

## DEEP GEOLOGICAL STRUCTURES OF THE EXTERNAL ALBANIDES DETECTED BY NEW SEISMIC METHODS

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### ABSTRACT

Paper deals with the contribution of New Seismic Methods in study of geological structures and relationship between units in the External Albanides. They build a part of the Alpine segment, that connects the Dinarides in the North with the Hellenides in the South and partly of Adria micro plate. Application of the SeisWork2D is powerful interpretative tool, that gives us new insight into subsurface. This new method is able to predict the subtle details, that hidden on paper section and can revealed on the screen, thanks to colour, high resolutions, graphics and a wide variety of display options. By our interpretation in the External Albanides starting from east to west distinguished, the following tectonic units: The Kruja unit, the Ionian one the Sazani unit, and the PAD that covers the Ionian unit. The units constructed from thrust belts.

The Kruja unit consists from prolonged structures thrust over the Ionian unit. The Ionian unit constructed of three thrust belts, associated by an intensive thrusting and evaporitic diapirs. Relationship between Ionian and Sazani units is different in various cross sections.

**KEY WORD :** External Albanides, Ionian Unit, Kruja unit, Sazani unit, thrust belt, backthrust, evaporitic diapirs, thrust sheet, duplex style, SeisWork2D, pitfalls, out of sequence sheet.

### 1. INTRODUCTION

The External Albanides are complicated, but with high interest for exploration of oil and gas. The Ionian and Kruja units, Peri-Adriatic Depression and partly the Sazani unit has been the main target of the seismic interpretation for a long time. The uses of SeisWork2D have improved considerably geological interpretation and clarified geology of the area.

### 2. THE MAIN TECTONIC FEATURES OF EXTERNAL ALBANIDES

The External Albanides located in the Western part of Albania Fig.1. Toward in the East they bounded from Internal Albanides, meanwhile toward the west relationship between platform and the External Albanides is unclear.

In External Albanides the new tectonic style determined by the applying SeisWork2D. The units and thrusting style clarified, so the units of External Albanides are:

- The Kruja unit (zone)
- The Ionian unit (zone)
- The Sazani unit (zone)

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Tectonic units consist from thrust tectonic belts. Thrust belts are structurally complex accompanied by seismic imaging problems. Fold of the thrusting unit is from east to the West. We will describe the effect of new seismic methods based on the tectonic units and thrust belts.

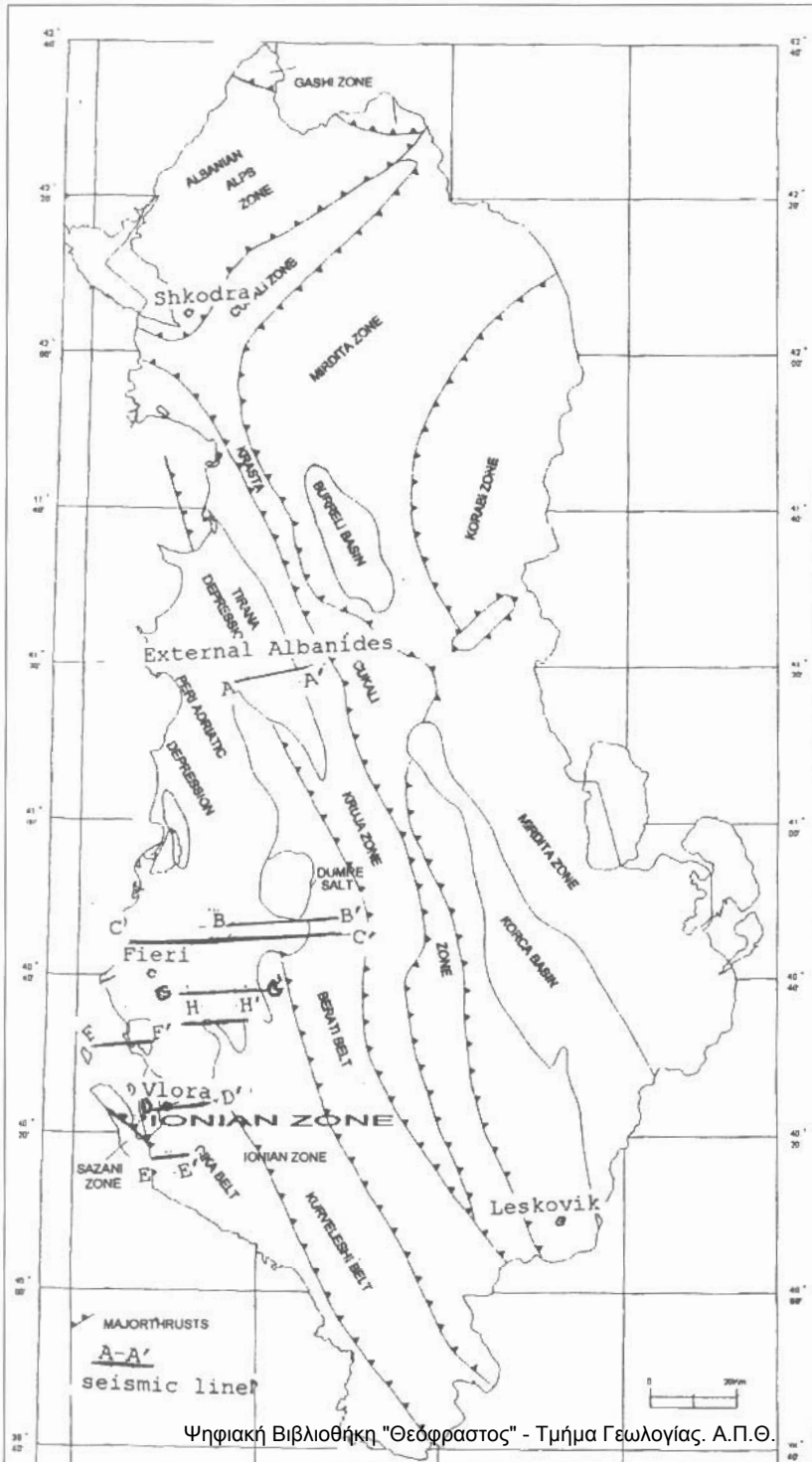


Fig. 1: Tectonic Map of Albanides and Location of Geological and Seismical Cross-Section

### 3. THE KRUJA UNIT

The Kruja unit is the eastern part of External Albanides that extends from Shkodra, in the North, to the Leskovik in the South continuing with the Gavrovos unit in the Greece. By applying SeisWork2D we have drawn some faults and thrust structures, unknown before, that are interesting for oil and gas exploration.

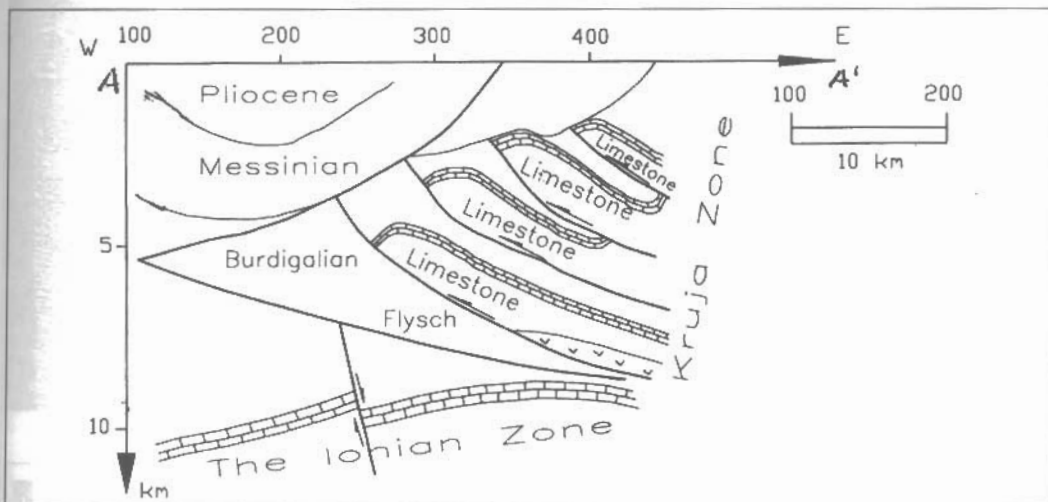


Fig. 2: A-A' geological cross-section Kruja zone

The Kruja unit constructed by anticline belts with narrow and prolonged structures Fig.2. All the structures of the Kruja unit are overthrust in each other.

The Kruja unit thrust over the Ionian one. Generally, the anticline structures eroded on their top and consequently well reflected on the seismic lines.

During the interpretation phase we have had some problems with pitfalls, caused by the geometry of the structures.

### 4. THE IONIAN UNIT

On the tectonic map of Albania Fig. 1, the Ionian unit occupies its south-western part with a southeast-northwest axis and constructed by three anticline belts:

- Berati anticline belt, which covers eastern margin of the unit.
- Kurveleshi anticline belt, which builds the central part of the unit.
- Cika anticline belt that, represents western edge of the unit.

All our conclusions are referring mainly to carbonate formation, as the flysch one, based on the numerous facts, have led to wrong conclusions.

#### a) The Berati anticline belt.

The seismic situation very complicated and the top limestones partly recorded, especially in its central and western part. In eastern margin of the belt the quality of seismic data is good Fig.3. Considering SeisWork2D application, our conclusions are: Berati belt represents an out-of-sequence sheet and constructed by structure units and relatively narrow structures with clear folding within the belt. The rocks are strongly tectonised, especially in its western flank. Conclusions supported by the different wells drilled in this belt.

#### b) The Kurveleshi anticline belt.

The seismic data from the Kurveleshi belt are better than other belts Fig.4. As can see from the geological model of above seismic line Fig.5, the Kurveleshi belt located in central part of the Ionian unit. It is a thrust sheet, associated by evaporate diapirs.

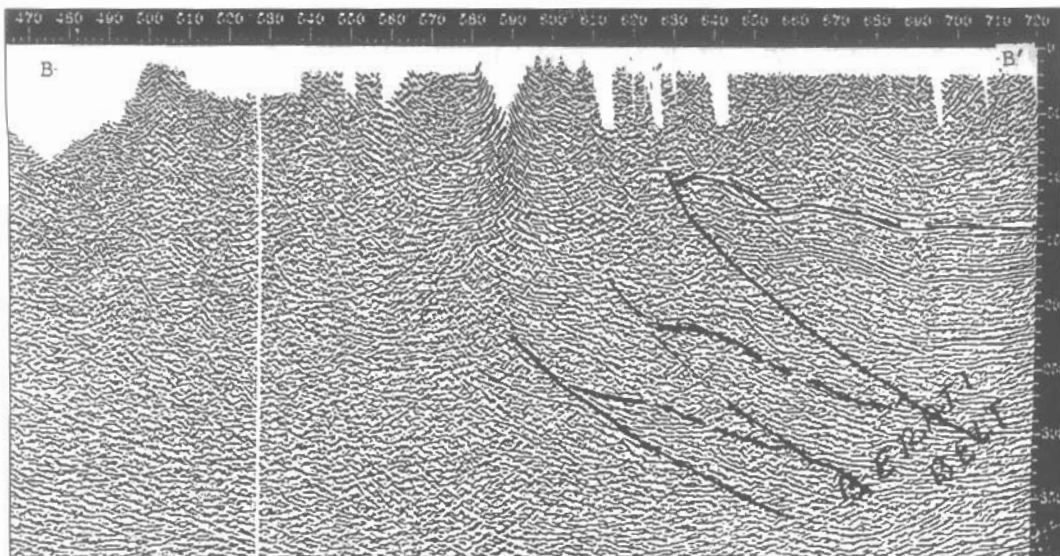


Fig. 3: B-B' seismic line cross Berati belt

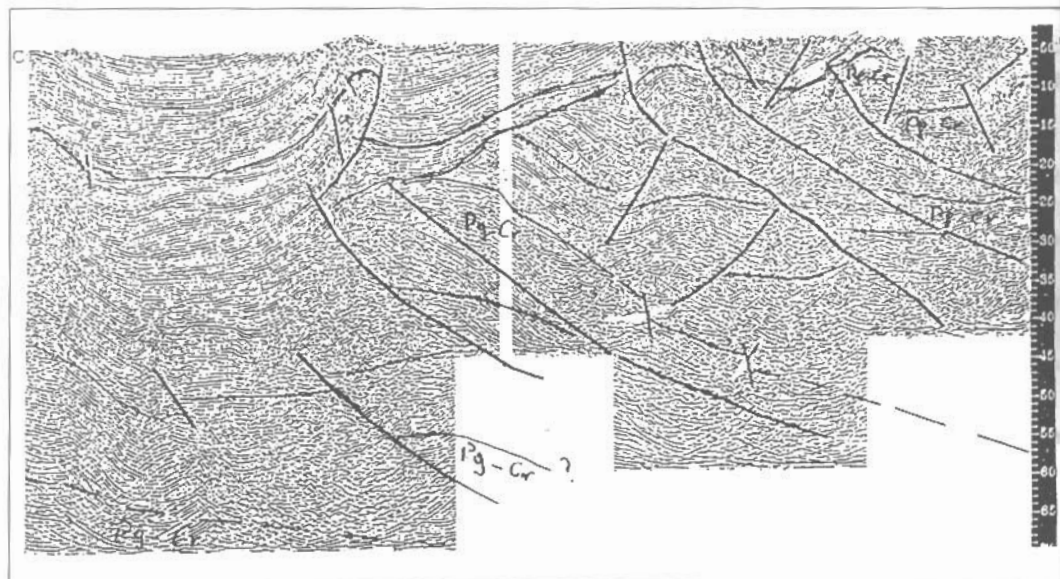


Fig. 4: C-C' seismic line cross Sazani and Ionian unit

Due to the overthrust, the complete coverage of some structures has resulted, as Delvina Karbunara. In Fig.4.5 shown the relationship between Ionian belts and Sazani with Ionian unit. The Ionian unit complicated by some different type faults. The duplex tectonic style is obvious in the central part.

c) *The Cika anticline belt.*

Seismic work in this belt dates back to the start of the exploration in Albania and still continuous today. The Cika constructed mainly by prolonged structures in considerable dimensions, associated by overthrusting in the West and in some cases have the flexural slip folding form that thrusts eastward Fig. 6. They also associated by evaporite outcrops as in Xara, Ftera, Cika.

Application of SeisWork2D was effectively in the northern part. By its use the structural maps prepared, which have

## 5. THE SAZANI UNIT

This unit crops out on Sazani island and Karaburun peninsula shown in Fig.1. The Sazani-unit involved by very active orogene creating a very developed uplift of powerful horsts and grabens, which form the Karaburun anticline. This anticline intersected by a diagonal fault displacing the eastern flank.

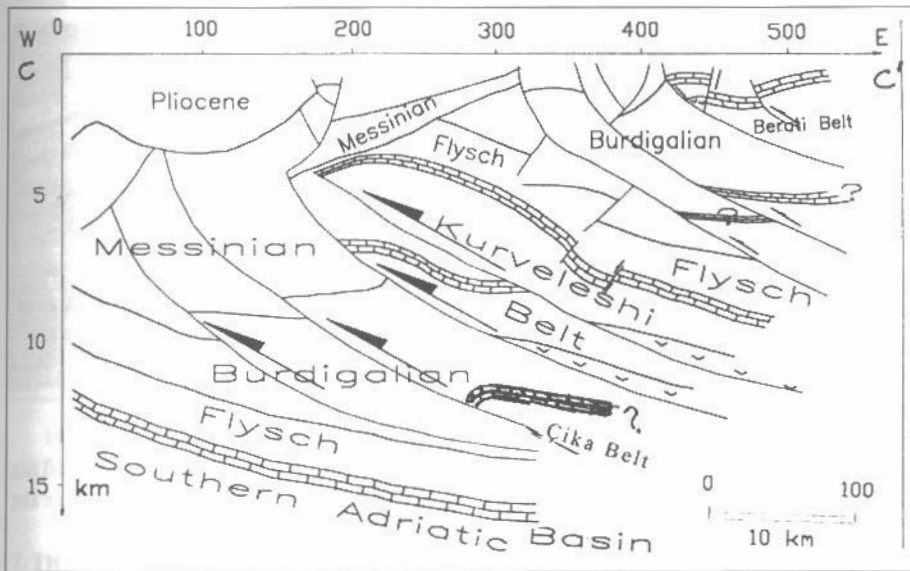


Fig. 5:  
Geological  
model of  
seismic line  
C-C'

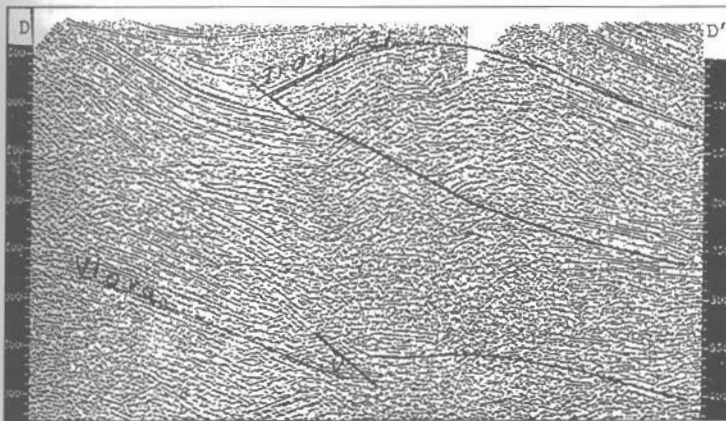


Fig. 6: D-D' seismic line cross  
Cika belt

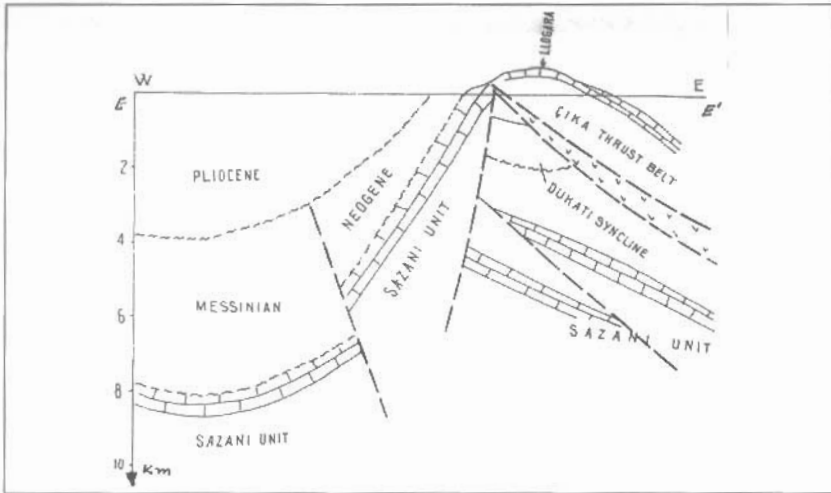
On the Llogara area the tectonic thrust is evident due to overthrust of Cika belt westward and Sazani block eastward Fig.7

By the new seismic interpretation we have identified some sectors that can be interest for the exploration of oil and gas Fig.8.

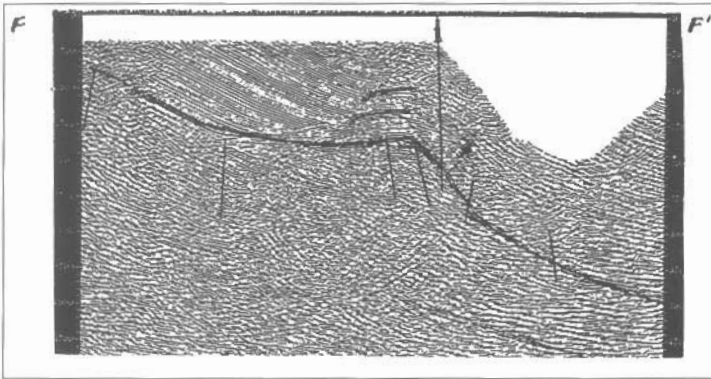
As we can see from the Fig.8 the transition area from platform to the slope is very interesting for exploration.

## 6. THE PERI-ADRIATIC DEPRESSION (PAD)

The Peri-Adriatic Depression (PAD) consists by anticlines and synclines as Povelça-Semani, Frakulla-Ardenica, Divjaka anticline, Myzeqeja and Karavasta syncline and Tirana depression. According to the geological mapping the Mio-Pliocene anticline folds buried under Quaternary deposits that extend horizontally and overlies the Karaburun and Sazani units.



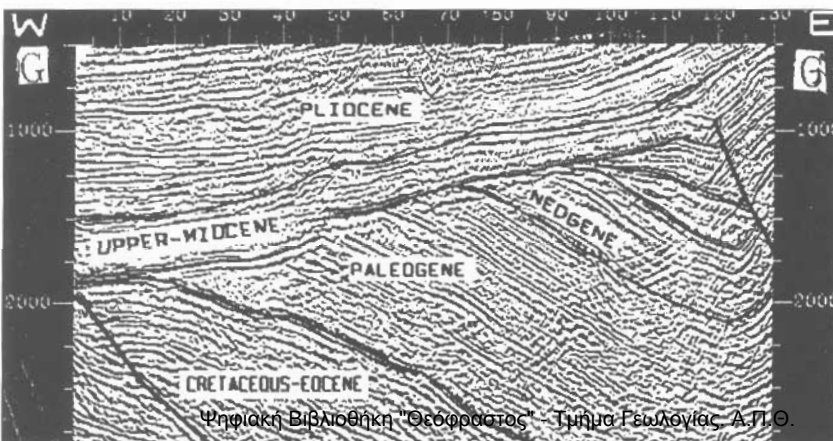
**Fig. 7:**  
E-E' geological cross section Ilogara area



**Fig. 8:** F-F' seismic line cross Sazanli unit

The contribution of new seismic interpretation is paramount to the morphology of anticline folds, that outcrop partially syncline and anticline folds buried under Quaternary deposits. The Fig 4,5 represent unconformity between Paleogene and Miocene.

The faults are relatively new, Pliocene and post-Pliocene, whereas some others are reactivated of old faults or their consequences. So, under the Neogene syncline of Myzeqeja, the carbonate structure of Patos-Verbas situated with a very considerable amplitude that develops up to Upper Miocene level Fig.9.



**Fig. 9:** G-G' seismic line cross Patos Verbas structure

Considering SeisWork2D interpretation Pliocene anticlines superimposed or associated by backthrust faults. Some of these strike slip faults represent the flower structures of "Palm tree" type for example in Ardenica Frakulla area Fig.10. In units, covered by Quaternary deposition of shelf waters, the application of SeisWork2D helps considerably in the prediction of the buried structures as well as the faults, their types and hydrocarbon exploration opportunities.

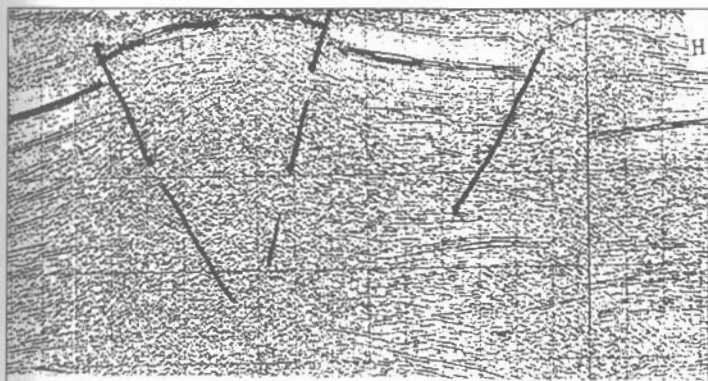


Fig. 10: H-H' seismic line cross Frakulla structure

In Peri-Adriatic depression seismic data used for stratigraphic interpretation. To be mentioned is the gas field discovering in Divjaka Pliocene, which is direct indication of use seismic attributes. Projections of gas wells in Peri-Adriatic depression mainly based on sequence and facies analysis.

## 7. THE RELATION BETWEEN TECTONIC UNITS

The Kruja unit thrusts over the Ionian unit. The relation between Ionian and Sazani units is different in various areas. In the Saranda area tectonic style

between unit clearly observed. As a result of a transverse fault that passes in the North of the Greek islands Evikuoso and Othovill, relations between the Ionian unit and Sazani unit are not well defined. By geological map of Corfu, this transition may occur in its west. Due to this transverse fault in the Karaburuni area, there is an inclination of Sazani unit towards the east.

As it seen, the eastern flank of the Sazani is tectonized creating uplift block that collides with the Ionian unit, at a time it would be deep and underlying Ionian unit. Under the structure uplift of Cika belt the platform slope should continue with its respective change towards the basin Fig. 7.

Further, north in Sazani-Vlora sections is more clear plunge of the platform slope. The space of platform slope extend passing to the most northern sector of Fieri parallel, which is actually a gentle, wide and deep slope. In this position fold forming intensity decreases. Thus, if in the south, Cika belt is represented by some chains in the position of Vlora, it represented by two anticlines (Vlora and Tragjasi) Fig. 6.

From above, complication of Sazani unit is very high toward Southern External Albanides. In the Karaburuni area, take place abnormal features of the platform carbonate over the Ionian unit, while in the northern part the Sazani unit underlies the Ionian unit.

## 8. CONCLUSIONS

Geophysical pitfalls more common in thrusting area are: velocity pull-ups ray path problems processing parameters et al.

Seismic data in thrust belts are often poor and applications of SeisWork2D have improved geological interpretation.

The Kruja unit characterised by the narrow and prolonged structures associated by each-other thrusting.

The Ionian unit characterised by the wide and shallow structures associated by each-other thrusting. The tectonic

belts overthrust to each other. The seismic pictures are involved, but the top limestone generally is distinctive with high amplitude and associated with transparent facies over it.

The Sazani unit characterised by tectonic and erosional hummocks represented with high amplitude for limestone top.

In Southern part of Vlora area the Sazani unit is subject to the action of Ionian unit, creating tectonic blocks, which overthrust eastward by colliding with Ionian unit structures.

The application of SeisWork2D from workstation is indispensable for the successful interpretation in the thrust belts. It is very important for determination of relationships between them and finding of prospective sectors for hydrocarbon exploration.

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