2010-2014 Seismic activity images the activated fault system in the Pollino area, at the Appennines-Calabrian arc boundary region

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Citation: DE GORI, P. ...et al., 2014. 2010-2014 Seismic activity images the activated fault system in the Pollino area, at the Appennines-Calabrian arc boundary region. Presented at GNGTS - Gruppo Nazionale di Geofisica della Terra Solida, Bologna (Italy), 25-27th November.

Additional Information:

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Metadata Record: https://dspace.lboro.ac.uk/2134/25710

Version: Published

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“Mercure” event in 1998 (Brons et al., 2009). The Parametric Catalogue of Italian earthquakes (CPT11, Rovida et al., 2011), shows very well the lack of strong earthquakes in the region: there is a clear evidence of large earthquakes in the Campania-Basilicata area (M=7.0) and several strong earthquakes in the Stila region and in the whole Calabrian territory. According to the seismic classification of the national territory, the area affected by the 2010-2014 seismic activity have a relatively higher probability to be shaken by a strong acceleration (Gruppo di Lavoro MPS, 2004). Most of the seismic events occurred in areas where the peak ground acceleration having 1% chance of being exceeded in next 50 years is between the values of 0.225 g and 0.275 g.

The 2010-2014 seismic activity and the temporary seismic networks. Between 2010 and 2014 the Italian Seismic Network (Amato and Mele, 2008) detected about 6000 earthquakes in the study area (Italian Seismological Instrumental and Parametric Data Base-ISIDE Working Group, 2010; ISIDE.rm.ingv.it; Fig. 1). The seismic activity shows an unusual spatio-temporal pattern (Pascuelli et al., 2012): swarm-like activity and mainshock-aftershock sequences coexist. In 2011 the earthquake rate has been variable, with increasing and decreasing phases and maximum magnitudes below Mw = 4.0. On May 28, 2012, a shallow event with local magnitude Mw =4.3 struck about 5 km E of the previous swarm. The seismic activity remained concentrated in the Mw = 4.3 source region until early August showing a mainshock-aftershock behaviour. At that time seismicity jumped back westward to the previous area, with several earthquakes of local magnitude larger than 3.0, culminating with a Mw = 5.0 earthquake on October 25, 2012. The seismic rate remained high for some months, but magnitudes did not exceed the 3.7. The seismic rate suddenly decreased at the beginning of 2013 and stayed quite low for the rest of the year up to June 2014 when a magnitude 4.0 occurred in the eastern cluster. The fault plane solutions identified by the Time Domain Moment Tensor (TDMT; http://cnt.rm.ingv.it/tdm.htm; Scognamiglio et al., 2009) for the two major events are consistent with normal faults trending ~N20W and dipping at about 45°.

During these years several temporary seismic stations were deployed in the area (Fig. 2). After the increase of seismic moment release in November 2010, the Centro Nazionale Terremoti of INGV, in collaboration with the Dipartimento di Fisica dell’Università della Calabria, improved the seismic monitoring network in the Pollino region in order to lower the detection threshold of the network and improve the hypocentral locations of small earthquakes. One permanent station of the Italian Seismic Network was installed to the south along the Tyrrhenian coast, 3 real time (UMTS transmission) temporary stations were deployed and 2 stand alone stations. At the end of May 2012, after the occurrence of the Mw = 4.3 event, two other temporary stations transmitting in real time to the INGV monitoring room were deployed. At the end of July 2012 the first temporary stations were removed leaving only the two real time stations installed at the end of May 2012 (Amato et al., 2012). Between the end of October and the beginning of November 2012, after the Mw = 5.0 earthquake, an international research team by the INGV and the German Research Centre for Geosciences (GFZ) installed 15 seismic stations and an array to improve the detection capabilities of the INGV permanent network giving us the opportunity to refine the location of the earthquakes hypocenters. Six stations constitute the small aperture seismic array (Grimaldi et al., 2013).

The activated fault system. A combined dataset, including three-component seismic waveform recorded by both permanent and temporary stations, has been analyzed in order to obtain appropriate 1D and 3D velocity models for earthquakes location in the study area. We produced refined locations by means of HypoELPSE (Laht, 1989) for events recorded from October 2011 to March 2013 using waveforms of temporary stations installed during the seismic sequence. In order to compute the final 1D velocity model we apply the inversion scheme introduced by Kisting et al. (1995) and implemented in the code VELFEST to an optimal sample of seismicity, representative of the seismic network's volume. We plot in figure 3 only events with small location errors (smaller than 1 km).

Refined earthquakes locations allowed us to infer the geometry of the faults relative to the two strongest shocks and to image the entire activated fault system. The seismicity is mainly...
distributed in two clusters: a larger one to the W below Mormanno (MMN station) where the $M_s=5.0$ event occurred, and a smaller one to the E, closer to Castrovillari town, where the $M_s=4.3$ event occurred. In the map of Fig. 3 these two larger events are represented by the purple stars and earthquakes with magnitude larger than 3.5 are the yellow stars.

The swarm-like activity of November 2011-May 2012 and again August 2012-November 2012, seems to be concentrated mainly in the northwestern part of the activated fault system and occurred on a diffuse crustal volume more than on fault planes (see sections in Fig. 3). The western cluster is active since the end of 2011: in its northern portion (section 3) hypocenters are localized in a ball-shaped volume, while in the southern part (section 5) hypocenters define a SW-dipping fault plane. The plane was imaged by the seismicity also in the period before the $M_s=5.0$ event. In the section 5 it is also visible an antithetic fault plane to the W. Even if the eastern cluster has a lower number of refined locations, nevertheless the hypocenters define a NE-dipping fault plane, which seems related to the occurrence of the $M_s=3$ event of May 2012.

Conclusion. The geometry depicted by the seismicity and shown in Fig. 3 images the activated fault system: i) it affects the shallower 10 km of the crust; ii) it is constituted by at least three faults shorter than 10 km; iii) it strikes towards NW-SE. The dip of the fault of the $M_s=5.0$ event is toward SW while the other smaller faults dip toward NE. A similar geometry of the main fault has been pointed out Torreone et al. (2013), although with lower resolution.

Comparing our results with the seismogenic sources reported in the DSS we find that the activated fault system is placed between the two major faults reported in this database. The geometry of the “rimondiello-Mormanno” fault system, constrained by geological data, is roughly consistent with the trend of the recent seismicity, but its dip is to the NE. The “Pollino” source (Castrovillari Fault, according to Cinti et al., 1997) has a comparable trend (N30W) and a western dip, as the 2010-2012 seismicity, but its northern edge corresponds with the southernmost epicenters. Lastly, the fault systems described by Broccianti et al. (2013), in the detailed structural map, shows several faults that could be connected to the faults depicted by the seismicity at depth.

The scientific developments of this work will aim at a better understanding of the origin of the ongoing seismic activity in the Pollino area. Furthermore we are analyzing thousand of seismograms looking for anisotropic parameters, by means of Anisomat code (Piccinini et al., 2013); and tomographic vp and vps models, by means of Simuls1D code (Haslinger, 1999) to gain a better understanding of the ongoing seismic activity and to yield a better correlation between the fault structures at the surface and at depth.

References
I TERREMOTI OLOCENICI DELLA FAGLIA DI CITANNOVA (CABALDRIA MERIDIONALE): NUOVI PALEOSISMOLÓGICI

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I terremoti olocenici della Faglia di Citannova (Cabaldría meridionale): nuovi paleosismologici

Introduzione. L’Arco Calabro, nel suo settore triestino, è stato l’area sorgente dei più energetici e catastrofici terremoti della storia siciliana. A partire dal diciassettesimo secolo, separati da poche oltre poche di anni: i più duri, essi, sono successivi a partire dal dolce costituito da dolci i quali sono siti conosciuti nel 1852 e 1883 di Milazzo, e da contemporanei a diattacchi con le disposizioni generali. E non conclusivo. L’unico per il quale si abbia contezza di danni molto gravi ed esiti è quello del 1844, avvenuto tra la valle del Crati e quella del Simm, ma con fonti così scarne ed elusivi che non ne hanno permesso una valida parametrizzazione.