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遅い電磁流体波動と地磁気西方移動
Hydromagnetic slow waves and geomagnetic westward drift

櫻庭 中[1*]
Ataru Sakuraba[1*]

[1] 東京大学大学院理学系研究科地球惑星科学専攻
[1]Department of Earth and Planetary Science, University of Tokyo

It has been argued that the geomagnetic westward drift is caused or significantly influenced by hydromagnetic waves confined in the Earth's outer core, where balance between Coriolis and Lorentz forces makes it possible for a slow wave to exist with appropriate time scales. Here we investigate linear stability of an axisymmetric toroidal magnetic field in a rapidly rotating fluid sphere and discuss the magnetic instability and the resulting slow waves traveling eastward or westward. The basic magnetic field is equatorially antisymmetric, and we adopt the magnetostrophic approximation in which inertial and viscous forces are neglected. We assume that the mantle is insulating and the magnetic diffusivity is finite. As the basic field is more confined near the equator of the core surface, the basic field becomes unstable at a lower Elsasser number that measures the square of the basic field intensity, and the most unstable mode tends to exhibit faster westward drift with a larger azimuthal wavenumber. The result suggests that it is possible to interpret the recent geomagnetic westward drift seen under the Atlantic hemisphere as manifestation of magnetic instability of a strong toroidal field just below the core equator. We also investigate effects of existence of basic zonal flows, which are chosen so that the flow velocity satisfies either the equation of motion or the magnetic induction equation. The results indicate that the addition of the basic flow makes the dispersion relation so complex that the unstable modes move eastward too. We also discuss interpretation of our recent low-viscosity geodynamo simulations using the linear stability results.