

WATER UPTAKE, DIFFUSION AND D/H SIGNATURE OF AMORPHOUS SILICATES DURING HYDRATION/DEHYDRATION AND MAGMA DEGASSING.

M. Roskosz¹, D. Laporte², E. Deloule³, H. Leroux¹, C. Depecker¹, L. Remusat⁴,¹UMET, CNRS, Université de Lille, mathieu.roskosz@univ-lille1.fr, ²LMV, CNRS, OPGC ; Université Blaise Pascal, ³CRPG, CNRS, Université de Lorraine, ⁴IMPMC, CNRS, Sorbonne Université, UPMC, MNHN, IRD.

Introduction: The origin of water in the inner solar system is still a matter of debate. In this context, the H isotopic signature of water in minerals is particularly useful to trace reservoirs and their interactions. Several studies suggest that temperatures were too high in the region of terrestrial planets to allow direct formation of hydrous phases in the protosolar disk [e.g. 1]. Conversely other studies show that hydrous silicates could theoretically be formed before the accretion of parent bodies [e.g. 2]. Understanding how magma degassing occurs during accretion and differentiation is also crucial to explain the water budget of differentiated bodies [e.g. 3]. From the pre-accretion history of hydrated silicates to the degassing of magmas, little is known on the way silicates acquired their D/H signatures. In this study we performed controlled hydration/dehydration and magma degassing experiments in order to model vapor-silicate interactions. We explore the possibility that diffusion-driven effects could affect the D/H signature of partially hydrated amorphous silicates at the molten and solid state.

Methods: Bulk water captation and diffusion were studied in cylinders of high purity synthetic fused silica (F500, Heraeus Co., [OH] ~ 0.02 ppm) between 200 and 1000°C at 20 10⁻³ bar water partial pressure for 1 to 30 days. Dehydration of initially hydrated silica (60 ppm) was also performed at 1000°C for a few hours. In addition, a set of rhyolitic samples previously synthesized to study bubble nucleation during magma decompression was also analyzed [4]. Water content and speciation were determined both by Fourier-Transform Infra-Red spectroscopy and Raman spectroscopy. Isotopic analyses were performed on IMS 1270 and IMS 1280.

Results and discussion: All the silica samples annealed between 200 and 1000°C show significant water uptake (>200 ppm). The [OH] profiles were quantitatively modelled by a standard diffusion formalism. Rhyolitic glasses also exhibit obvious water concentration profiles around nucleated bubbles formed during the decompression of the melt. In both cases, water speciation is not affected by the variation of the water content along the concentration profiles. Turning to the D/H ratios, no isotopic variation is detectable along the concentration profiles within an uncertainty of ±50‰ for silica and ±20‰ for rhyolitic glasses (2SD). Our data indicate therefore that water uptake occurs rapidly even at low water partial pressure. We also demonstrate that hydration, dehydration and magma degassing are not able to promote large diffusion-driven fractionation of hydrogen isotopes. This conclusion holds both in astrophysical and volcanic environments.

References: [1] Fegley B.J. and Prinn R.G. (1989) *in* The Formation and Evolution of Planetary Systems, Cam. Univ. Press, pp. 171– 211. [2] Ciesla F. and al. (2003). *Science* 299: 549-552. [3] Saal A.E. et al. (2013) *Science* 340: 1317-1320. [4] Mourtada-Bonnefoi C.C and Laporte D. (2004) *EPSL* 218: 521-537.