Estimating Stress from Fracture Injection Tests: Comparing Pressure Transient Interpretations with In-Situ Strain Measurements

Yves Guglielmi, Ph.D.
(Lawrence Berkeley National Laboratory)
and
Mark McClure, Ph.D.
(ResFrac)

Thursday February 17, 2022, 9 a.m. Central Time

Dr. Mark McClure, CEO of ResFrac, and Dr. Yves Guglielmi, Geological Staff Scientist at the Lawrence Berkeley National Laboratory, will speak on Thursday, February 17, 2022. The topic is "Estimating Stress from Fracture Injection Tests: Comparing Pressure Transient Interpretations with In-Situ Strain Measurements."

Abstract

The EGS Collab project is a mesoscale project performed at 1.25 and 1.5 km depth at the Sanford Underground Research Facility. A series of fracture injection tests and flow tests have been performed at two different locations within the facility. The tests involved cycles of injection at pressures above the minimum principal stress with fracture opening and propagation, followed by extended shut-in periods. The tests were instrumented with the SIMFIP tool, a double-packer probe with a high-resolution three-dimensional borehole displacement sensor. The tool allows direct observation of strain as the fractures open and close during the tests. These strain measurements can be correlated with pressure measurements to provide high fidelity, direct measurements of fracture closure and reopening, and thus, the minimum principal stress. Typically, in practical applications, only pressure measurements are available from injection/shut-in tests. Different methods to estimate stress from shut-in pressure transients have been proposed in the literature, and sometimes they yield meaningfully different results. Thus, because of the difficulty of validating these different proposed interpretation methods, stress measurement interpretations are sometimes ambiguous and/or debatable. The SIMFIP measurements provide an uncommon opportunity to test these proposed pressure transient methods against direct physical measurements. In this study, we compare the SIMFIP measurements against four extended shut-in pressure transients from the EGS Collab project. The shut-in transients were analyzed with two different techniques – the 'tangent'

method and the ‘compliance’ method. In three of the four tests, the tangent method significantly underestimated the minimum principal stress. The compliance method was reasonably accurate in all four tests.

Biography

Yves Guglielmi is a Geological Staff Scientist at the Lawrence Berkeley National Laboratory. His principal interests cover fundamental research in the hydromechanics of fractured and faulted rock. He focuses on the in situ understanding of the relationships between hydraulic, elastic and strength properties, rheology and induced seismicity of faults and fractures through field observation. Applications of his research concern giant rock landslides, and geo-energy (nuclear waste disposal, reservoir seal integrity and deep geothermal energy). He has been the Principal Investigator of several national and international programs on CO2 storage in deep reservoirs and on giant landslides in the European Alps

Mark McClure established ResFrac in 2015 to help operators maximize value through the application of advanced geomechanics and reservoir simulation. Before founding ResFrac, Mark was an assistant professor at the University of Texas at Austin in the Department of Petroleum and Geosystems Engineering. After earning a Bachelor of Science in chemical engineering and a Master of Science in petroleum engineering from Stanford University, Mark earned a PhD in energy resources engineering at Stanford.