Compositional Analysis of Iroquoian Pottery: Determining Functional Relationships between Contiguous Sites

By

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COMPOSITIONAL ANALYSIS OF IROQUOIAN POTTERY: DETERMINING FUNCTIONAL RELATIONSHIPS BETWEEN CONTIGUOUS SITES

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Studying site diversity is a growing research interest in Iroquoian archaeology. In this study, analyses of undecorated pottery sherds from two Cayuga Iroquois sites, Parker Farm and Carman, were carried out in the context of determining differences in site functionality. First, analyses relied on datasets of soil volume and pottery counts and categorizations. Pots were classified by interior color which served as a proxy for vessel use. Reduced (blackened) interiors are associated with cooking and oxidized (light) interiors correlate with dry storage. This information yielded differences both in overall concentrations of pottery and in concentrations of interior color. A second analysis used x-ray fluorescence to determine chemical composition of the sherds. Overall, analyses revealed similar levels of elements, but slightly different patterns for some elements. Parker Farm showed consistent elemental levels, but Carman showed more irregular levels, particularly for manganese. These results suggest a different use of space at the sites and a possible difference in site function, providing a contributing to our understanding of the nature of site diversity in this particular area.

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PREFACE

First of all, I must express endless gratitude to Dr. Kathleen Allen for her constant support throughout this project. She sparked my initial interest in Iroquoian pottery and has helped every step of the way in bringing this thesis to a reality. I am especially grateful for the use of the sherds excavated from her field schools and for her constant constructive editing. I would also like to thank Dr. Loukas Barton for allowing me the use of the Tracer IV-SD and for the generous use of his lab space. Also I am indebted to Camilla Kelsoe, who offered instruction on the use of the machine and the XRF process as a whole, as well as a careful eye that caught many an error in my dataset. A special thanks to those who participated in the Lab Practicum course at the University of Pittsburgh in Fall of 2014 who carried out the majority of the quantification and coding of the sherds (Anna Gallagher, Shannon Kulig, Kayla Wasik, Sara-Ladd Clark, Jessica Phares, and Brooke Gwin). The work done in that class provided the foundation for taking on this research project. Also I am very thankful to Dr. Elizabeth Arkush who gave me invaluable organizational suggestions and who helped me make pretty maps. To Dr. Kathleen Allen, Dr. Loukas Barton, Dr. Elizabeth Arkush, and Dr. William Engelbrecht: thank you for serving on my committee and for all of your advice and critiques. Your final evaluation was such a wonderful opportunity for me as a student and emerging researcher. Special thanks to Justin for finding my grammar mistakes and "silly sentences". Finally, I would like to express my thanks to my parents and friends their constant support of me throughout this endeavor.

1.0 INTRODUCTION – REGIONAL BACKGROUND

The area which now comprises New York State was dominated by the Haudenosaunee in the 16th and 17th centuries. In this region, there were five nations of Iroquois: Seneca, Cayuga, Onondaga, Oneida, and Mohawk. The Cayuga native land was on either side of Cayuga Lake in Central New York, with hunting lands spreading from Lake Ontario down to Susquehanna River. Populations emerged on the southwest side of the lake by around 1450 (Engelbrecht 2003:119-120). The sites of Klinko, Payne, Schempp, Indian Fort Road, Parker [Farm], and Carman are all located on this southwestern side of the lake and are thought to be the successive movements of a single community (Niemczycki 1984:73-74). Due to the ceramic similarities, it is believed that this community had some degree of social connection with communities on the east side of the lake (Engelbrecht 2003:120, Niemczycki 1984: 64).

1.1 CURRENT THOUGHT

In the past, Iroquoian studies of settlement patterns have focused on hypotheses of linear series of village occupations. Studies in the Cayuga region in particular have emphasized the chronological movement of permanent villages through the region (Niemczycki 1984). However, newer studies have pushed for the acknowledgment of and greater research on site diversity.

Generally, any large site is archaeologically classified as a village, despite the fact that only a small percentage of sites have been fully excavated (Engelbrecht 2003).

First, a brief chronological overview of studies reveals that some recent scholars have identified the need for a more systematic approach to site diversity. Ritchie and Funk (1973) attempted to address this problem by identifying several types of settlement patterns in the Late Woodland and Historic phases in Iroquoian New York, which include villages, hamlets, camps (recurrent and temporary), and workshops, among others. Other scholars have also addressed the topic of site diversity in terms of special purpose camps. These types of sites have been identified in Iroquoian Ontario and along Lake Erie and function as seasonal fishing camps (Fox 1976). Williamson has also provided context for small sites among the Northern Iroquois that functioned for the gathering and harvesting of nuts and the butchering of deer (Williamson 1985:169), in addition to temporary horticultural hamlets (1979:73). Bamann et al.(1992:445) acknowledge that "the generalized notion of Iroquoian village has been replaced by a spectrum of site types including hamlets and camps". Kapches (1994) offers an interesting interpretation of an Iroquoian site in South-Central Ontario as a possible firing special purpose camp, due to easily accessible water and clay resources, distance from a village, and its location in a ravine (1994:91). In the context of site diversity, Engelbrecht (2003:88) acknowledges that "some sites now classified as village sites were actually recurrently occupied camps". Warrick (2008) further addressed the issue of site diversity in historic Huron-Wendat territory. From historic accounts, he identified a size hierarchy of sites which encompassed very large villages of over 50 longhouses, small hamlets with 7-8 houses, and isolated cabins. Of these the villages were permanent and the hamlets and cabins were occupied seasonally (Warrick 2008:93).

1.2 CARMAN AND PARKER FARM

The two sites of Carman and Parker Farm are Haudenosaunee sites located in the Cayuga region of central New York State, on the west side of Cayuga Lake (Fig. 1 & 2). These two sites have been identified as part of the Klinko-Parker village sequence that occupied the west side of Lake Cayuga for about 200 years (Niemczycki 1984:73-74). The two sites are located only one mile from one another and were originally identified as village sites (Allen and Katz 2015).

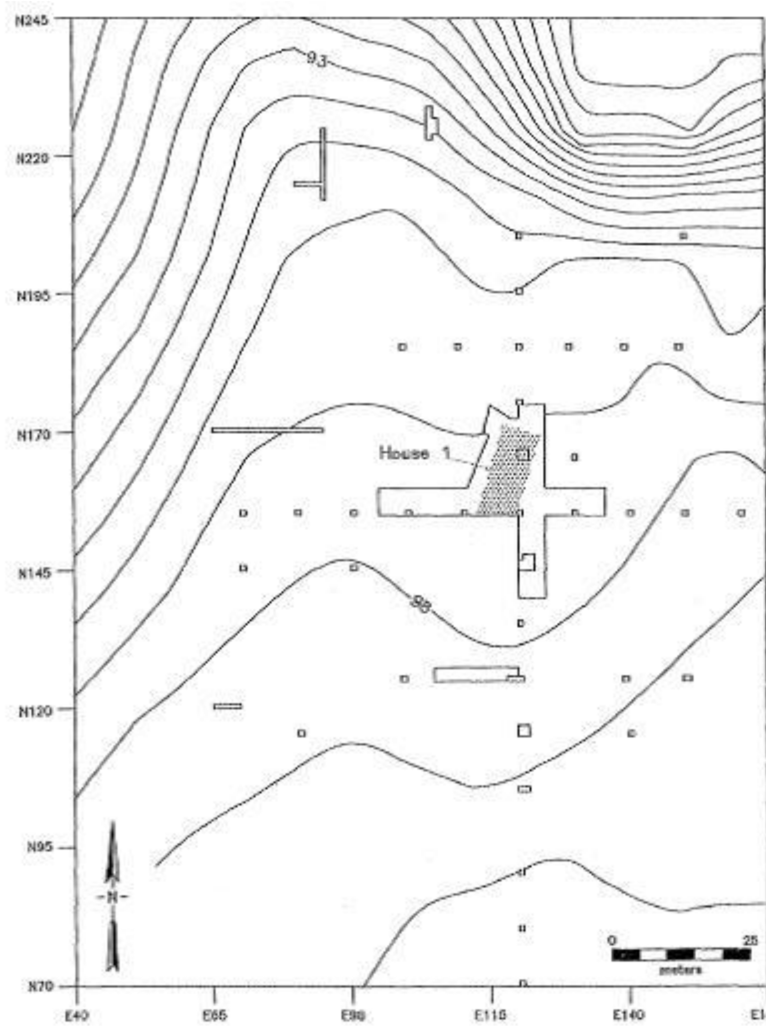

Figure 1 – Site Map of Carman

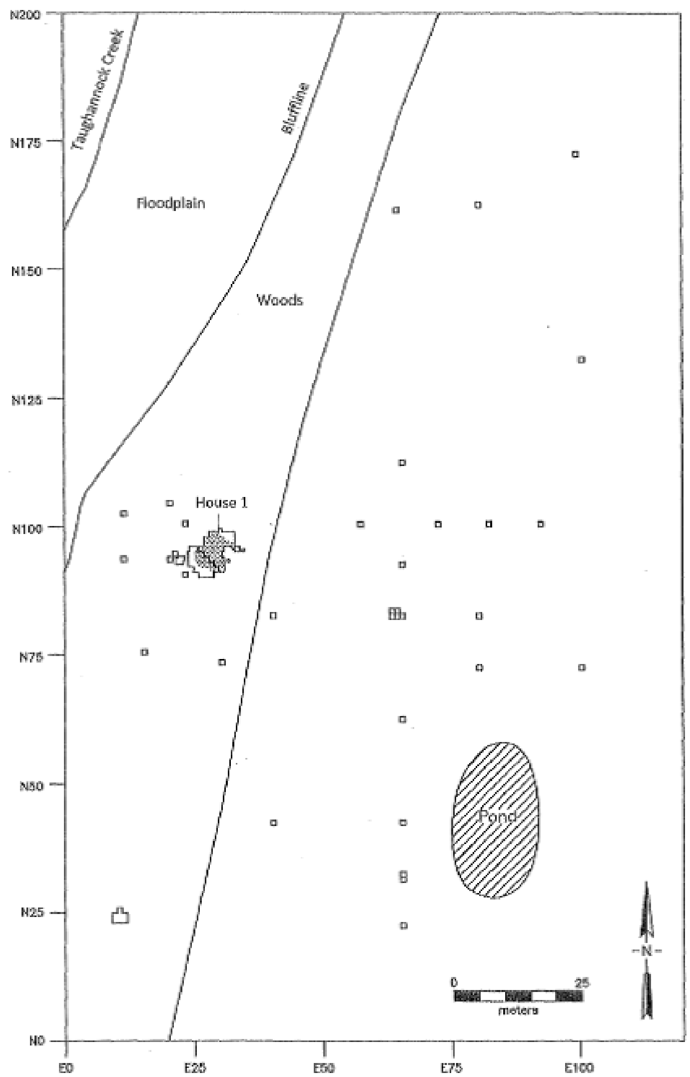

Figure 2 - Site Map of Parker Farm

The site of Carman is approximately 0.8 hectares (2 acres) in size and is located entirely in an open field which has been subject to extensive plowing. Parker Farm has quite a different geographic layout, with part of the site lying in an open, plowed field and the other half, which includes the house structure, located in the wooded area. It is one hectare (2.5 acres) in size. The site also lies in close proximity to the floodplain of the Taughannock Creek. One definite structure has been identified at each site, both about 6.1m in width (Allen and Katz 2015). One structure has been thoroughly investigated at Carman, although a possible second structure exists. Despite the annual plowing that has caused greater fragmentation of material at Carman, the cultural material itself also appears denser at this site. Middens have also been identified at both sites, but neither site has exhibited evidence for palisades (Allen and Katz 2015). Clay would have been readily available at both sites, found both in the lenses in the bluff at Parker Farm and in the creek bed below Carman. In regards to the faunal material, deer bones dominate the faunal remains, while hickory and walnut, maize, and berries make up the majority of the floral remains (Allen 2010:59).

Differences in the technical choices of the potters between the two sites have been identified by Sudina and Allen (2008). This study found that pottery from Parker Farm exhibited thicker vessel walls and much higher proportion of plagioclase temper in the clay paste. In contrast, the Carman assemblage had thinner walls and more variability in temper composition (Sudina and Allen 2008:8).

Despite the accepted classification of the two as village sites, previous work has called into question their functionality based on significant differences found at the site level (Allen and Katz 2015). If the two were indeed sequential, there would be noticeable similarities between the sites (Allen and Katz 2015). They both contain evidence for at least one structure (two in the case of Carman), numerous features, and large quantities of recovered lithics, pottery, and faunal material. Allen and Katz (2015) have identified that these materials occur in different proportions at the sites. Allen and Katz (2015) also found that the mean weight of both pottery and burned bone was significantly higher at Parker Farm than at Carman. Meanwhile, lithics and unburned bone were slightly greater at Carman. In addition, the proportion by weight of pottery to other cultural material was much higher at Parker Farm, while lithics composed the majority of the collection at Carman (Allen and Katz 2015: 19). The sites also differ in size, with Parker Farm being approximately 0.2 hectares (0.5 acres) larger than Carman. In addition, Parker Farm is a more dispersed settlement, while Carman presents a denser aggregation of activity (Allen and Katz 2015). Overall, these results suggested differing activities between the sites. Within the context of site diversity, this study will examine the extent of these differences exhibited in the pottery assemblages at the sites of Parker Farm and Carman and the implications of these differences for the greater understanding of site diversity and functionality in the Cayuga region of Iroquoia.

1.3 IROQUOIAN POTTERY

Pottery was essential for Iroquoian peoples for the storing and preparation of food. In general, Iroquoian subsistence relied mostly on the growth and storage of maize, which constituted a large portion of their diet. Other domesticates included squash and beans. In most areas, the gathering of wild resources, such as berries and nuts, also contributed to Iroquoian subsistence, acting especially as a buffer against poor crop yields. In areas near water resources, fishing was also a component of diets. Hunting was widespread, with the main game being deer (Engelbrecht 2003:24-25). The majority of foods prepared were varieties of corn stews, in addition to wild fruits and potatoes. Squash and beans were also consumed and meats were prepared for special occasions. Various teas were also prepared by boiling leaves or spices in water (Allen 1992: 137). Within the longhouse, women were responsible for cooking meals and they managed the distribution of food. The main meal of the day would be consumed in the morning, but the pot would remain on the fire to be available to any household member throughout the day (Allen 1992: 137).

This study hopes to further expand on the differences in the density of pottery noted by Allen and Katz (2015) by looking at the total assemblage of undecorated body sherds at both the sites of Parker Farm and Carman. Iroquoian pottery was most likely produced at the household level. Pots would have been produced by the women and there is little evidence for specialization (Allen 1992: 142). The primary function of pottery was as utilitarian vessels. Most vessels were utilized for cooking, primarily for cooking over an open fire. Despite the utilitarian nature of the pots, it is possible that some vessels were used for specific foods. Since cooking leaves a residue on the surface of the vessel, it is likely that separate pots were used for the cooking of food and for the preparation of teas (Allen 1992: 139). Ceramics may have been used as storage vessels, although the primary means of storage consisted of pits and above ground structures (Allen 1992: 139). This study will take into account the utilitarian uses of ceramics in the categorization of the sherds in question at the sites.

1.3.1 Reduced and Oxidized Interiors

In this study, pottery from the two sites of Carman and Parker Farm was compared in order to determine if differences in the overall density of pottery and specific areas of concentration could shed light on different site functions. In particular, densities of undecorated pottery sherds were compared between the sites to understand possible general differences. Intra-site differences were analyzed by using interior sherd color as a proxy for vessel use. Reduced (blackened) interiors suggest a conscious effort to reduce the porosity of the vessel and thus is associated with cooking vessels. Although food particles from the cooking process would eventually seal pores in the clay body, without technical choices to reduce permeability, water loss would occur and make pots less effective for cooking, as well as shorten their use-life (Schiffer et al. 1994: 200). The blackened surface exhibited in the reduced sherds could be a result of firing the pot in a particular way so as to deprive the surface of oxygen (Rieth and Horton 2010:10-11). The blackened hue left by this anaerobic firing environment is the result of unburned carbonaceous material left in the clay paste (Rice 2015: 279). This is indicative of a conscious effort during firing to reduce the porosity of the vessel. In a completely oxidized vessel, one in which oxygen was not reduced during firing, all carbonaceous material would be burned away, leaving open pores in the clay body (Rice 2015: 316). Therefore, through the technical decision to reduce oxygen during firing, a potter can manufacture pottery that would be better modified to serve as a cooking vessel.

Another manufacturing technique that reduces porosity and results in a blackened surface is smudging, a surface treatment in which carbon is deposited on the surface of a pot during or after firing (Rice 2015:289). This is another technical choice indicative of a cooking vessel since it uses carbon to fill pores in the clay paste in order to reduce porosity. This is most likely the method utilized at our sites to achieve a reduced interior since it is extremely hard to control reduction in an open firing environment (Kapches 1994; Rice 2015). In addition, pots from an open fire would exhibit a variation of interior color (Kapches 1994:94), but the sherds in this sample display a consistent black interior.

Finally, a blackened interior might not be a technical choice, but rather a result of the use of the vessel. Cooking would cause exposure to charring, smoke, and sooting, all of which would deposit carbon on the surface, leaving a blackened appearance (Rice 2015:290). However, whether pre- or post-firing, reduction, smudging, and sooting, all result in blackened surfaces and are associated with cooking. In particular, reduction and smudging are related to cooking because there was likely intentional reduction in order to reduce the pot's porosity. Oxidized sherds are then associated with the storage of dry goods because there has not been effort to seal pores in the clay body left by the burning of organic materials during firing (Rice 2015:316). Throughout this study, the interior colors will be referred to as reduced and oxidized, respectively. The distributions of these interior colors across sites can be used to indicate differing activities.

1.4 THE SAMPLE

In this study, pottery between the two sites of Carman and Parker Farm was compared in order to determine if differences in the overall density of pottery and specific areas of concentration indicate different site functions. In particular, densities of undecorated pottery sherds were compared between the sites to understand possible general differences. Intra-site differences were analyzed by using interior sherd color as a proxy for vessel use. Reduced (blackened) interiors suggest a conscious effort to reduce the porosity of the vessel and thus is associated with cooking vessels. Although food particles from the cooking process would eventually seal pores in the clay body, without technical choices to reduce permeability, water loss would constantly occur and make pots less effective for cooking, as well as shorten their use-life (Schiffer et al. 1994: 200). The blackened surface exhibited in the reduced sherds could be a result of firing the pot in a particular way so as to deprive the surface of oxygen (Rieth and Horton 2010:10-11). The blackened hue left by this anaerobic firing environment is the result of unburned carbonaceous material left in the clay paste (Rice 2015: 279). This is indicative of a conscious effort during firing to reduce the porosity of the vessel. In a completely oxidized vessel, one in which oxygen was not reduced during firing, all carbonaceous material would be burned away, leaving open pores in the clay body (Rice 2015: 316). Therefore, through the technical decision to reduce oxygen during firing, a potter can manufacture pottery that would be better modified to serve as a cooking vessel. Another manufacturing technique that reduces porosity and results in a blackened surface is smudging, a surface treatment in which carbon is deposited on the surface of a pot during or after firing (Rice 2015:289). This is another technical choice indicative of a cooking vessel since it uses carbon to fill pores in the clay paste in order to reduce porosity. This is most likely the method utilized at our sites to achieve a reduced interior since it is extremely hard to control reduction in an open firing environment (Kapches 1994 & Rice 2015). In addition, pots from an open fire would exhibit a variation of interior color, but the sherds in this sample display a consistent black interior (Kapches 1994:94). Finally, a blackened interior might not be a technical choice, but rather a result of the use of the vessel. Cooking would cause exposure to charring, smoke, and sooting, all of which would deposit carbon on the surface, leaving a blackened appearance (Rice 2015:290). However, whether pre- or post-firing, reduction, smudging, and sooting all result in blackened surfaces and are associated with cooking. In particular, reduction and smudging are related to cooking because there was presumed to be intentional reduction in order to reduce the pot’s porosity. Oxidized sherds are then associated with the storage of dry goods because there has not been effort to seal pores in the clay body left by the burning of organic materials during firing (Rice 2015:316). Throughout this study, the interior colors will be referred to as reduced and oxidized, respectively. The distributions of these interior colors across sites can be used to indicate differing activities.

2.0 RESEARCH QUESTION 1 – DENSITY COMPARISON

2.1 METHODOLOGY

In order for the comparison of material from both sites, the density of sherds from each unit of excavation was determined. First, the approximate volume of soil removed from each unit in cubic meters was calculated. Then, quantification and coding of the recovered sherds was carried out. This involved sorting the sherds into two categories based on interior color (reduced and oxidized), which, as stated earlier, is used as a proxy for function. Exfoliated sherds were not included because interior color cannot be determined due to lack of complete surfaces. After each sherd was categorized by interior color, they were counted and weighed as a group.

Large sherds were examined further. A large body sherd was identified as larger than 2.1cm in diameter, roughly the size of a nickel. The unit, level, and provenience number of the sherd were recorded and afterward each large sherd was weighed separately. The thickness of the sherd was also taken, recorded to the 0.1 centimeter, and the interior color of the sherd was documented. In addition, the temper type was determined and recorded. The most common temper was grit, but several sherds were found to have shell or sand temper.

Once all of the quantification was complete, this information was combined with the previously obtained volume data. Densities, by weight and by count, were obtained for each excavation unit from Carman and Parker Farm. Although both the counts and weights were recorded, the analyses focused on the density by weight rather than by count because fragmentation from plowing would have made the count inaccurately high.

2.2 DATA PRESENTATION

Table 1. Summary of Weight and Density Data

	Total Sherd Count	Total Weight	Average Sherd weight	Total Volume	Total Density (by weight)
Carman	1723	3236.2g	1.21g	$13.38m^3$	$237.32g/m^3$
Parker Farm	8876	8875.1g	1.01g	$13.89m^3$	$543.73g/m^3$

At first observation of the data (Table 1), it is clear that there is a sharp difference in the overall density of pottery material at the sites. While the total volume of the excavated units is fairly similar between the sites, the count of sherds at Parker Farm is much higher than that of Carman. While the average sherd weight shows greater fragmentation at Parker Farm, the total weight is still greater than Carman. Due to this, the overall density by weight of the material is much higher at Parker Farm than at Carman. Despite this, only slight differences are seen in the proportions of reduced and oxidized sherds at the sites (Table 2). Slightly higher proportions of exfoliated sherds are found at Parker farm, which further indicates greater fragmentation at this site. At both sides reduced sherds exist in much higher proportions than oxidized.

Table 2. Proportion of sherd categories

	Exfoliated	Reduced	Oxidized
Parker Farm	46.36%	44.20%	9.44%
Parker Farm (without Exfoliated)	---	85.25%	14.77%
Carman	38.79%	48.83%	12.38%
Carman (Without Exfoliated)	---	77.77%	22.23%

2.2.1 Overall Areas of Concentration

The first analysis that was done was to examine overall areas of concentration. Parker Farm and Carman exhibited different patterns of concentration; however, the patterning of areas of concentration at the site seems to suggest a widespread use of space. Generally, the concentrations at Carman are spread out along the central axis of the site, both within the house structure and in units surrounding the domestic area (Fig. 3). A particularly dense area of concentration is found in the northern section of the house, while other dense units are found to the south of the house.

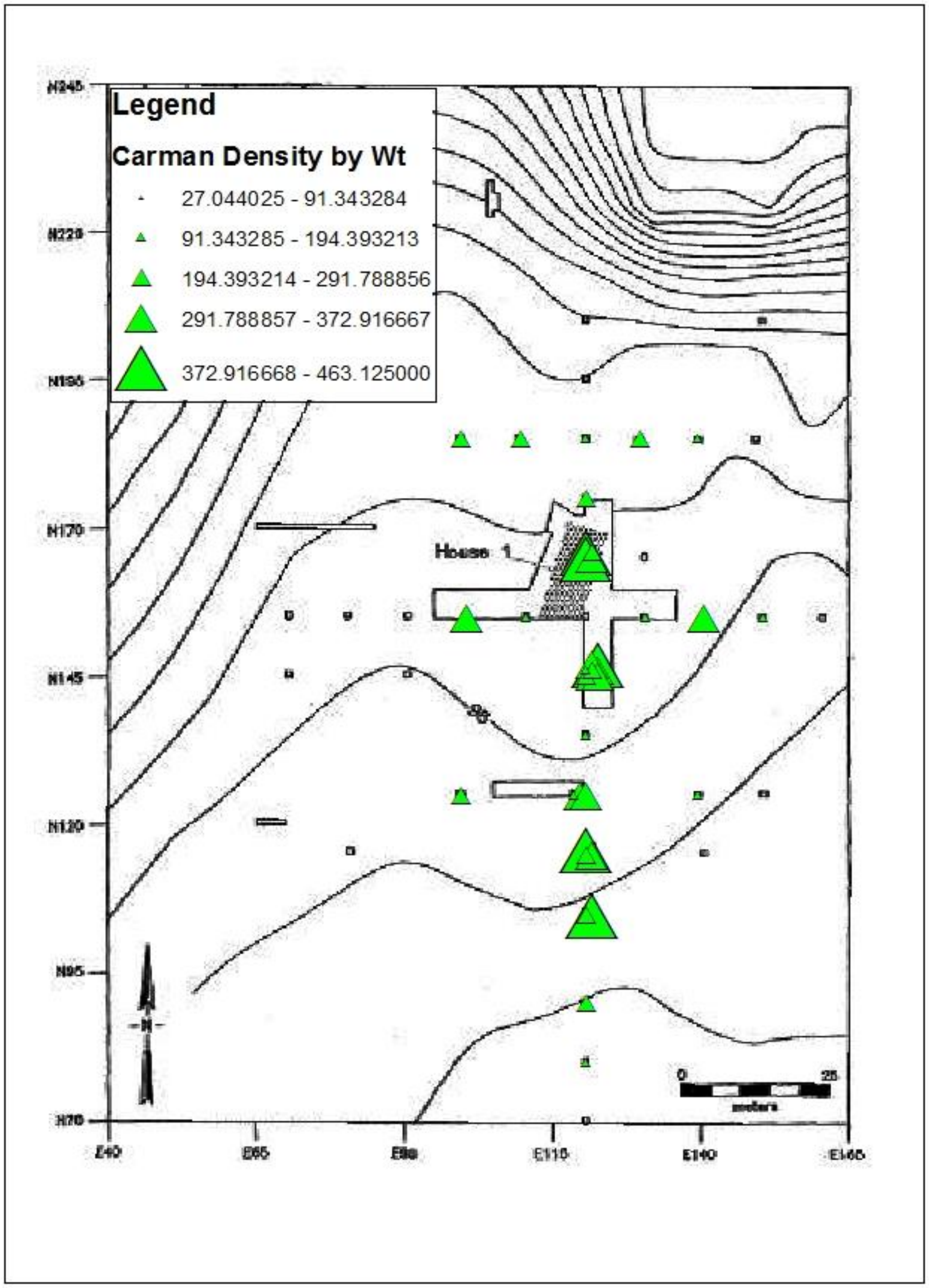

Figure 3 - Carman Density by Weight

At Parker Farm, the areas of the highest density of sherds are much more concentrated in small areas than at Carman. The units of highest density are located almost exclusively within the house structure with the exception of a midden unit located approximate 20 meters to the south (Fig.4). Another dense area is found approximately 75 meters south of the house. All of these concentrations are located within the wooded region of the site. This difference in the overall patterning at the sites suggests a less diverse range of activities occurring at Parker Farm due to the less dispersed nature of the pottery sherds. This along with the greater overall density at Parker Farm could indicate a possible focus on pottery production or a longer occupation of the site than at Carman.

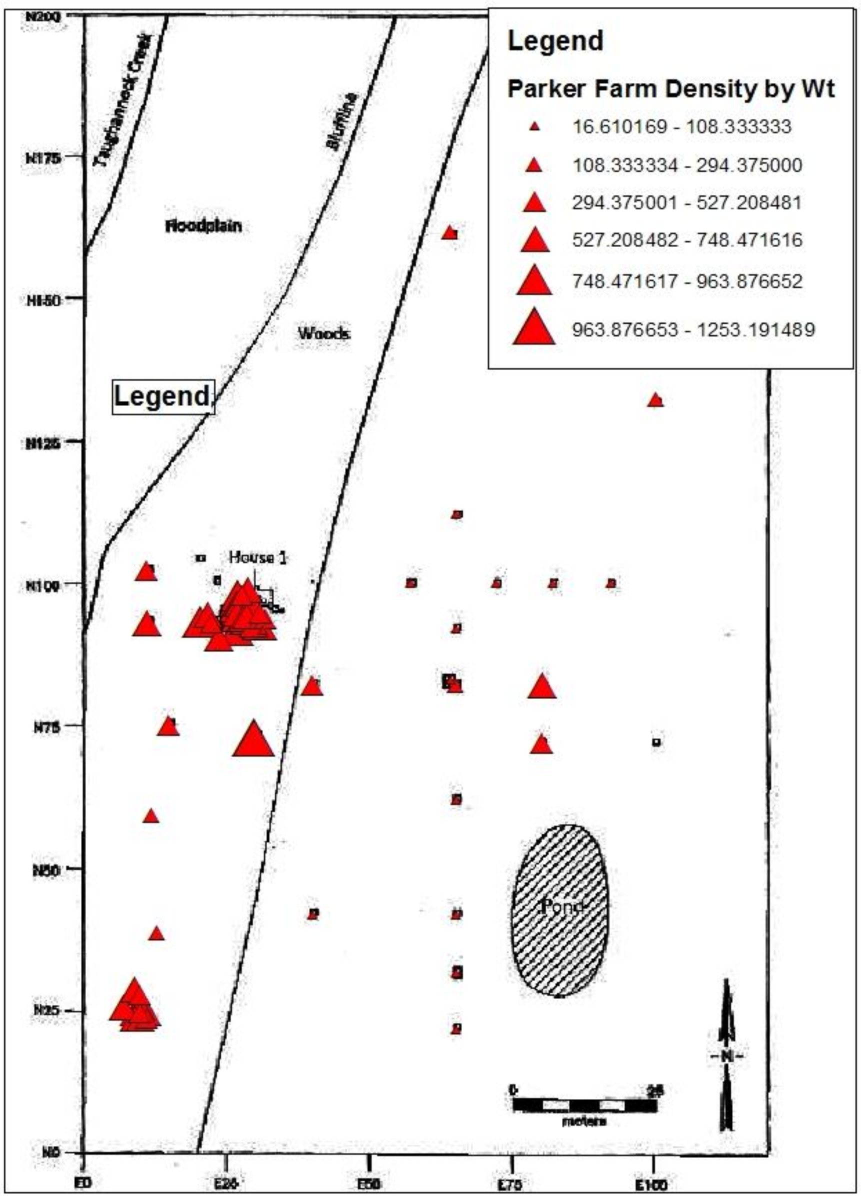

Figure 4. Parker Farm Density by Weight

2.2.2 Reduced and Oxidized Areas of Concentration

Further analyses examined the concentrations of reduced and oxidized sherds. For each of the units, the total weight for each of the interior colors was divided by the soil volume by unit in order to determine the density. From these calculations, only the units with higher densities are examined in order to better visualize patterns. Units of high density by weight for both reduced and oxidized interiors were plotted on site maps. The units at Carman with reduced interior sherds exhibiting a density of over 150 g/m^3 (Fig.5) and an oxidized interior density of over 50 g/m^3were considered "high density" (Fig. 6). At Parker Farm, a density of over 500 g/m^3 for reduced interiors (Fig.7) and over 100 g/m^3 for oxidized interiors (Fig.8) were also indicated as "high density".

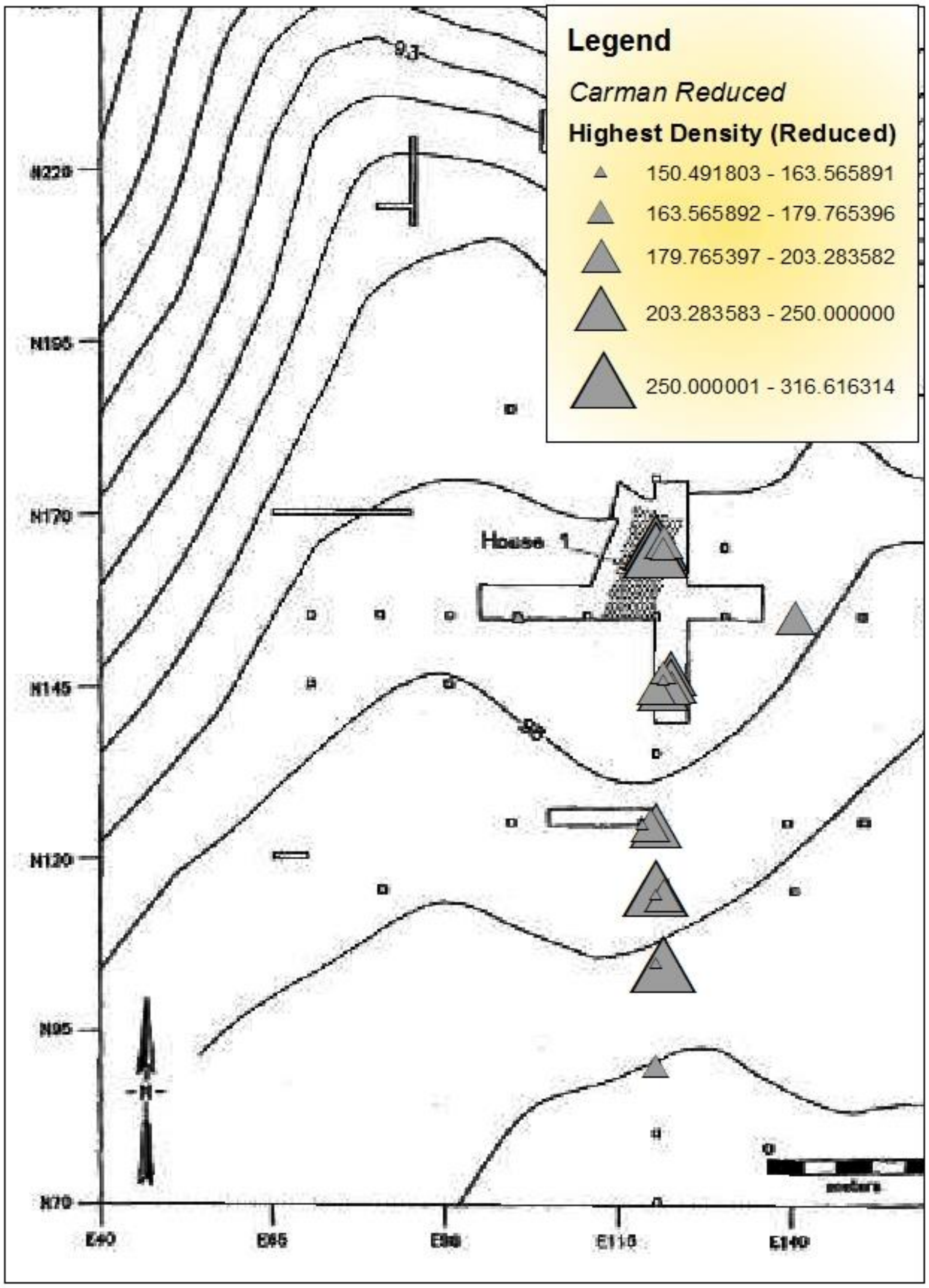

Figure 5. Carman Areas of Highest Density (Reduced)

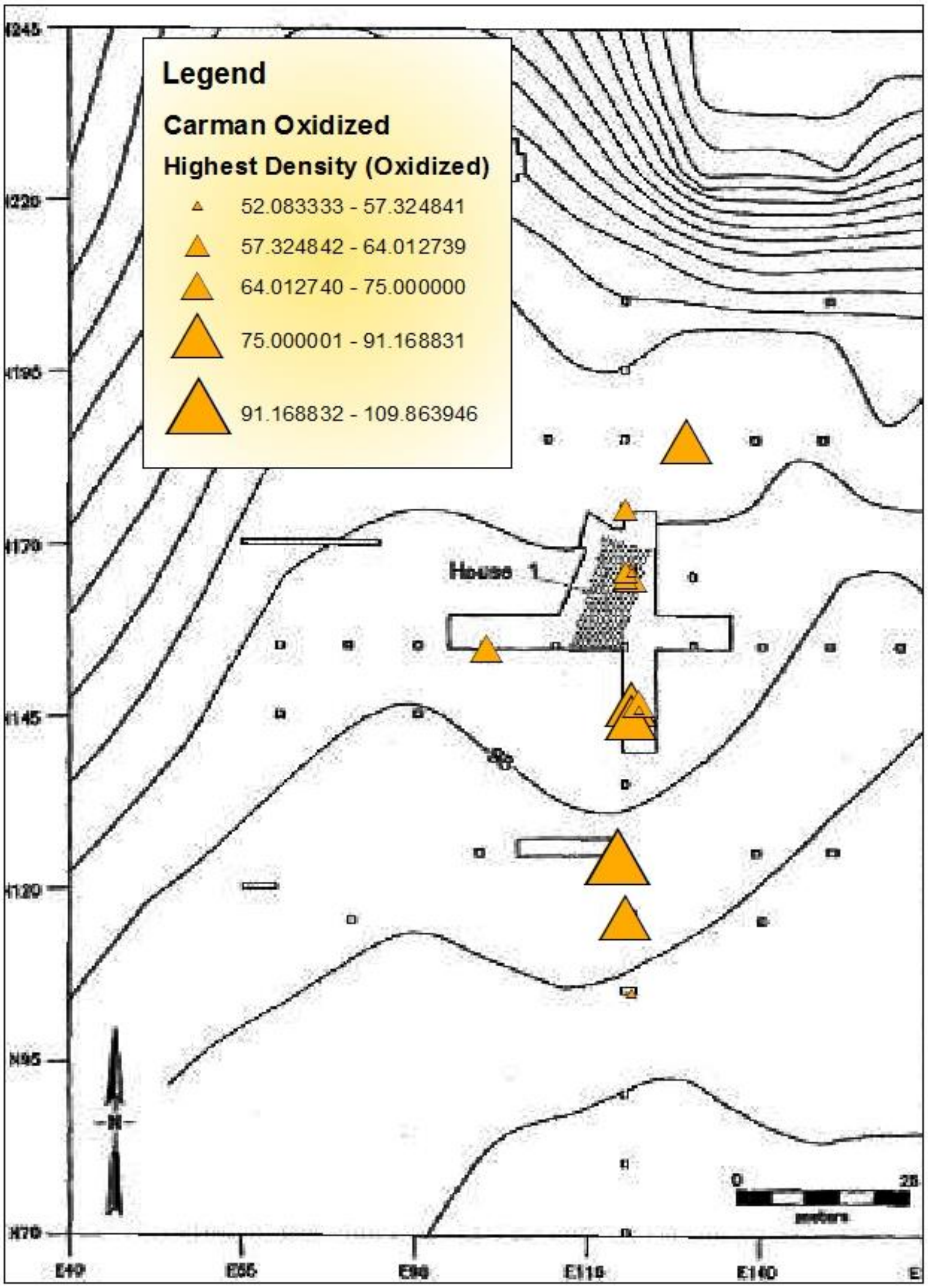

Figure 6. Carman Area of Highest Density (Oxidized)

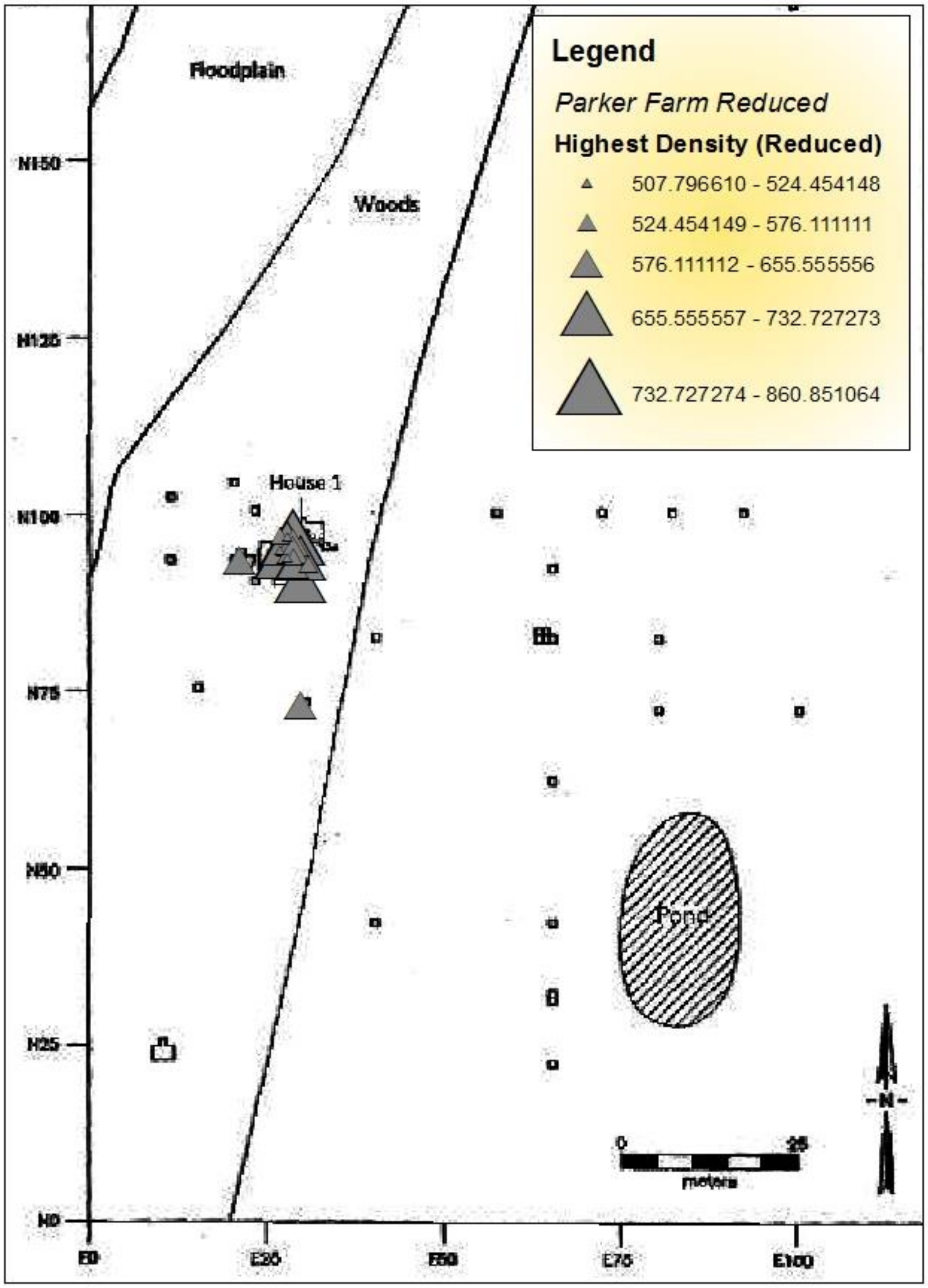

Figure 7. Parker Farm Area of Highest Density (Reduced)

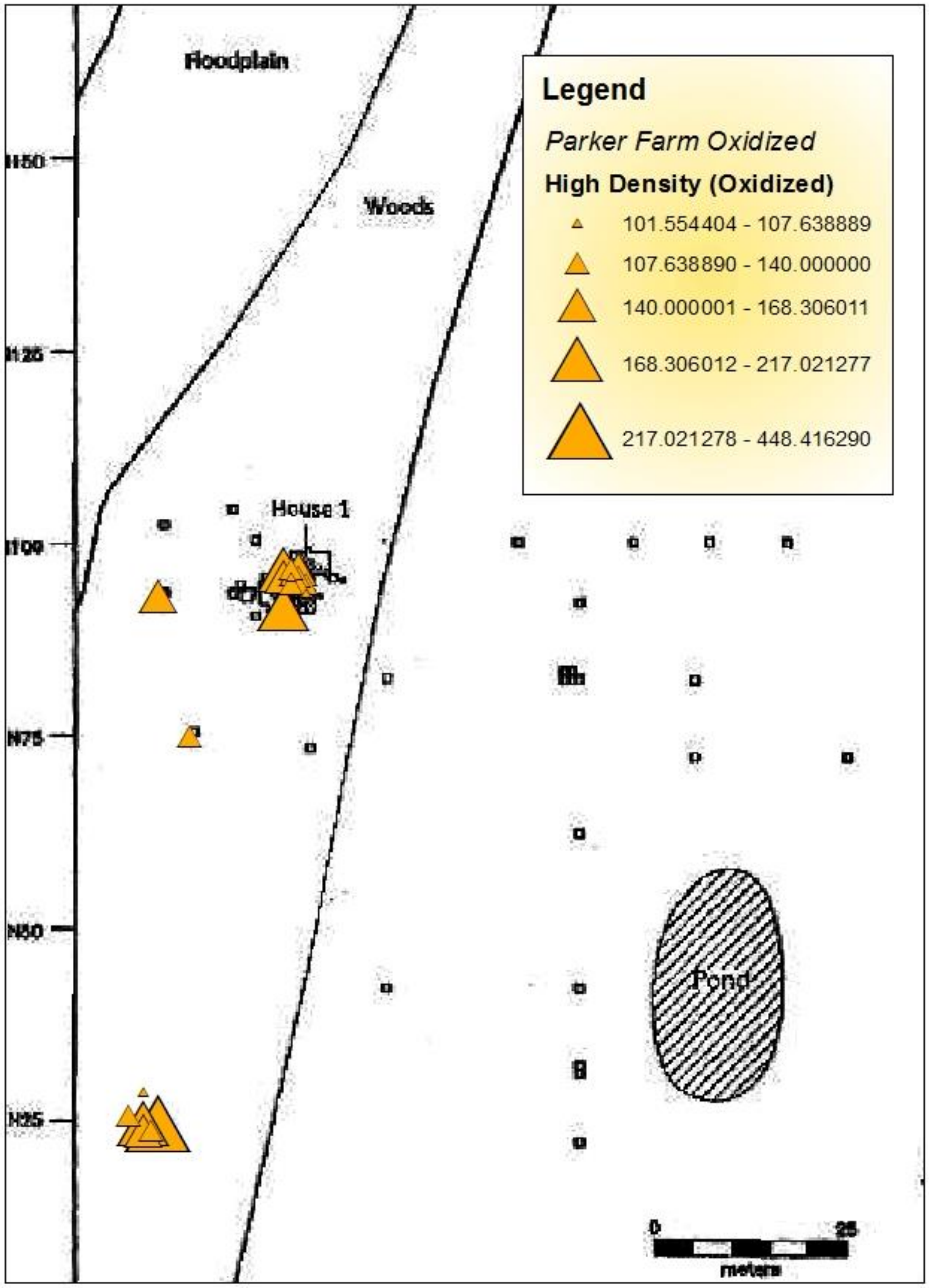

Figure 8. Parker Farm Area of Highest Density (Oxidized)

At Carman, a cluster of units slightly south of the house exhibited high concentrations of both oxidized and reduced interior sherds (Fig. 5 and 6). Aside from this cluster, another grouping of oxidized sherds occurs in the same northern section of the house that also exhibited the highest overall density (Fig. 6). A large amount of reduced sherds were found in units roughly 40-50m south of the house (Fig. 5). These patterns vary from that seen at Parker Farm. Generally, the main areas of reduced and oxidized concentration at Parker Farm reflect the same localized areas as the general areas of concentration. With the exception of a few units about 5-10m outside of the house, areas of concentration, both reduced and oxidized, are found within the domestic structure (Fig.7 and 8). However, a particularly dense area of oxidized sherds is found about 75 meters south of the house (Fig.8). This area exhibits low density of reduced sherds, possibly indicating an area of different function than the house structure. Because of the function typically associated with oxidized pots, this could have possibly functioned as a storage area. These concentration patterns differ from Carman, where areas of concentration are found within the house and dispersed throughout the units at the site. Conversely, the units in the open field at Parker Farm exhibit the lowest density of overall material. Overall, this further illustrates the differing spatial organization of the sites. Habitation at Parker Farm was organized into sections of heavy concentration, while a more broadly distributed use of space was present at Carman.

When examining the areas of concentration of the reduced and oxidized sherds it is important to keep in mind that deposition is not always indicative of where the pot was utilized (Schiffer 1972: 380). Therefore, it cannot be assumed that the areas of high densities of black interior are indicative of cooking areas. However, these densities can signify that there were locations primarily used for cooking in some areas on the site. It is also important to note that although a pot with a blackened interior could have been intended to function as a cooking vessel, its actual use could be different. The disparities between intended and actual function can often result from the fact the potter and the user of the vessel are often different people (Skibo 1992:2).

2.3 ANALYSIS

In looking at the areas of concentration discussed, one pattern that should be noted is the differences in sherd dispersal between Carman and Parker Farm. To reiterate, densities at Parker Farm are higher but much more concentrated in the house structure. At Carman, densities are lower, but areas of concentration are more dispersed across the site. These preliminary results suggest differing occupations at the sites and seem to call into question suggestions of consecutive occupation of the sites. Firstly, being only one mile apart, the sites seem too close to indicate consecutive village settlement of the same community. In addition, it is unlikely that they were concurrently inhabited by different communities since generally "contemporaneous villages in the same tribal area are separated from another by between five and ten miles" (Engelbrecht 2003:80). Secondly, if the sites were occupied sequentially for similar lengths of time by the same community, we would be expect to see more similarities in the density and dispersal of material (Allen and Katz 2015). However, occupation at Parker Farm indicates greater intensity around the house structure. Alternatively, inhabitants exploited more space at Carman.

Since there is a marked difference in density and dispersal of pottery, it is likely that the sites were either inhabited for different amounts of time, possibly indicating seasonality, or had different site functions. Due to the greater density of pottery material and its central concentration in the house structure, Parker Farm may have been occupied seasonally as a pottery production site. In addition to the close and accessible clay deposits, Allen and Katz

(2015) have identified a higher proportion of pottery as compared to lithics, which would further support this proposition. There has also been an identification of a greater emphasis on hunting at Carman due to the quantities of unburned bone present, as well as a “greater reliance on a diverse set of wild resources” (Allen and Katz 2015:26). Drawing from Kapches’ (1994) of a possible Iroquoian firing site, Parker Farm also has easier access to clay resources and is closer to water both in the nearby creek and at the pond on site. It also lies in close proximity to Carman, but far enough away that an out of control fire would not devastate the village. In addition, the clustering of oxidized sherds in the southern portion of the site may indicate either a storage area or a clustering of pottery that had not yet received surface treatment. Functioning as a pottery production or firing site would also indicate a seasonal occupation for Parker Farm, since pottery production would typically be carried out during the summer months (Allen and Zubrow 1989:81-89). On the other hand, Carman is located further away and uphill from clay and water, thus making it less likely that intensive pottery production was carried out at this site. Carman also exhibits differing dispersal patterns of pottery, which further illustrates possible functional differences at the sites. The two seem to have dissimilar occupational organization and use of the landscape. To further elucidate these distinctions, the elemental composition of the pottery was compared between the sites.

3.0 RESEARCH QUESTION 2 – CHEMICAL COMPOSITION ANALYSIS

In the second part of the study, chemical composition analyses were carried out on the sherds. These elemental analyses could indicate either similarities or differences between the sherds at the sites. A finding of different clay components in and between the sites would indicate a variety of things, including but not limited to the use of different clay sources, technical choices by specific potters, and the presence of nonlocal pottery. Similar clay components could indicate locally made pottery. However, sourcing clay in this area is very difficult since the clay is glacially deposited, thus most of the clay in the area would be very similar (Sudina and Allen 2008: 2). Thus, it is not likely that the exact clay source that was utilized could be determined. Despite this, a finding of similar clay components would also indicate that the pottery was made by the same people, using the same formula for the clay paste and temper. Another indication could be that the pottery was transported between sites, thus explaining similarities in the clay. These findings combined with the analysis of pottery densities to define differing site function would support the hypothesis that the sites were inhabited by the same people who utilized the sites for different specific functions.

3.1 PXRF ANALYSIS

To build on the density and concentration study, the sherds were examined more closely through X-ray fluorescence spectrometry. This analytical tool allows for the determination of the chemical composition of various types of materials through a process involving the use of X-rays to induce the atoms of the sample in question to move to an excited state. In turn, the sample then emits fluorescent X-rays which are characteristic of individual elements, thus allowing for the detection of the specific elemental composition of the sample[1]. This type of analysis has become increasingly popular in archaeological applications with the advent of the portable X-ray spectrometer (pXRF). This allows technology that was historically limited to laboratories to be taken out into the field. PXRF also allows for non-destructive methods that produce a multi-elemental analysis, thus lending itself to research in museum and archaeological fields. Access to these machines is also becoming more readily available, both in the academic and professional world (Speakman et al., 2011).

Despite the usefulness of pXRF, its increasingly common practice has prompted a variety of issues and concerns within the scientific community. Some support the convenience of the machine because it allows artifacts to remain intact, enables large data sets to be accessed, and is efficient for completing timely analysis (Forster et al., 2011). However, some concerns address the limitations of the machine, namely the lower sensitivity due to irregular surfaces and the heterogeneous nature of non-destructed samples (Forster et al., 2011). Because of this, some scholars feel that pXRF analyses should be limited to materials such as metal and obsidian and is less applicable for ceramic provenance studies (Speakman et al., 2011). This is particularly

[1] A more extensive explanation of the XRF process is available at bleedrake.com

relevant to this study, as the samples have irregular surfaces and a heterogeneous clay paste due to inclusions. This would be of particular concern if the samples were being compared to those of a different geographic location. Since the sherds from this study are only being compared to one another from the same general area, this lack of homogeneity should not be a major concern. It is, however, a factor that should be kept in mind during the analysis.

3.2 METHODOLOGY

The chosen sample was comprised of 50 sherds from each site, for a total sample size of 100 sherds. They were chosen randomly from the large body sherds, which, as discussed earlier, were defined as having a diameter of roughly 2.1cm. The sample was limited to the large body sherds because more information was obtained from the larger sherds and pXRF technology cannot be used on extremely small objects. Each large body sherd was assigned a consecutive number, and then a random sequence of fifty numbers was generated. These fifty sherds were then pulled for the study. Due to the use of the larger sherds, a slight preference was given to sherds in features or midden areas, since they were the least fragmented by plowing. Also, a new number was generated if the selected sherd was particularly small or unconducive to the study.

The instrument utilized for this study was a handheld Tracer IV-SD, which is manufactured by Bruker and housed at the University of Pittsburgh Department of Anthropology[2]. This machine has the capacity to allow the operator to change settings and filters

[2] Use of pXRF machine courtesy of Dr. Loukas Barton

to optimize detection for specific readings. This study utilized the most general settings (15kV, 40µA, no filter, no vacuum) in hopes of allowing for detection of the most elements, rather than focusing on specific elemental groups. Four readings were taken from each sherd, and then an average reading for each sherd was drawn. This allowed for a precise average to be obtained even if one of the readings was inaccurate. All the readings were 60-seconds long. Two were taken on the interior and two on the exterior surface. The settings and length of readings were kept consistent throughout the course of the study. Out of a desire to retain the integrity of the pottery sherds, destructive techniques such as abrasion or crushing were not used. However, it must be understood then that the analysis cannot take only the clay paste into account. The readings may also reflect temper or inclusions in the clay.

After all of the raw data was gathered, the Artax software was used to process the information. This involved overlaying multiple sets of spectra obtained from the sherds and identifying spectral peaks, which correlate with specific elements. Through identifying these peaks, the software creates a method of analysis, which acts as a model for the objects analyzed. Every peak must be identified in order to create an accurate model. To test the method, the program will show a best fit line overlaid on the spectrum based on the elements identified. If the best fit line does not line up with the spectrum, then some elements are missing. Once it was determined that the method created was as accurate as possible, the next step is deconvolution of the spectrum. In simpler terms, the method is applied to all of the spectra and the results are exported as an Excel spreadsheet (User Guide, PXRF).

After the results are exported, they must be manipulated before meaningful results can be drawn. First, the values had to be normalized by rhodium. Since the tubing of the Tracer IV-SD is made of this element, it needs to be removed from the analysis so as not to inaccurately affect data. This was done by dividing each value by the amount of rhodium in that sample. Afterward, the average of the four readings from each sherd was taken. The resulting data is presented in units of Intensity per second. If any of the numbers seemed vastly different from the other three sets of data, that particular reading was removed and the average of the three remaining readings was taken. In order to visualize the results, each element was compared to the others within and across the sites through multiple scatterplots.

3.3 DATA PRESENTATION

The pXRF analysis resulted in the detection of 15 elements: Argon (Ar), Bromine (Br), Calcium (Ca), Chromium (Cr), Iron (Fe), Potassium (K), Manganese (Mn), Nickel (Ni), Phosphorous (P), Palladium (Pd), Rhodium (Rh), Sulfur (S0, Silicon (Si), Titanium (Ti), and Zinc (Zn). In general, the sherds from Parker Farm and Carman exhibit very similar concentrations of elements. However, for all elements, the sherds from Parker Farm appear more tightly concentrated, while those from Carman exhibit more dispersed values. When each element was plotted against the others in the form of scatterplots, the dispersed differences were especially prevalent in the presence of Manganese (Fig. 9-18). All other elements displayed similar patterning and concentrations between sites. The differences in pattern seem especially prevalent at Carman, where the intensity of Manganese and Calcium varied greatly (Fig.9). The levels of these elements at Parker Farm remained fairly consistent and did not vary between sherds.

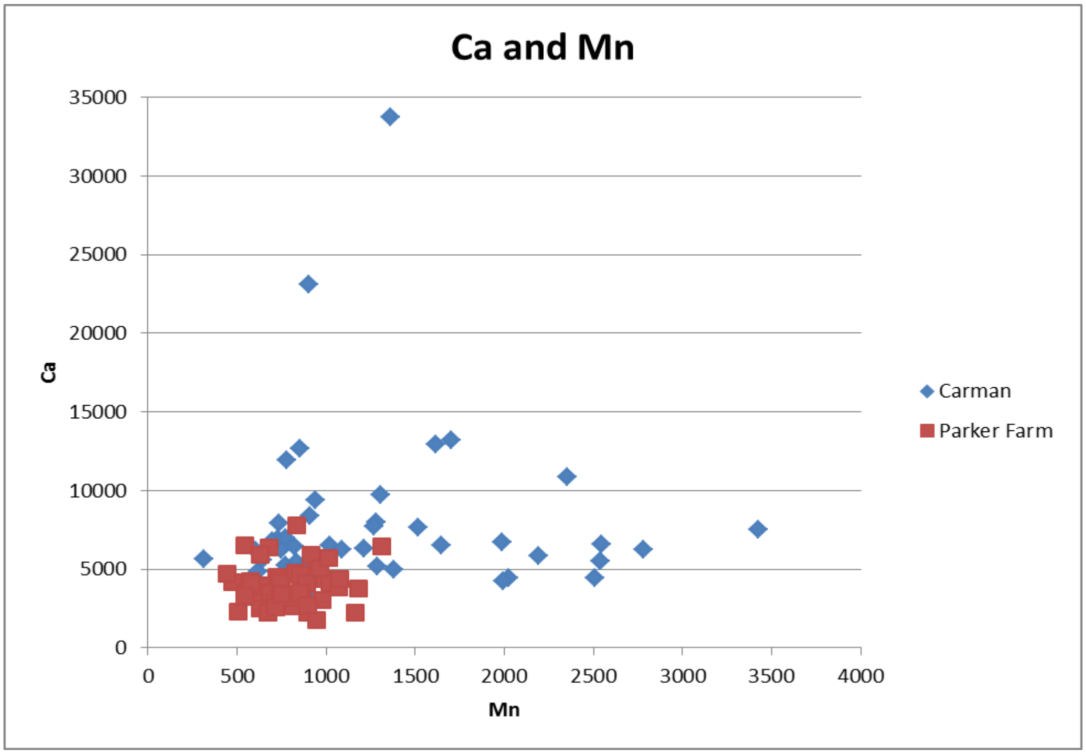

Figure 9. Intensity of Calcium and Manganese Photons

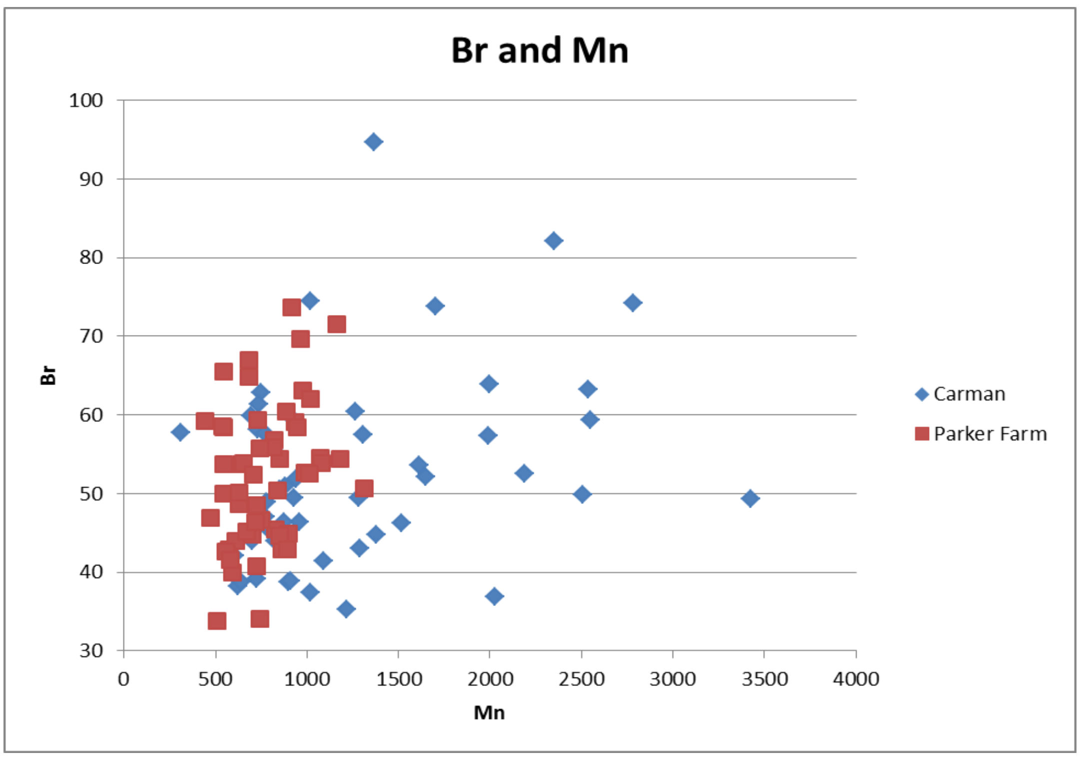

Figure 10. Intensity of Bromine and Manganese Photons

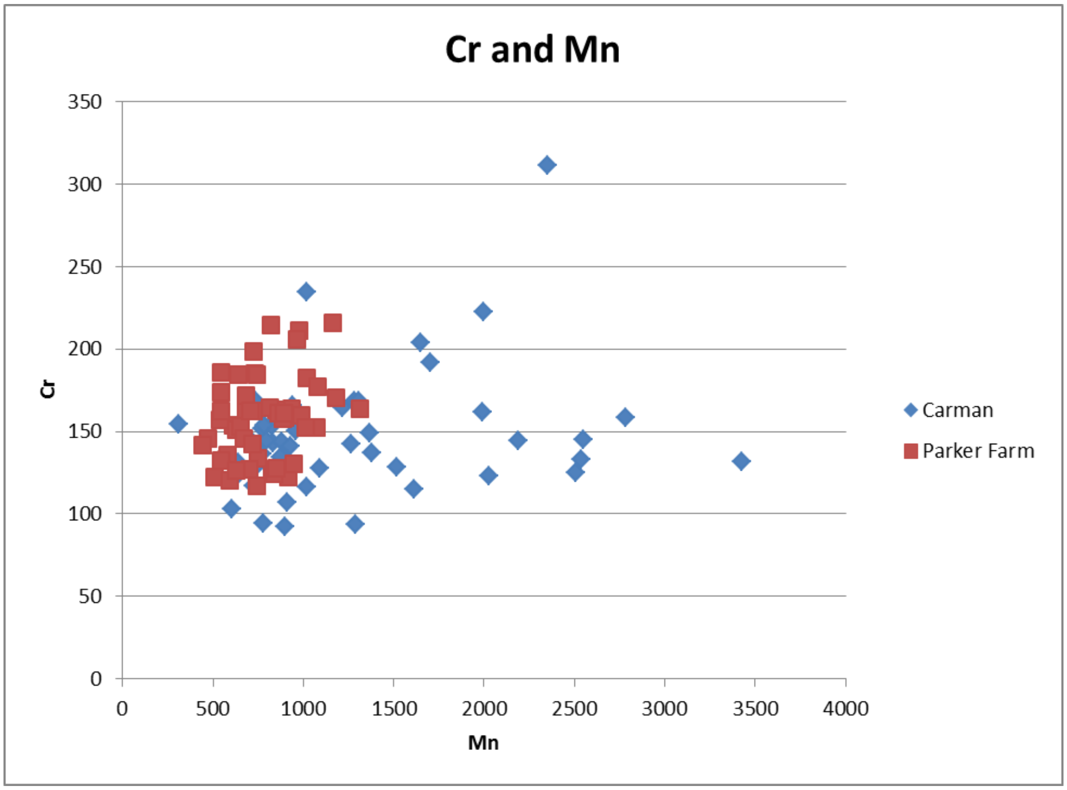

Figure 11. Intensity of Chromium and Manganese

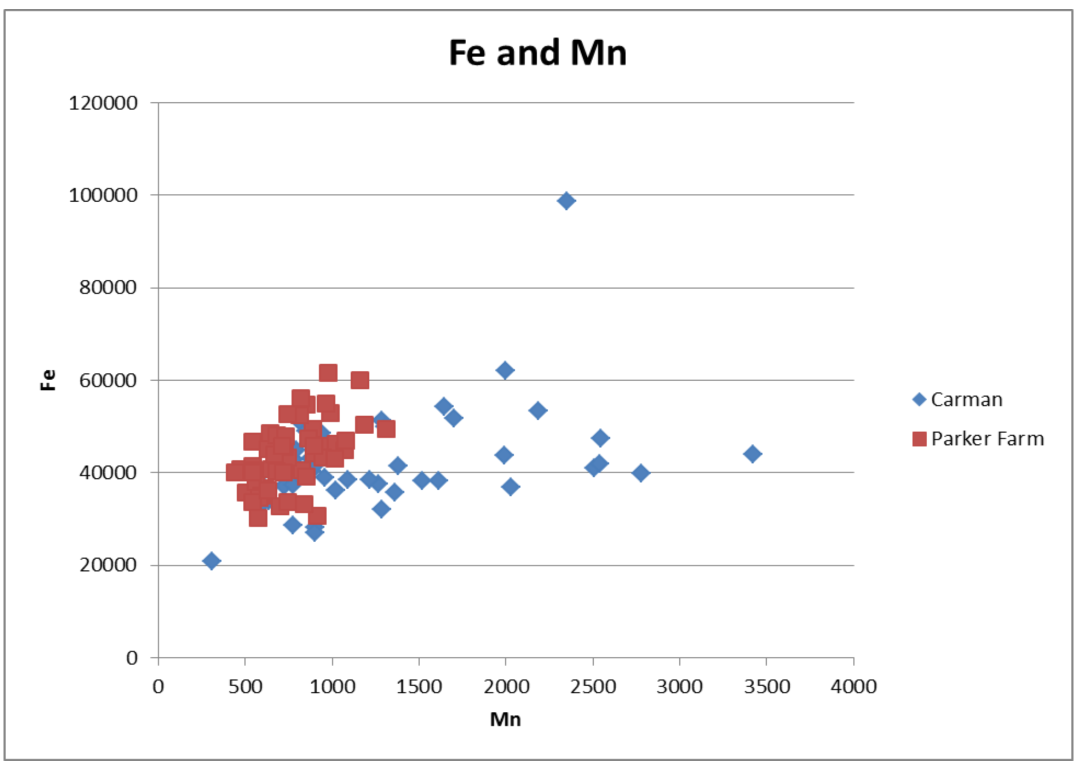

Figure 12. Intensity of Iron and Manganese

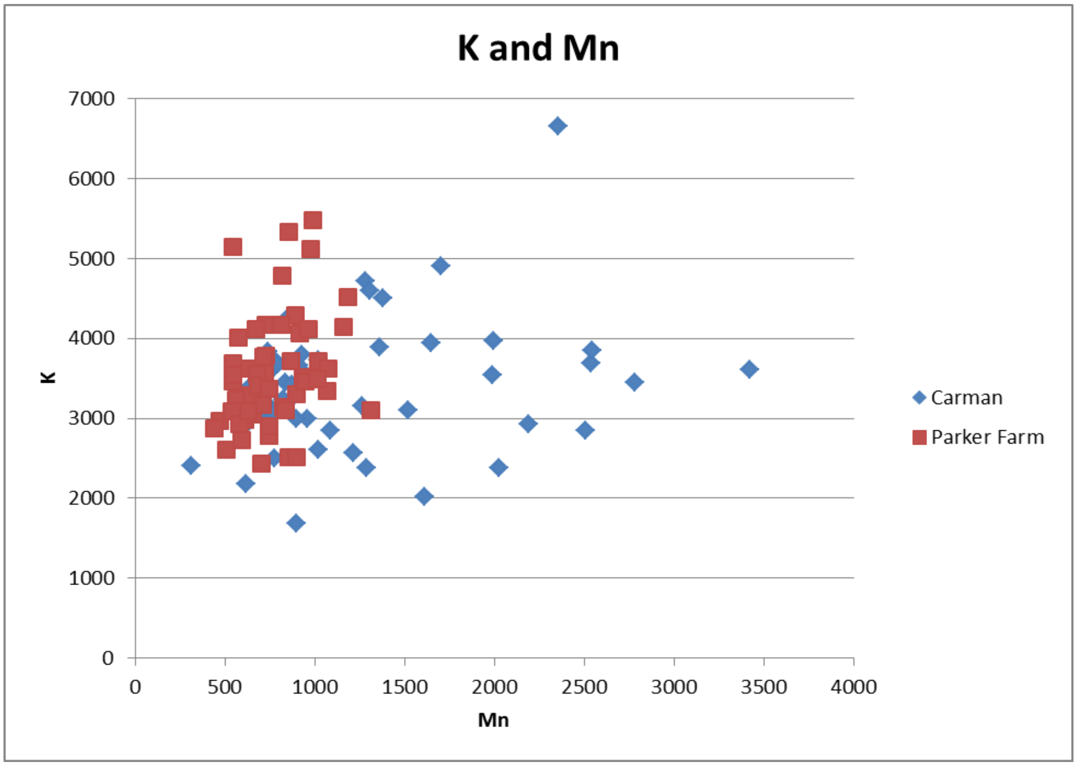

Figure 13. Intensity of Potassium and Manganese

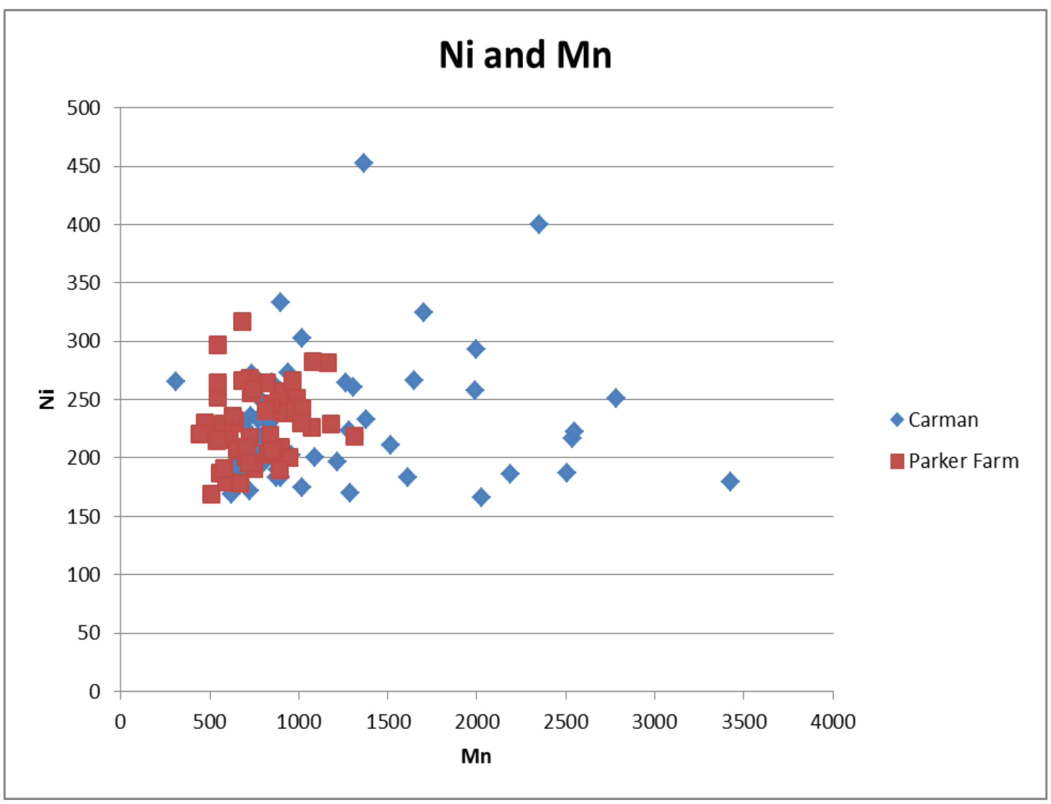

Figure 14. Intensity of Nickel and Manganese

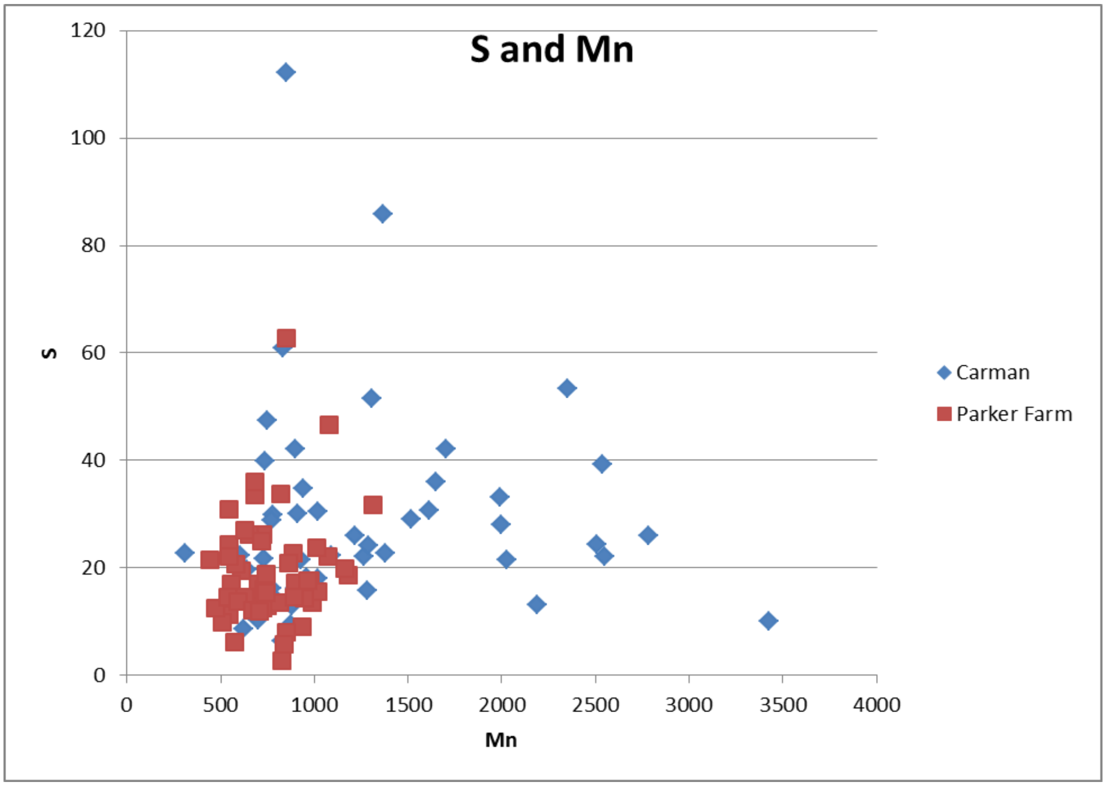

Figure 15. Intensity of Sulfur and Manganese

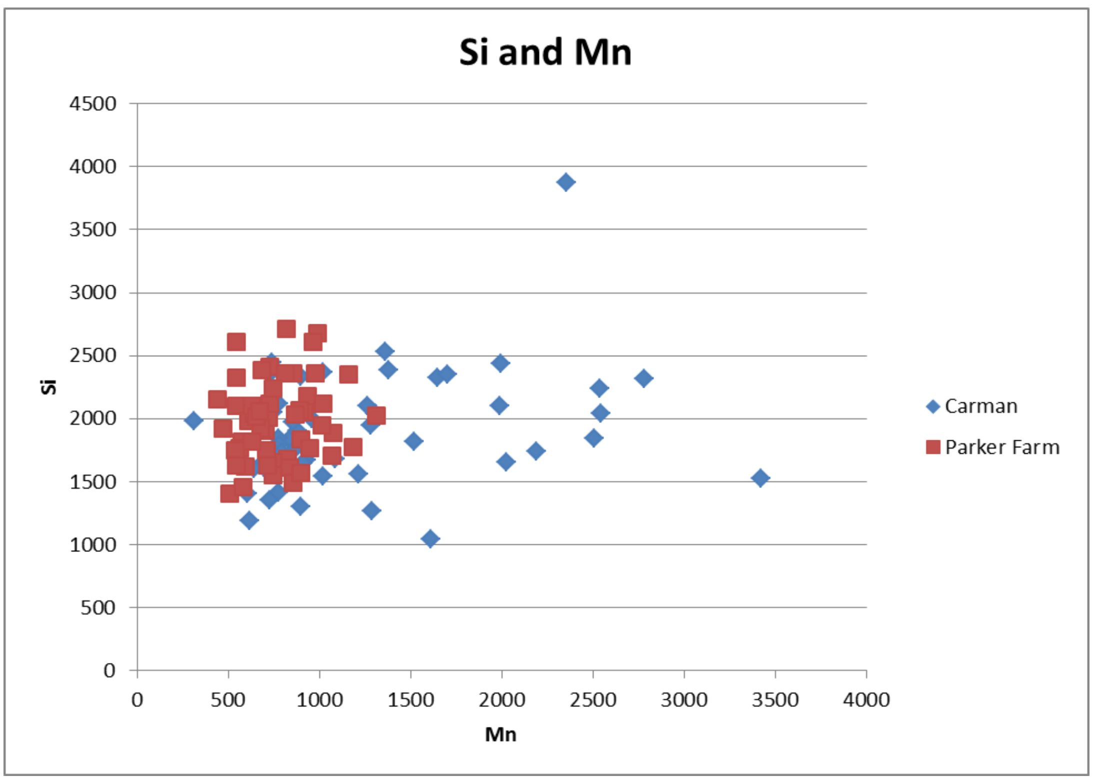

Figure 16. Intensity of Silicon and Manganese

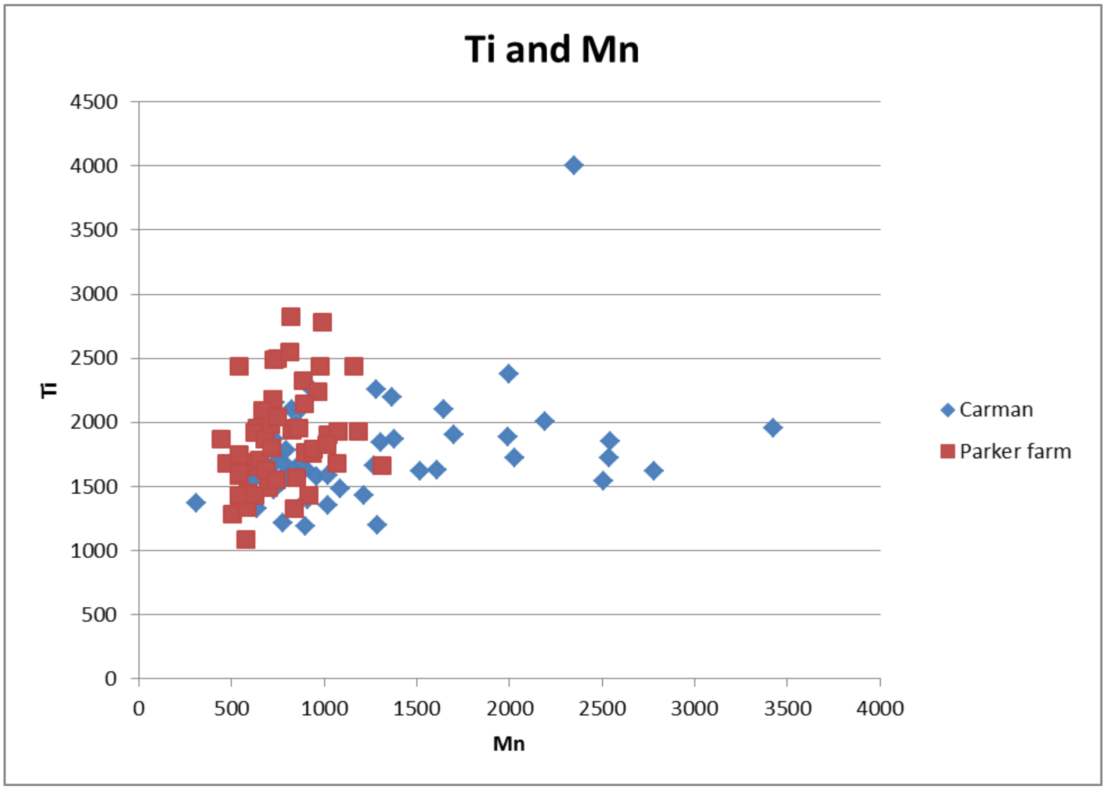

Figure 17. Intensity of Titanium and Manganese

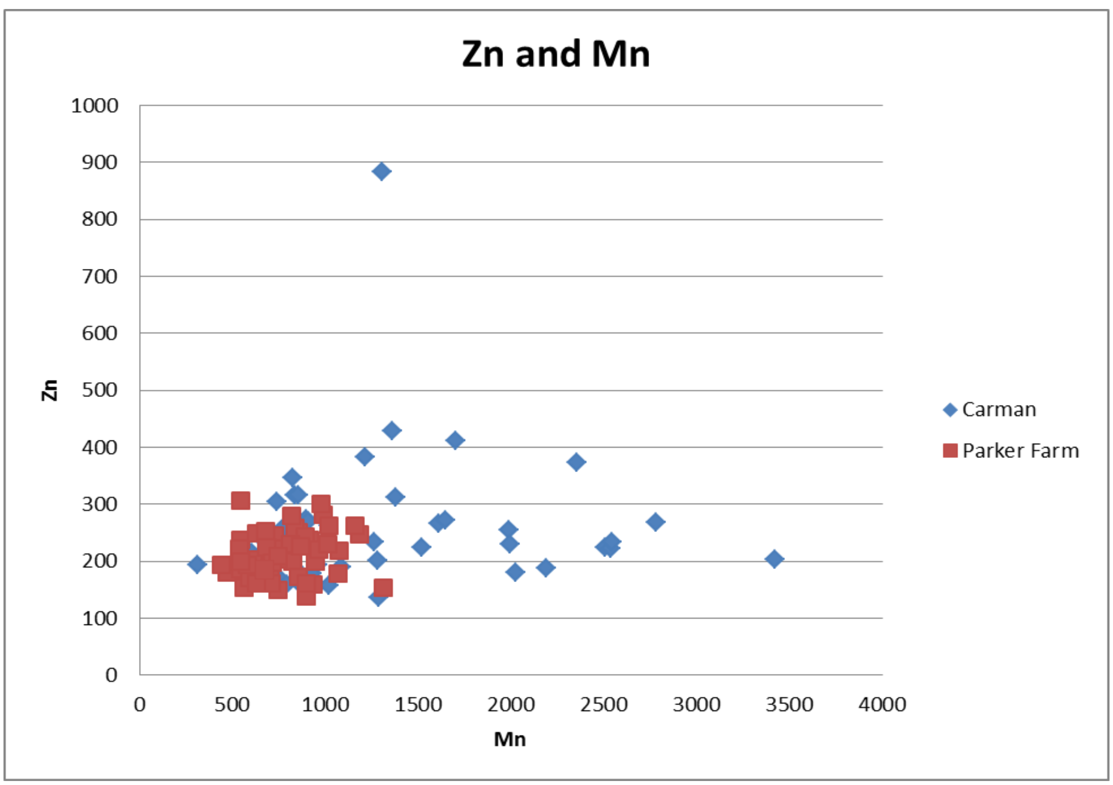

Figure 18. Intensity of Zinc and Manganese

4.0 DISCUSSION AND INTERPRETATION

As discussed earlier, one of the previous interpretations about the sites of Parker Farm and Carman suggested that they were consecutive sites inhabited by the same group of people. However, recent studies (Allen and Katz 2015) along with the new evidence uncovered would seem to suggest otherwise. First as the sites are only one mile apart, they seem to be too close to one another to indicate consecutive village settlement. Also if the sites were consecutively occupied for similar amounts of time, one would expect to see more similarities in the density and dispersion of the pottery material. However, it is evident that the density of material at Parker Farm is much higher than that at Carman. It is also much more concentrated in two locations, mainly in the house structure and midden unit. The units of highest density at Carman are more scattered, however they do seem to gather along the central axis of the site. Since the patterns of pottery deposition are so different, it would seem that differing patterns of activities were occurring at the sites, possibly indicating distinct site functions.

This interpretation is further supported by data obtained from pXRF analysis. Despite the overall similarities of the elemental composition of the sherds, Parker Farm exhibits much less variability in levels of elements than Carman. This is consistent with previous petrographic analyses that indicate much more variability in the temper components at Carman, while Parker Farm exhibits almost exclusively the same temper (plagioclase) (Sudina and Allen 2008). As stated, the pXRF analysis in this study did show more variable levels at the site of Carman, particularly in the presence of manganese. This could indicate differences in surface treatment, both between sites and in the interior color of the sherds. For low-fired, unglazed pottery few slips or colorants can survive the temperatures of firing without oxidation occurring. Manganese, iron, and carbon are the only naturally found colorants (in oxide form) that will survive the firing process (Rice 2015: 160). The pXRF analysis revealed that for most elements, the clay from Parker and Carman displayed a high degree of similarity. However, differences were found in the concentrations of manganese. Since manganese and iron pigment can be used to create a black slip (Rice 2015: 160), levels of manganese and iron were compared to each other at both sites. At Parker Farm, manganese levels for reduced sherds are fairly regular with few fluctuations. However, levels at Carman are much more variable (Fig.19). This was even more evident when iron was removed from the analysis and manganese levels were displayed as bar graphs (Fig.20).

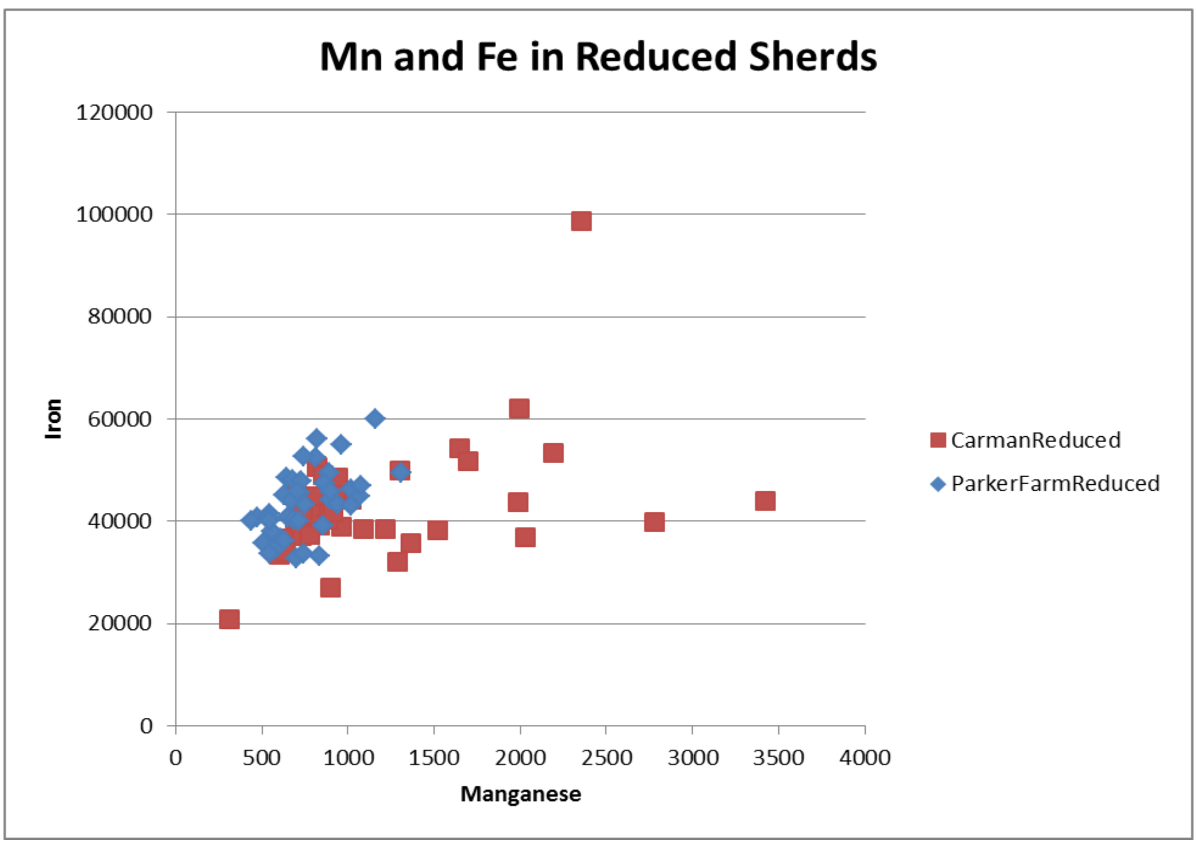

Figure 19. Intensity of Manganese and Iron in Reduced Sherds

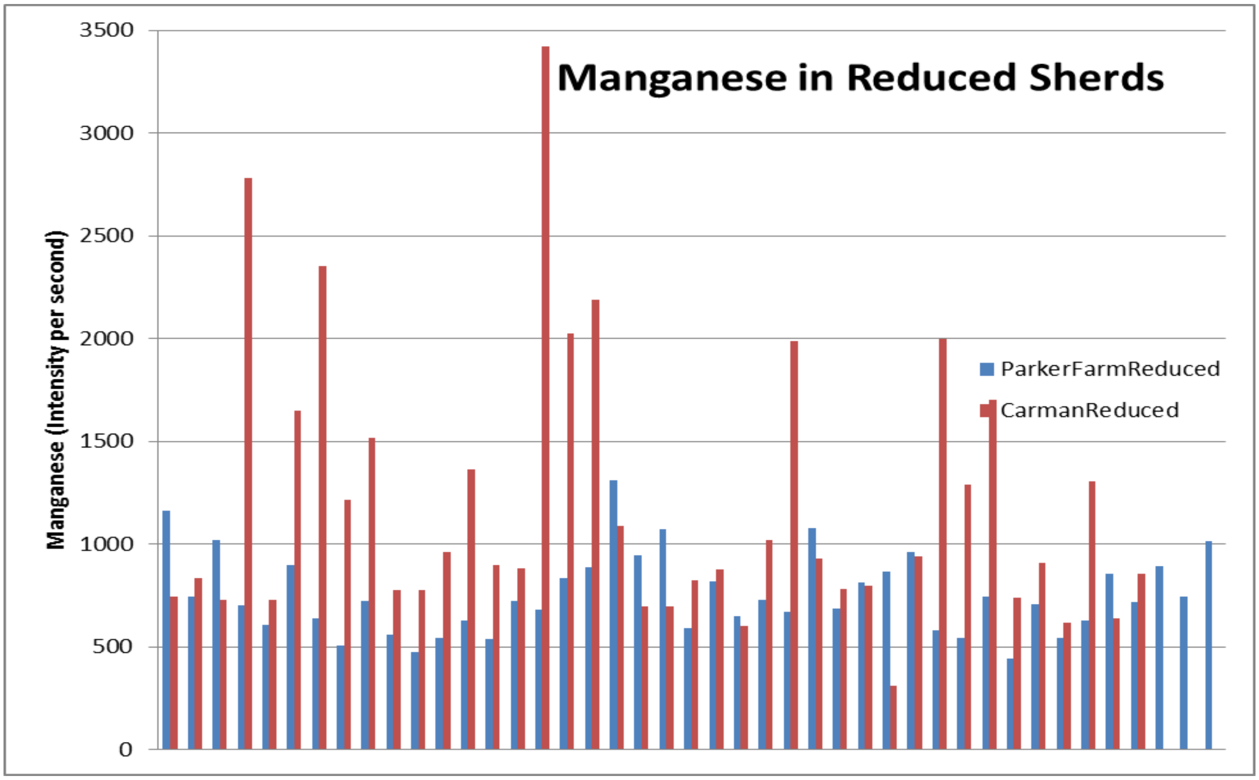

Figure 20. Intensity of Manganese in Reduced Sherds

The overall similarities in elemental composition of the sherds seem to indicate use of a similar clay source, but the difference in manganese could indicate that different surface treatments were occurring at the sites. It should be noted, however, that these apparent differences in composition could be the direct result of the number of potters at work. The greater similarity at Parker Farm could indicate fewer women carrying out the production while variation at Carman, which is the larger site, could be a result of more women taking on production duties.

Based on the differences of densities of material at the site and the comparison of the sherd chemical composition, another interpretation that could be put forth is that Parker Farm was primarily a pottery production site. Although no distinct remains of a firing or production area have been recovered, the significantly higher density of pottery material and the relatively close and accessible clay deposits and water resources would support this hypothesis (Allen and

Katz 2015). This explanation would lend itself to the interpretation that the Carman and Parker Farm had different functions, perhaps indicating specialization among the people who inhabited these sites. Also if Parker Farm is interpreted to have been a pottery production site, then it could function as a seasonal site since pottery production is typically only carried out at certain times of the year, most likely in summer (Allen and Zubrow 1989:83-84). Carman then may have been a permanent village site that was occupied year round. This is supported by the greater variety in the chemical composition of the sherds found at Carman. Furthermore, the overall similarities could indicate that clay was collected and manipulated at Parker Farm, where vessel manufacture also occurred. However, the variety in the chemical composition could suggest that surface treatments and firing occurred at both sites. The close proximity of the sites would mean that vessels could feasibly be transported between Parker Farm and Carman. This interpretation would account for both the overall clay similarities and the difference in manganese levels.

5.0 CONCLUSION

Modern analytical techniques and forms of technology have provided new approaches in studies of site level diversity. This study is a small addition in explanations of site variability in the Cayuga region. This study took a two strand approach to identify differences at the Haudenosaunee sites of Parker Farm and Carman. First the densities both at the inter- and intra-site level were compared. This included a comparison of sherds with different function, as determined by interior color. Second an elemental compositional analysis was carried out through the use of X-ray Fluorescence Spectrometry.

The results of the first analysis indicate sharp differences in the overall density of pottery at the sites. Parker Farm exhibits a much higher density of material, which is concentrated almost exclusively within the house structure and the midden. While the density of material is lower at Carman, areas of concentration are more dispersed across the site. These differing patterns of sherd deposition indicate possible differences in the activities that occurred at the sites.

The chemical analyses further indicated differences between sites, suggesting slight differences in the composition of the clay paste. Overall, the concentrations of elements were similar between sites. However, more variable levels of manganese were seen at Carman which is possibly a result of different surface treatments. An interpretation of the overall differences in density and elemental composition is that Parker Farm functioned seasonally as a pottery production site, while Carman might have occupied permanently as a village site. These results are by no means conclusive and more detailed analysis is needed to further identify elemental differences.

BIBLIOGRAPHY

Allen, Kathleen MS. "Iroquois ceramic production: A case study of household-level organization." *Ceramic Production and Distribution: An Integrated Approach, Westview Press, Boulder, CO* (1992): 133-154.

---. "Gender Dynamics, Routine Activities, and Place in Haudenosaunee Territory: An Archaeological Case Study from the Cayuga Region of Central New York State." In *Archaeology and Preservation of Gendered Landscapes*, edited by Sherene Baugher and Suzanne M. Spencer-Wood, 2010:57-77. New York: Springer,.

---, and Sandra Katz. (In Press.) "Iroquoian Settlements in Central New York State in the Sixteenth Century: A Case Study of Intra- and Inter-site Diversity." In *Process and Meaning in Spatial Archaeology: Investigations into Pre-Colombian Iroquoian Space and Place*, edited by Eric E. Jones and John L. Creese**.**

---, and Ezra Zubrow. "Environmental Factors in Ceramic Production: The Iroquois". In *Ceramic Ecology, 1988: Current Research on Ceramic Materials*, ed. C.C. Kolb.Oxford University Press, New York: 61-95. 1989.

Bamann, Susan, Robert Kuhn, James Molnar, and Dean Snow. "Iroquoian Archaeology." *Annual Review of Anthropology* 21, no. 1. 1992: 435-460.

Engelbrecht, William E. *Iroquoia: The Development of a Native World*. Syracuse, NY: Syracuse University Press, 2003.

Forster, Nicola, Peter Grave, Nancy Vickery, and Lisa Kealhofer. "Non-destructive Analysis Using PXRF: Methodology and Application to Archaeological Ceramics." *X-Ray Spectrometry X-Ray Spectrom.* 40, no. 5. 201:389-398. 2010.

Fox, William A. "The Central North Erie Shore." In *The Late Prehistory of the Lake Erie Drainage Basin: A 1972 Symposium Revised*, edited by David S. Brose. Cleveland: Cleveland Museum of Natural History, 1976: 162-191

Kapches, Mima. "The Hill Site: a Possible Late Early Iroquoian Ceramic Firing Site in South-central Ontario." *Northeast Anthropology*. 48:91-102. 1994.

Niemczycki, Mary Ann Palmer . *The Origin and Development of the Seneca and Cayuga Tribes of New York State*. Rochester, N.Y: Research Division, Rochester Museum and Science Center, 1984.

Rice, Prudence M. *Pottery Analysis: A Sourcebook*. 2nd ed. Chicago: U of Chicago, 2015.

Rieth, Christina B., and Elizabeth Horton. "Stylistic and Technological Analyses of Ceramic Vessels from the Bailey Site, Onondaga County, New York." *Preserving Tradition and Understanding the Past: Papers from the Conference on Iroquois Research, 2001-2005*. Ed. Christine Sternberg Patrick. Vol. 1. Albany: U of the State of New York, The State Education Department, 2010. 5-14. Print. New York State Museum Record.

Ritchie, William A and Robert E. Funk. *Aboriginal Settlement Patterns in the Northeast*. Albany: University of the State of New York, State Education Dept., 1973.

Schiffer, Michael B. "Archaeological Context and Systemic Context." *American Antiquity* 37, no.2. 1972:156-165.

Schiffer, Michael B., James M. Skibo, Tamara C. Boelke, Mark A, Neupert, and Meredith Aronson. “New Perspectives on Experimental Archaeology: Surface Treatments and Thermal Response of the Clay Cooking Pot”. *American Antiquity* 59, no. 2 (1994:197-217).

Skibo, James. "Understanding Pottery." In *Pottery Function: A Use-alteration Perspective*. New York: Plenum, 1992:1-25.

Speakman, Robert J. Nicole C. Little, Darrell Creel, Myles R. Miller, and Javier G. Iñañez. "Sourcing Ceramics with Portable XRF Spectrometers? A Comparison with INAA Using Mimbres Pottery from the American Southwest." *Journal of Archaeological Science* 38, no. 12 (August 2011: 3483- 3496).

Sudina, Anthony and Kathleen M.S. Allen. “The Utilitarian Characteristics of Iroquois Pottery Vessels”. Paper presented at the Eastern States Archaeological Federation, Lockport, NY. 2008.

User Guide PXRF: For use with Tracer III-SD and Tracer IV-SD. Bruker Elemental

Warrick, Gary A. *A Population History of the Huron-Petun, A.D. 500-1650*. New York: Cambridge UP, 2008

Williamson, Ronald F.. “Glen Meyer: People in Transition”. (PhD diss, McGill University, 1985).

Williamson, Ronald F.. “The Robin Hood Site: A Study of Functional Variability in Iroquoian Settlement Patterns” (Master’s Thesis, McGill University, 1979).