NOTICE CONCERNING COPYRIGHT RESTRICTIONS

Geothermal Resources of the USSR and Their Geologic-Economic Subdivision

V. M. FOMIN
B. F. MAVRITSKY
L. F. POLUBOTKO
All-Union Scientific Research Institute of Hydrogeology and Engineering Geology, Moscow, USSR
F. A. MAKARENKO
Geological Institute of the Academy of Sciences of the USSR, Moscow, USSR

ABSTRACT

On the basis of studying and mapping the underground thermal fields and hydrothermal systems of the USSR, the regional regularities of formation and distribution of the geothermal resources within the platform and folded regions of the country, including the regions of recent volcanism, have been ascertained. In the USSR territory there have been established promising regions wherein the predicted resources of thermal water and vapor-hydrotherms are estimated in a quantity of up to 250 m^3/sec with mineralization of 1 to 35 g/l and temperature of 40 to 200°C, with temperatures of 40 to 60°C for a flow rate of 200 m^3/sec; 60 to 80°C for 35 m^3/sec; 80 to 100°C for 10 m^3/sec; and 100 to 200°C for 5 m^3/sec. The total amount of heat contained in these resources exceeds 250-300 $\times$ 10^6 Gcal per year.

GEOLOGIC AND ECONOMIC MAPPING

In addition to the hydrogeothermal indices related to the perspectives of development of the predicted thermal water resources, geologic and economic mapping is of particular concern for planning geological and prospecting works and for the development of the deposits of thermal waters and vapor-hydrotherms. Such a mapping makes it possible to establish as a first approximation the areas of maximum profit obtained with the same initial costs for exploration, prospecting, and mining of thermal waters.

When carrying out geologic and economic mapping the following hydrogeological indices are considered: (1) depth of occurrence of productive aquifer complexes; (2) temperature of fluid at wellhead; (3) mineralization of water; and (4) transmissivity. The thermal water resources mined in different areas are economically estimated on the basis of analyzing the above indices. The estimation of these resources is made with the help of the cost per unit heat released (at the stage of output and profit).

The final stage is the compilation of a geologic and economic map with an estimation of economical effectiveness of developing thermal water deposits in different areas.

AREAS UNDER INVESTIGATION

The map of geologic and economic subdivision of the USSR territory has been compiled on the basis of the given technique. The Northern Caucasus and Georgia are the most promising regions where the cost of 1 Gcal heat output does not exceed 1 to 3 roubles and it is two to three times as small as the rate for thermal energy. Kamchatka belongs to these regions where 1 Gcal heat output does not often exceed 0.6 roubles, sometimes coming up to 1.5 roubles.

Among the promising regions may be mentioned the south of West Siberia, Central Asia, and the south of Kazakhstan where the production cost of 1 Gcal heat fluctuates from 2 to 3 roubles and does not exceed the rate for thermal energy.

The lowest cost of heat is typical of the thermal water of fissure vein type in the regions of the Tien-Shan, Pamirs, and Prebaikal, which most commonly ranges from 0.5 to 1.5 roubles for 1 Gcal heat (at the stage of output).

The cost of heat generated at the plants which operate on traditional fuels (coal, fuel oil, gas) is much more expensive than heat generated at geothermal plants. At a typical deposit of thermal water as Zugdidskoe where the temperature of water is about 80°C, well discharge is 80 l/sec, and the cost of 1 Gcal heat generated is 1 rouble, an annual economical effect from using thermal water in comparison to traditional generators of heat (coal, fuel oil, gas) is: (1) in comparison to coal—544 000 roubles; (2) fuel oil—515 000 roubles; and (3) gas—317 000 roubles.

Geological and prospecting works are under way in the most promising regions.