Recycling elements from the slab to arc crust: Insights from element mass balance of the Izu arc system

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One of the most important processes leading to formation of continental crust is element transfer from subducting lithosphere to newly-formed arc crust. Despite extensive study of HP/UHP metamorphic rocks that represent paleo subducted slabs and experiments to replicate subduction zone conditions, little consensus has been reached on the nature of the mass transfer agents (e.g. aqueous fluid or hydrous melt), or the efficiency of the recycling process. Here, I use a mass balance of K and Ce in the Izu arc system as an alternative approach to resolving recycling processes in subduction zones. Potassium and Ce are enriched in arc lavas and are controlled by phengite and allanite/monazite in subducted crustal rocks. The extensive stability of these phases in the slab means K and Ce in slab fluids should be buffered to beyond sub-arc depths [1, 2].

The Izu arc was chosen for this study as the subducting Pacific slab is relatively cold and has been well characterised for chemical composition [3]. The ~50 Ma tectonic and magmatic history of the arc is well constrained, and the volume and composition of the arc crust can be accurately determined thanks to an excellent ash record, numerous seismic profiles of the arc and exposure of mid/lower arc crustal sections in the Tanzawa plutonic complex, Honshu.

Rates of arc crustal growth are calculated to be 130 - 200 km^3 km^{-1} strike length m. $y.^{-1}$. Comparing the composition of this crust (corrected for mantle input and subduction erosion) to subduction inputs reveals that 50 to 90% of the K and 10 to 15% of the Ce is recycled from the subducting plate back to the arc crust. Using experimentally-determined solubility relations [1, 2], these fluxes would require all of the available water in the sub-arc crust plus a 0.1 - 0.7 km column of slab serpentinite if the mass transfer agent is a hydrous slab melt. By contrast, excessive volumes of slab serpentinite (6 - 60 km thick column!) are required to provide the water needed if the transport agent is an aqueous fluid. These results confirm slab melts to be the dominant mass transfer agent in the Izu subduction zone and highlights the importance of subducted serpentinite as a water source for arc magmatism.

[1] Plank *et al.* (2009) *Nature Geoscience* **2**, 611–615.
[2] Hermann & Rubatto (2009) *Chem. Geol.* **265**, 512–526.
[3] Plank *et al.* (2007) *Geochem. Geophys. Geosys.* **8**, Q04I16.

How to safely store water samples prior to stable hydrogen and oxygen isotope analyses?

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Safe storage of water samples between sampling and their stable hydrogen and oxygen isotope analyses (determination of δ^2H and $\delta^{18}O$ values) is still a topic of concern in hydrological studies. Water sorption and the diffusive transfer of water molecules through organic polymeric material may entail an isotopic fractionation [1]. A methodological study of variation of δ^2H and $\delta^{18}O$ values of waters stored in different type of bottles was performed.

A set of sixteen botlles of eleven different organic polymers (plastics), including low and high density polyethylene (LDPE and HDPE), polypropylene (PP), polycarbonate (PC, polyethylene terephthalate (PET), and high resistance Teflon® (PFA) from different size (10 to 500 mL) and wall thickness (0.20 to 1.50 mm) were completely filled (no headspace) with the same bottled water coming from a single natural spring (Evian® water, Evia-les-Bains, France) and were properly closed. Additionaly, 16 narrow neck bottles of amber glass were filled with the same water for comparison. All the water-filled bottles (n = 16 x 12 = 192) were stored at room temperature, and were opened one after the other over a period of time ranging from 0 to 659 days between 17 November 2008 and 7 September 2010. Immediately after the bottles have been opened, two 10 mL glass vials were filled, and stored at +4°C prior to analysis. The δ^2H and $\delta^{18}O$ values of all the water samples were determined using Cr-reduction in a Thermo Fisher Scientific H-Device and CO_2–equilibration in a Gas Bench II, respectively. Changes of up to +5‰ for δ^2H and +1.5‰ for $\delta^{18}O$ values were measured, depending on the type of plastic bottle. The carbon and hidrogen isotope compositions of the different plastic materials range from –33.3 to –27.5‰ and –108.1 to –71.7‰, respectively. The PET and PC plastics have $\delta^{18}O$ values ~22.5‰.

[1] Spangenberg & Vennemann (2008) *Rapid Commun. Mass Spectrom.* **22**, 672–676.