UURI 1988

Gene

Geothermal Studies

at

The University of Utah Research Institute

Earth Science Laboratory

University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108
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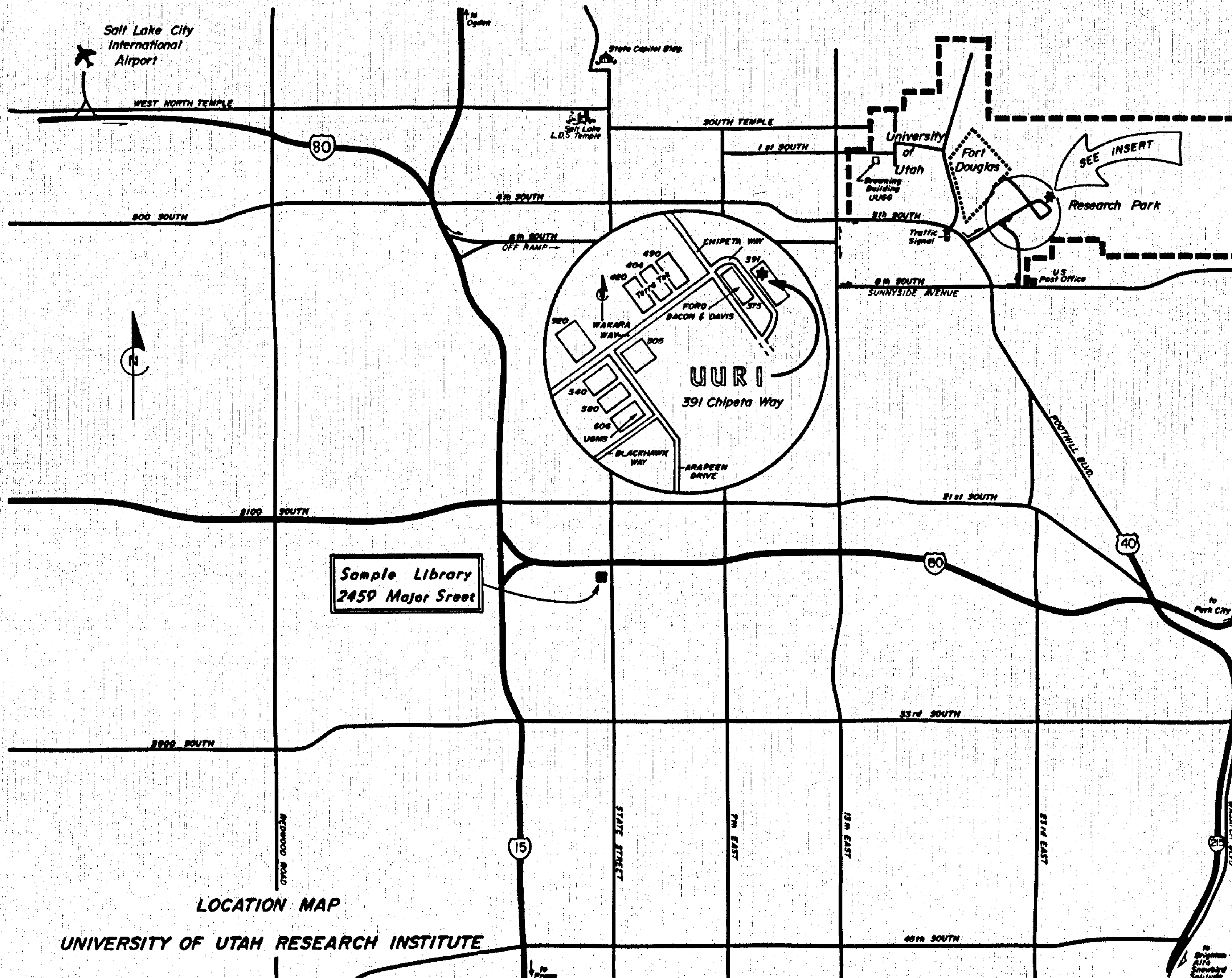
July 1988



LOCATION MAP

UNIVERSITY OF UTAH RESEARCH INSTITUTE

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UNIVERSITY OF UTAH RESEARCH INSTITUTE
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June 9, 1988

Dear Colleague:

The Earth Science Laboratory of the University of Utah Research Institute has been an integral part of the U. S. Department of Energy's geothermal research program for eleven years. This document provides a brief overview of our current geothermal research programs and accomplishments and of our staff and facilities.

Your inquiries about any of our work are welcome. We would also like to invite you to visit our facilities in the University of Utah Research Park at any time.

Sincerely,

Phillip M. Wright
Technical Vice President

attachments

PMW:kr

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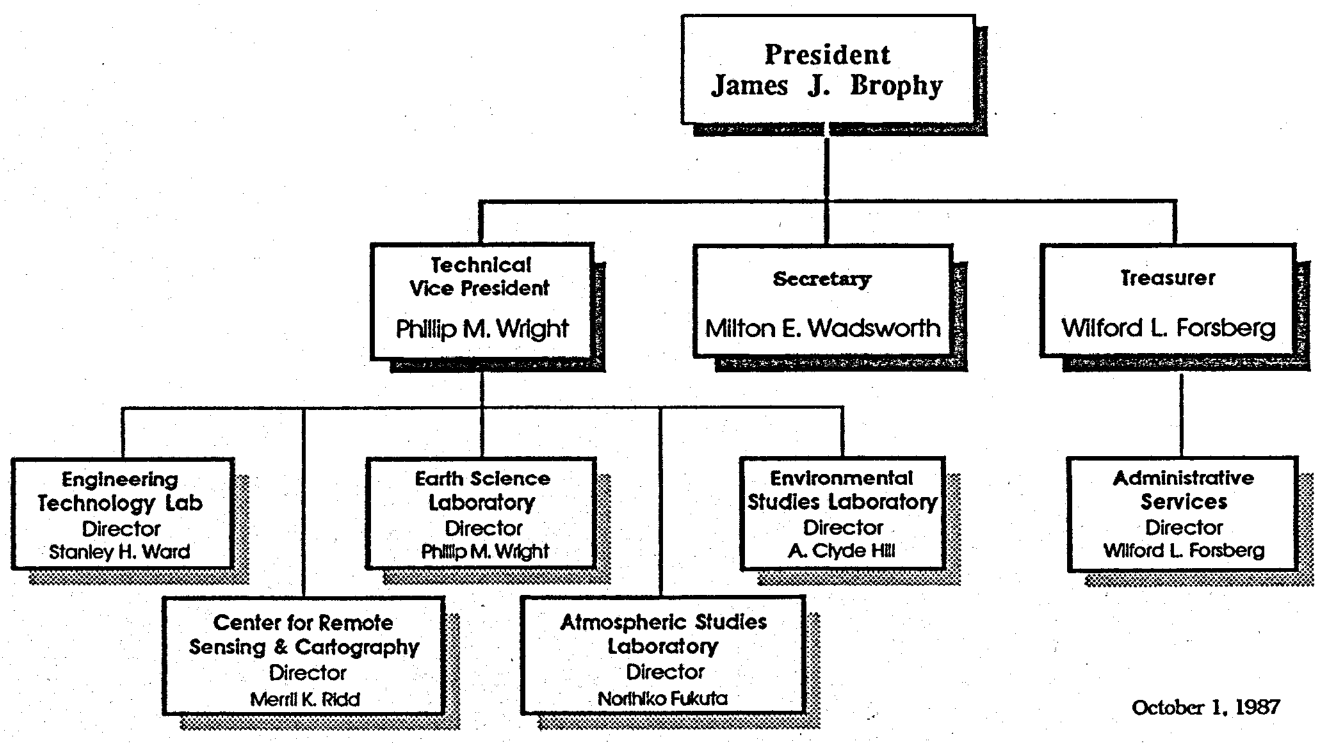
INTRODUCTION TO UURI

The University of Utah Research Institute (UURI) is a self-supporting corporation organized in December 1972 under the Utah Non-Profit Corporation Association Act. Under its charter, the Institute is separate in its operations and receives no direct financial support from either the University of Utah or the State of Utah. The charter includes provisions for UURI to conduct both public and proprietary scientific work for governmental agencies, academic institutions, private industry, and individuals.

UURI is composed of five divisions, shown in Figure 1: the Earth Science Laboratory (ESL), the Environmental Studies Laboratory (EVSL), the Center for Remote Sensing and Cartography (CRSC), the Engineering Technology Laboratory (ETL) and the Atmospheric Physics Laboratory (APL). The Earth Science Laboratory has a staff of geologists, geochemists and geophysicists who have a broad range of experience in geothermal research and field projects (see inside back cover) as well as in mineral and petroleum exploration. The Environmental Studies Laboratory offers a variety of technical services and research capabilities in the areas of air quality and visibility, acid precipitation, surface and groundwater contamination, and environmentally caused stress in vegetation. The Center for Remote Sensing and Cartography offers applied research and services with a full range of remote sensing and mapping capability, including satellite and airborne imagery processing and interpretation. The Engineering Technology Laboratory is currently studying the interaction of the human body with electromagnetic radiation. The Atmospheric Physics Laboratory is developing hygroscopic droplet growth theory and orographic seeding models for dispersal of fog.

The University of Utah Research Institute

ORGANIZATION



SUMMARY OF UURI'S CURRENT GEOTHERMAL RESEARCH

For the past eleven years, the Earth Science Laboratory of UURI has been involved in geothermal energy research on behalf of the U. S. Department of Energy. Our work has predominately concerned the development of new exploration, reservoir definition and mapping techniques for hydrothermal systems. We maintain a commitment to be of assistance in our work to the geothermal industry. Comments and suggestions regarding our research work are always welcome.

This section gives a brief overview of our current research efforts. Our past work is documented in the last section of this document, which gives a list of our geothermal publications.

INJECTION TECHNOLOGY--TRACER DEVELOPMENT

Background

Breakthrough of injected fluids into production wells may significantly decrease the useful life of a geothermal field. Such breakthrough has now been observed, or is suspected, in a number of structurally controlled geothermal systems. Tracers provide the most direct means of monitoring the movement of the injected fluids. The development of new tracers, better suited to the geothermal environment than the few that are currently available, has been the major objective of UURI's tracer research program. As a result of this program, 23 derivitized hydrocarbons have been identified that appear to be stable up to temperatures of 200°C. Of these, 15 have been shown to be stable at 250°C. The long-term in-situ stabilities of these compounds and the effects of rock-tracer interactions however, have not yet been established.

Objectives

Our primary research objective is to develop and test chemical tracers for the geothermal industry to use. The objectives of the current research are 1) to establish the decay rates and determine the effects, if any, of geothermal reservoir rocks on the compounds that appear to be most appropriate for use in high-temperature, liquid-dominated systems; 2) to establish the field procedures required for the handling, injection, and sampling of the tracers; and, 3) to perform one or more field tests of the candidate tracers in actual hydrothermal wells.

FRACTURE CHARACTERIZATION RESEARCH IN THE BACA AND COSO GEOTHERMAL SYSTEMS

Background

Ongoing fracture research has been focused on two dissimilar, active high-temperature liquid-dominated geothermal systems: the Baca system in the Valles caldera in New Mexico, and the Coso system in southern California. Whereas Coso rocks are obscured by a complex array of hydrothermal overprints, the very young rocks at Baca are characterized by simple, readily deciphered alteration signatures. Continuous core from recently completed, strategically situated, intermediate-depth (1700-2800 ft) coreholes at both Baca and Coso has greatly assisted in detailed fracture and alteration research. At Baca, we have recognized the importance of natural hydrofracturing to reservoir development and have improved the conceptual geologic model of the system to include the depth of hydrothermal brecciation, the contemporaneous state of stress, and the energy required to hydrofracture. At Coso, clay mineral geothermometry and fluid-inclusion microthermometry, when compared with current temperature profiles in the boreholes, suggest that the field has heated somewhat since the clays and associated hydrothermal phases were deposited.

Objectives

The objectives of this research are to describe and quantify the structural style and the development and evolution of geothermal reservoirs for the purpose of generating better conceptual geological and geochemical models for use by industry in exploration and reservoir engineering.

DIPMETER INTERPRETATION OF IN-SITU STRESS AND SUBSURFACE STRUCTURE IN GEOTHERMAL WELLS

Background

Recent advances in dipmeter technology, processing and interpretation make it one of the most powerful well logging tools available for determining subsurface structure and stress. Most dipmeter logs have been run in petroleum exploration wells in sedimentary environments and few of these data have been publicly released. The use of dipmeter logs in igneous or volcanic rocks is virtually unheard of, but has great potential for assisting in structural studies.

Objectives

The major goal is to demonstrate the effectiveness and usefulness of dipmeter logs in geothermal wells in igneous and volcanic sequences. Positive results will 1) lead to the availability of a new tool for structural studies of geothermal systems, and 2) encourage the logging industry to develop higher temperature tools.

GEOCHEMICAL TECHNIQUE DEVELOPMENT

Background

Permeability and temperature distribution within a geothermal reservoir affect the isotopic and chemical composition of the geothermal fluid and produce characteristic mineral assemblages. Often, the permeability and temperature distributions either cannot be measured or have changed with time due to fracture sealing. The signature of the distribution, however, is left in the minerals and their fluid inclusions. For instance, heating and freezing measurements of fluid inclusions can reveal the past or present temperatures and fluid salinities in the reservoir. Isotopic analysis of the minerals, combined with the fluid inclusion temperature data, can indicate the degree of oxygen-isotope shift in the fluid, which is a function of permeability. The composition of the fluid in the fluid inclusion indicates permeability distributions as related to boiling and mixing of the fluids. From these data, permeability variations in the reservoir through time and space can be measured.

Objectives

The objective of this research is to describe and quantify the evolution of geothermal reservoirs as evidenced from chemical, thermal, and isotopic changes in the fluids and minerals. This will lead to better models of the chemistry and fluid flow paths in hydrothermal systems.

DEVELOPMENT OF BOREHOLE ELECTRICAL GEOPHYSICAL TECHNIQUES FOR MAPPING FRACTURES IN GEOTHERMAL SYSTEMS

Background

For the last several years, we have been developing computer-based methods to evaluate the use of borehole geophysical techniques for locating fractures and permeable zones in geothermal systems. Our work has progressed to the point where we are ready to build a field system. We have begun to pursue methods for interpretation of field results.

Objectives

The objective of this research is to develop borehole electrical survey methods capable of detecting fractures and permeable zones in the walls of exploration holes in geothermal fields. This will enable the geothermal operator to increase the odds of success in drilling and, therefore, to save money in geothermal development.

This research has both interpretation and instrument-development tasks. We will continue to develop new computer algorithms to interpret the response of electrical geophysical techniques to fractures and permeable zones in geothermal wells. Present research will be directed toward: 1) the development of inverse algorithms for the modeling of surface-to-borehole, borehole-to-surface and borehole-to-borehole data; 2) testing of the algorithms on field data sets; and 3) reporting the results. We will also build a multi-array borehole electrical geophysical system capable of performing borehole-to-surface, borehole-to-borehole, and surface-to-borehole resistivity and induced polarization measurements.

DEVELOPMENT OF THE MAGNETOTELLURIC METHOD

Background

Although the magnetotelluric geophysical method has been used in the geothermal exploration by industry, its use has not been judged to be very cost effective. We believe that the primary reasons for this lack of success is that available instruments have not been capable of obtaining the very high-quality data that are needed for proper interpretation in complex environments and that interpretation techniques have not been adequate. Interpretation of the majority of MT data has been done using layered-earth, one-dimensional methods that are unsuitable for use in the geothermal environment, where the resistivity structure is variable in three dimensions, both with depth and laterally.

Objectives

Our objective is to develop improved instrumentation and interpretation techniques and to demonstrate how the MT technique can be used cost-effectively in geothermal exploration.

EVALUATION OF THE USE OF TIME-DEPENDENT SELF-POTENTIAL TO DETERMINE GEOTHERMAL RESERVOIR CHARACTERISTICS

Background

The self-potential method relies on the measurement of electrical potentials created by changes in fluid pressure, temperature or solute concentration. We have previously used the conventional SP method to monitor the effects of injection at Raft River and East Mesa with limited success. We propose to evaluate a refinement in the self-potential method, which we term the "time dependent self-potential (TDSP) method". To implement the method, an array of semi-permanent, non-polarizing electrodes is placed around a well and a base level of potential established. Next, production or injection is begun and the potential, relative to the base level, is measured for each electrode in the array during a short time interval, with the measurements being repeated for a series of times throughout the test. In this way, it may be possible to follow the pressure or chemical fronts induced by flowing or injecting into the well. By numerical modeling of the data, it is hoped that a two- or three-dimensional picture of the general permeability structure in the vicinity of the well can be developed.

Objectives

Our objective is to develop the TDSP method as a new geophysical tool for determining the permeability structure around a geothermal well and tracing the flow of fluid in the vicinity of a well.

FEASIBILITY STUDY FOR THE MEASUREMENT OF CONDUCTIVITY AND SPECIFIC-ION CONCENTRATIONS DOWNHOLE USING SOLID ELECTRODES

Background

If a borehole logging tool could be developed to measure conductivity, pH, and concentrations of specific ions such as chlorine, magnesium, and sodium in situ, it would be a very useful tool in exploration and characterization of geothermal resources. It may be possible to develop such a tool using solid electrode technology for the sensing elements.

Different electrode materials are sensitive to the presence of particular ions in solution and produce different response curves of voltage vs current as the concentration of ions to which individual electrodes are sensitive varies. The response curves will vary as a function of temperature and there will almost certainly be interactions, i.e., one electrode may respond to multiple ions in solution or multiple electrodes may respond in different ways to an individual ion in solution. It may be possible, however, through appropriate choices of electrodes and measurement procedures, to obtain sufficient electrode response data to allow application of nonlinear optimization algorithms to invert the data set for individual ion concentrations.

Objectives

The current objective of this research is to determine the feasibility of using solid specific-ion electrodes to perform chemical analyses on geothermal fluids down-hole.

CASCADES TECHNICAL ASSISTANCE

Background

During the past three fiscal years, DOE has participated in a cost-sharing arrangement with three geothermal developers to core 4,000 ft to 5,000 ft holes in the Cascades for research purposes. One of the over-riding questions in exploration in the Cascades region has been the nature and thickness of the zone of cold-water overflow. GEO-Newberry has completed two holes on the flanks of Newberry volcano, Thermal Power Corp. has cored one hole on the north flank of Mt. Jefferson and California Energy has begun a core hole on the southeast flank of Mt. Mazama volcano, in which Crater Lake is located. The California Energy hole was suspended nearly two years ago and coring has not been resumed to date.

Objective

The objective of this project is to provide DOE with technical assistance in this program and to collect and release all of the data generated to the public.

CHARACTERIZATION OF CASCADES RESERVOIRS

Background

Rocks of the Western Cascades province are known to be regionally altered and metamorphosed to the zeolite facies. The result of this regional alteration is that the primary porosity and permeability of these rocks have been largely destroyed. Because Western Cascades rocks are believed to underlie the High Cascades, a significant question revolves around the nature of permeability at depth in the High Cascades, where intrusive processes are active to provide heat for geothermal systems.

During FY 87, we initiated studies of the mechanical properties of Cascades rocks. We also initiated a study of the Glacier Peak disseminated mineral system, which was formed by hydrothermal processes. Using information from these studies, we have learned a great deal about the structural style that geothermal reservoirs may be expected to take in the Cascades. These studies need further work for completion.

Electrical geophysical surveys have been performed by others in the vicinities of the Clackamas and Newberry coreholes, and the coreholes intersected the sources of resistivity lows that the surface surveys found. The geologic explanation for the resistivity lows appears to be low-temperature illite-smectite alteration of volcanic rocks. There is no obvious way at present to separate such resistivity lows due to low-temperature alteration from resistivity lows due to high-temperature geothermal systems.

Objectives

The objectives of this project are to identify the rock types and/or structural conditions in the Cascades that are most likely to facilitate the formation of geothermal reservoirs, and to determine the exploration significance of the results.

Other objectives concern the measurement of physical properties of core from the Cascades and other similar volcanic environments for the purpose of determining whether or not some geophysical method might be capable of distinguishing between resistivity lows detected on surface geophysical surveys that are due to low-temperature alteration and resistivity lows that are due to high-temperature alteration.

MEXICO COOPERATIVE RESEARCH

Background

The Mexican Government, through the Comision Federal de Electricidad (CFE), has undertaken a major geothermal development program at the Los Azufres geothermal field in central Mexico, during which they have collected a great deal of data. These data, as well as drill chip samples and fluid samples from production tests, could be very useful in terms of the research underway at UURI because the setting of Los Azufres in many ways parallels the setting of volcanic-related geothermal systems in the United States.

During FY 87, we initiated cooperative research work with the Mexicans at Los Azufres and Cerro Prieto. Our cooperative work so far includes 1) study of drill chips from selected wells and exploration holes in the system at Los Azufres, 2) study and interpretation of geochemical data from the fluids, 3) joint studies of the application of chemical tracers to the system, 4) performing of an aeromagnetic survey over Los Azufres, and 5) work with Mexican geophysicists to help interpret resistivity data over the system by incorporation of the effects of topography on data which they had previously obtained.

Objective

The objectives of this project are to: 1) work with our Mexican colleagues to form a better understanding of the Los Azufres and Cerro Prieto geothermal systems, to the mutual benefit of both sides; and 2) obtain, interpret and publish pertinent data on these Mexican geothermal systems for the benefit of the U.S. geothermal industry.

GEOTHERMAL RESEARCH STAFF AND ASSIGNMENTS

The Earth Science Laboratory of UURI maintains a full-time, permanent geothermal research staff which is supplemented by Research Associates, University of Utah faculty and students. Table 1 shows the distribution of this staff. Not all of our Research Associates are currently working on geothermal research projects.

TABLE 1

EARTH SCIENCE LABORATORY RESEARCH STAFF

Permanent Staff		Research Associates	
Geology		Geology	
Ph.D.	2	Ph.D.	2
B.S.	1		
Geochemistry		Geochemistry	
Ph.D.	1	Ph.D.	2
M.S.	1		
B.S.	2		
Geophysics		Geophysics	
Ph.D.	4	Ph.D.	2
		B.S.	1
		Students	2
Remote Sensing		Remote Sensing	
Remote Sensing	1	Students	1
Electronics		Environmental Sciences	
B.S.	1	M.S.	1
		Geohydrology	
		Ph.D.	2
Total	13	Total	13

The distribution of research staff assignments is shown below in Table 2. An asterisk denotes the primary research scientist to contact for more information on a particular topic.

TABLE 2

RESEARCH STAFF ASSIGNMENTS

GEOLOGY	
M. Lee Allison Senior Geologist	- *Borehole breakout studies - *Dipmeter interpretation - Structural studies, geothermal systems - Ascension Project
Jeff Hulen Senior Geologist	- *Manager, X-ray Diffraction Laboratory - *Fracture permeability and alteration studies at Coso Hot Springs and Valles caldera - Geologic models of hydrothermal systems
Dennis Nielson Senior Geologist Section Head/ Geology	- Fracture permeability and alteration in geothermal systems, - *Geologic models of hydrothermal systems - *Cascades geological models - *Manager, Ascension Project
GEOCHEMISTRY	
Mike Adams Geochemist	- *Chemical tracer development - *Tracer tests in geothermal systems - Geochemistry of geothermal systems
Judy Ballantyne Research Associate	- Alteration and geochemistry of geothermal systems - *Clay formation in geothermal systems
Ruth Kroneman Senior Analytical Chemist	- *Manager, UURI Analytical Chemistry Laboratory - *Analytical technique development
Michele Lemieux Geological Engineer	- Fluid inclusion studies - Physical property studies - *Cascades research coring program

TABLE 2 cont.

Joe Moore Senior Geochemist Section Head/ Geochemistry	- - -	*Fluid inclusion studies *Geochemical and fluid-flow models of geothermal systems *Cascades geological-geochemical models

GEOPHYSICS

Craig Beasley Graduate Student	-	Borehole geophysical studies
Doug LaBrecque Graduate Student	-	Borehole geophysical studies
Howard Ross Section Head/ Applied Geophysics	- -	*Project Manager, DOE State Cooperative Program *Geophysical field studies
John Stodt Research Associate	- -	*Statistical treatment of MT field data *Borehole geophysical studies
Alan Tripp Research Associate	-	*Physical properties of rocks
Philip Wannamaker Section Head/ Research Geophysics	- -	*MT field studies: Long Valley, EMSLAB *MT & EM interpretation development
Stanley Ward Senior Scientist	-	Borehole geophysical studies
Phillip M. Wright Technical V.P., UURI	- -	*Geophysical studies, Los Azufres *Cascades research coring program

ELECTRONICS

Dale Green Senior Engineer	- -	*MT System Development Aeromagnetic system update

TABLE 2 cont.

REMOTE SENSING

Doug Ramsey	-	*Project Manager/Digital image processing
Graduate student	-	Remote sensing study, Los Azufres

FACILITIES

UURI has about 15,000 sq. ft. of laboratory and office space in Research Park, adjacent to the University of Utah campus (see Location Map, inside front cover). We also have about 6,000 sq. ft. of storage space for core and chip samples from geothermal areas.

Geochemical Laboratory

A geochemical laboratory designed especially for geothermal and mineral studies has been operational since 1977. The laboratory is equipped with an ARL Inductively Coupled Plasma Spectrometer (ICP), capable of analyzing 37 elements simultaneously, an IL Atomic Absorption Spectrophotometer, a Jerome Gold Film Mercury Detector, an Orion Specific Ion Meter and electrodes, and complete sample preparation facilities. In addition, an electron microprobe, a scanning electron microscope, and K-Ar and fission track age dating are also available.

X-Ray Diffraction Laboratory

Our x-ray diffraction laboratory is equipped with a Philips Model 3100 X-ray unit for the identification of primary and secondary minerals in rocks from geothermal systems.

Physical Properties Laboratory

UURI maintains laboratory facilities for the in-house determination of a variety of physical property measurements and associated chemical properties. Measurement capabilities include: electrical resistivity/induced polarization; cation exchange capacity; magnetic susceptibility; remanent magnetism, thermal conductivity, density and porosity.

Geophysical Electronics Laboratory

The Electronics Laboratory is well equipped for development of microprocessor-integrated geophysical instrumentation. Test, design, and prototype construction facilities are state-of-the-art. Recent projects include: 1) the redesign and modification of a state-of-the-art magnetotelluric recording system; 2) system integration of a portable (button-on) aeromagnetic data acquisition system which incorporates a radar altimeter and VHS recording of flight path and digital magnetic and altimeter data; and 3) instrumentation for remote monitoring of landslides.

Remote Sensing Laboratory

UURI has available a variety of software and hardware for use in remote sensing application and research. A large portion of our software is integrated into the image processing package called ELAS (Earth Resources Laboratory Application Software) designed and written by NASA's National Space Technology Laboratories, Earth Resources Laboratory. ELAS is currently one of the most powerful tools for the analysis of remotely sensed data. Its capabilities include the analysis of any digitally based remote sensing data collected from spaceborne, airborne or ground based sensors. UURI is a NASA distribution center for this software.

CRSC currently operated ELAS from an in-house PRIME 2655 super minicomputer. Digitizing capabilities include a Tektronic 4954 digitizing tablet interfaced with a Tektronic 4014-1 graphics monitor. RGB color monitor capabilities include an Advanced ELectronic Design (AED) 767 high-resolution display device.

Backup and support to ELAS is provided by the micro-based ERDAS image processing system and geographic information system (GIS). ERDAS currently runs on an enhanced IBM PC/AT with 40 megabyte capability.

Computer

Computer facilities consist of a PRIME 2655 super mini-computer system with links to the University of Utah's UNIVAC Computer Center and to the San Diego Supercomputer Center. The system includes a PRIME 2655 CPU with time-sharing capability and virtual memory, 4 M bytes of main memory, 615 M bytes of disk storage, a 9-track magnetic type drive, a 36-inch Zeta pen plotter, two line printers, 2 Tektronix 4014 graphics terminals with digitizing tablets, a DECwriter terminal and 15 CRT terminals. Three dial-in phone lines are available to users. The system is specifically oriented to scientific and engineering computation and to handling and interpreting geoscience data.

Geothermal Sample Library

The Geothermal Sample Library provides open-file accessibility and archival storage for both public domain and proprietary field and drill samples. At present, the Library contains over 80,000 meters of drill samples and 25,000 meters of core from more than 180 shallow thermal gradient holes and deep holes, mainly from geothermal areas of the western United States. Included are samples from 14 Industry Coupled Program areas in Utah and Nevada; Coso KGRA, California; Raft River, Idaho; and Cascades Range, Oregon; and sample from DOE and private geothermal projects in Wyoming, Colorado, Idaho, Washington, Oregon, California, and New Mexico.

The sample library has been used to archive samples from DOE projects and to distribute samples for authorized research and study. It has been used to advantage by geologists and researchers in preparation for new drilling within the represented areas, and for comparison with drill samples from their own project areas. Chipboards have been prepared for most DOE-supported geothermal holes in order to facilitate study. Downhole geophysical and temperature logs from many geothermal wells are also archived at UURI.

A current inventory of drill core and cuttings curated at the Library and a map summarizing the more important sample collection in the western United States is included in the Geothermal Sample Library Inventory, later in this document.

UNIVERSITY OF UTAH RESEARCH INSTITUTE

EARTH SCIENCE LABORATORY

PUBLICATION LIST

JUNE 1988

Explanation

This publication list includes technical reports, progress reports, journal publications, and meeting abstracts completed by ESL/UURI under Department of Energy funding since 1978. Geothermal reports and publications completed by the Department of Geology and Geophysics, University of Utah, are also listed. Final or selected other projects completed by ESL/UURI for other government (i. e., U. S. Geological Survey, U. S. Bureau of Mines) or United Nations agencies are also included.

ESL/UURI reports may be obtained from UURI at reproduction and handling costs. Reprints of journal publications are sometimes available upon request to the author.

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Appendix 3 - Fracturing and Rubblization, by Dennis V. D'Andrea, Wayne O. Ursenbach, Howard M. Wells, and Stephen R. Winzer.
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GEOTHERMAL SAMPLE LIBRARY INVENTORY

The locations of areas represented by significant drill samples at the Geothermal Sample Library are shown in Figure 3. An inventory of all samples curated at the Library follows.

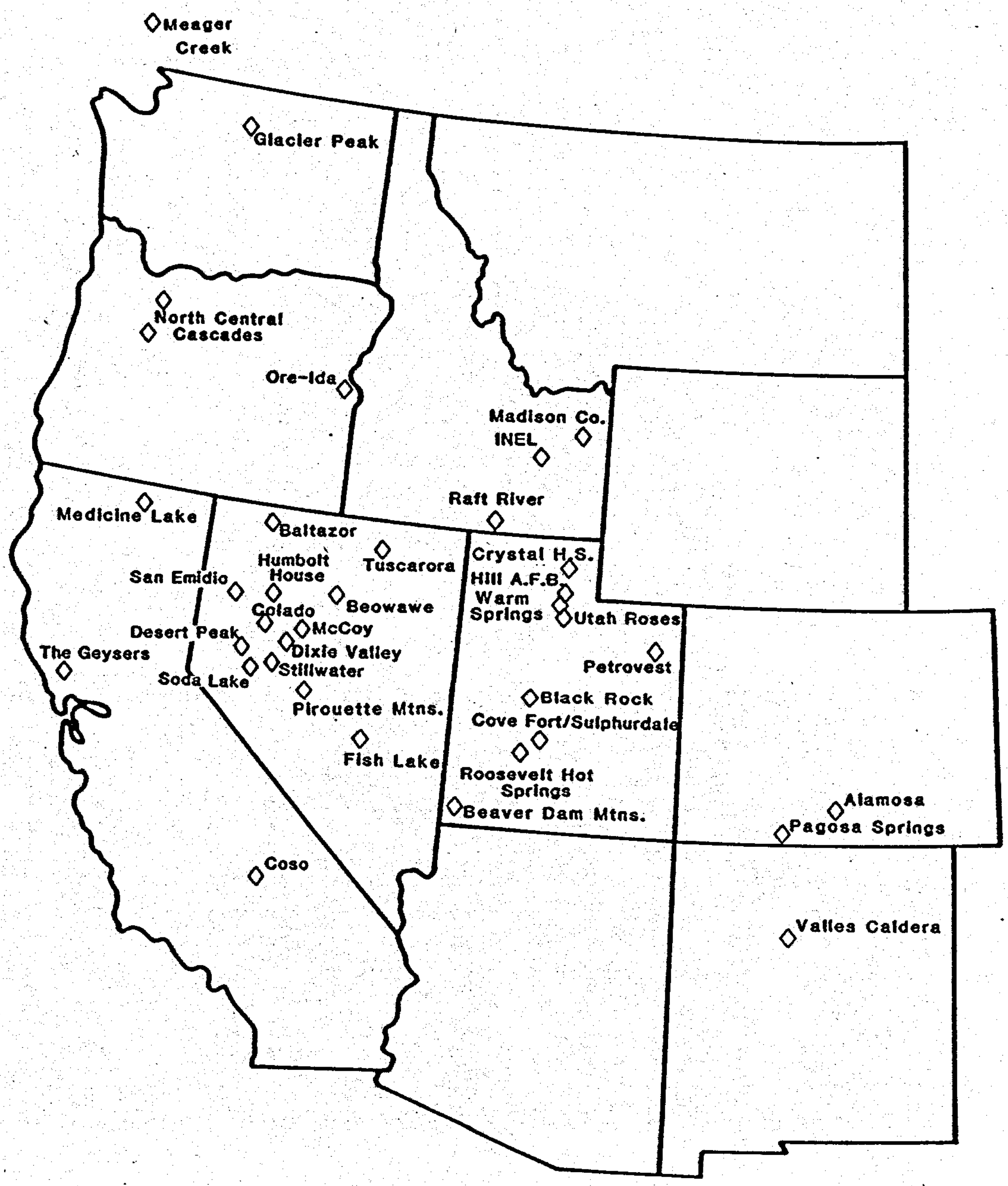

Figure 3. Location Map - Drill Hole Samples in Geothermal Sample Library

Area/Hole Name	Location				Footage	Driller
COSO						
CGEH-1	Inyo Co.	Sec. 6,	T22S,	R39E	Chips 0-4845'	DOE
CGEH-1 variable	Inyo Co.	Sec. 6,	T22S,	R39E	Core 0-4845'	DOE
Grad. Holes #1	Inyo Co.	Sec. 6,	T22S,	R39E	Chips	0-293' DOE
Grad. Holes #2						0-278'
Grad. Holes #3						0-300'
Grad. Holes #4						0-246'
Grad. Holes #5						0-296'
Grad. Holes #6						0-343'
Grad. Holes #7						0-309'
Grad. Holes #10						0-354'
Grad. Holes #11						0-225'
Grad. Holes #12						0-438'
Grad. Holes #13						0-304'
Grad. Holes #14						0-301'
Grad. Holes #15						0-325'
Grad. Holes #17						0-313'
BDSH-1	Inyo Co.	Sec. 6,	T22S	R39E	Core 11'-1342'	DOE
CGC 18-27	Inyo Co.				Core 306-2898'	Cal. Energy
CGC 74-2	Inyo Co.				Core 303-2990'	Cal. Energy
TCH 87-25	Inyo Co.				Core 315-2970'	Cal. Energy
TCH 86-30	Inyo Co.				Core 302-2786'	Cal. Energy
87-17	Inyo Co.				Core 304-2892'	Cal. Energy

June 27, 1988 CALIFORNIA

Area/Hole Name	Location				Footage		Driller
COSO							
CGEH-1	Inyo Co.	Sec. 6,	T22S,	R39E	Chips	0-4845'	DOE
CGEH-1 variable	Inyo Co.	Sec. 6,	T22S,	R39E	Core	0-4845'	DOE
Grad. Holes #1	Inyo Co.	Sec. 6,	T22S,	R39E	Chips	0-293'	DOE
Grad. Holes #2						0-278'	
Grad. Holes #3						0-300'	
Grad. Holes #4						0-246'	
Grad. Holes #5						0-296'	
Grad. Holes #6						0-343'	
Grad. Holes #7						0-309'	
Grad. Holes #10						0-354'	
Grad. Holes #11						0-225'	
Grad. Holes #12						0-438'	
Grad. Holes #13						0-304'	
Grad. Holes #14						0-301'	
Grad. Holes #15						0-325'	
Grad. Holes #17						0-313'	
BDSH-1	Inyo Co.	Sec. 6,	T22S	R39E	Core	11'-1342'	DOE
CGC 18-27	Inyo Co.				Core	306-2898'	Cal. Energy
CGC 74-2	Inyo Co.				Core	303-2990'	Cal. Energy
TCH 87-25	Inyo Co.				Core	315-2970'	Cal. Energy
TCH 86-30	Inyo Co.				Core	302-2786'	Cal. Energy
87-17	Inyo Co.				Core	304-2892'	Cal. Energy

Area/Hole Name	Location				Footage	Driller
COSO						
TCH 57-18	Inyo Co.				Core 306-2825'	Cal. Energy
6416	Inyo Co.				Core 315-2020'	Cal. Energy
GEYSERS						
68A-21	Lake Co.	Sec. 21,	T11N	R8W	Chips 820'-5000'	Occidental
E-9/38-1	Lake Co.	Sec. 1,	T10N	R8W	Chips 0'-3400'	Shell Oil
F-8/43-3	Sonoma Co.	Sec. 3,	T10W	R8W	Chips 30'-3000'	Shell Oil
D-7 24A-2	Sonoma Co.	Sec. 2,	T10N	R8W	Chips 2010-5000'	Shell Oil
G-11 33-4	Sonoma Co.	Sec. 4,	T10N	R8W	Chips 86-3000'	Shell Oil
CA-94 9M-14 72-1	Lake Co.	Sec. 3,	T10N	R8W	Chips 160-3000'	Shell Oil
CA-1862 57-27-2	Lake Co.	Sec. 27,	T11N	R8W	Chips 0-5468'	Aminoil
CA-5637 74-12	Lake Co.	Sec. 21,	T11N	R8W	Chips 300-5300'	Occidental
Q-13/CA-949 /53-2	Lake Co.	Sec. 2,	T10N	R8W	Chips 100-3000'	Shell Oil
Livermore 1	Lake Co.	Sec. 1,	T10N	R6W	Chips 0-8760'	AMAX
Geothermal Two-2	Lake Co.	Sec. 3,	T10N	R8W	Chips 100-3000'	Shell Oil
Geothermal 1-2	Lake Co.	Sec. 11A-1,			Chips 0-5300'	Shell Oil

CALIFORNIA cont.

Area/Hole Name	Location				Footage		Driller
MEDICINE LAKE							
Burnt Lava #18-34	Siskiyou Co.	Sec. 34,	T43N	R3E	Core	519-3500'	Geyser
Burnt Lava #27-27	Siskiyou Co.	Sec. 27,	T43N	R4E	Core	466-3000'	Geyser
Burnt Lava #62-21	Siskiyou Co.	Sec. 21,	T43N	R3E	Core	487-2139'	Geyser
Burnt Lava #86-23	Siskiyou Co.	Sec. 23,	T43N	R2E	Core	417-2939'	Geyser
36-28	Siskiyou Co.	Sec. 28,	T44N	R3E	Core	353-2146'	Geyser
57-13	Siskiyou Co.	Sec. 13,	T44N	R3E	Core	409-2994.5'	Geyser
68-16	Siskiyou Co.	Sec. 16,	T44N	R3E	Core	417-2939'	Geyser
MOUNT SHASTA							
52-4	Siskiyou Co.	Sec. 4,	T42N	R3E	Core	367-4000'	Geyser
88-12	Siskiyou Co.	Sec. 12,	T42N	R1W	Core	290-3940'	Geyser
WENDEL							
WEN-W-1	Lassen Co.	Sec. 13,	T29N	R15W	Chips	0-5788'	GEO Prod. Corp.
WEN-2	Lassen Co.	Sec.			Chips	327-4660'	GEO Prod. Corp.
WEN-3	Lassen Co.	Sec.			Chips	275-6430'	GEO Prod. Corp.

COLORADO

Area/Hole Name	Location	Footage	Driller
PAGOSA SPRINGS			
PS-3	Archuleta Co.	Chips 0-240'	Chaffee Geothermal
PS-4	Archuleta Co.	Chips 0-300'	Chaffee Geothermal
PS-5	Archuleta Co.	Chips 0-200'	Chaffee Geothermal

IDAHO

Area/Hole Name	Location			Footage	Driller
MCG #1	Madison Co. Sec.31,	T6N	R40E	Chips 200-3140'	Energy Service Inc.
INEL	Butte Co. Sec. 1,	T3N	R29E	Chips 0-10-324'	DOE
INEL	Butte Co. Sec. 1,	T3N	R29E	Core Variable	DOE
RAFT RIVER					
RRGE#1	Cassia Co. Sec. 23,	T15S	R26E	Core Variable	DOE
RRGE#2	Cassia Co. Sec. 23,	T15S	R26E	Core Variable	DOE
RRGE#3	Cassia Co. Sec. 25,	T15S	R26E	Core Variable	DOE
RRGE#3C	Cassia Co. Sec. 25,	T15S	R26E	Core Variable	DOE
RRGP#4(Leg B)	Cassia Co. Sec. 25,	T15S	R26E	Core Variable	DOE
RRGP#5	Cassia Co. Sec. 22,	T15S	R26E	Core Variable	DOE
RRGI#6	Cassia Co. Sec. 25,	T15S	R26E	Core Variable	DOE

IDAHO cont.

Area/Hole Name	Location	Footage	Driller
RAFT RIVER			
RRGI#7	Cassia Co. Sec. 25, T16S R26E	Core Variable	DOE

NEW MEXICO

Area/Hole Name	Location	Footage	Driller
BACA			
9RD 5A		2100-5500'	
9RD 5		2100-2800'	
17RD 1		3240-6254'	
19		60-5600'	
20		87-6860'	
20RD 1		2580-6374'	
21		40-2842'	
22		90-5980'	
22RD 1		2840-6485'	
22RD 2		2760-6000'	
22RD 3		2660-8800'	
23		40-5780'	

NEVADA

Area/Hole Name	Location			Footage	Driller
BALTAZOR					
1500-1	Humboldt Co. Sec. 13,	T46N	R28E	Chips 0-1581'	Earth Power Pro. Co.
1500-7	Humboldt Co. Sec. 14,	T46N	R28E	Chips 0-1487'	Earth Power Pro. Co.
2	Humboldt Co. Sec. 3,	T46N	R28E	Chips 0-170'	Earth Power Pro. Co.
Howard #189	Humboldt Co. Sec. 24,	T44N	R31E	Chips 0-200'	Earth Power Pro. Co.
117	Humboldt Co. Sec. 16,	T46N	R28E	Chips 0-220'	Earth Power Pro. Co.
122	Humboldt Co. Sec. 25,	T46N	R28E	Chips 0-280'	Earth Power Pro. Co.
143-A	Humboldt Co. Sec. 10,	T45N	R27E	Chips 0-200'	Earth Power Pro. Co.
189	Humboldt Co. Sec. 24,	T44N	R31E	Chips 0-200	Earth Power Pro. Co.
213	Humboldt Co. Sec. 1,	T46N	R28E	Chips 0-260'	Earth Power Pro. Co.
215	Humboldt Co. Sec. 14,	T46N	R28E	Chips 0-100'	Earth Power Pro. Co.
101-5	Humboldt Co. Sec. 7,	T47N	R30E	Chips 0-100'	Earth Power Pro. Co.
101-6	Humboldt Co. Sec. 36,	T42N	R29E	Chips 0-280'	Earth Power Pro. Co.
101-7	Humboldt Co. Sec. 34,	T46N	R28E	Chips 0-300'	Earth Power Pro. Co.
101-12	Humboldt Co. Sec. 5,	T47N	R30E	Chips 0-270'	Earth Power Pro. Co.
101-99	Humboldt Co. Sec. 16,	T47N	R30E	Chips 0-300'	Earth Power Pro. Co.
45-14	Humboldt Co.			Chips 20-2345'	Earth Power Pro. Co.
B-2-79	Eureka Co. Sec. 5,	T31N	R48E	Chips 0-500'	Chevron

Area/Hole Name	Location			Footage	Driller
BEOWAWE					
B-7-79	Lander Co. Sec. 18,	T31N	R48E	Chips 0-500'	Chevron
B-9-79	Eureka Co. Sec. 9,	T31N	R48E	Chips 0-500'	Chevron
B-11-79	Lander Co. Sec. 18,	T31N	R48E	Chips 0-500'	Chevron
B-14-79	Lander Co. Sec. 13,	T31N	R47E	Chips 0-500'	Chevron
B-19-79	Lander Co. Sec. 18,	T31N	R48E	Chips 0-500'	Chevron
B-20-79	Lander Co. Sec. 18,	T31N	R48E	Chips 0-340'	Chevron
B-22-79	Lander Co. Sec. 18,	T31N	R48E	Chips 0-500'	Chevron
B-24-79	Lander Co. Sec. 18,	T31N	R48E	Chips 0-450'	Chevron
B-25-79	Lander Co. Sec. 18,	T31N	R48E	Chips 0-430'	Chevron
B-27-79	Lander Co. Sec. 18,	T31N	R48E	Chips 0-240'	Chevron
B-29-79	Eureka Co. Sec. 13,	T31N	R47E	Chips 0-460'	Chevron
B-31-79	Lander Co. Sec. 18,	T31N	R48E	Chips 0-450'	Chevron
B-32-79	Lander Co. Sec. 18,	T31N	R48E	Chips 0-500'	Chevron
B-33-79	Eureka Co. Sec. 12,	T31N	R48E	Chips 0-200'	Chevron
B-35-79	Eureka Co. Sec. 16,	T31N	R48E	Chips 0-500'	Chevron
B-37-79	Lander Co. Sec. 18,	T31N	R48E	Chips 0-290'	Chevron
B-38-79	Lander Co. Sec. 18,	T31N	R48E	Chips 0-500'	Chevron

Area/Hole Name	Location			Footage	Driller
BEOWAWE					
B-39-79	Eureka Co. Sec. 17,	T31N	R48E	Chips 0-420'	Chevron
B-46-79	Eureka Co. Sec. 13,	T31N	R48E	Chips 0-160'	Chevron
B-47-79	Eureka Co. Sec. 20,	T31N	R48E	Chips 0-390'	Chevron
B-48-79	Eureka Co. Sec. 21,	T31N	R48E	Chips 0-490'	Chevron
B-49-79	Eureka Co. Sec. 24,	T31N	R48E	Chips 0-500'	Chevron
B-50-79	Lander Co. Sec. 18,	T31N	R48E	Chips 0-330'	Chevron
B-51-79	Lander Co. Sec. 19,	T31N	R48E	Chips 0-430'	Chevron
B-51-79	Lander Co. Sec. 19,	T31N	R48E	Chips 0-140'	Chevron
B-54-79	Eureka Co. Sec. 24,	T31N	R48E	Chips 0-450'	Chevron
USL-GBP #2	Lander Co. Sec. 17,	T31N	R48E	Chips 0-500'	Getty Oil
USL-GBP #3	Lander Co. Sec.	T31N	R48E	Chips 0-500'	Getty Oil
USL-GBP #5	Lander Co. Sec. 16,	T31N	R48E	Chips 0-500'	Getty Oil
USL-GBP #6	Lander Co. Sec. 20,	T31N	R48E	Chips 0-500'	Getty Oil
USL-GBP #7	Lander Co. Sec. 22,	T31N	R48E	Chips 0-500'	Getty Oil
USL-GBP #9	Lander Co. Sec. 22,	T31N	R48E	Chips 0-480'	Getty Oil
USL-GBP #15	Lander Co. Sec. 20,	T31N	R48E	Chips 0-500'	Getty Oil
USL-GBP #17	Lander Co. Sec. 16,	T31N	R48E	Chips 0-500'	Getty Oil

Area/Hole Name	Location			Footage	Driller
BEOWAWE					
Collins 76-17	Eureka Co. Sec. 17,	T13N	R48E	Chips 1200-9000'	Getty Oil
GBP #10	Eureka Co. Sec. 22,	T31N	R48E	Chips 0-500'	Getty Oil
GBP #12	Eureka Co. Sec. 14,	T31N	R48E	Chips 0-440'	Getty Oil
GBP #13	Eureka Co. Sec. 14,	T31N	R48E	Chips 0-460'	Getty Oil
GBP #14	Eureka Co. Sec. 11,	T31N	R48E	Chips 0-300'	Getty Oil
GBP #16	Eureka Co. Sec. 20,	T31N	R48E	Chips 0-440'	Getty Oil
#85-18	Lander Co. Sec. 18,	T31N	R43E	Chips 0-5400'	Getty Oil
COLADO					
8-34	Pershing Co. Sec. 34,	T28N	R32E	Chips 0-500'	Getty Oil
1-12	Pershing Co. Sec. 12,	T27N	R32E	Chips 0-500'	Getty Oil
9-34	Pershing Co. Sec. 34,	T28N	R32E	Chips 0-500'	Getty Oil
3-10	Pershing Co. Sec. 10,	T27N	R32E	Chips 0-500'	Getty Oil
4-16	Pershing Co. Sec. 16,	T27N	R32E	Chips 0-500'	Getty Oil
12-26	Pershing Co. Sec. 26,	T28N	R32E	Chips 0-300'	Getty Oil
2-2	Pershing Co. Sec. 2,	T27N	R32E	Chips 0-500'	Getty Oil
15-21	Pershing Co. Sec. 21,	T28N	R32E	Chips 0-500'	Getty Oil
10-34	Pershing Co. Sec. 34,	T28N	R32E	Chips 0-500'	Getty Oil

Area/Hole Name	Location			Footage	Driller
COLADO					
Ginn 1-13	Lander Co. Sec. 13,	T31N	R47E	Chips 0-6350'	Chevron Resources
Rossi 21-9	Lander Co. Sec. 19,	T31N	R48E	Chips 0-5686'	Chevron Resources
6-6	Pershing Co. Sec. 6,	T27N	R32E	Chips 0-500'	Getty Oil
16-22	Pershing Co. Sec. 22,	T28N	R31E	Chips 0-500'	Getty Oil
5-8	Pershing Co. Sec. 8,	T27W	R32E	Chips 0-500'	Getty Oil
17-24	Pershing Co. Sec. 24,	T28N	R32E	Chips 0-500'	Getty Oil
7-4	Pershing Co. Sec. 4,	T27N	R32E	Chips 0-500'	Getty Oil
18-24	Pershing Co. Sec. 24,	T28N	R32E	Chips 0-500'	Getty Oil
13-26	Pershing Co. Sec. 26,	T28N	R32E	Chips 0-500'	Getty Oil
14-22	Pershing Co. Sec. 22,	T28N	R32E	Chips 0-500'	Getty Oil
11-36	Pershing Co. Sec. 36,	T28N	R32E	Chips 0-500'	Getty Oil
1GH-1	Pershing Co. Sec. 26,	T28N	R32E	Chips 0-1500'	Getty Oil
1GH-2	Pershing Co. Sec. 10,	T27N	R32E	Chips 0-1160'	Getty Oil
USL 44X-10	Pershing Co. Sec. 10,	T27N	R32E	Chips 1215-7950'	Getty Oil
DESERT PEAK B					
No. 8-23-1	Churchill Co. Sec. 23	T22N	R27E	Chips 0-9615'	Phillips
Humboldt House					

Area/Hole Name	Location			Footage	Driller
DESERT PEAK B					
Campbell "E" #2	Pershing Co. Sec. 15,	T31N	R33E	Chips 0-8061'	Phillips
DIXIE FEDERAL					
45-14	Churchill Co. Sec. 14,	T23N	R35E	Chips 0-9020'	Thermal Power
66-21	Churchill Co. Sec. 21,	T22N	R36E	Chips 0-9780'	Thermal Power
DIXIE VALLEY					
SR-4	Churchill Co. Sec. 22,	T23N	R38E	Chips 0-1500'	Southland Royalty Co.
SR-3	Churchill Co. Sec. 32,	T25N	R37E	Chips 0-1500'	Southland Royalty Co.
FISH LAKE					
88-11A	Nye			Chips 0-8580'	
88-11	Nye			Chips 0-8120'	AMAX
LEACH HOT SPRING					
SUNEDCO 11-36	Pershing Co.			Chips 0-8565'	AMINOIL
MCCOY					
66-8	Churchill Co.			Chips 0-2500'	AMAX
14-7	Churchill Co.			Chips 0-940'	AMAX
26-8	Churchill Co.			Chips 0-2094'	AMAX
26-8	Churchill Co.			Core 1001-2094'	AMAX

NEVADA cont.

Area/Hole Name	Location			Footage	Driller
MCCOY					
864-25-9	Churchill Co.				Chips0-2000'AMAX
864-38-9	Churchill Co.				Chips0-2000'AMAX
864	Churchill/Lander Co. sent all chips to				AMAX
MCGEE					
2	Humboldt Co. Sec.26	T45N	R27E	Chips 0-1680'	Earth Power Pro. Co.
101-9	Humboldt Co. Sec. 2	T44N	R27E	Chips 0-300'	Earth Power Pro. Co.
145	Humboldt Co. Sec.1,	T45N	R27E	Chips 0-240'	Earth Power Pro. Co.
150	Humboldt Co. Sec.27	T45N	R27E	Chips 0-290'	Earth Power Pro. Co.
155	Humboldt Co. Sec.29	T45N	R27E	Chips 0-280'	Earth Power Pro. Co.
PIROUETTE MOUNTAINS					
66-16	Churchill Co. Sec. 16,	T19N	R34E	Chips 0-6700'	Rosewood Corp.
72-23	Churchill Co. Sec. 23,	T18N	R33E	Chips 1000-7460'	Rosewood Corp. Hunt Energy
Fed 52-14	Churchill Co. Sec. 14,	T18N	R33E	Chips 500-T18N	Rosewood Corp.
SAN EMIDIO					
Kosmos 1-8				Chips 0-4013'	Chevron Resources
Kosmos 1-9	Washoe Co. Sec. 9,	T29N	R23E	Chips 0-5356'	Chevron Resources

NEVADA cont.

Area/Hole Name	Location			Footage	Driller
SODA LAKE					
44-5	Churchill Co. Sec. 5,	T29N	R28E	Chips 0-5069'	Chevron Resources
1-29	Churchill Co. Sec. 29,	T20N	R28E	Chips 0-4306'	Chevron Resources
DeBraga #2	Churchill Co. Sec. 6,	T19N	R31E	Chips 0-6700'	Union Oil
11-33	Churchill Co. Sec. 33,	T20N	R28E	Chips 0-2000'	Chevron Resources
63-33	Churchill Co .Sec. 33,	T20N	R28E	Chips 0-2000'	Chevron Resources
860-33	Elko Co. Sec. 3,	T41N	R52E	Chips 0-770'	AMAX
860-41	Elko Co. Sec. 10,	T41N	R52E	Chips 0-1000'	AMAX
860-42	Elko Co. Sec. 5,	T41N	R52E	Chips 0-1740'	AMAX
860-68-8	Elko Co.			Chips 0-2020'	AMAX
860-81-7	Elko Co.			Chips 0-2010'	AMAX
57-8A	Elko Co.			Chips 0-80'	AMAX
AMAX 52-9	Elko Co. Sec. 5,	T41N	R52E	Chips 0-3120'	AMAX
860-32	Elko Co. Sec. 6,	T41N	R52E	Chips 0-1020'	AMAX
860-34	Elko Co. Sec. 14,	T41N	R52E	Chips 0-1040'	AMAX
860-36	Elko Co. Sec. 29,	T42N	R52E	Chips 0-300'	AMAX
860-43	Elko Co. Sec. 35,	T41N	R52E	Chips 0-1040'	AMAX
57-8A	Elko			Core 0-211'	AMAX

NEVADA cont.

Area/Hole Name	Location			Footage	Driller
STILLWATER					
Weishauft 1	Churchill Co. Sec. 1,	T19N,	R30E	Chips 0-10,000'	Union Oil
TUSCARORA					
57-8	Elko			Core 209-1709'	AMAX
66-5	Elko Co. Sec. 5,	T41N	R52E	Chips 0-4350'	AMAX
AMAX 51-9	Elko Co. Sec. 5,	T41N	R52E	Chips 0-3120'	AMAX

OREGON

Area/Hole Name	Location			Footage	Driller
CLACKMAS					
Thermal Power CTGH-1	Clackamas Co.Sec.28	T8S	R8E	Chips 0-527'	
Thermal Power CTGH-1	Clackamas Co.Sec.28	T8S	R8E	Core 527-4800'	
NO. CENTRAL CASCADE					
1	Linn Co. Sec. 32,	T13S	R7E	Chips 0-1837'	Southland Royalty Co.
2	Linn Co. Sec. 9,	T12S	R7E	Chips 0-1965'	Southland Royalty Co.
3	Clackamas Co. Sec. 5,	T7S	R8E	Chips 0-960'	Southland Royalty Co.
4	Clackamas Co. Sec. 10,	T7S	R8E	Chips 0-1160'	Southland Royalty Co.
5	Clackamas Co. Sec. 6,	T8S	R8E	Chips 0-730'	Southland Royalty Co.
6	Clackamas Co. Sec. 6,	T8S	R8E	Chips 0-1510'	Southland Royalty Co.

OREGON cont.

Area/Hole Name	Location				Footage	Driller
NEWBERRY						
N-1	Deshutes Co.	Sec. 25,	T22S	R12E	Core 487-4000'	Geo Newberry
N-3	Deshutes Co.	Sec. 24,	T20S	R12E	Core 453-4002'	Geo Newberry
OLD MAID FLAT						
Fenix & Scission 7A	Clackamas Co.	Sec. 15,	T2S	R8E	Chips 0-6018'	Fenix & Scission
ORE-IDA						
1	Malheur Co.	Sec. 3,	T18S	R47E	Chips 0-10,054'	Ore-Ida Foods
1	Malheur Co.	Sec. 3,	T18S	R47E	Core Variable	Ore-Ida Foods

TEXAS

Area/Hole Name	Location	Footage	Driller
LACKLAND A.F.B.			
Lackland	Bexer Co.	Chips 0-4130'	
Lackland	Bexer Co.	Chips 0-4128'	

UTAH

Area/Hole Name	Location				Footage	Driller
COVE FORT						
Black Rock		Sec.18 ADA	T24S	R11W	Core 19.0-204.7	
5-79/2204	Beaver Co.	Sec. 6,	T30S	R9W	Chips 0-5000'	Hunt Energy

Area/Hole Name		Location			Footage	Driller
COVE FORT						
5-27/2208	Beaver Co.	Sec. 3,	T30S	R9W	Chips 0-5000'	Hunt Energy
5-79/2210	Beaver Co.	Sec. 7,	T30S	R9W	Chips 0-500'	Hunt Energy
5-79/2214	Beaver Co.	Sec. 14,	T30S	R9W	Chips 0-500'	Hunt Energy
5-79/2218	Beaver Co.	Sec. 19,	T30S	R9W	Chips 0-490'	Hunt Energy
5-79/2219	Beaver Co.	Sec. 21,	T30S	R9W	Chips 0-500'	Hunt Energy
14-80/2230	Beaver Co.	Sec. 14,	T30S	R9W	Chips 0-500'	Hunt Energy
14-80/2231	Beaver Co.	Sec. 23,	T30S	R9W	Chips 0-500'	Hunt Energy
14-80/2233	Beaver Co.	Sec. 27,	T30S	R9W	Chips 0-500'	Hunt Energy
14-80/2235	Beaver Co.	Sec. 34,	T30S	R9W	Chips 0-500'	Hunt Energy
14-80/2237	Beaver Co.	Sec. 33,	T30S	R9W	Chips 0-500'	Hunt Energy
14-80/2240	Beaver Co.	Sec. 32,	T30S	R9W	Chips 0-500'	Hunt Energy
14-80/2243	Beaver Co.	Sec. 29,	T30S	R9W	Chips 0-260'	Hunt Energy
14-80/2243A	Beaver Co.	Sec.			Chips 510-1200'	Hunt Energy
CFSU 14-29	Millard Co.	Sec. 29,	T25S	R6W	Chips 0-2620'	Union Oil
CFSU 31-33	Millard Co.	Sec. 33,	T25S	R6W	Chips 0-5220'	Union Oil Co.
Union 42-7	Beaver Co.	Sec. 7,	T26S	R6W	Chips 0-7730'	Union Oil Co.
Forminco #1	Millard Co.	Sec. 29,	T25S	R6W	Chips 0-1051'	Union of Ca.

Area/Hole Name	Location	Footage	Driller
COVE FORT			
Forminco A	Millard Co.	Chips 0-300'	Union Oil
Forminco B	Millard Co.	Chips 0-110'	Union Oil
Forminco C	Millard Co.	Chips 0-300'	Union Oil
Forminco D	Millard Co.	Chips 0-90'	Union Oil
Forminco E	Millard Co.	Chips 0-300'	Union Oil
Forminco F	Millard Co.	Chips 150-255'	Union Oil
Forminco G	Millard Co.	Chips 0-300'	Union Oil
Forminco H	Millard Co.	Chips 0-300'	Union Oil
Forminco I	Millard Co.	Chips 0-245'	Union Oil
Forminco J	Millard Co.	Chips 0-300'	Union Oil
Forminco K	Millard Co.	Chips 0-250'	Union Oil
Forminco L	Millard Co.	Chips 0-250'	Union Oil
Forminco M	Millard Co.	Chips 0-250'	Union Oil
Forminco N	Millard Co.	Chips 0-120'	Union Oil
Forminco O	Millard Co.	Chips 0-250'	Union Oil
Forminco #1	Millard Co.	Chips 0-250'	Union Oil
Forminco #2	Millard Co.	Chips 0-250'	Union Oil

Area/Hole Name	Location				Footage	Driller
COVE FORT						
Forminco #3	Millard Co.				Chips 0-230'	Union Oil
Forminco #4	Millard Co.				Chips 0-250'	Union Oil
Forminco #5	Millard Co.				Chips 0-180'	Union Oil
Indian Crk #8					Core 105-491.5'	
CRYSTAL SPRINGS						
A-W	Box Elder Co.				Chips 70-230'	UT Min. Survey
CMGH-A	Box Elder Co.	Sec. 29,	T11N	R2W	Chips 0-275'	UT Min. Survey
CW	Box Elder Co.				Chips 150-280'	UT Min. Survey
E	Box Elder Co.	Sec.			Chips 40-200'	UT Min. Survey
D-Davis#1					Chips 0-235'	UT Min. Survey
F	Box Elder Co.	Sec.			Chips 0-150'	UT Min. Survey
GSLM/GH-A	Box Elder Co.	Sec. 6,	T6N	R3W	Chips 0-280'	UT Min. Survey
UT/GH-B	Box Elder Co.	Sec. 14,	T7N	R23W	Chips 0-90'	UT Min. Survey
UDY/GH-A	Box Elder Co.	Sec. 23,	T13N	R3W	Chips 0-130'	UT Min. Survey
UDY/GH-B	Box Elder Co.	Sec. 23,	T13N	R3W	Chips 0-290'	UT Min. Survey
HILL AIR FORCE BASE						
1	Davis Co.				Chips 0-1220'	Univ. of Utah

Area/Hole Name	Location				Footage	Driller
HILL AIR FORCE BASE						
2	Davis Co.				Chips 0-3260'	Univ. of Utah
ROOSEVELT						
Getty 52-21	Beaver Co.	Sec. 21,	T27S	R9W	Chips 0-7500'	Getty Oil Co.
Getty 52-21	Beaver Co.	Sec. 21,	T27S	R9W	Core Variable	Getty Oil Co.
TPC 72-16	Beaver Co.	Sec. 16,	T27S	R9W	Chips 0-1244'	Thermal Power Co.
GPC-1	Beaver Co.	Sec. 1,	T27S	R10W	Chips 0-400'	Geoth. Power Corp.
GPC-2	Beaver Co.	Sec. 6,	T27S	R9W	Chips 0-300'	Geoth. Power Corp.
GPC-3	Beaver Co.	Sec. 4,	T27S	R9W	Chips 0-300'	Geoth. Power Corp.
GPC-4	Beaver Co.	Sec. 33,	T27S	R9W	Chips 0-300'	Geoth. Power Corp.
GPC-5	Beaver Co.	Sec. 34,	T27S	R9W	Chips 0-180'	Geoth. Power Corp.
GPC-6	Beaver Co.	Sec. 25,	T27S	R10W	Chips 0-300'	Geoth. Power Corp.
GPC-7	Beaver Co.	Sec. 13,	T27S	R9W	Chips 0-300'	Geoth. Power Corp.
GPC-8	Beaver Co.	Sec. 25,	T26S	R9W	Chips 0-360'	Geoth. Power Corp.
GPC-9	Beaver Co.	Sec. 12,	T26S	R8W	Chips 0-290'	Geoth. Power Corp.
GPC-10	Beaver Co.	Sec. 6,	T26S	R8W	Chips 0-196'	Geoth. Power Corp.
GPC-11	Beaver Co.	Sec. 17,	T26S	R8W	Chips 0-110'	Geoth. Power Corp.
GPC-12	Beaver Co.	Sec.	T26S	R7W	Chips 0-260'	Geoth. Power Corp.

Area/Hole Name	Location			Footage	Driller
ROOSEVELT					
GPC-13	Beaver Co. Sec. 22,	T27S		Chips 0-240'	Geoth. Power Corp.
GPC-14	Beaver Co. Sec. 18,	T27S	R9W	Chips 0-540'	Geoth. Power Corp.
GPC-15	Beaver Co. Sec. 18,	T27S	R9W	Chips 0-1870'	Geoth. Power Corp.
GPC-18	Beaver Co. Sec.	T27S	R7W	Chips 0-90'	Geoth. Power Corp.
TPC-14-2	Beaver Co. Sec. 2,	T26S	R9W	Chips 0-6100'	Thermal Power Corp.
Cactus 520-1	Beaver Co. Sec. 3,	T27S	R13W	Core 0-2975'	AMAX
Cactus 520-2	Beaver Co. Sec. 10,	T27S	R13W	Core 0-2454'	AMAX
Cactus 520-3	Beaver Co. Sec. 3,	T27S	R13W	Core 0-2777'	AMAX
Cactus 520-4	Beaver Co. Sec. 4,	T27S	R13W	Core 0-875'	AMAX
Diamond #1	Sec. 34,	T26SD	R9W	Core 10.8-201.8'	
Diamond #1A	Sec. 3,	T27S	R9W	Core 20-217'	
Diamond #1B	Sec. 4,	T27S	R9W	Core 133-231'	
Ryan Springs	Sec. 4,	T27S	R8W	Core 215-331'	
UT State 24-36	Beaver Co.			Chips 0-5600'	Thermal Power Corp.
KGRA 9-1	Beaver Co. Sec. 9,	T27S	R9W	Chips 0-6883'	Phillips
HF1	Milford UT Sec. 8,	T27S	R8W	Core 101.7-503.9'	
HF3	Milford UT Sec. 25,	T26S	R9W	Core 29.0-489.3'	

UTAH cont.

Area/Hole Name	Location			Footage	Driller
ROOSEVELT					
HF3b	Opal Dome Sec. 2,	T29S	R9W	Core 4.7-55.2'	
TG 0	Milford UT Sec. 16,	T26S	R9W	Chips 15-245'	
TG 1	Milford UT Sec. 15,	T26S	R9W	Chips 25-205'	
TG 2	Milford UT Sec. 5,	T26S	R9W	Chips 0-232'	
TG 3	Milford UT Sec. 19	T26S	R9W	Chips 10-325'	
TG 5	Milford UT Sec. 14,	T26S	R9W	Chips & Core 15-170'	
TG 6	Milford UT Sec. 7,	T26S	R9W	Core 35-315'	
OTHER GRADIENT WELLS					
HF3B	Potsons Wrm Spg Sec. 2,	T29S	R9W	Core 17.4-498.3'	
Beaver Dam	St. George UT Sec. 23,	T42S	R19W	Chips 0-205'	
BLM #5	Pine Valley Area			Core 315-323'	
Dry Creek #9				Core 150-171'	
#1	Loa UT Sec. 10,	T27S	R2E	Core 8.5-209.8'	
EM1	Mussentuchit Flat Sec 16,	T24S	R7E	Core 20.0-209.8'	
Grass Valley UT	Sec. 1,	T39S	R15W	Chips 0-300'	
Monroe				Core 41.0-203.0'	
Monroe 2				Core 22.0-205.3'	

UTAH cont. -

Area/Hole Name	Location			Footage	Driller
UINTAH BASIN					
Petrodyne\ Jensen #3	Uintah Co. Sec. 21,	T5S	R23E	Chips 0-2545'	Res. Tech. Corp.
UTAH ROSES					
2	Salt Lake Co.			Chips 0-4910	Utah Rose
Savage Well	Salt Lake Sec. 22,	T2S	R2W	Soil 0-990'	

WASHINGTON

Area/Hole Name	Location	Footage	Driller

GLACIER PEAK

103 holes with a total of 51,698 feet of core

WYOMING

Area/Hole Name	Location			Footage	Driller
Research Tech. Corp.	Niobrara So. Sec. 11,	T40N	R66W	Chips 1475-7850'	Res. Tech. Corp.

Area/Hole Name	Location			Footage	Driller
OTHER GRADIENT WELLS					
Monroe 3				Core 50-252.0'	
Monroe M4				Core 20-260'	
Monroe 6				Core 15-250.3'	
Panguitch Lake UT	Sec. 27,	T35S	R7W	Core 0-295'	
Shauntie Hill UT	Sec. 9,	T29S	R12W	Core 14.0-207.0'	
Thermo 1a	Black Mts. UT Sec. 18,	T31S	R11W	Core 7-359.3'	
WARM SPRINGS FAULT					
WSF/GH-A	Salt Lake Co. Sec. 14,	T1N	R1W	Chips 0-250'	UT Min. Survey
WSF/GH-B	Salt Lake Co. Sec. 14,	T1N	R1W	Chips 0-90'	UT Min. Survey
WSF/GH-B	Salt Lake Co. Sec. 14,	T1N	R1W	Chips 0-250'	UT Min. Survey
WSF/GH-D	Salt Lake Co. Sec. 24,	T1N	R1W	Chips 5-250'	UT Min. Survey
WSF/GH-E	Salt Lake Co. Sec. 25	T1N	R1W	Chips 25-250'	UT Min. Survey
UINTAH BASIN					
Research Tech. Corp.	Uintah Co. Sec. 21,	T5S	R23E	Chips 140-1300'	Res. Tech. Corp.
Petrovest\ Jensen #1	Uintah Co. Sec. 21,	T5S	R23E	Chips 0-2615'	Res. Tech. Corp.
Petrodyne	Uintah Co. Sec. 21,	T5S	R23E	Chips 0-1300'	Res. Tech. Corp.

CANADA

Area/Hole Name	Location	Meters	Driller
MEAGER CREEK			
MCG-1		Chips 30-3040m	
MCG-2		Chips 15-3500m	
MCG-3		Chips 185-3500m	
M-1		Core Variable	
M-2		Core Variable	
M-3		Core Variable	
M-7		Core 40-360m	
M-7		Chips 40-360m	
M-8		Core 20-490m	
M-8		Chips 20-490m	
M-9		Core 130-1130m	
M-9		Chips 130-1130m	
M10-80D		Core 0-106m	
M10-80D		Chips 0-106m	
M13-81-D		Core 40-580m	
M13-81-D		Chips 40-580m	

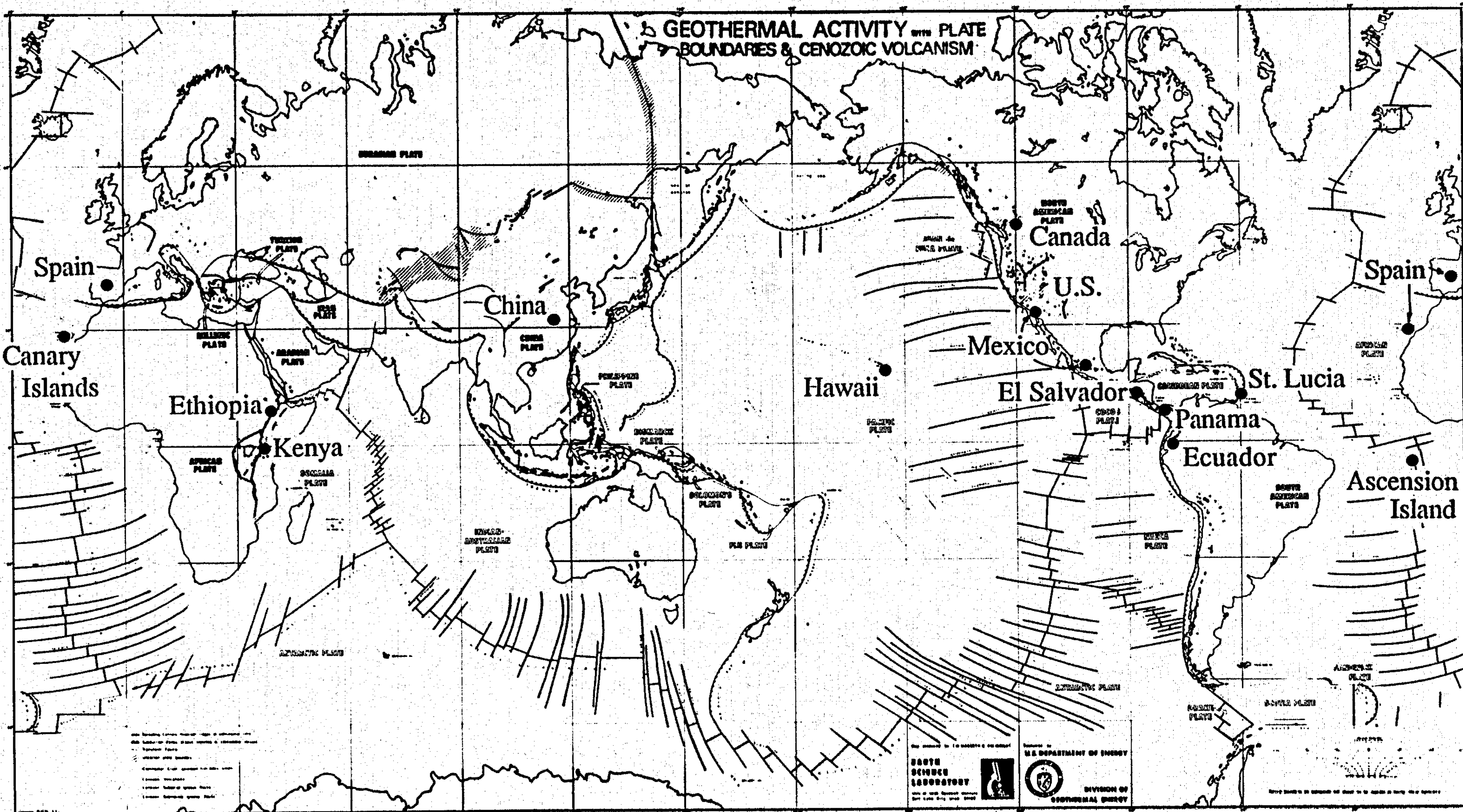

Figure 4. UURI Geothermal Studies - Worldwide

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