Numerical modeling of chemical heterogeneities in the Earth's mantle

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Convective flows govern much of the dynamics of the Earth. Examples of such flows are convection in the Earth's mantle, convection in magma chambers and much of the dynamics of the world oceans. Nowadays these time-dependent flows are often studied by means of three dimensional (3D) numerical models which solve the equations for the transport of heat and momentum alternatingly. These flows are often driven by a temperature difference. But for many flows there is also an active or passive chemical component that has to be considered. One characteristics of these flows is that the chemical diffusivity is very small. Implementing such a chemical field with a very low diffusivity into a numerical model using a field approach is difficult due to numerical diffusion introduced by the Eulerian schemes. Using Lagrangian tracers is also difficult in 3D flow since a massive amount of tracers is needed. A third class of algorithms are front-tracking methods where the the interface between two chemical distinct reservoirs calculated. Another class of algorithms are the mixed Eulerian-Lagrangian methods like the Level-Set methods. In my talk I will give an overview on the different methods highlighting their advantages and disadvantages.