Van Allen Probes observations of magnetic field dipolarization and its associated O\(^+\) flux variations in the inner magnetosphere at \(L<6.6\)

*Masahito Nose\(^1\), Kunihiro Keika\(^2\), Craig A. Kletzing\(^3\), Harlan E. Spence\(^4\), Charles W. Smith\(^4\), Robert J. MacDowall\(^5\), Geoffrey D. Reeves\(^6,7\), Brian A. Larsen\(^6,7\), Donald G. Mitchell\(^8\)


We investigate magnetic field dipolarization in the inner magnetosphere and its associated ion flux variations, using the magnetic field and energetic ion flux data acquired by the Van Allen Probes. From a study of 74 events that appeared at \(L=4.5-6.6\) between 1 October 2012 and 31 October 2013, we reveal the following characteristics of the dipolarization in the inner magnetosphere: (1) its timescale is approximately 5 min, (2) it is accompanied by strong magnetic fluctuations that have a dominant frequency close to the O\(^+\) gyrofrequency, (3) ion fluxes at 20-50 keV are simultaneously enhanced with larger magnitudes for O\(^+\) than for H\(^+\), (4) after a few minutes of the dipolarization, the flux enhancement at 0.1-5 keV appears with a clear energy-dispersion signature only for O\(^+\), and (5) the energy-dispersed O\(^+\) flux enhancement appears in directions parallel or anti-parallel to the magnetic field. From these characteristics, we argue possible mechanisms that can provide selective acceleration to O\(^+\) ions at \(>20\) keV. We conclude that O\(^+\) ions at \(L=5.4-6.6\) undergo nonadiabatic local acceleration caused by oscillating electric field associated with the magnetic fluctuations and/or adiabatic convective transport from the plasma sheet to the inner magnetosphere by the impulsive electric field. At \(L=4.5-5.4\), however, only the former acceleration is plausible. We also conclude that the field-aligned energy-dispersed O\(^+\) ions at 0.1-5 keV originate in the ionosphere and are extracted nearly simultaneously to the onset of the dipolarization.