Van Allen Probes observations of dipolarization and its associated O+ flux variations in the inner magnetosphere

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Recent study employing the MDS-1 satellite reveals that magnetic field dipolarization in the deep inner magnetosphere is not unusual. When the MDS-1 satellite was located at L=3.5-5.0 near the auroral onset longitude (MLT difference of <2.5 h), the occurrence probability of local dipolarization was about 16%. Surprisingly, an event was found at L~3.6, far inside the geosynchronous altitude. It was also shown that after the dipolarization, the oxygen ENA flux in the nightside ring current region measured by the IMAGE satellite was predominantly enhanced by a factor of 2–5 and stayed at an enhanced level for more than 1 h, while clear enhancement was scarcely seen in the hydrogen ENA flux. To better understand mechanisms of the selective acceleration of O^+ ions during dipolarization, an in-situ measurement of ion fluxes is needed. However, there are few studies investigating H^+ and O^+ flux variations during dipolarization in the deep inner magnetosphere.

In this study we investigate magnetic field dipolarization and its associated ion flux variations in the deep inner magnetosphere, using magnetic field and ion flux data obtained by the Van Allen Probes. From the magnetic field data recorded on the nightside (1800-0600 MLT) in the inner magnetosphere (L=3.0-6.6) in VDH coordinates, we select substorm-related dipolarization events in which the H component increases by more than 20 nT and the absolute value of the V component decreases by more than 8 nT in 5 minutes. About 150 dipolarization events are identified from 1 October 2012 to 30 June 2015. We find that the dipolarization mostly occurs at L=4.5-6.5 in the premidnight sector (2100-0000 MLT). No events are found at L<4.0. Some dipolarization events are accompanied by O+ flux enhancements in the energy range higher than a few keV, which have the pitch angle distribution peaked around 45 or 135 degrees. We also find that low energy O^+ ions often appear after dipolarization with an energy dispersion starting from around keV down to a few tens of eV. These energy dispersive O^+ ions are detected in the directions parallel and antiparallel to the magnetic field line. We will discuss possible mechanisms of the selective acceleration of O^+ ions and the generation of the field-aligned sub-keV O^+ ions in the deep inner magnetosphere during the dipolarization events.