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Bedretto Deep Underground Laboratory for Geoenergies –a new interdisciplinary research facility

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The Bedretto tunnel in Ticino, Southern Switzerland has been identified to provide ideal conditions for underground in-situ experiments on the meso-scale related to geo-energies. The tunnel is located in the Rotondo Granite and comes with 1'000m plus overburden rock mass, for this reason providing a setting that is similar to typical deep reservoirs.
The Bedretto tunnel is a 5km long side access, built during the excavation of the Furka base tunnel. At about 2km from the entrance in Val Bedretto, a 6 m wide and 100 m long niche has been excavated during tunnel construction, providing the ideal conditions for an underground laboratory. The tunnel has been retrofitted with a new access road, power supply, ventilation, IT-infrastructure and an external laboratory. Additionally, it is equipped with a background basic monitoring system along the tunnel.
We present an overview about a series of experiments planned for the next years in the context of EGS. Stimulation experiments will be conducted in dedicated boreholes with specially designed borehole completions that allows the direct access to the rock volume in individually accessible intervals.
The first project is focusing on the development of a reservoir of 100 m scale, which is a significant larger scale than other in-situ stimulation experiments conducted i.e., by Zang et al. 2017, Amann et al. 2018, Renner et al. 2019 and Kneafsey et al. 2019. The experiment will test and monitor the concept of multi-stage segmented stimulation in EGS creation. The reservoir will be developed through two injection boreholes at distances 200m to 300 m from the tunnel, i.e. in rock volume where both stresses as well as hydrology is undisturbed from the tunnel excavation. A multi-component monitoring network will ensure the observation of induced seismicity (-6 < Mw < 2), aseismic deformation and pressure as well as tilt and temperature. Challenges in network installation, including deep borehole installation, high pore pressures of more than 10MPa and sealing of boreholes using advanced grouting techniques, require the development of novel monitoring techniques which is here introduced.
A second project aims at Mitigating induced seismicity for successful geo-resources applications (MISS). Within this project we will conduct the first-ever program to perform controlled 50-100m scale fault stimulation experiments in basement rock at over 1'000m depth. We will investigate how earthquakes nucleate, propagate and arrest and find answers on the role of pre-stress conditions and geometrical/rheological complexities (i.e., barriers) on earthquake nucleation.

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