POTENTIAL FOR GEOTHERMAL DESALINATION IN THE SOUTHWEST UNITED STATES

by

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ABSTRACT

Combining the results of standard chemical geothermometry techniques, chemical analysis of ground water and geologic mapping of large sedimentary basins, we have delineated areas in the southwestern United States where geothermal desalination may help to augment deficient water supplies. Ten areas favorable for geothermal desalting have been located within Arizona, New Mexico, and southwest Texas.
Introduction

The southwestern United States is an area characterized by accelerating population and economic growth and water deficiency. Availability of water represents a limiting factor in the continued development of the area. Low annual precipitation, high mean annual temperatures, and low humidity with resultant loss of large amounts of water to evaporation assures a small net water yield available as runoff in streams and recharge of underground aquifers from within the area's boundaries. Much of the water presently used is obtained from ground water supplies.

Chemical quality of ground water is variable but significant amounts of previously unusable saline water (more than 1,000 parts per million total dissolved solids) may be made available for urban, industrial, and agricultural utilization in areas where geothermal resources occur in conjunction with large volumes of saline water in permeable aquifers.

This report outlines major sedimentary basins with saline water and geothermal potential in order to outline areas which may benefit from geothermal desalination. It follows from Imperial Valley studies for other major southwestern basins. A description of the techniques of geothermal desalting and its impact on fresh water resources is reported by Fernelius (1975).

Geology

The main area of interest is the Basin and Range province of California, New Mexico, Arizona, and Texas, including the Southern
Rockies province and the Rio Grande Rift. Basin and Range structure is dominated by generally north-northwest trending fault block mountains or ridges separated by sediment-filled basins.

The structural basins between the mountain ranges are filled to depths of thousands of feet with unconsolidated or weakly consolidated deposits of gravel, sand, silt, and clay (alluvium) and are the primary aquifers in most of the area. The large major basins with their great water storage capacity and high permeability are therefore prime sites for large volumes of easily accessible ground water. In the Colorado Plateau and Great-Plains provinces the primary aquifers are comprised of consolidated sandstone and limestone, respectively.

**Techniques**

Locations of deep sedimentary basins were obtained from the work of Gerlach et al. (1975) and Swanberg (1979). Data from Hahman et al. (1978) and Swanberg (1979) were used to determine the distribution and extent of major geothermal areas (Figure 1). Figure 2 represents additional and extended potential geothermal regions (Swanberg, unpublished data). This information was not available at the time figure 1 was prepared, but is included since the results were used in forming the conclusions drawn in this report.

Over 20,000 groundwater chemical analyses from the U.S. Geological Survey's WATSTORE "water quality file", plus those of approximately 300 water samples collected in the study area were used to locate major areas of saline water occurrence. Areas of overlap between abundant
saline water, geothermal potential and major sedimentary basins are shown in Figure 3. Availability of significant volumes of water for desalination in the Colorado Plateau Province was inferred from the approximate areal extent of consolidated sedimentary aquifers shown on the Productive Aquifers and Withdrawal from Wells map of the National Atlas of the United States.

Results

Geothermal resources may originate in deep sedimentary basins where the water is heated by the geothermal gradient and rises to the surface along active faults. Figure 3 shows 10 areas of overlap of high salinity groundwater, geothermal potential and major sedimentary basins. These are the areas that we suggest be targeted for detailed evaluation for desalting of geothermal brine.

The majority of the areas favorable for geothermal desalination occur in the Basin and Range. Waters of the province are generally of low salinity, however, areas where geothermal prospects occur may have saline water at depth. Also shown are three areas in the Great Plains region where abundant saline water occurs in areas of no known geothermal potential and potential for desalination is low.
Figure 1. LEGEND

- MAJOR GEOTHERMAL AREA DEFINED BY HIGH CHEMICAL GEOTHERMOMETERS
- CENOZIC BASINS
- APPROXIMATE MARGIN OF RELATIVELY DEEP BASINS
AREAS OF HIGH GEOCHEMICAL TEMPERATURES
INCLUDING Na-K-Ca-Mg
+ SINGLE HIGH Na-K-Ca-Mg GEOTHERMOMETERS

Figure 2.
Figure 3.

LEGEND

- RECOMMENDED AREAS FOR EVALUATION OF GEOTHERMAL DESALINATION
  - LARGE VOLUME OF WATER IN STORAGE
  - SALINE WATER
  - GEOTHERMAL POTENTIAL

- GREAT PLAINS PROVINCE
  - ABUNDANT SALINE WATER
  - NO KNOWN GEOTHERMAL POTENTIAL
  - POTENTIAL FOR DESALINATION LOW
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