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Neotectonic structures in the Vardar zone on the territory of the Republic of Macedonia

Неотектонски структури във Вардарската зона на територията на Република Македония

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Introduction

Polyphase tectonic processes, manifested by vertical differential movements, and in some regions accompanied by volcanic activity, directly influenced the creation of the grabens in the Republic of Macedonia (Arsovski et al., 1975, 1997; Petkovski, 1990). Many geological phenomena indicate polycyclic development of the vertical movements, i.e. from Middle Miocene to Late Pleistocene periods of intense sinking exchanged with periods of weak sinking and decline of basins, which had a direct reflection in the type of sedimentation.

The first cycle of the creation of grabens began in Badenian and lasted till the beginning of the Late Sarmatian, the 2nd cycle took place in the Late Sarmatian–Meotian, the 3rd cycle in the period from the end of Meotian–Pontian, 4th cycle began in Early Pliocene, and somewhere in the Late Pliocene, and the 5th cycle is represented by Pleistocene (Dumurdžanov et al., 1997, 2002, 2005).

Subsiding morphological structures in the Vardar zone

In the neotectonic period the reactivation of old and the creation of new fault lines in the Vardar zone led to the formation of uplifting morphological structures and subsiding (grabens). The reactivated faults are mainly longitudinal, represented in the whole Vardar zone, while the newly formed faults are transverse and diagonal to the spreading of the Vardar zone. The transverse and diagonal faults had a major role in the formation of grabens in the Vardar zone, because all the grabens stretch generally E-W (except the Lakavica graben).

In the northern part of the Vardar zone the Skopje and Kumanovo graben (1st cycle) were formed, filled

with Miocene and Pliocene sediments. To the south and southeast later were formed the Kočani graben (1st cycle), Veles and Sveti Nikole, Tikveš, Vitolište and Radoviš graben (2nd cycle), the Dojran graben (3rd cycle) and the Lakavica, Valandovo and Gevgelija graben (4th cycle), filled with Pliocene and Quaternary sediments (Fig. 1).

The Skopje graben occurred with sinking along the faults of neotectonic and pre-neotectonic age. The thickness of the deposited sediments is over 2000 m. The Kumanovo graben was formed along the transversely and diagonally oriented faults in relation to the spread of the Vardar zone. The Kočani graben spreads E-W and is limited on the northern and southern side with young neotectonic faults. The thickness of the deposited Pliocene–Quaternary material is over 700 m. The Veles-Sveti Nikole graben is a transversely oriented structure, narrowing (westward) along the valleys of the Topolka and Babuna rivers. The Tikveš graben is bounded by fault structures of which the most evident is the southeast one (towards the Vitačevo plateau), then the Raec faults (along the valley of the Raec river), and the faults along the northwestern contact are less expressed. The Vitolište graben is with small dimensions in the contact parts of the Vardar zone with the Pelagonian massif, spreading ESE-WNW. The Radoviš graben occurs in the form of a relatively narrow zone oriented in the direction E-W. The northern edge fault of the depression is more contrastively expressed. The Dojran graben is also transversely oriented towards the regional structures, with E-W orientation. The northern fault towards the mountain Belasica is more prominent. The southern fault is located in Greece. The Lakavica graben is formed with fault structures reactivated in the neotectonic stage, because only this graben in the Vardar zone is stretching NW-SE. The Valandovo graben is layered over the older complexes spreading E-W. It is limited by



Fig. 1. Schematic morphostructural map of the Vardar zone: Vardar zone (VZ), Pelagonian massif (PM), Serbo-Macedonian massif (SMM) – a, morphological uplifting structures; b, morphological sinking structures-grabens: 1, Skopje; 2, Kumanovo; 3, Kočani; 4, Veles-Sveti Nikole; 5, Lakavica; 6, Radoviš; 7, Tikveš; 8, Vitolište; 9, Valandovo; 10, Dojran; 11, Gevgelija

young neotectonic faults, of which the southern fault is more prominent in relief. The thickness of the mainly Quaternary terrigenous material is over 500 m. The Gevgelija graben is oriented in WNW-ESE direction, limited by neotectonic faults, of which the southern one is located in neighboring Greece. Along the valley of the river Vardar this graben is connected with the Valandovo graben.

Conclusion

Vertical differential movements in the neotectonic period in the Vardar zone is manifested with the reactivation of old pre-neotectonic faults and the formation of new faults. The newly formed faults are transversely or diagonally oriented in relation to the spreading of the Vardar zone and they are the main structures along which the morphological subsiding structure (grabens) were formed. The grabens were formed in four cycles, with the oldest in the northern part, and the youngest in the southern part of the Vardar zone.

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