

Summer Undergraduate Research Fellowship (SURF) Proposal

A Ground Penetrating Radar Survey of the Unexcavated 24BE2206 Site near Dewey, in the Big Hole Valley of Montana

Submitted by Michael Masters, Marvin Speece, Andrew Wilson (student), and Jacob Clarke (student)

Introduction

Typically archaeology is a destructive process, in which sites are excavated and materials are removed in order to learn about what lies beneath the ground surface. And while this common method of subsurface excavation can reveal a great deal about the cultural history of a region, and provide important information about population size, structure, social and political organization, site usage and occupation, etc., it is an inherently destructive process, is only able to focus on a limited area at one time, and progress in excavating cultural remains is often relatively slow. Geophysical techniques on the other hand, are relatively nondestructive because physical measurements are made at the ground surface to form images of the subsurface artifacts and features. Furthermore, geophysical surveys can be completed more quickly and applied over a much wider area compared with traditional subsurface archaeological excavation methods.

Geophysics can be extremely useful at archaeological sites when excavation is prevented either by buildings over the sites, or when religious considerations prevent digging. When geophysical surveys precede excavation, they can save time and money by helping to guide subsequent digging. One of the most valuable tools for geophysical prospecting at archaeological sites is Ground Penetrating Radar (GPR) [1]-[12]). Because of the utility of GPR to aid an archaeological survey – and particularly at early-stage sites where little is known about the size and past usage of an area – this SURF proposal requests funding for two undergraduate student researchers to conduct a three-dimensional (3-D) GPR survey at the unexcavated 24BE2206 site near Dewey, Montana, to locate anomalies in the shallow subsurface.

Based on visible surface features, these anomalies are likely to reveal subsurface cooking hearths, which are food processing sites where additional artifacts and tools are often recovered. Additionally, a broad-based GPR survey of the site and surrounding area could potentially help answer questions regarding whether a series of unconventional flat rocks were intentionally “transported” to this site by Native Americans, as suggested by a soil scientist and archaeologist at the Montana Bureau of Land Management. These odd stones, and certain areas with a high concentration of Native American artifact and features, were documented as part of a brief pedestrian surveys of this site carried out by Dr. Masters and Carrie Kiely, an archaeologist at the Montana Bureau of Land Management Butte Field Office.

These efforts revealed that this area of the Big Hole Valley sustained use by Native Americans, however, what the site was used for and when it was occupied remains a mystery. A GPR survey of this site and surrounding area – in conjunction with an archaeological field school offered through Montana Tech and directed by Dr. Masters, in which a subsurface excavation is planned to take place in early June – will help elucidate far more about the culture history of this previously unexcavated site, along what was almost certainly a major thoroughfare through, and an ideal habitation site between Mount Fleecer and the Pioneer Mountains of Southwest Montana.

Ground Penetrating Radar

In practice, transmitting and receiving antennas (1 MHz- 1 GHz) are moved along the ground surface to make GPR measurements. At a particular position along the surface, the transmitter emits an electromagnetic wave into the ground. When this wave encounters a boundary between materials of differing electrical properties, some of the incident wave energy is reflected back to the surface. The energy returning to the surface is, in turn, recorded at the receiving antenna. The information recorded at one ground position is called a trace and reflected energy on the trace is observed as an increase in the signal amplitude that occurs at a particular time along the trace. As the GPR system is moved along the ground surface, traces are recorded at regular intervals. When these traces are displayed side-by-side as a cross

In addition to these artifacts, a number of surface features were also apparent, which included numerous rings of fire-cracked rocks associated with ancient cooking hearths used to prepare food, which could easily be seen eroding out of the banks of a forest service road (Figure 3). Additionally, some presumably non-native rocks that are hypothesized to have been transported to this site were also observed as described above (Figure 4).

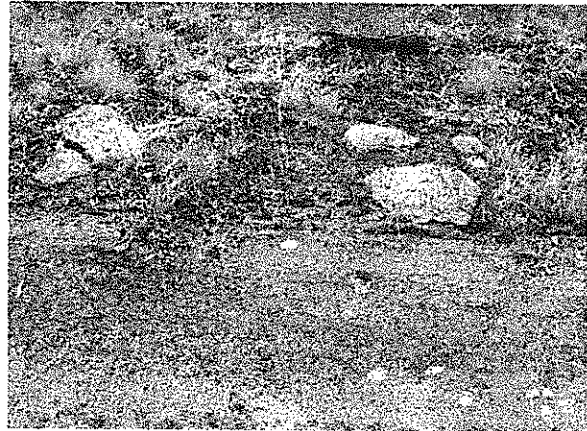


Figure 3. Ring of fire-cracked rocks forming an ancient hearth. Figure 4. Possibly transported rocks near forest service road.

This proposed GPR survey will primarily be carried out in the flatter and less wooded areas of the site where the largest concentration of artifacts and features were observed during the aforementioned pedestrian survey (Figure 5). Together, this GPR research, the archaeological field school excavation, and a proposed 3-D Plane Survey of the site and artifacts/features recovered from it as part of a separate proposed SURF project to be carried out in collaboration with the Mining Engineering Department at Montana Tech, has the potential to reveal a great deal about the Native American cultural prehistory at this unexcavated site, and of this broader area within the Big Hole Valley of Southwest Montana.

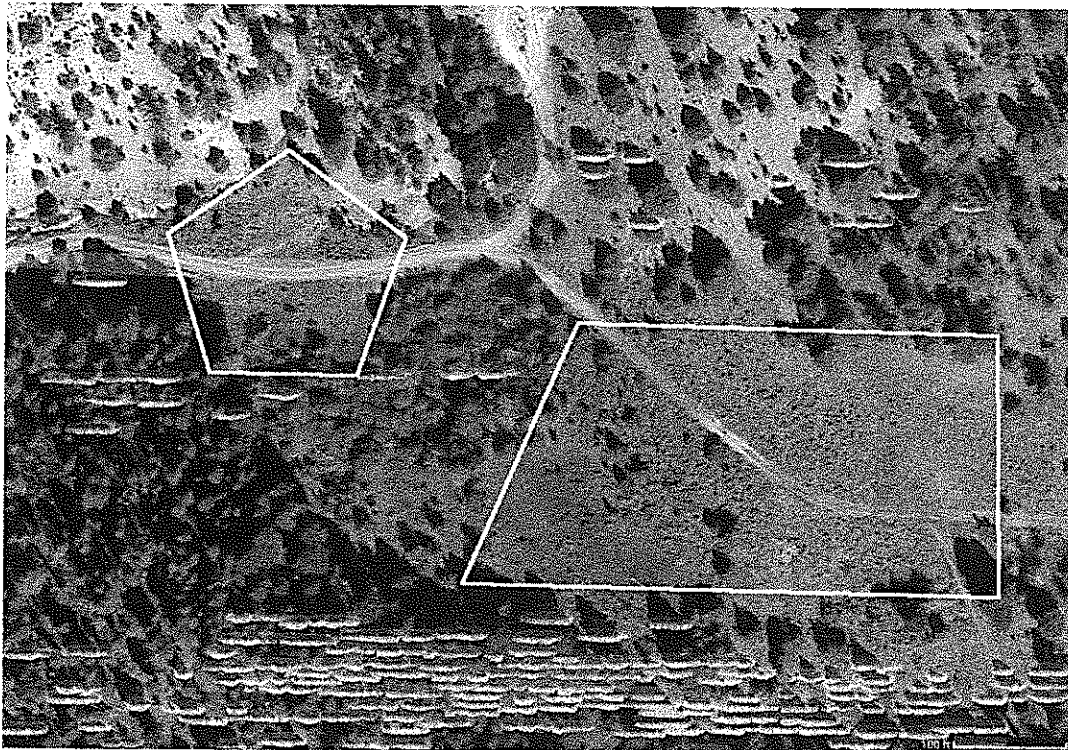


Figure 5. Principal areas at the 24BE2206 Site to focus on as part of the proposed Ground Penetrating Radar survey

Biographical Sketches

Dr. Michael Masters

Dr. Masters is currently an Associate Professor of Anthropology at Montana Tech, and has been working at the university for eight years. He has an active research program and collaborates with prominent researchers and research institutions in California, Wisconsin, Japan, Portugal, and Spain. Dr. Masters has mentored and advised numerous students at Montana Tech as external grant-funded undergraduate research assistants, and as part of the URP and SURF programs, conducting anthropological, sociological, and biomedical research. These studies have resulted in numerous journal articles and presentations at both national and international conferences, which were co-authored with undergraduate researchers working in his lab.

Dr. Masters also has ample archaeological experience, having worked at a 3.5 million-year-old site at Makapansgat Cave in South Africa for two separate field seasons, a 150,000-year-old Neanderthal cave site in Southwestern France, numerous Native American sites in the Midwestern United States, and he has been Co-Director of an archaeological field school at a 5,000-year-old bison butcher-kill / habitation site in Southwest Montana for three field seasons. In addition to educating students in excavation methods and Montana prehistory, the dig also welcomed numerous volunteers from Butte and the surrounding community, who participated in the dig in order to learn more about Native American prehistory in Southwest Montana.

Dr. Marvin Speece

Dr. Speece is currently a Professor of Geophysical Engineering at Montana Tech and Department Head of the Geophysical Engineering Department. He has taught 25 different courses at Montana Tech: many in applied geophysics. He maintains an active research program in controlled-source seismology and in engineering and environmental geophysics. His recent research touches on the subjects of climate, glaciers and tectonics. His research in Antarctica was featured in a NOVA special: *Secrets beneath the Ice*. He has generated approximately \$3.5 million in external funding and published 37 journal articles or book chapters and 14 refereed proceedings papers. He has published several papers on the use of geophysics for archaeological investigations [13]-[16]. In 2002-2003, during a Fulbright sponsored visit to Egypt, Dr. Speece conducted GPR and seismic surveys at numerous archaeological sites including near the pyramids at Giza and the Sphinx. Results from his research at Saqqara, Egypt, show manmade subsurface features near Djoser's Step Pyramid [16]. Dr. Speece has mentored seven students as part of the Montana Tech Undergraduate Research Program (URP). This URP research has produced two journal articles and two proceedings papers.

Jacob Clarke

Jacob Clarke is currently a second year student pursuing a Geophysical Engineering degree at Montana Tech. He is a Dean's list, student athlete who has received an academic All-Conference award. He has spent time working with AutoCAD and surveying projects using total stations. Clarke is hoping that this project will help guide him in the direction of his educational progress by using geophysical equipment in a research environment.

Andrew Wilson

Andrew Wilson is currently an undergraduate student enrolled in the Geophysical Engineering Department at Montana Tech. He is a member of Montana Techs Geology Club, Society of Exploration Geophysicists, and Tau Beta Pi Engineer Honor society. He is also an active member in the community, currently volunteering at the Butte Rescue Mission Center. The coursework at Montana Tech has provided Andrew Wilson with a background in Ground Probing Radar and surveying. Recipient of the George A. Cloudy Award, this is his first application to conduct an undergraduate research project.



United States Department of the Interior



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In Reply Refer To:
8110 (MTB070)

Montana Tech Undergraduate Research Committee
Montana Tech
1300 W Park St.
Butte, MT 59701

Dear Members of the Board:

The Bureau of Land Management's Butte Field Office is pleased to support Montana Tech's Summer 2017 archeological field school at Dewey, MT. We look forward to working with specialists in archeology, cartography and ground-penetrating radar equipment.

If you have any questions or comments, please contact our archeologist Carrie Kiely by phone at 406-533-7624, or email: ckiely@blm.gov

Sincerely,

Scott Haight
Field Manager