Mapping Mineral Systems Footprints Through Cover – Linking Remote and Proximal Surface Geochemical and Mineralogical Data to Bedrock Geology

Heta Lampinen,[1*] Carsten Laukamp,[2] Scott Halley,[3] Lyndon Hardy,[4] Sandra Occhipinti,[1] T. Campbell McCuaig,[1] and Marco Fiorentini[1]

[1]Centre for Exploration Targeting and ARC Centre of Excellence for Core to Crust Fluid Systems, School of Earth and Environment, UWA, M006 35 Stirling Highway, Crawley, WA 6009
[2]CSIRO Mineral Resources Flagship, 26 Dick Perry Avenue, Kensington WA 6151
[3]Mineral Mapping Pty Ltd, 24 Webb Street, Rossmoyne, WA 6148
[4]Abra Mining Pty Ltd, 34 Colin Street, West Perth, WA 6005

*E-mail, heta.lampinen@research.uwa.edu.au

Stratabound base metal mineralization at Abra occurs >200 m below the surface and is centered over a magnetic anomaly. The mineralization, thought to be of hydrothermal origin, is hosted in carbonate and siliciclastic rocks of the Mesoproterozoic Edmund Group depositional package one that underlie younger siliciclastic rocks in the region. The Jillawarra Subbasin structural corridor that Abra lies in is adjacent to the junction of two major faults, namely the northeast trending Bujundunna Fault and the east-trending Quartzite Well Fault. Because the deposit is "blind" to the surface, traditional surface soil geochemical studies have been unable to clearly delineate the mineralization signature. The objective of this study is to establish links between bedrock, regolith and ASTER remote sensing data in the region (60*110km area around Abra), by using reflectance spectroscopic data collected from the regolith as a medium, in order to identify mineral systems footprints potentially filtered through the cover. This study is a part of an ongoing PhD project focusing on differentiating signatures of mineralization from regional background variation by combining hyperspectral data with existing geological, geochemical, and geophysical datasets from the surface and subsurface. The project is funded by SIEF Capricorn Distal Footprints study, which nested in the larger UNCOVER initiative.

Surface VNIR-SWIR reflectance spectra were collected with a field spectroradiometer (FieldSpec3 Hi-Res) from 522 archived surface samples of the GSWA and CSIRO geochemical sampling campaigns. Additional sampling was conducted on site using a TerraSpec 4 Hi-Res to provide a denser sample grid in the areas of interest. The acquired reflectance spectra were processed in The Spectral Geologist (TSG^{TM}) software by using a Multiple Feature Extraction Method. Thirty XRD analyses on samples having multi-element geochemistry analysis were conducted to confirm the sample mineralogy inferred from the VNIR-SWIR data. For testing the remote sensing mineral maps, ASTER data was collected from sample coordinates and surface sample hyperspectral field spectroradiometer data were down sampled to ASTER multispectral band resolution.

Based on the preliminary results, the regolith geochemistry reflects the underlying lithology and correlates with the VNIR-SWIR data. The regolith over felsic Moorarie Supersuite granites and Edmund depositional packages 1 and 3 have high SiO_2% in contrast to dolerites and Edmund package 4 where silica content is relatively low. The analysis of reflectance spectra using 2200 nm feature depth as indicator for the Al-clay content, the 2160 nm feature depth for kaolinite and the 2350 nm feature depth for white micas, combined with 2200 nm wavelength position for tracking the Tschermaks exchange ($Al^{IV}Al^{VI} \leftrightarrow Si^{IV}(Fe,Mg)^{VI}$), suggests that Al-rich clays are dominated by kaolinite and white micas are predominantly of phengitic composition. Regolith covering the Moorarie Supersuite contains phengitic white mica, which is consistent with granite geochemistry. It appears that there is no Al-smectite in the regolith, however all observations of mineralogy need to be validated by XRD analysis. In preliminary tests the ASTER AlOH Group composition shows moderate correlation with geochemistry (Al_2O_3%) as well as with reflectance spectra Al-clay composition detected by the change in 2200 nm wavelength position.