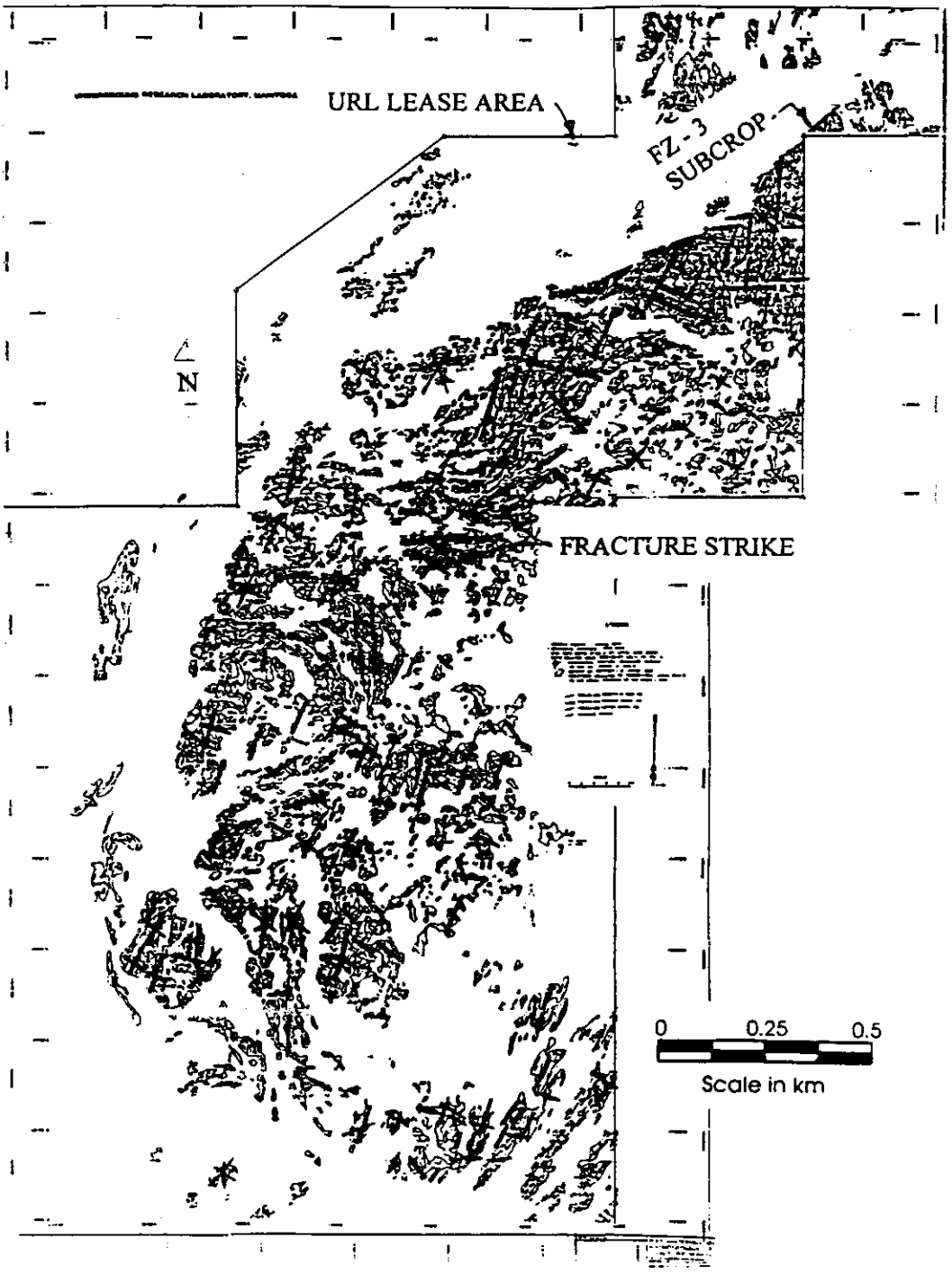
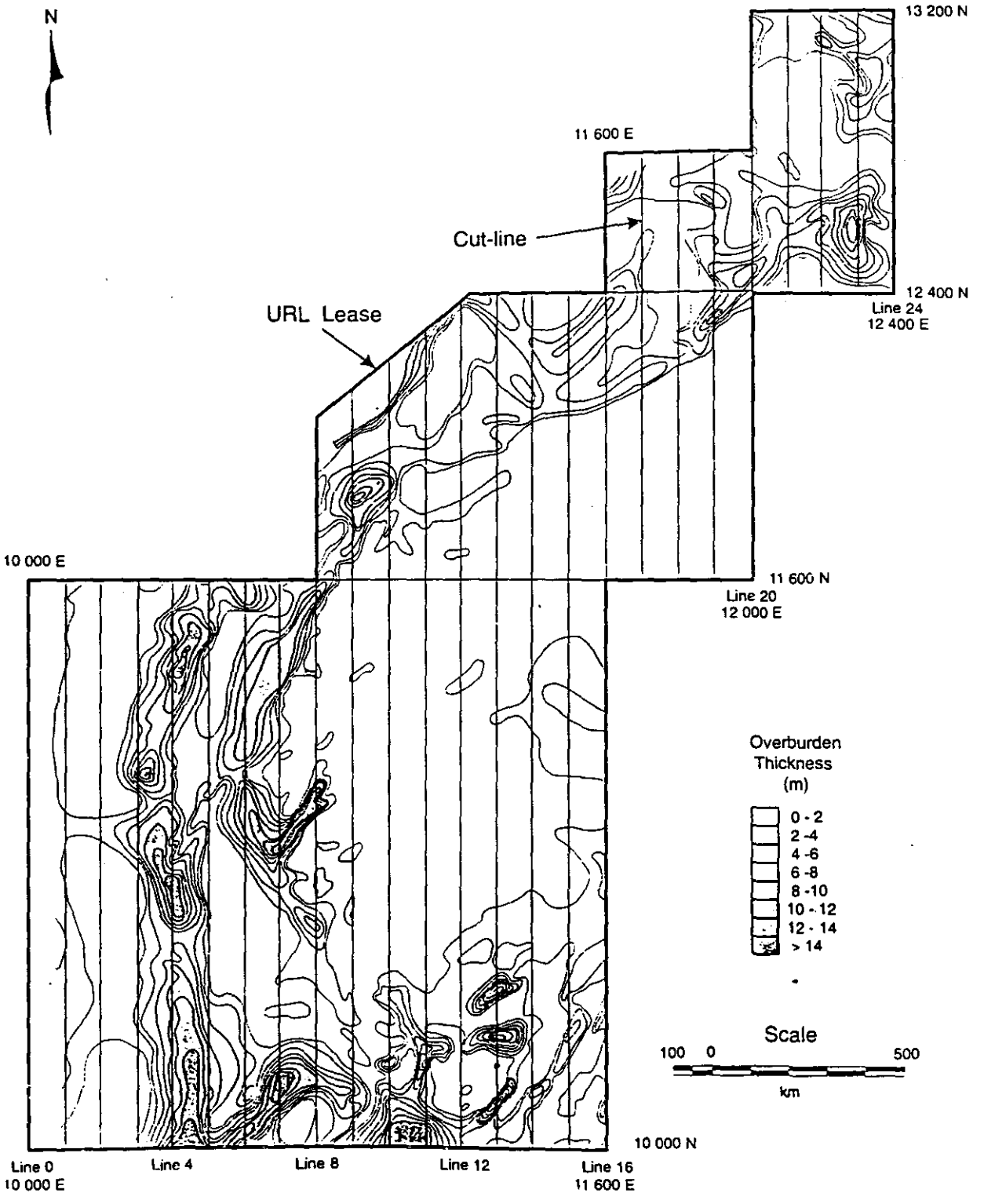
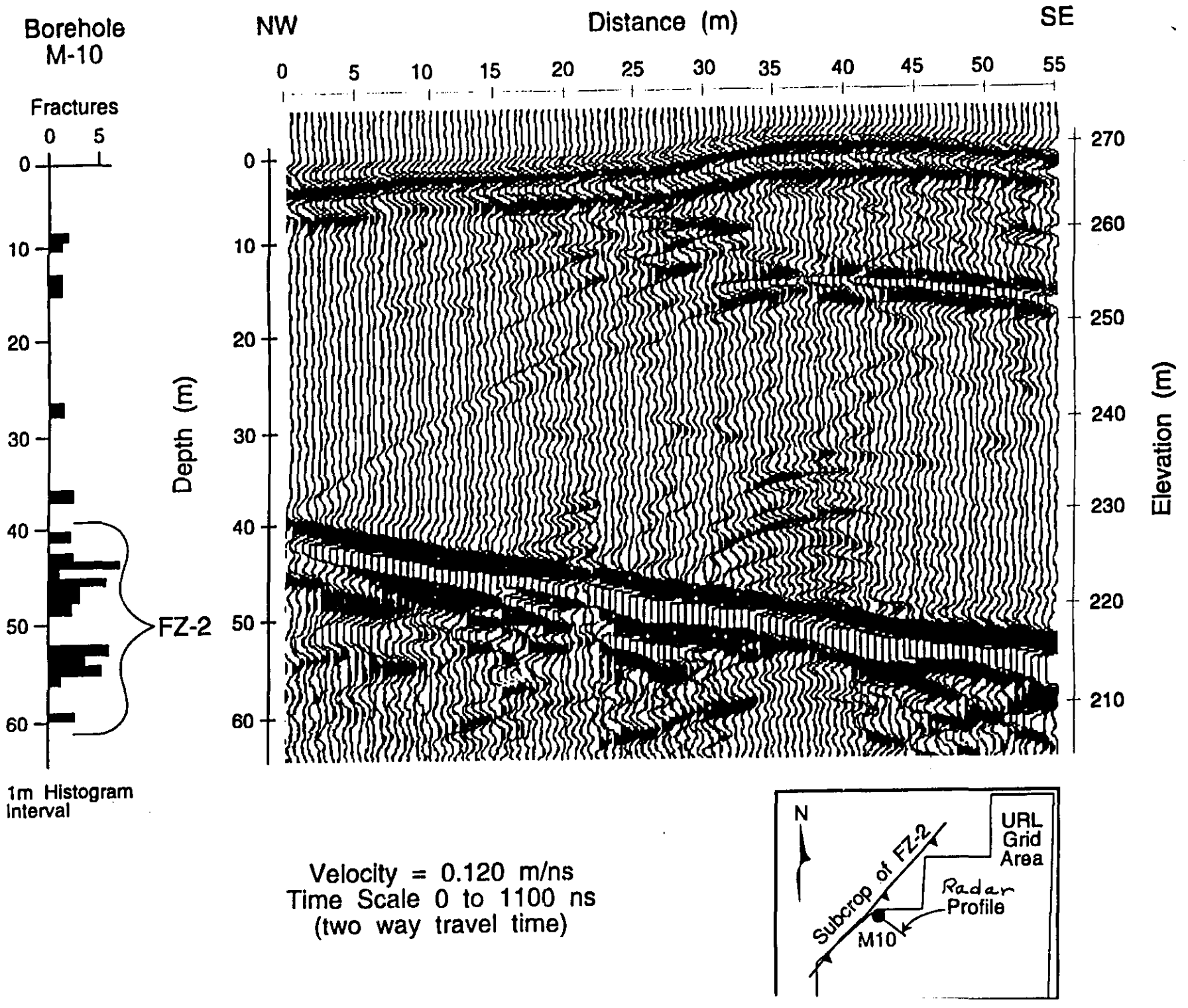
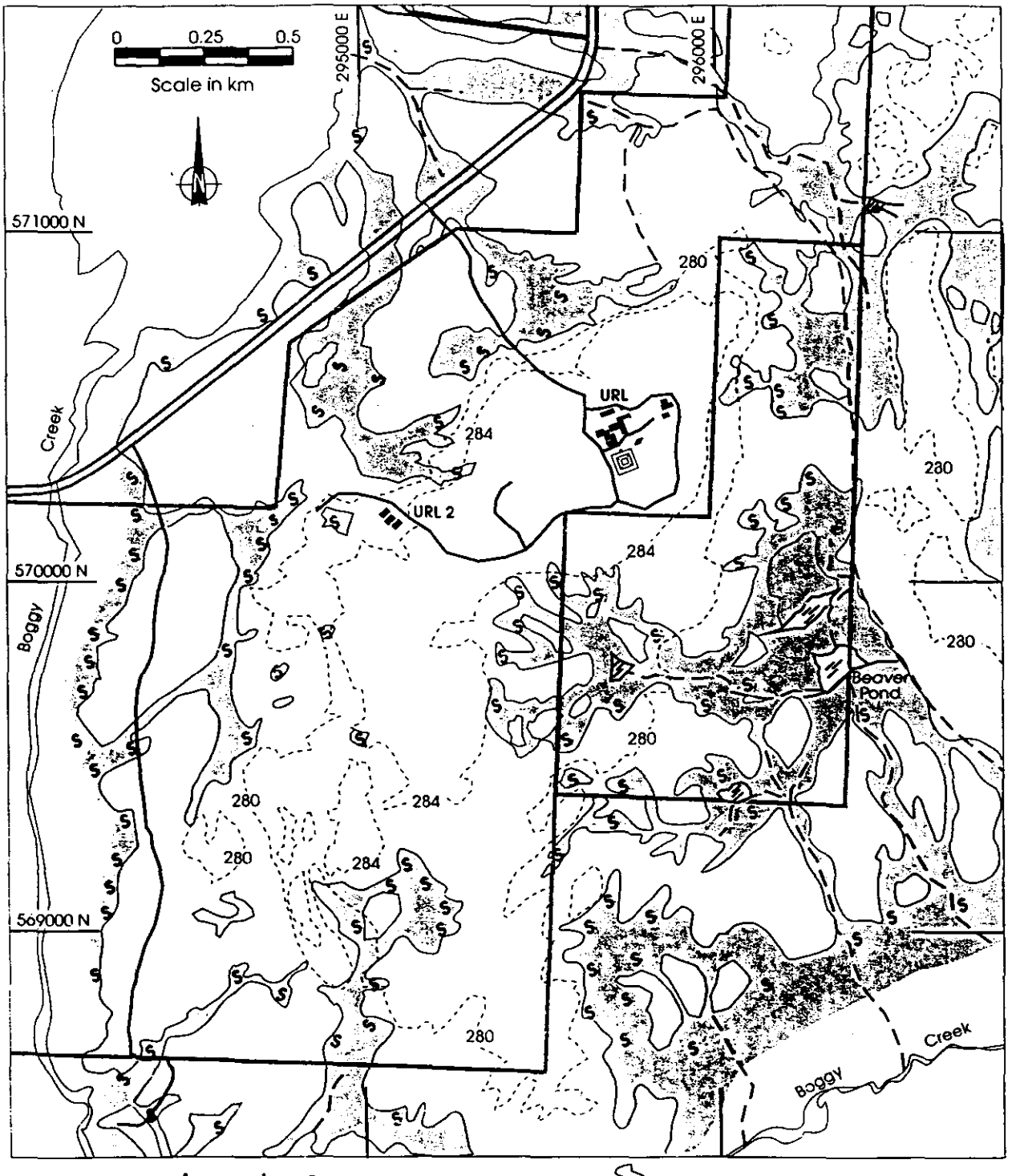
CANDIDATE SITE CHARACTERIZATION

- *SURFACE GEOLOGIC MAPPING*
- *SURFACE GEOPHYSICAL SURVEYS*
- *HYDROGEOLOGICAL MAPPING*
- *DRILLING, LOGGING, SAMPLING, TESTING AND MONITORING*
- *UNDERGROUND HYDROGEOLOGIC INVESTIGATIONS*


URL LEASE AREA
FZ - 3
SUBCROP
N
FRACTURE STRIKE
0
0.25
0.5
Scale in km


N
13 200 N
11 600 E
Cut-line
12 400 N
Line 24
12 400 E
URL Lease
10 000 E
11 600 N
Line 20
12 000 E
Overburden
Thickness
(m)
0 - 2
2 -4
4 -6
6 -8
8 -10
10 - 12
12 - 14
> 14
Scale
100 0 500
km
10 000 N
Line 0
10 000 E
Line 4
Line 8
Line 12
Line 16
11 600 E


Borehole
M-10
Fractures
0
5
NW
Distance (m)
SE
0
5
10
15
20
25
30
35
40
45
50
55
Depth (m)
Elevation (m)
270
260
250
240
230
220
210
FZ-2
1m Histogram
Interval
Velocity = 0.120 m/ns
Time Scale 0 to 1100 ns
(two way travel time)
N
URL
Grid
Area
Subcrop of FZ-2
Radar
Profile
M10


0
0.25
0.5
Scale in km
N
295000 E
296000 E
571000 N
570000 N
569000 N
Creek
Boggy
URL
URL 2
280
284
Beaver Pond
Boggy
Creek
Legend :
Groundwater discharge area
Spring/seepage
S
Beaver dam
Creek
Road
Contour (m)
280

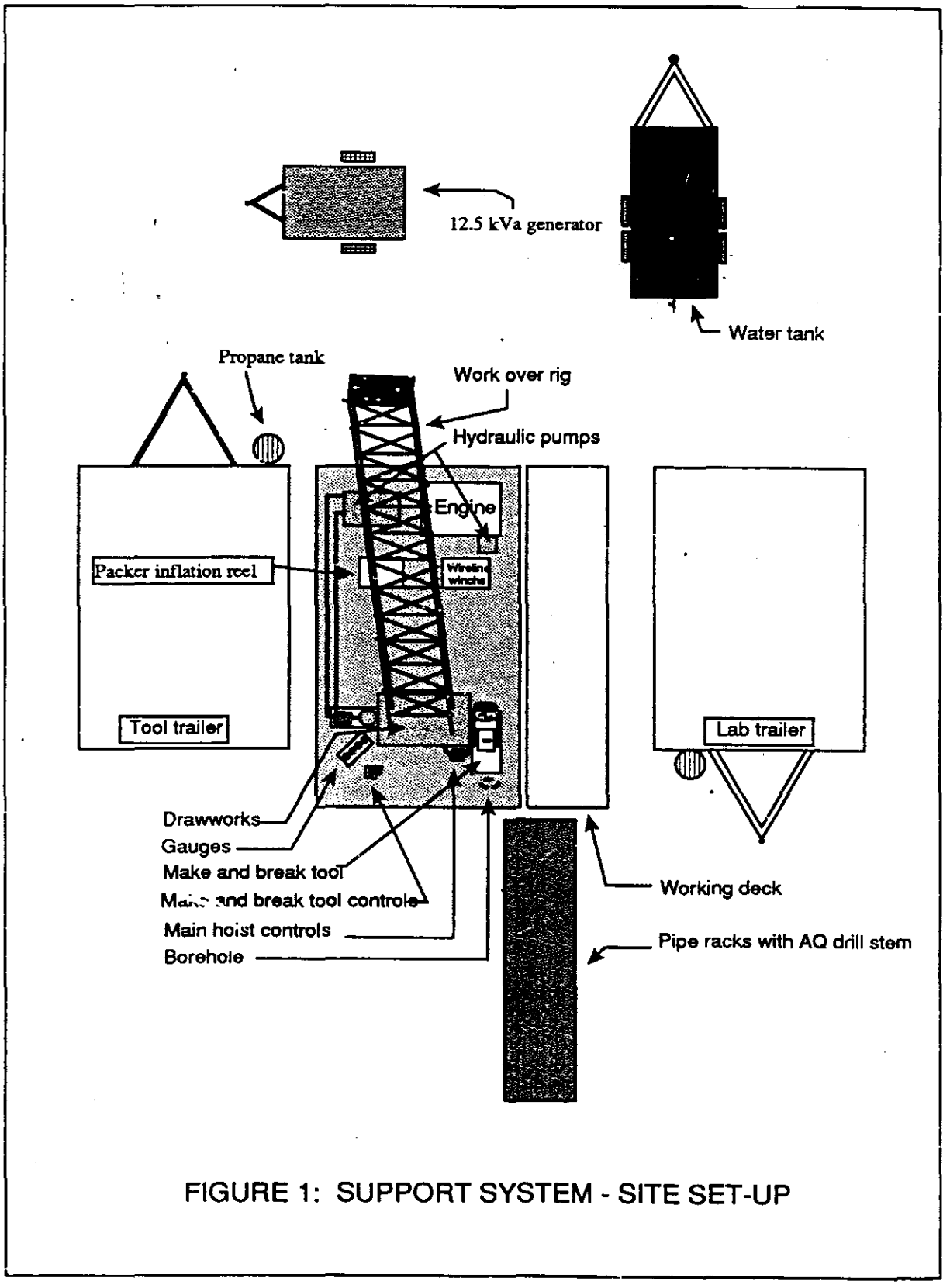
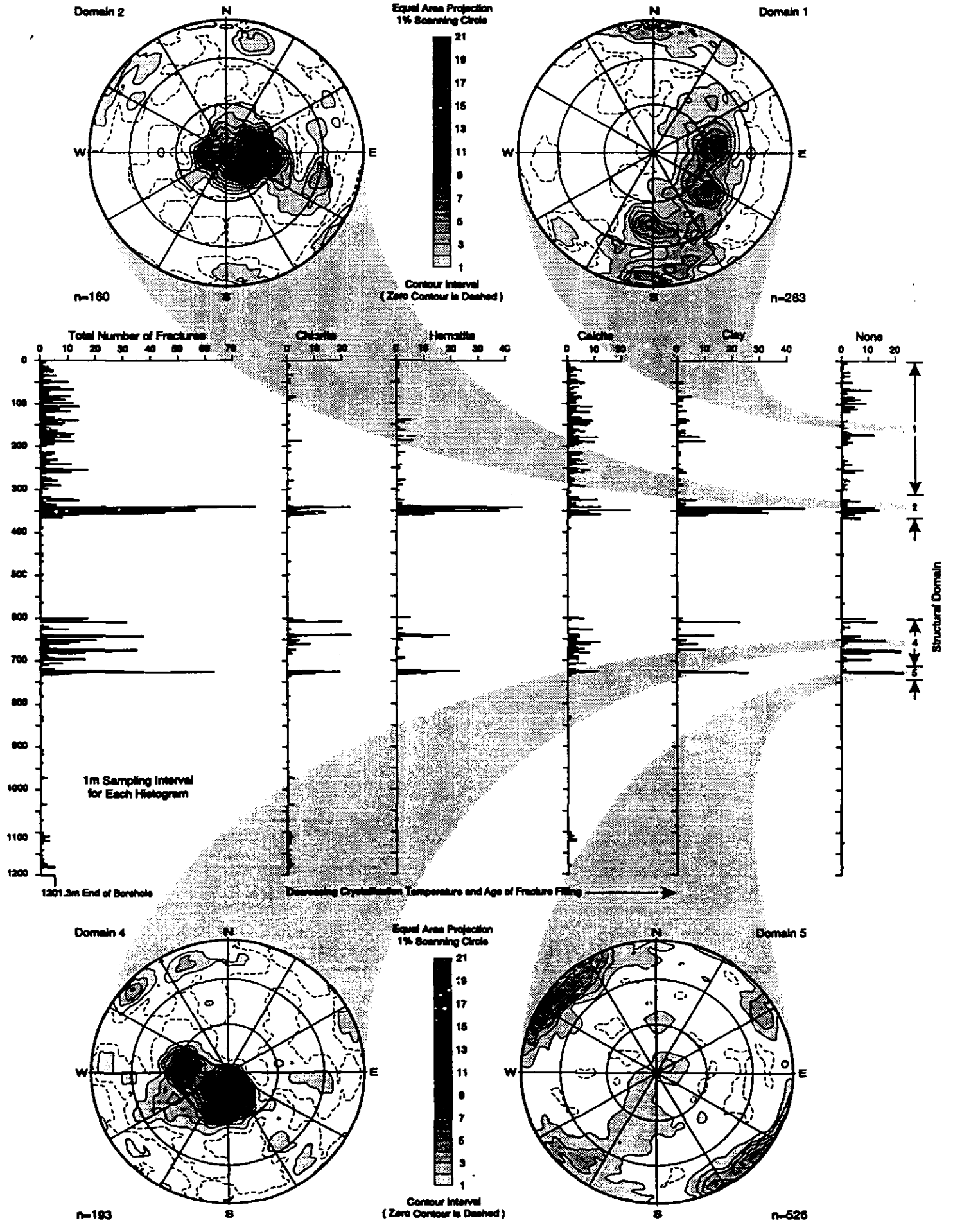
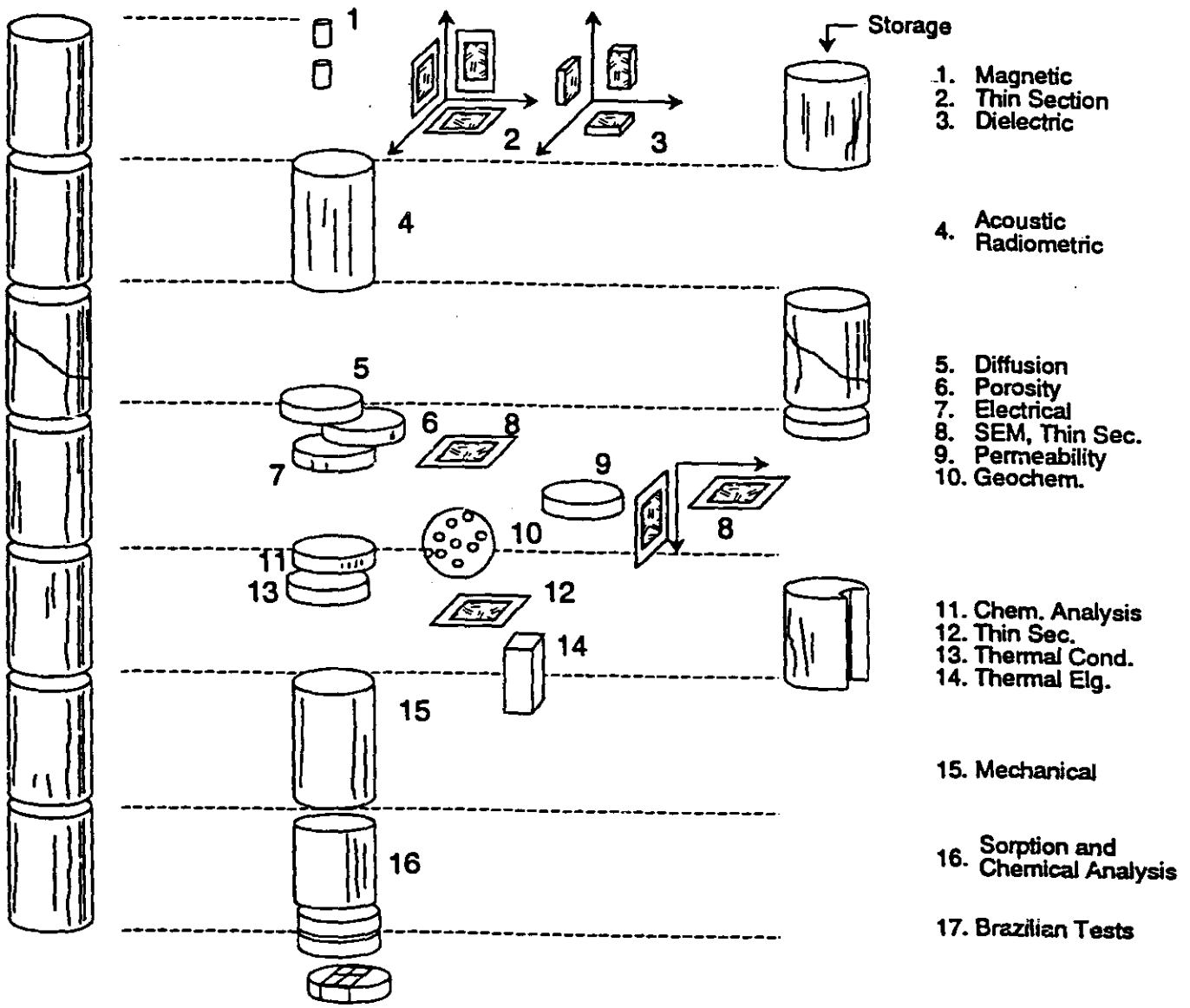
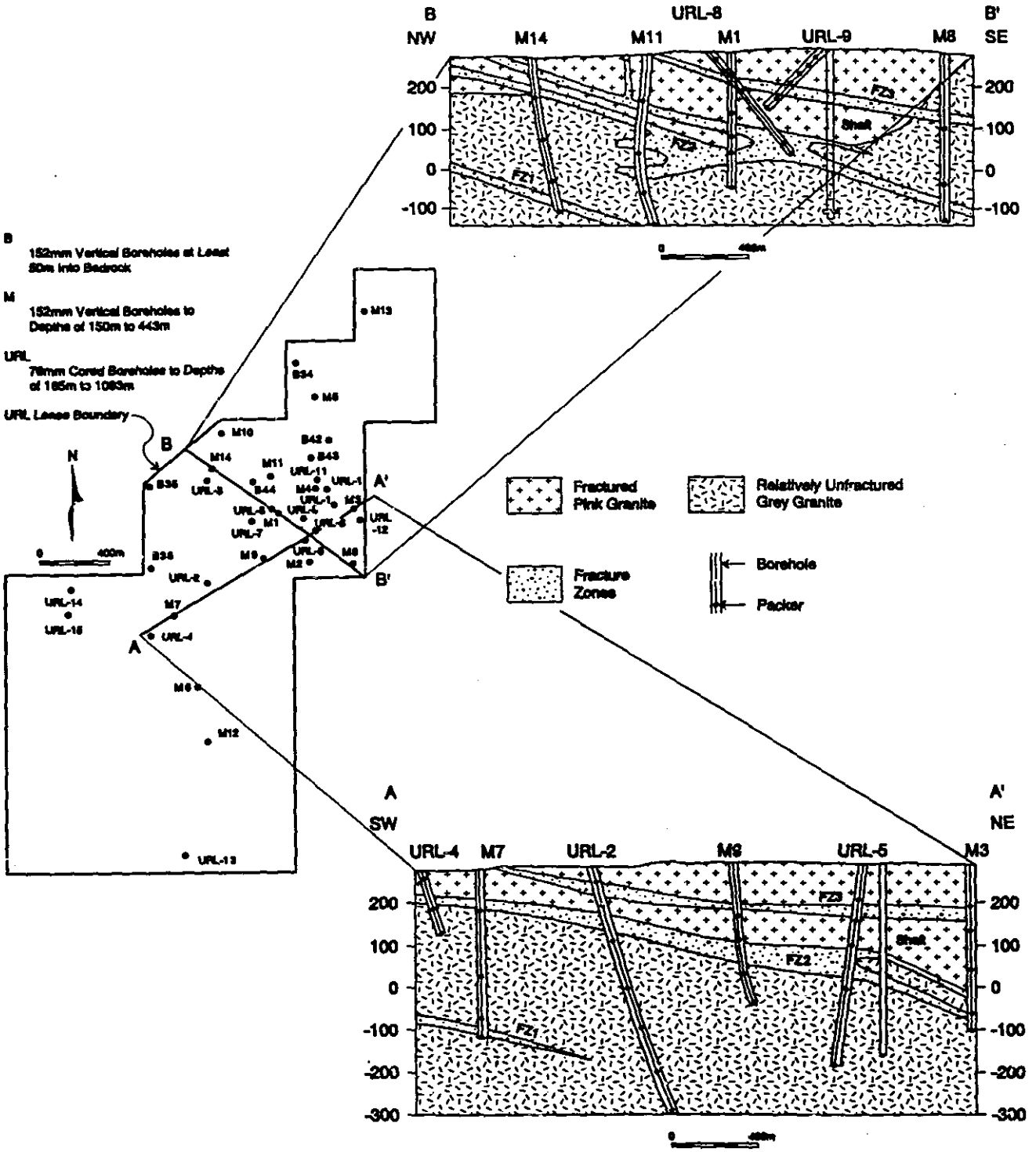


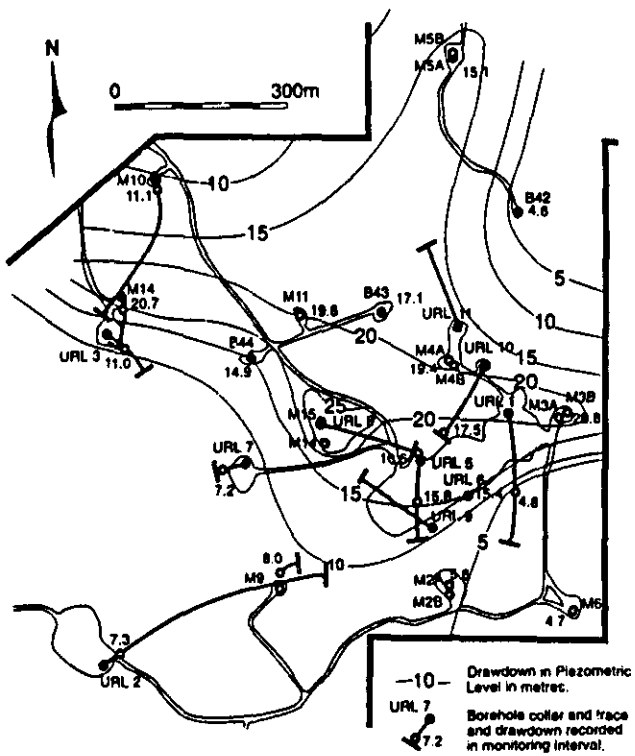
FIGURE 1: SUPPORT SYSTEM - SITE SET-UP


Domain 2
N
W
E
S
n=160
Equal Area Projection
1% Scanning Circle
21
19
17
15
13
11
9
7
5
3
1
Contour Interval
(Zero Contour is Dashed)
Domain 1
n=263
Total Number of Fractures
Chlorite
Hematite
Calcite
Clay
None
1m Sampling Interval
for Each Histogram
1201.3m End of Borehole
Decreasing Crystallization Temperature and Age of Fracture Filling
Structural Domain
Domain 4
n=193
Domain 5
n=526

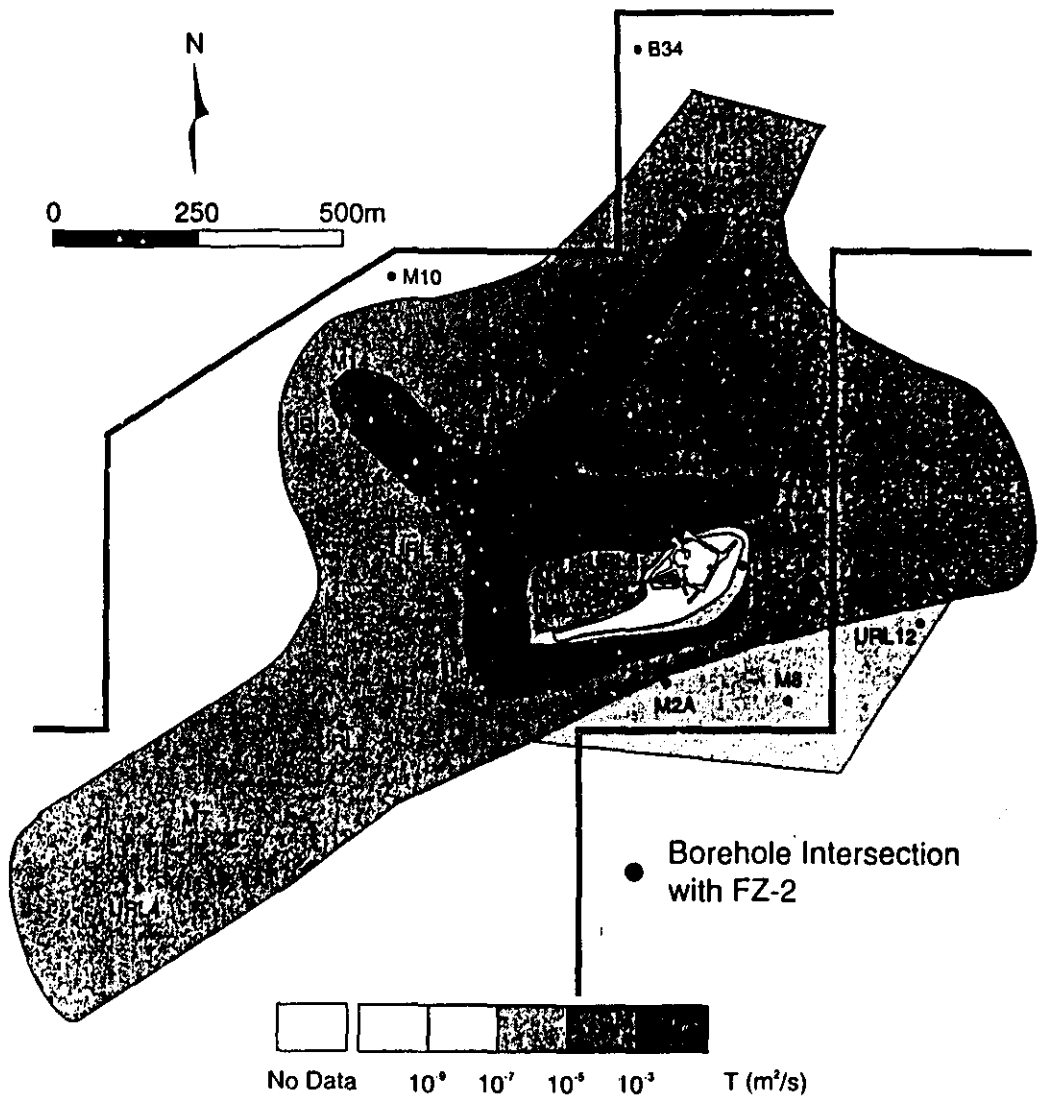


JRE 6-11: Schematic of Core Sampling Distribution


B
NW
M14
M11
M1
URL-9
M8
B'
SE
200
100
0
-100
FZ3
FZ2
FZ1
Shear
B
152mm Vertical Boreholes at Least 50m into Bedrock
M
152mm Vertical Boreholes to Depths of 150m to 443m
URL
76mm Cored Boreholes to Depths of 165m to 1083m
URL Lease Boundary
N
0
400m
M13
B34
M5
M10
B42
B43
M14
M11
URL-11
URL-1
B36
URL-3
B44
M4
M3
URL-6
URL-4
URL-5
M1
URL-7
URL-12
B35
M9
M2
URL-2
URL-14
URL-15
M7
URL-4
A
M6
M12
URL-13
B
A'
B'
Fractured Pink Granite
Relatively Unfractured Grey Granite
Fracture Zones
Borehole
Packer
A
SW
URL-4
M7
URL-2
M9
URL-5
M3
A'
NE
200
100
0
-100
-200
-300
FZ3
FZ2
FZ1
Shear



a) Drawdown in Observation Wells in FZ-2 in Response to Pumping at M1A (after 7400 min. of pumping), July 1983 test



b) Transmissivity (T) Pattern within FZ-2

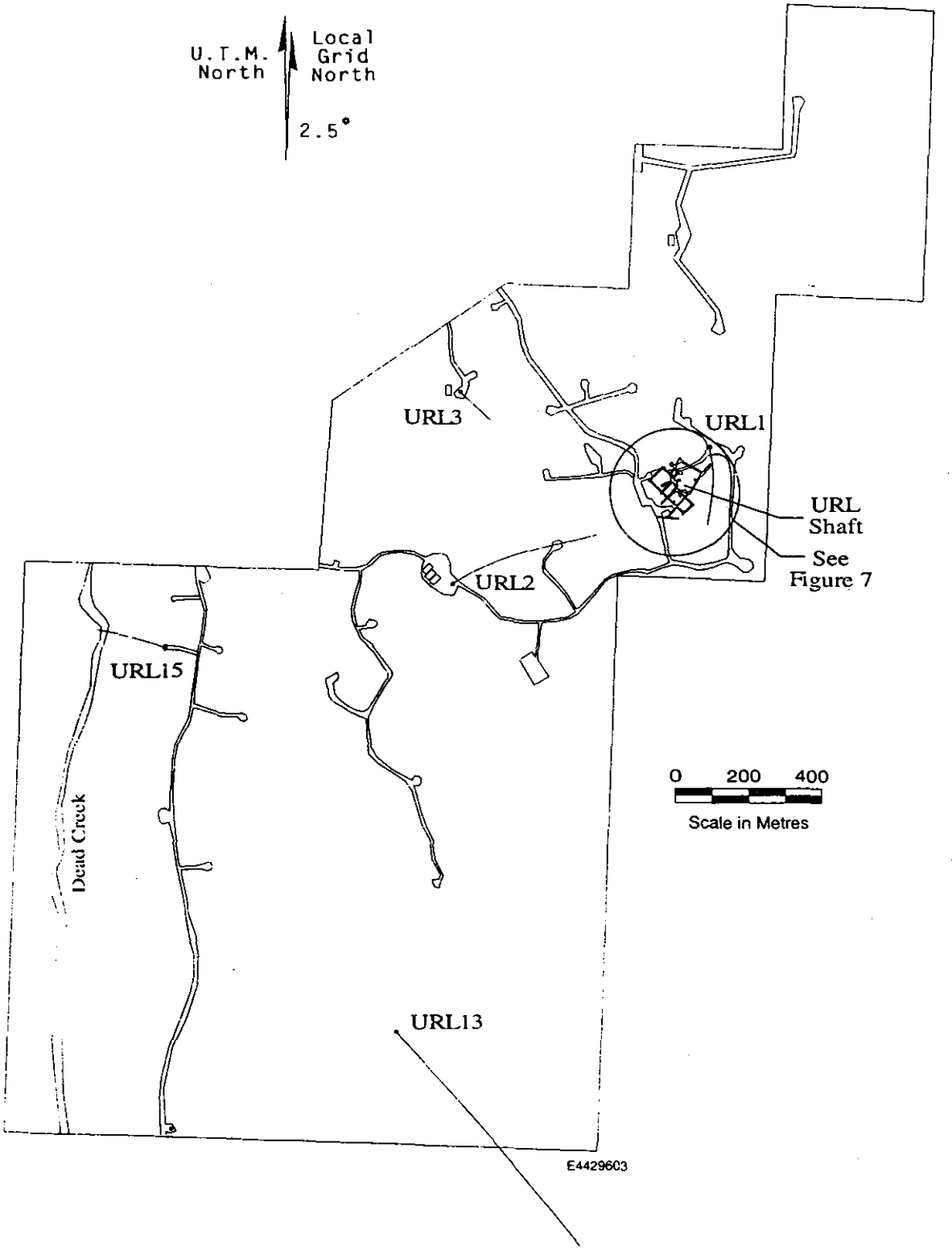


Figure 6 Location of boreholes collared at ground surface at the URL in which straddle packer injection tests were done in sparsely fractured rock.

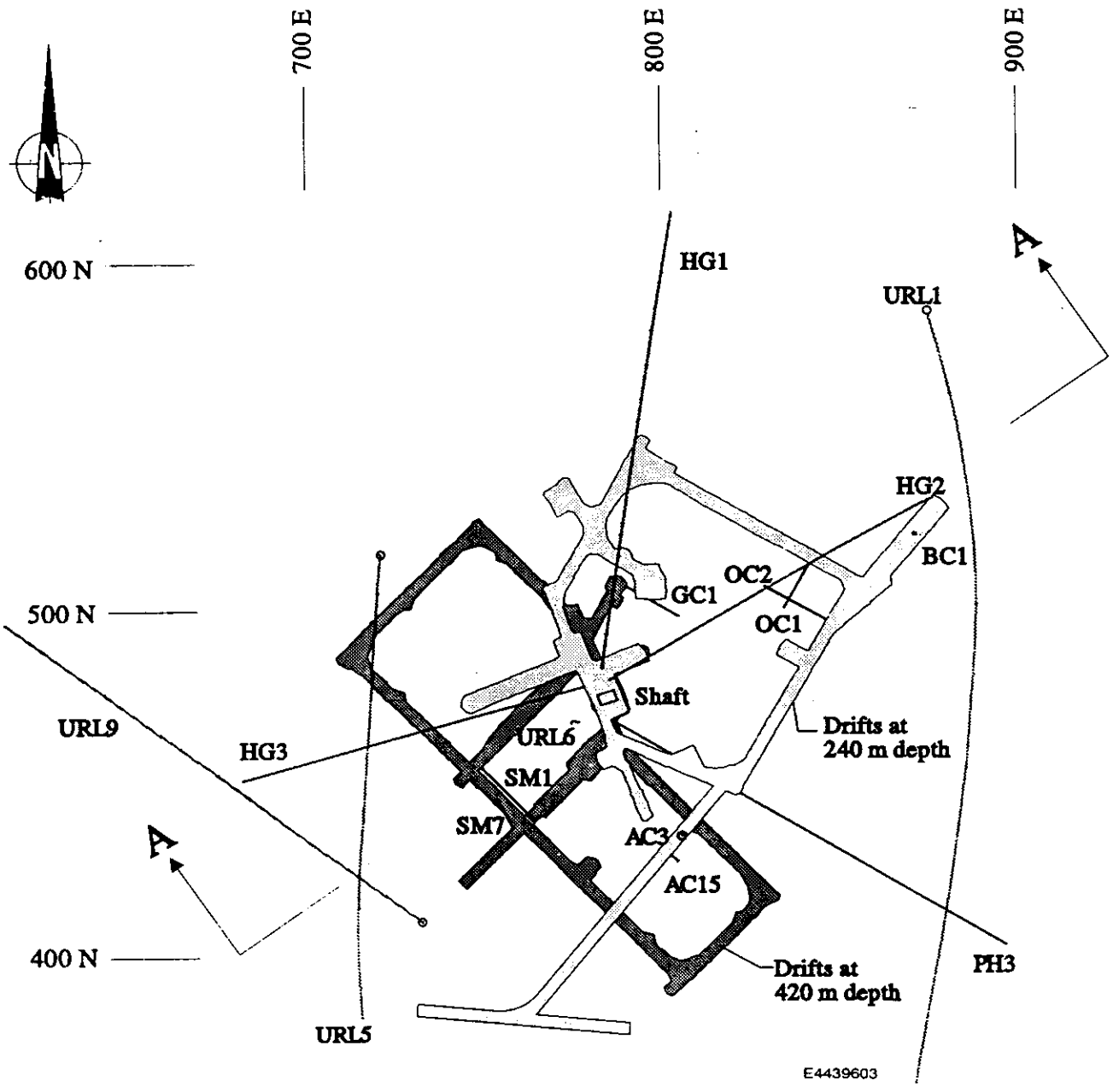


Figure 7 Plan view of drifts at the 240 m and 420 m depths, horizontal traces of surface boreholes URL1,5 and 9, underground boreholes used for water sampling and piezometric level monitoring, and the location of Section A-A (Figure 8) at the URL.

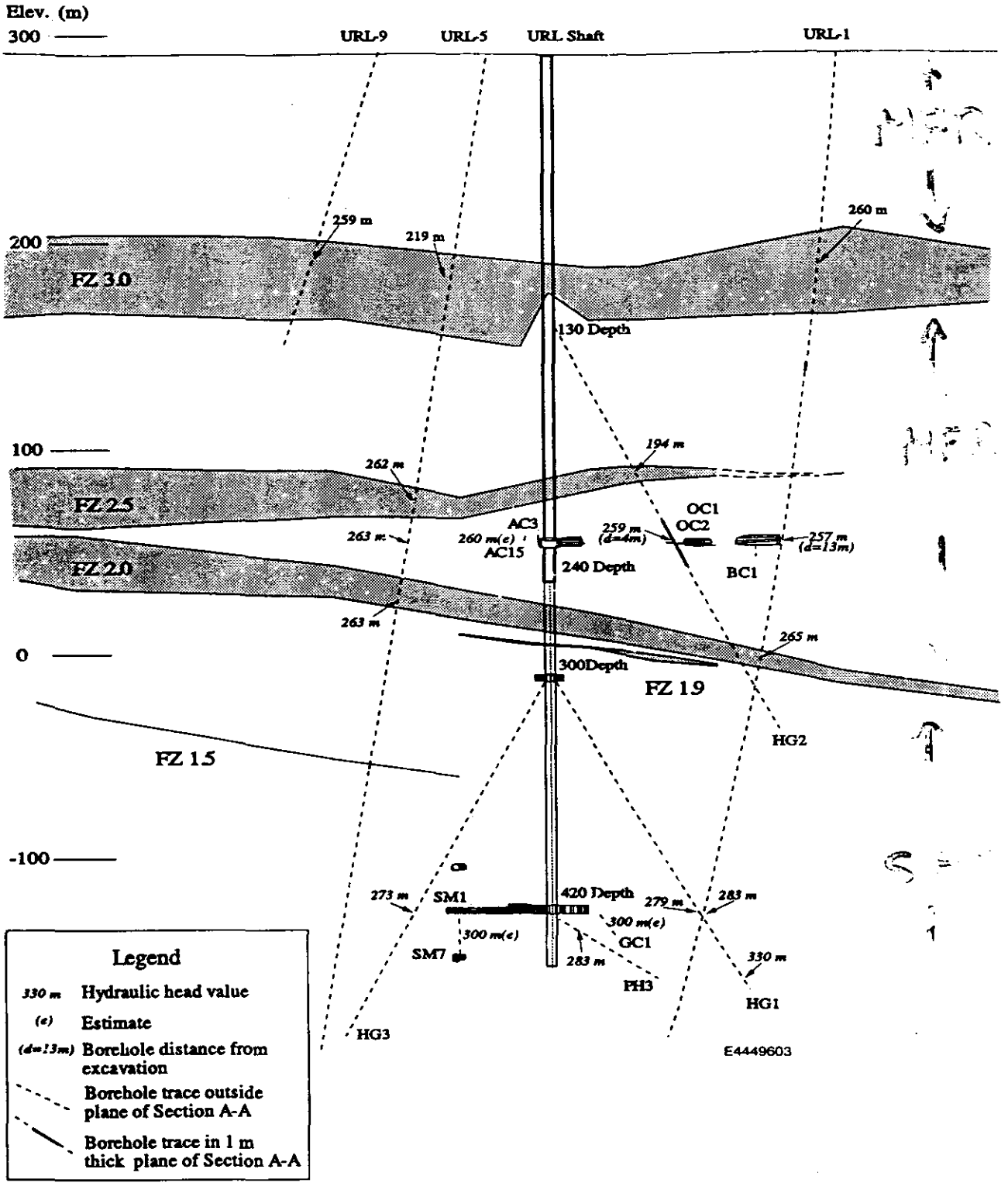
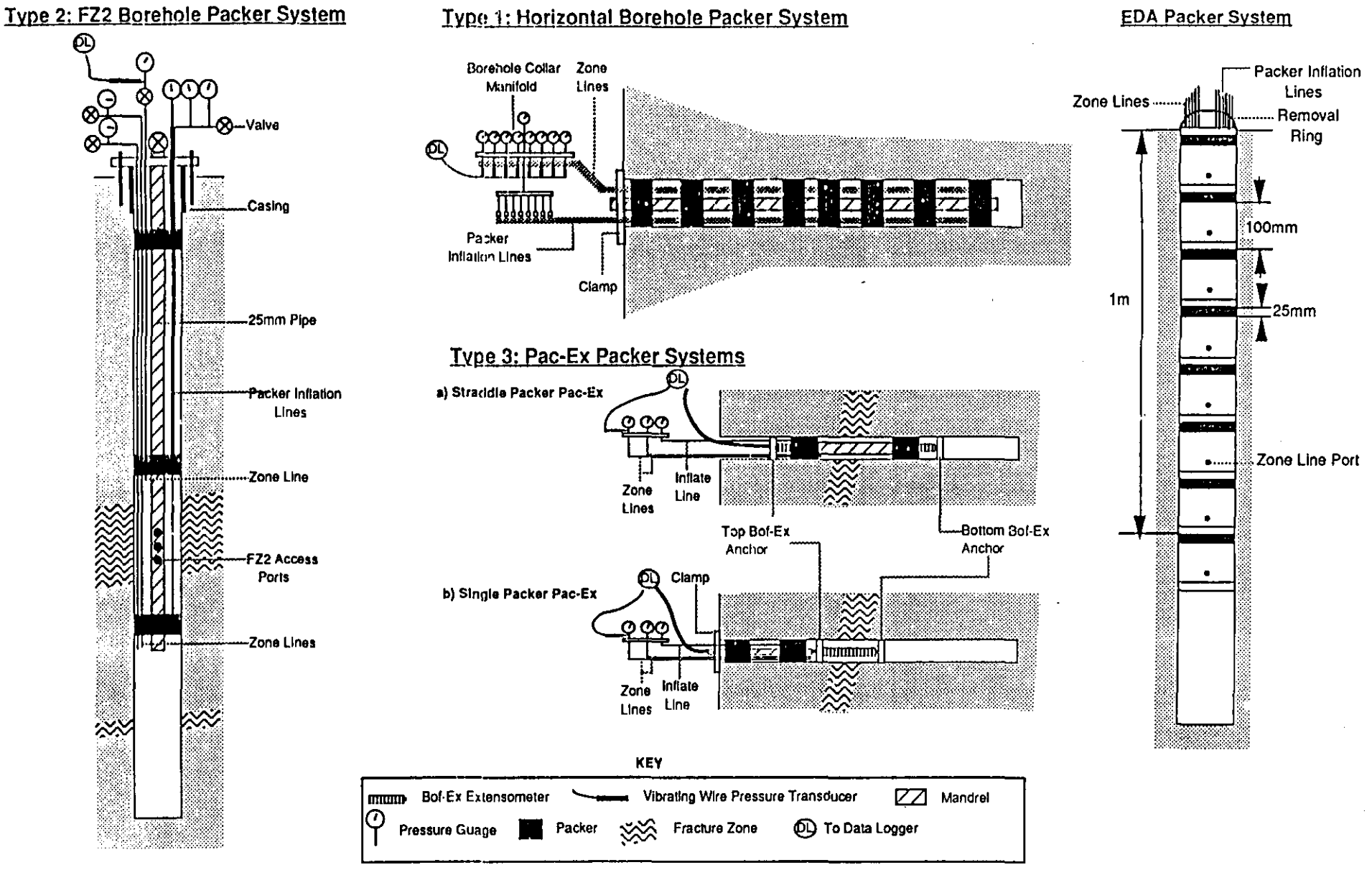
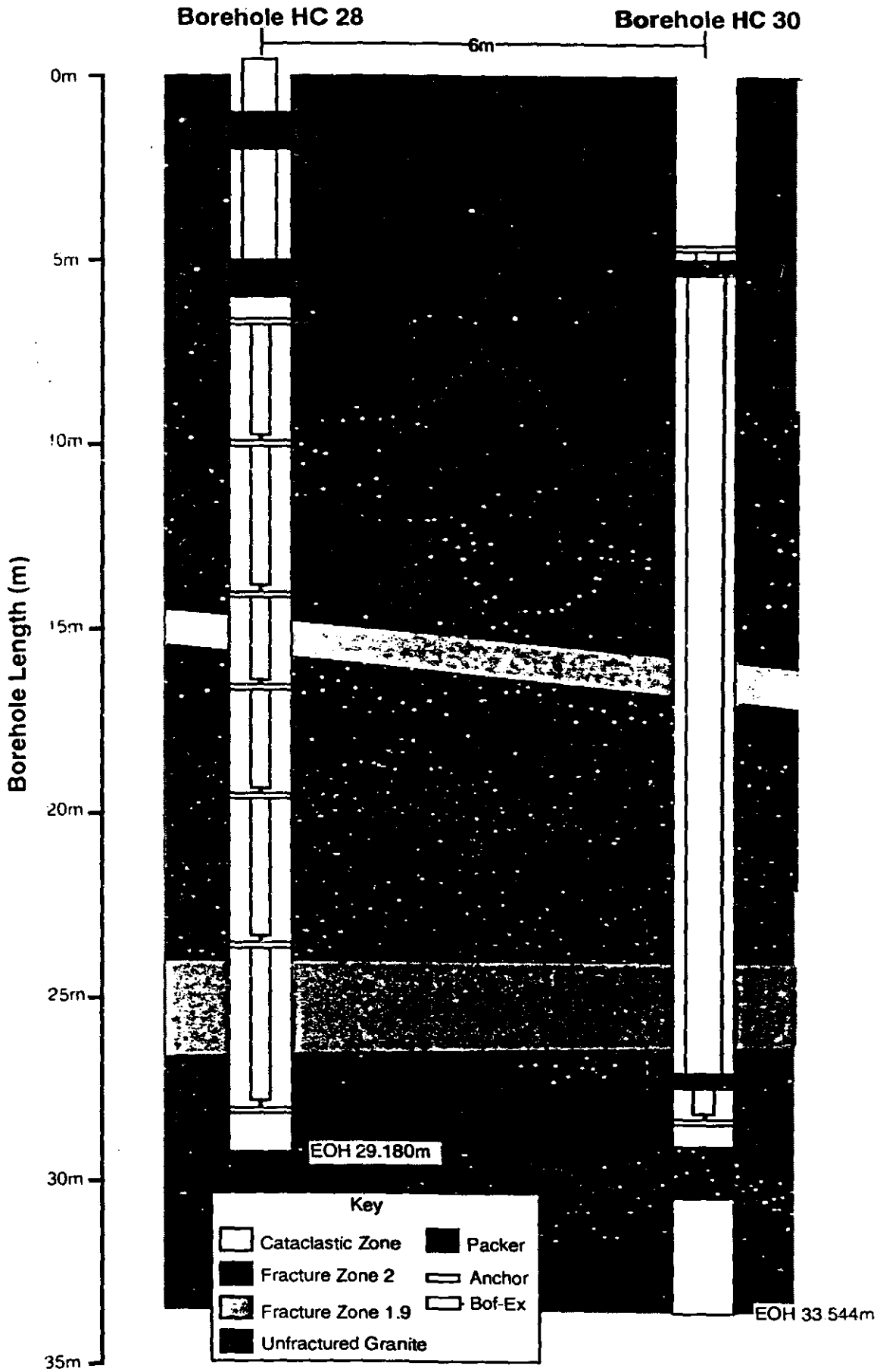


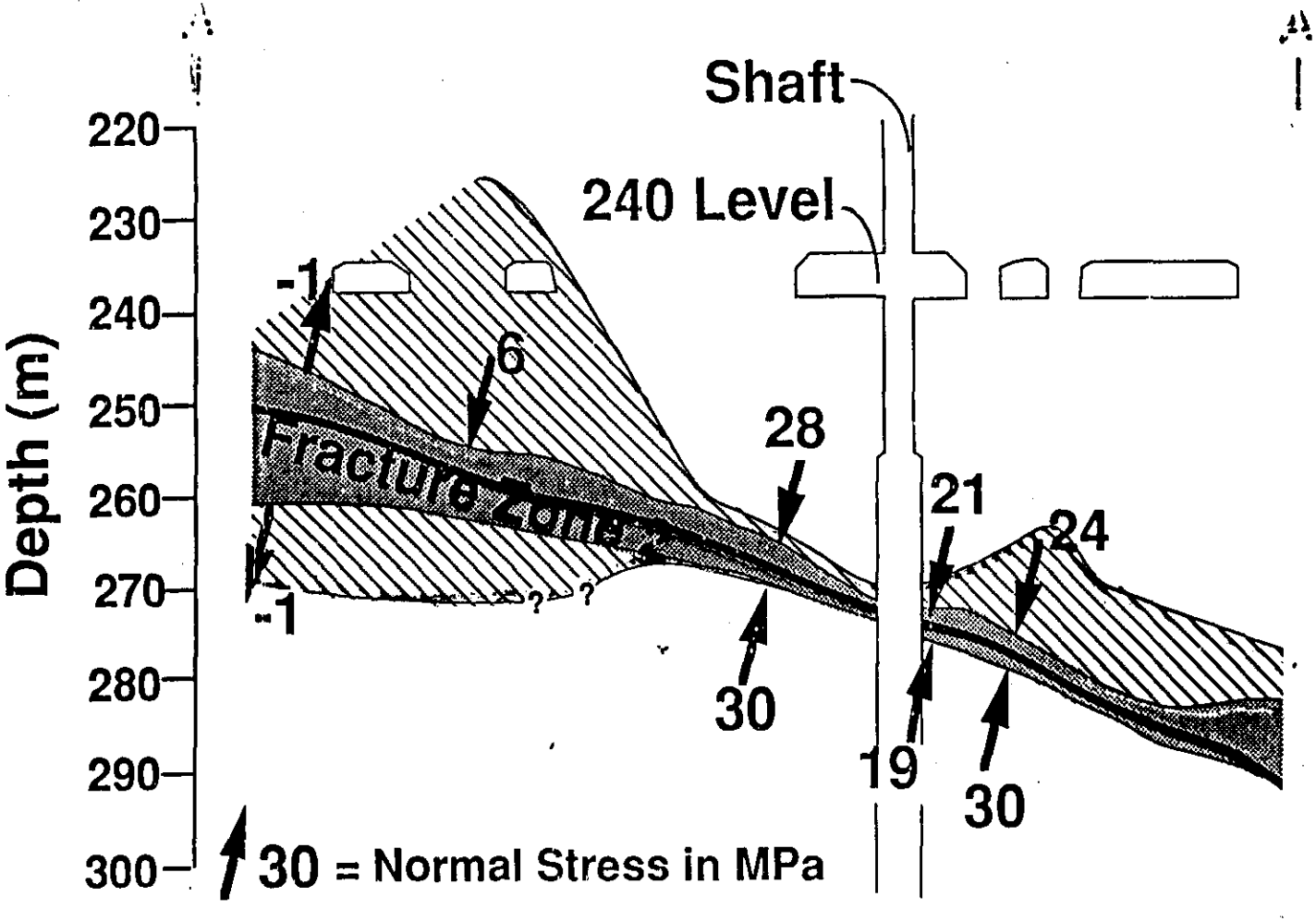
Figure 8 Section A-A (from Figure 7) showing vertical traces of boreholes and hydraulic head values at selected depths, and locations of boreholes where pore water seepages was collected.

Figure 1: Hydrogeological Packer Sytems for Underground Hydrogeological Characterization

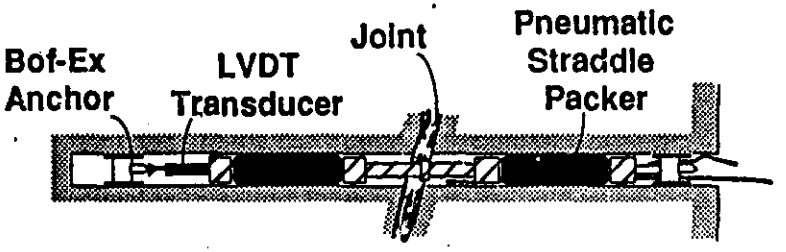



Borehole HC 28
Borehole HC 30
6m
0m
5m
10m
15m
20m
25m
30m
35m
Borehole Length (m)
EOH 29.180m
EOH 33.544m
Key
Cataclastic Zone
Fracture Zone 2
Fracture Zone 1.9
Unfractured Granite
Packer
Anchor
Bof-Ex

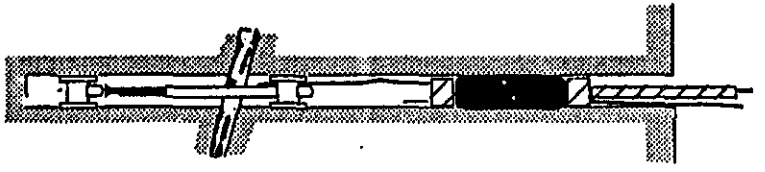
Normal Stress on FZ#2



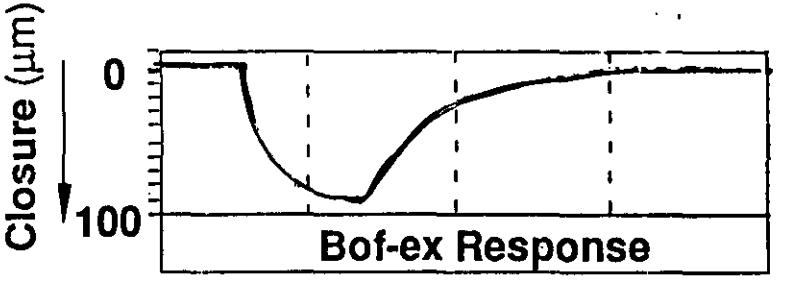
Pac-ex & Response

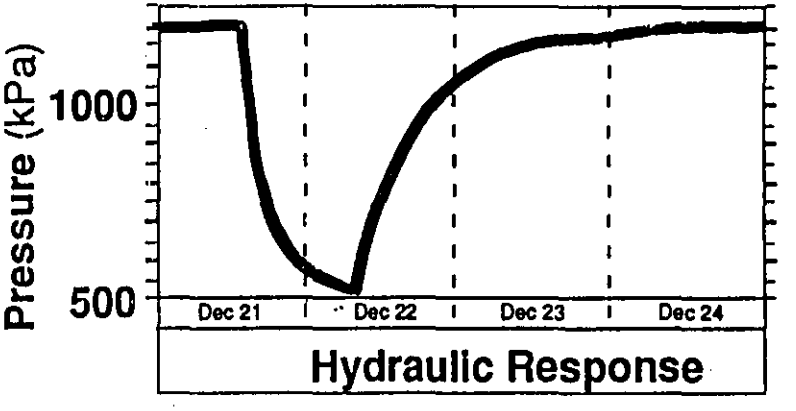


Double Packer Pac-ex

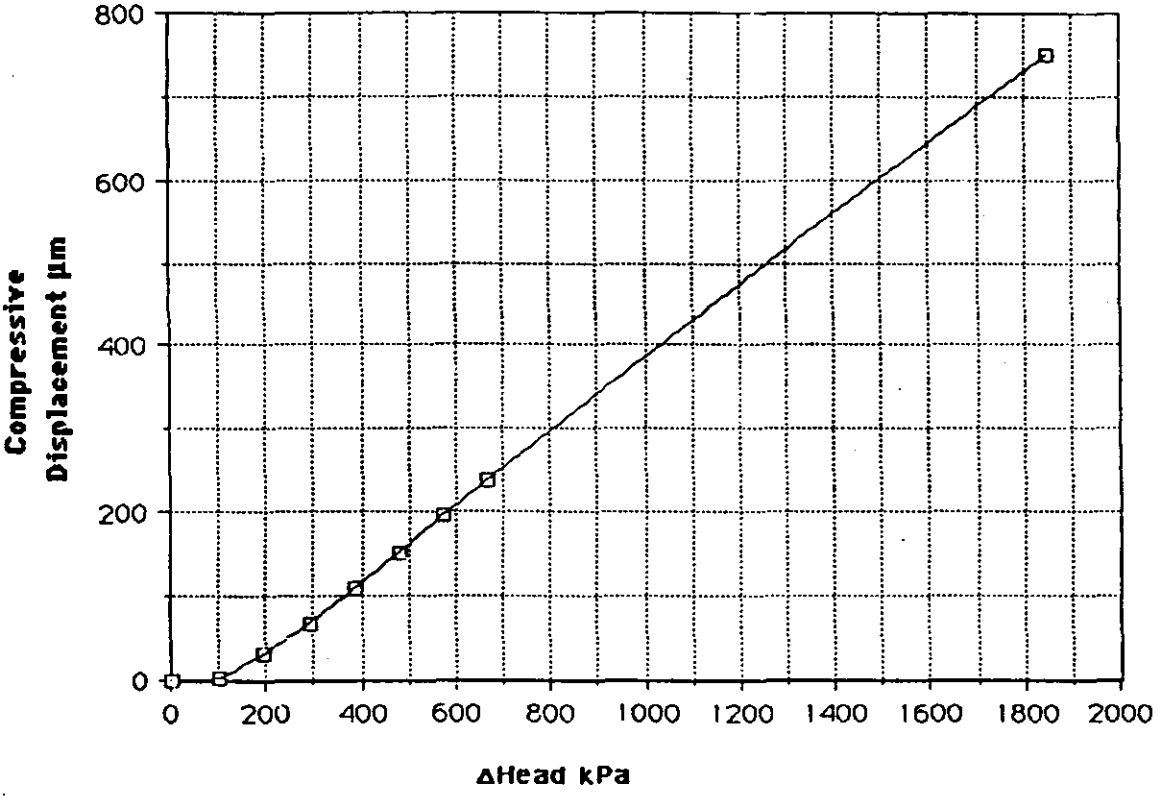


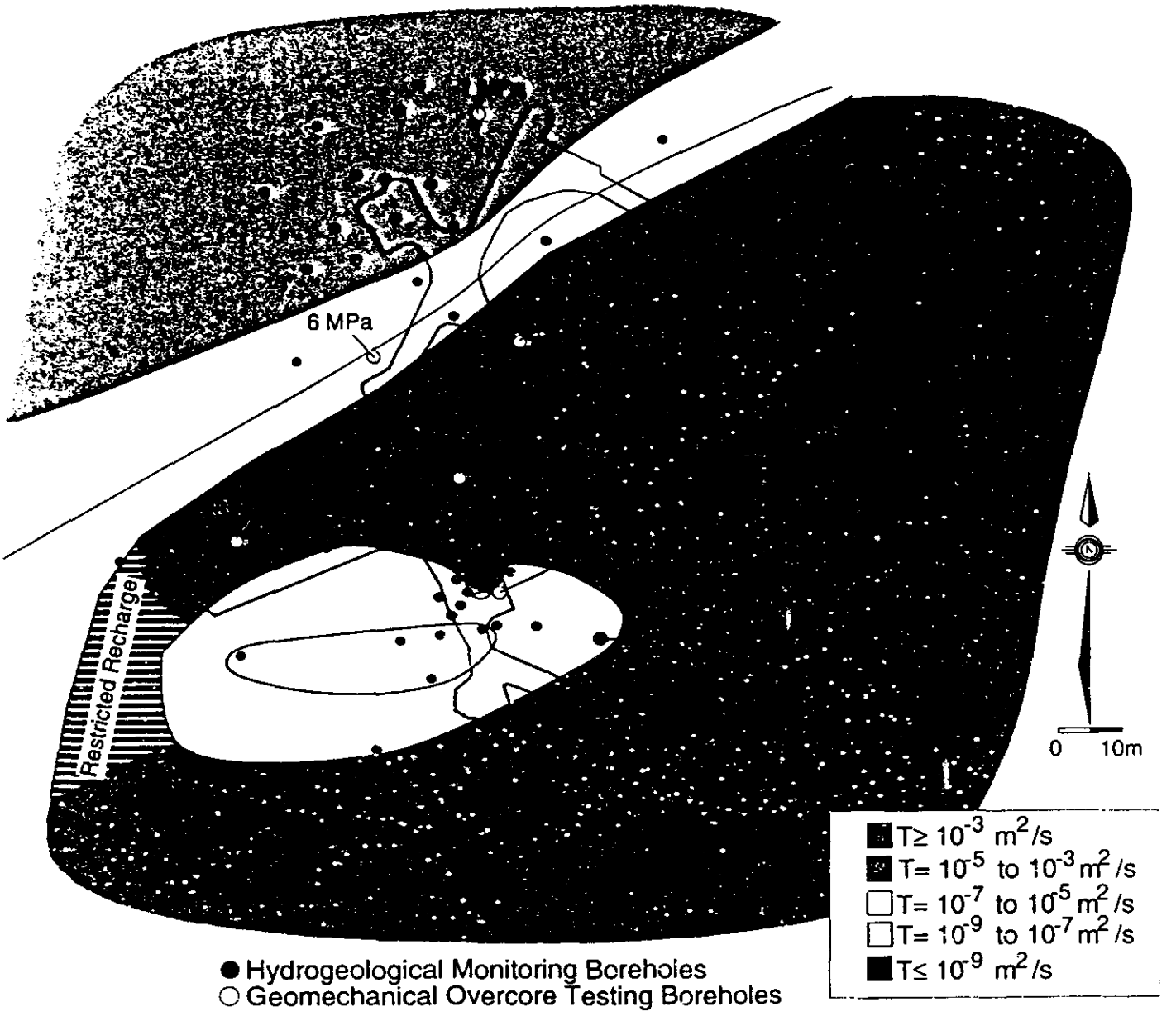
Single Packer Pac-ex

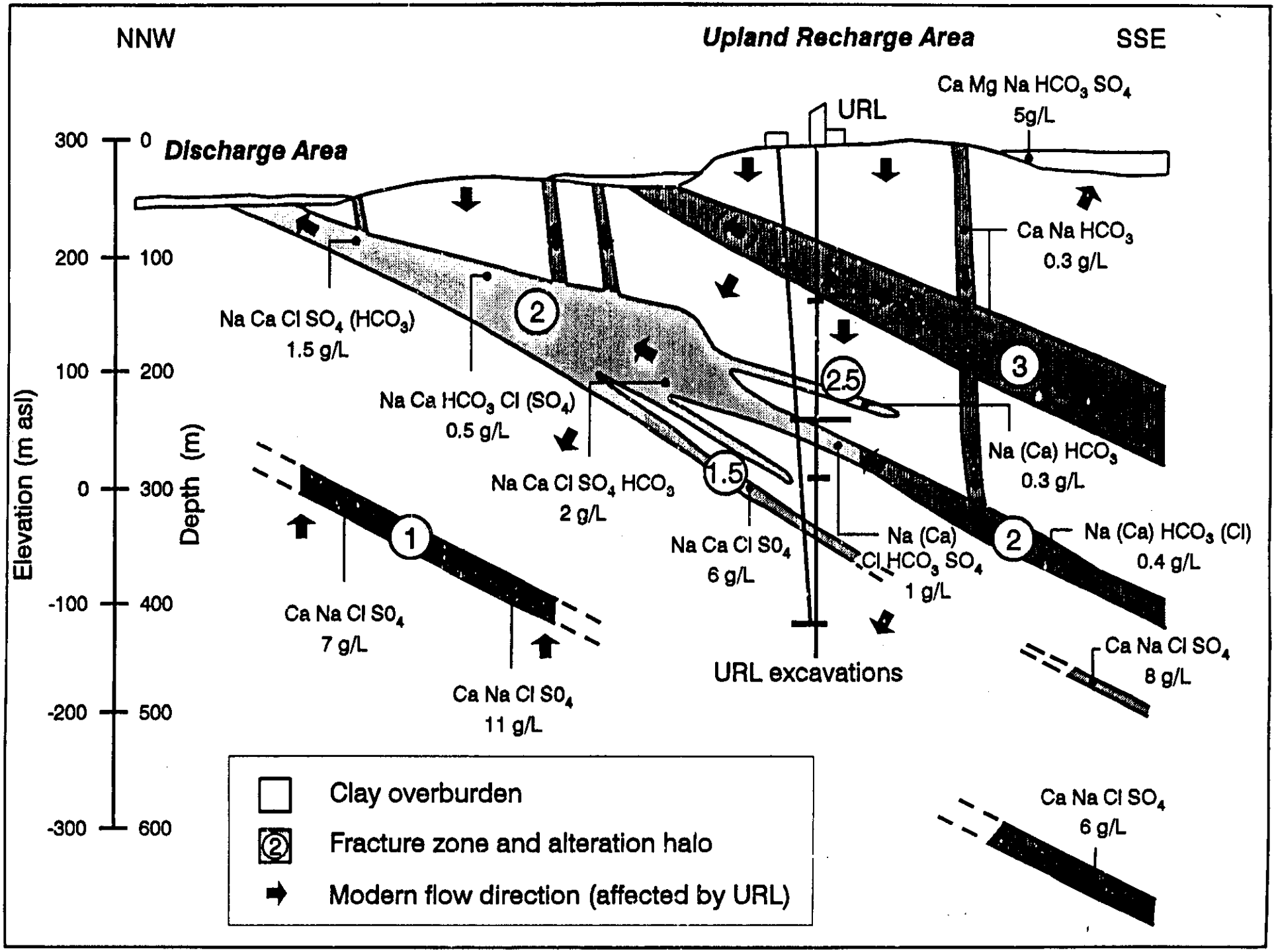




Fracturezone 2 Compressibility Testing
Borehole HC30 – Displacement vs ΔHydraulic Head




6 MPa
Restricted Recharge
N
0 10m
T≥ 10-3 m2/s
T= 10-5 to 10-3 m2/s
T= 10-7 to 10-5 m2/s
T= 10-9 to 10-7 m2/s
T≤ 10-9 m2/s
● Hydrogeological Monitoring Boreholes
○ Geomechanical Overcore Testing Boreholes


NNW
Upland Recharge Area
SSE
Discharge Area
URL
Ca Mg Na HCO3 SO4
5g/L
Ca Na HCO3
0.3 g/L
Na Ca Cl SO4 (HCO3)
1.5 g/L
Na Ca HCO3 Cl (SO4)
0.5 g/L
Na Ca Cl SO4 HCO3
2 g/L
Na Ca Cl S04
6 g/L
Na (Ca) Cl HCO3 SO4
1 g/L
Na (Ca) HCO3
0.3 g/L
Na (Ca) HCO3 (Cl)
0.4 g/L
Ca Na Cl S04
7 g/L
Ca Na Cl S04
11 g/L
URL excavations
Ca Na Cl SO4
8 g/L
Ca Na Cl SO4
6 g/L
Elevation (m asl)
Depth (m)
300
200
100
0
-100
-200
-300
0
100
200
300
400
500
600
1
1.5
2
2.5
3
Clay overburden
Fracture zone and alteration halo
Modern flow direction (affected by URL)

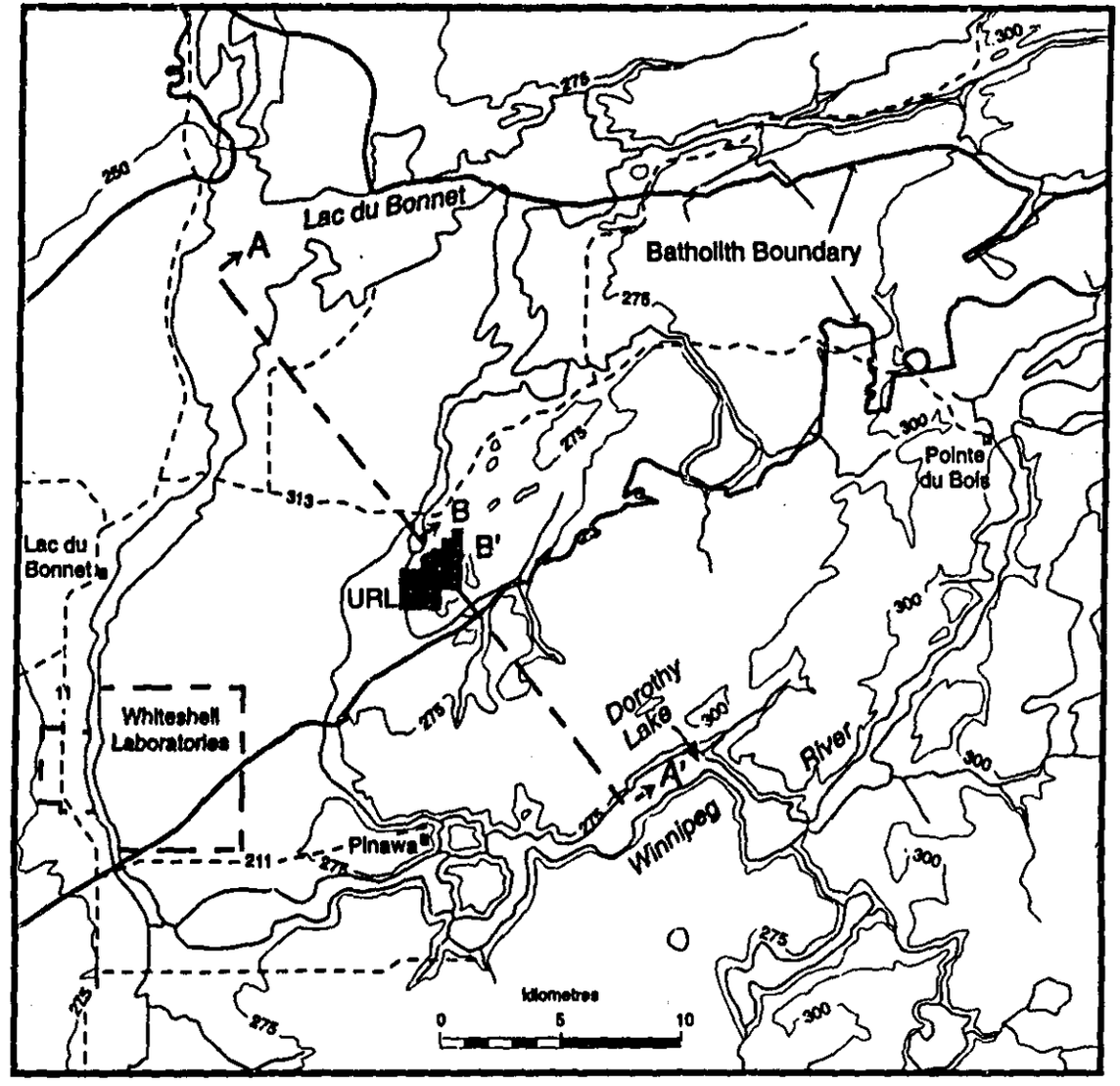


FIGURE 5.4.2: The Whiteshell Research Area showing the location of the two-dimensional numerical model, label AA'. This line is approximately along a regional groundwater flow line, i.e., there is little flow perpendicular to the plane.

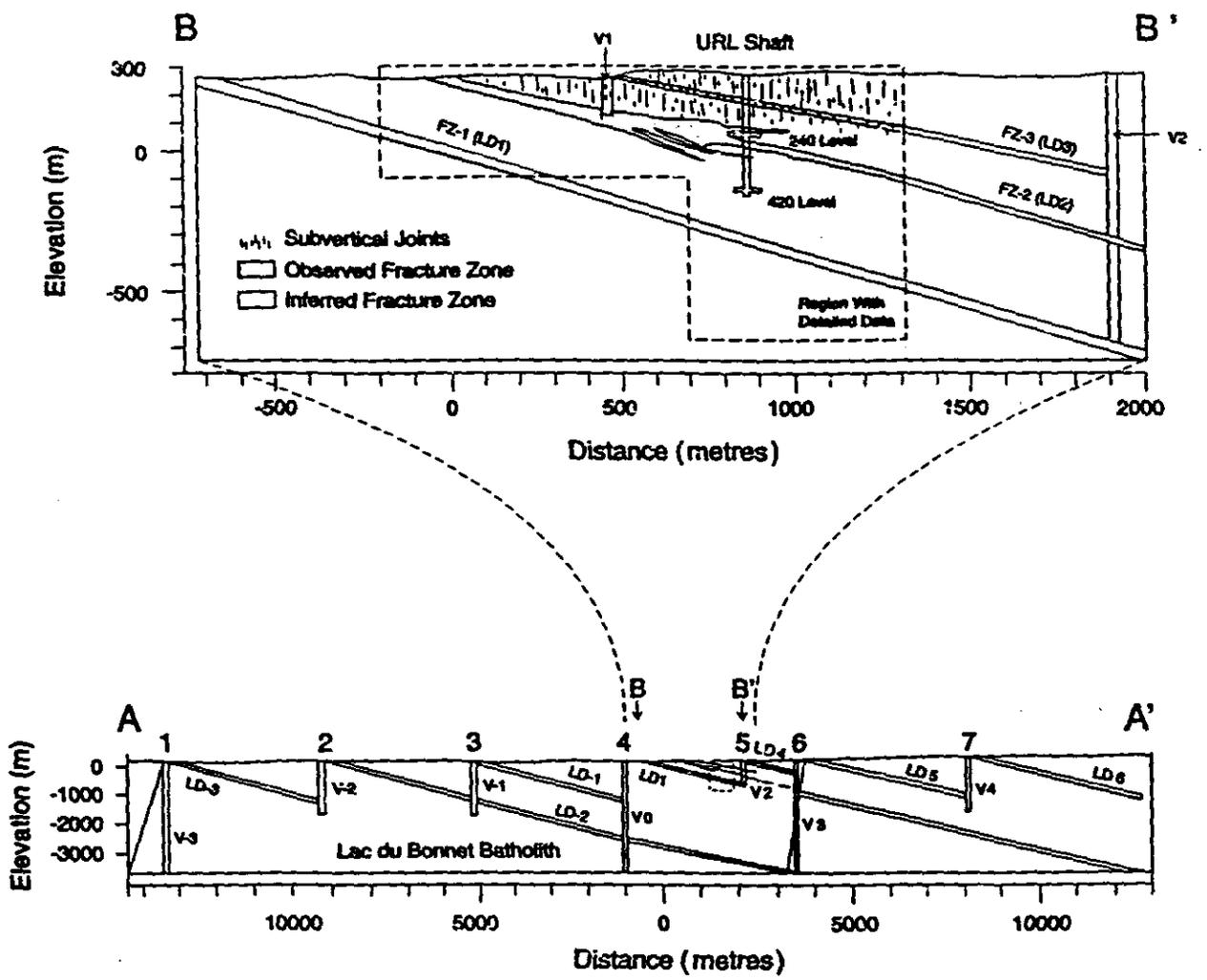
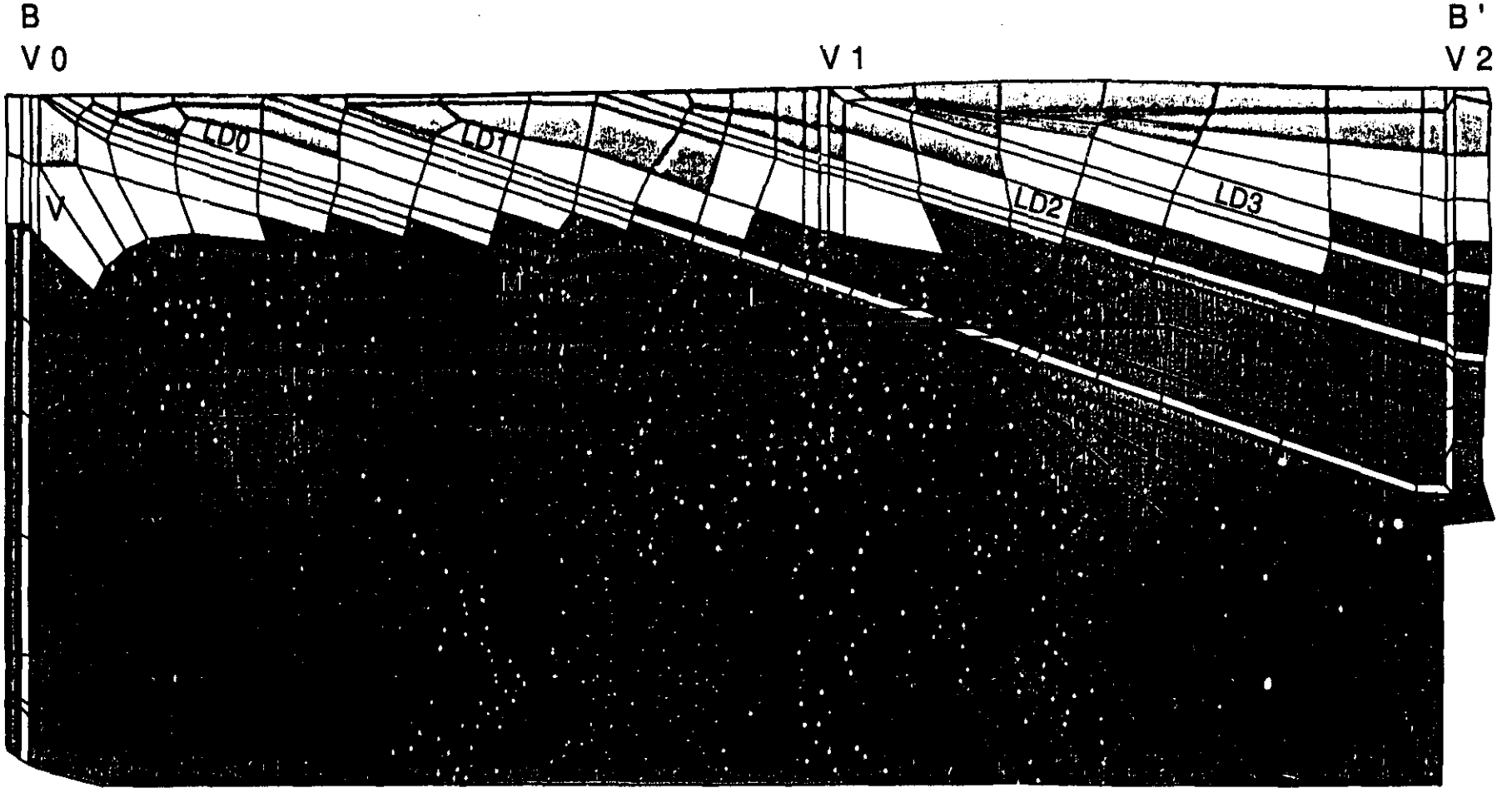
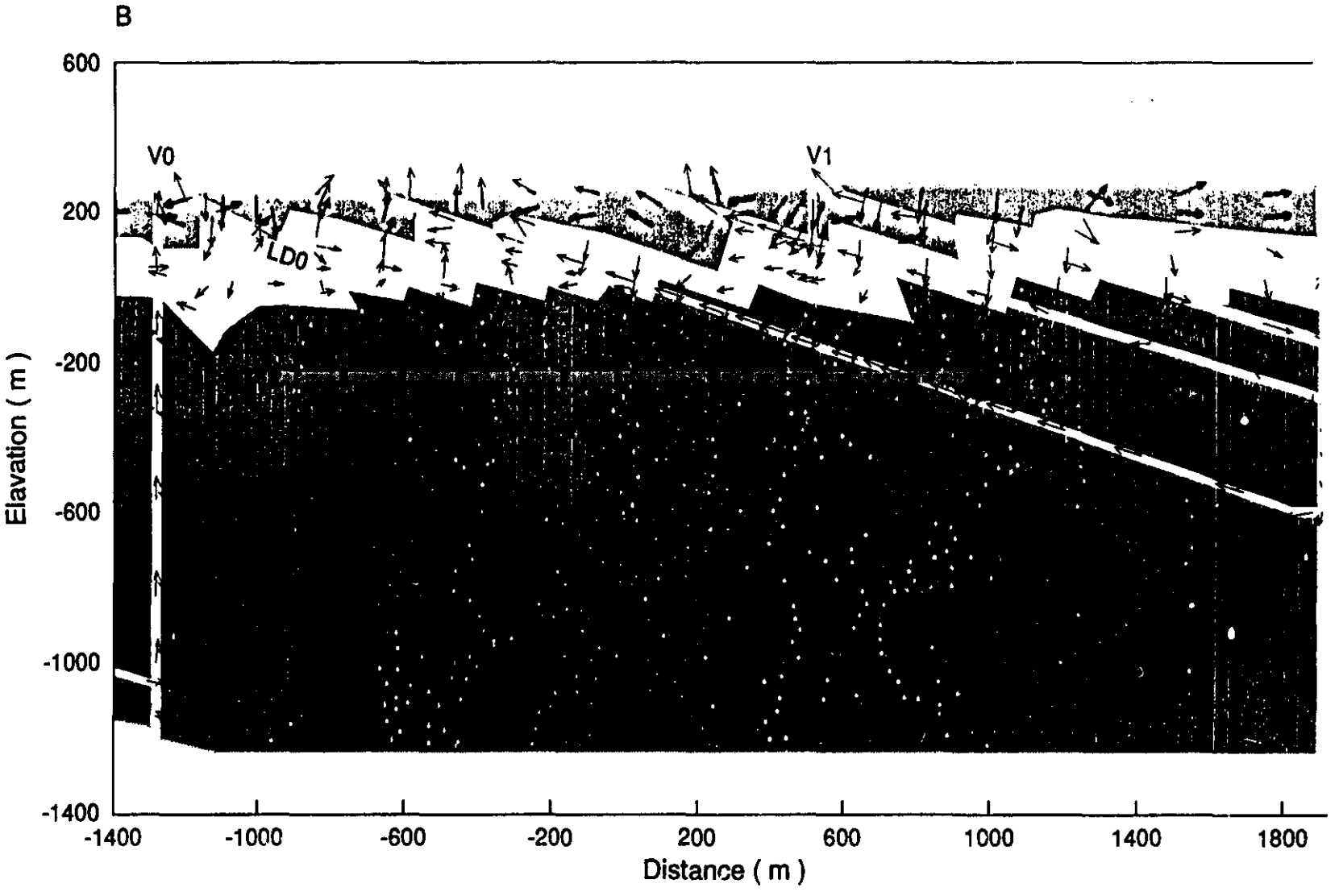


FIGURE 5.3.2: This figure illustrates in cross-section how the structural inferences from the region were combined with the conceptual model of the URL and how the geometry of the features in the conceptual model were regularized


B
V 0
V 1
B '
V 2
LD0
LD1
LD2
LD3
V
Vault
Fracture zone
-400
0.0
400 m
* Location Selected for Plots of Predicted Temperature and Velocity Versus Time


B
600
200
-200
-600
-1000
-1400
V0
V1
LD0
Elavation (m)
-1400
-1000
-600
-200
200
600
1000
1400
1800
Distance (m)

HYDROGEOLOGICAL ASPECTS:

- *HOST AREA SCREENING*
- *POTENTIAL CANDIDATE AREA EVALUATION*
- *CANDIDATE AREA CHARACTERIZATION*
- *FAVOURABLE CANDIDATE SITE CHARACTERISTICS*
- *CANDIDATE SITE CHARACTERIZATION*
- ***RESEARCH AND DEVELOPMENT***

RESEARCH AND DEVELOPMENT:

- *IN-HOUSE VERSUS CONTRACTED TECHNICAL EXPERTISE*
- *ACADEMIC AND PRACTICAL TRAINING*
- *TOOL DEVELOPMENT*
- *NATIONAL AND INTERNATIONAL SUPPORT*

IN-HOUSE VERSUS CONTRACTED TECHNICAL EXPERTISE

SCIENTIFIC DISCIPLINES:

ENVIRONMENT;
GEOLOGY;
GEOPHYSICS;
HYDROGEOCHEMISTRY
HYDROLOGY;
HYDROGEOLOGY;
HYDRAULICS;
GEOMECHANICS
MATHEMATICAL MODELLING

DEVELOP BROAD HYDROGEOLOGICAL EXPERTISE BASE:

INTERNATIONAL CONSULTANTS;
THAI GOVERNMENT AGENCY STAFF;
THAI UNIVERSITY STAFF;
PRIVATE CONSULTANTS AND CONTRACTORS

SPREAD INVOLVMENT AND SUPPORT:

PROMOTES THAI RESEARCH AND DEVELOPMENT;
PROMOTES MUTUAL UNDERSTANDING AND TRUST;
PROMOTES INTERNATIONAL RESPECT