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Quantitatively estimated mass transfer, volume change and quantitative kinematics investigations in ductile low-angle shear zones (Serifos, Greece)

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The island of Serifos, which lies ca. 100 km SSE of Athens, belongs geologically to the Attic-Cycladic massif. The island is dominated by a Late Miocene high-level I-type granodiorite pluton, which intruded orthogneisses, amphibolites, greenschists and marbles. The granodiorite intrusion, together with associated dykes and the host rocks, has been deformed by low-grade greenschist facies, brittle/ductile to cataclastic shear zones. These low-angle shear zones, which arch over the island, everywhere record top-to-SSW kinematics. In the SE part of Serifos (Aghios Sostis), the low-angle shear zones are exclusively developed in the massive granodiorite pluton. The footwall of the shear zone consists of the essentially undeformed to slightly foliated, medium to coarse grained granodiorite. The main components are partly zoned Pl, perthitic Kfs, Qtz, Bt and Hbl. Locally, interstitial intergrowth of Qtz and Kfs is observed. The granodiorite is intensely overprinted by a conjugate ca. NW-SE to NE-SW striking joint pattern along which mafic minerals have been altered in centimeter-thick rims. A few meters below the main shear zone, the granodiorite has been intensely foliated and isolated ductile shear zones develop at higher structural levels into an anastomosing network. The main, several meter-thick low-angle shear zone consists of completely mylonitized granodiorite. The mylonitic foliation dips moderately towards the SE and consistent shear sense criteria (shear bands, sc-, scą-fabrics) indicate top-to-SSW directed non-coaxial deformation, parallel to the well-developed stretching lineation. The grain-size of the rock-forming minerals generally decreases an order of magni-

tude within the shear zone. Quartz deformed mainly by dislocation glide, forming highly elongated monocrystalline grains. Isolated single grains of Pl do not record a preferred orientation but developed ČÔ-clast geometries associated with co-rotation of the clasts. In contrast, Bt, and to some extent also Hbl, do record stable orientations, developing mica-fish- and Čã-clast geometries, respectively. Quantitative kinematic indicators suggest a shortening component normal and stretching parallel to the shear zone boundaries. However, a possible volume change during deformation cannot be estimated based on the kinematic criteria. In order to investigate volume change during deformation, major and trace element compositions of selected rock-samples were analyzed and the specific gravities determined. From this, a geochemical profile, characterizing and quantifying the gradient from the undeformed to the intensively sheared (ultramylonitic) granodiorite was made. The results were plotted on isocon diagrams and additional volume- and mass-balance calculations were carried out to assess gain, loss and lateral migration of individual elements, as well as to quantify the flow path of the low-angle shear zone.