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Tectonic, magmatic and hydrothermal processes associated with Tertiary crustal extension in the basement domes of southeastern Rhodope Massif, Bulgaria

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The tectonic pattern of the eastern Rhodope Massif is dominated by detachment-bounded extensional metamorphic domes (the Kesebir and the Byala reka domes) that share many aspects characteristic for extension-related metamorphic core-complexes. The extensional tectonics in the region started in a syn-orogenic (syn-collisional) context during the early Tertiary as derived from stratigraphic data and continued in a post-orogenic setting making a transition to well-known latest Oligocene-Miocene Aegean extension. Different crustal and mantle processes were associated with the extensional tectonics, which we synthesize here, providing a structural framework, temporal 40Ar/39Ar and fission-track age constraints on their interplay during crustal extension in the region. The tectonostratigraphy in structurally ascending order comprises: (i) a footwall lower unit consisting of high-grade basement orthogneisses in the core of the domes; (ii) a hanging wall composed of an upper high-grade basement lithologically heterogeneous unit, (iii) a low-grade Mesozoic unit, and (iv) overlaying unmetamorphosed syn-tectonic Paleocene-Eocene sedimentary rocks hosting epithermal ore deposits and prospects and post-tectonic Oligocene sedimentary and volcanic cover rocks. The low-angle extensional detachments limit these units exposing distinct structural levels of the hanging wall succession. The NE oriented Kesebir dome displays a NNE-directed ductile overprinted by a brittle extensional shearing in the footwall mylonites and the bounding Tokachka detachment, along which the Ada tepe low-sulfidation gold deposit is exposed in the hanging wall consisting of sedimentary strata deformed under brittle conditions, and which are immediately overlain by calc-alkaline lavas of the adjacent Iran tepe paleovolcano. Rhyolite dykes intrude both the hanging wall and the footwall of this dome. The Byala reka dome exhibits the same structural pattern as the Kesebir dome in the footwall mylonites and the bounding Byala reka detachment, but with a SSW-directed extension. This structural feature reveals a partitioned kinematic flow direction, likely related to a transfer fault linking the opposite sense detachment systems in both domes at a high crustal level. In the Byala reka dome, the hanging wall sedimentary rocks host the Rozino low-sulfidation gold prospect, and the hanging wall and the footwall are intruded by acid dykes and subvolcanic bodies. In both domes, the 40Ar/39Ar mica cooling ages span 42.1-38.3 Ma in the hanging walls, whereas cooling ages of the footwalls fall within the interval 38.1-37.7 Ma. The Ada tepe hydrothermal adularia 40Ar/39Ar ages fall in the range 34.99-34.71 Ma, and are indistinguishable from the hornblende and biotite 40Ar/39Ar ages ranging between 34.69-33.91 Ma for the Iran tepe paleovolcano lavas. The 40Ar/39Ar age of 36.5 Ma characterizes hydrothermal adularia of the Rosino prospect and the acid dykes yield a 40Ar/39Ar mica age of 32.9 Ma. 40Ar/39Ar sanidine age of 31.82 Ma characterizes rhyolite dykes in the Kesebir dome. Apatite and zircon fission-track results constrain the low-temperature history of the hanging wall at 29.3 $\pm$ 1.7 Ma (sandstone in sedimentary package) in the Kesebir dome and 25.0 $\pm$ 1.5 Ma (amphibolite) in the Byala reka dome. The dykes of alkaline basalts and basaltic andesites at 28-26 Ma record latest magmatic pulse of enriched mantle source in the extensionally thinned crystalline basement of both domes. The new geochronology data, coupled with the structural frame, allow us drawing the following temporal evolution for the extension and exhumation history of the region. Crustal extension started as lately as Eocene (Ypresian youngest stratigraphic age of the syn-tectonic sedimentary rocks) with the initiation of the low-angle detachments. Progressive extension led to the cooling and exhumation of the hanging wall between 42-38 Ma, followed by cooling and exhumation of the footwall within the interval 38-37 Ma. Continued brittle extension and high-angle faulting in supra-detachment

grabens of the hanging wall was followed by hydrothermal alteration at 35-34 Ma along permeable zones and formation of epithermal ore prospects that are coeval with volcanism at 34-33 Ma. Overall, the data reveal intimately related tectonic, hydrothermal and magmatic processes within a narrow time interval with feedback from crustal and mantle (e.g. ductile-brittle basement thinning, hydrothermal activity, magmatism) processes involved in the extensional history of the eastern Rhodope Massif.

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