YUCCA MOUNTAIN PROJECT

Studies

Current Status of the Saturated Zone Flow and Transport Model

Presented to:
Nuclear Waste Technical Review Board

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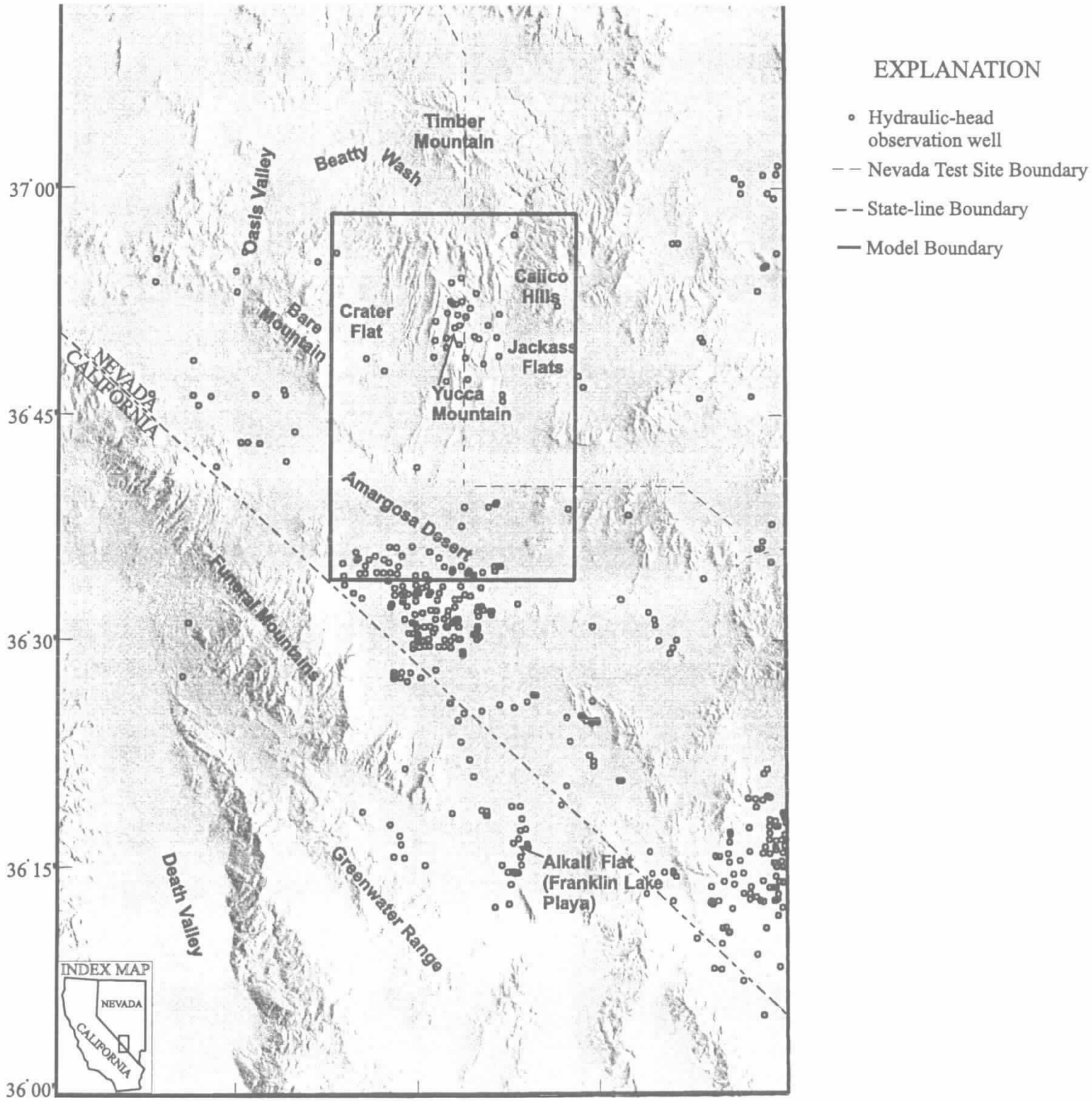
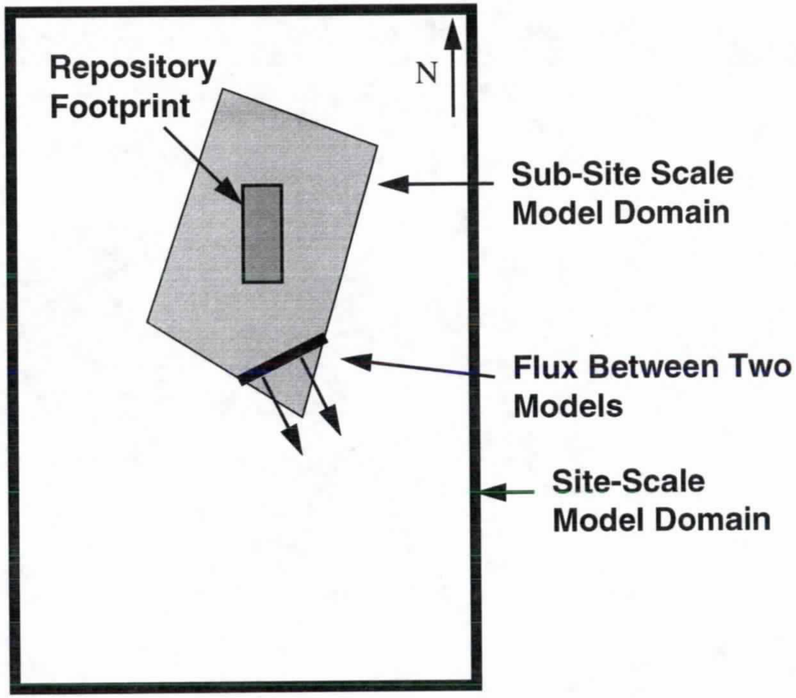
Outline

- **Description of flow and transport models**
- **Radionuclide transport studies - ^{99}Tc and ^{237}Np**
- **Sensitivity analyses**
  - *radionuclide source location*
  - *effective porosity*
  - *saturated zone flux*
  - *repository heat effects*
  - *sorption*
  - *colloids*
  - *dispersivity*
- **Future work**

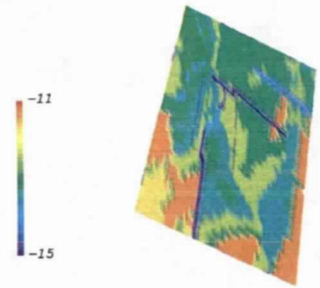
Site Scale Model Domain



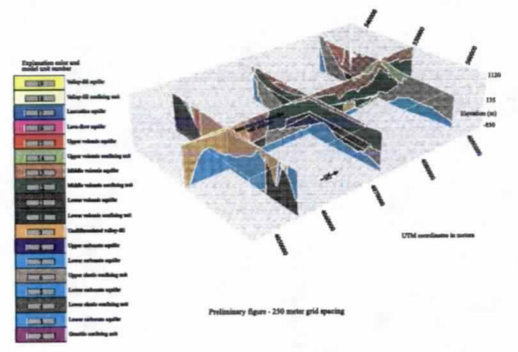
Integrated Transport Results

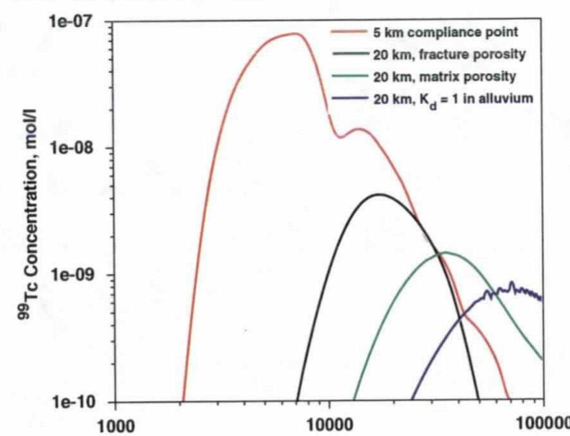


Sub-site scale Model

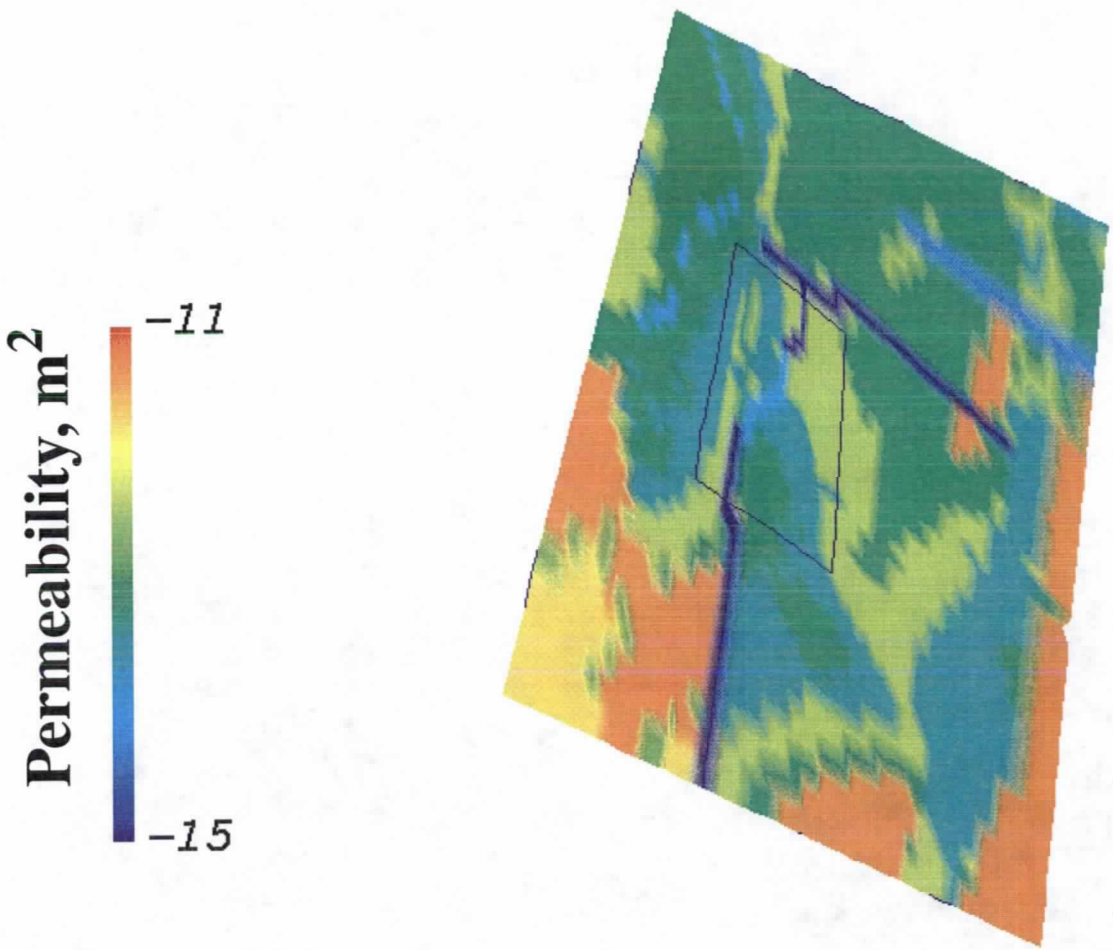


Site-Scale Model





Permeability Distribution - Sub-Site-Scale Model



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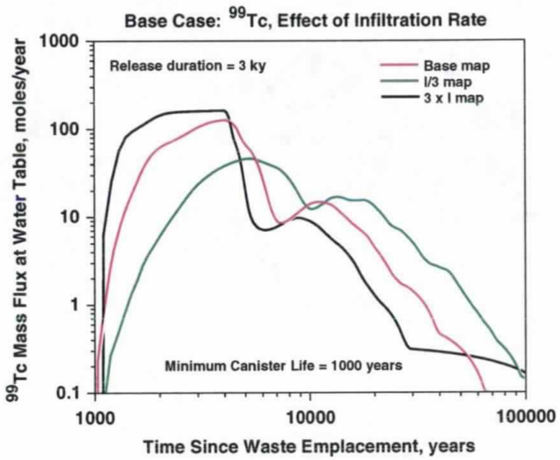
Saturated Zone Transport Model Predictions - 5 km

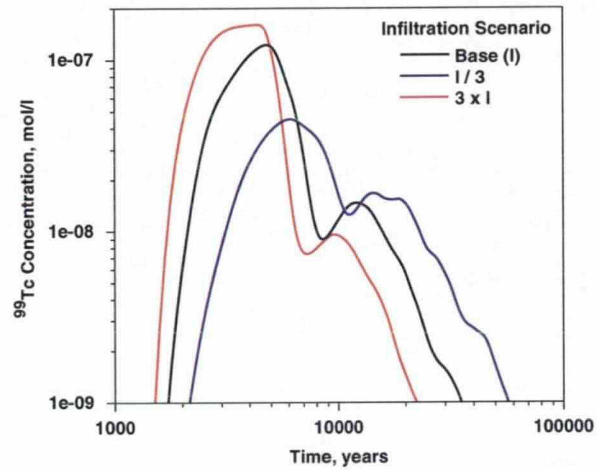
UZ Mass Flux

SZ Concentration

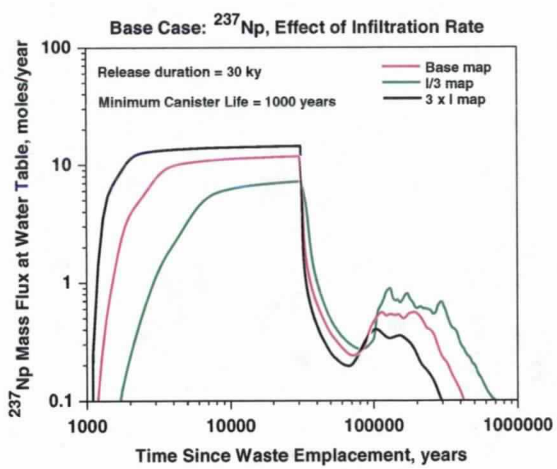
^{99}Tc



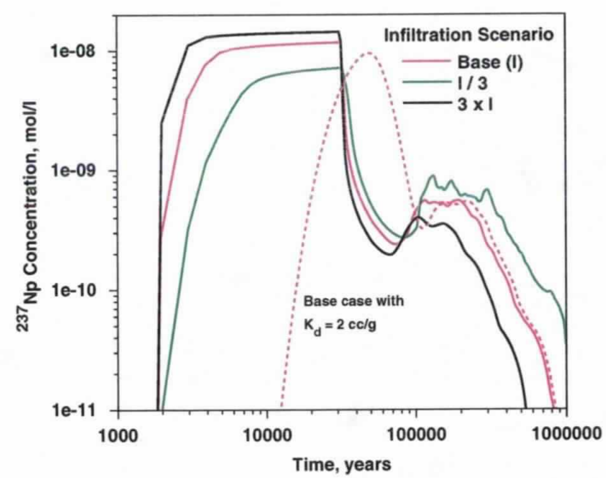
^{99}Tc convolution



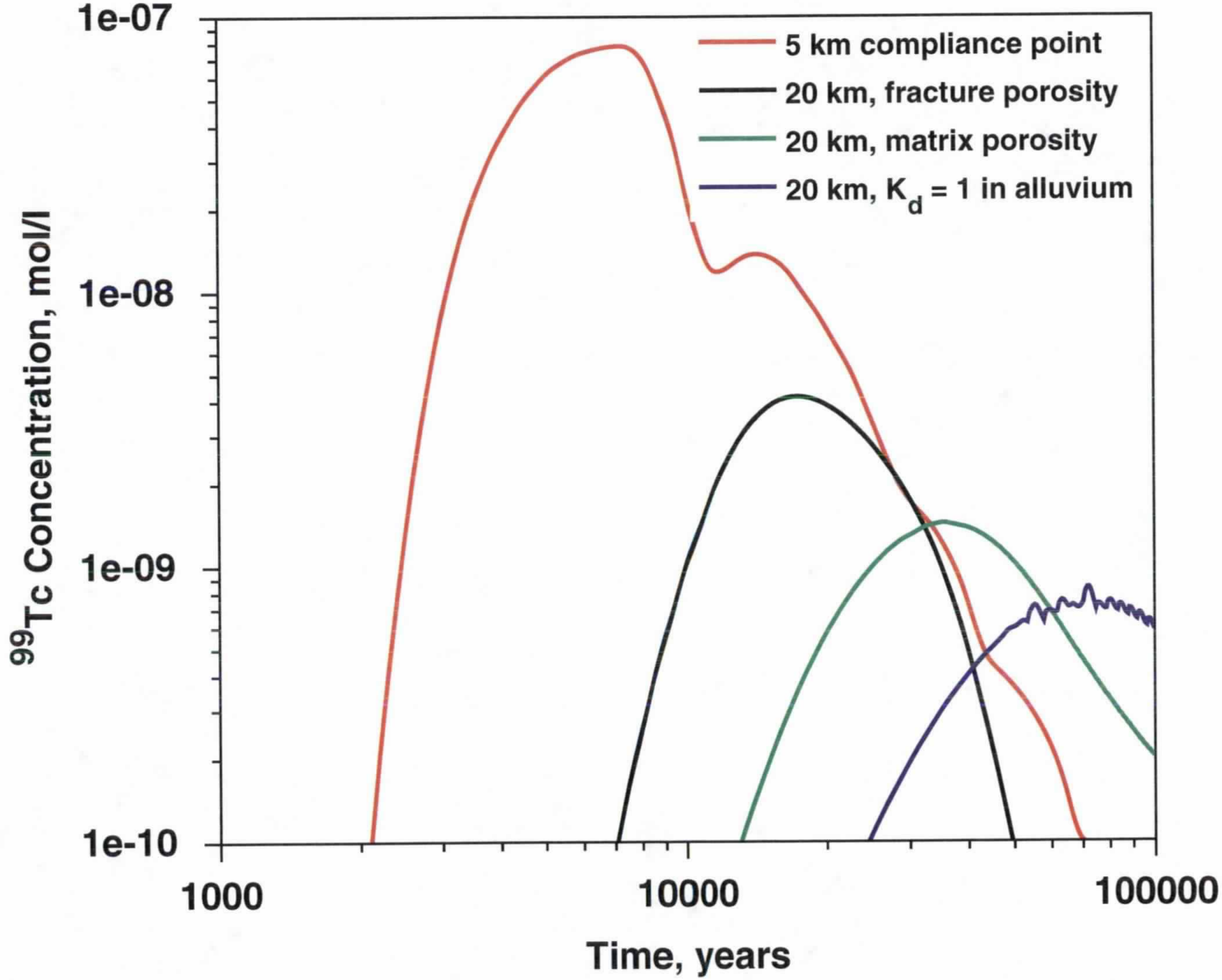
^{237}Np



^{237}Np convolution

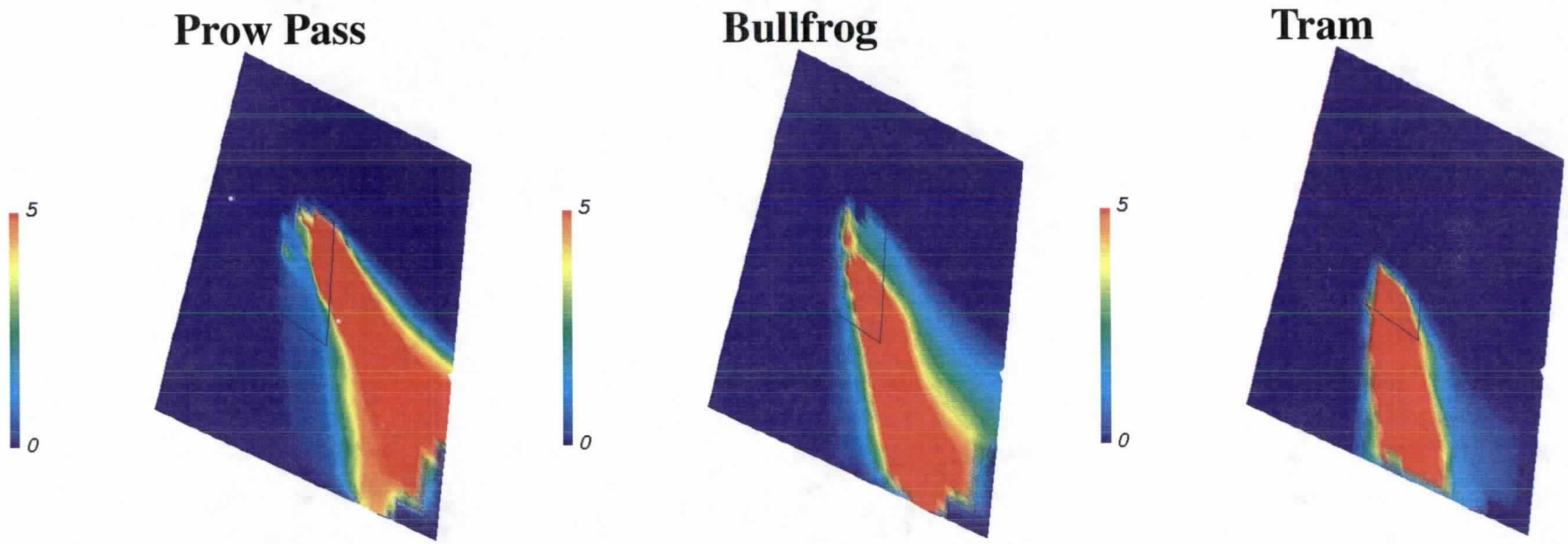


Saturated Zone Transport Model Predictions - 20 km



Smeared vs. Distributed Source at Water Table

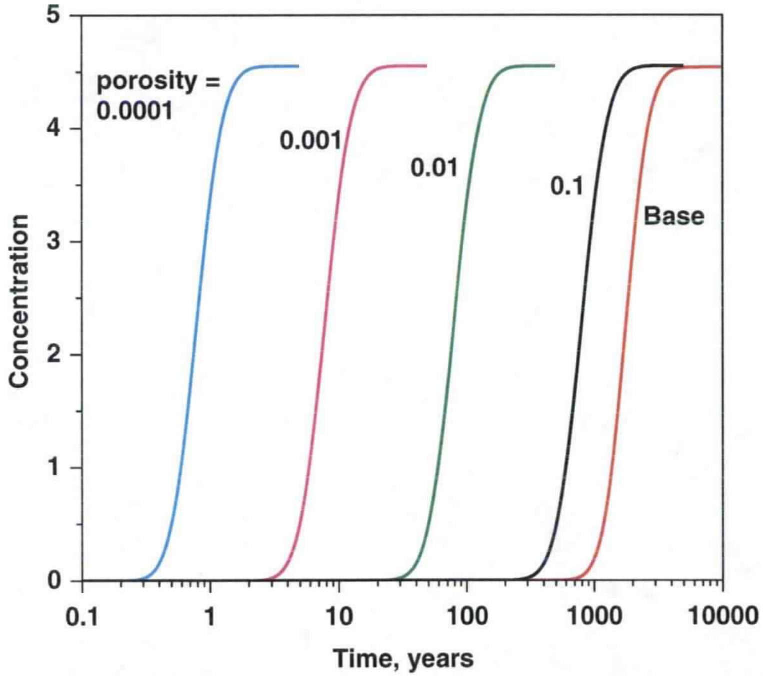
Plume predictions for radionuclide injected into saturated zone in three units:



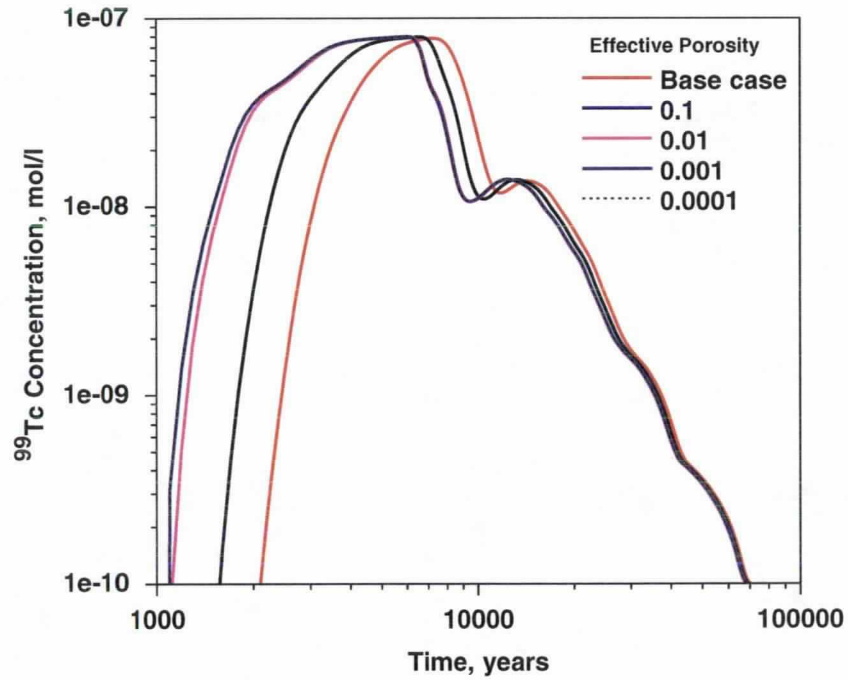
Conclusion: plume trajectory and concentration is a function of where radionuclides enter the saturated zone. The effect is important for 5 km observation points, and maybe also for 20 km observation points.

Saturated Zone Model Sensitivity: Effective Porosity

Generic Breakthrough Curves

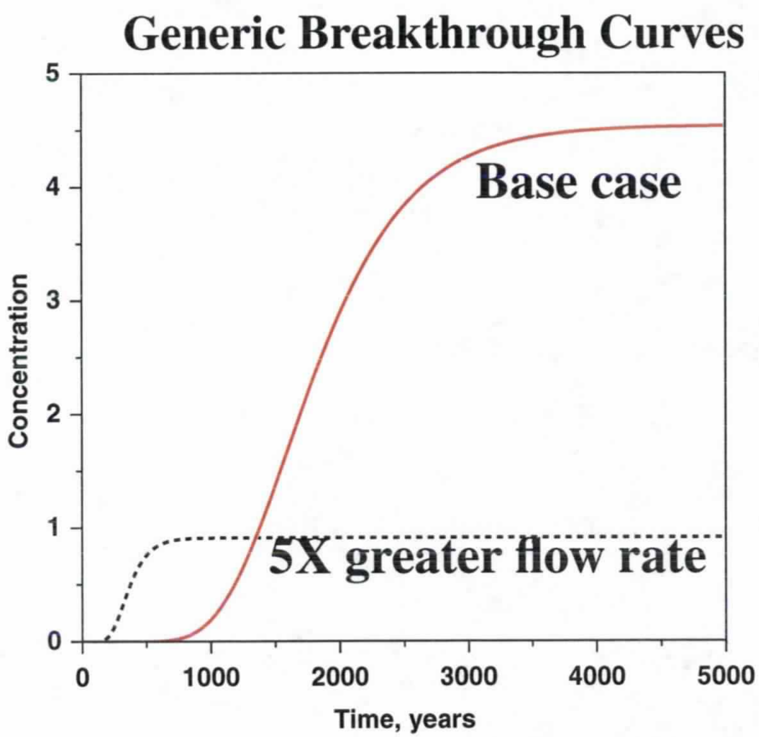


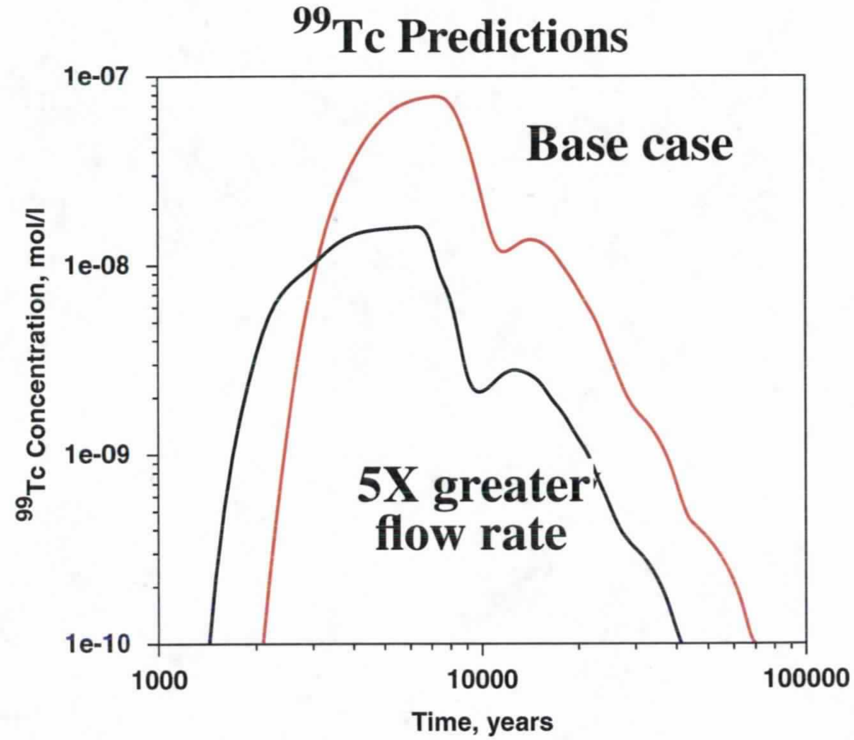
^{99}Tc Predictions



Conclusion: Degree of matrix diffusion can be captured in abstracted form through the use of an effective porosity. It affects arrival times, but not concentrations.

Saturated Zone Model Sensitivity: Fluid Flow Rate

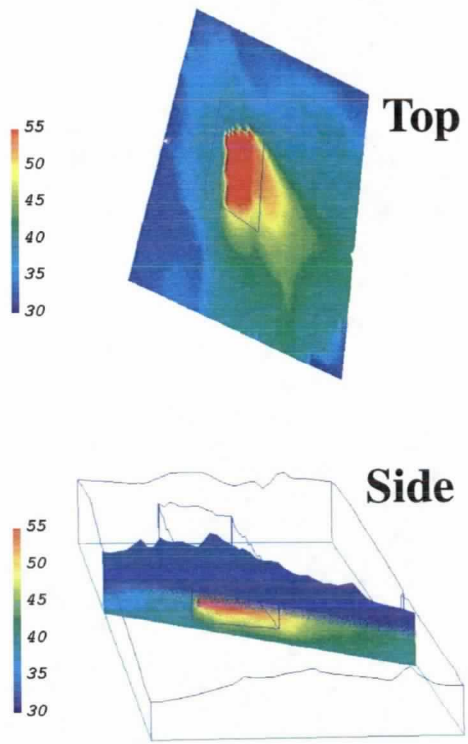




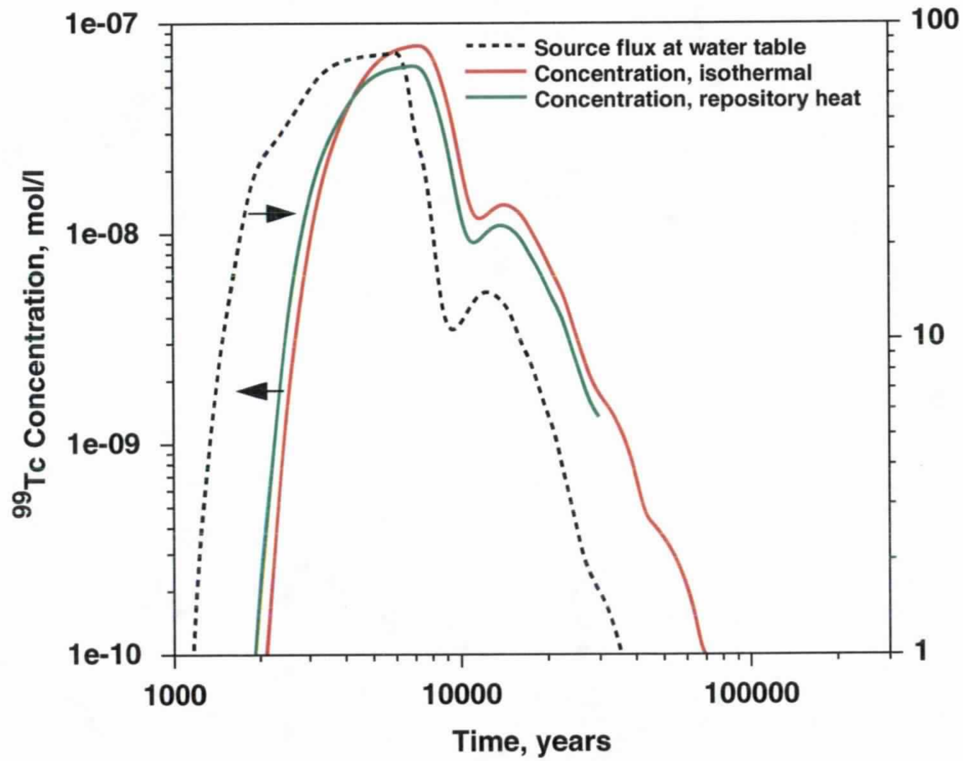
Conclusion: Saturated zone flow velocities impact both the travel time and the amount of dilution predicted.

Saturated Zone Model Sensitivity: Repository Heat

Thermal Plume



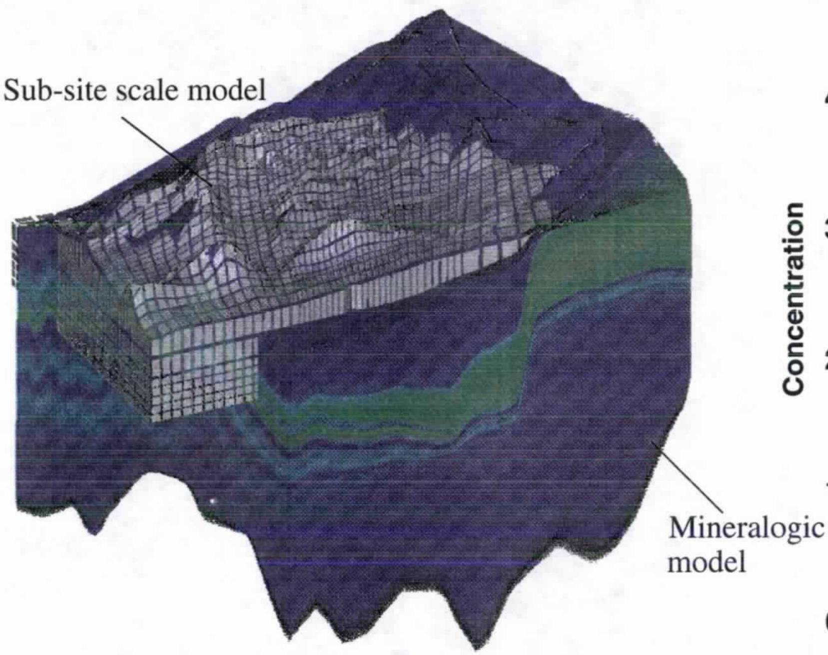
^{99}Tc Concentration: with and without heat



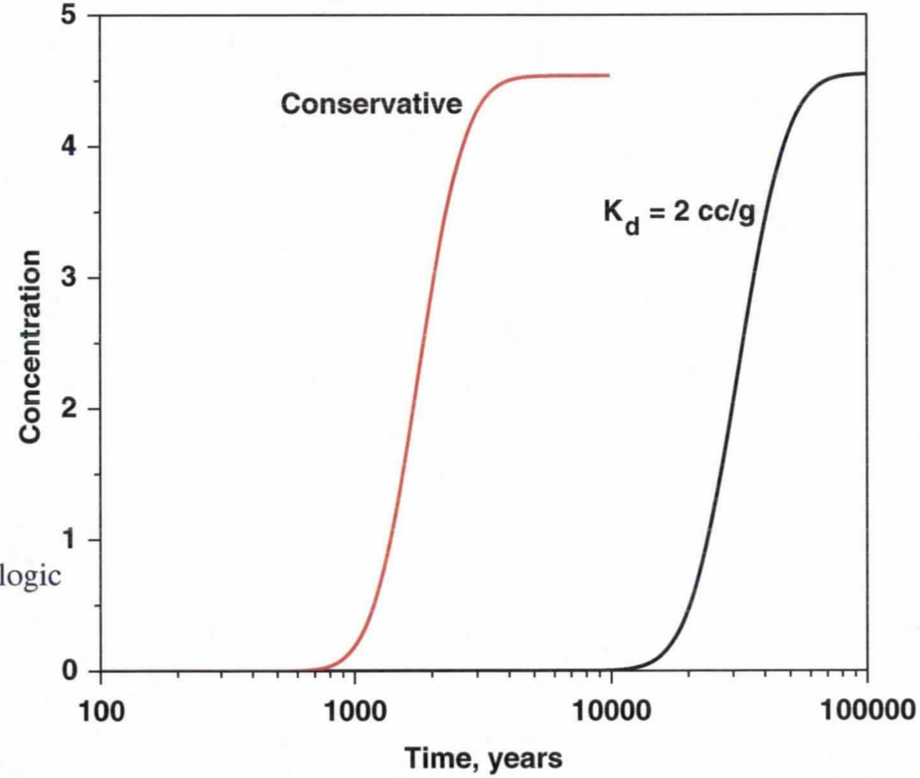
Conclusion: repository heat effects on SZ transport are minor as long as there are no durable changes to the hydrologic properties due to repository heat.

Saturated Zone Model Sensitivity: Sorption

Zeolites in SZ Model

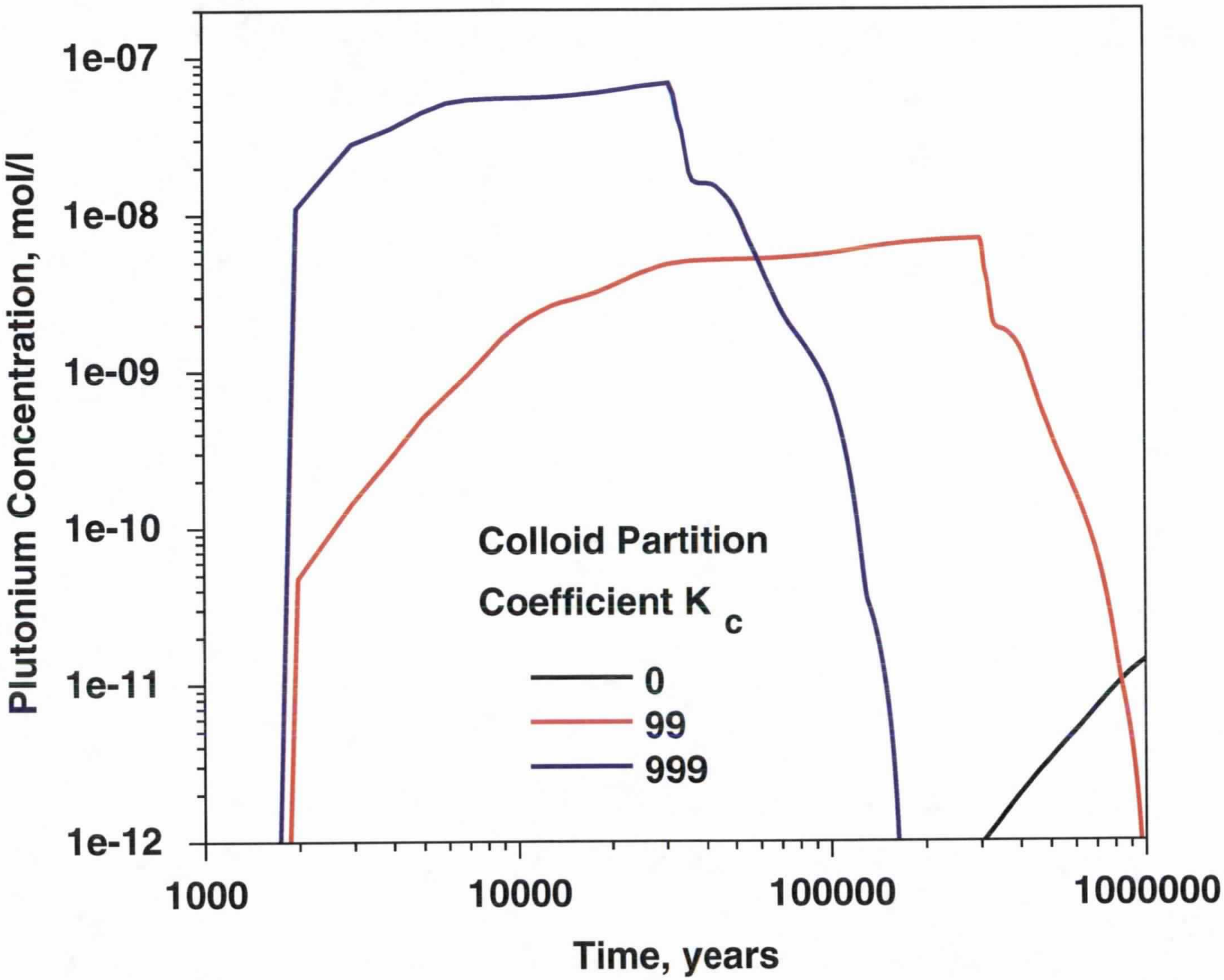


^{237}Np Breakthrough Curve



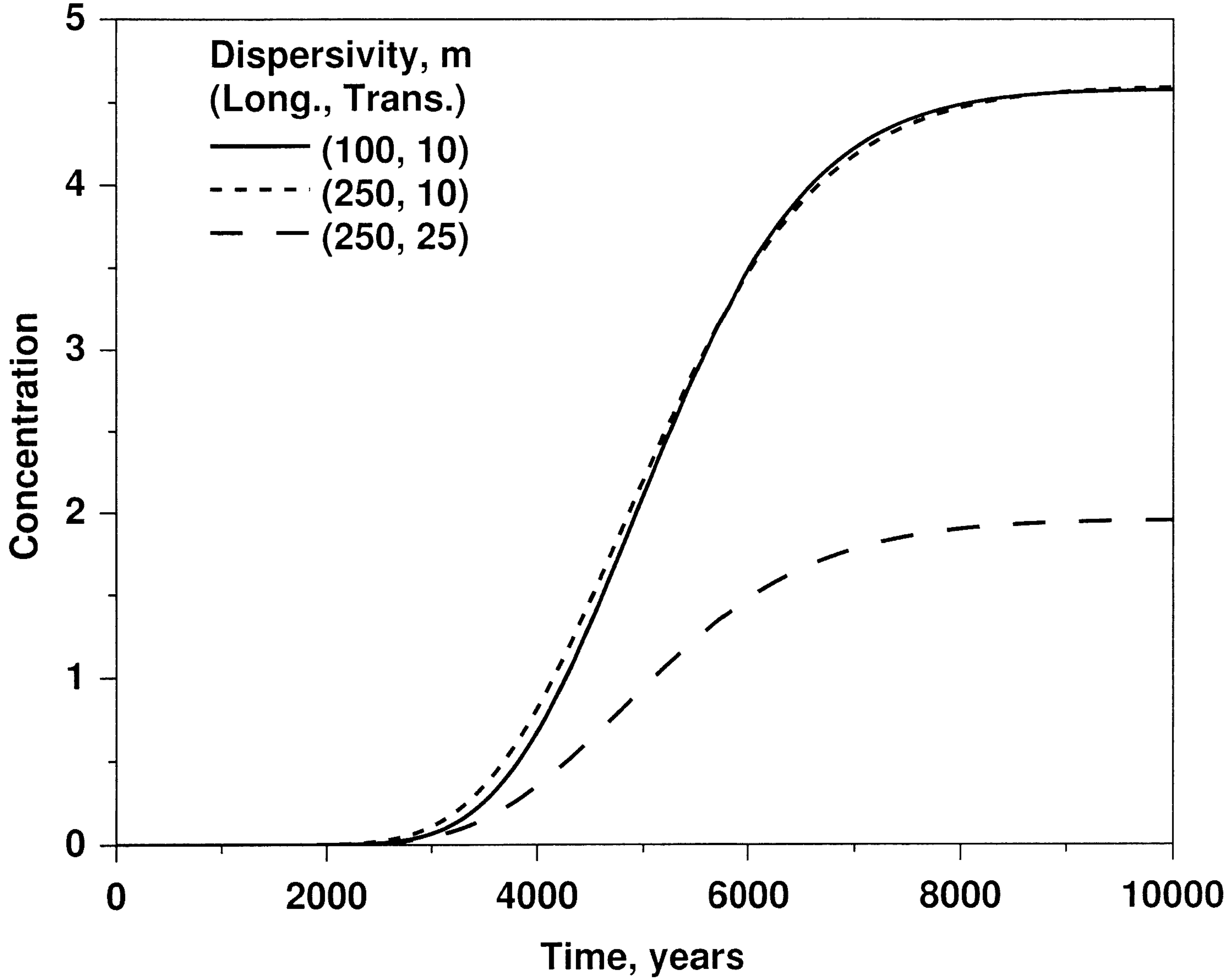
Conclusion: Sorption is a key retardation process in the saturated zone for mobile radionuclides such as ^{237}Np

Possible Effect of Colloids on Plutonium Transport



Uncertainties: colloid partition coefficient, transport parameters

Effect of Dispersivity on Saturated Zone Transport



Future Work

- Combining the sub-site and site scale models
- Constraining the model with hydrochemical data
- Dispersion studies using a heterogeneous model formulation
- Alternate conceptual models for flow - implications for transport
- Development of colloid-facilitated transport model

Conclusions

- **Development of the sub-site and site scale models has allowed for the study of transport processes both near Yucca Mountain and downstream**

- **The key sensitive parameters in the model are effective porosity, dispersivity, sorption coefficient, and colloid model parameters**

  Rock properties at the footprint of the repository have an effect on transport away from Yucca Mountain

  Repository heat effects appear to be minimal in the saturated zone *as long as there are no durable changes in rock properties*