Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PPS23-24 Room:201A Time:May 23 17:30-17:45

The effect of magnetic anomalies on the detection of Moon originating ions

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The Moon has only thin atmosphere and local magnetic field called ”magnetic anomalies”, which makes the Moon intriguing in terms of interaction between the solar wind and surfaces of astronomical bodies. In the second half of the 20th century, the Apollo series and ground-based observation revealed the existence of the thin atmosphere and heavy ions around the Moon. Although the generation / transportation processes of the ions originating from the Moon have long been discussed, they have not been sufficiently understood yet. At present, it is supposed that ions are generated by multiple processes including ionization of neutral exosphere by solar wind, processes at the lunar surface such as thermal desorption, photon / charged-particle / chemical sputtering, meteoric impact, and interior release. The generated ions are accelerated by surface potential / convection electric field in the solar wind, and then released to space [Vondrak, 1988].

An ion energy mass spectrometer MAP-PACE IMA on Kaguya first made in-situ observation of Moon originating ions. Yokota et al [2009] identified heavy ions such as C^+, O^+, Na^+, K^+, Ar^+ in the mass spectra obtained by integrating the ion counts observed by IMA (Ion Mass Analyzer) on Kaguya, when the Moon was in the solar wind. They showed that in general the energies of the ions could be explained by assuming that ions were accelerated by convection electric field in the solar wind.

Since the amount of detected ions would be affected by many factors, including electric field, magnetic field, positional relation between the Sun and the Moon, selenographical features and so on, to understand how detected ions are affected by these factors should be an important clue to reveal the generation / transportation processes.

We study how convention electric field and magnetic anomalies affect the Moon originating ions. Comparing the convection electric field and fluxes of the Moon originating ions detected by IMA at ˜100km altitude, we confirmed that the radial component of convection electric field has relatively good correlation with detected fluxes. This means that the quantity of the transported ions is in general dominated by the direction and intensity of the convection electric field. On the other hand, IMA detected less Moon originating ion fluxes whose energies are under ˜250eV above magnetic anomalies even when the radial component of electric field was positive. This indicates that magnetic anomalies affect generation or transportation of ions originating from the Moon.

Keywords: Moon, plasma, magnetic anomaly