

## Sc and P in haplo-komatiitic olivines: spatial covariation and partitioning

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Spatially correlated zoning of P and elements such as Al and Cr has been observed in both synthetic and natural olivines [1, 2] from numerous rock types, including the plate spinifex komatiites of Gorgona Island [3] and may provide information on crystal growth processes. To evaluate the physical parameters governing the incorporation of P, Al, and Sc (an  $fO_2$  insensitive proxy for  $Cr^{3+}$ ) in spinifex olivines, we performed isothermal and cooling-rate experiments on a haplo-komatiite (in CaO-MgO- $Al_2O_3$ - $SiO_2$ ; 29 wt% MgO) doped with 0.4–0.5 wt% each of  $P_2O_5$ ,  $Sc_2O_3$ , and MnO. Experiments were conducted in a 1-atm gas-mixing furnace at QFM. Isothermal experiments were run at temperatures of 1500 (~liquidus)–1425°C for 2–17 hours (h). Charges in the cooling-rate experiments were held at 1510°C for 2–4 h before being cooled to < 1400°C at a rate of 5°C/h or 20°C/h.

Runs contained olivine (ol) and glass (liq). Average microprobe analyses from the isothermal experiments yield apparent  $D_{Sc}$  (Sc in ol)/(Sc in liq) of 0.13–0.14 (by wt). At 1495–1450°C, ol-liq  $D_P$  is 0.14–0.17; in the lowest-T isothermal experiment, P appears to be heterogeneously distributed in the ol ( $D_P = 0.24 \pm 0.14$ ;  $1\sigma$ ); this run also experienced the largest P-loss to the furnace atmosphere (~50%; loss in the other runs: 6–18%). No spinifex ol (as defined in [4]) was generated in these experiments; however, bladed ol produced in the 20°C/h run display spatially correlated sector zoning in P and Sc broadly similar to features observed in P and Cr in Gorgona komatiitic ol [3]. The 5°C/h experiments contain some olivines that display high-P zones parallel to crystal edges. Melt inclusions in ol in both sets of cooling experiments are surrounded by ol regions low in P and Sc relative to the enriched regions. Individual ol spot analyses and average far-field glass compositions yield apparent ol-liq  $D_{Sc}$ 's of 0.11–0.13 (5°C/h) and 0.10–0.22 (20°C/h). Corresponding  $D_P$  values are 0.16–1.25 and 0.08–2.05. These results demonstrate that, compared to the isothermal experiments, dramatic enrichments in P in ol relative to +3 cations can occur at moderate cooling rates.

[1] Milman-Barris *et al* (2008) *CMP* **155**, 739–765 [2] McCanta *et al* (2008) *GCA* **72**, A610 [3] Hofmann *et al* (2008) *GCA* **72**, A385 [4] Arndt (2008) Komatiite.