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Jurassic-Cretaceous transform faults control the present-day shape of the Eastern Alps

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Paleogeographic reconstructions of the Alps for the Jurassic suggest an important role of transform faults during rifting and drifting of the Piemont-Liguria and Valais oceans. A common characteristic of such reconstructions is a roughly S- to SW-trending southern segment of the ocean where rifting and drifting was orthogonal to its margins, and an E- to ESE-trending eastern part controlled by transform faults. In the N or NE, Adria (or Apulia) would be delimited by a transform margin against the ocean. According to published sequential reconstructions, these transform faults were active from the Jurassic to the early Late Cretaceous (Cenomanian). Here we investigate the impact of such transform faults on the tectonics of the Eastern Alps.

The Northern Calcareous Alps (NCA) are the Cretaceous external thin-skinned foreland fold-and-thrust belt of the Cretaceous Alpine orogenic wedge. The NCA were detached from their basement at an salt-bearing evaporitic décollement. Thrust sheets in typical foreland settings form salients if salt-floored (e.g., Subalpine Chains of southern France, Jura fold-and-thrust belt, South-Central Pyrenees).

In contrast, the northern margin of the externmost NCA is straight. Folds tend to be tight and symmetric, and local thrusts verge both to the N and the S and are upward concave. Such a structural style has been observed in wrench zones, suggesting that the northern margin of the NCA is a wrench fault. Kinematics of this wrench zone is sinistral. This wrench zone duplicates the hanging wall cutoff of one of the NCA thrust sheets. Therefore, the wrench zone postdates initial nappe stacking in the NCA. Based on overthrust sediments, local stacking has an Early Albian age. The age of the wrench zone can be dated by Albian basanitic dykes intruded into wrench faults within the NCA which are parallel to the NCA northern margin.

At several places within the NCA, sinistral shearing across roughly E-W trending faults has been observed. We list three faults here, but there are probably more: The **Stanzertal fault** delimits the Austroalpine basement (Silvretta nappe) against the southern margin of the NCA. Quartz fibres on outcrop-scale faults probably formed during peak metamorphic conditions in the Lower Cretaceous. The sinistral **Puitental fault** S of Zugspitze is intruded by Albian basanitic dykes (as the Stanzertal fault). The **Trattberg fault** S of Salzburg is a transpressive sinistral fault, associated with Late Jurassic folding and transpressive thrusting, and Upper Jurassic growth strata are observed in the synclines. During the early Cretaceous, kinematics changed to sinistral transtension.

In summary, there is evidence for sinistral shearing across E-W faults at the northern and southern boundaries of the NCA, and within. These faults have a Late Jurassic to Early Cretaceous age, and were active intermittent with Alpine shortening. Locally, they channelized basaltic melts from the subcontinental mantle to the surface, as in present-day transform zones (e.g., Dead Sea transform, Atlas system). Such faults pre-determined the shape of NCA. According to previous studies also Cretaceous subduction initiated along such a transform fault.