EGU21-1316
https://doi.org/10.5194/egusphere-egu21-1316
EGU General Assembly 2021

Unveiling ductile deformation during fast exhumation of a granitic pluton in a transfer zone

Richard Spiess[1], Antonio Langone[2], Alfredo Caggianelli[3], Finlay M. Stuart[4], Martina Zucchi[3], Caterina Bianco[3], Andrea Brogi[3,5], and Domenico Liotta[3,5]

[1]Department of Geosciences, via Gradenigo, 6, University of Padua, Italy, richard.spiess@unipd.it
[2]CNR-IGG, Institute of Geosciences and Earth Resources, Pavia, Italy
[3]Department of Earth and Geoenvironmental Sciences, University of Bari, Italy
[4]Isotope Geosciences, Scottish Universities Environmental Research Centre, East Kilbride, UK
[5]CNR-IGG, Institute of Geosciences and Earth Resources, Pisa, Italy

Exhumation and cooling of upper crustal plutons is generally assumed to develop in the brittle domain, thus determining an abrupt passage from crystallization to faulting. To challenge this general statement, we have applied an integrated approach involving meso- and micro-structural studies, thermochronology, geochronology and rheological modeling. We have analyzed the Miocene syn-tectonic Porto Azzurro pluton on Elba (Tuscan archipelago – Italy), emplaced in an extensional setting, and have realized that its fast exhumation is accompanied by localized ductile shear zones, developing along dykes and veins, later affected by brittle deformation. This is unequivocally highlighted by field studies and the analysis of microstructures with EBSD. In order to constrain the emplacement and exhumation rate of the Porto Azzurro pluton we performed U-Pb zircon dating and (U+Th)/He apatite thermochronology. It results in a magma emplacement age of 6.4 ± 0.4 Ma and an exhumation rate of 3.4 to 3.9 mm/yr. By thermo-rheological modeling we were able to establish that localized ductile deformation occurred at two different time steps: within felsic dykes when the pluton first entered into the brittle field at 380 kyr, and along quartz-rich hydrothermal veins at c. 550 kyr after pluton emplacement. Hence, the major conclusion of our data is that ductile deformation can affect a granitic intrusion even when it is entered into the brittle domain in a fast exhuming extensional regime.