Characteristics of molecular ions in the ring current observed by the Arase (ERG) satellite

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There are two plasma sources for the terrestrial magnetosphere, i.e., the ionosphere and the solar wind. It is observationally known that the terrestrial plasma contribution, especially that of heavy ions increases with increasing geomagnetic activities, while the mechanisms of the enhanced ionospheric supply are far from understood. While the O+ ions are the main species of terrestrial heavy ions, the heavier molecular ions such as NO+ and O2+ have been observed in the various regions of the magnetosphere [e.g., Klecker et al, 1986; Peterson et al., 1994; Christon et al, 1994; Poppe et al., 2016]. Previous studies indicated that molecular ions tend to be observed during geomagnetically active periods. In order to get the molecular ion outflows from the deep ionosphere with altitudes of 250-500 km, they need to be energized at least up to the escape energy of ~10 eV within a short time scale (~order of minutes) to overcome the dissociative recombination lifetime at the source altitudes. The observations of the high-energy (~100keV) molecular ions in the ring current and outer magnetosphere suggest an effective acceleration mechanism is in operation during geomagnetically active periods.

In this paper, we report on observations of molecular ions in the ring current by the Arase satellite and their relations to the solar wind and magnetospheric/ionospheric conditions. The ion composition data of the MEPi instrument onboard the Arase satellite, which detects the ions in the energy range from ~10 to 180 keV/q was analyzed in details. The molecular ions with energized above several tens of keV are detected during early recovery phases of geomagnetic storms. The appearance of the molecular ions does not have a clear dependence of the substorm activities. It suggests indirect supply from the polar ionosphere to the inner magnetosphere and additional acceleration mechanisms such as the circulation of the molecular ions in the magnetosphere. During quiet periods, the molecular ions stayed less than the detection threshold of the MEPi instrument. In the presentation, preliminary comparison with low energy ions will be also reported.

References:
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