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Rheologically controlled mechanisms and initial conditions for lithosphere deformation by tectonic wedging (lateral injection of deep flakes) in mantle driven orogens

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The rheological behavior of continental crust during collision depends on the lithological distribution within lithospheric plates, initial thickness of both plates, and variation of geotherms across the growing orogen during thinning and thickening of active tectonic domains. Variations among these quantities control where injection of tectonic wedges (deep flake tectonics) occurs, as well as the location of decoupling (detachment or décollement) horizons. The initial conditions for the development of different types of collision orogen, and the likely mechanisms that will develop as collision proceeds, have been deduced using two dimensional numerical modeling. This fully dynamical 2D thermomechanical model is implemented in ANSYS finite element software package. The model is characterized by convergence of two blocks with contrasting rheological stratification and thermal structure connected by a smoothed transition of lithologies and temperature in a transitional zone. The model is marked by constant convergence velocity applied at lateral boundaries, an isostatically balanced mechanical boundary between asthenosphere and lithosphere and simple 1D surface erosion. Different types of orogen can be distinguished depending upon whether crust, or mantle, or the whole lithosphere thickens, or whether mass is exchanged from one continent's crust to the other continent's mantle. A systematic scheme has been constructed relating the various types of collisional orogen through initial thickness and thermal structure. It is suggested that the scheme can be used in an inverse fashion to deduce the conditions of former orogeny from observations of the internal struc-

ture of orogens. The most important tectonic injection-wedging processes develop when Standard (35 km crust) or Thick lithosphere (>40km crust) collides with Thin domains (<25 km crust). Mantle flake of Thin domain generates a splitting of continental lower crust from mantle and subduction of the latter. The thermal structure of Thick lithosphere controls the development of either double or single antithetic wedge patterns. The process of wedging leads to progressive hardening of the whole collisional system, and the thickness of wedges and length of wedged orogenic structure controls onset of potential buckling of the layered orogenic fabric. We discuss the limits of isovolumetric 2D models in terms of possible lateral escape of material positively influencing across-strike length-scales of wedging process.