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The utility of chlorine isotope measurements in melt inclusions: application to six different volcanic arcs

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Chlorine is a highly hydrophile and incompatible element which may provide insights into the transfer of elements from the slab to the surface in subduction zone settings. We studied Cl isotopes in olivine-hosted melt inclusions (OHMIs) from six different volcanic arcs [1-4] in order to improve our understanding of the behavior of Cl and δ^{37}Cl during degassing and fluid/melt transport.

The isotope data were obtained with an ion probe at the University of Lausanne. The reference materials reproducibility was ~0.3 – 0.4‰ (2SD). The δ^{37}Cl values of OHMIs vary from -3.4 to +3.1‰, a range comparable to that measured in bulk rock for volcanic arc [e.g., 5]. Within a single sample δ^{37}Cl in OHMIs vary by more than 2‰. Combined with either other stable isotopes systems or trace elements within the same OHMIs, it is possible to trace the signature of the different Cl sources beneath the different subduction zones. For example, for the Aeolian arc or northern Izu-Bonin arc, OHMIs have the lowest δ^{37}Cl of the dataset, reflecting the imprint of subducted sediments. On the contrary, beneath the Central America Volcanic Arc, the mantle wedge has a high δ^{37}Cl, up to +3‰, significantly higher than depleted MORB mantle and higher than any subducted material, which might reflect the presence of amphibole in the mantle source.

Compared to bulk rocks from the same arcs, OHMIs display either statistically higher, lower or similar weighted average δ^{37}Cl. The difference between bulk rocks and OHMIs suggests that the latter preserve undegassed signatures which might be lost in bulk rocks. OHMIs can thus be very useful to: (i) better constrain the behavior of Cl and δ^{37}Cl in subduction zone settings, in particular during fluid-rock interaction within the mantle wedge; and (ii) track the influence of amphibole in the context of arc magma genesis and differentiation.

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