

GEOHERMAL ACTIVITY IN 1972

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Leasing for geothermal investigations continued on private lands in Oregon during the year. Gulf Oil Company extended its acreage, and Anadarko Petroleum picked up leases in the Alvord Lake area (Figure 1, page 9). The work on the lease blocks by exploration parties was mostly related to geologic research, but some geophysical studies consisting of seismic ground noise, microearthquake, and electrical resistivity measurements were also made. Pacific Power and Light and Weyerhaeuser Timber Companies have continued geologic reconnaissance, airborne infrared mapping, and geochemical analysis of waters in Lake and Klamath Counties in an effort to target areas for more intensive exploration. Eugene Water and Electric Board financed some geophysical studies by the Geology Department of the University of Oregon. The Geophysical Research Group, Department of Oceanography, Oregon State University is making magneto-telluric, micro-earthquake, and ground-noise studies in the Klamath Falls region.

The Department of Geology and Mineral Industries was able to continue geothermal studies with a grant from the U.S. Bureau of Mines. The results of the geothermal gradient and heat-flow measurements made thus far by the Department are described in another section of this issue. A more detailed outline of the exploration plan appears in the July 1972 ORE BIN.

Late in the year, Magma Energy Company applied for a permit to drill a 6000-foot geothermal test on land which it had leased for several years near Vale. A permit to drill has been granted by the Department of Geology, but as yet the company has not received a solid-waste permit from the State Department of Environmental Quality.

Outside of Oregon, on areas of privately owned land, activity continued at a high level during the year. At The Geysers field in northern California units 7 and 8 were completed and placed on line during the summer and fall, bringing the installed capacity of the field to 302 megawatts. Construction is underway on units 9 and 10, which are scheduled for operation later this year. Unit 11 has been ordered and site preparation is underway for its installation; operation is expected in 1974. Unit 11, a 110-megawatt installation, will be the largest geothermal turbo-generator set in the world. Present turbo-generator sets are 55 megawatt, with two installed in each plant. Construction of the larger unit allows some economies of scale and will reduce the present low capital costs even more. It is interesting to note that new geothermal installations during the year cost about \$122/kw, while base-load fossil fuel plants were between \$200 and \$250/kw and nuclear plants ordered were between \$400 and \$475/kw.

The Union-Magma-Thermal partnership drilled 10 new wells in The Geysers area in 1972 to supply steam for the new plants under construction by Pacific Gas and Electric. Pacific Energy Corporation drilled 3 wells along the south side of the field during the year and is now negotiating with Pacific Gas and Electric for construction of a power plant on those leases.

In the Imperial Valley area, Magma Energy drilled five wells and is working with San Diego Gas and Electric to construct a binary fluid "Magmamax" power plant which is expected to be in operation in 1973.

Although Congress passed the law to allow geothermal exploration on Federal lands two years ago, implementation of the Federal leasing regulations is still delayed. Most of the steps required by Congress and by the National Environmental Protection Act before leasing can take place have been done. Preliminary draft of the leasing regulations and of the environmental impact statement were published and public hearings were held for comment; revised regulations were published in November 1972. After allowing time for public comment, the Secretary of Interior can place the regulations in force. However, actual leasing cannot take place until the final environmental impact statement has been completed and approved by the Secretary of the Interior.

It appears that Federal lands will be available for geothermal exploration in 1973. But the very restrictive regulations and onerous terms of the leases make it very doubtful that there will be much exploration on Federal lands. The Interior Department has not followed the mandate of Congress to "encourage the development of this resource;" it has instead made every effort to maximize the revenues from the leasing. These regulations have made exploration for geothermal resources more costly and more difficult than if the developer were looking for oil or gas, uranium, coal, or other leasable or claimable minerals.

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UNUSED WELLS NEEDED FOR TEMPERATURE LOGGING

In order to extend its geothermal study program in Oregon, the Department needs to know the location of all unused wells that are suitable for temperature measurements. To give a valid reading, the well must be one that has not been pumped for at least 6 months in western Oregon and 3 months in eastern Oregon. Depths should be greater than 500 feet for wells in the western part of the state and 300 feet in the eastern part. If you own such a well or know where one is located, please notify the Department.

GEOHERMAL GRADIENT AND HEAT FLOW MEASUREMENTS
BAKER AND MALHEUR COUNTIES, OREGON

PROGRESS REPORT ON GEOHERMAL MEASUREMENTS IN OREGON

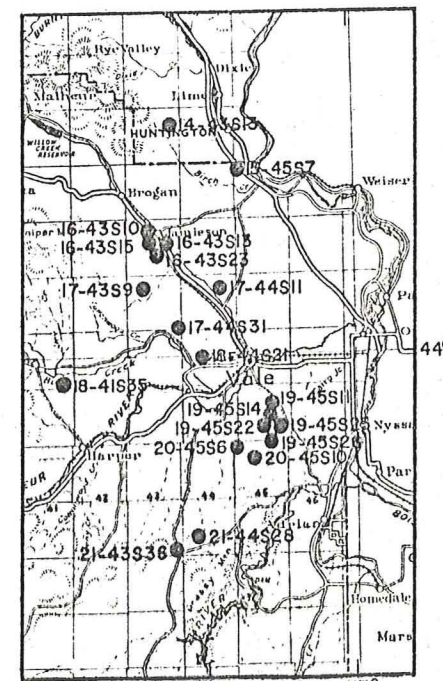
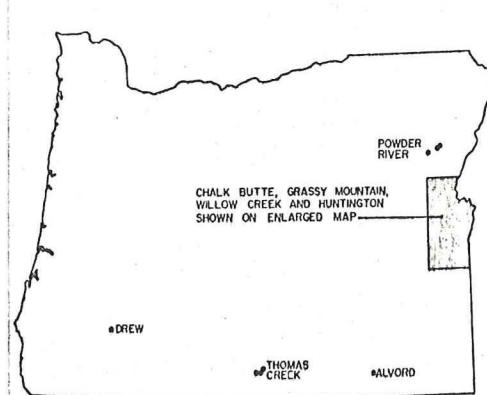
Locality	North Lat.	West Long.	Depth meters	Elev. meters	Rock type	Average Gradient °C/km	K mcal/cm sec °C	Heat flow cal/cm ² sec
<u>Chalk Butte</u>								
19-45S11	43°55'	117°10'	65	835	Tuffaceous sandstone	185±2	3.0±.2	5.7±.2
19-45S14	43°54'	117°10'	135	910	"	174±2	3.0±.2	5.4±.4
19-45S22	43°53'	117°11'	115	843	"	110±2	3.0±.2	3.3±.4
19-45S25	43°53'	117°09'	70	813	"	232±7	3.0±.2	6.9±.4
19-45S26	43°52'	117°10'	175	822	"	119±2	3.0±.2	3.6±.4
20-45S6	43°51'	117°15'	135	823	"	74±2		
20-45S10	43°50'	117°12'	135	780	"	114±2		
<u>Grassy Mountain</u>								
21-43S36	43°41'	117°23'	76	995	Tuffaceous sandstone	54±1	2.9±.2	1.5±.1
21-44S28	43°42'	117°20'	30	1000	"	106±1		
<u>Willow Creek</u>								
16-43S10	44°11'	117°26'	115	758		75		
16-43S13	44°10'	117°24'	170	768		* (20-130) 50 * (130-170) 90		
16-43S15	44°10'	117°26'	230	758		* (25-100) 35 * (100-230) 75		
16-43S23	44°09'	117°25'	170	749		* (20-110) 50 * (110-170) 90		
17-44S11	44°06'	117°17'	370	722		86±2		
17-44S31	44°02'	117°23'	70	819		86±2		
18-44S21	43°59'	117°20'	85	795		67±2		
18-41S35	43°51'	117°38'	45	887		44±6		
<u>Alvord</u>								
39-34S2	42°17'	118°41'	380	1498	Altered basalt	61±.4	3.7±0.2	2.3±0.2
<u>Powder River</u>								
8-42S24	44°51'	117°31'	70	835		40±4		
9-41S7	44°47'	117°44'	25	1131	Silicified gabbro	45		
<u>Huntington area</u>								
14-43S13	44°21'	117°24'	280	1174	Graywacke & phyllite	32±1		
15-45S7	44°16'	117°15'	170	857	Tuffaceous sandstone	* (20-90) 62±2 * (90-170) 30		
<u>Thomas Creek</u>								
37-19S30	42°20'	120°31'	135	1823		59±1		
37-18S14	42°22'	120°27'	75	1804	Tuff breccia	140±3	2.5±0.2	3.2±0.2
<u>Drew</u>								
32-2S4	42°49'	122°56'	215	931	Schist	20±1		

The accompanying list of geothermal gradients and heat-flow measurements is published here as a progress report on the geothermal study being conducted by the Oregon Department of Geology and Mineral Industries under the direction of R. G. Bowen. Cooperating in the study is Dr. David Blackwell of the Geology Department of Southern Methodist University, Dallas, Texas, who provided the heat-flow determinations. Funds for the program are provided by the U.S. Bureau of Mines.

The goals and methods of the Department's geothermal study were outlined in the July 1972 ORE BIN, following publication of some preliminary temperature gradient measurements in the April issue.

During the summer of 1972, a concentrated effort was made to locate pre-drilled holes and make temperature gradient measurements. The data for 25 holes are presented in the list. Included in the list are temperature gradients for five of the holes reported on in the April 1972 ORE BIN (locality nos. 19-45S22, 19-45S26, 19-45S25, 20-45S10, and 39-34S2).

Preliminary heat-flow measurements are given for eight of the holes. These measurements are based on thermal conductivity determinations of cuttings and cores that the Department was able to obtain on some of the wells for which gradients had been measured. More refined heat-flow determinations will be published at a later date, after corrections for radioactivity and topography have been made; however, it is probable that the presently determined values will be only slightly altered by the correction.



Index maps showing sites of temperature-gradient and heat-flow determinations.

*Two gradients are reported for these wells. This variation may be caused either by water movements in the aquifer or by difference in thermal conductivity of the bedrock at the depths measured.