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NOTATION AND CLASSIFICATION OF GEOMAGNETIC MICRO PULSATION

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Abstract: A electromagnetic micro pulsation recording system, consisting of a core coil, input filter, shaping filter, recorder and a statistical analog computer is described. A major consideration in the design of the system is that it be duplicable with a minimum of available technical facilities. The present system of classification of geomagnetic micro pulsations 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 micro pulsations of 120 to 20 sec periods (30-180 cph) observed in the Telluric current activity recorded in 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.

Keyword: Geomagnetic pulsation, Geomagnetism, Earth Science, classification of micropulsations.

INTRODUCTION:

It was in this year that story showed how radio 'Whistlers' must propagate along the Earth's magnetic field lines, and L cagniard established the basic theory of magneto telluric. Micro pulsation may be defined as almost periodic variation of small amplitude in the earth's magnetic field, they appear to have been first observed by Balfour Stewart during a magnetic storm, and the first study of them was made by Eschenhagen (1897), using faster and more sensitive recording apparatus then was usual for the time for the time. The periods of micro pulsation observed by Stewart and Eschenhagen were in the range of from 10 to 40 seconds, commonly occurring band in micro pulsation work. Shorter period micro pulsations with periods of about 2 seconds were studied by sucks dorff (1936). He found in groups and the recording trace resembled "A pearl necklace consisting of oval pearls of different sizes". It was common at this early stage to introduce descriptive names for magnetic variations from their appearance on the recording chart. The micro pulsation referred to above came to be called pearl type micro pulsation and the name micro pulsations is itself an example, the pulsations appearing 'Micro' in size and period on the observatory charts 'Giant' micro pulsations were first observed by Roff (1931) and further studied by Harange (1939) and Sucksdorff (1939) they have a period of above 80 seconds and an amplitude of about 5 to 15 gammas, as compared to a normal micro pulsation amplitude of less than one gamma. Micro pulsations may occur at any time of the day or night, and during any state of magnetic activity. They have also been observed simultaneously at widely separated recording stations.

EXPERIMENTAL

Classification of micro pulsation

Micro pulsation are recorded with widely differing amplitudes, periods, waveforms and durations the early systems of classification depended entirely on the visual appearance of the micro pulsations on the record charts or on the occurrence of special related phenomena (aurortes, for example) and proved only of limited use when more widespread recording was undertaken visual appearance has still retained some utility, but the basis of classification has now naturally came to depend largely on the period of the various three of the most commonly used classification systems will now be described, and then the system recently recommended for general use will be discussed. Troitskaya (1961), who recorded earth current pulsations in the range of periods of 1 to 15 seconds, used one of the few visual classification systems to gain any importance. Three of the terms introduced are the following.

- PP (pulsations of the pearl type) the waveform is approximately sinusoidal & appears to be amplitude modulated, although the modulation pattern is frequently irregular. Amplitudes in quiet days are small, in middle latitudes usually being of the order of 0.001 to 0.01 gamma on disturbed days the amplitude increases & may reach several gammas.
- SIP (sudden irregular pulsations). The waveform is irregular in appearance & has its largest amplitude in polar regions. There is a close correlation with auroral activity.
- IPDP (intervals of pulsations of diminishing periods). The waveform is described as beginning as SIP & contains a series of PP that slowly diminish in period – this type has also been called a solar whistle by DUFFUS et al. (1958). The

IPDP occur as the microstructure of magnetic forms & typically last about an hour.

RESULTS & DISCUSSION

It is clear from the brief explanation of the terms given here that they could hardly be expected to form the basis of a general classification system. Also the period range of troitskaya was observing to narrow to be fully representative. A better system of classification was devised by Benioff (1960), who recorded geomagnetic fluctuations in the period range of roughly 0.32 to 120 seconds. Here four characteristics types of oscillations were defined, not just visually, but with an associated period range as well. The four types has given by Benioff are the following.

Type A: approximately sinusoidal in form, range in period from 0.3 to 2.5 seconds & usually exhibit beats. There is a negative correlation with sunspot numbers.

TYPE B: nearly sinusoidal inform with periods ranging from about 3 to 8 seconds & occasionally longer. Appear to be associated with the local occurrence of auroras.

TYPE C: nearly sinusoidal in shape with periods ranging from about 7 to 30 seconds & show a strong correlation with sunspot numbers. This type appears to occur more frequently then any other.

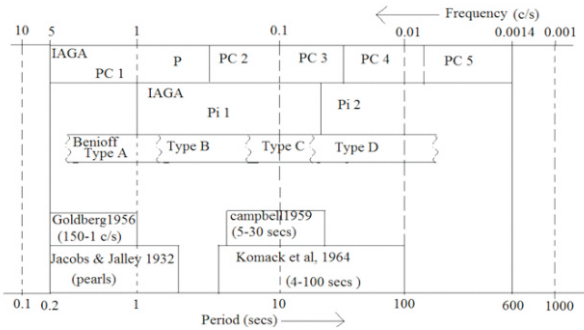
TYPE D: transients in me form of single or multiple pulses or trains of several oscillations. The pulse breadths or oscillation periods range from about 40 to 120 seconds. In 1957 an attempt was made by the international association of geomagnetism and aeronomy (I.A.G.A) which deals with rapid magnetic variations & earth currents, to lay down definitions of certain tyhpes of micro pulsations. The fact that these definitions were inadequate for the detailed description of the phenomena is perhaps demonstrated by the two classification system just given, which were published after the I.A.G.A recommendations. Nevertheless, the definitions from the bases of the most recent system proposed & are briefly as follows.

(a) PC (pulsations continuous): roughly sinusoidal, with a frequency range between 1 and 0.03 c/s (periods 1-30 seconds), and an average amplitude of one gamma or less. Continue constantly for many hours during the day. This type includes the pearl – type variations.

(b) PT (pulsation trains): a series of roughly sinusoidal pulsations, each series lasting generally 10 to 20 minutes with a frequency range between 0.03 & 0.02 c/s (periods 40-60 seconds). Amplitudes larger than pc's. occur during the night and the oscillations appear well –damped.

c)PG(pulsations giant): roughly sinusoidal, with a frequency range between 0.02 & 0.03 c/s (periods 60-300 seconds) & large amplitudes sometimes amounting to over a hundred gammas. Tendency to occur more often in both the morning & evening and observed only in or near the auroral zones.

Fig1



When it became clear that the 1957 system of classification recommended by the I.A.G.A was insufficient, Jacobs et al (1963) and matsushita (1963) proposed new systems. Based in this new system micro pulsations could be divided into two main classes those of mainly continuous character and those with an irregular pattern. Pc was extended in its range of period and divided into 5 subgroups, while pt, also extended in period , was renamed pi(pulsation irregular) & divided into 2 subgroups.

The sub group were chosen in the following way:

NOTATION	PERIOD RANGE(sec)
PC 1	0.2 - 5
PC 2	5 - 10
PC 3	10 - 45
PC 4	45 - 150
PC 5	150 - 600
NOTATION	PERIOD RANGE (sec)
PI 1	1 - 40
PI 2	40 - 150

CONCLUSION:

From the above experimental observation, it is concluded that the classification of micro pulsation gives pictorial representation of each type of pulsation in accordance with period range as well.

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