Post-Glacial Rebound, Lateral Viscosity Variations and Transient Creep

Luce Fleitout[1], **Yan Krien**[1]**and Georges Cailletaud**[2]

[1] *Ecole Normale Superieure, Paris*
[2] *Ecole des Mines, Paris*

Post-glacial rebound models often involve a layered viscosity and a Maxwell viscoelastic rheology. The inverted lithospheric thickness is found to be of the order of 100km. However, there is a thick cratonic lithosphere below the areas of Holocene glaciation. Assemblages of Maxwell solids do not behave like Maxwell solids and the mantle is expected to be heterogeneous at various scales: At a millimetric scale, it is made of minerals with different viscosities. At larger scale, variations of water content or of temperature should induce viscosity variations. Therefore, a Maxwell rheology may not describe appropriately the macroscopic properties of the mantle. Here, post-glacial rebound is modeled with lateral variations of the mechanical properties associated with cratonic roots and a Voigt-Reuss rheology, using a 3D spherical finite element code. The short wavelengths observed in the present-day rate of uplift, in particular in North-America, are compatible neither with a too stiff cratonic lithosphere neither with a very low average viscosity in the upper mantle. Dissipation in the lower part of the cratonic roots can explain the long time-scale associated with the relaxation of the short wavelengths. The transient rheology helps to have a long-term viscosity compatible with the stability of the cratonic roots. It also allows a larger viscosity contrast (100) between the sublithospheric upper mantle and the lower mantle. The asthenospheric viscosity below oceans and young continents is poorly constrained but can be as low as $3.10^19 Pas$, in agreement with models of heat transfer at the base of the plates. The total amount of ice over the various areas providing the best fit to sea-level data has been determined. It is larger over Scandinavia and Canada and thus lower over Antarctica for Burger models.