Geophysical Research Abstracts, Vol. 7, 00184, 2005
SRef-ID: 1607-7962/gra/EGU05-A-00184

Secular variations and the dynamic model of the geomagnetic field sources.

I. Demina, L. Nikitina, Yu. Farafonova
SPbF IZMIRAN Saint-Petersburg

Secular variations of the main geomagnetic field are assumed to be the result of the processes of internal origin. These are generally long term variations with time scale of decades and longer. Besides, in 20th Century sharp changes in secular variations named geomagnetic jerks were observed. It was shown a jerk can be of 2-3 year duration and also of internal origin. To understand what kind of processes of internal origin can produce secular variation it does seem quite useful to create the model of the main geomagnetic field sources whose parameters are continuously varying with time.

The authors of the present paper have come up with a new approach to solve this problem. The dipole model of the sources of the geomagnetic field has been developed on the basis of the iteration method without any preliminary assumptions about properties sources and their number. The calculations are carried out taking into account all three components of the geomagnetic field. Six parameters are determined for each found source within 100-year interval (from 1900 to 2000) with the 5-year time interval.

It was managed to produce the model of independent sources, reflecting completely the global anomalies of the main geomagnetic field. Depending on their magnitude the sources have different time of life and different rate of the parameters change. Besides the main dipole, 12 more sources have been confidently found to exist within the 100-year interval. The parameters of the sources are obtained to be changing with time. The dynamics of these sources determines the global features of secular variation. Moreover, a set of sources are found which approximate the local anomalies of main geomagnetic field. It can be said that these sources started to develop intensively in 20th century, causing the local anomalies of secular variations.

The authors consider also a physical model of the sources of the geomagnetic field.

It’s assumed that the sources are connected with large-scale convective cells or with large-scale vortices inside the Earth’s liquid core. It was considered the compositional convection in the Earth’s liquid core and it was shown that several large-scale cells whose sizes are compared with the radius of the inner core can exist there. It was estimated as basic parameters of the cells as turbulent velocity and vorticity of the cell. Then the authors considered the process of the magnetic field generation by the convective cell. It was shown that the magnetic field generated by the convective cell is approximately 15000 nT if a vortex diameter is about 500 km. It’s compared with the main sources in the model obtained by the geomagnetic data.

Compositional convection in the Earth’s liquid core consists of cells of different scales. Vortices and cells of small sizes can be sources of geomagnetic fields too. These cells are not as stable as big ones, and they influence to the changing of the geomagnetic field. So, the authors assume that local anomalies of secular variations are connected with convective cells or vortices with diameters about 100 km that can appear at the core-mantle boundary. These vortices can appear at any topographical peculiarity of the core-mantle boundary surface. The magnetic fields generated by the convective cells with diameter 100 km is approximately 1000 nT.

The approach offered by authors allows to find the detailed connection between the geomagnetic data and physical processes in the Earth’s liquid core.

This work is supported by INTAS grant No 01-0142.