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Detecting flow processes in peatlands using Li isotopes

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Mountainous fens are important hydrological components of the headwater catchments in Jizera Mountains, (the Czech Republic). Experimental catchment Uhlířská (1.78 km²) is formed by Paleozoic crystalline bedrock overlaid by shallow highly permeable cambisol on the hillslopes, whereas the thick saturated glacial deposits in the valley are overlaid by histosols. Standard meteorological and hydrological monitoring is supplemented by measurements of the soil moisture, soil pore water suction, water table fluctuation in the saturated riparian zone of Černá Nisa creek. Isotopes in water molecule ¹⁸O, ²H and ³H are analyzed in precipitation, shallow groundwater, soil pore water, groundwater and stream outflow to select proper hypothesis about the flow formation. Complementary sampling for the Li-isotopes ($\delta^7\text{Li}$) was performed in the period of 2008-2010 on the monthly basis in precipitation, shallow groundwater and outflow waters.

Lithium contents fluctuate significantly between the precipitation (mean: $0.35 \pm 0.21 \mu\text{g/l}$), the shallow groundwater (mean: $1.87 \pm 0.23 \mu\text{g/l}$) and the outflow (mean: $3.10 \pm 0.36 \mu\text{g/l}$). There is no link between the Li contents and the rainfall amount but a positive trend can be seen between Li contents and the outflow discharge. First set of Li-isotopes data shows an increase in the $\delta^7\text{Li}$ between the precipitation (mean: $+5.6 \pm 2.7\%$), the shallow groundwater (mean: $+13.9 \pm 4.4\%$) and the outflow (mean: $+18.4 \pm 3.5\%$). There is no evidence of link between the $\delta^7\text{Li}$ and the Li contents (as $1/\text{Li}$) revealing no simple mixing.

Comparing the data reveal causalities between content of lithium isotopes in precipitation, shallow groundwater in wetlands and outflow from the catchment and prove that naturally present lithium isotopes can be a very useful tool in hydrological tracing.

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