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## Deformation mechanisms in natural dolomite mylonites from a detachment system (Mt. Hymittos, Greece)

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Microstructures may be used to determine the processes, conditions and kinematics under which deformation occurred. For a given set of these variables, different microstructures are observed in various materials due to the material's physical properties. Dolomite is a major rock forming mineral, yet the mechanics of dolomite are understudied compared to other ubiquitous minerals such as quartz, feldspar, and calcite. Our new study uses petrographic, structural and electron back scatter diffraction analyses on a series of dolomitic and calcitic mylonites to document differences in deformation styles under similar metamorphic conditions. The Attic-Cycladic Crystalline Complex, Greece, comprises a series of core complexes wherein Miocene low-angle detachment systems offset and juxtapose a footwall of high-pressure metamorphosed rocks against a low-grade hanging wall. This recent tectonic history renders the region an excellent natural laboratory for studying the interplay of the processes that accommodate deformation. The bedrock of Mt. Hymittos, Attica, preserves a pair of ductile-then-brittle normal faults dividing a tripartite tectonostratigraphy. Field observations, mineral assemblages and observable microstructures suggests the tectonic packages decrease in metamorphic grade from upper greenschist facies (~470 °C at 0.8 GPa) in the stratigraphically lowest package to sub-greenschist facies in the stratigraphically highest package. Both low-angle normal faults exhibit cataclastic fault cores that grade into the schists and marbles of their respective hanging walls. The middle and lower tectonostratigraphic packages exhibit dolomitic and calcitic marbles that experienced similar geologic histories of subduction and exhumation. The mineralogically distinct units (calcite vs. dolomite) of the middle package deformed via different mechanisms under the same conditions within the same package and may be contrasted with mineralogically similar units that deformed under higher pressure and temperature conditions in the lower package. In the middle unit, dolomitic rocks are brittlely deformed. Middle unit calcitic marble are mylonitic to ultramylonitic with average grain sizes ranging from 30 to 8 μm. These mylonites evince grain-boundary migration and grain size reduction facilitated by subgrain rotation. Within the lower package, dolomitic and calcitic rocks are both mylonitic to ultramylonitic with grain sizes ranging from 28 to

5  $\mu\text{m}$  and preserve clear crystallographic preferred orientation fabrics. Calcitic mylonites exhibit deformation microstructures similar to those of the middle unit. Distinctively, the dolomitic mylonites of the lower unit reveal ultramylonite bands cross-cutting and overprinting an older coarser mylonitic fabric. Correlated misorientation angles suggest these ultramylonites show evidence for grain size reduction accommodated by microfracturing and subgrain rotation. In other samples the dolomitic ultramylonite is the dominant fabric and is overprinting and causing boudinage of veins and relict coarse mylonite zones. Isolated interstitial calcite grains within dolomite ultramylonites are signatures of localized creep-cavitation processes. Following grain size reduction, grain boundary sliding dominantly accommodated further deformation in the ultramylonitic portions of the samples as indicated by randomly distributed correlated misorientation angles. This study finds that natural deformation of dolomitic rocks may occur by different mechanisms than those identified by published experiments; notably that grain-boundary migration and subgrain rotation may be active in dolomite at much lower temperatures than previously suggested.