Geophysical Research Abstracts,
Vol. 11, EGU2009-9894, 2009
EGU General Assembly 2009
© Author(s) 2009

Measurements of the diffusion rate of stable isotopes in firn in a controlled laboratory experiment.

L.G. van der Wel (1), V. Gkinis (1,2), V.A. Pohjola (3), and H.A.J. Meijer (1)

(1) University of Groningen, Center for Isotope Research, Groningen, Netherlands (L.G.van.der.Wel@rug.nl), (2) Center for Ice and Climate, Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark, (3) Department of Earth Sciences, Uppsala University, Uppsala, Sweden

The stable water isotope signal in ice core records is known to be a proxy for past climatic conditions. The $^{1}H^{16}O^{2}H$ and $^{1}H^{18}O^{1}H$ isotope ratios in precipitation water depend on cloud temperature during snow formation. However, before the isotope signal is frozen into the ice it is altered as a result of firn diffusion. Firn diffusion is caused by random movement of water vapor in the pores of the snow. As a consequence the measured isotope signal in an ice core is a smoothed version of the original precipitation signal. Therefore, before we can use the measured signal as a climate proxy it has to be back-corrected for diffusion.

In order to obtain a higher quantitative understanding of the diffusion process we have set up two laboratory experiments in which we measure the diffusion rate. In both experiments snow made from isotopically enriched water was interlayered with snow made from natural water, where the layers were of varying thicknesses. At given intervals samples were taken from the firn stack and measured for their isotopic concentration. The measurements are compared to a model based on an existing theory for firn diffusion (see for example Johnsen et al [1]) and to a previous laboratory experiment [2]. The outcome of this experiment will help the understanding of the diffusion process and therefore make the back-correction more accurate.

[1] Johnsen S.J. et al., Diffusion of stable isotopes in polar firn and ice: the isotope effect in firn diffusion, in Physics of ice core records, edited by T. Hondoh, Hokkaido University Press, Sapporo, 121-140, 2000.

[2] Pohjola V.A. et al., Controlled experiments on the diffusion rate of stable isotopes of water in artificial firn, Journal of Glaciology, Vol 53, 537-546, 2007.