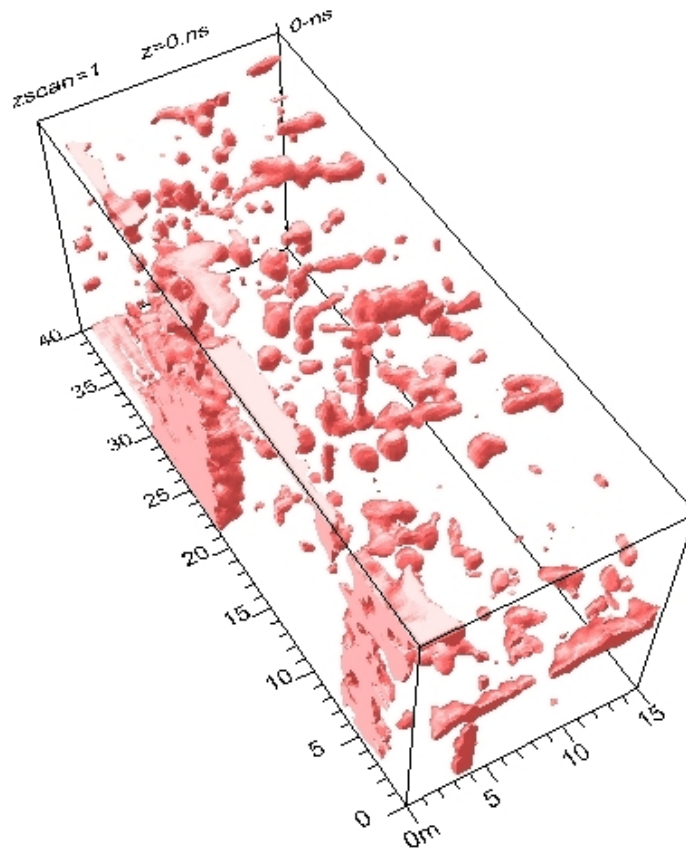


GPR Survey at Gascoigne Bluff, St. Simons Island, Georgia



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Report Number 165*

**The LAMAR Institute
Savannah, Georgia
2010**

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Introduction

This report presents the findings of a Ground Penetrating Radar (GPR) survey by the LAMAR Institute on a portion of Gascoigne Bluff on St. Simons Island, Glynn County, Georgia. This project was performed on October 16, 2010 in conjunction with the Fall meeting of the Society for Georgia Archaeology. The project had the combined purposes of a public demonstration project and a research project. The public was allowed to participate in the data collection and was informed of the employed non-destructive remote-sensing technology and preliminary findings. Data collected by the project was post-processed to create a series of maps that reveal the subsurface characteristics of the study site. Permission to conduct the project was granted by the property owners, Cassina Garden Club, who also assisted in the study site selection and survey preparation. This GPR survey examines only a small portion of Gascoigne Bluff but it demonstrates the potential utility of this technique for mapping buried cultural resources in this environment.

The project area consisted of a 40 meter north-south by 15 m east-west area that was situated just east of a picket fence that encloses the two tabby dwellings and yard garden, which are maintained by the Cassina Garden Club (Figure 1). The area selected for the GPR survey was a grassy area with a minor amount of shrubbery and one small hardwood tree. A tabby and cement walkway covered a minor portion of the sample block along its western edge. The topography of the sample block was nearly level, although some gentle relief was discerned.

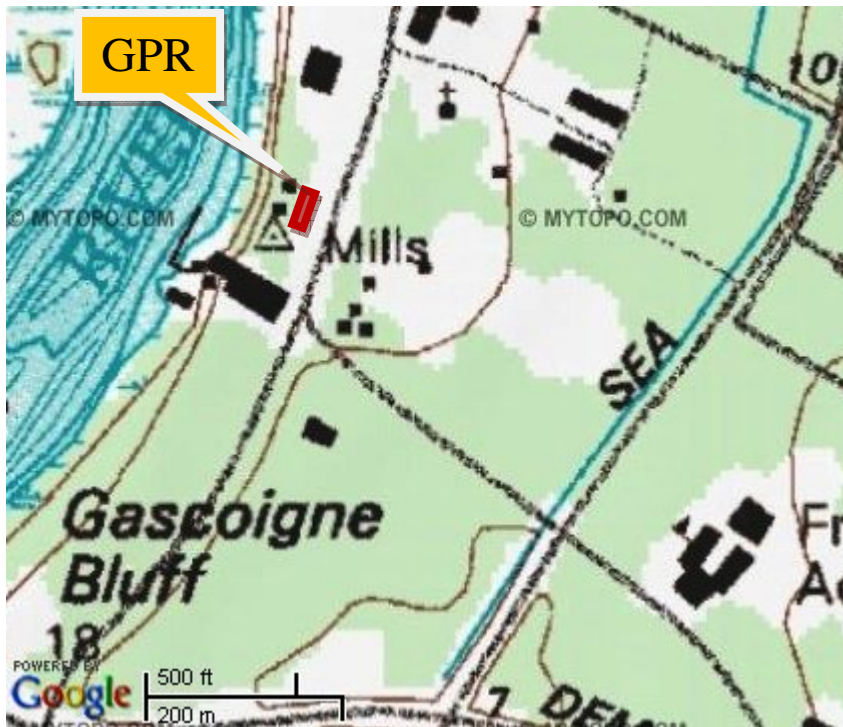


Figure 1. Project Location with General Location of GPR Survey Indicated.

Gascoigne Bluff derives its place name from Captain James Gascoigne who was associated with the property in the Trustee era. The bluff was used to store naval supplies for the fledgling Georgia government. Gascoigne received a land grant for 500 acres, where he built, “a convenient house” and other buildings on his plantation (Cate 1963:1).

Following the American Revolution the plantation at Gascoigne Bluff was owned by Alexander Bissett, and later by Richard Leake. James Hamilton established the plantation at Gascoigne Bluff after 1792. The property was associated prior to that by the Couper family. In 1857 the property was purchased by James Hamilton Couper. In 1874 the Hamilton plantation was purchased by Dodge Meigs and it was owned by the Hilton Dodge Company until 1896. Lumber mills were active at Gascoigne Bluff during this era. In 1936 the property was owned by Eugene Lewis, a northern industrialist. The two tabby dwellings are the only visible traces of the enslaved quarter (Cate 1930:132; 1963:1-18; Cooney 1933:380; NPS 1936; Huie and Wilcox 1991).

Hamilton plantation and its operations were described in great detail in an 1833 agricultural journal by the journal’s editor, John D. LeGare. That description was based on Legare’s 1832 visit to the plantation. He included the following paragraph about the enslaved housing, which is most insightful:

We were much pleased with the construction and arrangement of the negro houses, they are built on parallel rows, facing each other, and extending some distance, forming a wide avenue or street, which if we recollect aright, is planted throughout with trees. In the rear of the houses are the small gardens and hen houses of the occupants. The whole is situated near to the river, which at this spot, washes the island without there being any intervening marsh. The old buildings are of wood, but all of those recently erected, are of tabby, which adds much to the neatness of appearance, and to the comfort of the inmates. They are constructed by the plantation hands at leisure times, with but little expense of either time or labour; and when we consider the facility and ease with which they are built, we only wonder that, as the process has been known in the Southern States for nearly a century, every house on the sea-board has not been constructed of it. In the old town of Frederica, several of the houses were built of tabby, and the walls of many of them are still erect and in tolerable good preservation. So good were these walls found to be, that in erecting the light-house at the south-end of St. Simons, they were cut into blocks and used for that purpose. The whole building, we believe, is constructed of materials obtained from these walls (LeGare 1833:167).

The Cassina Garden Club was formed in 1928. The property containing the two tabby buildings was deeded to the Cassina Garden Club by the Glynn County government in the 20th century. In 1932 the garden club took as its mission the preservation of the two tabby dwellings, which were formerly part of the Hamilton plantation (Cassina Garden Club 2010). A photograph of one of the tabby dwellings on the Hamilton plantation was taken by the Historic American Buildings Survey team of the National Park Service in 1936 (Figure 2). The date of construction for the photographed dwelling tentatively can be bracketed at 1796-1811 based on information gathered by HABS historians. The two tabby buildings were listed in the National Register of Historic Places (NRHP) in 1988. The period of significance for the historic property was listed as 1825-1874 in the NRHP nomination.



Figure 2. Tabby Dwelling, Hamilton Plantation (NPS 1933).

Archaeological exploration at Gascoigne Bluff has been limited. Some exploration of the area was conducted in the 1930s by WPA archaeologist Preston Holder. Holder's work was never properly reported. Archaeologist Steven Hale conducted some excavations at Gascoigne Bluff with Georgia Southern University students in the early 1990s, which also remain unreported. Hale's excavations were located north and west of the area examined by the present GPR survey.

Relic collectors operate with impunity on St. Simons Island, often committing criminal trespass. Their activities typically include some excavation. For example, a 2007 posting on the internet contained this diary entry by a relic digger,

The first stop on yesterday's tour was Gascoigne Bluff on St. Simons Island. As you can see from the historical marker (now itself 51 years old), Gascoigne is a very historical place. On the upper end of the bluff, near the Hamilton Plantation slave cabins, I used to hunt regularly, and dug many relics from the plantation era there. However, in the last year or so, the garden club ladies who oversee the place are not as comfortable with detectorists around, so it is now all but closed to us. For a long time, I had exclusive permission there. So now I am left with the much larger lower bluff, which is not as hot with plantation-era relics, though there are bound to still be some. I had only halfheartedly hunted the lower bluff in the past, since it is liberally strewn with pulltabs and modern trash. But it is a big area, and it's a county park (RWS 2007).

Methods

Ground Penetrating Radar, or GPR, is an important remote sensing tool used by archaeologists (Conyers and Goodman 1997; Conyers 2004). The technology uses high frequency electromagnetic waves (microwaves) to acquire subsurface data. The device uses a transmitter antenna and closely spaced receiver antenna to detect changes in electromagnetic properties beneath them. The antennas are suspended just above the ground surface and are shielded to eliminate interference from sources other than directly beneath the device. The transmitting antenna emits a series of electromagnetic waves, which are distorted by differences in soil conductivity, dielectric permittivity, and magnetic permeability. The receiving antenna records the reflected waves for a specified length of time (in nanoseconds, or ns). The approximate depth of an object can be estimated with GPR, by adjusting for electromagnetic propagation conditions.

The GPR sample block in this study area was composed of a series of parallel radargrams (transects or traverses). Each radargram yielded two-dimensional cross-section or profile of the radar data. This two-dimensional image is constructed from a sequence of thousands of individual radar traces. A succession of radar traces bouncing off a large buried object will produce a hyperbola, when viewed graphically in profile. Multiple large objects that are in close proximity may produce multiple, overlapping hyperbolas, which are more difficult to interpret. For example, an isolated historic grave may produce a clear signal, represented by a well-defined hyperbola. A cluster of graves, however, may produce a more garbled signal that is less apparent.

The GPR signals that are captured by the receiving antenna are recorded as an array of numerals, which can be converted to gray scale (or color) pixel values. The radargrams are essentially a vertical map of the radar reflection off objects and other soil anomalies. It is not an actual map of the objects. The radargram is produced in real time and is viewable on a computer monitor, mounted on the GPR cart.

GPR has been successfully used for archaeological and forensic anthropological applications to locate relatively shallow features, although the technique also can probe deeply into the ground. The machine is adjusted to best probe to the depth of interest by the use of different frequency range antennas. Higher frequency antennas are more useful at shallow depths, which is most often the case in archaeology. Also, the longer the receiving antenna is set to receive GPR signals (measured in nanoseconds, or ns), the deeper the search. The effectiveness of GPR in various environments on the North American continent is widely variable and depends on solid conductivity, metallic content, and other pedo-chemical factors. Generally, Georgia's coastal soils have moderately good properties for its application.

GPR signals cannot penetrate large metal objects and the signals are also significantly affected by the presence of salt water. Although radar does not penetrate metal objects, it does generate a distinctive signal that is usually recognizable, particularly for larger metal objects, such as a cast iron cannon or man-hole cover. The signal beneath these objects is

often canceled out, which results in a pattern of horizontal lines on the radargram. For smaller objects, such as a scatter of nails, the signal may ricochet from the objects and produce a confusing signal. Rebar-reinforced concrete, as another example, generates an unmistakable radar pattern of rippled lines on the radargram.

Using the same RAMAC X3M GPR system as that used in the present study, Elliott has conducted several GPR studies of 18th and 19th century archaeological sites in coastal Georgia. The same equipment has been used successfully for GPR surveys on seven of Georgia's barrier islands, including Cumberland, Jekyll, Ossabaw, Sapelo, St. Catherines, St. Simons, and Tybee islands (Elliott 2005, 2006, 2007, 2008, 2009a-b, 2010; Elliott and Burns 2007).

The equipment used for this study consisted of a RAMAC/X3M Integrated Radar Control Unit, mounted on a wheeled-cart and linked to a RAMAC XV11 Monitor (Firmware, Version 3.2.36). A 500 megahertz (MHz) shielded antenna was used for the data gathering. MALÅ GeoScience's *Ground Vision* (Version 1.4.5) software was used to acquire and record the radar data (MALÅ GeoScience USA 2006a). The radar information was displayed as a series of radargrams. Output from the survey was first viewed using *GroundVision*. This provided immediate feedback about the suitability of GPR survey in the area and the effective operation of the equipment.

The time window that was selected allowed data gathering to focus on the upper 2 meters (6.56 feet) of soil, which was the zone most likely to yield archaeological deposits. Additional filters were used to refine the radar information during post-processing. These include adjustments to the gain. These alterations to the data are reversible, however, and do not affect the original data that was collected. This same combination of GPR equipment and radar imaging software was used previously in coastal Georgia with very satisfactory results.

Upon arrival at the site, the RAMAC X3M Radar Unit was set up for the operation and calibrated. Several trial runs were made on parts of the site to test the machine's effectiveness in the site's soils. Machinery settings and other pertinent logistical attributes included the following:

Machine Settings

Time Window: 87.5 ns

Number of Stacks: 4

Number of Samples: 632

Sampling Frequency: 7,462 MHz

Antenna: 500 MHz shielded

Antenna Separation: 0.18 m

Trigger: 0.04 m

Radargram orientation: Southwest to Northeast

Radargram progress: Northwest to Southeast

Radargram Spacing: 50 cm

Total Radargrams: 31; comprising 1,219.3 m total length

Dimensions: 40 m Northeast-Southwest x 15 m Southeast-Northwest

The GPR block consisted of 31 radargrams, which covered a total of 1.2 km of GPR data, or 600 m². A picket fence formed the northwestern boundary of the GPR block. The 0m, 0m point for the GPR block was positioned approximately 50 cm southeast of the corner of the picket fence. Dense shrubbery prohibited a complete collection of the first two radargrams from about 29.7-40 meters. Radargram 1 crossed a tabby and cement sidewalk from 27.7-29.5 meters. The other 29 radargrams measured 40 meters in length. Otherwise no obstacles were encountered to prohibit the survey. The grid arrangement of these radargrams is shown in Figure 3. Figure 4 shows the survey in progress.

GPR data from the survey was collected in the field and returned to Elliott's laboratory for post-processing. The GPR data from the present study was processed with *GPR-Slice* (Version 7.0). Goodman's *GPR-Slice* program is recognized as the world leader in GPR imaging (Goodman 2006, 2010). Mapping in 3D entailed merging the data from the series of radargrams for each block. Once this was accomplished, horizontal slices of the data were examined for important anomalies and patterns of anomalies, which had cultural relevance. These data were displayed as aerial plan maps of the sample areas at varying depths below ground surface. These horizontal views, or time-slices, display the radar information at a set time depth in nanoseconds (ns). Time-depth can be roughly equated to depth below ground. This equivalency relationship can be calculated using a mathematical formula.

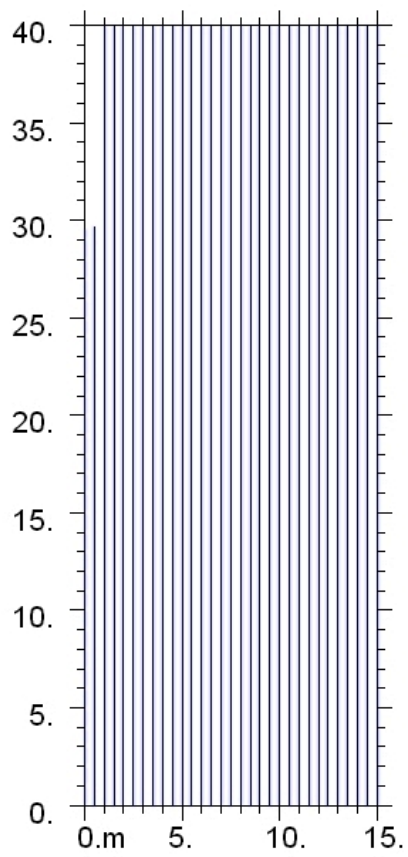


Figure 3. Radargram Plan Map, Gascoigne Bluff.



Figure 4. GPR Survey at Gascoigne Bluff in Progress.

Results

GPR survey of a portion of Gascoigne Bluff on St. Simons Island was completed on October 16, 2010. This project was a joint public outreach and research effort by the LAMAR Institute, the Society for Georgia Archaeology and the Cassina Garden Club.

A total of 31 radargrams was collected by the survey from a grid measuring 40 meters northeast-southwest by 15 meters northwest-southeast. An example of a radargram is shown in Figure 5. In this view are numerous hyperbolic shapes, which are strong radar reflections. Many of these reflections may have cultural significance. These occur from about 40-60 cm below ground.

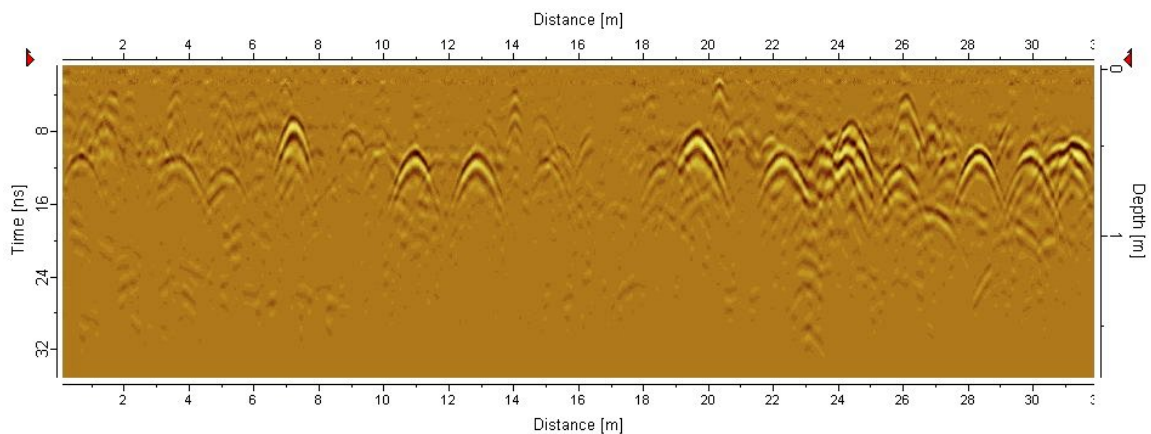


Figure 5. Example of a Radargram (Radargram 15, 0-32 m), Gascoigne Bluff.

It is useful to examine GPR data in plan view, termed “time slices”. One example of a GPR plan view from the upper soil strata (13-17 ns) is shown in Figure 6. In this view a series of linear radar reflections are visible.

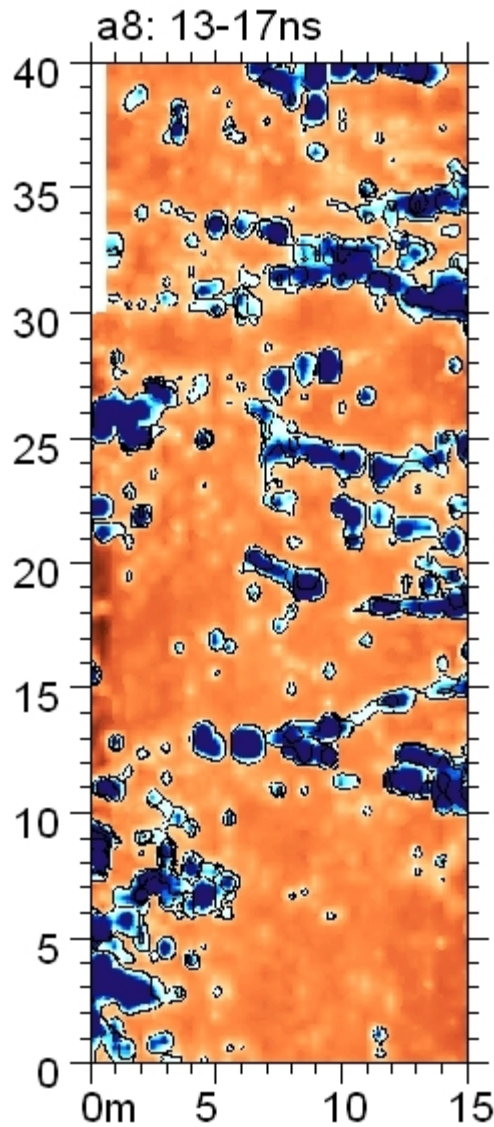


Figure 6. Example of GPR Plan View, 13-17 ns Timedepth, Gascoigne Bluff.

Overlay analysis of GPR time-slice data is another useful method for viewing the data. For this method GPR information from several depths are combined to create a composite plan view. Two examples are shown in Figures 7 and 8. Figure 7 is an example of a GPR overlay view from 27-31 ns. Figure 8 is an example of a GPR overlay view from 37-40 ns. Figures 9 and 10 show the relative position of the GPR plan maps on an aerial view of the study site. Iso-view feature of GPR-Slice software provides another useful way for imaging GPR data. An example of an Iso-view of the GPR data is shown in Figure 11.

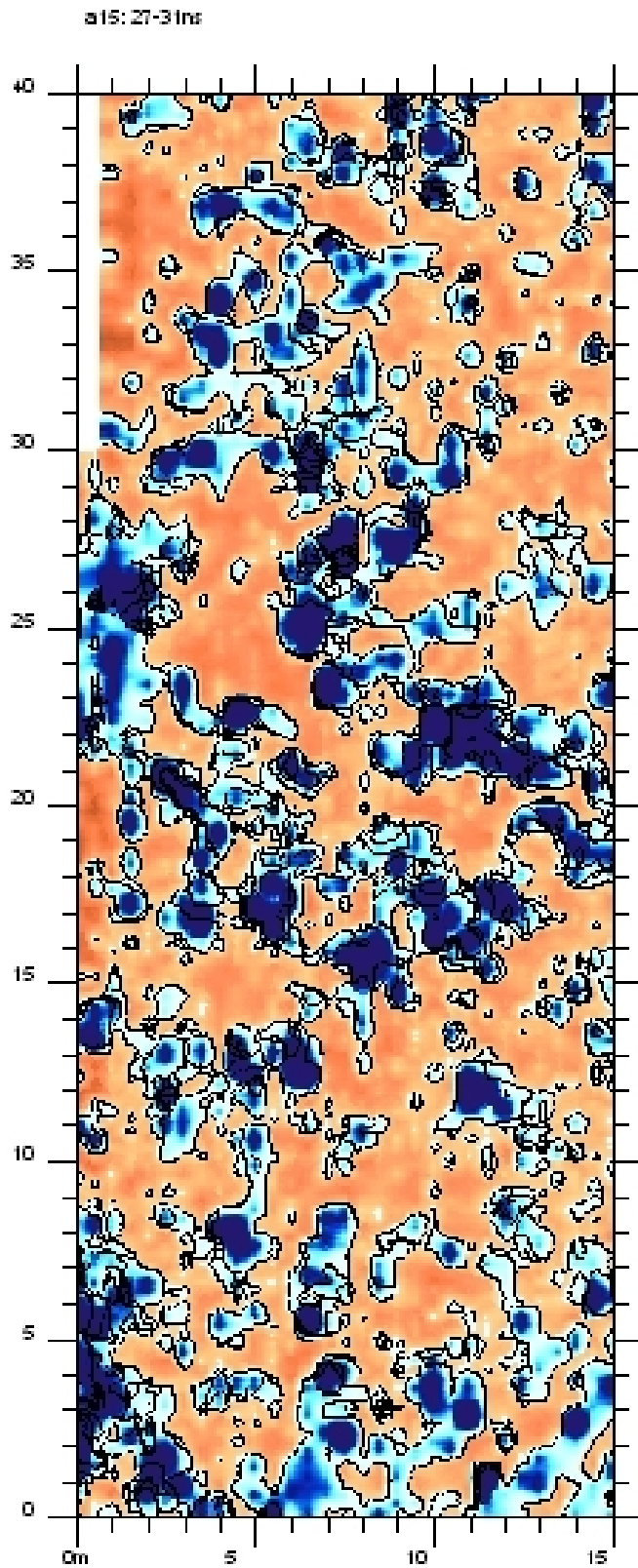


Figure 7. Example of GPR Overlay Map, 27-31 ns Timedepth, Gascoigne Bluff.

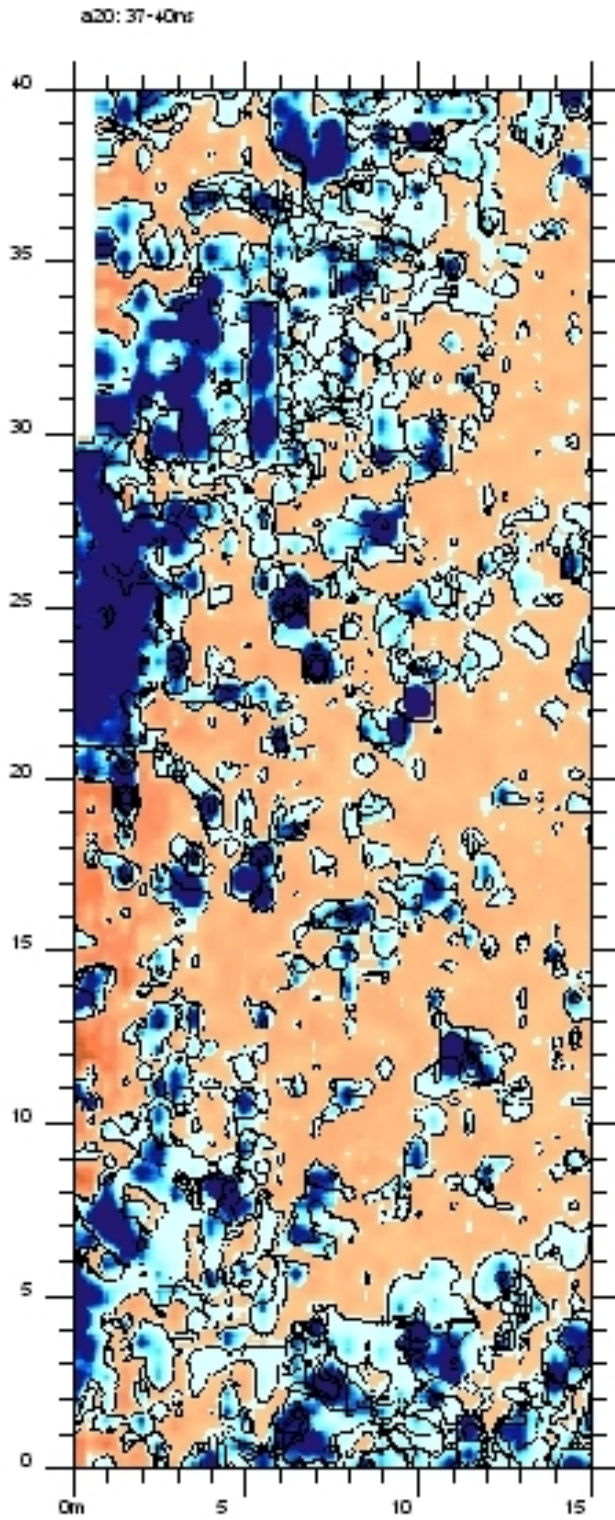


Figure 8. Example of GPR Overlay Map, 37-40 ns Timedepth, Gascoigne Bluff.



Figure 9. GPR Overlay Map (27-31 ns) on Aerial Image of Gascoigne Bluff Study Area.



Figure 10. GPR Overlay Map (37-40 ns) on Aerial Image of Gascoigne Bluff Study Area.

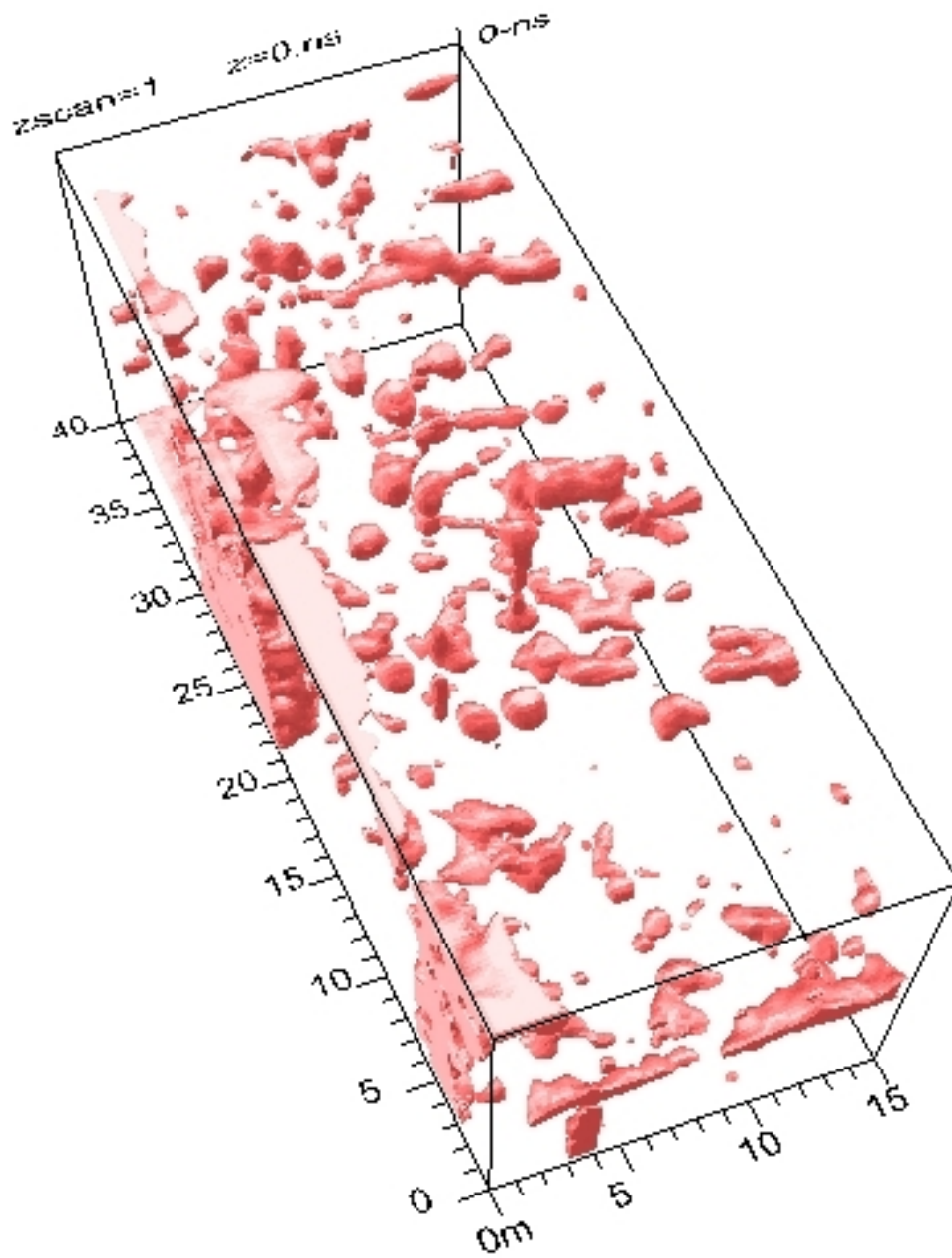


Figure 11. Iso-View of GPR Data, Gascoigne Bluff.

Summary

The LAMAR Institute completed GPR survey on a portion of Gascoigne Bluff on St. Simons Island, Georgia. This report details the findings from this public outreach and research project. The project was a joint effort by the LAMAR Institute, the Society for Georgia Archaeology and the Cassina Garden Club. The study site was a 40 meter by 15 meter area located immediately southeast of the garden gate that encloses the two tabby dwellings, which are the last standing remnants of the enslaved quarter of James Hamilton's plantation.

This GPR project is the third location on St. Simons Island to be examined. Previous GPR work at Frederica and St. Simons Village has demonstrated the effectiveness of GPR survey within the barrier island environment. The 40 meter by 15 meter GPR sample block from Gascoigne Bluff revealed many subsurface radar anomalies that may have cultural significance. Anomalies located in the deeper soil strata (40 cm below ground or more) are particularly interesting. These may represent aboriginal or historical features. Some undetermined percentage of these may represent natural disturbances. Examples from the upper soil strata, as typified in Figure 6, probably relate to large tree roots, pedestrian pathways, and modern utilities and constructions.

No obvious tabby ruin foundations were discerned. Members of the Cassina Garden Club were curious to determine if another row of tabby dwellings had formerly existed in Hamilton's enslaved quarter. The GPR data suggests that, if another row did exist, it was positioned northwest of the GPR sample block.

Radar reflections from greater depths, as shown in Figures 7-10, have greater antiquity and are targets worthy of further investigation. At this junction the age of these potential features is undetermined. Figure 8 displays a large are of disturbance along its western edge, which may represent a building. This is also in the vicinity of the tabby and cement sidewalk, however, and may be related to that construction episode. Many of the intermediate to small anomalies may represent prehistoric pits or midden deposits, or they may be associated with activity zones of Hamilton's antebellum plantation or some earlier plantation. Ground-truthing by archaeological excavation is necessary to fully understand these radar anomalies.

GPR does not provide a complete understanding of the subsurface environment. The interpretation of GPR data is an advancing science and some subtle interments may not have been recognized. The application of GPR technology is recommended for future studies where a non-intrusive means is desired to map subsurface cultural landscapes. What is revealed from this preliminary survey on a portion of the Gascoigne Bluff is a complex subsurface landscape that begs for understanding. The mysteries and human drama that are locked in the soil can be addressed through competent archaeological investigation. GPR survey helps to provide a map in charting a course for conservative excavations and responsible site stewardship.

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