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Regolith landforms and regolith geochemistry of the Tomahawk Au-in-calcrete anomaly, Tunkillia, Gawler Craton, SA

The 'Tomahawk' Au-in-calcrete anomaly is a zone of peak Au-in-calcrete content within the Tunkillia prospect of the central Gawler Craton, South Australia. Exploration drilling of this area has failed to intersect significant underlying mineralisation, making this an important setting to investigate controls on linkages between Au-in-calcrete expression and possible mineralisation sources. This study is the first to consider the multi-element geochemical characteristics of calcretes at 'Tomahawk' rather than using the Au-only approach of previous geochemical exploration. This investigation also considers the potential for laterally dispersed geochemical signatures across the landscape recorded at the surface of Au and associated elements, and suggests that Au was, and may still be physically mobilised along old and contemporary alluvial drainage depressions.

There is a low relief, but locally significant drainage divide to the south of 'Tomahawk', so the anomaly area is associated with a point of low, broad confluence of several north flowing palaeodrainage depressions. The interpretation of these palaeolandscape controls further builds on palaeodrainage channel identification from previous studies and supports hypotheses that 'Tomahawk' is in an upper catchment setting, relative to the 'Area 191' Au-in-calcrete anomaly.

Primary Au mineralisation at Tunkillia is associated with pyrite, minor galena and sphalerite within quartz-sulphide veins, and has a geochemical association with Au, Ag, Pb and Zn. Supergene Au enrichment has been recognised within ferruginised saprock overlying mineralised bedrock, and

this is largely considered Au-only mineralisation. The calcrete geochemistry here shows some distinction between possible primary and secondary Au occurrences based in the trace element characteristics. The Au-in-calcrete concentrations obtained in this study are up to 194 ppb within CHep and $ISps_2$ regolith-landforms in the north of the study area, corresponding to the lower margins of topography and areas interpreted to be within palaeodrainage systems. Silver concentrations above detection were found in association with many of the elevated Au results, therefore identifying areas of interest and possible alteration halos surrounding primary Au mineralisation. Furthermore small exposures of weathered *in situ* quartz veins support a possible source for the 'Tomahawk' Au-in-calcrete anomaly to the south, which is immediately upslope of the palaeodrainage system.