Effects of thermally heterogeneous structure in the lowermost mantle on the geomagnetic field strength

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We have conducted a study of 3-D numerical dynamo simulation with a prescribed non-uniform boundary heat flux pattern to examine effects of thermal structure at the core mantle boundary (CMB) on the geodynamo, especially on the magnetic field strength. In cases of an Ekman number, E = 10^{-5}, strong boundary heterogeneity with equatorial symmetry enhances the dipolar field strength. It is in contrast to the previous study for a larger Ekman number, in which dynamo ceases due to strongly heterogeneous heat flux at CMB. In the interior of the fluid outer core, strong magnetic fields are generated off the equatorial plane beneath the high heat flux boundary, while moderate magnetic fields are maintained with westerly migration underneath the low heat flux one. On the other hand, the equatorially anti-symmetric boundary heat flux distribution at CMB modifies the energy partition between the equatorially symmetric and anti-symmetric constituents of the magnetic fields without notable change in the total energy. The boundary-induced thermal wind has strong influence on the flow structure and on the magnetic field intensity. It is suggested that thermally heterogeneous structure of the lowermost mantle might cause the anomalously strong geomagnetic field such as that of the Cretaceous Normal Superchron.