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Thermal Perturbation Sensing for Monitoring Subsurface CO_2 Transport

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In the framework of the CO_2SINK project, a novel thermal borehole measurement method is being applied to enhance monitoring of brine and CO_2 transport. The distributed thermal perturbation sensor (DTPS) consists of two elements, a linear heater providing constant heating along the axis of the wellbore, and a distributed temperature sensor (DTS), for measuring temperatures. By creating a heat pulse and simultaneous registration of the change in temperature along a borehole, we can draw conclusions regarding the thermal properties of the formation and the flow processes inside the reservoir. As part of the CO_2SINK project, one injection and two observation wells were equipped with permanently installed fiber-optic DTS cables for monitoring of borehole temperatures. Using an additional electrical heating cable, the boreholes were heated with a power of 20 W/m for intervals of about two days, during which the borehole temperature increased $\sim$6 $^{\circ}$C. Preliminary results from numerical inversions of the measured heating curves prior to injection show a good correlation to the thermal conductivities measured on core samples. As CO_2 injection progresses at CO_2SINK, the CO_2 saturation in the formation around the injection and observation boreholes is expected to increase, resulting in a measureable reduction in the formation's thermal conductivity.