Geophysical Research Abstracts
Vol. 19, EGU2017-3044, 2017
EGU General Assembly 2017

Direct dating of Late Miocene-Early Pliocene compression on Elba Island: Is a new paradigm necessary for the opening of the Northern Tyrrhenian Sea?

Giulio Viola (1), Espen Torgersen (2), Francesco Mazzarini (3), Giovanni Musumeci (4), Paolo Stefano Garofalo (1), and Roelant van der Lelij (2)

(1) University of Bologna, Department of Biological, Geological and Environmental Sciences, Bologna, Italy (giulio.viola3@unibo.it), (2) Geological Survey of Norway, Trondheim, Norway, (3) Istituto Nazionale di Geofisica e Vulcanologia, Pisa, Italy, (4) University of Pisa, Department of Earth Sciences, Pisa, Italy

The northern Apennines accommodated the closure of the Liguro-Piemontese Ocean along the European and Adriatic continental margins. Crustal shortening via folding, eastward thrusting and stacking of oceanic and continental units during the westward subduction of Adria beneath the European plate shaped the orogenic prism starting in the Eocene and continuing to the Middle Miocene. Intrusive and volcanic rocks between 8.4 and 3 Ma crop out extensively in the northern Tyrrhenian Sea, and their emplacement in the inner portion of the belt is commonly interpreted as resulting from major crustal extension related to the Late Miocene–Pliocene opening of the northern Tyrrhenian Sea as a backarc basin. On the Island of Elba, which exposes the westernmost portion of the prism, the low-angle Zuccale fault (ZF) is generally interpreted as a major low-angle normal fault (LANF) whose Late Miocene activity would have greatly facilitated regional E-W extension in the geodynamic framework of the opening of the northern Tyrrhenian Sea between 10 and 5 Ma.
In order to better constrain the kinematic meaning of the ZF and the timing of these important events, we have used the K-Ar method to date a set of brittle-ductile and brittle fault rocks cut by the ZF and sampled from its immediate footwall. A last sample from the brittle ZF itself is currently also being dated. The dated deformation zones in the ZF footwall are both thrusts with top-to-the east kinematics. They are undoubtedly cut by the brittle ZF and thus predate it; they are 1) the Calanchiole shear zone, formed by strongly sheared carbonate hornfelses and 2) the Capo Norsi fault, a brittle fault zone within serpentinites of the Ligurian sequence. While the Calanchiole shear zone developed coevally with the c. 6.2 Ma Porto Azzurro (PA) monzogranite, the Capo Norsi thrust led to the internal stacking of the PA contact aureole, and separates an upper complex that did not experience contact metamorphism from the underlying medium-grade hornfels rocks of the contact aureole at c. 6.2 Ma. K-Ar ages were produced from synkinematic illite separated from multiple grain sizes, with the goal to discriminate the role of clay synkinematic authigenesis and thus date the last increment of deformation. The age of the dated finest fraction constrains the age of the Calanchiole shear zone to 6.14$\pm$0.64 Ma (<0.1 μm fraction) and of the Capo Norsi thrust to 4.9$\pm$0.27 Ma (<0.4 μm fraction).
Our results are fully consistent with the existing data and importantly provide the first direct dating of brittle deformation in the Apennines. In combination with field, kinematic and regional considerations, they undoubtedly constrain a Late Miocene-Early Pliocene regional compressive stress state, with the brittle ZF likely being its latest expression. This followed an earlier phase of upper crustal extension, presumably active since $\sim$16 Ma and was in turn followed by renewed extension. Compression at that time requires a re-evaluation of the geodynamic models of the evolution of the northern Apennines orogenic prism.