

Comparison of KAGUYA-MAP-PACE data with ACE plasma data to study the interaction between lunar magnetic anomalies and solar wind

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Although the moon has no global magnetic fields, there is a number of small crustal field and several large magnetic anomalies. Especially, recent studies by the Lunar Prospector data showed an extremely large anomaly on the far side of the moon (S20-S50, E150-E210). Interaction between the solar wind and the lunar magnetic anomaly has remained unclear due to the limitation of observations.

In this paper, we study the effects of solar wind on the electron heating above the magnetic anomaly, using initial data from KAGUYA (SELENE: SELEnological and Engineering satellite) which is a Japanese lunar orbiter launched on September 14, 2007. One of the scientific instruments boarded on KAGUYA is PACE (Plasma energy Angle and Composition Experiment) that consists of 4 sensors: ESA (Electron Spectrum Analyzer)-S1, ESA-S2, IMA (Ion Mass Analyzer), and IEA (Ion Energy Analyzer).

We found a good correlation between KAGUYA-PACE data and ACE data (solar wind magnetic field, density, etc.) when the moon was in solar wind. For example, on January 12, 2008, ion energy measured by IEA increased in accordance with an increase of solar wind speed. Also, PACE observed an increase of electron and ion densities as well as a decrease of their temperatures about 1 hour after a rapid density increase and temperature decrease in the solar wind at the ACE location. These facts suggest that solar wind variations have pronounced effects on the moon environment.

When the moon was in the solar wind and KAGUYA was orbiting above the large anomaly on the far side (on January 1-3, 2008), a strong electron heating was observed every 2 hours (period of orbit), which may be an anomaly-related phenomenon. During this period, the electron heating was observed in each orbit, and the characteristics of electrons varied depending on the solar wind conditions. The PACE data also suggest that the electron heating occurs both upward and downward region of KAGUYA. We will discuss the possible mechanism of electron heating by comparing PACE plasma data with ACE solar wind data.