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TITLE: Sequestration of CO_2 in a Naturally Fractured Siliciclastic Reservoir, Spitsbergen, Svalbard

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ABSTRACT BODY: As part of the Longyearbyen CO_2 laboratory (http://co2-ccs.unis.no), CO_2 is planned to be injected into shallow marine/paralic deposits of the Upper Triassic Kapp Toscana Group. The reservoir, located at approximately 670 to 970 m below the high arctic community of Longyearbyen, consists of tight sandstones and mudstones with a sandstone matrix permeability of less than 1 mD. Porosity measured from plugs in the LYB_CO2_DH4 borehole is low to moderate (8-20%). Nevertheless, water injection tests conducted in November 2009 and August 2010 in the lowermost 100 m of the reservoir revealed a total flow capacity of approximately 45 mD·m, thus verifying the injectivity potential of the reservoir. The observed injectivity of the otherwise tight reservoir is governed by the presence of fractures, some of them open, observed throughout the reservoir unit both in well cores and outcrops. The high frequency (up to 10 fractures per metre) of vertical and sub-vertical fractures penetrated by the narrow borehole is particularly significant. Televiewer data, available for part of the overburden, show mainly horizontal fractures. Fracture distribution in the reservoir appears to be linked to stratigraphy. Based on this we suggest a mechanical subdivision of the reservoir. Higher fracture frequencies are also observed adjacent to a 2 m thick igneous intrusion encountered close to the base of the well.

We here present the initial modeling of water injection into this complex reservoir. A sensitivity matrix of simulation cases is set up to account for the relative contributions of key parameters, including fracture length, -orientation, -apertures and -fill, on injection performance. Fractures form preferred flow pathways within the reservoir, but may also affect seal integrity. Well data, seismic data and field mapping of outcrops of the Kapp Toscana Group, some 16 km distant from the planned injection site, are used to constrain the subsurface model. Magmatic intrusions were mapped using LiDAR images of the outcrops, borehole and seismic data, in addition to conventional field mapping. A model of the regional geometry of the igneous bodies is presented, focusing on their impact on both reservoir compartmentalization and local impact on reservoir properties.

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