Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SIT41-P14 Room:Convention Hall Time:May 20 17:15-18:30

The high conductivity of iron and thermal evolution of the Earth's core

GOMI, Hitoshi[1*], OHTA, Kenji[1], HIROSE, Kei[1], LABROSSE, Stephane[2], CARACAS, Razvan[2], VERSTRAETE, Matthieu J.[3], HERNLUND, John W.[4]

[1]Department of Earth and Planetary Sciences, Tokyo Institute of Technology, [2]Laboratoire de geologie de Lyon, [3]Institut de Physique, Universite de Liege, [4]Department of Earth and Planetary Science, University of California

Earth's magnetic field is re-generated by dynamo action via convection currents in the liquid metal outer core, which are in turn driven by a combination of thermal buoyancy associated with secular cooling (along with possible radioactive heating) and buoyant release of incompatible light alloying components upon inner core solidification. Prior to the crystallization of an inner core, the energy for maintaining a geodynamo must be supplied in excess of the heat conducted down the isentropic gradient that develops in the presence of convection, placing tight constraints upon the core's thermal evolution. Here we present new measurements and calculations of the electrical resistivity of iron to 1 Mbar pressure, combined with a model accounting for saturation resistivity of core metal, to show that the thermal conductivity of the uppermost core is greater than 90 W/m/K. These values are significantly higher than previous estimates, implying rapid secular core cooling, an inner core younger than 1 Ga, and ubiquitous melting of the lowermost mantle during early Earth. An enhanced conductivity with depth suppresses convection in the deep core, such that its center was stably stratified prior to the onset of inner core crystallization.

Keywords: high pressure experiments, first-principles calculations, resistivity saturation, core conductivity, thermal evolution