

FIG. 1. Test of the validity of Law of corresponding states for molar sound velocities.

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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 regions¹⁻⁶. Burch⁵ 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 Rangarajan⁷ 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 Gupta⁸ 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 bays 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 amplitude (defined as the value of H in nT, nT = 10⁻⁶ 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 Svalgaard⁹. 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 Svalgaard prior to 1962 (pre-satellite era) in that 'toward' days were twice as active as 'away' days¹⁰⁻¹². 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.

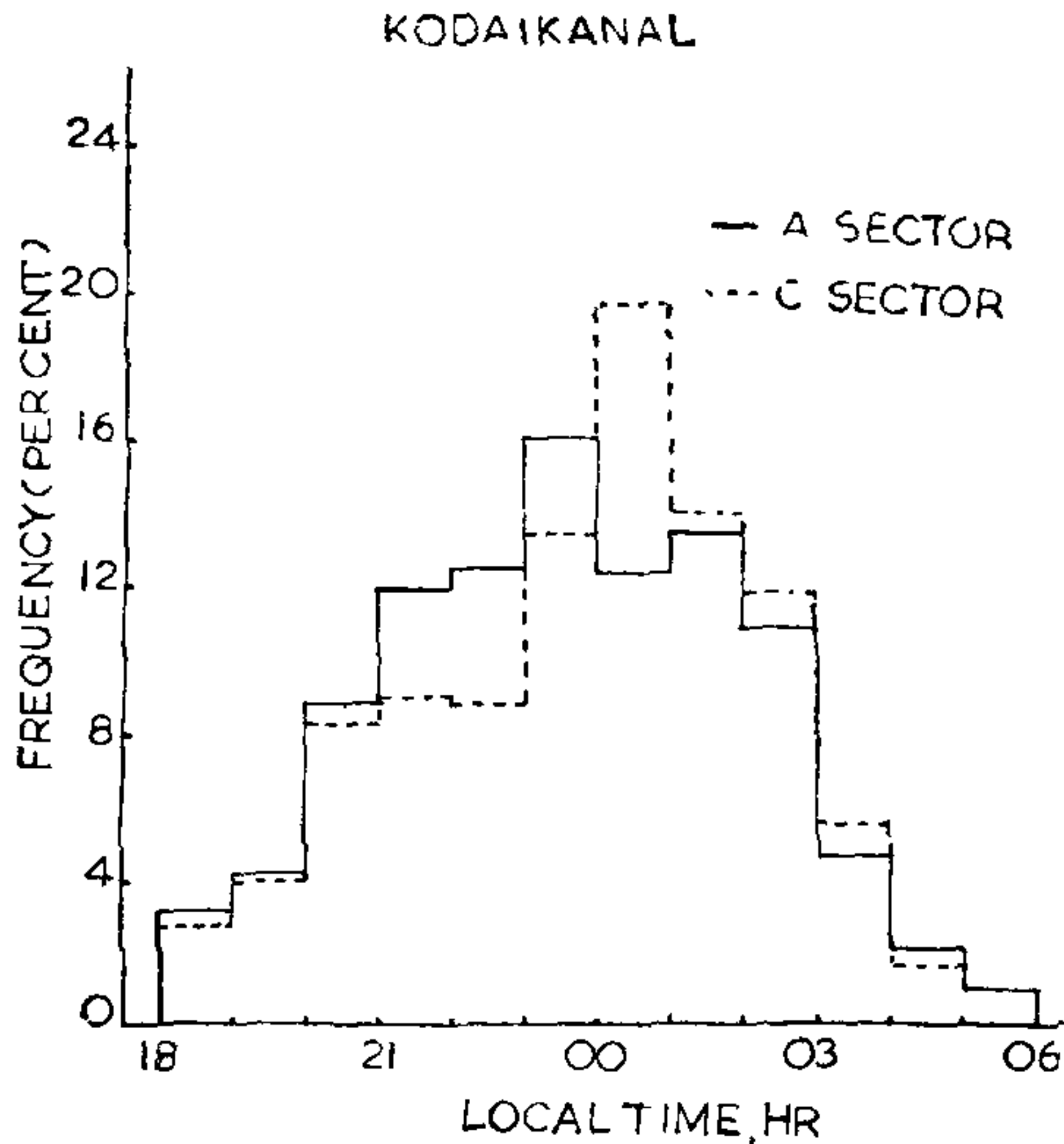


FIG. 1. Percentage frequency of occurrence of bays, as a function of local time, for events associated with 'A' and 'C' sectors.

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 Rangarajan⁷ 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

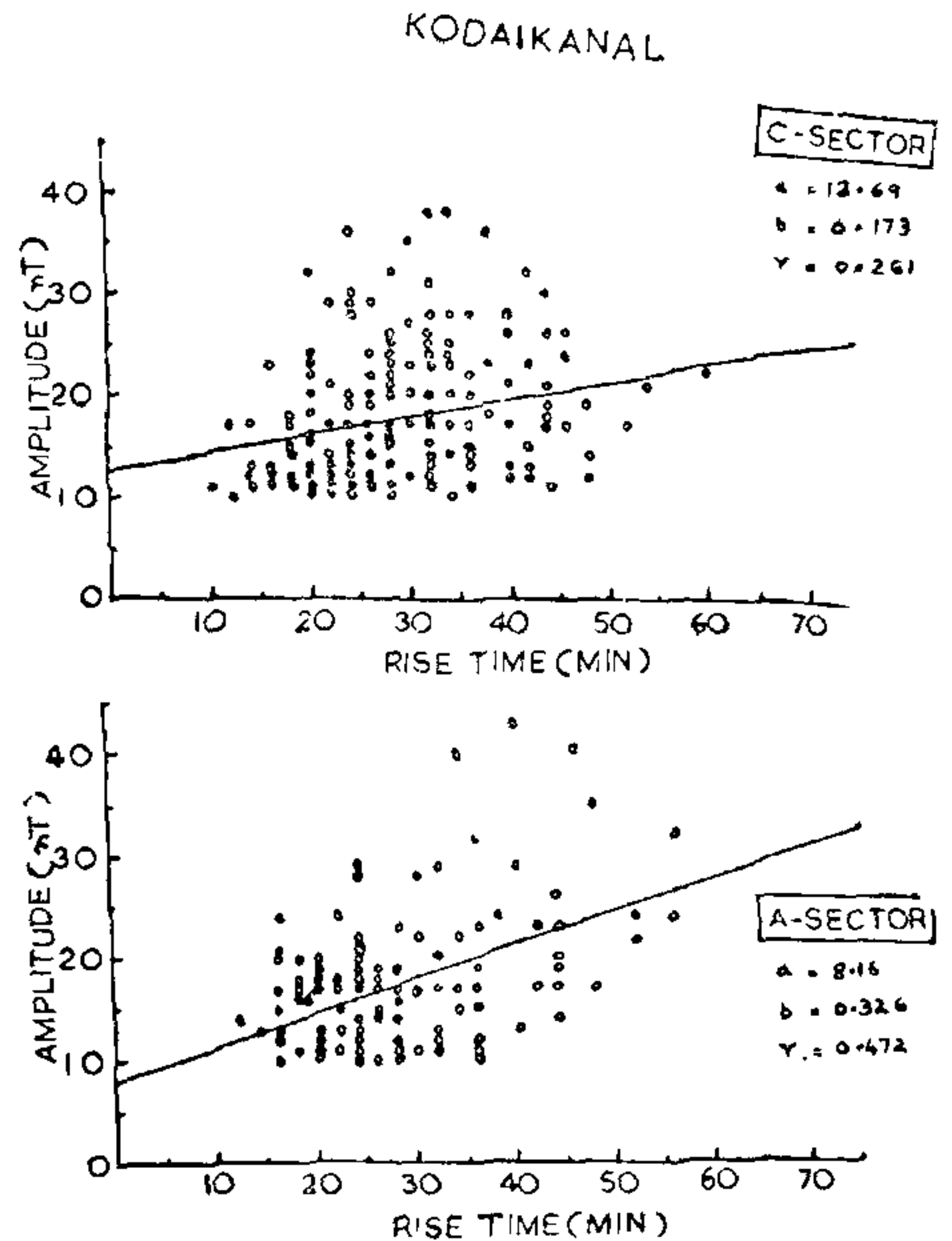


FIG. 2. Mass plots of rise time vs. amplitude of positive bays at Kodaikanal associated with 'A' and 'C' sectors. Also shown are the lines of best fit with their constants (a —intercept, b —slope) and the correlation coefficients (r). The solid circles indicate more than one observation.

'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 Rangarajan⁷ 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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IR SPECTROSCOPIC MANIFESTATIONS OF H-BONDING INTERACTION

SPECTROSCOPIC techniques provide powerful tools for investigating the nature of H-bonding. Infrared and Raman spectra reveal the characteristic frequencies of molecular vibrations. Such frequencies are fixed by the masses of the vibrating atoms, the molecular geometry and the restoring forces holding the atoms in their equilibrium positions in the molecule. Because of molecular interactions, frequencies of normal vibrational modes of a molecule are shifted to higher or lower values and the integrated intensity of the characteristic vibrational band is also modified. In general, the integrated intensity is increased and the stretching mode and its harmonics are shifted to lower frequencies by H-bond formation. In many systems the shift is 10% of normal mode of vibration. This effect is due to the weakening of the force constant for the A-H stretching mode caused by the formation of the H-bond. The shifted absorption bands due to the H-bonded A-H stretching vibrations are much broader than the corresponding bands of the

non-H-bonded A-H group. These spectral variations correlate very well with important chemical and physical properties of H-bonding systems. The correlation is based mainly on the fact that the formation of H-bond restricts certain rotational and translational degrees of freedom and forms an equal number of new vibrational degrees of freedom¹.

It is observed that there is a slight decrease in integrated intensity of the corresponding overtones. This can be explained on the basis that the intensity of absorption due to ir active vibrations is directly proportional to the rate of change of the electrostatic dipole moment ($d\mu/dr$) with internuclear distance. An estimation of the magnitude of $\vec{\Delta}\mu$, the H-bond interaction moment is possible from ($d\mu/dr$) calculation with ir spectra. In the present study an attempt is made to evaluate $\vec{\Delta}\mu$ by considering the interaction of phenol + carbonyl systems.

The integrated intensity (A) of the complexed C=O can be obtained from the relation derived by Freeman². Using the integrated intensity values and assuming that the carbonyl vibration is a pure stretching mode, the change in bond moment on stretching can be calculated from the relation³,

$$\left(\frac{d\mu}{dr}\right) = \left[\frac{1}{m_c} + \frac{1}{m_o}\right]^{-1/2} \frac{d\mu}{db}$$

and

$$\frac{d\mu}{db} = \pm \left(\frac{3C}{\pi} A\right)^{1/2}$$

where C is the velocity of light and m_c and m_o are the masses of carbon and oxygen atoms. The mean dipole moment derivatives of the C=O bond characteristic of the 1:1 and 1:2 complexes in various phenol + carbonyl systems and their frequency shift along with the fundamental⁴ are reported in Table I.

TABLE I

Complexing system	Frequencies (cm ⁻¹)			$(d\mu/dr)_{\text{mean}}$ 1:1	$(d\mu/dr)_{\text{mean}}$ 1:2
	$\nu_{\text{C=O}}$ free	1:1	1:2		
Phenol + methyl acetate	1757	1735	1713	8.865	6.503
Phenol + ethyl acetate	1749	1731	1714	5.447	4.063
Phenol + isobutyl acetate	1753	1726	1715	7.677	1.781
Phenol + <i>n</i> -amyl acetate	1750	1728	1718	7.706	4.518
Phenol + benzyl acetate	1756	1731	1720	8.013	4.199
Phenol + phenyl acetate	1778	1754	1748	8.395	5.913