SAND2014-4543P

# Used Fuel Disposition Campaign

## International Collaborations: DECOVALEX and KURT

**W. Payton Gardner and Yifeng Wang**
**Sandia National Laboratories**

**UFD Working Group Meeting**
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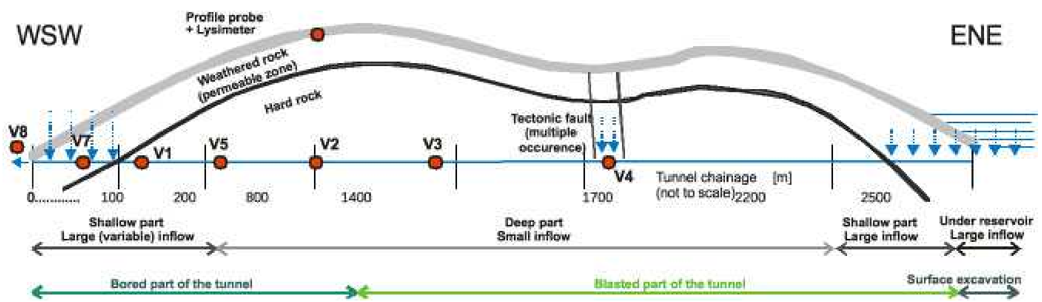
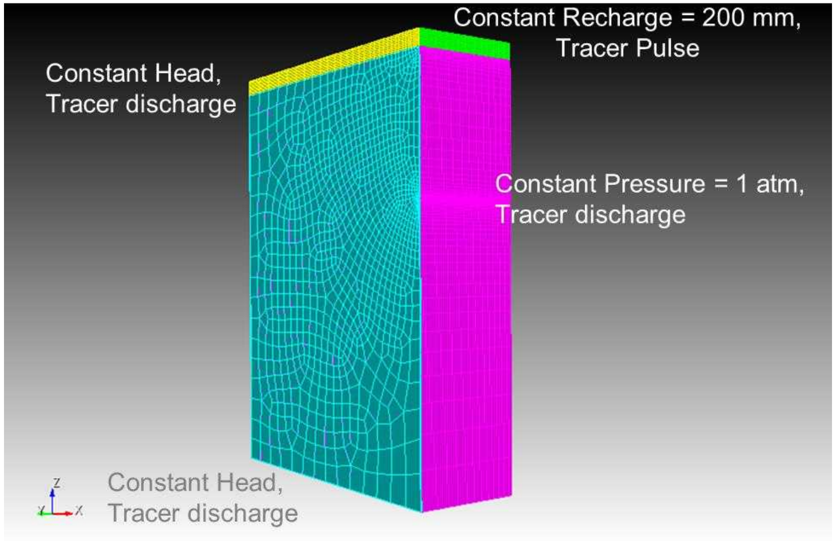
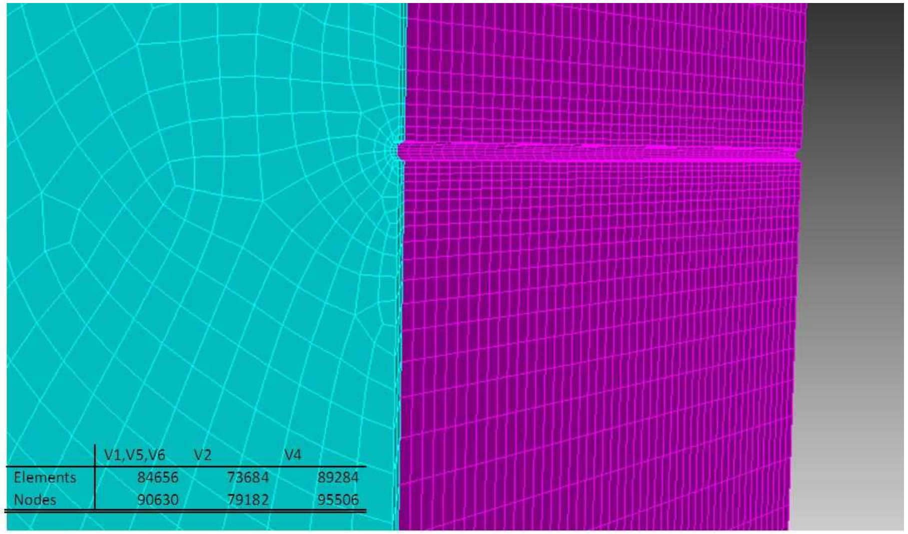
# DECOVALEX Task C2 – Bedrichov Tunnel Tests (Czech)

- **Understand the water behavior in the massif – distribution, movement, quality, reactions, etc.**
- **Issues to be addressed:**
  - Transition from discrete fractures to equivalent continuum
  - Linking conservative transport model to natural tracer data
  - Reactive transport modeling laboratory granite leaching experiments to site data




# Model Domain & Meshing

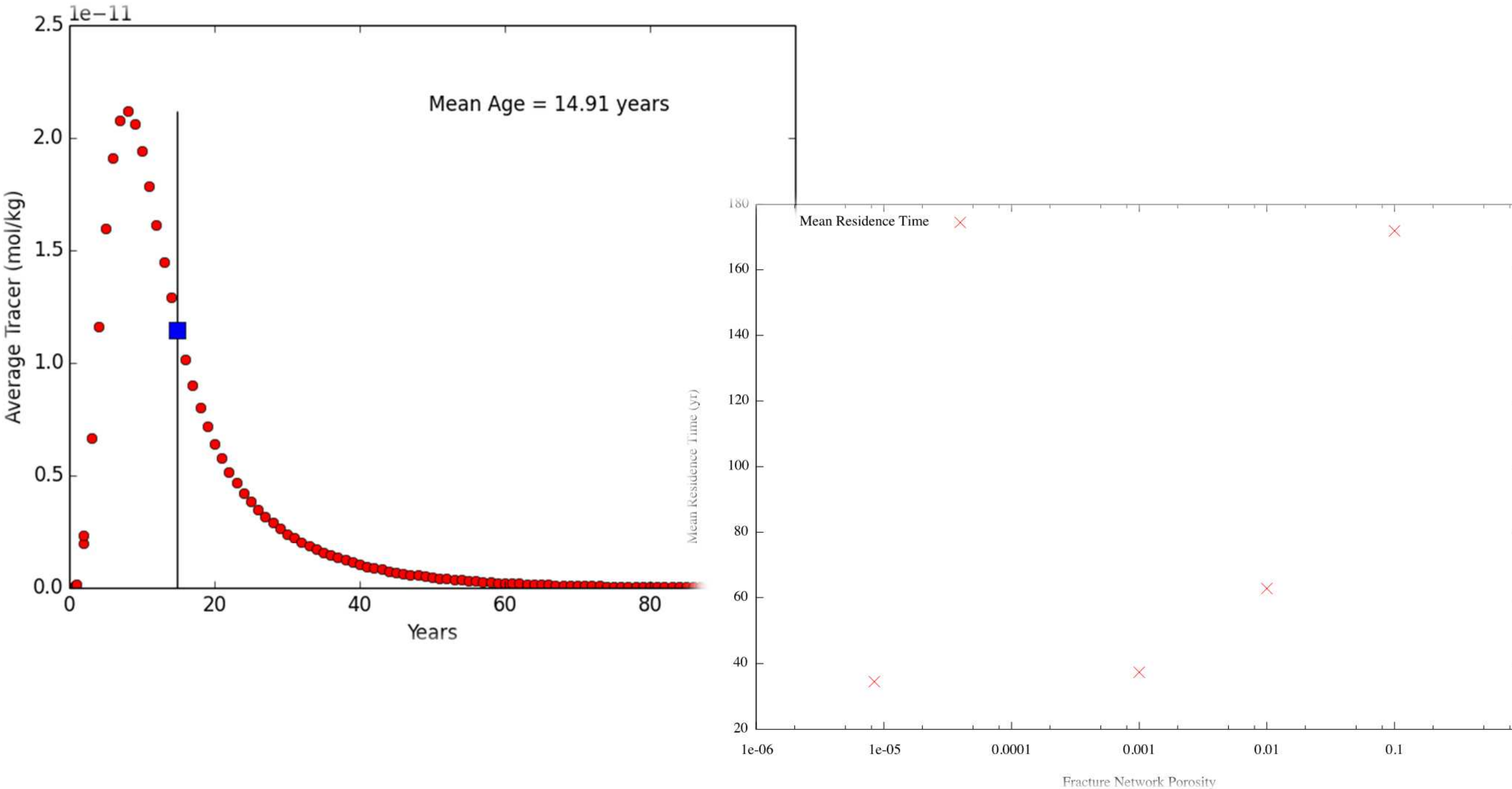



- **Weathered Granite**
  - k = $10^{-13}$ $m^2$
  - $n_e = 0.1$
- **Intact Granite**
  - k = $10^{-22}$ $m^2$
  - $n_e = 0.01$
- **Fracture**
  - 1 m width
  - k varied to match fracture discharge
  - $n_e$ varied to match general residence time

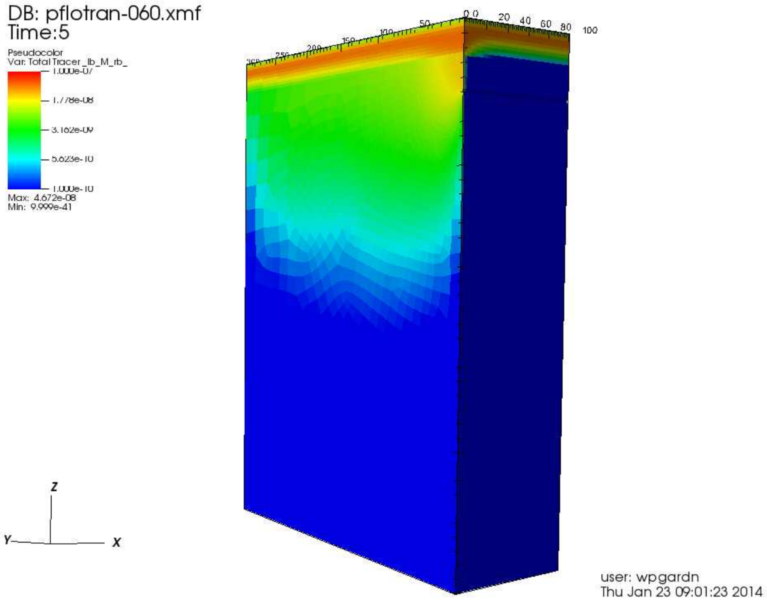
- **Initial Conditions**
  - First assumed fully saturated column at hydrostatic pressure
    - *Set tunnel to atmospheric pressure*
    - *Set recharge to 200 mm across the top*
    - *Run model until steady state achieved for initial flow field*
  - Assign zero tracer concentration through out
  - These initial condition are used in transient tracer pulse simulation where tracer is pulsed in recharge with a concentration:
    - *C=1 (t=0); C=0 (t>0).*

# Model Simulation Results



# Summary

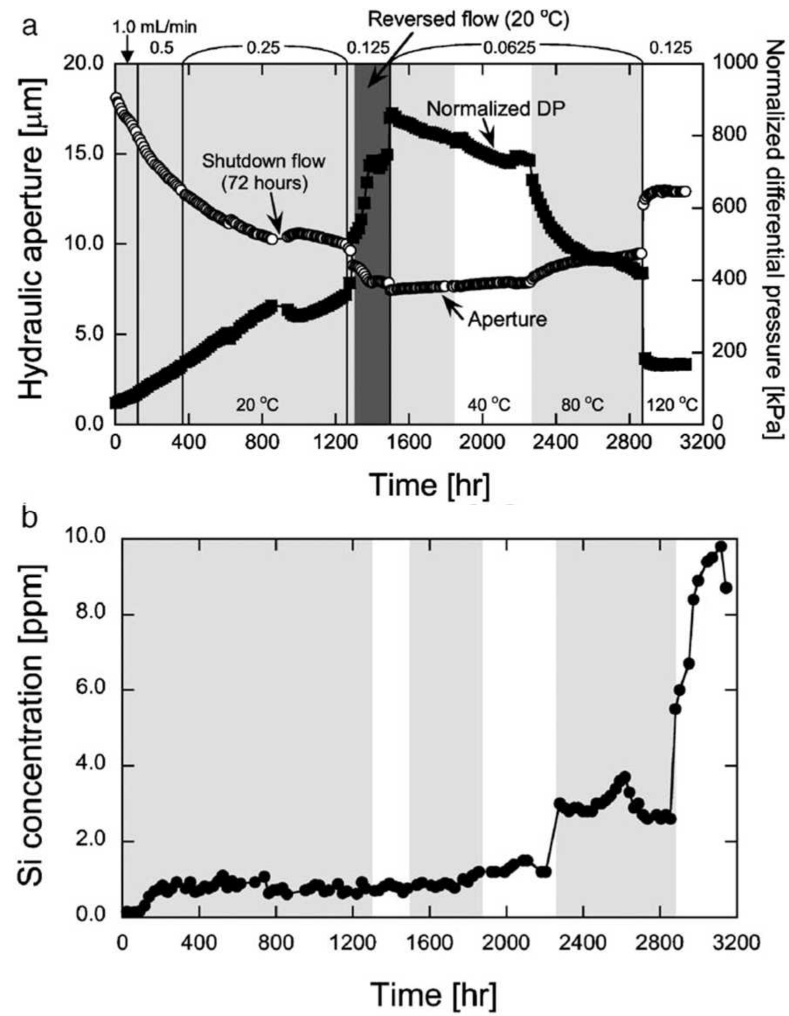
- **Our simulations show reasonable mass transport through the fracture system to the tunnel.**
- **Fracture bulk permeability is well controlled by the fracture discharge.**
- **Fracture porosity can only be informed the mean age from tracers.**
- **In order to match the transport velocities observed from the tracers a small porosity is needed.**
- **We still have work to do in matching tracer transport velocities**
- **Next steps**
  - Add matrix block permeability as a fitting parameter – fit to distributed discharge measurements
  - Compare to the actual tracer data!
  - Use isotope observations to constrain recharge and formation parameters

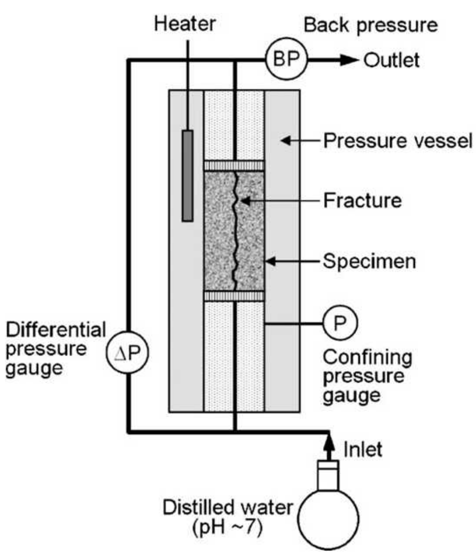


# DECOVALEX Task C1 – THMC Modeling of a Single Fracture

**Purpose of Task C1 under DECOVALEX-2015 is to:**

- Model the results of the two experiments (Yasuhara et al., 2006; Yasuhara et al., 2011). (Novaculite, granite)
- Investigate, develop and test robust process models for the representation of coupled THMC processes in fractured rock.
- Understand the transition of fracture closure to opening (SNL)



# KAERI Underground Research Tunnel (KURT)

- **SNL and KAERI have developed a multi-year plan for joint field testing and modeling crystalline disposal media.**
- **Work currently planned includes three tasks:**
  - Streaming potential (SP) testing
  - Sharing KURT site characterization data
  - Technique development for in-situ borehole characterization.
- **Status updates**
  - Received site characterization data
  - Received interim report on SP testing
  - Received a draft of report on the development and demonstration of in-situ borehole measurements
  - SP setup in lab (KAERI)
  - Overview of SP testing in progress (SNL)

**Natural System Evaluation and Tool Development - International Collaborations: FY13 Progress Report**

**Fuel Cycle Research & Development**

*Prepared for*
*U.S. Department of Energy*
*Used Fuel Disposition*
*Yifeng Wang, Payton Gardner*
*Sandia National Laboratories*
*Paul Reimus, Scott Painter, Nataliia Makedonska, Ahinoam Pollack*
*Los Alamos National Laboratory*
*Jim Houseworth, Jonny Rutqvist, Daisuke Asahina, Fei Chen, Victor Vilarrasa, H.H. Liu, Jens Birkholzer*
*Lawrence Berkeley National Laboratory*
James.D. Begg, Mavrik Zavarin, Annie Kersting
*Lawrence Livermore National Laboratory*
*Geon-Young Kim*
*Korean Atomic Energy Research Institute*
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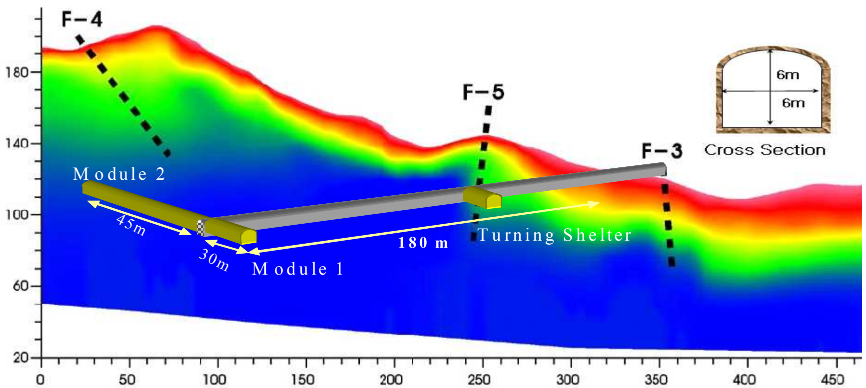
## Used Fuel Disposition

# Site Characterization Data Received from KAERI



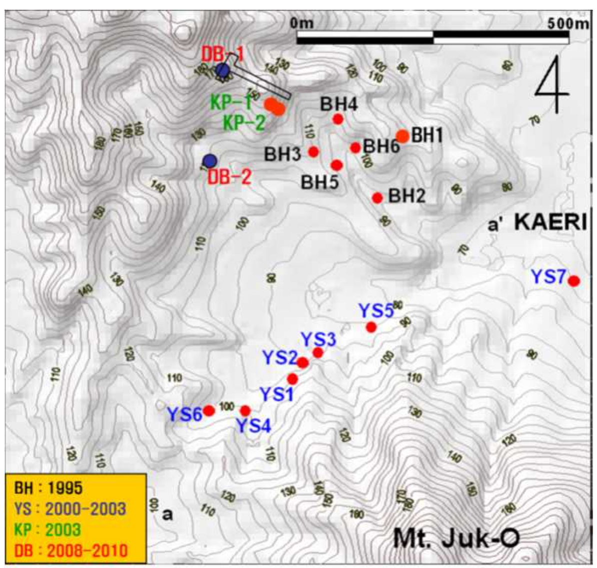




**Table 6-1.** Data list for the task of sharing KURT site characterization data

| | Data | | Detail | Format | |
|---|---|---|---|---|---|
| | Background information about KURT | | | MS Word | |
| Geology | General geology | Geological description | | MS Word | |
| | | Lineaments (local) | Orientation, Length | Excel | A1 |
| | | Topography | Digital elevation map | Cad | A2 |
| | Deep borehole data<br>DB-1 : 500m (length)<br>DB-2 : 1,000m (length)<br>YS-1 : 500m (Core, fracture) only<br>YS-6 : 500m | Core data | Core mapping | Cad/PDF | A3 |
| | | Logging data | Image by Acoustic televiewer | PDF and Excel | A4 |
| | | | Image by BIPS | PDF | A4 |
| | | Geophysical logging data | Natural gamma | Excel | A5 |
| | | | Full-wave sonic | Excel | A5 |
| | | | SP | Excel | A5 |
| | | | Electronic conductivity | Excel | A5 |
| | | | Temp | Excel | A6 |
| | Fractures | Deterministic fracture zones | Orientation, Width, Length | Excel | A7 |
| | | Background faults/large fractures | Frequency | Excel | A8 |
| | | Fracture set | Fracture set | Excel | A9 |
| Hydrogeology | Hydrogeological properties | Permeability | K | Excel | A10 |
| | | | T | Excel | A10 |
| | | Storage | S | Excel | A10 |
| | | Effective porosity | n | Excel | A10 |
| Geochemistry | Geochemical properties.<br>DB-1 : 500m<br>YS-1 : 500m | Major ion | Cation, Anion | Excel | A11 |
| | | Minor ion | trace element | Excel | A11 |
| | | In-situ data | pH, DO, EC, Temp | Excel | A11 |
| | | Rock/Fracture minerals | Chemistry, mineralogy | Excel | A12 |

# Concluding Remarks

- **Future work**
  - DECOVALEX Task C2
    - *Compare models with actual tracer data.*
  - DECOVALEX Task C1
    - *Develop a model for fracture closure-opening.*
  - KURT
    - *Develop a model for SP testing.*
    - *Start SP testing in the tunnel.*
    - *Select and demonstrate some key techniques for borehole characterization and in-situ measurements.*
- **General observations**
  - Clear objectives are the key to the success
    - *KURT data for development reference cases*
    - *KURT data for discrete fracture network model demonstration*
    - *DECOVALEX data for model development and testing (discrete fracture network model vs. continuum models)*
  - Need substantial commitment for actual technical work
    - *Funding for actual technical work*
    - *Face-to-face meeting*
  - Need stable and predictable funding