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5.0 STATE COOPERATIVE RESERVOIR ANALYSIS PROGRAM
by Howard P. Ross

Funded by
Department of Energy -- Geothermal Division

5.1 Introduction

The State Cooperative Reservoir Analysis Program (SCP) was established by DOE in the late 1970's as the State Coupled Program to assess low- and moderate-temperature geothermal resources in the United States. The early efforts of the program were national in scope and focused on statewide resource assessment, resulting in the publication and distribution of a series of state geothermal resource maps. More recent work has included detailed reservoir analysis and generic studies.

As a result of a 1987 DOE/ID solicitation, eleven grants were signed with state-designated agencies to conduct geothermal research. One additional grant was signed later to provide support for an unsolicited research proposal. The grant participants and a brief description of the status of the projects follows.

5.2 Research Objectives

The primary objectives of the State Cooperative Program (SCP) are to provide updated evaluations and assessments of the low- and moderate-temperature geothermal resources in the United States, to monitor reservoirs under development, and to address geothermal research of interest to industry, but not currently being pursued by the geothermal industry. Data generated by this program have been very useful to potential developers of geothermal resources.

5.31 Progress to Date -- Completed Projects

Alaska. The University of Alaska, Geophysical Institute, has completed a geological and geochemical study of the Geyser Bight geothermal resource, Umnak Island. Results of this study indicate that a zoned plutonic rock unit (9.5 Ma) is the probable reservoir rock, and volcanic rocks range in age from 75,000 to 534,000 years. A previously unreported fumarole field, 4 km south of Geyser Bight valley, was discovered during this study and has been mapped and described in detail. Heat for the geothermal system is derived from the Mt. Recheshnoi volcanic system.

Idaho. The State of Idaho, Department of Water Resources, has completed a geochemical study of the Wood River geothermal systems and a hydrologic and geologic study of the Banbury-Twin Falls reservoirs. A key result of the latter study is a simplified conceptual model of the Twin Falls County geothermal systems. The Berkeley Group, Inc., a subcontractor to ID-DWR, completed a detailed review of all existing data on the Boise geothermal aquifer. BGI used the most reliable data to constrain numerical simulations of present and future reservoir behavior under various development scenarios. All studies have been completed.

Nevada. The Division of Earth Sciences, University of Nevada-Las Vegas, has completed a study of the genesis of geothermal fluids of the Great Basin. The study has determined a late Pleistocene age (40,000 - 10,000 years BP) for the fluids which indicates a paleorecharge scheme. Range-bordering faults probably provide conduits for recharge of the deep geothermal systems. Pleistocene lakes probably contributed to recharge in western Nevada.
The Desert Research Institute, University of Nevada, has completed a 13 month hydrologic monitoring program at the Moana geothermal system. These and other geologic data were used to attempt a quantitative evaluation and numerical model of the Moana resource. The study results will be made available to regulatory agencies and developers to coordinate future development of the resource.

**New Mexico.** New Mexico Research and Development Institute is using a subcontractor, New Mexico State University, in a study to evaluate the use of time-integrated radon soil-gas surveys for geothermal resource assessment in the southern Rio Grande Rift. One drill hole, which tests a radon anomaly in the Rincon survey area, has recorded a temperature of 85 oC at a depth of 90 meters. This study has advanced the radon soil-gas technique and yielded several target areas for moderate-temperature geothermal fluids in the Rincon and Radium Springs areas. Self-potential surveys conducted by NMSU and UURI scientists have further defined the more promising target areas.

**Utah.** The State of Utah, Geological and Mineral Survey, has completed a multidisciplinary study of the Newcastle resource which currently provides space heating for greenhouses, a church and several residences. Geological, geophysical and geochemical studies have characterized this hidden resource in detail, and have determined a reservoir temperature in excess of 130 oC, with an anomalous heat loss of 12.4 MW. The study suggests new approaches for the discovery of other hidden Basin and Range geothermal systems. Electrical resistivity and self-potential surveys completed with UURI support appear to have delineated the upflow zone of thermal fluids feeding the outflow plume.

**Washington.** The State of Washington, Department of Natural Resources, drilled eight 152 m temperature-gradient holes to better define the Southern Washington Cascade Range heat flow anomaly. Two holes did not penetrate the effects of cold surface waters, but four holes had temperature gradients of 50 to 58 degrees C/km. A related study integrated K-Ar age dates, geochemistry and volcanic stratigraphy of the Indian Haven Quaternary volcanic field to evaluate volcanic production rates.

**5.32 Progress To Date -- Continuing Projects**

**Alaska.** The State of Alaska, Division of Geological and Geophysical Surveys, has completed a fluid-chemistry study of the Geyser Bight area in support of the Geyser Bight geological study. Fluid-chemistry analyses indicate that spring waters are derived from two intermediate-level hydrothermal reservoirs with minimum temperatures of 165 and 200 oC, and a probable deeper reservoir with a minimum temperature of 265 oC. Work continues on a second task, the compilation of the Aleutian Island - Alaskan Peninsula geothermal resource map.

**Hawaii.** The State of Hawaii, Department of Business, Economic Development, & Tourism, has engaged a subcontractor, the University of Hawaii, to study methods of controlling silica deposition from geothermal fluids of the Hawaii East Rift Zone. Mixing of 60% condensate and 40% brine, and treatment with weak acids, both show great promise in retarding silica precipitation. The high surface area of precipitated silica may have some commercial value. Completion of the study was delayed by shutdown of the HGP-A well, the only source of fluids for the study.

The grant has now been modified to extend the silica treatment study to mainland North American geothermal systems with high silica fluids. This will allow completion of the research and extension of results to other geothermal environments and systems.
North Dakota. The University of North Dakota is cooperating with the Geological Surveys of North and South Dakota in a comprehensive geothermal resource assessment of these states. Eight heat-flow holes have been drilled and logged in the South Dakota heat-flow anomaly, and two more test hydrologic anomalies in North Dakota. New studies suggest that the stratabound geothermal resource may be twice as large as previously reported.

Oregon. The State of Oregon, Department of Geology and Mineral Industries, has drilled a deep scientific and heat-flow hole at Santiam Pass on the crest of the Oregon Cascades. The completed depth of Santiam Pass 77-24 was 3046 feet (929 m). A preliminary, non-equilibrated bottom hole temperature of 24 °C is anomalously low, indicating the area is hydrologically disturbed. A temperature gradient of about $120^\circ\text{C} / \text{km}$ from 905-920 m is more encouraging. Petrologic, age dating and geochemical studies of the core are underway. This project was jointly funded by DOE and Oxbow Geothermal Corporation.

Wyoming. The University of Wyoming, Department of Geology and Geophysics, continues work on an improved three-dimensional modeling scheme for solving the combined heat-conduction and forced-convection equations for determining subsurface temperatures. A model will be developed for either the Cody or Thermopolis hydrothermal systems.

A review of interim and final results so far indicates this phase of the State Cooperative Program has been extremely productive in terms of new resource information (Washington Cascades; Newcastle, Utah; Rio Grande Rift), reservoir monitoring and evaluation, and in addressing production problems (Hawaii silica studies). Four studies have been presented at the 1989 and 1990 GRC conferences, and these and several other studies will be presented at other conferences. A number of quality technical reports and presentations will result from projects described above.

5.4 Reports and References


