Paleosecular variation in numerical geodynamo models

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Recent geodynamo models by numerical simulation have become able to self-consistently generate magnetic field and fluid advection in the miniaspace. Almost all those models can demonstrate some important properties of the actual geomagnetic field (ex. dominant dipole field) and some models also show reversals of the dipole field as seen in the paleomagnetic data. However, some nondimensional parameters, boundary conditions and other factors are still much far from real values of the Earth's core so that it is doubtful that they can make faithful reproduction of the field in detail. Dormy et al. (1999) tried to test some features of magnetic field between from paleomagnetic data and from results of simulations, but they focused only upon the distribution of the dipole, reversal rates and the magnetic power (energy) distribution among the degree l. Kono and Roberts (2002) also referred the numerical models and checked some characteristics.

In this study we investigate the recreation of the field properties with two numerical models; (A) homogeneous boundary condition model, (B) 'topographic' boundary condition model by Glatzmaier et al. (1999). (C) Sakuraba and Kono model (Sakuraba and Kono, 1999) will also be discussed in the presentaion.

We notice long-period geomagnetic characteristics such as the persitent quadrupoles in the time-averaged field (TAF) models (e.g. Wilson, 1970; McElhinny et al., 1996; Kelly and Gubbins, 1993; Hatakeyama and Kono, 2002), and large variances and small averages in (l=2, m=1) spherical harmonic components (Kono and Tanaka, 1995; Hatakeyama (2001, PhD thesis). Except predominant axial dipole (g10), it is indicated that only axial quadrupole (g20) are significant non-zero average in the integral time of both models. However, g10 and g20 have oppsite signs, whereas they have same sign in TAF models appearing in the inclination anomaly as 'VGP far-side effect' or 'offset dipole'. Moreover, there is a different distribution of g20 term between two boundary conditions; it is close to the normal distribution in the result of homogeneous boundary condition model in which the dipole flucutation is very stable, while distribution is asymmetric with respect to the average. in the latter case the 'mean' of g20 has opposite sign of g10. Kono and Roberts (2002) pointed out that the magnetic field on both surfaces of the core and the Earth are dominantly rotating westward in Model (A). This feature is much obvious in g-h diagram (Yoshida and Hamano, 1993). Almost all thelower degree components (l, m) show clear westward drift, though the speed is quite different among the mode.