



Results of H-D exchange experiments in forsterite

J. Ingrin and A. Ferot

LMTG, Université de Toulouse, CNRS, IRD, OMP, 14 Av. Edouard Belin, Toulouse, 31400, France. ingrin@lmtg.obs-mip.fr

The presence of hydrogen defects in olivine has a profound influence of its physical and mechanical properties, even when present at low concentrations. We present here the results of an isotope diffusion study (H-D exchange experiments) undertaken in natural iron-poor olivine single crystals.

The results show that diffusion is highly anisotropic with diffusion along [100] around fifty times faster than along the two other crystallographic directions. The isotopic diffusion is significantly faster than the rate of hydrogen extraction from the same mineral. The isotopic diffusion laws for the [100] and [001] directions are:

$D_{[100]} = D_0 \exp[-144 \pm 19 \text{ kJmol}^{-1}/RT]$ and $D_{[001]} = D_0 \exp[-188 \pm 77 \text{ kJmol}^{-1}/RT]$, with $\log D_0$ equal to -5.86 ± 0.41 and -7.82 ± 0.65 , respectively.

However, these diffusion laws are much slower than the diffusion laws for hydrogen uptake in San Carlos olivine, but they have the same anisotropic behaviour (Demouchy and Mackwell, 2006). Demouchy and Mackwell (2003) performed also uptake diffusion experiments in synthetic forsterite; they obtained similar diffusion rates but with different anisotropic behaviour: diffusion along [001] was ten times faster than along [100]. Our results point out the general complexity of the mobility of hydrogen defects in olivine.

Demouchy, S. and Mackwell SJ. (2006) *Phys. Chem. Minerals*, 33, 347-355

Demouchy, S. and Mackwell SJ. (2003) *Phys. Chem. Minerals*, 30, 486-494