

SOUTHWEST DRILLING AND EXPLORATION, INC.
GEOTECHNICAL SERVICES GROUP

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November 12, 1982

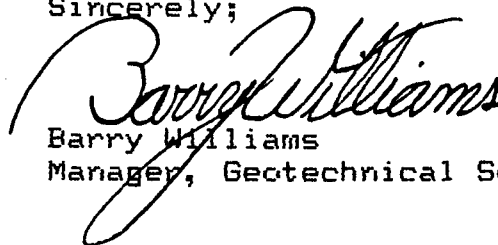
Dr. C. W. Berge
Grace Geothermal Corporation
970 E. 4800 S., Suite 2
Salt Lake City, Utah 84117

Dear Dr. Berge:

Enclosed please find copies of the Drilling History, Drilling Data Log, and daily Mud Logs with preliminary lithology descriptions for your geothermal test well No. 45-14 near Denio, Nevada. We will prepare a final report for this well as soon as the final temperature surveys are completed.

If you have any questions or would like further information, please do not hesitate to contact me.

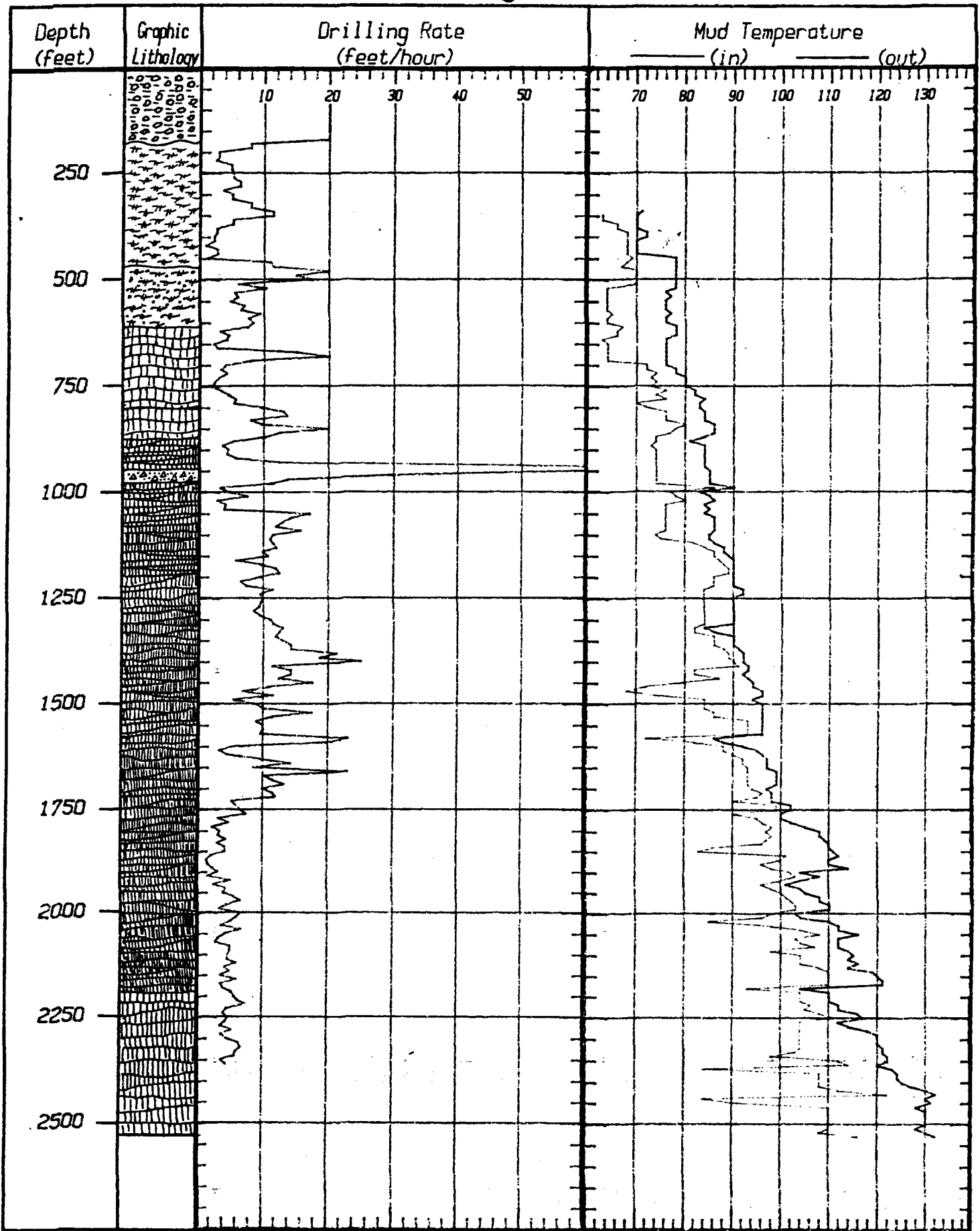
Sincerely;



Barry Williams
Manager, Geotechnical Services

Encl(s)
23-82

Drilling Data



DRILLING HISTORY

HOLE NO: 45-14
SWDX JOB NO: 23-82

DATE	DEPTH	SUMMARY OF OPERATIONS
9/21/82	0- 0	Move rig to site. Build road and pad. Dig one mud pit and rig up.
9/22/82	0- 0	Continue to rig up and dig second mud pit.
9/23/82	0- 0	Finish digging mud pits. Haul water and mix mud. Send flat bed truck to pick up casing.
9/24/82	0- 36	Stir up mud pits. Spud hole at 7:30 am with 17 1/2" bit and drill to 36' in alluvial fan deposits. Set 12 1/4" surface casing to 36'. Mix cement and pump down outside of casing. Build and install flowline.
9/25/82	36- 190	Make up 8 3/4" bottom hole assembly and drill to 147'. Trip to check bit. Run in hole with 9 7/8" bit and ream from 36' to 147'. Drill to 190' with 9 7/8" bit. Drilling in alluvial fan deposits to 180', rhyolite to 190'.
9/26/82	190- 280	Drill to 200'. Trip to check bit and adjust rotary table clutch linkage. Drill to 207'. Trip to lay down stabilizer and drill to 280' in rhyolite with 9 7/8" bit.
9/27/82	280- 394	Drill to 312' and encounter lost circulation zone. Loose 1/2 pit of mud. Mix mud and LCM. Regain circulation. Drill to 394' in rhyolite.
9/28/82	394- 407	Mix mud. Drill to 407' in rhyolite. Trip out of hole and make up 12 1/4" hole opener. Ream hole from 36'.
9/29/82	407- 421	Continue to ream hole with 12 1/4" hole opener to 407'. Trip out to lay down hole opener. Clean mud pits and mix mud. Run in hole with 9 7/8" bit and drill to 417'. Trip to lay down stablizer. Run in hole and drill to 421' in rhyolite.
9/30/82	421- 442	Drill to 442' in rhyolite. Trip out of hole. Make up hole opener. Run in hole and ream hole with 12 1/4" opener from 407'.

DATE	DEPTH	SUMMARY OF OPERATIONS
10/01/82	442- 442	Continue to ream hole with 12 1/4" hole opener to 418'. Pull out of hole. Gearhart logging hole. Run 9 5/8" casing. Unable to get casing past 320'. Pull casing out of hole.
10/02/82	442- 442	Continue to pull casing out of hole. Make up stacked hole opener. Run in hole with 12 1/4" stacked hole opener. Ream to straighten hole from about 280'.
10/03/82	442- 442	Continue to ream hole to straighten down to 403'. Pull out of hole and lay down pipe. Run 9 5/8" casing to 402'. Cement casing; good returns. Wait on cement.
10/04/82	442- 442	Wait on cement. Dig cellar for BOPE. Cut off casing, weld on well head and install BOPE. Test BOPE; passes test. Clean mud pits. Make up 8 3/4" down hole assembly.
10/05/82	442- 525	Run in hole with 8 3/4" bit. Tagged cement at 369'. Condition mud. Drill to formation 428'. Trip to change to 6 3/4" bit and stablizer. Drill in altered rhyolite to 525'. 500' to 520' is vesicular rhyolite and ash tuff.
10/06/82	525- 649	Drill with 6 3/4" bit to 649'. Drilling in vesicular rhyolite to 570', and rhyolite to 610'. Lithology change at 610' to andesite where drilling slows.
10/07/82	649- 736	Drill with 6 3/4" bit to 660'. Trip to change bit and drill to 736' in andesite.
10/08/82	736- 750	Drill to 750'. Pull out of hole to switch from mud to air. Run in hole. Encounter too much water (~200 GPM). Pull out of hole. Switch to mud and ream hole.
10/09/82	750- 881	Continue to ream hole with 6 3/4" bit to 750'. Trip to change bit. Drill to 881'. Lithology change at 870' to basalt.
10/10/82	881-1018	Drill to 940' in basalt, to 970' in ash flow tuff, to 990' in basalt, to 1018' in basalt/clay. Trip out of hole at 990' to clean 6 3/4" bit and put in jets.
10/11/82	1018-1228	Continue to drill with 6 3/4" bit from 1018' to 1228' in basalt.

DATE	DEPTH	SUMMARY OF OPERATIONS
10/12/82	1228-1483	Drill from 1228' to 1483' with 6 3/4" bit. Drilling in basalt with blue clay.
10/13/82	1483-1612	Drill with 6 3/4" bit to 1490' (still in basalt with blue clay). Thin mud and drill to 1570' in basalt. Trip out of hole to check bit. Clean mud pits and run maintenance on rig. Mix mud and run in hole with 6 3/4" bit. Drill to 1612' in basalt.
10/14/82	1612-1750	Drill with 6 3/4" bit to 1750' in basalt. Circulate to clean hole and drop drift tool (bad run). Run in hole and mix mud.
10/15/82	1750-1804	Drop drift tool again (6 deg off). Trip out of hole. Maintenance. Mix mud and run in hole with 6 3/4" bit, drill in basalt to 1804'. Drilling with reduced weight on bit to straighten hole.
10/16/82	1804-1872	Drill with 6 3/4" bit from 1804' to 1872' in basalt with ash/tuff.
10/17/82	1872-1913	Drill with 6 3/4" bit to 1895'. Mix mud and continue down to 1913' in basalt. Drop drift tool (3.25 deg off). Pull out of hole. Run maintenance on rig.
10/18/82	1913-1954	Rig maintenance. Run in hole with new 6 1/2" bit. Drill to 1920'. Mix mud and continue to 1954' in basalt.
10/19/82	1954-2038	Drill to 1994' with 6 1/2" bit. Circulate and drop drift tool (5.75 deg off). Pull out of hole, maintenance, run in hole. Drill ahead to 2038' with 6 1/2" bit in basalt.
10/20/82	2038-2132	Drill ahead to 2132' in basalt with 6 1/2" bit. At 2064' added water to pit to reduce viscosity of mud. Rig maintenance at 2114'.
10/21/82	2132-2184	Drill ahead to 2184' in basalt with 6 1/2" bit. Open 3rd mud pit and mix mud. Pull out of hole - 10 buttons missing from bit. Install new 6 1/2" journal button bit, mix mud and run in hole. Circulate and run wireline deviation survey (3.75 deg off). Pull out of hole - plugged float. Clean mud pump and lines.
10/21/82	2184-2268	Run in hole. Mix and condition mud. Drill with 6 1/2" bit to 2268' in basalt to 2190', to 2268' in andesitic basalt. Water added to mud pits at 2194', 2206', and 2254'.

DATE	DEPTH	SUMMARY OF OPERATIONS
10/23/82	2268-2375	Drill ahead with 6 1/2" bit to 2300' mixing mud at 2294'. Run wireline deviation survey at 2300' (2.25 deg off). Drill ahead to 2375' mixing mud at 2354'. Drilling in andesitic basalt 2268' to 2375'.
10/24/82	2375-2462	Maintenance (repair pump clutch yoke). Drill ahead to 2400'. Circulate and run wireline deviation survey (2.00 deg off). Drill ahead to 2434'. Maintenance (change hoisting line). Drill ahead to 2462', mixing mud at 2454'. Andesitic basalt 2375' to 2462'.
10/25/82	2462-2529	Drill ahead to 2500' with 6 1/2" bit. Circulate and run wireline deviation survey (bad run). Drill ahead to 2513', circulate, and run survey again (5.00 deg off). Drill to 2529' in andesitic basalt. Pull out of hole.
10/26/82	2529-2529	Maintenance (clean and re-install hoist line clutch). Clean mud pits and mix mud. Maintenance (change battery on rig, air line on draw works, and check gear boxes). Run in hole and mix mud. Problems with hoisting line clutch, will not pull pipe. Pull out of hole.
10/27/82	2529-2529	Maintenance on hoisting line clutch.
10/28/82	2529-2529	Make up 8 5/8" hole opener. Run in hole to 475'. Stir mud pits and mix mud. Ream hole from 475' to 758'.
10/29/82	2529-2529	Ream hole with 8 5/8" hole opener from 758' to 796'.
10/30/82	2529-2529	Pull out of hole and lay down pipe. Pick up and load equipment.
10/31/82	2529-2529	Run temperature survey on hole. TD = 2430'.
11/01/82	2529-2529	Rig down. Move rig to Denio Junction. Remove mud from pits.

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: 23-82

DATE: 9/26/82
 CLIENT: Gmce

DEPTH	DISCUSSION
180-190	Rhyolite - Aphanitic purple-gray, some chips (5%) with small vesicles, phenocrysts of feldspar (plagioclase) and quartz. Flow structure in some places. Alteration of feldspar shown by oxide staining, vesicles - some secondary mineralization. 5-10% of oxide stain. Calcite veins present.
190-200	Rhyolite - Rock type as above but higher degree of alteration, signs of calcite veining + iron sulfide.
200-210	Rhyolite - <5% vesicular frags, ~5% show oxide staining. Calcite veins.
210-220	Rhyolite - little or no vesicular frags. yellow-green clay alteration product occurring on frags and in some cases comprising complete frags. 4-5% total. Calcite veining.
220-230	Rhyolite - <5% show oxide stain. some calcite veins present.
230-240	Rhyolite - as above.
240-250	Rhyolite - as above.
250-260	Rhyolite - purplish-brown to purplish-gray, aphanitic groundmass. Phenocrysts of Qtz + hematite(?) which in some cases have a reddish-brown alteration ring. <1% of grains have green-yellow color. ~5% of fragments show reddish-yellow staining. Flow structure present on ~10% of fragments. little alteration + few if any calcite veins.
260-270	Rhyolite - As above with slightly more yellow-green clay (20% or more), and the presence of calcite veining.
270-280	Rhyolite - As above (in 260-270)

DEPTH feet	RATE ft/hr	MUD TEMP		BIT SIZE:	AIR:	MUD:
		in	out			
187-207	3.1			9 7/8"		X
207-217	2.7					VIS:
217-237	5.0			CASING: 12 3/4"	0-36'	WT:
237-257	5.3					pH:
257-277	6.3					

NOTES: Drilled from 190' to 280' with 9 7/8" bit

material hauls:
 mud - 6
 tail - 20.5
 top - 2
 main - .75
 misc. bit - .75

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: 23-82

DATE: 9/27/82
 CLIENT: Grace

DEPTH	DISCRIPTION
280 - 400	Rhyolite - purple-gray in color. Where oxidized reddish-brown Aphanitic groundmass. As above with fine crystals of Qtz, feldspar, + hornblende(?). Flow structure present on at least 20% of fragments. Alteration + deposits include calcite veins + a yellow-green clay. From 330-400' samples are slightly more red-brown in color - may possibly a slight change in composition(?). Fragment size increases in the intervals of 310-330' and 360-400' possibly indicating zones where the rock is more fractured.

DEPTH feet	RATE ft/hr	MUD TEMP in out	
<u>277-297</u>	<u>3.8</u>		
<u>297-315</u>	<u>5.1</u>		
<u>315-337</u>	<u>9.0</u>		<u>71</u>
<u>337-357</u>	<u>11.4</u>	<u>63</u>	<u>70</u>
<u>357-377</u>	<u>5.3</u>	<u>66</u>	<u>70</u>
<u>377-397</u>	<u>2.9</u>	<u>68</u>	<u>72</u>

BIT SIZE: 9 7/8" AIR: _____ MUD: X
 VIS: _____
 CASING: 12 3/4" 0-36' WT: _____
 PH: _____

NOTES: Drilled from 280-397 feet with
9 7/8" bit. Lost circulation at
312' lost 1/2 in. recirc. by adding
4 sacks back.

min _____ hours _____
mud - 23 drit - 22.25
Back - 4 min mud - 1.
circ - .75

MUD LOG

HOLE NO: 45-14
SWDX JOB NO: 23-82

DATE: 9/30/82
CLIENT: Grace

DEPTH	DISCRPTION
420-440	Rhyolite - Rhyolite as above with the addition of a light-gray ash(?) occurring as softer rounded fragments. Alteration as above.

DEPTH feet	RATE ft/hr	MUD TEMP in out
<u>421-427</u>	<u>2.9</u>	_____
<u>437-442</u>	<u>1.4</u>	_____

9 7/8" TO 442

BIT SIZE: 12 3/4" AIR: _____ MUD: X

CASING: 12 3/4" 0-36 VIS: 45-44

WT: 11

PH: 9

NOTES: Drill with 9 7/8" bit to 442'. Make up hole spacer and ream with 12 3/4" ream 400'.

ream = 6.5

make up hole spacer + trip = 2.5

MUD LOG

HOLE NO: 75-14
 SWDX JOB NO: 23-82

DATE: 10/1/82
 CLIENT: Grace

DEPTH	DISCRPTION

DEPTH
feet

RATE
ft/hr

MUD TEMP
in out

BIT SIZE: 12 1/4" AIR: _____ MUD: λ
 VIS: 41-50
 CASING: 12 3/4" 0'-36' WT: 10.7
 pH: 9

NOTES: reamed hole with 12 1/4" to #18'.
Geopart. Open lower note. Ran casing
(95/8) but hit casing at 10:30³²⁰ pulled out
casing.

MUD LOG

HOLE NO: 45-14
SWDX JOB NO: 53-82

DATE: 10/3/82
CLIENT: -115

DEPTH	DISCRPTION

DEPTH feet	RATE ft/hr	MUD TEMP in out			
			BIT SIZE: <u>12 3/4"</u> AIR: _____ MUD: <u>X</u>		
			CASING: <u>12 3/4" 0-36'</u> VIS: <u>45-47</u>		
			<u>9 5/8" 2-402'</u> WT: <u>10.6</u>		
			PH: <u>8</u>		
			NOTES: <u>Continue running to 403' @ 10:45a.</u>		
			<u>Trip out of hole. Run casing. Cement.</u>		
			materials hours		
			<u>mud - 13</u> run - <u>10.75</u> wait on cement - <u>3.5</u>		
			<u>bar - 2</u> Trip - <u>1.75</u>		
			<u>cement - 155</u> run casing - <u>5.0</u>		
			<u>wait on cement - 3</u>		

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: 23-82

DATE: 10/5/82
 CLIENT: Grace

DEPTH	DISCRIPTION
440-450'	Rhyolite - Rhyolite as above, alteration as above.
450-460'	Rhyolite + Vesicular Rhyolite - Rhyolite as above with the addition of 10-20% vesicular fragments which are aphanitic. Also present is rhyolitic breccia in amounts of 5-10%. Alteration: Slight argillization of sample with oxide staining. Vesicular grains in most cases are filled with calcite or calcite clay(?). Breccia + vesicular grains more argillized.
460-470'	Rhyolite + Rhyolite breccia - Rhyolite + Alteration as described above but an increase of breccia to 10-20% of sample.
470-480'	As above but slightly increased argillization
480-490'	As above but increasing argillization of sample to clay and increased oxidation giving some of fragments a red-brown color. 5% light-gray ash or argillized grains. Possibly some fault gouge.
490-500'	Vesicular Rhyolite - Aphanitic vesicular rhyolite with 15-20% rhyolitic chips without vesicles as described above. Alteration: Sample fairly well argillized more than above. Calcite + qtz as veins. Fault gouge occurs a light pink in color + soft. Oxidation to red-brown
500-510'	Vesicular Rhyolite - As above not as argillized

DEPTH feet	RATE ft/hr	MUD TEMP in	MUD TEMP out
440-450		69	78
450-460	11.5	68	78
460-470	11.5	67	78
470-480	20.0	70	78
480-490	15.0	70	79
490-500	17.5	70	78
500-510	6.1	70	78

BIT SIZE: 7 7/8" TO 428
6 1/4" TO 440 AIR: _____ MUD: X
6 3/4" TO 525
 CASING: 12 3/4" O-36 VIS: 34-34
9 5/8" O-402 WT: 10.5
 PH: 9

NOTES: Drill out cement plug - nit formation at 428. drill ahead with 6 3/4" to 525'.

11.57 hrs 11.00 hrs
Mud - 10 drill - 10 1/2 run - 1
Linger - 2 Top - 4 3/4 man + fuel - 4
run - out and - 1 1/2

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: 23-82

DATE: 10/6/82
 CLIENT: Grice

DEPTH	DISCRIPTION
510-520	Vesicular Tuff - Light beige to brown vesicular ash fall(?) Tuff. Vesicles lined or filled with calcite(?). 10-20% rhyolite chips. The tuff crumbles easily and not all fragments have vesicles. Alteration: Some yellow-green clay and vein deposits of calcite.
520-530	Vesicular Tuff - As described above, but % of fragments with vesicles decreasing.
530-540 540-550	Vesicular Rhyolite - Red brown oxidized vesicular rhyolite. Aphanitic groundmass. 50% contain vesicles. 10-20% light Tuff fragments. Alteration: Vesicles filled or lined + deposits on grains of clay + calcite, argillization.
550-560 560-570	Vesicular Rhyolite - Vesicular rhyolite as described above, grains larger due to less argillization(?). Vesicles still lined or filled, little or no tuff appears.
570-580 580-590 590-600 600-610	Rhyolite - Red-brown rhyolite aphanitic groundmass. sample appears to be fairly well argillized. Calcite still the main vein deposit mineral. Horizon 590-600 appears to be a vesicular more mafic rock (possibly basalt?).

(continued)

DEPTH feet	RATE ft/hr	MUD in	TEMP out
510-520	10.3	64	78
520-530	5.6	64	76
530-540	6.0	64	77
540-550	5.0	64	76
550-560	7.0	64	76
560-570	6.6	64	76
570-580	9.4	65	77
580-590	7.7	64	76
590-600	8.3	64	76
600-610	7.5	67	78
610-620	3.3	66	78
620-630	4.0	66	78
630-640	4.3	63	76

BIT SIZE: 6 3/4" JSS AIR: _____ MUD: X
 CASING: 12 3/4" 0-33 VIS: 24-36
9 5/8" 0-402 WT: 7.5-8.5
 PH: 11-12

NOTES: drilling 525-6:19

material _____
 mud - 12 _____
 lian - 2 _____
 Detergent - 5 gal _____

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: 23-22

DATE: 10/7/82
 CLIENT: Grace

DEPTH	DISCRIPTION
640-650	Andesite - Andesite as described above. Alteration as described above. Flicksides still present on some grains. Fragments slightly smaller in size (more dense?).
650-660	Andesite - Andesite as described above. Alteration as described above. Fragment size slightly larger again.
660-670	
670-680	
680-690	
690-700	Andesite - Andesite as described above. Alteration: little or no argillization, very little clay or vein deposits. little or no oxidation of whole grains mostly selected hornblende phenocrysts if any. From 690-700' there appears to be some fault gouge. Fragment size slightly larger 710'-720'.
700-710	
710-720	
720-730	

DEPTH feet	RATE ft/hr	MUD in	TEMP out
640-650	2.4	64	76
650-660	2.8	64	76
660-670	15.0	64	76
670-680	2.0	64	76
680-690	7.9	64	76
690-700	4.2	72	76
700-710	3.5	72	73
710-720	4.3	74	78
720-730	3.2	73	80

BIT SIZE: 6 3/4" TO 670'
6 1/4" TO 736' AIR: _____ MUD: X
 CASING: 12 3/4" O-26 VIS: 25-27
9 5/8" O-402 WT: 3.8
 pH: 11

NOTES: drill 244 with 6 3/4" bit to 670'
Trip + change bit to 6 1/4" drill to
736'

materials _____ hours _____
 deframer - 5 gal _____ drill - 21.5
 _____ man - 1
 trip - 1.5

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: 23-82

DATE: 10/9/82
 CLIENT: Grace

DEPTH	DISCRIPTION
750-760	Andesite - Andesite as described above. Alteration: little or no alteration - some staining (5%). Fault gouge present for the entire interval. little or no yellow-green clay.
760-770	
770-780	
780-790	
790-800	
800-810	
810-820	Andesite - Andesite as described above. Alteration: yellow-green clay 10-20% of grains. Shows staining. little agglutination.
820-830	Andesite - Andesite as described above. Alteration: little or no clay 5-10% of grains show staining. little or no agglutination. calcite veining(?)
830-840	Andesite - Andesite + Alteration as described above but fragment size slightly larger.
840-850	Andesite - Andesite as described above with the addition of a vesicular red-brown ash tuff(?). Vesicles lined or filled with calcite(?) + obsidian. Alteration: yellow-green clay calcite deposits. oxide staining (10-20%).
850-860	
860-870	Andesite to Basalt - Andesite as described above. red-brown ash tuff as described above. some obsidian. Some grains of basalt described below.
870-880	Basalt - Black-gray aphanitic Basalt. Massive structure, cryptocrystalline, with phenocrysts of plagioclase, pyroxene, + olivine(?). Alteration: minor staining, fault gouge.

DEPTH feet	RATE ft/hr	MUD TEMP in	out
750-760	3.4	76	82
760-770	4.6	74	82
770-780	5.7	76	84
780-790	5.5	70	83
790-800	9.7	72	83
800-810	13.0	76	84
810-820	13.6	76	84
820-830	8.1	76	84
830-840	9.7	80	86
840-850	20.0	78	86
850-860	12.5	77	86
860-870	10.3	74	84
870-880	5.5	74	81

BIT SIZE: 6 3/4" AIR: _____ MUD: X
 CASING: 12 3/4" 0-36 VIS: 38
4 5/8" 0-402 WT: 8.6 8.7
 PH: 11

NOTES: Ream hole to 750'. Change bit new 6 3/4" and drill ahead to 881.

mud-23 hours
drill-18 1/2 ream-2
lcm-2 trip-1 1/2
mix mud-2

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: 23-82

DATE: 10/10/82
 CLIENT: GRACE

DEPTH	DISCRIPTION
880-890 890-900 900-910 910-920	Basalt - Basalt as described above with ^{magnetite} hematite (?). Alteration: orange alteration of hematite. fault gouge and a little alteration of the basalt to clay (<5%). Some calcite veining.
920-930	Ash flow tuff - light gray white to brown white ash flow tuff. mostly washed out of sample. Remainder is basalt chips + obsidian + some qtz. Alteration: Blue + yellow-green clay filling veins + veins.
930-940 940-950 950-960 960-970	Ash flow tuff - as above but 60-70% basalt 20-30% obsidian. From 950-970 more of the ash is present.
970-980	Basalt - Basalt as described above. Presence of <20% ash fragments. Alteration: staining of some grains. Calcite veining.
980-990	Basalt - Basalt as described above with the addition of some (<20%) vesicular basalt which is altered to a red-brown. Calcite veining + qtz veining.
990-1010	Altered Basalt - Basalt as described above (<20%). Bluish gray product of basalt alteration. Brown product of vesicular grains. Calcite + qtz veining yellow-green clay present.

DEPTH feet	RATE ft/hr	MUD TEMP in	MUD TEMP out
880-890	3.8	73	84
890-900	4.6	74	84
900-910	4.5	74	84
910-920	5.8	74	84
920-930	12.5	74	84
930-940	60.0	74	84
940-950	60.0	74	85
950-960	30.0	74	85
960-970	13.7	74	85
970-980	11.5	74	85
980-990	3.4	86	90
990-1000	4.8	77	83
1000-1010	7.5	78	85

BIT SIZE: 6 3/4" AIR: _____ MUD: X
 VIS: 27 34
 CASING: 12 3/4" 0-36' WT: 8.7 9
9 5/8" 0-402' PH: 11 10

NOTES: Drill with 6 3/4" to 990. Trip to
put in jets for clay. drill to 1018"

materials hours
Detergent-5 drill-22
Trip-2

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: 23-82

DATE: 10/11/82
 CLIENT: Grace

DEPTH	DISCRIPTION
1010-1020 1020-1030	Basalt - Basalt as described above with the presence of fault gouge + calcite as veins. Green serpentinized basalt (<1%) or clay. 1020-1030 less calcite as veins.
1030-1040 1040-1050	Basalt - Basalt as described above. Alteration: green clay or serpentinized basalt. Brown clay grains soft makes up ~20% of sample (Zones of altered basalt?) Some fault gouge (little)
1050-1060 1060-1070 1070-1080	Basalt - Basalt with composition as described above but crystals slightly larger giving blockier appearance. Possibly from argillization (?) <5% brown clay fragments. Alteration of low magnitude in some grains Calcite veining
1080-1090	Basalt - Basalt as described above. Much more argillized giving brown clay (~40%)
1090-1100 1100-1110 1120-1120 1120-1130 1130-1140	Basalt - Basalt as described above. Alteration: <1% Brown clay ~5% green-gray clay? from argill Calcite veins.
1140-1150	Basalt - Basalt + Alteration as described above with the addition of oxidation of the magnetite to yellow-orange and less argillization of Basalt to green clay <5%.

DEPTH feet	RATE ft/hr	MUD TEMP in	MUD TEMP out
1010-1020	3.0	80	86
1020-1030	7.2	76	87
1030-1040	4.0	76	85
1040-1050	17.1	76	84
1050-1060	14.3	76	86
1060-1070	13.0	76	86
1070-1080	12.0	76	86
1080-1090	15.8	76	86
1090-1100	11.5	74	85
1100-1110	11.1	75	85
1110-1120	11.5	82	86
1120-1130	12.0	84	88
1130-1140	0.0	86	88
1140-1150	10.7	86	89
1150-1160	5.9	87	90

BIT SIZE: 6 3/4" AIR: _____ MUD: X
 CASING: 12 3/4" 0-36' VIS: 33 35
9 5/8" 0-402' WT: 9
 PH: 11 9

NOTES: drill ahead 1018' to 1228.

 material _____
 Mud - 8 _____
 Pore - 1 _____

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: 23-82

DATE: 12/12/82
 CLIENT: Grace

DEPTH	DISCRIPTION
1220-1230	Basalt - The basalt black to green-black or oxidized to a red-brown. Alteration: Sample appears to slightly Argillized and the magnetite altered to yellow-orange. Calcite veining.
1230-1240	Basalt - Basalt as above. Alteration as above but with much more alteration of the magnetite (on 15% of grains).
1240-1250	Basalt - Basalt as above but black 80% red-brown 30%. Alteration: As above but less alteration of magnetite (on 5% of grains).
1250-1260	
1260-1270	
1270-1280	Basalt - Basalt as above < 5% red-brown. Alteration as above but with less alteration of the magnetite.
1280-1290	
1290-1300	
1300-1310	Basalt - Below this point basalt is argillized to the point of almost a clay. crumbles fairly easily + fragments are subrounded to cubangular
1310-1320	
1320-1330	
1330-1340	Basalt - Basalt as above. Alteration as above 5% mag alteration
1340-1350	Basalt - Basalt + alteration as above < 5% mag alter But larger fragment size. maybe slightly less argillization
1350-1360	
1360-1370	
1370-1380	
1380-1390	
1390-1400	
1400-1410	
1410-1420	1420-1430 down to 140-1470
	1430-1440

DEPTH feet	RATE ft/hr	MUD in	TEMP out
1220-1230	11.5	84	92
1230-1240	9.7	84	92
1240-1250	10.0	84	90
1250-1260	9.7	84	90
1260-1270	9.4	84	90
1270-1280	8.6	84	90
1280-1290	9.4	84	90
1290-1300	11.1	84	90
1300-1310	11.5	84	90
1310-1320	13.0	82	84
1320-1330	12.5	82	86
1330-1340	12.0	86	90
1340-1350	13.0	86	90
1350-1360	14.3	86	90
1360-1370	14.3	88	91

BIT SIZE: 6 3/4" AIR: _____ MUD: X
 CASING: 12 3/4" 0-36' VIS: 35 36
9 5/8" 0-402' WT: 9.5 9.6
 PH: 11 9

NOTES: Drill ahead from 1228' to 1483'.

Materials hours
 mud - 8 drill - 22 3/4
 cmc - 1/4 mix mud - 24
 main - 1/2

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: 23-82

DATE: 10/13/82
 CLIENT: Grace

DEPTH	DISCRIPTION
1480-1490	Basalt - Argillized to almost clay black-gray mudstone
1490-1500	Basalt - Slightly less argillization than above but more oxidation of magnetite. Calcite
1500-1510	
1510-1520	Basalt - Once again argillized to almost a clay, but not as bad as 1480-1490. Calcite ~5%
1520-1530	
1530-1540	
1540-1550	
1550-1560	Basalt - Argillized to almost clay as in 1480-1490 Calcite appears to amounts of 5%
1560-1570	
1570-1580	Andest- Basalt(?) - As above but with trace amounts of biotite upto 5%. Calcite to 50-10% ↳ Biotite from LCM
1580-1590	
1590-1600	Basalt - As in 1550-1560. Calcite ~10%
1600-1610	

DEPTH feet	RATE ft/hr	MUD TEMP	
		in	out
1480-1490	5.5	84	94
1490-1500	9.1	84	96
1500-1510	10.0	84	96
1510-1520	17.6	86	96
1520-1530	11.5	86	96
1530-1540	9.1	93	96
1540-1550	10.0	93	96
1550-1560	10.0	93	96
1560-1570	9.7	93	96
1570-1580	23.1	72	86
1580-1590	20.0	82	88
1590-1600	5.2	88	92
1600-1610	3.4	88	95

BIT SIZE: 6 3/4" AIR: _____ MUD: X
 CASING: 12 3/4" 0.36 VIS: 3.5 3.5
9 5/8" 0.402 WT: 7.4 8.8
 pH: 10 9

NOTES: Drill ahead 1483 to 1612.

materials	hours
mud - 23	dall - 1.5
Detergent - 10 gal	trip - 2 1/2
oil - 2	main - 3 1/2
lime - 1/4	mix mud - 10 pits - 3
Lignite - 2	
LCM - 2	

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: 23-82

DATE: 10/14/82
 CLIENT: Grice

DEPTH	DISCRIPTION
1610-1620	Basalt-Andesite(?) - sample well argillized. biotite ^{from 1-2cm} present frags black to purple-gray to red brown frags much smaller (fine to medium) Calcite present, qtz(?) present
1620-1630	Basalt-Andesite - as above with the presence of a red-clay ^{brown}
1630-1640 1640-1650	Basalt Vesicular - red brown clay still present. Some frags have vesicles filled with calcite. oxidation + magnetite. Red clay could be oxidized + leached contacts. Calcite present
1650-1660 1660-1670	Basalt - black-gray + green black basalt fragments + green possibly serpentinite. calcite present 5%
1670-1680 1680-1690 ↓ 1750	Basalt - moderately argillized. calcite present. green-black + black fragments. green frags more argillized

DEPTH feet	RATE ft/hr	MUD TEMP in out
1610-1620	4.6	
1620-1630	9.7	92 97
1630-1640	14.3	92 97
1640-1650	8.6	93 97
1650-1660	23.1	93 99
1660-1670	10.3	93 99
1670-1680	11.5	93 99
1680-1690	13.0	93 99
1690-1700	10.0	94 97
1700-1710	11.5	96 98
1710-1720	12.0	95 98
1720-1730	5.4	90 99
1730-1740	6.0	99 102
1740-1750	6.7	99 102

BIT SIZE: <u>6 3/4"</u>	AIR: _____	MUD: <u>X</u>
CASING: <u>12 3/4"</u>	<u>0-36'</u>	VIS: <u>35</u>
<u>9 5/8"</u>	<u>0-402</u>	WT: <u>7</u>
		pH: <u>9</u>
NOTES: <u>Drill ahead 1612-1700. Drop</u> <u>drift tool at 1750'</u>		
<u>Mud - 15</u>	<u>hour -</u>	
<u>Mud - 14</u>	<u>drill - 16 1/2</u>	
<u>Drill - 5</u>	<u>top - 4 3/4</u>	
<u>hour - 1</u>	<u>drill - 1 3/4</u>	
<u>CAC - 1/2</u>	<u>circ - 1</u>	

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: 23-82

DATE: 10/17/82
 CLIENT: Grace

DEPTH	DISCRIPTION
1870-1880	<u>BASALT</u> - Aphanitic argillized black basalt w/ magnetite 30% white ash to grey-pink tuff w/ plag+qtz xls Alteration: minor calcite & hematite-goethite? alteration of ferromagnesium minerals
1880-1890	(AS ABOVE)
1890-1900	(AS ABOVE)
1900-1910	<u>BASALT</u> - Aphanitic black basalt 20% white/grey tuff w/ plag+qtz xls Alteration: calcite

DEPTH feet	RATE ft/hr	MUD TEMP in out
<u>1870-1880</u>	<u>1.7</u>	<u>96 110</u>
<u>1880-1890</u>	<u>2.5</u>	<u>98 114</u>
<u>1890-1900</u>	<u>3.3</u>	<u>102 104</u>
<u>1900-1910</u>	<u>1.8</u>	<u>103 108</u>

BIT SIZE: <u>6³/₄"</u>	AIR: _____	MUD: <u>X</u>
CASING: <u>12³/₄"</u>	<u>0-36'</u>	VIS: <u>45</u>
<u>9⁵/₈"</u>	<u>0-402</u>	WT: <u>2.7</u>
		pH: <u>8</u>

NOTES: Drill ahead to 1913 with 6³/₄" bit. Drop drill tool 3¹/₂ degrees. Trip out of hole. Rig maintenance.

materials	hours
<u>mud - 6</u>	<u>drill - 17.0</u>
	<u>trip - 1.25</u>
	<u>min mud - .5</u>
	<u>main - 5.0</u>

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: 23-82

DATE: 10/21/82
 CLIENT: GRACE

DEPTH	DISCRPTION
2132' MIDNITE	
2130-2140	BASALT - Black aphanitic basalt w/ magnetite 10% white-grey crystal tuft red-orange alteration of ferro magnesium minerals w/ minor secondary calcite & chalcedony
2140-2150	(AS ABOVE) increasing tuft to ~ 15%
2150-2160	(AS ABOVE)
2160-2170	(AS ABOVE)
2170-2180	BASALT - Black aphanitic basalt w/ some red, brn + blue grey microphyritic basalt & welded tuft chips Alteration as above
2184'	

DEPTH feet	RATE ft/hr	MUD TEMP in out
2130-2140	3.8	110 120
2140-2150	6.1	110 121
2150-2160	3.8	110 121
2160-2170	4.1	93 104
2170-2180	5.4	104 110

BIT SIZE: 6 1/2 AIR: _____ MUD: X

CASING: _____ VIS: 40

_____ WT: 9.5

_____ pH: 7.0

NOTES: PULL PIPE @ 2184 TO -16" BIT - 10 BENTONS
MISSING, RUN DEV SURVEY @ 2184' WITH
WIREFRAME UNIT 3.75° OFF VERTICAL

INSTALL NEW BIT HIGH SPEED BURTON BIT
@ 2184'

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: 23-82

DATE: 10/22/82
 CLIENT: GRACE

DEPTH	DISCRIPTION
2184 @ MIDNITE	
2180-2190	BASALT - ANDESITIC BASALT TRANSITION
2190-2200	ANDESITIC BASALT Grey-green microporphyritic andesitic basalt with calcite micro veins, plagioclase microphenocrysts some magnetite - 5-10% white to red crystal tuff - Qtz, plag & biotite x - Alteration: secondary calcite & some red-orange alteration of ferromagnesium minerals
2200-2210	(AS ABOVE)
2210-2220	(AS ABOVE)
2220-2230	(AS ABOVE)
2230-2240	(AS ABOVE)
2240-2250	(AS ABOVE)
2250-2260	(AS ABOVE)
2268' @ MIDNITE	

DEPTH feet	RATE ft/hr	MUD TEMP in out	
2180-2190	5.8	104	110
2190-2200	16.4	104	110
2200-2210	7.5	106	112
2210-2220	4.7	105	112
2220-2230	4.2	108	116
2230-2240	4.9	111	117
2240-2250	4.5	104	112
2250-2260	3.8	104	114

BIT SIZE: 6 1/2 AIR: _____ MUD: X
 CASING: _____ VIS: 42
 _____ WT: 9.4
 _____ PH: 9.0

NOTES: _____

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: _____

DATE: 10/23/82
 CLIENT: GRACE

DEPTH	DISCRIPTION
2268 MID	
2260-2270	ANDESITIC BASALT - Grey-green microporphyrific andesitic basalt waxy luster on some chips, plagioclase microphenocrysts with some magnetite calcite veins and chips - 5-10% white to red crystal tuff - plagioclase & biotite xls - Alteration: secondary calcite and red orange alteration of ferromag minerals
2270-2280	(AS ABOVE)
2280-2290	(AS ABOVE)
2290-2300	(AS ABOVE)
2300-2310	(AS ABOVE)
2310-2320	(AS ABOVE)
2320-2330	(AS ABOVE)
2330-2340	(AS ABOVE)
2340-2350	(AS ABOVE)
2350-2360	(AS ABOVE)
2360-2370	(AS ABOVE)
2375 MIDDLE	

DEPTH feet	RATE ft/hr	MUD TEMP in out
2260-2270	5.4	104 118
2270-2280	3.9	104 120
2280-2290	4.7	104 120
2290-2300	6.5	104 120
2300-2310	6.8	104 121
2310-2320	6.1	103 121
2320-2330	5.9	98 122
2330-2340	3.8	112 122
2340-2350	4.5	114 120
2350-2360		84 123
2360-2370		108 124

BIT SIZE: 6 1/2 HPSMS AIR: _____ MUD: X
 CASING: _____ VIS: 54-46_{out}
 _____ WT: 9.4
 _____ pH: 9

NOTES: PIU LEAK IN CASING @ 2300' → 2 1/4" OFF VERTICAL

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: _____

DATE: 10/24/82
 CLIENT: GAFK

DEPTH	DISCRIPTION
2375 m/d	
2370-2380	ANDESITIC BASALT - Grey-green, microporphritic andesitic basalt waxy, sugary luster - plagioclase phenocrysts - calcite chns and veins in basalt - 5 to 10% white, yellow, & red clay-tuff w/ xls of plq qtz and biotite - Alteration of ferromag minerals to red-orange hematite-goethite? and some brown grey clay
2380-2390	(AS ABOVE)
2390-2400	(AS ABOVE)
2400-2410	(AS ABOVE)
2410-2420	(AS ABOVE)
2420-2430	(AS ABOVE)
2430-2440	(AS ABOVE)
2440-2450	(AS ABOVE)
2450-2460	(AS ABOVE)
2460 @ MIDNITE	

DEPTH feet	RATE ft/hr	MUD TEMP in	MUD TEMP out
2370-2380		108	124
2380-2390		108	124
2390-2400		108	125
2400-2410		108	127
2410-2420		112	130
2420-2430		122	132
2430-2440		84	130
2440-2450		90	131
2450-2460		110	128

BIT SIZE: 6 1/2" 111105 AIR: _____ MUD: X
 CASING: _____ VIS: 46-47
 WT: 9.7
 pH: 9

NOTES: RUN DEVIATION SURVEY AT 2450' - 2° OFF VERTICAL
INCREASE WEIGHT ON BIT TO 1200#

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: _____

DATE: 10/25/65
 CLIENT: GRAPE

DEPTH	DISCRIPTION
2462 @ MID	
2460-2470	<u>ANDESITIC BASALT</u> - Grey-green, microporphritic basalt waxy to sugary luster - plagioclase crystals with calcite veins - 5% white to yellow clay tuff with plagioclase & biotite crystals - Alteration of ferromag minerals (m. in) to hematite-goethite
2470-2480	(AS ABOVE)
2480-2490	(AS ABOVE)
2490-2500	(AS ABOVE)
2500-2510	(AS ABOVE)
2510-2520	(AS ABOVE)
2520-2529 @ MID	(AS ABOVE) ↑ VERY LITTLE VARIATION

DEPTH feet	RATE ft/hr	MUD TEMP in out
2460-2470		
2470-2480		
2480-2490		
2490-2500		
2500-2510		
2510-2520		
2520-2529'		

BIT SIZE: 6 1/2 IN SMT AIR: _____ MUD: X
 VIS: 40-43
 CASING: _____ WT: 7.3
 PH: ?

NOTES: RUN DEVIATION SURVEY @ 2515'
- 5°
- DEVIATION ENT WAY TO 6000'

MUD LOG

HOLE NO: 45-14
 SWDX JOB NO: _____

DATE: 10/25/62
 CLIENT: G.P.F.E.

DEPTH	DISCRIPTION
2462 ^o MID	
2460-2470	<u>ANDESITIC BASALT</u> - Grey-green, microporphritic basalt waxy to sugary luster-plag phenocrysts with calcite veins - 5% white to yellow clay tuff with plag qtz & biotite cristals - Alteration of ferromag minerals (magn) to hematite-goethite
2470-2480	(AS ABOVE)
2480-2490	(AS ABOVE)
2490-2500	(AS ABOVE)
2500-2510	(AS ABOVE)
2510-2520	(AS ABOVE)
2520-2529 ^o MID	(AS ABOVE) ↑ VERY LITTLE VARIATION

DEPTH feet	RATE ft/hr	MUD TEMP in out
2460-2470	_____	_____
2470-2480	_____	_____
2480-2490	_____	_____
2490-2500	_____	_____
2500-2510	_____	_____
2510-2520	_____	_____
2520-2529'	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____

BIT SIZE: 6 1/2 IN-SMT AIR: _____ MUD: X
 VIS: 40-43
 CASING: _____ WT: 7.3
 PH: ?

NOTES: RUN DEVIATION SURVEY # 2515'
- OF " 5"
- DEVIATE OUT WEIGHT TO 6000#