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Isotope hydrological and geophysical studies on the perennial cave ice deposit of Saarhalle (Mammuthöhle, Dachstein Mts, Austria)

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The largest perennial ice deposit of the Mammuthöhle cave system is located in the "Saarhalle" chamber. Its extension is 40 m by 15 m and the maximum ice depth is 6 m as obtained from recent Ground Penetrating Radar (GPR) measurements (Behm and Hausmann 2007). The GPR data show that the base of the ice in Saarhalle is dominated by large boulders, and that the ice is stratified. The location of an optimal drill site was chosen based on the depth map derived from the GPR results. Requisites for an optimal place were that the ice thickness should be close to maximum and that the space above the ice surface should be at least $\sim$2.5 m to install the drillrods.
A 5.28 m long ice core was extracted from the Saarhalle ice block and sectioned into 105 subsamples. Stable oxygen and hydrogen isotopic compositions of the samples were analysed.
The stable isotope composition of the ice core samples showed relative enrichment and d-excess values were characteristically lower compared to the potential sources (local precipitation, karstwater) indicating the fractionation effect of the freezing process. However the cave ice water line provided a slope coefficient of 8.13. These isotopic characteristics reflect a mixed-component open-system freezing model described by Souchez and de Groote (1985). For the case of Saarhalle ice block the early spring less depleted karstwater could play the role of initial water (first component) and as the infiltrating isotopically lighter snowmelt reaches the Saarhalle ice block it could provide the depleted input (second component).
This mixed-component open-system model can be adopted in the future research for the isotope hydrological studies of this cave ice deposit. A transformation trial will be tested to recalculate the original composition of the parent water of the cave ice layers.
As for tritium concentration the previously applied LSC measurements cannot reached detection limit it was thought that the upper $\sim$1.2 m of ice has likely been deposited from precipitation fallen before the 1960s. In addition, a more sensitive method (3H-3He ingrowth method) is to be tested.

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