Geophysical Research Abstracts,
Vol. 11, EGU2009-9807, 2009
EGU General Assembly 2009

Geometry and cross cutting relationships of brittle deformation on Kea (Greece, W. Cyclades)

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The Aegean region represents an active extensional regime formed since the Oligocene due to roll-back of the African Plate within the Eurasian-African collision zone. Extension led to metamorphic core complex formation along low-angle normal faults, causing exhumation of rocks originating near the brittle-ductile transition zone. Bi-directional extension kinematics have been documented in the Attic-Cycladic-Crystalline Complex; the Eastern Cyclades show a top-to-N/NE extension whilst the Western Cyclades show top-to-S-SW extension. Kea, at the western end of the Western Cyclades shows evidence of a poly-metamorphic evolution, with relics of high-pressure metamorphism strongly overprinted by Oligocene-Miocene greenschist facies metamorphism. Kea comprises a footwall of chloritic schists with quartz lenses interlayered with calcite-mylonites. These are overlain by a ductile-brittle shear zone with a consistent top-to-SSW kinematics together with a WNW-ESE oriented shortening component, forming locally a strong crenulation cleavage. Stretching and mineral lineations have a mean NE-SW trend. Detailed structural investigations of the deformation in the western area of Kea (Pisses) were based on remote sensing analysis of fracture trends. This showed two dominant strike directions: ca. NE-SW and NW-SE. Fractures were spaced at ca. 2 – 2.5 m. From the north of Pisses southwards, the angle between the two main fracture directions changes gradually from a rhombohedral geometry (ca. 50°/130° angles between fractures, with the acute angle facing westwards) into an orthogonal geometry (ca. 90°/90°). Field observations revealed that both fracture geometries comprised steeply dipping (60°-90°) and mainly conjugate fractures. Due to the homogenous nature of the pelitic schists, offsets could only rarely be estimated; the maximum recorded was < 40 cm. Reverse offsets were never seen. Reliable slickenside lineations were also not seen. Early fractures show a brittle-ductile deformation mechanism, bending the regional pelitic foliation in a zone up to 1 m wide. Within this is a narrower zone (up to 70 cm wide), usually bounded by sharp planar surfaces, within which the schists were more strongly deformed, partially by brittle mechanisms. A new ‘foliation’ has formed (sub)parallel to these surfaces, and quartz-filled fractures are often present. In marbles, the fractures were narrower, localizing on sharp planes. Late fractures were dominantly brittle in character; they are narrower (< 2 cm), with little or no evidence of the schist foliation bending into the fault surface. Similar to the early fractures, offsets, where recordable, were also small. The ductile component of deformation seen in the early faults indicates that they were active during exhumation, before the rocks cooled to temperatures below the brittle-ductile transition zone. They were thus likely active during low-angled fault movement, and, although the offset on each fault was likely small, combined over the whole island (19.5 km parallel to the stretching direction) at a spacing of 2 -2.5 m, they indicate considerable relatively late extension.