Appendix 16. Location, physical characteristics, borehole-geophysical logs and interpreted structures for well Sut 1.

Sut 1 is located at the Blackstone National Golf Club in Sutton, Massachusetts. The well yields 1 gpm and is not used by the golf club. The well was logged from July 10 through July 13, 2007. The well ID is sut1.071007 and it has an elevation of 178 meters above sea level. The well is at the base of a large hill adjacent to a perennial stream and swamp. The well is reported to be 243 meters deep however the measured depth is 232 meters. Casing length is 6.4 meters.

The naturally occurring surficial deposit is a glacial till. However, much of the overburden was removed during golf course construction. At the time of drilling, approximately 2 meters of overburden was observed. The bedrock at the site is dark-gray to greenish-gray medium-grained amphibolite. The well lies less than 1 km from the Bloody Bluff Fault zone, which forms the east boundary of the Nashoba terrane.

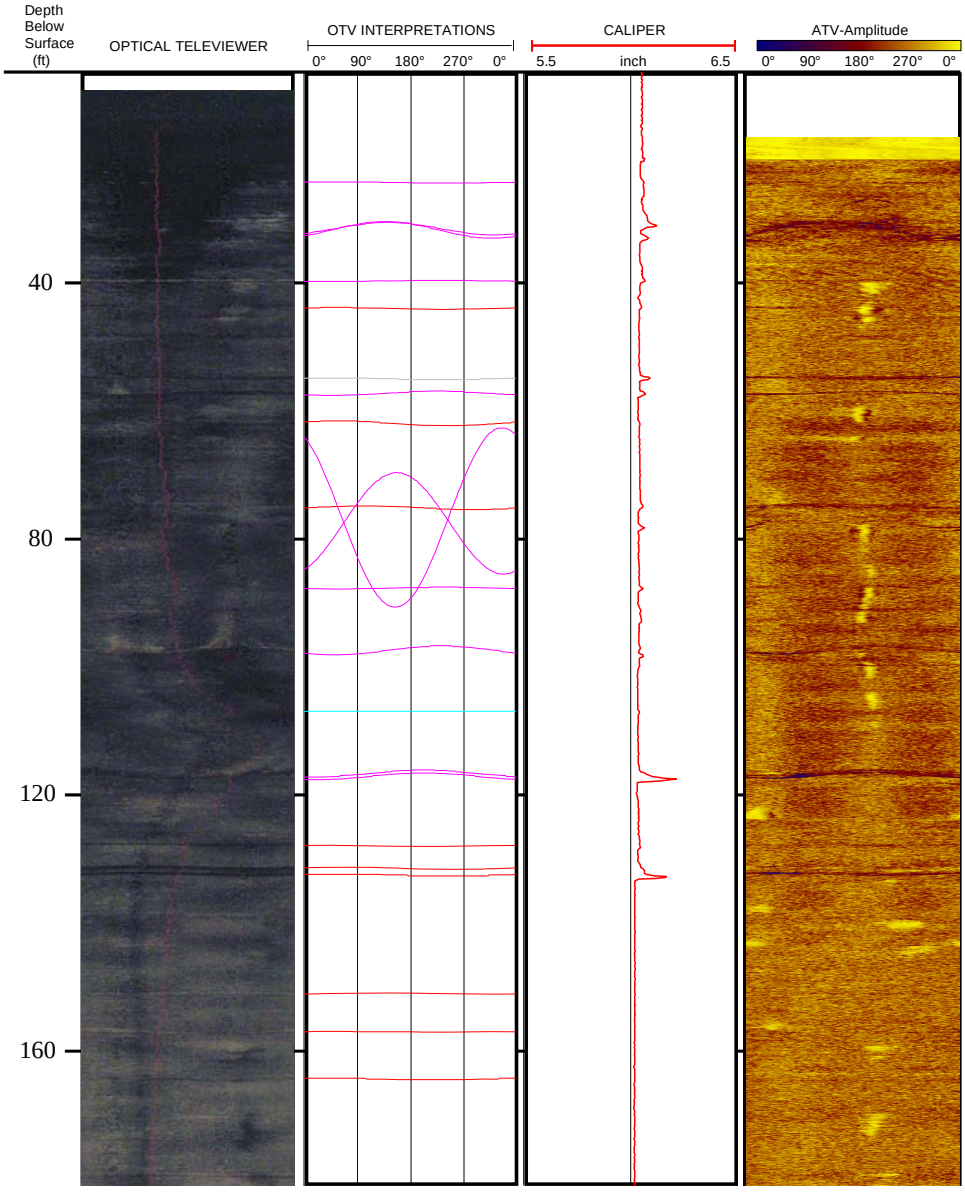
Fifty-two fractures were measured in the borehole. There are 8 subhorizontal unloading joints, 23 tectonic joints and 21 FPF. The water level in the well was 2.7 meters below the ground surface at the outset of pumping. The well was pumped at 0.5 gallons per minute for 1 hour and 2 minutes during which time the water level dropped 0.79 meters. The heat pulse flow meter testing identified two flowing fractures. The flowing fractures were at 16.8 and 32.6 meters depth. One flowing fracture is a subhorizontal sheeting fracture. The other is an FPF.

Appendix 16, continued. Midpoint depth, strike and dip of features identified in optical televiewer log, fracture type and heat pulse flowmeter data from Sut 1 (azimuth and dip reported using right hand rule convention; t = tectonic fractures, s = sheeting joints, p = foliation parallel fractures). Data shown under the pumping test have not been normalized.

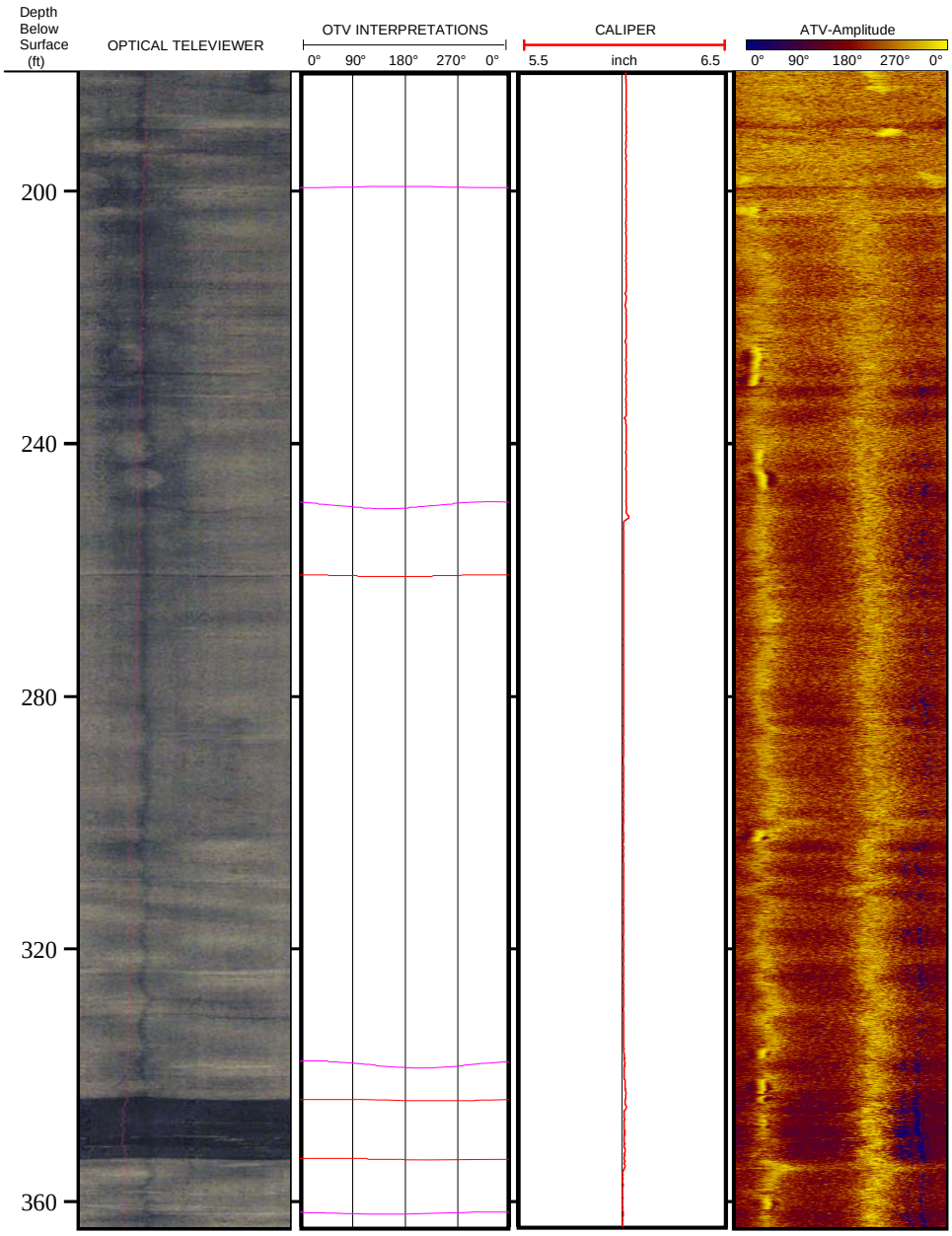
Site ID:	sut1.071007			
Location:	"Blackstone Nat'l Golf Club" Sutton, MA			
Elevation (m)	178			
Reported Yield (gpm)	1			
Rock Type:	Amphibolite			
Depth to water:	9	ft	2.74	m
Depth of casing:	21	ft	6.40	m
Depth of well:	760	ft	231.65	m
Land surface to MP:	0	ft	0.00	m

Fractures						Ambient			Pump at 0.5 gpm		
Number	Depth (m)	Depth (ft)	Azimuth	Dip	Parallel	Flow (y/n)	gpm (amb)	notes	Flow (y/n)	gpm (pump)	notes
1	7.0	22.9	100	51	t	y	-0.01	flow in	n	0.24	
2	7.4	24.3	333	34	t	n	-0.01		n	0.24	
3	9.6	31.6	51	80	t	n	-0.01		n	0.24	
4	9.7	31.7	47	83	t	y	-0.01	flow out	n	0.24	
5	12.1	39.7	139	27	t	n	0		n	0.24	
6	13.4	44.0	324	43	p	n	0		n	0.24	
7	16.8	55.0	317	37	p	n	0		y	0.24	flow in
8	17.5	57.3	134	64	t	n	0		n	0.12	
9	18.9	62.0	330	66	p	n	0		n	0.12	
10	22.9	75.1	14	58	p	n	0		n	0.12	
11	23.4	76.7	244	89	t	n	0		n	0.12	
12	23.6	77.6	66	89	t	n	0		n	0.12	
13	26.7	87.7	146	42	t	n	0		n	0.12	
14	29.7	97.4	142	77	t	n	0		n	0.12	
15	32.6	107.0	145	15	s	n	0		y	0.12	flow in
16	35.5	116.6	123	83	t	n	0		n	0	
17	35.7	117.1	127	80	t	n	0		n	0	
18	39.0	127.9	294	32	p	n	0		n	0	
19	40.0	131.4	342	52	p	n	0		n	0	
20	40.4	132.5	332	38	p	n	0		n	0	
21	46.0	151.0	47	30	p	n	0		n	0	
22	47.9	157.0	317	17	s	n	0		n	0	
23	50.1	164.4	305	36	p	n	0		n	0	
24	60.8	199.4	80	34	t	n	0		n	0	
25	76.1	249.7	236	73	t	n	0		n	0	
26	79.5	260.9	252	33	p	n	0		n	0	
27	103.1	338.3	295	73	t	n	0		n	0	
28	104.8	343.9	324	38	p	n	0		n	0	
29	107.7	353.3	326	28	p	n	0		n	0	
30	110.3	361.9	236	47	t	n	0		n	0	
31	113.6	372.8	307	18	s	n	0		n	0	
32	114.5	375.6	343	29	p	n	0		n	0	
33	115.0	377.2	236	44	t	n	0		n	0	
34	116.1	381.0	329	25	s	n	0		n	0	
35	116.2	381.3	290	23	s	n	0		n	0	
36	116.4	381.8	285	42	p	n	0		n	0	
37	116.7	383.0	334	43	p	y	0.01	flow out	n	0	
38	130.3	427.4	248	69	t	n	0.01		n	0	
39	130.4	427.9	255	64	t	n	0.01		n	0	
40	130.6	428.5	229	75	t	n	0.01		n	0	
41	136.4	447.6	54	73	t	n	0.01		n	0	
42	136.9	449.2	335	42	p	y	0.01	flow in	n	0	
43	138.6	454.8	50	82	t	n	0		n	0	
44	141.4	464.0	293	26	p	n	0		n	0	
45	141.7	464.8	2	28	p	n	0		n	0	
46	152.1	499.1	336	25	s	n	0		n	0	
47	185.3	608.1	9	33	p	n	0		n	0	
48	188.1	617.1	242	71	t	n	0		n	0	
49	202.7	665.0	0	27	p	n	0		n	0	
50	202.8	665.5	351	21	s	n	0		n	0	
51	203.1	666.4	1	38	p	n	0		n	0	
52	222.9	731.5	333	19	s	n	0		n	0	

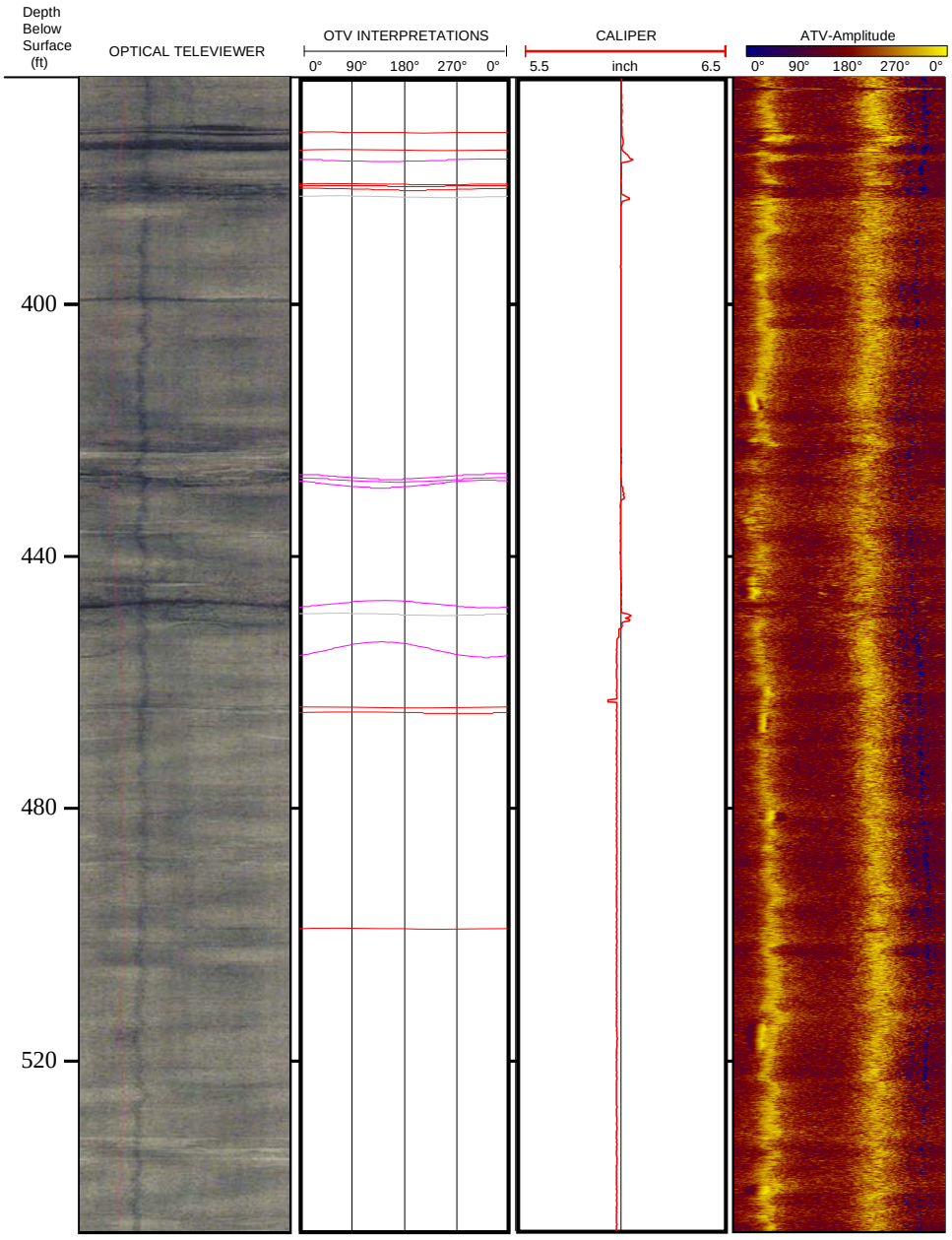
Appendix 16, continued. Interpreted features for Sut 1. Optical televiewer interpretations indicated by color: orange – subhorizontal sheeting joint; magenta – tectonic joint; red – foliation parallel fracture (FPF); cyan – transmissive subhorizontal sheeting joint; green – transmissive tectonic joint; grey – transmissive foliation parallel fracture (FPF). OTV – optical televiewer; ATV – acoustic televiewer.



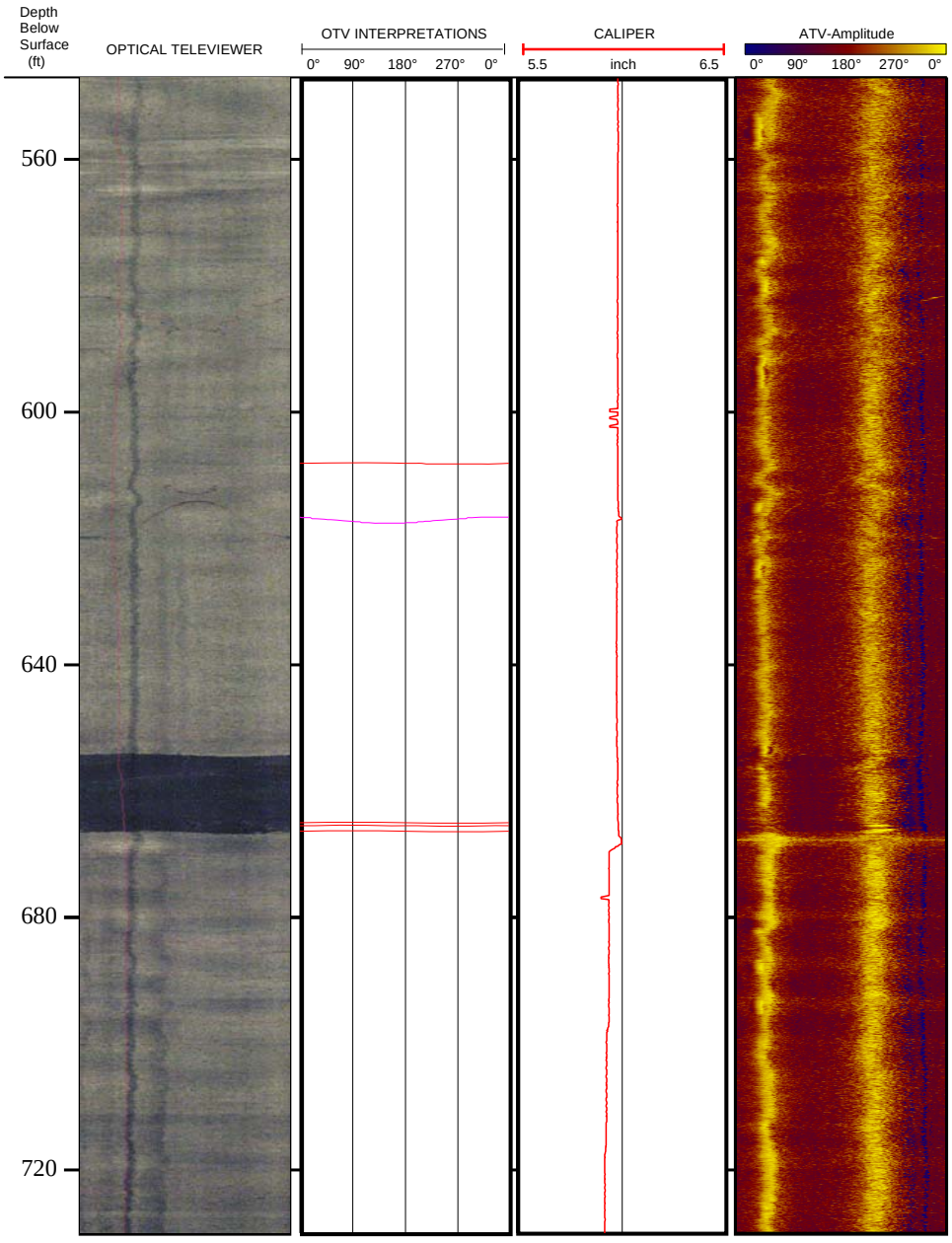
Appendix 16, continued. Interpreted features for Sut 1. Optical televiewer interpretations indicated by color: orange – subhorizontal sheeting joint; magenta – tectonic joint; red – foliation parallel fracture (FPF); cyan – transmissive subhorizontal sheeting joint; green – transmissive tectonic joint; grey – transmissive foliation parallel fracture (FPF). OTV – optical televiewer; ATV – acoustic televiewer.



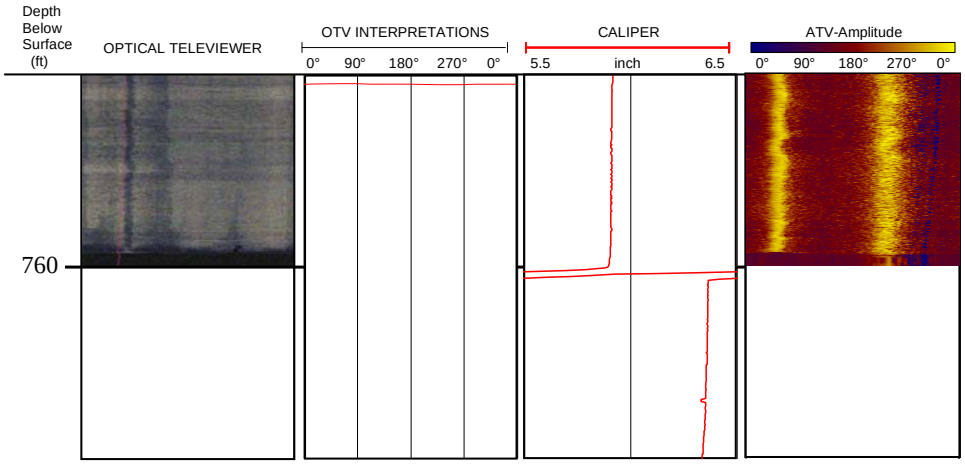
Appendix 16, continued. Interpreted features for Sut 1. Optical televiewer interpretations indicated by color: orange – subhorizontal sheeting joint; magenta – tectonic joint; red – foliation parallel fracture (FPF); cyan – transmissive subhorizontal sheeting joint; green – transmissive tectonic joint; grey – transmissive foliation parallel fracture (FPF). OTV – optical televiewer; ATV – acoustic televiewer.



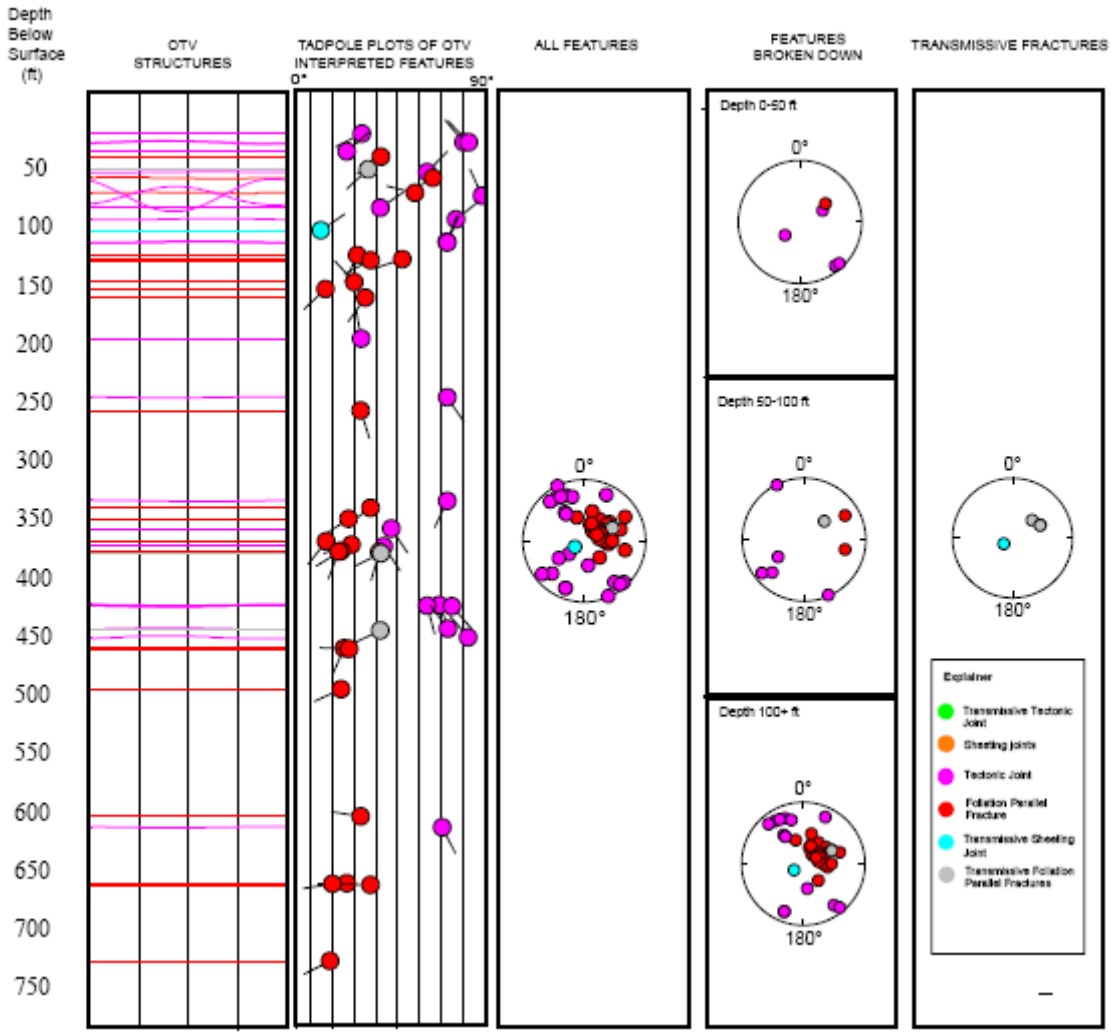
Appendix 16, continued. Interpreted features for Sut 1. Optical televiewer interpretations indicated by color: orange – subhorizontal sheeting joint; magenta – tectonic joint; red – foliation parallel fracture (FPF); cyan – transmissive subhorizontal sheeting joint; green – transmissive tectonic joint; grey – transmissive foliation parallel fracture (FPF). OTV – optical televiewer; ATV – acoustic televiewer.



Appendix 16, continued. Interpreted features for Sut 1. Optical televiewer interpretations indicated by color: orange – subhorizontal sheeting joint; magenta – tectonic joint; red – foliation parallel fracture (FPF); cyan – transmissive subhorizontal sheeting joint; green – transmissive tectonic joint; grey – transmissive foliation parallel fracture (FPF). OTV – optical televiewer; ATV – acoustic televiewer.



Appendix 16, continued. Tadpole plots and stereoplots of interpreted optical televiewer (OTV) structures for Sut 1. In the tadpole plot depth is plotted along the y-axis and magnitude of the dip plotted on the x-axis. The tail of the tadpole points in the direction of the dip, relative to true north, which is toward the top of the page. The stereonets represent poles to planar features plotted on a lower-hemisphere equal-area stereonet. Stereonets use right hand rule convention. Colors on the OTV structures plot correspond to those in the tadpole explanation.



Appendix 16, continued. Composite log for Sut 1 of natural gamma, fluid resistivity, fluid temperature and heat pulse flowmeter data under ambient and stressed (pumping) conditions. For the heat pulse flowmeter data collected under pumping conditions, the well was pumped at 0.5 gallons per minute and data have been normalized.