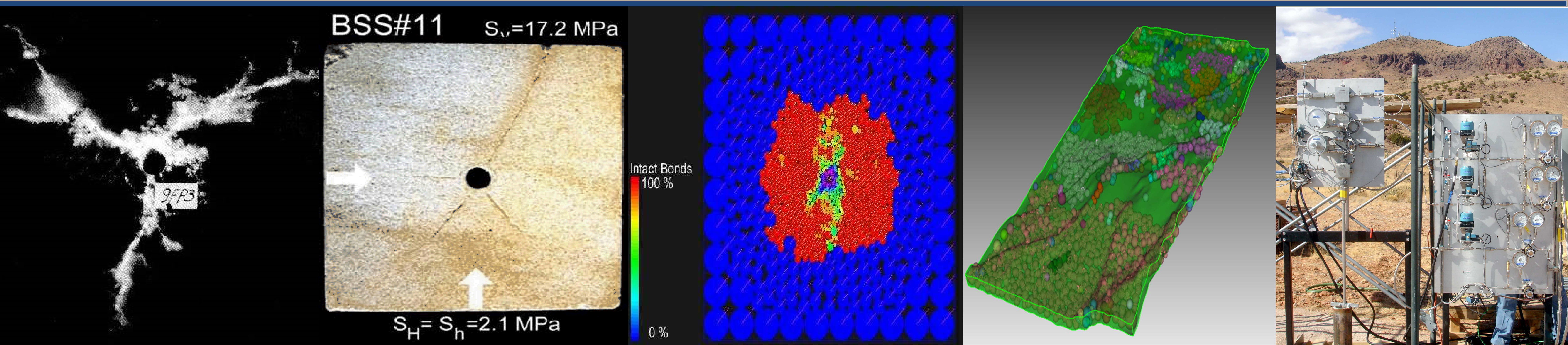


# Hydraulic Fracturing R&D at Sandia

*Geomechanics Department & Geothermal Research Department*

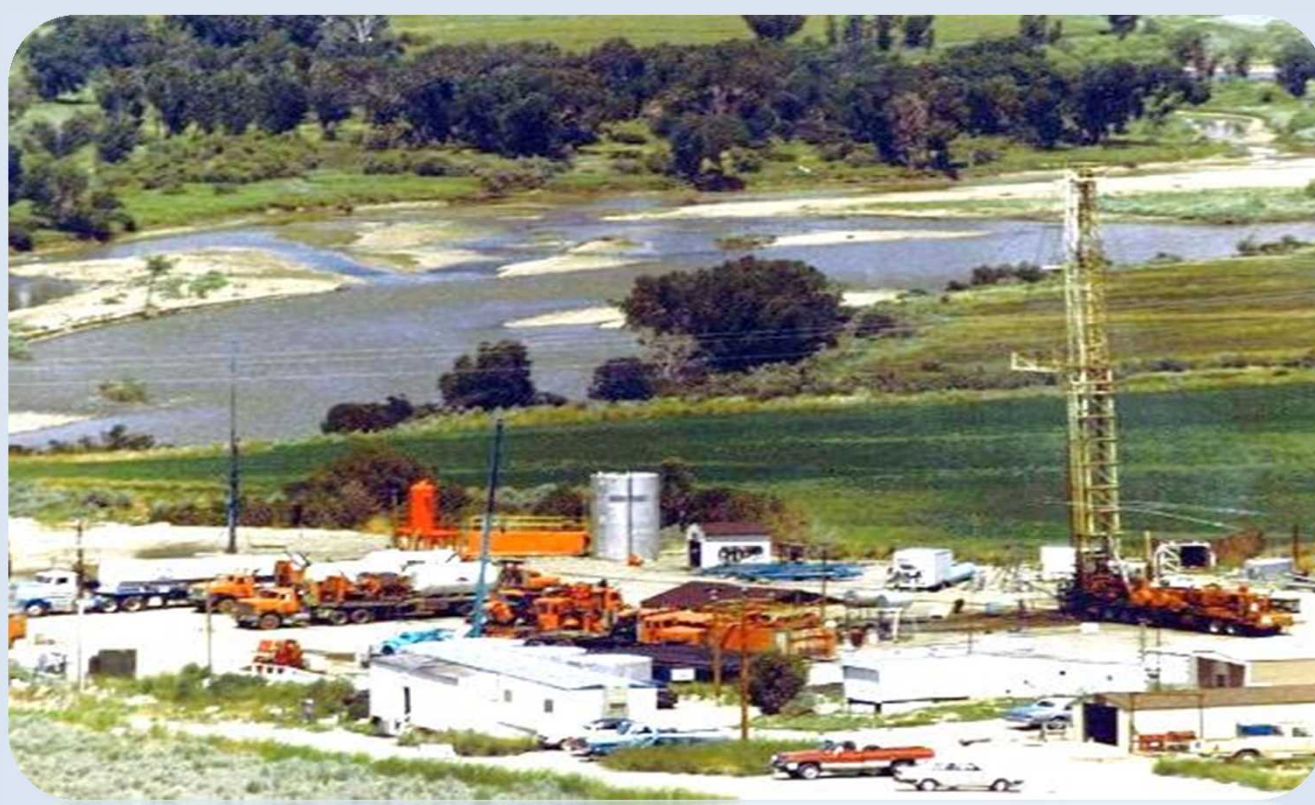


## Background

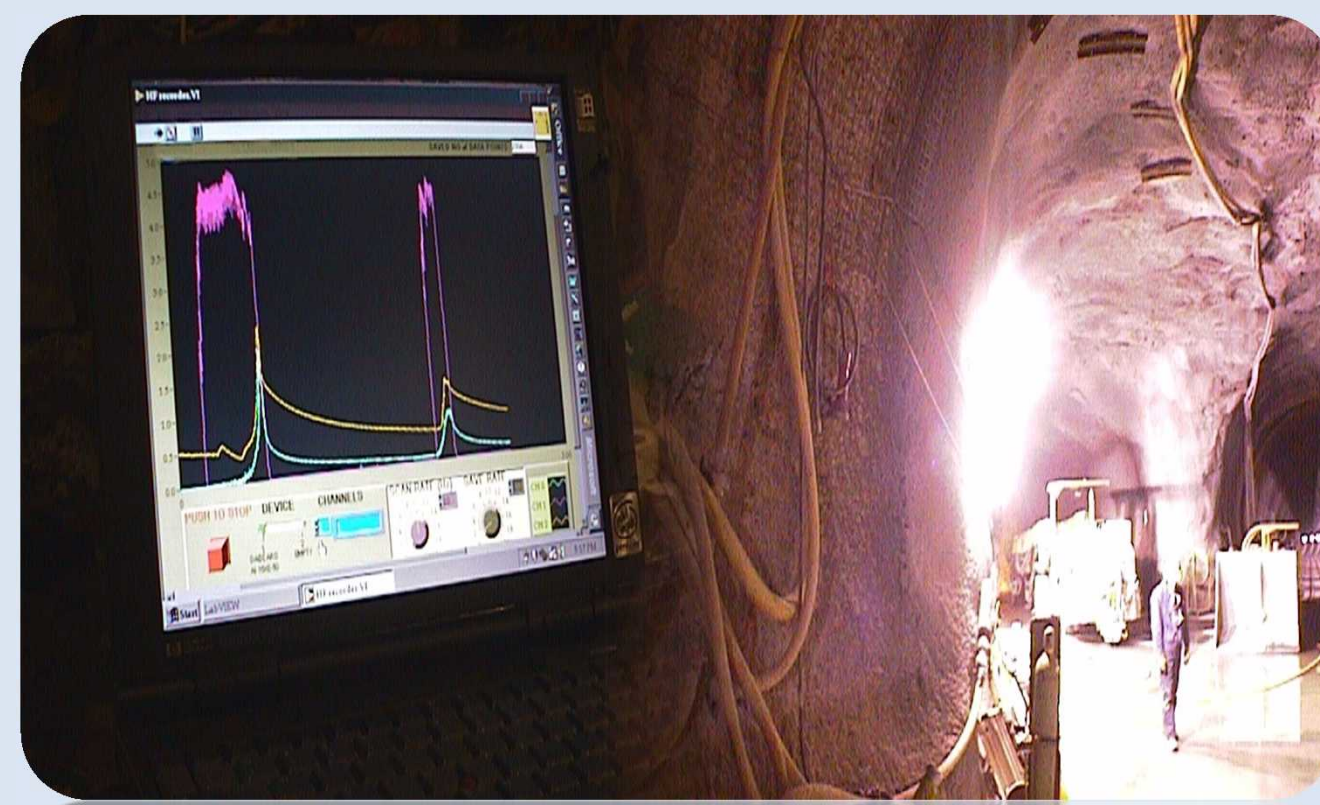
Hydraulic fracturing in conjunction with horizontal drilling has been a disruptive technology advance that enables greater access to oil/gas in shale formations. Hydrofrac involves injection of pressurized fluid from wellbore into a section of isolated intervals. A fracture network is induced and held open by injecting proppant to increase the flow in these low permeability shales. Oil/Gas will flow through the propped fracture network into wellbores, allowing access to previously inaccessible oil/gas resources.

## Previous Research

- Direct observation of hydraulic and explosive fracturing in “G tunnel” at Nevada Test Site to understand stimulation processes for the recovery of natural gas from low permeability formations (1977)
- Multiwell Experiment (MWX) hydrofrac monitoring in the Piceance Basin (1983)
- Multi-Site hydrofrac diagnostic project (1992)
- The Jasper “Deep Well Treatment and Injection” (DWTI) tests to study drill cuttings injection (1993)
- The Mounds drill cuttings injection project to study complex fracture environments (1998)
- Hydraulic Fracturing Stress Measurements for WIPP and Yucca Mt nuclear waste disposal projects (1988 and 1999)
- Discrete Element modeling and laboratory simulation of slurry injection (2001)



Site of the MWX and M-Site experiment in the Piceance Basin near Rifle, Colorado, for development of simulation diagnostic technology.



Hydraulic Fracturing in situ stress measurements in Thermal Test Facility, Yucca Mountain, Nevada

## Current Efforts

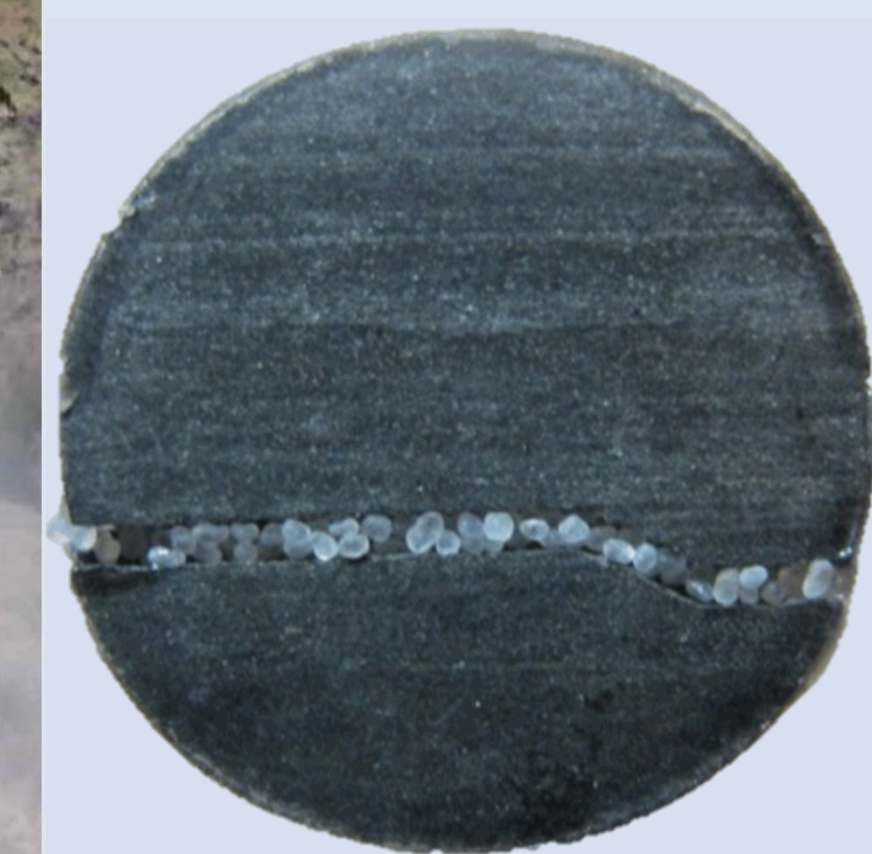
- Waterless stimulation
- Effect of Proppant Placement on Closure of Fractured Shale Gas Wells
- Characterization of fracture networking by monitoring natural noble gas tracers
- 3-D visualization of fractures and gas bearing nano-scale pores using Focused-Ion Beam/Scanning Electron Microscopy
- Fundamental shale science and material properties



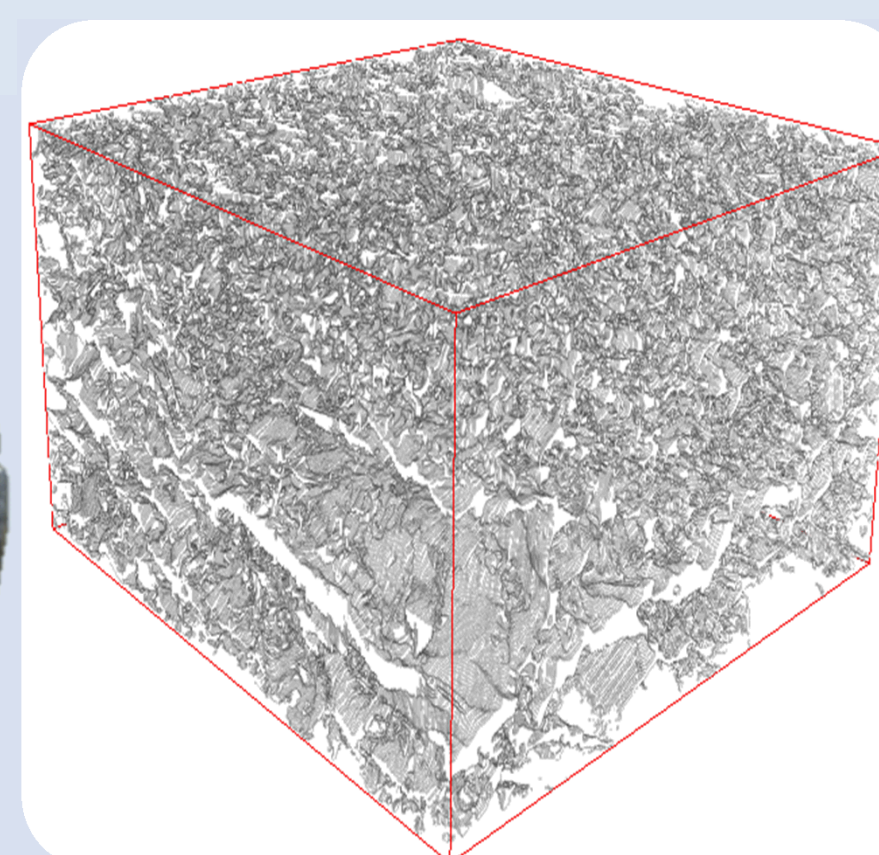
(Pre-Stimulation)



(Post-Stimulation)  
In Situ Waterless Stimulation Experiment at EMRTC



Laboratory scale hydrofrac with proppants



3-D visualization of nano-pores in chalk using Focused-Ion Beam and Scanning Electron Microscopy

## Future Direction

- Integrated geomechanics and geophysics in induced seismicity: mechanisms and monitoring (LDRD)
- Seismic wave interaction with evolving fracture systems (SubTER)
- Quantitative prediction of matrix-to-fracture gas release mechanisms to more accurately anticipate reservoir decline
- Remote sensing of fractures and proppant placement
- Improved well cementing methods and/or well deterioration diagnostics and remediation
- Disposal/treatment of flow back fluids

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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