EQUATORIAL GEOMAGNETIC BAYS AND IMF SECTOR POLARITY

Geomagnetic bays at equatorial latitudes, observed during night time as large perturbations in the geomagnetic field components, resembling indentations of coast line of a geographical map, are considered to be manifestations of polar magnetic substorms at the low and middle latitudes. Substantial evidence now exists in literature to show an influence of the north-south component/polarity of the interplanetary magnetic field (IMF) on terrestrial magnetic activity and geomagnetic perturbations in the polar regions[1-6]. Burch[6] found a dependence of the seasonal variation of auroral zone positive and negative bay activity on the sector structure of the interplanetary magnetic field. Very recently, Bhargava and Rangarajan[7] showed a dependence of the seasonal variation in the occurrence of positive bays at equatorial latitudes on the IMF sector polarity. They also noticed a difference in the local time variation of bay events associated with the passage of 'A' (away) and 'C' (toward) sectors, but only in the equatorial region. The earlier work of Gupta[8] showed a positive relationship between the rise time and amplitude of bays in the equatorial region. In this brief communication, the results of an analysis to point out an influence of the polarity of IMF on the degree of association between the rise time and amplitude of bays in the equatorial region are presented.

The present study is based on positive bays observed in the normal run magnetograms at the equatorial station, Kodaikanal (dip 3·5° N), over the ten year period 1962–1971. A total number of 350 basys has been identified at Kodaikanal over this period. For each bay, the rise time (defined as the time in minutes reckoned from the undisturbed H-trace to the point where H reaches the maximum value) and ampiitude (defined as the value of H in nT, $n\text{T} = 10^{-5}$ Gauss, from the undisturbed H-trace to the maximum value attained during the course of the bay) have been obtained. As the rise time of bays is quite large (of the order of several minutes), evaluation rise time from normal run magnetograms is considered to be adequate. Only those bay events, with both the amplitude and the rise time greater than or equal to 10 nT and 10 min respectively have been taken into consideration. Data on IMF sector polarity are taken from Svalgaard[9]. It is to be mentioned that in the recent past some workers have pointed out a strong geomagnetic bias of the sector polarity inferred by Svalgarrd prior to 1962 (pre-satellite era) in that 'toward' days were twide as active as 'away' days[10-12]. The sector polarity however was comparatively free from such bias from 1962–1971. The use of Svalgaard index is therefore quite adequate for the statistical analysis attempted here as the period considered is from 1962 to 1971.

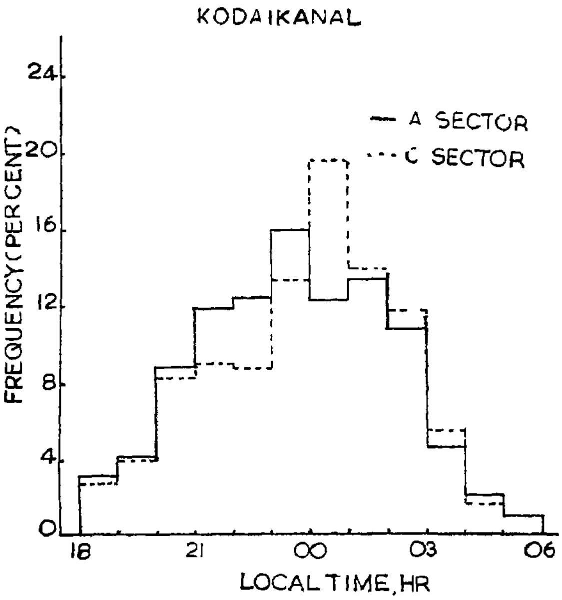

FIG. 1. Percentage frequency of occurrence of bays, as a function of local time, for events associated with 'A' and 'C' sectors.

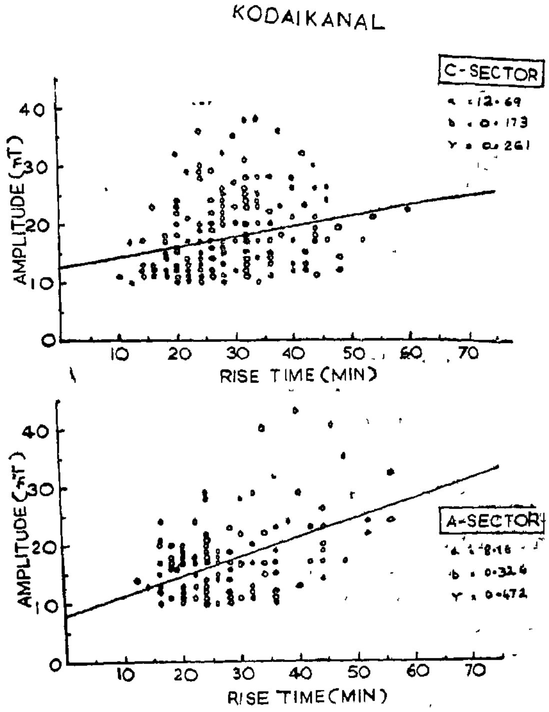

FIG. 2. Mass plots of rise time *vs.* amplitude of positive bays at Kodaikanal associated with 'A' and 'C' sectors. Also shown are the lines of best fit with their constants (*a*—intercept, *b*—slope) and the correlation coefficients (*r*). The solid circles indicate more than one observation.

Figure 1 shows the occurrence frequency of bay events as a function of local time for the 'A' and 'C' sectors. It may be seen that although the occurrence pattern is similar for the two sectors, there is a clear indication of a shift of the time of peak occurrence to a later hour of the night and an enhanced peak occurrence for events associated with the passage of 'C' sectors, compared to events associated with 'A' sectors. This nocturnal behaviour, in relation to IMF sector structure, of bays at Kodaikanal is more or less identical to the one noticed by Bhargava and Rangarajan[7] at Trivandrum and clearly indicates a dependence of the local time occurrence of bays in the equatorial region on IMF polarity. Fig. 2 shows mass plots of rise time *vs.* amplitude of bays associated with 'A' and 'C' sectors separately. The lines of best fit (drawn by the method of least squares) with their constants and the correlation coefficients are also shown in Fig. 2 It is seen that there is a positive relationship between the rise time and amplitude of bays as the observed correlation coefficients. 0·472 and 0·261 for 'A' and 'C' sectors respectively are highly significant for the data samples (N = 134 for 'A' sector; N = 216 for 'C' sector) used. A perusal of the mass plots in Fig. 2, however, indicates a difference in the degree of association between rise time and amplitude of bays for 'A' and 'C' sectors in that, the scatter of points is less for 'A' sector compared to 'C' sector. Application of 'Z' test showed that the difference of 0·211 between the correlation coefficients is significant at 5% level indicating a control of polarity of IMF on the degree of association between rise time and amplitude of equatorial geomagnetic bays. The results of the present study coupled with the recent work of Bhargava and Rangarajan[7] thus indicate an influence of the polarity of IMF not only on the occurrence pattern (nocturnal and seasonal) but also the characteristics (association between rise time and amplitude) of equatorial geomagnetic bays.

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