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ANNOTATED GEOTHERMAL BIBLIOGRAPHY OF UTAH

*Karin E. Budding and
Miriam H. Bugden, Compilers*

UTAH GEOLOGICAL AND MINERAL SURVEY

a division of

UTAH DEPARTMENT OF NATURAL RESOURCES

BULLETIN 121

1986

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INTRODUCTION

The geothermal bibliography of Utah was compiled under Department of Energy (DOE) Grant DE-FG07-84ID12543. Utah Geological and Mineral Survey (UGMS) staff assisting in the compilation included Kathleen A. Murphy, Patricia H. Speranza, and Sandra N. Eldredge.

The following sources were used in compiling the bibliography: 1) UGMS Bibliography of Utah Geology, 2) GEOREF, 3) DOE Energy Data Base, 4) Annotated and Indexed Bibliography of Geothermal Phenomena, 5) Earth Science Laboratory/University of Utah Research Institute publications, 6) U.S. Geological Survey publications, 7) UGMS publications, 8) graduate theses, 9) Geothermal Resources Council publications, 10) United Nations symposia, and 11) private industry publications. We have attempted to include all of the Utah geothermal references through 1984. Some 1985 citations are listed. Geological, geophysical, and tectonic maps and reports are included if they cover a high-temperature thermal area (● on fig. 1) because this information is critical to the understanding of a geothermal resource.

Those references which directly pertain to a geothermal resource are annotated. The annotations are intended to inform the reader of the information contained in the article, not to summarize the results.

Accompanying the bibliography is a list and description of geothermal projects and commercial geothermal developments in Utah from 1966 to the present that have been wholly or partially funded through Federal or State programs. The references listed in the project descriptions are keyed to the bibliography. Most of this work is by government agencies or universities. Private or industry-funded geothermal developments are not listed.

The following organizations provide information and publications on geothermal resources in Utah. State divisions in the Department of Natural Resources include the Utah Geological and Mineral Survey, Division of Water Rights, and the Utah Energy Office. Federal agencies in the Department of the Interior include the U.S. Geological Survey Public Inquires Office and the Division of Water Resources. The Earth Science Laboratory of the University of Utah Research Institute is another source of information and publications.

The references are indexed geographically either under 1) United States (national studies), 2) regional—western United States or physiographic province, 3) Utah—statewide and regional, or 4) county. Reports concerning a particular hot spring or thermal area are listed under both the thermal area and the county names. The thermal areas indexed are shown on figure 1 (on page 73).

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- Purpose of report; map showing locations of Cove Fort-Sulphurdale unit wells; drilling summary of four wells; summary of lost circulation in wells; discussion of oxygen corrosion rates while drilling two wells; summary of the geology of four exploratory geothermal wells; static fluid levels and temperature gradients from the four wells; chart showing geochemistry of formation waters encountered in the Cove Fort-Sulphurdale unit area; generalized lithologic logs of three wells; three summaries of downhole logging tables; reservoir analysis of Cove Fort-Sulphurdale unit based on tests from two wells.
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GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1980b, Utah state lease sale results: Geothermal Resources Council Bulletin, v. 9, no. 9, p. 12.

Bid received for one of 12 geothermal steam housing tracts; amount paid and location of tract; temperature ranges of existing springs in area.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1980c, Utah geothermal greenhouses produce large

tomato crop: Geothermal Resources Council Bulletin, v. 9, no. 10, p. 17.

Two ton tomato crop from a geothermal Utah farm; layout of greenhouses and tomato plant arrangements; temperatures of wells and total dissolved solids content of thermal waters; cost savings; location of area; future geothermal power development plans.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1980d, Wells completed at Utah prison site: Geothermal Resources Council Bulletin, v. 9, no. 11, p. 15.

State of Utah completed two exploratory wells for a space-heating project at Crystal Hot Springs; project funding and purpose; depth and temperatures of first well.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1981a, Utah Legislature to consider geothermal bill: Geothermal Resources Council Bulletin, v. 10, no. 1, p. 16.

Geothermal Conservation Act of 1981 established to assign regulatory authority of geothermal energy to the Division of Water Rights; other conditions stated in the act.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1981b, Roosevelt Hot Springs geothermal pact gets approval: Geothermal Resources Council Bulletin, v. 10, no. 1, p. 16.

Utah Public Service Commission approved a contract between Phillips Petroleum Company and Utah Power and Light Company for producing electricity with geothermal steam; Phillips to supply the steam for Utah Power and Light 20 MWe plant.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1981c, State may receive MX study money for geothermal: Geothermal Resources Council Bulletin, v. 10, no. 2, p. 13.

Application for funds to study the feasibility of using geothermal energy for powering the MX system; feasibility study to be completed March 1981; consideration of other energy sources.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1981d, Utah Roses holds geothermal operation open house: Geothermal Resources Council Bulletin, v. 10, no. 2, p. 13.

Open house held for Utah Roses, Inc. geothermal greenhouses; water temperatures and well depth; estimated cost of heating operation; long range construction plans; permitting delay for the discharge of geothermal production fluid into the Jordan River.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1981e, Utah geothermal bill passes: Geothermal Resources Council Bulletin, v. 10, no. 2, p. 13.

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GEOHERMAL RESOURCES COUNCIL BULLETIN, 1981f, Utah Prison exploration well completed: Geothermal Resources Council Bulletin, v. 10, no. 2, p. 13.

Completion of a 1005 foot exploratory well; location and water temperatures of well; source of funds for the geothermal space-heating prison project.

GEOHERMAL RESOURCES COUNCIL BULLETIN, 1981g, Geothermists participate in CATMECS meeting: Geothermal Resources Council Bulletin, v. 10, no. 3, p. 13.

Forty attendees to the tenth meeting of the Centers for the Analysis of Thermal-Mechanical Energy Conversion Concepts; topics addressed; availability of meeting report.

GEOHERMAL RESOURCES COUNCIL BULLETIN, 1981h, Utah PUC gives approval to power plant: Geothermal Resources Council Bulletin, v. 10, no. 3, p. 13-14.

Utah Public Service Commission approves a contract between Phillips Petroleum Company and Utah Power and Light for use of geothermal steam to produce electricity.

GEOHERMAL RESOURCES COUNCIL BULLETIN, 1981i, Environmental assessment released on first Utah geothermal power plant: Geothermal Resources Council Bulletin, v. 10, no. 8, p. 8.

Release of the draft environmental assessment on the proposed 20 MWe geothermal power plant at Roosevelt Hot Springs; construction schedule; environmental concerns; six commercial wells drilled at Roosevelt.

GEOHERMAL RESOURCES COUNCIL BULLETIN, 1981j, Utah geothermal unit approved: Geothermal Resources Council Bulletin, v. 10, no. 9, p. 21.

Utah Division of State Lands approval of the formation of the Drum Mountains Geothermal Unit; location and size of the unit; unit agreement provisions.

GEOHERMAL RESOURCES COUNCIL BULLETIN, 1981k, Biphase unit installed at Roosevelt Hot Springs: Geothermal Resources Council Bulletin, v. 10, no. 11, p. 13-14.

Equipment for Biphase Energy Systems mobile generating plant prepared for operation at Roosevelt Hot Springs in September of 1981; expected production; Utah Power and Light plans to study economic and technical feasibility of a 7 MWe and a 20 MWe steam turbine system; endurance test scheduled for spring 1982 depending on success of tests.

GEOHERMAL RESOURCES COUNCIL BULLETIN, 1982a, Roosevelt Hot Springs produces power, Utah Power and Light customers get their first geothermally produced electricity: Geothermal Resources Council Bulletin, v. 11, no. 1, p. 3-4.

Date first geothermal generating unit at Roosevelt Hot Springs began supplying electricity to Utah Power and Light; cooperative project of Utah Power and Light,

Phillips Petroleum Company, Biphase Energy Systems, and Electrical Power Research Institute.

GEOHERMAL RESOURCES COUNCIL BULLETIN, 1982b, WESTEC gets start-up contract: Geothermal Resources Council Bulletin, v. 11, no. 2, p. 23.

WESTEC Services, Inc. to provide start-up services for Utah Power and Light Company's Rotary Separator Turbine geothermal project at Roosevelt Hot Springs; total cost of contract and duration of project.

GEOHERMAL RESOURCES COUNCIL BULLETIN, 1982c, Utah lease sale gets no bids; Geothermal Resources Council Bulletin, v. 11, no. 2, p. 23.

No bids submitted for geothermal lease sale units in Box Elder and Millard counties, Utah.

GEOHERMAL RESOURCES COUNCIL BULLETIN, 1982d, Phillips plans Utah exploration: Geothermal Resources Council Bulletin, v. 11, no. 4, p. 22.

Phillips Petroleum Company plans exploratory geothermal drilling in the Drum Mountains unit of Utah; location of area; previously reported geothermal gradients.

GEOHERMAL RESOURCES COUNCIL BULLETIN, 1982e, Crystal Hot Springs water rights studied: Geothermal Resources Council Bulletin, v. 11, no. 5, p. 16.

Hearing held in 1982 to investigate the administration of water rights in Crystal Hot Springs area; successful drilling and test results in the area.

GEOHERMAL RESOURCES COUNCIL BULLETIN, 1982f, Phillips to drill new Roosevelt Hot Springs well: Geothermal Resources Council Bulletin, v. 11, no. 5, p. 17.

Plans for Phillips to drill more wells for the 20 MWe geothermal power plant; well locations and projected depths.

GEOHERMAL RESOURCES COUNCIL BULLETIN, 1982g, Union is sole bidder for Utah geothermal leases: Geothermal Resources Council Bulletin, v. 11, no. 5, p. 17.

Total bonus paid by Union Oil Company of California for 1314.57 acres of land for geothermal leasing from the state of Utah; location of lands acquired.

GEOHERMAL RESOURCES COUNCIL BULLETIN, 1982h, Hunt bid tops Utah lease sale: Geothermal Resources Council Bulletin, v. 11, no. 7, p. 19.

Location of tract and amount of W. H. Hunt's bid for leasing unit 4 in the Cove Fort-Sulphurdale KGRA; bids on four other tracts.

GEOHERMAL RESOURCES COUNCIL BULLETIN, 1982i, Utah State Prison well to be tested: Geothermal Resources Council Bulletin, v. 11, no. 8, p. 14-15.

Plans for a 30 day pump test on a well at the Utah State Prison; recovery monitoring to last seven to ten days; management and interpretation plans for the tests.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1982j, Hunt Oil plans four Utah wells: Geothermal Resources Council Bulletin, v. 11, no. 8, p. 15.

Hunt Oil Company plans to drill up to four 7000 ft deep geothermal wells in Iron County, Utah; availability of a copy of the plan of operation.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1982k, Drilling confirms Roosevelt Hot Springs geothermal potential: Geothermal Resources Council Bulletin, v. 11, no. 10, p. 19.

Combined flow capacity of two Phillips Petroleum Company wells; list of participating resource companies at Roosevelt.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1983a, Roosevelt Hot Springs power plant on target: Geothermal Resources Council Bulletin, v. 12, no. 1, p. 23.

Completion of two of four stages of a Utah Power and Light 20 MWe power plant at Roosevelt Hot Springs; schedule of completion of fourth stage; results of Phillips Petroleum's recent drilling projects; electrical power tests conducted at Roosevelt.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1983b, Roosevelt Hot Spring activity update: Geothermal Resources Council Bulletin, v. 12, no. 2, p. 26.

Testing of a 1.6 MWe Transamerica Delaval Biphase Rotary Separator Turbine at Roosevelt Hot Springs; total electrical production during the test; construction schedule of a 20 MWe single-flash power plant.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1983c, Geothermal to warm prisoners: Geothermal Resources Council Bulletin, v. 12, no. 10, p. 14-15.

Development and construction costs for converting the Utah State Prison minimum security building to a geothermal heating system; breakdown of DOE and State's costs; future plans.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1984a, Biphase turbine to operate for UP&L: Geothermal Resources Council Bulletin, 1984, v. 13, no. 6, p. 1.

A wellhead geothermal power unit to be installed at Roosevelt, Utah; expected power generation; unique features of unit; Utah Power and Light production history at Roosevelt.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1984b, Dry steam discovery/blowout: Geothermal Resources Council Bulletin, v. 13, no. 1, p. 27-28.

Discovery of a dry steam well near Cove Fort, Utah; estimated flow of dry steam and well head temperature; new well drilled in area; new development and plans for sale of power.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1984c, Dry steam discovery/blow out: Geothermal Resources Council Bulletin, v. 13, no. 2, p. 21-22.

Location and field operator for Olga's Well No. 34-7; initial drilling program for 34-7; time and date of blowout; estimated flow of "dry steam" from the blowout; efforts made to contain the well; equipment used; successful containment; power sale contract between the operator and Provo City; future development plans of the operator.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1984d, Second well completed at Cove Fort: Geothermal Resources Council Bulletin, v. 13, no. 4, p. 26.

Completion of a dry steam well at Cove Fort, Utah; location and depth of well; plans for further drilling.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1984e, Unidyne to acquire geothermal division of Amax: Geothermal Resources Council Bulletin, v. 13, no. 4, p. 27.

Preliminary agreement between Amax and Unidyne for Unidyne's purchase of Steam Reserve Corporation; terms of the agreement; properties involved in the agreement.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1984f, Roosevelt Hot Springs plant goes on line: Geothermal Resources Council Bulletin, v. 13, no. 11, p. 24.

Utah Power and Light's \$35 million, 20 MWe power plant start up; plant designers and construction company; further Utah Power and Light plans.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1984g, Provo to purchase geothermal power: Geothermal Resources Council Bulletin, v. 13, no. 11, p. 24.

Plans underway for Provo City to purchase geothermal power from wells at Cove Fort, Utah; developer of the wells; estimated power output from the Cove Fort area; approximate cost for Provo citizens.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1985a, UP&L wins award for energy innovation: Geothermal Resources Council Bulletin, v. 14, no. 1, p. 21-22.

Utah Power and Light Company wins an award for research and development of a high-efficiency turbine generator for the Roosevelt Hot Springs area; characteristics of the power plant; cost comparisons and projected savings.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1985b, UP&L subsidiary organized to explore energy resources: Geothermal Resources Council Bulletin, v. 14, no. 1, p. 22.

Organization of Energy National, Inc.; purpose of new company; maximum equity financing for Energy National, Inc.

GEOTHERMAL RESOURCES COUNCIL BULLETIN, 1985c, First power plant dedicated at Cove Fort, Utah: Geothermal Resources Council Bulletin, v. 14, no. 10, p. 5-6.

- Date and location of dedication ceremonies; speakers at the ceremonies; capacity and design of power plant; terms of agreement for Provo City's purchase of power; geothermal exploration history of the Cove Fort and Sulphurdale areas; production drilling; lifetime expectations of the field.
- GEOTHERMEX, INCORPORATED, 1977, Geothermal potential of the lands leased by Geothermal Power Corporation in the Mineral Mountains, Beaver and Millard Counties: Earth Science Laboratory/University of Utah Research Institute Open-File Report, no. UT/RHS/GPC-2, 43 p.
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showing noncondensable gas data for Utah Roses Production well; artesian flow test procedures and results; production potential; alternatives for disposal of spent fluids.

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Map showing low-temperature geothermal waters of Utah, thermal springs and wells, known geothermal resource areas, heat flow measurements, temperatures, total dissolved solid concentrations, flow rates and depth of wells, topography, major physiographic provinces, Indian and military reservations, national and state forests, national parks, monuments, wilderness areas, population centers, and highway systems; attached table of thermal springs and wells organized by county.

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Description of structure of the 28 story Church of Jesus Christ of Latter-Day Saints Office Building; ground-water heat-pump system in the building; pumps used; four wells into alluvium below building; production rates and temperature ranges of well; methods used to balance heating and cooling loads for the building; methods of operation of the building's two ventilation systems, the primary induction system, and the high velocity dual-duct system; operation efficiencies and problems; estimated heating and cooling load of 4135 million BTUs; electrical cost estimates.

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Purpose of study; interpretation of the magnetotelluric soundings; two-dimensional model studies and three-dimensional implications.

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Purpose of study; simulated effects of trends; regional distortion of electric field and effect on transverse electric interpretations.

WANNAMAKER, P. E., Hohmann, G. W., Sill, W. R., and Ward, S. H., 1979, Two- and three-dimensional magnetotelluric modeling with applications to crustal structure and reservoir assessment at the Roosevelt Hot Springs KGRA, Utah (abs.): Society of Exploration Geophysics Abstract, no. 49, p. 104.

Travel time delays beneath geothermal area; inversion modeling to obtain a three-dimensional model.

WANNAMAKER, P. E., Sill, W. R., Ward, S. H., and Combs, J., 1978, Magnetotelluric observations at the Roosevelt Hot Springs KGRA and Mineral Mountains, Utah: Geothermal Resources Council, Transactions, v. 2, sec. 2, p. 697-700.

See Wannamaker (1978).

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Magnetotelluric theory for three-dimensional bodies in layered earths; utility of one- and two-dimensional algorithms for interpreting three-dimensional geology; magnetotelluric theory includes electromagnetic field relations, tensor magnetotelluric quantities, and coupled body theory; three-dimensional magnetotelluric model includes responses of small scale structures and sedimentary basins; appendix of numerical tests of coupled body approximation.

WANNAMAKER, P. E., Ward, S. H., Hohmann, G. W., and Sill, W. R., 1983, Deep resistivity structure in southwestern Utah and its geothermal significance: Earth Science Laboratory/University of Utah Research Institute Report, no. DOE/ID/12079-89, 96 p.

Purpose of study; tectonic setting of eastern Great Basin and adjacent regions; seismicity, volcanism, heat flow, gravity, and magnetics of area; upper and middle crustal, deep crustal, and upper mantle resistivity mechanisms; previous resistivity studies in the eastern Great Basin including a 1977 multifrequency dipole-dipole galvanic resistivity survey at Roosevelt Hot Springs; 93 tensor magnetotelluric stations recorded near Roosevelt; problems of upper crustal lateral inhomogeneities of area; map of magnetotelluric site locations; observed apparent resistivity and impedance phase pseudosections of area; calculated pseudosections and model resistivity cross sections; graph showing best-fit regional resistivity profile for the area; deep resistivity profile beneath Roosevelt; controls on geothermal resources in southwestern Utah; conclusions.

WARD, R. W., 1979, Seismologists seeking heat: *Geotimes*, v. 24, no. 8, p. 21-24.

WARD, S. H., 1975, Seeking geothermal resources: *Geotimes*, v. 20, no. 11, p. 14-15.

WARD, S. H., 1977, Geothermal exploration architecture: ERDA Technical Report, v. 77-2, 19 p.

WARD, S. H., 1978, Program review: resource evaluation, reservoir confirmation, and exploration technology: University of Utah Department of Geology and Geophysics Technical Report, no. 78-1701.b.5.1, unpaginated.

WARD, S. H., 1983a, Controlled source electromagnetic methods in geothermal exploration: Earth Science Laboratory/University of Utah Research Institute Report, no. DOE/ID/12079-97, 46 p.

Objective of study; previous studies of electromagnetic methods for geothermal exploration; applications of controlled source electrical methods; problems with inductive CSEM systems including natural field noise, cultural noise, and geological noise due to overburden and resolution; effects of geological noise, topography, current channeling, depth of exploration, and lack of interpretational aids; graph showing generalized spectrum of natural magnetic fields; basis for selecting inductive electromagnetic systems; map of first separation dipole-dipole resistivity of the Roosevelt Hot Springs KGRA; CSAMT apparent resistivity maps of Roosevelt Hot Springs KGRA at frequencies of 98 and 977 Hz; graphs showing TM mode CSAMT field and modeled data from Roosevelt Hot Springs; graph showing two-dimensional model from which modeled data were calculated; other CSEM field examples.

WARD, S. H., 1983b, Geophysical studies of active geothermal systems in the northern Basin and Range, in *The role of heat in the development of energy and mineral resources in the northern Basin and Range Province*: Geothermal Resources Council Special Report 13, p. 121-158; also, 1984, Earth Science Laboratory/University of Utah Research Institute Report, no. DOE/ID/12079-108, 37 p.

Objectives of study; distribution of known high-temperature resources in the Basin and Range; methods of geophysical exploration; problems with geophysical methods in geothermal applications; table comparing values of Poisson's ratio for Roosevelt Hot Springs with other geothermal systems; brief reports on geology and geophysics of several known geothermal resource areas; map showing geology of Roosevelt Hot Springs KGRA and vicinity; alteration and mineral assemblages of the Roosevelt system; thermal studies map of Roosevelt; map showing first separation resistivity from 300 m dipole-dipole survey; map of the CSMAT 32 Hz apparent resistivity; self-potential map and map showing microearthquakes occurring during July 1981 swarm at Roosevelt; Wadati diagram derived from earthquakes occurring during July 1981 swarm; evaluation of the contribution made by each of 14 methods used to understand reservoirs at each of 13 geothermal projects in the Basin and Range.

WARD, S. H., Bodell, J. M., Brumbaugh, W. D., Carter, J. A., Cook, K. L., Crebs, T. J., Olsen, T. L., Parry, W. T., Sill, W. R., Smith, R. B., Thangsuphanich, I., and Tripp, A. C., 1977, Part II - Geophysics of the Roosevelt Hot Springs thermal area, Utah: Earth Science Laboratory/University of Utah Research Institute Report, no. 77-2, 17 p.

Microearthquake monitoring to study correlation of seismicity to known geothermal features; gravity anomaly map and interpretation; total magnetic intensity anomaly map and interpretation; cross sections of gravity anomalies and geologic structure; shallow geothermal gradient map and interpretation.

WARD, S. H., Bowman, J. R., Cook, K. L., Parry, W. T., Nash, W. P., Smith, R. B., Sill, W. R., and Whelan, J. A., 1978, Geology, geochemistry, and geophysics of the Roosevelt Hot Springs thermal area, Utah - a summary: Brigham Young University Geology Studies, v. 25, pt. 1, 71 p.

Geology, seismic activity, and sources of anomalous heat flow at Roosevelt; surface alteration deposits from the thermal springs.

WARD, S. H., Cook, K. L., Nash, W. P., Parry, W. T., Peebles, W. J., Sill, W. R., Smith, R. B., Brown, F. H., and Whelan, J. A., 1974, Systems of geothermal exploration with applications in Utah: University of Utah, Department of Geology and Geophysics Summary Progress Report Grant, no. NSF GI-43741, 9 p.

Over 99 km of traverse line surveyed on a dipole-dipole resistivity survey at Roosevelt Hot Springs; 50 electromagnetic soundings and 10 Schlumberger vertical electric soundings; seven weeks of microearthquake monitoring at Roosevelt Hot Springs and Cove Fort-Sulphurdale; regional gravity surveys from Roosevelt Hot Springs and central Mineral Mountains, southern Mineral Mountains, and Cove Fort area and northern Mineral Mountains; reduction of gravity data; interpre-

- tation of gravity data; aeromagnetic survey over the Mineral Range and Cove Fort-Sulphurdale; igneous petrology of Mineral Range and vicinity; paleomagnetic studies and results; brief discussion of geochemistry of Utah geothermal systems; list of consultants used in study.
- WARD, S. H., Cook, K. L., Parry, W. T., Peeples, W. J., Nash, W. P., Smith, R. B., and Whelan, J. A., 1974, Integrated exploration in geothermal area (abs.): *Geological Society of America Abstracts with Programs*, v. 6, no. 3, p. 272-273.
- WARD, S. H., Glenn, W. E., Smith, B. D., and Rijo, L., 1975, Electromagnetic soundings in the geothermal environment (abs.), in *Society of Exploration Geophysicists, 44th Annual International Meeting: Geophysics*, v. 40, no. 1, p. 177.
- WARD, S. H., Nash, W. P., Parry, W. T., Peeples, W. J., Sill, W. R., Smith, R. B., and Whelan, J. A., 1974, Systems of geothermal exploration with applications in Utah: University of Utah Department of Geology and Geophysics Project Definition Report Grant, no. NSF GI-43741, 39 p.
- WARD, S. H., Parry, W. T., Nash, W. P., Sill, W. R., Cook, K. L., Smith, R. B., Chapman, D., Brown, F., Whelan, J., and Bowman, J., 1978, A summary of the geology, geochemistry, and geophysics of Roosevelt Hot Springs thermal area, Utah: *Geophysics*, v. 43, no. 7, p. 1515-1542.
- Geology, spring deposits and associated alteration, and water chemistry at Roosevelt Hot Springs; microearthquake monitoring; gravity and magnetic surveys; electrical and heat flow measurements; reservoir configuration and heat source; guidelines for exploration procedures at Roosevelt Hot Springs.
- WARD, S. H., Rijo, L., and Petrick, W. E., 1975, Electromagnetic soundings in the geothermal environment (abs.): *United Nations Symposium on the Development and Use of Geothermal Resources, Abstracts*, no. 2., unpaginated.
- WARD, S. H., Ross, H. P., and Nielson, D. L., 1979, A strategy of exploration for high-temperature hydrothermal systems in the Basin and Range Province: *Earth Science Laboratory/University of Utah Research Institute Report*, no. DOE/ET/27002-5, 46 p.
- See Ward and others (1981).
- WARD, S. H., Ross, H. P., and Nielson, D. L., 1980, Strategy of exploration for high-temperature hydrothermal systems in Basin and Range Province (abs.): *American Association of Petroleum Geologists Bulletin*, v. 64, no. 5, p. 799.
- See Ward and others (1981).
- WARD, S. H., Ross, H. P., and Nielson, D. L., 1981, Exploration strategy for high-temperature hydrothermal systems in Basin and Range Province: *American Association of Petroleum Geologists Bulletin*, v. 65, no. 1, p. 86-102.
- Generalized model of a convective hydrothermal system; geologic cross sections of Roosevelt Hot Springs and Cove Fort-Sulphurdale KGRAs; summary of previous geothermal exploration studies in the Basin and Range; evaluation of the usefulness of geologic mapping, hydrology, gravity, ground magnetics, aeromagnetics, magnetotellurics, electrical resistivity, self-potential, passive seismic, reflection seismic, and thermal methods for geothermal exploration; table showing regional applicability of exploration/assessment techniques; proposed exploration strategies including literature and data search, chemical and isotopic analyses of water, mapping, thermal gradient measurements, conceptual modeling, hydrology, well logging, various geophysical and geochemical techniques, and reservoir modeling.
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- Purpose of survey; interpretations of resistivities plotted in pseudosection; maps of Roosevelt KGRA first separation resistivity dipole-dipole array and pseudosections.
- WARD, S. H., and Sill, W. R., 1976b, Dipole-dipole resistivity surveys, Roosevelt Hot Springs KGRA: University of Utah, Department of Geology and Geophysics Final Report, v. 2, National Science Foundation Grant GI-43741, 29 p.
- Dipole spacings used in survey; objective of survey; presentation of data; 1:24,000 scale fracture map; air photos, aeromagnetic map, and interpretive geology; alteration assemblages taken from drill hole data; hydrology and resistivity data; porosity and effects of clay alteration on resistivity; speculation on heat source; two-dimensional transmission-surface forward algorithm used to model observed data; results of modeling; one-dimensional resistivity, temperature, salinity, and porosity modeling; comparison of bipole-dipole and dipole-dipole resistivity techniques; conclusions and recommendations.
- WARD, S. H., and Sill, W. R., 1984, Resistivity, induced polarization and self-potential methods in geothermal exploration: *Earth Science Laboratory/University of Utah Research Institute Report*, no. DOE/ID/12079-90, 100 p.
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- WENDER, L. E., and Nash, W. P., 1979, Petrology of Oligocene and early Miocene calc-alkalic volcanism in the Marysvale area, Utah: Geological Society of America Bulletin, v. 90, no. 1, pt. II, p. 34-76.
- WHELAN, J. A., 1970, Radioactive and isotopic age determinations of Utah rocks: Utah Geological and Mineral Survey Bulletin 81, 75 p.
- WHELAN, J. A., 1976, Geothermal gradient data, Cedar City 1X2 degree quadrangle: Utah Geological and Mineral Survey Map, no. 40, scale 1:250,000.
- WHELAN, J. A., 1977, Thermal gradient and heat flow drilling: University of Utah, Department of Geology and Geophysics Final Report, v. 5, contract no. GI-43741, 48 p.
- WHELAN, J. A., and Petersen, C. A., 1974, Bonneville Salt Flats - a possible geothermal area?: Utah Geological and Mineral Survey, Utah Geology, v. 1, no. 1, p. 71-82; also, 1973, Utah Geological and Mineral Survey Open-File Report, no. 14, 11 p.
- Unusually high geothermal gradients from Bonneville Salt Flats noted in prior studies; depths, locations, specific capacities, and total dissolved solids for 13 deep brine wells; 27 brackish water well depths and two well transmissivities; brackish water sources; temperatures from two fault line springs; structural geology and stratigraphy of the Salt Flats; stratigraphy, structure, petrography, and volcanic history of the Silver Island Range; geothermal reservoir temperature estimates; land and well ownership; conclusions and recommendations.
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- WILLIS, C. P., 1980, Radium and uranium determination in samples of Utah Roses geothermal water: National Technical Information Service Report, no. EGG-PHYS-5169, 11 p.
- Analysis of Utah Roses geothermal well waters for uranium and radium by direct alpha counting on separated

elements; tables of uranium and radium fractions; appendix of chemical and radiochemical procedures used in study.

WILSON, W. R., 1980, Thermal studies in a geothermal area: Salt Lake City, Utah, University of Utah, unpublished Ph.D. thesis, 145 p.

Purpose of study; map of location and general geology of Roosevelt Hot Springs; methods used to measure temperatures in 53 drill holes in study area; graphs of temperature-depth curves; procedures for determining thermal conductivity and histogram of results; thermal conductivity values for major geologic units; heat transfer characteristics; plot showing magnitude of conductive lateral heat transfer; map showing surface conductive heat flow for area; map of downward continuation of the surface heat flow; appendix showing downward continuation formulas; graph of two-dimensional power spectrum of gridded surface heat flow; appendix of temperature-depth curves for Roosevelt Hot Springs; shallow heat flow surveys across normal fault geothermal systems providing fault geometry and fluid flow information; temperature-depth results from five drill holes at the Monroe KGRA; investigation of heat flow data for geometric properties of the Monroe geothermal system; datum correction for heat flow measurements made on an arbitrary surface.

WILSON, W. R., and Chapman, D. S., 1978, Interpretation of heat flow results at Roosevelt Hot Springs, Utah (abs.): EOS Transactions, American Geophysics Union, v. 59, no. 12, p. 1201.

Use of 47 drill holes to determine temperature gradients and thermal conductivity of lithologic units; configuration of near surface hydrothermal system; downward continuation model.

WILSON, W. R., and Chapman, D. S., 1979, Heat flow mapping at Roosevelt Hot Springs, Utah as a geothermal exploration method (abs.): Geophysics, v. 44, no. 3, p. 405.

Use of drill holes to obtain thermal conductivity measurements of lithologic units; conductive heat flow calculated for upper 30 meters of holes; heat flow pattern; downward continuation model.

WILSON, W. R., and Chapman, D. S., 1980, Three topical reports: I. Thermal studies at Roosevelt Hot Springs, Utah; II. Heat flow above an arbitrarily dipping plane of heat sources; III. A datum correction for heat flow measurements made on an arbitrary surface: Earth Science Laboratory/University of Utah Research Institute Report, no. DOE/ID/12079-19, 144 p.

Part I. Use of thermal gradient, thermal conductivity measurements, and heat flow determinations from 53 drill holes for geometry and temperature of the geothermal system; heat transfer characteristics in the geothermal system; assessment of factors that cause non-linear temperature profiles; appendices of temperature-depth

curves at Roosevelt and formulae for downward continuation of surface heat flow map. Part II. Use of shallow heat flow surveys across faults in geothermal system to provide information on fault geometry and fluid flow; two-dimensional model of fault zone as a plane of heat source embedded in a conductive medium; geometric parameter estimates using inversion theory; uses Monroe geothermal system for testing model. Part III. Adjusts heat flow measurements to a constant datum level; potential field theory and numerical techniques; use of three test models to determine accuracy of numerical approximation; correction of heat flow anomaly at Roosevelt Hot Springs.

WOODWARD, L. A., 1970, Tectonic implications of structures of Beaver and northern San Francisco Mountains, Utah: Geological Society of America Bulletin, v. 81, no. 5, p. 1577-1584.

WRIGHT, P. M., 1966, Geothermal gradient and regional heat flow in Utah: Salt Lake City, Utah, University of Utah, unpublished Ph.D. thesis, 181 p.

WRIGHT, P. M., Foley, D., Nichols, C. R., and Grim, P. J., 1978, Western states cooperative direct heat geothermal program of DOE: Geothermal Resources Council, Transactions, v. 2, p. 739-742.

YOUNG, C. Y., Ward, R. W., and Lin, T. L., 1979, Seismic attenuation observations across Roosevelt Hot Springs, KGRA (abs.): EOS Transactions, American Geophysical Union, v. 60, no. 46, p. 946.

Program design for mapping traveltimes beneath geothermal areas; procedures used to digitize the seismographs of 41 teleseisms for quantitative attenuation analysis; inversion technique used to obtain three-dimensional Q mode for the region.

YOUNG, R. A., and Carpenter, C. H., 1965, Ground-water conditions and storage in the central Sevier Valley, Utah: U.S. Geological Survey Water-Supply Paper, no. 1787, 95 p.

YUSAS, M. R., 1979a, Stress history of the Mineral Mountains pluton, southwestern Utah (abs.): Geological Society of America Abstracts with Programs, v. 11, no. 6, p. 306.

YUSAS, M. R., 1979b, Structural evolution of the Roosevelt Hot Springs geothermal reservoir: Salt Lake City, Utah, University of Utah, unpublished Masters thesis, 120 p.

Purpose of study; map showing general geology of the Mineral Mountains area; geology and tectonic setting of the Mineral Mountains; procedures used in mapping structure; analysis of structure and fracture systems; table showing tensile strengths of rocks; development of fracture permeability; procedures used in strain relief measurements; orientations and magnitudes of principal strains; table showing results of strain relief measurements; depth of producing geothermal reservoirs; formation of the geothermal reservoir; appendices showing

unreduced strain relief test results and results of uniaxial compression tests.

- YUSAS, M. R., and Bruhn, R. L., 1979, Structural fabric and in-situ stress analyses of the Roosevelt Hot Springs KGRA: University of Utah, Department of Geology and Geophysics, Report, no. DOE/ET/28392-31, 62 p.

Geometry and origin of fractures used to develop a structural model of the geothermal reservoir at the Roosevelt KGRA; geologic and tectonic setting; field mapping and structural analysis of joints, dikes, and shear zones; genesis and development of fracture permeability in the geothermal reservoir; measurement of strain relief to determine active and residual stresses; possible mechanisms of strain relief.

- ZANDT, G. M., McPherson, L., Schaff, S., and Olsen, S., 1982, Seismic baseline and induction studies: Roosevelt Hot Springs, Utah and Raft River, Idaho: Earth Science Laboratory/University of Utah Research Institute Report, no. DOE/ID/01821-T1, 58 p.

Analytical procedures; geographic orientation of Raft River and Roosevelt KGRAs in the Intermountain Seismic Belt; background seismicity; microearthquake swarm detected in the Mineral Mountains; techniques for locating hypocenters; geological interpretation of

data; conclusions of microearthquake information; equipment used and logistics involved in study at Roosevelt; appendix describing method used for calibration of induced- seismicity network at Roosevelt.

- ZIETZ, Isidore, Shuey, R., and Kirby, J. R., Jr., 1976, Aeromagnetic map of Utah: U.S. Geological Survey Geophysical Investigations Map GP-907, scale 1:1,000,000.

- ZIMMERMAN, J. T., 1961, Geology of the Cove Creek area, Millard and Beaver Counties, Utah: Salt Lake City, Utah, University of Utah, unpublished Masters thesis, 91 p.

- ZOBACK, M. L., and Anderson, R. E., 1983, Style of basin-range faulting as inferred from seismic reflection data in the Great Basin, Nevada and Utah, *in* The role of heat in the development of energy and mineral resources in the northern Basin and Range Province: Geothermal Resources Council Special Report 13, p. 363-382.

- ZOHDY, A. A. R., and Bisdorf, R. J., 1976, Schlumberger soundings in the upper Raft River and Raft River Valleys, Idaho and Utah: U.S. Geological Survey Open-File Report 76-92, 77 p.

GOVERNMENT-FUNDED GEOTHERMAL PROJECTS AND GEOTHERMAL DEVELOPMENTS IN UTAH

NATIONAL STUDIES

In addition to Utah specific projects, several U.S. Geological Survey national and regional geothermal projects have involved significant investigations in Utah. Although these studies were not Utah specific, parts of the studies involved field work in Utah and the reports have contributed significantly to understanding the geothermal systems in the state.

National projects include work used to develop the Assessment of Geothermal Resources of the United States - 1975, White, D. E., and Williams, D. L., editors, (see listings: Diment and others, 1975; Nathenson and Muffler, 1975; Renner and others, 1975; Smith and Shaw, 1975), Assessment of Geothermal Resources of the United States - 1978, Muffler, L. J. P., editor, (see listings: Brook and others, 1979; Sammel, 1979; Sass and Lachenbruch, 1979; Smith and Shaw, 1979), and Assessment of Low-Temperature Geothermal Resources of the United States - 1982, Reed, M. J., editor (see listings: Mariner, Brook, and others, 1983; Nathenson and others, 1983).

Significant work was also done as part of the evaluation of Known Geothermal Resource Areas (KGRAs) in Utah. The results of some of this work were published and are included in the reference list; however, some of the work did not result in publications.

STATEWIDE STUDIES

AREA:	<i>Northern and central Wasatch Front, Great Salt Lake area, and south-central Utah</i>
FUNDING:	Department of Energy and National Science Foundation
DATE:	1981-1983
TITLE:	Isotopic and Ion Chemistry of Thermal Waters
PRINCIPAL INVESTIGATOR:	Cole, D. R., Earth Science Laboratory/University of Utah Research Institute
SUMMARY:	The reports analyze major cations and anions, and oxygen and hydrogen isotopes from thermal springs associated with normal faults. Cole studied geothermometer temperatures, mineral saturation trends for thermal waters, mineral-fluid equilibria, origin of springs, and determined ages of Red Hill and Thermo waters.
REFERENCES:	Cole, 1981, 1982, 1983
AREA:	<i>Utah</i>
FUNDING:	Department of Energy
DATE:	1977-1983
TITLE:	Utah GEOTHERM Data Base
PRINCIPAL INVESTIGATOR:	Murphy, P. J., Utah Geological and Mineral Survey
SUMMARY:	Chemical data on Utah hot springs were entered in the U.S. Geological Survey computer file GEOTHERM, an information system that maintained data files on the geology, geochemistry, and hydrology of U.S. geothermal sites until 1983.
REFERENCES:	Bliss, 1983; Swanson, 1977; Teshin and others, 1979; U.S. Geological Survey, 1983b
AREA:	<i>Utah</i>
FUNDING:	Department of Energy
DATE:	1978
TITLE:	Thermal Waters of Utah
PRINCIPAL INVESTIGATORS:	Goode, H. D., Utah Geological and Mineral Survey
SUMMARY:	Regions yielding slightly warm, warm, or hot water are discussed. The report includes records of 1500 wells and springs with temperatures greater than 16°C.
REFERENCE:	Goode, 1978
AREA:	<i>Utah</i>
FUNDING:	Department of Energy
DATE:	1980
TITLE:	Geothermal Resources of Utah (map)
PRINCIPAL INVESTIGATOR:	Murphy, P. J., Utah Geological and Mineral Survey
SUMMARY:	The map identifies 327 thermal wells and springs, water chemistry and temperature, heat flow measurements, and the locations of nine KGRAs.
REFERENCE:	Utah Geological and Mineral Survey, compilers, 1980

AREA: **Utah**
 FUNDING: Department of Energy
 DATE: 1984-1985
 TITLE: Annotated Geothermal Bibliography of Utah
 PRINCIPAL INVESTIGATOR: Budding, K. E., Utah Geological and Mineral Survey
 SUMMARY: The bibliography contains approximately 750 references relating to geothermal resources of Utah. Those references which pertain directly to a resource are annotated. Accompanying the bibliography is a list and brief description of government funded geothermal projects and commercial geothermal developments.
 REFERENCE: this report

AREA: **Utah**
 FUNDING: Department of Energy, Utah Division of Water Rights
 DATE: 1979-1982
 TITLE: Commercialization Planning Program
 PRINCIPAL INVESTIGATORS: Green, Stanley, Water Rights; Hanny, J. A., Lunis, B. C., EG&G Idaho, Incorporated
 SUMMARY: The program worked towards the development of geothermal resources in Utah. The reports cover the hydrothermal resources and geology, activities that lead to commercialization, plans for development, government assistance to Utah projects, energy use, and leasing and permitting policies.
 REFERENCES: Green and Wagstaff, 1979; Hanny and Lunis, 1979; Lunis and Toth, 1982

AREA: **Utah**
 FUNDING: U.S. Geological Survey
 DATE: 1977-1983
 TITLE: Heat Flow
 PRINCIPAL INVESTIGATOR: Chapman, D. S., University of Utah Department of Geology and Geophysics
 SUMMARY: Sixty-two new heat flow determinations for Utah were added to known values. The greatest concentration of values are in southwestern Utah where geothermal potential is the highest. The reports outline two broad areas that have anomalous heat flux and high geothermal potential and define the thermal signatures of the Basin and Range and Colorado Plateau provinces.
 REFERENCES: Blackwell, 1983; Blackwell and Chapman, 1977; Bodell, 1981; Chapman and others, 1978

AREA: **Utah**
 FUNDING: U.S. Geological Survey
 DATE: 1977-1983
 TITLE: Reconnaissance of Hydrothermal Resources of Utah
 PRINCIPAL INVESTIGATOR: Rush, F. E., U.S. Geological Survey
 SUMMARY: This is an investigation of several geothermal areas in western Utah using hydrologic, geologic, geochemical and geophysical techniques.
 REFERENCES: Rush, 1977, 1983

AREA: **Utah**
 FUNDING: U.S. Geological Survey
 DATE: 1978
 TITLE: Na-K-Ca and Silica Temperature Estimates for Utah Spring and Well Waters
 PRINCIPAL INVESTIGATOR: Parry, W. T., University of Utah Department of Geology and Geophysics
 SUMMARY: The study contains Na-K-Ca and silica temperatures for spring and well waters calculated from chemical analyses in the U.S. Geological Survey computer file. Dugway Valley, Goshen Valley, Pavant Valley, and Skull Valley were studied in detail. Effects of mixing and clay exchange on chemical thermometers were evaluated.
 REFERENCE: Parry and Cleary, 1978

AREA: **Utah**
 FUNDING: U.S. Geological Survey, Utah Geological and Mineral Survey
 DATE: 1970
 TITLE: Major Thermal Springs of Utah
 PRINCIPAL INVESTIGATOR: Mundorff, J. C., U.S. Geological Survey

- SUMMARY:** This report details the work done on the thermal, chemical, and geologic characteristics of the major thermal springs of Utah.
- REFERENCE:** Mundorff, 1970
- AREA:** *Utah*
- FUNDING:** Utah Geological and Mineral Survey
- DATE:** 1966
- TITLE:** Geothermal Power Potential of Utah
- PRINCIPAL INVESTIGATOR:** Heylum, E. B., Utah Geological and Mineral Survey
- SUMMARY:** Six areas or belts of thermal springs in Utah are described. The report lists principal warm and hot springs, describes geology, temperature, and heat source, and includes some chemical analyses.
- REFERENCE:** Heylmun, 1966

REGIONAL STUDIES WITHIN UTAH

- AREA:** *Cache Valley*
- COUNTY:** Cache
- THERMAL AREA:** none
- FUNDING:** Department of Energy, Utah Geological and Mineral Survey
- DATE:** 1982-1983
- TITLE:** Low-temperature Geothermal Potential
- PRINCIPAL INVESTIGATOR:** de Vries, J. L., Utah State University Geology Department
- SUMMARY:** The study defines three areas of low-temperature geothermal potential using previous hydrologic and geothermal studies, water chemistry, conductivity, geothermometers, and thermal gradients.
- REFERENCES:** de Vries, 1982, 1983
- AREA:** *Cedar City and Richfield 1x2 degree quadrangles*
- COUNTIES:** Iron, Washington, Garfield, Kane, Beaver, Sevier
- THERMAL AREAS:** Laverkin, Veyo, Roosevelt
- FUNDING:** National Science Foundation
- DATE:** 1976-1977
- TITLE:** Geothermal Gradient Study
- PRINCIPAL INVESTIGATOR:** Whelan, J. A., Utah Geological and Mineral Survey
- SUMMARY:** Available data were used, primarily water well data, to produce a regional geothermal gradient map of the Cedar City quadrangle. The map includes hot spring locations with calculated minimum reservoir temperatures and cold springs with calculated equilibrium temperatures. Eight holes were drilled in Beaver and Sevier counties to determine heat flow, thermal gradient, geology, and alteration.
- REFERENCES:** Whelan, 1976, 1977
- AREA:** *East Shore of Great Salt Lake*
- COUNTIES:** Weber, Davis
- THERMAL AREAS:** Ogden, Hooper
- FUNDING:** Department of Energy, Utah Geological and Mineral Survey
- DATE:** 1980-1984
- TITLE:** Geothermal Potential of East Shore Area and Hill Air Force Base
- PRINCIPAL INVESTIGATORS:** Glenn, W. E., Earth Science Laboratory/University of Utah Research Institute; Murphy, P. J., Klauk, R. H., Utah Geological and Mineral Survey
- SUMMARY:** An intensive study was done in Davis and Weber Counties to advance the use of geothermal resources, particularly at Hill AFB in Weber County. Techniques used include geologic mapping; modeling of ground water; mercury concentrations in soils; gravity and reflection seismic surveys; thermal gradient drilling and well log interpretation; chemical analyses of common ions, stable isotopes, trace elements, dissolved solids; and calculation of geothermometers of area hot springs.
- REFERENCES:** Glenn, Chapman, and others, 1980; Klauk and Prawl, 1984
- AREA:** *Escalante Desert and part of Washington County*
- COUNTIES:** Iron, Washington
- THERMAL AREAS:** Newcastle, Lund

- FUNDING:** Department of Energy
DATE: 1980-1981
TITLE: Gravity Survey
PRINCIPAL INVESTIGATORS: Pe, Win, Green, R. T., University of Utah Department of Geology and Geophysics
SUMMARY: Four hundred thirty-six new gravity stations in the southern part of the Escalante Desert were combined with 917 existing stations to help evaluate the geothermal resource potential of the Newcastle and Lund KGRAs. A gravity survey delineated faults probably serving as hot water conduits in the geothermal systems. A separate gravity survey of the southwestern part of Washington County was done and regional and local gravity features were interpreted.
- REFERENCES:** Green, 1981; Green and Cook, 1980a, 1980b; Pe, 1980; Pe and Cook, 1980a, 1980b
- AREA:** *Escalante Valley*
COUNTIES: Beaver, Iron
THERMAL AREA: Thermo
FUNDING: Department of Energy, Utah Geological and Mineral Survey
DATE: 1983
TITLE: Geothermal Assessment
PRINCIPLE INVESTIGATOR: Klauk, R. H., Utah Geological and Mineral Survey
SUMMARY: The reports evaluate the low- to moderate-temperature geothermal resource potential of the area for a possible missile experimental (MX) operations base using geology, water chemistry, temperature-depth measurements, geothermal gradients, and gravity data.
- REFERENCES:** Klauk and Gourley, 1983a, 1983b
- AREA:** *Hansel and Curlew Valleys*
COUNTY: Box Elder
THERMAL AREA: Coyote Spring
FUNDING: Department of Energy, Utah Geological and Mineral Survey
DATE: 1984-1985
TITLE: Low-temperature Geothermal Potential
PRINCIPAL INVESTIGATOR: Davis, M. C., Utah State University Geology Department
SUMMARY: Two areas show potential for low-temperature geothermal resource development based on previous work, geology, geophysics, volcanic history, water sources and aquifers, water chemistry, and temperature surveys.
- REFERENCES:** Davis, 1984; Davis and Kolesar, 1985
- AREA:** *Jordan Valley*
COUNTY: Salt Lake
THERMAL AREAS: Beck, Wasatch, Hobo, Clark
FUNDING: Department of Energy, Utah Geological and Mineral Survey
DATE: 1981-1983
TITLE: Gravity Study
PRINCIPAL INVESTIGATORS: Adhidjaja, J. I., University of Utah, Department of Geology and Geophysics; Meiji Resource Consultants
SUMMARY: A gravity survey, consisting of 800 gravity stations, was done to compliment two previous surveys at the Warm Springs fault and Crystal Hot Springs areas. A complete Bouguer gravity map was compiled by Adhidjaja. Gravity based interpretive bedrock geology was done by Meiji.
- REFERENCES:** Adhidjaja and others, 1981; Meiji Resource Consultants, 1983
- AREA:** *Jordan Valley*
COUNTY: Salt Lake
THERMAL AREAS: Beck, Wasatch, Hobo, Clark
FUNDING: Department of Energy, Utah Geological and Mineral Survey
DATE: 1981-1984
TITLE: Low-temperature Geothermal Assessment
PRINCIPAL INVESTIGATOR: Klauk, R. H., Utah Geological and Mineral Survey

- SUMMARY:** The reports include a geothermal assessment of the study area based on a temperature survey, chemical analysis of wells and springs, temperature depth measurements, and a gravity survey and subsequent modeling.
- REFERENCES:** Klauk and Darling, 1984; Klauk and others, 1981
- AREA:** *Northern Wasatch Front*
- COUNTIES:** Weber, Box Elder
- THERMAL AREAS:** Utah, Crystal (Madsen), Belmont (Udy), Little Mountain, Stinking, Bothwell, Cutler
- FUNDING:** Department of Energy, Utah Geological and Mineral Survey
- DATE:** 1979-1984
- TITLE:** Geothermal Investigation
- PRINCIPAL INVESTIGATORS:** Murphy, P. I., Klauk, R. H., Utah Geological and Mineral Survey
- SUMMARY:** Four hot spring areas were investigated by studying the geologic structure of the Pleasant View salient, general geology, water chemistry and temperature. A valley-wide study identified three areas of low-temperature geothermal potential based on a temperature survey of 52 wells and springs, water chemistry, temperature versus depth measurements, geothermal gradients, and geothermometry for reservoir temperature calculations.
- REFERENCES:** Klauk and Budding, 1984; Murphy and Gywnn, 1979b
- AREA:** *Part of southwestern and west-central Utah*
- COUNTIES:** Juab, Millard, Sanpete, Sevier, Beaver, Piute, Iron
- THERMAL AREAS:** Abraham, Monroe-Red Hill, Joseph, Cove Fort, Roosevelt, Thermo, Newcastle
- FUNDING:** Department of Energy
- DATE:** 1984-1985
- TITLE:** High-temperature Geothermal Resources
- PRINCIPAL INVESTIGATOR:** Mabey, D. R., Utah Geological and Mineral Survey
- SUMMARY:** An assessment of the high-temperature resources of Utah with emphasis on the region of the seven high-temperature geothermal systems in southwestern and west-central Utah. The study was based on existing geological, geophysical, and geochemical data with emphasis on the relationships of geothermal resources to Cenozoic igneous systems and tectonic events. Particular attention was given to the Cove Fort area. The final report includes resource assessments and discusses exploration strategies for possible undiscovered systems.
- REFERENCE:** Mabey, D. R., and Budding, K. E., in review, High-temperature geothermal resources of Utah: Utah Geological and Mineral Survey Special Studies.
- AREA:** *Part of west-central Utah*
- COUNTIES:** Juab, Sevier, Millard, Beaver
- THERMAL AREAS:** Abraham, Monroe-Red Hill, Cove Fort, Roosevelt
- FUNDING:** National Science Foundation
- DATE:** 1974-1976
- TITLE:** Geochemistry and Hydrothermal Alteration at selected Utah Hot Springs
- PRINCIPAL INVESTIGATOR:** Parry, W. T., University of Utah Department of Geology and Geophysics
- SUMMARY:** The study analyzes the temperature and geochemistry of the springs, mixing models, geology, and alteration on the surface and at depth. Seismic, gravity, and aeromagnetic surveys were done in the Roosevelt Hot Springs and Cove Fort area.
- REFERENCES:** Parry and others, 1976; Ward, Cook, Nash, and others, 1974
- AREA:** *Twin Peaks, Black Rock Desert*
- COUNTY:** Millard
- THERMAL AREA:** Coyote Spring
- FUNDING:** Department of Energy, U.S. Geological Survey
- DATE:** 1979-1984
- TITLE:** Geology and Geophysics
- PRINCIPAL INVESTIGATORS:** Crecraft, H. R., Carrier, D. L., Serpa L. F., University of Utah Department of Geology and Geophysics
- SUMMARY:** The study discusses the petrology, geochronology, and chemical evolution of the Twin Peaks rhyolite domes. It includes a geologic map, oxygen and hydrogen isotope studies, gravity and thermal studies, and aeromagnetism of Twin Peaks and the Black Rock Desert.

- REFERENCES: Carrier, 1979; Carrier and Chapman, 1980; Crecraft, 1984; Crecraft and others, 1980b; Lynch and Nash, 1980; Nash, 1981; Serpa, 1980; Serpa and Cook 1979
- AREA: ***Utah and Goshen Valleys***
COUNTY: Utah
THERMAL AREAS: Saratoga, Crater, Goshen, Lincoln Point, Goose Point, Bird Island
FUNDING: Department of Energy, Utah Geological and Mineral Survey
DATE: 1983-1984
TITLE: Gravity Survey
PRINCIPAL INVESTIGATOR: Davis, D. A., University of Utah Department of Geology and Geophysics
SUMMARY: The study includes the physiography of the area, general geology, and structural features. Gravity studies were undertaken to provide the structural framework needed to define geothermal targets by delineating faults, structural trends, intrusions, thickness of valley fill, and areas of increased host rock density. The gravity survey was conducted with 536 new stations and 563 stations from previous surveys. These studies substantiate fault control for most of the springs in Utah County.
- REFERENCES: Davis and Cook, 1983; Klauk and Davis, 1984
- AREA: ***Warm Springs Fault***
COUNTY: Salt Lake
THERMAL AREAS: Beck, Wasatch, Hobo, Clark
FUNDING: Department of Energy, Utah Geological and Mineral Survey
DATE: 1979
TITLE: Geothermal Investigation
PRINCIPAL INVESTIGATOR: Murphy, P. J., Utah Geological and Mineral Survey
SUMMARY: The study looked at the geology and structure of the Warm Springs fault geothermal system, Hobo Springs fault, and the Salt Lake salient. It utilized a shallow ground temperature survey, temperature gradient holes, lithologic logs, water chemistry, and a gravity survey.
- REFERENCE: Murphy and Gwynn, 1979c

LOCAL HOT SPRING OR THERMAL AREA STUDIES

- AREA: ***Abraham (Crater)***
FUNDING: U.S. Geological Survey
DATE: 1976
TITLE: Audiomagnetotelluric Data Log
PRINCIPAL INVESTIGATOR: Senterfit, R. M., U.S. Geological Survey
SUMMARY: The report includes a data log with a map of station locations, and two skin-depth pseudosections with telluric lines that run east-west and north-south.
REFERENCE: Senterfit and Bedinger, 1976
- AREAS: ***Abraham (Crater), Joseph, Monroe-Red Hill, Thermo***
FUNDING: U.S. Geological Survey
DATE: 1977
TITLE: Chemical, Isotopic, and Gas Compositions of Selected Thermal Springs in Arizona, New Mexico, and Utah
PRINCIPAL INVESTIGATOR: Mariner, R. H., U.S. Geological Survey
SUMMARY: Chemical analyses were done on water samples from Crater, Thermo, Monroe-Red Hill, and Joseph KGRAs. Thermal aquifer temperatures were estimated, and the composition of gases escaping from wells and springs was tested.
REFERENCE: Mariner and others, 1977
- AREA: ***Cove Fort***
FUNDING: Department of Energy
DATE: 1976-1979
TITLE: Resistivity and IP Surveys
PRINCIPAL INVESTIGATORS: Phoenix Geophysics; Ross, H. P., Earth Science Laboratory/University of Utah Research Institute

- SUMMARY:** The reports include a dipole-dipole resistivity reconnaissance survey and an interpretation of the data. Methods used to interpret data and the problems encountered are outlined. Maps (scale 1:24,000) are included that show apparent and interpreted resistivity sections, interpreted electrical resistivity at 0-300' and 1500'-2000', and a comparison of resistivity distribution with the geologic data.
- REFERENCES:** Phoenix Geophysics, Incorporated, 1976; Ross, 1979
- AREA:** **Cove Fort**
- FUNDING:** Department of Energy
- DATE:** 1979-1982
- TITLE:** Multielement Geochemistry of Three Geothermal Wells
- PRINCIPAL INVESTIGATOR:** Christensen, O. D., Earth Science Laboratory/University of Utah Research Institute
- SUMMARY:** Analyses of whole rock samples and of a sample slurry of drill cuttings were used to determine areal distribution of As, Hg, Pb, and Zn in relation to sequential hydrothermal events. Models were developed for targeting geothermal drilling from geochemical zonation of elements.
- REFERENCES:** Bamford and Christensen, 1979; Christensen, 1982
- AREA:** **Cove Fort**
- FUNDING:** Department of Energy
- DATE:** 1979-1983
- TITLE:** Geological and Geophysical Case Study
- PRINCIPAL INVESTIGATORS:** Moore, J. N., Ross, H. P., Ward, S. H., Earth Science Laboratory/University of Utah Research Institute
- SUMMARY:** A geological study includes the regional stratigraphy, lithology, structure, mineralogy, alteration, and hydrology. Geophysical studies include reflection and refraction seismicity, microearthquakes, earth noise, detailed gravity, magnetics, dipole-dipole resistivity, electrical methods of IP, SP, and MT/AMT, radiometry, and heat flow. Well log interpretations are discussed.
- REFERENCES:** Cook, Serpa, and Pe, 1980; Glenn and Ross, 1982; Moore and others, 1979; Ross, 1979; Ross, Moore, and Christensen, 1982; Ward, 1983b
- AREA:** **Cove Fort**
- FUNDING:** U.S. Geological Survey
- DATE:** 1977
- TITLE:** Environmental Analysis
- PRINCIPAL INVESTIGATOR:** Office of the Area Geothermal Supervisor
- SUMMARY:** The geology, soils, air quality, noise, climate, hydrology, vegetation, socioeconomic characteristics, wildlife, and archaeological sites were studied to identify potential environmental impacts. Measures were outlined to lessen or eliminate adverse impacts. The report includes plans of Phillips Petroleum and Union Oil Company to drill 31 wells.
- REFERENCE:** U.S. Geological Survey, 1977
- AREAS:** **Cove Fort, Lund, Roosevelt, Thermo,**
- FUNDING:** Department of Energy
- DATE:** 1978
- TITLE:** Environmental Overview Report on Utah Geothermal Resource Areas
- PRINCIPAL INVESTIGATOR:** White, K. L., University of Utah Environmental Studies Laboratory
- SUMMARY:** The study assesses key issues which may influence the development of the KGRAs in southwestern Utah, such as hazardous pollution emissions, visibility reduction due to emissions, odor effects, natural water degradation, rare and endangered species, preservation of archaeological sites, noise, induced seismicity, and slope stability.
- REFERENCE:** White and others, 1978
- AREAS:** **Cove Fort, Roosevelt**
- FUNDING:** Department of Energy
- DATE:** 1963-1979
- TITLE:** Earthquake Study
- PRINCIPAL INVESTIGATORS:** Phillips Petroleum Company; Earth Science Laboratory/University of Utah Research Institute

- SUMMARY:** Reports include earthquake and microearthquake data with listings of seismic events according to year, date, time, location, depth and magnitude. Maps showing epicenters and hypocenters were compiled for the study area.
- REFERENCES:** Earth Science Laboratory/University of Utah Research Institute, 1979; Phillips Petroleum Company, 1979
- AREAS:** *Cove Fort, Roosevelt*
- FUNDING:** Department of Energy
- DATE:** 1974-1982
- TITLE:** Industry-coupled Program
- PRINCIPAL INVESTIGATOR:** Department of Energy
- SUMMARY:** The Department of Energy purchased geological, geophysical, seismic, geochemical, and temperature gradient data, along with drilling logs and flow tests from companies working at Roosevelt and Cove Fort. The Department of Energy released these data through University of Utah Research Institute open-file reports.
- REFERENCES:** Aerial Surveys, 1978a, 1978b; Geonomics Incorporated, 1976b; Geothermal Power Corporation, 1978a, 1978b, 1980, 1982; GeothermEx Incorporated, 1977; Getty Oil Company, 1978a, 1978b; Helton Engineering and Geological Services, Incorporated, 1978; Thermal Power Company, 1976, 1977a, 1977b; Union Oil Company reports 1974-1979
- AREAS:** *Cove Fort, Roosevelt*
- FUNDING:** Department of Energy
- DATE:** 1977
- TITLE:** Long-term Seismic Monitoring
- PRINCIPAL INVESTIGATOR:** Smith, R. B., University of Utah Department of Geology and Geophysics
- SUMMARY:** Seismic monitoring from January 1 - June 30, 1977 of seismic signals generated by withdrawal of stream from a well at Roosevelt.
- REFERENCE:** Smith, R. B., 1977a
- AREAS:** *Cove Fort, Roosevelt*
- FUNDING:** Department of Energy
- DATE:** 1977-1978
- TITLE:** Regional Gravity and Aeromagnetic Survey
- PRINCIPAL INVESTIGATORS:** Brumbaugh, W. D., Carter, J. A., University of Utah Department of Geology and Geophysics
- SUMMARY:** Six hundred seventy-one gravity stations were set up over an area of 1300 km². Results of two gravity profiles with interpretive geologic cross-sections, terrain corrected Bouguer gravity anomaly map, and an isometric three dimensional gravity anomaly model are discussed. A regional aeromagnetic survey of the Mineral Mountains and the two thermal areas was done and the anomalies are described.
- REFERENCES:** Brumbaugh, 1978; Brumbaugh and Cook, 1977; Carter, 1978; Carter and Cook, 1978
- AREAS:** *Cove Fort, Roosevelt*
- FUNDING:** Department of Energy
- DATE:** 1978
- TITLE:** Investment Analysis
- PRINCIPAL INVESTIGATOR:** Cassel, T. A., University of Pennsylvania Energy Center
- SUMMARY:** The study analyzes and models the investment behavior of companies involved in the development of hydrothermal electric power facilities. It provides a realistic and theoretically sound means for predicting capital investments in the development of hydrothermal well fields, and outlines investment considerations and financial attributes. A model is applied to Roosevelt Hot Springs and Cove Fort-Sulphurdale.
- REFERENCE:** Cassel and others, 1978
- AREAS:** *Cove Fort, Roosevelt*
- FUNDING:** Department of Energy
- DATE:** 1978-1979
- TITLE:** Geothermal Ground Noise Measurements
- PRINCIPAL INVESTIGATOR:** Laster, S. J., University of Tulsa Geophysics Laboratory
- SUMMARY:** A survey of ambient seismic noise.

- REFERENCES: Laster and Douze, 1978; Douze and Laster, 1979
- AREAS: **Cove Fort, Roosevelt**
- FUNDING: National Science Foundation
- DATE: 1974
- TITLE: Regional Geophysical Study
- PRINCIPAL INVESTIGATOR: Ward, S. H., University of Utah Department of Geology and Geophysics
- SUMMARY: The reports include results of a dipole-dipole resistivity survey, electromagnetic soundings, vertical electric soundings, microearthquake monitoring, regional gravity survey, and an aeromagnetic survey over the Roosevelt Hot Springs, Mineral Mountains, and Cove Fort areas.
- REFERENCES: Ward, Cook, Nash, and others, 1974; Ward, Nash, and others, 1974
- AREAS: **Cove Fort, Roosevelt**
- FUNDING: National Science Foundation
- DATE: 1976
- TITLE: Earthquake Surveys
- PRINCIPAL INVESTIGATOR: Olson, G. L., University of Utah Department of Geology and Geophysics
- SUMMARY: The project covers two recording sessions for a 49 day period. P-wave delays, S-wave attenuation, and cumulative energy release were monitored to provide information on stress orientation and location of fault zones.
- REFERENCES: Olson, 1976; Olson and Smith, 1976
- AREA: **Crystal Hot Springs**
- FUNDING: Department of Energy
- DATE: 1980-1982
- TITLE: Utah State Prison Geothermal Project
- PRINCIPAL INVESTIGATOR: Utah Energy Office
- SUMMARY: The objective of the project was to demonstrate the use of geothermal energy for direct utilization at the Utah State Prison. Crystal Hot Springs waters were developed for space and water heating at the prison's minimum security block. The project was divided into the following three phases: (1) resource assessment, (2) resource development, and (3) construction and inspection of demonstration.
- REFERENCES: Blair and Owen, 1981; Morrison-Knudson, 1982; Terra Tek, 1980a; Utah Energy Office, 1981
- AREA: **Crystal Hot Springs**
- FUNDING: Department of Energy, Utah Geological and Mineral Survey
- DATE: 1979-1981
- TITLE: Geothermal Investigation
- PRINCIPAL INVESTIGATOR: Murphy, P. J., Utah Geological and Mineral Survey
- SUMMARY: The investigation includes a study of the geology, structure, and stratigraphy of the Traverse Mountains horst, shallow ground temperature survey, water chemistry of springs and test wells, and a study of the reservoir heat source and recharge system.
- REFERENCES: Murphy, 1981; Murphy and Gwynn, 1979a
- AREA: **Fumarole Butte**
- FUNDING: Department of Energy
- DATE: 1974-1978
- TITLE: Gravity Study
- PRINCIPAL INVESTIGATOR: Smith, T. B., University of Utah Department of Geology and Geophysics
- SUMMARY: The study includes an overview of geology, lithologic descriptions, and structure. Three gravity surveys were done and geologic cross sections were drawn from interpreted gravity data. Simple Bouguer gravity map, aeromagnetic map, and geologic map were compiled.
- REFERENCES: Smith, 1974; Smith, Cook, and Peebles, 1978
- AREA: **Fumarole Butte**
- FUNDING: U.S. Geological Survey and University of Utah (Mineral Leasing Fund)
- DATE: 1979-1980
- TITLE: Geology and Petrology
- PRINCIPAL INVESTIGATOR: Peterson, J. B., University of Utah Department of Geology and Geophysics

- SUMMARY:** The study discusses the geology, geophysics, water temperatures, geochronology, mineral and rock chemistry, geothermometry, and geothermal potential of the area.
- REFERENCES:** Peterson, 1979; Peterson and Nash, 1980
- AREAS:** *Joseph, Monroe*
- FUNDING:** Department of Energy
- DATE:** 1978
- TITLE:** Gravity and Ground Magnetic Surveys
- PRINCIPAL INVESTIGATOR:** Halliday, M. E., University of Utah Department of Geology and Geophysics
- SUMMARY:** A regional gravity survey using 948 stations was made to produce a Bouguer anomaly map. A magnetic survey with a total of 840 ground stations along 19 profiles produced a diurnal-corrected total magnetic intensity anomaly map. Resulting data have provided valuable information on large scale faults, particularly those controlling hot springs.
- REFERENCES:** Halliday, 1978; Halliday and Cook, 1978; Halliday and others, 1978
- AREAS:** *Joseph, Monroe*
- FUNDING:** U.S. Geological Survey
- DATE:** 1976
- TITLE:** Audiomagnetotelluric Survey
- PRINCIPAL INVESTIGATOR:** Gardner, Susan, U.S. Geological Survey
- SUMMARY:** The publication is a data log and station location map from an 11 station AMT survey.
- REFERENCE:** Gardner, Williams, and Brougham, 1976
- AREA:** *Lund*
- FUNDING:** U.S. Geological Survey
- DATE:** 1976
- TITLE:** Audiomagnetotelluric Survey
- PRINCIPAL INVESTIGATOR:** Gardner, Susan, U.S. Geological Survey
- SUMMARY:** The publication is a data log and station location map from a 10 station AMT survey.
- REFERENCE:** Gardner, Williams, and Hoover, 1976
- AREA:** *Midway*
- FUNDING:** Department of Energy, Utah Geological and Mineral Survey
- DATE:** 1979
- TITLE:** Geothermal Potential
- PRINCIPAL INVESTIGATOR:** Kohler, J. F., Utah Geological and Mineral Survey
- SUMMARY:** The study involves the geology and structure of the area, chemical analyses and geothermometry of the thermal waters, thermal gradients, gravity anomalies, and modeling of heat source theories.
- REFERENCES:** Kohler, 1979; Kohler and Kolesar, 1979
- AREA:** *Monroe*
- FUNDING:** Department of Energy
- DATE:** 1980-1981
- TITLE:** Exploration Case History
- PRINCIPAL INVESTIGATOR:** Hulen, J. B., Earth Science Laboratory/University of Utah Research Institute
- SUMMARY:** The project examines the exploration techniques used to evaluate the Monroe KGRA and their usefulness in predicting resources. Techniques used include geology, alteration and spring geochemistry, various logs from test holes, heat flow data, and geophysical surveys. A reference list of publications on the Monroe Hot Springs and vicinity was compiled.
- REFERENCES:** Hulen and Sandberg, 1981; Earth Science Laboratory/University of Utah Research Institute, 1980
- AREAS:** *Monroe, Red Hill*
- FUNDING:** Department of Energy
- DATE:** 1978-1981
- TITLE:** Geophysical Study
- PRINCIPAL INVESTIGATORS:** Mase, C. W., Halliday, M. E., University of Utah Department of Geology and Geophysics

- SUMMARY:** The exploration of Monroe and Red Hill hot springs included extensive studies of the geology, lithology, structure, well log interpretations, spring geochemistry, and alteration. The geophysical studies included a gravity survey with 1000 stations, a magnetic survey with 19 lines and 840 stations, a resistivity survey, and interpretive geologic profiles. Temperature depth profiles, thermal gradient values, heat flow, and thermal conductivity values were also determined.
- REFERENCES:** Chapman and Harrison, 1978; Halliday, 1978; Halliday and Cook, 1978; Halliday and others, 1978; Kilty and others, 1979; Mase, 1979; Mase and others, 1978; Sandberg, 1980
- AREAS:** **Monroe, Red Hill**
- FUNDING:** Department of Energy
- DATE:** 1980-1982
- TITLE:** Utilization of Monroe Geothermal Resource
- PRINCIPAL INVESTIGATORS:** Blair, K. C., Harrison, R. J., Terra Tek
- SUMMARY:** The study includes an overview of the geology, geophysics, temperature-depth profiles, flow rates, reservoir assessment, production system design, costs, and practicability for development of space heating at Monroe.
- REFERENCES:** Blair, 1980; Blair and Owen, 1982; Blair and others, 1980; Harrison, 1980; Harrison and others, 1980; Terra Tek, 1980b
- AREAS:** **Monroe, Roosevelt, Thermo**
- FUNDING:** Utah Geological and Mineral Survey
- DATE:** 1973-1975
- TITLE:** Geology, Water Temperature, and Thermal Gradient Study
- PRINCIPAL INVESTIGATOR:** Petersen, C. A., Utah Geological and Mineral Survey
- SUMMARY:** The geology and temperature estimates of the Roosevelt and Thermo hot spring areas were studied. Other information presented in the reports includes water chemistry for Roosevelt, and thermal gradient, heat flow, and alteration studies in the Roosevelt and Monroe areas.
- REFERENCES:** Petersen, 1973, 1975a, 1975b; Whelan and Petersen, 1974
- AREA:** **Newcastle**
- FUNDING:** Department of Energy
- DATE:** 1981
- TITLE:** Heat Flow and Geothermal Assessment of the Escalante Desert with emphasis on the Newcastle KGRA
- PRINCIPAL INVESTIGATOR:** Clement, M. D., University of Utah Department of Geology and Geophysics
- SUMMARY:** The project assesses the geothermal potential of Escalante Desert using recently acquired heat flow values to define regional heat flow magnitude. Thermal gradients and heat flow determinations of the Newcastle geothermal system were studied.
- REFERENCES:** Clement, 1981; Clement and Chapman, 1981
- AREA:** **Newcastle**
- FUNDING:** U.S. Geological Survey
- DATE:** 1976
- TITLE:** Helium Sniffer Test
- PRINCIPAL INVESTIGATOR:** Denton, E. H., U.S. Geological Survey
- SUMMARY:** Two hundred soil-gas samples were collected two feet below the surface and analyzed for helium. A contour map of helium concentrations was produced.
- REFERENCE:** Denton, 1976
- AREA:** **Roosevelt**
- FUNDING:** Department of Energy
- DATE:** 1977-1978
- TITLE:** Hydrothermal Alteration
- PRINCIPAL INVESTIGATORS:** Bryant, N. L., Parry, W. T., University of Utah Department of Geology and Geophysics
- SUMMARY:** Petrologic, X-ray, and chemical methods were used to characterize systematic changes in chemistry and mineralogy in core from drill holes. A model that accounts for the zonation is included in the reports.

- REFERENCES: Bryant, 1977; Bryant and Parry, 1977; Parry, 1978; Parry and others, 1978
- AREA: **Roosevelt**
 FUNDING: Department of Energy
 DATE: 1977-1982
 TITLE: Geology, Geochemistry, and Geophysics
 PRINCIPAL INVESTIGATOR: Earth Science Laboratory/University of Utah Research Institute
 SUMMARY: The Department of Energy funded an intensive study of Roosevelt Hot Springs area and many aspects of the spring have been explored. These include geology, lithology, structure, mineralization, and alteration. Several wells have been drilled and the lithologic, temperature, caliper, porosity, density, and resistivity characteristics studied. Gravity, seismic, magnetic, resistivity, and electrical (IP, DC, MT, EM, SP) surveys have been conducted and the resulting data have been interpreted and anomaly maps and profiles drawn. Geochemical analyses of water, soil, gas, rock, and isotopes has been done, as well as geothermometer studies. Heat flow rates, thermal gradients, measured water temperatures, and calculated reservoir temperatures have been studied, and the reservoir size has been estimated.
- REFERENCES: Ballantyne, 1980; Ballantyne, G. H., 1978; Ballantyne, J. M., 1978; Ballantyne and Parry, 1978; Bamford and others, 1980; Capuano and Bamford, 1978; Frangos and Ward, 1980; Gertson and Smith, 1979; Glen and Hulen, 1979b; Hulen, 1978; McKinney, 1978; Nielson, 1978; Nielson and others, 1978; Sill, 1981, 1982; Sill and John, 1979; Smith, J. L., 1980; Wannamaker, 1978; Wannamaker and others, 1980
- AREA: **Roosevelt**
 FUNDING: Department of Energy
 DATE: 1978-1980
 TITLE: Heat Flow
 PRINCIPAL INVESTIGATOR: Chapman, D. S., University of Utah Department of Geology and Geophysics
 SUMMARY: The investigation used thermal gradient data, thermal conductivity measurements, and heat flow determinations from drill holes to determine the geometry and temperature of the Roosevelt geothermal system. Shallow heat flow surveys across faults were also used to study the fault geometry and fluid flow of the hydrothermal reservoir.
- REFERENCES: Wilson and Chapman, 1978, 1979, 1980
- AREA: **Roosevelt**
 FUNDING: Department of Energy
 DATE: 1979
 TITLE: Structural Evolution of the Geothermal Reservoir
 PRINCIPAL INVESTIGATOR: Yusas, M. R., University of Utah Department of Geology and Geophysics
 SUMMARY: The structure and fracture systems of the geothermal reservoir were analyzed. Strain relief was measured to determine active and residual stresses. A structural model was developed for the reservoir.
- REFERENCES: Yusas, 1979b; Yusas and Bruhn, 1979
- AREA: **Roosevelt**
 FUNDING: Department of Energy
 DATE: 1979-1982
 TITLE: Isotope Study
 PRINCIPAL INVESTIGATOR: Bowman, J. R., University of Utah Department of Geology and Geophysics
 SUMMARY: The reports discuss isotopic analyses of silicates, carbonates, regional spring waters, and the interaction of thermal waters with the reservoir rock at Roosevelt. Hot spring alteration products, origin of thermal waters, and the extent of isotopic exchange were studied.
- REFERENCES: Bowman, 1979; Bowman and Rohrs, 1981; Bowman and others, 1982; Rohrs, 1980; Rohrs and Bowman, 1980
- AREA: **Roosevelt**
 FUNDING: Department of Energy, National Science Foundation
 DATE: 1973-1976
 TITLE: Geology, Geochemistry, and Geophysics
 PRINCIPAL INVESTIGATORS: Parry, W. T., Ward, S. H., University of Utah Department of Geology and Geophysics

- SUMMARY:** The 1977 reports summarize the research and exploration efforts that took place between 1973 and 1976 at the Roosevelt thermal area. The reports discuss work done on the geology, spring deposits, alteration, and water chemistry. Microearthquakes, gravity, and magnetics were used to define the regional setting, resistivity and heat flow were used to localize the convective hydrothermal system, and magnetotellurics, gravity, and magnetics were used in attempts to locate the heat source.
- REFERENCES:** Parry, Nash, Bowman, and others, 1977; Parry, Nash, and Ward, 1977; Ward and others, 1977
- AREA:** *Roosevelt*
FUNDING: National Science Foundation
DATE: 1976
TITLE: Magnetic Survey
PRINCIPAL INVESTIGATOR: Petrick, W. E., University of Utah Department of Geology and Geophysics
SUMMARY: The study involves a vertical magnetic dipole survey at Roosevelt Hot Springs.
REFERENCE: Petrick, 1976
- AREA:** *Roosevelt*
FUNDING: National Science Foundation
DATE: 1976
TITLE: Resistivity Survey
PRINCIPAL INVESTIGATOR: Ward, S. H., University of Utah Department of Geology and Geophysics
SUMMARY: The project involves three surveys using different dipole spacing. The data were interpreted and modeled. The study included collection and interpretation of drill hole information, porosity and effects of clay alteration on resistivity, and heat source speculation.
REFERENCES: Ward and Sill, 1976a, 1976b
- AREA:** *Roosevelt*
FUNDING: U.S. Geological Survey
DATE: 1976-1977
TITLE: Environmental Analysis
PRINCIPAL INVESTIGATOR: Durham, Jon, U.S. Geological Survey
SUMMARY: Geology, soils, air quality, noise, climate, hydrology, vegetation, wildlife, and archeological sites were explored in an effort to identify potential environmental impacts of deep geothermal exploratory test wells drilled by Phillips Petroleum Company. Measures were outlined to lessen or eliminate adverse impacts on the environment.
REFERENCES: Durham, 1977; U.S. Geological Survey, 1976
- AREA:** *Roosevelt*
FUNDING: U.S. Geological Survey
DATE: 1977-1981
TITLE: Helium and Mercury Study
PRINCIPAL INVESTIGATORS: Hinkle, M. E., Denton, E. H., U.S. Geological Survey
SUMMARY: The study outlines the relationship of helium and mercury concentrations in soils and gases to geothermal and geologic features.
REFERENCES: Denton, 1977; Hinkle 1980, 1981; Hinkle and Harms, 1978; Hinkle and others, 1978
- AREA:** *Roosevelt, Mineral Mountains*
FUNDING: Department of Energy
DATE: 1976-1982
TITLE: Quaternary Magmatic System
PRINCIPAL INVESTIGATOR: Nash, W. P., University of Utah Department of Geology and Geophysics
SUMMARY: Quaternary silicic volcanic rocks associated with the Roosevelt Hot Springs geothermal area were investigated by studying the geology, geochemistry, mineralogy, and geothermometers. The source region was discussed.
REFERENCES: Evans and Nash, 1978; Nash, 1976; Nash and Crecraft, 1982; Nash and Evans, 1978
- AREA:** *Sandy*
FUNDING: Department of Energy
DATE: 1977-1982

- TITLE:** Floral Greenhouse Geothermal Project
PRINCIPAL INVESTIGATOR: Utah Roses, Incorporated
SUMMARY: The objective of the project was to convert an existing six acre greenhouse from gas and oil boilers to geothermal heat provided by Crystal Hot Springs geothermal resource. The test well (1,527 m) did not produce water as warm as expected, only 50°C with a slight flow; however, it does provide base load heating.
REFERENCES: Energy Services, Incorporated, 1982; Kunze and Stoker, 1979; Kunze and others, 1980; Miller Floral Company, 1977; Utah Roses, Incorporated, 1978; Willis, 1980
- AREA:** *Thermo*
FUNDING: Department of Energy
DATE: 1977
TITLE: Gravity and Ground Magnetic Survey
PRINCIPAL INVESTIGATOR: Sawyer, R. F., University of Utah Department of Geology and Geophysics
SUMMARY: A regional survey comprised of 273 new gravity and magnetic stations and incorporating 104 previous gravity stations was done. The data collected helped discern structural features, delineate between lithologies, and identify areas of hydrothermal alteration. Models and profile interpretations were made.
REFERENCES: Sawyer, 1977; Sawyer and Cook, 1977
- AREA:** *Thermo*
FUNDING: U.S. Geological Survey
DATE: 1976
TITLE: Audiomagnetotelluric Survey
PRINCIPAL INVESTIGATOR: Gardner, Susan, U.S. Geological Survey
SUMMARY: The publication is a data log and station location map from a 13 station AMT survey.
REFERENCE: Gardner, Williams, and Long, 1976
- AREA:** *Thermo*
FUNDING: U.S. Geological Survey
DATE: 1977
TITLE: Environmental Analysis
PRINCIPAL INVESTIGATOR: Durham, Jon, U.S. Geological Survey
SUMMARY: Geology, soils, air quality, noise, climate, hydrology, vegetation, wildlife, and archeological sites were explored in an effort to identify potential environmental impacts of a geothermal exploratory test well drilled by Republic Geothermal, Incorporated. Measures were outlined to lessen or eliminate adverse impacts on the environment.
REFERENCE: Durham and Hoops, 1977
- AREA:** *Wasatch Hot Springs*
FUNDING: Department of Energy
DATE: 1984
TITLE: Geothermal Heating for the Children's Museum
PRINCIPAL INVESTIGATOR: Karlsson, Thorbjorn, Oregon Institute of Technology
SUMMARY: The report evaluates the possibility of using Wasatch Hot Springs (along with a natural gas backup system) to heat the Children's Museum. It recommended drilling an exploratory well to establish the underground flow path of the thermal system, a necessary step before being able to determine the heating potential of the spring.
REFERENCE: Karlsson, 1984

CURRENT ACTIVITIES

AREA: **Utah**
FUNDING: Utah Division of Water Rights
DATE: 1985
TITLE: Regulatory Authority over Geothermal Resources
PRINCIPAL INVESTIGATOR: Mann, John, Water Rights
SUMMARY: Under the Geothermal Resource Conservation Act of 1981, Water Rights maintains regulatory control over geothermal exploration and development in Utah by authorizing drilling permits for all exploratory wells, collecting the well logs and drilling reports, and overseeing the unitization of geothermal areas.

AREA: **Utah**
FUNDING: Utah Energy Office
DATE: 1985
TITLE: Geothermal Permitting Manual
PRINCIPAL INVESTIGATOR: Burks, Jeff, Utah Energy Office
SUMMARY: The Utah Energy Office is writing a geothermal permitting manual which details the state and federal permits necessary to develop a geothermal resource in Utah.

CURRENTLY DEVELOPED THERMAL AREAS

SITE (Developer)	APPLICATION
Belmont (Udy) Hot Springs Cove Fort (Mother Earth Industries)	swimming pool and mineral bath electrical (binary) — power sold to Provo City through UP&L lines, 2.7 megawatt power plant with plans to increase production
Crystal Hot Springs (Utah Roses) Crystal Hot Springs (Utah State Prison) Crystal (Madsens) Hot Springs	greenhouses space heating swimming pool, mineral bath, and space heating
Laverkin Midway Monroe Hot Springs Newcastle (Christensen Brothers, Dick Hildebrand)	mineral bath space heating and swimming pool swimming pool and mineral bath greenhouses
Roosevelt Hot Springs (Utah Power and Light and Phillips Petroleum Company — now Intermountain Geothermal)	electrical (direct flash) — 20 megawatt power plant
Saratoga Hot Springs Utah Hot Springs Veyo	space heating greenhouses swimming pool

Figure 1. Map of Utah counties, thermal areas, and physiographic provinces listed in the geographic index. High-temperature areas have geological and geophysical references in bibliography.

GEOGRAPHIC INDEX

UNITED STATES

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 Berge and others, 1981
 Berry and others, 1980
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UTAH GEOLOGICAL AND MINERAL SURVEY

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