Geothermal exploration in Oregon in 1978

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ABSTRACT

Government agencies and university researchers continued the geothermal research begun in 1977 on the Geothermal Resource Assessment of Mt. Hood Volcano. Northwest Natural Gas Co. completed its Old Maid Flat No. 1, begun in late 1977, on the western flank of the volcano.

Industrial exploration decreased, and no major discoveries were reported. The major effort by industry has been the drilling of temperature gradient holes to depths of less than 2,000 ft. The Department issued 16 permits for gradient holes deeper than 500 ft and 12 prospect well permits which encompassed a total of 117 shallow-gradient (less than 500-ft) holes.

INDUSTRY ACTIVITY

The most recent deep geothermal test in Oregon was the Klamath Hills well drilled by Thermal Power Co. in 1976. However, gradient drilling has increased annually for the past 5 years. Gradient holes were usually drilled to 200 or 300 ft, but experience has shown that deeper holes are needed to obtain better quality temperature data. Last year, therefore, exploration firms drilled most gradient holes to depths of 500 to 2,000 ft.

Figure 1. Areas of geothermal activity in 1978 in Oregon.

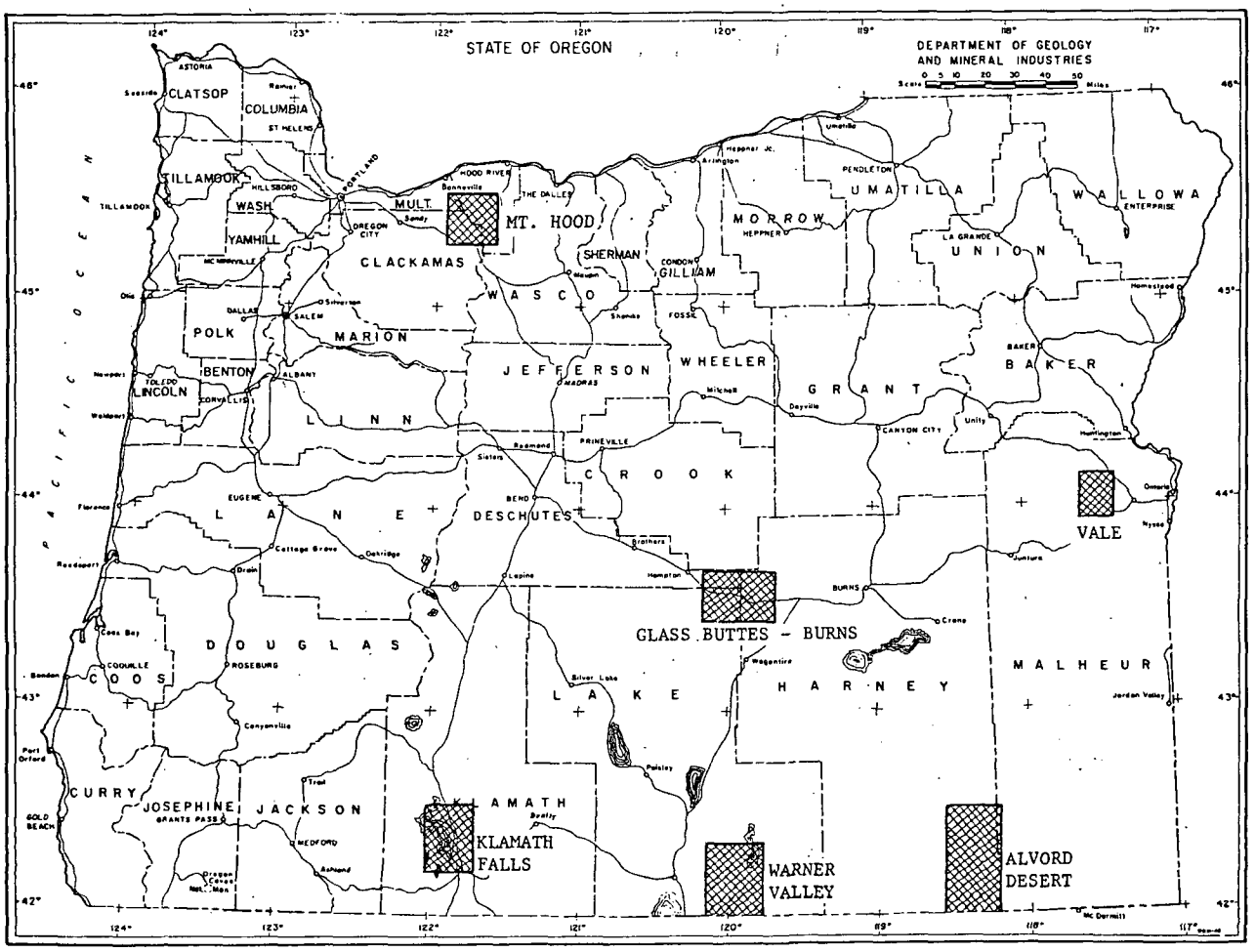


Table 1. 1978 State permits for geothermal wells

Permit no.	Company	Well name	Location	Depth drilled (ft)	Status
11	Northwest Natural Gas	Mt. Hood Old Maid Flat No. 1	SW¼ sec. 15 T. 2 S., R. 8 E. Clackamas Co.	4,003	Deepened from 1,850 to 4,003 ft; completed August 1978
20	Sunoco	Austin Hot Springs No. 1	NE¼ sec. 29 T. 6 S., R. 7 E. Clackamas Co.	1,484	Spudded December 1977; completed February 1978
32	Chevron Resources	Bully Creek Hole No. 5-1-78	SW¼ sec. 5 T. 18 S., R. 43 E. Malheur Co.	2,000	Monitoring temperature Nov. 11, 1978
33	Chevron Resources	Bully Creek Hole No. 9-1-78	NW¼ sec. 9 T. 18 S., R. 43 E. Malheur Co.	--	Drilling postponed until 1979
34	Wy'East Exploration	Timberline Hole No. 71-7	NE¼ sec. 7 T. 3 S., R. 9 E. Clackamas Co.	1,380	Work suspended Nov. 6
35	Anadarko Production	Alvord Valley Hole No. A-5	SE¼ sec. 6 T. 33 S., R. 36 E. Harney Co.	1,750	Completed Sept. 1978
36	Anadarko Production	Alvord Valley Hole No. A-6	SW¼ sec. 7 T. 33 S., R. 36 E. Harney Co.	1,994	Completed Oct. 1978
37	Anadarko Production	Alvord Valley Hole No. A-7	SW¼ sec. 18 T. 33 S., R. 36 E. Harney Co.	--	Drilling postponed
38	Anadarko Production	Alvord Valley Hole No. A-8	SE¼ sec. 14 T. 33 S., R. 35 E. Harney Co.	--	Do.
39	Anadarko Production	Alvord Valley Hole No. A-26	NE¼ sec. 29 T. 34 S., R. 34 E. Harney Co.	--	Do.
40	Anadarko Production	Alvord Valley Hole No. A-31	SW¼ sec. 34 T. 34 S., R. 34 E. Harney Co.	--	Do.
41	Anadarko Production	Alvord Valley Hole No. A-34	NE¼ sec. 8 T. 35 S., R. 34 E. Harney Co.	--	Do.
42	Anadarko Production	Alvord Valley Hole No. B-56	SE¼ sec. 10 T. 37 S., R. 33 E. Harney Co.	--	Do.
43	Anadarko Production	Alvord Valley Hole No. B-61	SW¼ sec. 13 T. 37 S., R. 33 E. Harney Co.	--	Do.

Table 1. 1978 State permits for geothermal wells (continued)

Permit no.	Company	Well name	Location	Depth drilled (ft)	Status
44	Anadarko Production	Alvord Valley Hole No. B-64	NW¼ sec. 22 T. 37 S., R. 33 E. Harney Co.	--	Drilling postponed
45	U.S. Geological Survey	Newberry Crater Hole No. 2	SW¼ sec. 31 T. 21 S., R. 13 E. Deschutes Co.	1,027	Drilling suspended Oct. 1978; will deepen to 2,000 ft or more in 1979
46	Ore-Ida Foods	Well No. 1	NE¼ sec. 3 T. 18 S., R. 47 E. Malheur Co.	--	Drilling to begin in April 1979; propose to drill to 8,000 ft
47	Ore-Ida Foods	Well No. 2	SE¼ sec. 3 T. 18 S., R. 47 E. Malheur Co.	--	To follow Well No. 1

According to present Oregon law, holes deeper than 500 ft are treated as production tests. The production holes listed in Table 1 were actually drilled for gradient information. The Department issued 17 geothermal well (deeper than 500 ft) permits (Table 1) and 12 prospect-well (shallow hole) permits (Table 2) in 1978. Prospect wells are granted under a blanket permit, and a total of 117 shallow gradient holes were drilled under the 12 permits (Figure 1).

Most of the known favorable geothermal areas have now been explored for gradient data. Additional deep production test holes are expected to be drilled within the next 2 or 3 years.

Leasing

Although acquisition of geothermal leases continued in 1978, the total acreage held may be somewhat less than in 1977. Gulf Oil reportedly relinquished more than half of its Oregon leases, and Thermal Power Co. turned back its leases in Klamath County in 1978. The relinquished acreage is believed to be larger than the 84,000 acres of new applications received by the U.S. Bureau of Land Management and the 7,000 acres of Known Geothermal Resource Area (KGRA) lands leased the past year.

Totals of federal and State leases in Oregon are shown in Table 3. The acreage noted for the private leases is an estimate inasmuch as confirmation is difficult.

U.S. Bureau of Land Management 1978 KGRA lease sales are shown in Table 4. The only lease sales activity was by SUNOCO Energy in the Breitenbush Hot Springs area. Tentative schedule for U.S. Bureau of Land Management KGRA lease sales for 1979-80 is given in Table 5.

Old Maid Flat No. 1, Clackamas County

The geothermal exploratory test hole, Old Maid Flat No. 1, located in the SE¼SW¼ sec. 15, T. 2 S., R. 8 E., at an elevation of 2,750 ft, was completed in midsummer 1978 at a depth of 4,003 ft (Figure 2). Specifically, the exploratory hole was drilled adjacent to the Sandy River, on the westerly flank of Mt. Hood.

This test originally began in October 1977 and was suspended at 1,859 ft because of mechanical problems in early December 1977. In late July 1978, a small, 4,500-ft-capacity oil rig was used to re-enter the hole. The existing hole, 7-7/8-in. in diameter, was carried to a total depth of 4,003 ft with bentonite mud. The U.S. Department of Energy and Northwest Geothermal Corp.,

Table 2. 1978 State permits for prospect wells

Permit no.	Company	Issue date	Area of work	Comments and status
36	Aminoil	March 1978	Alvord Valley and Glass Buttes, Harney and Lake Cos.	Drilled five 500-ft gradient holes at Alvord Valley and four 500-ft gradient holes at Glass Buttes
37	Aminoil	March 1978	Breitenbush, Marion Co.	Project canceled
38	Phillips Petroleum	May 1978	Brothers Fault Zone, Lake and Harney Cos.	Completed drilling 44 500-ft gradient holes in Oct. 1978
39	Union Oil	June 1978	Mickey Hot Springs, Harney Co.	Completed drilling seven 250-ft gradient holes in July 1978
40	Hunt Energy	July 1978	South Warner Valley, Lake Co.	Completed drilling 12 200-500-ft gradient holes in Sept. 1978
41	Hunt Energy	--	Owyhee Reservoir, Malheur Co.	Project postponed
42	Hunt Energy	July 1978	Klamath Falls, Klamath Co.	Completed drilling 11 500-ft gradient holes in July 1978
43	Chevron Resources	July 1978	Bully Creek, Malheur Co.	Completed drilling five 500-ft gradient holes in Sept. 1978
44	Anadarko Production	Aug. 1978	Alvord Desert, Harney Co.	Completed drilling 21 500-ft gradient holes in Oct. 1978
45	Dept. of Geology and Mineral Industries	Sept. 1978	Mt. Hood, Clackamas, and Hood River Cos.	Completed drilling 11 500-ft gradient holes in Dec. 1978
46	John Hook	Oct. 1978	Sisi Butte, Clackamas Co.	Project postponed
47	Northwest Natural Gas	Nov. 1978	Old Maid Flat No. 2, Clackamas Co.	Drilled Clear Fork gradient hole to 500 ft; approval granted to deepen hole; deepened to 1,320 ft

Table 3. Geothermal leases

Type of leases	Number	Acres
Federal		
Noncompetitive	107 USBLM*	147,333
	10 USFS**	22,337
KGRA	30 USBLM*	60,685
	4 USFS**	5,818
Applications pending		83,460
	Total	319,633
State		
Leases active in 1978		8,294
Applications pending		None
Private		
Leases active in 1978		180,000

*U.S. Bureau of Land Management
**U.S. Forest Service

a subsidiary of Northwest Natural Gas Co., supplied funds for deepening the hole. The drilling contractor was Taylor Drilling Co. of Chehalis, Washington.

A complete set of geophysical logs, including temperature gradient data, for this hole is available from the Oregon Department of Geology and Mineral Industries as Open-File Report O-78-6.

Ore-Ida Foods, Inc.

In late 1978, Ore-Ida Foods, Inc., and the U.S. Department of Energy agreed to a 3-year cost-sharing demonstration

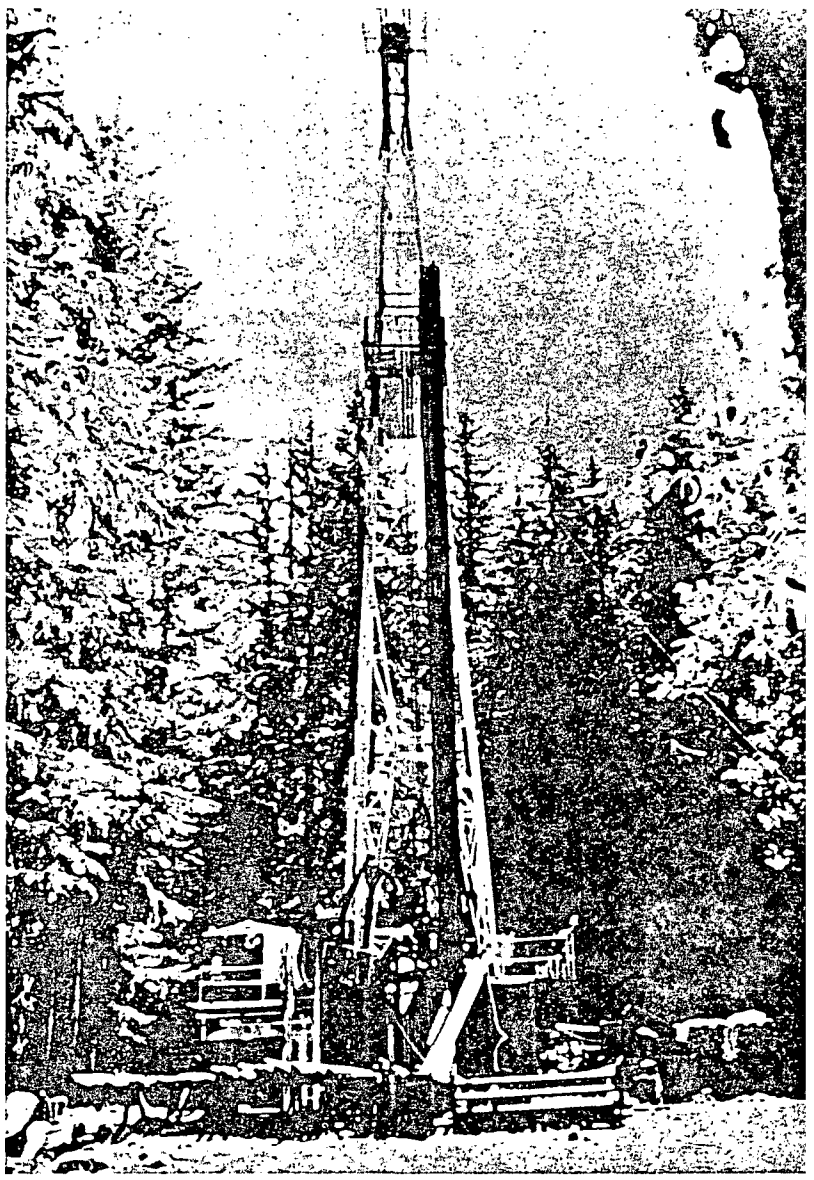


Figure 2. Old Maid Flat No. 1, Clackamas County.

Table 4. 1978 U.S. Bureau of Land Management KGRA lease sales

Tract no.	Date	Company	Area	Acreage	Bid/acre
* 1-13	July 27	--	Crump Geyser	22,756	No bids
*14-18	July 27	--	Klamath Falls	1,366	Do.
*19-29	July 27	--	Burns Butte	4,228	Do.
1	Oct. 19	Sunoco Energy	Breitenbush Hot Springs	2,133	$13.00
2	Oct. 19	Sunoco Energy	Breitenbush Hot Springs	1,280	$17.65
3	Oct. 19	Sunoco Energy	Breitenbush Hot Springs	1,365	$23.78
4	Oct. 19	Sunoco Energy	Breitenbush Hot Springs	1,040	$ 3.65
5	Oct. 19	--	Breitenbush Hot Springs	1,029	No bids

*These tracts were re-offered because no bids were received for them in previous sales

Table 5. Tentative U.S. Bureau of Land Management sales dates

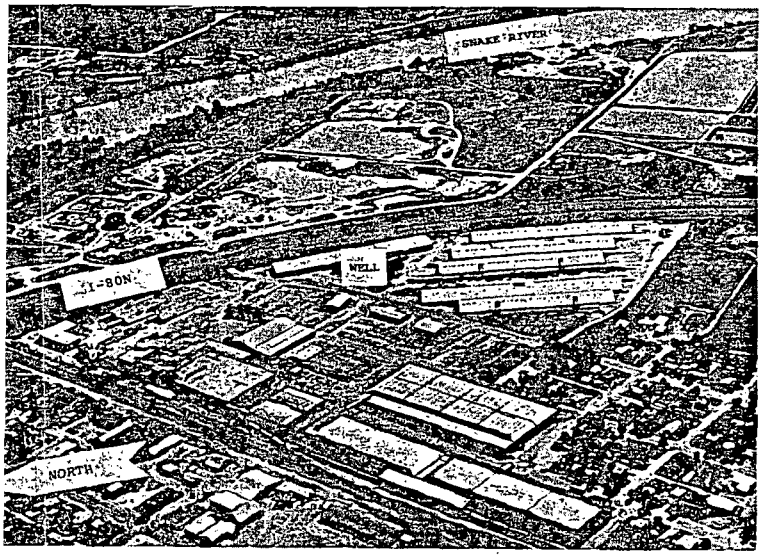
KGRA	Date of sale	Location
Mt. Hood	Jan. 15, 1979	T. 2 S., R. 9 E. Hood River and Clackamas Cos.
Carey Hot Springs	Feb. 13, 1979	T. 6 S., R. 6-7 E. Clackamas Co.
Belknap Hot Springs	Sept. 27, 1979	T. 16 S., R. 6 E. Lane Co.
McCredie Hot Springs	Oct. 23, 1980	T. 21-22 S., R. 4-5 E. Lane Co.
Newberry Caldera	Dec. 1980	T. 21-22 S., R. 12-13 E. Deschutes Co.
Alvord	No date set	T. 32-37 S., R. 33-36 E. Harney Co.

program to find and utilize geothermal energy which will be used to substitute a portion of the Ore-Ida food processing plant's energy requirements at Ontario, Oregon. Drilling of the initial well on Ore-Ida property (Figure 3) will begin in April 1979 if drilling equipment is available.

RESEARCH

Basic and applied geothermal research is being conducted in the State by several universities, the U.S. Geological Survey, and the Department of Geology and Mineral Industries. Recent Department geothermal papers include *Heat Flow of Oregon* (Special Paper 4) (in preparation), *Low- to Intermediate-Temperature Thermal Springs and Wells in Oregon* (Geological Map Series 10) (in press), *Geothermal Gradient Data* (Open-File Report O-87-4), and *Geophysical Logs, Old Maid Flat No. 1, Clackamas County, Oregon* (Open-File Report O-78-6).

Figure 3. Aerial view of Ore-Ida's food processing plant at Ontario, Malheur County, showing site of proposed geothermal well. (Photo courtesy Ore-Ida Foods, Inc.)



Mt. Hood geothermal resource assessment

In February 1977, the U.S. Department of Energy, U.S. Geological Survey, U.S. Forest Service, and the Department jointly undertook a geothermal energy resource assessment of Mt. Hood Volcano in the northern Oregon Cascade Range. This assessment continued throughout 1978 and will culminate in 1979 in the publication of final reports by the respective researchers. Some of the Department-administered field studies have been managed by staff personnel and/or consultants; other phases have been conducted by university researchers working under subcontract to the Department as noted below.

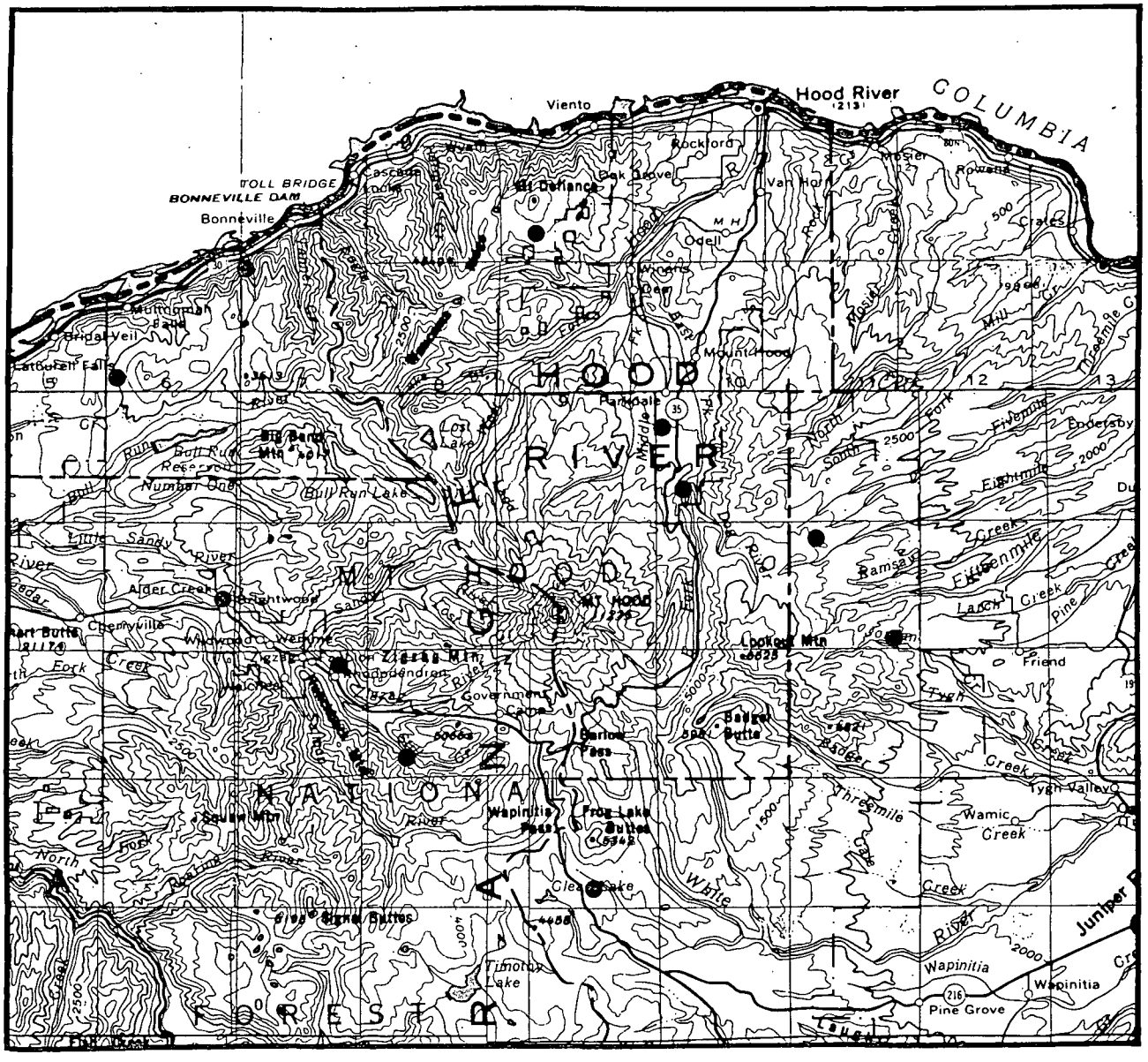
Geologic studies of the volcano are being jointly conducted by C.M. White, Department of Geology, University of Oregon, and D.A. Hull, Department of Geology and Mineral Industries. Rock geochemistry and magnetic polarity of the young andesite flows are also being investigated by White.

The Geophysics Group, under the direction of R. Couch and K. Keeling, Oregon State University, obtained gravity measurements for 239 stations in the Mt. Hood area. A free-air gravity map of Mt. Hood, based on the station data, has been completed and will be published soon. A complete bouguer gravity anomaly map of Mt. Hood will be published in 1979.

Thermal modeling of the Mt. Hood Volcano area has been undertaken by D.D. Blackwell, Southern Methodist University. Preliminary interpretation of the regional heat flow and geothermal gradient data in the northern portion of the Cascades Range in Oregon has been initiated and partially synthesized.

A program of systematic water sampling, begun in May 1977 and continued into late 1978, was designed to yield information on the hydrologic regime of Mt. Hood and to ascertain the degree of mixing between cold near-surface ground water and probable deep thermal water. Water samples were taken from cold springs, cold surface drainages, Swim Warm Springs, and condensate from the fumaroles at Crater Rock on Mt. Hood. The study was a joint effort by H.A. Wollenburg, Lawrence Berkeley Laboratory; J.H. Robison, U.S. Geological Survey;

Figure 4. Location of temperature gradient holes, Mt. Hood area, Multnomah, Hood River, Clackamas, and Wasco Counties. Scale - 1:500,000.



and R.G. Bowen, consultant to the Department of Geology and Mineral Industries.

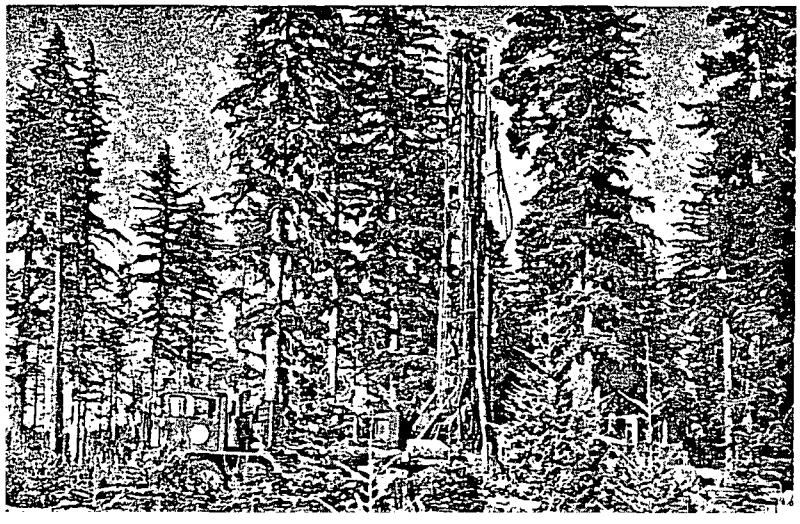
A study of the stratigraphy and structure of the Columbia River Basalt Group in the northern Oregon Cascade Range with particular emphasis on the Mt. Hood area has been undertaken by M.H. Beeson, Portland State University. The Department expects to publish the results of this study in mid-1979.

G. Bodvarsson, Oregon State University, and A. Johnson, Portland State University, are determining the rheological aspects of the Mt. Hood Volcano as they apply to the detection and delineation of volcanic geothermal resources, in particular those connected with subsurface molten or quasi-molten plutons.

Statewide low- to intermediate-temperature resource inventory

In addition to the Mt. Hood project, the Department has been engaged in a statewide inventory of low- to intermediate-temperature geothermal resources. The initial phase, completed in 1977, was a compilation of published and unpublished chemical data on thermal springs and water wells for inclusion in the U.S. Geological Survey computer-based GEOTHERM program. In 1978, thermal springs and wells not previously sampled were sampled and water analyses were determined for inclusion in the GEOTHERM program. These data appeared and were utilized in USGS Circular 790. As a result of this research, the Department has also published Geologic Map Series 10, which contains specific locations and data on thermal springs and wells in Oregon.

Figure 5. Thermal gradient drilling by Oregon Department of Geology and Mineral Industries near Clear Lake, Wasco County, November, 1978.



Temperature-gradient drilling

In late December 1978, the Department completed the last of 11 heat flow holes in the Mt. Hood area (Figures 4 and 5) to depths ranging from 250 to 500 ft. These holes are so equipped that temperature gradients can be measured. Data obtained will be synthesized and published as an open-file report in the near future.

Other Department research

During 1978 the Department compiled a preliminary geothermal resource map of Oregon which should be ready for publication and distribution in mid-1979.

U.S. Geological Survey research

As part of the Mt. Hood Assessment Program, the U.S. Geological Survey has completed aeromagnetic and seismic studies related to the geothermal potential of the volcano. Infrared and side-looking airborne radar (SLAR) remote sensing studies will continue into 1979.

Lawrence Berkeley Laboratory

Lawrence Berkeley Laboratory was responsible for the magnetotelluric study done at Mt. Hood. A telluric-magnetotelluric (T-MT) survey was utilized as the electrical resistivity technique, and the results were published in June 1978 as LBL-750.

Other research

The Department and GEO-Heat Utilization Center at OIT completed a study of the Agribusiness geothermal energy utilization potential of Klamath and western Snake River Basins, Oregon, under a U.S. Department of Energy contract. This study was published in March 1978 by OIT.

The Eastern Oregon Community Development Council at La Grande published its study on the Northeast Oregon Geothermal Project. This report, done under the direction of Rich Huggins, presents an inventory and analysis of available geologic data and a discussion of the economic, institutional, and environmental issues involved in geothermal development for Baker and Union Counties. □