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Fault geometries and deformation mechanisms in the evolution of low-angle normal faults (Kea, Greece)

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The overall tectonic regime in the Cyclades since the Oligocene has been characterized by crustal extension, accommodated by movements on low-angle normal faults (LANFs). On Kea, structural investigations have demonstrated the existence of an island-wide LANF within a large-scale ductile-brittle shear-zone traceable over a distance of 19.5 km parallel to the stretching lineation. The tectonostratigraphy comprises Attic-Cycladic Crystalline lithologies with a shallowly-dipping schist-calcite marble unit overlain by calcitic and dolomitic fault rocks. Notably, the calcitic marbles have been mylonitized, with a mean NNE/NE-SSW/SW trending, pervasive stretching lineation and intense isoclinal folding with fold axes parallel to the stretching lineation. Numerous SC-SCC´-fabrics and monoclinic clast-geometries show a consistent top-to-SSW shear-sense. Recorded within all lithologies is a consistent WNW/NW-ESE/SE and NNE/NE-SSW/SW striking network of conjugated brittle, brittle-ductile high-angle faults perpendicular and (sub)parallel to the main stretching direction. Field evidence and microstructural investigations indicate high-angle normal faults formed synchronously with movement on LANFs. This interplay of LANFs with high-angle structures, initiated and evolved from brittle-ductile to brittle conditions, indicates initial stages of movement below the calcite brittle-ductile transition but above the dolomite transition. Weakening processes related to syntectonic fluid-rock interactions highlight these observations. In particular, grain-size reduction and strain localisation in fine-grained (ultra)-cataclasites and fine-grained aggregates of phyllosilicate-rich fault-rocks promoted fluid-flow and pressure-solution-accommodated ‘frictional-viscous’ creep. These mechanisms show the importance for LANF slip and movement in the progressive development and interaction between contemporaneous active normal faults in the Andersonian-Byerlee frictional mechanics.