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## ABSTRACT

### Resource Investigation of Low- and Moderate-Temperature Geothermal Areas in San Bernardino, California

by Leslie G. Youngs

The California Division of Mines and Geology (CDMG) selected the San Bernardino area for detailed geothermal resource investigation because the area was known to contain promising geothermal resource sites, the area contained a large population center, and the City of San Bernardino had expressed serious interest in developing the area's geothermal resource.

Ninety-seven geothermal wells and springs were identified and plotted on a compiled geologic map of the 40-square-mile study area. These wells and springs were concentrated in three distinguishable resource areas: Arrowhead Hot Springs, South San Bernardino, and Harlem Hot Springs -- in each of which detailed geophysical, geochemical, and geological surveys were conducted. The Arrowhead Hot Springs geothermal area lies just north of the City of San Bernardino in the San Bernardino Mountains astride a shear zone (offshoot of the San Andreas fault) in pre-Cambrian gneiss and schist. The Harlem Hot Springs geothermal area, on the east side of the City, and the South San Bernardino geothermal area, on the south side, have geothermal reservoirs in Quaternary alluvial material which overlies a moderately deep sedimentary basin bound on the southwest by the San Jacinto fault (a ground water barrier). Geothermometry calculations suggest that the Arrowhead Hot Springs geothermal area, with a maximum reservoir temperature of 142°C, may have the highest maximum reservoir temperature of the three geothermal areas. The maximum temperature recorded by CDMG in the South San Bernardino geothermal area was 56°C from an artesian well, while the maximum temperature recorded in the Harlem Hot Springs geothermal area was 49.5°C at 174 meters (570 feet) in an abandoned water well.

The geophysical and geological surveys delineated fault traces in association with all three of the designated geothermal areas. The gravity survey revealed a heretofore unmapped, east-west trending fault that bisects

the Harlem Hot Springs geothermal area. The dipole-dipole resistivity survey suggested a more refined location of a segment of the Loma Linda fault, slightly to the southwest of the previously reported location in the South San Bernardino geothermal area. Interpretation of data from the geophysical, geological, and geochemical surveys and from temperature data indicates the presence of a major geothermal fluid up-welling, or "plume", along this segment of the Loma Linda fault. The data also suggest that other geothermal fluid "plumes" in association with faulting are present within the three designated geothermal areas.

On March 15, 1982, the City of San Bernardino, using data developed by the California Division of Mines and Geology, began a geothermal exploratory program to drill four holes along the Loma Linda fault segment in the South San Bernardino geothermal area. The City of San Bernardino will use the results of the exploratory program to site a geothermal production well to augment energy requirements for sewage digestors at its municipal wastewater treatment plant in the area.