

Dynamic coupling of bulk chemistry, trace elements and mantle flow

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Fully dynamical models that not only track the evolution of chemical heterogeneities through the mantle, but also incorporate the effect of chemical heterogeneities on the dynamics of mantle convection are now emerging. Since in general analytical solutions to these complex problems are lacking, careful testing and investigations of the effect and usefulness of these models is needed.

We extend our existing numerical mantle convection code that can track fluid flow in 3D spherical geometry and tracks both bulk chemical components (basal fraction) and different trace elements. The chemical components fractionate upon melting when and where the solidus is crossed. Now, the chemical information will effect the flow of the fluid in the following ways: The bulk composition will link to density and the (radioactive) trace element abundance to heat production.

Results will be reported of the effect of different density structures; either starting with a primordial dense layer at the base of the mantle, having all density variation originate from melting (basalt production), or a combination between these two end-member scenarios. In particular we will focus on the connection between large scale bulk chemical structures in the (deep) mantle and the evolution of the distribution of noble gasses (He and Ar). The distribution of noble gasses depend upon 1) assumptions on the initial distributions in the mantle, 2) the mantle flow, 3) radioactive production and, 4) outgassing to the atmosphere upon melting close to the surface.