Double-diffusive convection – a possible mechanism for layered mantle convection in planetary bodies

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The occurrence of layers within geological systems is a commonly observed phenomenon. Horizontally layered structures can appear on various scales. They can range from relatively small scales like magmatic intrusions ([1]) up to global scales like planetary mantles ([2], [3]). Already in the 1970's geochemists proposed the existance of a chemically layered Earth mantle, with a depleted upper and an undepleted lower layer [4]. This theory is supported by the seimological evidence showing an increase of seismic velocity at a depth of 660km.
Pure thermal convection is not sufficient to generate separatly convecting layers. Taking into account a second, stabilizing component with a different diffusivity distinct layers can evolve (double-diffusive convection). A prominent and still discussed feature observed in numerical studies of double-diffusive convection is the limitation of the first layer.
We present a numerical study on double-diffusive convection within the subcritical diffusive regime based on a 2-dimensional convection model. We investigate the mechanism of layer formation and the limitation of the growth of the first layer for an isoviscous fluid with different thermal Rayleigh numbers.

References

[1] Cawthorn, R. G. (1996). Developments in petrology, Elsevier Science.
[2] Stevenson, D. J. (1989). Mantle convection, Gordon and Bearch, Newark, New Jersey.
[3] Olson, P., Silver, P. G. and Carlson, R. W. (1990). Nature, 344, 209–215.
[4] Hofman, A. W. (1997). Nature, 385, 219–229.