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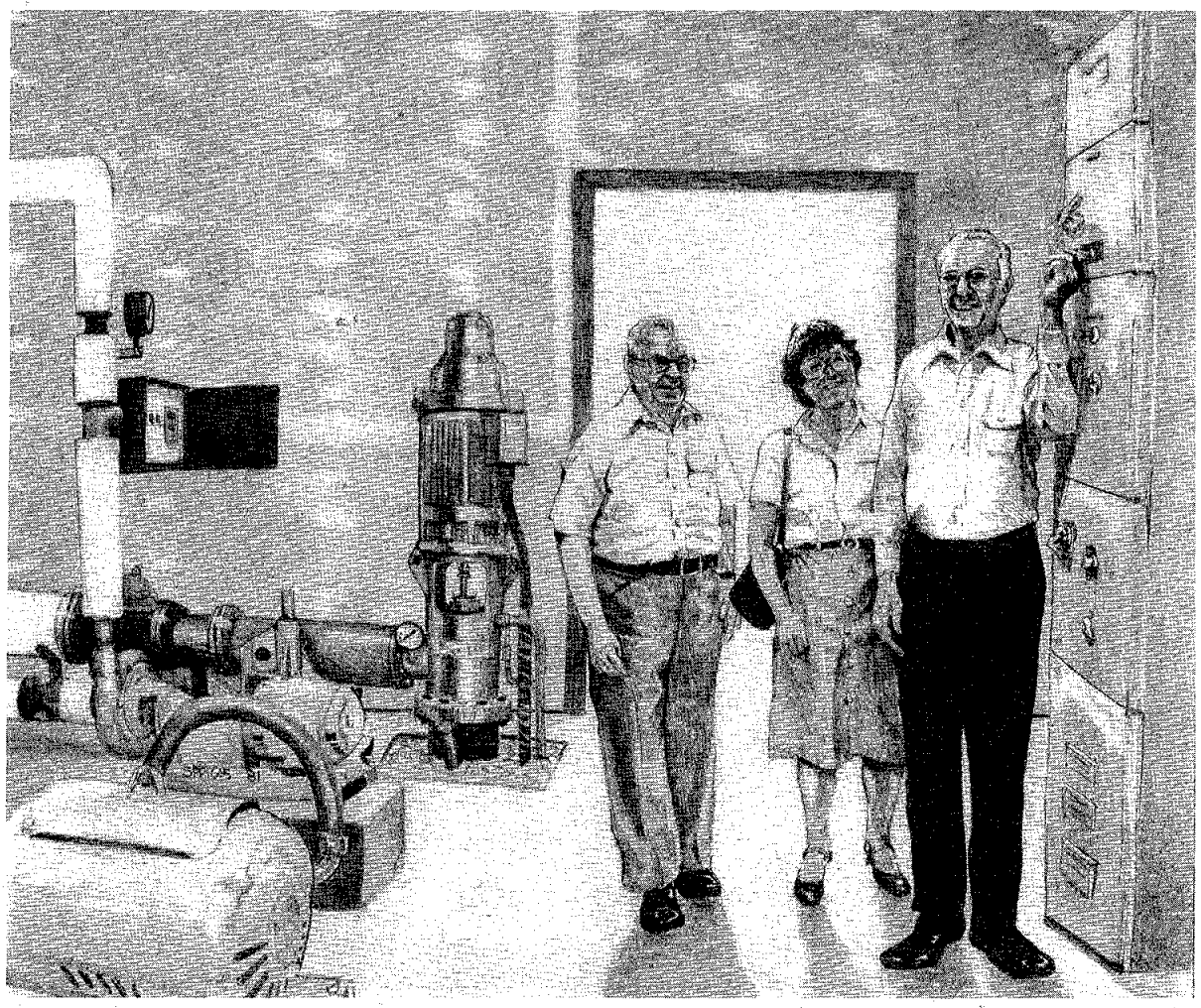
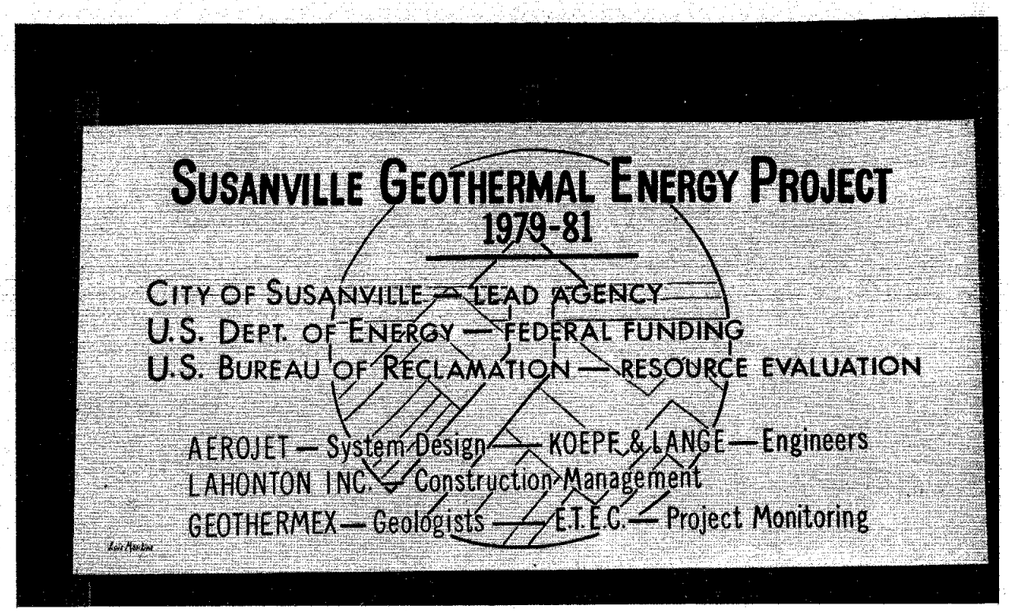
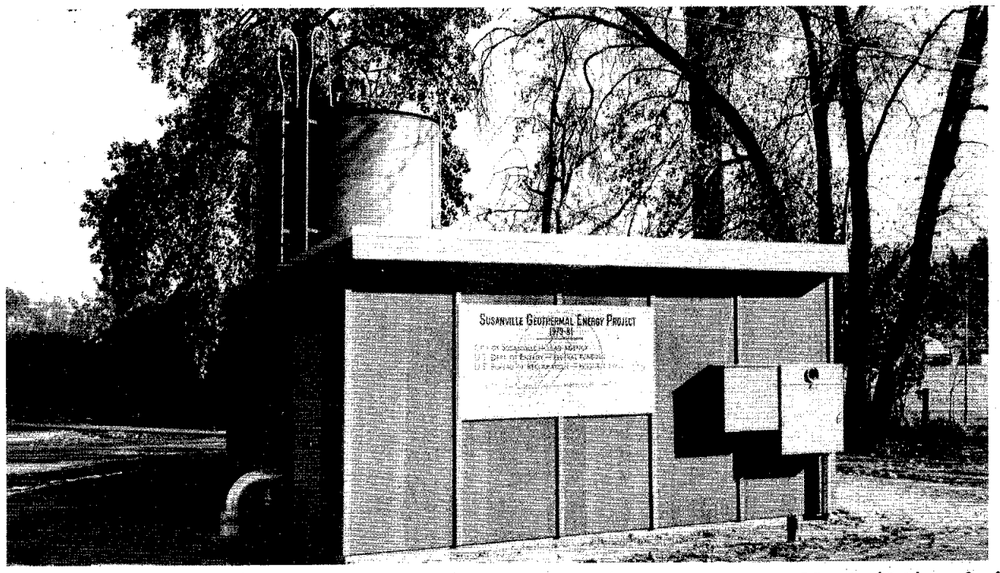


The switch is thrown by Senator Ray Johnson (R.-Chico), initiating the city-wide geothermal space-heating program in Susanville, California. At the Senator's right are Hilary Sullivan, Department of Energy representative, and Mayor Harold Grayson of Susanville. Drawing by Jim Spriggs.



The Susanville geothermal space-heating project was inaugurated on September 19,1981. In 1974, a city-funded study stated that Susanville's geothermal resources should be used for economic development. The study was the first step towards the present city-wide development. Photos by Susan Hodgson.



"Susan" 1 well site on South Lassen Street consists of a small building built around the well and two transfer pumps. The surge tank is behind the building.

Up to 800 gallons per minute of 77°C(170°F) water can be removed from the well and the drawdown is 130 feet with maximum flow conditions in a 24 hour period.

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HUEY D. JOHNSON, Secretary

DEPARTMENT OF CONSERVATION
JAN DENTON, Director

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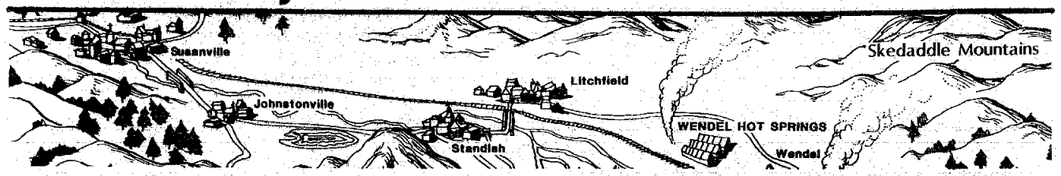


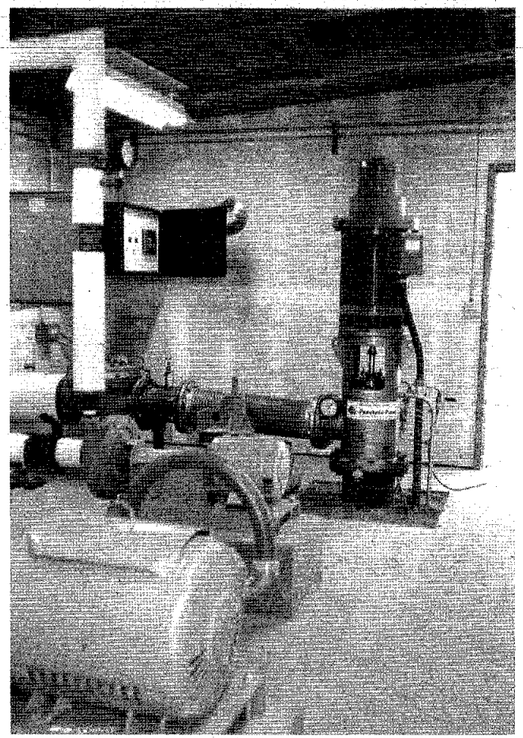
Update Susanville: Geothermal Project Underway

With a turn of a switch, Senator Ray Johnson (R.-Chico) inaugurated the Susanville, California geothermal space-heating system. For a moment, the city geothermal well "Susan" 1, drilled on South Lassen Street, two blocks from Main Street, began pumping hot water. Although the pump was turned off directly (the system won't be in use until late October 1981), city officials and a team of federal, state, and private industry representatives whose organizations participated in the project are sure they have the groundwork for a diversified, city-wide space-heating system that will benefit the area.

The Susanville space-heating system runs throughout the city. A series of predetermined tap points have been installed in the pipeline where new structures can be hooked into the space-heating system. The ease of retrofitting all buildings to use the system depends upon their present heating systems, according to Monty Koepf of Koepf and Lange, the engineering firm for the Susanville project.

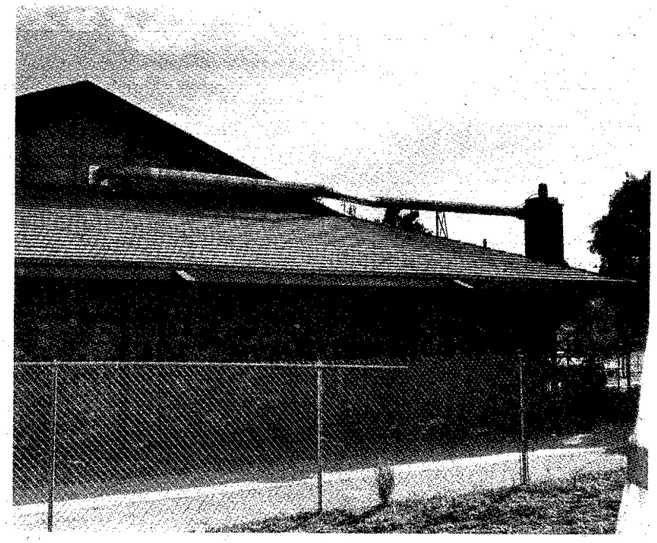
From well "Susan" 1, hot water eventually will pass through 14 retrofitted public buildings before reaching an injection well where it will be returned underground. The Lassen Union High School complex and the Lassen County Hospital are the first two facilities slated to receive the geothermal heat.

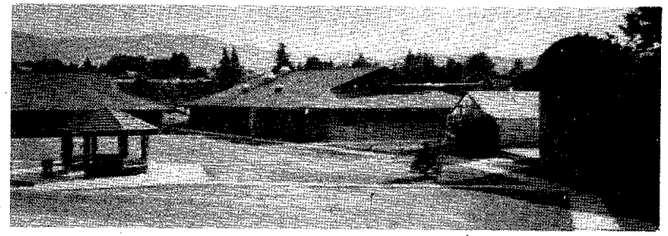
In addition to heating public buildings, other city geothermal projects are planned. A park of commerce will be built close to the well site. According



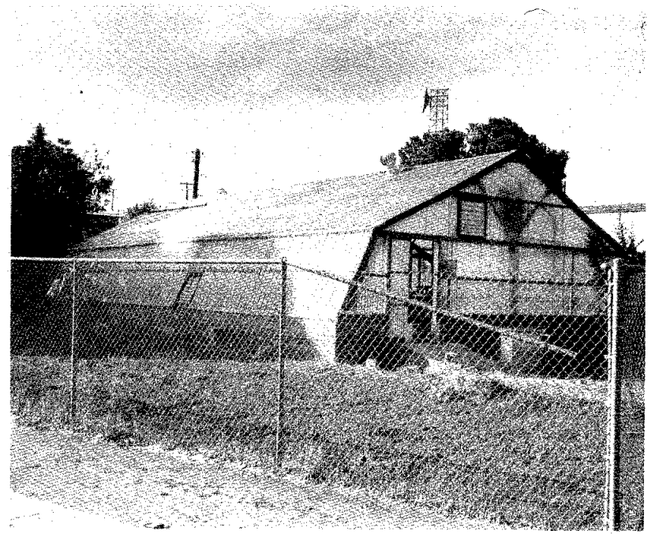
Well "Susan" 1 (photo right) and two transfer pumps. An additional pumping unit, welded to the well casing, pulls hot water out of the well. The water flows into a surge tank just outside the building. The surge tank allows the well pump to run at full capacity over a period of time, regardless of the current system-wide demand for water.

The smaller of the two transfer pumps (center photo) is used to move water through the system for most of the year. The larger pump (photo left) augments the flow in colder weather. Photos by Susan Hodgson.





Geothermally heated greenhouse and school building, Lassen Union High School complex. Although retrofitted for geothermal space-heating, the school's original space-heating system remains intact as a back-up system.



South Lassen Street, looking towards Main Street. The dark line in the asphalt roadway along the right side of the street is where insulated geothermal pipelines have been buried.

Although there will be a small, continuous flow throughout the entire system, at each service location a bypass valve may be operated to regulate the amount of water (thus, the heat) for a specific area.

to Pete Luthy of L & R Planning and Engineering, the park will be divided into industrial and agricultural sections. Many temperatures of geothermal water will be available in the park, so a wide range of industrial and agricultural activities can be undertaken. Dutch Scholz, Energy Manager for Susanville, said additional hot water wells can be drilled in the park, if necessary.

Houses will be space-heated in Susanville, as well. The City of Susanville was awarded $800,000 by the Office of Housing and Urban Development with a share of $100,000 from the Farmers Home Administration Industrial Development Grant for a field demonstration to heat 126 homes with geothermal energy in a low-to-moderate income area in an existing Block Grant Area. Payback of $300,000 of the grant money allocated for retrofit packages will be to a revolving fund, allowing the program to be expanded into further low-to-moderate income neighborhoods.

Litchfield Development

The California Correctional Center - Susanville uses 750,000 gallons of oil a year for space heating. About 550,000 gallons of the oil will be saved once a new geothermal space heating system is installed. The system is slated for completion before the winter of 1982-83.

The California Energy Commission has granted the City of Susanville $90,000 to conduct the necessary engineering to retrofit the Correctional Center to geothermal energy. The present boiler system at the correctional center will be left in place and used as a back-up unit.

The City of Susanville will develop two production wells on land about 1½ miles from the facility. A groundbreaking ceremony for one well, "Johnston" 1, was held on September 19, 1981. The wells will be fully funded by the city in conjunction with private investors and developers. The geothermal fluids will be transmitted to the boundary of the correctional facility at a cost of about $900,000.

A proposal for project hardware components was submitted by the California General Services Administration to the State Legislature. It was accepted and funded $1,430,000 for the 1981-82 fiscal year.

Geothermal fluids returning from the correctional facility will cascade through a Park of Commerce, separate

Senator Ray Johnson and Mrs. Tom Johnston break ground at the site of well "Johnston" 1, a 1500 foot geothermal well to be drilled at Litchfield, 1 1/2 miles from the Correctional Center - Susanville, and 8 miles from Susanville.

To the Senator's right is Mike Garland of the California Department of General Services. To Mrs. Johnston's left are John Geesman of the California Energy Commission, Mr. Tom Johnston, and Thatcher Johnson of the Department of Corrections.

from that planned within the city limits. The city, in cooperation with its developer, has acquired a 400-acre site overlaying the geothermal resource area for this second commercial development. Potential industries for the site include a 1,000,000 square foot greenhouse complex planned for construction in 1982-83, a confined swine-raising plant incorporating a feed mill complex, and an alcohol plant.

According to Monty Koepf, of Koepf and Lange, Inc., project engineers, "The order of magnitude of the correctional facility project is about twice of what we put in for the City of Susanville system."

Many persons at the groundbreaking ceremony said they felt the Susanville and Litchfield geothermal activities will have a statewide impact on other cities wishing to use geothermal energy.

For a copy of a booklet called "What's a Susanville," discussing the city geothermal projects, write F. A. "Dutch" Scholz, Energy Manager, City Hall, 66 N. Lassen St., Susanville, CA 96130. (916) 257-7130.

Calistoga Geothermal Resource Area

In 1979, the California Division of Mines and Geology began a study for the U.S. Dept. of Energy on the low-and moderate-temperature geothermal resources of the Calistoga area. The report includes the history of the resource, the geology of the area, geophysical studies, areal seismicity, geochemical sampling, and temperature testing for 206 water wells.

Because reliable geotechnical data was lacking, it was necessary to drill three exploratory holes at Calistoga to identify the subsurface stratigraphy and to obtain water samples from geothermal aquifers.

The October 1981 issue of California Geology contains an article by Gary C. Taylor, Geologist with the California Division of Mines and Geology, that describes part of this study. The article is titled the "Calistoga Geothermal Resources Area" and is excerpted from the Drilling Addendum to the Preliminary Report on Calistoga Geothermal Resources (1981) by G. C. Taylor, C. F. Bacon, R. H. Chapman, G. W. Chase, and H. H. Majmundar.

The October 1981 issue of California Geology is available for $.35 from the California Division of Mines and Geology, P.O. Box 2980, Sacramento, CA 95812.

New Oxy Power Plant at The Geysers

Stone and Webster Engineering Corporation will design and engineer a 80 MWe power plant for Occidental Geothermal, Inc. (OGI) at The Geysers Geothermal field. The two-unit plant is scheduled to go on line in May 1984. Ten geothermal wells will be drilled on OGI's 549 acre federal lease to provide steam for the plant. OGI completed two of the wells in 1980.

Stone and Webster's new pollution abatement system will be used to remove hydrogen sulfide gas (H_2S) from the condensed steam. The gas is removed by passing the steam through vertical stripping columns. Excess condensed steam from the plant will be injected.

The Price of Geothermal Energy

On August 1, Pacific Gas and Electric Company (PG&E) began paying an average of 7.104 cents per kilowatt-hour for electrical energy produced in geothermal power plants as well as in plants powered by other renewable resources and cogeneration plants.

PG&E updates quarterly the prices it pays under contracts for electrical energy from such facilities. The prices are based on the costs PG&E avoids by purchasing energy instead of producing the energy in its own plants. Currently, this is the cost of the oil PG&E burns in its power plants.

Reflecting the continuing escalation in oil costs, the prices have risen about 72 percent since the plan was introduced in February 1980.

Bottle Rock Power Plant

Ground-breaking ceremonies were held in May 1981 for the construction of the Bottle Rock Power Plant on the Francisco leasehold, in The Geysers Geothermal field. The Bottle Rock Power Plant is a 55 MWe generating facility owned and operated by the State of California's Department of Water Resources. The plant is scheduled to begin commercial production in June 1984, utilizing geothermal steam supplied by MCR Geothermal Corporation.

SMUDGEO #1 Power Plant Approved

The Sacramento Municipal Utility District received a permit from the State Energy Commission to construct a 72 MWe geothermal power plant at The Geysers Geothermal field. The plant, to be known as SMUDGEO #1, will be designed and constructed by Stone and Webster. It is scheduled to go on stream in December 1983.

Steam for the plant will be purchased from Aminoil USA, Inc., and piped to the plant from 9 or 10 wells.

Power Plant Unit 16 and Power Line Approved

On September 30, Pacific Gas and Electric Company received approval from the California Energy Commission to construct power plant Unit 16 at The Geysers Geothermal field and to build a 38-mile power line from the plant. The 110 MWe power plant will cost about $90 million.

One-and two-tenths miles of the power line will be run underground, in deference to residents of Oakmont, a retirement community east of Santa Rosa in the Valley of the Moon, through which the power line must pass. The cost of the underground cable portion will be $4.7 million and the total cost of the line, $42.7 million.

The Energy Commission decision was unanimous, following three years of public hearings. Most discussion concerned the power line that will run through Sonoma County to a substation in Petaluma.

Leases Studied in Lassen National Forest

A program for leasing more than 900,000 acres of land for geothermal exploration in the Lassen National Forest is awaiting U.S. Forest Service authorization, according to an article by Bill Wilson in the Sacramento Bee.

Forest Service officials are studying environmental concerns based on granting the leases on federal forest lands. The lands under consideration range from north of Lake Almanor to east of Burney and from Eagle Lake to west of the Lassen Volcanic National Park. Leases won't be permitted within the park boundaries.

Following a Forest Service review of the EIS, one of four leasing plans will be selected by Regional Forester Zane Smith. The plans range from going ahead with the leasing to abandoning the leasing program.

If Smith authorizes the granting of the leases, leases will be issued on a first-come priority basis at predetermined prices. Fifty-three lease applications are pending.

The extent of the geothermal resource beneath Lassen National Forest is unknown. However, in addition to the land designated as a Known Geothermal Resource Area south of the park, about two-thirds of the northern area of the forest has been classified by the U.S.G.S. as "...lands valuable prospectively for geothermal resources."

Modoc National Forest Land Leasing Considered

Nearly 300,000 acres in or near land in the Modoc National Forest, Northern California, is being considered for geothermal lease exploration. Interest centers on the Glass Mountain KGRA, for which a lease sale is scheduled in late 1981. The KGRA is in the Forest Service Medicine Lake Planning area.

The area extends from Lower Klamath Lake to Indian Spring Mountain and from Mount Dome to the Tionesta townsite.

After the Glass Mountain lease sale, conditions will be published for lease sales of the other acreage in the proposed project area.

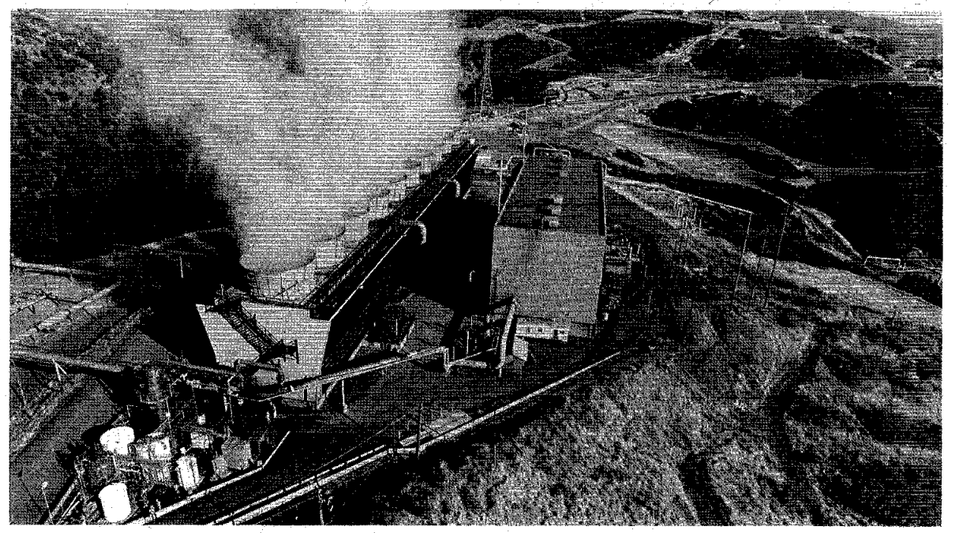
GRIPS Office Closing

The office of the GRIPS Commission will close on October 30, 1981. GRIPS stands for the Geothermal Research Information and Planning Services, a California Joint Powers Agency for Lake, Mendocino, Napa, and Sonoma Counties. The commission, itself, may continue to operate.

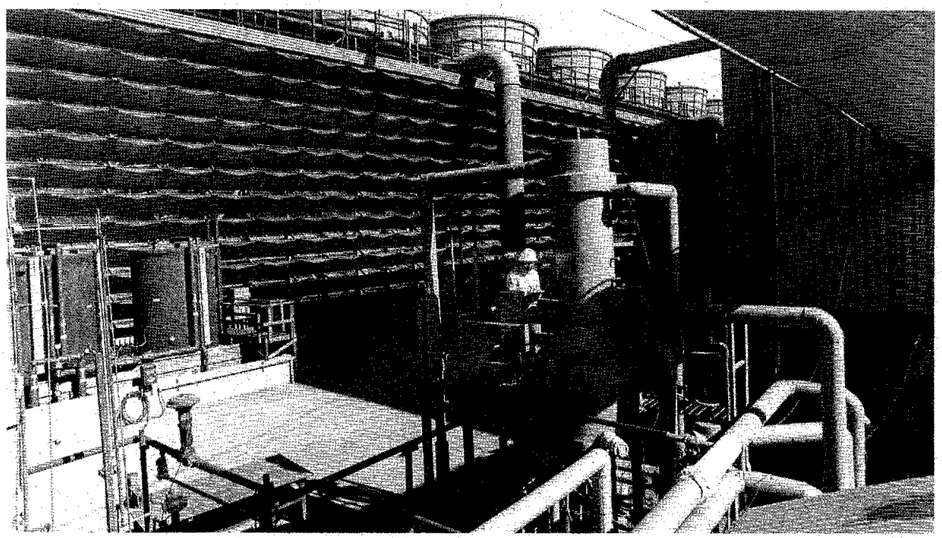
The GRIPS Commission has completed a 1-year contract with the U.S. Dept. of Energy to assist in the development of direct-use geothermal energy. Maps were prepared as part of the project, with low-temperature geothermal resources pinpointed in the four-county area. Because the GRIPS office is closing, map originals will be sent to the county planning departments, where the maps may be seen by the public.

The Commission held a series of workshops on direct-use applications of geothermal energy. It developed recommendations for expediting the permitting process and gathered an extensive general and technical library. It is hoped the library can be added to the computerized environmental data base on The Geysers Geothermal field now available at the Ruben Salazar Library, Sonoma State University, 1801 East Cotati Avenue, Rohnert Park, CA 94928.

Hydrogen Sulfide Control



Pacific Gas and Electric Company (PG&E) power plant Unit 7, The Geysers Geothermal field. At this 55 MWe power plant, the Electrical Power Research Institute (EPRI), in cooperation with PG&E, is testing a method of removing hydrogen sulfide (H_2S) from geothermal steam. Photo courtesy of EPRI.

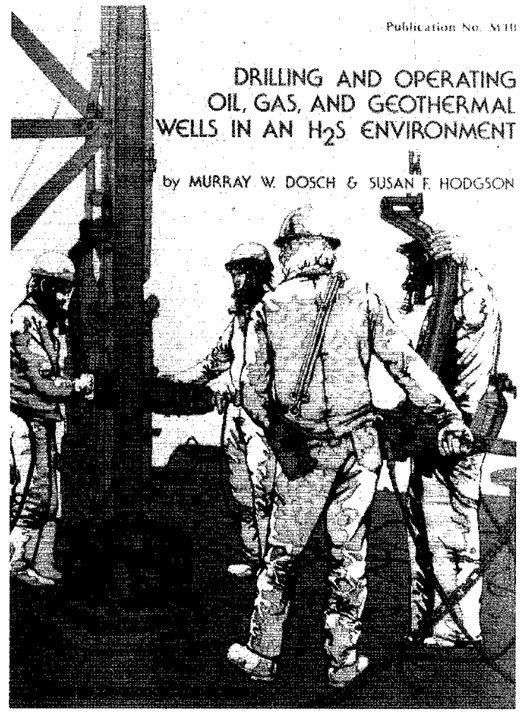


Close-up of PG&E power plant Unit 7. Tests for removing H_2S from geothermal steam at the power plant are being made with a system created by Coury and Associates of Denver. The method involves condensing and reboiling the steam before it goes to the turbine.

Results show that, on an average, about 94 percent of the H_2S can be removed from the steam. PG&E and EPRI plan to construct a larger test unit at The Geysers. Photo courtesy of EPRI.

Drilling and Operating Oil, Gas, and Geothermal Wells in an H_2S Environment is available, free, from the California Division of Oil and Gas.

The publication covers H_2S drilling and operating procedures, detection devices, protective equipment, hazard levels, safety procedures, and first aid.



Mitigation of hydrogen sulfide emissions in The Geysers KGRA. Publication number P700-81-010. $3.89 (first copy free). Published by and available from the California Energy Commission Publications Unit, 1111 Howe Avenue, MS-50, Sacramento, CA 95825.

Southern California

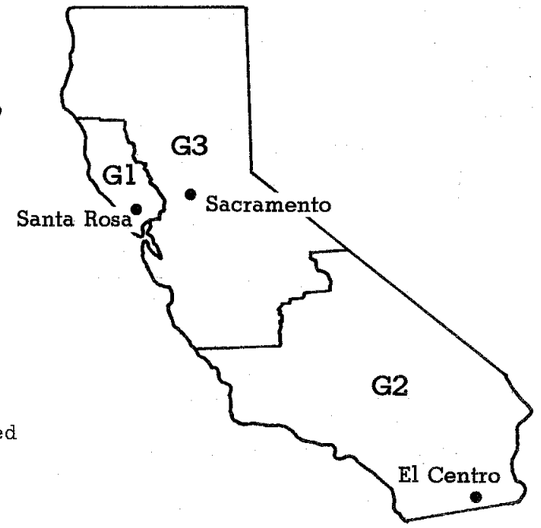
El Centro Office Opened

A new Geothermal Unit district office of the California Division of Oil and Gas (CDOG) has been opened in El Centro. All geothermal correspondence, inquiries, and calls for field tests, etc., for CDOG District G-2 should be directed to:

Mr. Richard Corbaley
Division of Oil and Gas
485 Broadway, Suite B
El Centro, California 92243
Telephone: (714) 353-9900

Office hours are 8:00 a.m. to 5:00 p.m.; any telephone calls made to the office after normal working hours will be handled by a 24-hour answering service.

The office for this geothermal district was formerly in Long Beach.



Imperial Valley Stratigraphy

Interpretation of a seismic-refraction survey of the Imperial Valley was completed by the U.S. Geological Survey in 1980, according to Marshall Reed in an article published in the February 1981 issue of Geotimes. The interpretation indicates that the crust in the valley consists of three major components: an upper zone of about 5 km of Cenozoic delta sediments, a middle zone of more than 5 km of Cenozoic metasedimentary rocks (basement), and a lower, probably intrusive, zone of diabase and gabbro or metagabbro (subbasement). Most of the geothermal areas are along axes of apparent rifting.

Yuha Basin Management Plan

The U.S. Bureau of Land Management (BLM) is preparing a management plan for an Area of Critical Environmental Concern in the Yuha Basin on the west side of the Imperial Valley of California.

The plan sets out management prescriptions for the protection of wildlife and cultural resources in the area. It also considers recreational and mineral material uses of the area.

For further information, contact the U.S. Department of Interior, Bureau of Land Management, El Centro Resource Area, 333 So. Waterman, El Centro, CA 92243, (714) 352-5842.

A Resource Assessment of the Desert Hot Springs Geothermal Resource Area, California

(Excerpted from a report by Richard Corbaley, Adolf Nation, and Roswitha Grannell presented in September 1981 at the UNITAR Small Energy Resources Conference.)

The California Division of Oil and Gas has undertaken a geothermal resource assessment of the Desert Hot Springs Geothermal Resource Area (GRA). This area is about 160km (100 miles) east of Los Angeles in the upper Coachella Valley, Southern California. The GRA includes portions of the Little San Bernardino Mountains, the San Jacinto Mountains, and the westernmost extension of the Indio Hills.

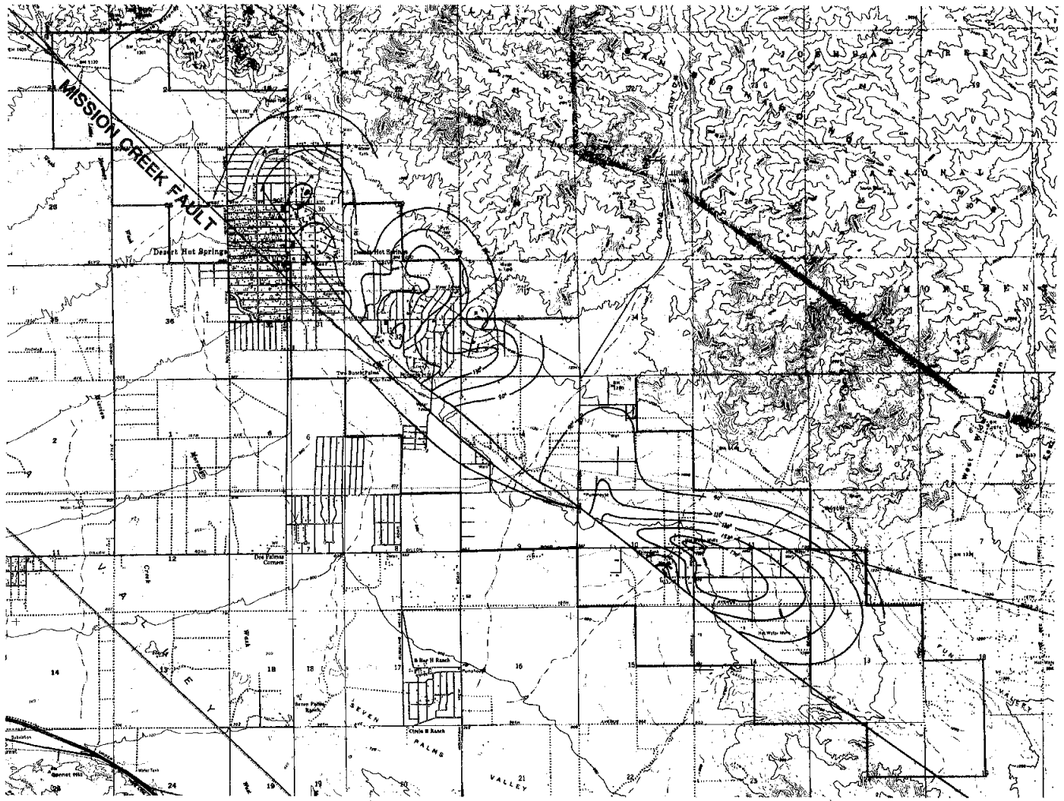
In the upper Coachella Valley, the bedrock is blanketed almost exclusively by alluvium. The older, upper Pleistocene Ocotillo Conglomerate crops out southeast of Desert Hot Springs, and old terrace deposits are found along the base of the Little San Bernardino Mountains to the north. The three units reach up to 712m (2,000 feet) in aggregate thickness. Geothermal water occurs in aquifers within these units. Drill holes 8km (5 miles) southeast of Desert Hot Springs have penetrated three additional lower Pleistocene to upper Miocene sedimentary units beneath the Ocotillo Conglomerate.

Structurally, the Desert Hot Springs GRA is characterized by active and recently active faulting, and hot water distribution is closely controlled by the Mission Creek fault. Maximum temperatures occur at a depth of 24.4m (80 feet) north of the fault, but occur at a depth of 55m (180 feet) south of the fault.

The hot waters in the Desert Hot Springs GRA occur in two discontinuous aquifers, each up to 6.1m (20 feet) thick; the upper aquifer is cooler than the lower.

Many wells in the GRA were drilled through the dual-aquifer system, where a temperature inversion occurs. Apparently, temperatures in the dual-aquifers are greatly affected by prevailing weather conditions. Well owners north of the Mission Creek fault report that the well temperatures decrease as much as 5.6°C (10°F) 2-to-6 weeks after rainstorms.

The waters are a mixture of hot water contaminated with cold water. Based on the geothermetrical Na-K-Ca method for determining water temperatures, it was concluded that waters from the city's domestic wells show geochemical reservoir source temperatures may exceed 200°C (392°F), while water from all other wells indicate reservoir source temperatures lower than 200°C (392°F).



Isothermal contours plotted from shallow water well temperatures along Mission Creek fault, Desert Hot Springs, California.

Most domestic water for the City of Desert Hot Springs comes from an aquifer extending to a known depth of 244m (800 feet) deep. This aquifer may have a hotter and different heat source than two, shallower aquifers.

A detailed gravity survey was conducted near Desert Hot Springs. Gravity values were taken either at stations of known elevation or at places where the elevations had been established by third-order or better leveling techniques, using the elevations from Department of Water and Power first bench-marks as control points.

The reduced data were plotted as a map with a contour interval of 1mgal. The map shows, for the most part, a smooth, steep, 10mgal/mile gradient across the Mission Creek fault. Gravity values become more positive towards the mountains, and the configuration of the contours suggests either that there is little vertical displacement associated with the Mission Creek fault, or else that the displacement is substantial and gravity values would be needed farther to the south to detect changes in the gradient. A suggestion of gradient change is seen in the more southerly contour lines, and may be associated with the fault zone.

Navy, BLM Reach Accord on Coso

A high-potential geothermal area on the China Lake Naval Weapons Center in Inyo County will be opened for commercial development under terms of

an agreement between the U.S. Navy and the Bureau of Land Management (BLM).

A modified public land order to permit the development, agreed to by Secretaries of the Navy and the Department of the Interior, was scheduled for publication in the Federal Register May 29, 1981.

The Navy lands equal a little over half of the 66,000 acres contained in the Coso Known Geothermal Resource Area (KGRA). The BLM offered this area in a competitive-bid lease sale on September 15.

The average bid per acre was $152.52. Bonus bids totaled $6,878,090 for 45,098 acres for 21 of the 24 tracts offered. Los Angeles Department of Water and Power (LADW&P) was the highest bidder, bidding $1,200 per acre for Unit 15 with 2,555 acres. LADW&P paid a total of $6.5 million at the sale. The next highest bidder was California Energy that bid $52.20 per acre for Unit 20.

The area is about 45 miles north of Ridgecrest, California. Dr. Carl Austin, head of the Geothermal Utilization Division at the Weapons Center, said preliminary studies indicate that the resource will be both steam and water with a temperature of about 425°F, considerably hotter than needed for the production of electricity.

Estimates of the potential generating capacity of geothermal resources in the lease sale area range from 675 to 4,000 MWe.

Austin said the Navy soon will invite industry to conduct exploratory work in the Weapons Center portion of the sale area for 90 days prior to the bid opening. He said the exploratory work will be carried out under Navy escort, guidance, and scheduling. He also said his office will make available to industry nonproprietary information it has accumulated in the area.

Not open for bidding in the sale area boundaries on Weapons Center land will be four and one-half square miles where the Navy has contracted with California Energy Corporation for geothermal development, and 2,560 acres that the Navy has reserved for other purposes.

Austin said the leases on Navy land will be conducted in accordance with the usual Department of Interior rules and regulations, plus such access and operational constraints needed by the Navy and agreed to by the Interior Department.

"As of this date," he added, "there is no requirement for a unit operation -- that is, to have all successful bidders operate through one operator."

Three major transmission lines already cross an edge of the KGRA: Southern California Edison, Pacific Northwest Intertie, and the Los Angeles Department of Water and Power. It is estimated that electricity production from the KGRA could be on line in about 5 years from the date the leases are awarded.

Steam Vents Through Landslide

Steam vents have been observed at a landslide mass near Gaviota, California by Jerry Treiman, geologist with the California Division of Mines and Geology. The venting area is near but west of the mapped trace of the South Branch Santa Inez fault. Six vents were located in a 75-foot zone: three ranging from very active to slightly active, and three were warm inside with no present evidence of steam. The maximum temperature in the two main vents was 70.5°C.

Drilling and Brines

High Temperature Logging Tools Tested

Field tests of prototype geothermal well logging tools equipped with electronic microcircuits that operate at 275°C will be conducted by Sandia National Laboratories. The high-temperature electronics have been under development at the Albuquerque labs for the past four years.

Temperatures in geothermal boreholes typically reach 275°C, greatly limiting the usefulness of conventional oil and gas logging tools, whose electronics do not operate reliably at temperatures above 180°C.

The new electronics employ hybrid thick-film circuits made by printing special resistor, conductor, and dielectric inks onto alumina substrates. After the inks are baked onto the substrates, semiconductors are added and the circuits are hermetically packaged.

Development and commercialization of the high-temperature microcircuits is part of the Geothermal Well Technology Program of the Dept. of Energy.

The new well logging tool is available from Teledyne Philbrick, Dedham, Mass.

Addition of Nitrogen May Cut Corrosion in Geo Drill Pipes

Addition of nitrogen to drilling fluid may reduce corrosion of drill pipes in geothermal wells by 90 percent, studies by Sandia National Laboratories indicate.

Results are based on a recent test in which an inert nitrogen-water mist drilling fluid was compared with a chemically treated air-water mist in drilling 2,825 feet in a northern New Mexico geothermal well.

"Corrosion rates were 10 times slower with the inert drilling fluid," says B. C. Caskey of Sandia's Geothermal Technology Division. "We feel confident that pipe used with nitrogen-water fluid could last up to 600 days instead of the 60 days which is normal for pipe used in deep geothermal drilling."

Sandia is now studying technologies needed to develop a portable generator that can produce nitrogen at the well site, either cryogenically or from diesel engine exhaust, so that the prohibitive cost of transporting liquid nitrogen to the site could be avoided.

This article was excerpted from the DOE newsletter, Energy Insider.

Scaling Study Underway

Why different metals appear to have different effects on the rate of crystalization of salts is the focus of research currently underway by Lawrence Casper at the Dept. of Energy Idaho National Engineering Laboratory. In this work, Casper uses a heat transfer rotating disc to study the causes of scaling. The disc is a dime-sized device that collects scalant deposits when it is rotated in a solution. Crystals collecting on the disc's surface are analyzed and photographed in order to record their growth rates as a function of time, temperature, and material.

Casper is experimenting with discs made of several materials, including brass, stainless steel, and carbon steel.

Lithium Extraction from Brines

A process to extract lithium from geothermal brines in the Imperial Valley is being developed by the U.S. Bureau of Mines. In the process, hydrated lime is added to the brine to convert zinc, iron, lead, and manganese from the chloride to the hydroxide form. Next, aluminum chloride is added, and lithium is precipitated as lithium aluminate.

Lead and zinc are recovered with a

SRI International process using sodium or hydrogen sulfide to produce lead or zinc sulfides. The lead or zinc sulfides, after thickening and filtration, are processed and the lead and zinc are recovered.

The average metals content of the geothermal brines used in both processes is within the range of a few hundred parts-per-million.

Brine Disposal Plan Tested

Man-made wetlands containing salt-tolerant aquatic plants may become a feasible disposal system for some geothermal brines, according to researchers at the EG&G Raft River Geothermal Experiment Site near Malta, Idaho.

The aquatic plants, such as cattails and duckweed, grow rapidly in the test wetlands and accumulate chemicals from the water. The plants were harvested on a regular basis to prevent any decay and reintroduction of the chemicals into the water. If the plants had been burned as an energy source, the fluorides would have become hydrogen fluoride and been released into the air.

A three-quarter acre wetland could treat the volume of water used to space heat a single, low-temperature greenhouse of about 6,500 sq. ft.

Saline Environments Studied

Studies of saline lakes, solar evaporation ponds, and lagoons show that the evaporitic environment can be very productive for organic matter, according to Robert Evans, Mobil Oil Corporation, Dallas.

In a paper presented to the New Orleans Geological Society, Evans noted that few species survive in the brines, but those that do commonly occur in great abundance.

Hot Oilfield Waters Provide Geothermal Energy

By Chris T. Higgins, California Division of Mines and Geology

Although abnormally warm geothermal resources are scarce in Los Angeles County, California, a large amount of hot geothermal water is extracted throughout the county from its 5,900 oil wells. Warm-to-hot water and oil are produced from well depths of only a few thousand meters, even without a high-temperature source of heat such as a body of magma. The water and oil temperatures reflect the general increase of temperature with depth throughout the earth's crust.

Even with oilfield water temperatures at a relatively low grade, and many fields producing only small quantities of hot water, oilfield waters remain attractive to geothermal developers. This is because, in the oilfields, the exploratory and drilling phases of any potential geothermal project have passed, and the results are known. Therefore, a geothermal project can be tailor-made to the resource, eliminating a great deal of financial risk.

To use oilfield geothermal energy, the heat is best extracted at centralized oil treatment facilities. During this process, the hot water, usually quite mineral-laden, passes through a heat exchanger, and a secondary fluid is heated that is piped to nearby energy users. Space-heating and industrial processes are likely candidates for such geothermal development.

Considerations in developing such projects are:

1. Adequate water temperatures and volumes;
2. Cooperation of companies holding l oilfield leases;
3. Legal clarification of who owns the heat;

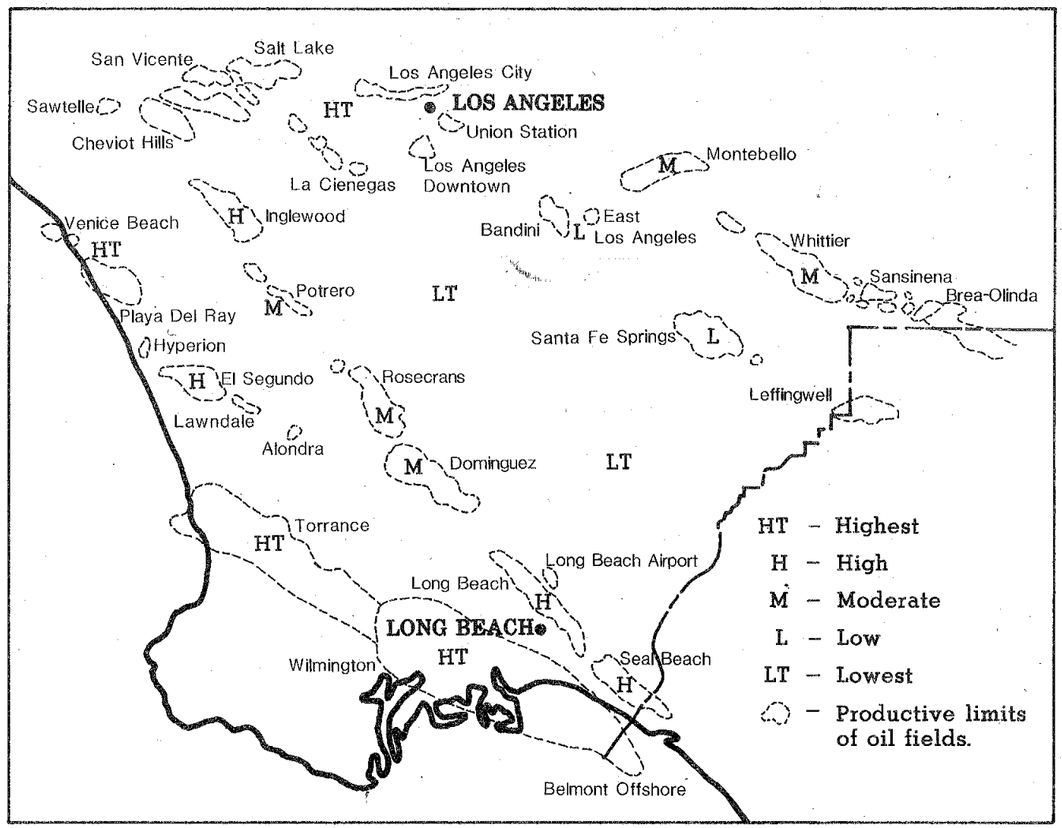


Figure 1. Relative geothermal gradients in the Los Angeles Basin.

4. Quantity and type of minerals in the water;
5. Ample room for facilities to extract and utilize heat; and
6. Realization that the life of the geothermal project is directly related to the life of the oil field.

Technologically, hot oilfield waters from any oil field probably could be used for geothermal projects. In the present study of Los Angeles County oil fields (see figure and two tables) it was discovered that several fields, especially those west of the Newport-Inglewood fault zone (Wilmington, Torrance, Venice Beach, Lawndale) could provide heat for nearby small-scale projects. The fields best suited for projects of this type are those in commercial-industrial areas or those near structures occupied by large numbers of people.

Higgins' entire report will be published by the California Division of Mines and Geology (see the CDMG bibliography in this Hot Line issue). The study was performed for the Division of Geothermal Energy, U.S. Department of Energy, Contract No. DE-FG03-80SF10855.

Table 1. Approximate temperatures and volumes of water produced in selected oil fields - Los Angeles County.

FIELD	TEMP. (°F) WELL-HEAD	ENTER TREATMENT FACILITY TEMP. (°F)	BBLS/DAY	EXIT TREATMENT FACILITY TEMP. (°F)	BBLS/DAY
ALONDRA	175°-210°	160°-180°	550	120°	500
BEVERLY HILLS	115°-140°	110°-140°	20,000	110°-135°	30,000
DOMINGUEZ	90°-140°	90°-135°	15,000	<135°	15,000
EL SEGUNDO	180°-200°	180°-200°	2,000	130°-150°	2,000
INGLEWOOD	70°-120°	90°-115°	250,000	90°-110°	250,000
LAWNDALE	175°-210°	170°-190°	2,500	120°	2,500
LONG BEACH	80°-140°	80°-135°	120,000	80°-110°	143,000
LOS ANGELES EAST		180°	2,700	80°-90°	2,700
MONTEBELLO	70°-120°	100°-115°	22,000	100°-115°	22,000
SANTA FE SPRINGS	80°-120°	105°-110°	44,000		44,000
SEAL BEACH	Up to 140°	120°	16,000	120°	
TORRANCE	95°-150°	100°-140°	53,000	115°-135°	54,000
VENICE BEACH	220°-240°	220°	8,000	150°-160°	8,000
WILMINGTON	100°-150°	105°-135°	1,100,000	Up to 135°	1,150,000
ALISO CANYON		85°	10,000	80°	9,000
PLACERITA	90°	Ambient	2,000	100°	2,000

All data supplied by field operators. Production figures for some fields are incomplete because all operators did not provide data.

Table 2. Chemistry of selected oilfield waters. (MG/L) T = Trace

FIELD	Na	Ca	Mg	Ba	Fe	SO_4	Cl	HCO_3	SiO_2	TDS	pH	HARDNESS $CaCO_3$
BEVERLY HILLS (HAUSER ZONE)	7,520	275	115	20	1	5	11,900	960	100	21,750	7.3	---
INGLEWOOD (VICKERS ZONE)	11,162	504	409	--	--	5	19,000	439	19	31,682	7.3	---
LONG BEACH (UPPER BROWN)	10,544	720	389	58	4	9	18,550	227	98	30,582	7.7	3,400
MONTEBELLO (COMMINGLED)	7,523	315	158	9	1	1	12,340	595	41	21,140	7.2	
WILMINGTON (COMMINGLED)	10,880	212	445	18	1	0	18,080	805	74	30,984	8.2	
WHITTIER (SIXTH ZONE)	7,250	100	58	T	3	0	10,710	1,476	38	19,922	7.8	
SEAL BEACH (COMMINGLED)	11,015	560	310	98	8	T	18,865	335	50	31,645	7.3	
DOMINGUEZ (E-4U5 POOL)	11,660	116	67	70	--	0	18,105	830	--	31,190	7.1	
LAS CIENEGAS (COMMINGLED)	8,375	780	600	10	5	3	15,800	1,040	67	26,780	6.8	
VENICE BEACH (UNKNOWN)	9,811	301	146	42	2	3	15,530	1,071	54	27,365	7.7	
ROSECRANS (UNKNOWN)	11,000	520	290	71	7	<5	18,200	1,340	110	32,300	7.3	
SANTA FE SPRINGS (MEYER ZONE)	4,419 (+ K)	76	30	2	--	5	6,666	626	20	12,000	7.8	
SANTA FE SPRINGS (O'CONNELL ZONE)	10,440 (+ K)	478	106	0	--	21	16,380	1,470	45	27,800	7.4	
TORRANCE (COMMINGLED)	9,900	375	325	15	1	5	16,700	1,000	200	29,000	7.2	
LAWNDALE (SCHIST CONG. ZONE)	7,230	55	15	T	<1	85	10,150	1,840	105	20,100	7.8	
SEA WATER (AVERAGE)	10,556	400	1,272			2,649	18,989	140	1-2	34,479		

Legal

Notice of Proposed Changes in the Regulations of the Division of Oil and Gas

Notice is hereby given that the Division of Oil and Gas, pursuant to the authority vested by Sections 3013, 3106, and 3712 of the Public Resources Code, and to implement, interpret, or make specific Sections 3234 and 3752 of the said Code, proposes to repeal, amend, and adopt regulations in Subchapter 5 (Disclosure and Inspection of Public Records), Chapter 4 of Title 14 of the California Administrative Code as follows:

1. Repeal of Section 1996.2 - The repeal removes the duplication of statutory language.

2. Amendment of Section 1996.5 - Present language implies that the supervisor can classify any well, regardless of its location, as an offshore well. An amended definition is proposed to remove the implication.

3. Adopt "written guidelines" regarding public access to well records.

4. Other amendments classified as procedural and organizational.

5. Include appropriate authority citations and references for Sections 1995-1997.4.

Notice is also given that any person interested may present statements or arguments orally or in writing relevant to the action at a hearing in Room 1320, 1416 - 9th Street, Sacramento, California, beginning at 10:00 a.m. on November 18, 1981.

Written comments must be received by the Division of Oil and Gas, 1416 - 9th Street, Room 1310, Sacramento, California 95814, not later than 5:00 p.m. on November 18, 1981 in order to consider them before taking action on the proposed changes. The division, upon its own motion, or at the instance of any interested party, may thereafter adopt the above proposals as described above without further notice.

A statement of the purpose of the action proposed, including the information upon which the division is relying, and a copy of the exact language of the proposed regulations may be obtained at/or before the hearing upon request.

These regulations involve no increased costs or savings to the state, state agency, local agency or school district, or in the federal funding to the state.

Inquiries concerning these proposed changes may be directed to Robert Reid, Division of Oil and Gas, at (916) 445-9686.

U.S.G.S. Proposes New Rule

A rule to clarify the geothermal regulations covering operation plans and reporting of exploration expenditures has been proposed by the U.S. Geological Survey.

The U.S.G.S. says the rule is designed to prevent misinterpretation and reduce the quantity of required geothermal reports.

The regulations would be amended to make it clear that:

- Geothermal production may begin one year after the start of environmental data collection;

- To evaluate environmental impacts, some data collection would continue during production and abandonment operations; and

- A U.S.G.S. supervisor may reduce the level and duration of data collection.

Comments on the rule should be submitted by October 8 to John J. Dragonetti, Deputy Division Chief, Onshore Minerals Regulation, Conservation Division, Geological Survey, National Center, Mail Stop 650, Reston, VA 22092.

For more information, contact Gerald R. Daniels (703) 860-7535, or Cecil Feeney (703) 860-6259.

Hot Dry Rock

Japanese Sign Hot Dry Rock Pact

Japan recently signed a 4-year cooperation pact with the U.S. and the Federal Republic of Germany regarding the Hot Dry Rock Geothermal Energy Development Program at Los Alamos, New Mexico. Under the terms of the agreement, which was negotiated through the International Energy Agency, the New Energy Development Organization of Japan will participate in the Fenton Hill part of the Hot Dry Rock Program and will make a cash contribution equivalent to 25 per cent of the Department of Energy's cost of that project, up to $2.5 million per year.

Three Japanese scientists will conduct experiments and will obtain data derived from the project.

Maryland-Virginia HDR Report Available

D'Appolonia Consulting Engineers, Inc. have finished the study of the hot dry rock site on the Delmarva Peninsula in Maryland and Virginia. The report, "Hot Dry Rock Geothermal Evaluation, Cris-Wal Site, Eastern Shore of Maryland and Virginia," is on file at the following locations: U.S. Geological Survey libraries in Menlo Park, CA; Reston, VA; and Denver, CO; the offices of the Geological Surveys of Georgia, Maryland, and New Jersey; the North Carolina Dept. of Natural Resources and Community Development; the Virginia Division of Mineral Resources; and the library of the Los Alamos National Laboratory. This is the final report to the Los Alamos National Laboratory, 4-X29-7745G-1.

Due to the large size of the report and its appendices, a summary is being published by Los Alamos. If you are interested in a copy, please send your request to the HDR Program Office, MS 575, Los Alamos National Laboratory, Los Alamos, NM 87545.

Nevada

Study of Nevada Geothermal Resources

The U.S. Dept. of Energy's Nevada Operations Office has awarded a 1-year, $241,500 contract to the University of Nevada, Las Vegas, to assess usable underground heat energy in Nevada.

The contract work includes: an assessment of geothermal resources in Carlin, Nevada, about 30 miles southwest of Elko, and in Pumpernickel Valley, about 30 miles southeast of Winnemucca; monitoring existing and newly found resources in Truckee Meadows near Reno; and preparing a Nevada geothermal resources map. The geothermal resources to be studied are those with temperatures less than 149°C (300°F).

Nevada is one of several states participating in DOE's Geothermal Energy State Coupled Program to identify potential geothermal resources that can be used without conversion to electricity.

Dixie Valley Well Tested

Sunoco Energy Development Company is preparing to test well "Federal 45-4," Sec. 5, T. 24N., R. 37E., in Dixie Valley, Churchill County, Nevada.

The company has tested the 2448-5850 foot interval, but no details have been released. The well is 1 mile northeast of Sunedco's well "Federal 84-7," Sec. 7, T. 24N., R. 37E., a reported geothermal production well.

Nevada Legislature Recognizes State Geothermal Potential

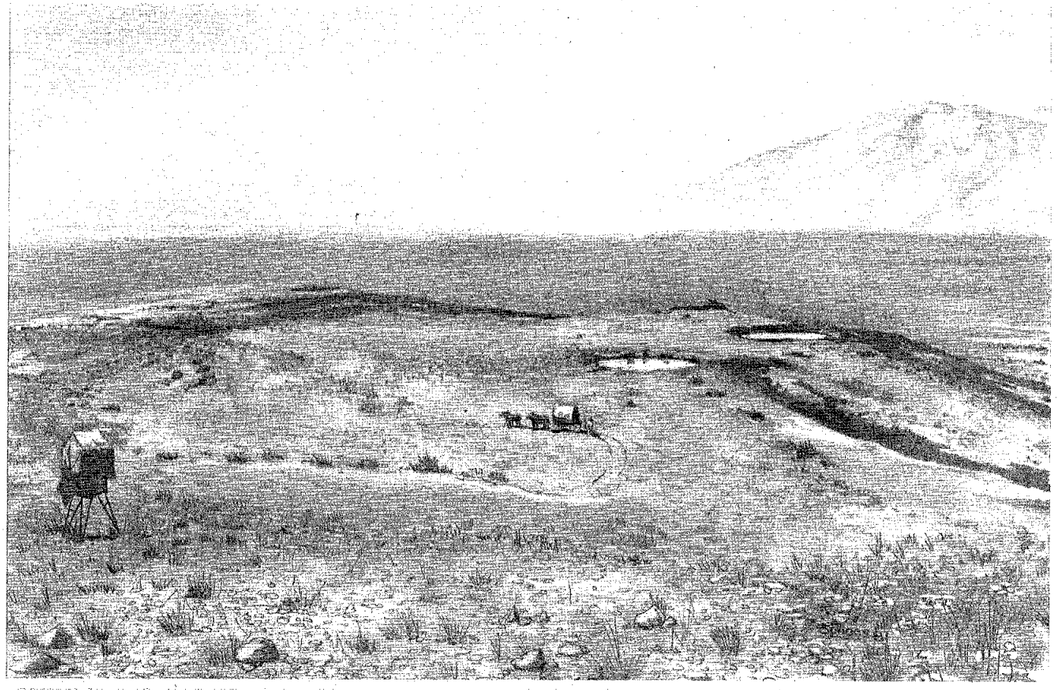
A subcommittee of the Nevada Legislature has called geothermal energy a "...major underdeveloped resource for the state of Nevada."

A 35-page report to the State Legislative Commission includes the following suggestions:

1. Redefine geothermal resources statutorily so that the definition specifies heat and the by-products, but does not include the fluid components;

2. Require at least two alternative energy system feasibility studies to be done before construction or repair of state-owned buildings larger than 20,000 square feet. Life-cycle cost analysis is to be employed in the study; and

3. Require political subdivisions of Nevada to maintain compatibility between building codes and zoning



Humboldt Hot Springs, probably present-day Dixie Hot Springs in Dixie Valley near the east slope of the Stillwater Range, Churchill County, Nevada. Drawn by Jim Spriggs from a photo by Timothy H. O'Sullivan, taken during the King survey, probably in 1868. O'Sullivan's equipment wagon and photographic outfit are shown. Photo from the U.S. Geological Survey and reprinted in Western Views and Eastern Visions by Eugene Ostroff, Curator of Photography, National Museum of American History.

ordinances and the utilization of alternative energy systems.

Beowawe Geothermal Power Plant

A group of five electric utility companies filed an application with the Nevada Public Service Commission for a permit to build a geothermal power plant in Northern Nevada.

The application seeks permission for the utility consortium, called NORNEV Demonstration Geothermal Co., to construct a 10-megawatt geothermal electric generating plant within the next two years. The proposed project site, called Beowawe, is approximately 45 miles southwest of Elko, Nevada.

The members of NORNEV include Sierra Pacific Power Company, the Sacramento Municipal Utility District, the Eugene (Ore.) Water and Electric Board, Portland General Electric Co., and Pacific Power and Light Co. of Portland, Oregon.

The demonstration plant will be used to evaluate reservoir production and electrical conversion technology for possible future large-scale geothermal development of Nevada's hot water resources. The technology and information developed as a result of the joint project will be shared by all members of the group.

The 10 MWe power plant will include portable modules that can be moved from site to site. HBA Energy Recovery Systems, Inc. of Tyler, Texas will construct the plant.

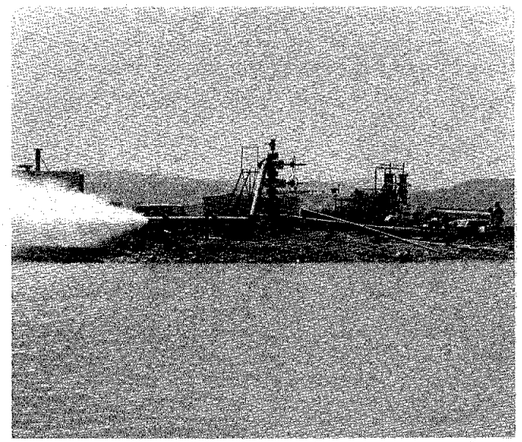
In June 1981, a month-long test of a plant heat exchanger system was completed. The test involved observing the effects of the geothermal fluid and mineral deposits on the heat exchanger's performance, and experimenting with chemical scale control and cleaning methods.

The heat exchanger was built by employees of the Sierra Pacific Power Company in conjunction with the Electric Power Research Institute.

Getty Drills at Beowawe

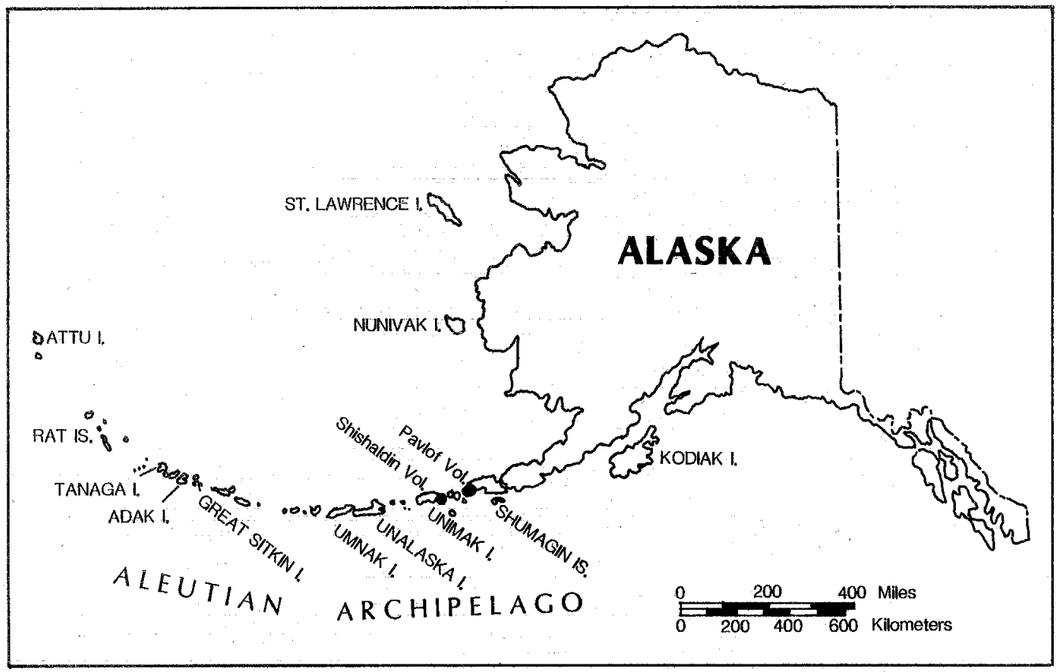
Getty Oil Company will drill a geothermal wildcat well, 76-17 Collins, in Sec. 17, T. 31N., R. 48E., in the Whirlwind Valley region of the Beowawe KGRA, Eureka County, Nevada. The well is projected to reach 9,000 feet. The deep Getty well will be the first deep geothermal well drilled on top of a major fault in the area.

Geothermal wells have been drilled at the Beowawe KGRA since the 1950's. Other companies with wells in the KGRA include Chevron U.S.A. Inc., Magma Power Company, Vulcan Thermal Power Company, and Sierra Pacific Power Company.



Geothermal steam is discharged into a holding pond during a month-long test of geothermal fluid and mineral deposits on Sierra Pacific's geothermal heat exchanger test unit. Photo courtesy of the Sierra Pacific Power Company.

Alaska & Hawaii



Aleutian Archipelago, Alaska.

Geothermal Resources of Alaska
Richard Corbaley

Much Alaskan geothermal activity is associated with recent volcanic activity along the Aleutian Archipelago. Approximately half of the more than 80 volcanoes in the archipelago have erupted during historic times.

According to the publication Geothermal Potential at U.S. Navy Bases (see the publications section of this issue), over 60 major volcanic centers of Quaternary age occur along the northern edge of the Aleutian arc, and at least 40 of these have been active in the past 200 years.

On September 26, a large lava flow was reported moving down the northern slopes of the 8,261 foot-high Pavlof volcano. It was the volcano's second eruption in a year. A nearby volcano, Shishaldin, began showing signs of activity the same day.

Small, short-lived, vapor-dominated systems of little economic value are associated with cooling pyroclastic flows from these active volcanoes. Several high-temperature springs with subsurface temperatures greater than 150°C, and many moderate-temperature springs with subsurface temperatures between 90°C and 150°C, are directly related to the recent volcanic activity. Studies indicate that the heat flow is not unusually high along this belt except at areas adjacent to volcanic vents or centers.

The northern part of Adak Island, part of the Aleutian Archipelago, contains three volcanic centers: Mt. Moffett, Andrew Bay, and Mt. Adagdak. Hot springs occur along the east side of Andrew Bay, and the maximum measured temperature was 71°C. Geophysical studies all generally

indicate the region south of Adagdak volcano to be favorable for the existence of a geothermal resource at depth. Two geothermal temperature gradient holes were drilled in 1977, and deeper test holes are needed to verify the resource.

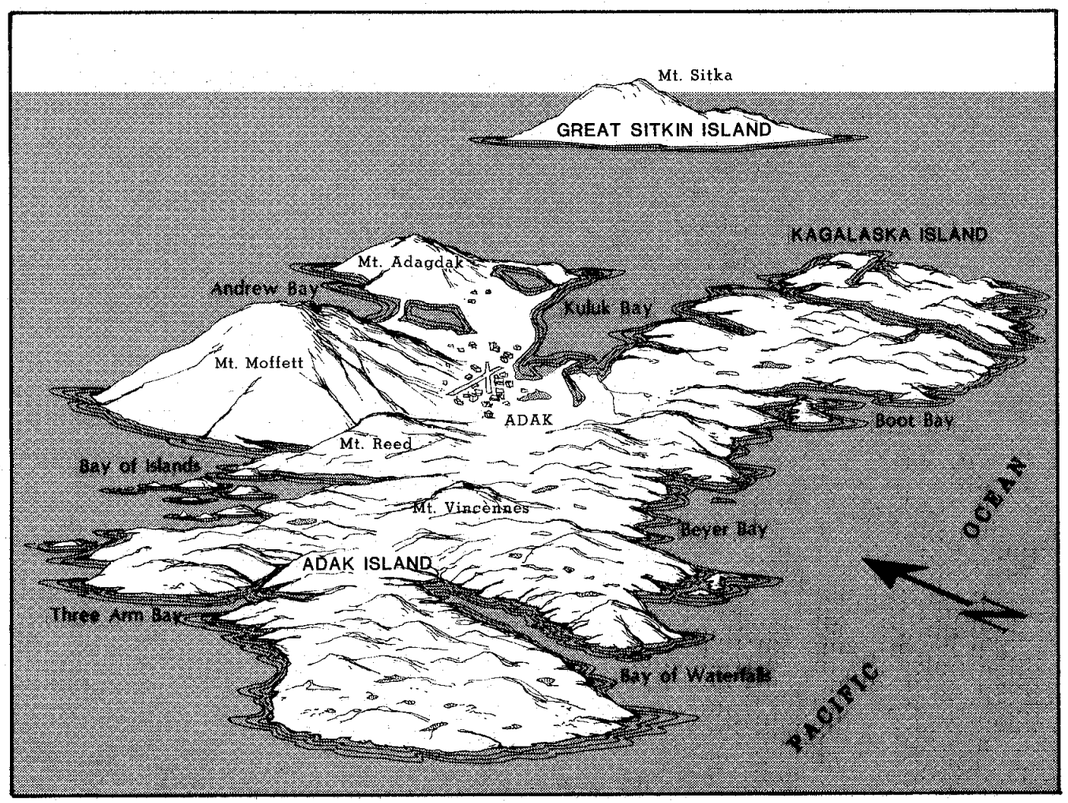
Many moderate-to low-temperature hydrothermal convection systems have been found in the central interior region of Alaska. This zone extends from the Canadian Border to the Seward Peninsula, and is south of the Brooks Range and north of the Alaska Range. No recent volcanic activity is associated with the systems. Pilgrim Springs is one of only a few geologic studies conducted on these thermally active areas. They are believed to be fault controlled, and the heat source is described as "due to normal geothermal gradient."

At the present time, three springs, Chena, Circle, and Manley, have been developed for agriculture, space heating, and tourism. All are accessible by road and within 90 miles of Fairbanks.

Alaska has a number of large, sedimentary basins. Oil wells drilled into the Cook Inlet Basin, on the Alaska Peninsula, and near Prudhoe Bay have abnormally high bottom-hole temperatures. These sedimentary basins should be carefully evaluated as possible target areas for tapping direct heat geothermal energy.

A map and table showing radiometric ages of rocks in the Aleutian Islands and the Alaska Peninsula are available for $9.00 from the Alaska Division of Geology and Geophysics Surveys, 3001 Porcupine Drive, Anchorage, Alaska 99501.

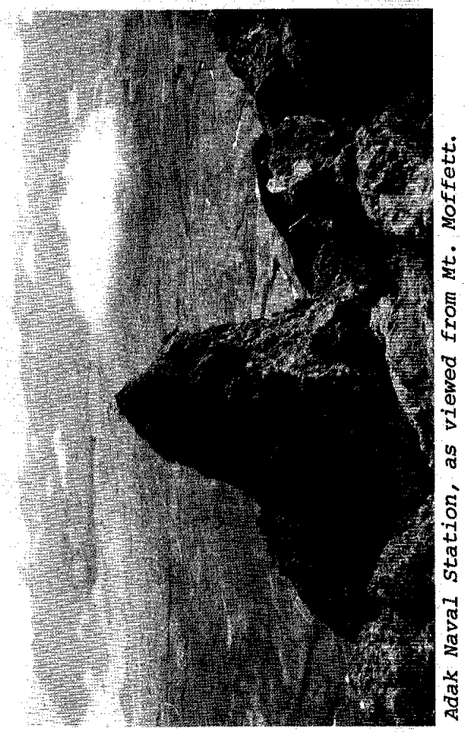
A conference on Alaskan alternative energy sources is planned for November (see conferences section of this issue).



Adak Island, Aleutian Archipelago, Alaska.

Andrew Lake and Mt. Sitka (not on the map and northeast of Adak Island) as viewed from Mt. Moffett.

Mt. Moffett, as viewed towards the northwest. The mountain is one of over 80 volcanoes on the Aleutian Archipelago. Photos by Robert Reid.



Adak Naval Station, as viewed from Mt. Moffett.

Hawaiian Power Plant Dedicated

The Hawaii Geothermal Plant, a 3.5 MWe power plant, built near the Kilauea Volcano, was dedicated in ceremonies on July 17, 1981.

The plant, a joint effort of the U.S. Dept. of Energy and the State of Hawaii, makes Hawaii the second state in the nation producing on-line electricity generated from geothermal steam.

The plant's generator is powered by steam from geothermal well HGP-A. The 6450 foot well produces steam at 358°C, making it one of the hottest geothermal wells in the world.

The single-wellhead, prototype power plant is seen as a forerunner for future plants.

Plant energy comes from steam produced on the super-hot east rift of Kilauea caldera. Steam supplied by the well is from rainwater that seeped through the hot rock.

Although the plant was built on a volcano that erupted only two years ago, scientists hope that major power equipment can be removed if lava from future eruptions threatens the site. This would be possible because Hawaii's volcanic eruptions are nonexplosive and sufficient advance warning is expected before any eruption.

All electricity produced at the plant is purchased by the Hawaii Electric Company.

For further information on the power plant, contact Takeshi Yoshihara, U.S. Dept. of Energy, P.O. Box 50168, Honolulu, Hawaii 96850. (808) 546-2184.

A publication titled the Changed Magma Budget Since 1975 at Kilauea Volcano, Hawaii (OF 81-0571) by D. Dzurisin and R. Y. Koyanagi is available for $5.75 from the Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, Colorado 80225.

New Drilling in the Puna Rift Zone

Permits to drill two 7000 ft. geothermal wells in the Puna Rift Zone have been issued to Barnwell Geothermal. Both wells will be drilled in the Keahialaka area on the Island of Hawaii. They are near well HGP-A, the field discovery well, drilled near the Kilauea Volcano. Well HGP-A is fitted with a wellhead power plant from which 3.5 MWe are generated.

Utah

Utah State Prison Wells Successful

An ample flow of hot water has been found by two wells drilled on the property of the Utah State Prison according to the Salt Lake Tribune. Geothermal water from the wells will be used to heat the prison's minimum security wing.

Intially, when the project was undertaken in 1978, the State intended to use geothermal water from wells drilled at Crystal Hot Springs, 1200 feet south of the prison grounds. However, private ownership of the property around the springs made this impossible. For this reason, the wells were drilled on prison property, according to Jeff Burks, energy facility siting coordinator for the Utah Energy Office and the manager of the prison project.

The wells produce 182°F water. The first well was drilled to a depth of 500 feet and produces about 300 gallons per minute. The second well was drilled to a depth of 1,000 feet, and was a gusher with an artesian flow of about 1,000 gallons per minute.

Project completion is slated for October 1982.

Two UP&L Geothermal Power Plants

Technological breakthroughs will put the first Utah Power and Light Company (UP&L) geothermal power plant on line in the fall of 1981, two years ahead of schedule, according to an article in The Salt Lake Tribune.

UP&L president Harry Blundell said the first unit will be about 1.6 MWe, much smaller than the 20 MWe power plant slated for operation in late 1983 or early 1984 at Roosevelt Hot Springs.

Because of the initial plant's small size, the generator will be placed right on the well head. The unit will be powered with both hot water and steam, while the Roosevelt Hot Springs plant will use steam only.

Kenya

Kenya's Geothermal Production

Six wells have been drilled in the Olkaria geothermal region in the Rift Valley province of Kenya in east Africa. Although the majority of the wells encountered conditions of low permeability, the two best wells yielded roughly 30-40 t/h (66-88x10^3 lbm/h) of liquid vapor-mixture. The reservoir occurs at 700-800m (2297-2625 ft.) below the surface, and the fluid temperature is 245°C (473°F). Temperatures as high as 300°C (572°F) have been reported at a depth of 1650m (5414 ft.) (Ellis and Mahon, 1977). A 15 MWe geothermal power unit began operating in the field in June 1980.

From Sourcebook on the Production of Electricity from Geothermal Energy, Joseph Kastin, Editor-in-chief.

Geothermal power plant in the Olkaria geothermal region, Rift Valley, Kenya. Photo by Mary Woods.

Leases

State Lands Commission Lease Net-Profit Bids In

The State Lands Commission opened bids October 1 in Sacramento for the competitive leasing of the geothermal resources from approximately 1480 acres of state-owned reserved mineral lands in Lake, Sonoma, and Mendocino Counties.

Because state law permits the surface owner of reserved mineral lands to match the high bid in a competitive lease sale, the latest sale had been divided into three lease tracts described as follows:

Lease 1, W9684

S1/2 of S1/2 of Section 26; S1/2 of SE1/4 of Section 27; NE1/4 of NE1/4 of Section 34; N1/2 of N1/2 of Section 35, all in T12N, R9W, Mendocino and Sonoma Counties, containing 440 acres more or less.

Lease 2, W40286

N1/2 of SW1/4, NW1/4 of Section 26 all

in T12N, R9W, MDB&M, Lake and Mendocino Counties, containing 240 acres more or less.

Lease 3, W9577

W1/2 of NW1/4, SE1/4 of NW1/4, S1/2, S1/2 of NE1/4, all in Section 23; S1/2 of NW1/4, N1/2 of SW1/4, SW1/4 of NE 1/4, W1/2 of SE1/4, all in Section 24, all in T12N, R9W, MDB&M, Lake County, containing 800 acres.

Terms of the sale were a fixed royalty of 12.5% of gross revenue, annual rent of $1 per acre and the biddable factor was the highest percentage of net profits.

Bids, opened October 1 at the office of the State Lands Commission, were as follows.

Lease 1
Highest bidder: Central Calif. Power Agency - 97.5%
Geoth. Resources Inter. - 38.7%
Aminoil - 20.3%

Lease 2
Highest bidder: Central Calif. Power Agency - 80.1%
Geoth. Resources Inter. - 36.7%
Aminoil - 18.67%

Lease 3
Highest bidder: Central Calif. Power Agency - 70.0%
Geoth. Resources Inter. - 62.3%
Union Oil Co. of Calif. - 30.0%

Members of the Central California Power Agency are the Sacramento Municipal Utilities District, the Modesto Irrigation District, and the Cities of Santa Clara and Redding.

Results of a technical and legal review of all submissions will be submitted to the State Lands Commission, who will then determine the highest qualified bidder.

Lease Sale Schedule as of 8/20/81

Lease sale dates are provided by the state directors of the U.S. Bureau of Land Management (BLM). Lease sale dates are tentative until public notice is issued 30 days prior to sale. Lease sale notices may be obtained by contacting the appropriate BLM office.

Location of KGRA	Latest Sale Date Scheduled	Original Sale Date
Baca Location One/Lightning Dock/ San Ysidro/ Socorro Peak NM	08/26/81	04/15/81
Coso Hot Springs CA	09/15/81	05/?/79
Brady-Hazen/Dixie Valley/Elko Hot Springs/ Monte Neva HS/Salt Wells Basin/Wabuska NV	09/29/81	10/21/81
The Geysers/East Mesa CA	09/29/81	05/?/79
Mono-Long Valley CA	10/15/81	02/?/79
East Brawley/Randsburg CA	10/29/81	10/01/81
Glass Mountain CA	11/19/81	11/19/81
Beckwourth Peak/Lassen Hot Springs CA	12/10/81	06/?/79

Indian Heaven WA	12/16/81	03/19/79
Bodie/Ford Dry Lake CA	01/05/82	01/05/82
Belknap-Foley Hot Springs/Carey Hot Springs OR	02/24/82	07/06/78
Gillard Hot Springs and Clifton AZ	04/01/82	08/?/79
Newberry Caldera OR	06/17/82	07/?/78
McCredie Hot Springs OR	10/14/82	07/ /78

Conferences and Courses

Geothermal Resources Council 1981 Annual Meeting, Shamrock Hilton, Houston, Texas, October 25-29, 1981.

Keynote speakers will discuss the future of the geothermal industry. For further information, contact Beverly Hall, Geothermal Resources Council, P. O. Box 98, Davis, CA 95617.

Third New Zealand Geothermal Workshop, University of Auckland, Auckland, New Zealand, November 9-11, 1981.

The meeting will provide a forum for exchange of new and significant information on all aspects of the development and use of geothermal resources in New Zealand and overseas.

For further information, write to Professional Courses, Centre for Continuing Education, The University of Auckland, Private Bay, Auckland, New Zealand.

Third Annual Alaska Alternative Energy Conference, Anchorage Community College, Anchorage, Alaska, November 13-15, 1981.

The conference goal is to provide information on current alternative energy technology and establish a communications network for Alaskans involved in energy planning, use, or generation. (See the article on Alaskan geothermal potential in this Hot Line issue).

For further information, contact the Alaska Alternative Energy Resource Center, 1069 West 6th Avenue, Anchorage, AK 99501. (907) 274-3621.

Geothermal Resources and the Institutional Maze, December 1-2, 1981.

The two-day symposium will cover the procedures, requirements, and regulations of the federal government and some state governments for the exploration and development of geothermal energy resources.

For further information, contact the Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

Volcanic Hazards Workshop, Empire Room, Woodlake Inn, 500 Leisure Lane, Sacramento, CA. December 3, 7:30 a.m. to 9:30 p.m. and December 4, 8 a.m. to 4:45 p.m. $45. For room reservations, call (916) 922-6251.

Sponsored by the California Department of Conservation, Division of Mines and Geology, in association with the State Office of Emergency Services.

The workshop will provide a forum for volcanologists and disaster response planners to examine the status of volcanic prediction capacities and emergency response options in California volcanic hazard zones. Among the topics to be discussed are the potentially active volcanic zones in California, and geochemical and experimental geophysical methods of monitoring volcanic activity.

For further information, contact Science and the Environment, University of California Extension, Davis, CA 95616. (916) 752-0880.

Legal Aspects of Geothermal Development, December 3-4, 1981.

A two-day course to be held immediately following the GRC course on Geothermal Resources and the Institutional Maze. The course will be co-sponsored by the American Bar Association.

For further information, contact the Geothermal Resources Council, P.O. Box 98, Davis, CA 95617.

Miami International Conference on Alternative Energy Sources, University of Miami, Miami Beach, Florida, December 14-16, 1981.

The Clean Energy Research Institute will present this conference that is co-sponsored by the Internation Association for Hydrothermal Energy. Two sessions on geothermal energy are planned.

For more information, contact Ms. Lynn Morris, Clean Energy Research Institute, University of Miami, P.O. Box 248294, Coral Gables, FL 33124. (305) 284-4666.

International Conference on Geothermal Energy, Florence, Italy, May 11-14, 1982.

The meeting will provide an opportunity to discuss current geothermal technology and how it relates to future development. For information, write to Conference Organiser, Geothermal Energy Conference, BHRA Fluid Engineering, Cranfield, Belford MK43 OAJ.

BHRA is an independent, international center that offers information, consultation, design, and development services covering all aspects of fluids in engineering systems. BHRA produces a variety of publications, and a full publications catalogue is available upon request.

Fourth Symposium on the Cerro Prieto Geothermal Field. August 10-12, 1982. Guadalajara Sheraton, Guadalajara, Mexico.

The meeting will be the final symposium in which 5 years of cooperative activities at the Cerro Prieto Geothermal field between the Comision Federal de Electricidad of Mexico and the United States Department of Energy are summarized.

Computerized Data

Well Data Available

A computer-generated file of production and injection statistics for all California geothermal wells with records open to public inspection is available from the California Division of Oil and Gas. All data are in metric units. Records for about 80 wells are included.

The file may be purchased for $50.00 from the California Division of Oil and Gas in Sacramento.

Computer-Assisted Well Log Analysis at LBL

Lawrence Berkeley Laboratory has recently acquired several computer programs to assist in the storage, analysis, and display of large amounts of data, such as those describing a geothermal reservoir. One program, PETROS, has the capability to manage data (i.e., store, graphically display, list), to analyze it according to prescribed formulae (e.g. to calculate porosity as a function of bulk, fluid, and matrix density), and to summarize raw data and/or calculated information. To use PETROS, digitized values of measured parameters as a function of individual well depth are required.

A second package, ROMEO, is a surface contouring program that will rapidly create maps according to one of three possible schemes for interpolation. Point control of data is required.

Together, PETROS and ROMEO provide the capability to take full advantage of data sets on any geothermal reservoir in the world.

From an abstract of a paper presented at the Third Symposium on the Cerro Prieto Geothermal Field, Baja California by J. H. Howard, S. P. Vonder Haar, and S. E. Halfman.

Geophysical Profile Programs

Geophysical profile data processing programs for the Hewlett Packard Model 2647A graphics terminal (OF 81-0447) by Hamdy Sadek, V. J. Flanigan, and George Kakatsakis. Paper copy $4.75, microfiche $3.50. Available from the Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, Colorado 80225.

DOE Computerized Retrieval System

DOE/RECON, the on-line energy information retrieval system managed by the Dept. of Energy Technical Information Center (TIC) at Oak Ridge, Tenn., now offers data bases with over 1,200,000 citations.

Each month, about 600 users at remote terminals dial information on almost every aspect of energy research, development, and use in over 7,000 operations.

The system currently contains 25 data bases, most of them created by the DOE, the Energy Research and Development Administration, the Atomic Energy Commission, and their contractors.

One base, the Energy Data Base, contains over 600,000 citations to worldwide literature on fossil fuels, alternative energy sources, nuclear energy, chemistry, physics, biology, environmental sciences, and engineering. Other data bases reference energy research contracts, policy statements by DOE officials, tables and graphs from Energy Information Administration publications, or computer software.

The center is currently searching for computerized data files now receiving limited use in the DOE but which, if made available through the DOE/RECON system, would benefit the scientific and engineering community served by TIC.

Organizations which have developed such data files and who want them mounted on DOE/RECON may contact David E. Bost, director of the Science and Technology Division, DOE, Technical Information Center, P.O. Box 62, Oak Ridge, Tenn. 37830.

This article is excerpted from the DOE newsletter, Energy Insider.

EPRI Data On Line

An Electric Power Database - R & D Information System (EPD-RDIS) has been prepared by the Electric Power Research Institute. The system is included in three major information retrieval services: DOE's RECON, System Development Corp.'s ORBIT, and Lockheed's DIALOG. There are no longer any subscription fees, minimum monthly fees, or minimum search costs for access to EPD-RDIS data.

The database has information on research from EPRI and about 120 utilities, projects run by the Nuclear Safety Analysis Center, and a number of owner's groups: the Utility Water Act Group, the Boiling Water Reactor Owners Group, the Steam Generator Owners Group, and the Relief Valve Program.

Data base information may be extracted by utility project number, Federal Energy Regulatory Commission category, EPRI subject category, reporting utility, prime contractor, cosponsors, and subject descriptors, as well as by a full text search with any combination of words from the descriptors, titles, or abstract.

The California Energy Commission sends all state research and development project data to EPRI for inclusion in the data base.

The reference book Digest of Current Research in the Electric Utility Industry is photocomposed from the data base and issued annually by EPRI. It is sent to member utilities and other contributors of R & D data. Another publication, Research and Development Projects, which is brought up-to-date three times a year, presents objectives of current projects funded by EPRI and highlights special tasks or phases of work. Major contractors and co-sponsors are named, and published reports are listed. These EPRI reports may be ordered from Research Reports Center and will soon be available for on-line ordering as well.

The Technical Information Division at EPRI can assist inquirers to obtain on-line access to EPD-RDIS or help with formulating inquirers' searches. EPRI is planning a series of workshops later this fall to help the utilities keep current with the evolving methods of retrieving EPRI information efficiently and effectively. Information on the locations and dates of the workshops or answers to any other questions on gathering information can be obtained from the Technical Information Division.

This information was excerpted from an article by Jenny Hopkinson in the September 1981 issue of the EPRI Journal.

Publications

Geothermal Energy is a journal not included in the list of geothermal newsletters and journals published in the July 1980 and January 1981 issues of the Hot Line. Annual subscription rates under a special introductory offer are $45, U.S.A., $70, other countries via airmail. The prices apply when payment is enclosed. Available from Geothermal World, 18014 Sherman Way, #169, Reseda, CA 91335.

Also available from Geothermal World are many geothermal publications, listed in a free pamphlet titled "Resourceful Readings." Among these is the Geothermal World Directory, 1980-81 Edition. $50.00 prepaid. The publishers describe the directory as a "...comprehensive reference guide to geothermal development worldwide."

EIA publications, new releases DOE/EIA-0204. Published every other week by the U.S. Dept. of Energy Information Administration, the Office of Energy Information Services. $14.00 per year. Available from the National Energy Information Center, E1-72, Forrestal Bldg., U.S. Dept. of Energy, Washington, D.C. 20585.

Also available from this address are:

EIA Publications Director -- A User's Guide (GPO Stock No. 061-003-00102-5; $5.00) which lists EIA publications released from October 1977 through December 1979;

EIA Publications Directory - A User's Guide--Supplement (1st Quarter 1980) (GPO Stock No. 061-003-00123-8; $3.50);

the EIA Publications Directory -- A User's Guide--Supplement (2nd Quarter 1980) (available from GPO by title; $3.25); and

the EIA Publications Directory -- A User's Guide--Supplement (3rd Quarter 1980) (available from GPO by title; $3.25).

Geothermal energy update. 12 issues a year. Published by the U.S. Dept. of Energy, Technical Information Center. Available from the National Technical Information Service, Springfield, VA 22161. $45.00 a year for domestic subscribers and $90.00 a year for subscribers outside the North American Continent. Single issues are $6.00 and $12.00, respectively.

Alternative energy data summary for the United States. Quarterly publication, $100.00 per year. Published by and available from the Resource and Technology Management Corporation, 714A S. 15th Street, Arlington, VA 22202.

The 1981 series consists of Vol. 1 -- 1975-80 Actuals by Sector; Vol. 2 -- 1975-80 Sales Revenues by Sector; Vol. 3 -- Projections 1981-86 by Sector; Vol. 4 -- 1975-80 Cost/Price profiles by Sector. Geothermal energy is one alternative energy source included in the series.

The new government reports annual index. 1980. $375.00. Available from the National Technical Information Service, U.S. Dept. of Commerce, Springfield, VA 22161. 6 volumes.

These volumes provide a single reference source for every government report announced by NTIS in 1980.

Energy data contacts finder DOE/EIA-0259 (81/2Q). 1981. Free. Available from the Information Referral Division of the National Energy Information Center, Energy Information Administration Room 1F-048, Forrestal Bldg., Washington, D.C. 20585. Phone orders accepted (202) 252-8800.

Four pages of who to call for what data at the NEIC.

Energy Questions?

For answers to your energy questions, contact the National Energy Information Center by phone, letter, or in person, at the:

National Energy Information Center
EI-20
Forrestal Building, Room 1F-048
U.S. Dept. of Energy
Washington, D.C. 20585
(202) 252-8800

If you wish to call a number in a western time zone, call the National Energy Information Center Affiliate, Albuquerque, NM (505) 846-2735.

Geothermal progress monitor. Rept. 5. DOE/CE-0009/5. $11.00. Available from the National Technical Information Service, U.S. Dept. of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

The report contains data on status changes and the overall rate of progress in the development of U.S. geothermal resources.

Research information packages from the Smithsonian Science Information Exchange. Several geothermal packages available. One, titled Geothermal Energy, costs $85.00. Further information available from Smithsonian Science Information Exchange, Inc., 1730 M Street, N.W., Suite 300, Washington, D.C. 20036. Phone (202) 634-3933.

A guide to obtaining information from the USGS, 1981, USGS Circular 0777. Free. Published by and available from the U.S. Geological Survey, Text Products Division, Eastern Distribution Branch, 604 South Pickett Street, Alexandria, VA 22304.

The publication offers information on the maps, reports, and other information available from the USGS.

The geothermal research program of the geological survey. Open File Report 81-564. $14.50. Available from the Distribution Branch, Text Products Section, U.S. Geological Survey, 604 So. Pickett Street, Alexandria, VA 22304.

Research projects may be categorized as studies of volcanic systems and magma chambers; hydrothermal systems and fluid geochemistry; geopressured geothermal systems; geothermal systems, and the transfer and storage of geothermal heat; regional geothermal investigations, and the development of geophysical and geochemical techniques for geothermal exploration and assessment.

Development of geothermal resources on federal lands, Serial No. 96-14 (hearings to amend the Geothermal Steam Act of 1970). Congressional Energy Document. Available from the Chairman, Committee on Interior and Insular Affairs, U.S. House of Representatives, Washington, D.C. 20515.

Geothermal potential at U.S. Navy bases, NWC TP6097. By Carl Austin, James Whelan, and J. M. Commander. Available from the Naval Weapons Center, China Lake, CA 93555.

Geothermal potential was studied at Navy bases around the world, including Adak Island in the Aleutian arc. See photos of the island with the article on Alaskan geothermal development in this Hot Line issue.

Minutes of ASTM Committee E-45 on geothermal resources and energy. Meeting of May 12-14, 1981, Phoenix, AZ. Free. Available from Drew Azzara, ASTM, 1916 Race Street, Philadelphia, PA 19103.

The minutes contain interesting data on guidelines for specifying thermal performance for geothermal power applications. Graphs are included of thermal efficiency and the utilization factor for single-flash steam cycles. There is also a schematic of a dual-flash steam cycle.

Geothermal energy enhancement by thermal fracture, La-8428. 1981. Available through DOE/contractor channels or from NTIS, U.S. Dept. of Commerce, Springfield, VA 22161.

The study by the Los Alamos National Laboratory showed that a thermal fracture process could double geothermal heat extraction over the amount of heat extracted by conduction alone.

Geothermal injection monitoring project UCID-19066. By L. Younker. $6.00. Available from the National Technical Information Service, U.S. Dept. of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

Materials selection for geothermal energy systems. DOE/RA/27026-1. Available from the Technical Information Center, P.O. Box 62, Oak Ridge, Tennessee 37830.

Geothermal scaling and corrosion. Edited by L. A. Casper and T. R. Pinchback. $29.50 (less 20 percent to ASTM members). Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

The book includes 16 papers discussing interfacial reactions between fluids and the surfaces of materials in pipes, heat exchangers, and other containers. The data is important for those working to solve scaling and corrosion problems.

Geothermal steam muffler diffusers: The Geysers, California, failure analysis report. NTIS No. DOE/ET/27026-T2. 1980. By R. McAlpin and P. F. Ellis II. 18p. Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.

The primary failure mechanism for the T304 diffusers at The Geysers was chloride-induced stress corrosion cracking (SCC). Once SCC had progressed to a certain point, high cycle corrosion/fatigue proceeded to final fracture. Alteration of The Geysers' environment to prevent SCC is not feasible. The existing environment will also cause sulfide stress cracking (SSC) in susceptible materials; therefore, alternate materials must resist SSC as well as SCC. The very large amplitude operational stresses make heat treatment to relieve residual fabrication stress questionable for the prevention of SCC.

Geothermal systems: principles and case histories. By L. Rybach and L. H. P. Muffler. $63.04. Available from John Wiley and Sons, Inc., 605 Third Avenue, New York, NY 10016. 360p.

The book is a summary of geothermal development in the 1970's. Case histories of systems representing a spectrum of current geothermal development are discussed.

Geothermal systems. By John Elder. $49.50. Available from Academic Press, Inc., 111 Fifth Avenue, New York, NY 10003. 508p.

The book was written to bridge the gap between large-scale volcanic and small-scale hydrothermal systems.

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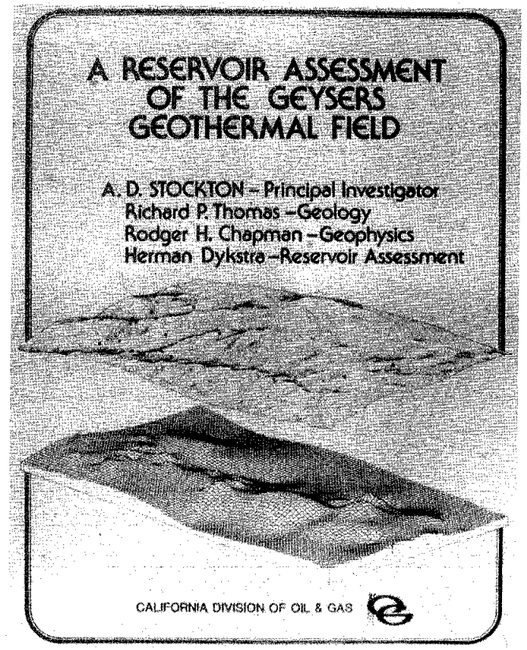

A reservoir assessment of The Geysers Geothermal field contains chapters on the subsurface geology, geophysics, and reservoir assessment of The Geysers Geothermal field. The report includes a chapter on drilling, logging, completion, and injection practices. An introduction by A. D. Stockton describes field development history.

The report will be available in the fall from the California Division of Oil and Gas. Cost unknown.

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Research in The Geysers - Clear Lake Geothermal Area, Northern California. Edited by Robert J. McLaughlin and Julie M. Donnelly-Nolan. U.S.G.S. Professional Paper 1141. $9.00. Available from the Distribution Branch, Text Products Section, U.S. Geological Survey, 604 So. Pickett Street, Alexandria, VA 22304. 259p.

The U.S. Geological Survey research program in The Geysers - Clear Lake area began in 1972. Papers in this volume present many of the main results of this endeavor as well as contributions from outside researchers.

In most cases, the authors agree upon the nature and extent of the geothermal system and the heat source. However, differences are found among the details of their geophysical and geological models.

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Resource assessment of low-and moderate-temperature geothermal waters in Calistoga, Napa County, California. By Les G. Youngs, C. Forrest Bacon, Rodger H. Chapman, Gordon W. Chase, Chris T. Higgins, Hasmukhrai H. Majmundar, and Gary C. Taylor. Price around $35.00. To be placed on a list to purchase a copy, write the California Division of Mines and Geology, Sacramento District Office, 2815 "O" Street, Sacramento, CA 95816; or call (916) 445-5716.

One open file copy is available for viewing in the California Division of Oil and Gas Geothermal Office at 2904 McBride Lane, Santa Rosa, CA 95401. Phone (707) 525-0479.

A chapter from the report, "Historical Uses of Moderate-Temperature Geothermal Resources in Calistoga" is in the April 1981 issue of California Geology. The issue is available from the CDMG "O" Street address for $.35.

An article based on Les Youngs' experiences in undertaking historical geothermal research titled "Historical Records Help to Assess Geothermal Resources" appeared in the January 1981 issue of the Hot Line.

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Data from geothermal gradient wells near Oasis, Lower Coachella Valley, California (OF 81-0411). By J. H. Robinson. Paper copy $3.75, microfiche $3.50. Available from the Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, Colorado 80225.

California energy directory. A guide to organizations and information resources. By Michael Paparian. 1980. Available from the California Institute of Public Affairs, P.O. Box 10, Claremont, CA 91711. 70p. $16.50 paper cover.

Energy tomorrow, challenges, and opportunities for California, biennial report of the California Energy Commission P01-81-001. First copy free. Additional copies $5.14. 212p. Available from the CEC Publications Unit, MS-50, 1111 Howe Avenue, Suite 613, Sacramento, CA 95825.

Full spectrum of California energy is treated. Some geothermal data is included. Also available, free of charge, is the CEC publications catalog with several publications on geothermal energy.

The following publications will be available from the California Energy Commission in September 1981. For cost information, call the Energy Commission Geothermal Programs Unit at (916) 920-2496, or write the unit at 1111 Howe Avenue, MS-66, Sacramento, CA 95825.

Geothermal energy opportunities for California business. The publication is an overview of opportunities for geothermal direct use application in California business and industry. It describes geothermal direct use projects operating in California and other states.

A guide to financial incentives for geothermal energy. A summary of existing state and federal financial incentives and assistance programs for geothermal energy projects.

Geothermal direct use feasibility projects. Describes geothermal direct use projects currently supported under Energy Commission contracts.

A blueprint for financing geothermal district heating in California. By Derek Hansen and Associates, prepared for the California Department of Conservation. Free. Available from the California Department of Conservation, 1416 Ninth Street, Room 1320, Sacramento, CA 95814.

The publication describes the current legal and investment climates surrounding the development of geothermal resources. Changes more favorable to direct heat geothermal investment are recommended.

Nonelectrical uses of geothermal energy: directory of active developers and users. 1981. $75.00 ($67.50 for members of the Geothermal Resources Council). Published by and available from the Geothermal Resources Council, P. O. Box 98, Davis, CA 95617. 36p. Updates will be available for purchase annually.

The names and telephone numbers of contact persons for organizations involved in the development or use of direct-heat geothermal energy are included. On the list are academic institutions, aquafarmers, and federal technical and general assistance centers.

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Every month, the Earth Sciences Division of Lawrence Berkeley Laboratory publishes reports describing the development of geothermal resources. For a free, up-to-date bibliography, write to Ms. Orah Goldman, U.C. Berkeley Laboratory, Earth Sciences Division Reference Room, Building 90, Room 1070, Berkeley, CA 94720.

A theoretical assessment of James' Method for the determination of geothermal wellbore discharge characteristics, LBL-11498 (GREMP-12). By Madhav Karamarakar and Ping Cheng, November 1980, $6.50;

CO_2 and carbonate chemistry applied to geothermal engineering, LBL-11509. By Donald Michels, January 1981, $6.50; and

Development of an instrument to measure the concentration of noncondensable gases in geothermal discharges, LBL-11499. By C. K. Blair and R. F. Harrison, January 1980, $9.50.

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Geothermal energy resources of Alaska. 1981. By Don Turner. $7.50. Published by and available from the Geophysical Institute Library, University of Alaska, Fairbanks, AK 99701.

The report estimates the geothermal energy resource base of Alaska to be the energy equivalent of seven times the total anticipated oil production from the Prudhoe Bay field. An article in this issue of the Hot Line has further Alaskan geothermal information.

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South Dakota geothermal institutional handbook, a user's guide of agencies, regulations, permits, and aids for geothermal development, 1980. $8.00. Available from the National Technical Information Service, U.S. Dept. of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

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Montana Geothermal Institutional Handbook. A user's guide of agencies, regulations, permits, and aids for geothermal development, 1980. DOE/ID/12014-2. By S. Perlmutter and J. Birkby. $11.00. Available from National Technical Information Service, U.S. Dept. of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

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For single copies of the following reports, as long as supply lasts, contact Ginger Alexander, Librarian, Washington State Energy Office, 400 E. Union, ER-11, Olympia, WA 98504.

Washington: A Guide to Geothermal Energy Development. Prepared for U.S. Department of Energy, Region X Office by R. Gordon Bloomquist, et al. Oregon Institute of Technology Geo-Heat Utilization Center. June 1980.

Proceedings of the Geothermal Symposium: Potential, Legal Issues, Economics, Financing, June 2, 1980, Seattle, WA. Edited by R. Gordon Bloomquist, Washington State Energy Office and Ken Wonstolen, National Conference of State Legislatures, Olympia, WA: Washington State Energy Office, September 1980. WAOENG-80-16

Proceedings of the Geothermal Symposium: Low Temperature Utilization, Heat Pump Applications, District Heating, September 24, 1980. Edited by R. Gordon Bloomquist. Sponsored by Washington State Energy Office and National Conference of State Legislatures (and) U.S. DOE. April 1981. WAOENG-81-05

Current Energy Research and Development in Washington State, 1980. Ginger Alexander, Editor. Washington State Energy Office, September 1980. 63 pages. WAOENG-80-17

Washington State Energy Use Profile, 1960-1980. George Hinman, et al, Washington State University, Office of Applied Energy Studies and Steven J. Craig, Washington State Energy Office. Olympia, WA, December 1980. 175 pages. WAOENG-80-19

The profile is the second annual compilation of information on energy, resources, and use in Washington.

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UURI Open File Reports

The Earth Science Laboratory of the University of Utah Research Institute (UURI) makes available for inspection, study, and purchase open-file data from the U.S. Department of Energy/ Division of Geothermal Energy (DOE/DGE) Industry Coupled Case Studies Program.

The data may be ordered from the Earth Science Laboratory, University of Utah Research Institute, 420 Chipeta Way, Ste. 120, Salt Lake City, UT 84108.

Beowawe Area, Lander and Eureka Counties, Nevada

Getty Oil Co., well histories of 14½ temperature gradient holes; 2 temperature surveys per hole run 30 days apart 60 days after drilling; NV/BEO/GOC-3; $4.

Chevron Resources Co., daily drilling reports, Baroid mud report, well 85-18; NV/BEO/CRC-14; $8.

Chevron Resources Co., lithologic descriptions and temperature data for all shallow temperature gradient holes; NV/BEO/CRC-15; $12.50.

Dixie Valley, Churchill County, Nevada

Mackay School of Mines, case study report vol. III, Appendix C: Environmental Isotope Hydrology; NV/DV/SR-17; $4.15.

Temperature-gradient and heatflow data for Grass Valley, Nevada, by GeothermEx, Inc.; NV/LCH/AMN-4; $12.

Magnetotelluric survey of the Leach Hot Springs Area of North-Central Nevada, by Geotronics Corp.; 23 p., 52 pl.; NV/LCH/AMN-5; $24.80.

Seismic reflection survey of Grass Valley area, by Geophysical Services, Inc.; NV/LCH/AMN-6; $13.35.

Geology and Geothermal Regime, Geothermal Test USA #11-36, Grass Valley, Nevada, by GeothermEx, Inc.; NV/LCH/AMN-7; $6.25.

Daily drilling reports and workover record, well USA #11-36; NV/LCH/AMN-8; $4.85.

McCoy Area, Churchill and Lander Counties, Nevada

The McCoy, Nevada Geothermal Prospect--an Interim Case History by Arthur L. Lange, AMAX Exploration, Inc.; NV/MC/AMAX-8; $5.50.

Resistivity survey, McCoy Project, by Mining, Geophysical Exploration, Inc.; NV/MC/AMAX-9; $3.

Magneto-telluric profiles, McCoy Prospect, by AMAX Exploration, Inc.; NV/MC/AMAX-10; $3.60.

Tuscarora Area, Elko County, Nevada

The Tuscarora Geothermal Prospect--a Continuous Case History by Fredrick E. Berkman, AMAX Exploration, Inc.; NV/TUS/AMAX-12; $4.50.

Tuscarora soil geochemistry; NV/TUS/AMAX-13; $6.60.

Tuscarora Magneto-telluric profiles; NV/TUS/AMAX-14; $3.

Other Reports

"Interpretation of Drill Cuttings from Geothermal Wells," by Jeffrey B. Hulen and Bruce S. Sibbett; DOE/ID/12079-36 (ESL-57).

"An Analysis of Geothermal Electrical Power Generation at Big Creek Hot Springs, Lemhi County, Idaho," Debra Struhsacker, editor; DOE/ID/12079-37 (ESL-58).

An Annotated Bibliography, Geothermal Publications of the California Division of Mines and Geology

by Leslie G. Youngs

1960

McNitt, J.R., 1960, Geothermal power: California Division of Mines and Geology, Mineral Information Service, v. 13, no. 3, p.1-9, cost $.25.

A general discussion of the nature of geothermal reservoirs and a history of geothermal power development at Larderello, Italy; Wairakei, New Zealand; and The Geysers, California is presented in the article. Geology, development, and power generation are discussed in more detail for The Geysers Area, California.

1963

McNitt, J.R., 1963, Exploration and development of geothermal power in California: California Division of Mines and Geology, Special Report 75, 45p., (out of print).

Part I of the report presents discussion of The Geysers, Casa Diablo, and Salton Sea geothermal areas of California. Part II explores some of the problems of natural steam exploration and development.

1966

Anonymous, 1966, Gravity map of Geysers area: California Division of Mines and Geology, Mineral Information Service, v. 19, no. 9, p. 148-149, cost $.25.

The article presents the results and some conclusions of a gravity survey at The Geysers, California. A nearly circular negative gravity anomaly is suggested to be caused by an igneous intrusive or magma chamber at a relatively shallow depth in the vicinity of the Clear Lake volcanic field.

California Department of Water Resources and California Division of Mines and Geology, 1966, Geothermal power in California, a response to Senate Resolution No. 138, relating to the use of geothermal power for the transportation of water over the Tehachapi Mountains, 8p., (out of print).

Senate Resolution 138, 1965, requested the California Department of Water Resources in conjunction with the California Division of Mines and Geology "to expend every effort necessary...to determine if geothermal energy can be used for pumping..." water from the State Water Project over the Tehachapi Mountains. The report presents the jointly reached conclusions and recommendations.

White, D.E. and McNitt, J.R., 1966, Geothermal energy, in Mineral Resources of California: California Division of Mines and Geology, Bulletin 191, p. 174-179, cost $3.00.

This section of Bulletin 191 capsulizes worldwide geothermal development with special emphasis on areas in California that were explored for geothermal energy. Power generation statistics of The Geysers for years 1960-1964 are presented, Types of geothermal reservoirs and problems hindering geothermal development are discussed.

1967

Anonymous, 1967, Geothermal energy lands outlined; California Division of Mines and Geology, Mineral Information Service, v. 20, no. 6, p. 58 and 72, cost $.25.

An announcement that the U.S. Geological Survey designated federal lands in the western states as having "current potential value for geothermal resources" and as "prospectively valuable". Statistics on acreage so designated are presented.

Gay, T.E., Jr., 1967, New California geothermal power report: California Division of Mines and Geology, Mineral Information Service, v. 20, no. 4, p. 43-44, cost $.25.

The article announces the issuance of the report "Geothermal power in California" (California Department of Water Resources and California Division of Mines and Geology, 1966). The conclusions and recommendations from the report are presented.

Geological Survey of Japan, 1967, Japan's new geothermal power plant: California Division of Mines and Geology, Mineral Information Service, v. 20, no. 5, p. 56, cost $.25.

A photograph of the Matsukawa, Japan geothermal power station.

Koenig, J.B., 1967, The Salton-Mexicali geothermal province: California Division of Mines and Geology, Mineral Information Service, v. 20, no. 7, p. 75-81, cost $.25.

The article discusses the proposed plans for mineral recovery from hot geothermal brines at Niland, Imperial County, California and the generation of electrical power from steam separated from geothermal brines at Cerro Prieto, Mexico. Both fields are part of the Salton-Mexicali geothermal province. The nature of the geothermal reservoir at each site is discussed in relation to geologic structure.

1968

Anonymous, 1968, California mining review, 1967 - geothermal resources: California Division of Mines and Geology, Mineral Information Service, v. 21, no. 2, p. 26, cost $.25.

The article capsules events in the geothermal industry for 1967 in California including legislative actions, land leasing, geothermal power generation, and geothermal exploration.

Proctor, R.J., 1968, Geology of the Desert Hot Springs - Upper Coachella Valley area, California: California Division of Mines and Geology, Special Report 94, 50p., 1 plate, cost $2.50.

The report is a geologic study of approximately 130 square miles centered about Desert Hot Springs, California which contains a discussion of the naturally occurring hot mineral waters of the area. Included in the report is a water temperature contour map, a table of analyses of Desert Hot Springs water, a table of hot water well data, and a location map of hot water wells.

1969

Anderson, W., 1969, The California Geysers in 1888: California Division of Mines and Geology, Mineral Inforamtion Service, v. 22, no. 8, p. 129-132, cost $.25.

An interesting account of a trip to The Geysers resort in the summer of 1888.

Anonymous, 1969, Japan moving ahead in geothermal development: California Division of Mines and Geology, Mineral Information Service, v. 22, no. 8, p. 136-137, cost $.25.

A summarization of a talk by Julian Feiss, U.S. Geological Survey, before the Geological Society of Washington (D.C.) on Japan's plans and progress in developing power generation from geothermal resources. The article includes 3 photographs and a small map outlining geothermal areas in Japan.

Brewer, W.H., 1969, A day at the Geysers in 1861: California Division of Mines and Geology, Mineral Information Service, v. 22, no. 8, p. 134-135.

A geologist's account of a visit to The Geysers, California in November, 1861.

Dunning, G.E., and Cooper, Jr., J.F., 1969, Letovicite from The Geysers, Sonoma County, California: California Division of Mines and Geology, Mineral Information Service, v. 22, no. 8, p. 135, cost $.25.

A brief article announcing the identification of the rare ammonius hydrogen sulfate, letovicite, in samples collected at The Geysers, Sonoma County, California.

Koenig, J.B., 1969, The Geysers geothermal field 1969: California Division of Mines and Geology, Mineral Information Service, v. 22, no. 8, p. 123-128, cost $.25.

An overview of The Geysers geothermal field. Topics include geology, thermal activity, geothermal development, power generation, technology, and reservoir assessment. Included are 2 photographs, location map of steam wells at The Geysers field, and two tables: 1. Characteristics of selected thermal areas, northern Coast Ranges. 2. Wells drilled in The Geysers area.

1970

Davis, F.F. 1970, California mining review - some highlights of 1969 - geothermal resources: California Division of Mines and Geology, Mineral Information Service, v. 23, no. 4, p. 74, cost $.25.

A summary of events in the geothermal industry in California in 1969. Includes legal actions, drilling activity, and power generation.

Koenig, J.B., 1970, Geologic setting of the Imperial Valley and its geothermal resources, in Compendium of papers Imperial Valley - Salton Sea area geothermal hearing: State of California Geothermal Resources Board and the California Legislature Joint Committee on Atomic Development and Space, Section E, 5 p., (out of print).

The article is one of 32 technical, legal, and general background articles presented at a hearing on the geothermal potential of the Salton Sea - Imperial Valley area held in Sacramento on October 22 and 23, 1970.

Weber, D., 1970, Kornelite at Coso Hot Spring: California Division of Mines and Geology, Mineral Information Service, v. 23, no. 1, cost $.25.

A brief article announcing the confirmation of the finding of the rare mineral Kornelite and other minerals at Coso Hot Springs, Inyo County, California, on the property of the Naval Weapons Center. Kornelite had not been previously reported from California, and, in fact had been noted from only two other localities in the United States.

1971

Anonymous, 1971, Geothermal steam exploration permit: California Division of Mines and Geology, California Geology, v. 24, no. 9, p. 173, cost $.25.

The brief article announces the issuance of a special use permit from the U.S. Bureau of Land Management to Geothermal Resources International, Inc., for the purpose of drilling a test well for geothermal steam at Mono Lake, California.

Anonymous, 1971, Interior Department of implement geothermal steam act of 1970: California Division of Mines and Geology, California Geology, v. 24, no. 4-5, p. 89, cost $.25.

The short article announces The Department of Interior's initiation of action to implement the Geothermal Steam Act of 1970, passed by Congress on December 24, 1970.

Anonymous, 1971, Promising geothermal lands listed: California Division of Mines and Geology, California Geology, v. 24, no. 6, p. 114, cost $.25.

A brief announcement of the listing of "known geothermal resources areas" (KGRA's) in the Federal Register.

Davis, F.F., 1971, 1970-California mining activity - geothermal resources: California Division of Mines and Geology, California Geology, v. 24, no. 9., p. 162-163, cost $.25.

The article capsules events in the geothermal industry for 1970 in California including geothermal exploration, power generation, and land leasing.

1972

Anonymous, 1972, Geologic story of Yellowstone: California Division of Mines and Geology, California Geology, v. 25, no. 6, p. 140-141, (out of print).

An announcement of the publication of "The geologic story of Yellowstone National Park" by the U.S. Geological Survey, Bulletin 1347. A few "briefs" from the report are presented in the article.

Anonymous, 1972, Geothermal conference: California Division of Mines and Geology, California Geology, v. 25, no. 5, p. 117-118, cost $.25.

An announcement that the First National Conference of the Geothermal Resources Council was held in February, 1972, in El Centro, California. A list of publications generated by the conference accompanies the announcement.

Anonymous, 1972, Geothermal research grant: California Division of Mines and Geology, California Geology, v. 25, no. 12, p. 283, cost $.25

The short article announces that the National Science Foundation, Washington, D.C., awarded a $462,500 one-year research grant to the Colorado School of Mines to perform geothermal investigations of Kilauea Volcano on the Island of Hawaii.

Axtell, L.H., 1972, Mono Lake geothermal wells abandoned: California Division of Mines and Geology, California Geology, v. 25, no. 3, p. 66-67, cost $.25.

The article describes the drilling and abandonment of two geothermal exploratory wells at Mono Lake, California. Geologic and temperature logs for each well are presented.

California Division of Oil and Gas, 1972, Resume of oil, gas, and geothermal field operations in 1971: California Division of Mines and Geology, California Geology, v. 25, no. 12, p. 271-280, cost $.25.

The article capsules events in the geothermal industry for 1972 monitored by the California Division of Oil and Gas. Exploration and/or production information is presented for the following California geothermal areas: The Geysers, Casa Diablo, Salton Sea, Imperial County, Lake County and Mono County.

1974

Anonymous, 1974, Geothermal conference: California Division of Mines and Geology, California Geology, v. 27, no. 8, p. 190, cost $.25.

A short announcement and description of an international conference on geothermal resources for industrial, agricultural and commercial-residential uses on October 7-9, 1974 at Oregon Institute of Technology, Klamath Falls, Oregon.

Anonymous, 1974, Historical geothermal book: California Division of Mines and Geology, California Geology, v. 27, no. 4, p. 95, cost $.25.

A short announcement of the publication of "Geothermal exploration in the first quarter century", edited by D.N. Anderson and B.A. Hall, Geothermal Resources Council Special Report 3, 191 p.

Anonymous, 1974, Special short course: California Division of Mines and Geology, California Geology, v. 27, no. 5, p. 98, cost $.25.

A brief announcement for the Geothermal Resources Council sponsored course "Geothermal Regulations" held May 23-24, 1974, at the Royal Inn, San Francisco.

Bacon, C.F., (recorded by), 1974, Minutes of the Geothermal Resources Board Meeting, Santa Rosa, California, August 1974: Geothermal Resources Board of the State of California, 21 p., (out of print).

Minutes of the Geothermal Resources Board Meeting held in Santa Rosa, California on August 9, 1974. The minutes contain brief summaries of 19 papers presented at the meeting primarily discussing the problems hindering the development of geothermal resources in The Geysers geothermal area.

Woods, M.C., 1974, Geothermal activity in Surprise Valley: California Division of Mines and Geology, California Geology, v. 27, no. 12, p. 271-273, cost $.25.

The article describes the geologic setting, geothermal surface manifestations (including the mud volcano eruptions of March 1-2, 1951), and geothermal well exploration in Surprise Valley, Modoc County, California.

1975

Anonymous, 1975, Geothermal potential in Western States: California Division of Mines and Geology, California Geology, v. 28, no. 4, p. 87, cost $.25.

The article announces the publication of "Classification of public lands valuable for geothermal steam and associated geothermal resources" by L.H. Godwin and others, U.S.G.S. Circular 647. Statistics of acreage classified as being withinknown geothermal resources areas (KGRA's) and acreage considered to have prospective value are presented for the Western States.

Anonymous, 1975, Second United Nations symposium on the development and use of geothermal resources: California Division of Mines and Geology, California Geology, v. 28, no. 2, p. 26, cost $.25.

An announcement of the Second UN Geothermal Symposium held on May 20-29, 1975, in San Francisco, California.

Chapman, R.H., 1975, Geophysical study of the Clear Lake Region, California: California Division of Mines and Geology, Special Report 116, 23 p., cost $1.25.

The report details the results of gravity, aeromagnetic, and electrical resistivity surveys and rock density and magnetic susceptibility measurements in the Clear Lake volcanic field and vicinity, California. A major negative gravity anomaly in the area is proposed to be the result of a hot intrusive mass, possibly a magma chamber underlying the Clear Lake volcanic field.

Jennings, C.W., 1975, Fault map of California, with locations of volcanoes, thermal springs, and thermal wells: California Division of Mines and Geology, Geologic Data Map Series, Map no. 1, scale 1:750,000, cost $5.00

A 4 1/2 by 5 foot, multi-color map of California's known faults. Quaternary faults and locations of historic fault displacements are color coded. The locations of thermal springs, thermal wells, and volcanoes of Quaternary or Pliocene age are also shown.

1976

Anonymous, 1976, Geothermal reports: California Division of Mines and Geology, California Geology, v. 29, no. 2, p. 47, cost $.25.

An announcement of the release of three California Division of Oil and Gas geothermal reports. 1. Report No. TR13. "The potential of low-temperature geothermal resources in Northern California" by J.L. Hannah. 2. Report No. TR14. "Geothermal professional papers" by M.J. Reed. 3. Report No. TR15. "Chemistry of thermal water in selected geothermal areas of California" by M.J. Reed.

Anonymous, 1976, Geothermal resources - USGS Circular: California Division of Mines and Geology, California Geology, v. 29, no. 1, p. 18, cost $.25.

An announcement of the publication of "Assessment of geothermal resources of the United States", 1975, by D.F. White and D.L. Williams, U.S. Geological Survey Circular 726. The article also presents an overview of U.S. geothermal resources.

Anonymous, 1976, Geothermal water for heating: California Division of Mines and Geology, California Geology, v. 29, no. 4, p. 74, cost $.25.

An announcement of the release of "Evaluation of geothermal activity in the Truckee Meadows, Washoe County, Nevada", Report 25 of the Nevada Bureau of Mines and Geology.

Bacon, C.F., 1976, Blowout of a geothermal well, the Geysers geothermal field, Sonoma County, California: California Division of Mines and Geology, California Geology, v. 29, no. 1, p. 13-17, cost $.25.

On March 31, 1975, Union Oil Company's geothermal well "G.D.C." 65-28 located at the Geysers geothermal field blew out. The article details the event and subsequent attempts to bring the well under control.

Bacon, C.F., Amimoto, P.Y., Sherburne, R.W., and Slosson, J.E., 1976, Engineering geology of the Geysers geothermal resource area, Lake, Mendocino, and Sonoma Counties, California: California Division of Mines and Geology, Special Report 122, 35 p., 1 plate, cost $3.50.

A geologic assessment of the Geysers geothermal resource area. Hazardous geologic conditions are identified and measures for mitigating those hazardous conditions are recommended.

California Division of Oil and Gas, 1976, Damaged well in the Geysers geothermal field: California Division of Mines and Geology, California Geology, v. 29, no 1, p. 18, cost $.25.

The article relates the finding and corrective action taken of a crimped geothermal well casing (well no. "DX State 4596") in October, 1975, at the Geysers geothermal field.

1977

Anonymous, 1977, Geothermal - state of the art: California Division of Mines and Geology, California Geology, v. 30, no. 5, p. 115, cost $.25.

A brief announcement of the 1977 annual meeting of the Geothermal Resources Council on May 9-11 in San Diego, California.

Bacon, C.F., and Koenig, J.B., 1977, in Geology and mineral resources of Imperial County, California: California Division of Mines and Geology, County Report 7, 104 p., 1 plate, cost $8.50.

The report contains two geothermal related sections, Geothermal Resources (p. 41-44) and Geothermal Exploration (p. 44-46). These sections provide a historical overview of geothermal development and an analysis of geothermal exploration techniques employed in Imperial County, California.

1978

Anonymous, (C.F. Bacon), 1978, Known geothermal resources areas in California and areas valuable prospectively for geothermal resources: California Division of Mines and Geology, California Geology, v. 31, no. 7, p. 160-161, cost $.25.

A 2-page size map of California showing selected thermal wells and springs with a symbol code indicating temperature range. Federal Known Geothermal Resources Areas (KGRA's) and Areas Valuable Prospectively for Geothermal Resources are marked on the map. California's major faults are also shown.

Bacon, C.F., 1978, Geologic hazards: in Report of the State Geothermal Resources Task Force, State of California Geothermal Resources Task Force, p. 36-40, cost FREE.

Copies are available from: The Director's Office, Department of Conservation, Room 1320, 1416 Ninth Street, Sacramento, CA 95814

The article is one of many in the 94 page report addressing geothermal resources assessment and conversion technology, environmental considerations, regulatory issues, and economics of geothermal development in the State of California.

Bedrossian, T.L., 1978, Geology and slope stability in the Geysers geothermal resources area: California Division of Mines and Geology, California Geology, v. 31, no. 7, p. 151-159, cost $.25.

A study of geologic features relating to the stability of the terrain in the Franciscan assemblage at the Geysers geothermal resource area. The article includes 12 photographs of geologic features, three maps, and one table classifying landslides.

Chapman, R.H., Chase, G.W., and Taylor, G.C., 1978, Preliminary results of a gravity survey in the Kelly Hot Spring area, Modoc County, California: California Division of Mines and Geology, Open-File Report 78-5SAC, 12 p., 3 plates, cost $3.00.

A reconnaissance gravity survey at the Kelly Hot Spring Area infers a large fault-bounded basin or possible caldera centered a few miles NW of the hot spring. The report includes a Bouguer gravity anomaly map of the area, and the results of both a 2-dimensional (profile) analysis and a 3-dimensional analysis of the gravity data in terms of possible geologic structure.

Hodgson, S.F., 1978, Well site safety at the Geysers: California Division of Mines and Geology, California Geology, v. 31, no. 7, p. 162-165, cost $.25.

The article explains the causes of the blow outs of four geothermal wells at the Geysers geothermal resources area. California Division of Oil and Gas's role in monitoring the siting, drilling, and abandonment of geothermal wells is also explained.

1979

Anonymous, 1979, California mining review, 1977-1978 - geothermal resources: California Division of Mines and Geology, California Geology, v. 32, no. 9, p. 198-199, cost $.25.

A brief summary of the activities of the geothermal industry in California for 1977-1978.

Anonymous, 1979, The Geysers heat source: California Division of Mines and Geology, California Geology, v. 32, no. 10, p. 226-227, cost $.25.

By studying seismic waves from distant earthquakes scientists of the U.S Geological Survey have located and delineated a magma chamber of molten rock directly under Mt. Hannah in The Geysers area. A cross-sectional model of The Geysers steam-production area and Clear Lake volcanic field accompanies the article.

1980

Chapman, R.H., Chase, G.W, and Youngs, L.G., 1980 (in press), Geophysical survey, Paso Robles Geothermal Area, California - Part of the resource assessment of low-and moderate-temperature geothermal resource areas in California - Part of the second year report, 1979-80 of the U.S. Department of Energy - California State - Coupled Program for reservoir assessment and confirmation: California Division of Mines and Geology, 43 p., 4 plates, cost (not determined).

The report details an aeromagnetic, ground magnetic, and gravity survey conducted at the Paso Robles geothermal area. Interpretations of data are presented. A general overview of the Paso Robles geothermal area, including geology, history, hydrology, geochemistry, and geothermal activity, is included in the report.

Higgins, C.T., 1980, Geothermal program...the search for hot water in California: California Division of Mines and Geology, California Geology, v. 33, no. 12, p. 263-265, cost $.25.

The article explains the California Division of Mines and Geology's low- and moderate-temperature geothermal assessment program and its relationships to the U.S. Department of Energy's State Coupled Geothermal Program. A chart of temperature ranges for direct use of geothermal resources is included with the article.

Higgins, C.T., and Martin, R.C., 1980, Geothermal resources of California: California Division of Mines and Geology, Geologic Data Map Series, Map no. 4, scale 1:750,000, cost FREE.

A 4 1/2 by 5 foot, 5-color map of California with more than 600 geothermal wells and springs located. In addition to high-temperature geothermal resources that can be used to generate electricity, the map shows geothermal resources from which energy in the form of low-and moderate-temperature (70° - 150° F) groundwater may be tapped for direct heat applications.

Martin, R.C., Higgins, C.T., and Olmstead, D., 1980, Resource Assessment of low- and moderate-temperature geothermal waters in California - Report of the first year, 1978-79 of the U.S. Department of Energy - California State-Coupled Program for reservoir assessment and confirmation: California Division of Mines and Geology, Report for U.S. Department of Energy Contract No. EW-78-S-07-1739, 188 p., 9 plates, cost $35.00.

The report is a compilation of California State wide low-and moderate-temperature geothermal resource data. The geothermal resources of Mono Basin, the South Bay Area of San Diego County, Paso Robles and the Southern Coast Ranges, and Bridgeport-Western Bodie Hill Region are presented in detail.

Youngs, L.G., Bacon, C.F., Chapman, R.H., Chase, G.W., Higgins, C.T., Majmundar, H.H., and Taylor G.C., 1980 (in press), Resource assessment of low-and moderate-temperature geothermal waters in Calistoga, Napa County, California - Report of the second year, 1979-80 of the U.S. Department of Energy - California State-Coupled Program for reservoir assessment and confirmation: California Division of Mines and Geology, Report for U.S. Department of Energy, Contract No. DE-PG03-79ET37035, 168, p., 13 plates, cost (not determined).

The report presents the data and results of a detailed scientific geothermal reservoir investigation of the Calistoga, California area. Methodology, history, geology, geophysical investigations, shallow and moderately deep hole temperature surveys, hydrology, geochemistry, seismicity, exploratory drilling, and reservoir evaluation are addressed in the report.

1981

Anonymous, 1981, Geothermal resources of California-geologic data map no. 4: California Division of Mines and Geology, California Geology, v. 34, no. 4, p. 66, cost $.35.

A brief announcement of the availability of "Geothermal Resources of California", California Division of Mines and Geology, Geologic Data Map no. 4 by C.T. Higgins, and R.C. Martin, 1980. The cover of this issue (v. 34, no. 4) of "California Geology" is a reduced reproduction of the "Geothermal Resources of California" map.

Higgins, C.T., 1981 (in press), Reconnaissance of geothermal resources of Los Angeles County, California - Part of the third year report, 1980-81, of the U.S. Department of Energy - California State-Coupled Program for reservoir assessment and confirmation: California Division of Mines and Geology, Report for U.S. Department of Energy, Contract No. DE-FG03-80SF10855, ?p., ? plates, cost (not determined).

The report evaluates the feasibility of developing a geothermal energy resource from oil fields in Los Angeles County, California. Geology, geochemistry, geothermal gradients, and conceptual feasibility are discussed.

Leivas, E., Martin, R.C., Higgins, C.T., and Bezore, S.P., 1981 (in press), Reconnaissance geothermal resource assessment of 40 sites in California - Part of the third year report, 1980-81, of the U.S. Department of Energy - California State-Coupled Program for reservoir assessment and confirmation: California Division of Mines and Geology, Report for U.S. Department of Energy, Contract No. DE-FG03-80SF10855, ?p., ? plates, cost (not determined).

The report presents geological, geochemical, and historical data for 40 low-and moderate-temperature geothermal sites located throughout California.

Taylor, G.C., 1981, Calistoga geothermal resource area: California Division of Mines and Geology, California Geology, v. 34, no. 10, p. 208-217, cost $.35.

The article is excerpted from the "Drilling Addendum to Resource Assessment of Low- and Moderate-Temperature Geothermal Waters in Calistoga, Napa County, California", California Division of Mines and Geology, Report for U.S. Department of Energy by G.C. Taylor, et al, 1981.

Taylor, G.C., Bacon, C.F., and Majmundar, H.H., 1981 (in press), Drilling Addendum to resource assessment of low-and moderate-temperature geothermal waters in Calistoga, Napa County, California - Report of the second year, 1979-80, of the U.S. Department of Energy - California State-Coupled Program for reservoir assessment and confirmation: California Division of Mines and Geology, Report for U.S. Department of Energy, Contract No. DE-PG03-79ET37035, approximately 30 p., 1 plate, cost (not yet determined).

The addendum presents the results and conclusions of the CDMG exploratory drilling program at Calistoga, California. The report includes geologic drill logs, geochemistry data, cross-sections, correlations of various investigative techniques, and geologic and hydrologic interpretations.

Youngs, L.G., and Higgins, C.T., 1981, Historical use of moderate-temperature geothermal resource, Calistoga, Napa County, California: California Division of Mines and Geology, California Geology, v. 34, no. 4, p. 67-72, cost $.35.

The article traces the development and use of the geothermal resources at Calistoga, California from days of early native Californians to the present.

Youngs, L.G., Bezore, S.P., Chapman, R.H., and Chase, G.W., 1981 (in prepartion), Resource investigation of low-and moderate-temperature geothermal areas in San Bernardino, California - Part of the third year report, 1980-81, of the U.S. Department of Energy - California State-Coupled Program for reservoir assessment and confirmation: California Division of Mines and Geology, Report for U.S. Department of Energy, Contract No. DE-FG03-80SF10855, ? p., ? plates, cost (not determined).

The report presents the data and results of a detailed scientific geothermal reservoir investigation of the San Bernardino, California area. Geothermal historical development, geology, geochemistry, geophysical investigations, temperature surveys, hydrology, seismicity, and geothermal reservoir evaluations are addressed in the report.

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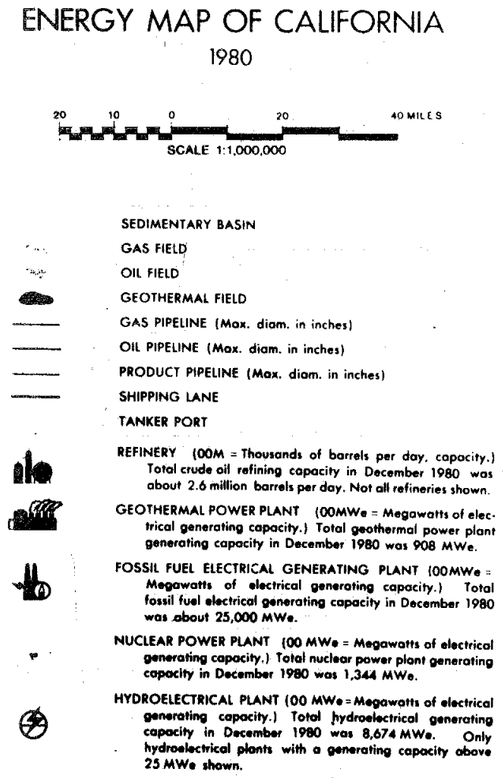
Maps



The Energy Map of California is available, for $3.00, from the California Division of Oil and Gas.

Preliminary isostatic residual gravity map of California. $9.00. Scale 1:750,000. 5 sheets. Available from the California Division of Mines and Geology, P.O. Box 2980, Sacramento, CA 95812.

BLM Map Sets Available

Sixty-three map sets showing surface management responsibilities and federal mineral rights in California are available from the Bureau of Land Management. Thirty-three additional sets will be produced within 2 years.

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Maps are $2 each ($4 a set). To order, send a check or money order payable to the Bureau of Land Management to: Bureau of Land Management, Attn. Public Information Section, 2800 Cottage Way, Sacramento, CA 95825. Prepayment is required.

Indexes showing which maps have been completed in the BLM series may be obtained without charge by sending a request to the same address.

USGS Maps

The following maps may be ordered from the Western Distribution Branch, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225.

Geologic map of the Crater Springs Known Geothermal Resources Area and vicinity, Juab and Millard Counties, Utah, I-1217. 1981. Scale 1:24,000 (1 inch = 2,000 feet). $1.50. (Supersedes open-file report 79-1158).

Preliminary map showing recently active breaks along the Maacama fault zone between Hopeland and Laytonville, Mendocino County, California, MF-1217. 1981. 2 sheets. $1.50. Scale: 1:24,000 (1 inch = 2,000 feet).

Geologic map of the Baker-Cypress BLM Roadless Area and Timbered Crater Rare II Areas, Modoc, Shasta, and Siskiyou Counties, California, MF-1214-A. 1981. $0.75. Scale: 1:62,500 (1 inch = about 1 mile).

Mount St. Helens and Vicinity. 1981. Special map. $1.00.

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Map data catalog S/N 024-001-03360-7. Issued by the U.S. Geological Survey. $7.00. Available from the Superintendent of Documents, U.S. Govt. Printing Office, Washington, D.C. 20402.

Explains how to order mapping products from the cartographic holdings of federal, state, and private agencies.

Shaded relief map of Nevada. $2.00. Scale 1:1 million. Available from the Nevada Bureau of Mines and Geology, Univ. of Nevada, Reno, NV 89557; or, when purchased in person, from Room 310, Scrugham Engineering - Mines Bldg., Univ. of Nevada, Reno.

On the multicolored map, Nevada surface configurations are depicted by hill shading. The map may be used as a companion to NBMG Map 43, Topographic Map of Nevada.

Bouguer Gravity Map of Nevada, Caliente Sheet, Map 70, has been published by the Nevada Bureau of Mines and Geology. The general geology on the map can be compared with the gravity values. The map may be purchased for $4.00 in Room 310, Scrugham Engineering-Mines Building, University of Nevada, Reno, NV 89557; or by mail from the Nevada Bureau of Mines and Geology, University of Nevada, Reno, NV 89557.

Oregon Maps

Geophysical maps of the Oregon portion of the Cascade Mountain Range are available. The new maps are compilations of new and previously existing geophysical data. The maps, prepared by the Geophysics Group of the Oregon State University School of Oceanography, are titled:

Free-air Gravity Anomaly Map and Complete Bouguer Gravity Anomaly Map, Cascade Mountain Range, Northern Oregon, GMS-15 (2 maps). $3.00;

Free-air Gravity Anomaly Map and Complete Bouguer Gravity Anomaly Map, Cascade Mountain Range, Southern Oregon, GMS-16 (2 maps). $3.00; and

Total-field Aeromagnetic Anomaly Map, Cascade Mountain Range, Southern Oregon, GMS-17 (1 map). $3.00.

Maps may be ordered from the Oregon Department of Geology and Mineral Industries, 1005 State Office Building, Portland, OR 97201. Payment must accompany orders under $20.00.

Circum-Pacific map project. 1981. Five maps covering the Pacific Basin at a scale of 1 to 10 million (1 inch equals about 160 miles); a sixth map covering the entire region at a scale of 1:20 million. $8.00 each. Two maps describing the eastern-Pacific area are now available; the others are under preparation. Published by and available from the American Association of Petroleum Geologists, P.O. Box 979, Tulsa, OK 94101. (918) 584-2555.

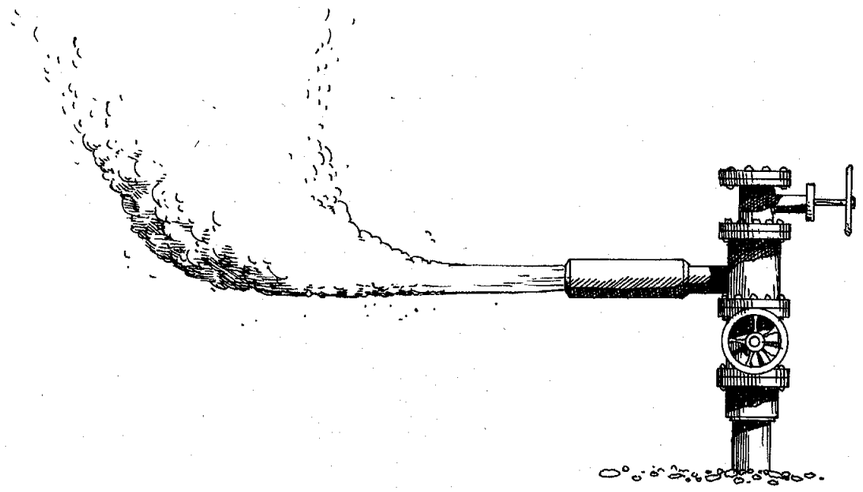
California Wells

DRILLING PERMITS APPROVED IN 1981

Date Notice Received	Operator, Well No.	API No.	Sec.	T.	R.	Location, Elevation
		Lake County				
1/21/81	MCR Geothermal Corp. "Tellyer" 1-24	033-90384	24	11N	8W	Fr. SE cor. 457m N, 229m W. 555m GR.
3/30/81	Aminoil USA, Inc. "Barrows" 2	033-90392	35	11N	8W	Fr. SE cor. 567m N, 61m W. 671m GR.
4/8/80	Phillips Petroleum Co. "Audrey A" 2	033-90292	4	13N	7W	Fr. SW cor. 274m N, 229m E. 604m GR.
4/8/80	Phillips Petroleum Co. "Bradley B" 1	033-90295	8	13N	7W	Fr. NW cor. 328m S, 320m E. 604m GR.
4/8/80	Phillips Petroleum Co. "Bradley C" 1	033-90294	5	13N	7W	Fr. SW cor. 914m N, 421m E. 433m GR.
4/8/80	Phillips Petroleum Co. "Pluth A" 1	033-90293	4	13N	7W	Fr. NW cor. 549m S, 213m E. 518m GR.
6/12/81	Northern Calif. Power Agency "Cobb Valley" 2	033-90420	29	12N	8W	Fr. SW cor. 483m N, 389m E. 754m GR.
7/14/81	Union Oil Co. of Calif. "NE Geysers Unit" 7A	033-90421	4	11N	8W	Fr. SW cor. 187m N, 579m E. 854m GR.
8/11/81	Aminoil USA, Inc. "M.L.M." 5	033-90422	26	11N	8W	Fr. SW cor. 670m N, 630m E. 661m GR.
		Sonoma County				
9/12/80	Union Oil Co. of Calif. "73B-12"	097-90466	12	11N	9W	Fr. NE cor. 505m S, 436m W. 975m GL.
1/23/81	GRI Operator Corp. "Prati State" 1	097-90486	36	12N	9W	Fr. SE cor. 198m N, 227m W. 939m GL.
1/23/81	Union Oil Co. of Calif. "Sulphur Bank" 29	097-90485	11	11N	9W	Fr. SE cor. 258m N, 704m W. 552m GL.
3/13/81	Union Oil Co. of Calif. "DX State 4596" 55	097-90488	7	11N	8W	Fr. SE cor. 945m N, 1402m W. 1017m GL.
3/13/81	Union Oil Co. of Calif. "DX State 4596" 58	097-90490	7	11N	8W	Fr. NE cor. 473m S, 114m W. 1050m GL.
3/2/81	Thermogenics, Inc. "Rorabaugh" A-19	097-90491	14	11N	9W	Fr. NW cor. 659m S, 655m E. 532m GL.

Date Notice Received	Operator, Well No.	API No.	Sec.	T.	R.	Location, Elevation
4/2/81	Union Oil Co. of Calif. "DX State 4596" 56	097-90493	7	11N	8W	Fr. SE cor. 945m N, 1402m W. 1050m GL.
4/2/81	Union Oil Co. of Calif. "DX State 4596" 59	097-90494	7	11N	8W	Fr. NE cor. 478m S, 128m W. 1050m GL.
4/2/81	Union Oil Co. of Calif. "Sulphur Bank" 30	097-90495	11	11N	9W	Fr. SE cor. 266m N, 701m W. 551m GL.
5/1/81	Shell Oil Company "13A-2"	097-90510	3	10N	8W	Fr. NW cor. of Sec. 2, 477m S, .9m W. 966m KB.
5/5/81	Union Oil Co. of Calif. "LF State 4597" 31	097-90508	19	11N	8W	Fr. NE cor. 397m S, 323m W. 825m KB.
5/5/81	Union Oil Co. of Calif. "Geyser Gun Club" 4	097-90507	11	11N	9W	Fr. SE cor. 550m N, 380m W. 689m GL.
5/26/81	Union Oil Co. of Calif. "DX State 4596" 60	097-90511	7	11N	8W	Fr. NE cor. 482m S, 142m W. 105m GL.
6/1/81	Thermogenics, Inc. "Rorabaugh" A-18	097-90512	14	11N	9W	Fr. NW cor. 501m S, 172m E. 569m GL.
6/2/81	Union Oil Co. of Calif. "65-29"	097-90513	29	11N	8W	Fr. SW cor. 732m N, 991m E. 743m GL.
7/15/81	GRI Operator Corp. "Prati" 2	097-90514	36	12N	9W	Fr. SE cor. 197m N, 231m W. 938m GL.
7/2/81	Union Oil Co. of Calif. "DX State 4596" 69	097-90516	7	11N	8W	Fr. NE cor. 480m S, 163m W. 105m GL.
7/27/81	Union Oil Co. of Calif. "GDC" 16	097-90517	27	11N	8W	Fr. NW cor. 637m S, 100m E. 986m GL.
8/17/81	Union Oil Co. of Calif. "123-19"	097-90518	19	11N	8W	Fr. NE cor. 414m S, 331m W. 825m KB.
		Imperial County				
1/29/81	Imperial Magma M-8	025-90450	33	11S	13E	Fr. SE cor. 83m N, 1551m W. -65m KB.
1/29/81	Imperial Magma M-6	025-90449	33	11S	13E	Fr. SE cor. 52m N, 867m W. -64m KB.
2/17/81	Union Oil Co. of Calif. "IID" 11	025-90451	5	12S	13E	Fr. NE cor. 137m S, 211m E. -64 m KB.
2/17/81	Union Oil Co. of Calif. "IID" 12	025-90452	5	12S	13E	Fr. NE cor. 529m S, 355m E. -64m KB.

Date Notice Received	Operator, Well No.	API No.	Sec. T. R.	Location, Elevation
2/17/81	Union Oil Co. of Calif. "Sinclair" 12	025-90453	5 12S 13E	Fr. NE cor. 670m S, 355m E. -64m KB.
2/17/81	Union Oil Co. of Calif. "Sinclair" 20	025-90454	5 12S 13E	Fr. NE cor. 762m S, 305m E. -64m KB.
2/17/81	Union Oil Co. of Calif. "Sinclair" 25	025-90455	5 12S 13E	Fr. SW cor. 107m N, 73m E. -62m KB.
	Lassen County			
6/12/81	GeoProducts Corp. "Wen" 1	035-90064	13 29N 15E	Fr. SW cor. 200 m N, 200m E. 1250m KB.



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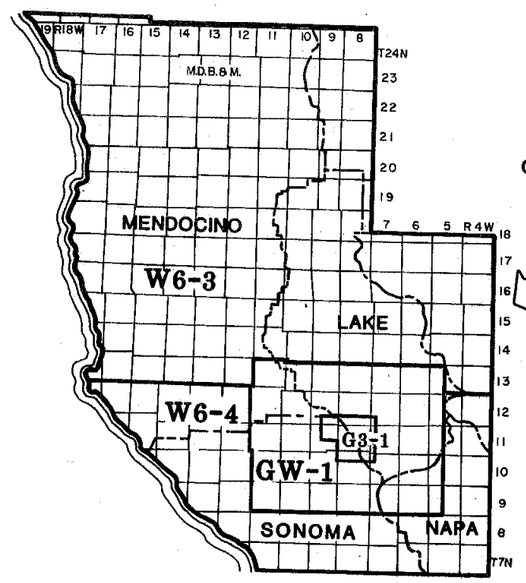
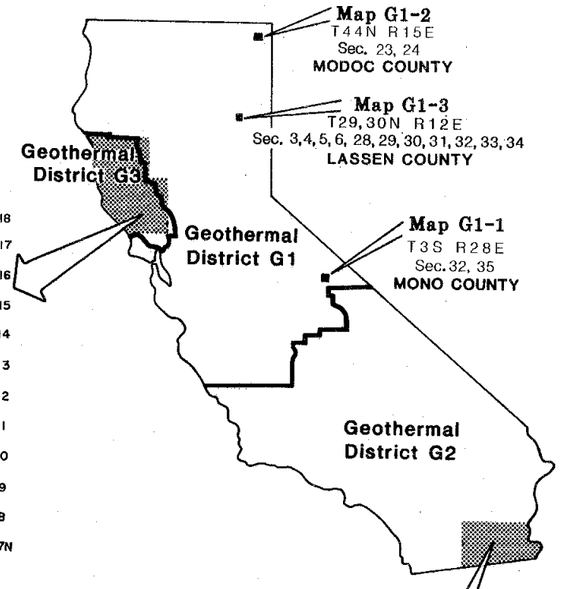
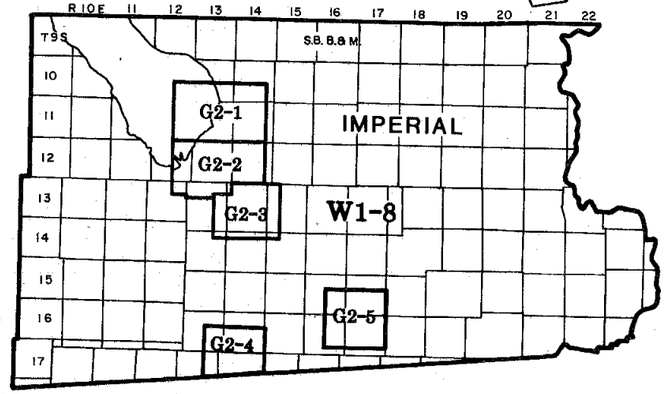
California Division of Oil and Gas
GEOTHERMAL MAPS







MAP NO.	FIELD OR AREA	MAP SCALE
G1-1	Casa Diablo	1:20,000
G1-2	Lake City	1:20,000
G1-3	Susanville	1:7,200
G2-1	Salton Sea (North)	1:20,000
G2-2	Salton Sea (South)	1:20,000
G2-3	Brawley	1:20,000
G2-4	Heber	1:20,000
G2-5	East Mesa	1:20,000
G3-1	The Geysers	1:20,000
GW-1	**The Geysers Area**	**1:62,500**
W1-8	Imperial County	1°=2mi.

GEOTHERMAL MAPS MAY BE PURCHASED FOR $3.00 EACH FROM THESE DIVISION OFFICES:

1416 NINTH ST., ROOM 1310
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PHONE (707) 525-0479

5199 E. PACIFIC COAST HWY.
SUITE 309-N, LONG BEACH 90804
PHONE (213) 590-5311

485 BROADWAY, SUITE B
EL CENTRO 92243
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These maps are revised and published annually. The revision date is the last Saturday in September, and revised maps are available November 1.

TR02(10-81-DWRR-12C)

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