Tracer Design and Gas Monitoring of a CO2 Injection Experiment at the ECCSEL CO2 Field Lab, Svelvik, Norway

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The ECCSEL Svelvik CO2 Field Lab outside Oslo has been set up for water and CO2 injection experiments. At the site, ongoing and future investigations on monitoring techniques for carbon capture and storage (CCS) shall support the development of CCS as a climate change mitigation technology in Norway.

In 2019, four 100 m deep injection wells with a sophisticated physical monitoring setup were established. For chemical monitoring a fluid sampling system at injection depth was installed and coupled to a continuously measuring mass spectrometer for observing CO2 distribution. Alongside, a network of soil gas flux chambers (LI-COR 8100) were set up to monitor possible surface leakages.

The field lab is placed in a sand quarry within the Svelvik Ridge consisting of Holocene, siliciclastic sediments. Injection is conducted into a saltwater aquifer at 65m, supposedly sealed by clay strata. We sampled the upper fresh water aquifer at 6.5m depth and the storage aquifer at 64 - 65 m depth on dissolved gases before injection in order to design a noble gas tracer for the CO2 injection experiment. Elevated helium concentrations in the saline aquifer indicate natural radiogenic accumulation; meanwhile krypton concentrations were not naturally increased.

During an injection experiment in fall 2019, we added noble gases, i.e. krypton and helium, in two subsequent injection cycles, three days and one week, respectively. Outgassing was observed and high helium concentrations verified a leakage at the injection well, which we quantified with a flux chamber.