

How isotopic hydrogeochemical tools can help policy makers to target priority area for drinking water preservation?

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The main objective of the Water Framework Directive (2000/60/EC) is to prevent further deterioration, protect and enhance the status of aquatic ecosystems in Europe. In details, WFD enforces member states to identify the hydrosystems that should be protected for present or future use as drinking water. In this context, water policy makers of the Rhône-Méditerranée-Corse district (south-eastern part of France, covering 1/5 of the French territory) plan to list and delimit all the areas related to groundwater that present outstanding interests regarding quality and quantity for drinking use.

Our study is focused on two groundwater bodies located on the Rhône-Méditerranée-Corse district that have been identified as being of primary importance and/or at risk by the policy makers. These groundwater bodies (Isere alluvial aquifer and molasse aquifer) are used for drinking water supply for the large cities of Lyon, Grenoble and Albertville, to a lesser extent. Objectives were to characterize and better understand the origin of water and dissolved elements of these aquifers in order to identify the areas of major interest and protect them in priority. For that purpose, combined geochemical analysis of major and trace elements, and isotopes ($\delta^{18}\text{O}$ and $\delta^2\text{H}$ of water, ${}^3\text{H}$, $\delta^{34}\text{S}_{\text{SO}_4}$ and $\delta^{18}\text{O}_{\text{SO}_4}$ of sulfates, ${}^{87}\text{Sr}/{}^{86}\text{Sr}$) have been successfully applied. This approach, in addition to geological and hydrogeological information, allow to identify groundwater units in each aquifer that i) present an uniqueness functioning and recharge and ii) permit low cost production for drinking purpose (water treatments reduced). For instance, the Isere alluvial aquifer presents high concentrations up to $3\mu\text{g/L}$ in As and Sb due to weathering of local rocks in the Alpes mountains. Hydrogeochemical knowledge, and especially isotopic tools, allow to target the groundwater units whose recharge area are less controlled by high As and Sb contents.

Lithium isotopic composition of the Tonga-Kermadec arc and its constraints on subduction recycling

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Understanding elemental transfer within subduction zones is integral to quantifying crust-mantle exchange and recycling. Lithium is water-soluble and potentially a useful tracer of subduction zone processes. We have analyzed the lithium concentrations and isotopic compositions of a suite of lavas from the Tonga-Kermadec island arc, as well as a depth profile through forearc marine sediments from ODP hole 204, and lavas from the Fonualei back-arc spreading center in order to trace how lithium isotopes manoeuvre through an intra-oceanic subduction zone.

The $\delta^7\text{Li}$ of the entire suite of sediments and lavas vary from 0.3 to 14.4. The depth profile, along with published data from another nearby core sample (DSDP 595/596), shows a systematic increase in $\delta^7\text{Li}$ (1.2 to 14.4) with depth. This is in relation with the sediment type; lithium isotopic signatures for pelagic sediments are often lighter because of fractionation from weathering, while volcanogenic sediments can be lighter or heavier as a direct result of their alteration effects.^[1] The $\delta^7\text{Li}$ of hole 204 pelagic sediments overlap that of the mantle, but range to lower values (1.2 to 5.2), while the $\delta^7\text{Li}$ of volcanogenic sediments are higher than the mantle (7.2 to 14.4). Thus, the Li isotope variation in the subducting sediments greatly exceeds that observed in the lavas. The fact that $\delta^7\text{Li}$ in some arc lavas (0.3 – 7.6) falls outside the range of MORB requires enrichments by fluid transfer of lithium from the sediments (which is reinforced with published B/Be data). Lavas from the back-arc spreading center ($\delta^7\text{Li} = 3.0 – 5.0$) show no variation from the widely accepted lithium isotopic signature range of the MORB (1.5 – 5.5), suggesting that there is little Li transfer from the slab in the back-arc.

[1] Chan, L.-H., Leeman, W.P., Plank, T., (2006). Lithium isotopic composition of marine sediments, *Geochem. Geophys. Geosyst.*, 7, 6.