A complex deformation pattern across Nubia-Eurasia boundary: Sicily, Calabria and the Messina Strait (Italy)

Nicola D'Agostino » Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy
Giulio Selvaggi » Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy

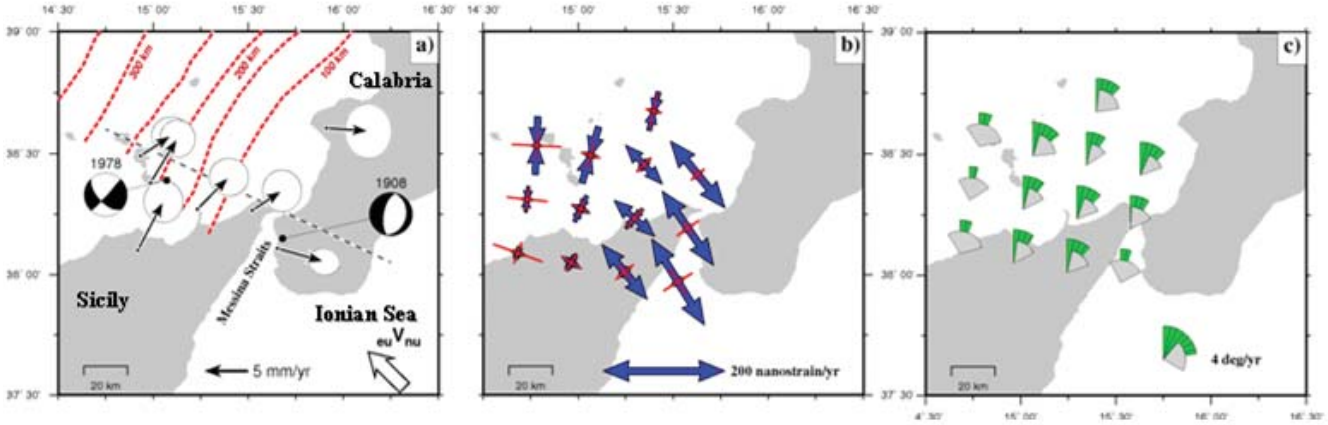

Figure 1. (a) Combined velocity solution in a Nubia reference frame. Focal mechanisms of the 1908 Mw 7.1 Messina earthquake and 1978 Mw 6.0 Golfo di Patti earthquake are also shown together with the depth contours of the Ionian slab. **(b)** Principal axes of the horizontal strain rate tensor (in blue) and associated 1-sigma errors (red bars). **(c)** Rotation rates (green wedges and associated 1 sigma error in gray) on a 30-km regular grid (modified from D'Agostino and Selvaggi, 2004).

The Eurasia-Nubia plate boundary in Calabria and Sicily, revealed by the GPS velocity field, is characterized by distributed deformation that varies spatially at short scales. The deformation involves a high rate of strains and rotations as indicated in Figure 1. Regionally, there are two main styles of deformation that accommodate the general NW-SE convergence of Nubia towards Eurasia. Crustal shortening along the former Tyrrhenian back arc passive margin in Sicily, west of the Messina Strait, and a trench-parallel motion in Calabria (in the Eurasia reference frame), east of the Messina Strait, suggest the presence of an intermediate crustal block which can be interpreted either as a forearc sliver or as an independent Ionian block. The resulting N115E-oriented Sicily-Calabria GPS relative motion is consistent with the extension observed during the large 1908 Mw 7.1 Messina normal fault earthquake, the most devastating earthquake to occur in the Central Mediterranean. We estimate that up to 3 mm/yr of relative motion between Sicily and Calabria may be taken up in the Messina Strait and presently accumulating on the fault responsible for the 1908 earthquake or other unknown faults. In developing the Italian CGPS network (RING), we recently installed seven additional high rate (1 Hz) CGPS receivers, some of them co-located with broadband seismometers and accelerometers, across the two edges of the Messina strait. The instruments will better define the extension rate, measure strain accumulation across the active normal faults, and help to detect and model seismic waveforms from moderate to large local earthquakes.

Reference

D'Agostino, N., and G. Selvaggi (2004), Crustal motion along the Eurasia-Nubia plate boundary in the Calabrian Arc and Sicily and active extension in the Messina Straits from GPS measurements, J. Geophys. Res., 109, B11402, doi:10.1029/2004JB002998.

D'Agostino, N., D. Cheloni, S. Mantenuto, G. Selvaggi, A. Michelini, and D. Zuliani (2005), Strain accumulation in the southern Alps (NE Italy) and deformation at the northeastern boundary of Adria observed by CGPS measurements, Geophys. Res. Lett., 32, L19306, doi:10.1029/2005GL024266.

Avallone A., N. D'Agostino, G. Selvaggi, M. Mattia, M. Rossi and the Cesis Project: a new satellite seismic and CGPS network in southern Italy to study plate boundary deformation in the Central Mediterranean, AGU fall Meeting, T053B-0494, 2004.