FILE # 1

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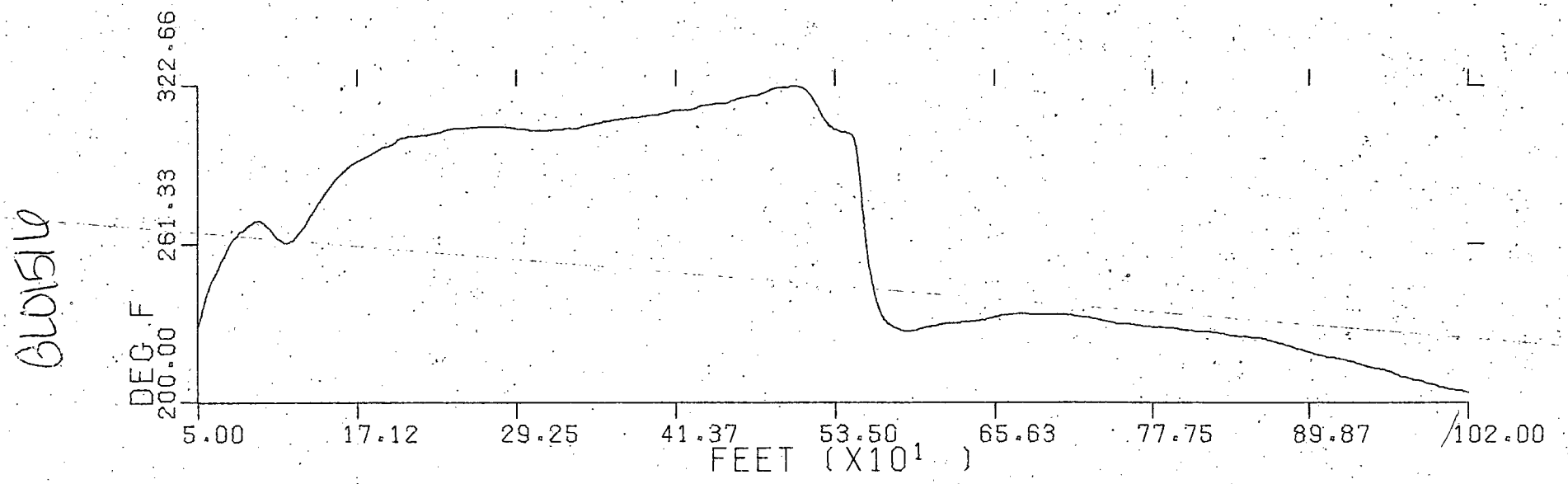
DATA TYPE: TEMPERATURE

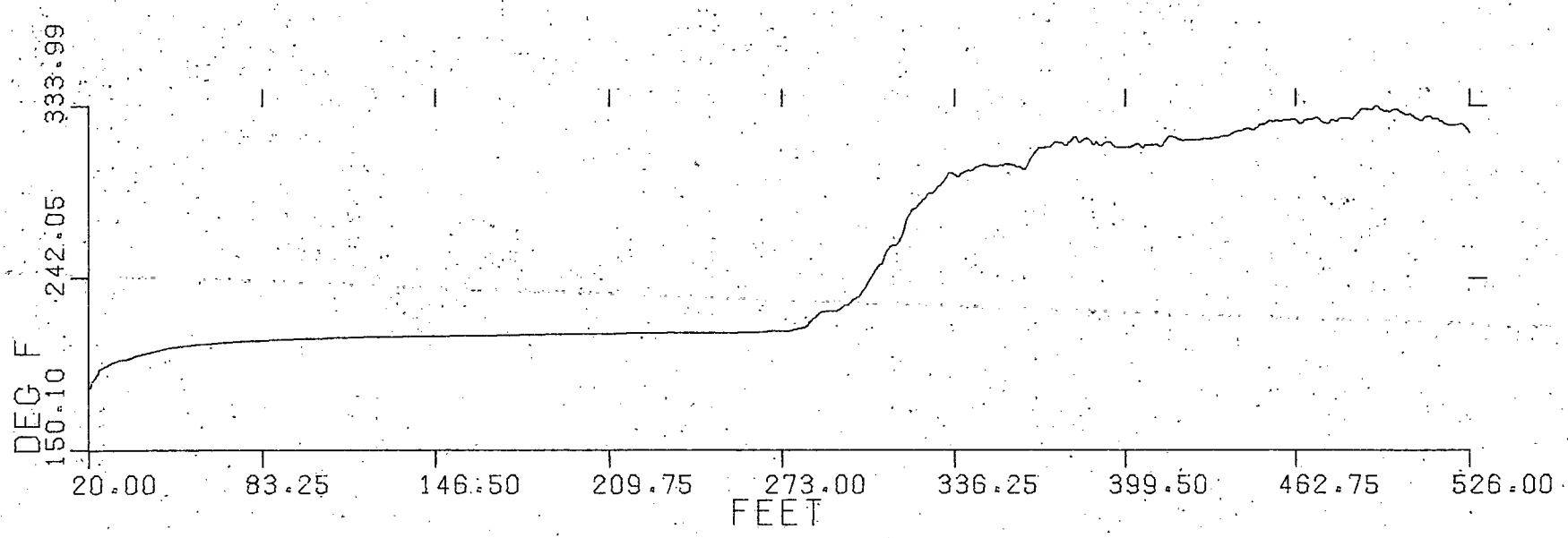


6105516

FILE # 2

WELL NAME: UTAH STATE NO 72-16

DATA TYPE: TEMPERATURE



FILE # 3

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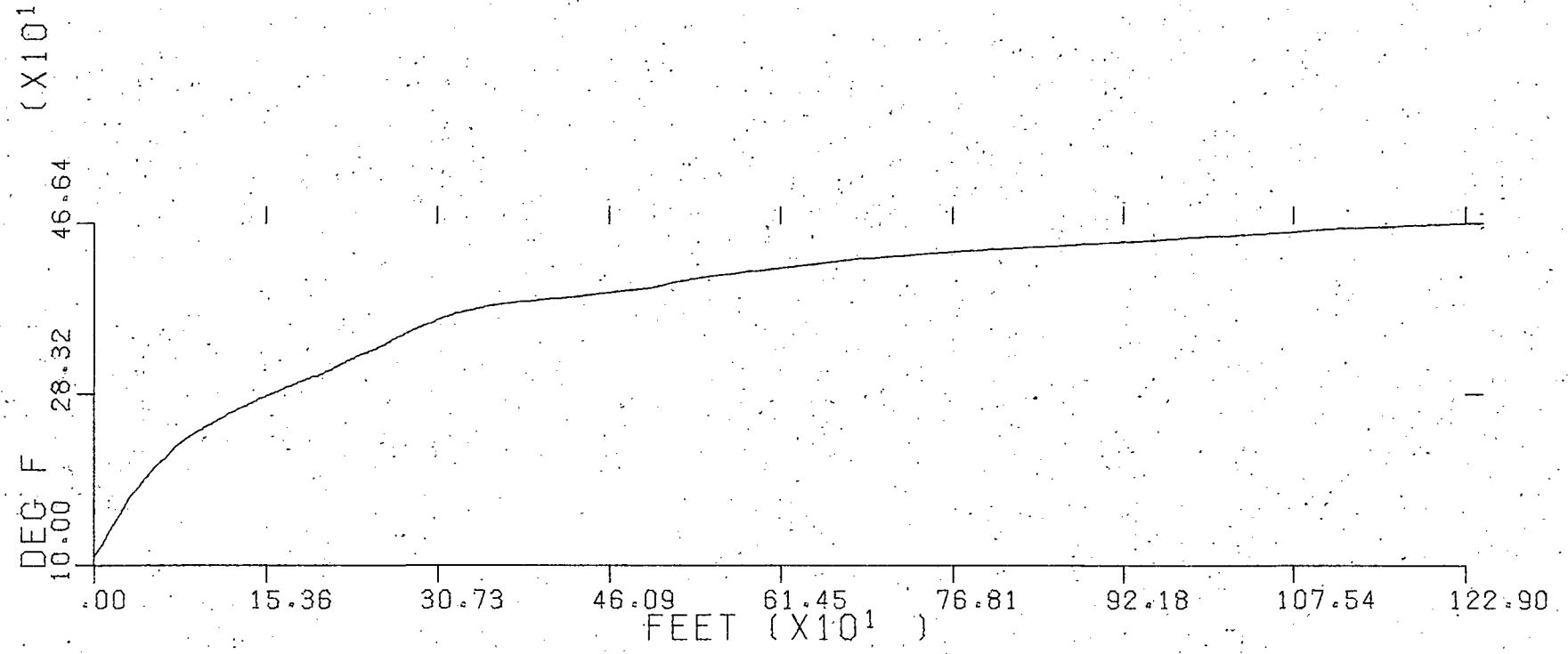
DATA TYPE: TEMPERATURE



FILE # 4

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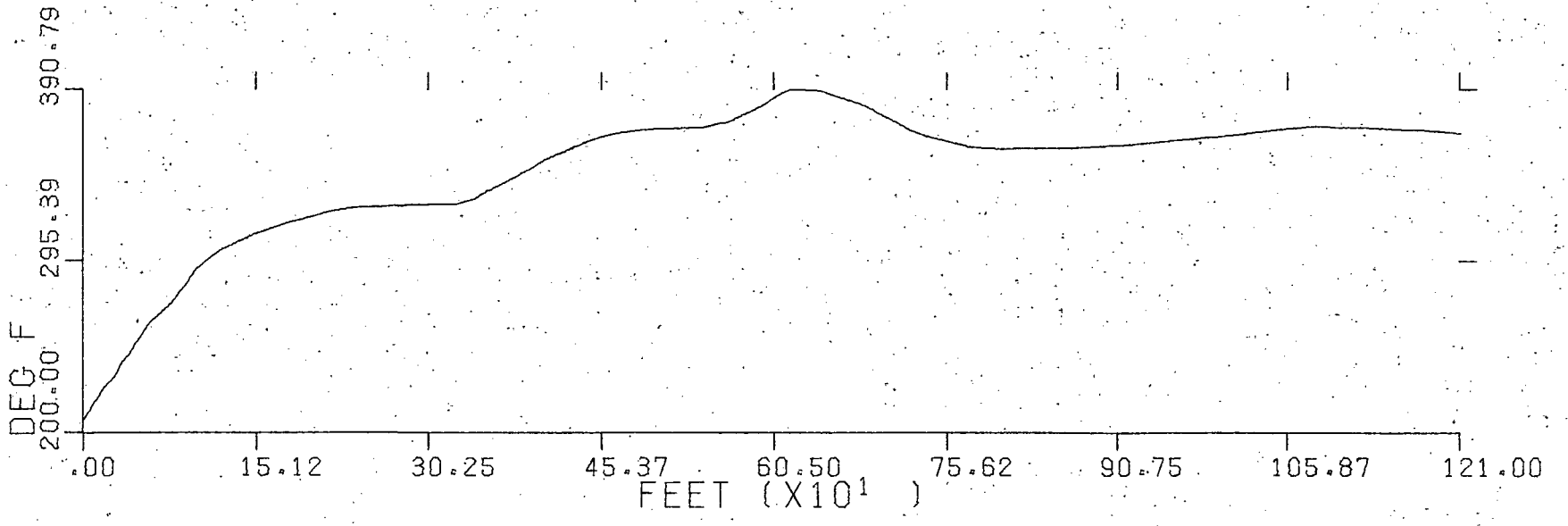
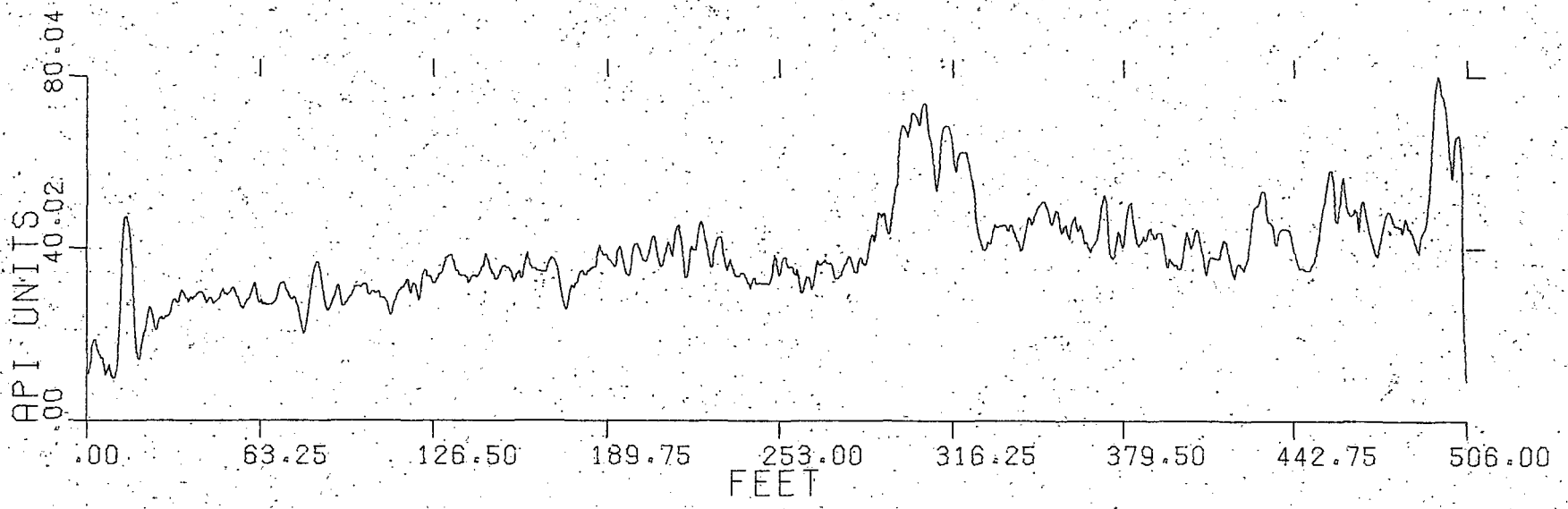
DATA TYPE: TEMPERATURE



FILE # 5

WELL NAME: UTAH 72-16

DATA TYPE: GAMMA RAY



Acaission of Utah State Drill Hole 72-16

Drill Hole Location and Drilling History

Utah State Drill Hole 72-16, located 990 feet south ~~of the south side~~ and 990 feet west ~~of the east side~~ of the northeast corner of Section 16, Township 27S and Range 9 West, Beaver County, Utah, was drilled by Lofgland Brothers Company for Thermal Power ~~Company~~ Corporation. Drilling began on 10/22/76 and was completed on 12/31/76. The hole was air-drilled to 85 feet and with mud thereafter.

Alpha Beta Gamma Associates Incorporated (ABGA) provided on site logging services: drilling rate, lithology, temperature, mud gas, H_2S and CO_2. Only the drilling rate is include in this report (Plate III). Hathaway Engineering (HE) has submitted a complete as of 1/17/77, drilling and well completion history. A summary of drill bit size and casing ? → ID's is given in Plate III.

The drillers log indicates that the well flowed water at three points during drilling: 312 feet, 585 feet and 633 feet. Complete lost circulation

occurred at a depth of 1245 feet. These observations are qualitative and do not preclude other flow events which were either recorded or not reported. Mud weight was used to control flow during drilling. Cemented casing to 1098 feet eventually completely sealed in flow zones at 312, 585 and 633 feet. Total open hole completion is apparently 156 feet, between depths of 1098 and 1254 feet (already stated above) ~~and encountered the last [illegible] feet.~~ The records are not clear, but the hole may have been cemented between 1098 and 1144 feet which would leave about 101 feet rather than 156 feet of open hole.

Wireline Logging

The wireline logs obtained for Utah State 72-16 and submitted to the Earth Science Laboratory are listed in Table 3 and plotted in Plate III. A discussion of each log follows.

Cement Bond Log (CBL) - Two cement bond logs were obtained during the drilling of 72-16, one on

11/5/76 after setting the 13 3/8" casing and the other on 12/21/76 after setting the 9 5/8" casing. The HE report claims the CBL on 11/5/76 shows "excellent bond from surface to 100 feet, fair bond from 100 to 260 feet and excellent bond from 260 to 522 feet (top of cement plug inside 13 3/8" casing)" and the CBL on 12/21/76 shows "excellent bonding from 999 feet up to 85 feet, then good to fair bonding from 85 feet to the surface." We believe the CBL on 11/5/76 shows excellent bonding between 275 feet and 435 feet and only fair to good bonding over the remainder of the logged interval. Copies of the cement bond logs are not included here but are available on request (Ross, 1978)

Natural Gamma Log - A natural gamma log was run simultaneously with the CBL on 11/5/76. Here the log was obtained in casing. The log shows an apparent linear increase in ~~activity~~ radioactivity with depth. This increase could be due to an increase in temperature affecting the instrument or an increase

in gamma emitters with depth. This log was obtained the same day as the temperature log labelled with a 1 in Plate III. No correlation with depth is evident between these two logs. Therefore, we believe the increase in natural gamma radiation with depth can be attributed to changes in mineralization with depth. Note that the gamma ray log is higher over the high temperature interval between 300 and 525 feet on temperature log 1, Plate III.

Two short intervals of highest natural gamma radiation are evident between 285 and 325 feet and between 490 feet and the end of the log at 515 feet. The upper interval correlates with a silica-cemented interval in the alluvium. This interval also contains a notable amount of sulfides. Since the alluvium is all of fairly uniform mineralogy the higher natural gamma radiation is believed to reflect mineralogy associated with the cementation and/or with the sulfides noted in this interval. Uranium occurrences, for example, are often

reference?

associated with an increase in sulfide mineralizatio
The lower interval of higher natural gamma radiatio
could be thicker since it occurs at the end of
the log. This interval is just below a second
interval of cemented alluvium and occurs
where subtidal fault breccia was observed in
the chips.

Temperature Logs — Four temperature logs
obtained in 72-16 have been submitted
to ESL; these logs are noted in Table 3 and
are plotted in Plate III. Note from the drill
log, ~~one~~ included in Plate III, ~~[redacted]~~
are very qualitative and can not be assume
to be complete or scientifically accurate
however the information is important to ~~the~~
evaluation of the temperature log.

Removal of the drill rig and well c
on 12/31/76 is the last event noted
our records before the Agnew and Sunc
was obtained on 3/30/77. A maximu

three months of shut-in may have occurred and the 3/30/77 temperature log should clearly depict the true geothermal gradient in the vicinity of 72-16.

Both the Lynes and Sweet temperature logs and the Schlumberger temperature logs of 11/5/76, 11/17/76 and 12/21/76 obtained shortly after some activity in the borehole, such as setting casing, a short flow test and circulation. Without drawing specific conclusions about what activities preceded each log, no quantitative and very little interpretation of these logs is possible. The date each casing string was set is annotated on the temperature log and is also shown in Plate III. No information indicative of the temperature was obtained in casing. Although the temperature characteristics are similar to temperature profiles in [redacted], they are not identical. Therefore, one should be careful in attaching any information from these logs.

The Agnew and Sweet temperature log of 11/17/76
was obtained within 48 hours of drilling to
1245 feet and with casing to 580 feet. ~~800~~ Our records
indicate that the log was obtained inside 5 inch
drill pipe to total depth. The character of the
log suggests the drill hole was circulated
sometime prior to logging. The log indicates
flow zone at 633 feet recovers more
rapidly than the one at the bottom of the hole.
[illegible] would be [illegible] if information about
to logging were available.

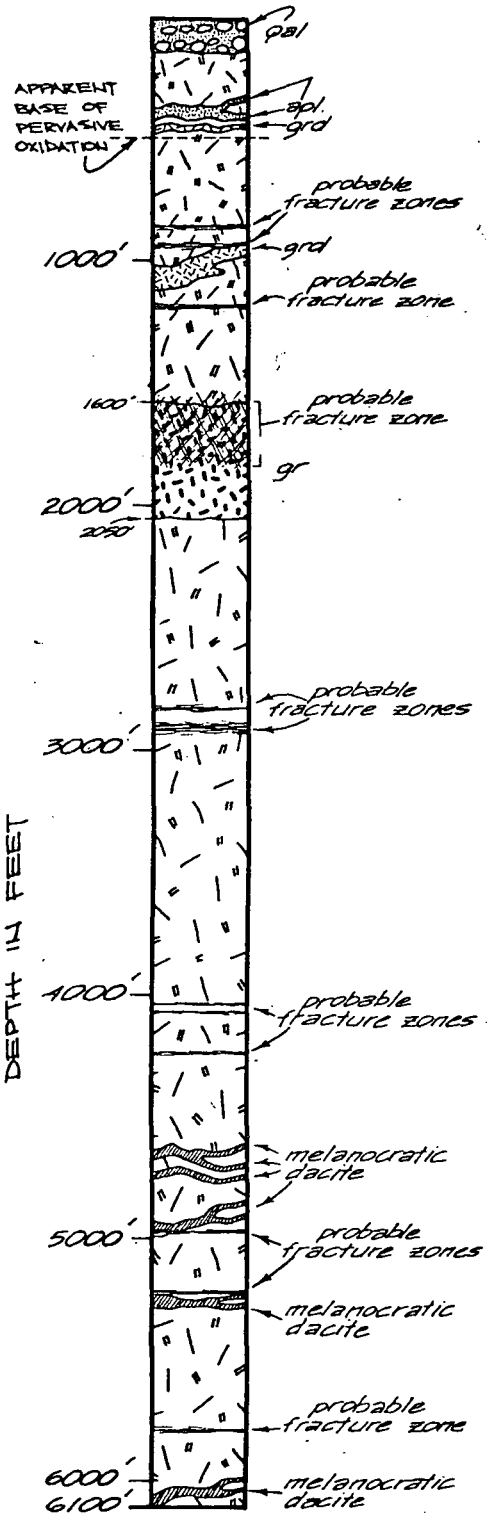
Temperature gradients were computed from the Agnew and Sweet log of 3/30/77 and are shown plotted in Figure 3. Three gradient curves are shown, each corresponding to different data interval averages. All three gradient curves show the same behavior. The gradient is very high above about 350 feet depth and appears to flatten asymptotically ~~asymptote~~ to 100°C/km below 900 feet depth.

We believe the temperature log and the gradient computed from this log, the lithology and drillers' notes indicate the geothermal system capped by cemented alluvium between 290 and feet depth. The cemented alluvium between and the top of the bedrock at 460 feet mable and permits fluid to move from bedrock fractures into the lower portion of luvium. The lower gradient in the corresponding to the base of the and the top of the bedrock suggests the flow in this zone into convection.

A more thorough discussion of heat flow is given in a later section of this report.

Drilling Rate — The record of rate of bit penetration during drilling is given in Plate III in minutes/foot. This rate will depend a number of things, among them: weight on the bit, mud weight, type of bit, circulation, bit wear and rock type. Sometimes drilling rate increases in fractured rock. The fractured rock, in turn, is often associated with fluid flow or lost circulation zones. This relation occurs at 312, 514 and 1245 feet 72-16 but not significantly at 633 feet.

GRAPHIC GEOLOGY



DESCRIPTION

0-160' QUATERNARY ALLUVIUM. MOSTLY FRAGMENTS OF HORNBLENDE-BIOTITE QUARTZ MONZONITE AND ITS CRYSTAL CONSTITUENTS. A FEW FRAGMENTS OF BIOTITE DACITE AND OBSIDIAN.

160-1600' HORNBLENDE BIOTITE QUARTZ MONZONITE (UNLESS OTHERWISE NOTED), MED.-CRYSTALLINE. SPHENE, MAGNETITE, AND ILMENITE(?) AS ACCESSORY MINERALS. TR. ZIRCON.

300-500': 50-60% of chips are biotite aplite
900-1000': 25% of chips are fine-crystalline hornblende-biotite granodiorite
1000-1100': same as above except 45% of chips.
900-500': same as above except 20% of chips.

ALTERATION INTENSITY THROUGHOUT INTERVAL GENERALLY V. WEAK. HORNBLENDE MOSTLY ALTERED TO CHORITE-CLAY-CALCITE AGGREGATES; BIOTITE GENERALLY FRESH TO WEAKLY CHLORITIZED. FELDSPARS FRESH TO V. WEAKLY CLAY-SERICITIZED. SPHENE FRESH TO PARTIALLY ALTERED TO LEUCOXENE AND CALCITE. OVERALL 1-3% (VARIABLE) QTZ-CLAY-SERICITE CHIPS, COMMONLY SLICKENSIDED, PROBABLY DERIVED FROM FAULT ZONES AND ASSOCIATED VEINLETS. MAGNETITE PARTIALLY ALTERED TO MAROON TO REDDISH-GRAY SUBMETALLIC HEMATITE.

TR. PYRITE BELOW 800' AS DISS. ANHEDRAL-SUBHEDRAL GRAINS, PREFERENTIALLY REPLACING HORNBLENDE & (SUBORDINATELY) MAGNETITE, BUT ALSO ALL OTHER MINERALS. A FEW SCATTERED FRAGMENTS OF GOETHITE-QTZ ± CALCITE, MANY APPARENTLY DERIVED FROM OXIDIZED VEINLETS, THROUGHOUT INTERVAL.

1600-2050' LEUCOCRATIC FINE-CRYSTALLINE BIOTITE GRANITE. PRONOUNCED LIGHT REDDISH-GRAY COLORATION DUE TO FINELY DIVIDED HEMATITE IN K-FELDSPAR & ITS ALTERATION PRODUCTS (CLAY & SER.)

1600-1800': FELDSPARS ALMOST COMPLETELY ALTERED TO CLAY-SERICITE AGGREGATES. BIOTITE ALTERED TO GREENISH-GRAY MICACEOUS MINERAL (CHL + SER.). MAGNETITE ALMOST TOTALLY ALTERED TO REDDISH-GRAY HEMATITE. TR. DISS. PYRITE 1600-1700'

1800-2050': ALTERATION SAME AS 1600-1800', BUT LESS INTENSE AND DECREASING DOWNHOLE.

2050-6100' HORNBLENDE BIOTITE QUARTZ MONZONITE, SAME AS 160-1600', CUT BY DIKES (OR INCLUDING XENOLITHS) OF MELANOCRATIC HORNBLENDE-BIOTITE DACITE(?). THESE OCCUR THROUGHOUT THE INTERVAL, BUT ARE GRAPHICALLY REPRESENTED IN THE LOG TO THE LEFT ONLY IF THEIR CHIPS MAKE UP 10% OR MORE OF A GIVEN 100 FT. COMPOSITE SAMPLE).

THE DACITE(?) IS AN APHANITIC TO V. V. FINE-XLINE DARK GRAY ROCK IN WHICH HORNBLENDE, BIOTITE, MAGNETITE & ILMENITE (THE LAST TWO OF WHICH ARE ACCESSORIES) MAKE UP 35-55% OF THE TOTAL MINERALOGY. SPHENE & APATITE ARE ALSO PROMINENT ACCESSORIES.

ALTERATION INTENSITY THROUGHOUT INTERVAL IS GENERALLY QUITE VARIABLE, BUT IS MODERATE TO INTENSE BETWEEN 2800' AND 2900', AND WEAK-MODERATE OVERALL BETWEEN 2500' AND 4600'—OTHERWISE V. WEAK TO WEAK. ALTERATION MINERALOGY & STYLE SAME AS 160-1600'. DACITE PREFERENTIALLY AND GENERALLY MORE STRONGLY ALTERED THAN QTZ. MONZONITE.

TR. PYRITE AS DISSEMINATED ANHEDRAL-SUBHEDRAL GRAINS PREFERENTIALLY REPLACING ALTERED HORNBLENDE & (SUBORDINATELY) MAGNETITE, BUT ALSO ALL OTHER MINERALS. DACITE, IN GENERAL, MORE STRONGLY PYRITIZED THAN QTZ. MONZONITE. PYRITE ALSO OCCURS RARELY AS MINUTE IRREGULAR VEINLETS WITH OR WITHOUT QUARTZ, CALCITE, SERICITE, & CLAY.

QTZ.-CLAY-SERICITE CHIPS, COMMONLY SLICKENSIDED, ERRATICALLY DISTRIBUTED THROUGHOUT INTERVAL IN AMOUNTS UP TO 5%. THESE PROBABLY DERIVED FROM FRACTURE ZONES AND ASSOCIATED VEINLETS.

PRELIMINARY GEOLOGIC LOG, DRILL HOLE TP-14-2

EARTH SCIENCES LABORATORY
UN. of UTAH RESEARCH INSTITUTE

NOTE: LOG IS BASED ON BINOCULAR MICROSCOPIC EXAMINATION OF 100-FT. COMPOSITE SAMPLES. CONTACTS BETWEEN LITHOLOGIC UNITS ARE DIAGRAMMATIC AND APPROXIMATELY LOCATED.

Power Companay
te 72-16
Field

T G

26" hole to 85'

20" conductor casing at 85', Cemented with 200 sacks class B. Alpha-Beta-Gamma logging equipment at 85'

11/23/76 Placed 40 sack Class B cement. 20? - 88'. Redrill at 88

(10/26/76) Displaced 100 sacks of 16 ppg. cmt. at 286'

(10/24/76) Displaced 900 Ft³ of slurry (Perlite, SiO_2 flour, Class B cement). Redrill at 100'

17 ½" hole to 585'

(10/28/76) 13⅜" casing at 580' Displaced 400 sacks Class B cement, mixed. Good cement returns to surface. Redrill

(10/29/76) Ran Schlumber Cement bond log, w/ Gamma Ray and Temp Survey. Excellent Bond from 260' - 522'

(11/10/76) Installed degasser to eliminate CO_2. Installed cooling loop for mud

12/21/77 Ran CBL log to 999'

12/21/77 Ran temp. log to 1012'

(12/?/76) Placed 9⅝" casing at 1098'. Circulated water to cool hole (12/18). Cemented casing with 650 sacks Class B cement. Circulated water to set cement (12/19/76) Found top of caked mud at 260'. Redrill

(12/16/76) Circulated water to cool hole the displaced water with 16ppg mud

(12/16/76) Placed 35 sack cement plug at 1158'

8 ½" hole to 1254'

11/17/76 Ran Agnew and Sweet Temperature Survey

11/2/76 Small hot water flow killed by pumping 360 sacks Class B cement, mixed, into annulus between 20" and 13⅜" csgs.

11/5/76 Small hot water leak outside 20" casing

(10/26/76) Well Flowed water during redrill. Killed well with 14 ppg mud.

Well Flowed water, killed well with 10.5 ppg mud. (10-24.)

(10/31/76) Well Flowed small amount of water at 585'.

(11/8/76) Well Flowed water at 633'. Killed Flow with 14.2 ppg.

(11/9/76) Mud weight cut From 14.2 ppg to 10.1 ppg From hot water entry and CO_2 gas.

(11/15/76) Lost complete mud returns (Lost Circulation) at 1245'.

(12/27/76) lowered well pressure by pumping in water & mud

(12/31/76) Closed well in.

Thermal Power Company
Utah State 72-16
Roosevelt Field

10/22 10/27 11/1 11/6 11/11 11/16 11/21 11/26 12/1 12/6 12/11 12/16 12/21 12/26 12/31 1/5

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 80

26"

20" casing installed

Cemented 20" casing with 2.00 sacks. Class B cement. Landed in Alpha Beta Gamma logging equipment installed at 85'.

17.5" 9.1 ppg

17.5" 9.8 ppg

Well Flowed water. Killed well with 10.5 ppg. mud Displaced 900 Ft³ of Class B cement at 252'. Shut well in.

17.5"

Well Flowed water. Killed well with 11.4 ppg mud on 10/18

17.5" Killed well Displaced 100 sacks. 16 ppg cement at 286'

17.5" 13.3 ppg

17.5" 13.5 ppg

Well Flowed, small amount of water diluting mud.

11/1 - 11/6 Placed 13 3/8" casing Cemented with 400 sacks Class B cement. Small hot water flow in annulus between casings stopped with 300 sacks Class B cement, mixed Ran Schlumberger cement bond log w/ Gamma Ray & Temp Survey

17.5" 14.5 ppg.

12.5"

12.5" with water

Well Flowed water. Killed with 12 ppg.

12.25"

Mud weight cut from 14.2 ppg. to 10.1 ppg. From hot water entry and CO_2 gas

12.25"

Installed degasser to eliminate CO_2 from mud.

12.25" 15.2 ppg

12.25" 15.2 ppg

11/16 - 11/29 Ran Agnew and Sweet Temp Survey. Mixed mud and installed Otis snubbing equipment. Ran EZSV Retainer - bridge to 207 and displaced 400 sacks of Class B cement, mixed. Tested casing and BOP at 1000 psig. Small hot water flowed observed from ground 25' SW of well. Very small hot water leak outside 20' casing. Found top of cement at 38'. Tested blind rams and 13 3/8 inch casing with 1400 psig.

12.25" 14.9 ppg

12.25" 15.2 ppg

12.25" 15.3 ppg

Lost complete mud returns Shut well in.

12.25"

12.25"

EZSV Retainer came loose with strong upward jolt.

12.25"

Pushed Retainer down hole to where it stopped. Pulled out of hole

12.25"

12/17 - 12/20. Ran 4 5/8" casing to 1098'. Circulated water to cool hole (12/18). Displaced water with 15 ppg mud and cemented with 1400 sacks. Class B cement, mixed. Circulated water (12/19) to set cement Tested casing with 1000 psig. Ran Gamma Ray log to 197' and Temp log to 0.2'. Found top of caked mud at 260' (12/21)

12.25"

12/10 - 12/16. Pulled third EZSV Retainer out of hole and set at 1144'. Placed cement plug set 1138' with 35 sacks of Class B cement, mixed

12.25"

Cleaned out cement. Circulated water to cold hole and displaced with 16 ppg mud.

Pushed Retainer to 1235', when it stopped

Pushed second Retainer to 1239' where it stopped

8.5"

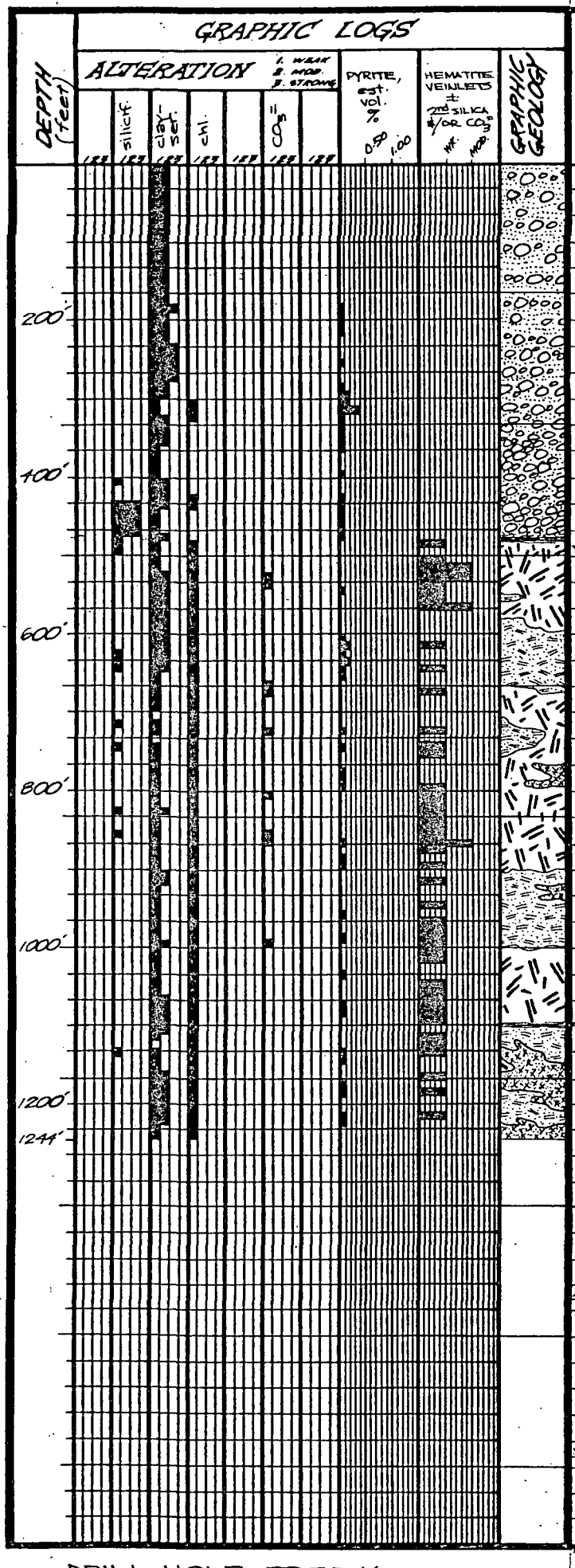
8.5"

8.5"

Shut down for Holidays lowered well pressure on 12/22 by pumping in water and mud

Mixed mud to 16.4 ppg. Pushed out retainers

Closed well in (12/31)



DESCRIPTIONS

ARKOSIC ALLUVIUM. SUBROUNDED TO ANGULAR FRAGMENTS AND GRAINS OF SILT TO FINE GRAVEL SIZE. DOMINATED BY LEUCOCRATIC GRANITE AND ITS CRYSTAL CONSTITUENTS, WHICH COMPRISE MICROCLINE, ORTHOCLASE, PERTHITE, PLAGIOCLASE, AND TRACES OF SPHENE, APATITE, AND ZIRCON. BECOMES PROGRESSIVELY MORE CONSOLIDATED WITH DEPTH.

LEUCOCRATIC BIOTITE GRANITE, FINE-MED.-XLINE, SUBEQUIGRANULAR. 50-60% POTASSIUM FELDSPAR (MICROCLINE PLUS ORTHOCLASE, 15-20% PERTHITE, 15-20% OLIGOCLASE, 10-15% QUARTZ, 1% BIOTITE, TR. ZIRCON, TR. APATITE, TR-0.1% ALLANITE, TR. MAGNETITE/ILMENITE, LOCAL TR. SCHEELITE. MYRMEKITIC INTERGROWTHS COMMON.

MAFIC-RICH BTE. HBL. META-QTZ. MONZONITE, MED.-CRS. XLINE. 30-35% ORTHOCLASE, 1-2% MICROCLINE, 20-25% OLIGOCLASE, 10-15% QUARTZ, 15-20% MED.-DK. GREEN AMPHIBOLE (PROBABLY HORNBLENDE), 2% SPHENE, 2% DARK OPAQUE MINERALS (MAGNETITE-ILMENITE), TR. APATITE, TR. ZIRCON. HORNBLENDE AND QUARTZ COMMONLY OCCUR AS WORMY INTERGROWTHS. QUARTZ COMMONLY STRAINED.

APATITE-RICH BIOTITE HORNBLENDE QUARTZ MIGMATITE (?). FINE-MED. XLINE, MOD. WELL-FOLIATED. 45-50% PLAG., COMMONLY ZONED, 5-7% STRAINED QUARTZ, 5-7% ORTHOCLASE, 5-7% APATITE, 2-3% SPHENE, 0.1-0.3% ZIRCON, 10-15% BIOTITE, 15-20 % HORNBLENDE

ALTERATION NOTES: CLAY-SER. REPLACES PLAG. & (LESS COMMONLY) K-SPAR AND OCCURS AS A CONSTITUENT OF MATRIX IN ALLUVIUM & IN BRECCIAS; ALSO IN MICROVNLTS. CUTTING ALL ROCK TYPES. CHLORITE MOST COMMONLY REPLACES BTE. & HBL., BUT ALSO OCCURS INTERGROWN W/ SER.-CLAY IN MATRIX OF BRECCIAS, IN SLICKENSIDED CHIPS, AND IN MICROVEINLETS. $CO_3^=$ REPLACES PLAG. & HBL., OCCURS IN MICROVEINLETS WITH HEMATITE & QTZ. 2nd QTZ. FLOODS AND REPLACES MATRIX IN ALLUVIUM & BRECCIAS (LOCALLY) OCCURS W/OR W/ $CO_3^=$, HEM., SER.-CLAY, CHL., PYRITE IN MICROVEINLETS.

MINERALIZATION NOTES: PYRITE PRIMARILY DISSEMATED IN GRAINS < 0.5 mm. AVG DIA., BUT ALSO IN RARE MICROVNLTS. W/OR W/O QTZ. HEMATITE VEINLETS OCCUR W/ OR W/O 2nd QTZ. AND/OR $CO_3^=$ — THEY ARE COMMONLY DELICATELY BANDED & SELDOM REACH MORE THAN 0.5 mm. IN WIDTH

DRILL HOLE TP72-16
ROOSEVELT KGRA

PRELIMINARY GEOLOGIC LOG
(Generalized)

47 0780

200 400 600 800 1000 1200

TEMP. GRADIENT (°C/Km)

Depth Interval Average

— · — 25'
— · — 50'
— · · — 100'

TEMPERATURE GRADIENT
IN UTAH STATE 72-16
THERMAL POWER CO.
AGNEW & SWEET TEMPERATURE
LOG OBTAINED 3/30/77

200 400 600 800 1000 1200

4/12/77

T-6 NOR

— · — 25'
— · — 50'
— · · — 100'

KGRA 72-16 Thermal Power

Shut-in 11/16/76 after flow 11/15/76

Agnew & Sweet Temp 11/17/76 5:40 p.m. run in 5" tubing.
20'/min.
Tool 90-660° F

Temp 3/30/77
20'/min
Tool 80-656

Schlumberger ✓ Temp 11/4/76 air
0-525

✓ " 12/21/76 water
50-1012

" VDL/GR 11/4/76
0-522 FGM
✓ only GR digitized

Agnew & Sweet Pressure Build up 4/5-6/77
Static Pressure 3/30/77

α-β-γ Associate
Lithology, drilling rate, Temp.