Geophysical Research Abstracts
Vol. 15, EGU2013-10365, 2013
EGU General Assembly 2013

Modeling the evolution of the slip of the North Anatolian Fault

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The extrusion of the Anatolian plate toward the Aegean domain is accommodated by the North Anatolian fault. For almost 10 Myr, the North Anatolian fault has been propagating over about 1000 km toward the West, therefore the different segments of the fault are not the same age. However, the displacement along the different segments that are older than 2 Ma does not depend on their age (Armijo et al. 1996) and the amount of cumulated slip is constant along these segments (Flery et al. 2001). Admitting that the fault tip propagates at the same rate as the rate of extrusion of the Anatolian block toward the West, this constant cumulated slip seems paradoxical.

Using the FEM code Castem, we model the propagation of the NAF using a plastic yield criterion on a pre-imposed fault. We first consider two dimensional models, we study the influence of rheological parameters as well as different geometries by adding an indenter in front of the model for instance. We also performed three dimensional simulations and compared the results for different vertically varying rheologies.

We show that the displacement imposed by the Arabic plate can be elastically accumulated at the front of the propagating tip of the fault and recovered totally or partially when the plastic yield criteria is reached at the tip of the fault and its strength drops. The amount of recovered displacement as well as the repartition of elastic strain is shown to depend on the rheological stratification of the lithosphere. We finally discuss how the model results help constraining the rheology of the Aegean lithosphere over the last 5 Myr based on geodetic, seismologic and geologic records.