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Multi-tracer approach (18O, 3H/3He, CFC, SF6, 35S) to find the best emergency drinking water supply, Vorarlberg, Austria

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To provide an emergency drinking water supply in case of catastrophic events (regional chemical accidents, floods, earth quakes etc.), wells and springs should be known which are fed by a large reservoir. Such reservoirs provide a good filtering capacity and long Mean Residence Times (MRTs) of the raw water. Their existence allows to use these resources for longer periods excluding the danger of contamination. This provides the water authorities the necessary time to set measures to protect the general water supply.
After preselection of 16 wells and springs all over the territory of the province of Vorarlberg at the western end of Austria by the local water authority, these wells and springs were measured (water temperature, electric conductivity, pH and dissolved oxygen content) and sampled monthly for δ 18O/2H measurements over the winter half-year 2013/14. At the same time the tritium concentrations of the October and March samples were measured as well.
Based on the variation of the monthly on-site measurements and the δ 18O/2H results 12 wells and springs were selected for further investigations. On these sites samples for 3H/3He, CFC-11/12/113, SF6 and sulphur-35 measurements were collected in August 2014.
As expected from a humid alpine area, non of the selected springs or wells showed really long MRTs. Five out of 16 investigated sites are regarded as well suited to be used as emergency water source with a range of MRTs of 9 – 30 years. Five springs and wells are regarded of limited suitability due to the shorter MRTs of 5 – 9 years. In two springs the 3H/3He method could not be applied due to He-degassing in a karst-system and during sampling. CFC and SF6 excess at some sites with anthropogenic and geogenic sources hampered the utilisation of these gases as dating tool, but they were useful as source tracers.
Sulphur-35 was detected in two wells only, indicating contribution of very young water (< 1 year). In both cases MRTs of 13 - 17 years, calculated from the other applied tracers, otherwise would have supported the suitability of these wells as emergency drinking water supply.
In general, the combination of tracers measured here over the period of one year are well suited to select and confirm springs or wells to be used as emergency drinking water supply, even situated in areas with fast groundwater cycles.