EPSC Abstracts
Vol. 9, EPSC2014-163, 2014
European Planetary Science Congress 2014

Planetary dynamo energies for paleomagnetic intensity, scaling, inversions and asymmetries

S. Starchenko, IZMIRAN, Russia (sstarchenko@mail.ru / Fax: +7-495-8510124)

I derive, simplify and analyze integral evolutional laws of the kinetic, magnetic, and an original orientation energies in the liquid core of the Earth or another Earth's type planet. These integral laws are reduced to the rude but simplest system of three ordinary differential equations for cross-helicity *Z*, root-mean square averaged magnetic field *Y* and velocity *X*. This system is controlled by the relatively well-known convection power *W* and other parameters:

$$Y\frac{dY}{dt} = W - \frac{c}{\rho}(X^2Y^2 - Z^2),$$
$$X\frac{dX}{dt} = \mu_0 c(X^2Y^2 - Z^2) - \frac{X^2}{\tau},$$
$$\frac{dZ}{dt} = CW - \omega(XY - Z).$$

Estimates are obtained for the characteristic velocities, magnetic fields, periods and scales depending on the convection power at the stable states and near the inversion/excursion where the above system has its stationary (market by *s*) points:

$$Y_s = \frac{1}{2}\frac{W_0 + W}{\sqrt{\tau\mu_0 c W_0 W}},$$
$$X_s = \sqrt{\tau\mu_0\rho W},$$
$$\frac{Z_s}{Y_s X_s} = \frac{W_0 - W}{W_0 + W} \approx \cos o,$$
$$W_0 \equiv \frac{\rho}{c}\left(\frac{\omega}{C}\right)^2.$$

It was shown that for the implementation of this short-time inversion/excursion the convection power should achieve some rare value, while a normal deviation from this value results in longer-time stable period. Here the inversion is a global process when the volume integral of the scalar product of convective velocity on the magnetic field changes sign. So, the inversions and asymmetries are due to two types of stable states. Named as "lined" is a state with the magnetic field predominantly directed along velocity, while "contra lined" state is with their opposite direction. The lined state is characterized by smaller convection power and magnetic field in contrast to the contra lined state. The duration of the lined state is likely smaller than the duration of opposite state when the geodynamo power gradually increases with time, while for decreasing power it is vice versa. Basing on the obtained results I estimate how diffusion can determine the average period between geomagnetic reversals due to turbulent, thermal, electromagnetic and critical viscosity-compositional processes. Predominant in this process, in many cases, can be identified from the dependence of the reversal frequency on the magnetic field intensity from paleomagnetic data. The data available to me suggest domination of the thermal processes.