

## Comparison of Total Magnetic Field to Vertical Magnetic Gradient Data from Effigy Mounds National Park, Iowa

By

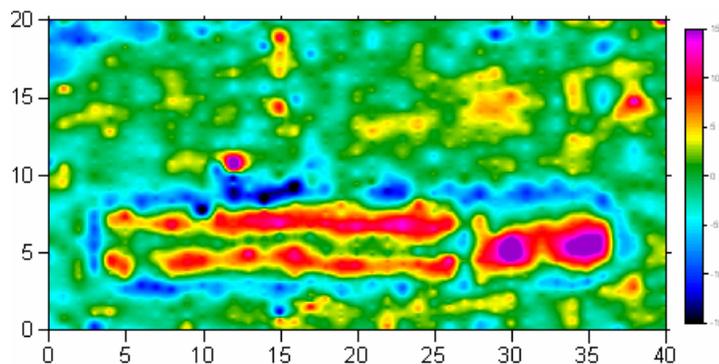
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It is unusual to find total magnetic field data presented or discussed in the body of archaeological geophysics case histories. Reasons for this may seem obvious: 1) total field data are subject to diurnal variations and require corrections and 2) vertical gradient data provides higher resolution results. Although both reasons are generally true, neither is sufficient to exclude the use of total field measurements.

Useful information may be present in the total field data that are not apparent in the gradient data. A set of data obtained by IMA Consulting at Effigy Mounds National Park in Iowa provides an excellent comparison not only between total field and vertical gradient data, but also between vertical gradient data collected with different sensor separations.

Data were collected using a Geometrics G-858 Cesium magnetometer with the gradiometer option. The line spacing was 0.5 meter and the sampling rate was 10 readings per second resulting in a measurement interval of about 11 centimeters. The survey was conducted with a sensor separation of 0.5 meter and then at 1.5 meter.



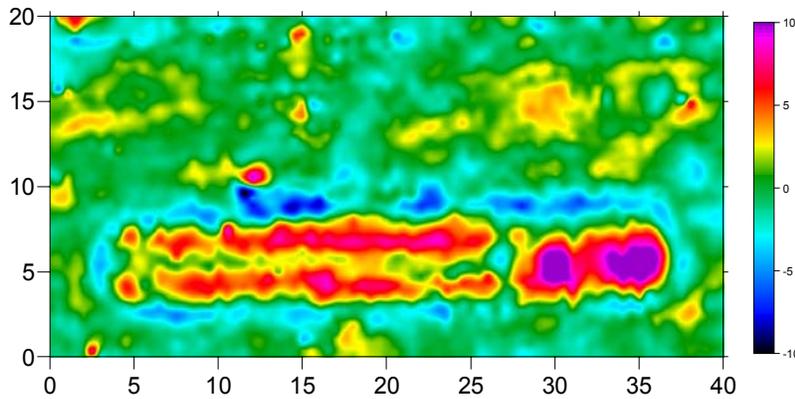
*Vertical Gradient with 0.5 meter sensor separation.*

*Grid units are in meters.*

The vertical gradient data collected with a sensor separation of 0.5 meter (the standard separation) is shown to the left. The linear mound is apparent in the data from roughly 3E-37E/3N-8N. The portion of the mound west of about 27E appears as two parallel magnetic highs. East of 27E, the data show two adjacent highs that do not correspond to the parallel highs to the west. The low magnetic values surrounding the mound may be due in part to topographic effects. The mound

has the same appearance in the other sets of data discussed in this paper.

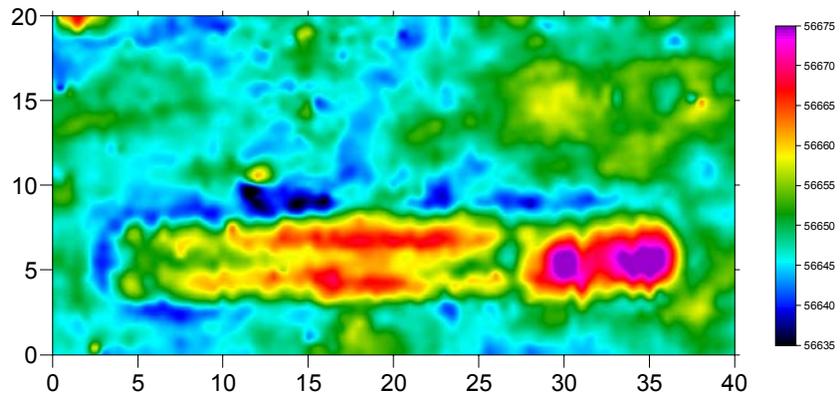
Relatively weak magnetic variations are apparent in the data in the north half of the area shown. Of most possible interest are the linear highs forming a rough square (35E-40E/13N-17N). A weak high centered at about 29E/14N. The cause of these anomalies is not known.



*Vertical magnetic gradient with 1.5 meter sensor separation.*

To the left is the gradient data collected with a sensor separation of 1.5 meters. The mound appears nearly the same as in the previous image. The weak anomaly at 29E/14N has taken on a better defined shape. Linear anomalies forming a triangle are now apparent at 0E-9E/13N-17N. A weak linear magnetic low can be seen extending NNE from the north edge of the mound at 17E/10N.

The total field image shown here is the bottom sensor data, taken approximately 1 foot above the ground. The appearance of the mound is similar, although not as sharply defined. The weak anomaly at 29E/14N is now the most significant anomaly that is not part of the mound. It may be related to the roughly square anomaly group to the east. The NNE trending linear low is well defined in this image. The triangular anomaly in the northeast is still apparent.



*Total magnetic field*

One of the so-called advantages of vertical gradient data is that it enhances the anomalies from shallower features that are more likely to be of archaeological interest. It is apparent from these images that some anomalies of possible interest have been eliminated from the gradient data. Collecting gradient data with a greater vertical separation between sensors shows some anomalies may be more significant than shown in the “normal” (0.5-meter separation) gradient data. Some of the anomalies are even better defined in the total field data. At this time, we do not know if the anomalies being discussed are caused by archaeological features (other than the linear mound).

The total field may have provided the best data at this site, but this might not be the case at all other sites. The total field data needed no diurnal correction because the area covered was small and took little time to collect. Collecting the gradient data with larger sensor separations appears to be a good compromise: deeper features can be mapped and there is no diurnal correction needed. Additional studies are needed at other sites to determine if the total field or vertical gradient with a large separation has advantages over the “normal” vertical gradient survey.