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Numerical simulations on the stability of the dense layer in the lower mantle

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Seismological observations suggest that there are strong lateral density anomalies present in the lower mantle[1].We aim to (1) identify models which can test both thermal and chemical contribute to lateral variations in density ,and maintain strong compositional anomalies in the lower mantle for a long period of time[2]. (2) compare the results to the probabilistic tomography.We conduct 3D-Spherical numerical simulations using STAGYY, in which we prescribed an initial layer of dense material at the bottom of the system. We focus on the parameters including the chemical density contrast between dense and regular materials(buoyancy ratio B),the volume fraction of dense material,the activation energy,and the ratio of the core radius to the total radius of the sphere.
The results of the simulations show that the stability of the dense layer is mainly controlled by buoyancy ratio,for small value of the buoyancy ratio B ($\leq$ 0.2),the dense material will sweep out to the upper mantle, for large($\geq$0.25) no strong lateral density anomalies observed.only the value between 0.2 and 0.25 may lead into a model with strong lateral density anomalies(to fit the seismological observations well).the value the volume fraction of the dense material is of second order, little evidence show the influence of the ratio of the core radius to the total radius of the sphere on the stability of the dense layer. And the tests on influence of the activation energy on the stability of the dense layer are still on-going.

References

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