Numerical Modelling of the magmatic crust production in Iceland
Abstract

By Robert Orendt

In my Bachelor-Thesis I intended to create 2D- models of the development history of the icelandic crust using the Fortran – based programming code FDCON and compare the results with the empirical data of the crustal thickness obtained by seismic measurements.
FDCON solves finite differential equations in a 2-dimensional grid with variable time step width and number of grid points to calculate new values for the density, temperature, viscosity fields using the previous. Equations like mass- , energy and momentum conservation are leading to the biharmonic equation, which is solved in dependence of the stream function. The Bousinesq – approximation neglecting density differences by compaction is in use. All layers are represented by incompressible fluids. The numerical stability is guaranteed by the Courant-criterion. First of all, basing on the paper *Crustal accretion and dynamic feedback on mantle melting of a ridge centred plume: The Iceland case* by Schmeling/Marquardt 2008, it was assumed that all magma which is produced beneath the crust is extracted directly to the surface by volcaneous activity. This lead to the case of *mantle wedge surfacing,* meaning that there was no crust production directly above the mantle plumes, but strong crust thickening to a maximum of 30km with larger distance from the plumes, which is believed to be situated in the mid- atlantic rift directly under the Vatnajökull volcano. Basing on this model, various parameters like the intrusional mass percentage and depth, the plumes temperature and velocity was varied leading to a more realistic case of a *weakly thickening crust.* The crustal thickness amounted to 25km in the plume area and 30 km in the distance, effective for a plumes temperature of 1484°C. For a plumes – temperature of 1634°C both the crustal thickness and expansion velocity of the crust was significantly higher, with a maximum of 40km thickness and 2 cm half – spreading velocity of the plate. In contrast, the seismic measurements indicate a maximum crustal thickness of 40 km directly over the plumes.
One of the biggest challenges of numerical modelling will be to bring the results of the computational models in accordance with the data obtained by geophysical measurements.

.