

GEOHERMAL ENERGY SOURCES IN ALBANIA

Alfred FRASHERI¹, Fiqiri BAKALLI²

Abstract

The results of geothermal investigations in Albania and the possibilities of exploitation of geothermal energy sources are treated in this article.

The aim of this paper is to present the possibilities for the extension of energetic resource in Albania through the use of geothermal energy.

Geothermal investigations in the past three years have shown there exist possibilities for the exploitation of the geothermal energy in Albania. The ways of exploitation of this kind of energy are also given.

1. INTRODUCTION

Albania is a mountainous Mediterranean country with numerous natural energetic resources. There are many rivers flowing from the mountains where seven hydro-power plants have been built, with an installed power of 1427.1 MW (Frasheri N., 1994)

There are about 20 oil and gas reservoirs under exploitation in Albania, producing about 1.2 Mt oil (Albanian Encyclopedic Dictionary, 1985), but the last years the production is decreased and in 1993 only about 649.8 Kt of oil was extracted.

There are tens of coal mines in Albania, with an output of over 2 Mt coal in 1984 and 214.6 Kt of coal in 1993.

The Albanian energetic system is mainly based on electricity produced by hydro-power plants. The climate of Albania is a typical Mediterranean one, with a hot and dry summer. This climate makes the electrical system (based on the water resources of Albania) very capricious.

In the present conditions of a new Albanian market economy, together with the transformations in the management of existing energetic system, the study of

other energetic sources has begun. There are great possibilities to use these sources of energy (about $129.3 \text{ K.kal}\cdot\text{cm}^{-1}\cdot\text{year}^{-1}$). In the coastal areas the average wind speed is about $2.8\text{-}3.8 \text{ m}\cdot\text{sec}^{-1}$ (Climate of Albania, 1978). There are many regions where the wind speed is several times greater than that in the above-mentioned regions. This is another important source of energy.

In Albania there are also many thermal water springs and wells of low enthalpy with a temperature of up to 65.5°C , which indicates that it is possible to make use of the geothermal energy.

2. GEOLOGICAL FEATURES

The Albanides form an integral part of the southern branch of the Mediterranean Alpine orogen. They are subdivided in two zones: the Internal and the External Albanides.

The Internides are formed by the Mirdita ophiolite nappe which is separate from the oceanic Subpelagonian Trough (Geological Map of Albania, scale 1:200,000, 1984)

Geological and geophysical studies carried out in the External Albanides and in the Adriatic Sea display distinct structural

¹ Polytechnic University of Tirana, Faculty of Geology and Mining, Albania

² Committee for Science and Technology, Tirana, Albania

belts which are related to different tectono-stratigraphic units. From East to West the External Albanides consist of the Krasta-Cukali isopic zone, the Kruja zone, the Ionian zone and the Sazani zone. While in northern Albania the Albanian Alps zone is located.

The Kruja zone is characterized by a 1500m thick Cretaceous to Paleogene neritic carbonates and 5km of Oligocene flysch. Local Tortonian of the continental sandstone facies lies unconformably on a variety of older strata.

The Ionian zone is made up of a thin-sinned fore and thrust belt which is detached from the basement at the level of Permo-Triassic evaporites. Late Triassic and Early Jurassic neritic limestones and dolomites contain cherts. Oligocene and Aquitanian series are developed into flysch and flyschoid facies.

At the base of Burdigalian to Serravalian series, in the clay-marl series of present molassic facies an angular unconformity is developed.

The Preadriatic Depression is filled with continental and deltaic Miocene and Pliocene series. Serravalian sandstones and clay lies unconformably on deformed older strata and are themselves involved in compression structures.

Generally, carbonate rocks are fissured and karstified, thus forming important groundwater reservoirs (Dakoli, H., et al. 1981, Hydrogeological Map of Albania, scale 1:200,000, 1985, Eftimi R et al, 1989).

In the western part of Albania, there are two cartesian basins: Adriatic and Tirana basin. The sandstone aquifer of the Tortonian deposits generally have a low permeability (the medium specific yield of the wells is about $0.04-1 \text{ l}\cdot\text{s}^{-1}\cdot\text{m}^{-1}$).

3. METHODS AND STUDY AREA

Geothermal studies carried out in Albania are oriented toward the study of the distribution of the geothermal field and the natural thermal water springs and wells. The temperatures have been measured and the geothermal gradient and the heat flow density at different depths have also been calculated (Frasheri et al. 1995). Temperature measurements were carried out both in 145 deep wells, in boreholes and in mines, at different hypsometric levels.

The temperature in the wells was recorded at regular intervals. It was measured by means of resistance and thermistor thermometers. The average absolute measurement error was 0.3°C . The measurements were carried out in a steady-state regime of the wells filled with mud or water. The recorded data were processed using the trend analysis of first and second degrees.

The chemical composition of the waters was found. The output of the springs and wells and their hydrogeology was evaluated.

Geothermal studies were extended all over the territory of Albania. In the western regions, where oil and gas reservoirs are situated, the temperature has been recorded in about 120 wells. In the North-East and South-East regions of Albania about 25 boreholes have been studied together with 8 thermal water springs the chemical analyses of which were also carried out.

4. RESULTS

The results of the geothermal studies are presented in maps and geothermal lines. Temperature maps have been drawn for different levels of up to 5000m depth. Geothermal gradient maps and heat flow density maps have also been drawn. The natural springs with thermal waters and the geological structures with high water temperature have also been mapped. The water basins with higher average temperature than that of yearly average in

one of the regions have been studied as well.

The study of the possibility of exploitation of abandoned deep oil wells as “Vertical Earth Heat Probes” (Frasheri A., Bakalli F., 1995), has already begun.

5. DISCUSSION

The geology of Albanides creates the premises for the research and exploitation of natural geothermal energetic resources (Frasheri A., et al., 1995., Frasheri A. & Bakalli F., 1995).

The greatest heat flow density with a value of $42 \text{ mW}\cdot\text{m}^{-2}$ is found in the center of the Preadriatic Depression (Fig. 1). In the east of the ophiolitic belt heat flow density reaches values of up to $60 \text{ mW}\cdot\text{m}^{-2}$.

The temperature varies from a minimum of 12°C at a depth of 100m up to 105.8°C at a depth of 6000m. In the central part of the Preadriatic Depression, there are many deep oil wells where the temperature reaches up to 68°C at a depth of 3000m. The isotherm runs in a direction that fits that of the strike of the Albanides. The configuration of the isotherm is the same down to a depth of 6000m. Going deeper

and deeper the zones of highest temperature move in a direction south-east to north-west, towards the center of the Preadriatic Depression and even further towards the north-western coast.

The geothermal gradient has the highest value about $18.7 \text{ mK}\cdot\text{m}^{-1}$ in the center of the Preadriatic Depression. Elsewhere the gradient is mostly $15 \text{ mK}\cdot\text{m}^{-1}$ (Fig. 2). In the south of the country the geothermal gradient has low values $11.5\text{-}13 \text{ mK}\cdot\text{m}^{-1}$. The lowest gradient value of $7\text{-}11 \text{ mK}\cdot\text{m}^{-1}$ is found in the deep synclinal belts. Towards the north-eastern and south-eastern regions of Albania, over the ophiolitic belt, the geothermal gradient increases, reaching the value of $23.5 \text{ mK}\cdot\text{m}^{-1}$.

6. GEOTHERMAL AREAS AND RESERVOIRS

In Albania there are many thermal springs and wells of low enthalpy. Their water has temperatures that reaches values of up to 60°C (Fig. 3).

Table 1 presents some data on the water temperature for such springs.

Table 1

THE THERMAL WATER SPRINGS IN ALBANIA

N° of Springs	Location	Temperature in $^\circ\text{C}$	Salt in mg/l	Artesian Spring yield in l.s-1
1	Lixha Elbasan	60	0.3	0
2	Peshkopi	5-43	9	10
3	Karne-Sarande	34	<10	
4	Langareci-Permet	6-31	>10	
5	Shupal-Tirana	9.5	10	
6	Sarandoporo-Leskovic	6.7	>10	
7	Tervoll-Gramsh	4	10	
8	Mamurras-Tirane	1	26	10

These thermal water springs are mainly near zones of regional tectonic fractures. Generally the water circulates through carbonatic rocks of the structures and

evaporitic beds at some kilometers of depth. The water of these springs contain salt, absorbed gas and organic matter.

They are sulfide: methane, iodine-bromium and sulfate types.

temperature that varies from 32 to 65.5°C (table 2)

In many deep oil and gas wells there are thermal water fountain outputs with a

Table 2

THE OIL AND GAS WELLS THAT GIVE THERMAL WATER

N°	Well Name	Temperature in °C	Salt in mg·l ⁻¹	Fontane yield in l·sec ⁻¹
1	Kozani-8	65.5	4.6	10.4
2	Ishmi 1/b	64	19.3	4.4
3	Galigati 2	45-50	5.7	0.9
4	Bubullima 5	48-50	35	
5	Ardenica 3	38	15-18	
6	Ardenica 12	32		
7	Semani 1	35	5	
8	Verbasi 2	29.3	1-3	

These waters comes from different depth levels (800-3000) of limestone reservoirs (wells 1, 2, 3, 4) and sandstone reservoirs (wells 5, 6, 7 and 8).

Until now the thermal waters of the springs 1, 2, 4, 6 and wells 1, 2, 3 in Albania are used only for health purposes. These waters may be used for heating purposes and green houses as well.

7. DIRECTIONS FOR THE EXPLOITATION OF GEOTHERMAL ENERGY IN ALBANIA

The geothermal situation in Albania offers two directions for the exploitation of geothermal energy, which has not been used so far.

- **First**, thermal water springs and wells of low enthalpy
- **Second**, the use of deep doublet abandoned oil and gas wells and single wells for geothermal energy, in the form of a “Vertical Earth Heat Probe”. The geothermal gradient of the Albanian Sedimentary Basin has average values of about $18.7 \text{ mK}\cdot\text{m}^{-1}$. At 2000m depth the temperature reaches a value of about 48°C . In these single abandoned wells a closed circuit water system can be installed. This “Vertical Earth Heat Probe”, by means of water conversion, is coupled with the heat transfer from the surrounding rocks downwards, to be finally recovered in the tubes (Hoffman F., et al., 1993).

Actually in Albania the study of the possibilities of exploitation of the geothermal energy has begun.

8. CONCLUSIONS

In Albania, there are several geothermal energy sources that can be used.

Such geothermal energy sources are natural thermal water springs and deep wells with a temperature of up to 65.5°C . Deep abandoned oil wells can be used as “Vertical Earth Heat Probe”.

The use of geothermal energy in the Albania must start as soon as possible, in the framework of a separate project, after the compilation of the Geothermal resource Atlas of Albania” in February 1996.

9. ACKNOWLEDGMENTS

The authors express their thanks to the Committee for Science and Technology of the Republic of Albania and the EU Commission of the “European Atlas of

Geothermal Resources” for all the help provided to us for carrying out geothermal resource studies in the Albania. The authors express their thanks also to their colleagues of the Geothermal Team at the Faculty of Geology and Mining of the Polytechnic University of Tirana and of Geophysical Institute at Academy of Sciences of the Czech Republic in Prague, for their help in our studies of geothermal energy. Particular thanks to Prof. Muhamet Doracaj, As. Prof. Rushan Liço, Dr. Nazif Kapedani, Eng. Burhan Çanga, Eng. Enkelejda Jareci. Special thanks to Dr. Suzanne Hurter, Coordinator of “European Atlas of Geothermal Resources”.

10. REFERENCES

1. Albanian Encyclopedic Dictionary, (1985), Academy of Sciences of Albania. 1245 pp. In Albanian.
2. Climate of Albania , (1978), Institute of Hydro-Meteorology, Academy of Sciences of Albania. 298 pp. In Albanian.
3. Dakoli H., Eftimi R., Tafilaj I., Shterpi P, (1981), “Applied Hydrogeology”. Tirane University Publishing House, 350 pp. In Albanian.
4. Eftimi R., Tafilaj I., Bisha G., (1989), “Hydrogeologic division of Albania”. Bulletin of Geological Sciences, 303-316. In Albanian, summary in English.
5. Frasheri A., Bakalli F., (1995), “The source of geothermal energy in Albania”. World Geothermal Congress, Florence, Italy, 18-31 May 1995.
6. Frasheri a., Liço R., Kapedani N., Çanga B., Jareci E., Çermak V., Kresl M., Kuçerova L., Safanda J., Shtulc P., 1995, Geothermal Atlas of Albania, 75 pp. In Albanian.
7. Frasheri N., (1994), “The Actual State of Albanian Energetic System and it’s Perspective”, Workshop on the use of IAEA Planning Models, Budapest, 18-22 July 1994, Budapest.
8. Geological Map of Albania, Scale 1:200,000, (1984), Tirana
9. Hoffman F., Poppei, J., Sebi P., (1993), “Utilization of Deep Single Wells for Geothermal Energy. Symposium “New development Geothermal Measurements in Boreholes”, Klein Koris, Germany, October 18-23, 1993.
10. Hydrogeological Map of Albania, Scale 1:200,000, (1985), Tirana.