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Active deformation in the Calabrian wedge supports a subduction origin for great historical Italian earthquakes in E. Sicily

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Southern Italy has been struck repeatedly by very strong historical earthquakes (Mercalli intensity IX or greater), in 1169, 1542, 1624, 1693, 1783, 1905, 1908, often associated with destructive tsunami (Piatanesi and Tinti, 1998). Certain events (like 1908 Messina or 1783 Calabria) are associated with known crustal normal faults, which produced observed surface ruptures. However, the source of two of the strongest earthquakes (1169 and 1693, which produced intensities of X to XI and killed up to 60,000 people) has still not been identified with certainty. Calabria is located above a 300 km wide, NW dipping subduction zone, which possesses an active volcanic arc (the Aeolian Islands) and a well-defined Wadati-Benioff zone, with earthquakes descending to nearly 500 km depth. The slab is imaged as a continuous, high P-wave velocity anomaly by travel-time tomography down to 660 km depth.

The 1693 earthquake, struck eastern Sicily, destroying Catania, Syracuse and Augusta and generated a 5-10 m high tsunami. The 1169 earthquake had similar intensities (X to XI) and a similar isoseismal pattern, suggesting a similar source. Because of the tsunami generated in 1693 and because the isoseismals are open to the sea, the majority of the source region appears to be offshore. The subduction fault plane is thus a strong candidate for the 1693 event. However, a lack of instrumentally recorded thrust earthquakes suggests that if subduction is active, the fault plane is locked (like

Cascadia or Nankai).

Thermal modeling is used to determine the limits of the seismogenic zone and tsunami modeling is performed to test the hypothesis of a subduction fault plane. This source (160 x 120 km with 2 m of co-seismic slip) successfully reproduces available historical observations, with regard to earthquake magnitude, tsunami polarity and relative amplitudes. It appears likely that only the SW segment of the subduction zone ruptured in 1693 and 1169, with a recurrence interval of roughly 500 years for similar events.

The degree of activity of the Calabrian subduction is a matter of ongoing debate, with some suggesting that subduction has ceased. Recent GPS data in the region suggest continued ESE-WNW convergence at rates of 4-5 mm/yr. High-resolution seismic profiles indicate ongoing compressive deformation at the toe of the wedge.

Future work is planned, including an upcoming cruise with the Italian vessel R/V Urania (in Dec. 2008) to complete multi-beam bathymetric mapping of the Calabrian prism, a region where compressional anticlines have been imaged at the toe and recently mud volcanoes have been discovered on the upper wedge. This and future work will seek to find evidence of continued tectonic activity of the system.