

## Geological sites of the External zones of Albania

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*А. Серьяни – Геологические объекты Внешних зон Албании.* Во Внешних зонах Албании выявлены многие интересные геологические явления, как например: стратиграфические разрезы осадочных пород, перерывы седиментации, складки, диапировая и надвиговая тектоника, и т.д. Литостратиграфические разрезы Мали Гере (Ионическая зона), Караборун (зона Сазани), Спитен (подзона Краста) и Комани (подзона Чукали) являются объектами особого дидактического и научного значения. Обнажения "амонитико rosso", посидоновых сланцев, богатых макрофауной фино плитчатых известняков тоже очень характерные. Обнажения карбонатно-радиоларитовых пород Комани выявляют разнообразные стратиграфические и тектонические особенности. Перерывы седиментации с бокситами установлены в карбонатных породах зон Круя. Многие проявления фосфоритов, нефти и газа, солей, битуммов и битуминозных пород, доломитов и т.д. были объектом геологической разведки. Чистые источники карстового происхождения и пещеры очень интересные. Во внешних тектонических зонах расположены также многие красивые туристские ландшафты, археологические и архитектурные памятники.

*Abstract.* Many interesting geological phenomena occur within the External zones of Albania, such as stratigraphic sections of sedimentary rocks, sedimentation breaks, folds, diapir and thrust tectonics, etc. The lithostratigraphic sections of Mali Gjere (Ionian Zone), Karaborun (Sazani Zone), Spiten (Krasta Subzone) and Komani (Cukali Subzone) are sites of special scientific and educational importance. Outcrops of "ammonitico rosso", *Posidonia* beds, finely stratified and laminated limestones rich in macrofauna, etc. are very typical. The outcrops of carbonate-radiolarite rocks at Komani demonstrate important stratigraphic and tectonic features. Sedimentation breaks with bauxite ores are observed in the carbonate rocks of the Kruja Zone. Many deposits and findings of phosphorites, oil and gas, salts, bitumen and bitumen-bearing rocks, dolomites, etc. are prospected in these zones. Pure underground springs of karst origin and karst caves are other very interesting sites. Many beautiful tourist landscapes, archaeological and architectural monuments are also situated within the External tectonic zones.

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*Key words:* Albania; External zones; geological heritage sites

### Introduction

Albania is situated in the southern part of the Balkan Peninsula, and is characterized by beautiful nature and Mediterranean climate. The mountain regions (Northern Albanian Alps, Eastern mountain chains, Southern Carbonaceous Plateau), the Adriatic Coast and the Albanian Riviera on the Ionian Seaside are real jewels.

No papers on the rich geological heritage of Albania have been published up to now. Now, with the First Subregional Meeting "Conservation of the Geological Heritage in Southeast Europe", comes the time to evaluate this heritage. Therefore, the present paper aims to

present some of the most typical geological sites of the External zones in the frame of archaeological, historic and tourist features.

I wish to extend my gratitude to the organizers of the Meeting, and especially, to Prof. Zagorchev and Dr. Nakov. Dr. G. Gorngrijp helped me considerably with important papers on nature conservancy.

### External tectonic zones of Albania

The External tectonic zones are situated in the southern and northwestern parts of this country (Fig. 1). These zones are: 1) Sazani (Preapulian) Zone; 2) Ionian Zone; 3) Kruja (Gavrovo,

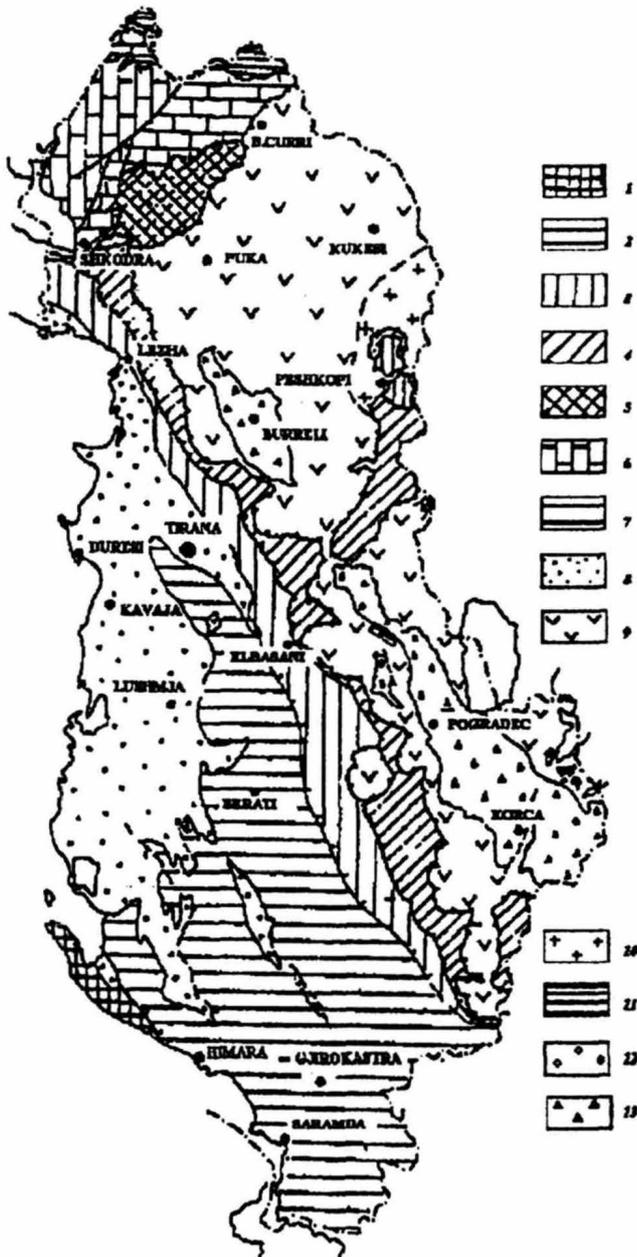


Fig. 1. Tectonic sketch map of the Albanides in Albania. 1 — Sazani Zone; 2 — Ionian Zone; 3 — Kruja Zone; 4 — Krasta-Cukali Zone, Krasta Subzone; 5 — Krasta-Cukali Zone, Cukali Subzone; 6 — Zone of the Albanian Alps, Malesia e Madhe Subzone; 7 — Zone of the Albanian Alps, Volbona Subzone; 8 — Vermoshi Unit; 9 — Mirdita Zone; 10 — Korabi Zone; 11 — Gashi Zone; 12 — Preadriatic depression; 13 — Albanian — Thessalian depression

Dalmatian) Zone; 4) Krasta-Cukali (Pindos, Budva) Zone.

The zones are traced in NW — SE trend. The contacts between them have a thrust character, and a western vergence. Each zone is thrust over the next one situated to the west. The External zones consist mainly of carbonate-chert formations of Mesozoic and Cenozoic age.

The External zones possess a great number of geological sites of different character:

geomorphological, regional-geological, stratigraphic-palaeontological, hydrogeological, industrial-mineral, etc.

### Geomorphological sites

The geomorphological sites are numerous. Many mountain ridges, river valleys, the high mountain plateaus of Kurveleshi, Cajupi, Tomorri, etc. are remarkable. The deep canyons with almost vertical walls of "Gurra", "Lengarica", "Mican" (Osom), Corovoda, Holta (Kruja Zone), and Komani — Fierza of the Drini River (Krasta-Cukali Zone) are particularly beautiful and interesting.

Many karst caverns are formed into the carbonate formations of the External zones. They are usually both of geological and of hydrogeological, archaeological and historical importance. Such caves are known and studied in Konispoli, Xara, Himara, Vanister, Kelcyra, Gusmari, Cajupi, Fushebardha, Kolonja, Pocemi, Benja, Pirogashi, Erzeni (Tirana), etc.

Waterfalls are formed in the Kurveleshi Plateau and in the Mican-Tomorri, Kruja-Dajti mountain chains. The karst lakes on the surface of the Dumrea, and the Kardhiqi evaporite diapirs are other important sites.

### Geological sites of regional geological, palaeontological, stratigraphic and tectonic importance

Many stratigraphic sites of the External zones have regional or wider scientific and educational importance. The section of Mali Gjere in the Ionian Zone (Fig. 2) begins with Upper Triassic evaporite and dolomite at Delvina (in the western side), and continues through formations of Jurassic, Cretaceous, Paleogene and Neogene age (Libohova). This section is studied in detail, and biozones have been divided. The section of Llogora, Sazani Zone (Fig. 3) is also of considerable interest. It is built up of Cretaceous limestones rich in rudist fauna. The section of Kruja is characterized by sedimentation gaps and bauxite ore. The section of Spiteni (Krasta-Cukali Zone) consists of carbonate and radiolarite rocks (Fig. 4). Numerous interesting stratigraphic sites in the Kurveleshi Plateau (Ionian Zone) consist of "ammonitico rosso", *Possidonia* beds, Jurassic (Lower-Middle Lias) limestones topped by major unconformity, etc. The outcrops of igneous and metamorphic rocks in the Kurveleshi anticlinal belt (Serjani, Bajo, 1992) are of regional importance as a rare phenomenon for the External zone.

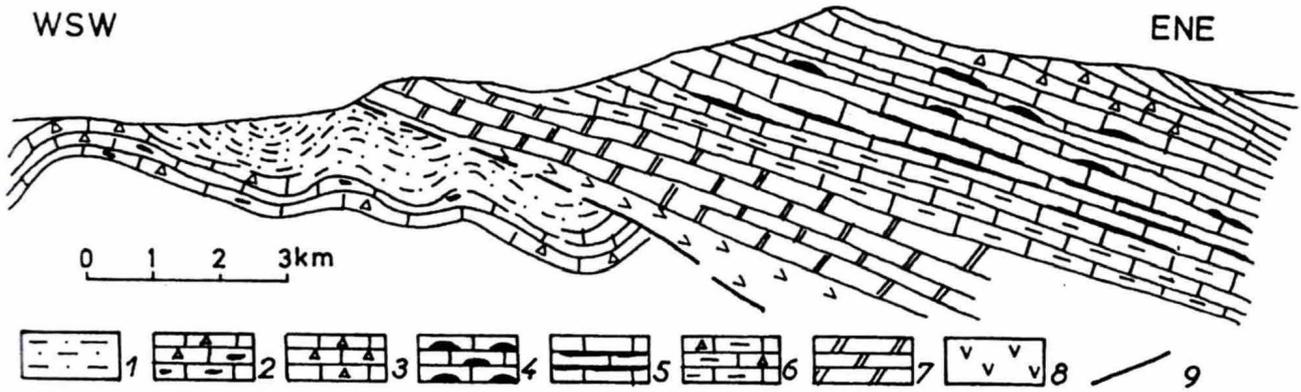


Fig. 2. Mali Gjere cross section. 1 – Upper Eocene – Lower Oligocene flysch; 2 – Eocene limestones with cherts; 3 – Cretaceous crystalline limestones; 4 – Upper Jurassic porcelainous limestones; 5 – Middle Jurassic siliceous slates; 6 – Lower Jurassic clayey crystalline limestones; 7 – Upper Triassic dolomites; 8 – Permo-Triassic evaporites; 9 – faults

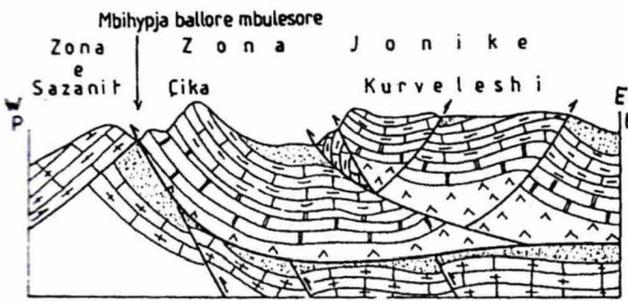


Fig. 3. Geological section at Llogora

Typical fossiliferous sites yielding ammonites, rudists, *Possidonia* sp., etc., in the Ionian, Kruja and Sazani zones, and typical microfauna in the Krasta-Cukali Zone, are studied in detail by the Albanian palaeontologists.

Well exposed and beautiful structural-geological sites as folds, thrusts, faults, etc. (Figs. 5, 6, 7) are studied and mapped in the External zones. Some of them represent regional interest, and should be protected as sites of special scientific importance.

### Hydrogeological basins and springs; industrial minerals

Important underground water basins are related to the karst and the carbonate rocks of the External zones. Many beautiful springs flow out of these carbonate massifs and form rivers as Pavla, Bistrica, Kalasa, Shuri, Borshi-Fterra, Vermiku, Gurra-Benca, Pocemi, Benja, etc. Some of the springs are beautiful spots within magnificent natural landscapes, and represent tourist centres. Thermal springs of balneological importance are situated at Leskovik, Labinot, Benja, and salt springs are located at Shkalla, Bufi, Vermik-Bashaj, etc.

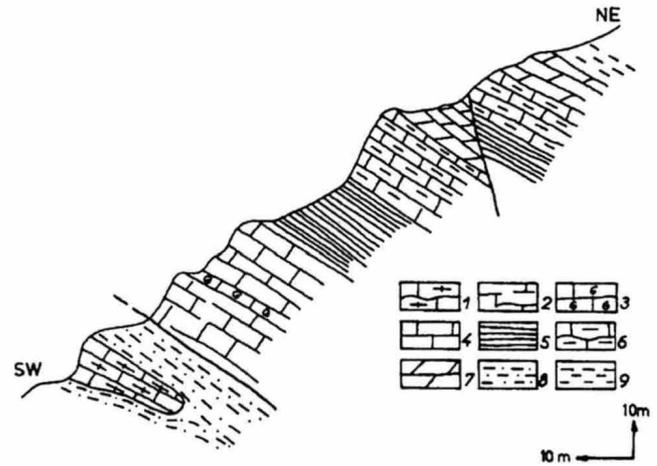


Fig. 4. Spiteni section. 1 – Upper Triassic limestones with *Megalodon*; 2 – Liassic biomicritic limestones; 3 – Toarcian "ammonitico rosso"; 4 – Dogger-Oxfordian biomicritic limestones with filaments; 5 – radiolarites (Kimmeridgian – Berriasian); 6 – Cretaceous limestones; 7 – Paleocene – Eocene marls; 8 – Maastrichtian – Eocene flysch of the Lisne-Spiten Unit; 9 – Paleogene shales

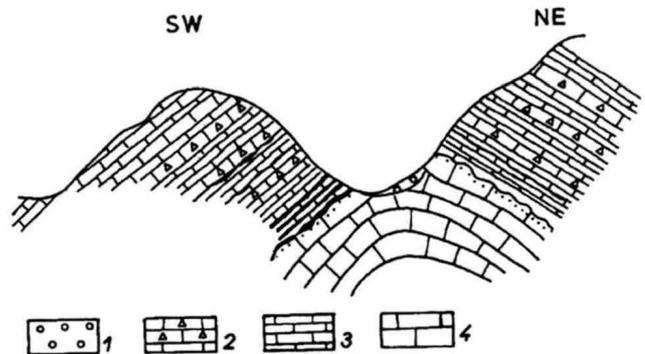


Fig. 5. Geological section of the Bogazi anticline (after Nasi et al.). 1 – cover; 2 – upper chert packet (Kimmeridgian); 3 – bedded limestones (Upper Jurassic); 4 – massive limestones (Lower – Middle Lias) with phosphates

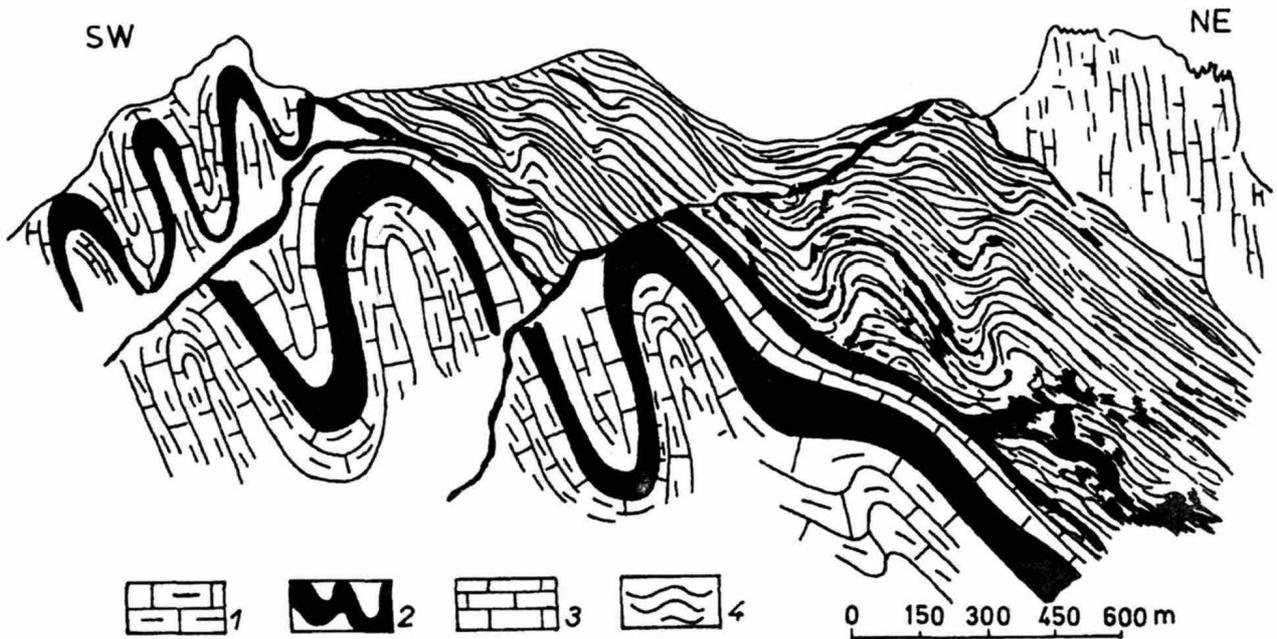


Fig. 6. Folds in the Cukali Zone. 1 – Clayey-cherty beds, radiolarian limestones and cherts (Lower – Middle Jurassic); 2 – radiolarian marls and radiolarites (Upper Jurassic – Lower Cretaceous); 3 – laminated marly limestones with cherts (Upper Cretaceous); 4 – alternation of shales and marls (Xhani flysch)

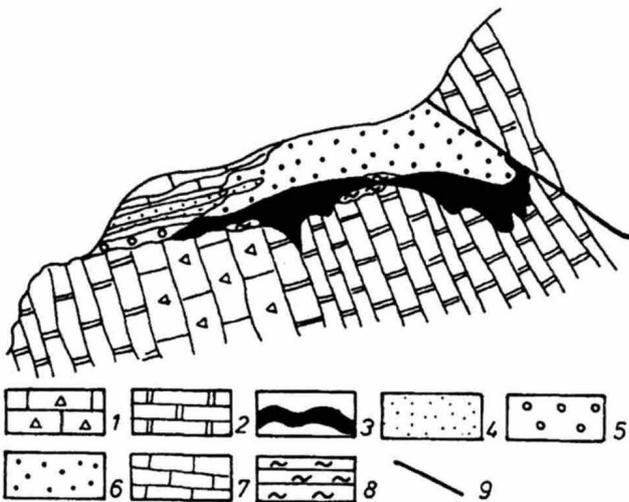


Fig. 7. Schematic cross section of the bauxite deposit Dajti. 1 – Limestones with rudists (Senonian); 2 – dolomites (Upper Senonian); 3 – bauxite ore (Upper Helvetian); 4 – sandstones; 5 – conglomerate; 6 – slope breccia (Upper Helvetian); 7 – lithothamnium limestone (Upper Helvetian); 8 – claystone (Upper Helvetian) 9 – faults

Industrial mineral deposits of phosphorite, salt, bitumen and bituminous rocks, dolomites, gause, gypsum and anhydrite (Ionian Zone), bauxite (Kruja Zone, Fig. 7), and decorative ornamental stones, are prospected and mined. Some of them represent sites of scientific and educational importance, and can be managed as open-air or mine museums when exhausted.

## Geological sites, historic and archeological monuments and tourism

Many important archeological centres (Apollonia, Antigonea, Butrinti, Himara, Komani, Ploca) and ancient towns with castles (Berati, Borshi, Durresi, Gjirokastra, Kanina, Kruja, Lezha, Libohova, Petrela, Shkodra, Tepelena, etc.) are closely linked to geological sites of interest. The development of internal and international tourism should take into consideration the necessity of preservation both of the natural (geological included) and historic monuments. Tourist centres are already in development. as, e.g., the beautiful island of Ksamoli, the town of Saranda, Himara, Dhermi, Llogora (at 1000 m above sea level), the cold water springs at Vlora, Tepelena, Kelcyra, Bogova, the town of Berati, Ardenica Monastery, the port of Durresi, Kruja, the town of Shkodra, etc.

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