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The impact of storage time and temperature in polyethylen bottles on the multi isotope composition of water

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Storage of water samples in polyethylen bottles for later hydrogeochemical analysis is a common practice in laboratories world-wide. It is, however, known for a long time to geochemists that aqueous solutions lose water as a function of time due to the diffusion of water molecules (similar to CO_2 or H2S) through the polymer membrane, a process that is suspected to increase with rising temperature. First observations on the impact of storage on O-18 and H-2 contents in water were reported by Spangenberg & Vennemann (RCIM 2008) and Spangenberg (RCIM 2012), but no study considered systematically the effect of temperature, sofar.

In the present study we carried out long-term experiments to investigate the impact of storage of fresh water in LDPE bottles for up to 18 months at 4 different temperatures (4°, 10°, 23°, and 60°C). The loss of water was followed gravimetrically, and the stable isotope composition of the water sample was analyzed with a Picarro CRDS 2140-i system.

Whereas, at the low temperatures of 4° and 10°C, no measurable loss of water was observed during a storage time up to 1.5 years, a substantial loss of water was observed at 23°C and 60°C. This change was associated with, for instance at 60°C: an increase in d18O (up to 10 ‰, d2H (up to 28 ‰, d17O (up to 5 ‰. The deuterium excess was shifted towards lower values by up to 55 ‰The magnitude of the isotope effect mostly depends on the extend of evaporation from the bottles, allowing for an estimate of the fractionation factor by considering a closed Rayleigh-type system.