Improved LA-ICP-MS analytical routine for low-concentration chalcophile and siderophile elements in olivine and orthopyroxene

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The upper mantle is well characterized in its major and minor element composition. Trace elements are preferably incorporated into clinopyroxenes and garnets, but these minerals may be completely absent in strongly depleted peridotites. This leaves the silicate minerals olivine and orthopyroxene as the main repositories for trace elements in many mantle rocks, particularly depleted Archean lithosphere that contains information on early mantle evolution. However, trace elements in olivine and orthopyroxene are poorly characterised because of their very low concentrations.

We are tackling the analytical challenges associated with the *in situ* investigation of trace elements with low concentrations in silicate minerals with an optimised laser ablation ICP-MS analytical routine. This will help to tease out further insights into mantle depletion and metasomatic processes, particularly those hidden in the refractory phases olivine and orthopyroxene. The new analytical routine adds hydrogen gas (5 mL/min) to the carrier gas (He, 0.65 L/min), with a resulting increase in count rates and decrease in detection limits. An overall improvement of approximately 50% in sensitivity as well as in the reproducibility was achieved. With these settings, a full REE pattern is routinely accessible for opx and olivine. Further, we can then investigate the abundance and distribution of the poorly investigated volatile siderophile and chalcophile trace elements (VSCE) in silicate phases in the Earth's upper mantle [1]. With the results we can shed some new light on (i) the geochemistry of refractory silicate phases (olivine, opx) and how this relates to the chemistry of coexisting cpx; (ii) the behaviour of VSCE during melting and metasomatism; and (iii) the allocation of VSCE between major silicate host phases. For instance, our preliminary data indicates that Mo is preferably incorporated into olivine > opx > cpx, whereas Cd, In and Sn, for example, show higher concentrations in cpx than in olivine.

[1] Witt-Eickschen, Palme, O'Neill & Allen (2009), *Geochim. Cosmochim. Acta* 73, 1755-1778.