MDS-1 satellite observations of magnetic field dipolarization in the deep inner magnetosphere

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There have been a large number of studies showing magnetic field dipolarization at the geosynchronous altitude (r=6.6 Re) and in the near-Earth plasma sheet (X>-15 Re) during the substorm expansion phase. Magnetic field dipolarization is usually accompanied by impulsive electric field, which can accelerate ions non-adiabatically. Some previous studies proposed that such ion acceleration process is mass-dependent; that is, O^+ ions gain more energy than H^+ ions. Thus dipolarization might be important in development of the ring current. However, there are only a few studies that investigated dipolarization in the inner magnetosphere inside the geosynchronous orbit, where the main portion of the ring current is located. According to Lopez et al. [1988, JGR, p.997], no dipolarization events were observed inside of r=6.4 Re by AMPTE/CCE satellite. On the other hand, Fu et al. [2002, JGR, doi:10.1029/2001JA002006]] reported an dipolarization event at L~5.8, using the CRRES satellite. Ohtani et al. [2007, JGR, doi:10.1029/2007JA012357] found a dipolarization event observed by the Cluster satellite at r=4.6 Re. It is not yet understood well how frequent and at what radial distance magnetic field dipolarization can be observed in the inner magnetosphere.

In the present study we intended to answer the above questions, using data from the magnetometer (MAM) onboard the MDS-1 satellite, which was placed in the geotransfer orbit with an orbital inclination of 28.5 degrees. The magnetic field variations were examined when substorms were identified by auroral images and/or the AE index for the period of February 2002 to September 2003. We found a number of dipolarization events at L=4-6 and an event even at L~3.6, which are far inside of the geosynchronous altitude. We also found that the energetic neutral atom flux obtained by the high-energy neutral atom (HENA) imager onboard the IMAGE satellite was enhanced in the inner magnetosphere when the dipolarization was found by MDS-1. This implies that the dipolarization plays an important role in local acceleration of ions in the ring current region.