THE GEODYNAMICS SEMINAR

№ 657



Dr. Masanori Kameyama

Professor

Geodynamics Research Center

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Venue: Meeting Room #486

Science Research Bldg. 1, 4th floor.
Ehime Univ.

Keywords

1. mantle convection
2. super-Earths
3. adiabatic compression



Roles of adiabatic compression on the vigor of thermal convection in the mantles of super-Earths with various sizes

We conduct a series of numerical experiments of thermal convection of compressible fluids with temperature-dependent viscosity, in order to study how the adiabatic compression affect the vigor of mantle convection on super-Earths. A two-dimensional basally heated convection is considered under the truncated anelastic liquid approximation (TALA). We varied the magnitude of adiabatic heating and the Rayleigh number as well as the depth profile of thermodynamic properties (thermal expansivity and reference density) in accordance with the planetary sizes. From our calculations by varying the planetary sizes up to 10 times the Earth's mass, we confirmed that the adiabatic compression affects the thermal convection more strongly for larger planets. We also developed scaling relationships between the vigor of thermal convection and the planetary mass by appropriately incorporating the effect of adiabatic compression into those of incompressible (or Boussinesq) cases. From the validity of our scaling relationships we can conclude that the thermal expansivity averaged over the entire depth is of ultimate importance in estimating the effect of adiabatic temperature change and, in turn, the vigor of the convection in the mantles of terrestrial planets under strong compression.

Contact: Steeve Gréaux, PhD. (e-mail: greaux.steeve_georgi.me@ehime-u.ac.jp)