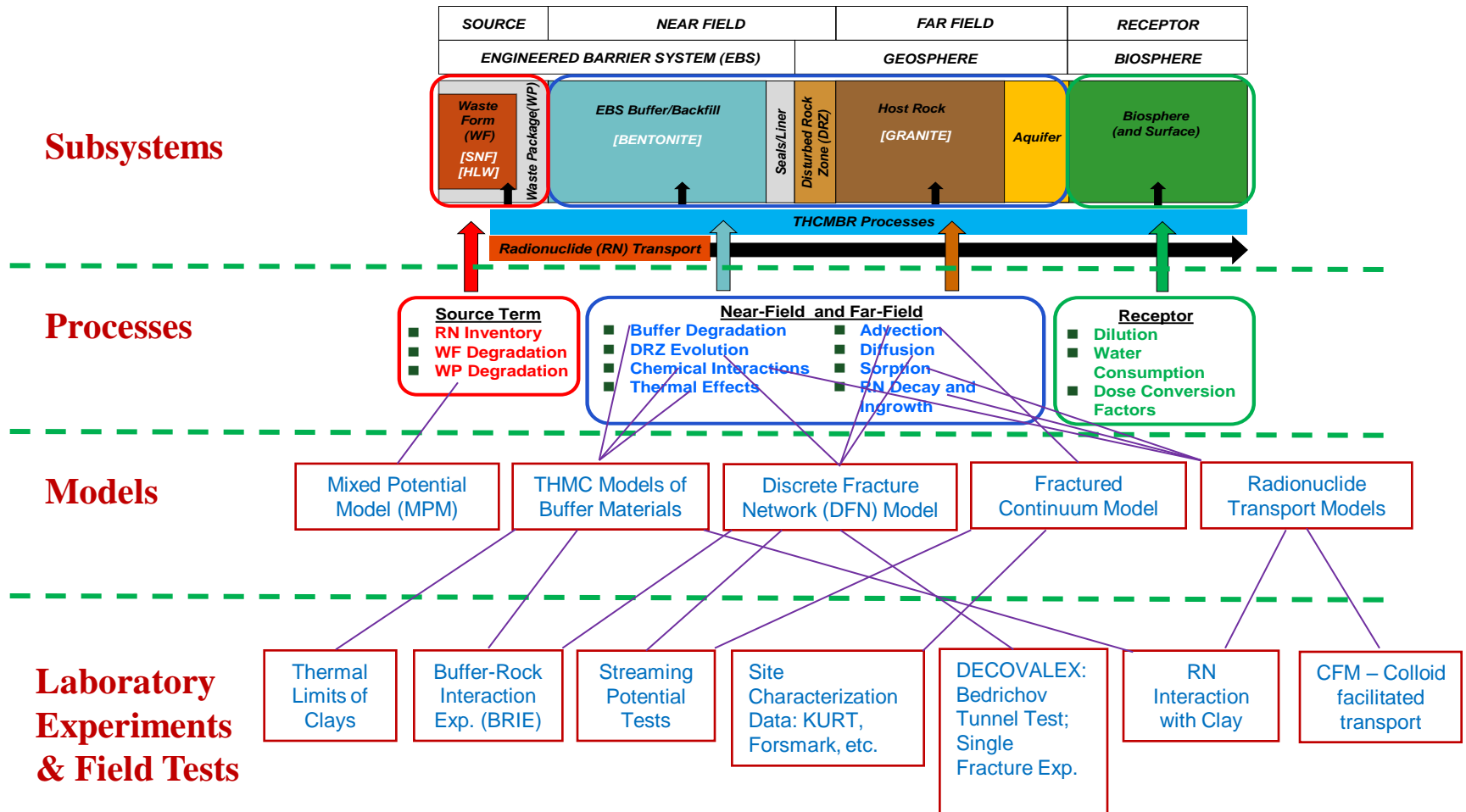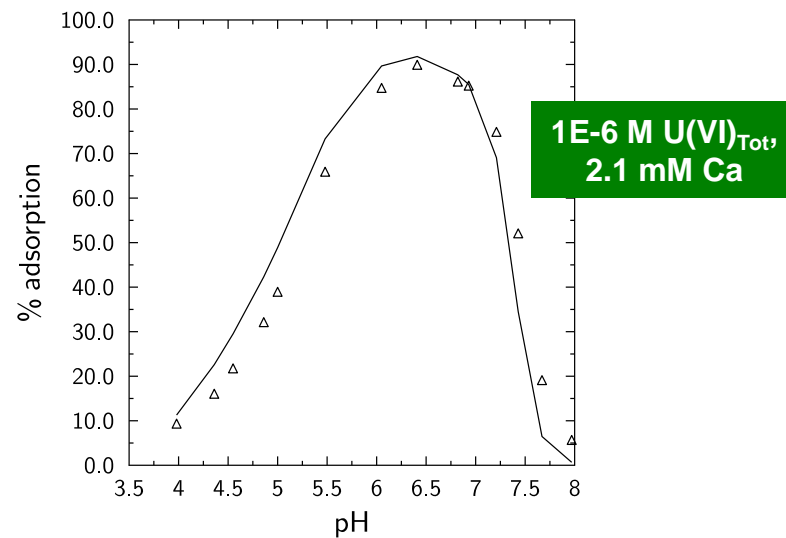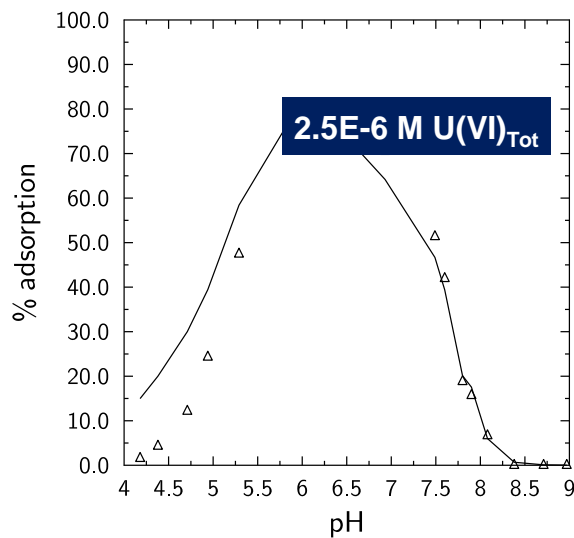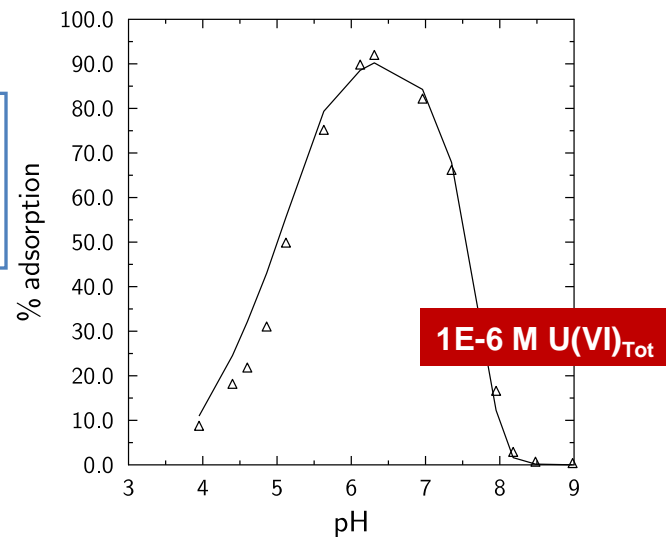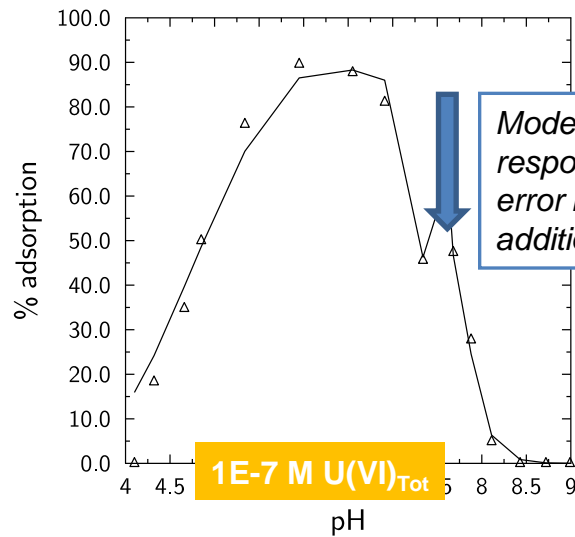# Argillite/Crystalline WPs

- R&D nature
  - Support other WPs
  - Crosscutting
    - Clay thermal limit studies
    - Thermodynamic data
    - Fuel degradation
- Tangible results
  - Colloid facilitated transport
  - DFN-FCM comparison
- International collaboration
  - Data exchanges: DECOVALEX, KURT
  - Exchange of materials: FEBEX
- Integration with GDSA
  - Reference cases
- Highlights

Experimental & modeling activities to support process model development and GDSA
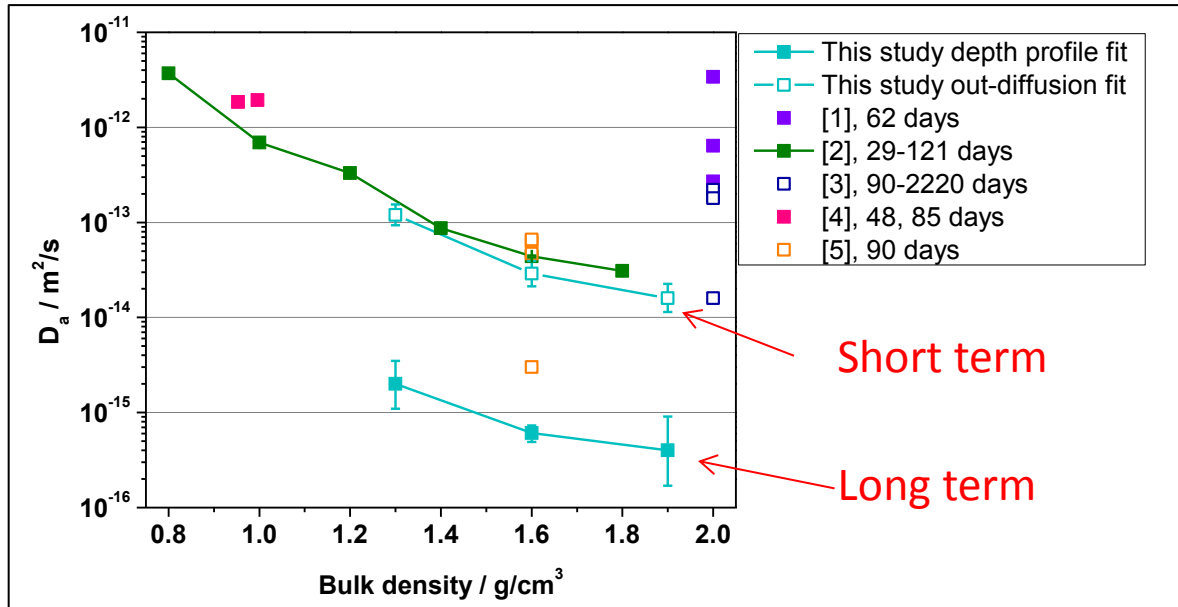
Surface Complexation Modeling
Blind prediction of Atmospheric P_{CO2} Data

Model predicts response to an error in $NaHCO_3$ additions

1E-7 M U(VI)$_{Tot}$

1E-6 M U(VI)$_{Tot}$

2.5E-6 M U(VI)$_{Tot}$

1E-6 M U(VI)$_{Tot}$, 2.1 mM Ca

# *Long-term U D_a* about two orders of magnitude lower than Short-term D_a values

[1] Torstenfelt et al. (1986), *SKB Technical Report 86-14*. SKB, Stockholm.
[2] Idemitsu et al. (1996), *Mater. Res. Soc. Symp. Proc.* **412**, 683.
[3] Ramebäck et al. (1998), *Radiochim. Acta* **82**, 167.
[4] Wang et al. (2005), *Radiochim. Acta* **93**, 273.
[5] Glaus et al. (2012), Clays in Natural & Engineered Barriers for Radioactive Waste Confinement 22.-25. Oct. 2012, Montpellier; Andra.

➤ The D_a values of the out-diffusion fit are in very good agreement with literature data [2, 5].

➤ The D_a values of the in-diffusion fit are two orders of magnitude lower.

Cs sorption: Reconciling Lab and Field Results

Parameter	Lab	Field (CFM 12-02)
Sorption rate constant, 1st site (ml/g-hr)	29600	
Desorption rate constant, 1st site (1/hr)	8	
Max. site capacity, 1st site (mol/g)	1e-3	
Sorption rate constant, 2nd site (ml/g-hr)	59200	30000
Desorption rate constant, 2nd site (1/hr)	0.4	0.17
Max. site capacity, 2nd site (mol/g)	6e-8	Unlimited
K_d value, 1st site	3700	
K_d value, 2nd site	148000	176000

Good Agreement
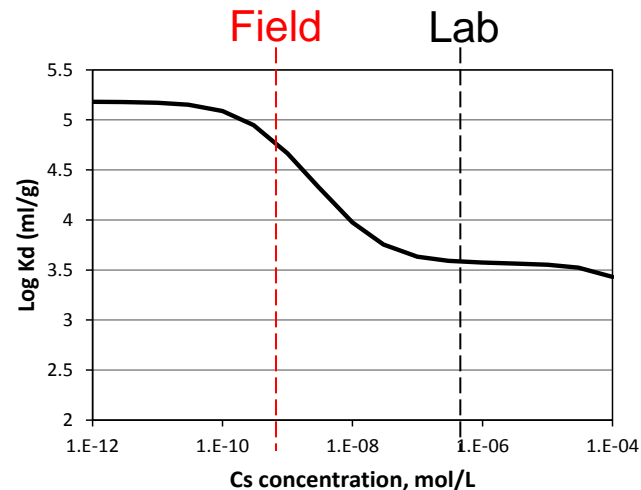
~95% of Cs predicted to be sorbed to colloids; 97-98% was reported for field test

UFD Argillite /Crystalline Session

Pollucite created from bentonite clay at high P,T
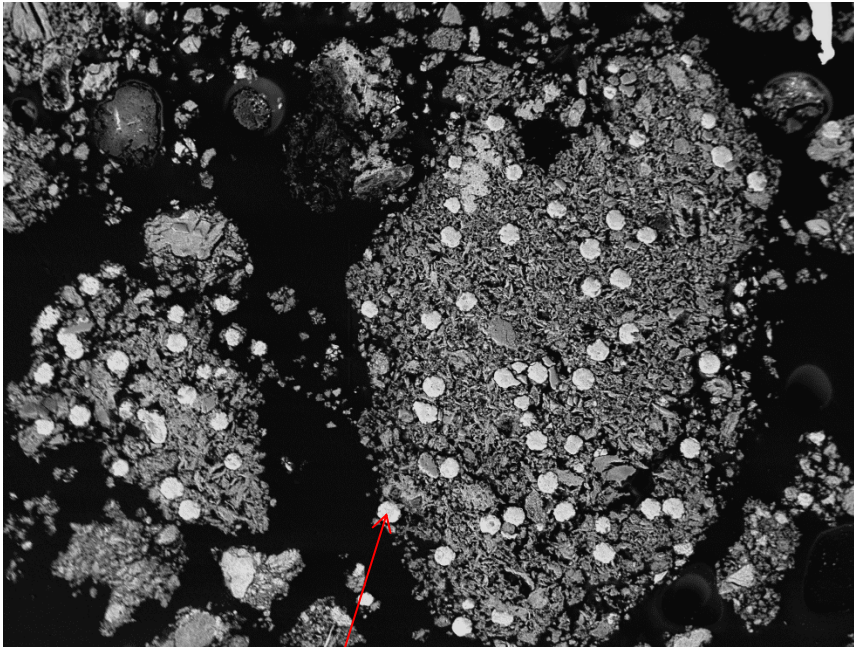
Pollucite

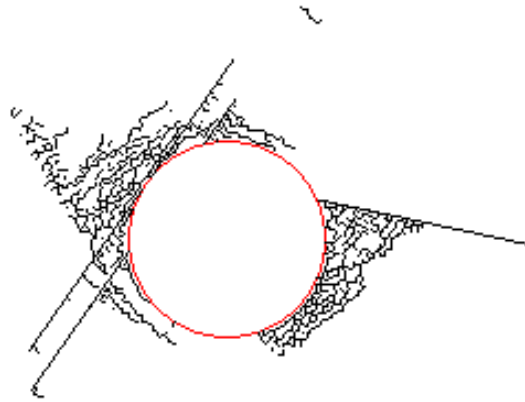|	
SiO_2	**56.64**
Al_2O_3	18.63
FeO	0.68
MnO	0.01
MgO	0.05
CaO	4.95
Na_2O	1.27
K_2O	0.05
Cs_2O	13.56
Cl	0.2
F	0.01
O=Hal	-0.05
TOTAL	96.01

Average of 30 EMP analyses

$An_{18.3}$ Wrk_{39} $Pol_{42.7}$
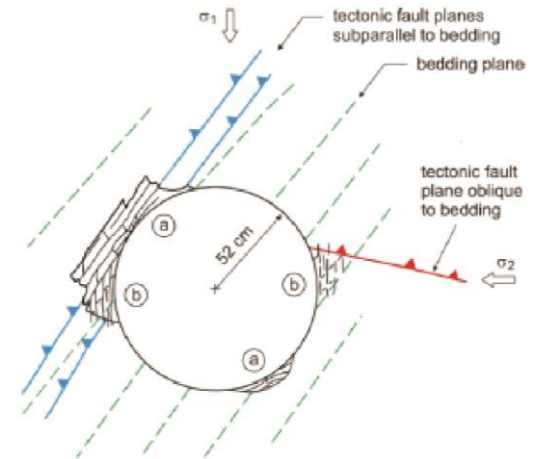
- Simulation of fracture pattern formation in DRZ
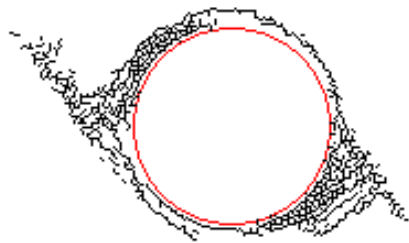
Without fault planes   With fault planes   Observation

Comparison of two modeling approaches for fractured media
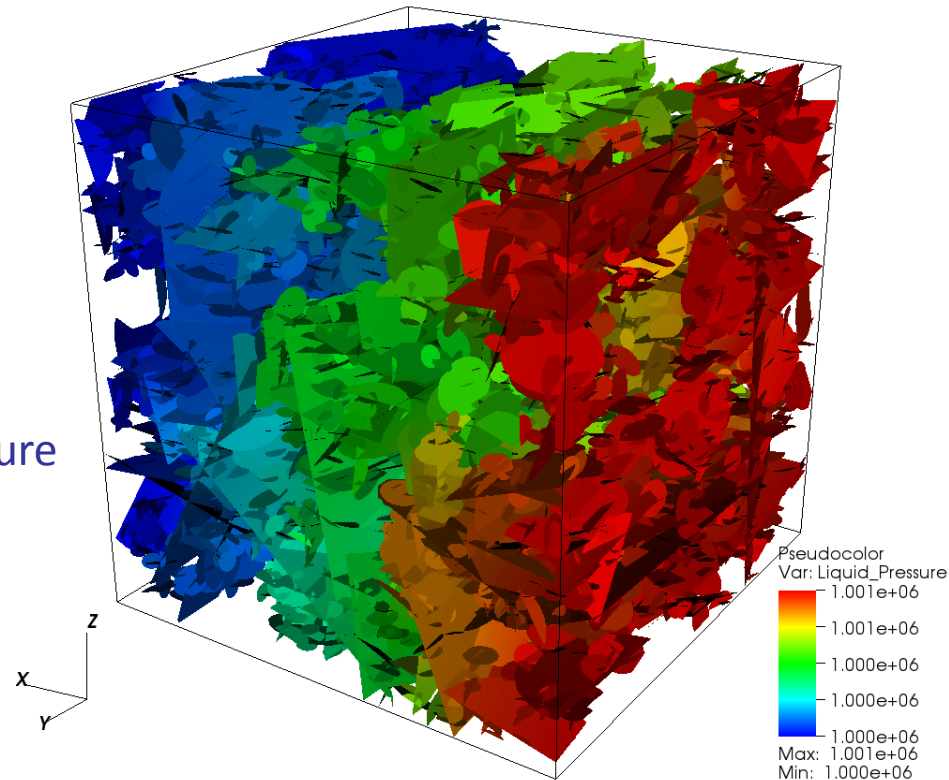
Flow direction:
  West-East

Pressure gradient:
  10^3 Pa

Compare Effective Permeability
of Discrete Fracture Network (DFN) and Fracture
Continuum Model (FCM):

Effective permeability
of 5 realizations is in the range:

DFN   3.347 e-17 − 4.242 e-17 m^2
FCM 3.68 e-17   − 4.67 e-17 m^2

DFNWORKS_v4.mov

Pseudocolor
Var: Liquid_Pressure
  1.001e+06
  1.001e+06
  1.000e+06
  1.000e+06
  1.000e+06
Max: 1.001e+06
Min: 1.000e+06