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Exploring for gold using radiometrics, magnetics, and petrophysical information in the Warrawoona greenstones of the East Pilbara, Western Australia

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SUMMARY

The Warrawoona Gold Project is located 25 kilometres southeast of Marble Bar in the East Pilbara region of Western Australia. Key prospects include the Klondyke deposit, which forms the main share of the 1.25 Moz gold resource owned by Calidus Resources Limited.

Intense deformation is localised in the narrow zone between the Mount Edgar and Corunna Downs batholiths, and which manifests as strong shearing, steeply dipping lineations, sheath folds and steeply plunging isoclinal fold hinges. Physical property measurements and borehole surveys have shown that ore-bearing structures containing sericitic alteration may be identifiable at the regional to project scale using potassium from radiometric data. Magnetite-destructive alteration and structural complexities relating to the compression and elongation of the greenstone units are also associated with mineralisation.

The project area is well exposed with minimal regolith cover. A regional 25m line-spaced airborne magnetic and radiometric survey was acquired across the project in 2020, with a north-south orientation, greatly superseding previous regional data of 100m – 400m line spacing. The detailed datasets have been used to identify radiometric potassium anomalies, which are generally mappable as stratigraphy-parallel elongate zones across the project area. Using the magnetic data, these zones were then assessed for structural complexity as a proxy for mineralisation traps, and for evidence of magnetite destruction as a proxy for alteration.

The magnetic and radiometric interpretation was integrated with published outcrop geology maps and local topography information. A total of 95 target areas were identified, including an untested trend to the west of the Klondyke deposit.

Key words: radiometrics, magnetics, potassium, deformation, alteration

INTRODUCTION

A regional review of gold potential in the Warrawoona greenstones has been carried out using detailed airborne magnetics and radiometrics data. Physical property analysis and review of regional datasets has indicated that ore-bearing structures containing sericitic alteration may be identifiable at the regional to project scale using potassium from radiometric data. Magnetite destructive alteration and structural complexities relating to the compression and elongation of the Warrawoona greenstone units have also been found to be associated with mineralisation.

The resulting regional structural and lithological interpretation and target area selection has focused on identifying potassium trends as a proxy for sericitic alteration. Priority has been given to areas showing complex structural features, relating to the compression and elongation of the greenstone units, which have the potential for trapping mineralisation. Areas with magnetite alteration, particularly magnetite destructive alteration, were also identified as priority target areas.

GEOLOGICAL SETTING

The project area (FIGURE 1) is centred approximately 25 km southeast of Marble Bar in the west-northwest trending Warrawoona Syncline between the Mount Edgar and Corunna Downs batholiths. The Warrawoona Syncline consists of the Marble Bar and Kelly greenstone belts juxtaposed along the Fielding's Find Shear Zone and is mainly comprised of mafic to ultramafic volcanic rocks with minor felsic volcanic rocks and sedimentary rocks, including bands of chert and silicified black shales. The greenstones were strongly deformed, very tightly folded and sheared during four major stages of mappable deformation. The most notable deformation is localised in the narrow zone between the batholiths and consists of strong shearing, steeply dipping lineations, sheath folds and steep fold plunge hinges.

PHYSICAL PROPERTIES

Physical property testing and borehole logging was previously carried out on multiple holes at the Klondyke prospect. The magnetic susceptibility results showed that the samples containing gold mineralisation have significantly lower readings of ~1 x10-3 SI compared to the non-mineralised samples. The significantly higher susceptibility of the non-mineralised samples indicates that the mineralised samples may be associated with magnetite destructive alteration, likely observable at regional to prospect scale.

The borehole logging also demonstrated a strong correlation between gold and potassium-uranium-thorium radiometrics, particularly potassium, and this was also observed in open file wide-spaced radiometric data which highlighted the gold-bearing shear zones in the area.

AIRBORNE SURVEY AND DATA PROCESSING

A detailed airborne magnetics, radiometric and digital terrain survey was predominantly used in the interpretation and targeting work. The survey was flown in 2020, at 25m line spacing and 25m mean terrain clearance in a north-south

orientation. Grid filtering, image processing and enhancement were carried out on the data to generate a suite of vector contours, flight paths and images. Images of the radar altimeter data overlain on the magnetics were used to highlight areas of large survey drape over localised sharp topographic ridges resulting in lower magnetic resolution to avoid misidentification as magnetite destructive alteration. Clipped 'north' and 'south' areas of the low count greenstone radiometrics were used to provide an appropriate colour stretch for observing detailed signal in these areas.

METHOD

The interpretation was based predominantly on the newly acquired aeromagnetic and radiometric data, published outcrop geology maps and topography data where applicable. The methodology involved the manual delineation of first order structures and the greenstone-granite boundary/s at 1:50,000 scale. Felsic units and areas of gneissic textures were also differentiated. Radiometric data were then used to identify trends and zones of potassium as a proxy for sericitic alteration.

Each potassium trend/ zone was then carefully reviewed in detail for any structural complexity that could be observed in the magnetic data. Emphasis was on features related to the compression of the greenstone belt which led to deformation along the northwest-southeast strike of the belt. This included features such as tight refolding, rotated blocks, parasitic folding, boudinage (necks and dilation zones), fractured fold hooks and c-shears.

Targets were identified within the potassium zones where structural complexity and/ or magnetite destruction is present, indicative of, respectively, trap potential and alteration.

RESULTS

Large-scale regional lithologies and first order structures of the Warrawoona area interpreted from the magnetics and radiometrics data are shown in FIGURE 2. The area is largely divided between granites and greenstones. Felsic units are differentiated in the greenstones as they have similar geophysical characteristics to the granitic areas, such as higher radiometric count and lower magnetic amplitude. Granite with a gneissic texture in the geophysical data is also separately divided.

Along-strike major faults and associated deformation resulting from the regional compression and elongation are generally regarded as syn-mineralisation. North-northeast to east-northeast trending cross-cutting faults are regarded as being younger than mineralisation.

High-potassium zones outlined using the radiometrics data trend along strike and are almost completely within the greenstone lithologies (FIGURE 3).

TARGETS

The regional review identified 95 targets over the Warrawoona regional area, of which 22 were ranked as high priority. The targets were selected within elevated radiometric potassium trends/ zones as a proxy for sericitic alteration. Targets were selected and prioritised based on the strength of the potassium anomaly, and evidence in the magnetic data for both structural complexities associated with compressive deformation as a proxy for potential traps, and magnetite destruction as a proxy for alteration.

An example of a potassium zone showing areas of structural complexity and magnetite destruction can be seen in FIGURE 4.

Two targets outside of the potassium trends were also selected for having strongly anomalous magnetic responses.

CONCLUSIONS AND RECCOMMENDATIONS

Physical property measurements and borehole logging encouraged the application of detailed magnetic and radiometric data for regional target area selection at the Warrawoona Project.

The integration of this data with published outcrop geology maps and topography data has resulted in a regional scale interpretation which can be used to identify high priority exploration areas for more detailed interpretation at 1:10,000 scale or higher going forward. This would allow delineation of the local geology, key mineralisation characteristics and target outlines.

Integration of the current target set with surface geochemical sampling is recommended as is ground-truthing over high priority targets to de-risk follow up exploration.

ACKNOWLEDGMENTS

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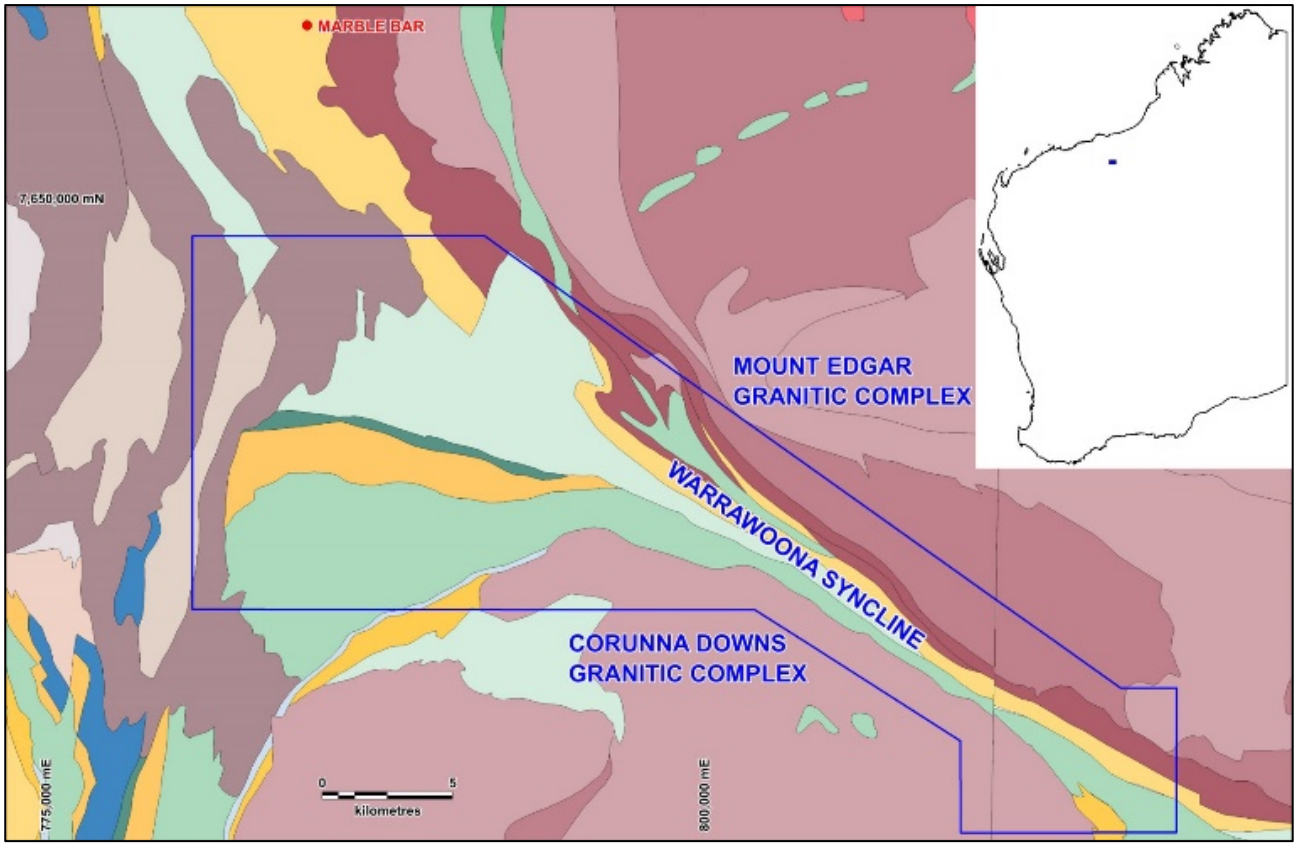

Figure 1. Regional 1:100,000 scale GSWA geology of the Warrawoona Greenstone Belt and project area (blue outline).

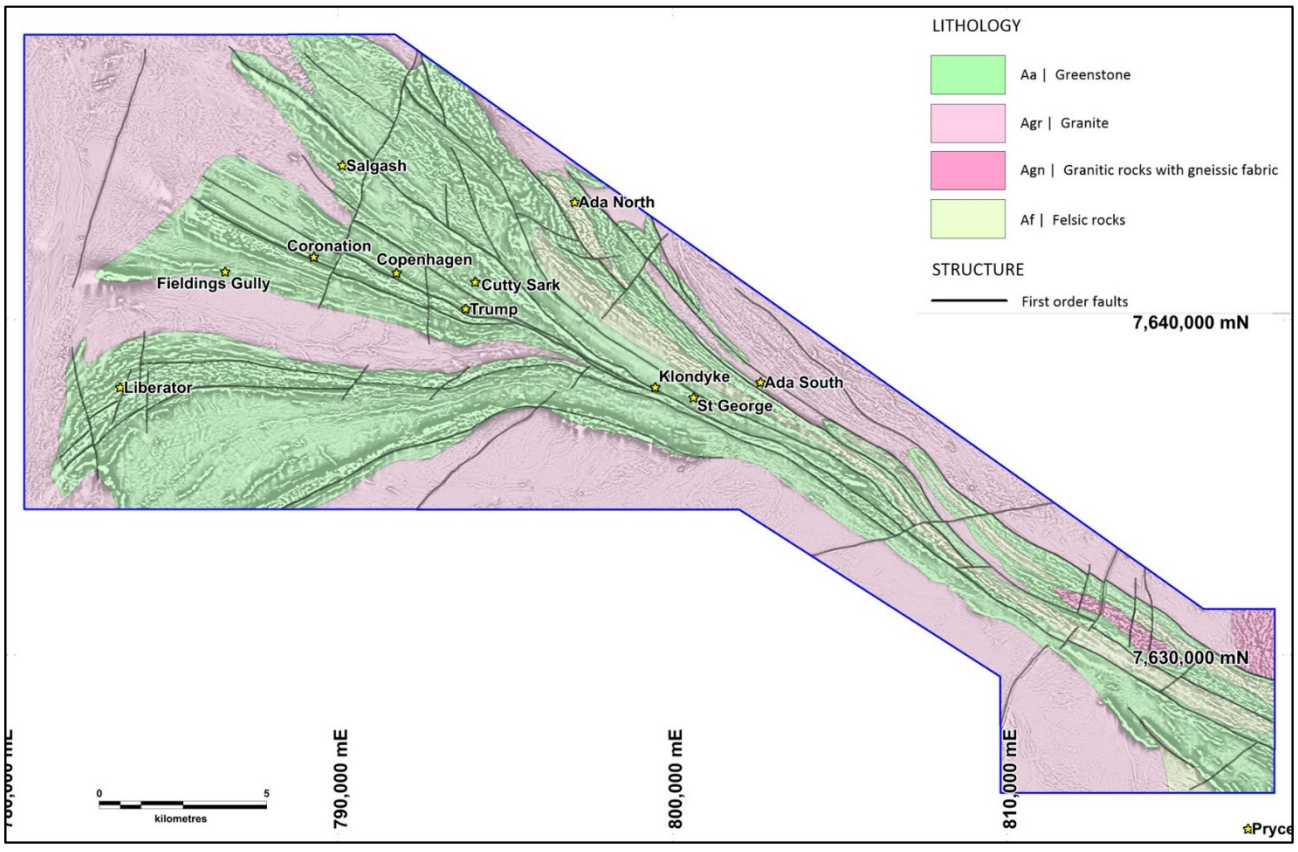

Figure 2. Interpreted lithologies and first order structures overlain on greyscale RTP first vertical derivative (1VD) magnetics image.

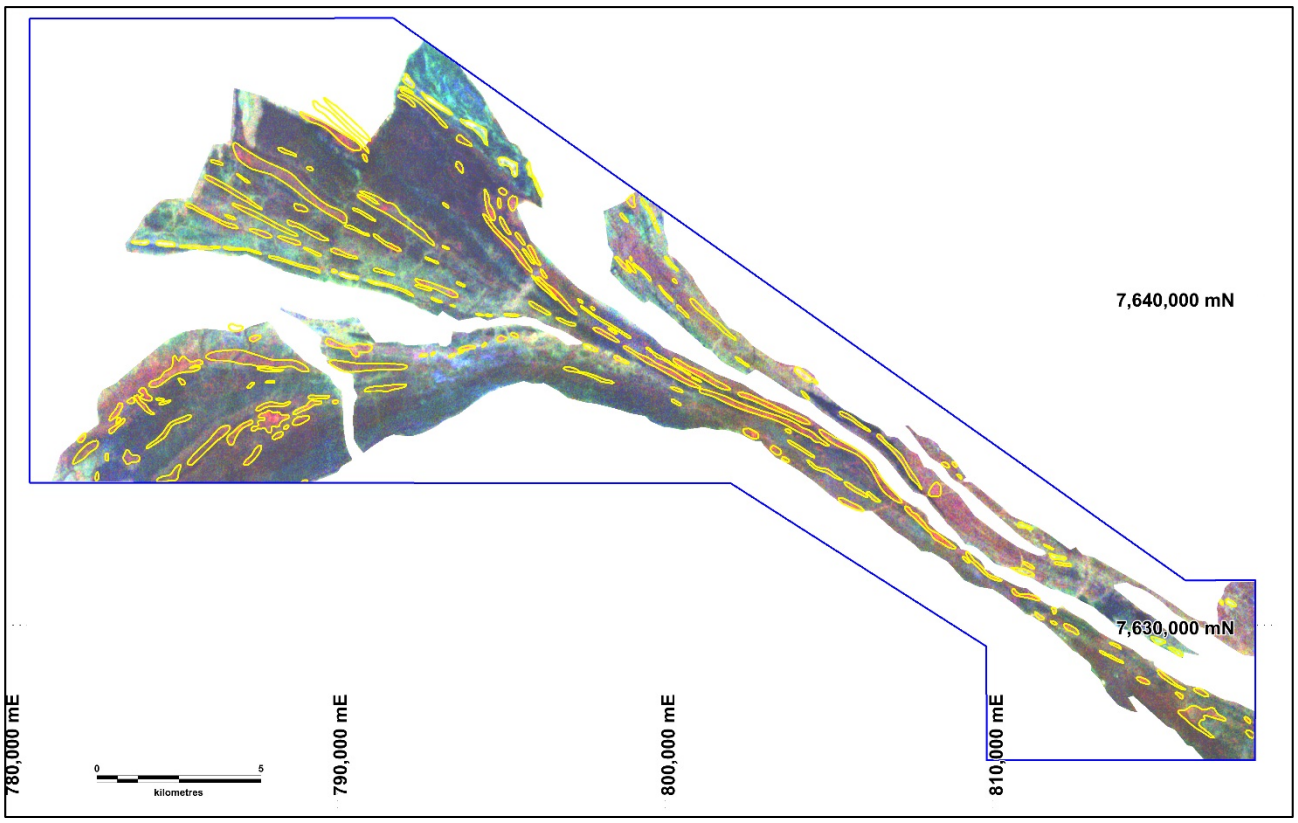

Figure 3. Clipped ternary image of radiometrics over the low count greenstone areas. Potassium trends and zones are highlighted as yellow outlined areas.

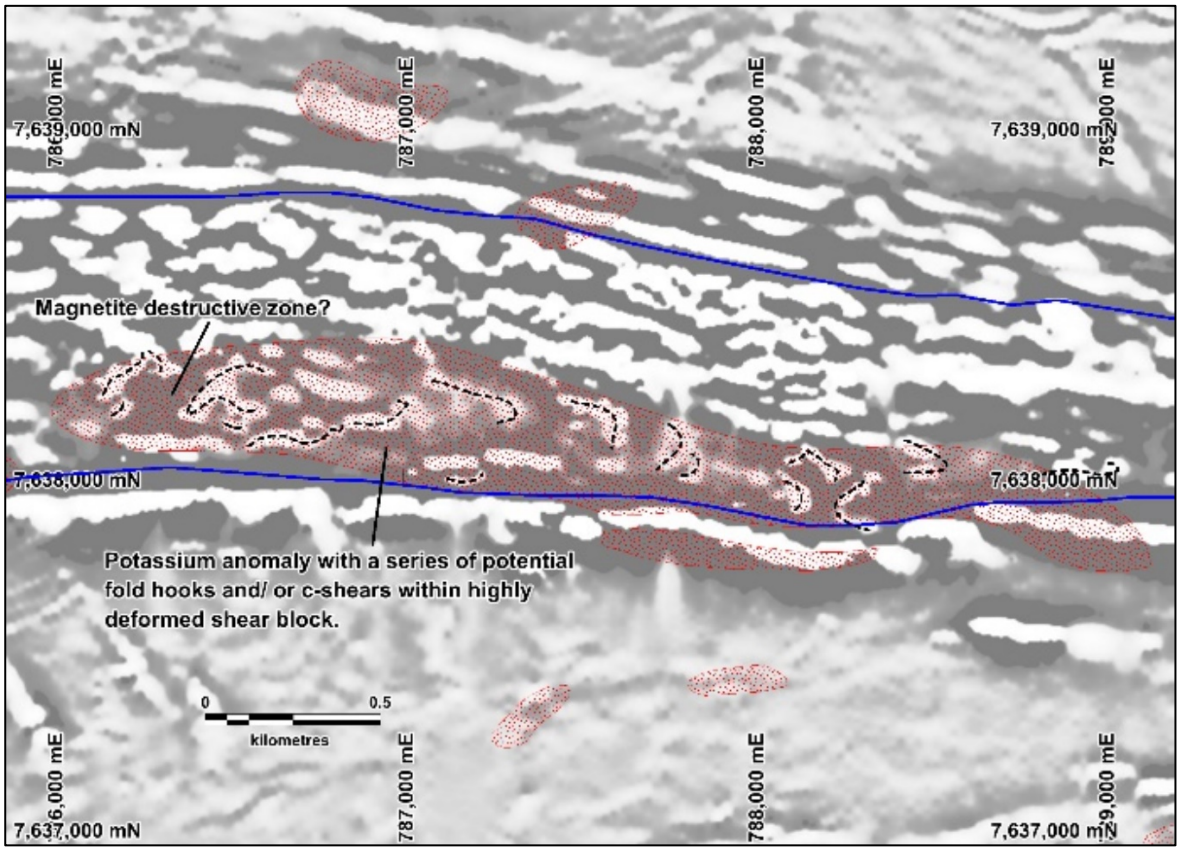

Figure 4. Example of an interpreted potassium zone (red hatching) showing areas of structural complexity and magnetite destruction, resulting in target areas WW002 and WW011.