[EE] Evening Poster | S (Solid Earth Sciences) | S-IT Science of the Earth's Interior & Tectonophysics

[S-IT18]Planetary cores: Structure, formation, and evolution

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There are fundamental links between the formation and evolution of planets and their satellites to that of their cores. Defining the physical and chemical properties of the cores of these terrestrial bodies are fundamental for understanding their internal structures and thermal profile. Recent advances in experimental and theoretical studies provide new insights and applications to the Earth's cores and other terrestrial bodies. Future exploration missions will obtain data on the internal structure of terrestrial planets (e.g., Mars and Mercury) and planet-satellite systems. We anticipate presentations on recent advances on the physical and chemical properties of cores and discussions regarding the latest views of their formation and evolution. We welcome contributions from mineral/rock physics, geophysics, geochemistry, geodynamics, and planetary science.

[SIT18-P03]Mercury's core detected by MESSENGER's vector magnetic data

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MESSENGER (MErcury Surface, Space Environment, Geochemistry, and Ranging) is the first probe launched into Mercury's polar orbits and observed the planet's electromagnetic (EM) environment including its vector magnetic field from 2011 to 2015.

This study is the first to clarify the characteristic periods of magnetic field variations at Mercury and to extract the induced magnetic field explicitly from the observed data. In order to discuss EM induction within Mercury, it is necessary to acquire time-series of internal and external Gauss coefficients. However, it is very difficult to determine those coefficients as in the case of the Earth due to the limited spatial distribution of the magnetic field data of MESSENGER. For the structure of Mercury's magnetic field, low degree zonal coefficients have been determined from spherical harmonic analysis of all MESSENGER data (Anderson et al., 2012). However, the temporal variation of Mercury's magnetic field has not yet been discussed so far because the Gauss coefficients estimated in the previous study are based on the annual means, For the EM induction in Mercury, there has been only an example estimating dipolar magnetic fields induced at the top of the Mercury's core by time-varying magnetospheric field (Johnson et al., 2016). They calculated the time-varying external field from a stationary magnetic model by regarding the model as a function of the subsolar distance that shows a clear annual variation due mainly to the large eccentricity of the Mearcury's orbit.

In this study, we estimated one of the most important parameters of the Mercury's internal structure, namely, its core radius by extracting time-varying internal Gauss coefficients from observed data not only for the axial dipole but also other zonal components. First, we revealed the characteristic periods of the Mercury's magnetic field variations by automatically identifying the position of the Mercury's magnetopause, converting them into the subsolar distances, and analyzing their frequency dependence. It was found that the characteristic periods that may contribute to EM induction within Mercury are mainly one Mercury year and half Mercury year. Second, we derived the time series data of internal Gauss coefficients by employing the KT14 stationary magnetic field model for Mearcury (Korth et al., 2015) as a function of the subsolar distance. Finally, we estimated the core radius of Mercury using the ratio of the internal to external Gauss coeefficients for the axial dipole and for one Mearcury year. A stable estimate of core radius, 2019±172km, was obtained using time segments when the Mercury's magnetic field is quiet at its magnetopause. This result is within a reasonable range compared with other results determined independently from EM method such as Harder and Schubert (2001), Hauck et al. (2013) and so on.