

## **Integrated LA-ICP-MS Software Solutions for Mineral Exploration and Orebody Knowledge**

**Jack Ward**<sup>1</sup>, Jeffrey Oalman, Carlos Carrasco-Godoy, Alice MacDonald, Ivan Belosouf

<sup>1</sup>Centre for Ore Deposits and Earth Sciences, University of Tasmania, Hobart, Australia

The compositions of minerals formed during magmatism and hydrothermal alteration provide insight into the complex physicochemical processes responsible for ore deposit formation. Inter- and intra-mineral compositional variability also influences geometallurgical behaviour, affecting ore processing performance through its control on metal deportment, mineral associations, and, ultimately, potential recovery. Over the past decade, laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) has been used to generate a wealth of mineral chemistry data from samples spanning early-stage greenfields exploration projects through to advanced mining and processing operations. Despite the rapid adoption of LA-ICP-MS as a routine tool in mineral chemistry workflows, comparatively little attention has been directed towards the development of software solutions that streamline data formatting, exploratory analysis, visualisation, archiving, and reporting. Here, we present the CODESverse, a collection of web-based tools designed to optimise and standardise mineral chemistry workflows across all parts of the mining value chain. CODES Mineral Chemistry Explorer supports silicate and carbonate mineral chemistry fertility and vectoring studies by performing mineral-specific stoichiometry calculations, filtering and formatting data according to user-defined criteria, and generating both predefined and custom plots, enabling rapid, interactive interrogation of large mineral chemistry datasets. LazAbMapper facilitates interactive visualisation and exploration of LA-ICP-(TOF/Q)-MS compositional maps, allowing users to create masked compositional maps, classify minerals, and perform cluster analysis on whole maps, individual minerals, or user-defined regions of interest. CODES U-Pb Plotter enables the interactive calculation of ages, assessment of fertility, and generation of concordia, weighted mean, and density plots as part of U-Pb geochronological investigations of igneous, metamorphic, and detrital minerals. Reference material data are also archived in an online database for QA/QC and long-term reproducibility tracking. Finally, CODES Metal Deportment Investigator facilitates the assessment of silicate and sulphide mineral chemistry data, with a focus on metal deportment for orebody knowledge.