Geophysical Research Abstracts, Vol. 9, 07967, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07967

New evidence of bidirectional extension in the Cyclades: SSW-directed low-angle normal faulting on the island of Kea, W. Aegean

M. Mueller (1), B. Grasemann (1), M.A. Edwards (1) and Team ACCEL

(1) Department of Geodynamics and Sedimentology, Structural Processes Group, University of Vienna, A-1090 Vienna, Austria (geomail@gmx.at / Phone: +43 (1) 4277 53446)

As part of the Aegean-Anatolian-Caucasus-Zagros segment in the eastern Mediterranean Region, the Aegean represents an area of oceanic lithosphere subduction and back-arc basin evolution, with concomitant extension due to Hellenic slab-retreat, during the ongoing convergence and collision between Eurasia and Africa/Arabia.

New results from the island of Kea concerning the regional tectonics within the Western Cyclades indicate top-to-SSW shearing, compared to the uniform top-to-NNE transport indicators which characterise the Eastern Cyclades. This recently compiled data will provoke discussions on where to place Kea within a broader geodynamic scenario during the active-margin evolution (extension plus thinning of the continental crust) of the Aegean since the late Mesozoic.

The island comprises a domed low-angle normal fault system formed during lower greenschist facies metamorphism. As part of this system, the Otzias Bay Detachment (OBD), in the northwest of the island, is part of a higher strain shear-zone within the southerly-directed extensional detachment system in the Western Cyclades.

Based on Quickbird imaging, high-precision GPS, kinematic, lithological and tectono-stratigraphic data, a detailed geological/structural map of the examined area has been created. Apart from the spectacular shear-sense indicators and macro-/microstructures present over the whole island, ductile to brittle progressive deformation, including key stages of this transition, have been observed in the northwest.

In detail, the folded Otzias Bay Detachment comprises a several metre-thick cataclastic fault zone, with large breccia fragment size distributions (0.1 – 10's cm) in-

terlayered with a few cm-thick ultra fine-grained clay-rich gouge layers, serpentinite-talc zones and fractured boudin lenses of opalescent serpentine. This separates (i) a hanging-wall, with microstructures indicating minimal deformation plus ankeritised (mega-)boudins of dolomite, from (ii) ductilely folded (ultra-)mylonitic marbles and well preserved re-mylonitised cataclasite (RMC), gneisses and quartzitic schists in the footwall. Phyllites are mainly observed around marble (mega-)boudins.

The fault dips at low angles towards the NNW. The mylonites have a pronounced stretching lineation with a maximum plunge of ca. 20˚ - 40˚ towards the NNE, parallel to the overall brittle kinematic extension direction. Axes of upright non-cylindrical folds in the mylonite have rotated into the finite stretching direction, generating various stages of ductile sheath folds. These suggest that folding occurred during shearing, due to shortening perpendicular to the stretching lineation.

Furthermore, brittle shear-sense indicators, in particular scaly fabrics and Riedel geometries of secondary fractures, are consistent with this shear direction. The varying orientations of veins and faults indicate different generation scenarios and multiple reactivation periods. To initiate movement along the OBD fault, we suggest that aseismic creep rather than seismic events occurred, since there are, except for a couple of sinter-filled veins, hardly any veins that cross-cut the mylonites, the RMC and also the cataclasite together. There is also an absence of pseudotachylite in the studied area.

We want to highlight that gentle folding of the OBD and the structurally upper cataclastic zones suggest that this W-E shortening component accompanied deformation from ductile, brittle/ductile to brittle conditions.

Using the Mohr Circle of the Second Kind, it was possible to quantify the kinematic flow by examining boudinaged quartz-veins and crosscutting veins in pelitic schists, to asses the amount and nature of the finite shear strain, identifying area-increase due to fluids affiliated with high-strain shearing.

Many textbook examples of a broad range of shear-sense indicators (e.g. flanking structures, asymmetric boudinage, stable porphyroclasts with monoclinic symmetry, rotated and boudinaged veins) indicate coeval NNE-directed extension and W-E shortening, within a consistently top-to-SSW-directed, non-coaxial hanging-wall displacement. This is in complete contrast to the north-directed hanging-wall movement in the Eastern Cyclades.

Further investigations will help to test models of SSW-directed thrusting compared to detachment folding by generating a detailed scenario for the evolution of the Western Cyclades, as well as for the broader Aegean region, based on ongoing field data analysis and geochronology.