Geophysical Research Abstracts
Vol. 12, EGU2010-10244, 2010
EGU General Assembly 2010

Double diffusive dynamo action in Mercury's core

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Recent numerical dynamo simulations which model a stably stratified layer at the top part of Mercury's liquid iron core where successful in reproducing the planets observed weak magnetic field. Assuming a sub-adiabatic temperature gradient at the core-mantle boundary convection was mainly driven by the effects of inner-core solidification in the deeper layers. In order to simplify matters, these models adopted a co-density approach which effectively assumes equal diffusivities for both heat and the lighter core elements, notably sulfur. In order to overcome this limitation, we have modified our dynamo code to include two separate transport equations that allow to model differences in diffusivities. To explore the potential effects of double diffusive convection on Mercury's dynamo we assume that sulfur diffuses ten times slower than heat and use an Ekman number of 3×10^{-4}. When adopting 2 wght% of sulfur, the double diffusive case exhibits a strong toroidal magnetic field within the stably stratified core region which is missing in the co-density model. As a consequence, the magnetic field at the planetary surface is two orders of magnitude stronger in the double-diffusive case and thus not compatible with the observations. However, the surface field strength becomes realistic again when the sulfur fraction is reduced below 0.2 whgt%. These results therefore imply that Mercury's core may be poor in sulphur and other light constituents.