Geomagnetic Micropulsation Measurements at the Ferraz Brazilian Antarctic Station: Preliminary Results

J. M. Da Costa[1,2], S. L. G. Dutra[2], N. B. Trivedi[2], A. L. Padilha[2],

I.Vitorello[2], A. Zanandrea[2], H. R. G. Lopes[1,2], E. C. Monteiro[1,2]

[1]University of Taubaté - UNITAU, Brazil

[2]National Space Research Institute - INPE, Brazil

Abstract

The measurement of temporal variations is very important for understanding the behavior of the earth's magnetic field and its relation with sun's activity. This work shows some results on the occurrence of geomagnetic micropulsations as measured at the Ferraz Brazilian Antarctic Station - EACF (62°S, 58.4°W). This station is situated near the southern border of the South Atlantic Magnetic Anomaly. The micropulsation events were chosen from the geomagnetic data measured during 1993, 1994 and 1997. The geomagnetic instrumentation included a high sensitivity ring core three-axis (H, D, Z) fluxgate magnetometer and a pair of magnetic coils installed at a remote site. The results obtained from the data analysis show the occurrence of Pc1, Pc2, Pc3, Pc4 and Pc5 micropulsations in the geomagnetic spectra observed at Ferraz. It seems that the geomagnetic micropulsation spectra observed at Ferraz may have an important contribution from the precipitation of Van Allen's belts energetic particles into the atmosphere.

INTRODUCTION

The low level of the artificial electromagnetic noise makes the Antarctic region one of the best natural geophysical laboratories for the study of geomagnetic micropulsations. The present study shows some preliminary results on the occurrence of geomagnetic field micropulsations as measured at the Ferraz Brazilian Antarctic Station - EACF (62°S, 58.4°W). This station is situated near the southern border of the South Atlantic Magnetic Anomaly. The micropulsation events were chosen from the geomagnetic data measured during 1993, 1994 and 1997 for the Brazilian Antarctic Program (PROANTAR/CNPq). The method of fast Fourier transform (FFT) was used to find the dominant frequencies. The results are discussed taking account the interaction between the earth's magnetic field and the solar wind, as well as the dynamics of the radiation belts energetic particles. The measurement of temporal variations is very important for understanding the behavior of the earth's magnetic field and its relation with sun's activity.

GEOMAGNETIC INSTRUMENTATION

A high sensitivity (better than 0.1nT) ring core three-axis (H, D, Z) fluxgate magnetometer measured geomagnetic variations in the DC to 4mHz range, at each 2-min interval, and a pair (X, Y) of magnetic coils measured variations in the 10mHz to 2.5Hz range at each 0.2s. Diesel generators provided the electric power for the fluxgate magnetometer from a distance of about 200 meters. The magnetic coils were installed at a remote site, which counts with solar panels and an wind generator for provision of electric power.

GEOMAGNETIC DATA

The fluxgate data included in this preliminary analysis are the ones measured during the periods of October 31–November 5, 1993 and February 23–28, 1994. The magnetic coils data are the ones measured on August 26, 1997. Fig. 1a–g and Fig . 2a–g show the plots of the geomagnetic diurnal variations observed at the EACF for the periods of October 31–November 5, 1993 and February 23–28, 1994. Fig. 3a–d show the east-west and the north-south raw data measured with the magnetic coils on August, 26 1997.

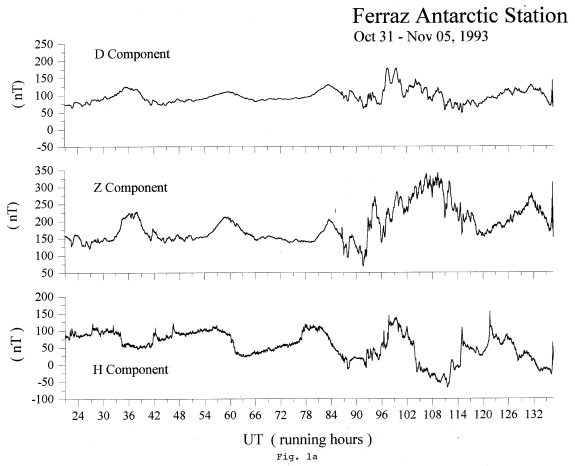

Fig. 1a

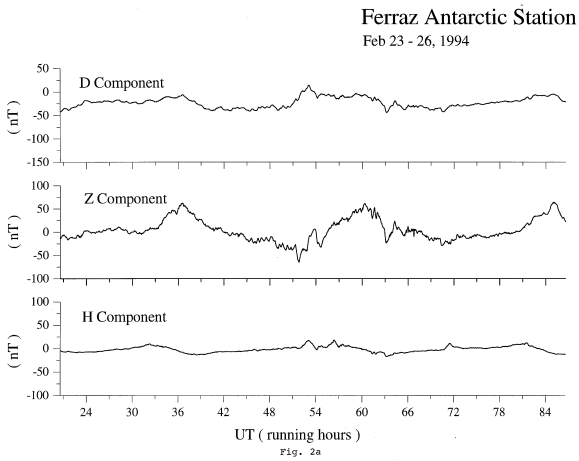

Fig. 2a

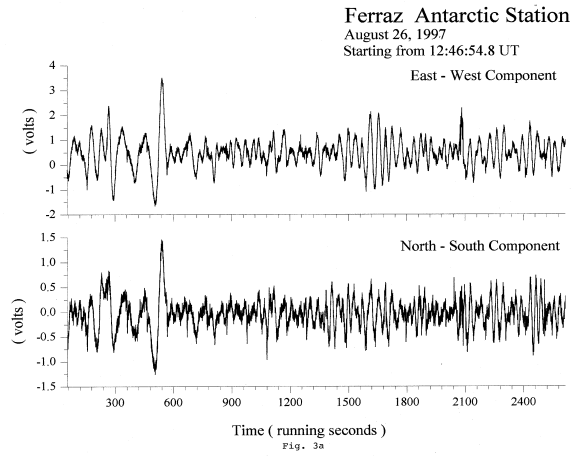

Fig. 3a

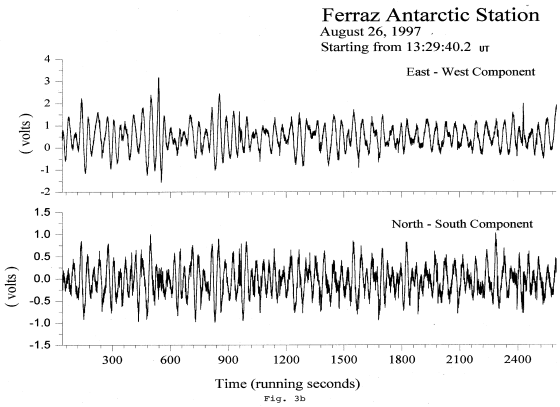

Fig. 3b

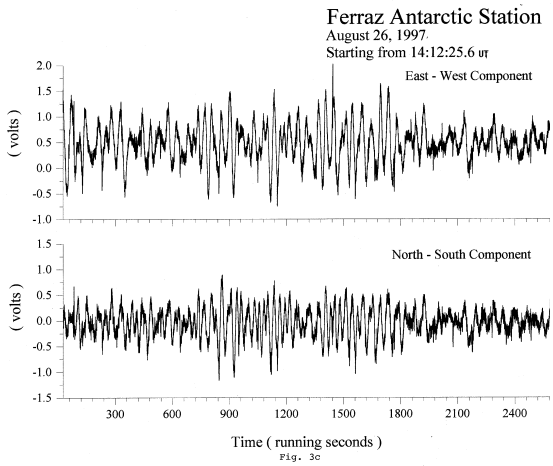

Fig. 3c

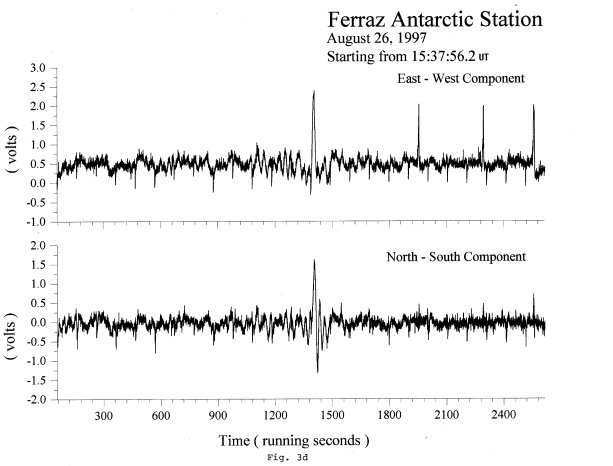

Fig. 3d

RESULTS

The results obtained from this preliminary data analysis show the occurrence of Pc1 (0.6–5s), Pc2 (5–10s), Pc3 (10–45s), Pc4 (45–150s) and Pc5 (300–600s) in the geomagnetic spectra observed at Ferraz. The dynamic spectra were calculated for Pc5 geomagnetic micropulsations observed during October 31–November 5, 1993 and February 23–26, 1994, respectively. They were also calculated for Pc1, Pc2 and Pc3 micropulsations observed on August 26, 1997 from about 1247 UT to 1610 UT.

CONCLUSIONS

It seems that the geomagnetic micropulsation spectra observed at Ferraz may have an important contribution from the precipitation of Van Allen's belts energetic particles into the atmosphere of the South Atlantic Magnetic Anomaly. This contribution could be higher for the micropulsation spectra observed in association with magnetic storms. For the storm of November 3–4, 1993, Knipp and Rostoker (1995) reported ULF wave activity in morning sector on November 4, 1993, possibly associated with relativistic electrons at geosynchronous orbit. In addition, Li et al. (1997) reported a periodicity of 12 hours, due to the South Atlantic Magnetic Anomaly, in the outer radiation belt electron flux (E > 1 MeV) measured with SAMPEX satellite during November 1-8, 1993.

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