Geophysical Research Abstracts
Vol. 14, EGU2012-3620, 2012
EGU General Assembly 2012

Requirements for extracting mantle viscosity from glacial isostatic adjustment

L.M. Cathles
Cornell University, Ithaca, NY, USA 14853 (lmc19@cornell.edu)

Extracting mantle viscosity from glacial isostatic adjustment (GIA) data is challenging because it requires a correctly posed rheological model, an accurate description of the ice and water load redistributions that occurred over at least the last glacial cycle, and the ability to interact model predictions with a large amount of observational data.

To address sealevel changes, models must be based on an appropriate rheology. Daly focused attention on this critical issue 78 years ago with his down-punching hypothesis. Observing the sympathetic uplift behavior of areas peripheral to continental glacial loads, he suggested a thick lithosphere was required to force this behavior on asthenosphere flow. At the same time Haskell pointed out that deep flow in a constant viscosity Newtonian mantle would produce the observed peripheral bulge behavior without a thick lithosphere. This debate is important today because sealevel changes are particularly impacted by deep mantle viscosity and mantle rheology.

Lithosphere and asthenosphere properties are another much discussed topic. The commonly observed substantial short wavelength response requires both a thin ($\sim$40 km thick) lithosphere and an asthenosphere $\sim$25 times more fluid than the mantle.

Because the manner of local ice removal can affect rebound calculations greatly, it is critical to have accurate ice and water load redistributions. Load redistributions must include changes in the levels of large lakes. Recent studies indicate how important it is to take into account sediment redistribution over the last glacial cycle.

Finally, evaluation of the calculated emergence requires the comparison to large amounts of accurate (or at least critically vetted) sea level, emergence, GPS, and other kinds of data.

These issues will be discussed and illustrated with some recent calculations.