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Mt. Hymittos, Central Attica: the northwestern exposure of the Western Cycladic Detachment System

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The bedrock of Mt. Hymittos, Attica, Greece is the northwestern exposure of the West Cycladic Detachment System (WCDS). The system is a >150 km-long top-S/SSW low-angle crustal-scale extensional detachment system that was one of several structures that accommodated Miocene bivergent exhumation of Attic-Cycladic metamorphic core complexes in the central Aegean. The footwall of these core complexes has been assigned to the Cycladic Blueschist Unit which has a complex geologic history of Eocene-Oligocene high-pressure metamorphism and Oligo-Miocene greenschist facies overprint during slab rollback and crustal extension. Field mapping on Mt. Hymittos identified a local tectonostratigraphy of three tectonic packages separated by ductile-to-brittle low-angle normal faults. Field observations, mineral assemblages and deformation mechanisms suggests the tectonic packages decrease in metamorphic grade from upper greenschist facies in the stratigraphically lowest package to sub-greenschist facies in the stratigraphically highest package. The uppermost package consists of low-grade Ms-Qz-Cal phyllites, massive calcitic marbles and serpentinites. The two lower packages consist of variably intercalated upper greenschist facies marbles and Qz-Ms-Cal±Plag±Cld metasedimentary schists. Both the middle and lower packages show a distinctive structural style of km-scale close-to-tight recumbent folds, crosscut by the low-angle normal faults that separate the packages. Mylonitic to ultramylonitic marbles and schists are present in the immediate footwall of the low-angle normal faults. Within these rocks, the folds have been reoriented and sheared into isoclines as part of a penetrative transposition foliation related to extension accommodated by ductile shear along the faults. Both low-angle normal faults exhibit cataclastic fault cores that grade into the schists and marbles of their respective hanging walls. The structures have clear top-S/SSW kinematics determined from flanking folds, sigmoids, delta clasts, stair-stepping of strain shadows on porphyroclasts, and SCC' fabrics. There is a marked step in metamorphic grade between the sub-greenschist facies uppermost package, and the middle-to-upper greenschist facies middle and lower packages. The ductile-to-brittle deformation of the structures suggests significant displacement has occurred in order to expose the range of observed crustal conditions. The jump in metamorphic grade and styles of deformation suggest these low-angle structures are part of a major, crustal-scale extensional complex. A suite of new white mica $^{40}Ar/^{39}Ar$ and zircon (U-Th)/He dates has been produced from above and below each of the low-angle normal faults. Fully reset white mica deformation ages from the footwalls suggest the faults were active as ductile structures in the middle Miocene, before transitioning to brittle deformation conditions during middle-to-late Miocene cooling as indicated by zircon (U-Th)/He dates. White mica $^{40}Ar/^{39}Ar$ and zircon (U-Th)/He ages from the uppermost package are significantly dispersed, indicating this package did not experience temperatures >200˚C. Based on the apparent step in metamorphic grade across the upper fault, style of deformation and similarities in deformation and cooling ages along-strike of the WCDS, the Mt. Hymittos low-angle normal faults are the northwesternmost exposure of the WCDS. The Mt. Hymittos faults may be mechanically linked to similar structures in Lavrion (a linkage previously proposed as the Attica detachment system).