Constraining the subsurface geochemical baseline of CMC Research Institutes' Field Research Station (FRS), Alberta

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Geochemical monitoring can verify secure CO_2 storage and detect unplanned CO_2 migration. A robust geochemical baseline is needed prior to subsurface CO_2 injection. We present the first multi-well gas and groundwater geochemical baseline characterisation at CMC Research Institutes' Field Research Station (FRS) in Alberta.

We confirm that CH_4 occurs pervasively in the shallow (<550 m) Upper Cretaceous bedrock succession. Using C_1/C_2+C_3 ratios, $\delta^{13}C_{CH4}$, δD_{CH4} we determine that the CH_4 is primarily of biogenic origin. However, we also identify a small, but resolvable (1 - 15 %), thermogenic CH_4 component that increases with depth, which is correlated with increasing radiogenic-sourced ^4He.

Measured ^4He concentrations exceed those that could be generated by in-situ radioactive decay of U and Th in the host Upper Cretaceous stratigraphy. ^4He concentrations lie on a mixing line between the atmosphere and a nearby petroleum well that produces natural gas from Lower Cretaceous Viking Fm. This excess ^4He could indicate mixing with a radiogenic component that is consistent with observed elevated nucleogenic and radiogenic-derived $^{21}Ne^*$ and $^{40}Ar^*$ present in several gas samples.

In contrast to previous work, this indicates a small, but resolvable crustal contribution to the subsurface fluids at the FRS site, showing that a fluid connection from the petroleum producing Viking Fm. is present in this portion of the Western Canada Sedimentary Basin.