Appendix 13. Location, physical characteristics, borehole-geophysical logs and interpreted structures for well Roc 2.

Two wells in this project were logged in the Avalon terrane. These wells were drilled as public water supply wells for the Town of Rockport, MA. The wells are approximately 300 meters apart and both are located just east of Cape Pond Reservoir, the surface water supply for the Town of Rockport. The town drilled the wells to supplement existing surface water supply reservoirs. Both wells yield in excess of 60 gallons per minute.

Roc 2, with well ID Roc2.082107, was logged from August 21, 2007 through August 25, 2007. The well is 168 meters deep, is located at an approximate elevation of 40 meters above sea level and has 6.1 meters of casing. Overburden thickness is about 3 meters and consists of till. The till consists mostly of a nonsorted, nonstratified matrix of sand with some silt, clay, and boulders. The bedrock is Cape Ann Granite. The Cape Ann granite is a medium- to coarse-grained, leucocratic rock. The composition in the area of the wells is alkali-feldspar syenite.

A total of 127 fractures were identified in this well. There were 2 subhorizontal sheeting joints, 96 tectonic joints and 29 FPF. The water table in the well was 11.66 meters deep at the outset of the pumping test. The well was pumped for 2 hours and 30 minutes at 1.0 gallon per minute during which time the water level decreased 0.8 meters. Three fractures were found to be contributing flow to the borehole in this well. The flowing fractures were at 52.2, 73 and 110 meters depth. All of the flowing fractures were tectonic joints.

Appendix 13, continued. Midpoint depth, strike and dip of features identified in optical televiewer log, fracture type and heat pulse flowmeter data from Roc 2 (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:	roc2.082107				
Location:	Rockport, MA "RW #1"				
Elevation (m)	7				
Reported Yield (gpm)	60+				
Rock Type:	Granite				
Depth to water:	38.26	ft	11.66	m	
Depth of casing:	20	ft	6.10	m	
Depth of well:	550	ft	167.64	m	
Land surface to MP:	2.21	ft	0.67	m	

Fractures						Ambient			Pump	at 1.0 gpm	
Number	Depth (m)	Depth (ft)	Azimuth	Dip	Type	Flow (y/n)	gpm (amb)	notes	Flow (y/n)	gpm (pump)	notes
1	6.3	20.8	270	1	s	n	0		n	0.6	
2	8.2	26.8	149	33	t	n	0		n	0.6	
3	8.6	28.2	33	55	t	n	0		n	0.6	
4	9.1	29.7	113	44	t	n	0		n	0.6	
5	9.4	31.0	160	56	t	n	0		n	0.6	
6	10.0	32.7	190	46	t	n	0		n	0.6	
7	10.5	34.5	169	49	t	n	0		n	0.6	
8	10.6	34.9	177	36	t	n	0		n	0.6	
9	11.6	38.2	155	74	t	n	0		n	0.6	
10	12.4	40.6	152	53	t	n	0		n	0.6	
11	12.5	41.0	310	77	t	n	0		n	0.6	
12	12.6	41.4	57	74	t	n	0		n	0.6	
13	12.8	42.1	181	74	t	n	0		n	0.6	
14	13.3	43.8	56	42	t	n	0		n	0.6	
15	13.4	43.9	138	56	t	n	0		n	0.6	
16	13.5	44.2	150	39	t	n	0		n	0.6	
17	13.7	44.9	160	39	t	y	-0.04	flow in	n	0.6	
18	14.5	47.6	15	69	t	n	-0.04		n	0.6	
19	15.5	50.9	43	68	t	n	-0.04		n	0.6	
20	16.8	55.3	17	68	t	n	-0.04		n	0.6	
21	17.0	55.8	250	72	t	n	-0.04		n	0.6	
22	17.7	58.1	170	78	t	n	-0.04		n	0.6	
23	18.5	60.6	32	72	t	n	-0.04		n	0.6	
24	18.9	61.9	6	72	t	n	-0.04		n	0.6	
25	19.1	62.5	356	72	t	n	-0.04		n	0.6	
26	20.6	67.7	18	70	t	n	-0.04		n	0.6	
27	21.2	69.7	5	63	t	n	-0.04		n	0.6	
28	21.5	70.5	9	62	t	n	-0.04		n	0.6	
29	22.5	73.9	356	63	t	n	-0.04		n	0.6	
30	23.1	75.9	18	69	t	n	-0.04		n	0.6	
31	23.7	77.6	1	81	t	n	-0.04		n	0.6	
32	24.5	80.4	350	79	t	n	-0.04		n	0.6	
33	25.1	82.3	198	37	t	n	-0.04		n	0.6	
34	26.3	86.1	179	82	t	n	-0.04		n	0.6	
35	26.6	87.2	179	80	t	n	-0.04		n	0.6	
36	27.2	89.4	78	31	t	n	-0.04		n	0.6	
37	28.0	91.8	200	52	t	n	-0.04		n	0.6	
38	29.1	95.5	172	60	t	n	-0.04		n	0.6	
39	30.5	100.2	64	83	t	n	-0.04		n	0.6	
40	31.8	104.2	154	68	t	n	-0.04		n	0.6	
41	33.7	110.7	24	70	t	n	-0.04		n	0.6	
42	34.2	112.1	20	70	t	n	-0.04		n	0.6	
43	36.9	120.9	34	45	t	n	-0.04		n	0.6	
44	37.5	123.0	129	17	s	n	-0.04		n	0.6	
45	37.8	124.0	133	40	t	n	-0.04		n	0.6	
46	39.2	128.5	311	86	t	n	-0.04		n	0.6	
47	39.4	129.2	71	81	t	n	-0.04		n	0.6	
48	39.8	130.4	350	63	p	n	-0.04		n	0.6	
49	40.1	131.5	7	42	t	n	-0.04		n	0.6	

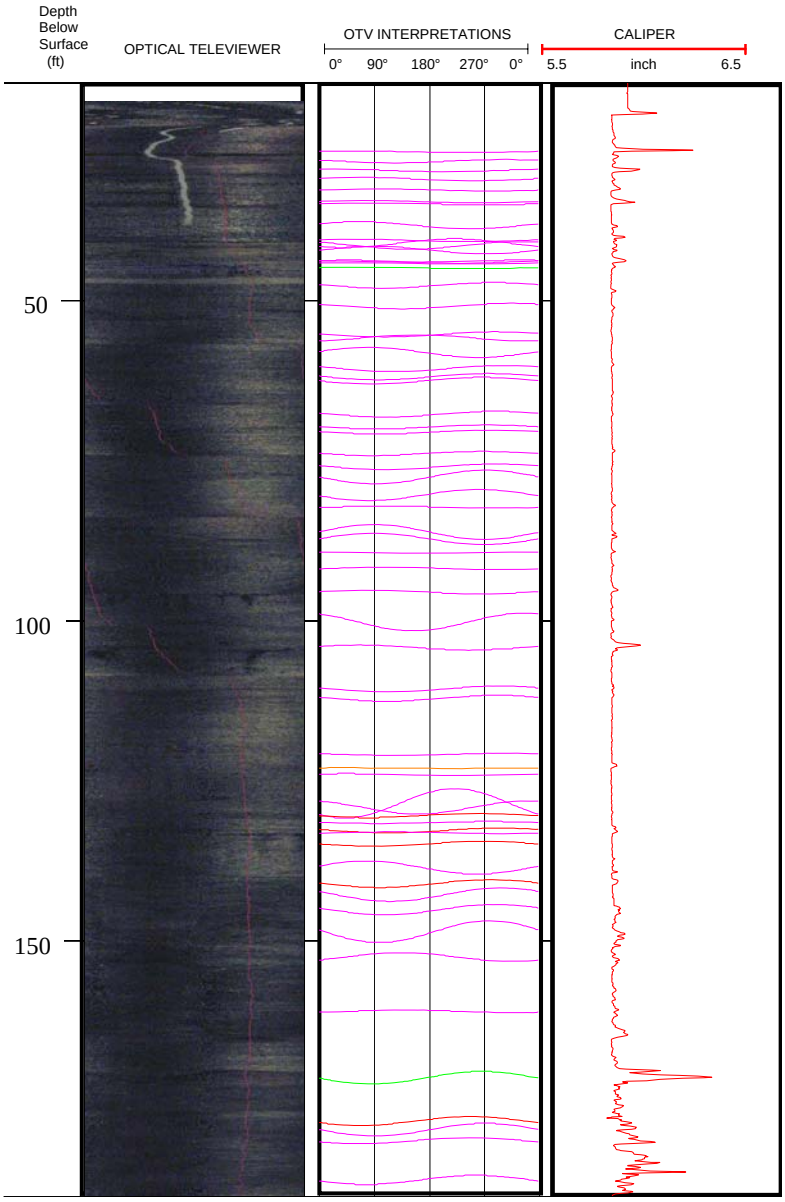
Appendix 13, continued. Midpoint depth, strike and dip of features identified in optical televiewer log, fracture type and heat pulse flowmeter data from Roc 2 (azimuth and dip reported using right hand rule convention; t = tectonic fractures, s = sheeting joints, p = foliation parallel fractures). Data shown under the pumping test have not been normalized.

60	40.5	132.8	24	65	p	n	-0.04		n	0.6	
61	40.6	133.1	208	42	t	n	-0.04		n	0.6	
62	41.1	134.9	358	67	p	n	-0.04		n	0.6	
63	42.3	138.6	167	81	t	n	-0.04		n	0.6	
64	43.0	141.1	9	75	p	n	-0.04		n	0.6	
65	43.5	142.8	26	81	t	n	-0.04		n	0.6	
66	44.2	145.1	17	79	t	n	-0.04		n	0.6	
67	45.3	148.6	8	85	t	n	-0.04		n	0.6	
68	46.5	152.5	224	76	t	n	-0.04		n	0.6	
69	49.1	161.0	229	46	t	n	-0.04		n	0.6	
60	52.2	171.4	355	81	t	y	-0.1	flow in	y	0.6	flow in
61	54.3	178.2	337	77	p	n	-0.1		n	-0.03	
62	54.7	179.5	1	81	t	n	-0.1		n	-0.03	
63	55.2	181.2	335	71	t	n	-0.1		n	-0.03	
64	57.1	187.4	345	77	t	n	-0.1		n	-0.03	
65	58.3	191.2	339	78	t	n	-0.1		n	-0.03	
66	59.1	194.0	313	69	p	n	-0.1		n	-0.03	
67	59.5	195.4	313	63	p	n	-0.1		n	-0.03	
68	61.7	202.6	313	64	p	n	-0.1		n	-0.03	
69	62.6	205.4	325	64	p	n	-0.1		n	-0.03	
70	62.8	206.0	332	73	t	n	-0.1		n	-0.03	
71	64.0	210.0	33	65	p	n	-0.1		n	-0.03	
72	65.0	213.2	16	73	t	n	-0.1		n	-0.03	
73	65.4	214.6	8	55	p	n	-0.1		n	-0.03	
74	65.7	215.6	3	75	t	n	-0.1		n	-0.03	
75	66.1	216.8	66	65	t	n	-0.1		n	-0.03	
76	68.7	225.4	0	68	p	n	-0.1		n	-0.03	
77	73.0	239.6	271	80	t	n	-0.1		y	-0.03	flow in
78	73.8	242.0	244	83	t	n	-0.1		n	-0.06	
79	74.8	245.4	16	69	p	n	-0.1		n	-0.06	
80	75.8	248.6	183	85	t	n	-0.1		n	-0.06	
81	76.7	251.6	60	64	p	n	-0.1		n	-0.06	
82	77.3	253.7	264	31	t	y	-0.03	flow out	n	-0.06	
83	81.7	268.1	189	77	t	n	-0.03		n	-0.06	
84	87.5	287.0	167	85	t	n	-0.03		n	-0.06	
85	88.6	290.8	37	76	t	n	-0.03		n	-0.06	
86	89.1	292.4	36	79	t	n	-0.03		n	-0.06	
87	91.1	299.0	259	86	t	n	-0.03		n	-0.06	
88	91.7	300.8	163	69	t	n	-0.03		n	-0.06	
89	92.0	301.9	68	59	p	n	-0.03		n	-0.06	
90	92.7	304.3	64	64	p	n	-0.03		n	-0.06	
91	93.3	306.2	277	82	t	n	-0.03		n	-0.06	
92	93.6	307.1	265	79	t	n	-0.03		n	-0.06	
93	95.6	313.8	286	55	t	n	-0.03		n	-0.06	
94	96.8	317.7	12	78	t	n	-0.03		n	-0.06	
95	97.6	320.4	282	84	t	n	-0.03		n	-0.06	
96	97.9	321.2	233	69	t	n	-0.03		n	-0.06	
97	102.2	335.5	281	66	t	n	-0.03		n	-0.06	
98	105.9	347.4	318	54	p	n	-0.03		n	-0.06	
99	106.3	348.7	325	65	p	n	-0.03		n	-0.06	
100	107.0	350.9	23	67	p	n	-0.03		n	-0.06	
101	107.3	352.0	28	65	p	n	-0.03		n	-0.06	
102	107.9	354.1	59	62	p	n	-0.03		n	-0.06	
103	109.1	357.8	82	59	p	n	-0.03		n	-0.06	
104	110.0	360.8	225	77	t	y	-0.01	flow out	y	0	flow out
105	118.2	387.9	59	68	p	n	-0.01		n	0	
106	119.4	391.7	292	38	t	n	-0.01		n	0	
107	122.7	402.5	19	58	p	n	-0.01		n	0	
108	126.7	415.6	33	70	t	n	-0.01		n	0	
109	130.7	428.7	177	76	t	n	-0.01		n	0	
110	133.7	438.7	236	60	t	n	-0.01		n	0	
111	139.0	456.1	224	68	t	n	-0.01		n	0	
112	139.8	458.7	286	53	t	n	-0.01		n	0	

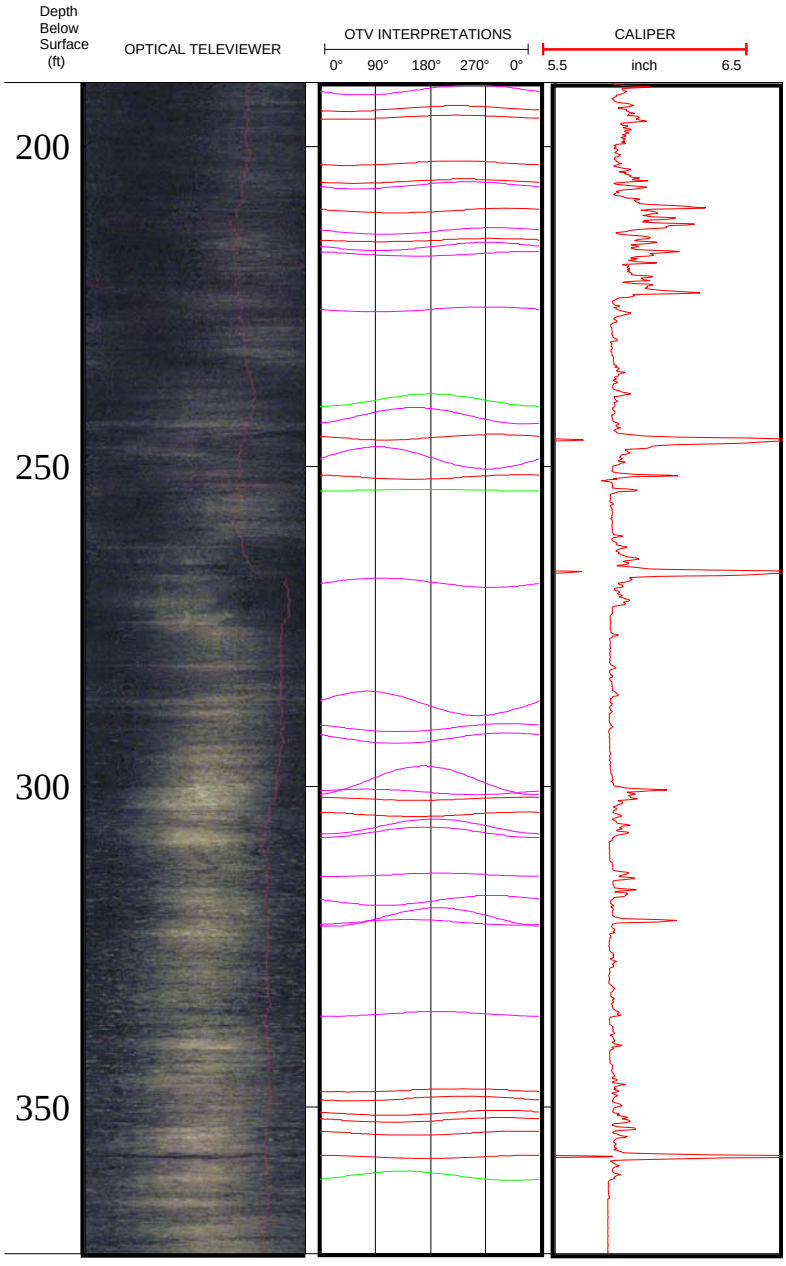
Appendix 13, continued. Midpoint depth, strike and dip of features identified in optical televiewer log, fracture type and heat pulse flowmeter data from Roc 2 (azimuth and dip reported using right hand rule convention; t = tectonic fractures, s = sheeting joints, p = foliation parallel fractures). Data shown under the pumping test have not been normalized.

113	140.4	460.5	283	67	t	n	-0.01	n	0
114	142.5	467.4	352	66	t	n	-0.01	n	0
115	142.6	467.8	115	73	t	n	-0.01	n	0
116	144.0	472.3	333	75	t	n	-0.01	n	0
117	147.3	483.2	19	83	t	n	-0.01	n	0
118	150.2	492.7	187	31	t	n	-0.01	n	0
119	152.9	501.7	78	49	t	n	-0.01	n	0
120	154.8	507.8	31	65	p	n	-0.01	n	0
121	155.5	510.2	3	66	p	n	-0.01	n	0
122	156.9	514.9	66	64	p	n	-0.01	n	0
123	161.1	528.5	56	52	p	n	-0.01	n	0
124	162.7	533.7	241	68	t	n	-0.01	n	0
125	164.2	538.6	89	27	t	n	-0.01	n	0
126	164.6	539.9	50	58	p	n	-0.01	n	0
127	166.7	546.9	356	60	p	n	-0.01	n	0

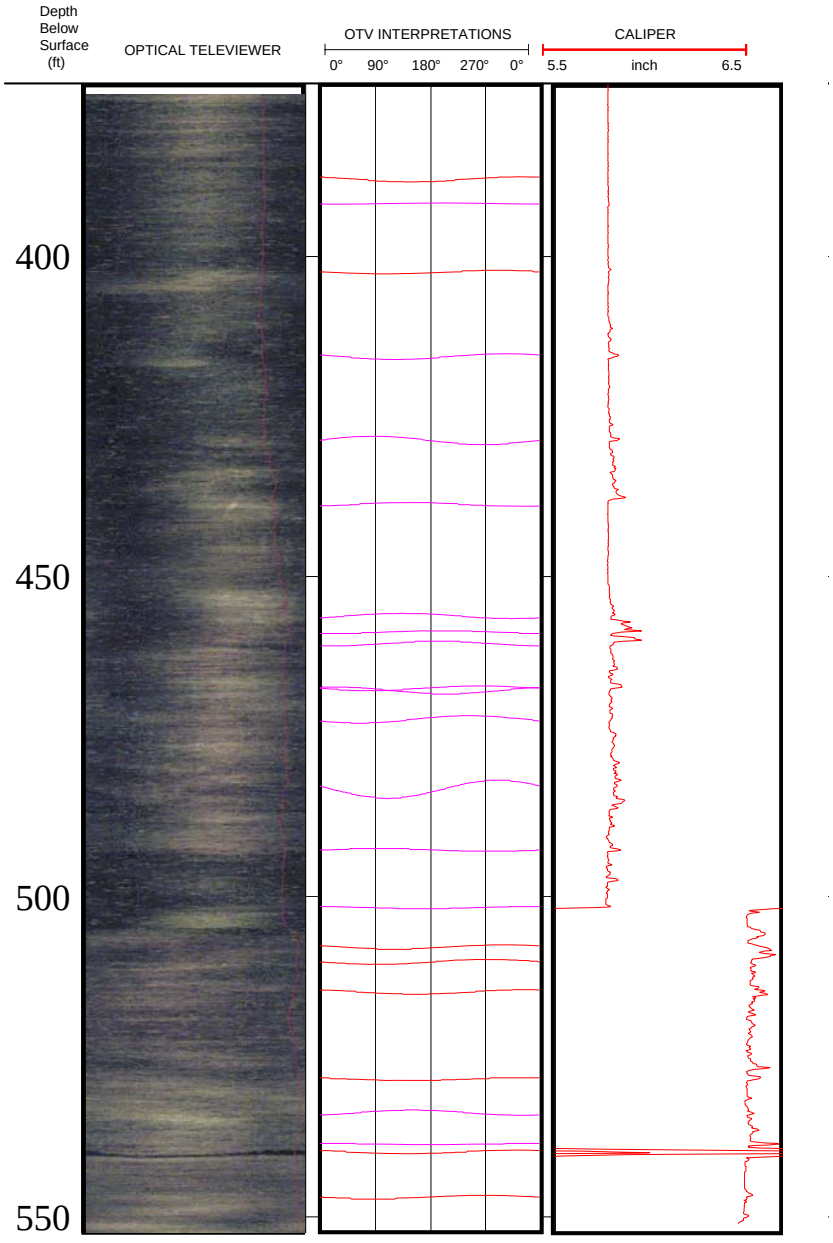
Appendix 13, continued. Interpreted features for Roc 2. Optical televiewer interpretations indicated by color: orange – subhorizontal sheeting joint; magenta – tectonic joint; red – foliation parallel fracture (FPF); cyan – transmissive subhorizontal sheeting joint; green – transmissive tectonic joint; grey – transmissive foliation parallel fracture (FPF). OTV – optical televiewer; no acoustic televiewer data collected, instrument not working.



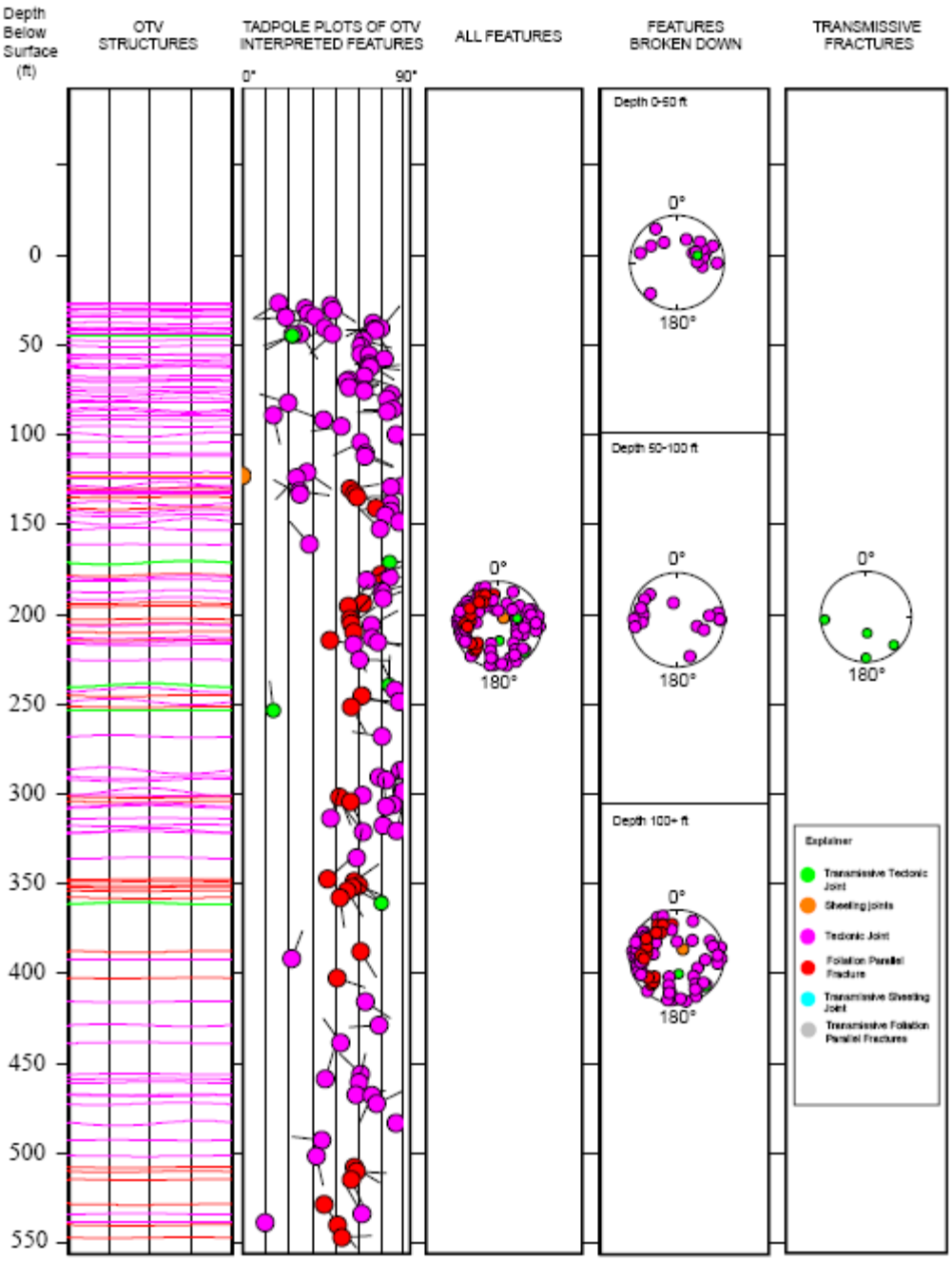
Appendix 13, continued. Interpreted features for Roc 2. Optical televiewer interpretations indicated by color: orange – subhorizontal sheeting joint; magenta – tectonic joint; red – foliation parallel fracture (FPF); cyan – transmissive subhorizontal sheeting joint; green – transmissive tectonic joint; grey – transmissive foliation parallel fracture (FPF). OTV – optical televiewer; no acoustic televiewer data collected, instrument not working.



Appendix 13, continued. Interpreted features for Roc 2. 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; no acoustic televiewer data collected, instrument not working.



Appendix 13, continued. Tadpole plots and stereoplots of interpreted optical televiewer (OTV) structures for Roc 2. 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 13, continued. Composite log for Roc 2 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 1.0 gallon per minute and data have been normalized.