Geochemical and isotopic approaches for monitoring CO_2 storage sites: applicability for shale gas development

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A long-term monitoring plan is important for assessing potential environmental impacts of both geological gas storage activities and unconventional gas exploitation. The geochemical monitoring approaches developed in the context of Carbon Capture & Storage (CCS) for potential leakage detection comprise (1) classic geochemical techniques with analysis of pH values and major and trace element concentrations in solution; (2) isotopic techniques with, for example, analysis of the C- and O- isotope ratios of CO_2 and noble gases; and (3) novel techniques based on "non-traditional" isotopic approaches [1, 2]. These tools include both direct indicators of the presence of CO_2 and indirect indicators resulting from water-gas-rock reactions induced by CO_2 intrusion. These geochemical and isotopic approaches developed at geological CO_2 storage sites can also be used for potential leakage detection at unconventional hydrocarbon reservoirs.

This presentation focuses on how recently conducted CO_2 storage studies can inform monitoring strategies for assessing potential environmental impacts of shale gas exploitation. This will be illustrated by examples from recent studies dealing with leakage scenarios of CO_2/stray gas accompanied by other contaminants and produced fluids (brine displacement in the case of CCS, fracking fluid flowback in the case of shale gas exploitation) and impact of leaking fluids on groundwater and surface water. Baseline studies to understand natural variability and sensitive tracers to track the potential shifts in geochemical compositions of groundwaters and their dissolved or free gases are key components of successful monitoring approaches.

[1] Humez *et al* (2014), *Chemical Geology* **369**, 11-30 [2] Humez *et al* (2014), *Applied Geochemistry, In press*