MINERAL MAPPING FROM BEDROCK TO PLAYA SEDIMENTS: EXAMPLES FROM ST IVES

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Introduction

Portable visible and shortwave-infrared spectroscopy is a reliable and fast technique for mineralogical analysis of regolith and primary lithology. The technique is sensitive to clays, hydrous silicates, other hydrous minerals and carbonates, and may recognise regolith type, primary lithology and gold associated alteration. It can provide valuable support to visual logging of drill core or chip tray material. However, the technique does not recognise feldspars, quartz, sulphides and other non-hydrous minerals present in many rocks. Spectra were taken from down-hole samples from two traverses over Au deposits in Lake Lefroy, Western Australia, courtesy of St Ives Gold Mining Company Pty Ltd. The equipment used was the ASD[1], which has a wavelength range from 350 to 2500 nm, followed by input into "The Spectral Geologist"[2]. The "Spectral Assistant" module was used to derive mineral compositions. Aims were to map fresh rock alteration, to test the capacity to "objectively" log regolith stratigraphy, and to investigate spectral parameters for the determination of lithological features from highly weathered samples.

[1]Analytical Spectral Device – Fieldspec Pro ©

[2]© Ausspec International Pty Ltd

Intrepide Traverse

The east-west Intrepide traverse extends for 730 m, with approximately 200 m of ultramafic flanked by intermediate rocks (Figure 1). The regolith consists of 10-12 m of sediments over saprolite and saprock weathered to 50 m. Gold distribution is erratic (Figure 2), but appears to be locally higher along lithological contacts.

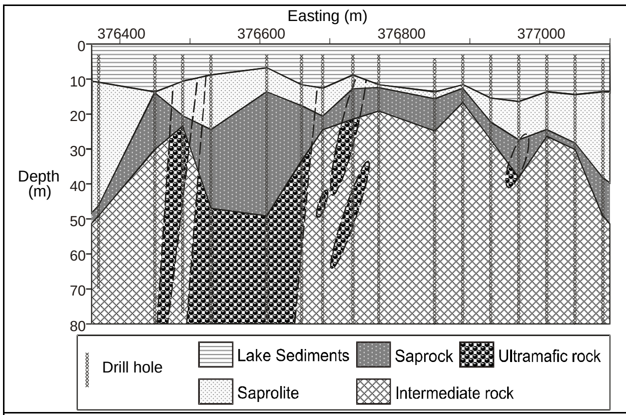

Figure 1: Geology and regolith stratigraphy of the Intrepide traverse

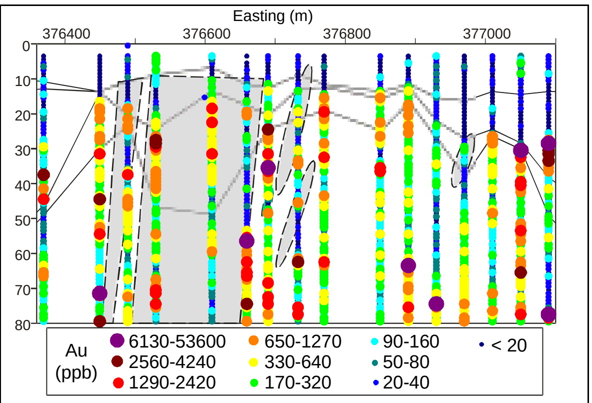

Figure 2: Gold distribution for the Intrepide traverse

Mineral maps and mineral assemblages obtained from the ASD are consistent with, and enhance visually logged geology. Intermediate rocks are distinguished by muscovite (Figure 3) and phengite (Figure 4) The phengitic zones, not observed by visual logging, may be a useful alteration indicator. Chlorite is a major mineral in ultramafic regions (Figure 5) with an outer chlorite/talc zone, and then carbonates observed (Figure 6) along the contact between ultramafic and intermediate rocks. On this basis, some drill holes appear to have been incorrectly logged as intermediate, with their chlorite-rich and mica-poor mineralogy indicating ultramafic rocks. In addition, the apparent deeper weathering on the western and eastern parts of the traverse may represent lithological contacts, weathered along fault.

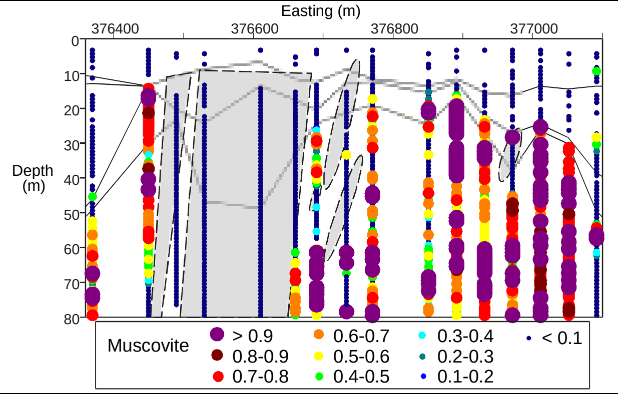

Figure 3: ASD-derived muscovite distribution for the Intrepide traverse

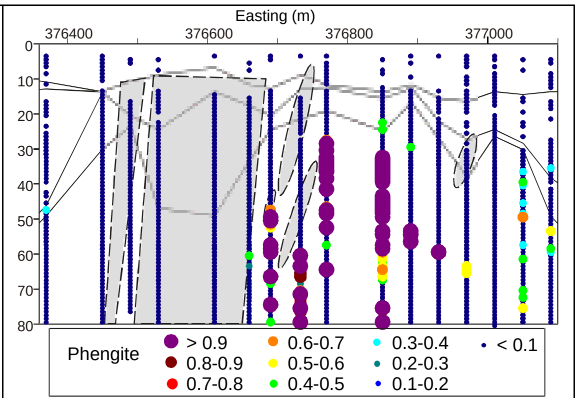

Figure 4: ASD-derived phengite distribution for the Intrepide traverse

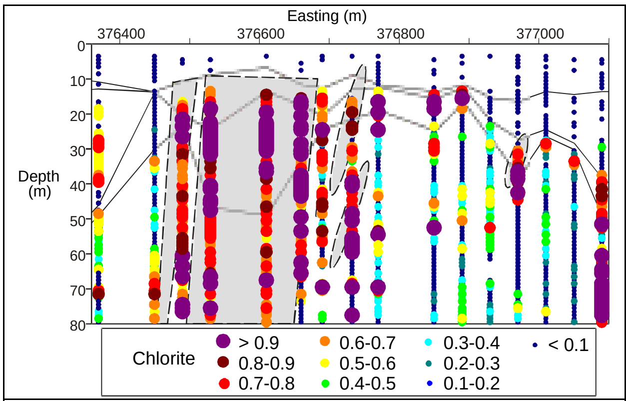

Figure 5: ASD-derived chlorite distribution for the Intrepide traverse

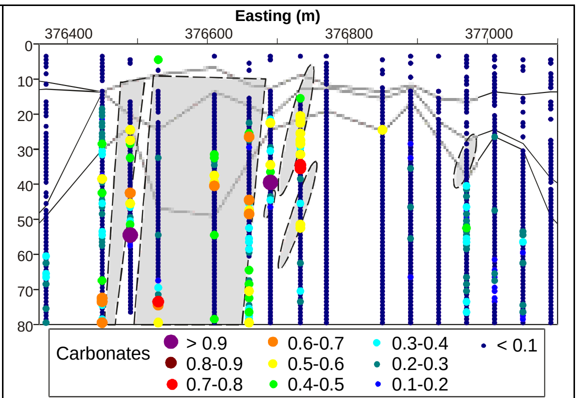

Figure 6: ASD-derived carbonate distribution for the Intrepide traverse

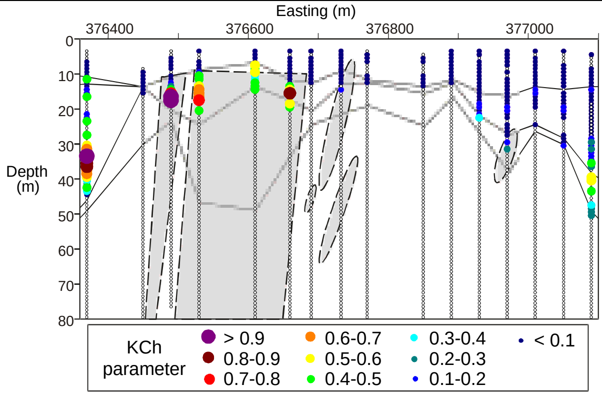

Figure 7: ASD-derived KCh parameter distribution for the Intrepide Traverse

Weathering of basic rocks commonly produces Fe-rich kaolinite, measured using the in-house derived KCh parameter. For the Intrepide traverse, this parameter (Figure 7) successfully indicates ultramafic rocks from analysis of overlying saprolite. As mentioned above, the high KCh parameter values on the eastern and western margins of the traverse indicate a contact with ultramafic rocks not identified in visual logging.

Using spectral data, areas of sediments (Figure 8), regolith (Figure 9), and rock (Figure 10) are distinguished respectively using the 500, 1950 and 2200 nm spectral regions. An overlap between regolith and rock indicates saprock (Figure 11). The spectrally interpreted zones agree well with those determined by visual logging, as indicated by the lines on Figure 11.

Revenge Traverse

The Revenge traverse is primarily composed of mafic rocks, with weathering down to 70 m below surface, and up to 25 m sediments. The presence of muscovite (Figure 12) is indicative of mineralization, with various alteration effects, such as Fe oxides at depth (Figure 13), also observed. Not surprisingly, high Fe oxide contents are also observed in the saprolite and clay.

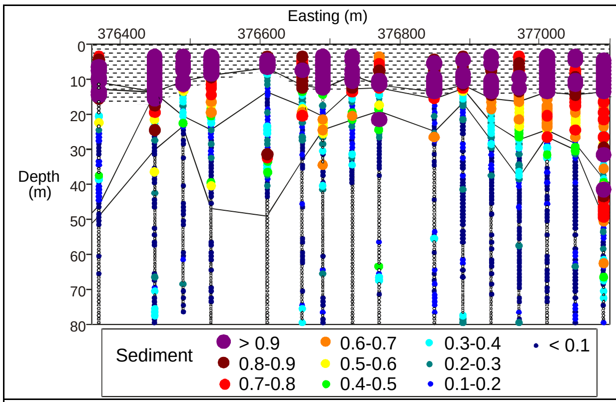

Figure 8: ASD-derived sediment distribution for the Intrepide Traverse

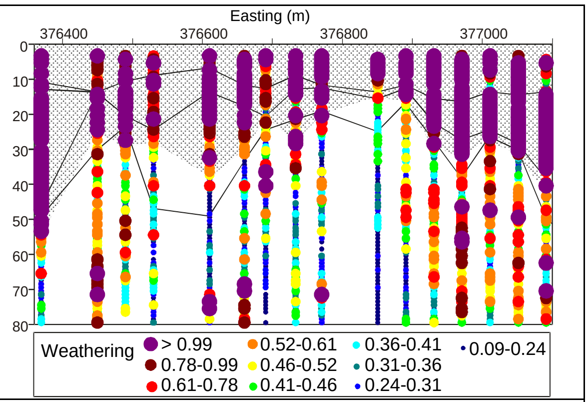

Figure 9: ASD-derived weathering distribution for the Intrepide Traverse

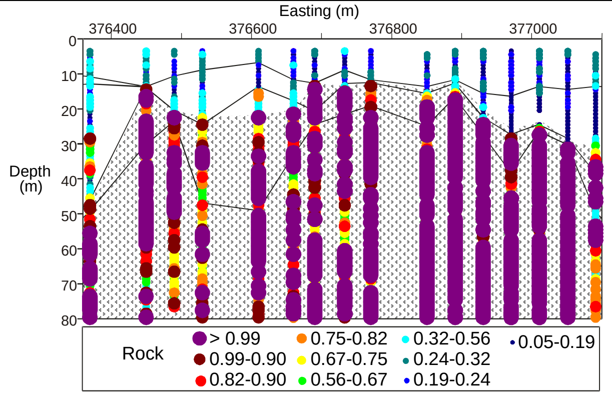

Figure 10: ASD-derived rock distribution for the Intrepide Traverse

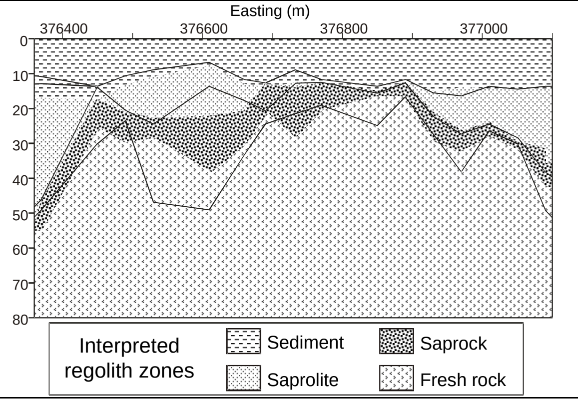

Figure 11: ASD-derived regolith zones for the Intrepide Traverse

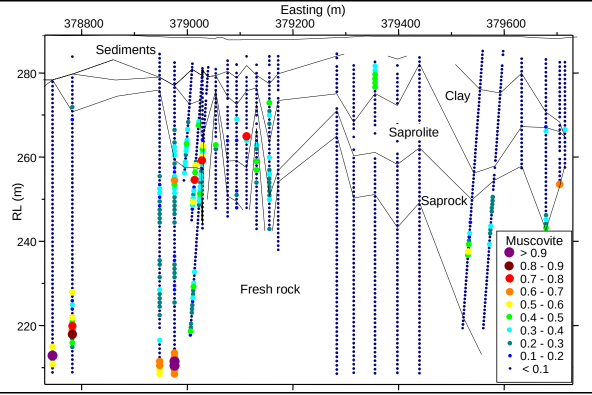

Figure 12: ASD-derived muscovite distribution for the Revenge traverse

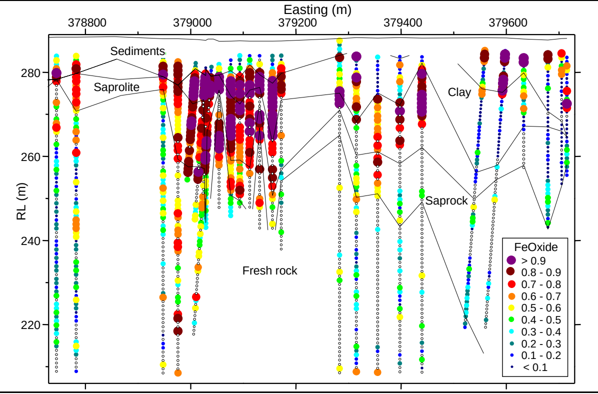

Figure 13: ASD-derived Fe oxide distribution for the Revenge traverse

Conclusions

Spectral analysis can recognise rock types, regolith units and differentiate sediments from in situ regolith. Alteration zones are clearly defined. Kaolinite chemistry of near surface zones, interpreted from the reflectance spectra, indicate underlying Fe-rich ultramafic parent rocks, with crystallinity measures indicative of transported materials. Reflectance spectral analysis can also recognise zones of oxidation and reduction in fresh rock and regolith. This study demonstrates the potential utility of rapid spectroscopic techniques for mapping mineralogical parameters in rock and regolith.