The 67th GRC & The 12th MEXT Shin-Gakujutsu "Core-Mantle Coevolution" International Frontier Seminar

Laboratory measurements of transport properties of planetary materials at deep planetary interior conditions

Dr. Stewart McWilliams (The University of Edinburgh)

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Venue: Meeting Room #486, Science Research Bldg. 1, Ehime Univ.

The transport properties of minerals and fluids at extreme pressure and temperature determine the dynamics of planetary deep interiors, including heat transport, fluid flow, and generation of magnetic fields, as well as precipitation and mixing. I will discuss recent measurements of the thermal, optical, electronic, and viscous transport properties of planetary materials in the laboratory using a combination of static and dynamic high pressure techniques and fast optical measurements. These studies have implications for both terrestrial and giant planets. Thermal conductivity measurements in metals at high pressure and temperature indicate a low thermal conductivity of Earth and terrestrial planet cores. This suggests a long-lived magnetic field on Earth, as required by paleomagnetic measurements, may be explained without high interior temperatures or unusual core energy sources in the far past. However, the onset of metallic behavior in mantle melts at extreme pressure suggests dynamo processes in rocky mantles may contribute to the magnetic fields of young terrestrial planets, including the early Earth. Measurements of insulator-to-conductor transformations in fluid hydrogen and several noble gases at extreme pressure and temperature yields new constraints on the nature of hydrogen metallization and helium-neon rain in giant planets. Deep sedimentation of noble gases in smaller gas giants (similar to Saturn) may play a role in the relatively larger core of Saturn compared to Jupiter, through the formation of a protective noble gas ocean around the core. New approaches to measuring high pressure viscosity in planetary fluids will also be discussed.

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