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Kinematics of low angle normal fault on Mykonos island (Cyclades, Greece)

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The Cyclades (Greece) have recorded an Oligo-Miocene post-orogenic stage of extension that resulted in the formation of several metamorphic core complexes and associate detachments. Among them, the eastern part of Mykonos island shows a low-angle normal fault dipping 12° NE which juxtaposes a Miocene sedimentary unit in the hanging-wall over Alpine greenschist-facies metabasites (Cycladic Upper Unit) and a 10-12 Ma granite. New field observations allow a better understanding of the structural evolution of these units related to detachment kinematics.

In the footwall of the detachment, the granite intrudes the metabasic Cycladic Upper Unit which is locally preserved. The contact between these units is a ductile shear band dipping 15° NE. NE-trending stretching lineations are widespread in the granite, carried by a shallow-dipping mylonitic foliation. A shearing gradient toward the detachment is deduced from the increase of the density of mylonitic and ultramylonitic shear bands. Top-to-the-NE kinematic indicators are systematically observed and the sheared contact is folded by asymmetric folds consistent with NE-ward displacement of the hanging-wall.

The lower part of the Cycladic Upper Unit contains granitic sills and is cut by steep and shallow-dipping normal faults, soling into the contact between granite and metabasites.

Below the detachment, both the upper parts of the Cycladic Upper Unit and the granite display a cataclastic deformation and a densification of veins near the detachment. Metabasites are overlain by a 50-centimeters thick orange-coloured gouge, containing the detachment itself (plane of maximal shearing) and a foliated wine gouge. When the detachment plane crops out, it shows a 10-meters scale corrugation parallel to the slip direction.

The hanging-wall unit consists of shallow-dipping or horizontal sandstones and conglomerates evolving into a 10-meter thick breccia close to the detachment. These formations are cut by regularly-spaced NE-dipping normal faults soling into gouges. Soft-sediment deformation is observed in the hanging-wall in the vicinity of normal faults. Slumps and fan-shaped deposits related to high-angle normal faults soling into the detachment, testifying for its syn-sedimentary kinematics.

The inversion of fault-slip data indicates that the direction of the minimal stress axis is parallel to the stretching lineation and the direction of the maximal stress axis is sub-vertical. This is consistent with late sub-vertical barite dikes cutting all units from the upper part of the granite to the sedimentary unit.

Both the attitude of sediments and palaeo-stress results preclude a significant post-slip tilt of the whole structure. The Mykonos detachment shows a continuum from ductile to brittle with a clearly reactivation of the detachment in brittle conditions.