

GEOTHERMAL RESOURCE ASSESSMENT FOR HAWAII \*

Donald M. Thomas

Hawaii Institute of Geophysics  
University of Hawaii  
Honolulu, Hawaii 96822

ABSTRACT

The preliminary phase of a geothermal resource assessment program for the State of Hawaii has been completed. Several locations on all the major islands of the Hawaiian chain have been identified as potentially having a geothermal reservoir within a few kilometers depth of the surface. Although geological and geophysical data were of some use in the regional surveys, groundwater chemical data was far more helpful in identifying more restricted areas in which to carry out site specific field surveys. Geochemical and geophysical surveys are presently underway in several of the areas identified as potentially having a geothermal resource.

INTRODUCTION

A regional assessment of potential geothermal resource areas in the State of Hawaii is presently being carried out by the Hawaii Institute of Geophysics under the Western States Cooperative Direct Heat Resource Assessment Program. The first phase of this research consisted of the compilation and evaluation of geological, geophysical, and geochemical data presently available for the State of Hawaii. The specific types of data used in our preliminary appraisal of the geothermal resource potential for Hawaii was as follows:

Geological: Structural geology of the islands and volcanoes, age of the islands, and age and location of most recent volcanism on each island.

Geophysical: Aeromagnetic data, gravity data, seismicity, infrared surveys and groundwater temperature data.

Geochemical: Elevated groundwater silica concentrations and anomalies in the Cl/Mg ratios in near surface waters.

The available geological and geophysical data were very useful in identifying areas in which geothermal reservoirs might exist, however, the regional nature of the earlier surveys rendered them virtually useless as a means of

confirming the presence of an existing reservoir. Groundwater chemistry data was found to be far more useful in this regard. Although Hawaii has very few natural spring discharges, the near total dependence of the State upon shallow near surface groundwater supplies has resulted in a widespread distribution and careful monitoring of drilled and dug wells throughout the State. The relatively complicated island-type hydrology in Hawaii prevented the direct application of standard chemical geothermometers, however, groundwater silica concentrations and Cl/Mg ion ratios (Cox and Thomas, this volume) proved to be very useful qualitative indicators in this environment.

RESULTS

The results of the preliminary survey have allowed the identification of several areas in the State which may have significant geothermal potential and which will receive more intensive site specific survey in the future. Table I presents an appraisal of several of the potential thermal areas in the State in terms of their probability for having a high or low temperature resource as well as their probability for near future development. (The latter assessment is based on the present state of the art in drilling and geothermal utilization technology, proximity to potential markets for heat/electric power produced, and local land use constraints [national park lands, urban residential zoning, etc].) Each area is ranked on a scale from 1 to 10: 1 having the highest potential, 10 having the lowest. Although other areas in the State undoubtedly have thermal resources, the probability of their being developed economically in the near future (1980-2000) is so small as to not justify their inclusion in the present assessment.

The second phase of the resource assessment program is presently underway and is conducting site specific surveys in Lualualei Valley (Oahu), Lahaina (Maui), Kawaihae-Kona and Keaau (Hawaii). The survey techniques which are being applied are:

1. Groundwater geochemistry: resampling of all wells within the region of interest to confirm existing data.

\*Hawaii Institute of Geophysics Contribution No. 986

2. Soil mercury concentrations and radon soil-gas anomalies (Cox, this volume) to identify areas of potentially thermally driven earth outgassing.
3. Groundwater isotopic compositions to identify  $\delta^{18}O$  anomalies.
4. Time domain electromagnetic surveys to identify deeper level resistivity anomalies.

If these surveys confirm the existence of a geothermal reservoir in any or all of the above areas, sites will be chosen for proposed exploratory drilling.

TABLE I

Location	High Temp. Resource	Low Temp. Resource	Probability for Development
<b>Hawaii</b>			
1. Puna	1	1	3
2. Ka'u	2	1	5
3. South Point	3	2	3
4. Hualalai-North Kona	5	3	1
5. Kawaihae	5	3	1
6. Keauau	6	4	1
7. Kohala	7	5	8
<b>MauI</b>			
8. Haleakala-Southwest Rift	3	2	3
9. Haleakala-East Rift	3	2	6
10. Pauwala	4	3	5
11. Lahaina	3	1	1
12. Olowalu-Ukumehame	3	1	2
13. Honokawai	5	4	2
<b>Oahu</b>			
14. Waimanalo	7	5	1
15. Lualualei	8	6	1
16. Honolulu Volcanic Series	8	7	3
17. Haleiwa	9	7	3
18. Laie	9	7	3
19. Pearl Harbor	10	9	1
<b>Kauai</b>			
20. Post Erosional Volcanic Series	10	8	5

The approximate locations of these areas are given in Figure 1.

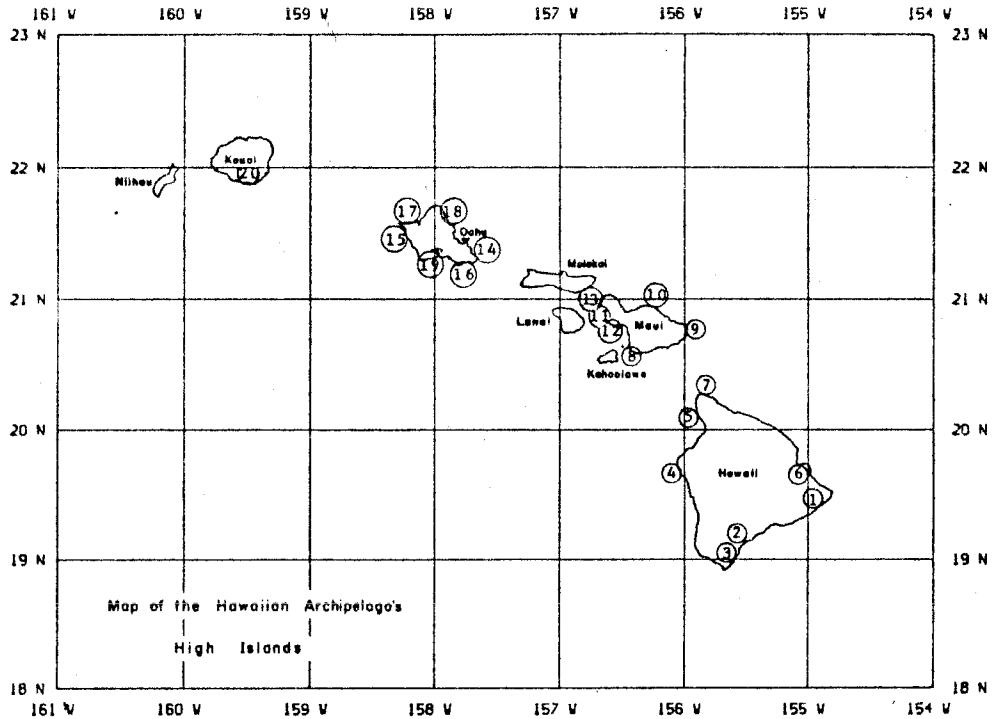


Fig. 1 Potential geothermal areas of Hawaii.