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OPEN-FILE REPORT O-94-09

Digital Data and Selected Texts from LOW-TEMPERATURE GEOTHERMAL DATABASE FOR OREGON

Low-Temperature Geothermal Resources and Technology Transfer Oregon - Phase I Final Report
(Open-File Report O-94-08)

by
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I. INTRODUCTION

In July 1992 the Oregon Department of Geology and Mineral Industries (DOGAMI) received a subcontract from the Oregon Institute of Technology-GeoHeat Center (OIT-GHC) to perform portions of the State Geothermal Energy Research, Development, and Data Base Compilation. The prime contractor for the project was the United States Department of Energy Geothermal Division (USDOE/GD). The project is part of their Low-Temperature Geothermal Resources and Technology Transfer program.

The goals of the project are to update the inventory of the nation's low- and moderate-temperature geothermal resources, study the location of those resources relative to potential users, and to collect additional information on the use of geothermal heat pumps. DOGAMI's effort is aimed primarily at the first of these goals. Specific tasks in the DOGAMI subcontract include:

1. Complete an updated inventory of low- and moderate-temperature geothermal resources for the State of Oregon, current to June 1, 1992.
2. Conduct a fluid geochemistry study of the more important resource areas for which

existing data are questionable or unavailable.
3. Complete a computer database compatible with Lotus 123 tabulating for each occurrence the name, location (T,R,S), county, latitude and longitude, depth, temperature, flow, chemistry, and other relevant data.
4. Review the OIT-GHC geothermal resource and demographic data for the State of Oregon for accuracy and completeness.
5. Assist OIT-GHC, UURI, AND IWRRI (Idaho Water Resources Research Institute) in studies to prioritize low- and moderate-temperature resource areas for new development.

II. TASK I: LOW- AND MODERATE-TEMPERATURE GEOTHERMAL RESOURCE INVENTORY

PREVIOUS INVESTIGATIONS

The first attempt to inventory thermal springs in Oregon was by Stearns and others (1937), which was a compilation of all known hot spring occurrences in the United States. Oregon made up only a small part of the total. Waring (1965), was an attempt to compile the known hot spring occurrences throughout the world. In the process, the Oregon inventory was updated.

In the early 1970s, DOGAMI, the U.S. Geological Survey, OIT-GHC, and USDOE all commenced geothermal investigations in the state. During the following decade many low-temperature geothermal areas were investigated, including the Harney Basin, Vale, Lakeview, Powell Buttes, Belknap-Foley Hot Springs, Willamette Pass, Ashland, Klamath Falls, and LaGrande. Most of these studies were funded by grants from USDOE/GD. The reports that resulted from these studies are listed in the references.

The first map of thermal springs and wells in the state was produced by Bowen and Peterson (1970). That map was updated by Bowen and others (1978). Riccio (1978) published a useful geothermal resource map of Oregon, but the most comprehensive map of thermal occurrences in the state was published by NOAA in 1982 (National Oceanic and Atmoshperic Administration, 1982). The NOAA map listed 912 wells and springs in the state of Oregon with temperatures greater than 20øC.

The U.S. Geological Survey first attempted to assess the geothermal resource potential of the United States in Circular 726 (White and Williams, 1975). Circular 726 made no attempt to address the potential of areas with temperatures of less than 90øC. Circular 790 (Muffler, 1979), which updated the assessment of Circular 726, included a section on low-temperature geothermal resoures (Sammel, 1979). Circular 892 (Reed, 1983) was specifically aimed at assessing the low-temperature (i.e., <90øC) geothermal resource potential in the United States.

In 1985, the states of Oregon, Washington, Idaho, and Montana prepared a report for the Bonneville Power Administration that analyzed the known geothermal resources in the four states (Bloomquist and others, 1985). Although no new data were generated for the report, it contained useful resource and economic analyses of the various sites, and ranked them on the basis of resource quality and economics.

This study is the first attempt to update the low-temperature geothermal resource base since the studies of 1982 (NOAA, 1982; Reed, 1983).

METHODOLOGY

The purpose of this study is to inventory those wells and springs with temperatures from 20ø to 150øC. The lower limit is based on a minimum temperature of 10øC above mean annual air temperature. The upper limit is considered to be the minimum reservoir temperature capable of generating electrical energy using conventional steam turbines (White and Williams, 1975).

In completing the inventory, all available published data prior to and including the NOAA (1982) map were utilized. Then, all published and unpublished data collected since 1982 were included. Finally, the entire set of State of Oregon water-well logs (maintained by the Oregon Department of Water Resources [ODWR]) was examined, and all locations not obtained previously were added. This last part was simplified because ODWR has computerized the logs for approximately half the counties in the state and was able to search its records for wells with temperatures ò20øC. The records of those counties not yet added to the computer database were searched manually.

For the Klamath Falls area, we also contacted OIT-GHC and obtained a copy of the Center's database of hot wells in and around the city.

RESULTS

A preliminary inventory of low- and intermediate-temperature geothermal resources for the State of Oregon was submitted to OIT-GHC in a letter dated February 5, 1993. The final inventory is contained in the database presented here and discussed under TASK III. The preliminary database was accompanied by a list of geothermal references for the State. That reference list has been updated and is included in this report.

III. TASK II: FLUID GEOCHEMISTRY

No new samples were taken for this project, so most of the chemical data included in the database came from published or otherwise available sources:

U.S. Geological Survey and Oregon Department of Geology and Mineral Industries (1979) and Mariner and others (1980) contain virtually all of the published chemical data for thermal springs in Oregon.

The chemical data from the OIT-GHC Klamath Falls database provided useful information for the Klamath Falls area.

Some previously unpublished data were taken from DOGAMI files.

Finally, all of the ground-water studies that have been completed in the state were examined, and any chemical data contained in them added to the database.

The resulting database is discussed in detail under TASK III.

IV. TASK III: DATABASE COMPILATION

The results of the database compilation are contained in three Microsoft Excel 5.0 files. The first (lotempdb.xls) contains all sites in the state except those in T. 38 S., R. 9 E. (the Klamath Falls area). In the paper copy (DOGAMI Open-File Report O-94-08), this file and an explanation of its database

entries make up Appendix A. The second file (klamath.xls) contains those sites in T. 38 S., R. 9 E. In the paper copy, this file and an explanation of its database entries make up Appendix B. The third file (chem.xls) contains the chemical data. The explanation of database entries for this file also includes a list of the references from which chemical data were obtained. In the paper copy, this file and an explanation of its database entries make up Appendix C.

On this disk, all the above-mentioned explanations for the three database files are included in the README.1st text file.

V. TASK IV REVIEW OF DEMOGRAPHIC DATA

The review of OIT-GHC resource and demographic data was completed by George Priest of DOGAMI in 1992, and the results were forwarded to OIT-GHC in a letter dated August 28, 1992. A copy of the letter is included in the paper copy of this report (DOGAMI Open-File Report O-94-08) as Appendix D.

VI. RESULTS

The NOAA (1982) compilation of low- and intermediate-temperature geothermal sites for Oregon contained a total of 912 sites. In this study, 2,193 sites were identified, a net increase of 1,281.

The paper copy of this report (DOGAMI Open-File Report O-94-08) is accompanied by five plates that show the locations of the sites contained in the databases. Plate 1 shows the location of wells and springs with temperatures from 20ø to 30øC. Plate 2 shows sites with temperatures between 30ø and 90øC. Plate 3 shows sites with temperatures >90øC. Plate 4 shows those sites in T. 38 S., R. 9 E. Plate 5 shows those sites for which chemical data could be obtained. Plates 1-3 and 5 have scales of 1:1,000,000; Plate 4 has a scale of 1:24,000.

No new geothermal areas were discovered as a result of this study. Instead, the results tend to confirm earlier thoughts on the distribution of low-temperature resources in the state. The NOAA

(1982) map indicated that the entire state east of the Cascade Range (except for the crest of the Wallowa Mountains) was "favorable for the discovery at shallow depth (less than 1,000 m) of thermal water of sufficient temperature for direct heat applications." This study reinforces that assessment. In particular, the entire Columbia Plateau Province (the north-central part of the state) appears to be underlain by large volumes of 20ø-25øC water at relatively shallow depths of less than 1,000 m (mostly less than 600 m). As a result, the small towns located on the Plateau (e.g. Hermiston, Umatilla, Pendleton, Stanfield, Heppner, Weston, etc.) are prime sites for the development of low temperature geothermal resources.

As mentioned previously, Bloomquist and others (1985) contains a comprehensive analysis of geothermal sites (both electrical generation and direct use) in the states of Oregon, Washington, Idaho, and Montana. Sites were ranked on the basis of resource quality and economics. In the paper copy of this report (DOGAMI Open-File Report O-94-08), a copy of the rankings from Bloomquist and others (1985) is included as Appendix E in the form of three tables. Table 10.2 is the resource ranking; Table 10.16 is the economic ranking; and Table 10.18 combines the resource and economic rankings into an overall ranking. At this point, there is no reason to revise the ranking scheme presented in those tables.

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