POTENTIAL VARIATIONS IN THE O-17 TO O-18 RELATION OF WATER AND ICE SAMPLES

M. C. Leuenberger

Climate and Environmental Physics, Physics Institute, University of Bern, Sidlerstrasse 5, CH-3012 Bern, Switzerland; leuenberger@climate.unibe.ch

ABSTRACT

It is generally assumed that the variations of O-17 and O18 contents of water samples are closely related. In literature there are different relations described, for instance the Craig relation that assumes O-17 to vary half compared to O-18. O-17 of water can be determined from the measured δ^{45} values after equilibration with an isotopically known CO_2 gas. The precision of the O-17 is with about 1 permil rather moderate. This originates from the fact that O-17 is 14 times less abundant than C-13 and that the precision of δ^{45} is in the order of 0.05 permil for water samples. Hence a similar uncertainty can be expected for $\Delta\delta^{17}O_{H2O}$ defined here as $\Delta\delta^{17}O_{H2O} = \delta^{17}O_{H2O} - 0.5 \times \delta^{18}O_{H2O}$. We reevaluated older measurements performed for $\delta^{18}O$ analyses from the Swiss Precipitation network for isotopes and ice samples from Greenland, Antarctica as well as Swiss glaciers. We found that in contrast to the younger samples from the Swiss precipitation network the ice samples showed slightly depleted $\Delta\delta^{17}O_{H2O}$ values. Variations of $\Delta\delta^{17}O_{H2O}$ could be explained by a changing stratosphere-troposphere exchange (STE) of heavily O-17 enriched stratospheric water vapour and carbon dioxide. If, indeed such a signal exists, it would require a significant correction for the $\delta^{13}C$ values on carbon dioxide [2]. Furthermore, this new parameter $\Delta\delta^{17}O_{H2O}$ could act as an indicator for STE. It certainly would also have implications for the interpretation of radio nuclides produced in the upper stratosphere like C-14 and Be-10 and others.

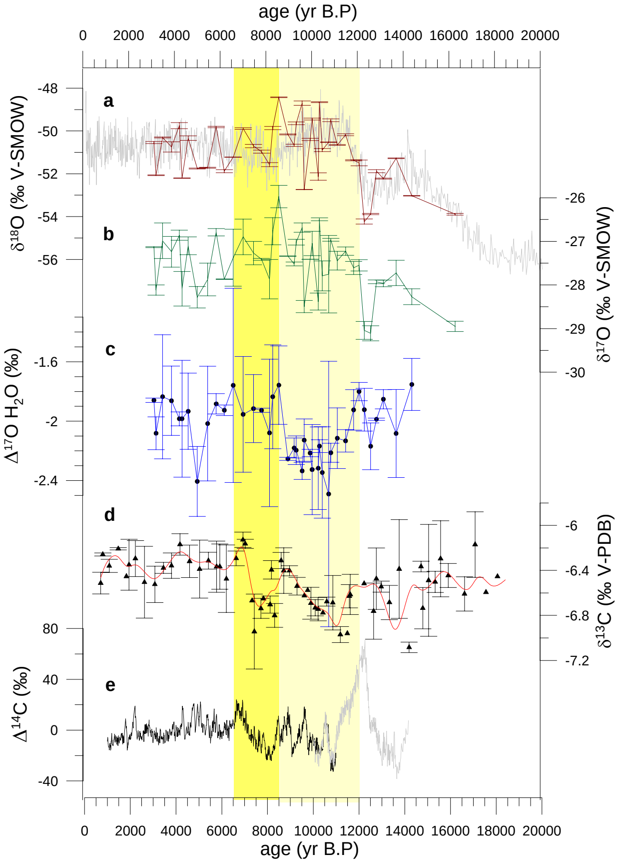

Fig. 1: a) $\delta^{18}O_{ice}$ Dome C [1] and $\delta^{18}O_{ice}$ of $\delta^{13}C$ samples measured at our institute, b) $\delta^{17}O_{ice}$, c) $\Delta^{17}O_{ice}$, d) $\delta^{13}C$ of CO_2 [2], e) $\Delta^{14}C$ [3,4].

REFERENCES

Stenni, B., V. Masson-Delmotte, S.J. Johnsen, J. Jouzel, A. Longinelli, E. Monnin, R. Röthlisberger and E. Selmo (2001), An oceanic cold reversal during the last deglaciation, *Science, 293*, 2074-2077, .

Leuenberger, M. C., M. Eyer, S. Bogni, J. Elsig and T. F. Stocker (2005), High resolution δ^{13}C measurements from the EPICA Dome C ice core, Abstract for the Seventh International Carbon Dioxide Conference, Boulder, CO, September 26-30, Session "Atmosphere."

Stuiver,M., P. Reimer, E. Bard, J. Beck, G. Burr, K. Hughen, B. Kromer, F. McCormac, J. v.d. Plicht, and M. Spurk (1998), INTCAL98 radiocarbon age calibration, 24,000, *Radiocarbon 40*, 1041-1083.

Hughen, K. A., J. R. Southon, S. J. Lehman, and J. T. Overpeck (2000), Synchronous radiocarbon and climate shifts during the last deglaciation, *Science, 290*, 1951-1954.