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Stable isotope monitoring of ionic trapping of CO_2 in deep brines

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CO_2 injection into a depleted gas-reservoir is used as a combined method for Enhanced Gas Recovery (EGR) and CO_2 storage. In order to safeguard this process, monitoring the degree of dissolution and potential further precipitation and mineral interactions are a necessity. Here a method is introduced, in which stable isotope and geochemical data can be used as a monitoring technique to quantify ionic trapping of injected CO_2.

Isotope and geochemical data of dissolved inorganic carbon (DIC) can be used to distinguish between already present and to be injected inorganic carbon. Injected CO_2, for instance, is formed during combustion of former plant material and is expected to have a different isotope ratio (δ^{13}C value) than the baseline data of the aquifer. This is because combusted CO_2 originates from organic material, such as coal and oil with a predominant C3 plant signature. Mixing the injected CO_2 with groundwater is therefore expected to change the isotope, as well as the geochemical composition of the groundwater. Mass balance calculations with stable isotope ratios can serve to quantify ionic trapping of CO_2 as DIC in groundwater.

However, depending on the composition of the aquifer, weathering of carbonate or silicates may occur. Enhanced weathering processes due to CO_2 injection can also further influence the isotopic composition. Such interactions between dissolved CO_2 and minerals depend on the temperature and pressure regimes applied. Field data, as well as laboratory experiments are planned to quantify isotope ratios of dissolved inorganic carbon as well as oxygen isotope ratios of the water. These are indicative of geochemical processes before, during and after EGR. The isotope method should therefore provide a new tool to quantify the efficiency of ionic trapping under various temperatures and pressures.

Keywords: Enhanced Gas Recovery, monitoring of CO_2 dissolution, stable isotopes