地上-静止軌道で同時観測されたサブストーム・カレントウェッジの上向き／下向き沿磁力線電流に伴う Pi 2 地磁気脈動

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Simultaneous ground-satellite observation of Pi 2 pulsations associated with upward/downward FACs of the substorm current wedge

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The formation of a substorm current wedge (SCW) is one of the fundamental processes in the expansion phase of the magnetospheric substorm [e.g. *McPherron et al.*, 1973]. A Pi 2 magnetic pulsation always occurs at the expansion onset [*Saito*, 1969]. High- and middle-latitude Pi 2s in the *D* (east-west) component, which are observed away from the auroral breakup region, have been understood as an oscillation of the field-aligned currents (FAC) associated with SCW [*Lester et al.*, 1983; *Uozumi et al.*, 2009, 2011]. *Sakurai and McPherron* [1983] examined Pi 2s that observed at the geosynchronous orbit, and presented that the initial perturbation in the azimuthal component of a Pi 2 is in the same sense as the perturbations caused by the SCW. *Uozumi et al.* [2011] found that the ground Pi 2 timeseries had high coherencies with simultaneously observed AKR timeseries, regardless of whether the Pi 2 timeseries were associated with upward FAC or downward FAC; this fact suggests that the upward SCW and the downward SCW oscillated in a synchronized manner. This aspect was deduced from ground observations, and should be verified by a simultaneous observation on the ground and in the magnetosphere. In order to clarify the timing relation of Pi 2s that are associated with SCW oscillations, we made a comparative study by combining the ground and satellite data.

We analyzed simultaneous ground-satellite observation of Pi 2 pulsation at the ETS-VIII geosynchronous orbit (GGLon=146E) [*Koga and Obara*, 2008] and at MAGDAS/CPMN [*Yumoto and the MAGDAS Group*, 2006] high-, middle- and low-latitude stations, TIK (GMLat.=65.7N, GMLon.=196.9E), ZYK (59.6N, 216.8E), MGD (53.5N, 218.8E), PTK (46.2N, 226.2E), KUJ (26.1N, 203.0E) and WAD (61.3N, 318.3E). ETS-VIII was located in the geomagnetic southern hemisphere (GMLat = ~-12), and a foot point of the magnetic field line is estimated as GMLat = 64.9N, GMLon = 215.8E by using Tsyganenko 96 and AACGM models. The nearest ground station to the foot point was ZYK. We picked up a Pi 2 event that exhibited a high coherency in the waveform among the ground and satellite Pi 2. A typical Pi 2 occurred around 1121UT on July 28, 2008. MLT of each ground station and ETS-VIII at the occurrence of the Pi 2 was as follows: TIK: 19.5h, KUJ: 20.0h, ETS-VIII: 20.8h, ZYK: 20.9h, MGD: 21.0h, PTK: 21.5h and WAD: 3.7h. ETS-VIII was located at almost the same magnetic meridian as ZYK. Characteristics of the Pi 2 event are summarized as follows: (1) the initial deflection of the ground Pi 2s and magnetic bay variations in the *D* (eastward) component indicate the signature of the upward (at TIK, ZYK, MGD and PTK) and downward (at WAD) FAC of the SCW. (2) Pi 2 oscillated in- or 180deg; out-of-phase among the *D* on the ground and *N* (eastward) components at the geosynchronous altitude (correlation coefficient: |gamma|>0.75, phase delay: $|dT|<10$s). (3) Pi 2 oscillations in the *H* (northward) and *P* (parallel to the earth rotation axis) component exhibited phase (time) difference among them ($|dT|<$~50s). By taking into account that the polarity of the *D* and *N* components Pi 2 oscillations were demarcated by the direction of the SCW FAC (upward or downward) and the sign of the geomagnetic latitude (northern- or southern-hemisphere), the present results indicate that the entire part of the SCW system (MLT span: ~8h) oscillated in a synchronized manner. This observational fact suggests that the substorm current wedge (SCW) is main source of global Pi 2 occurrence. On the other hand, the time differences in the *H* and *P* components Pi 2 can be explained by a characteristic of Pi 2 propagation in the magnetosphere, which was examined by *Uozumi et al.* [2000, 2009, 2011]. We will present other Pi 2 events that have the same characteristics, and also present results of statistical analyses.