CONTRIBUTION TO THE SEISMOTECTONIC STUDIES IN THE AREA AT THE CALABRIA-LUCANIA BORDER BY MEANS OF GEOPHYSICAL MONITORING AND ANALYSES

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Seismographic monitoring and elaborations

In the firm belief that local scientific institutions have among their own duties the collection of research data from about the quiescence, geophysical phenomena which could be more difficult (sometimes also impossible) to be monitored from greater distances, the seismographic team active at Calabria University (UniCal), has been monitoring the occurrence of the Pollino area during the period from 2010 to 2015. The team has undertaken a set of improvements: the installation of a new, single-component station with local recording on paper, and the development of a 3D device with in a real-time to the recording center at the UniCal Geophysical Laboratory. Since 2010 these signals are shared with Instituto Nazionale di Geofisica e Vulcanologia (INGV - Rome), as a role of the Italian Centralized National Seismic Network.

In October 2010, at the beginning of the sequance lasted until at least 2013-14, a set of temporary seismic stations were installed in Mornennia and in its surroundings, due to the increase of the seismic activity (Fig. 1), with shocks more and more frequently observed at the inhabited.

In the successive years this system, strengthened in 2011 by further stations of INGV, underwent several changes, due to technical and logistic reasons and also in response to regulations of epicenters. In 2014-2015 four temporary stations of UniCal and two of INGV have continued to operate (Fig. 1). Along with the field operations, in the frames of the 2014 DPC - INGV Project the software used in elaboration of data has been improved and the real-time analysis of the signals arriving to the recording center in the UniCal Campus has been recently introduced. Moreover, by using the algorithm recently proposed by Baldetti et al. (2016), a new computer program has been created for the automatic detection of shocks and automatic analysis of the documents received in the first year of the sequance at the lift stations.

The collection of data from different sources is performed by means of software ad hoc created at Geophysical Laboratory of UniCal. Data from offshore stations are added as soon available. In these cases the focal parameters are recalculated and the catalogue updated again.

The distribution of hypocenters in the span 2014-010-201503 shows a more intense activity along the westernmost structure in terms of locality events (Fig. 3). In the recent past, seismic sources are generally deeper along the westernmost cluster and only few sources are located at depth below 1 - 2 km. Hypocenters included in the catalogue are calculated by means of the program SGRID/P (Evans et al., 1994) using the velocity model described by Orecchio et al. (2011).

The energy and strain release evidences a maximum in correspondence to the m L 4.0 shocks on June 4, 2014 that marks an evident decrease of the release rate (Fig. 4).

The CAP technique (Zhu and Helmberger, 1996) is routinely applied to seismographic records of station lists with m L ≥ 2.5 for calculating a preliminary focal mechanism. The minimum value for which reliable and acceptable results has been obtained was m L = 2.3.

Geological and structural field surveys

The different lithotectonic structures thus far surveyed suggest that the Calabria-Lucania boundary area has been affected by multiple deformation episodes in the recent geological past. Our structural and geographical surveys have identified the different fault and characterized several faults (Fig. 11). The first tectonic phase was characterized by NE-directed thrust-folding, that developed a strataextensional/normal-high (Pollino Massif) trend. Later, the western sector of Pollino Massif was affected by extensional tectonics and the multi-branch extensional faults (Borghi et al., 2013). The associated deformation of the Mercure Basin is characterized by the formation of an Anti-Apennine tectonic faults (Fig. 11). The main tectonic expression of this system is a multi-branch SW trending normal and reverse fault along the SE flank of the basin (Fig. 11). This regional fault system is highlighted by the local structures and by both structural and geographical features, such as the lefthand of a prominent tear from the feeder valley (Frassino Valt). This fault zone is traceable for about 20 km of the basin and it is bounding the north the westernmost alluvial cones between the towns of Macerata and Prato. Technically, this left-extensional fault zone may separate the highly extended Mercure Basin from the less extended remaining part of the Pollino Massif.

GPS monitoring activities

After the identification of the Grottevecchio normal fault on the south-western slope of the Pollino mountain range as the origin of pre-epidemic quakes with magnitudes up to 6.2, (Cinti et al., 2002), a continuous GPS network was installed in order to study the current behavior of such geological structure. It was made up by ten stations and was monitored for the period 2003-2009. (Sabadini et al., 2005; Parisi et al., 2011). All its original benchmarks are located east of the seismotectonics of the 2010-2012 seismic sequences. This monitoring system was improved at the end of 2012 by the activation of a continuous GPS station of Prastio and a corner reflector to be utilized in interferometric studies of the crustal deformation. It was extended westward by a new campaign of the POL-NET network described by Orecchio et al. (2011). A new GPS network with the installation of a continuous GPS station at Prastio and a corner reflector to be utilized in interferometric studies of the crustal deformation. It was extended westward by a new campaign of the POL-NET network described by Orecchio et al. (2011). The comparison with previous measurements did not show any statistically significant displacement (Borghi et al., 2013). Our structural and geomorphological field surveys have identified and characterized several faults (Fig. 11). The first tectonic phase was characterized by NE-directed thrust-folding, that developed a strataextensional/normal-high (Pollino Massif) trend. Later, the western sector of Pollino Massif was affected by extensional tectonics and the multi-branch extensional faults (Borghi et al., 2013). The associated deformation of the Mercure Basin is characterized by the formation of an Anti-Apennine tectonic faults (Fig. 11). The main tectonic expression of this system is a multi-branch SW trending normal and reverse fault along the SE flank of the basin (Fig. 11). This regional fault system is highlighted by the local structures and by both structural and geographical features, such as the lefthand of a prominent tear from the feeder valley (Frassino Valt). This fault zone is traceable for about 20 km of the basin and it is bounding the north the westernmost alluvial cones between the towns of Macerata and Prato. Technically, this left-extensional fault zone may separate the highly extended Mercure Basin from the less extended remaining part of the Pollino Massif.