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# Time constraints for low-angle shear zones in the Rhodope Mountains (Bulgaria)

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The basement rocks of the Rhodope Metamorphic Complex (RMC) belong to a synmetamorphic nappe stack with layers of continental crust and ophiolites. It has been assembled during the Alpine orogeny in a complex subduction and collision succession along the southwestern border of Moesia. During late and post-collisional stages, deeper levels of the nappe stack have been exhumed as metamorphic core complexes along low-angle detachment faults. Some of these detachment faults likely started to be active during thrusting. Late stages of extension disrupted the whole nappe pile and were associated with rift basin formation, volcanism, erosion and sedimentation. Despite a comprehensive data base it is still difficult to derive details of the tectonometamorphic evolution of the Rhodopes from its still not well understood structure.

Based on ages of orthogneiss protoliths, high-pressure metamorphism, regional deformation, and overlying sediments, the present-day structure of the RMC has been subdivided into the Lower, Middle, Upper, and Uppermost Allochthon. The Lower and Middle Allochthon are separated by the top-to-the-SW Nestos Shear Zone and corresponding shear zones further east, the Middle and Upper Allochthon by the top-to-the-NW Kardjali Shear Zone. We combine structural, metamorphic and U-Pb zircon age data in order to unravel the history of the RMC. U-Pb zircon geochronology by LA-SF-ICP-MS was carried out on samples from pegmatite veins and granitoid intrusions.

In the Western Rhodopes and Pirin Mountains, zircons from the posttectonic Teshovo Pluton in the Lower Allochthon (Pangaion-Pirin Unit) yield crystallization ages of around 32 Ma. Zircons from two syntectonic plutons (Dolno Dryanovo and Spanchevo plutons) in the Middle Allochthon (Sidironero-Mesta Unit) have around 143 to 145 Ma old inherited magmatic cores and around 56 Ma old magmatic cores and rims. Variscan zircons typical for basement rocks from the Lower Allochthon are not present in samples from the Spanchevo and Dolno Dryanovo plutons. These ages and the structural relations indicate that at around 56 Ma the Middle Allochthon was not yet placed upon the lower one and that the southwest directed thrusting along the Nestos Shear Zone took place between around 56 and 32 Ma.

In the eastern part of the Central Rhodopes, rocks of the Lower Allochthon (Arda Unit) are overlain by rocks of the Middle Allochthon (Starcevo Unit) along the top-to-the-W Starcevo Shear Zone. More to the east the top-to-the-NW Borovica Shear Zone is an internal shear zone within the Middle Allochthon. It has emplaced lower-grade rocks without eclogites (Borovica Unit) onto high-grade metamorphic rocks with eclogites (Starcevo Unit).

Dating of samples from the Starcevo Shear Zone constrains its activity between 45 Ma (sheared pegmatite vein) and 36.3 Ma (undeformed granitoid). Dating results from synkinematic pegmatite veins from the Borovica Shear Zone establish a Lutetian age (around 43-45 Ma) for its top-to-the-NW shearing that possibly started already during Eocene high-pressure metamorphism of the Starcevo Unit.

These data reveal that important tectonic processes, including thrust and extensional shearing as well as the burial and exhumation of eclogites, took place during the Paleogene. We propose a model where the Lower Allochthon is Apulia-derived and where the present-day structure of the Rhodopes can be explained by a subduction polarity reversal from SW-dipping in the Jurassic and Early Cretaceous to NE-dipping in the Late Cretaceous and Palaeogene.