Geomechanics of Oil Shale In-situ Conversion Process

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In Situ Conversion Process (ICP)

- Heaters inserted into holes to gradually heat shale subsurface
- Applicable to oil shale and heavy oil
- Technology converts kerogen by gradual heating in oil shale
- Results in a high recovery of light hydrocarbon products yielding high quality transportation fuels
Freeze Wall Concept

- Low Perm Shale Upper Seal
- Lean Shale Aquifer (fractured rock)
- Rich Shale
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- Lean Shale Aquifer (fractured rock)
- Lean Shale Aquifer (fractured rock)
- Low Perm Shale Lower Seal

Refrigerant flow through the system to create a heated zone.

Frozen Water/Rock

Heated Zone
ICP and GEOMECHANICS

- Large variation in rock temp (from -40 to >400 °C)
- Thermal stresses and rock deformation
- Important to understanding and model rock behavior
Factors Affecting Thermal & Mechanical Properties of Oil Shale

- Richness
- Vugs and Fractures
- Bedding and Anisotropy
- Stress
- Temperature
Oil Shale Rock Mechanics

- Kerogen is part of rock structure
- Significant changes in rock mechanical properties with kerogen removal

Unconfined Compressive Strength (psi)

Stiffness (psi)
High-Temperature Rock Mechanics Laboratory

- Mechanical Properties, Thermal Conductivity, Permeability, Thermal Expansion & Creep
Block Size Tests of Oil Shale
Summary

- Geomechanics is an important consideration for ICP
- Extensive laboratory tests as well as field measurements have been carried out to understand rock mechanical behavior of oil shale
- Thermal-Geomechanical models have been developed and validated. These models are used in the design of Freeze Wall Containment System