

BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole
 Casing Elevation: 0.70 m above
 Azimuth of X-Axis: 70°
 Azimuth of Y-Axis: 0°

Reference Phone: CE = 6 + 0.7m
 Offset: 0
 Azimuth: 0
 Elev.: 0
 X = 0
 Y = -2.0

Channel Configuration:
 Borehole Phone
 V=Channel 1
 R=Channel 2
 T=Channel 3

Reference Polarization:
 V=Channel 4
 R=Channel 5
 T=Channel 6

Vert.(deg.)
 0
 90
 90

Date: 20 Dec 94 Location: SPT-3 Capital Station
 High Cut 1K Low Cut 8K2 Sample Int. 0.2ms Number of Samples 2500

Tr, 40dB gain

Shot		Sub C.E. } Borehole Geophone		Source				Source Polarization	
Rec	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Vertical
1	SPT0001	19.2	(CE - 19.0)	(6 + 0.7 - 19.0)			0	-1.0	180
2	SPT0002	18.5					0	-1.0	180
3	SPT0003	18.0							180
4		17.5							180
5		17.0							180
6		16.5							180
7		16.0							180
8		15.5							180
9		15.0							180
10	SPT0010	14.5							180

112c Table (5.2 meters + 1) T/D 19.24 m

Note: add + 0.37 meters to depths → (kgw spring depth)

BSU GEOPHYSICS VSP OBSERVER'S LOG

1.5" Zircaloy
Temp = 270°F

Coordinate System Origin at Borehole
Casing Elevation: $(7 + 6) = CE$
Azimuth of X-Axis: 90
Azimuth of Y-Axis: 0

Reference Phone: Offset
Azimuth
Elev. 0
X= 0
Y= -2.0

Channel Configuration:
Borehole Phone
V=Channel 1
R=Channel 2
T=Channel 3

Reference Polarization: Azl.(deg.) Vert.(deg.)
V 0 0
R 0 90
T 270 90

Date: 20 Dec 94 Location: SPT-3 Capital Station
High Cut 11KN2 Low Cut 847 Sample Int. 0.2 m/sec Number of Samples 2500

Shot		Sub Borehole CE ↓ Geophone		Source					Source Polarization	
Rec	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical
11	SPT00011	14.0					0	-1.0	0	180
12		13.5							0	180
13		13.0							0	180
14		12.5							0	180
15		12.0							0	180
16		11.5							0	180
17		11.0							0	180
18		10.5							0	180
19	∨	10.0					∨	∨	0	180
20	SPT00020	9.5							0	180

F. 2

BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole
 Casing Elevation: CE = (0.7 + 6) meter
 Azimuth of X-Axis 90°
 Azimuth of Y-Axis 0°

Reference Phone: Offset _____
 Azimuth _____
 Elev. 0
 X = 0
 Y = -2.0

Channel Configuration:
 Borehole Phone
 V=Channel 1
 R=Channel 2
 T=Channel 3

Reference Polarization:
 V 0
 R 0
 T 270

Vert.(deg.)
0
90
90

Date: 20 Dec 94 Location: SPT-3 Capital Station
 High Cut 1 KNZ Low Cut 8 NR Sample Int. 0.002 Number of Samples 2500

Shot			Sub Borehole CE } Geophone		Source					Source Polarization	
Rec	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical	
21	SPT00021	9.0					0	-1.0	0	150	
22		8.5							0	150	
23		8.0				0			150		
24		7.5				0			150		
25		7.0				0			150		
26		6.5				0			150		
27		6.0							0	150	
28		5.5				0			150		
29		5.0				0			150		
30	SPT00030	4.5							0	150	
									0	150	

11:00 AM

BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole
 Casing Elevation: $CE = (0.7 + 6)$
 Azimuth of X-Axis 90
 Azimuth of Y-Axis 0

Reference Phone: Offset _____
 Azimuth 0
 Elev. 0
 X = 0
 Y = -2.0

Channel Configuration:
 Borehole Phone
 V=Channel 1
 R=Channel 2
 T=Channel 3

Reference Polarization: Azi.(deg.) Vert.(deg.)
 V 0
 R 90
 T 90

Date: 20 Dec 94 Location: SPT-3 Capital Station
 High Cut 1 kHz Low Cut 8 Hz Sample Int. 0.2 ms Number of Samples 2500

Shot			Borehole Geophone		Source						Source Polarization	
Rec	File	CE	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical	
31		✓	4.0					0	-1.0	0	150	
32			3.5							0	150	
33			3.0									
34			2.5									
35			2.0									
36			1.5									
37			1.0									
38			0.5									
39			0.0									

change
 Gain
 To 100
 R = 150

END Vertical Hammer

BSU GEOPHYSICS VSP OBSERVER'S LOG

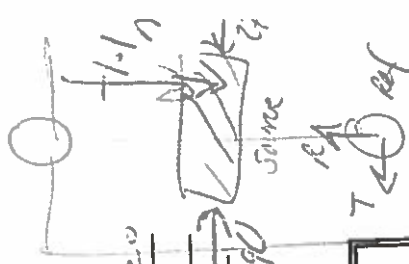
Coordinate System Origin at Borehole
 Casing Elevation: $CE = (0.7 + 6) m$
 Azimuth of X-Axis 90
 Azimuth of Y-Axis 0

Reference Phone: Offset _____
 Azimuth _____
 Elev. 4
 X = 0
 Y = -2.0

Channel Configuration:
 Borehole Phone
 V=Channel 1
 R=Channel 2
 T=Channel 3

Reference Polarization:
 V _____
 R _____
 T _____
 Azl.(deg.)
 V 0
 R 0
 T 270
 Vert.(deg.)
 V 0
 R 90
 T 90

Date: 21 Dec 94 Location: SPT-3 Capital Station
 High Cut 1000 Low Cut 8 Sample Int. .2 ms Number of Samples 2500



Shot		Borehole		Source			Source		
		File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y
39	SPT0039		19.0					0	-1.1
40			19.0						
41			18.5						
42			18.5						
43			18.0						
44			18.0						
45			17.5						
46			17.5						
47			17.0						
48	SPT0048		17.0						

12:00 PM

BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole
 Casing Elevation: CE ± (0.7 + 6)
 Azimuth of X-Axis 90
 Azimuth of Y-Axis 0

Reference Phone: Offset _____
 Azimuth _____
 Elev. 6
 X = 6
 Y = -2.0

Channel Configuration:
 Borehole Phone
 V=Channel 1
 R=Channel 2
 T=Channel 3

Reference Polarization: Azl.(deg.) Vert.(deg.)
 V 0 0
 R 0 90
 T 270 90

Date: 20 Dec 94 Location: SPT-3 Capital Station
 High Cut 1000 Low Cut 8 Sample Int. .2ms Number of Samples 2500

Shot		Borehole			Source				Source Polarization	
Rec	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical
49	SPT00049	16.5					0	-1.1	90	90
50		16.5							270	90
51		16.8							90	90
52		16.8							270	90
53		15.5							90	90
54		15.5							270	90
55		15.0							90	90
56		15.0							270	90
57		14.5							90	90
58	SPT00058	14.5							270	90

12:16
 Ground
 Thawing
 Warming
 up

BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole
 Casing Elevation: $CE = (0.7 + 6L)$
 Azimuth of X-Axis 90
 Azimuth of Y-Axis 0

Reference Phone: Offset _____
 Azimuth _____
 Elev. 0
 X = 0
 Y = -2.0

Channel Configuration:
 Borehole Phone
 V=Channel 1
 R=Channel 2
 T=Channel 3

Reference Polarization:
 V 0
 R 0
 T 270

Vert.(deg.)
0
90
90

Date: 20 Dec 94 Location: SPT-3 Capital Station
 High Cut 1000 Low Cut 8 Sample Int. 0.2ms Number of Samples 2500

Shot		Subs		Borehole		Source				Source Polarization	
		Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Y	Y	Vertical
59	SPT00059	14.0					0	-1.0		90	90
60		14.0								270	90
61		13.5								90	90
62		13.5								270	90
63		13.0								90	90
64		13.0								270	90
65		12.5								90	90
66		12.5								270	90
67		12.0								90	90
68	SPT00060	12.0								270	90

067

BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole
 Casing Elevation: CE = (0.7 + 6)
 Azimuth of X-Axis 90
 Azimuth of Y-Axis 0

Reference Phone: Offset
 Azimuth
 Elev. 6
 X = 0
 Y = -2.0

Channel Configuration: Borehole Phone
 V=Channel 1
 R=Channel 2
 T=Channel 3
 Reference Polarization: Azl.(deg.)
 V 0
 R 90
 T 90
 Vert.(deg.)
0
90
90

Date: 20 Dec 94 Location: SPT-3 Capital Station
 High Cut 1000 Low Cut 8 Sample Int. 2ms Number of Samples 2500

Shot		Subs	Borehole		Source				Source Polarization	
Rec	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical
69	SPT0069	11.5					0	-1.1	90	90
70		11.5							270	90
71		11.0							90	90
72		11.0							270	90
73		10.5							90	90
74		10.5							270	90
75		10.0							90	90
76		10.0							270	90
77		9.5							90	90
78	SPT0078	9.5							270	90

12:44 pm

Pc S

BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole
 Casing Elevation: CE = (0.7 + 6)
 Azimuth of X-Axis 90
 Azimuth of Y-Axis 0

Reference Phone: Offset _____
 Azimuth _____
 Elev. 6
 X = 0
 Y = -2.0

Channel Configuration:
 Borehole Phone
 V=Channel 1
 R=Channel 2
 T=Channel 3

Reference Polarization: Azi.(deg.) Vert.(deg.)
 V 0 0
 R 0 90
 T 270 90

Date: 20 Dec 94 Location: SPT-3 Capital Station
 High Cut 1000 Hz Low Cut 8 Sample Int. 0.2 ms Number of Samples 2500

Shot		Borehole CE / Geophone		Source						Source Polarization	
Rec	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical	
74	SPT0079	9.0					0	-1.1	90	90	
75		9.0							270	90	
81		8.5							90	90	
82		8.5							270	90	
83		8.0							90	90	
84		8.0							270	90	
85		7.5							90	90	
86		7.5							270	90	
87	✓	7.0					✓	✓	90	90	
88	SPT0088	7.0					✓	✓	270	90	

BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole
 Casing Elevation: CE = (0.7 + 6)
 Azimuth of X-Axis 90
 Azimuth of Y-Axis 0

Reference Phone: Offset
 Azimuth
 Elev. 6
 X = 0
 Y = -2.0

Channel Configuration:
 Borehole Phone
 V=Channel 1
 R=Channel 2
 T=Channel 3

Reference Polarization:
 V 0
 R 0
 T 270
 Azi.(deg.)
 Vert.(deg.)
0
90
90

Date: 20 Dec 84 Location: SPT-3 Capital Station
 High Cut 1000 Hz Low Cut 8 Hz Sample Int. .002 Number of Samples 2500
PC

Shot		Borehole Geophone			Source				Source Polarization	
Rec	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical
89	SPT0089	6.5					0	-1.1	90	90
90		6.5							270	90
91		6.0							90	90
92		6.0							270	90
93		5.5							90	90
94		5.5							270	90
95		5.5							90	90
96		5.0							270	90
97	✓	4.5					✓	✓	90	90
98	SPT0098	4.5					✓	✓	270	90

13:02

13:12

P. 10

BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole
 Casing Elevation: CE = (0.7 + 6)
 Azimuth of X-Axis 90
 Azimuth of Y-Axis 0

Reference Phone: Offset
 Azimuth
 Elev. 6
 X = 0
 Y = -2.0

Channel Configuration:
 Borehole Phone
 V=Channel 1
 R=Channel 2
 T=Channel 3

Reference Polarization: Azi.(deg.) Vert.(deg.)
 V 0
 R 90
 T 270

Date: 20 Dec 74 Location: SPT-3 Capital Station
 High Cut 1000 Low Cut 8 Sample Int. .2ms Number of Samples 2500

Shot		Borehole		Source				Source Polarization	
Rec	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Vertical
99	SPT0099	4.0					0	-1.1	90
100		4.0							270
101		3.5							90
102		3.5							270
103		3.0							90
104		3.0							270
105		2.5							90
106		2.5							270
107		2.0							90
108	SPT0098	2.0					V		270

13.24

09/11

BSU GEOPHYSICS VSP OBSERVER'S LOG

Coordinate System Origin at Borehole
 Casing Elevation: $CE = (0.7 + 4)$
 Azimuth of X-Axis 90
 Azimuth of Y-Axis 0

Reference Phone: Offset
 Azimuth
 Elev. 6
 X= 0
 Y= -2.0

Channel Configuration:
 Borehole Phone
 V=Channel 1
 R=Channel 2
 T=Channel 3

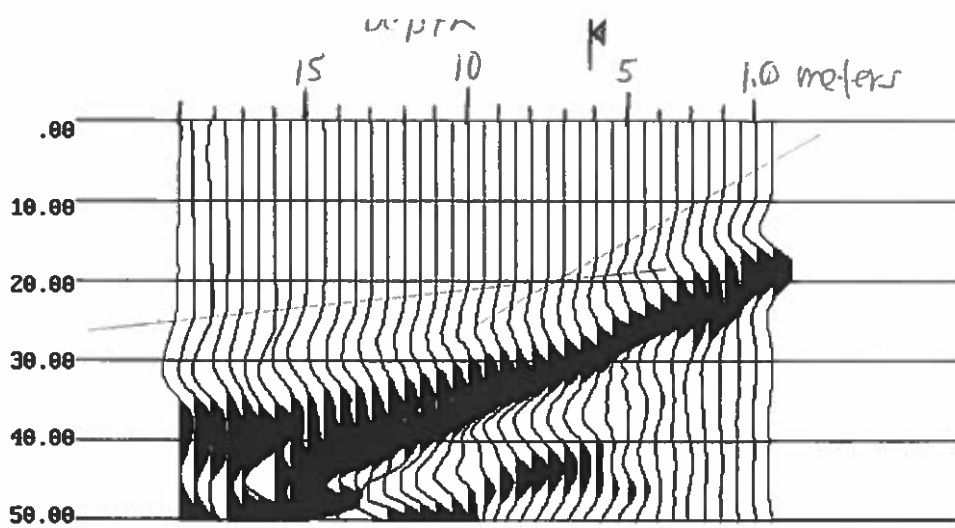
Reference Polarization: Azl. (deg.) Vert. (deg.)
 V 0 0
 R 0 90
 T 270 90

Date: 20 Dec 94 Location: SBT-3 Capital Station
 High Cut 1000 Low Cut 8 Sample Int. 2ms Number of Samples 2500

Shot			Borehole Geophone		Source					Source Polarization	
Rec	File	Depth	Elev.	Offset	Azimuth	Elev.	X	Y	Azimuth	Vertical	
109		1.5					0	-1.1	90	90	
110		1.5							270	90	
111		1.0							90	90	
112		1.0							270	90	
113		0.5							90	90	
114		0.5							270	90	

13.32
 13.55
 Tool
 1500

0.12



20 December 1994
 Capital Station Vertical Hammer Source
 Vertical Component
 Depths 19.0 to 0.5 meters, 0.5 meter stations

P-wave

$$V_2 = \frac{11.5m}{.005sec} = 2300. m/sec$$

$$V_1 = \frac{4m}{.018sec} = 400m/sec$$

$$\left(\frac{V_p}{V_s}\right)_{\text{Layer 1}} = \frac{400}{175} = 2.28$$

$$\left(\frac{V_p}{V_s}\right)_{\text{Layer 2}} = \frac{2300}{450} = 5.10$$

$$\frac{26.5}{27.5} = 2(25.5)$$

$$\mu = \frac{\left(\frac{V_p}{V_s}\right)^2 - 2}{2\left[\left(\frac{V_p}{V_s}\right)^2 - 1\right]} = \frac{5.2 - 2}{2(5.2 - 1)} = \frac{3.2}{8.4} = 0.380$$

Poisson's Ratio

$$\frac{\sigma_{11}}{\sigma_z} = \frac{\mu}{1 - \mu} = \frac{.617}{.520}$$

$$\sin \alpha = \frac{1 - \frac{\sigma_{11}}{\sigma_z}}{1 + \frac{\sigma_{11}}{\sigma_z}} = \frac{1 - \frac{.617}{.520}}{1 + \frac{.617}{.520}} = \frac{.186}{1.617} = .235$$

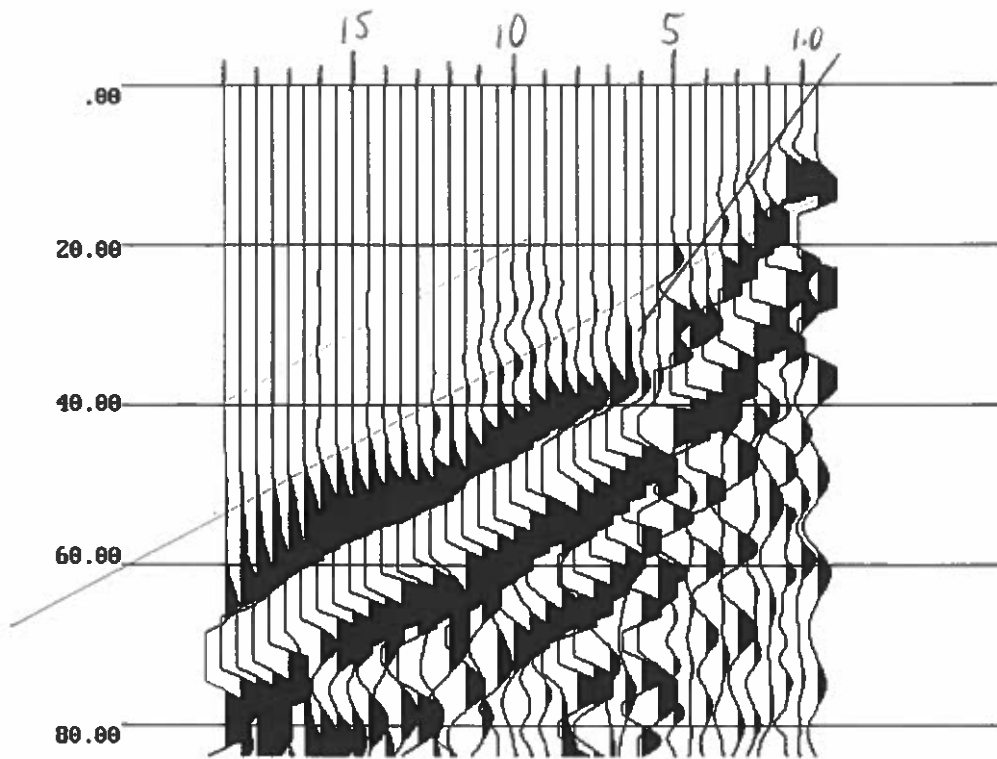
$$\alpha = 13.6^\circ$$

$$\alpha = 18.5^\circ$$

$$\frac{1.00}{.38} = .62$$

$$\frac{1.00}{.520} = .900$$

$$\frac{.480}{1.520}$$



Capital Station SPT-3 20 Dec 1994 Unrotated, Trace Equalized
Horizontal Hammer, Transverse Component

SH-wave

$$V_2 = \frac{9 \text{ m}}{0.028 \text{ sec}} = 450 \text{ m/s}$$

$$V_1 = \frac{3.5 \text{ m}}{0.028 \text{ sec}} = 175 \text{ m/s}$$

DOWN HOLE GEOPHONE FIELD CHECKLIST

Capital Station
STP-3

DATE: 20 Dec 94

ODOMETER

START:

28 mi

FINISH:

33 miles

ITEMS AT GEOSCIENCES

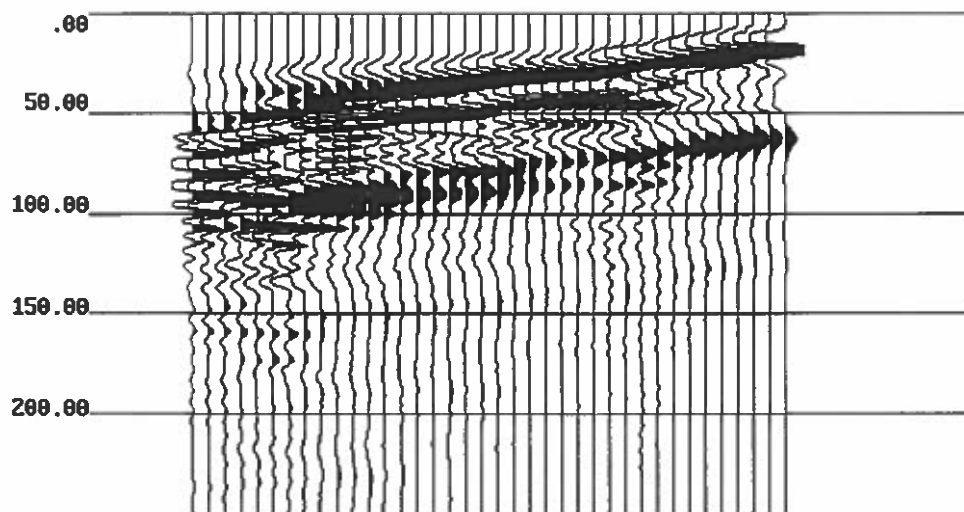
ITEM	OUT	IN	COMMENT
SWC TOOL	✓	✓	
REF PHONE AND CABLES	✓	✓	
BISON	✓	✓	
TAPE MEASURE (50M)	✓	✓	
PULLEY AND WINCH ASSEM.	✓	✓	
DUMMY SWC TOOL	✓	✓	
SLEDGE HAMMER	✓	✓	
COMPASS	✓	✓	
ROCK HAMMER	✓	✓	
ROPE	✓	✓	
WD-40	✓	✓	
OBSERVER SHEETS/ MAPS	✓	✓	
GAS CARD/ KEYS	✓	✓	
GLOVES	✓	✓	

ITEMS AT LINCOLN STREET

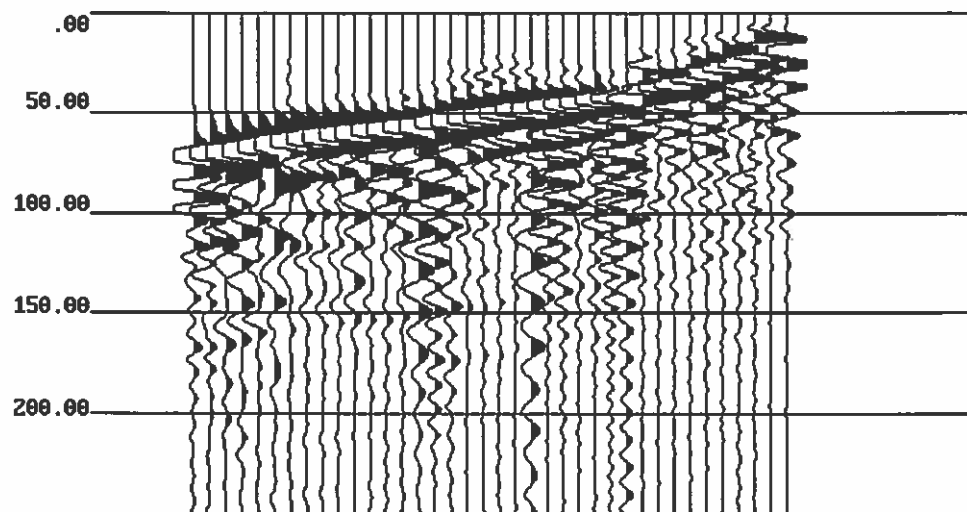
ITEM	OUT	IN	COMMENT
BISON CABLE BOX	✓	✓	
BISON TOOL BOX	✓	✓	Used Roll of paper
TOOL BOX	✓	✓	
TRIGGER CORD	✓	✓	
TRIPOD HEAD	✓	✓	gone
BATTERIES (2)	✓✓	✓✓	one placed on charge

LOCATED IN GARAGE

TRIPOD LEGS	✓✓✓	✓✓✓	
RAIL ROAD TIE	✓	✓	
SHOVEL	✓	✓	
PICK	✓	✓	
2 FT IRON ROD	✓	✓	
SAND BAGS	✓✓	✓✓	

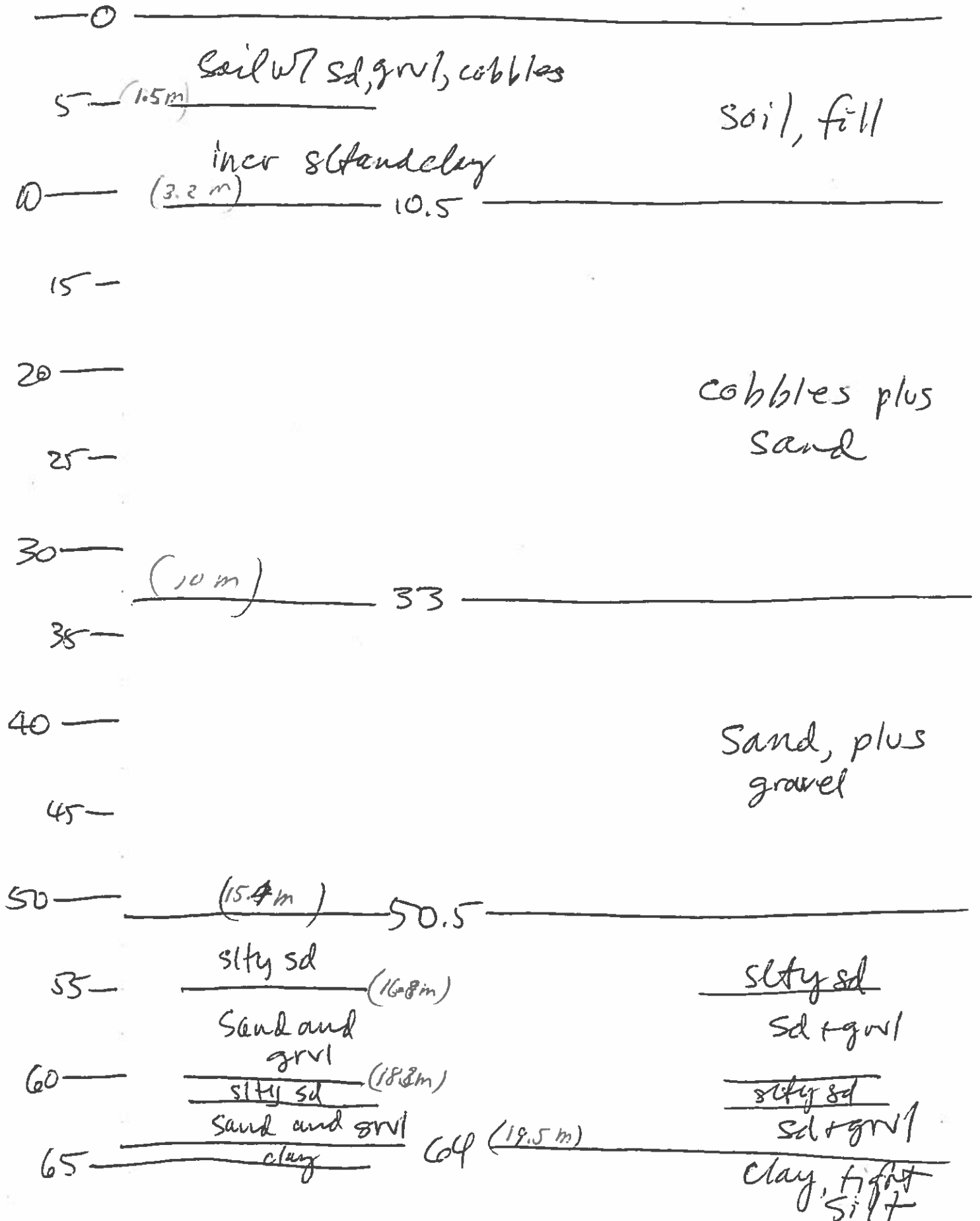


20 December 1994
Capital Station Vertical Hammer Source
Vertical Component
Depths 19.0 to 0.5 meters, 0.5 meter stations



Capital Station SPT-3 20 Dec 1994 Unrotated, Trace Equalized
Horizontal Hammer. Transverse Component

SPT 3



Well log: SPT-3 Capital Station Project
 Driller: Brian Nance, Haz-Tech
 Rig: CME: 10.5in OD, 6.25in ID auger to 25', drive casing and
 drill with a tri-cone rock bit
 Location: 54 ft southwest of MSPA-2
 Start: 12/7/94 1130hr snowing and several inches of snow on the
 ground

Depth Sample Description
 BLS
 ft

0-3	x	black and brown soil with sand and cobbles (<1-2 in)
3-5	x	brown and black soil with pea gravel and cobbles to 2 in (mostly .5 in)
5-7		- darker, more silty and clayey
7-10.5	x	black and brown clay, silty with some sand and gravel
10.5-16	x	cobbles (mostly .5-2 in, up to 4 in) with silt and sand (angular), cobbles rnded and spherical to rnded and oblong
16-17.5	x	black micaceous sand and silt, cobbles mostly 1-2 in, up to 4 in common
17.5-18.5		incr % cobbles
18.5-19		decreasing cobble size, mostly 1 in, rnded, spherical
19-19.5		decr cobble size to mostly .5-1 in, less spherical in shape
19.5-22	x	gravel (pea to .5 in) with gray sand
22-22.5		gray sand with cobbles, mostly 2 in, increasing size of largest cobble to 6 in (rnded and platey)
22.5-23		- cobbles increasing size to mostly 2-4 in
23-23.5	x	cobbles decreasing size, mostly 1 in, rounded and spherical with gray sand
23.5-24		cobble size incr to mostly 2 in, rnd and spherical, no sand
24-25	x	gray sand with cobbles, mostly <1-2 in
1230hr - stop drilling, drop in casing, pull augers		

Well log: SPT-3 Capital Station Project
 Driller: Brian Nance, Haz-Tech
 Rig: CME: 10.5in OD, 6.25in ID auger to 25', drive casing and
 drill with a tri-cone rock bit
 Location: 54 ft southwest of MSPA-2

Depth Sample Description
 BLS
 ft

 830 hr 12/8/94 - start drilling with bentonite and 3 7/8" tri-
 cone rock bit

25-27 x tan sand and cobbles

27 lost circulation

29-30 circulation returned, few returns, no sand few
 cobble chips

new bit added - green paint flakes from new bit

32-33 x sand and chips, mostly chips
 chatter at 33

33-35 x incr sand, tan, lithics

35-36.5 core 60% recovery, fine-med sand, gravel with well-
 sorted sd at btm

38-40 x tan sd with lithics, some muscovite

40-41.5 core 33% recovered - 3" cobble lodged in barrel
 tan lithic sand plus grvl

42 x coarser sd, incr lithics plus grvl

43 x coarser sd plus gravel

44-45 chatter at 44, med sd, incr lithics at 45, plus
 grvl

45-46 x med-cs sd, tan with abundant lithics (driller says
 "grvl here also")

46.5 x fine-med sd plus grvl

47-48 x cs sd plus grvl

48-50 x med sd plus grvl

50-51.5 core 100% recovery, tan lithic sd / grvl / fine tan
 lithic sd (note drilling mud in core)
 x sample is tan med lithic sd

Well log: SPT-3
Capital Station Project
Driller: Brian Nance, Haz-Tech
Rig: CME: 10.5in OD, 6.25in ID auger to 25', drive casing and
drill with a tri-cone rock bit
Location: 54 ft southwest of MSPA-2

Depth Sample Description
BLS
ft

51.5-53 core 100% recovery, fine sd/med-cs sd/slty v fine sd
53-54.5 core 65% recovery, tan v fine sd
54.5-56 core 88% returned, vf sd / cs lithic sd / tan slt with
cemented sd and cobbles, rnd and angular, .5-1.5
in

1525hr 12/9/94 coring

56-57.5 core 0% core, catcher teeth damaged
tan fine sd above grvl at 57 (lost circ at 57,
returned at 57.5)

0930hr 12/10/94

57.5-59 core 50% recovered, tan med-cs sd, few lithics (heavy
drilling mud) - also sample from barrel mouth (59)
59-60.5 core 85% recovered, well-sorted med sd, tan, few
lithics / finer sd/sd with silt
60.5-62 core 67% recovered, sd coarsens to grvl at 62, incl 1"
cobble
62-63.5 core 100% recovered, tan, loose cs sd with lithics
increasing and grain size decreasing downward,
tight well-sorted fine sd with few lithics but
some muscovite at 63.5 (sampled)
63.5-65 core 95% recovered, loose v f sd, tan with lithics /
med sd, well-sorted / reddish tan clay at 64 /
gray tight silt at 65 (sampled gray silt)

65 = TD