

## Using noble gas concentrations and $\delta^{13}\text{C}$ to monitor $\text{CO}_2$ leakage in a carbonate freshwater shallow aquifer

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The Aquifer-CO<sub>2</sub>Leak project is dedicated to the development of monitoring tools and a methodology for CO<sub>2</sub> leaking detection within the saturated zone, as well as understanding the behavior of CO<sub>2</sub> in a carbonate aquifer. From numerical simulations, an induced leakage experiment was performed on the pilot experimental site of Saint-Emilion [1] in France. Water was saturated with a gas mixture of CO<sub>2</sub>, He and Kr in a specially designed tank, and was then injected in the aquifer. Monitoring was conducted through 3 observation wells by collecting periodic samples. This study focuses on the complementary usefulness of geochemical tracers (<sup>13</sup>C isotopes [2] and noble gas [3]) to monitor CO<sub>2</sub> plume distribution. The comparison of noble gas concentrations with that of dissolved inorganic carbon (DIC) allow us to predict and estimate the extent and the rate of CO<sub>2</sub> migration. The DIC close to the injection site is isotopically enriched by 2‰ while its concentration jumps by 25%. Furthermore, He and Kr exhibit different times of arrival at the control well. However, far from the injection well,  $\delta^{13}\text{C}$  and DIC concentrations change less significantly, while noble gases arrive simultaneously. This suggests a change in the transport of species, from an initial diffusion regime to advection.

[1] Ossara and al., 2020, in review [2] Mayer and al. Int Jour Green Gas Con 37 (2015) 46–60 [3] Lafortune (2007), PhD Thesis, Institut de Physique du Globe de Paris.