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Crustal setting of the southern Tyrrhenian sea: new insight based on the reprocessed CROP M6A seismic profile

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A complete re-processing of a crustal-scale multi-channel seismic reflection profile (line CROP M6A) has been carried out to unravel the structural setting of the Northern Sicily Continental Margin (NSCM) and to find correspondences between seismicity and geological features. CROP M6A runs from the Sicilian Continental margin to the Marsili Basin in the southern Tyrrhenian Sea. It has been collected orthogonal to the normal fault system that bound Cefalù Basin and across the adjacent Solunto High region. This area was recently affected by a sequence of medium-low magnitude seismic events, characterised by compressive focal mechanism solutions. The most prominent of these events is the 6^{th} September 2002, M5.8 earthquake, that caused damages in Palermo and along the NW Sicilian coast. The relocation of aftershocks activity, obtained by combining seismological data from the permanent and temporary seismic network shows a NE-SW trending cluster which is crossed by our multi-channel seismic profile. The line CROP M6A was collected in 1991 by OGS of Trieste. Acquisition parameters were designed in order to achieve a coverage of 4500% and a record length of 17 s two way travel time (twt). We carried out a preliminary standard processing sequence in order to evaluate the overall data quality and decide further processing strategies. Standard sequence consisted of the following steps: trace editing, predictive deconvolution, sorting, velocity analysis, normal- and dip-move out corrections, stacking, time migration and time variant filters. It allowed us to obtain a seismic image at a crustal scale which shows the followings:

1. the overall deformation patter of the section is constituted by extensional faults;
2. the seismological Moho described in other papers on the basis of gravimetric and seismic constrains (reflection and wide angle profiles) is not marked by any high amplitude, laterally continuous reflector on CROP M6A line.

These results suggested to concentrate our efforts on the long-period multiple filtering and definition of an accurate velocity model in order to better imaging deep crustal structures and improve vertical and spatial resolution. Several iterative attempts with different processing parameters have been carried out before applying a K/L-transform based algorithm that enabled us to filter the multiple noise. To complete the processing a finite-difference time migration algorithm was applied, to take into account both lateral and vertical velocity variations. This processing sequence enabled us to produce high resolution seismic sections of the shallower NSCM with particular focus on the Cefalù Basin and the Solunto High features. We observed that:

1. Cefalù Basin is characterised by active extensional tectonics controlled by N dipping low angle listric fault;
2. in the Solunto High region a compressional deformation pattern extends at least 10 km in width across the marin. Comparison between tectonic features and aftershocks relocation suggests the presence of blind active NW-dipping thrusts fault.