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SUBSURFACE GEOMETRIES in CENTRAL SICILY FTB in THE FRAME of the SIRIPRO CRUSTAL PROFILE

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The study area, located in Central Sicily, is a part of the Maghrebian Sicilian FTB, a segment of the Alpine collisional belt, recently described (Catalano et al., 2000) as a result of both post-collisional convergence between Africa and Europe and roll-back of the subduction hinge of the Ionian lithosphere (Fig. 1).
Central Sicily extends from the Madonie Mts. southwards to the impressive NE-SW trending Tertiary clastic-evaporitic range, outcropping north of the Caltanissetta trough; the area covers the eastern side of the Sicani Mts.
Unlikely from the eastern part of Sicily, hydrocarbon exploration was only recently attempted and a new network of multichannel seismic profiles has been acquired by ENI E&P. New stratigraphy and mesostructural analyses, accomplished in the last years in the frame of the CARG Project (Catalano et al., 2007), support with field data the joint interpretation of the acquired seismic lines. The latter are calibrated by a crustal profile (SIRIPRO Project, Leader R. Catalano) recently acquired across Sicily from the Tyrrhenian coast to the Sicily Channel.

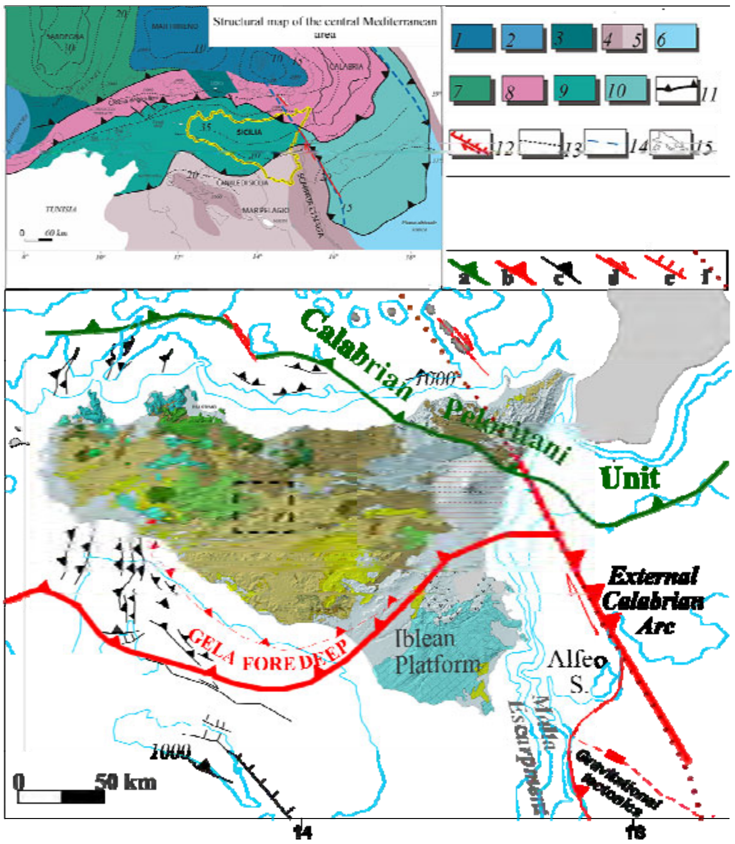

Fig. 1. Tectonic and bathymetric map of Sicily (mod. from Catalano et al., 2000). a) Kabylian-Calabrian thrust front; b) Sicilian-Maghrebian and Ionian thrust front; c) thrusts; d) faults with strike-slip; e) normal faults; f) hypothetical Ionian oceanic crust boundary. Left in the corner structural map illustrating different crustal sectors of central Mediterranean region. 1) Tyrrhenian oceanic crust; 2) Algerian Basin oceanic crust; 3) Thinned Sardinia and Kabylian continental crust; 4) African (5) thinned) continental crust; 6) Ionian oceanic crust; 7) Sardinia units; 8) Kabylian-Calabrian units; 9) Maghrebian-Sicilian units; 10) Ionian accretionary wedge; 11) thrust fronts; 12) fault with strike slip component; 13) Moho isobaths (km); 14) hypothetic continental-oceanic boundary; 15) bathymetry.

Regional setting

Geological sections that cross the Western Sicily (Catalano et al., 2000), have shown the geometry of the Sicilian thin skinned accretionary wedge. The tectonic multilayer shows from the bottom: a) the S-vergent shallow water Meso-Cenozoic carbonates units (derived from the deformation of the Trapanese to Saccense domains), up to 8 km thick, where the lowest unit represents the Sciacca deformed foreland, dipping towards the chain and lying on a presumed not involved northward-dipping crystalline basement; b) an intermediate level consisting of up-to-3000 m thick mostly flat lying deep water Meso-Cenozoic carbonate units (Imerese and Sicanian domains) overthrusting the deformed carbonate platform rock units; c) an upper level of thin Cretaceous to Neogene clayey and carbonate nappes (Sicilide and Numidian Flysch unit), detached from its mainly carbonatic substrate, and d) upper Miocene to middle Pleistocene clastic and evaporitic deposits, that fill thrust-top basins.
Eastern Sicily (Roure et al., 1990a; Bello et al. 2000) yields the same structural setting, highlighting the forward migration of the deformation, as proven by syntectonic basins, and the occurrence of backthrust geometries that involved both the shallow and deep seated units.

Stratigraphy

A recent available stratigraphy of the area, summarized in Fig. 2, illustrates the main lithostratigraphic units that are referred to the shallow and deep-water palaeogeographic domains. Imerese and Sicanian units are the Meso-Cenozoic deep water domains, the Trapanese-Saccense units represent the Meso-Cenozoic carbonate platform domains, as well the Iblean unit that is the foreland of the chain (Catalano & D'Argenio, 1978). These lithologies have been reached by deep wells in the neighbours of the study area. No transition to the Iblean succession has been found along a N-S trend. The stratigraphy scheme shows also the relationships between the Meso-Cenozoic rocks of the continental margin pre-orogenic domains and the syn-orogenic foredeep Neogene deposits.

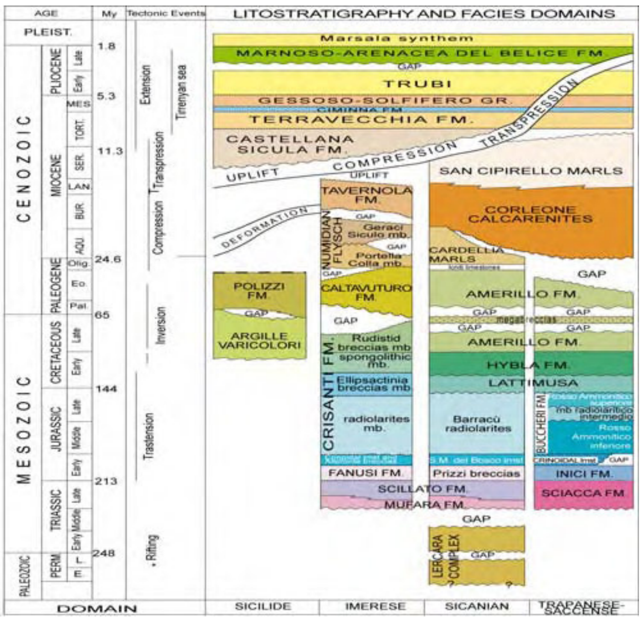

Fig. 2. Lithostratigraphy and facies domain of the study area.

Field data

Two main sectors can be differentiated in the study area (Fig. 3). To the east the numidian flysch and Tortonian foredeep deposits fill a flat depression, locally interrupted by NE-SO, tectonically controlled ridge associated to SE-ward verging folds. To the west, where Mesozoic and Permo-Triassic Sicanian deposits outcrop, N-S trending ridges (e.g. M. Cammarata, Castronovo, Serra del Leone) progressively rotate into ENE-WSW alignments (e.g. Serra Quisquina-Serra della Venere). These ridge are tectonically controlled as they correspond to the stiff lithologies (upper Triassic cherty limestones) at the core of the map scale anticlines. A set of SW-ward repeated imbricated units characterizes the area (Broquet et al. 1966; Catalano et al., 2000; Monaco *et al*., 2000), involving the whole 1.500-1.700 m thick Sicanian succession from the Triassic cherty limestones to the upper Miocene marls.

The Imerese as well Sicanian imbricates (or arranged into duplex structures) were originally superposed along nearly flat thrust surface: the floor thrust was located below the Triassic cherty limestones (Mufara fm. and Permian complex), the roof thrust within the Miocene marly deposits (Marne di Cardellia). Based on seismic reflection profiles and deep well data, sited on the adjacent areas, these units are thought to be transported over thicker platform carbonates units and overlain by mio-pliocenic syntectonic basin deposits. The originally flat thrusts planes, bounding the deep water carbonate outcrop as strongly folded and possibly faulted along NNW-SSE dx and WSW-ENE sx traspressive faults (deep seated structures); the interference between shallow and deep seated structures can be recognized following both map-scale and minor structures.

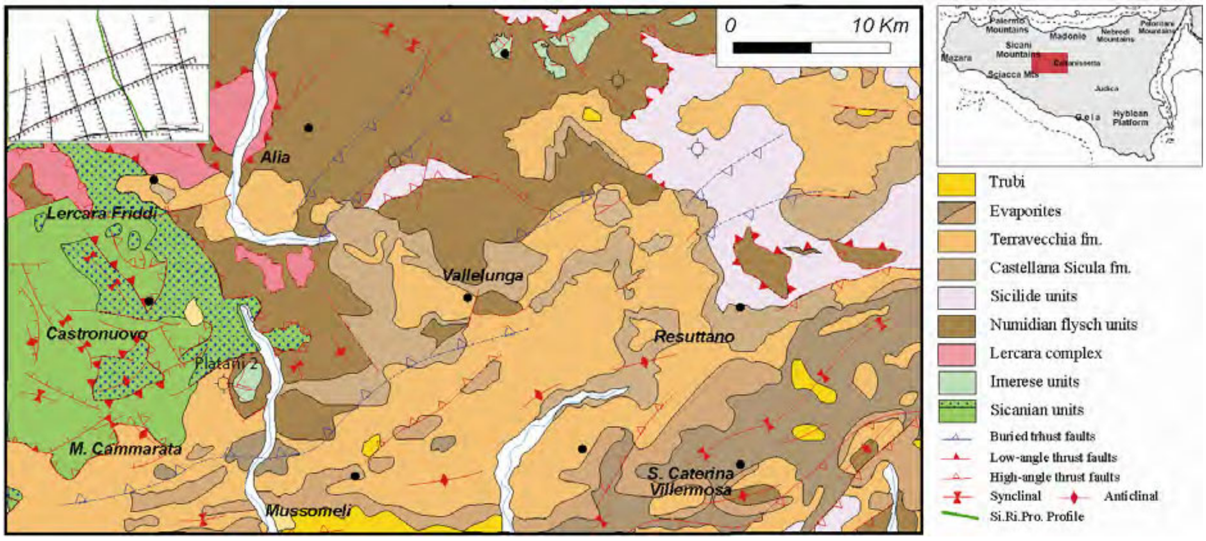

Fig. 3. Structural map of the study area.

Seismic interpretation

Based on field stratigraphy and well logs correlation, the several reflection 2D seismic lines yielded a consistent stratigraphic architecture in the whole study area confirming the tectonic piling up of allocthonous deep water carbonate units and the occurrence, at depth, of carbonate platform units. The carbonate platform is characterized by mainly low frequency, high amplitude group of reflectors. The deep water carbonates are high frequency, high to medium amplitude group of reflectors, 0.5 to 1 s/TWT thick, bounded by continuous reflectors that represent the top of the Cretaceous beds and the bottom of the upper Triassic strata. The syntectonic deposits are imaged by low amplitude, not continuous, high frequency, 0.2 to 0.5 s/TWT thick, group of reflectors, affected by reflection-free zones.

Conclusions

The structural sketch (Fig. 4) shows the setting of the tectonic edifice with the different structural levels (carbonate platform-deep water carbonates-deep water carbonates plus terrigenous covers) and their syntectonic basins. The lowest element (carbonate platform units) lies at a depth of 2 to 4 s/TWT. When observed at regional scale it shows a regular, 5 to 10 km wavelength, broad folding, while the imbricates are bounded by high-angle ramps that flatten on detachment surfaces, faintly dipping to the north. The overlying Imerese and Sicanian units are a stack, 0.5 to 2.5 s/TWT thick, becoming shallower and thinner both northwards and westwards (Sicani Mts.). They are bounded by flat surfaces which are refolded with the same wavelength of the carbonate platform units. The Sicilide and

Numidian flysch units appear as a chaotic assemblage with variable thickness, locally sealed by the syntectonic clastics.

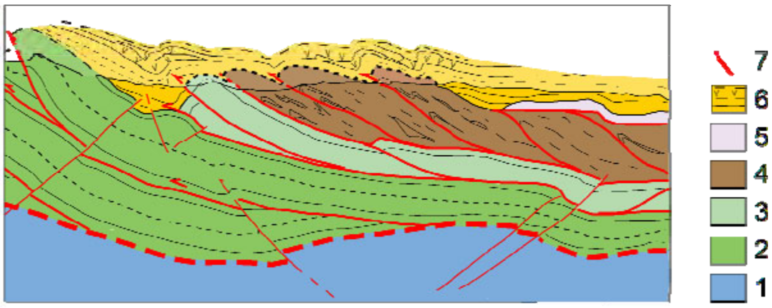

Fig. 4 - Schematic cross section of the study area. 1. Carbonate platform units; 2. Sicanian units; 3. Imerese units; 4. Numidian flysch units; 5.Sicilide units; 6. Tortonian - Pliocene deposits; 7. Faults

Forward migration of the study segment of the FTB started with the detachment of the Sicilide and Numidian flysch that were emplaced over more external domains between Langhian and late Serravallian. Two main tectonic events can be recognized. The early phase of thrusting involved the Imerese and Sicanian rock units with mostly duplex geometry and major tectonic transport since early Tortonian. Following their emplacement, the development of the deep seated thrusts reactivation (Roure et al., 1990b) detached and deformed the buried carbonate platform rocks forming axial culminations and ramp structures during latest Miocene-early Pleistocene.

The wedging at depth of the carbonate platform substrate implied re-imbrication and shortening into the overlying deep water carbonate thrust pile as well in the highest tertiary levels, accommodating their progressive stacking. These deep seated thrusts formed locally highs of the carbonate platform successions.

An interpretative model for the study area shows:

- a thick thrust pile repeated bodies of deep water carbonates (Imerese and Sicanian) units resting on carbonate platform imbricates (Trapanese-Saccense units), resulting from latest Miocene-early Pleistocene deformation;
- Tertiary terrigenous units covering the carbonate stack.

The occurrence of buried carbonate platform bodies, forming local structural highs, could be a new potential target for hydrocarbon opportunities in central Sicily.

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