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A crustal scale viscous-frictional shear zone (Kea, Western Cyclades, Greece)

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Kea is an island of the Western Cyclades located ca. 65 km SE of Athens in the Aegean archipelago. The single database previously available for the island was a geological map in the scale of 1:50.000 (Davis 1972). Recent structural investigation showed the existence of an hitherto unknown, viscous-frictional crustal-scale shear zone with highly strained rocks dominating the structural records of the whole island. The shear zone has a thickness of some hundreds of meters and acted at deformation conditions from lower greenschist facies to brittle. One major feature of the shear zone is a discordant 10's m thick marble-ultramylonite layer with m-thick cataclasite at its base, which is present in the north and south of the island, crosscutting at a low angle the greenschist and marble unit. The stretching and mineral lineations of all lithologies plunge NE or SW. All ductile (SC' or SCC', clasts with monoclinic symmetry, shear bands) and brittle/ductile (rotated veins, flanking structures, asymmetric boudinage) shear sense indicators are typical of those formed under extensional shearing, and show a consistent top to SW direction. In the northern part of the island, the marble-ultramylonites dips towards N bending in a dome-shape over the whole island and dipping towards the S in the southern parts of Kea. Therefore only the south has true extensional-sense kinematics; we simply interpret the present day thrust geometry in the north as being over rotated.

The greenschist and marble unit below the viscous-frictional shear zone records less localized lower greenschist facies deformation, although up to dm-scales shear zones have been identified. The greenschists are mostly fine grained and overprints a higher temperature fabric. Shear strain is indicated by macroscopic SC' fabric and lensoidal to angular boudins. A high density of syn to post mylonitic quartz veins are present as well as an ultramylonitic-graphitic shear zones indicating mass transfer and solution/precipitation mechanisms during deformation. Additionally the greenschists and interlayered marbles are affected by intense folding whose fold axes parallel the stretching lineation. A second minor fold system developed fold axes with NW-SE direction. There are three groups of brittle structures: (1) Foliation parallel distinct brittle fault zones with cm to m thick, cemented cataclasites indicate a top to SW movement, consistent with the ductile deformation. Extension is additionally supported by (2) a later population of brittle NE directed normal faults. A strong brittle overprint is furthermore associated with (3) the development of a conjugate, steep wrench fault system. The two groups of the conjugate pair system are almost perpendicular and strike NNE-SSW and SE-NW. The steep brittle faults developed dm to 10s m cataclasitic zones and accommodated horizontal displacement of some meters. These strike-slip faults have a transtensional component, generally showing dextral, but in some cases recording also sinistral sense of shear. Late brittle stages of extension are furthermore supported by joints and extension gashes, which indicate a main NE-SW, as well as NNW-SSE extension, clearly influencing the geomorphological evolution of Kea.