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NOTES ON THE METALLOGENY OF THE BANATE-SRENDNOGORIE ZONE

P. Popov

ABSTRACT

The Banate-Srednogorie metallogenic zone comprises a part of the Southern Carpathians and the Balkanides. It is characterized by the development of an Upper Cretaceous volcano-plutonic complex, including calcium-alkaline, tholeite, subalkaline and alkaline rocks included in it. A formation of different types endogenous ore deposits, with a dominated by copper ones, is related to the magmatism. Skarn polymetallic-iron, copper and molybdenum-tungsten, hydrothermal massive copper-sulphide, porphyry-copper, basemelallic copper, sulphide-barite, quartz-gold, manganese and other types of deposits are differentiated. The zone was formed during the pre-orogenic stage of the Alpides development in a rifting regime.

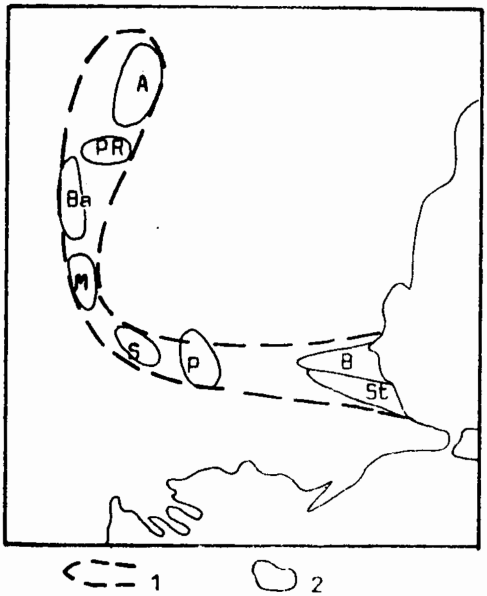

Fig. 1: Position of the Banat-Srednogorie zone on the Balkan peninsula.
1 - boundary of the zone; 2 - boundary of the ore regions: b - Burgas, St - Strandza, P - Panagjuriste, S - Sofia, M - Bor-Majdanpec, Ba - Banat, PR - Poyana Rusca, A - Apiseni ore regions.

INTRODUCTION

The Banate-Srednogorie metallogenic zone includes the territory of the homonymous Upper Cretaceous volcano-plutonic belt. It is an isolated arcuated structural zone with length of about 1000 km and width from 30 - 40 to 100 - 120 km. The zone is traced from the Apusenians to the South Carpathians and the Timok region, then it curves, comprises the Bulgarian Srednogorie and enters the Black Sea (fig. 1).

TYPE OF THE UPPER CRETACEOUS MAGMATISM

The Upper Cretaceous magmatic activity began in the Cenomanian and completed in the beginning of the Paleogene. The Cenomanian volcanism was displayed in the Timok region and partially in the Eastern Balkan Mountains, where it continued even during the Turonian. The Turonian volcanism was very intensive in the Timok region, and it was spread even to the north,

University of Mining end Geology, 1156 Sofia,Boulgaria

in the Voevodina region. The main mass magmatic rocks was formed during the Cenomanian. From Voevodina including to the Central Srednogorie this was realized mainly during the Lower Cenonian, in the Eastern Srednogorie - mainly during the Campanian, and in the South Carpathians and Apusenians - during the Maestrichtian.

On the basis of petrochemical data analysis Popov [1981] established the development of rock complexes of the calcium-alkaline, tholeite, subalkaline and alkaline series. The rocks of calcium-alkaline series are developed almost along the whole length of the zone. In some structures they reveal transitional features towards tholeite or subalkaline series (mainly more basic members). The volcanic rocks are related to the rhyolite-andesite formation, which is represented mainly of andesites, dacites and rhyolites, rarely high-allumimium basalts. The subvolcaniic intrusives are widely developed. The hypoabyssal intrusives are related to the gabbro-diorite-granodiorite formation. It is represented of gabbro, gabbro-diorite, diorites, quartz diorites, granodiorites and granites. Diorites and granodiorites are most widely spread.

The rocks of tholeite series are developed mainly in the Eastern and partially in the Western Srednogorie. Separate aggregations are very often of transitional character, probably because of the hybridism. The volcanic rocks are related to the andesite-basalt formation, represented of basalts, andesitobasalts, rarely andesites and as an exception of more acidic rocks. The intrusive rocks are specified as gabbro-diorite formation, composed of gabbro, quartz gabbro, gabbro-norites, gabbro-diorites, diorites and quartz-diorites, rarely pyroxenites.

The rocks of the subvolcanic series are developed almost along the whole length of the Banate-Srednogorie zone. Their spreading is more significant in the Western Srednogorie, and they prevail in the section of the volcanogenic complex in the Eastern Srednogorie. The volcanic rocks are related to a trachyandesite - trachybasalt formation. It is represented of alkaline olivine basalts, trachybasalts, trachyandesites, latites, trachytes to alkaline or quartz alkaline trachytes. Tephrites, phonotephrites, picrite-basalts, mugearites, melalites, melatrachytes etc. are seldom established. Intrusive rocks are represented as gabbro, quartz-gabbro, monzogabbro, monzodiorites, syenites to alkaline quartz syenites, and sometimes-essexites. Syenites and monzosyenites are prevailing.

The rocks of alkaline series are widely developed only in the northern parts of the Eastern Srednogorie, but they are also established as small bodies along the Ridansko-Krepolinski fault. Basic members are usually relatively poor with regard silicic dioxide, while the acidic members are represented of saturated rocks. The volcanic rocks are separated in a tephrite - trachyte formation, composed of tephrites, basanites, tephriphonolites, phonolites and alkaline trachytes and seldom trachybasalts, latites and trachytes. Referring the hypoabyssal intrusive bodies to the co-magmatic teralite-syenite formation has not yet been cleared out.

CEOTECTONIC CHARACTERISTIC

The position of the Banate-Srednogorie zone in the Alpides is an interesting one. The magmatism was determined as subsequent (Stille, 1940), orthogeosinclinal (Dimitrov, 1955), preorogenic (Popov, 1972), inversional (Dimitrovam et al., 1975) etc. A number of authors interpret the volcanic belt as an island arc or active continental edge. Other authors, form different points of view, consider this zone a paleorift structure (Antonijevic et al, 1974; Boncev, 1976; Ivanov, 1979; Grubic, 1980; Popov, 1981, 1987).

The Banate-Srednogorie zone occurs over the northern parts of the Trachia massif and the eastern parts of the Panonia massif, characterized by a continental type earth crust. A greater part of this foundation was treated during the Caledonian and Hercynian. Pre-upper-cretaceous Mesozoic terrigenic, terrigenic-carbonate and carbonate formations were deformated tectonically during the Early Kimmerian and Austrian phases.

The Banate-Srednogorie zone occurs discordantly on older structures, including the Austrian ones. This is a mark of the beginning of a new, qualitatively different stage in the development of the Alpides. Riftogenenic processes dominate in the zone during this period. The Upper Cretaceous volcanogenic and sediment rocks of thickness from 2-3 to 7-8 km were deposited in it, while in the neighbouring areas there was thin shallow sedimentation, and a part of it - on the dry land. Three stages of development of the zone are differentiated. A linear depression of terrigenic-coal and flishc-flischide sedimentation has taken place during the first stage (Cenomanian, Turonian). The second stage is characterized by a rift-formation during multi-lateral tangential stretching, total tearing of the earth crust and intensive effusive and intrusive magmatism combined with tephroid a flisch-formating. The third stage (Maestrichtian or Maestrichtian-Paleocene) is typical with the argillaceous-carbonate and flisch-flischoid sedimentation and almost complete absence of volcanism. The effusive activity is combined with molasse sedimentation in north-western regions.

A number of volcano-tectonic depressions and grabens are formed as a result of the magmatic activity. These are the sections with most intensive volcanic activity and most significant subsiding as the Bourgas depression and the Westsregnogorie depression, the Timok graben, the Panaguirishte graben and the Chelopech graben etc. Four types magmatic structures are formed: volcano-subvolnic, volcano-plutonic, plutonic and dike-like. Volcano-subvolanic structures are developed in sections with stable, faulted foundation and comparatively not thick volcanic complex, and volcano-plutonic structures are typical for volcano-tectonic depressions. Individual plutonic structures are developed mainly in the rocks of the foundation, and the dike-like structures are established very seldom.

Determining the character of geodynamic regime we should mention that rock aggregations composing separate magmatic structures show differentiation of magma formed at different depth. Such kind of magmatic rock associations are not typical for island arcs, active continental edges and continental rifts neither for orogenic zones. The lateral migration of magmatic activity to the eastern part of the zone is directed towards north, and in western parts - towards south or west. This does not enable linking of the magmatism with a subduction from northeast or southwest. A tendency of magmatism alkalization during later stage is established, which reveals sinking of the magma-generating cameras.

The metamorphic belts, typical for the subduction zones are not established, and the intensity of post-magmatic tectonic deformations is comparatively low. The arcuated , branching form of the zone, the linear, often telescoped longitudinal hypoabyssal and subvolcanic intrusives as well as the numerous horsts and grabens of higher order show the prevalence of stretching tensions.

A number of positive gravity and magnetic anomalies, differing the zone sharply from the neighbour crust blocks are established along its whole length. Evidently, there is a mantle diapirism and crust basification, connected with the stretching. Formation of the zone is preceded and accompanied with atypical orogenesis, conjugated with the diapirism.

Peculiarities pointed out show that the Banate-Srednogorie volcanic belt originated and developed as a result of riftogeneous processes, conjugated with asteospheric diapirism. These processes of regional stretching and fiftogenesis are realized during the preorogenic stages of the evolution of the alpides. Tectonic deformations of tangential compaction are realized in separate periods and regions on the background of the prevailing stretching. The development of the zone as an individual tectonic unit completes with an expressive Laramian tectonogenesis.

TYPES OF ORE DEPOSITS

The metallogenic peculiarities of the Banate-Srednogorie zone are determined by ore deposits, genetically or paragenetically connected with Upper Cretaceous magmatism. First attempts for generalizing the metallogenic characteristics of the Banate-Srednogorie zone are done by Petrascheck, Kostov, S. Dimitrov, Iovchev, R. Dimitrov and D. Dimitrov. Recently Bogdanov, Popov, Borcos, Cioflica, Jankovic, Karamata drew attention on some aspects of this topic and point out the copper-metallogenic specialization are the ore manifestations of polymetallic, iron-ore, rare-metal and gold mineralizations are in subordinated quantity.

The first systematycs of the different type of ore deposits (ore formations) in the discussed zone, done by Bogdanov et al (1970) has been improved and expanded. Vassileff (1982) proposed a classification on the base of metallic-formations. Ore deposits of different type form a uniform multi-component (iron-gold-polymetallic-copper) ore complex, the which formation is closely related to the Upper Cretaceous magmatic activity. Fourteen types ore deposits can be differentiated: ilmenite-titanomagnetiteous, skarn polymetallic-ferrous, skarn cupreous, skarn molybdenite-scheeliteous, copper-pyriteous, copper-porphyriticy, vein polymetallic-cupreous, argentous-polymetallic, quartz-auric, listwanite-auric, quartz-antimony, sulphide-barite, pyrolusite-psilomelaneous and stratiformy-cupreous.

Ilmenite-titanomagnetiteous mineralizations are established at Velikovetz (Strandga) where a lense-like body of early magmatic magnetite, ilmenite, titanomagnetite etc. is developed.

Skarn polymetallic-ferrous mineralizations are established in the ore field Boksha (South Carpathians) [Cioflica, Vlad, 1974]. Skarns and ore mineralizations are developed near the contact between the granodioritic intrusive and the carbonate Mesozoic rocks. They are spread as interrupted stripes of irregular, cylindrical, seldom layer-like

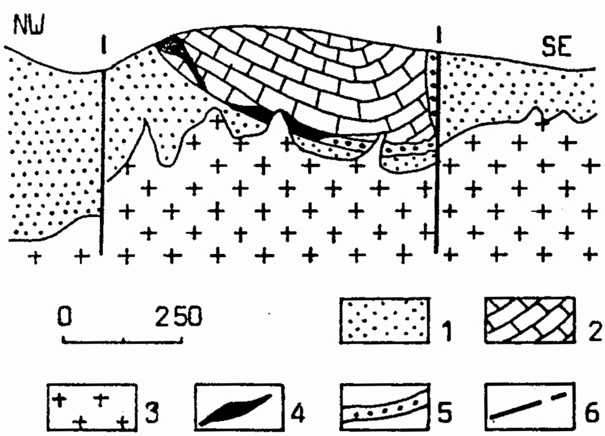

Fig. 2: Cross-section of the Dognecea ore deposit (acc. Cioflica and Vlad, (1974)
1 - Metamorphic rocks; 2 - Mesozoic carbonatic rocks; 3 - Upper cretaceous pluton; 4 - Magnesion skarns with Pb-zn ores; 5 - Calcic skarns with Fe ores; 6 - Fault.

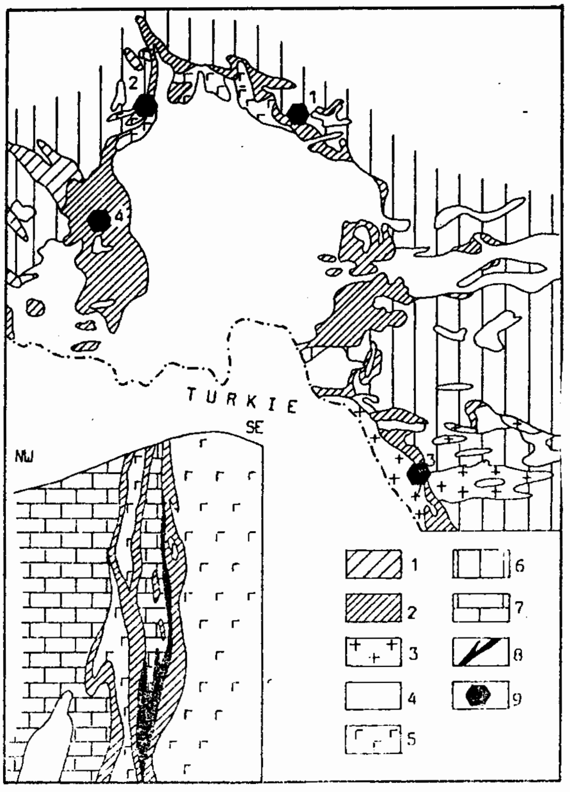

Fig. 3: Geological sketch of the Malko Tarnovo ore district and cross-section of Propada ore deposit. 1 - hornfelses; 2 - skarns; 3 - granites and granite-porphyres; 4 - diorites; 5 - gabbro; 6 - metamorphic rocks; 7 - marbles; 8 - ore body; 9 - ore deposits: 1 - Mladenovo, 2 - Propada, 3 - Bardtze, 4 - Gradishte.

bodies or metasomatic veins. Tow economical deposits are known. The northern one (Okna de Fier) is presented by a ferrous (magnetiteous) mineralization, and the southern one (Dognecea) - by polymetallic ores. The ferrous mineralization associated with garnet skarns, and the lead-zinc mineralization - with pyroxene ones (Fig. 2). The deposits Krumovo, Dryanovo (Monastiry Hills, Bulgaria), Valya Saka and Ridan (Eastern Serbia) are of this type.

Skarn cupreous deposits are of wide spreading. They are represented in the Strandga mountain (Malko Tarnovo ore field) (Fig. 3), in the Banate mountains (Moldova Nova, Oravitza, Saska Montana etc.) and in the Apusenians (Baisoara). They associate with hypoabyssal to subvolcanic intrusives of diorite-granodiorite composition. They are presented of approximately isometric joined bodies (Malko Tarnovo) or of linearly prolonged sheet-like bodies intruded in regional faults. Ore bodies are allocated along the exocontracts with intrusives, in the xenoliths of carbonates rocks, in the sections of wedging of intrusives and along the magma-conducting faults. Mineralizations of copper porphyry type (Malko Tarnovo, Moldova Noua, Oravitza etc.) are developed also in some deposits. Quartz-molybdenum veins are also developed (Malko Tarnovo ore field).

Skarn molybdenite-scheeliteous deposits are allocated in the ore field Baita-Bihorului (Apusenians) (Fig. 4). According to Cioflica and Vlad (1974) skarns and ore mineralization are developed in the over-intrusive zone of a granitoid pluton. They are allocated along the braccia contacts of lamprophyric and subvolcanic andesite dikes, in the sections of fault crossing and along the length of the regional faults. Two types of skarns can be divided - the first is early spinel-forsterite skarns and late, calcium and manganese skarns. The ore mineralization bears not only molybdenum and tungsten, but also bismuth, boron, copper, lead and zinc.

Copper-pyriteous deposits are very typical for the metallogenic characteristic of the Banate-Srednogorie zone. They are developed in the Timok district in Eastern Serbia (Bor, Lipa, Choka Marin) (Fig. 5) and in the Panaguirishte district of the Central Srednogorie (Chelopech, Elshitza, Radka, Krasen) (Fig. 6). The ore mineralization is in breccia effusive rocks around contacts with subvolcanic massifs, intruded in the central or periphery parts of strongly

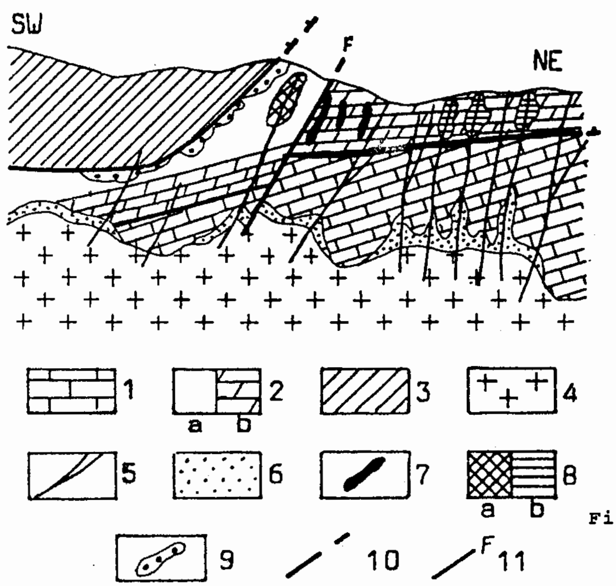

Fig. 4: Cross-section of the Baita Bihorului ore deposit (acc. Cioflica and Vlad, (1973).
1 - Baremian limestones; 2 - Norian limestones (a) and Carnian dolomites (b); 3 - Permian; 4 - Upper cretaceous pluton; 5 - Upper cretaceous dykes; 6 - magnesian and calcic skarns along the contact of the pluton; 7 - magnesian skarn with Cu-W-Bi ores; 8 - calcic skarn with Mo-Bi ores (a) and magnesian skarns with Cu and B ores; 9 - calcic skarns with Mo-Bi ores; 10 - overthrust; 11 - fault.

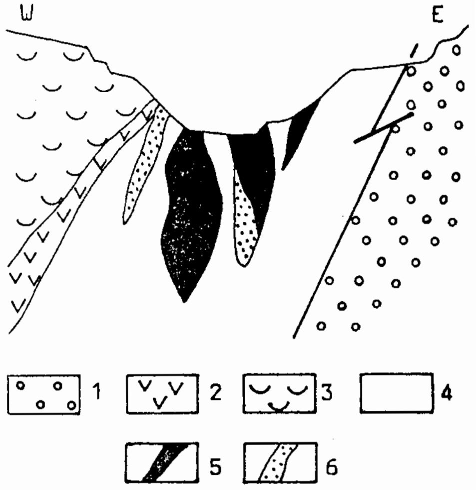

Fig. 5: Cross-section of the Bor copper deposit (acc. M. zikic).
1 - conglomerates; 2 - subvolcaniv andesite; 3 - pyroclastic rocks; 4 - andesite with chloritization or kaolinitization; 5 - massive sulfide ore body; 6 - impregnated ore body.

faulted volcanic structures. The ore bodies are with massive to vein mineralization and boss-like, lense-like, pipe-like and mount-like shape. Vein-like ore bodies (Vozdol) are typical for the periphery of the ore fields.

Porphyry-copper ore deposits are the greatest bearers of economic copper ores. They are allocated mainly in the Timok district (Maidanpek, Veliki Krivel) (Fig. 7) and in the Panaguirishte district (Medet, Assarel, Elatzite, Vlaikov Vrah, Tzar Asen) (Fig. 8, 9), where they associate with the deposits of the copper-pyrite formation. Relatively smaller deposits of this type are established also in the regions of the Sveti Iliya heights (Prohorovo) and Sofia district (Plana). Furthermore, as it has already been mentioned, these mineralizations are met in association with skarn-copper ore deposits in Strandga and Banate mountains. Intrusive bodies, they are connected with, are in some cases intruded in the rocks of the foundation, and in other cases - in the effusive rocks. There are hypoabyssal intrusives (Medet, Prohorovo, Plana), large subvolcanic bodies (Maidanpek) or series of dikes and apophises (Elatzite).

Veiny polymetallic-cupreous deposits are developed in the Bourgas district (Rosen, Varly Bryag, Zidarovo and Tamarino ore fields) (Fig. 10, 11). Their spatial position is controlled by the volcano-plutonic structures of central type. The ore veins (copper, molybdenum-copper, bismuth-copper and gold-basemental composition) are located mainly in reactivated radial or concentric

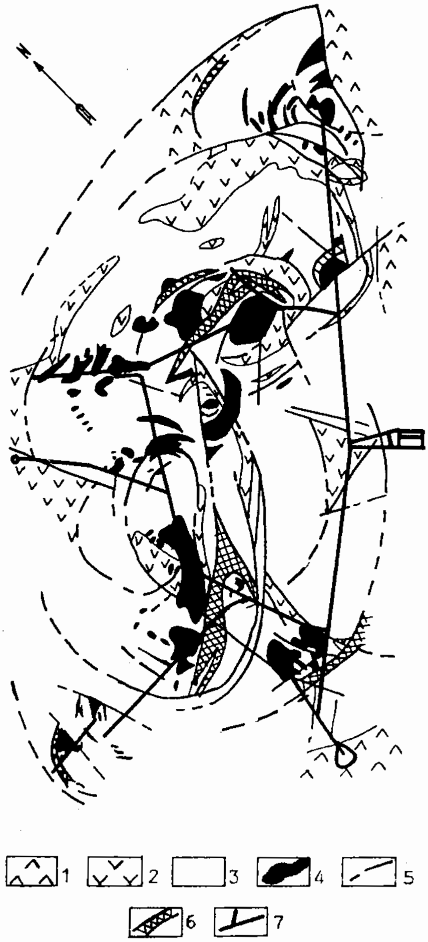

Fig. 6: Underground geological plan of the Chelopech ore deposit.
1 - subvolcanic andesites; 2 - neck andesites; 3 - effusive andesites; 4 - ore body; 5 - foult; 6 - tectonic breccia; 7 - galleries.

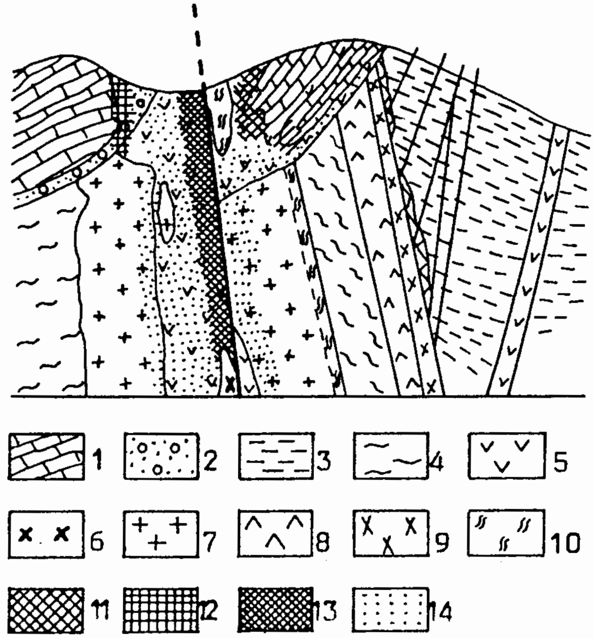

Fig. 7: Cross-section of the Majdanpec deposit (acc. Spasov and Milivojevic).
1 - Upper Jurassic limestones; 2 - Lower-Middle Jurassic conglomerates and sandstones; 3 - Rifean-Cambrian phyllites and schists; 4 - Proterozoic gneisses and amphibolites; 5 - Upper Cretaceous andesites and dacite; 6 -quartz-diorite porphirites; 7 - Younger Paleozoic graniroid gneisses; 8 - metadiabases; 9 - metasienites; 10 - serpentinites; 11 - garnet-magnetite skarns; 12 - massive sulphide pyrite bodies; 13 - ore stockwerk; 14 - vein-impregnation mineralization.

volcano-tectonic faults, in which pre-ore subvolcanic or post-intrusive dikes are intruded.

Sulphide-barite mineralizations are established in the Stara zagora deposit. A stock body, located in a subvolcanic andesite massif, intruded in the Senonian volcanogenic-sedimentary rocks. The andesites in the apical parts of the intrusive are intensively brecciated as a result of blasting processes. The barite mineralization cements the explosive breccia and there is an intensive pyrite mineralization in the flank and the depth of the deposit.

Argentous-polymetallic mineralizations are represented in the small Kuchaina and Antina Chuka deposits, to the south of the town of Kuchevo (Eastern Serbia). Ore veins are developed around the troat parts of small volcanic structures, cutting the Mesozoic limestones.

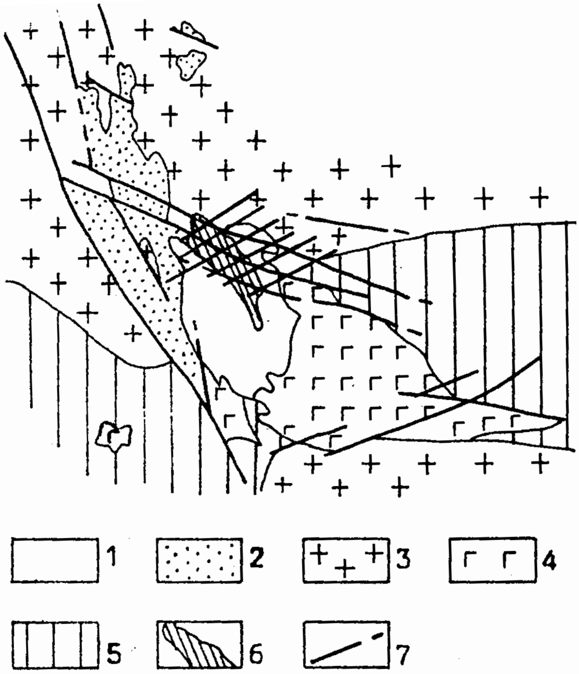

Fig. 8: Geological sketch of the Medet deposit.
1 - granodiorites; 2 - quartz-monzonites; 3 - paleozoic granites; 4 - paleozoic gabbro; 5 - proterozoic gneisses; 6 - ore stockwerk; 7 - foult.

Listwanite-gold mineralization is represented only in the ore-show Fik, positoned to the south of Kuchevo. Listwanites are developed over the Paleozoic ultrabasites, that are in contact with Mesozoic limestones. They are cut by dike andesite bodies and porphyry gold mineralization was found in the listwanites. Listwanites themselves can be used as decoration stones.

Quartz-gold deposits are poorly investigated. These are the deposits Blagoev kamen and Zlache, situated at the western periphery of the Maidanpek ore field. They are represented of quartz-scheelite, quartz-scheelite-auric and quartz-auric veins, that cut the Paleozoic metamorphoses near to the Upper Cretaceous subvolcanic bodies. Quartz-gold veins are established among the Upper Cretaceous volcanoes in Elhovo district and in the rocks of the Granitovo pluton. Their formational affiliation cannot be determined up to now. Possibly, the gold-polymetal ore veins in the Etropole Balkan mountain, developed as an aureoles around the porphyry-copper deposit Elatzite, can be related to this type deposits.

Quartz-antimony mineralizations are established up to now as ore veins in the deposit Osanitza in Eastern Serbia.

Pyrolusite-psilomelaneous mineralizations are represented in the Pojarevo deposit (Sofia district) and in a number of ore-shows. They are

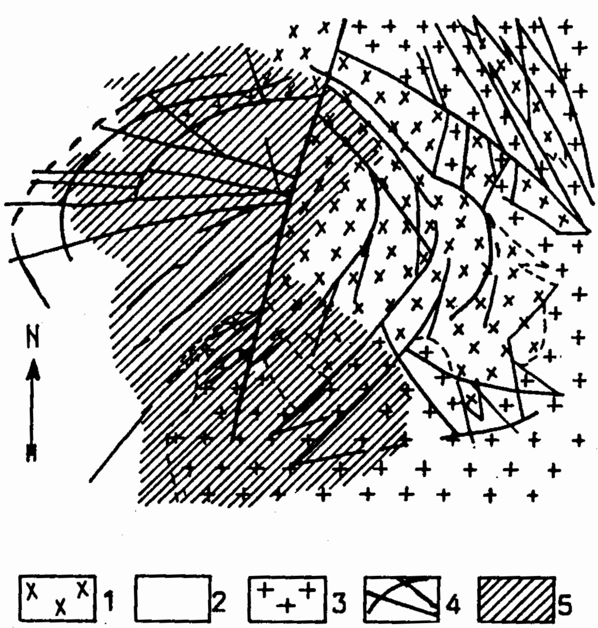

Fig. 9: Geological plan of the Assarel deposit.
1 - granodiorite porphirites; 2 - andesites; 3 - Paleozoic granites; 4 - foult; 5 - ore stockwerk.

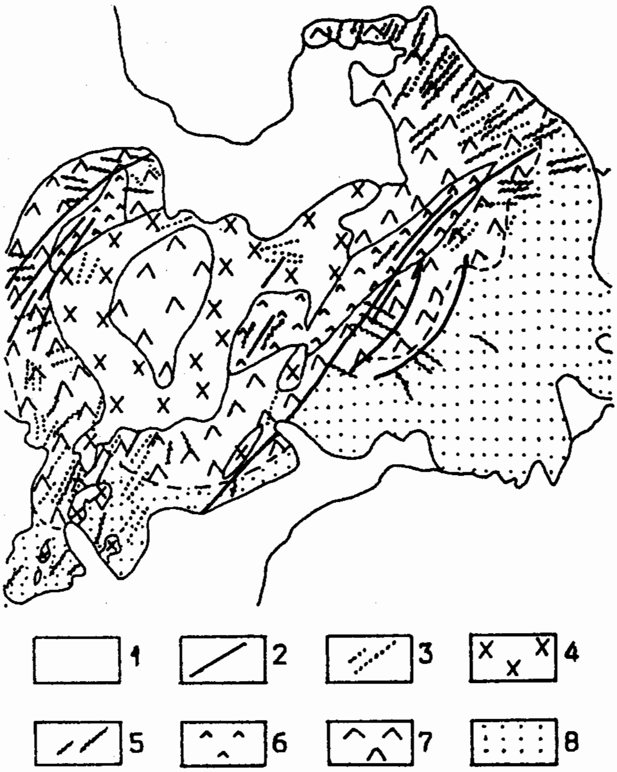

Fig. 10: Geological sketch of the Varly Bryag ore field.
1 - Tertiary sediments; 2 - foult with ore veins; 3 - postintrusive dykes; 4 - Upper Cretaceous intrusive; 5 - subvolcanic dykes; 6 - neck trachyandesites; 7 - trachyandesites; 8 - tuffs.

characterized with layered, volcanogenic-sedimentary orebodies, positioned in the most upper levels of the sedimentary-volcanogenic complex. Ore mineralizations around faults, that had been conductors of hydrotherms, are also presenting.

Sratiformy copper mineralizations are established in Eastern Serbia (Reshkovitza, Vavilo). They are presented of layered ore bodies in the sandstones of the Triassic and Permian.

The lower chronous boundary of the mineralization, typical for almost all types deposits is distinguish, because in most cases it is located completely or partially in the Upper Cretaceous volcanic or intrusive rocks. Several gold veins (Blagoev Kamen, Elatzite) have nor direct relations with these magmatic rocks.

The upper chronous boundary of the mineralization is not expressed very well at some places. This problem is solved unambiguously for magmatic and skarn deposits. The data available allow certain conclusions for the hydrothermal deposits. Fault movements typical for the Laramian deformations took place after the ore-formation in the Bourgas district, therefore, the mineralization is Upper Cretaceous. Analogical relationship is established also in the copper-pyrite and porphyry-copper deposits of the Panaguirishte district. The upper boundary of the ore-formation is rather clearly marked in the Chelopech deposit. Orebody bits in the rocks of final volcanic eruptions are established there. Even more, throat rocks of these eruptions cross the orebodies. Similar oreclasts are established in the base of postvolcanic sedimentary rocks and in other sections of Panaguirishte district.

Oreclasts could be found often in the agglomerate and blocky-agglomerate tuffs of the Timok district, in the Eastern and Western Srednogorie. That shows the existence of early ore-forming processes; synchronous with the eruption activity.

The upper chronous boundary of ore mineralizations is marked also by the position of volcanogenic-sedimentary manganese mineralizations. They occur as a rule in tuffaceous depositions of the most upper levels of the volcanogenic complex and are covered by post-volcanic and post-ore argillaceous-calcareous rocks of the Maestrichtian and Campanian - Maestrichtian ages.

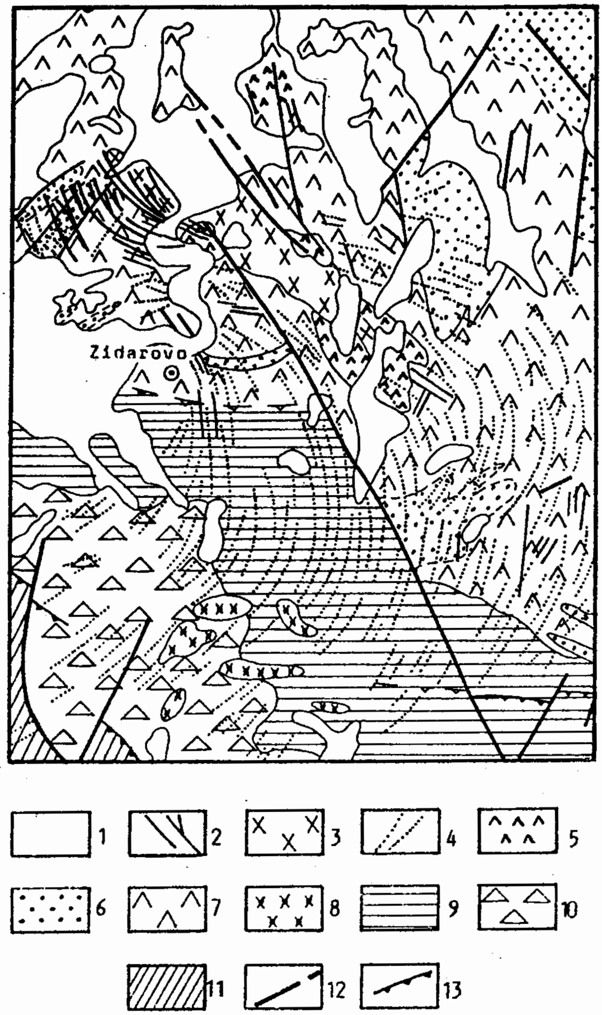

Fig. 11: Geological sketch of the zidarovo ore field.
1 - Tertiary sediments; 2 - ore veins; 3 - Upper Cretaceous intrusive; 4 - subvolcanic dykes; 5 - neck trachyandesites; 6 - tuffs; 7 - trachyandesites and trachybaslts; 8 - monzodiorites; 9 - tuffs and tuffites; 10 - olistostrome; 11 - Touronian sediments; 12 - foult; 13 - nappes.

Determinations of absolute age of ore mineralization are comparatively insufficient (Amov et al., 1974, 1979; Chipchakova, Lilov, 1976). They reveal an age that in general is analogical to the age according to geological data. The analyses show a greater age in some determinations, connected with the mobilization of metal from older mineralization.

A certain relation between different ore formations and serial or formational affiliation of associating rocks was noticed by Popov (1981) and Vassileff, Stanisheva-Vassileva (1981). This relation characterizes, to a certain extend, the metallogenic specialization of magmatism. The most variable ore formations and the largest ore deposits, with regard economic significance, are related to rocks of calcic-alkaline series. Copper-pyrite, argentous-polymetalic and porphyry copper deposits associate with the volcanites. With the increase of rock alkality there is an increase of gold content. Porphyry-copper deposits are developed in these complexes. Skarn polymetalic-ferrous copper and molybdenite-tungsten deposits and hydrothermal porphyry-copper mineralizations associate with hypoabyssal intrusives. Porphyry-copper ores are enriched with molybdenum and other rare metals when the alaklity is increased.

Rocks of the tholeits series show a certain ferrous metallogenic specialization determined by associating with them skarn magnetite deposits and titanomagnetite mineralizations.

The subalkaline series also show a comparatively distinguish metallogenic specialization. Rocks of this series associate with deposits of vein polymetalic-copper ores. The ore is enriched with molybdenum, cobalt, uranium etc. in the complexes showing transition to alkaline series.

Economic mineralizations have not been established in the alkaline series. Only oxidized copper mineralizations as well as tuffaceous layers enriched with zeolites have been observed.

The fact that the Bante-Srednogorie metallogenic zone is thrusted over different older structures and different earth crust blocks, as well as the uneven degree of dissolving of the riftogeneous structure and the depth of magma-generation, determine the specification of regions with specific magma-tectonic and structural-metallogenic peculiarities. They practically define the boundaries complicated magmo-tectonic complexes and separate magmogenic structures, that respectively define the position of ore knots and ore fields are differentiated. Location of these knots and fields is, to a certain extend, controlled by the network of faults of first, second and third order. Peculiarities pointed out show that the distribution of ore deposits in the zone subordinated to a clear knot zonality. On the basis of geological and structural peculiarities and the type of ore deposit development the following ore regions can be differentiated in the Banate-Srednogorie metallogenic zone from East to West: Bourgas, Strandga, Panaguirishte, Sofia, Bor, Maidanpek, Banate, Poyana Ruski and Apusenians.

GEOTECTONIC AND STRUCTURAL CONDITIONS OF THE FORMATION OF UPPER CRETACEOUS MINERALIZATIONS

The data pointed out reveal that endogenous ore deposits are formed mainly in the zones of high geodynamic activity with deep occurrence in the tectonosphere and intensive flow of substance and energy. These zones are developed mainly along the boundaries of the lithospheric plates or between the large earth crust blocks. The mantle diapirism determines the origination of intensive positive thermal anomaly, i. e. the existence of high energetic potential allowing the ore formation. Existence of high thermal flow is facilitated of the comparatively high thermal conductivity of magmatic and metamorphic rocks of the foundation as well as of its fault-block separation that supports the convection.

Local positive geothermal anomalies are determining for the formation of particular ore fields. Positive anomalies originate in the boundaries of magmogenic structures, where side by side with magma melts an immense quantity of thermal energy is convected. Similar anomalies are formed also around the highly permeable sections of large faults , where intensive thermal convection is realized. These processes are intensified by a number of physical and chemical effects - a result of ore-bearing fluids movement among embedding strata and reactions with them. Stable dynamic thermal fluid conductors, controlling the spatial development of ore deposits are formed as a result.

Three main structural types of ore-magmatic systems, in which the main types deposits are formed, could be divided: Plutonic, volcano-plutonic and volcano-subvolcanic.

The plutonic ore-magmatic systems are developed in connection with individual hypabyssal intrusives, that as a rule are intruded in the rocks of the Pre-Upper Cretaceous foundation. The hydrodynamic link with the surface is weak, and the overlay of the system is relatively high. Different skarn deposits are formed and rarely self-magmatic or porphyry-copper mineralizations. They are typical mainly for the Strandga and Banate ore regions, where the thickness of the effusive complex is comparatively low. Three stages of the development of these systems could be differentiated: intrusive, late intrusive (contact-metasomatic) and post-magmatic (hydrothermal).

The intrusive stage is characterized by the formation of polyphase, stock-like to sheet-like intrusives. In some of the basic cappings self-magmatic ilmenite-titanomagnetite mineralizations are formed, and in the contact zones - ferrous magnesium skarns of lense-like or mount-like shape are formed.

The late intrusive stage is characterized by the formation of calcic skarns in the contacts with marbles and limestones. In separate sections accumulation of magnetite, associating with ilmenite and titanite is realized.

The post-magmatic stage is characterized with the formation of quartz-calcic-feldspar metasomatites, and afterwards of greisen metasomatites. They are followed by the formation of aposkarn copper, lead-zinc or tungsten-molybdenum mineralizations. Porphyry-copper and quartz-molybdenite mineralizations are formed in some of the structures.

The volcano-plutonic ore-magmatic systems are composed of central stratovolcanos with intruded into them comagmatic hypabyssal intrusives and multiple subvolcanic and hypabyssal dikes. The presence of radial-concentric magmotectonic faulting that controls the position, morphology and inner composition of ore bodies of veiny shape is typical. These faults determine the comparatively higher bareness of the systems. They are typical for the Bourgas ore region, where thick volcanogenic sediments are developed and the foundation is at a high depth. Four stages in the development of these systems could be divided: volcanic, volcano-tectonic, intrusive and post-magmatic.

The volcanic stage is marked by the formation of central stratovolcanos. A regional propylitization and zeolitization are realized in some sections of copper-zeolite eneralization. In some places, around volcanic necks, quartz-sericite alterations of copper-sulphide mineralization are established.

The volcano-tectonic stage is characterized by a destruction of volcanic cones through radial-concentric faulting and caldera-formation. Multiple subvolcanic dikes, and rarely large bodies are intruded. High temperature propylitization is realized around them (after R. Tsvetkov, and V. Kovachev observed a quartz-pyrite mineralization.

The intrusive stage is marked by the formation of polyphase plutons of stock, arcuated and rarely conic shape. Propylites and quartz-potassium-feldspar metasomatites are formed during this period (Tzvetanov). In basic cappings, originate hysteromagmatic ferroxide mineralizations (Kovachev).

The post-magmatic (self ore-forming) stage is marked with reactivation of favourably orientated radial or concentric faults, along which reverse-slip motions are realized. Economical mineralizations of vein type are formed along the faults. They are accompanied with quartz-containing metasomatites.

The volcano-subvolcanic ore-magmatic systems are developed in structures, in which effusive rocks and rocks of the foundation are cut by a number of subvolcanic intrusives. They are typical with a significant fault-blocky differentiation and are formed in sections of solid crystalline foundation and not thick volcanogenic complex. This determines the high degree of bareness of the systems. They are typical mainly for the Panaguirishte district and the Timok district. The following stages can be separated in the development of above mentioned systems: early subvolcanic, effusive, middle subvolcanic-hypabyssal, volcano-tectonic; late subvolcano-hypabyssal, post-magmatic hydrothermal, post-ore effusive-subvolcanic, that are not evenly developed in the different structures.

The early subvolcanic stage (chelopech ore field) is marked with the intrusion of stock and dike shaped subvolcanic bodies in the rocks of the foundation.

The effusive stage is characterized with the formation of accumulated volcanic cones, usually linearly prolonged. Propylitic, quartz-sericitic to secondary quartzic alterations, sometimes accompanied with sulphide mineralizations have taken place in the central parts.

The middle subvolcanic-hypabyssal stage (Elshitza structure) is marked with the formation of intrusive bodies in the process of magma cooling.

The volcano-tectonic stage is characterized with intensive block faulting of the volcanogenic structures, mainly along longitudinal and rarely along diagonal and cross faults. In some cases this process begins with radial-concentric faulting and caldera-formation.

The late subvolcanic or subvolcanic-hypabyssal stage is marked with mass intrusion of subvolcanic, on some places to hypabyssal bodies both in the volcanic rocks and in the foundation. They cut the periphery of volcanic structures in some cases and in other cases they allocate themselves in their centre.

The post-magmatic hydorthermal stage is marked with the formation of the main share of the economic mineralizations. Copper-pyrite mineralizations of massive type, that are preceded by propylitic, quartz-sericitic to secondary quartzic alterations are formed along the length of the brecciated, mainly exocontact parts of the subvolcanic intrusives. Porphyry-copper mineralizations are formed in the fissurated sections of larger intrusives, at a high degree of covering. Depending on the conditions, it is preceded by potassium feldsparization, biotitization, propylitization, quartz-sericitization and argillitization.

The post-ore effusive-subvolcanic stage has taken place in some structures. It is marked with a limited effusive activity and intrusion of subvolcanic bodies.

CONCLUSION

The presented data characterize the Banate-Srednogorie volcanic belt as a specific metallogenic zone. It is formed after the closing of the Tethys, during a period of preorogenic riftogenic extension. The magmatism is rather variegated in composition, which is due to the different depth of initial magmatic sources and the complicated composition of the complicated type earth crust. The ore deposits are rather variegated in composition and genetic type, with evidently emphasized chalcophile metallogenic specialization. The main part of the mineral deposits originated during the development of the Upper Cretaceous plutonic, volcano-plutonic and volcano-subvolcanic structures.

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