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An unusual triangle structure associated with thrust front development in the thin-skinned Eastern Jura Mountains

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The Late Miocene to Early Pliocene Jura fold-and-thrust belt, stretching across northern Switzerland and eastern France, is a classical example of a thin-skinned foreland fold-and-thrust belt, its basal décollement being located in Mid- to Upper Triassic evaporites. The arcuate mountain range referred to as the Folded Jura is formed by mainly N-vergent thrusts and associated folds.

In our study area, comprising the easternmost part of the thrust belt, the border between the Folded Jura and the non-detached autochthonous foreland (Tabular Jura) is not clearly defined. In most interpretations, the frontal thrust is taken to coincide with the northernmost anticline of the Folded Jura visible at the surface. Newly reprocessed, depth-migrated reflection seismic sections allow us to closer analyse the regional structural framework of the thrust front. Constant line-length and area cross section balancing techniques are applied to verify geometry of the interpreted structures.

The best matching interpretation of the thin-skinned thrust belt front is a complex triangle structure, which traces an offset of the basal décollement by an inherited pre-exisiting normal fault that was previously associated with the border fault of a Late Paleozoic trough. This “unusual” triangle structure is defined by a number of (at least two) thrusts and backthrusts above each other associated with several secondary faults. The most characteristic feature of the fault zone is its low width with respect to the stratigraphic thickness influenced by the fault.

The triangle structure shows a very uniform amount of shortening over much of its length. We interpret this uniform shortening to suggest that the configuration of the structure represents a maximum attainable, “saturated” amount of deformation achieved during an initial phase of Jura folding.

To the west of our study area the triangle structure merges with the northernmost Jura anticline, which shows a conspicuous change in strike from an E-W to an ENE-WSW trend, the latter being parallel to the Palaeozoic trough. This strike change of the frontal thrust may imply that the triangle structure represents a kinematic “thrust-belt-stopper”, where the propagation of the thin-skinned frontal thrust ceased due to a disruption of the basal décollement along the inherited normal fault zone.