

## Hydrocarbon exploration under Kruja zone in Tirana-Rodon area, Albania

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**Abstract:** Albania is part of the Mediterranean Alpine Fold Belt and fits in the Dinaric-Hellenic range. The geological structure of the Albanides comprises of two major units: the Internal Albanides to the East and the External Albanides to the West. The Kruja zone consists of carbonate neritic deposits and belongs to the External Albanides. From a tectonic point of view, it is composed of several linear anticline structural chains separated by relatively narrow synclinal chains. Numerous oil seeps at outcrops and in deep wells have attracted attention for hydrocarbon exploration 50 years ago. The combined interpretation of geological and geophysical data, suggests that the folding of Papër-Rovë flysch belt are surface indication of the continuation of the Ionian zone North of Elbasan–Dibër transverse fault. These data are in agreement with the region pale geographic and geodynamic development. These lead us to the conclusion that Ionian zone, represented by two structural ranges described above, should continue further North, at least up to the line Nr.8-8.

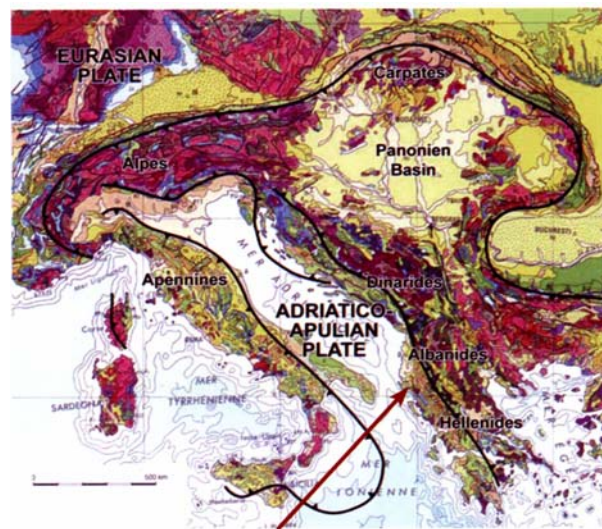
**Key words:** Oil exploration, Albania, seismic reflection.

### INTRODUCTION

Albania is part of the Mediterranean Alpine Fold Belt and fits in the Dinaric-Hellenic range (Fig. 1). The geological structure of the Albanides comprises of two major units: the Internal Albanides to the East and the External Albanides to the West.

The Internal Albanides are characterized by a developed magmatism. Intensive tectonics have led to overthrust and tectonic napes. The Internal Albanides are further subdivided from East to West into the Korabi (KO), Mirdita (M), Gashi (G), Albanian Alps (A), and Krasta Cukali zones (KC) (Fig. 2). Two post orogenic sedimentary (intermountainous) basins, the Burreli Basin to the North and the Korça Basin, overlie trasgressively the Mirdita zone and partially the Krasta-Cukali zone. The External Albanides, even though characterized by the lack of magmatism and by more regular structural models compared to the Internal Albanides, are highly affected by a considerable thrusting of the tectonic zones and/or structural belts Westwards. Both the Shkodër-Pejë (Scutari-Pec) lineament (I) and Vlorë-Elbasan-Dibër lineament (II) permeate the Albanide structure respectively in the North and in the central part with a SW-NE trending (Fig. 2). From East to West, the External Albanides comprise of the Kruja platform (Kr), further Westwards the

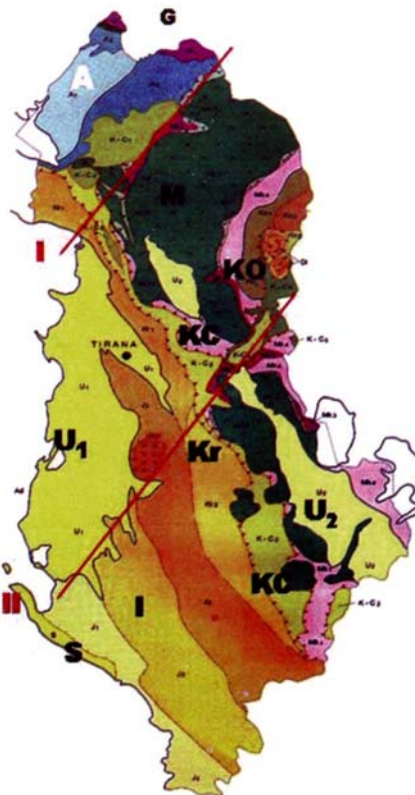
Ionian trough (I) and Sazani platform (S). In the central Albania, the overlying Peri-Adriatic Depression (U<sub>1</sub>) to the West masks the Ionian and partly Kruja tectonic zones. Westwards offshore, the Peri-Adriatic Depression is unified with the South Adriatic Basin, which overlay the Preapulian (Sazani zone) and Apulia Platform, (Silo, et al. 2008, 2006; Foto, 2000; Frashëri et al. 1996).



**FIG. 1.** Regional setting of Albania.

The Kruja zone consists of carbonate neritic deposits. From a tectonic point of view, it is

composed of several linear anticline structural chains separated by relatively narrow synclinal chains. Numerous oil seeps at outcrops and in deep wells have attracted attention for hydrocarbon exploration 50 years ago. A dense grid of seismic lines was scanned last year. The interpretation of these seismic data solved crucial geological problems, such as structural form, tectonic style and hydrocarbon migration. The carbonate sequence of the Kruja zone is characterized by longitudinal and cross tectonic faults as well as rare and small amplitude back thrusts along the Eastern flanks of the anticline structures. The region under investigation (Fig. 3) covers partly the North Kruja tectonic zone, the Ionian one and the South Adriatic basin. It has continuously been a problematic area as related to tectonic-facial zones. In particular, the main question is whether the Ionian zone continues North of Dumrea salt diapir.



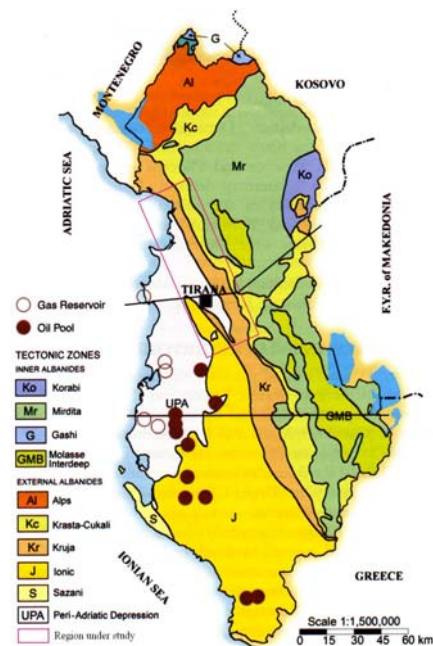
**FIG. 2.** Tectonic units of Albania. The Internal Albanides are subdivided into the Korabi (KO), Mirdita (M), Gashi (G), Albanian Alps (A), and Krasta Cukali (KC) zones. The External Albanides comprise of the Kruja platform (Kr), the Ionian trough (I) and the Sazani platform (S). In the central Albania, U<sub>1</sub> denotes the Peri-Adriatic Depression. The Shkodër-Pejë (Scutari-Pec) lineament (I) and Vlorë-Elbasan-Dibër lineament (II) are also shown with red lines.

The strong overthrust of Kruja zone structures towards West, the presence of the salt diapir and the facial changes of the deposits pose difficulties regarding the relationships between these tectonic units. Based on existing studies and recent seismic data, this paper advances the knowledge about the geologic-tectonic structure of this problematic region (Silo et al., 2008, 2006; Dhima et al., 2002; Foto, 2000; Frashëri et al., 1996).

## GEOLOGIC-TECTONIC STRUCTURE OF THE TIRANA-RODON AREA.

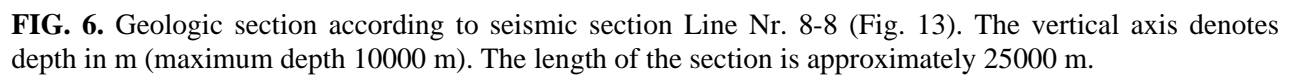
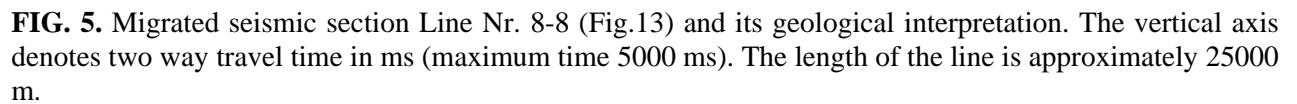
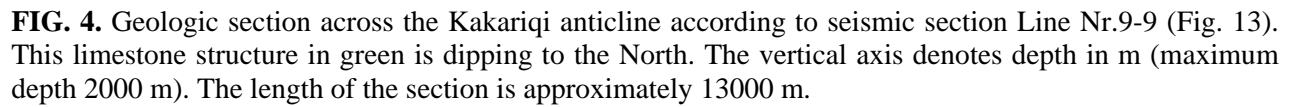
The structural model suggests that the region under study represents an interweaving of two tectonic-facial zones. The continuation of the Ionian limestone structures to the North under the Kruja overthrust is of special interest. To clarify this model, the geologic-tectonic structure of the region is briefly given as per tectonic-facial zones.

**1.- Kruja Zone:** Kruja tectonic zone represents a ridge bordered by Krasta-Cukali tectonic zone to the East, Ionian zone and South Adriatic basin to the West. The flysch is clearly seen along the Kruja zone. The Eastern boundary of this zone is well defined. On the contrary the Western boundary between the Kruja and the Ionian zones, is not clearly observed on the surface due to the following facts: **a)** The Oligocene flysch is present on both zones and **b)** many tectonic faults and the Tirana syncline overthrust are observed to the West (Figs. 2 and 3).



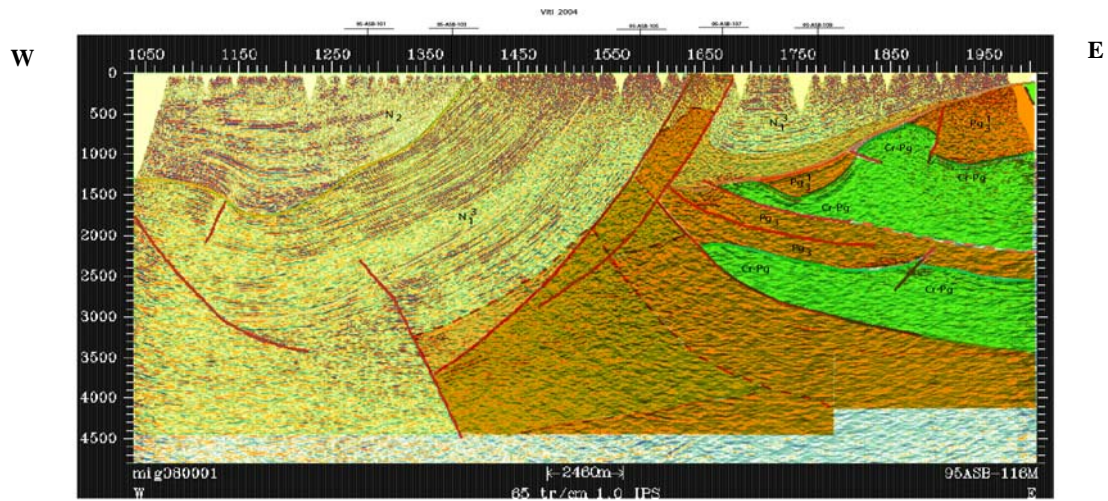
**FIG. 3.** Schematic tectonic map of Albania and its oil and gas reservoirs. The area under investigation is in red rectangle.



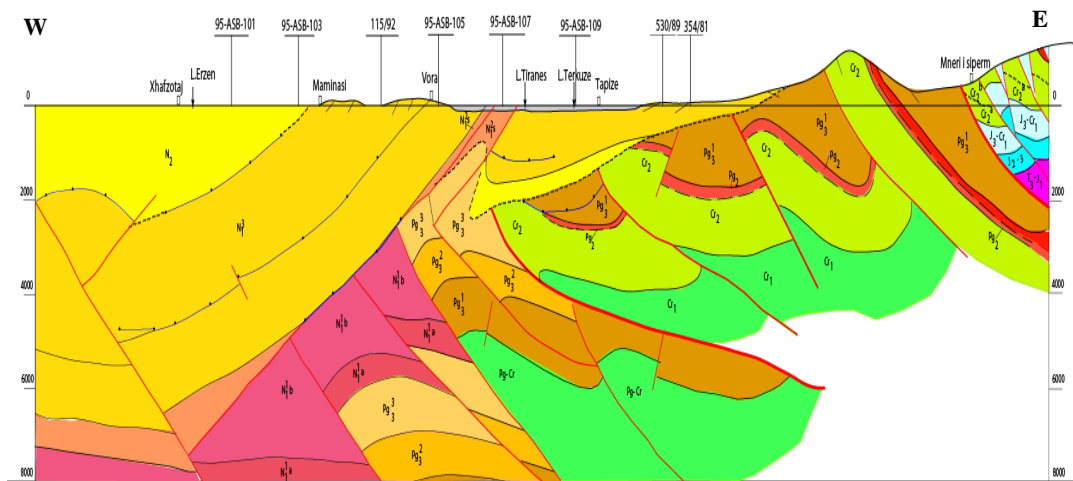




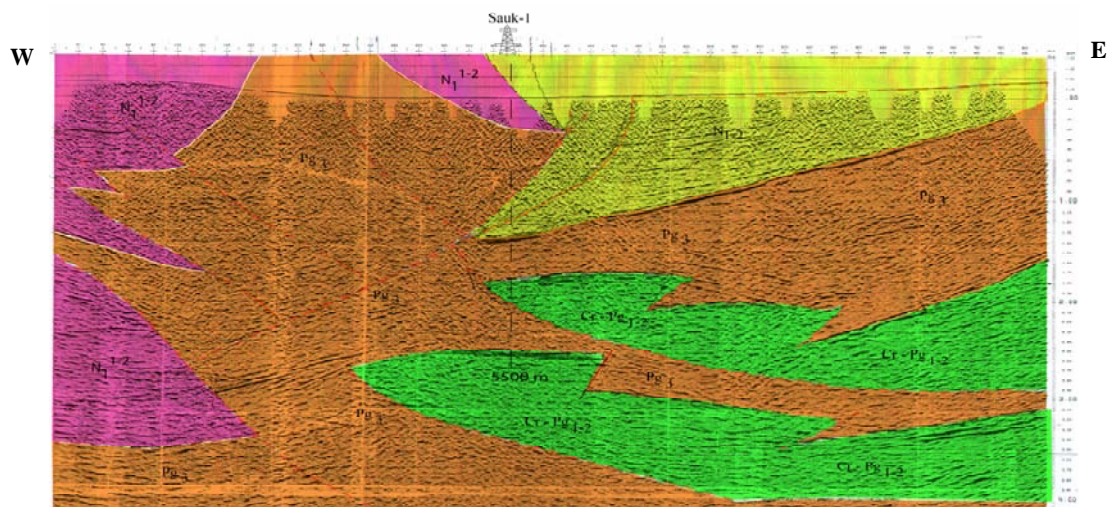




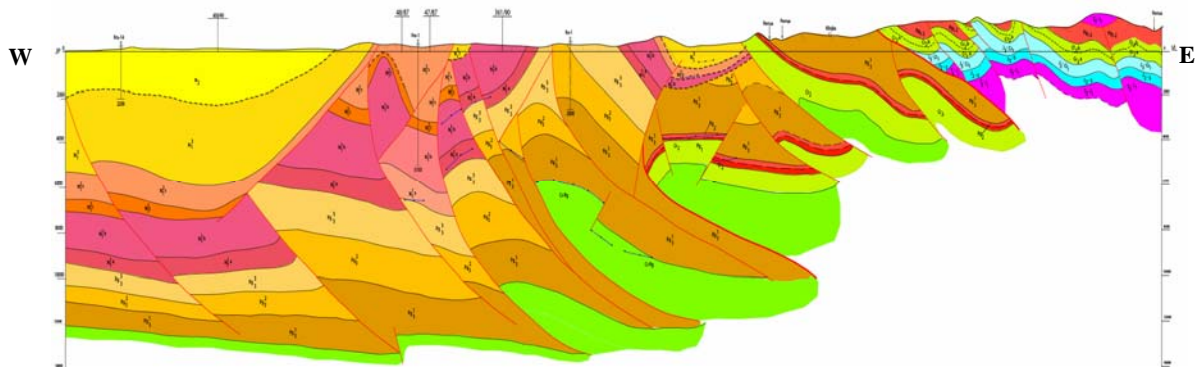
**FIG. 9.** Migrated seismic section Line Nr. 6-6 (Fig.13) and its geological interpretation. The vertical axis denotes two way travel time in ms (maximum time 4800 ms). The length of the line is approximately 30000 m.



**FIG. 10.** Geologic section according to seismic section Line Nr. 6-6 (Fig. 13). The vertical axis denotes depth in m (maximum depth 8000 m). The length of the section is approximately 30000 m.



**FIG. 11.** Migrated seismic section Line Nr. 4-4 (Fig.13) and its geological interpretation. The vertical axis denotes two way travel time in ms (maximum time 4000 ms). The length of the line is approximately 25000 m.





These faults have caused not only the limestone deformation but also their disjunction which is observed in the seismic profiles (Figs. 5-10), (Silo et al., 2008, 2006; Dhima et al., 2002; Foto, 2000; Frashëri et al., 1996).

**2.-Ionian Zone:** According to the geological and geophysical evidence the Ionian zone in this region exhibits two structural lines:

**a)** The anticline Rovë-Sauk-Nikël: Middle Oligocene deposits are present on the top, Eastern flank and two periclinal. The seismic profiles, shot recently, verify the presence of folding under the flysch formation. Using these profiles and earlier ones, a time section was constructed for a reflecting horizon at 2.5 to 3.8 s, which defines the Rove limestone anticline (Figs. 9-12). This horizon undoubtedly shows the limestone top, according to the geological concept, pale tectonic development, Oligocene deposit facies, reflection intensity, etc. This anticline continues towards North for about 22 km. The 6000 m isobaths show that there are two anticlines, namely the Rovë-Sauk to the South and Tirana-Nikël to the North (Fig. 13). The limestone anticline of Rovë-Sauk is evidenced by a well of 5500 m depth, projected to evaluate the hydrocarbon potential of this area (Fig. 11) (Silo et al., 2008, 2006, 2000).

**b)** The anticline Rinas-Gjuricë: It is interpreted based on seismic operations and data of well Adriatic-2 (Fig. 5 and 6). The complex interpretation shows an elevated belt with two hummocks, of which the Southern hummock is the more elevated (Fig. 13).

## CONCLUSIONS

The combined interpretation of geological and geophysical data, suggests that the folding of Papër-Rovë flysch belt are surface indication of the continuation of the Ionian zone North of Elbasan-Dibër transverse fault. The conclusion is based on these arguments:

1. Flysch belt structures are made up of flysch-flyschoid structures of Lower Oligocene up to Serravalian of sequential continuity. No deposits younger than Middle Oligocene are encountered in Kruja zone structures. The lithofacial nature of flysch belt deposits that outcrop (presence of calcareous flysch in Upper-Middle Oligocene and of argillaceous-sandy-marl thin flysch in Aquitanian) and the nature of transgressive setting of Burdigalian deposits show similarities to those of Ionian zone. The pale geographic development image shows that

the flysch belt should have been differentiated at least before Burdigalian and there are no reasons why this structure should not be associated with the limestone level. The presence of Upper Oligocene deposits at Adriatic-2 well at a depth of 1700-2000m, under the base of Serravalian transgression is a convincing argument for the continuity and stability of this structural belt (Figs. 5 and 6), (Silo et al., 2008, 2006, 2000; Dhima et al., 2002).

2. The seismic information shows that folding continues even in deeper levels than those encountered in Kruja zone limestone structures. The horizon, according to which the time section has been constructed, goes beyond the influence of Kruja zone structures, thus extending further West, that goes to show it should be another structural element. These data are in agreement with the region pale geographic and geodynamic development. These lead us to the conclusion that Ionian zone represented by two structural ranges described above should continue further North, at least up to the line Nr.8-8, (Fig. 13) (Silo et al., 2008, 2006; Frashëri et al., 1996).

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