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# **GEOMONUMENTS**

who tell the story of Albanian Earth

By: Alfred FRASHËRI

Chapter of the book:

### **GJEOMONUMENTET**

qe tregojne historine e tokes shqiptare

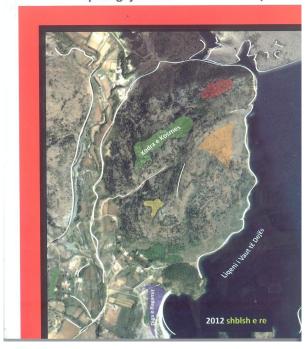
(in Albanian, summary in English):

TIRANA, ALBANIA, August, 2013

# Alfred Frashëri

# **GJEOMONUMENTE**

që tregojnë historinë e tokës shiptare



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# Vlora Bay, and Sazani island

Të lutem moj baltë e varrit mos i rënd o mëm ëdhetarit po bëji n dere sh qipëtarit. Abdyl beu ngreu nga varri, të shoh ësh Adriatiknë që u bë i Shqipërisë që ti luftove dhe punove deri sa vdiqe!

Populli i këndon **Abdyl Frashërit** 

Nga të gjithëç'kemi kënduar Për të njohur vetëhenë Kaqë gjë kemi mësuarë Të nderojmë mëmëdhenë

.....

Jak' o ditë e bekuar Që lind nga perëndon! At'an' e ke ndriçu ar e ne p se n a harron?

Naim Frashëri





Jezerca Mountain, Albanian Alps-Tropoja Region

### **Albert Einstein**

### Introduction

Albanian land and geological structures that extend, which the geologists named **Albanides**, with a history of about 430 million years development, despite the small surface of 28 thousand kilometers, was present to visitors the natural monuments that are unique in the Balkans and in Europe. These geomonuments have stunning landscapes and rare beauty, as well as express particular geological phenomena. They are located in good climate zones and with great and diverse amusement holiday opportunities. Show cognitive phenomena of great importance to read nature and to know the history of the evolution of the Albanian territory.

Traveling through Albania to appear beautiful fields and green hills around, mountains that are lined with forests, but also cliffs that rise up, mountain's rivers and streams with very steep slopes or terraces on both sides. The sea coastline is flat and with beautiful sandy beaches, but in some sectors the coastline is cliffed, where can observed the submersion of the mountain slopes to the sea. Different types of rocks build geoenvironment. In some zones the rocks are no layered, in others the visitor walks alongside the stratified rocks, like the pages of a book. These layers can be flat or folded, even thrusted in any zone.

By browsing these rock layers like the pages of a book, you can read and understand how rocks are formed, their structure, and the geological history of the region where you are traveling. And knowing the nature, it becomes more beautiful, more attractive and more interesting journey.

One day, my grandson and friend, publicist engineer Ilir Mati, who in Albania has traveled not less than geologists told me: write a simple book on the geology of Albania that travelers understand how it build the land where the walk. The trip was made more attractive. And I started to write this book.

Let's read the book, and through the geomonuments will learn as created Albanian land, will know the geology of Albania. The knowledge will help us to discover the nature

### 1. HOW WAS BUILT ALBANIAN TERRITORY OVER MILLIONS OF YEARS

Passenger plane flying in the Western Balkans behold panoramas of high mountain ranges, which are very beautiful. In these ranges, the mountains of Albania lie between those of the Dinarides in the North and Hellenides to the south (Fig. 1, 2). These ridges are formed in new geological times, and built by geological structures which are called the Dinarides, Albanides and Hellenides. They form the southern branch of the Mediterranean Alpine Folded Belt.

The Albanides represents the assemblage of the geological structures in the territory of Albania. Two major peleogeographic domains form the Albanides: the Internal Albanides in the eastern part and the External Albanides in the western part of Albania (Fig. 3).

### **INTERNAL ALBANIDES**

The Internal Albanides are characterized by presence of the immense and intensive tectonised ophiolitic belt, which is displaced from east to west as overthrusted nappe. There are two viewpoints about the placement of the ophiolites: Autochtone and Allochtone character of the ophiolitic belt.

The here tectonic zones represent the Internal Albanides:

- 1. **KORABI** zone (K) In this zone the oldest formations of Albania are present, and are represented by sandstones, schistose conglomerate and metamorphic limestone of Silurian, Devonian and Carboniferous ages, and sandstone-conglomerate and anhydrite of lower Permian-Cretaceous age. In some places there are also some volcanic and sub volcanic rocks with basic and acidic-alkaline contents. In the Korabi zone, some folds, thrust fault and cover rocks are presented.
- 2. MIRDITA zone (Mr) This zone represents a wide belt along the whole length of the country, from northeast to southeast (Fig. 5). During the different orogenic phases, three tectonic units were formed in Mirdita zone. The ophiolitic belt of the Albanides is genetically unique and tectonically split into two sunbelts along its length. The lower tectonic stage is made up of ophiolites. Ophiolitic belt has its biggest thickness is about 14 km in its northeastern extreme, in the ultramaphic belt of Kukes. Towards northwest and southeast this thickness reduced to 2 km. Geophysical data are represented the arguments for overthrust character of ophiolitic belt, under which the formation of Krasta-Cukal zone is laid (Fig. 4).

During the tarditectonic- neotectonic stages are formed internal Neocene depressions. Neogene molasses have a thickness about 1500 m in the northern part of the Baurreli fosse.

3. **GASHI** zone (G). Beyond its border it continues into the Durmitori zone of the Dinarides. This zone includes metamorphic rocks, terrigeneous rocks, limestone, metamorphic volcanites, and basic intermediate and acidic rocks.

### **EXTERNAL ALBANIDES**

The External Albanides was developed out of the western passive margin and continental shelf of the Adriatic plate. The External Albanides are characterized by regular structural belts, which are associated with thrust and over tectonic.

The sedimentary crust has 8-9 km thick in Adriatic seashore and reaches up to 15 km in northwestern regions of Albania. The depth of Moho discontinuity is 40 -50 km. Its deepest part is in northwestern part of Albania. The Earth crust in Albanides is interrupted by a system of longitudinal fractures in NW - SE direction and transversal fractures that touch even the mantel. Some of them separate even the tectonic zones. The crust setting and their dynamics are reflected in the geology of the tectonic zones of the Albanides, and their tectonic styles.

- 1. ALPS zone (A). In general, Alps represent limestone monoclines, combined with smaller anticlines.
- **2.KRASTA-CUKALI** zone (K-C). Krasta subzone lies like a narrow belt from Shkodra City in northwest region of Albania to Leskovik City at southeast region of Albania. This is an intermediately zone between the Internal and External Albanides. In the northern part Cukal lie older terrigenous and volcanic rocks of middle Triassic and Triassic limestone lower Jurassic-Cretaceous-Paleocene flysch. In the south lie flysch of the upper Jurassic-Early Cretaceous lower, upper Cretaceous limestone and flysch of the late Cretaceous-Eocene.
- **3. KRUJA** zone (Kr) lies to the west of the area Krasta-Cukal, south of Shkodra to Leskovik. This area is constructed from Cretaceous-Eocene limestone rocks and less neurotic dolomitic limestone. Above them lies a thickness of about 5 km of Eocene-Oligocene flysch. There distinguish several generations

anticline and synclinal extended for tens of kilometers. In geological formations of the area have deposits of bauxite, coal and industrial minerals and construction materials.

- 4. **IONIAN** zone (Io). This is the biggest zone of External Albanides and has been developed as a deep pelagic through since upper Triassic. The Permian- Triassic evaporites are the oldest rocks of this zone. Over this formation lies a thick deposits formed by upper Triassic- lower Jurassic dolomitic limestone and Jurassic-Cretaceous-Paleogene pelagic cherty limestone. Limestone are covered by Paleogene flysch, Aquitanian flyschoidal formation, thin section of Burdigalian-Helvetian and partially of Serravalian-Tortonian, which mainly fill the synclinal belts (Fig. 5). Burdigalian deposits are placed in angle discordance over anticline belts. This has brought about two- stage structure. During the Liassing rifting affected External Albanides including Ionian zone and in this last were formed three tectonic blocks that represent the structural belts.
- 5. **SAZANI** zone is the continuation of Apulian platform. A thick Cretaceous- Eocene limestone and dolomite section builds this). Marly deposits of Burdigalian are place trangressively over carbonate formation.

The interpretation of the recent geological geophysical data represents a new structural model and the tectonic styles of the External Albanides. Tectonic zones of the External Albanides are in compression tectonic regimen since upper Jurassic-Cretaceous periods. Only in western part, Apulian zone and South Adriatic basin, are in continues extension tectonic regimen. Over thrusting style of the south-eastern part of the External Albanides, with a great southwestward overthrust of the anticline chains, the presence of the old transversal faults at the present are well known. The lubrication substratum is represented by evaporites during the over thrusting movement. The regional neotectonic phenomena are also the back thrusting tectonic in the Ionian and Sazani zones. The formed structural-tectonic models are represented the results of interference of two main effects, that of southwestward over thrusting and that of secondary and newly northwestwards over thrusting.

6. **PERI-ADRIATIC DEPRESSION** (PAD. Overlying Peri-Adriatic Depression covers the Ionian, Sazani and partly Kruja tectonic zones. This is a fore depression filled with middle Miocene and Pliocene molasses, which are mainly covered by Quaternary deposits. Tortonian- Messinian- Pliocene molasses consist of a considerable number of sandy-clay mega-sequences. From south-east to north-west, the thickness of the molasses increases, reaching 5000 m. Sandstone-clay deposits of Serravalian and Tortonian are placed trangressively over the oldest ones, up to the limestone creating a two-stage structure. In the Neogene sandstone layers there are many oil and gas deposits (Fig. 5).

The Albanian sedimentary basin continues even in Adriatic shelf with terrigene and carbonate formations.

Based on the analysis of rocks and structures that build Internal Albanides, is presented their paleogeographic development (Geology of Albania 1970, 2002).

During the Triassic period of the Mesozoic era (225-190 million years ago) there has been an open sea basin, neritic, with flat sea-floor, where salt deposits predominate, and have been sedimented carbonate mud in the Ionian Sea area.

During Jurassic period (190-136 million years ago) Internal Albanides area was also an open marine basin where carbonate mud deposition continued. By the end of the Jurassic the Alps had begun to emerge on the water. But again Ionian areas remain under water, as an area where continued marine carbonate mud deposit. Krasta area-Cukali, who was deep trough, continue carbonatic mud deposition. But during Titonian century, in the upper Jurassic period, there was a marine transgression, which include Alps ridge that turned in a flat shallow marine basin. Transgression partly include also Mirdita zone and the sea was extended to the edge of the Korabi zone. The presence of this transgression are evidenced by argillaceous and siliceous limestone layers of bathyal facies.

During the Cretaceous period (136-65 million years ago) all foreign lands Albanides were submerged under water again and there continued sedimentation. Gashi and Korabi zones were on the water and there developed erosion process. Mirdita was partly under water. Cretaceous period sea began to retreat westwards step by step of the Mirdita zone, which toast back on the water and served as feed zone for flysch that began to form in Krasta-Cukali trough, from the end of the Cretaceous. Alps have been a large part of the sea-floor, a great neritic ridge covered by shallow sea, where the carbonatic mud sedimented. Kruja area was a cord with relatively shallow sea. In Ionian trough has been continued the regime that was launched since the Jurassic, there pelagic limestone and argillaceous limestone with ammonite deposited. Sazani zone was a ridge on the sea-floor, which was a western boundary for Ionian trough, where gather neritic carbonate sediments.

New Cenozoic era (65 up to 2, 5 million years ago) is characterized by accelerating the process of orogenesis (mountain-building) in entirety of Albanides and stood large units that make up today's geological ground and underground of Albania. During the Eocene were converted in the mountain ranges the Albanian Alps area Krasta-Cukali zone, was further raised the mountain range in the area of Mirdita and formed depression of Korça. During Oligocene were build mountainous area in Kruja Zone, and during the Miocene those in Ionian zone, turning onshore majority of Albanian territory. During the Pliocene and the following Quaternary, which lies between 2.5 million to 5,000 years ago and continues to this day, out on the water the lowland of western part of this territory, while many mountains areas were covered by alpine glaciers. Under the abrasive action of the ice was formed glacial relief in the high mountains above 1500 m in the north and over 1800 m in the south of the country. More widespread this relief observe near "Leqet e Hotit" (Hoti Road Cascades to valley) in Albanian Alps, Lura mountains, Korabi, Tomori, Nemërçka, Çika Mountain, etc. Main forms of this landscape are glacial valley with washtub form, as valleys in Boga, Thethi, Vermoshi etc. glacial trough, etc. in Alps, holes and glacial circus in Nemërçka, Whit, Korabi, Lucë, Alps, Lura etc.. Are widespread glacial deposits or moraine in Bogë, Theth, "Leqet e Hotit", Vermosh, etc.

From corrosive activity of rivers, which continued to create their slopes and valleys, thick layers were formed alluvial depositions in plain areas, and took step by step the hydrographic network, creating landscape variety from plain to mountain's areas. By the neotectonic movements was created the Otranto Strait, who joined the Ionian and the Adriatic seas, Sazani was separated from Karaburun, and Albanian coastline took the step by step the today landscape configuration.

Albanian sedimentary basin continues in the Adriatic Sea shelf, with molasses and carbonate formations.

Paleomagnetic studies have shown that Albanides have undergone a clockwise rotation with amplitude of about 45° after Oligocene, analog with the phase observed on the western edge of the Hellenides. Transversal fracture Shkodra-Peja represents a transition zone between the clockwise rotation of Albanides and Hellenides at its south, and county clockwise rotation of the Albanian Alps and the Dinarides to the north. Horizontal displacement of Albania reaches 173 km at its southern edge, in relation to the pole of rotation of located in Shkodra – Peja transversal fracture.

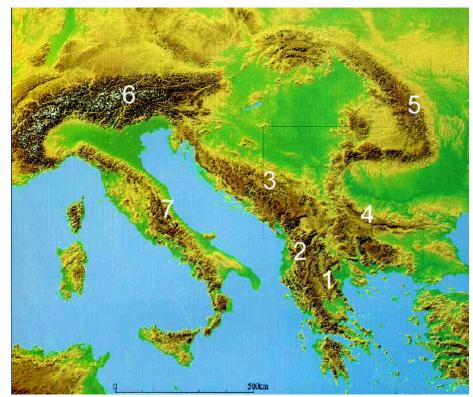


Fig. 1. Mountain ranges of the Mediterranean Alpine Folded Belt in Central and Southeastern Europe: Hellenides (1), Albanides (2), Dinarided (3), Alp (6), Apennines (7), and Rhodope Mountain in Bulgaria (4), Carpates Mountains in Bulgaria and Romania (5).



Foto 1. Mountain ranges in Albania

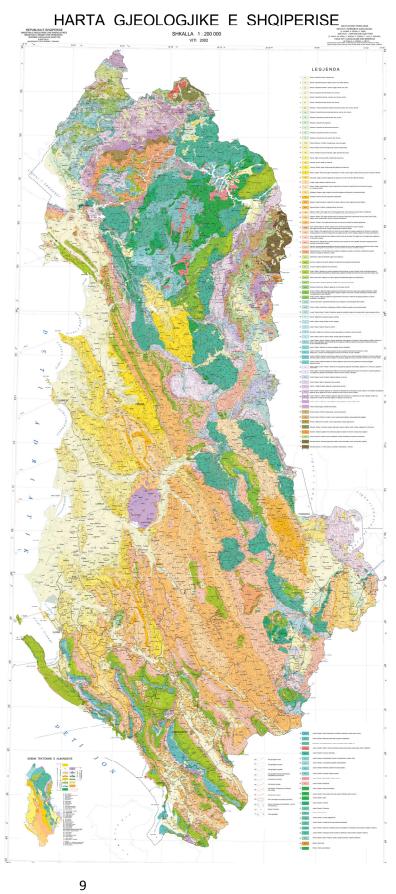


Fig. 2. Geological Map of Albania, at scale 1:200.000 [Albanian Geological Survey]

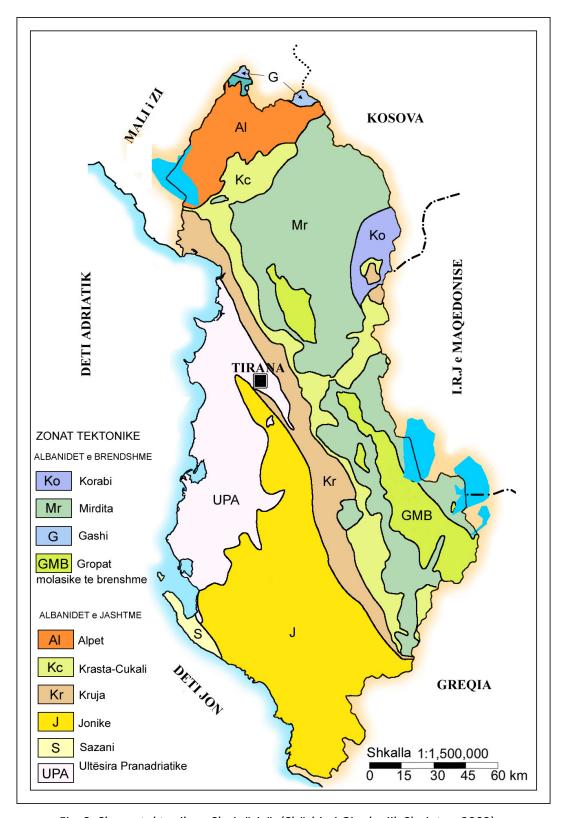


Fig. 3. Skema tektonike e Shqipërisë, (Shërbimi Gjeologjik Shqiptar, 2002).

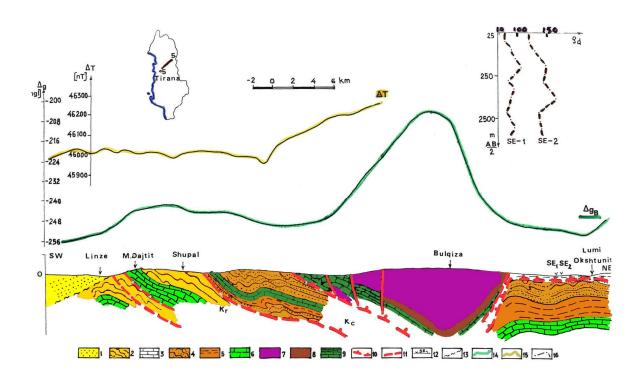


Fig. 4. Regional geolocical-geophysical profile Albanid-2. Tirana-Bulqiza-Okshtun (Frashëri A., Bushati S., Bare V. 2009)

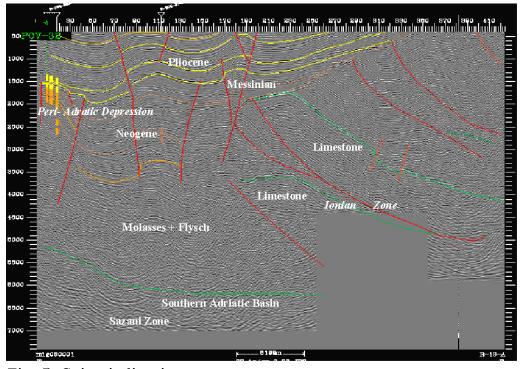


Fig. 5. Seismic line in Periadriatic Depression, in the Myzeqea field region (Frashëri A., Bushati S., Bare V. 2009)

### 2. GEOMONUMENTS IN ALBANIA

Our planet, Earth, keeps tracks of her past memories in minerals, rocks, fossils of living creatures that are between them and in the landscape of its surface relief. Geological information of these memories make it possible for them to "talk" with their language, be read and understood, showing the Earth's geological history.

Earth's geological heritage is represented by monuments, sites and geological parks. These are the study objects, the importance of which exceeds the boundaries of individual countries and serve for international knowledge, for exchanging knowledge and experience. Geological monuments or geomonuments represent elements of geology or ancient changes of the Earth and its inhabitants.

Natural, cultural and scientific values of the Earth heritage have become UNESCO, since 1972, to formulate "Earth Heritage Convention". According to Article 2 of this Convention, natural monuments are determined by the physical and biological formations, which have exceptional aesthetic and scientific value. Geological and physic-geographic formations have universal and scientific value. In 2000, UNESCO adopted the Declaration of the "Rights of the Memory of the Earth", where it is recommended to increase the number of geomonuments and geoparks in different countries, as well as working on the creation of the European Network of Geoparks. Today there are several natural heritage parks in different states Europe's. Actually are worked to preserve geomonuments, which often named "Earth history textbooks."

In this context, in Albania is organized PROGEO ALBANIA, which is Albanian Geologists Union of Geosciences Heritage, created by initiative and directed by Prof. Dr. Afat Serjani.

Geology of the Albanian land, Albanides, has hundreds of dozens geomonuments and geological heritage centers and parks. Visitor acquainted with them during trips across different itinerary. They have a stunning natural beauty.

Among geomonuments distinct following centers:

- Outcrops (exposure to the Earth's surface) of the rocks that form layers with folds and micro folds with a characteristic appearance, and different individualizations. Typical are layers of the sandstones, conglomerates, limestone, and some magmatic rocks. Among these examples we can mention sandstone layers in Krraba Pass, layers of the rare river's and lagoon's depositions in Priska, micro-folds of the flysch layers in Papër near Elbasani, way to Frashër of Përmeti, tabulated limestone layers in Tomorri Mountain, in Albanian Alps et Shqiptare and elsewhere, algal lithotamnic limestone in Priska near Dajti Mountain, pillow lava in Shënpal, and parallel dikes in Reps of the Mirdita, dunite and hartzburgite in Bulqiza, Kukësi, Tropoja and Shebenik, reddish conglomerates ultrabasic rocks in Librazhd, "Terra Rossa" in Pece of Saranda, subaqueous slumping of Malit të Gjerë in Muzina Pass, lourde and rare mineral placers in Rushkulli coastline, morainic deposits in Rrapsh near of "Leqet e Hotit" in Malësinë e Madhe, etj.
- Tectonic fractures: local, regional and Shkodër-Pejë transversal fracture.

- *Massifs of the magmatic ultrabasic rocks*, as hi of Bulqiza, Lura, Tropoja, Kukësi, Puka, Gomsiqe, Mount of Skënderbej, Shpati, Shebeniku, Voskopoja, etc.
- Massifs of the gabbros rocks, as hi of Kurbneshi, Shënmëria in Kukësi, Hasi, Qafzezi in Kolonja etc.
- Volcanic rocks in Mirdita, Puka, Kukësi, Rehova Korçë, etc.
- *Cliffs* from erosion residue rocks, inhabiting language are named "Guri" (stone). So there are many, but among them are; "Guri Cjapit" in Morava Mountain, "Guri Kajës", "Guri Topit" and "Guri Nikës" in Gorë-Mokër-Opar-Librazhdit region, "Guri Muzhaqit" in Çermenika, "Guri Prerë" in Gradec of Skraparit, "Guri Pishkashit" or "Sofra Skënderbeut", "Shkëmbi Kavajës", etj. In some areas are observed a rock section, which has vertical slope that named "muri", as "Muri Radohimës", "Muri Arapit" in Theth-Albanian Alps, etc.
- *Transgressions*, among which is the typical one of Greshica, south of Ballshi town, Mount Dajti Field, etc.
- *Karstic caves*, as Bënja in Përmet, Dragobia in Tropoja, "Dukë Gjonit" in western slope of Mount Rrëza Kanalit, Gajtani at east of Shkodra, "Haxhi Aliut" in Karaburun, Jubani in Shkodra, "Kusia Ndue Gjonit" in Mirdita, Katundasit at northeast of Beratit, Konispolit (Kërçmoit) near of the Mount Saraçini pick, "Lekë Petës" in Kurvelesh, Lepenica in Vlora, Pucit in Boga valley, Neziri in Mati region, Pëllumbasit near of Krraba, Pirates in Dhërmi, Pirogoshi near Çorovoda, Spilesë in Himara, "Shkëmbit të Blertë" in Librazhd, Vanistrës (Skotinia) near Gjirokastra, Velçës in Vlora, "Shpella e Zezë" in Krujë-Dajt mountain range, prehistoric cave of Treni at Micro Prespa lakeshore, etc.
- *Karstic phenomena*, among which is the typical one of "Mali me Gropa" (Mount with holles) at east of Tirana,
- *Canions,* as in Gradeci in Osumi River in Skrapar, Shkopeti in Mati River, Lëngarica in Përmeti, Drini in Koman, Brari east of Tirana, Canions in Gurrë of Kurveleshi, Gorge of Kalivaçi-Poçem Tepelena, etc.
- *River terraces*, as Vjosa riverside, of Shkumbi riverside, etc.
- Accumulative coastline, with sandy beaches as in Durrës, Velipojë, Shëngjin, Divjaka, Semani, etc.
- *Ersional coastline*, among which is the typical one of Currila Bishti Pallës Durrës, Albanian Riviera coastline, etc..
- **Submerged coast** under neotectonic activity. Typical is coastline in Semani and Patok.
- Erosional pass, as well-known of Mezhgorani Pass, Muzina Pass, etc.
- *Karstic springs*, as "Syri Kaltërt" in Bistrica River near of Saranda, Viroi in Gjirokastra, "Uji Ftohtë" in Tepelena, spring "Uji i Zi" in Këlcyra, "Ixori Borshit", springs in Tatzat, Picar, Radhimë, "Buronjat e Kuçe" in Kuçi of Labëria, of Poçemi, Tragjasi, Zhepa in Libohova, Bogova in Skrapar, Sotira in Gramsh, Tushemishti and Lini in Pogradec, of Qafë Thanës, Shënmëria and Selita springs at east opf Mount Dajti, "Guri Bardhë" spring in Mati region, Rrjolli in Shkodra, "Vrella sipërme" in Cemi River at Albanian Alps, Vukli in Theth, Selca, Qukut të Dunishës and Shoshanit springs in Valbona River, etc.

- *Gravel deposits and sandstone's pores springs* in western fields regions and in the Korça Field, Erseka, Bilishti, and Peshkopia fields, etc.
- Tectonic fissure springs, as in Lajthiza in "Qafë Mali", and "Qafë Shtamë".
- Springs from morainic deposits, as in "Fusha Hidrit" in Bulqiza.
- Artesian underground waters of Korça, Myzeqe, "Fushë Kuqe" fields, etc.
- *Thermal springs* in Peshkopia, "Llixha Elbasan", Holta in Gramshi, Kapajt in Mallakastër, Bënja in Përmeti, steam spring in Postenani Mountain, and thermal water springs in Sarandaporo River valley of Leskoviku.

*Glacial cirques* as in Jezerca (2690m), Shebeniku (2253 m), Tomorri (2414m), and Nemërçka montains (2185m), etc.

**Geological parks**, which are laid in larger areas, where there are many geomonuments. For each geopark of different regions, according to the itineraries, are describes geomonuments that can be observed and studying. In this paragraph are presented only as names most representative geomonuments, to understand complexities of the geoparks:

- Dajti Mountain area with Neogene transgression, where clearly distinguished the old coastal line, aged about of 15 million years ago, the eastern flank of the limestone structure. Neogene sandstone layers are extended over older formations, such as Oligocene flysch, and Eocene limestone. There can observe also the layers of the lithotamnic limestone in Priska village, the kastic phenomena in limestone, disjunctive tectonics, canyon in Brari village, etc.
- "Mali me Gropa" (Mount with holles) and Biza high land.
- Qafë Shtama (Shtama Pass).
- Pllaja e Sarisalltikut (Sarisalltik plateau) in Kruja, and in Korabi, etc.
- Ishëm- Rodoni Cap.
- Dumrea region with halogene deposits, and kastic phenomena in these deposits.
- Ultrabasic massif of Gjinari Elbasan.
- Zvërneci with characteristic phenomena of the sedimentation and fossils cemetery.
- Oil and gas bearing fields, where are oil reservoirs in Neogene sandstone (Patosi, Marinza, Kuçova), and in the limestone reservoirs (Cakrani, Gorisht-Koculi, Ballshi, Amonica, Delvina, Vurgu).

Gas bearing fields where are located gas reservoirs (Divjaka, Ballaj, Frakull, Durrës, and Povelça).

- Llogara Pass with subduction of the Adria micro plate under the Albanides orogen.
- Çika Mountain with glacial cirque.
- Melesini and Trebeshina mountains Cretaceous-Eocene limestone anticline, covered by Oligocene flysch.

- Mont Tomorri with tabulated limestone, karstic activities, and the Tomorrica region in the Easter slope of Tomorri, with intensive erosion of the Oligocene flysch formation, in both Tomorrica riversides.
- "Mali Gjerë" (Broad Mountain) with canyons, subaqueous slumping in Easter flank, the tectonic and halogene deposits belt in western flank.
- Mesozoic-Eocene limestone covered by flysch anticline belts of Kurveleshi.
- Mount Gramozi (2523 m) and mountain tourist center in Dardha, Korça.
- "Mali i Thatë" (Dry Mountain) and Ohrid-Prespa Lake system.
- Mount Korrabit with older geological formation of the Albanides, halogene deposits and Korari plateau.
- Bulqizë-Martaneshi region with ultrabasic chrome-bearing massif and large and well-known chromite deposits of Bulqiza, Batra, etc.
- Lurë-Kurbnesh region with ultrabasic massif and copper-bearing gabbros massif of Kurbneshi.
- Rubik-Kaçinar in Mirdita where extends volcanic rocks complex, where are sulphide mineralized zones and large copper deposits as well-known of Rubik, Kaçinar, Perlat, Derven, etc.
- One of the most important geological monuments is the Kçira, in the village of the same name, located to the left of road "Bridge Gomsiqes"-Puka town. Kçira exposed geological section from the middle Triassic to lower Cretaceous, belonging to an aging period of about 70-200 million years. The oldest layers are tabulated limestone with middle Triassic to lower Jurassic cherts. They are covered by rocks of the upper Jurassic to lower Cretaceous. In limestone is a very rich ammonite horizon, observed since the well-known geologist Franz Nopcsa, assessed as classic limestone horizon with Amonitico-rosso.
- Munellë- Qafë Bari- Tuç- Qafë Mali region, with the volcanic rocks complex. With this complex are linked sulphide mineralized zones and large copper and polymetalic deposits, like it Munella, Qafë Bari, Tuçi, Lak Roshi, etj...
- Shënmëri-Kukës-Morina region, where extends large complexes of ultrabasic rocks, gabbro, volcanic rocks, effusive-sedimentary series, etc. With these complexes are linked large deposits of chromite in Kalimash, of copper in Gjegjan, of ferro-nickel in Surroj, etc.
- Tropojë-Krumë Has- Golaj region, where in ultrabasic rocks of Tropoja massif and gabbro massif in Golaj in Hasi are located well-known chromite deposit of Kam Tropoja, Kepeneku, Ragami, and Paci, also copper-bearing quartz veins in Golaj.
- Granodiorite massif of Trokusit near Çeremi in Gashi tectonic zone, and in Levrushk.
- AlbanianAlps where are mountains and their picks: Pick Markule (2188m), Pick Radomira 2570 m), Thethi, Boga, Vermoshi, "Leqet Hotit".
- Valbona River valley Mount Jezerca, Mount Shkëlzeni, "Maja Hekurave", "Qetat Harushave", etc., with Mesozoic karstic limestone structures. There are many karstic caves, karstic underground waters springs, and in some sectors are some bauxites showings.

- Hydrographic System of the "Shkodra Lake - Drini River - Buna River"

### Mountains with altitudes above 2500m

In these mountains, but not only in they, are outcropped so spectacular structures of various geological sedimentary and magmatic formations. These mountains, which represent different geological structures, clad with forests, with mountain stream network, crystal water springs, important historical centers and healthy continental climate, representing areas for develop mountain-cultural and geological tourism.

Among the 41 mountains over 2000m altitude in Albania, ten of them are higher on 2500m: Jezerca (2693m), "Grykat e Hapëta" (2625m), Radomira (2570 m), Pick Papluku (2569m), "Maja e Hekurave" (2560 m), Pick Roshit (2524m) in Albanian Alps, Mount Korabit (2753m), Pick Velivaut (2374m) and pick of Kërçina (2325m) in Deshati Mountain, and the highest peak of Gramozi (2523 m). Holy Mountain Tomorr rises 2414 m and Mount Kulmakës in its south 2173m. Mount Nemërçka with glacial cirques rises 2185m, while the tick of Çika in Lightning Mountains (Acroceraun Mountains) rises 2045m. on the Ionian coastline.

Marine bay: of Drini, Durrësi, Vlora, Splilea, Porto Palermo, Kakomea, Saranda, and of Butrinti.

Lakes: Ohrid tectonic Lake, Shkodra Lake, Macro Prespa Lake and "Zaveri i Gorricës Vogël" where the water out of the lake and flows into Ohrid Lake, Micro Prespa Lake and cannel that connects the lake with it of Macro Prespa, karstic Dumrea Lake, Butrinti Lake and "Liqeni i Rrëzës" in his east, Alps Lakes, glacial origin lakes (seven Lura lakes, of Allamani, Shebeniku, Valamara), and hydropower plant lakes of Fierza, Vau Dejës, Komani, Ulza, Thana in Lushnja, Kurjani in Fieri, Gjançit in Korça, and of Deftia in Gjirokastër.

**Lagoons:** Karavasta Lagoon and Loop, Narta, Butrinti, Viluni (at the east of Buna River delta), Lezha lagons, Orikumit at south of Vlora and Patoku Lagoon north of Rodoni Cape.

Islands: Sazani, and Ksamili.

**High plains:** Plain of Korça (850 m), Devolli (850-900 m, Kolonjës plateau (1100 m), tectonic plain of Domosdova, etc.

**Rivers and their valleys,** where outcropped very beautiful geomonuments, where there is rich vegetation and clean water. From northern Albania to south are:

- Rivers: Drini, Drini of Lezha, Kir, Gjadër, Mat, Cemit River, Buna
- Deltas: of Buna, Island of Franz Jozef and unnamed island.
- Mati River, Great Fandi and Small Fandi, Mati River delta.
- Ishmi and Erzeni rivers.
- Shkumbini River and its mouth.
- Semani, Osumi and Devolli rivers.
- Vjosa River and its branches Lemnica, Lëngarica, Sarandaporo, Çarçova stream.

- Drinosi River
- Bistrica and Pavla rivers

Landscape of Albanian Riviera: Palasë, Dhërmi, Vuno, Himarë, Qeparo, Borsh, Lukovë villages.

As presented above, as part of the Mediterranean Alpine Folded Belt, Albanides represent more complex geological setting segment and with a typical geological evolution history for folded mountains belts, which in this complex do not meet in any of the Balkan or Europe countries. As indicated by geological monuments and parks, which are presented above, on the Albanian territory may be known various rock types: magmatic, sedimentary, and metamorphic, with age from Silurian system, about 430 million years ago, in Korabi Mountain up in the today Quaternary deposits.

Magmatic rocks have formed massifs of different sizes, veins, dikes and are also subjected to physical and chemical changes.

Geomonuments present the most varied structural forms, from the simplest to the most complicated, folded and affected by tectonics fractures.

### 3. TRAVELLING THROUGH ALBANIA TO VISIT GEOLOGICAL MONUMENTS

Geological monuments are rare heritage that Mother Nature has bestowed to Albania. They observed and touch anywhere in Albania, and through them you can understand and study how it is formed Albanian land, when it was builder and how it changed in about 500 million years of its history.

Their description will do the routes, which usually traversed by domestic or foreign travelers, to show them what can observe while traveling that have taken. Description we have begun systematically from northern Albania to the South.

Varieties of rock types and different geological processes have made that in Albania to visit regions and zones with landscapes not only very beautiful, but also storyteller of geological activity during the evolution of hundreds of millions of years. This makes visits to these geomonuments with large international scientific importance, to exchange knowledge and experience. Are these natural beauties that make geomonuments of Albanides as tourist destinations, and Albania as a country can be develop cultural and sport's tourism. His activity will also improve the living standards of communities in different provinces of the country.

Cultural, scientific and health benefits and pleasure that offer the geological-tourist traveling through Albania create the impression that to invite:

Welcome to Albania to visit Albanides! And you'll want to return again!

### **GEOMOMUMENTS IN ALBANIA**

# **OUTCROPS, ROCKS INDIVIDUALISATIONS, TECTONICS FAULTS**

- Zhveshjet si edhe veçime të ndryshme shkëmbinjsh, thyerjet tektonike











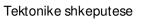


















Transgresion, Greshice Ballsh.

### **ALBANIAN RIVIERA AND VJOSA RIVER VALLEY**



Plazh zhavoror, Rivera Shqiptare



Bregdet akumulativ zhytës Seman



Lumi Vjosa në Grykën erozionale te Mezhgoranit



Morto Palermo

### **OHRID-PRESPA LAKES SYSTEM REGION**



Liqeni i Ohrit dhe tektonika në bregun perëndimor, Pojskë



Liqenet Ohër-Prespë













Zaveri i Gollo mbocit

Mbushja e L. Prespa e Vogël

Dukuria karstike ne brigjet e L. Prespës

# NEMERÇKA DHE DHËMBELI



Melesi ni shap kë bardhë

Nemërçka me cirqet akullnajore

# Lushnje – Fier - Mallakastër



Litorali shqiptar parë ng a Ardenica



Laguna e Karavastasë







Brahantiklinali neogjenik i Ardeni cës Dunat e rërës Seman

Bregdet akumulativ, Divjakë

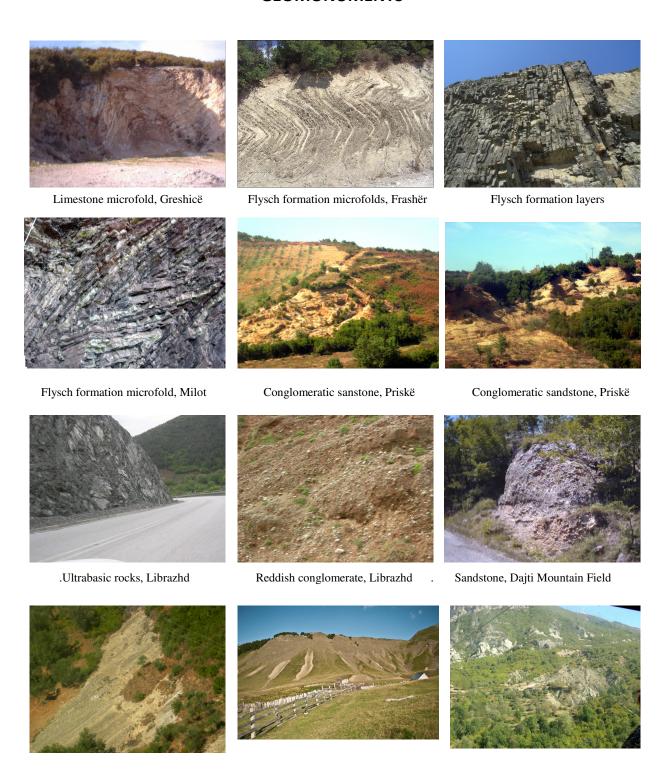


Bregdet zhytës, Se man



Transgresioni neo gjenik mbi gëlq erorët eocenikë, Greshicë, Ballsh

### **GEOMONUMENTS**



Coarse graned sandtone, Priskë

Muddy-sandy flyschoid, Lepushe, Albanian Alps (5) . Flysch formation, Dajti Mountain







Tabulated limestone, Vermosh, Albanian Alps (3) Limestone, Kruja Mountain





Limestone bed packet, Kruja Mountain Tectonized limestone, Kruja Mountain





Cretaceous limestone cover volcanic rocks, Mirditë





Cretaceous limestone cover volcanic rocks, Mirditë Limestine cliff, Dangëlli, Përmet



Morainic deposits, Hot, Albanian Alps



Guri i Qytetit (City Cliff), Përmet



Guri Cjapit (Cjapi Cliff), Moravë, Korça (2) Guri Cjapit (Cjapi Cliff) fragment,



Moravë, Korça (2)







Guri i Kamjes, (Kamje cliff), Gorë

Guri i i Kamjes, (Kamje cliff),fragment (2)

Limestone, Rubik







Muri Radohimës(Radohima Wall), Albanian Alps (3) Muri i Arapit (Arapi wall), Theth (3)

Tabulated limestone, Prekal Albanian Alps (3)



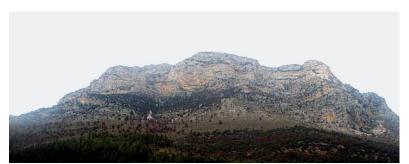




Glacial circus, Nemërçka Mountain



Vjosa River terraces, Përmet



Limestone anticline, Trebeshina Mountain, Këlcyra



Kamencka Canion, Dangëlli, Përmet



Neogene transgresioni over Eocene limestone, Greshicë, Ballsh



Karstification of limestone, Përmet



Karstified limestone, Tomorri Mountain



Karstified limestone, Vermosh, Albanian Alps







Karstified limestone stone, a fragment, Pogradec Canion in limestone, Shkrel, Kelment, Albanian Alps (5) Neogene sandstone layers trangressively extended over flysch formation, Dajti Mountain







. Karstified limestone,, Theth, Albanian Alps Contact between limestones and volcanic rocs, Mirdita Lithotamnic limestone, Priskë, Dajti Mountain Priskë







Morainic deposits, Rrapsh, Alps Malësi e Madhe



Intensive erosion of the flysch deposits, Tomorrica River valley







Accumulative Adriatic Sea costline, Buna River; Heavy and rare minerals placer, Rushkull, Lalzi Bay; Erosional Adriatic Sea coastline sector, Karpen, Kavajë







Erosional Ionian Sea coastline, and gravel beach, Albanian Riviera



Erosional Adriatic Sea coastline sector, Vlora Beach and beach in "Uji Ftohtë" ("Cold Water").



Gravel beach in erosive Ionian Sea coastline



Submerged coastline, Semani



Channel of the Butrinti Lake (4)



Islands in Ksamil, Sarandë ((3))



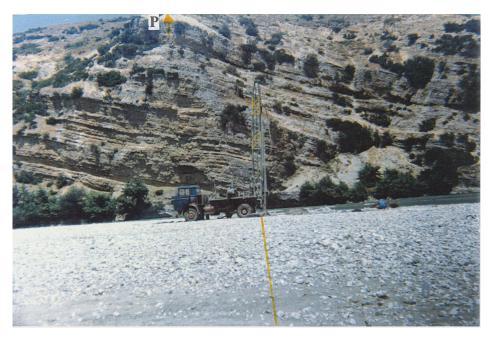




Geothermal deep well, Shijon, Elbasan

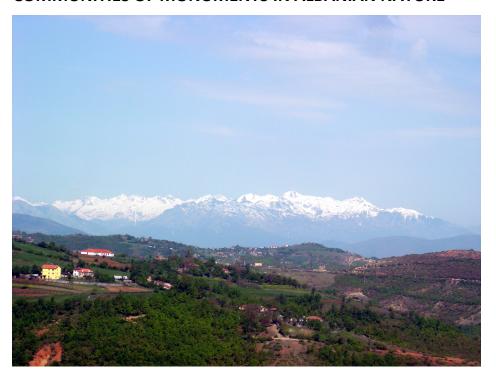
Selca sring, Albanian (3)

Karstic spring "Ixori i Borshit", Albanian Ionian Riviera



Vjosa River bed, Kalivaç, Tepelenë

# THE GEOMONUMENT PARKS REPRESENT THE AREAS OF COMPLEX COMMUNITIES OF MONUMENTS IN ALBANIAN NATURE



Albanian Alps observed from Kalimashi



Geopark of Boga (Malësi e Madhe), where extend the upper Triasic up to upper Jurassic carbonate formations, represented by limestone, dolomite limestone, dolomite [8]





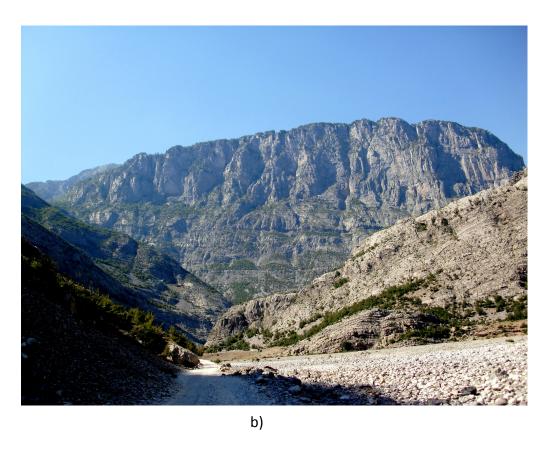
Geopark of Lepusha (Albanian Alps), where extend middle Cretaceous deposits (Mastriktian), të represented by the combination of flyschoids and clay-sandstone-limestone formations [8]



Geopark of Shkreli (Albanian Alps), where extend from upper Triassic to upper Jurassic carbonate formations, represented by limestone, dolomite limestone, dolomite [8]



a)



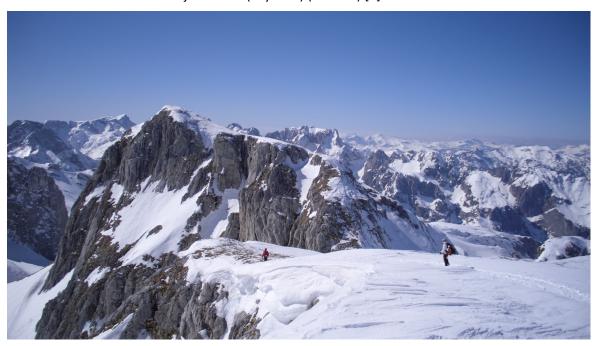
Geopark of Tamarjes, where extend upper Triassic represented by the limestone formations [3]



Gjeoparku i Selcës, where extend Jurassic formations, represented by the limestone [2]



Maja e Thatë (DryPeak) (2406 m) [4]



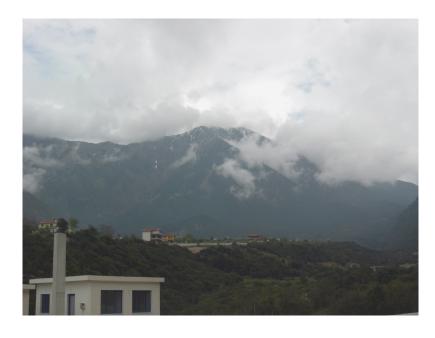
Gjeopark of Albanian Alpet Valbona area, where lie carbonate formations from upper Triassic to upper Jurassic, represented by limestone, dolomite limestone, dolomite, as well as the claysandy flyschoid-limestone of Cretaceous (Mastriktian) [4]



Geopark of Tomorri Mountain, build from Cretaceous-Eocene
Limestone that are covered by Olygocene flysch formations
In its flanks



Lihtnings Mountain – Çika, build by Mesozoic carbonate formations





Dry Mountain and Field of Korça, Mesozoic carbonate formations



Këlcyra Pass and Vjosa River



Porto Palermo (Palrmo Port), surrounded by Cretaceous limestone



Ohrid Lke, Pogradec and Mali i Thatë (Dry Mountain) -Galičica

Disjunctive tectonics at Ohrid Lakeshore





Geopark of Kraba, where limesgtone structure of Dajti Mountain is is covered transgresively by Neogene molasse among which is the coal-bearing suite



National Park "Hotova Fir.tree Forest", near Frashëri villege, Permet