Ductile and brittle structures, and kinematics related to crustal extension in the Central Byala Reka Dome, Eastern Rhodopes, Bulgaria

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The N-S oriented Byala Reka dome represents an extensional metamorphic dome in the Eastern Bulgarian Rhodopes. It is limited along the flanks by a detachment and high-angle fault, whose central part is tectonically overlain by metamorphic basement allochtonous rocks. An open questions still concerns the contractional vs extensional origin of these allochtonous rocks and their related structural record. In this contribution, we focus on the structures and kinematics in the central Byala Reka dome in order to clarify its tectonic evolution, which provides important clues relative to ore-forming and magmatic processes, also involved during the extensional evolution of the area.

A lower high-grade basement unit, consisting mainly of orthogneisses, constitutes the footwall, which is separated by a detachment fault from the marble-dominated allochton of an upper high-grade basement unit in the hanging wall. The Eocene-Oligocene sedimentary rocks, which fill a fault-bounded graben in the south supra-detachment hanging wall, represent syn- and post-tectonic cover sequences. The flat-lying regional foliation in the footwall rocks progressively grades to a mylonitic foliation in a shear zone underlying the detachment. The mylonitic foliation contains a NNE-SSW trending stretching lineation with shallow plunges. Penetrative fabrics and strain gradient from protomylonites to mylonites depict intense ductile non-coaxial deformation in the shear zone. This deformation becomes increasingly brittle towards the detachment, in turn marked by cataclasite and fault breccia. The sense-of-shear criteria in the footwall shear zone and detachment consistently demonstrate a top-to-the SSW tectonic transport, parallel to the ductile-brittle fabrics. Scarce top-to-the S kinematic indicators in the hanging wall associated with a N-S oriented lineation. Intense folding of the hanging wall has produced early intrafolial folds with WNW-ESE oriented axes and southeast verging closed folds with ENE-WSW trending axes, lying oblique or orthogonal to the lineation. Boudins and clasts used as strain markers in the hanging wall yielded a finite strain with $K \geq 1$. A set of WNW-ESE to E-W striking normal faults and small-scale brittle shears with retrogression to chlorite are developed in the hanging wall orthogonal to the shear direction and fabrics in the footwall, implying a NNE-SSW oriented brittle extension. As sedimentary strata in supra-detachment graben dips south towards the bounding high-angle fault, this suggests hanging wall sedimentation accompanied by faulting.

The ductile-brittle shear regime in the detachment and underlying shear zone shows that the localized deformation occurred at decreasing temperatures and metamorphic grade from amphibolite- to greenschist-facies. Kinematic continuity of ductile then brittle deformation, the decrease in metamorphic grade towards the detachment and associated hanging wall sedimentation, are all characteristics consistent with exhumation and an extensional origin of the basement allochton. These new results allow to constrain the tectonic evolution of the central Byala Reka dome, where the basement exhumation was accommodated by south-southwestward ductile-brittle extension. Cooling ages of the hanging wall and fault assisted sediment-hosted mineralization in the graben (ca. 40-36 Ma), together with stratigraphic ages of the sedimentary fill, constrain a mid-Eocene age for extensional deformation.