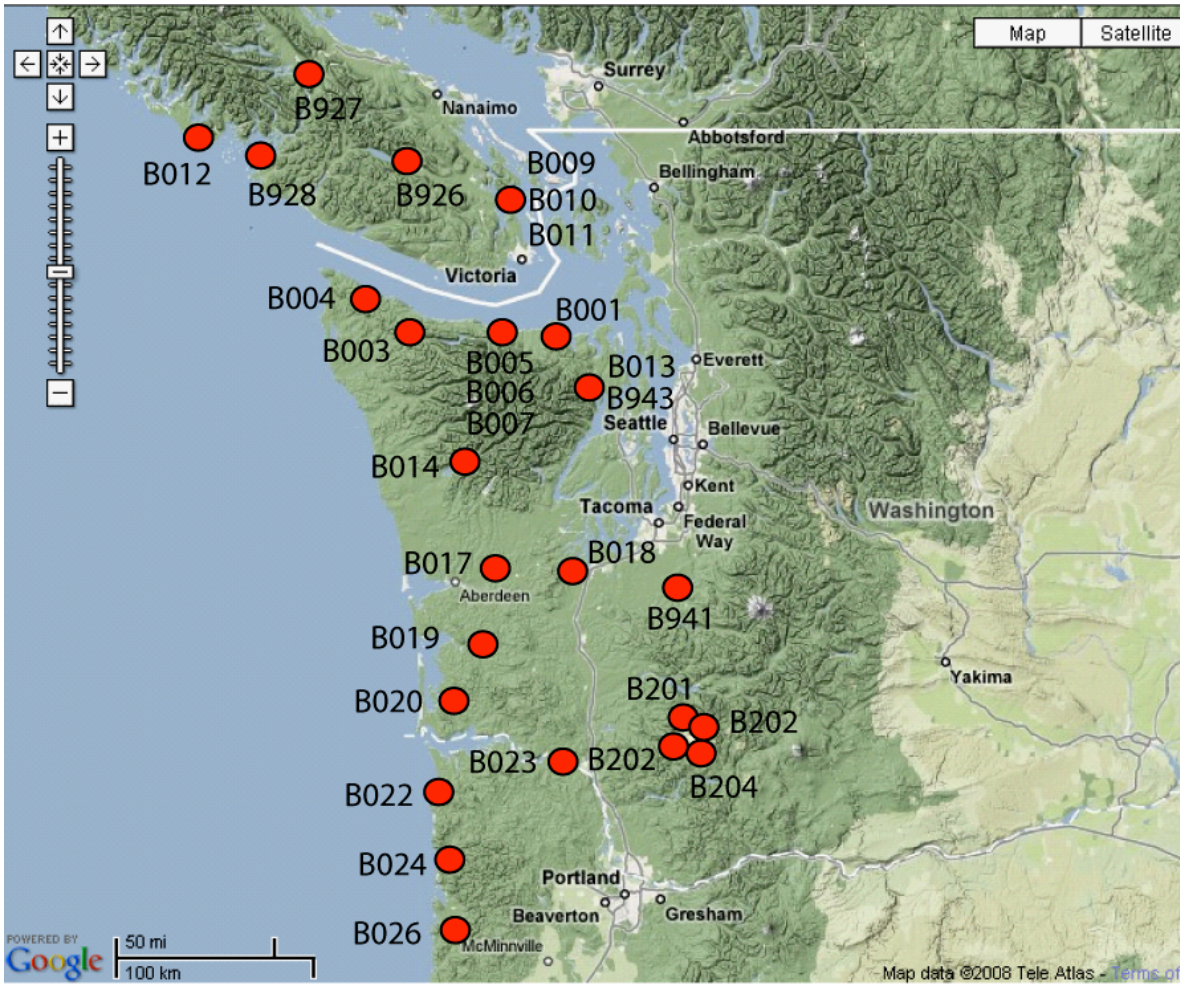
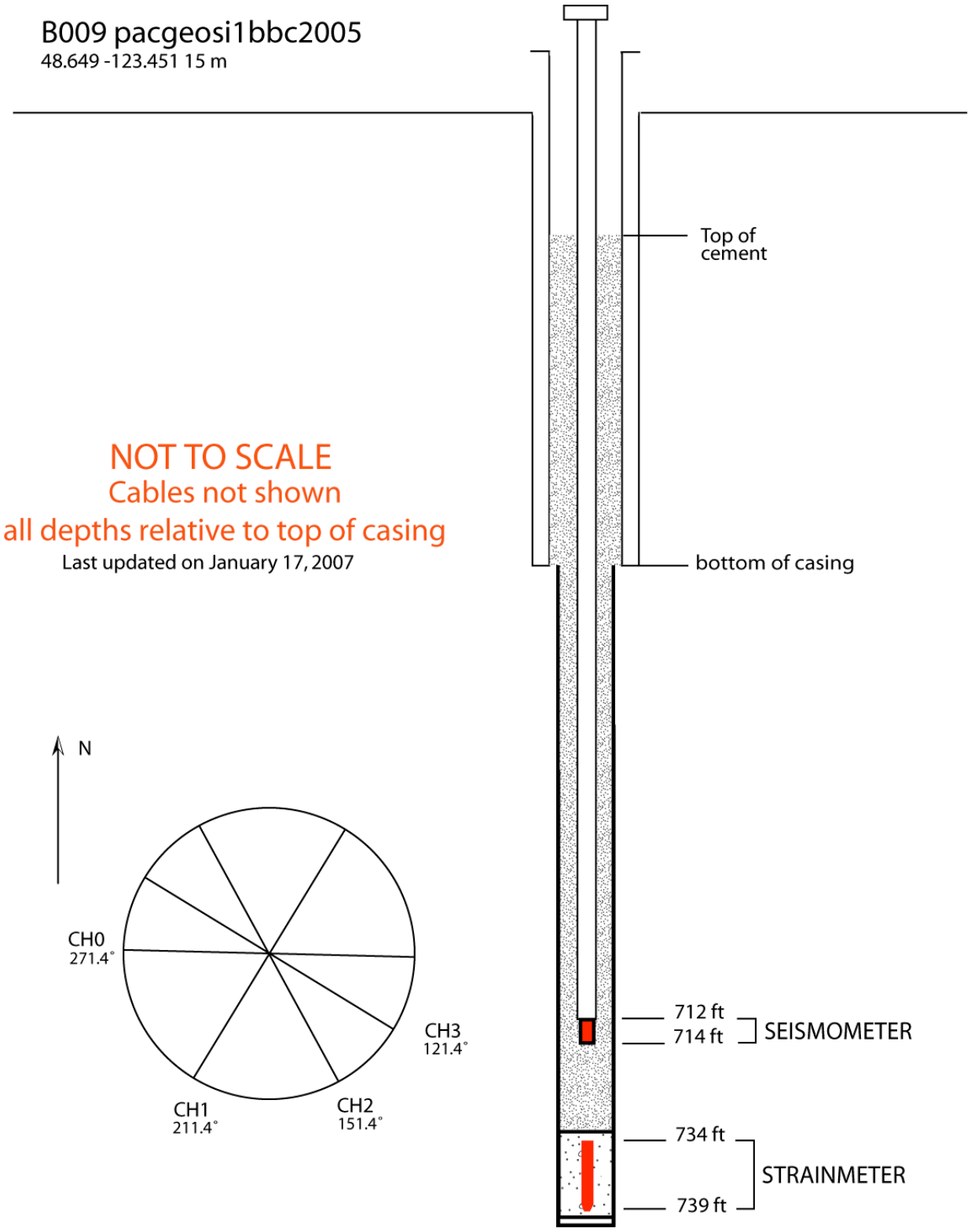
Station Notes for B009, pacgeosi1bbc2005

Latitude:	48.648667 (WGS 84)
Longitude:	-123.451167 (WGS 84)
Elevation:	15 m / 49.2 ft
Install Depth:[1]	225.25m / 739 ft
Orientations:[2]	CH0= 271.4, CH1= 211.4, CH2= 151.4, CH3= 121.4
Install Date:	2005-09-14
GTSM Technologies #:	US08
Executive Process Software:	Version 1.14
Logger Software:	Version 2.12
Home Page:	www.unavco.org/instrumentation/networks/status/pbo/overview/B009
Notes Last Updated:	October 1, 2019

[1]Install depth is from the top of the casing to the bottom of the strainmeter.
[2]Orientations are in degrees East of North.



Pacific Northwest PBO strainmeters, 17 October 2007.



Instrumentation at Strainmeter

Instrument	Units	Bottle/ASCII Scale Factor	SEED Scale Factor
Pore Pressure	Hecto Pascals	N/A	N/A

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	1.43E-4

1. General Information

- B009 is one of three strainmeters installed at PGC, Vancouver Island, Canada. B010 and B011 are located within 100 m of B009.
- Record amounts of rain fell on the Olympic Peninsula between the 1st and 9th November 2006.
- A change in strain rate was detected at the PGC strainmeters on May 29, 2007. Herb Dragert, of PGC, reported that there was a large farm field about 800 m to the southwest of B009 where irrigation was initiated about the time the anomalous trends started. A draw-down of the water table in that general location could account for the current strain transients observed at PGC. It is possible that a similar change in trend in April and May of 2006 could also be attributed to irrigation of nearby fields.
- Sensitivities of all EH channels were corrected in the dataless on March 4, 2010.

2. Strainmeter Maintenance

- September 14 00:30:30 - September 18 21:00:27, 2005, UTC. Engineers worked at the strainmeter site. Logger restarted several times.
- September 23 21:49:33 - September 24 23:29:19, 2005, UTC. Environmental door opened.
- September 26 22:30:16 - September 29 23:52:59, 2005, UTC. Environmental door opened and logger restarted several times.
- October 4 16:30:51 - 17:00:34, 2005, UTC. Environmental door opened, logger restarted several times, data download automated.
- October 27 00:25:45 - 00:28:28, 2005, UTC. Logger restarted.
- December 13 18:24:35 - December 14 01:11:53, 2005, UTC. Mick Gladwin visited strainmeter. He noticed a large bending radius on the main cable. He added lightning protection diodes.
- April 27 19:17:47 - 19:18:21, 2006, UTC. Environmental door opened
- May 25, 05:52:53 - 06:02:55, 2006, UTC. Logger restarted.
- June 1, 07:18:08 -07:19:59, 2006, UTC. Logger restarted.
- June 19, 2006. B009 lost GPS time when the logger was restarted Mon Jun 19 04:56:31 2006. On July 31, 2006 the strainmeter data logger time lagged UTC by two minutes and 29 seconds.
- Aug 10 18:06:08 - 18:39:17 2006. Mike Hasting visited strainmeter, upgraded GPS and RT firmware and restarted the logger. The logger time is within a few seconds of UTC time again. The error in the time test is about 5 seconds.
- August 17 00:45:39 - 00:47:32 2006, UTC. Logger restarted.

- August 29, 2006. Mike Hasting installs cover over the B009 borehole.

- October 25, 00:04:38 - 00:05:26, 2006, UTC. Environmental door opened.

- September 25, 2007, - Steve smith visited the site.
  (UTC time)
  17:55 - Onsite at B009.
  17:57 - Take pictures.
  18:03 - Examine batteries.
  1 battery for Network side.
  13.86 V @ 0.3A (charging)
  2 batteries for GTSM side.
  13.51V @ 0.2A (charging)
  18:10 - Box needs to be secured better. Only one concrete screw holding it in place. The 2nd screw appears to be sheared.
  18:15 - 2" j-box cover needs to be replaced. Cover is oval and measures 1.75" x 5.5".
  18:21 - Red Bull antenna mounted under rain gauge box is for Intuicom. Rain gauge j-box also houses GPS antenna for GTSM and Q330.
  18:35 - Data backup begins, walking into PGC building to visit comms site.
  18:58 - In "data center" where cisco and Intuicoms are.
  18:09 - Back to B009. USB backup not working. USB stick removed, no data on stick, USB activity light still flashing when door was closed.
  19:13 – Offsite.

- December 5, 2008. Mike Schmidt replaced the fiber modem (single port) on the GTSM with a new five port version of the old fiber modem.

- January 5, 2008. Mike Schmidt was able to help us diagnose this today as a failure of the 4-port fiber modem, which was replaced and the site is back online as of 1:40 PST.

- February 13, 2009. Mike Gottlieb visited the site from 10:30 to 11:00 PST. New fiber optic modems were installed.

- May 29, 2009. Pumping started at Pendray Farms. The wells are about 1 km from the strainmeters.

- July 16, 2009. Mike Gottlieb visited B009:
  RTs upgraded to 1.20
  PB upgraded to SP322 / UNID 27137.
  PB US6PB / 26534 was removed.
  White Marmot was replaced with a blue Marmot.
- September 10, 2010. Used birddog to measure calibration info on seismometer.

- December 12, 2011. Lost coms with the station. Mike Gottlieb worked with Brian Schoeffield at PGC to resolve this problem. He power cycled the radios and reseated all Ethernet plugs and the station came back online.

- July 10, 2012 – Pulled 3 batteries from 2005, and replaced them with 1x2 gtsm batteries and 2x3 mains batteries (8 total). Set the quadrature and chop of the GTSM.

- July 16, 2012 – There was a lightning storm on Vancouver Island on July 14, 2012 that has affected B009 B010 and B011. Lisa from PGC went and rebooted the equipment, but there are still a number of problems that will require attention. The logger board is unresponsive.

All 4 channels are flatlined. RT2 began smoking after the reboot, and was left powered off. Mike Gottlieb plans on going up there in early August with spare uphole electronics to see what he can do.

- August 20, 2012 – Mike, Wade, and Warren visited the site. The logger board had failed and was replaced. The oscillator board was found to not be oscillating and was replaced. RT2 board had been reported to be smoking shortly after the event, and was therefore replaced. Current status: RT0, RT1, and RT3 appear to be working normally, but RT2 is showing diminished amplitude of the response signal from downhole. It is still tracking tides, but the signal to noise ratio is poor, and there are large calibration pulses present. They suspect that this channel has lost a downhole amplifier. The tap-step for RT2 is also -.05 (normal is ~ +0.38)

- October 29, 2015 – Adjusted chops and quads.

- April 20, 2016 – Corrected file storage configurations from FW 2.12.

- September 20, 2016 – Completed down hole test procedure on GTSM. Adjusted chops and quads.

- November 11, 2016 – Mike Gottlieb visited the site with Mick Gladwin. There was definitely an issue with an amplifier downhole on CH2. Quadrature was responsive, and could be minimized, but the zero crossing point was well behind where it should be. So much so that even with all delays on, the signal was getting chopped in the wrong place, which means there is about 180 mV of quadrature on top of the real signal. This was problematic because the tap step is only 60 mV, so it was constantly operating outside the normal range. They attempted to correct for this by adding a 20 kohm resistor into the quad box, but the phase shift was not constant (it gets bigger the more out of balance the system gets) so it was not possible to find a value for this resistor that would solve the problem across the range of the calibration. They removed the resistor. The channel was failing to properly calibrate much of the time, but with the delays all maxed it seemed a little more consistent. They played with the frequency as well, which both helped and hurt. At 2 khz, the difference between the chop point and the quadrature zero crossing was smaller, but there was also a non-zero minimum quadrature that was not present at 1 khz. In the end, they left it at 1 khz. One possibility is adjusting the oscillator firmware to increase the delay range of the dip switches.

  They spent a long time digging into the problem of calibration offsets, which they saw on most failed channels, with some moderate success. In normal calibration, the system will vary the RT by 2 steps in the 5th decade to determine the tap step. This brief offset should not show up in the data because those points are corrected by 2x the previous tap step value There was a cut-off they figured out of 0.080 for the tap step where this changes. Values below this cutoff (20% of nominal) are flagged as bad (and have a negative sign in front of them) and the system uses a default value of 0.400 instead of the measured value. The way the code is written, the normal correction is not working properly below 0.080, and they believe these offsets are making it into the data (scaled somehow to the ratio of actual tap step / default). Therefore B009 with a tap step of 0.060 has an offset of 1700, but B010 has a tap step of 0.013 and an offset of 20000 counts.

  They were able to prove this by modifying a board (shorting a fixed resistor and adjusting a variable one) to create a low tap step on a functional channel. At a tap step of 0.084 the board performed as it should (no data offsets, show tap step menu gave correct 0.084 value) but at 0.064 they recreated the behavior of offsets in the 100 hz (1700 counts for this case)

and showed tap step giving the default 0.400.

So they know why this is happening now, but not necessarily a clear path to get rid of them. The math gets kind of circular if you just change the cutoff to use these low values. Perhaps a better solution is to stop calibrating except during events and startups, which would reduce the frequency of these spikes from 1 x hour to maybe 1 x week.

In summary, the blown downhole amplifier is causing several issues. Some potential paths forward might be to reduce the frequency of the calibration to minimize these offsets, and to potentially adjust the oscillator firmware to allow enough delay so that the signal can be chopped in the right place.

- August 28, 2019 – Firmware updated to 2.3, which lets you reduce the calibration frequency. This was set to disable, which turned the calibrations off all together. Added straps to better secure electronics and set quadrature.

- September 3, 2019 – Calibration frequency was changed to 1x per day. It appears the last calibration happened at 22:30.