Simultaneous entry of oxygen ions originating from the Earth and Sun into the inner magnetosphere during magnetic storms

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Ion composition data from the Polar satellite shows that number densities of both low- and high-charge-state O ions were almost simultaneously increased at L = 3 - 5 (ring current region) during magnetic storms. The low- and high-charge-state O ions are thought to originate from the Earth and the Sun, respectively. Data collected from the ACE and Geotail satellites indicate that high-charge-state O ions exhibited temporal variation in the solar wind and the near-Earth magnetotail, irrespective of the magnetic storms. The number density of high-charge-state O ions present in the near-Earth magnetotail was considerably lower than that of O ions present in the solar wind and the inner magnetosphere. These results can be sufficiently explained in terms of ion paths that depend on the convection electric field. In the near-Earth magnetotail, the Geotail satellite could observe the O ions that entered the magnetosphere through the low-latitude magnetopause. These ions can reach the Geotail satellite regardless of the strength of the convection electric field. However, a cutoff energy of the O ions could result in a low density at the Geotail satellite. In the inner magnetosphere, the Polar satellite could observe the O ions that entered the magnetosphere through the high-latitude magnetopause and moved earthward under a strong convection electric field. It is concluded that the enhanced convection electric field could result in the substantial penetration of O ions from the solar wind and probably from the ionosphere deep into the inner magnetosphere.