Sulfur XANES investigation of upper mantle metasomatic apatite

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Metasomatism is an essential process that controls the mobilization and reconcentration of sulfur and precious metals in the subcontinental lithospheric mantle (SCLM). Thus, the formation of sulfur and precious metal rich domains of the SCLM by metasomatism is considered a key process in the formation and distribution of large metallogenic provinces [1].

In the SCLM, apatite is a widespread metasomatic accessory mineral that remains largely understudied. Apatite—commonly $Ca_{10}(PO_4)_6(F, Cl, OH)_2$ can structurally incorporate trace concentrations of both sulfide (S^{2-}), sulfite (S^{4+}), and sulfate $(S^{6+})^{-}$ from its parental melt as a function of the redox state of the system [2]. Mineral-melt-fluid metal solubilities and distribution coefficients are often affected by the presence of sulfur and its valence state [3]. Thus, mantle-derived apatite may provide important clues about the enrichment processes sulfur and precious metals in the mantle that provided the basis for ore deposit genesis in different tectonic settings.

Here, we investigate metasomatic apatite from peridotite xenoliths that sample the SCLM beneath the Deseado Massif Auriferous Province in Patagonia, Argentina [1]. We performed micro-X-ray absorption near-edge structures (µ-XANES) spectroscopy analyses at the S *K*-edge to determine the oxidation state of sulfur in SCLM apatites.

Our XANES data show that the apatite grains contain both sulfide and sulfate. The results are discussed in the context of the mobility of sulfur and precious metals in the mantle, and its impact on ore-forming processes.

[1] Tassara *et al.* (2017) *Nature Communications* **8**, 843. [2] Konecke *et al.* (2017) *American Mineralogist* **102**, 548-557. [3] Zajacz *et al.* (2012) *Geochimica et Cosmochimica Acta* 89, 81-101.