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Quantitative microstructural analysis of western Mediterranean strike-slip kinematics: the Palmi Shear Zone, southern Calabria, Italy

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We apply Quantitative Microstructural Analysis (QMA) to a selection of mylonitic rocks that originate from different protoliths, ranging from tonalite to skarn and passing through migmatitic paragneiss. These rocks, that at the end of Paleozoic originally belonged to the lower crustal portion of the southern European Variscan chain, were successively involved in deep-seated strike-slip kinematics of the western Mediterranean realm, created by the relative movement in the Paleocene of the African-European colliding plates. This geodynamics leads to the roto-translation of the Sardinia-Corsica block and the drifting of the kabilo-clabride microplate system (Cirrincione et al., 2015). Remnants of these high strain-rate strike-slip zones are characterized by rheological behaviours controlled by the selective activation of their specific interconnecting weakening phase, as well as by the rheology and abundance of porphyroclasts. QMA is generated by means of new semi-automated GIS-based tools that allow us to extrapolate statistically meaningful kinematic and rheological properties of this meso-Alpine strike-slip mylonitic shear zone (i.e. Palmi Shear Zone). This, in turn, constrains the Alpine evolutionary stages of southern Calabrian geodynamics (Ortolano et al., 2020). Semi-automated image analysis of mXRF maps, combined with high-resolution thin-section scans involving new GIS-based tools developed for structural analysis (e.g. Ortolano et al., 2018; Visalli, 2018), was performed on a selection of three different mylonitic rock-types. These tools permit the user to quantitatively extrapolate rock-fabric parameters such as grain size, aspect ratio and orientation, which allows the nature and relative percentage of the weakening vs. hardening layers, as well as their kinematics, to be derived. Our results allow us to distinguish the porphyroclastic domain levels constituted alternatively by feldspar, amphibole, pyroxene or scapolite, from the weakening phase ones dominated by quartz, biotite plus quartz, or by calcite when the weakening layer is controlled by skarns. Image analysis of porphyroclastic domains has been used to infer the dominant shear-type through Rigid Grain Analysis, revealing a pure shear component of 66 to 68 % for the mylonitic tonalites; 62 to 66 % for the mylonitic paragneisses; and 58 to 62 % for the mylonitic skarn. Image analysis conducted on quartz-rich domains allows an estimate of the shear strain rate, which ranges on average from $1.14*10^{-12}$ (1/s) for mylonitic paragneiss to $5.91*10^{-12}$ (1/s) for mylonitic tonalite, and is in accord with high strain zones in natural settings. Our results provide new insights into the kinematics and rheology of this

exhumed relic of the deep-rooted early-Alpine strike-slip tectonics of the western Mediterranean.

References

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