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Numerical modeling of the arc-continent collision

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Using the 2D petrological-thermomechanical numerical code we have performed the modelling of an oceanic-continental subduction followed by a continental collision associated with a closure of a backarc basin and accretion of a magmatic arc to the continent. The initial model setup represents two continents and an oceanic plate between them. The finite difference subduction/collision model includes spontaneous slab bending and retreat associated with backarc spreading, dehydration of the subducted crust, aqueous fluid transport, partial melting of both crustal and mantle rocks and melt extraction processes resulting in magmatic arc crust growth. Model development during oceanic-continental subduction stage is accompanied with several realistic processes such as the construction of an accretionary wedge including frontal and basal accretion, as well as subduction erosion. Growth of a new volcanic layer atop the continental crust leads to subsidence and thinning of the underlying continental crust. The lateral width of this magmatic arc is constricted to 40-60 km due to the limited extent of the melt extraction area in the hydrated mantle wedge atop the slab. Rapid slab retreat triggers the formation of a backarc basin with the new spreading center resulting in dry decompression melting of the mantle and building of new oceanic floor. The opening stops when the second continental plate comes to the trench that results in continent-arc-continent collision process associated with deep continental crust subduction. Collision leads to a strong shortening of the previously formed backarc region which become buckled and displaced underneath the forming orogen.

We tested influences of a plate convergence regime and velocity, amount of sedimentation, volcanic rocks concentration in the melt, age of the oceanic plate and an initial geometry of the system onto the model development. We have found some notable variations in resulting continental collision zone structures which share many similarities with natural orogens such as European Alps and Bohemian Massif.