Structure of the lunar exosphere deduced from the ion observation by SELENE (KAGUYA) MAP-PACE

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Surface-bounded exosphere of the Moon has been observed by ground-based telescopes on many occasions since its discovery. The alkali components such as Na or K have been observed in order to understand the generation process and the transport mechanisms. The continuous ground-based observations 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. The major loss process of the exospheric particles is photoionization and ion-pickup process. The ion-pickup process is quite simple because the Moon has no global dipole magnetic field. The ionized exospheric particles are transported by the motional electric field E=-VxB where V is the solar-wind bulk velocity and B is the interplanetary magnetic field. If we know the electric field, it is possible for us to trace back the ion trajectory and to know where these ions are produced.

Japanese lunar orbiter SELENE (KAGUYA), which was launched on September 14, 2007, has in-situ plasma analyzers named MAP-PACE (MAgnetic field and Plasma experiment - Plasma energy Angle and Composition Experiment) in order to investigate the plasma environment at 100km altitude around the Moon. IMA (Ion Mass Analyzer), one of the MAP-PACE sensors, has observed heavy ions that are probably related to lunar exosphere. The amount of the observed pick-up Na+ ion flux is approximately consistent with the estimation considering the several major generation mechanisms. The observed exospheric ion flux has dependence on the solar zenith angle of the SELENE orbit. In this study, we will report the results of the exospheric ion observation by IMA. The obtained data show that IMA has detected heavy ions which contain Na^+/Mg^+ and $Ar^+/K^+/Ca^+$ components when the Moon is in the solar wind. We will discuss the structure and the generation mechanism of the lunar exosphere.