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Kinematics and deformation mechanisms along a major thrust in the Jura fold-and-thrust belt, Eastern France

Luca Smeraglia (1,2), Olivier Fabbri (1), Flavien Choulet (1), Philippe Boulvais (3), Martine Buatier (1), Stefano Bernasconi (4), and Francesca Castorina (2)

(1) Université de Franche-Comté, Laboratoire Chrono Environnement, Besançon, France (luca.smeraglia@uniroma1.it), (2) Dipartimento di Scienze della Terra, Sapienza Università di Roma, P.le Aldo Moro 5, 00185, Roma, Italy, (3) Geosciences-Rennes, Université de Rennes 1, 263 Avenue Général Leclerc, 35042 Rennes, France, (4) Geological Institute, ETH Zürich, Sonneggstrasse 5, 8092 Zürich, Switzerland

Foreland fold-and-thrust belts are the frontal and most seismically active part of convergent plate boundaries and generate by folding and thrusting of the sedimentary cover. In particular, fault-fracture distribution, fault rocks permeability, and fault rheology affect both geofluid migration (among which hydrocarbons) and fault slip behaviors (i.e. seismic vs. aseismic) along shallow thrust faults. Therefore, the detailed analysis of exhumed fold-and-thrust belts can provide important information regarding the geometry and connectivity of hydrocarbon and geothermal reservoirs, the mechanical properties of seismogenic faults, and the origin and chemical signatures of paleo-fluids circulating along faults and within hydrocarbon reservoirs. Here, we perform a similar analysis in the Jura fold-and-thrust belt (Eastern France), which represent the outermost toe of the Western Alps orogenic prism and has, so far, not been the site for such studies. This belt is characterized by a succession of folds and thrust faults, which accommodate several tens of km of shortening. We combine geological mapping with structural analyses to reconstruct the tectonic evolution along the frontal thrust of the inner Jura. Results show that: (1) the thrust is characterized by multiple folds and splay thrusts even if displacement is low (up to ∼200 m); (2) shortening is accomodated by thrusting, folding, strain partitioning, and flexural slip along bedding; (3) paleostress reconstruction shows a NW-SE to N-S shortening, consistent with the shortening direction active within the Jura fold and-thrust-belt since Late Miocene times; (3) at the microscale, deformation mechanisms consist of pressure solution and veining, which mainly records aseismic deformation and are consistent with the observed aseismic uplift of thrust-related anticline; (4) fault rock fabrics create a low permeability barrier for across-thrust fluid flow. Ongoing geochemical (stable and clumped isotopes) and mineralogical (X-ray diffraction) analyses will help constrain the origin and temperatures of circulating fluids and the depth of fault rock deformation.