U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

NUCLEAR WASTE TECHNICAL REVIEW BOARD

SUBJECT: FLOW AND TRANSPORT MODELS FOR YUCCA MOUNTAIN

PRESENTER: Bruce A. Robinson

PRESENTER'S TITLE AND ORGANIZATION: PRINCIPAL INVESTIGATOR
LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NM

TELEPHONE NUMBER: (505) 667-1910
robinson@lanl.gov

PAHRUMP, NV
JANUARY 28, 1997

Topics of Discussion

- UZ flow and transport modeling - ambient system
- UZ model of repository performance
- SZ flow and transport models - incorporation of field data into models
- UZ/SZ model of repository performance
- Planned Testing

Hydrologic Modeling of the Ambient System

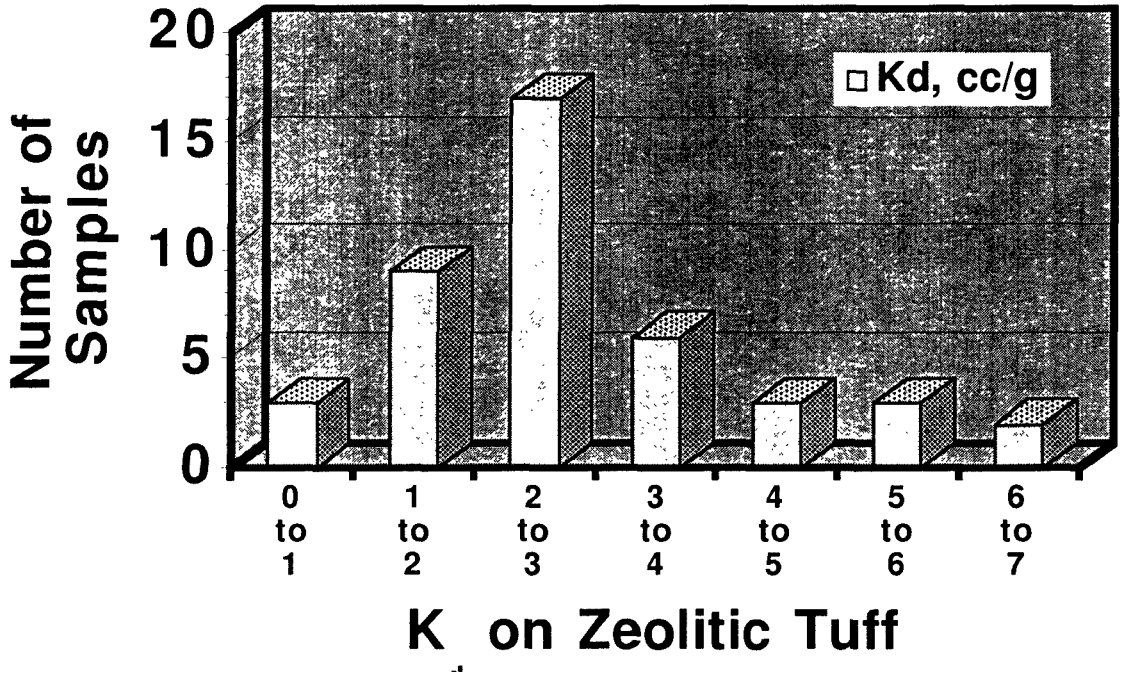
- Fluid saturation and moisture tension data
- Surface-based infiltration measurements
- Environmental isotopes
- Water chemistry

UZ hydrologic studies define the the hydrologic system (percolation flux, property values, stratigraphy, faults, etc.). This information is used in radionuclide transport studies.

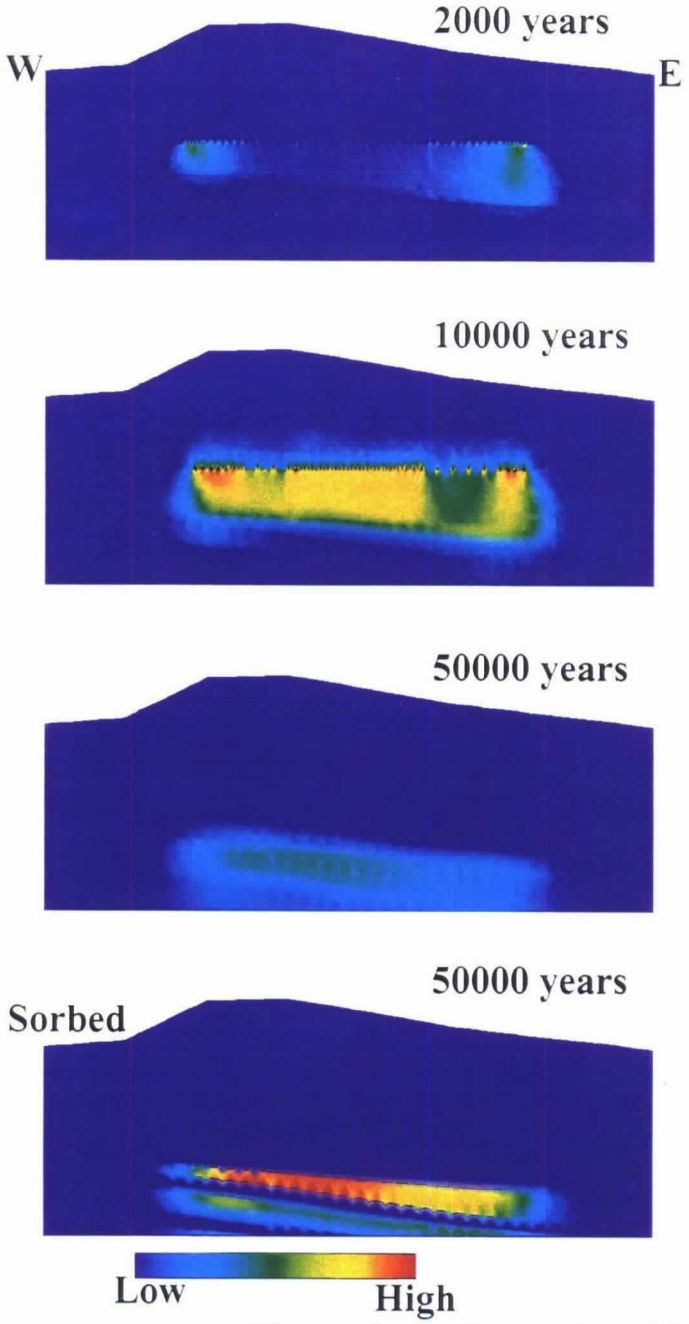
UZ Transport Model of Repository Performance

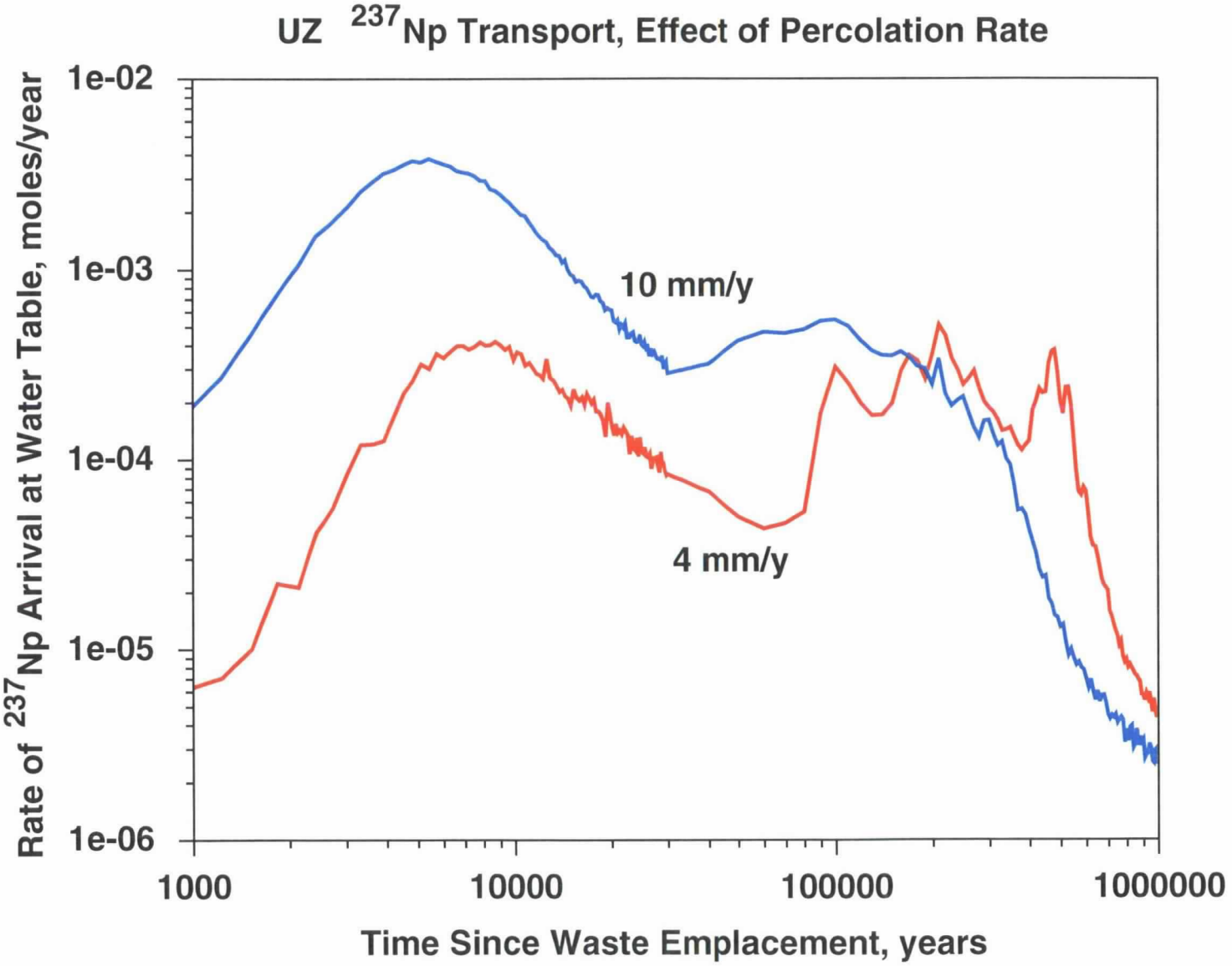
- Screening to determine key radionuclides
- Sorption, speciation, and solubility data
- Laboratory transport tests - diffusion and column tests
- UZ flow and transport model predictions

^{237}Np K_d Distribution on Zeolitic Tuffs



Neptunium Transport Predictions
4 mm/y Percolation Flux

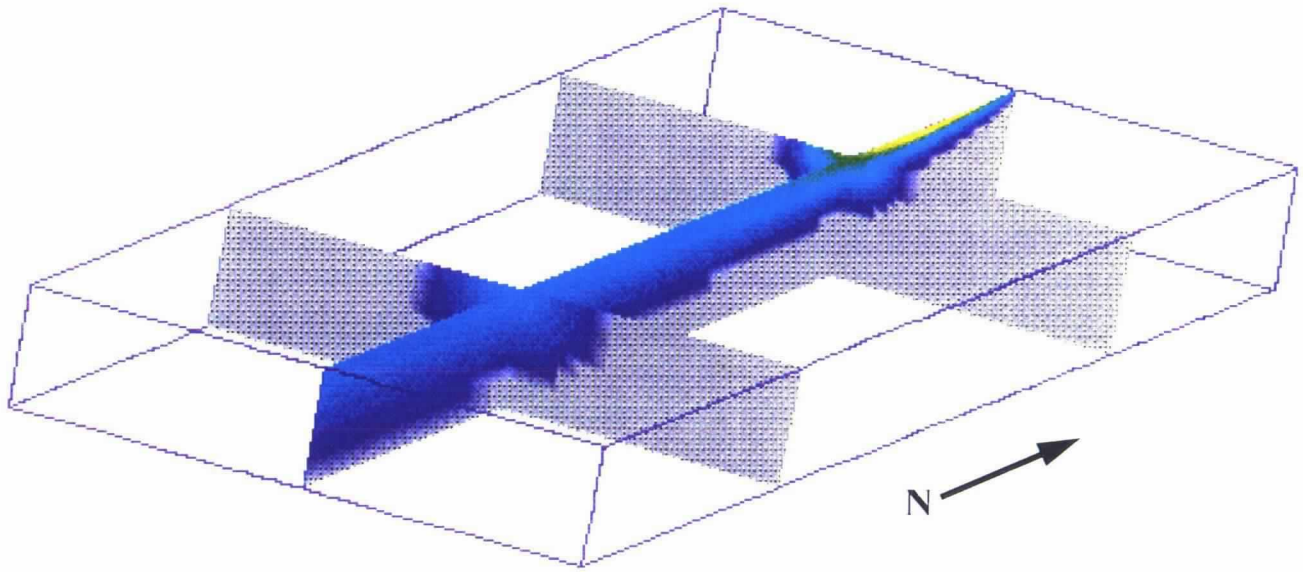



UZ 237Np Transport, Effect of Percolation Rate
Rate of 237Np Arrival at Water Table, moles/year
1e-02
1e-03
1e-04
1e-05
1e-06
10 mm/y
4 mm/y
1000
10000
100000
1000000
Time Since Waste Emplacement, years

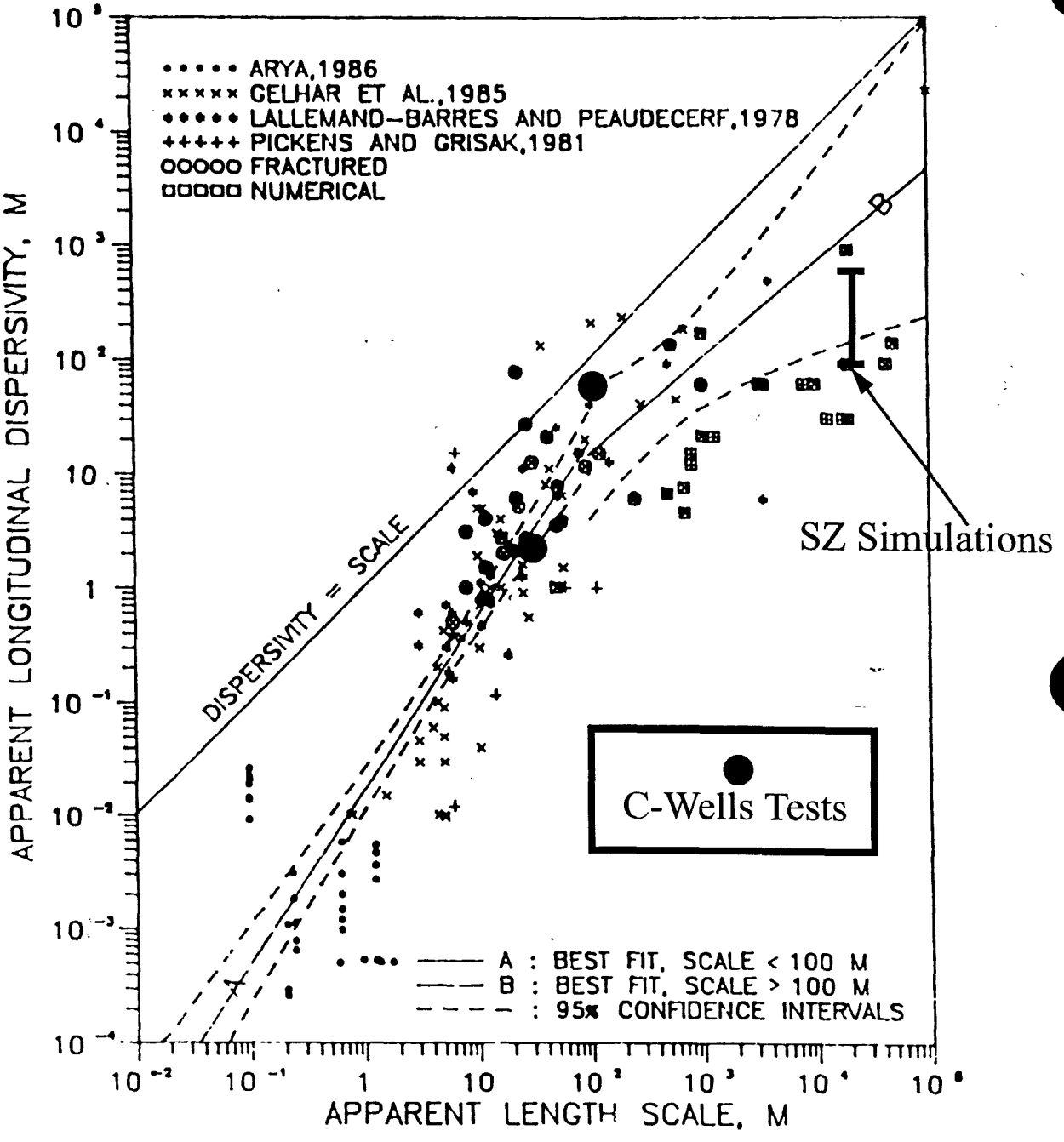
SZ Flow and Transport Model Development

- Water potential data from numerous wells
- Water chemistry and isotopes
- C-Wells transport testing has been used to:
  - Validate transport conceptual models
  - Estimate transport parameters

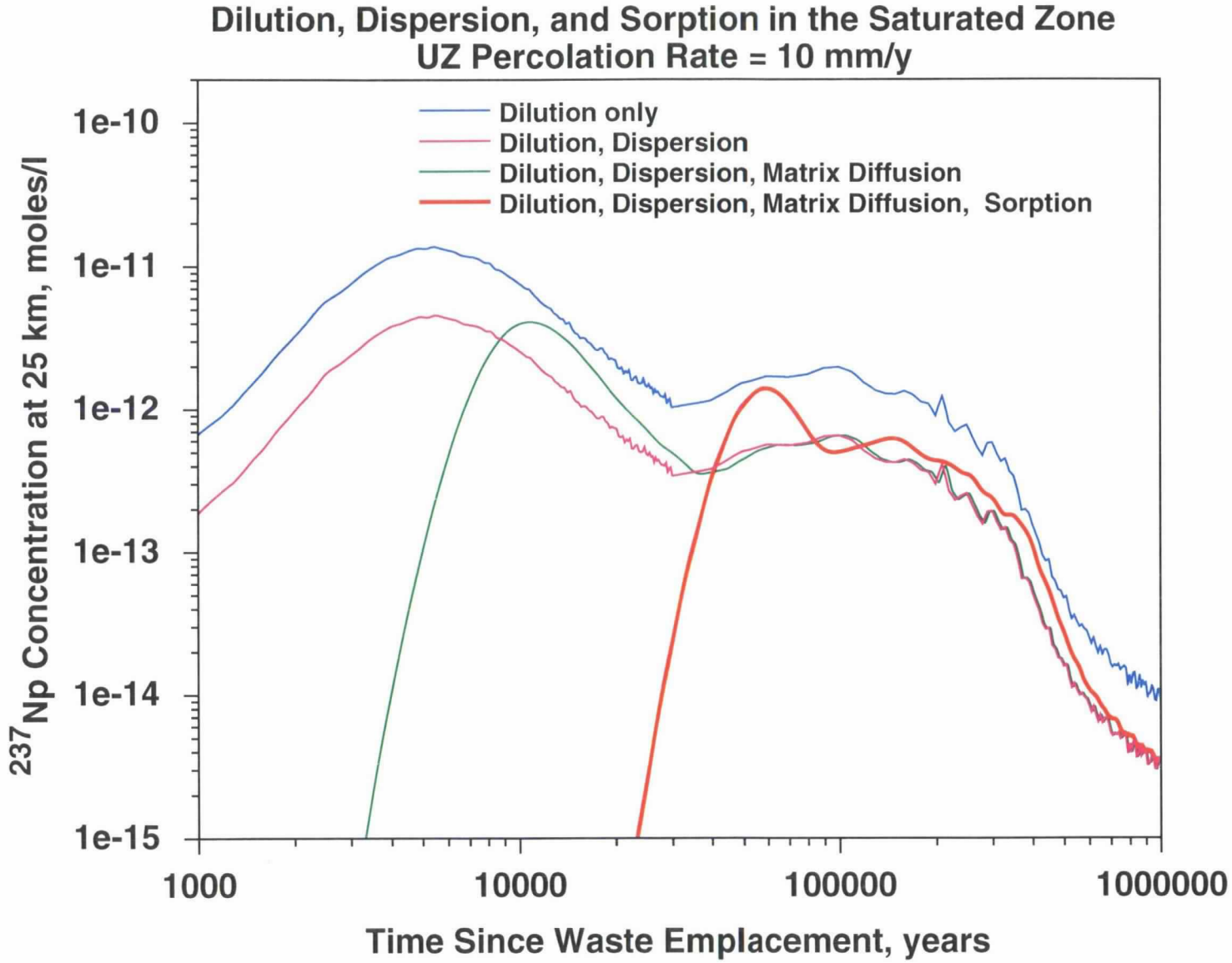
Saturated Zone Radionuclide Plume, 100 m Dispersivity

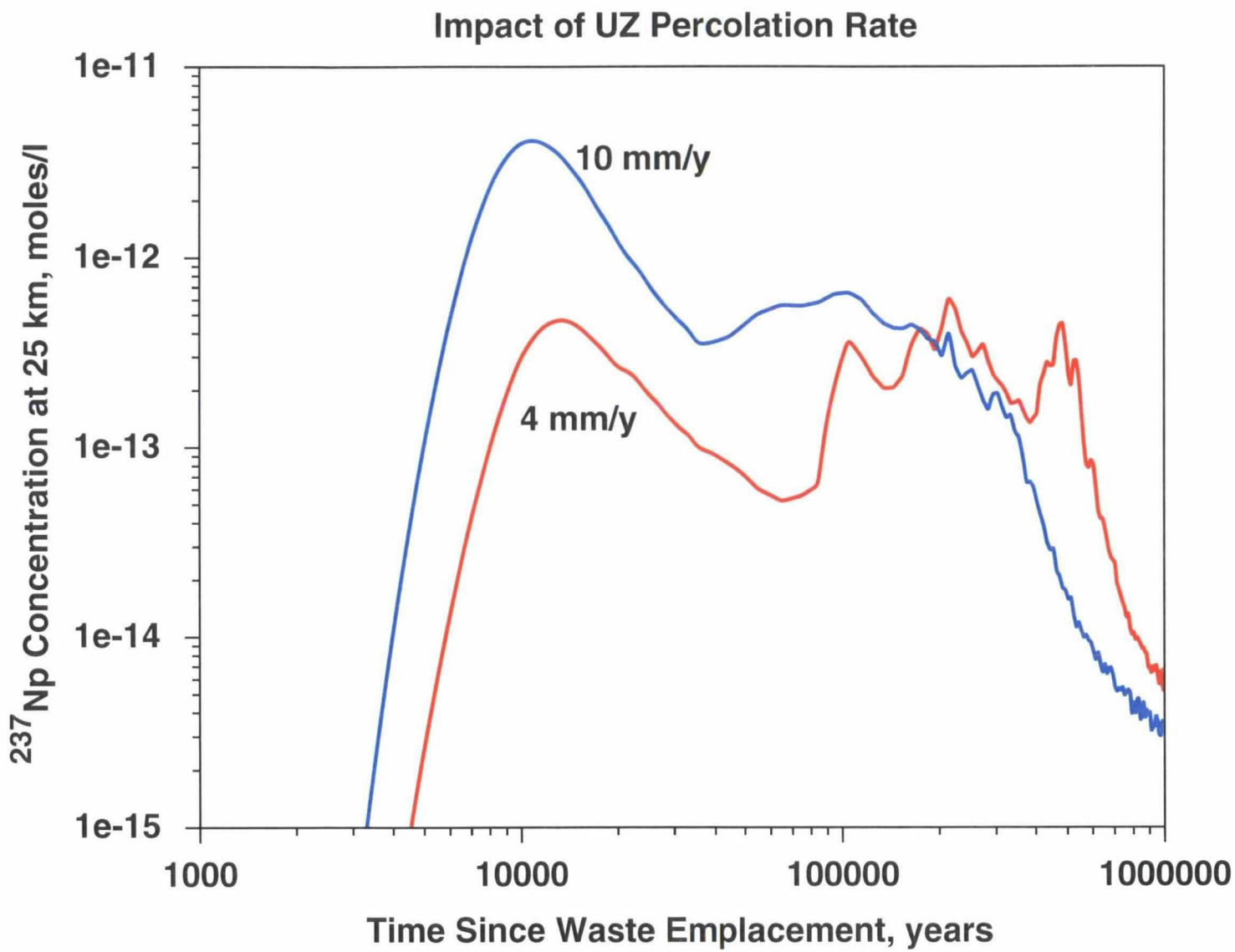


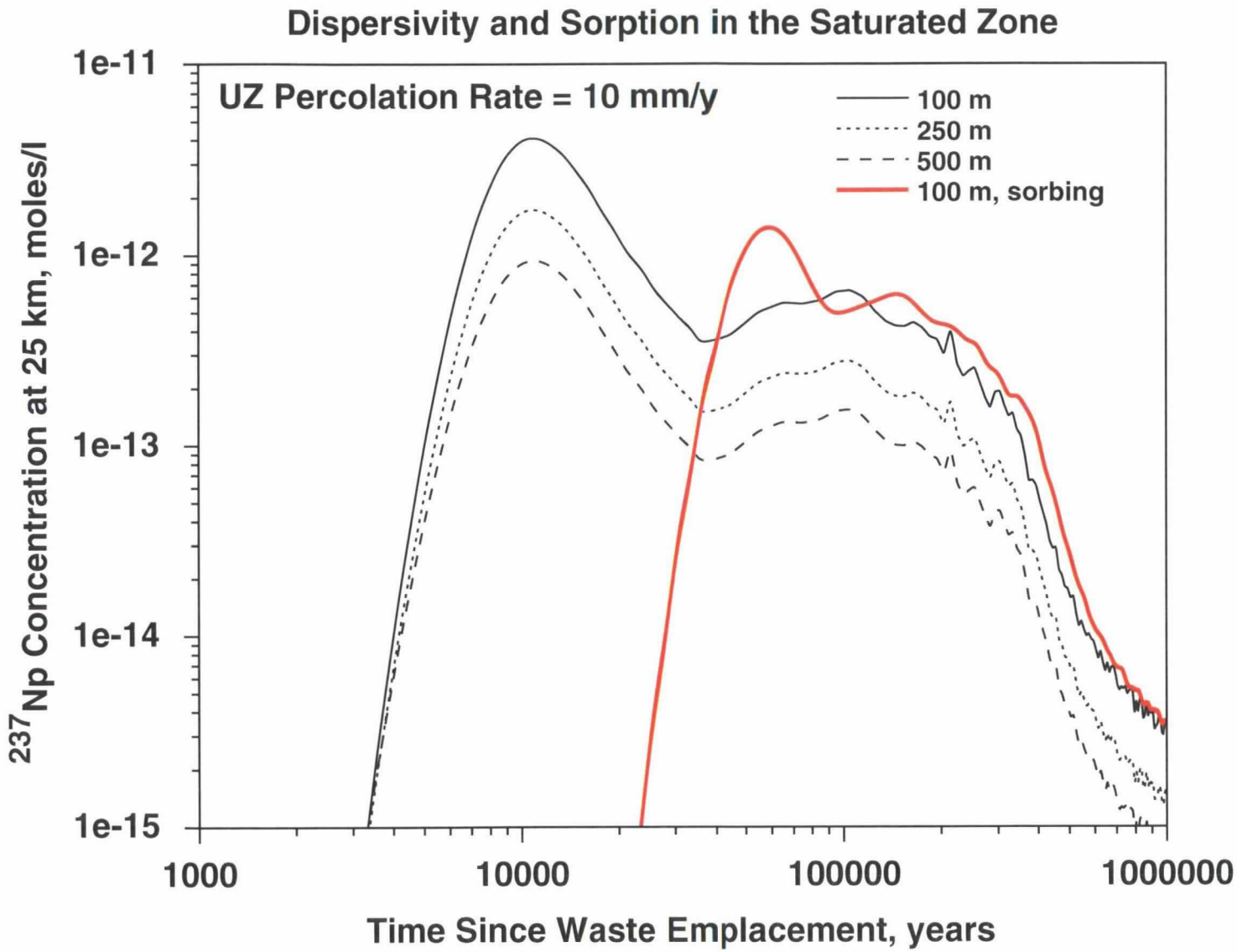
Scale Dependence of Dispersivity



from Neuman, 1990, *Water Resour. Res.*, 26, 8, 1749-1758.


Dilution, Dispersion, and Sorption in the Saturated Zone
UZ Percolation Rate = 10 mm/y
Dilution only
Dilution, Dispersion
Dilution, Dispersion, Matrix Diffusion
Dilution, Dispersion, Matrix Diffusion, Sorption
237Np Concentration at 25 km, moles/l
1e-10
1e-11
1e-12
1e-13
1e-14
1e-15
1000
10000
100000
1000000
Time Since Waste Emplacement, years


Impact of UZ Percolation Rate
1e-11
1e-12
1e-13
1e-14
1e-15
237Np Concentration at 25 km, moles/l
10 mm/y
4 mm/y
1000
10000
100000
1000000
Time Since Waste Emplacement, years


Dispersivity and Sorption in the Saturated Zone
UZ Percolation Rate = 10 mm/y
100 m
250 m
500 m
100 m, sorbing
1e-11
1e-12
1e-13
1e-14
1e-15
237Np Concentration at 25 km, moles/l
1000
10000
100000
1000000
Time Since Waste Emplacement, years

Planned Testing

- UZ transport validation test is being designed to provide confidence in transport models
  - Fracture/Matrix interaction parameters
  - Validity of sorption data
- Testing to further narrow the bounds on key SZ parameters
  - Scale dependence of dispersivity in SZ
  - Further validation of dual porosity transport models

Conclusions

- Peak dose may be controlled by fracture transport even if only a small fraction of released radionuclide travels through fractures
- Saturated zone dispersion and sorption will mitigate the negative impact of UZ fracture transport
- Saturated zone field testing has provided important information to constrain models and provide parameter values