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Transport and Energization of O+ Ions in the Near-Earth Magnetosphere
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We discuss the energization and transport of energetic O+ ions in the night-side magnetosphere with an emphasis on geomagnetically active periods. The oxygen ENA flux from the storm-time ring current increases simultaneously with substorm activity, which suggests that this ENA flux enhancement is caused by the energization of local O+ ions rather than by the transport/injection of O+ ions from farther down the tail. Thus the transport of the O+ ions is a crucial issue for better understanding storm dynamics. In the present study we address this issue by statistically comparing the characteristics of energetic protons and O+ ions in the nightside magnetosphere. Energetic ion flux measurements made by the Geotail/EPIC instrument are used. The results are summarized as follows: (1) Whereas the average proton energy does not change significantly during a solar cycle, the average O+ energy is lower during solar maximum and higher during solar minimum; (2) The O+-to-proton ratios of the number density and energy density are several times higher during solar maximum than during solar minimum; (3) The average proton and O+ energies and the O+-to-proton ratios of number and energy densities all increase with geomagnetic activity. The solar phase dependence of the average proton energy is found only for geomagnetically active times and it is higher during solar minimum. The differences of other quantities among different solar phases not only stay but also increase with geomagnetic activity. (4) Whereas the average proton energy increases toward Earth, the average O+ energy decreases toward Earth. The average energy increases toward dusk for both the protons and O+ ions; (5) The O+-to-proton ratios of number density and energy density increase toward Earth during all solar phases but most clearly during solar maximum. These results suggest that the effects of geomagnetic activity and solar illumination on the ionospheric ion outflow are synergetic rather than additive and that a significant portion of O+ ions is transported directly from the ionosphere to the near-Earth region rather than through the distant tail.

キーワード: Oxygen ions, Ring current, Plasma sheet, Magnetospheric Storm, Ion outflow, Solar Cycle
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