Geophysical Research Abstracts,
Vol. 10, EGU2008-A-10580, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-10580
EGU General Assembly 2008

Implications of geochemical reservoirs and transport properties in D″ on Earth's core thermal and magnetic evolution

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The magnetic history of the Earth places constraints on the heat flow across the core-mantle boundary (CMB) and implicitily on the geochemistry of the lowermost mantle and the transport properties in this region. If the heat flux across the CMB is high, vigorous convection takes place in the core and maintains the geodynamo process. If the heat flux is low, convection in the core is insufficient to maintain a magnetic field. In this contribution we analyze the effects on the geodynamo of the presence of hidden reservoirs of incompatible elements, enriched in radioactive elements, that may be present in the CMB region (Boyet and Carlson, 2005, Tolstikhin and Hofmann, 2005). Our analysis focuses on the presence of additional internal heating in a 200-Km layer in the D″ region, and considers both convection and thermal conduction mechanisms of heat transport in this layer. We use a 2D axisymmetrical numerical model for the mantle and we couple the CMB temperature output to energy and entropy evolution models in the core. Our results show that from a geomagnetic perspective, succesful scenarios can be constructed with low rates (up to 4TW) of additional internal heating in D″, with a trade-off between the efficiency of heat transport and the rate of additional heating. Lastly, we consider a mixed scenario in which a basal stagnant layer may be entrained in the whole mantle convection after approximately 2.0 Gyrs of evolution (Davaille, 2007) for which the magnetic field is present throughout geological time.