ION UPFLOWS IN THE POLAR MAGNETOSPHERE DURING GEOMAGNETIC STORMS

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We performed a case study of ion upflows in the polar magnetosphere for a geomagnetic storm which occurred on March 30, 1990, using electron density data observed by PWS, and an ion composition ratio and field-aligned velocities observed by SMS onboard the Akebono satellite in an altitude range of 6000-10000 km in the dayside. During the main phase of the storm, the electron density increased by a factor of 3-30 compared to the quiet-time level in the auroral zone and polar cap. The SMS instrument measured intense ion upflows in the entire polar cap along the satellite path. Eighty percent of the upflowing ions were composed of oxygen and the upward velocities of oxygen along the field lines ranged from 4 to 10 km/s, which was comparable to the escape velocity. The upflow flux of the oxygen ion mapped to 1000 km altitude corresponded to $1\text{-}4\times10^{9}$ /cm^{2}/s. Based on the parameters obtained by Akebono, we calculated trajectories of the upflowing oxygen ions released from 9000 km altitude, which was near the altitude of the ion upflow observed by Akebono, under an idealized storm condition, using a numerical code developed by Ebihara et al. [2006]. The oxygen ions which had initial velocities greater than 3 km/s, did not fall down to the Earth, but escaped into the magnetosphere for all of the initial positions considered in the trajectory calculations (8, 10, 12, 14 and 16 MLT at 75° ILAT, and 70° and 80° ILAT at 12 MLT). This result indicates that a large portion of the upflowing oxygen ions observed by Akebono in the dayside polar cap during geomagnetic storms flow into the magnetosphere. The ions released from 12 MLT first flew into the premidnight magnetotail, and

transported to the duskside at L = 3-5, where the storm-time partial ring current developed. In this region, some ions were energized to more than 50 keV. These results indicate that thermal oxygen ions with large upward fluxes, which cause the density enhancement in the polar cap during geomagnetic storms, can reach the plasmasheet and contribute to the ring current formation.

ion outflow, geomagnetic storm, polar ionosphere

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