Magnetopause Disturbance Associated with a Sudden Commencement Occurred on 15 July, 2000

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It is well known that a deformation of the magnetopause excites Field Aligned Currents (FACs) due to shear motion of magnetospheric plasma (Kivelson and Southwood, 1991). Especially in the case of a sudden commencement (SC), the deformation of the magnetopause generates large-amplitude FACs, and produces a twin vortex current system in the ionosphere, which is named the DPpi field (Araki, 1977, 1994). Magnetic variations due to this current system can often be observed even at middle and low latitudes on the ground. However, the relationship between the ground magnetic variation and the deformation of the magnetopause has not been well understood in an observational point of view.

The strong interplanetary shock (IPS) was detected by the ACE satellite at 14:15 UT on 15 July, 2000. The intensity of the interplanetary magnetic field increased from 10 to 40 nT. The buffeting of the IPS caused the strong SC on the ground with 110 nT of increasing in the H component at Guam. In this event, the three GOES satellites (GOES 8, 10,11) were located at 9LT, 5LT and 7LT, respectively, and detected large-amplitude magnetic variations. In particular, the Z-component of the magnetic field at GOES8 and 11 showed a negative excursion for 10 seconds after the SC. It indicates that the satellites located at geosynchronous orbit crossed the magnetopause and went out to the magnetosheath. We also note that, when GOES11 went out of the magnetosphere, the GOES8 was already back in the magnetosphere. These observational facts suggest that the deformation of the magnetopause due to the buffeting of the IPS was not caused by a simple compression of the magnetosphere, but caused a large-amplitude, low-wave-length deformation of the magnetopause.

On the other hand, by using three satellites located in the interplanetary space, the normal vector of the IPS plane is obtained from the times of IPS crossing and the locations of the three satellites: The result shows that the IPS buffeted the magnetopause from the hitting 9-11 MLT first. It indicates that the above-stated strong magnetopause deformation was excited in near first-contact-point between the IPS and the magnetopause.

The magnetic variation on the ground shows some evidences of the electric field disturbance in the polar ionosphere. The magnetic variation at TRD (Trinidad and Tobago, MLat=19.62, 10:30LT) shows a large-amplitude (40nT) magnetic variation just after the main impulse of the SC, though a similar variation did not appear at Guam which was located at the nighttime sector.

All of the present results can be interpreted in term of the solar wind-magnetosphere-ionosphere coupling. In particular, the angle of the IPS plane can be considered to play an important role in the energy propagation associated with the SC.