Preliminary Results of a Study to Identify Archaeological Artifacts from San Salvador in Colton, CA, Using Ground Penetrating Radar
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ABSTRACT

We present the preliminary results of an ongoing archaeological geophysical survey at Pellicer Ranch in Colton, CA. Historical archives suggest that the 200-acre vacant lot was home to a significant portion of San Salvador, the largest non-native settlement in the mid-1800s along the Old Spanish Trail between New Mexico and Los Angeles. An overgrown Santa Ana River (SAR) led to the Great Flood of 1862, which washed away or buried beneath a thick layer of sandy river deposits, all edible structures and settlers' belongings. Artifacts are anticipated to be buried at a depth of 1.5-4 meters, making them good targets for different types of geophysical surveys. Ground penetrating radar (GPR), Electromagnetic induction (EMI), and ground-based magnetic magnetometry have proven successful in non-invasively identifying archaeological artifacts in a variety of different environments. In dry, southwestern sites, the most successful of these approaches has historically been GPR. Much work has been accomplished by researchers at other sites in identifying structural remains of buried adobe walls in the subsurface by using "adobe"-like signatures in GPR profiles. We employ GPR using 400 MHz antennas across this site and have imaged several anomalies that have a high probability of being related to San Salvador. The most noteworthy are a very high coherence and a low EM attenuation in the survey area, which we anticipate to be a 10 to 12 meter thick deposit of sand, and a feature that resembles a collapsed structure that is ~30 meters long in profile view. Significant "hyperbolic" signatures exist in the profiles that image the potential collapsed structure, located just below the strong reflector interface at a depth of 3-5 meters. The high EM attenuation is evident in the GPR profiles, and the strong reflections are caused by the significant difference in dielectric properties between the sandy river deposits and the adobe walls which would have dissipated quickly in the flood and been redeposited. As GPR continues to locate potential San Salvador artifacts, concentrated surveys using magnetic gradiometry and EM are being planned for confirmation. Our goal is to add the Spanish Town Heritage Foundation in proving the cultural importance of this site before the city of Colton's plans to develop the land are implemented.

INTRODUCTION

Pellicer Ranch is an approximately 200-acre plot of vacant land on the border of Colton and Riverside, CA (Figure 1). In February 2018, the Spanish Town Heritage Foundation (STHF) reached out with a request for an archaeological geophysical survey at Pellicer Ranch. Officers of the foundation are the descendants of high-ranking settlers of the Agua Mansa/La Placita settlements (together known as San Salvador). San Salvador was the largest settlement between New Mexico and Los Angeles in the mid-1800s, populated by settlers from New Mexico. In a single night, the entire settlement of Agua Mansa/La Placita were inhumated by the SAR, with a peak flow of 9,000 cfs (Benzoni, 1997). Efforts to form the area post-flood were thwarted by the harsh, sandy deposits that the river had blanket各地的 fertile land (Vickers, 1946). Eventually, the settlers surrendered and moved to neighboring communities, but the question remains: what became of the remains of San Salvador? The largest settlement between Los Angeles and New Mexico in the mid-1800s? Despite a brief period during which a shovel was operated on the property, the land Pellicer Ranch has remained undisturbed. The city of Colton has been looking to change that recently with plans of developing the land into a warehouse. Nancy Melendez, Darlene Elliott, and the rest of the STHF team seek to stop this development by proving the cultural importance of this land.

Archaeological geophysics has become a rapidly growing field in recent decades. The advancement of technology and computer processing has made the non-invasive techniques highly desired for their efficiency in determining the archaeological importance of sites. When the location is large and it is unknown where buried artifacts are located, invasive techniques are too costly. This study aims to identify subsurface anomalies with different geophysical techniques at Pellicer Ranch that can be correlated with Agua Mansa/La Placita artifacts. Nancy Melendez and Darlene Elliott supplied us with images from historical records of the results of an adobe home in the mid-1800s (Figure 2). Metallic and wooden artifacts will contrast greatly in material properties with the surrounding soil.

GEOLOGY AND SITE PROPERTIES

Archaeological archives show that the settlers were forced to abandon the land post-flood due to increased difficulty of farming given the new flood deposits. La Placita pre-flood was a fertile land, rich with agriculture, so we can assume that there must have been a more lax soil at the surface pre-flood. Our lack of dig at Pellicer Ranch on 2/22/18 suggests the potential depth of the sandy soil (Figure 3). The modern surface soil of Pellicer Ranch has been classified by soil scientists from the United States Department of Agriculture as sandy loam (Natural Resources Conservation Service). Presently, it has been 150 years since the Great Flood of 1862, which allowed for the deposition of this sandy loam atop what would have been the river deposits. A test dig at a location in the middle of the site found that the sandy loam extended 0.5 meters deep. At this depth, the light colored sand, most probably deposited during the Great Flood of 1862, are seen (Figure 3).

METHODS

Geophysical elevation models (DEM) from the United States Geological Survey (USGS) show that in an overwatered river channel, the flow on approach to Agua Mansa and La Placita would be confined by two topographic highs (Figure 4). Also shown is that the Pellicer Ranch site was a drop of less than 1% percent between a small area, giving confidence that topography correction for GPR will not be necessary. Metallic and wooden artifacts would appear as GPR profiles as high-contrast hyperbolic reflections. However, GPR can only image an object that is buried as deep as it is large. Artifacts are anticipated to be buried at a depth of 1.5-4 meters making relatively small artifacts difficult to image. However, previous research (Conyers, 2012) proves it possible to image "adobe melt" in the subsurface (Figure 5).

A 530/350 Vibe Scan-Pro GPR with a SAR 4500 controller and 400 MHz antennas used to conduct several surveys in the last few months. With GPR, electromagnetic radar waves are emitted into the subsurface through a transmitter coil. When the waves encounter a change in dielectric properties, some of the energy is reflected up to the subsurface and recorded by the receiver coil. If there is a large difference in dielectric properties between the original material and the new environment material or artifact, the wave's reflection will be strong. When analyzing GPR traces, a strong reflection appears as either a bright white or dark black layer. If the materials do not differ greatly, the reflection will be less noticeable. From historical archives of San Salvador, materials and artifacts expected to be buried in the Pellicer Ranch include iron cookware, metallic utensils, wooden ladles/shovel/salad/foxes, kints, farming equipment, and adobe "melt" from the structures that were dismantled in the flood waters.

PRELIMINARY RESULTS

Preliminary profiles have not been finalized at the site, 16 of which are collected along the dirt roads of the site. Areas free of SAR did not contain significant anomalies. The highest amplitude anomalies within San Salvador's depth range came from profiles within 200 and Darlene Elliott's area along a wash (Figure 6). We present 6 profiles that contain the most significant results to date. In GPR profiles (Figure 7), we have imaged an irrigation canal (Figure 4) and a potential collapsed structure (Figure 6). We strongly hypothesize that these objects are related to San Salvador, although this has not yet been confirmed by excavation. The GPR depth of data collection was set at 7 meters. We performed a test dig in the middle of line 6 (Figure 8). We dug through the sandy loam until we reached the river deposits at 0.5 meters, and dug another 0.5 meters until the excavation became too extensive and stopped (Figure 2). In line 6, the strong reflection at 10 ms (horizontal) represents the air~ground interface. We next see a reflection at 15 ms. This layer change at 5.5 matches up with the sandy river deposits at 0.5 meters depth. After correlating this 5.5 reflection with the 0.5 meter layer, we can determine three things:

- the depth of data collection extended to 7 meters as expected
- the anomalous layer that returns a high amplitude reflection is buried at 40 cm, placing it at a depth of 3.5 meters
- the contrast between the 60 cm layer and the river deposits is significantly stronger than that between sandy loam and river deposits

CONCLUSIONS AND FUTURE WORK

Results from our GPR profiles show anomalies that can be correlated with San Salvador artifacts based on their large contrast from the soil matrices that they are buried in, and their depth of burial. Historical archives claimed at least one meter of sandy river deposits buried the settlement, but not deeper than four meters (Nancy Melendez, pers. comm.). We imaged several high amplitude reflections in our profiles in this depth range. Future surveys will include more concentrated GPR profiles over additional anomalies and generation of 3-dimensional maps. To improve our interpretation of these anomalies, we intend to perform small scale, high resolution, electromagnetics induction and magnetic gradiometry surveys over these areas and combine the results from these different geophysical approaches.

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Google Earth Pro (7.3.5.481) (July 24, 2020). Landmarks. Accessed (Feb 16, 2018)

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