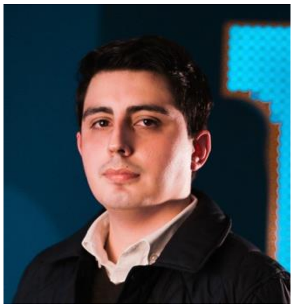

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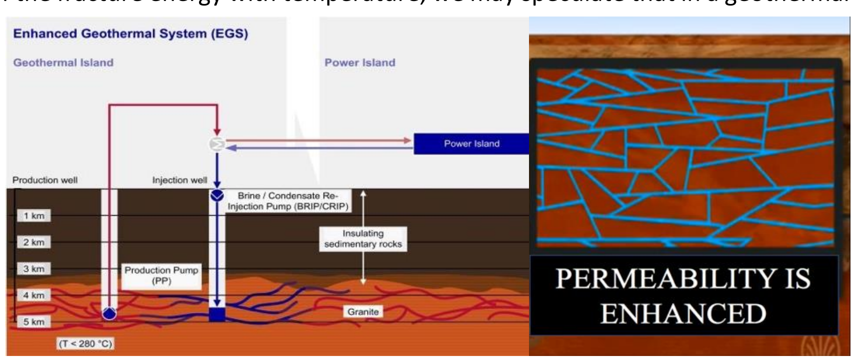
"Experimental study and modelling of the influence on fracture energy in low permeability rocks in a geothermal reservoir".

Abstract:

An Enhanced Geothermal System (EGS) can be thought of as an underground heat exchanger designed to extract geothermal energy. The performance of these systems can be improved by increasing permeability with hydraulic fracturing, following the same technique used for hydrocarbon reservoirs. To understand hydraulic fracturing, whether it is implemented in an EGS or in a hydrocarbon reservoir, it is important to know the fracture parameters of the rock at stake, e.g., the fracture energy. We report here the use of a method based on an energy balance during hydraulic fracture tests. Specimens were prepared and they have been mechanically and hydromechanically characterized at 20 .C and 100 .C, a temperature representative of actual reservoir conditions. The fracture energy is obtained from a balance of kinetic, potential and pressure energies involved in the hydraulic fracture tests. The method provides fracture energies that are consistent with the literature data on similar materials. It is also found that the fracture energy increases upon heating.

Results and Discussion:

In this contribution, hydraulically induced fracture has been studied experimentally on mortar and rock specimens. The experiments are performed on hollow cylinders subjected to inner fluid pressure up to fracture. The fluid used is oil. The set-up allows to perform tests at ambient temperature, but also at temperature of 100 º C at least. The mechanical and permeation properties of mortar and limestone have been measured prior to running the fracture tests. The fracture energy is estimated on the basis of conservation of energy. The energy supplied by the hydraulic pump turns out to be equal to the energy dissipated during fracture. In the set-up, dissipation due to fluid viscosity is negligible. Such an estimate is directly obtained from the hydraulic fracturing test data without any specific mechanical model. The fracture energy estimate, applied to the present laboratory set-up, provides fracture energies of mortar at ambient temperature that are consistent with the literature data on similar materials. Temperature is found to have an influence on the fracture energy as it increases for both limestone and mortar of 20–30%. By looking at the variation of the fracture energy with temperature, we may speculate that in a geothermal reservoir the fractures generated will be directed towards the coldest places. Of course, such a speculation does not account for heterogeneities of rock properties or of in situ stresses. These might be much more important than the gradient of temperature and would allow for fracture propagation in hot spots of geothermal reservoirs.



References:

Villarreal, O. R., Valdez, A. V., La Borderie, C., Pijaudier-Cabot, G., & Rivera, M. H. (2021). Estimation of Fracture Energy from Hydraulic Fracture Tests on Mortar and Rocks at Geothermal Reservoir Temperatures. *Rock Mechanics and Rock Engineering*, 1-9.