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

NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING

SUBJECT: TOTAL-SYSTEM PERFORMANCE ASSESSMENT EXERCISE (TSPA-91) PROBLEM DEFINITION

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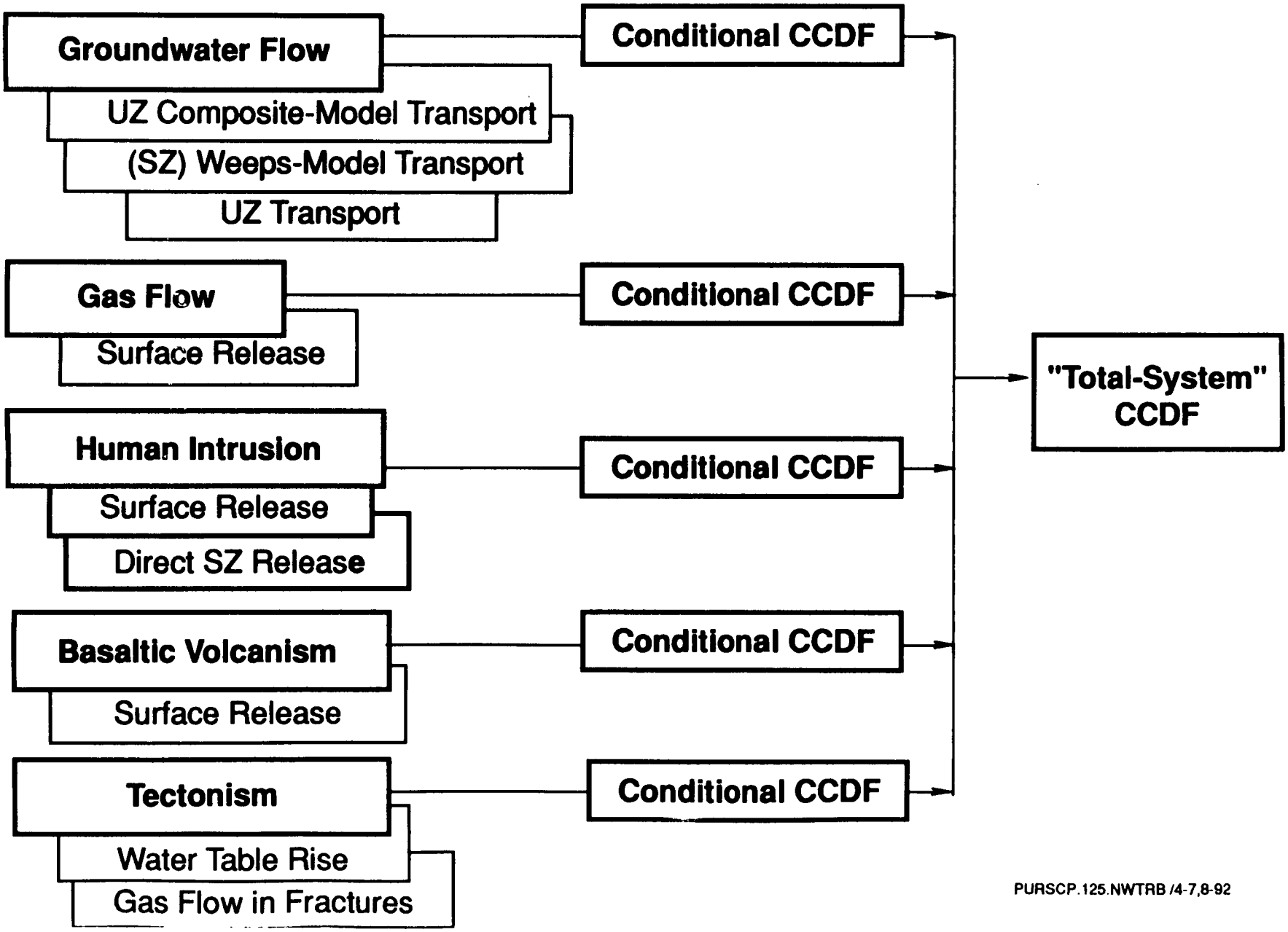
DALLAS, TX
APRIL 7-8, 1992

Outline

- **Scope**
- **PNL/SNL common data set**
- **Retardation**
- **Boundary conditions**

Scope of the Total System Performance Assessment (TSPA)



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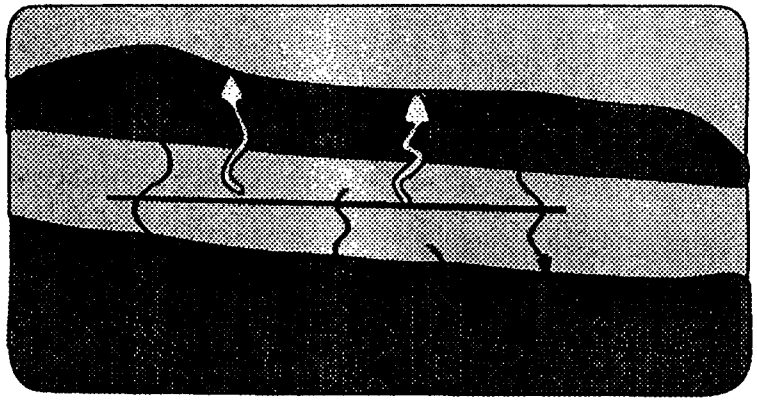
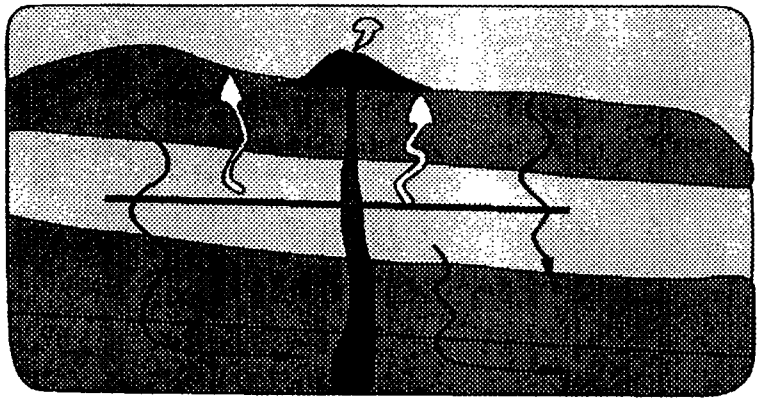
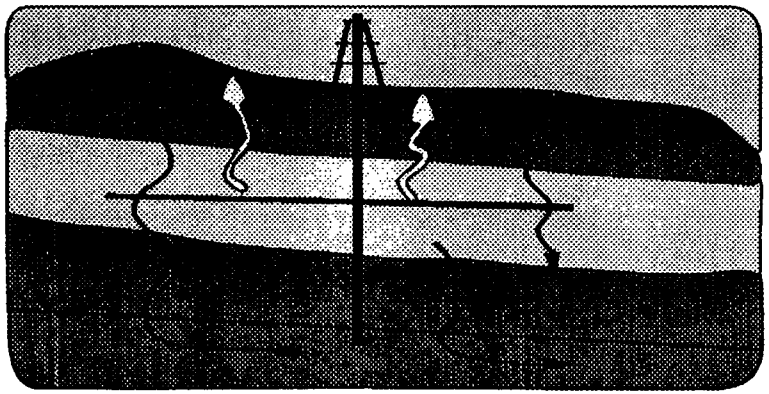
Conditions Modeled for Yucca Mountain



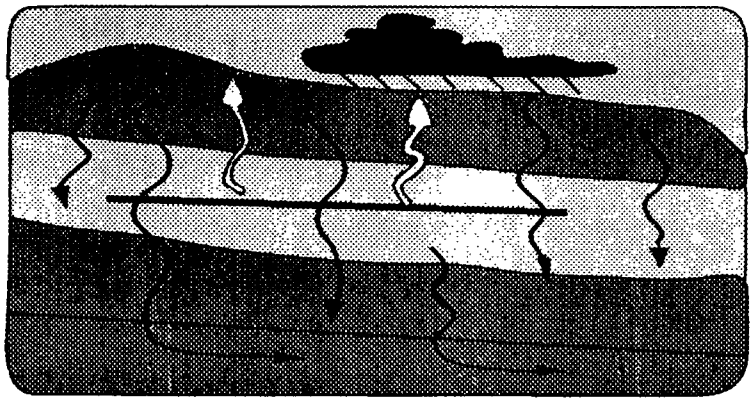
Undisturbed Conditions



Basaltic Volcanism



Human Intrusion



Climate Change

Expansions on Previous Exercises

- More phenomena modeled
- Releases calculated to AE along 2 paths
- More sophisticated source term used
  - Better understanding of water contact modes
  - Computationally simpler
  - Larger suite of nuclides incorporated
- Stochastic simulations performed
- Some sensitivity studies performed
- Results used in dose calculations

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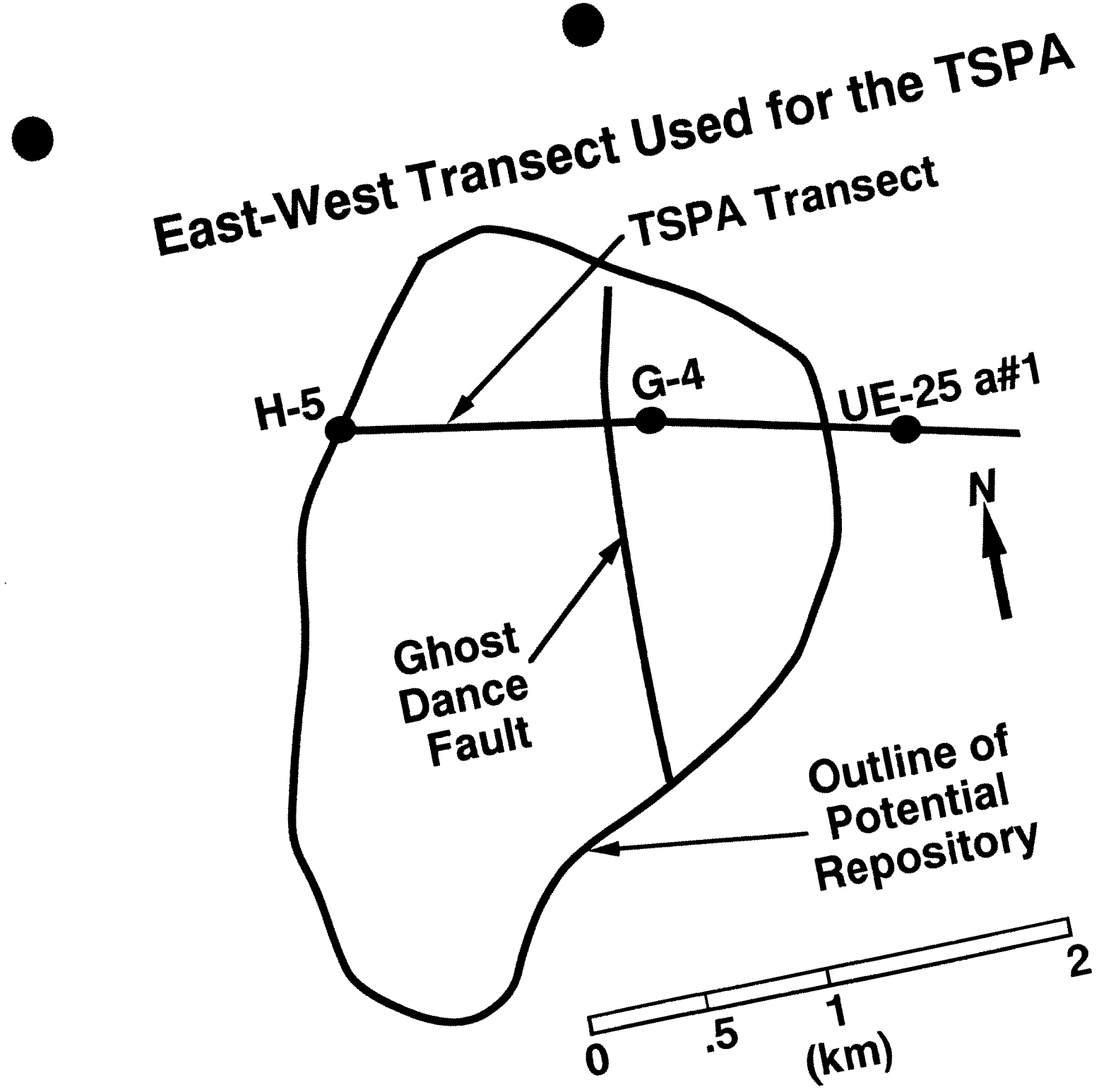
Common Factors

- **SNL and PNL common data:**
  - **Stratigraphic cross section**
  - **Geohydrologic parameters and distributions**
  - **Suite of radionuclides**
  - **Boundary conditions**

Aqueous Flow Problem Domain

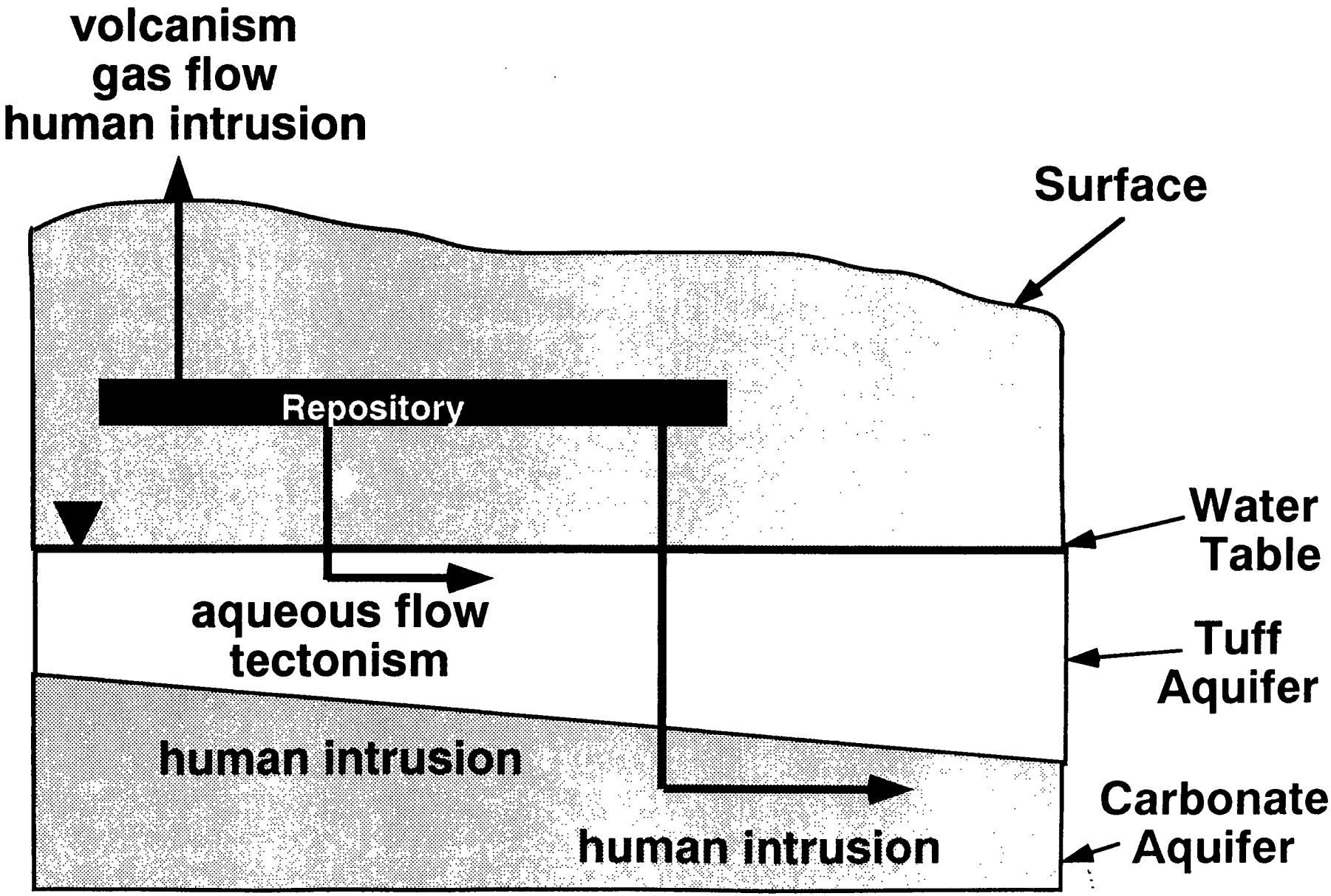
- **Horizontal domain**
  - **UZ modeled from H-5 to 500m east of UE-25a#1**
    - * **Representative of entire repository**
    - * **Area chosen for availability of data**
    - * **Section includes Ghost Dance Fault (14-m offset)**
  - **SZ extends from beneath repository to accessible environment (5km)**


East-West Transect Used for the TSPA
TSPA Transect
H-5
G-4
UE-25 a#1
N
Ghost
Dance
Fault
Outline of
Potential
Repository
0
.5
1
2
(km)

Aqueous Flow Problem Domain

- Vertical Domain
  - Aqueous flow and tectonism
    * Top of repository to water table
  - Human intrusion
    * Surface to saturated zone
  - Volcanism
    * Repository to surface

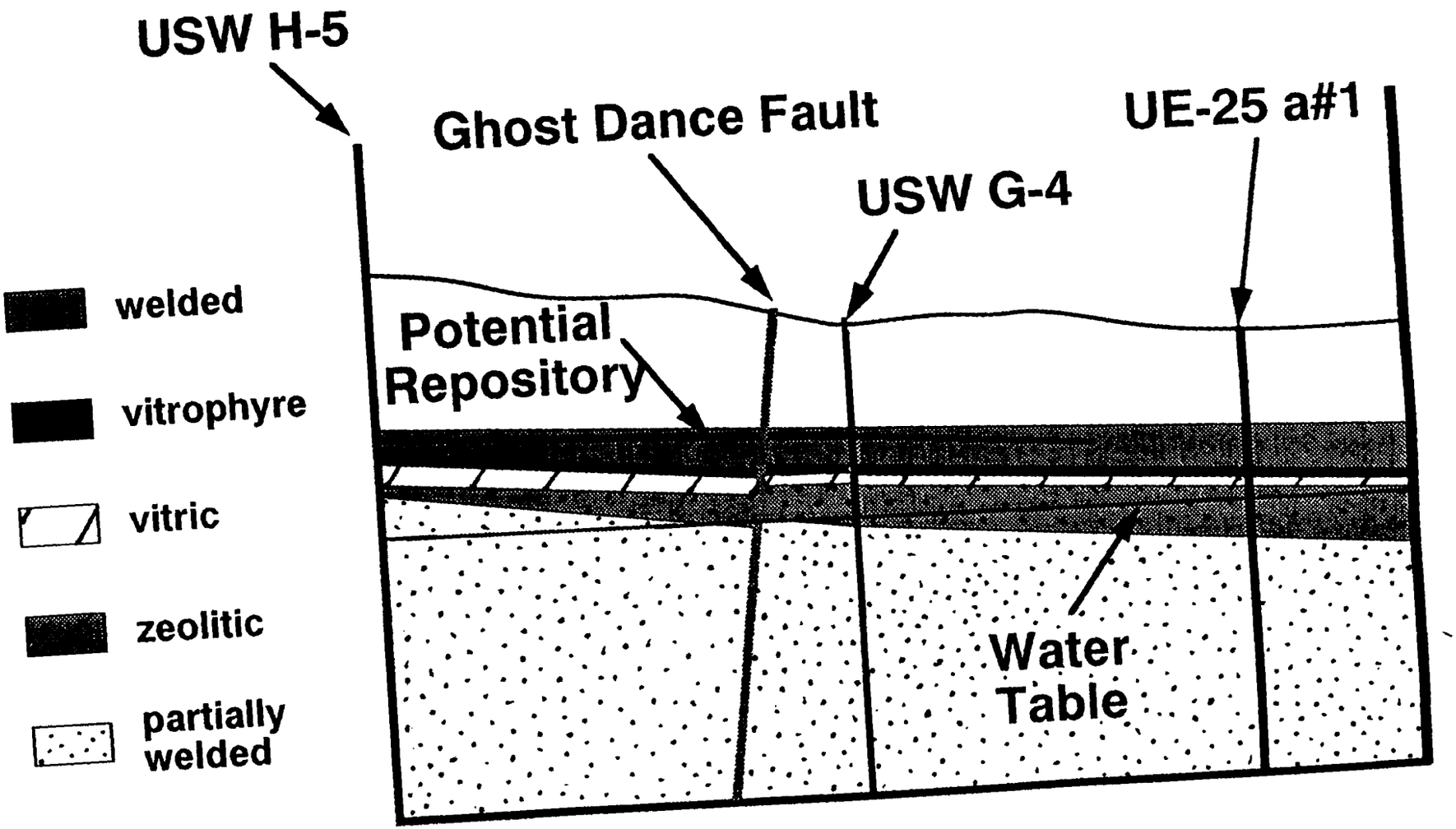
Release Pathways



Stratigraphy

- Unsaturated zone--5 layers
  - Number of layers decreased from PACE
  - Simplified from USGS downhole logs
    * Data from USW H-5, UE25a#1, and USW G-4
    * Multiple units lumped together, based on gross characteristics
- Saturated zone--2 layers
  - "Tuff" aquifer
  - "Carbonate" aquifer

Geologic Cross Section Used for TSPA



Geohydrologic Data Set Development

- Derived from site and analog data
  - Matrix values from Peters et al., PACE, and analog sites (Apache Leap)
  - Fracture properties from Spengler et al., Zimmerman, and Carsel and Parrish
  - Distributions developed for each parameter
- Provided a long-needed tool for this and subsequent analyses

Geologic Data Set Applications

- **Flow and transport calculations:**
  - **SNL**
    - * **Unsaturated aqueous scenarios**
    - * **Saturated aqueous scenarios**
  - **PNL**
    - * **All scenarios**

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Tuff Retardation Coefficients

- Geochemical information interpreted by Meijer (LANL)
  - Rocks subdivided into 3 types: vitric, devitrified, and zeolitic
    * Nuclides with retardation = 0: Tc, I, C
    * Nuclides with retardation = 100: Am, Pu, Sn
    * Nuclides with PDFs: U, Se, Cs, Np
  - Ranges of retardation values established for the range of pH values in J-13 water
    * Oxidizing conditions assumed

Carbonate Retardation Coefficients

- Carbonate-aquifer retardation values based on data from Waste Isolation Pilot Project (WIPP) (Culebra Dolomite)
  - Matrix values only
  - Water chemistry
    * Oxidizing conditions assumed
    * Chlorides assumed to have no effect on K_ds
  - PDFs for all nuclides except for Tc, I, and C

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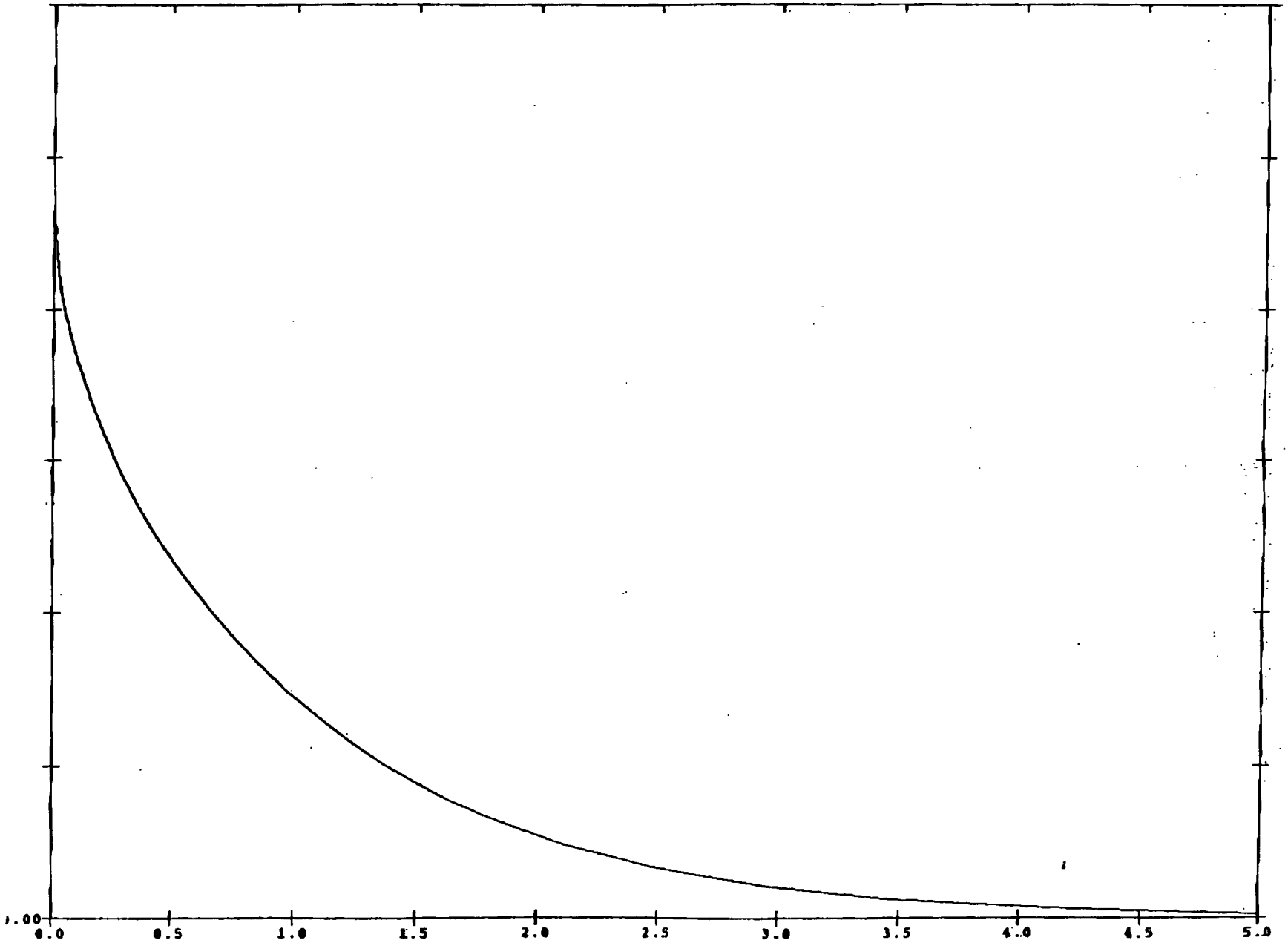
Boundary Conditions

- Lateral boundaries--no flow for 2D
- Run from initial saturation and flux to steady-state for specified percolation
- Range for flux at the repository horizon = 0.0 - 39.0mm/yr
  - Range of values allows for climate change
  - Range ensures some calculations exceed threshold for fracture-dominated flow
  - Shape of distribution weighted to low flux values

Distribution of Percolation Fluxes at Repository



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