Impact of a CO2 leakage on groundwater quality. Influence of regional flow using reactive transport models.

Clement Jakymiw, Nicolas Devau, Pauline Humez, Vanessa Barsotti, Julie Lions

Impact of a CO2 leakage on groundwater quality. Influence of regional flow using reactive transport models.

Jakymiw C. (1), Devau N. (1), Humez P. (2), Barsotti V. (3), Lions J. (1,*)

(1) BRGM, 3 Avenue Claude Guillemin, BP 6009, 45060 Orléans Cedex 2, France
(2) Applied Geochemistry group, Department of Geoscience, University of Calgary, 2500 University Drive NW, Calgary, AB, Canada T2N 1N4
(3) ISTO CNRS/Université d'Orléans, UMR 7327, Campus Géosciences, 1A rue de la Férollerie 45071 Orléans

Carbon Capture and Storage in deep and saline aquifers is one of the available technologies to reduce CO_2 emissions into the atmosphere. However, CO_2 leakages into shallow freshwater aquifers are one identified risk and potential impacts on groundwater quality have to be studied. A better understanding on how it could affect water quality, aquifer minerals and trace elements release is necessary to develop a future storage site. Moreover, monitoring and remediation solutions have to be evaluated before storage operations. As part of the ANR project CIPRES, we present reactive transport modeling studies.

In a 3D model using ToughReact2, we perform different CO_2 leakage scenarios (brines and CO_2) in a confined aquifer. Our models are based on the Albian aquifer at 700 m deep, a strategic water resource for the Paris basin, overlying the Dogger and Trias deep saline aquifers. The model consists in a mesh, divided roughly in 20000 cells making a 60 m thick and a 500 m large layer. Around the leakage point, cells are subdivided to consider or assess local water-rock interactions (secondary precipitation, minerals reaction kinetics, sorption/desorption...). The geochemical model (chemistry and mineralogy) was elaborated from experimental data performed in a previous study (Humez, 2012).

We observe different geochemical behavior (CO_2 plume shape, secondary precipitations, desorption...) according to different horizontal flow rate influenced directly by the hydrodynamics (regional groundwater flow). We highlight the importance of surface complexation processes on trace element mobilization (As, Zn and Ni). Understanding how geochemical reactions and regional flows influence water chemistry, allows to ascertain measurement, monitoring, verification plan and remediation works in case of potential leakage considering a given location.

* Corresponding author : Julie Lions, j.lions@brgm.fr