Distinguishing recycled heavy noble gases from atmosphere contaminants

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The heavy noble gas isotopes of the Earth's mantle imply these elements were transferred from the atmosphere to mantle, presumably via subduction [1]. However, the transfer pathway for the noble gases is unclear, primarily due to difficulties distinguishing uniquitous atmospheric contaminats from potentially recycled noble gases.

Noble gas concentrations and isotopic compositions determined in serpentinites suggest that they could have sampled recycled sea water and sediment pore fluids [2]. The potential atmospheric contamination of samples was excluded by taking account only noble gases realeased at temeprature higher than 300°C.

However, recent noble gas adsorption experiments revealed the persitance of an elementally fractionated air-like component at temperatures > 600°C [3]. Such a peculiar behavior is linked to the so-called "anomalous adsorption" effect and could have significantly contributed to the noble gas budget measured in crushed sertpentinites (Fig. 1; [1]).

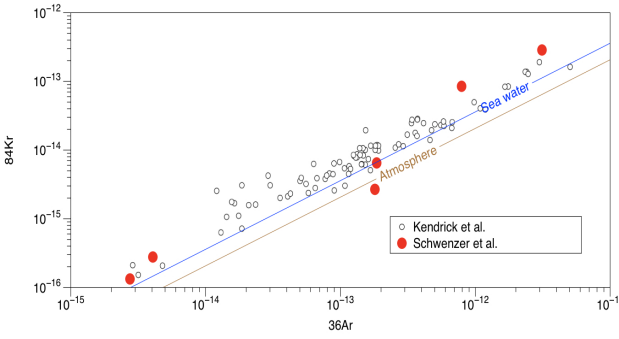

Figure 1: Comparison of "anomalous adsorption" (red symbols) and potential recycled noble gases (open symbols).

These studies highlight how critical the lack of knowledge about noble gas adsorption complicates interpretation. We present noble gas (He, Ar) diffusivities of this "anomalous adsorption" component. This allows us to propose protocols to better distinguish atmospheric contaminants from instrinsic noble gas signatures in geological materials.

[1] Holland & Ballentine (2006) Nature 441,186-191. [2] Kendrick et al. (2011) Nature Geoscience 4, 807-812. [3] Schwenzer et al. (2012) Meteoritics & Planetary Science 47, 1049-1061.