Time and compositional evolution of the Upper Cretaceous to Miocene magmatism in South Bulgaria, North Greece and Thrace: Implications for the Late Alpine geodynamic evolution of the Balkan Peninsula

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Based on the P-wave tomographic images and modeling for the Eastern Mediterranean region, many recent papers proposed a single, long-lived north-directed subduction zone, starting from Cretaceous or even Jurassic time to recent. However, detailed analyses of the magmatism from Late Cretaceous till Miocene times in the South Bulgaria and North Greece, presented here, require much more complicated model.

Late Cretaceous magmatism covers large areas in the Srednogorie zone, Strandzha and northernmost Rhodopes. It was active from 92 to 67 Ma, showing southward or centroclinal shifting. Magmatic products are represented by intrusive and extrusive rocks of variable composition, typical subduction-related signature and low Sr and Pb and high Nd isotopic compositions. This magmatism is related to N-NE-ward subduction of the Vardar ocean under the Rhodope Massif. The models of slab retreat and rifting can explain the increasing mantle input with time. After a break of ~11 Ma, probably related to continental collision, magmatic activity was renewed in the Kraishte and the Rhodope Massif. The Early-Middle Eocene magmatism (56-40 Ma) is represented by scattered felsic plutons in the Rhodopes and dacitic and rhyodacitic dike swarms in the Kraishte zone. The rocks have subduction-related signature and remarkably similar isotopic compositions, suggesting significant mantle component and uniform crustal thickness throughout the Rhodopes. The missing mafic magmas most probably were underplated to the crustal base, adding crustal material to the previously collision-induced thickening. Contemporaneity and isotopic similarity of this magmatism to the nearby ocean island basalt (OIB)-like basalts in the Eastern Serbia can be interpreted in favor of its origin from astenospheric OIB source, weekly to moderately influenced by intracrustal contamination and fractionation. The magmatism was followed by 5-7 Ma regional uplift and exhumation of the Upper Cretaceous and Early-MidEocene granitoids and core-complex formation. From 35 to 26 Ma the Rhodope massif and Pirin-Osogovo zone were affected by new episode of magmatism, directly overlying in places the Mid Eocene granitoids. It is represented by volcanic and plutonic rocks and dykes of variable composition, strongly controlled by the crustal thickness. The intrusive and extrusive rocks in Osogovo-Pirin have exceptionally felsic composition and the strongest crustal input. The Central Rhodope magmatism is explosion-dominated, represented by rhyodacite to rhyolite air-fall tuffs and strongly welded rhyolitic ignimbrites, followed by intrusion of dykes and subvolcanic intrusions of latitic to high-K andesitic and monzonitic compositions. The Eastern Rhodope magmas show the most complex compositional variations from basic to acid and calc-alkaline, shoshonitic and rare ultra-K lithologies. Here, the magmatism ended with OIB alkaline basalts and lamprophyres. The geochemistry, Sr and Nd isotopic compositions and zircon populations suggest a strong crustal influence of the magmatism, diminishing from west to east and north to south and with time. We suggest that this magmatism is the result of major orogenic extension, caused by the asthenospheric uplift and asymmetric crustal thinning. The youngest Early-Mid Miocene orogenic magmatism (22-15 Ma) occupies the southernmost (Greek) part of the Rhodope Massif. Its western part is represented by felsic intrusives, whereas the eastern sector is composed of intermediate to acid subduction-related volcano-plutonic associations. Contemporaneous with this magmatism is the OIB basaltic volcanism in the Central Bulgaria, cutting across in a NE-SW strip Srednogorie zone, Balkan zone and Moesian Platform. The orogenic magmatism was post-dated by OIB alkaline basalts (11-7 Ma) in the neighbor Trace basin and Biga Peninsula. The entire Early-Late Miocene magmatic evolution is repetition of the older Late Eocene-Early Oligocene magmatic period and, most probably, is the result of similar geodynamic processes.