Geophysical Research Abstracts, Vol. 7, 05438, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05438

Rheological properties of the lithosphere : 3D finite element modelling of the spatio-temporal distribution of the post-crisis deformation of northern Iceland.

A. Berger (1,2), F. Jouanne (1), R. Hassani (3) and T. Villemin (1).

(1) LGCA UMR. CNRS 5025, Université de Savoie, Campus Scientifique, 73376 Le Bourget du Lac, France, (2) Now at LGIT UMR. CNRS 5559, Université Joseph Fourier, BP53, 38041 Grenoble Cedex, France, (3) LGIT UMR. CNRS 5559, Université de Savoie, Campus Scientifique, 73376 Le Bourget du Lac, France (Antoine.Berger@univ-savoie.fr / Fax : +33 (0)4 79 75 87 77)

The specific geodynamic context of Iceland results from the simultaneous effect of an oceanic rift and a mantellic plume. In the northern Iceland, the extensive deformation is expressed by volcano-tectonic crisis which the recurrence is near 250 years in the Northern Volcanic Zone. The last event, the 1975-1984 rifting episode that occurred at Krafla fissures swarm, has shown that very high local deformation rates occurred sporadically at the plate boundary. After the rifting episode was over, time-average spreading rate measured 60 km apart from the fissure swarm remained high while farther continual E-W spreading occurred at 2 cm.y^{-1}.

In order to understand the influence of mechanical properties of the lithosphere and of the crustal structure on such a crisis and its following relaxation, we have realized, with the finite element code ADELI, a 3D numerical simulation of the Krafla Fissure Swarm crisis (which occurred between 1975 and 1984) and of the displacements evolution from the end of the crisis (1984) to nowadays. Our models integer the Krafla fissure swarm (simulated as a 3D rheological structure), the Askja fissure swarm and the Husavik-Flatey fault. The results obtained highlight that :

(1) this crisis and its post-crisis relaxation had a local impact in the northern Iceland which did not extend beyond 180 to 200 km from the rift axis ;

(2) the displacements measured by GPS between 1987 and 1995 can not be simulate without a strong opening (near 1m) in the Askja Fissure Swarm ;

(3) the Husavik-Flatey fault does not modify significantly the simulation of the displacements measured between 1987 and 2002, which highlights that this fault have no influence on the syn- and post-crisis deformation of northern Iceland ;

(4) the post-crisis response has continued only 10 to 15 years ;

(5) the viscosities obtained for the lower crust (LC) and the upper mantle (UM) reach 6.10^{20} Pa.s for LC and 6.10^{19} Pa.s for UM which is really stronger than those suggested by previous studies (around 3.10^{18} Pa.s and 3.10^{17} Pa.s for LC and UM respectively).