Statistical Study of Selective Transport of Energetic Oxygen Ions During Magnetic Storms Observed by Van Allen Probes in 2013-2017

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The ion transport from the plasma sheet to the ring current is the main cause of the development of the ring current. The energetic (>150 keV) ring current ions are known to be transported diffusively in several days [e.g., Gkioulidou et al., 2016]. Mitani et al. 2018 suggested that energetic oxygen ions are transported closer to the Earth than protons due to the diffusive transport caused by a combination of the drift and the drift-bounce resonances with Pc3-5 ULF waves during the April 24, 2013 magnetic storm. We hereafter call the energetic oxygen transport as the selective transport. In order to understand its occurrence conditions and roles in the ring current development, we investigate the phase space densities (PSDs) between protons and oxygen ions with the first adiabatic invariants (µ) of 0.1 keV/nT-2.0 keV/nT observed by Van Allen Probes at L˜3-6 during 90 magnetic storms in 2013-2017. We identified the selective transport as an event in which that oxygen PSDs increases while proton PSDs do not increase in >0.5 RE band of L-shells in >0.5 keV/nT range of µ. Among the 90 storms, 33% were accompanied by the selective transport events. The selective transport tends to occur in the night-dusk sector and in the lower-L shells during larger storms. When the selective transport occurs, the enhancements of Pc4 and Pc5 oscillations obtained by wavelet analysis of ground magnetic field data (e.g. from the CARISMA and THEMIS GMAG) are detected in global MLT at L>4 and at L>3, respectively. It suggests combination of the drift-bounce resonance with Pc4 oscillations and the drift resonance with Pc5 oscillations can be the cause of the selective transport of energetic oxygen ions. Contribution of the selective transport to the magnetic storm intensities is roughly estimated to be ˜20 % at most.

Reference:

Gkioulidou, M., A. Y. Ukhorskiy, D. G. Mitchell, and L. J. Lanzerotti (2016), Storm time dynamics of ring current protons: Implications for the long-term energy budget in the inner magnetosphere, Geophys. Res. Lett., 43, 4736-4744, doi:10.1002/2016GL068013.

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