Cycling of chalcophiles in subduction zones: a Se isotope perspective

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The chaclophile and redox-sensitive selenium isotope system may contribute to constrain the role of subduction zone processes on the terrestrial chalcophile element cycle. It has recently been shown that Se isotope compositions of Mariana lavas are more variable than ambient mantle, but with overall lighter values relative to the Mariana pre-subduction wedge [1]. This was interpreted to result from subarc mantle wedge refertilization by in light Se isotope-enriched components derived from subducted deep-sea sediments and sulfide-bearing altered oceanic crust.

In this study, we provide the first Se isotope data for a coherent suite of prograde high-pressure/low-temperature (HP/LT) metamorphic rocks from the Raspas Complex, SW Ecuador. This suite resembles a paramount example for a structurally pristine but extensively metamorphosed slice of oceanic lithosphere deeply subducted and subsequently exhumed without significant retrograde overprint [2].

Relative to Se reference solution NIST3149 and with an analytical precision of ±0.15 ‰ (2SD), eclogites show very variable $\delta^{82/76}$Se values between −2.05 to +0.33 ‰. Eclogite values therefore significantly extend to much lower $\delta^{82/76}$Se compared to those recently reported for N-type MORB from the Pacific Antarctic Ridge (-0.15±0.14 ‰, n=4) [3]. Samples with heavier Se isotope compositions also show elevated concentrations of large ion lithophile elements U, K, Rb, Cs and other fluid-mobile elements, such as Pb and Sb. In addition, $\delta^{82/76}$Se values negatively correlate with Ce normalized to the concentration of any of these fluid mobile elements. High-pressure serpentinites show rather uniform Se isotope compositions with an average $\delta^{82/76}$Se of 0.27±0.35 ‰ (n=3). The most characteristic feature is that $\delta^{82/76}$Se vs Ce/Pb of eclogites span the entire range from lowest Ce/Pb and highest $\delta^{82/76}$Se, to highest Ce/Pb and lowest $\delta^{82/76}$Se of subducted serpentinites. In this presentation we will discuss these Se isotope systematics of subducted HP/LT rocks in the context of their trace element and petrogenetic features. We then reconcile these with published data for Mariana arc lavas which may further improve our understanding of chalocphile element cycling in subduction zones.

[1] Kurzawa et al., 2019, ChemGeol, doi.org/10.1016/j.chemgeo.2019.03.011
[2] John et al., 2010, CMP 159, 265-284
[3] Yierpan et al., 2019, GCA 249, 199-224