

GLO 1874

GEO-NEWBERRY COREHOLE N-1

Drilling History

GEO N-1 is located on the south flank of the Newberry volcano, 3500 ft. west and 2450 ft. north of the southeast corner of Section 25, T22S, R12E, in Deschutes County, Oregon. The hole was spudded on August 23, 1985, and a 4000 ft. depth was reached on October 20, 1985. GEO-Operator chose to continue drilling for several more days and reached a depth of approximately 4550 ft.; however, since the cooperative agreement between GEO-Operator and the DOE required the corehole only to extend to a 4000 ft. depth, and since the DOE did not share in the cost of the additional drilling, data past 4000 ft. is not in public domain.

In general, the drilling of GEO N-1 progressed smoothly. Drilling averaged 69 ft./day (including time lost for technical delays). The drilling rate based only on days of actual drilling averaged 77 ft./day. There was greater than 90% core recovery. There were two lost-time problems. The first occurred during rotary drilling: the drill rods parted, leaving rods, sub and bit in hole. It was necessary to spend time retrieving the fish as well as wait on the delivery of a new button bit. The second delay occurred with the testing of the BOP. When the BOP was tested, a weld leak was detected. After repair of the weld leak, the gates of the BOP appeared to be leaking also, thus requiring the O-rings to be replaced. This resulted in a lapse of 4 days between rotary and wireline drilling. However, problems of this nature are to be expected.

Total drilling fluid loss greatly increased the cost of the mud program. It does not appear that any efforts were made to regain circulation. However, since the lithology is volcanic rocks and lost circulation is typical in volcanic rocks, these efforts may have been futile.

A brief summary of the events, problems and cost of each segment of the corehole GEO N-1 is given in Appendix I, and a daily list of depth and events during drilling is given in Appendix II. A tabular presentation of costs and penetration rates is given in Appendix III.

APPENDIX I

GEO N-1 Drilling History - Summary

Aug. 23 - 30

GEO N-1 was spudded with a 5 5/8 in. tricone button bit and rotary drilled to a depth of 470', 5 ft. into hard rock, for the setting of the 4.5 in. casing. Circulation was lost at 2 ft. depth and never regained, therefore, cuttings samples have not been collected. Casing was run in the hole to 430 ft., where it encountered caving or tight hole. Casing with shoe was then drilled down to 468 ft.

The main problem occurred when drill rods parted leaving 9 rods, sub and bit in hole. This required a 4.5 in. bit to clean the hole and fish retrieval with a tap. There was also an additional delay in waiting for delivery of a new 5 5/8 in. button bit.

The average rotary drilling rate was 68 ft./day. The cost to this point was \$34,953. (not including cost of casing). Drilling cost averaged about \$68/ ft.

Aug. 31 - Sept. 3

No additional depth was gained during these four days. 40 cu. ft. of cement was pumped through casing, and 20 cu. ft. of cement was pumped through annulus. Then the BOP was nipped up. In the first test of BOP, a weld leak was detected. After the weld leak was repaired, the gates on the BOP were noticed to be leaking as well. Drilling ahead was approved on the condition of replacing the O-rings on BOP gates later. The estimated total cost at this point in the project was \$52,783, including cost of casing, cement job and damaged rods.

Sept. 4 - Oct. 20

Cored to an approximate depth of 4550 ft., however, drilling history is not available past 4000 ft. Core recovery was usually greater than 90%. The
which was reached
on October 20.

penetration rate averaged 76 ft./day for this section of drilling. The total penetration rate (entire 59 days) averaged 69 ft./day. A total of 9 core bits was used, averaging about 400 ft. each. Most of the time the static water level was at a depth of 1600 ft.

Several minor problems occurred while drilling the cored section of the hole, however, no serious delays resulted. One problem was the stripping of the bevel drive shaft, causing the rig to shut down while waiting for a replacement part. Other difficulties such as mud pump breakdown, core barrel sanded in, and breaking of wirelines, proved to cause only small delays in drilling.

The final T.D. of the hole is approximately 4550 ft. of which data is available to 4000 ft. Additional information is proprietary of GEO-Operator. The drilling cost for this section was \$66/ft. The total drilling cost for the entire corehole was \$286,559. The overall average was \$70.9/ft. (These figures do not include logging time and cost).

Nov. 1 - Nov. 9

After drilling was ceased, the hole was conditioned for logging, and the following geophysical logs were run: caliper, temperature, natural gamma, SP, 16" normal resistivity induction, acoustic velocity and acoustic fraclog. The cost of the geophysical logging was ? bringing the total cost of entire project to ?

APPENDIX II

Daily Drilling Activities

GEO N-1

<u>Date</u> <u>Day/Mo.</u>	<u>Footage</u> <u>Drilled</u>	<u>Depth</u>	<u>Activity</u>
23 Aug.			5 5/8 in. bit - Spud at 9:00 P.M.
24 Aug.	110'	110'	Circulation lost at 2 ft. depth. Rotary drilled 5 ft./hr. without returns. POH to grease rods at night.
25 Aug.	50'	160'	Rotary drilled 10 ft./hr. with no returns.
26 Aug.	40'	200'	Rotary drilled 3 ft./hr. with no returns.
27 Aug.	105'	305'	Drill rods parted leaving 9 rods, sub and bit in hole. RIH with 4 1/2 in. bit to clean hole.
28 Aug.	0	305'	Fish retrieved with tap. POH, waited for delivery of new 5 5/8 in. button bit.
29 Aug.	75'	375'	Drilled 3 ft./hr. with no returns.
30 Aug.	95'	470'	Hard rock began at 465 ft. POH, ran 4 1/2 in. casing with diamond shoe to 450 ft., tight hole necessitated turning casing to 468 ^{ft.}
31 Aug.	0	470'	Pumped 40 cu. ft. Portland type 1-P cement through casing, displaced with 13 cu. ft. water. No cement returns. Pumped 20 cu. ft. cement mixed with cotton seed hulls down annulus. Nippled up hydril, blind rams, pipe rams. Accumulator not functioning.
1 Sept.	0	470'	Accumulator repaired. Nippled up BOP, tested BOP. Weld leak detected.

<u>Date</u> <u>Day/Mo.</u>	<u>Footage</u> <u>Drilled</u>	<u>Depth</u>	<u>Activity</u>
2 Sept.	0	470'	Repaired weld leaks. Gates on BOP leaked; attempted to seal leaks. Drilling approved on condition of replacing O-rings on BOP gates when possible.
3 Sept.	0	470'	RIH with 3 15/16 in. tricone; tagged cement at 210 ft., drilled out cement. POH, picked up 3 25/32 in. core bit and barrel, RIH.
4 Sept.	109'	579'	Drilled 8-10 ft./hr.
5 Sept.	93'	672'	Drilled 6 ft./hr.
6 Sept.	42'	714'	Rig shut down; waiting ^{ed} for replacement part. Rig repaired. Bevel drive shaft stripped.
7 Sept.	55'	769'	Drilled ahead. New O-rings installed in BOP.
8 Sept.	82'	851'	At 787 ft., POH, changed bit. RIH drilled 5-6 ft./hr.
9 Sept.	45'	896'	Mud pump broke down. Rig shut down while new pump is obtained. Installed new pump, RIH. Drilled ahead.
10 Sept.	121'	1017'	Drilled 4-10 ft./hr. BOP test.
11 Sept.	135'	1152'	Drilled 5 ft./hr.
12 Sept.	98'	1250'	Drilled 5-6 ft./hr.
13 Sept.	125'	1375'	Drilled 4 ft./hr.
14 Sept.	27'	1402'	Drilled 7 ft./hr. At 1400 ft. POH, changed bit, RIH, drilled ahead, core barrel sanded in, POH, cleaned out. RIH, drilled ahead.
15 Sept.	110'	1512'	Drilled 5-7 ft./hr. Fluid samples taken from core barrel at 1402 ft. and 1512 ft.
16 Sept.	100'	1612'	Drilled 5-7 ft./hr.

<u>Date</u> <u>Day/Mo.</u>	<u>Footage</u> <u>Drilled</u>	<u>Depth</u>	<u>Activity</u>
17 Sept.	86'	1698'	Drilled 3-4 ft./hr. Fluid sampling tool ran at 1698 ft. Changed bits at 1698 ft.
18 Sept.	53'	1751'	Drilled 3-4 ft./hr.
19 Sept.	79'	1830'	Drilled 5 ft./hr. Fluid samples taken from core barrel at 1817 ft.
20 Sept.	75'	1905'	Drilled 4 ft./hr. Fluid samples from core barrel at 1900 ft.
21 Sept.	75'	1980'	Drilled 4-5 ft./hr. Water level 1200 ft.-1800 ft. depth. Repaired wireline.
22 Sept.	98'	2078'	Drilled 4 ft./hr. Collected fluid samples of core barrel at 2078 ft. Collected mud samples.
23 Sept.	99'	2177'	Drilled 4 ft./hr. Fluid level 1500 ft.
24 Sept.	117'	2294'	Changed O-ring on hydraulic ram. Fluid level 1600 ft.
25 Sept.	104'	2398'	Drilled 5 ft./hr. Fluid level 1600 ft. Fluid sampling tool would not function.
26 Sept.	54'	2452'	At 2424 ft., POH, changed bit, RIH. Fluid level at 1600 ft. Fluid samples from core barrel at 2412 ft.
27 Sept.	112'	2564'	Drilled 5 ft./hr. Fluid level 1600 ft.
28 Sept.	104'	2668'	Drilled 7 ft./hr.
29 Sept.	56'	2724'	At 2707 ft. POH; changed bit, fixed broken wireline, took fluid samples from core barrel. RIH, drilled ahead at 5 ft./hr.
30 Sept.	76'	2800'	Drilled 2-5 ft./hr. Fluid level 1600 ft.
1 Oct.	91'	2891'	Drilled 5 ft./hr.

<u>Date</u> <u>Day/Mo.</u>	<u>Footage</u> <u>Drilled</u>	<u>Depth</u>	<u>Activity</u>
2 Oct.	32'	2923'	Core tube stuck, wireline snapped, POH, repaired wireline, freed core tube, RIH. Drilled ahead 5 ft./hr. Fluid sample collected from core barrel at 2923 ft.
3 Oct.	73'	2996'	Drilled 4 ft./hr.
4 Oct.	106'	3102'	Drilled 3-5 ft./hr.
5 Oct.	65'	3167'	At 3109 ft. POH, changed bit, RIH, drilled 4-5 ft./hr.
6 Oct.	96'	3263'	Drilled 3-5 ft./hr.
7 Oct.	69'	3332'	Drilled 3-4 ft./hr.
8 Oct.	80'	3412'	Drilled 5 ft./hr.
9 Oct.	56'	3468'	Drilled 4 ft./hr. Fluid sample taken from core barrel at 3424 ft.
10 Oct.	78'	3545'	At 3545 ft. POH, changed bit. Fluid sample taken at 3545 ft.
11 Oct.	59'	3605'	RIH to 3540 ft., washed and reamed to T.D. Drilled ahead 5-6 ft./hr.
12 Oct.	30'	3635'	Mislatched, POH, cleaned tube and bit, RIH.
13 Oct.	37' ft.	3672'	Conducted time-temp. build up test, wireline snapped during testing. Fished for wireline-unsuccessfully, rigged up new set up to continue test.
14 Oct.	64'	3736'	Drilled 5 ft./hr.
15 Oct.	26'	3762'	At 3762 ft. POH, changed bit, RIH.
16 Oct.	22'	3784'	Drilled 4 ft./hr.
17 Oct.	73'	3857'	Drilled 4-5 ft./hr.
18 Oct.	61'	3918'	Drilled 4 ft./hr.

<u>Date</u> <u>Day/Mo.</u>	<u>Footage</u> <u>Drilled</u>	<u>Depth</u>	<u>Activity</u>
19 Oct.	72'	3990'	Drilled 4-5 ft./hr.
20 Oct.	69'	4059'TD	Drilled 4-5 ft./hr.
21 Oct. - 1 Nov.			GEO-Operator continued drilling without participation of Dept. of Energy - proprietary information.
2 Nov. - 7 Nov.			POH, removed BOP, rigged up Dresser Atlas; ran geophysical logs. Ran 1 1/2 in. tubing inside rods; filled tubing with water.
8 Nov.			Pumped Shur-Gel and tripped out rods, pumped LCM and Shur-Gel from top of hole, capped and locked tubing. Tonto rigs down.
9 Nov.			Temperature log by Geotech Data run; pipe locked, cellar covered with planks.

APPENDIX III

GEO-NEWBERRY N-1

COST AND PENETRATION RATES

	ROTARY 8/23-8/30	BOPE 8/31-9/3	CORING 9/4-10/20	LOGGING 11/1 - 11/9	OVERALL
COST PER PHASE	\$ 31,953	\$ 17,830	\$233,776	?	
CUMM. COST	\$ 34,953 *	52,783	286,559	?	?
DRILLING RATE (incl. delays)	68 ft./ day	---	76 ft./ day	---	69 ft./ day
DRILLING RATE (excluding delays ***)	78 ft./ day	---	76 ft./ day	---	76.6 ft./ day
COST/FT. (includes delays - does not include mobilization, logging or derigging)	\$68/ft.	---	\$66/ft.	---	\$70.9/ft. **

* includes mobiliz. cost of \$3000

** includes time spent setting up BOPE and cementing casing

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