Basin Evolution and Hydrocarbon Plays in Albania*

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Abstract

The geological structures in Albania form part of a foreland fold and thrust belt system that includes Mesozoic-Eocene carbonate sequences of the Ionian Basin. The sequences are incorporated into three major Tertiary thrust sheets verging towards Apulia foreland in the southwest and overlain by foreland basin deposits, part of which forms the Durresi Basin. The oil and gas fields are all concentrated onshore in western Albania in these two basins. This presentation discusses some important features that control tectonic history as a prerequisite for assessing the petroleum systems as well as the type and location of accumulations and plays.

A new geodynamic model based on structural and kinematic observations and presented here predicts that anticlockwise rotation of the Apulia foreland along with its uplifted promontory in the southwest of Albania provided a buffer stop for the incoming 'train' of the Ionian basin thrusts during the Oligocene to Pliocene. A regional shear couple was formed between the hinterland and the buffer stop which was accommodated by strain partitioning along the strike. The Ionian basin thrusts were uplifted and exhumed in the south as they buttressed towards the promontory, while propagating freely in the north towards the foreland and overlain by Durresi foredeep basin during the Miocene–Pliocene.

Such a geologic framework formed the natural setting for the formation of two petroleum systems, one in each basin. In the Ionian Basin, all source rocks have good to excellent potential for liquid hydrocarbon generation and are of types II and I. The highest maturation occurs in the Triassic and Jurassic source rocks of the Ionian Basin buried beneath the southern part of the Durresi Basin in central Albania. The beginning of oil generation from the source rocks is related to this Miocene and Pliocene burial. Oil accumulated in two types of reservoirs. The first type of accumulation relates to deep–water carbonates of Late Cretaceous – Eocene age. The reservoirs are fractured with predominantly vuggy porosity. The second type of accumulation relates to molasse deposits of the foreland basin. The oil is located in stratigraphic traps formed during the late Miocene. In the Durresi Basin, the source rocks consist of Tortonian turbidity sequences and Pliocene shales. A large volume of gas was generated by bacterial action. The reservoir is provided by the same Tortonian-Pliocene turbidity sequences and shales.

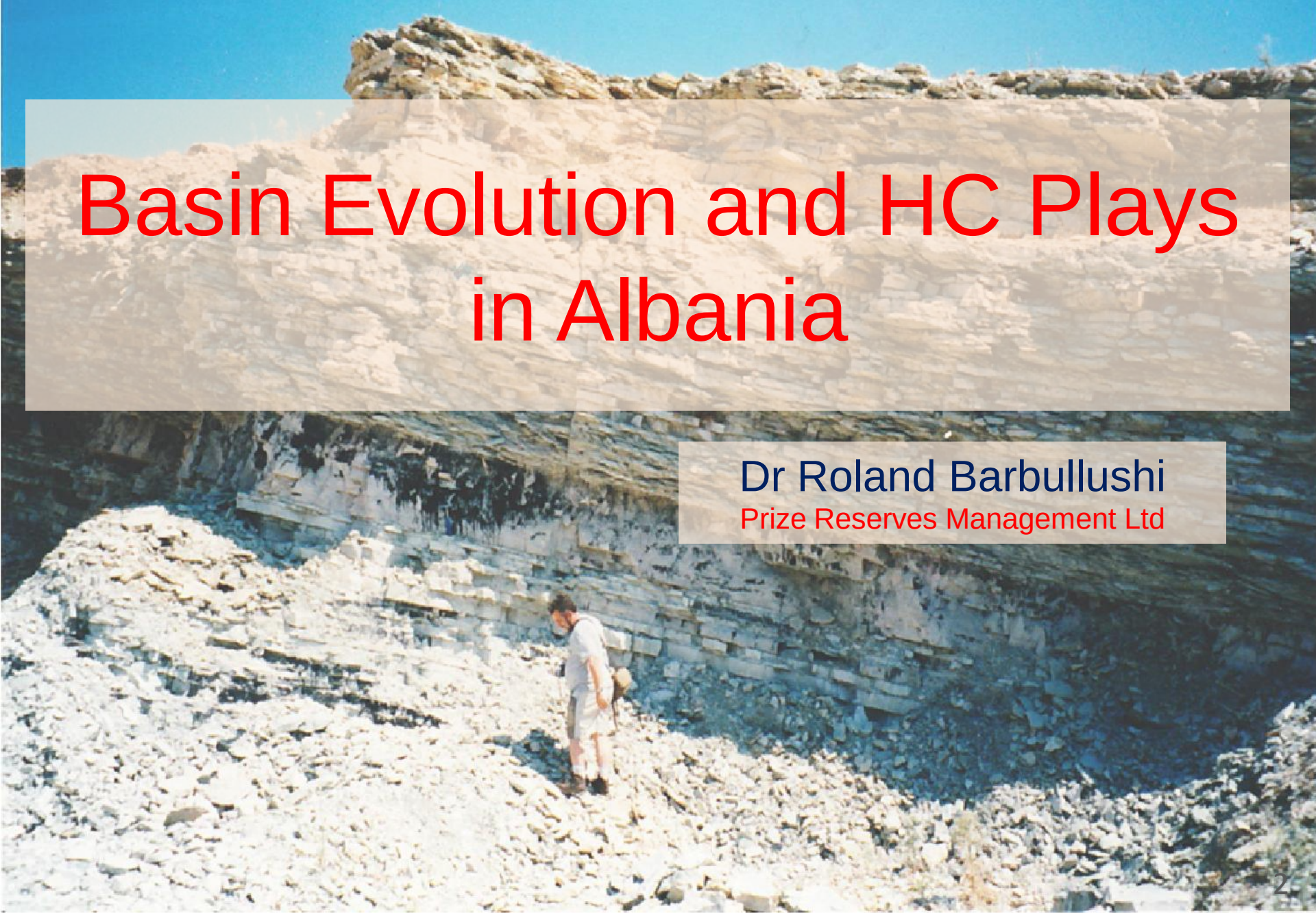
There are three main types of traps and possible complementary plays, all located onshore Albania: (i) a carbonate oil and gas play that comprises Upper Cretaceous - Eocene deep-water carbonate reservoirs of the Ionian Basin in fault-controlled anticlines sealed by Oligocene

flysch and charged from the Mesozoic source rocks; (ii) a clastic oil play that comprises Tortonian-Messinian reservoirs of the Durresi Basin in Tortonian-Messinian sand pinch-outs and sand lenses sealed by intraformational Tortonian-Messinian shales charged by Mesozoic deep-water carbonate rocks of the Ionian Basin, and; (iii) a clastic gas play that comprises Tortonian-Messinian reservoirs in the Durresi Basin in Tortonian-Messinian sand pinch-outs and sand lenses sealed by intraformational Tortonian-Messinian shales charged by the terrigenous source rocks of the foreland basin.

The hitherto investigation of the petroleum systems in Albania suggests that future complementary oil and gas plays may still occur within the Ionian Basin. Some gas plays may still be found in the Durresi Basin. For both these plays, the HC charge is known, and the key risk lies mainly in the trap configuration and to a lesser degree on the timing of generation, migration, and accumulation.

Reference Cited

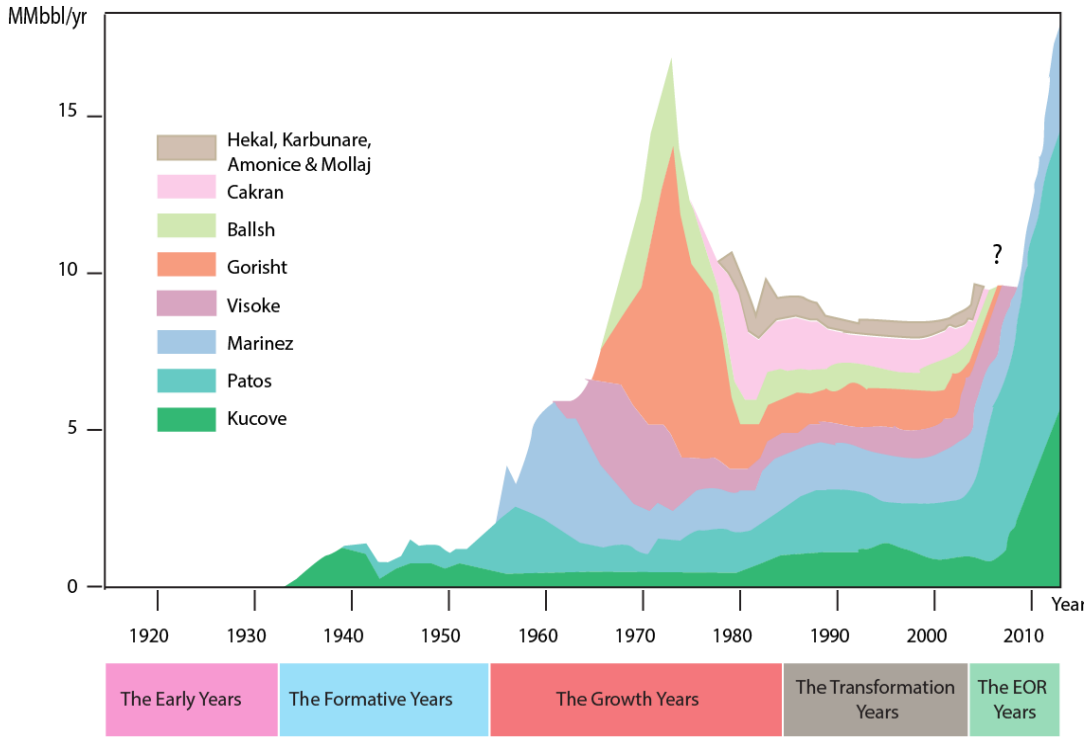
Curi, F., 1993, Oil generation and accumulation in the Albanian Ionian basin, *in* A.M. Spencer (ed.), Generation, accumulation and production of Europe's hydrocarbons: EAPG, Special Publication, Springer, Oxford, UK, v. 3, p. 281-285.

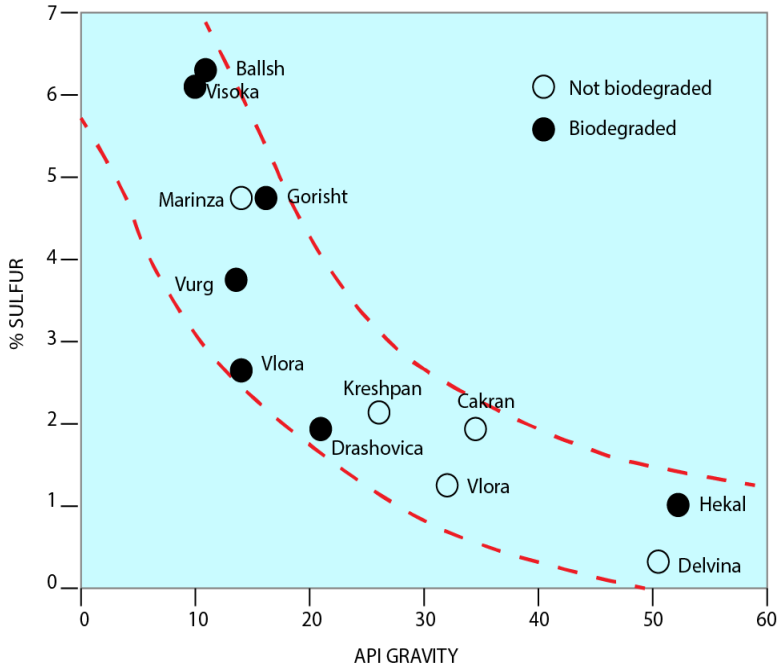


Basin Evolution and HC Plays in Albania

Dr Roland Barbullushi
Prize Reserves Management Ltd

Exploration and Production History



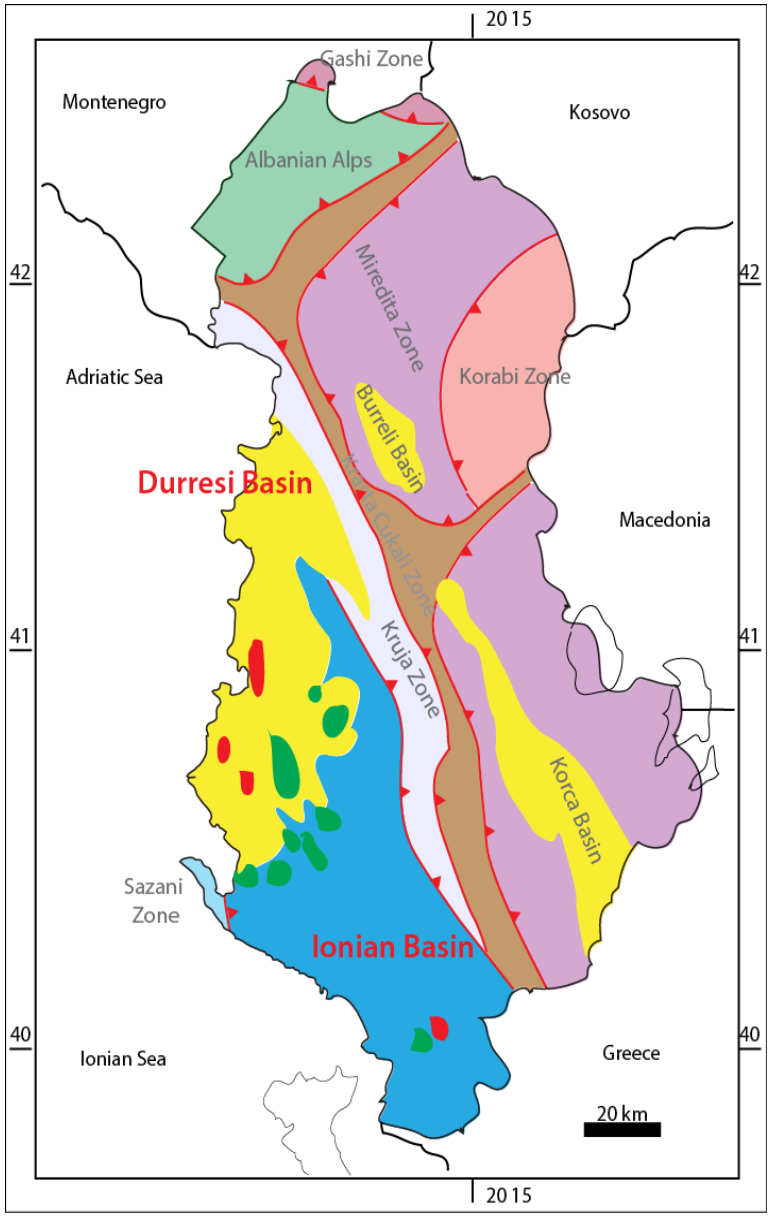


Data source: Albpetrol, Bankers Petroleum

Key Questions

All the oil and gas fields are found in **the Ionian and Durresi basins** in the west and southwest of the country.

There are only few **oil shows** in the **Kruja Zone.**

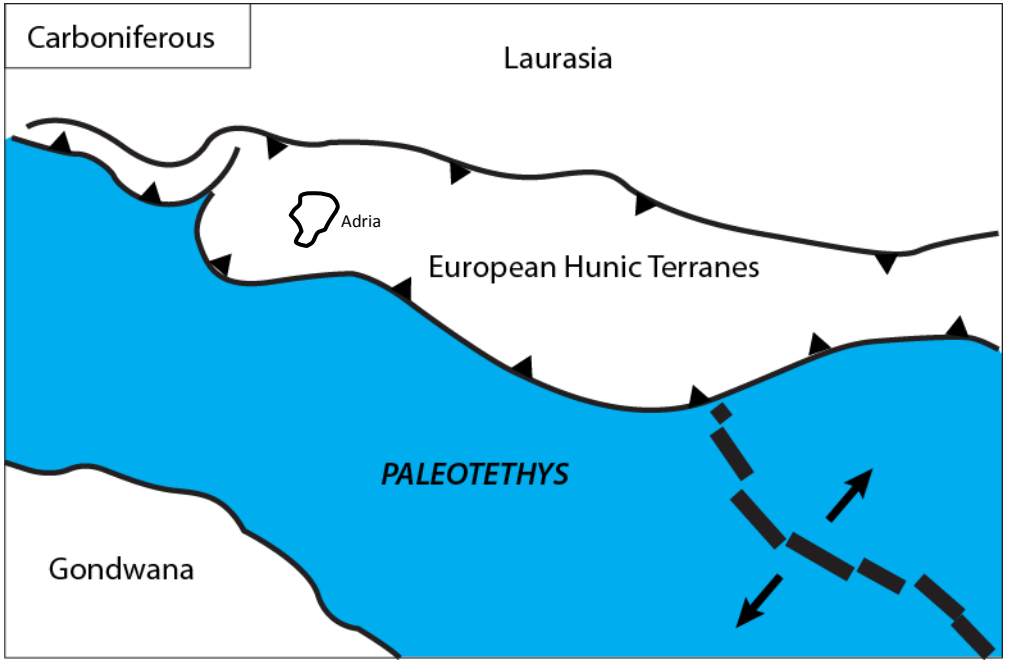


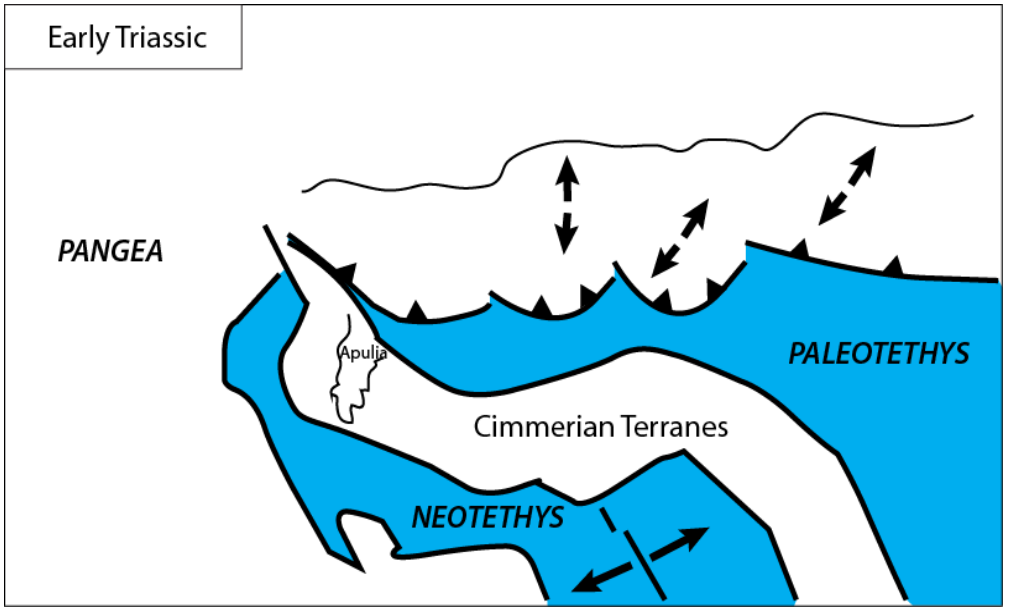
1. What are the important features that control **tectonic history?**
2. What is the relative **charging potential** of the petroleum systems?
3. Where do the main zones of potential petroleum **accumulations** occur?

Paleozoic Evolution

The oldest rocks in Albania are **Ordovician in age,** now exposed as metamorphic rocks to the northwest of the Ionian Basin.

The Apulia microplate is thought to be part of the **Cimmerian terranes.**

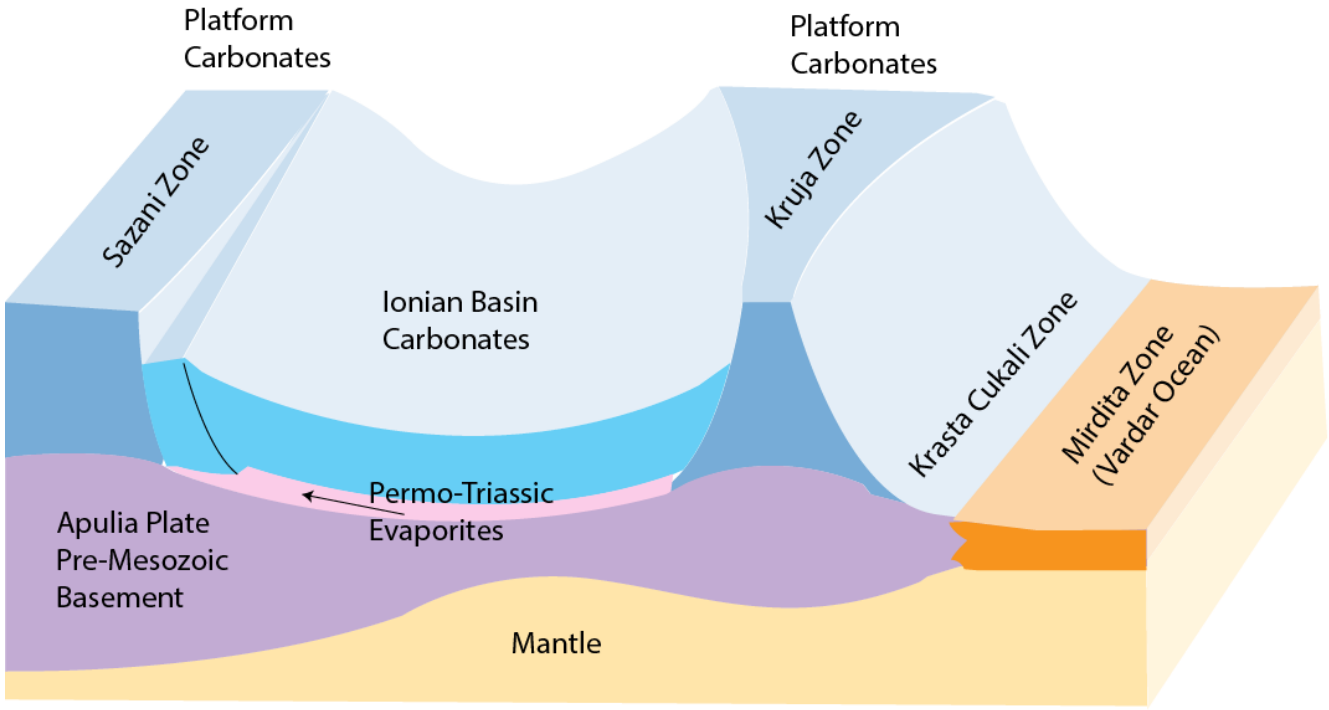


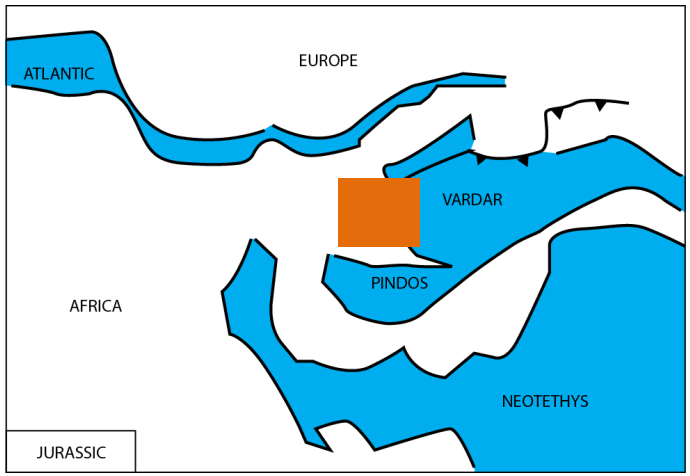


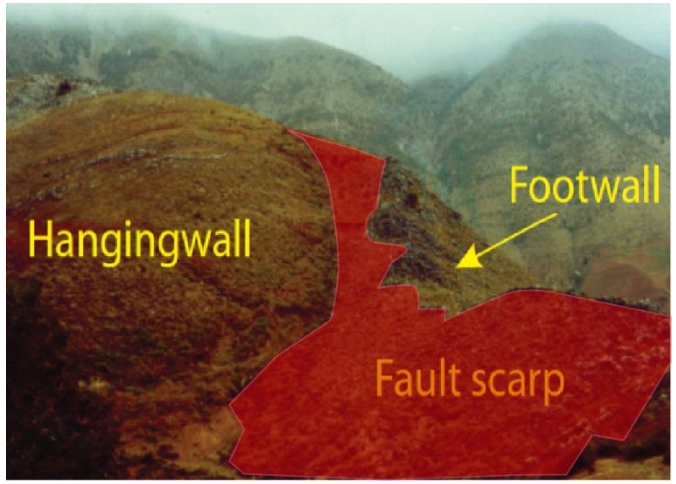
Mesozoic Evolution

Ionian Basin formed by rifting in response to the opening of the **Vardar Ocean in the east**

Deep- water carbonates were deposited in Ionian Basin, whereas **shallow-water carbonates were** deposited on the associated horsts (Sazani and Kruja zones).







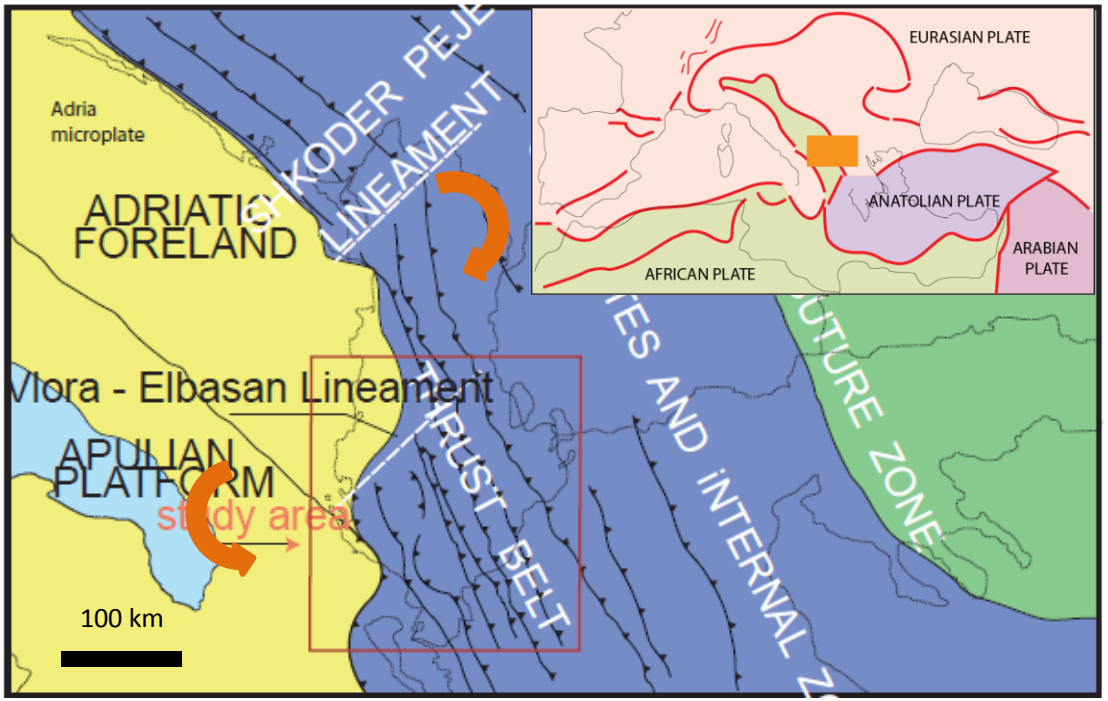
Cenozoic Evolution

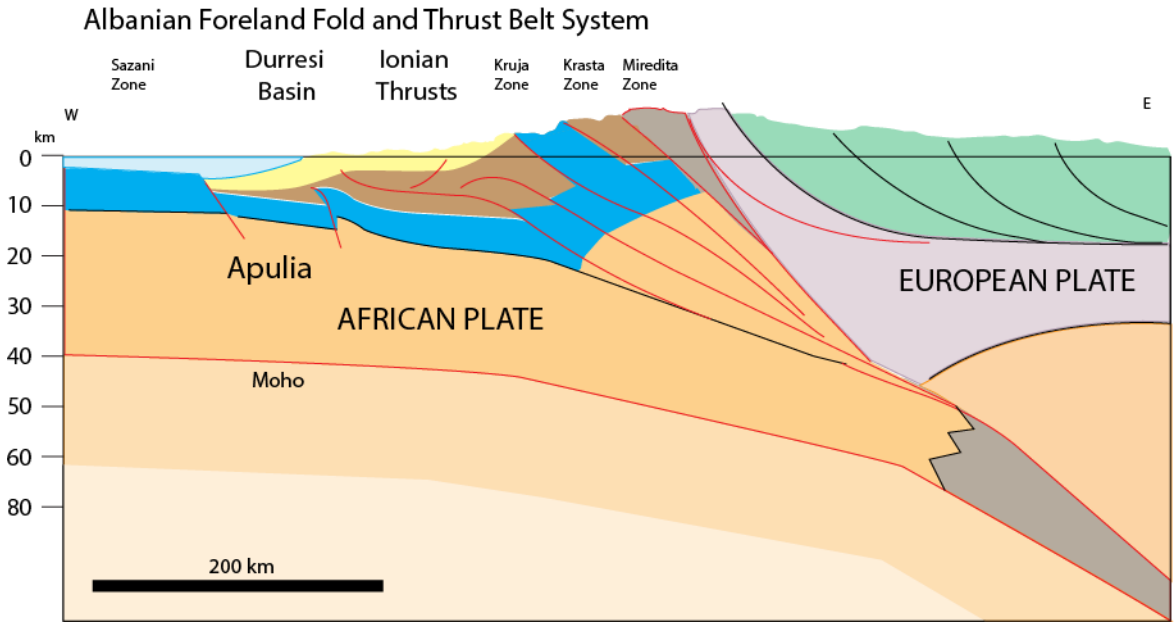
The Vardar Ocean closed during the Late Jurassic – Cretaceous and the **collision of the Apulian (African) and European Plate** occurred.

Thrusting reached the Ionian Basin during **Acquitanian – Burdigalian.**

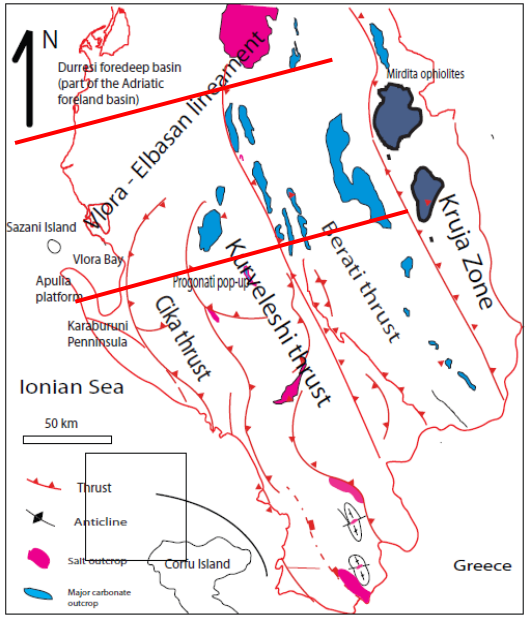
A foredeep basin formed in the central part of Albania.

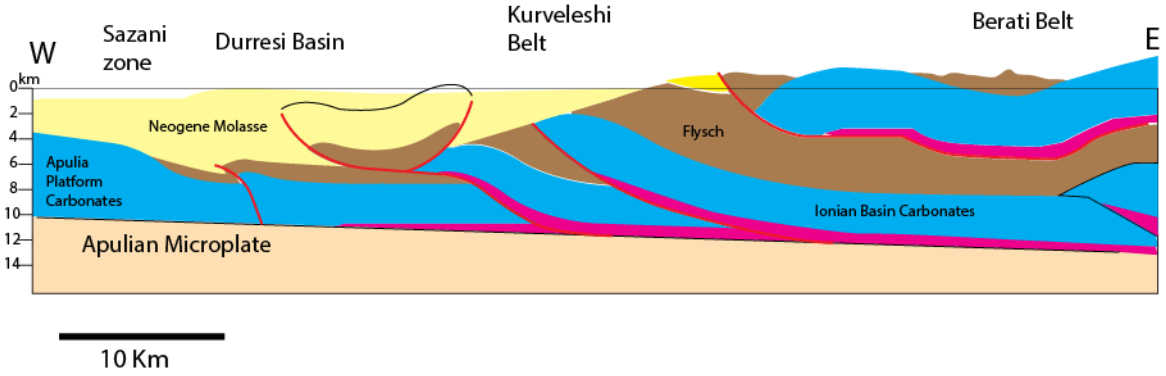
Paleomagnetic data show 45-degree **clockwise rotation** of the thrusts and 45-degree **anticlockwise rotation of the Apulia.**

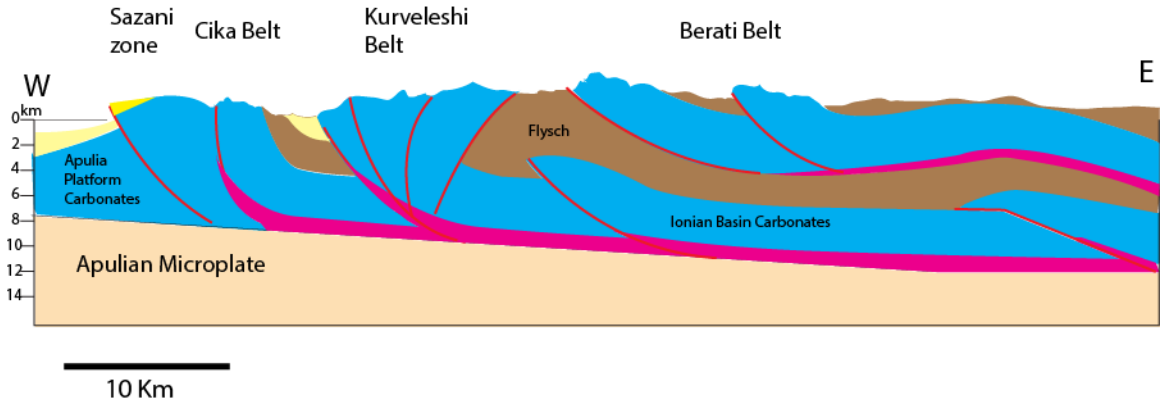




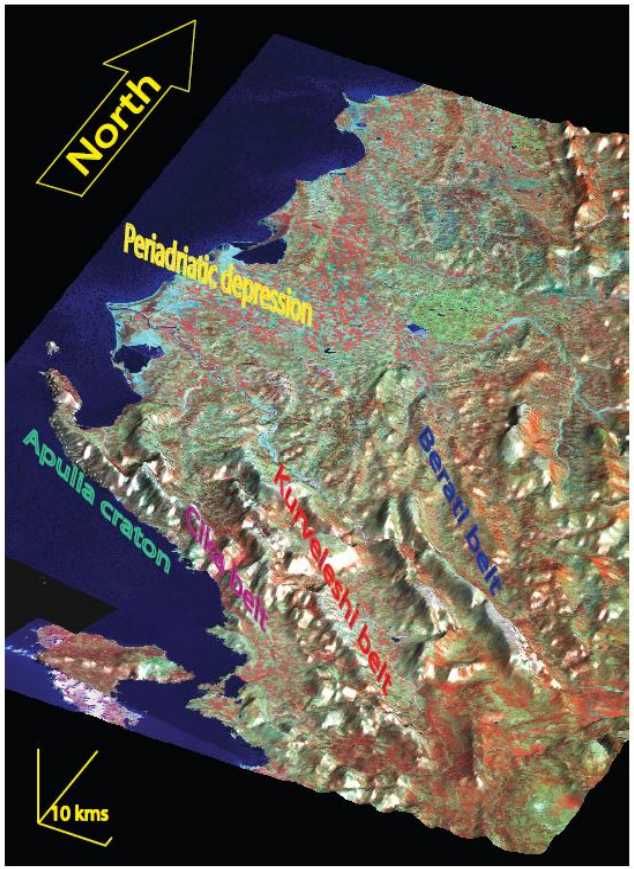
Structural Changes along the Strike

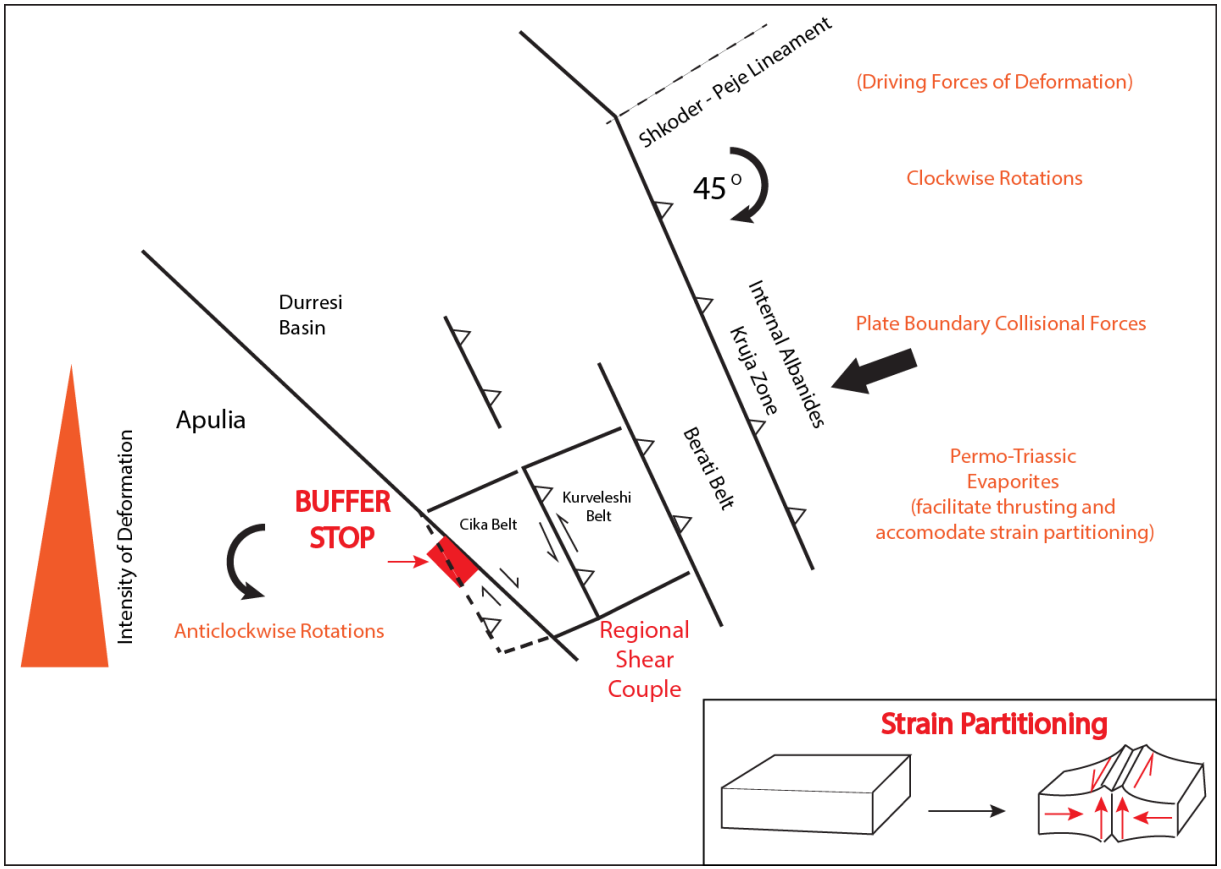






Geodynamic Model



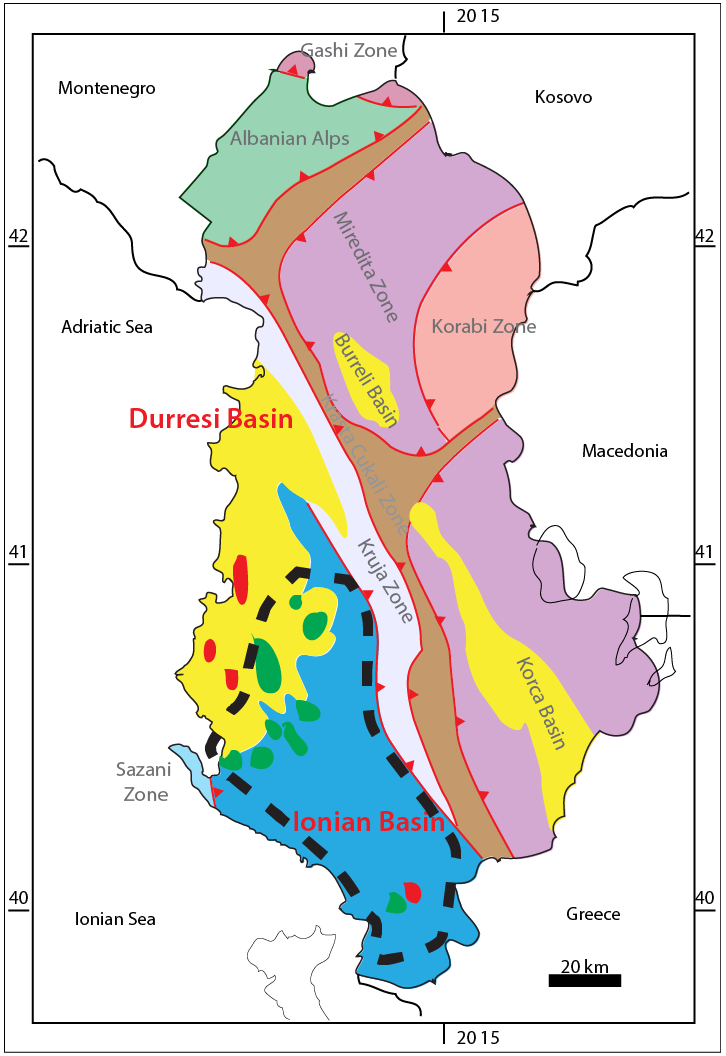


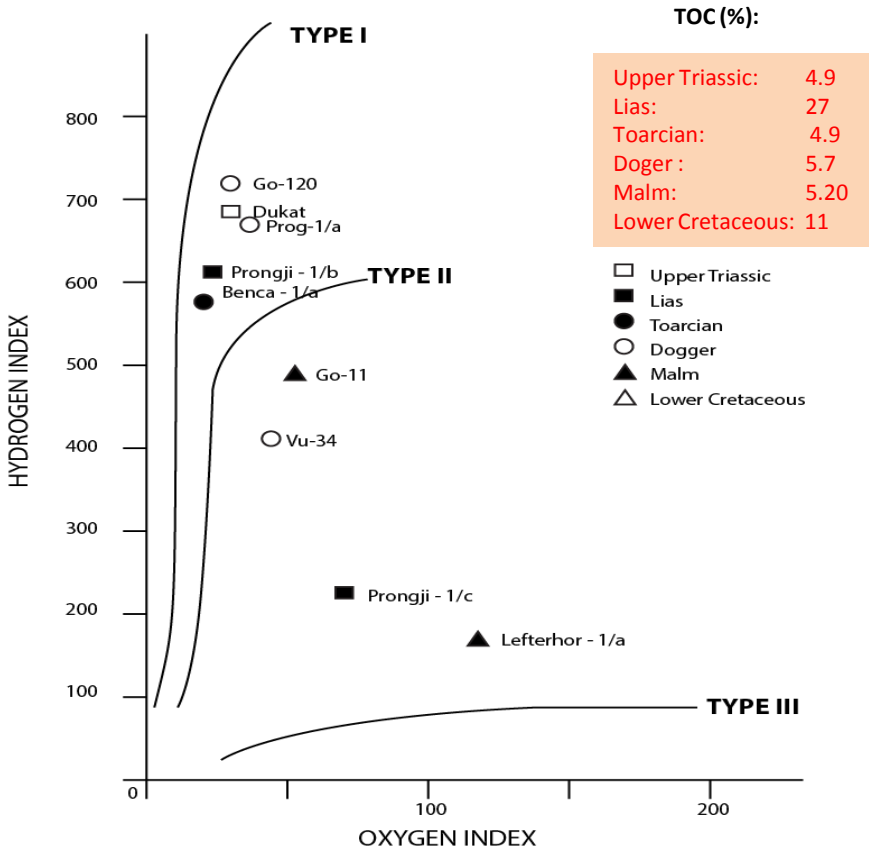
Sazani Zone uplift in the southwest acted as a **buffer stop** for the incoming 'train' of thrusts in the south.

A **regional shear couple** formed between the hinterland and the buffer stop which is accommodated by **strain partitioning** along the strike.

As the intensity of deformation is higher in the south than in the north, the thrusts were **uplifted and exhumed in the south** but **propagated freely towards the foreland in the north.**

Ionian Basin:
Jurassic – Eocene
Petroleum System



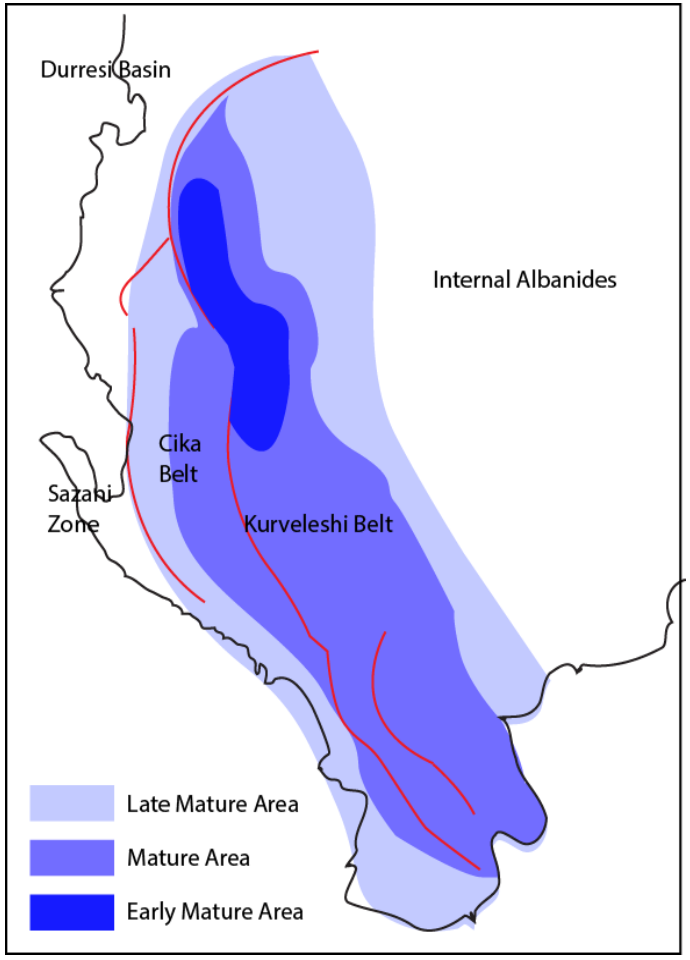


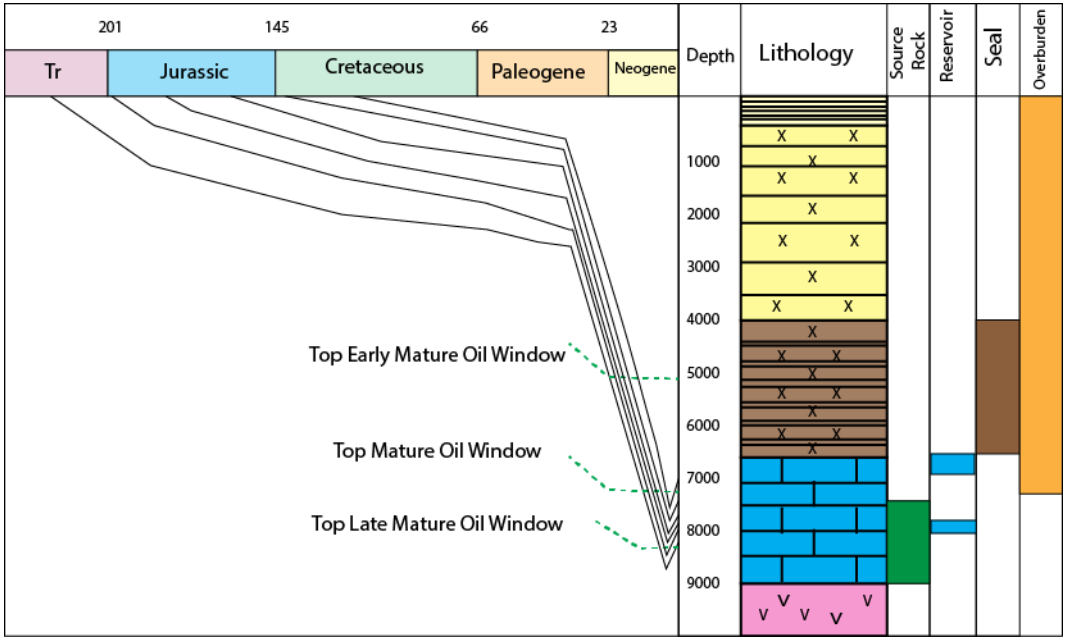
TOC (%):

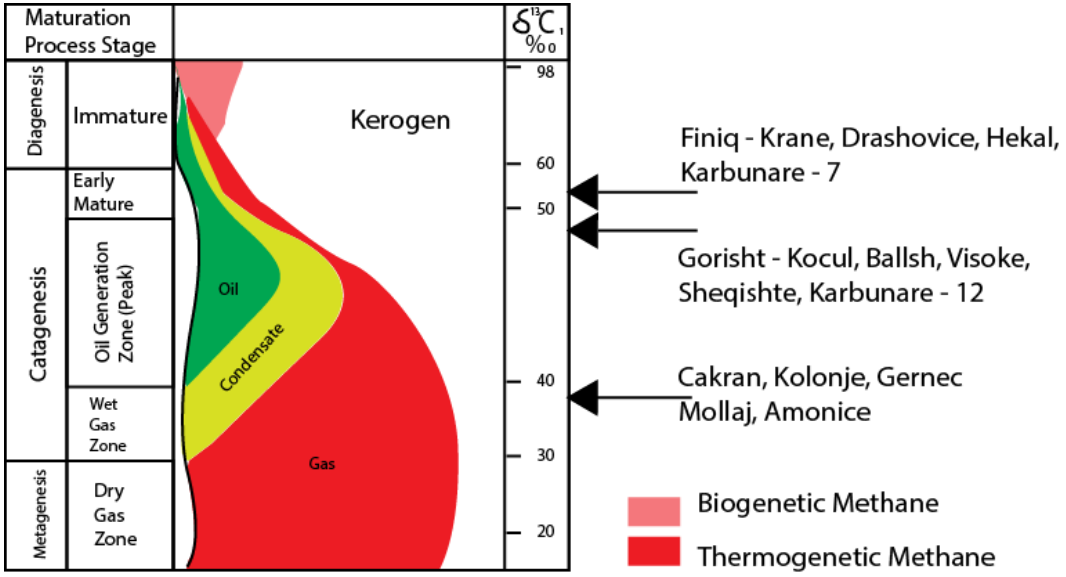
Upper Triassic:	4.9
Lias:	27
Toarcian:	4.9
Doger :	5.7
Malm:	5.20
Lower Cretaceous:	11

Carbon isotope analysis from the main reservoirs of western Albania shows that the oil originated mainly from **six black shale levels within Upper Triassic, Jurassic, and Lower Cretaceous formations**.

HC Charge





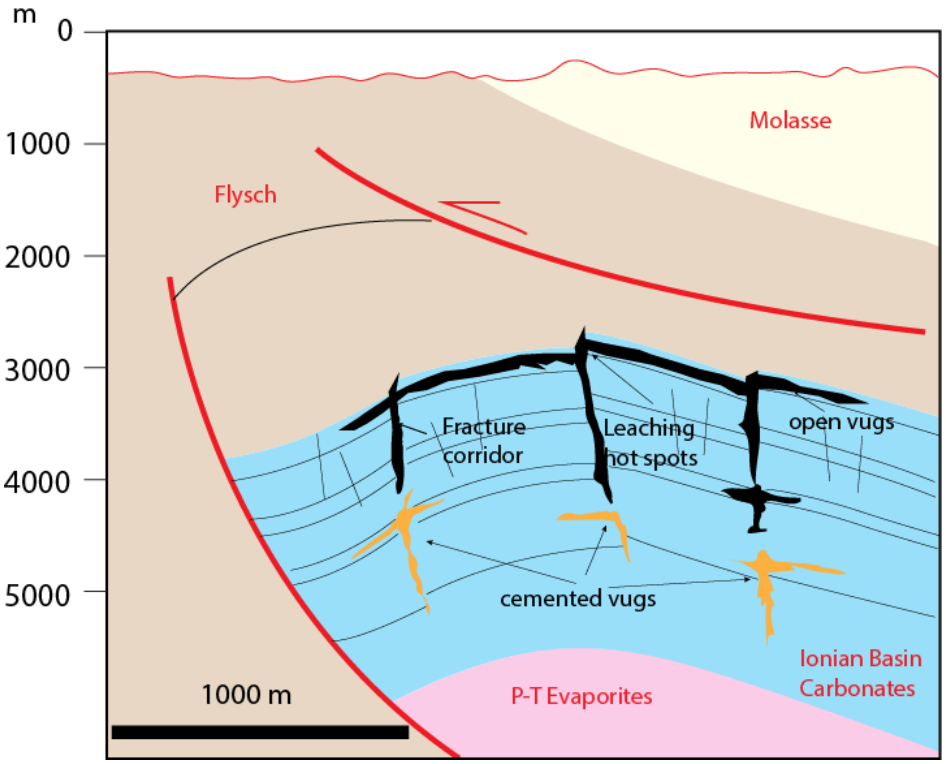


Modified after Curi, 1993

Carbonate Accumulations

Upper Cretaceous – Eocene reservoirs are fractured with predominantly vuggy porosity.

Many of the traps were completed when the Oligocene flysch was deposited on top of the carbonates.

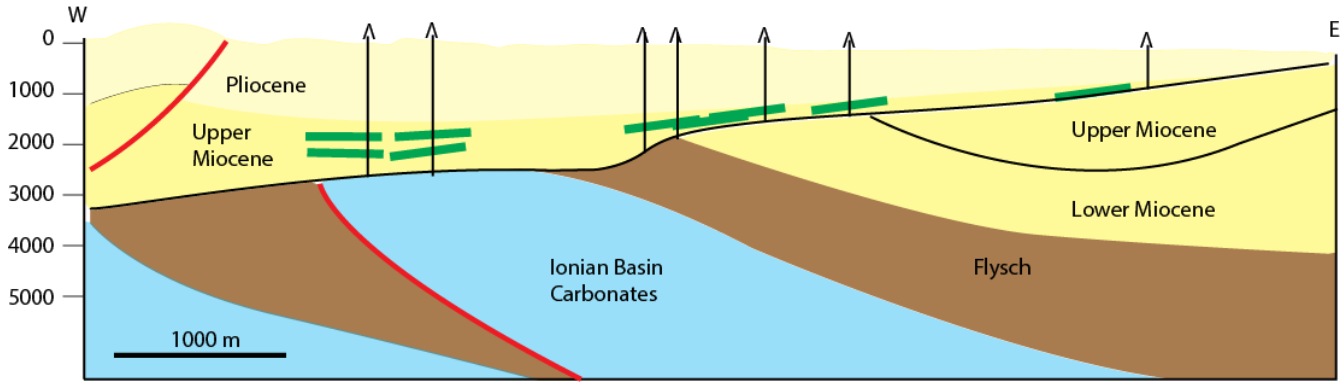


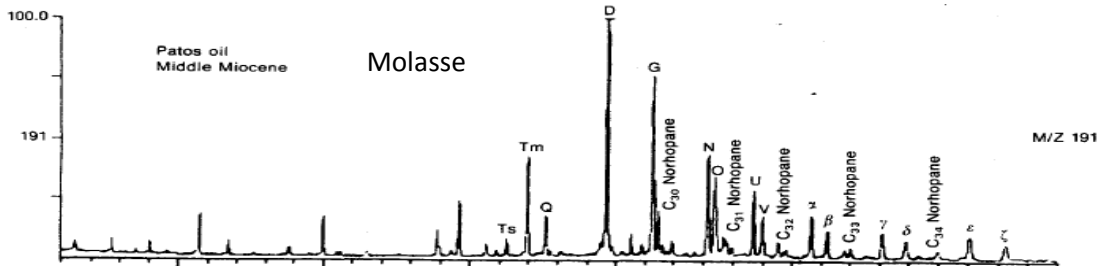
Field Name	Reservoir Depth (m)	Porosity (%)	Permeability (mD)
Visoke	800 – 1000		
Gorisht – Kocul	1000 – 2500	4 -5 + frac	44 – 224
Ballsh – Hekal	1000 – 3000	4-5 + frac	44 – 224
Cakran - Mollaj	3000 – 4500	4 – 5 + frac	44 – 224
Finiq – Krane	800 – 2000	3 – 4 + frac	
Delvine	2800 – 3400	3 – 4 + frac	

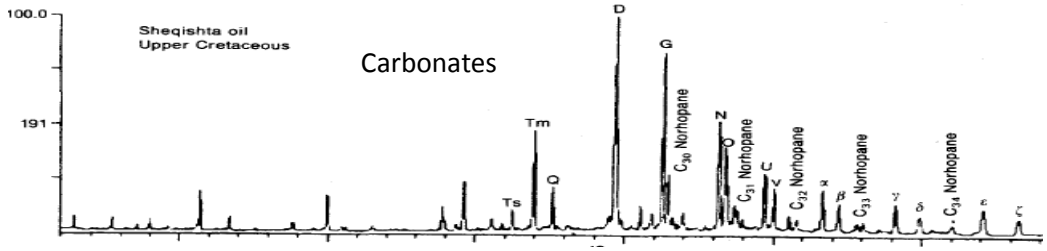
Clastic Accumulations

The filling of these traps is postulated to have occurred during **post-Pliocene** times.

A very good correlation between mass fragmentograms of oils from carbonate and clastic reservoirs shows that **oil migrated from underlying carbonates**.



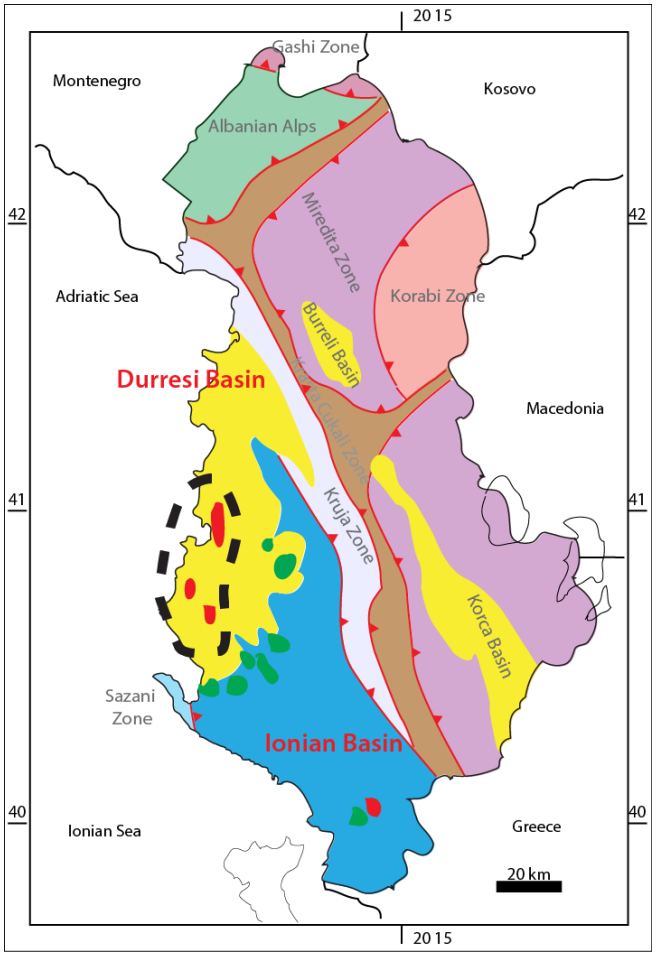


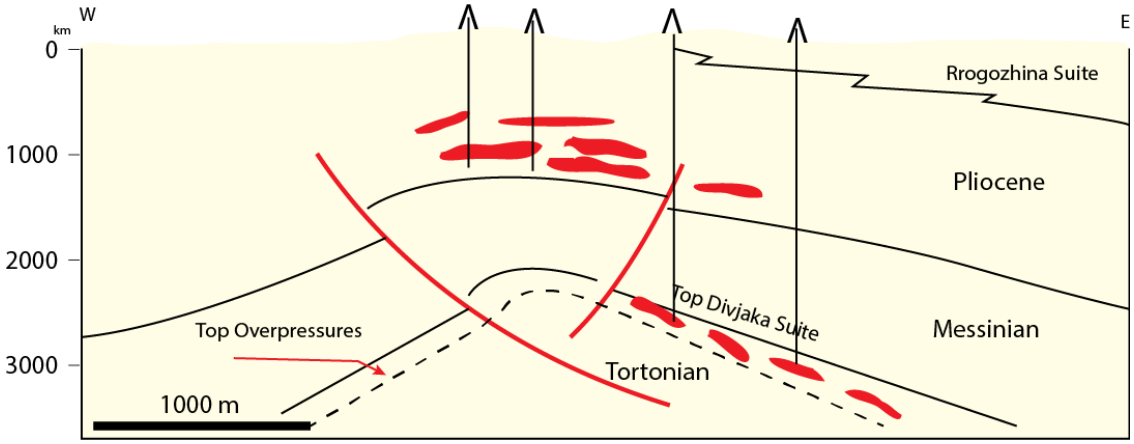


Field Name	Disc Year	Reservoir Depth (m)	Porosity (%)	Permeability (mD)
Patos	1927	Surface to 1200	**10 – 32**	**200 - 2000**
Kucove	1928	Surface to 1500	**2 5- 30**	**500 - 2000**
Marinez	1957	1200 – 1800	**10 - 30**	**200 - 2000**

Curi, 1993

Durresi Basin: Miocene Gas System

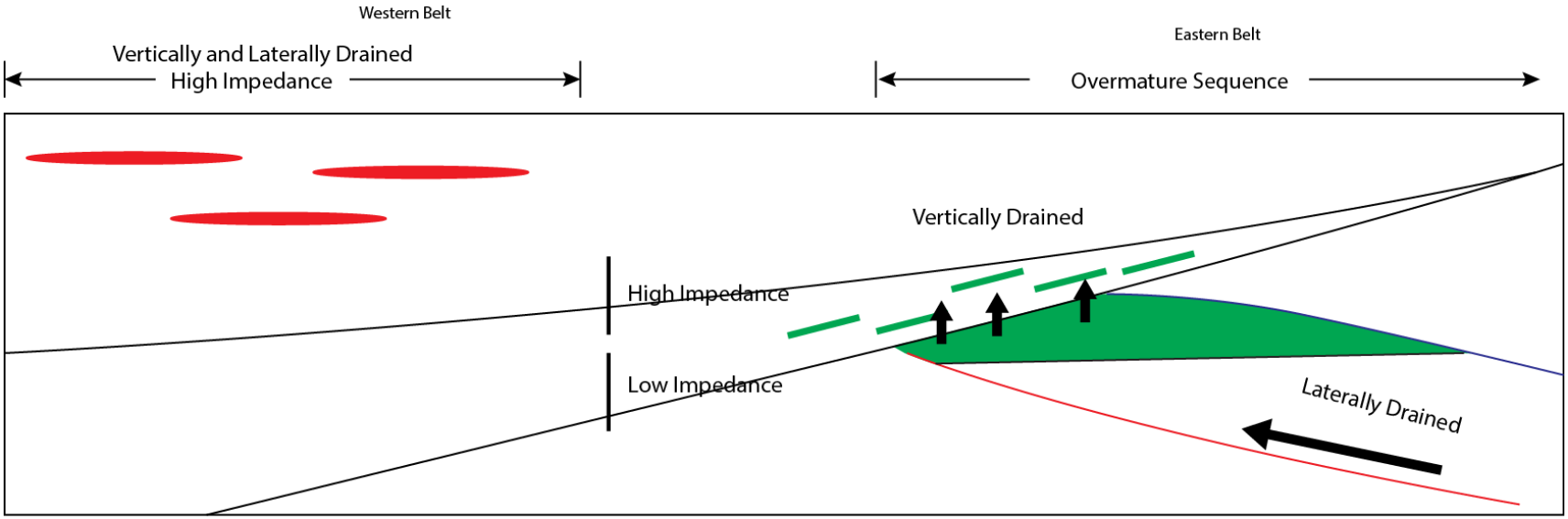




Field Name	Discovery Year	Reservoir Depth (m)	Age of Reservoir	Porosity (%)	Permeability (mD)
Divjake	1963	2400 – 3000	Tortonian – Messinian, Pliocene	13 - 30	7 - 300
Ballaj - Kryevidh	1983	300 – 1700	Pliocene	16 – 32	2-35
Frakull	1965	300 – 2500	Tortonian - Messinian	13 – 30	7-300
Povelce	1987	1800 – 3500	Tortonian - Messinian	13 – 30	7-300

Drainage and Entrapment Styles

The western and eastern belts refer to the western and eastern part of the Durresi Basin, respectively.



In the west, the trapping mechanism is related to locally occurring lateral and top seals with the source rocks occurring in very close proximity. These are related to **gas accumulations in the Durresi Basin.**

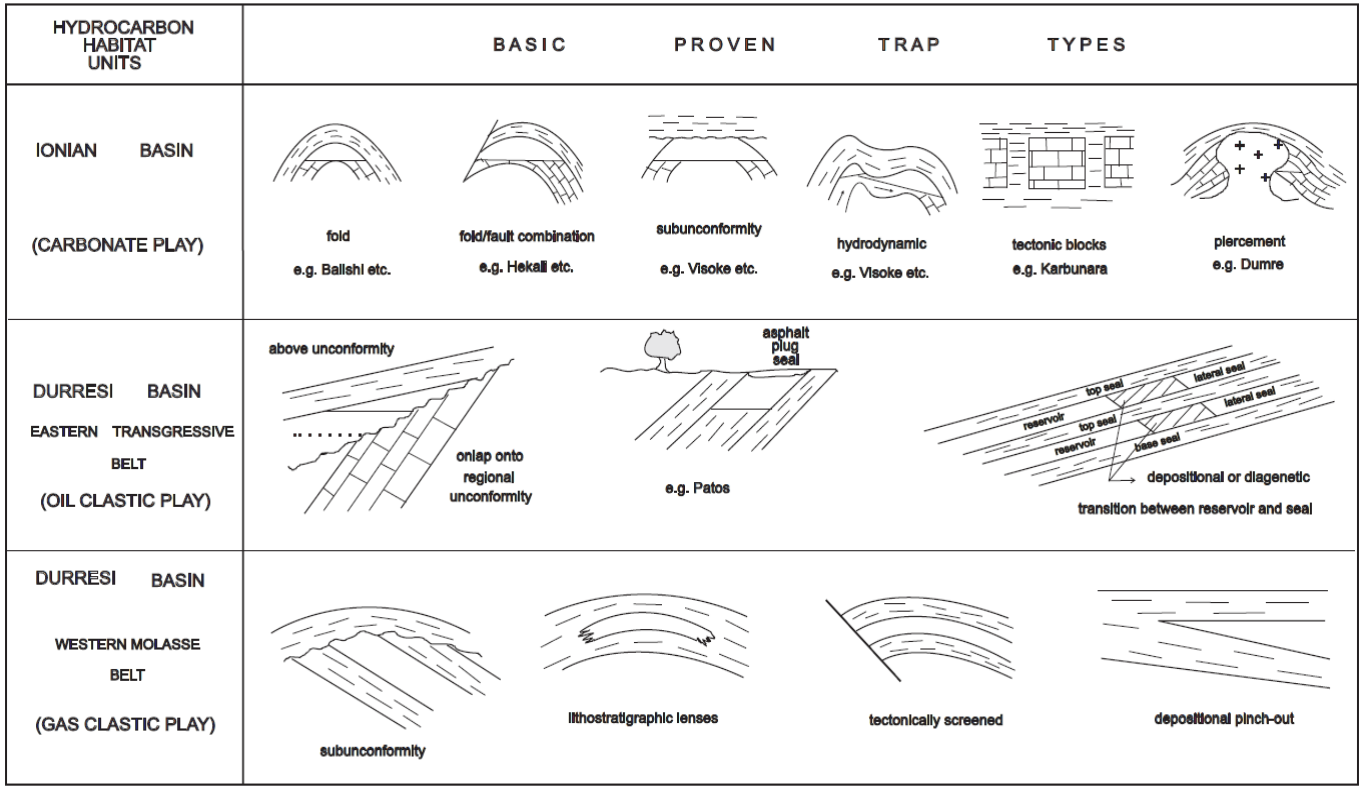
In the east, there are two types of trapping related to regional top seals and filled via two different types of drainage systems. These mechanisms relate to migration of oil and its associated gas within the **Ionian Basin petroleum system.**

Proven and likely Traps in Albania

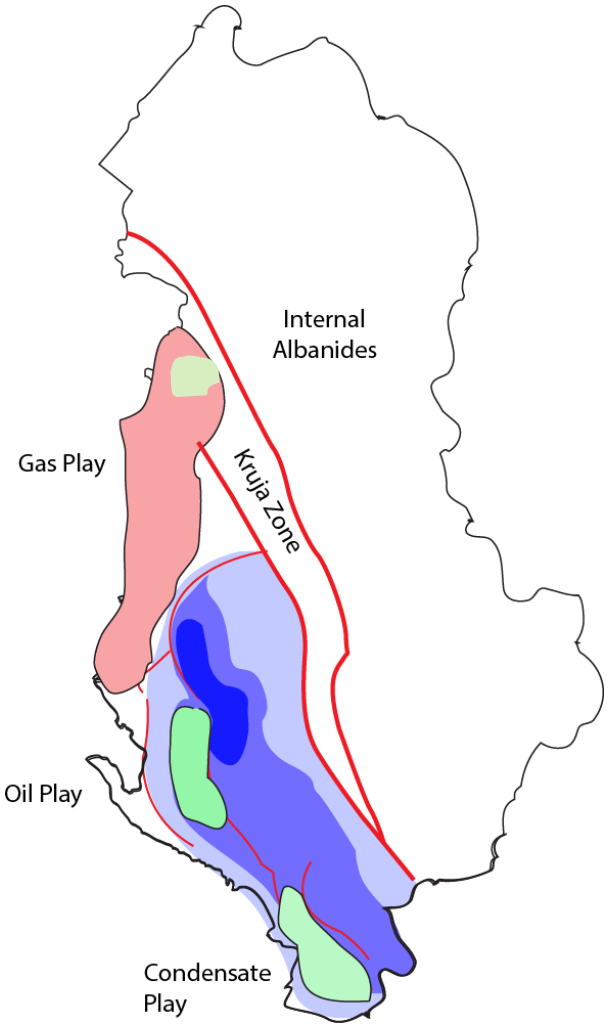
The carbonate Oil and Gas play comprises Upper Cretaceous - Eocene deep-water carbonate reservoirs .

The clastic Oil play comprises Tortonian-Messinian reservoirs charged by Mesozoic deep-water carbonate rocks.

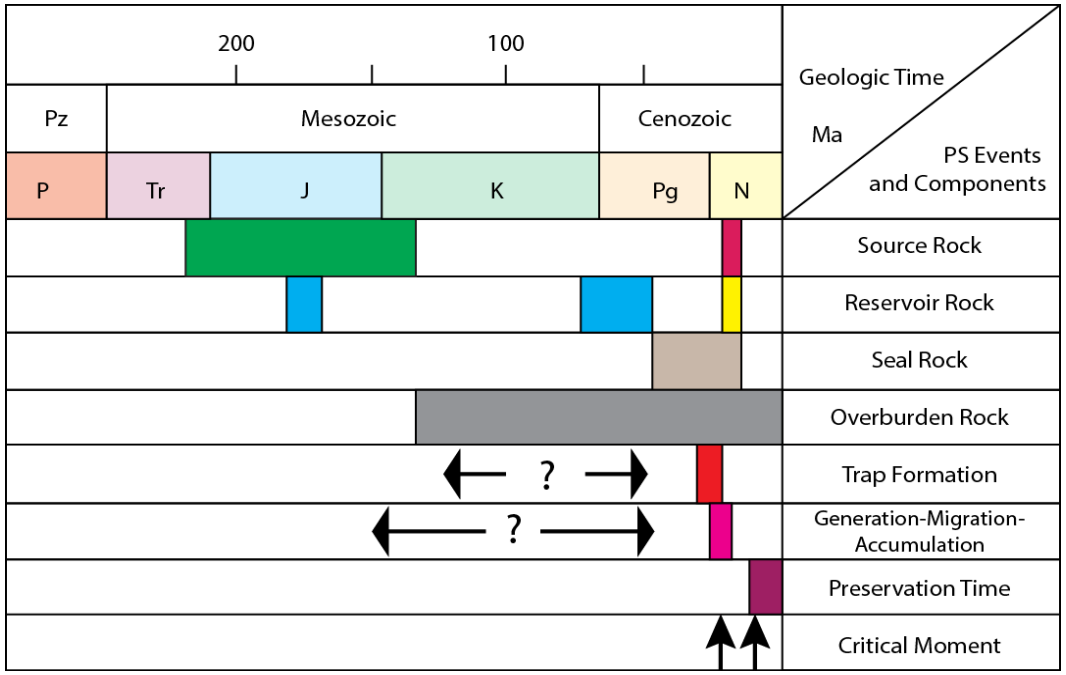
The clastic Gas play comprises Tortonian-Messinian reservoirs charged by the terrigenous source rocks of the foreland basin.



Exploration Risk and Recommendations



Complementary Play – Prospect Risk Chart



The future complementary plays may still occur within the Ionian basinal belt at a much smaller scale. Some gas plays on the other hand may still be found in the Durresi Basin.

For both these plays, the HC charge is known, and the key risk lies only in the trap configuration and to a lesser degree on the timing of generation, migration, and accumulation.

Summary

Two sedimentary basins

Two petroleum systems

Three types of plays