KECK GEOLOGY CONSORTIUM

PROCEEDINGS OF THE TWENTY-SECOND ANNUAL KECK RESEARCH SYMPOSIUM IN GEOLOGY

April 2009
Franklin & Marshall College, Lancaster PA.

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Faculty: *WILLIAM H. PECK*, *BRUCE W. SELLECK* and *MARTIN S. WONG*: Colgate University
Students*: JOE CATALANO*: Union College; *ISIS FUKAI*: Oberlin College*; STEVEN HOCHMAN*: Pomona College; *JOSHUA T. MAURER*: Mt Union College*; ROBERT NOWAK*: The College of Wooster*; SEAN REGAN*: St. Lawrence University*; ASHLEY RUSSELL*: University of North Dakota; *ANDREW G. STOCKER*: Claremont McKenna College; *CELINA N. WILL*: Mount Holyoke College

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Students: *GARRISON LOOPE*: Oberlin College; *DOUGLAS MERKERT*: Union College; *JOHN LINDEN NEFF*: Amherst College; *NANCY PARKER*: Lafayette College; *KYLE TROSTLE*: Franklin & Marshall College; *BEVERLY WALKER*: Colgate University

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Students: *AVERY R. COTA*: Minnesota State University Moorhead; *JANE DIDALEUSKY*: Smith College; *ROWAN HILL*: Colorado College; *ANNA PENDLEY*: Washington and Lee University; *MAIJA SIPOLA*: Carleton College; *STACEY SOSENKO*: Franklin and Marshall College

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Students: *ELIZABETH BROWN*: Occidental College; *GIA MATZINGER, ANDREA SEYMOUR, RYAN J. LEARY*, *KELLY DUNDON* and *CHELSEA C. DURFEY*: Whitman College; *BRITTANY GAUDETTE*: Mount Holyoke College; *KATHRYN LADIG*: Gustavus Adolphus College; *GREG MORTKA*: Lehigh U.; *JODI SPRAJCAR*: The College of Wooster; *KRISTIN E. SWEENEY*: Carleton College.

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Students: *ALANA BARTOLAI*: Macalester College; *EMMA KRAVET and CONOR VEENEMAN*: Wesleyan University; *RACHEL NEURATH*: Smith College; *JESSICA SCHEICK*: Bryn Mawr College; *DAVID JAKIM*: SUNY.

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Project Faculty: ***SARA BON-HARPER*****:** Monticello Department of Archaeology

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Research Advisor: Dr. Rinita Dalan

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Research Advisors: Dr. Sara Bon-Harper, Dr. David Harbor, and Dr. Robert Sternberg

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Research Advisor: Mary Savina, Carleton College

MAGNETOMETRY IN THE PODERE FUNGHI AT THE ETRUSCAN ARCHAEOLOGICAL SITE OF POGGIO COLLA

STACEY SOSENKO: Franklin and Marshall College
Research Advisor: Rob Sternberg

Funding provided by: Keck Geology Consortium Member Institutions and NSF (NSF-REU: 0648782)

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MAGNETOMETRY IN THE PODERE FUNGHI AT THE ETRUSCAN ARCHAEOLOGICAL SITE OF POGGIO COLLA

STACEY SOSENKO: Franklin and Marshall College
Research Advisor: Rob Sternberg

INTRODUCTION

The purpose of this project was to conduct geophysical research at the archaeological site of Poggio Colla in Vicchio, Italy. Poggio Colla is an Etruscan archaeological site that is part of the Mugello Valley Archaeological Project located in Tuscany, about 30 km northeast of Florence, Italy. Poggio Colla is the name of the acropolis, located on top of a hill; related survey and site archaeology includes the surrounding area. This area includes a field below the main site called the Podere Funghi, which is an area of known Etruscan ceramic production. Magnetometry is a non-invasive subsurface technique that is particularly useful for the localization of kilns, furnaces, and brickwork (Pasquinucci et al, 1996). The technique measures anomalies in the Earth's magnetic field that may be caused by archaeological features that have differing magnetic properties from the natural background (Cheetham, 2007). Archaeologists are increasingly using the technique because it can locate archaeological features where there are no surface indications of remains (Cheetham, 2007).

Magnetic surveys were conducted in the Podere Funghi, a field north of the Podere Funghi, a field west of the Podere Funghi, and a plateau below Poggio Colla. A long term goal with the survey conducted in the Podere Funghi is to integrate the data sets of the other studies conducted in the field, specifically the magnetic susceptibility study, to see if there is a correlation between the different scientific methods as well as a correlation between archaeological and scientific methods. The data show interesting anomalies in the Podere Funghi, the field north of the Podere Funghi and the plateau below Poggio Colla. For some of the anomalies the sources have been identified, while others are only subject to speculation.

METHODS

A proton precession magnetometer served as the base station magnetometer during the project. It was located in the edge of the woods on the northwestern edge of the Podere Funghi. A measurement of the geomagnetic field was recorded every 60 seconds. A cesium vapor magnetometer was used as the roving magnetometer for the project. Depending on the size of the areas surveyed, the distance between lines would either be every ½-meter, 1-meter, or 2-meters. Lines were walked from south to north or north to south on the fields north and west of Podere Funghi and on the plateau below Poggio Colla. In the Podere Funghi, lines were walked from west to east and east to west. Measurements were taken and recorded every 0.2 seconds by the magnetometer while a line was being walked. Positioning of the data used a combination of global positioning system points and total station surveys, assuming a constant velocity of walking the lines.

All data collected in the field were uploaded to a computer and processed using MagMap2000 and Surfer software. Data were processed and the correction for diurnal variation was made using MagMap2000. Contour maps were generated using Surfer. Profiles of every line walked were generated using Microsoft Excel. A few technical problems were encountered during the processing stage of this project. The format of some base station files were unreadable in MagMap2000 and had to manipulated to allow for the diurnal correction. When working with the roving magnetometer data files, a firmware bug was encountered. After unsuccessful attempts to correct the problem, the manufacturer described how to circumvent the problem by opening the

.INI file and changing the time correction. After these problems were solved, processing continued smoothly.

RESULTS

Results from the Podere Funghi have revealed a number of interesting anomalies (Fig. 1). Anomaly A shows two small monopole anomalies in the northwestern corner of the field. The first peak is approximately 25 nT and the second, smaller peak is approximately 10 nT. Figure 2 shows a profile of a line walked directly over the anomaly. The peaks in the profile match up almost perfectly with the anomaly on the contour map. Anomaly B on Figure 1 shows a dipole anomaly of 50 nT in the northeastern corner of the field. Anomaly C is a very large dipole anomaly on the western edge of the field. The anomaly is approximately 1,400 nT in amplitude. Figure 3 shows the profile of a line walked directly over the anomaly. The high and low of this anomaly match up with the high and low of the contour map. Anomaly D is a large area of high-amplitude anomalies.

Contour maps have a tendency to overemphasize large anomalies, which in these surveys were due to non-archaeological sources such as rebar stakes related to the recent excavations. Because of this tendency, more subtle anomalies are lost in the large signal. These smaller anomalies are more likely to be of interest to archaeologists than large signals. Figure 4 shows a small dipole anomaly that is approximately 16 nT in amplitude. The anomaly does not seem to appear on the contour map where it is shown on the profile displayed, because it is being suppressed by the larger anomalies.

Figure 5 is a contour map of a plateau to the north of and just below Poggio Colla. Anomaly A on this figure is a very distinct dipole anomaly that is 80 nT in amplitude. The field north of the Podere Funghi showed a very distinct dipolar anomaly that is approximately 200 nT in amplitude. The field west of the Podere Funghi showed a small anomaly of 25 nT in the western portion of the grid.

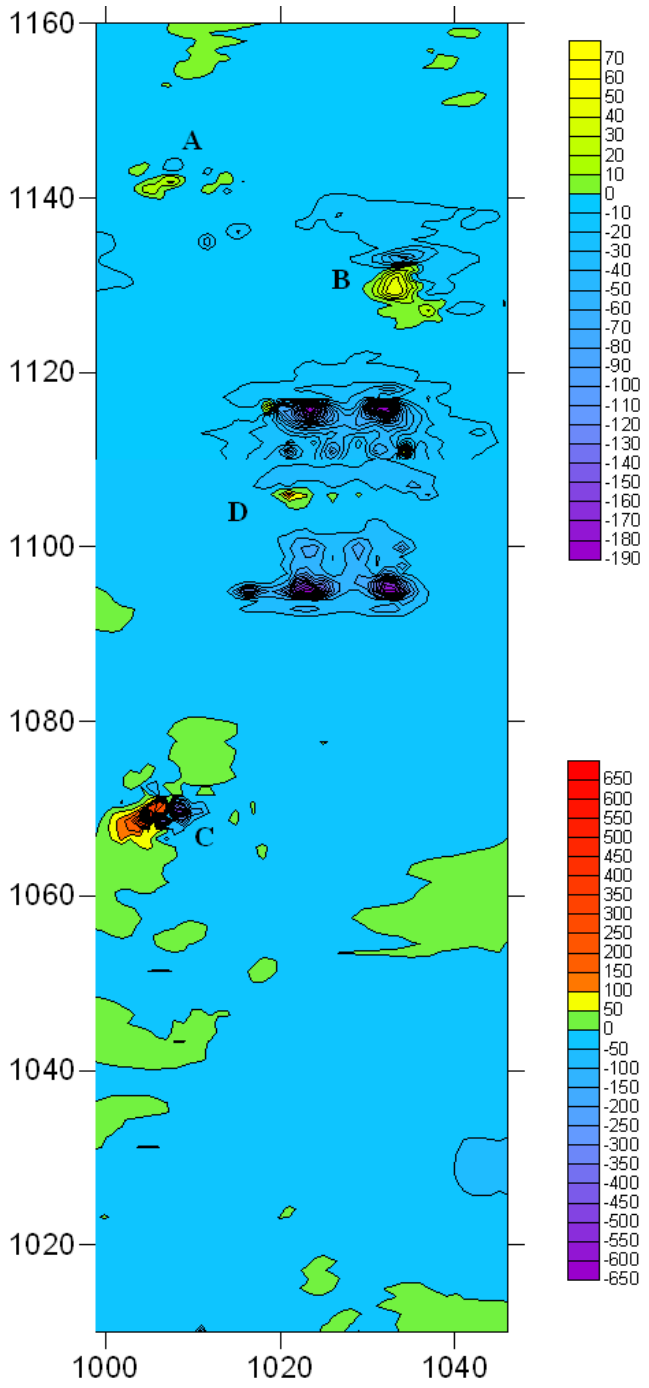

Figure 1: Magnetic contour map of the Podere Funghi. Labeled anomalies are discussed in the text.

DISCUSSION

Some of the anomalies displayed in the figures have been identified and ground-truthed, while others still remain unknown. The size of the anomaly is indicative of whether or not it may be archaeological (Gaffey and Gater, 2003). Anomaly C (Fig. 1) is a

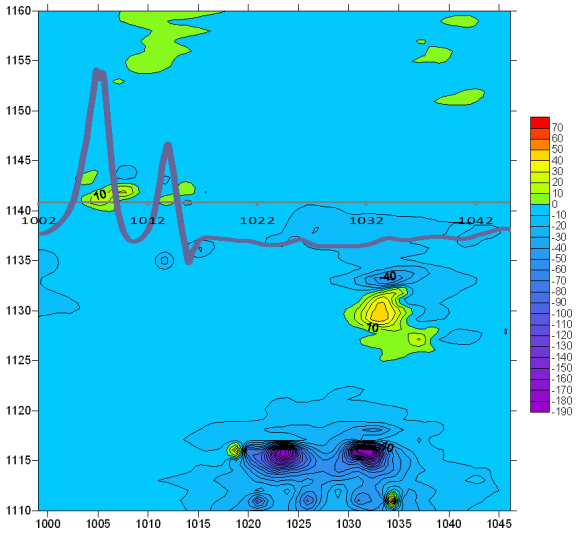

Figure 2: Magnetic contour map of the north 50 meters of the Podere Funghi with the profile of line 18. The two anomalies can be seen in both the profile and the map on the left side of the figure.

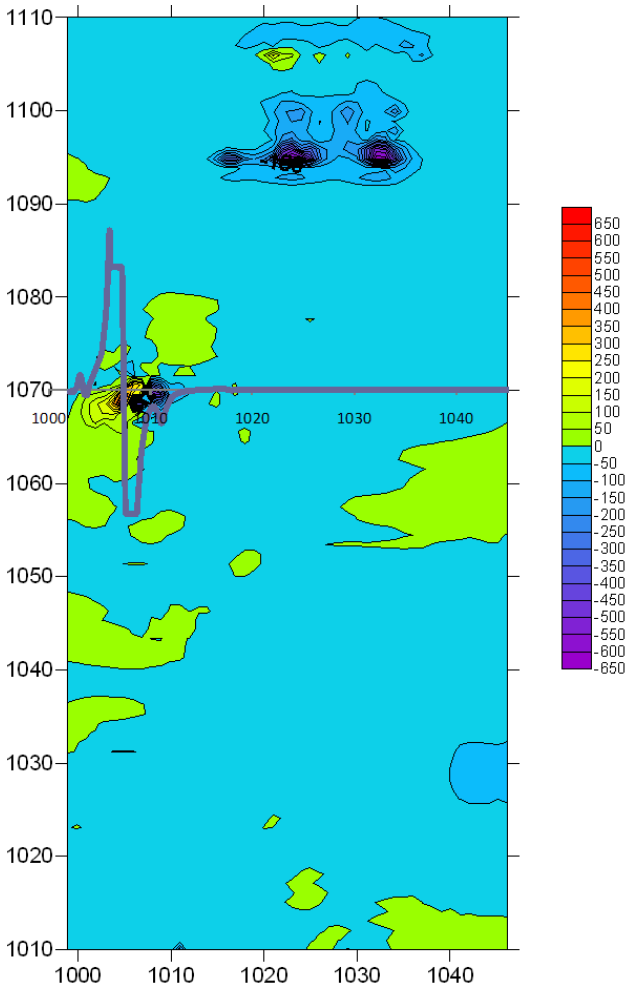

Figure 3: Magnetic contour map of the south 100 meters of the Podere Funghi with the profile of line 40. The large anomaly shown both in the profile and map is due to rebar.

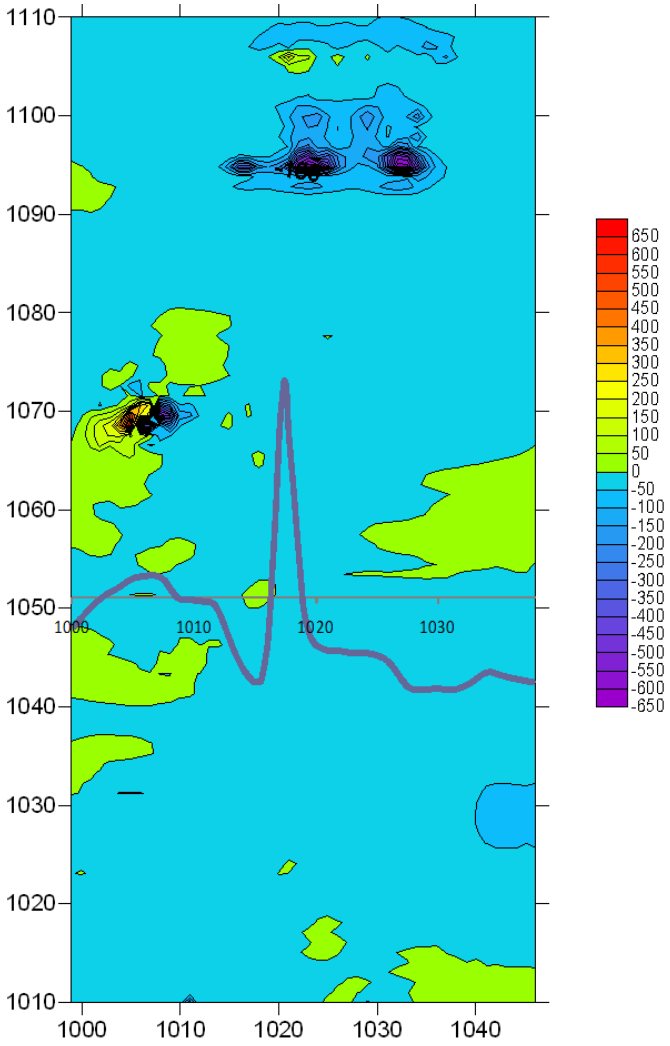

Figure 4: Magnetic contour map of the south 100 meters of the Podere Funghi with the profile of line 59. The dipolar anomaly show on the profile is not clearly evident in the contour map.

high amplitude dipole anomaly. This anomaly is due to a rebar stake that marks the location of midden. The large anomaly is indicative of ferrous metal (Pasquinucci et al, 1996). Anomaly D (Fig. 1) covers a large area and contains several strong anomalies. This is the location of a previously excavated trench. The uniformity of the anomalies in the area and the correlation of the location of the anomalies with the known boundaries of the former trench confirm the non-archaeological source of the anomalies (Gaffney and Gater, 2003).

Anomaly A (Fig. 1) is small enough that it may be of archaeological significance, especially when

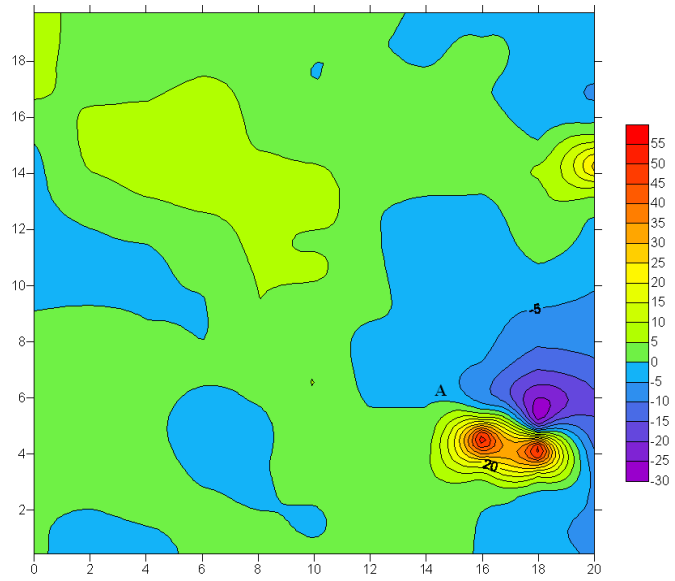

Figure 5: Magnetic contour map of the plateau below Poggio Colla. The very distinctive anomaly in the lower right-hand corner of the figure is of unknown origin.

compared to the size of anomaly C in Figure 1. Anomaly C is very large with sharp peaks and an amplitude of 1,400 nT that can be seen in its profile (Fig. 3) whereas anomaly A is much smaller with its largest peak only being 25 nT. Anomaly B (Fig. 1) is a dipolar anomaly with a high to the south and a low to the north, which is characteristic for the northern hemisphere (Breiner, 1973). Its small size of 50 nT and its location near the previously excavated trench where the site of known Etruscan ceramic production is located suggests that anomaly B may be of archaeological interest. The anomaly located in the field north of the Podere Funghi was ground-truthed during the 2008 field season. Because baked clay tends to be significantly more magnetic than surrounding soil, it produces a distinctive anomaly (Clark, 1990; Jordan, 2000). Excavation of the area of the anomaly did reveal a post-Etruscan kiln and confirmed the source of the anomaly found by Bradley's survey of the field during the 2007 field season (Bradley, 2007).

Anomaly A on the plateau below Poggio Colla (Fig. 5) is significant, however, at this time its source cannot be identified. It still remains to be ground-truthed, which could happen during the 2009 field season. The small anomaly in the field west of the Podere Funghi also remains to be ground-truthed. The survey in that field was disrupted by a property dispute with the landowner, which led to surveying of the field being discontinued.

CONCLUSION

The magnetometer surveys proved to be successful in locating magnetic features. Though the features were not always of interest archaeologically, some were, and new areas of interest were identified. Rebar proved to be very problematic during the course of this project and it is believed that the magnetic signals of some archaeological features in the Podere Funghi may appear suppressed due to the overwhelming size of the rebar anomalies. The point of plotting every profile walked was to located features that may be hidden by the rebar anomalies, which is shown in Figure 4 with an anomaly that does not seem to appear on the contour map.

Magnetometry proved to be successful in the field north of the Podere Funghi because of the discovery of a kiln, though not from antiquity. The survey of the field north of the Podere Funghi focused on the anomaly discovered by Bradley (2007) by using a smaller grid to produce a more detailed map of the anomaly. The kiln was excavated during this field season and was determined to likely be from the 19th century. The survey of the Podere Funghi this field season has produced a more complete and detailed map of the field (Fig. 1). The anomaly on the plateau below Poggio Colla may be of archaeological significance, but that will not be confirmed or disproved until it is ground-truthed. Further filtering of the magnetic data and additional comparison of the different methods used in this project may better identify areas of archaeological interest.

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