GEOTHERMAL ANOMALIES IN THE NORTHERN APPALACHIAN BASIN; WESTERN AND CENTRAL NEW YORK

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The known geothermal resources in the eastern U.S. are asociated with: (1) deep sedimentary basins with normal temperature gradients, (2) warm springs, (3) radiogenic granites covered by low thermal conductivity sedimentary rocks. Areas with a moderately thick sedimentary sequence underlain by radiogenic granite have great potential for hot dry rock geothermal application in the eastern U.S., whereas hydrothermal geothermal resources are associated with permeable stratigraphic layers in the deep sedimentary basins. Several areas in New York have been identified through previous investigations with the Los Alamos National Laboratory and New York State Energy Research Development Authority (NYSERDA) and are deemed to have good potential. In order to provide data to determine the geothermal character of this area, an integrated analysis of heat flow, bottom-hole temperatures (BHT), temperature gradients, geochemical indicators and gravity has been adapted. Detailed temperature-gradient analysis indicates that higher than normal geothermal gradients exist in New York; consistent patterns of high temperature gradients for areas near Cayuga Lake, East Aurora and Elmira were identified by using bottom-hole temperatures. Initial results suggested that the regional and local variations in temperature gradients were related to vertical and lateral conductivity changes and to local changes in heat flow due to heat generation in granitic plutons in the basement; this preliminary conclusion was consistent with the interpretation of heat flow on the Atlantic coastal plain by Costain. Due to the relatively simple geology, New York State provides an ideal location for the analysis of heat flow variation and relationship of this variation to basement lithology.

In March 1982 NYSERDA, in cooperation with the Department of Energy, completed drilling of a geothermal test well in Auburn, New York. This site is located within an area of anomalously high geothermal gradients determined from mean annual surface temperature and BHT. This well intersected marble in the Precambrian basement at 5100 feet and yielded a bottom-hole temperature of 51°C at 5260 feet about 12 hours after cessation of drilling. Hydrologic testing showed significant flows of water at greater than 50°C from 4750 feet in the Theresa Formation, a Cambrian dolomitic sandstone. Geophysical well logs suggest that water flow is from fracture permeability in this stratigraphic layer. The analysis of thermal conductivity, detailed temperature gradients, and permeability suggest that the elevated BHT-derived geothermal gradients in this area are caused by hydrothermal circulation along fractures in the stratigraphic section.

Similar results are indicated in other areas of the state; elevated gradients are often associated with observable faults and topographic linear features derived from interpretation of LANDSAT imagery. In light of this new data, the association of high geothermal gradients and regions underlain by radiogenic granites may be masked by structural effects in the stratigraphic layers. Many geothermal gradient anomalies in the Appalachian basin may be a result of hydrothermal circulation along faults and fractures and not entirely the result of conductive heat flow adjacent to radioactive granites.