

GLO1470

## GEO-NEWBERRY COREHOLE N-3

### Drilling History

GEO N-3 is located on the north flank of the Newberry volcano, 4,100 ft. north and 500 ft. east of the southwest corner of Sec. 24, T20S, R12E, in Deschutes County, Oregon. The hole was spudded on June 2, 1986 and completed on July 31, 1986. Out of 60 days operation, 47 were spent actually drilling, 7 days setting up BOP and cementing casing, 4 days handling technical problems, and 2 days logging the hole and rigging down.

Drilling progress was good in GEO N-3, even though several problems were encountered, such as extensive caving, lost circulation, BOP failure, stuck rods, and equipment breakdown. The penetration rate averaged 69 ft./day, (including days lost for technical problems). The drilling rate not including days lost on problems was 87 ft./day. There was approximately 92% core recovery. However, the core recovery varied with lithology. For instance, when drilling in andesitic flows, core recovery was 100%, while drilling in the frequently encountered cinder ash rocks, recovery was significantly lower. The cinder/ash lithology was also responsible for caving problems. Not only did caving behind the bit slow down the penetration rate, it caused rods to stick, and in one instance caused a loss of 138 ft. of previously drilled corehole.

There were two considerable time loss problems. The first delay occurred while cementing the casing and testing the BOP. The casing had to be cemented 3 times due to the permeable nature of the formations. In addition, the flange on the BOP had to be machined, and a technician called in to repair the hydril and ram preventor. The second major time loss occurred when rods became stuck at a depth of 1645 ft., 195 ft. off the bottom. A day was spent trying to loosen the rods with no results, so the HQ rods were left in the hole as casing, and the hole re-entered with NQ tools. It was then necessary to wait for bits, cement the HQ rods, drill out the cement, and since caving occurred below 1702 ft., regain lost footage.

A brief summary of the events, problems and cost of each segment of GEO N-3 is given in Appendix I, and a daily list of depth and events during drilling is given in Appendix II. The casing completion schematic is given in Appendix III. A tabular presentation of costs and average penetration rates is given in Appendix IV.

## APPENDIX I

### GEO N-3 Drilling History - Summary

June 2 - June 7

GEO N-3 was spudded with a 5 5/8 in. tricone bit and rotary drilled to a depth of 454 ft. Circulation was lost at 1 ft., therefore no cuttings have been collected. Caving occurred in the upper 40 ft. A 4 1/2 in. casing was run to 453 ft.

The average penetration rate was 76 ft./day for this phase of rotary drilling. This section required 2 tricone bits, as the first bit only penetrated 180 ft. At a depth of 358 ft., there was a dramatic slow down in drilling rate due to a formation change.

The cost to this point was \$33,680, including mobilization. Drilling costs averaged about \$55/ft.

June 8 - June 15

No additional depth was gained for 7 days, due to a variety of problems that occurred while cementing casing and testing the BOPE. After the cement was pumped in and the BOP hooked up, it became necessary to machine the flange on the BOP so that a tricone bit could fit through to drill out the cement. However, then it became apparent that the casing had to be cemented again, because the formation was very permeable and there were no returns, or cement to drill. After a second attempt at cementing, it was determined that the hydril and ram preventor were not working and a repair technician was called. Since the cementing job was still inadequate, a third attempt was made at cementing the casing, and this time was successful. The BOP test was then passed.

The cost for this phase of the project was \$33,682, bringing the total cost to \$66,362.

June 16 - July 29

Cored to 4002 ft. with good progress in spite of many difficulties. Core recovery averaged 92%. Core loss was

mainly due to cinder/ash lithology. Recovery was usually 100% when coring basaltic andesite. There were several times of difficult drilling in hard and broken formations. Caving problems consistently plagued the drilling operation, mostly in the cinder/ash lithology.

A significant 4 day time loss occurred when rods were stuck at 1645 ft. One entire day was spent trying to loosen the rods. It was then decided to leave the HQ rods in hole as casing and reduce to NQ rods. Since the hole had been lost below 1702 ft. due to caving, the HQ rods were pushed down to 1702 ft. and cemented in. It was also necessary to wait for new bits. An additional delay occurred when drilling out the cement; 3 ft. below the HQ rods, the bit was shot and it was necessary to POH to cement broken pieces of bit. The drilling proceeded until 1732 ft., still 108 ft. below original depth of hole, when a bit needed to be changed.

Other minor problems occurred during this phase, however, <sup>they did not</sup> ~~none~~ caused any serious time delays. At 1904 ft., the rods became stuck again. At 2262 ft. the water truck broke down, and drilling was shut down temporarily. At 3441 ft. the inner core tube stuck and a wireline was broken. There were several problems with the core dropping out of the inner barrel as well. Caving occurred often when pulling out of hole to change bit.

The average penetration rate for this section is 78.9 ft./day. The overall penetration rate is 69 ft./day. (Both these figures include days lost for technical problems). A total of 10 bits were used, averaging about 426 ft. each. (However, 2 bits were not used to determine this average due to circumstances that resulted from having to change from HQ rods to NQ rods). The water level remained static at approximately 1720 ft.

The drilling cost for this phase averaged \$72/ft. The total cost to this

point was \$322,824. The overall average drilling cost is \$78.5/ft.

July 30 - July 31

Geophysical logs <sup>a</sup>run, hole conditioned, and liner pipe put in. The rig then moved off the drilling site. The final total cost of project is \$360,443.

<u>Date</u> <u>Day/Mo.</u>	<u>Footage</u> <u>Drilled</u>	<u>Depth</u>	<u>Activity</u>
27 June	95'	1702'	Drilled 7 ft./hr. Mud loss and caving problems at 1685 ft.
28 June	138'	1840'	Rods stuck 140 ft. off bottom.
29 June	-0-	1840'	Rods stuck 195 ft. off bottom. Tried to loosen.
30 June	-0-	1702'	Hole lost below 1702 ft. due to caving problems. Pushed stuck rod down to 1702 ft. Hole will be re-entered and drilled out with NQ tools. Cemented in HQ rod.
1 July	-0-	1702'	Waited for bits, then drilled out cement.
2 July	-0-	1705'	Drilled 3 ft. below H rods - bit gone at 1705 ft. POH to cement broken pieces of bit.
3 July	1'	1841'	Drilled out cement and cave to depth of original hole. POH at 1732 ft. to change wrong bit and grease rods.
4 July	106'	1947'	Drilled ahead.
5 July	125'	2072'	Drilled 5.2 ft./hr. Static fluid level at 1720 ft.
6 July	69'	2141'	Stuck rods at 1904 ft. Freed rods, washed and reamed to bottom.
7 July	111.5'	2252.5'	Drilled 4.5 ft.-5 ft./hr. Caving between 2230 ft. and 2243. Static fluid level at 1720 ft.
8 July	66.5'	2319'	At 2262 ft. pulled rods back to 1700 ft. and cleaned hole. Water truck breakdown early this morning - shut down.
9 July	83'	2402'	Washed to bottom and resumed drilled after water truck delay. Fluid level static at 1740 ft.

<u>Date</u> <u>Day/Mo.</u>	<u>Footage</u> <u>Drilled</u>	<u>Depth</u>	<u>Activity</u>
10 July	126'	2528'	Caving between 2432 ft. and 2460 ft. in cinders and ash. Fluid level remained static at 1720 ft.
11 July	97'	2625'	2564 ft.-caving problems; sticky at 2610. Fluid level static at 1720 ft.
12 July	106'	2731'	Drilled 5 ft./hr.
13 July	63.5'	2794.5'	POH for bit change at 2751 ft. Encountered cave upon re-entry about 130 ft. off bottom. Drilled cave and washed back to bottom.
14 July	103'	2897.5'	Stuck rods at 2868 ft., worked free after 15 min. Muddy and sticky.
15 July	100.5'	2998'	Drilled ahead. Fluid level 1720 ft.
16 July	91'	3089'	Drilled ahead.
17 July	94'	3183'	Drilled ahead.
18 July	93'	3276'	Drilled ahead. Fluid level 1850 ft.
19 July	81'	3357'	Drilled ahead. Fluid level 1720 ft.
20 July	40'	3397'	Caving and torque problems at 3377 ft. POH at 3385 ft. for bit change. Tripped in greasing rods to 2650 ft., washed and reamed to 2800 ft. lowered to 3320 ft. and washed and reamed to bottom.
21 July	47'	3444'	Caving at 3397 ft., 3410 ft. Stuck inner tube at 3441 ft. Broke wire. POH to retrieve tube, changed bit (rerun bit). Tripped in greasing rods.
22 July	51.5'	3495.5'	Caving problems 3475 ft.-3495 ft.
23 July	37'	3532.5'	POH bit change at 3525 ft., tripped in greasing rods to 3480 ft., washed and reamed 3480 ft. to bottom. Fluid level at 1720 ft.

<u>Date</u> <u>Day/Mo.</u>	<u>Footage</u> <u>Drilled</u>	<u>Depth</u>	<u>Activity</u>
24 July	99.5'	3632'	Drilled ahead. Fluid level 1720 ft.
25 July	77'	3709'	Problems with dropping core out of inner tube at 3656 ft., 3691 ft.
26 July	83.5'	3792.5'	Drilled ahead.
27 July	86'	3878.5'	Drilled ahead.
28 July	82.5'	3961'	Drilled ahead.
29 July	41'	4002' TD	Completed drilling. POH. Rigged up Dresser Atlas; ran temperature, caliper and acoustic logs.
30 July		4002' TD	Temp., caliper, acoustic frac-log and neutron logs to TD Gamma, density log to approx. 1700 ft. (bottom of HQ rods in hole). Dismantled BOP, conditioned hole to TD and pumped hole abandonment mud.
31 July		4002' TD	Liner pipe (1.516 in. <sup>I.D.</sup> <del>casing</del> <del>dug</del> ). Successfully put in hole, filled with water and hung approx. 6 in. off bottom. Moved off drill site.

APPENDIX III

Well Completion Diagrams



APPENDIX IV

GEO N-3 COST AND PENETRATION RATES

	ROTARY 6/2-6/7	BOPE 6/8-6/15	CORING 6/16-7/29	LOGGING 7/30 - 7/31	OVERALL
COST PER PHASE	\$ 24,957	\$33,682	\$25 <del>6</del> ,462	\$ 37,619	\$360,443
CUMM. COST	\$ 33,680 *	\$ <del>67</del> ,362	\$ 322,824	\$ 360,443	
DRILLING RATE (incl. delays)	76 ft./day	---	79 ft./day	---	69 ft./day
DRILLING RATE (excluding delays ***)	76 ft./day	---	86.5/day	---	87.0 ft./day
COST/FT. (includes delays - does not include mobilization, logging or derigging)	\$55/ft.	---	\$72/ft.	---	\$78.5/ft. **

\* includes mobiliz. cost of \$8723

\*\* includes time spent setting up BOPE and cementing casing

\*\*\* does not include any other time than days spent actually drilling

APPENDIX II

Daily Drilling Activities

GEO N-3

<u>Date</u> <u>Day/Mo.</u>	<u>Footage</u> <u>Drilled</u>	<u>Depth</u>	<u>Activity</u>
2 June			Spuded with 5 5/8 in. X tricone.
3 June	35'	35'	Lost circulation at 1 ft.
4 June	105'	140'	Drilled 5 ft./hr. - caving - ream and wash required.
5 June	130'	270'	Changed bit at 180 ft. Caving in upper 40 ft.
6 June	120'	390'	At 358 ft. drilled slowed from 10 ft./hr. to 3 ft./hr. <sup>ing</sup>
7 June	64'	454'	Stopped drilled at 454 ft. POH, Reamed and washed hole. <sup>ing</sup> Start Run 4 1/2 in. casing to 453 ft. <sup>R.C.</sup>
8 June	-0-	454'	Pump in Portland type II cement. Set BOP and hydraulics to accumulator. I.D. of bottom flange too small to let 3 7/8 in. Tricone bit into hole to drill out cement. Lifted BOP - test delayed while flange <del>is being</del> <sup>was</sup> machined. <sup>R.C.</sup>
9 June	-0-	454'	Flange machined, BOP was reconstructed and hooked up, ran rods to bottom - no cement. Washed out hole, no returns pulled rods, cemented again.
10 June	-0-	454'	Lowered rods to 120 ft. hit cement. Drilled through cement to 390 ft. Not set up. Waited for cement to set.
11 June	-0-	454'	Drilled cement to 445 ft. Hydril and ram preventor tested negative due to faulty equipment. Sent for repair technician.

<u>Date</u> <u>Day/Mo.</u>	<u>Footage</u> <u>Drilled</u>	<u>Depth</u>	<u>Activity</u>
12 June	-0-	454'	BOP repaired late 6/11/86. Third attempt to cement casing/shoe made.
13 June	-0-	454'	Casing cemented, rehooked BOP, Drilled cement.
14 June	-0-	454'	POH, tested BOP and casing - positive, RIH, cleaned out cement, LCM, plugs.
15 June	111'	565'	Drilled 8 ft./hr. with HQ wireline.
16 June	151'	716'	Drilled at 6.3 ft./hr. Some recovery problems in cinder agglomerate.
17 June	86'	802'	Drilled 4 ft./hr. Caving problems behind bit has slowed advance. Core loss due to cinder/ash lithology. At 742 ft. changed bit.
18 June	95'	895'	Drilled 7.5 ft./hr. Rod broken at 135 ft. off bottom, but was successfully retrieved.
19 June	37'	932'	Ash falling on top of core barrel caused mislatch. Tripped out, greased rods, RIH.
20 June	134'	1066'	Drilled 5 ft./hr. Bad rod vibrations; tripped out and greased rods.
21 June	101'	1167'	Drilled 3 ft./hr.
22 June	74'	1241'	Drilled 3 ft./hr. Changed bit at 1241 ft.
23 June	86'	1327'	Drilled 3.6 ft./hr. Static water level approx. 1220 ft.
24 June	97'	1424'	Drilled 4 ft./hr. Caving problems.
25 June	105'	1529'	Drilled 4.4 ft./hr. Caving problems.
26 June	78'	1607'	Drilled 3.3 ft./hr. POH, greased and changed bit at 1570 ft. RIH