



A Magnetometry Survey of Fort Glenford

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Overview

In July, 2018, the Heartland Research Group performed a magnetometry survey on a field at the west base of the Fort Glenford Hilltop Enclosure along the creek running from south to north. This area was selected for the survey for two reasons. The area inside the stone wall enclosure on the top of the hill was inaccessible due to a soybean crop and the area was suspected as a possible location for long term occupation by the Adena people who constructed the hilltop enclosure and mortuary complex known as Fort Glenford Hilltop Enclosure.

The survey was performed by using a 16 sensor, 3.75 meter (12.3 foot) wide magnetometry array pulled by an all-terrain vehicle. The array was designed and built by SENSYS, a German company and funded by Heartland Research Group. The SENSYS technology is a new generation magnetometry system which is more sensitive and generates more data than any previously known system. The data density is around 160 samples per square meter with a 25 cm transact spacing and 40 linear readings per sensor, per meter. With all 16 array sensors a width of 3.75 meters (12.3 feet) can be scanned in one pass, producing 640 magnetic readings per linear meter. This system was recently used on the terrain surrounding Stone Henge in England and revealed many features previously unknown to archaeology.

The results of the survey in the lower field at the Fort Glenford site revealed a large



Figure 1. SENSYS MAGNETO[®] MX V3. Large area magneto-meter survey system which has 16 fluxgate gradiometers arrayed on a trailer with a width of 3.85 meters.



Figure 2. The outline of the area along the creek below Fort Glenford which was scanned in July 2018.

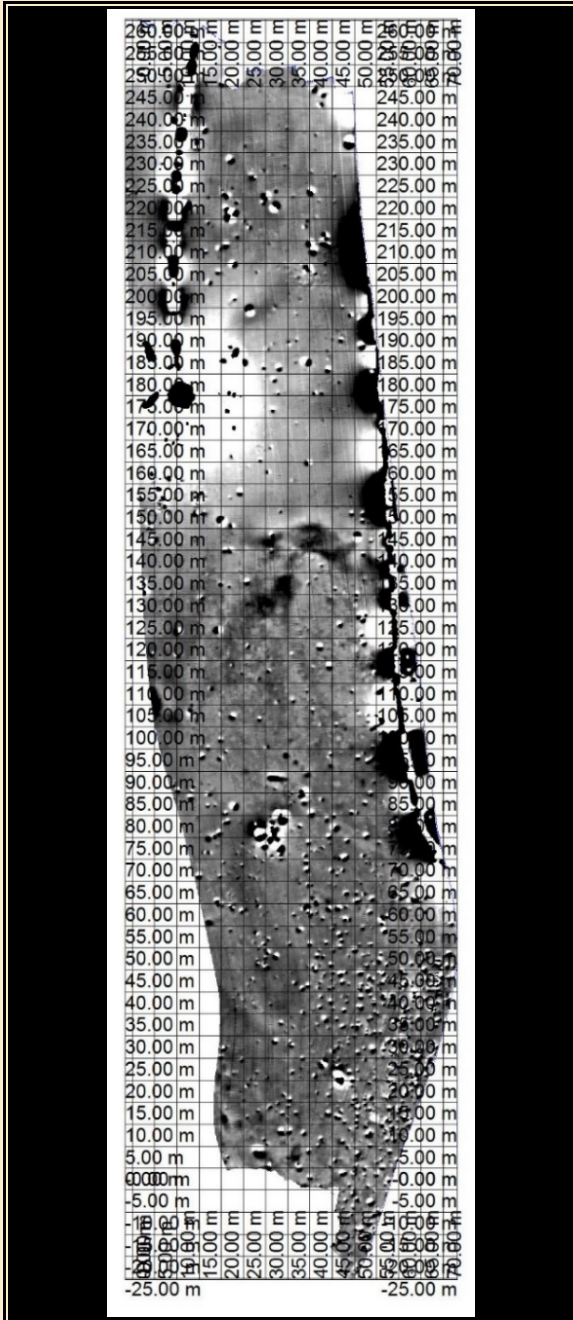


Figure 3. The results of the July 2018 SENSYS scans are displayed within the GPS grid overlay.



Figure 4. The area where there is a 21 meter (68 feet) diameter symmetric circle with a 5 meter (17 feet) diameter inner concentric circle on the July 2018 SENSYS scans.

circular feature. The circle has a diameter of 21 meters (68 feet) encompassing a concentric inner circle with a diameter of 5 meters (17 feet). Post molds in these circular features are consistent with a 21 meter (68 foot) diameter "roundhouse" with a central roof support system of vertically placed log posts. This type of structure is consistent with

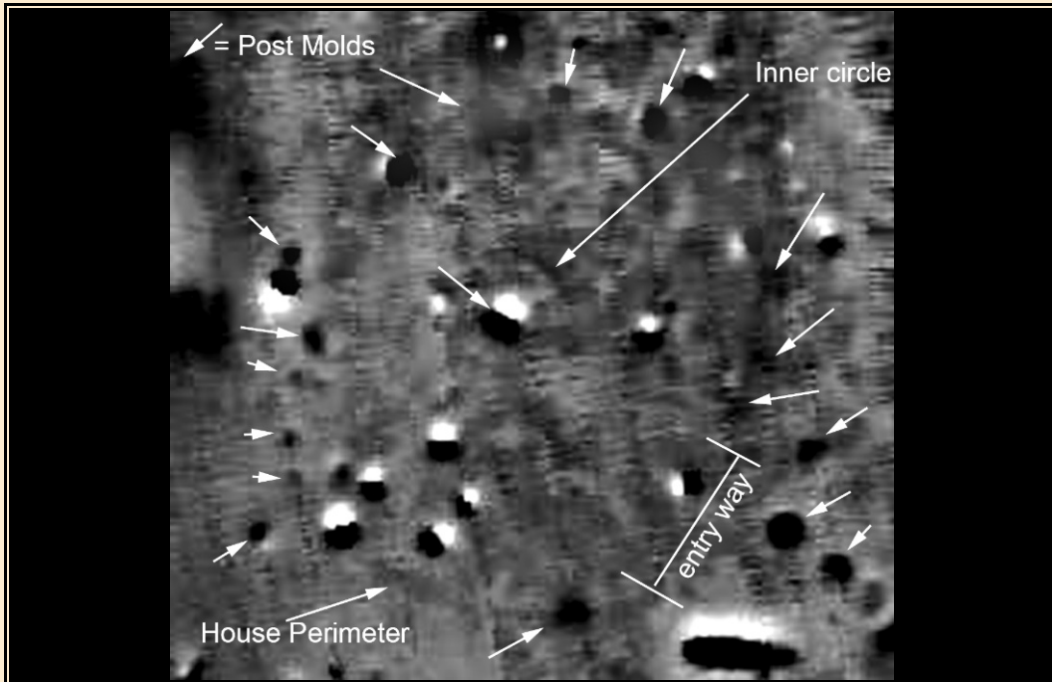


Figure 5. Round House located in July 2018 SENSYS scans. Arrows point to post molds where log posts were set into the ground. There is a gap in the outer circle on the South East suggesting an opening indicative of a passageway. Black with white spots are bi-pole returns of naturally magnetized rocks or ferrous metal in the ground.

the Adena culture who were identified as the people who constructed the Fort Glenford Hilltop Enclosure

In December, with the crop off of the field, an additional scan was performed in the field inside the stone wall forming the hilltop enclosure. The signatures of six round houses were discovered. Further evidence of a large earthen circle with an internal ditch was also revealed. This structure apparently became the perimeter for a subsequent stone mound. The stone mound likely represents the end of Adena activities on the site at about 270 BC. A straight line alignment between the lower circular round house, the west stone wall entryway, one or more of the hilltop round houses, and the stone mound suggests all of these features are related.

Magnetometry

The magnetic field of the earth can be detected and plotted using an instrument called a Flux Gate Gradiometer, commonly known as a Magnetometer. The instrument is passed over the earth in a manner similar to "mowing the grass." The data generated is then digitally manipulated and displayed with accurate linear measurements by referencing Ground Positioning Satellites. The resulting image is a map of the area scanned comprised of variations in the magnetic field.

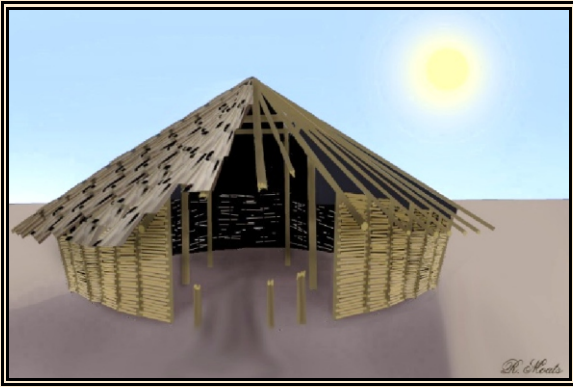


Figure 6. Round House with an inner circle area formed around center posts which support the roof. (*Ohio History Connection 2018*).

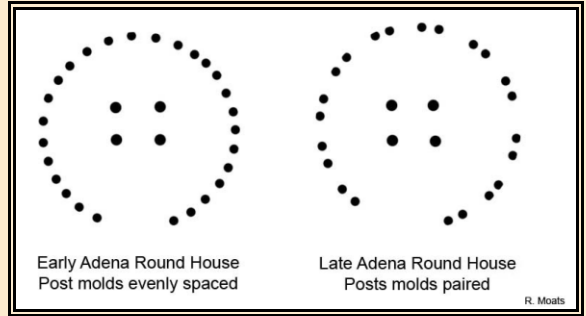


Figure 7. Configurations in the Adena culture where the posts of the outer walls are paired. (*Converse 2003*)

When soil is removed, replaced, or laid over pre-existing soil, the magnetic field is altered and can be detected for hundreds or even thousands of years after the original event. Ditches, storage pits, fire pits, earthworks, and post molds tend to produce anomalies in the magnetic gradient readings. These changes can also be detected when an area of ground is protected from occupation and weather. Areas having increased activity of humans or animals such as the soil beneath a building can also be detected. Specific characteristics of changes in the natural magnetic field of the earth caused by human activity can sometimes be identified with a particular culture and time frame such as round houses versus long houses.

The SENSYS Magnetometry System used in this survey is a next generation technology in that it can be pulled over the earth at a speed up to 9 miles per hour. The combined speed by which the array can be pulled over terrain and its width of 3.75 meters (12.3 feet), enables the user to cover as much as 60 acres in a single day.

The West Side, Lower Field Scan

The SENSYS Magnetometry Array is pictured in Figure 1. The 16 vertical tubes are the sensors and the tall central mast is the GPS receiver. The electronics are carried on the four wheel ATV.

The area along the creek below Fort Glenford was scanned in July 2018. The area scanned is outlined in Figure 2.

This area was selected because it is located at the bottom of the high hill on which is located an archaeological site known as Fort Glenford Hilltop Enclosure, 33PE3 in the Ohio Registry. The hilltop site is known to have been a mortuary complex constructed by the Adena Culture. Activities at the site ended at 270 BC. (Dutcher 1988). The area along the creek was suspected to be a location for long term occupation by the Adena people who constructed the mortuary enclosure and mound atop the nearby hill.

The results of the scan are displayed below in Figure 3 with the GPS grid overlay. Figure 4 shows the area where there is a 21 meter (68 feet) diameter symmetric circle with a 5 meter (17 feet) diameter inner concentric circle. The large white area with a central black circle is the result of a dismantled oil well with a metal pipeline extending to the north.

The area of primary interest is enlarged in Figure 5. Arrows point to post molds where log posts were set into the ground. There is a gap in the outer circle on the South East suggesting an opening indicative of a passageway. Black with white spots are bi-pole returns of naturally magnetized rocks or ferrous metal in the ground.

The anomalies in the magnetometry display are consistent with a large early Adena culture round house 21 meter (68 feet) in diameter. The inner circle is an area formed around the inner post which supported the roof as in the cut away rendition in Figure 6. (Ohio History Connection 2018).

Adena Round Houses can have diameters



Figure 8. An aerial image of the hilltop field and the restored stone mound where December 2018 SENSYS scanning occurred.



Figure 9. SENSYS December 2018 magnetometry scan of Fort Glenford hilltop field. The mound could not be scanned for obvious reasons but the array was pulled as close to the mound perimeter as possible.

up to 90 feet and are seen in two general configurations. One is early Adena dating to as much as 1000 BC. These are characterized by the posts of the outer wall being evenly spaced. The other configuration is seen late in the Adena culture where the posts in the outer wall are paired, Figure 7. (Converse 2003)

Therefore, the even spacing of posts in the perimeter in the structure in Figure 5, without pairing, suggests it is an early Adena constructed round house with a passageway toward the southeast.

The Hilltop Enclosure Scan

In December 2018, after the crop was harvested, a scan of the field inside the hilltop stone enclosure was performed. Figure 8 is an aerial image of the field and the restored stone mound. The mound was restored in early 2018 to somewhat of its original configuration before it was opened by Dutcher in 1987. The round house previously described in Figure 7 is illustrated as concentric circles in the field on the left side of Figure 8.

Figure 9 is the magnetometry scan of the field. The mound could not be scanned for obvious reasons but the array was pulled as close to the mound perimeter as possible.

At the resolution seen in Figure 9, only large features can be identified. The long, irregular black features are consistent with fissures in the underlying bedrock. The geology of this hill is such that there is less than five feet of overburden above the bedrock. The sensitivity of the array is revealing features at a depth of more than five feet. Long parallel lines are caused by farming activity. Curvilinear dark lines may be cultural.

A feature in the north end of the field is consistent with a 9.2 meter (30 feet) diameter

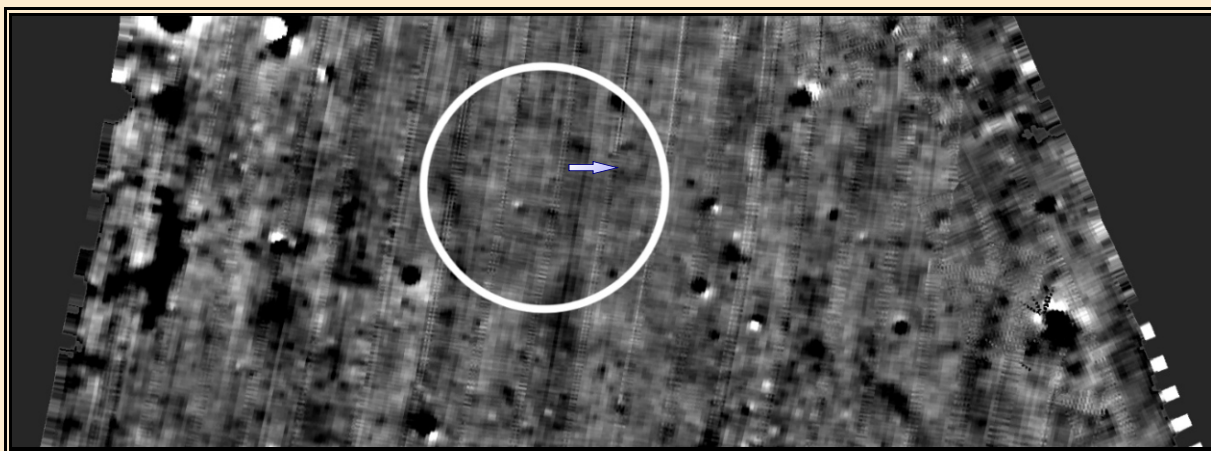


Figure 10. December 2018 SENSYS scans show a feature in the north end of the hilltop field which is consistent with a 9.2 meter (30 feet) diameter round house with a "reversed C" shape structure on the east side.

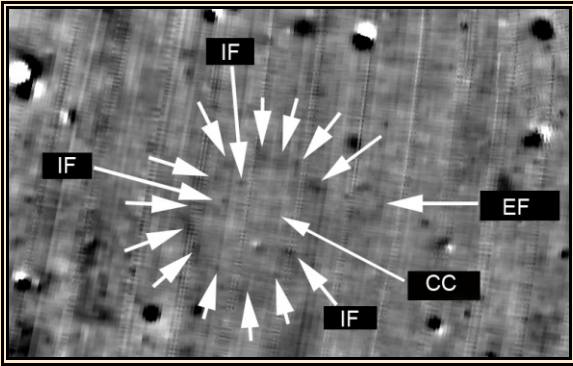


Figure 11. December 2018 SENSYS scans where the arrows indicate the post molds of the outer perimeter. The post molds do not appear to be paired indicating the feature is early Adena. The indication of a central concentric circle is consistent with a round house structure, "CC".

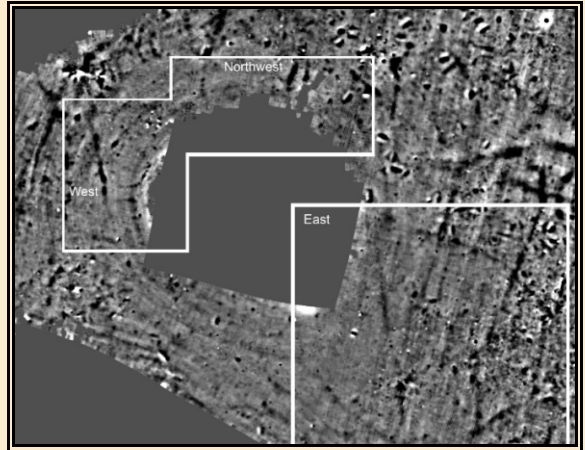


Figure 12. December 2018 SENSYS scans. There are multiple cultural features in the south end of the field around the mound.

round house with a "reversed C" shape structure on the east side, Figure 10.

Referencing Figure 11, the arrows indicate the post molds of the outer perimeter. The post molds do not appear to be paired indicating the feature is early Adena. The indication of a central concentric circle is consistent with a round house structure, "CC". Features inside the structure may be small pits or post molds marked by "IF". The "reversed C" structure is on the right. This may be a 2.2 meter (7.8 feet) circular earthwork feature, "EF". This type of structure has been seen at other Adena sites such as the Wolf Plains Group near Athens, Ohio. (Woodward & McDonald 2002).

There are multiple cultural features in the south end of the field around the mound, Figure 12. A higher resolution image of the area west of the mound shows circular features. Figure 13.

The arrows in Figure 13 point to post molds and curvilinear lines in three circular configurations. These three features are consistent with three round house structures. The largest circle is 15 meters (50 feet) in diameter followed by a 12 meter (40 feet) and a 10.5 meter (35 feet). The overlapping of these features suggests different ages. All three have evenly spaced posts indicating these structures are early Adena. The order of construction and presence before or after the mound was constructed cannot be assessed.

In the same area are additional features. On a plot map made in 1862 by the Salisbury brothers, they indicate the possibility of an earthen circle and internal ditch surrounding the stone mound, Figure 14.

The signature of an earthen circle with an internal ditch in the magnetometry survey is indicated which verifies the Salisbury observation, Figure 15

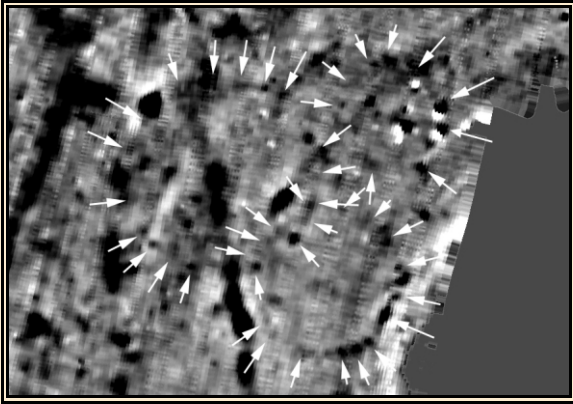


Figure 13. December 2018 SENSYS scans. These three features are consistent with three round house structures. The largest circle is 15 meters (50 feet) in diameter followed by a 12 meter (40 feet) and a 10.5 meter (35 feet). The overlapping of these features suggests different ages.

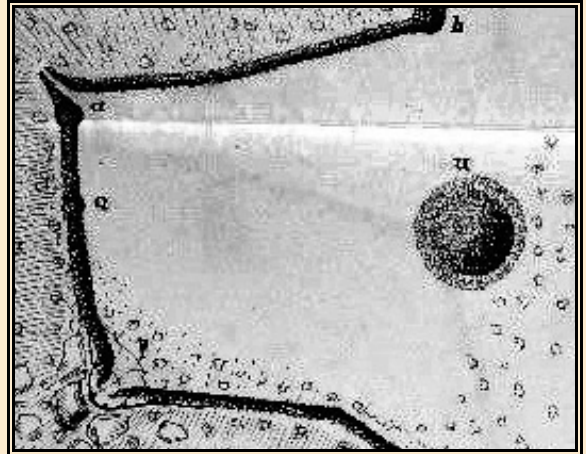


Figure 14. The Salisbury brothers in 1862 made a plot map where they indicate the possibility of an earthen circle and internal ditch surrounding the stone mound.

To the northwest of the mound area are several post molds, two possible fire pits, and post molds in the right side of the image consistent with parts of round house with internal roof supporting posts, Figure 16.

To the east of the mound there are two long curvilinear lines possibly indicating an irregular earthen berm or wall. These features could also be long fissures in the bedrock. There is also a set of post molds consistent with an 18 meter (60 feet) diameter round house. Immediately to the north of the round house is a rectangular structure consistent with a pit, Figure 17. This pit appears to extend into the round house structure suggesting the round house may have been a charnel house.

Similarities in Building Methods

The construction methods between the round houses revealed in the survey and the Charnel House discovered in the mound floor by Dutcher, are very similar in pattern and time period, Figure 18, (Moats, 2011). The rectangular pit and round house east of the mound are very similar to the crematory pit and nearby charnel house discovered beneath the mound floor. This suggests a common practices by a culture over an extended period of time and is consistent with Adena burial and cremation practices.

In Figure 19, the plot map of the mound floor is registered to the magnetometry survey by cardinal direction and spatial orientation. This clarifies the association between the three circles to the west of the mound, the features in the mound floor, and the structure to the east.

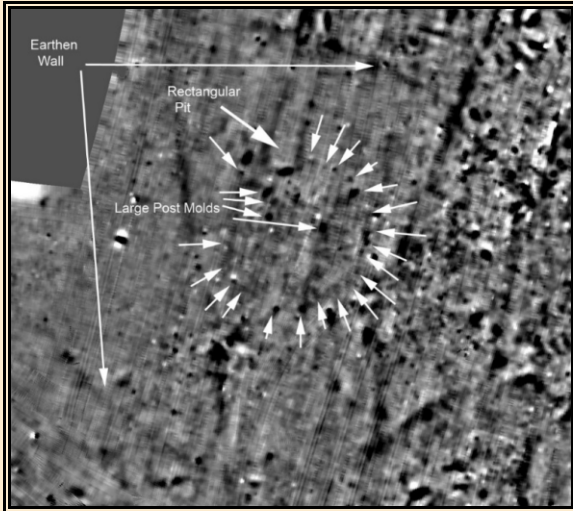


Figure 17. December 2018 SENSYS scans show immediately to the north of the round house that there is a rectangular structure consistent with a pit. This pit appears to extend into the round house structure suggesting the round house may have been a charnel house.

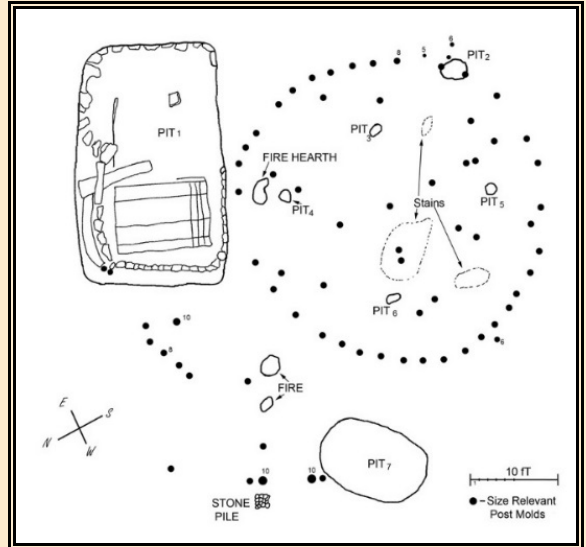


Figure 18. The construction methods between the round houses revealed in the survey and the Charnel House discovered in the mound floor by Dutcher are very similar in pattern and time period, (*Moats, 2011*).

Lower Field Round House and Hilltop Alignments

In a wide view of the area, both scans are GPS registered to a LiDAR image of the site. The area in the lower field and the field inside the hilltop enclosure are indicated. Starting from the lower field round house in the center of the inner circular feature, a straight line is constructed to the center of the mound. This line passes through the west entryway in the stone wall which forms the hilltop enclosure and then through the center of the larger 15 meter (50 feet) circular round house. This alignment strongly suggests the round house in the lower field was constructed in intentional straight alignment with the mortuary complex atop the hill, and that all of the round houses were constructed by the same culture, Figure 20.

Summary

The SENSYS Magnetometry array was deployed at two locations on and near Fort Glenford Hilltop Enclosure in July and again in December 2018. The features revealed by detecting anomalies in the magnetic field most notably are the presence of seven total round house structures consistent with the early Adena culture. The sensitivity of the SENSYS array has revealed the circle signatures of the perimeters of these structures with post mold characteristic of early Adena construction techniques. The magnetometry scan indicates an earthwork in the north end of the field adjacent to a

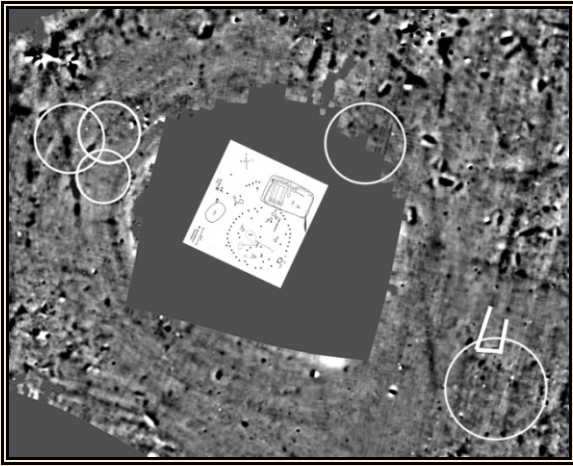


Figure 19. The plot map of the mound floor is registered to the magnetometry survey by cardinal direction and spatial orientation. This clarifies the association between the three circles to the west of the mound, the features in the mound floor, and the structure to the east.

round house, a circular earthwork with an internal ditch surrounding the stone mound, and a possible earthen berm/earthwork east of the mound. The round house east of the mound may be a charnel house because of the associated presence of what appears to be a rectangular pit consistent with a crematory pit and the similarity to the charnel house feature discovered in the mound floor in 1988.

It is apparent in this survey that the SENSYS Magnetometry Array detects anomalies in the magnetic field of the earth at a resolution, depth in the soil, and farther back in time than any previous types of survey equipment. The imaging of post molds is an important

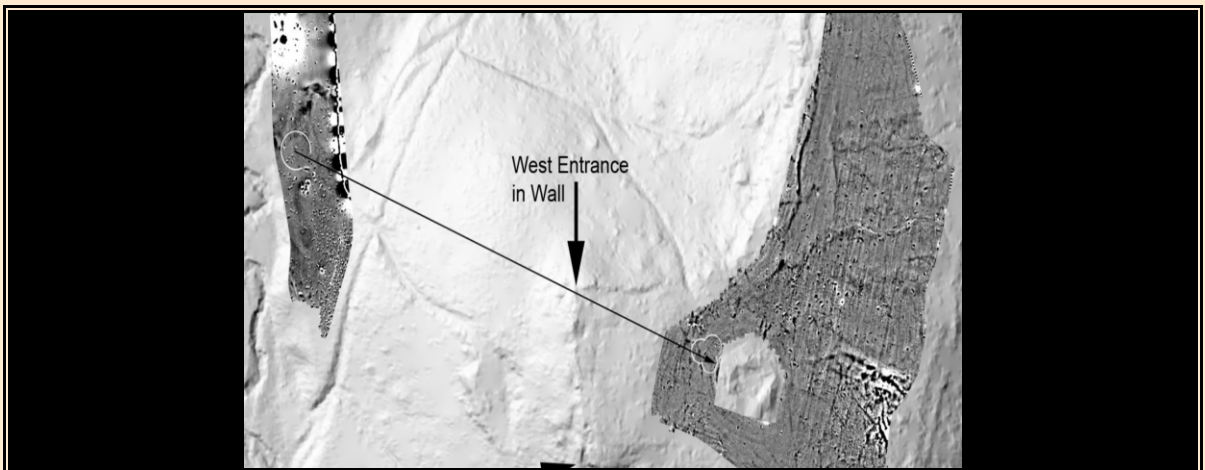


Figure 20. In a wide view of the area, July 2018 SENSYS and December 2018 scans are GPS registered to a LiDAR image of the site. The area in the lower field and the field inside the hilltop enclosure are indicated. Starting from the lower field round house in the center of the inner circular feature, a straight line is constructed to the center of the mound. This line passes through the west entryway in the stone wall which forms the hilltop enclosure and then through the center of the larger 15 meter (50 feet) circular round house. This alignment strongly suggests the round house in the lower field was constructed in intentional straight alignment with the mortuary complex atop the hill, and that all of the round houses were constructed by the same culture.

breakthrough in North American archaeology.

The sensitivity of the array has also revealed sub-surface fissures in the bedrock, polarized sand stones indicated by black and adjacent white spots, and pieces of ferrous metal from modern farm equipment as indicated by bright white spots. Since the data is georeferenced, any feature in the scan can be located to within inches for the purpose of sub-surface excavation and investigation.

References

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Plot map made in 1862 by the Salisbury brothers / Salisbury observation [Figure 14].

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