Geodynamics Seminar

第364回ジオダイナミクスセミナー

Thermal convection of highly compressible fluids with depth-dependent physical properties: Implications for the mantle convection of super-Earths

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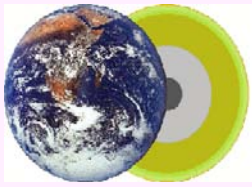
主催：愛媛大学地球深部ダイナミクス研究センター
日時：7/19（金）午後 4時30分～
場所：総合研究棟 4F 会議室



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Abstract

We examined in an analytical manner the stability of thermal stratification of highly compressible fluids with depth-dependent physical properties, in order to obtain the fundamental insights into the convective motion in the mantles of "super-Earths". We consider a stability in a horizontal layer of a highly compressible fluid which is in a hydrostatic (motionless) state under a uniform gravitational field. By using the "parcel method" as in meteorological studies, we investigated the change in the stability of thermal stratification depending on the adiabatic compression as well as the depth-dependence of thermal expansivity and conductivity, with a special emphasis on the changes in the depth ranges (or the vertical extent) of unstable thermal stratifications. We found that, for the conditions relevant to super-Earths of 10 times mass of the Earth's, the stability of thermal stratification significantly varies. For example, the stratification is unstable in the entire layer only for a strong decrease in thermal expansivity with depth and/or low surface temperature. If this condition is not met, the fluid layer will be split into a "troposphere" and "stratosphere", depending on the stable or unstable thermal stratification. The present findings may imply that the models of thermal evolution of super-Earths have to be carefully reconsidered by incorporating the effects of "stratosphere" on the overall heat transfer within the planets.

詳細は当センターホームページ: http://www.ehime-u.ac.jp/~grc/をご覧ください
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