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# CENOZOIC STRUCTURES AND POLYMETALLIC MINERALIZATIONS IN THE CENTRAL PART OF THE SERBO-MACEDONIAN MASSIF

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## INTRODUCTION

Serbo-Macedonian massif (SMM) represents remarkable geotectonic unitwithin central parts of the Balkan Peninsula where have been confirmed numerous structures, morphostructures and significant ore mineralizations. From the geological point of view the SMM has been built mainly of gneisses, mica-schists and Paleozoic schists, while the structural construction has been dominated by plicative structures and disjunctive ruptures. Tertiary magmatism, intruded along Cenozoic structures has been related to the polymetallic mineralization of Pb, Zn, Cu, Au, Ag, AS, Sb (Jankovic and Serafimovski, 1997 etc.).. Significant morphostructural forms in the central parts of the SMM have been related to the productive mineralizations of Cu-Pb-Zn (Plavica type), Cu-Au (Borov Dol type) and Cu±Au±Ag±Mo (Bukovik-Kadiica type). Neo-tectonic structures are of SW-NE to E-W direction and within this area they are not related to the mineralization, but they are just seismically active.

## REGIONAL GEODYNAMIC EVOLUTION OF THE CONSIDERATION AREA

From Paleogene to Recent time, FYR Macedonia was part of the South Balkan extensional region, the northern part of the Aegean extensional regime. Extension began in the middle to late Eocene in Eastern Macedonia with the formation of a NNW-trending east-tilted half graben lying east of a forearc basin in central Macedonia.

The tectonics of FYR Macedonia from the late Eocene to the present is dominated by two periods of regional extension separated by a short interval of shortening deformation in late Oligocene–early Miocene time. Extensional deformation in Macedonia is part of the broader South Balkan extensional regime that in addition to Macedonia affects northern Greece, Bulgaria, Albania, Serbia, Montenegro, and probably parts of south-western Romania (Fig. 1; Dumurdzanov et al., 2005).

The Serbo-Macedonian massif (SMM) consists of Riphean/Cambrian mafic plutonic and volcanic rocks and early Paleozoic schist and phyllite all intruded by large bodies of Paleozoic granite.

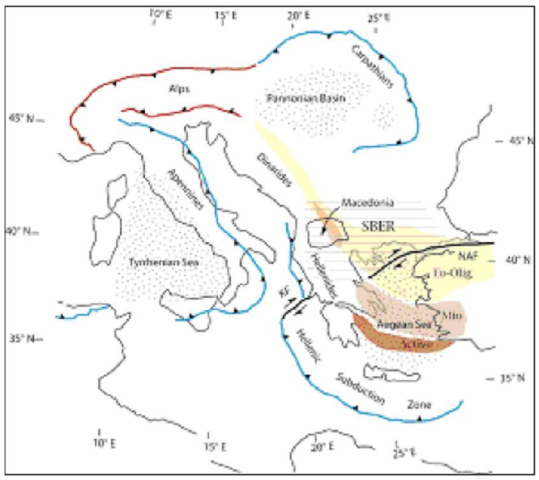


*Figure 1 – Simplified tectonic map of Eastern Mediterranean region showing Southern Balkan Extensional Region (SBER; horizontal lines) in relation to selected tectonic features (Dumurdzanov et al., 2005). Retreating subduction zones (blue) and related areas of backarc extension (dotted pattern) and advancing subduction zones (red) are highlighted. In Balkan region, position of the volcanic arcs of Eocene-Oligocene age (Eo-Olig: yellow), Miocene (Mio: pink), and Pliocene to Recent (Active: red-brown) are shown. The location of Macedonia is outlined. KF—Kefalonia fault zone; NAF—North Anatolian fault zone*

With the exception of the north-plunging nose of the Pelagonian anticlinorium, the structures in the pre-Cenozoic basement rocks are dominated by NW-trending foliation, folds and faults that form an important crustal anisotropy that controlled many of the basin bounding faults in Cenozoic time.

## CENOZOIC MORPHOSTRUCTURES AND POLIMETALLIC MINERALIZATION

The morphostructural analysis and detailed scientific studies have enabled us to understand

the processes which preceded the formation of the zone of Cenozoic activation. The zone of Cenozoic autonomous activation of the Balkan Peninsula is characterized by a specific structural plan, multiphase volcanic-intrusive magmatism and interesting mineral deposits (Fig.2).

A special characteristic of the zone of autonomous activation is its many ringlike structure. These megastructures correspond to broad, gentle arches, are elliptical or circular in shape and have a diameter of 60 to 100 km.

There are numerous and varied mineral deposits in the zone of Cenozoic autonomous activation. Interesting occurrences of tin and niobic tantalum are the only ones genetically linked with the granites (Cer, Bukulja). All the other endogenous deposits are paragenetically linked with the volcanic-intrusive complexes of granodioritic magma. The magnetite deposits (Suva ruda type) magnetite and hematite (Damjan type) - belong to typical metasomatic scarns. The copper deposits are either porphyric (Bucim) or vein-impregnation (Zlatica, Plavica). The molybdenum deposits are stockwork impregnated (Mackatica). The lead and zinc deposits are of scarn type (Rudnik), hydrothermal-metasomatic (Sasa, Toranica) or vein type (Zletovo). The antimony deposits are usually monomineral (Krstov Dol), but there are also transitions to lead-antimony, arsenic-antimony deposits. Logical metallogenic analysis was made possible for the first time by the distinguishing of the megastructures in the Tertiary autonomous activation zone. Thus the megastructures correspond to the ore districts and coincide with the centres of-magmatic activity, while the distribution of mineral deposits in them is found to be distinctly laterally zoned. The lesser ringlike structures correspond to the structure of the ore fileds or mineral deposits, as we are showing that later on the Bukovik-Kadiica polymetallic ore system.

## CONCLUSION

FYR Macedonia experienced two periods of extension separated by two abbreviated periods of shortening in Cenozoic time.

The Cenozoic activization of NW-SE strike diagonaly crossed through the large tectonic units Dinarides, Vardar Zone, central parts of the Serbo-Macedonian Massif and Rhodope massif. This activization significantly contributed to the localization of the Cenozoic mineralizations within the Eastern Macedonia

The disruption structures of of NW-SE direction control three major Cenozoic metallogenetic zone. Two of them are characterized by the Oligocene-Miocene magmatism and mineralization in the major ore region Kratovo-Zletovo and Bucim-Damjan-Borov Dol and the third one has been characterized by Miocene volcanics and related mineralization in the Osogovo ore region (Bukovik-Kadiica).


*Figure 2 – Scheme of the Cenozoic metallogeny in the Eastern Macedonia (FYR).*
*1. Cenozoic magmatic rocks, 2. Followed fissure, 3. Faults defined by satellite images and morphostructural analysis, 4. Fissure zones and cracking systems, 5.Semi-curved structures and calderas, 6.Pericline structures, 7. Metallogenetic zones, 8. Polymetallic deposits (a) and ore occurrences (b), 9.Copper deposits and occurrences, 10. Uranium deposits, 11.Tungsten deposits, 12. Antimony deposits, 13. Iron deposits.*

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