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Modeling the Structural and Deformational Architecture of Complex Hydrocarbon Traps by HCA Numerical Techniques

Kinematic and geometric models have been proved to be very useful for the interpretation and balancing of fault-related folds. A major limitation of geometric models is that they are fully constrained by geometrical rules that do not take into account the rheology of the deforming rocks, the mechanical balance of the growing structures, and their interaction with surface processes. On the other hand, finite element numerical models are strongly dependent on the architecture of the undeformed mesh and on remeshing algorithms.

We approached the modelling of fault-related folds by developing a set of self-determining algorithms that successfully reproduce the behaviour of natural rock multilayers undergoing faulting and folding. The rheology and thickness of each layer (both pre-growth and growth strata) are specified, with no geometrical constraints apart from initial layering and the shape of the faults. The shape of the fault and the mechanical behaviour of the deforming material then determine the shape of the folded hangingwall. A great variety of both compressional and extensional fault-fold kinematics can be modelled, including synchronous faulting and re-faulting of deformed structures. Deformation intensity is computed during each iteration and can be displayed as a model output. In this work we apply our modelling technique to the evolution of field analogues of typical carbonate trap structures in the Apennines.