

One of Possible Interpretations of the Origins of Depressions in the Valleys of Južna Morava and Velika Morava

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Abstract

The Morava Massif (formerly considered as a part of a Serbian and Macedonian mass, i.e. crystalline in the valleys of Južna Morava and Velika Morava) consists of gneiss and green complex. Down their entire stretching lines they are divided by one tectonic zone, which Petrović (1969) defines as "Vrvi Kobilica zone". A zone of depressions stretches along it with Cenozoic sediments whose thickness ranges from 900 to 5000 meters, and under them there are Mesozoic sediments (found in boreholes). If we consider the thickness of Cenozoic sediments and roughly estimated thickness of Mesozoic we get thickness of at least 7000 metres, which obviously shows the outstanding depth of the mentioned depressions. Through investigation of the totality of relations of gneiss and green complex, including "Vrvi Kobilica zone", an idea has been formulated about this zone which could be a rudiment of old Baikalian (?) collision structure, i.e. it represents the remains of subduction zone of primary oceanic crust, which is today represented by the formations of green complex, under continental crust, which is today composed of formations of gneiss complex and that tectonic activity along this zone has provided necessary conditions for the origin of the depressions.

Keywords: gneiss complex, green complex, "Vrvi Kobilica zone", subductions, depressions, Južna Morava, Velika Morava.

During metallogenic investigation of pre-Mesozoic epochs, it has been observed that the Morava Massif does not represent a unique geotectonic whole. That possibility was already mentioned by Dimitrijević in 1967 when he said that a part of the massif belongs to one, and the other belongs to another type of geosyncline, defined as lower complex mainly composed of gneisses and upper complex "sedimented in eugeosyncline space", composed of green schist, regionally metamorphosed basites and ultrabasites. More recent investigations (Popović, 1991, 1995, 1998) impose a conclusion that these are two different petrogenic and geotectonic environments, distinguished as gneiss and green complex. It is assumed that gneiss complex is formed in a region of a type of continental Earth crust (maybe the margin of the continent) while green complex, according to petrochemical investigations and its petrologic content, was formed in the area of oceanic type of Earth crust.

According to the stratigraphic development and metallogenic properties of the Morava Massif as a whole, it has been agreed that during its formation one part of this massif belonged to middle-European, i.e. the Chech Massif (gneiss complex), and the other part belonged to the Paleo-Asian Ocean (green complex) which was situated between the Chech Massif and Mediterranean subcontinent, which existed almost one billion years ago (Popović, 1998).

A Review of Mutual Relations of Gneiss and Green Complex

From the above discussion it is clear that relation between the two complexes is not...20.... simple. If we observe the problem from the point of view of contemporary scientific explanation about individual segments or plates of the earth crust of the we can notice suitable markers of characteristic and permanent dynamics.

In general, Earth crust consists of a series of separate plates, which mostly fall into two main types: oceanic and continental. Within them, there are continuous dynamic processes which lead to their separation from each other on one hand, and their collision which is manifested by subduction of plates, on the other. In that sense, there is particularly characteristic relationship of contemporary ocean and continental crust in circum-Pacific and Mediterranean region, where the processes of subduction are prominent, at least contemporary geological science holds that view. Subduction zones in Pacific and Mediterranean regions are clearly marked, from one hand with deep depressions in ocean region and uplifted parts in continental region. These two extremely important features are extremely outstanding. The third one that should be added is a collision zone, in this case - subduction zone, followed by concentration of earthquake focuses and strong development of volcanisms, which are manifested in island arches and active continental margins.

If we observe the region of the Morava Massif and within it gneiss and green complex, for which it has already been mentioned that they belong to the continental and oceanic type of crust of the earth, respectively, we can see two particularities, the first is the structure of "Vrvi Kobilica zone", and the second is the zone of depressions which stretches along the valleys of Južna and Velika Morava.

If we consider contemporary tectonic dimensions of the "Vrvi Kobilica zone" we could not claim there is a collision structure of subduction type. But, if we consider geologic time and possible and numerous tectonic deformations which gneiss and green complexes were exposed to, depth of depressions, their continuity, width of Neogene basins, then a possibility that "Vrvi Kobilica zone" represents a rudiment of a great collision structure of subduction type should not be neglected.

Vrvi Kobilica Zone

"Vrvi Kobilica zone" represents a prominent tectonic zone (fracture) whose all three dimensions are clearly marked. According to Petrović (1969), who gives the most about it (although, that is not enough) the structure is three kilometers wide in places, and it has been followed down its length in the direction

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south - north until Jastrebac, in total 80 km. Towards the south this zone disappears into the subsidence of the Južna Morava. Hydrogeological drilling in Vranjska Banja in 1990 and 1991 into the depths of 1100 and 1300 m (at that interval a drill hole was inclined so there would be a reduction of vertical projection, actual depth would be from 980 to 1100 m) tectonic zone was identified manifested as tectonic breccia (Popović, 1992). It was assumed the tectonic zone in the drill hole corresponds to the "Vrvi Kobilica Zone". Accordingly, this was a zone of fracturing that also has its south extension. Its most important feature is that it separates gneiss and green complex. In the area of "Vrvi Kobilica Zone" the width of the zone is over three kilometers which had already been established by Petrović (1969), and also the fact that it stretches to Mali Jastrebac. However, the author of this text thinks that it separates the gneiss and green complex along the entire length of the Morava Massif, from the contact with Pelagonian and Rodopian subsidence on the south, to the Pannonian subsidence on the north, where it disappears. In this zone the rocks are often cataclazed to the point when they can not even be distinguished, but there can be noticed tectonic breccias where there are fragments of various rocks. The investigation of this zone, especially after hydrogeologic borehole in Vranjska Banja and considering the fact it represents the separation zone of gneiss and green complex, excludes their direct stratigraphic relation, i.e. It should be concluded that here has missed a direct stratigraphic development of these two complexes, thus denying a possible interpretation one of them as older and the other as younger (these are actually of the same age), Popović (1995). At the time, he stated that the "Vrvi Kobilica Zone" could represent rudiment of the subduction zone, which accordingly could have been active during Upper Proterozoic. This paper is based on the above-mentioned fact.

Depressions in the Valley of the South and Great Morava

Another property of the contact zone between gneiss and green complex, i.e. the "Vrvi Kobilica Zone", is a zone of depressions which stretches down the entire contact line. These depressions are mainly situated in the part that belongs to green complex. So far, the investigations have not registered any depressions in gneiss complex. So that do exist in the valleys of certain rivers (the Zapadna Morava, etc.) are shallower and

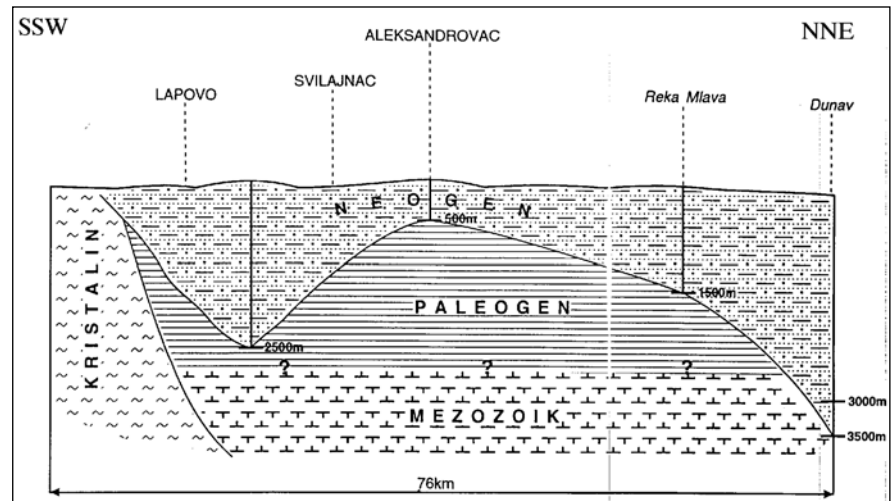


Fig.1. Thickness of Neogene sediments down the cross-section: The River Danube-Lapovo.

were formed in another way (transform faults). Depressions located in parallel with the contact zone of two complexes are 900 to 4000 meters deep (in places even 5000 m), if we consider only the thickness of Tertiary sediments. If we include Mesozoic sediments (Triassic was drilled near Smederevska Palanka) it can be estimated these depression are 7000 meters deep, or even deeper if we take into account the depth of crystalline basement. According to these data we come to a conclusion that individual depressions represent 1/4, and even more of the total thickness of the Earth crust in the region of the Južna and Velika Morava (Dragašević, Andrić, 1982 claim the thickness of the Earth crust is approximately 30 kilometers). According to Bundalesku (manuscript, unpublished map done on the basis of geophysical investigations and exploratory oil drilling) in the lower flow of the Velika Morava valley, from Smederevo to Golubac, the thickness of Neogene sediments reaches 3000 m, in places over 5000m. Going towards south near Azanja, Smederevska Palanka and Lapovo, the thickness of the sediments reaches 2500m.

The most prominent depressions here are in Stig - over 4500m, near Velika Plana over 900 m, near Varvarin over 2000m, then there is the Leskovac-Niš depression with Neogene sediments whose thickness is over 1000m, and in the depressions of the Južna Morava there are Neogene sediments over 2000 m thick (near Vranjska Banja). According to Vujanović and Teofilović (1983) during hydrogeological drilling performed twenty years ago, Triassic sediments were found at Velika Plana on the depth of around 900 m.

The fact that in the surrounding terrain, along the depressions, there are not any Tertiary or Mesozoic sediments and in this depressions there are. Further towards the east, there are Meso-

zoic formations, which are part of the Homoljske Mountains, Beljanica, Kučaja, Babička Gora and other mountains towards southeastern parts towards Bulgaria, but close to the depressions there are not any Mesozoic sediments. In the depressions, there are also very thick formations explained by long sedimentation through Mesozoic and Cenozoic time, which indicates the remains of old pre-Mesozoic depressions. Today they are not continual, but horizontally and vertically drifted, so there is an impression that there are not any great depths. In places, there were also changes of local direction of some depressions because of tectonic movements. All these deformations that happened after subduction and continentalization of this segment of the Earth crust through Mesozoic and Tertiary. In other case, horizontal movements are more prominent, connected to fracture with properties of transform faults, which were active during the Jurassic period. Throughout these structures there are horizontal shears of certain blocks, which can be seen in the valleys of Velika Morava (near Stalać, Lapovo, Velika Plana) which disturbed the continuity of these depressions so that they can be viewed as isolated (if we consider maximal depths). This phenomenon has great influence on decreasing or increasing the potentials of these depressions in terms of layers of coal, oil shales and oil related to these depressions.

Conclusion

Beginning with the comparison of given geological phenomena, which follow the contact zone of gneiss and green complex in the valleys of the Južna Morava and Velika Morava, with the collision zones of individual contemporary continental or oceanic plates, we have come to a conclusion that the above-mentioned

contact zone resembles contemporary subduction zones in the Mediterranean and circum-Pacific region, and particularly in the collision of oceanic and continental type of the crust of the earth. The absence of the island arches and corresponding volcanisms in this zone is interpreted by the loosing the island arch under gneiss complex. Thus subduction, during Upper Proterozoic and Paleozoic, and green complex below gneiss complex there was a formation of the depressions in the subduction zone whose remains can be found in the valleys of the Južna Morava and Velika Morava, and tectonic zone of "Vrvi Kobila" represents rudiments of the subduction zone.

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