Van Allen Probes衛星によって観測された$L<6.6$の内部磁気圏における磁場双極子化とそれに伴うO^+フラックスの変動

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

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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.