

# **PBO Borehole Strainmeter Drawings**



## **PBO Borehole Strainmeter Analysis center**

Kathleen Hodgkinson  
Brent Henderson

## **PBO Strainmeter Engineers**

Dave Mencin  
Steve Alm  
Korey Dausz  
Tim Dittman  
Warren Gallaher  
Michael Gottlieb  
Mike Jackson  
Wade Johnson  
Bob Mueller  
Emily Sieder  
James Stair  
Alan Stroeve  
Andrew Tiedeman  
Elizabeth Van Boskirk  
Sarah Venator  
Heidi Willoughby

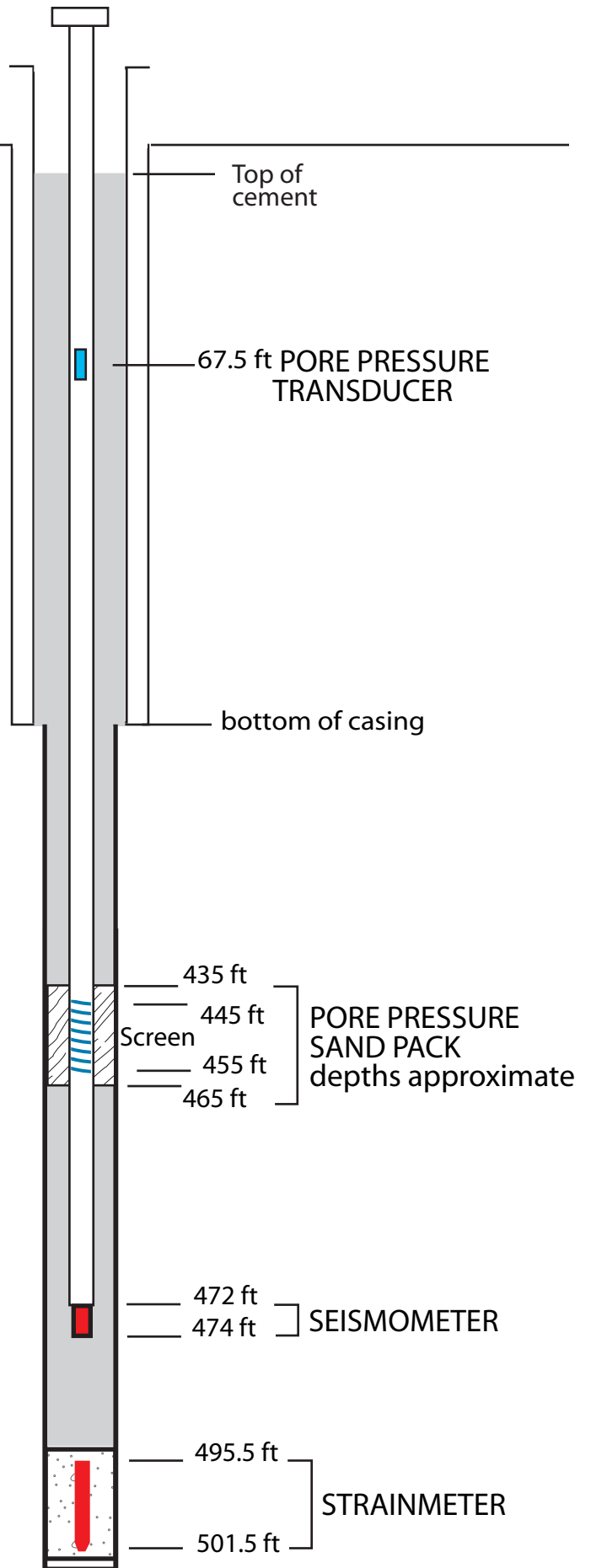
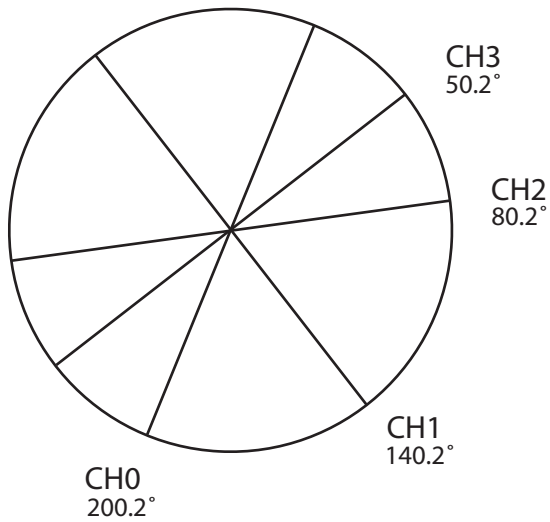
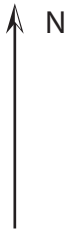
**22 September 2008**  
Updated 17 August 2010



# B001 golbeck01bwa2005

48.04307 -123.13141 237 m

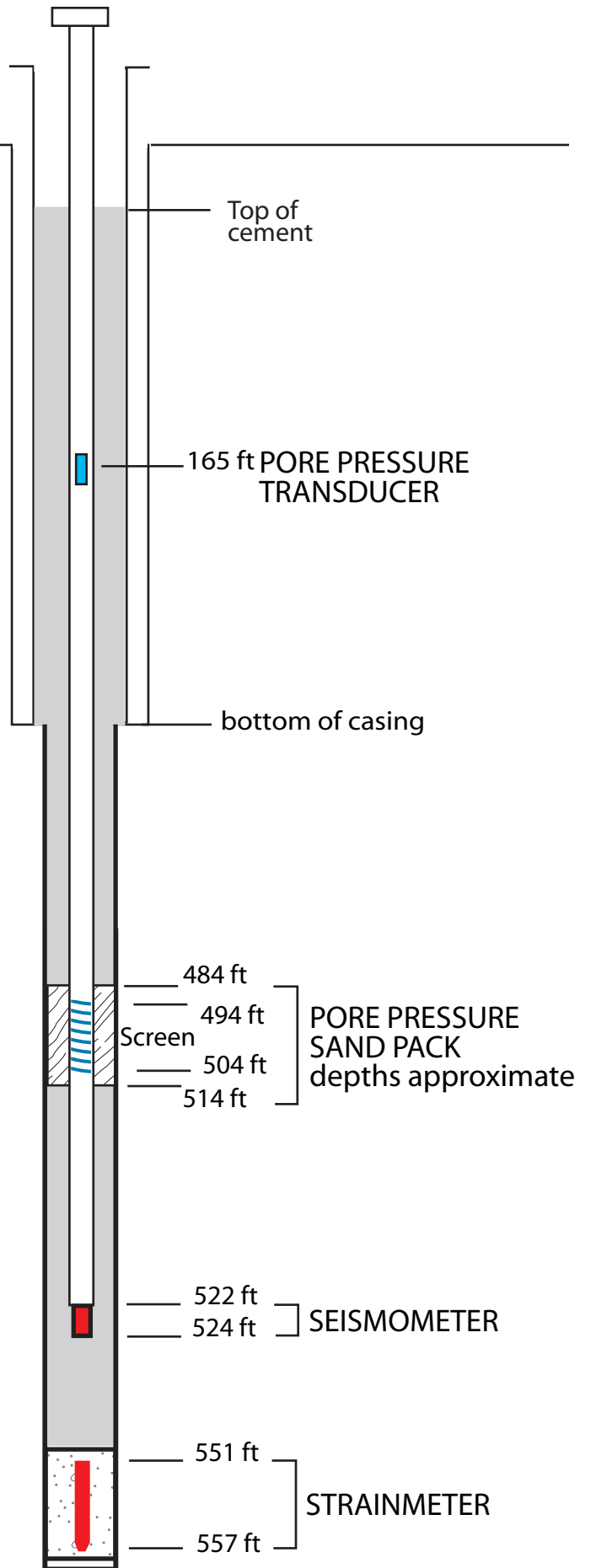
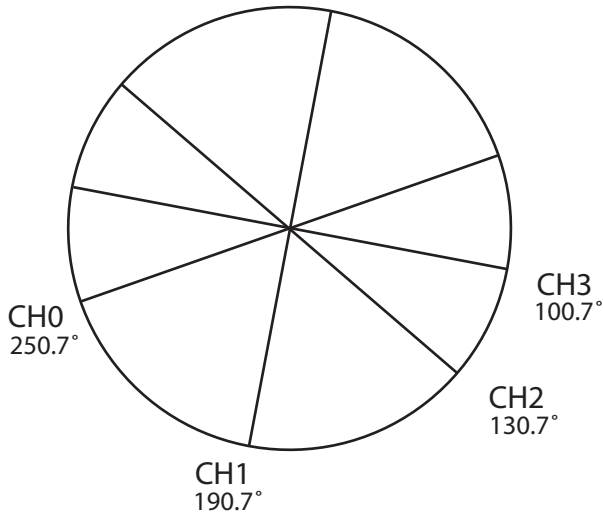
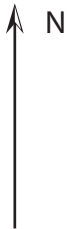
**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing  
Last updated on April 7, 2009



# B003/P403 floequarybwa2005

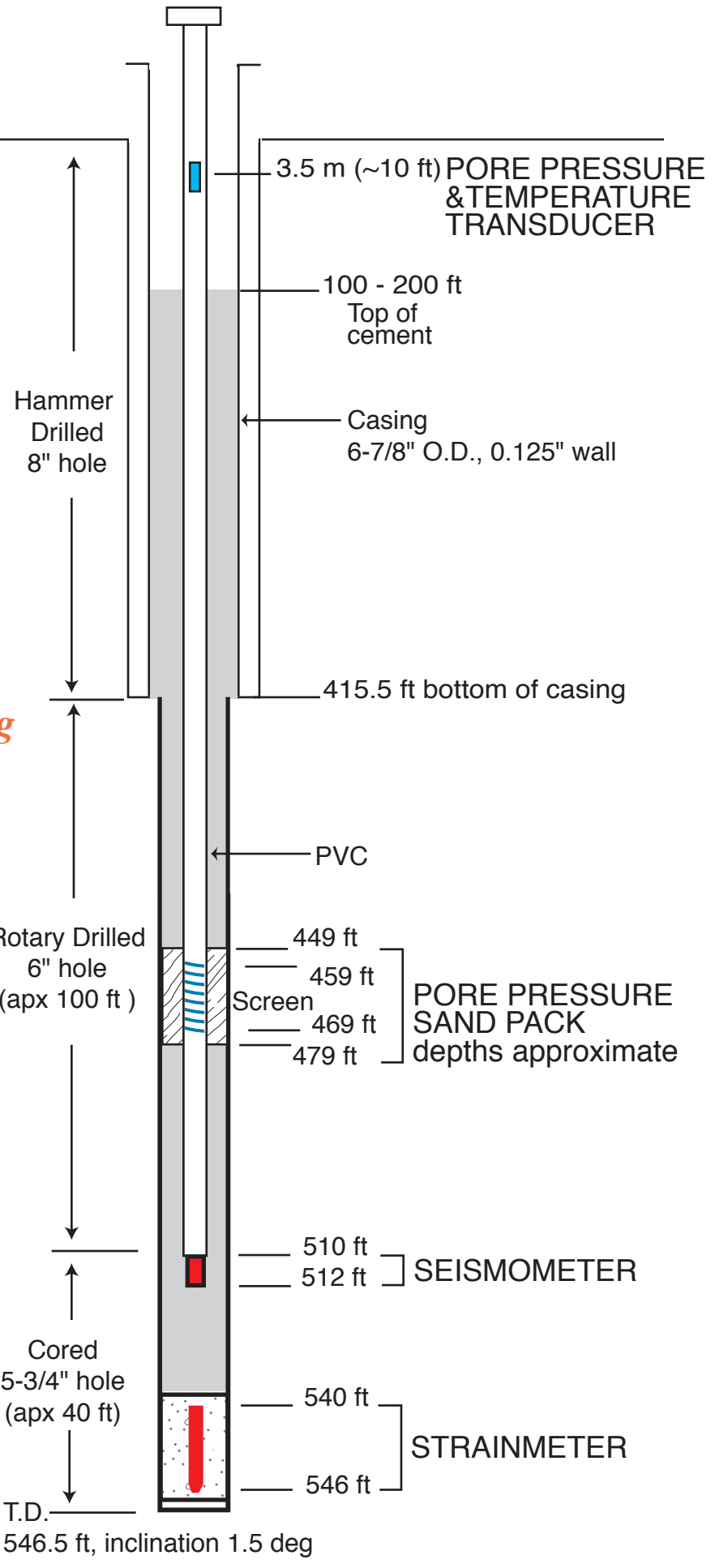
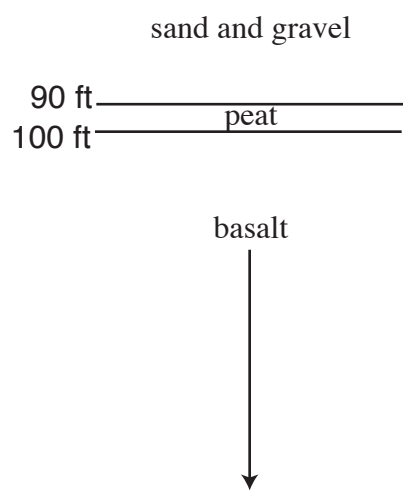
48.06236 -124.14086 285 m

**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing  
Last updated on April 13, 2009



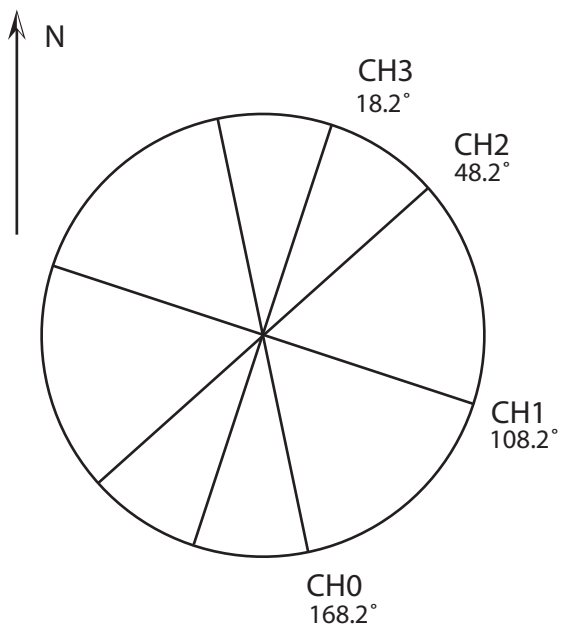
# B004 hokofallsbwa2005

48.202 -124.427 30 m



**NOT TO SCALE**  
 Cables not shown

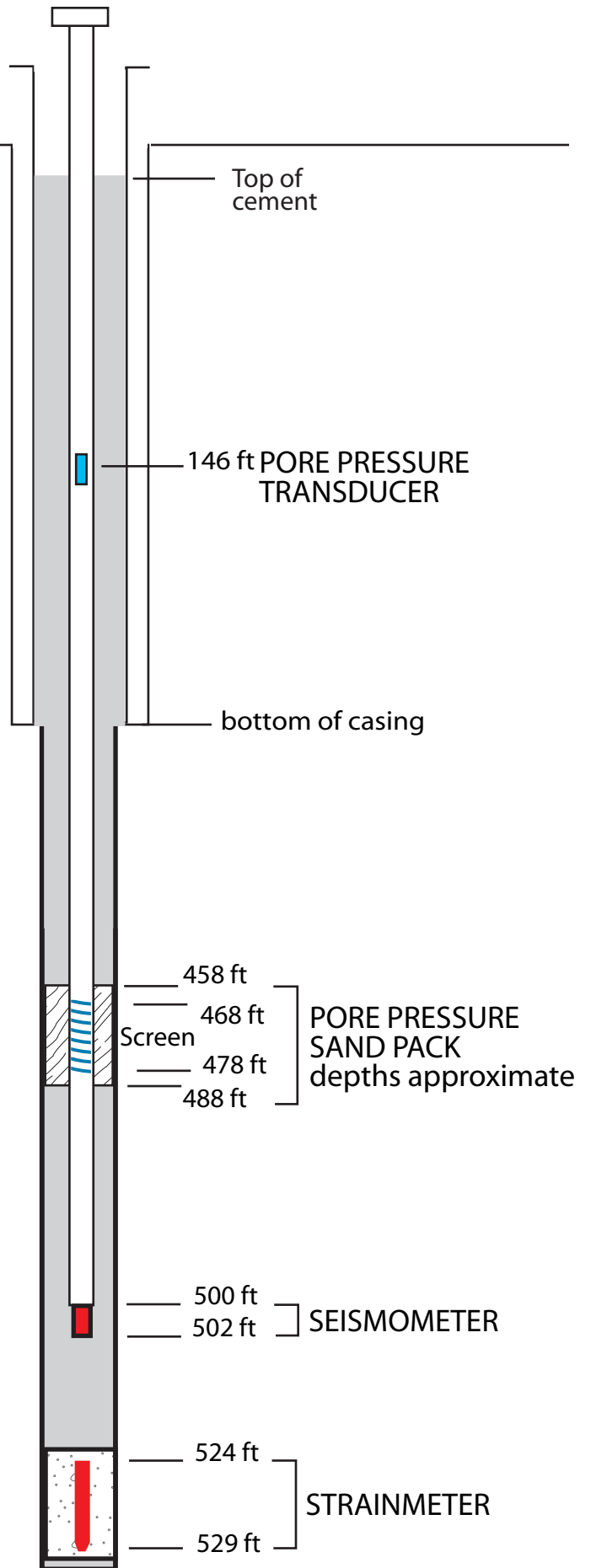
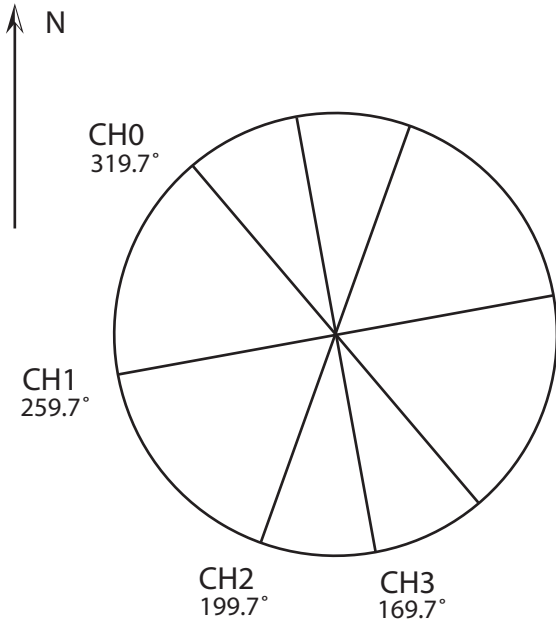
*all depths relative to top of casing*  
 Initial diagram prepared by E. Roeloffs  
 Last updated on August 13, 2010



# B005 shoresnw1bwa2005

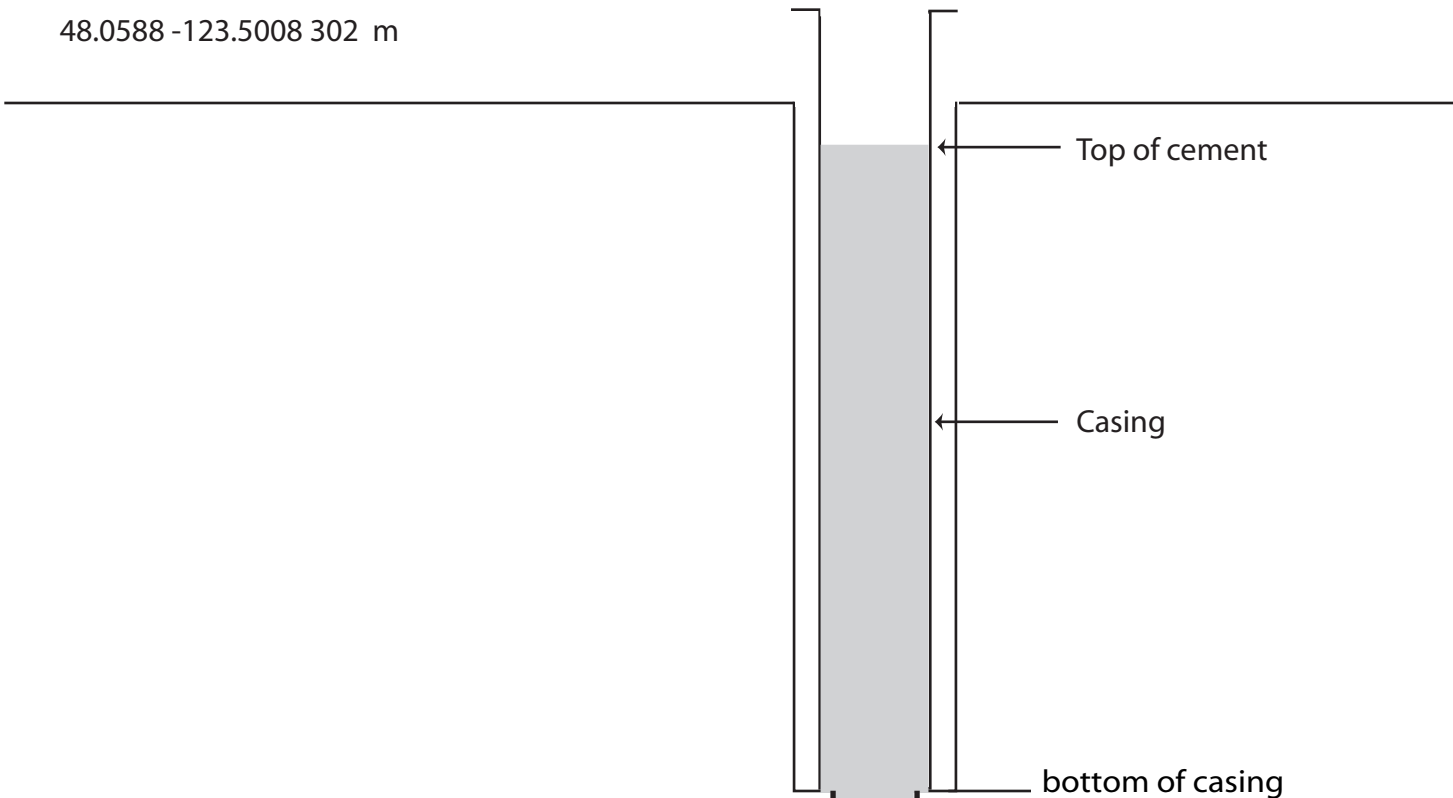
48.059549 -123.503278 302.7 m

**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing  
Last updated on April 1, 2007



# B006 shoresne2bwa2005

48.0588 -123.5008 302 m

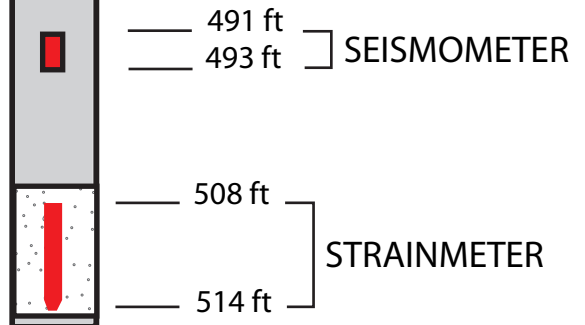


**NOT TO SCALE**

**Cables not shown**

**all depths relative to top of casing**

Last Updated 25 May 2007

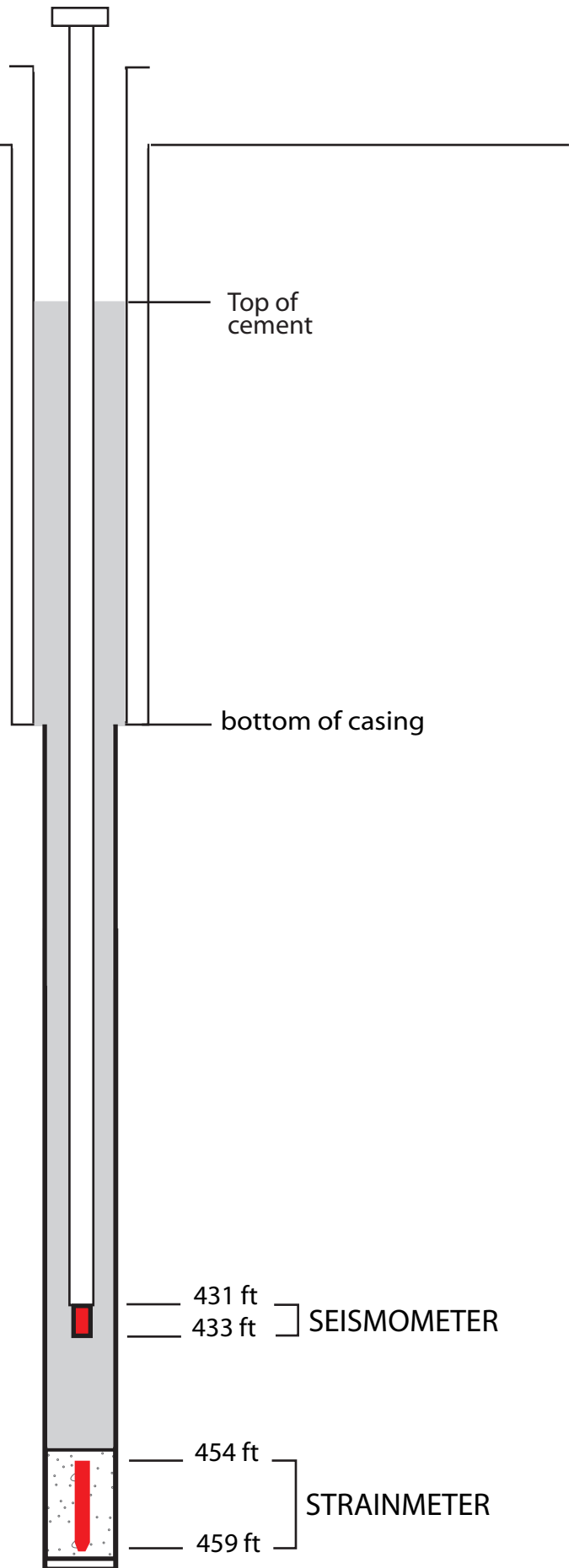
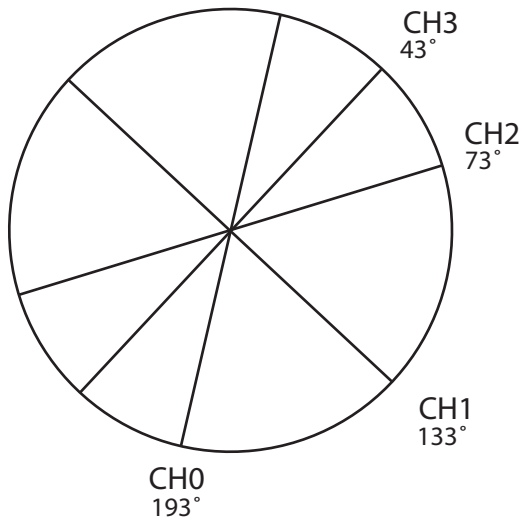
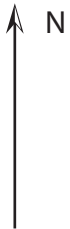


# B007 shoresso3bwa2005

48.058 -123.504 293 m

**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing

Last updated on January 17, 2007



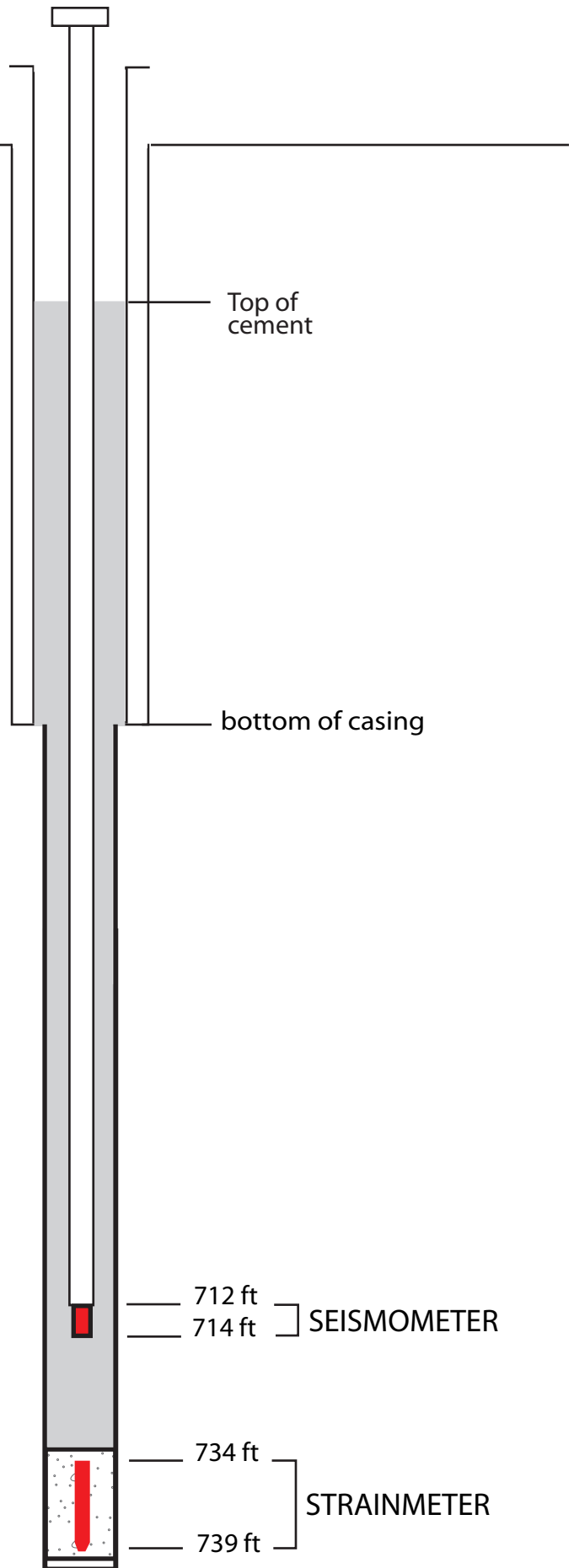
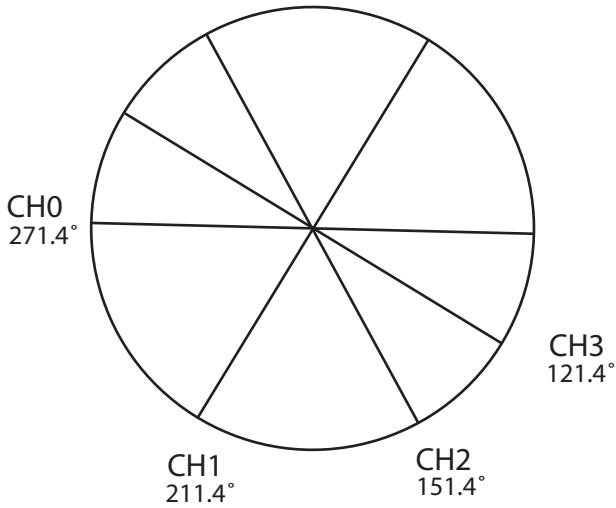
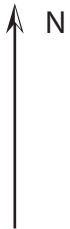


B009 pacgeosi1bbc2005

48.649 -123.451 15 m

**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing

Last updated on January 17, 2007

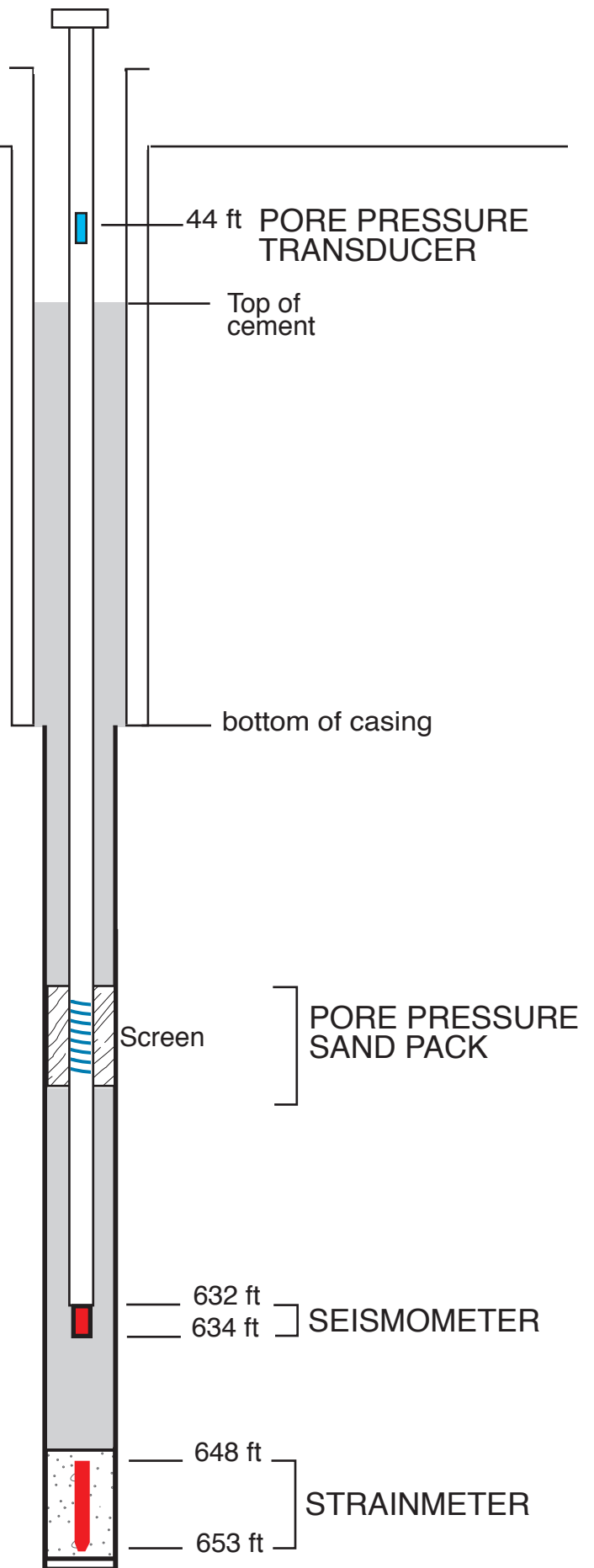
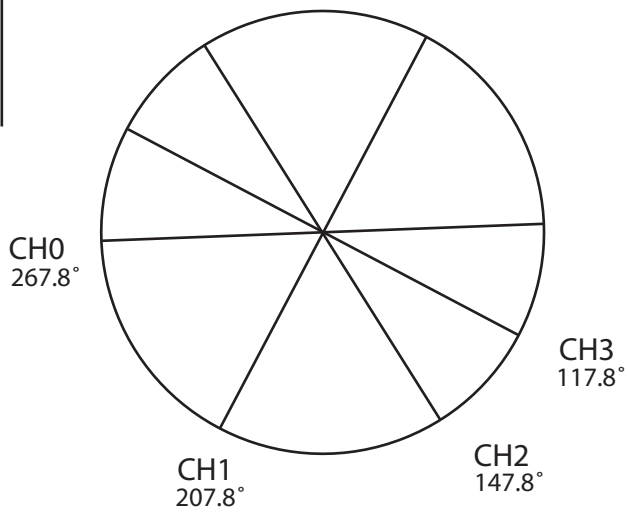
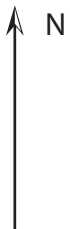


# B010 pacgeosi2bbc2005

48.65017 -123.45133 5 m

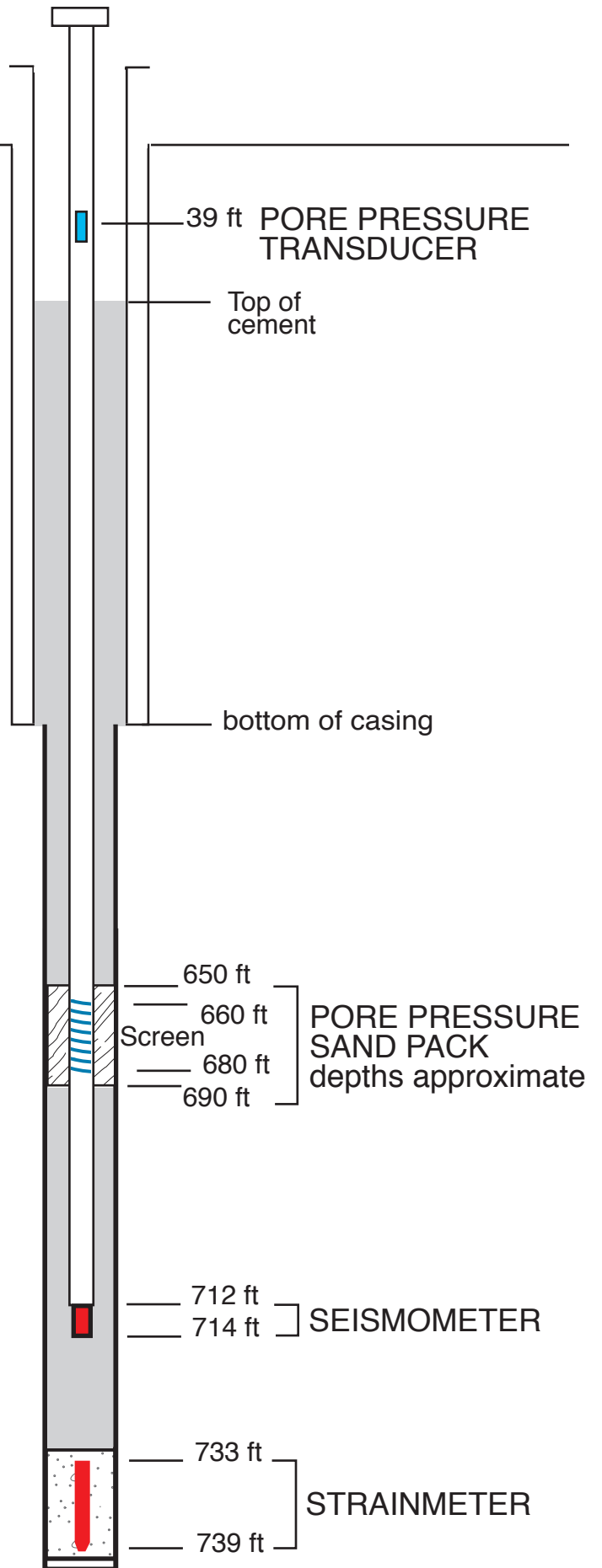
**NOT TO SCALE**  
*Cables not shown*  
*all depths relative to top of casing*

Last updated on June 18, 2010



# B011 pacgeosi3bbc2005

48.6495 -123.4482 22 m



***NOT TO SCALE***

***Cables not shown***

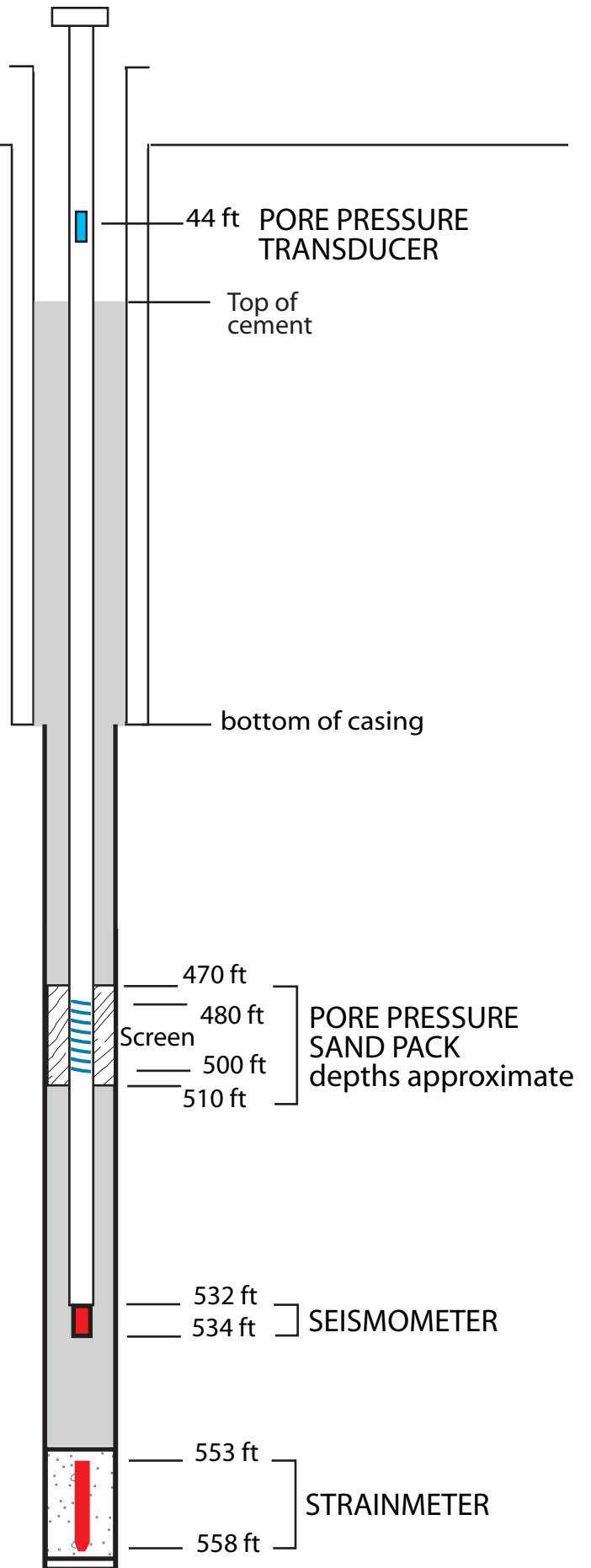
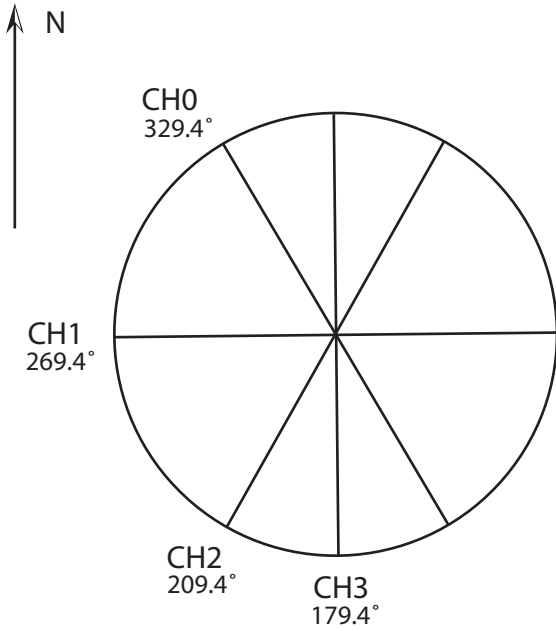
***all depths relative to top of casing***

Last updated on January 17, 2007

# B012 ucluelet1bbc2005

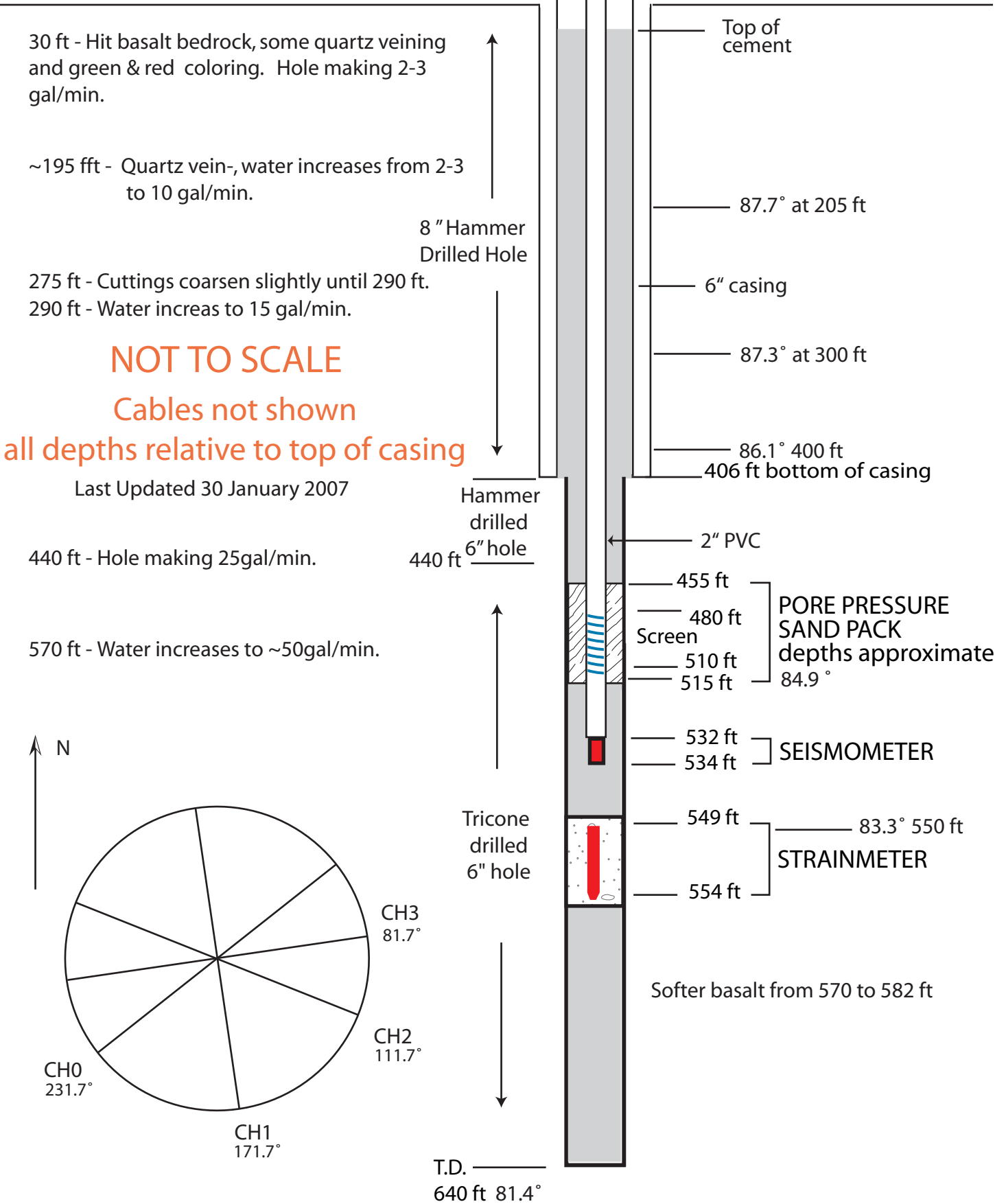
48.925 -125.542 13 m

**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing  
Last updated on January 17, 2007

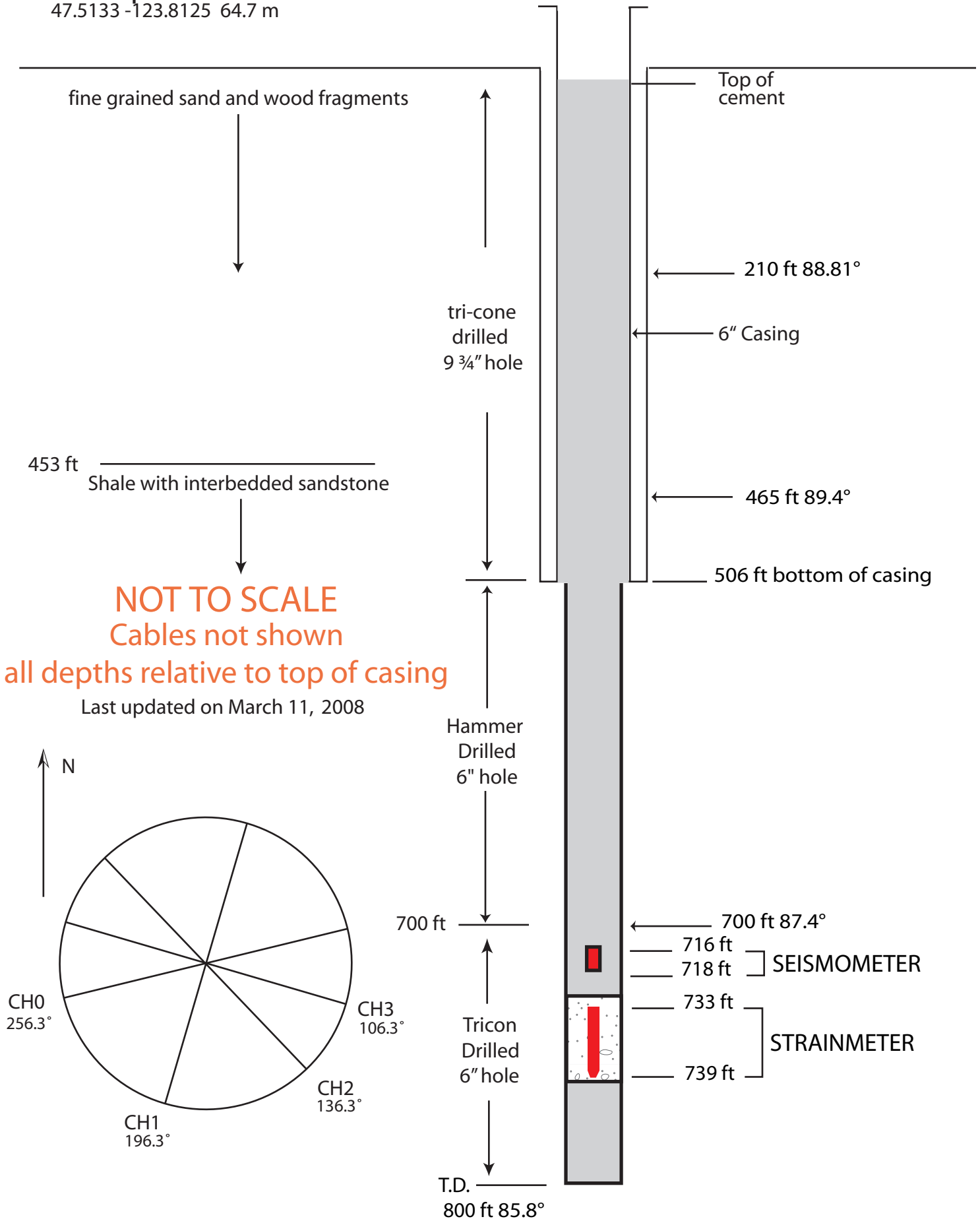


# B013 pnycrk013bwa2007

47.813 -122.9108 75.3 m



B014 quint014bwa2008  
 47.5133 -123.8125 64.7 m



# B017 flinkm017bwa2007

46.996 -123.5575 33.9 m

siltstone



Top of cement

6" Casing

455 ft 86.4°

465 ft bottom of casing

**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing

Last updated on 17 July 2007

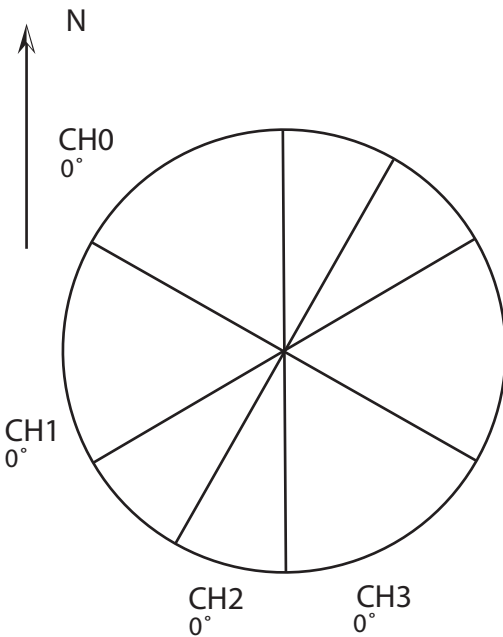
6" tri-cone drilled hole

620 ft 84.6°

719 ft } SEISMOMETER  
721 ft }

735 ft } STRAINMETER  
741 ft }

T.D.  
744 ft

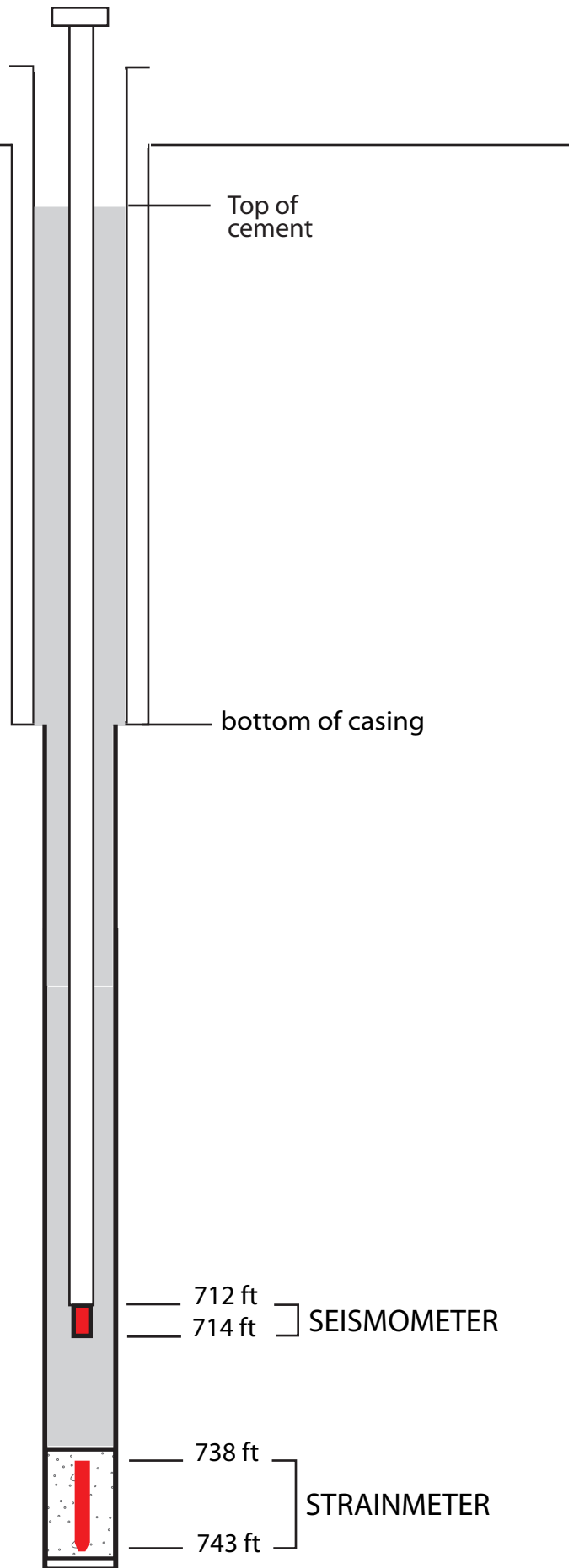
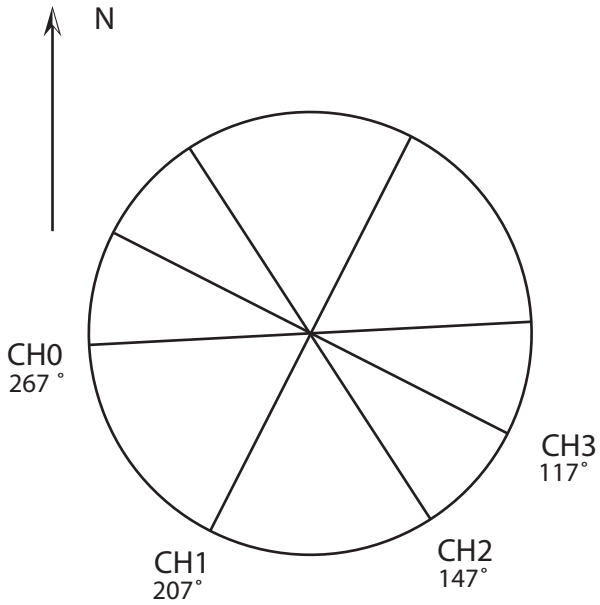


# B018 delphi018bor2006

46.9795 -123.0203 10m

**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing

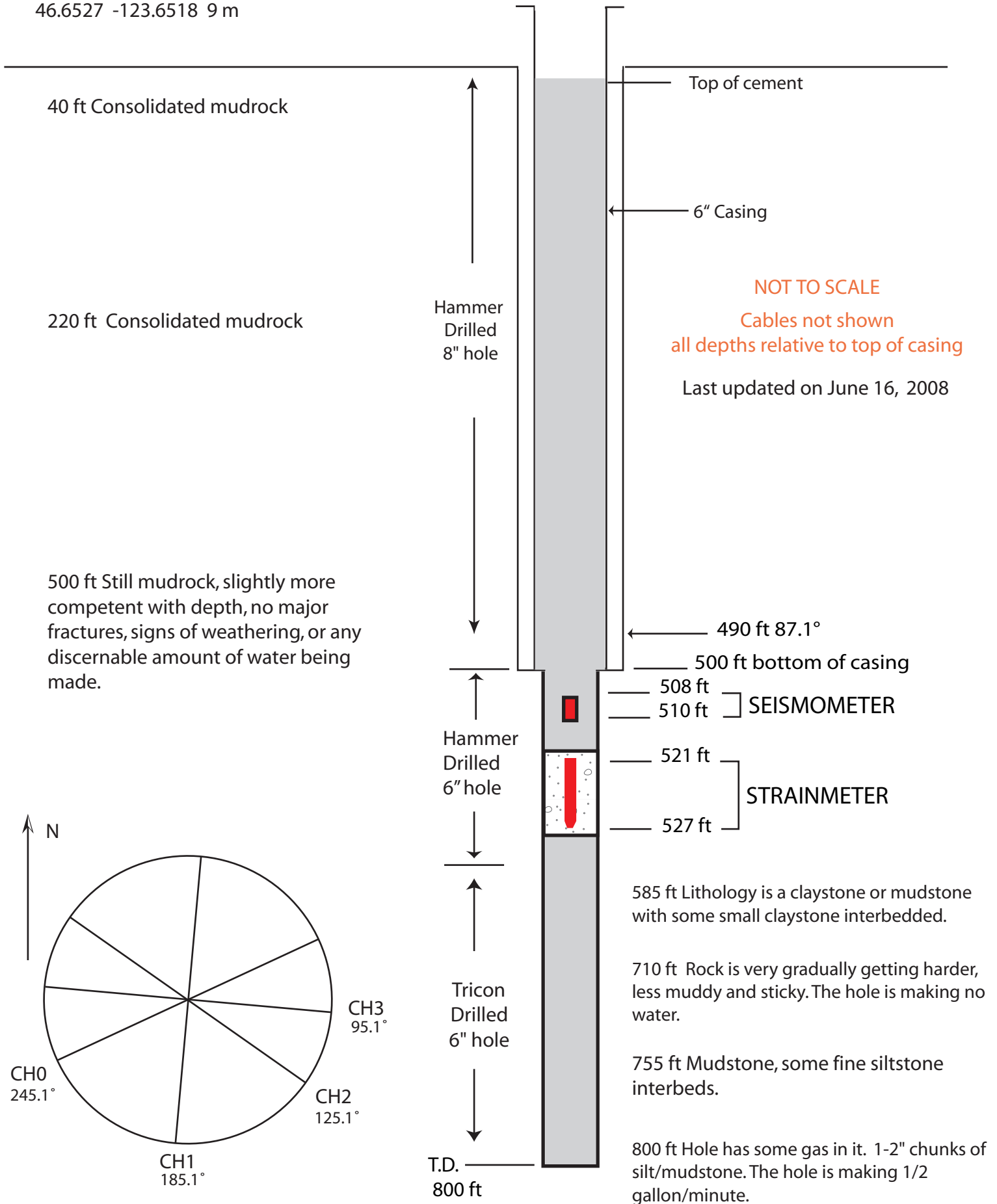
Last updated on June 27, 2007





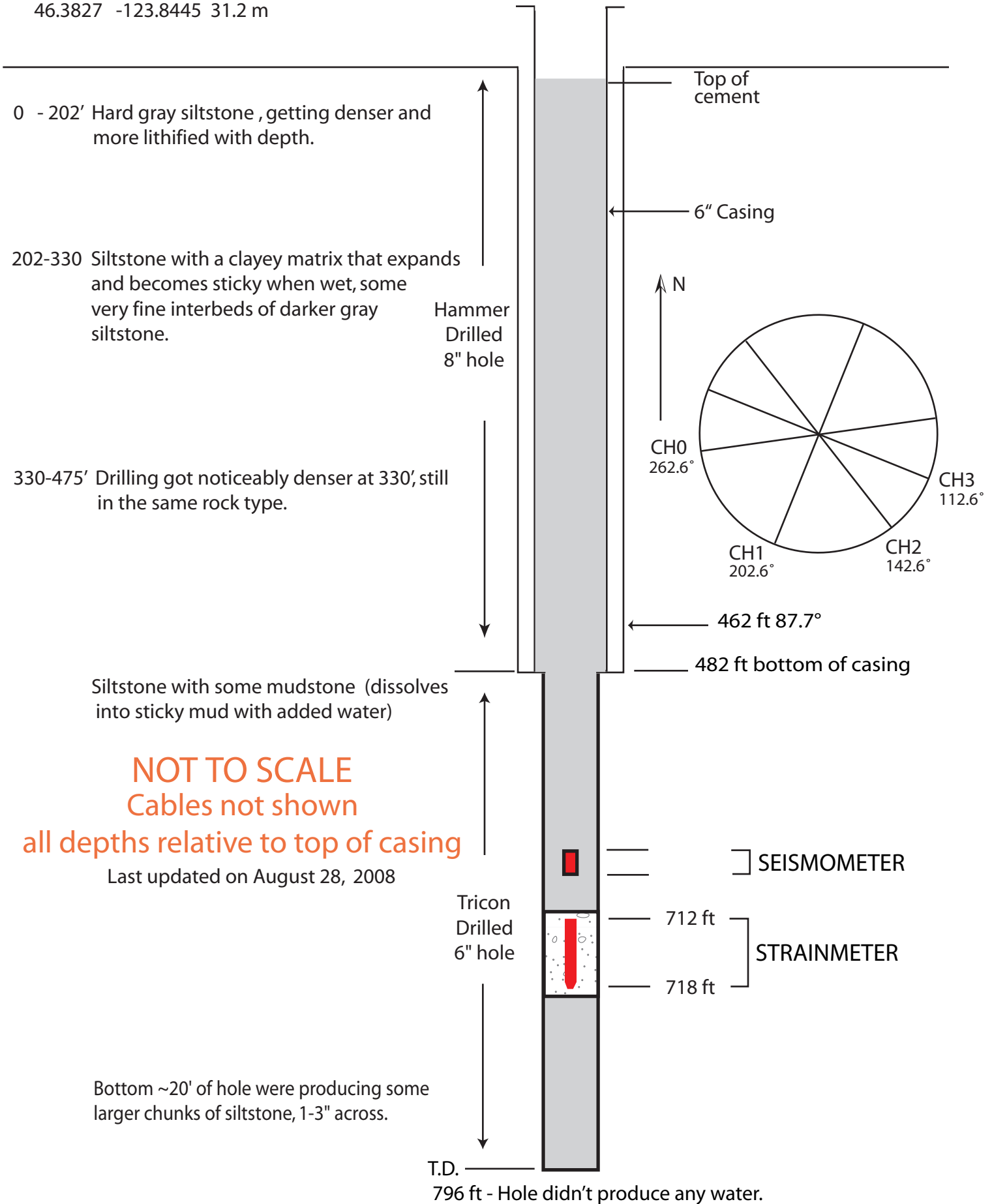
# B019 waldrf019bwa2008

46.6527 -123.6518 9 m



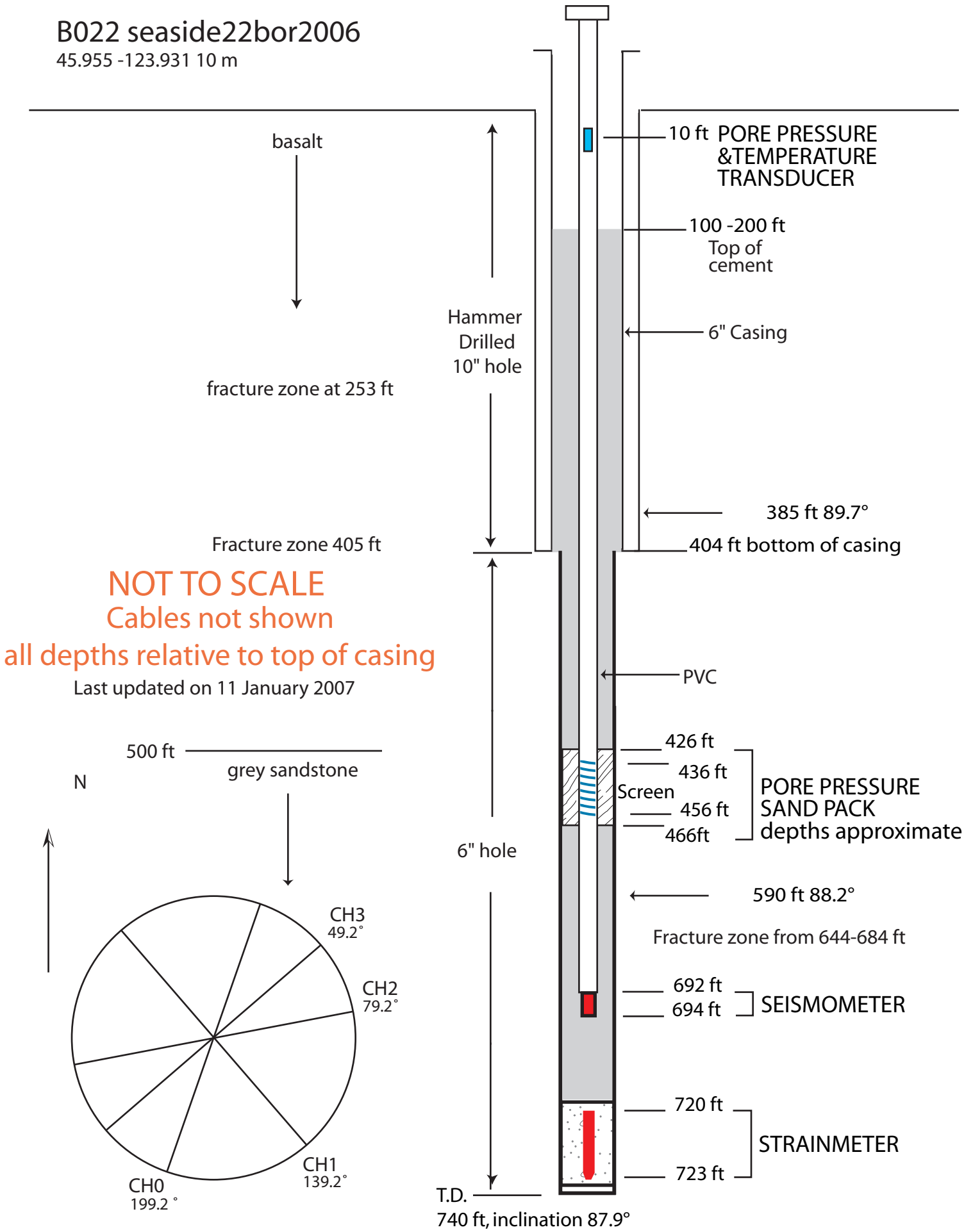
# B020 wirkla020bwa2008

46.3827 -123.8445 31.2 m



# B022 seaside22bor2006

45.955 -123.931 10 m



basalt  
fracture zone at 253 ft

Hammer Drilled 10" hole

10 ft PORE PRESSURE & TEMPERATURE TRANSDUCER

100 - 200 ft Top of cement

6" Casing

385 ft 89.7°

404 ft bottom of casing

Fracture zone 405 ft

**NOT TO SCALE**  
**Cables not shown**

**all depths relative to top of casing**

Last updated on 11 January 2007

PVC

426 ft

436 ft

Screen

456 ft

466 ft

PORE PRESSURE SAND PACK depths approximate

6" hole

590 ft 88.2°

Fracture zone from 644-684 ft

692 ft

694 ft

SEISMOMETER

720 ft

723 ft

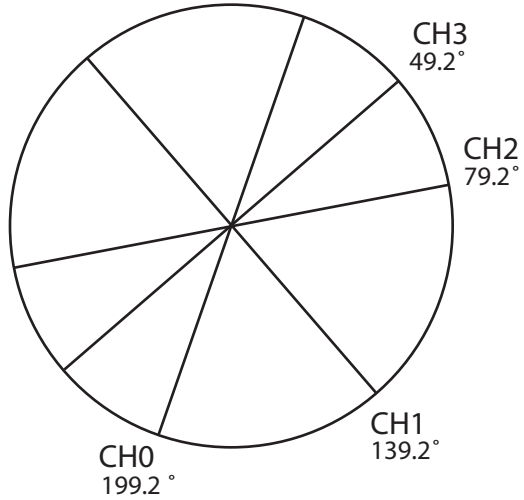
STRAINMETER

T.D.

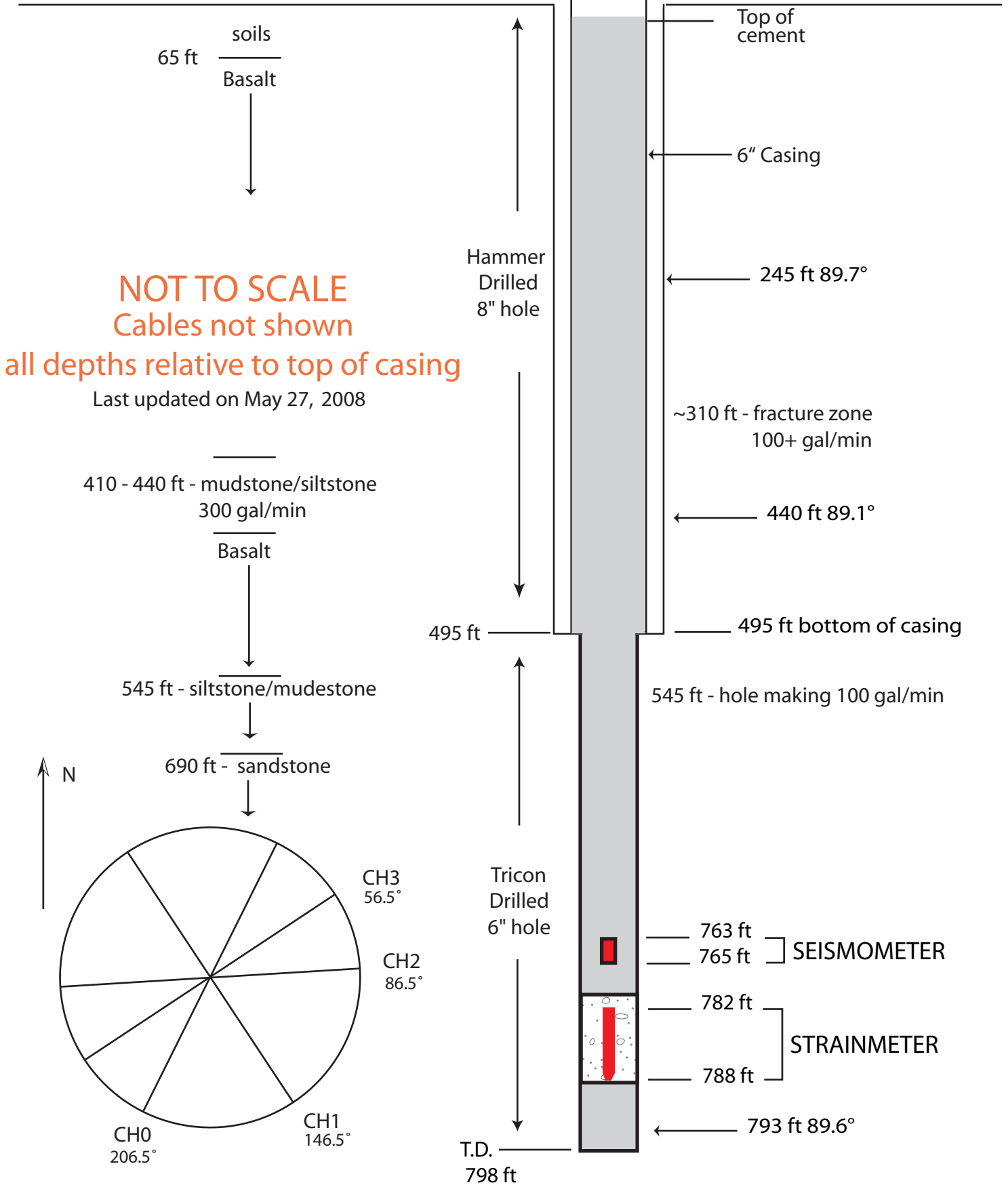
740 ft, inclination 87.9°

500 ft grey sandstone

N

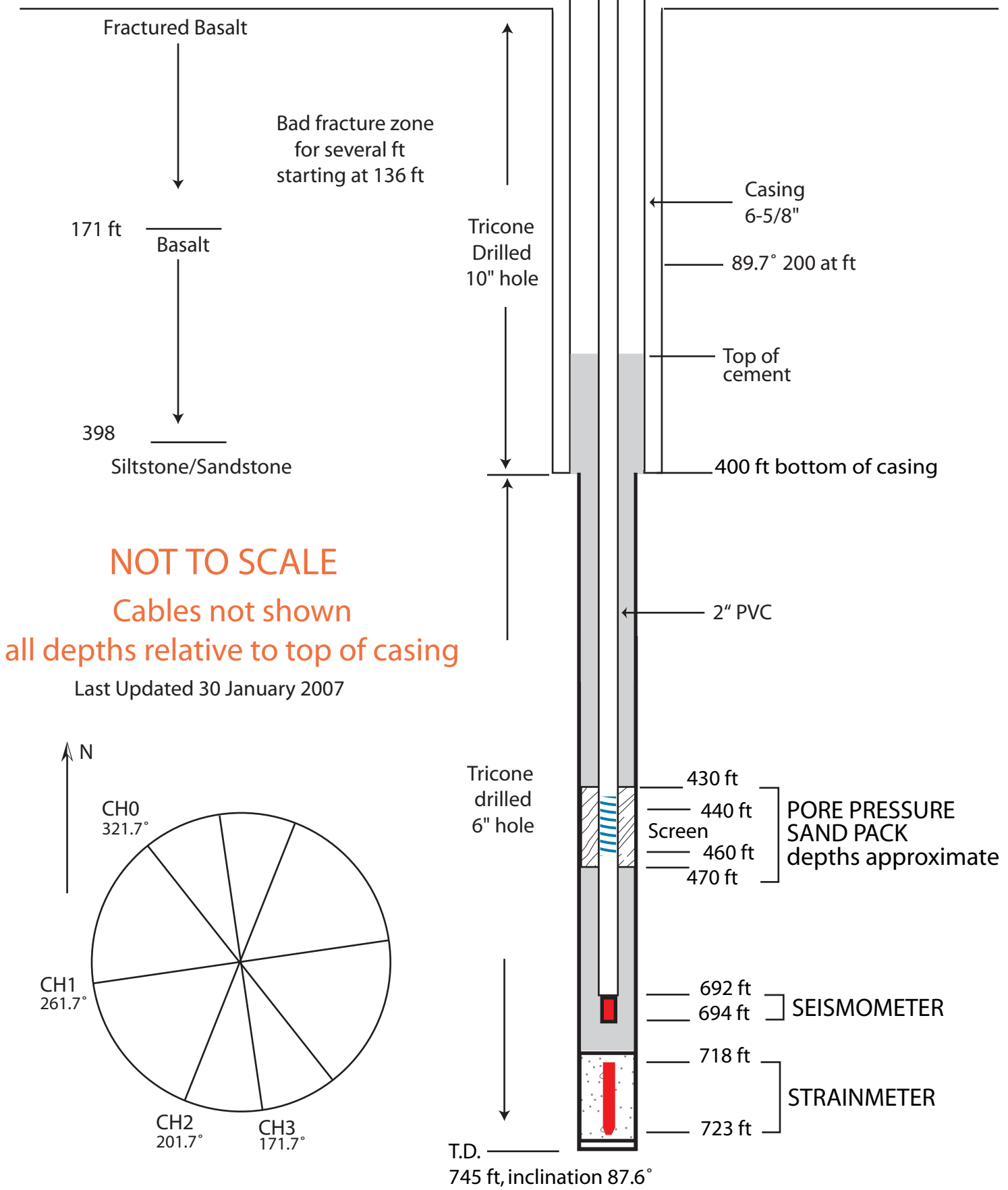


**B023 cataln023bor2008**  
 46.1112 -123.0787 177.4 m



# B024 kuntza024bor2006

45.634, -123.863 226 m



# B026 roosbc026bor2007

45.309351, -123.823049 232 m

30 ft ———  
grey siltstone  
85 ft ———

volcanic breccia

410 ft ———

bedded siltstone/mudstone

460 ft ———  
volcanic breccia

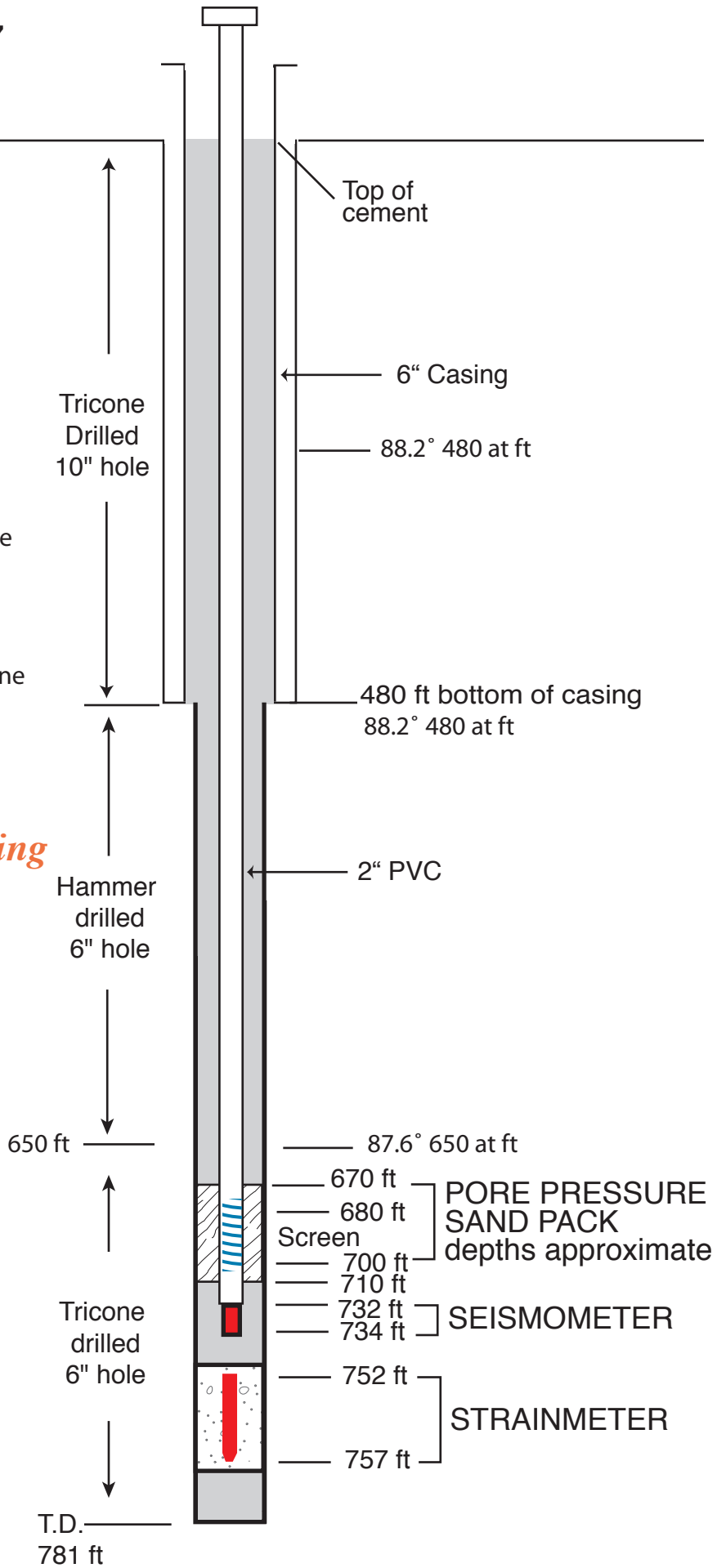
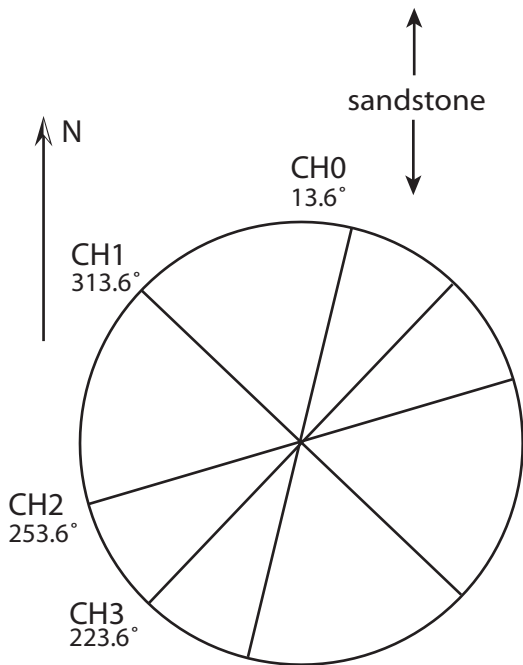
472 ft ———  
bedded siltstone/mudstone

**NOT TO SCALE**

*Cables not shown*

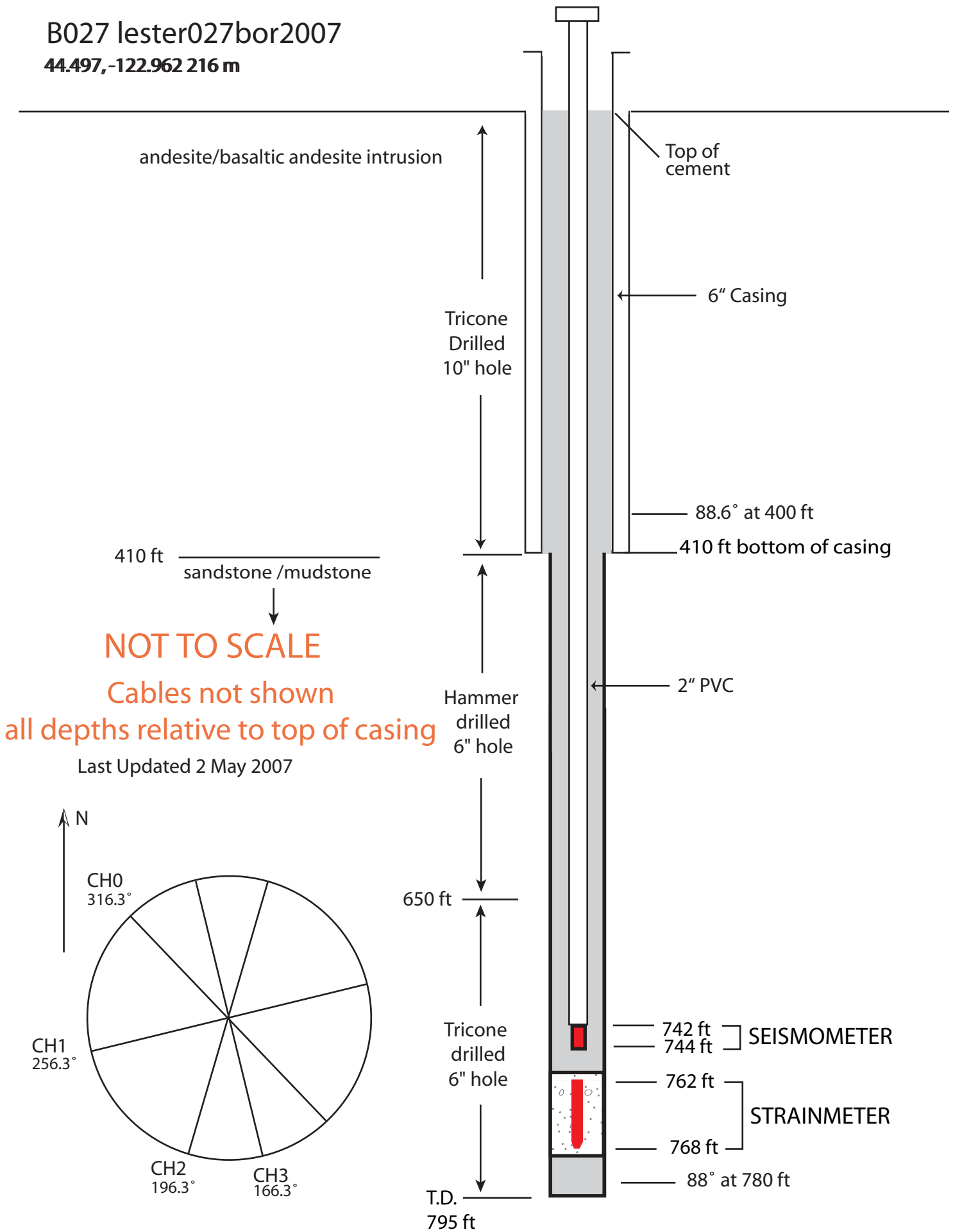
*all depths relative to top of casing*

Last Updated 14 August 2010



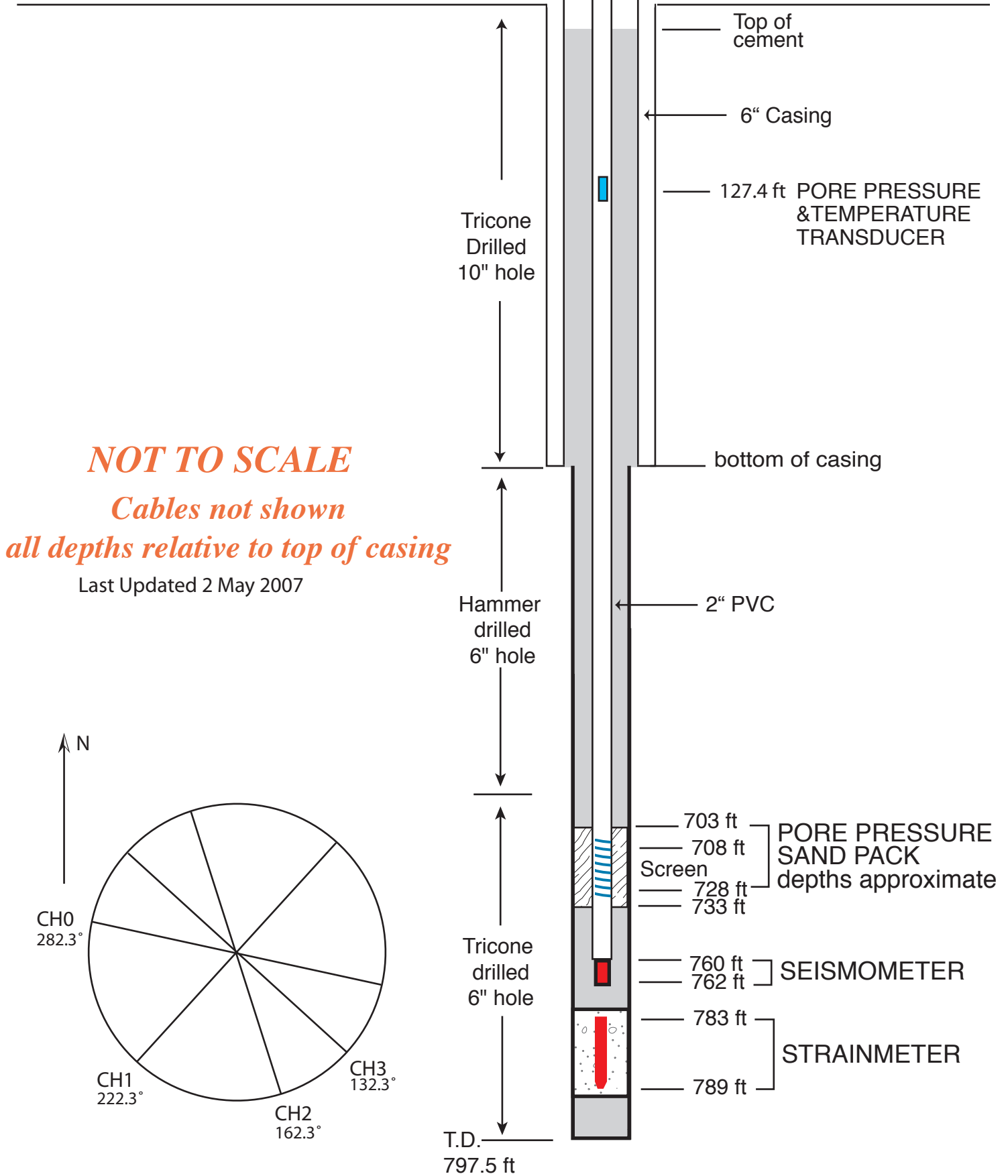
# B027 lester027bor2007

44.497,-122.962 216 m



# B028 lester028bor2007

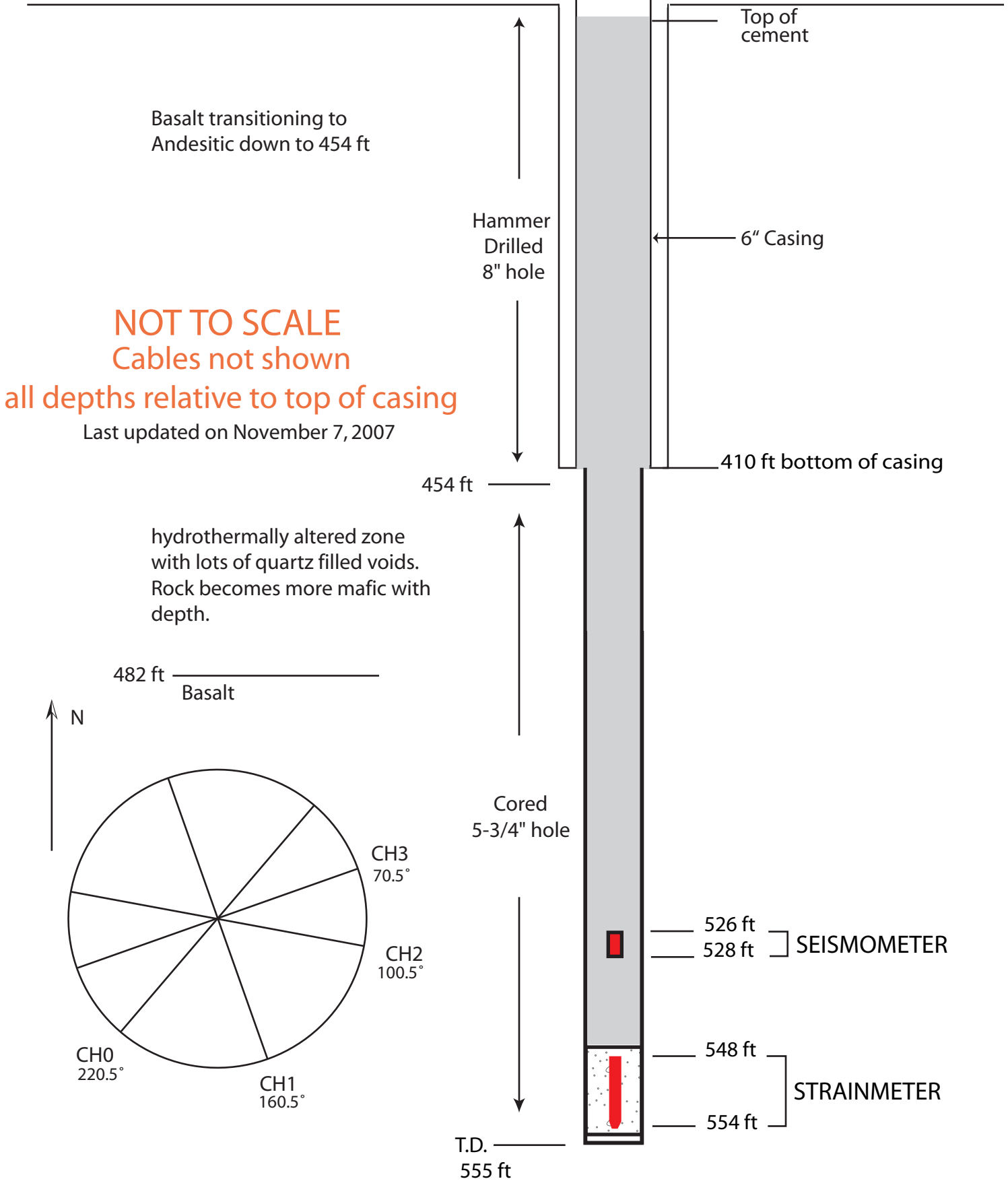
44.4937, -122.9638 140 m





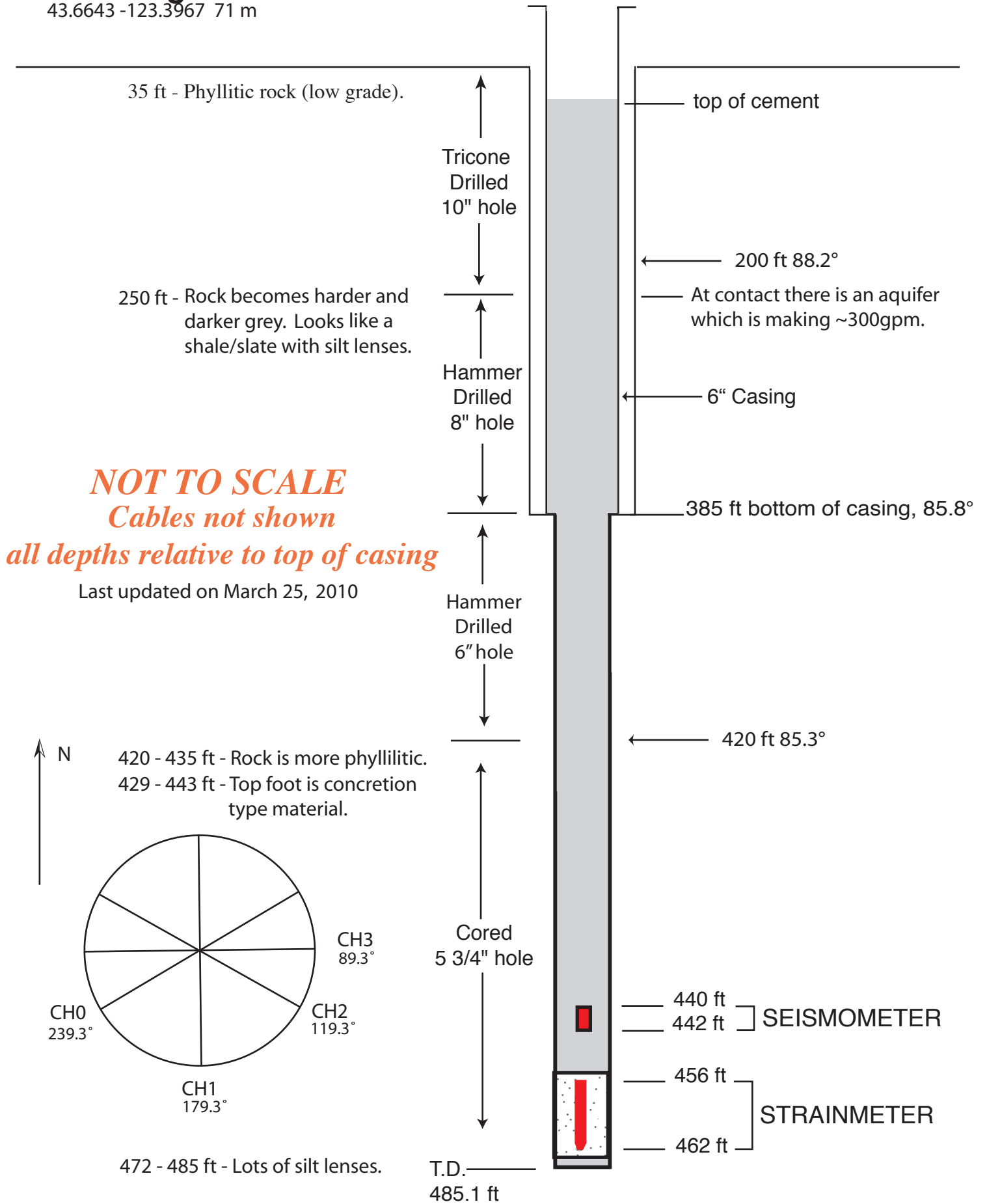
# B030 pattrs030bor2007

44.619 -110.8485 2182 m



# B031hergrt031bor2007

43.6643 -123.3967 71 m



# B032 hergrt032bor2007

43.668 -123.3923 63.8 m

Phyllitic



Hammer Drilled 8" hole

top of cement

200 ft 88.3°

6" Casing

378 ft bottom of casing, 87.5°

**NOT TO SCALE**

*Cables not shown*

*all depths relative to top of casing*

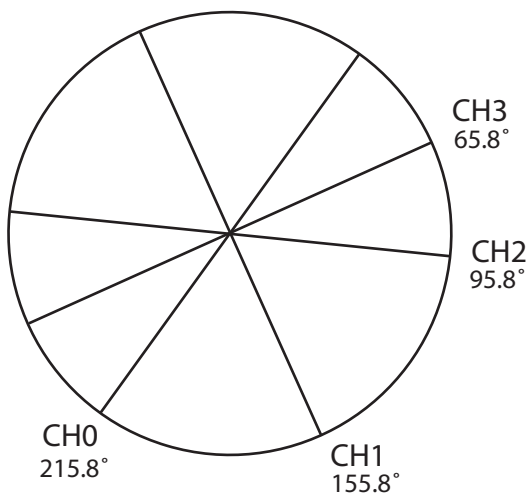
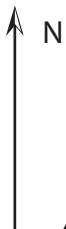
Last updated on February 20, 2008

Hammer Drilled 6" hole

440'

435 ft 88.2°

mudstone/shale



Tricone Drilled 6" hole

738 ft

740 ft

SEISMOMETER

764 ft

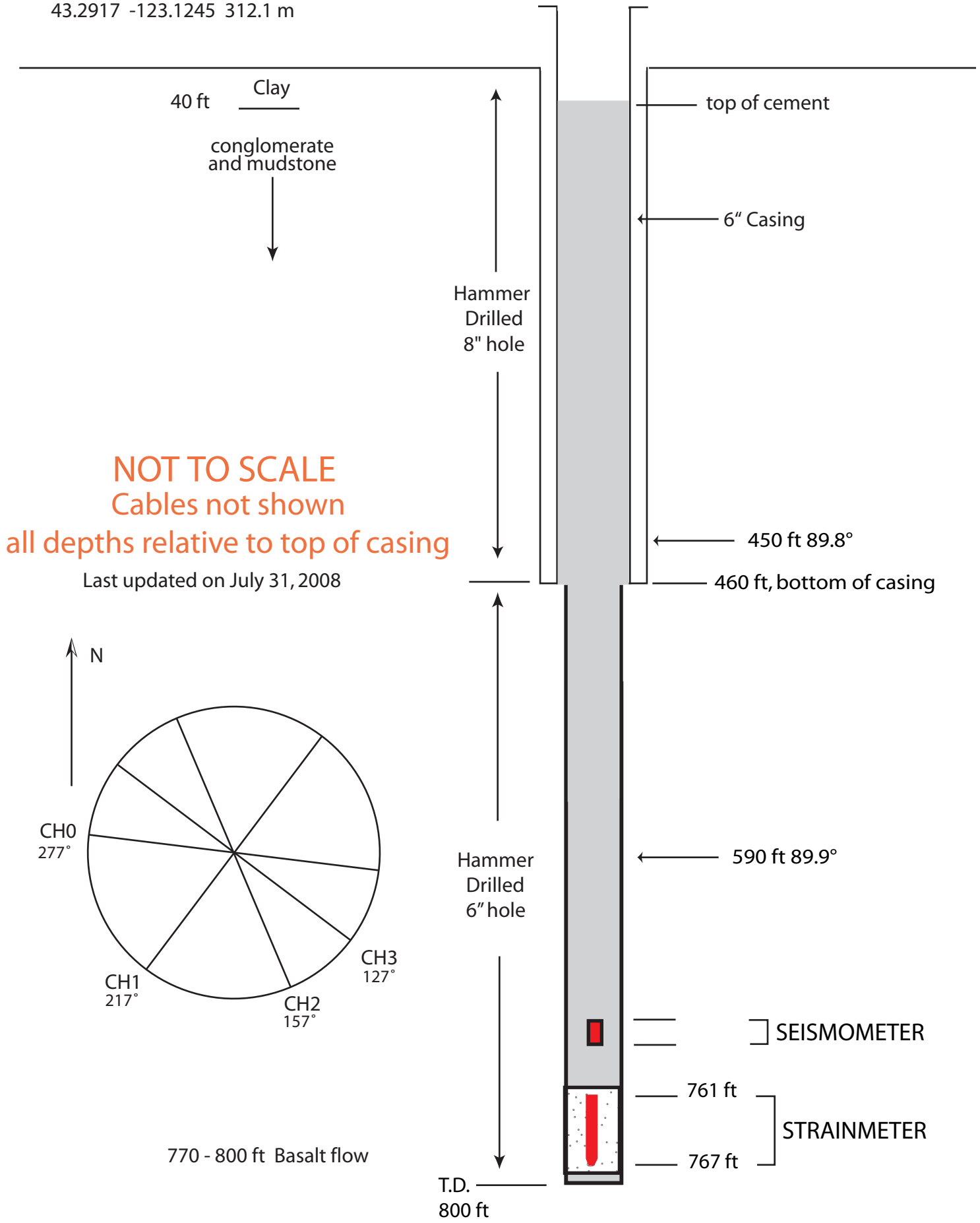
STRAINMETER

770 ft

T.D.

773 ft, inclination ??°

B033 vanvlk033bor2007  
43.2917 -123.1245 312.1 m



# B035 grants035bor2006

42.5035 -123.3834 370 m

red clay changing to sandy brown clay  
100 ft  
clay with 1-4" gravel  
165 ft  
weathered granodiorite  
H<sub>2</sub>O ~15 gal/min, decreasing with depth

Drilled with 9 7/8" tricone

Borehole cemented to surface

10" Casing

PVC

300 ft bottom of casing

**NOT TO SCALE**

**Cables not shown**

**all depths relative to top of casing**

Last Updated 14 August 2010

Rotary Drilled 6" hole

500 ft 89.9°

640 ft 89.6°

650 ft

718 ft

720 ft

SEISMOMETER

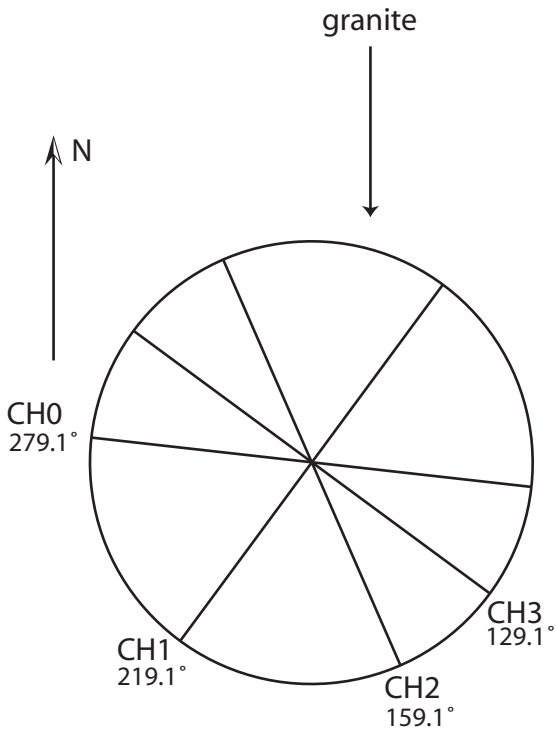
Tricone

736 ft

742 ft

STRAINMETER

88.6°

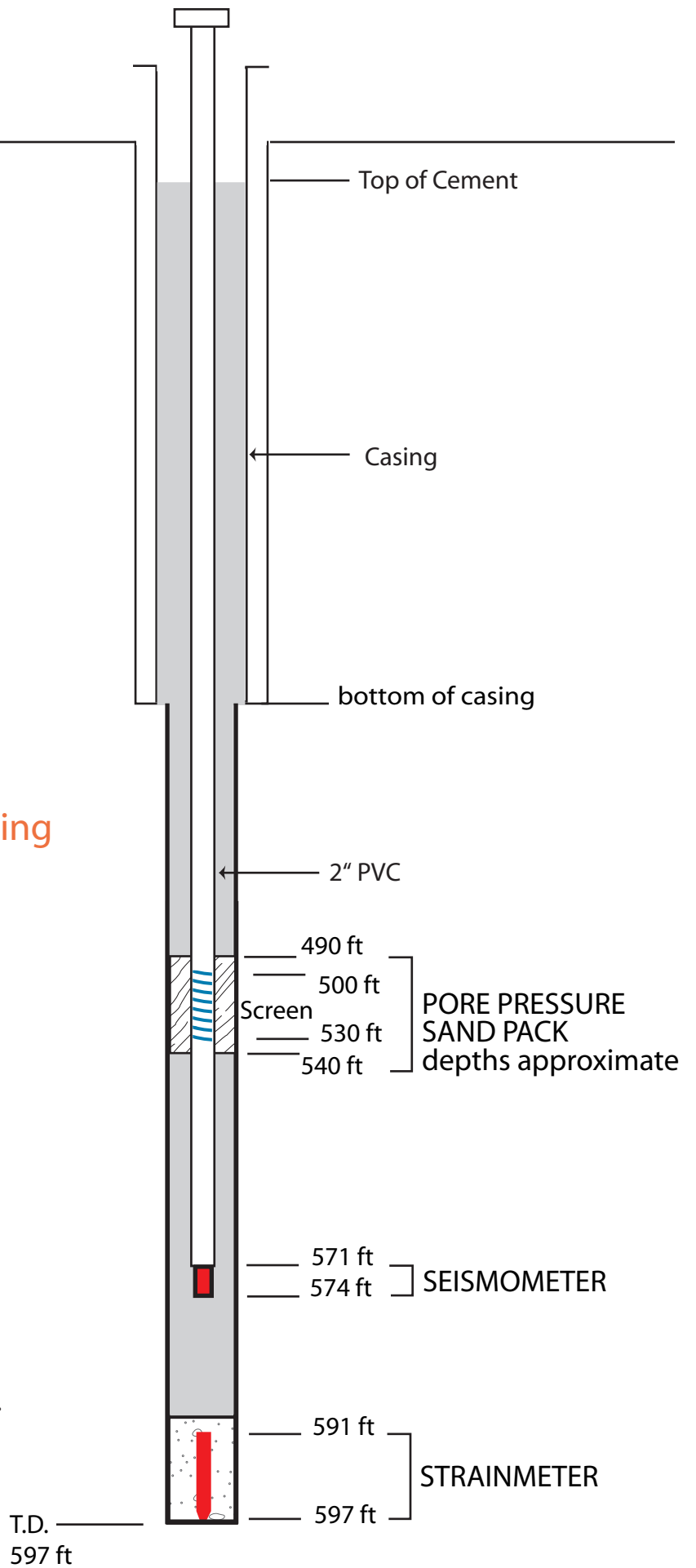
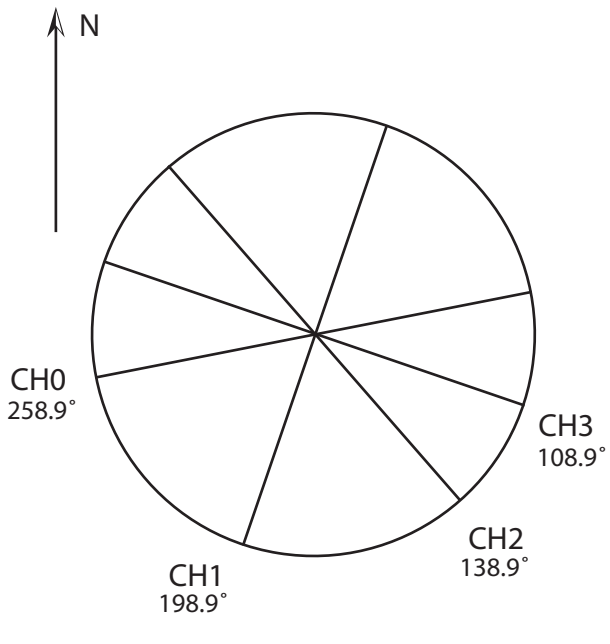


# B036 grants036bor2007

42.5058 --123.3817 315.3 m

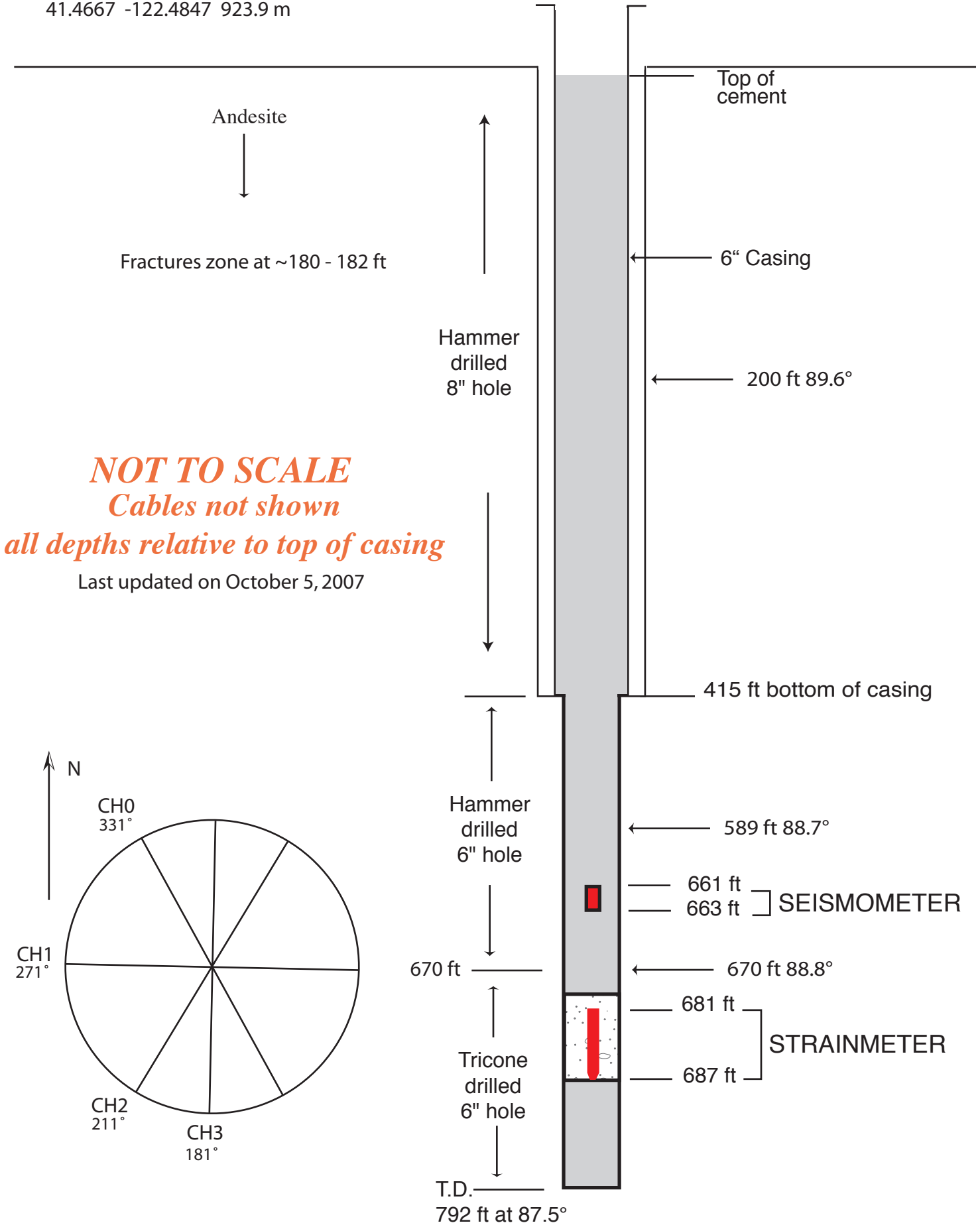
**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing

Last Updated 14 May 2007



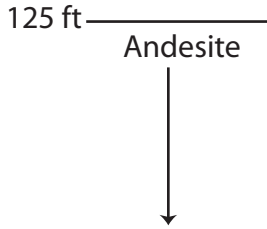
# B039 cofflt039bcn2007

41.4667 -122.4847 923.9 m



B040 yorkmn040bcn2007  
41.8308 -122.4205 783.5 m

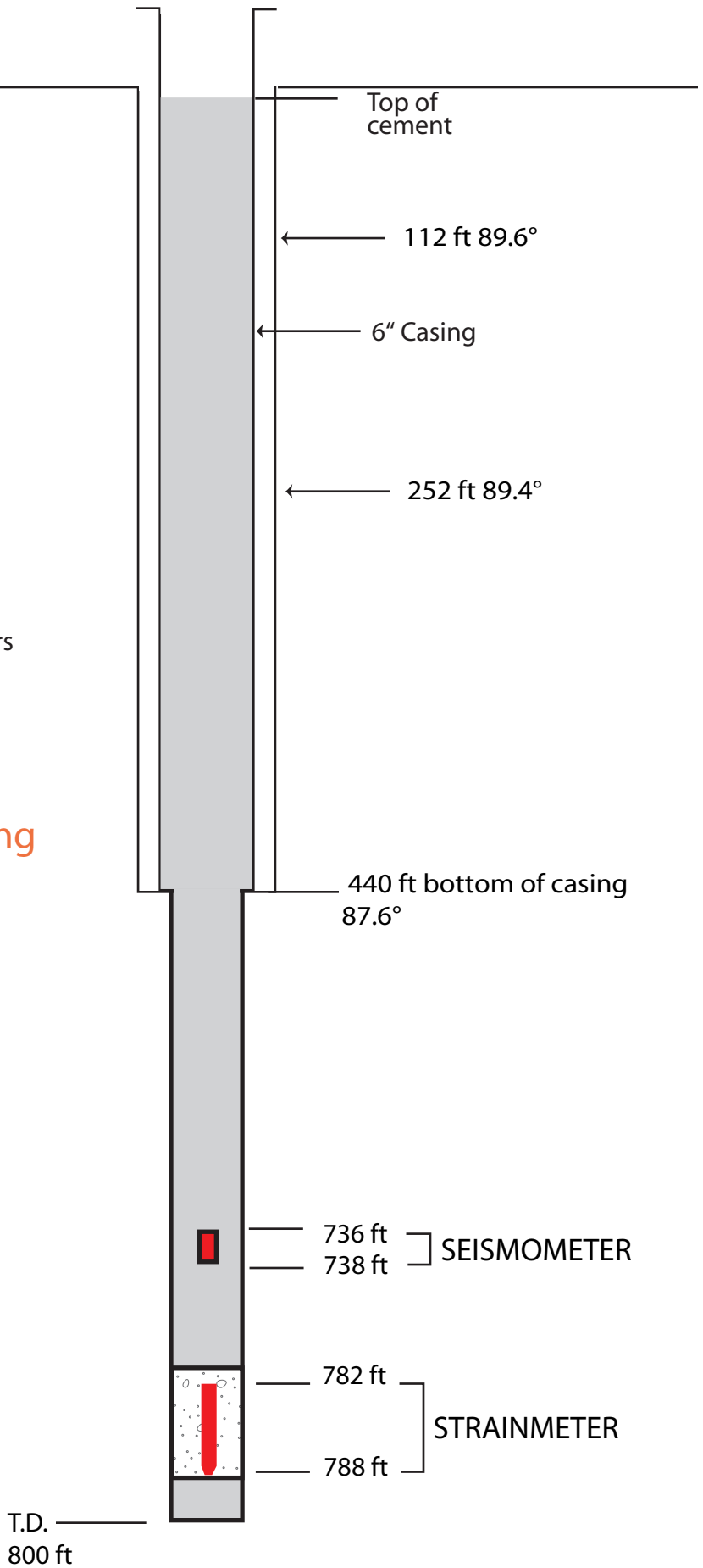
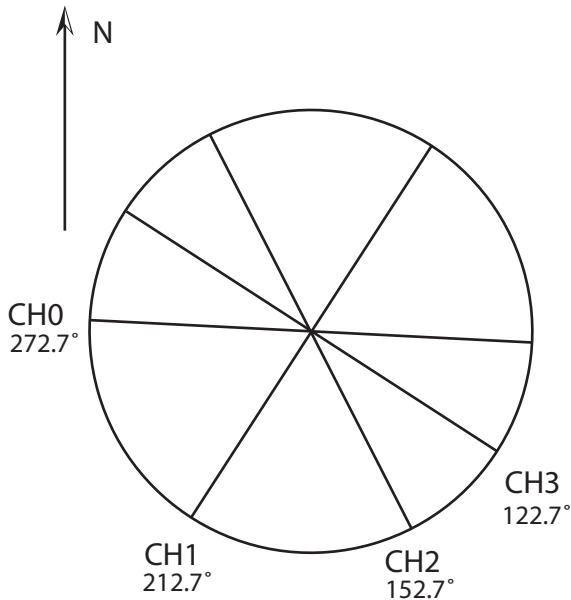
Tan sandstone, grey clay,  
and basalt fragments



300 ft & 333 ft - Brown clay layers

**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing

Last updated on October 17, 2007





# B045 rdcrst045bcn2008

40.4360 -123.9965 29.4 m

150 ft - Still in medium gray silstone with some fine sand-sized clasts.

249 ft - Small fracture.

327 - 332 ft - harder dark gray shale.  
332 ft - back into siltstone

380 ft - Mudstone with shale interbeds.

410 ft - Silty claystone.

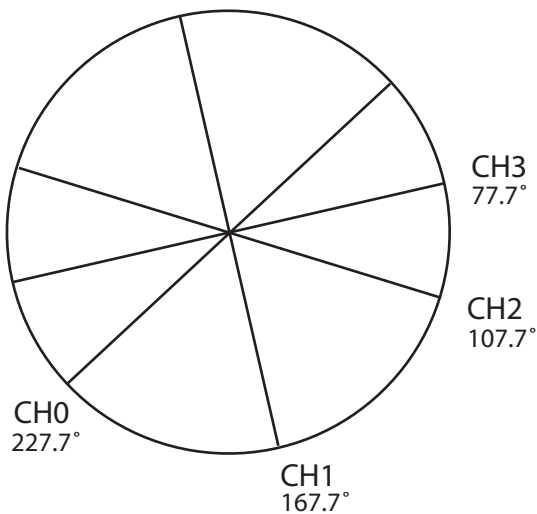
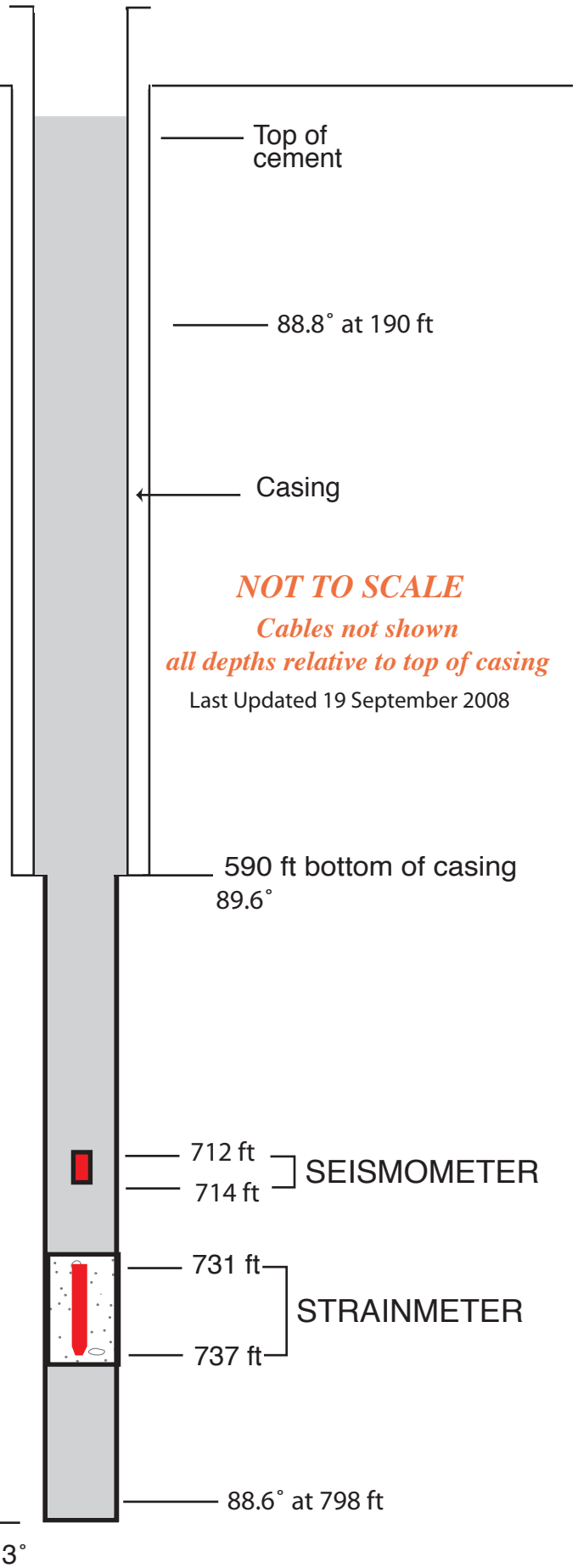
470 ft - Mudstone with traces of shale.

500 ft - Mudstone with shale beds.

510 ft - Mudstone with trace shale.

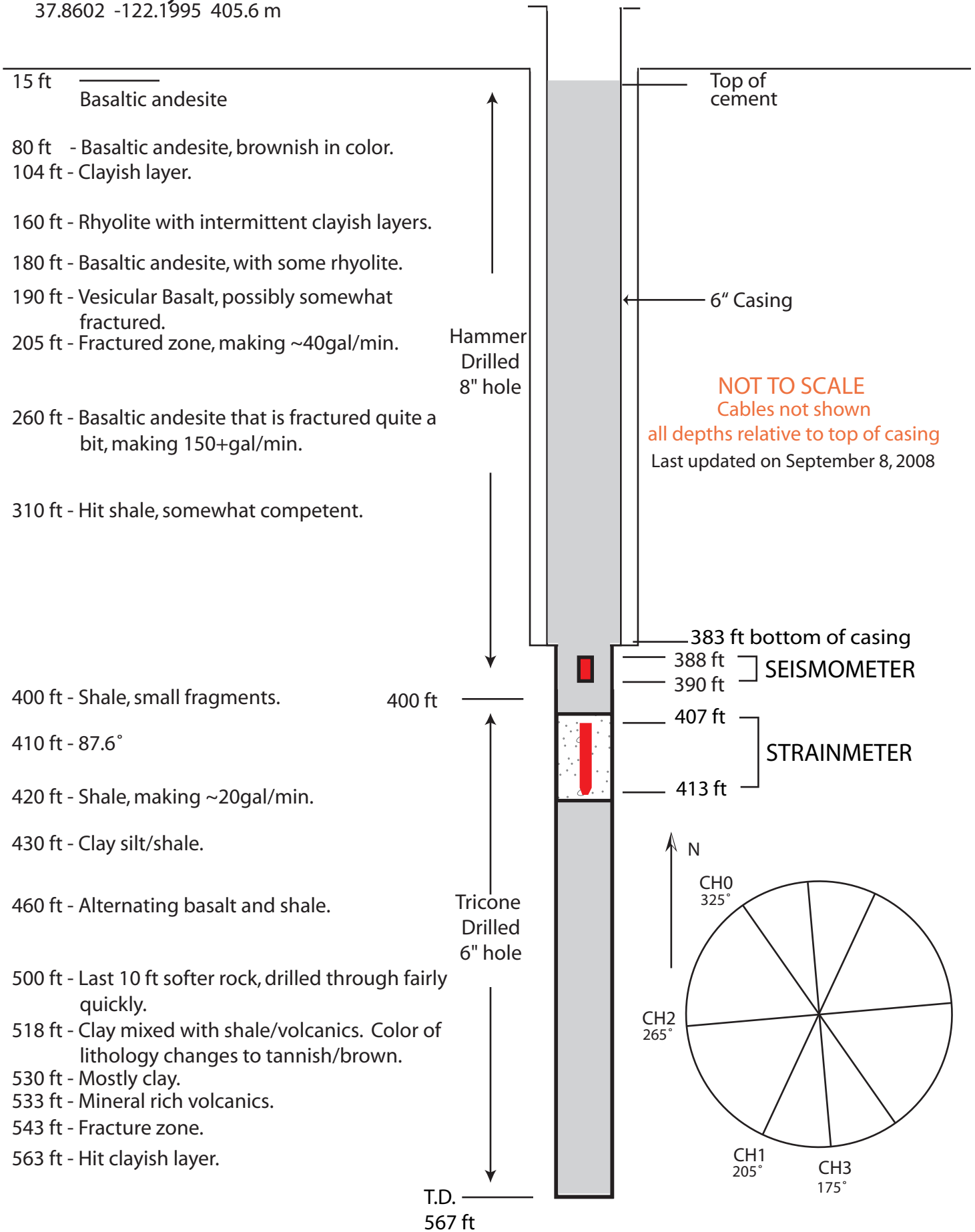
590 ft - Shale/lithified siltstone.

804 ft - Mudstone/Siltstone

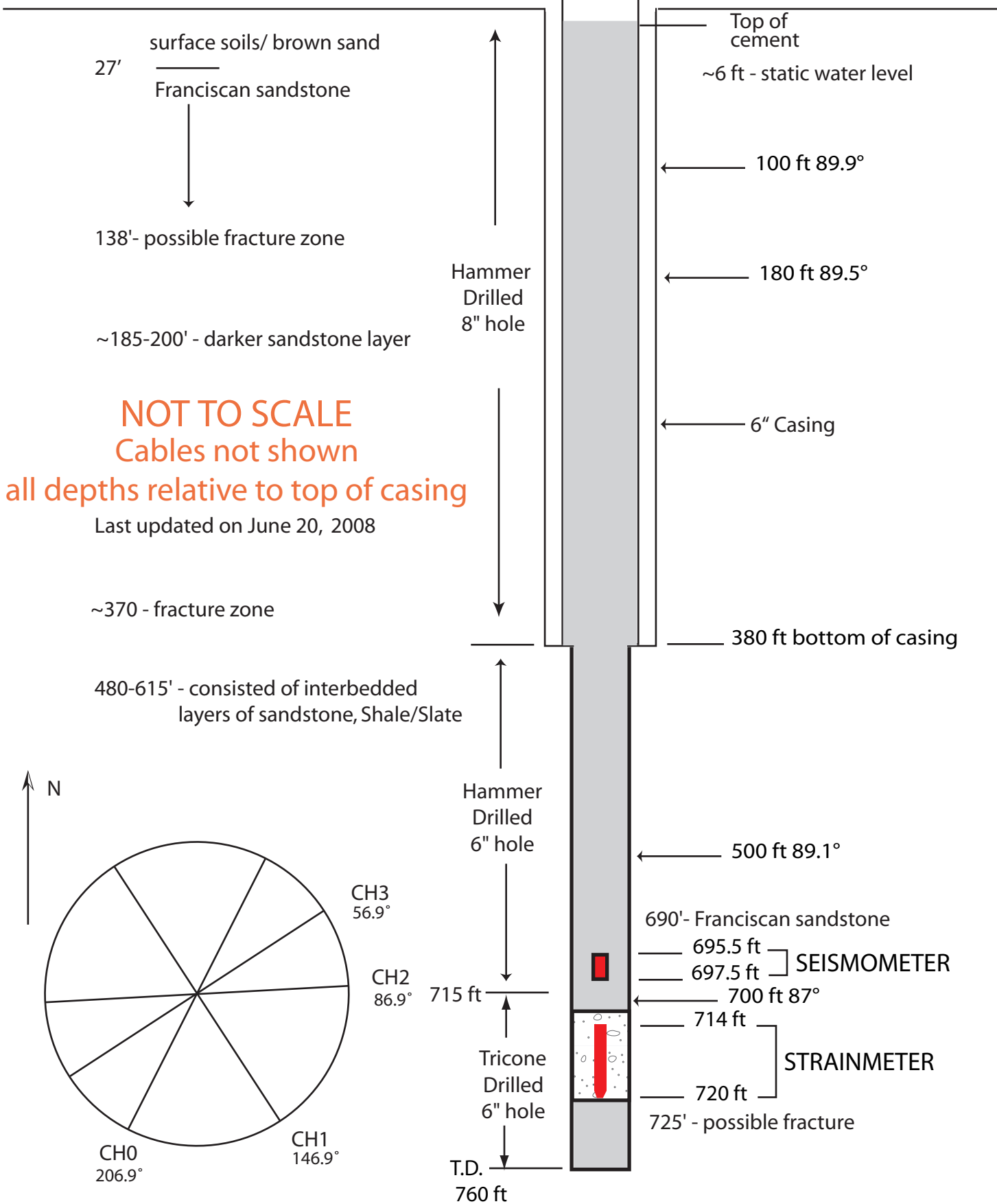


# B054 sibley054bcn2008

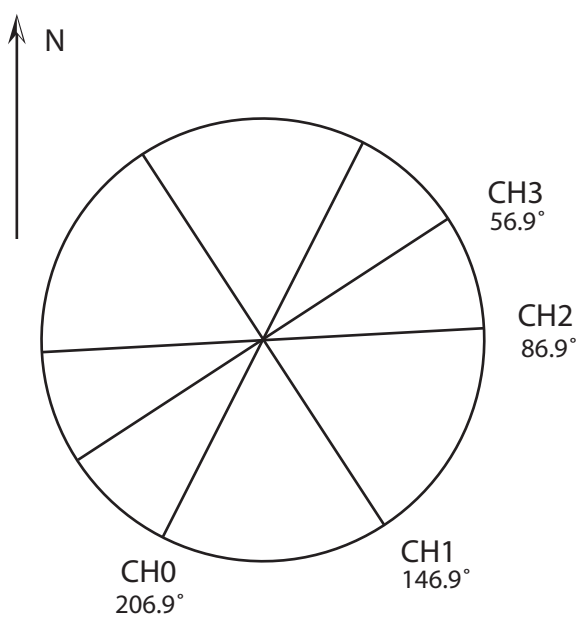
37.8602 -122.1995 405.6 m



**B057 lucasv057bcn2008**  
 46.1112 -123.0787 177.4 m



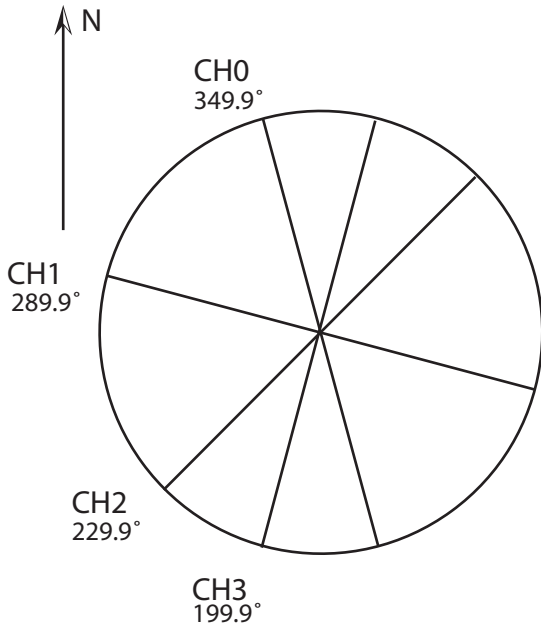
**NOT TO SCALE**  
**Cables not shown**  
**all depths relative to top of casing**  
 Last updated on June 20, 2008



# B058 sjgrad058bcn2007

36.7995 -121.5808 114.2 m

Lithology: Grano-diorite



**NOT TO SCALE**

*Cables not shown*

*all depths relative to top of casing*

Last Updated 14 August 2010

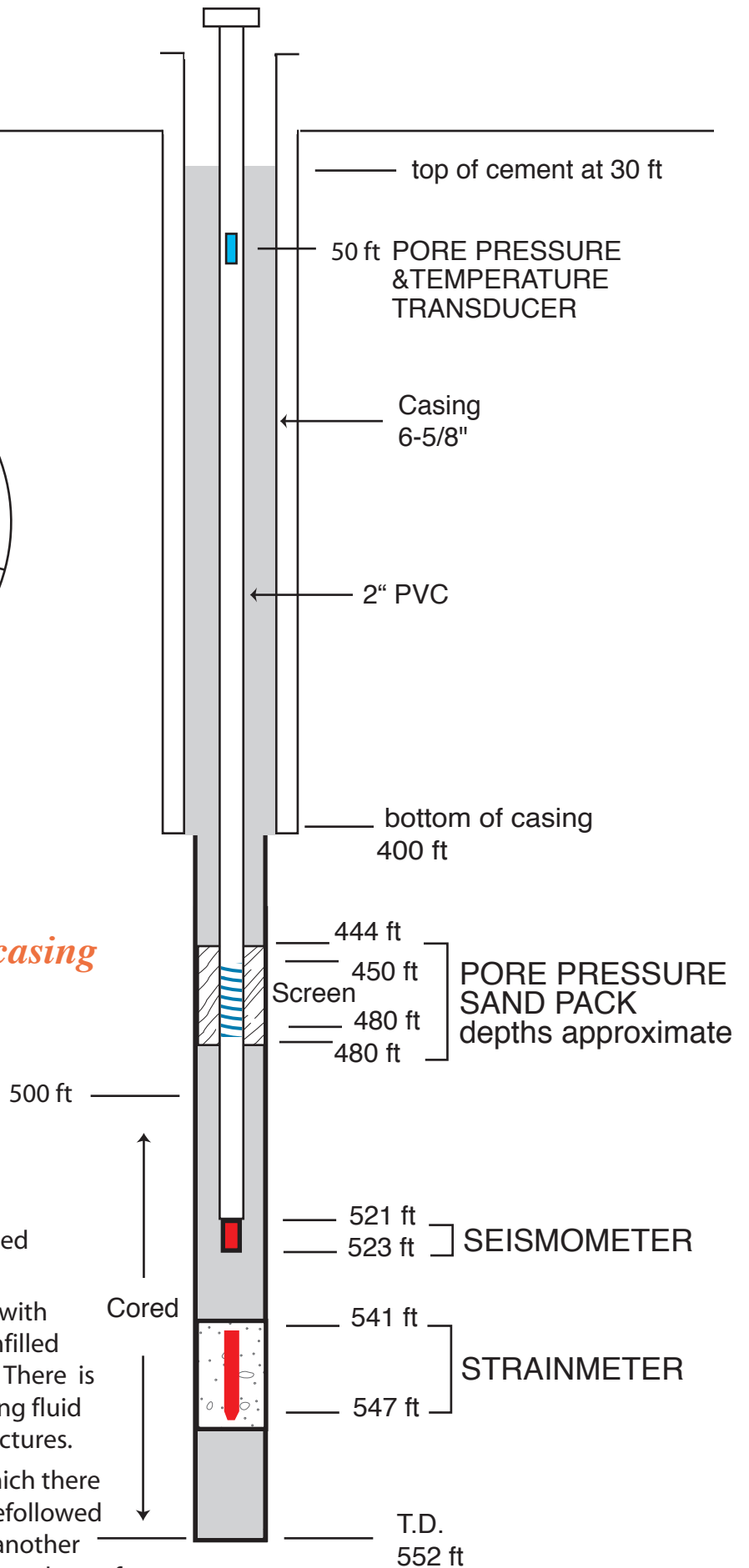
505 to 520 ft - Hydrothermal alterations of grano-diorite along fractures

520 to 535 ft - Fractures

536 ft - Fracture infilled with a fine-grained sandy clay, green in color.

536 to 541 ft - Four fractures, three lines with hydrothermally altered minerals. One infilled with 1/10 cm of white clay-like material. There is also a 10 inch segment of minerals infilling fluid paths, rock did not break along these fractures.

541 - 551 ft - Fractures have zones in which there is a fracture with a smooth green surface followed by 1" of shattered rock, and then below another fracture with smooth green mineralized on the surface.



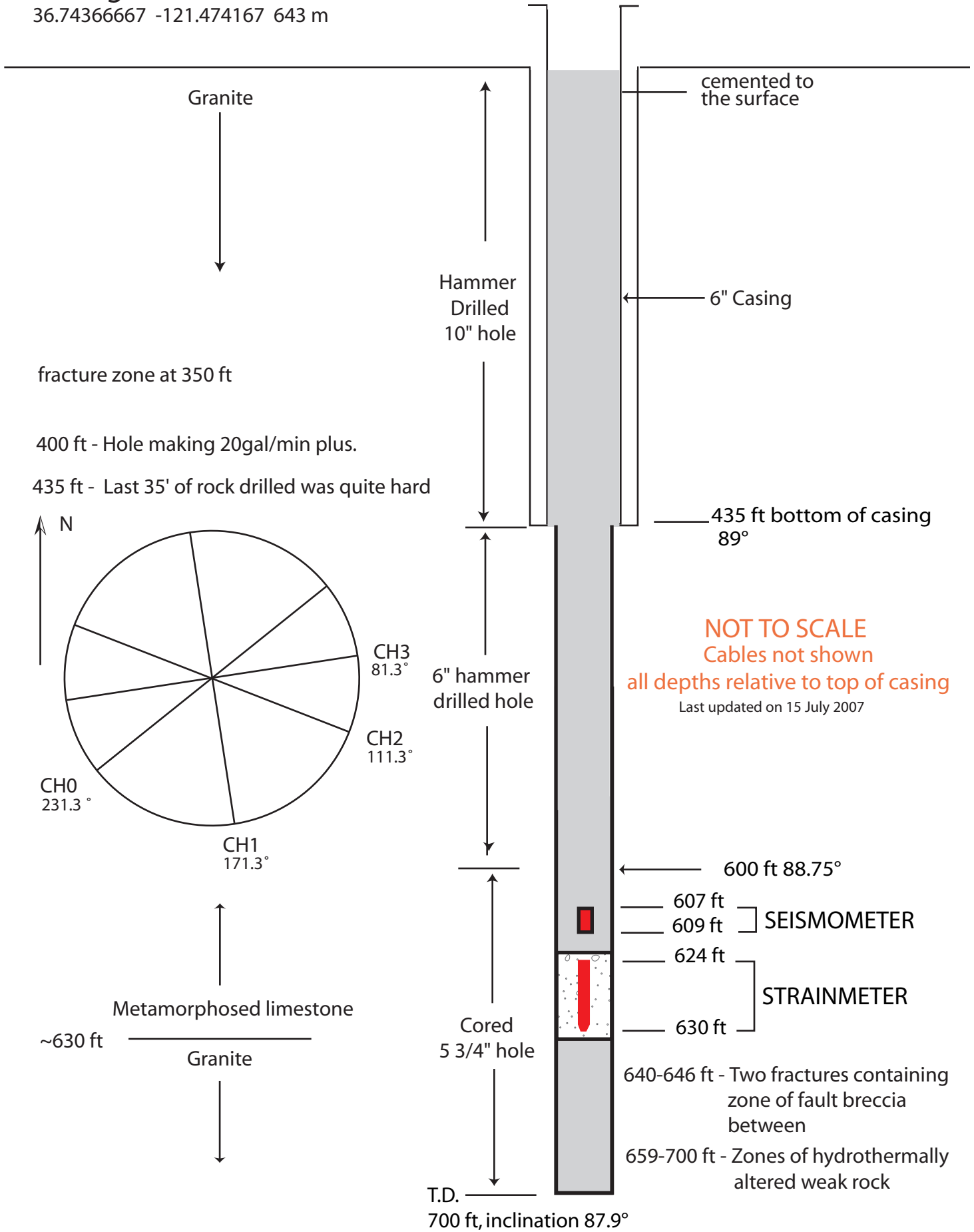
500 ft

Cored

T.D.  
552 ft

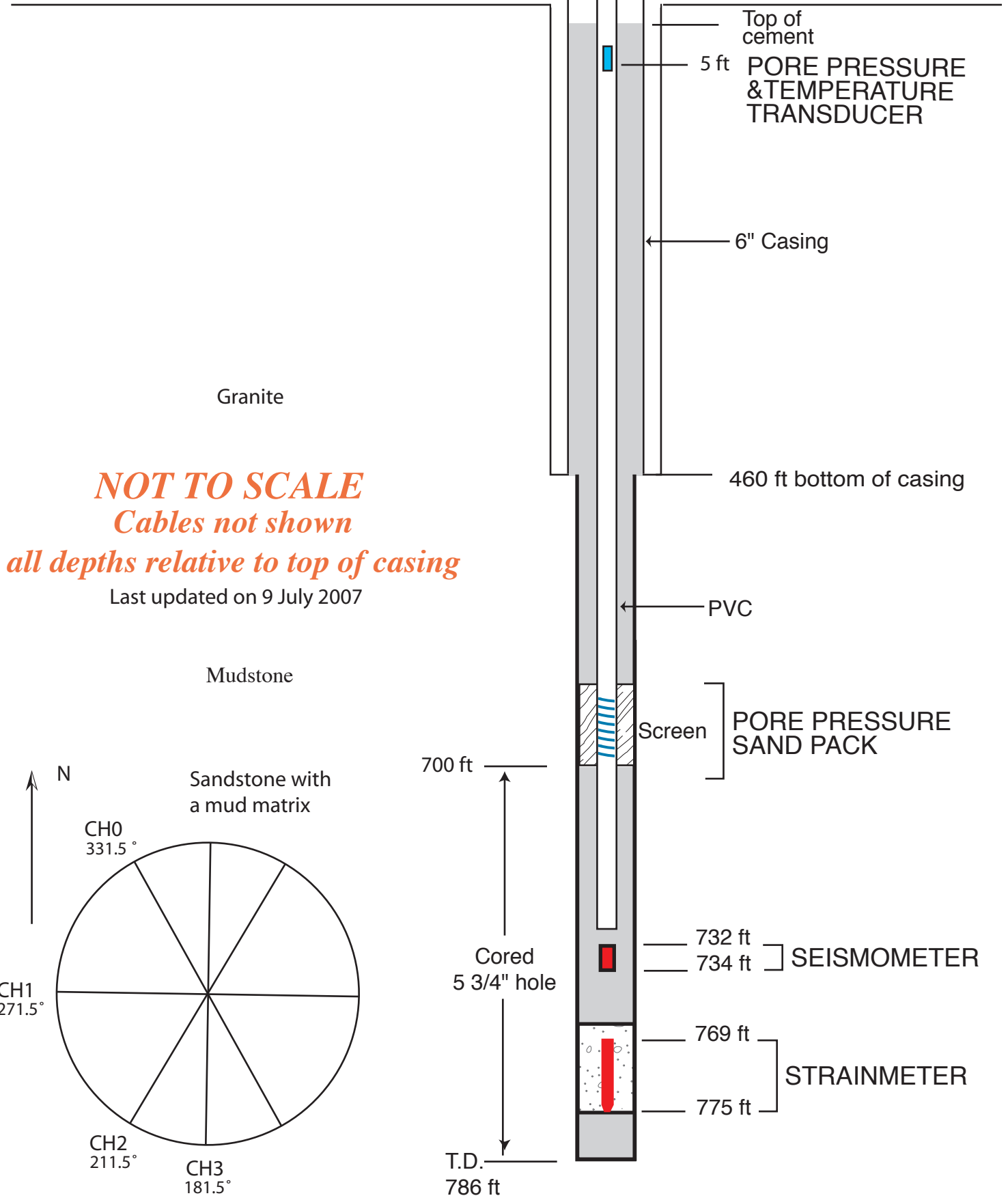
# B065 gabiln065bcn2007

36.74366667 -121.474167 643 m



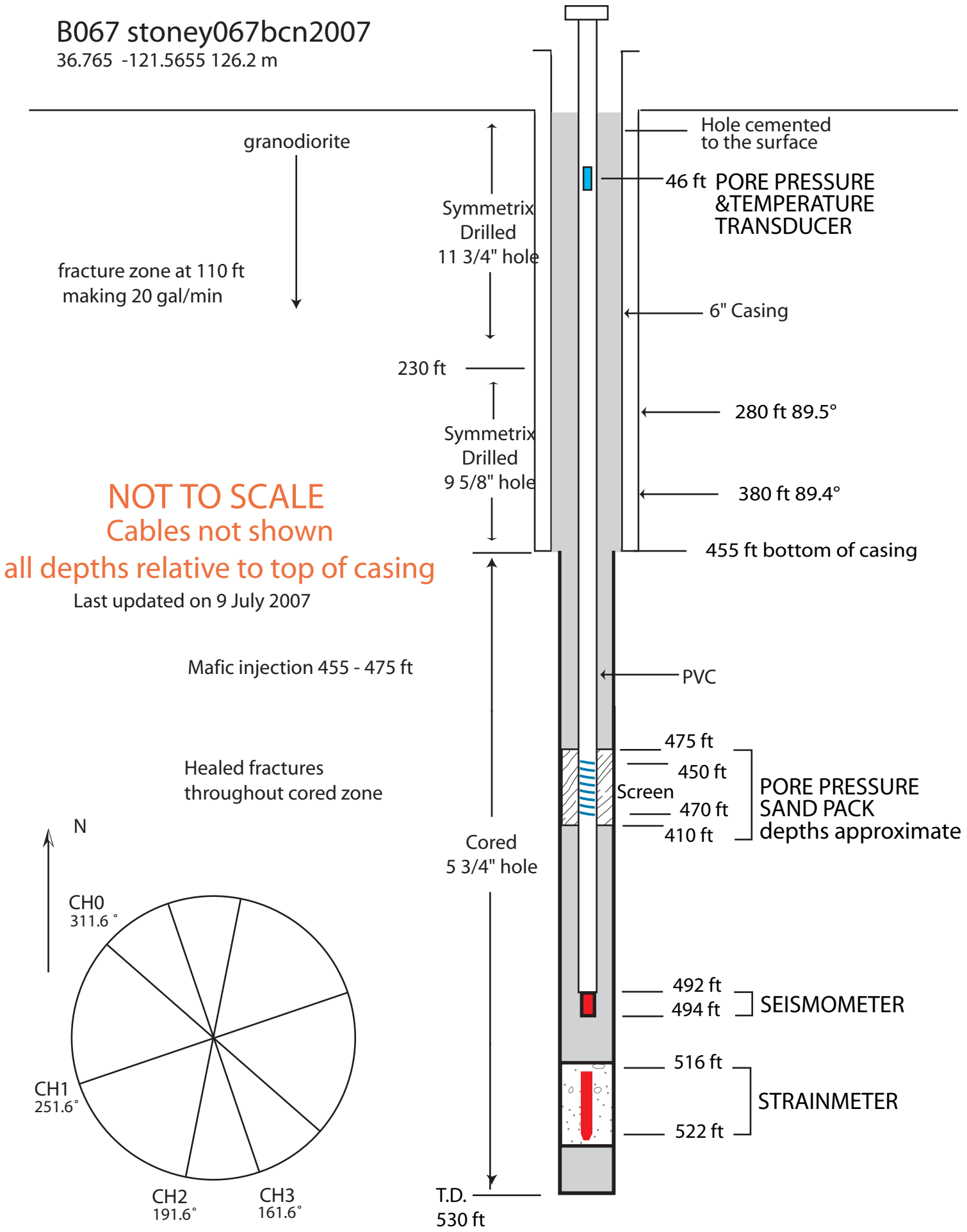
# B066 rockrd066bcn2007

36.857333 -121.592167 67 m



# B067 stoney067bcn2007

36.765 -121.5655 126.2 m

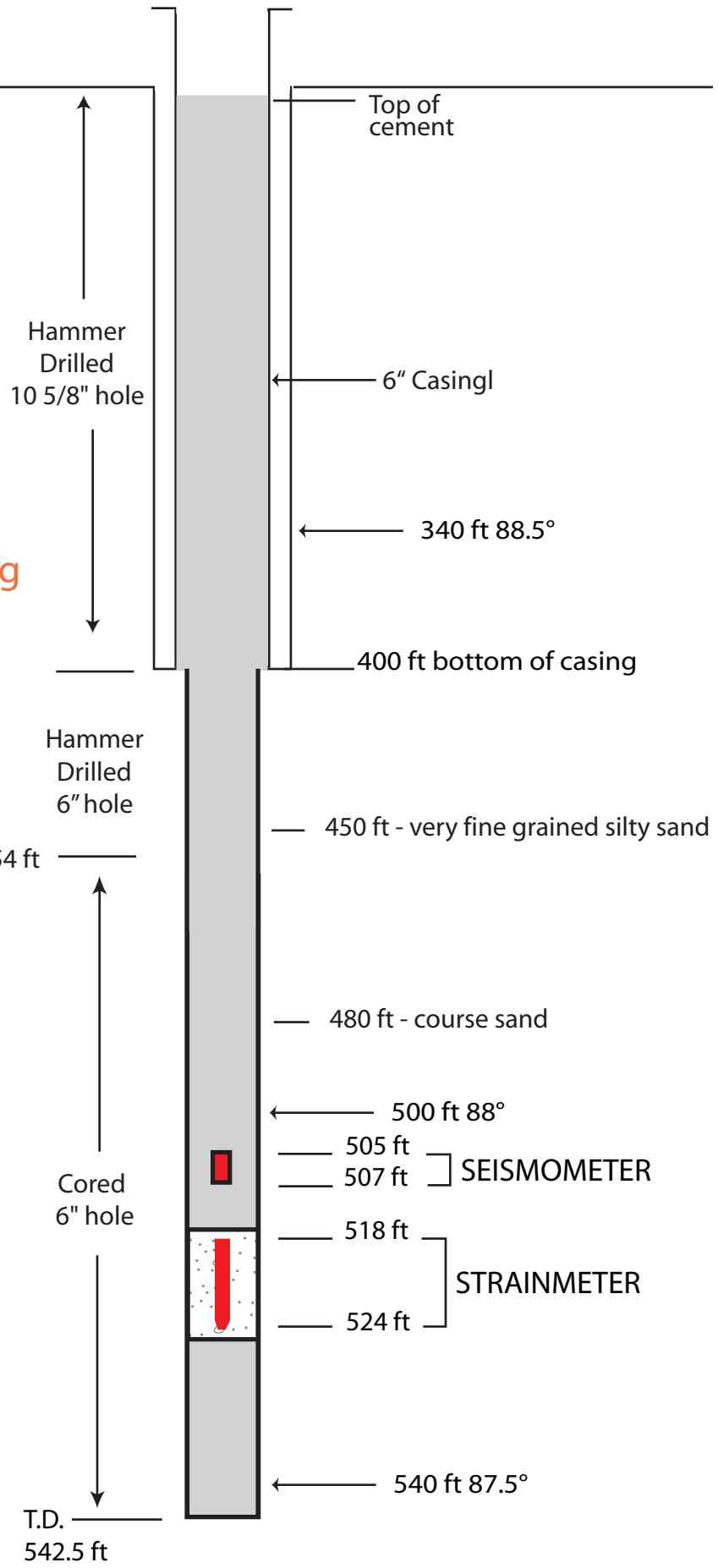


# B072 goldhl072bcn2007

35.831 - 120.345 397.7 m

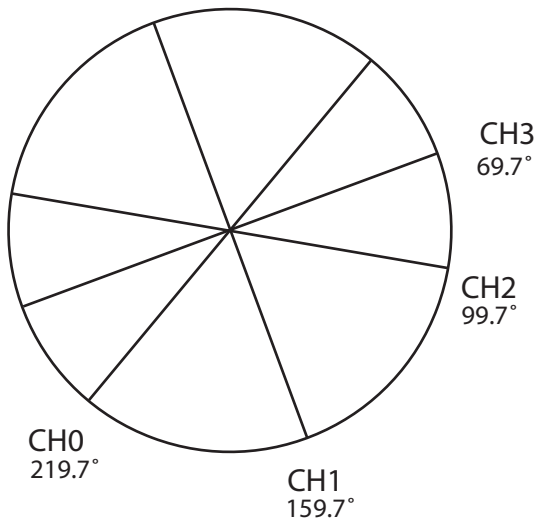
Granite  
↓

**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing  
Last updated on August 24, 2007



weathered granite  
wackestone/mudstone/ breccia  
↓

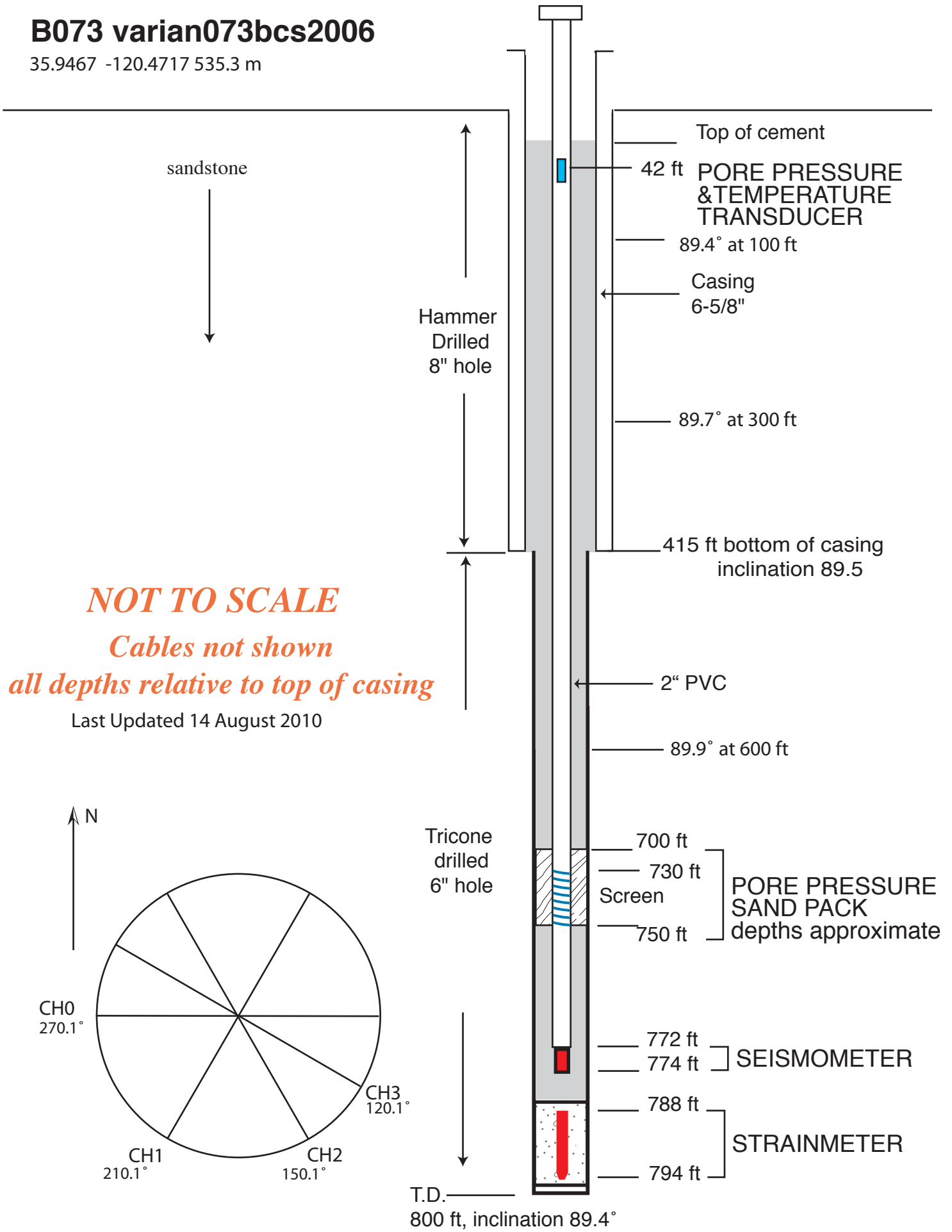
N  
↑





# B073 varian073bcs2006

35.9467 -120.4717 535.3 m



**NOT TO SCALE**

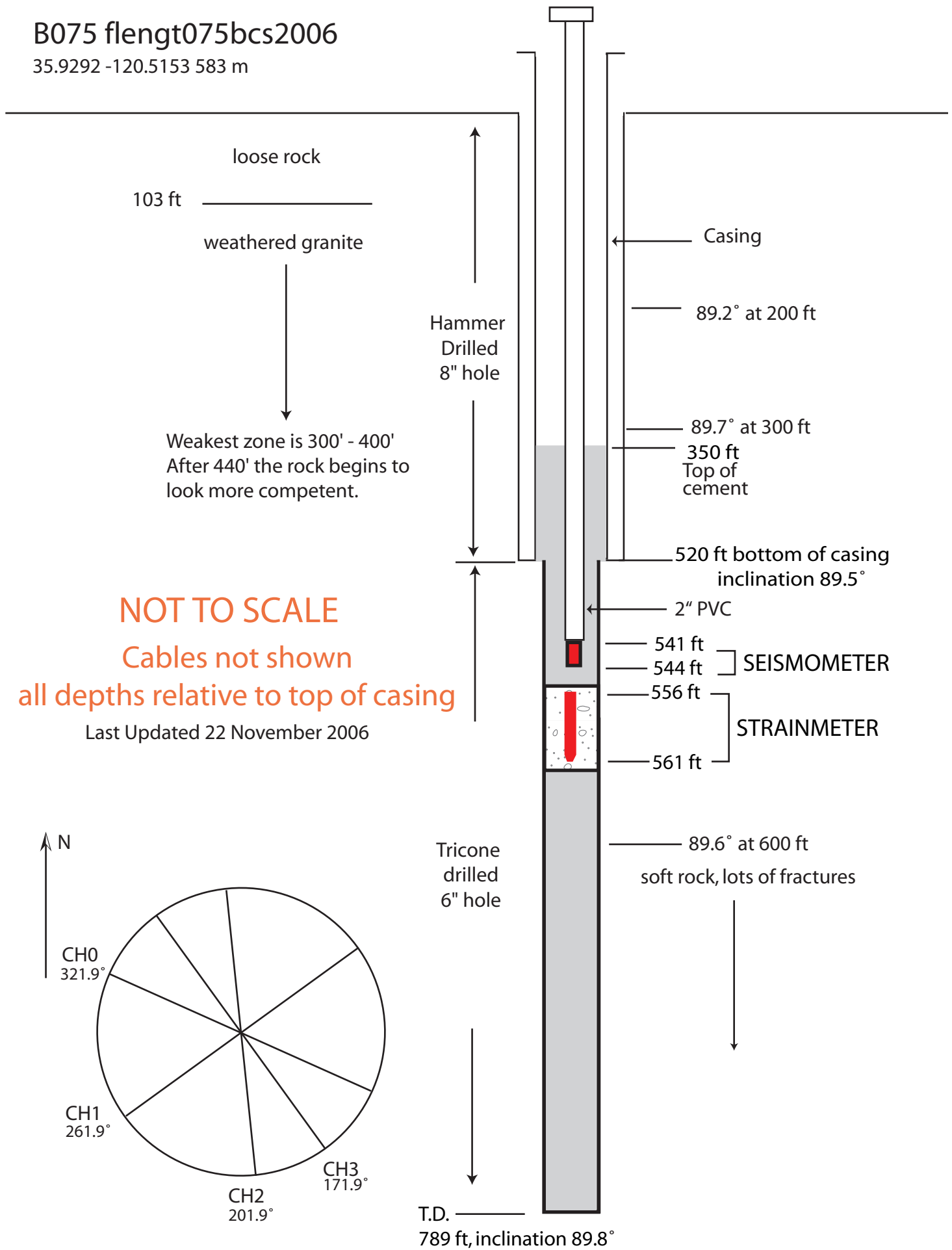
*Cables not shown*

*all depths relative to top of casing*

Last Updated 14 August 2010

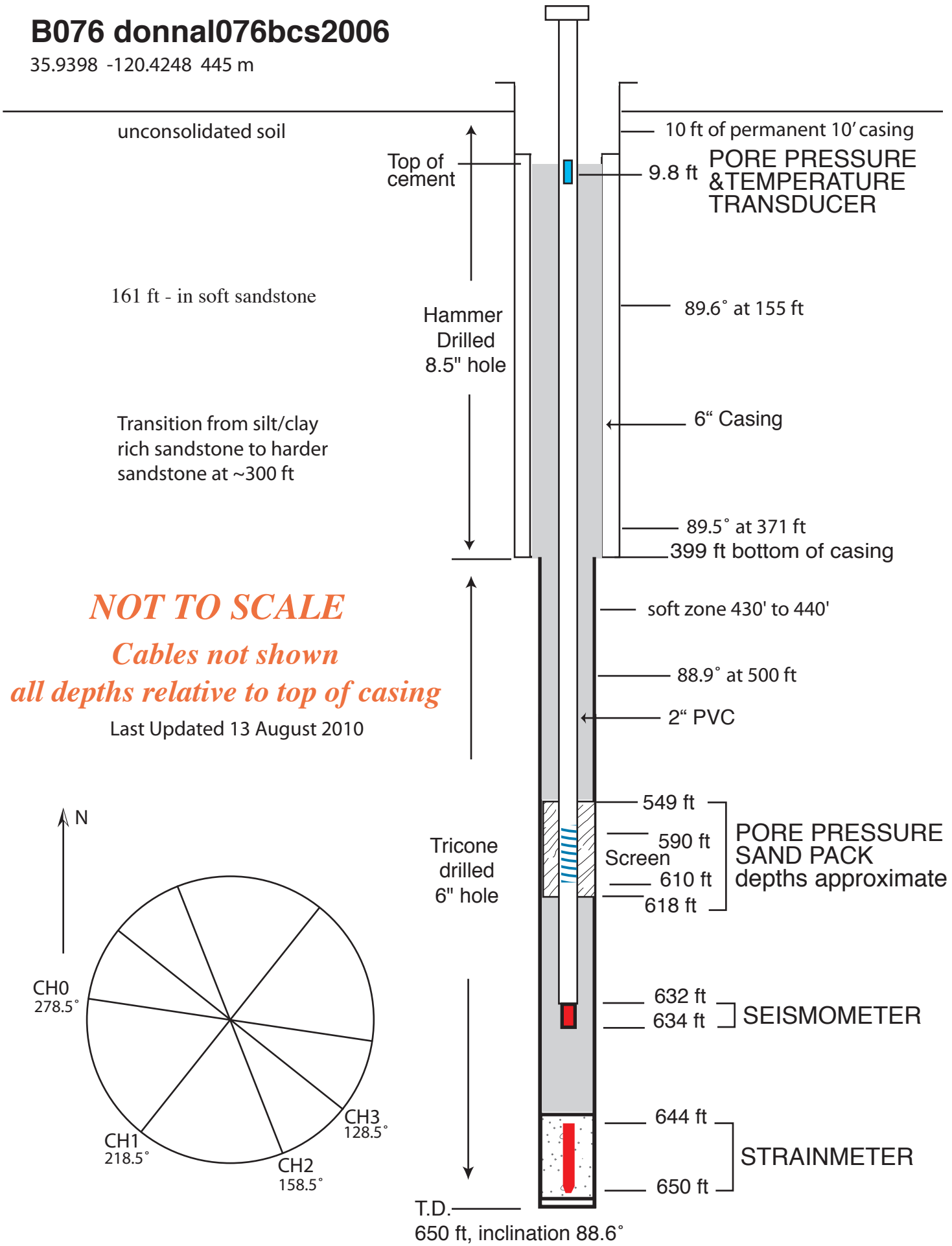
# B075 flengt075bcs2006

35.9292 -120.5153 583 m



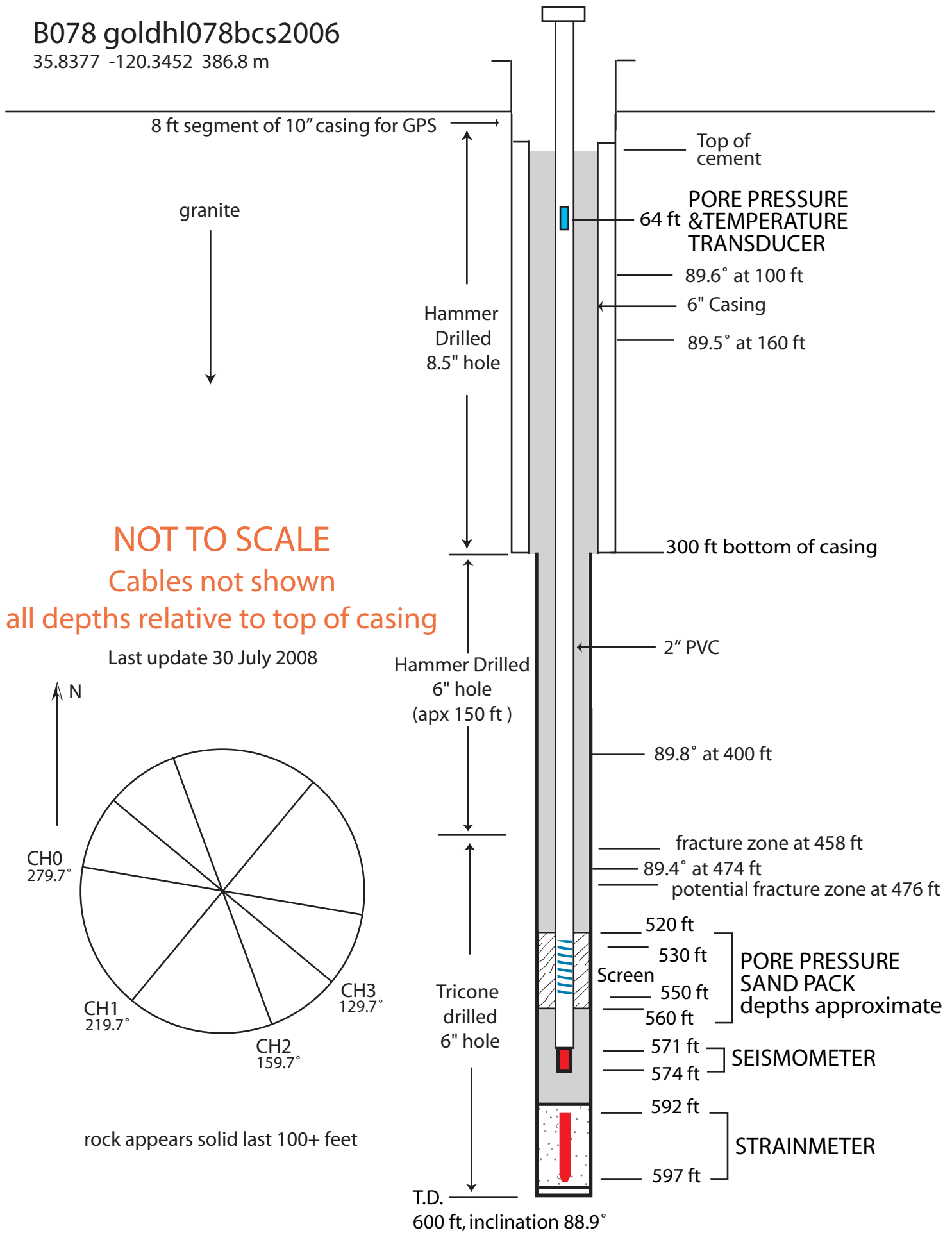
# B076 donnal076bcs2006

35.9398 -120.4248 445 m



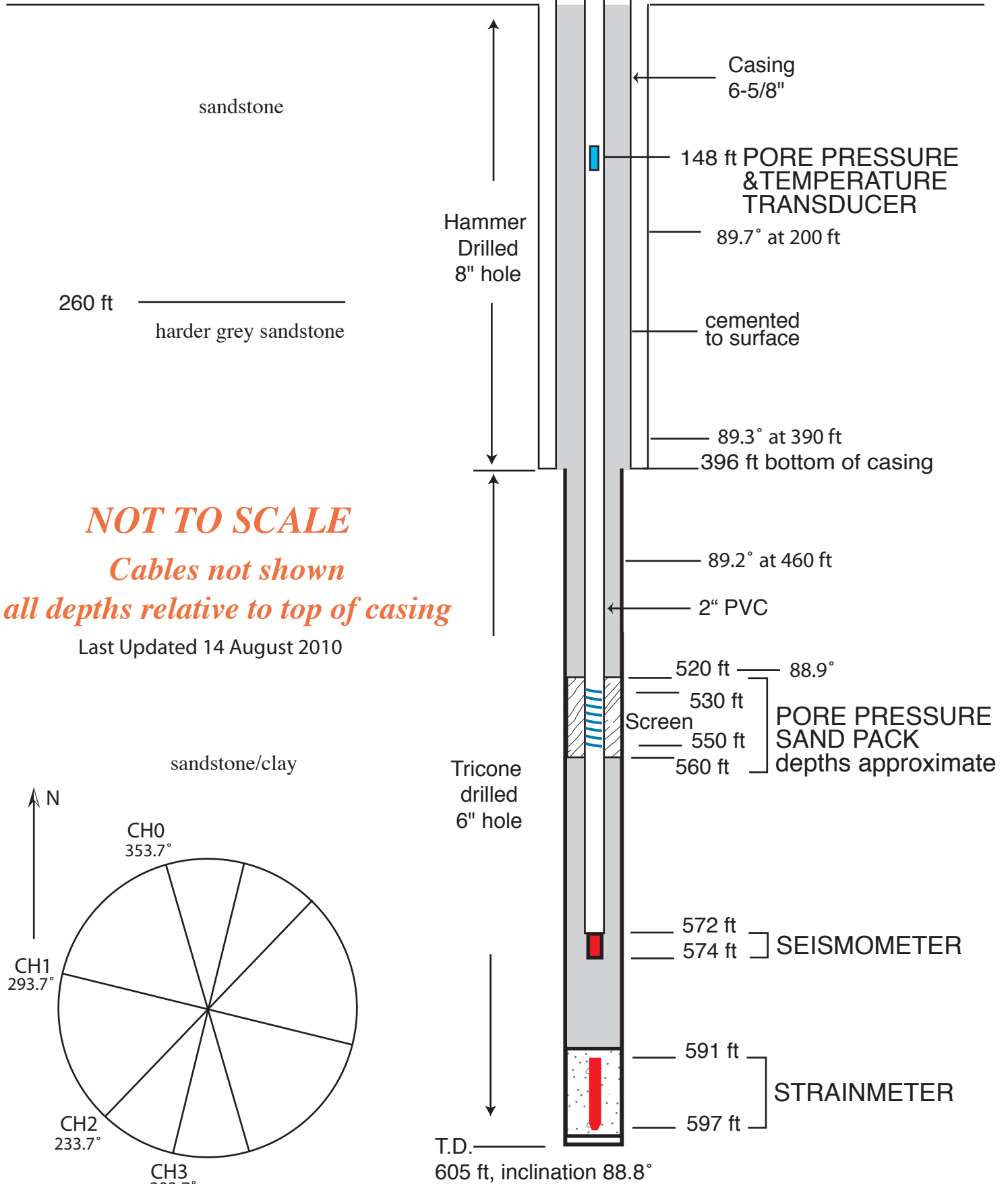
# B078 goldhl078bcs2006

35.8377 -120.3452 386.8 m



# B079 jackcn079bcs2006

35.7157 -120.2057 436.6 m



# B081 keenwi081bcs2006

33.713 -116.714 1467 m

Granitic

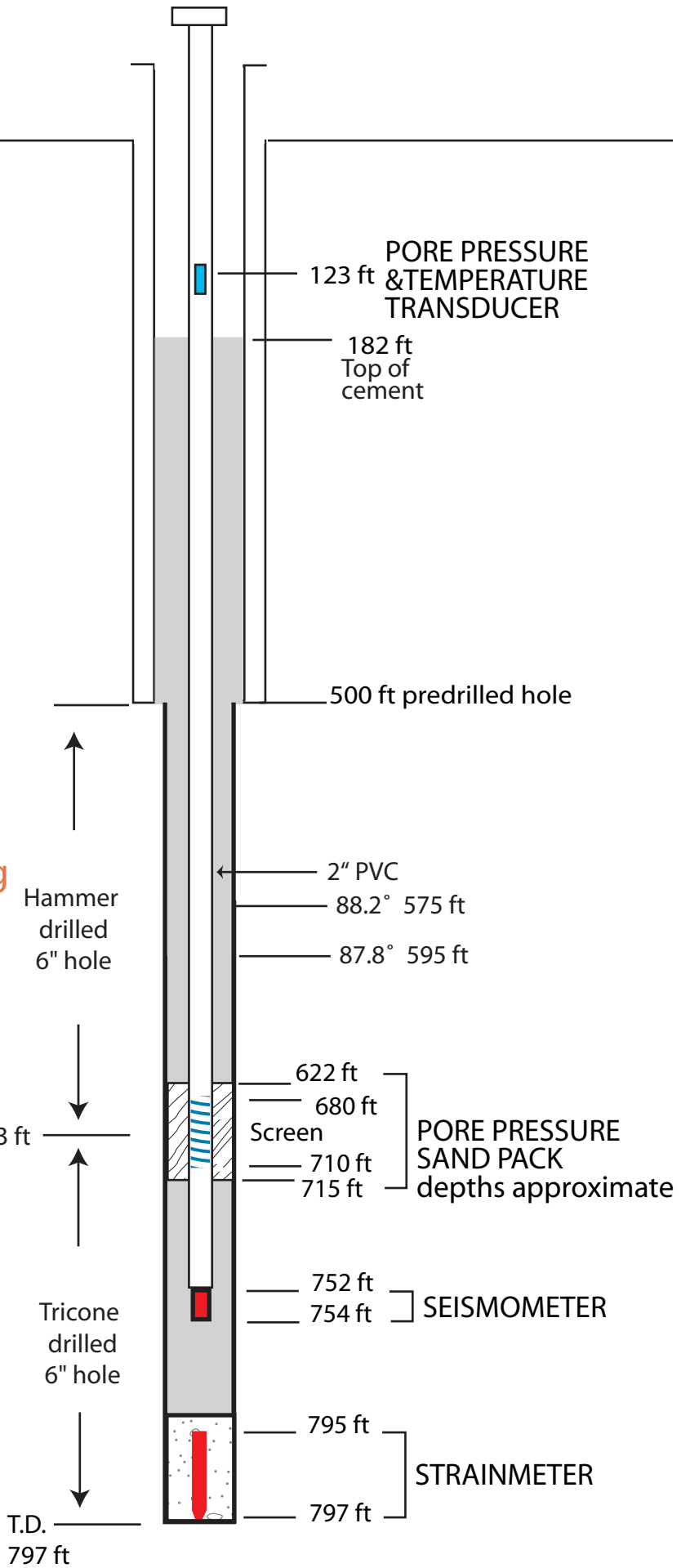
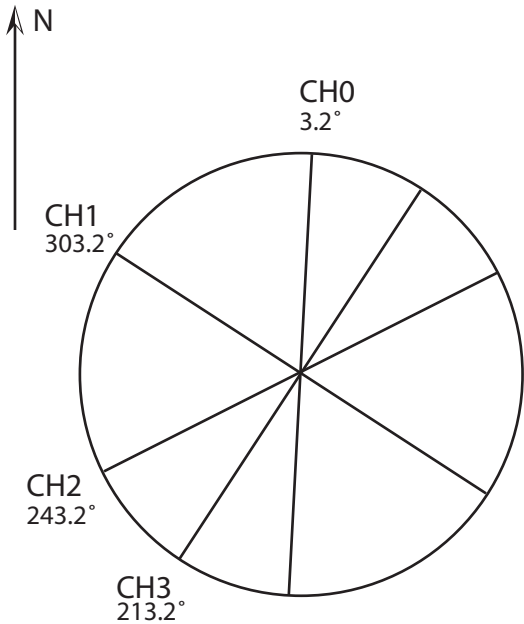


**NOT TO SCALE**

**Cables not shown**

**all depths relative to top of casing**

Last Updated 27 December 2006



# B082 pathfin82bcs2006

33.598182 -116.5960046 1374.84 m

Metamorphic  
Mostly Gneiss

~280 ft  
Quartz rich vein

8 1/2" Hammer  
Drilled Hole

6 ft  
Top of  
cement

74 ft  
PORE PRESSURE  
& TEMPERATURE  
TRANSDUCER

6" casing

89.4° at 318 ft

89.1° at 328 ft

580 ft bottom of casing

**NOT TO SCALE**

*Cables not shown*

*all depths relative to top of casing*

Last Updated 14 August 2010

Hammer  
drilled  
6" hole

2" PVC

86.7° 550 ft

560 ft 86.4° 560 ft

620 ft  
Screen  
625 ft  
640 ft  
PORE PRESSURE  
SAND PACK  
depths approximate

86.2° 687 ft

86.0° 707 ft

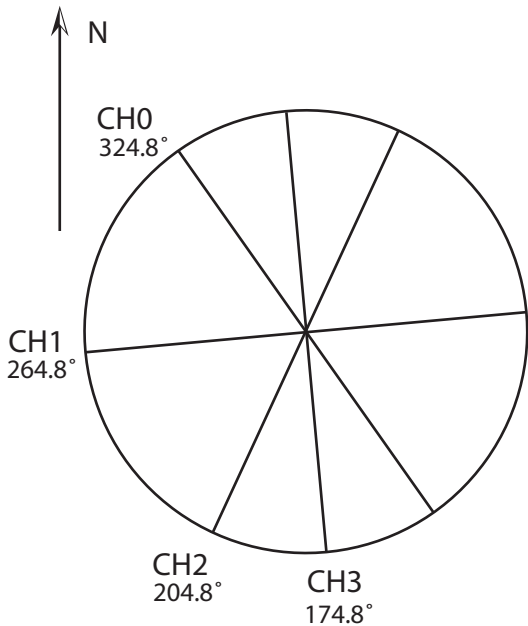
722 ft  
724 ft  
SEISMOMETER

790 ft  
796 ft  
STRAINMETER

707 ft

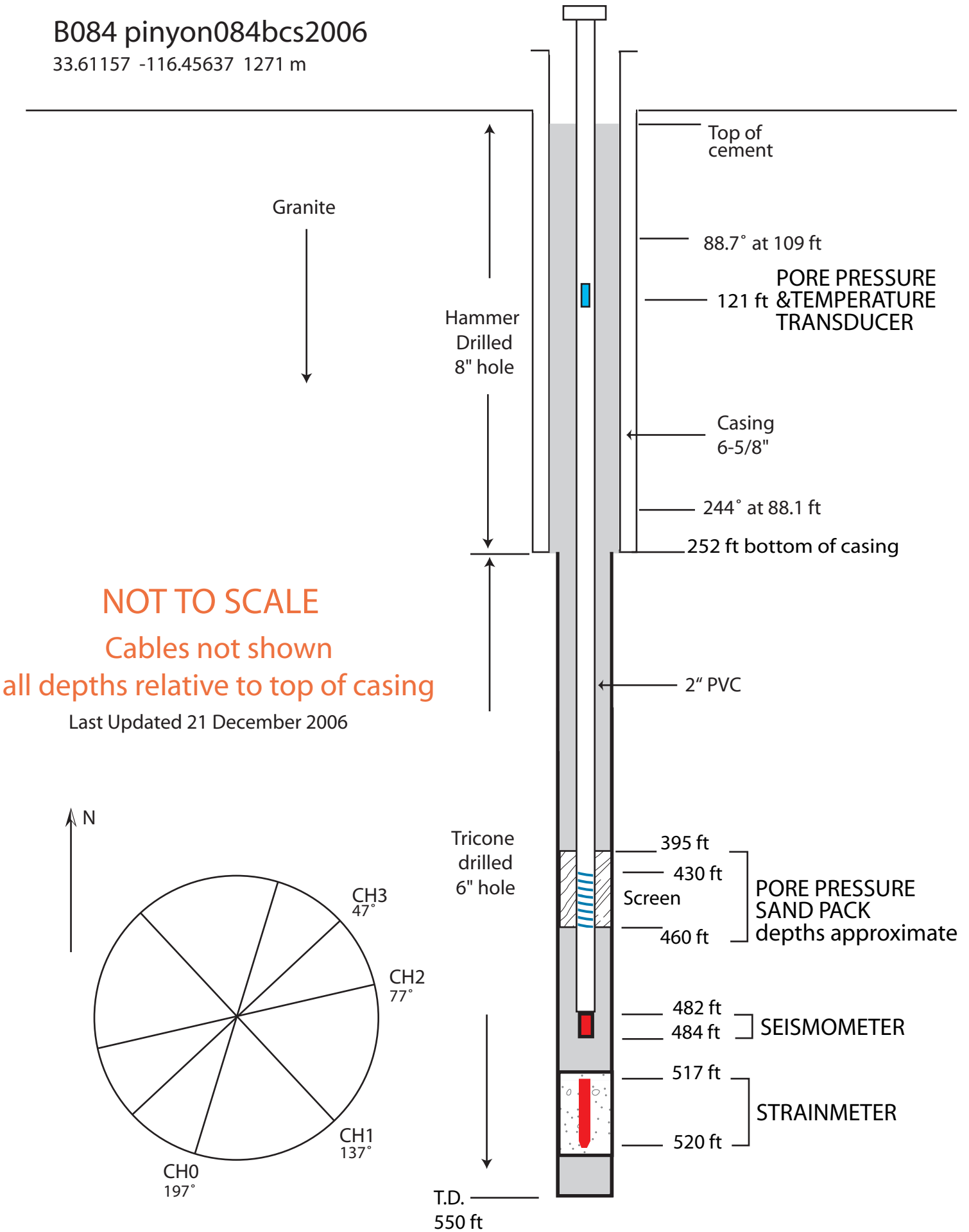
Tricone  
drilled  
6" hole

T.D.  
798 ft 85.7° 687 ft



# B084 pinyon084bcs2006

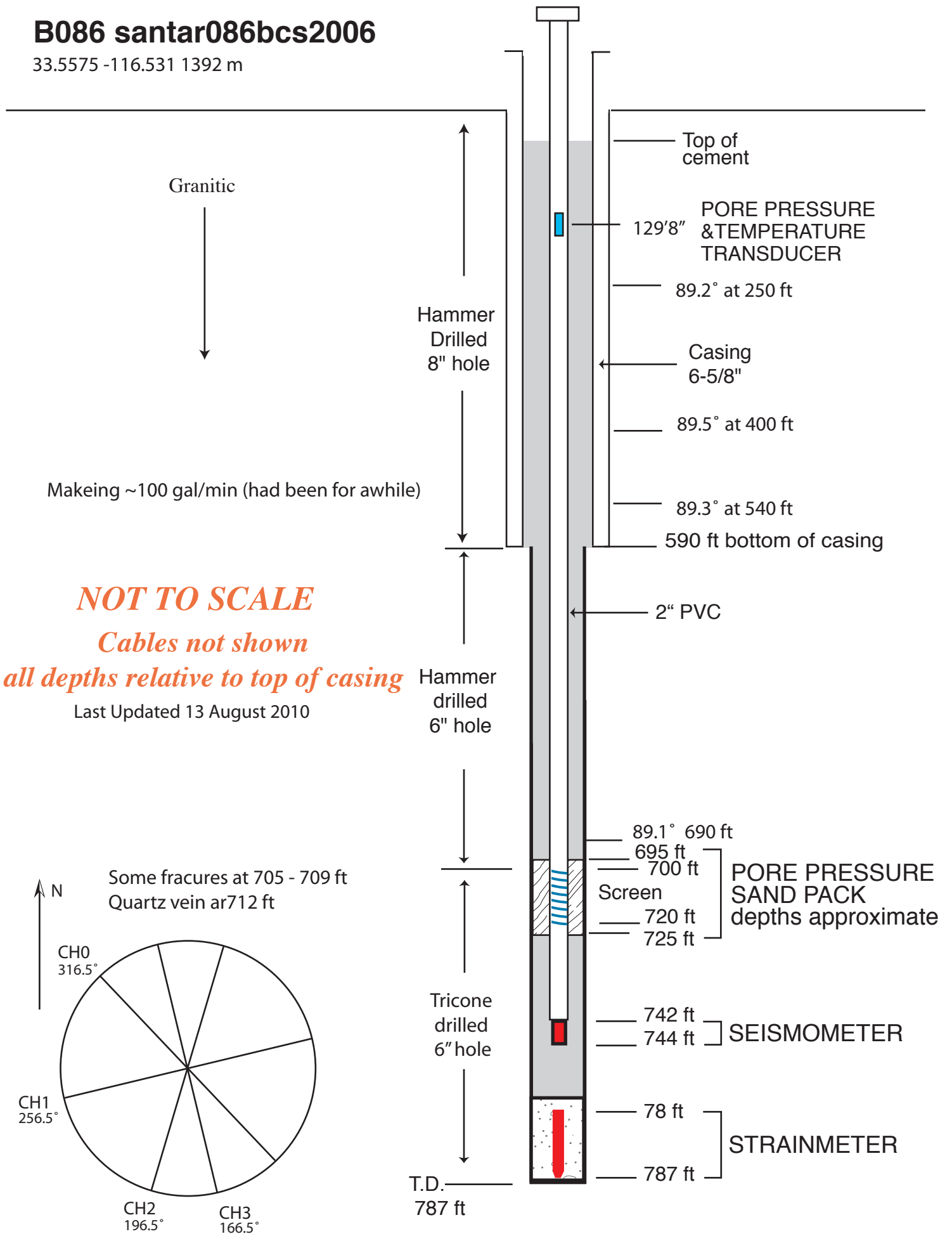
33.61157 -116.45637 1271 m





# B086 santar086bcs2006

33.5575 -116.531 1392 m



# B087 fordra087bcs2006

33.4955 -116.6027 1139 m

granite



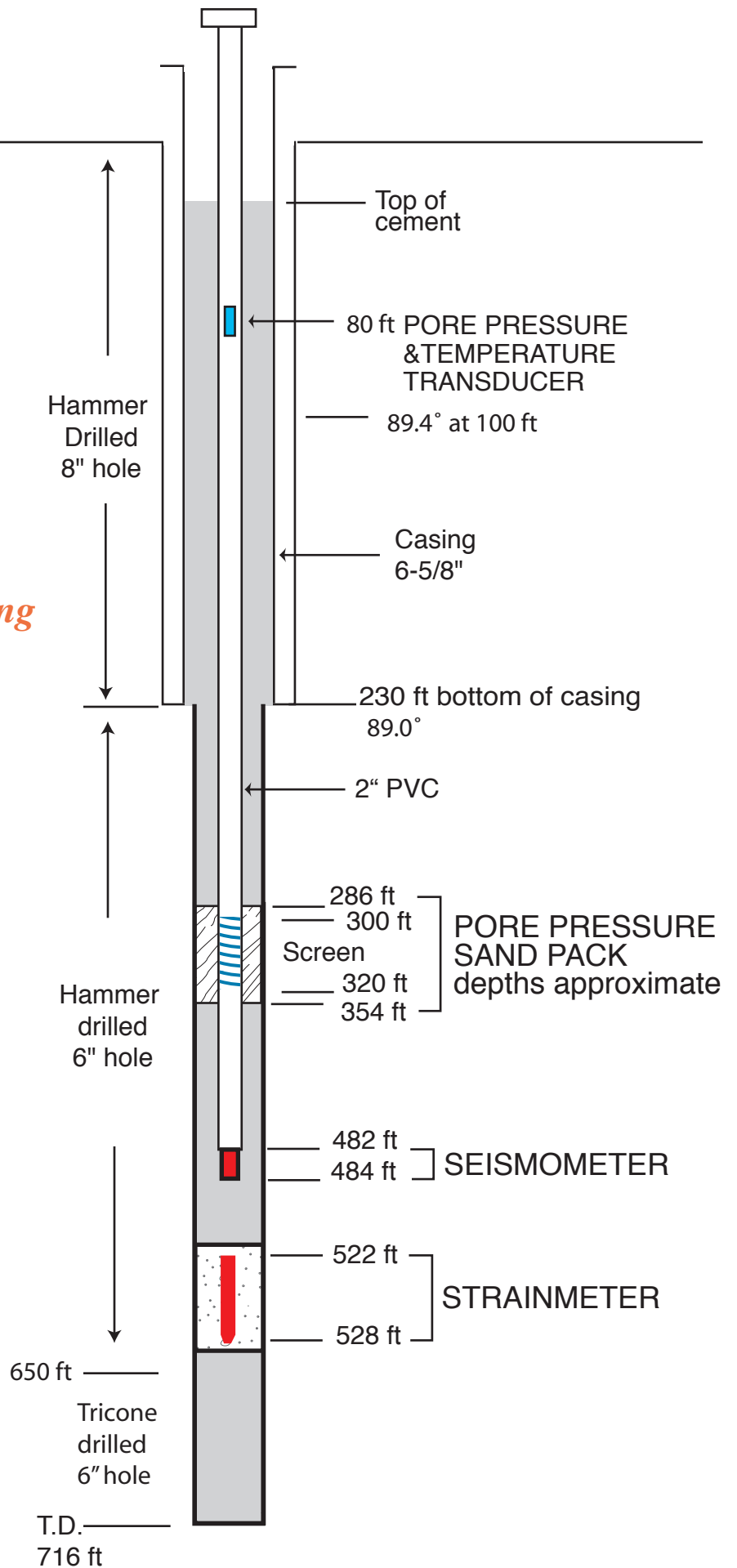
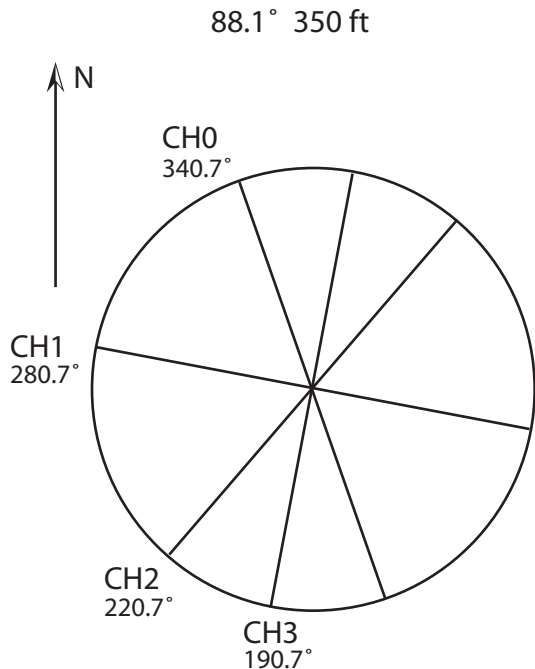
**NOT TO SCALE**

*Cables not shown*

*all depths relative to top of casing*

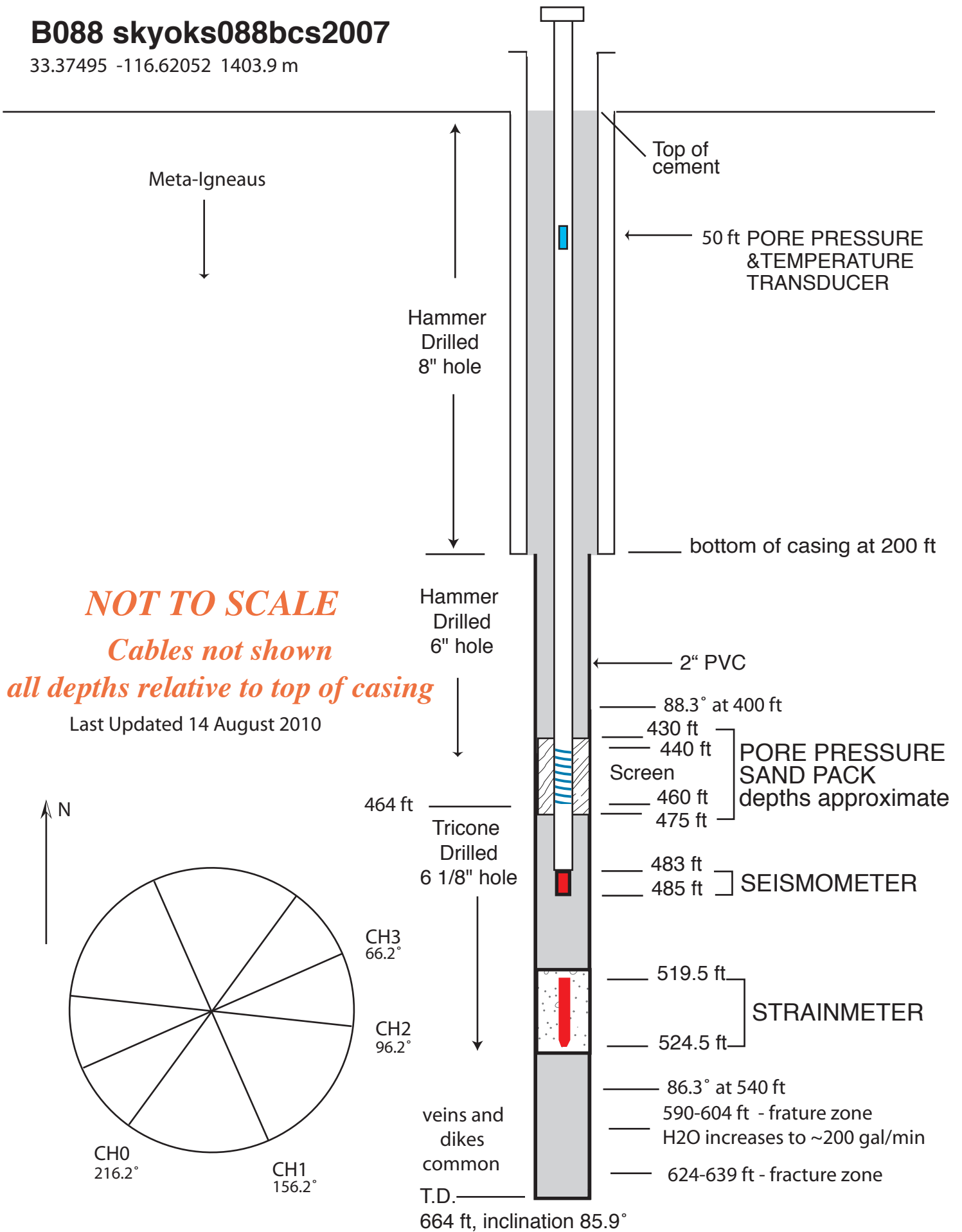
Last Updated 13 August 2010

hole making ~60 gal/min



# B088 skyoks088bcs2007

33.37495 -116.62052 1403.9 m



# B089 pathfi089bcs2006

33.6 -116.596 1362 m

highly folded gneiss

Hammer Drilled  
7.5" hole

89.7° at 97 ft

Casing  
6-5/8"

cemented to the surface

bottom of casing

**NOT TO SCALE**

**Cables not shown**

**all depths relative to top of casing**

Last Updated 2 January 2007

Hammer drilled  
6" hole

87.4° at 387 ft

387 ft

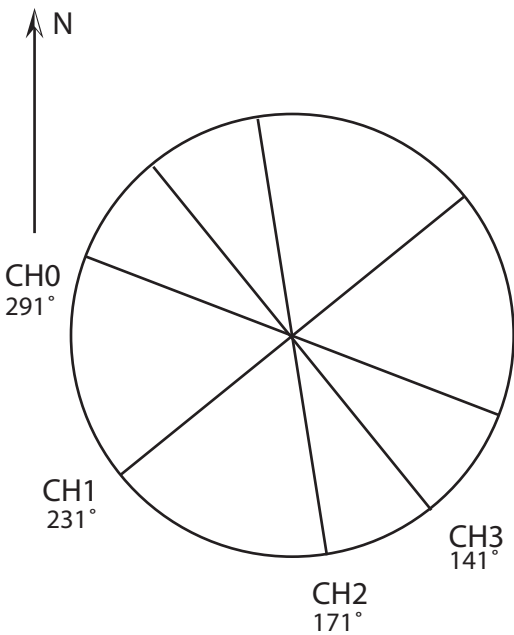
Tricone drilled  
5 7/8" hole

434 ft

437 ft

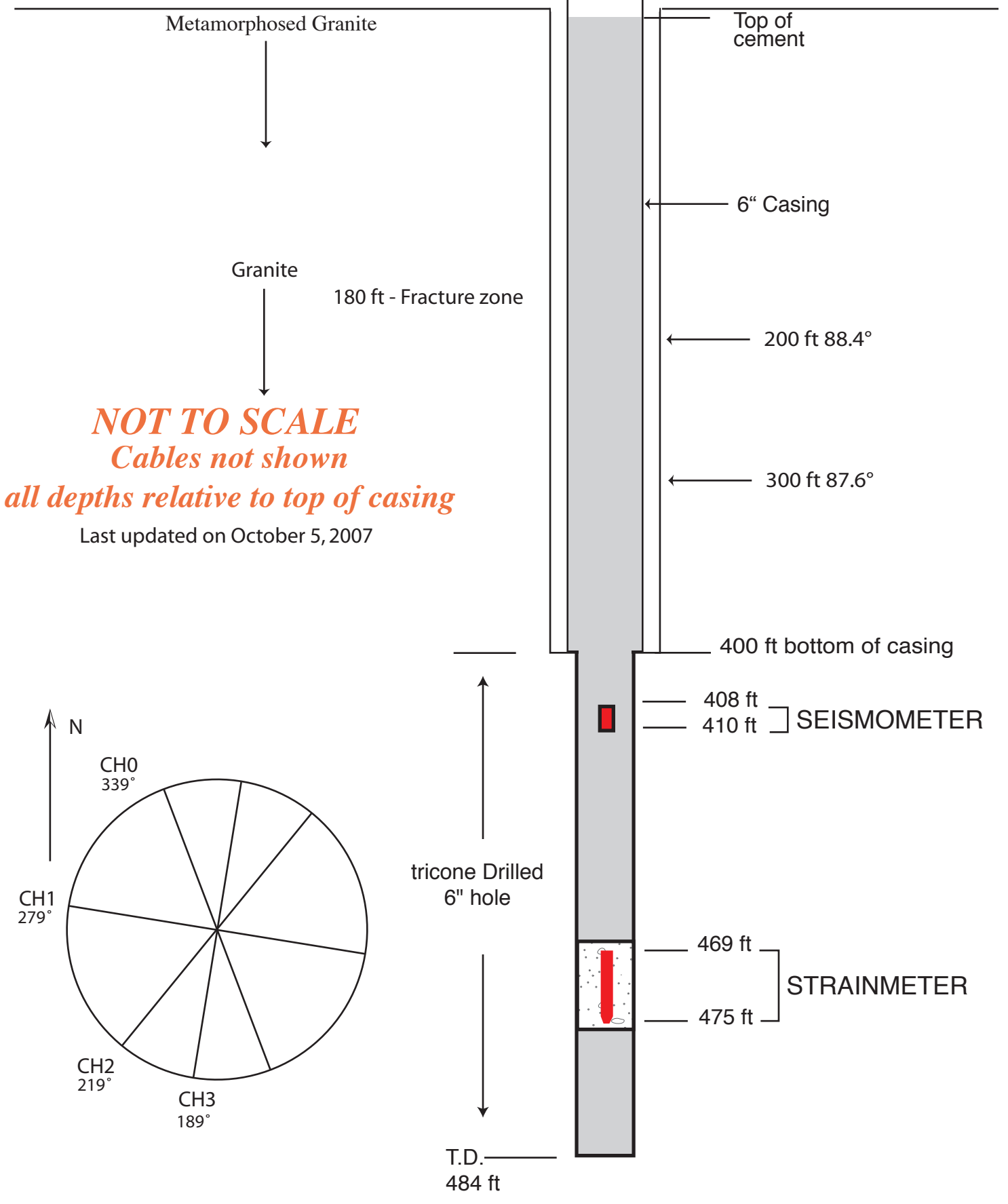
STRAINMETER

T.D.  
497 ft



# B093 trippf093bcs2007

33.5937 -116.7638 1244 m



Metamorphosed Granite



Granite

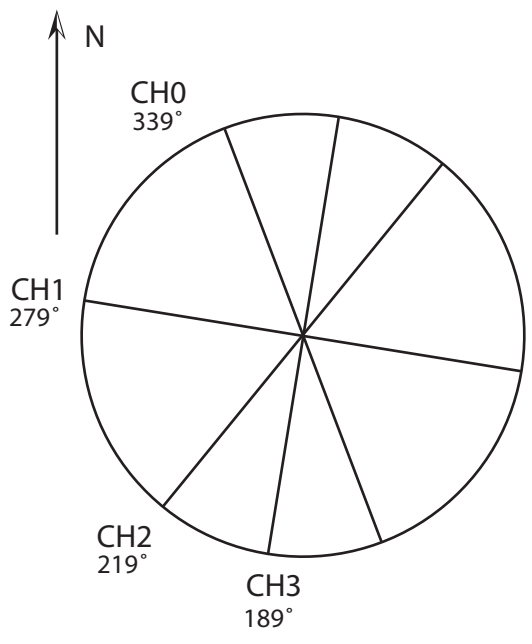
180 ft - Fracture zone



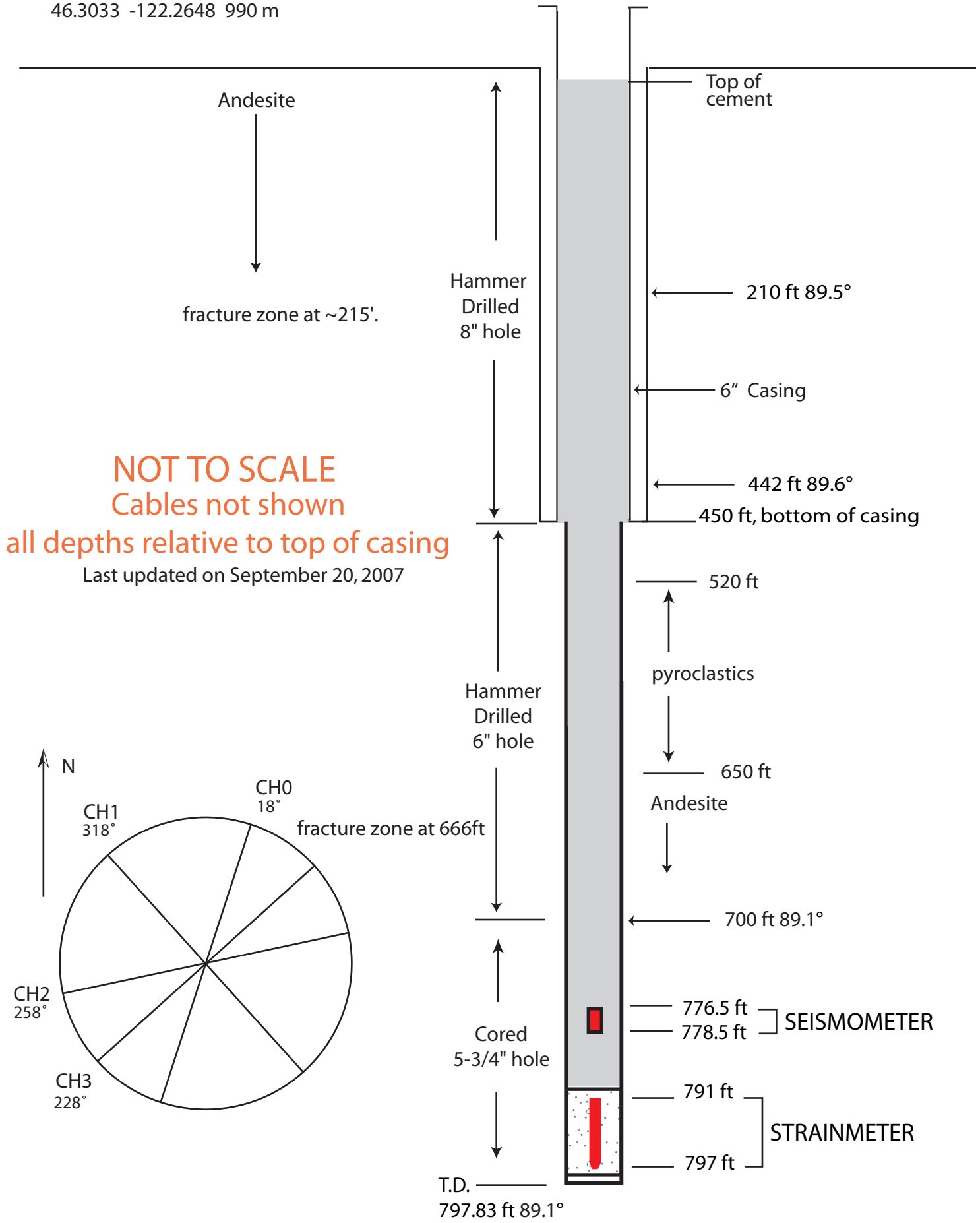
**NOT TO SCALE**  
*Cables not shown*

*all depths relative to top of casing*

Last updated on October 5, 2007

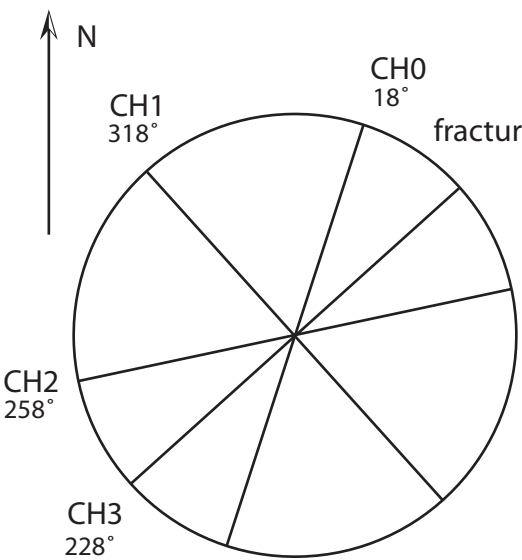


B201 coldwt201bwa2007  
 46.3033 -122.2648 990 m



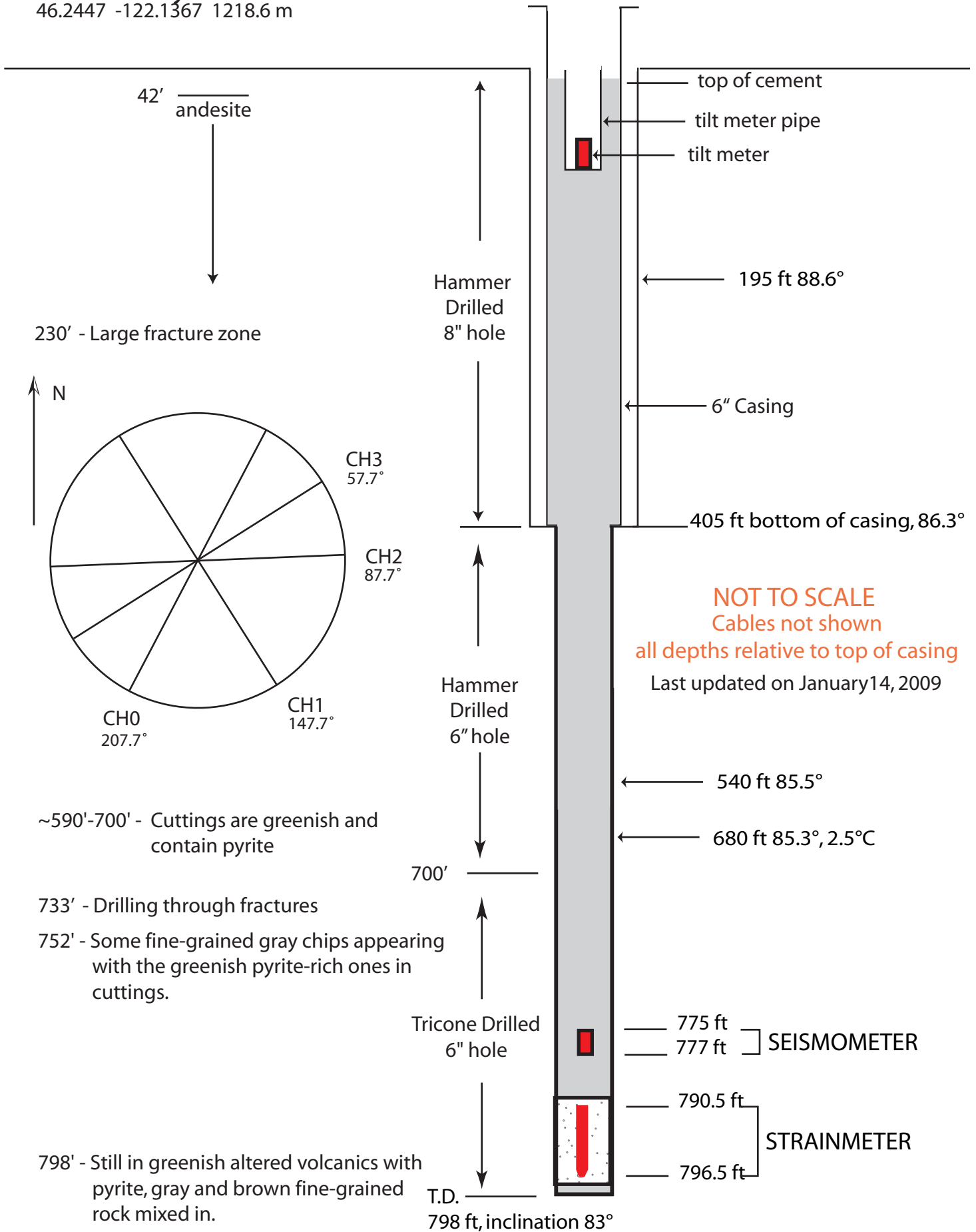
**NOT TO SCALE**  
**Cables not shown**

**all depths relative to top of casing**  
 Last updated on September 20, 2007



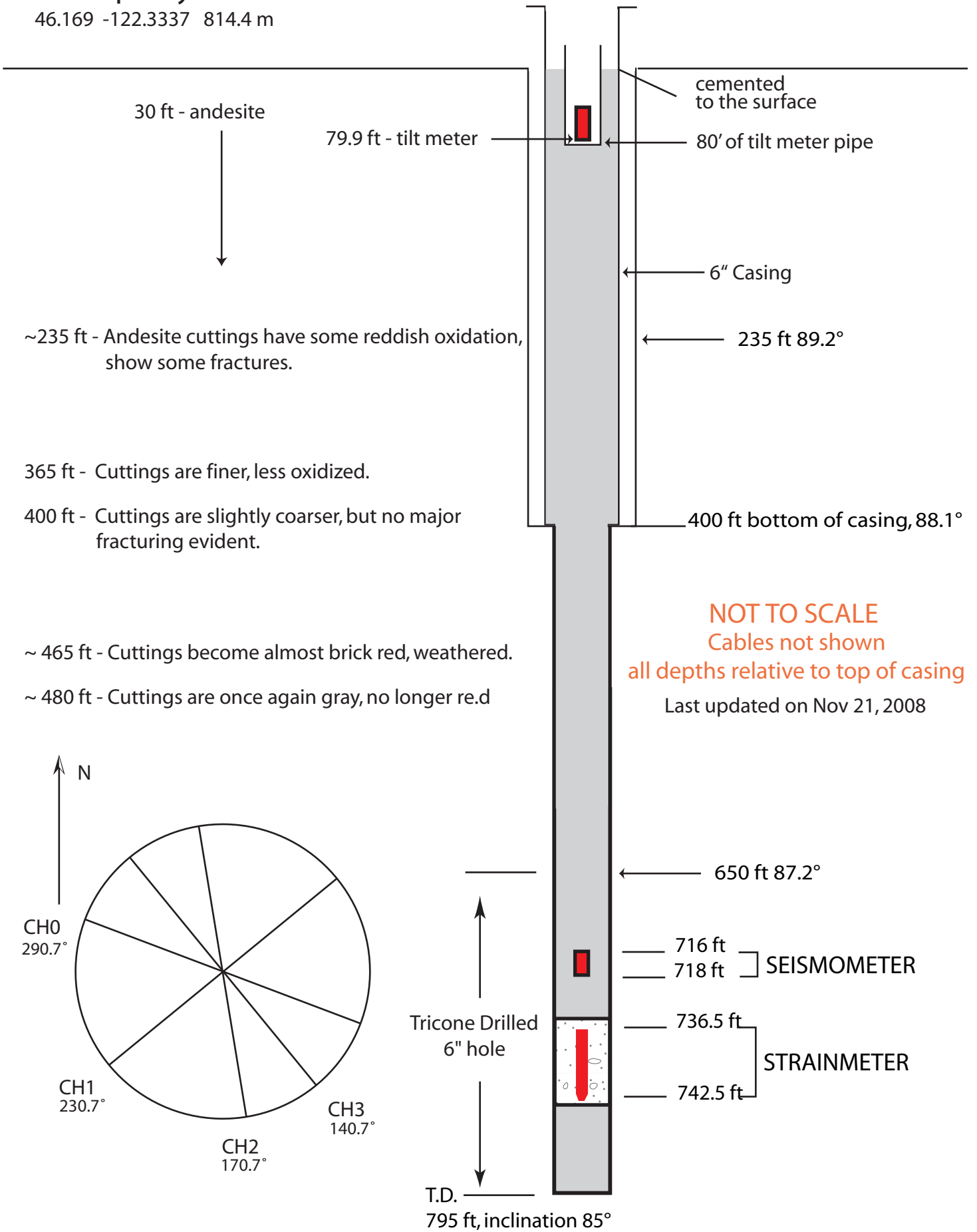
# B202 windy202bwa2007

46.2447 -122.1367 1218.6 m



# B203 quarry203bwa2007

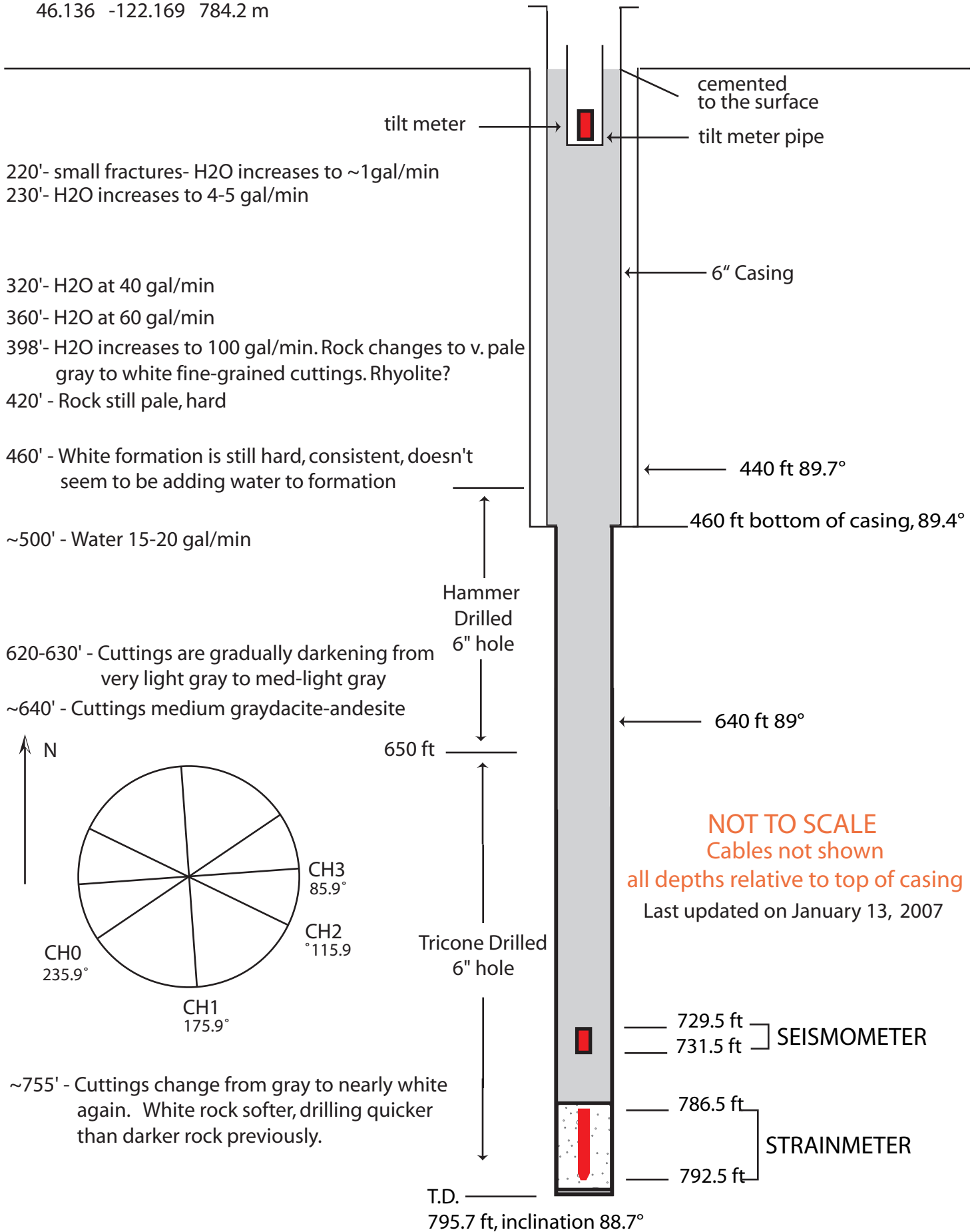
46.169 -122.3337 814.4 m





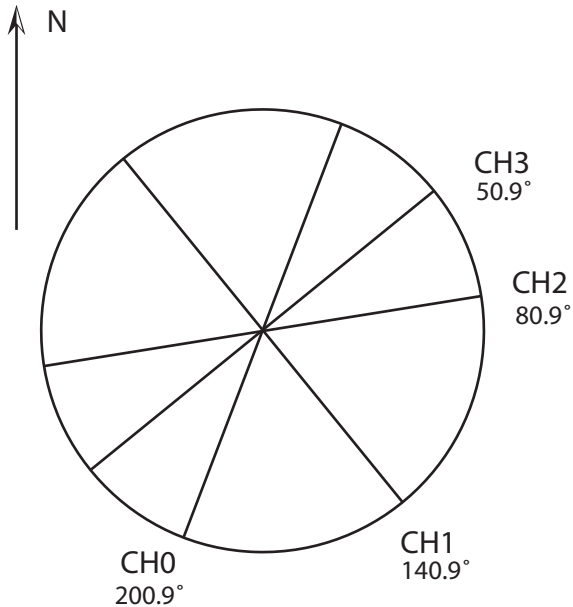
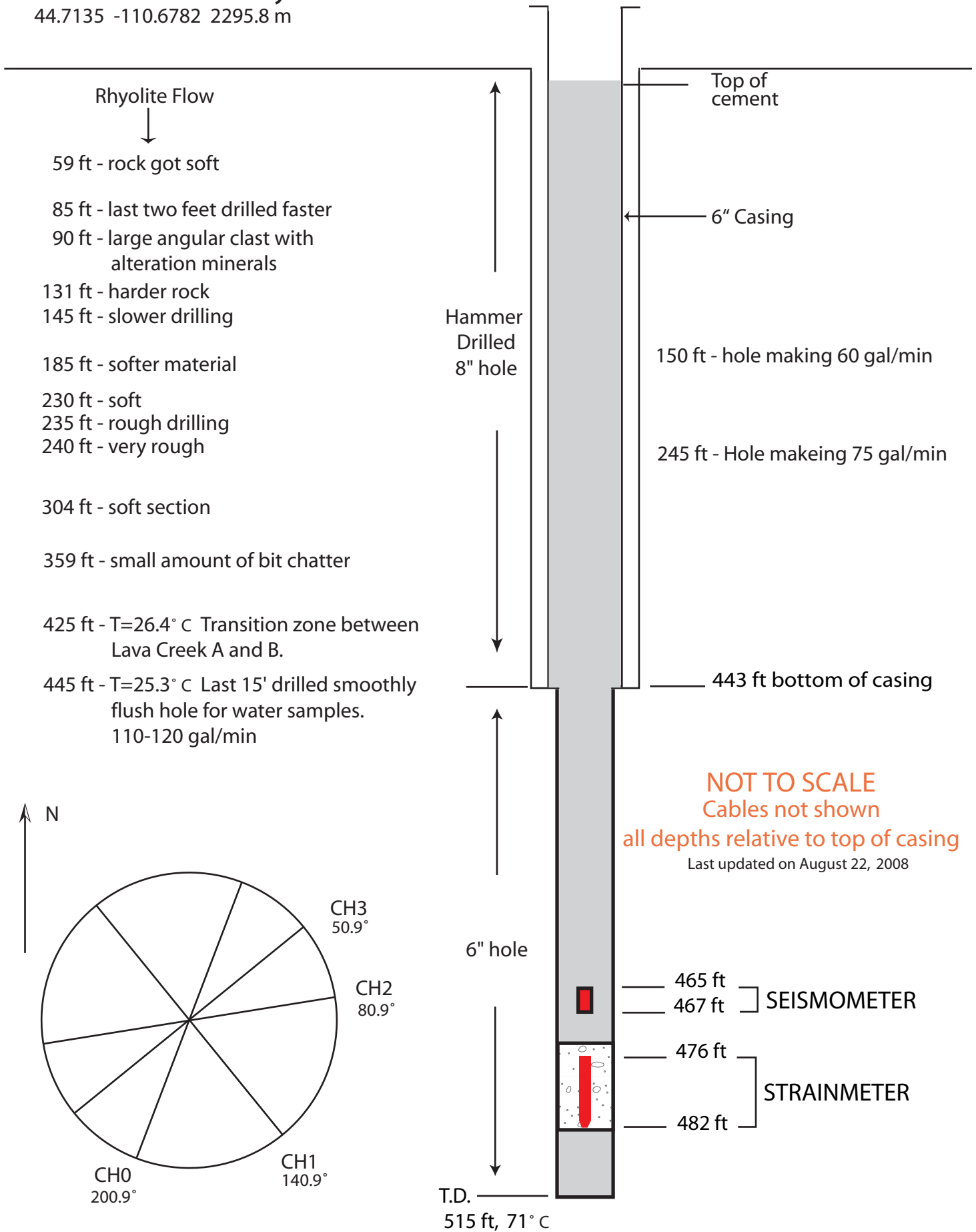
# B204 marble204bwa2007

46.136 -122.169 784.2 m



# B205 norris205bwy2008

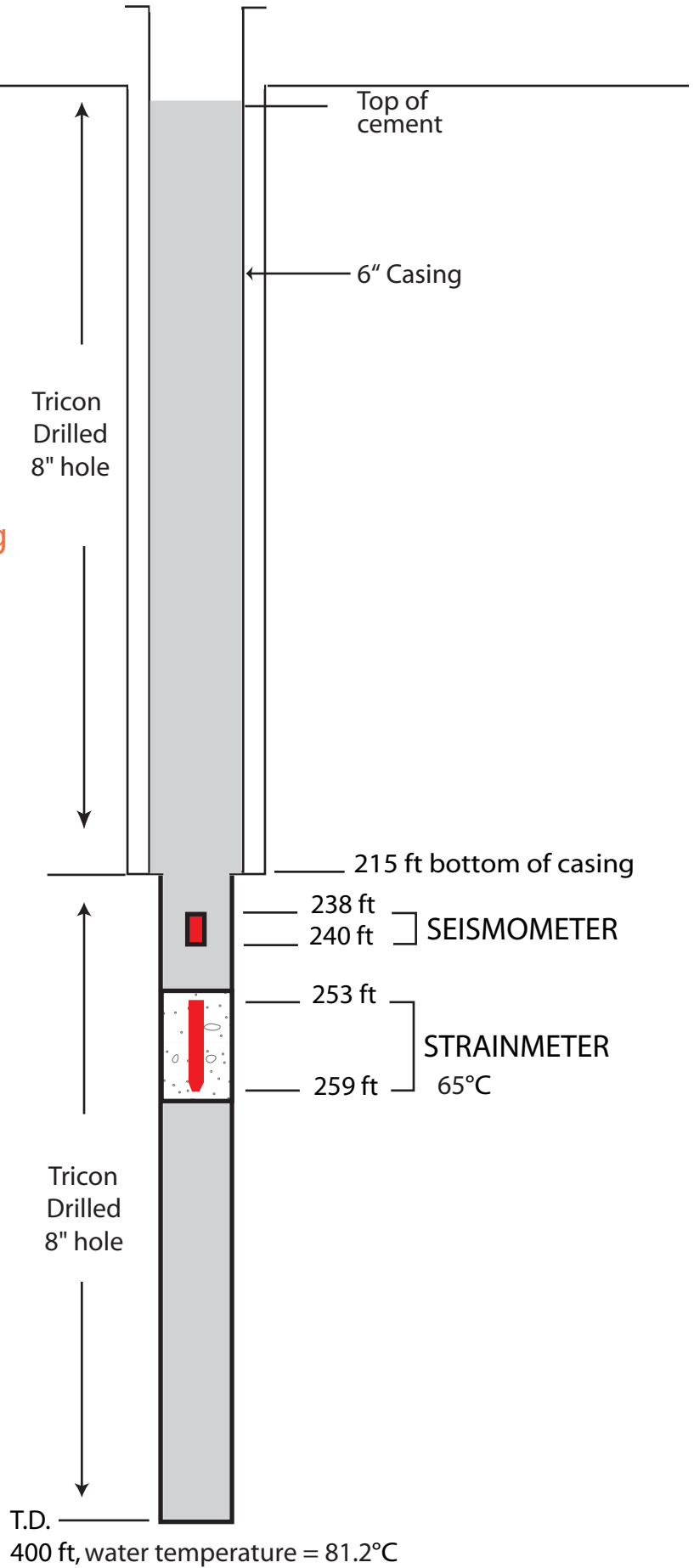
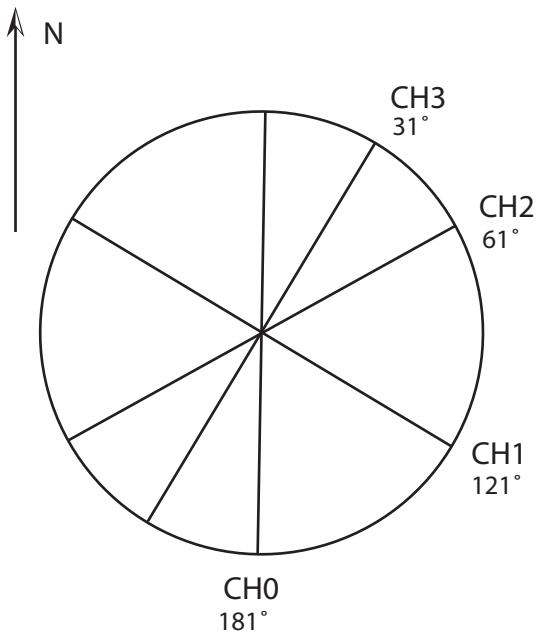
44.7135 -110.6782 2295.8 m



# B206 canyon206bwy2008

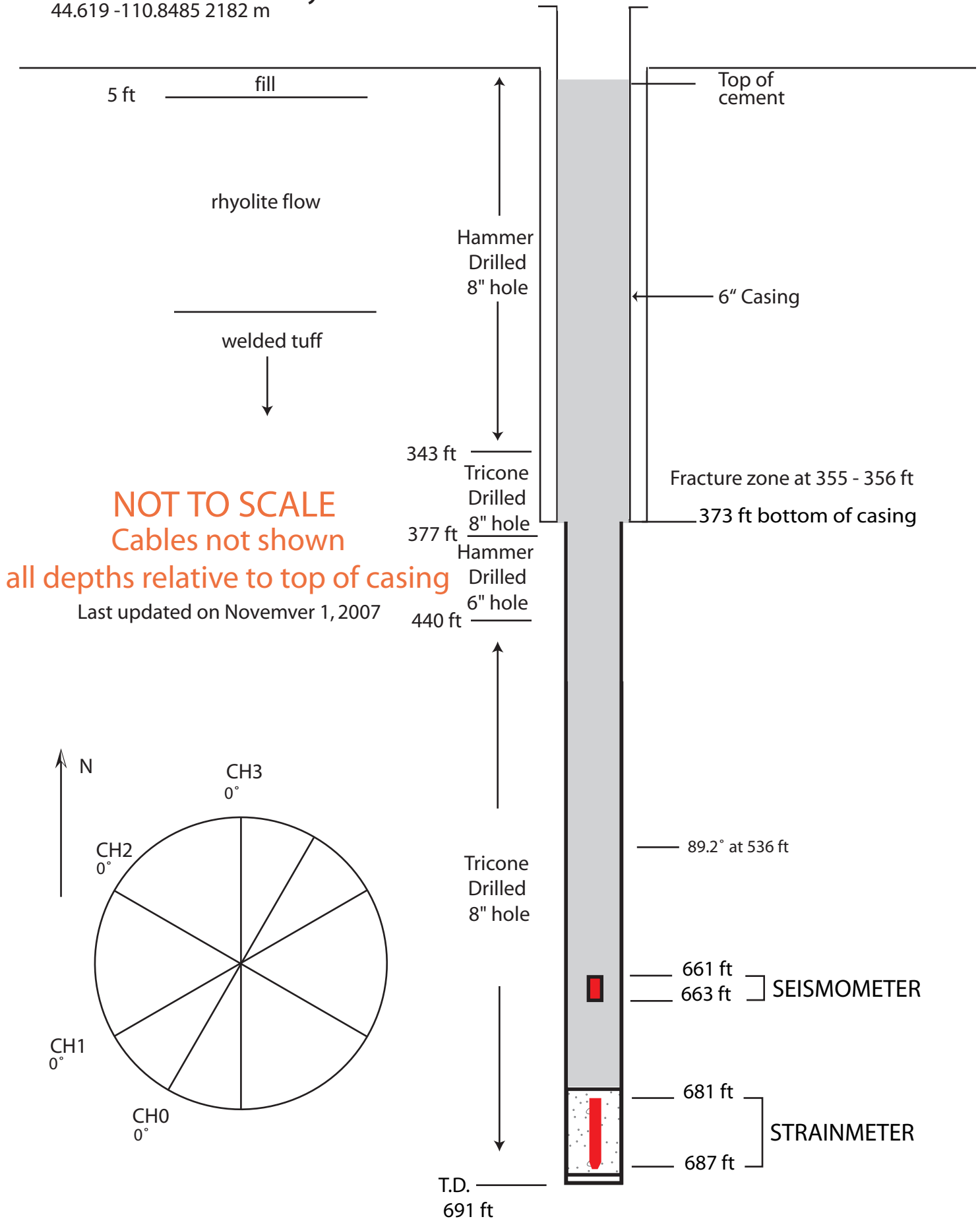
44.7177, -110.5117, 2399.5 m

**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing  
Last updated on July 14, 2008



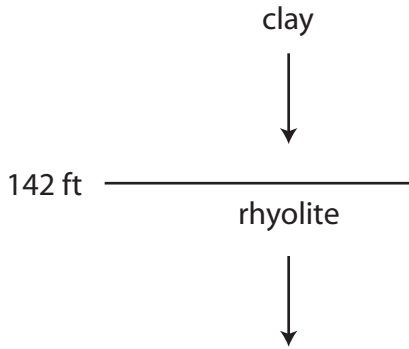
# B207 madisn207bwy2007

44.619 -110.8485 2182 m

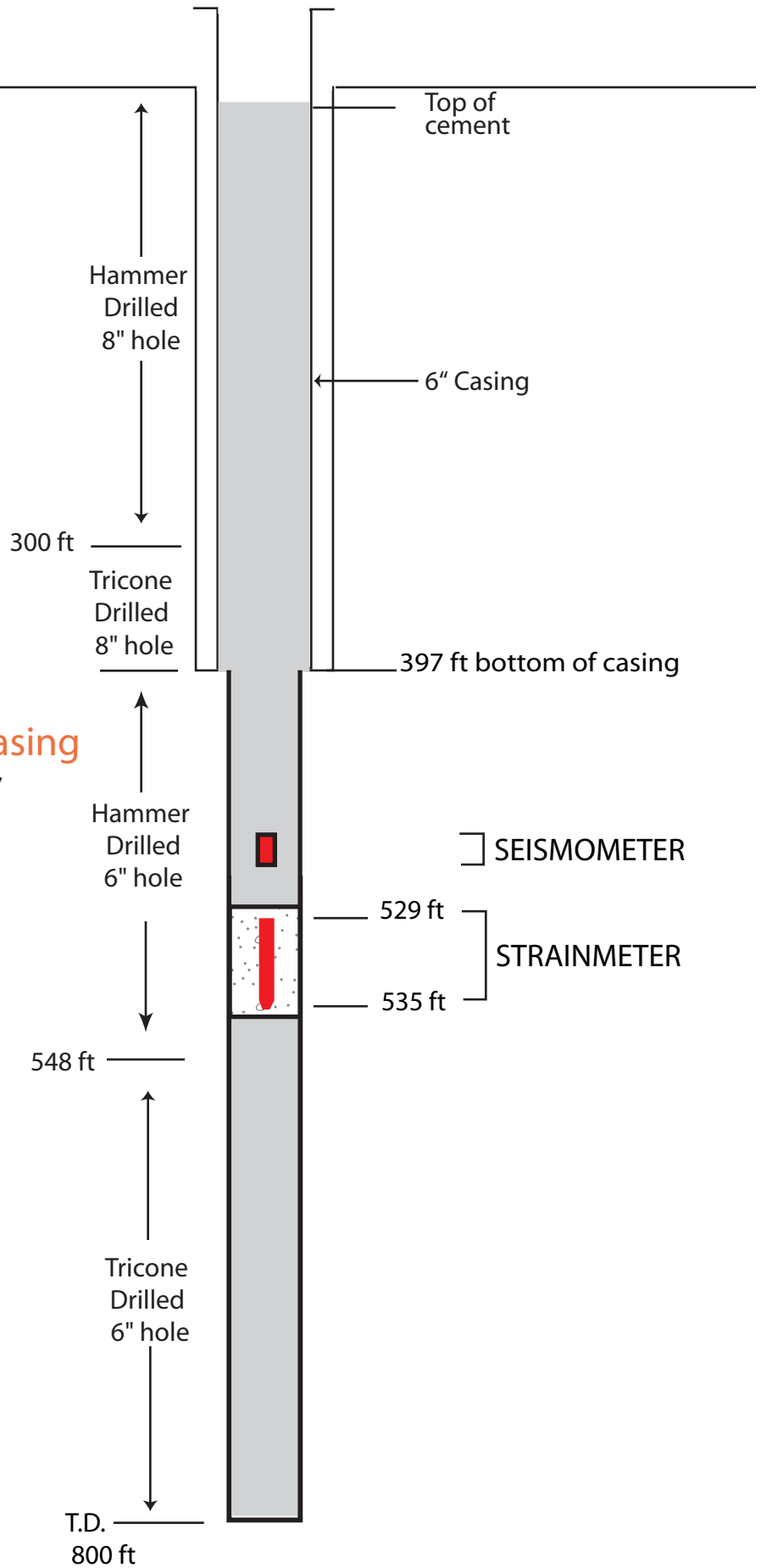
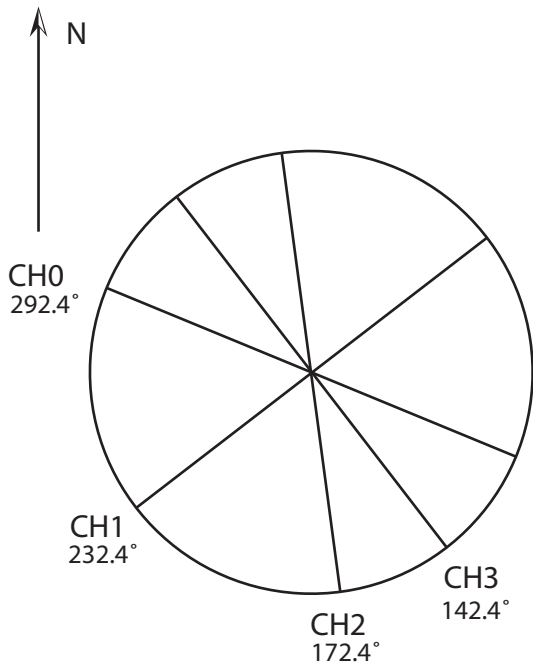


# B208 lakejn208bwy2007

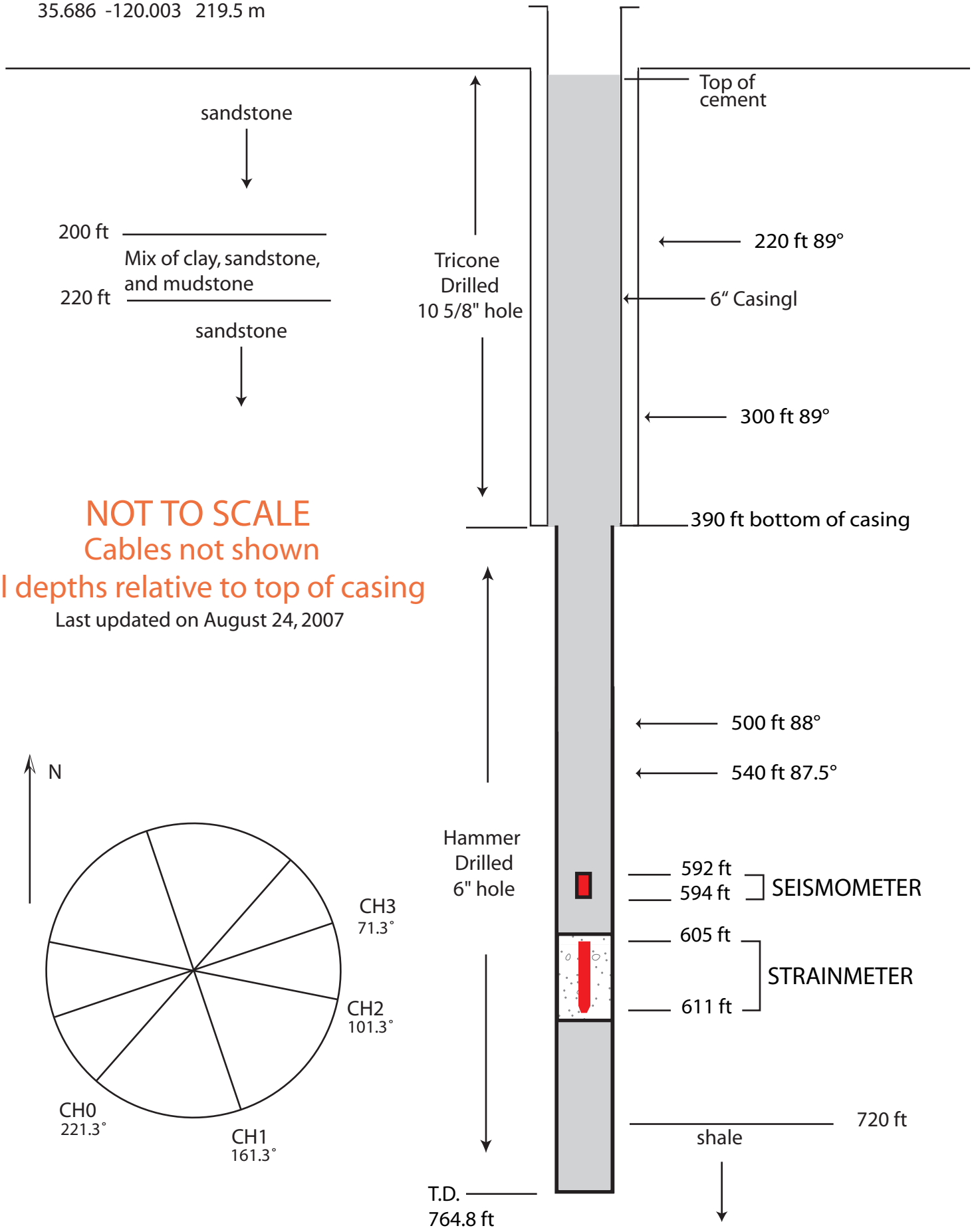
44.5602 -110.4015 2405.8 m



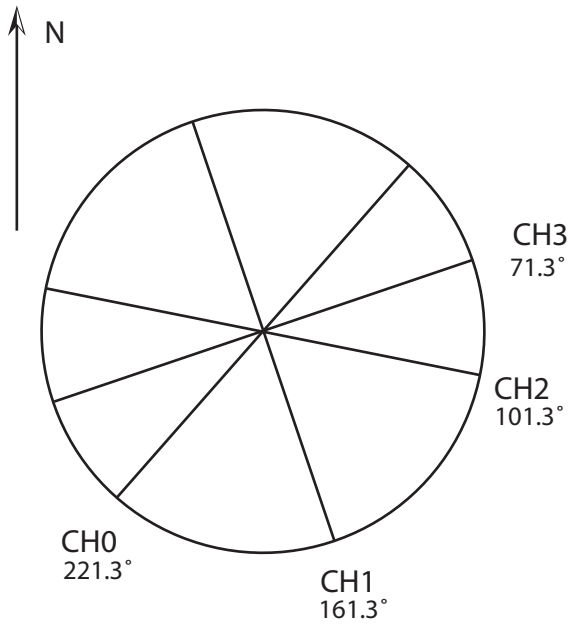
**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing  
Last updated on November 15, 2007

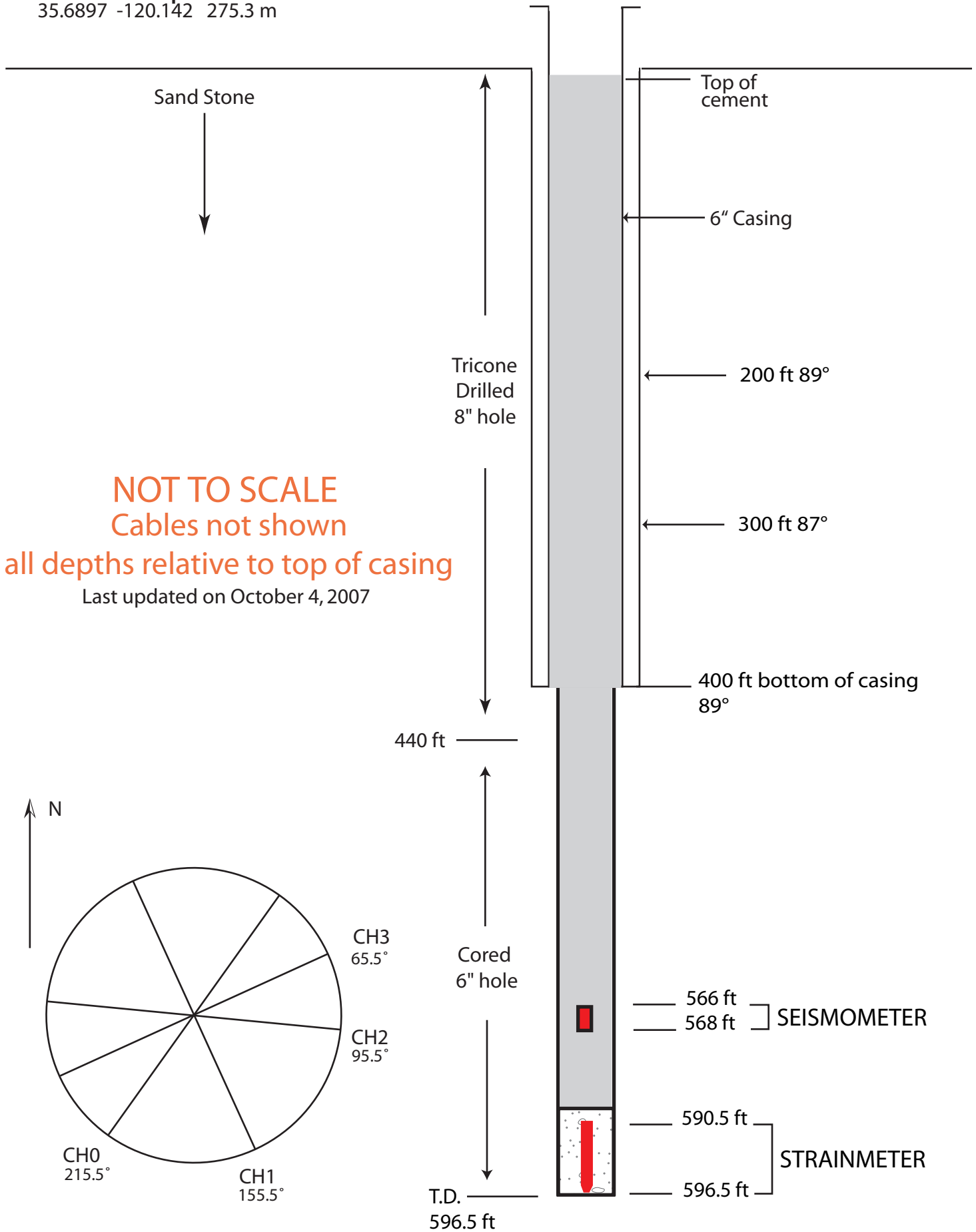


B900 blacka900bcn2007  
35.686 -120.003 219.5 m



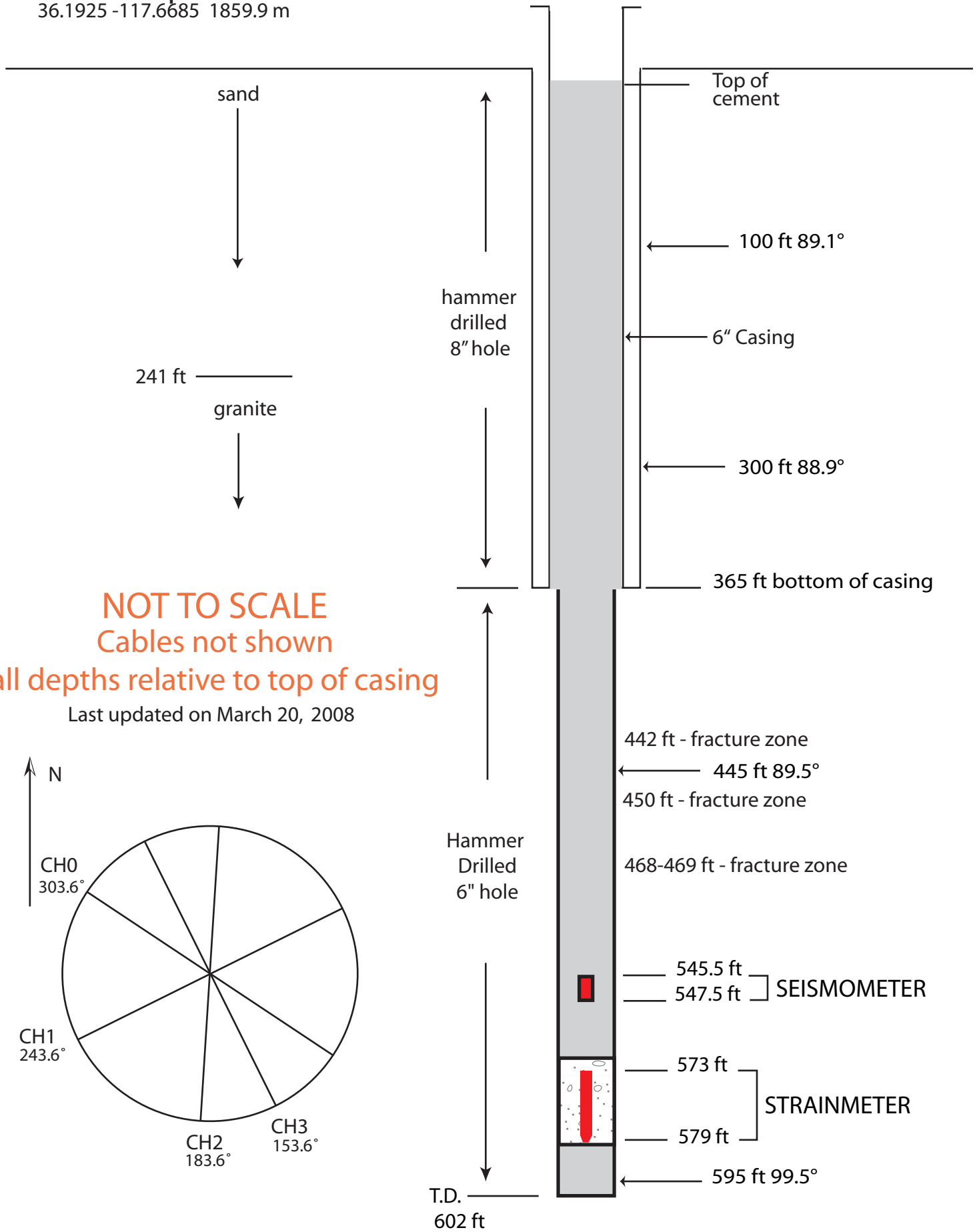
**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing  
Last updated on August 24, 2007





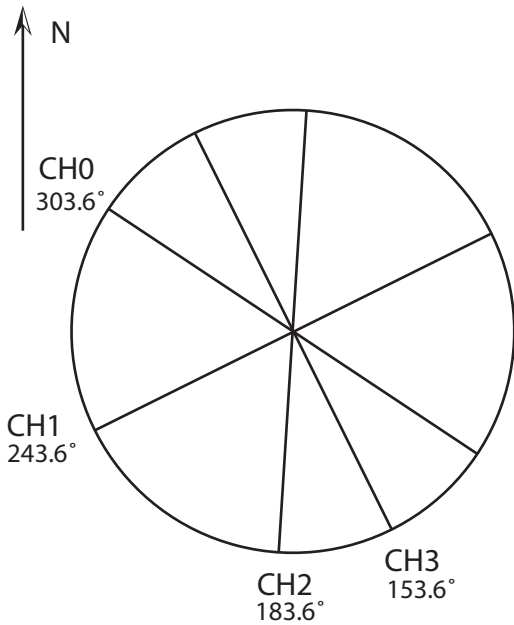
# B916 marips916bcs2008

36.1925 -117.6685 1859.9 m



**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing

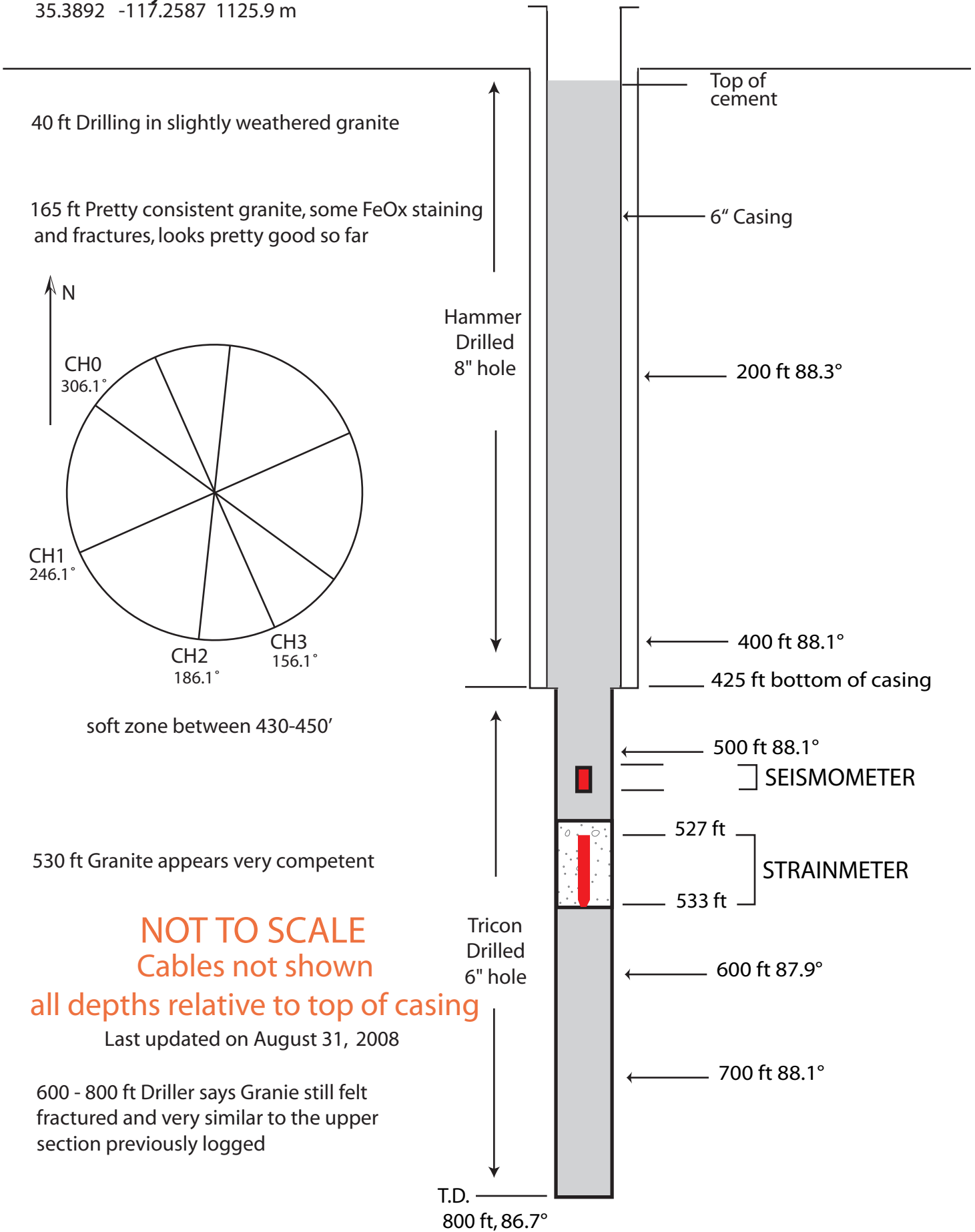
Last updated on March 20, 2008





# B917 tonyso917bcs2008

35.3892 -117.2587 1125.9 m



**NOT TO SCALE**  
**Cables not shown**

**all depths relative to top of casing**

Last updated on August 31, 2008

600 - 800 ft Driller says Granie still felt fractured and very similar to the upper section previously logged

# B918 mtsprn918bcs2008

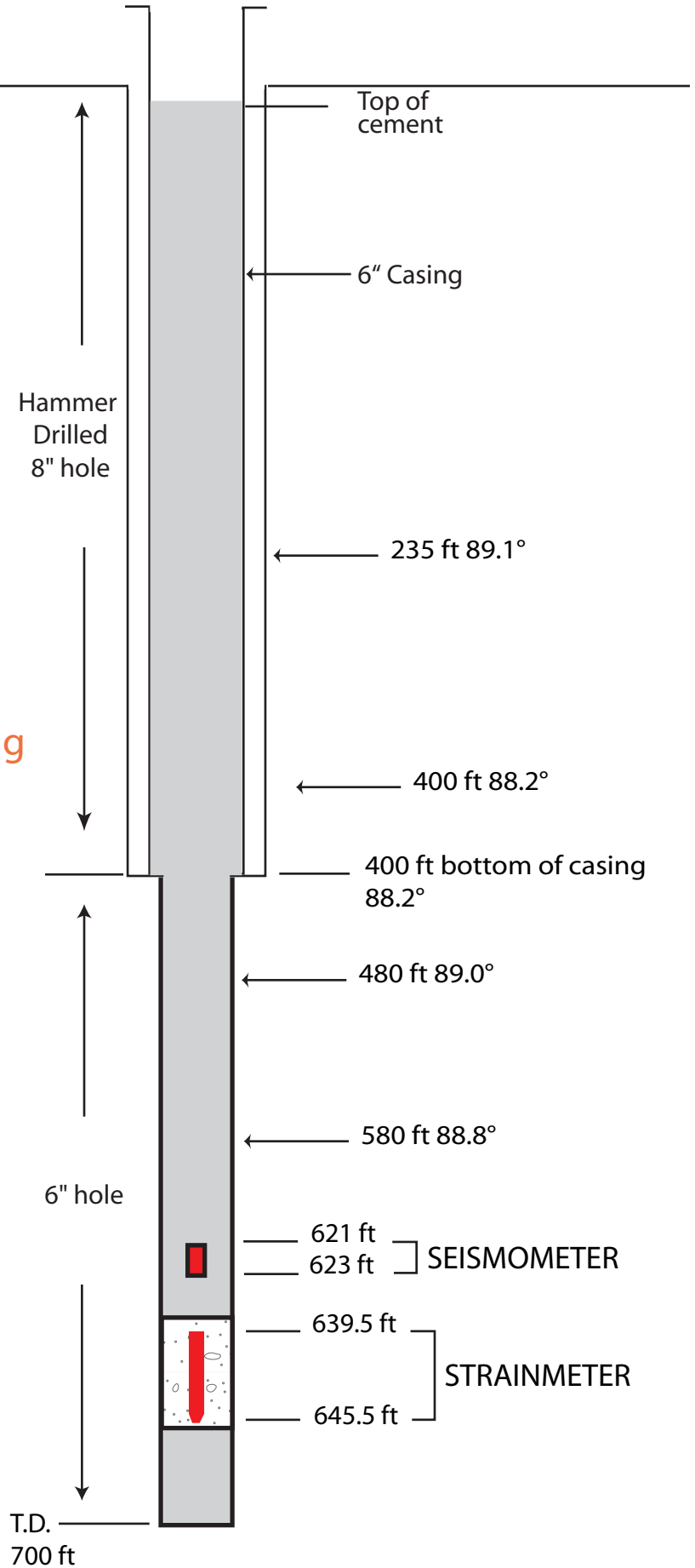
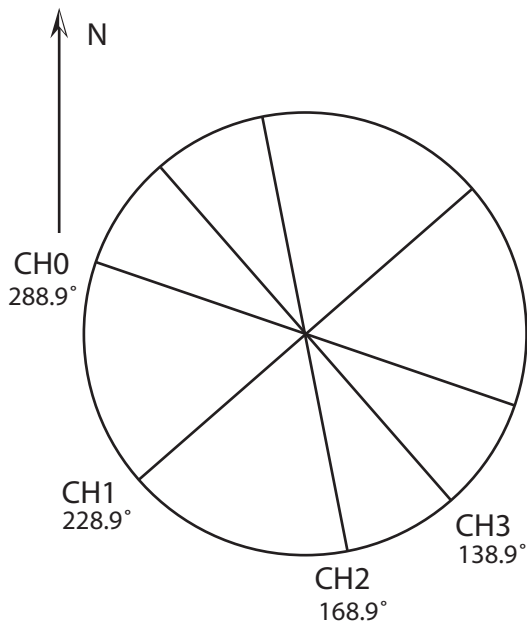
35.9357 -117.6017 1042.6 m

- 30 ft sand/small boulders
- fractured/heavily oxidized basalt.
- 65' ft - basalt becoming less fractured/oxidized and more vesicular.
- 82 ft - Through bottom of Basalt flow and into cinder material consisting of loosely consolidated, highly oxidized basalt.
- 140ft - still in loose material
- 192 ft granite
- 228 ft - Hit a very small basalt dike.

**NOT TO SCALE**  
**Cables not shown**  
**all depths relative to top of casing**

Last updated on July 2, 2008

- 445 ft - Still in granite.
- 483 ft - Hit a fracture.



# B921 randsb921bcs2008

35.5865 -117.4622 694.5 m

63 ft ——— Aeolian Sands/Colluvium  
 Basalt  
 72 ft ———  
 Granite  
 80 ft ——— Basalt  
 Hit more basalt at 114 ft  
 135 ft ——— Granite

Fracture zone at ~150 ft, making 5-10 g/min.  
 The grain size of samples are larger and slightly oxidized.

173 ft - Back into hard granite

Hammer  
 Drilled  
 8" hole

Top of  
 cement

6" Casing

100 ft 89.1°

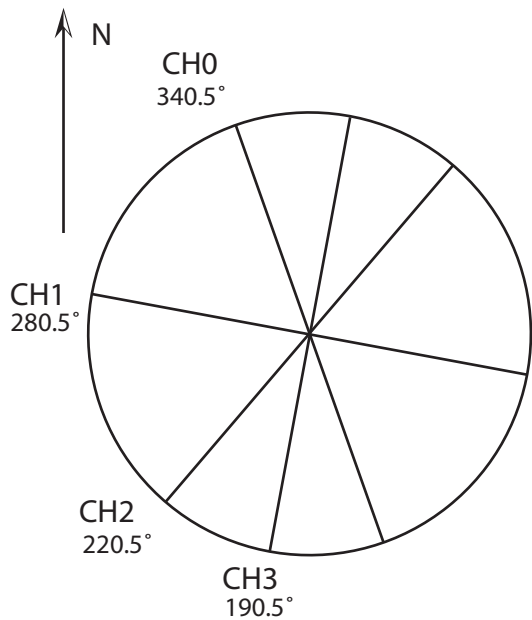
bottom of casing

**NOT TO SCALE**  
**Cables not shown**  
**all depths relative to top of casing**

Last updated on June 18, 2008

200 ft - very fractured

Encountered basaltic dikes  
 at 218 - 230 ft and 240 - 245 ft



605 ft - Hit a loose gravelly zone with small rounded granite cobbles

T.D.  
 620 ft

450 ft 88.1°

457 ft

459 ft SEISMOMETER

477.5 ft

STRAINMETER

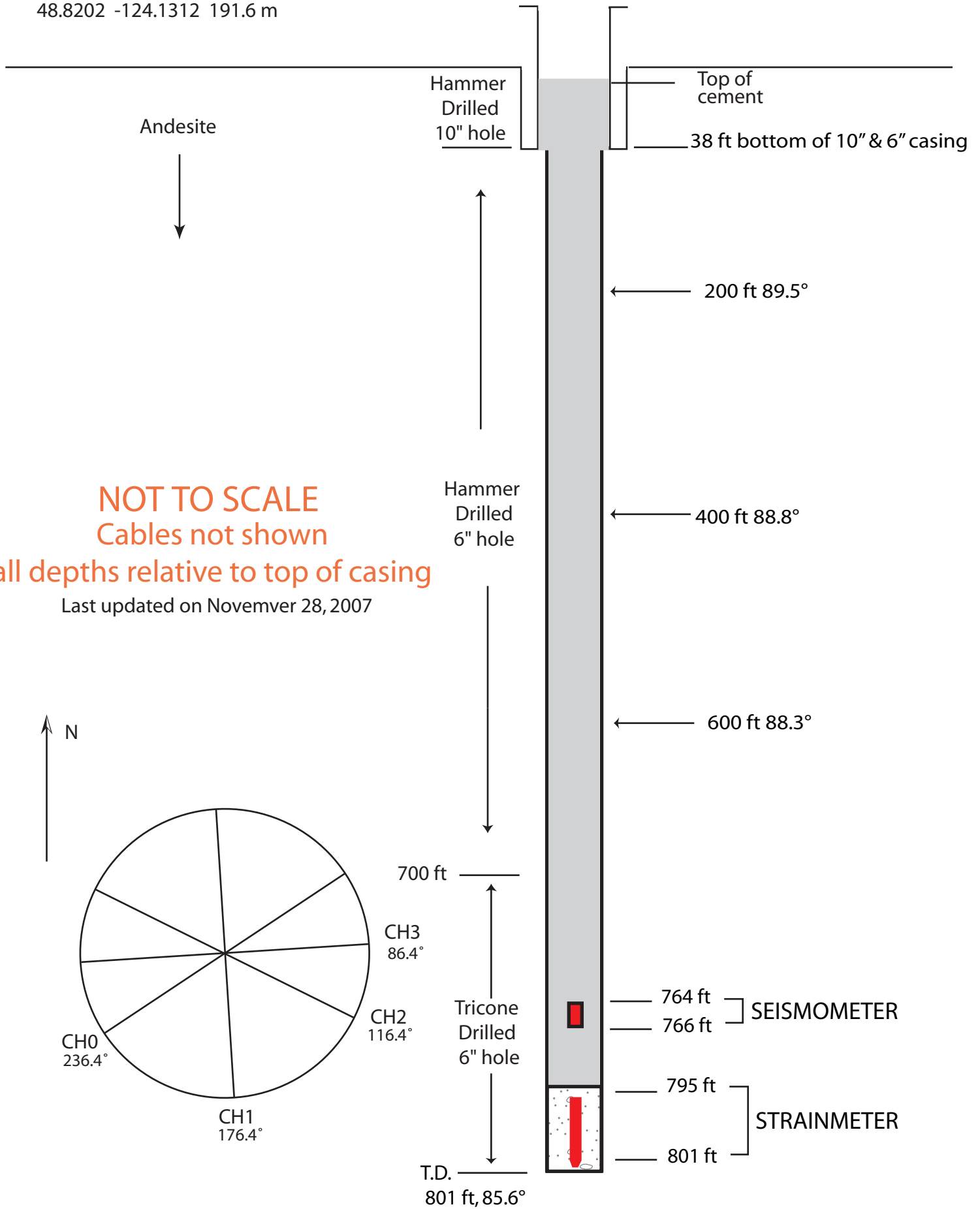
483.5 ft

500 ft 88.2°

500 - 540 ft - fracture zone

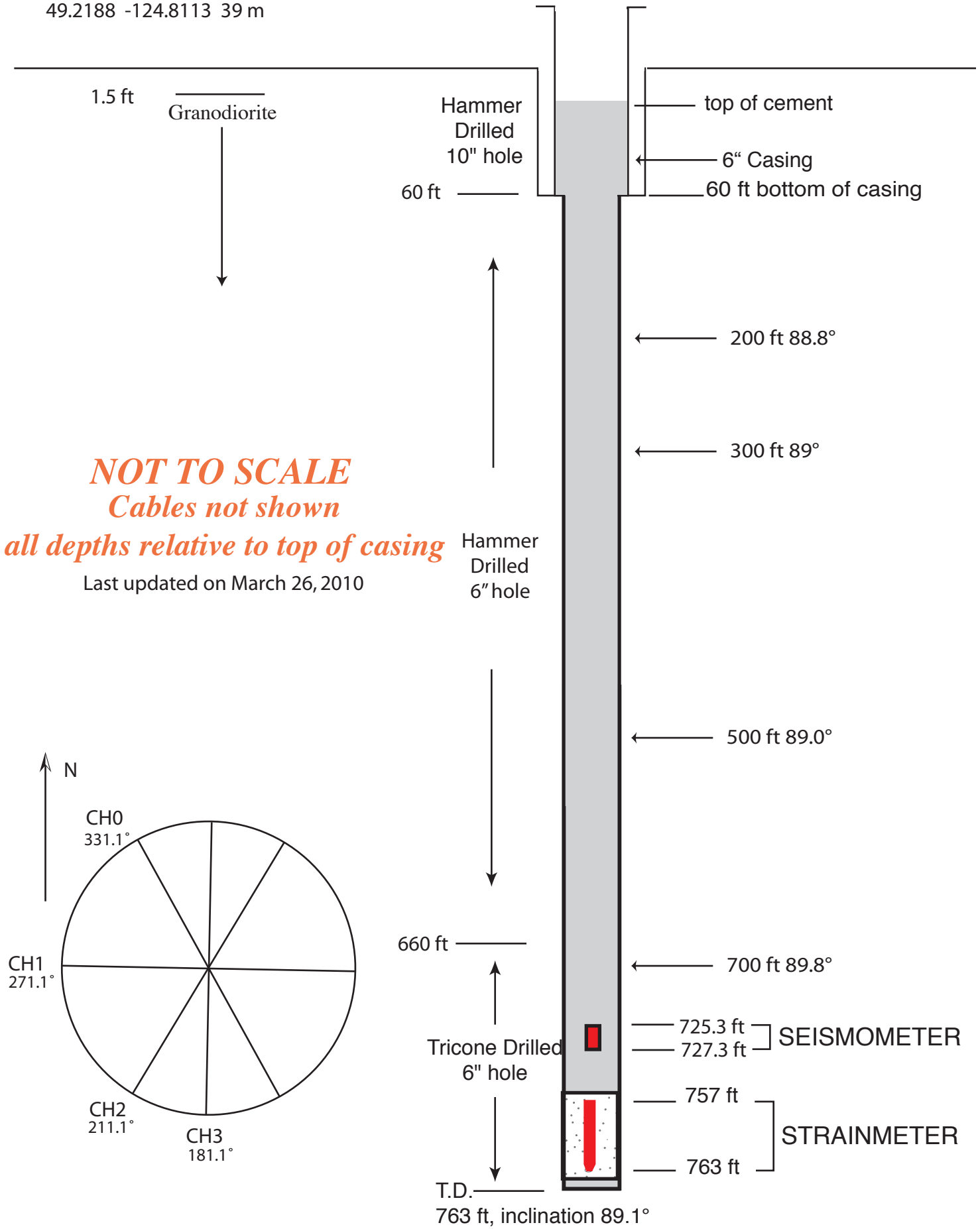
600 ft 86.8°

B926 cowich926bbc2007  
48.8202 -124.1312 191.6 m



# B927 albern927bbc2007

49.2188 -124.8113 39 m



**NOT TO SCALE**  
*Cables not shown*

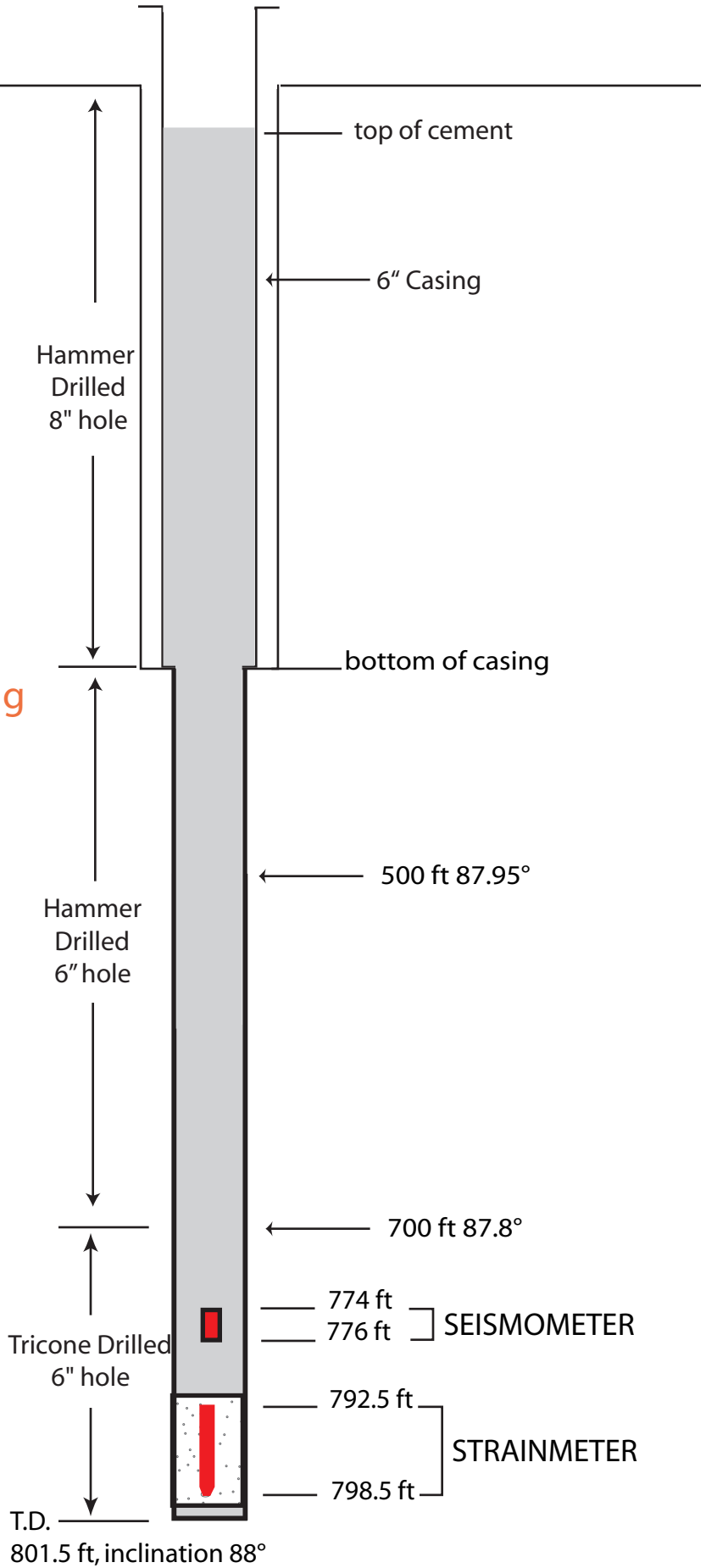
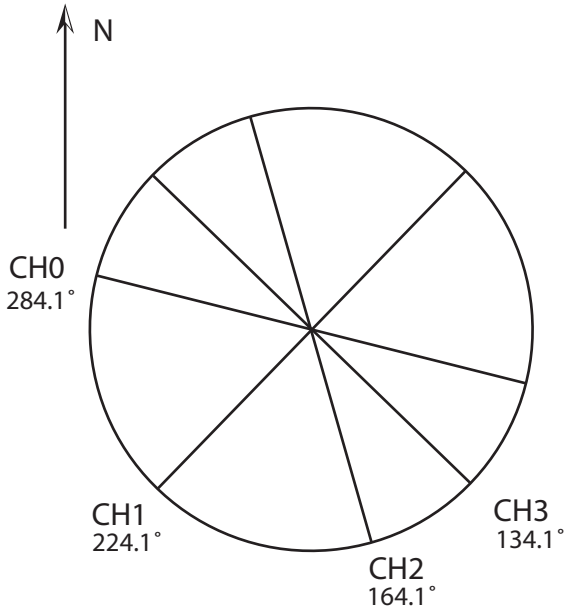
*all depths relative to top of casing*

Last updated on March 26, 2010

B928 bamfld928bbc2007  
48.8353 -125.1351 26.8 m

Gabbro  
↓

**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing  
Last updated on December 19, 2007



# B933 mckee933bcn2008

40.0600 -123.9690 268.1 m

10 ft  
Sandstone with fine grained interbeds



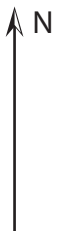
**NOT TO SCALE**

**Cables not shown  
all depths relative to top of casing**

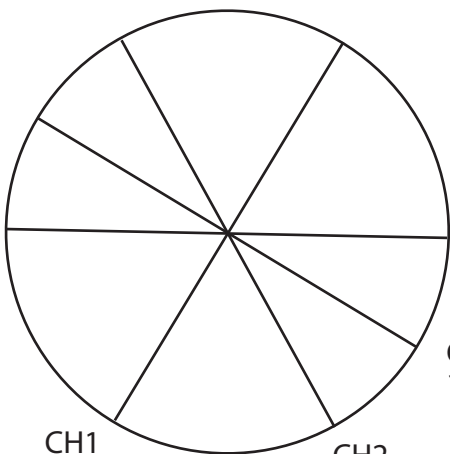
Last Updated 18 September 2008

The hole was producing some gas, which was odorless until hole was drilled below the casing.

Drilled through more sandstone with fine interbedded mudstones.



CH0  
271°

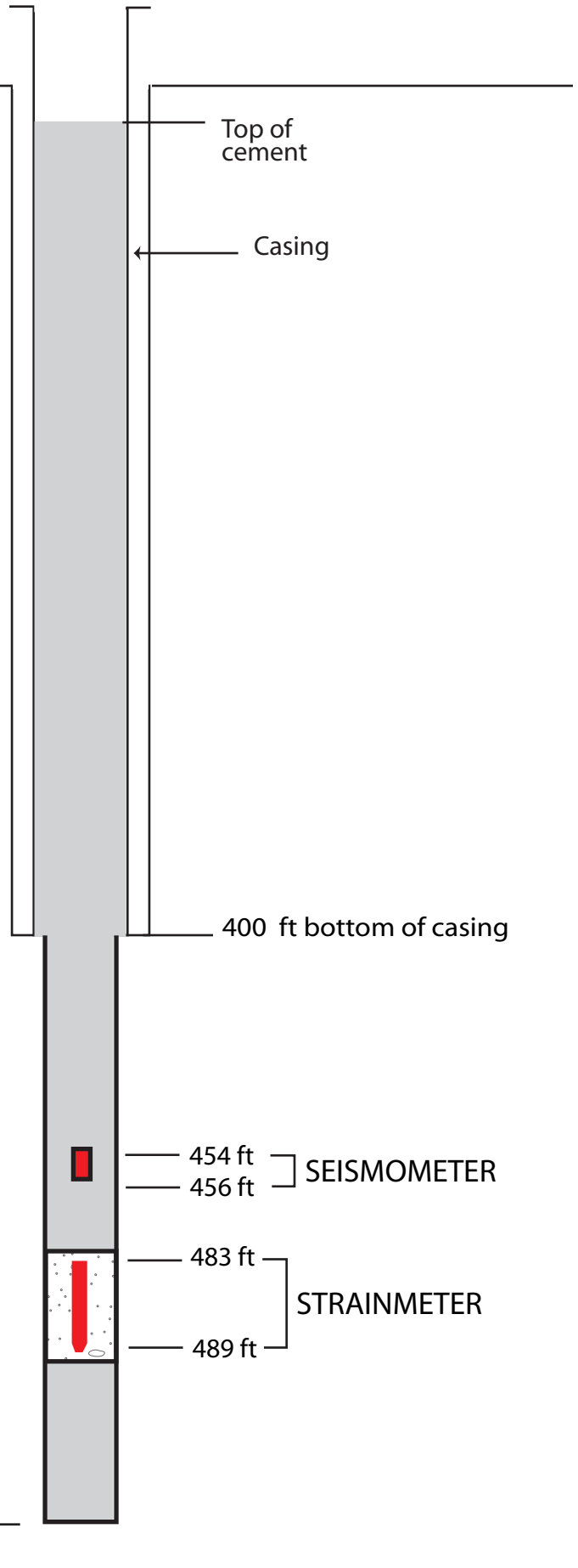


CH1  
211°

CH2  
151°

CH3  
121°

T.D.  
520 ft



Top of cement

Casing

400 ft bottom of casing

454 ft

456 ft

SEISMOMETER

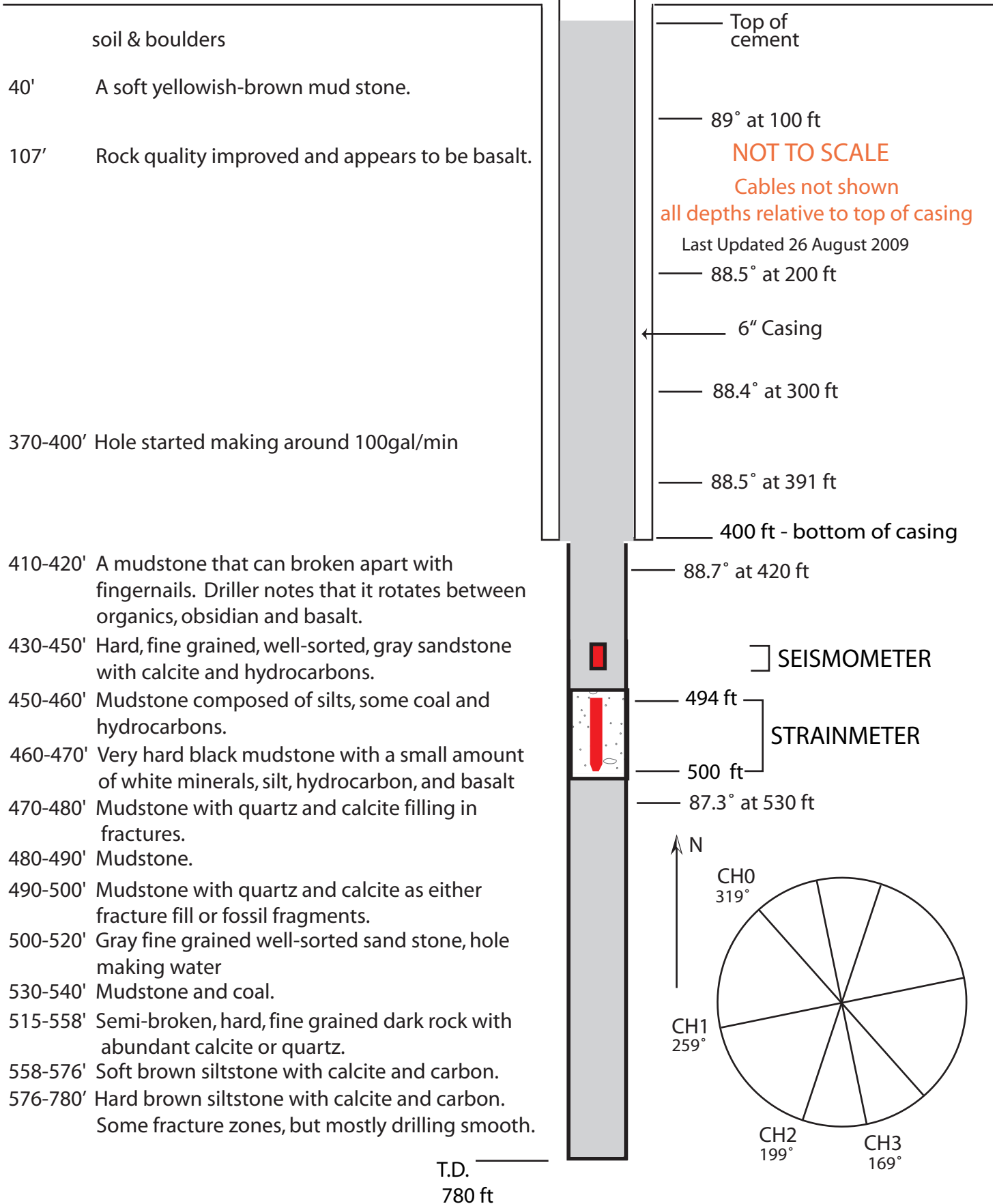
483 ft

489 ft

STRAINMETER

# B934 legget934bcn2008

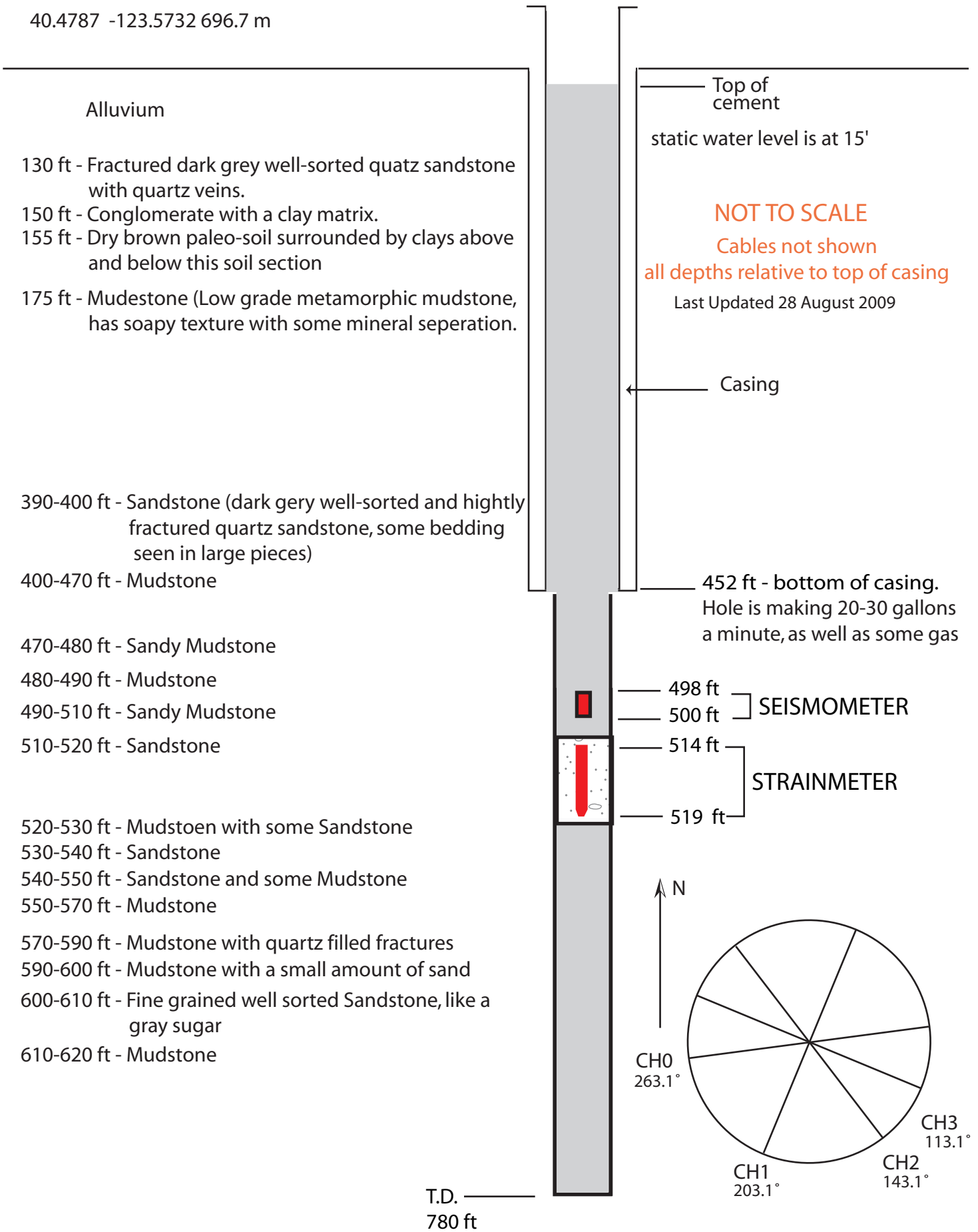
39.8445 -123.6914 331 m

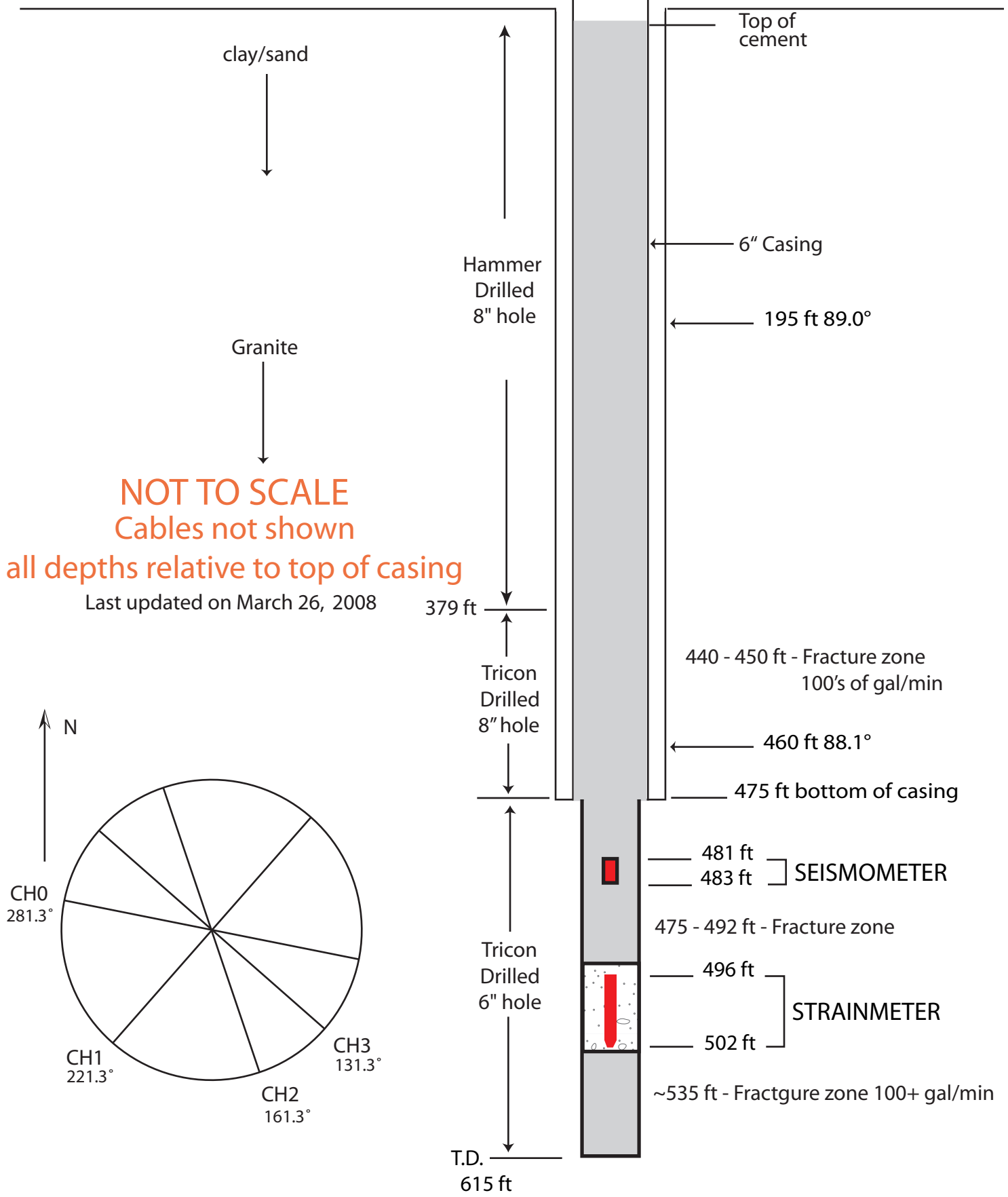




# B935 dinsmr935bcn2008

40.4787 -123.5732 696.7 m





25 ft  
basalt

390' Fractured Zone, 25gal/min

Hammer  
Drilled  
8" hole

Top of  
cement

6" Casing

415 ft 89.1°

442 ft bottom of casing

**NOT TO SCALE**  
Cables not shown  
all depths relative to top of casing  
Last updated on March 5, 2008

Hammer  
Drilled  
6" hole

570 ft - oxidized (red) Layer,  
possible fracture zone

640 ft - Fracture zone 30gal/min

690 ft - Fracture zone, 100gal/min

700 ft

700 ft 87.6°

705 ft

707 ft

SEISMOMETER

735 ft

STRAINMETER

741 ft

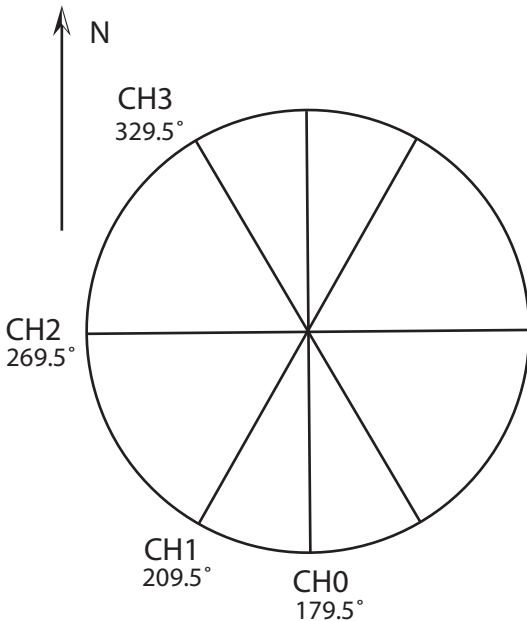
Tricon  
Drilled  
6" hole

740 ft - Fracture zone

790 ft 86.8°

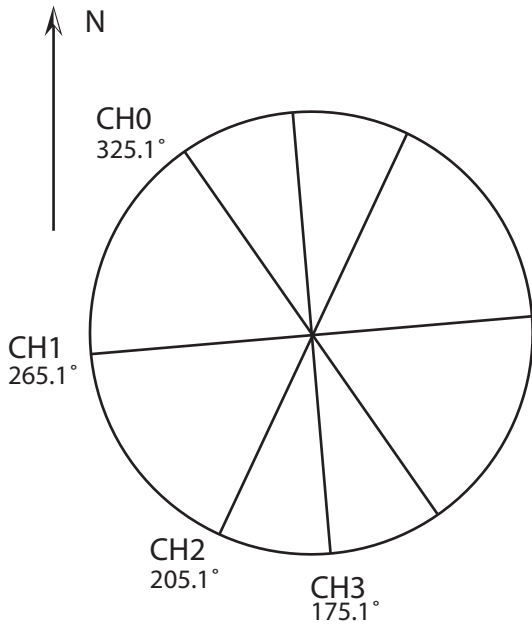
T.D.

799 ft



# B944 grantt944bwy2008

44.3897 -110.5438 2364.6 m



Hammer Drilled 8" hole

Top of cement

Casing 6"

200 ft - water took on brown tint and penetration rate slowed,  $t=24.8\text{ C}$

243 ft - rough drilling

269.5 ft ~100gpm

**NOT TO SCALE**

**Cables not shown**

**all depths relative to top of casing**

Last Updated 3 September 2008

397 ft -  $T = 46\text{ C}$

412-413 ft - ashy

431 ft - fractures

434 ft - very rough drilling

435 ft - smoother dilling, 200 gpm

445 ft - more then 200gpm,  $T = 34.8\text{ C}$

464 ft - rough drilling,  $T = 34.8\text{ C}$

472 ft, 473-475 ft, 476 ft - rough drilling

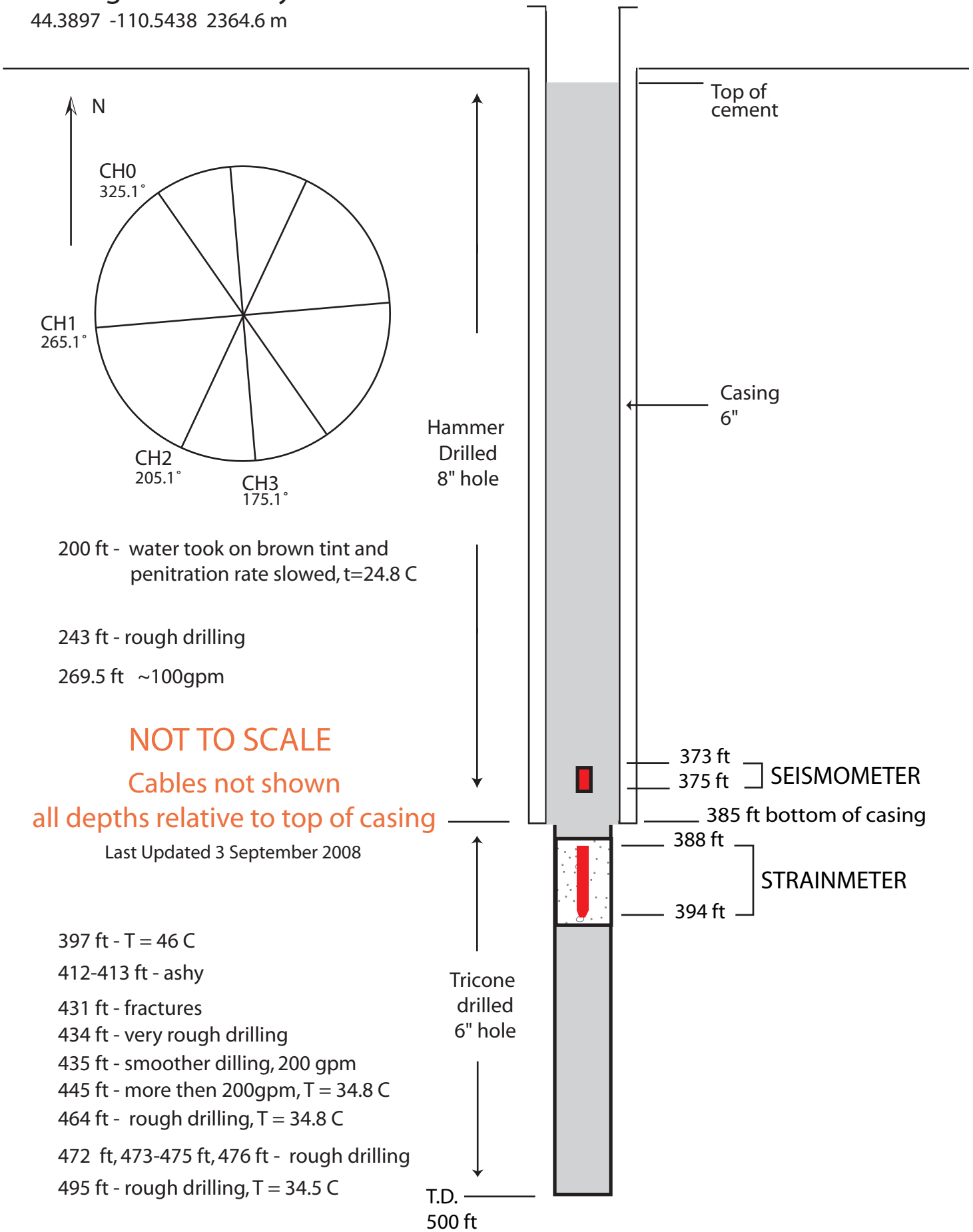
495 ft - rough drilling,  $T = 34.5\text{ C}$

T.D.  
500 ft

373 ft  
375 ft } SEISMOMETER  
385 ft bottom of casing

388 ft  
394 ft } STRAINMETER

Tricone drilled 6" hole



# B946 sagebf946bcs2010

33.5373 -116.5925 1429 m

Granite

65-75 ft - Harder rock.

170 ft - Static water level.

**NOT TO SCALE**

*Cables not shown*

*all depths relative to top of casing*

Last Updated 28 July 2010

298 ft - Clay band.

1 cm size gravel under casing.

400 ft - Blow out hole. Weird blueish grey fluid and fresh granite gravel is blocking hole.

415 ft - Cutting fluids turn blue. Samples are more mafic

421 ft - Fracture.

440-450 ft - Cuttings are lighter.

445 ft - Bit caught up on something. Lots of muscovite and biotite in samples

452 - 460 ft - Blow out (26in, max of caliper).

