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Accommodation of collisional shortening along the Alpine plate boundary : plate kinematics vs rheological controls

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The style of collision in the Alps varies along strike, reflecting different amounts and different modes of accommodation of collisional shortening. These differences control the patterns of exhumation during collision. Whereas the western Alps largely consist of a metamorphic complex formed during subduction and largely exhumed before the initiation of collision, the subduction nappe-stack of the Central and the Eastern Alps is strongly overprinted by collisional shortening and by Barrovian metamorphism. Based on compiled and new data we estimate amounts of collisional shortening along the strike of the chain and set it in relationship to the geometry of the collisional prism.
The western Alpine collisional structures form a very large (in map view), but moderately shortened wedge, terminating in front of a poorly developed Molasse basin. Shortening of this wedge was mainly localized along its external parts, resulting in accretion of basement and cover units thrusted towards the foreland. Back-folding and back-thrusting are barely developed and no shortening takes place in the upper, Adriatic plate.
In the Central Alps, the amount of collisional shortening is larger and it is distributed both in the lower and in the upper plate. The collisional prism is bivergent and partitioning of the amount of shortening between the upper and lower plates varies along strike, being most probably controlled by rheological, heterogeneities. The thickened accreted lower plate is strongly affected by Barrovian metamorphism where shortening is largest and localized within a confined area. A deep Molasse basin developed in front of the prism.
In the Eastern Alps collisional kinematics vary from east to west, with orogen-parallel displacements dominating in the east and orogen-perpendicular ones in the West, where they culminate in the structural and metamorphic dome of the Tauern Window. Nowhere else in the Alps collisional shortening is so strongly localized in one and the same area throughout the entire collisional history. As in the Central Alps Barrovian metamorphism overprints the nappe stack, where it is highly shortened. Retrodeformation of collisional displacements indicates that the kinematic boundary conditions are responsible for such a localization of shortening. The sediment thickness of the foreland basin correlates with the amount of shortening within the prism.
Based on these observations, we discuss the boundary conditions and the rheological parameters allowing for the localization of shortening into high-amplitude, orogenic-scale folds, which are the site of exhumation of Barrovian metamorphism, and the cause of deeper foreland basins.