Geomechanics of Oil Shale In-situ Conversion Process

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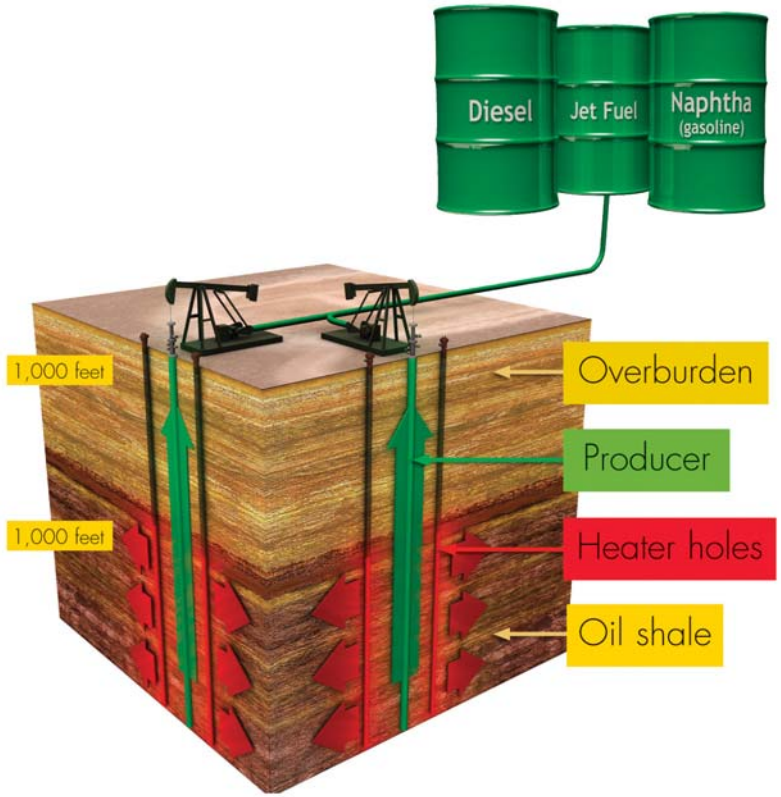
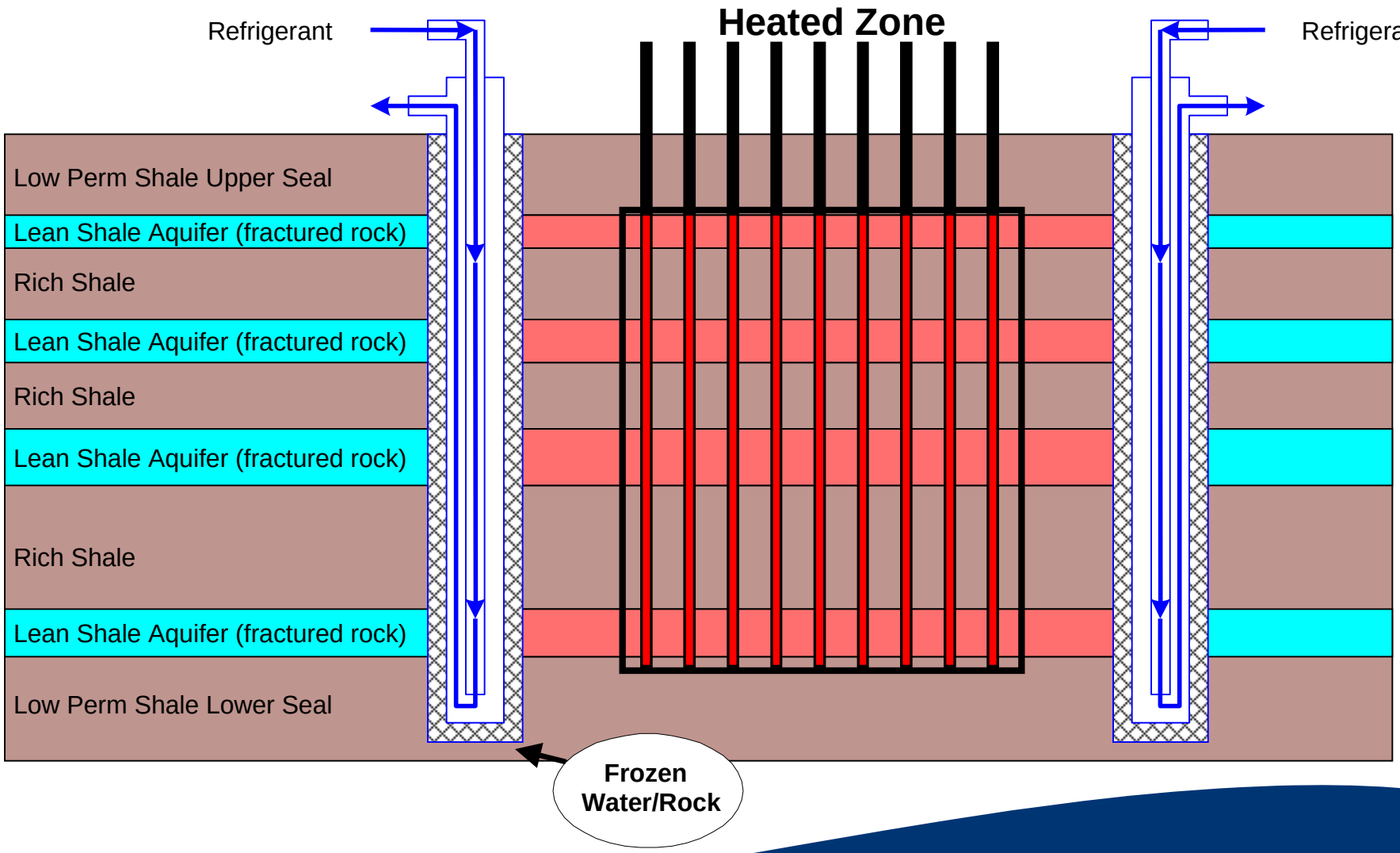
In Situ Conversion Process (ICP)

- 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

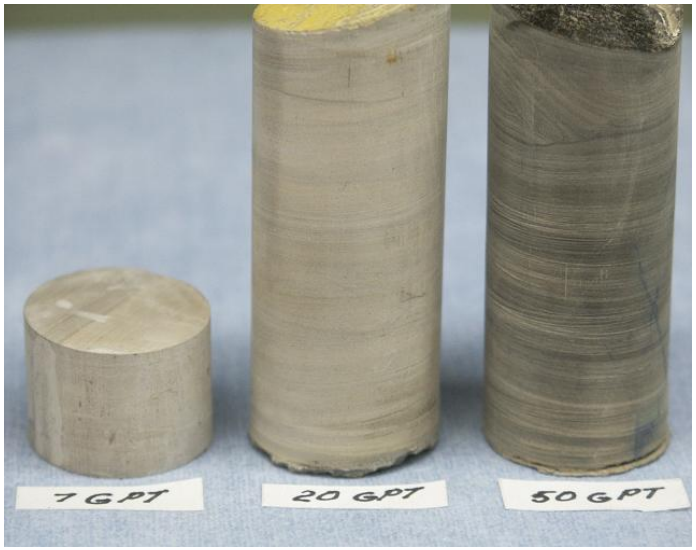


ICP and GEOMECHANICS

- Large variation in rock temp (from - 40 to > 400 °C)
- Thermal stresses and rock deformation
- Important to understanding and model rock behavior

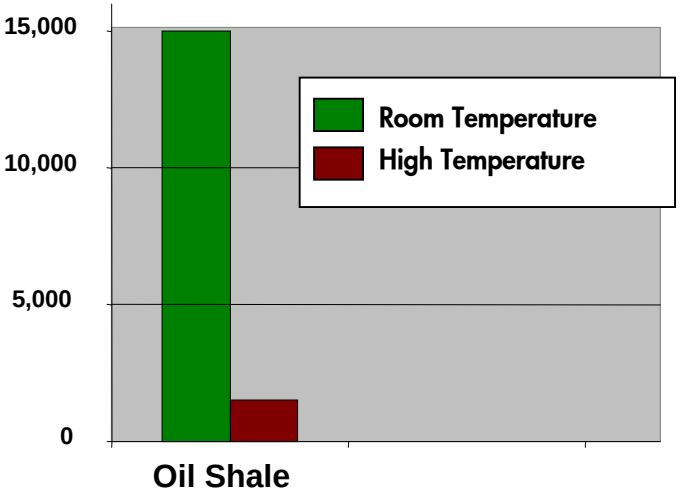
Factors Affecting Thermal & Mechanical Properties of Oil Shale

- Richness
- Vugs and Fractures
- Bedding and Anisotropy
- Stress
- Temperature

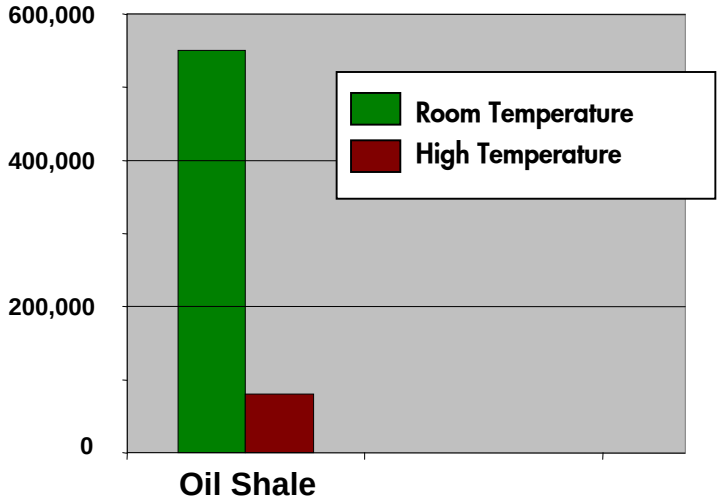


Oil Shale Rock Mechanics

- 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