



GLO1774

Department of Energy  
Idaho Operations Office  
550 Second Street  
Idaho Falls, Idaho 83401

*Mike- we just  
got this -  
I'll have prelim.  
comments by ~~1~~ this -  
D*

TO: DISTRIBUTION

FROM: M. A. WIDMAYER  
Geologic Program Manager *Maggie*

SUBJECT: OREGON RESOURCE ASSESSMENT PROGRAM

Enclosed for review and comment is a proposal for continued funding of the Oregon State Resource Assessment Program.

Please provide all comments regarding the technical scope of the work to this office by March 24, 1980.

1 Enclosure

Distribution: G. Brophy, DOE-HQ  
D. Foley, UURI  
M. Reed, USGS



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## INTRODUCTION

During Phase I of the Western States Cooperative Direct-Heat Geothermal Program (Contract No. EG-77-C-06-1040) available data on low temperature ( $20^{\circ}\text{C} < T < 90^{\circ}\text{C}$ ) geothermal resources were collected in Oregon. Based on review of these data, nine low-temperature resource areas were identified. During the Mt. Hood geothermal Resource Assessment project (1978), Contract No. AC06-77-ET-28369, two other low-temperature resource areas were identified: Parkdale, northeasterly of Mt. Hood, and Powell Buttes, northeast of Bend.

Phase II of the direct-heat geothermal program primarily entails the selection of specific sites, based on Phase I data, for detailed evaluation. Geological-geophysical investigations of the specific sites are to be conducted in order to select drill test locations. Sites selected will be drilled on a priority basis for reservoir confirmation and assessment. Results, including maps and reports, will be published by DOGAMI and made available to the geothermal community, governmental agencies, and the public. Development of direct heat geothermal resources should have a significant near-term impact by fulfilling, in part, the energy requirements of Oregon and the United States.

During the 1979-80 portion of the Phase II project (Contract No. DE-FC07 79ET-27220), geological-geophysical investigations have been carried out for certain low-temperature areas as shown on Figure 1 in compliance with the aforementioned contract.

It is hereby requested that the Glass Buttes area be dropped from further consideration because of existing industry involvement and that Parkdale and Powell Buttes be assimilated into the project for 1980-81. Other modifications

will be treated below in the assessment plan portion of this proposal.

This proposal describes the studies necessary to continue and complete most aspects of the Phase II program, the selection of specific sites for deep test drilling and requests funds in the amount of \$400,000 to continue these studies during the year of 1980-81. Summary costs by task are provided in the Budget Section of this proposal.

Not contemplated in this proposal is intermediate to deep geothermal drilling for final confirmation and assessment of promising geothermal targets such as the Lakeview area. As these areas are identified, they will continue to be brought to the attention of DOE. Future assessments should include scientific supervision by DOGAMI.

DE-FC07-79ET27220

Data Compilation

Geologic Mapping

Geochemistry

Temperature Gradient

Western Snake River Basin

Dec. 1979

Glass Buttes

(To be eliminated from consideration)

Alvord

Lakeview

Southern Harney Basin

Northern Harney Basin

Craig

Mountain - Cove

Willamette Pass

Belknap - Foley

0 20 40 60 80 100%

## ORGANIZATION AND MANAGEMENT PLAN

The Department of Geology and Mineral Industries (DOGAMI) is responsible under Oregon State Law for the conduct of geologic research and the regulation for the exploration and development of minerals and mineral fuels including geothermal energy. DOGAMI and its predecessor organization have been in existence since 1913. The agency has a staff of 15 geologists and engineers; a chemical, assay and spectrographic laboratory; library; cartographic facilities; and an editorial and accounting staff. These facilities will be available to the project described in this proposal at no additional cost.

DOGAMI has been engaged in continuing geothermal research, involving a variety of geological, geochemical and geophysical studies, for the past eleven years. The results of these efforts are included in the geothermal publications list included below.

The principal investigator is Dr. Joseph F. Riccio, Geothermal Specialist, DOGAMI.

Dr. Riccio, as Geothermal Development Manager for the Public Service Department, City of Burbank, California, was responsible for the city's program of geothermal development leading to electric power production. He recently completed geological studies associated with the exploratory drilling for a geothermal deep test at the Long Valley KGRA, California. He has also contributed research and authorship to an ERDA grant, Contract No. E (0-4-1311) entitled "Site-Specific Analysis of Hybrid Geothermal/Fossil Power Plant's" which deals with the evaluation of hybrid power plants that combine geothermal energy with that of coal. While as a consultant to the State of California Energy Commission (ERCDC) he was involved with state-sponsored development

of electric power plants utilizing geothermal energy for the geothermal fields in Imperial Valley, California.

He has completed the work on Phase I of the Oregon Low Temperature Geothermal Resource Assessment and the Geothermal Resource Assessment of the Mt. Hood Volcano, Oregon (Contract No. EG-77-C-06-1040); especially heat flow studies and evaluation of the exploratory holes drilled by Northwest Natural Gas Company at Old Maid Flat and Timberline.

Dr. Riccio is currently the Program Manager for DOGAMI of the Low Temperature Geothermal Resource Assessment, Phase II, 1979-80, Contract No. DE-FC-07-79ET27220 and the Geothermal Resource Assessment of the Western and Central Cascades, Contract No. DF-FC-07-79ID12044.

DOGAMI, as project manager for work in Oregon funded by the U.S. Department of Energy (DOE), will: (1) coordinate various State and Federal agencies and other organizations which may participate in this project; (2) act as liaison and coordinator between the project and other ongoing Federal and State supported geothermal projects; (3) coordinate site-specific geological-geophysical studies; (4) subcontract temperature-gradient drilling; (5) prepare and compile final maps and reports for the project. Geophysical studies, if required, will be administered by DOGAMI. Consulting geophysicists and geologists will be utilized, wherever necessary, to complement the assessment portion of this proposal.

It is anticipated that cost of site deep-test drilling, if done, is to be borne by DOE, and funds for this drilling are not provided herein. Portions of the site deep-test drilling may be managed either by DOE or DOGAMI. DOGAMI would oversee the downhole geologic logging and geologic studies associated with the site deep-test drilling.



DOGAMI will administer all phases of the low-temperature resource assessment described for which funding is herein to be made available. DOGAMI will conduct the necessary geologic studies; air-photo and imagery interpretation; temperature-gradient studies including shallow drilling (to 500 ft); and geochemical testing. DOGAMI would also manage the accounting functions inherent to this proposal.

An organization chart of DOGAMI personnel that will be utilized in the Phase II (1980-81) study is shown in Figure 2.

ORGANIZATION CHART

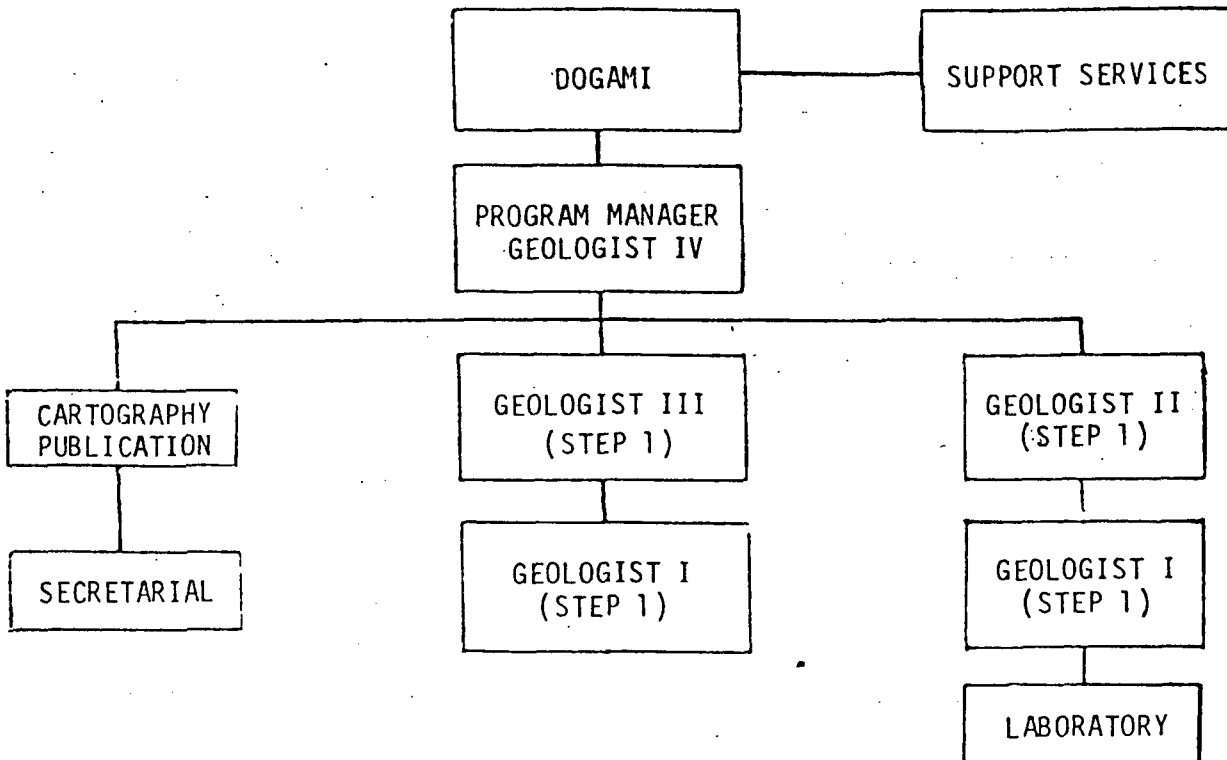


Figure 2

## ASSESSMENT PLAN

### Data Compilation

Geological, geophysical, geochemical, and heat flow data for the low temperature resource areas identified in Phase I (Belknap-Foley, Willamette Pass, Craig Mountain-Cove, Western Snake River Plain, Northern and Southern Harney Basins, Alvord and Lakeview) (Figure 3) are in various stages of completion and no additional funding is requested for these areas except as noted below. Funding for data compilation is required for Parkdale and Powell Buttes as well as for Walla Walla and McDermitt, the latter two being part of the original Phase I identification. Data compilation will be an ongoing process throughout the assessment period.

### Geologic Mapping

Initial assessment of the additional four resource areas will consist, in part, of geologic mapping and air-photo and imagery interpretation.

A geologic map, at an appropriate scale, extending into adjacent areas, based on either field mapping or literature research-field reconnaissance, and air-photo interpretation, will be produced for each of the resource areas. The map also will depict all known major structures or trends as well as surface geothermal manifestations. Cross-sections based on available geologic data will be drawn through the resource areas.

Besides black and white, color and color IR photos, air-photo studies will involve the interpretation of SLAR, LANDSAT (ERTS), NASA U-2 and Apollo imagery, as available. Data obtained will be utilized to produce a lineament

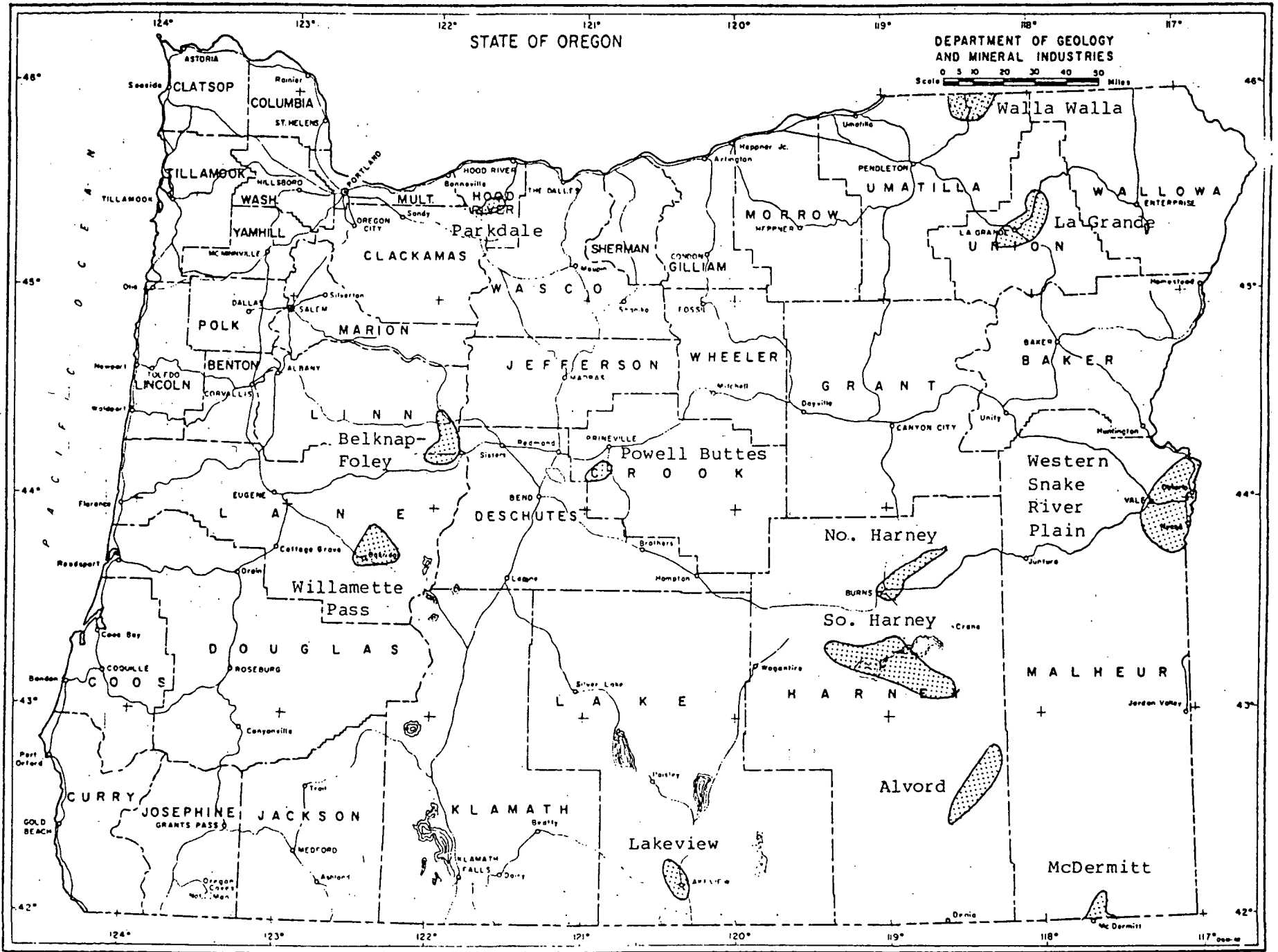


Figure 3. Index map of low temperature areas

map for each of the four resource areas. Ground-truth verification may be needed to resolve ambiguous interpretation and may be accomplished during field mapping. It is contemplated that some of this work may be done by consultants to DOGAMI.

### Temperature-Gradient Study

Temperature-gradient drilling has been completed at Lakeview and La Grande, two of the resource areas previously identified. Under this present proposal, funding is requested for temperature-gradient drilling at Belknap-Foley, Willamette Pass, and Parkdale. Drilling of heat-flow holes is not contemplated for the remainder of the resource areas because of either prior industry involvement, remoteness of resource area to available markets, availability of drilling sites, or the large size of the resource area. Any drilling funds remaining after drilling of the above three resource areas will be utilized in the drilling of hole(s) in the Harney Basin.

Because the three resource areas represent varied geologic conditions, holes to be drilled will encounter materials that may vary from valley-fill sediments to volcanics of diverse types. Each area should exhibit distinct drilling characteristics with differing attendant problems. Part of the compilation process will be to better define the drillability within the respective resource areas so that loss of future drilling-completion time can be kept to an absolute minimum.

It is proposed that a minimum of four (4) up to 500-foot (152 m) deep, temperature-gradient holes be drilled in each of the three aforementioned areas. However, site conditions may dictate that a lesser or greater number of such holes be drilled. It is contemplated that the holes should not be

any deeper than that expressed above, but there may be a possibility that gradient holes up to 1,000 feet may be a necessity.

Whatever "scrounge or free" holes may be located within the resource areas; i.e., water wells, oil-test wells, mineral exploratory holes, etc., temperature gradients will be measured for these holes. These data will complement that obtained from the proposed temperature-gradient holes.

Drilling projects in young volcanic environments throughout the world encounter repeated costly and time consuming difficulties. Therefore, it is felt that an exchange of ideas with others is important for the successful completion of the test holes. Funds are included herein for travel by the principal investigator or his designee to Washington, D.C., to confer with DOE drilling specialists.

#### Geochemistry

During the Phase I and II (1979-80) investigation, available thermal springs and wells were sampled, water analyzed, and geothermometry computed. This process will continue for the resource areas for additional wells and springs that may not have been included in the previous work by virtue of their availability. If thermal fluids are encountered in the temperature-gradient holes, samples of these fluids will be chemically analyzed and the data submitted to the U.S. Geological Survey (USGS), Menlo Park, California, for their inclusion in the GEOTHERM data base.

#### Site Selection

The final selection of deep test drill sites will be decided after a thorough review with appropriate USGS and DOE personnel of all geological, geochemical, and geophysical data collected for the resource areas.

Selection of precise drill sites must take into account whether surface and subsurface occupancy rights are available for lands under Federal, State, and local government ownership or control. It is not anticipated that drill sites will be located on private lands unless special arrangements can be made with the fee holders and/or lessors.

### Deep Test Drilling

Deep test drilling should commence sometime after the second half of 1981 and therefore is not a part of the present proposal. It is possible that the selection process, based on the ongoing assessment, may eliminate identified resource areas from consideration. On the other hand, all of the areas could be drilled. Drilling of one hole per area, for example, if successful, would tend to identify a specific reservoir. However, reservoir evaluation leading to exploitation can only proceed when confirmation wells are drilled.

Funding for the actual deep test drilling, drilling and geological supervision, geophysical logging, and flow testing is not contemplated as part of this proposal and cannot be accurately forecast at the present time. It will be the subject of continuing discussions between DOE and DOGAMI.

### Publication

It is envisioned that the final report would consist of the assessment portions (i.e., geologic and lineament maps, geophysical maps, data on heat flow and geochemistry, and associated text) as well as recommendations for each of the resource areas either as one compendium or as individual treatises. This decision will be predicated on the quantity of the data collected and the needs of the geothermal community.

## RELATED STUDIES

A statewide inventory of low-temperature geothermal resources (Phase I); i.e., geothermal waters with a reservoir temperature of 90°C or less, was begun on July 1, 1977. The inventory, as originally planned, consisted of two parts - the first was a compilation of chemical data on Oregon's thermal springs and wells, and the second part was an inventory of low-temperature reservoirs utilizing a combination of geochemistry, heat flow data, temperature-gradient data, and geological-geophysical information.

Geochemical data obtained from the Phase I study have been sent to USGS for their inclusion in the GEOTHERM data base. The collection of low-temperature data during the Phase II (1979-80) study will be likewise submitted to USGS.

DOGAMI, under Contract No. DE-FC07-79ID12044, is currently drilling temperature-gradient holes in the Central Cascades area. This work should be completed in late 1980. Data that may relate to an understanding of the geothermal regime in the Willamette Pass and Belknap-Foley resource areas will be incorporated in the final report(s) of these two areas. Similarly data generated under Contract No. AC06-77-ET-28369 for the geothermal assessment of Mt. Hood will be utilized in the evaluation of the Parkdale area.

Because of its long-term involvement in the study of Oregon's geothermal resources, DOGAMI holds a considerable quantity of unpublished data which will be available for this project.



#### PATENT INFORMATION

There is no proprietary information included in this proposal and the information to be collected during the proposed study will not be confidential.

#### APPLICATIONS TO OTHER SPONSORS

This proposal has not been submitted to other potential sponsors and we do not plan to submit it to others in the future.

RESUME AND BIBLIOGRAPHY

RESUME

Joseph F. Riccio

Summary: Technical, administrative and management experience in petroleum geology, engineering geology, hydrogeology, environmental geology, and geothermics.

Education: University of Southern California BA 1950 Geology  
University of Southern California MS 1951 Geology  
University of Southern California Ph.D. 1965 Geology

Experience:

- 5/78 to Present Oregon Department of Geology and Mineral Industries, Portland, Oregon; Geothermal Specialist. Responsible for the completion of the low-temperature resource assessment in Oregon (DOE Contract No. EG-77-C-06-1040) and the geothermal resource assessment of Mt. Hood Volcano, Oregon (DOE Contract No. EG-77-C-06-1040).
- 8/77 to 5/78 Consultant in California in geothermics to the State of California Energy Resources Conservation and Development Commission and to private geothermal development firms.
- 4/76 to 8/77 Geothermal Development Manager, Public Service Department, Burbank, California. Responsible for the city's program of geothermal development leading to electric power production. Research and author contribution to ERDA grant (Contract No. E(O-4-1311) entitled "Site-Specific Analysis of Hybrid Geothermal/Fossil Power Plants."
- 4/74 to 4/76 Consulting Engineering Geologist (California); Consultant to civil engineering firms, architects, land developers, and attorneys in engineering geology.
- 10/70 to 4/74 Consulting Engineering Geologist (Alabama); Consultant to the State of Alabama (Geological Survey) in engineering/environmental geology and hydrogeology. Staff engineering geologist, and regional geologist, Mobile District, Alabama Geological Survey.

Typical responsibilities: Hydrogeologic studies pertaining to sanitary landfill sites and land-disposal sewage systems; deep-well disposal studies; engineering geology, and hydrogeology for several counties in South Alabama. Project Director of an environmental geology study for the U.S. Corps of Engineers entitled "Environmental Impact of the Proposed Tennessee-Tombigbee Waterway in Alabama." Project leader of an engineering/environmental geologic study for a proposed super-port and associated land-based support facilities on the Alabama Gulf Coast. Dam site geology, exploration, and reservoir studies for a proposed nuclear generating plant for the Alabama Company.

7/55 to 7/70

Pacific Soils Engineering, Inc., California, President and Chief Engineering Geologist. Director and Supervisor of 55 employees engaged in consulting engineering geology, foundation engineering, and soil engineering.

11/53 to 6/55

Senior Engineering Geologist (California), employed by a private consulting foundation engineering firm. Responsible for the firm's geological studies pertaining to urban, commercial, and industrial land developments.

3/52 to 7/53

Petroleum Geologist/Engineer for an independent oil producer in California. Responsible for drilling, work-over, casing, and logging programs and completion procedures for developmental wells.

2/51 to 2/53

Subsurface geologist for International Petroleum, Ltd. (Colombia). Duties similar to that above plus well-site geology.

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B U D G E T

PROJECT BUDGET SUMMARY

	<u>DOE</u>	<u>DOGAMI</u>
<u>Personnel (including OPE)</u>		
Geologist IV      12 mo. @ 0.5 FTE		\$ 20,450
Geologist III     12 mo. @ 1.0 FTE	\$ 27,265	
Geologist III     3 mo. @ 1.0 FTE	8,730	
Geologist II      12 mo. @ 1.0 FTE	23,855	
Geologist I       24 mo. @ 1.0 FTE	37,490	
Cartographer II   6 mo. @ 1.0 FTE	10,225	
Editor             3 mo. @ 1.0 FTE	6,390	
 <u>Travel</u>		
500 days @ \$30/day	15,000	
Transportation - 40,000 @ 7¢/mi., and 5 pickups @ \$132/mo.	10,000	
 <u>Services and Supplies</u>		
Direct material, maps, sample bags, thin sections, photos	10,000	
Drilling (Temperature-gradient)	170,000	
Water chemistry	805	
Printing	<u>23,000</u>	
TOTAL DIRECT COSTS	\$342,760	\$20,450
INDIRECT COSTS	<u>57,240</u>	
TOTAL	\$400,000	\$20,450
 PROJECT TOTAL	 <u>\$420,450</u>	

BUDGET MATRIX - DOE FUNDING

	Task 1	Task 2	Task 3	Task 4	Task 5	Total
	<u>Data Compilation</u>	<u>Geological Mapping</u>	<u>Temperature Gradient</u>	<u>Geochemistry</u>	<u>Publication</u>	
Geologist III		\$27,265				\$ 27,265
Geologist III		8,730				8,730
Geologist II			\$ 23,855			23,855
Geologist I	\$ 9,373	9,373	9,372	\$ 9,372		37,490
Cartographer II					\$10,225	10,225
Editor					6,390	6,390
Travel		10,000	15,000			25,000
Direct Material	1,000	1,000	4,000	3,000	1,000	10,000
Drilling			170,000			170,000
Water Chemistry				805		805
Printing					23,000	23,000
Indirect Costs	<u>1,733</u>	<u>9,413</u>	<u>37,111</u>	<u>2,201</u>	<u>6,782</u>	<u>57,240</u>
TOTAL	\$12,106	\$65,781	\$259,338	\$15,378	\$47,397	\$400,000

GEOLOGY AND MINERAL INDUSTRIES

OVERHEAD

PERSONNEL

Z6320 Director	60,360	
Z3064 Deputy Director	53,424	
Z0010 Administrative Assis.	28,272	
Z0051 Business Manager	39,816	
C0101 Accounting Clerk	19,368	
C3006 STD SCNTFC-TECH TR. (60%)	7,747	
OPE 20.3%		210,924
Total Personnel		<u>42,817</u>
		<u>251,391</u>

SERVICE AND SUPPLIES (PROGRAM 1 BB)

(1) Instate and Reg. Travel	16,809	
(2) Out-of-State Travel	3,363	
(3) Office Expenses		
a) Phone (6 of 17 phones) (excluding proj.)	4,200	
b) Shuttle Mail	5,316	
c) Central Stores	1,944	
d) Copier	9,936	
(4) Fiscal Control	12,664	
(8) Attorney General	1,388	
(9) Insurance	1,961	
(11) Housing and Grounds (670 x 62 x 24)	9,970	
Total Services and Supplies		<u>61,272</u>
Total Overhead		<u>312,603</u>
Total Budget, Minus Overhead		<u>1,867,625</u>
Overhead Rate		16.7%

