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Dynamic Topography Revisited

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Dynamic topography is usually considered to be one of the trinity of contributing causes to the Earth's non-hydrostatic topography along with the long-term elastic strength of the lithosphere and isostatic responses to density anomalies within the lithosphere. Dynamic topography, thought of this way, is what is left over when other sources of support have been eliminated. An alternate and explicit definition of dynamic topography is that deflection of the surface which is attributable to creeping viscous flow.

The problem with the first definition of dynamic topography is 1) that the lithosphere is almost certainly a visco-elastic / brittle layer with no absolute boundary between flowing and static regions, and 2) the lithosphere is, a thermal / compositional boundary layer in which some buoyancy is attributable to immutable, intrinsic density variations and some is due to thermal anomalies which are coupled to the flow. In each case, it is difficult to draw a sharp line between each contribution to the overall topography.

The second definition of dynamic topography does seem cleaner / more precise but it suffers from the problem that it is not measurable in practice. On the other hand, this approach has resulted in a rich literature concerning the analysis of large scale geoid and topography and the relation to buoyancy and mechanical properties of the Earth [e.g. refs 1,2,3]

In convection models with viscous, elastic, brittle rheology and compositional buoyancy, however, it is possible to examine how the surface topography (and geoid) are supported and how different ways of interpreting the "observable" fields introduce different biases. This is what we will do.

References (a.k.a. homework)

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