Stimulating crystalline rock for enhanced geothermal systems: results from the EGS Collab project

Dr. Timothy Kneafsey P.E.
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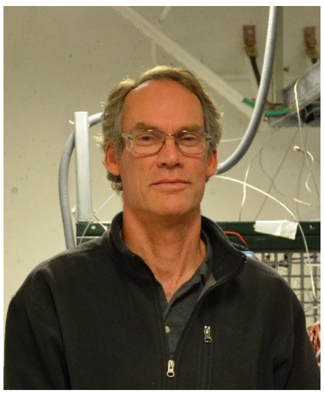

Dr. Timothy Kneafsey P.E., Staff Scientist at Lawrence Berkeley National Laboratory, will speak on Thursday, September 30, 2021.

The topic is "Stimulating Crystalline Rock for Enhanced Geothermal Systems: Results from the EGS Collab Project."

Abstract

The EGS Collab project, supported by the US Department of Energy, is addressing challenges in implementing enhanced geothermal systems (EGS). In EGS, stimulation of crystalline rock introduces appropriate flow pathways to enhance the subsurface heat exchanger. Improving the ability to effectively simulate both the stimulation and the flow and transport processes in the resulting fracture network is required. The project is performing intensively monitored rock stimulation and flow tests at the 10-m scale in an underground research laboratory. Data and observations from the field test are compared to simulations to understand processes and to build confidence in numerical modeling of the processes.

In Experiment 1, we examined hydraulic fracturing an underground test bed at the Sanford Underground Research Facility (SURF) in Lead, South Dakota, at a depth of approximately 1.5 km. We drilled eight sub-horizontal boreholes in a well-characterized phyllite. Six of the boreholes were instrumented with many sensor types to allow careful monitoring of stimulation events and flow tests, and the other two boreholes were used for water injection and production. We performed a number of stimulations and flow tests in the testbed. Our monitoring systems allowed detailed observations and collection of numerous data sets of processes occurring during stimulation and during dynamic flow tests. Long-term ambient temperature and chilled water flow tests were performed in addition to many tracer tests to examine

system behavior. Data were rapidly analyzed, allowing adaptive control of the tests. Numerical simulation was used to answer key experimental design questions, to forecast fracture propagation trajectories and extents, and to analyze and evaluate results. Many simulations were performed in near-real-time in conjunction with the field experiments, with more detailed process study simulations performed on a longer timeframe.

Experiment 2 will examine hydraulic shearing in a test bed being built at the SURF at a depth of about 1.25 km in amphibolite under a different set of stress and fracture conditions than Experiment 1. The testbed is being constructed to optimize encountering approximately five fracture set orientations. Nine wells have been drilled and are currently being instrumented in preparation for the stimulation experiments.

Biography

Timothy Kneafsey P.E., Ph.D. is a Staff Scientist at Lawrence Berkeley National Laboratory and serves as the Hydrocarbon Resources Program Lead. He has bachelor's degrees in mechanical and civil engineering from the University of New Mexico, a master's degree in civil engineering from the University of California at Berkeley, and a Ph.D. in civil and environmental engineering from the University of California at Berkeley. He has led, performed, and collaborated on numerous laboratory and field studies related to heat and mass transfer and phase change in fractured and porous rock. He is currently the principal investigator of the EGS Collab project; a multi-investigator project composed of researchers from national laboratories, universities, and industry focused on better understanding stimulation of crystalline rock to facilitate enhanced geothermal systems.