Geophysical Research Abstracts
Vol. 20, EGU2018-13722-1, 2018
EGU General Assembly 2018

ELEGANCY: Enabling a Low-Carbon Economy via Hydrogen and CCS

Alba Zappone (1,2,3), Claudio Madonna (2), Stefan Wiemer (1), and the ELEGANCY team

(1) ETH, Swiss Seismological Service, Zurich, Switzerland (alba.zappone@sed.ethz.ch), (2) ETH, Department of Earth Sciences, Zurich, Switzerland, (3) ETH, Department of Mechanical and Process Engineering, Zurich, Switzerland

ELEGANCY (Enabling a Low-Carbon Economy via Hydrogen and CCS) is an European project within the ACT (Accelerating CCS Technologies) initiative, aiming at advance sustainable geo-energy processes through studies on risk mitigation, characterization and public perception, whose achievements will benefit the fields of seasonal gas and heat storage, as well as carbon dixode (CO_2) sequestration.

The geological storage of CO_2 is an essential component for enabling the efficient generation of emission-free hydrogen (H_2) as a transport fuel. The large volumes of CO_2 produced in the natural gas reforming H_2 manifacture require a coupling with direct CO_2 separation techniques, and safe geological storage. For the latter it is important to guarantee both quality and security of storage, for example ensuring adequate injection rate, long term containment, and robust monitoring tools development. The experimental approach plays an essential role, both at laboratory and at pilot test scale. The first scale provides input parameters for numerical simulations on the behaviour of CO_2 and hosting rocks at depth; the second validates modeling, and proves the technology at a scale that is small enough to be safe for experimental testing, but large enough to be significant.

A key challenge for geological storage is played by the integrity of the caprock. Within ELEGANCY, this challenge is addressed by executing a decameter-scale experiment at the Mont Terri Underground Rock Laboratory (URL) in Switzerland. The design of the experiment is led by the Swiss Competence Center for Energy Research - Supply of Electricity (SCCER-SoE) through its partner institutions, namely Swiss Seismological Survey, ETH Zurich and EPF Lausanne, in collaboration with the Swiss Federal Office of Topography (Swisstopo). The experiment aims at investigating the mechanisms and the physical parameters governing (i) the migration of CO_2-rich brine through a damaged zone within faults; (ii) the interaction of the CO_2 with the neighboring intact rocks (including CO_2 ex-solution from the brine and chemical interactions with the microporous matrix), and (iii) the impact of the injection/migration on the damaged zone and on the intact rocks. In particular, the test seeks to understand the conditions for slip activation to occur (e.g., seismic vs. aseismic slip) and the stability of clay faults, as well as the evolution of the coupling between fault slip, pore pressure, fluid migration and possible induced “micro” seismicity. To this end, the damaged zone will be stimulated by injecting CO_2-rich brine into the fault core (Opalinus Clay) for a period of about eight months, while monitoring its geo-mechanical response. Additional tracer and transmissivity tests will be conducted at regular time intervals to determine the fluid path evolution of the injected fluid and to infer the potential evolution of CO_2 from the brine. Numerical simulation work will assist the different phases of the field experiment. Moreover laboratory measurements will provide input parameters in terms of baseline rock properties of both the damaged zone and the intact rock. These include estimates of porosity, permeability, dispersivity, and multi-phase flow properties (capillary pressure, relative permeability and gas trapping characteristic curves).