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From subduction to back arc extension in Syros (Cyclades; Greece)

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Subduction zones allow important vertical movement across the lithosphere and the upper mantle. High-Pressure/Low-Temperature (HP/LT) metamorphic rocks represent part of the material first buried and then exhumed during subduction. In the Cyclades (Greece), HP units have surprisingly conserved (1) their initial geometry and even their stratigraphy and (2) evidence of prograde HP/LT metamorphism –e.g. Lawsonite and Aragonite pseudomorphs- in spite of superposed deformations during subduction and exhumation. We aim here at describing the specific deformation mechanisms that lead to the structural patterns observable in the field.
Syros Island presents the best-preserved HP parageneses of the Cycladic Blueschists Unit (CBU). Detailed mapping shows that deformation is localised along two main lithological and tectonic interfaces: (1) thrusting shear above and below oceanic crust units emplaced on top of the sedimentary sequence during subduction in early Eocene times and (2) a flat-ramp-type extensional system that accommodated the exhumation of the whole pile of oceanic and sedimentary material, likely in late-Eocene to Oligocene times. Shear criteria associated to these two main deformation events are rather scattered. The first “prograde” event displays a top to SW sense of shear, only observed in association with lawsonite pseudomorphs that crystallized during burial. The second “retrograde” event displays a top to NE sense of shear that can be observed in most of Syros rocks. Stretching lineations related to the second event display at island scale an arcuate pattern that was previously interpreted as ductile wrenching that occurred at a deep crustal level. Our structural mapping shows that late brittle deformation and associated block rotation are responsible for the reorientation of lineations, likely during late-Miocene-Pliocene times.
The evidence summarized above lead to three main conclusions. (1) Subduction induced deformation is conserved in the Cycladic blueschists. Undeformed lawsonite pseudomorphs are excellent criteria to identify materials deformed during subduction and preserved of later deformation, in particular during exhumation. (2) Opposite senses of shear are not synchronous and are not related to a core complex-type deformation, as often quoted. (3) The flat-ramp extensional system identified at island scale is a key feature to explain why rocks with HP parageneses are so well conserved. In the frame of the Hellenic orogeny, we suggest that flat lying structures that characterize the whole Cycladic Blueschists unit should be re-examined in this light. Finally, comparison of Syros evidence with neighbouring islands sustains that the exhumation of blueschists is not accommodated by several flat lying detachments but more likely by a single normal sense shear zone that correspond to the previous subduction zone, reactivated in extension.