# Thermo-Hydro-Mechanical Coupled Modelling and Data Assimilation for Fractured Geothermal Reservoir

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The permeability of fractured geothermal reservoirs is very sensitive to pressure- and thermally-induced stress changes during hot water extraction at the producer well and cold water injection at the injector well. This sensitivity emerges from the strong coupling between stress-induced fracture aperture changes and fracture permeability. Typically, injection of cold water decreases the temperature of the reservoir rock and causes the matrix block to shrink, resulting in an increase of the fracture aperture and thus permeability. This Thermo-Hydro-Mechanical (THM) coupling is desired for enhancing permeability and hot water extraction. However, the rate of fluid circulation should be "controlled" in order (1) to optimize fluid-matrix contact-time and (2) avoid direct cold water circulation between injector and producer well, so called "water breakthrough".

Hot-water extraction and more generally production of thermal energy is accompanied by large uncertainties about the subsurface parameters and processes. For any forecasting method to be useful, this uncertainty must be taken into account, and, where possible, reduced. We propose a workflow coupling fast forward modelling and production data assimilation scheme in order to better constrain the subsurface parameters and refine our production predictions. This is of great importance for field development planning, an example of which is the optimization of well placement.

A relatively fast semi-analytical forward model has been developed in order to assess the THM coupling and the long-term rate of hot water extraction and thus more generally production of thermal energy. Our model assumes a dual porosity medium for flow and heat and a single medium for mechanics. It also handles the effect of convection on pressure, temperature and strain distribution. Prior modelled heat-rate production are conditioned using a confrontation with the data to refine the predictions.