THE SIRIPRO PROJECT: AN INTEGRATED APPROACH TO SICILY GEODYNAMIC SETTING. THE GEOLOGICAL INTERPRETATION OF THE CENTRAL SICILY CRUSTAL SEISMIC LINE

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Sicily is a sector of the Apenninic-Maghrebian chain whose building up is referred to the subduction of continental and oceanic crusts beneath a complex "european crust" (Calabrian Arc,

Bonardi et al., 2001). A number of qualitative descriptions for the tectonic-sedimentary evolution of the collisional system point out that the subduction A system in Sicily and its offshore prolongation appears as an E- and SE-vergent chain, locally more than 15 km thick (Catalano & D'Argenio, 1982; Roure et al., 1990; Lentini et al., 1994; Catalano et al., 1996; Bello et al., 2000; Catalano et al., 2000; Finetti et al., 2005). The tectonic wedge is superimposed on the Iblean-Pelagian foreland (Fig. 1). The aforementioned tectonic assemblage is the result of two Miocene-Pleistocene compressional tectonic events. In the growing chain, the simultaneous development of thrusts, back-thrusts, and lateral displacement and the occurrence of clockwise nappe rotations during Late

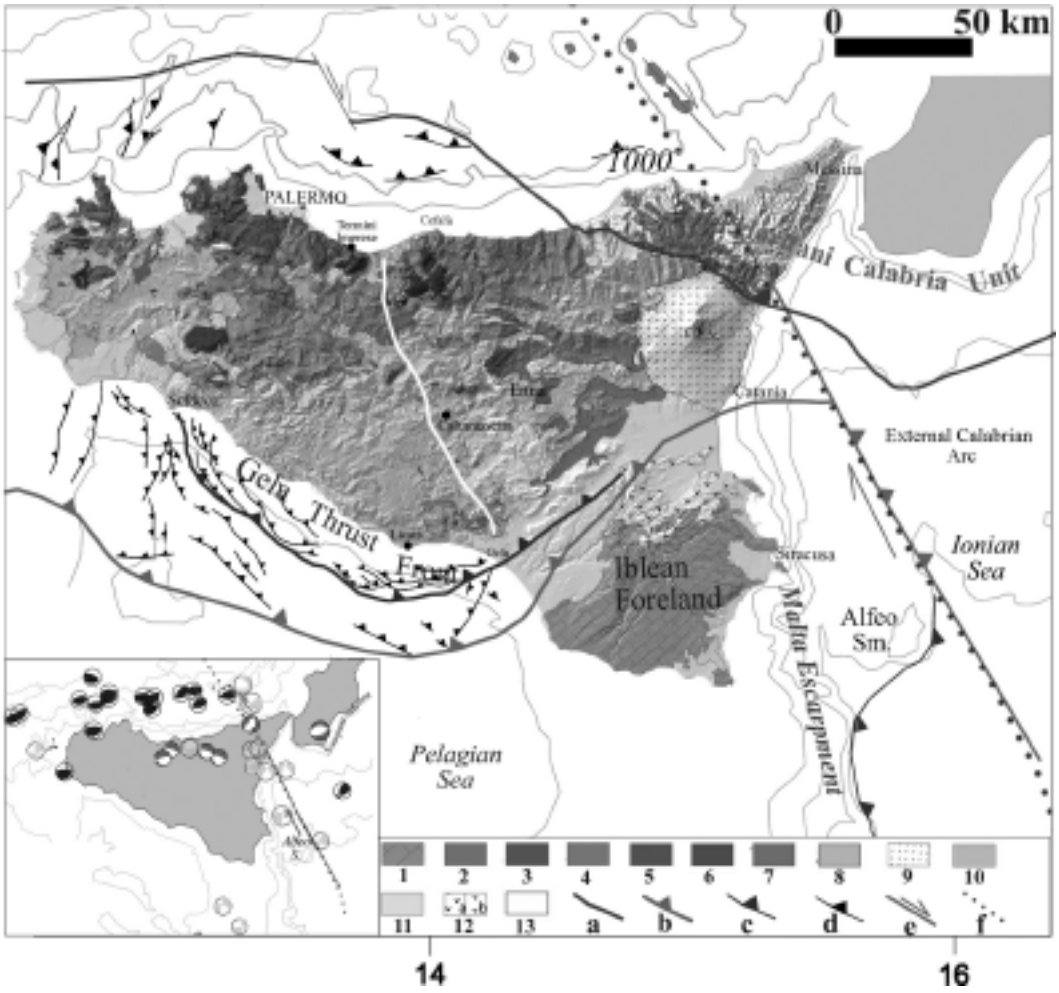

Fig. 1 - Structural map of Sicily (modified from Catalano et al., 2000): 1) Iblean units; 2) shelf to pelagic carbonate (Trapanese–Saccense) units; 3) shelf to deep-water carbonate (Monte Genuardo) units; 4) deep-water carbonate (Sicanian) units; 5) shelf carbonate (Panormide) units; 6) slope to deep-water (Imerese–Panormide) units; 7) Miocene Flyschs; 8) Sicilide units; 9) Calabrian–Peloritani units; 10) Miocene–Pliocene syntectonic deposits; 11) Plio-Pleistocene syntectonic deposits; 12) Plio-Quaternary volcanic rocks; 13) Pleistocene deposits; a) Fossilized southern margin of the Calabrian units; b) Maghrebian–Sicilian thrust front; c) Ionian accretionary wedge thrust front; d) thrusts; e) faults with strike-slip component; f) hypothetic continental oceanic boundary (modified by Catalano et al., 2000; Chamot-Rooke et al., 2005). In white bold line the location of SIRIPRO profile. In the left-hand corner CMT (1977–2003) focal solutions from the area (after Pondrelli et al., 2004) are also shown. Hypocentral depth: < 50 km; Magnitudo > 4.0.

Miocene-Early to Middle Pleistocene, originate syncline structures filled by Miocene-lower Pleistocene syntectonic deposits in the frame of a continuous forward migration. These published data well illustrate the outcropping thrust wedge, even if they don't give information about the crustal structures in Sicily. The necessity to overcome the lacking knowledge of the crustal characteristics has promoted the SIRIPRO project (scientific leader R. Catalano) recently granted by MIUR.

The crustal seismic profile SIRIPRO 1 (Accaino et al., 2010) acquired together with refraction seismic, gravimetry and magnetotelluric data, has strongly improved the knowledge of the deep crustal characters beneath the central Sicily between the Northern Sicilian coast and the Southern region of Gela (Fig. 1). The paper deals with the geological interpretation of the seismic reflection line crossing central Sicily. The preliminary geological profile (Fig. 2) reveals the main deep geometries of the chain-foreland system and the crustal characters down to the mantle/crust discontinuity.

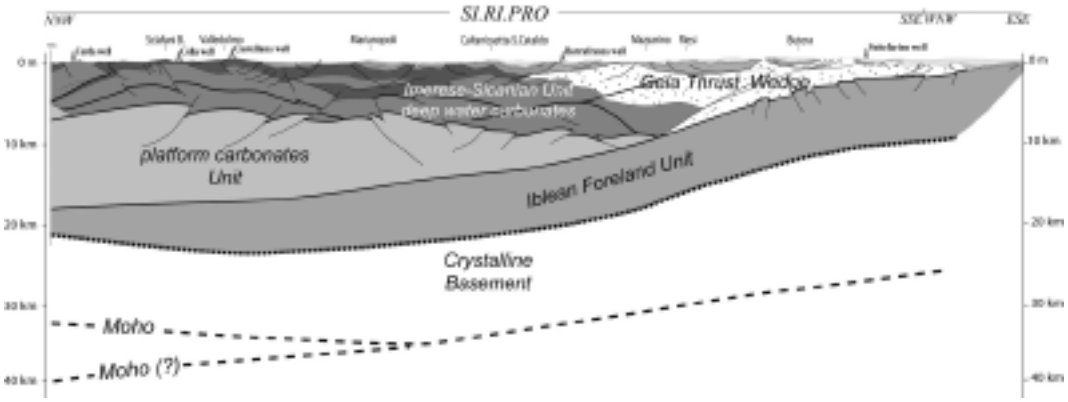

Fig. 2 - Geological interpretation of the SIRIPRO crustal seismic line.

Geological and geophysical parameters (field geology, commercial seismic lines calibrated by boreholes, seismic facies characters, wide-angle reflection/refraction seismic, velocity models) contributed to recognize some structural levels in the processed stacked section (from the top, Fig. 2):

a) the Gela thrust wedge (Falda di Gela) with some Plio-Pleistocene thrust-top basins;
b) the main fold and thrust belt;
c) the foreland and its regional monocline;
d) the crystalline basement;
e) the crust/mantle boundary.

The northern sector of the geological cross section shows the thicker part of the chain as formed by a 18 km thick platform and basinal carbonate, Numidian flysch and Sicilidi stack of northward-dipping imbricated thrusts. The wedge is well bounded at the bottom by a decoupling level at the magnetic basement/cover boundary. In the Sclafani Bagni-Valledolmo area (Fig. 2) the chain reach the main culmination showing the Imerese carbonate thrust sheets at the surface. In the central sector, the stack of folded and thrust rigid bodies (progressively thinning towards the southern Caltanissetta depression) shows southeast-ward vergency. The deep seated carbonate and clastic south-verging thrust sheets are overlaid by the Gela thrust wedge. The tectonic wedge, 5 km thick in its inner part (Mazzarino-Riesi area, Fig. 2), is thinning progressively towards south-east. It has a common basal decollement enveloping the internal thrust units, to the north.

In the southern sector is evident the impressively steep Iblean carbonate regional monocline, acting as foreland of the Sicilian-Maghrebian FTB. The Iblean unit is downwarped from the outcopping Iblei to the Caltanissetta area, with a north-ward strong immersion. The top of the carbonate body is the base of the Caltanissetta trough, now recognized at about 18 km. The buried mono-

cline, 8-10 km thick at the southern end, appears variously deformed (more than previously known) but not unrooted from its basement. The top of the crystalline crust (lower and upper crust) is recognized at a depth of about 20 km (8.5 s/TWT) in the northern sector; it reaches more than 20 km in the Sclafani Bagni-Valledolmo area and is imaged at about 10 km in the Iblean region.

Some reflections, calibrated by DSS refraction seismic, occurring at place are related to the Moho discontinuity. A depth of about 30-32 km is calculated in the northern sector of the profile, reaching the deepest location to the south of Villalba at a depth of about 35 km; from there, it progressively shallows reaching the Iblean region at a depth of about 25 km. An alternative hypothesis about the M occurrence in the northern part of the abovementioned transect is suggested. The location of the supposed M-discontinuity and the crystalline basement suggest the occurrence of a crystalline crust thinner than previously believed as well a major thinning (?) beneath the Caltanissetta depression.

Conclusion. Results from seismic reflection processing together with gravimetry, magnetotelluric data (see different contributions) support the geolocial interpretation and are able to improve our knowledge about a) the location of the African/Thyrrhenian european boundary at depth; b) the pronounced crustal flexure in central Sicily; c) the architecture of the FTB foreland system; d) the interaction of the basement and the FTB; e) the occurrence of shear zones and transversal lines. Finally, the results confirm the role of the SIRIPRO Project in defining an optimal exploration methodology to integrate the obtained different types of data by means of a software Platform.

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