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Petrophysical measurements for CO2 storage: application to the Ketzin site.

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Reservoir simulations and monitoring of CO2 storage require specific petrophysical data. We show and illustrate an integrated workflow dedicated to CO2, including log data analysis and laboratory measurements.

This workflow has been applied on the Ketzin site. It is the first in-situ testing site of CO2 injection in Germany and is located near the city of Ketzin. Carbon dioxide has been injected into a saline aquifer of the Triassic Stuttgart Formation in an anticlinal structure of the northeast German Basin. Two observation wells are used to detect the CO2 plume arrival time, among other quantities, and all three wells are equipped with permanent resistivity sensors to monitor the change of the resistivity map during injection.

As clearly evidenced by NMR logs, the formation considered for injection contain a significant amount of clays. The cut-off for clay bound water has been determined precisely on two sub-regions using centrifuge data, in conjunction with experiments designed to obtain drainage capillary pressure.
For reservoir simulations, capillary pressure and relative permeability in drainage and imbibition are necessary. As a first step, we used air-brine centrifuge drainage capillary and water relative permeability curves, which can be used quickly in pre-simulations.
For monitoring purposes, formation factor, drainage and imbibition resistivity index curves are necessary. These data have been acquired using the Fast Resistivity Index Measurement method in drainage and imbibition, both at laboratory and storage conditions using supercritical CO2.
Finally, the caprock has also been considered: pore diffusivity was determined using a quick NMR deuterium tracer technique, liquid permeability was measured using an innovative technique as well as entry pressure.

Such a data set can be acquired in a reasonable amount of time and is very useful for the above mentioned aspects, especially as constraints for the evaluation of time-lapse results from the resistivity sensor array. Since similar data are acquired using different techniques (e.g. capillary pressure), this workflow also provides a consistency control in addition to standard quality control.