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Assessing anthropogenic pressures on groundwater using stable OH isotopes: perspectives and issues

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Large developments of isotope hydrogeology were done and well-established techniques mainly applying stable isotopes of the water molecule (hydrogen and oxygen) are now used largely to trace water provenance but also recharge processes. New methods allow the use of non-traditional isotopes (metals, compound specific stable isotope analysis CSIA…) to trace anthropogenic pressures in surface- and groundwater. Groundwater contamination in large industrial sites may come from several origins such as leakage from tanks during the production process of chemical products, liquid storage tanks, solid end product or past accumulated product in soil which is released over the time. The understanding of the origin and the further evolution of the chemical contamination in groundwater in an industrial site issued from past or current industrial activities is essential for the industrial companies regarding their environmental policies. The objective of this study was to use with an innovative way the stable isotopes of the water molecule as a low cost tool to trace pollutant plumes in groundwater and help to a better management of contaminated industrial sites.

We present data on stable isotopes O and H in an European region where electrochemistry plants occur. For confidentiality purposes, the sites remain anonymous. Present day industrial activities have a direct impact on the groundwater over the site and migration of the contaminant(s) plume out of the site is supposed.

We first characterize the natural groundwater background through the O-H characterization of surface water, lakes, thermal waters and regional shallow aquifers. High and low altitude recharge can be demonstrated in the area. Secondly, we used the stable isotope of the water molecule to trace over the site the impact of the Cl-rich liquor manufacturing process. Large deuterium enrichment was evidenced in the groundwater and the high values can be related to a direct contamination of the groundwater through leakage of Cl-rich liquor with a δD values up to 400‰Àfter technical operations to improve sealing of the liquid storage tanks, no evidence of δD enrichment can be shown in present day groundwater. All values are along the global meteoric water line even for wells previously H-enriched, reflecting the absence of new leakage from tanks or during the manufacturing process over the site. Therefore our study shows that the stable isotopes of the water molecule can also be successfully used in an innovative way to trace pollutant plumes in groundwater.