

Appendix 12. Location, physical characteristics, borehole-geophysical logs and interpreted structures for well Roc 1.

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 1, with well ID Roc1.081507, is the northernmost well of the two and was logged August 15, 2008 through August 20, 2008. The well is 136 meters deep and located approximately 37 meters above sea level. The casing is 6.1 meters in length. The till overburden is approximately 3 meters thick. It 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 133 fractures were identified. Of the total, 112 are tectonic joints, 20 are FPF and 1 is a subhorizontal sheeting joint. The water table in the well was 7.61 meters deep at the outset of the pumping test. The well was pumped at one gallon per minute for two hours and 20 minutes with a drawdown of 0.14 meters. Heat pulse flow meter analysis revealed four fractures contributing flow to the well. The fractures were at 75, 88.9, 101.8 and 133 meters. Three of the flowing fractures were tectonic joints and one was an FPF.

Appendix 12, continued. Midpoint depth, strike and dip of features identified in optical televiewer log, fracture type and heat pulse flowmeter data from Roc 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.

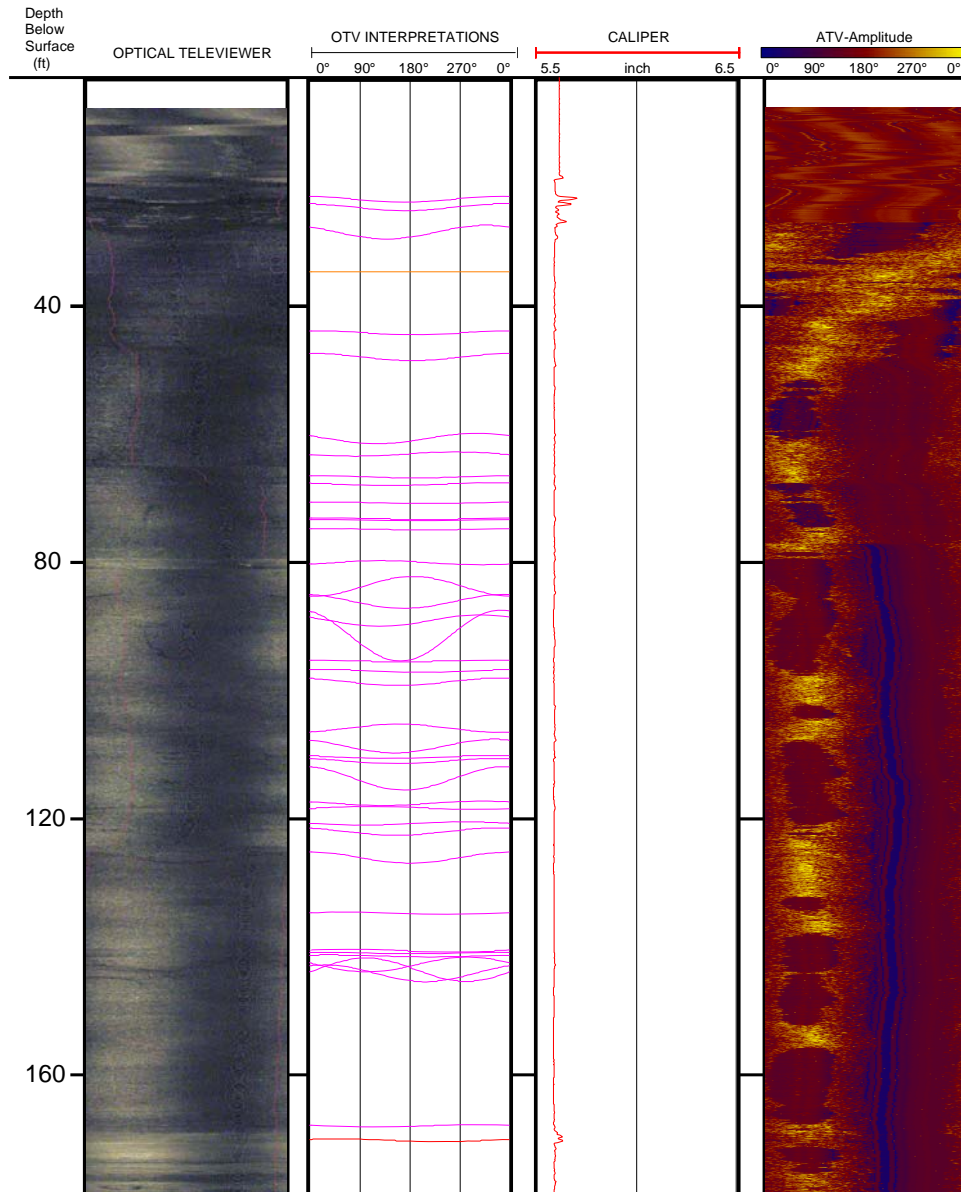
Site ID: roc1.061507
 Location: Rockport, MA "RW #2"
 Coordinates:
 Elevation (m): 37
 Reported Yield (gpm): 60+
 Rock Type: Granite
 Depth to water: 24.97 ft 7.61 m
 Depth of casing: 20 ft 6.10 m
 Depth of well: 446 ft 135.94 m
 Land surface to MP: 2.25 ft 0.69 m

Number	Fractures					Ambient		Pump at 1.0 gpm		
	Depth (m)	Depth (ft)	Azimuth	Dip	Type	Flow (y/in)	gpm (amb)	Flow (y/in)	gpm (pump)	note
1	7.10	23.30	79	71	t	n	0	n	0.6	
2	7.48	24.53	81	73	t	n	0	n	0.6	
3	8.67	28.44	48	81	t	n	0	n	0.6	
4	10.58	34.71	360	4	s	n	0	n	0.6	
6	13.45	44.12	97	61	t	n	0	n	0.6	
8	14.62	47.96	94	73	t	n	0	n	0.6	
7	18.50	60.69	31	79	t	n	0	n	0.6	
8	19.23	63.10	350	63	t	n	0	n	0.6	
9	20.30	66.60	100	50	t	n	0	n	0.6	
10	20.66	67.77	53	47	t	n	0	n	0.6	
11	21.53	70.63	121	33	t	n	0	n	0.6	
12	22.30	73.18	115	29	t	n	0	n	0.6	
13	22.37	73.40	103	28	t	n	0	n	0.6	
14	22.80	74.81	116	30	t	n	0	n	0.6	
16	24.39	80.01	218	63	t	n	0	n	0.6	
18	25.52	83.72	276	84	t	n	0	n	0.6	
17	26.25	86.14	79	81	t	n	0	n	0.6	
18	27.15	89.08	36	80	t	n	0	n	0.6	
19	27.85	91.39	73	88	t	n	0	n	0.6	
20	29.07	95.38	76	26	t	n	0	n	0.6	
21	29.54	96.91	111	53	t	n	0	n	0.6	
22	30.07	98.67	68	74	t	n	0	n	0.6	
23	32.27	105.89	250	75	t	n	0	n	0.6	
24	33.11	108.64	62	81	t	n	0	n	0.6	
26	33.64	110.38	55	52	t	n	0	n	0.6	
28	33.82	110.96	66	67	t	n	0	n	0.6	
27	34.67	113.75	80	85	t	n	0	n	0.6	
28	35.83	117.55	41	64	t	n	0	n	0.6	
29	36.05	118.28	203	51	t	n	0	n	0.6	
30	36.81	120.77	7	59	t	n	0	n	0.6	
31	37.19	122.03	65	74	t	n	0	n	0.6	
32	38.44	126.11	90	79	t	n	0	n	0.6	
33	41.06	134.71	154	48	t	n	0	n	0.6	
34	42.84	140.56	163	53	t	n	0	n	0.6	
36	42.97	140.99	97	37	t	n	0	n	0.6	
38	43.11	141.44	125	41	t	n	0	n	0.6	
37	43.51	142.76	13	82	t	n	0	n	0.6	
38	43.76	143.59	191	85	t	n	0	n	0.6	
39	43.91	144.07	117	83	t	n	0	n	0.6	
40	51.19	167.96	29	48	t	n	0	n	0.6	
41	51.86	170.16	141	50	p	n	0	n	0.6	
42	56.39	185.02	113	72	p	n	0	n	0.6	
43	56.70	186.04	184	50	t	n	0	n	0.6	
44	57.06	187.23	133	83	t	n	0	n	0.6	
46	57.26	187.86	11	53	t	n	0	n	0.6	
48	57.93	190.06	69	64	t	n	0	n	0.6	
47	58.95	193.43	194	85	t	n	0	n	0.6	
48	59.76	196.07	336	25	t	n	0	n	0.6	
49	59.84	196.33	183	77	p	n	0	n	0.6	
60	59.98	196.78	140	33	t	n	0	n	0.6	
61	64.23	210.75	38	75	t	n	0	n	0.6	
62	64.93	213.05	43	88	t	n	0	n	0.6	
63	65.00	213.25	115	54	p	n	0	n	0.6	
64	66.93	219.61	224	60	t	n	0	n	0.6	
66	67.15	220.33	197	57	t	n	0	n	0.6	
68	69.20	227.06	215	60	t	n	0	n	0.6	
67	70.33	230.74	211	64	t	n	0	n	0.6	
68	70.47	231.21	226	59	t	n	0	n	0.6	
69	72.80	238.85	118	84	t	n	0	n	0.6	

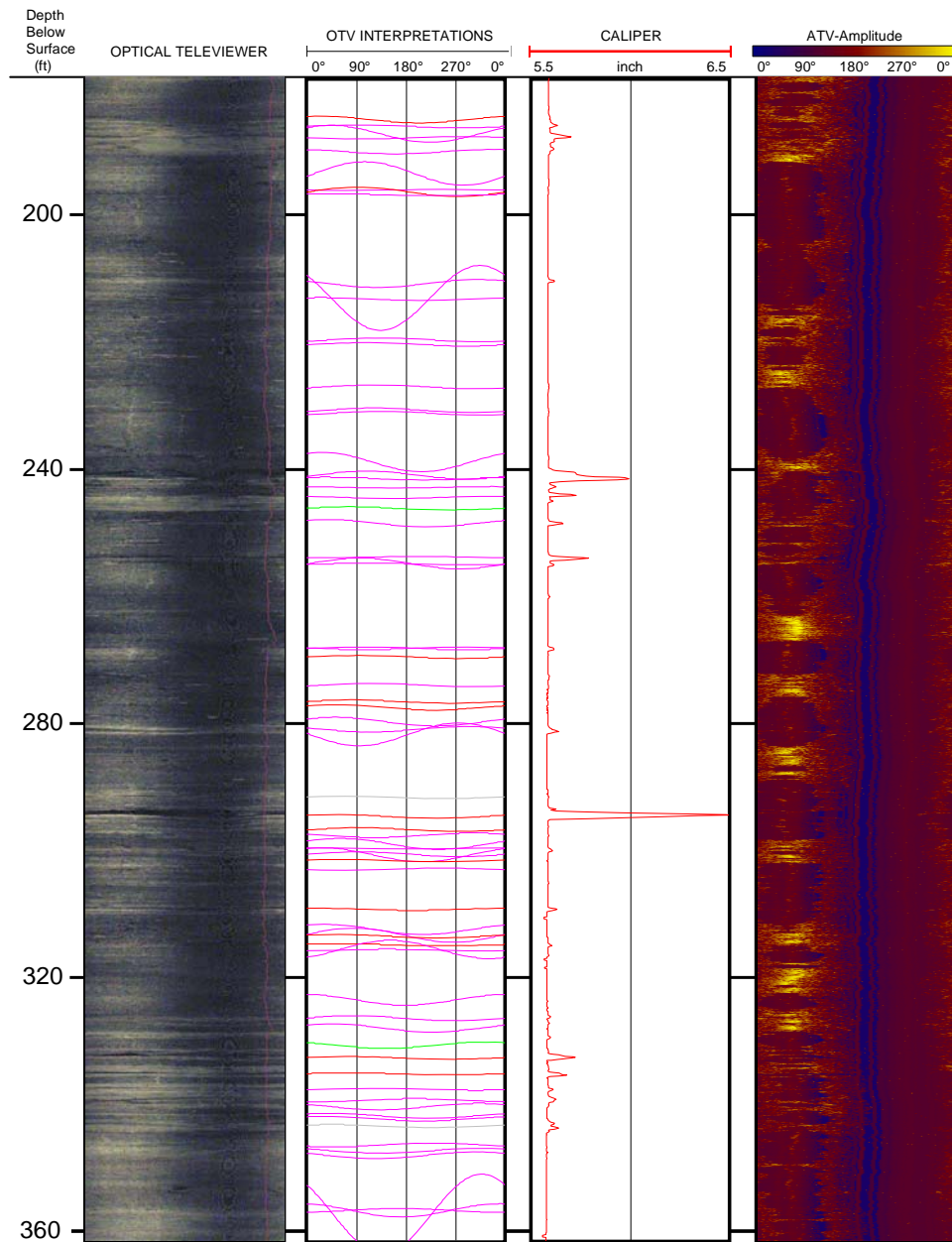
Appendix 12, continued. Midpoint depth, strike and dip of features identified in optical televiewer log, fracture type and heat pulse flowmeter data from Roc 1 (azimuth and dip reported using right hand rule convention; t = tectonic fractures, s = sheeting joints, p = foliation parallel fractures). Data shown under the pumping test have not been normalized.

80	73.42	240.89	199	73	t	n	0		n	0.6
81	73.60	241.49	123	34	t	n	0		n	0.6
82	74.00	242.80	67	40	t	n	0		n	0.6
83	74.49	244.40	65	47	t	n	0		n	0.6
84	75.03	246.17	167	33	t	y	-0.14	flow in	y	0.6
86	75.74	248.51	128	74	t	n	-0.14		n	0.17
88	77.36	253.81	291	31	t	n	-0.14		n	0.17
87	77.66	254.79	186	79	t	n	-0.14		n	0.17
88	77.69	254.89	204	32	t	n	-0.14		n	0.17
89	81.72	268.13	195	31	t	n	-0.14		n	0.17
70	81.73	268.17	14	30	t	n	-0.14		n	0.17
71	82.15	269.52	185	34	p	n	-0.14		n	0.17
72	83.48	273.90	210	62	t	n	-0.14		n	0.17
73	84.30	276.60	172	36	p	n	-0.14		n	0.17
74	84.57	277.46	141	69	p	n	-0.14		n	0.17
76	85.25	279.72	142	76	t	n	-0.14		n	0.17
78	85.62	280.93	23	69	t	n	-0.14		n	0.17
77	85.85	281.69	5	83	t	n	-0.14		n	0.17
78	88.88	291.61	157	33	p	y	-0.25	flow in	y	0.17
79	89.78	294.58	144	37	p	n	-0.25		n	-0.07
80	90.43	296.71	187	39	p	n	-0.25		n	-0.07
81	90.70	297.58	32	63	t	n	-0.25		n	-0.07
82	91.12	298.96	149	79	t	n	-0.25		n	-0.07
83	91.34	299.69	99	27	t	n	-0.25		n	-0.07
84	91.62	300.60	185	66	t	n	-0.25		n	-0.07
86	91.62	300.62	119	82	t	n	-0.25		n	-0.07
88	91.91	301.53	150	30	p	n	-0.25		n	-0.07
87	92.31	302.88	334	48	t	n	-0.25		n	-0.07
88	94.25	309.22	102	43	p	n	-0.25		n	-0.07
89	95.20	312.35	120	78	t	n	-0.25		n	-0.07
90	95.30	313.32	175	82	t	n	-0.25		n	-0.07
91	95.33	313.44	144	37	p	n	-0.25		n	-0.07
92	95.96	314.83	154	36	p	n	-0.25		n	-0.07
93	96.17	315.52	241	83	t	n	-0.25		n	-0.07
94	96.21	315.63	236	41	t	n	-0.25		n	-0.07
96	98.58	323.43	89	79	t	n	-0.25		n	-0.07
98	99.46	326.34	175	68	t	n	-0.25		n	-0.07
97	99.93	327.86	136	76	t	n	-0.25		n	-0.07
98	100.75	330.56	34	72	t	n	-0.25		y	-0.1
99	101.37	332.61	167	33	p	n	-0.25		n	-0.1
100	102.14	335.13	165	33	p	n	-0.25		n	-0.1
101	102.88	337.53	217	40	t	n	-0.25		n	-0.1
102	103.40	339.25	286	36	t	n	-0.25		n	-0.1
103	103.70	340.24	41	72	t	n	-0.25		n	-0.1
104	104.14	341.67	129	67	t	n	-0.25		n	-0.1
106	104.29	342.17	120	63	t	n	-0.25		n	-0.1
106	104.65	343.33	135	36	p	y	-0.1	flow out	n	-0.1
107	105.54	346.29	318	63	t	n	-0.1		n	-0.1
108	105.82	347.20	44	66	t	n	-0.1		n	-0.1
109	106.05	347.93	36	73	t	n	-0.1		n	-0.1
110	108.67	356.53	81	81	t	n	-0.1		n	-0.1
111	108.69	356.60	257	39	t	n	-0.1		n	-0.1
112	108.85	357.14	47	88	t	n	-0.1		n	-0.1
113	110.56	362.73	166	44	p	n	-0.1		n	-0.1
114	111.05	364.37	140	31	p	n	-0.1		n	-0.1
116	111.78	366.74	16	38	t	n	-0.1		n	-0.1
118	112.10	367.80	1	81	t	n	-0.1		n	-0.1
117	112.74	369.90	103	33	p	n	-0.1		n	-0.1
118	114.22	374.77	357	43	t	n	-0.1		n	-0.1
119	115.50	378.96	151	30	t	n	-0.1		n	-0.1
120	117.83	386.59	43	83	t	n	-0.1		n	-0.1
121	119.69	392.70	225	61	t	n	-0.1		n	-0.1
122	121.10	397.32	206	82	t	n	-0.1		n	-0.1
123	121.27	397.89	297	44	t	n	-0.1		n	-0.1
124	122.97	403.46	6	69	t	n	-0.1		n	-0.1
126	123.34	404.68	74	63	t	n	-0.1		n	-0.1
128	125.27	411.00	116	69	p	n	-0.1		n	-0.1
127	126.92	416.41	57	39	t	n	-0.1		n	-0.1
128	127.64	418.80	53	71	t	n	-0.1		n	-0.1
129	128.40	421.29	104	38	t	n	-0.1		n	-0.1
130	129.14	423.70	238	38	t	n	-0.1		n	-0.1
131	133.06	436.56	181	71	t	y	0	flow out	y	0
132	134.47	441.19	337	77	t	n	0		n	0
133	134.66	441.81	334	80	t	n	0		n	0

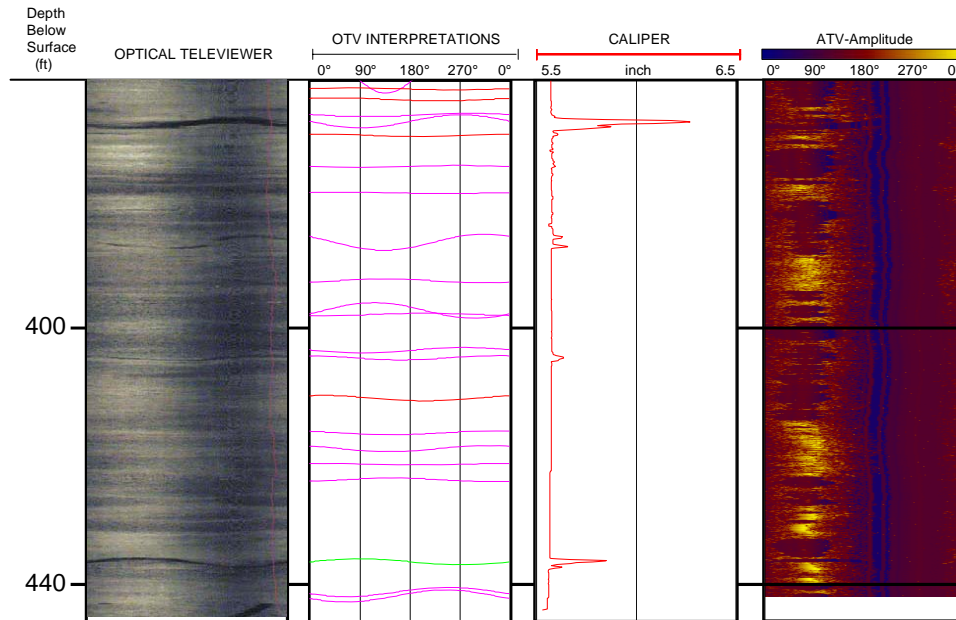
Appendix 12, continued. Interpreted features for Roc 1. Optical televiewer interpretations indicated by color: orange – subhorizontal sheeting joint; magenta – tectonic joint; red – foliation parallel fracture (FPF); cyan – transmissive subhorizontal sheeting joint; green – transmissive tectonic joint; grey – transmissive foliation parallel fracture (FPF). OTV – optical televiewer; ATV – acoustic televiewer.



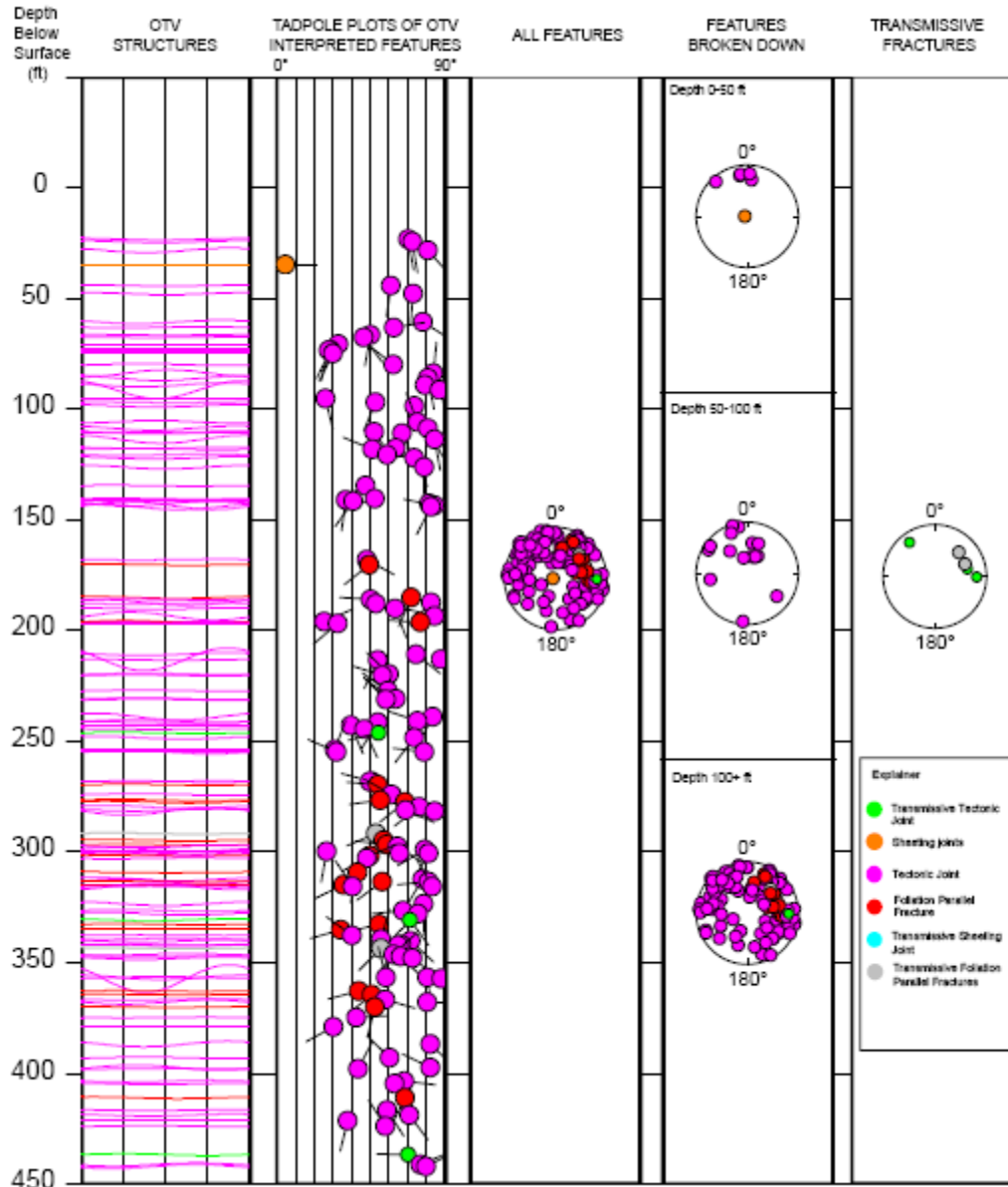
Appendix 12, continued. Interpreted features for Roc 1. Optical televiewer interpretations indicated by color: orange – subhorizontal sheeting joint; magenta – tectonic joint; red – foliation parallel fracture (FPF); cyan – transmissive subhorizontal sheeting joint; green – transmissive tectonic joint; grey – transmissive foliation parallel fracture (FPF). OTV – optical televiewer; ATV – acoustic televiewer.



Appendix 12, continued. Interpreted features for Roc 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 12, continued. Tadpole plots and stereoplots of interpreted optical televiewer (OTV) structures for Roc 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 12, continued. Composite log for Roc 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 1.0 gallon per minute and data have been normalized.

