EGU24-6192, updated on 17 Oct 2024
https://doi.org/10.5194/egusphere-egu24-6192
EGU General Assembly 2024

Structural, petrophysical, and geophysical characterization of a fault zone in southern Finland – application for subsurface fluid flow in granitic settings

Jon Engström, Alan Bischoff, Evgenii Kortunov, Mira Markovaara-Koivisto, Nikolas Ovaskainen, Nicklas Nordbäck, and Markku Paananen
Geological Survey of Finland, ESPOO, Finland (jon.engstrom@gtk.fi)

Southern Finland crystalline basement was formed and modified during the 1.9–1.8 Ga Svecofennian orogeny, which constitutes a portion of the Fennoscandian Shield. The bedrock comprises supracrustal and early to late-orogenic igneous rocks of mafic to felsic compositions and is characterized by an overall high metamorphic grade associated with high-T and low-P conditions. The bedrock was subjected to multiple tectonic events of distributed deformation, first during a compressional stage, then followed by an extensional stage and finally a transpressional stage.

Hence, the Kopparnäs study site in southern Finland has been subjected to several stages of ductile and brittle deformation. The site has been studied by the Geological Survey of Finland for several years, with special research emphasize on a subvertical E–W orientated multi-core fault zone that intersects granites, amphibolites, and migmatites. A drillhole cuts through this fault zone at 100 m depth. This drillhole has beed studied using downhole instrumentation, such as optical and acoustic imaging and diverse geophysical surveys (fullwave sonic, magnetic susceptibility, gamma density, natural gamma radiation, drillhole caliper and various electrical loggings). In addition, a comprehensive study of the drill core enables detailed geological and petrophysical characterization of the fault architecture, including recognition of fractures, alteration zones, and mineralization across the fault and its host rocks. These studies together with fluid flow measurements with a packer system, enable us to define subsurface properties for this fault zone.

The initial results suggest that faulting strongly impacts the petrophysical characteristics of the rock, typically increasing porosity and reducing bulk density. This change is most likely related to the fracturing at the site being often associated with mineral alteration and dissolution. These events altered and deformed the multiple fault cores in distinctively manner, affecting the subsurface fluid flow which can be observed in fluid chemical composition differences.

These studies are part of the FLOP project (FLOw Pathways within faults and associated fracture systems in crystalline bedrock) and the Deep-HEAT geothermal energy project.