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The anatomy of the Cycladic Blueschist Unit on Sifnos Island (Cyclades, Greece): implications for exhumation model of high-pressure rocks

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Since 35 Ma, the kinematics of the Aegean domain has been mainly controlled by the southward retreat of the African slab, inducing backarc extension. The main structures and associated kinematic are well constrained, but the kinematics of deformation before 35 Ma, coeval with the exhumation of blueschists and eclogites of the Cycladic Blueschist Unit, has been so far poorly studied. Hence, syn-orogenic deformation and exhumation mechanisms of the Cycladic Blueschists Unit remain disputed in part because the structure and kinematic history of High Pressure and Low Temperature (HP-LT) rocks are interpreted differently in the literature. In order to understand and constrain the exhumation history of HP-LT rocks, Sifnos Island is particularly relevant because HP-LT parageneses are exceptionally well preserved and different degree of retrogression are observed in two main units. The aims of this work attempts at firstly solving uncertainties on the position and geometry of major contacts between units and, secondly, to provide new structural constraints on the tectonic history of HP-LT units generated in the subduction zone during the Eocene.

We show, through new geological and metamorphic maps, cross-sections and analyses of kinematic indicators and their relation to metamorphism, that Sifnos is characterized by shallow-dipping shear zones reactivating weak zones due to competence contrasts or earlier tectonic contacts (i.e., syn-orogenic). Structures and kinematics, associated with these shear zones, show a top-to-the-N to -NE ductile shearing deformation. A continuum of deformation can be observed from the Eocene syn-orogenic blueschist-facies to the Oligocene-Miocene post-orogenic greenschist-facies with the same top-to-the-NE sense of shear showing that the same shear zones, formed during syn-orogenic exhumation were reactivated during the formation of the Aegean Sea. A progressive localization of strain along discrete shear zones toward the base of the tectonic pile is also observed. The present-day shape of the island is largely controlled by late brittle fault reshaping the older domal structure. These late low-angle and steeper normal faults with kinematic indicators top-to-the-SW cross-cut the ductile structure and may represent the brittle expression of the West Cycladic Detachment System. Hence, we propose a model of progressive exhumation also based on available radiochronological constraints, first in the subduction channel of the Hellenic subduction, then in the backarc region with the same top-to-the-NE non-coaxial component of shearing. This reconstruction partly explains the different degrees of retrogression observed on the Cycladic Islands. The main discontinuities allowing this exhumation are the Vari Detachment (cropping out on Tinos and Syros islands) during the syn-orogenic period (Eocene) and then the NCDS and WCDS afterward.