GEOTHERMAL RESOURCES OF GEORGIA AND OUTLOOK OF ITS REALIZATION

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KEY WORDS

Geothermal fields, renewable source of energy, georgia.

ABSTRACT

Thermal water manifestation in Georgia has been known since ancient times and they account 44 fields with the temperature of 30-110 C and total resources of 160,000 cub.m per day. Implementation of this renewable source of energy using the modern technology gives us economy of 2.5 mln TCF and decrease amount of CO2 in air for 1.2 mln ton per year. Georgia is abundant in natural thermal waters and has a long history and tradition of their utilization. Since ancient times water has been used only for balneological and hygienic purposes. The history of using thermal waters as thermal power began in 1951 when explorers for coal revealed water with temperature 800C in a well driller in the village of Tsaishi not far from the Zugdidi region and on the basis of which a small - size greenhouse was built. Currently, about 250 natural (springs) and artificial (wells) water manifestations with temperature 300C - 1100C have been registered in Georgia. Their total discharge is about 160000m3/day. But their potential is far greater.

1. INTRODUCTION

Thermal water deposits available on the territory of Georgia are connected with almost every lithostratigraphic unit of the sedimentary cover, beginning with the Liassic slates (Torgvas Abano 40"C) and ending with the Quaternary lavas. Of them two main thermal aquifers are distinguished for their wide regional expansion, considerable thickness, high collecting and filtration properties, water abundance and water high temperature. They are: a water-bearing complex composed of Paleocene-Middle Eocene volcanic-sedimentary rocks which occurs in the AjaraTrialeti folded system from the Black Sea to Tbilisi and a water horizon composed of Neocornian limestones and dolomites which stretches throughout the Kolkhis lowland from the Black Sea to Kutaisi.. They are the most promising from the point of view of revealing new deposits also.

Propitious temperature conditions are here It has been determined that the average amount of heat flow in the Caucasus south slope is 1,8-HFU, in the Ajara- Trialeti folded system (in its central part) it reaches up to 2,0 HFU and in the Transcaucasian intermediate (intermontane) massif 0,8-HFU. So, the following relationship in distribution of heat flow is observed in the Georgian territory: maximal heat flow is observed in the central part of the folded system and minimum - in the zone of subsidence of the Georgian block. According to the value of heat flow, the Ajara- Trialeti folded system is in intermediate position.

2. THE PALEOCENE-MIDDLE EOCENE VOLCANIC SEDIMENTARY WATER-BEARING COMPLEX

The complex is composed of layers of andesitic lava and their tuffs, tuff breccias, terrigenous sandstones and tuff sandstones. Its average thickness is up to 3 km. The Paleocene-Lower Eocene sporadically watered Borjomi flysch and the roof represented by thick (1, OOO m) Upper Eocene clays and marls represent its actual bed.

Rocks composing the thermal water-bearing complex are intensively fractured by rather deep tectonic joints due to the effect of the folding which caused presence of numerous jointly-stratified water-bearing beds, horizons and zones and consequently abundant water manifestations.

Regionally the Ajara- Trialeti folded system is characterized by favorable geothermal conditions that is why the majority of water manifestations are thermal. Since ancient times they have been used for balneological and hygienic purposes. Drilling near the natural thermal water manifestations allowed to considerably increase their resources. Due to this there are many geothermal deposits in this region. Their heat is used in balneology and various sectors of the national economy.

Temperature conditions of the Paleocene-Middle Eocene thermal water-bearing complex are best studied within Tbilisi and environs. It has been established that the temperature conditions have been affected both by the depth of occurrence of Upper Eocene heat-resisting rocks overlapping it and their thickness.

From the site of outcrop of the Middle Eocene volcanic sedimentary formation temperature of rocks is gradually rising up to 100°C in all directions of their subsidence. To the NE the rise in temperature is slowing down due to nearness of the Georgian block. At the contact between Cretaceous and Eocene temperature value fluctuates over the wide range. For example, to the westernmost where Upper Chalk occurs to the depth of 500m, temperature in its roof is 70"c. Within Tbilisi, where it has subsided to about 2500-4000m, temperature ranges from 100 to 160 C while northeastward where it has subsided to about 6000m, temperature is 240°e. The statistical data of geothermal gradients allowed to establish that the gradient universe mean for the Tertiary complexes of the Ajara-Trialeti folded system is 3,1"C/100m. Compared with other complexes this index is quite high.

3. THE WATER-BEARING COMPLEX OF THE LOWER CRETACEOUS CARBONACEOUS SERIES OF GEORGIA

In Western Georgia the area of recharge of the Lower Cretaceous water-bearing complex is located at the quite high hypsometric elevations (1200-2200m above sea level) of the Caucasus south slope. In its upper part the complex is overlapped by the Aptian-Cenomanian water impermeable roof which extends for almost the entire area of its occurrence.

To the SW of the area of recharge, the water-bearing complex is gradually subsiding under the young sediments and in the Black Sea zone it occurs in the depth of 2 to 4-5 km. Such considerable difference in the levels of recharge and discharge, considerable thickness (up to 1200m), rocks' intensive jointing and the degree of karsted, good percolation properties (about km _ 350m2 / day), abundant atmospheric precipitation (1700- 2000 mm annually) make the Neocornian water-bearing complex watery and waters moving in it have high pressure.

The water horizon is basically composed of stratified, cryptocrystalline, pelitomorphic and dolomitic limestone which in the upper part are replaced by massive, thick-bedded organic limestone. Further upward, they are followed by the alteration of marls and pelitomorphic limestone. The limestone are mainly white and whitish-gray. They are characterized by intensive jointing and the high degree of being karsted.

Numerous wells have penetrated the Neocomiam complex at different depths (550-3700m) where water with different discharge (700- 10000 l\day;temperature -35"C-1O8°C) and totall miineralization of 0,35-2,53 g/l) has been found (Besleti,. Dranda, Kindgi, Okhurei, Khorga Kvaloni, Zugdidi, Tsaishi, Menji ,Samtredia,Tskaltubo, Simoneti)
The analysis of the well pressure changes shows that the waters of the Neocomian complex may be mainly discharging into the Black Sea. The coefficient of water permeability of rocks varies over a wide range (10-350 m2/day). The highest index of water permeability (200-350 m2/day) has been obtained within the Samegre> lo syncline, the lowest one (10 m2/day)- in the western the most deeply plunged part of the Rioni depression.
The geothermal gradient varies over a wide range both to the depth and width. The statistically assessed universe mean of the geothermal gradient in the Neocomian carbonaceous rocks of the zone of western subsidence of the Georgian block is 23,48 - 28,00 C/1O00m. The basic area of recharge of the thermal water-bearing complex is represented by quite a wide area (698 km2) of Lower Cretaceous, intensively fractured and karsted limestone outcropping in the Caucasus south slope.
The recharge of the water-bearing complex by percolated atmospheric precipitation and underground drainage was estimated. This allowed to establish that 25570 L/sec of water is percolating into the area. The average modulus of the underground drainage is 14 m3/sec that makes up 55% of the percolated atmospheric precipitation...
For today the most perspective geothermal fields are:Tbilisi,Zugdidi-Tsaishi,Tskhaltubo and Abkhasian.
Two Projects are ready for the implementation. Preliminary estimation shows-heat capacity of them are in Tbilisi-10,6 MW (1 stage), in Zugdidi-100 MW,in Tskhaltubo-40 MW. Using modern technology for the development of available geothermal resources will make it possible to save 2.5 million tones of equivalent fuel (TEF) annually. This will be of considerable economic and ecological importance. By replacing this amount of traditional fuel by geothermal energy, it will be possible to reduce the amount of CO_2 released into the air by about 1.200.000 tones annually.
Estimations have shown that, in the majority of cases, geothermal heat in Georgia is 2-3 times cheaper then other kinds of fuel and the period of recoupment of investments is faster.