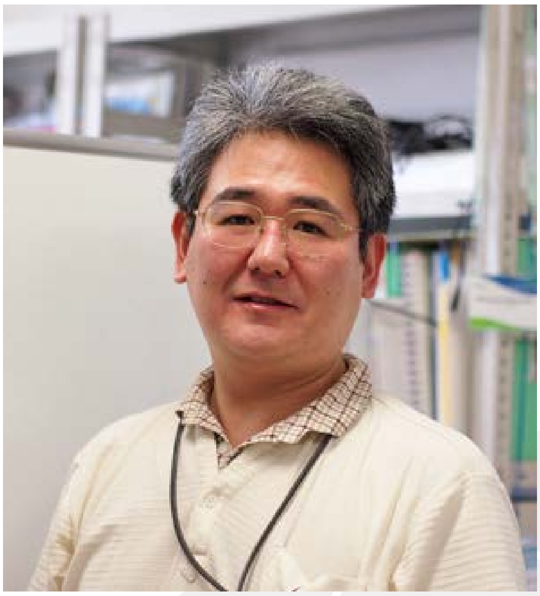
THE GEODYNAMICS SEMINAR

№ 626



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Venue: Meeting Room #486
Science Research Bldg. 1, 4th floor.
Ehime Univ.

Keywords:
1. Moon
2. Mantle convection
3. Magmatism

Numerical experiments of the thermal evolution of the Moon by coupled magmatism-mantle convection system in 2-D axisymmetric spherical shell geometry

We are developing numerical models of coupled magmatism-mantle convection system in two-dimensional axisymmetric spherical shell geometry, in order to understand the thermal evolution of the Moon. The solid-state convection in the lunar mantle is assumed to be that of a Newtonian fluid whose viscosity strongly depends on temperature. The mantle material contains heat-producing elements (HPEs) that are incompatible and exponentially decay with time. Mantle magmatism is modeled by the generation of liquid phase (magma) owing to the pressure-release melting induced by upwelling flows of solid-state convection and the motion of the generated magma as a permeable flow through the solid matrix. The permeable flow of magma was assumed to be driven by a buoyancy due to the density difference between the solid and the liquid phases. The expansion and contraction of the planetary volume is estimated not only from the changes in temperature but also from those induced by melting.

We found that the thermal evolution of the lunar mantle is significantly affected by the initial thermal state in the deep mantle. When the deep mantle is initially hot, a vigorous magmatism occurs at a very early stage and efficiently extracts the HPEs from the mantle. This results in a rapid and monotonous cooling of the lunar interior, and makes the magmatism very short-lived. When the deep mantle is initially cold, in contrast, a significant portion of the HPEs resides in the interior at the very early stage because the magmatism is too week to effectively extract the HPEs from the mantle. This helps maintain the magmatism for a long time, and leads to a large expansion of the planetary volume.

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