Chuck Carrigan
LLNL
Attachment 11

UCRL-ID-105340

A Scoping Study of Water Table Excursions Induced by Seismic and Volcanic Events

Charles R. Carrigan
Geoffrey C.P. King
George E. Barr

November 1990

Lawrence Livermore National Laboratory

This is an informal report intended primarily for internal or limited external distribution. The opinions and conclusions stated are those of the author and may or may not be those of the Laboratory.

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9103280162 910319
PDR WASTE
WM-11 PDR

Fig. 2

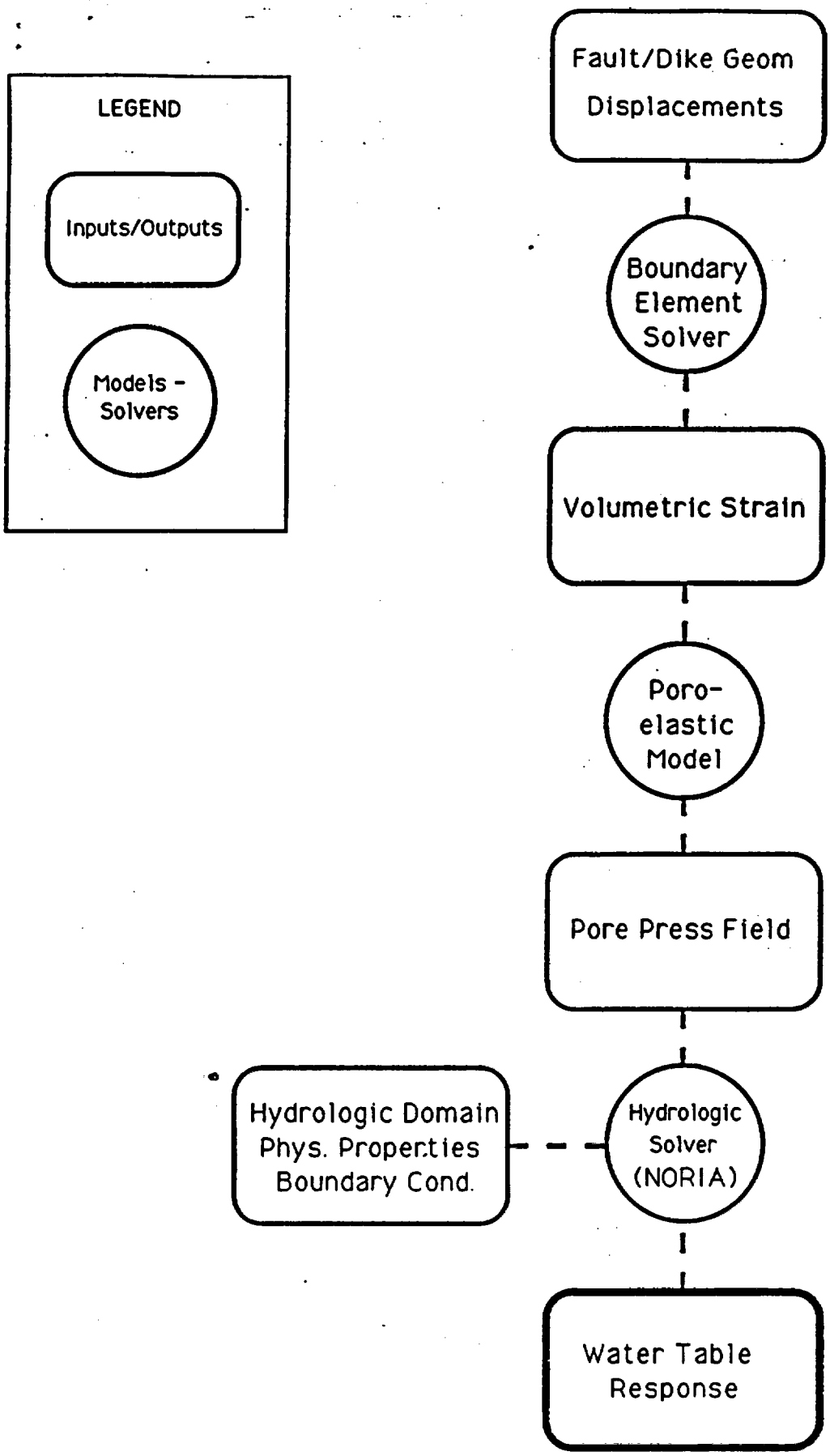

LEGEND
Inputs/Outputs
Models - Solvers
Fault/Dike Geom Displacements
Boundary Element Solver
Volumetric Strain
Poro-elastic Model
Pore Press Field
Hydrologic Domain Phys. Properties Boundary Cond.
Hydrologic Solver (NORIA)
Water Table Response

Fig. 4

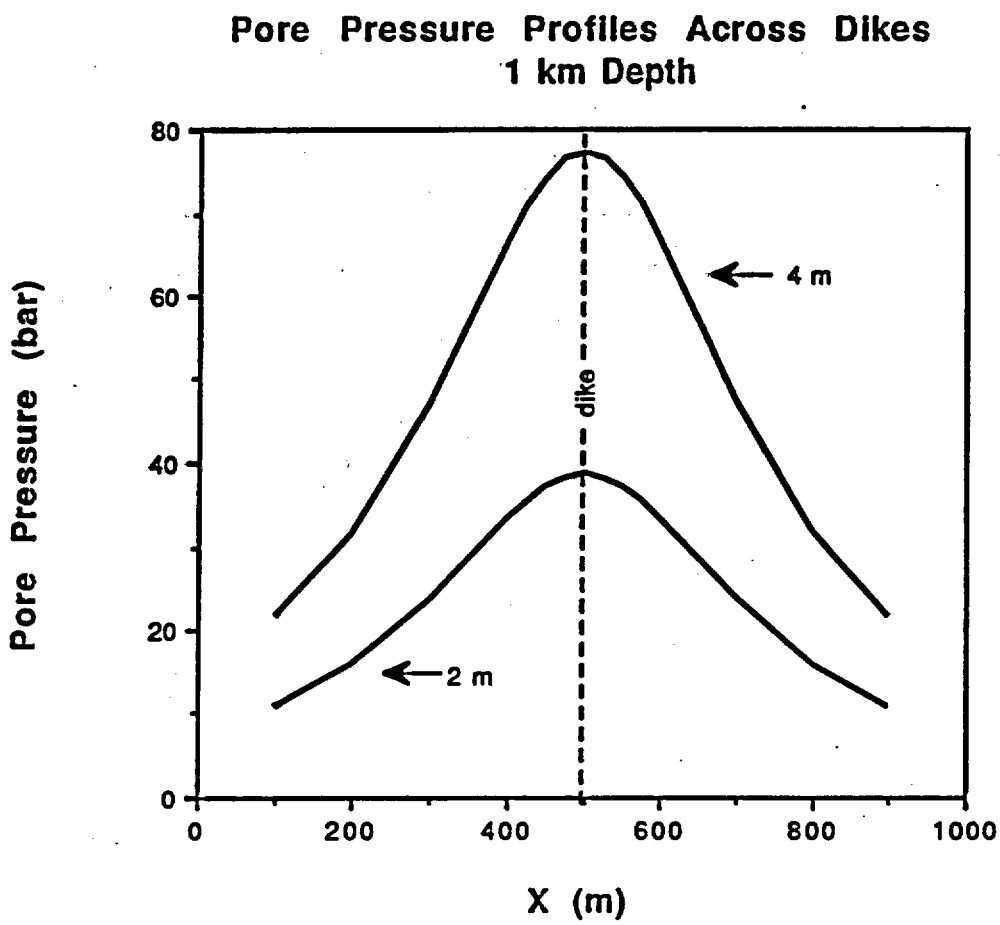
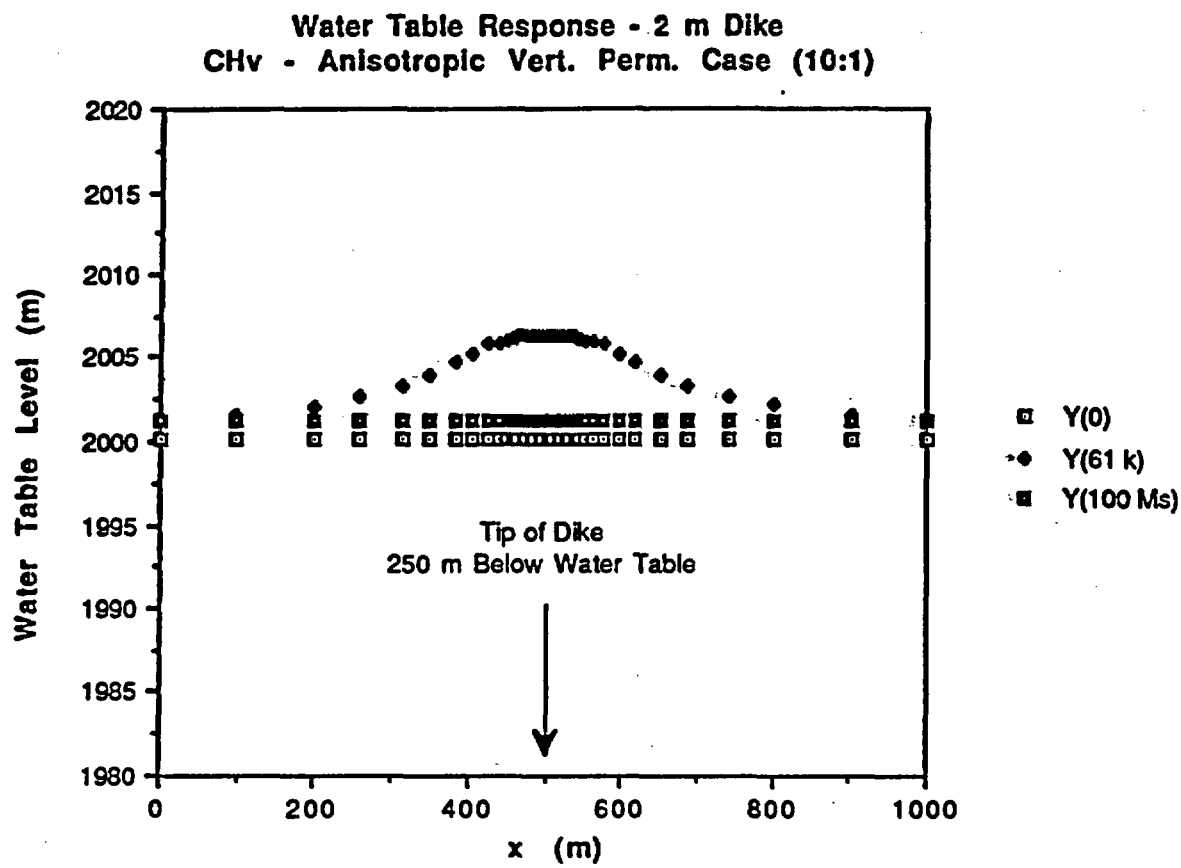

Pore Pressure Profiles Across Dikes
1 km Depth
Pore Pressure (bar)
80
60
40
20
0
0
200
400
600
800
1000
X (m)
dike
4 m
2 m

Fig. 6



Obtained with 100 m grid over vadose zone

Fig. 8

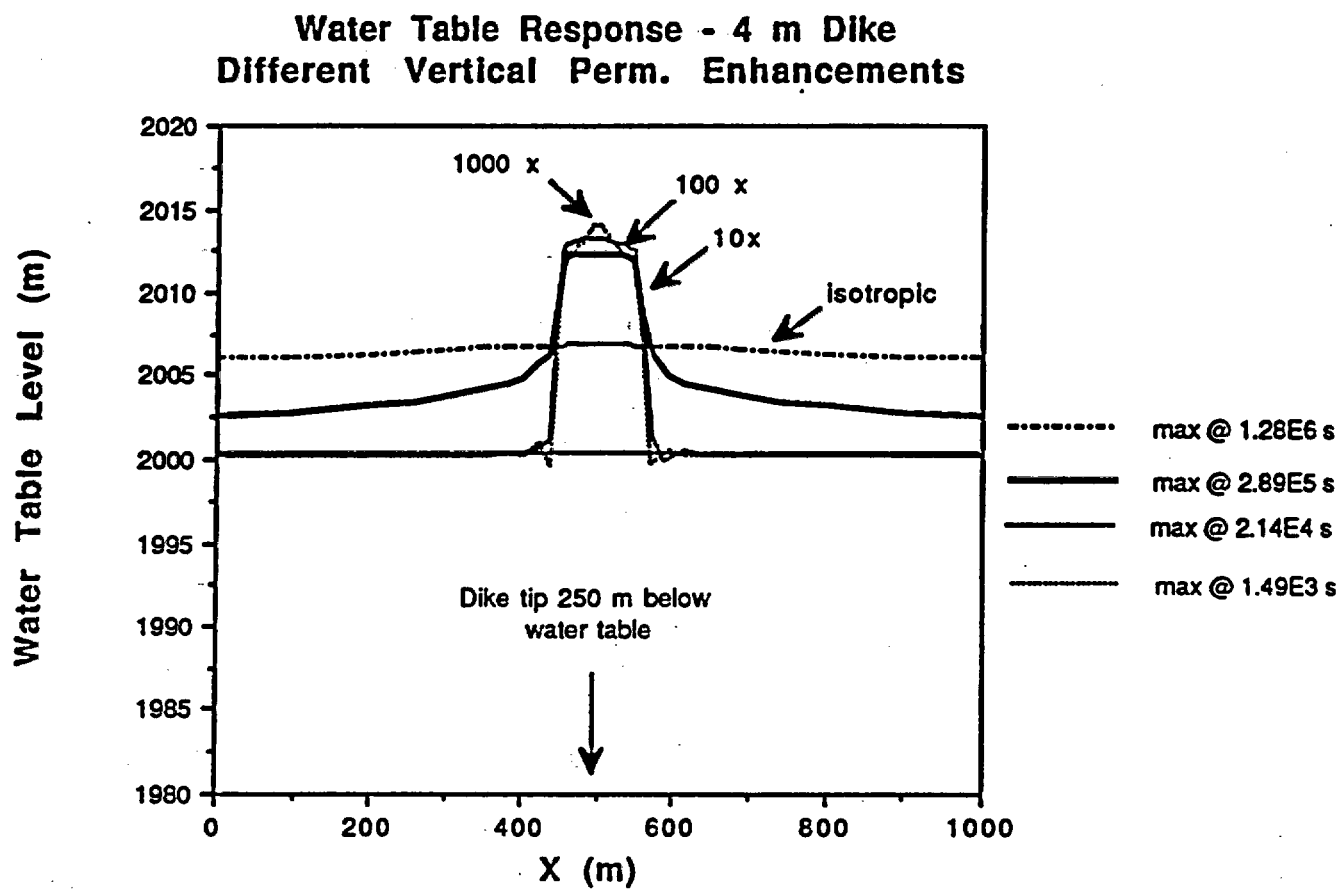

Water Table Response - 4 m Dike
Different Vertical Perm. Enhancements
Water Table Level (m)
2020
2015
2010
2005
2000
1995
1990
1985
1980
0
200
400
600
800
1000
X (m)
1000 x
100 x
10x
isotropic
Dike tip 250 m below
water table
max @ 1.28E6 s
max @ 2.89E5 s
max @ 2.14E4 s
max @ 1.49E3 s

Fig. 10

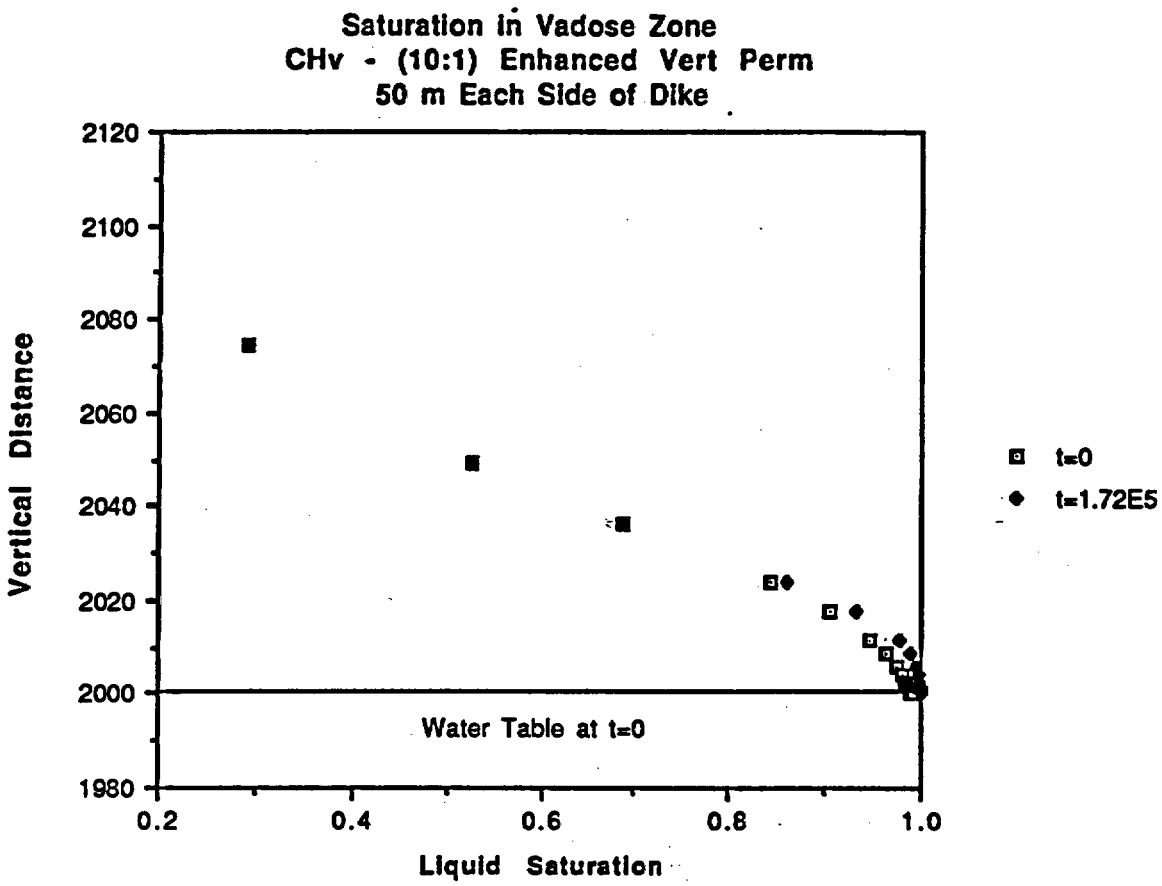

Saturation in Vadose Zone
CHv - (10:1) Enhanced Vert Perm
50 m Each Side of Dike
Vertical Distance
2120
2100
2080
2060
2040
2020
2000
1980
0.2
0.4
0.6
0.8
1.0
Liquid Saturation
Water Table at t=0
t=0
t=1.72E5

Fig. 12

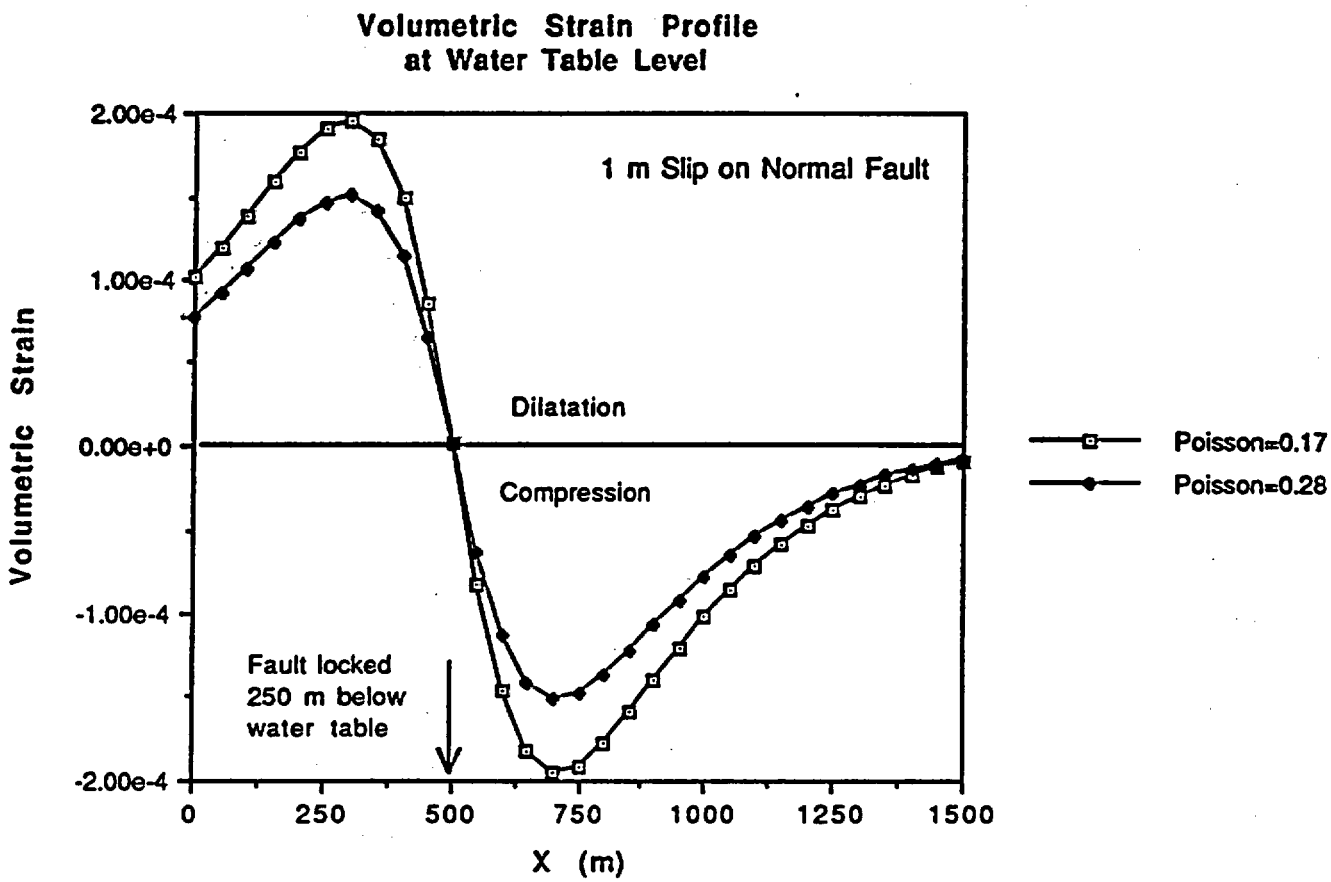

Volumetric Strain Profile
at Water Table Level
1 m Slip on Normal Fault
Dilatation
Compression
Fault locked
250 m below
water table
Volumetric Strain
2.00e-4
1.00e-4
0.00e+0
-1.00e-4
-2.00e-4
0
250
500
750
1000
1250
1500
X (m)
Poisson=0.17
Poisson=0.28

Fig. 14

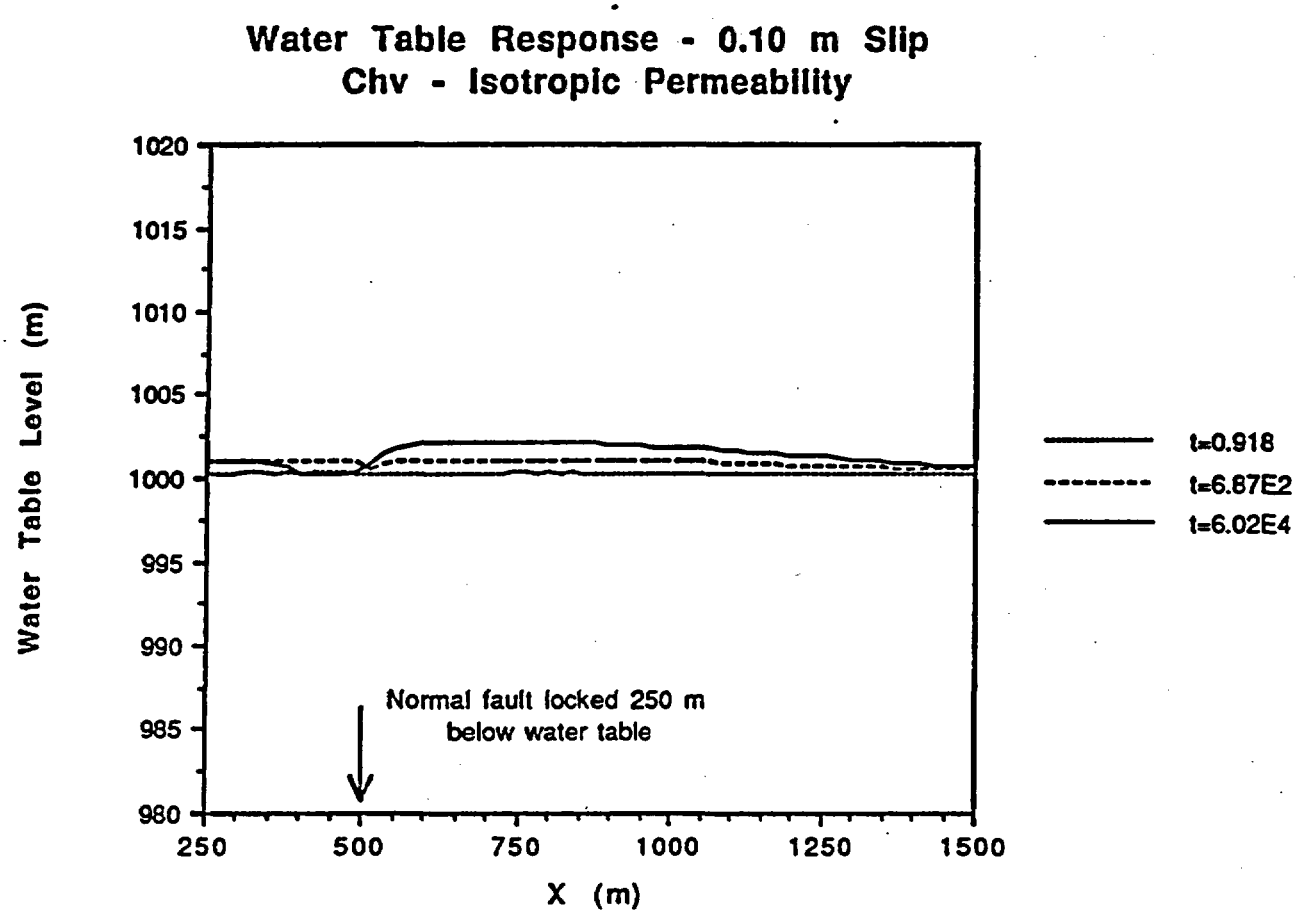

Water Table Response - 0.10 m Slip
Chv - Isotropic Permeability
Water Table Level (m)
1020
1015
1010
1005
1000
995
990
985
980
250
500
750
1000
1250
1500
X (m)
Normal fault locked 250 m
below water table
t=0.918
t=6.87E2
t=6.02E4

Fig. 16

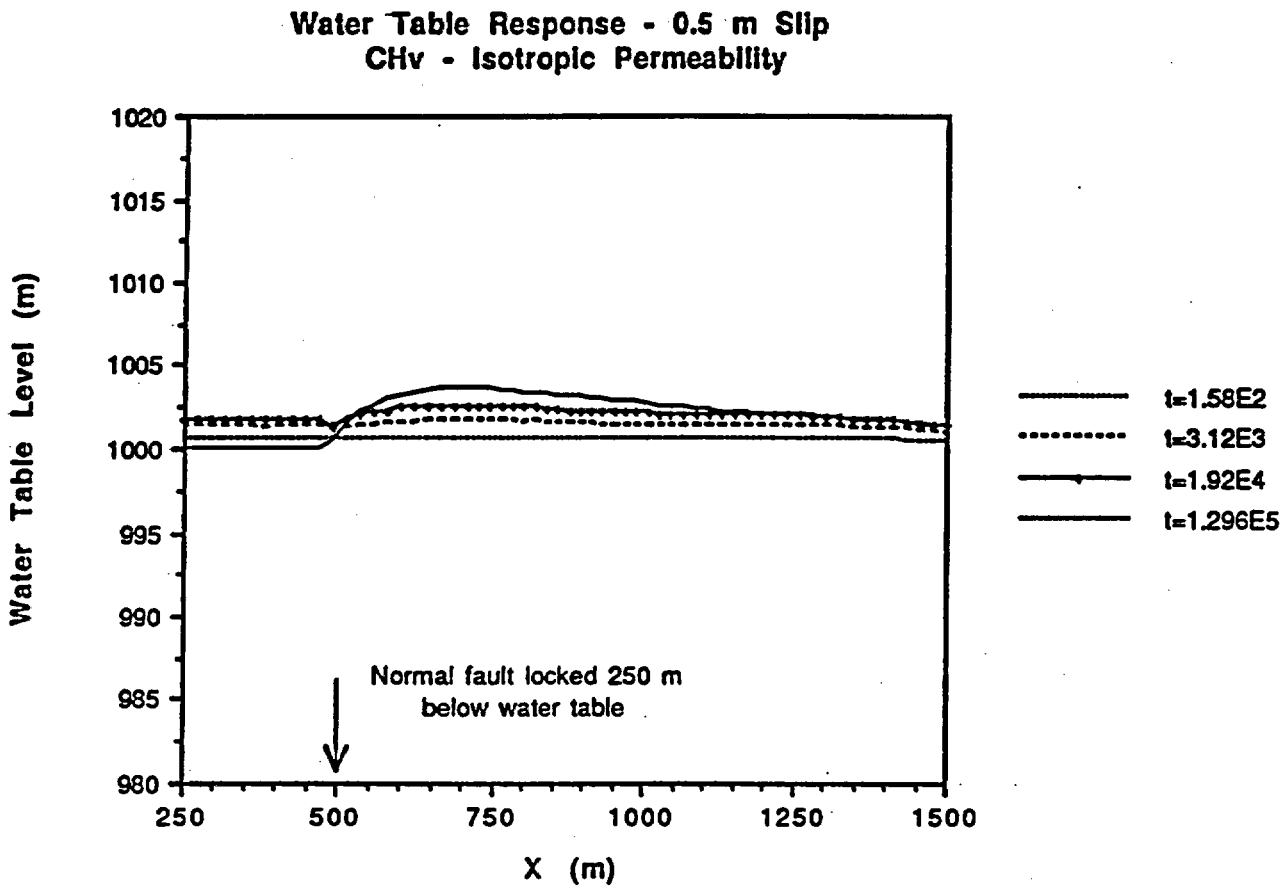

Water Table Response - 0.5 m Slip
CHv - Isotropic Permeability
Water Table Level (m)
1020
1015
1010
1005
1000
995
990
985
980
250
500
750
1000
1250
1500
X (m)
Normal fault locked 250 m
below water table
t=1.58E2
t=3.12E3
t=1.92E4
t=1.296E5

Fig. 18

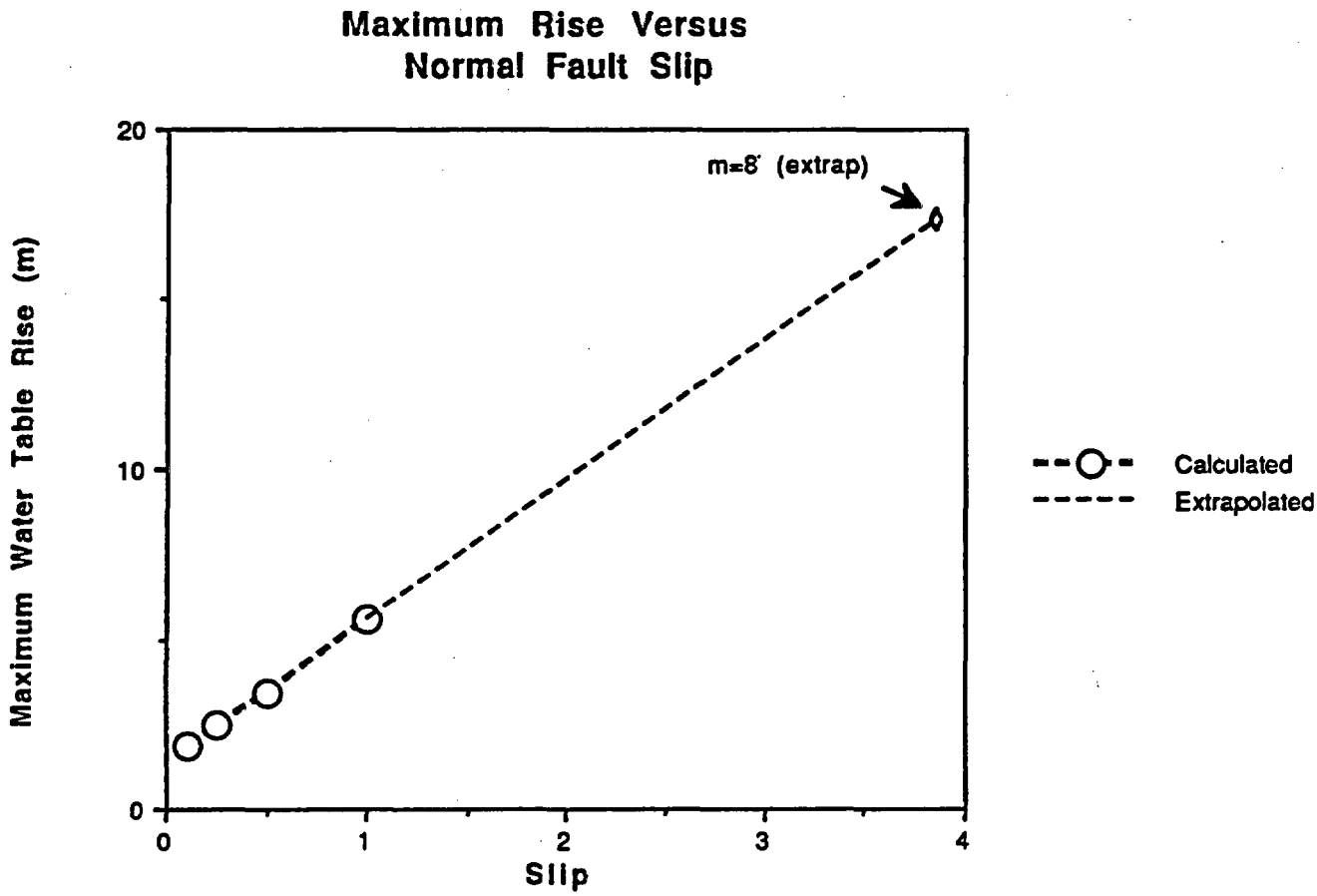

Maximum Rise Versus
Normal Fault Slip
m=8' (extrap)
Maximum Water Table Rise (m)
20
10
0
0
1
2
3
4
Slip
Calculated
Extrapolated

Fig. 20

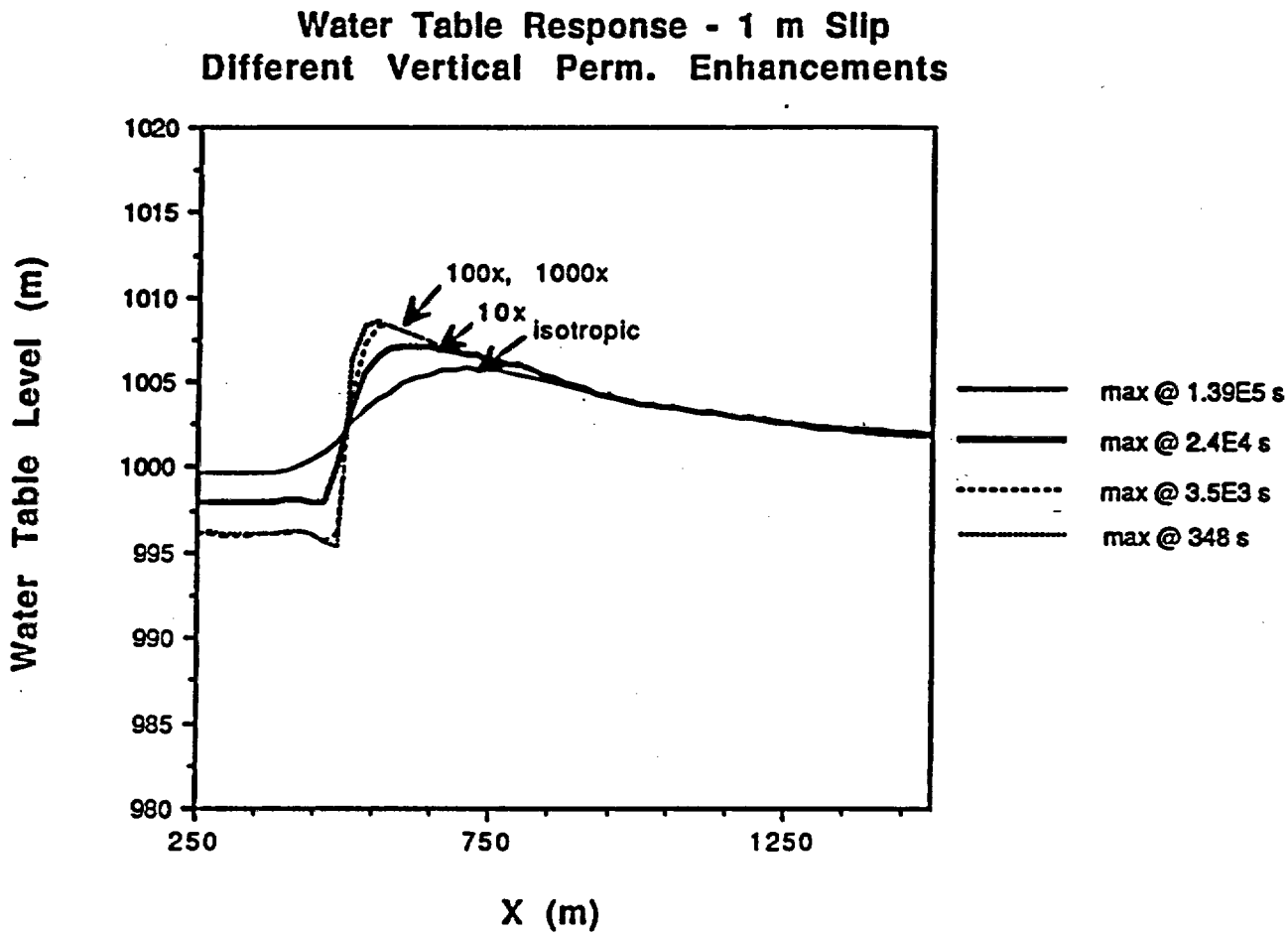

Water Table Response - 1 m Slip
Different Vertical Perm. Enhancements
Water Table Level (m)
1020
1015
1010
1005
1000
995
990
985
980
250
750
1250
X (m)
100x, 1000x
10x
isotropic
max @ 1.39E5 s
max @ 2.4E4 s
max @ 3.5E3 s
max @ 348 s

Fig. 22

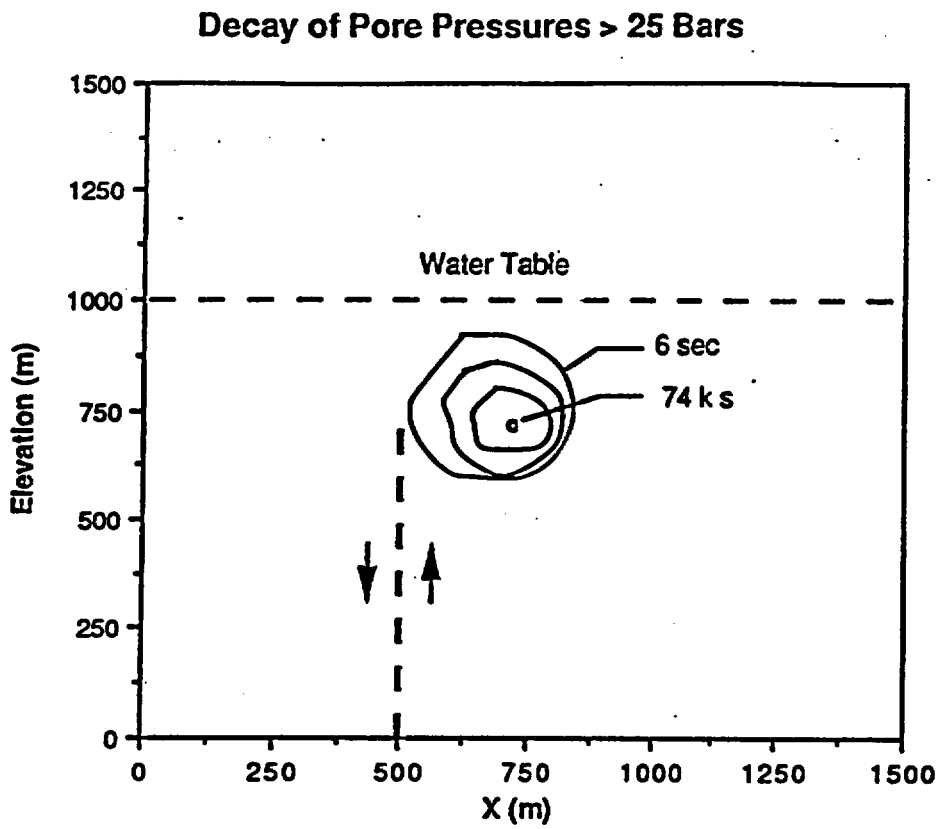
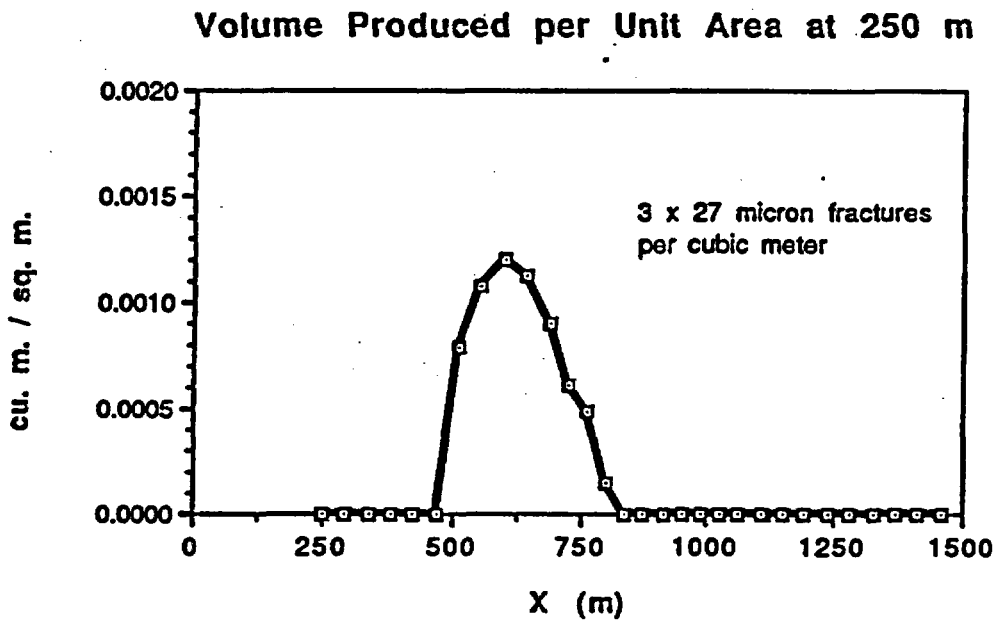

Decay of Pore Pressures > 25 Bars
Water Table
6 sec
74 k s
Elevation (m)
X (m)
0
250
500
750
1000
1250
1500

Fig. 24


Volume Produced per Unit Area at 250 m
0.0020
0.0015
0.0010
0.0005
0.0000
cu. m. / sq. m.
3 x 27 micron fractures
per cubic meter
0
250
500
750
1000
1250
1500
X (m)

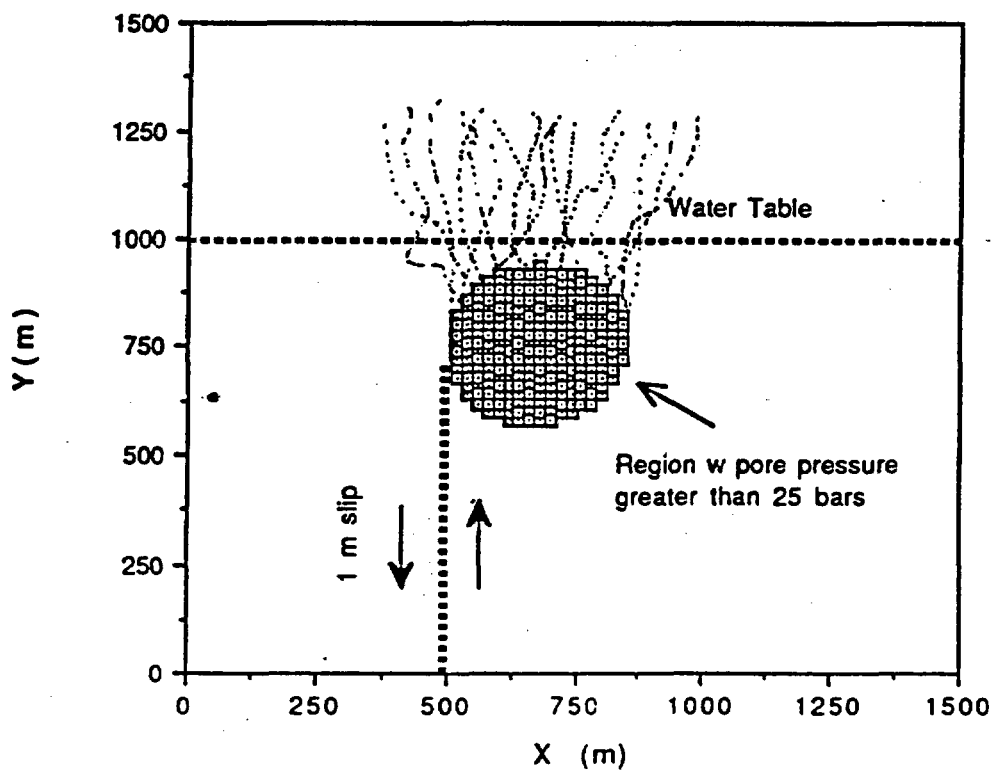
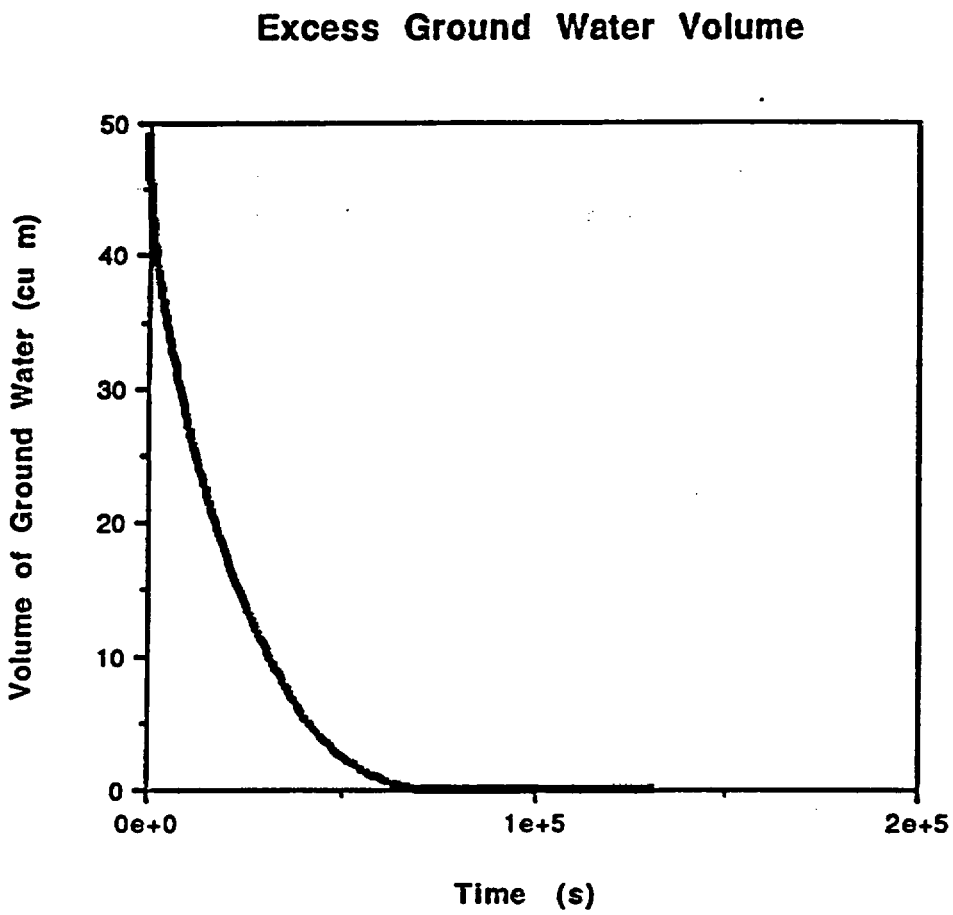

1500
1250
1000
750
500
250
0
Y (m)
Water Table
Region w pore pressure
greater than 25 bars
1 m slip
0
250
500
750
1000
1250
1500
X (m)

Fig. 26


Excess Ground Water Volume
Volume of Ground Water (cu m)
50
40
30
20
10
0
0e+0
1e+5
2e+5
Time (s)

B. Robinson
LANL
Attachment 10

REACTIVE TRACER TESTING AT THE C-WELL COMPLEX

Bruce Robinson
Los Alamos National Laboratory

Objectives of the Study

- Demonstrate applicability of laboratory-determined sorption parameters
- Validate transport model for saturated zone
- Evaluate potential for colloid transport

Approach

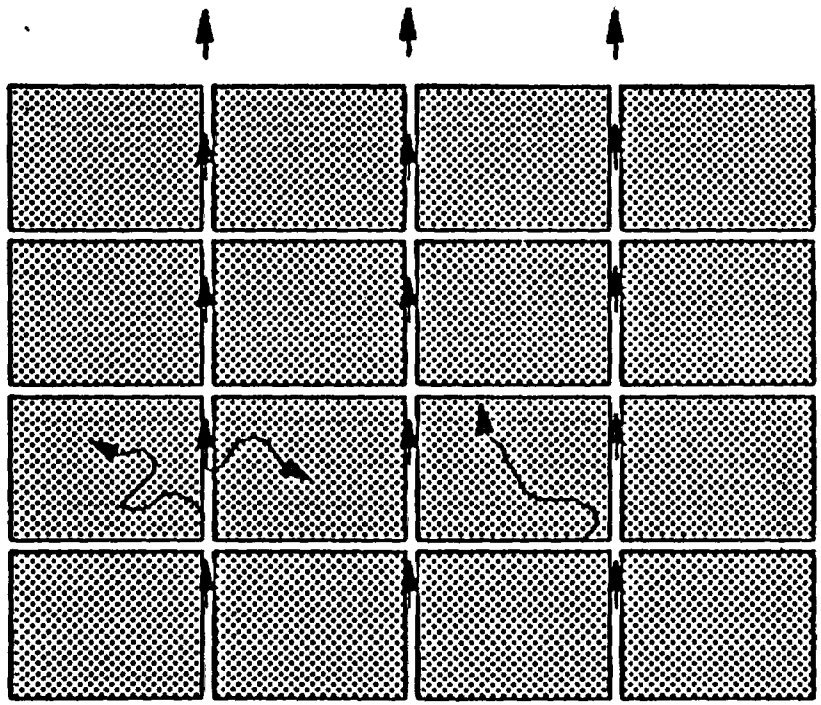
Test transport models at the field scale using carefully selected, well-characterized tracers.

- Radionuclide sorption: LiBr
- Colloid transport: polystyrene microspheres

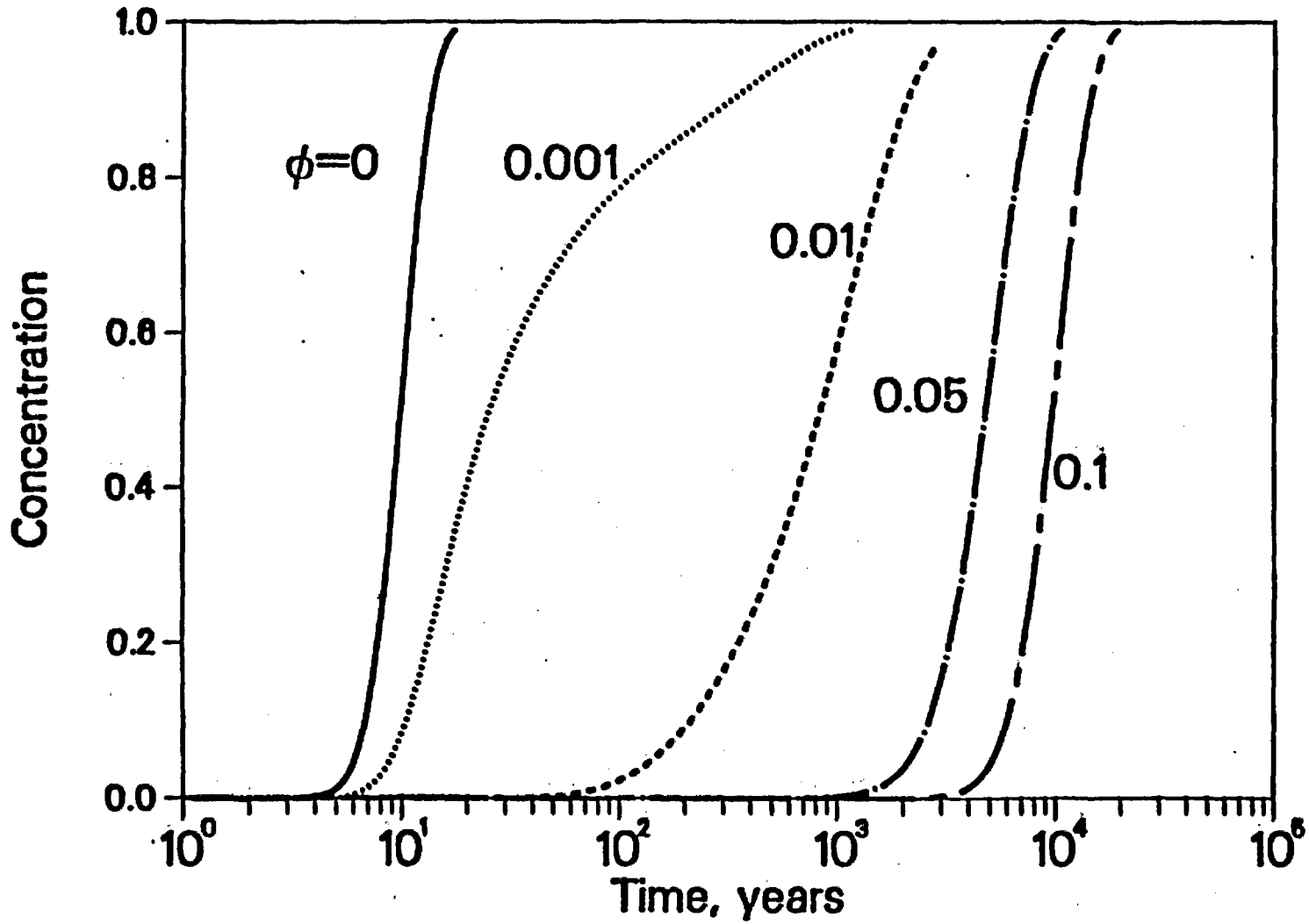
Test Procedure

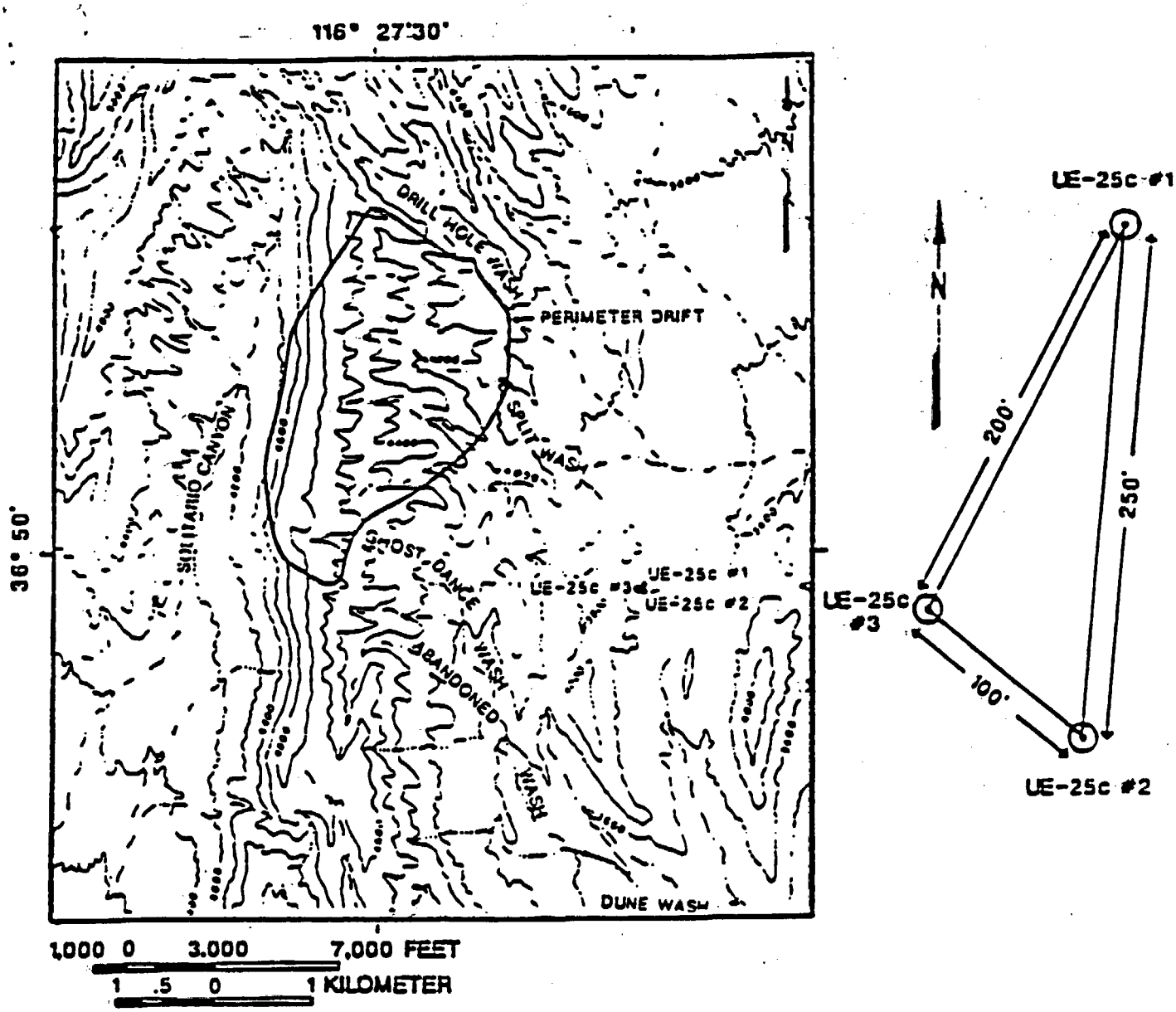
- Identify and characterize tracers in the laboratory
- Conduct field tests
- Simulate hydrologic and conservative tracer behavior
- Determine the applicability of laboratory sorption data for predicting field behavior

Fracture Flow With Matrix Diffusion

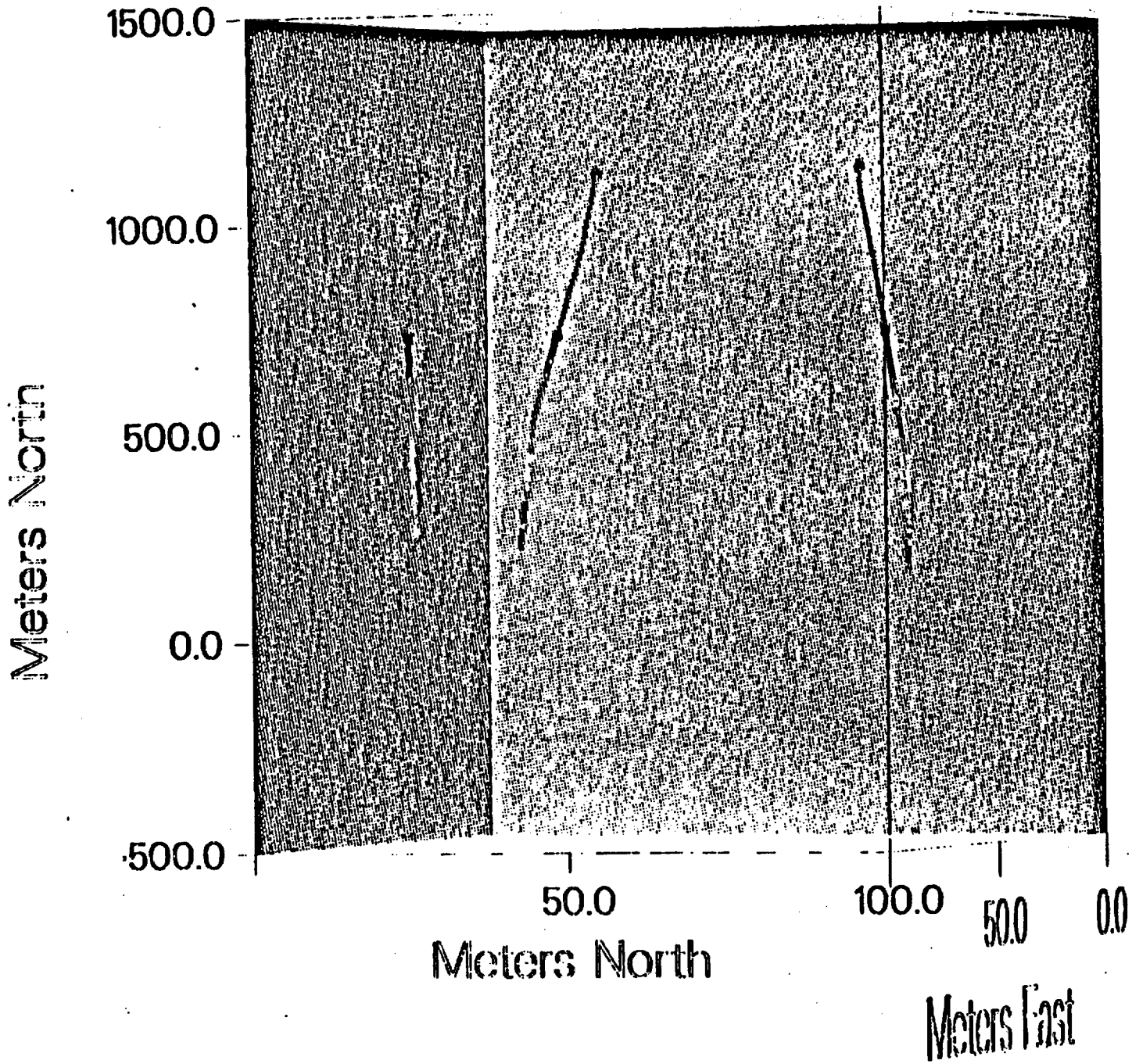


Effect of Matrix Porosity

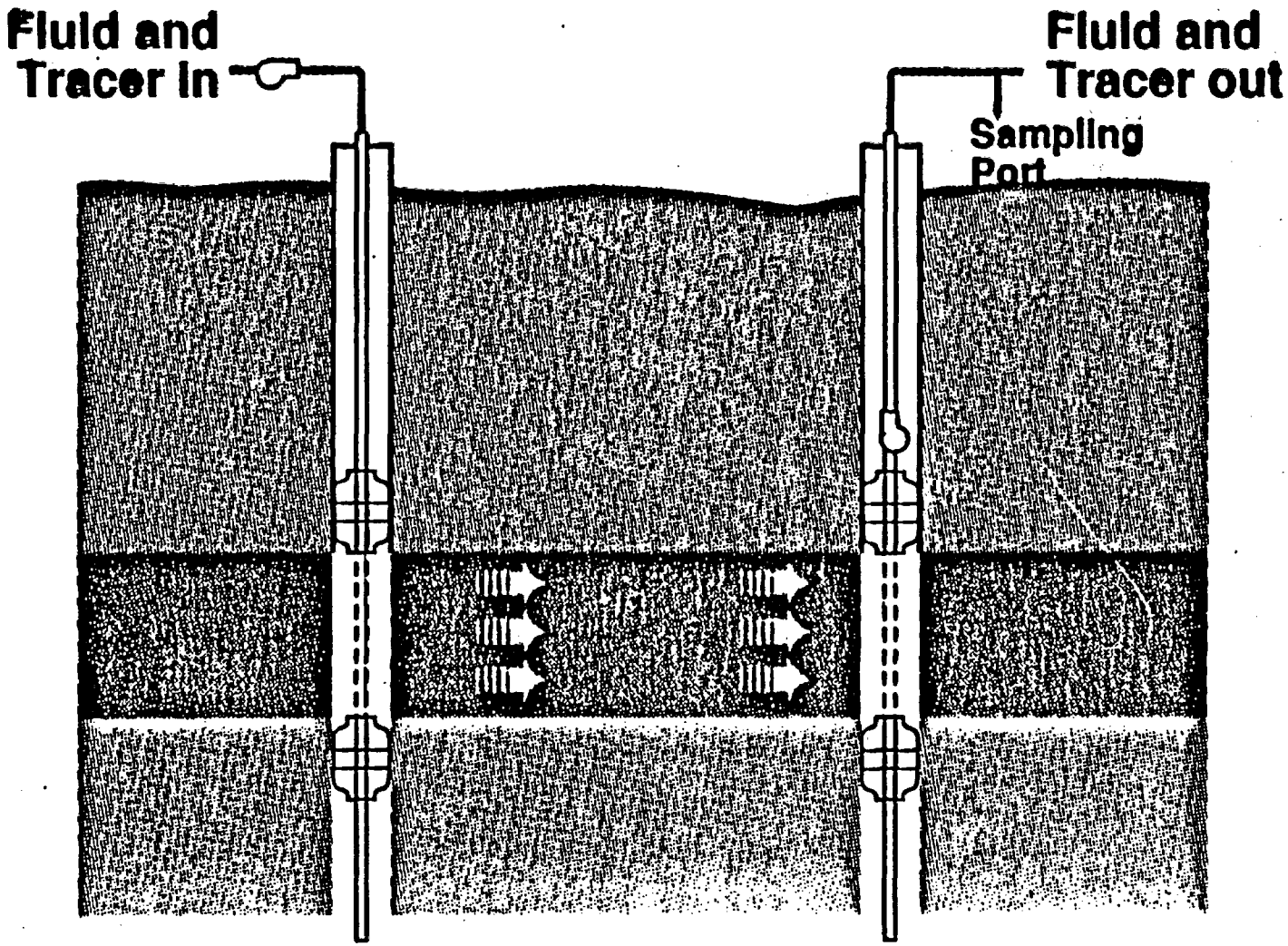


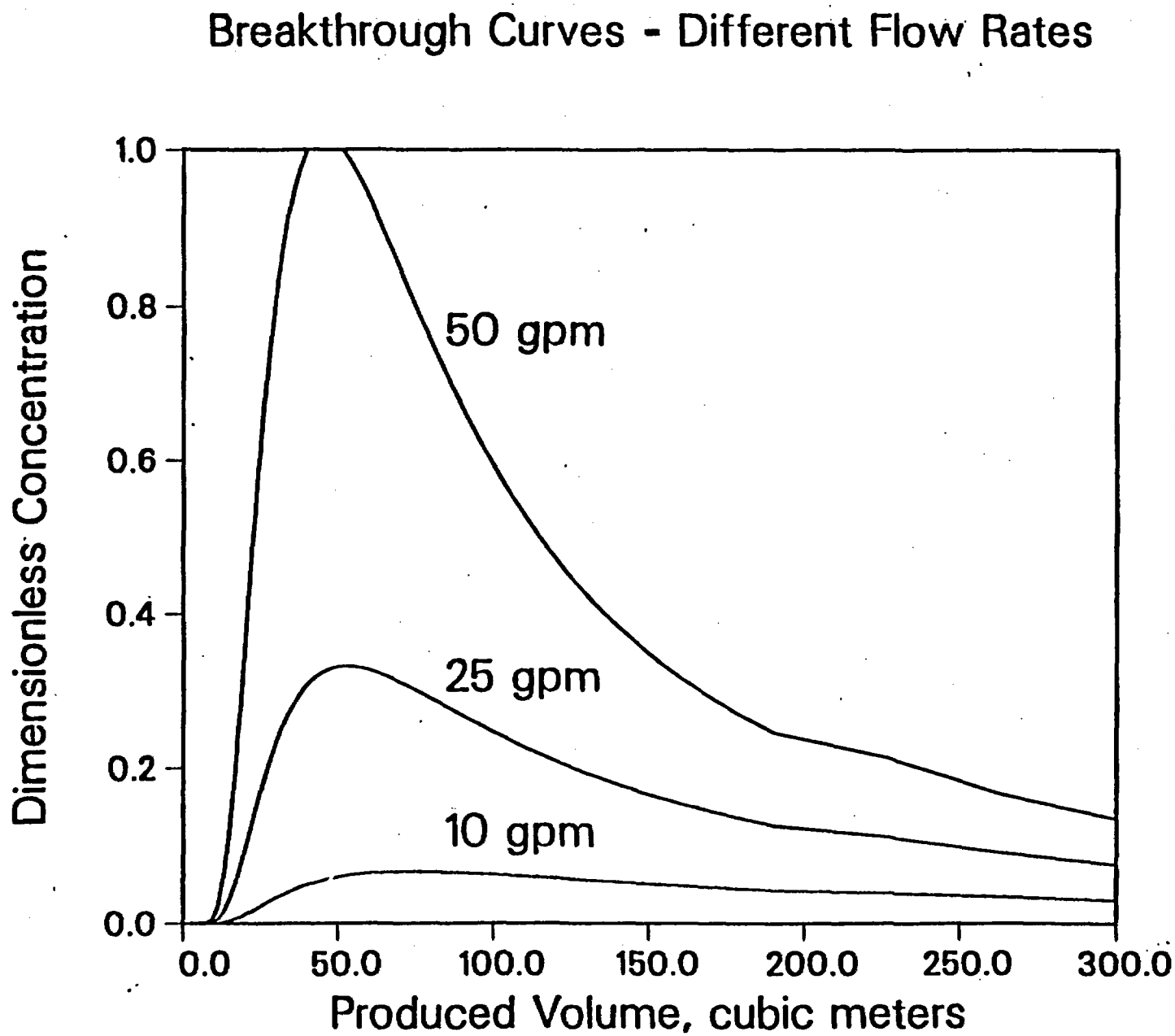

116° 27'30"
36° 50'
DRILL HOLE WASH
PERIMETER DRIFT
SPLIT WASH
SOLITARIO CANYON
GHOST DANCE WASH
ABANDONED WASH
DUNE WASH
UE-25c #1
UE-25c #2
UE-25c #3
1,000 0 3,000 7,000 FEET
1 .5 0 1 KILOMETER
N
200'
250'
100'

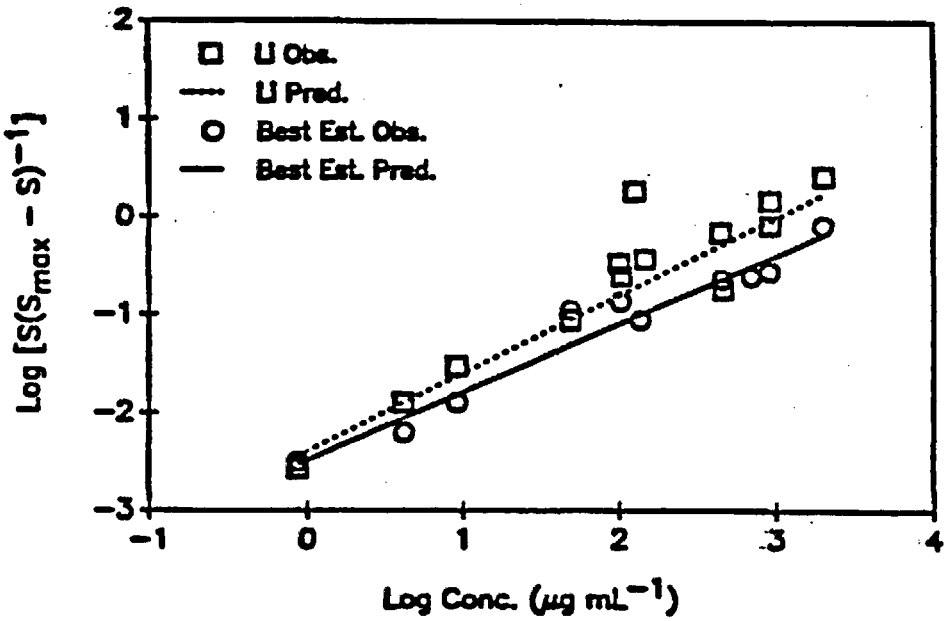
100.0
50.0
Meters East
50.0
0.0
Meters North

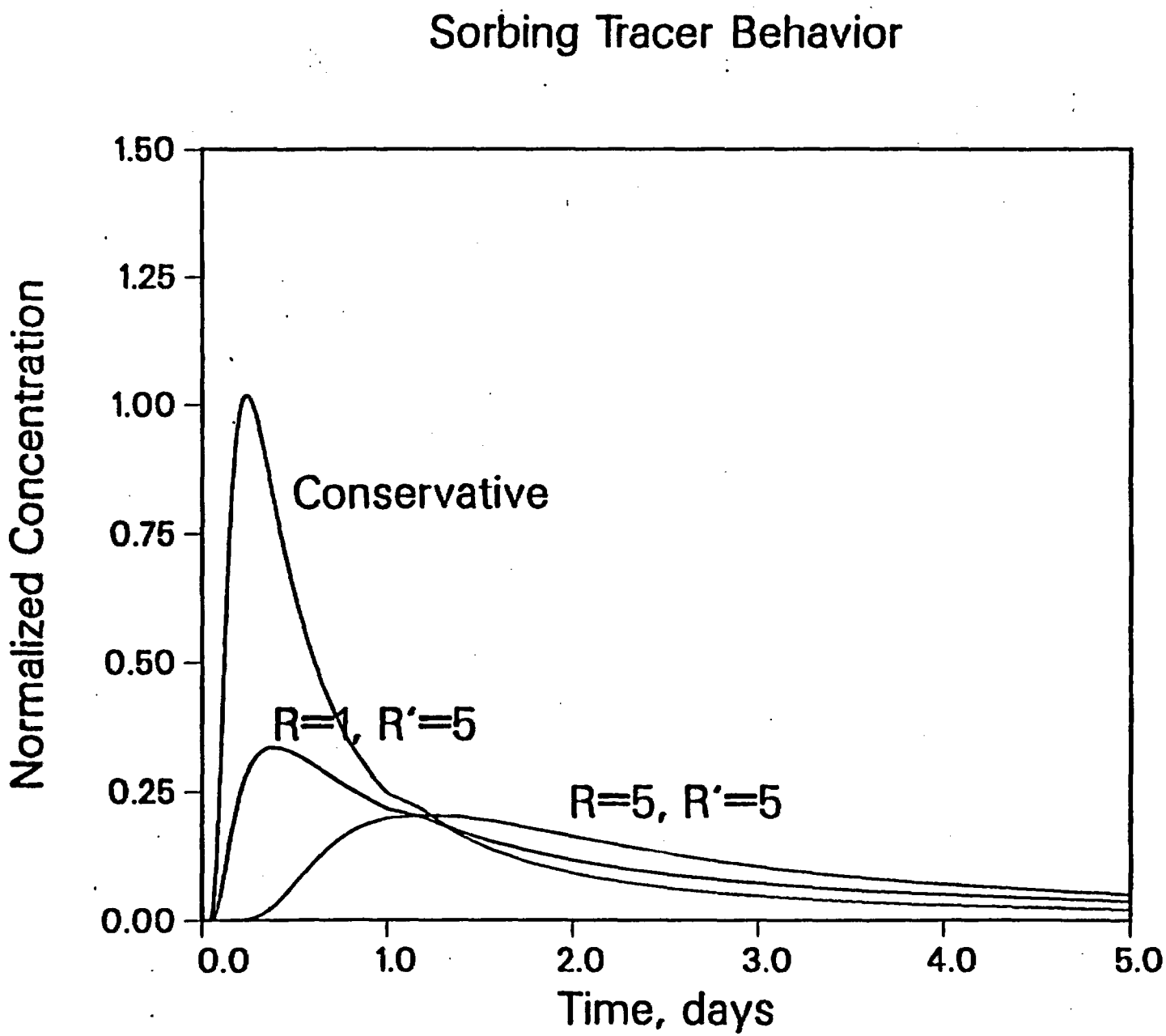

1500.0
1000.0
500.0
0.0
-500.0
Meters North
50.0
100.0
Meters North
50.0
0.0
Meters East

Two Well Recirculating Tracer Test

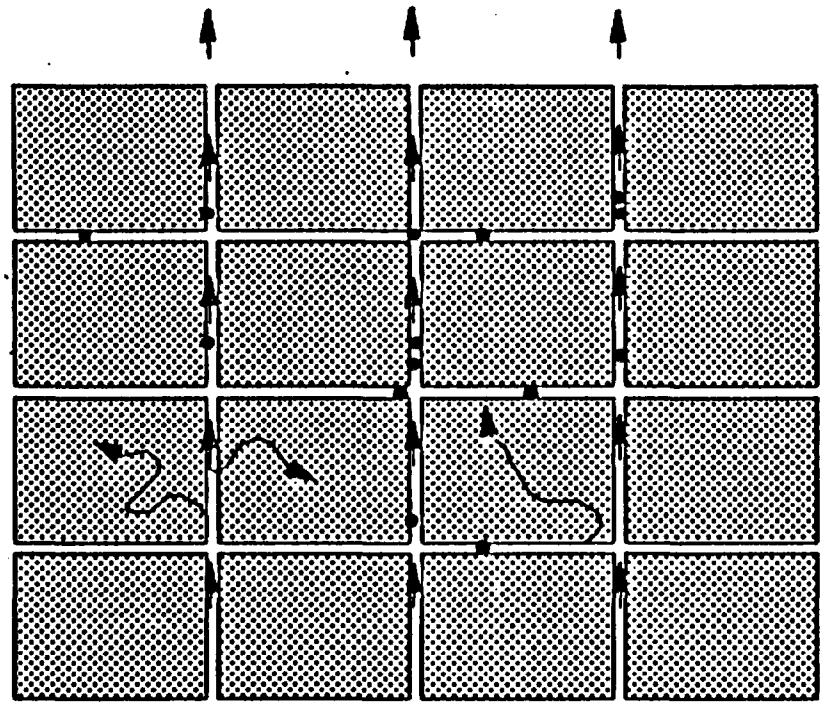



Breakthrough Curves - Different Flow Rates
Dimensionless Concentration
1.0
0.8
0.6
0.4
0.2
0.0
50 gpm
25 gpm
10 gpm
0.0
50.0
100.0
150.0
200.0
250.0
300.0
Produced Volume, cubic meters

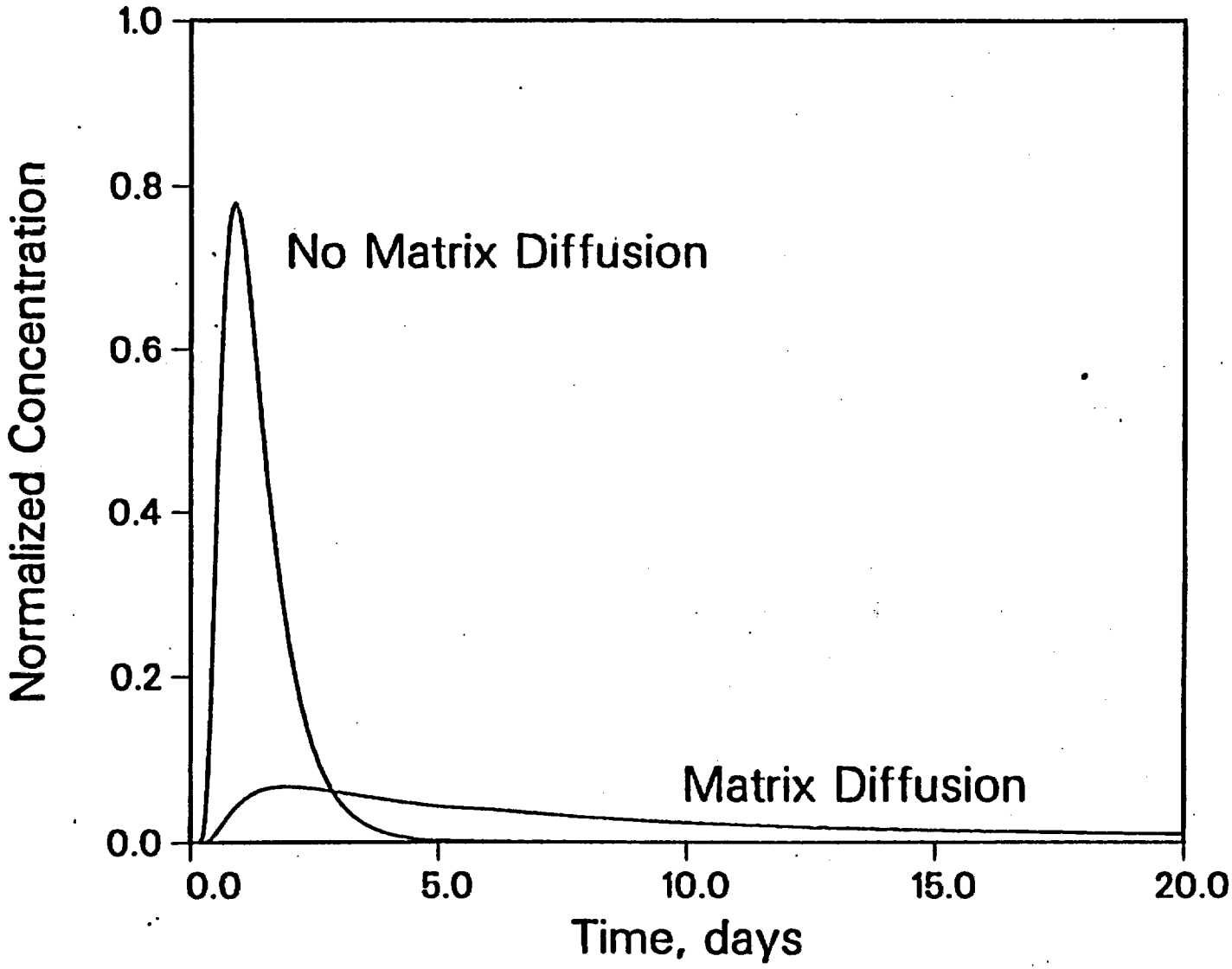

LI Obs.
LI Pred.
Best Est. Obs.
Best Est. Pred.
Log [S(S_max − S)^−1]
Log Conc. (μg mL^−1)
2
1
0
−1
−2
−3
−1
0
1
2
3
4


Sorbing Tracer Behavior
Normalized Concentration
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Conservative
R=1, R'=5
R=5, R'=5
0.0
1.0
2.0
3.0
4.0
5.0
Time, days

Colloid Transport Through Fractures



Transport With and Without Matrix Diffusion



Issues Addressed by a Fourth Well

- QA Level 1 Core
- Density of Vertical Fractures

Other Issues:

- Fracture Mineral Coatings
- Scale Dependent Transport

Conclusions

- Test plan provides a means for validating matrix diffusion model
- LiBr tracer will justify the use of laboratory-determined sorption parameters to site-scale modeling
- Colloid mobility will be examined

D. Hoxie
USGS
Attachment 9...

NET MOISTURE FLUX IN THE UNSATURATED ZONE AT YUCCA MOUNTAIN

--- UP, DOWN, OR SIDEWAYS?

D.T. Hoxie
U.S. Geological Survey
Denver, CO

DEFINITION

VOLUMETRIC FLUX

= Volume of fluid (liquid or gas) flowing through unit area in unit time

Components of net MOISTURE FLUX in the Unsaturated zone:

- Liquid-water flux
- Water-vapor flux

What is the present state of the geohydrologic system at Yucca Mountain with respect to moisture flow in the unsaturated zone?

- Steady state
- Dynamic

Of primary concern is the present and future liquid-water flux at the repository horizon, which is needed to assess

- Ground-water travel time
- Waste cannister corrosion
- Radionuclide transport

Liquid-water flux cannot be measured directly but must be inferred from prevailing

- Rock matrix saturation
- Hydraulic gradients
- Hydraulic conductivity

Sources of net downward liquid-water flux at the repository horizon:

- Net infiltration at land surface
- Upward moving flux of water vapor

COMPLICATIONS:

- Flowpaths - Matrix vs. Fracture
- Short-term transients
  - Dynamics
  - Spatial extent
  - Recurrence rate
- Long-term system evolution

Current "best" estimates of liquid-water flux F_w averaged over repository area:

Present day: $0.02 \leq F_w \leq 4$ mm/yr

Maximum future sustained:

$0.1 \leq F_w \leq 11$ mm/yr

FEBRUARY TPO MEETING

RELEASE OF SITE CHARACTERIZATION PROGRAM BASELINE (SCPB)

RESENTED BY
TOM BJERSTEDT
ACTING CHIEF, REGULATORY INTERACTIONS BRANCH

FEBRUARY 22, 1991

SCP WAS RELEASED IN 1988 WITHOUT AN EXPLICIT MEANS TO STRUCTURE CHANGES TO IT

- MUCH INTERNAL DOE DEBATE, AND CONCERN ABOUT SCP's FLEXIBILITY AMONG SCIENTISTS
- CONCERN EXPRESSED BY NRC, STATE OF NEVADA, AND OTHER SCP COMMENTORS REGARDING "CHANGEABILITY" AND WHAT CONSTITUTES A CONTROLLED PROGRAM
- DOE NEEDED TRACEABILITY AND "RECORD OF DECISION" FOR CHANGES
- DOE NEEDED A MEANS TO KEEP SCP AND STUDY PLANS (SP) IN AGREEMENT

TECHNICAL PLANNING BASIS (TPB)

- EARLY 1989 OGD/YMPO TOOK INITIATIVE AND RELEASED "TECHNICAL PLANNING BASIS" AS MEANS TO CONTROL SCP TECHNICAL PROGRAM
  - SCP STUDY AND ACTIVITY OBJECTIVES
  - PERFORMANCE ALLOCATION TABLES
  - HYPOTHESIS TESTING TABLES
- CHANGES TO THESE ITEMS INVOLVED PROJECT CCB

TPB SOUGHT TO CONTROL TECHNICAL PROGRAM AT A HIGH-LEVEL

- SCP/TPB WAS THE ONLY CCB-CONTROLLED DOCUMENT AFFECTING SPs
- BECAUSE TPB WAS HIGH-LEVEL, FEW CCB ACTIONS WERE NEEDED TO MAINTAIN AGREEMENT BETWEEN SCP/SPs

SITE CHARACTERIZATION PROGRAM BASELINE (SCPB)

- SCPB (REV 0.) RELEASED 2/7 - SUPERSEDES TPB
  - ESSENTIALLY THE TPB WITH FULL-TEXT BASELINING OF ACTIVITY DESCRIPTIONS
- BECAUSE SCPB CONTROLS TECHNICAL PROGRAM IN GREATER DETAIL, MAY BE MORE OCCASIONS WHERE SCPB AND APPROVED SPs DISAGREE

WHAT IS IN SCPB

SCPB CONTAINS MOST OF SCP CHAPTER 8

- 8.0 INTRODUCTION
- 8.1 RATIONALE
- 8.2 ISSUES
- 8.3.1 SITE PROGRAM
  - PROGRAMS 8.3.1.1 TO 8.3.1.17
- 8.3.2 REPOSITORY PROGRAM
  - 8.3.2.1 AND 8.3.2.2
- 8.3.3 SEAL PROGRAM
  - 8.3.3.1 AND 8.3.3.2
- 8.3.4 WASTE PROGRAM
  - 8.3.4.1 TO 8.3.4.4
- 8.3.5 PERFORMANCE ASSESSMENT PROGRAM
  - 8.3.5.1 TO 8.3.5.20
- 8.4 PLANNED SITE PREPARATION ACTIVITIES
  - 8.4.1 TO 8.4.3
- 8.7 DECONTAMINATION AND DECOMMISSIONING
- REFERENCES
- GLOSSARY

WHAT IS NOT IN SCPB

SCPB DOES NOT CONTAIN:

- SECTION 8.5 MILESTONES, DECISION POINTS, AND SCHEDULE
- SECTION 8.6 QUALITY ASSURANCE PROGRAM
- SCHEDULES AND MILESTONES DISCUSSIONS IN OTHER SECTIONS
- METHODS AND TECHNICAL PROCEDURES SECTIONS AND TECHNICAL PROCEDURES TABLES
- APPLICATION OF RESULTS SECTIONS

SCPB IMPLEMENTATION PLANNING

- TPOs REQUIRED TO REVIEW THEIR CONTROLLED DOCUMENTS (INCLUDES APPROVED SPs) FOR CONSISTENCY WITH SCPB
- IDENTIFY IMPACTED CONTROLLED DOCUMENTS INCLUDING SPs ON AFFECTED DOCUMENT NOTICES (ADNs) DUE 1/21/91
- TPOs NEED TO TAKE CORRECTIVE ACTION

SPs AND SCPB MUST BE CONSISTENT

- IF THE SCPB AND SP ARE NOT CONSISTENT, THEN EITHER
  1.) SCPB MUST BE REVISED BY SUBMITTING CHANGE REQUEST (CR) FOR CCB ACTION THROUGH AP-3.3Q
  2.) THE SP MUST BE REVISED USING AP-1.10Q
- EITHER 1 OR 2 IS ACCEPTABLE: CONSISTENCY BETWEEN SCPB AND SP IS THE GOAL

WHAT IS THE ROLE OF AP-1.10Q INTERIM CHANGE NOTICE (ICN) FOR SPs?

- PAST REVISIONS OF AP-1.10Q PROVIDED FOR ICNs, BUT HAD NO IMPACT ON SCP
- YMPO NOW USES ICNs TO INDICATE A TEMPORARY CHANGE TO AN SP PRIOR TO A REVISION
  - USE ICN AS 'QUICK CHANGE' MECHANISM

EFFECT ON DRAFT SPs

- DRAFT SPs TO BE COMPARED TO THE SCPB TO DETERMINE IF DIFFERENCES EXIST
  - PIs DETERMINE IF SP CONSISTENT WITH SCPB
  - T&MSS SP COORDINATORS WILL VERIFY
- ANY DIFFERENCES WILL BE RESOLVED BY THE TPO SUBMITTING A CHANGE REQUEST AGAINST THE SCPB TO THE CCB USING AP-3.3Q
- A STUDY PLAN CAN ONLY BE APPROVED AFTER THE CCB AGREES TO THE CHANGE

SPs NOT YET SUBMITTED TO YMP

- PRIOR TO SUBMISSION, PI REVIEWS SCPB AND DRAFT SP
- IF NECESSARY, PREPARES CR (AP-3.3Q) TO REVISE SCPB
- TPO SUBMITS CR TO CCB
- YMP STUDY PLAN REVIEW INCLUDES SP AND ANY CRs THAT ARE SUBMITTED
  - IF REVIEW FINDS DIFFERENCES BETWEEN SCPB AND SP THAT ARE NOT INCLUDED IN A CR, THEN MANDATORY COMMENT(S) ARE MADE
  - SP CAN NOT BE APPROVED UNTIL CRs ARE APPROVED BY CCB

BECOMING AWARE

OUTREACH PROGRAM FOR AP-3.3Q IMPLEMENTATION

- POINT OF CONTACT- SAM C. MATTHEWS, CCB SECRETARY, FTS 544-7633
- ORIENTATION OF RESIDENT INTEGRATORS COMPLETED
- SNL AND LANL VISITED ON SEPTEMBER 16-18, 1990
- ONGOING INTERFACE WITH RSN AND REECo
- SCHEDULING VISITS WITH LLNL AND USGS