Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.11947

Multi-isotope geochemical baseline study of the CMC Research Institutes CCS Field Research Station (Alberta, Canada), prior to CO_2 injection

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Carbon capture and storage (CCS) is an industrial scale mitigation strategy for reducing anthropogenic CO_2 release to the atmosphere [1]. Geochemical monitoring tools are essential for verifying secure storage of CO_2 and detecting unplanned migration [2]. However, use of these tools critically depends on geochemical baselines being established prior to CO_2 injection.

Carbon Management Canada Inc., in collaboration with The University of Calgary, constructed a Field Research Station (FRS) for development and demonstration of monitoring technologies for the containment and migration of subsurface fluids, in particular CO_2 [3]. Consisting of multiple boreholes in Upper Cretaceous Belly River Group sediments, the site allows monitoring of gas phase CO_2 that has been injected into the Basal Belly River Sandstone and other gases throughout the storage complex.

We will present a multi-well gas and groundwater characterisation of the natural gas geochemical baseline at the FRS. All gas samples exhibit low CO_2 concentrations, with biogenic CH_4 occurring pervasively throughout the succession. FRS samples have elevated radiogenic ^4He compared to the atmosphere. ^4He concentrations are higher than modelled concentrations that can be generated from in-situ radioactive decay of U and Th within the bedrock stratigraphy. All samples lie on a mixing line between the atmosphere and natural gas in a reservoir below the FRS storage complex. This confirms an identifiable radiogenic contribution at the FRS.

We find that the injected CO_2 is depleted in He, Ne and Ar, yet enriched in ^{84}Kr and ^{132}Xe relative to ^{36}Ar, highlighting the potential use of inherent noble gas geochemical tracers in injected CO_2 at the FRS and elsewhere.

References

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