Geophysical Research Abstracts
Vol. 20, EGU2018-16208, 2018
EGU General Assembly 2018

Connections between surface- and groundwater compartments in the Critical Zone through isotopic tracing

Emmanuelle Petelet-Giraud, Philippe Négrel, Lise Cary, Wolfram Kloppmann, and Nicole Baran
BRGM, Laboratories Division - LAB/ISO, Orléans, France (e.petelet@brgm.fr)

The Critical Zone is defined as the near-surface environment (roughly down to the bottom of aquifers) supporting terrestrial life, and thus need to be investigated as a real continuum with strong interactions between the compartments. Within the Critical zone, water (liquid, solid, gas) is ubiquist and is the link between its components. In that way, rivers and aquifers are now approached as a real continuum with strong mutual influences between river, aquifer and the interconnecting hyporheic zone. Numerous research approaches have been developed to identify and quantify the river-aquifer exchanges that can be in both directions depending on the river profile and the seasonal water levels and hydraulic gradients. The understanding of the links between hydrological, biogeochemical, and ecological process dynamics and their implications for river water quality and ecology are also of major concern for water management and decision makers.
Among the existing methods for investing surface water and groundwater relations, isotope techniques constitute a powerful approach; stable isotopes δ18O and δ2H being the most commonly used as an intrinsic “ideal” tracers of the water molecule. In addition, isotopes of dissolved elements (strontium, boron, sulfur,…) also constitute valuable tracers to identify and, in optimal conditions, to quantify the exchanges between surface- and ground-water bodies.
Through various examples, we present the contribution of isotopic tracers to the understanding of groundwater recharge in alluvial valley-fillings, riverbank aquifers counting worldwide among the most important water resources for drinking water supply, irrigation and industrial activities.
Sr isotopes constitute excellent tracers of water-rock interactions as 87Sr/86Sr reflect the signature of the minerals that constitute the drained aquifer lithologies. Boron isotopes also differ according to the drained lithologies, but, contrarily to strontium, signatures can be affected by secondary processes like adsorption/desorption onto clays; in urban context, they are good tracers of wastewaters whose signature are characteristic of the boron origin used in detergents. Sulphur and oxygen isotopes of sulphates are also potential tracers of drained lithologies (solid sulphates in evaporites, sulphides in igneous and sedimentary rocks) in cases where fertilizers do not provide the majority of dissolved SO4. The understanding of surface- and ground-water relations, gained through a multi-tracer approach, can thus explain groundwater quality but also the spatial variability of surface water quality along a river section, information of primary importance for water managers.