



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

Volume 5 Number 1

May, 1975

**THE SECOND UNITED NATIONS SYMPOSIUM
ON THE
DEVELOPMENT AND USE OF GEOTHERMAL RESOURCES**

SAN FRANCISCO, CALIFORNIA

20-29 May 1975

The Symposium is being organized by the United Nations Secretariat in cooperation with United States authorities (U.S. Department of the Interior; U.S. National Science Foundation; and U.S. Atomic Energy Commission), the State of California's Resources Agency, and the University of California. In addition, the Geothermal Resources Council, the American Association of Petroleum Geologists, and public and private development corporations are providing assistance.

This symposium, like its predecessor, will undoubtedly be a landmark in the development of geothermal resources throughout the world, and its proceedings, which will be rapidly published, will serve as a reference for years to come. This will be one of the rare occasions where all of the great and near-great names in the geothermal world will be in one place at one time. Attendance at this symposium will provide the exposure, contacts, and background that will be of use for years to come.

The registration is still open, for additional information and a second circular containing registration forms, applications to submit papers and pertinent information, contact:

Symposium Coordinator
United Nations Geothermal Symposium
P.O. Box 7798
San Francisco, California 94120

Please note: If you have not completed and submitted the second circular and you plan to attend, please do so as soon as possible. Registration can only be accomplished by sending the form to the Symposium Coordinator.

THE GEYSERS GEOHERMAL FIELD

On March 31, 1975, a Union Oil Company well, "G.D.C." 65-28, blew out at approximately 6:45 p.m. The initial blowout created a 20-foot deep crater and bent the well head to the south about 30° from vertical. Steam, rock dust, and small rocks continued to blow from the crater for about two days until the casing valve was opened. Most of the rock and dust being blown out were probably due to slumping within the crater. After the casing valve was opened, only clean steam was observed escaping from the well head.

The cause of the blowout is not known, but is believed to be casing failure about 40 to 50 feet below ground surface. Primary plans to control the well include excavation to expose the damaged casing, reinforcement of the casing, partial backfilling of the excavation to permit moving a rig over the well, killing the well with water, and finally recompletion or abandonment. The excavated material is being used to construct a nearby drilling pad for a relief well in the event the primary method of control is unsuccessful.

The well was completed in September 1968 and has been bleeding through a 1/4 inch line since that time, awaiting connection to a power plant that has not yet been built.

Rain and snow have delayed the remedial work somewhat but by May 1, almost 70,000 yards of material had been excavated, and it is expected that the damaged portion of the casing will be exposed within a week.

GEOHERMAL LAND LEASES

"The Bureau of Land Management has tentatively accepted high bonus bids of more than \$1-million for geothermal leasing rights to 21,600 acres of national resource lands in Eureka, Lander and Churchill Counties as a result of a competitive lease sale held in Reno on December 18, 1974. John Hillsamer, BLM lands and minerals chief, said the next step is for the BLM to secure from the high bidders, Chevron Oil Company, Getty Oil Company and the Natomas Company, the remaining

lease requirements. When these requirements are met, he said BLM possibly could issue leases for geothermal development in 3 weeks. The high bids received were for leasing rights to 3 Known Geothermal Resource Areas (KGRAs): Beowawe KGRA in Lander and Eureka Counties; Hot Springs Point KGRA in Eureka County, and Brady-Hazen KGRA in Churchill County. In Beowawe, bids were received on 5 parcels averaging between 1900 and 2500 acres each. Chevron Oil Company was successful bidder on 3 parcels with bonus bids of \$505,089; \$75,491, and \$15,075, ranging from approximately \$204 to \$8 per acre. Successful bidder for the other 2 parcels was Getty Oil Company with high bids of \$45,371 (\$18 an acre)

and \$30,232 (\$12.50 an acre). In Hot Springs Point, Chevron was high bidder on both parcels with bonus bids of \$125,619 (\$49 an acre) and \$115,275 (\$54 an acre). In Brady-Hazen, successful bidder was the Natomas Company on both parcels with bonus bids of \$51,224 (\$20 an acre) and \$37,688 (\$15 an acre). No bids were received on 6 other parcels offered at the lease sale. They will be reoffered at a later date. Hillsamer said once leases are issued, the companies will continue to pay yearly rentals plus a royalty on the value of any steam produced.... He said competitive leasing sales are scheduled in April for the Fly Ranch KGRA, north of Pyramid Lake and in June for the Stillwater Soda Lake KGRA in central Nevada"...B.L.M..

GEOHERMAL LEASE SALES

Following is the schedule for the sale of certain Known Geothermal Resource Areas for the remainder of fiscal year 1975 and all of fiscal year 1976:

FISCAL YEAR 1975	
Date	Location
May 15, 1975	Kilborne Hole, New Mexico
May 20, 1975	The Colorado Four, Colorado (Poncho Hot Spring, Mineral Hot Spring, Valley Hot Spring, and Alamosa County)
May 22, 1975	Mickey Hot Springs, Oregon
May 29, 1975	Alvord Hot Springs, Oregon (Alvord Desert K.G.R.A.)
June 5, 1975	Borax Lake Hot Springs, Oregon (Alvord Desert K.G.R.A.)
June 12, 1975	Thermo-Lund, Utah
June 19, 1975	Mountain Home-Bruneau, Idaho
June 23, 1975	Surprise Valley, California
June 26, 1975	Stillwater-Soda Lake, Nevada

FISCAL YEAR 1976	
July 31, 1975	Crump Geyser, Oregon
August 7, 1975	Vale Hot Springs, Oregon
August 15, 1975 (Tentative)	The Geysers-Calistoga, California
Sept. 23, 1975	Steamboat Springs and Wabuska Hot Springs, Nevada
October 21, 1975	Baca Location No. 1, New Mexico
January 20, 1976	Gerlach Hot Springs, Nevada
February 26, 1976	Klamath, Oregon
April 20, 1976	Darrough and Dixie Valley, Nevada
May 20, 1976	Lightening Dock, New Mexico
June 15, 1976	Brady, Beowawe, and Hot Springs Point, Nevada (re-offering)

NORTHEASTERN CALIFORNIA GEOHERMAL GRANT APPROVED

A \$35,000 grant to fund a 12-month geothermal study in Modoc and Lassen Counties was approved in January by the Economic Development Administration, Department of Commerce. The study, to be conducted by the Geothermal Unit of the California Division of Oil and Gas, will focus on uses of geothermal energy to stimulate long-range economic growth and the creation of jobs in northeastern California. Special emphasis will be given to geothermal heating of greenhouse operations involved with production of seedling conifers, bedding plants, and cut flowers. The study will also consider use of the area's geothermal water as an energy source for light industry and in the expansion of ranching operations.

AERIAL PHOTOS OF UTAH K.G.R.A. AVAILABLE

The geothermal team of the University of Utah contracted to obtain aerial photography of the Roosevelt Hot Springs K.G.R.A., Utah. Low sun angle illumination was used for the nonmountainous parts of the K.G.R.A. Prints of these photographs may be purchased from: Olympus Aerial Surveys, Inc. 50 West 2950 South Salt Lake City, Utah 84115 Phone: (801) 484-4351

Job Title 4059, series No.1-5

GEOHERMAL EXPLORATION SHORT COURSE

Colorado School of Mines is offering a week-long course entitled "Geothermal Exploration," June 2-7, 1975. The course will include lectures, laboratory sessions, and seminar-type discussions. Topics discussed will include: nature of geothermal reservoirs, modern volcanism in the U.S., neotectonism and tectonic flux; use of remote sensing data, deep resistivity surveys, seismicity surveys, design of exploration programs, and others.

The course will be presented by Professor George V. Kelter, Department of Geophysics; and Professor L.

Trowbridge Grose, Department of Geology, Colorado School of Mines. For additional information and registration materials, write:

W. E. Leckie
Office of Continuing Education
Colorado School of Mines
Golden, Colorado 80401
Phone: (303) 279-0300,
Extension 393

THREE-DAY CONFERENCE IN AUSTIN

The Center for Energy Studies and the College of Engineering at the University of Texas, Austin, have announced plans for a three-day conference entitled "Geo-pressured Geothermal Energy Resources: Research and Development," to take place June 2-4, 1975, at the Joe C. Thompson Conference Center in Austin. The conference will be chaired by Myron Dorfman, and will include sessions on resource assessment, reservoir research and technology, surface technology and power systems, and legal and environmental aspects.

For additional information on the conference, contact:

Engineering Institutes of the
College of Engineering
Cockrell Hall 2.102
The University of Texas
Austin, Texas 78712
Phone: (512) 471-3506

ALASKA HOSTS GEOHERMAL AND WIND PLANNING CONFERENCE

The Alaska Energy Office, under the direction of Bill McConkey, plans to sponsor a geothermal and wind planning conference in Anchorage, July 8 and 9, 1975. The State Energy Office will coordinate with the Federal Energy Administration and the Geophysical Institute at the University of Alaska to present a program with top geothermal and wind experts in America.

For further information, write to:

Bill McConkey, Director
Alaska Energy Office
338 Denali Street
Anchorage, Alaska 99501
Phone: (907) 272-0527

NILAND TEST FACILITY TO BE BUILT

San Diego Gas and Electric Company received a three-year extension on its conditional use permit for its Niland site from the Imperial County Planning Commission in January. The extension will allow the company to build a \$2.5 million test facility for studying the steam field and determining if the system will work. Construction of the plant will begin shortly. Scaling of equipment caused by the high concentration of salts in the water has held up geothermal development in the area; however, Gil Lombard, geothermal project engineer, has indicated that solutions to this problem are in sight. The steam will be cleaned by flashing--brought about by a decrease in pressure-- before entering the heat exchanger where the heat will be transferred to low boiling point isobutane, which will drive the turbine for the generation of electricity.

The test facility, scheduled for completion in September, will be complete except that it will lack a turbine and electric generator for the first series of tests, to evaluate the reservoir and estimate its stability. It will also yield reasonable estimates of operating costs.

--IMPERIAL VALLEY PRESS

UNION OBTAINS UTAH LEASES

Union Oil Company's \$2.7 million offer was the highest bid for 6 geothermal steam-tract leases offered by the Bureau of Land Management. The lease area consists of 11,830 acres, north of Beaver, Utah. The Bureau of Land Management has announced that Union will pay rental for use of the land and royalties on any steam production, in addition to the amount bid.

TWO NEVADA KGRAs EXPANDED

The Secretary of Interior announced in December 1974 the addition of 29,061.66 acres to two known geothermal resources areas in Nevada. The Beowawe known geothermal resources area has gained 20,512.50 acres and Hot Springs Point known geothermal resources area has gained 8,549.16 acres. The added acreage in the Beowawe area is in T.30N., R.47E.; T.31N., R.47E.;

T.31N., R.48E.; T.32N., R.48E.; and T.31N., R.49E. The added acreage for the Hot Springs Point area is in T.29N., R.48E.; T.30N., R.48E.; and in T.30N., R.49E.

WELL OPERATIONS, IMPERIAL COUNTY, CALIFORNIA

Heber Area

On April 2, while conducting normal drilling operations, the derrick collapsed on Big Chief Drilling Company's rig #10, which was making hole for Republic Geothermal, Inc. "Silzle" 1 (see December 1974 issue of the Hot Line). The driller was severely injured and was still in the hospital at the end of April. In addition, two roughnecks suffered minor injuries. The derrick and substructure on the rig were replaced, and drilling operations are expected to resume near the first part of May.

The Chevron Oil Company drilled three shallow, slim-hole observation wells near the town of Heber, to further delineate the anomaly on which they have already drilled four deeper production wells. GTW-1 and GTW-2, both in Sec. 27, T. 16 S., R. 14 E., were drilled east of the area where the other productive wells are located. This is the area where Chevron, in a joint project with Magma Energy Company and San Diego Gas and Electric Company, has been conducting equipment, production, and injection tests to determine feasibility of building a prototype Magmamax power plant (see L.L.L., "Geothermal Brine Studies", this issue).

Brawley Area

Union Oil Company of California is currently drilling the third well, "Benson" 2, of the five-well program described in the previous issue of the Hot Line. "Veysey" 1 and 2 have been completed.

U.S. GEOLOGICAL SURVEY OPEN FILE REPORTS

The U.S. Geological Survey has released the following reports in open file. Copies are available for inspection in U.S.G.S. libraries: 12201 Sunrise Valley Drive, Reston,

Virginia 22092; and 345 Middlefield Road, Menlo Park, California 94025. Extra depositories are listed with each report. In making inquiries, please give Open-file Report number, title, and author(s).

1. Preliminary hydrogeologic appraisal of selected hydrothermal systems in northern and central Nevada, by F.H. Olmsted, P.A. Glancy, J.R. Harrill, F.E. Rush, and A.S. VanDenburgh, Report No. 75-76, 360 p., 46 figs. Also available at U.S.G.S., Room 229 Federal Building, 705 North Plaza Street, Carson City, Nevada 89701.
2. Audio-magnetotelluric apparent resistivity maps, Cedarville, California, 15' quadrangle, by D.B. Hoover, Susan Gardner, and Jackie M. Williams, Report No. 75-102, 5 pl., scale 1:62,500. Also available at 504 Custom House, San Francisco, California 94111; 7638 Federal Building, Los Angeles, California 90012; California Division of Mines and Geology offices at the Resources Building, 1416 Ninth Street, Sacramento, California 95814; Ferry Building, 107 S. Broadway, Los Angeles, California 90012; and also at Building 25, Federal Center, Denver, Colorado 80225.
3. Audio-magnetotelluric apparent resistivity maps, Weiser, Idaho-Vale, Oregon, by C.L. Long, D.B. Hoover, and Erik Bramsoe, Report No. 75-103, 7 pl., scale 1" = approximately 4 mi. Also available at 8102 Federal Office Building, Salt Lake City, Utah 84111; 678 U.S. Court House Building, Spokane, Washington 99201; Building 25, Federal Center, Denver, Colorado 80225; 504 Custom House, San Francisco, California 94111; 7638 Federal Building, Los Angeles, California 90012; 365 Federal Building, Boise, Idaho 83702; and Oregon Department of Geology and Mineral Industries, 1069 State Office Building, Portland, Oregon 97201. (Material from which copy can be made at private ex-

pense is available at the Salt Lake City, Spokane, San Francisco, Los Angeles, and Boise offices of the U.S.G.S.)

4. Schlumberger soundings and total field measurements in the Raft River geothermal area, Idaho, by Adel A.R. Zohdy, Dallas B. Jackson, and Robert J. Bisdorf, Report No. 75-130, 87 p., 82 figs., and 4 pl., scale 1:250,000. Also available at Building 25, Federal Center, Denver, Colorado 80225; 1012 Federal Building, Denver, Colorado 80202; 8102 Federal Office Building, Salt Lake City, Utah, 84111; 678 U.S. Court House Building, Spokane, Washington 99201; 635 Federal Building, Boise, Idaho 83702; and at the Idaho Bureau of Mines and Geology, Moscow, Idaho 83843. (Material from which copy can be made at private expense is available at the three U.S.G.S. Public Inquiries offices in Denver, Salt Lake City, and Spokane; and at the Idaho Bureau of Mines and Geology.)

LAWRENCE LIVERMORE LABORATORY CONTINUES GEOTHERMAL BRINE STUDIES

Researchers of the Lawrence Livermore Laboratory, operated by the University of California, are continuing studies of pipe-clogging deposit buildup and other problems related to harnessing energy from the high temperature, high salinity geothermal brines near El Centro, California. Current studies are being performed on wellhead products from an existing geothermal well near the southern tip of the Salton Sea.

The following subjects are being examined:

1. Basic brine chemistry - The brines contain up to 30 percent dissolved salts and minerals and undergo chemical changes as they travel through the well to the surface. The chemical character and changes are being studied.
2. Scale formation analysis - Attempts are being made to

determine how changes in temperature and pressure affect the buildup rate and the character of clogging deposits from the brines.

3. Materials studies - Resistances of various polymers and alloys to erosion and scale buildup will be analyzed in order to develop improved materials for eventual use in turbine blades and nozzles.

Field exploration this year and next in the Salton Sea area is intended to help researchers select a site for a 10 megawatt demonstration power plant scheduled for operation by 1980.

LAKE CITY-SURPRISE VALLEY KGRA LEASE SALE

The Bureau of Land Management is offering 34,591 acres within Lake City-Surprise Valley KGRA for geothermal leasing by sealed bids on June 23, 1975. The area up for bid is divided into 16 leasing units in Townships 41, 42, 43, 44, and 45 N, and Ranges 16 and 17 E, totalling 34,591 acres.

WATER GEOCHEMISTRY SURPRISE VALLEY CALIFORNIA Introduction

Surprise Valley, located in the northeastern corner of California, is of continuing interest for geothermal exploration. Several deep wells have been drilled in the valley, with varying degrees of success. The U.S. Bureau of Land Management plans to

hold a competitive lease sale for Surprise Valley on June 23, 1975.

The California Division of Oil and Gas with cooperation from the U.S. Geological Survey conducted a geochemical study of Surprise Valley and other geothermal areas. The results presented here will be published as part of a California Division of Oil and Gas Technical Report entitled *Chemistry of Thermal Water in Selected Geothermal Areas of California*.

GEOLOGIC SETTING

Structurally, Surprise Valley is a graben which lies between two tilted horsts, the Warner Mountains on the west and the Hays Canyon Range on the east. The recently active Surprise Valley fault bounds the valley on the west and has a vertical displacement of at least 3,500 m. To determine this displacement, the elevation of the Warner Mountains above the valley floor (1,500 m) is added to the depth of sediments and volcanic debris between the valley floor and bedrock (2,000 m). Radiometric dating suggests that faulting began less than 15 million years ago (Duffield and McKee, 1974) and scarps in the alluvium attest to its recent activity.

Tertiary rhyolite flows and obsidian bodies crop out in the Fandango Valley of the northern Warner Mountains and also near the southern end of the range (Duffield and Fournier, 1974). It is possible that the volcanic rocks are related to a shallow crustal magmatic heat source.

Surface and ground water are supplied by runoff mainly from the

Warner Mountains; and streams, springs, and artesian wells are numerous on the western side of the valley. The eastern side is an alkali desert with few springs and wells. Surprise Valley forms a closed basin, and lakes have occupied the basin since late Tertiary time. At present, three shallow intermittent alkali lakes are on the valley floor. Figure 1 shows the locations of wells and springs sampled for this study. Sample 2 was collected from the site of a violent steam eruption in 1951 (White, 1955), but only quiet hot springs activity has occurred since that time.

WATER CHEMISTRY

All but one of the samples from Surprise Valley are sodium-sulfate type water (Tables 2 and 3). The sample from Fort Bidwell (Sample 1) is a sodium-bicarbonate type water.

The chemical compositions and temperature indicators of the samples indicate shallow aquifers, with water up to approximately 170°C. The great depth of the valley fill makes it possible for a deeper geothermal reservoir to exist, but it is not reflected in the surface water chemistry. Duffield and Fournier (1974) have applied various mixing models to chemical analyses from Surprise Valley wells and springs, and they calculate temperatures of 220°C for the Leonards Hot Springs and Fort Bidwell areas. The sources of thermal waters are aligned in zones sub-parallel to the sides of the valley, and faults in these zones act as conduits for the water rising through the thick valley fill.

Table 1. Exploratory Geothermal Wells, Surprise Valley

Location	Operator	Well	Status	Total Depth (m)
A NE/NE sec 23, T. 44N., R. 15E., M.D.	Magma Energy, Inc.	"Phipps" 2	Idle	1,508
B NW/NW sec 24, T. 44N., R. 15E., M.D.	Magma Energy, Inc.	"Phipps" 1	Idle	386
C SW/NW sec 24, T. 44N., R. 15E., M.D.	Magma Energy, Inc.	"Parman" 1	Idle	655
D SW/NE sec 24, T. 44N., R. 15E., M.D.	Magma Energy, Inc.	"Parman" 3	Blowout 1962	28
E SE/NE sec 24, T. 44N., R. 15E., M.D.	Magma Energy, Inc.	"Parman" 2	Idle	600
F SE/SW sec 30, T. 44N., R. 16E., M.D.	Gulf Oil Corp.	"Surprise Valley" 1-ST	Idle	2,085
G SE/SE sec 13, T. 43N., R. 16E., M.D.	Gulf Oil Corp.	"Surprise Valley" 2-ST	Abd. 1973	1,982
H SW/SW sec 6, T. 42N., R. 17E., M.D.	Magma Energy, Inc.	"Cedarville" 1	Abd. 1962	224
I NW/NE sec 11, T. 41N., R. 16E., M.D.	American Thermal Resources	"Goodwin" T-11	Abd. 1974	2,135

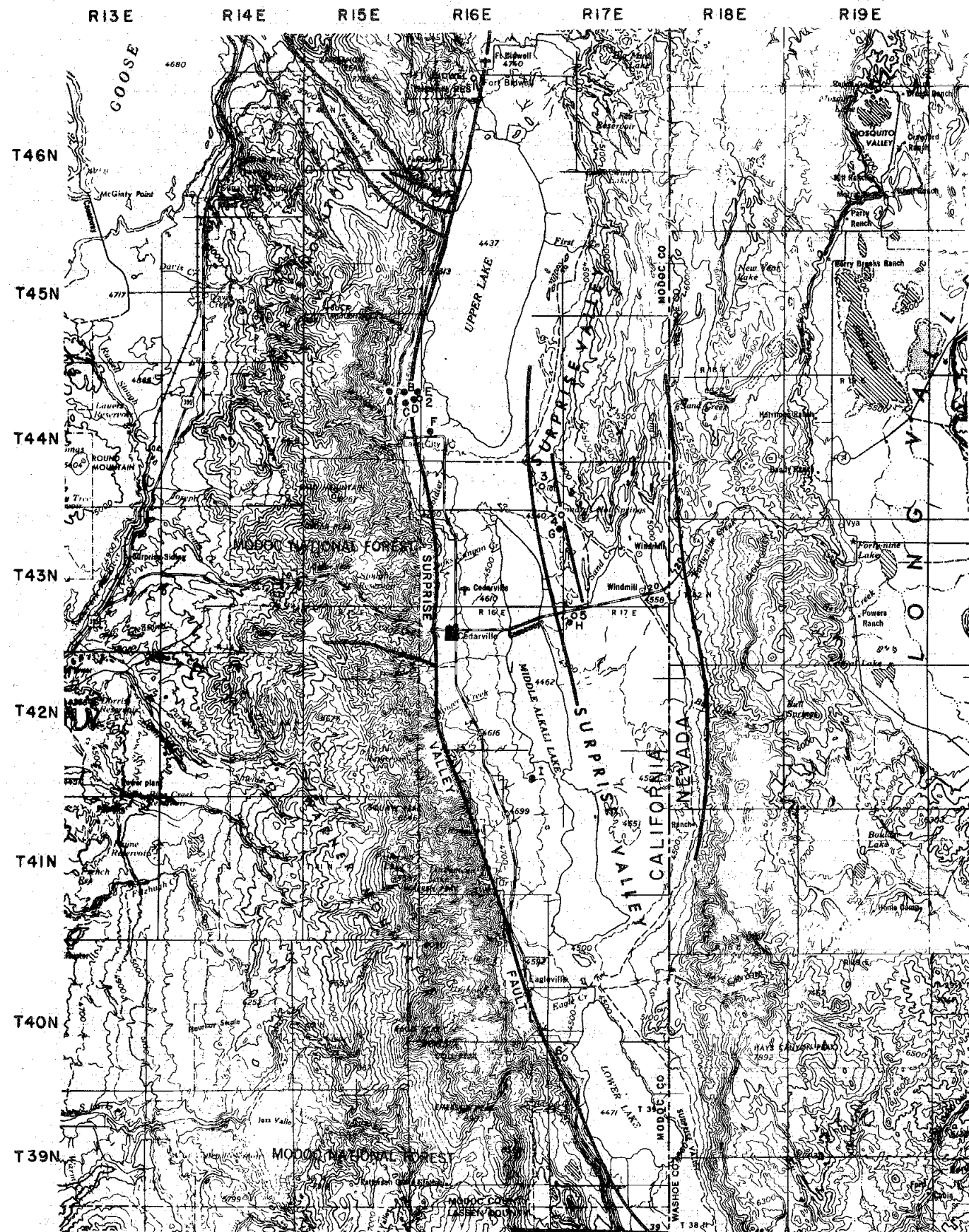


FIGURE 1, SAMPLE LOCATIONS IN SURPRISE VALLEY CALIFORNIA

— QUATERNARY FAULTS ◊ GEOTHERMAL WELLS ○ SAMPLE LOCATIONS

Table 2 - Springs and Artesian Wells, Surprise Valley

Sample Number	Location	Name	Date Sampled (mo/2y/yr)	Depth (m)	Altitude (m)	Water Temperature (°C)	pH	Conductivity (mmho/cm)	Discharge (l/min)	Isotopes ¹	
										¹⁸ O	² H
1	NW/NE Sec. 17 T. 46N., R. 16E., M.D.	Fort Bidwell Reservation	7/26/73		1,414	45.1	7.85	0.733	400		
2	SW/NE Sec. 24 T. 44N., R. 15E., M.D.	Lake City Hot Springs	8/16/73	pool	1,366	96.5	7.44	3.74	0	-14.79	-113.0
3	NW/NW Sec. 12 T. 43N., R. 16E., M.D.	Seyferth Hot Springs	7/26/73	spring	1,417	85.4	7.66	3.28	500	-14.05	-121.2
4	NE/NE Sec. 13 T. 43N., R. 16E., M.D.	Leonards Hot Springs	7/25/73	spring	1,390	61.8	7.82	2.59	150		
5	NE/SW Sec. 6 T. 42N., R. 17E., M.D.	Hot Springs Motel	7/27/73	27	1,372	98.1	8.40	2.66	300	-13.81	-112.0
6	NE/NE Sec. 7 T. 39N., R. 17E., M.D.	Menlo Hot Springs	8/23/73	spring	1,384	57.4	8.91	0.808	500	-15.30	-112.3

¹Isotopic analysis by T.S. Presser

Table 3 - Chemical Constituents of Thermal Waters, Surprise Valley (in mg/l)¹

Sample Number	Location	Cations										Anions				Other	Calculated Dissolved Solids
		Li	Na	K	Rb	Mg	Ca	Mn	Zn	F	Cl	HCO	CO	SO	SiO		
1	NW/NE Sec. 17	0.03	110	9.5	0.01	0.1	4.2	<0.01	<0.005	2.2	31	131	1	86	82	0.61	458
2	SW/NE Sec. 24	0.24	320	15	0.08	<0.1	7.7	<0.01	<0.005	7.6	220	112	0	320	200	6.3	1,210
3	NW/NW Sec. 12	0.15	300	9.0	0.04	<0.1	28	0.01	<0.005	5.4	220	63	0	370	110	7.6	1,110
4	NE/NE Sec. 13	0.13	330	8.5	0.03	0.6	26	0.09	<0.005	5.2	220	82	1	390	110	7.6	1,180
5	NE/SW Sec. 6	0.10	280	5.5	0.03	<0.1	16	<0.01	0.014	5.1	200	57	2	320	100	5.7	991
6	NE/NE Sec. 7	<0.02	100	1.4	<0.01	<0.1	5.1	<0.01	<0.05	3.8	25	27	34	120	53	0.93	370

Trace Constituents Below Detection:

- Cs < 0.1
- Fe < 0.06
- Cd < 0.01
- Co < 0.05
- Cu < 0.02
- Ni < 0.04
- Pb < 0.1

¹ Chemical analysis by L.M. Willey, T.S. Presser, J.B. Rapp, and M.J. Reed.

Table 4. Subsurface Temperatures of Thermal Waters Calculated from Chemical Indicators, Surprise Valley

SAMPLE NUMBER	MEASURED TEMPERATURE (°C)	SILICA TEMPERATURES (°C)					Feldspars	Empirical $\beta = 1/3$	CATION TEMPERATURES (°C)	
		Cristobalite	Chalcedony	Quartz	Quartz (steam loss)	Na, K, Ca $\beta = 4/3$				
1	45.1	75.9	98.7	126.4	123.6	167.2	178.8		141.2	
2	96.5	130.4	159.1	180.0	168.1	109.7	160.4		160.6	
3	85.4	92.2	116.7	142.6	137.2	76.3	129.0		101.0	
4	61.8	92.2	116.7	142.6	137.2	66.2	124.4		101.9	
5	98.1	86.7	110.7	137.2	132.7	49.6	114.5		95.8	
6	57.4	54.2	75.0	104.5		31.0	95.9		64.6	

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Duffield, W.A., and Fournier, R.O., 1974, Reconnaissance study of the geothermal resources of Modoc County, California: U.S. Geol. Survey Open File Rpt., 19 p.

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White, D.E., 1955, Violent mud-volcano eruption of Lake City hot springs, north-eastern California: Geol. Soc. America Bull., v. 66, p. 1109-1130.

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Calif. State Div. of Mines & Geology
RECEIVED
JUN 16 1975
Sacramento, California

Geothermal Hot Line
A periodic publication of the California Division of Oil and Gas. Subscription price, \$3 per year

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