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## SUMMARY

The State Coupled Program has been instrumental in identifying low- and moderate-temperature geothermal resources throughout the nation. In several cases, such as Pagosa Springs, Colorado, development has taken place that would not have occurred without the program. Twenty-two maps depicting geothermal resources have raised the profile of this alternative energy. Numerous reports produced within each state (Ruscetta and Foley, 1981b; Ruscetta, 1982b; and individual state final reports) have transferred the data compiled to public and technical audiences.

## INTRODUCTION

The State Coupled Resource Assessment Program was initiated by the U.S. Department of Energy, Division of Geothermal Energy (presently Division of Geothermal and Hydropower Technologies) in 1977. The original goal of the program was to compile and publish state-by-state data concerning the nature and occurrence of low- and intermediate-temperature geothermal resources. It was felt that these resources could contribute significantly to the availability of alternate energy sources in the U.S., but at that time the lack of geoscientific data hindered development.

The State Coupled Program is a cost-shared program, with the DOE funding most of the work, but state agencies (either geological surveys, university groups or, in one case, a division of water rights) also funding a portion of the work. DOE and the states have both received technical support from contractors to DOE, including the Earth Science Laboratory/University of Utah Research Institute. Figure 1 depicts the regions that have been investigated during the program. State Coupled Program participants are listed in Appendix I with respective tasks listed in Table 1.

**FIGURE 1**  
**STATE COUPLED PROGRAM**  
**PARTICIPANT STATES AND REGIONS**



TABLE 1

RESPONSIBILITIES OF STATE COUPLED PROGRAM PARTICIPANTS

DOE - HEADQUARTERS (WASHINGTON)

Program Planning, Guidance, Priorities

DOE - OPERATIONS OFFICES

Program Guidance, Implementation, Contracting, Management

STATE CONTRACTORS

Performance of State Project

EARTH SCIENCE LABORATORY/UNIVERSITY OF UTAH RESEARCH INSTITUTE (ESL/UURI)

Communicate program objectives for 16 western states  
Provide liasions among participants and other federal geothermal programs  
Provide status reports  
Convene annual meetings  
Technical support to states and DOE

LOS ALAMOS NATIONAL LABORATORY

For 2 states, tasks similar to ESL/UURI

GRUY FEDERAL

Regional inventory of midwestern and eastern resources  
Technical support to DOE Headquarters

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Resource assessment along Atlantic coastal plain

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Publish resource maps

U.S. GEOLOGICAL SURVEY

Compile regional resource assessments  
Store national geothermal data

The primary accomplishment of the State Coupled Program has been to increase the amount of data available about low- and intermediate-temperature geothermal resources. The increase in data has led directly to the expansion of several existing geothermal applications, and the development of new applications. Data generated by the State Coupled Program have also been used in promulgating legislative actions at local, state and federal levels.

The State Coupled Program has been a phased program, from regional tasks such as statewide inventories to more local and detailed resource assessments. The mix of tasks has had a wide range among states, and has varied from year-to-year within individual states. Table 2 presents a general summary of state activities, which tasks are discussed below.

The State Coupled Program has interfaced with several other federal geothermal programs, which were intended to promote commercialization of geothermal resources, support DOE data requirements, and provide data for national resource assessments. These other programs are also listed below.

Earth Science Laboratory/University of Utah Research Institute activities, which were typical of support contractors, are discussed in a separate section.

#### STATE PARTICIPANT TASKS

##### Geoscientific Data

At the initiation of the program, few integrated geoscientific data on geothermal resources existed for any state. Thus, statewide compilation of the occurrence, chemistry, and geologic nature of thermal springs and wells was the first major effort of the program. Other tasks have followed, including more detailed studies, publication of maps, and support of U.S. Geological Survey assessments.

TABLE 2

ACTIVITIES OF STATE PARTICIPANTS

Statewide Inventory - identify and assess all thermal springs and wells in a state, including locating previously unknown sites.

Regional Reconnaissance - study geothermal systems within geologic provinces of a state.

Area Exploration and Model Development - study individual thermal systems; develop models to explain the nature and occurrence of the resources; develop exploration strategies to locate new resources.

Map Production - develop maps depicting geothermal resources for technical and non-technical audiences.

Reporting - produce reports on resources.

User Assistance - answer questions from people interested in development of specific sites.

USGS Interface - provide data to USGS for their use in performing resource assessment and to archive.

Commercialization Planning Support - provide data to state agencies involved in promotion of geothermal resources.

DOE Requests for Data - provide requested data to DOE.

Statewide and regional studies of geothermal resources have emphasized direct identification of resources through temperature measurements rather than indirect identification, such as geophysical indications of probable sites. For the purpose of this program, a lower limit of 10°C above mean annual air temperature at a particular site has been used to define the lower limit of a thermal anomaly. Resources identified in most states have had temperatures under 100°C. The direct measuring of spring and well temperatures has resulted in the discovery of many previously unknown thermal sites within each state.

In addition to direct temperature measurements, many other geological, geochemical and geophysical techniques have been applied by program participants to the search for thermal water. These techniques, from a survey by ESL/UURI in 1981, are listed in Figures 2, 3, and 4. Success of individual exploration techniques has varied depending upon site conditions; individual state reports summarize conditions of applicability for these.

Many sites have been investigated by state participants; these are listed in Appendix II. State teams have also been active in the development of resource models, upon which exploration philosophies could be developed. The nature of geothermal resources is much better understood as a result of studies under this program.

State teams have also been responsible for the production of reports. These are cited in Ruscetta and Foley (1981b) and Ruscetta (1982), as well as in individual reports available from the state agencies cited in Appendix I.

#### Geothermal Resource Maps

The production of maps depicting geothermal resources in many states has been a major effort of the State Coupled Program. Twenty state maps, intended for use by the general public and non-geoscientific decision makers, have been

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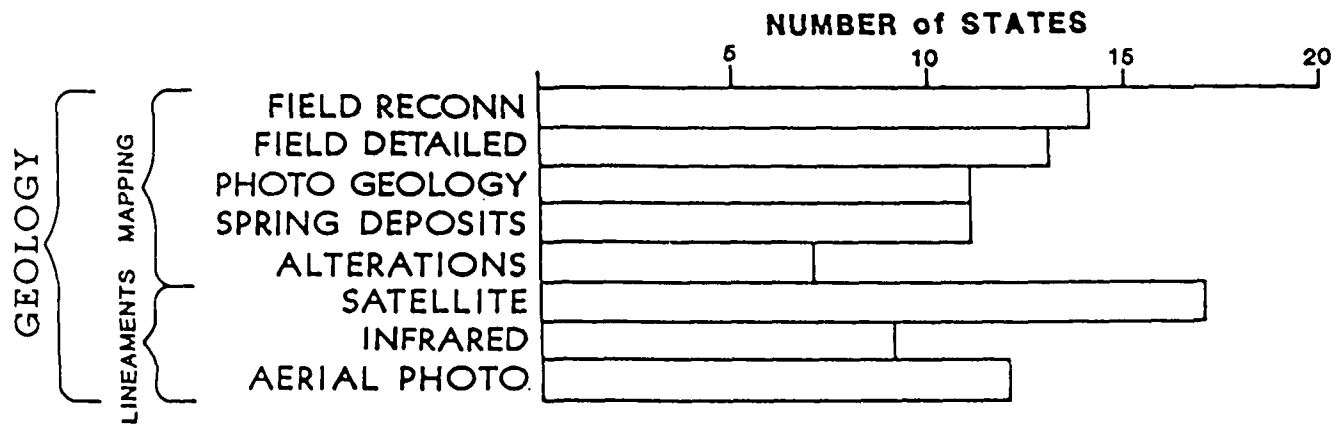


FIGURE 2 GEOLOGICAL EXPLORATION TECHNIQUES



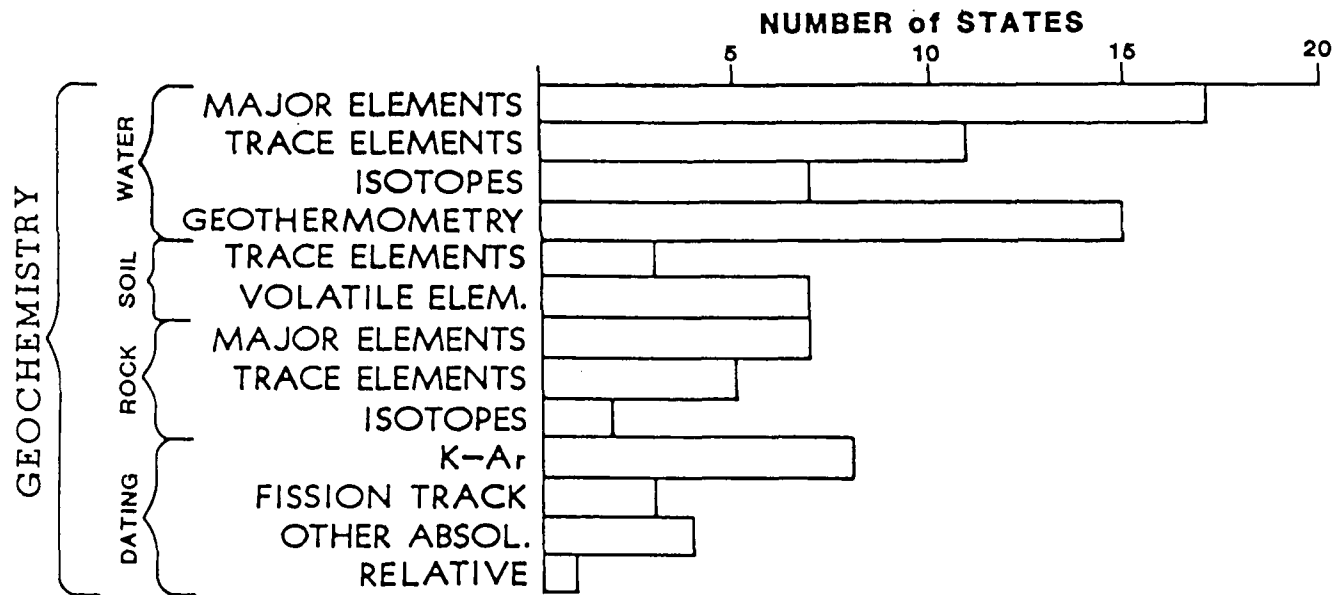


FIGURE 3 GEOCHEMICAL EXPLORATION TECHNIQUES

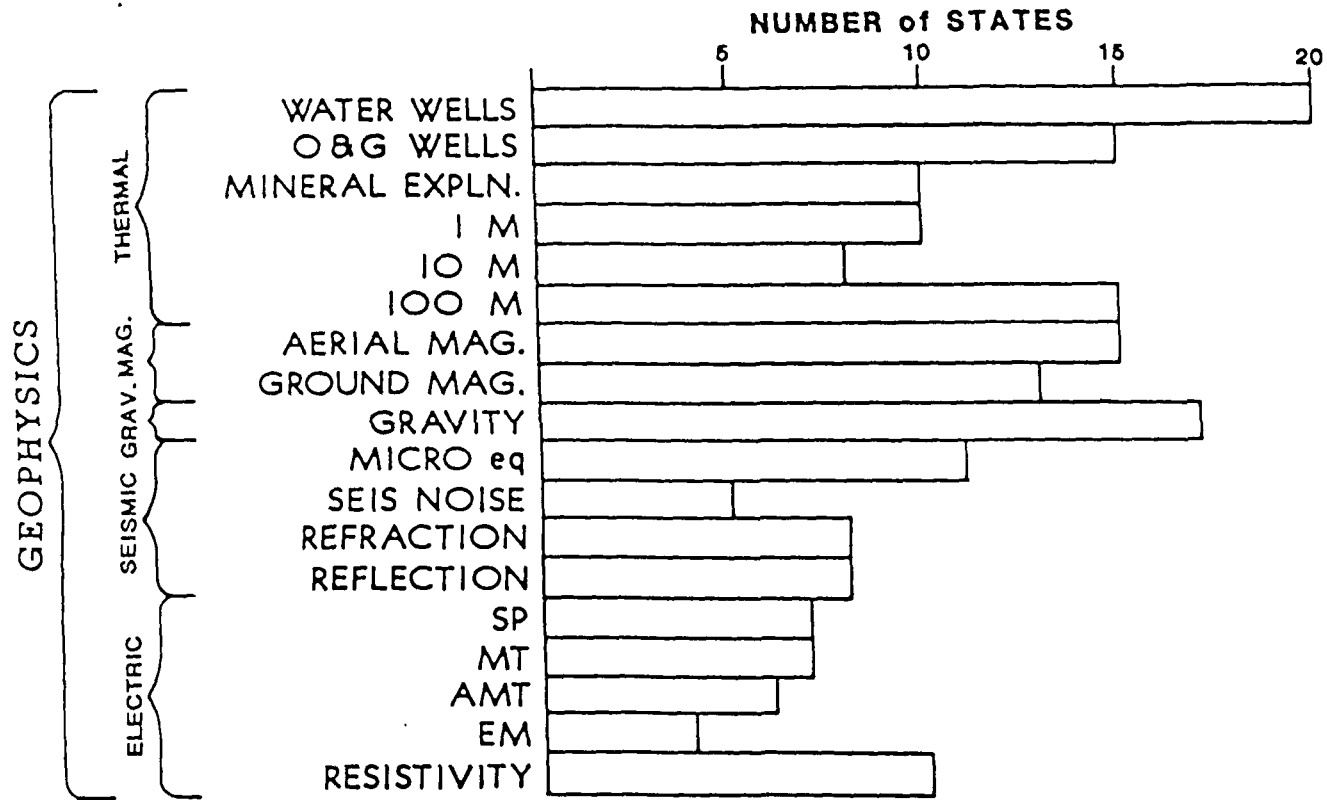


FIGURE 4 GEOPHYSICAL EXPLORATION TECHNIQUES

published; two maps directed toward a scientific audience have also been produced. Figure 5 depicts the states for which these maps have been produced. Maps are available from the respective state agencies listed in Appendix I and from NOAA (address in Appendix I).

Geoscientific data for the maps have been compiled by the individual state teams. These have included identification and characterization of geothermal sites, including thermal regime and water quantity and quality data. Technical maps present additional supporting geoscientific information. The maps also contain depictions of areas interpreted by the state teams as having highest potential for the existence of undiscovered resources. Geothermal data have been plotted on state topographic base maps produced by the U.S. Geological Survey.

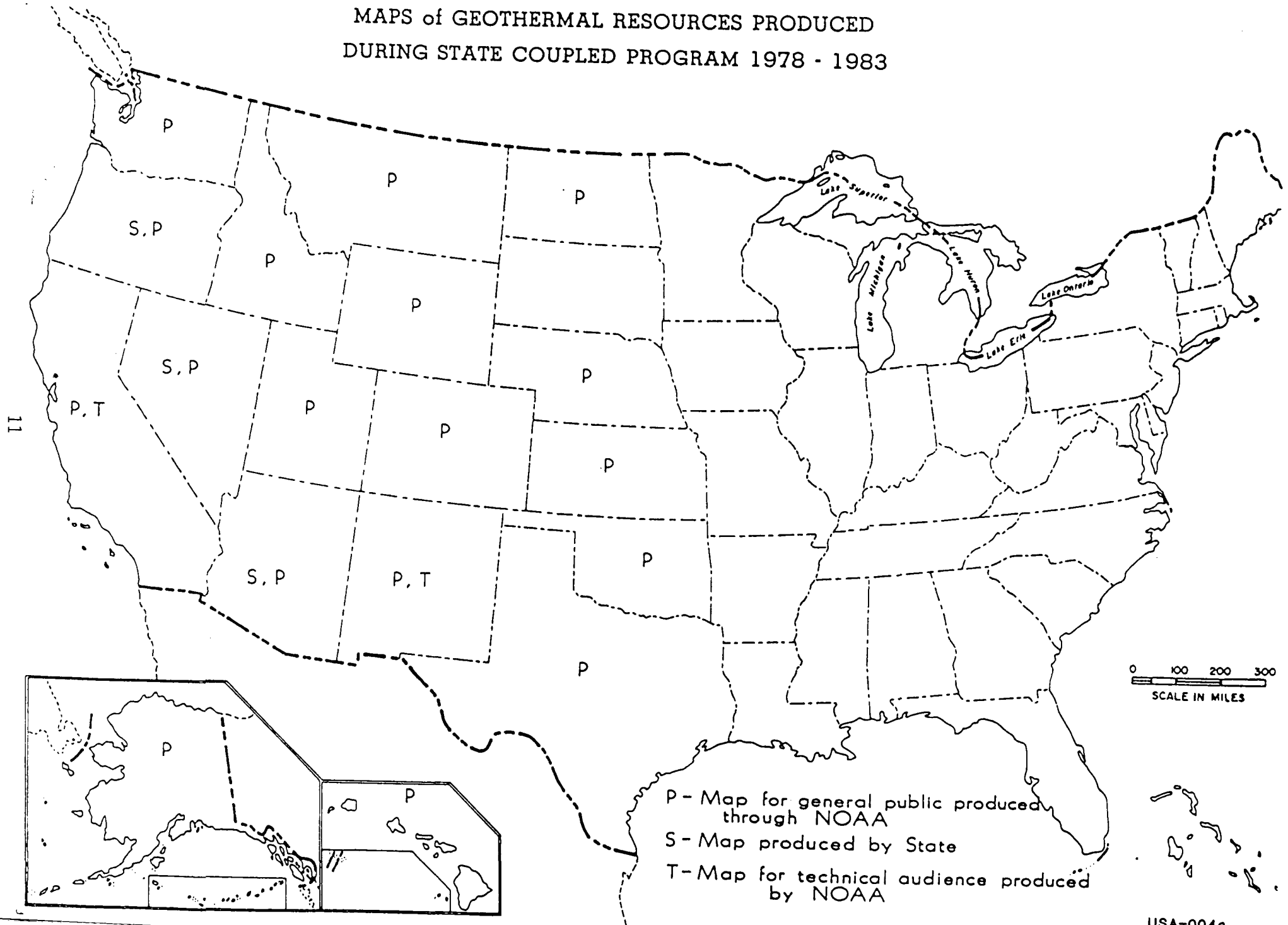
The National Oceanic and Atmospheric Administration facility at Boulder, Colorado, has been funded by DOE under the State Coupled Program to coordinate production of most of the maps. Their coordination tasks have included compilation of base data, production of proof maps for each state, and coordination with the Government Printing Office on final production of the maps.

Several states have coordinated production of their own individual maps; these are indicated on Figure 5. Quality control for the NOAA-produced maps has been accomplished through the participation of a map review committee, composed of representatives of DOE, the individual states, NOAA, the USGS, ESL/UURI and other support contractors. Generalized map design standards and data format, as well as individual map text and layout decisions have been handled by this committee, with ESL/UURI taking a lead role.

In addition to production of individual state maps, data compiled by State Coupled Program participants have been published in other maps. These

FIGURE 5

MAPS of GEOTHERMAL RESOURCES PRODUCED  
DURING STATE COUPLED PROGRAM 1978 - 1983



0 100 200 300  
SCALE IN MILES

P - Map for general public produced  
through NOAA  
S - Map produced by State  
T - Map for technical audience produced  
by NOAA

have included a national map of geothermal resources coordinated by DOE Headquarters personnel, maps published in association with USGS Circular 790, and a map of geothermal resources published by National Geographic Magazine as part of a special issue on energy.

#### Utilization of Data

Data compiled by State Coupled Program resource assessment teams have been used by both private concerns and other federal programs. Much of the individual site data have been used by local developers, in promoting and developing geothermal resources. These have included large projects, such as district heating programs in Pagosa Springs, Colorado, and Boise, Idaho, and the heating of the Utah State Prison, as well as many smaller projects.

Other federal geothermal programs have been one of the prime beneficiaries of State Coupled Program data. These programs have included the State Commercialization Planning Program, the Federal Buildings Program, the User Coupled Confirmation Drilling Program, the Technology Transfer and Outreach Programs, the Energy Technology Program, the National Progress Monitor system, the geothermal PON and PRDA efforts of DOE, the National Market Shares Estimates Study, and the identification of resource conflicts between geothermal sites and proposed Forest Service and BLM wilderness study areas. All of these other programs have used both site data and state team interpretations of overall resource potential. Most of the coordination with these programs has been through the efforts of ESL/UURI and other support contractors, although some efforts, most notably the Commercialization Planning program, have been coordinated directly among respective teams in individual states.

Three projects of the USGS have benefited directly from the State Coupled Program. These are computer file GEOTHERM (the national repository for

geothermal data) and Circulars 790 and 892. Prior to the inception of the State Coupled Program, GEOTHERM had approximately 250 geothermal sites in its data base. At the present time, more than 6000 entries are included. Data in GEOTHERM include not only temperature and production flow rate for geothermal wells and springs, but also chemistry of thermal waters, and, where applicable, comments on development of the field. Circular 790 was undertaken in 1978 by the USGS, to assess geothermal resources with temperatures greater than 90°C. Cooler resources were discussed but not quantified. State teams participated in the assessment by providing resource data and assisting in the development of maps depicting the cooler resources. Circular 892 was published in 1983, and quantified the assessment of geothermal resources with temperatures less than 90°C. State team participation in this assessment included providing much new data. Efforts of state resource assessment teams on USGS projects were coordinated by ESL/UURI.

Several other smaller projects have used State Coupled Program data. Perhaps the most notable of these was by National Geographic magazine, which included a discussion and map of geothermal resources in a special issue on energy.

#### EARTH SCIENCE LABORATORY ROLE

During the State Coupled Program, ESL/UURI has been funded to perform a variety of tasks. These have included technical support to DOE at both Headquarters and Operations Office levels, including monitoring state programs in 16 western states, serving as interprogram liaison, technical support to states and publishing summary reports.

Support to DOE has primarily focused on technical portions of the State Coupled Program. ESL/UURI has aided DOE by communicating technical program

objectives to the state participants, through annual or more frequent visits to each state participant, in addition to phone calls and letters. ESL/UURI has also convened annual meetings of program participants, one in Glenwood Springs, Colorado, one in Seattle, Washington, and two in Salt Lake City. Proceedings of most of these meetings are available as ESL/UURI publications (Ruscetta and Foley, 1981a,b; Ruscetta, 1982a,b). Monitoring each state program has included following progress on individual tasks and coordinating with each state concerning content of proposals. ESL/UURI has also served as a technical reviewer for many reports published by individual states.

The State Coupled Program has had to interface with many DOE and other Federal geothermal programs; ESL/UURI has been active in acting as a liaison with all the programs listed earlier. The ESL/UURI role has been most active in coordination with the USGS resource assessments and the User Coupled Confirmation Drilling Program. ESL/UURI visited each of the states to explain the User Coupled Program. Major emphasis was also placed on wilderness land studies.

Many requests for talks summarizing geothermal resource occurrence and exploration have been received by ESL/UURI. State Coupled Program data were extensively relied upon in making these presentations.

ESL/UURI has also been active in supporting individual state efforts through providing technical expertise in geology, geochemistry and geophysics. Table 3 is a summary of some of these efforts. ESL/UURI also ran an exploration technology workshop at one of the meetings of State Coupled Program participants. Topics discussed at this meeting included gravity, magnetics, thermal gradients, electrical methods, trace element studies, geothermometry, drilling and reservoir testing. In addition, ESL conducted an intensive mercury technique workshop with personnel from the Colorado team.

TABLE 3

PARTIAL LIST OF ESL ANALYTIC SUPPORT

K-AR DATING - Montana  
Oregon  
Washington

GEOPHYSICS - Alaska - Electrical Studies  
Arizona - Resistivity Data Modeling  
California - Resistivity Data Modeling  
Colorado - Resistivity Data Modeling  
Idaho - Geophysical Data Package Development  
Utah - Program Design, Data Interpretation, Gravity Program  
Washington - Resistivity Modeling

GEOCHEMISTRY - California - Water Analyses  
Oregon - Water Analyses  
Utah - Water Analyses

HYDROLOGY - Utah - Aquifer Test Modeling



## REFERENCES CITED

- Ruscetta, C. A., and Foley, D., eds., 1981a, Geothermal Direct Heat Program, Glenwood Springs technical conference proceedings, volume I, papers presented: Earth Science Laboratory Report 59, 313 p.
- Ruscetta, C. A., and Foley, D., eds., 1981b, Geothermal Direct Heat Program, Glenwood Springs technical conference proceedings, volume II, bibliography of publications: Earth Science Laboratory Report 60, 39 p.
- Ruscetta, C. A., ed., 1982a, Geothermal Direct Heat Program roundup technical conference proceedings, volume I, papers presented: Earth Science Laboratory Report 98, 312 p.
- Ruscetta, C. A., ed., 1982b, Geothermal Direct Heat Program roundup technical conference proceedings, volume II, bibliography of publications: Earth Science Laboratory Report 99, 64 p.

APPENDIX I

STATE COUPLED PROGRAM LIST OF PARTICIPANTS

DOE-Headquarters, DOE-Idaho Operations, DOE-San Francisco Operations and DOE-Nevada Operations personnel have been involved in program management of the State Coupled Program.

STATE TEAMS

ALABAMA	Geological Survey of Alabama P.O. Drawer 0 University, AL 35486
ALASKA	Geophysical Institute University of Alaska Fairbanks, AK 99701  Alaska Div. of Geological and Geophysical Surveys 794 University Ave., Basement Fairbanks, AK 99701
ARIZONA	Arizona Bureau of Geology and Mineral Technology 845 N. Park Ave. Tucson, AZ 85719
CALIFORNIA	California Division of Mines and Geology 1416 Ninth St., RM 1341 Sacramento, CA 95816
COLORADO	Colorado Geological Survey 1313 Sherman Ave., RM 715 Denver, CO 80203
DELAWARE	Delaware Geological Survey University of Delaware Newark, DE 19711
HAWAII	Hawaii Institute of Geophysics University of Hawaii 2525 Correa Rd. Honolulu, HI 96822

IDAHO	Idaho Department of Water Resources Statehouse Boise, ID 83702
KANSAS	Kansas Geological Survey University of Kansas Lawrence, KS 66044
MASSACHUSETTS	Amherst College Department of Geology Amherst, MA 01002
MISSISSIPPI	Mississippi Geologic, Economic and Topographic Survey P.O. Box 4915 Jackson, MS 39216
MONTANA	Montana Bureau of Mines and Geology Butte, Montana 59701
NEBRASKA	Nebraska Geological Survey University of Nebraska 304 Administration Building Lincoln, NE 68588
NEVADA	University of Nevada-Las Vegas Earth Sciences Division 255 Bell St., Suite 200 Reno, NV 89503
NEW MEXICO	New Mexico Energy Institute Box 3-EI New Mexico State University Las Cruces, NM 88003
NEW YORK	New York State Energy Research & Development Agency Bldg. No. 2 Rockefeller Plaza Albany, NY 12223
NORTH DAKOTA	North Dakota Geological Survey Grand Forks, ND 58202
OKLAHOMA	Oklahoma Geological Survey University of Oklahoma 830 S. Van Vleet Oval, Rm. 163 Norman, OK 73019

OREGON	Oregon Dept. of Geology and Mineral Industries 1005 State Office Bldg. Portland, OR 97201
TENNESSEE	Institute for Energy Analysis P.O. Box 117 Oak Ridge, TN 37830
TEXAS	Texas Bureau of Economic Geology University Station, Box X Austin, TX 78712  Dept. of Geological Science University of Texas El Paso, TX 79968
UTAH	Utah Geological and Mineral Survey 606 Black Hawk Way Salt Lake City, UT 84108
WASHINGTON	Division of Geology and Earth Resources Washington Dept. of Natural Resources Mail Stop PY 12 Olympia, WA 98504
WYOMING	Department of Geology University of Wyoming Laramie, WY 82071
ASSOCIATED GROUPS:	
LANL	Geological Applications Group G-9 Los Alamos National Laboratory P.O. Box 1663 Los Alamos, NM 87545
NOAA	National Oceanic and Atmospheric Administration Code D64/NOAA/EDIS 325 Broadway Boulder, CO 80302
GRUY FEDERAL	Gruy Federal 2001 Jefferson Davis Hwy. Arlington, VA 22202
USGS	U.S. Geological Survey 345 Middlefield Road Menlo Park, CA 94025

ESL/UURI

Earth Science Laboratory/  
University of Utah Research Institute  
420 Chipeta Way, Suite 120  
Salt Lake City, UT 84108

## APPENDIX II - SITE LIST

This is a list of selected sites investigated by State Coupled Program resource assessment teams, 1978-1983. Major investigations are included; reconnaissance investigations of individual springs are not listed. For information about a particular site in a state, contact the agency listed in Appendix I.

### ALASKA

#### Sites

- Akutan
- Chena
- Circle
- Copper River Basin
- Manley
- Pilgrim
- Tenakee
- Unalaska
- Willow

#### Regional Surveys

- Aleutians
- Southeast Alaska
- Seward Peninsula

### ARIZONA

#### Sites

- Avra Valley
- Big Sandy Valley
- Bowie
- Buena Vista
- Castle Hot Springs
- Cactus Flat
- Clifton Hot Springs
- Coolidge
- Harquahala-Tonopah
- Hassayampa Plain
- Hyder
- Paloma Plain
- Papago Farms
- Safford Basin
- San Bernardino Valley
- San Francisco River

ARIZONA, continued

San Manuel  
San Pedro River  
San Simon  
Scottsdale  
Springerville-Alpine  
Tucson  
Verde Valley  
Willcox  
Yuma

CALIFORNIA

Sites

Bridgeport  
Calistoga  
Geysers  
Los Angeles  
Paso Robles  
San Bernardino  
Sonoma Valley  
Ukiah

General publication on 40 additional sites

COLORADO

Sites

Alamosa  
Animas Valley  
Canon City  
Hartsell  
Hot Sulphur Springs  
Idaho Springs  
Ouray  
Pagosa Springs  
Ranger  
Shaw Springs  
Steamboat-Routt Springs  
Waunita

HAWAII

Islands

Hawaii  
Maui  
Oahu

IDAHO

Sites

Boise  
Nampa-Caldwell  
Pocatello-Tyhee  
Wood River  
Weiser

Regional study of eastern and southeastern Idaho

KANSAS

Statewide data compilation only

MONTANA

Sites

Bozeman  
Centennial Valley  
Deer Lodge Valley  
Ennis  
Helena  
Hot Springs  
Little Bitterroot Valley  
Madison Valley  
Norris  
Radersberg  
Warm Springs  
West Yellowstone  
White Sulphur Springs

NEBRASKA

Only regional reports

NEVADA

Sites

Big Smoky Valley  
Caliente  
Carlin  
Carson City-Eagle Valley  
Carson Sink  
Fallon  
Golconda  
Hawthorne  
Kane Springs  
Moana  
Paradise Valley  
Pumpnickel Valley



NEW ENGLAND

Primarily regional study

NEW MEXICO

Sites

Albuquerque  
Animas Valley-Lighting Dock  
Black Range  
Chamberino  
Columbus  
Las Cruces  
Mesquite  
Portillo Mountain  
Tularosa Basin  
Socorro  
Truth or Consequences

County studies

NEW YORK

Areas

Capital district  
Lebanon Springs  
Saratoga Springs

Regional study of western and central New York

NORTH DAKOTA

Regional studies only

OKLAHOMA

Regional studies only

OREGON

Sites

Alvord Desert  
Ashland  
Belknap-Foley  
Breitenbush Hot Springs  
Burns  
Corbett-Moffett  
Glass Buttes  
Harney Basin  
Lakeview  
McDermitt

OREGON, continued

Milton-Freewater  
Mount Hood  
Parkdale-Hood River

Powell Buttes  
Vale-Ontario  
Walla Walla  
Wilamette Pass

Regional studies of Cascade Range

TEXAS

Areas

Austin  
Hueco Bolson  
Marlin  
Presidio Bolson  
San Antonio

Regional study of Balcones Fault Zone

UTAH

Sites

Cache Valley  
Crystal Hot Springs  
Crystal-Madsens Hot Spring  
Escalante Desert  
Jordan Valley  
Little Mountain  
Locomotive Springs  
Midway  
Udy Hot Springs  
Utah Hot Springs  
Utah Valley  
Warm Springs Fault

WASHINGTON

Sites

Camas  
Moses Lake  
Mount Saint Helens  
North Bonneville  
Walla Walla  
White Pass  
Wind River

Regional studies in the Cascades

WYOMING

Sites

Cody  
Thermopolis

Basins

Great Divide-Washakie  
Green River  
Hanna  
Laramie  
Powder River  
Shirley  
Wind River

U.S. DEPARTMENT OF ENERGY  
STATE COUPLED RESOURCE ASSESSMENT PROGRAM  
FINAL REPORT FOR FY 1983

by

Duncan Foley  
Earth Science Laboratory  
420 Chipeta Way, Suite 120  
Salt Lake City, Utah 84108

January, 1984

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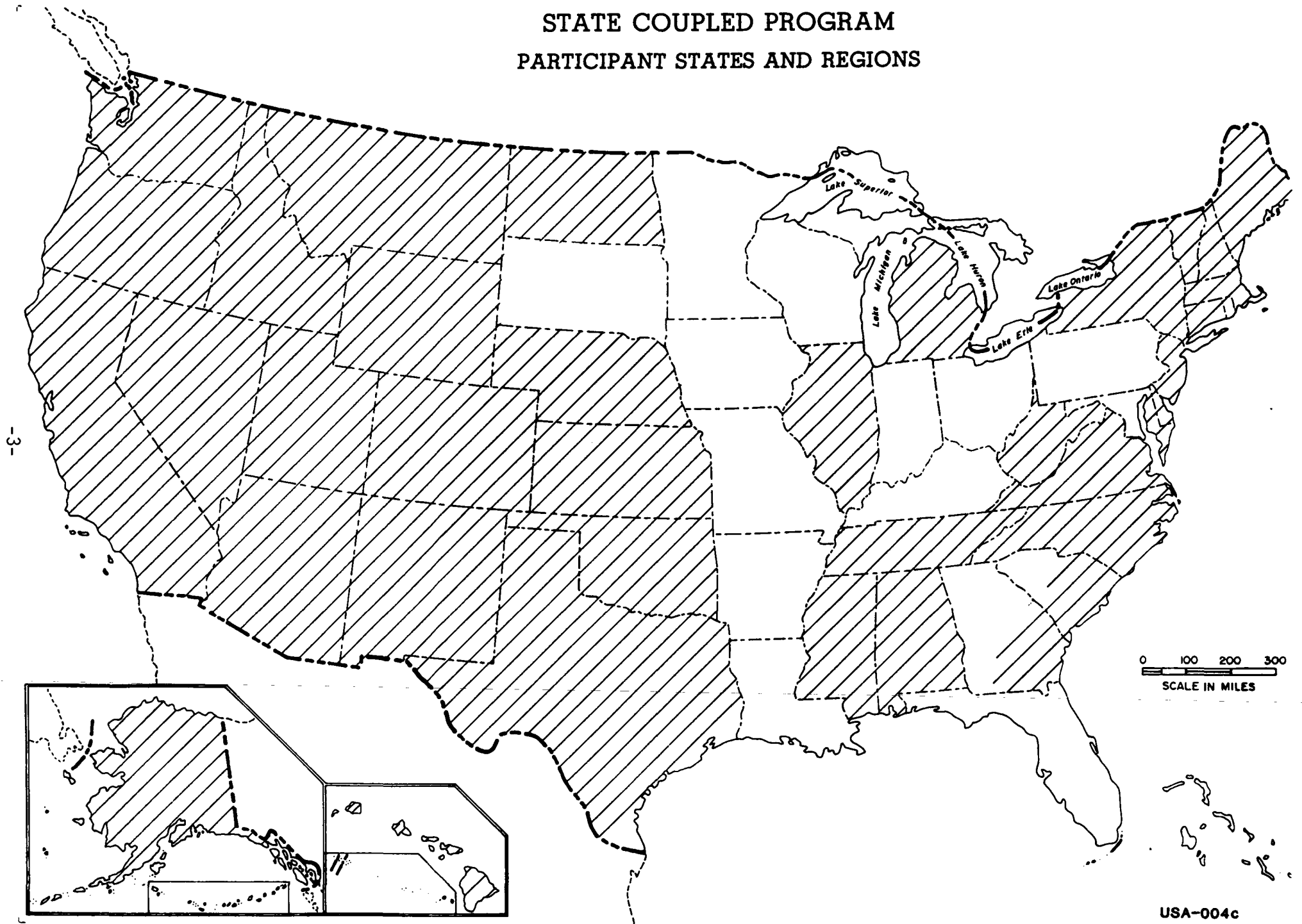
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Publish resource maps

U.S. GEOLOGICAL SURVEY

Compile regional resource assessments  
Store national geothermal data

FIGURE 1  
STATE COUPLED PROGRAM  
PARTICIPANT STATES AND REGIONS





The primary accomplishment of the State Coupled Program has been to increase the amount of data available about low- and intermediate-temperature geothermal resources. The increase in data has led directly to the expansion of several existing geothermal applications, and the development of new applications. Data generated by the State Coupled Program have also been used in promulgating legislative actions at local, state and federal levels.

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Many sites have been investigated by state participants; these are listed in Appendix II. State teams have also been active in the development of resource models, upon which exploration philosophies could be developed. The nature of geothermal resources is much better understood as a result of studies under this program.

State teams have also been responsible for the production of reports. These are cited in Ruscetta and Foley (1981b) and Ruscetta (1982), as well as in individual reports available from the state agencies cited in Appendix I.

#### Geothermal Resource Maps

The production of maps depicting geothermal resources in many states has been a major effort of the State Coupled Program. Twenty state maps, intended for use by the general public and non-geoscientific decision makers, have been

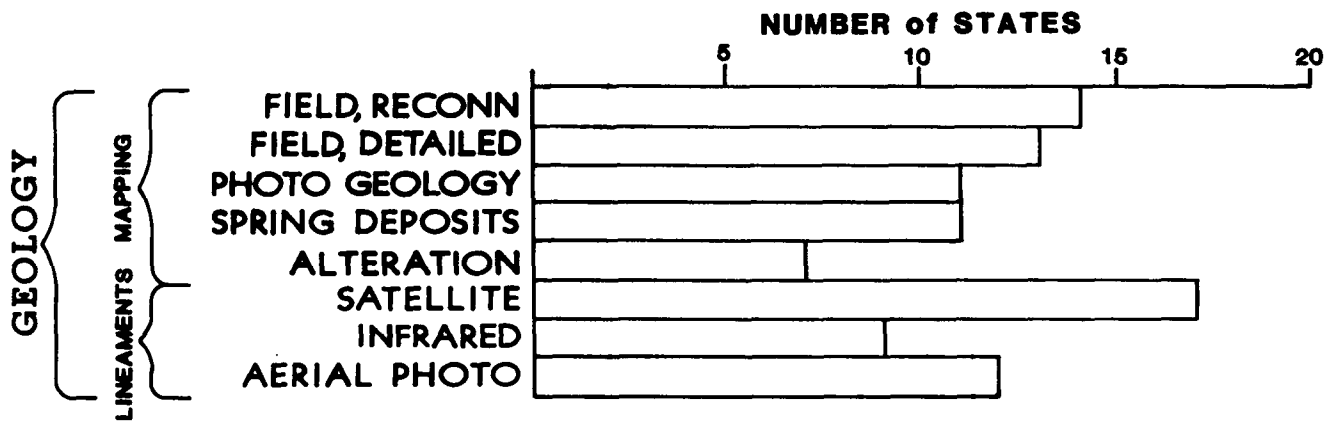


FIGURE 2 GEOLOGICAL EXPLORATION TECHNIQUES

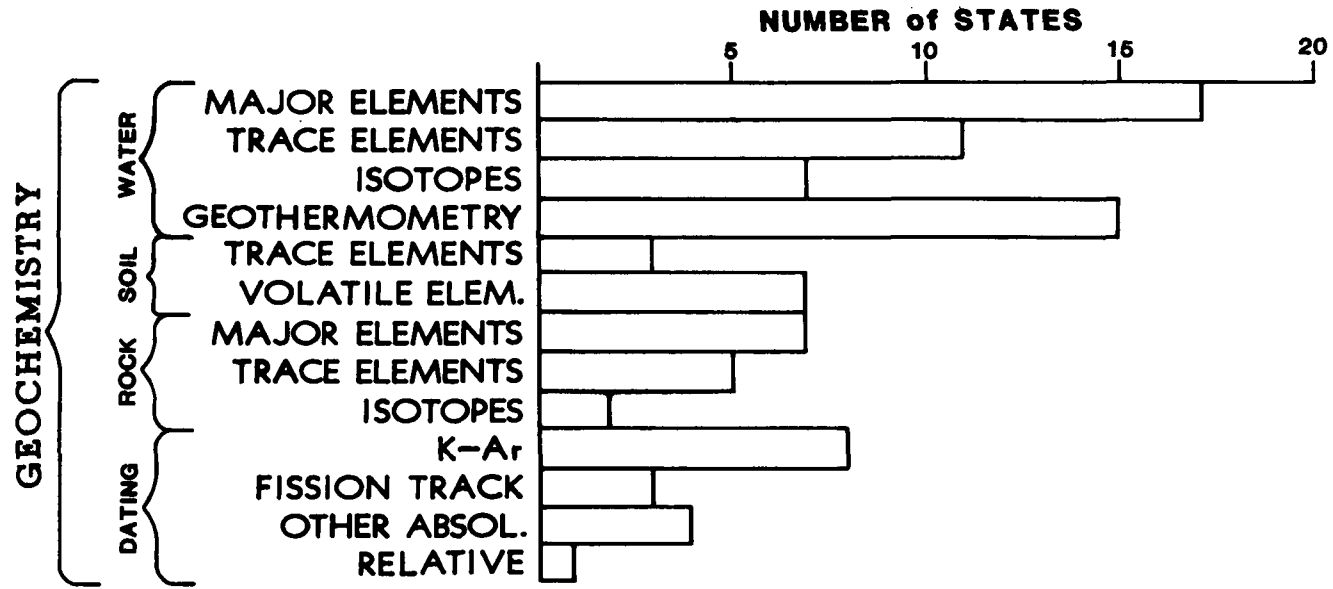


FIGURE 3 GEOCHEMICAL EXPLORATION TECHNIQUES

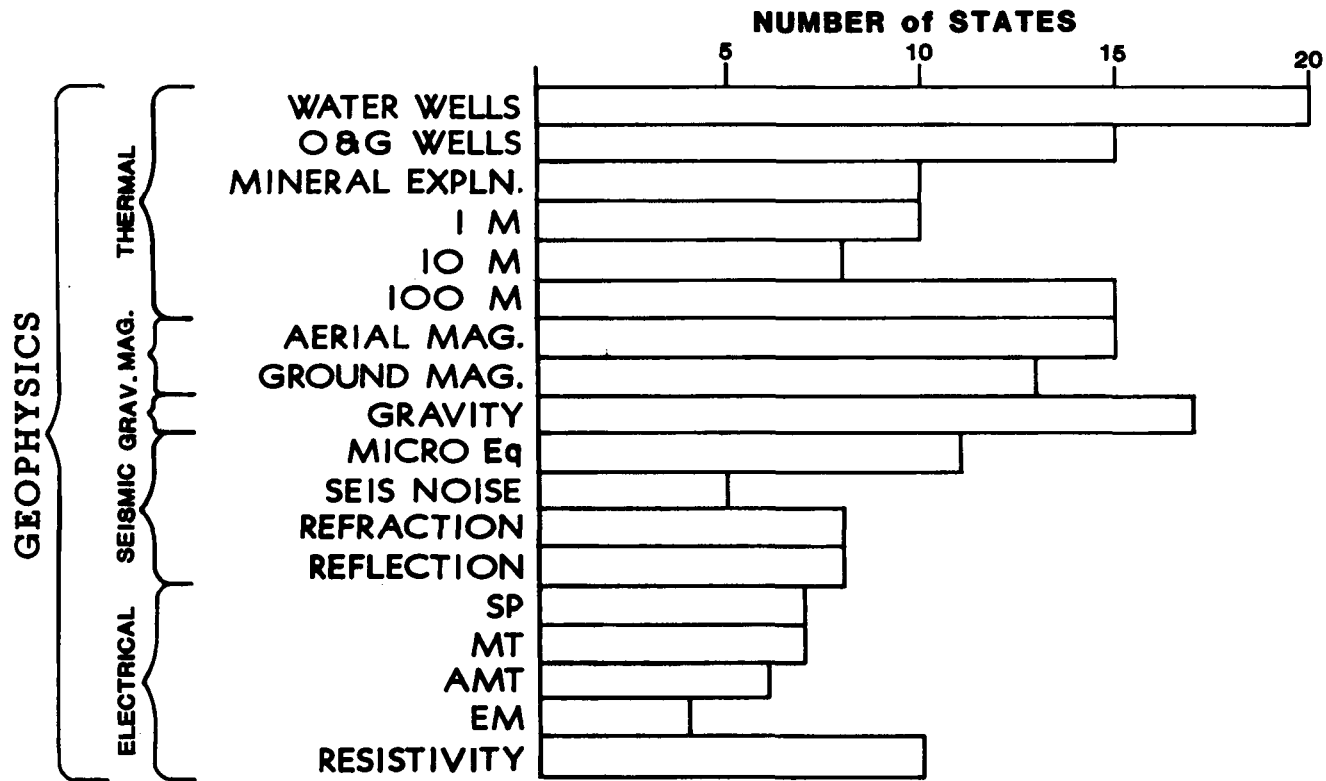


FIGURE 4 - GEOPHYSICAL EXPLORATION TECHNIQUES

published; two maps directed toward a scientific audience have also been produced. Figure 5 depicts the states for which these maps have been produced. Maps are available from the respective state agencies listed in Appendix I and from NOAA (address in Appendix I).

Geoscientific data for the maps have been compiled by the individual state teams. These have included identification and characterization of geothermal sites, including thermal regime and water quantity and quality data. Technical maps present additional supporting geoscientific information. The maps also contain depictions of areas interpreted by the state teams as having highest potential for the existence of undiscovered resources. Geothermal data have been plotted on state topographic base maps produced by the U.S. Geological Survey.

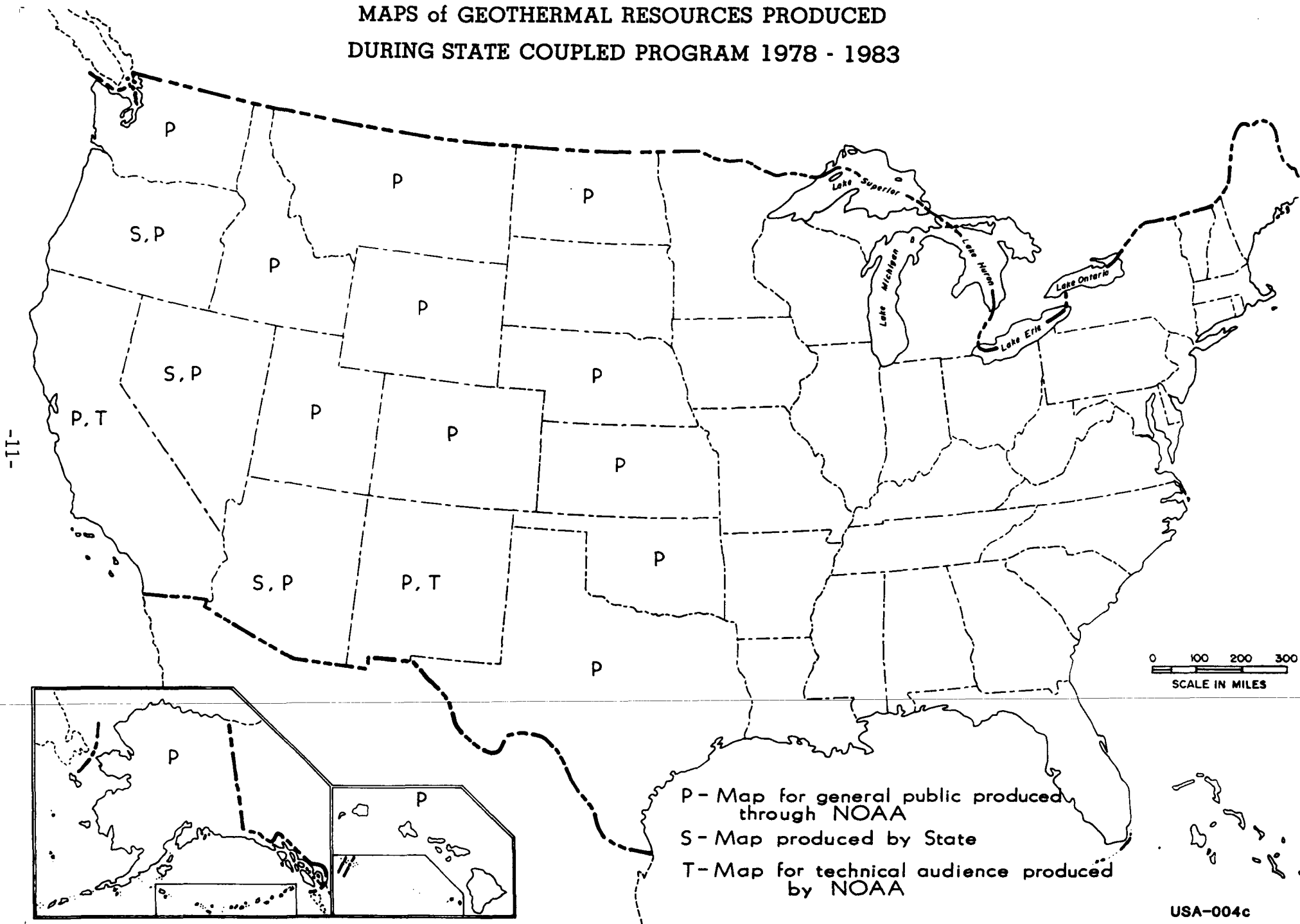
The National Oceanic and Atmospheric Administration facility at Boulder, Colorado, has been funded by DOE under the State Coupled Program to coordinate production of most of the maps. Their coordination tasks have included compilation of base data, production of proof maps for each state, and coordination with the Government Printing Office on final production of the maps.

Several states have coordinated production of their own individual maps; these are indicated on Figure 5. Quality control for the NOAA-produced maps has been accomplished through the participation of a map review committee, composed of representatives of DOE, the individual states, NOAA, the USGS, ESL/UURI and other support contractors. Generalized map design standards and data format, as well as individual map text and layout decisions have been handled by this committee, with ESL/UURI taking a lead role.

In addition to production of individual state maps, data compiled by State Coupled Program participants have been published in other maps. These

# FIGURE 5

## MAPS of GEOTHERMAL RESOURCES PRODUCED DURING STATE COUPLED PROGRAM 1978 - 1983





have included a national map of geothermal resources coordinated by DOE Headquarters personnel, maps published in association with USGS Circular 790, and a map of geothermal resources published by National Geographic Magazine as part of a special issue on energy.

#### Utilization of Data

Data compiled by State Coupled Program resource assessment teams have been used by both private concerns and other federal programs. Much of the individual site data have been used by local developers, in promoting and developing geothermal resources. These have included large projects, such as district heating programs in Pagosa Springs, Colorado, and Boise, Idaho, and the heating of the Utah State Prison, as well as many smaller projects.

Other federal geothermal programs have been one of the prime beneficiaries of State Coupled Program data. These programs have included the State Commercialization Planning Program, the Federal Buildings Program, the User Coupled Confirmation Drilling Program, the Technology Transfer and Outreach Programs, the Energy Technology Program, the National Progress Monitor system, the geothermal PON and PRDA efforts of DOE, the National Market Shares Estimates Study, and the identification of resource conflicts between geothermal sites and proposed Forest Service and BLM wilderness study areas. All of these other programs have used both site data and state team interpretations of overall resource potential. Most of the coordination with these programs has been through the efforts of ESL/UURI and other support contractors, although some efforts, most notably the Commercialization Planning program, have been coordinated directly among respective teams in individual states.

Three projects of the USGS have benefited directly from the State Coupled Program. These are computer file GEOTHERM (the national repository for

geothermal data) and Circulars 790 and 892. Prior to the inception of the State Coupled Program, GEOTHERM had approximately 250 geothermal sites in its data base. At the present time, more than 6000 entries are included. Data in GEOTHERM include not only temperature and production flow rate for geothermal wells and springs, but also chemistry of thermal waters, and, where applicable, comments on development of the field. Circular 790 was undertaken in 1978 by the USGS, to assess geothermal resources with temperatures greater than 90°C. Cooler resources were discussed but not quantified. State teams participated in the assessment by providing resource data and assisting in the development of maps depicting the cooler resources. Circular 892 was published in 1983, and quantified the assessment of geothermal resources with temperatures less than 90°C. State team participation in this assessment included providing much new data. Efforts of state resource assessment teams on USGS projects were coordinated by ESL/UURI.

Several other smaller projects have used State Coupled Program data. Perhaps the most notable of these was by National Geographic magazine, which included a discussion and map of geothermal resources in a special issue on energy.

#### EARTH SCIENCE LABORATORY ROLE

During the State Coupled Program, ESL/UURI has been funded to perform a variety of tasks. These have included technical support to DOE at both Headquarters and Operations Office levels, including monitoring state programs in 16 western states, serving as interprogram liaison, technical support to states and publishing summary reports.

Support to DOE has primarily focused on technical portions of the State Coupled Program. ESL/UURI has aided DOE by communicating technical program

objectives to the state participants, through annual or more frequent visits to each state participant, in addition to phone calls and letters. ESL/UURI has also convened annual meetings of program participants, one in Glenwood Springs, Colorado, one in Seattle, Washington, and two in Salt Lake City. Proceedings of most of these meetings are available as ESL/UURI publications (Ruscetta and Foley, 1981a,b; Ruscetta, 1982a,b). Monitoring each state program has included following progress on individual tasks and coordinating with each state concerning content of proposals. ESL/UURI has also served as a technical reviewer for many reports published by individual states.

The State Coupled Program has had to interface with many DOE and other Federal geothermal programs; ESL/UURI has been active in acting as a liaison with all the programs listed earlier. The ESL/UURI role has been most active in coordination with the USGS resource assessments and the User Coupled Confirmation Drilling Program. ESL/UURI visited each of the states to explain the User Coupled Program. Major emphasis was also placed on wilderness land studies.

Many requests for talks summarizing geothermal resource occurrence and exploration have been received by ESL/UURI. State Coupled Program data were extensively relied upon in making these presentations.

ESL/UURI has also been active in supporting individual state efforts through providing technical expertise in geology, geochemistry and geophysics. Table 3 is a summary of some of these efforts. ESL/UURI also ran an exploration technology workshop at one of the meetings of State Coupled Program participants. Topics discussed at this meeting included gravity, magnetics, thermal gradients, electrical methods, trace element studies, geothermometry, drilling and reservoir testing. In addition, ESL conducted an intensive mercury technique workshop with personnel from the Colorado team.

TABLE 3

PARTIAL LIST OF ESL ANALYTIC SUPPORT

K-AR DATING - Montana  
Oregon  
Washington

GEOPHYSICS - Alaska - Electrical Studies  
Arizona - Resistivity Data Modeling  
California - Resistivity Data Modeling  
Colorado - Resistivity Data Modeling  
Idaho - Geophysical Data Package Development  
Utah - Program Design, Data Interpretation, Gravity Program  
Washington - Resistivity Modeling

GEOCHEMISTRY - California - Water Analyses  
Oregon - Water Analyses  
Utah - Water Analyses

HYDROLOGY - Utah - Aquifer Test Modeling

## REFERENCES CITED

Ruscetta, C. A., and Foley, D., eds., 1981a, Geothermal Direct Heat Program, Glenwood Springs technical conference proceedings, volume I, papers presented: Earth Science Laboratory Report 59, 313 p.

Ruscetta, C. A., and Foley, D., eds., 1981b, Geothermal Direct Heat Program, Glenwood Springs technical conference proceedings, volume II, bibliography of publications: Earth Science Laboratory Report 60, 39 p.

Ruscetta, C. A., ed., 1982a, Geothermal Direct Heat Program roundup technical conference proceedings, volume I, papers presented: Earth Science Laboratory Report 98, 312 p.

Ruscetta, C. A., ed., 1982b, Geothermal Direct Heat Program roundup technical conference proceedings, volume II, bibliography of publications: Earth Science Laboratory Report 99, 64 p.

APPENDIX I

STATE COUPLED PROGRAM LIST OF PARTICIPANTS

DOE-Headquarters, DOE-Idaho Operations, DOE-San Francisco Operations and DOE-Nevada Operations personnel have been involved in program management of the State Coupled Program.

STATE TEAMS

ALABAMA	Geological Survey of Alabama P.O. Drawer 0 University, AL 35486
ALASKA	Geophysical Institute University of Alaska Fairbanks, AK 99701  Alaska Div. of Geological and Geophysical Surveys 794 University Ave., Basement Fairbanks, AK 99701
ARIZONA	Arizona Bureau of Geology and Mineral Technology 845 N. Park Ave. Tucson, AZ 85719
CALIFORNIA	California Division of Mines and Geology 1416 Ninth St., RM 1341 Sacramento, CA 95816
COLORADO	Colorado Geological Survey 1313 Sherman Ave., RM 715 Denver, CO 80203
DELAWARE	Delaware Geological Survey University of Delaware Newark, DE 19711
HAWAII	Hawaii Institute of Geophysics University of Hawaii 2525 Correa Rd. Honolulu, HI 96822

IDAHO	Idaho Department of Water Resources Statehouse Boise, ID 83702
KANSAS	Kansas Geological Survey University of Kansas Lawrence, KS 66044
MASSACHUSETTS	Amherst College Department of Geology Amherst, MA 01002
MISSISSIPPI	Mississippi Geologic, Economic and Topographic Survey P.O. Box 4915 Jackson, MS 39216
MONTANA	Montana Bureau of Mines and Geology Butte, Montana 59701
NEBRASKA	Nebraska Geological Survey University of Nebraska 304 Administration Building Lincoln, NE 68588
NEVADA	University of Nevada-Las Vegas Earth Sciences Division 255 Bell St., Suite 200 Reno, NV 89503
NEW MEXICO	New Mexico Energy Institute Box 3-EI New Mexico State University Las Cruces, NM 88003
NEW YORK	New York State Energy Research & Development Agency Bldg. No. 2 Rockefeller Plaza Albany, NY 12223
NORTH DAKOTA	North Dakota Geological Survey Grand Forks, ND 58202
OKLAHOMA	Oklahoma Geological Survey University of Oklahoma 830 S. Van Vleet Oval, Rm. 163 Norman, OK 73019

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Mineral Industries  
1005 State Office Bldg.  
Portland, OR 97201

TENNESSEE Institute for Energy Analysis  
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Oak Ridge, TN 37830

TEXAS Texas Bureau of Economic Geology  
University Station, Box X  
Austin, TX 78712

Dept. of Geological Science  
University of Texas  
El Paso, TX 79968

UTAH Utah Geological and Mineral  
Survey  
606 Black Hawk Way  
Salt Lake City, UT 84108

WASHINGTON Division of Geology and Earth  
Resources  
Washington Dept. of Natural Resources  
Mail Stop PY 12  
Olympia, WA 98504

WYOMING Department of Geology  
University of Wyoming  
Laramie, WY 82071

ASSOCIATED GROUPS:

LANL Geological Applications Group G-9  
Los Alamos National Laboratory  
P.O. Box 1663  
Los Alamos, NM 87545

NOAA National Oceanic and  
Atmospheric Administration  
Code D64/NOAA/EDIS  
325 Broadway  
Boulder, CO 80302

GRUY FEDERAL Gruy Federal  
2001 Jefferson Davis Hwy.  
Arlington, VA 22202

USGS U.S. Geological Survey  
345 Middlefield Road  
Menlo Park, CA 94025



ESL/UURI

Earth Science Laboratory/  
University of Utah Research Institute  
420 Chipeta Way, Suite 120  
Salt Lake City, UT 84108

## APPENDIX II - SITE LIST

This is a list of selected sites investigated by State Coupled Program resource assessment teams, 1978-1983. Major investigations are included; reconnaissance investigations of individual springs are not listed. For information about a particular site in a state, contact the agency listed in Appendix I.

### ALASKA

#### Sites

- Akutan
- Chena
- Circle
- Copper River Basin
- Manley
- Pilgrim
- Tenakee
- Unalaska
- Willow

#### Regional Surveys

- Aleutians
- Southeast Alaska
- Seward Peninsula

### ARIZONA

#### Sites

- Avra Valley
- Big Sandy Valley
- Bowie
- Buena Vista
- Castle Hot Springs
- Cactus Flat
- Clifton Hot Springs
- Coolidge
- Harquahala-Tonopah
- Hassayampa Plain
- Hyder
- Paloma Plain
- Papago Farms
- Safford Basin
- San Bernardino Valley
- San Francisco River

ARIZONA, continued

San Manuel  
San Pedro River  
San Simon  
Scottsdale  
Springerville-Alpine  
Tucson  
Verde Valley  
Willcox  
Yuma

CALIFORNIA

Sites

Bridgeport  
Calistoga  
Geysers  
Los Angeles  
Paso Robles  
San Bernardino  
Sonoma Valley  
Ukiah

General publication on 40 additional sites

COLORADO

Sites

Alamosa  
Animas Valley  
Canon City  
Hartsell  
Hot Sulphur Springs  
Idaho Springs  
Ouray  
Pagosa Springs  
Ranger  
Shaw Springs  
Steamboat-Routt Springs  
Waunita

HAWAII

Islands

Hawaii  
Maui  
Oahu

IDAHO

Sites

Boise  
Nampa-Caldwell  
Pocatello-Tyhee  
Wood River  
Weiser

Regional study of eastern and southeastern Idaho

KANSAS

Statewide data compilation only

MONTANA

Sites

Bozeman  
Centennial Valley  
Deer Lodge Valley  
Ennis  
Helena  
Hot Springs  
Little Bitterroot Valley  
Madison Valley  
Norris  
Radersberg  
Warm Springs  
West Yellowstone  
White Sulphur Springs

NEBRASKA

Only regional reports

NEVADA

Sites

Big Smoky Valley  
Caliente  
Carlin  
Carson City-Eagle Valley  
Carson Sink  
Fallon  
Golconda  
Hawthorne  
Kane Springs  
Moana  
Paradise Valley  
Pumpnickel Valley

NEW ENGLAND

Primarily regional study

NEW MEXICO

Sites

Albuquerque  
Animas Valley-Lighting Dock  
Black Range  
Chamberino  
Columbus  
Las Cruces  
Mesquite  
Portillo Mountain  
Tularosa Basin  
Socorro  
Truth or Consequences

County studies

NEW YORK

Areas

Capital district  
Lebanon Springs  
Saratoga Springs

Regional study of western and central New York

NORTH DAKOTA

Regional studies only

OKLAHOMA

Regional studies only

OREGON

Sites

Alvord Desert  
Ashland  
Belknap-Foley  
Breitenbush Hot Springs  
Burns  
Corbett-Moffett  
Glass Buttes  
Harney Basin  
Lakeview  
McDermitt

OREGON, continued

Milton-Freewater  
Mount Hood  
Parkdale-Hood River

Powell Buttes  
Vale-Ontario  
Walla Walla  
Wilamette Pass

Regional studies of Cascade Range

TEXAS

Areas

Austin  
Hueco Bolson  
Marlin  
Presidio Bolson  
San Antonio

Regional study of Balcones Fault Zone

UTAH

Sites

Cache Valley  
Crystal Hot Springs  
Crystal-Madsens Hot Spring  
Escalante Desert  
Jordan Valley  
Little Mountain  
Locomotive Springs  
Midway  
Udy Hot Springs  
Utah Hot Springs  
Utah Valley  
Warm Springs Fault

WASHINGTON

Sites

Camas  
Moses Lake  
Mount Saint Helens  
North Bonneville  
Walla Walla  
White Pass  
Wind River

Regional studies in the Cascades

WYOMING

Sites

Cody  
Thermopolis

Basins

Great Divide-Washakie  
Green River  
Hanna  
Laramie  
Powder River  
Shirley  
Wind River