Van Allen Probes RBSPICEで観測された2015年3月17日磁気嵐の3段階発達
Three-step development of the 17 March 2015 storm: Van Allen Probes/RBSPICE observations

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We investigate enhancements and losses of energetic (~10-~500 keV) protons and oxygen ions during an intense storm with Dst_min of -223 nT on 17 March 2015. We use >10 keV proton and oxygen ion data from the RBSPICE instrument onboard the two Van Allen Probes spacecraft.
During the storm event, Van Allen Probes traveled in the pre-midnight sector on the outbound path and around midnight on the inbound path. The orbits of the two spacecraft were in opposite phase. The Dst index displayed a two-step decrease with the first minimum at 9 UT and the second at 22 UT. Enhancements of ring current ions began at RBSPICE-B at ~7 UT, and RBSPICE-A entered the ring current region at ~8 UT. The RBSPICE data show penetration of the lower part of energetic proton populations (mu = 0.01-0.1 keV/nT, 20-80 keV at L~3.5) down to L~3.5 and the higher part (mu = 0.1-0.4 keV/nT, 80-100 keV at L ~ 4) down to L~4 during the first storm development. The protons penetrated more deeply during the second development, with the lower part to L ~ 2.5 and the higher part to L~3. During the storm maximum, the higher part was more enhanced in energy density without further penetration. Protons with mu up to ~0.8 keV/nT, ~300 keV at L ~ 3.5 made a significant contribution to the total energy density. Flux of energetic oxygen ions (>50 keV) was suddenly enhanced at ~9 UT. The oxygen-to-proton energy density ratio for >50 keV, which was below 0.1 prior to the storm, reached ~1 during the first development. Although the ratio remained high between 0.1 to 1.0 during the second and third development phases, it did not increase over unity.
We conclude that the 17 March 2015 storm developed in three phases: penetration of cold plasma sheet population, further penetration of the population and oxygen energization (acceleration and/or transport), and deep penetration of hot plasma sheet population. We will examine the evolution of ion energy spectra to identify how oxygen ions were energized and to determine source plasma sheet population that can make the most contribution to each phase of the ring current buildup.

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