EGU22-10884
https://doi.org/10.5194/egusphere-egu22-10884
EGU General Assembly 2022

Effect of Icelandic hotspot on Mantle viscosity in southeast Greenland

Valentina R. Barletta[1], Wouter van der Wal[3], Andrea Bordoni[2], and Shfaqat Abbas Khan[1]
[1]Technical University of Denmark, DTU Space, Geodynamics, Lyngby, Denmark (vr.barletta@gmail.com)
[2]Technical University of Denmark, DTU Compute, Lyngby, Denmark
[3]TU Delft, The Netherlands

Recent studies suggest the hotspot currently under Iceland was located beneath eastern Greenland at ~40 Ma BP and that the upwelling of hot material from the Iceland plume towards Greenland is ongoing. A warm upper mantle has a low viscosity, which in turn causes the solid Earth to rebound much faster to deglaciation. In the area of the Kangerlussuaq glacier, a large GPS velocities residual after removing predicted purely elastic deformations caused by present-day ice loss suggests the possibility of such fast rebound to little ice age (LIA) deglaciation. Here we investigate the lithospheric thickness and the mantle viscosity structure beneath SE-Greenland by means of model predictions of solid Earth deformation driven by a low viscosity mantle excited by the LIA deglaciation to the present day. From the comparison of such modeled deformations with the GPS residual, we conclude that 1) a rather thick lithosphere is preferred (90-100 km) 2) and the upper mantle most likely has a viscosity that changes with depth. Assuming a two layer upper mantle, it is not well constrained which part of the upper mantle has to be low, with a preference for low viscosity in the deeper upper mantle.

To understand such results we implemented forward modelling with more realistic earth models, relying on improvements in seismic models, petrology and gravity data. This yields 3D viscosity maps that can be compared to inferences based on the 1D model and forms the basis for 3D GIA models. The conclusion based on the 1D model can be explained with 3D Earth models. In the area of the Kangerlussuaq glacier the seismic derived viscosities prefer a higher viscosity layer above a lower viscosity one. This stems from the slow decrease in viscosity with depth. The layer that is characterized as shallow upper mantle still contains shallow regions with low temperatures, while the deeper upper mantle reaches low viscosities. Generally, for GIA earth models the “higher above lower” viscosity layering is unusual. However, the analysis of the 1D model clearly shows this to be one of the preferred model regions, in combination with a large lithosphere thickness of 100 km. This is a notable result that draws attention to the importance of shallow layering in GIA models.