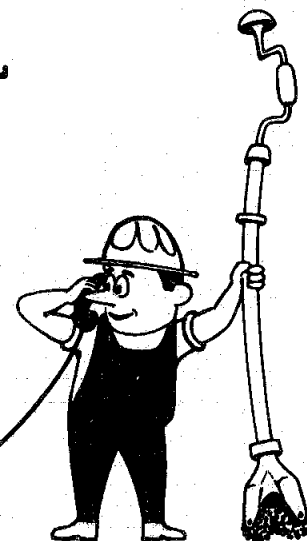
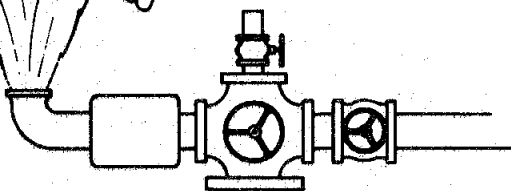
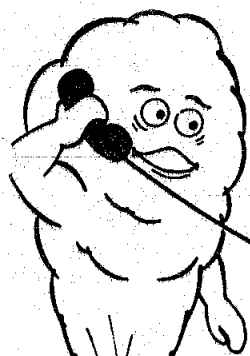


GEOHERMAL

Hot Line



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

Volume 3, Number 5

October 1973

"Information breeds understanding."

--Phillips Petroleum Co.
"Bulletin to 66 Management"

● COMING MEETINGS ● ●

COLORADO GEOTHERMAL SYMPOSIUM

"Geothermal Energy and Colorado" will be discussed at a one-day symposium hosted jointly by the Colorado Geological Survey, the Colorado Board of Land Commissioners, and the Colorado School of Mines on December 6, 1973 in Denver. Governor John A. Love, Director, Office of Energy Policy, Washington, D. C., will be keynote speaker at the banquet.

The following topics will be presented:

1. Geological and geophysical conditions of Colorado as they pertain to geothermal energy.
2. Economics of geothermal systems.
3. Marketing of geothermal energy.
4. Legal and tax problems in relation to geothermal energy.
5. Environmental considerations.
6. Problems private industry is facing in developing geothermal energy.
7. Federal and State governmental leasing regulations.

Interested persons should contact Richard H. Pearl, Colorado Geological Survey, Room 254, 1845 Sherman Street, Denver, Colorado 80203.

G.E.C.

LOS ANGELES BASIN GEOLOGICAL SOCIETY

The Los Angeles Basin Geological Society has scheduled a three-day short course, as part of their Continuing Education Program, for October 9, 10, and 11, 1973. Dr. John C. Crowell, University of California at Santa Barbara, will present an illustrated lecture series covering "Concepts of Tectonics and Structural Geology" emphasizing the tectonics of the western United States and the Pacific Ocean region--a subject with definite geothermal applications.

The lectures will be given in the Union Oil Company auditorium, 461 Boylston, Los Angeles, California, from 2:30 to 6:30 p.m. each day.

Schedule of fees:

Members of Pacific Coast Section of the American Association of Petroleum Geologists -----	\$30
Non-members -----	\$35
Students -----	\$10

Checks should be sent to Mr. Scott Knight, c/o Texaco Inc., 3460 Wilshire Boulevard, Los Angeles, California 90010. For further information, call (213) 380-5830.

Free parking will be available on Bixel Street.

G.E.C.

WORLD GEOPHYSICAL CONFERENCE

The Society of Exploration Geophysicists and the Asociacion Mexicana de Geofisicos de Exploracion will jointly sponsor an international meeting in Mexico City on October 21-25, 1973. As part of the meeting, two geothermal symposia will be offered on Wednesday, October 24.

Geothermal Symposium I

1. The application of the Self-Potential Method in the Search for Geothermal Energy
L. Anderson and G. Johnson
2. Regional Aspects of the Geothermal Resource Base in Northwestern Mexico and the Southwestern United States
J. F. Hermance
3. A Comparative Study of Two Resistivity Techniques as Applied to the Delineation of a Geothermal Reservoir
A. Mazzella and A. Day
4. Geoelectric Investigations Near The Geysers Geothermal Area, California
W. D. Stanley and D. B. Jackson
5. An Aeromagnetic Study of the Colorado River Delta Area, Baja California, Mexico
M. de la Fuente and J. Sumner
6. A Review of Geothermal Exploration by Infrared Line Scanning in North America, Europe, and East Africa
D. T. Hodder

Geothermal Luncheon Speaker

Frederico Mooser, Chief Geologist, Comision Federal de Electricidad "Geothermal Exploration in Mexico"

Geothermal Symposium II

1. Microearthquakes and Seismic Groundnoise Mapping - Conjunctive Geothermal Exploration Tool
J. R. Bailey
2. Utilization of Gravimetric Data for Estimation of Convective Heat Flow
T. Meidav
3. Assessment of Geothermal Exploration Technology
J. Banwell, T. Meidav, and F. Tonani
4. Round Table Discussion - The Future for Geothermal Energy
G. Keller (Chairman), J. Banwell, M. K. Hubbert, and T. Meidav

T. Meidav

INTERNATIONAL SYMPOSIUM ON WATER-ROCK INTERACTION

The International Association of Geochemistry and Cosmochemistry, along with the Geological Survey of Prague, will cosponsor a symposium on Water-Rock Interaction. This symposium will consist of a meeting in Prague, Czechoslovakia, September 9-13, 1974, followed by a field trip to hot springs of the Bohemian Massif, September 14-17.

Subjects for discussion are:

1. Criteria for distinguishing thermal and mineral waters of different origins.
2. Dilute water-rock interaction at low temperatures; water-rock interaction in weathering and nutrient migration.
3. Experimental water-rock interaction.
4. Kinetics of water-rock interaction.
5. Active geothermal systems and magmatic environment.

6. Water-rock interaction in metamorphic environments.
7. Geochemical behavior of interstitial waters; diagenesis, membrane filtration.
8. Computer modeling of fluid composition.

Applications for membership in the symposium and abstracts for papers must be received before December 1, 1973. English and Russian are the official languages for the symposium, and papers must be in one of these languages.

For information contact:

Dr. Tomas Paces, Secretary-General
Geological Survey Prague
Malostranske nam. 19
11821 Praha 1
Czechoslovakia

M.J.R.

SAN JOAQUIN GEOLOGICAL SOCIETY

The San Joaquin Geological Society, as part of their Continuing Education Program, will present geothermal seminars on November 5, 12, and 19. The meetings will be held from 7:00 to 10:00 p.m. in the Forum East Building at Bakersfield College, Bakersfield, California. The fee, which includes all three meetings, will be \$25, payable at the door.

Following is the schedule:

November 5, 1973 - "Hydrologic Aspects of Geothermal Exploration", Professor Paul Witherpoon, Department of Geological Engineering, University of California, Berkeley, California

November 12, 1973 - "Reservoir Engineering of Geothermal Production", Professor William Brigham, Department of Petroleum Engineering, Stanford University, Palo Alto, California

November 19, 1973 - "Legal Problems Before the Geothermal Industry", Professor Owen Olpin, College of Law, University of Utah, Salt Lake City, Utah

Interested persons should contact Bill D'Olier of American Thermal Resources, Inc., 5405 Stockdale Highway, Suite 205, Bakersfield, California 93309. Phone (805) 833-1420.

G.E.C.

U. S. GEOLOGICAL SURVEY OPEN FILE REPORTS

"Sources of data for evaluation of selected geothermal areas in northern and central Nevada," by Olmsted, Glancy, Harrill, Rush, and Van Denburgh. Available for inspection at 345 Middlefield Road, Menlo Park, California, and Room 132, George Washington Building, 1011 Arlington Boulevard, Arlington, Virginia.

The following reports can be inspected in the U.S.G.S. libraries: Room 1033, G.S.A. Building, Washington, D. C.; Building 25, Federal Center, Denver, Colorado; and 345 Middlefield Road, Menlo Park, California. Local offices may also have copies for inspection.

"Aeromagnetic map of Yellowstone National Park and vicinity," four map sheets, scale 1:125,000. Reproductions can be made at Idaho Bureau of Mines and Geology, University of Idaho, Moscow, ID 83843; Montana Bureau of Mines and Geology, Montana College of Mineral Science and Technology, Butte, Montana 59701; and U.S.G.S., Room 1012, Federal Building, Denver, Colorado 80202.

"Aeromagnetic map of the Clear Lake area, Lake, Sonoma, Napa, and Mendocino Counties, California." Reproductions can be made at California Division of Oil and Gas, 1416 Ninth Street, Sacramento, California 95814; and U.S.G.S., Room 504, Custom House, San Francisco, California 94111.

"Geologic setting and chemical characteristics of hot springs in central and western Alaska," by Miller, Barnes, and Patton. Copies can be made at Alaskan Geology Branch, U.S.G.S., 345 Middlefield Road, Menlo Park, California 94025.

"Reconnaissance for mercury over geothermal areas of the Imperial Valley, California," by Hinkle and Vaughn. Copies are also available for inspection at the California Division of Mines and Geology, 1416 Ninth Street, Sacramento, California 95814; Ferry Building, San Francisco, California 94111; and 107 S. Broadway, Los Angeles, California 90012.

M.J.R.

WELL OPERATIONS SONOMA COUNTY, CALIFORNIA

The Geysers Geothermal Field -
Geothermal Kinetics Systems Corporation

On September 18, 1973, after a long series of delays, Geothermal Kinetics spudded their first geothermal well in California. The well, "Rorabaugh" 1, in Sec. 14, T. 11 N., R. 9 W., M.D.B.&M., is approximately 460 m. east of Pacific Energy Corporation's well "Rorabaugh" A-4.

G.E.C.

The Geysers Geothermal Field
Pacific Energy Corporation

On August 28, 1973, Pacific Energy Corporation began drilling "Rorabaugh" A-7, near the center of Sec. 14, T. 11 N., R. 9 W., M.D.B.&M. Surface casing was scheduled to be set at 760 m. If completed, this well will be shut-in pending construction of Pacific Gas and Electric Company's Turbine-generator Unit 15. On August 24, 1973, P.G.&E. signed an agreement with P.E.C. to purchase steam for the new power plant.

At a public hearing in Sonoma County, August 24, P.E.C. obtained permission from the Board of Supervisors to drill a well in the southwest 1/4 of Sec. 13, T. 11 N., R. 9 W., at a point approximately 1,000 m. east of their "Rorabaugh" A-6. If commercial steam is found in this new well, the productive limits of P.E.C.'s holdings will be extended considerably.

G.E.C.

ANOTHER POWER PLANT AT THE GEYSERS

In late August 1973, Pacific Energy Corporation signed a contract with Pacific Gas and Electric Company for the sale of geothermal steam from their wells on the Rorabaugh lease in The Geysers geothermal field. The agreement provides that PG&E initially will construct a 55 mw unit to be in operation by early 1977. PG&E will construct additional units to utilize future steam reserves developed by P.E.C. in the area.

This new 55 mw unit will bring to 15 the number of units PG&E intends to have in operation in The Geysers field by early 1977. Eight units are now in service; Unit 9 is undergoing final testing and should be fully operational by October 15, 1973. Two units are under construction, and the remaining four are in the engineering stage or are awaiting construction authorization by the California Public Utilities Commission. The total field capacity with all 15 units running will be 908 mw.

G.E.C.

IMPERIAL VALLEY - SURVEY NET

The Geothermal Unit of the California Division of Oil and Gas is acting as lead agency in an intergovernmental cooperative effort to resurvey the first- and second-order subsidence detection net originally surveyed in the winter of 1971-72. Work on the project should begin about October 15, 1973.

Land surveys in the Imperial Valley must be done during the winter months because heat waves generated by temperatures as high as 50° C during the summer cause surveying errors.

The purpose of the resurvey is to compile background data for monitoring tectonic movements and possible subsidence in the various geothermal areas before wells are placed on production. The Division of Oil and Gas requires that each geothermal well must be tied into the net before it can be produced.

G.E.C.

WELL OPERATIONS IMPERIAL COUNTY, CALIFORNIA

Magma Energy, Inc.

Magma Energy, Inc. of Los Angeles, California applied to the Imperial County Planning Commission for permission to drill two deep exploratory wells. "Sharp" 3 is to be drilled in Sec. 34, T. 16 S., R. 16 E., S.B.B.&M., 4 miles southwest of the Mesa anomaly and near "Sharp" 2, which was drilled as an observation hole to 1,977 m. last April. The second proposed well, "Bonanza" 2, will be drilled in Sec. 22, T. 15 S., R. 14 E., S.B.B.&M., northeast of El Centro near "Bonanza" 1, also an observation well which was drilled last March to 1,531 m.

It is not yet known when Magma plans to begin drilling operations.

G.E.C.

**East Mesa Anomaly -
U. S. Bureau of Reclamation**

On August 15, 1973, the Bureau of Reclamation completed their second geothermal well, "Mesa" 6-2, as part of their continuing exploratory effort on the East Mesa anomaly in the Imperial Valley. The hole was drilled to a total depth of 1,831 m. Production casing, (7 5/8") preperforated from 1,660 m. to the bullplug at 1,815 m., was stage cemented through ports above the perforations.

A temperature survey, run on September 13, 1973, indicated a bottom-hole temperature of 187° C.

At present, U.S.B.R. is flow-testing the well for production data.

JOINT VENTURE - IMPERIAL VALLEY

In August 1973, Chevron Oil Company (a subsidiary of Standard Oil Company of California), Magma Energy, Inc., and New Albion Resources Company (a subsidiary of San Diego Gas and Electric Company) announced that they have joined forces to evaluate the geothermal potential of their combined holdings in the Heber area, four miles south of El Centro.

Operations are scheduled to begin in mid-November and will include production and injection testing of the three existing geothermal wells: Chevron has one and Magma has two. Chevron will be operator for the project.

Plans are to produce two of the wells into a closed system to test their production characteristics and inject the fluid into the third well. The test should last for about three months. During this testing phase, attempts will be made to establish the areal extent and characteristics of the geothermal reservoir, as well as to test various types of equipment, such as pumps, heat exchangers, and pipe.

If the test results are favorable, it is probable that new wells will be drilled in the near future.

JOINT VENTURE - IDAHO

Sun Oil Company of Dallas, Texas and Kennedy Enterprises of Salt Lake City, Utah are reported to have joined forces in a geothermal exploration venture near Preston, Idaho, a prime prospect area in the southeast corner of the state.

In addition to the Preston area, Kennedy Enterprises is reported to own valuable private lands surrounding the perimeter of Yellowstone National Park in eastern Idaho.

It is thought that Sun Oil Company will drill exploratory wells in both areas sometime next year.

G.E.C.

NEW GEYSERS IN LONG VALLEY, CALIFORNIA

During the early morning of August 24, four new hot springs burst into existence on Hot Creek in Long Valley. For the first few days, these springs were geysering 3 to 5 m in the air, but at present only two are active. The new springs are 100 m south of another group of boiling springs on Hot Creek (Sec. 25, T. 3 S., R. 28 E., M.D.B.&M.) in Mono County, California.

On August 25, an earthquake of magnitude 3.5 occurred between Hot Creek and Bishop. The geysers and earthquake may reflect tensional tectonic activity in the area.

M.J.R.

**WELL OPERATIONS
ARIZONA AND UTAH**

Geothermal Kinetics Systems Corporation

Geothermal Kinetics Systems Corporation is continuing with an extensive series of temperature, pressure build-up, and flow stimulation tests in both of their "Power Ranches" wells near Higley, Arizona (see "Hot Line", v. 3, nos. 1, 3 and 4).

It has been reported that Geothermal Kinetics will be drilling a geothermal well in Utah sometime before the end of this year.

G.E.C.

**WELL OPERATIONS
PHILIPPINES**

Union Oil Company of California

As a result of three successful geothermal wells drilled by a subsidiary of Union Oil Company in the Tiwi area of southern Luzon's Bicol Peninsula, the Philippines now have their first geothermal steam field. Exploratory drilling to expand the field limits will continue this year and development drilling will be done as required.

Last month, the Philippines accepted a \$4.2 million loan from the United States in order to develop this important new geothermal field. A 10 mw electric generating plant and the necessary power transmission system will be constructed by the National Power Corporation--a Philippine government-owned utility--to supply the provinces of Albay, Sorsogon, and Camarines Sur in southern Luzon. If the new field is expanded and developed, additional power plants will be built and transmission lines will be run into Manila.

G.E.C.

**JOINT VENTURE
NEW MEXICO - NEVADA**

In August 1973, it was announced that Sun Oil Company and Calvert Exploration Company had reached an agreement to conduct a joint geothermal exploration program on their respective lease holdings in New Mexico and Nevada.

Calvert's wholly-owned subsidiary, Calvert Geothermal Resources, Inc., owns geothermal leases on 116,000 acres in New Mexico, and Sun has leases on 32,000 acres in Nevada.

The agreement calls for an initial undisclosed amount provided by Sun for joint operations on the New Mexico holdings, together with a pooling of presently owned and future acquired properties by both companies in the two states. After these initial expenditures, Sun and Calvert will explore for steam for the generation of electric power with each company contributing 50 percent of the cost. Calvert will be the operator of the program in New Mexico and Sun will be operator in Nevada.

Sun Oil Company is currently involved in an active exploratory geothermal program in California, and Calvert presently a contract driller for geothermal wells in New Mexico.

G.E.C.

State of California
Division of Oil and Gas
Geothermal Unit

CONVERSION FACTORS

from
Handbook of Chemistry & Physics, 1972
and
National Bureau of Standards, S.P. 330, 1972

Distance	cm	in	ft	m	mi	
	1 centimeter	1	0.39370079	0.032808399	0.01	6.2137119 x 10 ⁻⁶
1 inch	2.54	1	0.0833333	0.0254	1.57828 x 10 ⁻⁵	
1 foot	30.48	12	1	0.3048006	1.89393 x 10 ⁻⁴	
1 meter	100	39.370079	3.2808399	1	6.2137119 x 10 ⁻⁴	
1 mile	160934.4	63360	5280	1609.344	1	
Pressure	Pa	lb/in ²	kg/cm ²	bar	atm	
	1 pascal	1	1.45038 x 10 ⁻⁶	1.019716 x 10 ⁻⁵	0.00001	9.86923 x 10 ⁻⁴
1 pound/inch ²	6894.76	1	0.070306958	0.0689476	0.0680460	
1 kilogram/centimeter ²	98066.5	14.223343	1	0.980665	0.967841	
1 bar	100000	14.5038	1.019716	1	0.986923	
1 atmosphere	101325	14.6960	1.03323	1.01325	1	
Energy	J	cal	Btu	W hr		
	1 joule	1	0.239006	9.48451 x 10 ⁻⁴	2.777778 x 10 ⁻⁴	
1 calorie (NBS)	4.18400	1	3.9683207 x 10 ⁻³	1.162222 x 10 ⁻³		
1 British thermal unit	1054.35	251.99576	1	0.292875		
1 watt hour	3600	860.421	3.41443	1		
Enthalpy	J/kg	J/g	Btu/lb	cal/g		
	1 joule/kilogram	1	0.001	4.30211 x 10 ⁻⁴	2.39006 x 10 ⁻⁴	
1 joule/gram	1000	1	0.430211	0.239006		
1 British thermal unit/pound	2324.444	2.324444	1	0.555556		
1 caloric/gram	4184	4.18400	1.8	1		
Volume	l	gal	ft ³	bbl	m ³	acre ft
	1 liter	1	0.26417205	0.035314667	6.2898107 x 10 ⁻³	0.001
1 gallon	3.7854118	1	0.13368055	0.02380952	3.7854118 x 10 ⁻³	3.0688833 x 10 ⁻⁶
1 foot ³	28.316847	7.4805195	1	0.1781076	0.028316847	2.2956841 x 10 ⁻⁵
1 barrel (oil)	158.98729	42	5.614583	1	0.15898729	1.288830 x 10 ⁻⁴
1 meter ³	1000	264.17205	35.314667	6.2898107	1	8.1071319 x 10 ⁻⁴
1 acre foot	12334818	325851.43	43560	7758.367	1233.4818	1

WELL OPERATIONS LAKE COUNTY, CALIFORNIA

The Geysers Geothermal Field -
Signal Oil and Gas Company

As per agreement with Pacific Gas and Electric Company, Signal Oil and Gas Company is drilling a new geothermal well, "McKinley" 6, in the Castle Rock Springs area of The Geysers field. To date, Signal has six potential producers shut-in, awaiting completion of PG&E's proposed 135 mw Powerplant, Unit 13, scheduled for completion in 1976.

Signal also has plans for an extensive exploratory and development program in an area southeast of their existing wells at Castle Rock Springs. A discovery in this area could extend the present field boundary 3 km. Signal has submitted an environmental impact statement to the Lake County Planning Commission and a public hearing is pending.

G.E.C.

NEW ZEALAND - HOT AGAIN

For the past several years, interest in geothermal exploration and development in New Zealand has been slack, due, mainly, to numerous natural gas discoveries in that country. In recent months, however, interest in geothermics has been renewed and, as a consequence, four new wells and a re-injection project are planned for Broadlands, as well as exploratory drilling in new areas.

At Wairakei the power generation facilities are in full operation, with 90 percent well availability and no problems.

G. Facca

API NUMBERS FOR ALL NEVADA GEOTHERMAL WELLS

The Nevada Bureau of Mines and Geology is now assigning unique API numbers to all geothermal wells drilled in Nevada. The numbering system will include a 3-digit county code plus a 5-digit number from the API series. For example, the first well (Magma Power Co. No. 1) drilled at Brady's Hot Springs, Churchill County, will have API number 001-90000.

These numbers will be recorded by the API, but at this time will not be made part of the API digital file. Instead, the numbers will be maintained in hard copy, and will be available on request through the American Petroleum Institute, Washington, D. C.

J. Schilling

PUBLICATIONS GEOTHERMAL PAMPHLET

"Geothermal Energy in California", Pamphlet No. PR01, has just been released by the Division of Oil and Gas. The publication, which was designed for the lay public, students (general science teachers should find it a valuable teaching aid) briefly describes California's geothermal resources, their availability, and potential use as an energy source.

Anyone wishing to obtain copies of this publication

should contact the Division's Publications officer, Ray Rothermel, at 1416 Ninth Street, Sacramento, California 95814.

G.E.C.

NEW EARTH RESOURCES OBSERVATION SYSTEMS DATA CENTER

The National Center for Earth Resources Observation Systems was dedicated recently. This center will process and disseminate spacecraft and aircraft images of the earth and provide professional and instrumental assistance to users of the data. The address is EROS Data Center, Sioux Falls, South Dakota 57198.

M.J.R.

METRIC USAGE

The General Conference on Weights and Measures defines the International System of Units (SI) as the standard for worldwide metric usage. The U. S. National Bureau of Standards has accepted these units for use in the United States. Following is a partial list of approved units:

Base Units:

length	- metre (meter) (m)
mass	- kilogram (kg)
time	- second (s)
temperature	- kelvin (K)

Derived Units:

area	- square metre (m ²)
volume	- cubic metre (m ³)
force	- newton (N)
pressure	- pascal (Pa)
energy	- joule (J)
enthalpy	- joule/kilogram (J/kg)
mass flow	- kilogram/second (kg/s)
volume flow	- cubic metre/second (m ³ /s)

The Division of Oil and Gas, Geothermal Unit, will be using these approved units. In addition, two secondary metric units will be used because of their greater convenience:

temperature	- degree Celsius (°C)	K-273.15
pressure	- bar (bar)	10 ⁵ Pa

M.J.R.

GEOTHERMAL RESOURCES COUNCIL

The first of a series of Special Short Courses on Geothermics has been scheduled by the Council. The first course entitled "Geothermal Exploration - S.S.C. No. 1" will include sections on geology, geophysics, geochemistry, and land acquisition. It will be held from January 14 to 16, 1974 at the Senator Hotel in Sacramento, California. Enrollment is limited to 225 persons, including 25 students. The course fee will be \$100.00 for regular enrollees and \$25.00 for students. Dr. Jim Combs of the University of California, Riverside, will act as chairman.

Send all replies concerning enrollment to the Course Coordinator: Beverly Hall, Geothermal Resources Council, P. O. Box 1033, Davis Ca. 95616, (916) 758-2360. Watch the Hot Line for details.

CORRECTIONS

The announcement of publication of "Advanced Binary Cycles for Geothermal Power Generation" on page 4 of the July 1973 "Hot Line" should read

"... by *Holt, Huchinson*, and Cortez is available from the Ben *Holt* Company..."

Our apologies to Mr. Holt.

The metric conversion chart in the last "Hot Line" (July 1973) contains several incorrect numbers. Please destroy the July chart and replace it with the conversion factor chart in this issue.

M.J.R.

EDITOR'S NOTE

Because of the increasing work load and a minimum staff, the Geothermal Unit is unable to keep abreast of all geothermal activities in the western United States and in other countries. In order to give the "Hot Line" broader scope, we would like to expand the coverage on activities outside of California, but we can only do this with your help. If you have a newsworthy item, please send it to us. You will be given credit for your contribution. By keeping us informed, we will be better able to keep the geothermal com-

munity informed.

Editor

Back issues of the "Geothermal Hot Line" are available.

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