



4D modelling of the Alto Tiberina Fault system (Northern Apennines, Italy)

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The Alto Tiberina Fault (ATF) in the Northern Apennines of Italy is a low-angle normal fault dipping to the East and accommodating up to 10 km of extension. The fault is ~ 70 km long and is the detachment for the SW-dipping Gubbio normal fault.

The ATF fault system has been dramatically exhumed and the ATF footwall has evolved in a horst bounded to the east by ATF synthetic faults and to the west by the Corciano west-dipping normal fault. The fault has been widely studied over the last years in order to understand its mechanical behaviour, its present-day deformation rate and its seismological role.

By using a wide data-set including subsurface data (seismic reflection profiles and boreholes) and surface geological data (new maps of the CARG project of Italy), we have reconstructed the 3D geometry of both the fault and of the main lithostratigraphic boundaries at the fault hanging-wall and foot-wall. The CARG map data were integrated by local observations and mapping using mobile GIS software (BeeGIS) and Android app (Geopaparazzi). Surface data were combined with seismic reflection profiles and wells interpretation and other data from available literature. The large amount of information were combined in MOVE software (Midland Valley Exploration Ltd). Our reconstruction allows to i) build up a three-dimensional geological model of the subsurface including the main faults and lithostratigraphic boundaries; ii) identify a set of east-west trending faults the role of which was previously underestimated; iii) test a 3D-restoration of extension for the visualization of the time evolution and for the validation of the structural reconstruction.

The restored structures are the main normal faults in the region. The sequential restoration was performed by taking into account the timing of deformation as derived from the literature. The model was sequentially restored according to the following chronological order from the latest to the oldest: 1a) last deformational event along Gubbio Normal Fault on ATF coeval with 1b) latest event along Corciano fault and 2) ATF detachment fault activity. The resulting maximum values of displacements has been calculated as: 1a) about 2300m with a throw of about 1600m (measured in the 3D model on the top of Carbonates surfaces cut off); 1b) about 1900m for the slip and 2900m for the throw (measured along this fault both on the top of Carbonates as on acoustic Basement cut off); 2) 8 km of maximum extension measured between Umbertide e Citta' di Castello and progressively decreases toward NW and SW.