The potential of using a sector field ICP-MS for analysis of fluid inclusions by laser ablation ICP-MS

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Laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS) is a successful technique to measure elemental concentrations in fluid inclusions [1]. Depending on their salinity, inclusions in the size a 10 to several tens of micrometres are needed to determine trace element concentrations reliably. Up to now, quardupole (Q-) ICP-MS have been used for this kind of analyses due to its ability to switch fast (e.g. within one millisecond) from one mass to another over the entire elemental mass range. Short settling times are required to record the fast changing transient signals obtained by LA-ICPMS analyses of fluid inclusions. Sector field (SF-)ICP-MS would provide a higher sensitivity than Q-ICPMS and, therefore, have to potential to measure smaller inclusion, demand a higher settling time than the latter ones due to changing the magnetic field.

A fast scanning SF-ICPMS was used to explore the potential of this instrument for analysing fluid inclusions. An assemblage consisting of fluid inclusions in the range of a few micrometres up to 150 μm and a salinity of 4wt% NaCl was used to (i) check the accuracy of the fast scanning SF-ICPMS system and (ii) compare the performance of a Q-ICPMS (PerkinElemer, Elan 6100 DRC) and a SF-ICPMS (ThermoFisher, Element XR) coupled to the same laser ablation system. The fast scanning SF-ICPMS system was able to analyse fluid inclusions with a 1.8 to 2 times smaller diameter, i.e. 5 to 8 times in mass, with a similar accuracy, e.g. on elements like Pb, Ba, Sb or Mg, than the Q-ICPMS system measuring the same elements.

[1] Heinrich *et al.* (2003), *Geochim. Cosmochim. Acta* **67**, 3473-3496.

Magma formation in hot-slab subduction zones: Insights from volatile contents of melt inclusions from the southern Cascade arc

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Cross-arc geochemical variations can provide insight into dehydration reactions in the subducting slab and magma generation processes in the mantle wedge. In this study, cinder cones were sampled at varying distances from the trench in the Lassen Region, the southern segment of the Cascade Arc, which subducts some of the youngest oceanic crust globally. Olivine-hosted melt inclusions (Fo84-90) from the tephra of 6 calc-alkaline basaltic cinder cones have been analyzed for volatile, major and trace elements.

Using the maximum volatile contents at each cone to represent the undegassed magma, we find values (2.1-3.4 wt% H_2O and 500-1200 ppm CO_2, corrected to be in eq. with Fo90 olivine), slightly higher than primitive melt inclusions from central Oregon [1]. These values from the Cascades overlap with data for other arcs, but are lower on average. We have also analyzed fluid-mobile trace elements to understand the trace element signature of the slab component and the extent of fluid-fluxing across the arc. At the arc axis, $(Sr/P)_N$ values are high, although variable, and they decrease towards the backarc [2]. $(Sr/P)_N$ correlates with other slab-derived fluid tracers such as H_2O/Ce and Cl/Nb, indicating a link between volatile and trace element enrichment of the mantle wedge.

Slab surface temperatures calculated using the H_2O/Ce thermometer [3] range from 740-870±50°C, which is slightly lower than those predicted by new 2D geodynamic models for this region (850-950°C). The similarity of the temperature estimates suggests active fluxing of hydrous material from the slab into the mantle wedge beneath the arc rather than downdragging of hydrous mantle from the forearc region. Both H_2O/Ce and geodynamic model temperatures are at or above the MORB+H_2O solidus [4] suggesting the likelihood of hydrous slab melting beneath the arc. Because high slab temperatures require the slab to largely dehydrate beneath the forearc, our results require either substantial metastability of hydrous phases in altered oceanic crust or serpentinite-derived water from the mantle of the downgoing slab.

[1] Ruscitto(2010) *EPSL* **298**, 153–161. [2] Borg (1997) *Can. Min.* **35**, 425-452. [3] Cooper (2012) *G^3* **13**, (3). [4] Schmidt (1998) *EPSL* **163**, 361–379.

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