Abstract

The transport and energization of planetary ions within Kelvin-Helmholtz (KH) vortices developing in the magnetospheric flanks of Mercury are investigated using both numerical methods and data analysis. Due to the presence of heavy ions of planetary origin (e.g., O^+, Na^+, and K^+) and the complicated field structure present during the KH vortex development, the scale of electric field variations can be comparable to that of the ion gyromotion. Therefore, ions may experience non-adiabatic energization as they drift across the magnetopause. In this study, we focus on the effects of the spatial/temporal variations of the electric field along the ion path. We show that the intensification, rather than the change in orientation, is responsible for large non-adiabatic energization of heavy ions of planetary origin. This energization systematically occurs for ions with low initial energies in the direction perpendicular to the magnetic field. The energy gain is of the order of the energy corresponding to the maximum ***E***x***B*** drift speed. It is also found that the ion transport across the magnetopause is controlled by the orientation of the magnetosheath electric field. Analyzing data from MESSENGER allow us to compare the observational facts with our numerical results. We find that the counts of Na^+-group detected by FIPS increase with the existence of KH waves, which is consistent with our numerical results. Although some differences in the energy distribution are expected in our numerical results, the data show no significant differences. This will be the subject of further studies using the newly developed BepiColombo instruments.