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MAJOR ALPINE STRUCTURES AND Cu-PORPHYRY MINERALIZATION IN THE SERBO-MACEDONIAN MASSIF

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A b s t r a c t: The geodynamic evolution of the Serbo-Macedonian massif can be reviewed in few geological and geotectonic epochs, but very specific is the Cenozoic evolution from geodynamic, geotectonic, structural, magmatism and metallogenetic point of view. The Cenozoic longitudinal structures are deep in their origin and represent a boundary to the Vardar Zone on the one side and Struma Zone on the other side. Morphostructural forms of different rank and intensity are of high importance for the spatial distribution of the ore mineralization (Kratovo-Zletovo Pb-Zn-Cu ore district, Bucim-Damjan Cu-Au-Fe ore district, Bukovik-Kadiica Cu-Au-Ag-Fe ore system etc.). Predominant structures within the Serbo-Macedonian massif are those with NW-SE direction, which served as orebearing systems too (ore zone Besna Kobila-Osogovo-Tasos and metallogenetic zone Lece-Chalkidiki).

Key words: Serbo-Macedonian massif; morphostructures; Cenozoic activization; polymetallic mineralizations; ore systems

INTRODUCTION

Serbo-Macedonian massif (SMM) represents remarkable geotectonic unitwithin central parts of the Balkan Peninsula (Dimitrijević, 1958) where have been confirmed numerous structures, morphostructures and significant ore mineralizations (Janković and Petković, 1974; Janković et al. 1980; Serafimovski, 1990). 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 (Arsovski and Ivanov, 1977; Serafimovski, 1990, 1993), has been related to the polymetallic mineralization of Pb, Zn, Cu, Au, Ag, AS, Sb etc. (Serafimovski et al. 1995; Janković 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). Neotoectonic 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 AREA OF CONSIDERATION

From Paleogene to Recent time, Macedonia was part of the South Balkan exten-sional 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 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 southwestern Romania (Fig. 1; Dumurdžanov et al. 2005).

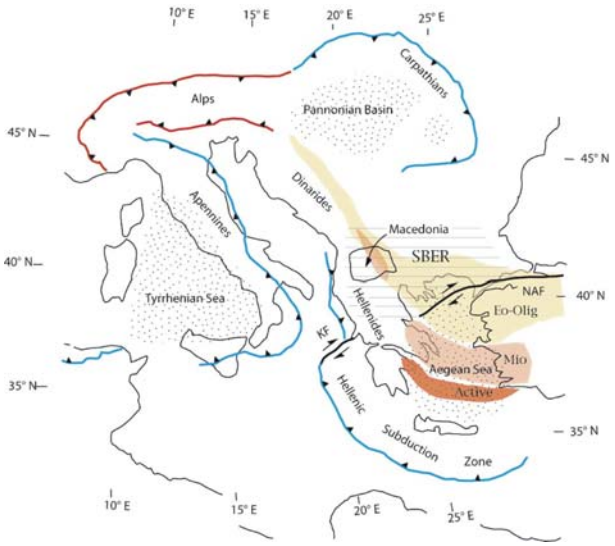

Fig. 1. Simplified tectonic map of Eastern Mediterranean region showing Southern Balkan Extensional Region (SBER; horizontal lines) in relation to selected tectonic features (Dumurdžanov et al. 2005).
Retreating subduction zones (blue) and related areas of backarc extension (dotted pattern) and advancing 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

Development of the extensional system was diachronous throughout the South Balkans and was related not only to changes at the boundaries of the extensional system, but also to changes in lithospheric rheology. This paper develops the late Eocene to Recent tectonic evolution of Macedonia and relates it to our evolving understanding of the regional South Balkan extensional regime.

Most of the understanding of the tectonic evolution of Macedonia comes from the study of the numerous Cenozoic sedimentary basins that contain the record of its extensional history. Unfortunately, the deeper parts of many of the sedimentary basins of Macedonia are poorly exposed and covered by Quaternary deposits. Thus, much of the data from these basins come from drill holes and limited surface exposures, and the three-dimensional framework of these basins is poorly known.

The crust that underlies the Cenozoic basins of Macedonia has had a long and complicated evolution, and structures within the pre-Cenozoic basement rocks have affected the development of some of the basins. Macedonian pre-Cenozoic basement consists of five major tectonic units from west to east: the Chukali-Krasta zone, the Western Macedonian zone, the Pelagonian massif, the Vardar zone, and the Serbo-Macedonian massif.

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. 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 STRUCTURES AND MORPHOSTRUCTURES

The detailed scientific studies and morphostructural analysis have enabled us to understand the processes which preceded the formation of the zone of Cenozoic activation. Contribution to the more complete understanding of the Cenozoic activization and definition of real longitudinal structures and large morphostructural segments at the Balkan Peninsula was in given in workings of Janković and Petković (1974); Petković (1978); Kocneva et al. (1978), Janković et al. (1979); Serafimovski (1993); Janković and Serafimovski (1997); Serafimovski et al. (1997); Serafimovski and Jelenković (1998); Tomson et al. (1998); Tomson et al. (2004); Burchfiel et al. (2008.).

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.

Striking transcurrent faults can be recognized from air and satellite pictures, striking in the same direction as the zone of activation, as well as systems of smaller parallel faults, systems of diagonal jagged faults and systems of straight, tension faults. 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 (Petković et al. 1982). Their internal structure features a wealth of forms. They are built of concentric ringlike segments, and sometimes have the appearance of a coil. Central parts are usually raised, while the other rings are alternately lowered and raised. The

radially arranged faults separate internal parts of the megastructure into sector blocks. These structures are contoured along the periphery by depressions which are either bow-shaped or oval-shaped. Within the megastructure there are numerous smaller ringlike forms ranging from several hundred meters to a few kilometers in diameter (Fig. 2).

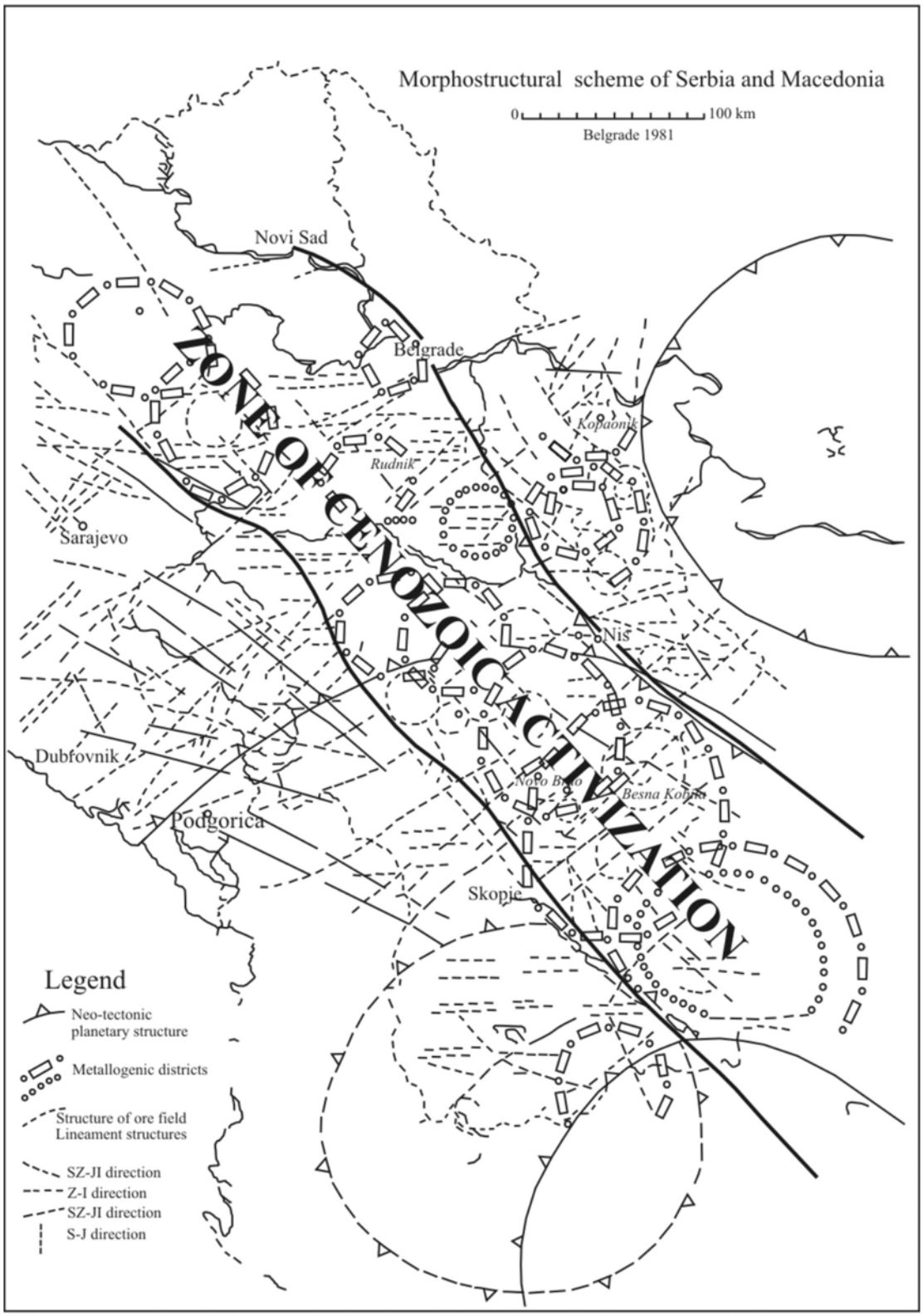

Fig. 2. Morphostructural sketch of Serbia and Macedonia (Petković et al. 1982)

The first signs of magmatic activity in the zone of Tertiary autonomous activation had already occurred at the end of the Eocene, but it is still not clear what connection they have with this zone. The magmatism culminated in the Miocene, while it gradually calmed down in the Pliocene, occasionally extending into the Quaternary. The magmatic rocks correspond to the volcanic-intrusive granodiorite complexes chemically they belong to the Ca-alkali rocks and in later phases are rich in potassium. Besides dacite-andesites, we also find trachyandesites, quartz-latites, latites, trachybasalts, trachytes and subordinate leucite roks (lamprophyric facies). The rocks are accompanied by pyroclastics, agglomerates and breccia. Tuffs are extremely rare. Intrusives of quartzdiorite, granodiorite and quartzmonconites are, in principle, synchronous with analogous volcanic rocks. Magmatic rocks are consolidated at the subvolcanic-volcanic level, in the process of which plutons are formed as "high plutons". According to more recent ideas, granites in the zone of autonomous activation were formed by metasomatic transformation of granodioritic plutons.

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 ofmagmatic 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.

SOME MORPHOSTRUCTURES RELATED TO THE CENTRAL PART OF THE SERBO-MACEDONIA MASSIF

From the general point of view the Macedonian territory have passed through the detailed geological evolution. One part of the territory of the Macedonia belongs to the SMM and Pelagonian massif as old crystaline complexes. These two complexes are divided by the riftogene Vardar zone, which has been represented by ophiolite melange and Jurassic and Cretaceous molasse sediments. Within the SMM dominate Precambrian, Riphean-Cambrian and Paleozoic rocks.

The Cenozoic tectono-magmatic activizitation happened in the eastern parts of Macedonia and has been manifested by deposited structural elements in the existing relief and occurrence of volcanogene-intrusive magmatic complexes in conditions of disseminated spreading. In frame of the newly formed structures dominate fissure zones of lineament type, riftogene zones with emphasized concentric structures of different sizes etc (Fig. 3).

Serbo-Macedonian massif as a remarkable geotectonic unit has been built of two structural-lithological complexes or more precisely two metamorphic complexes (upper and lower). Lower metamorphic complex is represented by highly metamorphic rocks such as gneiss, amphibolites followed by quartzites, marbles and migmatites. Upper metamorphic complex is lying trangresivelly over the lower complex. It is repreented by greenschist facies, where dominate chlorite, chlorite-sericite, chlorite-amphibolite and graphite schists and quartzites. These complexes were intruded by different types of granitoide intrusions during the Baikal, Caledonian, Herzinian and Alpine cycle. Metamorphic rocks represented as complex forma and cumulates have direction NW-SE and sometimes are forming submeridian flexures.

Cenozoic activization at the territory of the Republic of Macedonia enclosed the most complex geotectonic units such as Vardar zone and SMM. Its occurrence is mainly along fissures of general NW-SE direction and activated meridian cracking zones and faulting systems of general NE-SW direction. In a such conditions came to complete re-

distribution of the lineament structures network when on the main direction of Mesozoic structures NW-SE (340°) occurred fault system of the same direction but slightly different angle (320°). Later ones determined the structural plan of the area of the Cenozoic activization. The results from the satellite images and morphostructural analysis of modern relief allowed determination of three zones of similar direction, mainly NW-SE (Fig. 4).

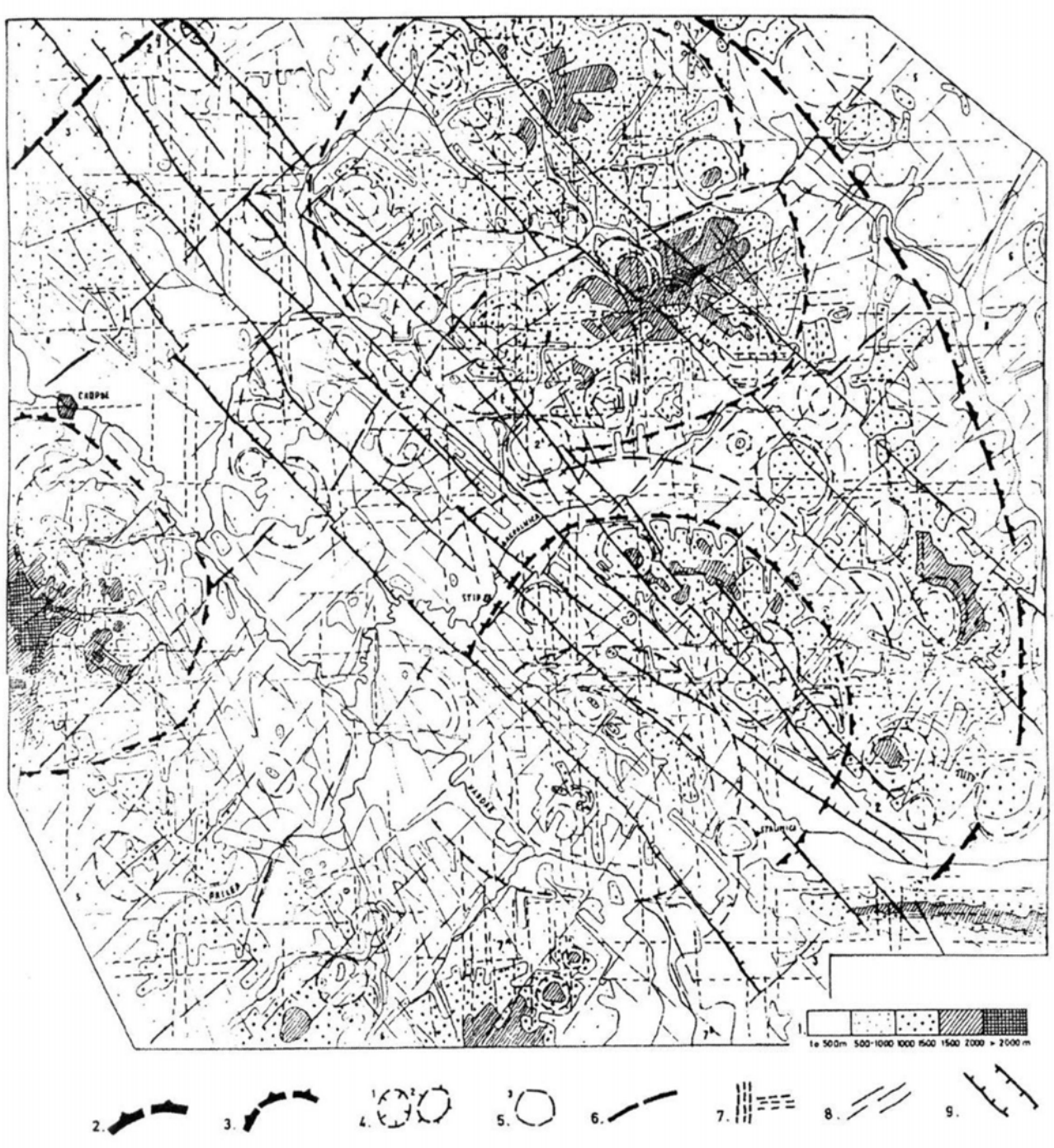

Fig. 3. Morphostructural scheme of the Eastern Macedonia
1) Height peak, 2) Boundary of Macedonian dome, 3) Boundary of local dome, 4) Boundary of concentric structures, 5) Occurences of structures by satellite images, 6) Faults, 7) Faults zone systems of ortogonal strike, 8) Zones of oblique cuts of N-W strike.

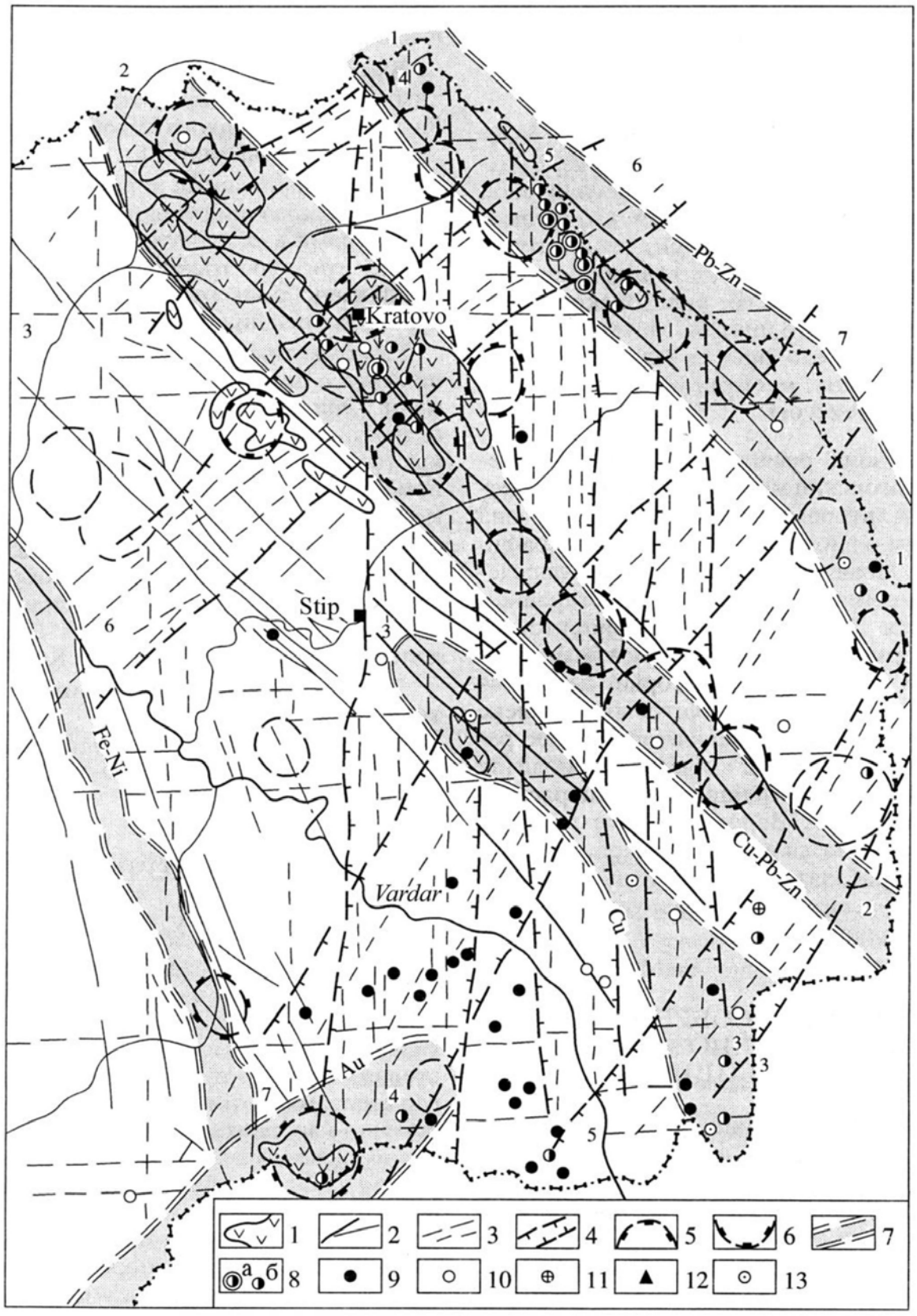

Fig. 4. Scheme of the Cenozoic metallogeny in the Eastern Macedonia
1) Cenozoic magmatic rocks, 2) Followed fissure, 3) Faults defined by satellite images and morphostructural analysis, 4) Fissure zones and cracking systems, 5) Semi-curved structures and calderas, 6) Pericline structures, 7) Metallogenetic 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

These systems practically determined the angle of graben structures, which have been filled with Cenozoic sediments. Numerous drill holes drilled in the Kocani geothermal area confirmed the composition of those graben structures. It should be pointed out that along the fissure structures, of general direction NW-SE, was localized Tertiary magmatism, also. It controled the Cenozoic metallogenetic zones (Fig. 4).

Activated cracking zones of meridian direction quite common comply with flexures directions of flexures in already formed sediments in grabens. Mainly were distinguished three crack zones, which have played an important role as ore bearing structures and localization of the ore fields and ore knots (Fig. 4).

Especial feature within these structural elements are the faulting structures with general direction NE-SW which relicts are saved up to date. They have controled seismic zones and have shown influence to the loalization of mamatic bodies and ore mineralization on places where structures of NW-SE cross cut. These types of structures are common in so called wide zones of relaxation. After the activization of Cenozoic faults followed stage of formation of pericline structures and systems of concentric structures of volcanic type. In that context were distinguished numerous volcanic calderas in frame of the Kratovo-Zletovo volcanic area. With satellite images and morphostructural analyses has been determined that within older concentric structures occurred radial fissures which have been manifested by common presence of faults with NW-SE direction (Fig. 4).

MORPHOSTRUCTURAL FEATURES OF THE BUKOVIK-KADIICA MINERALIZED SYSTEM

The Bukovik-Kadiica ore district has been located in the most eastern parts of the Besna Kobila-Osogovo-Tassos metallogenic zone (Aleksandrov, 1992) and it has been characterized by complex polymetallic mineralization. Within this ore district were determined ore body systems and intersected dykes of quartz-latites with an absolute age of 24–12 Ma. In this zone were located some ore districts while by the detailed analyses were found structures of the Osogovo polymetallic ore district, where it was confirmed that the deposits are situated on the dome's margins and their intersection and crossing with the fissures of SW meridian system and fissures of NW direction (Serafimovski et al. 1997; Janković and Serafimovski, 1997; Thompson et al. 1998). All structural elements were determined with detailed morphostructural analysis and interpretation of satellite imagery. Since earlier it was proven that the Macedonian territory had long and uninterrupted development that allows use of the tectonic elements in the field in determination of the ore controling structures.

By analogy to Osogovo, structural-geomorphological analysis helped in the study of the Bukovik-Kadiica ore district. Determination of tectonic elements in the recent relief was done by use of different set of metodologies: generalization of horizontals, study of river network, interpretation of satellite imagery etc. Relief analysis was based on the topographic map at 1 : 100 000 scale and remote prospecting materials at different scales. For eaxmple, we were using Earth Sat satellite images at scale range 15 to 50 m (step 5m) and covered area in range of 7.5 × 7.5 km to 25 × 25 km (step 2.5 km). Also, it was performed detailed desk study of some previous materials related to the area of interest.

Studied area has been located in the upper parts of the Bregalnica River, Pehcevska River and Celevica. In these water streams were formed two systems: *centrifugal* in the upper parts of Bregalnica and *centripetal* within the boundaries of the Kadiica Mountain. the northern part of the area is of mild mountain character and raises up to 1700-1900 m above the sea level, while the southern part is slightly lower with altitude of 1000–1300 m, divided by wide valley with loose direction and numerous water streams inflowing into the main water-way (Tasev et al. 2008).

From north to the east, the lower part of the area, has been surrounded by the raised arc with altitudes of 1600–1700 m. Radial and radial-centrifugal form of raised water-ways and lowered parts allowed determination of two crossed oval structures: southern one (11 × 8 km) and northern one (7.5 × 6 km). Higher points, erosion study and alluvial accummulation are pointing our to a slope-like development with characteristic valleys and slopes on the southern oval structure and raise of the northern oval structure (Fig. 5).

Intersection of the oval forms has been complicated by the ring structure 3.5 km in diameter. The central part of that structure overlaps with the

independently raised bukovik (1700 m). Around the raised area there is a depression belt, which has been articulated with the highest parts of Celevica, Pehcevska-Rakocevica river valleys. To the east, outer side of the structure has been limited by an arc raised up to 1700–1900 m.

Located group of ring structures has been located on the intersection between the two metallogenic zones: the polymetallic Besna Kobila-Osogovo-Tassos and Kožuf-Aridea (encloses Alšar deposit) with associated Pliocene mineralization.

The area of intersection is higher than earlier mentioned zones and have complex composition. According to that the Bukovik ring structure has been located within the intersection of orthogonal system of fissures determined on the linear tectonic elements of the recent relief (Serafimovski et al. 2010). Dispositions of meridian direction represented as more fractured zones were determined from the satellite imagery, while on the topographic they were shown as fine linear elements in the relief.

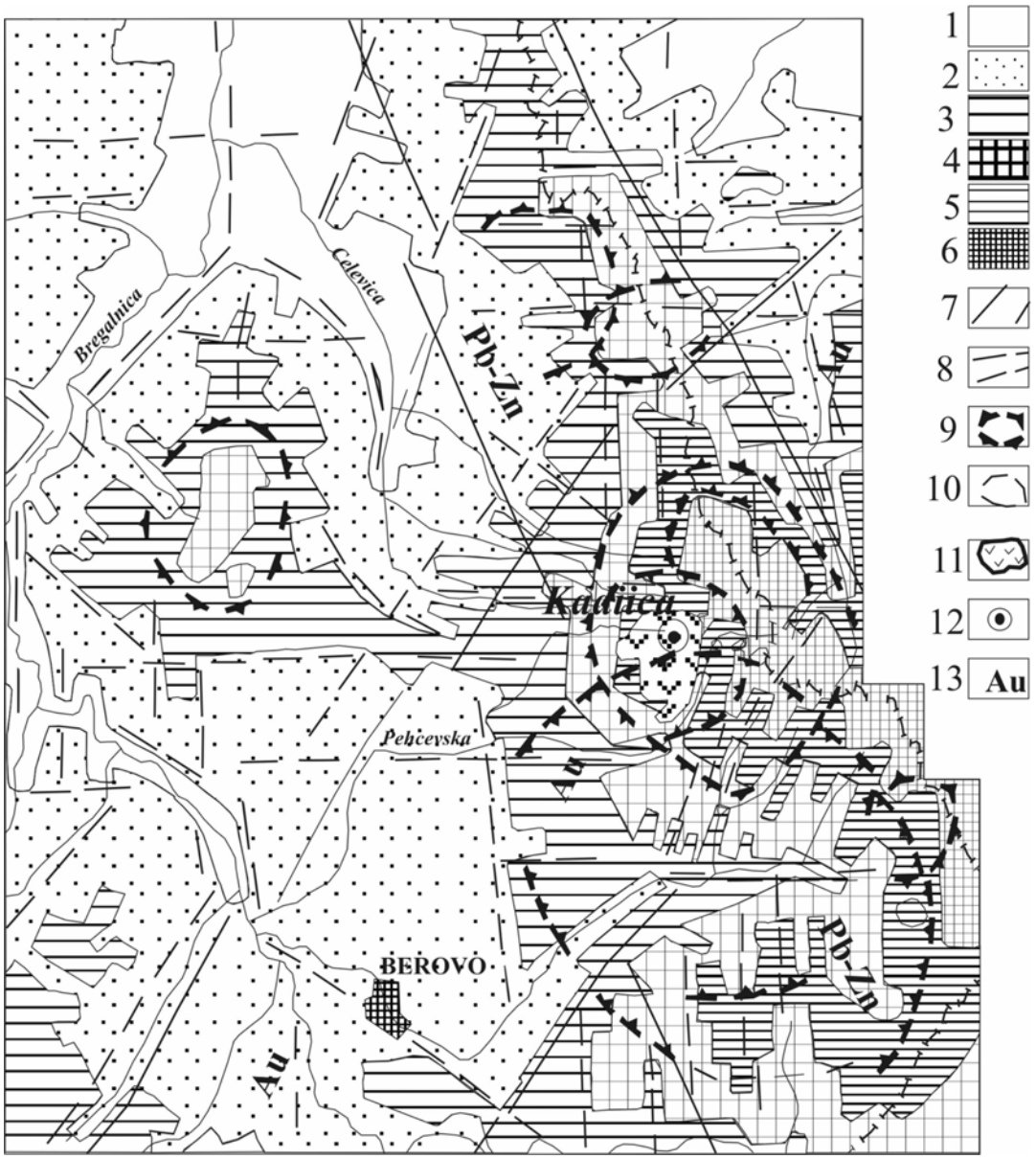

Fig. 5. Morphostructural map of the Bukovik-Kadiica area, Macedonia (Tasev et al. 2008)
1–6 – hypsometric levels (in m): 1) lower than 800 m; 2) 800–1000 m; 3) 1000–1200 m; 4) 1200–1500 m; 5) 1500–1700 m; 6) more than 1700 m; 7) metallogenetic zones, structures, ocurrences on the topographic and satellite imagery; 8.) linear dislocations; 9) concentric structures boundaries; 10) concentric dislocations; 11) pliocene volcanics manifestations; 12) Bukovik-Kadiica ore deposit; 13) specialized metallogenetic zones

These linear lineaments are directly exposed to the upright systems (articulated tectonic flatening, large water-ways curves recent graben incavations). As it has been said already, orthogonal systems run by direction and quite often are connected by the fissure zones. Within the Bukovik-Kadiica area has been detected linear zone that can be followed from Gradiska until the Kadan Bunar, in the corner of the upright Kožuf-Aridea metallogenetic zone. It is a deeply eroded zone defined by welded rectilinear valleys, which can indicate deep zones with the highest permability at the surface.

According to the field and desk study of reality in the field, satellite imagery, metallogenetic features, professional literature etc., we have concluded that morphostructural parameters of the Bukovik-Kadiica area are characterized by structures of two general directions, NW-SE and NE-SW ones. Also this study that mineralization was closely associated to the intersection knots of major structures have shown.

CONCLUSION

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).

REFERENCES

Aleksandrov M., 1992: *Metallogenetic features of the polymetallic ore field Sasa-Eastern Macedonia*. Ph. D. Thesis, Faculty of Mining and Geology in Štip, Macedonia, 264 p. (in Macedonian).

Arsovski M., Ivanov T., 1977: *Neotectonics magmatism and metallogeny on the territory of Yugoslavia. – Metallogeny and platetectonics in the NE Mediterranean*, Belgrade, pp. 471–482

Burchfiel B. C., Nakov R., Dumurdžanov N., Papanikolaou D., Tzankov T., Serafimovski T., King R. W., Kotzev V., Todosov A. and Nurce, B., 2008: Evolution and dynamics of the Cenozoic tectonics of the South Balkan extensional system, *Geosphere*; December 2008; **4**, 6, 919–938; DOI: 10.1130/GES00169.1

Dumurdžanov N., Serafimovski T. and Burchfiel B. C., 2005: Cenozoic tectonics of Macedonia and its relation to the South Balkan extensional regime. *Geosphere*, **1**, 1, 1–22,

Janković S., Petković M., Tomson I. N., Kravcov V., (1980): *Porphyry copper deposits in the Serbo-Macedonian province, Southeastern Europe*. SGA Special Publication No. 1, Janković, S. and Sillitoe, R. H. (eds.), Belgrade, p.96–102

Janković S. and Petković M., 1974: *Metallogeny and Concepts of the Geotectonic Development of Yugoslavia. Metallogeny and Concepts of the Geotectonic Development of Yugoslavia*, 443–477, Rud. geol. fak., Beograd.

Janković S., Serafimovski, T., 1997: Alpine Metallogeny of SE Europe: regional geotectonic setting and major ore deposits. *Annual General Meeting of IGCP 356 Carpatho-Balkan Metallogeny*, Glasgov University, January 8–11.

Janković S., Serafimovski, T., 1997: Specific Features of Mineralization Related to Different Tectonic Environments in the Serbo-Macedonian Metallogenic Province. *Symposium – Annual Meeting*, Proceeding-Abstract, 285–286, Dojran.

Kocneva N. T,, Romić K., Petković M., 1978: Rekonstrukcija struktura neogene aktivizacije u Srbiji i Makedoniji. *IX Kongres geologa Jugoslavije*, Sarajevo.

Petković M., 1978: *Neogene activation and its importance for the Yugoslavian metallogeny*. II Counceling for the Pb-Zn mineralizations in Yugoslava, Štip (in Serbian).

Petković M., Grubić, A. and Romić, K., 1982: The structural and metallogenic analysis of the zone of Cenozoic autonomous activation. *Symposium International Commission VII International Society for Photogrammetry and Remote Sensing*, Toulouse, Actes 2, pp. 203–208.

Serafimovski, T., 1990: *Metallogeny of the Lece-Chalkidiki zone*. Ph. D. Thesis (in Macedonian), Faculty of Mining and Geology, Štip, 380 p.

Serafimovski T., Janković S., Čifliganec V., 1995. Alpine Metallogeny and Plate Tectonics in the SW Flank of the Carpatho-Balkanides. *Geologica Macedonica*, **9**, 1, 3–14, Štip.

Serafimovski T., 1993: *Structural metallogenetic characteristics of the Lece-Chakidiki zone: Types of Mineral Depos-*

its and Distribution). Special edition of RGF Štip, No 1, 328 pgs. With extended summary in English, Štip,

Serafimovski T., Tomson, I. N., Kochneva, N. T., 1997: Alpine orogenic structures and metallogeny in the Serbo-Macedonian massif and the Vardar zone of the territory of Macedonia. *Symposium-Annual Meeting*, Proceeding 113–117, Dojran.

Serafimovski T., Jelenković, R., 1998: Principle metallogenic units in the SW part of the Carpatho-Balkanides: Geotectonic setting and metallogenic features. *XVI Congress of the Carpathian-Balkan geological Association*, Vien, Austria.

Serafimovski, T., Blažev, K., Tasev, G. and Volkov, A., 2010: Relationship between Cenozoic structures and polymetallic mineralizations in the central part of the Serbo-Macedonian massif. *XIX Congress of the Carpathian-Balkan Geological Association*, Abstracts Volume (eds. Chatzipetros, A., Melfos, V., Marchev, P. and Lakova, I. – *Special Issue of Geologica Balcanica*), Thessaloniki, Greece, pp. 356–357.

Tasev G., Serafimovski, T., Volkov, A. and T. Kochneva, N., 2008: Morphostructural features of the ore zone Bukovik-Kadiica, R. Macedonia. *First Congress of geologists of the Republic of Macedonia*, Proceeding book, pp.201–206 (in Macedonian).

Tomson I. N., Serafimovski T. and Kochneva N., 1998a: Cenozoic metallogeny in Eastern Macedonia. *Geology of ore deposits*, **40**, 3, 195–204 (in Russian).

Tomson N. I., Serafimovski, T., Kochneva, T. N. and Stojanov, R., 2004: New structural background and relation between the Cenozoic structural and metallogenic zones in the Republic of Macedonia. *Geologica Macedonica*, **18**, pp. 1–6, Štip.

Р е з и м е

ГЛАВНИТЕ АЛПИСКИ СТРУКТУРИ И Cu-ПОРФИРСКА МИНЕРАЛИЗАЦИЈА ВО СРПСКО-МАКЕДОНСКИОТ МАСИВ

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Клучни зборови: Српско-Македонски масив; морфоструктури; Кенозојска активизација; полиметалични минерализации; рудни системи

Геодинамичката еволуција на Српско-Македонскиот масив може да се разгледува во неколку геолошки и геотектонски епохи, но многу специфична е Кенозојската еволуција геодинамички, геотектонски, структурен, магматски и металогенетски аспект. Кенозојските лонгитудинални структури се длабоки и претставуваат граница кон Вардарската зона од една страна и Струма зоната од друга страна.

Морфоструктурните формии од различен ранг и интензитет се од големо значење за просторната дистрибуција на рудната минерализација (Pb-Zn-Cu рудна област Кратово-Злетово, Cu-Au-Fe рудна област Бучим-Дамјан, рудоносен систем Cu-Au-Ag-Fe Буковик-Кадиица и др.). Доминантни структури во рамките на Српско-Македонскиот масив се оние со правец СЗ-ЈИ, кои служеле како рудоносни системи, исто така (рудна зона Бесна Кобила-Осогово-Тасос и металогенетска зона Леце-Халкидики).