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# A rapid characterisation strategy involving hyperspectral core logging (HyLogging™), X-ray diffraction (XRD) and Laser Induced Breakdown Spectroscopy (LIBS) – A case study

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A new multi-technique rapid characterisation procedure that helps geologists to understand ore system mineralogy and mineral chemistry with increased confidence is proposed. Hyperspectral drill core logging undertaken as part of the AuScope National Virtual Core Library (NVCL) has permitted comparison of calc-silicate mineralogies from two mineralised targets in NW Queensland, Cannington (Pb, Zn, Ag) and Maronan (Pb, Ag, Cu, Au). To this we have added targeted and domain specific x-ray diffraction (XRD) analysis and laser induced breakdown spectroscopy (LIBS)

The Cannington Pb, Zn, Ag ore deposit spans 185m into the garnetiferous quartzites and schists within a quartzo-felspathic gneissic terrain. The Maronan prospect is characterised by sulphide (Pb, Ag) bearing ore zones hosted within two banded iron formation horizons separated by predominantly magnetite and garnet bearing psammites, pelites and quartzites (also with minor banded iron units), all encompassed within quartzite metasediments[1].

Based on the principle of reflective spectroscopy, HyLogging non-destructively scans the surface of drill core samples for its detailed mineralogy, using one of the fastest sampling rates (125 samples/m at 150 m/day). The HyLogger-3 works in the range of visible-near-shortwave infrared (380-2500 nm) and thermal infrared (6000-14500 nm) regions of the electromagnetic spectrum and delivers depth-referenced mineralogical information at ~8 mm spectral resolution, alongside high-resolution images (0.1 mm resolution).

First-pass HyLogging is followed by second-pass context domaining and mineralogical modelling to pin-point samples for targeted third pass on-site bench top X-ray diffraction (XRD) validation and clarification of mineral assemblages. This provides detailed mineralogy of the drill core samples and their unit cell phase identification respectively. This is then followed by selective fourth pass confirmation of chemical trends in target mineral groups, garnet, pyroxene, carbonate and sulphides using hand-held Laser Induced Breakdown Spectroscopy (LIBS). Hand-held LIBS provides a rapid chemical analysis technology that ablates a small volume of the sample surface using a concentrated laser pulse, creating a high-temperature micro-plasma containing free electrons, excited atoms and ions. The radiation emitted to reach ground state will be characteristic to individual elements contained in the mineral sample, thus qualitatively and quantitatively representing the elemental composition characteristic of individual minerals.

We showcase the effective utilisation of these three technologies, used in concert, and describe the drill cores from Cannington CUD5198 and Maronan MRN14003 mineralised systems as seen by these integrated techniques. It is hoped that such a structured routine will help generate a more confident and authoritative characterisation of a mineral system, including recognising and validating mineralogical and chemical vectors towards mineralised intervals, thus enabling quick modelling decisions for the exploration community.

*References:*
[1] Chapman LH and Williams PJ (1996) Econ Geol 93: 1390-1405