Report of Transnational Access Projects

Project ID: C3_TA3-82-1_4

Principal investigator: Prof. Dr. Joerg Renner

Project title: Testing a periodic injection protocol at the BedrettoLab Testbed

Project acronym: B-PIP

Hosting installation: BedrettoLab testbed (TA3-82-1)

Hosting team: Marian Hertrich, Mathilde Wimez, Liliana Vargas Meleza, Valentin Gischig

Period of access: Remote access from October to December 2025

Report of activities:

The physical access did not take place but, instead we used up the 8 allotted weeks for remote access to the lab infrastructure distributed between October and December 2025. We were able to execute the entire experiment remotely using the in-house software developed by BedrettoLab that operates the pumps. We had the assistance of the operations staff to select the borehole, setup the packer system and the acquisition systems, data transmission and storage, the on-site monitoring and dashboard preparation.

This TA was comprised of a series of periodic production and injection tests in the Geothermal Testbed at the BedrettoLab (Plenkers et al., 2023; DOI: https://doi.org/10.3390/s23063315). The selected borehole was SB1.1, a 30 m deep, vertical borehole equipped with a multi-packer system used for zonal isolation, to divide the granite rock intervals for controlled fluid injection, pressure monitoring, and hydromechanical testing. It consists of large, rubber-wrapped inflatable cylinders lowered into underground boreholes.

Flow rate and pressures for the selected interval as well as the passive intervals were. Several periodic pumping tests were performed in SB1.1 using the multi-packer probe allowing to target natural and induced fractures fractures produced during mini-frac tests, previously performed at four depth levels for stress determination (Bröker, K. and Ma, X., 2022; DOI: https://doi.org/10.1007/s00603-021-02743-1; Bröker, K., 2019; DOI: https://doi.org/10.3929/ethz-b-000463936). We applied harmonic and square oscillations of injection and production flow rates with a range of periods from 100 to 100,000 seconds and different average flow rates and flow-rate amplitudes. The protocols aim at constraining the hydro-mechanical properties of individual fractures and the fracture network surrounding SB1.1.

Geo-INQUIRE is funded by the European Commission under project number 101058518 within the HORIZON-INFRA-2021-SERV-01 call



Figure 1. LEFT - Setup at the testbed: Tripod above borehole SB1.1, pressure sensors (blue cabinet), and flow-control board (far right). RIGHT - Close up of the the multi-packer probe placed in borehole SB1.1.

Flowrate and pressure data were streamed near real-time to ETH servers in Zurich, to which we had access for the duration of the TA project. Figure 2 shows an overview of the pressure measurements recorded at five depth intervals in borehole SB1.1 and the flowrate measured, from October to December 2025.



Figure 2. Pressure measurements at five different intervals in borehole SB1.1 from October to December 2025.

Project outcomes:

Fracture sets trending NE-SW are dominant around SB 1.1, but absent in the other boreholes, where sets with NW-SE orientation and N-S are prevalent. We performed a stress analysis on the traces of these induced fractures, which confirmed that the stress regime is predominately strike-slip but also suggests that the vertical stress is not strictly a principal stress. The data collected is relevant to understand the hydro-mechanical properties of the fracture network.

Geo-INQUIRE is funded by the European Commission under project number 101058518 within the HORIZON-INFRA-2021-SERV-01 call

A dataset of the hydraulic time series recorded during this project has been made available at DOI: https://doi.org/10.3929/ethz-c-000803588. It consists of continuous pressure measurements recorded every minute, for five intervals in borehole SB1.1. Each interval at a different depth. The flow injected in SB1.1 borehole was recorded with a Bronkhorst flow meter every minute.

This project was possible in the framework of the TA 3rd Call of Geo-INQUIRE, a project funded by the European Union (GA 101058518).