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Strain localization along micro-boudinage

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The progressive development of boudinage strongly depends on the kinematic framework and the mechanical properties of the boudinaged layer and host rock. A common type of boudin, which can often be observed in natural examples, is the domino boudinage. This boudin type typically reflects a strong competency contrast of the interlayered rock sequences. Numerical models have shown that a relatively high amount of strain is necessary in order to develop separated boudin segments. With ongoing deformation and consequent rotation of the individual segments into the shear direction, the terminal sectors tend to experience a higher rotation rate, progressively resulting in isoclinal folding.

Whereas most investigations of domino boudinage are cm- to dm-scale examples, we examined one order of magnitude smaller examples, where the deformation mechanism between the segments and the matrix could be directly investigated. The samples are from Kalymnos Island located in the southeastern Aegean Sea (Dodecanese islands-Greece). The analysed sample belongs to the upper unit of the pre-Alpidic basement, which consists of a succession of marbles, which were deformed under lower-greenschist facies conditions during the Variscan orogeny. 40Ar/39Ar geochronological dating on white micas in the adjacent upper quartz-mica schists unit yielded deformation ages between 240 and 334 Ma.

The calcitic marble comprises boudinaged dolomite layers with thickness varying between 1 and 20 mm. Progressive deformation of the boudinaged layers resulted in the development of ptygmatic folds with fold axes parallel to the stretching lineation. The grain size from the host rock marbles (10 μm) decreases towards the boudinaged dolomite layer (5 μm) indicating strain localization adjacent to the dolomite layers. Furthermore, strain is localized within micro shear zones which nucleate in the necks of rotated boudin segments. Crystallographic preferred orientations (CPO) derived from electron backscatter diffraction analysis show a distinct variation in CPO between the coarser and finer grained calcite next to the boudinaged dolomite. Detailed microstructural analysis revealed that strain is strongly partitioned parallel to the boudin segments and to the almost oblique inter-boudin surfaces.