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EFFECT OF SUNSPOT ACTIVITY ON THE OCCURRENCE OF M AND N ECHOES IN THE EQUATORIAL REGION

OBSERVATIONAL evidence now exists in the literature to show that M and N echoes occur during daytime on bottomside ionograms in the vicinity of the geomagnetic dip equator, in association with the various types of sporadic-E (Es) layers characteristic of the equatorial region[1–4]. In an earlier study, based on ionogram data at Kodaikanal (10° 14′ N, 77° 28′ E, dip. 3·5° N) pertaining to a one year period of high sunspot activity (Jan.–Dec. 1968; mean sunspot number = 104), we found that the occurrence of M and N echoes is characterised by the presence of either isolated M echoes or a combination of M and N echoes but very rarely as isolated N echoes[2]. This rather abnormal behaviour now appears to be a unique characteristic of Es layers in the equatorial region as a similar pattern was reported recently to have been noticed in ionograms at Huancayo, an equatorial station near the 75° W meridian[4]. Our previous study had also shown that the combination of M and N echoes occurs predominantly in association with blanketing sporadic-E (Esb) layers and in the afternoon period (irrespective of season), whereas isolated M echoes occur mostly with equatorial sporadic-E (Esq) layers and in the forenoon period during D and E months and in the afternoon period during J months[2]. Very recently, we reported evidence from high time resolution ionogram data (1 minute interval) at Kodaikanal to show that an isolated N reflection sometimes occurs on equatorial ionograms in association with short-lived secondary Es layers at an altitude of 140 km, well above the height domain of regular Es layers[5]. In this brief communication we present the results of a further analysis to show the presence of a marked influence of sunspot activity on the occurrence characteristics of M and N echoes in the equatorial region.

Quarter-hourly ionogram data at Kodaikanal corresponding to a one year period of low sunspot activity (Jan.–Dec. 1964; mean sunspot number = 10) are carefully examined in the present analysis to evaluate the occurrence characteristics of M and N echoes. The results thus obtained are then compared with those of our earlier study[2] to infer the effect, if any, of the level of sunspot activity on the occurrence of M and N echoes and their association with the various types of Es layers. The results showed the absence of any definite effect of sunspot activity on the nature of association of the occurrence of isolated M echoes and simultaneous M and N echoes with the various types of Es layers. The M and N echoes together occur mostly with Esb layers whereas isolated M echoes predominantly with Esq layers, more or less independent of sunspot activity conditions. However, a significant effect of the level of sunspot activity on the occurrence characteristics of isolated M echoes and simultaneous M and N echoes is evident from the present study. This can be clearly seen from Fig. 1, wherein the diurnal variation of the occurrence of M echoes and the combination of M and N echoes is depicted separately for each of the three seasonal groups of months and for years of low (1964) and high (1968) sunspot activity conditions. During D and E months of low sunspot activity, the occurrence of isolated M echoes is relatively more during the afternoon period than in the forenoon period, which pattern is in sharp contrast to that during high sunspot activity when the occurrence shows a prominent and well-defined maximum in the forenoon period (Fig. 1*a*). Further, during J months of low sunspot activity, the occurrence is high both in the afternoon and forenoon periods (the afternoon occurrence is relatively more) with a minimum around noon, which is also in deviation to the pattern during high sunspot activity when the occurrence shows a prominent maximum in the afternoon period. These observations suggest a clear-cut influence of sunspot activity on the diurnal occurrence pattern of isolated M echoes, particularly during D and E months. Regarding the occurrence of simul-

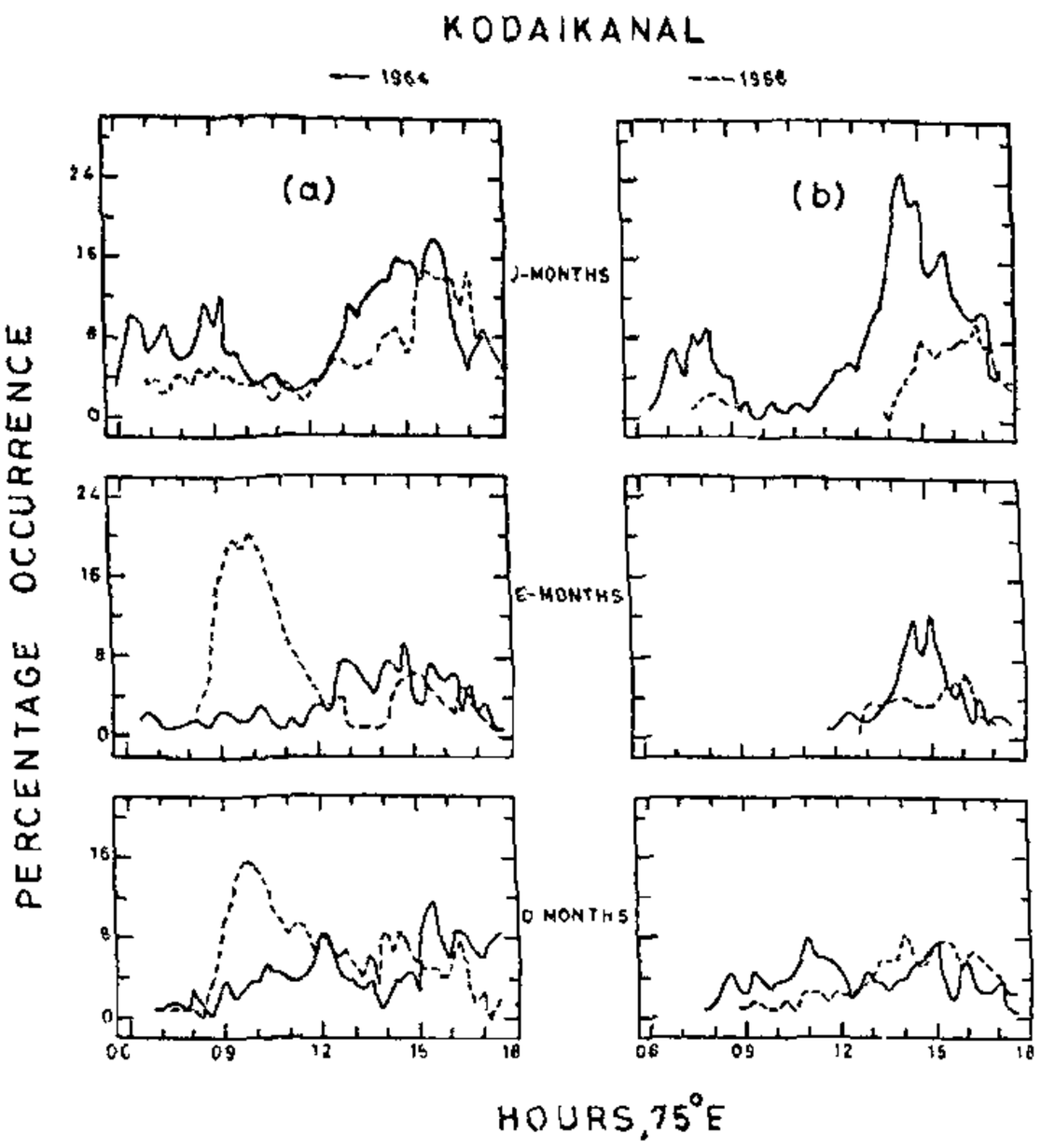

FIG. 1. Diurnal variation of the occurrence of (*a*) isolated M echoes and (*b*) simultaneous M and N echoes on ionograms at the equatorial station, Kodaikanal, during each season for years of low (1964) and high (1968) sunspot activity.

taneous M and N echoes, it can be seen from Fig. 1*b*, that there is no perceptible change in their diurnal pattern of occurrence with the level of sunspot activity during J and E months. However, the percentage occurrence during these months is conspicuously more for conditions of low sunspot activity, clearly indicating a negative correlation between the occurrence of simultaneous M and N echoes and sunspot activity. During D-months, there is no significant difference in the occurrence of simultaneous M and N echoes between low and high sunspot activity conditions, although a slight tendency for the occurrence to be higher during low sunspot activity compared to high sunspot activity in the forenoon period and an opposite trend in the afternoon period is noticed. The present study thus reveals the presence of a significant influence, dependent on season, of sunspot activity on the occurrence of M and N echoes in the equatorial region. The negative association between the occurrence of simultaneous M and N echoes and sunspot activity noticed here can be understood, at least qualitatively, in terms of the facts that the simultaneous M and N echoes occur mostly with Esb layers irrespective of sunspot activity and, that the occurrence of Esb layers is negatively correlated with sunspot activity[6,7]. The reason for the marked influence of sunspot activity on the occurrence of isolated M echoes, noticed conspicuously during the forenoon period of D and E months, is not apparent at the moment and merits further detailed investigations.

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3-ETHYL-4-BENZYLIDENE-5-MERCAPTO-1,2,4-TRIAZOLE AS A NEW GRAVIMETRIC REAG NT FOR COPPER

Introduction

SULPHUR containing ligands are good complexing agents for metals like Cu(I). They serve as effective gravimetric reagents for the determination of copper. The present work pertains to gravimetric determination of copper in ores, alloys and complexes using 3-Ethyl-4-benzylidene-5-mercapto-1,2,4-triazole. The reagent reduces Cu(II) to Cu(I) in ammoniacal medium and precipitates it quantitatively as light yellow Cu(I) complex. Being insoluble in hot water, the complex can readily be freed from foreign ions. The reagent is selective for copper in ammoniacal tartrate medium. Moreover, the method is rapid (< 2 hr), simple and demands no stringent control of precipitation conditions. Low conversion factor (0·2155) and high thermal stability are the other advantages of the method.

Other methods reported in literature require either reduction of Cu(II) to Cu(I) using SO_2 or need expensive reagents. The reagent used for this work can readily be synthesized from common laboratory chemicals. Further, Cu(II) can readily be reduced to Cu(I) quantitatively by the reagent itself. These factors favour the new method.

3-Ethyl-4-benzylidene-5-mercapto-1,2,4-triazole was prepared by the method reported elsewhere[1]. A twice recrystallized reagent (m.p. = 168° C) from absolute alcohol was used for estimations. Ethanol solution (1%) of the reagent was used for the estimation of copper.