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Late Cretaceous-Paleogene spatiotemporal evolution of the Babyak deposit area, Western Rhodopes, Bulgaria

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The Alpine evolution in the western parts of the Rhodopes is related to intensive granitoid magmatism that produced hydrothermal ore mineralizations. The mineralized zones at Babyak Mo-Ag-Au-W-Bi-base metal deposit are hosted in the granites/pegmatites of the Rila-West Rhodopes batholith (RWRB) and gneisses of the metamorphic basement, mailnly centered in the brittle contacts between the different lithologies. The deposit is attached to NNE-SSW faults of the main tectonic structure in the region – Babyak-Grashevo shear zone (BGSZ). Molybdenite and pyrite are the major ore minerals, whereas sphalerite, galena, chalcopyrite, Pb-Bi sulfosalts are minor.

A simplified temporal model for the magmatic-hydrothermal evolution of Babyak deposit is developed based on field relationships, succession of mineral assemblages and isotope geochronology. Three main tectono-magmatic events and related hydrothermal activity are distinguished. The first stage is marked by the intrusion of the Upper Cretaceous granitoids (~70 Ma) in the host metamorphic basement of the Sarnitsa Lithotectonic Unit. This stage is also associated with weakly manifested hydrothermal activity, forming small exoskarn bodies (~68.5 Ma). The next stage reflects the emplacement of the Early Eocene granitoids at ∼54 Ma (U-Pb zircon dating), which are the carriers of the main part of the ore mineralization in the deposit. This is evidenced by the age of the mineralization (53–52.6 Ma; by Re-Os of molybdenite), as well as the Ar-Ar dating of coarse hydrothermal muscovite (~50 Ma). The last stage in the model is associated with subsequent tectono-magmatic activity, which could be assumed by the dated sericite from the deposit with an age of ~38 Ma. These single data do not allow us to assess the influence of this last stage in terms of ore mineralization. The obtained age coincides with the time interval of the Late Eocene phase of the RWRB 42–39 Ma and the development of the BGSZ <39 Ma.

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