65th EAGE Conference & Exhibition, Stavanger 2003

# OUTLOOK ON PLATFORME FOR INTEGRATED AND CASCADE USE OF THE GEOTHERMAL ENERGY IN ALBANIA

Alfred FRASHERI*, Niko PANO**

**Faculty of Geology and Mining*
*Polytechnic University of Tirana, ALBANIA.*
*** Institute of Hydrometeorology, Tirana, ALBANIA*

**Abstract**

Large numbers of geothermal energy of low enthalpy resources are located in different areas of Albania. Thermal waters are sulfate, sulfide, methane, and iodinate-bromide types. Thermal sources are located in three geothermal zones:

**Kruja geothermal zone** represents a zone with bigness geothermal resources. Kruja zone has a length of 180 km. Identified resources in carbonate reservoirs are $5.9x10^8$-$5.1x10^9$ GJ,
**Ardenica geothermal zone** is located in the coastal area of Albania, in sandstone reservoirs.
**Peshkopia gjeotermal zone** at northeastern area of Albania. Several springs are located with disjunctive tectonics of the gypsum diapir.

The geothermal situation in Albania offers three directions for the exploitation of geothermal energy:

- **First**ly, thermal sources of low enthalpy are natural sources or wells in a wide territory of Albania. They represent the basis for a successful use of modern technologies for a *complex and cascade exploitation* of this energy, achieving an economical effectiveness:

1. SPA clinics for treatment of different diseases and hotels for ecotourism.
2. The hot water for heating and sanitary waters of the SPA and hotels, greenhouses and aquaculture installations.
3. From thermal waters it is possible to extract chemical microelements.

- **Secondly,** the use of deep abandoned oil and gas wells as "Vertical Earth Heat Probe".

- **Thirdly,** the use of the heat flow of shallow geological section for heating and cooling of the buildings. Integrated exploitation and cascade direct use of the geothermal energy must realize by integrated scheme of geothermal energy, heat pumps and solar energy to fulfil.

Actually in Albania the study of the possibilities of exploitation of the geothermal energy has begun. The aims of the project are to examine, demonstrate and disseminate the positive technical and financial aspects of transfer and utilization of innovative geothermal energy technologies in Albania.

Keywords: Geothermal energy, thermal water, geothermal gradient, heat flow.

## 1. INTRODUCTION

In Albania, rich in geothermal resources of low enthalpy and mineral waters, new technologies of direct use of geothermal energy are still untouched. Large numbers of geothermal energy of high and low enthalpy resources, a lot of mineral water sources and some $CO_2$ gas reservoirs represent the base for successfully application of modern technologies in Albania, to achieve economic effectively and success of complex exploitation.

Actuality, there are many geothermal, hydrogeological, hydrochemical, biological and medical investigations and studies of thermal and mineral water resources carried out in Albania. The results of the geothermal studies carried out in Albania are presented in maps and geothermal sections. Temperature maps have been drowning for different levels of up to 5000m depth. Geothermal gradient, heat flow density and geothermal resources maps have also been drawn. The natural springs with thermal waters and the geological structures with high water temperature have also been mapped. Generally, these investigations and studies are separated each from the other. Their information and data will serve for studies and evaluations in Albania regional scale. These studies and evaluations are necessary to well know in regional plane the thermal and mineral water resources potential and geothermal market of the Albania.

According to results of these new studies, the evaluation for the perspective level of the best areas in country will be necessary. After the evaluation is possible to start investments in these areas. Integrated exploitation and cascade direct use of the geothermal energy will realized by integrated scheme of geothermal energy, heat pumps and solar energy to fulfil. This scheme has an environmental benefit by using renewable energies (geothermal energy, solar energy), new technologies (heat pumps) and energy savings (cascade scheme). Cascade scheme should be used to fulfil the thermal energy demand for the selected area in order to get the maximum benefit from geothermal energy and the minimum energy supply from heat pumps: the promotion of energy savings will be in place.

Exploitation of geothermal energy will have a direct impact in the development of the regions, by increasing their per capita income and at the same time ameliorating the standard of living of the people. These investments will be profitable in a short period of time.

## 2. GEOTHERMAL ENERGY IN ALBANIA

### 2.1. Methodic

The results of the geothermal studies carried out in Albania are presented in maps and geothermal sections. Temperature maps have been drowning for different levels of up to 5000m depth. Geothermal gradient, heat flow density and geothermal resources maps have also been drawn. The natural springs with thermal waters and the geological structures with high water temperature have also been mapped (Frasheri A. 1992, Frasheri A. et al. 1995). The water basins with higher average temperature than that of yearly average in one of the regions has been studied as well. The study of the possibility of exploitation of abandoned deep oil wells as “Vertical Earth Heat Probes” has already begun.

### 2.2 Geothermal 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 geology of

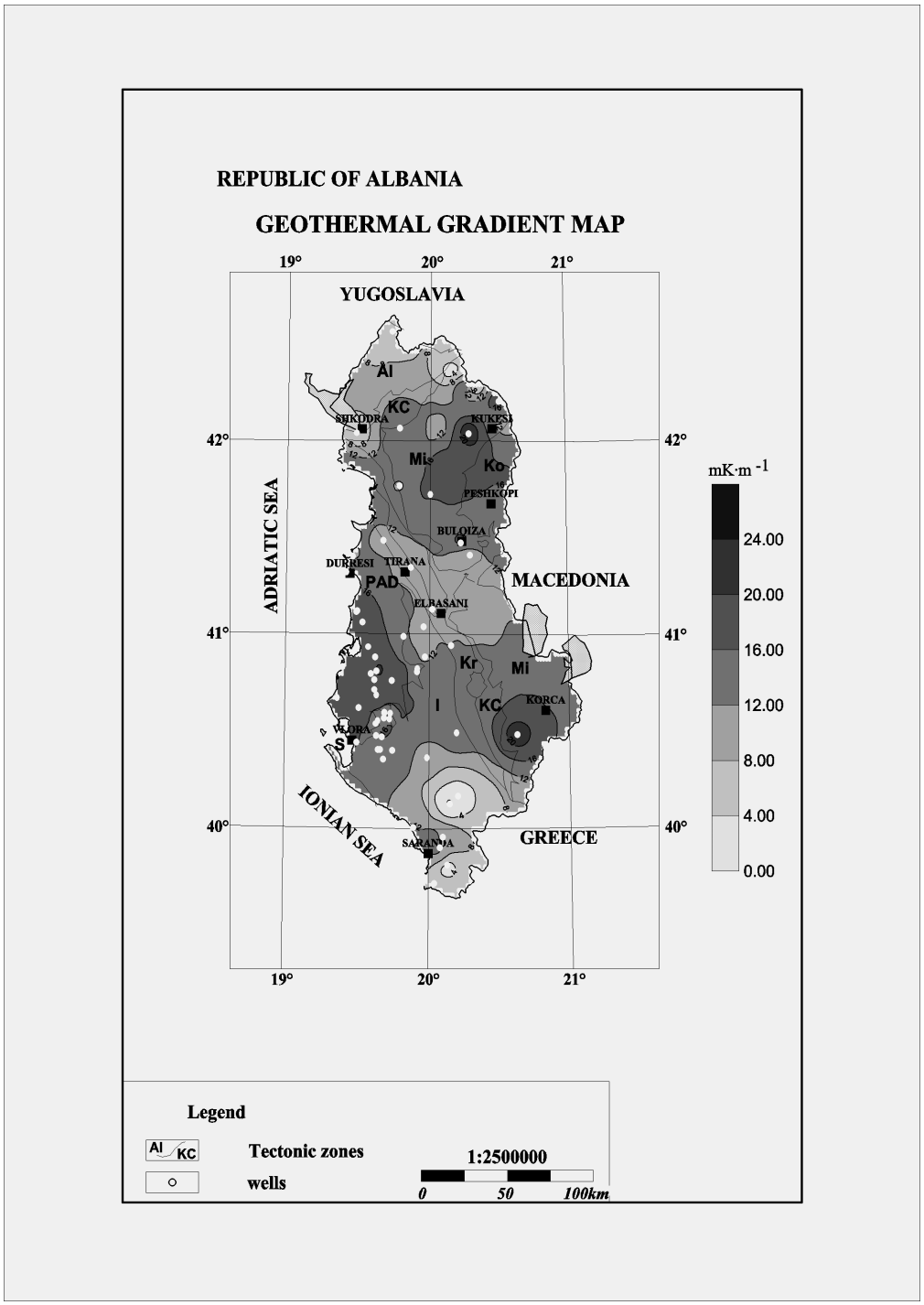


Fig. 1

Albanides creates the premises for the research and exploitation of natural geothermal energetic resources.

The greatest heat flow density with a value of 42 $mW \cdot m^{-2}$ 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 $mW \cdot m^{-2}$ .

The temperature at a depth of 100m ranges 6.7 to 18.8°C, in average 16.4°C and at a depth of 500m from 21 to 27.7°C.The temperature ranges 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 geothermal gradient has the highest value about 18.7 $mK \cdot m^{-1}$ in the center of the Peri Adriatic Depression. Elsewhere the gradient is mostly 15 $mK \cdot m^{-1}$ (Fig. 2). In the south of the country the geothermal gradient has low values 11.5-13 $mK \cdot m^{-1}$. Towards the northeastern and southeastern regions of Albania, over the ophiolitic belt, the geothermal gradient increases, reaching the value of 23.5 $mK \cdot m^{-1}$.

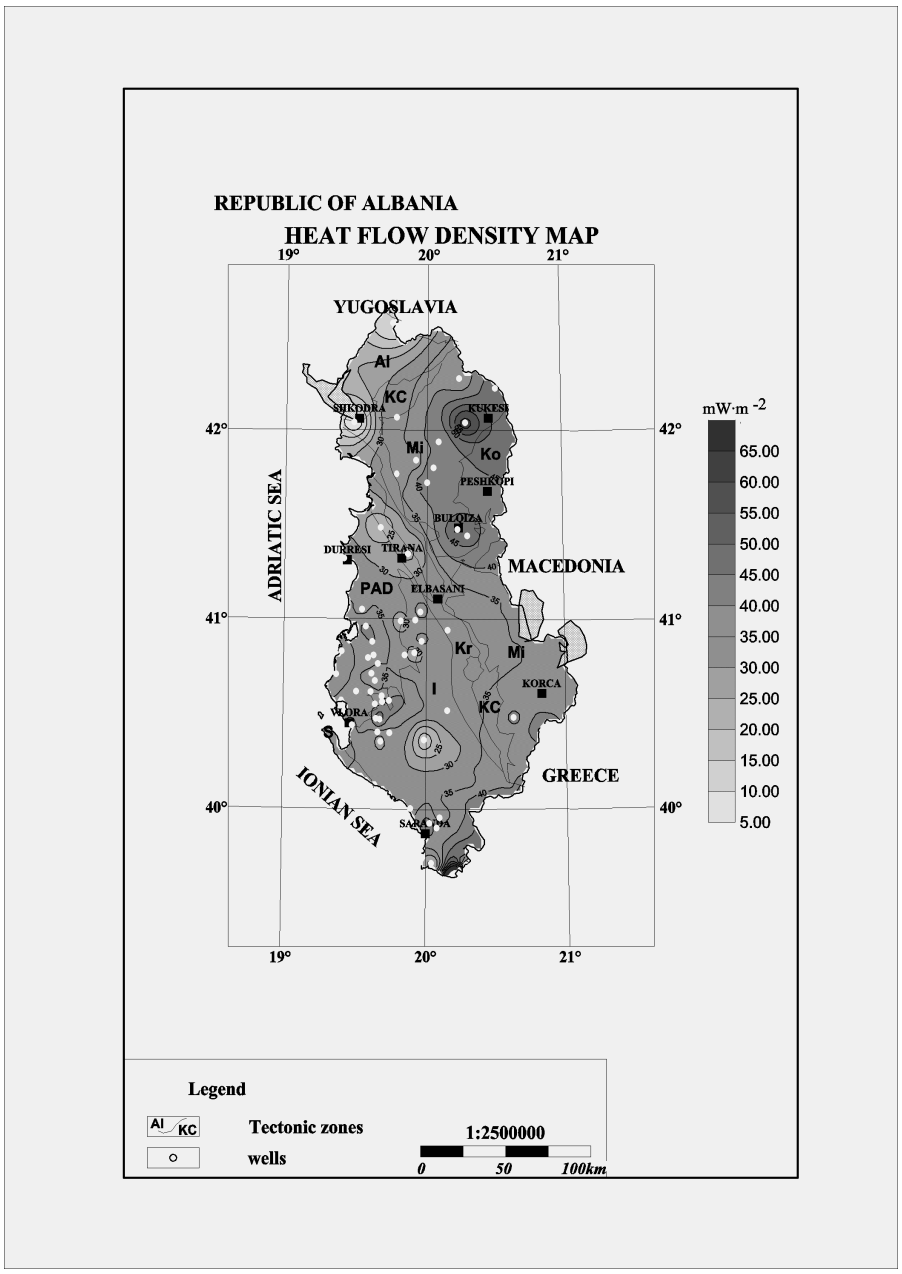
REPUBLIC OF ALBANIA
HEAT FLOW DENSITY MAP
19°
20°
21°
42°
41°
40°
YUGOSLAVIA
Al
KC
SHKODRA
KUKESI
Mi
Ko
PESHKOPI
BULQIZA
DURRESI
TIRANA
MACEDONIA
ADRIATIC SEA
PAD
ELBASANI
Kr
Mi
I
KORCA
KC
VLORA
GREECE
IONIAN SEA
SARANDA
mW·m -2
65.00
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
Legend
Tectonic zones
wells
1:2500000
0
50
100km

Fig. 2

### 2.3. Geothermal Areas and Reservoirs

In Albania there are many thermal springs and wells of low enthalpy (Fig. 3, Tab. 1) (Frasheri A. et al. 1997) .

Tab. 1

**Thermal water sources and wells in Albania**

| Type of the source | Location | Tempe-rature, (°C) | Salt, (mg/l) | Yeild, l/sec |
|---|---|---|---|---|
| Natural Spring | Llixha Elbasan, Peshkopi, Krane (Sarande), Langaric (Permet), Shupal (Tiranë), Sarandoporo (Leskovik), Tërvoll (Gramsh), Mamurras (Tiranë). | 21-60 | 0.3-26 | 10-40 |
| Deep wells | Peri Adriatic Depression and in the Kruja tectonic zone | 29.3-65.5 | 1-19.3 | 0.9-18 |

These thermal water springs and wells 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 contains salt, absorbed gas and organic matter. They are sulfide: methane, iodine-bromium and sulfate types. The waters come from different depth levels (800-3000 m) of limestone reservoirs and sandstone reservoirs. Thermal sources are located in three geothermal zones:

**Kruja geothermal zone** represents a zone with bigness geothermal resources (Fig. 3). Kruja zone has a length of 180 km. Identified resources in carbonate reservoirs are $5.9x10^8$-$5.1x10^9$ GJ,
**Ardenica geothermal zone** is located in the coastal area of Albania, in sandstone reservoirs.
**Peshkopia gjeotermal zone** at northeastern area of Albania. Several springs are located with disjunctive tectonics of the gypsum diapir.

## 3. DIRECTIONS FOR THE EXPLOITATION OF GEOTHERMAL ENERGY OF LOW ENTHALPY IN ALBANIA

The geothermal situation of low enthalpy in Albania offers three directions for the exploitation of geothermal energy, which is unused until now. This exploitation will realized by integrated scheme of geothermal energy, heat pumps and solar energy, and cascade use of this energy (Frasheri A. 2000, Frasheri A. et al. 1997).

- **Firstly**, thermal sources of low enthalpy and of maximal temperature up to 80°C. These are natural sources or wells in a wide territory of Albania, from the South near Albanian-Greek boundary to Northeast districts in Diber Region.

  Thermal waters of springs and wells in Albania may be used in several ways:

1. Modern SPA clinics for treatment of different diseases and hotels, with thermal pools, for development of eco-tourism.

Such centers may attract a lot of clients not only from Albania, because not only the good curative properties of these waters but also because they are situated in nice places near sea side, mountains or Ohrid lake. In the present some SPA, with a primitive technology, worked in some geothermal springs and wells in Albania.

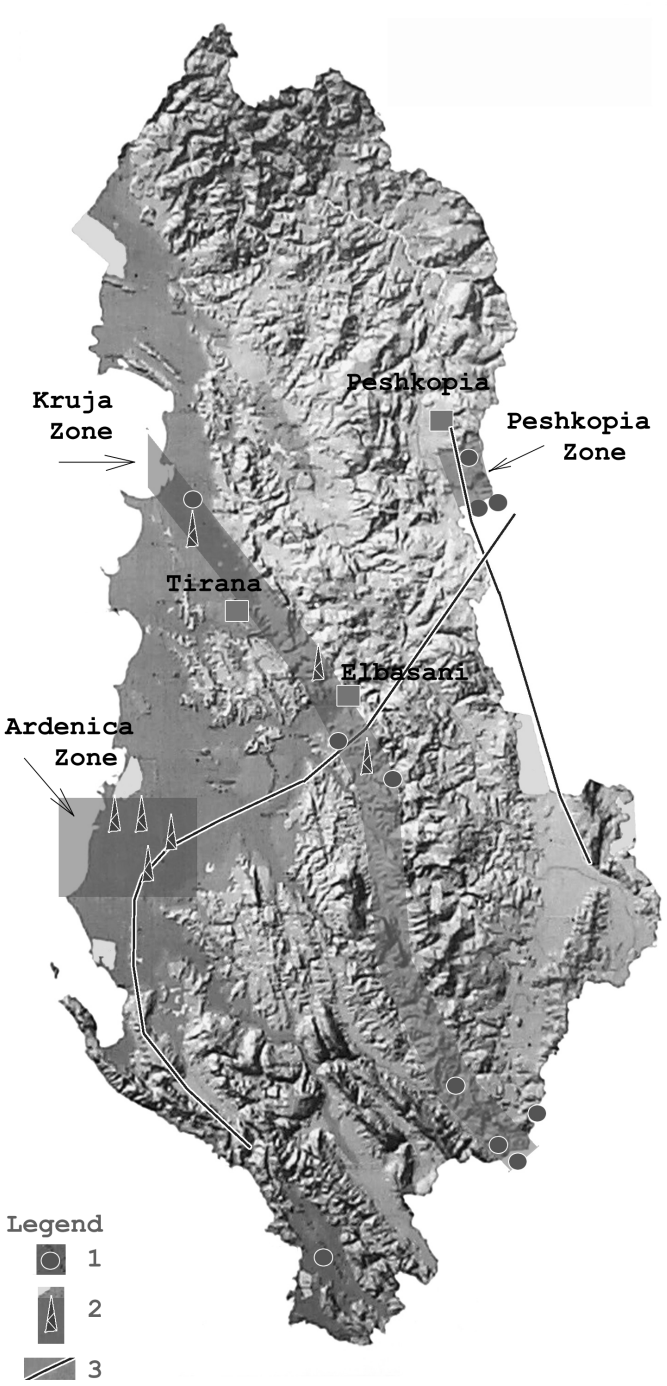


Fig. 3 Thermal zones in Albania.
1- Thermal springs; 2- Thermal wells;
3. Tectonic regional deep fractures

The oldest and important is **Elbasani Llixha SPA,** which located about 10 km south of Elbasani city and 61 km in south-east 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. This area may be frequented by a large number of people from different countries. These thermal springs from about 2000 years ago are known. According to historic data, in Elbasani Llixha thermal springs there has been a center near of the old road "Via Egnatia" that has passed from Durresi to Constantinople. Numer of the Albanian patients treated for rheumatism and various illnesses in Elbasani Lixha SPA in maximum are 7899 person/year. All seven groups of the springs in Llixha Elbasani and Kozani-8 well geothermal area will have the possibilities for modern complex exploitation. The beautiful landscape of Elbasani Lixha 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. Ishmi 1/b geothermal well is located in beautiful Tirana field, near of Rinasi (Tirana) Airport, near of the Adriatic coastline and Kruja - Skendergeg Mountain.

2. The hot water can be used also for heating of hotels, SPA and tourist centers, as well as for the preparation of sanitary hot water used there. Near these medical and tourist centers it is possible to built the greenhouses for flowers and vegetables, and aquaculture installations.

3. From thermal mineral waters it is possible to extract very useful chemical microelements as iodine, bromine, chlorine etc. and other natural salts, so necessary for preparation of creams for the treatment of many skin diseases as well as for beauty care products. From these waters it is possible to extract sulphidric and carbonic gas. It is possible to built installations for processing of mineral waters.

**Consequently, the sources of low enthalpy geothermal energy in Albania, which are at the same time the sources of multi-element mineral waters, they represent the basis for a successful use of modern technologies for a *complex and cascade exploitation* of this energy, achieving a economical effectiveness.** Such developments are useful also for the creation of new working places and improvement of the level of life for local communities near thermal sources.

- **Secondly,** 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 $mK \cdot m^{-1}$. At 2 000 m depth the temperature reaches a value of about 48°C. In these single abandoned wells a closed circuit water system can be installed. Near of these wells, can be build greenhouses.

- **Thirdly**, space-heating system, to use ground heat is the shallow borehole heat exchanger (BHE)-Heat Pumps systems. These systems, actually are presented the most popular and technologically advanced (Rybach L., 2000).

Actually in Albania the study of the possibilities of exploitation of the geothermal energy has begun. Based on the above analysis, for the best area selected, a Feasibility Study will be

performed to analyze three components: energy supply, environmental impact and financial aspects, and to suggest the best solution of the innovative geothermal energy utilization technology applications in that area.

## 4. CONCLUSIONS

1. Albania has the resources of geothermal energy, which is possible for direct use as alternative energy.
2. Resources of the geothermal energy in Albania are;
   a) Natural springs and deep wells with thermal water, of a temperature up to 65.5°C.
   b) Heat of subsurface ground, with an average temperature of 16.4$^{o}$C and depth Earth Heat Flow.

3. Deep doublet abandoned oil and gas wells and single wells are possible to use for geothermal energy exploitation, in the form of a "Vertical Earth Heat Probe" for space heating, greenhouses etc.

4. Construction of the space-heating system, using ground heat is the shallow borehole heat exchanger (BHE)-Heat Pumps systems. .

## 5. REFERENCES


Frasheri A., 1992. "Geothermy of Albanides". Gethermal Atlas of Europe. Published by Geo Forschung Zenhrum Posdam, Germany.

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.

Frasheri A., Çermak V., Liço R., Kapedani N., Bakalli F., Çanga B., Jareci E., Vokopola E., Halimi H., Malasi E., Safanda J., Kresl M., Kucerova L., Stulc P., 1997. Geothermal resources of Albania. Published in " Atlas of Geothermal Resouces of Europe". Hanover 1997.

Frasheri A., Doracaj M., Bakalli F.,1997. Proposal for the use of geothermal energy in Albania. Workshop: Raising funds for the commercialization of R&D achievements, Sofia, 6-7 November, 1997.

Frasheri A. 2000. Geothermal energy in Europe, State of the Art and necessary actions and measures to accelerate the development.- Albania. IGA & EGEO Questionaire 2000.

Frasheri A., 2000. The source of Geothermal Energy in Albania. World Geothermal Congress 2000. Kyushu-Tohoku, Japan, May 28-June 10,2000.

Rybach L., Brunner M., Gorhan H., 2000. Present situation and further needs for the promotion of geothermal energy in European Countries: Switzerland. Geothermal Energy in Europe. IGA&EGEC Questionnaire 2000. Editors: Kiril Popovski, Peter Seibt, Ioan Cohut.