

Hydrogen mobility in Wadsleyite at low temperatures

E. VIGOUROUX¹, J. INGRIN¹, C. DEPECKER¹,
N. BOLFAN-CASANOVA² AND D. FROST³

- ¹UMET - UMR CNRS 8207 - Université Lille 1 – Cité Scientifique, 59655 Villeneuve d'Ascq, France (eric.vigouroux@ed.univ-lille1.fr, jannick.ingrin@univ-lille1.fr, christophe.depecker@univ-lille1.fr)
²LMV - UMR CNRS 6524 - Université Blaise Pascal – 5 rue Kessler, 63038 Clermont-Ferrand, France (n.bolfan@opgc.univ-bpclermont.fr)
³BGI – Bayreuth University– Universitätsstrasse, 95447 Bayreuth, Germany (dan.frost@uni-bayreuth.de)

Mantle wadsleyite may incorporate large amount of H in its structure (up to several wt % H₂O). A good knowledge of hydrogen diffusion in wadsleyite and its relationship with electrical conductivity is critical to estimate the amount of water present in the transition zone. We present here the results of diffusion experiments realized in deuterium-rich atmosphere at room pressure between 300°C and 450°C. Wadsleyite samples have been synthesized from forsterite powder with a minute amount of water by multi-anvil presses at 16 GPa - 1100°C. The average grain size is less than 5 μm and the water content is around 0.01 wt% H₂O. All samples show major IR peaks at 3372, 3350 and 3322 cm⁻¹ with minor peaks at 3726, 3665, 3615, 3523, 3472 and 3208 cm⁻¹.

We observed the same OH extraction behavior in the three slides annealed: extraction kinetics of bands 3726, 3523, 3372 and 3208 cm⁻¹ is almost 100 times slower than other bands while deuteration affects all the bands in the same way. We obtain an activation energy of 175 kJ/mol for extraction of the “fast” decreasing bands and an activation energy of 202 kJ/mol for H-D exchange.

Our data extrapolated to high temperatures suggest that hydrogen mobility in Mg-wadsleyite is two orders of magnitude higher than extraction kinetics from Hae *et al.* (2006) (D=8.3*10⁻¹¹ m²/s at 1000°C) or it implies an activation volume of 11,3 cm³.mol⁻¹. If we neglect the effect of a potential activation volume, we predict a concentration of hydrogen two orders of magnitude smaller.

[1] Hae *et al.* (2006) *Earth Planet Sci Let* **247**, 141-148.

Half lives of nuclides for geological use: 2012 evaluation for ⁸⁷Rb

I.M. VILLA^{1,3,4}, M.L. BONARDI^{2,5}, P. DE BIÈVRE^{2,6},
N.E. HOLDEN^{2,7} AND P.R. RENNE^{1,8,9}

- ¹International Union of Geological Sciences
²International Union of Pure and Applied Chemistry
³Universität Bern, CH-3012 Bern, Switzerland; igor@geo.unibe.ch
⁴Università di Milano Bicocca, I-20126 Milano, Italy
⁵LASA, Università di Milano; INFN, I-20090 Segrate, Italy
⁶Duineneind 9, B-2460 Kasterlee, Belgium
⁷Brookhaven Natl Laboratory, Upton, NY 11973, USA
⁸BGC, 2455 Ridge Road, Berkeley, CA 94720, USA
⁹EPS, U of California at Berkeley, Berkeley, CA 94720

The IUPAC-IUGS joint Task Group “Isotopes in Geosciences”, TGIG, has evaluated the published measurement results for the decay constant (i.e. half life) of ⁸⁷Rb. A significant part of our evaluation was the effort to follow strict metrological criteria (VIM, 2012) in our assessment of the measurement uncertainties according to GUM (2008).

The ⁸⁷Rb half life was estimated by three groups using totally independent approaches. Kossert (2003) determined the specific activity of Rb salts by liquid scintillation counting. This approach assumes that inter-sample variations are due to stoichiometry. Nebel *et al.* (2011) compared Rb-Sr and U-Pb ages of cogenetic minerals. This approach assumes that certain natural samples behave “ideally”, i.e. all the relevant ages are expected *a priori* to be equal, and relies on control on the samples’ petrology. Rotenberg *et al.* (2012) measured the radiogenic ⁸⁷Sr accumulated in a batch of Sr-free Rb salt over 35 years. This approach relies on having performed precise and accurate measurements of the concentration and isotopic composition of the Sr present in the RbClO₄ at the time of crystallisation. The three sets of experiments yield indistinguishable results, which is a good indication that systematic biases were either coincidentally of the same magnitude and direction in three radically different experimental designs, or negligible after accurate correction. The resulting best estimates are $\lambda_{87} = (1.395 \pm 0.002) \times 10^{-11} \text{ a}^{-1}$ (1s uncertainty), $t_{1/2} = 49.7 \pm 0.1 \text{ Ga}$.

- [1] GUM (2008) Guide to expression of uncertainty in measurement. www.bipm.org/en/publications/guides/gum.html
[2] Kossert K. (2003) *Appl. Rad. Isot.* **59**, 377 [3] Nebel O., Scherer E.E., Mezger K. (2011) *EPSL* **301**, 1-8. Rotenberg E., *et al.* (2012) *GCA* **85**, 41-57. [4] VIM (2012) The International Vocabulary of metrology. <http://www.bipm.org/vim>