XVI...Magnetic Storms from the Ground

Introduction

Coronal Mass Ejections and other solar storms can buffet the magnetic field of the Earth with clouds of charged particles and magnetic fields. Not only do these interactions affect the large-scale properties of the geomagnetic field, but their affects can also be easily detected on the ground. During the last 100 years, many 'magnetic observatories' have been commissioned around the world to monitor the Earth's surface field conditions. These have been, historically, important for navigation by ships at sea. The data from these observatories can also be used to examine what happens when solar storms arrive at the Earth.

Objective

By analyzing graphical data, students will become familiar with the Earth's changing magnetic field through solar storm activity plots.

Procedure

1) Plot the location of each magnetic observatory on a map of Canada. Label each station number next to the plotted point.

2) Analyze the magnetic intensity plot for each station and identify the difference between stable activity, and the largest difference in change in activity, either positive or negative, on the plot. The units of magnetic intensity are in micro-Teslas, abbreviated as 'mT'.

3) Find the percentage change for each station. Round the answer to the nearest hundredth of a percent. Write the number below the location of the station on the map. See the Teacher's Answer Key.

4) Discuss and work the following questions and procedures:

—Where are the largest magnetic changes located for this event?

—Draw a circle around the three stations with the largest magnetic changes. Did the largest changes occur at the same time? Explain.

—On the Data Sheet, organize the plots in order from the largest to the smallest change. Do you see any patterns?

—Organize the magnetic intensity plots according to similar shapes. Are there any trends?

Materials

—5-station magnetic field Data Sheet.

—Calculator

—Map of Canada

Example: For Fort Churchill the normal 'stable' level was 59.3 mT and the largest deflection happened near 8:00 Universal Time (UT) at about 59.8 mT,

$$\% = 100 \times \frac{(\text{max} - \text{stable})}{\text{stable}}$$

$$\% = 100 \times \frac{(59.8 - 59.3)}{59.3}$$

or 0.85 percent.

Conclusion:

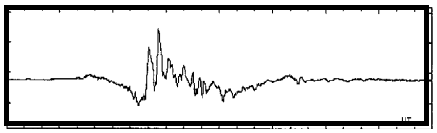
Students should have learned that the Earth's magnetic field does not remain constant in time, but can change its strength. By investigating and plotting data, students should have revealed the changes in intensity of the Earth's magnetic field due to solar storms. From this, students will locate those regions of the Earth that are most susceptible to solar storms.

Teacher's Answer Key

Note: Times given to 1/2 hour accuracy are adequate for this exercise. Percentages may vary by 0.1 percent depending on how students measure. Students may average their results for each station to produce a better 'class average' percentage.

0 **Time (in hours)** **24**

58

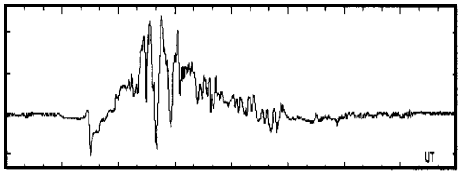


57

Station 1: **Meanook**
Latitude: **54.6 North** **Longitude:** **113.3 West**

Time: **8:00** **Percent:** **0.70**

60

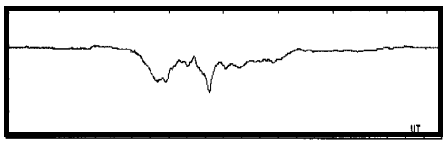


59

Station 2: **Fort Churchill**
Latitude: **58.8 North** **Longitude:** **94.1 West**

Time: **8:00** **Percent:** **0.85**

52

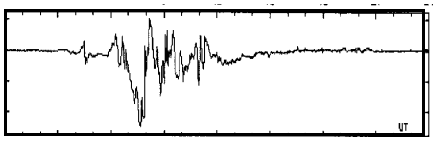


51

Station 3: **Victoria**
Latitude: **48.5 North** **Longitude:** **123.4 West**

Time: **11:00** **Percent:** **0.58**

58

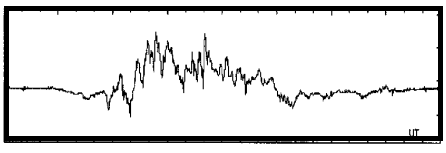


57

Station 4: **Poste-de-la-Baleine**
Latitude: **55.3 North** **Longitude:** **77.8 West**

Time: **7:30** **Percent:** **1.05**

60



59

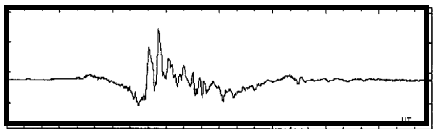
Station 5: **Yellowknife**
Latitude: **62.4 North** **Longitude:** **114.5 West**

Time: **8:00** **Percent:** **0.60**

Student Data Sheet

0 **Time (in hours)** **24**

58

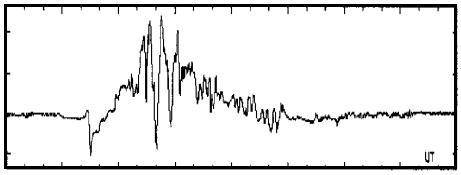


57

Station 1: **Meanook**
Latitude: **54.6 North** **Longitude:** **113.3 West**

Time: **Percent:**

60

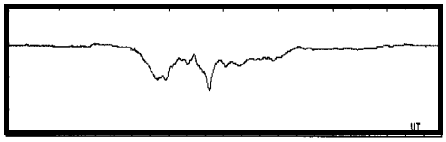


59

Station 2: **Fort Churchill**
Latitude: **58.8 North** **Longitude:** **94.1 West**

Time: **Percent:**

52

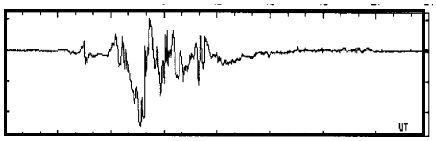


51

Station 3: **Victoria**
Latitude: **48.5 North** **Longitude:** **123.4 West**

Time: **Percent:**

58

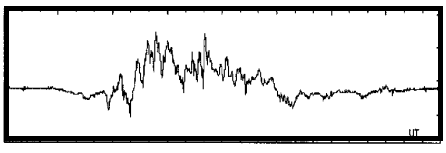


57

Station 4: **Poste-de-la-Baleine**
Latitude: **55.3 North** **Longitude:** **77.8 West**

Time: **Percent:**

60

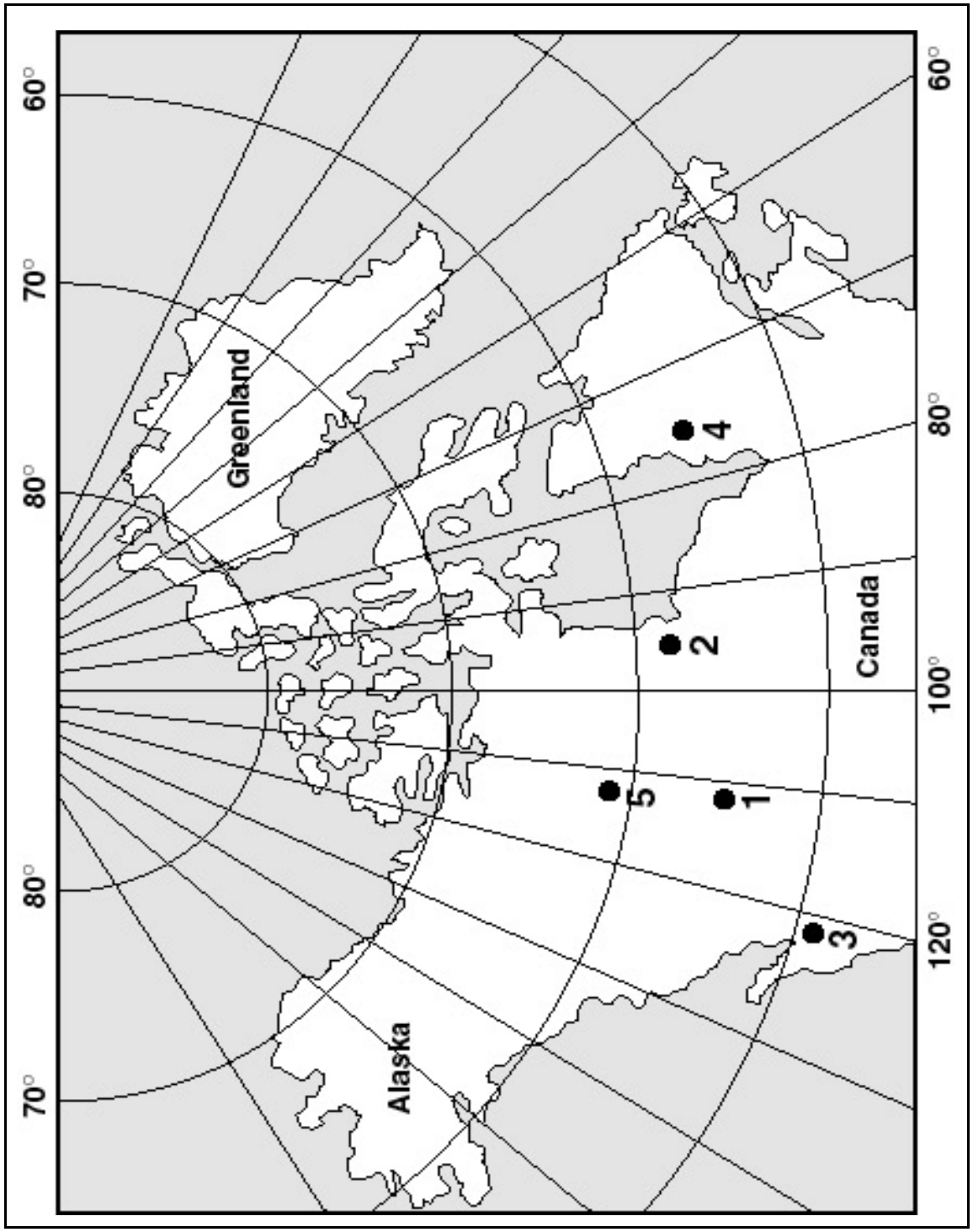


59

Station 5: **Yellowknife**
Latitude: **62.4 North** **Longitude:** **114.5 West**

Time: **Percent:**

Name _____ **Date** _____



Teacher's Answer Key