

Global helical magnetic field formation with thin sheet convection in the geodynamo simulation

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We have performed geodynamo simulation with low Ekman number ($Ek=O(10E-7)$) and high Rayleigh number (at least three hundred times larger than the critical Rayleigh number).

We found new convection structure and dynamo process in the core. The convection is organized as a set of thin sheet plumes, rather than columnar cells. This convection efficiently amplifies magnetic fields. Saturated magnetic energy is several times larger than the convection kinetic energy.

The magnetic field is organized as many flux tubes with current coils. The width of flux tubes are almost the same as that of convection sheet. We found these magnetic flux tubes are connected by globally helical shape magnetic fields. The global helical magnetic field is observed in both the northern and southern hemisphere. The winding of the helical magnetic curve is left handed or magnetic helicity is negative in the southern hemisphere. In the northern hemisphere, that is right handed or magnetic helicity is positive. A pair of helical magnetic field lines in northern and southern hemispheres means the existence of double ring currents one by one in each hemisphere.