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OUTLOOK ON THE INFLUENCE OF GEOLOGICAL STRUCTURES IN THE SCATTERING OF GEOTHERMAL FIELD IN ALBANIA

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ABSTRACT

In this paper the geothermal situation in Albania is analysed. There are determined the geological factors that condition this regime. The method used for geothermal studies is described briefly.

INTRODUCTION

The study of the geothermal field in Albania has been carried out on the basis of temperature logs in the 87 oil and gas wells, located in the Ionian tectonic zone, Kruja zone and Preadriatic Depression, and also in 15 drillholes in the ophiolitic belt of Mirdita zone and in the Alpine zone (fig. 1). These wells, with a depth of 50 - 6700m, are situated in different geological conditions, in External Albanides and in the Inner Albanides. The Inner Albanides are presented by Korabi, Mirdita (ophiolitic belt) and Gashi zones. The External Albanides are presented by the Alps, the Krasta-Cukali, the Kruja, the Ionian zone, the Sazani zone and the Preadriatic Depression (see Geological Map. Albania, Tirana 1983). The geological cross-section of Albanian Sedimentary Basin is about 12000m thick and it continues also in the Adriatic Sea.

1. THE METHOD OF GEOTHERMAL MEASUREMENTS IN BOREHOLES

The temperature was measured with resistance and thermistor thermometers. The thermal inertia of these thermometers are 5-6 seconds and 3.5 seconds, respectively. The temperature in the wells was recorded continuously. The standard deviation of the measurements was 0.1-0.3 ^{o}C. The measurements were carried out in a steady-state regime of the wells filled with mud or water. The temperature was recorded by downhole thermometer.

The recorded data were processed by means of trend analysis of first and second degree. The data from 6700m deep well in the centre of the Preadriatic Depression were separated in groups and each of them was processed separately using trend analysis to calculate the temperature's gradient.

The maps of temperatures for the depths 100m, 500m, 1000m, 2000m, 3000m together with the maps of average geothermal gradient (Frasheri A. 1993) were drawn, using the processed data.

The heat-flow density was calculated using the formula:

$$q = L \cdot (t_2 - t_1)/h$$

where: t_1, t_2 are the temperatures (in ^{o}C) in two different depths; L is the thermal conductivity of the rocks (in W/(K.m));
h is the thickness of the interval (in meters).

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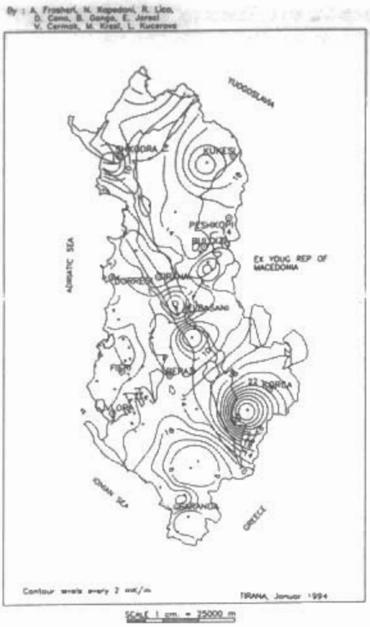

Fig. 1: Geothermal gradient map
External Albanides

These calculation of the heat-flow density were made for those parts of geological cross-sections that have homogenous lithology as the clays of the Helmesi suite of Pliocene, marl's of Burdigalian, the clays part of flysch. The thermal conductivity of these rocks was determined in the Laboratory of Geothermics of the Institute of Geophysics of the Academy of Sciences, in Prague.

2. ANALYSIS OF THE RESULTS OF THE GEOTHERMAL STUDIES

Many thermoplots has shown the existence of some phenomena of distribution of the geothermal field. These phenomena are conditioned by local thermal properties and geological location.

Ionian zone is developed as a large and deep pelagic trough in the Upper Triassic. There, the evaporites of the Permian-Triassic are overlapping by a thick carbonatic formation of the Upper Trias-Eocene. The geological section on this carbonatic formation is composed by Oligocene flysch, a flyschoid formation of the Aquitanian and by schlieres of the Burdigalian, Helvetian and partially of Tortonian. Burdigalian deposits are overlapping transgressively with an angular unconformity, anticlinal belts, whereas the deposits of Tortonian age fill the synclinal belts.

The Miocene and Pliocene molasses of Preadriatic Depression overlies the structures of northern part of the Ionian zone. The structure of these molasses represents the upper tectonic stage of the structure of the Preadriatic Depression as a part of Albanian Sedimentary Basin, continued towards the shelf of the Adriatic Sea.

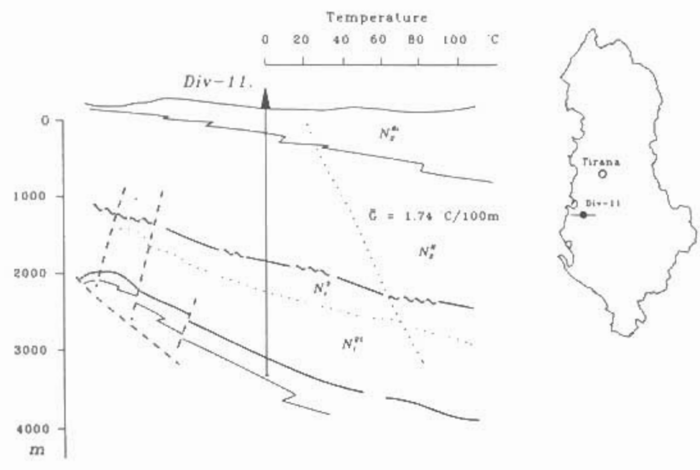

Fig. 2: Geothermal profile of Divjaka

In the lower part of the section of Kruja zone, the carbonatic neritic rocks of the Cretaceous-Paleogene age are overlaying the oligocenic flysch of a thickness of 5 km.

All these structural and facial lithological variations in the Ionian zone and Preadriatic Depression are reflected in the distribution of geothermal field.

The highest values of the geothermal gradient (about 21.3 mK/m) were observed in the Pliocenic clay section,

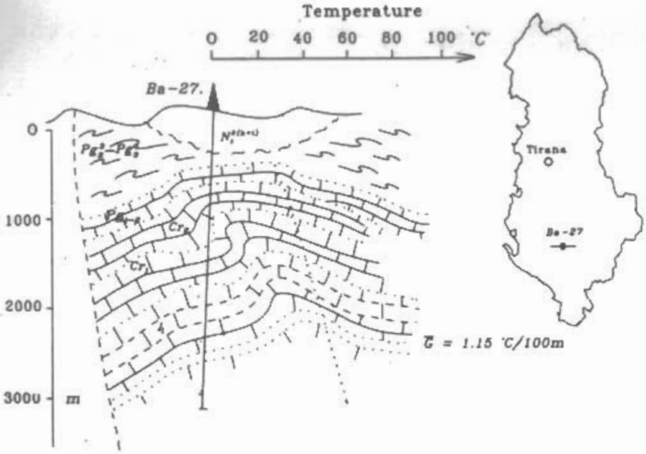

Fig. 3: Geothermal profile of Balishi

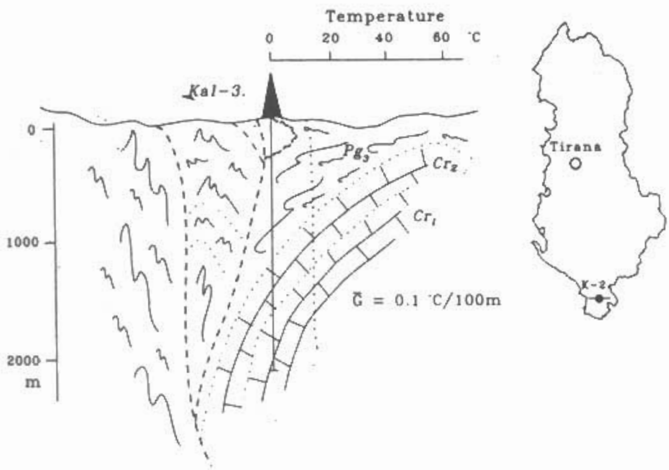

Fig. 4: Geothermal profile of Kalcati

in the centre of Preadriatic Depression (fig. 1). Elsewhere the gradient is mostly 15 mK/m. Low gradient values even (5 mK/m) are observed in the south of Albanides and in the Albanian Alps.

External Albanides are characterized by low geothermal gradient, as well as the Dinarides. In Dinarides the geothermal gradient mean value is of 15 mK/m (Ibrahimpasic I, 1983). In Southern Albanides, in Helenides the geothermal gradient highest values were reported (Fytikas M. I. and Kolios N. P.).

The geothermal gradient value is conditioned by the tectonics of the region and the lithology of geological section. The largest gradients are detected in the anticlinal molassic structures of the upper structural stage. The gradient values decreases about 10-20% when the core of the anticline contains limestones (fig. 3). It decreases even more when the cold surface waters flow into these anticlinal limestones, the gradient decreases towards the zero or becomes negative (fig. 4). The lowest value of 7-11 mK/m of the gradient are observed in the deep synclinal belts.

The gradient values decreases even in the case, when around the well a carbonatic structure with an intensive circulation of underground waters (fig. 5) is situated.

In the ophiolitic belt of the tectonic zone of Mirdita, the geothermal gradient values increases up to 36 mK/m, especially in southeastern Albania, towards the Albanian - Greek border, towards Konica.

The described geothermal field, with relatively low values of temperature, is a characteristics of the sedimentary basins with a great thickness of sediments.

The temperature at a depth of 100 m varies from 8 - 20oC and at depth of 500 m raises from 21 - 24°C (fig. 6). The isotherms which fits well with the direction of structures of Albanides. The configuration of the isotherms is the same down to a depth of 6000 m, where the temperature is 105.8oC, in the

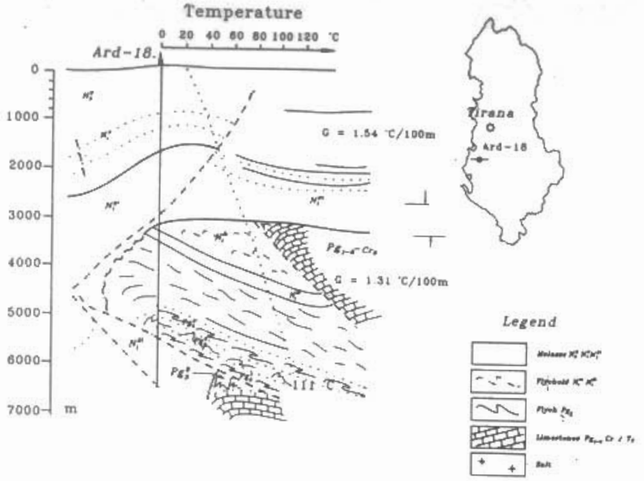

Fig. 5: Geothermal profile of Ardenica

central part of the Preadriatic Depression.

Local variations of the temperature and its geothermal gradient values are observed on small distances of 7 - 8 km. For example, at a depth of 3000m on these distances the temperature may vary from 8 - 9oC. Even in vertical direction, the geothermal gradient values changes from 10.5 to 17.5 mK/m.

In the Albanian Sedimentary Basin, the geothermal gradient greatest values were observed in the clay sections. With the increasing of sands they decreases (fig 7).

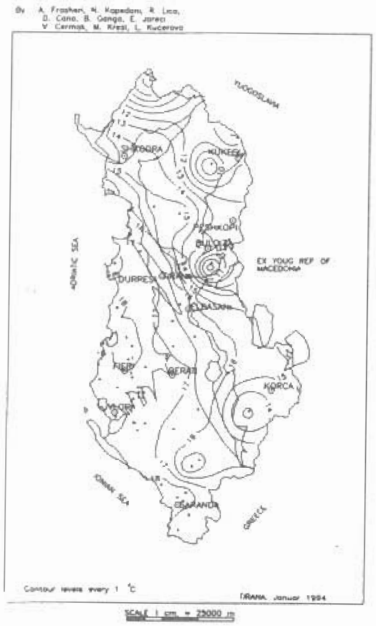

Fig. 6: Temperature at 100 m depth (External Albanides)

The greatset values of heat - flow density 42 mW/m^2 was observed in the centre of Preadriatic Depression in the region between the Fieri and Lushnja cities. The 30 mW/m^2 value isotherms are open towards the Adriatic sea shelf, where the epicentre of the anomaly with a heat - flow density up to 100 mW/m^2, discovered by Italian geothermists (Geothermal Atlas of Europe, 1991) , is situated. In the east of the ophiolitic belt the heat - flow density values, up to 60 mW/m^2.

CONCLUSIONS

1.The Albanian Sedimentary Basin is characterized by relatively low values of temperature at depths. The temperature reaches the value of 105.5°C only at a depth of 6000 m.

2.The geothermal gradient value in the External Albanides is low, between 7 - 11 mK/m and 21.3 mK/m. This gradient increases to 36 mK/m, in the Inner Albanides.

3.The heat - flow density is about 42 mW/m^2 in the centre of the Preadriatic Depression and up to 60 mW/m^2, east of the ophiolitic belt.

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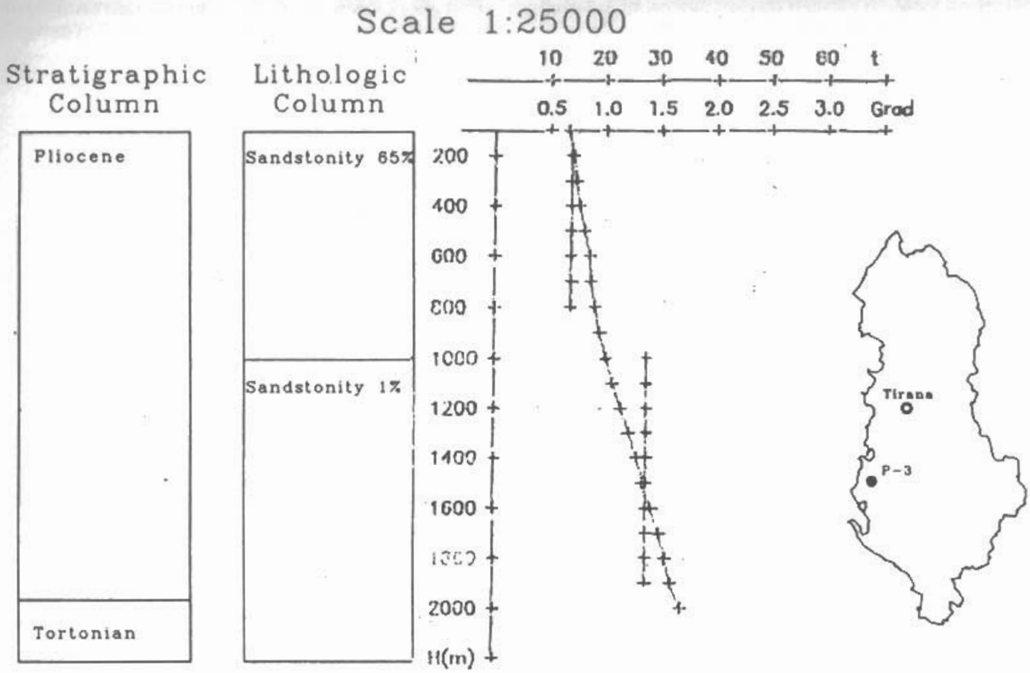

Fig. 7: Geothermal section of Povelça-3 well

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