

SELENE(KAGUYA) observation of the lunar exosphere

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The Moon has no global intrinsic magnetic field and only has a very thin atmosphere called surface-bounded exosphere. The lunar exosphere has been observed by ground-based technique on many occasions since its discovery. The alkali components such as Na or K have especially been observed to understand the generation process and the transport mechanisms. Some ground-based measurements and laboratory experiments have confirmed that the alkali exospheric components are produced by ion-induced desorption (sputtering), photon-stimulated desorption, meteorite-induced vaporization and/or thermal desorption from the surface. One of the loss processes of the exospheric particles is photoionization and ion-pickup process. The ionized exospheric particles are transported by the surrounding electric field. Therefore, ion measurements made from lunar orbit is another way to study the lunar exosphere as well as interactions between the solar wind and the planetary surface. SELENE (KAGUYA) is a Japanese lunar orbiter which was launched on 14 September 2007 from Tanegashima Space Center in Japan. MAP is one of the scientific instruments onboard SELENE. MAP consists of LMAG (Lunar MAGnetometer) and PACE. LMAG is a triaxial flux gate magnetometer that is equipped at the top plate of a 12-m long mast in order to reduce an offset of the interference magnetic fields caused by the spacecraft. LMAG measures the vector magnetic field with a sampling frequency of 32 Hz and a resolution of 0.1 nT. PACE consists of four sensors: ESA (Electron Spectrum Analyzer)-S1, ESA-S2, IMA (Ion Mass Analyzer) and IEA (Ion Energy Analyzer). ESA-S1 and S2 measure the distribution function of low-energy electrons below 15 keV, while IMA and IEA measure the distribution function of low-energy ions below 28 keV/q. MAP-PACE IMA has detected low-energy ions at 100-km altitude. The MAP-PACE measurements have elucidated that the ions originate from the lunar surface and exosphere and that the ions are at least composed of He⁺, C⁺, O⁺, Na⁺, K⁺ and Ar⁺. The measurements of ions from the Moon enable us to continuously monitor the lunar exosphere. The 1.5-year observation of SELENE(KAGUYA) shows that the ions from the Moon have been detected both when the Moon is exposed to the solar wind and when it is in the Earth's lobe region. The observation suggests that the solar wind is not the dominant source mechanism for the lunar exospheres. Moreover, the MAP-PACE observation shows the dependence on the solar zenith angle and the dawn-dusk asymmetry of the lunar exosphere. We report the features of the lunar exospheres obtained by the SELENE(KAGUYA) observation and discuss the source mechanism of the lunar exospheres.