived from this research

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VAN DER HOEK B. G., HILL S. M. & DART R. C. 2011. Regolith carbonate geochemical and plant biogeochemical inter-relationships for the expression of deeply buried mineralisation at the Tunkillia gold prospect, central Gawler Craton, Australia. International Applied Geochemistry Symposium, Rovaniemi, Finland.

VAN DER HOEK B. G., HILL S. M. & DART R. C. 2011. How deep is deep? Plant biogeochemistry for detecting deep mineralisation. Goldschmidt 2011, Prague, Czech Republic.