

衛星磁場観測による月の核の大きさの検出についての再検討

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Probe-ability of the highly electrically conducting lunar core by magnetic field measurement using orbiting satellite

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Observationally constrained size of the lunar core is informative to investigate the thermal history of the moon by discussing how the lunar magnetism was generated by probably a small core, how the core was cooled, and when the lunar dynamo ceased to generate its magnetic field. Efforts have been made to probe the size of the lunar core using seismic, geodetic, and lunar-magnetic observation. Among them, magnetic field around the moon was employed to detect the induced magnetic moment by the lunar core and corresponding lunar radius. Estimates of the radius using Apollo 15, 16, Lunar Prospector and SELENE (KAGUYA) ranges from 330 to 400 km, which are in agreement with those obtained using other data. However, the signal from the core was small and it has been difficult to discriminate if the observed signal was really due to the core. The induced moment by the lunar core can be observed while the moon is in the Earth's magnetosphere. The necessary conditions to detect the induced moment are (1) the core is highly conducting to sustain the induced moment for at least several days, (2) the core is sufficiently large to generate sensible induced moment, and (3) the mantle is not very conductive for the magnetic field signal to reach the core within a short time without much decay. A simple analysis on electromagnetic response of a spherical conductor with respect to a step-like magnetic field input shows that the core signal can be detected if the structure of the mantle is similar to those obtained previously. In this paper, we analyze the induction problem more precisely to classify in which condition the induced moment by the lunar core can be detected.