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From continental subduction to uppercrustal nappes stacking : a numerical analysis.

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The mechanics of the transition from continental subduction towards upper crustal nappes stacking that is still poorly understood, is studied here through the 2D thermal and rheological evolution of a subducted passive margin. Field observations in recent mountain belts show pilling up of HP-LT uppercrustal units at early stages of the crustal thickening history. In the Alps lepontine dome, higher grade upper crustal units are first detached from the subducted margins and upper crustal units of decreasing peak pressure are then stacked below. The Lepontine units have rather regular thickness and length between 5-10 km and 30-50 km, respectively. 2D finite element thermal models show that two successive steps characterize the burial history of the passive margin submitted to continental subduction. First ($<$3 My), the thermal evolution of the margin is quasi-adiabatic and thus marked by an increase of the margin strength up to around 1 GPa (increase of the confinement pressure). Second, the ongoing heating of the subducted margin leads to a decrease of strength down to 10 MPa that progressively counter-balance the increase in confining pressure. Time evolution of the crustal shear strength is then compared to the applied shear stress (resulting from the summ of buoyancy and tectonic stresses). Detachment of crustal sliver occurs when the crustal shear strength becomes lower than the applied shear stress. Peak pressure as well as width and thickness of the sliver are computed from the models for different subduction velocities and dip angles. Only the first fault event is analyzed here, which controls the formation of first thrust units with the higher peak pressure. Computations show that width and thickness of the thrust units increase with dip angle and subduction velocities, and are consistent with Alpine examples. The results likely indicate that UHP thrust slices marke high velocity and high dip angle of subduction, while HP thrust slices are consistent with lower velocity or lower dip angle.