THE TECTONIC EVOLUTION OF THE WESTERN CATANZARO TROUGH (CALABRIA, SOUTH ITALY), PRELIMINARY RESULTS
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Introduction. The study area is located in the western sector of Catanzaro Trough (central Calabria), extending from the Sila Massif, to the south, to Serre Massif to the north (Fig. 1). Although the partitioning in strike and oblique slip fault systems has been widely studied, it is still a matter of debate. These faults are considered responsible for the present-day shape of the whole Calabrian Arc, as well as the segmentation into several blocks that allow the opening of several transversal basins (Ghisetti and Vezzani, 1981; Turco et al., 1990; Van Dijk et al., 2000; Peacock and Parfitt, 2002; Booth-Rea et al., 2004; Tansi et al., 2007; Schlische and Withjack, 2009). According to Tansi et al. (2007) these structures are represented by three major faults;
among which the Lamezia-Catanzaro Fault Zone had controlled the Catanzaro Trough from the Middle Miocene up to Middle Pleistocene.

Geophysical studies, especially seismic anomalies (Barberi et al., 2004), allow to identify these transcurrent regional fault systems, which are considered by Del Ben et al. (2008) as two tectonic elements accommodating movements between northern and southern sector of Calabrian Arc.

The structural framework of the Calabrian belt is further complicated by the activation of recent longitudinal fault systems, namely the N–S and NE–SW striking faults that are parallel to the mountain system.

Considering the high structural complexity and the currently active tectonics, the Calabria is one of the Mediterranean regions which present the highest probability of occurrence of major earthquakes (Rotondi, 2010). The distribution of crustal seismicity shows that most of the events which have occurred in the study area are located in the hanging-walls of Plio-Pleistocene normal faults. The largest events reached magnitude of around Mw 7, as during the sequence of February-March 1783, in the S. Eufemia 1905 earthquake, and during the sequence of March-June 1638.

The aim of this work is to define Plio-Quaternary evolution of central Calabrian Arc and, if possible, to evaluate the seismogenic potential of this area. This purpose is supported, essentially, by geo-structural data analysis and geomorphological observations.

**Geological setting.** The Catanzaro Trough is infilled by a Neogene-Quaternary sedimentary succession separated by major unconformities. This succession overlies the igneous-metamorphic basement, which is widely outcropping in the Serre and the Sila massif, both located in the central Calabrian Arc (Fig. 2).

Basically, the sedimentary sequence documents the pulsating displacement of the Calabrian block towards the southeast and the opening of the Tyrrenhenian back-arc basin during the last
10 My due to the SE-ward roll-back of the Ionian slab (Faccenna et al., 2005; Zecchin et al., 2012). The latter has partially or completely undergone detachment (Neri et al., 2009; Guarnieri et al., 2006; Wortel and Spakman, 1992), and the whole subduction system experienced a tectonic rebound (uplift) when the propagating tear passes underneath the plate margin segment (Wortel and Spakman, 2000).

The study area is influenced by different NW-SE major transcurrent faults and their antithetic lineaments that show alternating episodes of transtensional and transpressional activity. These structures belong to a larger fault system (i.e., Lamezia-Catanzaro Fault) which partly corresponds to the sinuous NW-SE trending transcurrent fault previously recognized by Van Dijk et al. (2000). These faults, arranged in a right-hand en echelon pattern, dissected the Oligocene-Early Miocene orogenic belt made of Alpine nappes overthrusting the Apennine Chain (Tansi et al., 2007).

The Pliocene-Pleistocene basin-fill succession unconformably overlies the Messinian deposits (Fig. 2). The lowermost interval is represented by ~300 m thick limestone-marl alternations, matching the so-called Trubi Formation (Zanclean) (Fig. 2). This succession is overlain by Lower Pleistocene interval, which consists of mixed silici-bioclastic sands (Longhitano et al., in press). Since the Middle Pleistocene, an intense ESE-WNW oriented regional extensional phase occurred. During Quaternary time, the Calabria block experienced a regional intense uplift witnessed by the occurrence of spectacular flight of marine terraces, mainly developed along the western Calabria coastline (Capo Vaticano promontory, the S. Eufemia Plain, and the Coastal Range). The terraces record also Quaternary cyclic sea-level changes (Tortorici et al., 2002).

Structural features of Catanzaro Trough. The Catanzaro Trough is bounded by different fault sets controlling the morpho-tectonic evolution (Fig. 3a).

The preliminary structural data analysis allow us to identify a transtensional/transpressional phase that has characterized the study area during the Middle Miocene - Lower Pleistocene time. This faults system has been replaced by a NE-SW normal faulting related with an overall WNW-ESE extension, likely due to the development of the Tyrrhenian Rift Zone. These two important phases include a number of different fault systems. The WNW-ESE trending fault zones (Fig. 3b), corresponding to the Lamezia-Catanzaro Fault (sensu Tansi et al., 2007; Fig. 3a), border the northern side of the Catanzaro Trough. This system show firstly transcurrent kinematics, while at a later stage this trend was overprinted by normal and oblique faulting (Fig. 3c). Galli and Bosi (2003) mapped the trace of this faults system and they tentatively attributed it one of the 1638 shocks (March 28, Mw=6.6).

The southern side of Catanzaro Basin, which is limited discontinuously by the Stalettì-Squillace-Maida fault system (Fig. 3a; Ghisetti, 1981), is the epicentral area of other strong
historical earthquakes (e.g., 1626, Mw=6.1; March 28, 1783, Mw=6.9.) indicating a possible activity of the structure (Galli et al., 2007).

The NE-SW trending fault zones characterize the western margin of Catanzaro Trough, and they are arranged into two antithetic faults. One of these, the Vibo Valentia Fault, (Monaco and Tortorici, 2000; Fig. 3a), is a NW-dipping normal fault which borders the northwestern edge of Serre Massif. In turn, the south-western margin of Sila Massif is bounded by a N35-trending, SE-dipping normal faults where we have collected a significant number of mesostructural data (Fig. 3c). The activity of these faults is documented in both onshore and offshore area. Indeed, close to the shoreline of the S. Eufemia Gulf, Loreto et al. (2013) map the NE-trending S. Eufemia normal fault, which they tentatively suggest as being the seismogenic source of the 1905 Calabrian earthquake. In the light of this, here we propose that the S. Eufemia Fault could continue on-land and stop against the northern tectonic border of the Catanzaro Trough, in the Bagni River valley.

In the Capo Suvero area, extending from the southern flank of the Coastal Range, we identified further normal faults showing NW-SE trend; this structures, although poorly visible on mesoscale, border marine terraces and are cut by the NE-trending fault system (Fig. 3d).

In recent times, the evolution of the western Catanzaro Trough was also affected by N-S oriented west-facing normal faults, here named Curinga Faults (Fig. 3a). These structures modify the evolution of this sedimentary basin, producing a further western deepening of Catanzaro Trough, this evidence is possibly shown by the presence of Holocene alluvial fans in the western sector, that are missing in the eastern side (Fig. 3a). On the south of the basin, N-S trending faults are more relevant on the mesoscale, being quite common in the Strofolio River valley, where they show a right oblique kinematics.
Conclusion. The new geo-structural data allow to provide new insights on the Neogene-Quaternary “Catanzaro Trough” evolution. The development of this basin can be divided into two main stages, both characterized by several fault sets. During the first Middle Miocene-Lower Pleistocene stage, the left lateral transcurrent kinematic represents the main tectonic feature. This main structural style is shown along the WNW-ESE oriented faults system, bordering the northern (Lamezia Terme-Catanzaro Fault) and southern (Stalettì-Squillace-Maida Fault) edges of the Catanzaro Trough. Locally some of the faults are reactivated as normal and oblique faults.

In the second stage, which could be still ongoing, NE-SW (S. Eufemia and Vibo Valentina faults) and N-S (Curinga faults) trending fault systems show normal and likely right oblique kinematics. These systems outcrop along the northwestern and southwestern margins of Catanzaro Trough. Despite the few evidences in the western sector of the basin, these structures displace the Pleistocene deposits. On the other hand, in the Tyyrhenian offshore, the S. Eufemia Fault activity has been hypothesized on the basis of geophysical data that image the faulting of Holocene sediments, and the deepening of the basin (Loreto et al., 2013).

In conclusion, according to our hypothesis, WNW-ESE oriented faults were responsible for the opening of a NW–SE paleo-strait that connected the Tyyrhenian area to the Ionian Sea until the early Pleistocene. Moreover, as a response to one of the last extensional stages of the Tyyrhenian back-arc basin opening, NE-SW and N-S fault systems developed and controlled the growth of a minor Late Quaternary basin, here named Catanzaro Trough Sub-basin, which looks presently arranged as a graben feature.

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