Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09833, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09833
EGU General Assembly 2008

Nature of the plate contact and subduction zones diversity.

R. De Franco (1), R. Govers (1), R. Wortel (1)

Tectonophysics Group, Department of Earth Sciences, Utrecht University, The Netherlands (defranco@geo.uu.nl/Fax-Nr. +31 30 2535030)

We recently showed that the overall dynamics of oceanic subduction depend on whether the plate contact is a fault or a channel (De Franco et al., 2007. GJI, doi: 10.1111/j.1365-246X.2006.03498.x). Here we investigate how the plate contact affects the subduction of a passive margin (of a continental block or fragment) arriving at the plate contact. 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: subduction of the entire continental lithosphere, shear delamination of the continental crust or slab break-off.

We make the following observations from our numerical experiments. 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 ocean-continent transition. The approaching continental sliver starts to subduct and the subduction is characterized by a non-plate-like behavior, 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 the upper crust is expected. In the channel model this type of delamination never occurs. The tectonic setting does not significantly affect the nature of the model response. We conclude that the plate contact type, together with the geometrical and rheological properties of

the incoming continental fragment, is a crucial subduction characteristic controlling the response of continental collision during the transition from oceanic subduction to continental collision. During the early stage of continental collision, the plate contact plays a more relevant role than the magnitude of slab pull and the tectonic setting.

Subsequently, we combine results of our numerical experiments with a re-analysis of published observations. Overall, our synthesis connects seismic moment release with back-arc deformation and tectonic processes at the margin. It leads us to identify four classes of subduction zones. The first two classes results directly from our numerical experiments. In class 1, subduction zones are characterized by a plate contact that is largely fault-like with an accretionary margin. In class 2, the plate contacts are largely channel-type and have an erosive margin. Class 3, where the plate contact is entirely channel-like, consists of accretionary margins with a high sediment supply. Subduction zones of class 4, mostly characterized by an erosive convergent margin (northern Chili, Peru, Honshu and Kuril), are more complicated. They can be explained by incorporating regional observations.