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228

CASCADES NEWSLETTER
NO. 3

6 February, 1987

**CASCADES GEOTHERMAL PROGRAM**
**U. S. DEPARTMENT OF ENERGY**

ANNOUNCEMENT OF OPEN FILE DATA RELEASE

The U. S. Department of Energy (DOE) Geothermal Technology Division as part of their mandate to support research for the identification, evaluation and utilization of geothermal energy, has maintained for the past two years a program to support industry efforts in the Cascades volcanic region. The Cascades region is an area with high geothermal potential but few surface manifestations and limited subsurface data. To stimulate further development of hydrothermal resources, DOE-Idaho Operations Office has issued two solicitations. As explained in the first Cascades Newsletter (Sept. 20, 1985), the objective of these solicitations was cost sharing with industry for the drilling of gradient holes which would penetrate the shallow hydrologic regime and obtain deep thermal, lithologic and structural data. The data obtained and studies conducted under this program are to be released to the public for the benefit of the geothermal industry and the scientific community.

The first thermal gradient hole drilled under this program was finished about 1 November, 1985 by GEO-Newberry Crater, Inc. on the south flank of the Newberry Volcano. GEO-Newberry is a wholly-owned subsidiary of GEO Operator Corporation. The hole, Corehole N-1, is located 3500 ft west and 2450 ft north of the southeast corner of Section 25,T22S R12E in Deshutes County, Oregon. It was rotary drilled to a depth of 487 ft, and was then cored at HQ size (3.8 in) to a depth greater than 4000 ft. UURI open-filed the data from N-1 and made available a split of the core for inspection in Salt Lake City on 24 February 1986.

The purpose of this newsletter is to announce the release of data from two more coreholes drilled jointly by industry and DOE. GEO-Newberry Crater drilled N-3, a 4002 ft corehole on the northern flanks of Newberry Volcano. Figure 1 shows the location of Corehole N-3 on a regional map, along with the location of Corehole N-1. The specific hole locations are as follows:

N-1: East Lake Quad. 3500 ft W and 2450 ft N of the SE corner Sec 25, T22S, R12E

N-3: Fuzztail Butte Quad. 4100 Ft N and 500 ft E of the SW corner Sec. 24, T20S, R12E.

The second hole completed this summer was drilled by Thermal Power Company in joint venture with Chevron Geothermal. This corehole, named CTGH-1, was drilled to a depth of 4800 ft in the Squirrel Creek area on the north slopes of Mt. Jefferson, as shown on Figure 1. The specific hole location is:

CTGH-1: Breitenbush Hot Springs Quad. approximately 2200 ft N and 1500 ft W of the SE corner Section 28, T8S,R8E.

UURI will open-file data for both of these holes on 23 February 1987. The data that will be available along with costs are shown in the individual tables below. The core will be available for inspection at UURI by prior appointment beginning 23 February 1987 also. Copies of the geophysical well logs will be available from Rocky Mountain Well Log Service, P. O. Box 3150, Denver, CO 80201.

## COREHOLE GEO N-3

Corehole N-3 was spudded on 2 June 1986 and was completed at 4002 ft total depth on 1 August, 1986, for a total of 60 elapsed days. The driller was Tonto Drilling Services of Salt Lake City, Utah. A rotary bit was used on the core rig to drill to 454 ft, and surface casing was set to 453 ft. After the BOP was set and tested, drilling proceeded using wireline HQ core. Minor problems with coring were experienced, and there were no mud returns in the basaltic and andesitic flows and flow breccias. At 1840 ft the rods became stuck 95 ft off the bottom, and the hole was subsequently lost below 1702 ft due to caving. The HQ drill string was cemented in place, and the drilling was continued to 4002 at NQ size. The core recovery was greater than 95 percent in solid flow units, but was as low as 50 percent in flow breccias and fractured obsidian. Maximum reading thermometers were run in the hole periodically. MRT readings remained below 60°F to about 2862 ft, where 64°F was observed. MRT values then sporadically increased to 119°F at 3961 ft. A temperature log taken on 18 August 86 showed a maximum temperature of 135°F at 4000 ft.

The data available are listed by order number and described in the table below.

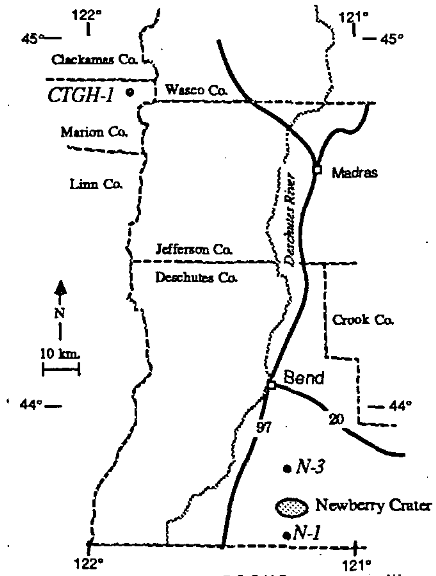


FIGURE 1

GEO - NEWBERRY N-3

| NO. | ITEM | DESCRIPTION | NO. PAGES | COST * |
|---|---|---|---|---|
| N-3-1 | Core Photos | Color Photographs of Core | -- | ## |
| N-3-2 | Lithologic Log | -- | 1 | $ 0.30 |
| N-3-3 | Drillers Log | | 74 | 11.75 |
| N-3-4 | Hole Completion Schematic | -- | 1 | 0.30 |
| N-3-5 | Temperatures During Drilling | -- | 1 | 0.30 |
| N-3-6 | Standing Fluid Level | -- | 1 | 0.30 |
| N-3-7 | Temperature Log | Geother. 8-18-86 | 3 | 0.60 |

Geophysical Well Logs: Dresser-Atlas (Order from Rocky Mountain Well Log Services)

1. Temperature, differential temperature (50-4002 ft)
2. Neutron (50-4000 ft)
3. Caliper (1690-3999 ft)
4. Fraclog (1700-4001 ft)
5. Densilog Neutron, Gamma Ray (50-1692 ft)

* Includes First-Class postage. For air mail or Federal Express, call UURI for quote.
## Color photos at cost plus handling. Call UURI for estimate.

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COREHOLE THERMAL POWER CTGH-1

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The data available from UURI will be as follows:

THERMAL POWER CTGH-1

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| CTGH-1-1 | Core Recovery Log | Intervals and Amount of core recovered | 30 | $ 5.00 |
| CTGH-1-2 | Daily Drilling Report | Drilling info and cost estimates | 80 | 14.00 |
| CTGH-1-3 | Cutting and Core Description | Lithologic logs of cuttings (0-527 ft) and core (527-4800 ft) | 124 | 21.00 |
| CTGH-1-4 | Graphic Drilling Log | Lithology, temperature from MRT, penetration rate, water level, lost circulation zones | 9 | 1.80 |
| CTGH-1-5 | Drilling and completion history | narrative drilling history | 4 | 1.00 |
| CTGH-1-6 | Secondary Minerals from CTGH-1 Drill Core | Analysis by USGS of selected core samples for alteration mineralogy | 1 | 0.30 |
| CTGH-1-7 | Report and data for Geophysical well logs 0-515 ft, Colorado Well Logging | Surveys run 13 June 86 (SP, short and long normal resistivity, temperature, density, natural gamma, ground resistivity, duration survey) | 75 | 13.00 |
| CTGH-1-8 | Report and data for geophysical well logs to TD (4800 ft), Colorado Well Logging | Surveys run 3-5 Sept. 1986 including density (4200-4800 ft), full wave form sonic (4225-4425 ft), 16"-64" resistivity and SP (4200-4800 ft), natural gamma-neutron, (0-4100 ft) temperature (0-4800 ft) deviation | 59 | 10.00 |

Well Logs can be obtained from Rocky Mountain Well Log, Denver, Colorado

13 June 86 Runs

✓1. Temperature and fluid resistivity (16-514 ft)
✓2. SP and 16"-64" resistivity (35-515.5 ft)
✓3. Natural gamma, neutron, guard resistivity (20-516 ft)
o4. Caliper and gamma-gamma density (0-510 ft)

3-5 Sept., 1986 Runs

✓1. Density (4200-4295 ft)
✓2. Temperature and fluid resistivity (0-4785 ft)
✓3. Natural Gamma, neutron (0-4800 ft)
✓4. Sonic velocity (4225-4425 ft)
✓5. SP, 16"-64" resistivity (4200-4799 ft)
o6. Natural Gamma, neutron composit

**Earth Science Laboratory / UURI**
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108

## CASCADES GEOTHERMAL PROGRAM
## U. S. DEPARTMENT OF ENERGY

The U. S. Department of Energy (DOE), Division of Geothermal and Hydropower Technologies (DGHT), is mandated to perform research in support of industry for identification, evaluation, extraction, and utilization of geothermal energy as an alternative energy source. As part of this effort, DGHT has initiated a new program designed to support industry efforts in the Cascades volcanic region of California, Oregon and Washington.

The majority of the world's known high-temperature geothermal resources are closely associated with active volcanism. A relatively small amount of data are in the public domain from volcanic areas in Japan, the Philippines, Mexico, Central America and from Newberry Caldera (Oregon), Lassen (California), and Meager Creek (British Columbia) in the Cascades. The key aspects of exploration in this environment are knowledge of the locations of heat sources (high-level plutons) and of the locations and nature of fracture systems which would allow meteoric fluids to communicate with the hot rock and ascend within reasonable drilling depths. The western andesitic volcanic province of the U.S., the Cascades, remains one of the areas of high geothermal potential which has seen relatively little systematic exploration by the U.S. geothermal industry. One of the reasons has been the paucity of direct surface geothermal manifestations, which, in turn, has been attributed to high rainfall. Downward percolation of cold water may reduce or eliminate surface thermal phenomena and require deep temperature-gradient measurements as well as deep geophysical exploration to see through the near-surface, cold-water aquifers. This hypothesis can be tested only by drilling below the so-called "rain curtain". Resource assessment and exploration research have been conducted by the U.S. Geological Survey and by the states involved--Washington, Oregon and California--as well as by industry. However, there have been few wells drilled in the Cascades to sufficient depth to evaluate the zone of cold water overflow and the temperature and hydrological conditions beneath it.

DOE's objectives are 1) to gather data to characterize the deep thermal regime of the Cascades volcanic region and 2) to transfer these data to the public in order to stimulate further development of hydrothermal resources. The first step in achieving these objectives was taken when the DOE-Idaho Operations Office issued Solicitation Number DE-SC07-85ID12580 to receive and consider for support proposals to enter into Cooperative Agreements for the drilling of gradient holes and for the release of data generated from the drilling project. To qualify for consideration, the proposals had to meet the following criteria:

1. The proposed site was to be located within the Cascades volcanic region of the United States as delineated by Figure 1;
2. The proposal was to include a cost-share plan in which DOE's share would not exceed 50 percent;
3. The proposed hole was to be a minimum of 3000 feet deep; and,
4. The proposer was to agree to complete the hole and allow DOE access to the hole for data acquisition purposes.

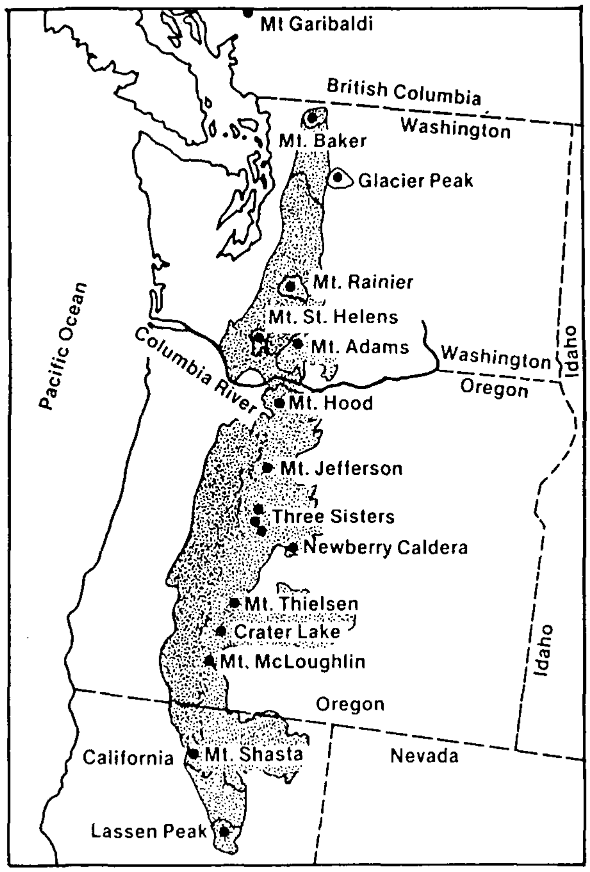


Figure 1. Defined Proposal Area (stippled area)

Three companies submitting proposals were selected to negotiate cooperative agreements. The three firms selected and the proposed drilling projects are: GEO-Newberry Crater, Inc. for drilling two 4000-foot coreholes on the flanks of Newberry volcano; Thermal Power Company for drilling one 5000-foot corehole in the Clackamas area; and, Blue Lake Geothermal Company for drilling one 3000-foot hole (upper 2000 ft rotary, lower 1000 ft core) in the Santiam pass area.

The program will result in the release of such items as rock samples, fluid samples and well logs, as well as data generated from the samples and interpretation of these data.

Splits of rock and fluid samples will be housed at UURI during the active phases of the program, with splits also being retained by the industry participant and the state geological agency as negotiated with DOE. The holes will generally be completed with 2-1/2 in. pipe so that equilibrium temperature gradients can be measured. An access period for entry into the holes up to 1 year after drilling will be allowed for publically funded research. Prior to setting the pipe, the holes will be logged to total depth with a suite of logs that will vary from project to project but will generally include caliper, temperature, resistivity, self potential and gamma ray tools.

The first hole under the program is currently underway in the Newberry Crater area by GEO-Newberry Crater, Inc., a subsidiary of Geothermal Resources International, Inc. Surface casing has been set to 470 feet and coring has begun. At this time the hole is drilling at 1830 feet. Core recovery has been about 90%.

More information on this DOE program can be obtained by calling or writing to one of the following:

Marshall Reed
U.S. Department of Energy
Division of Geothermal Energy
Room 5F-078
1000 Independence Ave. S.W.
Washington, D.C. 20585
(202) 252-8017

Susan Prestwich
U.S. Department of Energy
Idaho Operations Office
550 Second Street
Idaho Falls, ID 83401
(208) 526-1147

Mike Wright, Dennis Nielson or Bruce Sibbett
University of Utah Research Institute
Earth Science Laboratory
391 Chipeta Way, Suite C
Salt Lake City, UT 84108
(801) 524-3422

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The first thermal gradient hole to be drilled under this program was finished about 1 November, 1985 by GEO-Newberry Crater, Inc. on the south flank of the Newberry Volcano. GEO-Newberry is a wholly-owned subsidiary of GEO Operator Corporation. The hole, Corehole N-1, is located 3500 ft west and 2450 ft north of the southeast corner of Section 25,T22S R12E in Deshutes County, Oregon. It was rotary drilled to a depth of 487 ft, and was then cored at HQ size (3.8 in) to a depth greater than 4000 ft. Core recovery was about 95 percent.

UURI will open file data from the drilling and make available a split of the core for inspection in Salt Lake City on 24 February 1986. The data that will be available includes the following:

1. GEO N-1 Well Data to 4,000'
   a) Drillers log
   b) Well summary including casing schematic
   c) Temperatures measured during drilling
   d) Temperature log (detailed), 9 Nov. 85
   e) Table of measured thermal conductivity
2. GEO N-1 Core Hole Lithologic Log
3. GEO N-1 Geophysical Logs (Dresser Atlas) to 4,000', 2 Nov 85
   a) Gamma ray
   b) BHC acoustic fraclog
   c) 4-Arm caliper log
   d) BHC acoustilog
   e) Geothermal temperature log
   f) Induction electrolog
4. Core Hole GEO N-1, Photographs 487' - 4,003'

Additional wells will be drilled under the Cascades Geothermal Drilling Program this spring and the data will be released as it becomes available.

SUMMARY OF LITHOLOGIC LOG

A detailed lithologic log made from observations on the core by Michael Johnson of GEO-Newberry will be available. Rock names are tentative at the present time because no chemical or microscopic work has been done on the core. Basalt and basaltic andesite flows dominate the sections. There are a number of interspersed units of basaltic ash, pyroclastic deposits and basalt dikes. Below about 3100 feet the section apparently becomes somewhat more felsic, as indicated by an increased gamma ray response. Flows or dikes tentatively classified as dacitic occur frequently below 3200 feet. There are a number of clay-altered basaltic ash and latitic tuff units.

SUMMARY OF GEOPHYSICAL WELL LOGS

Caliper Log

The tool was a 4-arm caliper. The hole size is quite uniform at 3.8 in., with only a few minor washouts.

Temperature Logs

The Dresser log shows temperature and differential temperature observed 35 hrs. after circulation stopped. The temperature is a uniform 42°F to 2100 ft., where a positive temperature gradient begins. The gradient between 2500 ft and 3100 ft averages 53°C/km. Temperature at 3260 is 74°F, and at this depth the gradient becomes much higher. At 3400 the temperature is 113°F, but thereafter the gradient decreases again and the observed temperature at 4000 ft is 155°F. The rapid temperature increase at 3260 ft occurs within a dacite flow or dike.

A more detailed temperature log was recorded on 9 Nov 85 by Geotech Data. This profile differs from the Dresser log because the seven days between logs allowed borehole temperatures to move toward equilibrium. The log shows a sharp temperature increase of about 50°F centered at a depth of about 3260 feet and a temperature of 160°F at 4000 feet.

Gamma Ray Log

The gamma ray log shows a great deal of character that can be correlated with lithologic changes. Rocks tentatively classified as basalt and basaltic andesite show a much lower count than those tentatively classified as dacite or latite. The clay-altered horizons, especially below about 3100 ft, give a high count.

### Induction Electrolog

This log is comprised of an induction log, a 16 in short normal resistivity log and a spontaneous potential log. The mud resistivity apparently was not measured at the time of logging. The SP log is off scale for most of the hole. The short normal log is helpful in indicating some lithologic boundaries but would not give true formation resistivity without interpretation. The induction log yields formation resistivity, but the precision is not known. The resistivity above about 2800 feet averages 50-100 ohm-meters. Below about 2800 feet conductors begin to appear, apparently coincident with altered beds of latite(?) tuff and basaltic ash. The frequency and thickness of conductive horizons increases downward to 4000 ft, and the interval 3300 to 3900 ft is comprised 50 percent of material having resistivities lower than 20 ohm-m and as low as about 3 ohm-m.

### BHC Acoustilog

This is a borehole-compensated sonic log. Typical seismic velocities in basalt flows is 1800 ft/sec, and velocities in ash units and altered units is appreciably less, with volume as low as 7000 ft/sec being observed. The log shows a great deal of character, and many of the sharp velocity decreases correlate with flow contacts within lithologic units and with the boundaries between units.

### BHC Acoustic Fraclog

This is a borehole compensated log of seismic wave amplitude vs. time. It shows much the same information as the Acoustilog discussed above.

Copies of the Dresser Logs can be obtained from Rocky Mountain Well Log Service, P.O. Box 3150, Denver, CO 80201. Copies of all other data can be obtained from UURI by contacting Joan Pingree (UURI; 391 Chipeta Way, Suite C; Salt Lake City, UT 84108). A split of the core can be inspected at the UURI Sample Library by prior appointment arranged through Joan Pingree. Prices for data released from UURI are as follows:

| | Cost |
|---|---|
| 1. GEO N-1 Well Data to 4,000' | |
| a) Drillers log | $ 9.50 |
| b) Well summary including casing schematic | $ 1.00 |
| c) Temperatures measured during drilling | $ .50 |
| d) Temperature log (detailed) | $ 2.50 |
| e) Table of measured thermal conductivity | $ .50 |
| 2. GEO N-1 Core Hole Lithologic Log | $ 8.50 |
| 3. Core Hole GEO N-1, Photographs 487' - 4,003' @ $.50/print | ~$200.00 |

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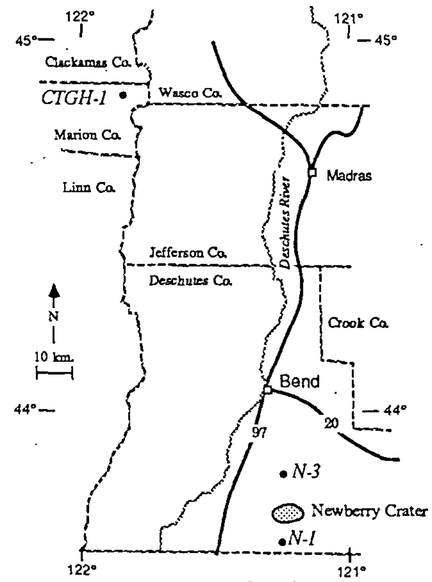

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GEO - NEWBERRY N-3

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391 Chipeta Way, Suite C
Salt Lake City, Utah 84108

1172

# MEMORANDUM

October 15, 1985

TO: Geothermal Distribution List

FROM: Earth Science Laboratory, University of Utah Research Institute

SUBJECT: Release of Reports on October 25, 1985

The Earth Science Laboratory announces the release of the following reports generated under Department of Energy funding:

| | | |
|---|---|---|
| ✓DOE/ID/12079-125 | GeoProducts WEN-2 Well, Wendel-Amedee, California, by B. S. Sibbett | $ 7.00 |
| ✓DOE/ID/12079-126 | User Coupled Confirmation Drilling Program Case Study: City of Alamosa, Colorado, Alamosa #1 Geothermal Test Well, by J. Zeisloft and B. S. Sibbett | $ 8.50 |
| ✓DOE/ID/12079-127 | Case Study of the Wendel-Amedee Exploration Drilling Project, Lassen County, California, User Coupled Confirmation Drilling Program, by J. Zeisloft, B. S. Sibbett and M. C. Adams | $10.50 |
| ✓DOE/ID/12079-128 | Preferred Methods of Analysis for Chemical Tracers in Moderate- and High-Temperature Geothermal Environments, by R. L. Kroneman, K. R. Yorgason and J. N. Moore | $ 8.50 |
| ✓DOE/SAN/12196-3 | Three-Dimensional Mise-a-la-Masse Modeling Applied to Mapping Fracture Zones, by C. W. Beasley and S. H. Ward | $12.50 |
| ✓DOE/SAN/12196-13 | PW2D - Finite Element Program for Solution of Magnetotelluric Responses of Two-Dimensional Earth Resistivity Structure (User Documentation), by P. E. Wannamaker, J. A. Stodt and L. Rijo | $12.50 |
| ✓ DOE/SAN/12196-14 | Very Low Frequency Magnetotelluric and Dipole-Dipole Responses of Three-Dimensional Thin-Layer Resistivity Structure Modeled Using Finite Elements, by P. E. Wannamaker | $12.50 |

Publications must be requested in writing from the address below. Items will not be sent unless prepayment accompanies order.

Publications
Earth Science Laboratory/UURI
391 Chipeta Way, Suite C
Salt Lake City, UT 84108

**Earth Science Laboratory / UURI**
391 Chipeta Way, Suite C
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7 February, 1986

**CASCADES GEOTHERMAL PROGRAM**
**U. S. DEPARTMENT OF ENERGY**

ANNOUNCEMENT OF OPEN FILE DATA RELEASE

The U. S. Department of Energy (DOE), Division of Geothermal and Hydropower Technologies (DGHT), as part of their mandate to support research for the identification, evaluation and utilization of geothermal energy, has initiated a program to support industry efforts in the Cascades volcanic region. The Cascade region is an area with high geothermal potential but few surface manifestations and limited subsurface data. To stimulate further development of hydrothermal resources, DOE-Idaho Operations Office issued Solicitation Number DE-SC07-85ID12580. As explained in the first Cascades Newsletter (Sept. 20, 1985), the objective of this solicitation was cost sharing with industry for the drilling of gradient holes which would penetrate the "rain curtain" and obtain deep thermal, lithologic and structural data. The data obtained and studies conducted under this program are to be released to the public for the benefit of the geothermal industry and the scientific community.

The first thermal gradient hole to be drilled under this program was finished about 1 November, 1985 by GEO-Newberry Crater, Inc. on the south flank of the Newberry Volcano. GEO-Newberry is a wholly-owned subsidiary of GEO Operator Corporation. The hole, Corehole N-1, is located 3500 ft west and 2450 ft north of the southeast corner of Section 25,T22S R12E in Deshutes County, Oregon. It was rotary drilled to a depth of 487 ft, and was then cored at HQ size (3.8 in) to a depth greater than 4000 ft. Core recovery was about 95 percent.

UURI will open file data from the drilling and make available a split of the core for inspection in Salt Lake City on 24 February 1986. The data that will be available includes the following:

1. GEO N-1 Well Data to 4,000'
   a) Drillers log
   b) Well summary including casing schematic
   c) Temperatures measured during drilling
   d) Temperature log (detailed), 9 Nov. 85
   e) Table of measured thermal conductivity

2. GEO N-1 Core Hole Lithologic Log

3. GEO N-1 Geophysical Logs (Dresser Atlas) to 4,000', 2 Nov 85
   a) Gamma ray
   b) BHC acoustic fraclog
   c) 4-Arm caliper log
   d) BHC acoustilog
   e) Geothermal temperature log
   f) Induction electrolog

4. Core Hole GEO N-1, Photographs 487' - 4,003'

Additional wells will be drilled under the Cascades Geothermal Drilling Program this spring and the data will be released as it becomes available.

SUMMARY OF LITHOLOGIC LOG

A detailed lithologic log made from observations on the core by Michael Johnson of GEO-Newberry will be available. Rock names are tentative at the present time because no chemical or microscopic work has been done on the core. Basalt and basaltic andesite flows dominate the sections. There are a number of interspersed units of basaltic ash, pyroclastic deposits and basalt dikes. Below about 3100 feet the section apparently becomes somewhat more felsic, as indicated by an increased gamma ray response. Flows or dikes tentatively classified as dacitic occur frequently below 3200 feet. There are a number of clay-altered basaltic ash and latitic tuff units.

SUMMARY OF GEOPHYSICAL WELL LOGS

Caliper Log

The tool was a 4-arm caliper. The hole size is quite uniform at 3.8 in., with only a few minor washouts.

Temperature Logs

The Dresser log shows temperature and differential temperature observed 35 hrs. after circulation stopped. The temperature is a uniform 42°F to 2100 ft., where a positive temperature gradient begins. The gradient between 2500 ft and 3100 ft averages 53°C/km. Temperature at 3260 is 74°F, and at this depth the gradient becomes much higher. At 3400 the temperature is 113°F, but thereafter the gradient decreases again and the observed temperature at 4000 ft is 155°F. The rapid temperature increase at 3260 ft occurs within a dacite flow or dike.

A more detailed temperature log was recorded on 9 Nov 85 by Geotech Data. This profile differs from the Dresser log because the seven days between logs allowed borehole temperatures to move toward equilibrium. The log shows a sharp temperature increase of about 50°F centered at a depth of about 3260 feet and a temperature of 160°F at 4000 feet.

Gamma Ray Log

The gamma ray log shows a great deal of character that can be correlated with lithologic changes. Rocks tentatively classified as basalt and basaltic andesite show a much lower count than those tentatively classified as dacite or latite. The clay-altered horizons, especially below about 3100 ft, give a high count.

### Induction Electrolog

This log is comprised of an induction log, a 16 in short normal resistivity log and a spontaneous potential log. The mud resistivity apparently was not measured at the time of logging. The SP log is off scale for most of the hole. The short normal log is helpful in indicating some lithologic boundaries but would not give true formation resistivity without interpretation. The induction log yields formation resistivity, but the precision is not known. The resistivity above about 2800 feet averages 50-100 ohm-meters. Below about 2800 feet conductors begin to appear, apparently coincident with altered beds of latite(?) tuff and basaltic ash. The frequency and thickness of conductive horizons increases downward to 4000 ft, and the interval 3300 to 3900 ft is comprised 50 percent of material having resistivities lower than 20 ohm-m and as low as about 3 ohm-m.

### BHC Acoustilog

This is a borehole-compensated sonic log. Typical seismic velocities in basalt flows is 1800 ft/sec, and velocities in ash units and altered units is appreciably less, with volume as low as 7000 ft/sec being observed. The log shows a great deal of character, and many of the sharp velocity decreases correlate with flow contacts within lithologic units and with the boundaries between units.

### BHC Acoustic Fraclog

This is a borehole compensated log of seismic wave amplitude vs. time. It shows much the same information as the Acoustilog discussed above.

Copies of the Dresser Logs can be obtained from Rocky Mountain Well Log Service, P.O. Box 3150, Denver, CO 80201. Copies of all other data can be obtained from UURI by contacting Joan Pingree (UURI; 391 Chipeta Way, Suite C; Salt Lake City, UT 84108). A split of the core can be inspected at the UURI Sample Library by prior appointment arranged through Joan Pingree. Prices for data released from UURI are as follows:

| | Cost |
|---|---|
| 1. GEO N-1 Well Data to 4,000' | |
| a) Drillers log | $ 9.50 |
| b) Well summary including casing schematic | $ 1.00 |
| c) Temperatures measured during drilling | $ .50 |
| d) Temperature log (detailed) | $ 2.50 |
| e) Table of measured thermal conductivity | $ .50 |
| 2. GEO N-1 Core Hole Lithologic Log | $ 8.50 |
| 3. Core Hole GEO N-1, Photographs 487' - 4,003' @ $.50/print | ~$200.00 |

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TELEPHONE 801-524-3422

July 29, 1985

MEMORANDUM

TO: ESL Scientific Staff

FROM: Mike Wright

SUBJECT: Cascades Drilling Program

Attached to this memo are copies of paper generated over the past few weeks on behalf of DOE/ID to get our portion of Cascades program underway. The information will give you a good idea of our involvement in the program.

We basically have two areas of involvement: (1) monitoring of each of the drilling projects for DOE, and (2) research. As you know, $100K was cut from our Cascades budget this year, and this money must come from the research effort since ID will need us to monitor the drilling in any event.

In order to optimize results from the remaining research money it is imperative that we work as a team. I would therefore like to suggest the following program management:

| | Responsibilities | Territory |
|---|---|---|
| Wright: | Program coordination, geophysical research | Regional and site geophysical data, geophysical well logs, physical property data |
| Nielson: | Geologic research, alternate for Sibbett on monitoring | Regional geologic studies, permeability development |
| Moore: | Geochemical research | Geochemical study of surface and subsurface fluids, drill samples, etc., including isotopes, fluid inclusions, alteration |
| Sibbett: | Monitoring | Lithologic and petrographic study of drill samples, geology and structure of drill site areas |

These individuals will be responsible for each of the designated areas and for the management of work by others in their areas. They will meet periodically to discuss progress, problems and plans.

PMW/jp

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July 19, 1985

MEMORANDUM

TO: Sue Prestwich

FROM: Mike Wright

SUBJECT: Cascades Drilling -- UURI Monitoring Role

As I see our role, these are the basic tasks, which are expanded and discussed below:

1. Daily contact with DOE contractor;
2. Daily contact with DOE/ID;
3. Site visits;
4. Quality assurance;
5. Data archiving and open-filing, and
6. Documentation.

1. Daily contact with DOE contractor. UURI will maintain at least daily phone contact with the DOE contractor and or the driller during drilling, logging and completion, including weekends. More frequent contact will be made as necessary. The contractor should name the point of contact and at least 1 alternative who will be cognizant at all times. For UURI it will be Bruce Sibbett with Dennis Nielson as an alternate. UURI will keep drill records, progress reports, reports of problems, casing reports, etc. up to date. UURI will also keep a running estimate of expenditures to date. Copies of all written documents pertaining to these subjects should be forwarded to UURI by the contractor on a periodic basis, probably weekly.

2. Daily contact with DOE/ID. UURI will make daily reports on project status to ID. At ID's option, these will be telecopied or telephoned. We suggest telecopy except in times of drilling trouble, when telephone reports may be necessary to supplement. These reports will include status, daily drilling progress, assessment of problems if any, plans, anticipated problems, noteable events such as lost circulation, stuck rods, etc. and mitigation measures. The Friday reports will anticipate occurrences expected during the weekend.

3. Site Visits. If and when it becomes apparent that a moderate or serious problem has developed with the project, UURI will be prepared to visit the site at any time to lend advice, give first-hand status reports to ID, and act as ID's representative in communications with the project to the extent legally allowed.

4. Quality Assurance. UURI will perform an independent assessment of sample and data collection techniques and of the quality of data collected. This quality assurance program will include collection of rock samples, collection of fluid samples, geophysical well logging, lithologic logging of samples, mud logs and reports kept on the rig by the driller or DOE contractor, and all other items. We will report to DOE on these matters and endeavor to work with the site personnel to maximize quality of all data, samples and procedures.

5. Data Archiving and Open-Filing. UURI will collect and archive copies of all data as well as DOE's share of all samples collected in this program. We will make samples available for inspection and use by others and we will open-file copies of all public data according to standard UURI procedures, worked out during the Industry Coupled Program.

6. Documentation. UURI will write, release and publish written reports on each project to document the project and all data collected. The nature and extent of these reports will depend on the reports that the DOE contractors themselves publish, and will be agreed with ID.

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**CONFIDENTAL**

MEMORANDUM

May 29, 1985

TO: Susan Prestwich

FROM: Mike Wright

SUBJECT: Recommendations on Cascades Scientific Drilling

As a result of the meeting which I convened in Menlo Park at your request and of further thinking on the specific Cascades proposals in light of what I have learned of the gaps in knowledge of Cascades geothermal systems, I would like to make some points and recommendations that may be of use to you.

1. In my opinion, a serious omission of the current proposals for Cascades drilling is lack of adequate plans for obtaining fluid samples. Especially at the Thermal Power and Blue Lake proposed locations for drilling, there are unanswered questions about movement of fluids at depth. None of the research programs to date (USGS, DOGAMI, SMU) have answered the questions about possible westward flow of thermal waters from the volcanically active High Cascades. If the known thermal springs along the boundary between the High Cascades and Western Cascades are an indication of this outflow, the net permeability along the flow path is high, which has great exploration significance. We need subsurface fluid samples (as well as very deep drilling) to get at this problem.

2. Adequate temperature-gradient and heat-flow values can be obtained by periodically reading bottom-hole temperature during drilling with a

maximum-reading thermometer. Precise temperature logs in cased holes taken at intervals after drilling would be nice, but could be done without if the sacrifice meant being able to obtain fluid samples.

3. I recommend that if possible the contacts be so negotiated that either; (a) The holes are left uncased until a fluid sample can be obtained, even at the risk of losing part of the hole before a precision temperature log can be made. If the hole is lost we could rely on BHT's during drilling; or (b) the black iron pipe is not cemented in. It would then be possible to remove it with an appropriate rig and to try to produce the well by air lift, and/or to obtain downhole fluid samples. The casing could be left in the hole long enough to obtain an equilibrium temperature profile.

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May 29, 1985

MEMORANDUM

TO: Susan Prestwich

FROM: Mike Wright

SUBJECT: Meeting on Scientific Objectives of Drilling in the Cascades Range

On 23 May 1985 I convened a short meeting at your request of a select group of scientists who were attending the USGS Cascades workshops in Menlo Park for the purpose of discussing potential scientific objectives of drilling in the Cascades Range. The information gained at that meeting may be useful to you in evaluating the proposals written in response to the latest SCAP on the same topic. Several people in attendance at the meeting were also on the Technical Advisory Panel for the SCAP. We deliberately stayed away from discussion of any material related to the response to the SCAP, and instead treated the topic in a generic sense, i.e. what specific types of information do the scientific community want and what are the priorities.

In attendance at the meeting were: Marshall Reed, Clay Nichols, Marty Molloy, Norm Goldstein, Marcelo Lippman, Patrick Muffler, Bob Mariner, Mike Sorey, George Priest, Dave Blackwell and Mike Wright.

A summary of conclusions from the meeting is given below:

1. Three types of information are nearly equally important to obtain from the drilling:

   (a) core or cuttings samples, carefully acquired, for lithologic information;
   (b) a temperature log; and
   (c) fluid samples from the various aquifers.

   These items are in their order of priority, but they are all very important.

2. Blackwell noted that it will be important to get bottom-hole temperatures at each stopping point in the drilling by lowering a maximum-reading thermometer in the hole. This will help in planning completion and temperature logging.

3. It was agreed that fluid samples from drill holes are important for research into the fluid flow regime in the Cascades. Speaking as a member of the TAC, I believe that a serious deficiency exists in lack of plans in the current proposals to obtain water samples. There are essentially three ways in which water samples could be collected:

   (a) By producing and sampling water at the well-head. This will require either a down-hole pump or an air lift. Provision must be made at the surface to handle and dispose of a sufficient volume of water to thoroughly clean the hole of drilling fluids before sampling;

   (b) By use of a down-hole sampler. Slim-hole samplers are available. If used in conjunction with (a) above, it may be possible to separate the effects of various aquifers. Otherwise the sampler would have to be used weeks to months after drilling in the hope that fluid flow in aquifers had flushed drilling fluids away. This is clearly not compatible with putting permanent casing in the holes.

   (c) By doing one or more drill stem tests during drilling. The test would have to be conducted for a large enough period to acquire uncontaminated samples, which would require fluid handling facilities on the surface. The availability of slim-hole DST equipment was questioned.

4. For the purpose of obtaining good heat-flow measurements, it will be better to cement casing into the well. However, this precludes other useful work, such as removing the casing at some time to acquire fluid samples after casing is set.

5. Another important parameter, but of lesser importance than those listed in (1) above, is obtaining a measure of permeability at depth. This could conceivably be done with an injection test, but injecting cool water into a hot zone will perturb the data interpretation.

6. Geophysical well logs are important to obtain in the well and can be used to help characterize porosity, permeability and perhaps changes in native fluid characteristics.

7. There was some discussion on the advisability of setting up a steering committee to help advise DOE on matters such as potential completion techniques, etc. as the drilling progresses.

DRILL SAMPLE COLLECTION AND CURATION POLICY FOR
THE CASCADES DEEP THERMAL GRADIENT DRILLING PROGRAM

## Introduction

Core and cuttings recovered during exploration drilling are an important resource for research and evaluation of the geothermal potential. When the cost of drilling is considered, it is evident that the core and cuttings are an expensive and valuable product of the exploration effort. Lithologic samples are the first products recovered from a drill hole and the possibility that the hole may be lost before wireline logs are run or fluid samples are collected further indicates the value of the core and cuttings recovered.

The Cascades Deep Thermal Gradient Drilling Program is a combined effort of industry and public agenices in a potential resource area where subsurface data, particularly in the public domain, are very limited. The data gained through this program will be of value to industry, public agenices and private researchers. It is therefore the purpose of this drill sample collection and curation policy to provide procedures for sample handling that will ensure preservation and equitable distribution of sample for the maximum benefit of the program. Sample handling procedures must be uniform enough to protect sample integrity and reasonable enough for well site personnel to follow without undue extra work.

## Well-Site Core Handling

The core will be transferred from the core barrel either to the core trough or directly into core boxes if a core trough is not available. Care will be taken during handling to ensure that all pieces of core remain in their original orientation and sequence. Directly after removal of core from the core barrel, all core pieces with length equal to or greater than core diameter will be marked with an arrow pointing downhole using a grease pencil or permanent felt tip marker (Fig. 1). If the core needs to be washed this will be done while it is in the core trough. When the core is placed in the core box, a wooden block labeled with the bottom depth of the core run will be placed at the end of the core from that run. If a core run did not directly follow the previous core run because of rotary drilling or other non-coring operations, a wooden block labeled with the beginning depth of the core run will be placed at the top of the run such that beginning and ending depth of each run will be indicated. All core will be placed in core boxes following a uniform system: with the box orientation label on the left, the box will be filled from upper left to lower right (Fig. 1). The label on each core box will be completely filled out using care to ensure that lettering is easily legible, as large as practical and done with an appropriate permanent marker. The drilling crew will be responsible for marking orientation arrows on the core, placing the depth labeled blocks at the top and bottom of each core run, and labeling core boxes unless the well-site geologist does these duties personally.

## Drill Cuttings Sampling

Drill cuttings samples will be collected from any intervals which are rotary drilled or drilled with a core plug bit. Cuttings will be collected at 10-foot intervals from the shaker table or if a shaker table is not being used, caught from the blooie line with a bucket and/or screen device. Samples will not be taken from a drain ditch or catchment where contamination from surface materials or earlier cuttings may occur. DOE will require 1 kilogram of sample for each 10-foot interval. Drilling mud will be rinsed from the cuttings if needed and the samples placed in bags labeled with hole name and drilling depth. Proper and timely collection of drill cuttings samples is the responsibility of the drilling crew. Bagging and labeling of the sample bags are also the responsibilities of the drilling crew unless the drill site geologist assumes this task while logging the samples.

Logging of Core and Cuttings

Whenever a geologist is present, the samples (core or cuttings) will be logged on site or at a nearby convenient operations base prior to sample splitting or transfer to curation facilities. Responsibility for the initial sample logging will be coordinated between the operating company and Department of Energy, Idaho Office (DOE) or their representative. On-site sample logging is important for several reasons: 1) the log will provide a data base upon which drilling and well-test decisions can be made; 2) the on-site log will be made before any sample split or sampling by collaborating investigators; 3) the on-site log will be made prior to possible sample degradation due to sample drying, disaggregation due to drying and pressure release, oxidation, vibration during transport, possible loss or damage during transport and storage; 4) the on-site log will provide a data base for interpreting wireline logs and for subsequent detailed studies of the rocks drilled; and, 5) on-site logging provides the best opportunity for the geologist to interface with the drilling crew to note any drilling operations or conditions which may affect the quality of sample recovery and reasons for sample loss.

Core and cuttings should be logged on a standard form (see Appendix for our example), previously approved by the operating company and DOE, which provides both uniformity of format and flexibility to facilitate different lithologies drilled. All involved companies, government agencies and collaborating investigators, who request a copy of the field log, will receive a copy in a timely manner consistent with DOE's policies on release of data.

The lithologic log will include project name, well name or number, location, well-head elevation, geologist and date logged. For each core run, the box number, depth in feet and tenths of core recovered, and recovery will be recorded (Fig. 2). Next the lithology will be described followed by fractures, joints, faults and alteration if present. Lithologic descriptions are best given by rock unit which may be thicker or thinner than coring runs. The depth of upper and lower contacts (unit interval) will be stated, followed by a one- to two-word lithologic name, then a description of the unit in appropriate detail. Additional comments may be added for each core run after the unit description for thick but variable units. Lithologic descriptions will be observations rather than interpretations. Core size or bit type, drilling fluid and lost circulation material will be noted as it affects the sample's condition. Cuttings samples for intervals not cored will be logged in the same manner with cuttings and bit type noted. Also depth of all significant drilling operations or events such as setting casing, loss of fluids or bit change will be noted on the core log at the drilling depth that these occur.

Although field lithologic classifications are hand-sample names which may be found to be incorrect by later petrographic or chemical study, they will provide the basis for sample selection and contact depth picks for later, more detailed studies.

## Sample Split and Sample Cutting

No sample splits or selected sampling of the core and/or cuttings will be done by any party prior to completion of lithologic logging. After logging, the core will be split and/or selected samples taken by the involved entities and collaborating investigators as agreed upon by the operating company and DOE or their agent(s) for the particular well. Appropriate and timely sample splits and sample selection will be the responsibility of the operating company's site personnel and the project manager or agent for DOE or their delegated representatives. Any samples cut on the drill site after logging will be noted on the field lithologic log and a block of wood or note with the sample interval and entity taking the sample will be placed in the core box in place of the sample taken. After the sample split between the operating company, DOE or their agent and any other involved agencies (i.e. state geologic survey), the curation and sample availability of the DOE split will be the responsibility of DOE or their agent.

Water and Gas Samples

Water and/or gas samples may be collected during drilling or at the completion of a well as agreed upon by the operating company and DOE. Such factors as hole condition and cost may require on site geologist to make final decisions concerning water and gas sample collection. Sample collection, on-site analysis and treatment of samples for proper preservation will be the responsibility of the authorized DOE representative or collaborating investigator. Instructions for fluid sampling are the topic of a separate memorandum.

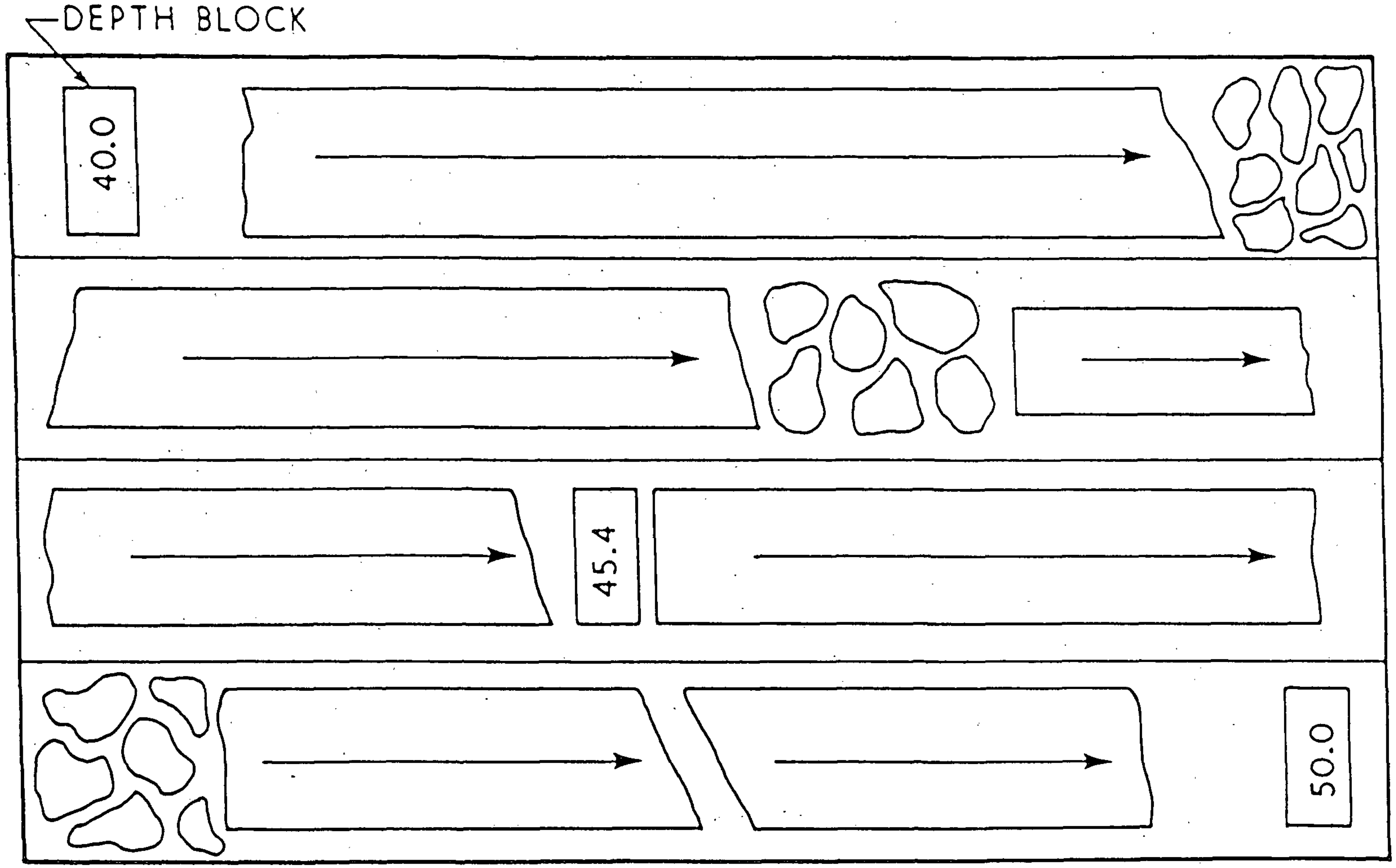


Figure 1. Core box is filled from upper left corner with depth blocks at the end of each run and arrows pointing downhole on core pieces.

# CORE LOG

PROJECT ______________ WELL NUMBER ______________ LOCATION ______________

WELL HEAD ELEV. ______________ LOGGED BY ______________ DATE ______________ PAGE ______

| BOX # | Depth | Recovery | Graphic Symbol | LITHOLOGIC DESCRIPTION | Fractures & Alteration | Drilling Information |
|---|---|---|---|---|---|---|
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Figure 2