

Impact of CO₂-Rock-Fluid Interaction in a Carbonate Reservoir in a High CO₂ Gas Field

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The Sarawak basin offshore Malaysia contains a number of giant gas fields, some of which are rich in CO₂ and some of which are not. The Miocene S field is unique compared to other sequestration projects since CO₂ injection is planned into a carbonate reservoir under extreme P&T conditions of 36 MPa and 150°C, with low salinity (~20,000 ppm TDS), that already contains large amounts of CO₂. The reservoir is sealed by two thick shale sequences. This paper will focus on experimental work and modelling of mineralogy in the shales and carbonates as well as pore fluid properties resulting from exposure to supercritical CO₂. Analyses utilized in this study include XRD, XRF, SSA, CEC, QEMSCAN and Micro CT Scanning. Changes in pore fluid composition are evaluated from in situ composition and static geochemical modelling using PhreeqC. For the experiments, shale and carbonate reservoir samples were aged with brine and scCO₂ using two methods, (i) using one pore volume of fluid saturation for 6 months and (ii) using 10 sample volumes of pore fluid for 31 days, both close to in situ P/T conditions (4200 psi and 150°C). The results of the first ageing method indicate no significant changes in mineralogy or major element geochemistry of both, the carbonate reservoirs and the seals. The minimal changes may result from the original reservoir already being exposed to CO₂ in situ for millions of years. These results may be different to other carbonate reservoirs with no CO₂ in situ where more extensive reaction may occur.

**This abstract is too long to be accepted for publication.
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