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Relationship between surface and deep structure at Mt. Etna volcano (Sicily)

Giorgio De Guidi, Salvatore Scudero, and Stefano Gresta
Department of Geological Sciences, University of Catania Italy

Introduction
The eastern Sicily is dominated by a long fault belt named Siculo-Calabrian Rift Zone (SCRZ), accommodating a N 115°E directed extension rate of about 3.0 mm/year. Catalano et alii (2008) noted that the fault segments of the SCRZ running next to the volcanic edifice of Mt. Etna do not obey to the empirical scale-law relating fault length and maximum expected Magnitude that fit the other segments. We combine seismological, morphological and tectonic data in order to better constrain the seismotectonic behaviour of this relatively restricted area.

Seismological data
We collected information about fault parameters (strike, length, displacements, kinematics) for more than 50 episodes of coseismic surface faulting. Earthquake Magnitude was regressed on the geometrical parameters of the faults in order to calculate empirical relationships. For the calculations, we assumed a square-shaped rupture area, hence the rupture width is equal to the rupture length for each event. The Magnitude – Seismic Moment relation well agrees with those proposed by other authors but calculated through spectral analysis of seismic signals (SARAÒ et alii, 2001; GIAMPICCOLO et alii, 2007).
Assuming a mean dip angle of 60°, that is common in normal faults, the seismogenic thickness corresponding to the maximum rupture lengths ever recorded (6 - 6.5 km) is $\sim$5.5 km. This value agrees with the main decrease in depth of the earthquake number (GRESTA et alii, 1998; LA DELFA et alii, 2007) and, assuming a gradation from the absence of surface faulting to complete surface expression in dependence of depth, with equal magnitude, it explain the low earthquake magnitude ($\sim$2.5) necessary to have coseisimc ground rupture

Morphological and tectonic data
A submerged marine platform has been recognized through seismic profiles carried out by BOUSQUET et alii (1998) and referred to the Last Glacial Maximum of about 20 ky ago (ANTONIOLI et alii, 2004). The platform formed when the sea level was 130 m below the present sea level and nowadays is located at various depths. It reaches its minimum depths approximately at the same latitude of the summit of the volcano (60-80 m b.s.l) and deepens gradually Northward and Southward. The irregular uplift that the platform experienced can not fully explained by the regional signal or by the local active faults tectonics that play a role in the uplift of the entire eastern coast of Sicily (CATALANO & DE GUIDI; 2003). The unsolved uplift component is likely linked to an isostatic compensation caused by a thermal anomaly heating the crust that become less dense and thinner. The thermal anomaly is connected to the occurrence of the volcano at the surface.

Conclusions
We support the hypothesis of a local thinning of the seismogenic layer below eastern Mt. Etna due to the influence of the heat on the rocks rheology. Consequently, fault segments on the lower Eastern flank of Mt. Etna affect a shallow, brittle-deforming crust, whereas offshore segments are deeper rooted. This also would account for the seismic behaviour of the Etnean branch of the SCRZ: onshore faults segments are characterized by high-frequency, shallow and low-energy earthquakes while offshore faults, as shown in seismic profiles (NICOLICH et alii, 2000), have greater dimensions and gave also large earthquakes in historic time (BIANCA et alii, 1999, CATALANO et alii; 2008).
Finally, according with a pure-shear rift model (MC KENZIE, 1978), a discrete shear zone defines the base of upper-crustal normal faulting at or near the brittle-plastic transition in the crust and accommodates the extension. The detachment runs along the upper-lower crust mechanical discontinuity, ramping down towards the Ionian offshore. Conversely, beneath the detachment the crust accommodates stretching across a broad zone, either by development of penetrative ductile strain, or by movement on an array of anastomosing shear zones.

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