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Coupled Structural/Stratigraphic Forward Modeling in the Central Apennines

The relationship between tectonics and sedimentation can be a key to understanding the evolution of foreland basins. Structural forward modelling can be coupled with stratigraphic modelling in order better constrain the chronology of structural events. The Central Apennines site was chosen to test our methodology, in a region where foreland basin turbidites are an exploration target. Our studied zone is situated in the East of the Umbria-Marche Apennines, where Messinian to Pliocene synflexural and synkinematic series crop out. Given the eastward migration of the foredeep depocentres with time, the series deposited in a flexural foreland setting were progressively involved in thrusting, uplifted and eroded.

Four regional seismic sections were interpreted, unfolded and balanced. We retained a model with thrusts involving the basement, with total shortening of around 20%. At each step of the structural forward model, sediment was eroded from the thrust belt and redistributed according to diffusive transport laws. The results of the coupled modelling allowed us to iteratively correct and refine the structural interpretation of the seismic data, define the sedimentary mass balance of the studied region and establish the chronology of the major faults by fitting the simulated facies, thickness and lithology of the synkinematic sediments to our observations in the field and on seismic. The modelling also led us to revise and update our a priori facies model in areas where no field or well control was available. This new approach has great potential for petroleum exploration in peri-orogenic basins.