Activity 39: Field Use of a Magnetometer

Maine Geological Survey

Objectives:

To give the students first-hand use of a real magnetometer. To extend the validity of Activity #38 (A Magnet as a Magnetometer). To let the students gain experience in establishing a sampling grid.

Time:

To establish the grid, 40-75 minutes. To have students test the grid, 45 minutes (more time will be needed with classes greater than 20 students). One good approach is for the students to construct the grid one day, the teacher bury some objects and dig some false holes that evening, and the students test the grid the next day.

Background:

Magnetometers are sensitive to any nearby objects that have magnetic properties; even weakly magnetic buried objects may be easily located. Magnetometers are routinely used to locate underground water and gas pipes, culverts, sewer pipes, and storage tanks such as those used for petroleum products. Even cement structures that are reinforced with steel rods (ferroconcrete) such as household septic tanks can be located. The key to success in any such activity is not only the accuracy of the instrument, but the test pattern developed and used by the person using the equipment. In actual use a metallic object will cause a number of low value readings to be found adjacent to a significantly higher reading; an example is shown in Table 1.

Table 1. Data from a sample grid. Something is located at location B-3 or at the very least BETWEEN locations B-2 and B-3.

Station	Line			
	A	B	C	D
1	516	512	515	511
2	523	401	521	502
3	536	600	535	529
4	524	560	555	515

Materials:

- Magnetic compass
- 50 foot tape measure
- Wooden stakes
- Hammer
- Several iron objects weighing at least 2 pounds
- Data sheets
- Magnetometer. If your school does not have a magnetometer you may be able to borrow one from a local water district, geophysical firm, surveying company, or state agency. Purchase of a magnetometer can cost between $100 and $500.

Procedure:

Select an area free of magnetic "noise." Any object capable of interfering with the readings of a magnetometer - chain link fences, transmission lines, steel framed or walled buildings, etc. - is said to create "noise."

Students, using the compass, should establish a north-south base line along one side of the area. Along this line place a stake every 5 (or 10) feet. These will be the reading stations. Now directly east or west of your base line establish another parallel line the same distance away from the first line as the distance between the stakes in your first line. Put stakes along this second line parallel to the stakes in the first line. Repeat this procedure until the entire area is marked off with a grid of stakes. The north-south lines should be designated A, B, C,.... and the stakes as stations 1, 2, 3.... Set up a data sheet

to correspond with the survey area. Bury the iron objects, at random, close to the surface inside the survey area.

Starting at Line A, Station 1, take magnetometer readings at each station (stake) on each line until the whole area has been surveyed. Record the data. Students should use the data to determine the location of the objects.

Follow-Up:

Have students accompany a crew that is in the process of doing some "underground" survey work.

Use sample data sheets to have students predict the possible location of metal-rich ore bodies, buried tanks, etc.

References:

Activity developed by Herbert Dobbins during the 1991 CREST intern program.

Name_____

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Student Sheet

Purpose:

To lay out a grid and survey an area with a real magnetometer to locate one or more concealed objects.

Materials:

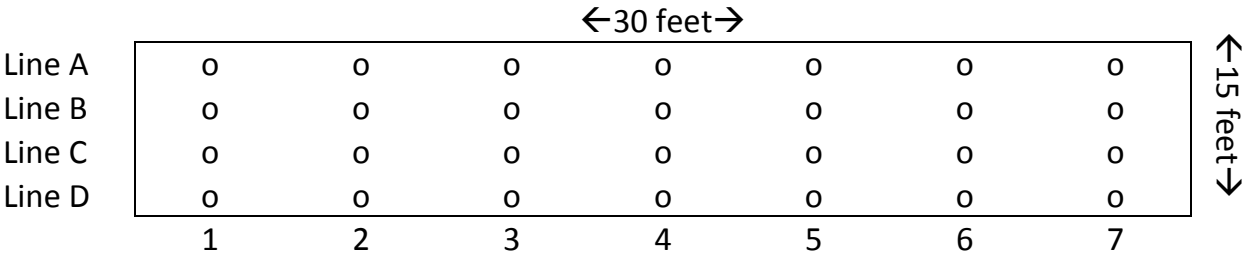
Compass, 50 foot tape measure, wooden stakes, hammer, several iron objects, magnetometer, data sheet (attached), notebooks, and pens. Flagging tape is optional.

Procedure:

In this exercise you will use a real magnetometer to locate iron objects on the surface of the ground or that have been buried in the ground. If the objects have been buried, there will be a number of "false" holes located in the testing area. Your teacher has selected the general area for this activity; he or she will show you where to start.

PART I - ESTABLISHING A TEST GRID:

From the starting point, use the compass to establish a north-south base line. While one student holds the compass, other students should drive a stake in the ground every five or ten feet along this base line for a predetermined distance. Establish a second line parallel to the first. Make certain that all stakes are equally distanced from their neighbors. Continue this process until told to stop by your teacher. Your grid should be similar to the diagram below:



Each dot in the above grid is a stake, since the stakes are five feet apart the grid is 30 feet long and 15 feet wide. There are 28 stakes total.

PART II - TESTING:

After being instructed in the use and reading of the magnetometer take a reading next to each stake in each line and record the data on the attached data sheet. After all the readings have been completed, look at the data and try to locate the iron objects.

If the objects are buried, dig to test your hypothesis regarding their location. Did you find an object?

Magnetometer Data Sheet

General Location: _____ Date: _____

Number of objects “buried” (real or simulated) in grid: _____

Distance between stakes: _____

Person or group gathering data: _____

Line								
A								
B								
C								
D								
E								
F								
G								
	1	2	3	4	5	6	7	8

Questions:

1. Were you successful in locating the object(s) placed in the grid on the first try? If not, why?

2. Were there any “random fluctuations” in your readings? What do you think caused these?

3. Can you think of any way to hide an iron object from the magnetometer? See if your teacher will let you test your ideas.