KECK GEOLOGY CONSORTIUM

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

April 2009
Franklin & Marshall College, Lancaster PA.

Dr. Andrew P. de Wet, Editor
Keck Geology Consortium Director
Franklin & Marshall College

Dr. Stan Mertzman
Symposium Convenor
Franklin & Marshall College

Kelly Erb
Keck Consortium Administrative Assistant

Diane Kadyk
Academic Department Coordinator
Department of Earth & Environment
Franklin & Marshall College

Keck Geology Consortium
Franklin & Marshall College
PO Box 3003, Lancaster PA 17604-3003
717 291-4132 keckgeology.org

ISSN # 1528-7491

The Consortium Colleges National Science Foundation
2008-2009 PROJECTS

THE BLACK LAKE SHEAR ZONE: A POSSIBLE TERRANE BOUNDARY IN THE ADIRONDACK LOWLANDS (GRENVILLE PROVINCE, NEW YORK)
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

PALEOECOLOGY & PALEOEENVIRONMENT OF EARLY TERTIARY ALASKAN FORESTS, MATANUSKA VALLEY, AL.
Faculty: DAVID SUNDERLIN: Lafayette College; CHRISTOPHER J. WILLIAMS: Franklin & Marshall College
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

SEAFLOOR VOLCANIC AND HYDROTHERMAL PROCESSES PRESERVED IN THE ABITIBI GREENSTONE BELT OF ONTARIO AND QUEBEC, CANADA
Faculty: DAVID DETHIER: Williams College and Williams-Mystic and NEIL R. BANERJEE, U. of Western Ontario
Students: LAUREN D. ANDERSON: Lehigh University; STEFANIE GUGOLZ: Beloit College; HENRY E. KERNAN: Williams College; ADRIENNE LOVE: Trinity University; KAREN TEKVERK: Haverford College

INTERDISCIPLINARY STUDIES IN THE CRITICAL ZONE, BOULDER CREEK CATCHMENT, FRONT RANGE, CO
Faculty: DAVID P. DETHIER: Williams College and MATTHIAS LEOPOLD: Technical University of Munich
Students: EYEV GANNAWAY: The U. of the South; KENNETH NELSON: Macalester College; MIGUEL RODRIGUEZ: Colgate University

GEOARCHAEOLOGY OF THE PODERE FUNGHI, MUGELLO VALLEY ARCHAEOLOGICAL PROJECT, ITALY
Faculty: ROB STERNBERG: Franklin & Marshall College and SARA BON-HARPER: Monticello Department of Archaeology
Students: AVERY R. COTA: Minnesota State University Moorhead, JANE DIDALEUSKY: Smith College; ROWAN HILL: Colorado College; ANNA PENDLEY: Washington and Lee University; MALIA SIPOLA: Carleton College; STACEY SOSENKO: Franklin and Marshall College

GEOLOGY OF THE HOH SERH RANGE, MONGOLIAN ALTAI
Faculty: NICHOLAS E. BADER and ROBERT J. CARSON: Whitman College; A. BAYASGALAN: Mongolian University of Science and Technology; KURT L. FRANKEL: Georgia Institute of Technology; KARL W. WEGMANN: North Carolina State University

BLOCK ISLAND, RI: A MICROCOSM FOR THE STUDY OF ANTHROPOGENIC & NATURAL ENVIRONMENTAL CHANGE
Faculty: JOHAN C. VAREKAMP: Wesleyan University and ELLEN THOMAS: Yale University & Wesleyan University
Students: ALANA BARTOLAI: Macalester College; EMMA KRAVET and CONOR VEEVEMAN: Wesleyan University; RACHEL NEURATH: Smith College; JESSICA SCHEICK: Bryn Mawr College; DAVID JAKIM: SUNY.

Funding Provided by: Keck Geology Consortium Member Institutions and NSF (NSF-REU: 0648782)
GEOARCHAEOLOGY OF THE PODERE FUNGHI, MUGELLO VALLEY ARCHAEOLOGICAL PROJECT, ITALY
Project Director: ROB STERNBERG: Franklin & Marshall College
Project Faculty: SARA BON-HARPER: Monticello Department of Archaeology

MAGNETIC SUSCEPTIBILITY INVESTIGATIONS OF THE PODERE FUNGHI, ITALY
AVERY R. COTA: Minnesota State University Moorhead
Research Advisor: Dr. Rinita Dalan

GEOCHEMICAL AND MINERALOGICAL COMPARISON BETWEEN CLAYS AND CERAMICS FROM THE ETRUSCAN ARCHAEOLOGICAL SITES OF POGGIO COLLÀ AND PODERE FUNGHI, TUSCANY, ITALY
JANE DIDALEUSKY: Smith College
Research Advisors: Bosiljka Glumac and Robert Newton

PHOSPHORUS ANALYSIS OF THE PODERE FUNGHI
ROWAN HILL: Colorado College
Research Advisor: Paul Myrow

ARTIFACT DISTRIBUTION AND GEOARCHAEOLOGICAL INVESTIGATION OF THE PODERE FUNGHI
ANNA PENDLEY: Washington and Lee University
Research Advisors: Dr. Sara Bon-Harper, Dr. David Harbor, and Dr. Robert Sternberg

GEOMORPHIC AND ANTHROPOGENIC IMPACTS ON ARTIFACT DISTRIBUTION WITHIN THE PLOWZONE IN THE PODERE FUNGHI, TUSCANY, ITALY
MAIJA SIPOLA: Carleton College
Research Advisor: Mary Savina, Carleton College

MAGNETOMETRY IN THE PODERE FUNGHI AT THE ETRUSCAN ARCHAEOLOGICAL SITE OF POGGIO COLLÀ
STACEY SOSENKO: Franklin and Marshall College
Research Advisor: Rob Sternberg

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

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
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...
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.

**ACKNOWLEDGEMENTS**

I would like to thank Rob Sternberg and Sara Bon-Harper for their wonderful work as the Keck project directors, and the Poggio Colla Field School for logistical support. Many thanks to Avery Cota, Anna Pendley, Maija Sipola, Jane Didaleusky and
Rowan Hill for their help in the field. I owe a special thank you to Franklin and Marshall College for additional funding with the Leser Scholars Grant. Finally, I would like to thank Rob Sternberg again for his excellent guidance over the year as my advisor on this project.

REFERENCES


