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Classification of Geomagnetic Micropulsations in Relation to the Interplanetary Magnetic Field Parameters

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The present system of classification of geomagnetic micropulsations is rather arbitrary based mainly on the morphological features observed in the records. A better method would be to base the classification on some physical parameters connected with their generation and propagation. An attractive possibility is seen in the measurements by satellites of the interplanetary magnetic field and magnetospheric quantities. Using interplanetary magnetic field parameters recorded aboard Explorer 28, an attempt is made to find a relation between these parameters and the geomagnetic micropulsations of 120 to 20 sec periods (30-180 cph) observed in the Telluric current activity recorded at College (Alaska). It is found that pulsations in the range 30-120 cph behave in a different manner compared to the pulsations in the range 130-180 cph.

1. Introduction

THE STUDY of geomagnetic micropulsation started when it was observed that the magnetic records of an observatory situated at higher latitudes, showed wave-like patterns superposed on the normal variations. So certain names were attributed to them depending upon how they looked like. Later, it was agreed to use a P system of classification[1]. This is rather arbitrary because the division of the different wave bands into some five groups is not done on proper basis. It is argued that it is very essential that this division should be done on the basis of some physical parameters connected with the generation and propagation of the micropulsations. An attractive possibility is seen in the measurements by satellites of the interplanetary and magnetospheric field.

Geomagnetic micropulsations recorded on the surface of the earth are due to the processes occurring both inside and outside the magnetosphere. The general characteristics of these micropulsations have been amply studied and excellent reviews are available by Troitskaya[2], Campbell[3], Akasofu[4] and Jacobs[5]. Most of the salient features observed in the case of these pulsations are in general related to the earth-bound observations. This in itself does not give much information regarding their excitation and propagation processes. Sen[6] has pointed out the importance of the interplanetory field directions when considering the instabilities at the boundary of the magnetosphere. The solar wind discontinuities impinging on the boundary of the magnetosphere produce turbulent conditions in the magnetosheath resulting in the generation of pulsations. These pulsations propagate in the magnetosphere along and across the lines of force, Gringauz *et al.*[7,8] have reported the correlation of the solar wind density with micropulsation activity. They find that large changes in solar wind particles density result in micropulsation activity observed at Borok. So the conditions observed in the interplanetary medium have important relationship with the micropulsation activity.

Hence it is possible to use interplanetary magnetic field parameters for classifying geomagnetic micropulsations.

2. Sources of Data

Ten geomagnetic storms recorded at College (Alaska) from July to December 1965 are selected from Geomagnetic and solar data[9]. The duration, type and time of maximum activity for each of the storms are given in Table 1. The corresponding micropulsation activity recorded in N-S Telluric currents at College (Alaska) for the durations of the geomagnetic storms is taken from the data compiled by Hessler[10]. The micropulsation frequency for each hour as given by Hessler[10] is used in the present study. The micropulsation activity is calculated on the basis of the range of variations in the corresponding hour and expressed in units of mV/km. Hourly averages of the interplanetary field parameters obtained from the Explorer-28 data are taken into consideration.

3. Interplanetary Field and Micropulsation Frequencies

Fig. 1 (A) shows the relation between the *resultant interplanetary magnetic field* for each of the frequen-

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Table 1—List of Geomagnetic Storms during July to December 1965 Recorded at College (Alaska) and Selected for the Present Study

No.	From	To	Type	Max. activity
1.	July 5, 23 hrs	July 7, 12 hrs	Grad.	July 6, 12 hrs
2.	July 9, 23 hrs	July 10, 22 hrs	Grad.	July 10, 12 hrs
3.	July 18, 15 hrs	July 19, 23 hrs	S. C.	July 19, 12 hrs
4.	Aug. 18, 15 hrs	Aug. 21, 16 hrs	S. C.	Aug. 19, 9 hrs
5.	Sept. 3, 15 hrs	Sept. 4, 22 hrs	S. C.	Sept. 4, 12 hrs
6.	Sept. 15, 05 hrs	Sept. 19, 22 hrs	Grad.	Sept. 16, 15 hrs
7.	Sept. 27, 15 hrs	Sept. 28, 22 hrs	Grad.	Sept. 28, 9 hrs
8.	Oct. 22, 01 hrs	Oct. 26, 03 hrs	S. C.	Oct. 23, 12 hrs
9.	Nov. 30, 14 hrs	Dec. 2, 14 hrs	Grad.	Dec. 1, 15 hrs
10.	Dec. 28, 06 hrs	Dec. 28, 23 hrs	Grad.	Dec. 26, 12 hrs

Note: Grad. = Gradual; S. C. = Sudden Commencement

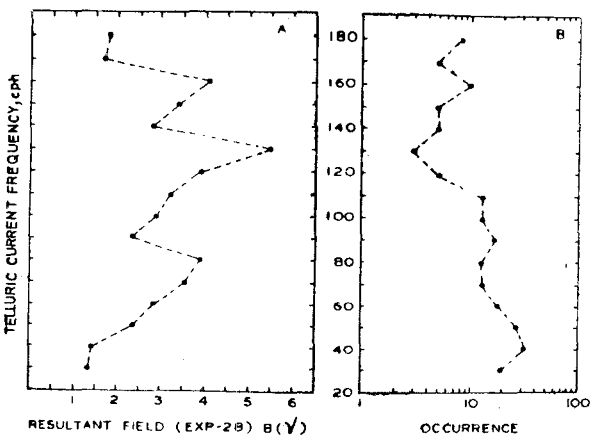

Fig. 1 — (A)Plot of Telluric current frequencies for the 10 storm durations given in Table 1 and the resultant interplanetary field for each frequency occurrence; (B) Plot showing the frequency of occurrence of the pulsations of frequencies from 30-180 cph for which the resultant field is calculated

cies from 30 to 180 cph and the Telluric current frequencies for the 10 storm durations given in Table 1. In Fig. 1 (B) is shown the frequency of occurrence of the pulsations of frequencies from 30 to 180 cph. Only those pulsations are considered where the activity for that hour is above the average of the activity from July to December 1965. Each point in Fig. 1 (A) indicates, for the particular frequency the vectorial average of the interplanetary field for all the occurrences for that frequency. It can be seen that there is an increase in the resultant field with the increase in frequency until it attains a maximum value at 130 cph. After this frequency the field value starts decreasing with increase in frequency. So the frequency bands from 30-120 cph and 130-180 cph behave in different manner. Thus the micropulsation frequency range of 30-180 cph can be divided into two parts, i.e. pulsations having frequencies less than 130 cph and pulsations having frequencies greater than 130 cph.

The two groups of micropulsation frequencies mentioned in the previous section are dependent upon the interplanetary field conditions and their occurrence is local time-dependent, indicative of the processes happening in the magnetosphere[11]. This division is phenological, being based on the generation of micropulsations, and so it is closely linked with the phenomena happening outside the magnetosphere. Thus due to the discontinuity observed at 130 cph we conclude that one class of micropulsation ends at 130 cph and another class begins at this limit.

It is suggested that a more intensive study should be made on similar lines, studying a wide range of micropulsation frequencies. An integrated approach which could explain the various factors observed in the micropulsation activity should be taken.

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