Nightside auroral characteristic responses to magnetospheric compressions associated with SCs

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We have studied nightside auroral responses to magnetospheric compression associated with SC for following four cases in 1989; 22:23 UT on Apr.13; 23:14 UT on June 6; 19:52 UT on June 8; 00:26 UT on Sep.4. As main optical instrument for this study, we used the data from the scanning photometers at Syowa and Asuka Stations in Antarctica. Observed wave lengths were 557.7, 630.0, and 486.1 nm for each photometer. This is the first detailed report of photometric observation of the nightside auroral activity associated with SC, especially including the proton emission line. Following two characteristic auroral activities were found associated with SCs; (A) Emission intensity of main proton & electron auroral oval increased from about 3 minutes after SC; (B) An electron discrete auroral activity appeared from the high latitude side of the main oval about 8 minutes after SC, and it gradually migrated to higher latitudes. VLF and ULF (Pi1 range) wave activities were also observed in two cases of the four, but their durations (about 6 minutes) were too short to explain the source mechanism of (A) and (B) with wave-particle interaction. Corresponding to the wave activities, increased CNAs were also observed. Checking the high energy electron data of geosynchronous satellite located around midnight, it was found that these wave and CNA enhancements occurred during a transition period from a quiet level to a fully compressed level at the geosynchronous orbit, and main part of (A) and (B) appeared after the transition period . Source mechanisms for (A) and (B) can be considered as follows; (A) Loss cone widening. Proton auroral oval should be created by protons with isotropic pitch-angle distribution at the equatorial plane in the magnetosphere. Magnetic total force increase due to the magnetospheric compression makes the loss cone wider at the equatorial plane, hence the precipitation flux increases. In that case, the flux enhance rate is roughly equal to the total force enhance rate. We have checked and estimated both rates, and found it was the case.; (B) Upward field-aligned current (FAC) generation in the tail. This auroral activity is discrete one and shows a rapid motion. Photometer data showed that a harder electron precipitation is responsible to this activity. These facts implies that this activity is created by electrons accelerated along field-line by field-aligned electric field. This electric field should be closely associated with upward FAC. (B) appeared about 5 minutes after the start of (A). If we assume that the start of (A) corresponds to the compression around the geosynchronous orbit, then the start of (B) does around 34 Re in the nightside. Hence the generation mechanism of the FAC should be related with the plasma sheet thinning due to the compression in the middle tail. In a thinned plasma sheet, ions can be unmagnetized, while electrons are still magnetized. The Hall effect in such situation could be responsible to the FAC generation.