Geophysical Research Abstracts
Vol. 12, EGU2010-10188, 2010
EGU General Assembly 2010

Factors controlling subduction initiation at passive margins: numerical modelling

Ksenia Nikolaeva (1), Taras Gerya (1), Fernando Marques (1,2)

(1) ETH Zurich, Geophysics, Zurich, Switzerland (nikolaeva@erdw.ethz.ch), (2) Univ. Lisboa, Edificio C6, Pisco 2, 1749-016 Lisboa, Portugal

Despite its crucial significance for the plate tectonics theory, subduction initiation remains a largely enigmatic open problem. It has been showed that at most passive margins elastic and frictional forces exceed gravitational instability and ridge-push forces, which preclude subduction initiation. We studied numerically which physical parameters can control tectonic processes at passive margins. The investigated parameters are thermal age of the oceanic plate, temperature structure (thickness) and density of the continental lithosphere, and the rheology of crust and mantle. Our experiments show that three different geodynamic regimes can be discriminated: (1) stable margin, (2) overthrusting and (3) subduction. Both overthrusting and subduction are driven by inherent gravitational instability of the passive margin due to the strong density contrast between the continental crust and adjacent oceanic lithosphere. This instability forces continental crust to thrust over the oceanic plate. In the case of overthrusting regime the thrusting of the continental crust over the oceanic plate is associated with deflection but not subduction of this plate, which remains attached to the continent. Transition from stable margin to either overthrusting or subduction is mainly dependent on the ductile strength of the lower crust with weak and hot crust favouring its oceanward movement. On the other hand, transition from overthrusting to subduction is crucially controlled by the ductile strength and density of the continental mantle lithosphere. Subduction is strongly favoured by rheologically weak (hot, hydrated) and depleted continental mantle characterized by lowered density compared to the oceanic lithosphere. Moreover, the present numerical experiments show that the age of the oceanic lithosphere at a passive margin does not play any significant role for the initiation of subduction.