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HOW THE SUBDUCTION CONTACT CONTROLS THE RESPONSE TO CONTINENTAL COLLISION

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Anatolia is an assemblage of terranes that were accreted during various collisional events. Continental collision may actually result in a wide range of tectonic responses. In search of the controlling conditions and parameters, we start from the results of our previous work, which demonstrated that the properties of the plate contact are important for the dynamics of convergent plate margins. We distinguish two fundamental types of subduction plate contact: one based on a fault and the other based on a subduction channel. We investigate how the plate contact affects the initial stage of continental collision. We use a finite element method to solve the heat and the time-dependent momentum equations for elastic, (power-law) viscous and plastic rheologies. For the same rheological properties and driving forces, varying the nature of the plate contact leads to three types of responses. The presence of a subduction channel promotes coherent and, when the boundary conditions allow it, plate-like subduction of the continental margin. In models with a subduction fault, coherent subduction of the incoming continental lithosphere occurs when the colliding passive margin has a gentle slope. The approaching continental sliver starts to subduct and the subduction is characterized by a non-plate like behaviour—slower subduction velocity than in channel models and strong slab deformation. If the continental margin is steep and the strength of the incoming continental crust is high, fault models result in locking of the trench, eventually leading to slab break-off. If the crustal strength is relatively low, shear delamination of part of the crust is expected. In the channel model, this type of delamination never occurs. The tectonic settings used in our experiments (prescribed plate velocity of the subducting plate versus fixed subducting plate corresponding to a landlocked basin setting) do not significantly influence the nature of the model response. We conclude that initial stages of continental collision are strongly affected by whether the subduction contact is a fault or a channel. Neither the slab pull magnitude nor the tectonic setting is very important to the overall geodynamics at this stage. The plate contact type, along with the slope of the incoming passive margin and the rheology of the continent, controls whether the incoming crust (1) subducts entirely; (2) separates partially or entirely from the lithospheric mantle or (3) blocks the trench, likely leading to slab break-off.

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