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# Community prospection: archaeological ground-penetrating radar analyses performed for and by the Healy Lake Village community, Interior Alaska

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## INTRODUCTION

In 2014, a ground penetrating radar (GPR) survey was conducted in the Healy Lake Village of Interior Alaska, a location that has played a pivotal role in shaping concepts in interior Alaskan archaeology and with an extensive record of North American human occupation (Cook 1969; 1996; Holmes 2001; Potter 2008). Prior to beginning field data collection, an open dialog was established in order to provide the community with an opportunity to become more familiar with the operation of GPR technologies, field data collection methodology, post-processing training, and interpretation on questions individuals had about the archaeology in their village.

From these initial conversations a threefold research approach was established and conducted the aim being: (1) to determine whether GPR technologies can record radar imagery of potential archaeologi-cally-related anomalies from underwater contexts in Healy Lake, which is a seasonally freezing lake consisting of lacustrine and alluvial deposits ranging from 1 m to a known 3 m depth, (2) to establish the placement of unmarked graves based on ethnographic data, as well as detect marked graves accurately in signal reducing media, such as the local Fairbanks schist bedrock; and (3) to detect other anomalies in loess that could be associated with unexcavated areas near the Old Village Site, which was the first site to be excavated regularly in the interior of Alaska. During the examination favorable results were reached for all three approaches.

## METHODOLOGY

In order to gather data appropriately, collection protocols had to be tailored to each research approach independently. As a result slight differences exist in the data collection procedures for each survey location. Device settings reported in Table 1 describe overall GPR protocols and settings for each research location.

GPR data collected during these examinations came from four locations: Healy Lake itself, the Upper and Lower Cemeteries, and the Old Healy Lake Village Site (Fig. 1). Data collected in order to assess the potential for underwater prehistoric archaeological material in Healy Lake was conducted in the center of the lake as a preliminary test in order to determine, if vegetation levels, ice, water, and sediments at Healy Lake presented an acceptable candidate for further underwater research. In order to collect data on the quantity and placement of burials, as well as loss of signal

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Table 1. Device settings for Healy Lake surveys

| Survey location | Antenna (mHZ) | Recording method | Dielectric constant | Scans/ meter | Gain points |
|---|---|---|---|---|---|
| Healy lake Bathymetric Analysis | 200 | Distance | 3 | 30 | 5 (-14, -14, 27, 36, 36) |
| Ethnohistoric Grave Location and Bedrock Signal Loss (Lower Cemetery) | 400 | Distance | 5.3 | 50 | 3 (-20, 36, 52 [corrected to match the Upper Cemetery]) |
| Ethnohistoric Grave Location and Bedrock Signal Loss (Upper Cemetery) | 400 | Time | 5.3 | N/A | 3 (-20, 36, 52) |
| Old Healy Lake Village Site | 400 | Distance | 5.3 | 50 | 3 (-20, 38, 55) |

from within the local bedrock, two locations were selected for evaluation. These two locations, referred to as the Lower and Upper Cemeteries, are relatively close to one another, but separated by a great deal of elevation. The Lower Cemetery lacks standing fences and superficial/surface grave features. For this area, data was collected using a survey wheel attachment and a distance setting in a grid pattern to maximize our potential for locating unmarked grave-related anomalies. Alternatively, within the Upper Cemetery, where grave fences and monuments were still standing and present for all graves, a timed pulse setting was necessary to gather data. As a result, a distance test had to be conducted at the Upper Cemetery in order to determine accurately, which signal of the time-collected data represented a given burial. Gain points were corrected between cemeteries to ensure comparability of received signals.

At the Old Healy Lake Village Site, the northeast portion of the site was selected for survey. This approach was taken because this part of the site constituted one of the only locations where earlier archaeological testing had not disturbed the natural stratigraphy. Grid data were collected utilizing a one meter interval and a directionally alternating pattern in order to be combined into a plan view map of anomalies located within the survey grid area.

All data collected during these examinations were processed primarily using Radan 7 GSSI software. For plan view mapping Golden Software's Surfer 10 and Voxler 3 were used to generate spatial maps. ESRI ArcGIS 10.2 was then used to generate point locations for discovered anomalies and to provide a spatial context with regard to areas outside the current GPR survey boundary.

## RESULTS

Preliminary data gathered on the potential for locating paleo-shore lines of Healy Lake, as well as underwater prehistoric archaeological material, showed the approach to be successful. During our examination we were able to differentiate easily the locations of all aspects of the lake surface and bottom, including the depth of surface snow and ice, water, the presence of lake bottom, and

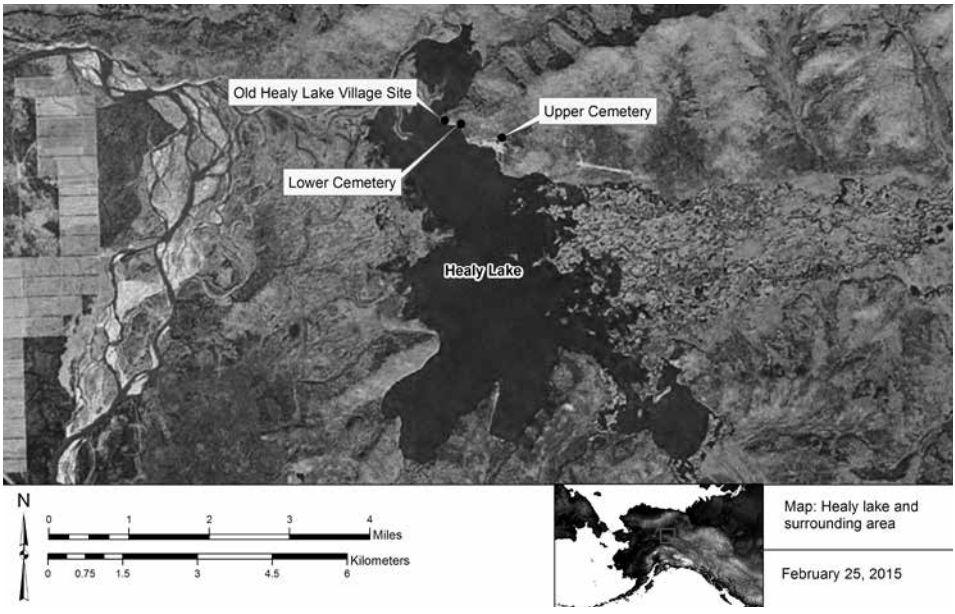


Fig. 1. Healy Lake and surrounding terrain, survey locations represented by black points

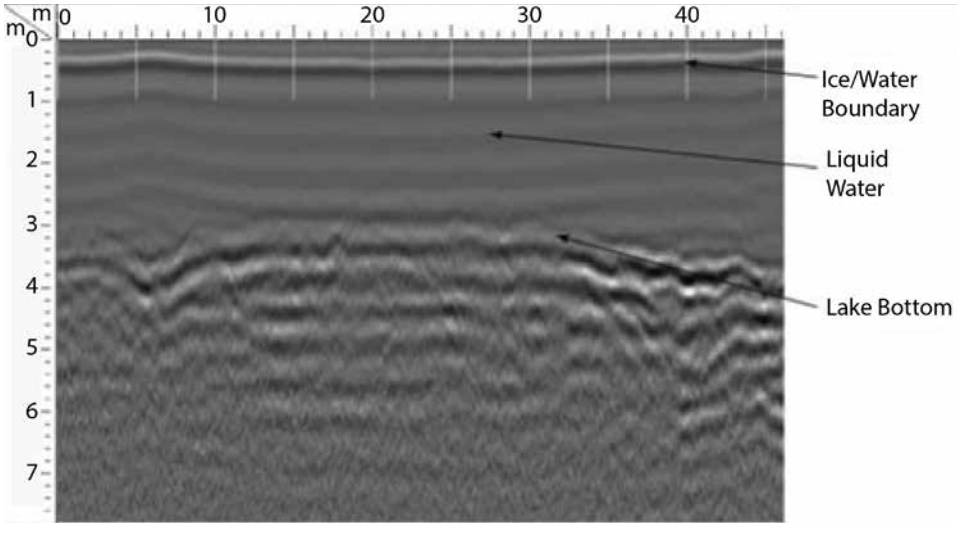


Fig.2. GPR reflection profile of Healy Lake, 200 mHZ antenna

potentially related vegetation (Fig. 2). This leads us to believe that Healy Lake will be a good candidate for upcoming GPR surveys, attempting to locate underwater cultural materials and paleo-shorelines.

During our examination of the Lower Cemetery potential unmarked burial locations were confirmed. Unmarked grave-related anomalies were located at the edges of the Lower Cemetery and may have been added without markers, or markers may have disintegrated or had been removed over time. During our examination of the Upper Cemetery signals associated with burial directly in the upper layers of the local bedrock displayed approximately 36% signal loss proportionally when compared to marked burials located at the Lower Cemetery buried in aeolian silt (Fig. 3).

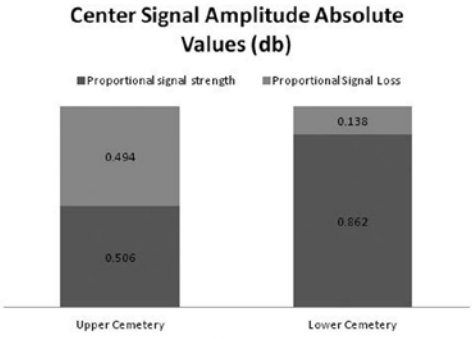


Fig. 3. Proportional differences in electromagnetic signal amplitude (in decibels) between the Upper and Lower Cemeteries

Examination of the Healy Lake Village Site revealed more than 20 anomalies associated with cultural remains ranging in age from the end of the Pleistocene into the historic period. As this examination was performed to provide preliminary data for potential future testing endeavors, a more detailed electromagnetic survey will need to be undertaken in order to make detailed statements about individual anomaly interpretations at this survey location.

## CONCLUSIONS

Throughout the course of our investigation, positive results were achieved for each of our three research questions. A preliminary analysis of the potential for locating underwater cultural materials and paleo-shorelines for Healy Lake was established. Regarding the placement of marked and unmarked graves in the Lower Cemetery, GPR survey results suggest that larger numbers of burials exist within the cemetery boundary than indicated by surface markers, depressions, and features. This data helped to confirm information provided by local residents and the ethnographic record that more people were likely buried at this location than displayed currently. Together with the presented data from the Lower Cemetery, this research was able to determine that the local bedrock does act as a significant signal reducer. Burial features placed in this medium (coffins dug into and placed in the bedrock) at the Upper Cemetery displayed approximately 36% more signal loss when compared proportionally to burial signals from coffins located in aeolian silts in the Lower Cemetery. More than twenty anomalies were located on the Old Healy Lake Village Site, corresponding to archaeological material ranging in temporality from the end of the Pleistocene to Euro-American contact. Based on these conclusions, continued work will be performed in the Healy Lake village to assess these questions in more detail as well as to refine datasets presented here, and continue to answer questions asked by the residents of Healy Lake and train them in the operation, methodology, and interpretation of geophysical equipment.

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