SSCL-SR-1079

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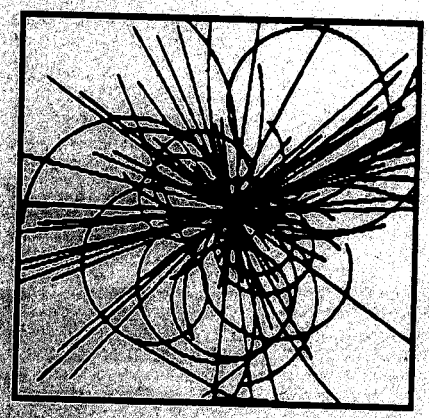
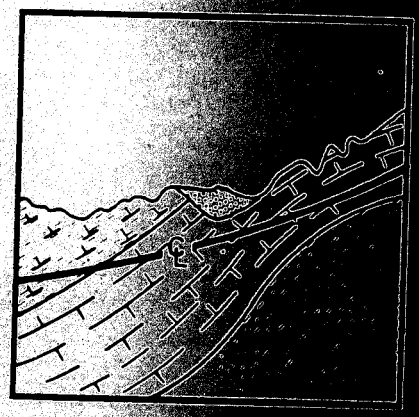
Project No. 87-888-C015
January 1990
GR-20

Data Report for Corehole BK 1'





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FOREWORD

The goal of the geotechnical studies at the Texas Superconducting Super Collider (SSC) site is to allow the geologist and engineer to build their level of knowledge and confidence about the geologic structures and geotechnical properties of the site materials to the point at which there remains only a realistically small risk of encountering geotechnical conditions during construction that would significantly increase construction costs or delay construction schedules. To do this, a characterization program has been designed to meet the following objectives:

- To confirm the site's suitability and optimize the ring location (the "footprint") and hall positions on the ring
- To provide data for a preliminary structural design
- To provide a rational framework within which construction contracts and schedules can be formulated
- To maximize the use of the site-specific data already gathered by the proposer.

The geotechnical program to meet these objectives has been divided into the following three phases of study:

- Footprint location data (the present phase)
- Global data (planned)
- Structure-specific data (planned).

The primary purpose of the present footprint location phase is to quickly assess whether individual components of the collider footprint, or the entire footprint, need to be relocated because of geotechnical constraints. Accordingly, the following areas have been assessed:

- Areas on the western side of the footprint where the geologic structure brings the Eagle Ford Shale close to the depth of the tunnel and experimental halls, thus presenting potential constraints due to weak, deformable rock.
- Areas where the tunnel placement is shallow and/or there are nearby sources of vibration such as major highways and railroads that may represent a problem due to unacceptable vibrations at tunnel depth.
- Zones of potentially poor rock quality and high water inflow in the rock that should be avoided for the experimental hall excavations.

This is one in a series of data reports prepared for the footprint phase of geotechnical characterization at the SSC site. Each data report includes the results of both field and laboratory tests for a specific drilling and sampling site. Interpretations of these data will be covered in topical reports, including three planned reports, as follows:

- Train- , traffic-, and quarry-caused vibrations
- Geomechanical properties of the Eagle Ford Shale
- Structure and stratigraphy of the near-cluster.

Future planned program phases--global and structure-specific data collection--will concentrate on (1) evaluating ring areas where few geotechnical data are currently available and (2) conducting more detailed studies at the sites of the injector and experimental halls.

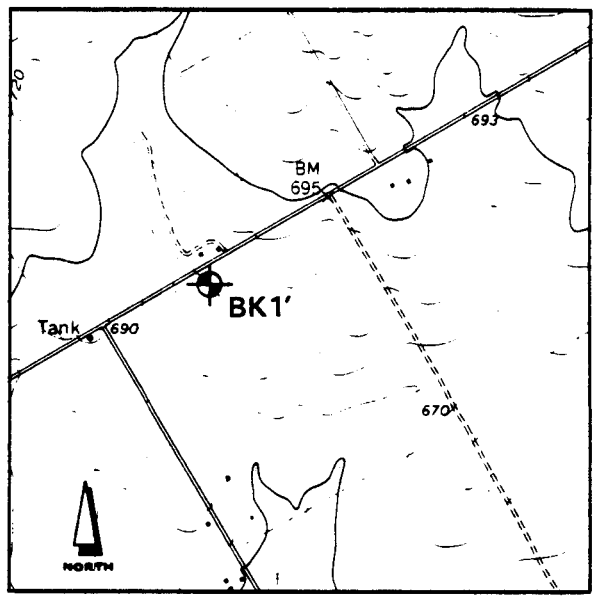
DATA REPORT

Site Designator: BK1′

Objective: To delimit the top of the Eagle Ford Shale and obtain core samples of Austin Chalk and Eagle Ford Shale for geomechanics laboratory testing. To do hydrologic straddle packer tests in the Austin Chalk and Eagle Ford Shale.

Location: North N 241,115 feet
East E 2,175,593 feet
Surface Elevation 676.4 feet

BK1′ is located on the west side of the ring, +1 mile south of State Highway 66.



SCALE 1:24,000

1000 0 1000 2000 3000 FEET

CONTOUR INTERVAL 10 FEET

Scope and Schedule:

Coring (full depth)	June 1, 1989 to June 5, 1989
Wire-line Logging	June 5, 1989
Hydrologic Testing	June 6, 1989
Laboratory Geomechanical Testing	June 3, 1989 to June 14, 1989
Plugging and Abandonment	June 6, 1989

Conditions Encountered:

Total Hole Depth: 330.0 feet

Soil: 0.0 to 5.3 feet

Austin Chalk: 5.3 to 224.4 feet

Eagle Ford Shale: 224.4 to 330.0 feet
(see lithologic log, Appendix A)

Geophysical Logging: (see wire-line logs, Appendix B)

Spontaneous Potential
Normal Resistivity (short)
Guarded Resistivity (long)
Natural Gamma
Compensated Density (caliper)
Sonic Velocity (full wave)

Hydrological Test: (see Table 3)

#1 Double Packer
248.0 to 269.1 feet

#2 Double Packer

145.0 to 166.1 feet

#3 Double Packer

110.0 to 131.0 feet

Hole Status: Plugged with cement grout and abandoned on June 6, 1989 (see as-built drawing/cementing report, Appendix C)

TABLE 1. GEOMECHANICAL TEST RESULTS - BORING BK1'

Geologic Formation and General Lithology	Depth	Moisture Content	Dry Density	Sample Dimension Ratio L/D	Uniaxial Compressive Strength	Triaxial Compression		Tangent Young's Modulus		Poisson's Ratio	Direct Shear		Brazil Tensile Strength	2nd Cycle Slake-Durability Index	Modified Tabor Abrasion/ Hardness Index	Swell Pressure Index	Comments
						σ_c	$\sigma_1 - \sigma_3$	E_{50}	σ_3		σ_n	τ					
	feet	percent	pcf		psi	psi	psi	psi x 10^5	psi		psi	psi	psi	percent		psi	
Austin Chalk Limestone	12.9												344				
Austin Chalk Limestone	13.0										50	172					
Austin Chalk Limestone	13.2	13.7	119.6								150	416					
Austin Chalk Limestone	13.5										300	597					
Austin Chalk Limestone	40.3												225				
Austin Chalk Limestone	40.7	14.8	122.4								50	192					
Austin Chalk Limestone	41.0										150	339					
Austin Chalk Limestone	41.2										450	402					Sample damaged during preparation
Austin Chalk Limestone	41.5										450	611					
Austin Chalk Limestone	107.3			2.2	1550												
Austin Chalk Limestone	108.1	16.0	116.8	2.5	1416												
Austin Chalk Limestone	109.0			2.1		120	1939										
Austin Chalk Limestone	109.4			2.0		1000	3069										
Austin Chalk Limestone	109.8												186				
Austin Chalk Limestone	148.2													96.2			
Austin Chalk Limestone	148.8	13.8	121.1														
Austin Chalk Limestone	149.0														0.393		
Austin Chalk Limestone	180.0	15.2	115.7	2.7	2266												
Austin Chalk Limestone	220.2	14.1	115.2	2.5	2152												
Austin Chalk Limestone	220.7			2.0	2110												
Austin Chalk Limestone	221.0												321				
Eagle Ford Shale	229.0	17.3	115.7	2.5	127												
Eagle Ford Shale	229.7			2.0	171			0.94	0	0.31							
Eagle Ford Shale	239.5	16.5	118.3	2.4	190												
Eagle Ford Shale	240.0			2.2	348												
Eagle Ford Shale	259.9	16.5	117.4	2.5	434												
Eagle Ford Shale	260.5															38	
Eagle Ford Shale	260.6															38	
Eagle Ford Shale	260.7															38	
Eagle Ford Shale	280.9	15.2	112.6	2.3	432												
Eagle Ford Shale	281.6															26	
Eagle Ford Shale	281.7															26	
Eagle Ford Shale	281.8															30	
Eagle Ford Shale	282.0			1.9		300	701										
Eagle Ford Shale	282.4			2.3		900	811										
Eagle Ford Shale	290.6	13.8	121.1														
Eagle Ford Shale	290.9														0.690		
Eagle Ford Shale	291.4													7.3			
Eagle Ford Shale	305.0	15.0	121.9	2.1		300	781										
Eagle Ford Shale	305.8			2.2		600	680										
Eagle Ford Shale	306.4			2.2		1200	775										
Eagle Ford Shale	320.9														0.425		
Eagle Ford Shale	321.5	14.2	122.7														
Eagle Ford Shale	321.7													20.0			
Procedure		ASTM-D2216			ASTM-D2938	ASTM-D2664		ASTM-D2938		ASTM-D2938	ISRM		ISRM	ISRM	ISRM	ISRM	

Note: Mineralogical data available in Table 2.

WP.84/BK1

TABLE 2. BULK AND CLAY MINERALOGY TEST RESULTS

Depth 221.2 feet **Austin Chalk**

Whole Rock Composition:

Mineral	Percent
calcite	100
clay minerals	<1
	100

Relative Clay Abundance:

Mineral	Percent
No test performed	

Depth 260.8 feet **Eagle Ford Shale**

Whole Rock Composition:

Mineral	Percent
quartz	20
clay minerals	80
	100

Relative Clay Abundance:

Mineral	Percent
illite	50
kaolinite	25
montmorillonite	25
	100

Depth 261.1 feet **Eagle Ford Shale**

Whole Rock Composition:

Mineral	Percent
quartz	5
clay minerals	95
	100

Relative Clay Abundance:

Mineral	Percent
montmorillonite	73
kaolinite	16
illite	11
	100

Depth 280.4 feet **Eagle Ford Shale**

Whole Rock Composition:

Mineral	Percent
quartz	10
clay minerals	90
	100

Relative Clay Abundance:

Mineral	Percent
montmorillonite	44
kaolinite	28
illite	28
	100

TABLE 2. BULK AND CLAY MINERALOGY TEST RESULTS

Depth 281.4 feet **Eagle Ford Shale**

Whole Rock Composition:

Mineral	Percent
quartz	15
clay minerals	85
	100

Relative Clay Abundance:

Mineral	Percent
illite	41
montmorillonite	29
kaolinite	30
	100

TABLE 3. HYDROLOGIC TEST RESULTS

Hole No. BK1'

Test Depth	Formation and Lithology	Hydraulic Conductivity (cm/sec)	Comments
110.0 to 131.1 feet	Austin Chalk	3.0×10^{-7}	test centered on fractured zone
145.0 to 166.1 feet	Austin Chalk	4.0×10^{-7}	test centered on fractured zone
248.0 to 269.1 feet	Eagle Ford Shale	1.3×10^{-5}	test centered on fractured zone

Objective: The objective of these tests is to provide estimates of the hydraulic conductivity at tunnel depth and of distinct zones within the host bedrock formations (Austin Chalk, Eagle Ford Shale) characterized by increased frequency of fractures, faults, or bedding plane partings, which may transmit water at increased rates.

Procedure Used: Straddle packer test intervals were selected based on inspection of rock cores and geophysical logs. A straddle packer assembly was lowered to the desired depth and water was pumped through the system. The packers were inflated to a calculated pressure and water was pumped into the test zone at a predetermined pressure. The flow rate and pressure fluctuations were recorded over time. The data were analyzed in accordance with U.S. Bureau of Reclamation procedures (1974, Earth Manual).

NOTE: In the above tests, the take of water was observed to decline with time, suggesting that the fractures have a finite capacity and are only poorly interconnected.

APPENDIX A

LITHOLOGIC LOG

LOG OF BORING

PROJECT: SSC
CLIENT: TETC
TASK NO.: 15

BORING NO: BK1' PG 1 OF 9
LOCATION: N 241,115 feet
E 2,175,593 feet
GROUND EL: 676.4 feet

DATE: 6/1/89 TYPE: Nx Core CASED TO: 4.0' CONTRACTOR: MJA

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.
5		4.0 Box 1	4.0	9.0	100	90		
10		12.8	9.0	13.8	100	86		
15		C1 12.8 to 13.8 Box 2	13.8	22.0	100	100		
20		22.4	22.0					
25		Box 3			99.5	91		
30		31.4		32.0				
35		Box 4	32.0		99.5	99.5	(11:00-11:15)	
40		40.6		42.0				

SAMPLE LEGEND
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

DESCRIPTION OF STRATUM

Rock at 3.0' Set Casing at 4.0' Start Coring 4.0'

0-3.0' Topsoil, silty clay, tan/gray

3.0-5.3' LIMESTONE, med. hard, wea., tan
Iron stained along core

5.3 LIMESTONE, (Austin Chalk), fresh, mod. hd., slightly fossiliferous w/argillaceous bands, lt. gray
5.35-6.55 Dk. gray argillaceous zone
8.1-8.2 Dk. gray argillaceous zone
9.7-10.3 Dk. gray argillaceous zone
10.3-10.8 Mod. dk. gray argillaceous zone
11.3-11.8 Mod. dk. gray argillaceous zone
12.5-12.9 Mod. dk. gray argillaceous zone
13.1-13.6 Mod. dk. gray argillaceous zone
14.9-15.3 Dk. gray argillaceous zone
16.2-16.5 Dk. gray argillaceous zone
19.5-19.7 Dk. gray argillaceous zone
21.1-21.7 Dk. gray argillaceous zone

14.9 pyrite nodule

23.3-23.35 Dk. gray argillaceous zone
23.5-23.8 Dk. gray shale zone
23.9 Dk. gray argillaceous zone
25.0-25.3 Dk. gray argillaceous zone

27.7-27.8 Mod. dk. gray argillaceous zone
27.9-28.6 Dk. gray argillaceous zone

29.0-29.3 Dk. gray shaly zone
29.8-30.1 Dk. gray argillaceous zone
30.7-31.2 Dk. gray argillaceous zone

33.5-33.85 Mod. dk. gray argillaceous zone
34.0-34.8 Dk. gray argillaceous zone
34.3-34.55 Dk. gray shale zone
36.1-36.4 Dk. gray argillaceous zone
37.5-38.5 Dk. gray argillaceous zone

41.6-41.95 Dk. gray argillaceous zone

DRILLING GEOLOGIST Gary James/ Wayne Cowan ASSISTANT Gary Kincaid

LOG OF BORING

BORING NO: BK1' PG 2 OF 9

PROJECT: SSC

CLIENT: TETC

TASK NO.: 15

LOCATION: N 241,115 feet
E 2,175,593 feet

GROUND EL: 676.4 feet

DATE: 6/1/89 TYPE: Nx Core CASED TO: 4.0' CONTRACTOR: MJA

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
				42.0					**LIMESTONE (Austin Chalk) fresh, med. hard, slightly fossiliferous, with argillaceous bands, lt. gray.**
		Box 5 C 2 44.2 to 45.7	42.0		99.5	99.5	(11:20-11:35)		42.0-42.4 Dk. gray argillaceous zone 44.6-45.6 Dk. gray argillaceous zone 45.9 Low angle fracture, 25°, smooth clean surface 48.6-49.7 Dk. gray argillaceous zone
45									
		49.2							
50				52.0					
		Box 6	52.0		101	100	(12:30-12:47)		52.2-52.7 Dk. gray argillaceous zone 55.2-55.7 Dk. gray argillaceous zone 56.5 Lignite band 1/8"
55									
		58.3							58.5-58.7 Mod. dk. gray argillaceous zone
60				62.0					61.3-61.7 Dk. gray argillaceous zone 61.7-61.85 Dk. gray shale zone
		Box 7	62.0		100	100	(12:50-1:18)		62.55-62.95 Dk. gray argillaceous zone 64.4-65.0 Dk. gray argillaceous zone 64.4-65.3 Highly fossiliferous 66.4-67.2 Dk. gray argillaceous zone
65									
		69.8							69.5-69.9 Dk. gray argillaceous zone
70				72.0					73.7-74.1 Dk. gray argillaceous zone
		Box 8	72.0		78	78			
75		76.3							77.1-78.1 Dk. gray argillaceous zone
80				82.0					80.6-81.3 Dk. gray argillaceous zone 2.2' Core left in hole

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LOG OF BORING

BORING NO: BK1' PG 3 OF 9

PROJECT: SSC

CLIENT: TETC

TASK NO.: 15

LOCATION: N 241,115 feet
E 2,175,593 feet

GROUND EL: 676.4 feet

DATE: 6/1/89 TYPE: Nx Core CASED TO: 4.0' CONTRACTOR: MJA

SAMPLE LEGEND
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
				82.0					**LIMESTONE (Austin Chalk) fresh, med. hard, slightly fossiliferous, with argillaceous bands, lt. gray.**
		Box 9	82.0				(1:45-1:55)		Core Loss Zone 80.6' (?)
					108	100			Recovered 0.8' from previous run
85									Core Loss Zone 82.6' (?)
									87.0-88.4 Dk. gray argillaceous zone
		87.1							
									90.2-90.5 Dk gray argillaceous zone
90				90.0					90.5-91.3 Mod. dk. gray argillaceous zone
		Box 10	90.0						91.3-91.5 Dk. gray argillaceous zone
									93.6-93.8 Mod. dk. gray argillaceous zone
					100	100			
95									97.0-98.1 Dk. gray argillaceous zone
		96.6							
									99.1-99.3 Dk. gray shale zone
		Box 11							
100		C 3		100.0					
		107.3 to 110.0 Contains bentonite	100.0				(2:15-2:35)		102.1-102.2 Dk. gray argillaceous zone
									102.5-102.6 Dk. gray argillaceous zone
					97	97			
105		106.3							
									107.6-107.7 Dk. gray shale zone
									107.7-107.8 Bentonitic zone, blue-gray, waxy soft nonlaminated
		Box 12							107.8-107.9 Dk. gray shaly zone
110				110.0					
			110.0						110.2-110.6 Dk. gray argillaceous zone
					100	100			
									115.5-115.8 Dk. gray shale zone
115		115.65							117.1-117.6 Dk. gray argillaceous zone
		Box 13							
				120.0					
120			120.0						

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LOG OF BORING

PROJECT: SSC
CLIENT: TETC
TASK NO.: 15

BORING NO: BK1' PG 4 OF 9
LOCATION: N 241,115 feet
E 2,175,593 feet
GROUND EL: 676.4 feet

DATE: 6/1/89 TYPE: Nx Core CASED TO: 4.0' CONTRACTOR: MJA

SAMPLE LEGEND
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
			120.0				(3:35-3:50)		**LIMESTONE (Austin Chalk) fresh, med. hard, slightly fossiliferous, with argillaceous bands, lt. gray.**
		124.6			100	100			120.0-120.8 Dk. gray argillaceous & fossil.zone 121.1-121.4 Dk. gray shale zone 123.2-123.4 Fracture, 80°, mod. rough, clean surface
125		Box 14							123.6-123.7 Dk. gray shale zone 126.6-126.9 Bentonitic zone, blue-gray, waxy, soft, nonlaminated 129.4-130.0 Dk. gray argillaceous zone
130				130.0					
			130.0				(4:00-4:11)		
		133.7			100	100			130.0-130.7 Dk. gray argillaceous zone 133.2-134.0 Dk. gray argillaceous zone 135.6-135.9 Mod. dk. gray argillaceous zone 135.9-136.3 Dk. gray argillaceous zone 137.9-138.4 Dk. gray argillaceous zone
135		Box 15							
				140.0					
140			140.0						140.0-141.1 Dk. gray argillaceous zone 142.1-143.6 Dk. gray argillaceous zone 143.6-144.2 Mod. dk. gray argillaceous zone 145.9-147.1 Mod. dk. gray argillaceous zone 148.1-148.7 Mod. dk. gray argillaceous zone 148.7-149.5 Dk. gray argillaceous zone
		142.8							
145		C 4 148.2 to 149.5			100	100			
		Box 16							End Day - 150.0'
				150.0					
150			150.0				(7:15-7:35)		Start Drilling 150.0' 6/2/89
		151.9							151.0-151.3 Dk. gray argillaceous zone 151.3-151.9 Dk. gray shale zone (Broken) 152.7-153.0 Dk. gray argillaceous zone
155		Box 17			99	99			154.7-155.8 Bentonitic zone, blue-gray, waxy, soft, nonlaminated 156.7-156.8 Fracture, 45°, slickensided, smooth clean surface
				160.0					
160									
		161.6							

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LOG OF BORING

PROJECT: SSC
CLIENT: TETC
TASK NO.: 15

BORING NO: BK1' PG 5 OF 9
LOCATION: N 241,115 feet
E 2,175,593 feet
GROUND EL: 676.4 feet

DATE: 6/2/89 TYPE: Nx Core CASED TO: 4.0' CONTRACTOR: MJA

SAMPLE LEGEND
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
		161.6	160.0				(7:40-8:00)		**LIMESTONE (Austin Chalk) fresh, med. hard, slightly fossiliferous, with argillaceous bands, lt. gray.**
		Box 18			100	100			160.0-160.6 Dk. gray argillaceous zone 161.5-162.1 Dk. gray argillaceous zone 163.3-163.7 Dk. gray argillaceous zone 165.3-166.0 Mod. dk. gray argillaceous zone 167.8-168.4 Dk. gray argillaceous zone 168.8-169.9 Dk. gray argillaceous zone
165									
170		170.7		170.0					
			170.0						170.9-171.3 Dk. gray argillaceous zone 171.3-171.5 Dk. gray shale zone 172.2-173.2 Dk. gray argillaceous zone 173.4-173.6 Dk. gray argillaceous zone 174.9-175.1 Dk. gray argillaceous zone 174.3 Pyritized Fossil 176.4-176.5 Dk. gray argillaceous zone 178.9-179.3 Dk.gray argillaceous zone
		Box 19			100	100			
175									
180		180.0		180.0					
			180.0						180.1-180.2 Dk. gray shale zone 182.6-182.8 Dk. gray shale zone 183.5-184.1 Dk. gray argillaceous zone 186.3-186.6 Dk. gray shale zone 187.5-187.6 Pyritized Fossil 188.9-189.6 Dk. gray argillaceous zone
		Box 20 C 5 180.0 to 181.5			97	97			
185									
		189.6		190.0					
190			190.0				(9:50-10:15)		190.4-190.7 Dk. gray argillaceous zone 192.9-193.5 Mod. dk. gray argillaceous zone 194.3-194.7 Dk. gray argillaceous zone 196.1-196.2 Dk. gray shale zone 198.6-198.8 Dk. gray argillaceous zone
		Box 21			100	100			
195									
		198.7		200.0					
200									

DRILLING GEOLOGIST Gary James/ Wayne Cowan ASSISTANT Gary Kincaid

LOG OF BORING

PROJECT: SSC
CLIENT: TETC
TASK NO.: 15

BORING NO: BK1' PG 6 OF 9
LOCATION: N 241,115 feet
E 2,175,593 feet
GROUND EL: 676.4 feet

DATE: 6/2/89 TYPE: Nx Core CASED TO: 4.0' CONTRACTOR: MJA

SAMPLE LEGEND
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
		Box 22	200.0	210.0	101	100			**LIMESTONE (Austin Chalk) fresh, med. hard, slightly fossiliferous, with argillaceous bands, lt. gray.** 201.1-201.8 Dk. gray argillaceous zone 204.7-205.3 Dk. gray argillaceous zone
205		208.2							
210		Box 23	210.0	220.0	87	87	(12:20-12:45)		211.7-212.1 Dk. gray argillaceous zone 216.7-218.7 Dk. gray argillaceous zone 216.7-216.8 Pyritized Fossil 218.0-219.5 Dk. gray argillaceous zone
215		217.7							
220		Box 24 C 6 220.2 to 221.45	220.0	228.9	113	100			223.4 Transition zone, argill., arenaceous, fossil.,mod.hd., med. to dk. gray 224.4 Top Eagle Ford Shale, soft to med. hd., very close bedding planes, fine grained, fresh, dk. gray 226.7 Fracture, 20°, smooth clean surface
225		226.7							
230		Box 25 C7A 229.0 to 229.65 C7B 229.65 to 230.8	228.9	239.2	100	96			230.2 Fracture, 15°, smooth clean surface 231.5 Fracture, 20°, smooth clean surface 234.8-235.2 Broken zone 235.2 Fracture, 25°, smooth clean surface 235.6 Fracture, 30°, smooth clean surface 236.3 Fracture, 40°, smooth clean surface
235		236.4							
240		Box 26	239.2						

DRILLING GEOLOGIST Gary James/ Wayne Cowan ASSISTANT Gary Kincaid

LOG OF BORING

PROJECT: SSC
CLIENT: TETC
TASK NO.: 15

BORING NO: BK1' PG 7 OF 9
LOCATION: N 241,115 feet
E 2,175,593 feet
GROUND EL: 676.4 feet

DATE: 6/2/89 TYPE: Nx Core CASED TO: 4.0' CONTRACTOR: MJA

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.
		C8 239.3 to 240.8			100	94		
245								
		Box 27		249.5				
250			249.5				(4:20-4:45)	
		254.9			98	98		
255		C9 259.7 to 261.4						
				259.5		Stop Drilling		
260		Box 28	259.5			Start Drilling 6/5/89		
		264.7			100	89		
265								
		Box 29		269.5				
270			269.5				(9:20-9:55)	
		272.6			100	99		
275		Box 30						
				279.5				
280		281.7						

SAMPLE LEGEND
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

DESCRIPTION OF STRATUM

LIMESTONE (Austin Chalk) fresh, med. hard, slightly fossiliferous, with argillaceous bands, lt. gray.

239.3 Calcite nodule, lt. gray, hard
240.0 Calcite seam, lt. gray, hard 1/16"
241.6-241.7 Fracture, 25°, smooth slickensided black
242.6 Fracture, 20°, smooth, slickensided, blk.
243.2 Calcite seam, lt. gray, hard, 1/8"
245.4 Fracture, 20°, smooth slickensided, blk.
246.5 Fracture, 15°, smooth slickensided, blk.
247.4 Calcite seam, lt. gray, hard, 1/8"
246.2 Calcite nodule, lt. gray, hard
250.1 Calcite nodule, lt. gray, hard
250.2 Fracture, 10°, smooth surface, slickensided
250.5 Calcite nodule, lt. gray, hard
251.2 Calcite nodule, lt. gray, hard
251.7 Calcite nodule, lt. gray, hard
252.1 Fracture, 20°, closed
254.3 Pyrite seam 1/4"
255.1 Calcite seam, lt. gray, hard, 1/16"
256.3 Fracture, 30°, closed
256.8-257.0 Calcite seam, lt. gray, hard
257.9 Calcite seam, lt. gray, hard 1/4"
263.4-264.3 Fracture zone - 9 fractures, 10-30° open fractures w/slickensides & smooth surface, 2 closed fractures
264.0-264.4 Calcareous zone, lt. gray, hard No apparent bedding planes
264.4-264.5 Pyrite crystals
264.6 Fracture, 15°, smooth clean surface
265.3 2 fractures, 40 & 15° intersect, slick, smooth surface
267.2 Fracture, 30°, closed
267.6 Fracture, 30°, closed
273.9 Calcareous nodule, lt. gray, hard
275.8 Fracture, smooth clean surface, 25°
278.2 Fracture, smooth clean surface, 20°
278.3 Fracture, smooth clean surface, 10°

DRILLING GEOLOGIST Gary James/ Wayne Cowan ASSISTANT Gary Kincaid

LOG OF BORING

PROJECT: SSC
CLIENT: TETC
TASK NO.: 15

BORING NO: BK1' PG 8 OF 9
LOCATION: N 241,115 feet
E 2,175,593 feet
GROUND EL: 676.4 feet

DATE: 6/5/89 TYPE: Nx Core CASED TO: 4.0' CONTRACTOR: MJA

SAMPLE LEGEND
S= SPLIT SPOON
T= 2" THIN WALL TUBE
U= 3" THIN WALL TUBE
C= NX ROCK CORE

WATER INFORMATION

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES	HAND PEN. TSF.	DESCRIPTION OF STRATUM
		Box 31	279.5						**LIMESTONE (Austin Chalk) fresh, med. hard, slightly fossiliferous, with argillaceous bands, lt. gray.**
		C10							280.5 Fracture, 10°, smooth, clean
		280.4	A						281.0 Fracture, 20°, closed
		280.9			100	100			282.8-284.1 Calcite stringers & nodules, lt. gray, hard
		280.9	B						
285		281.9							285.7-285.8 Calcite stringer, lt. gray, hard
		281.9	C						285.8-285.9 Pyrite crystals in shale
		292.8							
		289.5		289.5					
290			289.5						
		C11							
		290.6	A						292.6-292.7 Calcareous concretion, lt.gray,hd.
		291.4							293.0-293.3 Calcareous concretion, (Broken up), lt. gray, very hard
		291.4	B						
		292.5			100	100			295.3-295.4 Fracture, 25°, smooth, clean surface
295									296.1-296.3 Calcareous nodule, lt. gray, hard
		Box 32							298.1-299.0 Calcareous concretion, lt. gray to dk. gray, very hard, calcite crystals inside
		299.0							
				299.8					299.1 Fracture, 30°, smooth, clean surface
300		Box 33	299.8						
									301.9-302.0 Pyrite crystals
		C12							302.1-302.2 Pyrite crystals
		304.8	A						302.6-302.8 Calcareous zone, lt. gray, hard
		305.75							
305					100	100			304.7 Pyritized nodule
		305.75							305.6 Calcareous nodule, lt. gray, hard
		307.2	B						
		307.7							307.2-307.4 Calcareous shale, lt. gray, mod. hd.
				309.8					
310		Box 34	309.8				(12:45-1:10)		310.1-310.8 Broken zone, soft, dk. gray, v. argillaceous, at least 10 mech. breaks
315					100	100			318.8 Calcite stringer 1/16", lt. gray, mod.hd.
		316.9							319.3 Calcite seam 1/16", lt. gray, mod. hard
		Box 35		319.8					
320			319.8						

DRILLING GEOLOGIST Gary James/ Wayne Cowan ASSISTANT Gary Kincaid

LOG OF BORING

PROJECT: SSC
CLIENT: TETC
TASK NO.: 15

BORING NO: BK1' PG 9 OF 9
LOCATION: N 241,115 feet
E 2,175,593 feet
GROUND EL: 676.4 feet

DATE: 6/5/89 TYPE: Nx Core CASED TO: 4.0' CONTRACTOR: MJA

SAMPLE LEGEND: S= SPLIT SPOON; T= 2" THIN WALL TUBE; U= 3" THIN WALL TUBE; C= NX ROCK CORE

WATER INFORMATION

DEPTH IN FEET	SYMBOL	SAMPLE TYPE & NUMBER	DEPTH RANGE TOP	DEPTH RANGE BOT.	PERCENT REC.	PERCENT RQD.	STANDARD PENETRATION TEST PER 6 INCHES		HAND PEN. TSF.	DESCRIPTION OF STRATUM
		C13 320.9 to 322.4	319.8		100	100				LIMESTONE (Austin Chalk) fresh, med. hard, slightly fossiliferous, with argillaceous bands, lt. gray. 323.5 Calcite seam 1/8", hard, lt. gray
325		325.9								329.2 Calcite seam, hard, lt. gray
		Box 36								
330		330.0		330.0						
										Bottom of Boring 6/5/89
										Wireline Logged 6/5/89
										Hydrotested 6/6/89
										Nx Boring Plugged 6/6/89

DRILLING GEOLOGIST Gary James/ Wayne Cowan ASSISTANT Gary Kincaid

APPENDIX B

WIRE-LINE LOGS

WIRE-LINE LOGGING PARAMETERS

Hole No. BK1′ **Log Measured From:** Ground Level

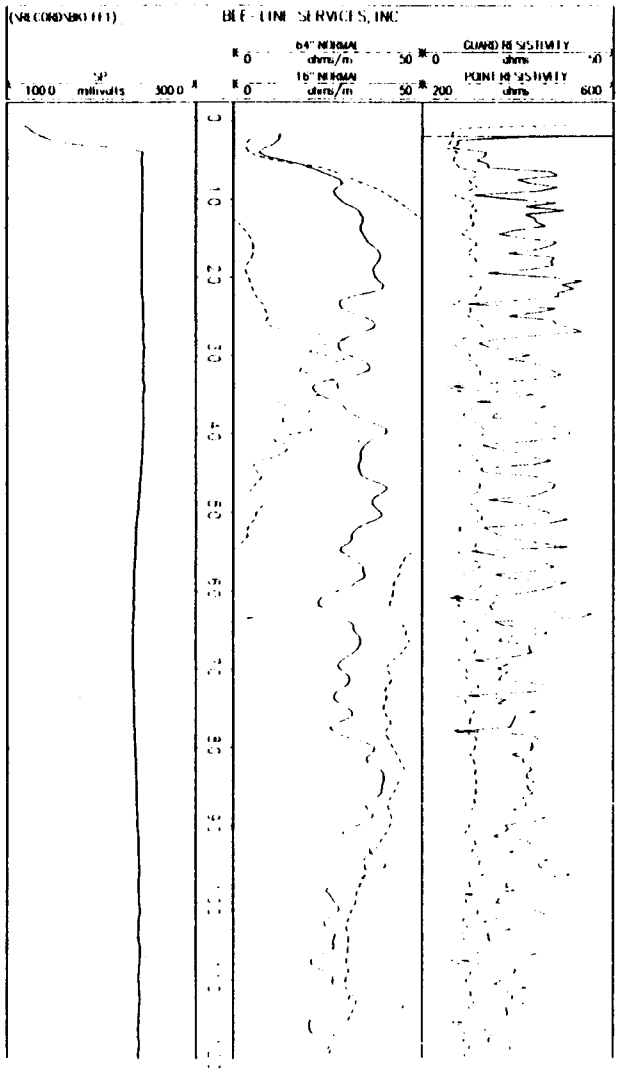
Drilling Parameters
Depth 330 feet
Bit Diameter 3.125 inches

Logging Parameters	Electrical Log	Gamma Log	Sonic Log
Date	June 5, 1989	June 5, 1989	June 5, 1989
Bottom Log Interval	327.5 feet	327 feet	323 feet
Top Log Interval	surface	surface	surface
Type of Fluid in Hole	boring fluid	boring fluid	boring fluid
Time Since Circulation Stop	1.5 hours	1.5 hours	1.5 hours
Probe Type/S.N.	ALP-4979	XAP-4383	CLP-4877A
Module Type/S.N.	ALM-4979	XAM-4383	CLM-4877A
Logging Speed	30 feet/min.	16 feet/min.	9 feet/min.
Sample Interval	0.5 feet	0.5 feet	0.5 feet

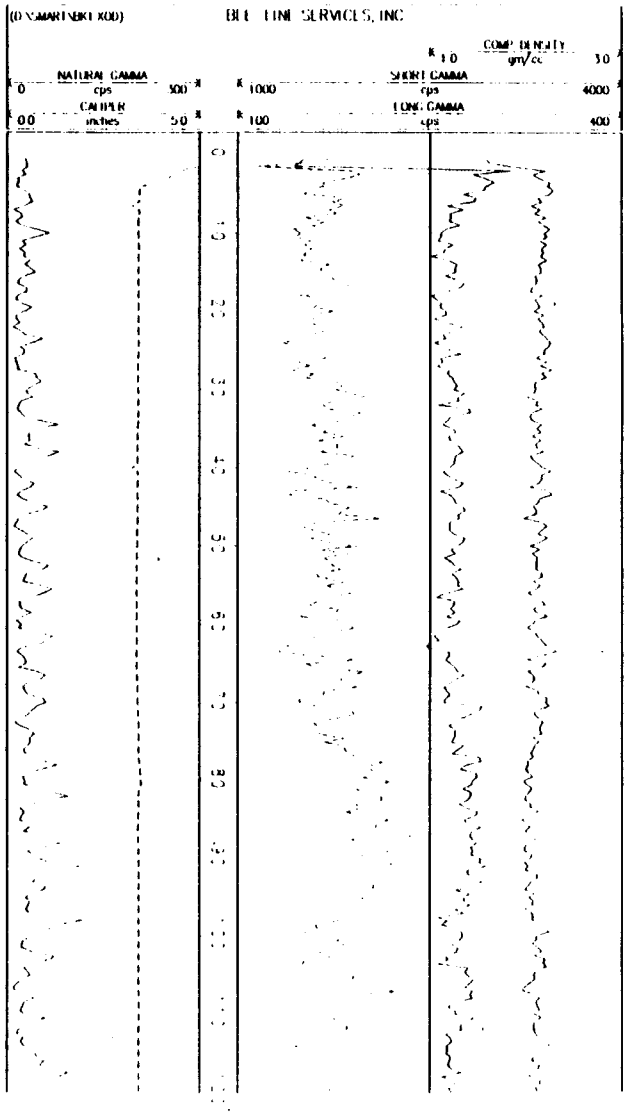
Logged by: BEE-LINE SERVICES, INC.
P.O. Box 2096
Corsicana, TX 75151

BK1' Wire-line logs run June 5, 1989. Surface elevation 676.4 feet.

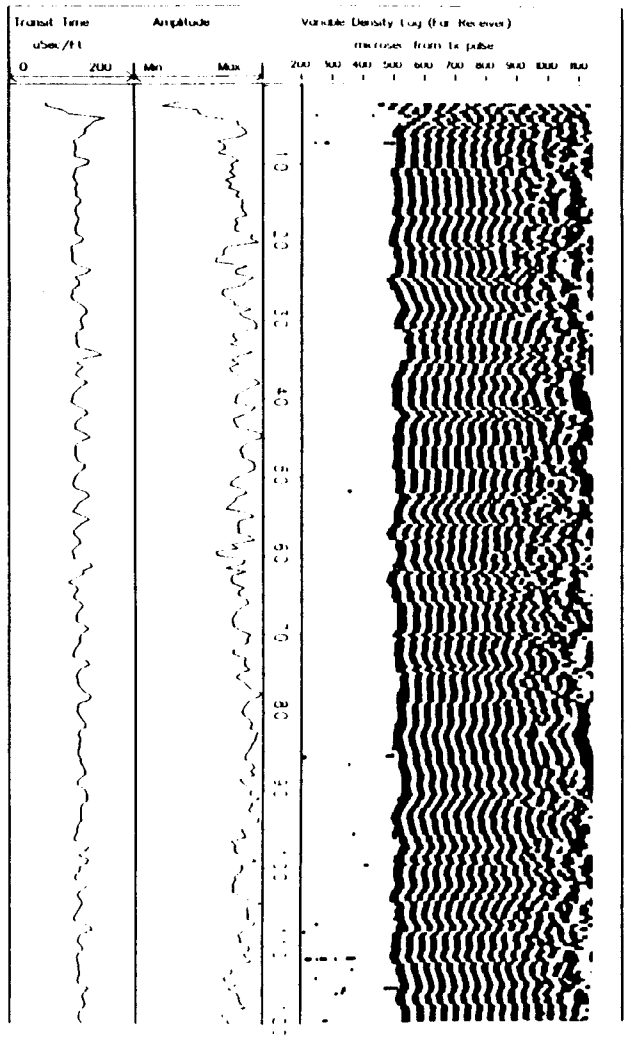
ELECTRICAL LOG



GAMMA LOG

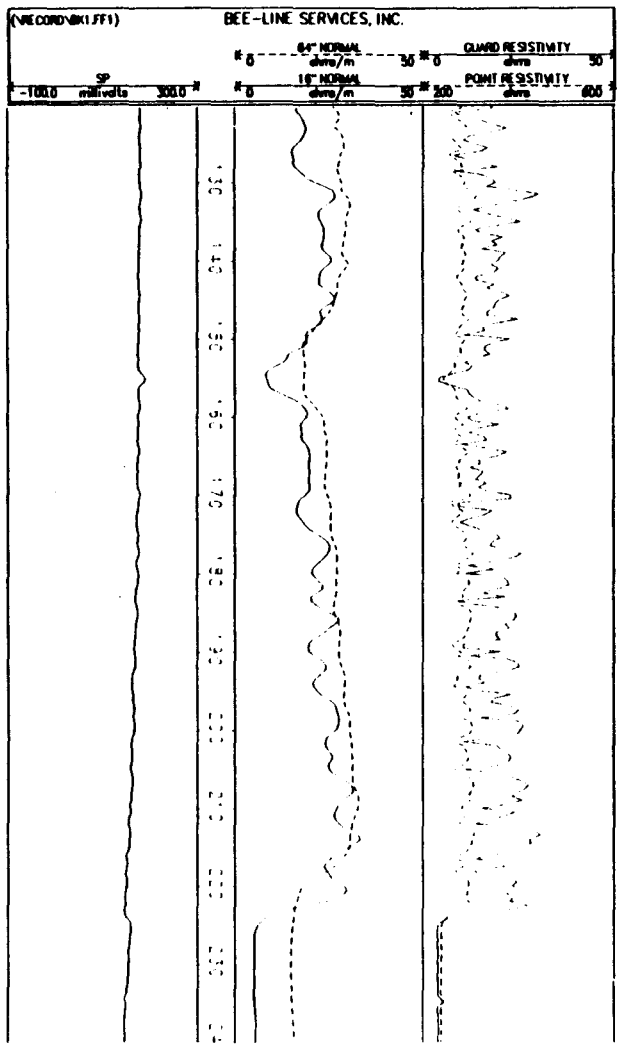


SONIC LOG

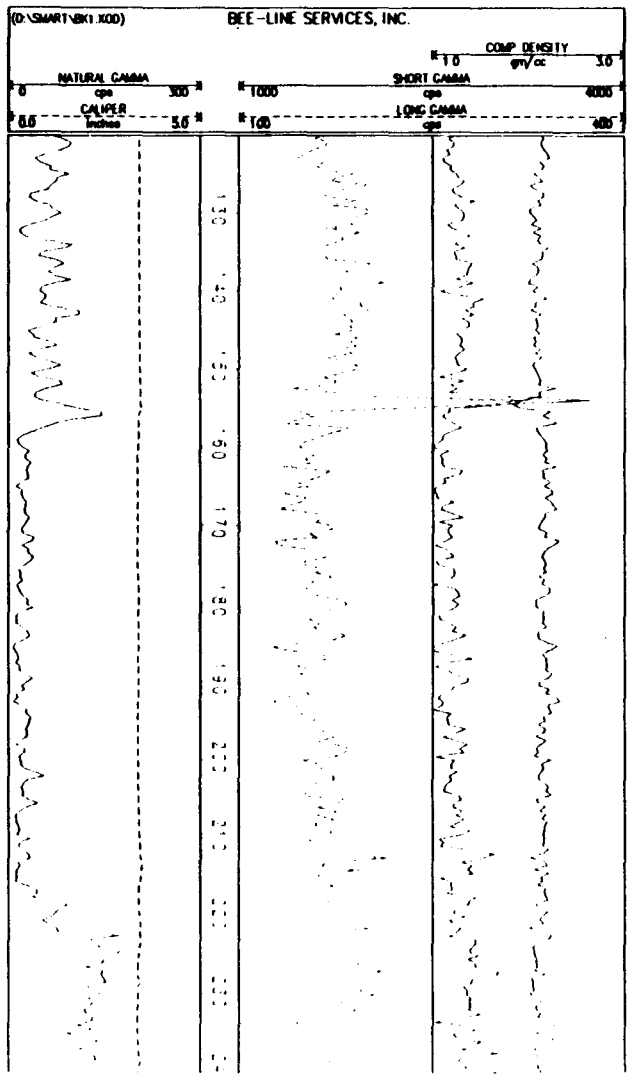


BK1' Wire-line logs run June 5, 1989. Surface elevation 676.4 feet.

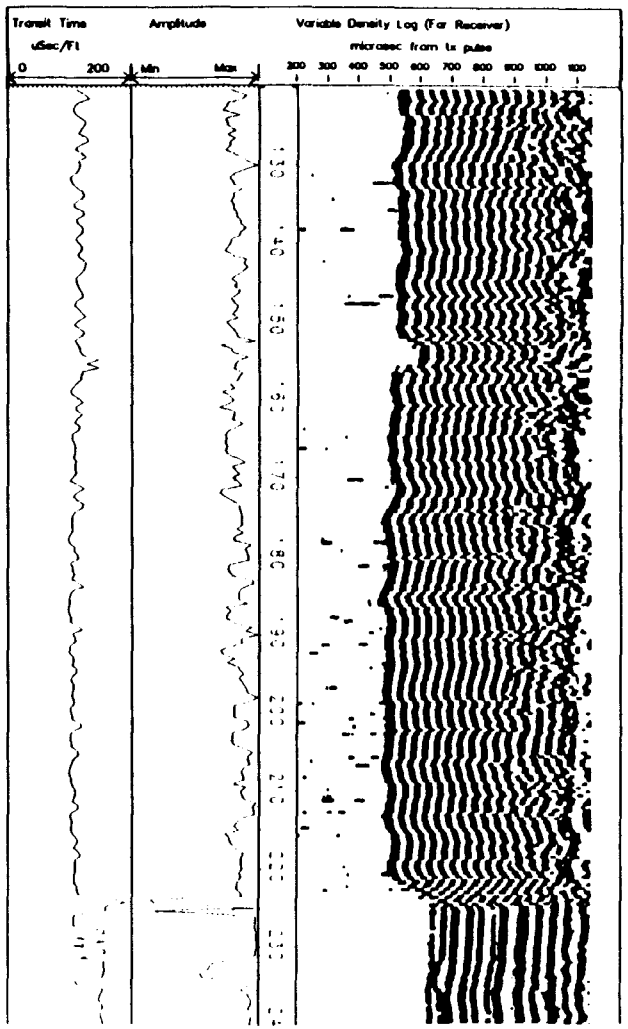
ELECTRICAL LOG CONTINUED



GAMMA LOG CONTINUED

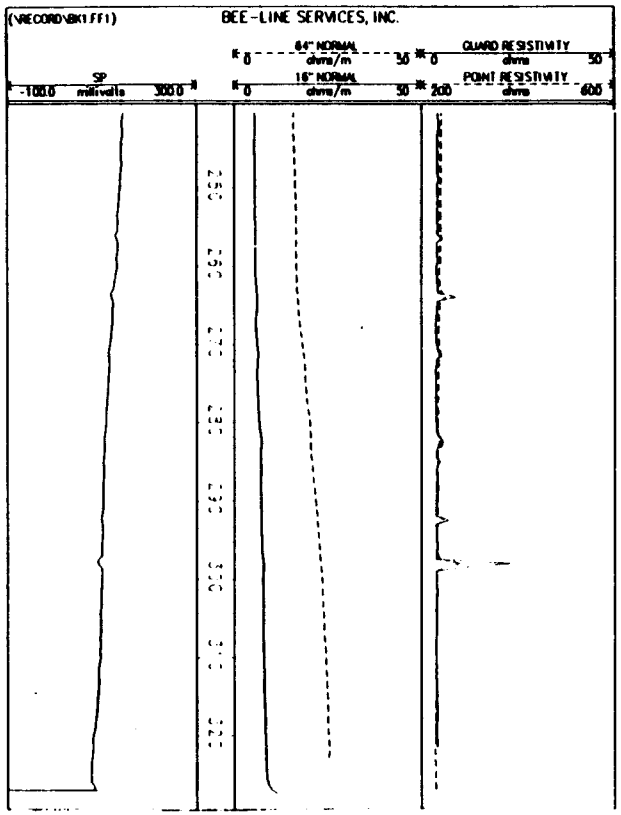


SONIC LOG CONTINUED

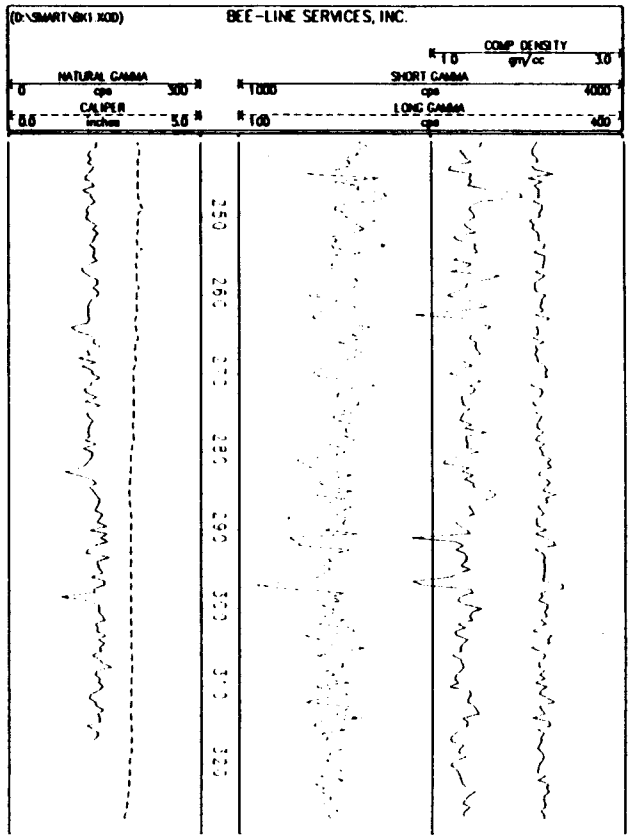


BK1' Wire-line logs run June 5, 1989. Surface elevation 676.4 feet.

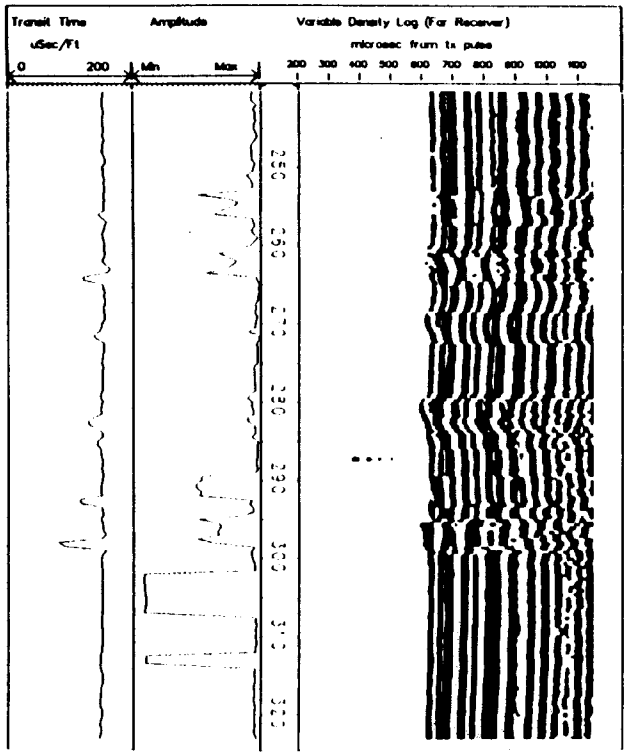
ELECTRICAL LOG CONTINUED



GAMMA LOG CONTINUED



SONIC LOG CONTINUED



APPENDIX C

PLUGGING REPORT

SSC BOREHOLE PLUGGING REPORT

TETC Project No. 87-888-00 15

Task No. 15

Boring No. BK 1'

Texas Coordinate Location:

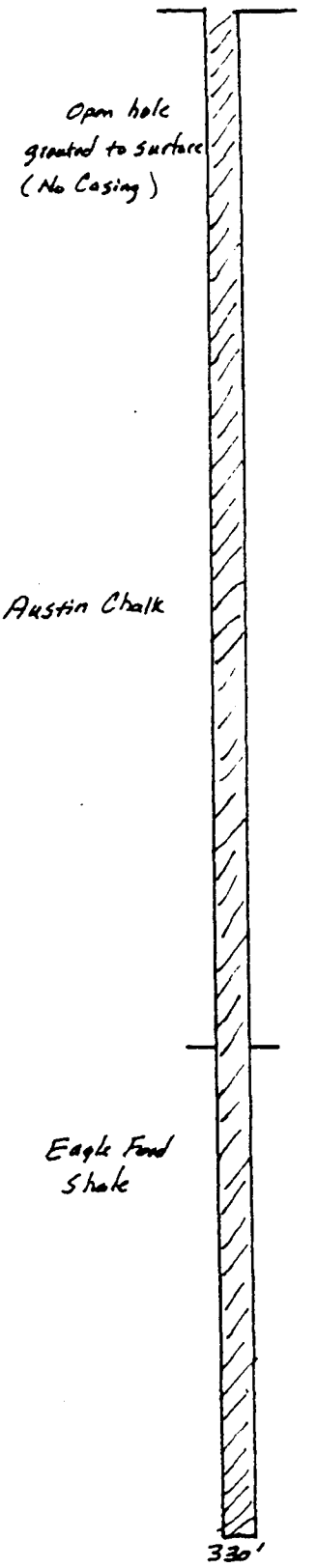
N 241,115 feet

E 2,175,593 feet

Surface Elevation: 676.4 feet

Total Boring Depth: 330.0

Plugging Remarks: Boring grouted with cement/bentonite upon completion of drilling and field testing. 16 sacks of cement and approximately 1.5 sacks of bentonite used. Approximate Water Cement ratio was 7½ gallons per sack. Grout placed through PVC Tremie Pipe



Date Plugged: 6/6/89

Time Completed: 5:00 PM

Drilling Geologist: Wayne Cowan & Gary Jones

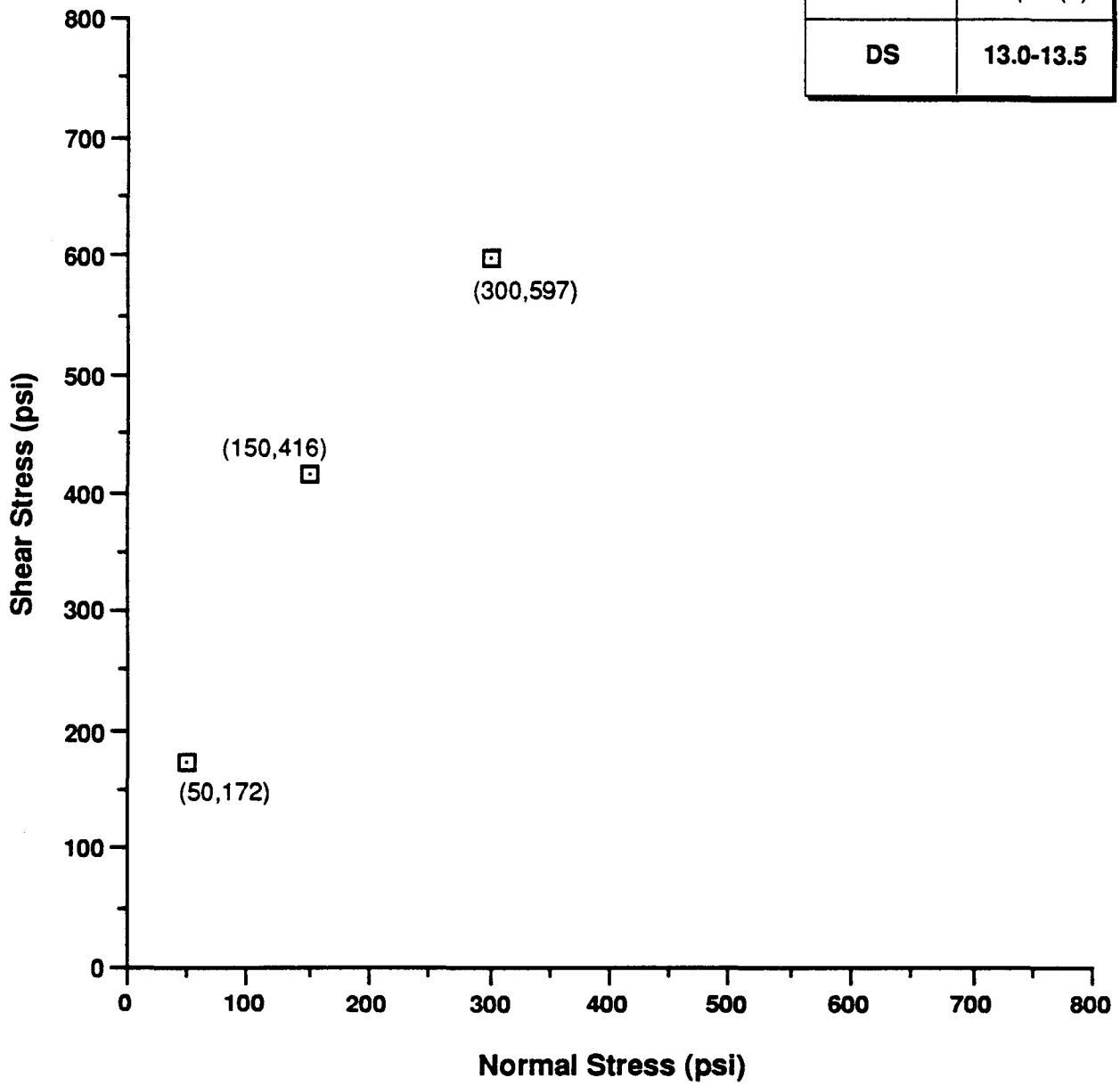
MJA Coordinator: Bill Flanigan

MJA No.: 5530. 15

APPENDIX D

DIAGRAMS OF LABORATORY RESULTS

BORING BK1' Austin Chalk	
Test	Depth (ft)
DS	13.0-13.5



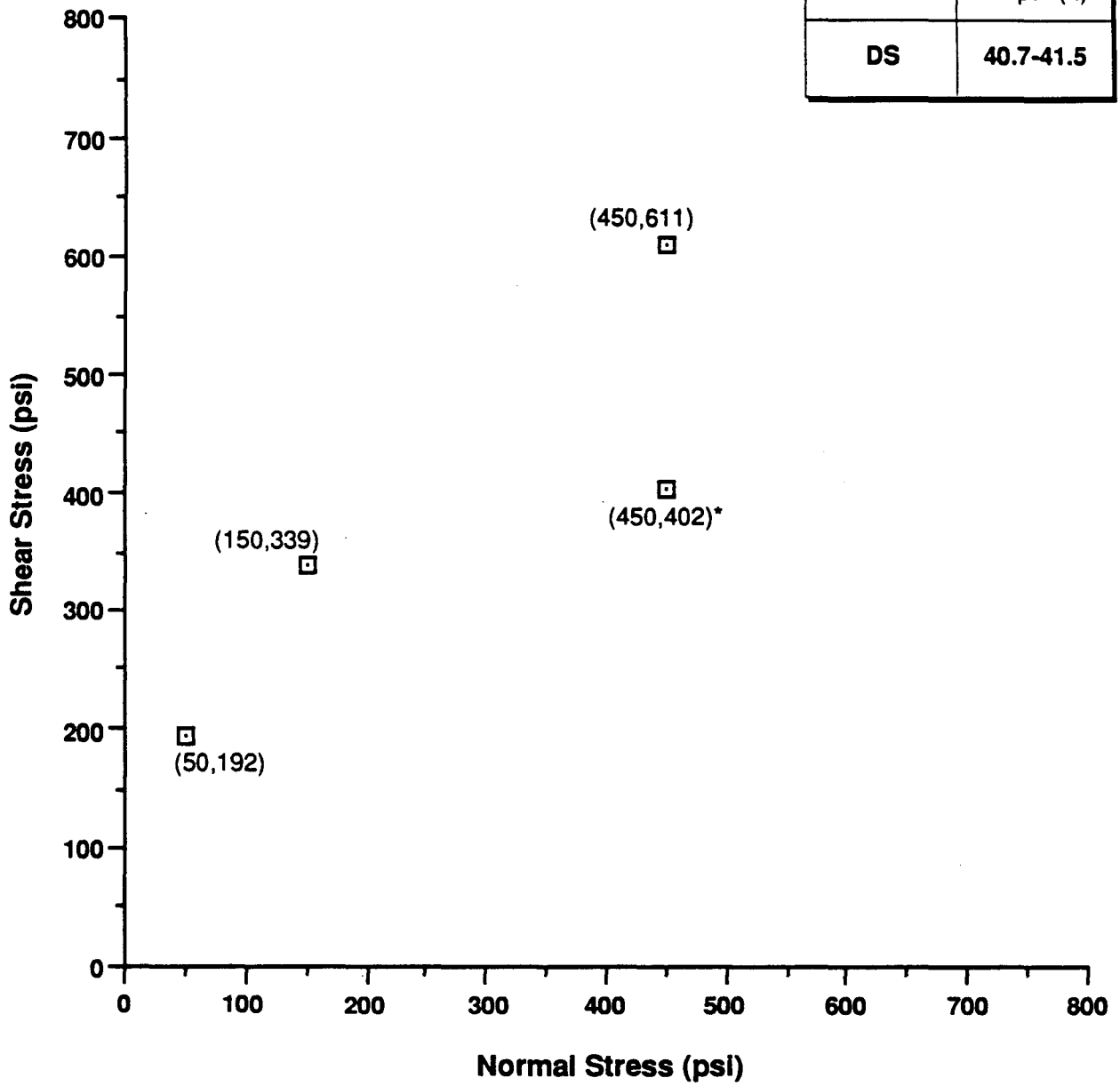
DS-ISRM

The Earth Technology Corporation

Direct Shear Test
Texas SSC Site

FIGURE
D-1

BORING BK1' Austin Chalk	
Test	Depth (ft)
DS	40.7-41.5



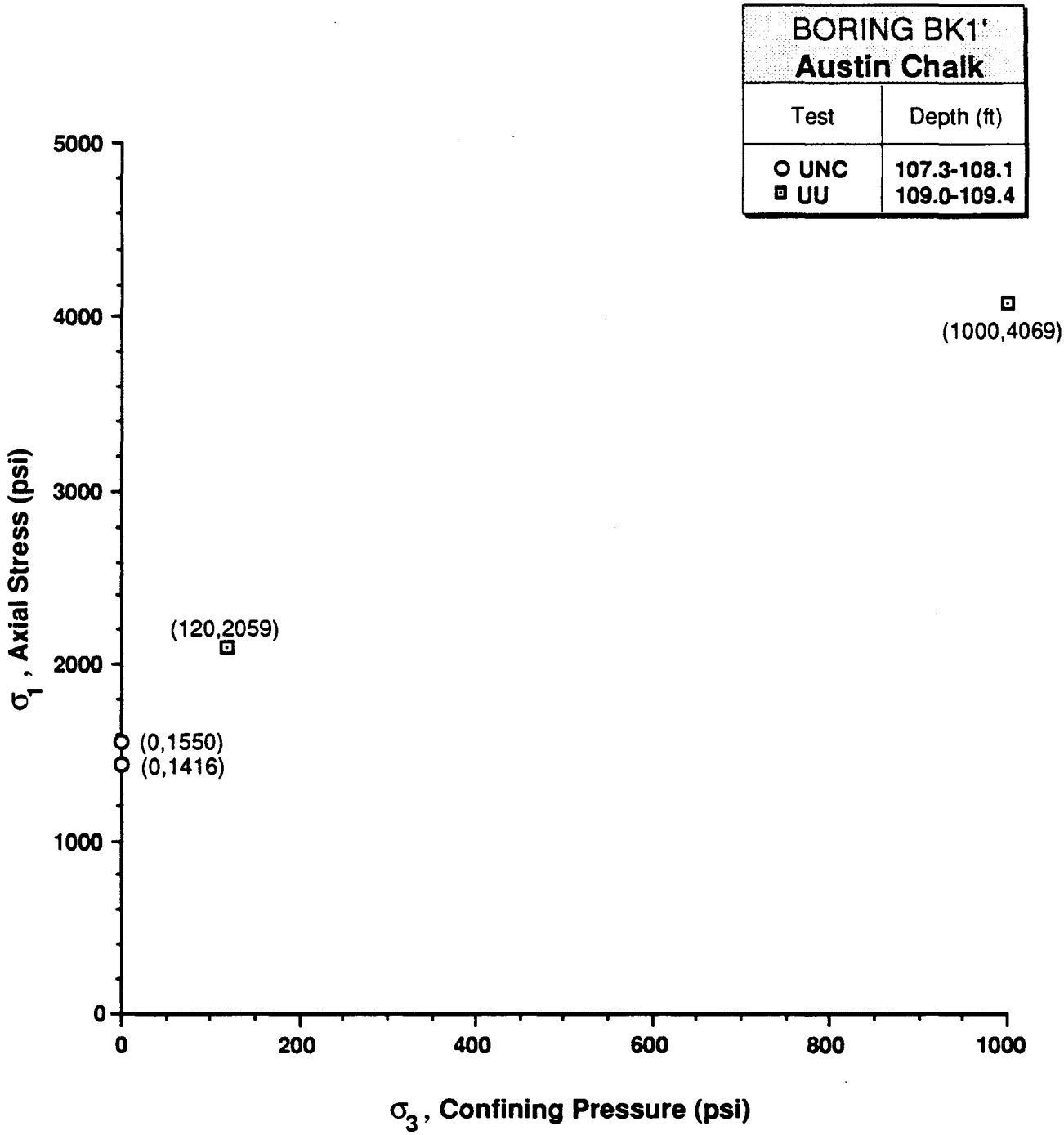
*Sample was damaged during test preparation

DS-ISRM

The Earth Technology Corporation

Direct Shear Test
Texas SSC Site

FIGURE
D-2



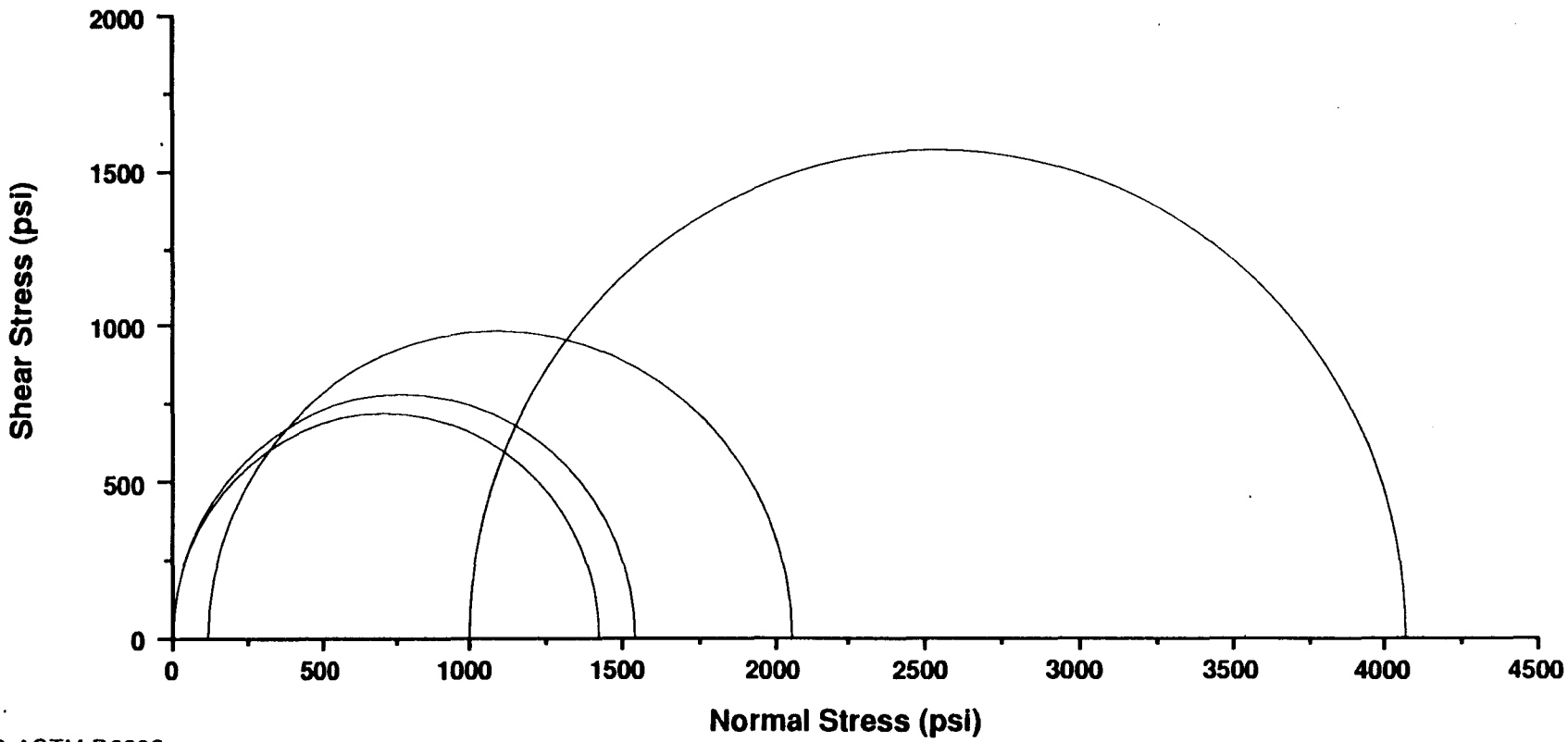
UNC-ASTM D2938
UU -ASTM D2664

The Earth Technology Corporation

Compression Test
Texas SSC Site

FIGURE
D-3

BORING BK1' Austin Chalk	
Test	Depth (ft)
UNC UU	107.3-108.1 109.0-109.4

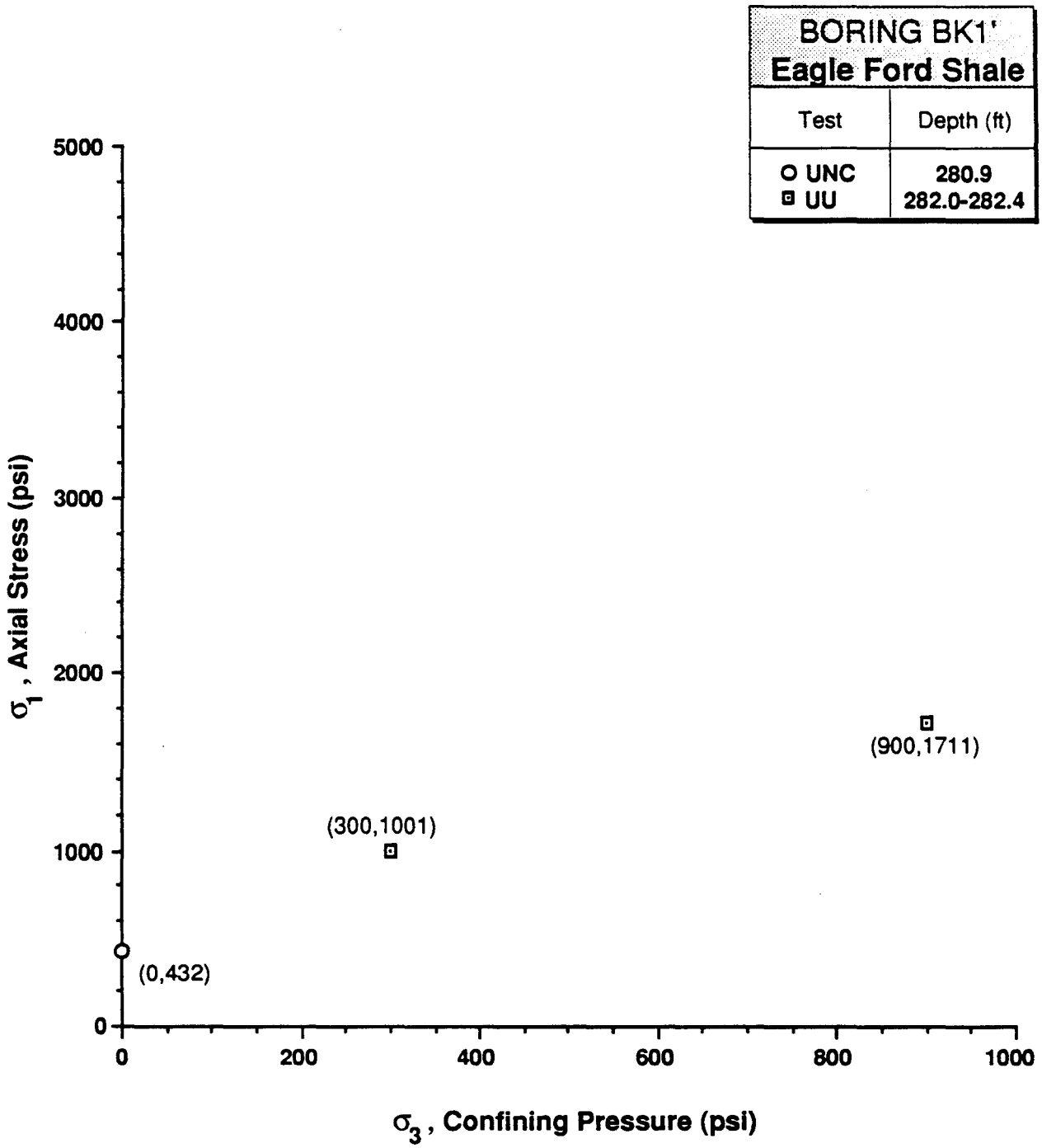


UNC-ASTM D2938
UU-ASTM D2664

The Earth Technology Corporation

Mohr Circle Plot
Texas SSC Site

FIGURE
D-4



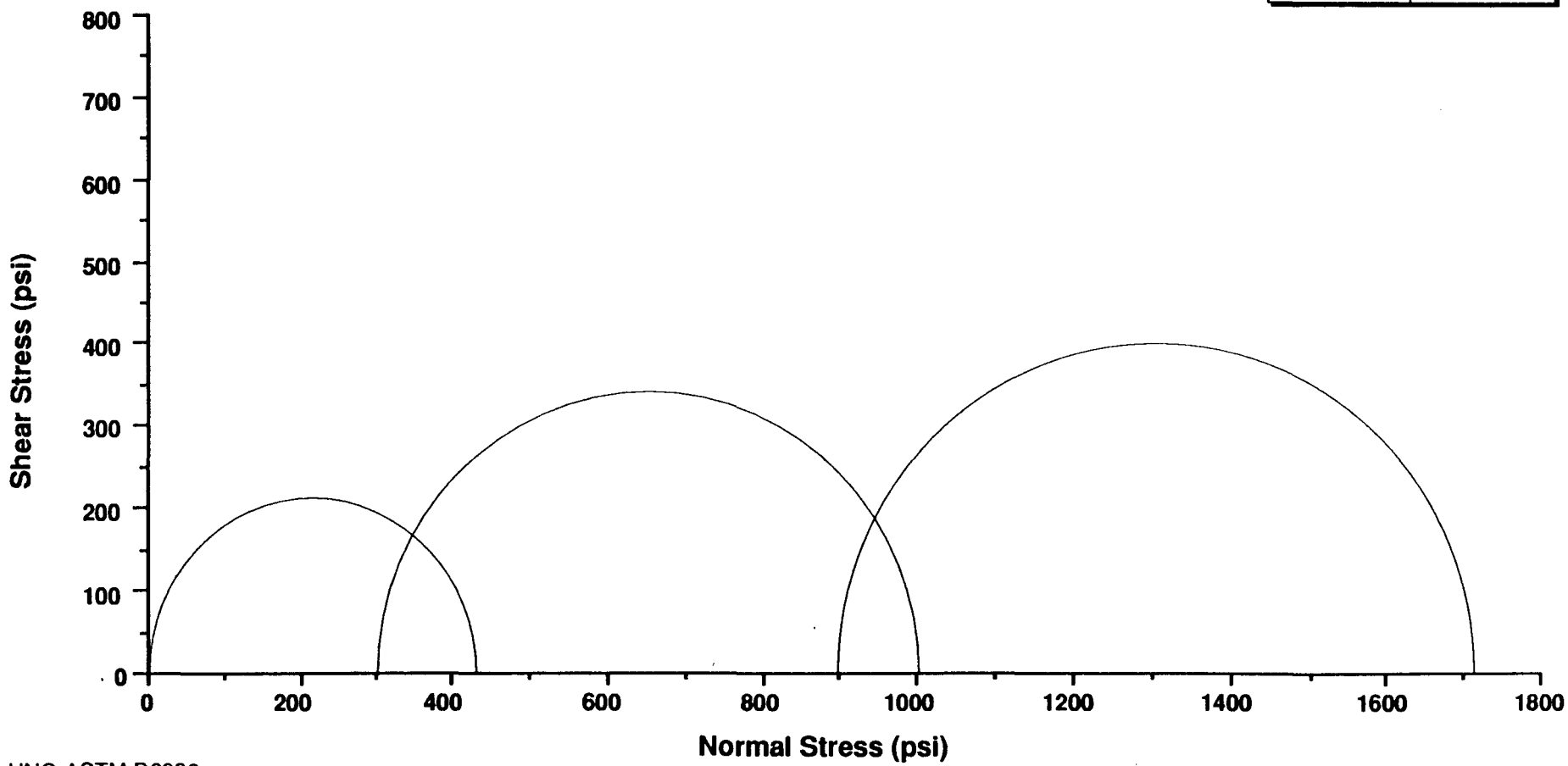
UNC-ASTM D2938
UU -ASTM D2664

The Earth Technology Corporation

Compression Test
Texas SSC Site

FIGURE
D-5

BORING BK1' Eagle Ford Shale	
Test	Depth (ft)
UNC	280.9
UU	282.0-282.4



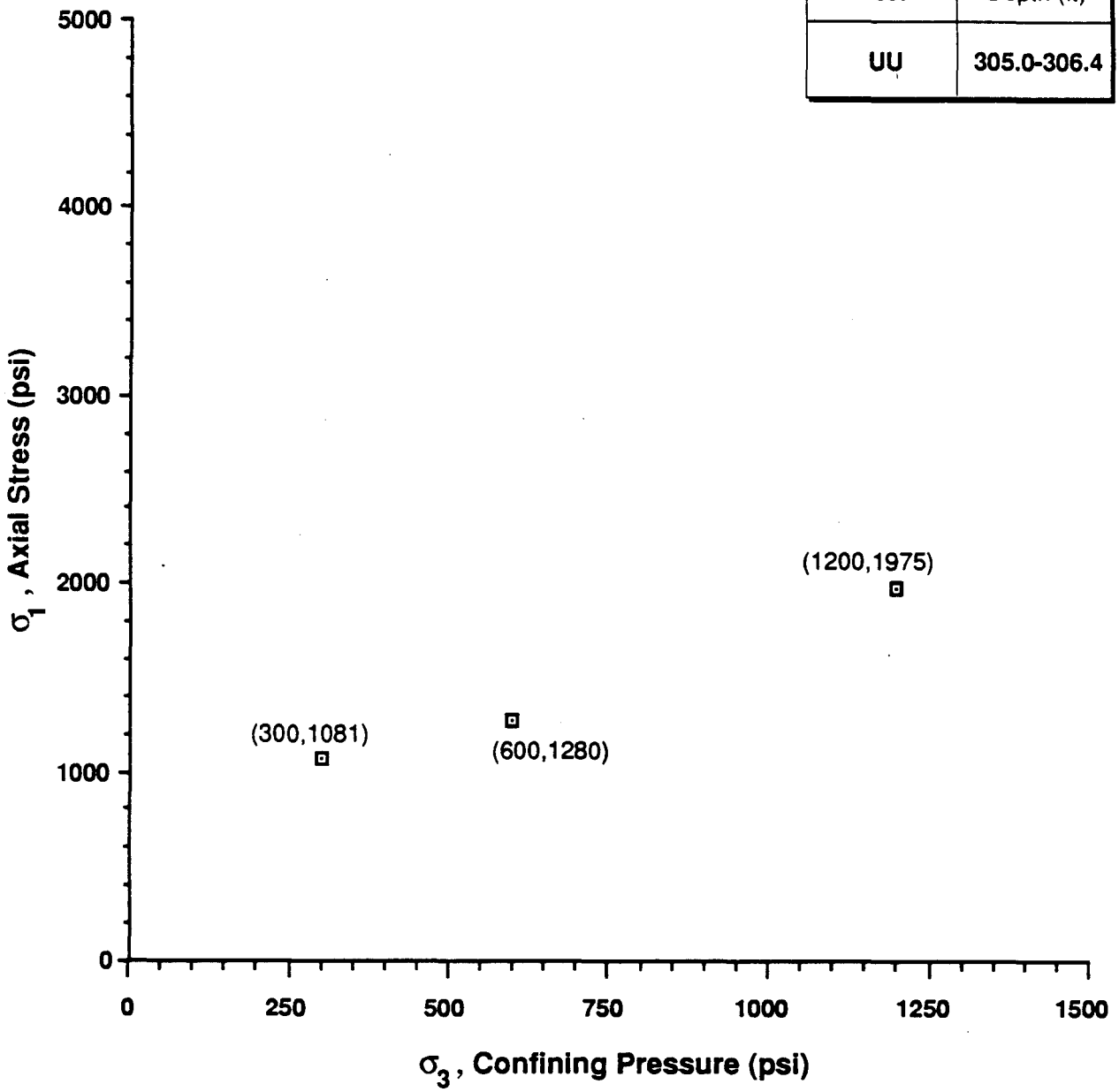
UNC-ASTM D2938
UU-ASTM D2664

The Earth Technology Corporation

Mohr Circle Plot
Texas SSC Site

FIGURE
D-6

BORING BK1' Eagle Ford Shale	
Test	Depth (ft)
UU	305.0-306.4



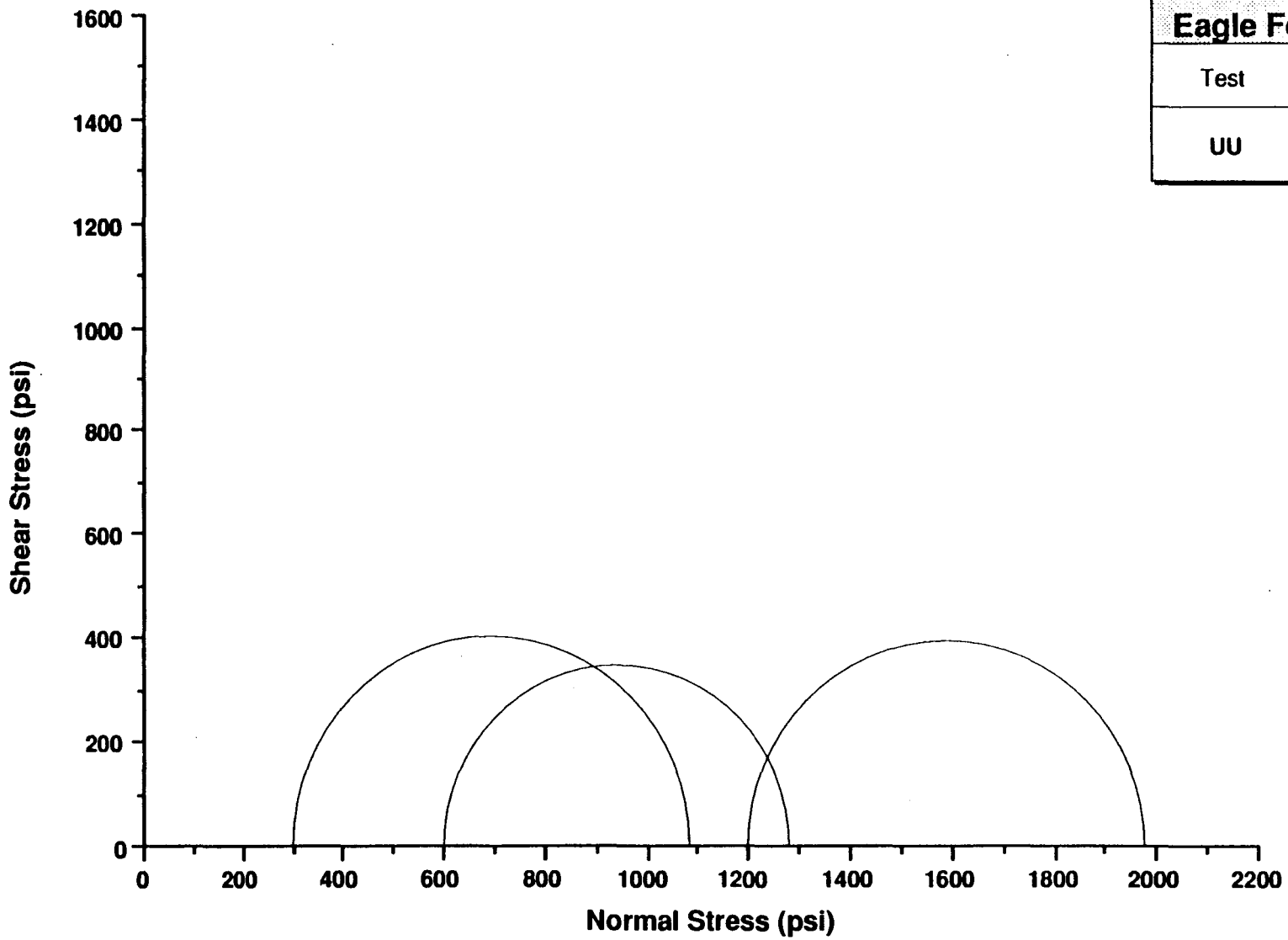
UU-ASTM 2664

The Earth Technology Corporation

Compression Test
Texas SSC Site

FIGURE
D-7

BORING BK1' Eagle Ford Shale	
Test	Depth (ft)
UU	305.0-306.4



UU-ASTM D2664

The Earth Technology Corporation

Mohr Circle Plot
Texas SSC Site

FIGURE
D-8