FRC Local Area 3 Model Development

NABIR Fall Meeting
October 2005

Fan Zhang, Jack Parker, David Watson,
Kenneth Lowe, Kirk Hyder, and Scott Brooks

Objectives

❖ **Work was undertaken to develop a smaller scale model encompassing Area 3 as an aid in the interpretation of flow and tracer studies in the vicinity of FW106 and to help design of subsequent studies.**

❖ **Of particular interest is assessment of potential interactions between current experiments in Area 3 and proposed new studies and to adjust experimental plans if necessary.**
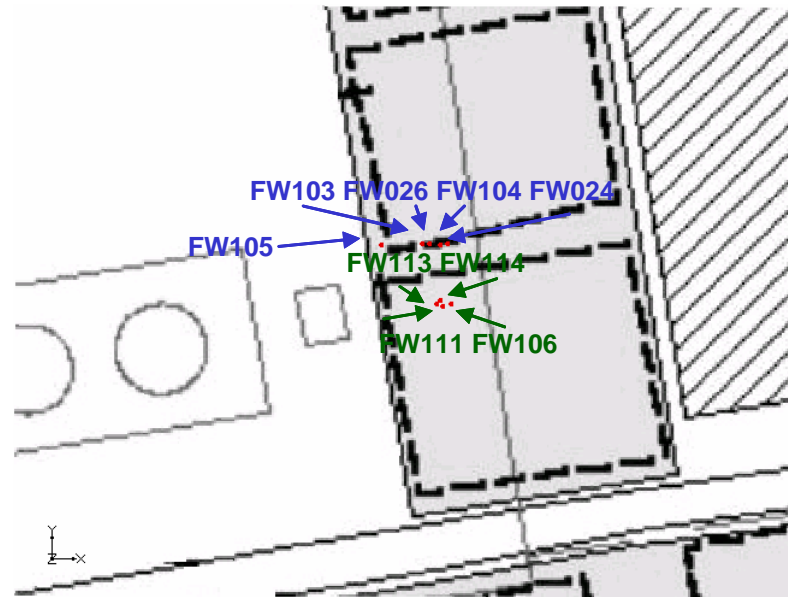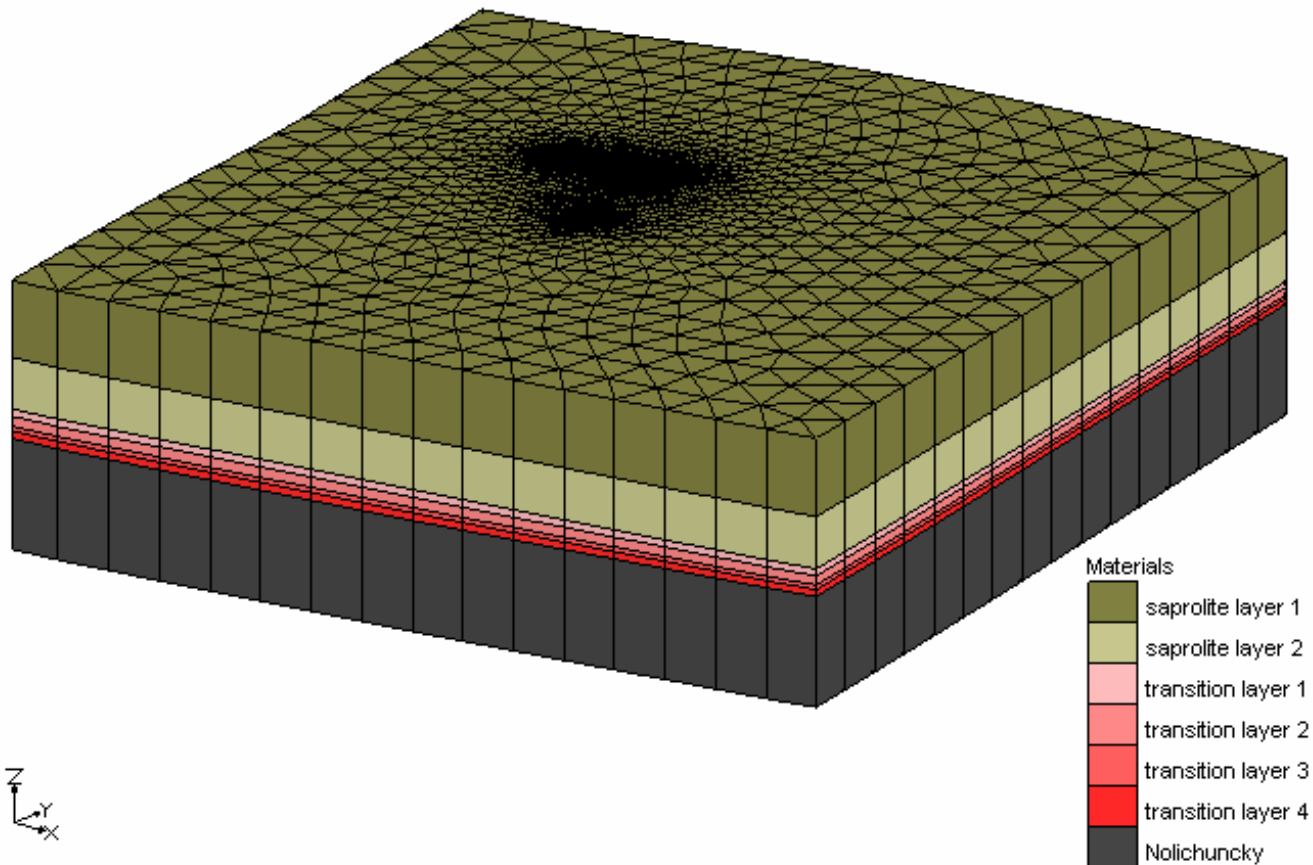
Model Domain

Boundary conditions on the local model are being obtained from the site-wide model results.

Discretized Model Domain

There are 7 layers of 21980 elements and 8 layers of 12824 nodes to accommodate the experimental resolution.

Materials
- saprolite layer 1
- saprolite layer 2
- transition layer 1
- transition layer 2
- transition layer 3
- transition layer 4
- Nolichuncky

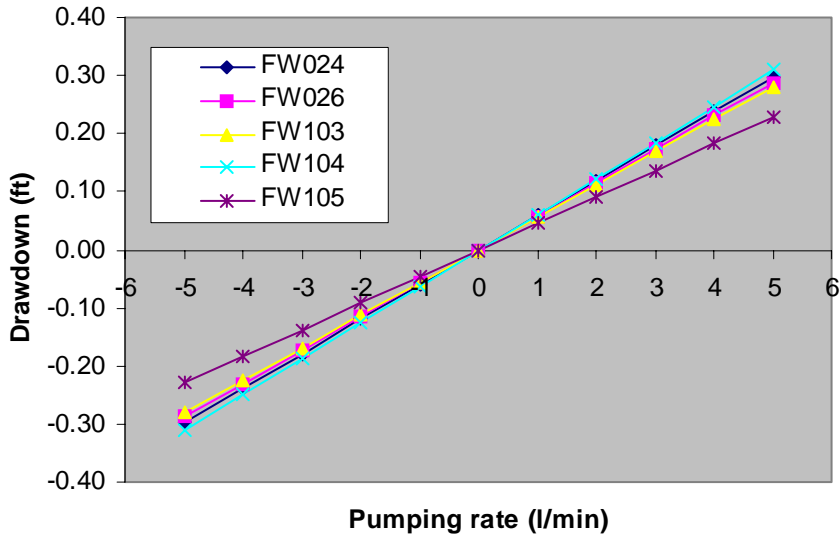# FW106 Pumping Test Calibration

Material properties were initially mapped from the site-wide model, but then refined to account for finer level details relevant to the experimental data interpretation.
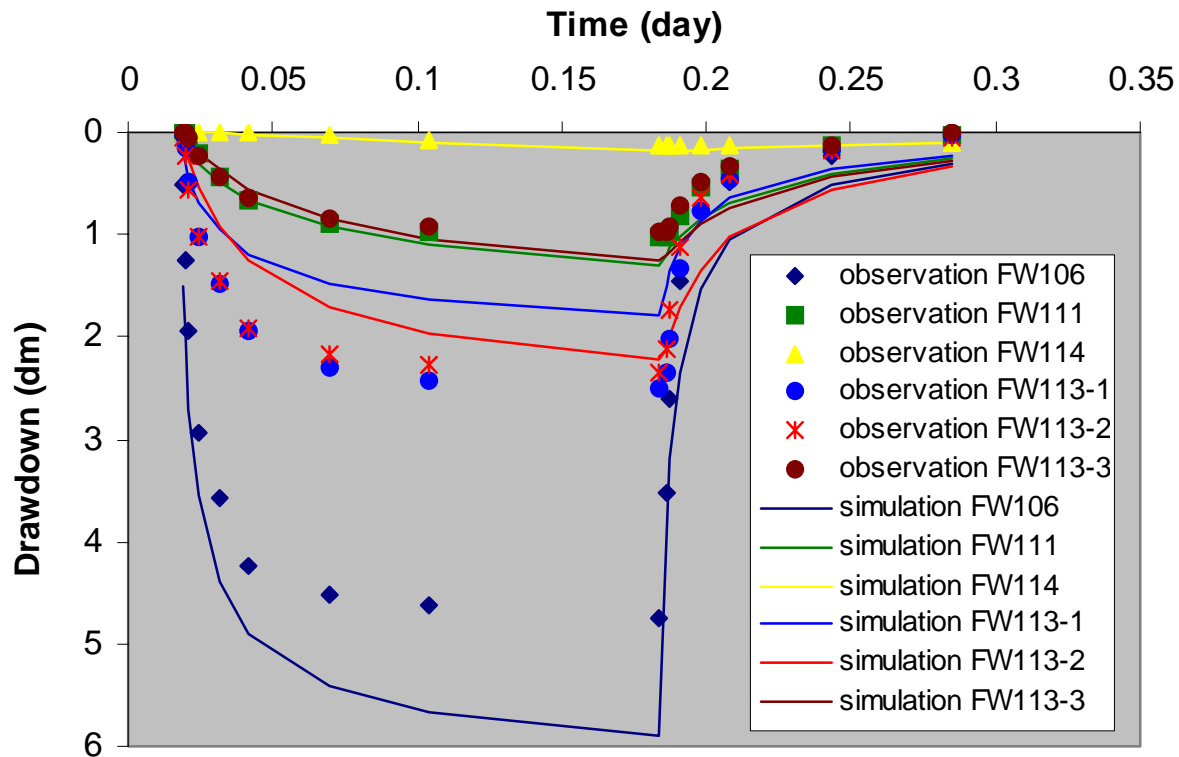
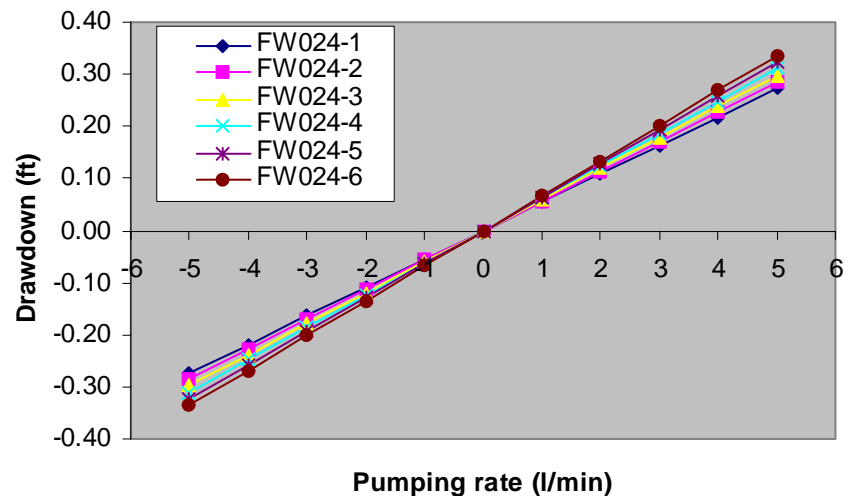**Pumping rate at FW106 is 0.75 l/min.**

FW106 Pumping Steady State Simulation

Effect of pumping at FW106 on FW024 et al

Well	Distance to FW106 (ft)
FW024	33
FW026	35
FW103	36
FW104	33
FW105	50
FW106	0

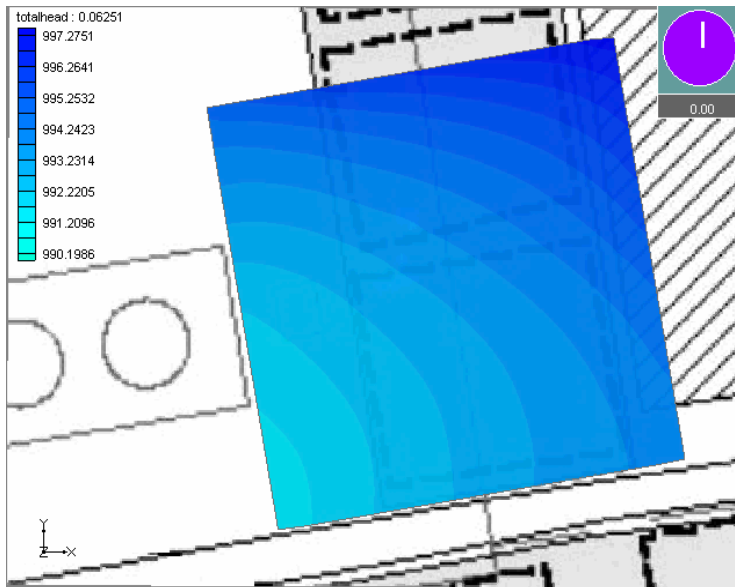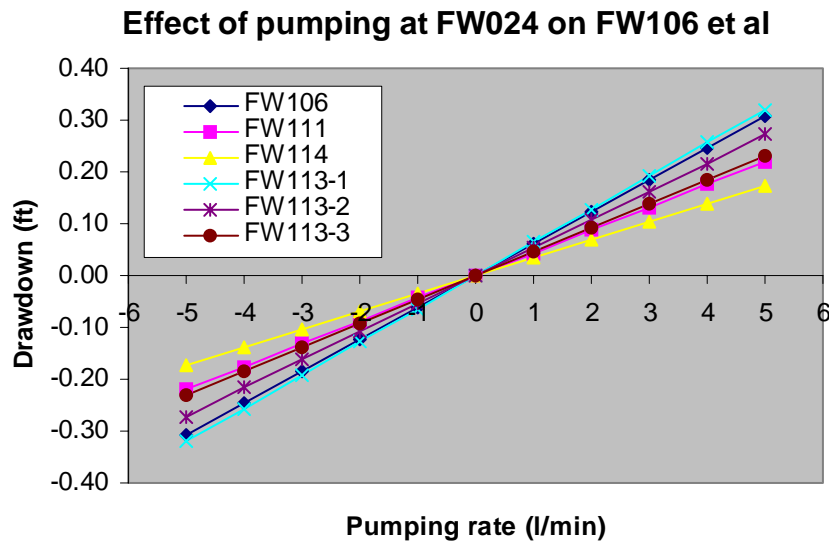| Well	Depth (ft)
FW024-1	43
FW024-2	41
FW024-3	40
FW024-4	39
FW024-5	37
FW024-6	36

Effect of pumping at FW106 on FW024

FW106 Pumping Transient Simulation

Pumping rate at FW106:
   0 l/min for t = 0 ~ 10 min & t = 50 ~ 90 min
   5 l/min for t = 10 ~ 50 min

FW024 Pumping Steady State Simulation

Effect of pumping at FW024 on FW106 et al

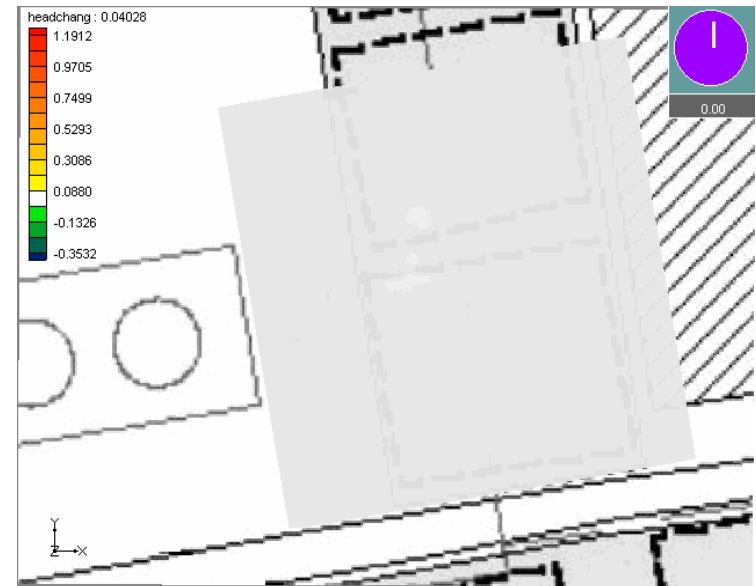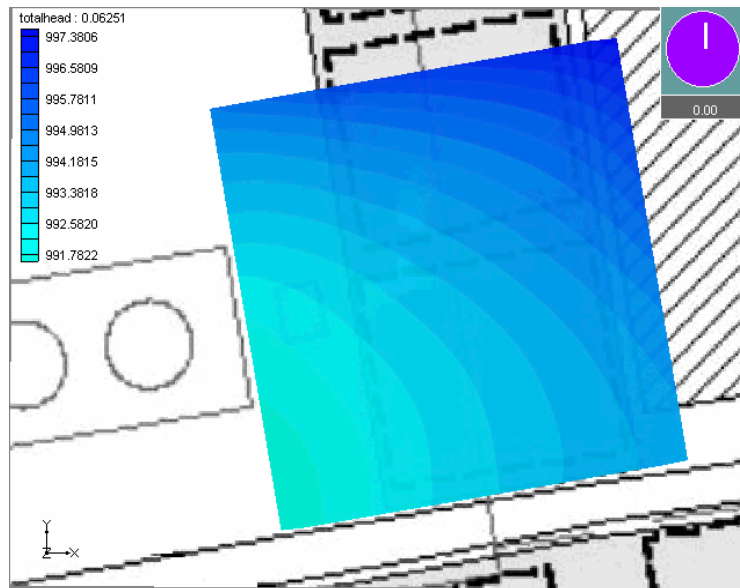| Well	Depth (ft)	Distance to FW024 (ft)
FW106	40	33
FW111	29	34
FW114	18	32
FW113-1	45	34
FW113-2	37	34
FW113-3	30	34

FW024 et al Injection Transient Simulation

Pumping rate:
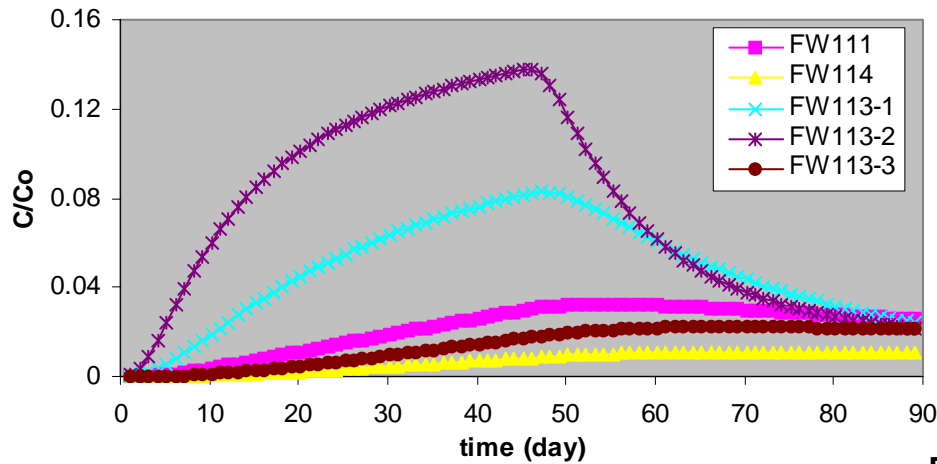 t = 0 ~ 10 min & t = 50 ~ 90 min: 0 l/min at all wells
 t = 10 ~ 50 min: -1.6 l/min at FW024 & 0.56 l/min at FW103
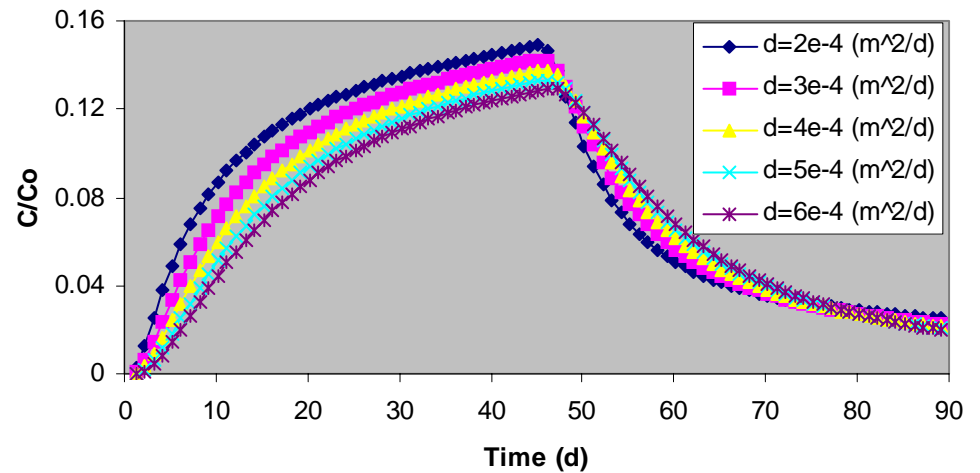   -0.6 l/min at FW104 & 0.6 l/min at FW026

BT curve of FW106 tracer test

BT curve of FW106 tracer test (d = 4e-4 m^2/d)

BT curve of FW106 tracer test (at FW113-2)

FW024 Tracer test Simulation

The difference of simulated tracer concentrations for the cases without and with pumping (1 l/min) at FW106 ranges from -0.028 To 0.018.


Without pumping at FW106

With pumping at FW106

Another Topic

# Simulation of Fate and Transport of Uranium(VI) in Weathered Saprolite

Packed Column U(VI) Breakthrough Curve

❖Uranium elution from a packed soil column can be predicted using the surface complexation model and equilibrium geochemical parameters of Waite et al. [1994].

❖The surface complexation model assumes that sorption occurs simultaneously onto a small number of high affinity (strong) sites and a larger number of low affinity (weak) sites.
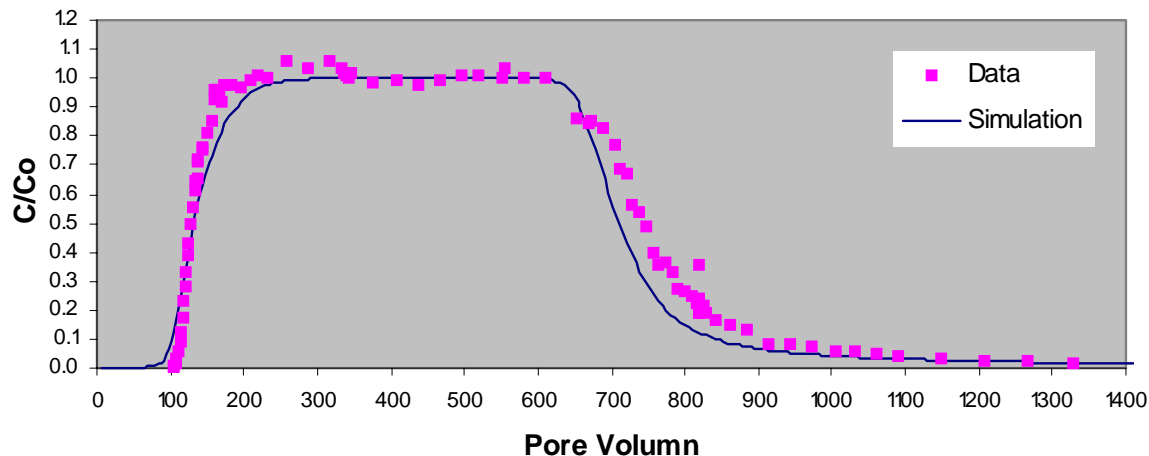
Undisturbed Column U(VI) Breakthrough Curve

The reaction network with equilibrium sorption reactions was not able to fully predict U(VI) transport through an undisturbed soil column.

Uranium Break Through Curve
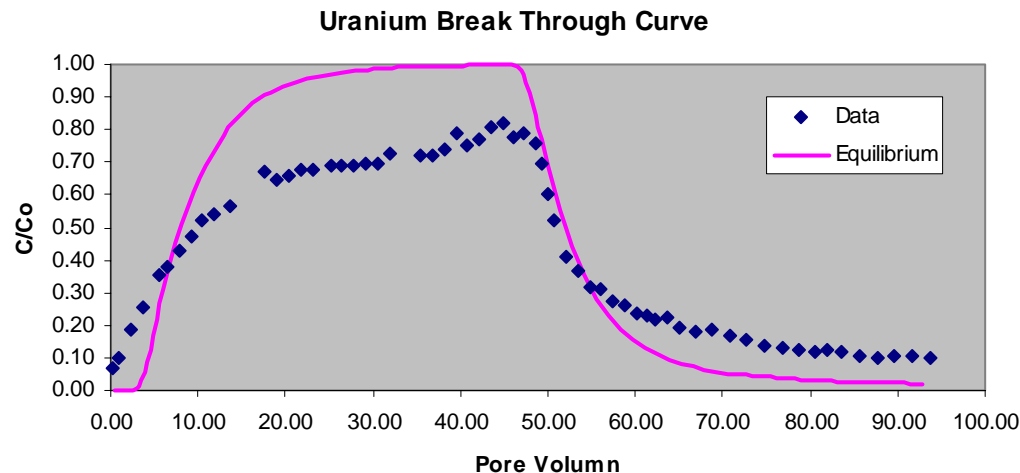
According to speciation information, two U(VI) sorption reactions were considered to be the most kinetically limited. Forward and backward kinetic rate constants for the two reactions were fitted to the observed kinetic data using a nonlinear parameter estimation procedure coupled with HGC 5.

Undisturbed Column U(VI) Breakthrough Curve

Simulation of U(VI) transport through the undisturbed column using kinetic parameters yielded good agreement with the measured results indicating that U(VI) transport may be kinetically controlled in heterogeneous media.

Uranium Break Through Curve
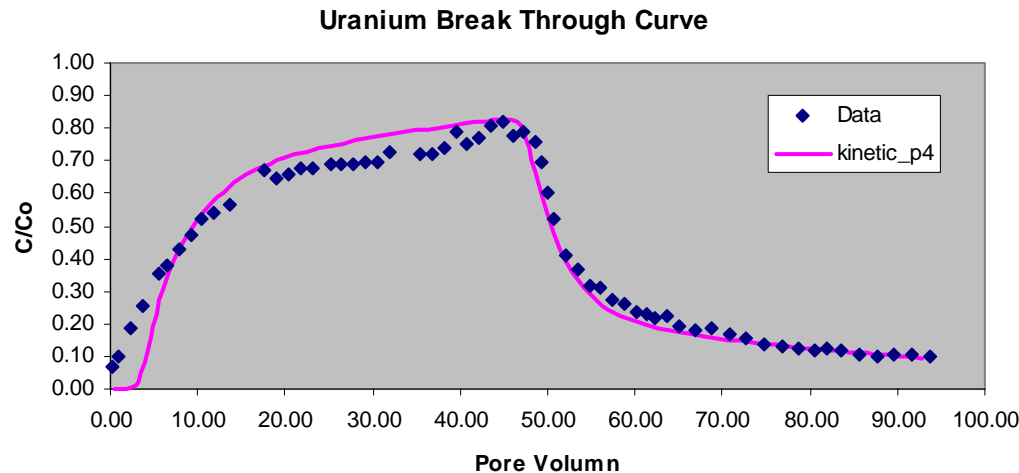
Further efforts have been undertaken in cooperation with Brooks, Kim and others to model experimental studies of uranium sorption kinetics in weathered saprolite.