Discussion on “Geomagnetic Effects in the Dark Hemisphere Associated with Solar Flares”

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1. Introduction

SASTRI and MURTHY (1975) examined the magnetograms of Kodaikanal (10°14'N, 77°28'E in geographic coordinates; +0.6°, 147.1° in geomagnetic coordinates; and dip lat. 1.7°N), a station in the equatorial electrojet region in India, for the 3-year period 1969-1971, studied the characteristics of 40 well-defined NTSFE events (night-time geomagnetic solar flare effect) and 56 SFE events (day-time geomagnetic solar flare effect) recorded in the Kodaikanal magnetograms, correlated the events with solar and ionospheric data, and concluded that conspicuous geomagnetic effects with sufficient amplitudes in H-component do occur in the dark hemisphere in association with solar X-ray flares observed in the day hemisphere. In Plate 1 of their paper, are shown four typical examples of NTSFE events, which are described as clear-cut, well-defined and large-sized in H-component. These features naturally differ, as pointed out by the authors, from the earlier observations of OHSHIO (1964) who found the NTSFE's to be small in amplitude and not to exhibit a distinct shape even at the maximum stage, based on his study of the events observed at a number of stations in the dark hemisphere. The prominence of NTSFE's at Kodaikanal has been ascribed to the location of Kodaikanal in the equatorial region where relatively strong eastward ionospheric electric currents are supposed to flow at night during solar flares occurring on the sunlit side of the earth.

The authors also presented diagrams depicting the results of their analysis of the NTSFE and SFE data for Kodaikanal. Their Fig. 1 shows the occurrence frequency of NTSFE’s at Kodaikanal with a peak around the local midnight. Their Fig. 2 shows the most frequent rise-time and total duration of NTSFE as around 35 minutes and 60 minutes respectively, while that of SFE as around 5 minutes and 12 minutes respectively. Their Fig. 3 shows the time correlation of NTSFE events with solar X-ray flares (1–8 Å) observed on the sunlit side. They also found that the amplitude of the NTSFE is independent of the peak solar X-ray flux level in the two bands 1–8 Å and 8–20 Å observed in the day
hemisphere during solar flares, which is in contrast to that of SFE event whose amplitude is linearly correlated with peak solar X-ray flux level in the two bands 1–8 Å and 8–20 Å (SASTRI and MURTHY, 1975a).

Srivastava and Habiba Abbas (1975) examined the Hyderabad magnetograms for the 6-year period 1968–1973, and also the magnetograms of a few American stations for selected days, for detection of possible NTSFE’s. They found that under calm magnetic conditions, a small NTSFE (2–5 γ) corresponding to a major day-time SFE (20–60 γ) could be identified in 10% of the cases. They further found that the NTSFE’s at Hyderabad and the American stations did not exhibit the characteristic features of the day-time SFE’s and were generally vitiated by perturbations and pulsations of the geomagnetic field. These results agree with the theoretical predictions of Rikitake and Yukutake (1962), and the observations of Ohshio (1964) and Nagata (1966). Srivastava and Habiba Abbas (1975a) also studied the characteristics of geomagnetic bays observed at Hyderabad and other Indian stations. They found that both the occurrence frequency and the H-amplitude of positive bays (which occur during night hours) observed on relatively calm days at Hyderabad, were maximum around the local midnight.

2. Observations and Discussion

The four typical examples of NTSFE events shown in Plate 1 of the paper under discussion (SASTRI and MURTHY, 1975), have been examined from the relevant records of the Hyderabad Geomagnetic Observatory (Geomagn. Coords: +7.6°, 148.9°) as well as some Russian and American stations. They turn out to be very good examples of positive magnetic bays observed during night hours at Indian and some middle-latitude stations in the U.S.S.R. (Tashkent and Sverdlovsk) and negative bays at the auroral zone station of Dixon Island, caused by the precipitation of charged particles (protons and electrons) in the auroral zone upper atmosphere, and not the night-time geomagnetic solar flare effects due to X-rays and EUV radiation from solar flares on the day side, as claimed by SASTRI and MURTHY (1975). Furthermore, the relevant day-side geomagnetic records taken at Huancayo, Honolulu, San Juan and Fredericksburg have also been examined only to find that the imagined SFE’s do not really exist. In Fig. 1 of SASTRI and MURTHY, the maximum frequency of the so-called NTSFE events occurs around the local midnight, and this has already been established to be a characteristic feature of geomagnetic bays (Srivastava and Habiba Abbas, 1975a). The rise times and total durations of the so-called NTSFE’s (average values 28.7 min and 66.6 min) as against the SFE’s (average values 9.1 min and 26.5 min) are nearly three times larger. When the rise time and
the total duration of a day-time SFE are less than 30 minutes, the question arises as to why their counterparts in the dark hemisphere should extend over durations thrice as long. This is so because the night-time prominent positive bays in $H$-component (where durations are longer) have been mistaken for NTSFE's at Kodaikanal, and studied as such. Also, there does not exist a night-time remanent electrojet over Kodaikanal to enhance the NTSFE's (RASTOGI et al., 1966). The starts of the solar X-ray (1–8 Å) flares treated by SASTRI and MURTHY are indicated as seen in their Fig. 3. But the actual time and date of individual events (numbering 25) are not given, which are so very important. The NTSFE event should be observed simultaneously with the SFE event. It may be mentioned that one or two geomagnetic bays are quite frequent in the records of Indian stations night after night. That the NTSFE's examined by the authors (at least the 4 events that were reproduced) should have coincided with the bay

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**Fig. 1.** A day-time geomagnetic solar flare effect (SFE) as recorded in $H$, $D$, and $Z$-components at the six Indian magnetic observatories on May 3, 1973.
events is quite an accident, and there is nothing in common between the two phenomena.

In Fig. 1, are reproduced the $H$, $D$ and $Z$-records of the prominent solar flare effect (day-time SFE) of May 3, 1973, taken at the Indian stations. Its counterpart in the dark hemisphere is shown in Fig. 2 as observed at Huancayo. Another example of a night-time solar flare effect together with its causative day-time SFE is also shown in Fig. 2. This is the type of NTSFE which is expected to be observed corresponding to a major day-time SFE in the opposite hemisphere.

In Fig. 3, are reproduced the Hyderabad records of the $H$-component of the four so-called NTSFE events given by SASTRI and MURTHY (1975) in their

![Diagram](image-url)

Fig. 2. Simultaneous day-side and night-side deviations in the magnetograms caused by two major solar flares of October 20, 1957 and May 3, 1973, respectively, showing clearly the SFE and the associated NTSFE events.
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Plate 1 for Kodaikanal. These are clear examples of night-time positive bays showing relatively large amplitudes, large rise times, and large total durations, as compared to SFE events (Figs. 1 and 2). The $H$-records for the bay observed on October 23, 1970 at some middle and high latitude stations in the U.S.S.R. (Tashkent, Sverdlovsk and Dixon Island) are also shown to demonstrate the genuineness of the bay event. It appears as a negative bay at the auroral zone station of Dixon Island (a DP-substorm).

It is thus abundantly clear that the so-called NTSFE events studied by SASTRI and MURTHY (1975) are in fact night-time positive bay events which have nothing to do with the causative SFE events observed on the sunlit side of the earth.

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REFERENCES


