ER
ENERGY
RESILIENCY

DOUBLE TORSION RAMAN TECHNIQUE FOR INTERROGATING CHEMOMECHANICAL FRACTURING

Pacific Northwest
NATIONAL LABORATORY

ATOMIC | MICRO | BENCH | SYSTEMS | DEPLOYMENT

IMPACT

Predicting and controlling subsurface fracture behavior is critical for petroleum and geothermal energy production, as well as storage of CO_2 and nuclear waste.

APPLICATION

- Enhanced petroleum and geothermal production
- Subsurface characterization for waste storage
- Protection of underground sources of drinking water
- Reduced risk of induced seismicity
- Safer and more efficient well drilling

ENGINEERING SUBSURFACE SYSTEMS FOR BETTER PERFORMANCE

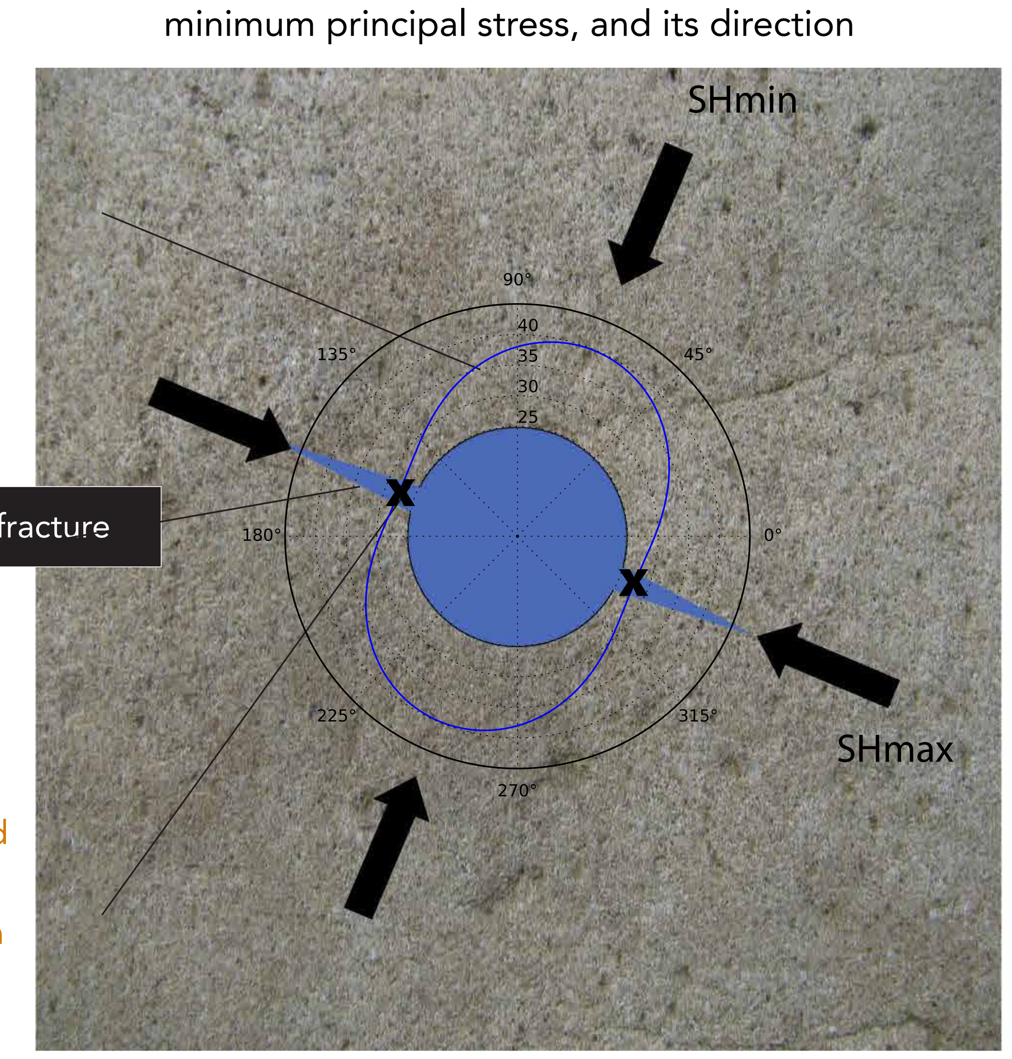
In some cases, such as petroleum and geothermal energy production, fractures can improve production efficiency. In others, such as waste disposal and storage, fractures can hinder project success. Fracturing is controlled by the stresses and fluid pressures in the subsurface and also by chemical reactions between the rock and fluids. This chemo-mechanical process is not yet well understood, and thus cannot be reliably predicted or controlled. The Raman-coupled double-torsion fracture apparatus developed at PNNL is the first device capable of simultaneous in situ measurement of fracture growth rate, stress, and chemical reactions, all with tightly controlled temperature, pressure, and fluid chemistry. This allows an unprecedented level of understanding of these complex multi-physical processes and opportunities to better control engineered subsurface systems.

Cross-section of a mini-frac test, which provides only the minimum principal stress, and its direction

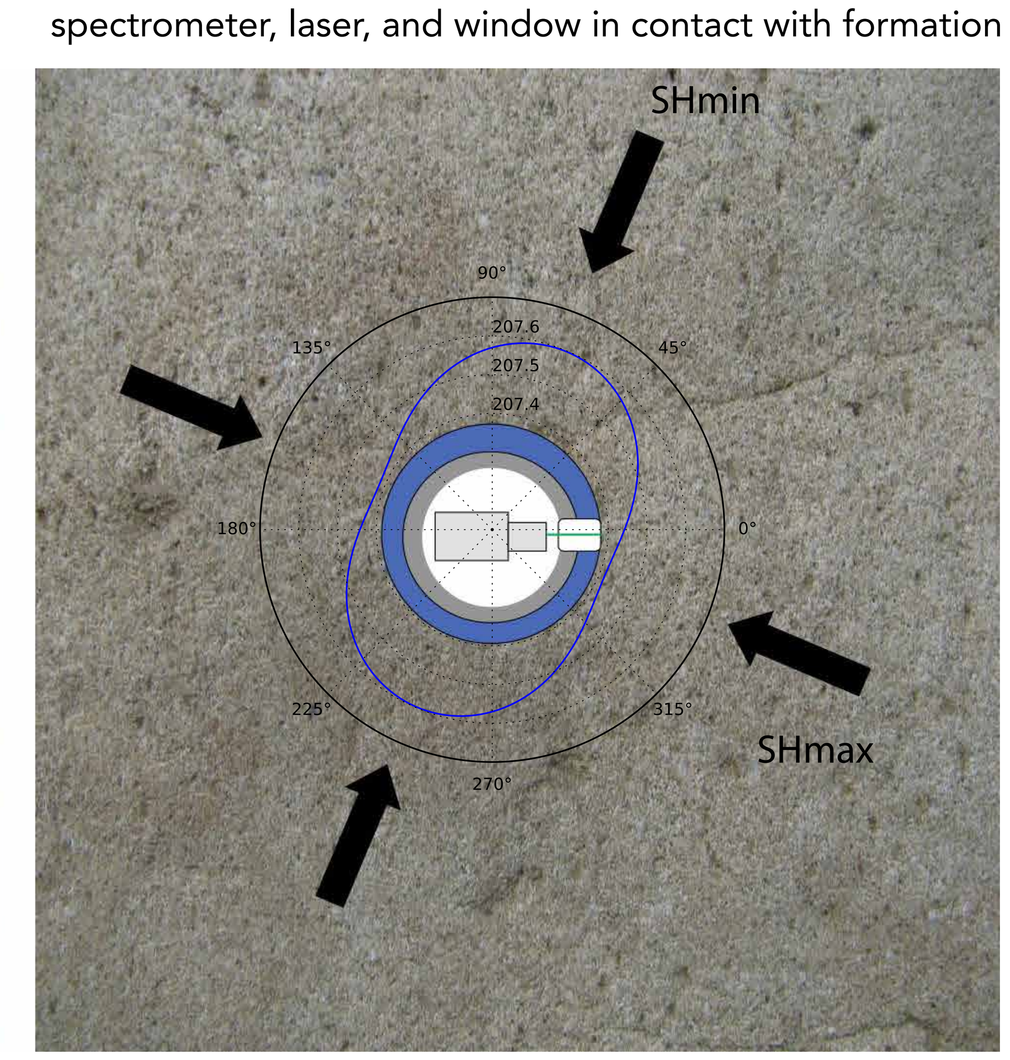
This is an estimated tangential stress profile around the circumference of the wellbore

Hydraulic fracture

Only a single data point can be obtained from the current technology, which is a mini frac test



Conceptual cross-section of sonde in a wellbore with spectrometer, laser, and window in contact with formation



This is the estimated Raman peak shift as a function of stress around the borehole circumference

The min/max shift could provide principal stresses in all three directions