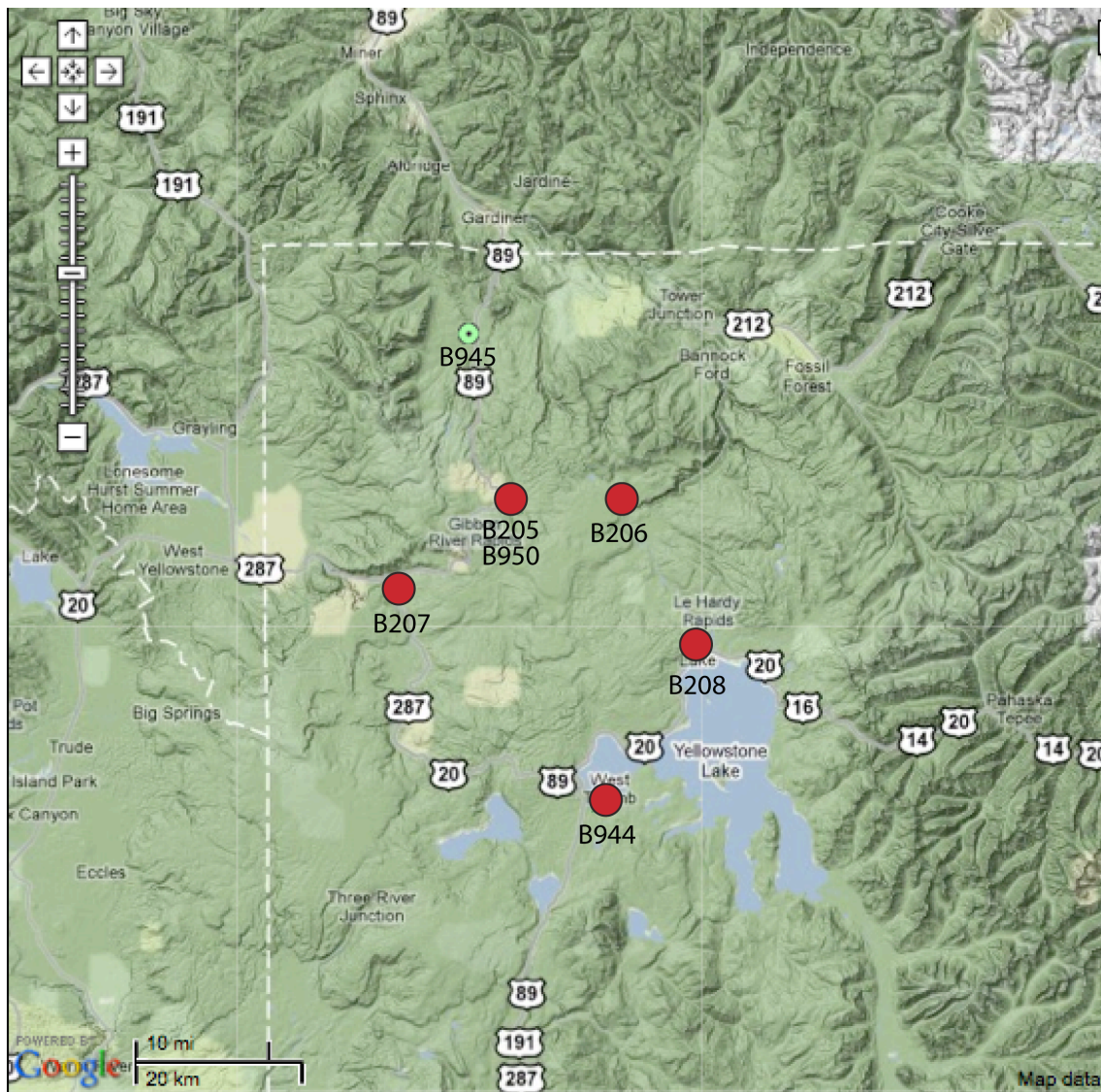


Station Notes for B950, norris950bwy2008

Latitude:	44.7128 (WGS 84)
Longitude:	-110.6785 (WGS 84)
Elevation:	2328.4 m / 7639 ft
Install Depth:	111.9 m / 367 ft
Orientations:	CH0=184.2, CH1=124.2, CH2=64.2, CH3=34.2
Install Date:	October 1, 2013
GTSM Technologies #:	US86
Executive Process Software:	Version 1.14
Logger Software:	Version 2.12
Home Page:	www.unavco.org/instrumentation/networks/status/pbo/overview/B950
Notes Last Updated:	November 7, 2019

• Install depth is from the top of the casing to the bottom of the strainmeter.

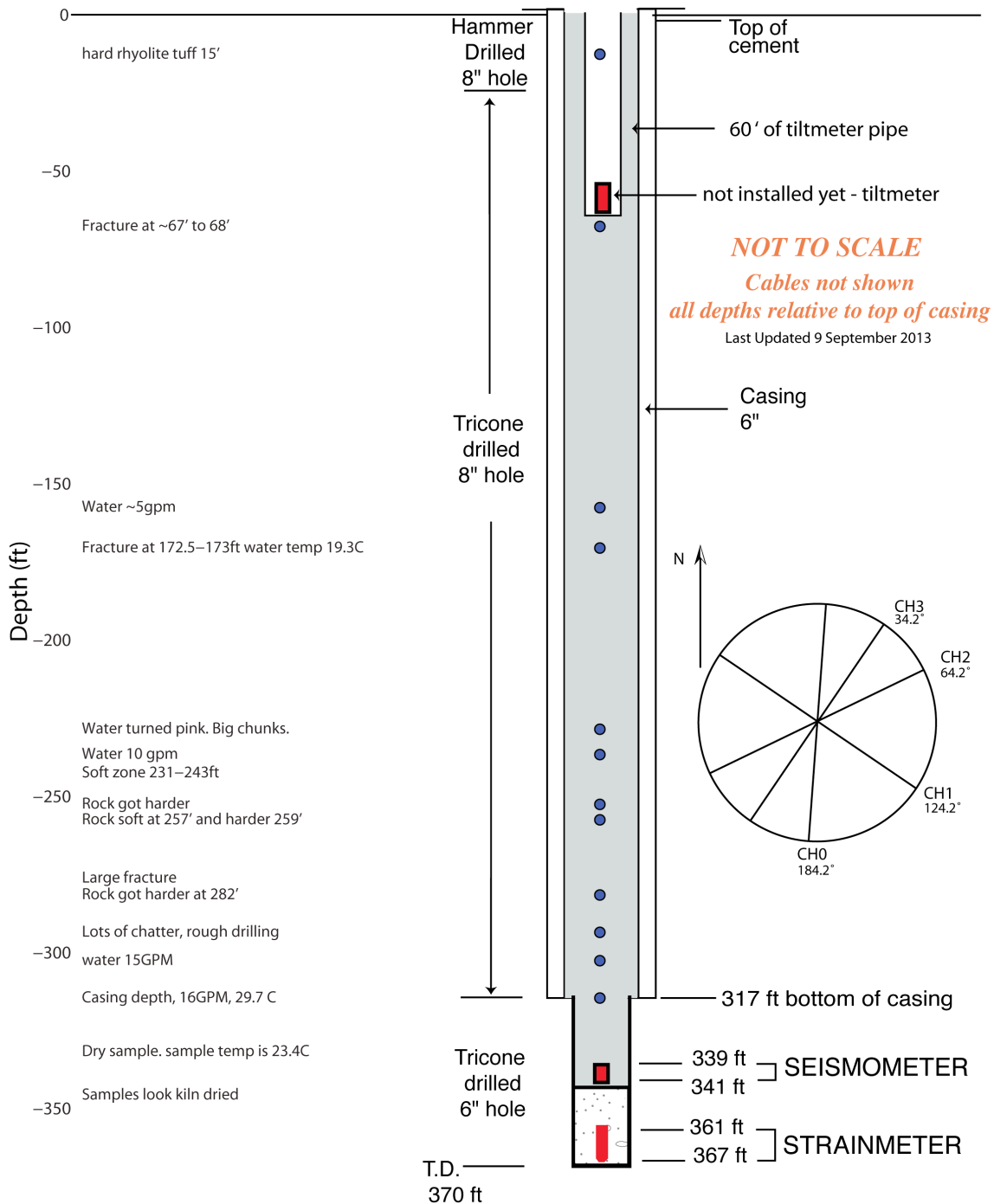
• Orientations are in degrees East of North.



Yellowstone PBO strainmeters, October 2013. Green dots represent boreholes that only have a seismometer.

B950 norris950bwy2013

44.7128 -110.6785 2328.4 m



Instrumentation at Strainmeter

Instrument	Units	Bottle/ASCII Scale Factor	SEED Scale Factor
Pore Pressure	Hecto Pascals	None Installed	---
GTSM Barometer	Kilopascals	1.0	0.0001
Rain Gauge	Millimeters/hour	1.0	0.252
Down hole Temperature Sensor	Degrees Celsius	1.0	0.0001
Logger Temperature Sensor	Degrees Celsius	1.0	0.0001
Setra Barometer	Hecto Pascals	1.0	1.42908E-4

1. Installation notes

October 1, 2013 – Strainmeter US86 was successfully installed at a depth of 367' from the casing (this was 365.5' on the logs, which were from ground level).

08:10 local time – Entered park. The engineers were able to negotiate access for a few days during the government shutdown to complete this project.

09:00 – On site, setting up pump hoist over well,

10:00 – After several attempts they were able to find a level position for pump hoist.

11:00 – Mark 100' marks on new sand line

11:00-12:30 – Hole prep: sound bottom. Should have been 367 according to drillers. Found a hard bottom at 367.5. Test dump bailer, trips well at 367.25. Water level was at 7', was 2' at end of the previous day, lost ~5' overnight.

12:00-13:00 – Test strainmeter US86. Data from overnight looks good, all channels tracking. RT boards had old firmware (1.18) so these were upgraded to 1.20.

13:00-15:00 – Prep site. Moved install trailer into position, set up cable reel, capstan, grout mixer.

15:30 – Ran 2 loads of cold water to the bottom of the hole with dump bailer to cool off install zone. Bottom now appears to be about 367'.

15:43 – 1st grout added.

15:50 – Last grout added (9 bags of Masterflow 1341).

15:54 – Last water added (15.5 gals, or 1.72 gal per bag).

16:00 – Stopped mixing.

16:05 – Bailer full, headed down hole.

16:09 – Bailer on bottom (367'). Successful trip.

16:16 – Bailer out of hole.

16:21 – Begin lowering GTSM.

16:28 – GTSM on bottom. The instrument sank through the grout all the way to bottom (367') with very little resistance.

16:45 – GTSM on, quads look good, renamed B950.

17:30 – Shut down GTSM to move install trailer.

17:55 – GTSM back on, will run overnight.

19:00 – Site cleaned up, drive back to West Yellowstone.

October 2, 2013 - Installed the standard Malin 3 channel geophone at a depth of 341'. This is 5' above the grout, which was tagged with the tremmie at 346'. This means they got 20' out of a 4-section bailer plus GTSM, which is normal. Also installed 60' of tilt meter pipe. The hole was cemented to surface with 55 bags of portland cement.

Seismometer test results (SN 176)

Uphole:

V-2.325 ohm
H1-2.292 ohm
H2-2.292 ohm
Downhole:
V-2.439
H1-2.431
H2-2.432

Buried the cable and poured the pad for B950. The GTSM was shut down in order to do this around 21:00 UTC, and was left off overnight.

October 3, 2013 – Due to heavy snow, decided it was unsafe/unproductive to go out to site.

October 4, 2013 – Personnel on site: Mike, Liz, Korey, Charlie, Hank

08:15 local time - Received permission to go to site.

09:45 - At turnoff to Norris service road. There is ~12-18" of snow on the ground. Weather forecast looks clear.

11:30 - Arrive at site after chaining up, dealing with downed trees, and abandoning the flatbed truck loaded with cement at the base of the hill.

11:30-12:30 - Unbury site and equipment. Tagged cement in B950 at 6', and tagged water in B949 at 212'. Hank ran a temperature log on B949.

12:00-13:00 - Set up to trip in the 1 1/4" galvanized temperature pipe to B949.

13:00-15:00 - Trip in temperature pipe. 20 x 21' and 8 x 10'. Tagged bottom at 498', then lifted pipe up a foot. Joints were sealed with pipe dope and teflon tape, then pipe wrenched together.

16:00-17:30 - Tripped in 480' of tremmie pipe.

16:00-19:00 - Took apart B205 and worked on building a tilt meter/coms station in its place.

Moved the large enclosure to B950, set up GTSM environmental box and power system, and turned on the GTSM.

19:00 - Off site.

October 5, 2013 – On site: Mike, Liz, Korey, Charlie, Hank

Spent most of the day cementing B949. Mixed 78 bags of cement, which filled the casing and also the annulus. It was very cold in the morning, and all the plumbing to the water tank and cement pump were frozen solid. Spent a good portion of the morning thawing parts. There was still a fair amount of snow on site, but with chains they were able to get the flatbed with cement and the water trailer up and down the hill. They had to cement in 2 stages as the water tank was too small to do it all at once, and they had to refill midway. Finished cementing around 6 PM local time. As they tripped out the tremmie pipe, there was noticeable discoloration (browning) to the pipe that grew stronger with depth (and heat). They also ran a weatherproof extension cord 200' from B205 to B950, which will be used as temporary power over the winter. Tried to set up the VSAT, but there appears to be a bad ODU. They will not be able to get coms working until after the park re-opens.

October 6, 2013 – On site: Mike, Liz, Hank

Cement at surface in B949. Changed network settings at NRWY gps site. Anchored the hut and equipment racks. Installed batteries, uphole electronics, and set IPs. Installed radio shot between B205 and B950. Tried to adjust DH temp on GTSM. Hole is too hot for dashpot temperature adjustment, need to change the resistor on the logger board. DH temp is pegged at 4.383 V.

Took final compass reading: X – 1.757 v (1.362 : 2.111) Y – 1.105v (1.005 : 1.805)

Tried to install tiltmeter 27596, but couldn't get it past 18' in the pipe (out of 60' installed). After several attempts they decided they were running out of time and that the tiltmeter would have to

be installed later. Cleaned up site, loaded all equipment on trucks and trailers. Downloaded the GTSM data. There was a large strain signal on all four channels that corresponded with pumping cement in the nearby B949 hole. Took final site photos

2. General Information

- B950 is a replacement for B205, which was struck by lightning.

3. Strainmeter Maintenance

- October 29, 2013 – Wade visited the site to get the coms working.
- October 31, 2013 – Korey visited the site to get the coms back online.
- February 4, 2014 – Mike Gottlieb visited the site. He replaced the q330. He also replaced the powerbox with one that was modified for high altitude (set pressure_offset = 70 on February 6, 2014 to reflect this). He was unable to replace LG board, so it will need to be done in the spring.
- June 16, 2014 – Power cycled all the boards after it was hit by lightning a few weeks ago.
- June 17, 2014 – New tiltmeter installed at 58' 6". +x is 78 degrees true north, left in XDR mode. Adjusted quads and chops and ran birddog on seismometer. Added more anchors to hut and equipment rack. Cleaned up site. Attempted to install a high temperature logger board, but had to leave the old one in for now. They also met with the electrician to make a plan for power install.
- June 18, 2014 – Replaced the logger with a high temp modified board. Downhole temperature offset to 50 C. The new board was showing compact flash card errors when installed, so they ended up using the compact flash card from the original logger.
- September 26, 2014 – Checked and set quadrature.
- April 21, 2015 – Site was hit by lightning on 4/3/15, also had been losing ~50% of the seismic data. Q330 and marmot were replaced. Q330 gps antenna was bad, showing 0 mA current. Used GTSM antenna (temporarily) to get GPS lock and initial date set, but should expect clock to drift. Left Q330 with bad antenna, which should be replaced ASAP. Rebooted system after lightning strike. Status report looked better, tap steps were good. Noticed noise on all channels with oscilloscope, so replaced oscillator board, and set quads and chop.
- June 26, 2015 – Replaced Q330 antenna.
- September 16, 2015 – Swapped RT2 board to see if fixes step issue. Left old RT2 boards on site in a box, to be replaced if this does not fix steps.
- September 23, 2015 – Set tiltmeter averaging rate to 360, was 28.

- April 20, 2016 – Corrected file storage configurations from FW 2.12.
- September 26, 2016 – CH3 started showing a lot of noise in mid September. Rebooted all equipment, no improvement.
- June 29, 2017 – Site had sustained potential lightning damage. Radio antenna bracket was damaged. RT1 showed 50018180 gain zero. Test on board indicated problem was down hole. Screen on RT3 was dead which is a good indication of lightning a strike. Placed US86RT0 into CH3, they worked fine. Placed SR423 in CH1, it showed 50000000 G1. Placed SR423 and 447 into CH3, both showed 50000000. Indicates something is wrong with board. Tried reseating in different slots and got same result. Swapped screen from new RT board and placed into US86RT3. Placed US86RT3 into RT1, no change. Swapped Oscillator board with new one to see if intermittent noise on CH3 would clear up. Left it in to see if it makes any difference over time. No change on CH1. Site will need visit with quad box to confirm down hole damage in CH1. Left all board on site.
- July 20, 2017 – reversed signal wires on setra to deal with issue of negative raw counts. need to look at data and determine if this fixed the issue. Replace bad screen on RT1. CH0 look ok. CH1 Amp I/P only 300 mV, no quad control, 50000 +079 G1 no variance. looked ok with load cell. Ch2 looked ok. Ch3 Amp I/P 3V, O/P signal noisy, dropping to G2 and G1 due to high variance (hundreds to thousands of counts), looked noisy with load cell too. Need to confirm Ch3 on silver load cell is ok though.
- July 27, 2017 – Installed new high altitude setra. Old setra had come from B205. It looks like it was damaged at B205 and was bad from the start.
- March 29, 2018 – CH2 no longer performing well either, in addition to existing problems with CH1 and CH3. Mike rebooted the electronics, which did not fix "new" problem with CH2. Will need to try replacing the oscillator and RT boards.
- June 8, 2018 –Only CH0 looks good. CH2 is flatlined. Oscillator reboot did not fix. Swapped RT2 and RT3 boards temporarily, but that did not have any affect either. Return boards to original positions. Could still try a new oscillator next visit. Remeasured tiltmeter pipe. 78 degrees magnetic or 67 degrees true.
- June 3, 2019 – Restarted electronics, CH3 is operating, site still looks pretty bad.
- September 20, 2019 – Swapped GTSM backplane to see if that would help resolve lightning damage issues. So far does not appear to have helped, quads still unresponsive on all channels, tap steps bad, only Ch0 has a non-zero RT number. Added earthquake straps.