Developing tools for the sustainable exploration of epithermal ore deposits: alteration mineral chemistry for targeting and assessment of fertility

Ore deposits are exceedingly scarce. Only one in every one thousand prospects that are explored by companies is developed into a mine, and finding these prospects has already consumed significant time and resources. Consequently, understanding what controls the location of ore deposits, recognizing the potential fertility of an area before costly and invasive exploration has taken place, and exploring efficiently within such domains are important for reducing risk, energy use and environmental impact.

Epithermal ore deposits source much of the gold, silver and significant amounts of the copper utilized by humankind. They form at relatively shallow crustal levels, often directly or indirectly associated with magmatism at subduction zones. Ore-forming processes are relatively well understood, as are the typical alteration mineral assemblages that develop and their zonation patterns. However, little work has been done on the minor and trace element chemistry of alteration phases which has been to be shown to be a powerful tool for exploration in porphyry ore systems. The use of such approaches is becoming increasingly important because most new resources will be buried under cover; either pre-mineralization rocks that may be altered into barren lithocaps, or post-mineralization cover. Thus, utilising all possible information from shallow alteration domains and maximising knowledge from limited drillcore samples is critical.

In this project, we propose to apply award-winning laser ablation ICP-MS technology to develop tools for the early-stage assessment of epithermal prospects. The goal will be to identify gradients in mineral chemistry that allow the centre of hydrothermal systems at depth to be effectively targeted. In addition, we hypothesize that fertility information will be locked up in the minerals that will allow assessment of the likely endowment of a system prior to extensive drill testing. Multivariate statistical methods will enable discrimination tools to be developed to recognise different system types and endowments. Ultimately, with the support of the CASE partner, we will translate the results of the research into operationally effective tools that can be rapidly incorporated into exploration workflows.