Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19748

Geochemistry of groundwaters from the first subsurface CO_2 mineral carbonation pilot site in Saudi Arabia

SERGUEY ARKADAKSKIY[1], ERIC H. OELKERS[2], GRIMUR BJORNSSON[3], SIGURDUR R GISLASON[4], THOMAS FINKBEINER[5], HUSSEIN HOTEIT[6], ABDULKADER AFIFI[7], MOUADH ADDASSI[5], JAKUB FEDORIK[1], DAVIDE BERNO[8], ZEYAD AHMED[1] AND NOUSHAD KUNNUMMAL[1]

[1]Saudi Aramco
[2]University of Iceland
[3]Warm Arctic ehf
[4]Institute of Earth Sciences, University of Iceland
[5]KAUST
[6]King Abdullah University of Science and Technology (KAUST)
[7]KAUST, King Abdulla University of Science and Technology
[8]King Abdullah University of Science and Technology

Presenting Author: serguey.arkadakskiy@gmail.com

The fulfilment of the Kingdom of Saudi Arabia's (KSA) decarbonisation policies depends on the timely implementation of large-scale Carbon Capture and Storage (CCS) projects capable of sequestering the bulk of the CO_2 emitted from the Kingdom's industrial facilities. However, no sedimentary reservoirs capable of storing significant CO_2 volumes have been identified in western KSA yet. The in-situ mineral carbonation of CO_2 in basalt is an effective CCS method capable of sequestering substantial quantities of CO_2. Western KSA hosts large accumulations of mafic and ultramafic rock suitable of sequestering CO_2 by mineral carbonation. Amongst those are the massive Oligocene basalts of the Jizan Group, which outcrop to the NE of the CO_2 emitting facilities at the Jazan City for Basic and Downstream Industries (JCBDI). The total mineral carbonation potential of the Jizan basalts in the area has recently been estimated at >4 Gt. Consequently, a site north of JCBDI has been selected for the first in the KSA carbon mineralization pilot test. This pilot test will utilize groundwater as a CO_2 carrier fluid, thus the geochemical properties of groundwaters from the area need to be determined. This presentation will discuss the results of a groundwater geochemistry study conducted at and near the pilot test site. An integral part of this study is the characterization of the local hydrogeological system based on a multitude of parameters including dissolved major and trace element concentrations and ratios, chemical thermometry and stable and radiogenic isotopes of hydrogen, carbon, oxygen chlorine strontium and bromine of water samples collected from private groundwater wells and during and after the drilling of the pilot test wells. The geochemical data identify the provenance and recharge area(s) of local groundwaters, their water-rock interaction histories, pathways and sources of dissolved salts. The water samples' chemical saturation state with respect to secondary minerals illuminates both the reactivity of the subsurface rocks and the potential of these rocks for carbon mineralization. Reactive transport calculations based on the compositions of waters and rocks collected from the reservoir provide insight into the likely rates and extent of carbon mineralization during the upcoming pilot CO_2 injection.