Au-Ag±W mineralization related to the collisional granitoids of the composite Lutzkan magmatic complex, Bulgaria

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The Lutzkan magmatic complex in Western Bulgaria hosts the first gold deposit in Bulgaria - "Zlata" (means "gold"). It crops out as bigger plutons (Lutzkan and Ruy) and few small bodies S and NW from the town of Trun and about 50 km W of the Bulgarian capital Sofia. The rocks of the magmatic complex intrude amphibolite facies metamorphic rocks with presumed Precambrian age and Lower Palaeozoic low-metamorphic carbonaceous metasediments and basic metavolcanics. They are covered by Permian sediments and overlain and intruded by Paleogenic volcanics and dykes.

The rock types of Lutzkan pluton range from gabbros and diorites to leucocratic aplite-granites where the granites and granodiorites being the most widespread variety. The Ruy pluton and its vein rocks are mainly granitic in composition. Geochemical studies and U-Pb zircon/titanite conventional and LA-ICP-MS dating of the plutons revealed that the gabbro-diorites of the Lutzkan pluton belong to the basement unit. They are Cambrian in age (537 ± 1.6 Ma) with mantle-dominated island-arc geochemical characteristics (Ta-Nb negative anomaly; εHf-zircon values between +8.9 and +12.4). The granitoids of Lutzkan and Ruy pluton are dated at 334.1 ± 1.2 Ma. They show distinct geochemical characteristics typical for most Paleozoic collisional granites of the European Variscides: negligible or absent Ta-Nb anomaly; enrichment in K, U, Rb, Ba, Cs, Sr, Th; εHf-zircon values between +3 and -10. The geochemical characteristics and zircon inheritance imply melting of lower-middle crustal materials with mixed crust-mantle origin. Two sampled vein rocks of the Ruy pluton show some striking geochemical characteristics and are dated as Eocene in age.

The characteristics of the Au-Ag±W mineralization at Zlata deposit are evident for a link with the differentiated Carboniferous granitoids. The intrusion of basic magma (dykes of gabbroic to diorite composition) into the granitoids might lead to magmatic volatile saturation and potentially trigger the formation of the magmatic-hydrothermal ore.

Alkali volcanism of the Carter Seamount (Central Atlantic)

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Composition of alkali volcanic rocks (olivin melilites and nephelinites) dredged from Carter Seamount that is located in the Bathymetrists chain of east part of the Central Atlantic was examined. They have typical for alkali rocks REE spectra with sharp increase from heavy (10-15 x chondrites) to light REE (300-500 x chondrites). Spiders-diagrams are similar to volcanic rocks that were melted from EM 2 type mantle source. However significantly higher Nb, Pb, Sr, Hf and especially Th concentrations, than in typical derivatives of EM 2 source, suggest that the Carter volcanic rocks mantle source was more enriched. Such distributions of rare elements are not typical among alkali volcanic rocks of the ocean islands, including the nearest Cape Verde islands volcanic province. Two groups that differ in Nb, Pb, Sr, Hf, Th concentrations are distinctly allocated among the studied volcanic rocks. Most high Th varieties (nephelinites) are geochemically similar to K_2 alkali volcanic rocks from the Parana province in Brazil, which were formed by melting of metasomatically enriched subcontinental mantle. Available data set indicate that melts of the Carter Seamount volcanic rocks were formed from mantle sources which composition differed significantly from those of the volcanic province of the Cape Verde Islands. Their increased isotope ratios on the $^{208}Pb/^{204}Pb$ - $^{206}Pb/^{204}Pb$ diagram gives separate field. This testifies to addition of HIMU component typical to St. Elena Island into mantle source. Thus, the formation of the Bathymetrists Seamounts can be related to the melting of the metasomatically enriched subcontinental mantle that was retained in the oceanic mantle after break up and divergence of continents along the tectonically weakened zone of the northeastern strike with addition of HIMU component. According to available data, the volcanic Bathymetrists Seamounts, including Carter Seamount, were formed in the Early Eocene. This was the time of the onset of strong mantle pulse, which is continuing at the present time and led to the formation of the Cape Verde Islands north of the Bathymetrists Seamounts. Magmatic activity can be caused by ascent of a large mantle plume located beneath Western Europe and North Africa, with flowing of heated material in the southwestern direction towards the oceanic structures. This process presumably was the main reason for melting of the subcontinental mantle fragments in the tectonically weakened zones.