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HYDROCHEMICAL IMPACTS OF CO_2 LEAKAGE ON FRESH GROUNDWATER: A FIELD SCALE EXPERIMENT

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One of the questions related to the emerging technology for Carbon Geological Storage concerns the risk of CO_2 migration beyond the geological storage formation. In the event of leakage toward the surface, the CO_2 might affect resources in neighbouring formations (geothermal or mineral resources, groundwater) or even represent a hazard for human activities at the surface or in the subsurface.

In view of the preservation of the groundwater resources mainly for human consumption, this project studies the potential hydrogeochemical impacts of CO_2 leakage on fresh groundwater quality. One of the objectives is to characterize the bio-geochemical mechanisms that may impair the quality of fresh groundwater resources in case of CO_2 leakage. To reach the above mentioned objectives, this project proposes a field experiment to characterize *in situ* the mechanisms having an impact on water quality and the CO_2-water-rock interactions and also to improve the monitoring methodology by controlled CO_2 leakage in shallow aquifer.

The tests ran on an experimental site in the chalk formation of the Paris Basin. The site is equipped with an appropriate instrumentation and previously characterized (8 piezometers, 25 m deep and 4 piezairs 11 m deep). The injection test was preceded by 6 months of monitoring in order to characterize hydrodynamics and geochemical baselines of the site (groundwater, vadose and soil).

Leakage into groundwater is simulated via the injection of a small quantity of food quality CO_2 (~20 kg dissolved in 10 m^3 of water) in the injection well at a depth of about 20 m. A plume of dissolved CO_2 is formed and moves downward according to the direction of groundwater flow and probably by degassing in part to the surface. During the injection test, hydrochemical monitoring of the aquifer is done *in situ* and by sampling. The parameters monitored in the groundwater are the piezometric head, temperature, pH and electrical conductivity. Analysis on water samples provide chemical elements (major, minor and trace metals), dissolved gases, microbiological diversity and isotopes (^{13}C).

The evolution of the composition of the groundwater in terms of major elements, trace elements and isotope signatures is interpreted in terms of geochemical mechanisms, and the water-rock-CO_2 interactions are characterised. Modification of the chemical composition of the water in the aquifer due to CO_2 injection is assessed in term of groundwater quality i.e. metal element release and the possibility of exceeding references and quality of water for human consumption.

One outcome of the CIPRES project will be to highlight mechanisms that can impact groundwater quality when a CO_2 leakage occurs and to propose recommendations to prevent or/and eliminate negative effects and any risks to the environment and human health. This project is partially funded by the French Research Agency (ANR).