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3D reconstructions of fault surfaces and key stratigraphic horizons to define recent tectonic activity in the northern Apennines outer fronts and foredeep (northern Adriatic Sea, Italy)

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Fault plane attitude and dimension are important parameters for deriving seismotectonic information or input data for earthquake hazard assessment and in this sense a complete 3D view and characterization of geological and structural elements is essential. However, there is always a trade-off between structural complexity and data availability at the scale of the designed application.

In the last few years, merging public and confidential seismic reflection profiles and borehole data, were used in order to carry out a 3D reconstruction of fault planes and Plio-Pleistocene stratigraphic horizons in the northern Adriatic Sea, at the front of the northern Apennine fold-and-thrust belt and associated foredeep. The study area straddles the Italian coastline and subsurface data interpretation allowed us to reconstruct the structural setting of both onshore and offshore structures. Although it is known that this area has low rates of active tectonic deformation, it hosts important seismogenic faults associated with instrumental seismicity and historical earthquakes.

The dense distribution of seismic reflection profiles allowed us to perform an accurate 3D reconstruction of almost 50 fault planes, of different dimensions and order of importance. Their geometrical and structural features helped to define the most recent tectonic phases. To this end, we also mapped several Plio-Pleistocene regional unconformities and integrated them with previously published reconstructions of key horizons.

In some cases, where further published data were available, it was also possible to perform detailed cross sections whose restoration allowed us to reconstruct the post-Miocene (5.33 Ma) slip-rate history of some important tectonic structures with a detail of ~1 Ma. The 3D geological model revealed several structural features like fault continuity and terminations, level of connectivity, presence of lateral ramps, along strike variations of displacement that could not be fully addressed using cross sections alone.