Geophysical Research Abstracts, Vol. 8, 06735, 2006
SRef-ID: 1607-7962/gra/EGU06-A-06735

Modelling the Failure of a Plate-Interface Segment in a Subduction Zone

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Rheological parameters like friction, viscosity and plasticity influence the deformation, stress state, and the mechanical interaction between the subducting and overriding plates in a subduction zone. Numerical modelling with the finite-element method has been performed to study the failure of a large plate-interface segment. The frictional parameters of the failing segment and adjacent segments are varied to study their influence and to quantify the relation between rheological parameters and observables like seismicity rate, deformation and stress changes.

The Hellenic subduction zone and the M=8.3 earthquake of 365 A. D. will be studied exemplary. The complex and curved geometry of the Hellenic subduction zone implies that the relative plate motions and directions vary along the strike of the subduction zone. This leads to a variation of the shear stresses on the different plate-interface segments. This leads to an asymmetric loading of the segments. Results show that the geometry and the frictional state of the failing segment and adjacent segments have strong influences on the deformation pattern and stress changes produced by a large inter-plate earthquake. The total cumulative slip of the generated earthquake and therefore its magnitude also depends on the frictional properties of the adjacent segments.