The effect of the crustal magnetic field on the Martian plasma density

Miho Kanao[1]; Yoshifumi Futaana[2]; Atsushi Yamazaki[3]; Takumi Abe[3]; Masato Nakamura[3]

[1] Earth and Planetary Sci.Tokyo Univ.; [2] IRF; [3] ISAS/JAXA

Mars and Venus have the atmosphere and no strong dipole magnetic field. The solar wind velocity, VSW, and the interplanetary magnetic field, BIMF, induce the motional electric field, Em =-VSW x B. It has been shown from our previous studies that the motional electric field affects the ionopause altitude and the escape process from the Martian and Venusian ionosphere. In the nightside, the ionopause position in the E_m+ region (where the E_m is downward to the planet) is constant independently of the E_m magnitude. The number density changes rapidly in this E_m+ ionopause. The E_m+ ionopause is the sharp boundary layer. On the other hand, the E_m- (where the E_m is upward to the planet) ionopause altitude depends on the E_m magnitude. The ionopause position is very variable. The number density changes gradually. The E_m- boundary layer is very thick region. The ionopause altitude is asymmetry due to the motional electric field, E_m.

Since 1990s, the observation of the magnetic field data by the OMAG onboard Mars Global Surveyor has been shown that Mars has the crustal magnetic field as strong as over 100nT at 400km altitude. In this study, the crustal magnetic field effect on the asymmetric ion (proton) number density distribution is investigated by the statistical analysis.

The relationship between the observed proton number density distributions and the Martian crustal magnetic field is shown on the E_m-V_{SW} plane. The proton number density is observed by the ion mass analyzer (IMA) onboard Mars Express. The motional electric field is estimated using the magnetic field data observed by OMAG onboard the MGS and the solar wind velocity. The available data term is from March 2004 to March 2006. In the term, we can use both the IMA data and the OMAG of MGS data. The result shows the enhancement of the observed proton number density as the motional electric field is toward southern where the crustal magnetic field is strong.

In this study, we considerate the mechanism of this proton number density enhancement above the crustal magnetic field using the proton velocity distribution and the oxygen number density. We also study the effect of the crustal magnetic field by analyzing the magnetic field data and the electron number density data observed by MGS. We studied the effect of the crustal magnetic field on the dayside ionopause altitude and the ion escape process in addition to the nightside asymmetry due to the motional electric field.