SocioBrains
ISSN 2367-5721, JOURNAL HOMEPAGE: WWW.SOCIOBRAINS.COM
INTERNATIONAL SCIENTIFIC REFEREED ONLINE JOURNAL WITH IMPACT FACTOR
ISSUE 42, FEBRUARY 2018

THE BULGARIAN CONTINENTAL MICROPLATE MORPHOTECTONIC POSITION IN THE EASTERN PART OF BALKAN PENINSULA

Abstract: The Bulgarian Continental Microplate is disposed in eastern part of the Balkan Peninsula (South East Europe). It covers the territories to the east from the Timok, South Morava, Pchinya and Vardar River and includes the territories of Bulgaria and parts from East Serbia, the eastern part of the Republic of Macedonia, the Nort-East Greece and the North-West Turkey. The observed Microplatte is composed by the Sub Balkan, Upper Thracian, Strumeshnitsa, Middle Struma, Middle Mesta, West Thracian, Lower Thracian, South Morava, Fore Hemus, Hemus, Kraishte-Sredna gora, Bregalnitsa, Rila-Rhodope, Sakar-Strandzha and Gradesh-Belasitsa Morphostructural Zones. The seismic activity in the investigated area is sharply reduced in comparison with the most west part from the neighbor continental microplates.

Keywords: morphotectonics, continental microplate, transcontinental collision, geomorphostructural suture, Balkan Peninsula.

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Introduction

The article introduces the results of the author's investigations about the origin, Quaternary morphotectonic evolution and the modern morphostructure of the Bulgarian Continental Microplate from the eastern part of Balkan Peninsula.

The research was realized on a base of the contemporary Plate tectonic study principia by means of the morphostructural analysis apply (*Tzankov*, 2013). It was provided the principal relief building role of the regional mosaic pattern and the listric faulting in the eastern part of the Balkan Peninsula.

The Quaternary Earth superficial relief building processes was and are predominantly provoked and controlled by the Upper Mantle - Astenosphere energy. Its Earth superficial effects are expressed by the relationships between the seismic effects and the regional faulting.

Methodological basement

The investigation is conformity with the represented on a Table I methodological model:

Table I

METHODOLOGICAL MODEL OF THE INVESTIGATION

SCIENCE	METHODS	ENERGY SOURCES	PROCESSES	*RESULTS*
Morphotectonics	Morphostructural analyze	Astenospaere	Deformation	*Morphostructures*

Geomorphology **Morphosculptural** **Solar** **Erosion**
Morphosculptures **analyze** **Abrasion**
Deflation
Exaration

The proposed characteristics of the Bulgarian Continental Microplate is based on the preceived model of the lithostructural layers of the continental Earth crust (Fig. 1)

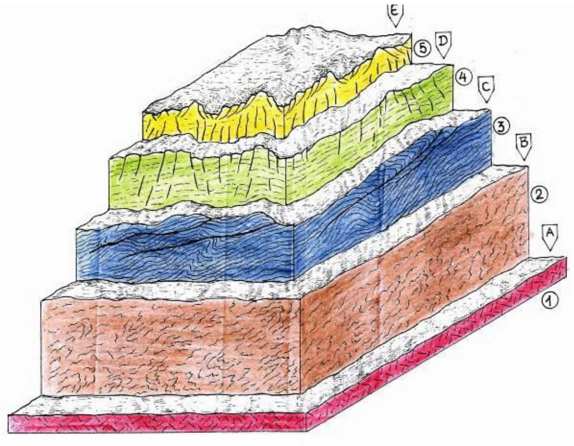


Fig. 1
Lithostructural layers of the continental Earth crust (after *Tzankov* et all., 2013)
E – Earth superfition
5. SUPERFICIAL LITHOSTRUCTURAL LAYER
Contemporary morphostructural block mosaic of the relief.
Orthoplans, regional fault net (listric tectonics), negative and positive morphostructures)
D – Mosaic block relief lower border
4. DEEP BLOCK LITHOSTRUCTURAL LAYER
Terminating of the plastic deformations. Building of the lithosphere deep block structures
C – Upper border of the Plastic deformations
3. FOLD-OVERTHRUST LITHOSTRUCTURAL LAYER
Plastic and ruptural deformations.
B – Lower/high metamorphisms border
2. HIGH METHAMORPHIC
LITHOSTRUCTURAL LAYER
Plastic deformations in high metamorphic rocks
A- Lithosphera/Upper Mantle border
1. UPPER MANTLE

The adopt type and the regional relationships between the morphotectonic and morphostructural units are represent on a Table II

Table II

MORPHOTECTONIC AND MORPHOSTRUCTURAL UNITS
GLOBAL MORPHOTECTURAS
CONTINENT
Continental margin
Active ***Passive***
Continental shelf
Continental slope
Accretionary prism ***Continental foot***
Collision zone

Trans continental ***Intra continental***

Geomorphostructural Suture

OCEAN

Oceanic bottom

Oceanic ridge

Oceanic trench

Hot spot

Island arc

Volcanic ***Avolcanic***

Subduction zone

Spreading zone

Obduction zone

REGIONAL MORPHOTECTURES

Macrotecture - Macroplate

Tecture - Plate

Microtecture - Microplate

Continental ***Oceanic***

REGIONAL MORPHOUNITS

Obligatory	*Optional*
Morphostructural zone	**Morphostructural range**
Morphostructural area	**Morphostructural group**
Morphostructural region	**Morphostructural line (row)**
Morphostructure	***Longitudinal Diagonal Transverse***

REGIONAL MORPHOSTRUCTURES

INITIAL

Orthoplain

DERIVATIVE

Negative	*Faults*	*Positive*
Plain	**High angular (normal)**	**Mountain arched**
Lowland	**Low angular listric**	**Concentric**
Passage	**Strike-slip**	**Dome-like**
Complex passage	**Overthrust**	**Comb-like**
Kettle	**Upperthrust**	**Anteclise**
Threshold	**Transform**	**Hemianteclise**
Gorge	**Fault bundle**	**Syneclise**
	Fault zone	**Hemisyneclise**

Listric prism

Listric prisms Line (morphostrudtural cascade)

Orohydrographic survey

The eastern part of the Balkan Peninsula covers the area to the east from the Timok, Southern Morava, Pchinya and Vardar River (Fig 2). This area includes (from the north to the south) the following west–east in general oriented orographic units: southern part of the Lower Danube Plain (to the south from Lower Danube River), low mountain-hills Fore Balkan Zone, high and middle mountain Stara Planina (Balkan) Zone, Sub Balkan Kettle Range Zone, middle mountain Sredna Gora Zone, hills-low mountain Kraishte Zone, low-land and hills Upper Thracian Zone. middle mountain Bregalnitsa Zone, high mountain Rila-Pirin Mountain Range Zone, high and middle mountain Rhodopean Zone, low and middle mountain Sakar-Strandzha Zone, high and middle mountain Belasitsa Zone, low land Western Thracian Zone and lower Thracian Zone (Fig. 3).

The varied, quickly and often space changed relief is one of the most important characteristics of the Balkan Peninsula observed part. It is on effect of the very active Quaternary endogen processes.

Fig. 2
Overview map of the Balkan Peninsula
Boundary between the western and eastern part of the Peninsula (interrupted black line).
Borders of the Bulgarian Continental Microplate (pointed and blacked line)

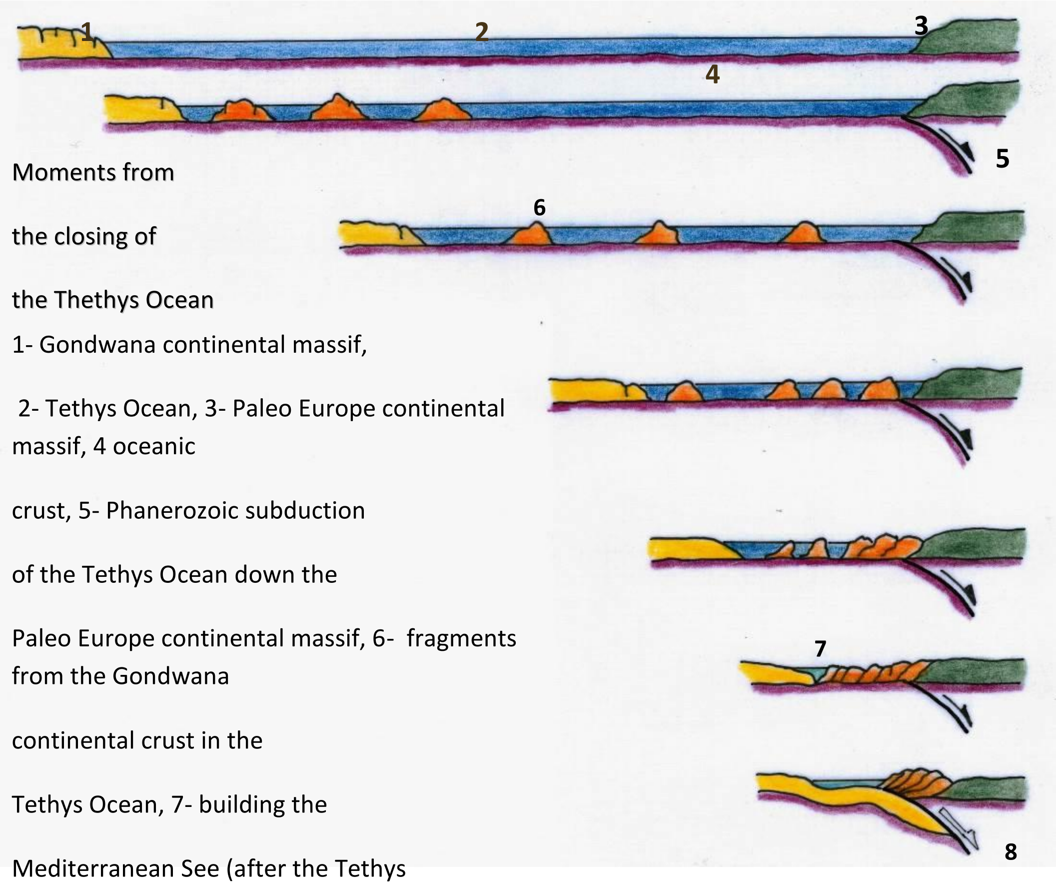
Fig. 3
Overview map of the Balkan Peninsula eastern part

Origin and morphotectonic evolution

Pre Upper Oligocene geotectonic evolution.

The Bulgarian Continental Microplate is disposed in eastern part of the Balkan Peninsula (South East Europe). The last one covers the territories to the east from the Timok, South Morava, Pchinya and Vardar River. It includes the territories of Bulgaria and parts from East Serbia, the eastern part of the Republic of Macedonia, the North-East Greece and the North-West Turkey. The investigated Balkan Peninsula part is composed by numerous micro morphotectures (Fig. 5). Those continental microplattes were separated from the northern passive paleo margin the Gondwana Continent in different moments of the Phanerozoic evolution (Fig. 4). They have moved as islands (Fig. 4) or archipelagos with different geological and tectonic history to the north during the closing of the Tethys Ocean. The mentioned Gondwana continental fragments were arrived to the south and south west margin of the Paleo Europe continental massif in the time of the ending of the Tethys oceanic crust subduction. They have tectonic sutured (weld together) and built the modern southwestern and southern margin of the European continent – Neo Europe (Fig. 5). This circumstance determinate the mosaic pattern of the continental crust in the region.

The Neo Europe uniform geotectonic evolution was began in Early Paleogene – the time of the full ending of the Tethys oceanic crust subduction. The last most important Alpidian deformations in the observed region were realized during the Paleocene and Eocene Epochs and the Early Oligocene Age. It was the time of the deep crust folding and over thrusting deformations (Fig. 1). This processes mark the end of the Alpidian geotectonic era. The Paleocene-Early Oligocene predominantly low or hill-low mountain relief in the region was connected with volcanic activity.



Moments from the closing of the Thethys Ocean

1- Gondwana continental massif, 2- Tethys Ocean, 3- Paleo Europe continental massif, 4 oceanic crust, 5- Phanerozoic subduction of the Tethys Ocean down the Paleo Europe continental massif, 6- fragments from the Gondwana continental crust in the Tethys Ocean, 7- building the Mediterranean See (after the Tethys Ocean cloosing), 8- intra continental collision between of the Gondwana and the Neo Europe continental massifs

Fig. 4

Balkan Peninsula as a part of Neo Europe

The contemporary mosaic geotectonic pattern of the south eastern parts of Neo Europe includes the Bavarian, Bohemian, Moravian (Hungarian and Middle Danubian), Carpathian, Alpean, Dinarian, Pindian, Heladian, Moesian, Bulgarian, Halkidikian, Aegean, Pontian (West Pontian and East Pontian), West Anatolian, East Anatolian, Cretean, Cyprian Continental Microplates and Black Sea (Pontean) Oceanic Microplate (Fig. 6). The oriental part of the Balkan Peninsula includes the Bulgarian, Halkidikian and southern part from Moesian Continental Microplates (Fig. 5). The Bulgarian Continental Microplatte is composed by the Sub Balkan, Upper Thracian, Strumeshnitsa, Middle Struma, Middle Mesta, West Thracian, Lower Thracian, South Morava, Hemus, Kraishte-Sredna gora, Bregalnitsa, Rila-Rhodope,

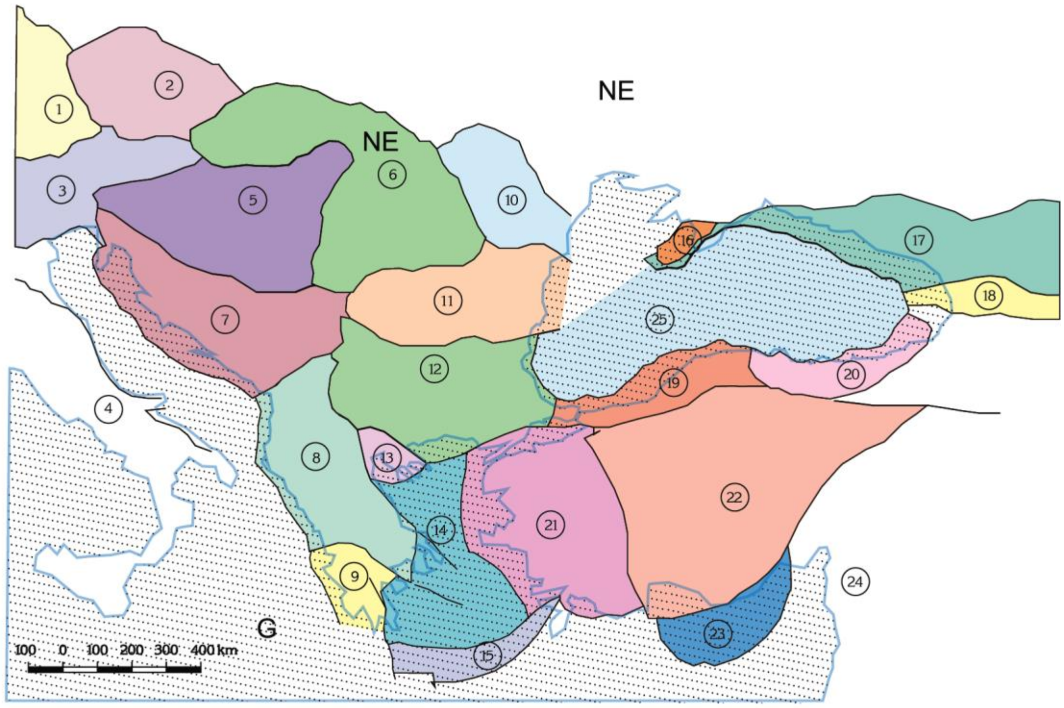


Fig 5

Mosaic tectonic pattern schematic model of the Neo Europe South-eastern part (after *Tzankov, Iliev*, 2015 with modification and addition)

G- Gondwana Continental Macroplate (Continent); E- Europe Continental Macroplate (Continent): PE- Paleo Europe Continental Macroplate, NE – Neo Europe Continental Macroplate.

1-20 - Neo Europe Continental Microplates: 1- Bavarian, 2- Bohemian, 3- Alpean, 4- Apeninian, 5- Moravian, 6-Carpathian, 7-Dinarian, 8- Pindian, 9- Heladian, 10- Scitian, 11- Moesian, 12- Bulgarian, 13- Halkidikian, 14- Aegean, 15- Cretean, 16- West Pontian, 17- East Pontian 18- West Anadolian, 19- East Anadolian, 20- Cyprian; 21- 23 Paleo Europe Continental Microplates: 21- Creamean, 22- Caucasian, 23- Georgian; 24- Arabian Continental Plate, 25 Black Sea Oceanic Microplate.

Sakar-Strandzha and Gradesh-Belasitsa Morphostructural Zones (Fig. 6). The South Moesian Morphostructural Zone (most south part from the Carpathian Continental Microplate) spread in North

Bulgaria, to the north from Fore Balkan and Stara Planina Mountain Ranges (Fig. 3). The Halkidiki Continental Microplate is disposed on the Halkidiki Peninsula (North Greece – Fig. 3).

The northern border of the Balkan Peninsula eastern part coincides with the Lower Danube fault system (Fig. 6). It separates the South Moesian Morphostrucrural Zone from the other parts of the Moesian Continental Microplate to the north (Fig. 6). The western border of the oriental part of the Balkan Peninsula is marked by the not so active today tectonic suture between the Carpathian, Dinarian and Pindian Continental Microplates to the west and Moesian, Bulgarian and Halkidikian Continental Microplates to the east (Fig. 6). The southern boundary of this part of the Peninsula coincides with the North Anatolian transform fault between Channel of Bosporus and the Gulf of Thessalonica (Fig. 6).

The eastern border of the Balkan Peninsula has a character of passive continental margin between the Moesian and Bulgarian Continental Microplates to the west and the Pontian (Black sea) Oceanic Microplate to the east (Fig. 6).

The Balkan Peninsula is bordered on a east with Black Sea Basin. The last one is a relict from the north eastern marginal parts of the phanerozoic Tethis Ocean.

The subaeral part of the West Black Sea passive continental margin includes different wide band from the terrestrial areas of the South Moesian, Hemus, Upper Thracian and Sacar-Strandzha morphostructural zones (Fig. 7). The subaqual part of the margin is composed by the high and low shelf steep, the continental slope and the continental foot (Fig. 7). The western border of the subaeral part of the margin, between Danube and Kamchiya rivers (Fig. 7) is marked by Venelin-Prut fault zone on the meridian of the Suha Reka river (Fig. 7). The border souther prolongation is following the fault predestinated Luda Kamchiya, Mochuritsa and Tundzha river valleys (Fig. 7) to the parallel of the town of Edina (Odrin – Fig. 7). The south eastern border of the subaeral margin coincides with the south west boundary of the Sakar-Strandzha Morphostructural Zone between the town of Edina and Black Sea coast (Fig. 7).

The subaeral part of the West Black Sea Passive Continental Margin include the North Dobrudzha and South Dobrudzha (Dobrich) block, the Frangen Hemisineclize and the Momino Anteclize of the South Moesian Morphostructural zone, the Primorska Morphostructural area of the Hemus Morphostructural zone, the Burgas Low land morphostructure of the North Thracian morphostructural zone and the Strandzha Morphostructural area of te Sacr-Strandzha Morphostructural zone (Fig. 7).

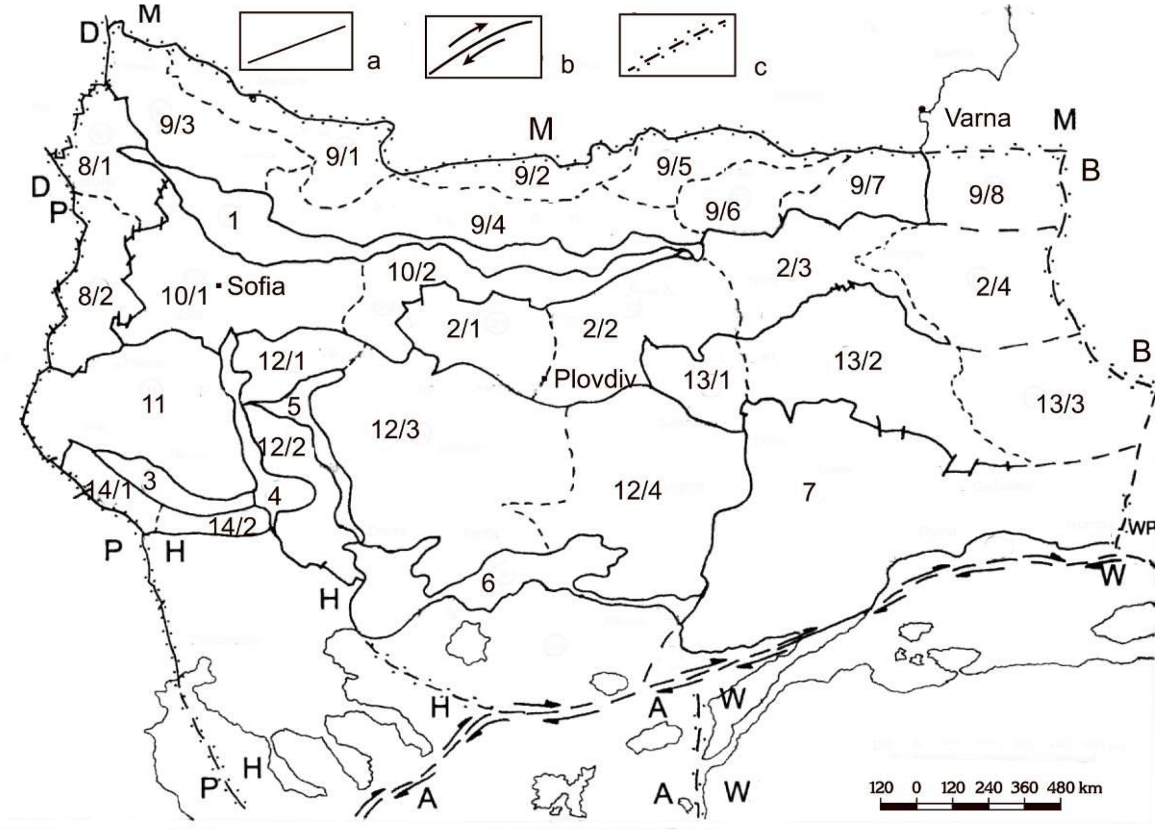


Fig. 6

Bulgarian continental microplate (zones and *areas*)

1- Sub Balkan, 2- Upper Thracian (2.1- *Plovdiv*, 2.2- *Zagore*, 2.3- *Burgas*), 3- Strumeshnitsa, 4- Middle Struma, 5- Middle Mesta, 6- West Thracian, 7- Lower Thracian, 8- South Morava (8.1- *Nishava*, 8.2- *Surdulitsa*), 9- Hemus (9.1- *Vratsa*, 9.2- *Veliko Tarnovo*, 9.3- *Preslav*, 9.4- *Midzhur*, 9.5- *Mazalat*, 9.6- *Udvoy-Matoria*, 9.7- *Primorsko*), 10- Kraishte-Sredna gora (10.1- *Kraishte*, 10.2- *Sredna gora*), 11- Bregalnitsa, 12 - Rila-Rhodope (12.1- *Rila*, 12.2- *Pirin*, 12.3- *West Rhodope*, 12.4- *East Rhodope*), 13- Sakar-Strandzha (13.1- *Sakar*, 13.2- *Strandzha*), 14- Gradesh-Belasitsa (14.1- *Gradesh*, 14.2- *Belasitsa*).

The subaqual part of the West Black Sea passive continental Margin is composed by consecutively orderly from west to the east, terrace-like to the Black Sea bottom: high and low shelf steep, continental slope and continental foot (Fig. 7).

The meridian oriented West Black Sea Passive Continental Margin finishes in the south direction to the north of the Istanbul City. The mentioned morphounit is following to the north till the parallel of the towns of Mangalia and Constance in Rumania (Fig. 7).

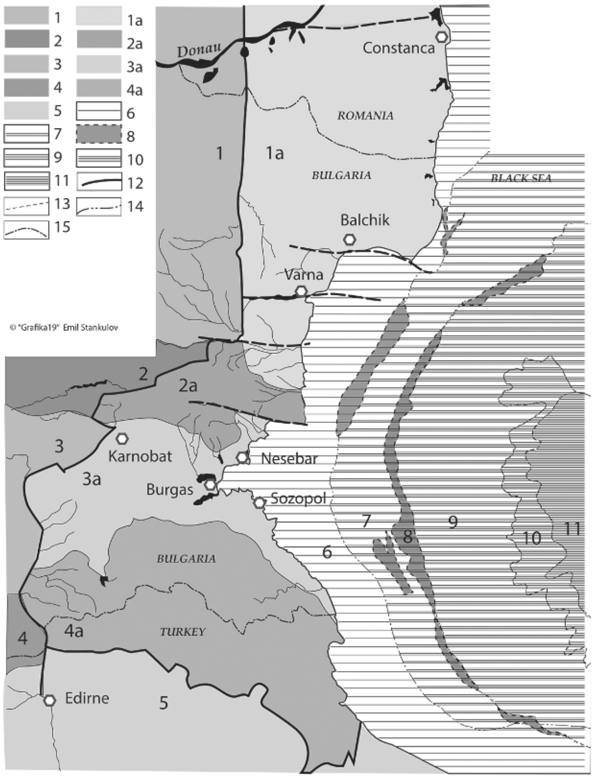


Fig. 7

Survey morphostructural sketch of the West Black Sea Passive Continental Margin

1-5 – subaeral margin area: 1-1a – South Moesian Morphostructural Zone: 1- continental part, 1a- margin part: 2-2a -Hemus Morphostructural Zone: 1- continental part, 1a- margin part: 3–3a - Upper Thracian Morphostructural Zone: 3- continental part, 3a- margin part: 4 – 4a - Sakar-Strandzha Morphostructural Zone: 4- continental part, 4a- margin part: 5- Lower Thracian Morphostructural Zone; 6-11 – subaqual margin area: 6-8 – continental shelf: 6- high step, 7- down step, 8- fault zone; 9- continental slope, 10- continental foot, 11- Black Sea Bottom; 12 – west border of the West Black Sea Passive Continental Margin, 13- some important faults, 14- border between the morphostructural zones, 15 – boundary between Turkey and Bulgaria.

The morphotectonic contact between the Moesian and Bulgarian Continental Microplates to the west and the Black Sea Oceanic microplate to the east is coming in to being in the Early Paleocene time, immediate after the suturing between the different continental fragments (terrains) in this part of Neo Europe as a part of the suth eastern end of the Neo Europe. The West Black Sea Passive Continental Margin has a very clear west fault border. The morphounits superficias in the subaeral part of the margin lover everywhere to the east. This is an important difference with the morphostructural pattern of the most west part from the Moesian and Bulgarian Continental Microplates.

The eastern part of the Stara Planina mountain range loses its unity and “disfingers” it crest in the area of the West Black Sea Passive Continental Margin.

The firth and lack abundance (more than 20 firths and lacks on the Bulgarian Black Sea Coast (Krastev, Stankova, 2011) show the morphotectonic “calm” and passive character of the West Black Sea continental margin.

The firsts of the Primorska and Sakar-Strandzha morphostructural zones are formed in the mountain relief of the coast. This events is not observed in the other parts of the Black Sea Coast).

The seismic activity in the area of the West Black Sea Passive Continental Margin is sharply reduced in comparation with the most west part from the Moesian and Bulgarian continental microplates. The not numerous earthquake centrums are group together the some Quaternary active faults or fault zones.

The separate morphotectonic parts of the West Black Sea Passive Continental Margin have the some mosaic block pattern of the respective morphostructural unit.

The western Black Sea Passive Continental Margin show spatial satisfactory dimensional character along the whole it length. It origin, orographic and morphotectonic characteristic is essentially differ from the north and south Black Sea coasts.

Post Early Oligocene morphotectonic evolution

The post Aliped geotectonic evolution of the eastern part of the Balkan Peninsula was began with the Late Oligocene – Early Pleistocene relatively long (28 – 0.78 Ma) apparent geodynamic „calm". This paleogeographical setting was determined the low land – plateau relief and savanna similar landscape of the region. The wide-spread braded rivers were contributed to the building of several super posited large denudation-accumulative planes – orthoplains. The building of the last of them – the Post Early Pleistocene Orthoplain (before 780 000 – 800 000 years) precede probably the beginning of the intercontinental collision between Gondwana and Europe in the East Mediterranean area (Fig. 8, 9). This process was provoked the relative very rapid and high intensive uplifting of the Neo Europe most southern parts and the building of the high mountain massifs of Alpes, Dinarides, Pind, Helenides, Rila, Pirin Rhodope. Their morphogenesisis is connected with the Middle Pleistocene – Holocene temporal progressive destruction of the parts of the Post Early Pleistocene Orthoplain and positive (dome-like, concentric) morphostructures building. The dimensions and the mosaic regional position of those morphounits were limited by the deep crust faulting (Fig. 5).

The central morphotectonic position in the Balkan Peninsula east part belongs to the (Fig. 5). The high mountain relief of it south-western parts of the Bulgarian Continental Microplate was caused by the contemporary intra continental collision between of the Gondwana and the Neo Europe Continental Massifs (Fig. 8, 9). This geodynamic process is controlling by the morphotectonic setting in the region. It determine the pressing the Bulgarian Continental Microplate to the north over the Moesian Continental Microplate (Fig. 6, 8). The effect of those relationships is the building of the long around 500 *km* Stara Planina Mountain Range on the north border of the Bulgarian Continental Microplate (Fig.6, 8). Their central parts includes the contemporary most fragments from the primary Post Early Pleistocene Orthoplain – Sub Balkan and Upper Thracian Morphostructural Zones (Fig. 6). The contact between the Bulgarian and the Halkidikian Continental Microplate has character of the ticking of the last one up to the north in connection with the intra continental collision of Gondwana verso Neo Europe. This type of relationships are be able to explain the high mountain relief of the Bulgarian Continental Microplate southern boundary in compareison with of low land relief of the north border of the Halkidiki micro plate (Fig. 6).

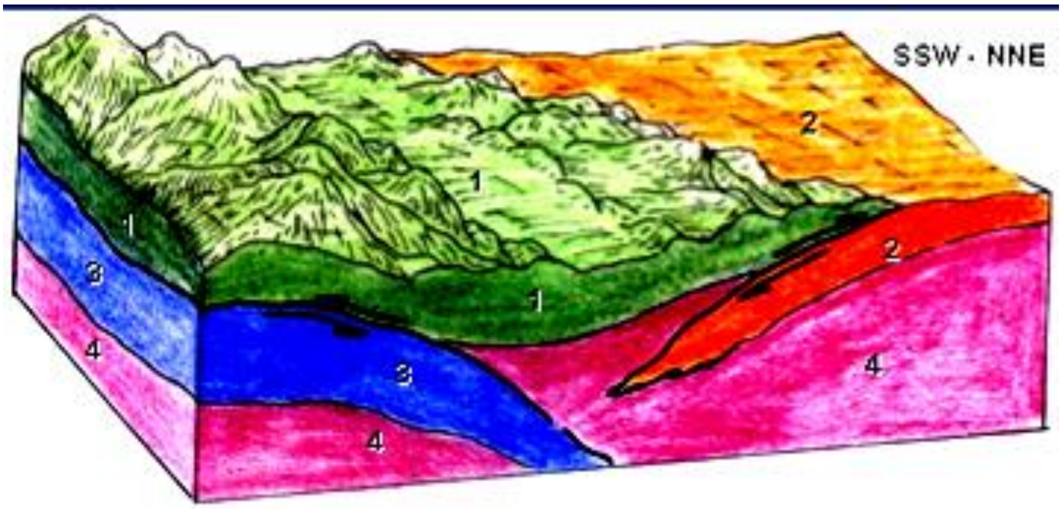


Fig. 8
Morphotectonic position of the Bulgarian continental microplate (block-diagram model)
1- Bulgarian continental microplate, 2- Moesian continental microplate, 3- Gondwana continental plate, 4- Upper Mantel

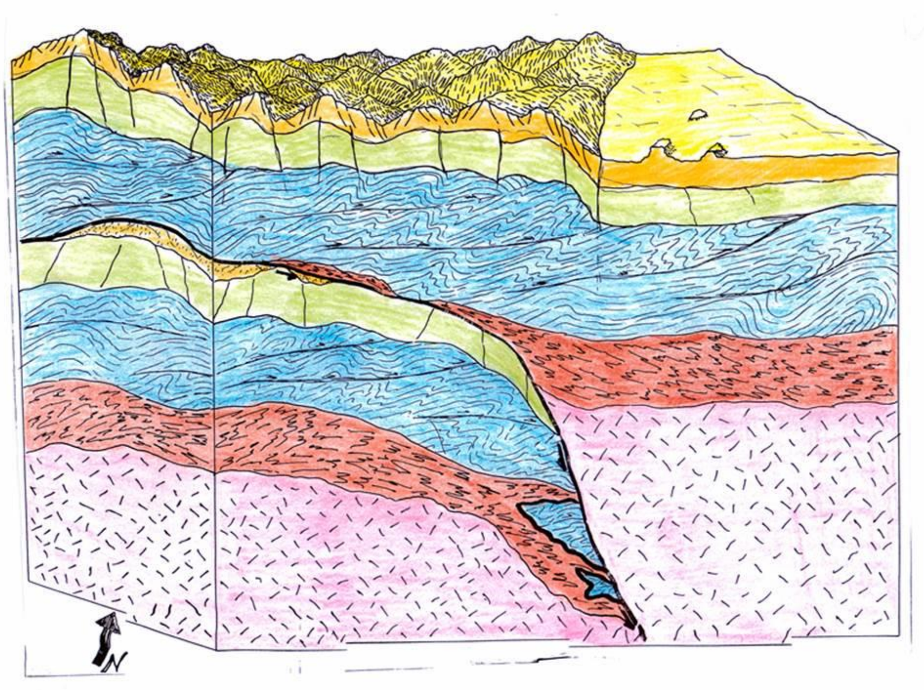


Fig. 9
Schematic section trough the intracontinental collision between Gondwana and New Europe in the Rhodopean Morphostructural Area (block-diagram model)

UM- Upper Mantle; G1 – G4 – Gondwana lithostructural layers: G-1 – High metamorphic lithostructural layer, G-2 – Fold-over thrust lithostructural layer, G-3 – Deep block lithostructural layer, G-4 – Superficial lithostructural layer; R- Fault zone of the intracontinental collision between Gondwana and New Europe; NE1 – NE4 – New Europe lithostructural layers: NE-1 – High metamorphic lithostructural layer, NE-2 – Fold-over thrust lithostructural layer, NE-3 – Deep block lithostructural layer, NE-4 – Superficial lithostructural layer.

Concept evolution.

The questions of the presence, time and type of origin, peculiarities, evolution and relationships of the mentioned Late Pleistocene-Holocene morphogenerations in the eastern part of the Balkan Peninsula have arise in connection to the primary complex Plate tectonics (mobillity) regional interpretation (*Цанков* и др., 2005). It was constituted primary, that the Late Quaternary morphostructures in the observed area are result of some deformation acts with different morphostuctural characteristics and different ages (*Цанков* и др., 2005). The following investigations (see the references) have builded the concept for the consecutive origin of Late Pleistocene concentric morphostructures, Late Pleistocene-Early Holocene dome-like morphostructures and Late Holocene dome-like morphostructures on the places of the districted parts of post Late Pleistocene orthoplain. The modern investigations shows the conditional character of dividing of the above-mentioned two groups of dome-like morphostructures – the evolution of some Late Pleistocene-Early Holocene dome-like morphostructures is following today. A local widespread of one earlier (post Early Pleistocene) generation of comb-like morphostructures was constituted only in the South Moesian and Lower Thracian morphostructural zones (*Цанков*, *Станкова*. 2012, 2012a, 2012b, 2016). Those morphoforms represents effects of the very slight epidermal bending of some most superficial parts of the post Early Pleistocene orthoplain.

Morphostructural analysis

Morphostructural generations

The questions of the presence, time and type of origin, peculiarities, evolution and relationships of the mentioned Late Pleistocene-Holocene morphogenerations in the eastern part of the Balkan Peninsula have arise in connection to the primary complex Plate tectonics (mobillity) regional interpretation (*Цанков* и др., 2005). It was constituted primary, that the Late Quaternary morphostructures in the observed area are result of some deformation acts with different morphostuctural characteristics and different ages (*Цанков* и др., 2005). The following investigations (see the references) have build the concept for the consecutive origin of Late Pleistocene concentric morphostructures, Late Pleistocene-Early Holocene dome-like morphostructures and Late Holocene dome-like morphostructures on the places of the destructed parts of post Late Pleistocene orthoplain. The modern investigations shows the conditional character of dividing of the above-mentioned two groups of dome-like morphostructures – the evolution of some Late Pleistocene-Early Holocene dome-like morphostructures is following today. A local widespread of one earlier (post Early Pleistocene) generation of comb-like morphostructures was constituted only in the South Moesian and Lower Thracian morphostructural zones (*Цанков*, *Станкова*. 2012, 2012a, 2012b, 2016). Those morphoforms represents effects of the very slight epidermal bending of some most superficial parts of the post Early Pleistocene orthoplain.

The modern model of the genesis, type and age of the Quaternary Morhpogenerations in the eastern part of the Balkan Peninsula is presented on a Table II.

Table II

SUCCESSION OF THE QUATERNARY MORPHOSTRUCTURAL GENERATIONS IN THE EASTERN PART OF THE BALKAN PENINSULA

FIRST MORPHOGENERATION **-** *post Early Pleistocene orthoplain (Quaternary protomorphostructure)* – enveloped in the all areas of the eastern part of the Balkan Peninsula.

SECOND MORPHOGENERATION - *post Early Pleistocene anteclises and syneclises (formed by comb-like morphostructures)* - enveloped on the some most fragments (Moesian and Lower Thracian morphostructural zones) from the destructed post Early Pleistocene Orthoplain in the eastern part of the Balkan Peninsula**.**

THIRD MORPHOGENERATION - *Late Pleistocene – (?)Early Holocene dome-like intensive eroded and conserved today as fragments from concentric morphostructures* – enveloped in the intensive destructed parts from the post Early Pleistocene orthoplain in the eastern part of the Balkan Peninsula (Belasitsa and Bregalnitsa morphostructural zones, Rila-Pirin morphostructural range, Sakar-Strandzha, Kraishte-Sredna gora, Hemus and South Morava morphostructural zones).

FOUR MORPHOGENERATION - *Early and Late Holocene dome-like morhostructures* – enveloped in the intensive destructed parts from the post Early Pleistocene orthoplain in the eastern part of the Balkan Peninsula (Belasitsa and Bregalnitsa morphostructural zones, Rila-Pirin morphostructural range, Sakar-Strandzha, Kraishte-Sredna gora, Hemus and South Morava morphostructural zones)
and
syncinematic (simultaneously formed) negative morphostructures (lowland and plane morphostructures, complex morphostructural

and morphostructural passages, kettle morphostructures, morphostructural thresholds, gorges) – enveloped in the conserved relicts from the post Early Pleistocene orthoplain.

FIFTH MORPHOGENERATION - *Late Holocene mountain arched morphostructures*, marked the most elevated parts of the mountain relief in the eastern part of the Balkan Peninsula.

The Late Holocene generation of the concentric and arched mountain morphostructures was established in the Rhodope morphostructural zone (*Tzankov, Iliev,* 2015). The contemporary investigation show relicts from this generation in the Belasitsa and Bregalnitsa morphostructural zones, Rila-Pirin morphostructural range, Sakar-Strandzha, Kraishte-Sredna gora, Hemus and South Morava morphostructural zones.

The origin and evolution of the Quaternary succession of the morphostructural generations in the eastern part of the Balkan Peninsula is inherited the more than 23 million years prolonged relatively „calm“ geotectonics period from the beginning of the Late Oligocene (Chat) till the end of the Early Pleistocene (Villa frank) end (*Цанков* и др., 2005). The beginning of this time interval coincides with the saturation end between the heaped (during the late period of the Thetys Ocean Subduction) Perry Gondwana terrains in the north-east margin of the Mediterranean area. The sutured terrains build up the part of the New Europe continental massif. The sutures between the terrains were the probably field of the Late Alpine intensive fold-over thrust deformations in the responded deep crustily zones. Those structure building processes had not directly reflection on the time Earth superficies. The Late Oligocene - Early Pleistocene landscape of the observed part from New Europe was similar with the modern savannas – relatively low stiles plate-low land relief with plateaus and mesas. This natural setting was favored the forming of the large sub structural terrains of the consecutively formed orthoplains (*Цанков* и др., 2005). The last one of them – the post Early Pleistocene orthoplain is the base of the Quaternary regional deformations (Tab. II)

The Late Pleistocene beginning coincides with the sharp geodynamic activity increases in the eastern part of the Balkan Peninsula. It is thanks to the beginner transcontinental collision between New Europe and Gondwana. This process was provoked the step by step increased the destruction of the post Early Pleistocene Orthoplain. The new formed morphounits are result from brittle deformations.

The proved today continued uplifting of the predominantly mountainous relief from the southern sector of the eastern part of the Balkan Peninsula show the domination of the endogenous processes role by the contemporary relief building.

The origin of the every one from the morphogenerations is connected to determinate geodynamic processes in the upper Earths crust parts.

The post Early Pleistocene comb-like morphostructures (Fig. 10) are result from the very weak epidermal bending of some Earths superficial regions. They are forming the regional proto morphostructures - very flat and shallow syneclisas and anteclisas or their parts (hemisyneclises and hemianteclises) of the responded orthoplain regions in the area of the South Moesian and the Upper Thracian morphostructural zones. They are very flat and shallow sagging of some parts of the orthoplain superficia. Its inclination is very slowly (of the order of some grades). Those homoclinal morphostructures form specific came-like (initially „fork-like“ called - *Цанков, Станкова*. 2012a) landforms (Fig. 10). It relatively most elevated part is limited by one relatively stronger and one more sloping slope. The last one is indented by longitudinal or sub longitudinal different deep combs or gullies (Fig. 10). The direction of the sloping slope dipping is parallel to the homoclinal inclination. The size of the various came-like landforms is very different.

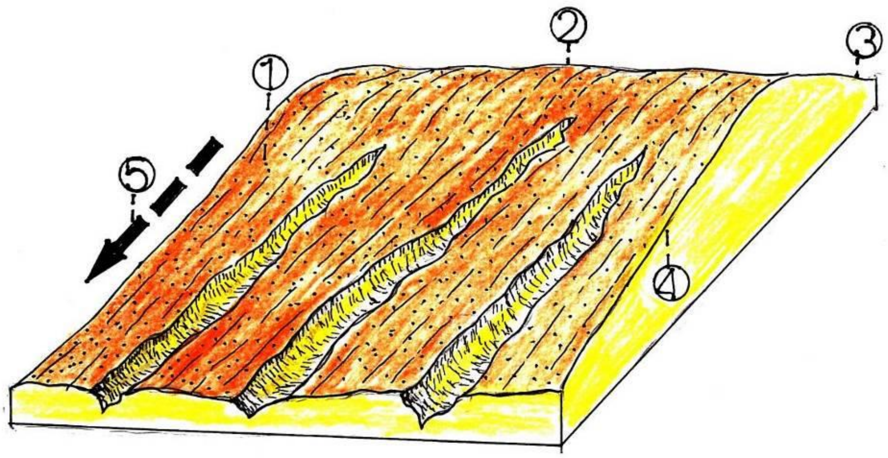


Fig. 10
Shematic block-diagram of the came-like landforms
1- orthoplain superficial, 2- top (most elevated parts), 3- stronger slope,
4- sloping slope, 5 – direction of the orthoplain superficial generl dipping.

The Late Pleistocene concentric morphostructures are represented in the modern relief through the contemporary erosion relics – traces of the most early dome-like morphoforms. They were formed in the intensive destructed areas of the post Early Pleistocene orthoplain in the eastern part of the Balkan Peninsula (Belasitsa and Bregalnitsa morphostructural zones, Rila-Pirin Morphostructural Range, Sakar-Strandzha, Kraishte-Sredna gora, Hemus and South Morava Morphostructural Zones). The mentioned traces are forming some of the second or third degree mountain or hills ridges within the framework of the separate Early and Late Holocene dome-like morphostructures. The determining of the primary size and forms of the Late Pleistocene concentric morphostructures is very difficult till impossible.

The principal peculiarities of the contemporary mountain and hills-mountain relief in the eastern part of Balkan Peninsula are controlled by the effects of the four morphogeneration - Early and Late Holocene dome-like morhostructures (Fig. 11). Its synchrony morphostructural analogs in the areas of the conserved orthoplain parts are different negative morphounits (Fig. 12) - lowland and plane morphostructures, complex morphostructural and morphostructural passages, kettle morphostructures, morphostructural thresholds and gorges. The mentioned positive and negative morphounits form the modern mosaic relief of this area (Fig. 13). The dome-like morphostructures are relatively smaller numerous, but very distinct expressed on the relief. They have from irregularly oval or oval-elongated till elliptic form. Their dimensions are varying from 5 - 10 till more than 30 - 40 km (mean 15 20 km). For them is characteristic the expressive dome-like mountain or high hilly relief, with a difference between the altitude of the central highest part and visible basement of the structure of the order of some huntress till more than thousand meters. The river network shows a radial swelling from the central part of the structure. The building of the dome-like morphostructures is connecting with a very quickly uplifting of the corresponding area. Those morphounits can belong to different generations.

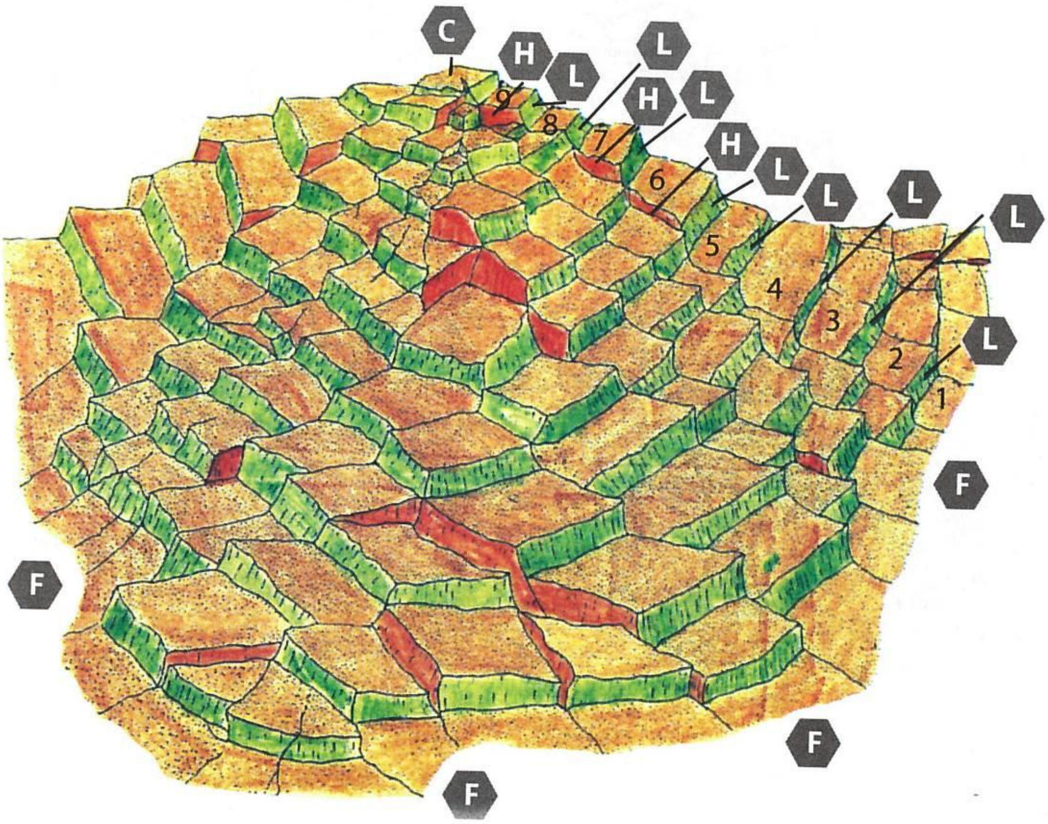


Fig. 11

Dome-like morphostructures
C- listric prism, corresponded with the centrum of maximal intensive uplifting – top of the dome-like morphounit, F- foot of the dome-like morphounit, L- listric (low-angle) normal fault, H- high-angle normal fault, 1-9- cascade uplifting line of listric prisms

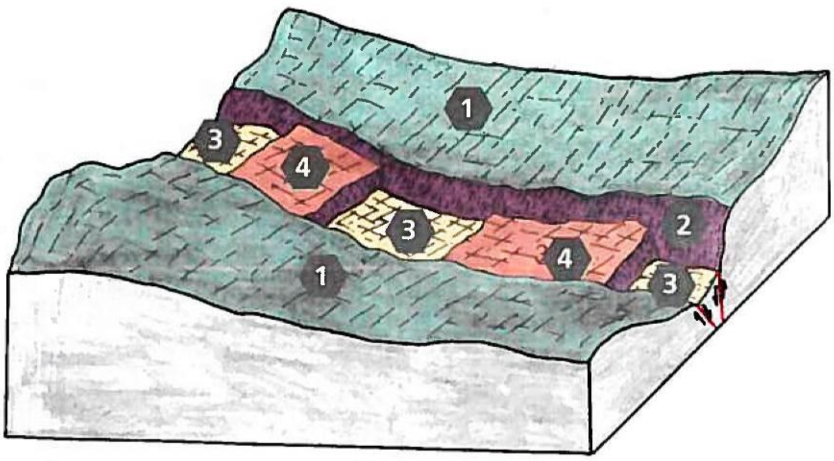


Fig.12
Complex morphostructural passage:
1- flanked positive morphostructures, 2- fault planes
3-4 - complex morphostructural passage: 3- negative morphostructures (kettles, passages), 4- thresholds.

Fig. 13
The post early Pleistocene orthoplain near the Emine cap – Black Sea coast.
On a fore ground: relics from pre Neogene structures (anticline), cover by the early Pleistocene orthoplain; on the second distance: fragment from the early Pleistocene orthoplain; on the back graund (left): Early and Late Holocene dome-like morhostructures

Listric faulting and relief

This type of brittle destruction of the superficial parts of the Earth crust was and is playing a leading geodynamic role during the Quaternary in the eastern part of the Balkan Peninsula. One very important specific of the observed tectonic listric effects is their geomorphologic expression in the forms of the relief.

The essential of the distinctions between the listric (low-angle) and the high-angle faulting reduce to the following:

1/ The listric faults differ by the relative low, gradually decreased (in a depth) inclination of their fault plane. This very sensitive changeably of the spatial position of the separate parts of the low-angle fault plane determine its specific longitudinal and transverse (in a depth) morphostructural conduct. The mentioned special features of these faults concerned namely determine its very important play for the "opening" of the continental Earth crust during the regional extension.

2/ A very important morphostructural peculiarity of the listric faulting represent it direct reflection on the relief. The separate listric prismatic blocks have a morphological expression as a asymmetric steps, which are closed between two neighbor listric faults. An older pre listric erosion plane (part of the last peneplain), which was rotated from the horizontal, forms the more gently dipping surface of the tilted block. The stepper dipped block surface corresponds with a part of the frontal limited listric fault plane. The gently dipping erosion surface is often at least covered by sedimentation an overlying half graben. Post-faulting erosion often destroys the features of the more steeply dipping surface. The post listric erosion destroys mostly the frontal edge (between the slanting and the steep side) of the listric step. The syn- and post cinematic high-angle faulting are causing the dismembering, the lateral transposing and the denivelation between the neighbor fragments of one and the some listric fault prismatic block.

3/ The field investigations show, that the listric fault represents usually not one plane, but a system of sub parallel, dense disposed fault planes. Over them are realizing movements of displacement (with very rare exceptions) with a small one, in many cases even imperceptible amplitude. In a given interval the density of the listric faulting is so intensive, that it is creating an impression for the "moonlit" fault zone. It is namely represented as a respective listric fault on a different tectonic maps and profiles. In a reality the listric faulting is a repeatedly more wide-pared fracturing of the rocks. The very small amplitude of the movements over its fault planes is making practically imperceptible the scale of the realized deformations.

4/ The density of the listric faults (or the listric fault zones) is usually very high. It explain the very important play of this fractures for the „opening“ of the Earth crust in the extension zones.

Mosaic pattern of the relief

The mosaic pattern of the eastern part of Balkan Peninsula was predetermined during the Neo Europe Continental Massif building. The mosaic internal character of the Bulgarian Continental Microplate was formed in connection with the pre Early Pleistocene Orthoplain destruction during the regional processes of the transcontinental collision between Gondwana and Neo Europe. The deep block destruction of the Earth Crust (in the deep block lithostructural layer – Fig. 1) has limited the borders of the morphostructural zones, areas and some of the regions. Its internal patterns was and is formed from the composed by hay angular and listric faults regional fault net. The last one has limited the most little Earth superficial blocks in which are closed the single positive dome-like morphostructures.

The mosaic pattern of the Balkan Peninsula eastern part supplement to the relics from the pre Late Pleistocene Orthoplain – planes, low planes complex morphostructural passages, isolated morphostructural kettles and others.

The mentioned specifics of the mosaic pattern determine the highly varied and regional rapid changing character of the relief in the eastern part of the Balkan Peninsula.

Geodynamics and relief building

Peculiarities of the relief on easter part of Balkan peninsula is the participation ratio between endogenous and exogenous earth processes during the formation of the landforms. In these area very important role play the underlined mosaic construction of the Earth upper parts and the decisive role on listric tectonics. In addition, research has shown that the velocityy of rising on newly formed morphoscluptures has been rising since the last glacial maximum - Wurm Glacial period. This is evident from the expressive rocky appearance of the highest parts of the mountains, the areas on the arc and concentric mountain morphostructures. This in your side show the limited role on the influence on exogenous earth forces for relief formation. These tendency is evident from:

1/The expressive stepped (cascading) profile on generality (big part) of the Bulgarian mountains. This cascading does not allow to be accepted classical metod for average calculation on the tilt on mountain slopes, not taken in mind, the significant differences between slopes and steep slopes. This effect of the listric faulting especially good is evident in the foodtstool and in the highest part of mountain massives.

2/Despite its limited area exposure, the exaration process in these part of peninsula shown determined forces and they practically control the process of new formation relief in affected area. On further prolonged survey on slopes of cirques thresholds and cirque kettle will allow possibility to reading (reliance) on the velocity in mountain relief formation after the Würm glacial period.

The conducting analysis on the highest on center of maximum uplift at the dome (dome-like) morphostructures since third generation can be decisive for extraction of additional information concerning on the Late Quaternary block displacement in the high and medium-high mountain massifs on eastern part of Balkan peninsula.

Overview of the seismic activity

In seismic terms, the lands of the Balkan Peninsula are part of the Alto-Himalayan seismic belt, which accounts for 5-6% of the world's earthquakes (Короновский, 2003). The Balkan Peninsula is one of the most geodynamical active regions in the whole belt. Its seismicity is a specific expression of the tectonic processes that occur in the Earth's crust and the upper mantle of the Eastern Mediterranean. The region is subject to continuous collision processes from the south as a result of the transcontinental collision between Eurasian and Gondwana Continental Macroplates. In the Eastern Mediterranean region the situation is compounded by the Arabian Plate movement in the northwest. This in turn puts pressure on the Anatolian Continental Microplate, causing the movements of the North Anatolian Transform Fault and hence the increased seismicity in the region. It is these tectonic events that determine the geodynamic environment in the eastern parts of the Mediterranean and Balkan Peninsula respectively.

The epicenter map of the earthquakes in the Balkan Peninsula region (Fig. 13) shows that the concentration of seismic phenomena is much higher in the western and southern parts of the peninsula than in the eastern ones.

The main seismic activity within the Balkan Peninsula is realized through the Hellenic Arc, the Anatolian Fault System, the Struma-Rhodopes direction, the Adriatic strip, the bend of the Carpathian Arc (Vrancea Fireplace), etc. (*Христосков, Солаков*, 2009) A general idea of the distribution of earthquakes in the Balkans can be obtained from the table III .

The depth distribution of earthquakes in the Balkan Peninsula has its own specificity. Two seismogenic layers of depths of 20-40 km and 90-110 km and a slightly active layer between 50 and 70 km are clearly distinguished. The relatively small depth of the earthquakes greatly increases the effects of the impact on the Earth's surface.

Earthquakes in the eastern part of the Balkan Peninsula are predominantly of low magnitude (micro-earthquakes prevail). For the last 50 years, earthquakes with a magnitude greater than 5.0 on the Richter scale have occurred very rarely. Almost all seismic events are shallow with the exception of the northernmost parts of the peninsula, in the region of Vrancea, Romania, where part of the earthquakes occurs in the Earth's mantle.

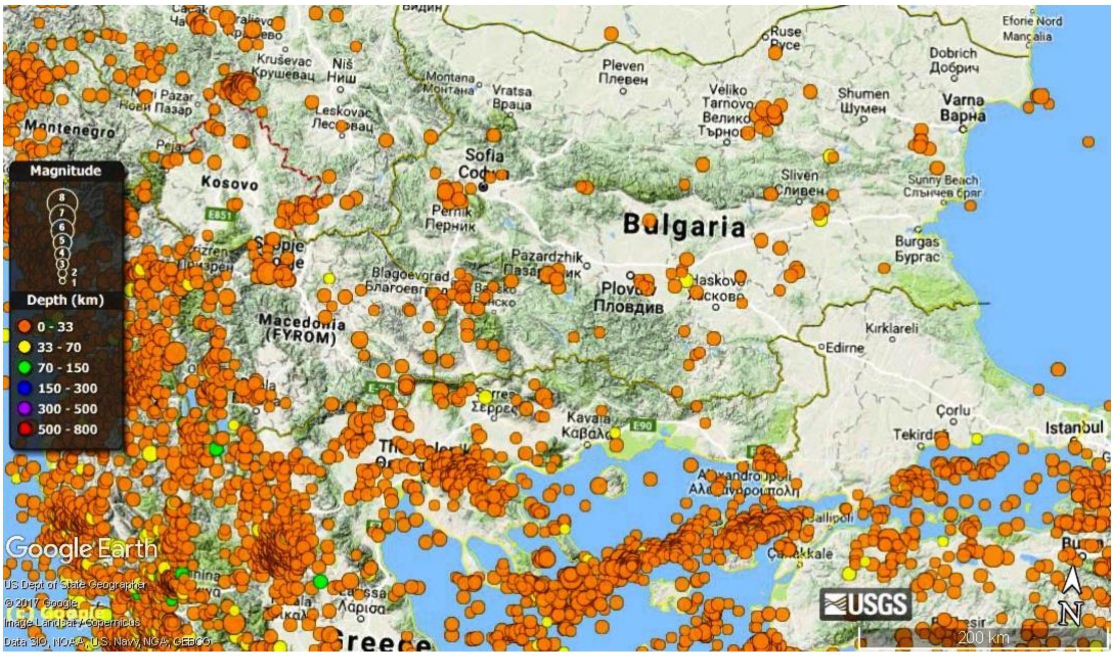


Fig. 13

Comparative map of the seismic activity of the eastern part of Balkan Peninsula during the period of fifty years (1965 – 2016).

Table III

Earthquake Repeatability in the Central and Eastern Balkans (after *Христосков, Солаков,* 2009)

Magnitude (M)	**Annual average number of earthquakes (N)**	**Average interval in years (*T=1/N*)**
3	91	0,01
4	11	0,09
5	1,32	0,76
6	0,16	6,3
7	0,02	52
8	0,0023	440

The West Black Sea passive continental margin is the unig conserved segment from the border between Neo Europe and Paleo Tethis Ocean in the east part of the Mediterranean zone. The first one represent the natural east prolongation of the orographic, morphotectonic and morphostructural units of the Moesian and Bulgarian continental microplates. The mentioned margin is characterised by lower seismic activity and relative morphotectonic „calm".

Results.

The from the authors realised up to now morphotectonic investigation of Balkan Peninsula eastern part are giving good reason for the following general conclusion:

1/ The Bulgarian Continental Microplate was a fragment from the Paleo Gondwana Northern Margin. It is now good detached first-rare morphotectonic element from the Neo Europe Continental Massif in the eastern part of Balkan Peninsula.

2/ The morphotectonic evolution of the Bulgarian Continental Microplate can be divided to two stages: early – connected with the Neo Europe Continental Massif building time and contemporary - connected with the processes of the Gondwana-Neo Europe Intracontinental Collision. Those processes have and are demanded the number, character, intensity and morphostructural expression of the Quaternary morphotectonic deformations.

3/ The mosaic pattern is a principal distinctive feature of the eastern part of Balkan Peninsula. It determine the highly varied and regional rapid changing character of the relief in the eastern part of the Balkan Peninsula.

4/ The Quaternary morphotectonic activity in the investigated area express thought fifth up to now established morphogenerations with different specific characteristics. The morphostructural relics from those morphogenerations participle in the contemporary relief.

5/ The listric faulting are played a very important role by the relief building in the eastern part of the Balkan Peninsula.

6/ The seismicity in the territory of the Eastern Balkans is defined as „secondary". It is a reflection of the tectonic processes operating in the western and southern parts of the peninsula or of the result of the very deep Earth mantel cataclysms. The earthquakes in the Bulgarian Continental Microplate are less frequent and with less magnitude.

7/ In the eastern part of the Balkan Peninsula, seismic energy is released primarily along the edges of negative morphostructures (kettles and complex morphostructural passages) at the boundary with fence positive morphounits.

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