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Geometry and sequence of thrusting in the Alpine Foreland of western Austria and Bavaria

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Paleomagnetic data from all main external tectonic units of the Western part of the Eastern Alps indicate large vertical axis rotations between the undeformed (=foreland Molasse) and deformed foreland (= Subalpine Molasse), and between the Helvetic nappes and the Subalpine Molasse. Large rotations of large blocks can only be accommodated by thrust planes, as rotation between vertical faults would create major space problems. Differential rotations should be expressed in differential shortening across the Alpine thrusts. As available shortening estimates within the Subalpine Molasse are far too small to be compatible with paleomagnetic data, we re-examined several cross sections and tried to describe lateral changes in structural style and amount of shortening.

From the most external to internal, following major structural zones have been identified: (1) A detachment fold on top of a triangle zone at depth, which is replaced by a foreland-facing fold without triangle zone to the east. (2) An eastward diminishing number of imbricates is superimposed out-of-sequence onto zone (1) and their basal thrust truncates the passive backthrust on top of the triangle zone. Locally, this thrust overturns the foreland-facing limb of the detachment fold. The thrust at the base of the southernmost slice systematically superimposes the deepest part of the foreland sequence onto intermediate parts. Seismic sections show that this slice sits on top of a major upper footwall flat and the northerly adjacent slice is a footwall imbricate. The footwall flat reaches far to the south beneath tectonically higher units, whereas the northern duplex slices are frontal hanging-wall imbricates of a major thrust sheet. Out-of-sequence thrusts dissecting the southernmost slice cut down to the basal detachment of Subalpine Molasse and stack older thrusts. A triangle zone forms the contact to the tectonically higher Helvetic and Flysch nappes, which is locally exposed but also indicated by wells.

The age of triangle zone formation at the tectonic front of the Alps is constrained by southward wedging and onlap of Middle to Late Miocene (16-7 Ma) deposits against the triangle zone. Out-of-sequence thrusting of the northernmost imbricate onto the triangle zone marks the end of foreland propagation of thrusting and the onset of internal thickening of the orogenic wedge during the Tortonian. Apatite fission track dating in a well penetrating the southernmost Molasse slice in Eastern Switzerland revealed more than 1 km exhumation relative to the more northern slices postdating the Early Pliocene (4.7 Ma), which was related to thrusting (Cederbom et al., 2007). It shows that out-of-sequence thrusting started to propagate backward into the Alpine orogen in the Pliocene.

CEDERBOM, C., SCHLUNEGGER, F., SINCLAIR, H. D. & VAN DER BEEK, P. (2007): What can the Swiss Molasse basin tell us about the Late Neogene development of the Alps?- Abstr. 8th WAGS Davos, 10-11, Bonn.