Used Fuel Disposition Campaign

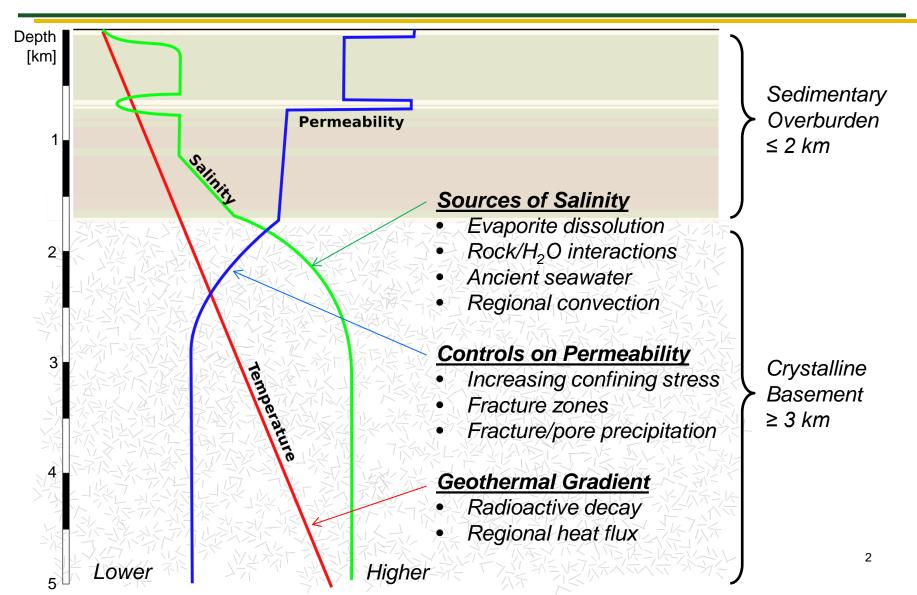
Deep Borehole Field Test Borehole Characterization

Kris Kuhlman Sandia National Laboratories

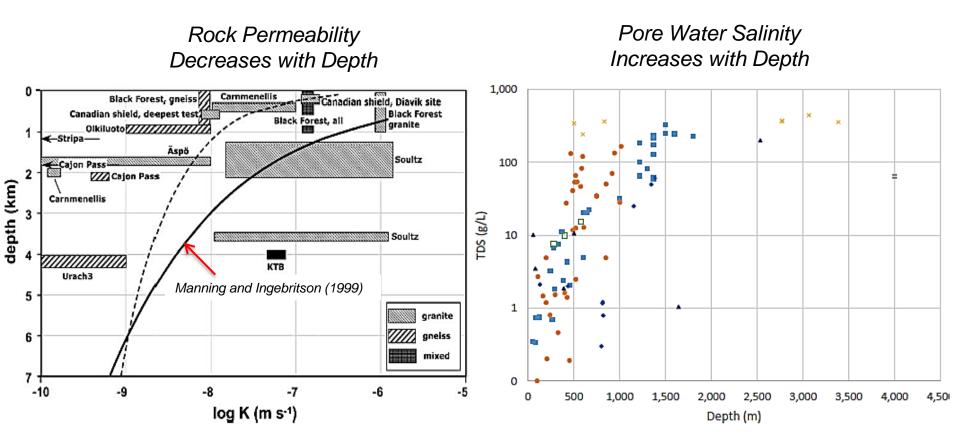
Used Fuel Disposition Working Group Meeting June 2016

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Conceptual Profiles



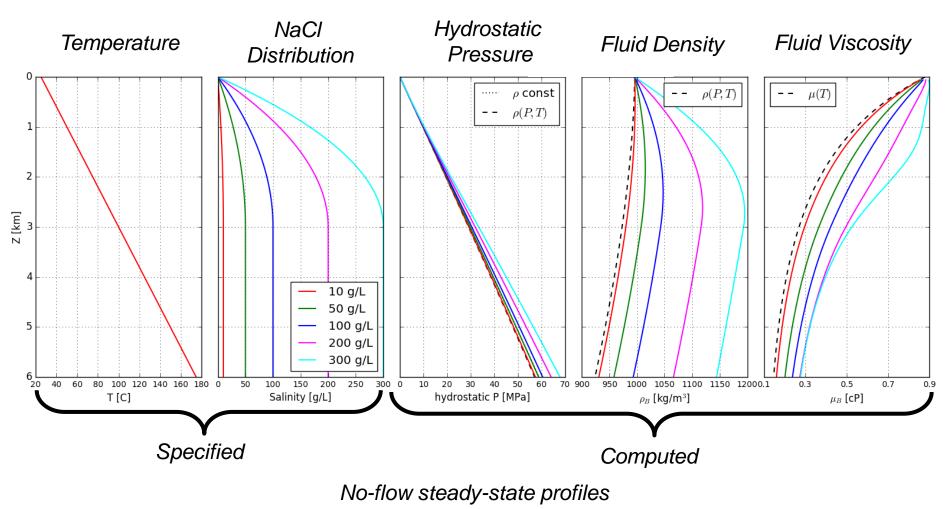
Supporting Data



Stober and Bucher (2007)

DeMaio and Bates (2013)

Simple Density Profiles



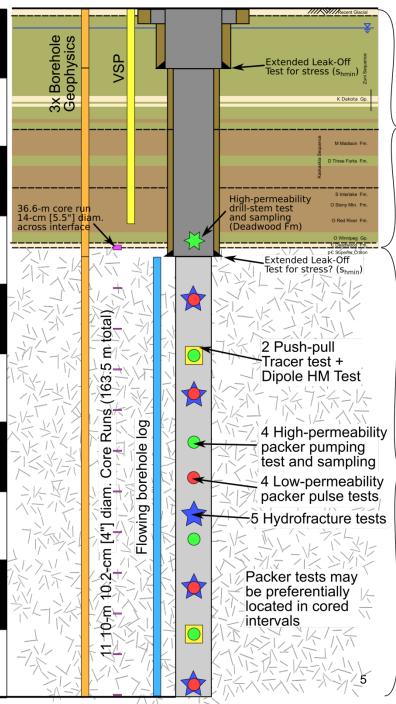
Density equation of state: Batzle and Wang (1992)

Sedimentary Overburden (1.73 km)

Used Fuel Disposition

Sampling Profiles

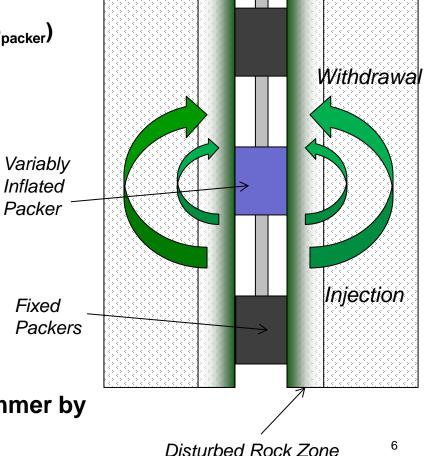
- Borehole Geophysics
- Logging During Drilling
 - Mud fluids/solids/tracers/dissolved gases
 - Torque, weight-on-bit, etc.
- Basement Rock Samples
 - Coring (150 m total)
 - Cuttings/Rock Flour (XRD + XRF)
- Basement Pore Fluid Samples
 - Fluid density/temperature/major ions
 - ⁴He sampling from cores
 - Stable water isotopes
 - U/Sr isotope ratios
 - Samples from
 - In Situ (packers) from high K zones
 - Extracted from cores in low K zones
- Flowing borehole log



Crystalline Basement (3.27 km)

In Situ Testing

- Test Design with Battelle/Schlumberger/SolExperts
 - No heater test
 - No dipole tracer test
 - New hydromechanical dipole test: k(p_{packer})
- Hydrologic Tests
 - Static formation pressure
 - Permeability / compressibility / skin
 - Sampling in high K intervals
- Tracer Tests
 - Single-well injection-withdrawal
- Hydraulic Fracturing Tests
 - σ_h magnitude
 - Estimate stress tensor via existing fractures
 - Drilling & Testing Plan ready this summer by Battelle/Schlumberger/SolExperts



Deep Borehole Field Test

Characterization <u>different from</u>:

- Mined waste repositories characterization
 - Single-phase fluid flow
- Oil/gas or mineral exploration
 - Low-perm Crystalline basement vs sedimentary rocks
- Geothermal exploration
 - Low geothermal gradient
- Deep Borehole Performance:
 - Less reliance on engineered barriers
 - More dependence on basin-scale geologic conditions
- DBFT Purpose:
 - Demonstrate ability to sample and test at depth