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]

1.Graduate School of Science, Kyoto University, 2.Institute for Space-Earth Environmental Research, Nagoya University, 3.Department of Physics and Astronomy, University of Iowa, 4.Institute for the Study of Earth, Oceans and Space, University of New Hampshire, 5.Solar System Exploration Division, Goddard Space Flight Center, 6.Space Sciences and Applications Group, Los Alamos National Laboratory, 7.Space Sciences Division, The New Mexico Consortium, 8.Applied Physics Laboratory, Johns Hopkins University

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.

