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# Volatile content, S partitioning, speciation and isotopes in the mantle wedge

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Spinel harzburgite xenoliths from the andesitic Avacha volcano (Kamchatka, Russia) record a two-stages history: their protolith was (a) initially formed by high degrees (28-35%) of flux-melting in the mantle wedge asthenosphere and (b) slowly re-equilibrated at 900-1000˚C in the mantle wedge lithosphere [1].

Avacha harzburgites contain two types of spinel-hosted melt inclusions: HT and LT inclusions [2]. HT inclusions contain pyroxenes, homogenize at 1200˚C, and have primitive island-arc basaltic major element compositions with up to ∼12 wt.% MgO. LT inclusions contain amph+glass, homogenize at 900˚C, and have dacitic major element compositions. All the trace element patterns of the melt inclusions are enriched in $LREE_N$ and $LILE_N$ relative to $MREE_N$-$HREE_N$, displaying a strong slab-related chemical overprint.

Volatile abundances were measured by Secondary-Ion Mass Spectrometry (SIMS) with the Cameca IMS 1280 at WHOI. Volatile abundances are moderate in HT inclusions (2000-4700 ppm $CO_2$ and 1.5-2 wt.% $H_2O$), consistent with their formation by high-degrees of melting in the mantle wedge asthenosphere from a source with ∼1.5 wt.% $H_2O$. LT inclusions may have very high $CO_2$ (up to 2.6 wt.%) and $H_2O$ (up to 12.1 wt.%). The highest $CO_2$ abundances in the LT correspond to theoretical saturation pressures of 1.3 to 1.5 GPa at 900 ˚C using solubility model from [3]. The LT show a large range of $CO_2$ content (37 ppm to 2.6 wt.%) with less variable $H_2O$, suggesting that their parental liquids were trapped during an open-system process with separation of a $CO_2$-rich fluid phase upon their ascent (devolatilization). This process may be polybaric melt-rock interaction in the mantle wedge lithosphere.

S partition coefficients were estimated from SIMS data on minerals and glass in partially crystallized melt pockets in the harzburgite xenoliths. The partition coefficients (∼0.01 in anhydrous mantle silicates) suggest that S is as incompatible as Ce during hydrous melting in the mantle wedge. Some LT inclusions are S-rich (up to 0.6 wt.%). Preliminary data acquired by Raman spectroscopy at Frankfurt University on unheated LT reveal a sharp band at ∼1017 $cm^{-1}$, which indicates the presence of crystalline anhydrite. $\delta^{34}S$ was measured in homogeneous LT by SIMS at WHOI and range from +7.0 to +11.0‰ (±0.6‰ $2\sigma$). This reveals the presence of "heavy sulfur" relative to MORB source mantle (-0.89±0.6‰ $1\sigma$, [4]), consistent with the presence of sulfates in the homogeneous glass.

These results provide the first direct insights into the volatile abundances and behaviour during recycling processes through the mantle wedge. Based on these data, we propose a mantle wedge structure model taking into account melting degrees, volatile abundances and ambiant oxydation state, pressure and temperature, which appears to be in agreement with most recent inferences from experimental data [5].

[1] Ionov (2010) *J. Petrol.* **51**, 327-361. [2] Ionov *et al.* (2011) *CMP* **162**, 1159-1174. [3] Papale *et al.* (2006) *Chem. Geol.* **229**, 78-95. [4] Labidi *et al.* (2011) *Min. Mag.* **75**, A1261. [5] Grove et al. (2006) *EPSL* **249**, 74-89.