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Tracer (18O, 3H, 3H/3He, CFC and SF6) and hydrochemistry to elucidate processes and mean residence times in porous aquifers in the South-East of Austria (Grazer and Leibnitzer Feld)

M. Kralik (1), F. Humer (1), G. Darling (2), J. Sültenfuß (3), and S. Wyhlidal (4)

(1) Environment Agency Austria & Univ. Vienna, WIEN, Austria (martin.kralik@umweltbundesamt.at), (2) British Geological Survey, Wallingford, U.K. (g.darling@bgs.ac.uk), (3) University of Bremen, Bremen, Germany (suelten@uni-bremen.de), (4) Austrian Institute of Technology, Seibersdorf (stefan.wyhlidal@ait.ac.at)

The European Water Framework Directive requires the surface and groundwater bodies in the EU to be back to good quality conditions by 2015. To elucidate the mean residence time (MRT), the recharge area and the potential source of contaminations in particular monitoring wells a combination of several tracers has to be applied at least over one year to answer these questions with confidence. For the implementation of this goal it is necessary that any measures to improve groundwater quality show an impact depending on the MRT.
The two groundwater bodies “Grazer Feld” and “Leibnitzer Feld” in the southern part of Styria, Austria stretch out along the river Mur in the N – S direction and covers an area of 166 and 103 km2. The porous aquifer of 10 - 20 m (Grazer Feld) of 6 – 10 m (Leibnitzer Feld) thickness consists of sandy gravel and boulders. In both groundwater bodies are about 2/3 of the aquifer is covered by loam of variable thickness. The depth to water varies between 2 – 20 and 2 – 8 m, respectively.
The mean precipitation rate is 900 mm/a. The groundwater runs more or less along the river Mur with a small gradient. The northern part of the Grazer Feld groundwater body is dominated by the urban structure of the city of Graz. The southern part and the groundwater body Leibnitzer Feld is impacted intensively by agricultural use.
Due to the extensive agricultural use it contains high concentrations of nitrate and pesticides and shows other hydrochemical changes caused by urbanisation and industrial use. In 33 monitoring wells delta oxygen-18 was analysed four times during one year within the framework of the Austrian hydrochemical groundwater monitoring system. During one campaign 3H, 3H/3He, CFCs and SF6 was analysed in all wells. In addition, the same methods were applied on depth-resolved groundwater samples at selected wells (Kralik et al. 2011).
The results of the 3H-input and 3H/3He-models support in both groundwater bodies the rapid water circulation (<5 years) with two exceptions of MRT of 5 – 10 years. Oxygen isotopes indicate about 50% of summer-water recharge. Both suggest a rapid recharge with local contaminants partly depending on the meteorological variation during the previous years. All CFC-11 and CFC-12 data show high excess values most likely due to buried CFC-contaminations underground. SF6 data show mostly too old MRT indicating loss of SF6 during sampling or complex exchange histories. The depth resolved groundwater samples indicate an increase of MRT with depth.
Kralik, M., Wenter, F., Humer, F. and Grath, J. (2011): Grundwasseralter ausgewählter Grundwasserkörper, 2009/2010: Grazer Becken, Jauntal, Leibnitzer Feld, Rheintal, Unteres Salzachtal, Wulkatal. 205 S., Ber. S259, Umweltbundesamt, Wien (http://www.lebensministerium.at/publikationen/ wasser/grundwasser.html).