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Low-angle normal fault mechanics and architecture in the Western Cyclades (Greece)

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Exhumation of metamorphic rocks and core complex formation is due to movements on low-angle normal faults (LANF) in the Cyclades. The overall tectonic regime since the Oligocene has been characterized by crustal extension, showing top-to-N/NE-directed kinematics from the middle to the upper crust in the Eastern – Central and top-to-SW/SSW-directed kinematics in the Western Cycladic islands. This work is part of project ACCEL (Aegean Core Complexes along an Extended Lithosphere), which focuses on investigating the petrology, geochronology, structural geology and geodynamic interpretation on the Cycladic islands of Serifos, Kythnos and Kea. Based on field observations and detailed microstructural investigations, different stages of LANF-evolution and architectures have been identified:

Serifos represents a textbook example of a multistage magmatic and metamorphic core complex (MCC), characterized by an asymmetric ductile to brittle detachment system with LANF formation top-to-SW/SSW now preserved in the NE and SW tips of the island. An ultramylonitic calcite marble layer up to 2.5 m thick and ultracataclasites $\sim$ 0.5 m thick form the detachment 'surface', representing a late stage of MCC exhumation. Strains in the hanging and footwalls decrease very rapidly away from this zone.

On Kythnos, the Intermediate unit of the Attic-Cycladic Crystalline is overlain by a ca. 10 m thick top-to-SW/SSW LANF Mn-rich calcite marble-ultramylonite, with several generations of cohesive cataclasites and protocataclasites. A significant observation is the interaction between the underlying schists and the calcite ultramylonite, which have been folded together during considerable WNW-ESE oriented horizontal shortening, perpendicular to the main stretching direction, under brittle-ductile conditions.

On Kea, a key area of LANF formation in the Cyclades, structural investigations have demonstrated the existence of a hitherto unrecognised large-scale ductile-brittle shear zone, also within the Attic-Cycladic Crystalline. The tectonostratigraphy comprises a $>$ 380 m thick, shallowly-dipping schist-calcite marble unit, overlain by ca. 150 m thick fault rocks consisting of up to 5 m of cohesive ultracataclasites, ca. 30 m ultramylonitic calcite marbles and ca. 100 m of brecciated dolostones and protomylonitic calcite marbles. The presence of blueschist-facies lenses in contact with the main shear zone points to a significant role of LANFs in exhumation processes and greenschist-facies overprint during Miocene crustal evolution. In addition, minimum crustal displacements of 19.5 km along the LANF and an interaction between contemporaneous movements on high-angled normal faults and LANF formation have been demonstrated.

These observations show that there are significant differences in the evolution in time, scales, velocity regimes and architecture of LANFs. However, their consistent top-to-SW/SSW kinematics demonstrates the importance of the Western Cyclades in the overall tectono-metamorphic evolution of the Aegean region.