



## **Asymmetric gravitational spreading – Analogue experiments on the Svecofennian orogen**

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Over-thickened orogenic crust may suffer from rheological, gravitational and topographical unbalancing resulting in discharging via gravitational spreading. If the thickened orogen is also hot, then increased temperature may reduce the viscosity of the crust that may induce large-scale horizontal flow. The effect of flow on the crustal architecture has previously been modeled with symmetric two-way spreading or asymmetric one- or two-way spreading (like channel flow) experiments. Most models do not take into account of the contrasting mechanical properties of the juxtaposed terranes. We have made analogue experiments to study gravitational one-way spreading and the interplay between two crustal blocks with contrasting rheological properties. The models are 3 cm thick replicas of 60 km thick crust. They have three horizontal layers representing strong lower, weak middle and brittle upper crust. The models have cuts to study the effect of inherited crustal-scale weakness zones. The experiments have been conducted within a large centrifuge in the Hans Ramberg Tectonic Laboratory at Uppsala University.

The analogue models propose that asymmetric, unilateral flow has different effect on the contrasting crustal units, in both horizontal and vertical directions. The laterally heterogeneous crust flows towards the direction of extension, and it rotates and extends the pre-existing weakness zones. The weakness zones facilitate exhumation and they increase strain rate. The weakness zones split the crust into subblocks, which stretch individually and which may show signatures of compression or rotation. The changes in thickness of the model reflect changes in the layers, which may thin or thicken depending on the mechanical properties of crustal layers. A consequence of this the total amount of flattening is less than the model extension. The results are compared to geophysical and geological data from Precambrian Svecofennian orogen in Fennoscandia. The comparison suggest that the orogen suffered from gravitational spreading and that induced doming, crustal scale ramp-and-flat and normal faults, and block rotation, and that the net thinning of 10-20 % took place in 12 my.