Mineralogical and Textural Characterization of the Ag-Pb-Cu-Au Maronan Deposit (NW-QLD) Using Laser-Induced Breakdown Spectroscopy (LIBS)

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Laser-induced breakdown spectroscopy (LIBS) provides fast (40 seconds per cm^2), high-resolution chemical mapping at a microscopic scale (50 µm pixel resolution). It gives detailed insights into mineral distribution and textures, helping to better understand ore bodies and make informed decisions in the mining industry.

In this study, LIBS was used to analyze drill core specimens from the Proterozoic sediment-hosted Maronan deposit, with a JORC 2012 total resource of about 118 Moz Ag, 2 Mt of Pb, 272 000 t of Cu and 0.76 Moz of Au (ASX: MMA March 12th, 2024). The aim was to improve the understanding of rock type variability, alteration styles, cross-cutting relationships and their association with mineralization, supporting exploration and future metallurgical decisions. A total of 30 drill core specimens were analyzed, with additional validation performed through SEM-TIMA scanning. Four distinct mineralogical and alteration domains were identified: (1) a Mn-rich domain exhibiting skarn-like characteristics, with variable amounts of magnetite-pyrrhotite, carbonate minerals, and quartz, showing notable Ag and Pb mineralization with occasional minor Cu; (2) a carbonate-rich domain containing Mn-rich minerals such as rhodonite and Ca-Mn garnet, frequently associated with Pb (galena) and Ag mineralization (sulfosalts); (3) a K-Mg-Na-rich domain associated with Cu mineralization, containing albite, muscovite, biotite, chlorite, amphibole, and pyrite; and (4) a silica-rich domain dominated by quartz, typically barren.

LIBS identified minerals in fine-grained rocks, revealing Cu and Pb mineralization linked to specific alteration styles and rock types. Some Cu-rich specimens show early sodic alteration cross-cut by late K-Mg-Ca phases. Lead-enriched samples are usually associated with carbonate ± apatite ± fluorite, overprinting Mn-rich skarn minerals. Qualitative chemical and semi-quantitative mineral maps improved geological interpretation, matched assays data, and provided additional insights compared to traditional methods such as geochemical assays, XRF scanning, or SEM-based mineralogy, highlighting LIBS' potential for ore body knowledge studies.