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The Calabrian subduction zone (Ionian Sea): Historical seismicity and a new review of the system from multi-channel seismic data

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The Calabrian subduction zone is included in the long W-E elongated compressive South Mediterranean belt. This subduction is located in the complex Central Mediterranean area and accommodates the African/Eurasian convergence at very slow rates (<5 mm/y reported by a recent GPS study). The presence of shallow to deep earthquakes (down to 500 km depth) under Calabria and the South East Tyrrhenian Sea images a 70° NW dipping slab, associated with an active volcanic arc: the Aeolian Islands in the Tyrrhenian Sea. But no thrusts events characteristic of active subduction have been recorded during the instrumental era.

However, the South Calabrian/East Sicilian region is well-known to have been affected by strong historical seismicity with Mercalli intensities reaching XI. The sources of these events is often linked to the activity of crustal, normal faults in the Calabrian region: 1638, 1783, 1905. Furthermore, important details of the Messina 1908 earthquake (72000 killed) and tsunami remain unresolved, in particular the origin of the tsunami (fault induced or submarine landslide). Moreover, the origin of two of the most destructive earthquakes (1169 and 1693) remains enigmatic. For the 1169 and 1693 (60000 killed and 5 to 10 m tsunami wave) Catania earthquakes, the source faults are the subject of debate and linked alternatively to the activity of the Malta escarpment or of the subduction fault plane (because the isoseismals are open to the sea). In this case, the 1169 earthquake which had similar intensities and a comparable isoseismal pattern, is suggested to have the same source and so the fault plane may have be locked between these two events.

To better understand the origins of the 1169 and 1693 major events and seek evidence of activity of Calabrian system, we present new results from reprocessed 96-channels seismic reflection profiles (French Archimede cruise, 1997) offshore Sicily. Interpretation of the seismic dataset is based on correlations with published seismic data and with ESP results and allows us to identify the following thick sedimentary cover (>5km) in the Ionian Abyssal Plain overlying an oceanic crust: Mesozoic (1400 to 1800m) and Tertiary (∼1800m) sequences, a Messinian unit (1400m) and the Plio-Quaternary deposits (450 m). Compressive deformation seems to affect the basement, Pre-Messinian and possibly Messinian strata under the Ionian Abyssal Plain. We associate this deformation with re-activation of old (Mesozoic?) faults. Crossing the external Post-Messinian Calabrian prism, the Messinian units is thickened from 1400 m in the Ionian Abyssal Plain to 2400 m in the prism. We interpret this thickening as accretion of the Plio-Quaternary and Messinian units due to the activity of anticlines and thrusts, which are recognized on all profiles orthogonal to the deformation front of the prism.

Future work will include combining dataset with the reprocessed PM01 profile (French PRISMED cruise, 1994) and a Italian seismic surveys (Calamare 2008 and CROP profiles). Additional work is the CIRCEE cruise proposal (submitted in January 2010) to study the Calabrian subduction with OBS, new MCS seismic, heat-flow measurements to characterize the thermal state of the subduction and sediment coring and dating to study the turbidites in order to estimate recurrence of strong earthquakes and better constrain the seismic hazard in South Italy.