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Report of Geomagnetic Observations Carried out in Antarctica During the Period March-December 1991

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Abstract

A three-component flux gate magnetometer was installed at Maitri to obtain continuous record of magnetic field changes in H, Z and D components. The data collection was satisfactory.

Introduction

The earth's magnetism is a dynamic and complex field, the origin of which may be traced to terrestrial, atmospheric, planetary and interstellar phenomena. Accurate recording of the three component variations of the field is an important aspect of navigation, surveying, communication and fundamental research.

Antarctica, a huge continent containing one of the poles of the earth's magnetic field, becomes an ideal location to study geophysical phenomena occurring in the ionosphere and magnetosphere. Antarctica can be imagined as a screen where the dynamic processes occurring in the magnetosphere get projected through associated electric fields and currents, particle precipitation etc. This is so because magnetic lines of force act, to a high degree of accuracy, as equipotential lines of force for electric fields. As the polar region is at one end of the magnetic lines of force, magnetospheric electric field and particle motions are mapped over the Antarctic ionosphere.

Geomagnetic recordings over here are significant in this regard because not only the various segments of the magnetosphere are projected over the Antarctica, a certain portion of this continent is also directly accessible to interplanetary particles.

During the winter period of 1991 the three components of the earth's magnetic field were continuously monitored with the equipment installed during the austral summer period of 1991. As it was clear that the year 1991 was a high solar activity year, all efforts were made for continuous monitoring of the magnetic field components.

Methodology

The equipment used was a 3 component flux gate magnetometer, oriented to respond to magnetic field changes in H (horizontal), Z (vertical) and D (declinations) components. The output of the unit was taken in two modes (a) for normal daily variation and (b) for micropulsations through a filter in the periodicity of 50 to 1200 seconds. The output was fed to two digital data loggers with internal crystal controlled clock systems and sampled every 10 seconds for micropulsations and every 60 seconds for daily variation. Analog recordings were also simultaneously obtained which clearly revealed the good quality of the data (Figs 1,2).

The sensor for the magnetometer was housed in a well insulated cabin and was buried below ground level. It's location was away from heavy magnetic materials

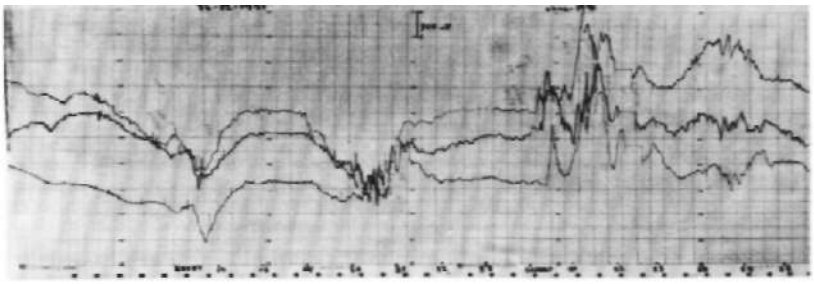

Fig.1. Sample analog record of magnetic field variations (daily variation).

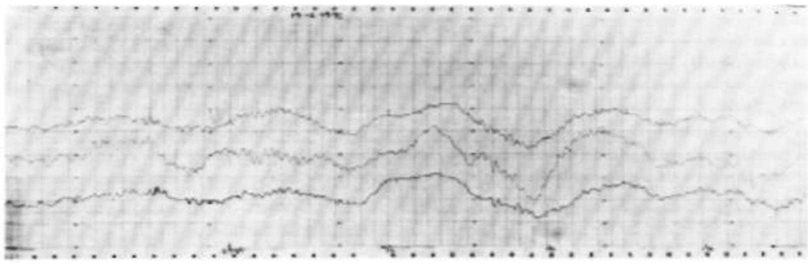

Fig.2. Sample analog record of magnetic field variations (micropulsations).

and man made disturbances. The signal cable from sensor to the electronic unit was buried one foot below ground level to prevent damage from extreme cold and high winds. The recordings started from January 18, 1991 and continued throughout the winter period.

Table 1: Indian Antarctic Station Maitri
(Magnetically disturbed days from January 1991 to December 1991)

Month Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
01	—	**D**						**D**	**D**	**D**	**D**	**D**
02	—	**D**	—	**D**	**D**	**D**	—	**D**	**D**	**D**	**D**	**D**
03	—	_	—	**D**	—	**D**	**D**	**D**	**D**	—	**D**	
04	—	—	—	**D**	—	**D**	**D**	**D**	**D**	**D**	**D**	
05	—	—	—	**D**	—	**D**	—	**D**	**D**	**D**	**D**	
06								**D**	**D**	**D**	**D**	
07						**D**						
08	—	.—	_	**D**	—	**D**	**D**	**D**	**D**	**D**	**D**	
09	—	—	**D**	—	—	**D**	**D**	**D**	**D**	**D**	**D**	
10	—	—	**D**	—	—	**D**	**D**	—	**D**	**D**	—	
11	—	—	—	—	—	**D**	**D**	—	**D**	—	**D**	
12						**D**	**D**	**D**	—	—	—	
13	—	—	**D**	—	**D**	**D**	**D**	—	—	—	**D**	
14	—	—	—	—	—	—	**D**	**D**	**D**	—	—	
15							**D**	**D**	**D**	—	**D**	
16	—	—	—	—	**D**	—	**D**	—	—	—	**D**	
17	—	—	**D**	—	—	**D**	**D**	**D**	—	—	**D**	
18												
19	—	—	**D**	—	_	**D**	**D**	**D**	—	—	**D**	
20							**D**	**D**	—	**D**	**D**	
21						**D**	**D**	**D**	—	**D**	**D**	
22	—	—	D	—	—	**D**	—	**D**	**D**	**D**	**D**	
23	**D**	—	—	—	D	**D**	**D**	_	—	**D**	—	
24	—	—	**D**	—	D	**D**	—	—	**D**	**D**	—	
25	**D**	—	**D**	—	**D**	**D**	—	—	**D**	**D**	—	
26	—	—	**D**	—	—	**D**	_	—	**D**	**D**	—	
27	—	—	—	—	**D**	—	—	**D**	**D**	**D**	—	
28	—	—	**D**	—	**D**	—	—	**D**	**D**	**D**	**D**	
29										**D**	—	
30	—	—	**D**	—	**D**	**D**	—	**D**	**D**	**D**	—	
31	—	—	**D**	—	**D**	—	—	**D**		**D**	—	

Results

As the year 1991 was a high solar activity year, during the whole winter period a maximum number of strong magnetic storms and sub storms associated with aurora australis were recorded.

Seen from the ground, the aurora takes on a great variety of appearances from quiet, barely visible arcs low in the sky to spectacular rayed, moving draperies of red, violet and green which fill the sky and recede and fade, leaving diffuse patches as dawn approaches. The maximum number of aurora occurred overhead almost every night from April to September. During this period, all efforts were made for an uninterrupted recording of the magnetic field. Heaters and hot air blowers were installed in the hut to keep the room temperature between +5°C to +15°C.

Up to June '91, the data collected suffered slightly due to high fluctuations in the power supply and during the period when the high frequency communication system was operated. The flux gate magnetometer power source was changed from mains to batteries in June and the data collected thereafter was satisfactory. Some data loss occurred due to sudden power failures, very high winds and blizzards. Failure of the equipment also caused data loss. However, in all the cases, the defects were detected well in time and immediate remedial measures were taken.

In the whole winter period, the magnetic data collected was satisfactory. The final analysis of the data will be carried out at IIG in due course.

Acknowledgement

I am thankful to the Department of Ocean Development for giving me an opportunity to winter at Maitri. My thanks are due to Dr A.K. Hanjura, Station Commander and all other members of the 8th wintering team. My grateful thanks are extended to Prof. B.P. Singh, Director, IIG, Prof. G.K. Rangarajan, Mr Daga and Mr Ajay Dhar for the encouragement given during the course of the study.