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NEAR-FIELD DRIPPING AND THERMAL MODELS

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Total System Performance Assessments for Yucca Mountain

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IMPORTANCE TO PERFORMANCE ASSESSMENT

- **Differences in the Amount of Seepage Into the Emplacement Drifts and Onto WPs Lead to Calculated Radionuclide Releases That Vary by Several Orders of Magnitude.**
- **Seepage Into Drifts and Onto WPs Is a Complex Process With Large Uncertainties. Both DOE and NRC Performance Assessments Use a Much Simplified Approach to Seepage Abstraction. Given the Large Uncertainties It Is Desirable to Err on the Conservative Side.**

CONCERNS

- Data Needed to Characterize Heterogeneity Have Not Been Collected in the Main Repository Block
- Existing Models Do Not Capture the Scales of Variability
- Degradation of Emplacement Drifts Is Neglected
- Several Thousands of Years of WP Performance Are Gained by Assuming No Dripping Occurs During the Thermal Period

OUTLINE

- Seepage Into Drifts Process Model
  - Model scales and fracture properties
  - Drift degradation
- Thermal Abstraction
  - Neglecting seepage during thermal period

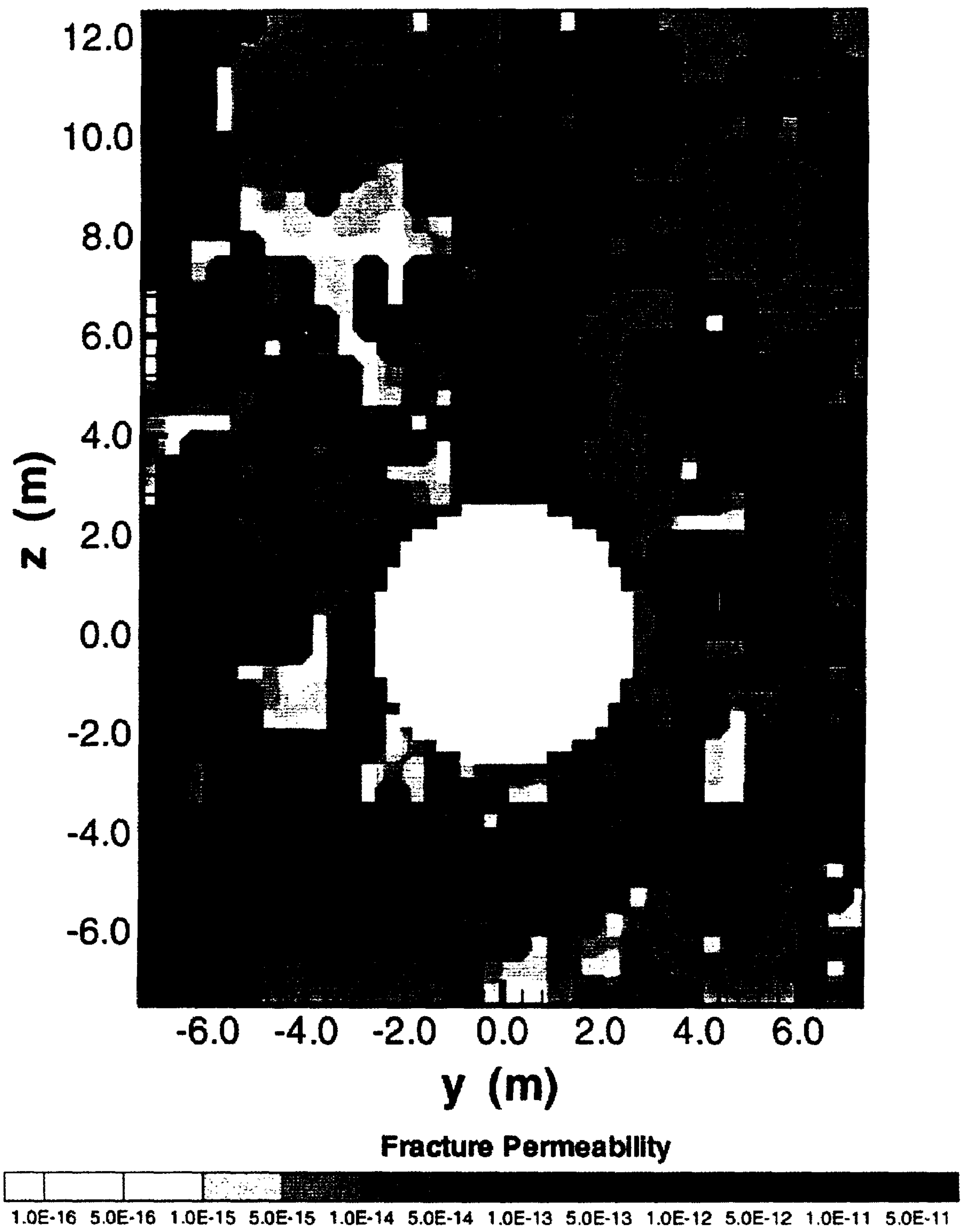


Figure 2-58b. Simulated Heterogeneous-Permeability Field for Vertical Slice 2 of the 3-D Block

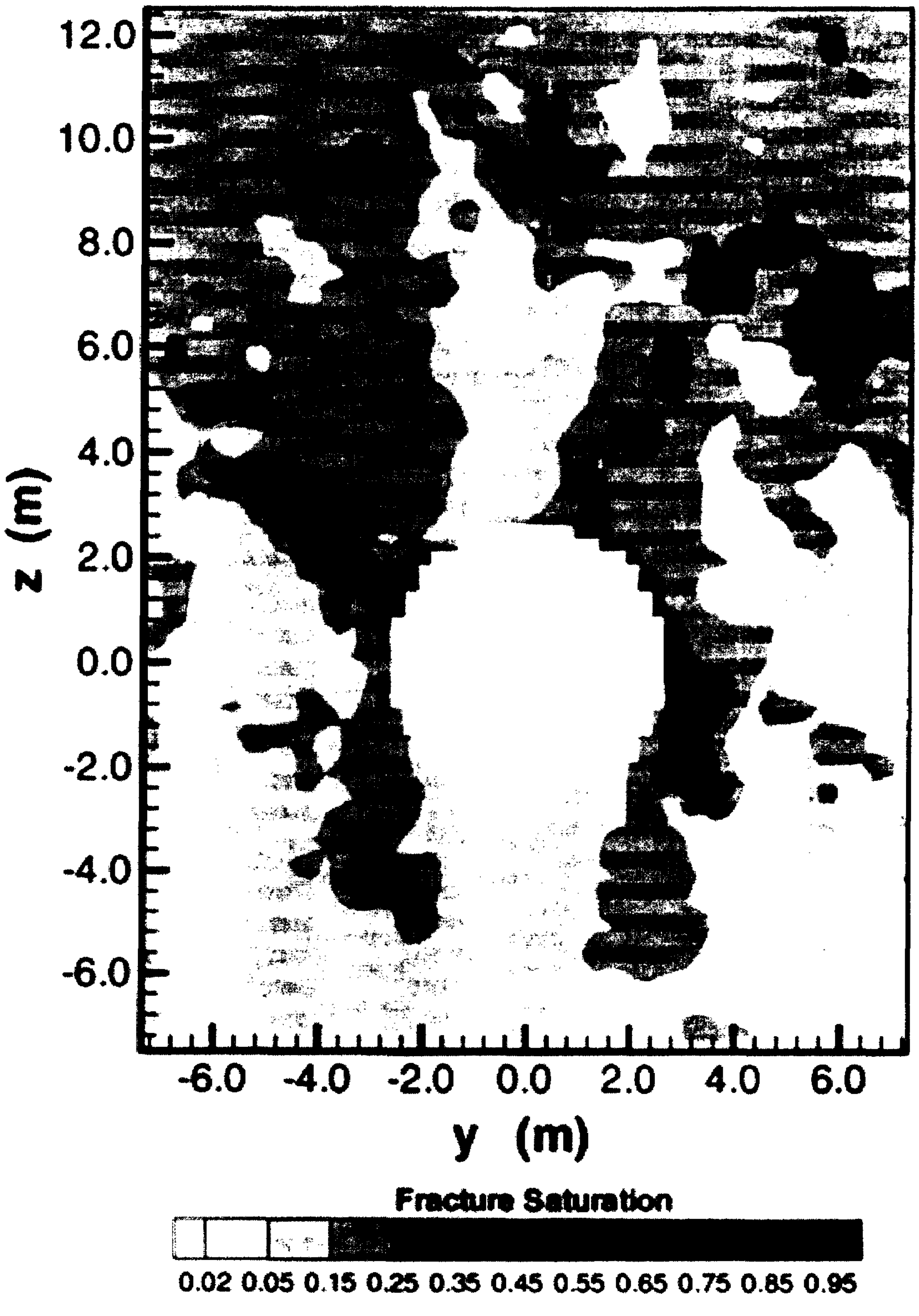
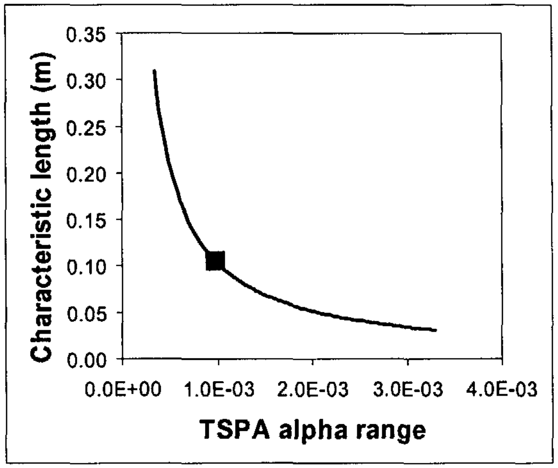


Figure 2-71a. Calculated Saturation Profiles in Fracture Continuum on Slice 1 of the 3-D Block at $t = t_p$ = 1 Year

BASE CASE PARAMETERS AND PHYSICAL INTERPRETATION



Fracture Permeability
$k_s = 10^{-14}, 10^{-13}, 10^{-12}$ m^2

Fracture Alpha Parameter
$\alpha = 3.3E\text{-}4, 9.7E\text{-}4, 3.3E\text{-}3$ Pa^{-1}

pore size distribution

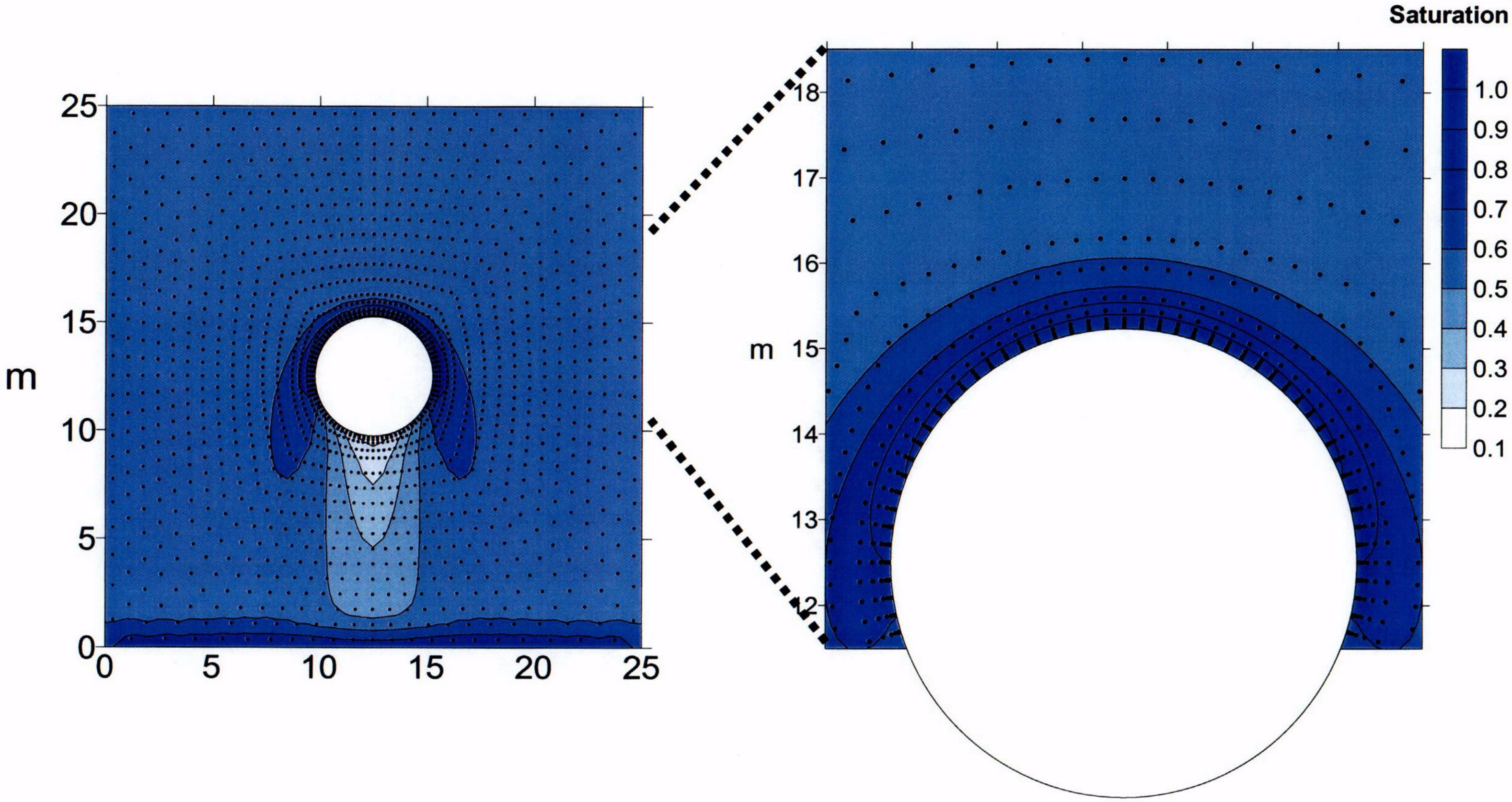
Threshold Percolation Flux

$$q^* = \frac{k_s}{\vartheta}$$

ϑ Is Dimensionless Potential, a Function of α and Drift Radius

BOUNDARY LAYER FORMED WITH MEDIAN

$\alpha = 9.7 \times 10^{-4}$ Pa^{-1}



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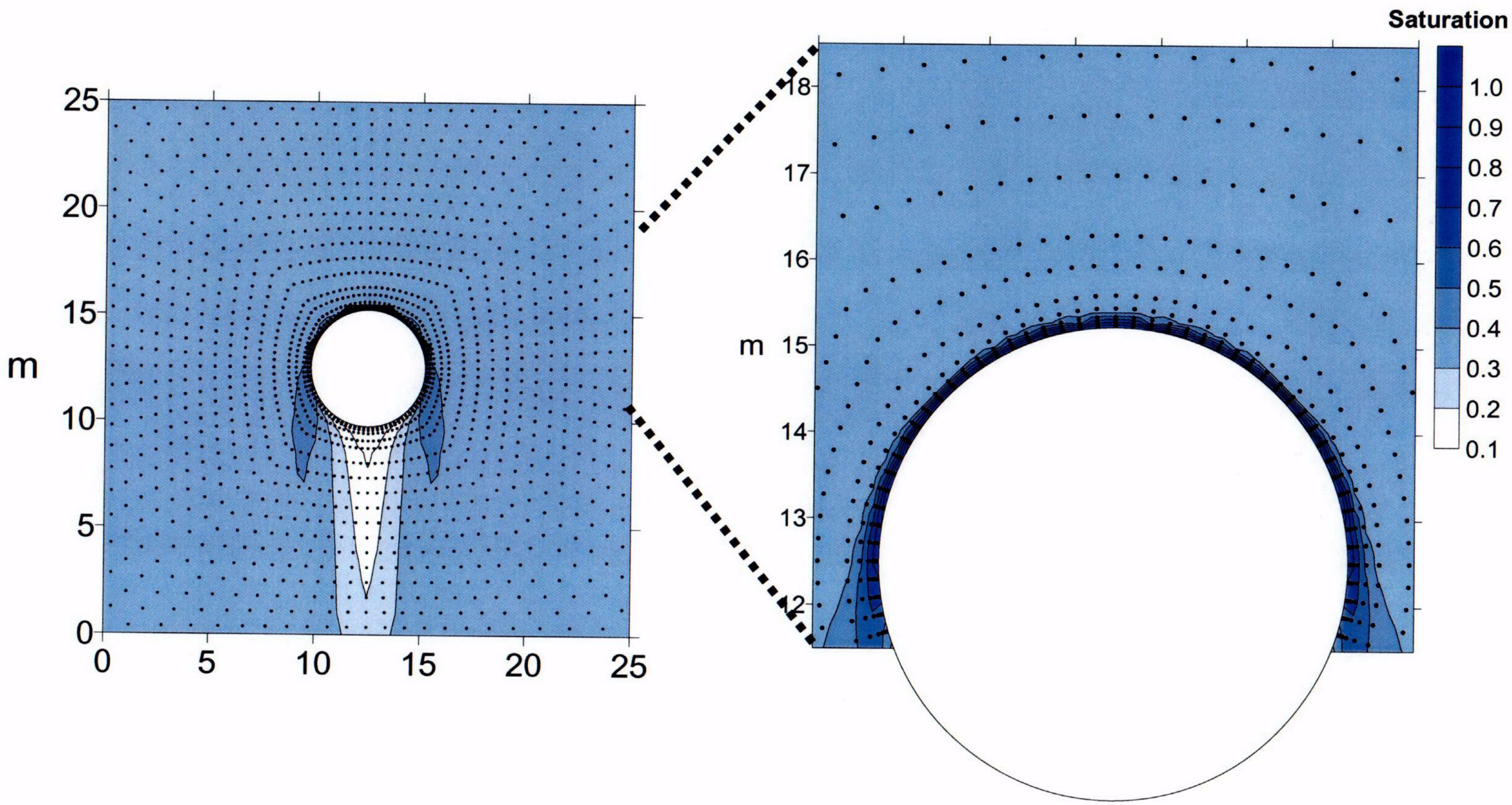
BOUNDARY LAYER FORMED WITH MAXIMUM

$\alpha = 3.3 \times 10^{-3}\ Pa^{-1}$



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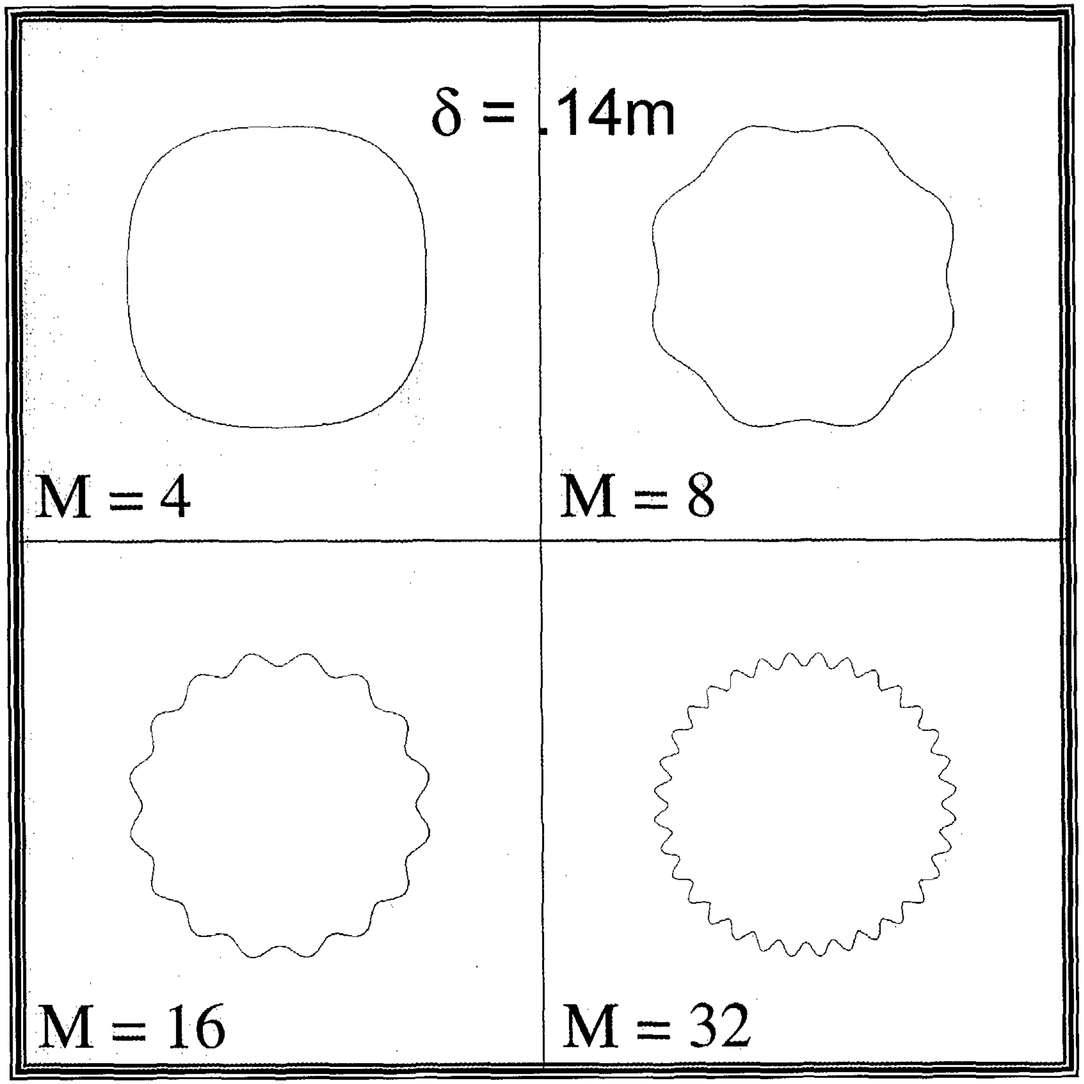
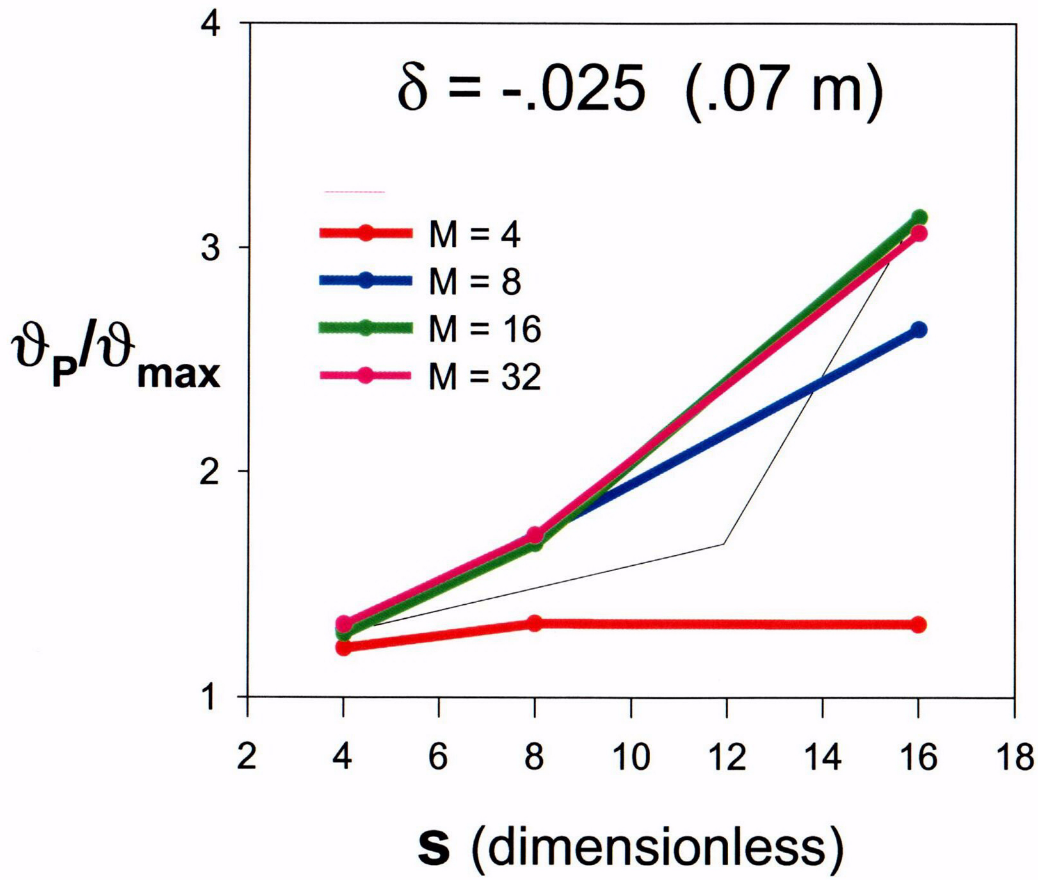
COMMENTS ON SCALE AND HETEROGENEITY

- Model Scales and Fracture Properties
  - Heterogeneity in the alpha parameter within the boundary layer may be important
- Drift Degradation and Wall Irregularity: What Happens If the Boundary Layer Shape Is Perturbed?

MODEL SHAPES FOR DRIFT DEGRADATION



FACTOR BY WHICH THRESHOLD PERCOLATION FLUX IS DECREASED



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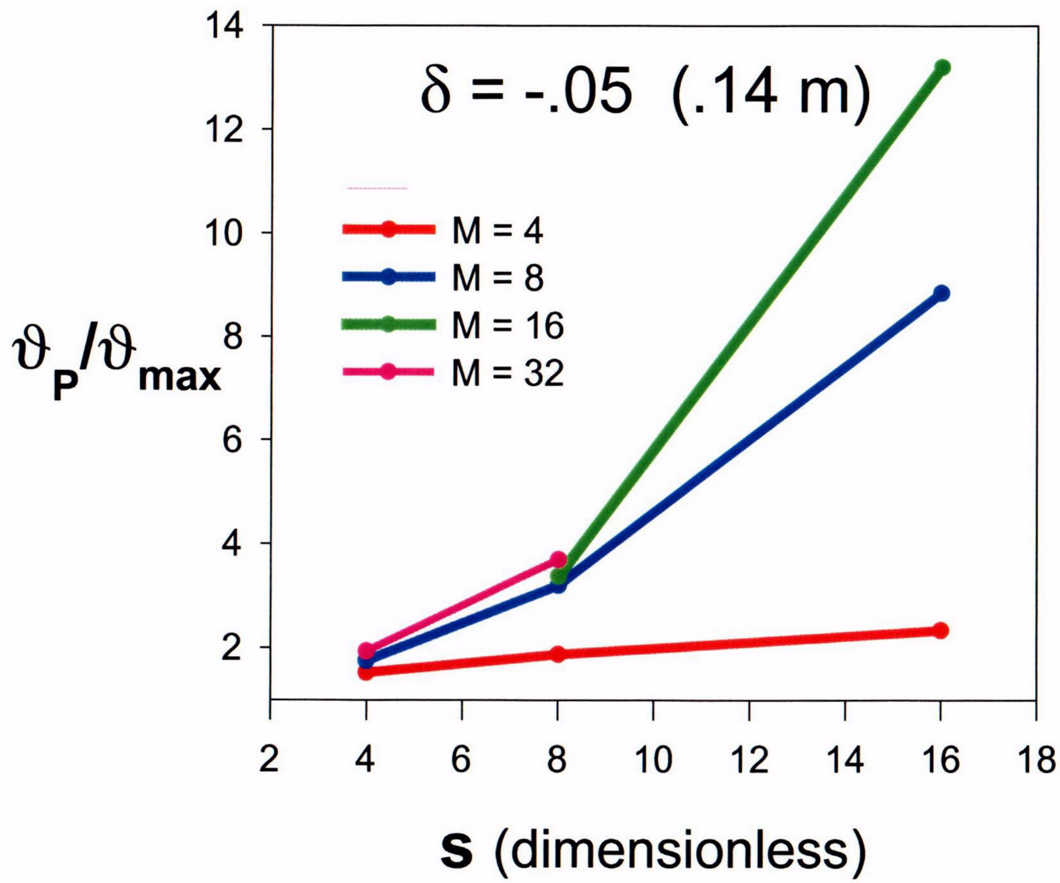
FACTOR BY WHICH THRESHOLD PERCOLATION FLUX IS DECREASED



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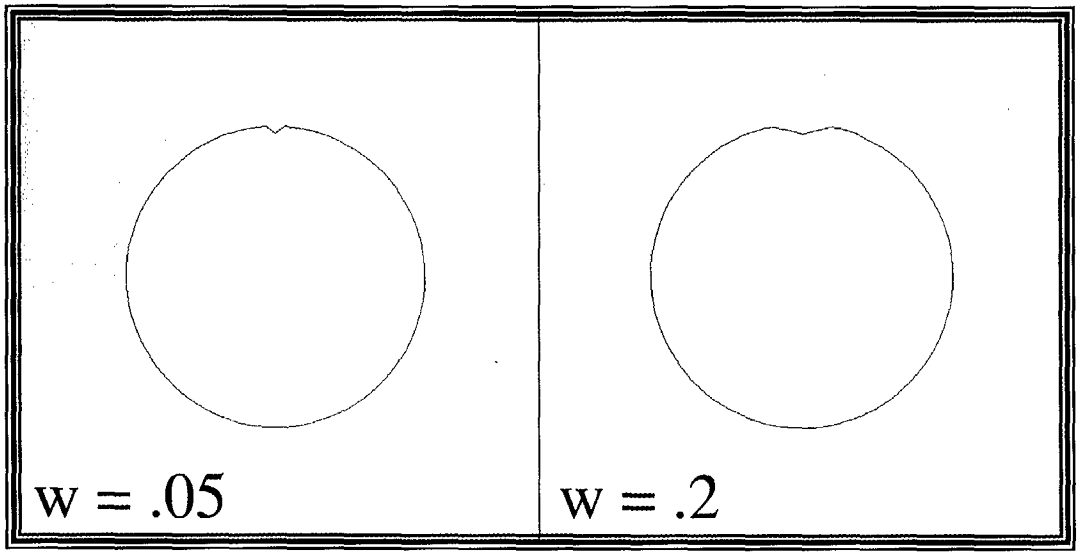
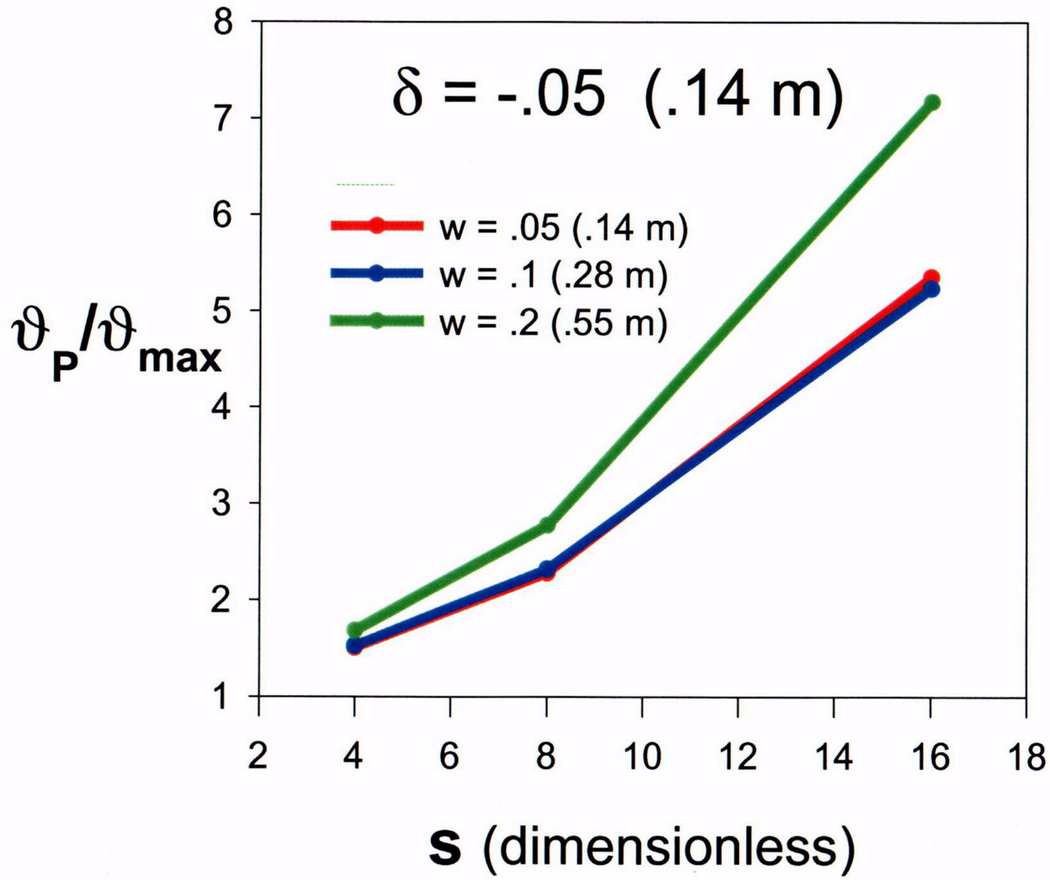
MODEL SHAPES FOR DRIFT DEGRADATION

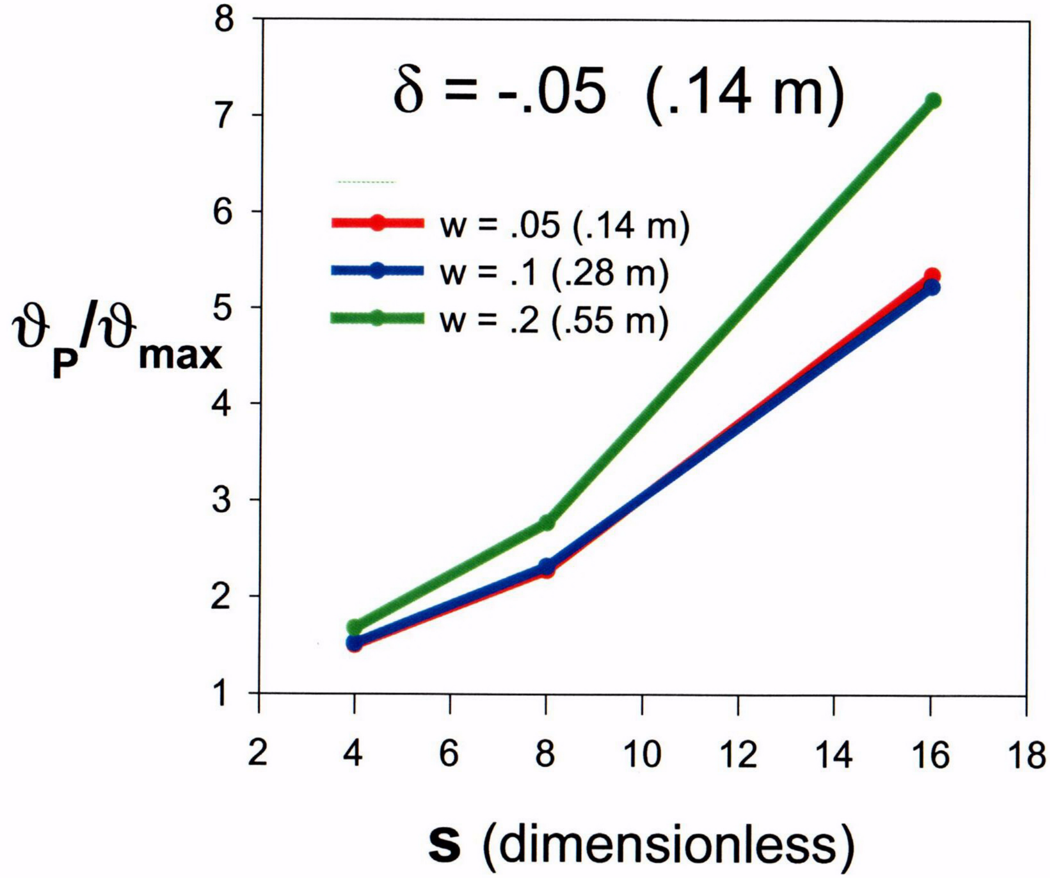
$\delta = .14\text{m}$



FACTOR BY WHICH THRESHOLD PERCOLATION FLUX IS DECREASED



FACTOR BY WHICH THRESHOLD PERCOLATION FLUX IS DECREASED



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COMMENTS ON DRIFT DEGRADATION

Irregularities in the Range of 15 cm Can Result in Order of Magnitude Decreases in Threshold Percolation Flux for s Less Than 16. Note the Dramatic Increase in This Reduction Factor With Increasing s. Larger s Corresponds to the Larger α, (i.e., smaller characteristic length scale, representative of the larger vertical fractures.)

THERMAL-HYDROLOGICAL CONCERNS IN TSPA-VA

- TH Processes on Seepage Are Required for the Entire Repository Performance Period. TH Driven Flow Cannot Be Neglected for the Initial 5,000 years After Waste Emplacement
- Penetration of the Boiling Isotherm by Flow Down a Fracture Is Omitted. The Assumption That Water Will Not Contact the WP Until WP Temperature Decreases Below Boiling Is Not Conservative.

SUPPORTING TECHNICAL BASIS

- Theoretical Analysis, O.M Phillips
- Numerical Simulations, K. Pruess
- Laboratory Scale Heater Experiments, R. Green.
- Field Scale Observations in the G-tunnnel at Climax