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Hengill, SW-Iceland: Operating a fractured reservoir for geothermal production and carbon storage

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Fractures and fracture networks play fundamental roles in the operation of subsurface systems such as geothermal production and geological carbon storage: Fractures are the circulatory systems of such reservoirs, driving them via transport of fluids, gases, heat, and dissolved elements, channelling the flow as both carriers and barriers, and providing connection to the rock matrix. Furthermore, due to their role, they provide important insights into the reservoirs, such as the dominant flow paths, the thermal evolution and the dominant chemical processes taking place and affecting e.g. the permeability via dissolution, precipitation and mechanics within the subsurface.

At Hengill central volcano, SW-Iceland, the subsurface reservoir is utilised for geothermal production, re-injection of geothermal fluids and injection of carbon dioxide (CO₂) for the means of mineral CO₂ storage, at the two field sites in Nesjavellir and Hellisheidi. The operation involves thousands to millions of tonnes of fluid, steam, and gases that are circulated annually through the subsurface bedrock via extraction and injection. Over 100 production and injection wells have been drilled in the two fields, ranging in depths from 800 m to 3300 m. The increased emphasis on the mapping of surface and subsurface faults and structures, and the opportunity of tracing the fluid flow via injection of tracers into the reinjection wells of the fields has provided deeper understanding of the role of fractures in this fracture dominated reservoir. This knowledge has benefitted the field operation by the drilling of very powerful production wells, and successful injection wells – both in terms of injectivity and their locations, providing pressure support to the geothermal production while preventing thermal breakthrough of colder fluids. Furthermore, the use of tracers has been an invaluable tool for managing injection of dissolved CO₂ into fractured basaltic reservoirs for mineral carbon storage, both in terms of quantitative monitoring and detection of dissolved and mineralised CO₂.

The utilisation of the Hengill field sites at Nesjavellir and Hellisheidi offers unique opportunities to increase our understanding of subsurface processes, providing large-scale field laboratories with enormous datasets, and building bridges between industry and academia.

