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Field and micro-structural record of fault rock evolution within a low-angle normal fault system (Kea, Greece)

Monika Müller, Bernhard Grasemann, and Christoph Iglseder

University of Vienna, Department of Geodynamics and Sedimentology, Structural Processes Group, A-1090 Vienna, Austria (geomail@gmx.at)

Detailed lithostratigraphic and structural mapping on the northwestern part of the island of Kea (Western Cyclades, Greece) revealed a major low-angle normal fault system dominated by both high- and low-angle extensional faults – the Otzias Bay Detachment. It forms parts of a dome-shaped low-angle normal fault system which is characterised by SW/SSW-sense of shear and bends over the whole island, thus representing a Miocene extensional event.

An early stage extension-related deformation phase encompasses ductile mylonitic processes within the metabasitic/calcitic footwall and ductile-brittle cataclastic conditions dominating the calcite/dolomite hosting fault-rock zone. As recorded by samples taken along a profile across the Otzias Bay Detachment structures give evidence for a variety of transitions between the mylonitic and cataclastic end-members such as mylonitic to cataclastic fabrics and also cataclastic fabrics overprinted by mylonitic SCC'-foliations. Within the cataclasite of the fault-rock zone fabric evidence for viscous /frictional interaction is observed. Due to a variation in frictional behavior broken-up components form angular fragments of various sizes and zones of very fine-grained material of intense micro-fracturing, as almost to a fault gouge. Some fragments act as clasts and become rounded components, in some parts they are even enveloped in a rim of fine-grained phyllosilicate. Different vein generations can be observed as ductilely rotated and folded as well as cataclastically deformed together with its host rocks. In later exhumation multiple low-angle cataclastic fault zones formed within, and (sub) parallel to a regional mylonitic ductile foliation. A system of minor and major sets of high-angle cross-cutting steep normal-faults is present. Acting as conduits for hydrothermal fluid infiltration, some of these host remnants of high fluid pressure events such as healed up joints of angular breccia and fluidised cataclastic injection veins.

Different deformation mechanisms within the microstructural record along the Otzias Bay Detachment and the observed cross cutting relationship between frictional dominated and viscous dominated deformation suggests, that it acted as a sub-horizontal extensional fault within the brittle/ductile transition zone with a switch between a velocity strengthening and velocity weakening regime occurring several times during ongoing extension.