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Balanced cross sections of the Subalpine Molasse of Austria and Bavaria: Differential Miocene shortening causes clockwise vertical axis rotation in the external Alps

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The Subalpine Molasse is the most external tectonic unit of the Alps and represents the sediments of the peripheral Alpine foreland basin displaced by Alpine tectonism. We compiled a new tectonic map and measured shortening in nine cross sections of the Subalpine Molasse from the Rhine valley to Salzburg in the east to investigate alongstrike changes in structure.

Alpine thrusting started to affect the Subalpine Molasse at the end of the lower Miocene . Growth strata on top of the frontal anticline document the initial development of the structure. Subsequent back-breaking thrusts truncate the preexisting structures; from these relationships we conclude that most of the thrusting within the Subalpine Molasse postdates the late Early Miocene.

Total shortening within the Subalpine Molasse changes dramatically alongstrike: around 50km are measured near the Rhine valley (compare contribution Pomella et al., this session), almost zero near Salzburg.

A continuous eastward decrease of shortening is observed in the balanced cross sections, which is controlled by the interaction of escape tectonics with post-collisional shortening. Transfer of shortening into the hinterland, which was the zone of lateral escape, causes the end of foreland-propagation of the Alpine thrusts, and an apparent break-back sequence of thrusting. However, the thrusts remained active, as the escape related faults remained transpressive throughout their activity. In such a scenario, tectonic units on top of the Subalpine Molasse must experience clockwise vertical axis rotation. As thrusting in the Subalpine Molasse is closely related to contemporaneous transport and shortening within the tectonically higher Helvetic thrust sheets, that have no counterpart near Salzburg, values for Miocene differential shortening and clockwise vertical axis rotation are minimum values, and probably exceed the 12° as deduced from the Subalpine Molasse thrust belt alone.

It seems quite likely that further late Alpine shortening is transferred southwards into the Tauern Window, and the Southern Alps, where corresponding Middle to Late Miocene structures are well known.