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GENERALIZED GEOPHYSICAL OVERVIEW ON SHKODËR-PEJË DEEP TRANSVERSAL FRACTURE

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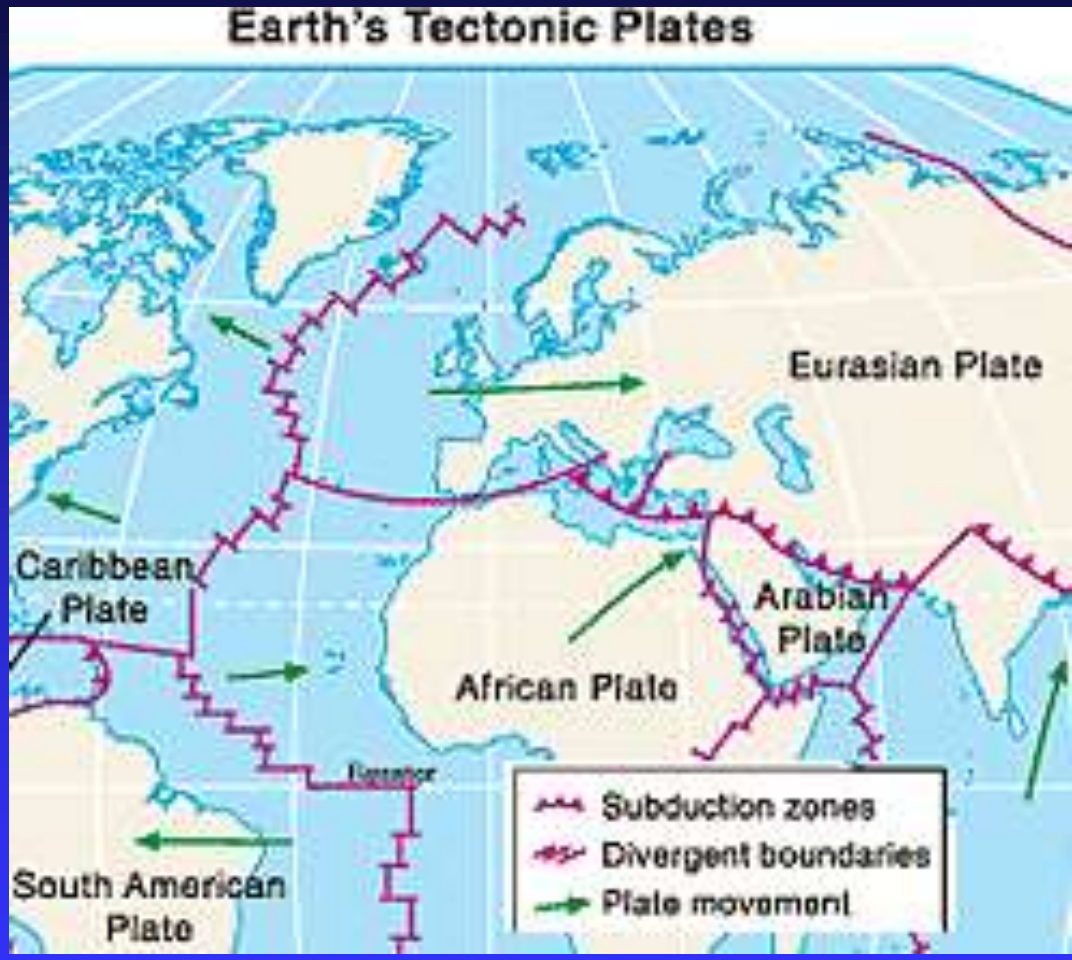
In the paper are presented:

The generalization of the complex of geophysical data:

- Gravity,
- Magnetic,
- Paleomagnetic,
- Geothermal,
- Seismological,
- Marine seismic data, and hydrological observations on the shelf of the Southern Adriatic Basin.
- Remote Sensing

Analyses of the results of these studies are based on regional geological setting data.

- Hellenides-Albanides-Dinarides, branch of the Mediterranean Alpine Folded Belt, are interrupted by a deep transversal tectonic fracture in the Shkodër-Pejë segments. This fracture is correlated with contact between Eurasian and African Plates in Drini Bay in Adriatic Sea



Regional geological-tectonic setting of Shkodër-Pejë sector of Mediterranean Alpine Folded Belt, presents the existence of this important disjunctive deep tectonics element.

Consequently, have brought about the different concepts on it:

"scharung" (1901), Svijich J.

"deviation" (1920—1930), Kosmat, Nopca, Bourcard, Novack, Zuber, etc

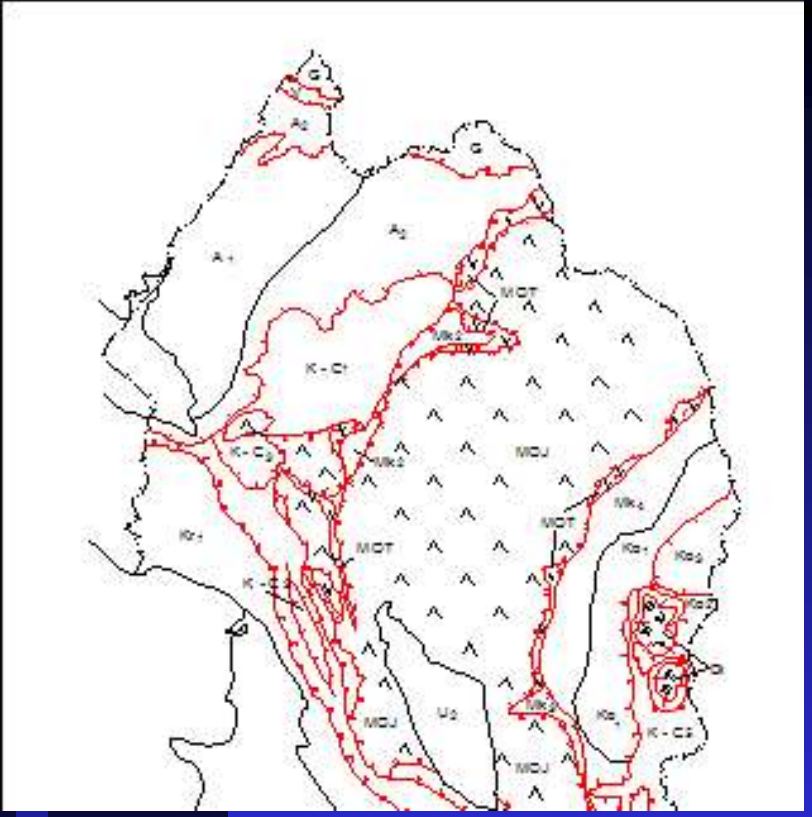
"an accident" (1960), Aubouin. & Ndoja,

"transform transversal fault" (1970-2012),

"transverse fault" (1990-2012), Çollaku & Cadet,

"deep transversal fracture" (2012), and to

- silence about its existence, even to denial of its presence.



For almost several decades in Albanian geological studies, this fracture had not been mentioned, because the Albanides geological setting and its geologic history had been based on geosyncline's theory (Geology of Albania, 1970).

Only later, some authors, who admit the opening of the Mirdita Ocean and interpreted this transversal as oceanic transform fracture, represented by the north-western front of the ophiolitic belt (Kodra, et al. 1994, Melo, 1986, Melo, et al. 1991, Peza et al. 1971, Xhomo et al. 2002), or

this transversal is represented by the northern border of Cukali subzone as natural geological border between Alps Zone and Cukali ones (Papa et al. 1991).

According to Qirinxhi A., show that the existence of Shkodër – Pejë thrust and its position cannot being observed and mapped during geological field surveys, but, perhaps, exist in the depth.

The above interpretations regarding the Shkodër-Pejë fracture also have resulted in alternative of the geological opinion concerning its position.

The Shkodër-Pejë deep fracture represents one of deep thrusts, which transversally divides Albanides in two parts . In northern part are including western-northern edge of Kruja tectonic zone, northern part of Cukali zone, Albanian Alps and Gashi zones, which follow by the Dinarides tectonic zones. In the southern part of the Albanides, represented by Sazani, Ionian, southern part of Cukali zone, Krasta-Cukali, Mirdita and Korabi tectonic zones, which follows by the Hellenides (Collaku & Cadet)

These changes in the course of a century, not just in terms of use, **were related to different geological schools over the geological setting of the Albanides**

. This transformation of concepts, unfortunately even in our days in some studies, related to the fact that the geological hypothesis or theories about the geological-tectonic setting of the region, were formed solely on the basis of surface geological surveys, which undertake to presented geological setting to the Moho Discontinuity without geophysical data, as necessary to known the depth.

- During the last two decades, the Shkodër-Pejë region was involved in geophysical surveys polygons:

Gravity Bouguer Anomaly Map,

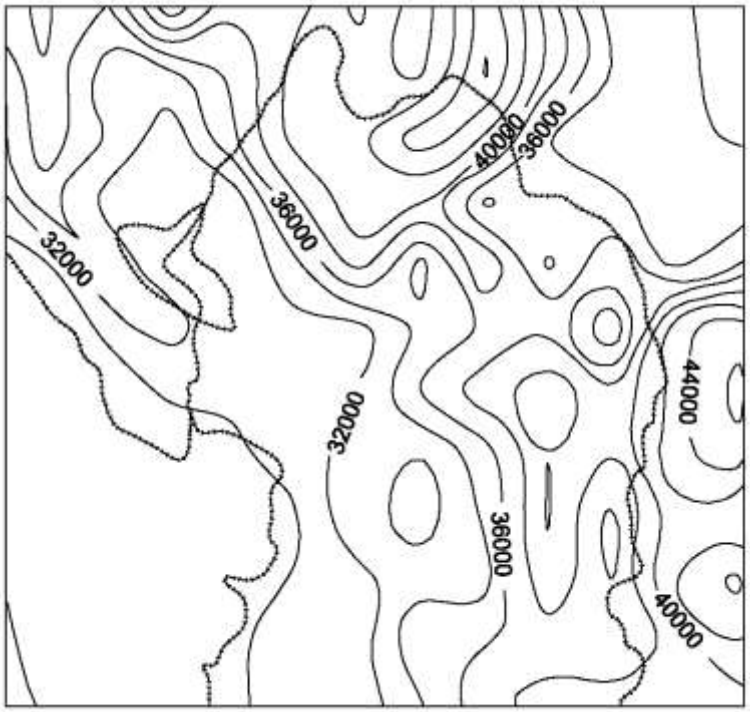
Magnetic Anomaly Map,

Paleomagnetic Studies,

Heat Flow Density Map, and

Satellite imagery,

This data complex have provided important information about tectonic setting in the depth of the region. This information, interpreted in complex with the existing geological-tectonic data has cast light on the depth of the area, where it crosses the transverse Shkodër-Pejë. They argued that it represent a deep transverse vertical fracture, which affects the Moho Discontinuity.



Geophysical investigation results show that crystal basement of Albanides has a blocks character.

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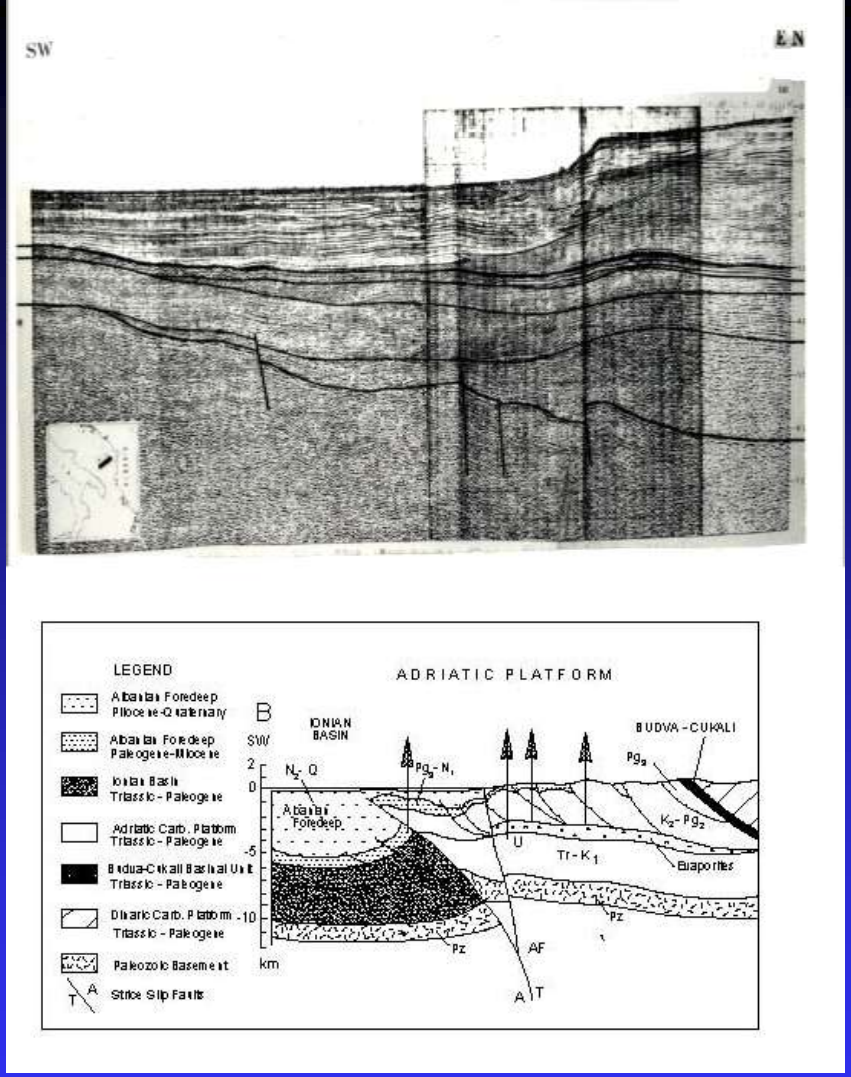
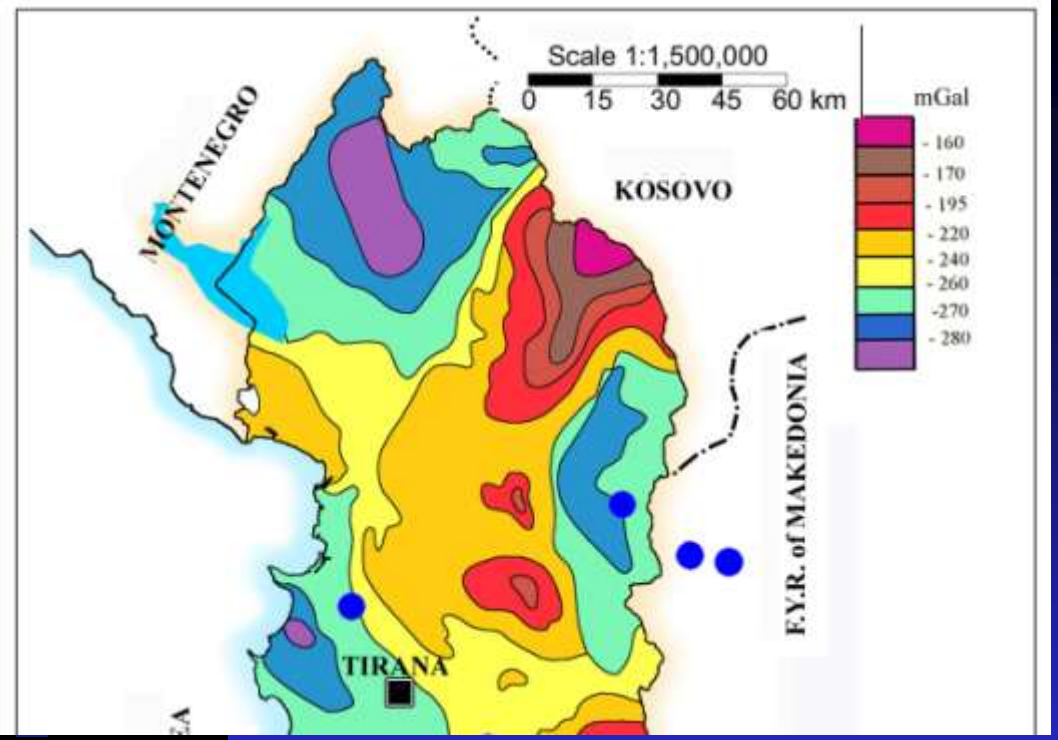
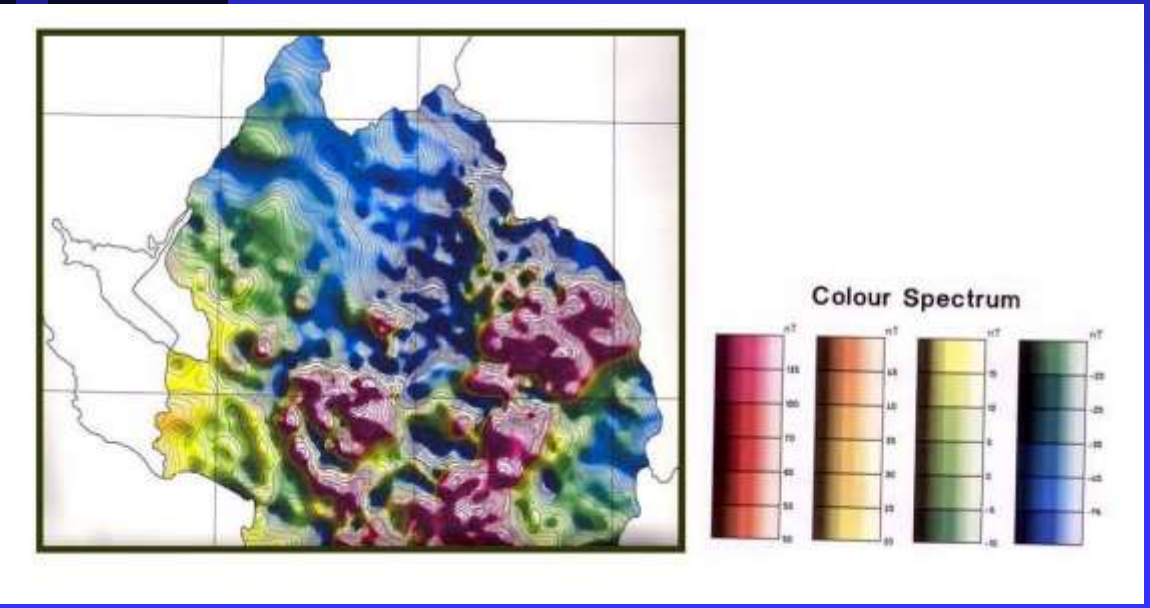


Offshore seismic surveying at the Montenegrin Adriatic shelf and deep wells (Dragasević T. 1983, Picha F.J. 2002) very well have enlightened geological setting at the depth on the western edge of Shkodër-Pejë deep thrust in the Adriatic shelf

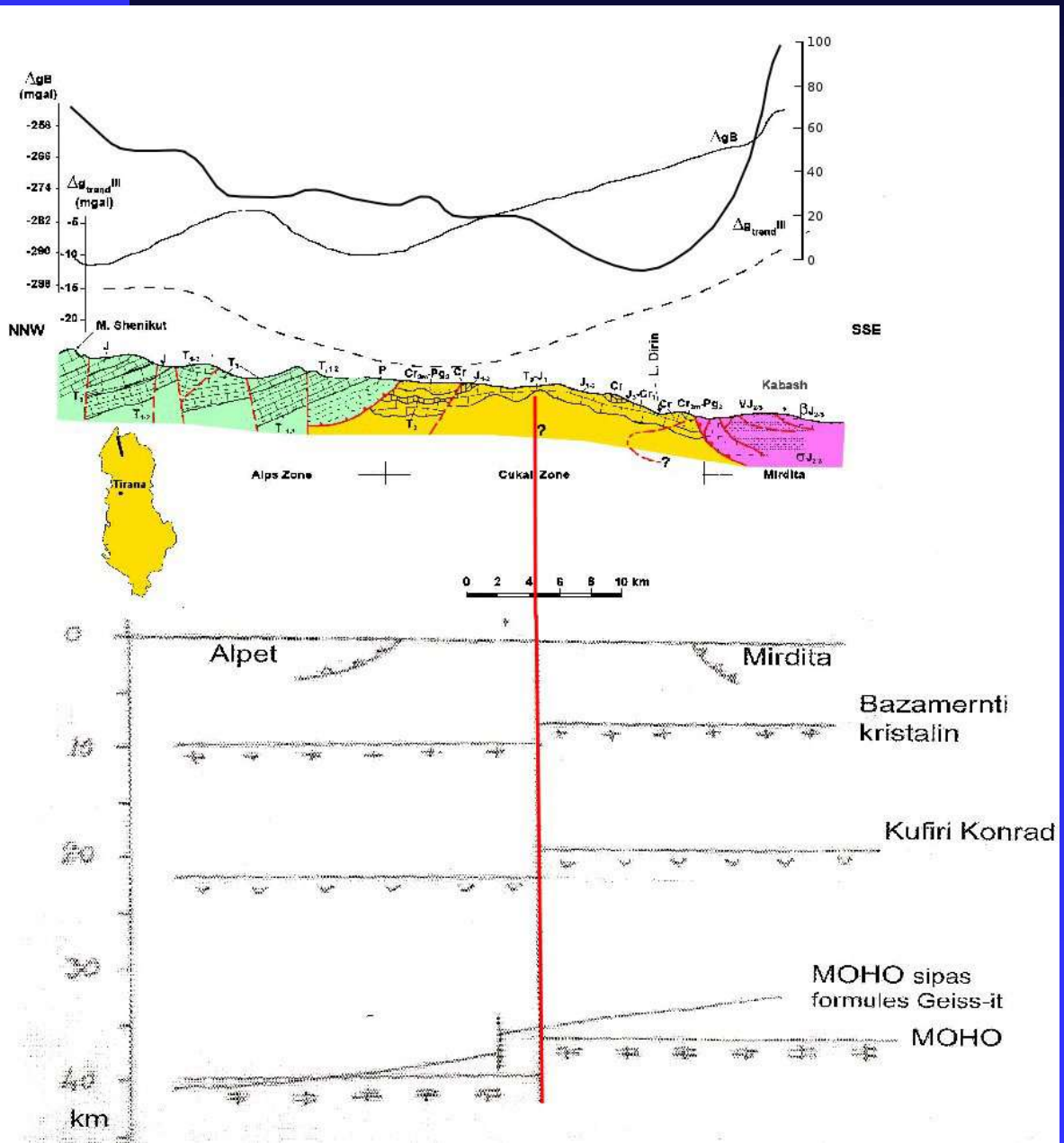




•According the gravity and magnetic surveing (Bushati S. 1987), Alps zone represented by a minimum of Bouguer gravity anomaly in general, with particularly a small amplitude anomaly in southern part of the Alp's zone. In the northern direction there are observed the trend of the increasing of the intensivity of magnetic anomaly. This pecularity of the magnetic anomaly express overthrust character of the

•Albanian Alps, too. Over the Cukali subzone is observed a linear upward trend of the intensity of the Bouguer anomaly toward the Mirdita zone

This trend's anomaly can explained by the presence of the vertical deep tectonic thrust.

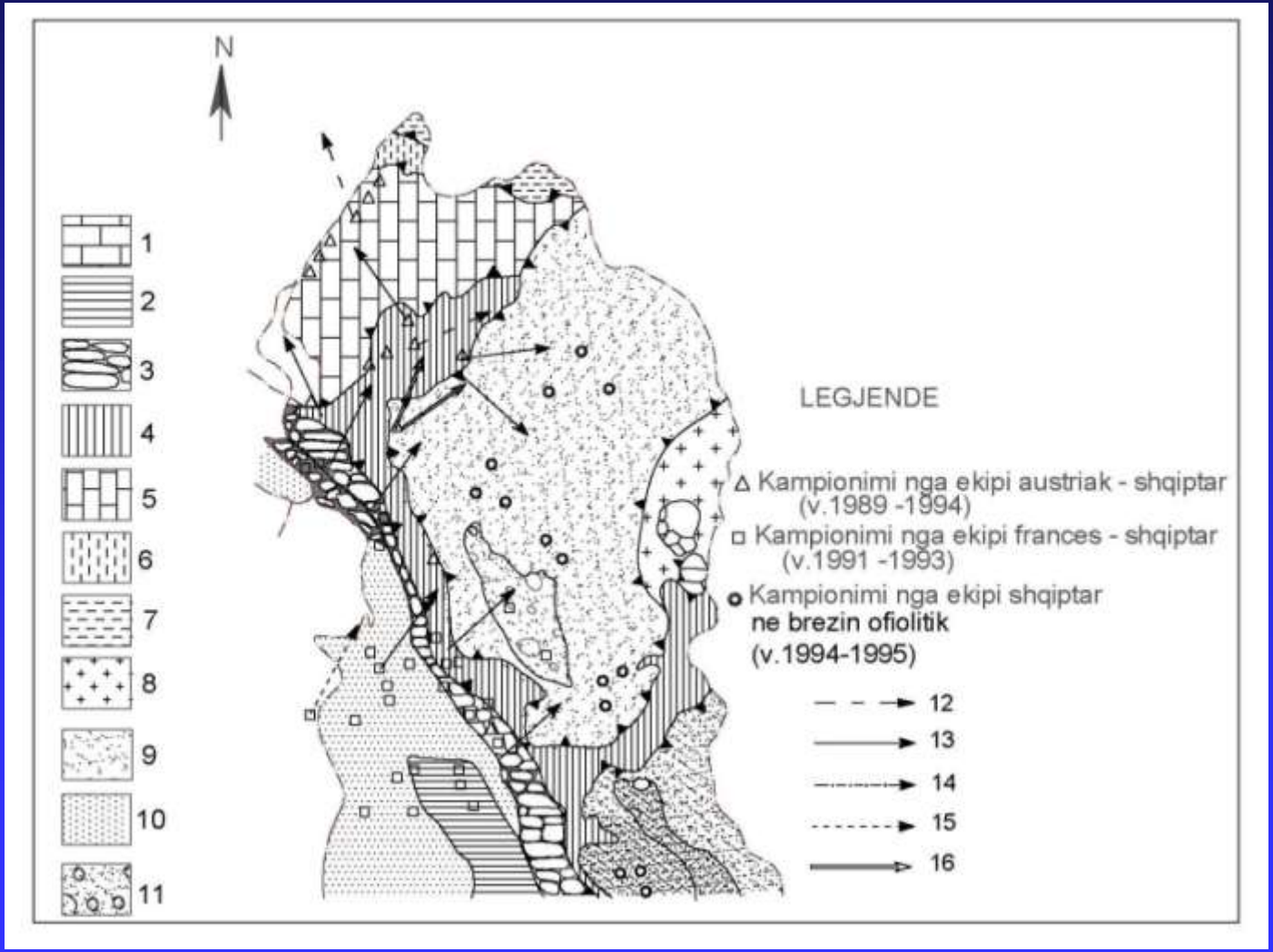


After the inversion model, thrust level resulted with amplitude about 4km in the Moho Discontinuity . Thrust amplitude toward the Earth's surface is gradually reduced

This deep thrust represents Shkodër - Pejë fracture.

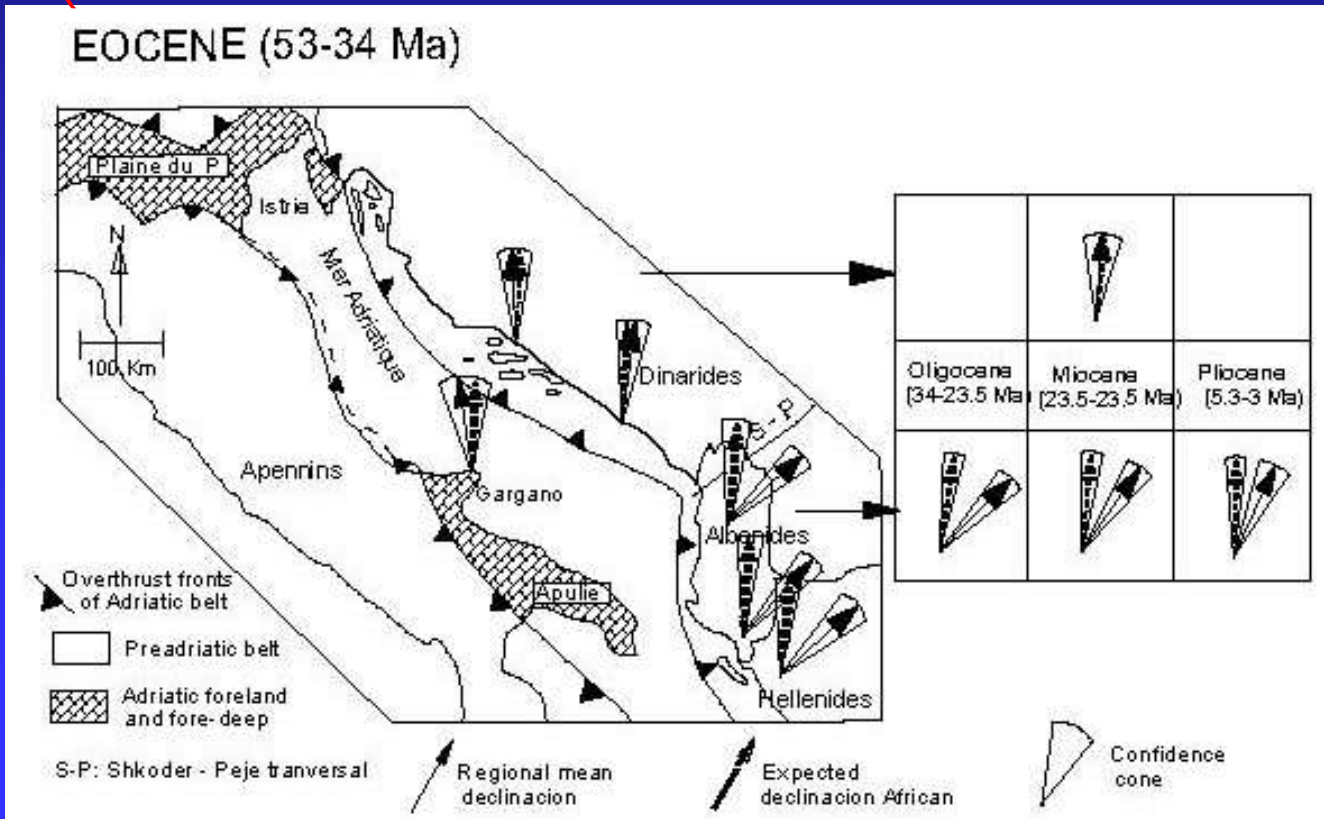
By analogy with the deep strike-fault in the Adrietic Shelf Crust and this, Shkodër - Pejë deep fracture, at the depth expected to be composed by several branches, occupying a wide zone of their influence and action.

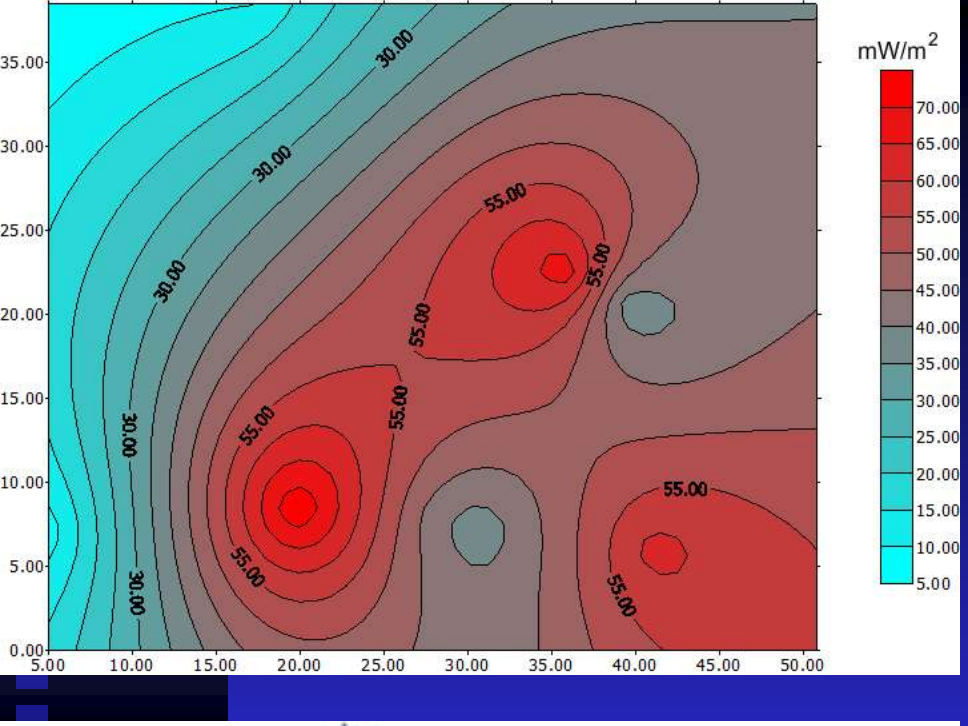
Paleomagnetic studies shows that Ionic and Kruja tectonic zones, located at southern side of the Shkodër - Pejë transversal, have support a joint clockwise rotation, with an angle 40-50^{o} during and after Eocene-Oligocene period. Clockwise rotation for 40^{o}-45^{o} since Early-Middle Miocene is observed at Kçira site. [Mutoni G. et al. 1996, Mauritsch et al., 1994].

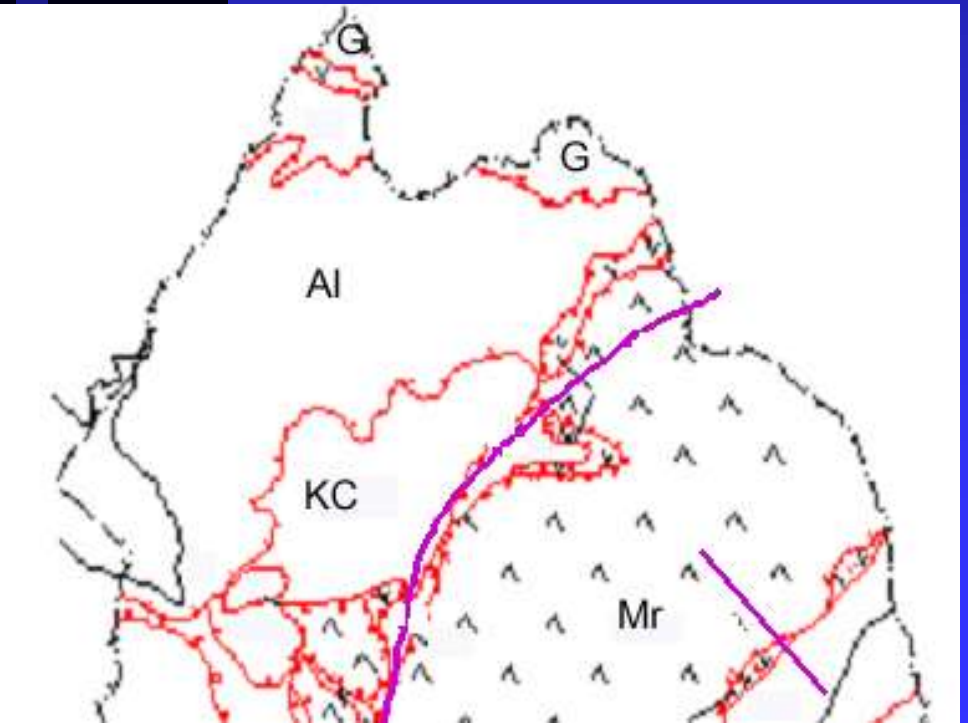


Limestone samples from Albanian Alps at Selca area, in the north of Shkodër - Pejë transversal, shows a counterclockwise rotation for 20º in relation with present north, the same value as in southern Dinaride's structures. Paleomagnetic studies have demonstrated that Shkodër - Pejë belt presents a transition zone between counter-clockwise rotation in the north, and clockwise rotation in the south sides. Consequently has a great tectonic influence over Cukali subzone. Thus, Shkodër-Pejë lineament, defines a transition zone which separates the Albanian Alps and the Dinarides (counterclockwise rotation), from Albanides and Hellenides (clockwise rotation

For the rotation pole located at Shkodër - Pejë transversal thrust, Southern Albania has undergone a horizontal displacement is about 173 Km [Speranza



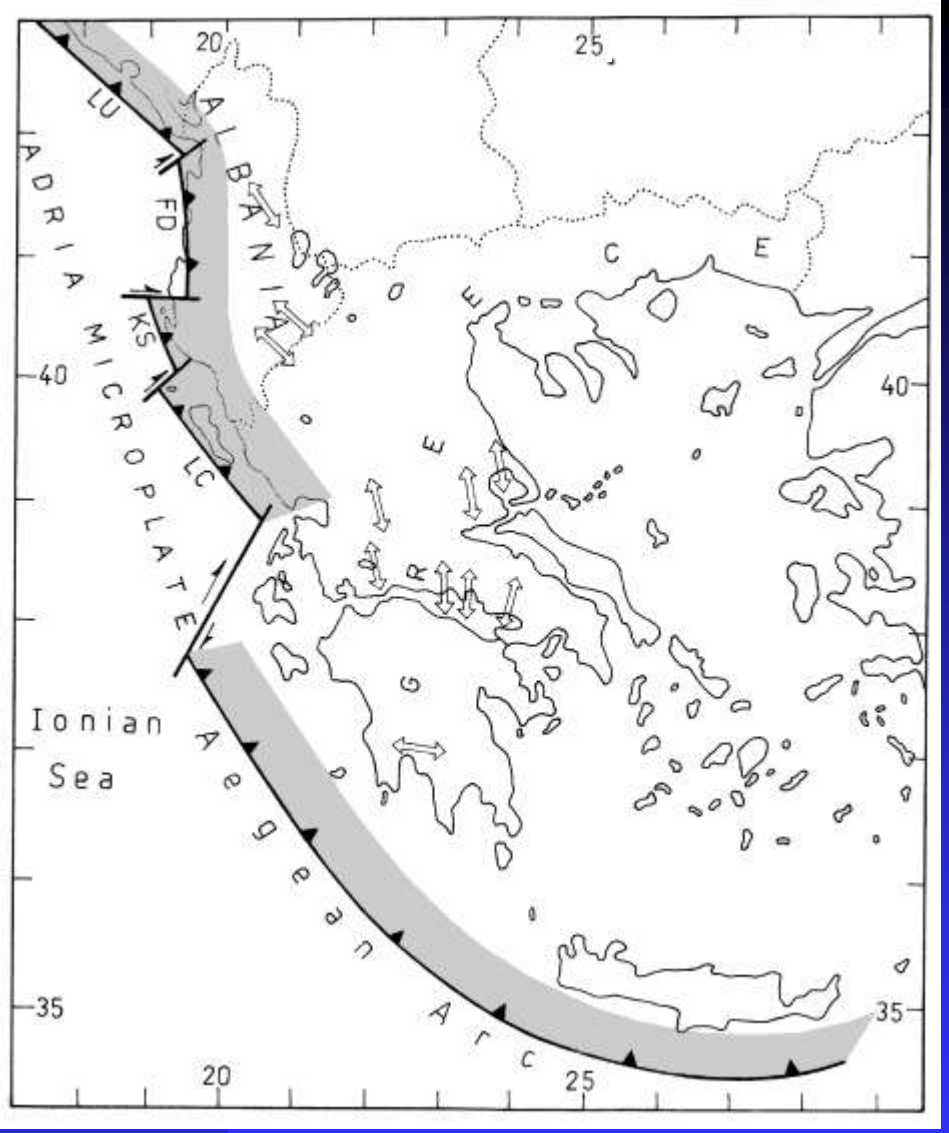




Two Heat Flow Density anomalies axes are located in the unic axis, which extends from northeast to southwest, over the overthrust tectonics in the northern border of the ophiolitic belt.

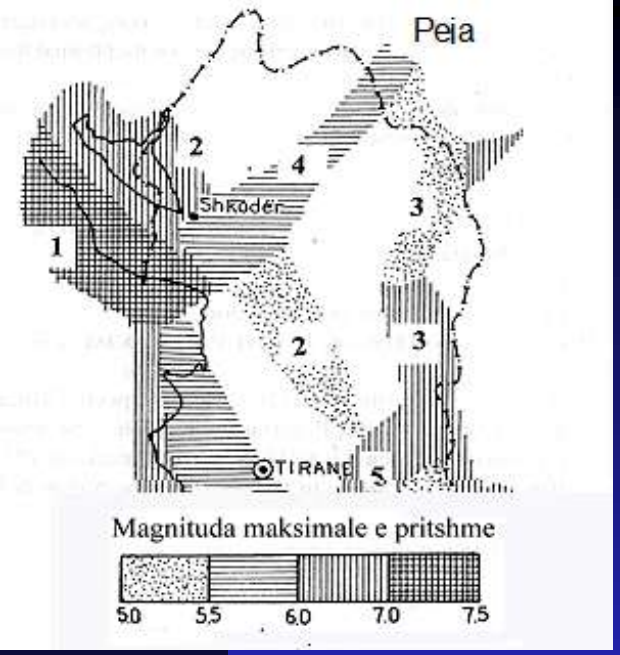
The heat flow density values are up to 60-70 mW/m^2. Radiogenic heat generation of the ophiolites is very low. In these conditions, increasing of the heat flow in the ophiolitic belt is linked with heat flow transmitting from the depth. The granites of the crystalline basement, with the radiogenic heat generation, represent the heat source.

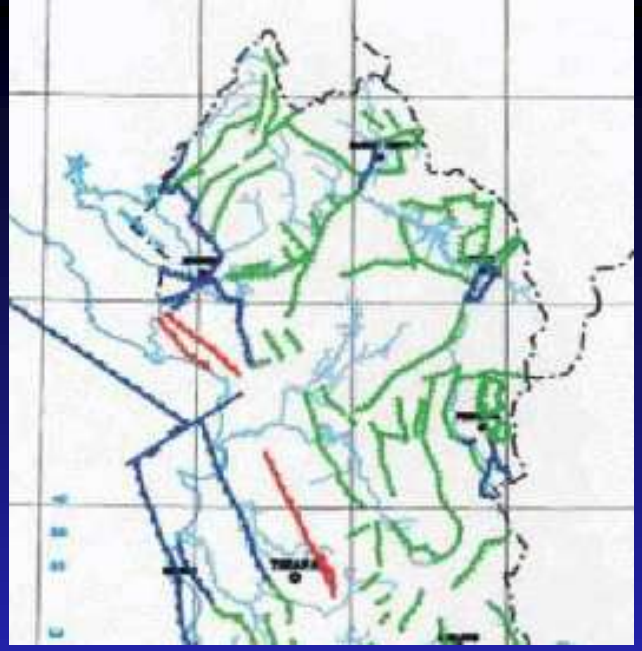
Heat flow anomalies are conditioned by intensive heat transmitting through deep and transversal fractures.

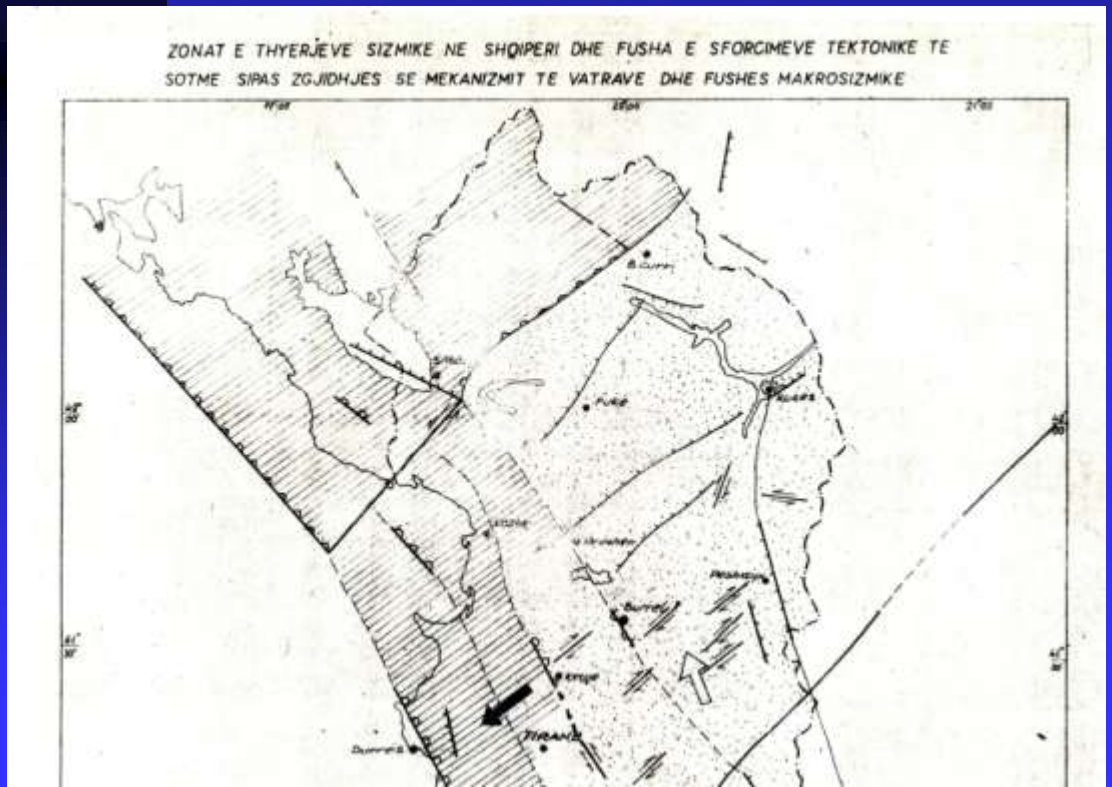


The seismological studies have argued the presence of an active fault zone in well- known Shkodër-Pejë direction (Aliaj, 1988, Muço et al. 2001, and Sulstarova, et al. 1972)

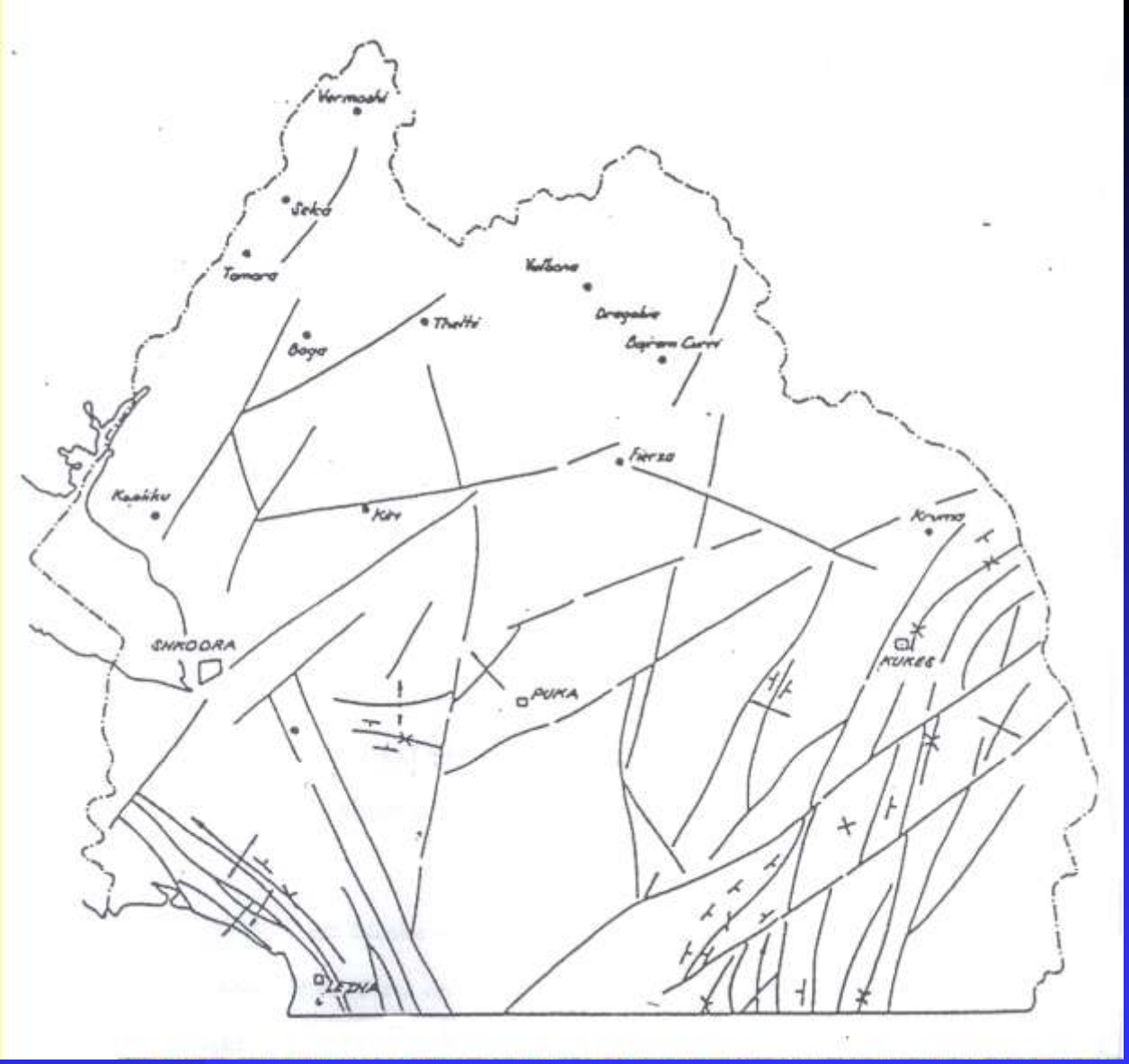
The Albanian orogenic thrust front is cut and displaced by the Othoni Island-Dhërmi, the north of Sazani Island, and the Gjiri i Drinit-Lezha strike-slip faults (Aliaj Sh., 2006). The orogenic front, north of the Drini Bay-Lezha town strike-slip fault, in the Adriatic offshore, belongs to the Kruja Zone.







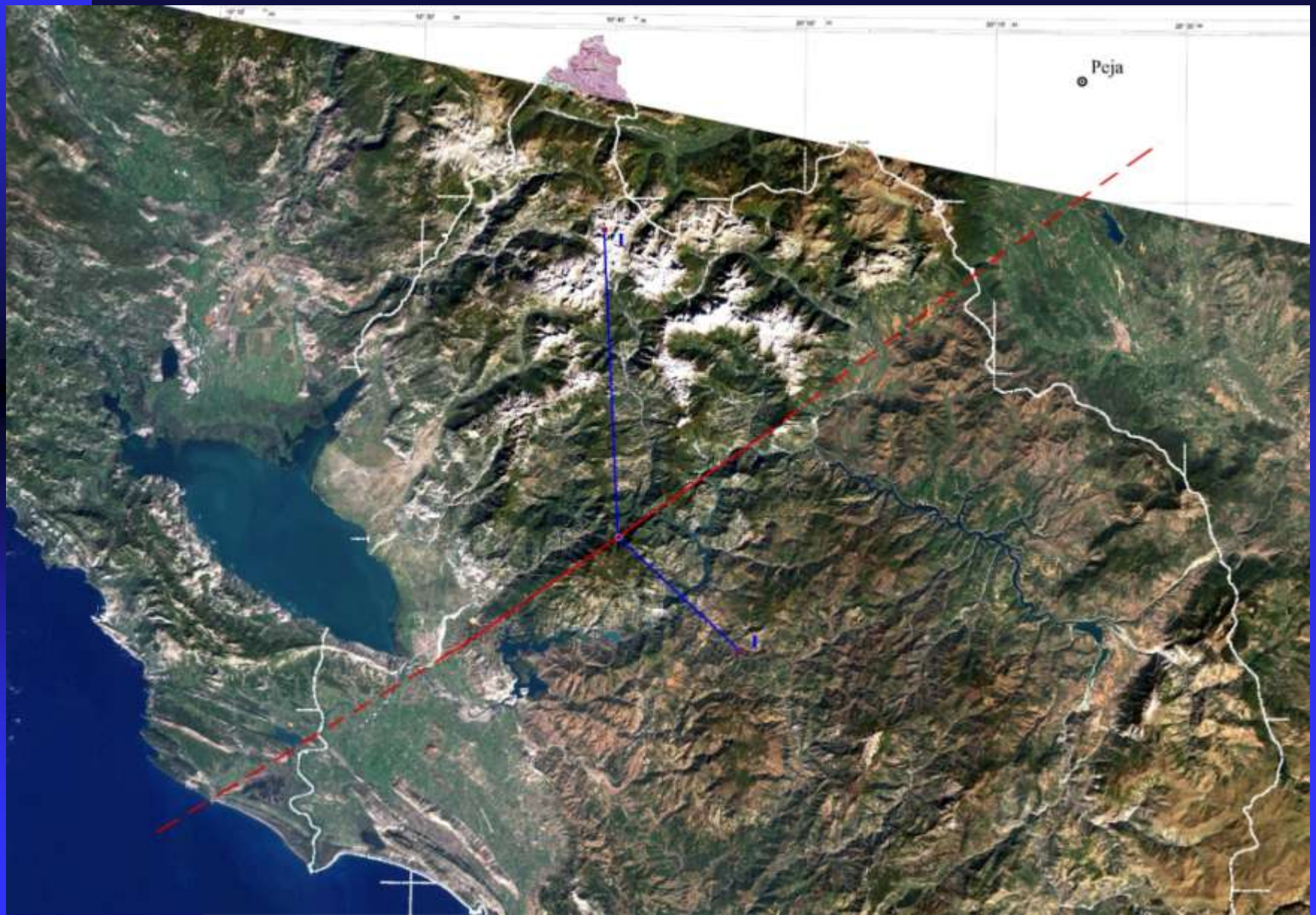
Based on focal mechanism solution, results that in Northern littoral side of the Shkodër- Pejë fault zone, the compression strain has a P=16^0 NE-W strike, and 10^0 plunge, while the axis of expansion T = 124^0 and 79^0 dep. In the Southern side of the Shkodër- Pejë fault zone, the compression strain has a P=274^0 E-W strike, and 10^0 deep, and the axis of expansion T = 164^0 SE-NW and 64^0 deep.

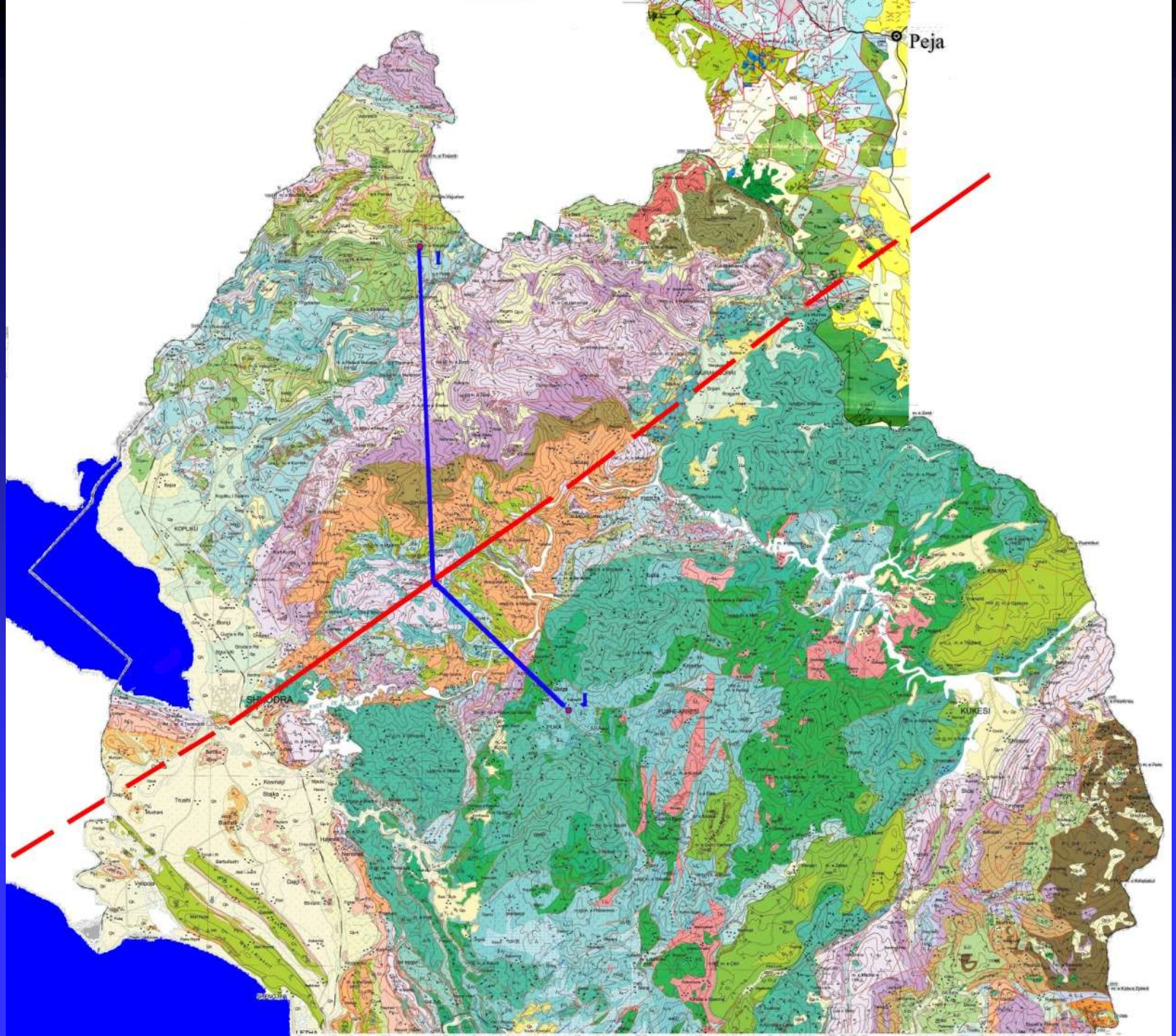


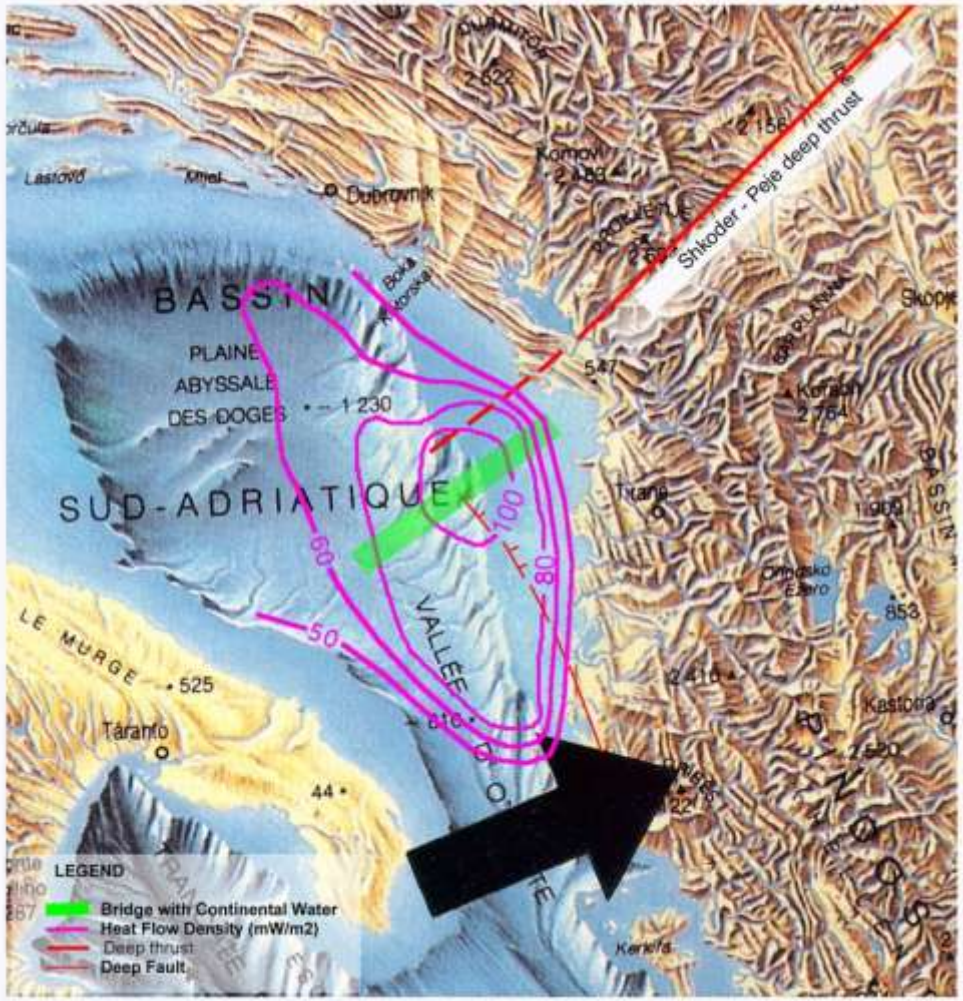
First study by Landsat imagery has presented a sketch of thrust tectonic in Northern Albania, which differenced clearly main segments of Shkodër - Pejë transversal fault .

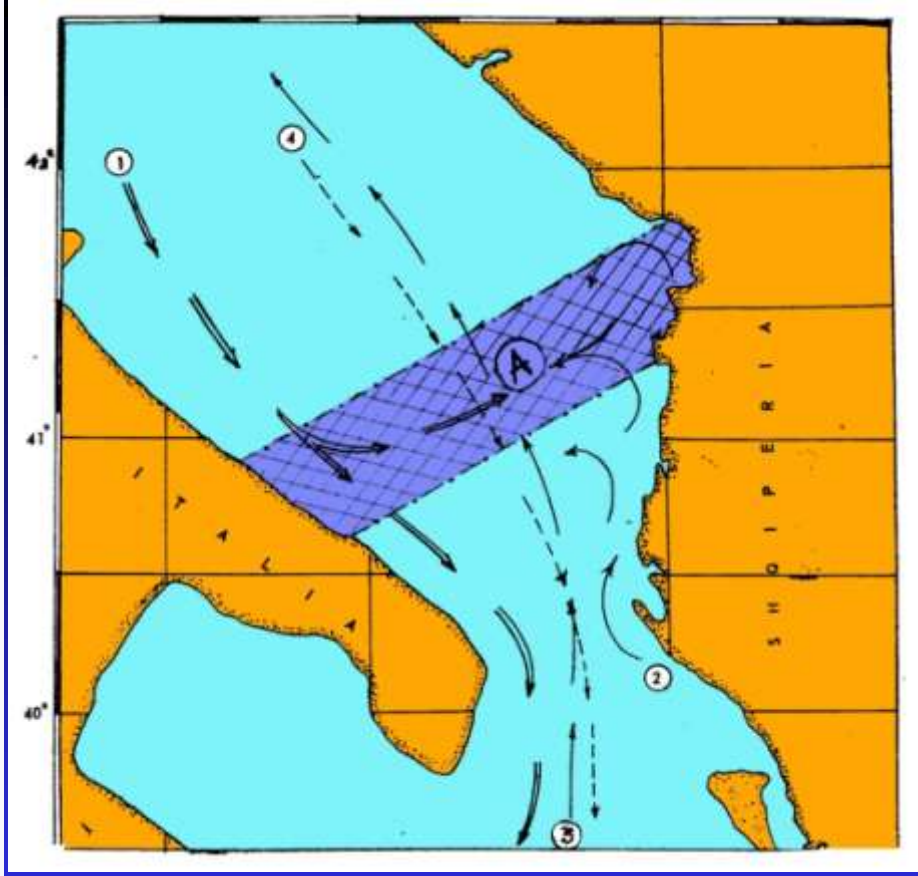
According to the geophysical studies results above indicated, as well as satellite image, have show Shkodër – Pejë tranversal fault (Chorowich J. et al. 1981)

Usage of satellite imagery for identification of geological structures result that is possible to distinguish two areas separated during the same delineation of Shkodra – Pejë fault (Fig. 20).

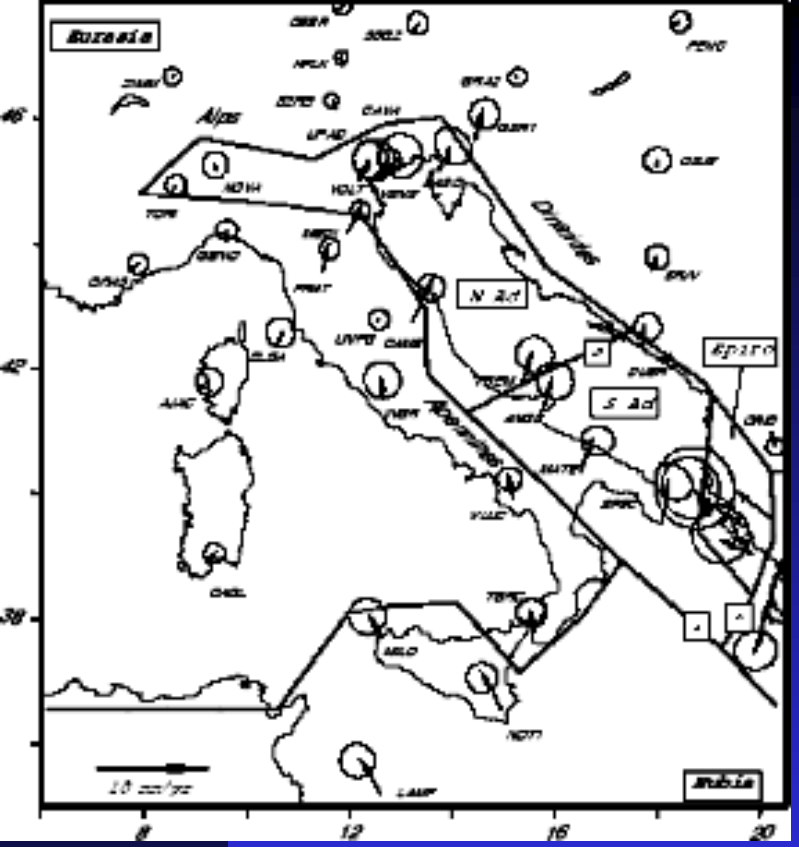


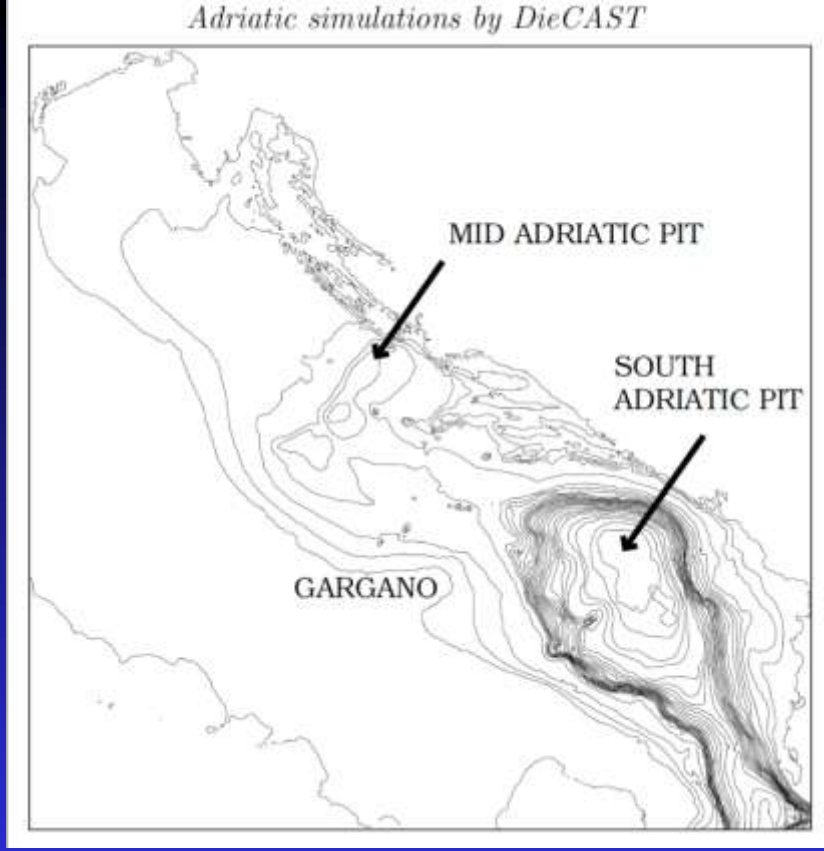

Peja
SHKODRA
KUKESI



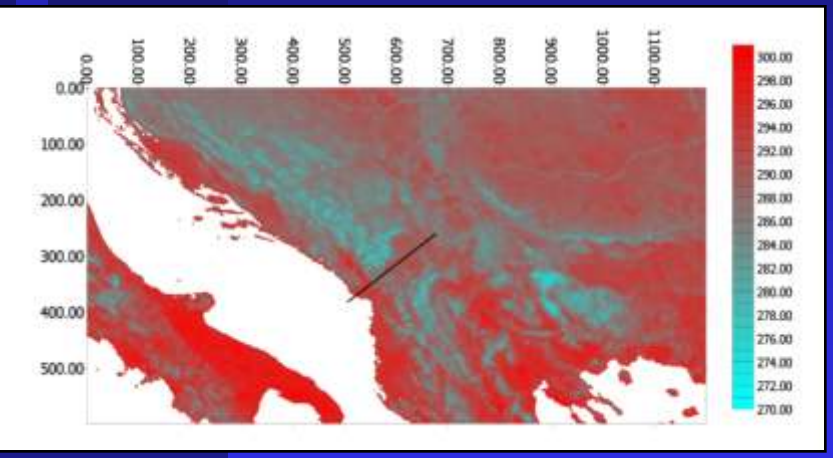


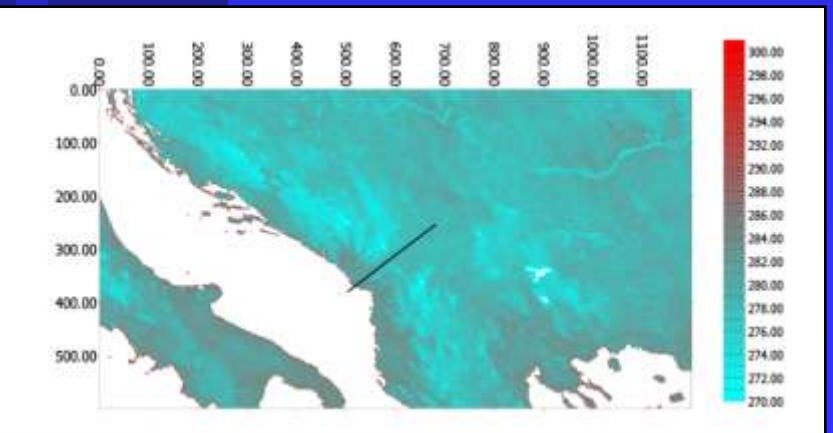
The thermal anomaly over the Adriatic Shelf, is observed at the epicenter in Drini Bay ("Geothermal Atlas of Europe", 1992). In the same time, this thermal anomaly epicenter is located over the prolongation into Albanian Adriatic Shelf of Shkodër - Pejë transversal deep fracture. These facts show that the Shkodër - Pejë transversal deep thrust continues even in the Adriatic Shelf, where interrupted with Adriatic longitudinal strike-slip fault system.





Based on GIS and seismological investigations were determined velocities of microplates movement in Adriatic Sea. Africa microplate is moving NW with respect to Eurasia, while the Adria microplate moves NE (Battaglia M. et al. 2004). Adria is considered as an independent microplate within Africa – Eurasia plate boundary one, which is divided by Gargano-Dubrovnic fault in two blocks (Oldov et al. (2002). In the frame of these interpretation data is necessary to discussed also the position of NW edge of Otranto Street, which is located in the direction of the Shkodër-Pejë deep transversal fault in the eastern Adriatic Shelf, that result parallel with Gargano – Dubrovnic fault zone.





Analysis of ground temperature from MODIS images was done calculating the average for day and night temperatures.

In these images it is visible a “bridge” of relatively higher temperature delineated between Shkodra and Peja.

Conlusions

1. Earth Crust of the Albanides exhibits a block structure controlled by a system of NW-SE longitudinal faults as well as transverse ones.

2. Shkodër-Pejë zone present a vertical deep transversal fracture, which separate two Earth crust blocks, and seismically active belt. Fracture interrupts the MOHO Discontinuity with amplitude about 4 km that decrease towards the Earth surface.

3. Paleomagnetic studies have demonstrated that Shkodër-Pejë transverse fault represents a transition zone between the clockwise rotation of the Albanides and Hellenides and the counterclockwise of Albanian Alps on e and Dinarides.

4. Continuation of Shkodër-Pejë fracture in the Albanian Adriatic Shelf in Drini Bay passes over the epicenter of Heat Flow. This correlation argues relation of the geothermal anomaly with depth fractures of the Earth Crust in Adriatic Shelf.


THANK YOU VERY MUCH FOR YOUR ATTENTION