

## **Epidote Chemistry in Contrasting Hydrothermal and Metamorphic Environments**

Clara C. Wilkinson,<sup>1,2\*</sup> Eloise M. Harman,<sup>1,2</sup> and Jamie J. Wilkinson<sup>1,2</sup>

<sup>1</sup>Department of Earth Sciences, Natural History Museum, London SW7 5BD, UK

<sup>2</sup>Department of Earth Science and Engineering, Imperial College London, SW7 2AZ, UK

\*E-mail, j.wilkinson@nhm.ac.uk

The unique crystal structure of epidote group minerals allows the incorporation of a wide variety of major, minor, and trace elements. Variations of these elements are a result of the environment in which epidote formed, either by magma crystallization, metamorphism, or as a secondary mineral in hydrothermal alteration systems. Samples from a variety of settings, some associated with mineralization, were analyzed to explore the natural variability and potential controls on the chemistry of epidote. Compositions were determined using SEM EDS analysis and laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS). It was found that epidote chemistry varied markedly both between and within samples.

Within individual samples, epidote compositions were different for vein and replacement types, with vein epidote generally containing lower concentrations of trace elements such as the transition metals and REE reflecting the relative importance of local sourcing from minerals undergoing replacement and advection of trace elements in fluids. Differences in epidote chemistry between environments are attributed to bulk rock compositional controls and the composition of either the precursor mineral being replaced by epidote, and/or the competition for trace elements with phases co-precipitating with epidote. For example, epidote hosted by felsic igneous rocks is generally lower in Ti and V relative to intermediate and more mafic compositions, and epidote replacing garnet is interpreted to have acquired its HREE-enriched pattern from the precursor mineral. A similar relationship may also exist for epidote replacing pyroxene, where the REE pattern of the precursor phase appears to be preserved. Conversely, epidote co-precipitating with actinolite is depleted in REE and displays a pattern similar to an inverted amphibole distribution, suggesting that competition for REE by the amphibole controlled partitioning into the associated epidote.

The chalcophile elements are the most diagnostic of a given style of mineralization, potentially providing a fingerprinting tool. In particular, Sn, As, Sb, and Ga are low in epidote from mineralized settings relative to unmineralized settings and skarn samples, and Pb is low in epidote in the (limited) porphyry samples studied. These results indicate that epidote trace element chemistry is complex and more work is required to fully constrain the controls of compositional variations in nature.