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Multiple flow dynamics in karst aquifers following recharge events highlighted by dissolved gases – case of the Lez karstic system (South of France)

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Karstic aquifers are important reservoirs for water supply but their heterogeneous structure and very different flow velocities complicate their management. Geochemical tracers are various and give information of water origin and/or residence time. Amongst geochemical tracers, gas tracers are interesting since their solubility depends on physical conditions (temperature, pressure, salinity). They give information about recharge conditions (Recharge temperature and Excess Air) and physical processes as matrix/conduits flux exchanges.

The present work assesses the benefits of gaseous tracers to characterise the recharge dynamics in the Lez Karst aquifer, which is a complex system subjected to an active management for the water supply and where multiple flow paths mix.

Noble gases (Ne, Ar) and N_2 were measured during autumnal recharge events of 4 hydrological cycles at a quasi-daily time-step from 2012 to 2016 at the spring outlet of the Lez system. In addition, a high frequency (intra-day time step) monitoring by in-situ mass spectrometry was conducted at the Lez spring during the 2019 autumnal recharge event. At the same time, Excess Air was measured in several boreholes representative of capacitive and transmissive karst compartments on the Terrieu experimental site, located in the main aquifer feeding the spring.

A peak of He was observed at the spring one day after the autumnal recharge event, indicating a deep flow contribution by piston effect. Between three and five days after, the Noble Gas Temperature increases of 5°C, associated with an increase of ^{222}Rn and of the natural organic matter fluorescence. These tracers indicate a contribution of fast infiltrated water from the surface under warmer recharge conditions compared to the water flowing at the spring during baseflow. Excess air measured before and after the recharge show opposite trends between boreholes intersecting only matrix and those intersecting conduits, highlighting matrix/conduits flux exchanges.

These results show the interest of gaseous tracers to discriminate flow origins and recharge dynamic during flood event in the karstic spring both at a local scale (matrix vs conduits) and at the catchment scale (deep flow, main aquifer and fast flow from surficial infiltration).