Morphology of dynamos by double diffusive convection with a stably stratified layer beneath the core-mantle boundary

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Seismic and geomagnetic observations reveal the presence of a stably stratified layer below the core-mantle boundary. Effects of the stably stratified layer on convective motions in the fluid outer core, and the resultant dynamo processes are investigated to gain insights into the origin of the layer. In this study, we use a dynamo model adopting double diffusive convection with an either thermally or compositionally stably stratified layer. Regardless the origin of the stable layer, of which thickness is 0.1 fold of the core radius, the resultant magnetic fields show weak non-dipolar fields, whereas strong-field dipolar dynamos are obtained in the runs without the stably stratified layer. In order to be compatible with the observed geomagnetic field strength and secular variation, it is suggested that the stably stratified layer should be thinner or more weakly stably stratified. When the compositional driving is dominant as in the present Earth's core, the attenuating effects through the compositionally stably stratified layer is stronger than that through the thermal one. From a viewpoint of the magnetic field, it is suggested that a relatively thin stably stratified layer of thermal origin is preferable.