Revealing low-temperature alkaline alteration of zircon via unpolished grain mapping

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Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) was used as a tool to map the rare earth element (REE) geochemistry of the outer surface of unpolished, naturally metasomatized Neoarchean zircon. Independent secondary ion mass spectrometry U-Pb and LA-ICP-MS REE depth-profile analyses on separate zircon from the same sample confirm the presence of micrometre-scale rim material that is geochemically unique from the interior of the grain. Rims are characterized by elevated REE contents (up to several orders of magnitude enriched relative to the interior), suggesting that the REE geochemistry, particularly the concentration of LREE, is a suitable proxy for the distribution of rim material. Element maps were constructed by using a grid of contiguous 7 μm diametre laser ablation spots excavating the outermost 3 μm of the unpolished zircon. Element maps indicate that the alteration of zircon is heterogeneous in nature, consistent with depth-profile studies, and manifests itself primarily along pre-existing cracks and fractures or within isolated domains. In order to gain insight into the origin of the observed REE variations, we have conducted laboratory zircon alteration experiments. Three reference material zircon were selected to cover a range of U content and crystal morphology: AS3 (1099 ± 0.5 Ma; [1]), FC-1 (1099 ± 0.6 Ma; [1]), and Plešovice (337 ± 0.4 Ma; [2]). Further heterogeneity was produced in the samples by abrading an aliquot of the Plešovice zircon to simulate transport as detritus. Preliminary experiments involved saturating the zircon material in 1M KOH, at 350°C and 100 MPa for ~100 days. These P-T conditions closely approximate the metasomatic conditions that the Neoarchean zircon have experienced. We hope to demonstrate both the occurrence and nature of micrometre thin rims formed as a direct result of the coupled dissolution-reprecipitation of zircon in the presence of low-temperature alkaline fluids.

[1] Paces & Miller (1993) *JGR* **98,** 13997 – 14013. [2] Slama et al. (2008) *Chem. Geol.* **249,** 1 – 35.