Experimental protocol for diffusion of noble gas in polycrystalline olivine

PETE BURNARD[1], SYLVIE DEMOUCHY[2,*], RÉMI DELON[1], NICOLAS ARNAUD[2], M. ALI BOUHIFD[3], YVES MARROCCHI[1], PATRICK CORDIRER[4], AHMED ADDAD[4]

[1]Centre de recherches pétrographiques et géochimiques, UMR 7358, Université de Lorraine & CNRS, Vandoeuvre-lès-Nancy, France.

[2]Géosciences Montpellier, UMR 5243, Université Montpellier & CNRS, Montpellier, France, *demouchy@um2.fr

[3]Lab. magmas et volcans, UMR 6524, Université b. Pascal & CNRS, Clermont-Ferrand, France.

[4]Unité Matériaux et Transformations, UMR 5243, Université Lille1 & CNRS, Villeneuve d'Ascq, France.

Noble gases are key tracers of the evolution of the terrestrial mantle-atmosphere system: a realistic description of their abundance and isotopic heterogeneities in the Earth's mantle is required to properly understand the mantle-atmosphere interactions. At present, the storage mode and mobility mechanisms of Ar and He are parameters poorly constrained since it is technically challenging to perform experiments with volatiles at high temperature and high pressure in samples mimicking properly mantle rocks. It is also difficult since the inert behaviour of noble gas in silicates is complex and can be related to numerous different host sites and incorporation mechanisms. Here, we will present in details a new method of noble gas doping in olivine aggregates at high pressure and high temperature (Burnard *et al*., 2015, 10.1016/j.epsl.2015.08.024). The experiments are performed in a gas vessel (Paterson's press). First, a hot-press sample of fine-grained olivine (San Carlos) is sintered in a Ni sleeve. Ni is used to control the O_2 fugacity during annealing. Second, slabs of the hot-press sample are packed surrounded by a mixed powder of old orthoclase (Madagascar) and uraninite (Minsk) in a telescopic Ni canister and annealed for at least 24 h. The large hot zone of the Paterson's press insures an homogeneous doping by ionic diffusion. Afterwards, run products are characterized by SEM, EBSD, TEM and high resolution TEM and noble gas spectrometry (step-heating). The presentation will also discuss the relevance of the diffusion domain parameters for polycrystalline fine-grained olivine.