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Study of the tectonic evolution of the South-Eastern Alpine and Western Dinaric Foredeep by means of tomographic analysis from multichannel seismic reflection data in the Gulf of Trieste (North Adriatic Sea)

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The Gulf of Trieste (GOT) is located south of the intersection between the External Dinarides and the South-Eastern Alps. It is considered the foredeep of both the orogens and its sedimentary sequence consists of the Mesozoic-Paleogenic Carbonate Platform, the Eocene turbiditic sediments of the Flysch, the Late Oligocene-Miocenic continental to coastal units of Molassa, the Plio-Quaternary continental and marine deposits. The area underwent a multiphase tectonic activity that started in the Mesozoic, when an extensional regime, with NW-SE oriented normal faults, allowed the aggradation of the Carbonate Platform. In the Late Cretaceous-Paleogene, the Dinaric fold-thrust system gradually migrated towards SW, deflecting the Carbonate Platform E-ward. The main frontal ramp of the External Dinarides is the Karst Thrust that extends along the eastern and rocky coastline of the GOT and that separates the hanging-wall, topographically expressed by the Karst highland, from the footwall lying in the gulf. In the Oligocene-Miocene, the convergence that generated the S-ward vergent Southern Alpine orogen, caused a N-ward deepening of the platform and reactivated the inherited Mesozoic and Cenozoic structures with a dextral transcurrent motion.
In the last decade, a dense geophysical dataset has been acquired in the GOT: it consists of 632 km of multichannel seismic (MCS) reflection and sub-bottom profiles, that have been processed and interpreted in time domain by OGS. The data evidenced fault systems related to the extensional Mesozoic and compressional Cenozoic phases and their reactivation with transcurrent kinematics, due to the ongoing N-ward motion of the Adria plate. The transcurrent fault systems show evidence of neotectonic activity and are often the preferential way along which fluids migrate from the carbonates to the seafloor.
The MCS lines were used in this work to perform a tomographic analysis providing a detailed velocity model that can enhance seismic imaging and depth conversion and migration, for a deeper understanding of the tectonic evolution of the GOT.
The tomographic method started from the identification of the main reflected and refracted events on common shot gathers. The related travel times were used in an iterative process that uses SIRT method (Simultaneous Iterative Reconstruction Technique) for the evaluation of the velocity field and an algorithm, based on the principle of the minimum dispersion of the estimated reflection/refraction points, for the definition of the interface's depth and geometry. The iterative process was stopped when the last model reached a minimum difference from the previous model. The time residuals were then computed to estimate the reliability of the results. The tomography provided us crucial information about the structural setting of the gulf, such as a vertical displacement for the Karst Thrust bigger than 1500 m.