Trace Element Compositions of Micro Inclusions Extracted from Mixed LA-ICP-MS Analyses and Their Use in Exploration

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Micro-inclusions in minerals are observed in a range of magmatic as well as hydrothermal minerals. In magmatic environment they reflect co-crystallising assemblages and could be used to better fingerprint melt composition as well as temperature, pressure and redox conditions. In the environment of hydrothermal alteration compositions could be either inherited from the original mineral or reflect conditions of formation of the host minerals and composition of fluids involved. Use of compositions of micro-inclusions in exploration is limited due to them often being too small to obtain confident analyses by LA-ICP-MS. However, they are frequently ablated accidentally when analysing host minerals for mineral chemistry or geochronology. Currently mineral inclusions are mostly excluded from the integration intervals at data reduction stage. However, trace element compositions of micro-inclusions in many cases could be extracted from such mixed analyses.

We present examples of apatite inclusions in zircon from porphyry Cu deposits as an example of magmatic environment and show that LREE contents of apatite inclusions in zircon can be accurately quantified through deconvolution of mixed LA ICPMS signals and potentially can identify fertile intrusions and provide discrimination between different deposit types and stages of magma evolution. When used in conjunction with host zircon compositions they can improve prediction of magma fertility for exploration. We also present compositions of rutile and titanite inclusions in chlorite from propylitic alteration environment around porphyry Cu deposits and show how their compositions could complement use of chlorite compositions for vectoring and fertility studies.

Inclusions are often too small to analyse directly and use of deconvoluted composition of inclusions can provide a cost-effective addition to an exploration when using LA-ICP-MS analyses for mineral chemistry or geochronology, however analytical conditions and downhole fractionation correction are crucial for obtaining accurate data.