Extensional crustal-scale shear zones in the Western Cyclades (Kea, Greece)

Poster

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Intense seismicity and intensely developed active and ancient fault systems are common to the Aegean Region. Extending/thinning crust involves a complex interplay of (1) Gulf of Corinth rift-expansion, (2) west- and south-ward retreat of the Hellenic Trench, (3) westward impingement of the Anatolian Platen, and/or (4) propagation of the Anatolian Fault system into the Aegean. New geological/structural investigations on Kea (also known as Tzia), in the Western Cyclades reveal a low angle crustal-scale, detachment-type ductile shear zone probably formed during Miocene extension and thinning of the continental crust.

The area of interest, which lies in northwestern Kea, comprises a large-scale detachment shear zone. Brittle deformation and lithospheric failure in the region includes at least two failure phases: (1) multiple low angle cataclastic fault zones formed within, and parallel to, a regional mylonitic ductile foliation and (2) a widespread system of (sub)vertical cross-cutting steep faults. For low angle extensional faulting, *a priori* co-seismic deformation (i.e. pseudotychylites) is absent and therefore aseismic creep is suggested, is overprinted by younger steep/vertical fault zones.

A several meter thick low angle cataclastic fault zone, with interestingly developed S–C fabrics, separates (i) steeply dipping, minimal deformation-related microstructure, ankeritised dolomite in the hanging wall from (ii) folded (ultra-)mylonitic marbles in the footwall and is regarded as the upper crustal expression of the failure of regionally thinning crust. The locally more than 10 m thick brittle fault zone comprises numerous generations of cataclasites ranging from foliated protocataclasites with brittle/ductile overprint, incohesive coarse grained fault breccias and partly graphitic fine grained fault gouges. This brittle fault zone locally includes a 2 m thick serpentinite-talc zone, fractured boudin lenses of opalescent serpentine associated with partly ankeritised (mega-) boudins of dolomites. In the northern part of Kea, this brittle fault zone can be mapped over several kilometres. The faults dip at low angle towards the NNW. Slickenlines on brittle faults show consistent NNE–SSW orientations. Shear sense indicators including scaly fabrics and Riedel geometries of secondary fractures consistently indicate south-directed hanging wall displacement direction.

The footwall of the brittle fault zone consists of a several tens of meters thick ultramylonitic shear zone, mainly comprising marbles, phyllites, gneisses and quartzitic schists. The mylonites have a pronounced stretching lineation that has maximum plunge gently towards NNE parallel to the brittle kinematics. Countless textbook examples of a broad range of shear sense indi-

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cators (flanking structures, asymmetric boudinage, stable porphyroclasts with monoclinic symmetry, rotated and boudinaged veins) consistently indicate a south-directed, non-coaxial shearing. Beside a pronounced stretching lineation towards NNE specially in one area distinctive lineations and recurvature is observed. However, the most striking structural observation is the upright non-cylindrical folding of the mylonites with fold axes parallel to the stretching lineation. Shearing of these folds into tubular/sheath folds suggests that folding occurred during shearing due to shortening perpendicular to the stretching lineation. The same shortening direction is associated with gentle buckling of the structurally overlying cataclastic zones suggesting that the W–E shortening component accompanied deformation persisting from ductile, to brittle/ductile to brittle conditions.

Several generations of extension gashes filled with calcite, quartz and actinolite are widespread throughout the mylonitic rocks. Locally, some extension gashes with associated flanking folds are rotated into the shearing direction developing trains of elongated boudins. Quantitive kinematic flow analyses suggest an effective shear strain in the orders of several tens of gamma supporting the interpretation of a high-strain shear zone corroborating with the observation of sheath folds.

The low angle cataclastic fault zones are regarded as the upper crustal expression of the failure of regionally thinning crust. Further investigations will reveal whether steep faults suites may be related to more than one tectonic event and show, for example, a regional genetic link with the actively widening Gulf of Corinth.

In summary, lithological and structural investigations on Kea indicate that the island is a further example of crustal scale shear zone. Preliminary observations suggest that the shear zone bends around the whole island forming a dome-shaped antiform. In analogy to Serifos, a metamorphic core complex to the S of Kea, we speculate that, complementary to the N directed shear zones of Naxos and Paros, the mapped shear zone on Kea is part of an extensional S-directed detachment system.