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THE EXPLOITATION OF WATERS OF GEOTHERMAL WELLS AND SPRINGS IN ALBANIA REPRESENT GREAT IMPORTANCE AND FRUITFUL INVESTMENT

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GENERAL DATA ABOUT THERMAL AREA IN CENTRAL ALBANIA AND SIGNIFICANCE OF THE PROPOSED INVESTMENT

Two thermal wells and Ishmi-1/b, Kozani-8 and thermal springs of Llixha-Elbasani SPA in central region of Albania and of Kruja geothermal area have a self-discharge of hot and mineralized water (Fig. 1) (Frasheri A. et al. 1995, 1995, 1996).

Kruja geothermal area start on the Adriatic coast, Northern of Durresi city, in Ishmi region, continues in Tirana, in Elbasani up to South-Eastern Albanian-Greek border and extends to the Konica district in Greece.

Heat Flow Density in Albanian territory has its highest value of 42 mWm^{-2} in the center of the Peri-Adriatic Depression, in western part of country. Thirty $mW.m^{-2}$ contours stay open towards the Adriatic Sea shelf, where the epicenter of the anomaly is situate with a Heat Flow Density up to 100 mWm^{-2}, discovered by Italian geothermists (Geothermal Atlas of Europe). In the salt diapir of Dumrea, near of Elbasani in western direction, Heat Flow Density value is 37 mWm^{-2}. The contours of Heat Flow Density with maximal values up to 60 mWm^{-2} give a clear configuration of ophiolitic belt in eastern regions of Albania.

In the Ishmi area, the **Ishmi-1/b well** is the northernmost well of the Kruja geothermal area. It is located in the upper part of the fissured and karstified limestone structure. It is 20 kilometers NW of Tirana (near of Rinasi-Tirana Airport), in the flat area. It enters limestone section at 1300 meters and continues through carbonatic strata of more than 1000 meters in thickness. Ishmi carbonatic section is characterized by relatively low apparent electrical resistivity, varying between 50-200 Ohm.m. Such low resistivity zone can be explained as a result of alternating high permeability collectors filled with mineralized water with low permeability limestone layers. These former are of 5-10 meters in thickness, having an effective porosity of $(5.8\text{-}7)\cdot 10^{-3}$, with a permeability of 0.05-3.5 mDarcy. Limestone shown hydraulic conductivity of $8.6\cdot \times 10^{-10}$- $8.8\cdot \times 10^{-8}$ m/sec and the transmisivity of 8.6×10^{-7} to 8.5×10^{-5} $m^2.sec^{-1}$ (Frasheri et al., 1996, Doracaj M. 1986). There are a primitive small SPA.

Kozani-8 well is located 35 kilometers southeast of Tirana, on hills only 2 km from the Tirana-Elbasani national road. It enters limestone strata at 1819 meters of depth and penetrates 10 meters deeper. Thermal water of this well discharged unused in the river during a ten years period.

In the Kruja geothermal area there are **thermal springs of Llixha Elbasani SPA**. It is located about 12 kilometers south of Elbasani. There are seven groups of springs that extend in a belt of the 320° azimuth. All of them are connected to a main regional thrust tectonics of the Kruja zone. Thermal waters flow out through the contact of conglomerate layer with calcolistolith. In this area too, the reservoir is represented by the Llixha limestone structure (Frasheri et al., 1996, Çela, 1991).

Surface water temperatures in the Tirana-Elbasani zone vary from 60°C to 65.5°C. At the depth on the top of the aquifer in the Kozani-8 hole the temperature of water is 80°C. According to the temperature log in Ishmi-1/b measured prior to water outflow started, temperatures of the carbonatic section were 42.2°C. The difference between the temperatures of thermal water and limestone section shows that a mixture of waters has occurred: water of the reservoir mixed with thermal water which comes from the greater depth.

Aquifer temperature for Elbasani Llixha springs varies form 143^{o} to 254^{o} and 235^{o}C, respectively according the calculations carried by Na+K+Ca, Fournier and Truesdell formulas.

Elbasani Llixha springs, and since the end of the drilling operation of Ishmi-1/b and Kozani-8 wells (in 1964, and/or 1988 respectively.) Hot water has continued to fountain and have constant yields for THESE long periods of time, from 3.5 to 15 l/sec for 50 years and/or 10 years, respectively.

Water temperature is stable. Hot water is mineralized, with a general mineralization of 4.6-19.3 g/l. Elbasani Llixha water has the following formula (Avgustinsky et al., 1957):

$$H_2S_{0.403}M_{7.1}\frac{Cl_{59}\cdot SO^4_{38}}{Na_{46}\cdot Ca_{35}}$$

In Tirana-Elbasani area, thermal waters are of chlor-magnesium type. They contain cations Ca^{++}, Mg^{++}, Na^{+} and K^{+}, as well as anions Cl^{-}, $SO4^{--}$, HCO_3^{-} etc. with pH=6.7-8 and density 1.001 to 1.006 g/cm^3.

For the Tirana-Elbasani subzone heat in place is 5.87 x·10^9- 5.08·x 10^{10} GJ, identified resources are 5.87·x 10^8-5.08·x 10^9 GJ, while specific reserves gave values of 38.5-39.6 GJ/m^2.

Elbasani Llixha SPA is located about 10 km south of Elbasani City and 61 km in southeast of Tirana, in the Central part of Albania. By national road communication, Llixha area is connected with Elbasani and Tirana. Only 10 km will be from the highway Durresi- Skopje- Sofia- Istanbul, which is projected for construction in the future and nominated as No. 8 European Corridor. The proximity with highways creates great possibilities for Elbasani Llixha SPA to be a nice place. This area may be frequented by a large number of people from different Balkan countries, Italy, UK, Germany, Ostrich, France, Low Countries, and by Albanians from Albania, Macedonia and Kosovo as well. These thermal springs from about 2000 years are known years ago. According to historic data, in Elbasani Llixha thermal springs there has been an inn, near of the old road “Via Egnatia" that has passed from Durresi to Constantinople.

There are seven spring groups that extends like a belt with 320^o azimuth. Surface water temperature is about 60^{o}C and yield in total 15 l/sec. Springs have constant hot water yield and temperature for a long period of time. These data are evidence of a stable thermo-hydrodinamic reservoir regime.

Before the Second World War, in one from the springs (“Nosi spring”) has been constructed “ PARK-NOSI” SPA (***), with 166 beds, for medical treatment of various diseases, generally rheumatic. The “NOSI” SPA functioned during a period of time more than 60 years and for the present is private property. Land with surface of 20 000 m^2, hotel and restaurant are owned by PARK NOSI Sh.p.k. Particularly reconstructed hotel after the privatization actually is in work. Near this property there is located a public hotel, with 180 beds, almost in destruction state, but which may be reconstruct.

About 330 Albanian patients in year treated (during two weeks period) for rheumatism and various illnesses in two hotels of the Elbasani Llixha SPA

Actually, there is not a law for thermal waters in Albania. The PARK NOSI Sh.p.k. Llixha Elbasani and SPA is used thermal water as ex-owner of SPA before the Second World War. SPA in Ishmi well area has privates in 1993.

All seven groups of the springs in Llixha Elbasani and Kozani-8 well geothermal area will have the possibilities for modern complex exploitation and cascade use of thermal water. The beautiful landscape of Elbasani area will be not only for medical treatment but also as tourist place. This area located near of the very know Ohrid Lake pearl or mountains Gjinari, with their fantastic forests and nice climate.

In conclusion, reservoir is a heterogeneous collector and its thermo-hydrodynamic regime is stable in Kruja geothermal area. In this geothermal zone could find other springs with greater geothermal resources, higher yield and water temperature. For that, it is necessary that hydrogeological and geophysical investigations must carry out and new wells must drilled, in order to capture the water deeper where the temperature is higher.

OBJECTIVES OF THE PROJECT PROPOSAL

Integrated exploitation and cascade direct use of the geothermal energy has projected.

The objectives of the project:

2.1. The detailed feasibility study of the geothermal and mineral water resources in Kozani-8 and Ishmi-1/b wells, and in Elbasani Llixha SPA. General project idea and particularly, technical designs will be compiled for new investment

2.2. Modern unit of equipment for the thermal water in the wells, and in Llixha Elbasani springs will be installed.

2.3. Clinic SPA in the Saint Joan Monastery, heating of the existing buildings of the Monastery and greenhouse for the flower projected to construct, for the integrated and cascade use of thermal water of Kozani-8 well, located 1.3 km from the Monastery.

Reconstruction of the PARK Hotel or Ishmi SPA heating system and thermal baths will help to create normal condition for all the year SPA frequenting.

2.4. Green house will be constructed for flowers, for sale in Albania and for export. The green house will be used particularly for legumes, to provide the restaurant of the SPA.

2.5. Construction of new modern hotel of (****), with thermal water and mud baths, thermal swimming pool, clinic, halls for the massage and physical rehabilitation, restaurant and bar. In the beginning, this hotel may be design for 30-40 beds. In the perspective, in the hotel will be built new floors, for a total of 80-100 beds. This hotel will serve for foreign and rich Albanian patients.

2.6. An aquaculture installation has projected.

2.7. Unit equipment for thermal water treatment will be constructed, before their outflow. Construction of unit equipment for chemical microelements, different natural salts extraction. These salts are very valuable to prepare the pomades for skin diseases medical treatment and beauty creams. The unit will be used also for CO_2 and H_2S free gas extraction. H_2S gas is very valuable for the special treatment of the respiratory apparatus. This process will protect the area echo-system.

2.7. A promotion and tourist agency will be organized. This agency will prepare the reclaims and booking of the rooms for Albanian and foreign patients.

WORK PROGRAMME

This project will be implemented during the 3 years period, by the integration of the following four Phases:

First Phase

1. Geothermal and mineral water resources detailed feasibility study will be carried out for Kozani, Ishmi and Elbasani Llixha area. Project idea will be compiled, too.
2. Technical projects will be compiled for investments in Kozani-8, Ishmi wells or in PARK NOSI SPA.

6 months

Second Phase

1. Construction of thermal water unit equipment in Kozani-8 well, in Llixha Elbasani springs or Ishmi well.
2. Heating system, the thermal water unit equipment and baths will be reconstructed in PARK Hotel of Ishmi SPA. After second phase, all year SPA frequenting will realize. During the winter there are more demands for the medical treatment.

Good conditions in the SPA will help to have patient numbers increasing. Two green house, up to 3000 m^2 surface, will be constructed in the territory of Kozani-8, and in Ishmi 1/b wells or in PARK NOSI Sh.p.k.

6 months

Third Phase

Clinic SPA in the Saint Joan Vladimir Monastery and new hotel construction of (****) in Kozani, Ishmi or Llixha Elbasani area. For the first time, the SPA Clinic and the hotel will have two or three floors, with the possibilities to build and 2 or three other floors in the future. In the ground floor will be located the restaurant, bar, medical clinic and thermal baths. Bedrooms will be located in the first and second floors. Thermal swimming pool will construct in the ground floor or in the yard.

24 months

Fourth Phase

1. Unit equipment for the extraction of chemical microelements and salts, CO_2 and H_2S gas will be designed and installed.
2. Unit equipment and collector for treatment and clearing the thermal water before their outflow will be designed and installed, to protect echo-system of the area.
3. Promotion and tourist agency will be organized. Put in full efficiency of all complex of the SPA will be completed.

10 months

PRELIMINARY COST FOR THE INVESTMENT FOR PHASES I-III

Cost estimation is carried out only for the three first phases, to realize investment step by step:

No	Object	Cost, in USD
1	Reconstruction of heating and thermal baths	50 000
2	Construction of two thermal water unit equipment's	80 000
3	Construction of green houses, 2 * surface 3 000 m^2	240 000
4	Construction of SPA Clinic in Saint Joan Vladimir Monastery and for new hotel (building), (****)	5 000 000
5	Feasibility study and project idea	53 000
6	Technical projects	100 000
7	Travel and subsistence	20 000
8	External Assistance	20 000
9	Other Expenditures	20 000
10	Overhead rate	15 000
	TOTAL exc. VAT	5 968 000

Well come to investment in geothermal areas in Albania for the integrated and cascade direct use of geothermal energy.

REFERENCES

Avgustinsky V. L., Astashkina A. A. Shukeviç L. I., 1957. Mineral Springs and Health Centers in Albania. Ministry of Health, Tirana, Albania.

Cela R., 1991. On the presence of caolinite clays at the Llixha region in Elbasan. Bulletin Nafta dhe Gazi, Nr. 3, pp 41-46, in Albanian, summary in English.

Doracaj M., 1986. Mechanics of Fluids in Porous Media, University Publishing House.

Frasheri A., Bakalli F., (1995), "The source of geothermal energy in Albania". World Geothermal Congress, Florence, Italy, 18-31 May 1995.

Frasheri A., Çermak V., Kapedani N., Liço R., Kresl M., Jareci E., Çanga B. 1995. Geothermal Atlas of Albania. Polytechnic University of Tirana, Faculty of Geology and Mining, Tirana, Albania and Geophysical Institute of Academy of Sciences of Czech Republic, Prague.

Frasheri A., Çermak Doracaj M., V., Kapedani N., Liço R., Bakalli F., Kresl M., Jareci E., Halimi H., Çanga B., Malasi E. 1996. Geothermal Resource Atlas of Albania. Polytechnic University of Tirana, Faculty of Geology and Mining, Tirana, Albania.

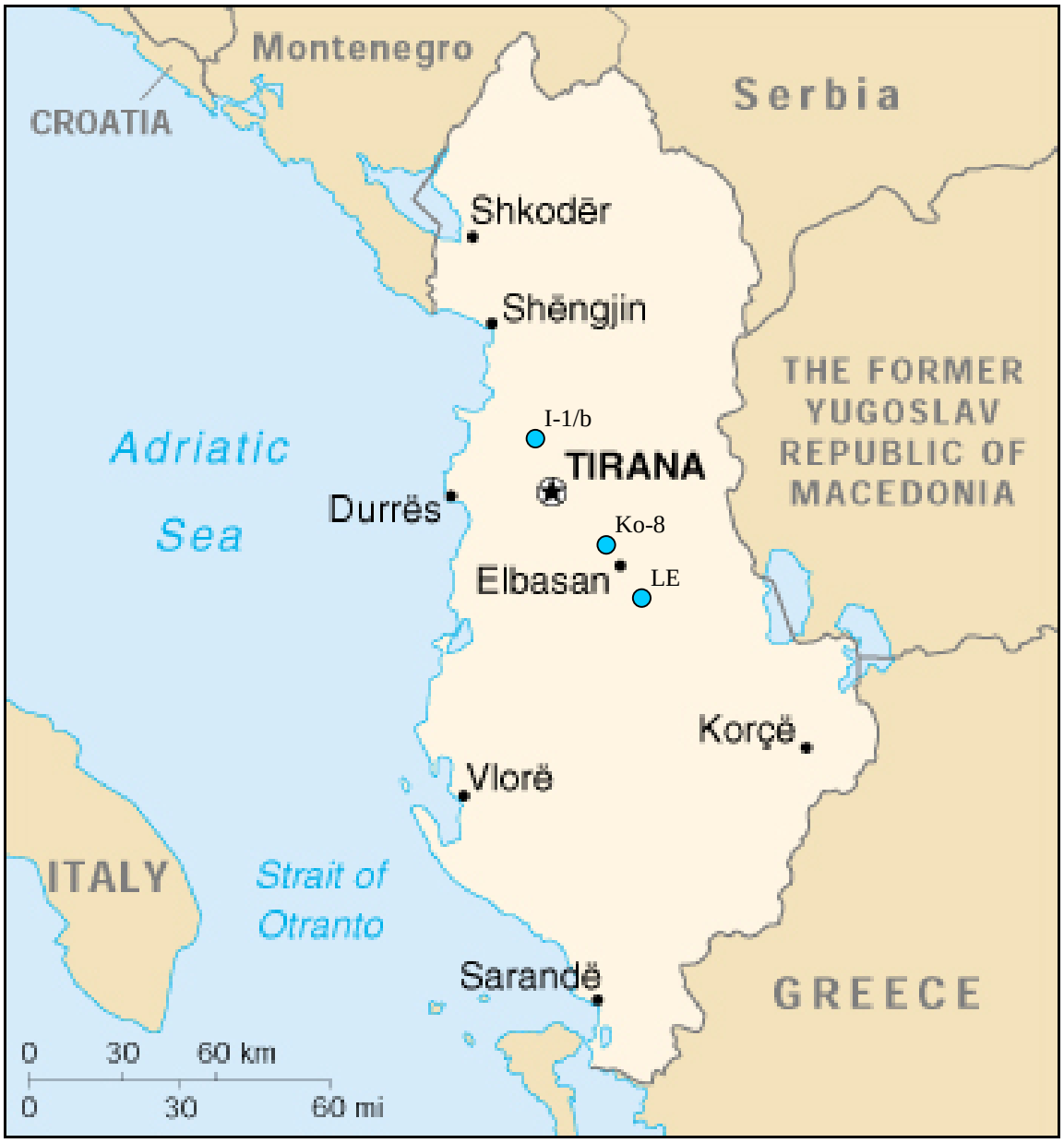

Fig.1 Ishmi 1/b - Kozani 8 - Llixha Elbasan Geothermal Area