JOURNAL OF THE BALKAN GEOPHYSICAL SOCIETY, Vol. 13, No. 1, February 2010, p. 9-16, 13 figs.

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

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(Received 16 May 2009; Accepted 03 February 2010)

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 p art of the M editerranean Alpine Fold Belt and fits in t he Dinaric-Hellenic range (Fig. 1). The geological structure of the Albanides comprises of two m ajor units: the Internal Albanides to the East and the External Albanides to the West.

The Internal Albanides are characte rized by a developed magmatism. Intensive tectonics have led to overthrust and tectonic napes. The Internal Albanides are further subdivided fr om East to West into the Korabi (KO), Mirdita (M), Gashi (G), Albanian Alps (A), and Krasta Cukali zones (KC) (Fig. 2). Two p ost orogenic s edimentary (intermountainous) basins, the Burreli Basin to the North and the Korça Ba sin, overlie tra sgressively the Mirdita zone and partially the Krasta-Cukali zone. The External Albanides, even thou gh characterized by the lack of m agmatism and by more regular structural m odels compared to the Internal Albanides, are highl y affected by a considerable thrusting of t he tectonic zones and/or structural belts Westwards. Both the Sh kodër-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 com prise of the Kruja platfor m (Kr), further Westwards the Ionian trough (I) and Sa zani platform (S). In the central Albania, the overlying Peri-Adriatic Depression (U_1) to the West masks the Ionian and partly Kruja tectonic zone s. 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).

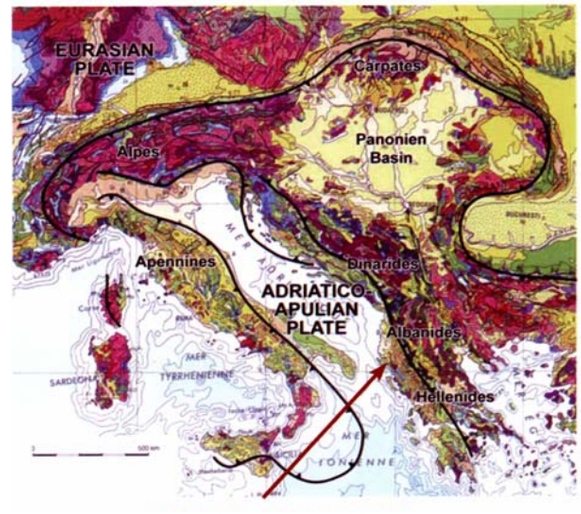

FIG. 1. Regional setting of Albania.

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

composed of several lin ear anticline structural chains separated by relatively narrow sy nclinal chains. Numerous oil seeps at outcrops and in deep wells have attracted attention for h ydrocarbon exploration 50 years ago. A dense grid of seism ic lines was scanned last y ear. 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 zo ne is chara cterized by longitudinal and cross tectonic faults as well as rare and small am plitude back thrusts along t he Eastern flanks of the anticline structures. The region under investigation (Fig. 3) covers partly the North Kruja tectonic zone, the Ion ian one and the South Adriatic basin. It has continu ously been a problematic area as related to tectonic-facia l zones. In particular, the main question is whether the Ionian z one continues North of Dumrea salt diapir.

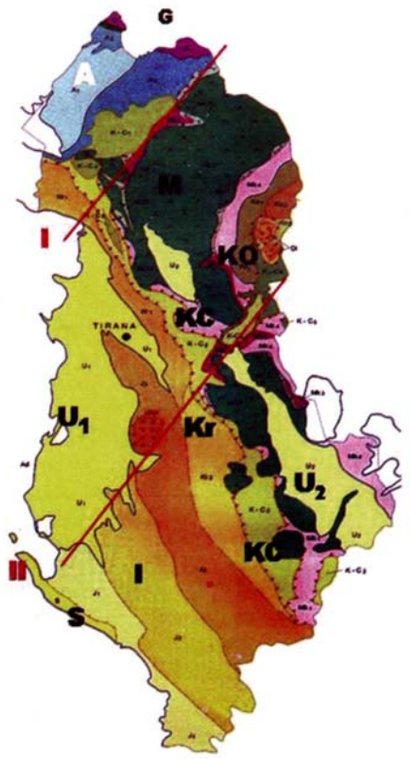

FIG. 2. Tectonic units of Albania. The Internal Albanides are subdivided into the Korabi (KO), Mirdita (M), Gashi (G), Albanian Alps (A), and Krasta Cukali (KC) zones. The External Albanides comprise of the Kruja platfor m (Kr), the Ionian trough (I) a nd the Sazani platform (S). In the central Albania, U_1 denotes the Peri-Adriati c Depression. The Shkodër-Pejë (Scutari-Pec) lineament (I) and Vlorë-Elbasan-Dibë r lineament (II) are also shown with red lines.

The strong o verthrust of Kruja zone structures towards West, the presence of the salt diapir and the facial cha nges of the deposits pose difficulties regarding the relationships between these tectonic units. Based on existing studies and recent seis mic data, this paper advances t he knowledge about the geologic-tectonic structure of this problematic region (Silo et al., 2008, 2 006; 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 a interweaving of two tectonic-facial zones. Th e continuation of the Ionian limestone structures to the North under the Kruja overthrust is of sp ecial interest. To clarify this model, the geologic-t ectonic structure of the region is briefly given as per tectonic-facial zones.

1.- Kruja Zone: Kruja te ctonic zone re presents a ridge bordered by Krasta-Cukali tectonic zone to the East, Ioni an zone and South Adriatic basin to the West. The fly sch is clearly seen along the Kruja zone. The Eastern boundary of this zone is well defined. On the contrary t he Western boundary between the Kruja and the I onian zones, is not clearly observed on the surfa ce 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).

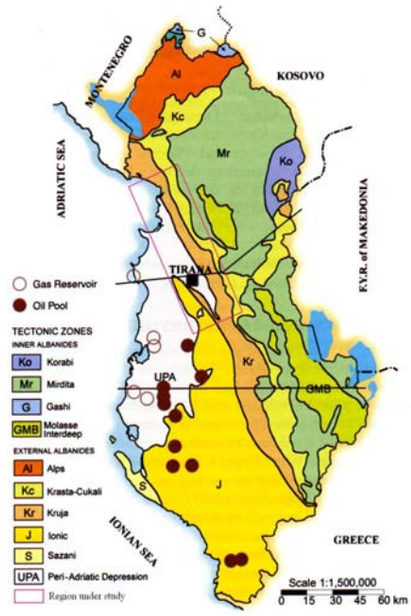

FIG. 3. Schematic tectonic map of Albania and its oil and gas reservoirs. The area under investigation is in red rectangle.

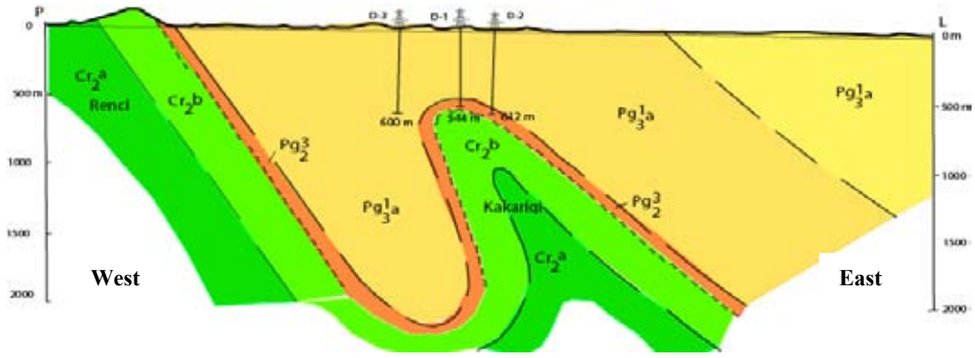

FIG. 4. Geologic section across the Ka kariqi anticline accord ing to seismic section Line Nr.9-9 (Fig. 13). This limestone structure in green is di pping to the North. The vertical axis denotes depth i n m (maximum depth 2000 m). The length of the section is approximately 13000 m.

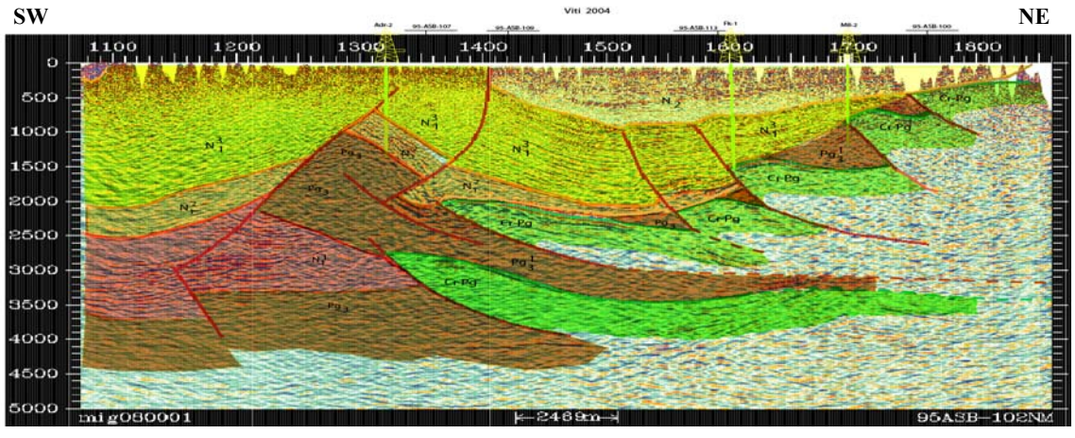

FIG. 5. Migrated seismic section Line Nr. 8-8 (Fig.13) and its geological interpretation. The vertical axis denotes two way travel time in ms (maximum time 5000 ms). The length of the line is approximately 25000 m.

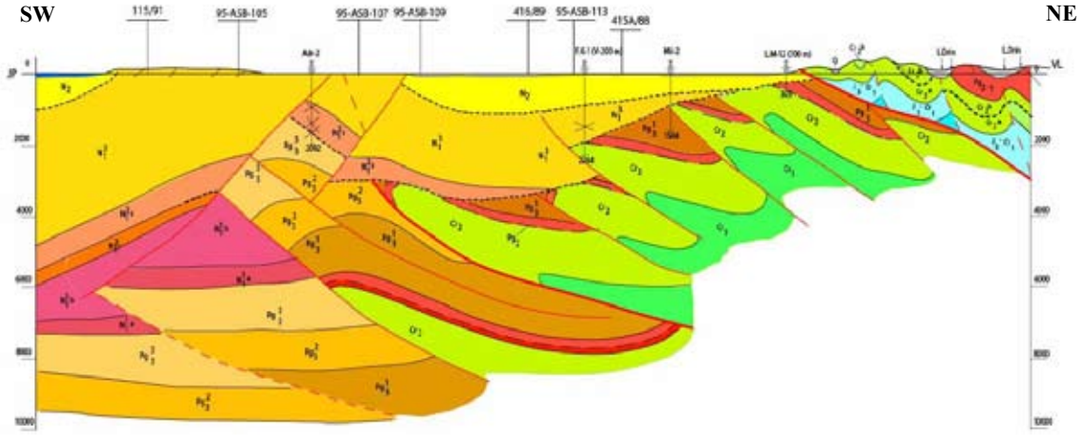

FIG. 6. Geologic section according to seismic section Line Nr. 8-8 (Fig. 13). The vertical axis denotes depth in m (maximum depth 10000 m). The length of the section is approximately 25000 m.

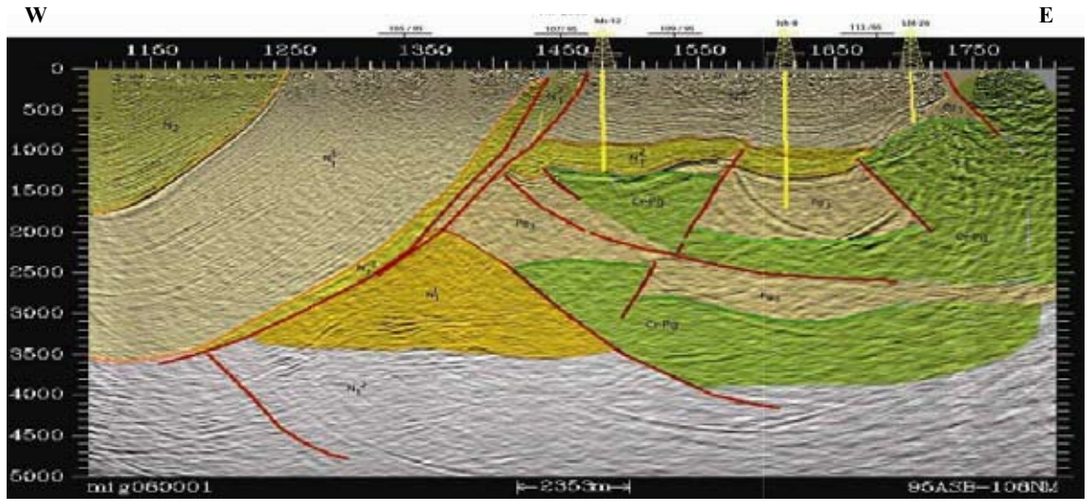

FIG. 7. Migrated seismic section Line Nr. 7-7 (Fig.13) and its geological interpretation. The vertical axis denotes two way travel time in ms (maximum time 5000 ms). The length of the line is approximately 19000 m.

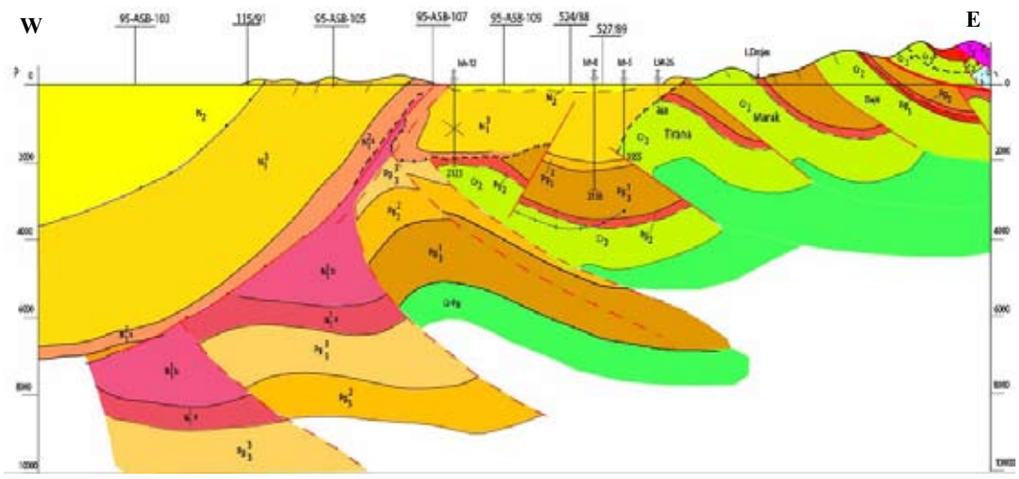

FIG. 8. Geologic section according to seismic section Line Nr. 7-7 (Fig. 13). The vertical axis denotes depth in m (maximum depth 10000 m). The length of the section is approximately 19000 m.

The interpretation of the seismic data suggests the separation of this zone in two parts with different tectonic characteristics:

a) The Northern Kruja orogen and the Dalmatian orogen exhibit the same tectonic style (Figs. 1 and 2). The limestone structures do not show a great continuity; the Northern and Southern periclines (Kakariq, Renci) are distinct; have narrow tops and are overtaking isoclinal forms (Fig. 4). In the Dalmatian orogen, following wells information, a thick Cretaceous-Jurassic salt layer has been witnessed within the limestone formation. The structures are directed mostly to the West, compared to the general direction of the Albanides. Overthrusting is more pronounced in this part, overlaying the South Adriatic basin. The geologic-geophysical data do not support the continuation of Ionian zone in this region.

b) The central part is located between the Elbasan-Dibër and Shkodër-Pejë lineaments (Fig. 2, red color). The limestone structures are linear, very prolonged without distinct periclines. Their Western flank is tectonically faulted. The overthrusting is less pronounced in the central part than in the Northern part. The Western boundary of Kruja zone orogen contacts the flysch belt. There are all types of faults such as normal, near vertical, overthrusting, covering ones and flower type.

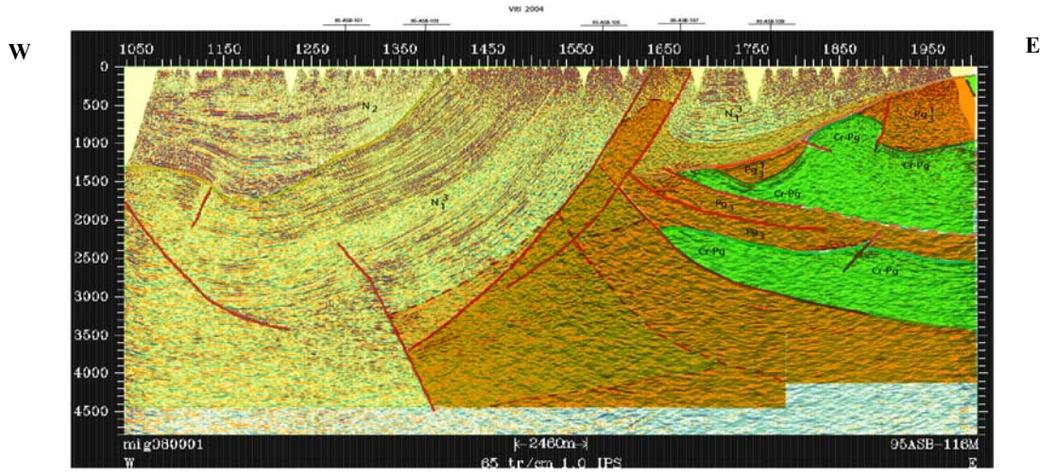

FIG. 9. Migrated seismic section Line Nr. 6-6 (Fig.13) and its geological interpretation. The vertical axis denotes two way travel time in ms (maximum time 4800 ms). The length of the line is approximately 30000 m.

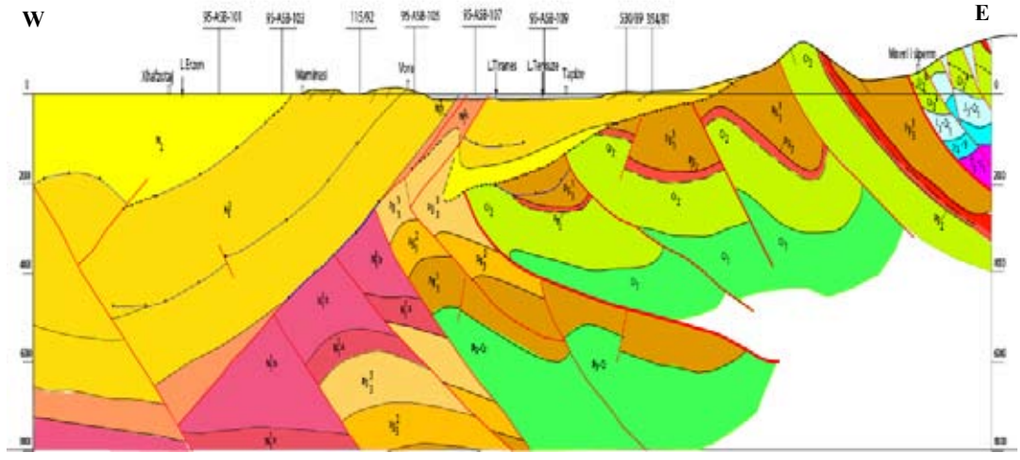

FIG. 10. Geologic section according to seis mic section Line Nr. 6-6 (Fig. 13). The vertica1 axis denotes depth in m (maximum depth 8000 m). The length of the section is approximately 30000 m.

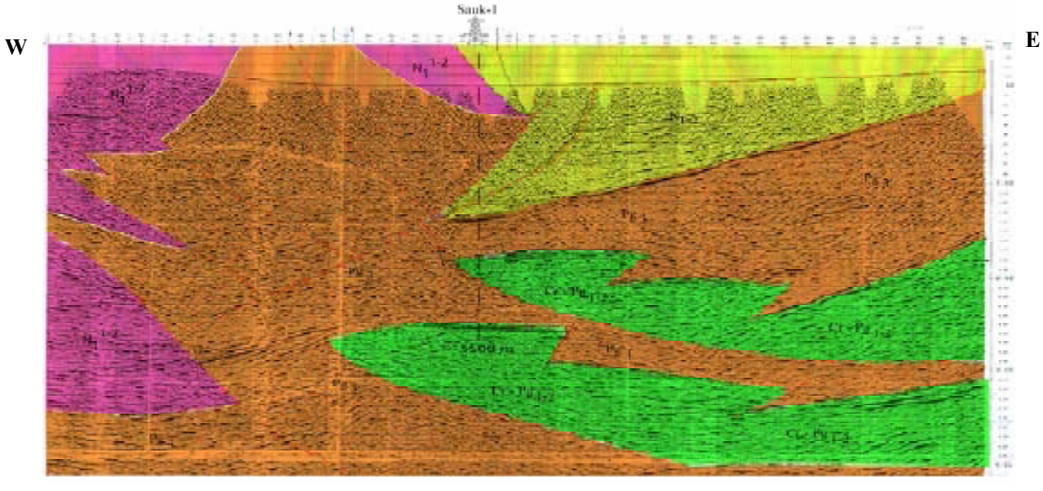

FIG. 11. Migrated seismic section Line Nr. 4-4 (Fig. 13) and its geological interpretation. The vertical axis denotes two way travel time in ms (maximum time 4000 ms). The length of the line is approximately 25000 m.

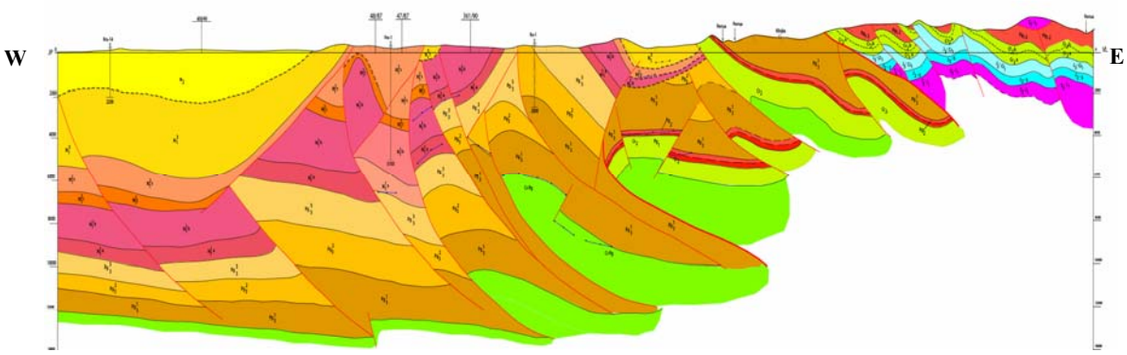

FIG .12. Geologic section according to seis mic section Line Nr. 3-3 (Fig. 13). The vertica1 axis denotes depth in m (maximum depth 14000 m). The length of the section is approximately 25000 m.

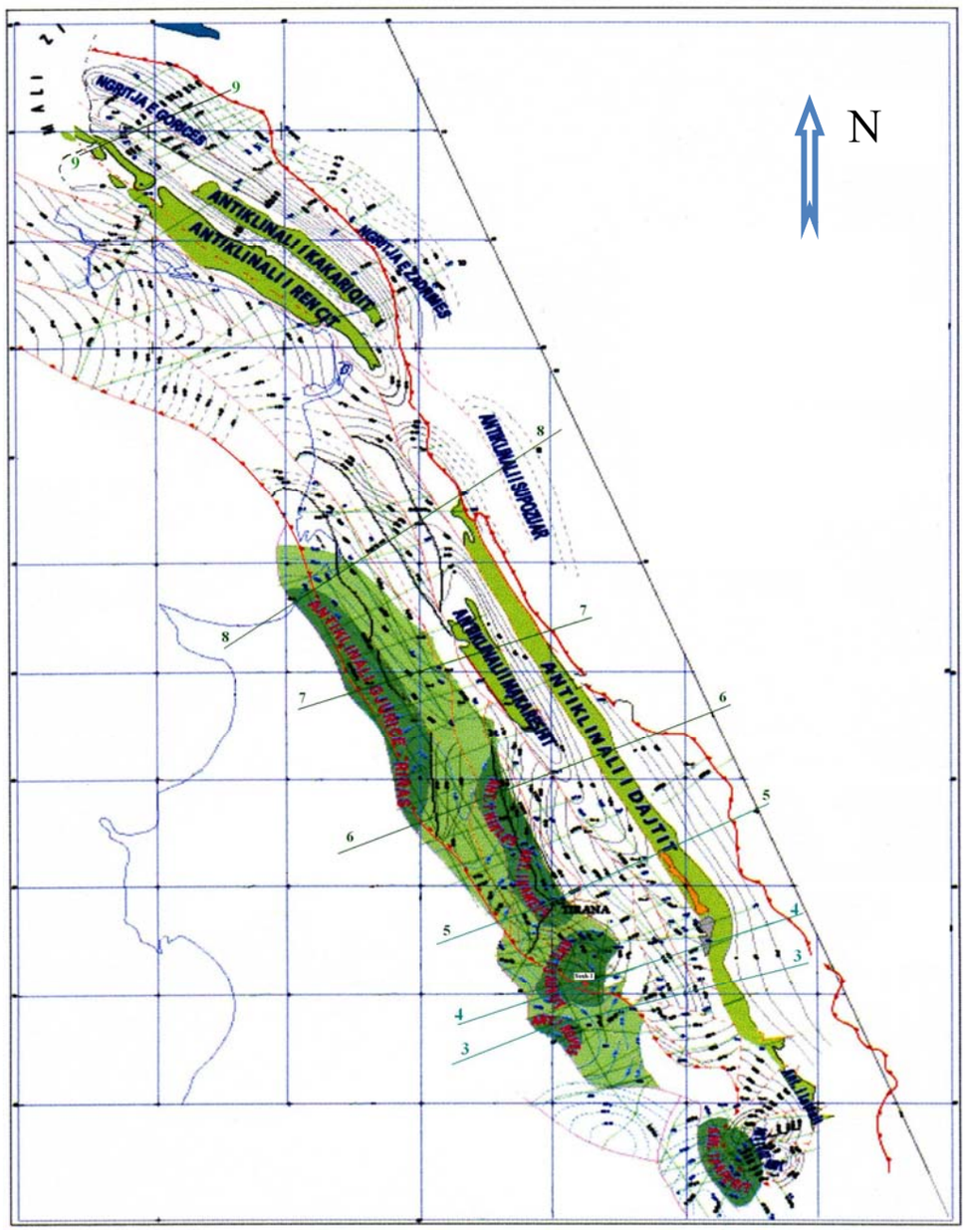

FIG. 13. Limestone Structures Map of Tirana area, Albania.

These faults have caus ed not only the limestone deformation but also their di sjunction which is observed in the seismic profiles (Figs. 5-10), (Silo et al., 2008, 2006; Dhima et al., 200 2; Foto, 2000; Frashëri et al., 1996).

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

a) The anticline Rovë-Sauk-Nikël: M iddle Oligocene deposits are present on the top, Eastern flank and two periclines. The seis mic profiles, shot recently , verify the presence of folding under the fly sch formation. Using these profiles and earlier one s, a ti me section was constructed for a reflectin g horizon at 2.5 to 3.8 s, which def ines the Ro ve limestone anticline (Figs. 9-12). This horizon undoubtedly shows the limestone top, according to the geological concept, pale tectonic development, Oligocene deposit facies, reflection intensit y, 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 550 0 m depth, projected to evaluate the hydrocarbon potential of t his area (Fig. 11) (Sil o et al., 2008, 2006, 2000).

b) The anticline Rinas–Gjuricë: I t is interpreted based on seis mic operations and data of well Adri atic-2 (Fig. 5 and 6). The co mplex 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-flyschoide structures of Lower Oligocene up to Serrav alian of sequential conti nuity. No deposits younger than Middle Oligocene are encountered in Kruja zone structures. The litho-facial nature of fl ysch belt deposits that outcrop (presence of calcareous flysch in Upper-Middle Oligocene and of argilla ceous-sandy-marl thin flysch in Aquitanian) and the nature of transgressive setting of Burdigalian deposits show similarities to those of Ionian z one. The pale geographic develop ment 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. Th e presence of Upper Oligocene deposits at Adriatic-2 well at a depth of 1700-2000m, under t he base of Serravalian transgression is a convincing argument for the continuity and stability of this structural belt (Figs. 5 and 6), (Silo et al., 200 8, 2006, 2000; Dhima et al., 2002).

2. The seis mic information shows that folding continues even in deeper levels than those encountered in Kruja zone lim estone structures. The horizon, according to which the time se ction has been constructed, goes beyond the influence of Kruja zone structures, thus extending further West, that g oes to show it should b e another structural element. These data are in agree ment with the regi on pale geographic and ge odynamic development. These lead us to the conclusion that Ionian zone represented b y two structural ranges described above should continue fur ther North, at least up to th e line Nr.8-8, (Fig. 13) (Silo et al., 2008, 2006; Frashëri et al., 1996).

REFERENCES

Dhima, S., Prenjasi, E., Guri, S., and Silo, V., 2002, Complex geo-seism ic study on thrusting tectonics and reflection of flysch folds at top limestone lev el in the Ionian zone: Paper presented at the 3-rd Balkan Geophysical Congress and Exhi bition 24-28 June, Sofia, Bulgaria.

Dore, P., S ilo, V., and Thom ai, L., 2005., Presence of carbonate structures under throw of Kruja zone based on the seismic new data in Elbasani region, Albania: Paper presented at the 4-th Congress of Balkan Geophysical Society, 9-12 October, Bucharest, Romania.

Foto, Gj., 20 00, Carbonate reservoirs in Ionian zone and their natural characteristics: Paper presented at the 8-th Congress of Geosciences in Albania "Position of the Albanides in Alpine Mediterranean Folded System", Tirana, 8-10 November.

Frashëri, A., Nishani, P., Bushati, S., and Hyseni, a., 1996, Relationship between tectonic zones of the Albanides, based on results of geophysical studies. Peri-Tethys Memoir 2: Structure and Prospects of Alpine Basins and Forelands: Mé moire Musée Nationale d'Historie Naturelle, 170, 485-511.

Silo, V., and Bare, V., 2000, Com parative analysis of s eismic migration methods in Paper-Rodon area: Paper presented at the 8-th Congress of Geoscie nces in Albania "Position of the Albanides in Alpine Mediterranean Folded System", Tirana, 8-10 November.

Silo, V., Nishani, P., and Silo, E., 2008 , Hydrocarbon exploration under of K ruja zone in Tirana-Rodon area, Albania: Paper presented at the 5-th Congress of Bal kan Geophysical Society, 5-8 October, Belgrade, Serbia.

Silo, V., an d Nishani, P ., 2006, Seismic data contribution in prosp ecting carbonate structures of Ionian zone under of K ruja zone: Paper presented at the International Scientific Symposium "Geo-Mining Potentials-Strategy and their Management", 27-30 September, Mitrovicë, Kosovo.