火星探査機MAVENの観測データを使用したMagnetic Pileup BoundaryとIon Composition Boundaryの比較

Comparison of Martian Magnetic Pileup Boundary with Ion Composition Boundary Observed by MAVEN

*松永 和成[1,2]、関 華奈子[3]、Brain David A.[4,5]、原 拓也[6,7]、益永 圭[3]、McFadden James P.[6,7]、Halekas Jasper S.[8]、Mitchell David L.[6,7]、Mazelle Christian[9,10]、Connerney Jack E. P.[11]、Jakosky Bruce M.[4,5]
*Kazunari Matsunaga[1,2], Kanako Seki[3], David A. Brain[4,5], Takuya Hara[6,7], Kei Masunaga[3], James P. McFadden[6,7], Jasper S. Halekas[8], David L. Mitchell[6,7], Christian Mazelle[9,10], Jack E. P. Connerney[11], Bruce M. Jakosky[4,5]

1.名古屋大学大学院理学研究科、2.宇宙地球環境研究所、3.東京大学院理学研究科、4.Laboratory for Atmospheric and Space Physics (LASP)、5.University of Colorado at Boulder、6.Space Sciences Laboratory (SSL)、7.University of California, Berkeley、8.University of Iowa、9.IRAP CNRS、10.University Paul Sabatier, Toulouse、11.NASA Goddard Space Flight Center
1.Graduate School of Science, Nagoya University, 2.Institute for Space-Earth Environmental Research (ISEE), 3.Graduate School of Science, University of Tokyo, 4.Laboratory for Atmospheric and Space Physics (LASP), 5.University of Colorado at Boulder, 6.Space Sciences Laboratory (SSL), 7.University of California, Berkeley, 8.University of Iowa, 9.IRAP CNRS, 10.University Paul Sabatier, Toulouse, 11.NASA Goddard Space Flight Center

The Martian upper atmosphere directly interacts with the solar wind, since Mars does not possess the intrinsic global magnetic field. This interaction forms a transition region between the shocked solar wind (magnetosheath) and the ionosphere, in which characteristic boundary structures are embedded. In this transition region, the neutral atmospheric heavy atoms can be ionized and involved into the solar wind flow. This is called the mass loading process [e.g., Dubinin and Lundin, 1995]. The loaded heavy ions form a dense layer which called “ion composition boundary” (ICB). ICB separates the solar wind protons dominant region from the planetary heavy ions dominant one [e.g., Erkaev et al., 2007]. Since the interplanetary magnetic field (IMF) frozen-in the solar wind plasma, IMF also drape around the transition region. Due to the draping IMF piles up in the front of the Martian upper atmosphere, the magnetic pileup boundary (MPB) is formed [e.g., Luhmann et al., 2004].
Previous studies have shown existence of the magnetic pileup region or the induced magnetosphere in the transition region. Mars Global Surveyor (MGS) observed MPB, a boundary between the magnetosheath and the Martian magnetic pileup region by its magnetometer and electron reflectometer [e.g., Vignes et al., 2000, Trotignon et al., 2006]. ICB was also observed by the ion mass analyzer of Phobos 2 and Mars Express (MEX) [e.g., Breus et al., 1991, Dubinin et al., 2006]. Due to the lack of continuous simultaneous observations of the magnetic field and ion composition, however, relations between MPB and ICB are far from understood. In this study, we investigate relative locations and characteristics of MPB and ICB, and their dependence on solar wind parameters, utilizing a full package of plasma instruments onboard Mars Atmosphere and Volatile EvolutioN (MAVEN).
We conducted a statistical analysis of the ion, electron, and magnetic field data obtained by MAVEN from November 2014 to March 2015 in order to investigate relations between MPB and ICB. We identified MPB from the electron and magnetic field data by inspection based on criteria of Trotignon et al. [2006]. We calculated the density ratio between the planetary heavy ions and the solar wind protons to investigate the ion composition around MPB. Results show that there is a north-south asymmetry in locations of MPB and ICB. Observations also indicate that the relative

location of MPB and ICB has deference between dayside and nightside. Moreover, the southern crustal magnetic fields seem to play a role of the north-south asymmetry in locations of MPB and ICB. However, dependences of MPB and ICB on the solar wind dynamic pressure, density, and velocity are not clear. The solar wind induced magnetic field direction also has no clear effects on ICB and MPB locations.

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