Detection of Plio-Quaternary faults in Madonie Mountains (Sicily) by using quantitative geomorphic and structural geology analyses

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The Northern Madonie Mountains (Northern-Central Sicily), sector of the Sicilian Maghrebian chain, consist of a tectonic thrust system developed through two subsequent main contractional events: 1) a shallow-seated compressional event developed during the Middle-Upper Miocene; 2) a deep-seated transpressional event occuring since the Late Miocene. Lower Pliocene (Trubi) to Quaternary clastic deposits unconformably lie on the tectonic units and are partially involved by deformation.

In the selected area, syntectonic sedimentary basins characters are able to define the timing of deformation only until the Lower Pliocene; to resolve this gap of information application of quantitative geomorphic techniques, based on relationships between tectonics and hydrographic network development could contribute to recognize and characterize Quaternary structures in areas where clayey/marly deposits, widely outcropping, are not marked by pervasive tectonic deformations.

In order to define the geological setting of the study area and to detect Quaternary tectonic structures, geological, structural and geomorphological analyses have been carried out.

Geological and structural analyses have shown:

1) characters and style of deformation of fold structures: two main systems of folds have been recognized - the early system NW-SE-trending is refolded by a later system (trends in the E-W to NE-SW range);

2) orientation and kinematics of faults related to superimposed compressional events: an early thrust system characterized by SW-ward tectonic transport; a later transpressive system consistent with a maximum compression oriented N-S ± 20°, and nearly horizontal.

Although the occurence of two compressional deformation events, interplaying in the construction of the Sicilian chain, is well-known, the field data, here collected, help to better characterize the relationship between shallow-seated and deep-seated structures.

Due to rare and thin Quaternary deposits, quantitative geomorphic analysis has been performed on the hydrographic network of the study area, because the river drainage of Sicily is believed to have developed during the Quaternary age. In particular, have been carried out:

1) azimuthal distribution analysis, by cumulative length, of stream channels related to different orders, taking into account structurally and lithologically homogeneous areas to evaluate the

influence of Quaternary tectonics on the geometry of drainage patterns; NNW-SSE, NNE-SSW, E-W and N-S domains have been evidenced in lower orders of channels;

2) “azimuthal transect method”, performed along 16 suitable segments crossing previously inferred fault zones, able to detect possible Quaternary strike-slip kinematics. Progressive apparent rotations of stream channels have been found, documenting the occurence along the main rivers of Quaternary faults and suggesting both right-lateral (NNW-SSE oriented) and left-lateral (NE-SW oriented) kinematic components.

The multidisciplinary approach used suggests the geological/geomorphological setting of the study area is influenced by Quaternary faults with strike-slip component, highlighting a general congruency between hydrography and tectonics.