Geophysical Research Abstracts
Vol. 17, EGU2015-9063, 2015
EGU General Assembly 2015

Numerical Modeling of Middle Crustal Flow of the Central Svecofennian Orogen

Hannu Lammi (1), Annakaisa Korja (1), and Patrice Rey (2)

(1) University of Helsinki, Institute of Seismology, Helsinki, Finland (hannu.lammi@helsinki.fi), (2) Earthbyte Research Group, School of Geosciences, The University of Sydney

This work explores the lateral spreading of thickened hot crust via a series of 2D thermo-mechanical numerical experiments using Ellipsis, a particle-in-cell finite element code. High Paleoproterozoic radiogenic heat production is assumed. The material viscosity is temperature-dependent following the Arrhenius law. The experiments use two sets of rheological parameters for the crust: wet (granite/diorite/mafic granulite) and dry (granite/felsic granulite/mafic granulite) crustal rheologies and dry olivine for the upper mantle.

The first set of models, plateau-models, is based on a 480 km long section of 65 km-thick three-layer plateau crust. In the second set of models, plateau margin-models, a transition from 65 km thick plateau to 40 km thick foreland is imposed in the middle of the model. The models are studying the effect of free moving boundaries on the crustal structure. The models extended symmetrically from both ends with slow (2x0.95 mm/a) and fast (2x9.5 mm/a) velocities. Gravitational collapse is simulated with an additional set of fixed boundary plateau margin models. The models are testing the conditions for mid-crustal flow and core complex formation in high heat flow regime relevant to the Paleoproterozoic.

The results of the modeling are compared to seismic reflection sections and surface geological observations from the Central Svecofennian orogen, where large volumes of granitoid intrusions as well as high-temperature low-pressure gneisses are exposed. The flow patterns are compared with seismic reflection images. The P-T-t paths of rocks at 15 km depth in the models are examined and compared to observations of peak metamorphic conditions of rocks at present-day surface level.

Hot geotherm together with slow extension velocity leads to significant partial melting in the plateau models and in the plateau region of the plateau margin models. P-T-t paths of rocks at these regions best match the observations of high temperatures, but the vertical movement of the partially molten material destroys lateral flow structures in the middle crust. Plateau margin models with dry rheology at any extension velocities and with wet rheology at slow extension velocity develop middle crustal flow in the foreland region and domes in the plateau region.