A Low-Cost Technique for In-Situ Stresses and Geomechanical Properties Measurement Based on Leak-Off and Caliper Logs

Award Number: DE-FE0026825

Project Summary:

The goal of this project was to develop an in-situ technique for state of in-situ stress and geomechanical properties measurement at low cost with enhanced accuracy and to demonstrate the feasibility of such a technique for in-situ stress measurement by comparing different field data from oil fields.

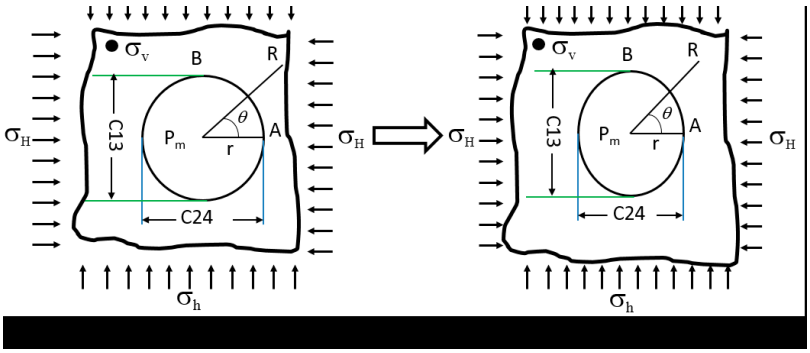

Figure 1: Schematics of borehole deformation

Prime Performer:
University of Wyoming

Key Performers:
University of Stavanger
Baker Hughes Inc.

Principal Investigator:
Shunde Yin

Project Duration:
10/1/2016 -6/30/2018

Performer Location:
Laramie, Wyoming

Field Sites:
Southern Appalachian Basin, West Virginia

Program:
Carbon Storage

Project Outcomes:

Researchers developed two methods to estimate in-situ stresses using borehole deformation in combination with numerical simulation and machine learning techniques. In the first method, finite element and poroelastic modeling incorporating Mogi-Coulomb rock failure criteria were used to simulate the formation of borehole breakouts from initiation to stability. This method was tested only on numerical data. The second method used probabilistic recapitulation with a generic algorithm and artificial neural network (PR-GA-ANN) machine learning methods to determine in-situ stresses from four-arm caliper borehole deformation data. The method was tested using data from a field site in West Virginia with a well into the lower Marcellus formation in the southern Appalachian Basin. Obtaining accurate geomechanical information and state of stress related to carbon storage sites is beneficial to understanding the potential for geomechanical deformation of the injection zone, confining zone, and wellbore as a result of carbon dioxide injection. The impact of such deformation may include induced seismicity, opening and closing of faults and fractures, and damage to wellbore materials. The accomplished research leads to lower cost of field characterization of geomechanical properties with improved accuracy and is significant to successful carbon storage in saline aquifers or oil/gas reservoirs.

Presentations, Papers, and Publications

Final Report: A Low-Cost Technique for In-Situ Stresses and Geomechanical Properties Measurement Based on Leak-Off and Caliper Logs (June 2018) Shunde Yin