SEG Annual Meeting International Showcase.

GLOBAL THEATER

17–22 October 2010 - Denver, Colorado USA

ALBANIAN GEOPHYSICS AND FACING THE CHALLENGES DURING THE TRANSITION PERIOD TOWARD FREE MARKET ECONOMY

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Abstract

In the speech are presented the development of the geophysical exploration in Albania, contribute of the geophysics and facing the challenges during the transition period toward free market economy.

Albania is a rich country in mineral resources, chrome, copper, iron-nickel, coal, oil and gas etc. The exploration for these mineral deposits is carried out successfully by using a wide and complex range of geological, geophysical and geochemical methods. There are tens of oil and gas reservoirs, tens of copper, chromite, etc. deposits that have been discovered through geophysics contribution. Gravity, magnetic, geothermal and seismic zoning maps of different scales up to 1:200.000 and 1:500.000 are important part of regional studies on the recognition of geological setting of Albanides. Geophysical studies and research are conducted in Albania for more than 70 years. The first geophysical researches have been performed during thirty years, with gravity, and magnetic survey, vertical electrical soundings, by Italian companies in the years 30-40. Geophysical research in large polygons for oil and gas reservoirs, and copper, chromite deposits explorations began systematically to 50 years period. Gradually, step by step, we have applied different geophysical methods. The successful Albanian geophysics in search for metallic deposits and oil and gas reservoirs have been published in many papers in national and international scientific press, and presented in the national and international meetings.

On shore and of shore oil and gas exploration have been performed using seismic reflection surveys, gravity mapping, and small volume of the vertical electrical soundings. Mining geophysics for copper, chromite, bauxites deposits exploration is developed through application of the gravity and magnetic mapping of different scales, induced polarization profiling and real-section surveys, electromagnetic profiling, resistivity profiling and vertical electrical soundings, self potential mapping. Radiometric and nuclear geophysics have been used for phosphorite research. Oil and gas, copper, chromite, phosphorite, coal wells have been studies using complex of the electrical, sonic, radioactive and nuclear well logging,

Important direction of Geophysics presents seismological studies in Albania. These studies have been developed to three areas: seismotectonics, seismology and seismologic engineering.

Last two decades represent the period of extension of the field of application of shallow engineering and environmental geophysical methods to solve the geotechnical tasks, hydrogeological research,

the micro-zoning of main Albanian cities, the study and evaluation of geothermal energy, and environmental studies for impact evaluation and water pollution, etc.

Geophysical Branch in the Faculty of Geology and Mining, Polytechnic University of Tirana, during a half of century period from 1961 up to present have graduated 304 geophysicist engineers, and 48 doctors of sciences.

Albanian Geophysicists have established since 1989 Geophysical Society of Albania (GSA), which is part of the Albanian Association of Geoscientists and Engineers (AAGE). GSA is a member of the European Association of Geoscientists and Engineers (EAGE) and the Balkan Geophysical Society (BGS).

Key words: Albanian Geophysics, Mining Geophysics, Oil and Gas Geophysics, Engineer and Environmental Geophysics.

Introduction

Albania is rich with natural resources: oil, gas and solid minerals (Fig. 1). Integrated geological-geophysical-geochemical prospecting have discovered and developed tens of solid mineral deposits, and oil and gas reservoirs in Albania.

In order to demonstrate the economic capacity of the Albanian Mining and Petroleum Industries, it is sufficient to indicate that only during 1984 there were extracted 1,007,000 tons of copper minerals and processed 12,600 tons of blister copper, as well as 960,000 tons chromites. The average income from the copper and chromium extracting industries was 120 million USD. About 20 million tons of copper minerals and 21 million tons of chromites have been extracted by the Albanian Mining Industry. Oil production reached a peak of 2.250.000 tons in 1973. Up until 1990s, there were extracted 49, 5 million tons of oil, about 12 million cubic meters of natural, and 47 million tons of coils. Unfortunately, during the transition period among 1990 to 2010, the volume of extraction by the mining and oil industry has steadily decreased. According to the official statistics, INSTAT, the mining production has decreased as following*:* 88.6 in 1994, 86.5 in 1995, 75.8 in 1996, 47.1 in 1997, 74.5 in 1998, 35.5 in 1999, 31.0 in 2000, and 27.0 in 2001.

Geological prospecting have evaluated the mineral resources, capable of extraction as 31 million tons of oil, 53 million tons of cooper minerals, 40 million tons of chromites, 220 million tons of Ferro nickel, 100 million tons of nickel, 700 million tons of coil. More than twice of the extracted copper and chromites ores are estimated by geological exploration and developing statement of the resources for the future.

The Bitumen from the Selenica mines in southern Albania has been extracted since the ancient times. Illyrian tribe of pirusts was well known for copper processing. An activist of the Albanian Renaissance, the philosopher Sami Frashëri, in his book "Albania, What It Was, What It Is, and What Will It Be (1899), wrote "…it is necessary to explore all metals all over Albania ... In the capital of Albania, in addition to secondary schools must be a university, and an academy….. to develop in Albania the literature, history,…. and geology, etc.". Nearly half a century later, a politician Mehdi Frashëri in his book "The Albanian Problem" (1944) wrote: "... At near future, Albanian oil in Kuçovo as well as in Patos will form a source of national wealth and a key target for state revenues " and "... in Albania there have been explored some ores, which can also reasonably be used for developing the economy and industry of the country….".

In the 1920s and 1930s, oil was discovered in Kuçova, and it was processed, also copper was extracted in Rubik, and a little later started the extraction of chromium. The programs elaborated by our philosophers and statesmen were fully

implemented after the World War II. The new state took particular attention to further developing the exploration, extraction and processing of the natural

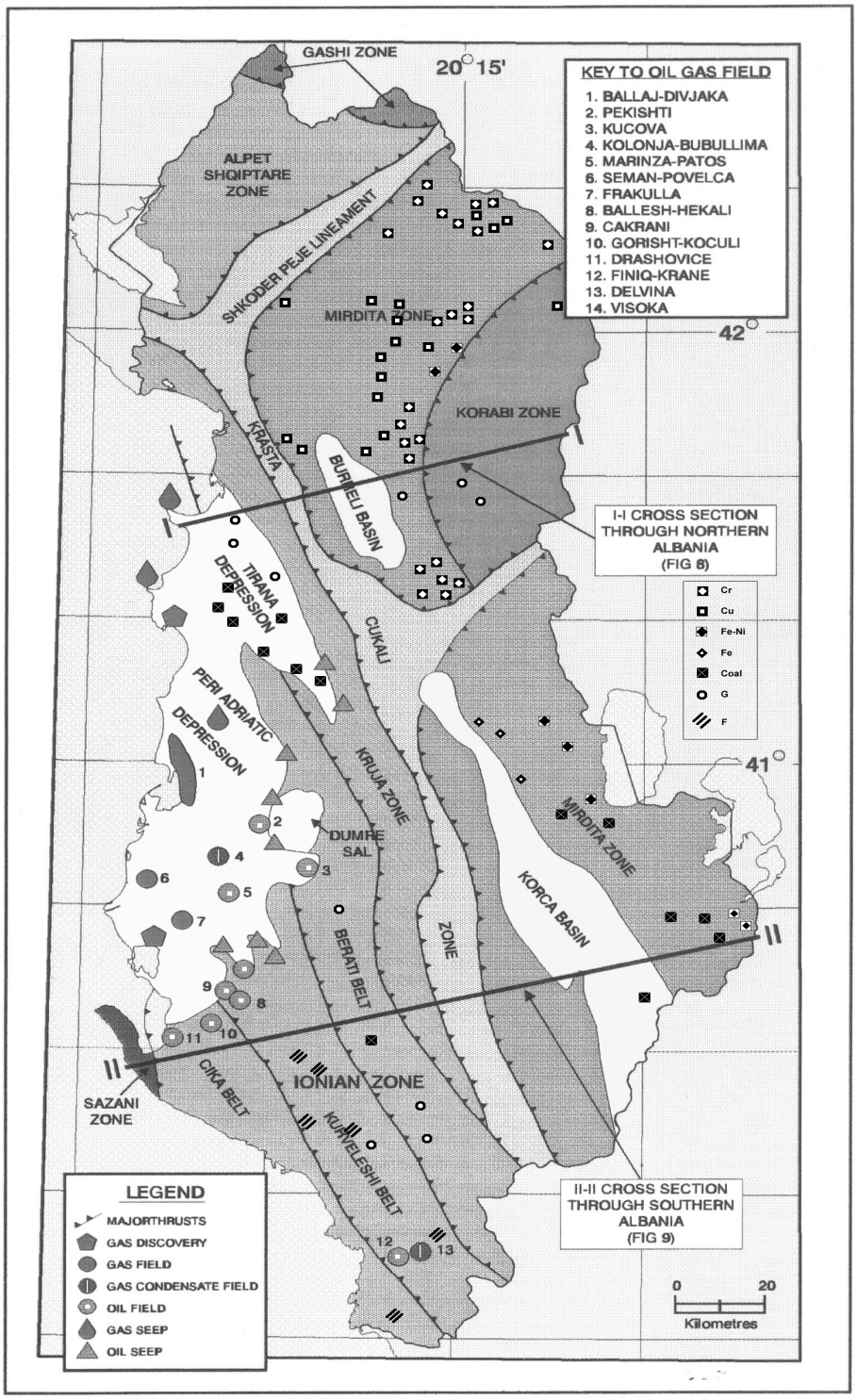

Fig. 1. Important oil and gas reservoirs and solid minerals deposits in Albania.

resources, and it put those industries at the cornerstone of the socio-economic development of Albania. The development of those industries went hand in hand with the formation of a new cadre of young specialists, who were able and willing to explore and to extract the mineral wealth of the homeland, and to selflessly contribute to the development of the state and economy.

Geophysical studies and research are conducted in Albania for more than 70 years. First gravimetric and magnetic surveys and electrical soundings have been performed during thirty years by Italian company. Geophysical research in large polygons has started systematically from 1950 year for oil and gas, gradually to apply different methods: Gravity survey, Vertical Electrical Soundings, and Well logging (1950), Seismic surveys (1952). From 1953 has started application of the Geoelectrical surveys for cooper exploration, magnetic surveys (1957) and gravity surveys (1958) for chromite exploration. Radiometric surveys (1959), and geothermal studies (1989). Offshore seismic and geoelectrical surveys in Albanian Adriatic Sea Shelf for oil and gas exploration have started from 1982. Geophysical research in fifty's years was performed by Soviet and German geophysicists. From 1952 he returned from overseas studies two first Albanian engineers. At that time was formed also the first geophysicist's technicians. After 1961, all geophysical surveys have been performed by Albanian geophysicists. For two years in the seventy's years, the Albanian geophysicists have worked together with the Chinese geophysicists. Today, after 60 years, there are 304 geophysicists, as well as dozens of physicists, electrical engineers, etc. that have working on geophysical surveys. Among them are 48 doctors of sciences, 7 professors, and 22 leading researchers and masters.

Albanian Geophysicists have established since 1989 Geophysical Society of Albania (GSA), which is part of the Albanian Association of Geoscientists and Engineers (AAGE). GSA is a member of the European Association of Geoscientists and Engineers (EAGE) and the Balkan Geophysical Society (BGS).

Geophysical studies in Albania, year by year have been developed as complex methods, such as technological level of the surveys and interpretation, and are raised up coordination with other geological and geochemical methods. The realization of the development of Geophysics at the beginning of the period 1972-1986 is sensitive behavior of equipment and modern technologies for seismic, gravity, geoelectric, magnetic surveys, radiometric studies and well logging.

Geophysical Exploration and studies have been performed in the framework of the three Geophysical Enterprises [Biçoku T., 2004, Frashëri A. et al. 2010].

1. Oil and Gas Seismic and Gravity Enterprise in Fieri City: 70 geophysicists enginees, four seismic teams, gravimetric one, a geoelectrical team, as well as marine expedition with seismic, geological and geoelectrical teams. Enterprise has realized about 2500 km/year of seismic profiling by multiple coverage.

2. Oil and Gas Well Logging Enterprise in Patosi City: 30 geophysicist's engineers, the electric, radioactive, sonic groups, gas logging, and perforator's groups, laboratory of physical properties of the rocks and interpretation group. Well logging groups carry integrated geophysical study of exploration deep wells for oil and gas with an annual volume of 80,000 linear meters of wells with a depth up to 6700 m, and tens of thousands linear meters of production wells.

3. Geophysical Enterprise of Tirana for mining geophysics: 106 geophysicist's engineers. Geoelectrical Teams have realized about 35-40 km^2/year mapping at the scale of 1:10 000, 1:5.000 and 1:2.000. Averagely the same area has covered also by the gravity and magnetic survey. In 2008, the restructuring of the Albanian

Geological Service, the company was reformed: several specialists went to the Institute of Earth Sciences was established, some remained in the unit geophysical Albanian Geological Service.

Application fields and geophysical methods applied in Albania

Tab. 1

GEOPHYSICS	Methods	Application fields			
		Oil & gas	Mining	Engineering & Environmental	Regional
Applied	Seismic reflection	++		++	+
	Electrical	+	++	++	+
	Gravity	+	+	+	++
	Magnetic		+	+	++
	Well logging	++	+	+	+
	Radiometric		+	+	+
Seismology	Earthquakes	1. Seismological Surveys Network 2. Seismological zoning of Albania			
	Engineering	1. Seismic Micro zoning and seismic risk evaluation 2.Seismic monitoring of the hydropower plant dams			
Geothermic	1. Geothermal studies 2. Geothermal energy platform and use scenarios.				

++ Principal method

In Geological & Geodesic Enterprise of the Ministry of Construction and in the Hidrogeological Enterprise of Tirana have two specialized geophysical expeditions for engineering geophysics (1983) and water research (1980).

Important direction of Geophysics in Albania presents the seismological studies, which have been conducted by the Institute of Seismology, Academy of Sciences. These studies pertain to three areas: seismotectonic, seismology and earthquake engineering. The first seismic station was established in 1968, at the Chair of Geophysics, Faculty of Geology and Mining. Seismological Institute was established in 1973 at the Academy of Sciences. Has been set-up the seismological network with 13 stations in Albania. In 2008 the institute, was involved in the Institute of Earth Sciences in the Polytechnic University of Tirana

Teaching of Applied Geophysics case began in the Geological of Department of the Polytechnic Institute of Tirana (1955). The formation of geophysical engineers and their post graduate training since 1961 have been performed in the Geophysical Branch, Chair of Geophysics Faculty of Geology and Mining, Polytechnic University of Tirana. The period of study was five years for engineers [Frashëri A. et al, 2008].

Geophysicists of all generations have given outstanding contribution to the discovery of ten oil and gas reservoirs, eleven copper deposits, and many other solid minerals. They have performed geophysical regional studies of the Albanides. There are 637of papers published in national scientific journals, 33 of papers published in international scientific journals, and hundred papers that have been presented to major success in international scientific meetings [Biçoku T. 2004, Frashëri A. et al. 2010, Papa A. 2001, Rama M. 1995].

Unfortunately, during a very difficult post communist transition among 1990 to 2010, geological research and other scientific activities, including the geophysics went downhill. Geophysical companies were reformed and closed, the volume of work has fallen to the minimum possible, leading to zero discovery of oil and gas, as well as solid useful minerals. The geophysics branch in the Polytechnic University of Tirana was recently closed. There is only option for t Scientific Master Diploma on geophysics. Many of the best geophysicists have migrated and actually work in their specialty in France, U.S.A., and Canada etc.

Despite all these processes for geophysics and geological researches, the Albanian geophysicists currently in Albania are trying to save the geophysics in the conditions of the Albanian market economy. We have started to widen the field of the application of geophysics in other areas. We are convinced that the geophysical surveys, with modern equipment and software, are as important to geological exploration and studies as the X-ray equipment and echo-sounds are to the doctors. Therefore, geology without geophysics risks a return to the nineteenth-century level.

Last two decades represent the period of extension of application fields of geophysical methods for solving geotechnical tasks, hydrogeological research , micro zoning of the main cities of Albania, geothermal studies and evaluation of geothermal energy, geoenvironment studies and its impacts assessments, archaeological geophysics, etc. An important contribution has been given by joint projects with other institutions and academics as well as professionals from leading countries in the field. Unfortunately, Geotechnical and Environmental Geophysics surveys, there are not to the extent appropriate of modern techniques and technologies, particularly for the evaluation of natural geologic hazards.

However, in order to assess the new scientific research, inter alia, it is necessary to ask and analyze what was done, how it was done, and to determine future goals and objectives. In order to present a modest contribution in this direction, we have made a review of the Albanian Geophysics in the years 1950 to 2010.

1 The role of geophysical methods in the framework of integrated oil & gas exploration

Integrated geophysical exploration for oil and gas had the reflection seismic survey as the main method. Besides its, prospective regions for oil and gas have mapped by gravity surveys. Have been used also some vertical electric soundings. Successful experiments, but in small volume, were also made for direct search of oil and gas reservoirs by complex of methods: natural electric field, radiometric and magnetic surveys. All deep oil and gas wells have studies by integrated well logging methods.

History of the development of seismic work can share in the four main stages:

1. 1952-1970: Oscilographic recording, and manual processing and interpretation of the seismic data. The works were carried out in lowland terrains.

2. 1970 to 1978: Analog magnetic recording, multiple coverage profiling, and surveys were extended also in rugged terrain, with complicated geology.

3. 1980 to 1990: Digital recording and processing of the seismic data, the widely used multiple coverage, and improvement data processing.

4. After 1990 there were gradually declining to zero geophysical exploration works for oil and gas by Albanian geophysicists. Actually, performing of the seismic exploration there is realized by foreign companies.

Gravity survey on the scale 1:100.000, and 1: 50,000 and 1:25.000 have covered the whole perspective territory for oil and gas bearing.

In 1978 has restarted application of the vertical electric soundings with depth of investigation about 2.5 km. The object for the electric soundings have been identification of the limestone structure top, and evaluation of the sandstone content in the Neogene molasses in onshore, and in the Albanian Adriatic shelf, etc.

In the years 1978-1982 was successfully experimented direct exploration of the oil and gas reservoirs by integrates methods: natural electric field, magnetic and radiometric surveys.

Albanian Well Logging Service has celebrated 80th anniversary. The systematic geophysical study of all oil and gas deep wells was begun in 1950, with electric logging, well deflection and factice diameter measurements. The temperatures were recorded in well with electric thermometers. Were performed first experimentation of the gamma logging, and gas logging.

The main feature of the later period, the launch of sixty years, was the step to the full quantitative and qualitative interpretation of logging data, performance of the logging in the well, and determination of the physical properties of the terigjene productive horizons.

Currently, unfortunately even this direction of the Geophysics is abolished, because there are stopped the drilling of the exploration and development deep wells by Albanian Oil and Gas Industry. There remained only a small nucleus in the oil industry, to study any of Albpetrol well.

2 The role of geophysical methods in the framework of integrated exploration of solid minerals

Geophysical methods, used in the framework of integrated geological-geophysical-geochemical exploration, have an important role in search for solid minerals. The role of geophysical methods has depended on many factors such as the kind of mineral to be prospected, the stage of the search, and the kind of problems to be solved.

Application of geophysical methods has been concentrated in two major directions:

1. ***Direct search*** *for many kinds of solid mineral deposits such as copper sulphide, polymetalic, and chrome ores.*

The methodology of the geophysical exploration for copper ores deposits (from the 1930's until today) and chrome resources (from 1958 until today) in Albania was developed in conformity with the geological tasks to be solved and the scientific-technical levels of the geophysical methods.

Geophysical copper deposits search and development has high efficiency. The geophysical methods application has been depended by **ore body depth** of location, and kind of the mineralization type. Geoelectrical surveys have been main prospecting methods, through following evolution:
- **1953-1960** discovery have been based on geophysical self-potential method and resistivity profiling for massive and shallow ore bodies, where redox phenomenon is developed.

- **1973-19**89- geophysical exploration was based on application of induced polarization, which was the main exploration method at the depth, and self-potential method and resistivity profiling for detalization and selection massive ore bodies from mineralization zones.

During the **phase of detailed exploration** have been applied: the induced polarization method, EM profiling, the radio wave floodlighting method, mise a la mase method, the borehole vectorial magnetic surveys, the electrical and gamma-gamma logging. In 1978, usefully was started developing of the IP/Resistivity "Real Section".

In Albania was gained a good experience for the integrated geological-geophysical-geochemical **exploration of chrome deposits** and were set up integrated methods to be used in ground and underground surveys. The geophysical methods have an important contribution for discovery in series of chromite deposits. Only during 1989 year, in the ultrabasic massif of Bulqiza were projected 356 boreholes to verify geophysical anomalies in 35 objects. From them, 145 boreholes have discovered mineralized horizons.

The geophysical complex for direct chromite deposit search includes surface mapping by gravity, magnetic and IP methods. Underground geophysical surveys were carried out for the search surrounding space of the mine works and boreholes. In order to get the geophysical documentation of the boreholes, have been performed electrical and radiation (density/selective gamma-gamma and neutron activation) logging.

For the search of chrome deposits, a further and continuous improvement is required to improve the coordination of the direct search for ore bodies with the geophysical methods used for geophysical-structural mapping and under-ground surveys. This is connected with the fact that petrophysical properties of the ore and those of surrounding rocks vary in a wide range, sometimes overlapping each other. All this factors have their influence on the effectiveness of the geophysical search for chrome ore bodies, which is lower than for copper ore bodies.

Through the exploration activity we learned in practice that the ores and surrounding rocks are characterized by unique value of the physical properties. The inverse is not true, i.e. the same magnitude of a physical property or feature may be the same for several minerals and rocks. For example, good electrical conductors are not only massive sulphides but kaolin and clays as well. Therefore, a single geophysical method and one physical feature of the medium are not sufficient to solve the problem. To find the solution is necessary to know the complex of different physical properties. Consequently, exploration has been integrated, with complex of the geophysical methods**.**

Perturbations caused by the topographic effect, variation of thickness and composition of the overburden beds, should be considered carefully to avoid false signals and spurious anomalies. To solve this problem, started from 1973 the application of mathematical methods and computer's data processing and interpretation.

Heights year's period was characterized by **e**xploration of copper sulphide massive and disseminated ore deposits, which are located at the depth up to 700-800 m. The main exploration method has been induced polarization method, and underground surveys. The increase of the depth of investigation has been supported by mathematical modeling.

These achievements were based on further methodological and organizational improvements organization of the geological-geophysical surveying in Albania. Complex geological-geophysical-geochemical teams for the search of copper deposits were created to carry out mappings at scale 1:5000 and detailed studies of anomalies at scale 1:2000. **This was the key of success.** The implementation of

geophysical methods in search for mineral resources, in general, and for mineral ore bodies, in particular, has been based also on methodological criteria: **moving from known areas toward unknown**, which made possible to discover the biggest copper fields in Albania, which consisted of 11 copper deposits, located at different topographic levels from surface down to depth of several hundred meters.

In the mid eighty's year's period there have been solved also two other problems:

- The discrimination of massive ore bodies in great depth, between mineralized zones.
- The discrimination of anomalies composed by the superimposed of the effect from the sulphide ore bodies and from the nearby serpentines individualization.

These complicated problems stand in front of search for all geophysicists of these days. To solve them we needed another improvement of the methodology of geophysical search, which started at the second half of the years eighty up to date.

After 1990 year up to present, geophysical exploration of the copper and chrome deposits with the minimal field volumes there are realized by foreign companies, which actually are worked in Albania.

2. ***Geophysical structural mapping*** *in the complex with geological mapping in order to recognize the geological settings of perspective zones and ore control factors.* The contribution of geophysical studies in the recognition of tectonic the zones and their relationship, is well known in Albania.

The gravity and magnetic mapping at scales between 1:25.000-1:200.000. A particular attention has been paid to petrophysical studies as well.

3. Development of the gravity and magnetic surveys

The development of magnetic and gravity surveys were performed in several directions:

- Expanding the field of use of gravity and magnetic methods for solid ores deposits exploration, including copper, chromium, and iron - nickel, bauxites, asbestos, heavy mineral placers.
- Study of magnetic properties and density of minerals and rocks.
- Building of the magnetic and gravitational country networks of Albania and their connection to international ones.
- The compilation of algorithms and standard software for processing and interpretation of magnetic and gravity data.
- The major results present the Bouguer Anomalies of the Gravity Field and Magnetic Field of Albania Maps, at the scale 1:200.000.
- Performing of the paleomagnetic studies in all Albanian territory, according to the bilateral projects Albania Austria, France, and Greece.

4. Radiometric studies and explorations

The first measurements of natural radioactivity in Albania, carried out in 1958-1959. Until 1990, radiometric studies and research have been secret.

Ninety years brought opening of radiometric research. Radiometric researches have applied to solve many important problems, which have not the relations with the Uranium explorations:

- Implementing radiometric gamma spectrometric determinations by radioactive elements U, Th, K, in the framework of an international project, and regional survey for Geochemical Atlas of Albania.

- Regional radiometric studies according to the total gamma radiation parameter. Has been realized the study "Natural Radioactivity of Albania."

Currently, radiometric studies are oriented to solving environmental problems.

5. Geothermal studies

Results of the geothermal studies and researches have been presented in the monographs: “Geothermy of Albanides” (1990), “ Geothermal Atlas of Albania” (1995), “Atlas of Geothermal Resources in Albania” (, 1996, published 2004), “Geothermal Atlas of Europe” (1992) published by Geographisch-Kartographische Anstalt Gotha, Germany, and “Atlas of Geothermal Resources in Europe”, European Commission (2002). Monograph “Geothermal energy resources in Albania and platform for their use”, published by Faculty of Geology and Mining, Polytechnic University of Tirana, (2010).

6. Seismological studies

Albania's seismological network was established in the period up to 1979, with fourteen stations in major cities of the country. During this period have been making Albanian seismological network part of the European and global network through the International Central Bureau of Seismology in Strasbourg, France.

Among major seismological study was conducted “Seismic Zoning Map of Albania” (1972), “Catalog of Earthquakes in Albania” (1975), and “Seismological Zoning of Albania” (1979), published by Academy of Sciences of Albania. Eighties years were period when spread massively seismological studies for solving engineering problems, realizing complex seismological- engineering and geotechnical engineering micro zoning of leading cities of the country.

Continued high levels of international cooperation on the problem of seismic risk the corner of the Balkans, in the event of the Assembly of European Council of Seismology, as well as in projects of UNESCO. Are conducted seven joint international projects and has collaborated on eight projects under the National Program for Research and Development for the publication of seismological, seismological-engineering, neotectonic and of the geological risks maps.

7. Forming of the geophysicist engineers and their post graduate qualification

Has given great contribution in development of the geophysics in Albanian by Section of Geophysics in the Faculty of Geology and Mining, Polytechnic University of Tirana in both directions: engineers forming, their postgraduate qualification, and scientific research.

Forming of geophysical engineers since 1961 and their postgraduate training was realized in the Branch of Geophysics, Section of Geophysics in Department of Earth Sciences, Faculty of Geology and Mining, Polytechnic University of Tirana. The period of study has been five years for engineers, taken 1-2 years (postgraduate school) and three years for doctoral studies. Current main course of applied geophysicist engineers have been exploration of the oil and gas reservoirs, other solid minerals deposits, hydrogeological research, engineering and environmental studies. During the period 1961-2008 are compiled and continuously improve the curriculum, they respond better to the requirements of time and level of scientific and technological research and geophysical studies and exploration.

In the Framework of implementing the Bologna Protocol, is closed Branch of Geophysics. Under the new curricula, after the first three years of common cycle (Diploma Bachelor for Georesources and Geoinformatics), a geophysical option is in

the second year of the Scientific Master degree. With this curricula, , as have been prepared in implementation of Bologna Protocol, results level landing of the scientific and professional formation of geophysical engineer.

In the Geophysical Branch have been formed 303 of engineering geophysics, and are specialized in geophysics and were re-qualified as geophysicists many physicist. Since 1962, Geophysical Brach was also conducted postgraduate qualification of 48 doctors of sciences.

1. Mining geophysics: Application of the new methods and technologies in Albania:

- Induced polarization method (1962 up to present)
- Micromagnetit surveys (1967)
- IP & RD Real section (1978 up to present)
- Increasing of depth of geophysical investigation (1984 up to present)

2. Mathematical and physical modeling for geoeelectric, gravity and magnetic methods, and inversion in geophysics. Compilation of the algorithms and software's for data processing and interpretation.
3. Extension of the application fields of geophysical methods for exploration of: chromite, asbestos, bauxites, heavy, rare and precious mineral placers, geotechnical and environment investigations, hydrogeological research, application of the natural electrical field for direct search of oil reservoirs.*5. Marine geophysics* (1974-1990): Design and construction of the marine geoelectrical station, marine vertical electrical sounding and profiling, and participation in performing of the marine integrated geological-geophysical studies of the Albanian Adriatic Shelf and design of deep wells for gas exploration in Durres Bay.
6. Regional geophysical studies: Geothermal (1989 up to present), Palomagnetic (1989-1997).

8. *Engineering and environmental geophysics* (1982 up to present), **Publication of the books:** The Section of Geophysics has completed all courses with textbooks, published in the period 1963-upo to present: 19 books for Branch of Geophysics, 4 books for Geological Branch and 5 monographs.

8. What shall we do further - as conclusions

Twenty last year's represent the period of expansion in the field of application of geophysical methods to solve the geotechnical tasks: soil and bedrocks study in the construction areas, control of the dams and landslides, hydrogeological explorations, micro zoning of the main cities in Albania, the study and evaluation of geothermal energy, etc. in Albania. Actually are taken the first positive results, first experience, as well as problems of the beginning.

Currently, the geophysical prospecting of oil and gas reservoirs, copper and chromium and other solid minerals deposits are suspended entirely by Albanian geophysical teams. Cessation of work and geophysical studies extremely serious consequences for future geological researches: The geological explorations remain free modern research methods, and turn to the thirty years of the last century level. With the termination of geophysical explorations, the teams were destroyed and lost a half century of their experience, well known also from prestigious institutions of advanced countries.

Today, for Albanian petrol and mining industries are important to take the proper development and implementation of Applied Geophysics directions in accordance with the requirements of market economy, for oil & gas and solid minerals explorations, using modern methods and surveys technology. At the same time, it is necessary to begin implementation of new technologies for geophysical surveys of shallow depths for solving of the geotechnical tasks, environmental control,

environmental impacts assessment, urban planning, water exploration, medical geophysics, archaeological sites searches, etc.

In response to the demands of time and development directions of the geophysics in the last two decades, there were worked successfully for the creation of Engineering and Environmental Geophysics in Albania. Geophysical methods have been applied in many fields: In-situ seismic and geoelectric topographies' for dams investigation, the slope stability evaluation and landslides study, soil and bedrocks study in construction and dam areas, of highways, tunnels, etc., for karst areas exploration, quality assessment of the concrete during construction works, and in the airport runway, water exploration, for study of the urban and industrial landfills, also for the assessment of the environmental impacts.Engineering and environmental studies are performed by the same methods, technologies, and equipments that are used for search of minerals. So, at the present, the geophysical and environmental engineering investigations are used the technology and equipment eighties years period, with exceptions when were working in the framework of European project. Albanian geophysical teams are necessary to obtain modern equipment to solve these new geological tasks, presented by today the market economy in Albania. In particular, this situation is very serious for the study of construction areas, of roads, the investigation of the hydrotechnic constructions like dams, the evaluation of the slope stability and landslides, the assessment of geological hazards, water exploration, etc.

For the forming of the yang geophysical engineers, currently the problem is the preparation and implementation of curricula and programs in accordance with the requirements of the Bologna Protocol, and actual scientific and technologic level of the geophysical methods. Future geophysicists should be able to realize the oil & gas, and solid minerals exploration because Albania is riche country with natural resources, in parallel is necessary to be able to solve also the engineering and environmental problems, applied surveys with modern technology and digital processing of data.

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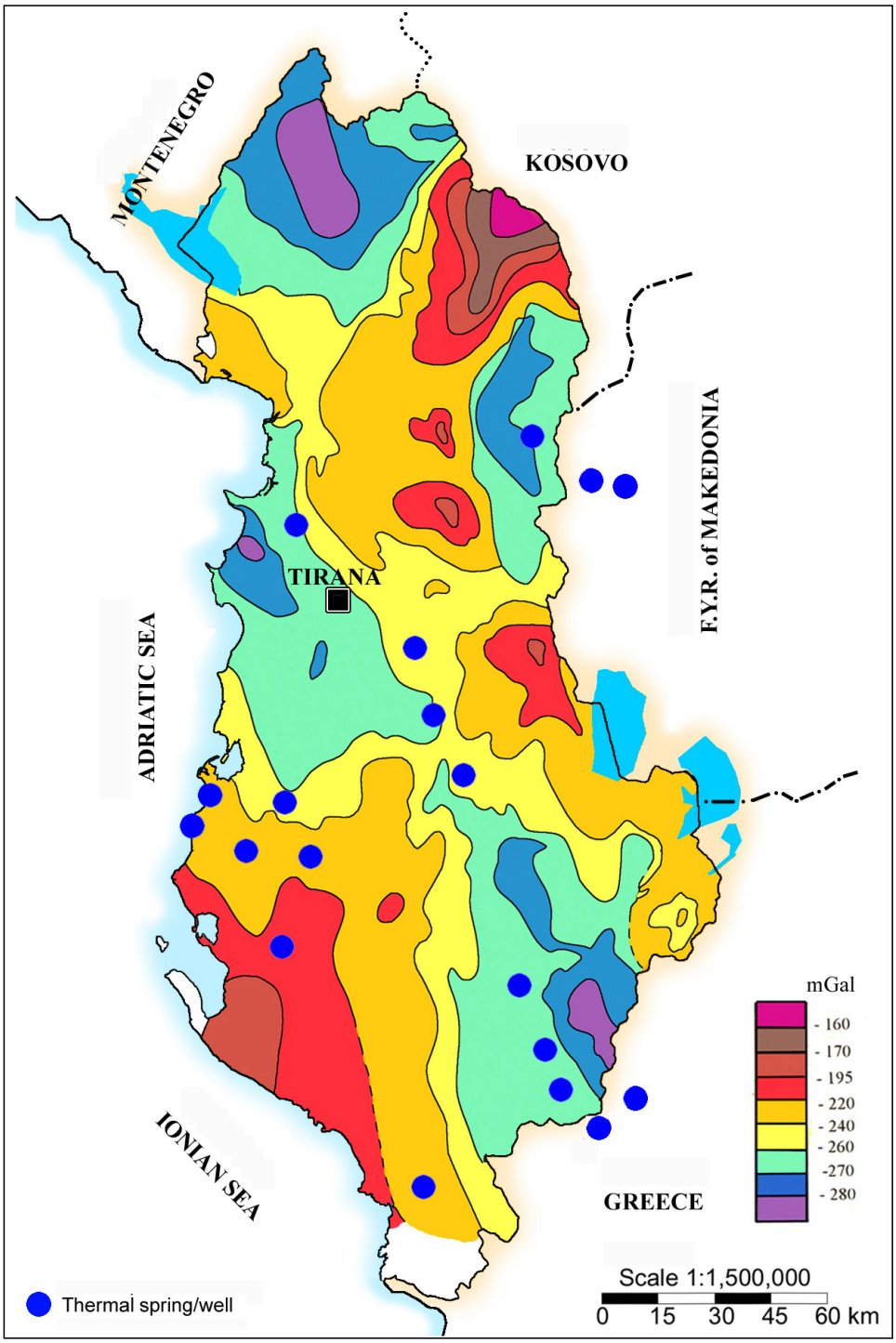
CASE STUDIES HISTORY

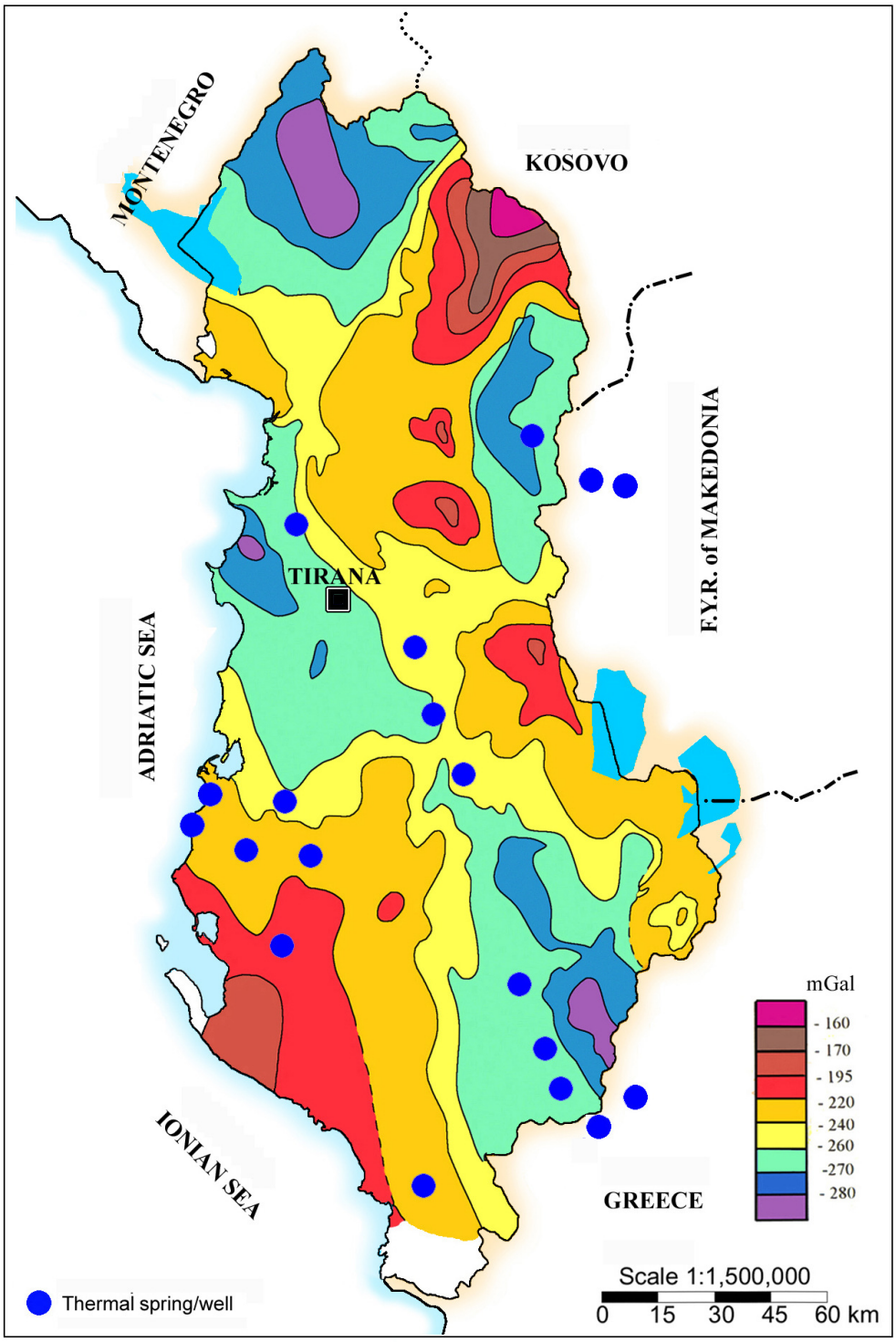
REGIONAL GEOPHYSICS



BOUGUER GRAVITY ANOMALIES MAP OF ALBANIA

(After Bushati S., 1988)

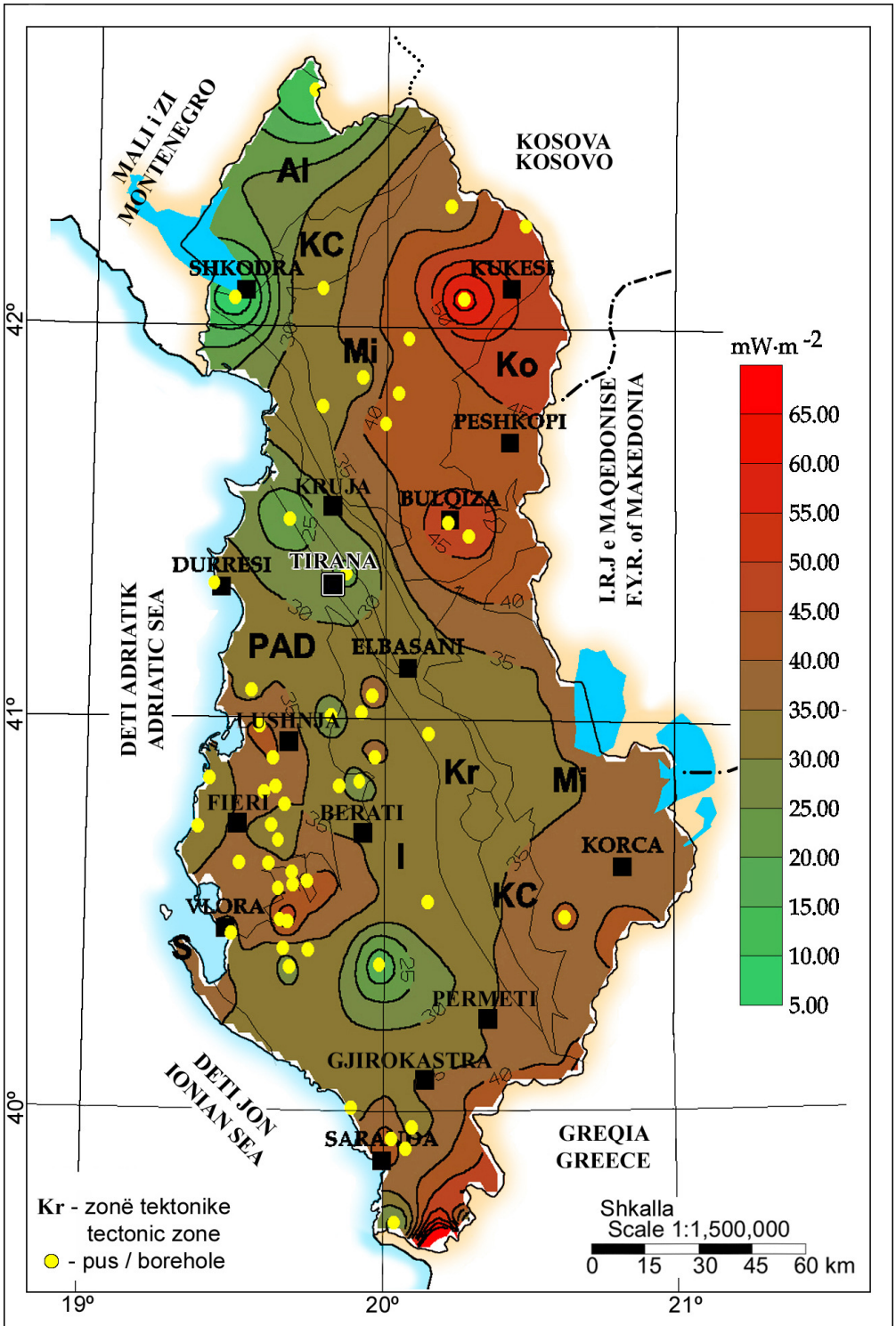
Fig. 1



BOUGUER GRAVITY ANOMALIES MAP OF ALBANIA

(After Bushati S., 1988)

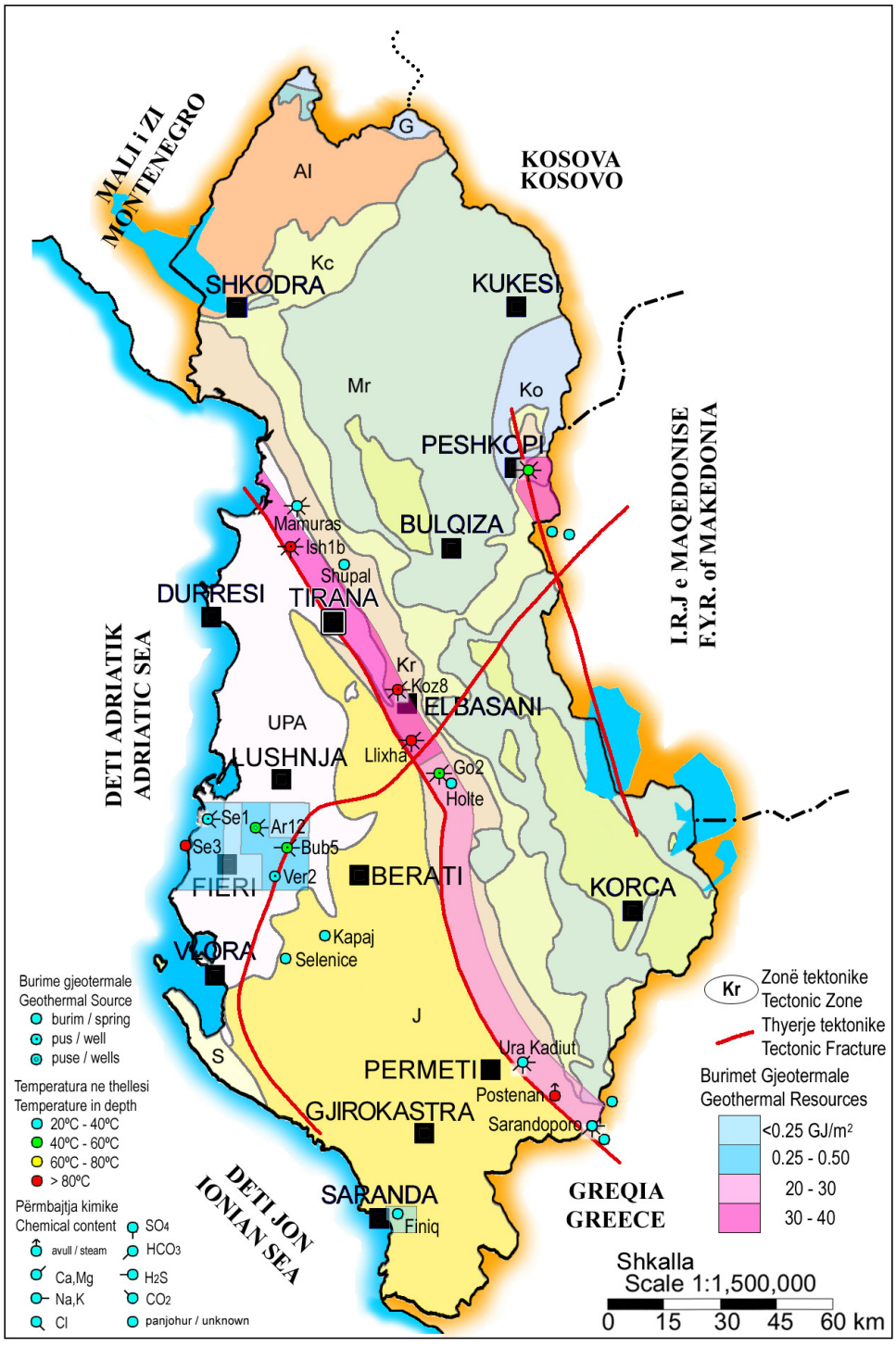
Fig. 1



Harta e dëndësisë së fluksit të nxehtësisë
Heat Flow Density Map

Fleta / Plate 16

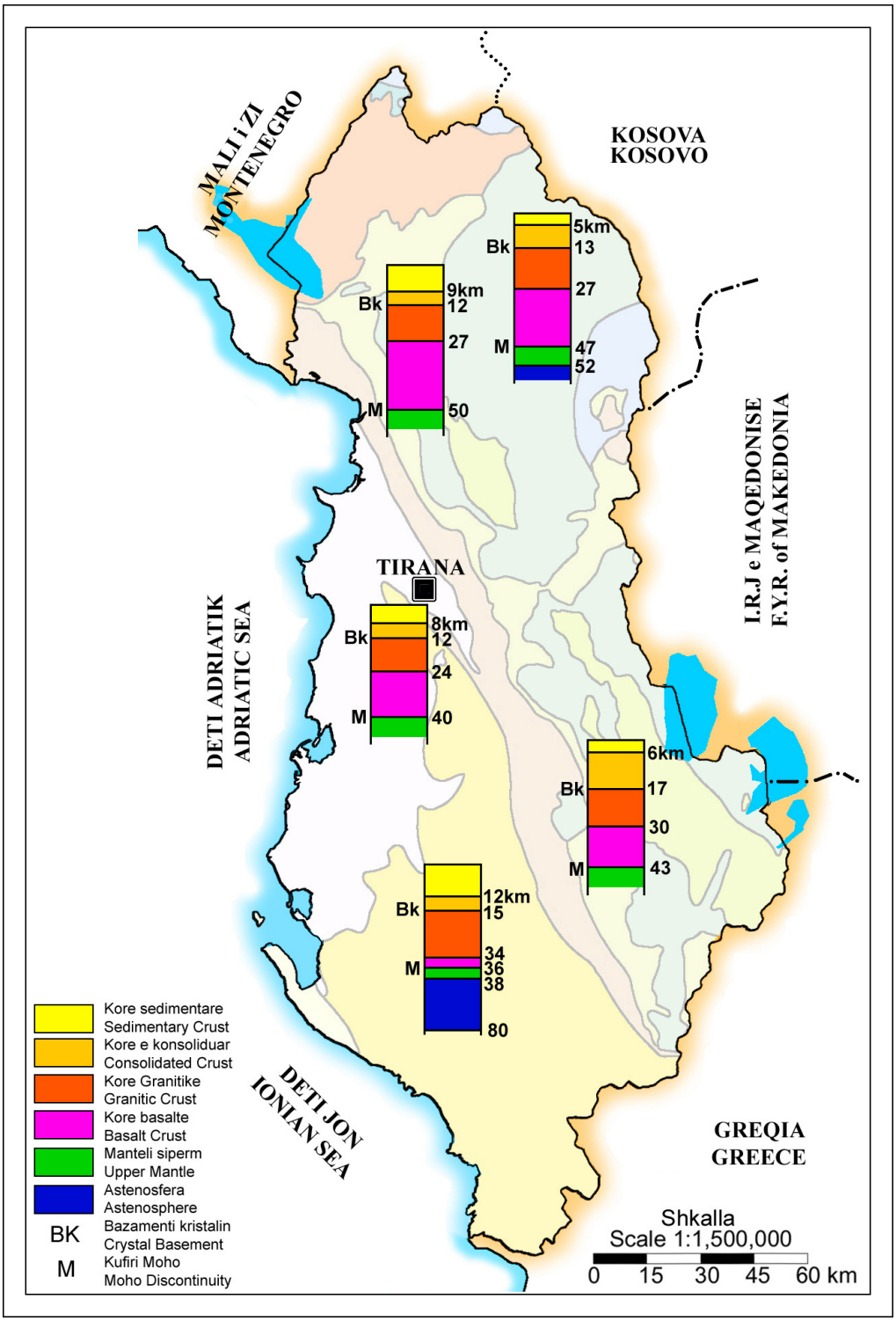
(After Frashëri A, Čermak V. et al. 1995)



Harta tematike gjeotermale
Geothermal Thematic Map

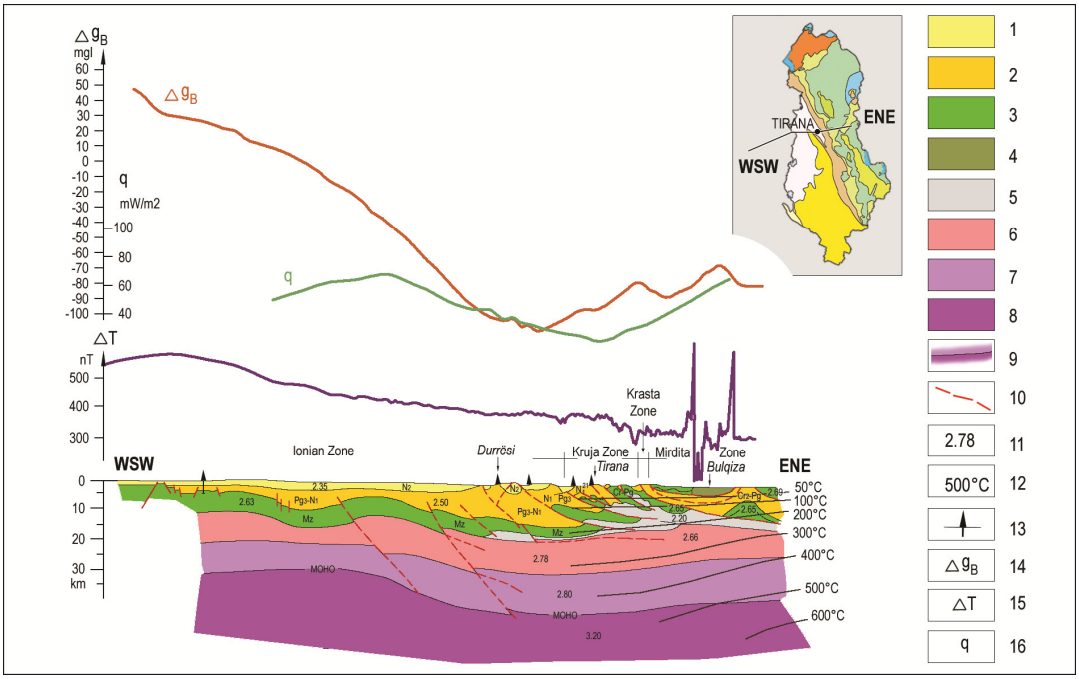
Fleta / Plate 17

(After Frashëri A, Čermak V. et al. 1996)



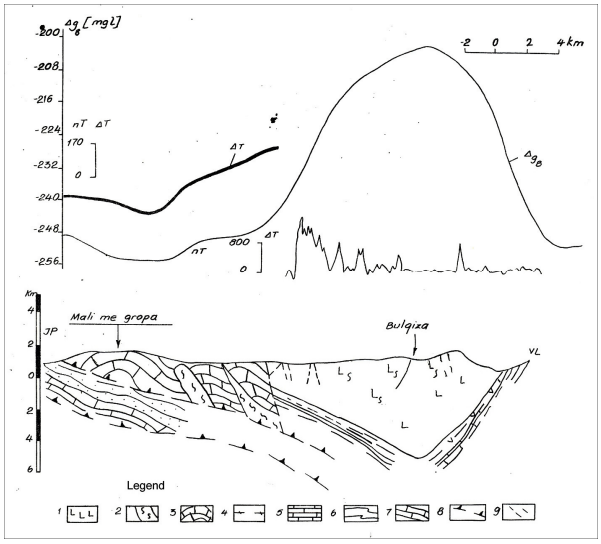
Geologic structure of Earth's Crust and Upper mantle based on seismological studies (data taken from Koçiu S. 1989).

The numbers given in legen show the velocity of the seismic waves, in km/s). Sedimentary Crust; 2- Consolidated crust; 3- Granite Crust; 4- Basalt Crust; 5- Upper mantle; 6- Asthenospehere; 7- BK Crystal Basement; 8- Moho Discontinuity

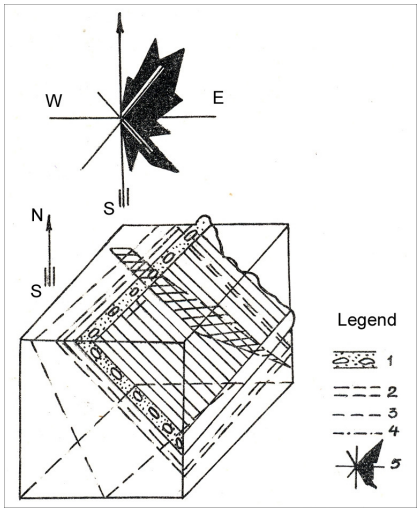


Geological-geophysical profile Albanid-2: Falco Adriatic Sea- Durres-Tirana- Peshkopi (The gravity data for the Adriatic Sea after Richetti, 1980)(Frashëri A. et al. 2002).

1. *Pliocene Sustratum; 2- Substratum of Serravalian Molasses; 3- Paleogenic flysch (Pg_3) and molasses over the limestone; 4- Flysch of the Mastrichtian (Cr^m_1), Lower and Middle Paleogene (Pg_{1-2}); Old flysch of Jurassic (J) and middle Cretaceous (Cr_2); 6- Carbonatic facies divided by the tectonic zones; 7- Ultrabasic rocks; 8- Disjunctive tectonic; 9- Depth up-rupt; 10- Top of chrystal basement; 11- The basal of the Earth Crust; 12- Moho Discontinuity' 13- Focus nodal plan of the earthquakes in the Kavaja region, western Albania; 14- Seismic reflection; 15- Deep well.*
   $G_{B,t}$- Trend of 2nd degree of Bouguer anomaly; $G_{B,t}$- Residual Bouguer anomaly; T_t - Trend of the 2nd degree of total magnetic anomaly; T_r - Residual of the 2nd degree of total magnetic anomaly; T_o - Observed magentic anomaly;



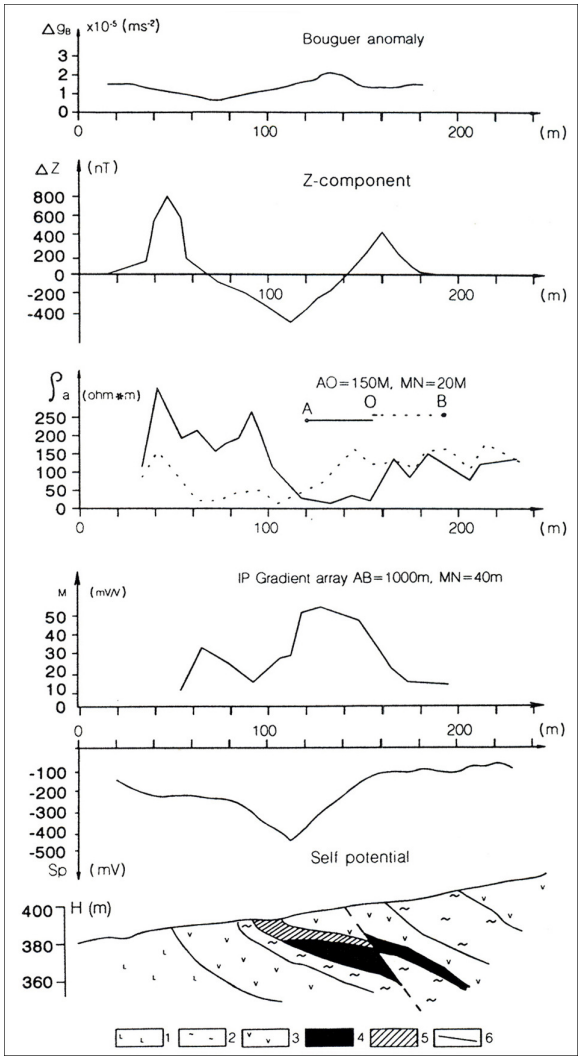
Bulqiza ultrabasic massif



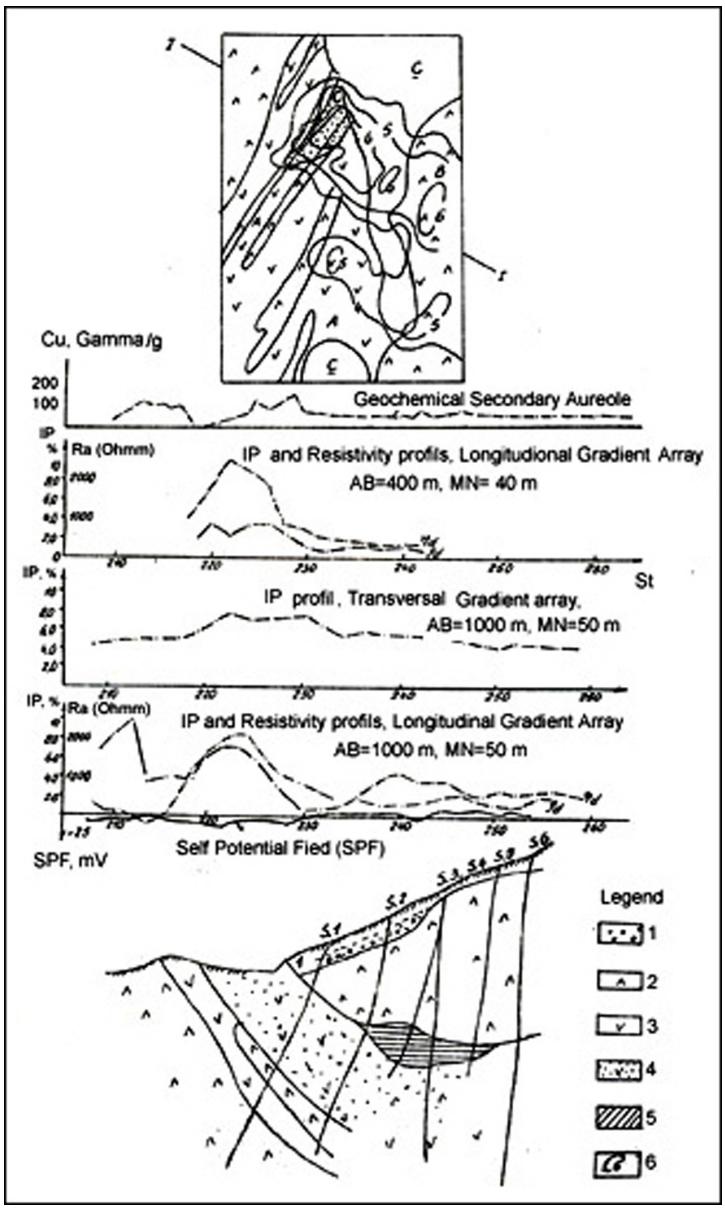
Micromagnetic surveys

MINING GEOPHYSICS

Copper deposits exploration

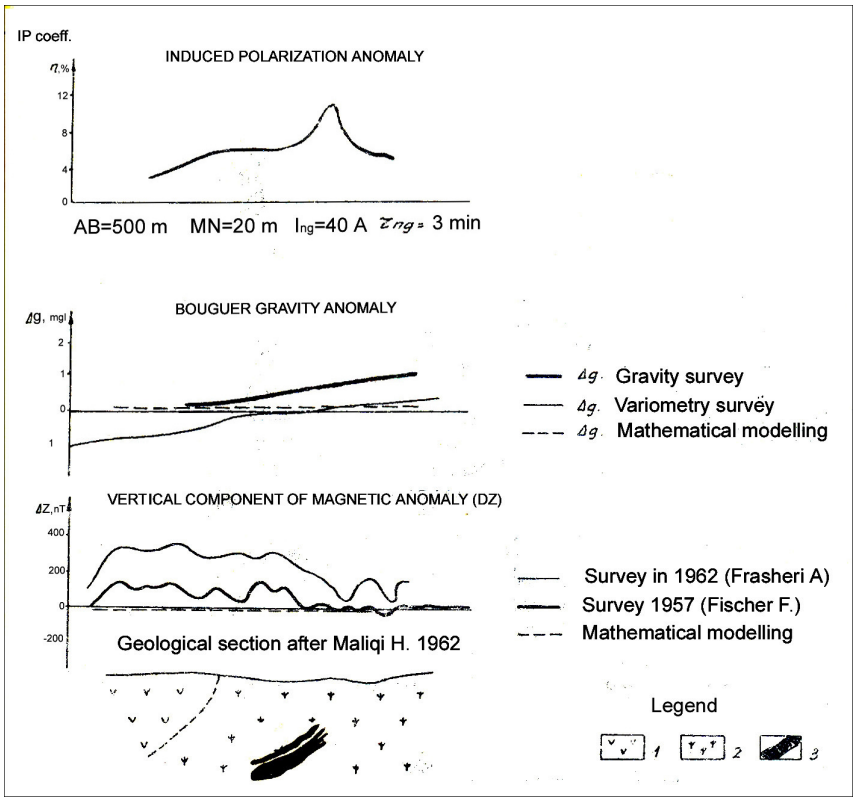


Gjegjani deposit
(Pogrebinsky S.A., 1961)

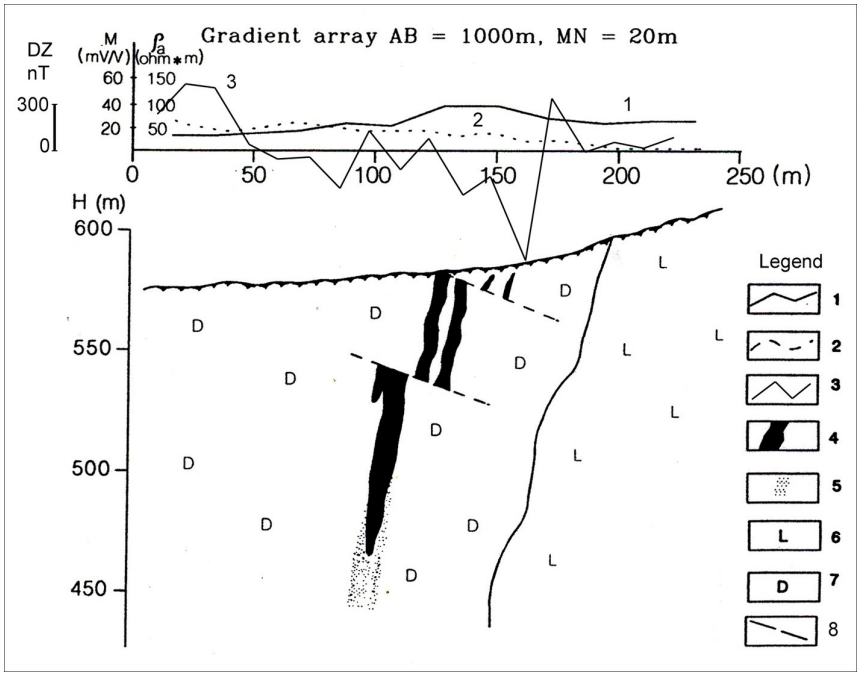


Qafa Barit deposits
(Frashëri A. 1961, Avxhiu R. 1973)

Chromite deposits exploration

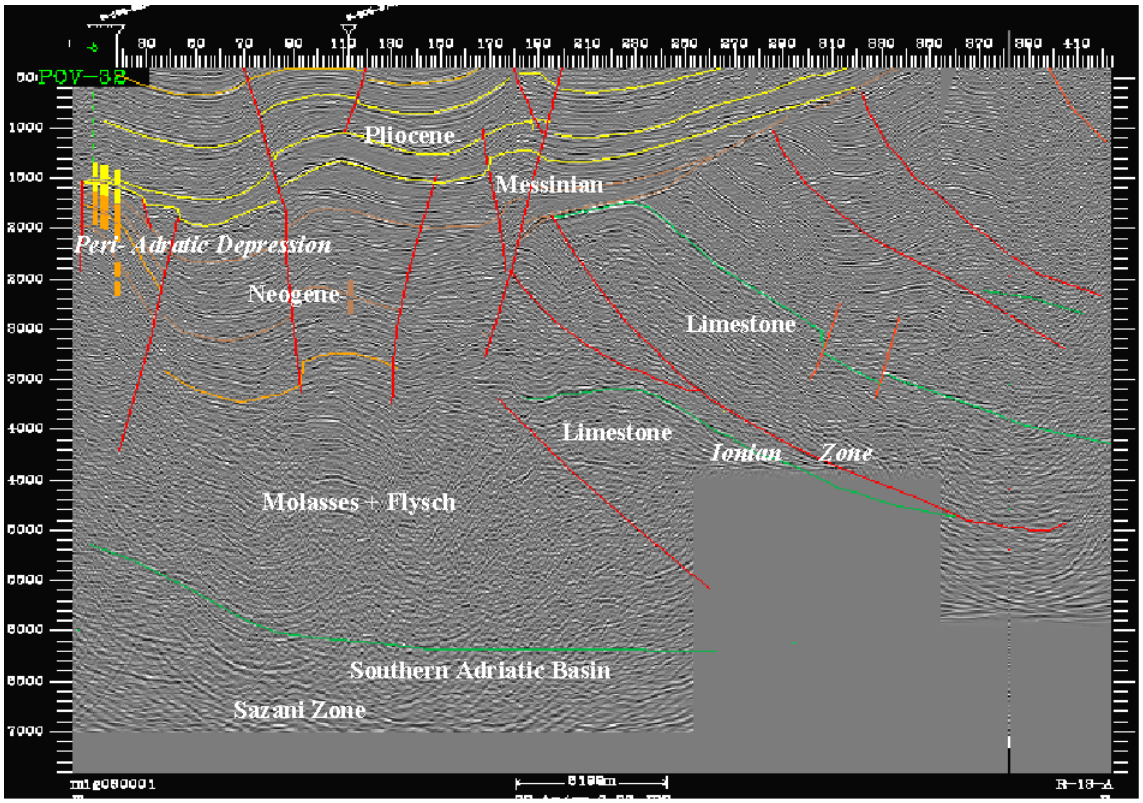


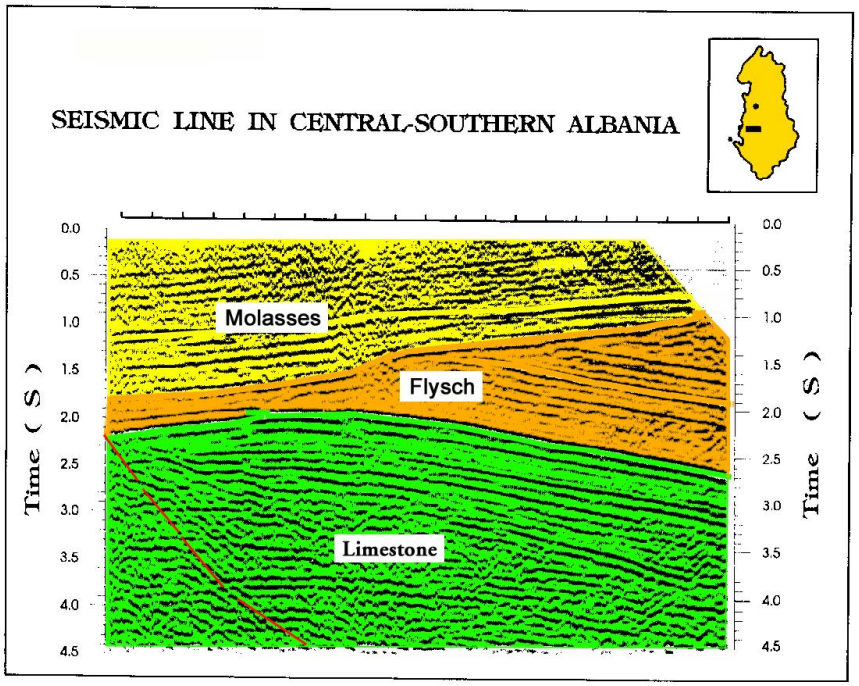
a)



b)

Kam Tropoja deposit (a) ; Vlahna deposits (b) (Frashëri A., Lubonja L., 1962)





Seismic lines, Periadriatic Depression (Bare V. 2002)

ENGINEERING GEOPHYSICS

Dam invetigation

Qyrsaqi dam, Vau Dejes Hydropower Plant

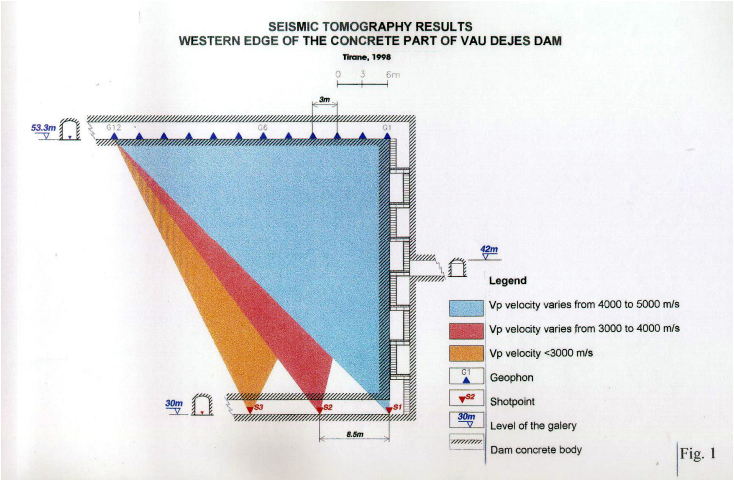
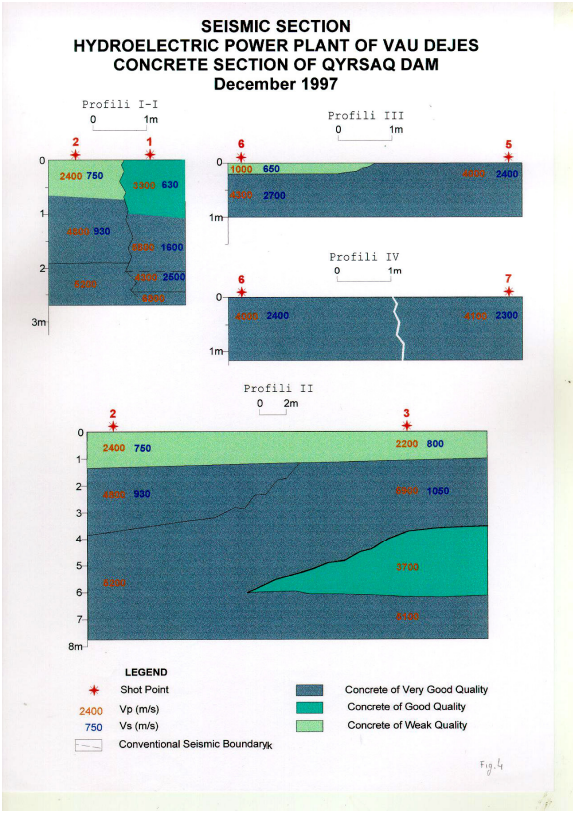


Fig. 1



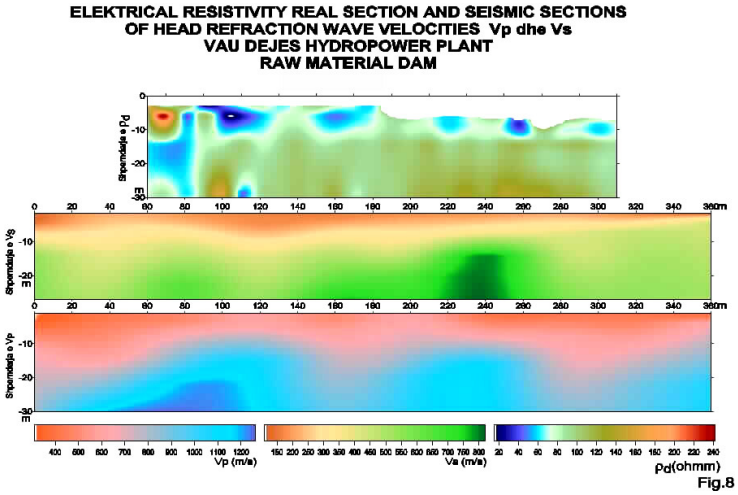
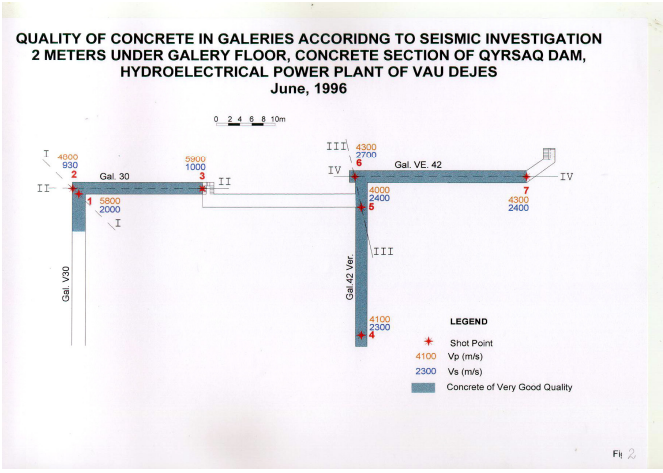
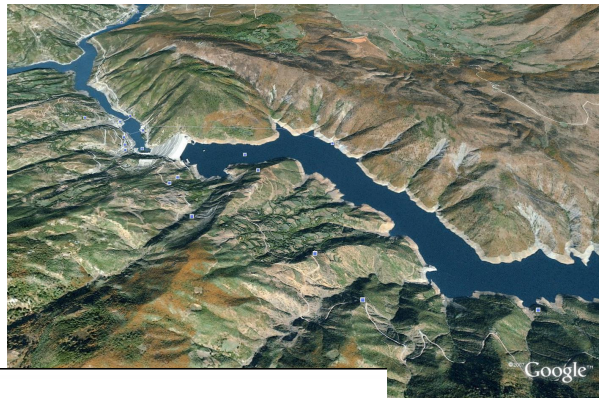


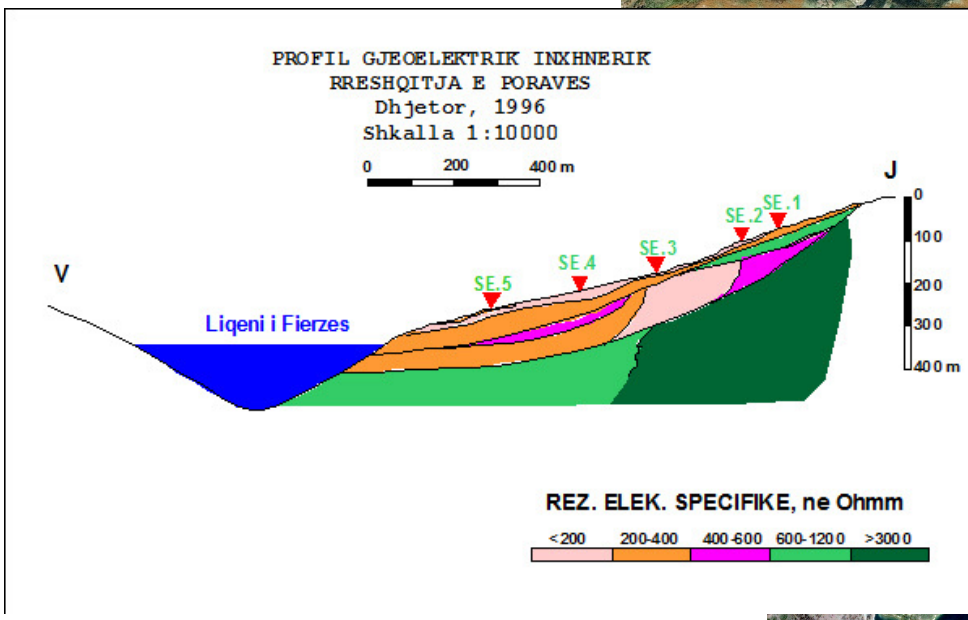
Fig.8



Lanslide investigation

Porava landlide, Fierza lakeshore





Ragami landlide, Vau Dejes lakeshore