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BEOWAWE GEOTHERMAL RESOURCE ASSESSMENT

FINAL REPORT

SHALLOW-HOLE TEMPERATURE SURVEY GEOPHYSICS AND DEEP TEST HOLE COLLINS 76-17

NILE O. JONES

MARCH 1983

WORK PERFORMED UNDER CONTRACT
DE-AC08-79ET27009

GETTY OIL COMPANY
P.O. BOX 11148
BAKERSFIELD, CA. 93389

PREPARED FOR:
U.S. DEPARTMENT OF ENERGY
NEVADA OPERATIONS OFFICE
BY HOLMES & NARVER, INC.
UNDER CONTRACT DE-AC08-76NV00020

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GEOPHYSICS AND
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ABSTRACT

In late 1978, Getty Oil Company began geothermal resource investigation field efforts in the Beowawe Geysers Area, Eureka County, Nevada. The objectives included acquisition of geotechnical data for understanding the nature and extent of the geothermal resource boundaries south of the known resource area. Fourteen shallow (<500 feet) temperature-gradient holes plus geophysics were used to select the site for a deep exploratory well, the Collins 76-17, which was completed to a total depth of 9,005 feet. Maximum downhole recorded temperature was 311°F, but no flow could be induced.

The project was partially funded through a cost-sharing agreement between the Department of Energy, Nevada Operations Office (DOE/NV), and Getty Oil Company under Contract No. DE-AC08-79ET27009.

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1. INTRODUCTION

a. Purpose and Background. In October 1978, Getty Oil Company and the Department of Energy, Nevada Operations Office (DOE/NV), entered into a cost-sharing arrangement under Contract No. DE-AC08-79ET27009 to assess the geothermal potential in the Beowawe Geysers Area, Eureka County, Nevada (Figure 1). This work supplemented information gathered from an adjacent area under a similar cost-sharing arrangement between Chevron Resources Company and DOE/NV.

Information presented in this report is the result of integrating existing data with data acquired from these new investigations. Data interpretations represent current conceptual preferences. They will no doubt be refined as further data and knowledge are developed.

b. Participation. Contract No. DE-AC08-79ET27009 provided partial funding for geophysics, drilling and testing shallow temperature-gradient holes, and the drilling and testing of a deep exploratory/production hole. Electrodyne Survey Services was subcontracted for the geophysical work, Western Geophysical Company and Polar Drilling Company drilled 14 shallow temperature gradient holes, Brinkerhoff Drilling Company drilled the 9,000-foot deep Collins 76-17 well, Dresser-Atlas ran the deep logs, and BC Laboratories analyzed water samples. The University of Nevada's Desert Research Institute provided a Cultural Resource Inventory of the area. Cuttings from the Collins well are on open file at the University of Utah Research Institute (UURI) in its Geothermal Sample Laboratory.

A complete drilling summary plus the temperature records from the 14 shallow holes were also sent to UURI. Detailed information and raw data related to work done under this cost-sharing type contract may be obtained from the University of Utah Research Institute, Earth Science Laboratory (UURI/ESL), 420 Chipeta Way, Suite 120, Salt Lake City, Utah 84108.

LOCATION MAP, BEOWAWE GEYSERS AREA, EUREKA CO., NEVADA

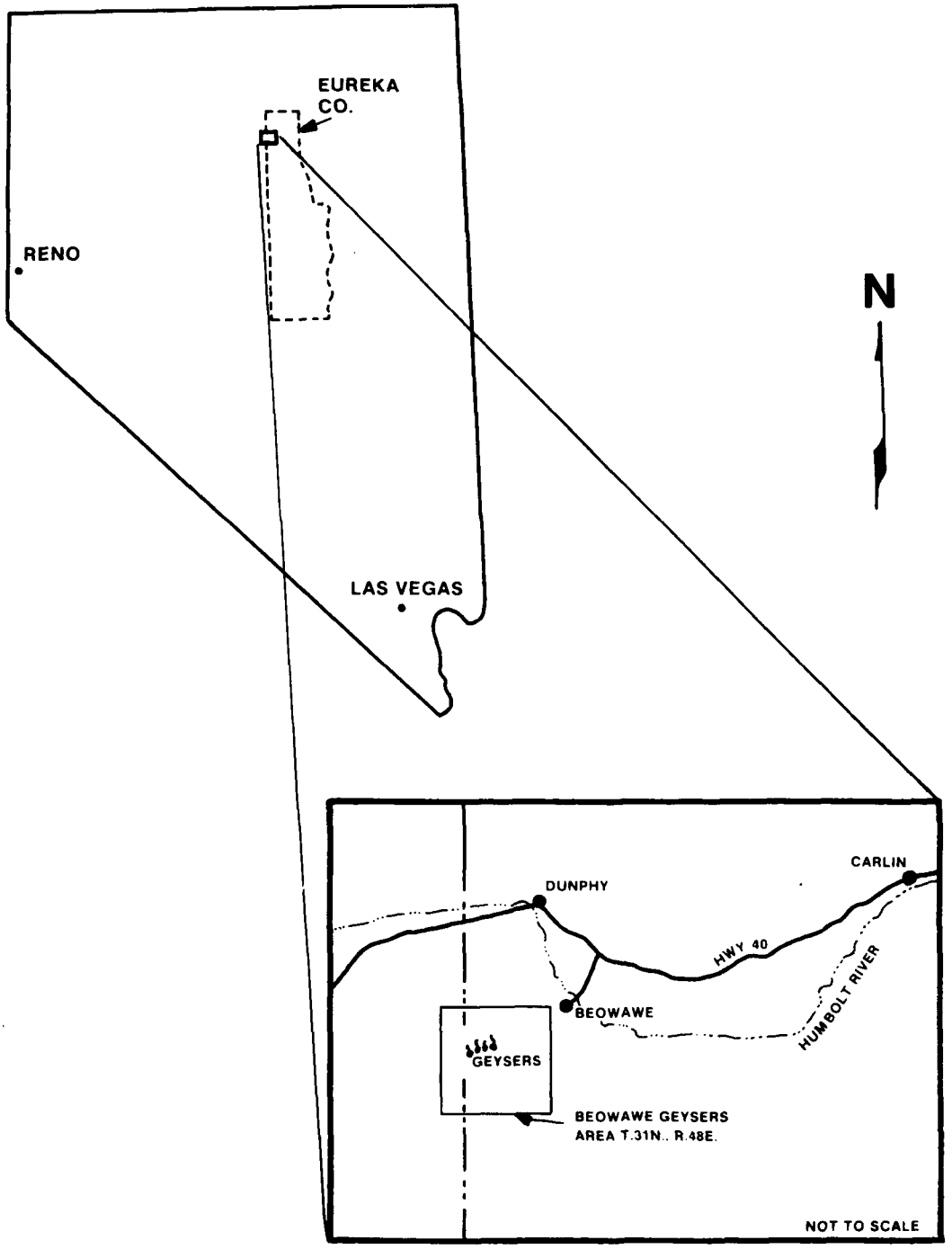


FIGURE 1

c. Project Tasks. Assessment of the geothermal reservoir potential in the previously identified portion of the Beowawe Geysers Area was to include:

(1) New data from a gravity/magnetic survey and a resistivity survey.

(2) Drill and thermal log 14 shallow (500-foot) temperature-gradient holes.

(3) Drill and log one intermediate depth (1,500-foot) temperature-gradient hole.

(4) Drill, log, and test one deep (9,500-foot) exploratory/production hole.

The intermediate-depth hole was not drilled and the deep hole terminated at 9,005 feet.

d. Previous Work in the Beowawe Geysers Area. Numerous hot springs, mud pots, fumaroles, and geysers attest to this unique resource. Between 1959 and 1964, Magma Power Company and Sierra Pacific Company drilled 11 exploration holes in the general area of these surface manifestations. Four of the wells are known to have encountered temperatures in excess of 400°F. Only three additional holes were drilled between 1964 and 1978. Two of them, Chevron Resources Ginn 1-13 and Rossi 21-14, stabilized at approximately 400°F. The Batz No. 1 was the third hole drilled during this time interval. It was funded by Magma Power Company and Dow Chemical. They have not released any temperature information on this 6,000-foot well.

In June 1979, the Chevron Resources Company entered into a cost-sharing type contract (No. ET-78-C-08-1590) with the DOE/NV. By July 1980, they had completed a mercury-in-soil survey, a self-potential survey, drilled and logged 25 shallow temperature gradient holes, as well as the Beowawe 85-15 Exploratory Well. In November 1979, Chevron Oil Company provided Getty Oil Company with all data pertaining to their 25 gradient holes. These data were used to help plan further work under the Getty contract.

2. SURFACE WORK

a. Geology. The Beowawe Geysers Area is located in the southern spur of the Shoshone Range along the Eureka-Lander County line. Northeast-striking, southeast-dipping Tertiary age basaltic andesite (Tvu) caps the Malpais Hills (southern spur, Figure 2). The volcanics lie unconformably on lower Paleozoic sediments assigned to the Valmy Formation (Ov). These crop out along the Malpais fault scarp, east of the geysers. The Valmy exposures are mostly thin-bedded black and brown chert and shale. Thick beds of chert conglomerate can be locally prominent, while thin-bedded quartzite occurs sparsely throughout the section.

A large lobate or fan-shaped landslide (Pleistocene) off the Malpais fault scarp extends about a mile northward into Whirlwind Valley. This feature is designated Ql in Figure 2. The scarp face exposes basaltic andesite and pyroxene dacite. The glide plane lies in the Oligocene to early Miocene tuffaceous sediment, whose surface expression is poory represented.

Quaternary alluvium (Qal) covers the floor of Whirlwind Valley and laps onto the lower slopes of the Malpais Hills. Poorly sorted sands and gravels predominate.

Siliceous sinter (Qs) is being deposited by the Beowawe Geysers located in the northern half of Section 17., T.31N., R.48E. Sinter terraces attest to the shifting hot springs activity through time. Small sinter deposits along fault traces south of the present day terraces, mark zones of earlier fluid transport. Both hydrothermal alteration and sinter deposits decrease rapidly southward away from the Malpais fault scarp. What little other sinter still found above the present terrace level suggests movement and uplift along the Malpais fault. The clear-cut fault scarp, southeast tilting of the Malpais block, youthful nature of the landslide, and active geysering provide evidence for placing the most recent faulting in post-early Pleistocene time.

GENERAL GEOLOGY OF THE BEOWAWE GEYSERS AREA, NORTH-CENTRAL NEVADA

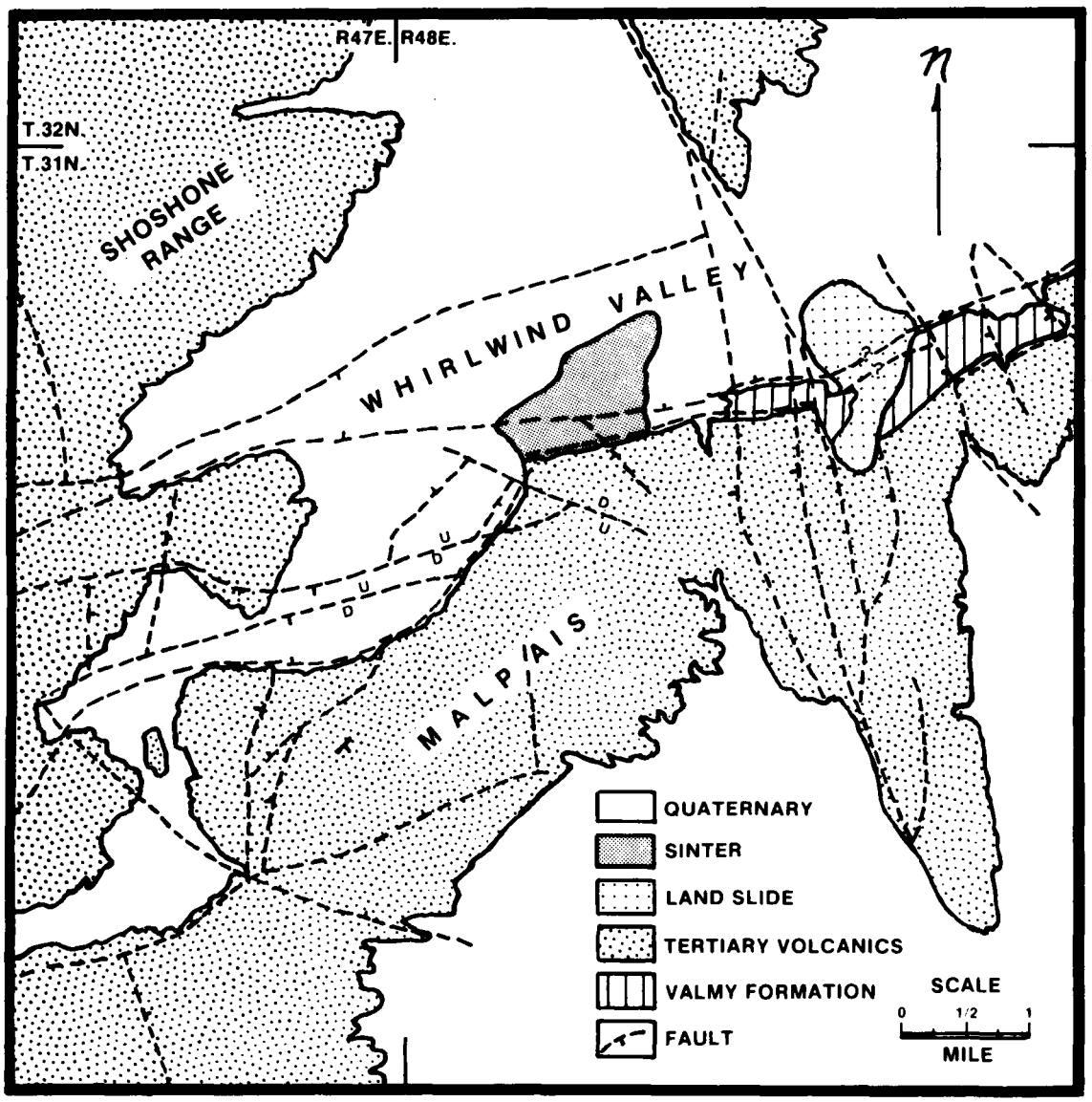


FIGURE 2

b. Geophysics. Electrodyne Surveys of Reno, Nevada, under contract with Getty Oil Company, ran a combined ground magnetics, gravity, and electrical resistivity survey over the Beowawe Geysers Area. Survey permits were secured in January 1979, and the survey was run during February and March. Two hundred twenty-six ground magnetic and gravity stations were established. The electrical resistivity survey consisted of 106 time-domain electromagnetic soundings (TDEM), nine magneto-telluric-audiomagnetotelluric sounds (MT-AMT), and five sets of modified Schlumberger galvanic (DC) soundings. Major structural interpretations from this survey have been included in Figure 2.

Quoting from Electrodyne's final report to Getty Oil Company (September 1979):

> "The most interesting area within the prospect occurs at the intersection of the structural trends in Section 22, T.31N., R.48E. The conductive anomaly occurring at this intersection coincides with the elongated minimum magnetic anomaly that extends along the northeast-southwest structural trend. The resistivity anomaly south of the intersection coincides with a maximum magnetic anomally, and the minimum gravity anomaly occurs in the northeast gradient created by the intersecting structural trends. This is a very complex area and one that should be investigated for geothermal potential.
>
> "The magnetic anomalies are probably due to igneous intrusives that could be related to the diabase dike emplacement in the Cortez Mountains during the Pliocene. Intersection of the structural trends is a good indication of fracturing, this providing channels for water to percolate down to the intrusives. The conductive anomaly is not large in lateral extent, but one would not be expected if a fracture dominated system is encountered. The existence of the conductor astride the ridge is significant by itself. The fact that these unusual anomalous conditions are coincident or in such close proximity is intriguing and certainly the result of some complex tectonic activity."
>
> and:
>
> "...The complexity of the anomaly set, the possibility of fracturing associated with the trend intersection and the existence of low apparent resistivity with little anisotropy make this area the most promising target for future exploration work. If this is a fracture dominated system, then the conductor should be encountered at depths as shallow as 3,000 feet."

Interpretative models were constructed by Earth Science Laboratory geophysicists from these dipole-dipole measurements and other Open File data. A low-resistivity zone was found to extend away from the Geysers along a southeast trend going across the Malpais Fault (Figure 3). The southern boundary appears to be controlled by the South Cross Fault while the northern boundary is subparallel to the Dunphy Pass Fault. The Malpais Fault influence is obvious; all present and past geyser activity lies within the low-resistivity anomaly.

3. DRILLING SUMMARY

a. Shallow Gradient Holes. Fourteen drill sites were selected in February 1980, after an in-depth review of the geophysical survey and the temperature logs from Chevron's 25 shallow holes. Applications for drilling permits were submitted to the U.S. Geological Survey near the end of February. An amended drilling plan was recorded in mid-March. Actual drilling started during the second week of July and was completed in October 1980. Figure 4 shows the location of the gradient holes in relation to Getty Oil Company's land holdings. Figures 5a through 5n are the 14 equilibrated temperature logs.

Data from the Chevron Resources Company shallow-hole survey were combined with the Getty Oil Company survey to produce two isogeotherm maps. Figure 6 shows the 200-foot below surface isotherm, while Figure 7 is the isogeotherm map resulting from bottom hole values. Both isogeotherm maps resemble, in shape, the 10 ohm-m resistivity map (Figure 3); suggesting a commonality between the two information sources.

b. Collins 76-17. The large-diameter deep test hole was sited 3,489 feet south and 849 feet west of the northeast corner, Section 17, in Township 31 North, Range 48 East, Nevada Coordinate System (T.31N.,R.48E., Sec. 17 dab). Brinkerhoff-Signal Drilling Company spudded in on July 6, 1981. Conventional rotary drilling techniques were used throughout. Mud weights were kept near nine PPG and viscosity, generally in the 30-50 second range. A 12 1/2-inch pilot hole was drilled to 1,893 feet and then opened to 17 1/2 inches. A

13 3/8-inch, 54.5 pound/foot casing was set to depth and cemented in. Blow-out prevention equipment was installed on July 24, 1981, and pressure tested to 1,000 psi. A 12 1/2-inch hole was drilled to 5,955 feet and then reduced to 8 1/2-inches to attain total depth of 9,005 feet. Wellhead equipment was installed on September 16, 1981. The hole was cleaned and filled with fresh water. Air and nitrogen blowdown tests on September 17 failed to stimulate the well. The well was filled with fresh water and the rig released at noon on September 17, 1981.

Figure 8 summarizes the drilling and testing program, and Figure 9 gives the completion configuration for the Collins 76-17 well. Appendix A is a summary of the daily drilling activities and Completion Report. Appendix B details the blowdown tests. The depth and deflection profile of the Collins well is found in Figure 10; plan view in Figure 11. Table 1 is a record of bit usage, Table 2 lists the casing run in the hole, and Table 3 the logs. Lithology and temperature profile are shown in Figures 12 and 13.

The only water sample collected was during the Drawdown Test No. 6. Maximum discharge temperature obtained during Test No. 6 was 180^{o}F. This is substantially less than the maximum recorded temperature of 311^{o}F. Total dissolved solids were 3,225 ppm (or milligrams per liter). Appendix C gives the results of the chemical analysis.

INTERPRETED INTRINSIC RESISTIVITY (10 ohm-m) 915m ELEVATION, 550 - 880 m DEPTH

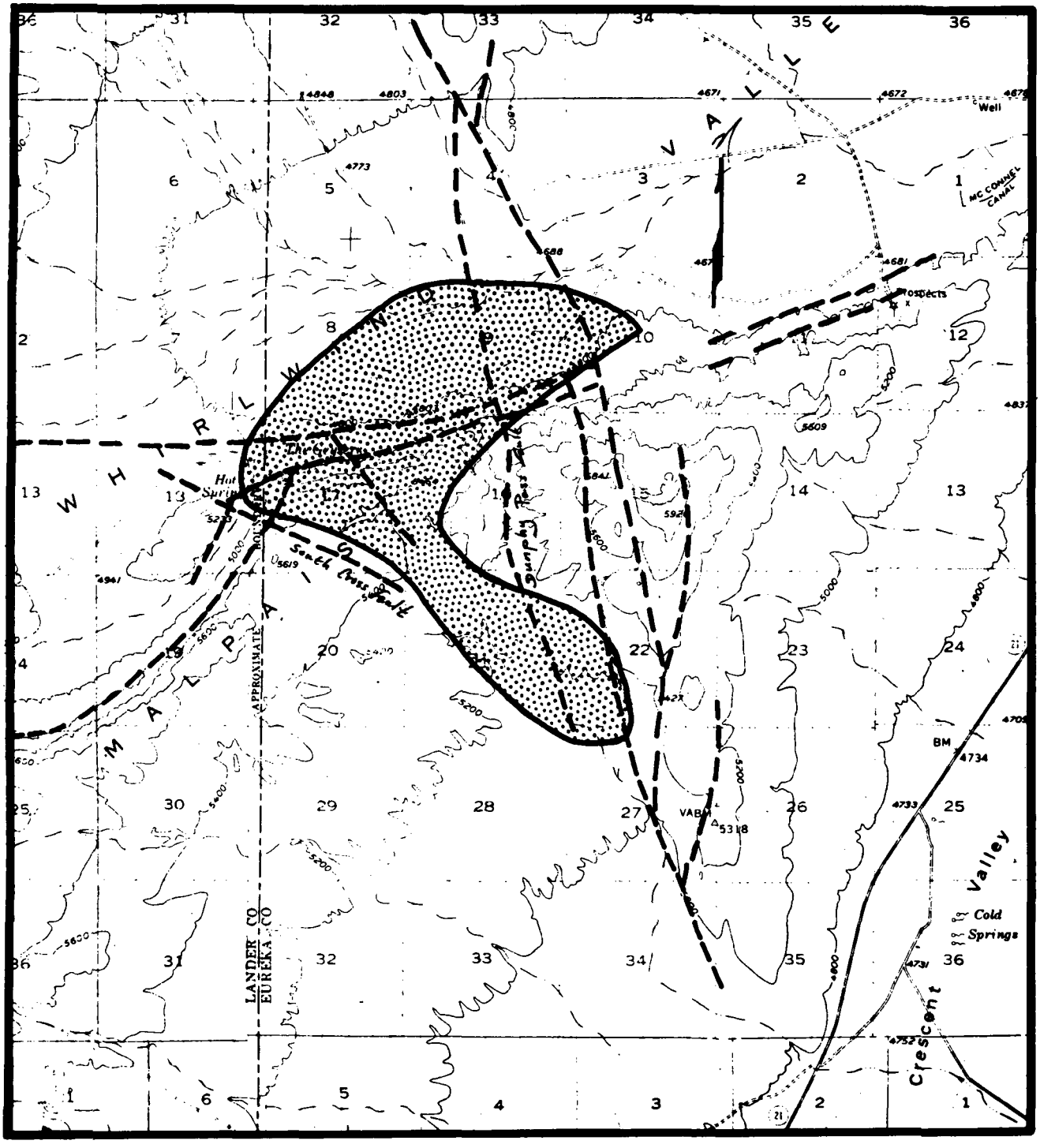


FIGURE 3

GETTY OIL COMPANY LAND STATUS MAP WITH LOCATION OF FOURTEEN NUMBERED SHALLOW GRADIENT HOLES.

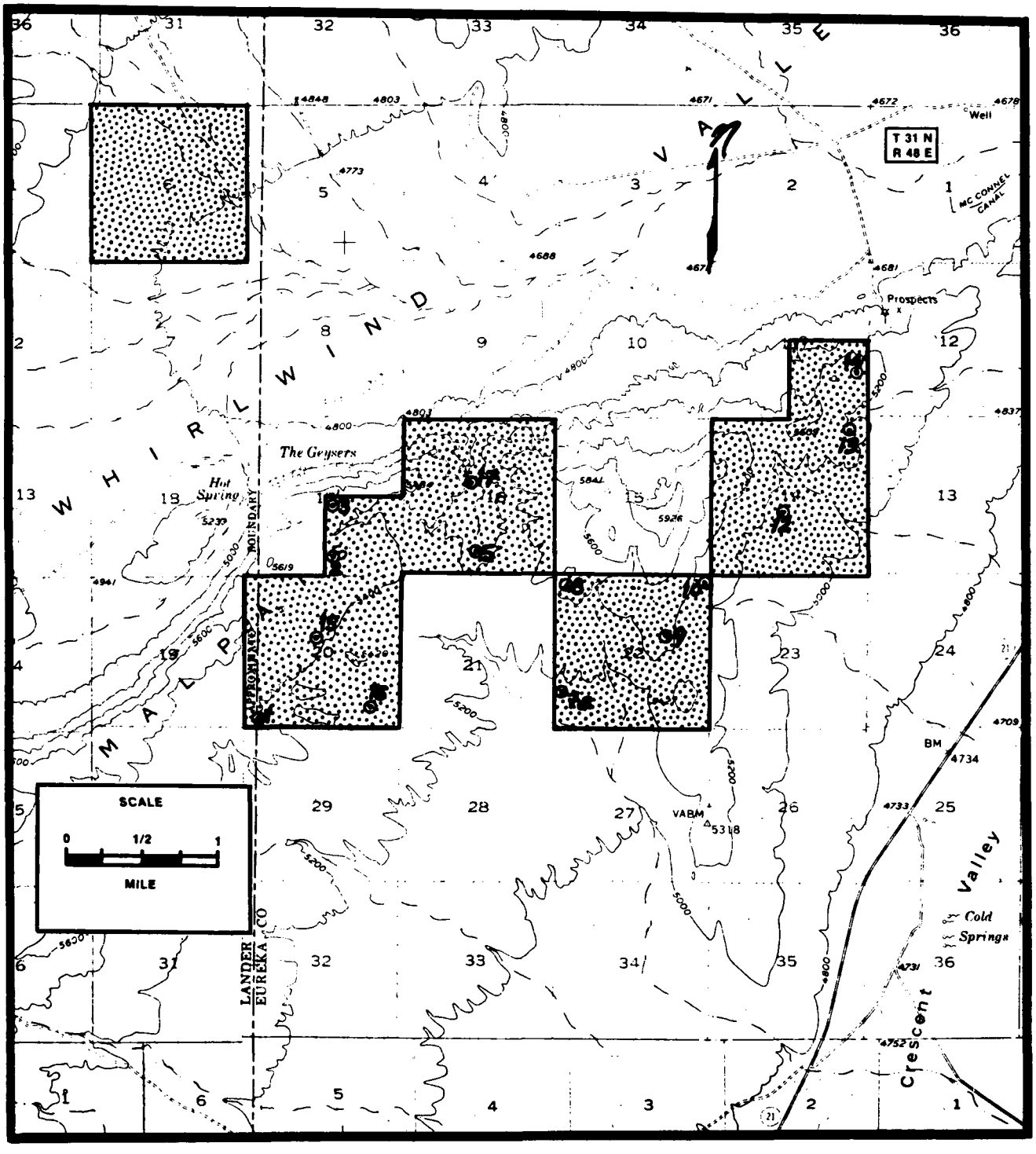


FIGURE 4

NOTATION USED IN LOCATING THE BEOWAVE SHALLOW GEOTHERMAL - GRADIENT HOLES

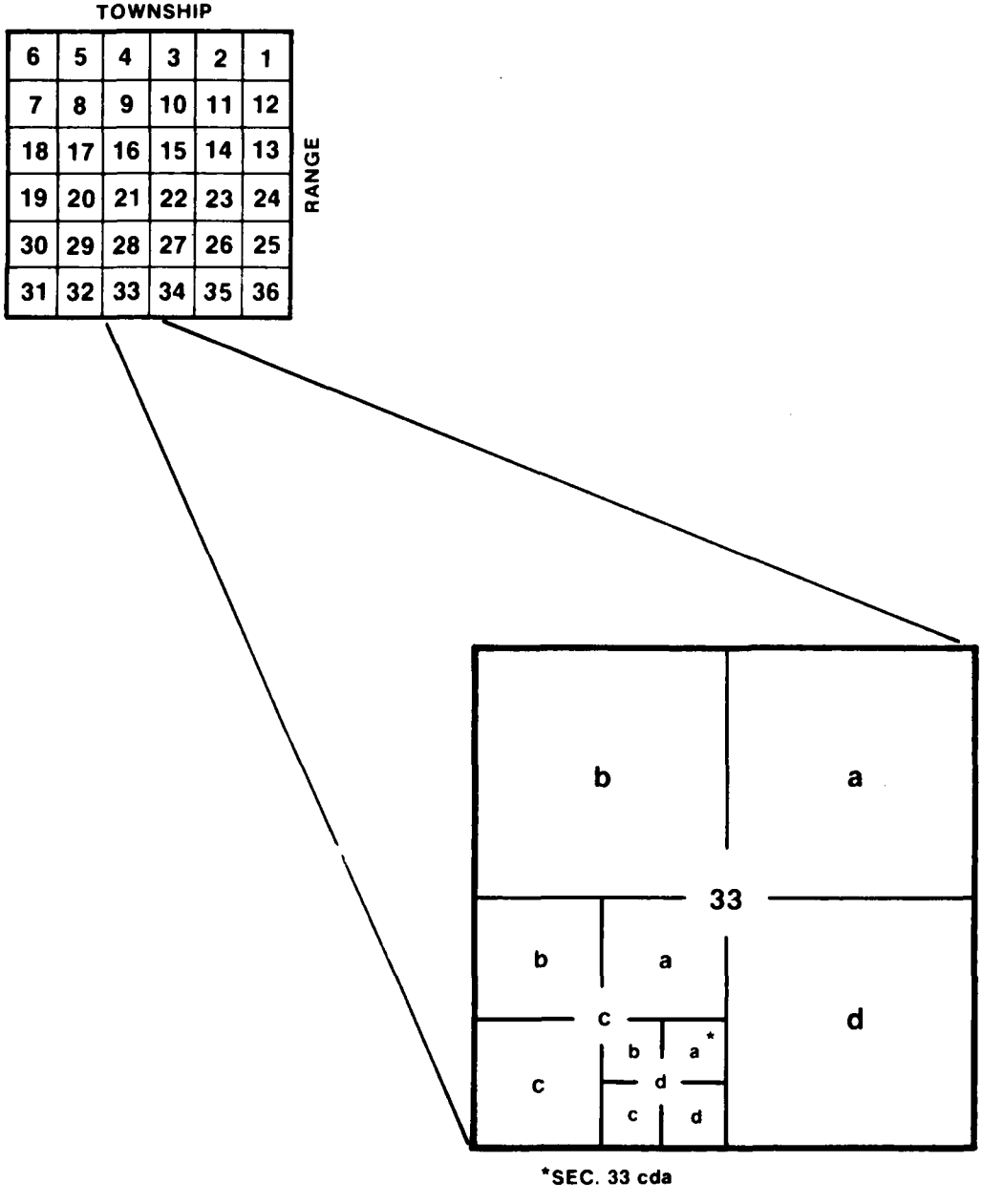


FIGURE 5

BEOWAWE GBP-1
T.31N., R.48E., SEC. 20 ccc

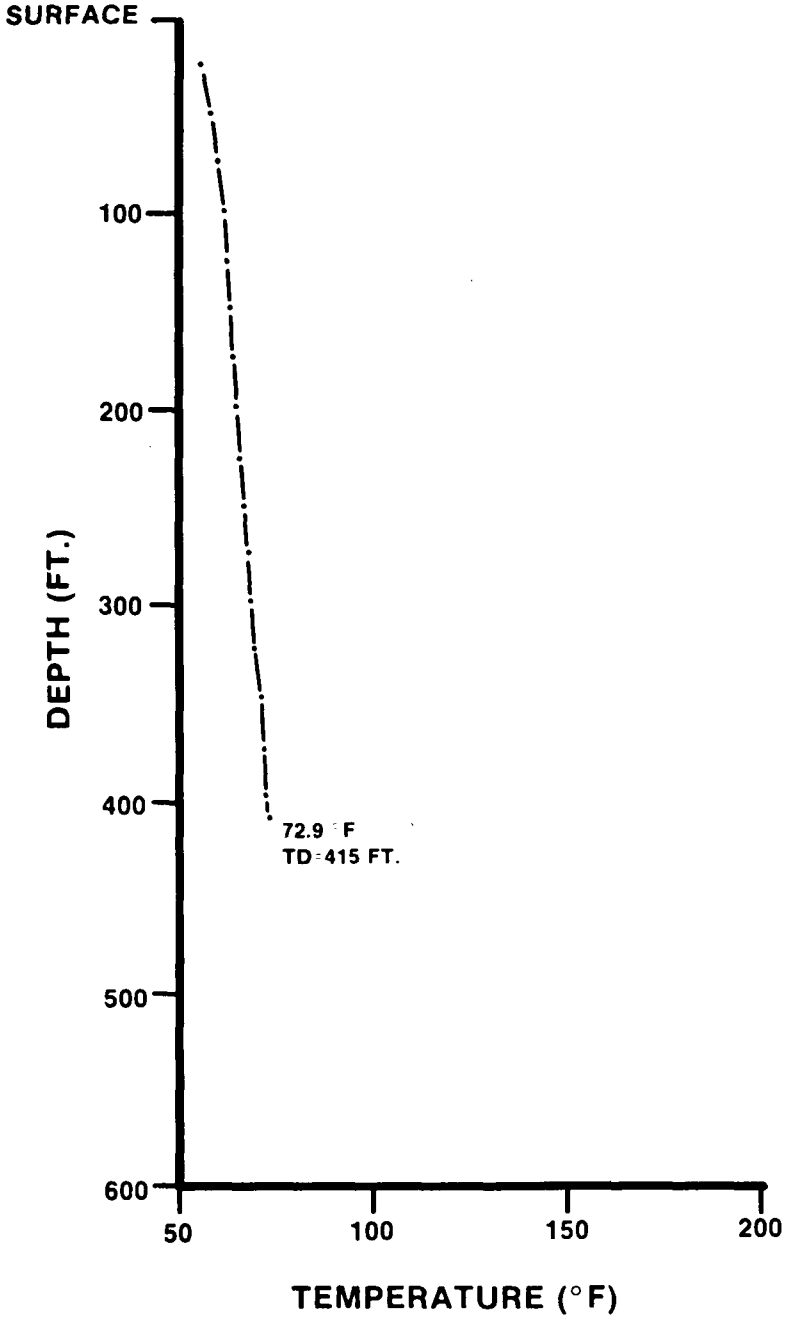


FIGURE 5a

BEOWAWE GBP-2
T.31N., R.48E., SEC. 17 dcc

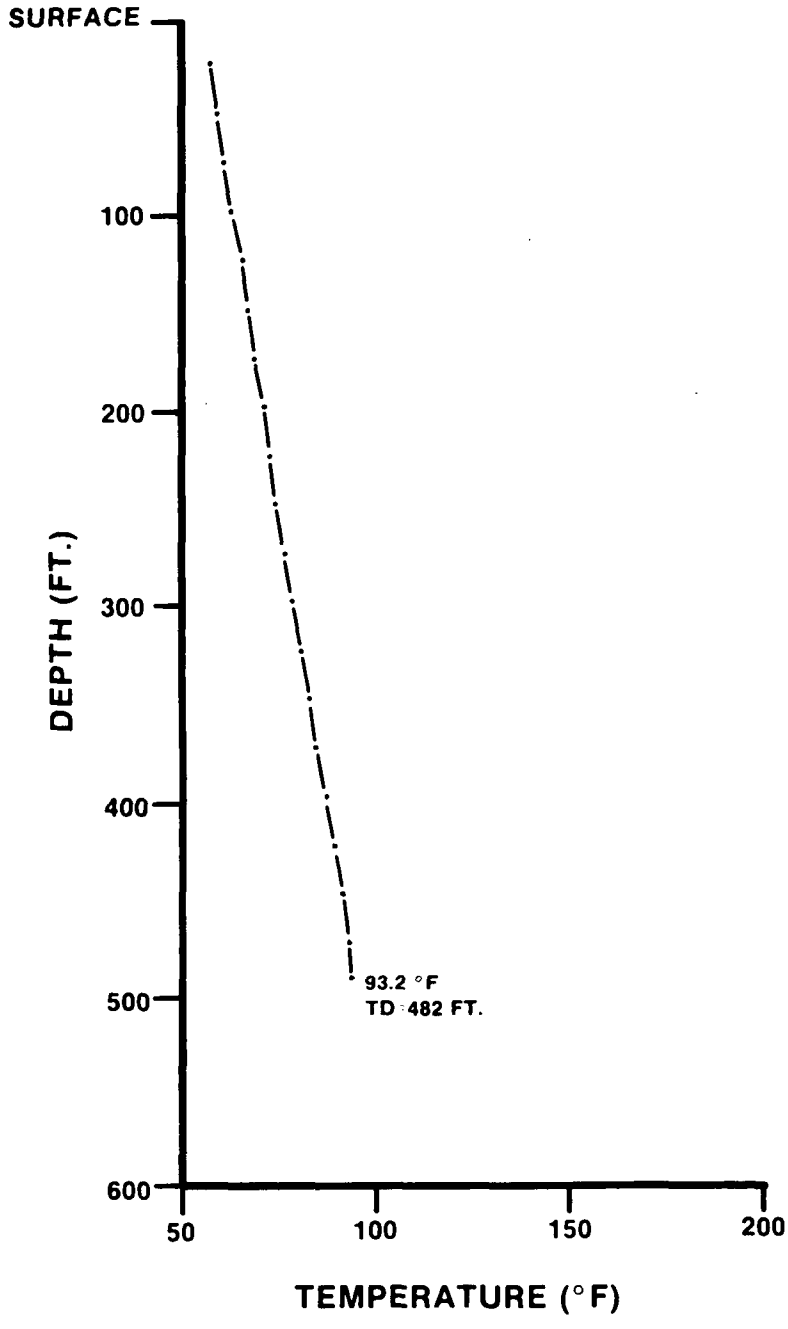


FIGURE 5b

BEOWAWE GBP-3
T.31N., R.48E., SEC. 17 dbb

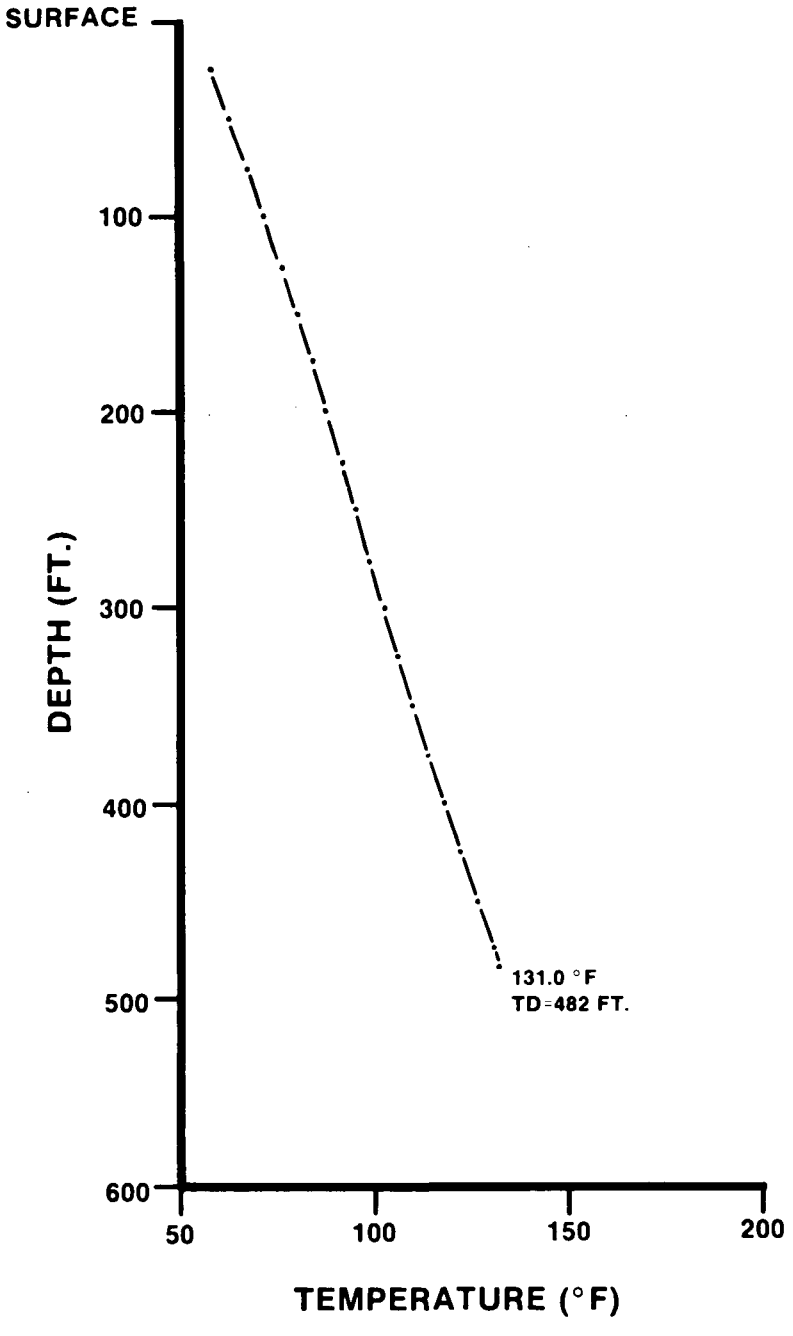


FIGURE 5c

BEOWAWE GBP-5
T.31N., R.48E., SEC.16 cda

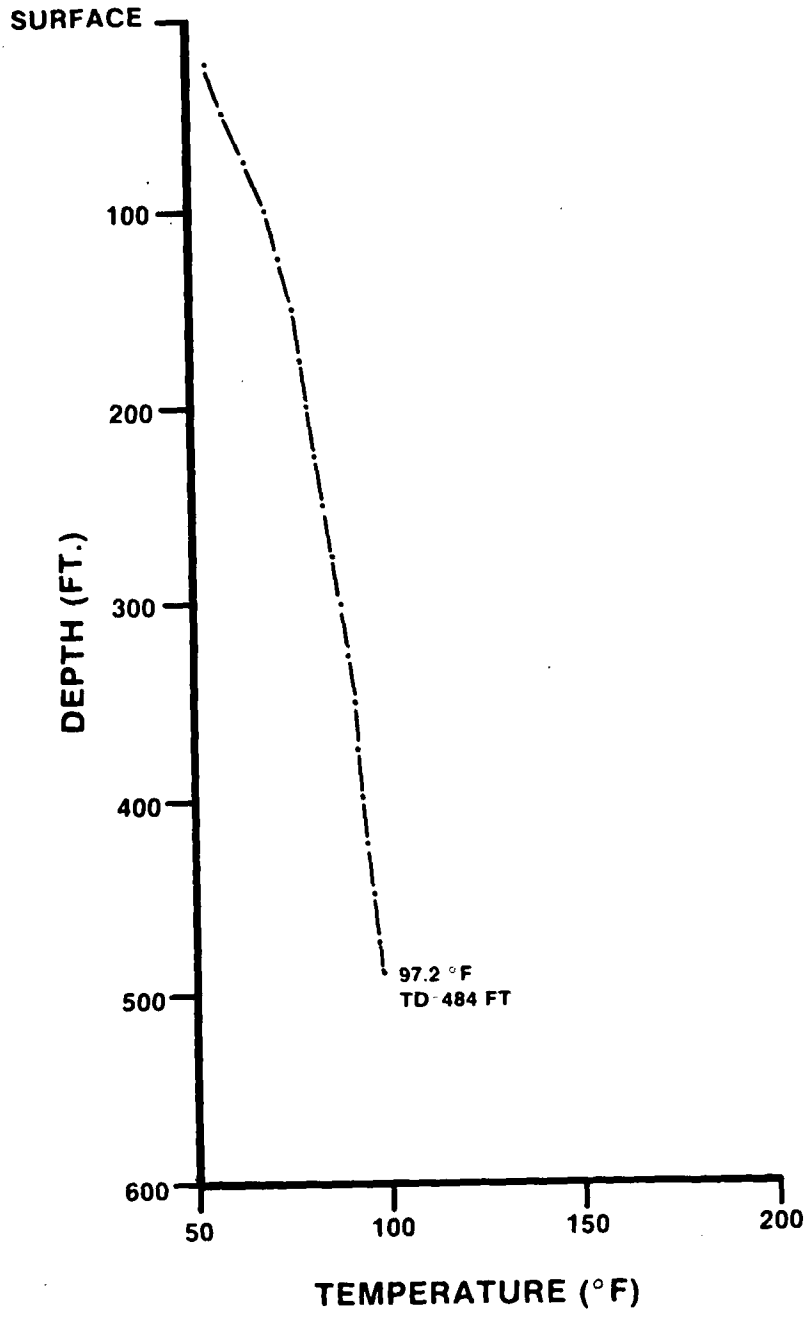


FIGURE 5d

BEOWAWE GBP-7A
T.31N., R.48E., SEC. 22 ccb

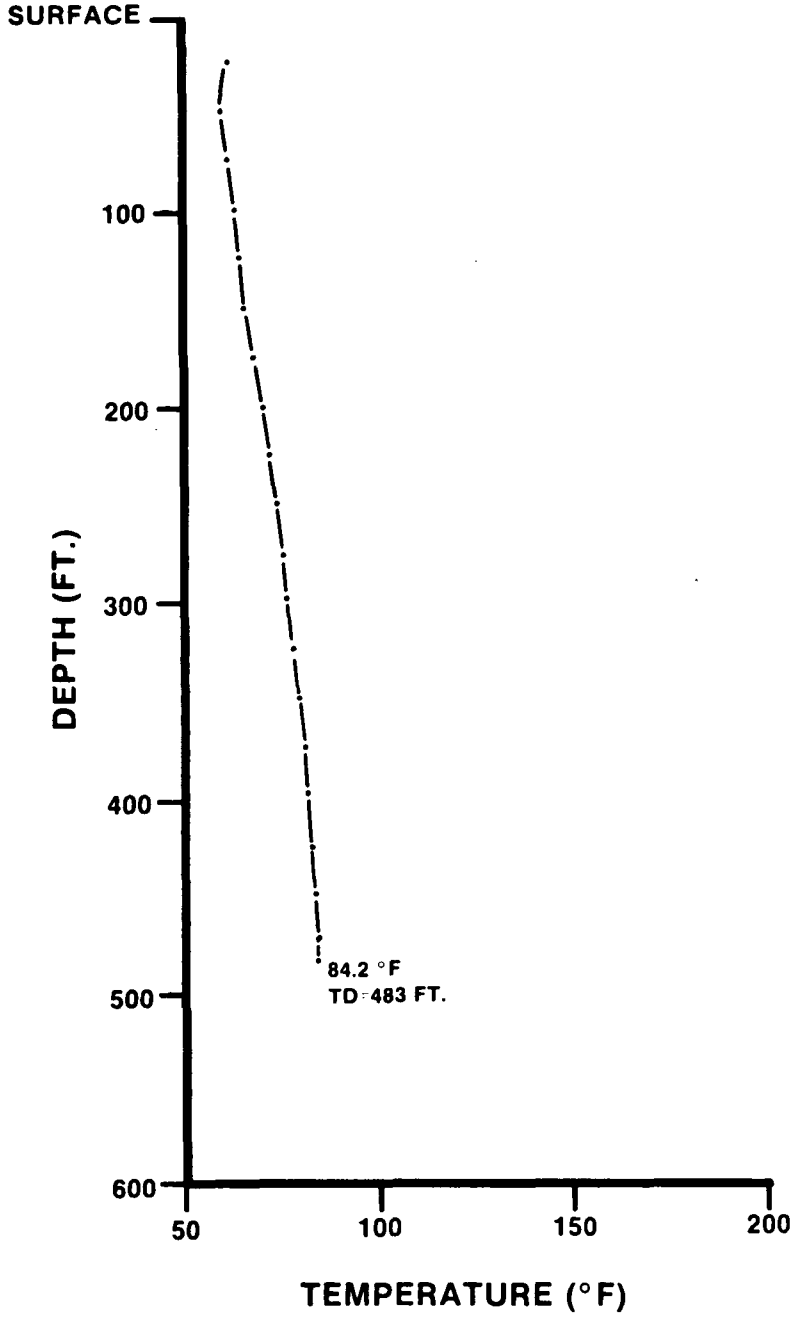


FIGURE 5e

BEOWAWE GBP-8
T.31N., R.48E., SEC.22 bbb

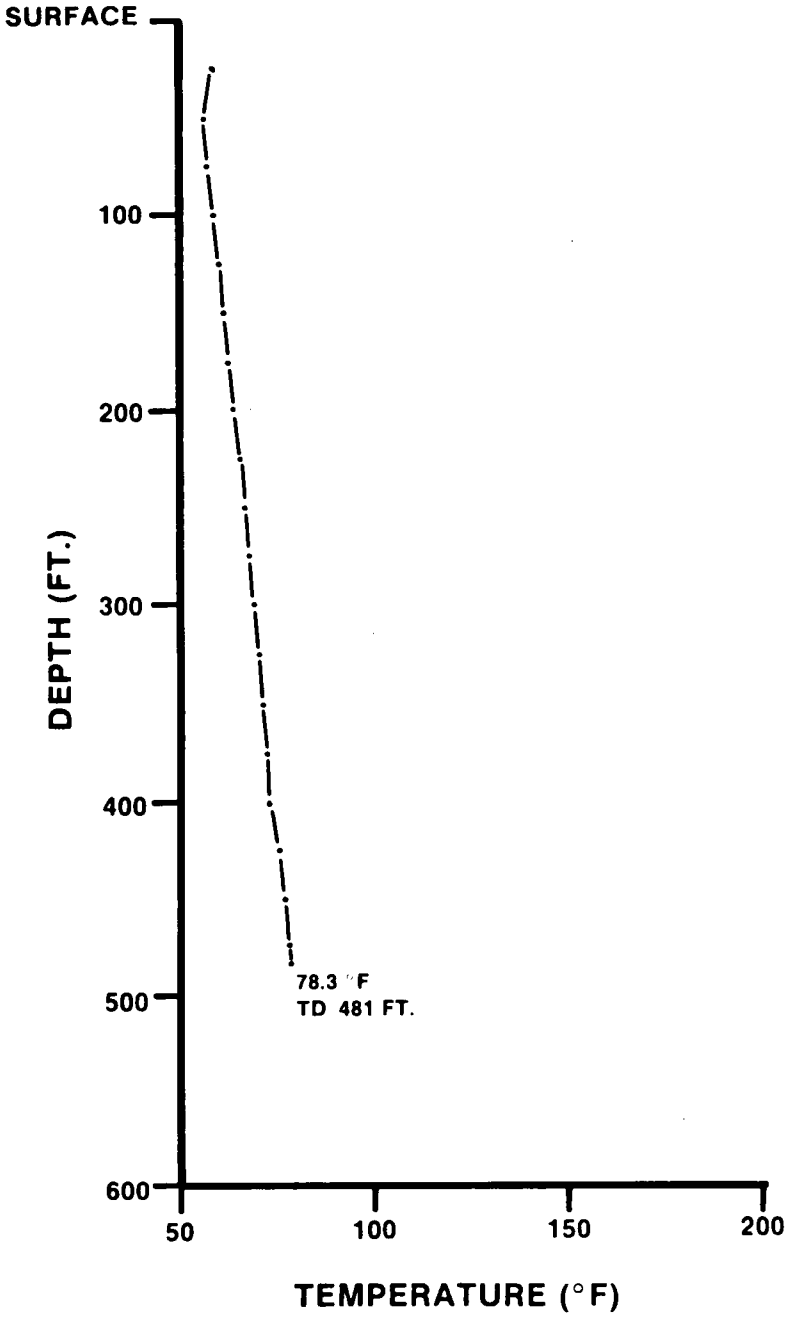


FIGURE 5f

BEOWAWE GBP-9
T.31N., R.48E., SEC.22 acd

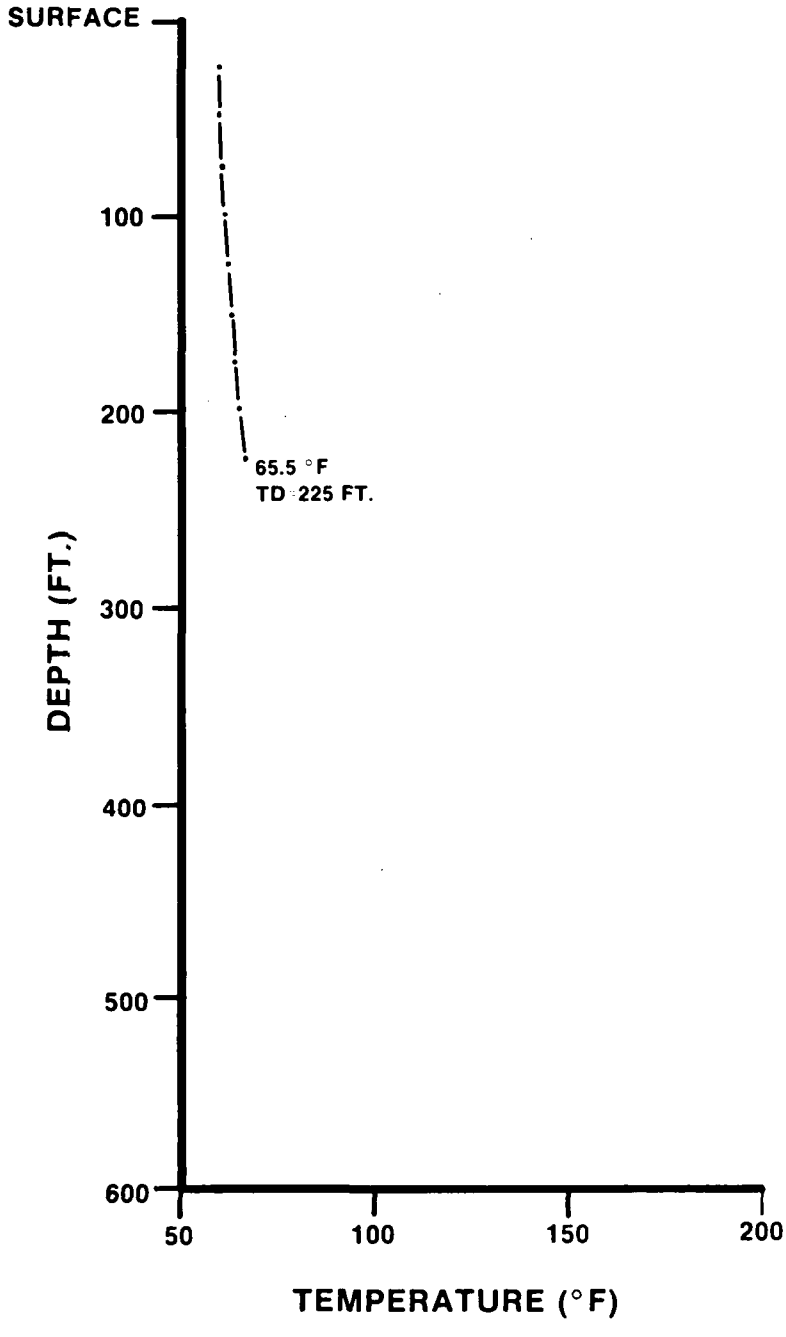


FIGURE 5g

BEOWAWE GBP-10
T.31N., R.48E., SEC.22 aaa

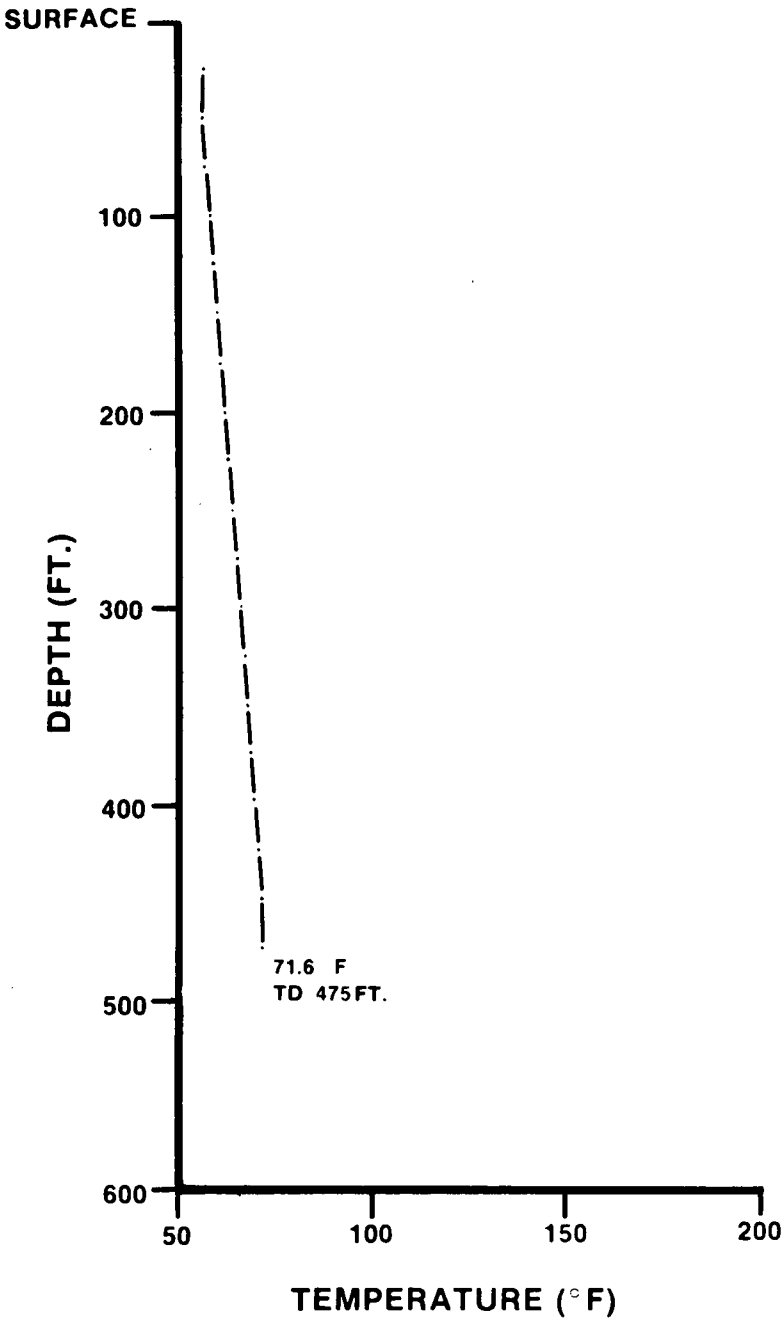


FIGURE 5h

BEOWAWE GBP-12
T.31N.,R.48E., SEC.14 caa

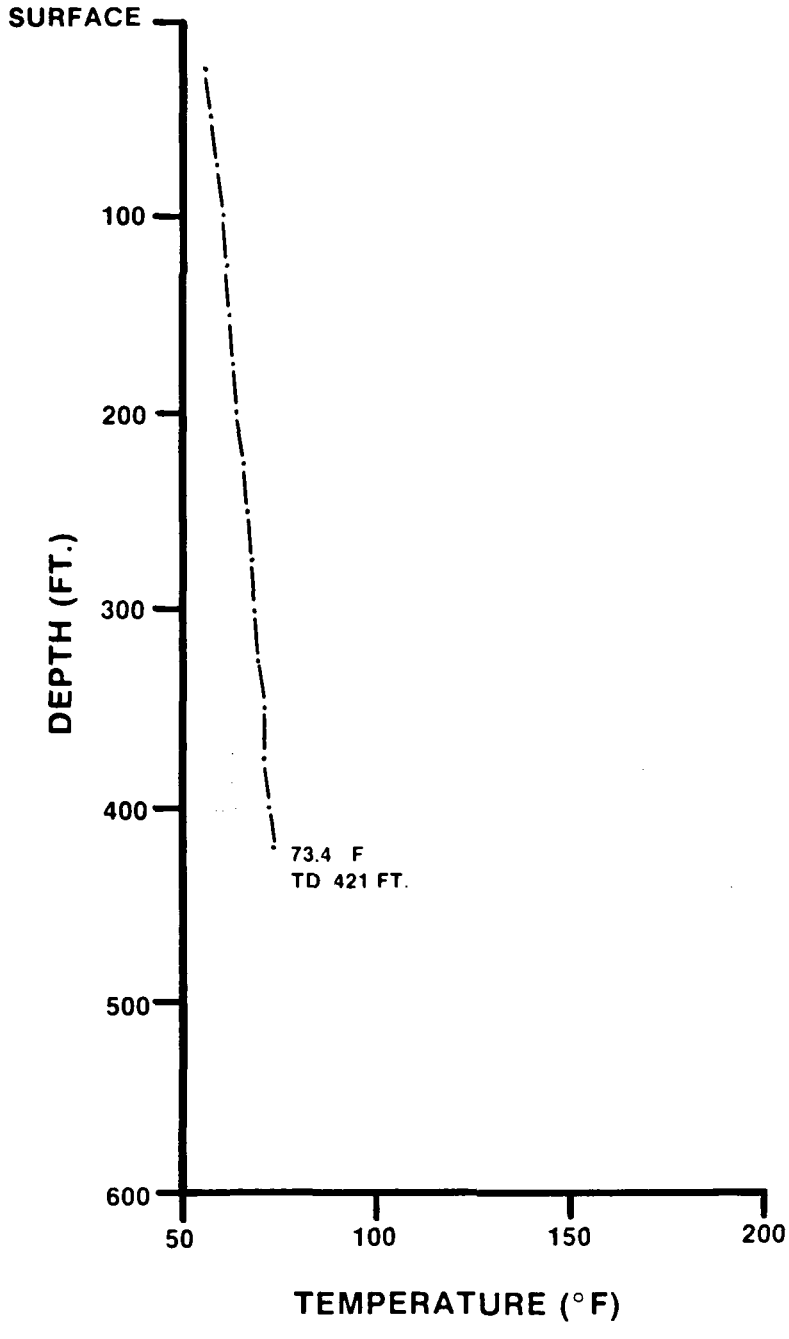


FIGURE 5i

BEOWAWE GBP-13
T.31N., R.48E., SEC.14 aab

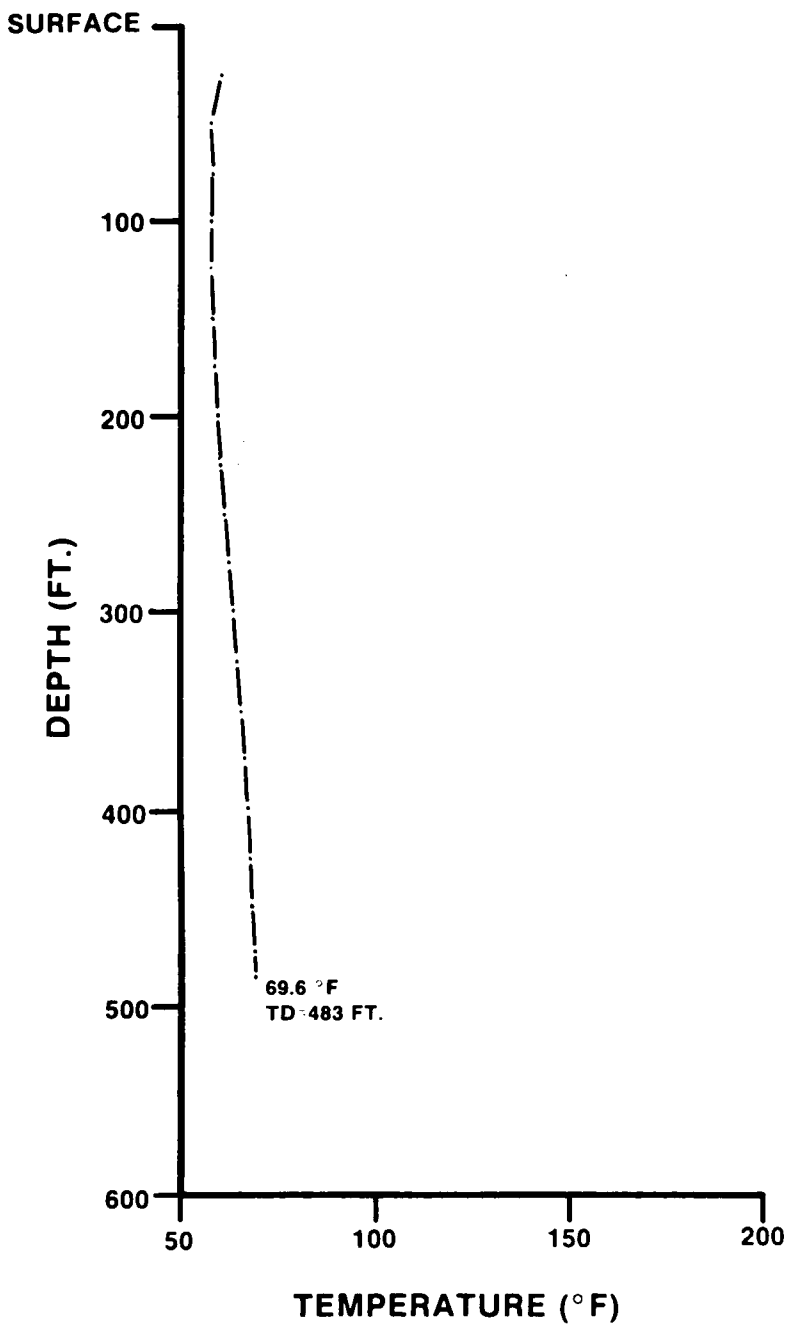


FIGURE 5j

BEOWAWE GBP-14
T.31N.,R.48E.,SEC.11dad

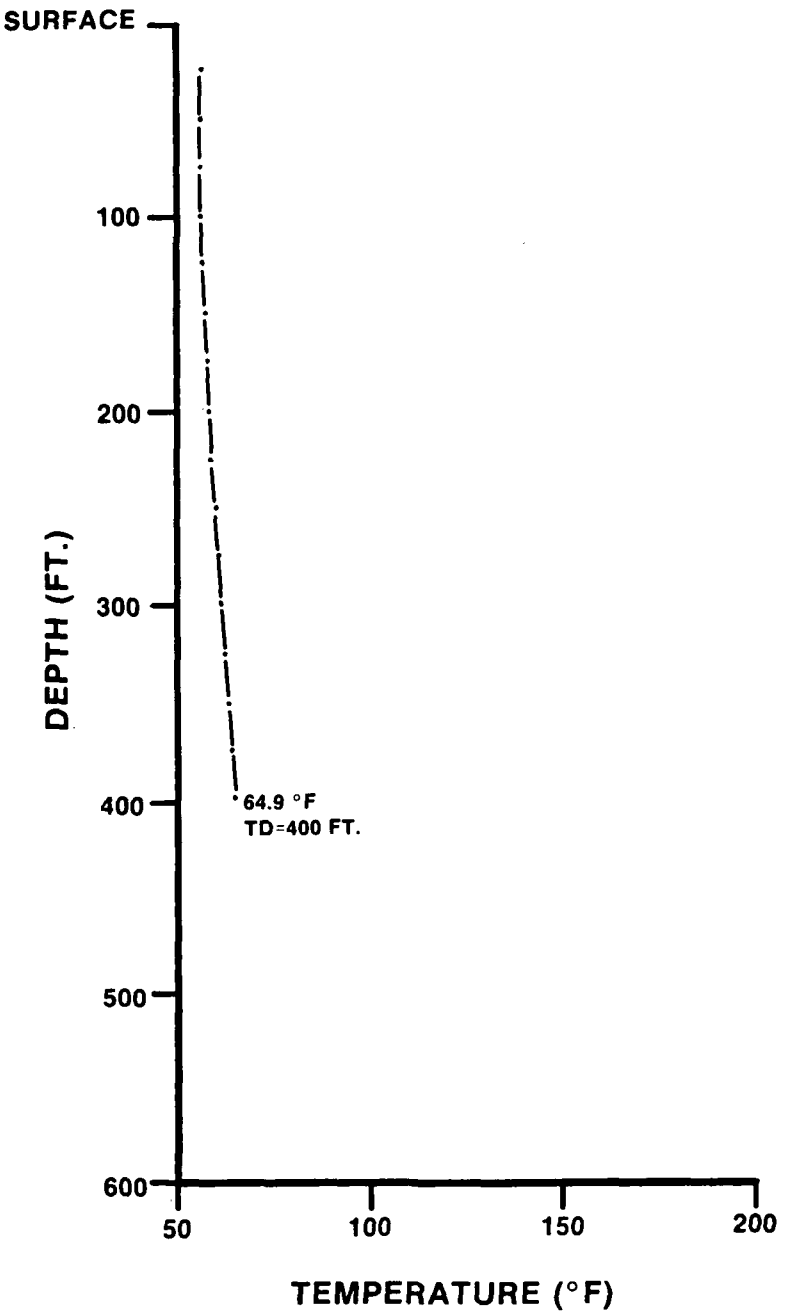


FIGURE 5k

BEOWAWE GBP-15
T.31N., R.48E., SEC.20 bdd

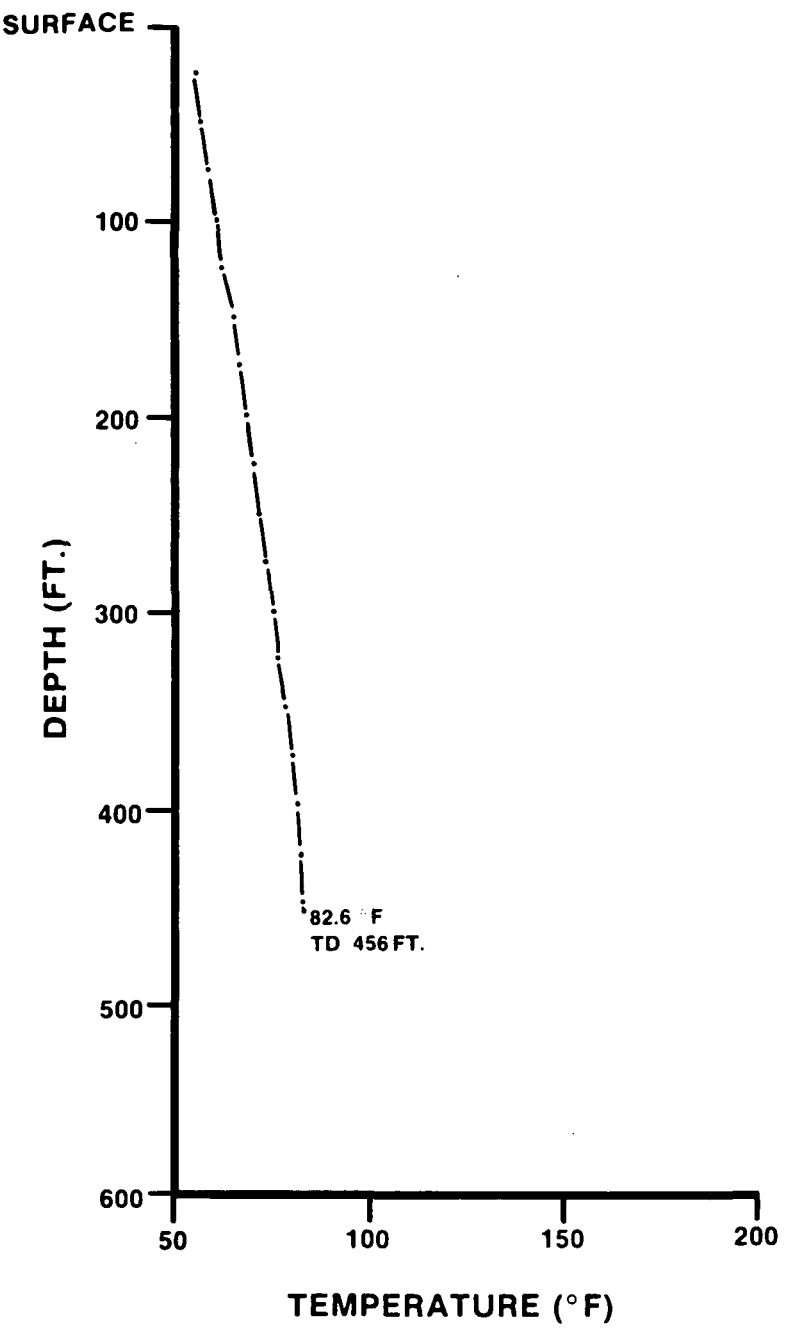


FIGURE 5I

BEOWAWE GBP-16
T.31N., R.48E., SEC.20 ddb

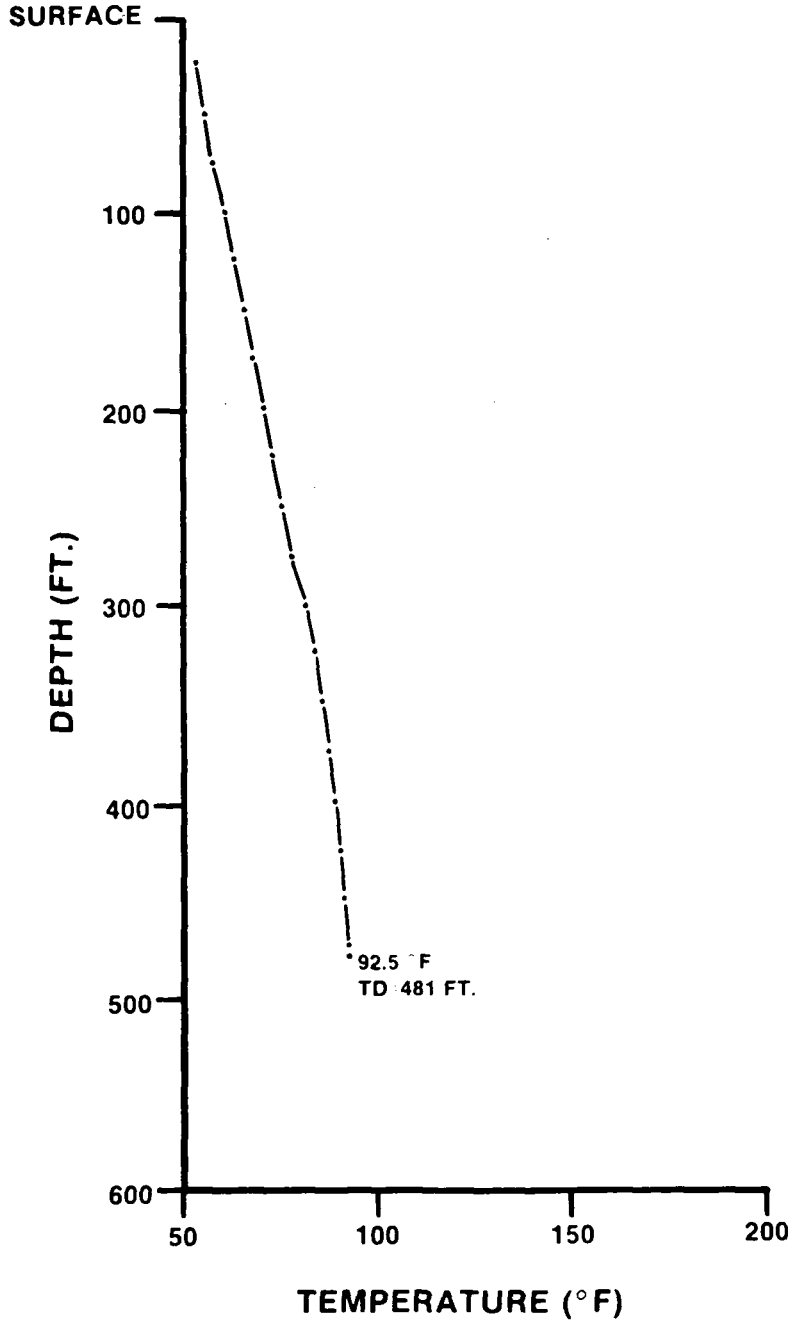


FIGURE 5m

BEOWAWE GBP-17
T.31N., R.48E.,SEC.16 bdd

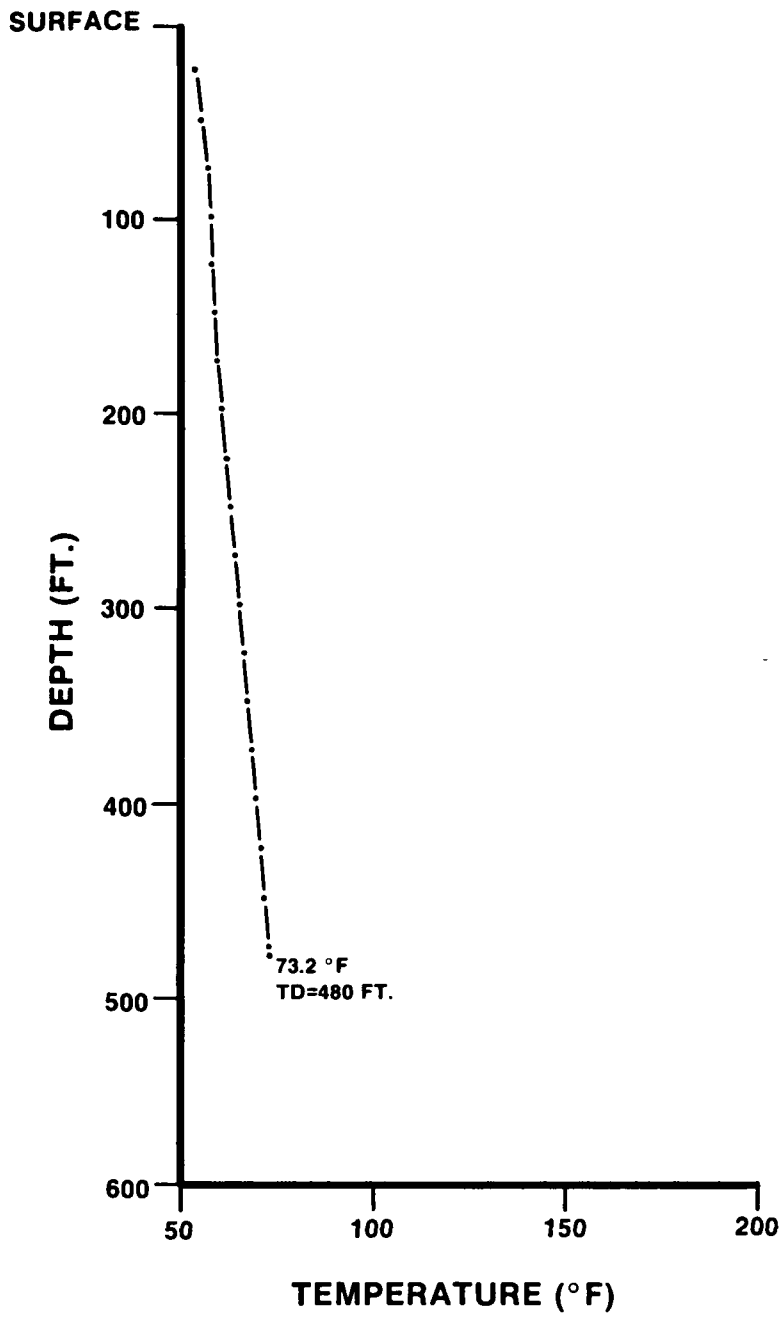


FIGURE 5n

THE 200-FOOT ISOTHERMS (IN °F) FROM GETTY OIL CO. AND CHEVRON INC., SHALLOW HOLE DRILLING PROGRAMS.

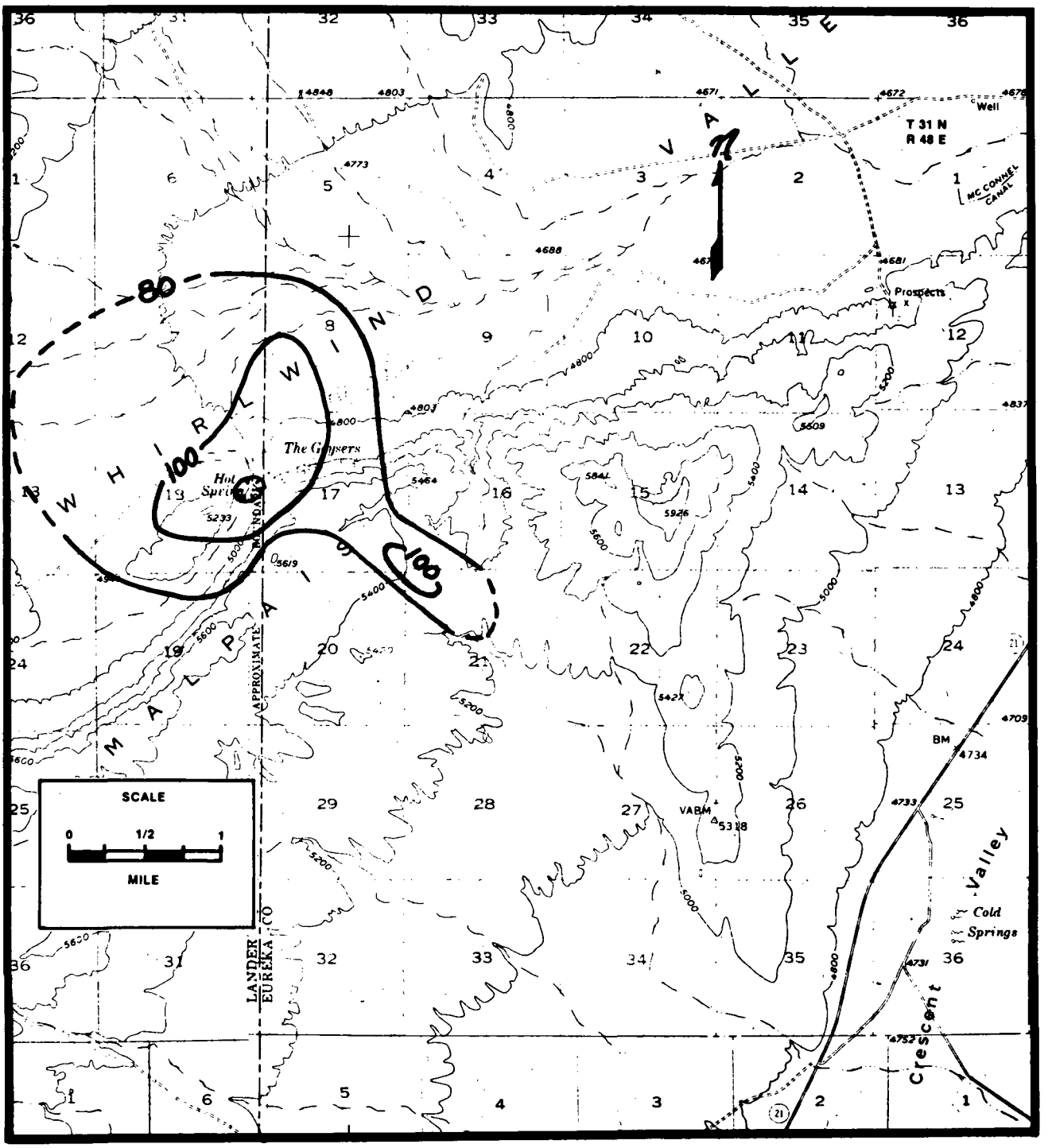


FIGURE 6

BOTTOM HOLE ISOTHERMS (IN °F) FROM THE GETTY OIL CO. AND CHEVRON INC., SHALLOW HOLE DRILLING PROGRAMS.

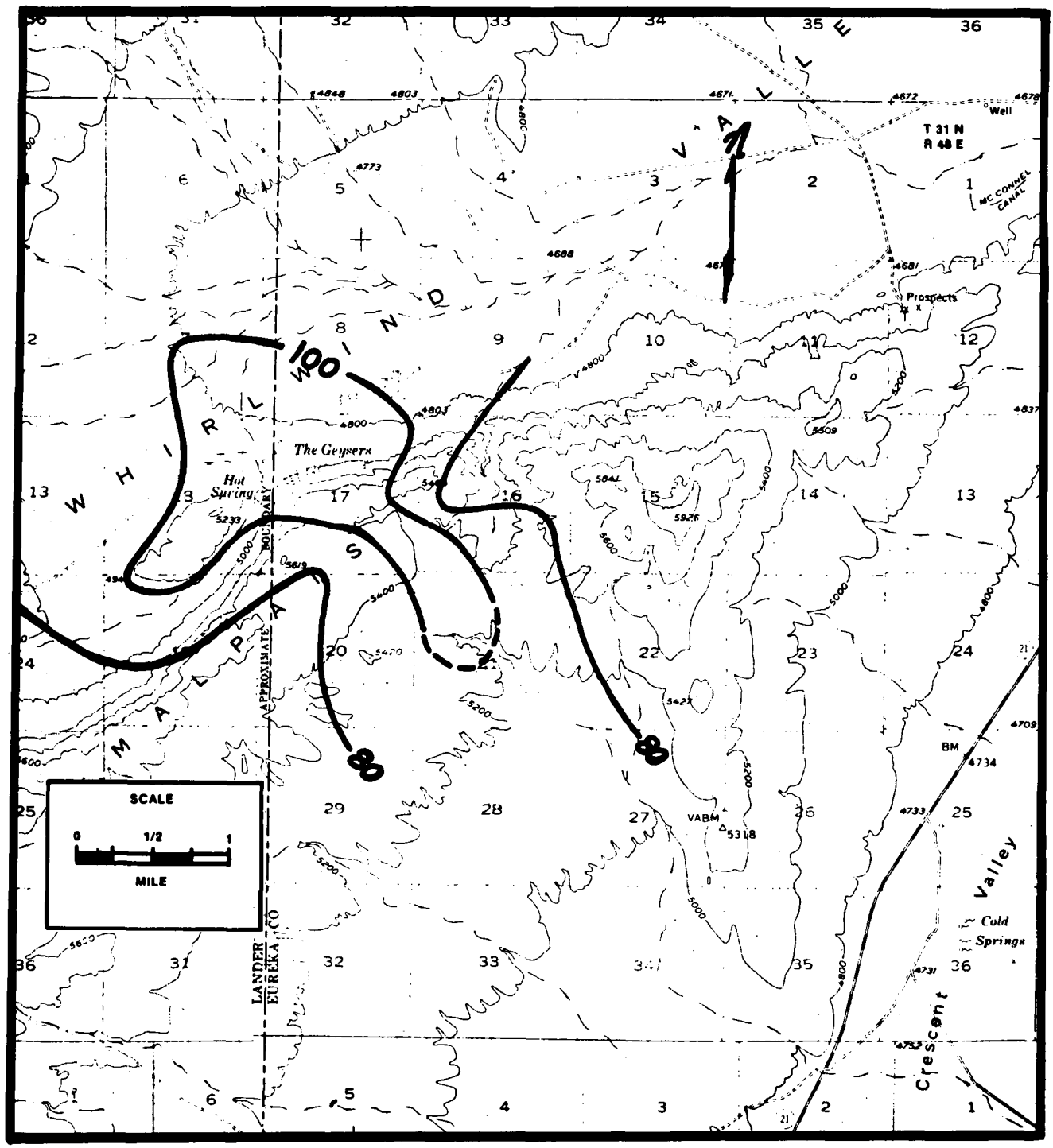


FIGURE 7

DRILLING PROGRESS CHART; COLLINS 76-17

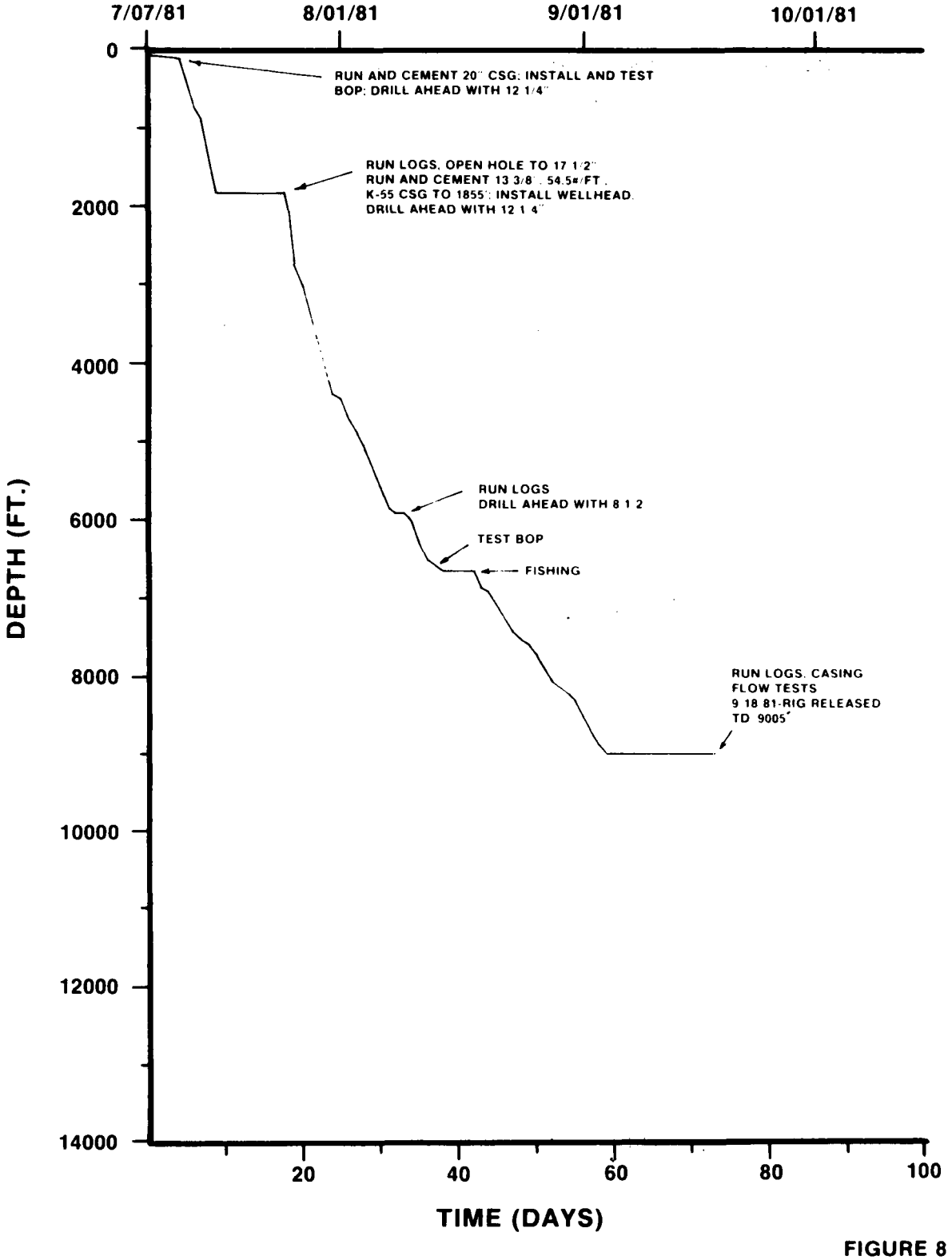
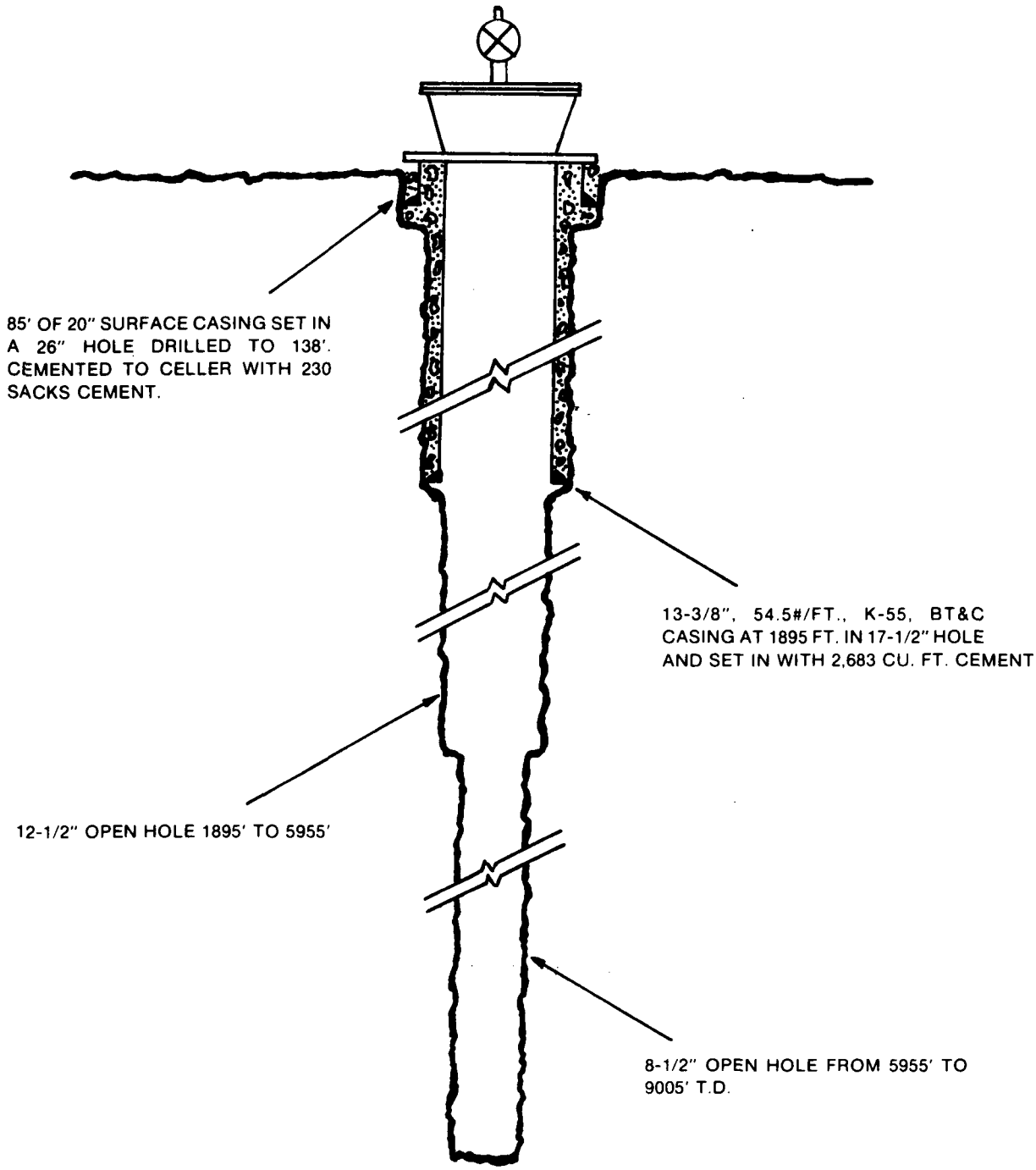


FIGURE 8

HOLE COMPLETION STATUS FOR COLLINS 76-17



NOTE: WELL WAS FILLED WITH FRESH WATER AND SHUT IN 9/17/81.
MEASUREMENTS ARE FROM KELLEY BAR, 26 FT. ABOVE GROUND LEVEL.

FIGURE 9

DEPTH AND DEFLECTION PROFILE
COLLINS 76-17

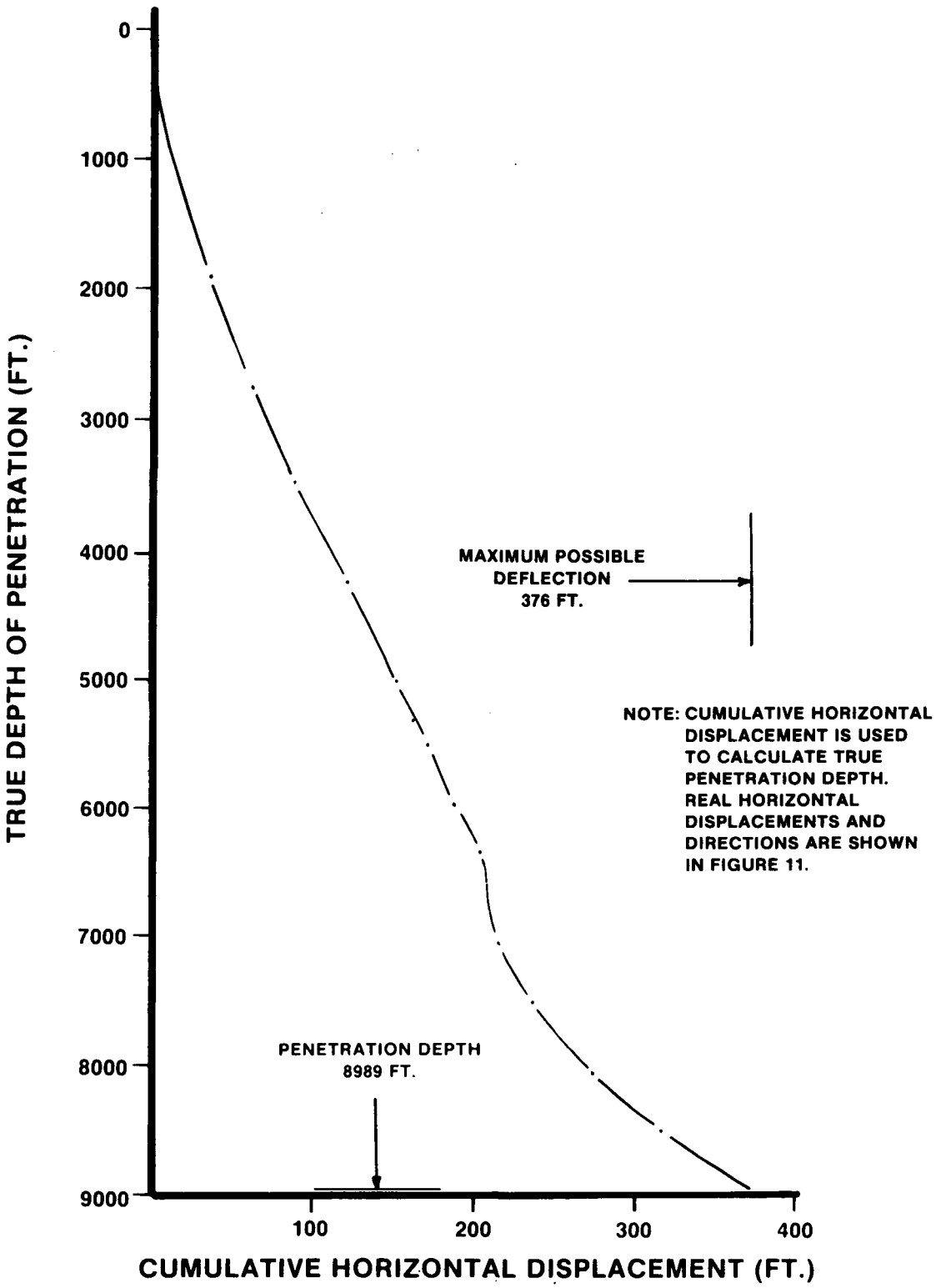


FIGURE 10

DIRECTIONAL SURVEY, COLLINS 76-17

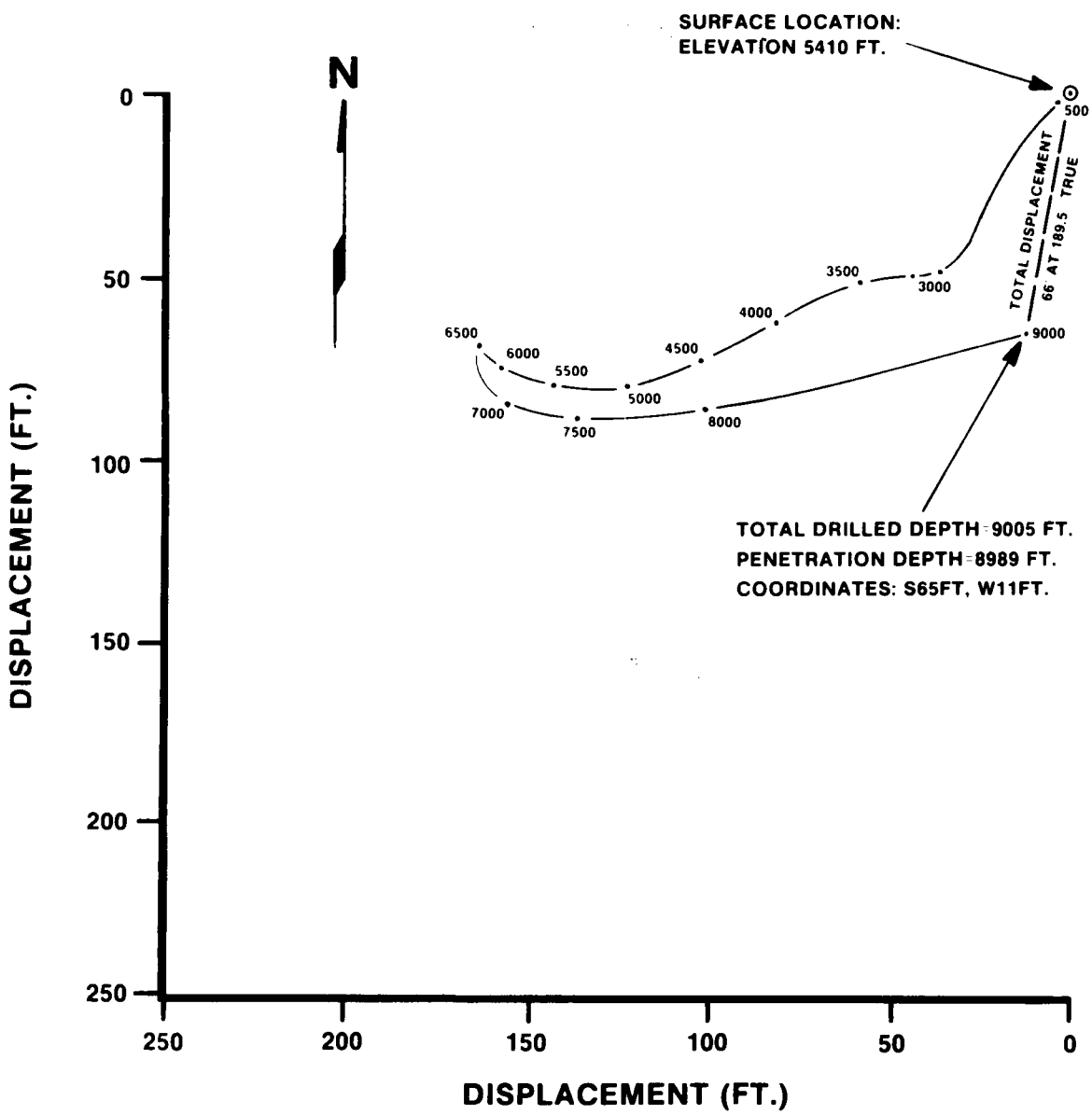
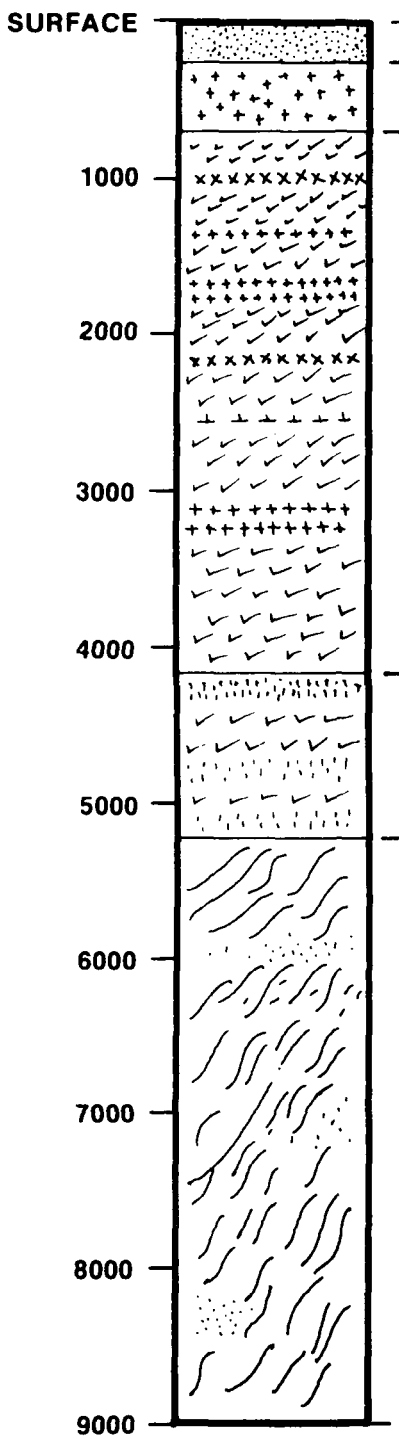


FIGURE 11

LITHOLOGIC LOG: COLLINS 76-17



0-270'	QUARTZITE
270'-720'	DACITE; APHANITIC WITH OCCASIONAL QUARTZ-FELDSPAR VEINS.
720'-4170'	BASALT, ANDESITE, DIABASE AND DIORITE FLOW. SOME QUARTZ-FELDSPAR VEINS. CLAY, BENTONITE AND QUARTZITE OCCASIONALLY ARE FOUND BETWEEN FLOWS.
4170'-5230'	INTERBEDDED QUARTZITE AND BASALT FLOWS. CALCITE-PYRITE-QUARTZ VEINS AND FRACTURE FILLINGS.
5230'-TD	VALMY FORMATION: QUARTZITE, ARGILLITE AND METASILTSTONE. QUARTZ AND CALCITE IN VEINS AND AS FRACTURE FILLINGS; MINOR PYRITE; MINOR BASALT FLOWS IN INTERVAL 6180-6330'.

FIGURE 12

TEMPERATURE PROFILE: COLLINS 76-17
T.31N., R.48E., SEC. 17 dab

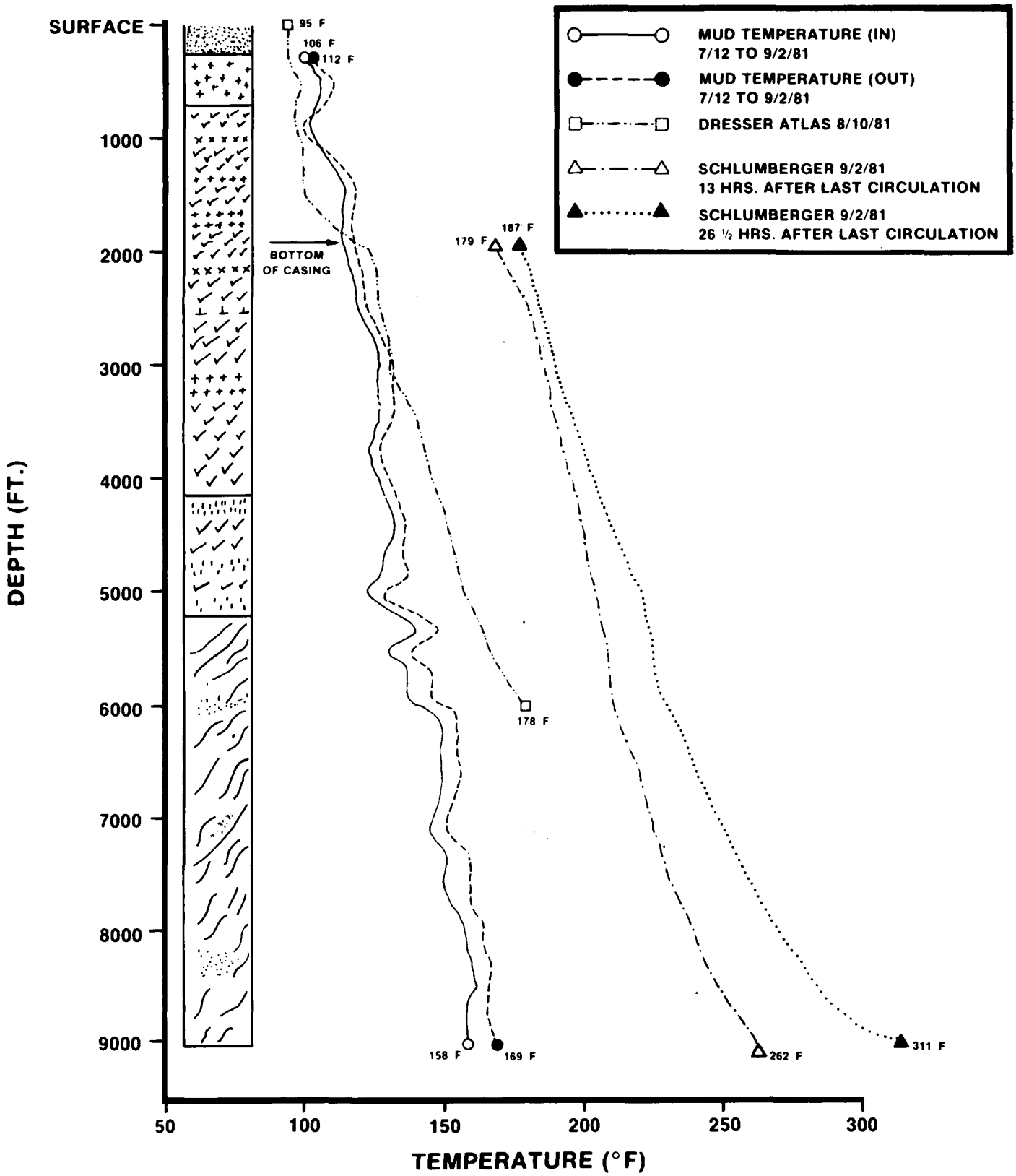


FIGURE 13

TABLE 1

ROTARY BIT RECORD--COLLINS 76-17

RUN	SIZE	* MAKE	TYPE	**DEPTH OUT	FEET DRILLED	HOURS ON BIT
1	12 1/4"	--	Rerun	3	3	3
2	26"	--	Rerun	112	109	22
3	12 1/4"	STC	F3	796	684	42
4	12 1/4"	STC	F3	1,871	1075	51 1/2
5	17 1/2"	HTC	Hole opener	--	--	75 1/2
6	12 1/4"	HTC	XDV	1,879	8	2
7	12 1/4"	STC	F2	2,140	261	10
8	12 1/4"	STC	F2	2,922	782	43 1/2
9	12 1/4"	STC	F3	3,762	840	44
10	12 1/4"	Reed	FPS3	4,424	662	44
11	12 1/4"	STC	F4	5,040	616	59
12	12 1/4"	Reed	FPG2	5,541	501	38
13	12 1/4"	STC	F4	5,961	420	35
14	8 1/2"	STC	F4	6,394	433	37 1/2
15	8 1/2"	Reed	FP62	6,657	263	22
16	8 1/2"	STC	F5	6,740	83	9
17	8 1/2"	STC	F7	6,938	198	24
18	8 1/2"	Reed	FP72	7,143	205	30
19	8 1/2"	STC	F5	7,217	74	20 1/2
20	8 1/2"	STC	F5	7,550	333	25 1/2
21	8 1/2"	HTC	J77	7,812	262	34
22	8 1/2"	HTC	J77	8,056	244	30 1/2
23	8 1/2"	HTC	J77	8,189	133	26 1/2
24	8 1/2"	HTC	J77	8,566	377	23
25	8 1/2"	HTC	J77	8,874	308	30 1/2
26	8 1/2"	STC	F7	8,979	105	14

* STC = Smith Tool Company
HTC = Hughes Tool Company

** Penetration below ground. Collar elevation = 5,410 feet, Kelly Bushing elevation = 5,436 feet.

TABLE 2

CASING AND TUBULARS IN COLLINS 76-17

HOLE DIAMETER	CASING DIAMETER	JOINTS	DEPTH (FEET)	TYPE	WEIGHT (#/FT)
26"	20"	2?	85	--	94
17 1/2"	13 3/8"	48	1,895	K55 BT&C	54.5
12 1/2"	9 5/8	150	5,823	N80 BT&C	43.5
12 1/2"	Open Hole		5,929		
8 1/2"	Open Hole		8,979		

TABLE 3

LOG LISTINGS: COLLINS 76-17*

7/16/81	Dresser Atlas Temperature Log	Scale:	5"	= 100'
8/20/81	Dresser Atlas Temperature Log	Scale:	5"	= 100'
9/2/81	Schlumberger Temperature Log	Scale:	5"	= 100'
7/16/81	Dresser Atlas BHC Acoustilog	Scale:	5"	= 100'
7/16/81	Dresser Atlas Formation Density, Neutron, Gamma Ray Log	Scale:	2"&5"	= 100'
9/2/81	Schlumberger Formation Density, Neutron Log	Scale:	2"	= 100'
7/16/81	Dresser Atlas Dual Induction Laterolog	Scale:	2"&5"	= 100'
8/9/81	Schlumberger Dual Induction Laterolog	Scale:	5"	= 100'
9/2/81	Schlumberger Dual Induction Laterolog	Scale:	2"	= 100'
8/10/81	Dresser Atlas Continuous Dipmeter/ Directional Log	Scale:	2"	= 100'
7/2/81	Schlumberger Continuous Dipmeter/ Directional Log	Scale:	2"	= 100'

*Copies of all logs are available from:

Rocky Mountain Well Log Service
P.O. Box 3150
Denver, CO 80201
(303) 740-7100

APPENDIX A

COLLINS # 76-17
DRILLING SUMMARY
(6:00 a.m. Report)

7/07/81. Spud at 6 p.m. on July 6, 1981. Drill 12 1/4-inch hole to three feet in three hours, could not make hole, hole deviating. POH and wait on Dynadrill and 26-inch bit. Brinkerhoff Rig #2.

7/08/81. Rigged up Dynadrill. Drilled mouse hole and rat hole. Picked up 26-inch bit and drilled from 29 feet to 64 feet K.B. (K.B. = 26 feet above ground level).

7/09/81. Drilled 26-inch hole from 64 feet to 68 feet POH with Dynadrill. Picked up one 8-inch DC and 26-inch bit and drilled to 138 feet. POH. Picked up 26-inch hole opener. Ran in. Found no tight spots. POH. Attempted to run 20-inch casing, stopped at 68 feet K.B. Attempted to wash down. POH. Attempted to run 20-inch casing, stopped at 68 feet. Laid down 20-inch. Picked up two 26-inch hole openers. Piggybacked on two 8-inch drill collars. 6 a.m. going in hole.

7/10/81. Ran in hole with two 26-inch hole openers reamed to T.D. Reamed hard (112 feet in five hours). Ran 20 feet casing, stopped at 85 feet. Attempted to work down, no success. Ran drill pipe with stinger, stabbed into shoe. Pumped 30 barrels. H_2O ahead of 230 sx. Class "G" cement, 3 percent $CaCl_2$. Circulated cement to surface. Pulled D.P. C.I.P. 8:14 p.m., July 7, 1981. W.O.C. four hours. 6 a.m. now NU 20-inch Hydril and mud loggers.

7/11/81. Nipple up BOP. Pressure tested to 500 psi, OK. Rigged up mud logger. RIH with 17 1/2-inch bit. Drilled out shoe and cleaned out to 138 feet POH. PU 12 1/4-inch bit on Dynadrill and drilled to 159 feet, ran survey (survey depth 129 feet, 1/2^{o}). Drilled to 186 feet, 6 a.m. drilling ahead, mud 9.0#, 40 vis.

7/12/81. Dynadrilled 12 1/4-inch hole to 225 feet. POH. Laid down Dynadrill. RIH with bit and new BHA. Reamed from 138 feet to 225 feet. Drilled from 225 feet to 303 feet. 6 a.m. drilling ahead. MUD: 8.7 PPG, 51 vis., 104^{o}F in, 102^{o}F out.

7/13/81. Drilled 12 1/4-inch hole from 303 feet to 752 feet. Hole took 300 barrels of mud from 500 feet to 520 feet. SURVEYS: 324 feet; 1/4^{o}, 543 feet, 1/2^{o}. MUD: 8.7 PPG, 41 vis., 106^{o}F in, 112^{o} out at 510 feet. LITHOLOGY: 635 feet to 752 feet 100 percent quartzite.

7/14/81. Drilled 12 1/4-inch hole to 826 feet. POH. Changed bit. RIH. 6 a.m. drilling at 918 feet. MUD: 8.7 PPG, 45 vis., 102^{o}F in, 100^{o}F out at 900 feet. LITHOLOGY: 752 feet to 918 feet 100 percent Basalt.

7/15/81. Drilled from 918 feet to 1,454 feet. 6 a.m. drilling ahead. MUD: 8.8 PPG, 45 vis., 115°F in, 119°F out at 1,450 feet.

7/16/81. Drilled 12 1/4-inch hole 1,454 to 1,845 feet (390 feet in 19 hours, 21 feet/hour). Lost circulation at 1,508 feet (400 barrels). Regained circulation, will LCM material. MUD: 8.9 PPG, 36 vis., 113°F in, 118°F out at 1,845 feet.

7/17/81. Drilled 12 1/4-inch hole 1,845 feet to 1,893 feet (48 feet in two hours, 24 feet/hour). Pulled out of hole to log. Rigged up Dresser Atlas. Ran tempera-ture, DIL, Sonic, and Neutron Density Logs. Preparing to open 12 1/4-inch hole to 17 1/2 inches. MUD: 8.9 PPG, 41 vis., no temperatures available.

7/18/81. Opened 12 1/4-inch hole to 17 1/2 inches from 138 feet to 476 feet (338 feet in 21 hours, 16 feet/hour). MUD: 8.9 PPG, 35 vis., no temperature available.

7/19/81. Opened 12 1/4-inch hole to 17 1/2 inches from 476 feet to 940 feet (464 feet in 21 hours, 22 feet/hour). Pulled out to change hole openers. MUD: 8.9 PPG, 35 vis.

7/20/81. Opened 12 1/4-inch hole to 17 1/2 inches from 940 feet to 1,340 feet (400 feet in 18 1/2 hours, 22 feet/hour). Changed hole openers at 999 feet. MUD: 8.9 PPG, 36 vis.

7/21/81. Opened 12 1/4-inch hole to 17 1/2 inches from 1,340 feet to 1,650 feet (310 feet in 15 hours, 21 feet/hour). Changed hole openers at 1,467 feet. MUD: 8.9 PPG, 36 vis.

7/22/81. Twisted off drill collar box at 1,658 feet. Top of fish 1,470 feet. Ran overshot and recovered fish. Opened 12 1/4-inch hole to 17 1/2 inches from 1,658 feet to 1,895 feet. Preparing to run 13 3/8-inch casing. MUD: 8.9 PPG, 36 vis.

7/23/81. Ran 48 jts of 13 3/8-inch 54.5 #/feet, K-55 buttress threads to 1,895 feet. Float shoe at 1,895 feet. Float collar at 1,855 feet. Centralizers on shoe joint, second joint, and every third joint to 200 feet. Halliburton pumped 50 cubic feet of water ahead of 20 barrels of Flocheck 21. Cemented with 2,683 cubic feet Class "G" 1:1 perlite, 40 percent silica flour, 0.5 percent Halad 22-A, 0.5 percent CFR-2. Tailed with 200 cubic feet of Class "G" 40 percent silica flour, 0.5 percent Halad 22A, 0.5 percent CRF-2. Displaced with 1,625 cubic feet of water. Did not bump plug. Float valve held. 1,475 cubic feet of returns C.I.P. 6:30 p.m., July 23, 1981. Wait on cement eight hours, tag top of cement at 125 feet. Installing wellhead at report time.

7/24/81. Installed 13 3/8-inch wellhead. Tested welds to 1,500 psi. Ran 1-inch pipe to 126 feet down annulus. Halliburton pumped 144 ft^3 of construction cement with 3 percent $CACl_2$. Got returns to surface. Nippled up BOE, pressure tested casing and blind rams to 900 psi. Running collars at report time.

7/25/81. Pressure test pipe rams to 1000 psi. RIH with slick assembly. Tag cement 1,645 feet (210 Hi). Drill to 1,903 feet. POH to change bits. RIH with slick assembly. Drill to 2,053 feet. Drilling ahead at 6 a.m.

7/26/81. Drill to 2,164 feet. POH. Make up stiff assembly. RIH. Ream 1,873 feet to 2,164 feet. Drilling ahead at 2,412 feet, 6 a.m. Bit, 6 pt., Monel, PWP, Shock Sub, IBS, DCs.

7/27/81. Drill 12 1/4-inch hole 2,412 feet to 2,771 feet. Drilling ahead at 6 a.m.

7/28/81. Drilled 12 1/4-inch hole from 2,771 feet to 3,013 feet (242 feet in 17 hours, 14 feet/hour). Changed bits at 2,946 feet. SURVEY at 2,729 feet, 1-1/2°S 40°w. MUD: 8.9 PPG, vis. 35. Temperature in 127°F, out 131°F.

7/29/81. Drilled 12 1/4-inch hole from 3,013 feet to 3,410 feet (397 feet in 22 hours, 18 feet/hour). SURVEY at 3,221 feet, 1-1/4°S 80°W. MUD: 8.9 PPG, vis. 37, temperature in 127°, out 132°W.

7/30/81. Drilled 12 1/4-inch hole from 3,410 feet to 3,786 feet (376 feet in 17 hours, 22 feet/hour). SURVEY at 3,535 feet, 2°S 80°W. MUD: 9.0 PPG, vis. 37. Temperature in 123°F, temperature out 128°F.

7/31/81. Ran in hole with new bit. Drilled 12 1/4-inch hole from 3,786 feet to 4,180 feet (394 in 17 hours, 20 feet/hour). SURVEYS at 3,851 feet, 2-3/4°S 56°W; 4,125 feet, 3-3/4°S 69°W.

8/01/81. Drilled 12 1/4-inch hole from 4,180 feet to 4,418 feet (238 feet in 20 1/2 hours, 12 feet/hour). SURVEYS at 4,225 feet, 3°15'S 36°W; 4,347 feet, 3°15'S, 87°W. MUD: 9.0 PPG, 38 vis., CO_2 - 0 PPM. Temperature in 133°F, temperature out 137°F.

8/02/81. Drilled 12 1/4-inch hole from 4,418 feet to 4,458 feet (40 feet in 4 1/2 hours, 9 feet/hour). Changed bits at 4,448 feet. Magnafluxed drill collars and tested BOP to 1,000 PSI. SURVEY at 4,448 feet, 2° (drift only). MUD: 8.9 PPG, 38 vis., CO_2 -0 PPM. Temperature in 127°F, temperature out 131°F.

8/03/81. Drilled 12 1/4-inch hole from 4,458 feet to 4,708 feet (250 feet in 23 1/2 hours, 10 feet/hour). SURVEY at 4,659 feet, 2-1/4°S, 43°W. MUD: 8.9 PPG, vis., 37, CO_2 - 0 PPM, temperature in 128°F, temperature out 137°F.

8/04/81. Drilled 12 1/4-inch hole from 4,708 feet to 4,910 feet (202 feet in 24 hours, 8 1/2 feet/hour). SURVEY at 4,830 feet 2°45'S 75°W. MUD: 8.7 PPG, 35 vis., CO_2 -0 PPm. Temperature in 129°F, temperature out 139°F.

8/05/81. Drilled 12 1/4-inch from 4,910 feet to 5,087 feet (177 feet in 16 hours, 11 feet/hour). Changed bits at 5,064 feet. SURVEYS at 5,001 feet, 2° 15'S 88°W'; 5,064 feet, 2°45' (drift only). MUD: 8.8 PPG, 37 vis., CO_2 -0 PPM. Temperature in 123°F, temperature out 130°F.

8/06/81. Drilled 12 1/4-inch hole from 5,087 feet to 5,373 feet (286 feet in 24 hours, 12 1/2 feet/hour). SURVEY at 5,347 feet, 2°15'N, 85°W. MUD: 8.9 PPG, 37 vis., CO_2 - 0 PPM. Temperature in 142°F, temperature out 148°F.

8/07/81. Drilled 5,353 feet to 5,584 feet (211 feet in 16 hours, 13 feet/hour). Changed bits at 5,535 feet. Tight hole at 4,850 feet. SURVEY at 5,535 feet, 2°0'. MUD: 8.9 PPG, 39 vis., CO_2 - 0 PPM. Temperature in 130°F, temperature out 140°F.

8/08/81. Drilled 5,584 feet to 5,869 feet (285 feet in 24 hours, 12 feet/hour). SURVEY at 5,662 feet, 1-1/4°N 75°W. Fluid loss test as survey dropped 15 feet in 45 minutes (equivalent to 70 bbl/day leakoff). MUD: 8.9 PPG, 39 vis., CO_2 - 0 PPM. Temperature in 138°F, temperature out 146°F.

8/09/81. Drilled 12 1/4-inch hole from 5,869 feet to 5,955 feet (86 feet in nine hours, ten feet/hour). Circulate and condition mud. Made wiper trip to shoe. RIH. Circulate and prepare to POH for loggers. SURVEY at 5942 feet, 2-1/4°N 77°W. MUD: 8.9 PPG, 36 vis., CO_2 - 0 PPM. Temperature in 137°F, temperature out 147°F.

8/10/81. POH for loggers. Rig up Dresser-Atlas. Ran temperature log, DIL, FDC-CNL with G.R., sonic. Running dipmeter log at report time. MUD: 8.9 PPG, 36 vis., CO_2 - 0 PPM. No temperature.

8/11/81. Ran dipmeter and second temperature log. RD Dresser Atlas PU 8 1/2-inch bit and made up new BHA. Drilled 8 1/2-inch hole from 5,955 feet to 6,035 feet. MUD: 8.9 PPG, 36 vis., CO_2 - 0 PPM. Temperature in 146°F, temperature out 155°F.

8/12/81. Drilled 8 1/2-inch hole from 6,035 feet to 6,359 feet (324 feet in 23 hours, 14 feet/hour). SURVEY at 6,134 feet, 2 1/2°N 75°W. MUD: 8.9 PPG, 37 vis., CO_2 - 0 PPM. Temperature in 149°F, temperature out 155°F.

8/13/81. Drilled 8 1/2-inch hole from 6,359 to 6,388 feet. POH for bit trip. Tested BOP. Drilling at 6,532 feet. (173 feet in 16 hours, 11 feet/hour). SURVEY at 6,322 feet 1-3/4°. MUD: 8.9 PPG, 39 vis., CO_2 - 0 PPM. Temperature in 150°F, temperature out 156°F.

8/14/81. Drilled 8 1/2-inch hole from 6,388 to 6,650 feet (118 feet in 8 1/2 hours, 14 feet/hour). Lost 550# pump pressure. POH. Left bit and float valve in hole at 6,650 feet. Now inspecting BHA bit and float value in hole at 6,650 feet. Now inspecting BHA waiting on fishing tools. SURVEY at 6,632 feet, 1-1/4°S 52°E. MUD: 8.9 PPG, 38 vis., CO_2 - 0 PPM. Temperature in 150°F, temperature out 157°F.

8/15/81. Magnafluxed drill collars. RIH with magnet. Recovered pieces of float value and bit bearings. RIH with magnet and skirt. Recovered more junk. RIH and screwed into bit. POH with bit at report time. MUD: 8.9 PPG, 39 vis., CO_2 - 0 PPM. No temperatures.

8/16/81. POH with bit. Left two cones in hole. RIH with magnet and skirt. POH and recovered both cones. RIH with junk basket above new bit. Reamed and washed from 6,645 feet to 6,650 feet. Drilled 8 1/2-inch hole from 6,650 feet to 6,734 feet (83 feet in 9 hours, 9 feet/hour). POH to lay down junk basket. RIH with drilling assembly at report time.

8/17/81. Drilled 8 1/2-inch hole from 6,734 feet to 6,882 feet (148 feet in 15 1/2 hours, 10 feet/hour). POH for washout in drill pipe 6,858 feet. MUD: 8.8 PPG, 36 vis., CO_2 - 0 PPM. Temperature in 148°F, temperature out 154°F.

8/18/81. Drilled 8 1/2-inch hole from 6,882 feet to 6,972 feet. (60 feet in 18 hours, 5 feet/hours). POH for bit. RIH. Now drilling at 6,972 feet. SURVEY at 5,930 feet, 1/2°. MUD: 8.9 PPG, 37 vis., CO_2 - 0 PPM. Temperature in 146°F, temperature out 154°F.

8/19/81. Drilled 8 1/2-inch hole from 6,972 feet to 7,135 feet (163 feet in 21 hours, 8 feet/hour). POH for bit. Now RIH. SURVEY at 7,132 feet 1/2°. MUD: 8.9 PPG, 38 vis., CO_2 - 0 PPM. Temperature in 146°F, temperature out 152°F.

8/20/81. RIH with bit. Drilled 8 1/2-inch hole from 7,135 feet to 7,311 feet (176 feet in 19 1/2 hours, 9 feet/hour). Now POH for bit. MUD: 8.9 PPG, 38 vis., CO_2 -0 PPM. Temperature in 152°F, temperature out 157°F.

8/21/81 POH with bit. Tested BOP. RIH with bit. Drilled 8 1/2-inch hole from 7,311 feet to 7,433 feet (122 feet in 14 hours, 9 feet/hour). SURVEY at 7,311 feet, 2°. MUD: 9.0 PPG, 42 vis., CO_2 -0 PPM. Temperature in 152°F, temperature out 159°F.

8/22/81. Drilled 8 1/2-inch hole from 7,433 feet to 7,576 feet (143 feet in 11 hours, 13 feet/hour). POH for bit. RIH. Reamed from 7,400 feet to 7,485 feet. Blocks fell (automatic driller failure). Slipped drilling line and restrung blocks. PU Kelly. Had full string weight. Now POH. SURVEY at 7,576 feet, 3°. MUD: 8.9 PPG, 39 vis., CO_2 - 0 PPM. Temperature in 150°F. temperature out 160°F.

8/23/81. POH. Inspected BHA. Had four bad drill collars. RIH. Reamed from 7,485 feet to 7,576 feet. Drilled from 7,576 feet to 7,592 feet (16 feet in 2 hours, 8 feet/hour). MUD: 8.9 PPG, 40 vis., CO_2 -0 PPM. Temperature in 128°F, temperature out 155°F.

8/24/81. Drilled 8 1/2-inch hole from 7592 feet to 7,759 feet (167 feet in 24 hours, 7 feet/hour). Now drilling at 7,759 feet. MUD: 8.9 PPG, 40 vis., CO_2 - 0 PPM. Temperature in 155°F, temperature out 160°F.

8/25/81. Drilled 8 1/2-inch hole from 7,759 feet to 7,892 feet (133 feet in 15 1/2 hours, 9 feet/hour). Changed bits to 7,838 feet. SURVEY at 7,838 feet, 4°30'; 7,855 feet, 4°30'N 86E. MUD: 8.9 PPG, 39 vis. Temperature in 154°F, temperature out 161°F.

8/26/81. Drilled 12 1/4-inch hole from 7,892 feet to 8,082 feet (190 feet in 23 1/2 hours, 8 feet/hour). POH for bit change at report time. SURVEY at 7,897 feet, 4°15 feet. MUD: 8.9 PPG, 39 vis. Temperature in 157°F, temperature out 164°F.

8/27/81. Finished POH to change bits. RIH. Reamed from 7,998 feet to 8,082 feet. Drilled 12 1/4-inch hole from 8,082 feet to 8,150 feet (68 feet in 13 hours, 5 feet/hour). SURVEY at 8,050 feet, 4°15'. MUD: 8.9 PPG, 38 vis. Temperature in 158°F, temperature out 164°F.

8/28/81. Drilled 12 1/4-inch hole from 8,150 feet to 8,205 feet (55 feet in 13-1/2 hours, 4 feet/hour). POH to change bit and BHA. SURVEY at 8,155 feet, 4°45'N 88°E, 8,205 feet, 5°15'N 87°E. MUD: 8.9 PPG, 41 vis. Temperature in 158°F, temperature out 165°F.

8/29/81. RIH with new bit. Reamed 8,161 feet to 8,205 feet. Drilled 8 1/2-inch hole from 8,205 feet to 8,310 feet (105 feet in 19 1/2 hours, 5 feet/hour). SURVEY at 8,294 feet, 5°30'N 28°E. MUD 8.9 PPG, 39 vis. Temperature in 160°F, temperature out 167°F.

8/30/81. Drilled 8 1/2-inch hole from 8,310 feet to 8,585 feet (275 feet in 23 hours, 12 feet/hours). SURVEY at 8,514 feet, 5°45'N 43°E. MUD: 8.9 PPG, 37 vis. Temperature in 162°F, temperature out 166°F.

8/31/81. Drilled 8 1/2-inch hole from 8,585 feet to 8,730 feet (145 feet in 14 1/2 hours, 10 feet/hour). Changed bits at 8,592 feet. Reamed 8,535 feet to 8,592 feet. SURVEYS at 8,592 feet, 5°30' no direction. MUD: 8.9 PPG, 37 vis. Temperature in 158°F, temperature out 166°F.

9/01/81. Drilled 8 1/2-inch hole 8,730 feet to 8,900 feet (170 feet in 16 1/2 hours, 10 feet/hour). POH to change bits. RIH at report time. SURVEY: None. MUD: 8.9 PPG, 45 vis. Temperature in 165°F, temperature out 171°F.

9/02/81. RIH with new bit. Drilled 8 1/2-inch hole from 8,900 feet to 9,005 feet (105 feet in 14 hours, 7 feet/hour). Circulate and condition mud for logs at report time. SURVEYS: None. MUD: 8.9 PPG, 38 vis. Temperature in 158°F, temperature out 169°F.

9/03/81. POH to run logs. Ran DIL from 5,966 feet to 9,005 feet. Ran temperature log from 1,895 feet to 9,005 feet. Maximum temperature 262°F at 9,005 feet. Ran FDC/CNL with G.R. from 5,955 feet to 9,005 feet. Ran dipmeter 5,955 feet to 9,005 feet. Running second temperature log at report time. SURVEY at 9,000 feet, 7°0'S 84°E. MUD: 8.9 PPG, 38 vis.

9/04/81. Ran second temperature log from 1,895 feet to 9,005 feet. Maximum temperature 312°F at 9,000 feet. Ran Pruett Tandem temperature Log to 8,960 feet. Maximum temperature 275°F. Laying down drill pipe at report time. SURVEYS: None. MUD: No report.

9/05/81. Finish laying down drill pipe and collars. Nipple down BOP. NU test tree and BOP. Rigged up Pruett. Ran temperature survey from 500 feet to 8,950 feet (10 minute stops every 500 feet). Maximum temperature; 5,991 #1, 280°F at 8,950 feet; tool #2 284°F at 8,950 feet. (44 hours since circulation.) Now fabricating blooie line to pit.

*9/06/81. Finished fabricating blooie line. RU PU machine and tongs. Ran 2 7/8-inch N-80 tubing to 1,514 feet. Hookup air and blew well down. Maximum pressure 600 psi. Ran tubing to 3,007 feet. Blew well down. Maximum pressure 950 psi. Ran tubing to 4,000 feet. Pressured to 1,250 psi, no flow. Pulled to 3,550 feet. Maximum pressure 1,250 psi, no flow. Pulled to 3,294 feet. Well kicked while pulling. Stabbed tubing valve and closed pipe rams. Well blew air, mud, and water for five minutes and died. Pumped air continuously at 950 psi. Wellheaded every 20 to 30 minutes with five to ten minutes of flow each time. Maximum flowing temperature 182°F. Shut down for one hour. Well died. Started air at 980 psi, recovered 100 percent water. Fluid gradient indicates fluid level at 1,031 feet (2,263 feet of water). Temperature 200°F on first head after starting up. Pumped air continuously. Wellheaded every 20 to 30 minutes. Maximum temperature 185°F. Now circulating air.

*9/07/81. Pumped air until blowing clean. Shut compressors down for one hour. Well flowed for 20 minutes and died. Maximum temperature 180°F. Restarted compressors. Maximum pressure 880 psi, wellheading. Shut down air compressors for one hour. Well flowed for 15 minutes and died. Maximum temperature 180°F. Cannot unload any deeper. Prepare to run tubing to bottom. Pumped mud down kill line to cool and kill well. Run 2 7/8-inch tubing to 7,185 feet. Tubing stopped. Attempted to work down, would not go. Pulled tubing. PU bit. D.C. and 4 1/2-inch D.P. Now RIH.

9/08/81. RIH to 2,271 feet. Reamed out bridges from 2,271 feet to 3,317 feet. Lost 150 barrels of mud. Now reaming at 3,317 feet. MUD: 9.0 PPG, 51 vis.

9/09/81. Reamed with 8 1/2-inch bit from 3,317 feet to 3,819. POH. Nipple down test tree. Nipple up B.O.P.E RIH. with 12 1/4-inch bit at report time. MUD: 9.0 PPG, 65 vis.

9/10/81. Finished running in hole with 12 1/4-inch bit. Clean out from 2,194 feet to 3,379 feet. Hole sloughing at 3,379 feet. POH to remove one jet. RIH with new bit. Reaming at 2,624 feet at report time. MUD: 9.3 PPG, 55 vis.

9/11/81. Reamed from 2,542 feet to 3,375 feet with 12 1/4-inch bit. Sloughing formation at 3,375 feet. Pumped thick pill. Reamed and circulated from 3,375 feet to 5,840 feet (casing point). Circulate and condition mud at report time. MUD: 9.6 PPG, 40 vis.

9/12/81. Wiped hole to shoe at 1,800 feet. Tight spot at 2,794 feet. RIH to 5,840 feet. Circulate and condition mud. POH to run casing. Ran 150 jts. of 9 5/8-inch 43.5 #/ft N-80 BT&C to 5,823 feet. Float shoe at 5,823 feet. Float collar at 5,783 feet. Circulate mud. Rig up Halliburton. Pumped preflush (20 barrels Flocheck 21 plus 30 barrels water). Cemented with 1,494 sacks Class "H" with 50#/sack Spherlite, 40 percent silica flour, 5 percent lime, 4 percent gel, 1 percent CFR-2, five-inch Diacel LWL. Tailed with 200 sacks of Class "H" 40 percent silica flour, .5 percent CFR-2, and .5 percent Halad 22-A retarder. Unable to reciprocate casing. Displaced with 1,400 cubic feet of mud. Ran out of mud. Displaced with 200 cubic feet of H_2O. Lost returns. Had 400 cubic feet of returns, did not bump plug, float valve held. CIP 7 a.m., September 12, 1981.

9/13/81. WOC. 11 hours. Cut off casing and installed expansion spool and nipple tree and B.O.P.E.

9/14/81. Finished nippling up B.O.P.E. RIH tagged cement at 3,756 feet. Drilled out cement and shoe at 5,823 feet. Reamed, washed and circulated to 6,949 feet. MUD: 9.1 PPG, 34 vis.

9/15/81. Reamed, washed, and circulated from 6,949 feet to 9,005 feet with 8 1/2-inch bit. Circulate and condition mud. Wiped hole to 5,950 feet. POH Laying down drill pipe. Removing B.O.P. at report time. MUD: 8.5 PPG, 40 vis.

9/16/81. ND B.O.P. RU wellhead. Ran 2 7/8-inch 6.5# N-80, used tubing to 8,989 feet. Changed over from mud to water. Now rigging up blooie line.

*9/17/81. F RU blooie line. RU Halliburton nitrogen. Started displacing at 10:45 a.m. Displaced with 196,000 SCF of N_2. Final temperature 300°F and pressure 300 psi at end of blooie line. N_2 came back to surface and well died. Waited three hours. Started displacing at 4 p.m. Displaced with 257,000 SCF N_2. Blew full 9 5/8-inch water stream for two minutes, headed water and N_2 for seven minutes and went to N_2. Shut down N_2 and well died. Maximum temperature 225°F and pressure 150 psi. No flow. RD Halliburton. Filled well with water and released rig at 12 a.m., September 17, 1981.

9/18/81. Released rig at 12:00 a.m., September 17, 1981. No further report.

*See attached "Well Blowdown Test Summary"

APPENDIX B

BLOWDOWN TEST SUMMARY
COLLINS 76-17
EUREKA COUNTY, NEVADA

Two blowdown tests were conducted on the Collins 76-17 geothermal test well. The first test used air as a blowdown media and tested the open hole from 1,895 feet to 9,005 feet. Due to significant formation water influx and the pressure limitations of the air compression equipment used, it was not possible to unload the well below 3294 feet. (For more detailed test information, refer to attached Figures B-1 through B-6.)

Upon encountering water influx at temperatures in the 180°F range, it was speculated that any steam influx from below 3,294 feet would be cooled and condensed by the water influx. It was not possible to determine the depths of fluid entries with 7,110 feet of open hole, so it was decided to case the hole to a depth of 5,823 feet. This allowed testing the formations below 5,823 feet independently of upper zones and will allow selective testing of the upper zones through jet perforations.

Prior to running 9 5/8-inch casing, a cleanout run with a 12 1/4-inch bit was made to ensure stable hole conditions. Severe hole sloughing was encountered at depths from 2,194 feet to 3,375 feet, indicating that this could be the zone from which the water was produced, or that this zone became unstable when the mud hydrostatic pressure was relieved during the blowdown test. Upon reaching 5,823 feet, casing was run to this depth and cemented to surface.

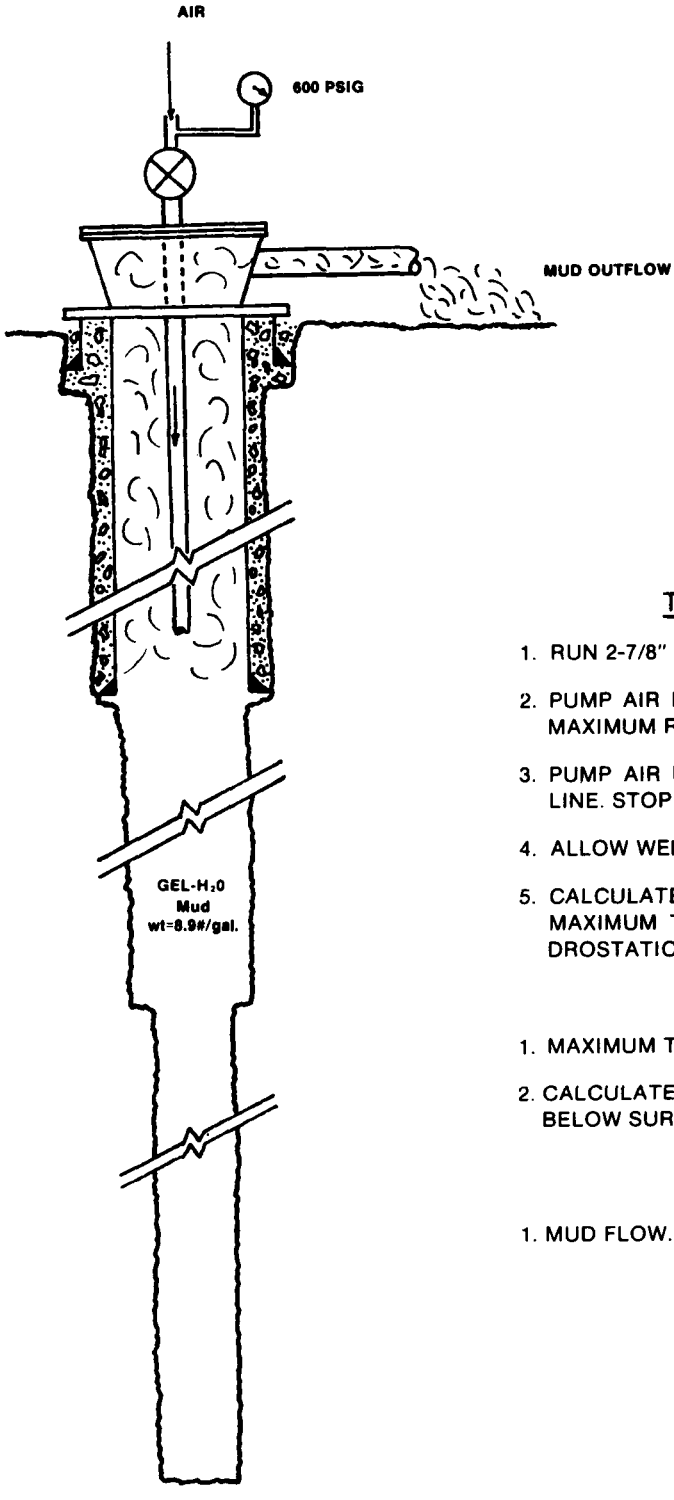
The casing shoe was drilled out with an 8 1/2-inch bit, and the hole was cleaned out to 9,005 feet. Further sloughing and bridging was encountered at depths near 7,185 feet.

2 7/8-inch tubing then run to a depth of 8,989 feet and the hole was circulated clean with fresh water.

The second blowdown test was conducted using nitrogen as a blowdown media. Nitrogen was selected for the significantly higher pressure capability of the pumping equipment.

Nitrogen was pumped down the tubing and allowed to circulate to surface. When the well was blowing clean nitrogen, circulation was discontinued. This was repeated after a three-hour wait to ensure that the well was dry. Upon establishing continuous circulation of dry nitrogen, the test was ended. There was no indication of formation fluid influx below the 5,823-foot casing shoe. (See attached Figures B-1 and B-7.)

BLOWDOWN TEST NO. 1
COLLINS 76-17



TEST PROCEDURE

1. RUN 2-7/8" TUBING TO 1514'.
2. PUMP AIR MONITOR TUBING PRESSURE FOR MAXIMUM READING.
3. PUMP AIR UNTIL MUD FLOWS FROM BLOOIE LINE. STOP AIR FLOW AT TUBING.
4. ALLOW WELL TO DIE.
5. CALCULATE INITIAL FLUID LEVEL BASED ON MAXIMUM TUBING PRESSURE AND MUD HYDROSTATIC GRADIENT.

TEST RESULTS

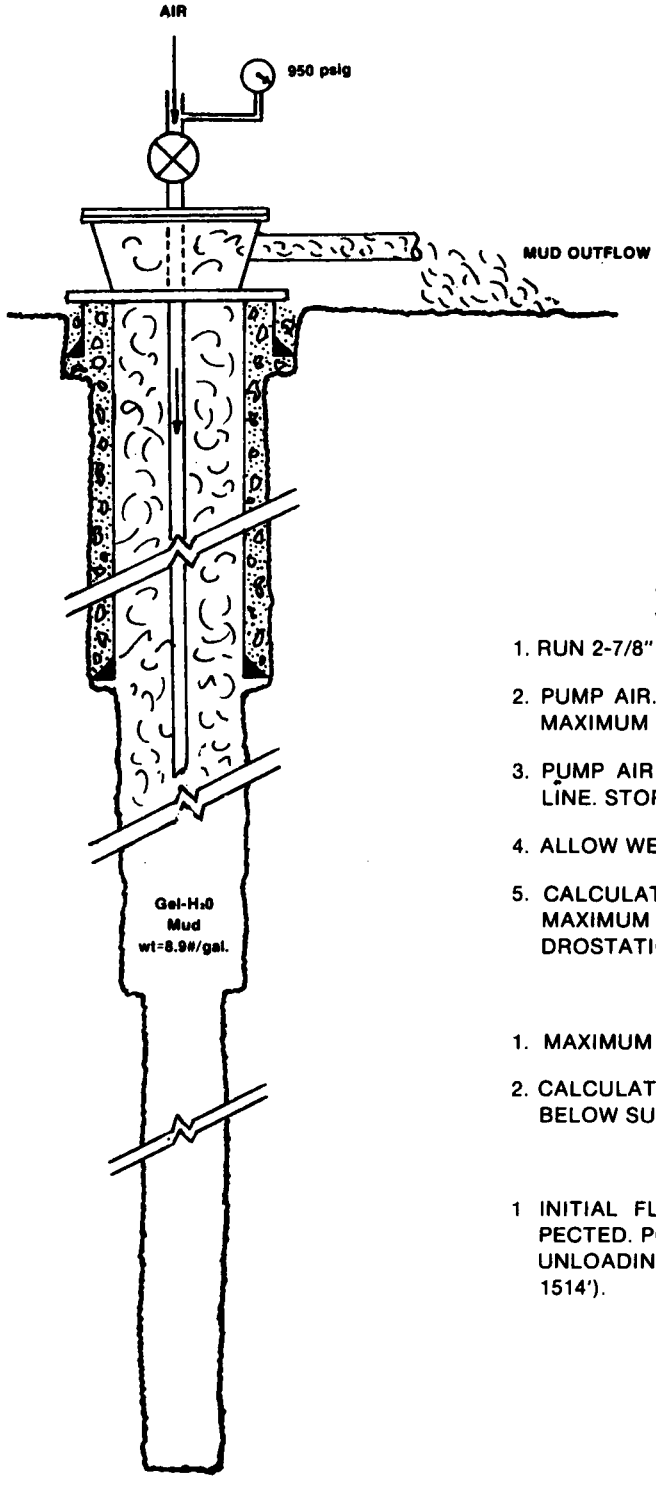
1. MAXIMUM TUBING PRESSURE PAIR = 600 PSIG.
2. CALCULATED INITIAL FLUID LEVEL h = 217.5 FT. BELOW SURFACE (K.B.)

REMARKS

1. MUD FLOW.

FIGURE B-1

BLOWDOWN TEST NO. 1
COLLINS 76-17



TEST PROCEDURE

1. RUN 2-7/8" TUBING TO 3007'.
2. PUMP AIR. MONITOR TUBING PRESSURE FOR MAXIMUM READING.
3. PUMP AIR UNTIL MUD FLOWS FROM BLOOIE LINE. STOP AIR FLOW AT TUBING.
4. ALLOW WELL TO DIE.
5. CALCULATE INITIAL FLUID LEVEL BASED ON MAXIMUM TUBING PRESSURE AND MUD HYDROSTATIC GRADIENT.

TEST RESULTS

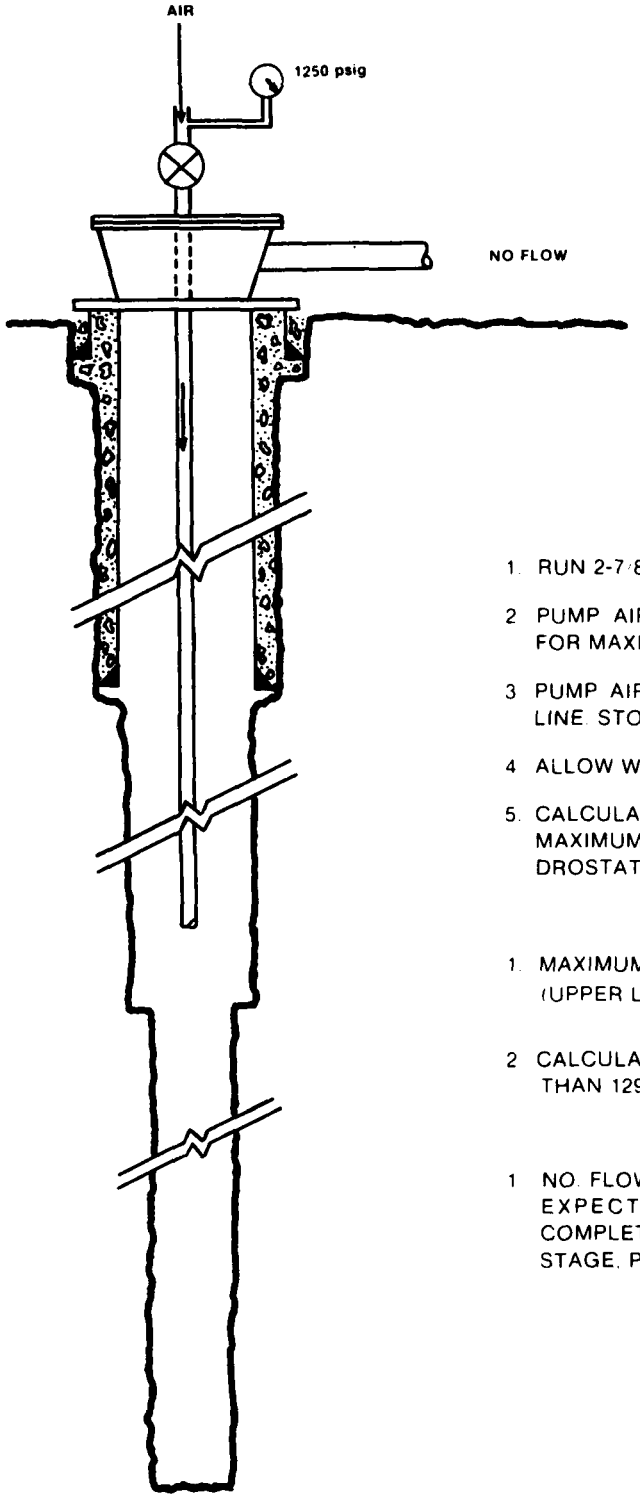
1. MAXIMUM TUBING PRESSURE PAIR = 950 PSIG.
2. CALCULATED INITIAL FLUID LEVEL h = 954 FT. BELOW SURFACE (K.B.).

REMARKS

1 INITIAL FLUID LEVEL IS HIGHER THAN EXPECTED. POSSIBLY DUE TO NOT COMPLETELY UNLOADING WELLBORE ON LAST STAGE (tbg. @ 1514').

FIGURE B-2

BLOWDOWN TEST NO. 1
COLLINS 76-17



TEST PROCEDURE

1. RUN 2-7/8" TUBING TO 4000'.
2. PUMP AIR. MONITORING TUBING PRESSURE FOR MAXIMUM READING.
3. PUMP AIR UNTIL MUD FLOWS FROM BLOOIE LINE. STOP AIR FLOW AT TUBING.
4. ALLOW WELL TO DIE
5. CALCULATE INITIAL FLUID LEVEL BASED ON MAXIMUM TUBING PRESSURE AND MUD HYDROSTATIC GRADIENT.

TEST RESULTS

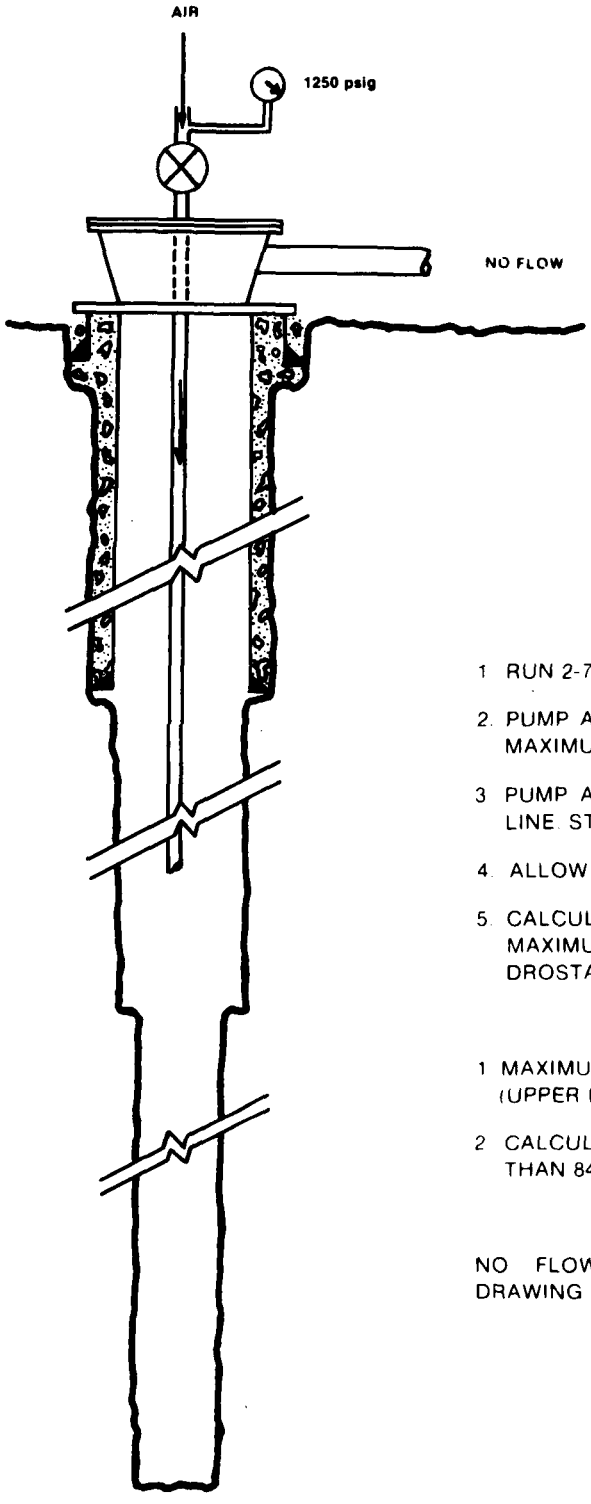
1. MAXIMUM TUBING PRESSURE PAIR : 1250 PSIG. (UPPER LIMIT)
2. CALCULATED INITIAL FLUID LEVEL h LESS THAN 1299 FT. BELOW SURFACE (K.B.)

REMARKS

1. NO. FLOW INITIAL FLUID LEVEL HIGHER THAN EXPECTED. POSSIBLY DUE TO NOT COMPLETELY UNLOADING WELL ON LAST STAGE. POSSIBLE FLUID ENTRY

FIGURE B-3

BLOWDOWN TEST NO. 1
COLLINS 76-17



TEST PROCEDURE

1. RUN 2-7 8" TUBING TO 3550'
2. PUMP AIR MONITOR TUBING PRESSURE FOR MAXIMUM READING
3. PUMP AIR UNTIL MUD FLOWS FROM BLOOIE LINE. STOP AIR FLOW AT TUBING
4. ALLOW WELL TO DIE
5. CALCULATE INITIAL FLUID LEVEL BASED ON MAXIMUM TUBING PRESSURE AND MUD HYDROSTATIC GRADIENT.

TEST RESULTS

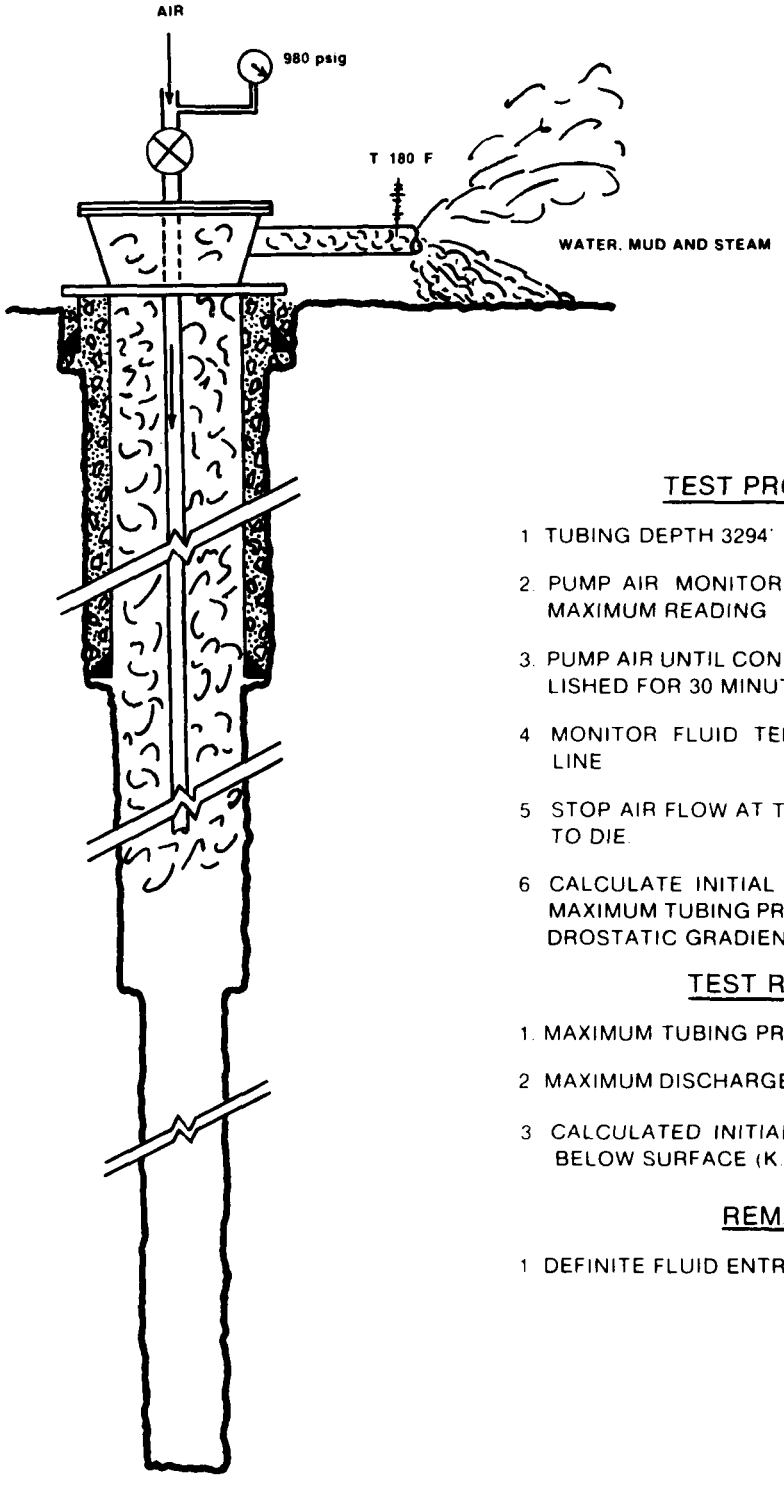
1. MAXIMUM TUBING PRESSURE PAIR 1250 PSIG (UPPER LIMIT)
2. CALCULATED INITIAL FLUID LEVEL h LESS THAN 849 FT BELOW SURFACE (K.B.)

REMARKS

NO FLOW. FURTHER REMARKS - SAME AS DRAWING #3.

FIGURE B-4

BLOWDOWN TEST NO. 1
COLLINS 76-17



TEST PROCEDURE

1. TUBING DEPTH 3294'
2. PUMP AIR MONITOR TUBING PRESSURE FOR MAXIMUM READING
3. PUMP AIR UNTIL CONTINUOUS FLOW IS ESTABLISHED FOR 30 MINUTES
4. MONITOR FLUID TEMPERATURE AT BLOOIE LINE
5. STOP AIR FLOW AT TUBING AND ALLOW WELL TO DIE.
6. CALCULATE INITIAL FLUID LEVEL BASED ON MAXIMUM TUBING PRESSURE AND WATER HYDROSTATIC GRADIENT.

TEST RESULTS

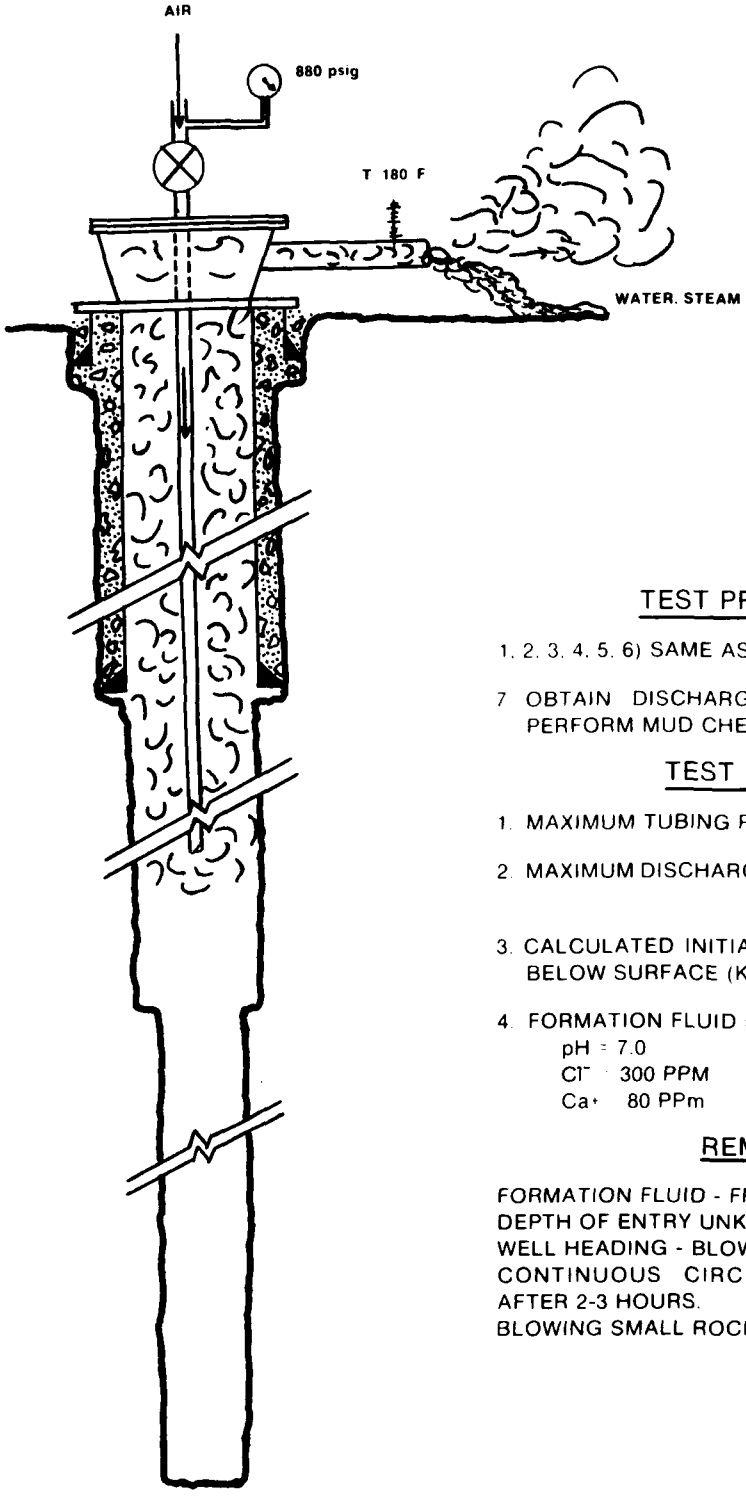
1. MAXIMUM TUBING PRESSURE PAIR = 980 PSIG.
2. MAXIMUM DISCHARGE TEMPERATURE Tbl = 180° F
3. CALCULATED INITIAL FLUID LEVEL h = 1031' BELOW SURFACE (K.B.).

REMARKS

1. DEFINITE FLUID ENTRY - WATER

FIGURE B-5

BLOWDOWN TEST NO. 1
COLLINS 76-17



TEST PROCEDURE

1. 2. 3. 4. 5. 6) SAME AS FIGURE B-5.

7 OBTAIN DISCHARGE FLUID SAMPLE AND PERFORM MUD CHECK.

TEST RESULTS

1. MAXIMUM TUBING PRESSURE PAIR 880 PSIG

2. MAXIMUM DISCHARGE TEMPERATURE Tbl 180 F

3. CALCULATED INITIAL FLUID LEVEL F.L. 1261' BELOW SURFACE (K.B.)

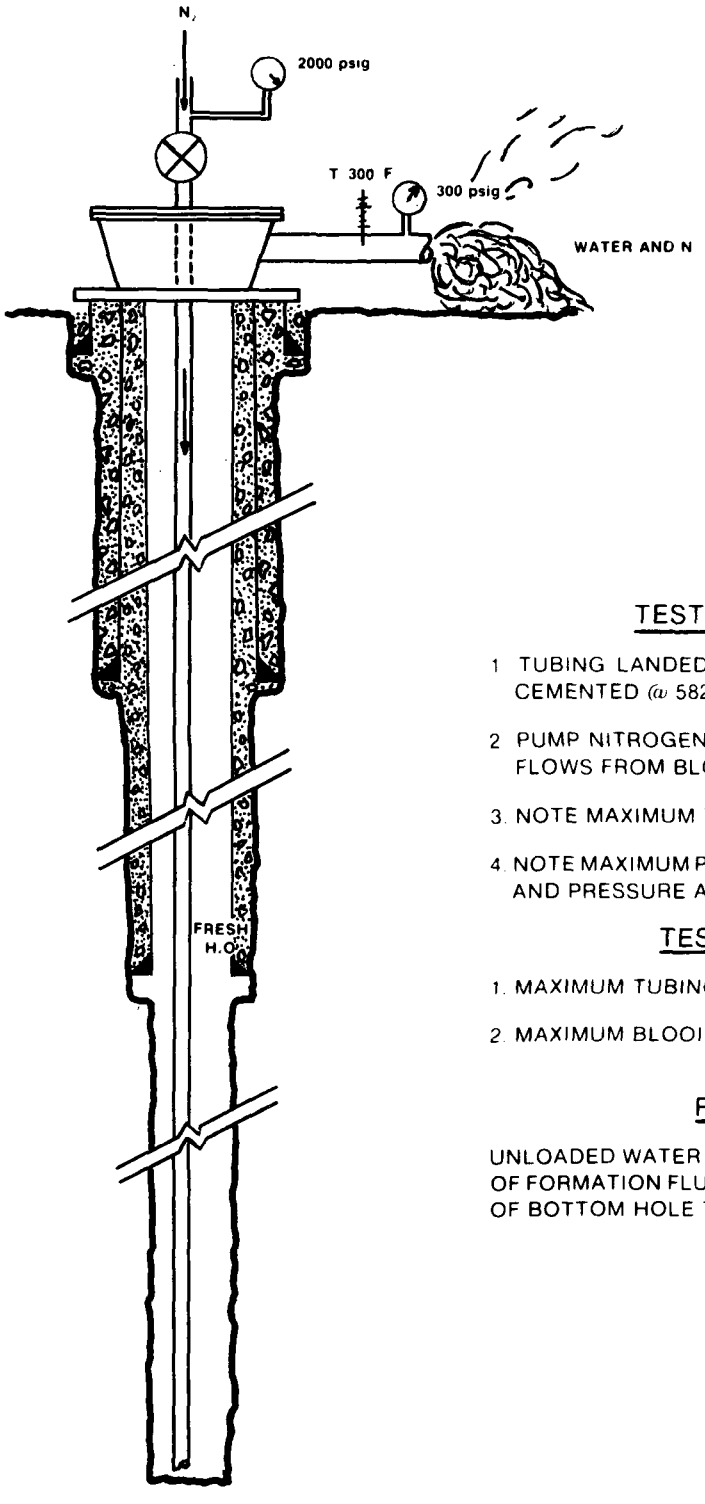
4. FORMATION FLUID PROPERTIES
   - pH = 7.0
   - Cl^- 300 PPM
   - Ca^+ 80 PPm

REMARKS

FORMATION FLUID - FRESH WATER
DEPTH OF ENTRY UNKNOWN
WELL HEADING - BLOWS EVERY 20-30 MINUTES.
CONTINUOUS CIRCULATION ESTABLISHED AFTER 2-3 HOURS.
BLOWING SMALL ROCKS, STEAM, CLEAR WATER.

FIGURE B-6

BLOWDOWN TEST NO. 2
COLLINS 76-17



TEST PROCEDURE

1. TUBING LANDED @ 8989' CASING LANDED & CEMENTED @ 5823'
2. PUMP NITROGEN DOWN TUBING UNTIL FLUID FLOWS FROM BLOOIE LINE
3. NOTE MAXIMUM TUBING PRESSURE
4. NOTE MAXIMUM PRESSURE AND TEMPERATURE AND PRESSURE AT END OF BLOOIE LINE

TEST RESULTS

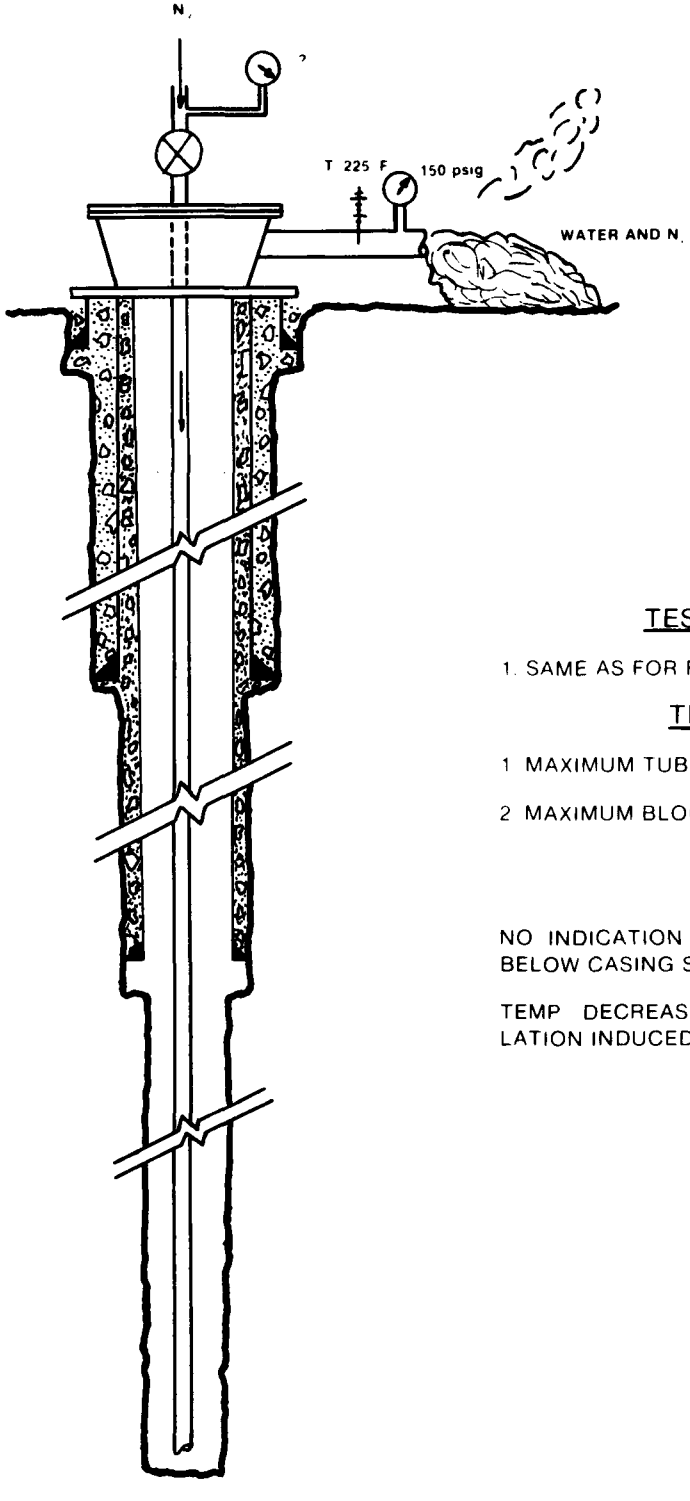
1. MAXIMUM TUBING PRESSURE 2000 PSIG
2. MAXIMUM BLOOIE LINE TEMP 300° F
   PRESS 300 PSIG

REMARKS

UNLOADED WATER FROM WELL - NO INDICATION OF FORMATION FLUID INFLUX. GOOD INDICATION OF BOTTOM HOLE TEMPERATURE

FIGURE B-7

BLOWDOWN TEST NO. 2
COLLINS 76-17



TEST PROCEDURE

1. SAME AS FOR FIGURE B-7

TEST RESULTS

1 MAXIMUM TUBING PRESSURE ?

2 MAXIMUM BLOOIE LINE TEMP 225 F
PRESS = 150 psig

REMARKS

NO INDICATION OF FORMATION FLUID ENTRY BELOW CASING SHOE (5823').

TEMP DECREASE PROBABLY DUE TO CIRCULATION INDUCED WELLBORE COOLING.

FIGURE B-8

APPENDIX C

Attention: Mr. John Dieckman, 5329 Office Centre Court, Bakersfield, CA 93309

GEOCHEMICAL ANALYSIS OF WATER Pro-391

Date of Report		Well No.	COLLINS #76-17
Date of Sampling		Company	Getty Oil Company
Sampled by		Field	
Laboratory No.		Zone	
Analyst		Sample Source	Hydrothermal Water

RADICALS		PARTS PER MILLION Milligrams Per Liter	REACTING VALUE Equivalents Per Million	REACTING VALUE Percent
Sodium	Na	1,106.6	48.11	49.10
Calcium	Ca	17.5	0.88	0.90
Magnesium	Mg	0.01	-----	-----
Barium	Ba	(-) 1.		
Strontium	Sr			
Potassium	K			
Sulphate	SO_4	1,175.	24.48	25.03
Chloride	Cl	523.9	14.80	15.17
Carbonate	CO_3	281.2	9.37	9.60
Bicarbonate	HCO_3	0.		
Hydroxide	OH	2.4	0.14	0.20
Iodide	I			
Silica	SiO_2	118.		
Iron, Alumina	R_2O_3			
Total		3,224.6	97.78	100

GROUP	CHEMICAL CHARACTER	
Alkalis	Primary Salinity	78.56
Earths	Secondary Salinity	
Strong Acids	Primary Alkalinity	17.66
Weak Acids	Secondary Alkalinity	3.78
Ca/Earths		
Chloride Salinity		
Sulphate Salinity	Carbonate/Chloride	
		100

MISCELLANEOUS		
Boron	4.8	ppm
Hydrogen Sulfide	0.3	
Equivalent Salt	2,630.3	ppm
Resistivity @ 77°F	2.22	o.m.
Chlorinity	865.1	ppm
Specific Gravity	1.008	
pH	10.7	

REMARKS

NOTE: The subject water contains 0.092 times the solids content of "normal seawater."

Potassium	(K) =	96.0	ppm
Iron	(Fe) =	0.30	ppm
Mercury	(Hg) =	0.0002	ppm