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3D kinematic and thermal evolution of the Sicilian Fold-and-Thrust belt in the Kumeta-Busambra Mts. area (Italy)

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The Sicilian Fold and Thrust belt (SFTB) is a structurally complex area where along-strike variations of structural styles, shortening amounts, exhumation rates and amounts of syn-tectonic sedimentation frequently occur. Moreover strong differential clockwise rotations around vertical axes affected the different tectonic units during their emplacement. This complexity, coupled with debatable or incomplete subsurface dataset (e.g., available 2D onshore seismic lines) allowed previous authors to propose different interpretations for the tectonic evolution of the SFTB since Cenozoic time. The study area, located in the Western sector of the SFTB comprises the Kumeta and Busambra ridges (derived from the deformation of Mesozoic and Cenozoic shallow water and pelagic carbonate deposits, named Trapanese unit), represents a paradigm of such a structural complexity. The two main structural interpretations available for this area consider the Kumeta and Busambra ridges either as: I) flower structures due to strike-slip tectonics or II) thrust sheets deeply buried by the overthrusting of Mesozoic-Cenozoic deep-water carbonate thin-skinned thrust sheets (named Imerese and Sicanian units), subsequently exhumed by more deeply seated thrusts or transpressive faults.
The 3D structural model was reconstructed based on both seismic interpretation and field data. The horizons interpreted are: the top of Cretaceous carbonates and top of Miocene marl deposits of the Trapanese unit, which represent the “autochthonous” unit, and the top of Mesozoic-Cenozoic deep-water carbonates (Sicano, Imerese units) and Oligocene-Miocene foredeep deposits (named Numidian Flysch unit) which represent the allochthonous unit. A detailed structural model was reconstructed only for the autochthonous unit.
Along strike variation of structural style was recognized. The main structures reconstructed are: WNW-ESE thrusts in the western sector of the study area; WNW-ESE backthrusts in the eastern sector; NNE-SSW tear faults in the northern sector; WNW-ESE to E-W high angle reverse to transpressive faults along the Kumeta and Busambra ridges. The transpressive movement along high angle faults probably reactivates pre-existing normal faults of the original passive margin.
Paleo-thermal data (vitrinite reflectance, Tmax, illite content in mixed layers illite-smectite) and thermal modelling indicate levels of thermal maturity higher in the Imerese unit than the Trapanese unit. Low burial amounts (0.8 - 1.2 km) occurred on top of the outcropping Trapanese unit. Conversely, the structural low between the Kumeta and Busambra structural highs hosted at least 2 km of sedimentary rocks whose origin could be either tectonic, gravitational or sedimentary.
On the basis of geometric and thermal reconstructions and differential rotations of blocks, we suggest the following kinematic evolution for the study area: I) internal thrusting of the Imerese unit (located in a more internal position) during Serravallian times; II) overthrusting of Imerese unit/Numidian flysch above the Trapanese unit during Tortonian times; III) deformation of the Trapanese unit (since the end of Tortonian) with complex deformation, strongly influenced by inherited paleogeography.

Key words: Sicilian FTB, 3D model, thermal modelling, along strike variation of structures