From constrictional geometries to transpressional tectonics: the geometry of an extruding wedge (Rhodope Metamorphic Complex, N-Greece)

Kurt Krenn[1], Christoph Bauer[1], Matthias Krismer[2], Helene Tirk[1], Barbara Puhr[1], Alexander Proyer[1], Evripidis Mposkos[3] & Georg Hoinkes[1]

1 Institute of Earth Sciences, Department of Mineralogy and Petrology, Karl Franzens University of Graz, Austria (kurt.krenn@uni-graz.at)
2 Institute of Mineralogy and Petrography, University of Innsbruck, Austria
3 National Technical University of Athens, Department of Mining and Metallurgical Engineering, Greece

The Rhodope Metamorphic Complex (RMC) records multiphase subduction and exhumation related to Early Cretaceous collision and accretion between Apulian and the European continents (e.g. Burg et al. 1996; Ricou et al. 1998). It is characterized by tectonic intermixing of continental and oceanic rock types and preserves rock units with highest metamorphic grade at highest structural levels. Two tectonostratigraphic bottom-to-top complexes, the continentally derived Upper Sidironero Unit and the oceanic/continentally derived Kimi Complex were mapped and studied in detail. Both units are nowadays juxtaposed by eastward-directed, N-S striking detachment systems, which operated since Late Eocene/Oligocene time (e.g. Krohe & Mposkos 2002). For the early ductile evolution of the RMC, exhumation and extension is due to the interplay between SW-directed ductile shear at the base of the Upper Sidironero Unit (Nestos Fault) and NE-directed normal faulting at the top of the Complex (Kimi Complex). This separates the high-grade metamorphosed Sidironero Complex in the hanging wall from the low-grade metamorphosed Falakron Marbles in the foot wall. Within the Central Rhodope domain, predominantly represented by the Upper Sidironero Unit, early subduction-related constrictional fabrics are preserved on macro-(sheath folds) and meso- to micro-(L>>S tectonites) scale as a result of the interplay between slab-pull and ridge-push during subduction at deep crustal levels (e.g. Zulauf 1997). Constrictional fabrics are detached by SW-sheared metabasitic boudin-structures during SW-directed transpressive extrusion to shallow crustal levels. Transpression led to macro-scale folding of the Central Rhodope domain and to the formation of a penetrative ductile cleavage (fold-axial plane cleavage) during amphibolite-facies metamorphism. SW-directed shear and coeval NE-directed normal faulting is established by LPO textures of recrystallized quartz aggregates. Towards hangingwall units, within the low-grade Albite Gneiss Series, constrictional geometries are absent and deformation is restricted to sinistral transpression. Hence, the internal architecture of the Central Rhodope Complex can be related to a wedge geometry that is dominated by constriction-

al folded fabrics in the central, in-situ wedge position with highest velocity gradient and by sinistral transpression towards the wedge margins with lower velocity gradients. The whole exhumation tectonics is displayed by a steep (~40°) NE-dipping stretching lineation, tracing the steep dipping subduction plane between Europe and Apulia.
The highest tectonostratigraphic unit, the Kimi Complex, consists of continental crustal material and serpentinized mantle peridotites and was exhumed earlier, due to the driving force of the subducting plate and the lower average density of the material within the subduction channel compared to the Upper Sidironero Complex. Ductile structures within the Kimi Complex can be explained as the result of sinistral transpression where NE-SW macro-scale open to closed folding and discrete SW shear zones developed during amphibolite facies metamorphism. Transpression led to a subhorizontal NE-SW directed stretching lineation. Sediments cover the Kimi Complex during the Eocene (Lutetian) and provide an early time limit for wedge tectonics. The Kimi Complex was detached by post-Lutetian E-directed brittle extensional tectonics.
As a result, for the Central Rhodope, exhumation to shallow crustal level was achieved by constriction due to subduction at deep crust followed by NE-SW directed wedge extrusion during sinistral transpression, while material extrusion and subsequent shallow sinistral transpression dominated within the Kimi Complex. Transpression resulted from a long-lasting oblique convergence between the Apulia and the European continent during the Cretaceous. Ductile deformation phases were overprinted by late E-directed extensional tectonics that led to faulting and brittle overprinting of hanging wall units of the RMC.

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