Geothermal overviews of the western United States

15328

GEOTHERMAL RESOURCES OF IDAHO

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1972

Potential

A projected extension under the continent of the general strike of the East Pacific Rise and particularly its central rift will place this major earth structure somewhat east of the Gulf of California. The transform faults and escarpments such as the Mendocino Mountains and the Murry Mountains, which cross the East Pacific Rise nearly at right angles, arch slightly southward as they approach the west coast. If the faults continue to show this right angle relationship to the rise beneath the continent, then the projection of the rise to east of the Gulf of California is required. Such a projection seems to be a logical possibility. The westward bend of the north end of the rise which lines it up with the Gulf of California may be the result of large secondary rifts such as the San Andreas fault and, as such, would not reflect the true strike of the rise. A continued extension of the eastern projection will place the East Pacific Rise and rift beneath the continent along a line that extends through central Arizona, western Utah, and central Idaho. It is very interesting that this axial line of projection intersects the volcanic areas and hot spring areas of greatest prospective value for geothermal resources in each of these three states.

A projected extension of the Mendocino Escarpment and fracture zone of the Pacific basin west of northern California will place this structure beneath the continent along a line that crosses northern California, northern Nevada, southern Idaho, northern Wyoming, and on across southeastern Montana and parts of the Dakota states. This line of projection intersects most of the known geothermal resource areas of northern California and northern Nevada, all K. G. R. A.'s of Idaho, and the geothermal region of Yellowstone National Park. A projection of the westward bend in the northern end of the East Pacific Rise, and the fault system associated with it and with the San Andreas fault will follow a path which includes most of the remaining K. G. R. A.'s of California, Oregon and Washington.

The projected extensions of these three major earth structures intersect nearly all the known geothermal resource areas of the western United States. These oceanic ridges, and large rift zones are know for their close relationship to zones of high heat flow, tertiary and Quaternary volcanism and tectonic activity. Therefore, it is very reasonable to believe that the geothermal anomalies in the western USA are largely the result of thermal activity along these large subsurface structural trends.

Since two of these significant structures extend beneath Idaho and underlie most of the state, there is good reason to expect a very high geothermal potential for the state. There are more than 200 hot springs in the state

#2 2.0mw steam)
#3 4.0mw steam) Lihue Sugar Co. 3.5mw
#4 4.0mw hydro) 3.5mw
Waiahee-upper 0.8mw hydro)
Waiahee-lower 0.5mw

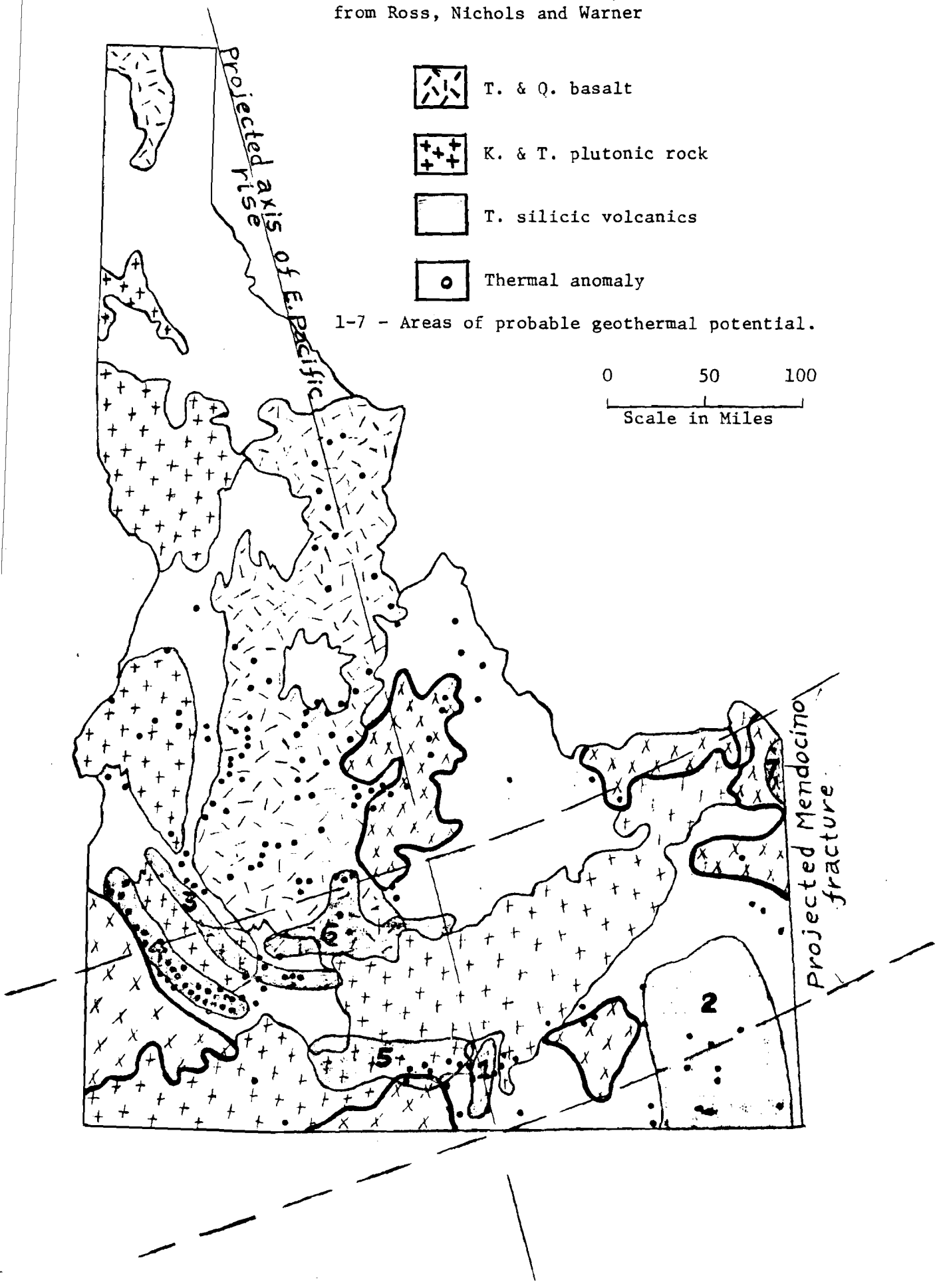
Figure 10. KAUAI

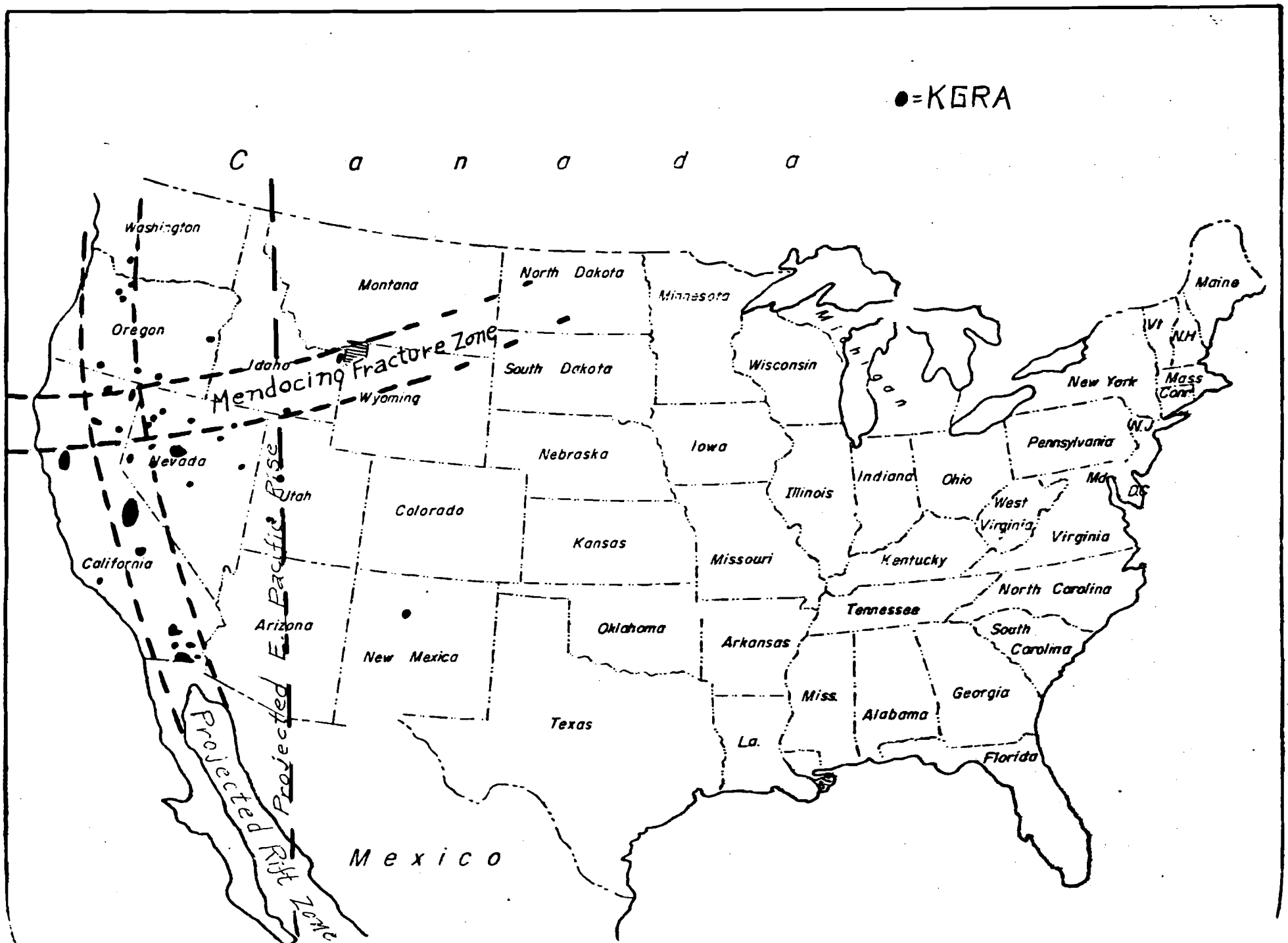
of Idaho and numerous hot wells. Most of these thermal waters are within the projected limits of the postulated controlling structures. The granitic rocks of the Idaho Batholith and all of the silicic Tertiary volcanics aslo lie within the project limits of the large subsurface structures, and most of the thermal springs are closely associated with these particular rocks.

The U. S. G. S. has to date outlined two Known Geothermal Resource Areas in Idaho. One of these is on the state's eastern border next to Yellowstone Park (No. 7 on the map) and the other is near the southcentral border along the Raft River (No. 1 on the map). The total area of these two K. G. R. A.'s is about 22,000 acres, which ranks Idaho 6th from the top of nine western states in regard to known potential according to the U. S. G. S. This is not an accurate picture, however, according to more recent findings of independendent investigators. The U. S. G. S. has also ranked Idaho as 3rd from the top of fourteen western states in terms of prospective values with a total area of about 15 million acres in this catagory. This is a more realistic evaluation of Idaho's potential according to the independent reconnaissance that has been completed to date. This recconnaissance has outlined five areas in addition to the two K. G. R. A.'s of the U. S. G. S., which show indications of probable geothermal potential. These areas are numbered 2 to 6 on the accompanying map. If this postualted potential proves to be valid, the acreage of known potential in Idaho will be increased 15 to 20 times that of the U. S. G. estimate - All of the favorable areas known to date are located in the southern half of the state which need further investigation. Although rock permeabilities are not generally as good in the northern region, there are some areas that could have a fair potential. Surface conditions in and around the 7 favorable areas indicate that most of them will be of the hot water type system rather than the vapor dominated type. Much of the southern part of the state where most of the favorable areas are, is underlain with hundreds to thousands of feet of permeable sediments. It should be remembered, therefore, that more than one geothermal aguifer may exist beneath these areas and that surface indicators may reflect subsurface conditions of only the upper most aguifer.

The great vertical distance of transfer of the thermal waters under such conditions plus the presence of much amorphous silica in the numerous ash beds and a large inflow of meteoric water from the Snake River Aguifer should make the surface geochemical indexes to subsurface conditions of this region very questionable. According to these indexes, none of the 7 areas appear to be underlain by waters of very high temperatures nor very active geothermal systems. The maximum surfact temperatures range from 125° to 150°C. Recent acidic volcanism is absent, there is no geyser activity, extensive argilliation of surface rocks is lacking, and the water chemistry does not, in most case, indicate high temperatures at depth. On the other hand, there is a rather wide distribution across the Snake River Plane of palized wood, chalcedonic rocks, silicified sediments, thich oolite beds, leached lake sediments and siliceous sinter. Run off of waters, rich in

Generalized Geologic Map Showing Features Pertinent to Geothermal Exploration--Modified from Ross, Nichols and Warner

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Minnesota
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Illinois
Indiana
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Kentucky
Tennessee
Miss.
Alabama
Georgia
Florida
South Carolina
North Carolina
Virginia
West Virginia
Pennsylvania
New York
Maine
Vt
NH
Mass
Conn
RI
NJ
Md
DC
Mendocino Fracture Zone
E. Pacific Rise
Projected Rift Zone
Mexico

silica, must have been much greater in the recent past than it is today. The sinter, the thick oolite deposition and the highly leached lake carbonates are of particular interest because they are more indicative of thermal waters and possible geyser activity near by. The change in climate since the quaternary ice age, with a reduction is precipitation, runoff, and infiltration over the geothermal zones could account for the arrest of geyser activity. The hot springs of today might not be over the major thermal areas but merely represent fringe seeps. The hot zones might be in the higher, dryer areas. We must not assume that geothermal surface seeps are the only places to find geothermal resources. In truth they may not even represent the best places to look, as is often true in the case of petroleum.

The most promising area in Idaho to date for geothermal prospecting appears to be the Raft River area (No. 1 on the map). Here two surface wells are near the boiling point, the water chemistry is characteristic of thermal fluids, and the surrounding geologic conditions are favorable.

Activity in Geothermal Resources

The people of Idaho have used their thermal waters for recreation, irrigation and space heating for over a century. The greatest use has been irrigation of crops after cooling the water. The residents of Warm Springs Avenue in Boise have used well water of 70° to 77°C to heat their houses since 1890. The people of Sun Valley, and southwestern Idaho also utilize hot water for this purpose. The waters are also being used for greenhouse heating and for growing of vegetables.

In 1937 N. D. Stearns published information on thermal waters of Idaho and in 1965 G. A. Waring published similar information. The first comprehensive study of geothermal potential in Idaho was undertaken by Sylvia H. Ross, Groundwater Geologist for the Idaho Bureau of Mines and Geology. This work, called "Geothermal Potential of Idaho" was published by the Bureau of Mines and Geology in Jan, 1970. Included in this report are - uses of thermal waters, description of anomalies, chemical analyses, heat sources, geology of geothermal areas and hot spring and well locations.

Since the 1970 World Conference in Pisa, Italy, considerable interest in geothermics has been generated. Geothermal investigations have been made by a number of persons from the state colleges and universities, service companies and industrial firms have supported geothermal research and exploration, and outside interests have acquired oil and gas leases in geothermal areas of Idaho and are carrying on geologic and geophysical surveys in these areas.

Legislation regarding geothermal resources is currently being prepared to present to the legislature this month (Jan. 1972). The governor of Idaho has appointed a state representative to keep abreast of all current developments and future plans dealing with geothermal resources.

The increasing interest in this area of both state residents and outside firms indicates an accelerated rate of activity in the future for Idaho.

The southern half of Idaho in 1972 has a power capacity of approximately 1,537 megawatts and a projected capacity of about 2,337 megawatts by 1980. These are peak figures and the projection is based on a 6.5 percent load growth. Idaho is reaching its limit for construction of hydro-power plants and the state's potential for fossil fuels is probably very low. Therefore, like most of the Northwest, Idaho is in great need of a new power source. The state is also in great need of a new revenue source, so future exploration for geothermal resources in Idaho should increase rapidly.

Laws and Regulations

Legislation for geothermal resources will probably be completed this year. Information regarding it can be obtained from the following: Edward Williams, Administrative Assistant to the Governor, Statehouse, Boise, Idaho; Anthony Park, Attorney General, Statehouse, Boise, Idaho; or Mont M. Warner, Geothermal Representative, 6708 Holiday Dr, Boise, Idaho, 83705.

Regulatory agencies have not yet been designated.

Conclusions:

Regional and local geology indicate that Idaho should have high geothermal potential. Geochemical geothermometers do not support a postulated high potential in regard to very hot water or steam. Numerous hot springs across the state indicate a very broad energy source and a wide distribution of subsurface hot water, even though it may not be hot enough for electrical power production at the present.

The following facts are pertinent and important to Idaho's geothermal situation:

1. Geothermics is in its infancy and is developing rapidly. New methods, techniques, inventions, and discoveries will undoubtedly expand the geothermal industry greatly within the next decade.

2. Our understanding of geothermal systems is too meager at the present time to be depended upon for rapid or early evaluation of wild cat geothermal prospects.

3. We are still prospecting only surface seeps as the oil industry was 50 years ago. These seeps may or may not represent the major geothermal zones.

4. Geothermal reservoir indexes, which are found at the surface, such as the geochemical geothermometers are not always dependable by themselves. Their reflection of subsurface conditions can be hindered by long transfer of the thermal waters or by surface amorphous silica and other factors.

5. Geothermal resources are of multipurpose and their use can expand in several directions.

Considering the whole picture, the future development of the geothermal industry in Idaho appears to have a very good chance of succeeding.

References: In addition to Sylvia Ross's work, the following persons can be contacted for information from personal efforts, unpublished at this time.

Jack Barnett, 8310 Crestwood Dr., Boise, Idaho
Clayton Nichols, Boise State College, Boise, Idaho
Cal. Warnick, Water Resources Research Institute, University of Idaho, Moscow, Idaho
Mont M. Warner, Boise State College, Boise, Idaho

Others are undoubtedly involved in geothermal activities in the state, but are unknown to me.