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The Kapan mining district in the Lesser Caucasus: multiple ore-forming events during northeastwards subduction of the Tethys below the Eurasian margin

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The Kapan mining district in south-eastern Armenia is situated in the Lesser Caucasus which forms part of the Tethyan metallogenic belt. Middle Jurassic to Lower Cretaceous volcanic and volcaniclastic rocks with calc-alkaline signature are the dominant rock types in the area and are genetically related to the northeastwards subduction of the Tethys below the Eurasian margin. Three major ore deposits with different mineralization styles occur in the Kapan district. The Centralni West, Centralni East and Shahumyan deposits are hosted by Middle Jurassic andesitic to dacitic lava flows, breccia lavas, tuffs, ignimbrites and subvolcanic quartz-dacite intrusions. Middle Jurassic ore-bearing rocks and hosted mineralization were partially eroded before volcanic and volcaniclastic rocks of Upper Jurassic age were unconformably deposited on top of the Middle Jurassic sequence. The Centralni West deposit is characterized by massive east-west striking veins and stockwork style mineralization within sericite-chlorite-carbonate altered volcaniclastic rocks. Chalcopyrite and pyrite with minor sphalerite, fahlore and galena in a gangue of quartz and carbonate are the dominant minerals. The Centralni East deposit is characterized by a higher sulfidation state mineral assemblage that includes pyrite, colusite, fahlore, chalcopyrite and minor enargite, luzonite and galena. Stockwork style mineralization occurs within argillic altered lava flows and tuffs. At the polymetallic Shahumyan deposit, steeply dipping east-west striking veins with phyllic alteration halo are hosted by a subvolcanic quartz-dacite intrusion. Major ore minerals in the veins are chalcopyrite, pyrite, tennantite-tetrahedrite, sphalerite, galena and different gold- and silver tellurides.

Intrusive rocks are rare in the district but 6 samples were collected for zircon U-Pb dating by LA-ICP-MS. Rounded granodiorite clasts from a hydrothermal pebble dyke were dated at 165.6±1.4 Ma. Two gabbro stocks were dated at 137.7±1.2 and 131.5±1.6 Ma and diorite and granite from the composite Tsav intrusion were dated at 136.2±0.8 and 133.6±1.7 Ma, respectively. An Eocene age of 50.82±1.0 Ma was obtained from a gabbro stock in the west of the area. $^{40}Ar/^{39}Ar$ dating of hydrothermal muscovite yielded a mineralization age of 161.78±0.79 Ma for the Centralni West deposit. Re-Os dating of pyrite from the Centralni East deposit yielded a mineralization age of 144.7±4.2 Ma. An $^{40}Ar/^{39}Ar$ age of 156.14±0.79 Ma was obtained from magmatic-hydrothermal alunite which is associated with advanced argillic alteration in the upper part of the Shahumyan deposit.

Our dating results indicate different pulses of ore formation in the district over a protracted period of at least 17 Ma. The obtained Middle Jurassic U-Pb zircon ages from intrusive rocks in the district reflect subduction-related magmatism in the Lesser Caucasus. The Eocene gabbro stock represents a post-collisional magmatic event in the Kapan district with respect to the collision between the South-Armenian Block and the Eurasian margin.