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About the Perspective of Exploration of the Oil and Gas in Sub-thrust of External Albanides, Albania

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Abstract

The Albanides are part of the Alpine Orogenic belt and represent one most significant of fields in SE Europe. They are located between the Hellendes of Greece and Dina rides of Montenegro, which together form the Southern branch of Mediterranean Alpine belt. During the Jurassic and most of the Cretaceous the Adriatic-Apulia sub-plate moved in the east and northeast direction, relative to Euro Asia. At this time, it was mainly affected by the extensional tectonics, thus forming a series of parallel ridges and forrous. Owing to the different depositional environments, these alterations of horst and graben units structures formed a series of tectonic zones with alternating deep and shallow marine lithofacies. As result of a further Adriatic-Apulia sub-plate movement towards SE during the Late Cretaceous the tectonic style changed from extensional to compression.

During the Neogene's the northwards movement of the African Plate, enhanced compression, leading to a large scale folding and thrusting in the SW direction in Albania and NW of Greece. The above-mentioned compression tectonics, with over thrusting towards SW, formed the southern branch of the Mediterranean Alpine thrust belt, which comprises a continuous mountain range from Dina rides in the North (Montenegro, Serbia), in the Albamdes in Albania and the Hellenides in Northwest of Greece. The Ionian zone is Ove thrusted above the Apulian platform with an amplitude of about 50-100km, hiding under itself a zone of perspective, which are included in sub thrust complex. The pozitive carbonate structures of this zone (up thrust and subthrust) are included in three anticlinal belts and in Eastern bord of the synclinal between them: Berati, Kurveleshi and Cika belts. The general characteristics of these belts is the westward thrusting that is estimated in the range 25-30km. The Kruja zone consists of a succession of tectonic duplexex. It is represented by some structural line complicated by a regional over thrust fault in the western front, which separates this zone from the South Adriatic basin.

Keywords: Back thrust; Belt; Exploration; Evaporate; Structure; Over Thrusting

Introduction

Albania is part of the Dinaride-Albanid-Hellenic are of Alpine orogeny. It is located between the Dina rides in the in the north and Hellenides in the south. The collision of the African and Euroasian plates caused the Albanides to become folded and displaced from the east to the west (Figure 1). A conventional foreland-thrust system characterized the present-day architecture of Albanian thrust-belt [1,2], The Apulian Platform is over thrusted in the east by Albanides-Dinarides-Hellenides and in the west by the Apennines (Figure 1).

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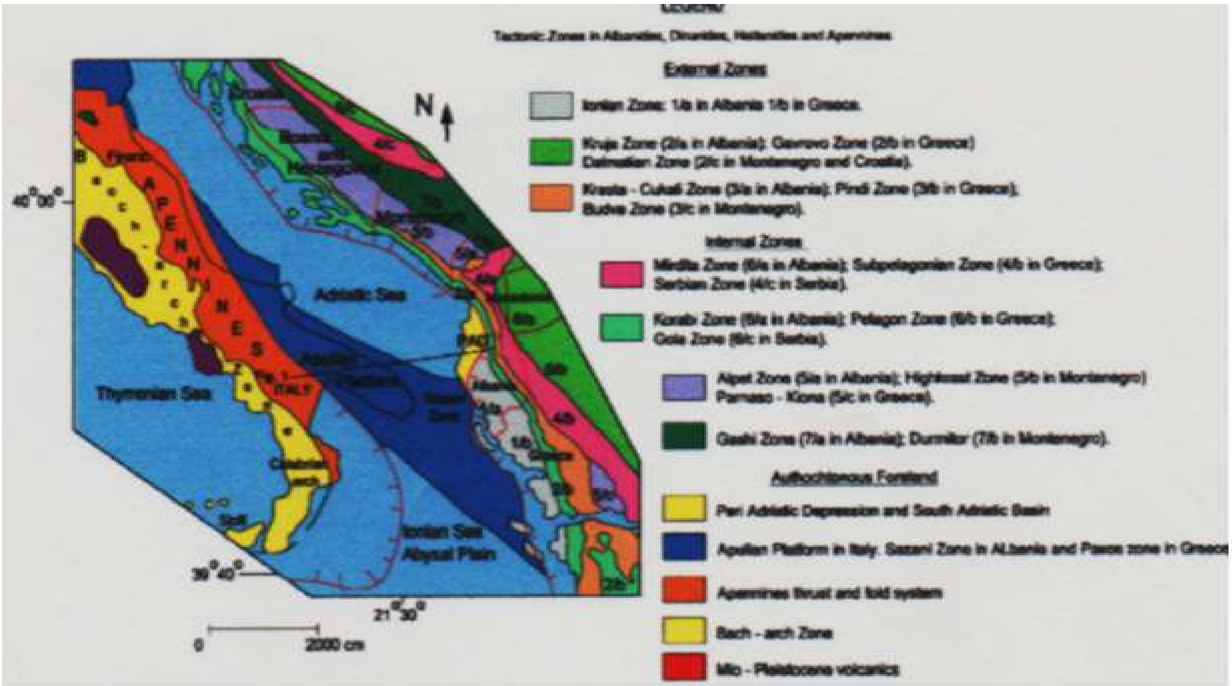


Figure 1: Schematic map of tectonics units of peri Adriatic area (According Zapaterra 1994, modified by Velaj) [3].

Al the tectonic zones of the Albanides-Dinarides-Hellenides are thrusting westward (Figure 1), over the autochtonous foreland (the Apulia platform, the Peri Adriatic depression and South Adriatic basin) [2]. The Albanides constitute of the wider Circum-Mediterrenean peri-Thethian thrust belt. The Apennines are over thrust toward the east above the Apulia platform. Here, the subthrust play include oil fields such as Monte Alpi, Tempa Rossa, etc [4,5]. Over thrusting occurred during the Neogene and Quaternary period. [6]. The autochthonous foreland is represented by Apulia platform (Italy), Sazani zone (Albania) and Paxos zone (Greece). The Apulia platform is not folded, but Sazani and Paxos zones are folded, offering a greater prospect for oil and gas exploration [2] (Velaj 2011). Fold, thrust and nappes are typical structures recording contractive in the orogenic belts encircling the Apulia platform. Due to continuous and continue over thrusting from the east to the west, there are some tectonic nappes and moved westward (figure 2) [7].

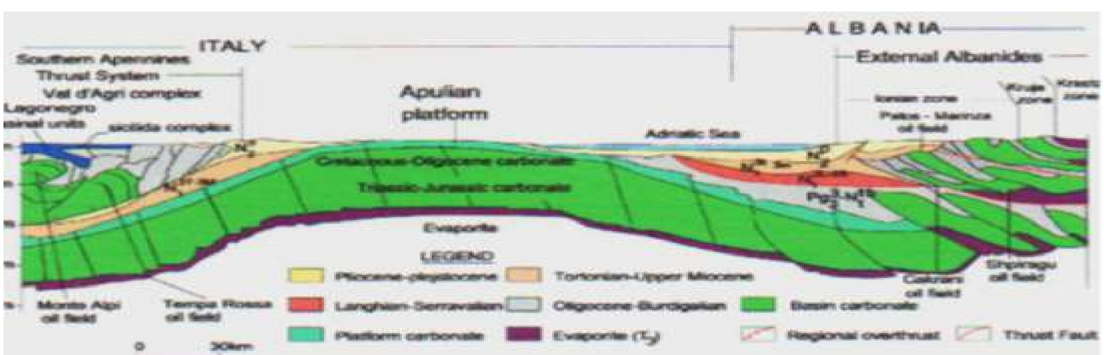


Figure 2: Regional geological croos-section through area (Albania and Italy) (See Figure1 for location, according to Cazzola et al. 2001, modified by Velaj) [5].

General Information in The Albanide

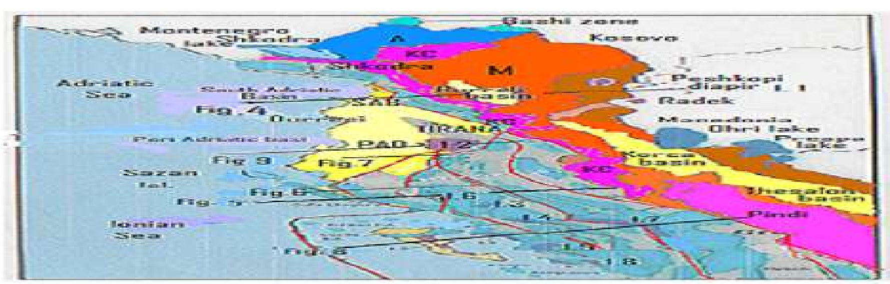
Regional geology

In Albania territory are three main geological units:

1- The foreland and Apulian platform (Sazani zone) that is extended in Adriatic and Ionian Sea and partly onshore (under the Peri Adriatic depression). It is an autochthonous unit and is partly underneath the orogen units The Sazani zone is characterized by slope-to-platform-carbonate facies, with thick sequences of well-bedded rudist-bearing Cretaceous biocalcarenites. Wells have even locally reached Jurassic and Triassic dolomite. Unconformable Burdigalian clastic attest to a relatively late flexurial subsidence in Sazani zone The Peri Adriatic depression represents a basin between the External Albanides Thrust belt (Ionian and Kruja zones) and Sazani zone. The whole postcarbonatic deposition is represented by a terrigeneous sedimentation, which in itself included in South Adriatic basin. This has in overlies Ionian zone to South-East and Kruja zone in far East [8]. The Peri Adriatic depression molasses consists of a considerable number of sandy-clayey mega sequences (going upward). In some cases, sequences become more complete and begin with conglomerate and clastic limestone and ends with clay coals or gypsum. From the South-East to North-East, the thickness of molasses increases, reaching 5000-7000m [3]. As a result of sedimentation condition changing in Messinian, the clay-sandy was formed in the Eastern sector of Peri Adriatic depression and clayey-gypsum lithofacies in the Western part. The tectonic regime has been developed in the context of active margin and has always been of compressible type, which observed in the more restricted sedimentation tracts beginning from Serialization onward. By the time the Peri Adriatic depression were formed and folded the adjacent carbonate structures of the Ionian and Kruja zone, as a result of the intensive submerging of the South Adriatic basin, were "absorbed" towards the North-East and rotated anti-clockwise, increasing their tectonic complication degree. One consequencs of this process of the formation of the back thrust tectonics incident encountered in the Eastern and South-Eastern edge of Peri Adriatic depression.

Albania orogen is divided in two parts

a. Internal Albanides in the eastern part of Albania which are characterized by a developed of ophiolites (Upper Jurassic) and by the intensive tectonics (many folding phases), which has led to the total alloctony and tectonic napes. [9] The Internal Albanides are further subdivided from East to the West into Korabi (Pelagonia in Greece. Golia in Serbia), Mirdita (Subpelagonia in Greece and Serbian in Serbia), which is the main ophiolite bearing zone, Krasta-Cukali (Pindi in Greece and Budva in Montenegro), Albanian Alps (Parnaso-Kiona in Greece and High Karst in Montenegro) and Gashi zones. The two post-androgenic sedimentation basin: Burris basin (U1) in the north and Korea basin (U2) in the south-eastern part of Albania, overlie transgresively the Mitdita zone and partially the Krista-Cukali zone (Figure 3).



Legend: T ectonic zone I-Ionian KR- Kruja KC-Krasta-Cukali M - Mirdita K -Korabi A-Alpe G-Gashi PAD. Peri Adriatic dee. Evaporite diapirs : 1.1 -Peshkopi 1.2. Durnre 1.3. Picar -Kardhiq 1.4. Delvina 1.5. Xara 1.6. Bashaj 1.7. Zavrohon 1.8. Filati

Figure 3: Tectonic map of Albanides and carbonate structures in the Ionian and Kruja zones. (modified by Velaj).

b. External Albanides, dispute being characterized by the lack of magmatism and more regular structures than the Internal Albanides, they are highly affected by a considerable thrusting of the tectonic zones and sructural belt westwards. The structural architecture of the External Albanides is characterized by NW-SE- running and SE-verging thrust fault systems that involve a thick series of Mesozoic-Tertiary passive margin carbonates, unconformable overlain by Oligocene clastic units. The northern Ionian zone has been prolific for oil and gas production, whereas the more intensely deformed southern Ionian zone has been less explored [10,11]. From tectonic point of view, the External Albanides are subdivided into three tectonics-stratigraphic units: The Kruja zone (shallow carbonate water) in the east, the Ionian in the middle, which represented by pelagic carbonate and Sazani zone in the west (shallow carbonate water), which represented by Apulian platform.

The Kruja (Gavrovo in Greece and Dalmate in Montenegro) is represented by some anticlinal structural lines which are tectonically faulted in their western flank. Western edge of this zone is complex due to regional over thrust faults, which have caused their over thrusting above the South Adriatic Basin with the amplitude of about 70-100km. A folded with the high perspective plays must have developed in subthrust complex under this over thrust) (Figure 4).

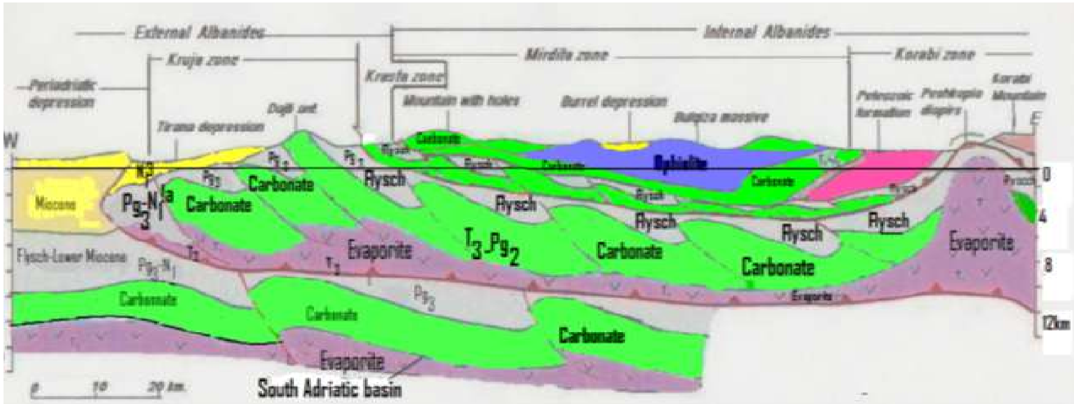


Figure 4: Schematic geological croos-section through the Albanides and South Adriatic basin [12].

The Ionian zone (Ionian in Greece) consists of three anticlinal belts (Berati, Kurveleshi and Cika), which are over thrusted westwards (20-30km). The phenomena of back thrust are frequently developed in the eastern flank of the anticline, units with magnitude (5-10km).

The large scale of the thrusting, approaching of the belts with each-other and coverings of the other western structures are the argument for the presence of new hydrocarbon prospects [10,11]. The most oilfields discovered in Albania are in the carbonate structures not affected by the thrusting of adjacent units. There is another new prospects of the carbonate structures under regional over thrust of the Kruja, Ionian zones and three anticline belts (Berati, Kurveleshi and Cika) of the Ionian zone 3. In the central of the western part of Albania the overlying Peri Adriatic Depression, which masks partly the Ionian and Kruger zones. The Peri Adriatic depression westwards offshore is unified with the South Adriatic basin, which overlies the Preapulian (Sazani zone) and Apulial platform. The uplifted foreland Sazani zone is located in the southwestern part of Albania and outcrops in Karaburun and Sazani island. The whole post carbonation deposition is represented by a terrigeneous sedimentation, where its position and distribution is definitely performed in basin, which in itself is included in South Adriatic basin. The Peri Adriatic depression in the west of the Ionian zone identified as a major gas prospect [10,11,13]. The Ionian zone is a major oil and province in Albania. Patos-Marinza, Kucova and Pekisht-Muirrizi are related to Tortonian -Messinian elastic reservoirs. Patos-Marinza is the biggest oilfield in Albania. The oilfields related to the carbonate reservoirs (Cr2-Pg2) are: Visoka, Ballsh-Hekali, Gorisht, Carkran, Amonica, Delvina and Karbunara. The gas fields are related sandstone of Tortonian-Pliocene represents by Divjala, Frakulla, Ballaj, Povelca and Durres. The well Adriatic-4 offshore proved condensate and gas-bearing in Messianic clastic reservoir.

Subthrust Geology

The sub thrust in the Ionian zone is divided in three types [10,11]:

1. The sub thrust beneath over thrust of the anticline belts. These over thrusts are related to the evaporate detachment horizon, and they mask folded structures of subthrust
2. The subthrust beneath the over thrust of the anticlinal units. These over thrusts have a local character and they are more developed in the Kurveleshi anticlinal belt (Figure 5).

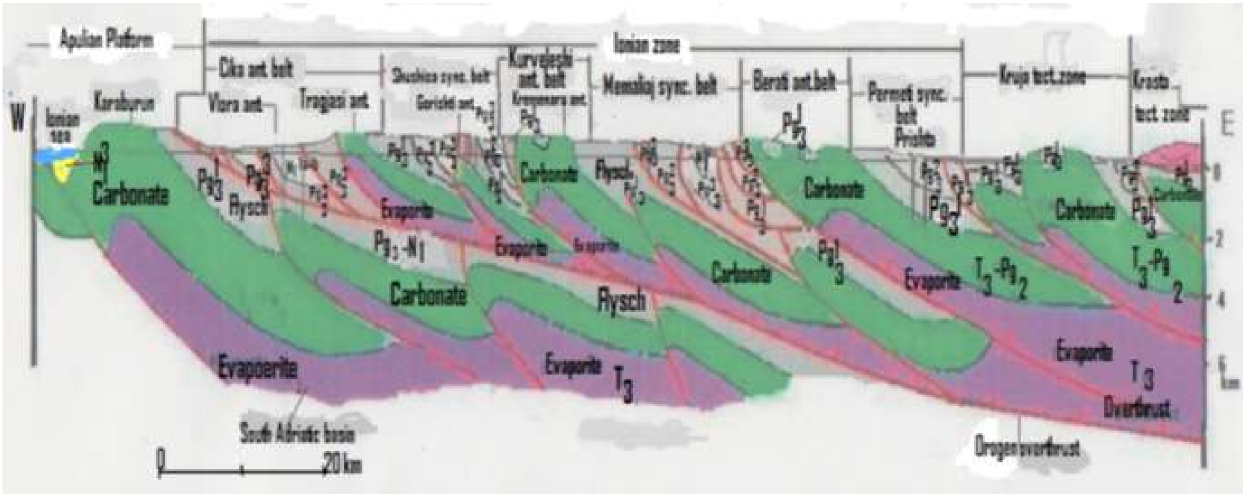


Figure 5: Geological schematic crcroos-section through Apulia platform and Ionian, Kruja and Krasta-Cukali zones [12].

3. The subthruts beneath the overthrusts of the tectonic zone of the orogenetic front (Ionian and Kruja zones) above the western autochthonous (Apulian Platform and South Adriatic Basin) The exploration of new oil fields in the carbonate of subthrust is related to the compressive structures that are expected developed beneath belt (Berati, Kurveleshi and Cika). They are very difficult for exploration due to complicated geological situation and mountainous terrain. The Berati anticlinal belt is the most eastern of Ionian zone and it spread partly in Albanian territory and partly in Greek territory and overthrust considerably towards the west (20-30km), thereby hiding perspective structures that occur along all the subthrust of Berat belt anticlinal (Shpiragu oilfield, Dumre, Molishti etc.). In same time continuous seismic works in the south direction to discover the new oilfield in subthrust [14,15]. The Kurveleshi anticlinal belt is spread in the central of the Ionian zone and is characterized by anticline with heterogeneous dimensions, predominantly those of great dimensions and linear type, over thrusting of the anticline units are more developed in Kurveleshi anticlinal belt. Its magnitude is aboutt 8-10km. As result of these overthrusts, imbrication and duplex style are formed, leading to the masking of the subthrust complex of structures, where two oilfields have been discovered beneath the Mali Gjere anticline (Delvina oilfield) and Kremenara anticline (Karbunara oilfield) [10,11]. Future perspective in the Kurveleshi anticlinal belt related with the carbonate in the subthrust complex under the anticline structures along all anticlinal belt. The subthrust under the regional overthrust of Ionian and Kruja zones is very important for oil and gas perspective. This complex has the form of regional momoclinal, folded in its eastern part (under the thrustbelt) and unfolded in its western part. Over this is set the Peri Adriatic depression and South Adriatic basin.

Tectonic Style in Albanides

The presence architecture of Albanides show a convectional foreland and thrust belt system. The subduction of the thinned continental crust at the margins of the Apulia-Adriatic plate, resulted in a large amount of horizontal shortening by the formation of Thrust belt. Tectonic zone and respective structural line (Kruja zone) and structural belt (Berati, Kurveleshi and Cika) have a general orientation NW-SE and over thrust over each-another from east to west direction. The Apulian platform was broken up into the Ionian basin and the Kruja platform under extensional tectonic regime. In the Late Jurassic the Mirdita oceanic basin was completely closed and the folding played a dominant role in the area. Though was considerably folded and the Krasta basin began to subdue beneath the Mirdita frontal thrust. In the Late Eocene the Krasta basin was closed and subsequently folded whereas the Kruja platform commenced to subdue overlaid the Krasta zone. At the end of Oligocene, the Kruja zone and the Internal Ionian zone were folded, while the external Ionian zone sub ducted beneath the Internal Ionian zone and was folded at the Middle Miocene. At the same time the Sazani platform stated to subduct beneath the frontal of external Ionian front zone, Except overthrustung in the SW direction, some differential horizontal displacement of mountain front deformation arcs. The Upper Triassic evaporates comprise the main detachment plane for regional over thrusting for structural anticlinal belts. Locally the thick of Upper Triassic evaporates not only played the role as gliding plane, but also pierced of salt diapirs on surface like Dumre, Zavrohon, Picar-Kardhiq etc. in South of Albania (Figure 6).

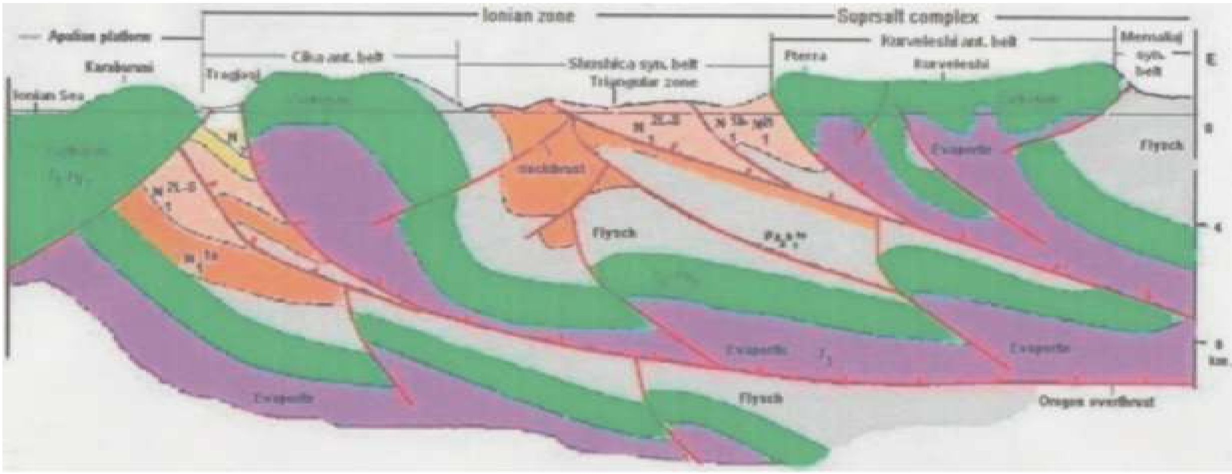


Figure 6: Geological cross-section through Apulia platform and Ionian zone.

The mountain front and fold belts in Albanide and especially in the External Albanides taken places comprise the main features of the thrust system, including for back thrust and triangle zone. From genetic point of view, thrust and over thrust fault, have taken place during the collision stage (J3-Serravalian) time, in which Ionian and Kruja zones, structural belt (Berati, Kurveleshi, Cika), and individual tectonic units (anticlines, synclines) have taken less or more the final form. The tectonic fault took place together with sedimentation and fold formation processes. These faults represent the reactivation of the normal faults of rifting stage (T3-Upper Jurassic). The fact that the Neogenic basins (Upper Miocene-Pliocene) of Tirana, Kucova and Marinza are not affected by the tectonic of the carbonate structures, structural belts, or tectonic zone, show that the (Figure 7) main compression phase happened before Serravalian. The westward thrust processes of all structural units continued in the post collision stage (Tortonian-Q).

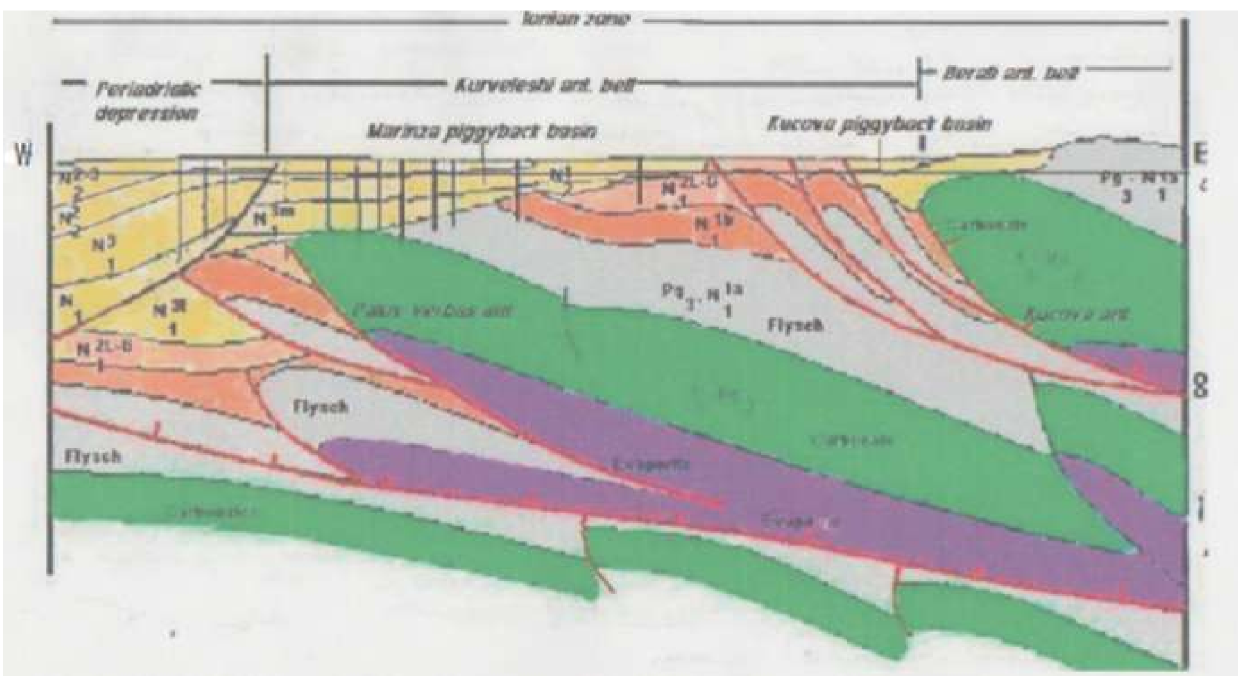


Figure 7: Geological croos-section in Marinza and Kucova piggyback basin.

This expressed by several inter formation new faults (fault in the flysch). As result of their action, flysch deposits of the folded sub thrust complex are brought in western margin of the thrust units, exposed in the form of rootless folds. Their roots represent perspective structures of sub thrust. The thrust tectonic of several structural units took with them Neogene piggyback basin. They did also cause the folding of Neogene deposits of Peri Adriatic depression and South Adriatic basin. These folding are SE-NW trend, showing similarity of the carbonate structures, which gives evidence for the formation compressive of the carbonate orogenic front. Thrusting of tectonic zone and their structual belts or individual structures on one another westwards, represents one of main tectonic features in Ionian zone. There are some evidences on the surface showing thrusting westward. The flysch deposits of Tunisian window (Krista-Cukali zone) in Peshkopi region (Mirdita zone) indicate indicate for a relative thrusting amplitude more than 100km. of the Mirdita zone westwards. The presence of Mirdita, Krista-Cukali and Ionian zone at the same place in the Molesin region shows a horizontal thrusting amplitude of the Internal Albanians over the External zones at the range of around 100km. Thrusting westward is proved as a common geological model in most oilfields discovered in Albania [7].

General Geological Setting of the External Albanians: Kruger and Ionian Zones

The thrusting process in Ionian zone was supported by the presence of a Triassic evaporite sheet under the carbonate section, which have flowed along the regional and local fault planes. Sometimes they outcrop as diapirs (Dumre, Xara, Picar-Kardhiqi, Delvina, Zavrohon, etc.). The most general model of duplex structures in the Ionian zone is the following: carbonate structures in surface, fault plane, evaporite, flysch and underlying carbonate structure in subthrust complex, which is with high perspective for hydrocarbon exploration. The great scale of thrusting has caused the approaching the belt with each-other and mask the other adjacent western structures are joint arguments for the presence of new prognostic hydrocarbon prospects subthrust of three mentioned belts.

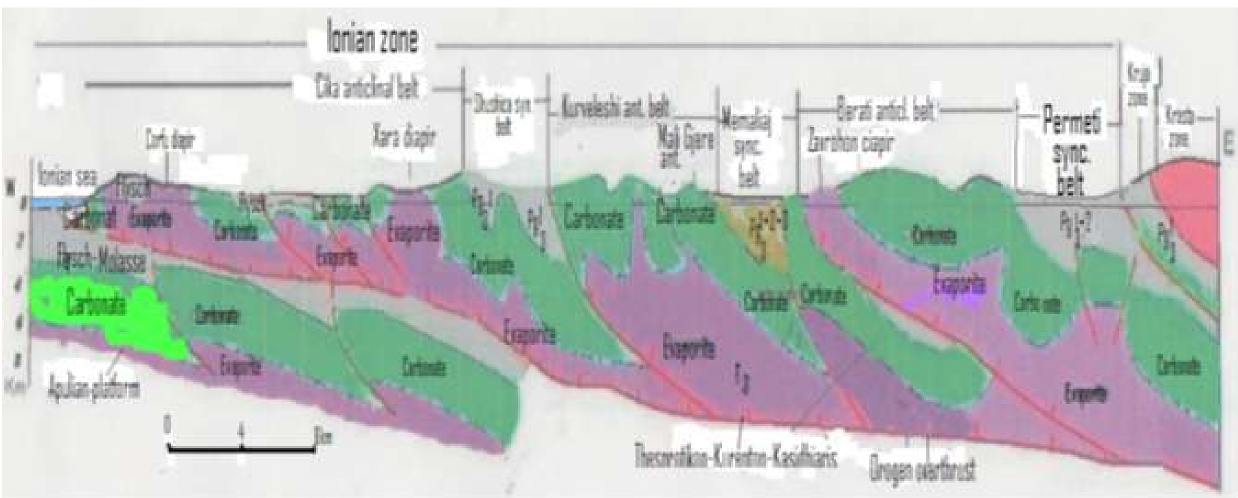


Figure 8: Geological croos-section in South part of Ionian zone.

According to surface geology, the western wedge of all structural belts of the Ionian zone there is a narrow flysch belt, rather folded that associated with thrusting faults, which show for the presence of the underlying carbonate structures in subthrust. However, on the other hand, this flysch has lost, in general, its connection with carbonate root. The Berati anticlinal belt have the main characteristic the western asymmetry due to westward thrusting. Sometime, their western flank is missing on the surface. In its south part, large scale fan type anticlinal structures have been formed, with back thrust in the eastern flanks. The structures of the northern sector are characterized by a smaller dimension, but their density is larger in the surface units. The structural lines within the belt are not thrust faults and because of this only the western side, on subthrust under anticline belt, is with great perspective (Dumre, Shpiragu oilfield, Molishti, etc.) [10,11]. In the Berati anticlinal belt there are two evaporitic diapir on the surface: Dumrea's in its northern part and Zavrohon's in the South. The Dumrea diapir has a cupola form on the surface, whereas in subsurface is a large westward over thrusted diapir. The diapirism features are associated everywhere with fault plane westward thrust fault and back thrust eastern flank of units. Together westward thrust fault and back thrust create space the over thrust new in perspective structures.

The exploration of oilfield in Kurveleshi anticlinal belt is related to the carbonate structures developed in the subthrust complex. On the upthrust of this anticlinal belt a number of oilfields have been discovered, which can divide into two categories: First, there are the oilfields in subthrust under the over thrust of Mali Gjere anticline (Delvina oilfield) and Karbunara oilfield (under over thrust of the Kremenara anticline. Second, there are the oilfields discovered in the eastern flank of the Shushica synclinal belt, which are "free" from regional over thrust of the Kurveleshi anticlinal belt. The further perspective in Kurveleshi anticlinal belt is with the carbonate anticline structures in the subthrust complex, that are divided as follows:

First, there are the anticline structures developed under the of the large structure of the eastern line of the Kurveleshi anticlinal belt (Mali Gjere and Kurveleshi anticlines). Under the over thrust of the Kurveleshi anticline one anticlinal should developed as a direct continuation of the Kremenara anticline. These structure should have big dimensions. Second, there are the anticline structures that developed under the regional over thrust of the Kurveleshi anticlinal belt, belonging to folded eastern flank of the Shushica synclinal belt. The Cakran-Mollaj anticline should continue in the northern direction under the over thrust of the Patos-Verbas anticline. The Amonica anticline should continue toward the south, under regional of the Kurveleshi anticlinal belt, with a whole anticline line comprising some anticline structures in the subthrust. In this way, the future perspective in Kurvelesh anticlinal belt s in its subthrust [5, 10, 14].

The Cika anticlinal belt is a more western unit of the Ionian zone. It is over thrust westward above Apulian platform and its transitory part; which have been folded in the big anticlinal structures and will be great prospect for exploration for oil and gas in the future. In the western side; it is limited by a regional thrust fault. This over thrust, which have amplitude 50-100km, caused that all the External Albanides over thrusting above the western autochton [10,11] (Figure 9).

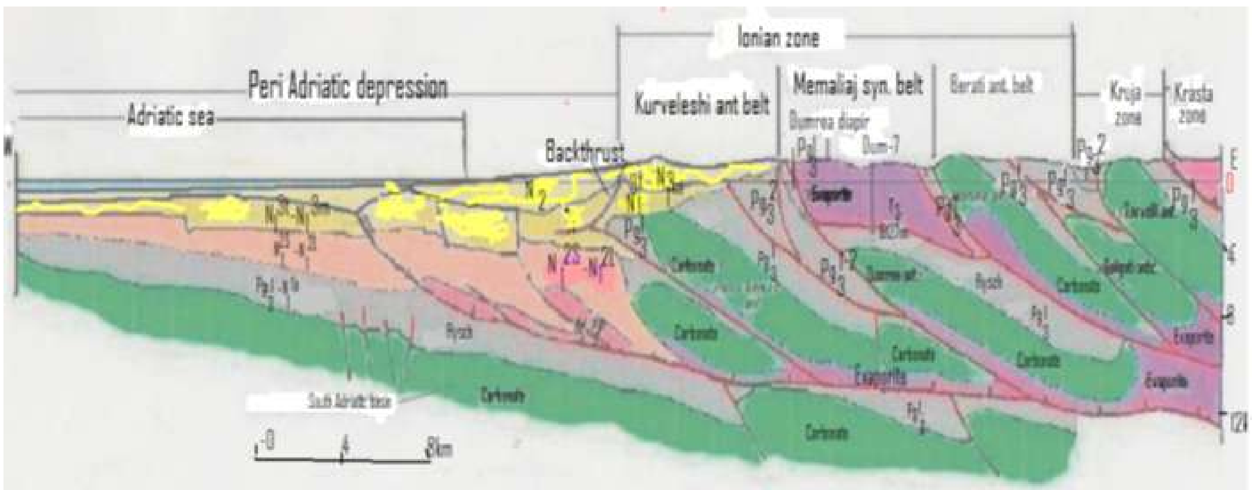


Figure 9: Schematic croos-section between the Peri Adriatic depression, Ionian and Kruja zones.

From the south (Butrinti) to the north (Vlora), the number of the structural line of the Cika anticlinal belt is decreasing. Generally, the structures are of linear type and have great dimensions (30x10km). The diapirism is very intensive, especially in the southern part, where they form the principal character of the geological features (Filati, Xara-Mursi, Korfuzi diapirs). In the northern part the Cika anticlinal belt over thrust above the Sazani zone (Apulian platform), while the Sazani zone is back thrusted in east direction (Figure 8). An extraordinaire overlook can be traced at Dukati village, where the Cretaceous platform-to-slope deposition systems belonging to Sazani zone are cut by a high-angle fault (almost vertical) of Pleistocene age (Prrenjasi, Bare et al. 2004)

In the Llogara Mountain section, the Mesozoic Ionian pelagic of Cika belt are directly thrust on to of p of rudist-bearing Cretaceous deposits belonging to Sazani zone, without any presence of Neogene deposits among them. The Neogene probably still preserved in depth and it is part Peri Adriatic depression. The Kruja tectonic zone extends in eastern part of the Ionian zone is composed mainly by carbonatic neritic deposits. The depositional environment of the carbonatic sequence going westward changes from neritic to mixed (pelagic and neritic) facies. From tectonic point of view, it is represented by some structural lines, complicated by a regional fault in the western side. This regional fault of the overthrust type separates the Kruja zone from the South Adriatic basin, masking perspective structures. This phenomenon is more distinguished in the north part of Kruja zone, where amplitude of overthrusting is around 80-100km. In this region, the Kruja zone consist of linear anticline structure and consistue two surface structures: Dajti and Makareshi. There are two additional buried structures which are Fushekruja and Ishmi anticlines. Southward two other anticline structures are identified: Kozani dhe Letani.

In the south part, the anticline structures smaller are developed and structural anticlinal line decreased. In this area the Kruja zone is divided from Permeti synclinal belt a tectonic fault of overthrusting type, with throw smaller than that in north. From the north (Tomorri anticline) towards the south happenn transition: From transitional (neritic and pelagic) to pelagic facies (Melesini anticline) the same with Ionian zone.

1.1.1 Stratigraphy

Stratigraphy of Ionian, Kruja and Sazani zones can be subdivided in four sedimentary sequences:

a.) Triassic evaporites b.) Ionian Triassic to Eocene basin and Kruja and Sazani platform carbonate c.) Oligocene to burdigalian flysch and premolasses d.) Serravalian to Pliocene Molasses the Upper Triassic evaporites consist of gypsum, anhydrides, salts, multicolored clays and breccias with interbeded dolomite and organic-rich shales. Volcanic rocks (Dumre, Picar-Kardhiq), quartz bipyramidal (Dumre, Picar-Kardhiq, Delvine, Gline, amphibolite rocks (diabaze, gneis and volcanic tuffs) are encountered locally. Salts are widespread in the Kurvelesh anticlinal belt, whereas gypsum and anhydrites facies predominate in the Berati and Cika anticlinal belts [15]. The carbonate is to Upper Triassic to Eocene, and it in general, belongs to pelagic facies. Upper Triassic dolomite and massive rocks (diabaze, gneis and volcanic tuffs) are encountered locally. Salts are widespread in the Kurvelesh anticlinal belt, whereas gypsum and anhydrites facies predominate in the Berati and Cika anticlinal belts (Figure 10) [15].

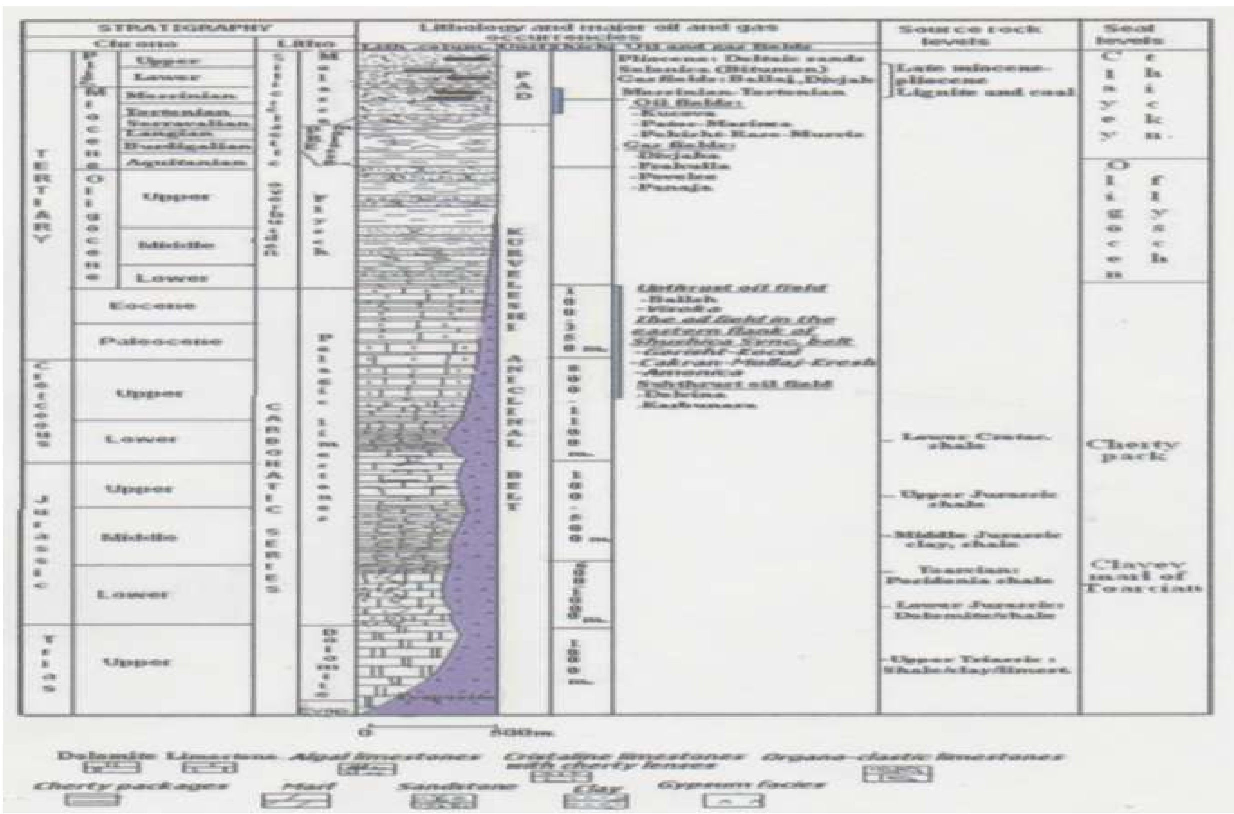


Figure 10: General litologo0stratigraphic column of Ionian zone.

The carbonate is to Upper Triassic to Eocene, and it in general, belongs to pelagic facies. Upper Triassic dolomite and massive limestone with organic-rich shale interbedded (Lower Jurassic) represented neritic facies and are overlain by pelagic limestones with chert, marl and shale interbedded, which was deposited continentualy throughout the Jurassic, Cretaceous and up to Upper Eocene. At the beginning of the Lower Jurassic (Lias), Ionian zone differentiation is noticed at the bottom of the basin, which is associated with the formation of two carbonate facies: pelagic facies represented by crystalline limestone with chert lenses and neritic facies represented by algal limestone and dolomite. In the Toarcian (J13t), the differentiation of the basin bottom of the Ionian Trough becomes clearer, having an island archipelago view. In central of the Ionian zone (Kurvelesh anticlinal belt), lithofacies of marls schist with Posidonia is formed, whereas on both sides (Cika and Berati anticlinal belts), the lithofacies of limestone and dolomite limestone with amonities, known as "Amonitico Rosso", are formed. It is shallower the "Posidon" facies. The Middle Jurassic is represented by the lower chert package which consists of many chert followed by micritic and biometric limestone deposition also rich in chert. During the Upper Jurassic, the deepening of the Ionian Trough continue and is associated with a marked increase in siliceous material (the Upper chert package), which meets in the entirety of the Ionian zone. At the Tithonian-Berrasian the sea depth reaches largest values covering the Liassic neritic deposits. These deposits are overlain unconformable on mi critic-biometric limestone rich in infanticide. In the Ionian zone, the Cretaceous depositions are pelagic faces and are of pelagic faces and are represented by miscellaneous, clayey limestone and bituminous clays (Lower Cretaceous) on which lies phosphorescent-bio metric milestones and the organic-clastic and pelitomorphic limestone (Upper Cretaceous). During the Paleocene-Eocene, the pelagic condition of Upper Cretaceous paleogeography is still preserved, reflected in the formation of micritic and detrital limestone intercalations. At this time, the erosion activity in the Upper Cretaceous carbonate platform from the Kruja zone in the east and the Sazani zone in the west, contributed as a distal source to the thick carbonate turbidities deposited in the Ionian basin during the Upper Cretaceous and Paleocene These turbidities, which reworked platform carbonate, are interbedded within a finer-grained pelagic limestone. These carbonates are highly fractured because of orogenic processes and they make up the main hydrocarbon reservoirs in the large structural closure in the thrust and subthrust. Carbonate formation thickness in the Ionian zone varies from 2100 to 2900m.

A transitional zone with the marks, 20 to 30m thick, mark the change in sedimentation from pelagic carbonate to a flysch succession of the Oligocene age, which form the overlying seal for the carbonate reservoirs of thrust and subthrust sheets. The flysch consists of intercalation of sandstone, silistone and clays, as well as pudding stones and milestones olistoliths of Upper Cretaceous-Eocene age., Its thickness varies from 1000 to 3000m, which reduces from the east (Berati anticlinal belt) to the west (Cika anticlinal belt). The eastern part of Ionian zone (Berati anticlinal belt) emerged from the end of Upper Oligocene, because the coastal line (Berati anticlinal belt), continues its regression westward. From the Oligocene to the Aquitanian, the sea regression is intensified, and at the end of Aquitanian, the western sector of the Ionian zone (Kurveleshi and Cika anticlinal belt) is tectonized and emerged. The top of anticlinal structures is eroded. The sedimentation continues without interruption in the synclines. The premolasses formation consist of marls, marl with the clays, sandstone and lithothamnic organogenic limestones. It belongs to Aquitanian-Burdigalian-Lower Serravalian period, and it meets only in the Kurveleshi and Cika anticlinal belts.The thickness of this formation varies from 900m in the east (Kurveleshi anticlinal belt) and up to 2300-2500m in the west (Cika anticlinal belt).

The molasses formation of the Middle Serravalian to Pliocene age are composed of a large number of sandy-clayey mega-sequences (going upwards). in some cases, this mega-sequences become more complete and beginning with conglomerate and clastic limestone with lithothamnion and ending with coals or clayey-gypsum. They are wide-spread in the Peri Adriatic depression and South Adriatic basin. In the eastern board, these depositions are placed transgresively in the Ionian and Kruja zones, in the northeastern part of Albania. Conversely, in the west and southeast, the section is successive with thicknesses of about 7000-8000m. A result of the sedimentation conditions changing in the Messinian, the clay-sandy lithofacies was formed in the eastern part of the Peri Adriatic depression, and the clayey-gypsum lithofacies was formed in the western part.

The Upper Miocene molasses deposits lie transgresivey over the eroded part of the carbonate of Kucova and Patoc-Verbas anticline structures. It is known that a great quantity of oil and gas reserves has migrates from the eroded the eroded carbonate to the sandstone reservoirs of these deposits, and has saturated them, up to outcrop on surface, in the south of Patos and in east of Kucova. During the geological period from the Upper Miocene to the Quaternary, at the part where these process of deposits come out to the surface, the oil is oxidized, and the light fraction move, and are turned into bitumen, and this have served as a screen (seal) to prevent further of migration.

A common feature of the Ionian zone is that during the molasses cycles their structures and the structural belts (Berati, Kurveleshi and Cika anticline belts) have increased the thrusting and back thrusting degree, as a result of a powerful tectonic development. Their thrusting westward and backward, is a process assisted by the presence of Upper Triassic evaporites beneath the thick carbonate (T3-Pg2). The local evaporites are exposed to the surface, because of regional and local faulting (e.g. Dumrea and Zavrohon diapirs). Kruja deposits is represented by the Upper Cretaceous to Eocene shallow water platform carbonate. These deposits consist of dolomite, milestones with rudiste etc, detritus limestones, rich in miliolides and textularides with frequent hiatus, emersion, erosional and even bauxite horizons. The deposit of carbonates changes toward west (Ishmi) and south (Tomorri) into mixed (neritic and pelagic one). More to the south (Melesini) the carbonate are completely basin facies [10,14].

The Oligocene flysch sequences confirms the development of a Paleocene foredecp basin, sourced by the erosional region when the Lower Oligocene was filled with flysch deposits reaching thickness of 3000 to 4000m. The Oligocene-Aquitanian is represented by intercalations of flysch-flyschoidal sandstone-clays-silts with underwater slumping horizons and olistoliths of origanogenic-clastic limestones (Cr2-Pg2), which became thicker and coarser eastward and upward. Nonconformity of Tortonian molasses deposits which lies on top of the major structures and locally scales of the thrust contact between successive duplexes, is composed of Mesozoic carbonates and Oligocene flysch. They represent a Neogene piggyback basin (Tirana depression) between the west-verging overthrust of Dajti units and regional east-verging backthrust involving the Pliocene t and anhydrites facies predominates in the Berati and Cika anticlinal belts (Figure 11) [15]

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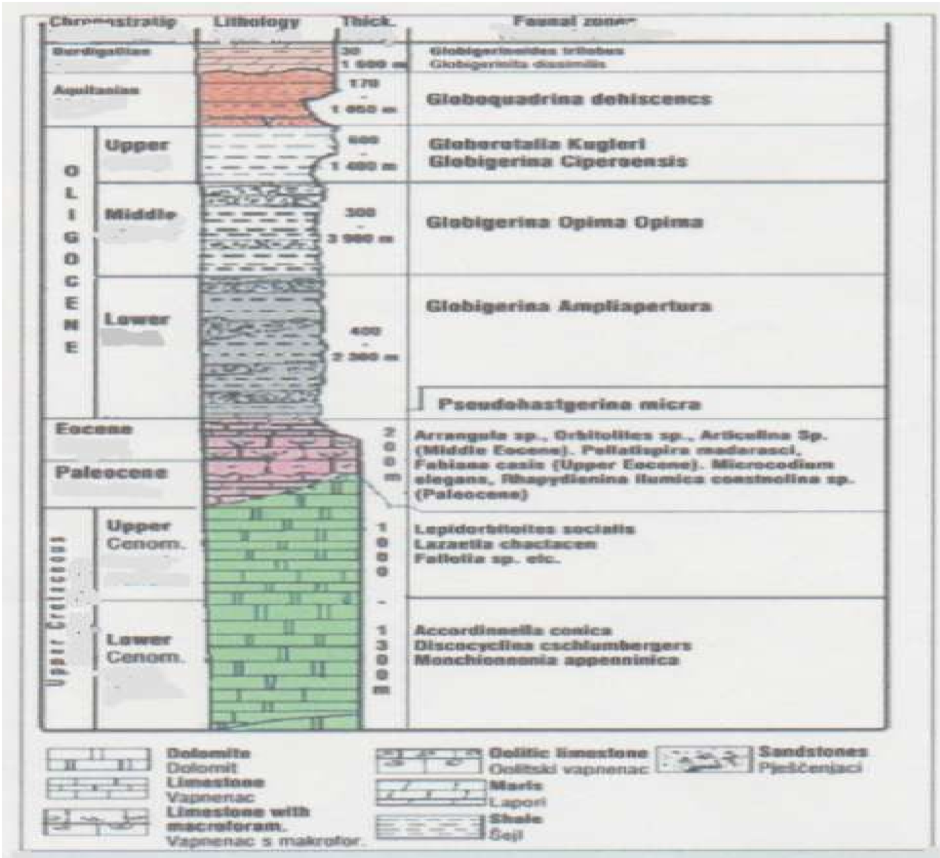

Figure 11: Liyhological and stratigraphic section of Kruja zone.

The carbonate is to Upper Triassic to Eocene, and it in general, belongs to pelagic facies. Upper Triassic dolomite and massive rocks (diabaze, gneis and volcanic tuffs) are encountered locally. Salts are widespread in the Kurvelesh anticlinal belt, whereas gypsum and anhydrites facies predominates in the Berati and Cika anticlinal belts [15] rigeneous fill of Peri Adriatic depression. The western flank of Tirana piggyback basin is composed of a range of hills with very steep slopes and geological strata with 90^0 dip.

Petroleum system

The thrusting and over thrust model in the External Albanides (Ionian and Kruja zones) and Sazani zone, was proved from geological surface observation, and seismic works and deep wells (Shpiragu-1, Shpir.agu-2, Dumre-7, Kanina-1, Ardenica-7, Vlora-10, Vlora-11, etc.). From these data, it seems that Albania has good potential for further hydrocarbon exploration. The prospect of Albania is associated with folded and hanging wall anticlines formed by high angle faults formed good structural traps, sourced by the Mesozoic source rocks (Table 1). The focus in recent years has been on deeper subthrust carbonate structures that contain the lighter oil and condensate [10, 14] Potential discoveries will be found in sub thrust complexes, under of over thrust of the structural anticlinal belts (Berati, Kurveleshi and Cika anticlinal belts) and of under the over thrust of the anticline units (Kurveleshi anticlinal belt). In addition, good potential will be found under the regional of the over thrust of tectonic zones orogenetic front (Ionian and Kruja zones), above the western Albanian autochthonous (Apulian Platform and South Adriatic Basin). This over thrust has a regional character [10, 14] Albania, Greece and Montenegro) and has masked the subthrust structures with its large dimensions and high perspective. One of these structures is attacked by one exploratory well in Vlora region (Vlora-10, Vlora-11). [10, 14]

Source rocks

Several source rocks levels have observed in outcrops and deep wells of the Ionian zone of Albania.In the Kurveleshi anticlinal belt have been observed several source rocks levels: Upper Triassic, Lias, Toarcian, Malm and Lower Cretaceous. All these source rocks have a high content of oil-prone-organic-matter (type I type II). Condensate and light oil formed in the Post-Pliocene period, whereas the heavy oil accumulations in an early time (Middle Miocene). Four main organic-rich source rock formation have been considered: In the Upper Triassic-Lower Jurassic, there are black shale, from thin (i.e. centimeters) to thick organic-rich layer with a TOC value up to 5.5%, comparable to those of the Burano formation (Lower Triassic) in Southern Italy, which are the main effective source rock in the Kurveleshi anticlinal belt. In the Middle and Lower Jurassic bituminous black shale and clays consists of thin organic-rich intercalation with the maximum TOC value re aching up to 5.25% with a Ro ranging from 0.52 to 0.57.

The upper organic-rich horizons can reach a maximum TOC value of 1.5% with Ro values of 0.51%. A couple of thin bituminous milestones intervals are known from the Lower Cretaceous with TOC of 1-27% and vitrinite reflectance of 0.41 to 0.44%. These organic matter is type I or II and of marine origin. The argillaceous limestone package of the Lower Cretaceous is the younger source rocks horizon in the Kurveleshi anticlinal belt. T thrust type I/II source rocks of good or excellent quality are present in the Upper Triassic, Lower Jurassic and Lower Cretaceous. The Toarcian, Middle Jurassic and Upper Jurassic of the Kurveleshi anticlinal belt contain poo r to good quality type I/II source rocks for oil. The outcrops of Upper Triassic and Lower Jurassic source rock levels show mature oil generation (VR/E 0.53-0.88). During the early Tortonian, tectonic burial led the Upper Triassic-Lower Jurassic source rock to partially enter the dry gas window. Since the Messinian period the Upper Triassic source has been over mature (Ro 7.0-22.019) in foreland, whereas in the thrust units, is still maturing or in condensate window (1%<Ro<1.4%). In the Cika anticlinal belt Early Triassic source rocks have a gross thickness of up to 15m. Based on the outcrop samples TOC=0.1-38% have been recorded for these source rocks. In the basal Jurassic similar intercalations with higher TOC value (up to 52%) have been recorded. In the Sazani zone only one Triassic level has been recognized. The Toarcian limestone comprises a somewhat thicker and locally more organic- rich interval, corresponding to the widespread Posidonia Shale's (Table 1).

In Shpiragu-1 well a 600m gross interval was recorded with Posidonia shale inter layer. In the Middle Jurassic and also in the Late Jurassic some further thin, organic-rich shale intercalations with maximum TOC=9% have been evidenced. A couple of thicker bituminous shale intervals are known from the Lower Cretaceous with the maximum TOC=27% have been recorded. Although no commercial hydrocarbon accumulation has yet been found in the Kruja zone, numerous surface oil seeps have occurred there along the Neogene nonconformity in Tirane piggyback basin. These seeps confirm the existence of a currently active petroleum system in this area. The source horizon is proved to be related to Upper Cretaceous deposits, which is most likely to be situated in oil window in earby under thrust synclines. The analyses performed for this source rock horizon show that TOC ranges from 0.664 to 1.05. The Hydrogen Index Values (HI) as well as the maceral components show that the matter belongs the type I/II able to generate liquid hydrocarbons. The Vitrine Reflectance is 0.338 to 0.403 that show the organic matter has just started maturation. The flysch and flyschoides deposits of Kruja zone, based in the imaceral components as well as on average values of HI=71mg Ho/gr., show that their organic matter is to generate gases hydrocarbons.

No	ZONE	AGE	LITHOLOGY	SAMPLE LOCATION	TOC (%)	HI MgrHc/gr	Tmax	KEROG TYPE	VR/E
1	Sazani	Upper Triassic	Dolom/ Shale	Well	0.16-1.72	162	424	II/III	0.87
1	IONIAN	Upper Triassic	Shale/Clay/limes	Outcrop	0.02-38.5	617	416	I	0.54-0.88
2		Lower Jurassic	Dolomite Shale	Outcrop	0.0.1-52	450	434	I/II	0.55-0.75
3		Toarcian	Possidonia Shale	Outcrop	0.09-3.7	588	432	I/II	0.5-0.6
4		Middle Jurassic	Clay	Well	2	505	424	II	0.57
5			Shale	Outcrop	0.04-9.4	508	432	I	0.52
6		Upper Jurassic	Shale	Outcrop	0.03-5.9	520	430	I	0.45-0.57
7		Lower Cretaceous	Shale	Outc/ Well	0.02-27	521-700	413	I/II	0.45-0.54
1	KRUJĄ	Upper Cretaceous	Dolomite/shale	Outcrop	0.18-4.2	540	427	I/II	0.3-0.403
1	IO,KR,SA PAD	Aquitan/Burdigal	Clastic	Outc/ Well	0.19-1.72	71	434	III	0.4-0.5
2		Tortonian-Pliocene	Clastic	Well	0.05-1.62	34.8	431.5	III	0.330-0.28

Table 1: Source rocks in External Albanide.

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Seals

Flycsh and flyschoides deposits of the Oligocene age (Pg3) have proven to be effective seals for hydrocarbon accumulations in the carbonate section including Gorisht-Kocul, Cakran, Ballsh-Hekal and Amonica oil fields. In the addition, analogue flyschs are effective seals for carbonate subthrust resevoirs (Shpiragu, Delvina Karbunara oil fields) and will be effective for all the subthrust of the Ionian, Kruja zones etc. The considerable clayey thickness of the Tortonian-Pliocene has been proved as a good seal for the gas fields (Divjaka, Kryevidhi, Frakulla, Povelca, Ballaj, etc.) and oil fields (Patos-Marinza, Kucova and Pekisht-Murrizi), in the Peri Adriatic depression. Lateral econdary porosity facies variation occurs, limiting the petroleum storage large amount of bituminous deposits generated during heavy oil expulsion (Langian and Messinian) at least constitute good superficial seals. The following are also predicted to be good seals within the carbonate formation is of the Ionian zone: clayey-marl of the Toarcian the(J13t), chert package of the Jurassic and clayey thin layer of the Lower Cretaceous.

Reservoirs

Oil and gas reservoirs have been proved in both the deeper marine carbonates of the Ionian zone and in the clastic section of Peri Adriatic depression. The limestone reservoir in Albania in age from Cretaceous to Eocene, it is virtually clay-free, massive and represented by micritic and clastic limestone. The main type of oilfields consists of fractured carbonates, going deeper from Eocene-Paleocene to Cretaceous, is noted that the reservoir storage consists of fracture, and vuggy porosity. From some well cores of Cakran oil field, the matrix porosity result to be mainly 2.5% going up to a peak 6% for a couple of samples. Also, from well core measurements of the Paleocene reservoirs belonging to the Ionian zone (Kurveleshi anticline belt), the fractured porosity resulted to be a range between 2.4-2.5%. The Upper Cretaceous reservoir in the Kruja zone, consisting of dolomite and dolomite limestone, has not been penetrated by any well, thus they are described from outcrops. Considering the fact those reservoirs in Kruja belonging to neritic plat formic facies, good to excellent reservoir properties are expected to be found there. From the well cores of the Upper Triassic-Lower Jurassic reservoir in Sazani zone, the effective porosity consisting of inter crystalline, fracture, and vuggy porosity range from 2-10.00%. In the Lower Cretaceous reservoir (Sazani zone) the fracture and inter crystalline porosities ranges from 2.6-7.9%, whereas for the Paleocene-Eocene reservoirs fracture porosity varies from 0.9-1.3%. Matrix porosity and vuggy porosity of the Upper Cretaceous reservoirs are measured A4-1x well cores are respectively 4.3-10.00% and 6-7%. In Upper Cretaceous (Apulia platform) reservoir consisting of dolomite limestone of A5-1x well the total porosity is 13.6%. Reservoirs, in some oil fields in the central part of Albania, is related to Miocene deltaic sandstone with porosity ranging between 10-30% and permeability's 2000-3000md, such as in Marinza, Patos and Kucova fields. Reservoir in the gas fields of Peri Adriatic depression is related to molasses sandstone of Late Miocene of Tortonian-Messinian in age or in the sandstone of Pliocene age, with the porosity ranging between 12-37%.

Trap formation and migration

Three main periods of massive migration and accumulation of oil are distinguished. These periods coincide three main phases in the formation of structures of the Ionian basin: The Berati anticlinal belt underwent a compression regime during the Upper Cretaceous-Aquitaniane, whereas the Kurveleshi and Cika anticlinal belt were thrust-folded at the end of the Lower Miocene and Pliocene. These main folding phase are responsible for formation of the carbonate trap (Cr2-Pg2), for oil and gas accumulation. The trap-formation in the Ionian zone and in its subthrust, is linked to the compressive tectonic regime and resulting in over thrusting. This mechanism is valid not only for the carbonate reservoir, but also foremost traps concerning the clastic reservoir located in lithologic-stratigraphic traps, formed during the Upper Miocene (e.g. the Kucova oil field, etc.). Many traps were completed when the Oligocene flysch was deposited on the top of the carbonate. Hanging wall anticlines formed by high-angle faults are present beneath the over thrust of the structures of Ionian, Kruja zones etc. Traps may also exist in the Lias shallow water carbonates sealed by Posidonia shale and the pelagic thin bedded Lower Cretaceous limestone. The main trap formation in the Kurveleshi anticlinal belt links to the compression tectonic regime of the Alpine orogeny and the resulting over thrusting. The Kurveleshi anticlinal belt displays a unique petroliferous fold-and-thrust system. It es to a complex tectonic assemblage, made up of thin-skinned allochtonous units, progressively emplaced during the Neogene deformation occurred on. Traps in thrust and subthrust carbonate are primarily hanging wall anticlines with three or four over closures. The main folding phases responsible for the trap formation relate to the geological times: the late Eocene to early Oligocene; the Burdigalian; the Tortonian and the Pliocene. Oil generation has occurred in two phases: during the early Miocene period, when the main part of source rock as in the oil mature highly window; and during the Pliocene, when source rock was in a more advanced stage of oil genesis. This generation phases continues today. In the Lectureship anticline belt the main periods of expulsion occurred: (I) heavy oil formed during the Lagrangian period; (II) heavy oil formed during the Tortoni a mentioned phases of heavy oil and (III) light oil or condensate formed during and after the Pliocene [16]. The Cretaceous to Eocene limestone has been highly fractured due to mountain processes and form the primary reservoirs zone in the large structural, and is the principal target hydrocarbon in the Kurveleshi anticlinal belt. The entire oil fields were discovered in the anticline structures of carbonate reservoirs (Cr2-Pg2).

Oil accumulation occur in the Lectureship anticline belt limestone and in Peri Adriatic depression sandstone (Patos-Marinza oil fields) of the Messinian age. Migration is thought to have started during the Aquitanian, maximum generally reached its peak during the Tortonian-Upper Miocene and Pliocene. Prospect in subthrust of Ionian and Kruja zone is associated folded and faulted anticines, which provide good structural traps, sourced by Mesozoic source rocks. These deep comprehensive structures are expected beneath of the over thrust of the structural belt, units, tectonic zone etc., forming the main objective of sub thrust hydrocarbon accumulation in the Upper Cretaceous-Eocene fractured carbonate. Hydrocarbon production from carbonate depends on a system of faults and fractured. The timing of oil generation and expulsion occurred in two phases: during the Lower Miocene and Pliocene. Migration on the carbonate intervals oil fields occurred in sample path-ways within a single thrust, from mature source at depth, up dip to reservoir in hanging wall anticline traps. All deposition within the Ionian. Kruja, Sazani and Peri Adriatic the evidence of oil migration as in sample of wells drilled, as well as in surface seeps. The Ionian Basin oil fields formed at the different periods, depending the trap-formation time and maturation stage of the source rocks, is reflected in oil composition changes. Condensate and light accumulation formed in the post-Pliocene (Carbonate oil field: Cakran, Delvina and Shpiragu), whereas heavy oil fields: Gorishti, Ballshi, Amonica, Karbunara, Visoka,etc. and clastic sandstones oil fields: Patos-Marinza, Kucova etc.) [17]. The clastic oil play comprises the Upper Miocene reservoir charged by Mesozoic deep-water carbonate rocks in lithologic-stratigraphic traps, formed above the nonconformity.

Hydrocarbon potential in Albania

Onshore, thrusting westwards and especially in the External Albanides is associated with the masking of the separate anticline structures or anticlinal belt which have potential for new oil and gas discoveries. Thrusting westward is associated with backthrust tectonic faults and the tectonic of triangle type is are not easy to these formed: these not easily identified but they are possible to hide potential traping structures for oil and gas accumulation. Oil potential offshore is related to the possible Ionian carbonate structures and morphological highs of Apulian platform. In appropriate offshore conditions, these are possibilities for new potential oil accumulations both in the clastic section, as it was case in A4-1x well and in the Platform carbonate reservoirs. Gas potential is related to the Miocene-Pliocene folded structures, as is identified by 3D seismic. Most of oil and gas deposits are discovered in the Ionian zone and Peri Adriatic depression. Based on field observations, seismic profiles, the thrusting scale range from 10 to 20 km. and also deep wells drilled into various tectonic structures, such as Dumrea, Delvina, Kanina, Ardenica, Molishti, etc. have verified thrusting 15 to 30km. That is a great possibility to find deposits with oil and gas field in subthrust complex of the Berati, Kurveleshi, and Cika belt [10,11]. Dry gas fields occur mainly in the western sector of the basin, whereas the oil fields are found in the eastern zone. Reservoir rock are well sorted to poorly, finer-grained pebbly sandstone and silicilstones of Miocene (Serravalian) to Pliocene age, deposited in deep waters (turbidities), deltaic and litoral environments. The type of the traps is different: lithologo-stratigraphic, lithologic, structural-strathegraphic, etc. The Upper part of the Pliocene basin belong to deltaic deposits sandstone are coarse grain to conglomeratic. The Neogene clastic deposits contain more to half of the reserves discovered in the Albanian territory, from which more than 25-30% are still underdeveloped. These reservoirs constitute trangressive milestones deposited on the top of the underlying Mesozoic and Paleogene carbonate above a major erosional surface. The paleorelieve mainly shelf, controlling the distribution of the molasses, is made up of contintetal margin of the Ionian plate during the episodes of the thrust-related tectonic uplift. The links between tectonics erosion and sedimentation have controlled both the distribution of the main molasses depocenters, and the coeval depositional environments. The molasses deposits were initially devoided of organic matter premolasses preluding any city generation hydrocarbon. As a consequence, the oil currently in the Neogene reservoir results from the secondary migration in the time where the Oligocene has been entirely removed by the errosion. The oil accumulation concentrated dominantly stratigraphic traps in their bays and outside them. The main folding phases responsible for trap forming in Albania are related to the geological times as follows: The Late Eocene to Early Oligocene, the Burdigalian, the Tortonian and the Pliocene to recent. In Albania three main periods of expulsion occurred: Heavy oil formed during Langhian, heavy oil formed during Tortonian and light oil-condensate formed during and after Pliocene [16].

Hydrocarbon occurrence in Albania

The first oil discovery in Albania happened in 1918 Drashovica Oligocene flysch. In 1927 and 1928 Kucova and Patosi were discovered, followed by Marinza oil field, the biggest oil field in Albania, which was discovered in 1957. (Table 2)

Field	Discovery year	Reservoir type	Reservoir depth (m)	O/g gravity (api)	Sulphur content (%)
Drashovica	1918	Oligoc.flysch	100-200	Oil<10°	?
Patos	1927	Mess-clastics	Surf. To 1200	Oil (12-24°API)	2.5-6
Kucova	1928	Mess-clastics	Surf. To 1500	Oil (13-16°API)	4
Marinza	1957	Mess-clastics	1200-1800	Oil (12-35°API)	4-6
Visoka	1963	Cret Eoc.Carb	800-1000	Oil (5-16°API)	5-6
Gorisht–Kocul	1965	Cret Eoc.Carb	1000-2500	Oil (17°API)	6
Ballsh-Hekal	1966	Cret Eoc.Carb	1000-3000	Oil (12-24°API)	5.7-8.4
Cakrran-Mollaj	1977	Cret Eoc.Carb	3000-4500	Oil (14-37°API) Cond. 52°API	0.9
Finiq-Krane	1973	Cret Eoc.Carb	800-2000	Oil (<10°API)	3.7-4.3
Delvina	1989	Cret Eoc.Carb	2800-3400	Oil (31°API) Cond. 53°API	0.7
Divjaka	1963	Tort clastics	2400-3000	Gas &Condens	Na
Ballaj-Kryevidh	1983	Plioc clastics	300-1700	Gas	Na
Frakulla	1965	Mess clastics	300-2500	Gas	Na
Povelca	1987	Mess clastics	1800-3500	Gas &condens	Na
Panaja	1988	Mess clastics	2500	Gas	Na
Ad-4 (offshore)	1994	Mess clastics	2500-3100	Biogenic Gas & Cond. 54.3°API	Na
Shpiragu	2012	Cret Eoc.	4930-5333	Oil (37°API)	2.3
Amonica	1980	Cr-Pg2	2500-3000	—	—

Table 2: Summary of the exploration history in External Albanians.

In these fields the oil was found to be reservoir in the sandy layers of the Upper Miocene, and was charged from the underlying Ionian Mesozoic limestone of Kucova and Patos-Verbas. During the early of 1960 when the seismic survey began to reveal a more picture of the subsurface structures under the Patos-Marinza complex and other areas, significant discoveries within deeper seated carbonate reservoirs were brought on stream. Visoka oil field (1963) was the first discovery, which proved a new hydrocarbon play type to be related to the fractured carbonate reservoirs of Cretaceous-Eocene age, underneath the clastic section. A new era began in exploration of oil in Albania with discovery of oil in lime stones. This discovery was followed by other discoveries in the carbonate reservoirs such as: Gorisht-Kocul (1965), Ballsh-Hekal (1966), Cakran-Mollaj (1977), Amonica (1980), Delvina (1987) and Shpiragu (2011). With the first gas dicovery (1963) in the Tortonian sandstone layers of Divjaka, other gas fields respectively are discovered: Frakulla (1972), Ballaj (1983), Povelca and Panaja (1987), and Durresi (1988) in the Peri Adriatic depression. The A4-1X drilled in 1993 by AGIP and Chevron (Adriatic offshore), proved condensate and gas-bearing in Messinian clastic reservoirs.

Conclusion

From all the material submitted we draw following conclusions:

The External Albanide consist of some tectonic zones (Ionian and Kruja), which are are over thrusting westward with a large amplitude (50-100km) above the Apulia platform and South Adriatic basin. Ionian zone and the structural belts (Berati, Kurveleshi and Cika), which are westward thrusting with the amplitude 30-30km, hiding structures with high perspective.

The Kruja zone is represented by some anticlinal structural line, which are tectonically faulted in their western side, through this regional fault Kruja zone over thrust above the South Adriatic basin, hiding plays with perspective in subthrust. From tectonic point of view, the External Albanides are divided in three tectonic-stratigraphic zones: Kruja zone (shallow carbonate water), the Ionian zone represented by pelagic carbonte facies and Sazani zone in the west (sshallow carbonate water), which represented by Appliance platform. Peri Adriatic basin (PAD) in north direction is unified with the South Adriatic basin, which overlies transgressive in the eastern bord the Ionian and Kruja zone, The Peri Adriatic basin repents extension of the Cenozoic Adriatic basin into onshore. Several oil dry gas fields discovered in this basin. Dry gas fields occur mainly on the western sector of the basin, whereas oil fields are found in the eastern one. Reservoir rocks are well sorted. The External Albanides are dominated by a series of NNW-SSE structural thrust sheets divided into tectonic zones, the evolution evaporates tectonics it's very important in determination of the principal features of the structural model of the Ionian zone.

There are two types of hydrocarbon accumulation in Albania: fractured limestone of Upper Cretaceous-Eocene and those in the Neogene of Peru Adriatic depression and South Adriatic basin. The complexity and diversity of the subthrust plays remain a challenge for the future exploration for oik and gas in Albania. At present, the more interesting play is the sub thrust beneath the of the over thrust of the Berate anticline belt has already experienced intensive activity from Shell company. At the same time, the sub thrust beneath the over thrust of the other anticline belts (Kurveleshi and Zika) and beneath the over thrust of the External Albanide (Ionian and Kruja zones) are the main objects of the interest for future.

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