

Geomagnetic responses of large interplanetary magnetic clouds observed during super storms on October 29-31, 2003

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During the period from late October to early November of last year the sun became very active. The plural numbers of active region appeared on the solar surface. The most prominent one was the number 486, which produced an extremely large flare X17/4B at 0951 UT on Oct. 28 and successively another large flare X10/2B at 2037 UT on Oct. 29. These big flares, most powerful solar flares ever recorded, hurled massive coronal mass ejections (CMEs) toward the Earth. Two fast-moving clouds of gas from the sun swept past Earth and sparked extreme geomagnetic storms. The storm suddenly commenced at 0611 UT on Oct 29 and at 1637 UT on Oct.30, respectively and produced the field depression of about 423 nT and 300 nT in the horizontal component (H component) of the geomagnetic field at Kakioka. One of the interesting features was a variation of magnetic structure of CMEs, i.e., the fields showed reverse rotations each other. The first CMEs rotated from northward to southward and the second one was from southward to northward. These reverse field rotations were very clear and occurred through a full day. The field intensity was about 20 nT. Another interesting feature was geomagnetic field response to these field rotations. The first storm began with a large storm sudden commencement (ssc) followed by moderate magnetic disturbances, and successively produced severe magnetic disturbances in association with large substorms. However, the second storm began with severe magnetic disturbances associated with substorms and very moderate magnetic variations appeared as enriched pulsation activity were followed over the world. Among them the extremely large amplitude Pc 5 pulsations appeared at the low latitude ground stations. It should be pointed out that these ground super-storm signatures are supposed to be principally controlled by the magnetic field structures of these extremely large interplanetary magnetic clouds.