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Geology and Geotechnical Considerations of the SSC Site in Texas:

A Tale of Four Tunnels

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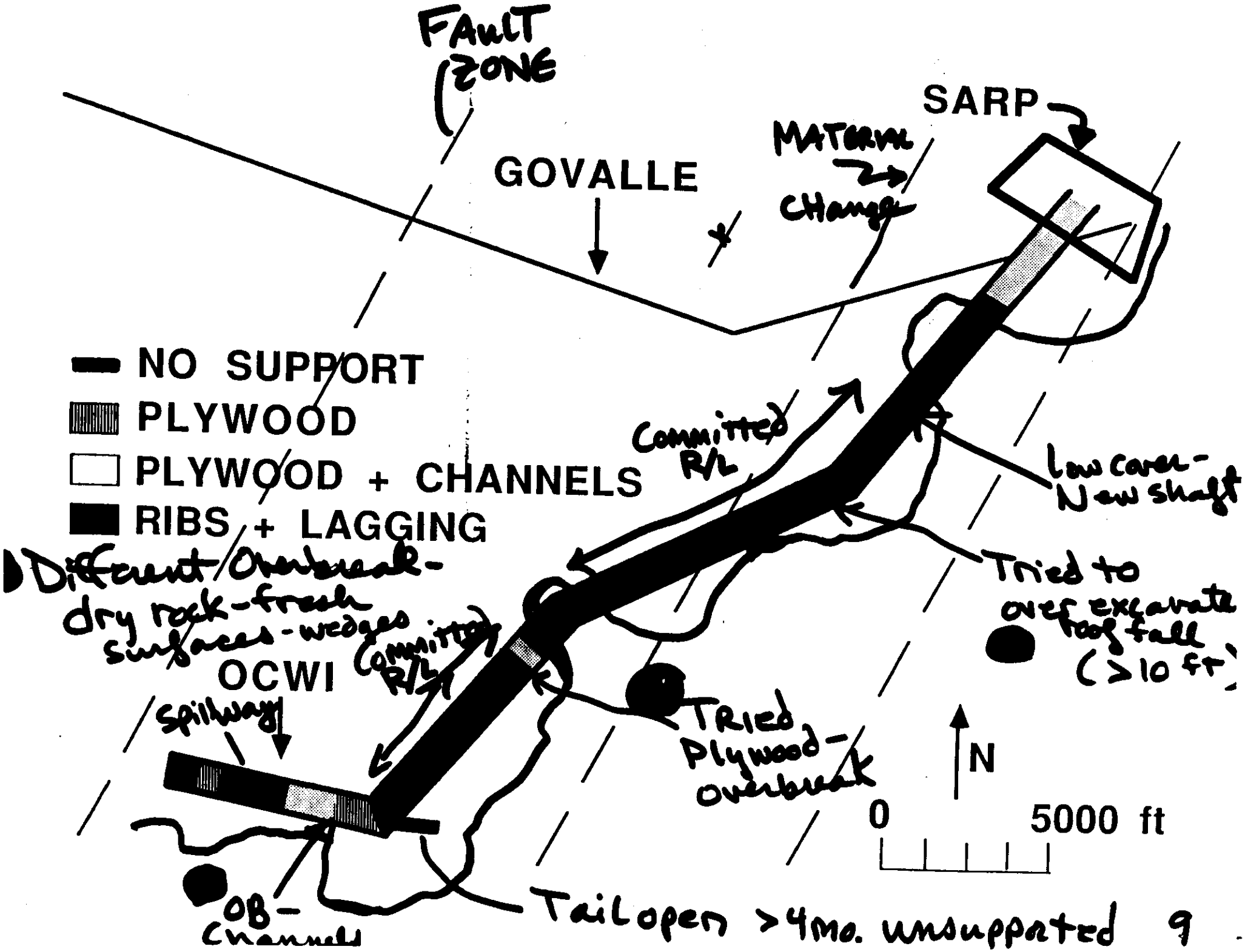
SSC Laboratory at Lawrence Berkeley Laboratory

A TALE OF FOUR TUNNELS

	Approximate Excavated Diameter	Length	Completion
ACWI	≈ 10 ft	57,700 ft (25% in Taylor)	1975
OCWI	≈ 10 ft	50,000 (65% in Taylor)	1985, 1986
Govalle	≈ 10 ft	43,000 (60% in Taylor)	1987
San Antonio/ San Pedro	25 ft	22,400 (100% in Taylor)	?


FAULT ZONE
SARP
MATERIAL CHANGE
GOVALLE
NO SUPPORT
PLYWOOD
PLYWOOD + CHANNELS
RIBS + LAGGING
Committed R/L
Low cover - New shaft
Different/Overbreak - dry rock - fresh surfaces - wedges
Tried to over excavate roof fall (>10 ft)
OCWI
Committed R/L
spillway
Tried Plywood - overbreak
N
0
5000 ft
OB - Channels
Tail open >4mo. unsupported

OPTIMISTIC

OCWI

32,365 ft in Taylor

Support	Distance (%of Total)	Advance (ft/day)
Ribs (II)	9	130
Ribs (IV)		40
Required	8	
Regardless	54	122
Plywood	9	125
Plywood/ Channels	20	118

expansion Ring

Geotech

- Low cover
- slaking
- grippers
- invert
- some faulted areas

but

big stick on coring

and

Dice positive statems on core log

7

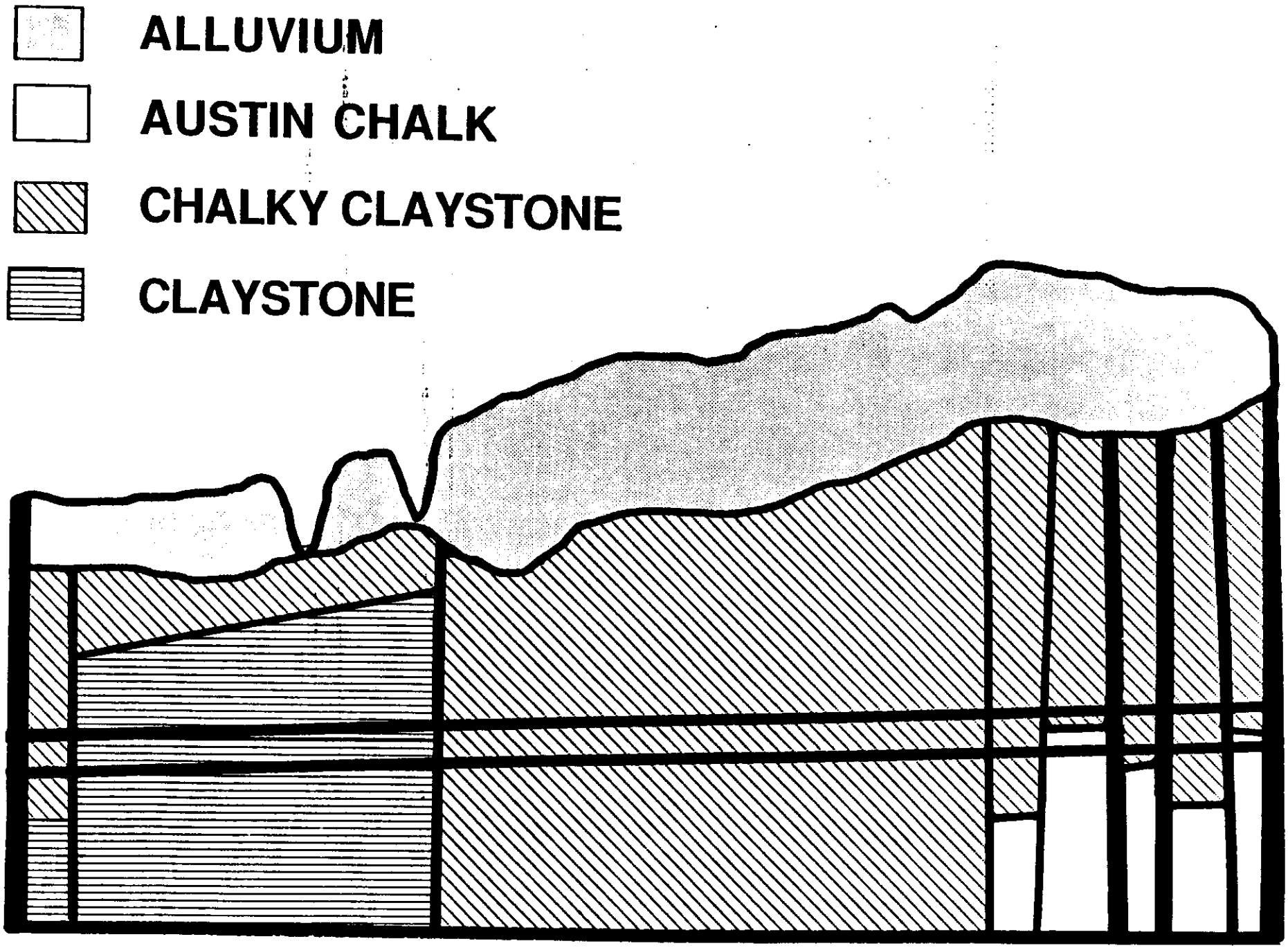
OCWI PROBLEMS

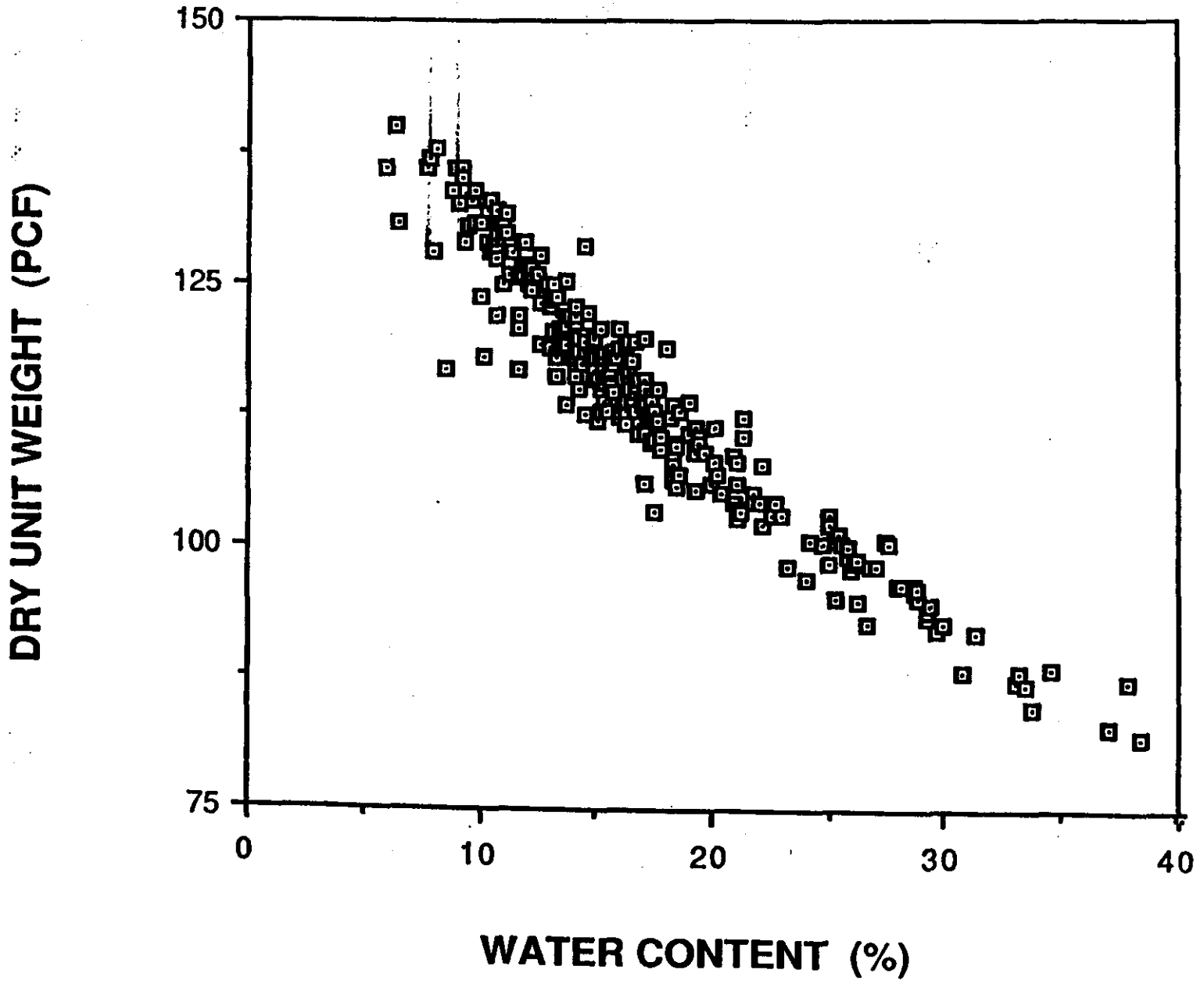
1. Alluvium/Rock Interface - unexpected Channels
2. Weathered, Seamy Rock - esp. near Onion Creek
3. Blocky, Slickensided Rock - in places other than anticipated
   - 2 kinds
     - wet, slick
     - dry OB w/ fresh surface
4. TBM Reaction to Thrust and Torque
   - Reaction Ring

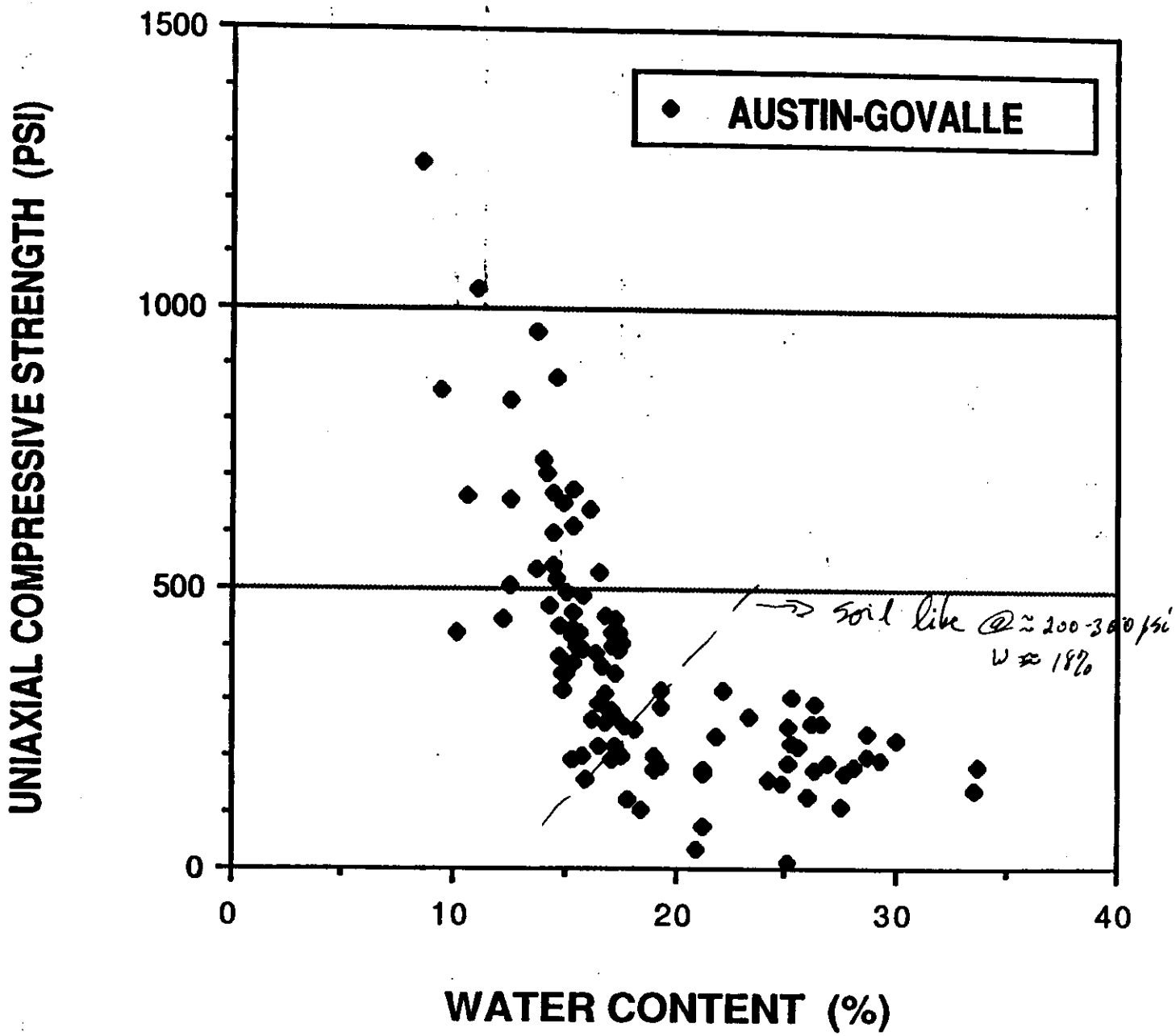
→ loosening
→ softening in shallow cover

w < 18% - elastic rock, Maybe blocky

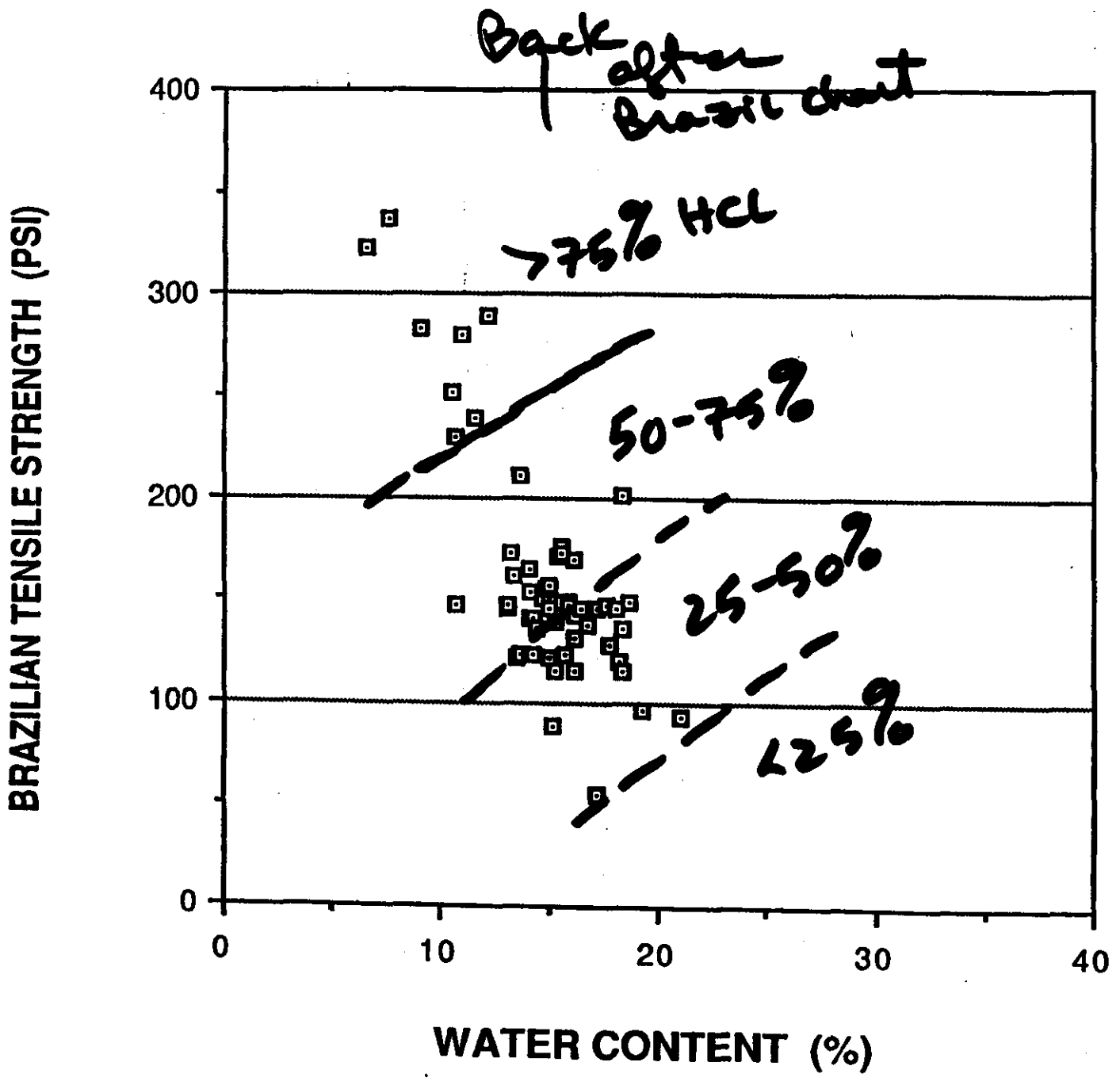
w > 18% - Seamy rock


ALLUVIUM
AUSTIN CHALK
CHALKY CLAYSTONE
CLAYSTONE


150
125
100
75
DRY UNIT WEIGHT (PCF)
0
10
20
30
40
WATER CONTENT (%)

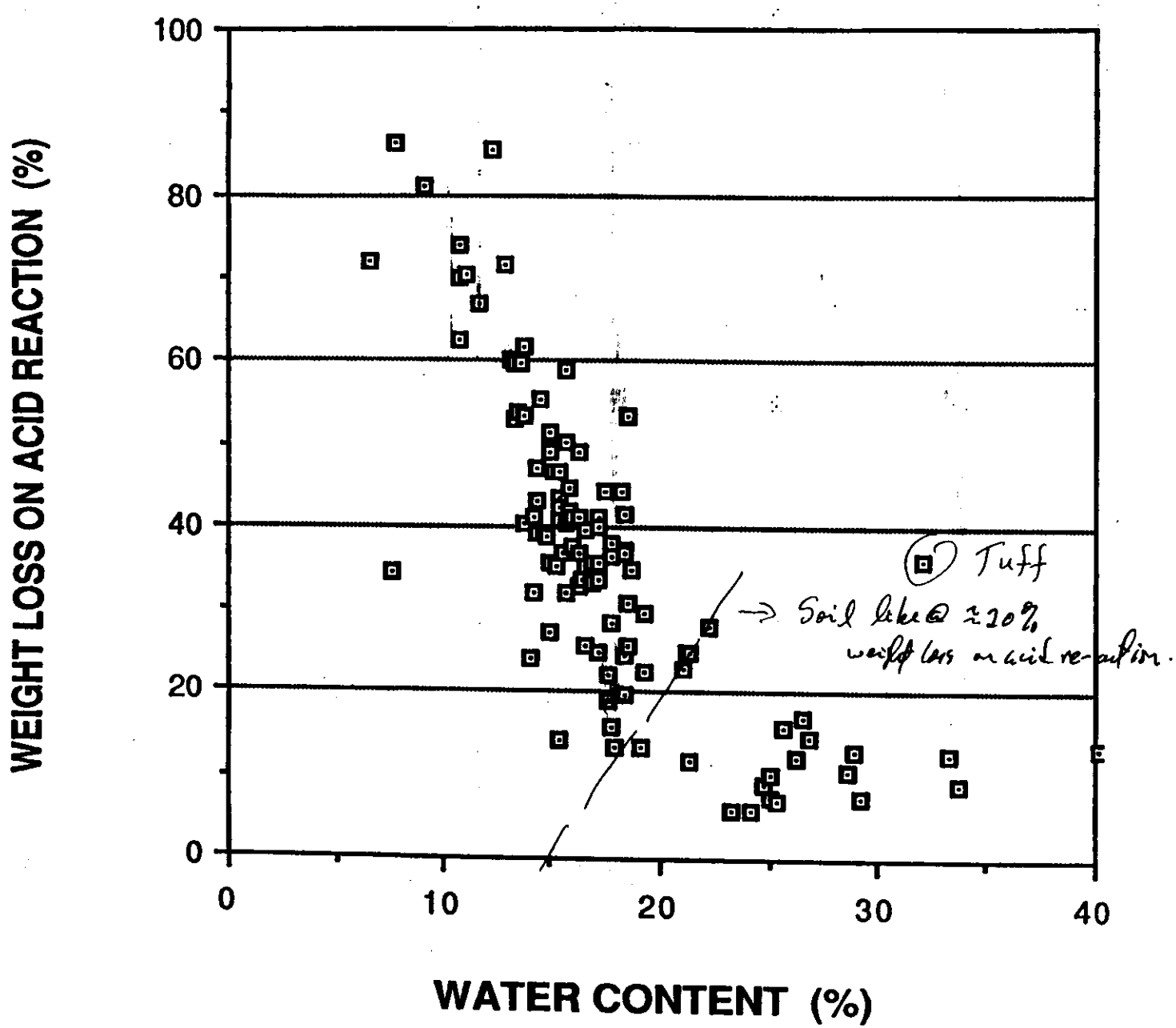

AUSTIN-GOVALLE
UNIAXIAL COMPRESSIVE STRENGTH (PSI)
1500
1000
500
0
0
10
20
30
40
WATER CONTENT (%)
soil like @ ≈ 200-300 psi
w ≈ 18%

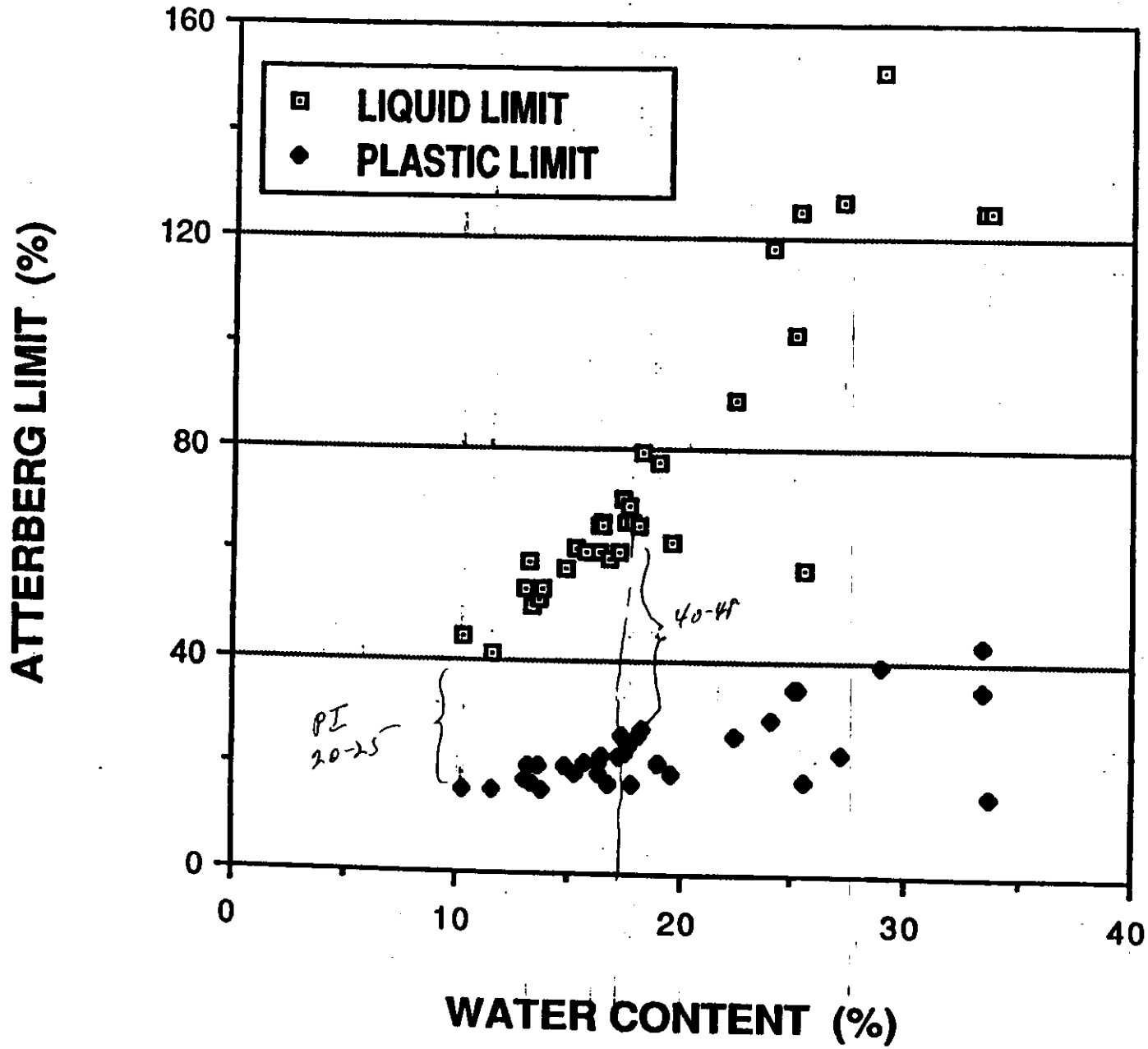
Look at rock-like Mat'l

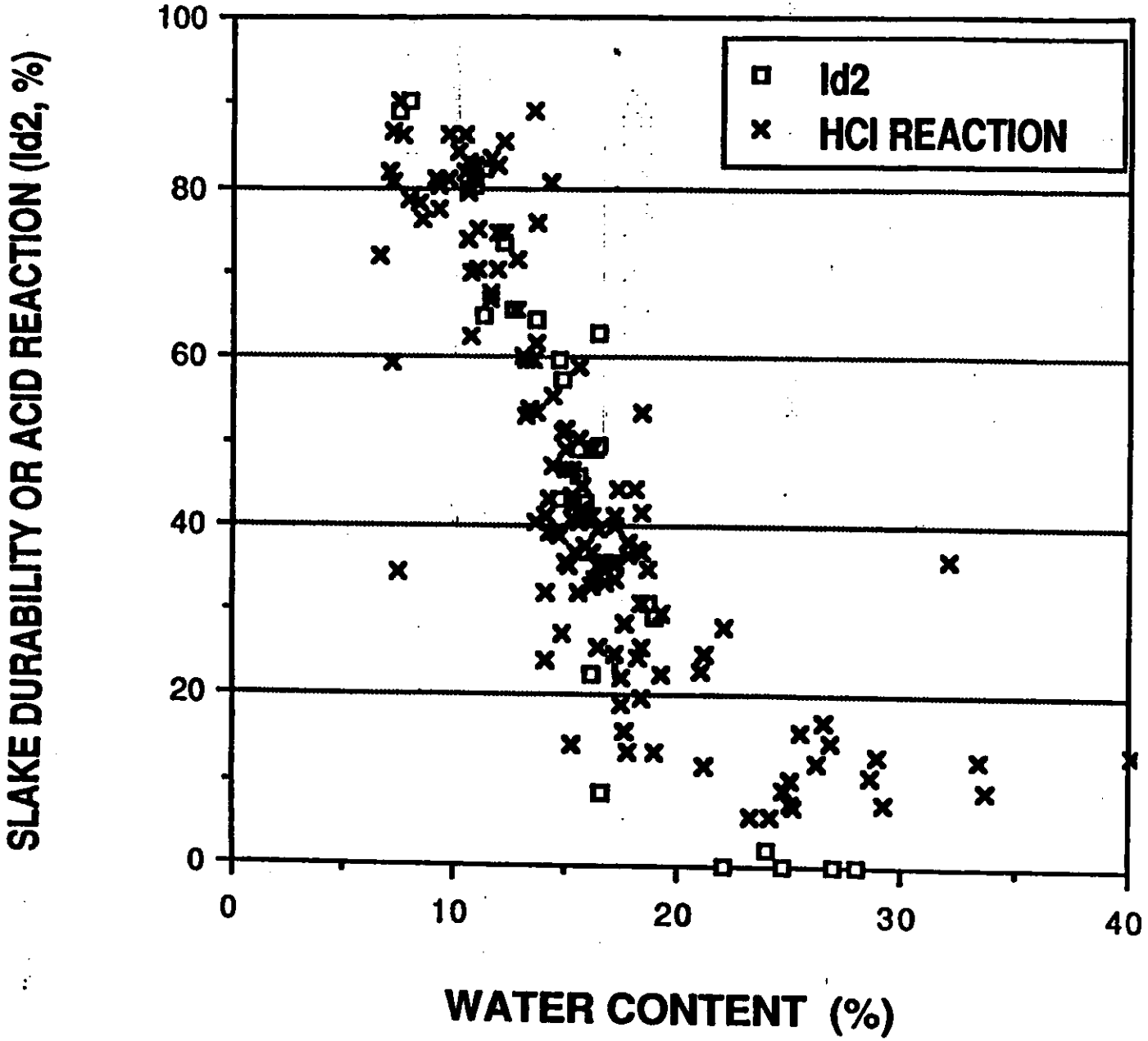


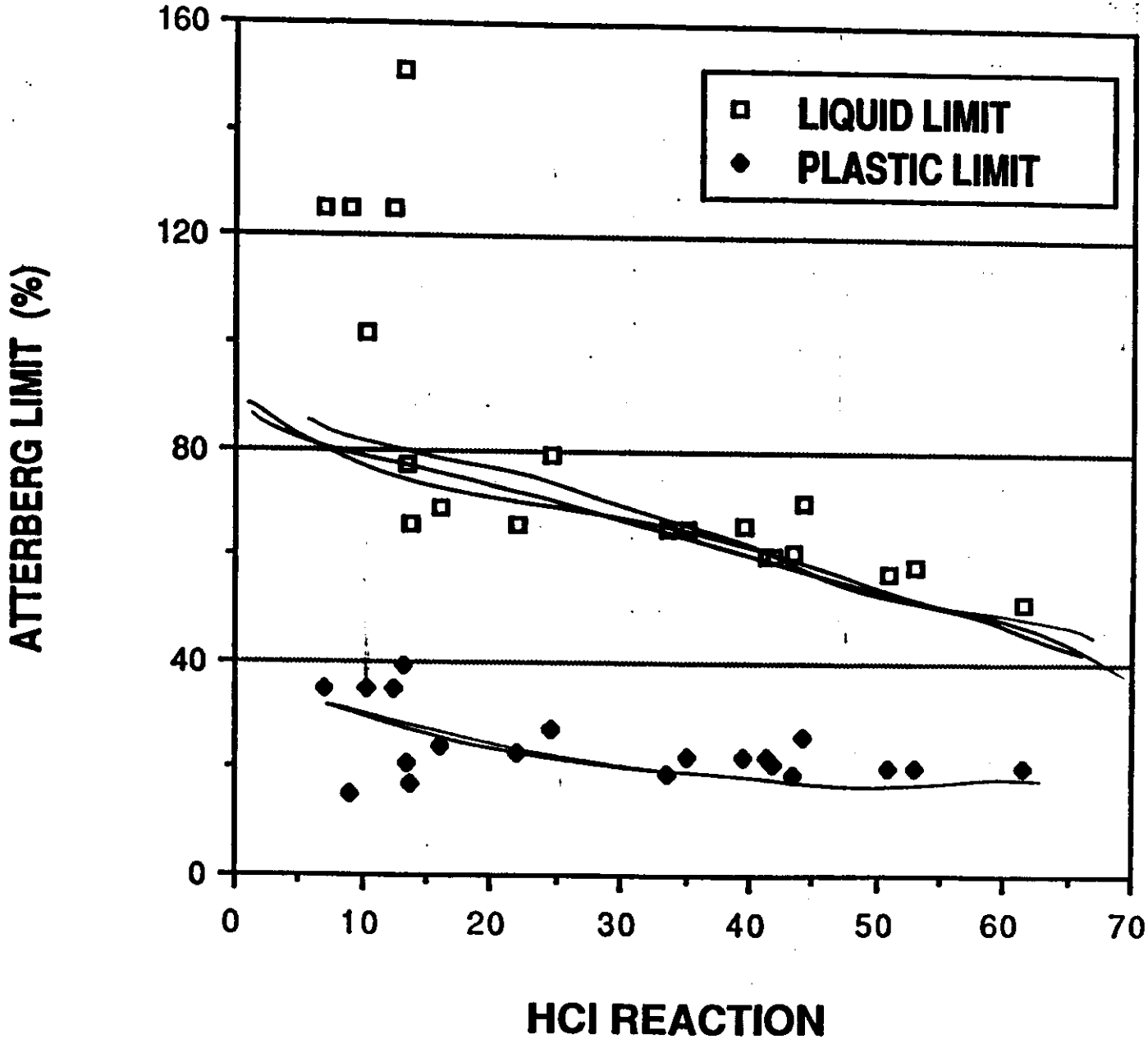
ALSO TRIED Point load — too much indentation for most

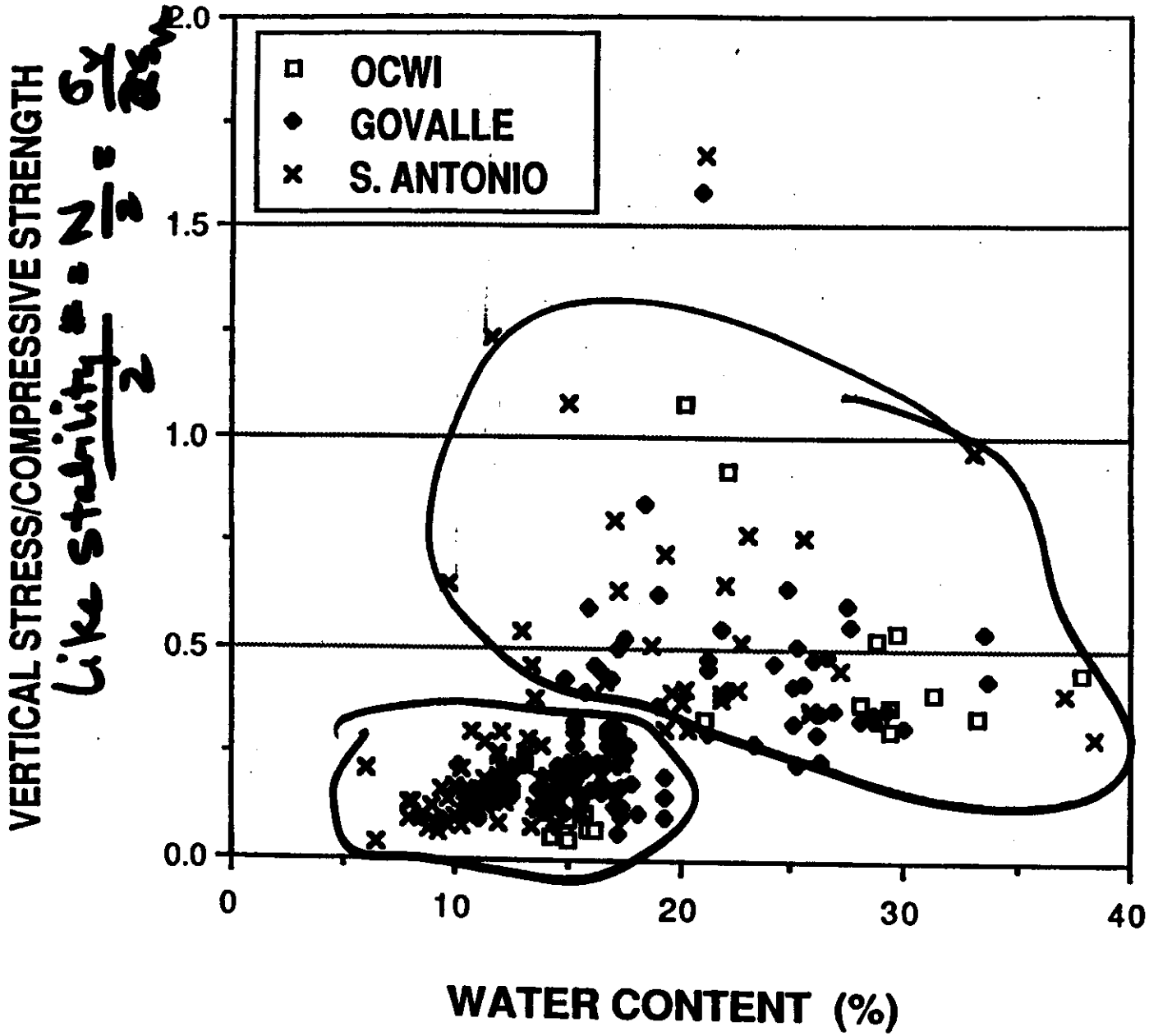
Brazil test: brittle response — good crack to ≈ 100 psi, W in same range


WEIGHT LOSS ON ACID REACTION (%)
100
80
60
40
20
0
0
10
20
30
40
WATER CONTENT (%)
Tuff
→ Soil like @ ≈20% weight loss on acid reaction.


LIQUID LIMIT
PLASTIC LIMIT
ATTERBERG LIMIT (%)
WATER CONTENT (%)
160
120
80
40
0
0
10
20
30
40
40-44
PI
20-25


Id2
HCl REACTION
SLAKE DURABILITY OR ACID REACTION (Id2, %)
WATER CONTENT (%)
100
80
60
40
20
0
0
10
20
30
40


LIQUID LIMIT
PLASTIC LIMIT
ATTERBERG LIMIT (%)
160
120
80
40
0
0
10
20
30
40
50
60
70
HCl REACTION



OCWI
GOVALLE
S. ANTONIO
VERTICAL STRESS/COMPRESSIVE STRENGTH
Like stability # = N/2 = σy/σsw
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
WATER CONTENT (%)

TUNNELING PROBLEMS

IN WEAK ROCK

DEVELOPMENT OF LOOSENING CONDITIONS

1) Shallow Cover-Weathering

2) Surface Stream Channels

3) Slickensided Zones

4) TBM Grippers or Reaction Rings

5) Support Capability/Versatility

Predict? Not economically
(San Antonio used Geophys. Correlations)

U.S. Practice - Commit to a method with up front decisions

Swell? - stress after excavation?
Drying?
water availability