

Appendix 10. Location, physical characteristics, borehole-geophysical logs and interpreted structures for well Nor 1.

This well is located in the median of I-290 at the I-290 and I-495 interchange. It was constructed by the Massachusetts Highway Department. The well is open and unused. This 29 meter deep well was logged on June 25, 2007 and was completed in one day. The ID is nor1.062507. The elevation of the well is approximately 138 meters above sea level. There is a large outcrop of bedrock only a few meters to the south, which was excavated during highway construction.

The top of the well is at the ground surface and there are only a few centimeters of surficial material on top of the bedrock. Casing length is 4.6 meters. The well is located near the contact of the schist of the Nashoba Formation and an unnamed amphibolite unit. The bedrock at the location of the well is mapped as an interlayered coarse-grained amphibolite and schist.

A total of 42 fractures measured. Of the fractures measured 15 are subhorizontal unloading joints, 13 are tectonic joints and 14 are FPF. The nor1.062507 well flows throughout the spring and summer and was flowing when studied. The well was pumped for one hour 59 minutes during which the water level fell 1.2 meters in the well. Heat pulse flow meter tests revealed two flowing fractures at 10.3 and 26.6 meters depth. One was a tectonic fracture and one was a foliation parallel fracture.

Appendix 10, continued. Midpoint depth, strike and dip of features identified in optical televiewer log, fracture type and heat pulse flowmeter data from Nor 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 been normalized.

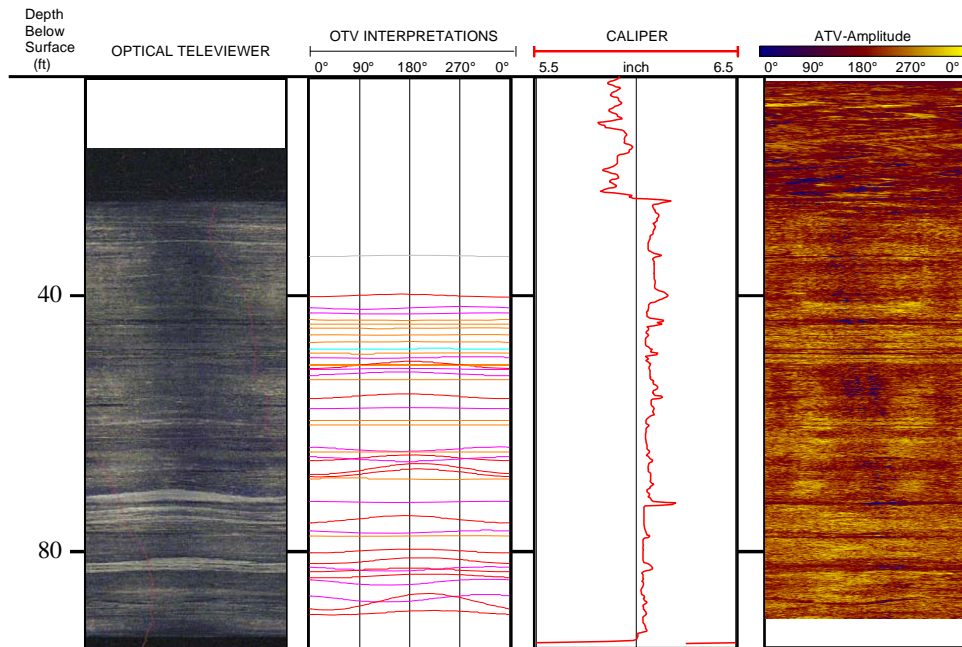
Site ID: nor1.062507
Location: "I 495" Northboro, MA

Elevation (m) 138
Reported Yield (gpm) unknown
Rock Type: Amphibolite

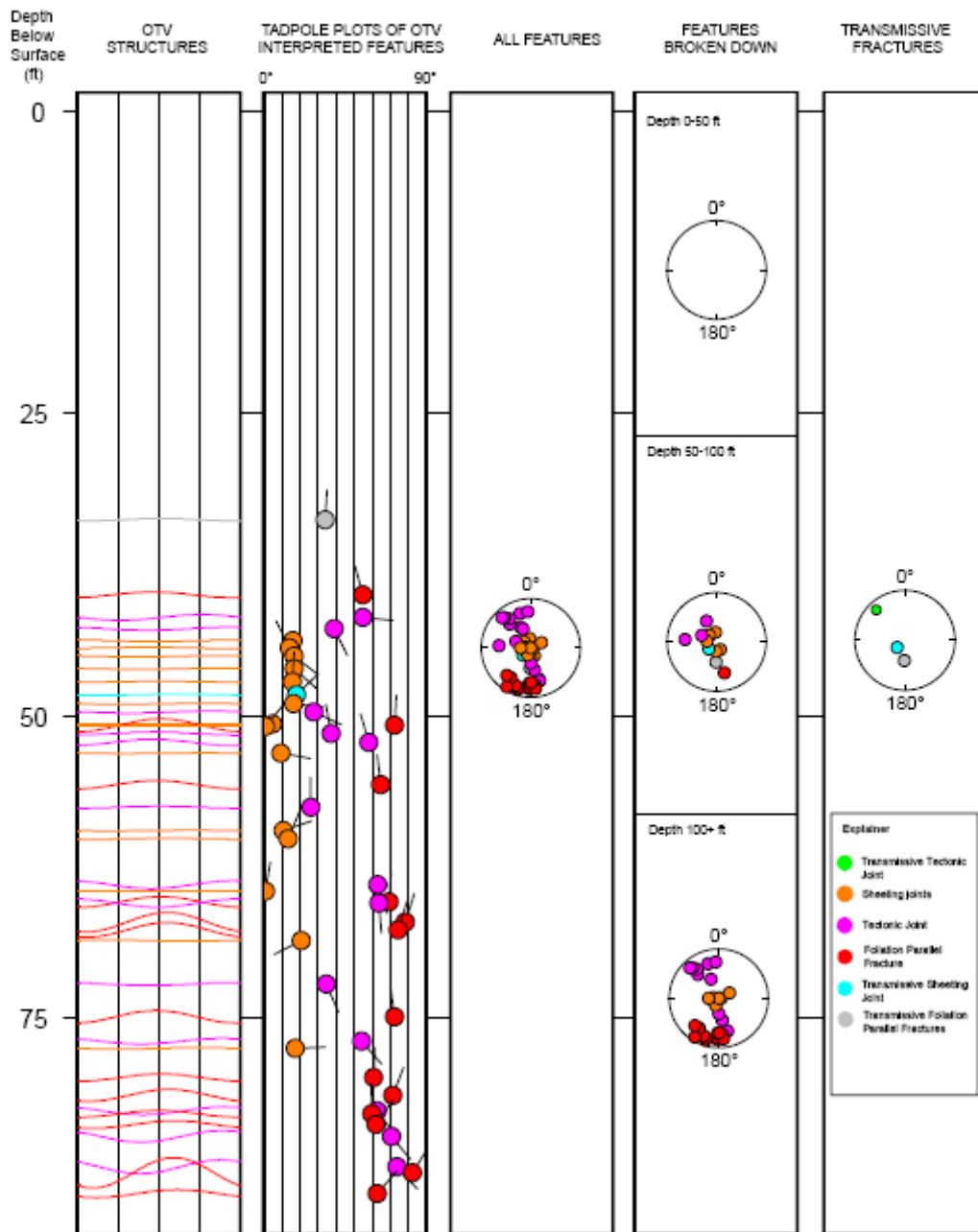
Depth to water: 0 ft 0 m
Depth of casing: 15 ft 4.572 m
Depth of well: 99 ft 30.1752 m
Land surface to MP: 0 ft 0 m

Fractures						Ambient			Pump at 0.5 gpm		
Number	Depth (m)	Depth (ft)	Azimuth	Dip	Type	Flow (y/n)	gpm (amb)	notes	Flow (y/n)	gpm (pump)	notes
1	10.3	33.8	273	34	p	n	0.04		y	0.5	flow in
2	12.2	40.0	255	55	p	n	0.04		n	0.05	
3	12.8	41.9	5	55	t	n	0.04		n	0.05	
4	13.0	42.8	64	39	t	n	0.04		n	0.05	
5	13.3	43.8	82	16	s	n	0.04		n	0.05	
6	13.5	44.4	245	14	s	n	0.04		n	0.05	
7	13.8	45.1	37	17	s	n	0.04		n	0.05	
8	14.1	46.1	41	17	s	n	0.04		n	0.05	
9	14.4	47.2	274	16	s	n	0.04		n	0.05	
10	14.7	48.3	316	18	s	y	0.04	flow in	n	0.05	
11	14.9	49.0	6	17	s	n	0.02		n	0.05	
12	15.2	49.7	24	28	t	n	0.02		n	0.05	
13	15.4	50.7	174	5	s	n	0.02		n	0.05	
14	15.5	50.8	273	73	p	n	0.02		n	0.05	
15	15.5	50.9	309	1	s	n	0.02		n	0.05	
16	15.7	51.5	260	37	t	n	0.02		n	0.05	
17	15.9	52.2	255	58	t	n	0.02		n	0.05	
18	16.2	53.1	10	9	s	n	0.02		n	0.05	
19	17.0	55.7	263	65	p	n	0.02		n	0.05	
20	17.5	57.6	270	26	t	n	0.02		n	0.05	
21	18.1	59.5	341	11	s	n	0.02		n	0.05	
22	18.4	60.2	292	13	s	n	0.02		n	0.05	
23	19.5	64.0	72	63	t	n	0.02		n	0.05	
24	19.6	64.5	279	1	s	n	0.02		n	0.05	
25	19.9	65.4	273	69	p	n	0.02		n	0.05	
26	20.0	65.5	85	64	t	n	0.02		n	0.05	
27	20.5	67.1	288	79	p	n	0.02		n	0.05	
28	20.6	67.7	288	75	p	n	0.02		n	0.05	
29	20.9	68.6	153	21	s	n	0.02		n	0.05	
30	22.0	72.2	67	35	t	n	0.02		n	0.05	
31	22.8	74.9	263	73	p	n	0.02		n	0.05	
32	23.4	76.9	49	54	t	n	0.02		n	0.05	
33	23.6	77.5	357	17	s	n	0.02		n	0.05	
34	24.4	79.9	273	61	p	n	0.02		n	0.05	
35	24.8	81.4	291	72	p	n	0.02		n	0.05	
36	25.2	82.7	53	63	t	n	0.02		n	0.05	
37	25.3	82.9	269	60	p	n	0.02		n	0.05	
38	25.5	83.8	304	62	p	n	0.02		n	0.05	
39	25.8	84.8	50	71	t	n	0.02		n	0.05	
40	26.6	87.3	47	74	t	n	0.02		y	0.05	flow in
41	26.8	87.8	302	83	p	n	0.02		n	0	
42	27.3	89.5	311	63	p	n	0.02		n	0	

Appendix 10, continued. Interpreted features for Nor 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 10, continued. Tadpole plots and stereoplots of interpreted optical televiewer (OTV) structures for Nor 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 10, continued. Composite log for Nor 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.

