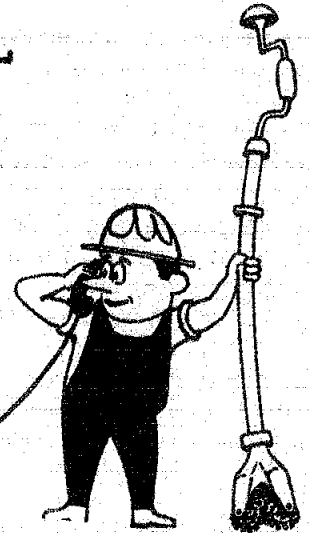
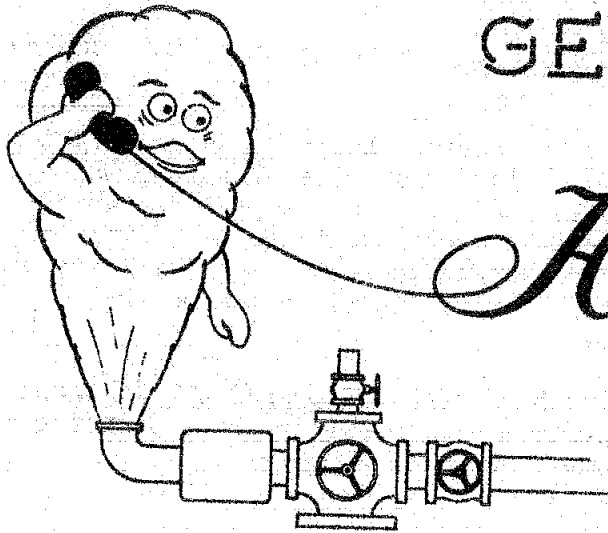


## GEO THERMAL

Hot  
Line

*A publication of the State of California - Division of Oil and Gas*

Volume 7, Number 1

April 1977

"Nothing is new except arrangement."  
Will Durant

### SUSANVILLE STUDY

The Bureau of Reclamation has announced a geothermal study in the Susanville and North Honey Lake Valley area to determine the feasibility of developing a geothermal energy source for the benefit of the community of Susanville.

The study will culminate in a demonstration site or sites with one or more slim (6-8 inch diameter) pilot wells to test the reservoir and aquifer for possible community uses. A prime objective will be to locate, drill, develop, and test 2,000+ foot geothermal wells. Injection wells will be drilled or disposal sites constructed if necessary. The wells will be operated by the Bureau of Reclamation for a sufficient period of time to monitor the results and evaluate the benefits.

The Bureau's investigation will be closely coordinated with the city of Susanville and its Geothermal Energy Program. Meetings will be held with the city and other interested parties.

### California State Lands Commission

The California State Lands Commission is accelerating geothermal development with two different, but related programs.

The first is a land management program which involves substantial land exchanges with the Federal Government. The aim of this program is to "block up" the State's widely scattered land holdings. The consolidated units will be much more manageable from a land-use standpoint and available for a multiple-use approach to energy, mineral resource, and revenue generation. High on the list of lands to be acquired or retained are those with high potential for geothermal energy development.

The second program focuses on the assessment of geothermal potential on lands under the jurisdiction of the Commission. This search for target geothermal lands will include ex-

ploration on uplands, lowlands, and eventually offshore within the three-mile limit controlled by the Commission.

The Commission last year executed a \$40,000 contract with Lawrence Berkeley Laboratory for the design, fabrication, and testing of instruments to explore underwater for abnormal heat flows at Clear, and Mono Lakes and the Salton Sea. Data derived from the project, which is being funded jointly by the Commission and the Federal Energy Administration, will be used to develop more sophisticated methods to expand the knowledge about geothermal resources on State lands. Eventually, the program will lead to deep drilling to determine the location of exploitable energy resources on State lands.

As a result of this initial study, geothermal anomalies have been discovered at all three lakes and the Commission staff is now considering a program of temperature hole drilling and geochemical work to confirm the extent of the anomaly found at Mono Lake.

### EPRI Geothermal Study

Much of the hydrothermal energy in the US cannot be used economically in conventional turbine generator systems because of its low-to-moderate temperatures. The Electric Power Research Institute has awarded a contract to the Elliot Company Division of the Carrier Corp. to determine whether scale-up versions of hydrocarbon turbine generators can be economically built to make use of lower-temperature hydrothermal energy in a binary cycle. In this process, heat from underground hot water is used to boil hydrocarbon fluids, which are then expanded through hydrocarbon turbines to produce electricity. For details, contact V. Roberts, EPRI, 3412 Hillview Avenue, P.O. Box 10412, Palo Alto, CA 94303.

### Thermal Depletion of a Geothermal Reservoir with Both Fracture and Pore Permeability (Abstract) - P. W. Kasameyer and R. G. Schroeder

The useful lifetime of a geothermal resource is often calculated from the volume of available hot water. The lifetime may actually be longer if injected fluid is heated by the rock matrix and produced again. Here is a method for estimating the useful lifetime of a reservoir in porous rock where the injection and production wells intersect a fracture system. Equations are derived for the pore-fluid and fracture-fluid temperatures averaged over large regions of the geothermal field. Problems such as incomplete areal sweep and interfingering of cool and hot fluids are ignored. Approximate equations are developed relating average temperatures to the heat flowing from rock to fluid, and justification of their use may be done by comparing these results with solutions of the exact equations. Equations presented for the temperature decline can be solved quickly.

In this model, fractures are characterized by three parameters: aperture  $w$ , permeability  $k_{fr}$ , and spacings between fractures  $D$ . For certain values of these parameters, cool injected fluid in fractures may reach the production wells long before all the warm pore fluid has been tapped, shortening the useful lifetime of the field. Ignored are the traditional (and important) problems of reservoir engineering, flow rate determination, drawdown, sweep patterns, etc. Thus, the results are most useful in providing a correction factor which can be applied to lifetime estimates obtained from a detailed simulation of a field, assuming porous rock. That correction factor is plotted for clean fractures ( $k_{fr} = w^3/12$ ) as a function of  $w$  and  $D$  for several lifetime ranges.

Small-scale fractures in cores from the Salton Sea Geothermal Field are too closely spaced to reduce lifetime estimates. However, large-scale fault systems exist within that field, and they are attractive drilling targets because they allow large flow rates. If large scale faults communicate between injection and production wells, they may reduce the useful lifetime of those wells.

## INTERNATIONAL

### C.G.R.A. ORGANIZED

The Canadian Geothermal Resources Association was recently incorporated in British Columbia as a non-profit technical society to serve in the development of this exciting new energy resource.

Several geothermal energy projects and studies are currently in progress in B.C., the Yukon and Northwest Territories, and the Prairie Provinces sponsored by industry, Federal and Provincial Governments and municipalities. As natural hot water and steam fields are developed for heating, or for generating electricity, Canada will realize substantial savings in the consumption of fossil fuels.

Geologists and engineers investigating geothermal resources founded the Canadian Geothermal Resources Association after recognizing the need for an interdisciplinary society. Membership applications are being accepted from earth scientists, engineers, economists, resource planners, qualified environmentalists, and others who are interested in the proper development and utilization of the resource. Students in accredited institutions may apply as student members. For information, write to: Canadian Geothermal Research Association, P.O. Box 5059, Vancouver, B.C., V6B 4A9.

The first activity of the Association will be to bring members up to date on research and exploration programs in progress in Canada by means of a Newsletter. The first Annual General Meeting will be held in Vancouver in conjunction with the GAC/MAC/SEG/CGU meeting the last week in April.

### IDAHO

#### Geothermal Heating

ERDA and the Economic Development Administration are jointly funding a \$10,000 study of the geothermal potential near Sugar City, Idaho, a community which was destroyed during the Teton Dam flood last June. An initial feasibility study indicated that geothermal energy could be a space heating source for the reconstructed town, but additional data are needed before the drilling of an exploratory geothermal well could be recommended. For details, contact ERDA Idaho Operations Office, 550 Second Street, Idaho Falls, ID 83401.

### NEVADA

#### Geothermal Leases

On October 19, 1976, the Bureau of Land Management auctioned off six geothermal leases on 12,886 acres of land in Nevada for a total of \$54,145. Aminoil USA, Inc., Santa Rosa, California, bid a total of \$49,038 for five parcels totaling 12,246 acres in the Leach Hot Springs area 20 miles south of Winnemucca, Humboldt County. Getty Oil Company, Bakersfield, California bid a total of \$5,107 for the remaining 640 acre parcel, 10 miles north of Lovelock in the Colado geothermal resource area. Prices ranged from \$1.76 to \$7.98 an acre.

### UTAH

#### Phillips Petroleum Company

Phillips Petroleum Company has announced plans to drill six new geothermal wells to depths of at least 10,000 feet in the Roosevelt Hot Springs area, six to eight miles northeast of Milford, Beaver County, Utah. The new wells are part of an overall drilling program calling for 16 wells located on the Phillips-held federal leases where six geothermal wells have already been completed. Phillips chose the new drill sites on the basis of known geological conditions and related that land disturbances will be very minimal. To a large extent, existing roads in the vicinity will be used.

## Thermal Power Corporation

Thermal Power Corporation has completed a well at Roosevelt Hot Springs to produce commercial quantities of steam. Geothermal drilling in Utah during 1976 has been brisk with deep exploratory wells completed or underway in other parts of southwestern counties of the state. In addition to the work at Roosevelt Hot Springs, two deep wells were completed near Beryl in Iron County. More geothermal drilling is on tap for Utah during 1977. Several plans of operation on Federal lands are pending before the U.S. Geological Survey.

## CALIFORNIA

### Funds Sought For Geothermal Power Plant

San Diego Gas & Electric Company revealed it is requesting the Federal Energy Research and Development Administration to fund half the cost of a planned \$42 million demonstration geothermal power plant at Heber in California's Imperial Valley.

The company said it is inviting 25 Western Electric utilities and the Electric Power and Research Institute to participate in the proposed 50-megawatt plant, either through partial ownership or contributions.

The San Diego Utility Company said cost-sharing in connection with the projected facility would not be necessary due to the plant's prototype nature which will reduce the cost of the power generated to a figure comparable with that generated by other sources.

### Geothermal Task Force

Assembly Bill 3590 (Kapiloff) was signed into law by the Governor on August 27, 1976. The bill set up a State Geothermal Task Force to answer 16 questions on geothermal resources. The bill requires that the Secretary of the Resources Agency and the Director of the Office of Planning and Research organize a state task force to study all parameters of geothermal resources development and to report these findings to the Legislature and Governor by July 1, 1977. The bill names representatives to the state task force.

<u>Agency</u>	<u>Representative</u>
1. Department of Conservation	Priscilla Grew (Chairperson)
2. Resources Agency	Jim Rote
3. State Lands Commission	Don Everitts
4. Division of Oil and Gas	Doug Stockton
5. Energy Commission	Evan Hughes
6. Office of Planning and Research	Bill Kirkham
7. Public Utilities Commission	Robert Moeck
8. Department of Fish and Game	Richard Forester
9. Department of Water Resources	Lloyd Harvego
10. State Water Resources Control Board	Alvin Franks
11. Division of Mines and Geology	Forest Bacon

### Notice of Public Hearing -- Investigative Hearings

Notice is hereby given that the State Task Force on Geothermal Energy will hold a series of investigative hearings on geothermal energy development in California. The purpose of these hearings is to solicit oral and written testimony on all aspects of geothermal development under the authority set forth in Assembly Bill No. 3590 (Chapter 958, 1976-77 legislative session).

The first set of hearings will convene at 9:00 a.m. on Thursday, April 14, 1977 in Senate Room 5007, and at 9:00 a.m. on Friday, April 15, 1977, in Assembly Room 4202, in the State Capitol, Sacramento, California.

The tentative schedule for the complete set of hearings is as follows:

April 14-15

Sacramento

Introductory Remarks  
Status of Geothermal Resource Development  
State of Current Technology  
    Geological and geophysical problems  
    Environmental mitigation techniques  
Open Session

April 28-29

San Diego

The hearings will be held at the State Building, Room B-109 on the first day and at the San Diego Gas and Electric auditorium on the second day.

Introductory Remarks  
Status of Geothermal Resource Development  
Economic and Business Concerns  
Regulatory Problems (including environmental  
    documentation required by CEQA and NEPA)  
Environmental Problems and Considerations  
Open Session

May 19-20

Sacramento

The hearings will be held in Assembly Room 2117 on the first day and in Assembly Room 2170 on the second day.

Introductory Remarks  
Economic and Business Concerns  
Regulatory Problems (including  
    environmental documentation)  
Environmental Problems and Considerations  
Open Session

May 26-27

San Francisco

The hearings for both days will be held in the Public Utilities Commission Hearing Room - 1158, 350 McAlister Street, San Francisco, California.

Introductory Remarks  
The Role of the Federal Government  
    in Geothermal Development  
Open Session

For further information, you should contact Susan Brown, Office of Planning and Research, 1400 Tenth Street, Sacramento, CA 95814, Tel. (916) 445-0613.

Blowout Prevention

A new Oil and Gas Well Blowout Prevention Manual No. M07 written by Fred O. Hallmark and Peter R. Wygle is now available to the public.

It not only replaces an older one issued by the Division of Oil and Gas in 1970, but it is also vastly improved. Briefly, it contains sections on: Scope, Classification and selection of equipment, equipment descriptions, operating characteristics and requirements, and

inspection and testing procedure. To obtain the manual, contact any Division district office or the Sacramento Office.

#### LAKE COUNTY

##### GRIPS

On October 19, 1976, the Lake County Board of Supervisors approved \$10,000 as initial funding for Planning Department use to begin a comprehensive Geothermal Resource Impact and Planning Study (GRIPS). It will be a data gathering study designed to develop a comprehensive evaluation of the various environmental, economic and social consequences, both positive and negative, which could result from geothermal development in Lake County. The fundamental purpose of this evaluation is to provide the County with the tools for interim and long-range planning and management of geothermal development.

#### IMPERIAL COUNTY

##### UPDATE: Activities of the East Mesa Geothermal Test Site (Hotline June, 1976)

Geothermal well Mesa 5-1, on the east flank of the Mesa anomaly, is utilized for fluid disposal. A Sundstrand pump, Model 311, was installed in the well and placed in operation in November 1976. Injected fluids include brine blowdown from two desalting units and portions of geothermal fluids from production wells. The fluids are filtered and pumped directly to the injection well. Prior to injection operations, Mesa 5-1 was produced at flow rates of 90 to 180 gallons per minute to establish flow characteristics and injection performances. A full range of temperature, pressure, and flow data is gathered continuously during injection into Mesa 5-1 and other Bureau wells. Also, samples of the injection fluid are collected for chemical analysis. So far, injection rates range from 50 gallons to 200 gallons per minute.

The Bureau of Reclamation has started a groundwater monitoring test program. In March 1976, nine shallow groundwater monitoring holes were drilled at East Mesa. Information collected from these wells provide baseline data to detect any geothermal fluid contamination of the groundwater.

The Bureau is operating three test desalting units at East Mesa. The multistage flash unit and the vertical tube evaporator have been operating for several months and proving high temperature electrodialysis desalting unit is now on test. Typical studies include analyzing the behavior of geothermal fluids for scaling, corrosion, and chemical characteristics. The Mesa 6-2 well, with an average flow of 50 gallons per minute, has been providing fluids for these operations.

The Bureau set up a permanent microseismic network in January 1976 to provide continuous seismic activity monitoring during the operation of the geothermal wells. The system consists of six remote sensing and transmitting stations, with the central receiving station at the geothermal test site.

Past and present testing at the site, independent of the Bureau's test program, includes tests by the Bureau of Mines for corrosion and scaling, Hydrothermal Power Company for a helical screw expander to generate 20 kw of electrical power, Austral-Erwin Engineers of Texas for scaling characteristics of geothermal fluids on teflon coated pipe, and Allied Chemical for the effects of heat transfer in a fluidized filter bed. Other tests are also being run on the effects of geothermal fluid on polymer-impregnated concrete pipe.

#### LEXAL

##### UPDATE - Geothermal Kinetics vs. Union Oil (See Hotline, December 1975)

The Superior Court of the State of California for the County of Sonoma ruled that the

rights to a geothermal steam system underlying 408 acres of mountainous property in northeastern Sonoma County, California, belongs to the holders of mineral rights to the land. The mineral rights to the 408 acres were acquired by Geothermal Kinetics, Inc. of Nevada, while the property along with water and other surface rights were acquired by George and Hazel Curry, defendants in the case. In later years, Union Oil Company, the Thermal Power Company and the Magma Power Company acquired interests in the Curry's holdings.

Geothermal Kinetics claimed that Union Oil and the other defendants had no claims or interest in the geothermal steam and power or geothermal resources underlying the 200 square-mile area. Union Oil and the others filed a counter claim charging Geothermal Kinetics with trespassing. Both sides presented extensive scientific and technical testimony about the origins and nature of the underground steam.

However, the California court stated that "examined by its four corners, it appears to this court that what this case is all about is 'energy' and who owns it." Superior Court Judge Kenneth Eymann stated that despite the claims and counterclaims regarding the minerals in the land, "both plaintiff and defendants are basically interested in owning, capturing and eventually delivering energy to the Pacific Gas and Electric Company for profit."

Judge Eymann rejected claims by Union Oil and other defendants that ownership of the water must carry with it ownership of the total resources, since the water which carries the heat is in the form of steam. "The traditional reasons for giving water to the surface ownership (agriculture, drinking water) no longer exist in the case before the court," he said. "Here it is shown that water is brought to the surface only after a tremendously expensive extraction process. It emerges not in the form of water, but as superheated steam."

The court noted that the water, even if recovered, would be dangerously toxic and corrosive and could not be used for drinking or agriculture without extensive filtering at great expense. "Steam, as steam, is not beneficial to the land, and there is no realistic basis to find that water condensed from the steam is or could be beneficial," he concluded.

He added that the geothermal resources had more in common with minerals under the ground than with the water on top of it. Noting that geothermal steam is mined and drilled like natural gas and oil, the court said geothermal resources belonged in the mineral family. "The energy (from geothermal steam) which is produced is a direct product of the molten minerals and gases within the resource. The water which transports the energy to the surface is a conveyor belt, nothing more," the judge stated.

"In the final analysis, a geothermal system is an energy resource," the court asserted. "The surface owner wants the energy which the water carries, not the water itself. It is for these reasons that the court holds that (Geothermal Kinetics) is the owner and entitled to the possession and control of all the geothermal steam and power and geothermal resources in and under the subject property."

#### FEDERAL GOVERNMENT

#### UPDATE - ERDA Loan Program (See Hotline, October, 1976)

By now, most of you know that ERDA has received the first applications for a geothermal loan guaranty. The first application was jointly submitted by the Bank of America (B of A) and Dry Creek Exploration, Inc. (DCE) on October 6, 1976 and it is currently being processed.

The guaranteed loan is for \$7.5 million at a rate of 120% of floating prime plus .5% for nine years. DCE is a wholly-owned subsidiary of Geothermal Resources International, Inc. Chevron is supposed to be the 50/50 partner in the project, which is aimed initially at developing the field for a 55 MWe power plant. The site is in the southeast corner of the Geysers in Lake County, California.

On October 26, the second and third applications were received. The second one was from a limited partnership, Geothermal California Partners, whose principal officers form Geo-Products, Inc. The lender is the Bank of Montreal who proposes an interest rate of 12 1/2% of floating prime on a loan of \$2,269,000 which represents 62% of the project's total estimated cost of \$3,654,000. The project, including lease acquisition, is to explore for wet steam resource in Honey Lake, California, and to produce steam for a 55 MWe power plant. If the resource proves out, the Bank of Montreal will refinance this first loan and GeoCal and B of M will jointly apply for a second guaranteed loan for the drilling needed for full field development.

The third application was received from Republic Geothermal, Inc. Lender is the Bank of America who proposes an interest rate of 12 1/2% of floating prime plus .5% on a loan of \$10,000,000 which represents 75% of the total estimated cost of the project of \$13,350,000. The project is to drill eleven production and four injection wells in East Mesa, California (three exploratory wells have already been completed). The goal is to produce enough steam for a minimum of 32 MWe and a maximum of 48 MWe. The most likely customer is the Imperial Irrigation District which might buy either the steam from RGI, or electricity. In this latter case, RGI could build the power plant with the assistance of another ERDA guaranteed loan to be applied for early next summer. On January 21, the application was sent from the San Francisco operations office to the ERDA Administrator in Washington with a recommendation that it be approved.

On February 28, 1977, Geothermal Kinetics and McCulloch Oil Corp. became partners in submitting the fourth application to ERDA. They propose a 55 MWe plant for Utah or California. The loan would be for \$6,326,000 from the Bank of Montreal.

In the first few weeks of March three more applications were received. The Southern California Public Energy Corp. soon to be formed by the City of Burbank has applied for a 25 million dollar loan. The project will be a 50 MWe plant if it is driven totally by geothermal steam and a 200 MWe plant if a combination of fossil fuel and geothermal power are used. Another request of \$3,400,000 has been received from the Nevada Geothermal Food Processers for a food dehydration plant. It is at Brady Hot Springs and the Nevada National Bank is the lender. The last application was filed by Diablo Exploration for \$18,750,000 for field development in New Mexico along with another \$18,750,000 for a 50 MWe power plant if the field proves to be successful.

#### U.S.G.S. - Electronic Consultant

A computer system to serve as an electronic consultant to help find new U.S. mineral deposits will be developed for the U.S. Geological Survey.

First, computers will store geological, geochemical, geophysical, and satellite and aircraft remote-sensing data on known mineral deposits. This will then be used as a check list to assess other mineral-exploration sites. USGS has let a \$172,125 contract to Stanford Research Institute to develop the system.

#### Competitive Lease Sale Action Schedule as of 3/24/77

The lease sale dates are those provided by the State Directors of the U.S. Bureau of Land Management Lease. Sale dates are tentative until public notice is issued 30 days prior to sale.

<u>Location of KGRA</u>	<u>Latest Sale Date Scheduled</u>
Alamosa, CO	4/15/77
Mineral Hot Springs, CO	4/15/77
Valley View, CO	4/15/77
Flinto Hot Springs, WY	5/17/77
Warm Springs, WY	5/17/77



Baca Location One, NM	5/24/77
Radium Springs, NV	6/ 5/77
Burns Butte, OR	6/ 9/77
Marysville, MT	6/14/77
The Geysers, CA	6/21/77
Randsburg, CA	6/21/77
Breitenbush, OR	7/14/77
Baltazor, NV	7/19/77
Dixie Valley, NV	7/19/77
Long Valley, CA	7/21/77
Witter Springs, CA	7/21/77
Windel-Amadee, CA	8/11/77
Socorro Peak, NM	8/25/77
Gerlack NE, NV	10/18/77

### CONFERENCES

#### April 12-14, 1977

The American Nuclear Society and ERDA are sponsoring a topical meeting on ongoing Energy research, at the Colorado School of Mines' Green Conference Center in Golden, Colorado. About 100 papers will report on results and studies in Coal Gasification, Oil Shale research, Gas and Oil Stimulation, Non Ferrous metal recovery, Geothermal Resource production and conversion, Geologic storage, and Geophysical and Rock Mechanics research.

Of particular interest, are the sessions dealing with Geothermal research. About 20 papers will deal with all aspects of geothermal work in progress. Many of the 17 papers on Rock Mechanics also bear directly on problems in geothermal, especially those on high-temperature drilling technology and others concerned with rock strength and fracture.

Detailed information and registration forms may be obtained from General Chairman Frank Stead, USGS, P.O. Box 25046, Denver, Colorado 80225, or Program Chairman Fred Holzer, Lawrence Livermore Laboratory, P.O. Box 808, Livermore, California 94550.

#### April 14-15, 1977

The SPE-AIME 47th Annual California Regional meeting will be held in the Bakersfield Convention Center. About 50 exhibiting companies will occupy more than 70 booths. Among the 51 papers scheduled for presentation are five on geothermal topics.

#### April 27, 1977

The International Society for Geothermal Engineering will sponsor a one-day tutorial seminar that will explore both fundamentals and applied equipment relationships for some of the more important "back-up" machinery for geothermal services. The seminar will be held at the Hyatt Regency, 711 South Hope Street, Los Angeles, CA 90017. For more information contact ISGE, P.O. Drawer 4743, Whittier, CA 90607.

#### May 2-6, 1977

Volcanic Rocks and their vent areas presented by Mackay School of Mines, Nevada Bureau of Mines and Geology and the Department of Geology and Geological Engineering of Michigan Technological University. Information: Jan Dunbar, Conferences and Institutes, University of Nevada -- Reno, Reno, NV 89557. (702) 972-0781.

May 9-11, 1977

The Geothermal Resources Council will hold the 1977 Annual Meeting at the Royal Inn on the Wharf, San Diego, California. This meeting is intended to provide a forum for exchange of new technical information in the geothermal community rather than an overview of material that has been published previously. Exhibits will be held concurrently with the three days of technical sessions; optional one- and possibly two-day field trips to Imperial Valley geothermal sites and Cerro Prieto will follow the meeting. For more information contact GRC, P.O. Box 1033, Davis, CA 95616.

A free workshop on the Computation of Flow Rates and Temperature Loss During the Production of Geothermal Wells in Natural Flashing Two-Phase Flow will also be conducted by the Denver Research Institute at the meeting on May 11. A computer program has been prepared for use by the geothermal industry. This is an opportunity to bring your own problems and run them on the computer terminal. For further details, contact Glenn E. Coury at (303) 232-3823.

June 27-28, 1977

SPE-AIME International Symposium on Oilfield and Geothermal Chemistry, University of California -- San Diego Conference Center, La Jolla, California. Program Chairman: Carl E. Johnson, Jr., Chevron Oil Field Research Center, P.O. Box 446, La Habra, CA 90631.

#### PUBLICATIONS

##### Circum-Pacific Energy and Mineral Resources

This publication contains 126 papers or abstracts from the Circum-Pacific Energy and Mineral Resources Conference held in Honolulu in August, 1974. Presented is an overview of Pacific Basin hydrocarbon, mineral, and geothermal resources. AAPG, P.O. Box 979, Tulsa, Oklahoma 74101, 608 pages.

##### Energy Atlas

Edited by Eric Lower, A handbook of U.S. federal and state agencies, 100 congressional committees, organizations, and 600 publications and periodicals dealing with energy issues. The guide is cross-referenced by energy topics, updated semiannually, and includes names, addresses, activities, and jurisdictions for each entry. It includes listings helpful to those working in petroleum, geothermal, nuclear, and solar areas. Fraser/Ruder and Finn, 1710 K Street, NW, Washington, D.C. 20006.

##### Geothermal Data from Test Wells Drilled in Grass Valley and Buffalo Valley, Nevada

Prepared by Lawrence Berkeley Laboratory for ERDA, July 1976. Available from National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161, \$5.00, 43 pages.

##### Geothermal Development and the Salton Sea

By Martin Goldsmith, February 1976. Environmental Quality Laboratory, California Institute of Technology, Pasadena, CA 91125, 15 pages.

##### Geothermal Energy: Legal Problems of Resource Development

Published by Stanford Environmental Law Society. Examines the law relating to geothermal resource and acquisition and development, and suggests alternative means of regulation. Available from Stanford Environmental Law Society, Stanford Law School, Stanford, California 94305. \$3.95, post-paid. California residents, add 6% sales tax to the price of each book.

## Geothermal Project Summaries

ERDA 76-53, September, 1976. This publication covers active research and development projects and contains a list of ERDA geothermal contractors.

## Hydrogeological Data of Thermal Springs and Wells in Colorado

This report presents such data as location, temperature, and specific conductance for over 150 thermal springs and wells in Western Colorado. Most of the wells have a complete chemical and spectiographic analysis presented. Also, 39 thermal sites were analyzed for radioactivity associated with the waters; these results are also presented.

## Map Showing Thermal Springs, Wells, and Heat - Flow Contours in Colorado

Information Series 4 was prepared in cooperation with the U.S. Geological Survey, drawn on a scale of 1,000,000. The map shows the location of 49 thermal areas in western Colorado which consist of one or more thermal springs or wells, and the total dissolved mineral matter in the waters. Contours showing the rate of heat-flow from the earth are also presented.

## Mean Annual Temperature Map, State of Arizona, No. GT-2

By Charles E. Druitt, 1976, published by the Arizona Oil and Gas Conservation Commission, 8686 North Central Avenue, Room 106, Phoenix, Arizona 85020. Price \$1.75, postage prepaid.

## North America-Subsurface Temperature Map

A subsurface Temperature Map of North America, giving depth in thousands of feet below the surface of three selected temperatures—158° F, and 212° F, and 302° F, by contours, and ranges of bottom hole temperatures by color symbols of more than 30,000 bore holes, is now available at \$4 from Branch of Distribution, US Geological Survey, 1200 South Eads Street, Arlington, VA 22202.

## Ocean Thermal Energy Conversion

"The State Variable Analysis, Control, and Feasibility of Design of an Ocean Thermal Power Plant, TR-EE-76-45," presents details of the design of a 24 MWe ocean thermal energy converter. For copies of the report, which examines economics, siting and considerations, heat cycle description, heat exchanger design, electrical system design and control of the power plant, contact the Purdue Electric Power Center, School of Electrical Engineering, West Lafayette, IN 47907.

## Volcanoes of the Earth

By Fred M. Bullard, 1976. Recent advances in heat-flow studies, the concepts of sea-floor spreading and plate tectonics are incorporated to present a view of volcanology consistent with current geological theory. Also included is a discussion of geothermal energy. University of Texas Press, P.O. Box 7819, Austin, Texas 78712, \$26.95, 579 pages.

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