

Large-scale recumbent isoclinal folds in the footwall of the West Cycladic Detachment System (Greece)

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The Pindos Zone in the Cyclades underwent Eocene high-pressure metamorphism and syn-orogenic exhumation, overprinted by Miocene low-angled extension. Although this represents a combination of likely high-strain-events, structural evidence of large-scale folding is rare. Here potential examples of such folding on Kea and Kythnos, in the Western Cyclades, are evaluated. These islands lie within the Cycladic Blueschist Nappe (lower nappe) of the Pindos Zone and in the footwall of the top-to-SSW West Cycladic Detachment System (WCDS).

On Kea, no lithostratigraphy can be established in the ~450 m thick greenschist facies mixed sedimentary-volcanoclastic-marble mylonite/phyllonite succession. On the east side of the island, lensoid marble layers frequently bifurcate, which might be reflecting early, sheared-out isoclinal folding, although no evidence of folded compositional layering has been found in potential fold-hinge zones and the bifurcation points are not arranged in a way suggestive of a fold axes parallel to the NNE-SSW oriented stretching lineation. However, at two localities, medium-scale recumbent isoclinal folding has been mapped, with NNE-SSW fold-axes exposed for up to 250 m and amplitudes of up to 170 m.

On Kythnos, stretching lineations in greenschist facies rocks show a rotation from ~ENE-WSW in the north to NNE-SSW in the south, taken to represent a reorientation of the Eocene exhumation strain during block rotation coincident with top-to-SSW movement of the WCDS. The distribution of the three marble units that crop out in central/southern Kythnos suggest large-scale, likely isoclinal folding occurred. (1) Petroussa Lithodeme - a blue-grey calcite (BGC) marble with quartz-calcite-white-mica (QCWM) schists, forming a continuous outcrop around the island, thinning from >16m in the SE to <8m thick mylonites in the SW, overlain by grey sericite-albite-graphite-schists (Flabouria Lithodeme); (2) Rizou Lithodeme - massive grey to BGC marble, with abundant quartz layers, only cropping out above the Flabouria Lithodeme south of Aghios Dimitrios, directly below the WCDS; (3) Mavrianou Lithodeme - mylonitic QCWM schists with lenses of BGC mylonites cropping out above the Flabouria Lithodeme along the west coast, 2.5-9 km N of Aghios Dimitrios. Thus, offshore in the 2.5 km north of Aghios Dimitrios, the Mavrianou Lithodeme is 'replaced' by the Rizou Lithodeme; these units are lithologically quite distinct. However, mylonitic outcrops of the Petroussa Lithodeme are very similar to the Mavrianou Lithodeme mylonites. A tentative structural solution is to argue that the Mavrianou Lithodeme is a large-scale isoclinal fold repetition of the Petroussa Lithodeme; southwards the fold amplitude decreases and dies out offshore north of Aghios Dimitrios; repetition of other lithodemes supports this solution. The origin of the fold is not known but the lithological repetition persists towards the central part of the island, where the transition from ENE-WSW trending Eocene exhumation deformation has not been fully overprinted by NNE-SSW trending Miocene deformation. Hence the fold may have formed as a large-scale structure during syn-orogenic Eocene exhumation of the Cycladic Blueschist Nappe and then been flattened and rotated during Miocene deformation in the footwall of the West Cycladic Detachment System.