

January 19, 2013

TO: Dennis J. Suszkowski, Ph.D.
Science Director
Hudson River Foundation
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New York, NY 10004

FROM: Joel W. Grossman, Ph.D.
PI, Grant 003/11A (Grossman)

RE: Submission of Final Report: *The Archaeology of Little Wood Creek: Synopsis, Context and New Chronometric Evidence*

Dear Dennis,

Please find attached the final draft of the Little Wood Creek study in completion of our Hudson River Environmental Society contract (003/11A - Grossman) with the Hudson River Foundation. We are hopeful that the report will be taken as a significant contribution to the archaeology and environmental history of the upper Hudson.

In addition to minor formatting and editorial changes, this revised digital manuscript incorporates the results of three new Late Woodland AMS dates and adds an expanded English and Spanish language abstract. The three new AMS dates (all mid-to late 14th century AD) corroborate and dovetail with the results of the initial three Late Woodland AMS determinations. The findings of the overall study stay the same.

Respectfully yours,

Joel

The Archaeology of Little Wood Creek: Synopsis, Context and New Chronometric Evidence

Grant No. 003/11A (Grossman)

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January, 2013

The Archaeology of Little Wood Creek: Synopsis, Context and New Chronometric Evidence

Table of Contents

Abstract	1
I. The Archaeology of Little Wood Creek - Summary of Results	5
Introduction	6
Environmental Context and Change	8
The Buried Transitional Period Occupation	10
The Late Woodland Period Occupation	13
Human Burials and Forensics	15
The Southern Bastion of Historic Fort Edward	16
Summary	18
II. Current Trends in Transitional Period Archaeology	19
Introduction	20
Early Constructs	20
New York Manifestations	22
Cultural Diffusion and Shad	23
Steatite and Mast Processing	24
Idea Exchange Versus Migration	24
Steatite in Ritual Exchange Networks	27
Conclusion	28
Bibliography	29
III. The Chronometric and Archaeological Record: New Evidence from AMS Dating	31
Introduction	32
AMS Dating	33
Phytoliths	33
Direct and Indirect Dating	34
The BETA Analytic Calibration Plots	35
The 2012 Transitional Period AMS Results	38
The "T.P.Q." Logs	39
Regional Comparisons	40
The 2012 Late Woodland Period AMS Results	40
The Antiquity of Maize in the Northeast	42
Maize and Climate Change	44
Contact Period Evidence	45
Summary of Findings	46
Chronometric and Paleoclimate References	49
IV. New Insights into Prehistoric Environmental Conditions	51
Regional Paleoclimate and Paleoecology - New Insights	52
Transitional Period Conditions (cal BC 1120-1500)	52
Late Woodland Period Conditions (cal AD 1270-1440)	52
V. Appendices - The BETA Analytic Calibration Plots	54

Abstract

This Hudson River Foundation-supported study reports on the establishment of viable dates for several major cultural components at the Little Wood Creek site on the upper Hudson in Fort Edward, New York. The original excavation in the mid-1980's resulted in the identification of two major periods of occupation, a deeply buried Transitional Period series of living floors, and closer to the surface, and separated by circa five feet of sterile flood silts, a series of Late Woodland Period pits and features. Both were overlain by the discovery of the southern bastion of Revolutionary War-era Fort Edward. Ambiguities in the original radiocarbon dating of the site left it in chronological limbo with widely divergent determinations for both prehistoric occupation periods. The central goal of this study was to retrieve minute amounts of non-diagnostic charcoal from the remaining seed collection and submit them for high resolution AMS (Accelerator Mass Spectrometry) dating to refine and resolve the antiquity of the site. The resultant dates from ten samples, four Transitional Period and six Late Woodland Period assays, both refine the absolute chronology of the site complex and clarify several major issues in the cultural and environmental history of the region.

Instead of spanning over thirty five centuries as the initial radiocarbon assays suggested, the new AMS determinations resolve the Transitional Period time frame down to four centuries between cal BC 1120 and 1500 and suggest that this Frost Island manifestation was part of a broad based horizon of limited time depth in the northern Hudson River area. The Late Woodland AMS determinations are of equal importance in clarifying the chronology of later occupations at the site. Instead of spanning over six hundred years with the implication of early dates for maize in this region, the new AMS age ranges for the Late Woodland Period indicate that the site was occupied late and for a relatively short period of time between the late 13th and mid-15th centuries AD. Individual AMS age ranges are limited to ca 110 to 120 years per assay and a short cumulative time frame of ca 170 years. The new AMS dates also serve to disprove the previously identified presence of early corn cultivation in the eighth century AD and instead document that maize was not visible in the site record until after 1270 AD.

Together, these two sets of dates, combined with recent high resolution environmental sequences, provide sufficient resolution to correlate the newly defined periods of occupation with major events in the pollen and climate record of eastern New York State. Specifically, the Transitional Period age ranges suggest that the BROADSPEAR associated Transitional Period site may have been occupied following a period of drought in the region and with the advent of the Oak-Chestnut forest at about 1600 BC. The Transitional Period

pollen record of the 1980's also documented the presence of fireweed (Epilobium sp.) and ragweed (Ambrosia sp.) and suggests the local environment may have been disturbed by human activity in general and by fire in particular between cal 1120 and 1500 BC.

The Late Woodland chronology likewise suggests the possibility that the onset of the later period of occupation may have correlated with the advent of the Medieval Warm Period and may have ceased as a maize reliant settlement with the onset of the Little Ice Age in the Northeast. Finally, the prehistoric archaeological evidence suggests that the indigenous inhabitants continued to be present until the mid-15th century. The recovery of a small spherical brass bell suggests in turn that they may have persisted at Little Wood Creek until the mid-16th century.

El estudio fundido por el “Hudson River Foundation” nos informa del establecimiento de fechas viables para algunos de los mayores componentes culturales en el emplazamiento de “ Little Wood Creek “, localizado en la parte superior del Hudson en ”Fort Edward, NY “.

La excavación original de mediados de los ochenta, dio como resultado la identificación de dos de los mayores periodos de ocupación, una serie de capas de suelos vivientes de "Periodo de Transición" profundamente enterados y más cerca de la superficie, separado por aproximadamente cinco pies de limos de inundación, una serie de pozos y características del periodo “Late Woodland”. Ambos fueron sobrepuestos por el descubrimiento del bastión de protección de “Fort Edward”, de la era de la Guerra de Revolución. Ambigüedades en la datación original por radiocarbono del emplazamiento, deja en el limbo cronológico con determinaciones ampliamente divergentes para ambos periodos de ocupación. El principal objetivo del presente estudio es recuperar minúsculas cantidades de carbón sin diagnosticar de las semillas restantes de la recolecta y someterlas a un proceso de fechado AMS (Acelerador de Espectrometría de Masas), refinando así y resolviendo la antigüedad del emplazamiento. Las fechas resultantes de diez muestras, cuatro del Periodo Transicional y seis ensayos del periodo “Late Woodland” refinaron con exactitud la compleja cronología del emplazamiento y clarificaron varios de los mayores dilemas con respecto a la historia cultural y medio ambiental de la región.

En lugar de abarcar treinta y cinco siglos como sugieren los ensayos preliminares de radiocarbono, las nuevas determinaciones por AMS reducen considerablemente el marco del tiempo del “Periodo de Transición” en cuatro siglos, entre 1120 y 1500 BC y sugiere que esta manifestación de “Frost Island” fue parte de un horizonte ampliamente fundado con una limitada profundidad en el tiempo en la zona Norte del Rio Hudson. Las determinaciones por AMS de “Late Woodland” fueron de igual importancia a la hora de clarificar la cronología de ocupaciones posteriores en dicho emplazamiento. En lugar de abarcar más de seiscientos años con la consiguiente implicación de las fechas tempranas para el maíz en esta región, los nuevos rangos de edad determinados por AMS para el periodo de “Late Woodland” indican que el emplazamiento tuvo una ocupación tardía y durante un periodo relativamente corto entre los siglos trece y mediados del siglo quince AD. Pruebas individuales de AMS fueron limitadas a ca 110 años a 120 años por ensayo y un marco de tiempo corto de acumulación de ca 170 años. Las nuevas fechas de AMS también sirvieron para desmentir la identificación previa de presencia temprana de cultivos de maíz en el siglo 8 AD, en su lugar fue documentado que el maíz no fue visible en el record del emplazamiento hasta después de 1270 AD.

*Juntos, estas dos pares de fechas, combinado con las recientes secuencias medioambientales de alta resolución, proveen suficiente resolución para correlativizar el periodo de ocupación nuevamente determinados con mayores acontecimientos en el polen y en el registro climatológico del este del estado de NY. Específicamente, los periodos que abarcan el “Periodo Transicional” sugieren que el emplazamiento “Broadspear” asociado al “Periodo Transicional” quizás fue ocupado seguido de un periodo de sequia en la región y con la llegada de el bosque “Oak-Chestnut” sobre 1600 BC. El registro de polen de los años 80 del “Periodo Transicional”, también documentado con la presencia de “fireweed” (*Epilobium* sp.) y ambrosía (*Ambrosia* sp.), sugiere que el medioambiente local pudo haber sido traumatizado por la presencia de actividad humana en general y en particular por fuego, entre cal 1120 y 1500 BC.*

La cronología de “Late Woodland” sugiere así la posibilidad de que el comienzo del siguiente periodo de ocupación quizás estuviera correlacionado con el comienzo del “Periodo Cálido Medieval” y quizás cesara con un asentamiento dependiente del maíz y el comienzo de la “Pequeña Edad de Hielo” en el noreste. Por último, la evidencia arqueológica prehistórica demuestra que los habitantes siguieron presentes hasta mediados del siglo 15. La recuperación de una pequeña campana de bronce esférico indica a su vez que permanecieron en Little Wood Creek hasta mediados del siglo 16.

I. The Archaeology of Little Wood Creek - Summary of Results

The Archaeology of Little Wood Creek Summary of Results

Joel W. Grossman, Ph.D.
Principal Investigator

Introduction

The federally mandated rescue excavation at the Washington County Sewer District II Little Wood Creek



Figure 1. Air photo of Little Wood Creek site at Fort Edward, New York.



Figure 2. Wide area exposure of Late Woodland Period surface at Little Wood Creek.

site (NYS No. 5852) in Fort Edward, New York, documented a 30 century record of buried and well preserved occupations dating from the 15th century BC, through to the 18th century AD. The 1986 "discovery under construction" had to be undertaken because the site complex was belatedly encountered under the footprint of a much needed sewer treatment plant being built with US EPA funding by the Washington County Sewer District II. The site complex was exposed on the east bank of the Hudson River, opposite Rogers Island, and at the confluence of the Champlain Canal and the Hudson River (Figure 1 and Map 1). The series of discoveries gained added significance because they were well separated stratigraphically and unmixed by later disturbances. The challenge posed by the emergency rescue excavation was exacerbated by the exposure of six Late Woodland Period human burials. The discovery precipitated intensive negotiations between the Native American community and county, state and federal agencies and resulted in the in-situ



Figure 3. View looking north of Deep Cut A excavation of buried Transitional Period living surface.

documentation and reburial of the remains under spiritual supervision.

The project results provided important new lines of information on the cultural history of the Transitional and Late Woodland Periods of the Upper

Hudson region. Three major periods of occupation were documented. From earliest and deepest deposits, the excavation identified the buried remains of a series of Transitional Period living floors and hearths. Closer to the surface, and separated by four to five feet of sterile flood silts, the excavation revealed and recorded nearly 1000 Late Woodland pits and features (Figures 2 and 7). Finally, closest to the modern surface, the team exposed the triangular bastion of historic 18th century Fort Edward.

The use of wide area exposure techniques (Figure 2), combined with deep controlled stratigraphic excavation units (Figure 3) provided a clearly definable sequence of superimposed deposits and buried living surfaces which yielded information on the structure and spatial patterning of Pre-Contact settlement for each period of occupation. This section will highlight the major conclusions and results which have emerged in the areas of cultural chronology, environmental reconstruction, nutrition, forensics, and the antiquity of corn in the region.

The analysis focused on the reconstruction of the past environmental conditions and food sources for each of the identified cultures. The use of micro recovery techniques, including water-screening and flotation procedures, resulted in the recovery of large samples of preserved animal and plant remains which provided critical new evidence on the economy and natural environment of these ancient settlements. The focus on environmental change through time helped to construct a picture of how the river edge setting formed and changed throughout the last three thousand years. The use of detailed soil and geological analyses permitted the reconstruction of the physical setting and forces of change which led to shifts in where the ancient inhabitants could and did choose to live. The quantified analysis of the relative density and location of recovered artifacts from the earliest buried

deposits permitted the computer assisted reconstruction of the artifact distribution patterns across the Transitional Period living floors.

Environmental Context and Change

The changing landscape and environments of the site area were investigated through two major approaches: (1) the analysis of soil structure and composition or geomorphology, and (2) the recovery and identification of a broad range of environmental data including animal and plant remains and ambient pollen. Together, these multiple lines of evidence provided an understanding of environmental conditions, how the site formed and changed through time, and human adaptations to both environmental and geomorphological conditions.

The soil and geomorphological analysis by Dr. Segovia and Dr. Foss suggested that during the initial phase of human occupation at the site, the Transitional Period inhabitants lived on the northern bank of a U shaped "oxbow", or bend in the stream, which curved through the site area forming a wide meander some 400 to 500 feet to the south of the present location of the Little Wood Creek drainage. The ancient living floor existed some 7 to 9 feet below the 1980 land surface. In that earlier period, elevation ranged between 118 to 120 feet above sea level, versus the ca. 125 to 130 foot contour surface elevations of the modern flood plain of the Hudson. Sometime after circa 1100 BC, the course of Little Wood Creek shifted from its previous oxbow formation to the north, close to where it now runs. This shift cut off the former meander leaving a swampy backwater, and also cut off the former stream bank hearth locations from easy access, causing the inner flood plain to be abandoned for the higher and

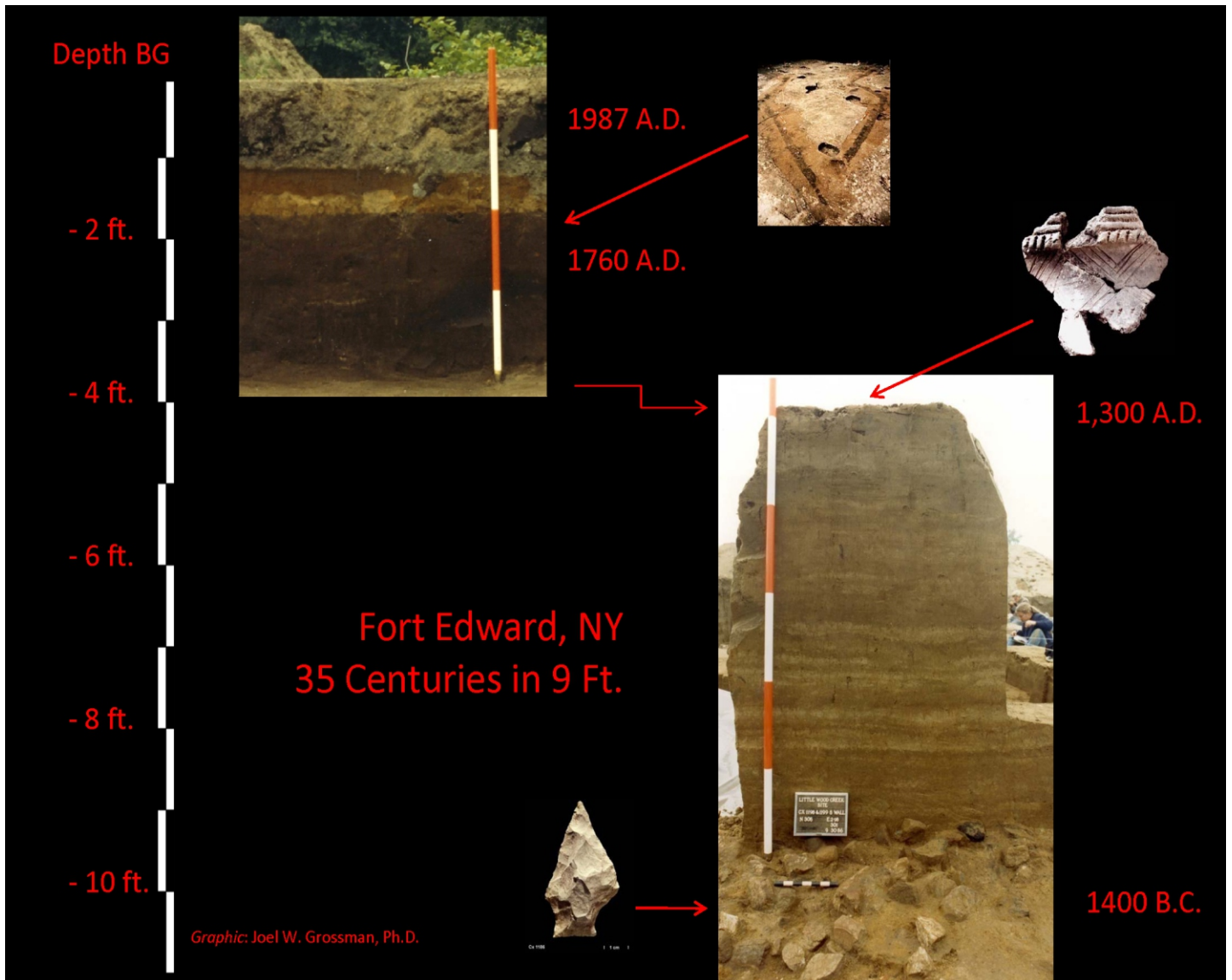


Figure 4. Composite view of vertically stratified sequence of superimposed cultural deposits of Deep Cut A at Little Wood Creek, Fort Edward, New York. A deeply buried Transitional Period hearth or roasting platform is visible at the lower right.

safer levee areas south of the former oxbow.

The evaluation of the changes in soil particle size and composition from the bottom to the top of the entire 30 foot stratigraphic sequence indicated that the deposits found below the Transitional Period surfaces were derived from the constantly shifting stream channels and flooding from the Little Wood Creek with no evidence of over-bank flooding from the Hudson. However, the sediments above the buried Transitional Period living floor were derived from

over-bank flooding and levee formation from the Hudson River, which formed new surfaces in vertically increasing layers of sand and silt. These accumulating deposits finally formed the Late Woodland Period living surface three thousand years later. While the accumulated 5 to 6 feet of superimposed sediments showed deposits from both high and low velocity flooding episodes, the ca. 2600 year gap in time between the two occupations and the circa 5 foot thickness of the intervening sterile deposits, suggested that this

flood history was consistent with modern flooding cycles.

The Buried Transitional Period

Occupations

Beneath the Late Woodland Period village, at a depth of seven to nine feet below the modern surface, the team discovered a buried island covered with thousands of chipped flakes, fire cracked rocks from cooking hearths and distinctive chipped stone "Broadspear" projectile points (Figure 5) which were AMS dated to between 2980 and 3160 +/- 30 BP, or cal BC 1120 to 1500. Two of the calibrated AMS dates clustered between the 12th and 14th centuries BC. One AMS determination dated to an early range of cal 1400 to 1500 BC. However, stratigraphic evidence suggests that this is too early and that the initial occupation began around cal 1400 BC (see radiocarbon section below).

The deeply buried living floors revealed undisturbed distinct tool making areas, well preserved stone hearths or roasting platforms, different food processing stations and activity areas distinguished by a range of chipped stone artifacts, steatite bowl fragments and clumps of brightly colored ochre pigment, presumably for decoration or ceremonial use.

The excavation exposed three areas with buried Transitional Period living surfaces. Two localities were found in two large wide area exposure blocks designated Deep Cut A and Deep Cut B, located on the northern embankment of the oxbow mentioned above, the third, somewhat later early Transitional Period occupation zone was found on what was formally the high levee of the Hudson River, in the southern portion of the site.

While the evidence for the buried Transitional Period occupation within Deep Cut B was limited to two isolated hearths and associated artifacts (flakes), the Deep Cut A exposure revealed a laminated series of discontinuous cultural deposits over a completely undisturbed living floor located along the crest of a low,



Figure 5. Sample of Susquehanna Broadspear and "Fishtail" points from the Early Transitional Period components.

70 foot long ridge, or sand bar, in the elbow of the curving Little Wood Creek stream channel. This primary occupation surface, designated Component C, contained over 43,000 *in situ* artifacts found in association with five contemporary hearths or roasting platforms, arranged in a "T" shaped configuration across and down the crest of this buried ridge.



Figure 6. "Netsinker" chipped stone weight from the Deep Cut A Component C living floor.

Each of the hearths (Figure 4) contained specific kinds of stone and fuel sources implying that the ancient residents carefully selected the materials from an assortment of sources and suggests the

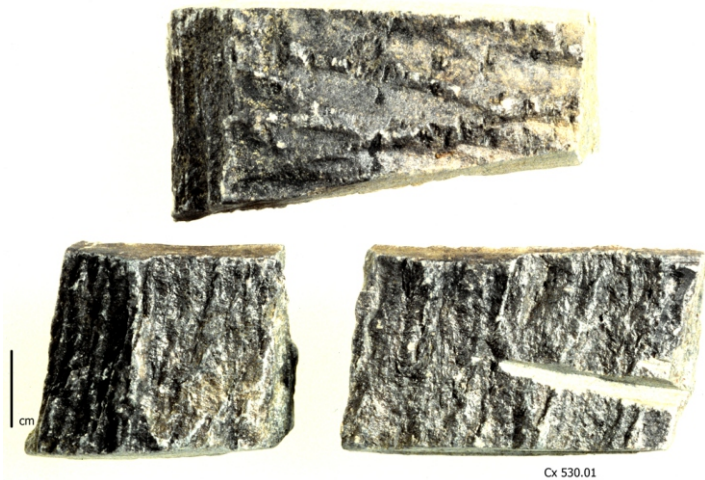


Figure 7. *Steatite (soapstone) sherds from the Transitional Period deposits at Little Wood Creek.*

possibility that the cooking hearths were used during different short term episodes versus all at once. Furthermore, each of the five hearths showed the presence of predominantly quartz and sandstone (53-73%) cobbles with a small percentage of granite (22-42%), suggesting that the stone materials were selectively collected. The charcoal analysis from each of the hearths consistently indicated the use of small branches and twigs and each hearth, in turn, showed the presence of different kinds of fuel. For example, the largest hearth was fired with twigs of red oak, while the fuel of the smallest was pine, hemlock and hickory. The reason for these differences is uncertain. The hearths might have been used by different individuals or family groups at the same time, or might have represented several distinct episodes of cooking and roasting over several months or a year, or might have been used for different purposes.

The thirty identifiable chipped stone points and tools (Figure 5) as well as chipped stone "netsinkers" (Figure 6), and fragments of steatite stone bowls (Figure 7), together with the radiocarbon determinations, indicate that these people were affiliated with the Susquehanna Broad point tradition in general, and with the Frost Island

Phase of the Transitional Period in particular.

Computer-based 3D data control permitted the reconstruction of a series of density distribution maps showing the relative concentrations of different classes of artifacts across the living floor. These permitted the graphic reconstruction of what the ancient inhabitants were doing, and where, across the living surface circa three thousand years ago. Each hearth showed overlapping clusters of tool making and food processing activities suggesting that different family groups lived and worked together in the vicinity of each hearth. The presence of "net sinkers" adjacent to a hearth where the excavators identified at least three post molds suggested that this buried living area may have held a roasting platform, presumably for the curing of fish.

This is an undisturbed Frost Island Phase site without materials mixed from other periods. It is



Figure 8. *Field view of Late Woodland pit being excavated by natural stratigraphic levels.*

significant in the regional history of New York because it clearly documented a Susquehanna Broad point occupation. While this was the first undisturbed such occupation to be found in the Hudson-Mohawk confluence area, research subsequent to the 1986 excavations has documented the presence of the Frost Island Phase in the

southern Hudson drainage, the upper reaches of the Hudson and in the Susquehanna drainage of the south central portion of New York.

Water screening and flotation techniques documented the presence of micro remains of animals (heavily burned) and a range of wild and collected plant foods, as well as potential medicinal plant remains. In addition to the harvesting of fish, fresh water shellfish, hickory and butternut shells, the recovery of several native varieties of plants indicative of human disturbance also suggested that these early people might have been very possibly managing and altering their environment rather than simply living off a pristine natural setting.

Several lines of evidence come together to suggest what season of the year the site may have been occupied during the Transitional Period. Although theoretically available throughout the year, the study of macrofossil wood charcoals, in addition to their ecological clues and implications, provide evidence suggesting the selective collection of branch and twigs from dead fall wood for fuel use from the peripheries of the site (September to December). Hickory nuts are available for gathering from October to December, while butternuts are available only from September to October. The presence of Fireweed and Ragweed pollens are also seasonally diagnostic. Fireweed (*Epilobium* sp.) flowers from July to August; ragweed (*Ambrosia* sp.) flowers from July to October. Together, these resources suggested at the very least a Summer to late Autumn, and/or Winter occupation for the Transitional Period peoples.

The late Les Sirkin also suggested that the presence of *Epilobium* (fireweed) and composites in the levee pollen sample may suggest the possibility of cleared, humanly disturbed, or burned flood plain areas, that is, an anthropogenic environment at circa 3000 BP. Fireweed colonizes heavily traumatized habitats such as areas of mine talus and recent burning. Its presence at Little Wood



Figure 9. Late Woodland Period “Castle Creek Incised Neck” sherds.



Figure 10. Late Woodland Period “Bainbridge Collared Incised” sherd.



Figure 11. Late Woodland Period “Owasco Corded Collar” sherds (Context 1040).

Creek at the time of Transitional Period occupation hints at the possibility that the immediate area of the shoreline of Little Wood Creek may have been

subject to seasonal clearing by humanly induced fire.

The Late Woodland Period Occupation

Separated from the buried Transitional Period living surface by sterile flood sediments, at a depth of two to three feet below modern grade, the team discovered ca. 160,000 square feet of a pre-Iroquois village. The buried living surface revealed a wide area of prehistoric pits and post molds (Figures 2 & 8). The archaeological team identified, evaluated, and excavated over 400 Late Woodland Period features and pits. Once the analysis of the pits and features was complete, 135 of these were identified as Pre-Contact features with "diagnostic" ceramic and stone artifact associations. Of these, a restricted sample of 85 pit features were selected for intensive analysis of both artifact and environmental indicators, due to the presence of stylistically and/or chronologically diagnostic ceramics.

These Late Woodland Period features were subjected to five kinds of analysis: (1) the formal comparison of the contents of the pits relative to their form and ceramic associations, (2) the evaluation of the intra-site density and distribution patterns of the datable pits, (3) a detailed analysis of the stylistic characteristics and cultural affiliations of the highly diversified pottery that was recovered, (4) the detailed documentation of the diagnostic lithic and ceramic artifacts recorded, and (5) flotation and water screening to reveal a wide range of data on the economy, food resources, and environmental conditions of these Late Woodland Period inhabitants.

The ceramic assemblage was dominated by three distinct ceramic styles: Castle Creek Incised Neck (Figure 9), Bainbridge Collared Incised (Figure 10) and Owasco Corded Collar (Figure 11). With the exception of Middle Woodland Period sherds found as isolated surface remains, the identified ceramic types belonged to the Owasco Series classified by archaeologists as belonging to the Castle Creek and Oak Hill phases of the Late W

Woodland Period. All of the Woodland Period stone projectile points were Levanna style triangular forms (Figure 12).

The new AMS age determinations indicated that the identified ceramics dated to between the last quarter of the 13th century and the middle of the 15th century AD, several hundred years later, and more recent, than was initially suggested by the traditional radiocarbon dates from the 1980's. (See Table II). The revised age ranges returned by the AMS procedures also document that the Owasco style was dominant relatively late in the prehistoric sequence of the upper Hudson region.

The ceramic analysis provided a series of new insights into the identity and regional correlations between the Late Woodland Period at Fort Edward and other parts of New York. The diversity of ceramic types identified suggest that the people of Fort Edward had a cultural affiliation with early Iroquois peoples in central New York, and, thus, that a ceramic complex, the Owasco style, thought to be focused in west-central New York, was clearly present in the region of the Upper Hudson in east-central New York State. Whether these ceramic parallels represent the by-products of actual travel by the people, or long distance trade cannot be determined based on available information.

In addition to these ceramic parallels, the collection was distinguished by the recovery of five ocean bivalves, *Mercenaria mercenaria*, or Northern Quahog, of which two were worked with chipped edges. Their presence provided concrete evidence that the Late Woodland inhabitants of Little Wood Creek had direct or indirect access to marine shell resources along the Atlantic coast. Hard shell clams are widespread along the Atlantic coast, but do not

occur in inland fresh water environments, therefore they indicate importation or long distance travel. They indicate that not only did the Late Woodland Period inhabitants of Little Wood Creek have contacts to the west, as indicated by the pottery, but also to the south.

A total of 25 kilograms of animal bone, and 23 kilograms of shell, were recovered from the 85 analyzed Woodland Period pits. In addition to several small rodents, these food remains came from at least 50 deer, 8 beaver, and 3 bear. Whereas the deer and beaver were primary food sources, the bear was only represented by foot bones and claws, suggesting the remains may have been derived from skins alone. The Late Woodland Period bone sample also included the remains of 2 raccoons, at least 1 river otter, 2 examples of flying



Figure 12. Late Woodland Period triangular Levanna points and possible Madison point on the right.

squirrels, and unidentified remains belonging to dog and cat species. Also found were the bones of either toads or frogs who commonly lived in the margins of rivers and streams and in stagnant waters such as those that appear to have existed at the confluence of Little Wood Creek and the Hudson River. Finally, a large number of fish bones and scales were recovered from 16 of the excavated pits, some of which could be identified as fresh water catfish. Also recovered were large number of fresh water clams which appear to have been frequent in the Upper Hudson prior to the onset of modern contamination.

The Woodland Period pits also yielded large numbers of charred seed and plant remains, with a total of 1,463 from a restricted sample of 26 of the pits. A



Figure 13. Detail of Late Woodland corn kernels from Context 1063.01. Charcoal from this pit dated to cal AD 1270-1380.

total of 1,289 nutshell fragments were recovered from 21 of the pits. Maize was also well represented with a total of 66 kernels and 50 cupules found in 16 of the pits (Figure 13). The large number of burned or charred corn kernels confirmed maize as a significant cultivated food source for the Late Woodland Period Little Wood Creek inhabitants. Specimens from three of the AMS (Accelerator Mass Spectrometry) dated pits yielded corn kernels that dated from the late 13th to the 15th centuries AD.

The archaeological remains clearly documented that the principle dietary sources of the Late Woodland Period inhabitants were White-tailed deer and nuts (hickory and butternut), followed by corn, grapes, and fresh water fish and bivalves. Grapes occurred naturally on strands along streams and riverbanks. While 27 plant food resources were identified, only hickory, butternut, corn and grapes were found in large quantities.

Hickory nuts are available from October to December and butternuts from September to October, suggesting a site occupation from September through December. Grapes were available from late summer to early autumn. The large

numbers of burned or charred corn kernels suggests that the site was occupied throughout the time of growing and harvesting of corn, late Spring through Summer. The recovery of cranial remains from white tailed deer suggested occupation at the site and hunting during the



Figure 14. Mapping buried pit features with the EM-38 conductivity meter. Use of the instrument provided subsurface pit identifications without having to penetrate cultural features with electrodes.

winter months of February and March, when the deer shed antlers. Thus, Late Woodland Period inhabitants at Fort Edward were present for at least three out of the four seasons of the year, and possibly throughout the winter months as well.

The analysis of lithic source material showed significant shifts between the Transitional Period and Late Woodland Period occupations. In the Transitional Period occupations, the stone tools were made exclusively of Onondaga chert. The only notable exception to this pattern was the debitage recovered from the Transitional Period Levee occupation. Although Onondaga chert was still the predominant material at this later occupation, other lithic sources were used as well. In contrast, Onondaga chert, although present, was used for only a small percentage of the subsequent Late Woodland Period stone tools. The Late Woodland Period contexts yielded a variety of lithic material from numerous New

York regional sources with cherts, represented by Esopus, Fort Ann, Oriskany, Cocksackie, and Little Falls varieties, along with quartzes and quartzites of various grades. The increase in the diversity of stone tool materials during the Late Woodland Period suggests the possibility of much greater trade and/or travel than was the case for the earlier Transitional Period peoples. On the other hand, it is equally reasonable to speculate that the Transitional Period inhabitants were possibly more selective, rather than less widely traveled, than their Late Woodland Period counterparts.

Human Burials and Forensics

The discovery of six human burials raised difficult legal, scientific and spiritual issues for the government, the archaeologists and the Native American community. The finds preceded the 1990 enactment of the Native American Graves Protection and Repatriation Act (NAGPRA) and thus there were limited legal and scientific antecedents for guidance. Working with Mayor King of Fort Edward, Dr. Grossman established formal interagency negotiations between senior representatives of Native American leadership and federal, state and local agencies. The negotiated solution stipulated the coordinated oversight of the burial exposure and study by Leon Shenandoah, spiritual leader of the Iroquois, the non-destructive, in-situ, documentation of the burials and environmental evidence to the highest scientific and legal standards by Dr. Anagnostis Agelarakis of the Grossman and Associates team, followed by ceremonial reburial under spiritual supervision. All forensic documentation was done on-site. This permitted the reconstruction of not only the age and sex of the pre-European individuals, but also their work habits, cause of death, dietary and health

habits. Canadian and British geophysical experts were flown in to assist in the non-intrusive identification of human burials. A new generation of geophysical equipment, an EM-38 non-contact conductivity system, was used to identify buried pit and burial features prior to physical exposure (Figures 14). Following analysis, working with indigenous participants, all Native American human remains were reinterred by Chief Shenandoah of the Six Nations in unmarked graves, in plain pine coffins, without fencing, within federally protected property adjacent to the federally funded sewer treatment facility.

The on-site analysis of the six burials revealed that 5 of the 6 were females with an average height of 5.4 feet who died as adults between 23 and 40 years of age, with most in their mid 20's to mid 30's. The one male of the group died between the age of 35 and 40. Several of the women showed signs of systemic osteoporosis, or weakening of the bones through loss of calcium. In addition, several of the individuals showed severe cases of degenerative arthritis in the arms and leg joints as well as in the lower back. The increase in bone size at points of stress and muscle attachment, in particular the ankle and thigh bones, showed that several of the individuals had been involved with the lifting and carrying of heavy bundles or loads. Most interestingly, the study of the bone surfaces and points of muscle attachment showed a specific pattern of bone and ligament enlargement in the upper arm and forearms which is consistent with movements associated with the grinding of food with a mortar and pestle as well as the repetitive strokes of canoeing.

The study of the teeth of the six individuals showed that they had severe dental problems and extensive cavities. Many of the teeth were heavily worn. Some teeth had been specifically worn into grooves that indicated that the women used their teeth for processing soft fibrous materials such as leather, porcupine quills, or,



Figure 15. Outline of excavated southern bastion of historic mid-eighteenth century Fort Edward.

as suggested by Chief Leon Shenandoah, sweetbreads. Other grooves between teeth indicated the use of toothpicks, either for cleaning purposes, or possibly to alleviate pain.

The Southern Bastion of Historic Fort Edward

Close to the surface, the field team documented the triangular outlines of the southern bastion of historic Fort Edward (Figure. 15). Overlays onto 18th century maps of the historic fort fixed the actual location of this aspect of the fort relative to the modern landscape. Historic artifacts recovered from within the bastion builder's trench dated the bastion to the 18th century. The recovery of post-1736 pipe fragments, and the surface find of a King George II coin, lost or deposited sometimes after 1746, suggests that the bastion was abandoned or destroyed sometime after the second quarter of the 18th century. Unfortunately, the limited number

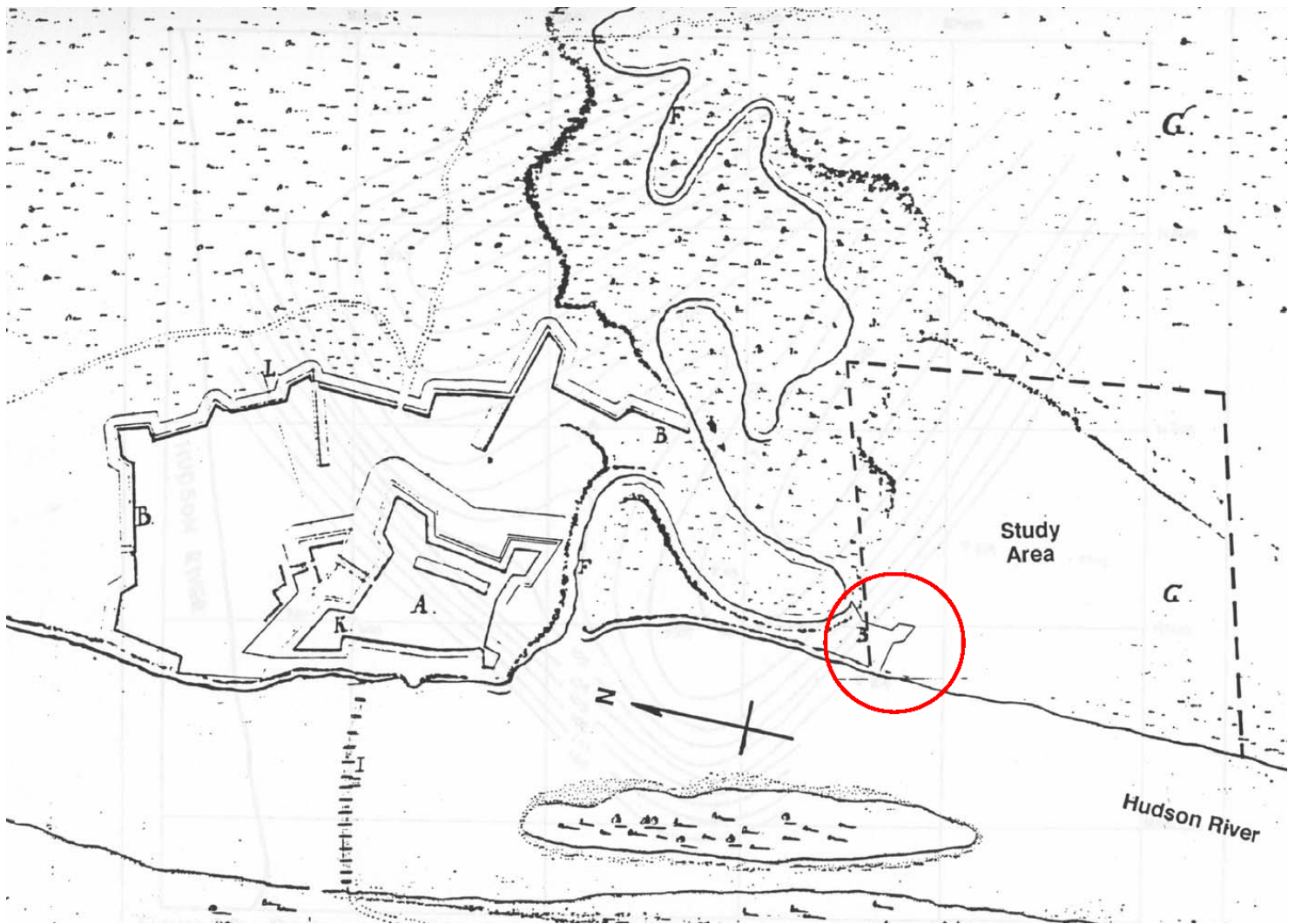


Figure 16. Detail of mid-eighteenth century Wetterstrom map of Fort Edward showing archaeologically identified southern bastion in red circle relative to main body of the fort to the north.

of material clues was too small to provide a strong correlation with the historical record of the site and region. Only the fortuitous discovery of a mid-18th century map was sufficient to fix the temporal context of the archaeologically defined bastion or outwork.

This previously unpublished 1756 map of Fort Edward, found in the Henry Huntington Library in San Marino, California, which had been drawn by Captain G. Wetterstrom, a Swiss engineer attached to the British Army, provided the only cartographic record of the small bastion found by the archaeologists (Figure 16).

Wetterstrom called it the "circumvallations Line, wher the English Armee' was Encamped" (sic). The archaeological

discovery of a stain in the shape of a bastion indicated that Wetterstrom was a highly accurate 18th century cartographer. The joint archaeological and cartographic evidence provided proof not only of the existence of these outworks, and the location and limits of the fort's southern extent, but also, when overlaid on modern maps, identified the precise location of the fort as a whole.



Figure 17. Closeup view of spherical brass bell from a Little Wood Creek feature that suggests the possibility of an early to late 16th century import by French traders (Context 945.01).

dates and second, the results of the new AMS dating of ten samples. These new AMS determinations showed that the Late Woodland Period pits dated to between cal AD 1270 and 1440. The results of four Transitional Period AMS determinations indicated that the buried Broadspear complex of living floors dated to between cal BC 1120 and 1500. In addition to these chronometric age determinations, the potential antiquity, or continuity, of the Late Woodland Period features was augmented by the recovery of a single Contact Period spherical brass bell (Figure 17). As discussed below, this find in turn suggests that at least portions of the Late Woodland site may have continued to be occupied into the 16th century era of French exploration and fur trading along the Mid-Atlantic coast, including the upper Hudson drainage.

Summary

In sum, the emergency excavation of the Little Wood Creek multicomponent site documented three major periods of occupation, the mid-18th century bastion of historic Fort Edward, a large Late Woodland Period settlement, and deeply buried beneath both, a well preserved and stratigraphically unmixed series of Transitional Period living floors. Despite the time constraints and rigors posed by this "discovery under construction", the site was mitigated to the highest standards. Furthermore, the discovery of six human burials precipitated intense negotiations between the Native American community and involved federal, state and local agencies. This process led to the introduction of new protocols for the sensitive and collaborative documentation in-place of the early pre-contact remains and culminated in the respectful reburial on-site under the spiritual supervision of the Iroquois leadership.

Following the discussion of current issues of Transitional Period archaeology, Section III details first the recalibration of the original series of radiocarbon

II. Current Trends in Transitional Period Archaeology

Current Trends in Transitional Period Archaeology

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Introduction

Over the last two and a half decades, subsequent to the excavations at Little Wood Creek in the mid-1980's, several major debates have dominated the archaeological treatment of Transitional Period cultural traits as they pertain to Susquehanna broadspears and associated artifacts. This was particularly true for steatite vessels, which, together with broadspears, were new cultural traits in the northeast some 3200 years before the present. Some of these discussions hark back to issues initially raised over half a century ago and some to ones that emerged only in the last twenty years. Four topics are addressed in this overview: 1) the relative importance of diffusion and trade versus migration and adaptation; 2) the economic significance of river drainages and fish spawning runs versus availability of mast (nut) foraging areas or habitats as key environmental drivers of broadspear diffusion; 3) the timing and antiquity of the dissemination of steatite as a major attribute of the broadspear tradition; 4) the role of steatite vessels as part of a broad-based, presumably religious, regional exchange network, in particular a network that was tied to the ritual-based Poverty Point exchange system found throughout the southeast and the Middle Atlantic.

Early Constructs

At the time of the original excavations at Little Wood Creek, it was commonly thought that

the end of the late Archaic of the Northeast was characterized by the sudden appearance of a new form of broadspear projectile point made from specific lithic materials, and that associated with, or coterminous with, these broadspear points (and/or knives) were soapstone (steatite) vessels. It was also thought that this influx, presumably from the south, came through the mechanism of migration in general and, in particular, travel up and inland along the major river valleys, presumably via canoes. This model was initially proposed by Witthoft in 1953 and became a dominant theme for northeastern and Mid-Atlantic archaeological constructs until the decade of the 1990's.

Witthoft originally wrote that the common recovery of steatite in association with what he called the Susquehanna Broad broadspear points was an indicator of a "Transitional" phase of cultural development preceding the introduction of pottery. Witthoft called his archaeological complex the Susquehanna Soapstone Culture. He saw this cultural complex as, "the source for many of the most distinctive features of other cultures of the Transitional period in the east and north, in central New York, the western and northern Delaware drainage systems, and the Hudson-Mohawk system" (Witthoft 1953:15). He also saw these innovations as being associated with a change in "adaptive strategy involving a more intensive use of rivers both for associated food resources and for transportation" (Miller 2008, 2).

Since Witthoft's original work, federal and state-mandated surveys have greatly expanded the extent of known Susquehanna broadspear distribution patterns. It is now apparent that this point type, together with steatite vessels, was widely dispersed throughout the eastern seaboard and the Midwest. Susquehanna broad related point types

have been identified in the Ohio Valley, Massachusetts, Delaware, New York, New Jersey, Pennsylvania, Michigan, West Virginia, Indiana, Vermont and as far north as Montreal (Justice 1990:167-169; Funk 1993, 224). Steatite vessels and sherds have been documented from Florida to Maine (Turnbaugh 1975; Truncer 2004; Sassaman 1999, 2006). In Pennsylvania, Patricia Miller surveyed known Transitional Period sites listed in the state's Cultural Resources GIS inventory and identified 194 sites which were distinguished by the presence of Susquehanna broadspears, steatite and /or, as was specific to that region, the use of rhyolite for the production of points and knives for that period (Miller 2008: 2).

Within New York, the computer inventory of Transitional Period materials at the NYS Museum identified nearly 500 steatite sherds in the southern and western part of the state, but few in the northeast portions of the Hudson River drainage near Fort Edward (Truncer 2004: 493, Figure 4). In a parallel study, the interstate survey for the Iroquois Pipeline (Cassedy 1999) has demonstrated that the Susquehanna Broad tradition is much more prevalent than previously thought. For example, the pipeline survey, running across New York and Connecticut, identified a total of 616 points, of which 62 were of the "Susquehanna Tradition" from the Hudson drainage (Cassedy 1999: 131). In a prior survey of Susquehanna points within the Hudson River drainage, Funk identified 155 Susquehanna points in eight survey areas up and down the Hudson Valley (Funk 1976: Fig. 21, 195). Of these, 49, or 31.6%, were identified in Funk's Geographic Area II in the vicinity of Fort Edward (Funk 1976:195). From these indicators alone, it is clear that the Susquehanna broadspear tradition was not only widely dispersed throughout the eastern U.S.,

but also the Hudson River drainage.

These often broad-based geographic surveys have also provided critical new information on the nature of the broadspear manifestation in numerous states; coverage that in turn permitted comparisons between regions on a scale that was not previously possible. By the late 1990's new data in the form of large geographic databases in New York, New Jersey and Pennsylvania containing inventories of site distribution patterns began to show strong regional trends. In Pennsylvania a survey of known Transitional Period sites in the state survey files by Carr (1998) showed that 70% of Broadsppear components are "floodplain related sites". In 2001 Carr and Bergman argued, like Dincauze before them (1968), that Susquehanna Broadsppear sites were focused on stream confluences and large streams because of the onset of dry and warmer conditions (2001). This notion of riverine adaptation was expanded upon by Pagoulatos to include seasonal shifts in settlement patterns in the coastal plains of New Jersey (2003). Pagoulatos argued that Late Archaic groups grouped together in riverine zones of the Inner Coastal Plain in the Fall [for nut collection, fishing and hunting],dispersed to the upland zones in the winter to hunt mammals and then shifted to coastal areas in the spring and summer to exploit "aquatic-related" resources (2003: 85-127).

It was also thought that this broadpoint complex was indicative of an intrusion of select cultural traits from the south and or south east which spread from south to north over a relatively short time period. Witthoft's Susquehanna Soapstone Culture was seen, by some, as an evolutionary time marker and, and by others, an

indicator of an adaptation to new habitats, versus simply the introduction of new traits or ideas into a region. Which habitats these were became the focus of considerable debate.

New York Manifestations

The concept of an intrusive set of cultural traits, in general, and Whittohft's Susquehanna soapstone culture in Pennsylvania in particular, was adopted by Ritchie to explain the infusion of broadpoint technology and steatite vessels into New York State. Ritchie called the New York manifestation of the Broadspear and steatite complex the Frost Island phase and because he saw it as being lightly represented elsewhere in the Northeast, he considered a ".....central New York manifestation" (Ritchie 1980:156). Excavations at the O'Neil type site on the Seneca River in Cayuga County, New York first defined the attributes of the Frost Island phase which he radiocarbon dated to 1,250 B.C.+/-100 (Ritchie 1980: 156-157). This date is also contemporary with the median determinations of ca 3,200 to 3,300 B.P. for the Frost Island occupations at Little Wood Creek (see radiocarbon discussion below).

The Frost Island phase has been characterized by Funk as a period dominated by an Oak Hickory forest and warm and dry conditions that saw an increase in the abundance of mast foods, small animals and deer (Funk 1992, 15).

Like the Little Wood Creek site, the Frost Island type site was found on an old meander channel on "....swampy land now [1965] lying between the site and the river"(Ritchie 1980, 156). This type site was also similar to the Little Wood Creek site because it was buried and stratified (Ritchie 1980:156). It was also important because, at the time there was only one other site of the period

known, Frontenac Island, near the east shore of Cayuga lake, in the Finger Lakes. It is one of the few sites where Susquehanna broad points have been found in a stratified, all-but-shallow site instead of as surface finds (ibid). In the 1960's, Ritchie noted that the Frost Island Phase was well represented in the New York Finger Lakes region (the Seneca, Oneida and Oswego river valleys) and present in the Delaware, Hudson and Mohawk valleys (Ritchie 1980:157). Ritchie's list of traits for the Frost Island phase included Susquehanna points and knives, steatite sherds and bowls, a series of distinctive chipped stone tools, but no evidence for utilized flakes or milling stones (Ritchie 1980:156). Ritchie distinguished the steatite bowls of the Frost Island phase as having flat bottoms, flaring exteriors which had exterior quarry marks, and smooth interiors; this was in contrast to the smooth rounded interior and exterior forms of the Orient phase defined principally as a Long Island manifestation of the Transitional Phase (1980:162).

Ritchie's model for the Frost Island phase assumed that the steatite vessels of the northeast were similar to, and in fact derived from, those in the Middle Atlantic states, and, in particular, that they were being literally imported from the south. As summarized by Sassaman, Ritchie postulated that examples of steatite found in New York were first imported by peoples from the Susquehanna River Valley and then later "acquired through trade" (Sassaman 1999:89).

Sassaman found Ritchie's early suggestion of the broadpoint and steatite-carrying Frost Island phase peoples as a regional analogue of Whittohft's Susquehanna Soapstone Culture and as a model of intrusive third and fourth

millennium immigration into New York in particular, out of date for two reasons. First, Robert Funk noted that very few sites dating to before 3200 B.P. were found with steatite and that there was no evidence for steatite being found in association with the earlier Snook Kill phase in New York State (Funk 1993: 198; Sassman 1999:89). In addition, Funk's 1993 reevaluation noted that, when steatite appeared in the Frost Island phase, it was late, possibly contemporaneous with the first pottery (Funk 1993:199).

The second primary reason for debunking Ritchie's idea of an invasive broadpoint tradition coupled with steatite bowls as part of the Frost Island culture coming into New York from the south had to do with the availability and sources of steatite in the east coast. When Ritchie and others were writing in the 1960's it was assumed that steatite bowls found in Pennsylvania, New York and New Jersey were being imported from quarries in the Pennsylvania interior and Middle Atlantic States. However new trace element analyses by Truncer and others now demonstrate that most, if not all, New York steatite vessels derived not from further to the south in the Mid-Atlantic region, but instead from sources in southern New England. Distribution maps of areas where steatite vessels were found relative to natural outcrops and mine locations clearly document that known mines clustered in Massachusetts and that calc sources extend north to the Canadian border (Sassaman 1999: Figure 5.1; Truncer 2004:489; Sassaman 2006: Figure 1).

Cultural Diffusion and Shad

Other debates in the field of Transitional Period archaeology have involved vehement disagreements about the origin and dissemination patterns of Susquehanna broadspear cultural traits.

Turnbaugh (1975) argued that these new peoples immigrated inward from the coast due to the onset of warmer conditions and population pressure. Turnbaugh also pointed to the correlation between the distribution of Susquehanna broadspear material remains and the ... "adjusted range of certain anadromous fish, such as shad and alewife, along the Atlantic slope." He described the appearance of these cultural traits as the result of a movement of peoples versus diffusion of ideas or trade items (Turnbaugh 1975).

Turnbaugh argued that the expansion of these broadpoint projectiles and associated elements of their tool kits over a wide area in a short amount of time came about for a number of technological reasons as well as the need to adapt to environmental changes. In particular he suggested that this expansion was tied to both major river systems and maritime means (canoe) of transport of peoples and artifacts up these rivers. Turnbaugh inferred an important role for dugout canoes based on the distribution of sites along and within major drainages and on the presence of adzes and "other heavy woodworking tools" on many broadspear sites (Turnbaugh 1975: 62). Most importantly, Turnbaugh tied what he perceived to be the rapid expansion of the broadpoint peoples to seasonal fish runs, and specifically to the seasonal shad runs up the tributaries and rivers of the east coast. He noted that by ca 4000 B.P. the sea level had reached a stasis (modern levels), climate had shifted to more temperate conditions and mast(nut)-bearing mixed hardwood forests had expanded northwards (Turnbaugh 1975:59-60). These new conditions explained the rapid dispersal of the broadpoint horizon to the north of its presumed homeland in the southeast. The rising temperatures and fixed sea levels came together to

support what Turnbaugh argued was a prime resource for the broadpoint peoples, seasonal fish runs. He made the case that, given the small size of most of the broadspear sites, they implied either family or at most band-level groups that would have to fission and expand elsewhere when they reached the maximal economic supporting capacity of any given river or drainage. Turnbaugh hypothesized ... "the appearance of broadpoints in the North may well have been due to environmental factors that, in effect, pushed the shad further north and required already dependent groups to follow" (Turnbaugh 1975:64).

Steatite and Mast Processing

Over the last decade, and in contrast to Turnbaugh's focus on seasonal shad runs, Truncer presented a theory that steatite vessels were used as dedicated food handling vessels for the processing of mast or nuts, and that the Susquehanna broadspear cultural manifestations followed, or overlapped with, the distribution of mixed hardwood forest environments (1999, 2004a, 2004b, 2006). Truncer based his argument that steatite vessels may have been used to boil what he called "low-preference" mast resources on three lines of evidence 1) that the distribution of steatite vessels overlapped in geographical extent with nut-bearing mixed hardwood forests, 2) that "acorn and hickory remains increased during the time of peak steatite vessel manufacture" and 3) that steatite vessel residues are compatible with mast or nut processing (Truncer 2004:507).

Truncer's model of steatite vessels overlapping in extent with mast producing areas was particularly evident for New York. He relied upon the computerized inventory of archaeological sites at the New York State Museum, the files of

other institutions, and published and unpublished reports to compile a GIS model of the distribution of known sites with steatite in the state (Truncer 2004:493; Figure 4). His plots of steatite vessel distribution in New York showed that they were prominent throughout the south and central part of the state and that they correlated with the distribution of mast forest (Truncer 2004:493). He pointed out that steatite vessels do not occur in non-riverine upland contexts and instead "appear to be mapping onto diverse stands of mast-producing trees at lower elevations" (Truncer 2004:493). This pattern was replicated for Massachusetts where the extent of steatite vessel distribution also matched the extent of mast forest (Truncer 2004: 495). Likewise, Truncer made the case that like Massachusetts and New York, the distribution of steatite vessels in Florida is correlated with mast forest (Truncer 2004, 492). He specifically argued that "Steatite vessel distribution closely corresponds to that of protohistoric mast-producing forests ... east of the Appalachian Mountains and is particularly evident at mast forest edges in New England and Florida (Truncer 2004: 490).

Idea Exchange versus Migration

Truncer rejected the notion promulgated by others (Sassaman, 1999, Turnbaugh 1975, and Witthoft 1953) of a "diffusion/migration model postulating a southeastern origin of steatite vessel manufacture and its subsequent spread to the northeast" (Truncer 2004:497). In addition, Truncer rejected the concept that steatite vessels reflect a short-lived "horizon," instead arguing that they occurred over a long time period beginning as early as 4300 B.C. (Truncer 2004: 505; Figure 6). "....Steatite vessel manufacture

occurred at low levels of production for about 1800 years (4300-2500 cal B.C.), increased over the next 1000 years (2500-1500 cal B.C.) and then subsided over the next 1500 years (1500 B.B. - 50 B.C.)"(Truncer 2004, 506).

Truncer used trace element analysis of the interior soot of steatite vessels to argue that the residues were "compatible with mast" and that steatite vessels might have been used to boil mast resources (Truncer 2004:507). Tache et al. (2008) used similar techniques of mass spectrometry to argue that slightly more recent pottery containers recovered from the Saint Lawrence River were used to process fish and nuts "possibly for their oils at ceremonial feasts" (Lindner 2011, 70).

Truncer's idea concerning the relevance of interior residue on Transitional Period steatite sherds to mast processing was recently countered by analytical work by Hart et al. (2008) which used comparable chemical assays to argue that the fatty acids extracted by Truncer were not in fact indicative of mast in general or acorn processing in particular. Instead Hart et. al. determined that the charred interior and exterior traces of vegetable soot were derived from a variety of organic resources including"grass seeds, a legume, pine resources, animal flesh, and unidentified plants (Hart et al. 2008, 738-739). That analysis suggested that steatite vessels were used as "generalized cooking tools" and that, while they may have been used for acorn leaching in some regions at some times," the mast-processing hypothesis cannot stand as a general explanation for steatite vessel use throughout eastern North America."(Hart et.al. 2008, 739). In addition, countering Truncer's argument for mast processing as the primary role of steatite vessels, Sassaman made the case that not

only did mast processing predate the advent of steatite vessels, but also that pre-broadspear populations ..."without soapstone [steatite]vessels routinely procured and consumed mast resources" (Sassaman 2006:152).

Sassaman questioned the validity of several purportedly early dates for steatite reported by Truncer based on what Sassaman argued were poor associations and the lack of clear stratigraphic separation with radiocarbon dated samples (Sassaman 2006: 147-148). In particular, Sassaman made the case that steatite vessels did not predate 3700 B.P. and reached a peak in popularity between 3100 to 3200 B.P. (Sassaman 1999,77: 82; Figure 5.3). With one exception, Truncer argued in response that several early sites did indeed have valid radiocarbon dates in association with steatite vessels that predated 3700 B.P., and dated to between 4300 B.C. to 2500 B.C. (Truncer 2004:506) Truncer took exception to Sassaman's rejection of his assessment of several early sites (Hagerman, Warren Wilson and Falcon Field) which he dated to between at 4,100 to 4,800 B.P. (2006:161). Truncer subsequently also argued that while one early date for the Gaston site on the North Carolina piedmont may have been invalid, its stratigraphy clearly showed that steatite vessels preceded pottery at the site (Truncer 2006: 159).

Sassaman argued that while..."pottery in the Southeast clearly predates ceramic traditions to the north, soapstone [steatite] vessels in the Southeast are not technologically antecedent of pottery, nor do they predate their soapstone counterparts in the Northeast" (Sassaman 1999,77). Sassaman subsequently argued that pottery in the southeast preceded the appearance of steatite by "as much as 600 to 900 years" (2006:

152). He also concluded that "There is little to recommend that soapstone vessel technology in the Southeast is older than its Northeast counterpart; if anything, Northeast origins may be slightly older" (Sassaman 1999: 84). Sassaman's regional and chronometric comparisons suggest that the earliest pottery may have preceded steatite by a number of centuries in the Southeast, that the two technologies may have emerged in tandem in the Middle Atlantic region, "...while in New York and New England soapstone may have preceded pottery by a century or two" (Sassaman 1999:84). Earlier, Sassaman had made the argument that steatite might have been introduced from the south because stones of this material (steatite) were used for stone boiling long before stone bowls had been developed in the south (Sassaman 1993). Sassaman concluded "The so-called Broadpoint Tradition may in fact have involved the northward migration of people from the Southeast to the Middle Atlantic region...and beyond....In each of the areas of their occurrence, soapstone vessels were adopted or developed at least 200 years after members of broadpoint cultural affiliation became established locally" (Sassaman 1999: 93). (The stratigraphic evidence at Little Wood Creek suggests that steatite and broadspear points were, at least for the east-central Hudson drainage, indeed contemporary, and devoid of any ceramic associations. Steatite sherds were recovered in unambiguous stratigraphic association with Susquehanna broadspears in Component C of the Deep Cut A exposure.)

Sassaman's presumption of migration was rejected by Truncer (2004). Truncer compared the early dates for steatite vessels and determined that "These results indicate no trend in age and geographic location and are inconsistent with a diffusion/migration model postulating a

southeastern origin of steatite vessel manufacture and its subsequent movement to the Northeast" (Truncer 2004: 497).

Instead, Truncer (2004, 2006) reiterated his earlier contention that the first appearance of steatite vessels in the southeast can be dated to a relatively long early period of 1800 years (4300-2500 B.C.). This argument in turn supported his position that the concept of a short term "Horizon" marked by the appearance of Susquehanna broadspear points, steatite vessels and other diagnostic artifacts is not valid as a construct for characterizing the long-term appearance and duration of steatite vessel use in the eastern U.S. (Truncer 2004, 506). Truncer made the case that a four thousand year period covering the appearance of steatite can hardly be taken to reflect a short term horizon in eastern North America. In fact, Truncer argued that ... "steatite vessels occurred in low frequency in eastern North America for almost 2000 years before they peak clearly and strongly around 1500 B.C., a peak that accounts for the general success of the horizon-marker use" (Truncer 2004, 506).

Continuing the debate over trade versus migration, Patricia Miller suggested that the data for Pennsylvania supported the notion of trade versus the mass movement of peoples up and down the Susquehanna drainage. Miller argued that the Susquehanna Broadsphear component was not reflective of new or different people, but instead the infusion of cultural traits into the existing population and economic systems (Miller 2008). The increase in the number of Susquehanna broadspear sites associated with the broad-based but sparse presence of steatite vessels there suggested.... "a relatively high degree

of sedentism with large group sizes. Sites located along the rivers were likely situated there to facilitate participation in a drainage wide trade network." (Miller 2008:7).

The predominance of rhyolite as the main source material for Susquehanna broadspear in the Susquehanna drainage presents a potentially significant counterpoint to the predominance of Onondaga chert in the Upper Hudson, as evidenced by the finds at Little Wood Creek. Miller's comparative work in the Susquehanna drainage of Pennsylvania documented that as much as 88% of the Transitional Period debitage, or chipping debris, consisted of rhyolite (Miller 2008: 3). Miller also observed that debitage (flakes) from earlier, pre-Susquehanna horizon components (dating to between 3400 and 3800 B.P.) were of predominantly local argillite, but those from occupations dating to more recent contexts (3300 and 3000 B.P.) consisted of over 80% rhyolite (Miller 2008:3). The predominance of Onondaga chert (over 90 percent of lithic debitage) at Little Wood Creek supports the notion of idea exchange versus the physical introduction of people from somewhere else such as the Susquehanna drainage in Pennsylvania.

In 1993 Funk used evidence of stone tool source materials to argue against migration of Broadspire peoples into New York:

"The use of exotic lithic materials by northeastern Broadspire-Susquehanna groups is often cited as evidence that they migrated from places where the materials could be obtained, in particular central Pennsylvania and the Mid-Atlantic region. However, the early Broadspire points in New York State are almost always of local cherts....[which]...suggests that the inferred

complexes resulted from diffusion rather than migration.....The implication is that the Susquehanna tradition in New York represents an in situ development lasting at least 700 years....Although migration may have played a dominant role in introducing Susquehanna traits to certain areas, such as New England, our preferred hypothesis is that the rapid internal change in diverse regional cultures was the primary mechanism in most areas" (1993, 225).

The predominance of Onondaga chert in the Little Wood Creek Broadspire components likewise suggests strongly that, as was the case for the upper Susquehanna drainage, Fort Edward manifestations were the result of diffusion. In concert with Funk, it is probably the case that although the Little Wood Creek and upper Susquehanna drainage components represent "whole cultural systems" in west-central and east-central New York State...."they were the products of diffusion and in situ development rather than migration "(Funk 1993, 225).

In 2010, in a parallel line of reasoning, Pagoulatos supported this idea, stating that "....Although low level migration and short distance movements likely occurred, current data indicate that the majority of transmission was by way of diffusion-based processes, better typified by the movement of ideas, concepts, and material culture, rather than the mass movement of human populations across the Atlantic seaboard."(2010, 155).

Steatite in Ritual Exchange Networks

Finally, Michael Klein sidestepped both the notion of a riverine adaptation and a mast

oriented economy, to argue that steatite artifacts had a ritual and symbolic significance that superseded their function (Klein 1997). Based on the technological characteristics of steatite bowls, and ethnographic parallels to the use of steatite by such groups as the California Chumash, he suggested that their wide ranging distribution in the Southeast and Mid-Atlantic regions was due to their ceremonial importance as “prestigious exchange objects” in a broad-based regional network.(Klein 1997,:151). Klein further proposed that with the collapse of the Southeastern exchange network, centered at Poverty Point, the regional benefits of this exchange went into decline. He argued that the short appearance of steatite-tempered ceramics (Marcey Creek) in the Middle Atlantic was, in fact, a belated effort to continue these ritual exchange practices after the collapse of the southeastern network. "...Marcey Creek pottery continued the behaviors associated with soapstone bowls using [a] functionally and symbolically less efficient, but less labor intensive, medium" (Klein 1997: 149). He furthermore suggested that"the collapse of the southern exchange system may have decimated southern Middle Atlantic ritual and exchange systems while affecting those of the Northeast little" (Klein 1997:150). In other words, his work underscored the physical and cultural separation between what was going on in the Transitional Period in the Southeast and Middle -Atlantic regions from what may have been occurring at that time in the central reaches of New York's Hudson River Drainage. The small number of steatite sherds encountered in the midden surface scatter at Little Wood Creek suggests their presence was functional and that if they did represent manifestations of a ritual network of exchange, then their involvement must have been ephemeral.

With reference to Massachusetts, Curtiss Hoffman pointed to a number of Transitional Period sites which he interpreted to have been centers of "production and/or transfer of specialized artifacts" (Hoffman 2006: 91). He argued that these artifact classes in turn suggested interregional exchange centers, which were interrelated and connected to individual habitation sites throughout the region. In general his thesis depended on the identification of objects and source materials that were derived from further than 75 km. from a site, which he defined as "exotic" sources. These items included exaggerated amounts of certain artifact types that alone would imply little, but in large concentrations suggested potential hoarding and exchange activities. He specifically pointed to the transport of crystals and paint stones that "might have been kept in a shaman's bag". He described one site in particular with 217 polished pebbles, 2709 paint stones and 99 quartz crystals (Hoffman 2006: 100; Table 1). Hoffman makes no claim that his localized or regional trading networks were intertwined with that of the Poverty Point culture of the Southeast. He does however address regional "interaction spheres" and interregional exchange in general. His model highlighted the exchange of people and ideas, principally through marriage and kinship ties (2006:93).

Conclusion

In conclusion, this survey has highlighted multiple points of discussion and debate in the archaeological literature concerning the Transitional Period since the original work was done at Little Wood Creek at Fort Edward in the mid 1980's. This review focused initially on theories of dissemination of the Broadspear

complex, first via riverine habitats, secondly via shad runs, thirdly as a consequence of nut-bearing forest composition and finally as being due to ceremonial exchange networks. A central theme of debate has involved the time depth and nature of BROADSPEAR dissemination as it relates to the distribution and timing of steatite bowl production and use. Commensurate with this line of discussion is a strong series of back and forth articles arguing over the relative antiquity of soapstone in the eastern seaboard. One school of thought underscored what was perceived to be dissemination as a short term "horizon", or the broad based dissemination of steatite cooking technology over a relatively short period. Another line of debate argued that steatite had a long tradition that in fact, given its time depth, negates the notion of a temporally circumscribed "horizon". In addition, discussions have focused on whether the diffusion of traits represent the exchange of ideas or the infusion of new peoples into each region. Finally, these debates have been augmented by discussions involving the role of ceremonial exchange as the primary mechanism of dissemination. Together, they coalesce to present a series of ongoing themes that have yet to be resolved. Part of the reason has to do with the dynamic, and still unresolved, nature of the debates. Another reason has to do with the lack of data and tightly dated sites belonging to this cultural tradition. In this context, the Little Wood Creek finds are important because they present a case of clear cut broadspear associations with steatite in what can now be defined as tightly dated chronological framework between the 12th and 15th centuries B.C. in the Upper Hudson.

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III. The Chronometric and Archaeological Record: New Evidence from AMS Dating

The Chronometric and Archaeological Record: New Evidence from AMS Dating

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Introduction

The current effort focuses on the issue of Little Wood Creek's antiquity. The original radiocarbon dates were problematic and confusing based on widely disparate age determinations from different laboratories using traditional radiocarbon dating. Accordingly, a major goal of the HRF-supported grant was to cull the surviving archeological seed collection for appropriate non-seed samples and to submit ten carbon samples for high resolution AMS (Accelerator Mass Spectrometry) dating to establish accurate time frames for both the early Transitional Period levels and the Late Woodland Period features, specifically those distinguished by the presence of maize.

The purpose of this section is to summarize the initial radiocarbon determinations which provide background for evaluating the AMS dates which were analyzed as part of the Hudson River Foundation supported initiative. The goal of the new AMS determinations is to provide accurate age estimates on two sets of data from the Little Wood Creek site: first from the early Transitional Period contexts and second from a series of Late Woodland pit features that were found in association with maize. A total of ten AMS samples were processed, four from Transitional Period samples and six from later Late Woodland Period contexts.

As discussed below, these new AMS determinations show that the Late Woodland Period pits dated to between cal AD 1270 and 1440. The results of four Transitional Period AMS determinations indicated

that the buried Broadspear complex of living floors dated to between cal BC 1120 and 1500. In addition to these chronometric age determinations, the potential antiquity, or continuity, of the Late Woodland Period features was augmented by the recovery of a single Contact Period spherical brass bell (Figure 17). This find in turn suggests that at least portions of the Late Woodland site may have continued to be occupied into the 16th century era of French exploration and fur trading along the Mid-Atlantic coast, including the upper Hudson drainage.

The original radiocarbon dates have been converted to calendar years and we present the converted dates as a range in age to the second sigma (95% Probability). The actual age has a 95% probability of falling within the high and low reading. Thus, the calibrated dates are not presented as a single date, but instead as a set of projected high and low readings (Tables I and II). All of the Little Wood Creek samples, both Transitional and Late Woodland Periods, were recalibrated to match the newest tree ring correction curve (Intcal09) by BETA Analytic Radiocarbon Dating Laboratory of Miami, Florida.

In addition to the results of the original 1980's radiocarbon determinations which were analyzed using traditional chronometric procedures (Grossman et al. 1990, Tables 3.9 and 4.4), the data will be discussed in terms of comparative dates from New York State, Pennsylvania, New England and southern Canada. It will also be discussed in terms of new insights in method and theory that have impacted the field in the last twenty five years. In the introduction to *Current Northeast Ethnobotany II*, Hart (2008) underscores the need for any theoretical advances to be evaluated against the background of developments and innovations in the techniques of ethnobotany. This is particularly true for the nearly three decades since the Little Wood Creek

excavations. Flotation was used extensively to recover botanical remains from the sediments at Little Wood Creek, and two applied technology developments have emerged more recently as important to the issues of dating and domestication.

AMS Dating

One of these developments was the advent of Accelerator Mass Spectrometry (AMS) dating; the other the advent of phytolith analysis. AMS dating permits assays of much smaller samples than traditional radiometric techniques. It also holds the potential of significantly resolving the time frame of the site's occupation periods from a range of several centuries down to within a century or less. For these data sets, the AMS age ranges are shorter (or more resolved), between 100 to 200, versus a minimal of a 1000 years for the non-AMS radiocarbon samples. Likewise, the reported standard deviation is often as small as +/- thirty years versus the 100 to 150 year fudge factor for non-AMS determinations. In this case, the newer procedure has resolved and or refined the results by 100%, or a reduction in age range by 50 percent. AMS dating has also helped to resolve the antiquity of a number of crops in the northeast and has documented the age of both macrobotanical samples (i.e. corn kernels) and of microbotanical samples such as phytoliths from the charred residues in prehistoric cooking pots (Hart et al. 2007; Hart 2008).

Each of the recent AMS dates and all of the prior radiocarbon determinations were calibrated to the most recent tree ring correlation plots ("Calibration of Radiocarbon Age to Calendar Years" data sheets) and are presented as individual data sheets in two appendices. The data sheets are divided into two chronological groups: the early Transitional Period (Appendix I) and the later Late Woodland Period (Appendix II). Each temporal group is introduced by a summary plot of

patterns or clusters of age ranges. These two summary plots by the author represent high-low graphs of chronologically associated age ranges for each major period (see Tables I & II). All of the associated individual correlation sheets are in turn comprised of two data sets: 1) the 2012 recalibrations of the original 1987 scintillation determinations and 2) the ten new 2012 AMS age ranges. All individual data plots are arranged in sequential order within each appendix by laboratory sample number, regardless of the laboratory identifier prefix. All references in the text to individual data sets are by laboratory sequence number. Each calibration plot converts the radiocarbon age in years before present (BP) to actual calendar years based on detailed tree ring graphs, as cal BC or AD.

Phytoliths

A second major methodological breakthrough involves the use of phytoliths to document corn and other succulents in the archaeological record. "Phytoliths are silicate structures found in plant cells"....which can be distinguished to the genus and species level with microscopic and statistical techniques (Hart et al. 2007, 170; Hart 2008, 2; Serpa 2008). Phytoliths have proven identifiable at the species level for a variety of grasses, including maize, for members of the gourd family, for beans, tobacco, marshelder, knotweed and goosefoot (Serpa 2008, Table 8.2). While no phytolith evidence was part of the current study, the antiquity and significance of corn from Little Wood Creek must be evaluated based both on dates from the macrobotanical remains as well as the results of the earlier phytolith dates. The identification of phytoliths from the interior residue on early pottery and steatite vessels has indicated the presence of early corn in the northeast, hundreds of years before it becomes visible as macrobotanical specimens (Hart et al. 2007). Most recently, this line of evidence has been expanded back in

time based on an increasing early series of phytolith dates from an initial projection of the 7th century AD (Hart et al. 2003), to ca 1900 BP dates (Thompson et al. 2004), to what is now being argued to date to 2270 +/- 35 B.P.(cal B.C. 399-208), or ca the fourth century B.C., hundreds of years before it became archaeologically visible as actual kernels of corn or cob fragments in the archaeological record (Hart et al. 2007, 564; Hart et al. 2008). This age determination in turn led Hart et al. to suggest that corn was "certainly continuously used by 1500 B.P. [450 AD] in this region" (Hart et al. 2008, 89). It also led Hart et al. to conclude that"maize was present in central New York up to eight centuries before the earliest macrobotanical evidence for this crop in southern Ontario ...and five to six centuries before the earliest macrobotanical remains in Ohio" (Hart et al. 2007; 577). Likewise, Chilton observed that..."The presence of maize and squash phytoliths in pottery residues suggests the use of maize by native peoples in New York State more than 2,000 years ago, far before the oldest macrobotanical evidence would indicate" (Chilton 2008, 56).

Direct and Indirect Dating

Finally, as a prelude to discussing the actual dates from Little Wood Creek, it is important to distinguish between the different dating techniques and reporting procedures that are now dominant in the archaeological literature. It has traditionally been the case that dates were based on the assay of charcoal found in association with specimens of interest, in this case - for the Late Woodland samples - primarily maize. However with the advent of AMS dating, much smaller samples, such as individual seeds or kernels of corn, can be directly dated. Direct dating has obviated the persistent problem of the "associated" charcoal being from old wood. Archaeologists have become more attuned to the fact that not only do direct dates and

associated dates not always agree because there is a persistent possibility that the associated charcoal from a pit or layer may have come from old wood (Hart 2008,4; Chilton 2008, 55) and as such may be misleading. "What is becoming increasingly clear is that relying on specially associated charcoal to obtain dates for crops ...[is]... untenable and that AMS dating used in conjunction with microbotanical research can provide unanticipated results" (Hart 2008, 4).

These concerns notwithstanding, it is also the case that direct dating results in the destruction of an otherwise irreplaceable specimen and, therefore, some archaeologists are loath to employ this technique. In this current study the Late Woodland samples used were of associated charcoal from the same feature or pit that the maize was recovered from. No primary seed specimens were sacrificed for AMS testing, meaning that the dates may be up to a century early depending on the age of the tree whose charcoal was dated.

In addition, a further distinction in the literature has had to do with the fact that some age determinations are reported as "raw", uncalibrated, dates in radiocarbon years before the present (BP) which in fact counts backward from the date of the atmospheric atomic bomb tests in 1950. As such, when reported as years before the present (B.P.) it is understood that the reported age can be over sixty years younger than is actually the case. When calibrated, the initial radiocarbon age is correlated relative to tree ring curves correlating radiocarbon years to calendar years. The original 1980's Little Wood Creek radiocarbon assays were analyzed on charcoal found in individual features or pits and were neither corrected nor calibrated to actual calendar years. The current 2012 age determinations analyzed with AMS procedures are corrected and calibrated to actual calendar years and the original dates have also been corrected and calibrated.

Accordingly, all of the dates will be comparable to published calibrated dates from other sites.

The BETA Analytic Calibration Plots

Nine of the recalibrated non-AMS Transitional Period age determinations showed multiple intersects within the two-sigma ranges of the high resolution radiocarbon-years-to calendar years correlation plots (Each such case is highlighted with an asterisk next to the date in Tables I). Staff at Beta Analytic laboratories have pointed out that there is no statistically sound basis for selecting one intersect range over another. Therefore, as is the protocol for reporting calibrated "dates", all intersects within the two sigma range (95% probability) are added together to provide the most inclusive range of dates for each calibration.

For example, the recalibration of the Levee Hearth (Context 530.01 - GX-13251) showed three segments of intersection within the two sigma overall range. This multiple intersect may reflect the small size of the original sample, short counting times and finally the high resolution undulations of the most current tree-ring correction curve (INTCAL09 data base). One of the two sigma ranges spans from cal BC 1050 to 1775. However, undulations in the correction curve define two other segments of intersection, one at cal BC 1805 to 1805 and a slightly older segment of cal BC 1865 to 1845. Because there is no basis for selecting one over the other, the final age range for this assay is defined as the cumulative total for all intersects, or in this case, a overall determination of cal BC 1865 to 1050. While this older radio carbon determination is probably too broad to be of much use for defining the feature, instead of being more recent than other Transitional Period features, as had been initially thought, the assay seems to suggest that the Levee hearth may actually be older than or contemporary with other components of the Transitional Period occupation.

As another case in point, the Cut B hearth (Context 1339-GX13809), also a recalibrated 1980's era non-AMS determination, showed two segments of intercept within the two sigma overall range. Reflecting the significant undulation of the tree ring curve at this time period, one of these two segments was cal BC 1630 to 1260. The other intercept was a very short cal BC 1230 to 1220. Again, while the latter 13th century BC "date range" appears reasonable in the overall context of the site, there is no statistical basis for selecting one over the other. Reflecting the shorter time spans and short thirty year error bars (standard deviations) for each of the new 2012 determinations, no AMS dates returned multiple two sigma intersects with the tree ring correction curve and only one age range was returned for each.

Finally, one other example deserves to be highlighted. Two buried logs provided basal dates for the evaluation of later radiocarbon determinations. One, Log B, found five feet below the living floor of Deep Cut B, (Sample GX-13760 Context 1322.19b) with a recalibrated non-AMS radiocarbon date (Conventional age of 3230 +/- 70 BP), illustrates the problem of interpreting a long two sigma age range. The two sigma (95% probability) results returned an age range of cal BC 1680 - 1390. This one log date is important because it brackets the cal BC 1500 years range of the earliest 2012 AMS age determination from Hearth 1 (Beta-317204, Context 1221A-Hearth 1). As discussed below, there was a 95% probability that the actual date of the buried log showed an uppermost potential age of cal BC 1390 (at two sigmas). However, while it did not show multiple 95% intersects with the tree ring curve, it did show multiple intersects at the one sigma, or 68% range. When evaluated relative to the one sigma range the returned recalibrated dates ranged between cal BC 1605 - 1430. At one sigma, that means that there is a 68% probability that the actual date falls between this age

Table I
Calibrated Two Sigma (95% probability) Age Ranges for Transitional Period Contexts
Little Wood Creek, Fort Edward, New York

* All Calibrations by Beta Analytic Radiocarbon Dating Laboratory

Context-Feature	Sample No.- Context	Conventional		High	Low
		Age - BP	SD	(Cal BC)	(Cal BC)
Cx-1221A - Hearth 1	Beta-317204 - Cx 1221A - AMS	3160	30	1500	1400
Cx-1221 - Hearth 1	Beta-317205 - Cx 1221 - AMS	3070	30	1410	1260
Cx-1221 - Hearth 1	Beta-317206 - Cx 1221 - AMS	2970	30	1300	1120
Cx-1187 - Hearth 1	Beta-317207 - Cx 1187 - AMS	2980	30	1310	1120
Cx-1099 - Hearth 1	GX-13252 - Cx 1099	2455	130	840	205
Cx1221 - Hearth 1 (1099)	GX-13825 - Cx 1221	4045 *	110	2890	2235
Cx1173.00 - Comp C	GX-13256 - Cx 1173	4320 *	185	3505	2470
Cx1181.01 - Comp A/B	GX-13255 - Cx 1181.01	2380	130	805	170
Cx1167.04 - Comp C	Gx-13257 - Cx 1167.04	4320 *	90	3325	2695
Cx768.00a CompD Hearth-6	Beta17465 - Cx 768.00a	4710 *	100	3690	3130
Cx 941 - Comp D	Beta-17530 - Cx941	2620 *	100	980	410
Cx768.00b CompD Hearth-6	Beta17438 - Cx 768.00b	3270 *	100	1770	1320
Cx 1163.02 - Comp C Surf.	GX-13757 - Cx 1163.02	3280	95	1770	1390
Cx1188 - Hearth 1	Gx-13758 - Cx 1188	3275	75	1740	1410
Cx. 530.1-Levee Hearth	GX-13251-Cx 530	3185 *	150	1865	1050
Cx1137 - Hearth 2	GX-13253 - Cx 1137	3115	85	1600	1130
Cx1138 - Hearth 3	GX-13254 - Cx 1138	2840	110	1370	800
Cx1339-CutB Hearth	GX-13809 - Cx 1339	3170	90	1630	1220
Cx1322.19a-LogB	GX-13258 - Cx 1322.19a	3380 *	90	1895	1455
Cx1322.19b-LogB	GX-13760 - Cx 1322.19b	3230 *	70	1680	1390
Cx1153.22-Log A	GX-13792 - Cx 1153.22	3795	95	2475	1950

* - Multiple ranges on tree ring curve
See calibration charts

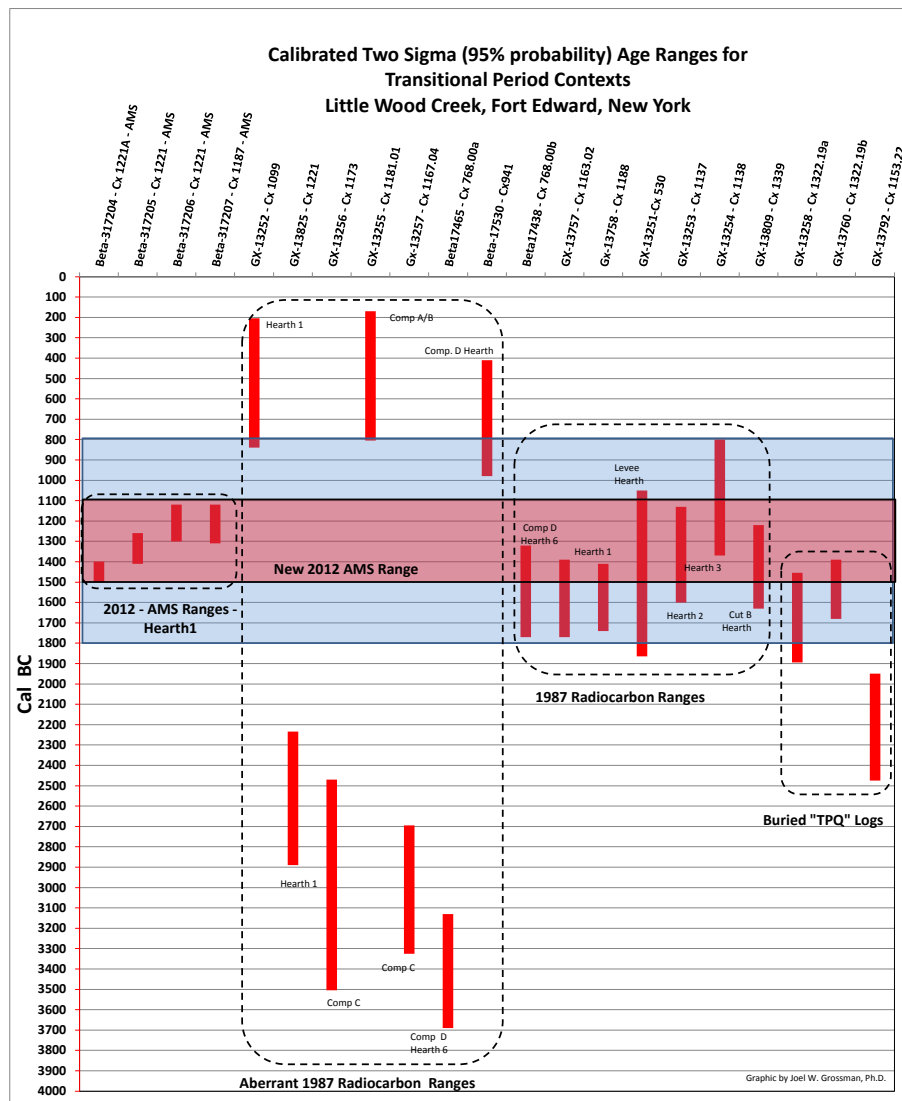
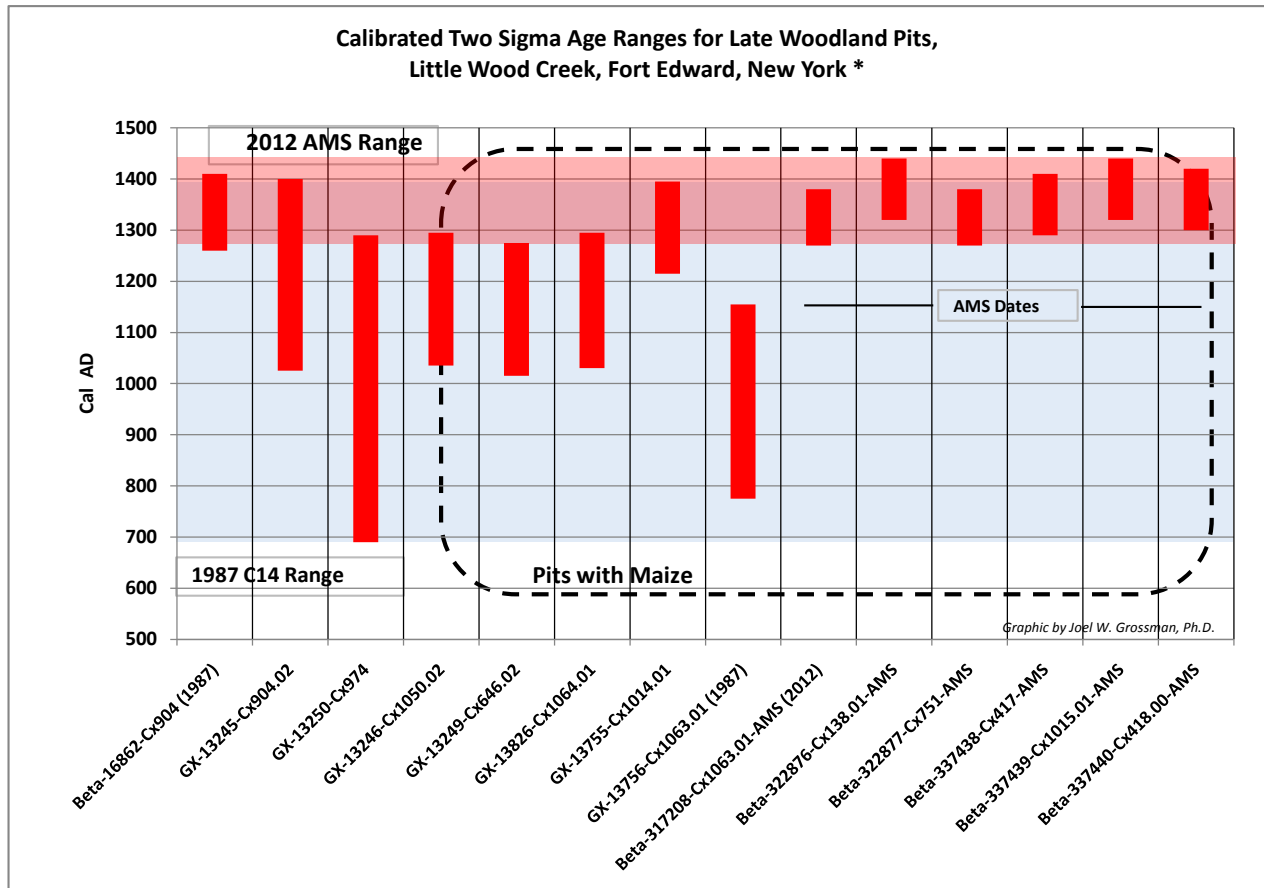


TABLE II

Calibrated Two Sigma (95% probability) Age Ranges for All Dated Late Woodland Pits *

Context	Lab. Sample No. - Context No.	Dates BP	SD	Low (Cal AD)	High (Cal AD)	Pit Association (Maize=Mz)
904	Beta-16862-Cx904 (1987)	650	60	1260	1410	burial pit fill
904.02	GX-13245-Cx904.02	780	105	1025	1400	burial pit fill
974	GX-13250-Cx974	975	150	690	1290	Pit - Castle Creek
1050.02	GX-13246-Cx1050.02	805	75	1035	1295	Mz - Castle Creek
646.02	GX-13249-Cx646.02	890	75	1015	1275	Mz - Castle Creek
1064.01	GX-13826-Cx1064.01	815	75	1030	1295	Mz - Owasco
1014.01	GX-13755-Cx1014.01	710	65	1215	1395	Mz - Castle Creek / Bainbridge
1063.01	GX-13756-Cx1063.01 (1987)	1075	80	775	1155	Mz - Owasco
1063.01	Beta-317208-Cx1063.01-AMS (2012)	700	30	1270	1380	Mz - Owasco
138.01	Beta-322876-Cx138.01-AMS	530	30	1320	1440	Mz - Castle Creek / Bainbridge
751	Beta-322877-Cx751-AMS	690	30	1270	1380	Mz - Castle Creek
417.01	Beta-337438-Cx417-AMS	600	30	1290	1410	Mz
1015.01	Beta-337439-Cx1015.01-AMS	530	30	1320	1440	Mz
418.00	Beta-337440-Cx418.00-AMS	570	30	1300	1420	Mz

* - All Calibrations of radiocarbon age to calander years by Beta Analytic Radiocarbon Dating Laboratory



range. This determination also shows that the actual point of interception with the calibration curve was cal BC 1500. While it is a tendency for some to interpret this point of intercept as the "median" date for the feature, it is in fact simply a statistical artifact with little or no chronological significance. Nevertheless, when both the one sigma and point of intersect are evaluated together, the results indicate that the buried log was in fact probably a bit earlier than the two sigma 1390 BC end number suggests. That being the case, it appears probable that this early non-AMS recalibrated radiocarbon date from the 1980's is both reasonable and stratigraphically consistent with the relative depth of the buried log below the Deep Cut B hearth. This suggestion in turn indicates that the earliest AMS date of cal BC1400-1500 for Hearth 1 fits nicely with the one sigma calibration range for the Deep Cut B log feature. In sum, we suggest that the two determinations are in fact consistent and imply strongly that the initial occupation of the site may have begun as early as the century between cal BC 1400 and 1500. It also suggests that the living floors of both Deep Cut A and Deep Cut B were not stabilized and inhabitable, or formed, until this date.

The 2012 Transitional Period AMS Results

The earliest 1980's era buried Transitional Period determinations were widely divergent and, therefore, of limited utility. Some appeared to be credible, while others were simply not reasonable. Graphing the Transitional Period determinations, both new AMS and old non-AMS samples, reveals four groups of chronologically related ranges: 1) the four recent AMS dates, 2) a group of aberrant very early and very late ranges, 3) the 1987 ranges that overlap with the AMS ranges and 4), the buried logs that serve as stratigraphic "TPQs", or temporal benchmarks, in addition to the subsequent AMS ranges (Table I). All

subsequent discussions are geared to the information in these Summary plots of Age Range patterns.

The four Transitional Period AMS assays reveal calibrated age determinations that refined the time span of the buried occupations down to four centuries or less. The four AMS dates (Samples 1-4; Beta Nos. 317204-317207) were run from a single Transitional Period feature (Hearth 1), but from different context units and areas within it (Table I). This feature, Hearth 1 (Contexts 1099, 1187 and 1221), yielded four AMS dates that were internally consistent with one another, consistent with the stratigraphic sequence of dated logs from below the hearth, and consistent with published dates for other contemporary Frost Island sites in New York (Funk 1998). When compared to the conventional radiocarbon dates from the 1980's, these new AMS dates both clarify and correct the inconsistencies of the original radiocarbon data set. The wide variability in the 1987 non-AMS dates returned from the Transitional Period occupation made re-dating particularly important for this period.

The four Transitional Period AMS samples returned calibrated dates spanning from the 12th to the end of the 15th centuries BC. The four samples returned conventional age determinations between 2970 +/- 30 and 3160 +/- 30 BP, or short individual time spans of ca 100 to 190 years per determination. When calibrated, the four AMS samples defined age ranges of between cal BC 1300 to 1120 and cal BC 1500 to 1400. Three of the Transitional Period AMS dates, for Hearth 1, were close to one another with age determinations of 3070 +/- 30 BP (Context 1221, Beta-317205), 2970 +/- 30 BP (Context 1221, Beta-317206) and 2980 +/- 30 BP (Context 1187, Beta-317207) (Table I). These three determinations translated to between cal BC 1410 to 1120. Two of the dates, both also from Hearth No 1, returned almost identical results with conventional ages

of 2970 +/-30 and 2980 +/-30 BP In tandem they translated to between cal BC 1300 to 1120 and cal BC 1310 to 1120. They also focused the Transitional occupations down to a four hundred year period, versus the several thousand year spread of the earlier 1980's non-AMS dates.

Excluding the aberrant highs and lows, the old, now recalibrated, non-AMS dates (in the third group) together define a range of cal BC 800 to 1800 (shown in blue)(Table I). In contrast, when combined, the relatively short individual AMS date ranges focus down to a 380 year period for the Transitional deposits and define a cumulative range of from 1120 to 1500 BC. For the Transitional Period samples alone, the contrast between the AMS and non-AMS date ranges translates to a 100% increase in resolution, or at a minimum, a 50% drop in apparent time span. As illustrated in Table I summary graph, the new AMS range(shown in red) spans from the twelfth to the edge of the sixteenth century BC. However, as discussed below, this earliest 16th century assay must be evaluated in light of the recalibrated dates from buried logs beneath the Transitional period living surface.

The *Terminus Post Quem* "T.P.Q." Logs Two sets of data exist to evaluate the earlier 1980's era non-AMS dates. One comparative data set comes from the new AMS determinations from four samples from Hearth 1 (Table I). The second set of comparative dates comes from two buried logs under Deep Cut A and Deep Cut B. The logs were not associated with any cultural items, but did provide chronological beginning markers for the evaluation of the other non-AMS dates. These log dates provide *Terminus Pro Quem* (T.P.Q.) or loosely translated as "dates after which" determinations that limited the age of the overlying deposits and hearths in both exposures. The deeply buried log of Deep Cut A (Context 1153.22-GX-13792) yielded a calibrated age

determination of between cal 2475-1950 BC. This early log date is immaterial since the Log B date is more recent, providing a later T.P.Q.

The Deep Cut B buried log (Cx 1322.19 a&b), interpreted by Dr. Segovia as being from an old channel to the southwest and 5 feet below the hearth was tested twice and yielded two dates that, while different from one another, were slightly older than the overlying hearth. One determination for the buried log of Deep Cut B (Context 1322.19a-GX13258) yielded a calibrated date of cal BC 1895-1455. The second determination from the same buried log (Context 1322.19b-GX13760) yielded a slightly more recent calibrated age of cal BC 1680-1390, the most recent upper limit of the T.P.O. provided by buried logs of Deep Cut A and Deep Cut B. That means that there is a 95% probability that the actual age of the logs falls between cal BC 1390 and 1680.

Neither of these buried logs had any cultural associations. Their value is derived from the fact that when dated, they serve to limit the ages of the overlying Transitional Period features. By stratigraphic definition, the overlying features must post-date the most recent ages of the buried logs. In the first case this means that the overlying cultural deposits of Component C must postdate cal BC 1390 the uppermost date of the most recent log. This temporal marker represents the most recent "edge" of the calibrated age determinations for these features. It also indicates that the overlying Component C living floor and hearths have to, by definition, post-date sometime within a three hundred year range between the late 14th and the 17th centuries BC.

Accordingly, these stratigraphic and chronological benchmarks suggest that the new AMS dates from 2012 show that the buried living floors and hearths of the Frost Island occupation at Little Wood Creek date between the 12th and 15th centuries BC.

This new AMS data also confirms that the supposedly early ca. 4000 BP dates initially received in the 1980's (Table I) which were internally inconsistent with other stratigraphic samples, inconsistent with the documented ages of other regional manifestations of the Frost Island Phase, and out of sequence with the site stratigraphy based on the ages of the buried logs, should be rejected. The old Transitional Period radiocarbon dates were, with a few exceptions, predominantly also grossly out of sync with the new AMS dates of 2012. However, seven of the old dates overlap with the new AMS dates albeit with large ranges (Table I).

Regional Comparisons In addition to the log dates, the new AMS dates are also consistent with the determinations in the literature for comparable Frost Island sites in the New York region in general and for the Susquehanna drainage in particular (Funk 1998, 309). In addition to the nearby O'Neal site date of ca. 1250 BC, (uncalibrated) four dates from the Susquehanna drainage overlap in time with the Little Wood Creek dates. Funk cited dates of between 1475 BC and 1250 BC for Frost Island sites in New York (Funk 1998, 309). These apparently uncalibrated dates ranged from the ca 1475 BC from the Camelot No. 1 site, to 1330 B.C. from the Fortin site, to 1300 B.C. from the Enck No. 1 site and finally to 1290 B.C. from the Camelot No. 2 site (Funk 1993, 197; Funk 1998, 309). Funk also noted the significantly earlier occurrence of three 16th century BC dates from the Kuhr No. 1 site (Funk 1998, 308). As Funk pointed out, these three dates from Susquehanna Broadspire levels at the Kuhr No. 1 site were early relative to those from other Frost island period sites with determinations of 1535, 1550 and 1595 BC (Funk 1998, 308). This time span is close to the earliest 2012 AMS date from Little Wood Creek that returned a determination (Beta-317204) of cal B.C. 1500 to 1400 (Table I). In other words, this assay of Hearth 1 at Little Wood Creek yielded a series of calibrated AMS dates

that are close to, within a century, the three early determinations from the Kuhr No. 1 site and overlapped with the 1475 BC date reported for the Camelot No. 1 site (Funk 1998, 309).

Given the apparent 14th through 17th century B.C. age of the most recent logs, it appears that the earliest AMS determination (cal BC 1400-1500) overlapped with, or followed soon after, the most recent log date and suggests also, as was the case for the Susquehanna dates, that the Transitional Period occupations may have begun as early as the 15th to 16th centuries BC at Fort Edward as well. Given Dr. Segovia's interpretation of log B's arrival at the site, it would seem that the people occupied the site as soon as it was stable and available.

The 2012 Late Woodland Period AMS Results

The 2012 AMS results provide critical new information on the antiquity of the Late Woodland Period Fort Edward site components. They define the time span of the Woodland Period both precisely and with results that contradict most of the original radiocarbon assays. Six new Late Woodland Period samples were selected for AMS testing. One of the six samples, Context 1063.01 (Beta-317208), was being tested again because of its association with corn and because it appeared early for New York State. Two other Late Woodland samples, Contexts 138 and 751 (Beta 322876 and 322877) were selected for AMS testing because of their association with maize (corn) and diagnostic pottery.

Two of the six Late Woodland Period AMS determinations returned identical age ranges of cal AD 1270 to 1380 (Cx 1063.01-Beta 317208 and Context 751- Beta 322877). Context 1063.01 was associated with maize and Owasco style pottery. Context 751 was also

found with corn, and with Late Woodland Period *Castle Creek* pottery. The third, Context 138 (Beta-322876), a pit with both maize and two ceramic types (*Castle Creek/Bainbridge Collared Incised*), dated to between cal A.D. 1320 and 1440, or nearly to the middle of the fifteenth century (Table II).

The three new dates, from pits with pottery, together suggest that the range of stylistic variation of the ceramic assemblage was also late. Instead of dating back to as early as the 8th or eleventh centuries, as the initial 1987 assays suggested (Grossman et al 1990), all three determinations indicate that at least the three main types of the pottery assemblage (*Owasco Corded Collar*, *Castle Creek Incised Neck* and *Bainbridge Collared Incised*; Figures 9 - 11.) can now also be attributed to the late Late Woodland and/or proto historic period, clustering between the late thirteenth and mid-fifteenth centuries. The range of variation of the ceramic assemblage and the chronological resolution suggests also that these ceramic "types" may in fact have been roughly contemporary.

Three of the Late Woodland AMS samples (Contexts 417.01, 1015.01 and 418.00; see Table II) were recovered exclusively associated with maize, but not with any diagnostic ceramics or artifacts. Like the three samples with diagnostic pottery and maize (Contexts 1063.01 138.01 and 751; see Table II), the three additional maize determinations defined short periods of 120 years. All ranged within a 150 year period between cal 1290 and 1440 AD. Like the first three dates, the three maize dates fell between the late 13th century and the mid-15th century at Little Wood Creek.

All of the six determinations were internally consistent as a sample and clustered in both short and uniformly late time frames. All dated to between cal 530 and 700 BP. Together, the six AMS determinations define a late Late Woodland occupation of between

1270 and 1440 AD (Table II). The six AMS dates also strongly indicate that maize cultivation was late at Little Wood Creek and was not being practiced there until after cal 1270 AD.....and as discussed below, during the Medieval Warm Period.

Like the Transitional Period determinations, both the recalibrated Late Woodland Period radiocarbon dates and the new AMS ones were plotted as age ranges showing high and low readings, versus as individual dates (Table II). In contrast to the prior Late Woodland assays of the late 1980's, the six AMS dates returned age ranges that were of relatively short duration. Together, the six AMS determinations defined a time span of just 170 years, shown in red. Individually, the AMS determinations covered even shorter time spans of 110 and 120 years each (Table II).

As illustrated in the Table II plot, the non-AMS determinations also defined a significantly longer time span between its earliest and latest ranges. In contrast to the short cumulative span of the latest AMS date ranges, the earlier non-AMS determinations in sequence, shown in blue, and overlapping, spanned 665 years, or nearly seven centuries. The contrast in age ranges between the non-AMS and AMS determination translates to a more than a threefold increase in resolution.

The AMS dates were also uniformly late in the Late Woodland Period. All six post-dated 1270 AD (Table II). Together, these six assays suggest strongly that corn (maize) was not exploited at this site in the Fort Edward area until the late 13th century. The consistency and short time frames of the six AMS dates further raises questions about the accuracy and temporal ranges of the 1987-era radiocarbon dates. The AMS age ranges strongly suggest that the earlier non-AMS age determinations were, with one or possibly two exceptions, returning ranges that were, at a minimum, two to three centuries too early (Table II).

As mentioned, one of the Late Woodland Period charcoal samples (Context 1063.01) was tested twice, first in the 1980's as a traditional radiocarbon sample, and then again in 2012 as an AMS sample (Table II). Its original conventional radiocarbon date was early and led to the impression that the Fort Edward maize was potentially early in New York State. The conventional 1987 determination for Context 1063.01 (GX-13756) returned a radiocarbon age 1075 BP and a calibrated age of cal AD 775-1155.

The new 2012 AMS date from Context 1063.01 (Beta 137208) contradicted the original radiocarbon determination and established instead, that the pit had been filled at Fort Edward between cal AD 1270 and 1380. (Table II). Therefore, the new AMS determination indicates that the associated corn in context 1063.01 was late as well, dating to between the late 13th century and mid-14th centuries AD. This acute change in projected antiquity between the traditional radiocarbon age estimate and the current AMS date underscores the pitfalls of relying on either traditional radiometric assays and/or the recalibration of older dates in general relative to the more accurate results from AMS dating.

Finally, a total of eight radiocarbon samples were originally tested from the Late Woodland pit features and components in the 1980's (Table II). Of the eight Late Woodland Period assays, two samples came from charcoal recovered from the fill of a single burial pit (Contexts 904 and 904.02) and the remainder derived from individual pit features filled with refuse. The single burial pit fill sample was tested twice with charcoal fragments from two different areas of the fill and yielded two determinations that overlapped in time (Table II). The first age determination from the burial pit (Context 904.2) was done at the Krueger Enterprises laboratory and yielded a date of 780 +/- 105 BP (cal AD 1025-1400). The second sample (Context 904.00; Beta-

16862) - also from charcoal recovered from the fill of the burial pit - was tested at BETA-Analytic in the 1980's and yielded a determination of 650 +/- 60 BP (cal. A.D. 1260-1410). Together, these assays suggest that the individual in burial 904 was interred sometime between the 13th and 15th centuries A.D., but not as early as the eleventh century as had been initially thought.

This BETA date, which corresponds well with the newer AMS range of between cal AD 1270 and 1440, is only one of two Late Woodland radiocarbon determinations from the 1980's that overlaps in its entirety with the new AMS results. One other context of the non-AMS group partially overlapped with the restricted AMS range. This feature, Context 1014.01-GX13755, returned a date range of cal AD 1215-1395, which was slightly early relative to the AMS determinations, but close enough to suggest a comparable time span.

The Antiquity of Maize in the Northeast

Traditionally, the "three sisters," corn, beans and squash, were thought to have traveled together across the continent. However, AMS dating and phytolith analysis have served to segment these assumed associations. It is now clear that "squashes were present in the Northeast by the end of the third millennium B.P., while gourds were in use at least two millennia earlier" (Hart 2008, 89). Phytoliths of both squash and maize have been found together in residues dating as early as 1525 BP (cal to two sigma at 1518-1345 BP) (Hart 2008, 90). In addition, almost a decade before the early phytolith date for corn was established, AMS dating served to document the fact that the age of common beans in the archaeological record was significantly more recent than had been previously assumed and significantly later than both maize and

squash (Hart and Scarry 1999; Hart 2008, 90). Beans did not become archaeologically visible before 1300 AD and as a result there is - given the antiquity of maize -"no convincing evidence for the co-occurrence of maize, beans and squash before that time" (Hart and Scarry 1999, 657). "Maize-beans-squash agriculture was not established in the Northeast until the late thirteenth to early fourteenth centuries AD" (Hart and Scary 1999, 656-657). As summarized by Hart"each of the crops have separate histories, only merging together after cal 700 BP" (2008, 90).

In addition, the early phytolith dates by Hart et al. (2007) for corn significantly impact traditional theoretical treatments of subsistence and settlement systems in the region. As laid out by Chilton...."the timing of the adoption of maize....has important implications for understanding the relationships between sedentism, farming and social complexity..."(2008, 57). Simply stated, corn and squash were present long before the advent of what are presumed to have been nucleated villages.

The antiquity of corn in the archaeological record varies greatly by region. The earliest macrobotanical evidence for corn in the eastern United States has been documented in Tennessee and Ohio around the second century AD (Cassedy and Webb 1999,91). However, the direct dating of maize from specimens in this region suggest that corn was present"before 1000 BP in southern New England and New York and around 1200 BP in north-central Pennsylvania (Hart 1999, 5). But these generalized time frames may reflect only the limited number of samples evaluated to date. "The potential for earlier maize in the Northeast is suggested by AMS dates in southern Ontario as early as 1500 B.P. (Crawford et al. 1997; Hart 1999, 5). "Maize was introduced into Pennsylvania by at least A.D. 750, possibly much earlier considering its presence in Ohio

sites by A.D. 425" (King 1999, 21). The earliest evidence for maize in Pennsylvania came from a pit found to contain corn which was dated to A.D. 705 +/- 70 (King 1999, 19). In other words, maize has been documented in Pennsylvania by the eighth century A.D., approximately a century before it has been documented in New York State. On this point, McConaughy concluded that "...maize may have been present in small quantities prior to A.D. 900, but was not a constituent of the local diet until after that date"(2008, 22).

For New York state proper,...."multiple radiocarbon dates from excavations in the Susquehanna and Hudson Valleys of central and eastern New York since 1990 strongly suggest that maize was cultivated in the region starting by the 9th century AD "(Cassedy and Webb 1999, 85). As of this writing, the earliest radiocarbon dates in New York State for corn have come about as a result of research conducted as part of the cultural resource survey for the Iroquois Pipeline project through eastern New York and Connecticut (Cassedy and Webb 1999). These dates came from a site designated 211-1-1 on the Roeliff Jansen Kill in southeastern Columbia County, ca 150 kilometers to the south of the Little Wood Creek excavations in Washington County. From this site,"two early dates of AD 850 +/- 70 (Feature 44) and AD 900+/-60 (Feature 32) were obtained ...on charcoal associated with maize in the feature" (Cassedy and Webb 1999, 87). Both of these initial determinations were not tested with AMS procedures. Several years later, both associated charcoal and a maize kernel from Feature 32 were tested again with AMS dating. Both yielded AMS dates of 1050 BP (cal to two sigma at 1166-833 BP, or a mean date of cal AD 900) (Cassedy and Webb 1999,87-89). These early dates are the earliest against which the Little Wood Creek samples can be evaluated in the state.

Although early for New York, these dates are not the earliest for the northeast. The New York determinations were in turn preceded in time by a cluster of five dates from the Great Lakes region which indicate that introduction of corn into southern Ontario had occurred by the 6th century AD (Crawford et al 1997, 117). These determinations led Crawford et al. to conclude that: "The conservative interpretation is that corn diffused from regions to the south and/or west over a period spanning six centuries; once it was present in southern Ohio and Tennessee, it took only two or three centuries to move to Ontario" (Crawford et al, 1997, 117). By extension, and given the dates for corn in New York, it can probably be safely said that a parallel trend for the rapid expansion of maize into New York took place over an equally short period for this region as well.

Despite the early period for the initial or earliest maize dates for New York, for New England most of the reported dates for maize fall within the period AD 1300-1600 (Little 2002, 114; Chilton 2010, 170). The earliest direct date east of New York State is from the Ingalls site in New Hampshire which yielded an age determination of cal AD 1019-1159 (Chilton 2010, 170). This determination suggests the introduction of corn into New England some three to four centuries after it became visible as macrobotanical remains in the Great Lakes region and at least a century or two after it became visible as macrobotanical remains in New York.

The increasing antiquity for maize in the Mid-Atlantic and New England has also affected a once widely held theory as to the onset of widespread corn cultivation in the Long Island Sound region of New York. In the 1980's, Lynn Ceci (1982) proposed a model that hypothesized that maize cultivation was not common in Southern New England until after AD 1500. This model was tied to the proposition that.... "Native

American sedentary farming villages were recent phenomena along the coast ...[which were]... spurred by contact with the newly arrived Europeans and the trading opportunities they offered" (Cantwell and Wall 2001, 110). However, subsequently Ceci herself undertook a series of radiocarbon tests of corn from early 20th century excavations in the New York region which returned age determinations which ranged between the thirteenth and fifteenth centuries (Cantwell and Wall 2001, 110). Work by other archaeologists - a number of these samples were taken from sites investigated along the route of the Iroquois Pipeline project route through Connecticut and southern New England (Cassedy and Webb 1999, 95) - confirmed the radiocarbon dates predating ca 1500 AD. The findings of this study have also established that maize may not have been visible in the north-central Hudson drainage until the last quarter of the 13th century, or between cal A.D. 1270-1440 (Table II).

Maize and Climate Change

The clustering of the Little Wood Creek Late Woodland Period dates, and especially those with associations of corn, between late 13th and mid-15th centuries, raises an intriguing possible correlation with climatic events. The AMS age range that ended in the fifteenth century is suggestive, and may correlate with the onset of the Little Ice Age (LIA) in Europe and the Northeast U.S. (Penna 2010, 284; Gehring 2009, 78). This suggestion, as it pertains to the onset of intensive corn cultivation in the Northeast, is not new. The relatively late dates for corn in some parts of the northeast suggested to some authors that it was associated with climate warming in general and with the onset of the Medieval Warm Period in particular (King 1999, 21; Chilton 2010, 173). Locally, in the "Northeast, at least, climatic warming may have extended the growing season, making maize agriculture

reliable enough to evolve into a major food crop"(King 1999,21). The Medieval Warm Period was a worldwide event. "This is the period during which the Vikings settled on Iceland, Greenland and the Labrador coast only to be later frozen out of Greenland by the Little Ice Age" (King 1999, 21).

At least two authors have proposed a correlation of intensive corn cultivation with the onset of warmer conditions for both the Mid-Atlantic and New England. In discussing Pennsylvania, Frances King (1999) suggested that the grouping of corn dates after the 13th century may have had something to do with the onset of the Medieval Warm Period ... "we might expect to see a peak in the number of sites with maize during the period from AD 900 to 1200, following by a [sic] local or regional declines in maize use as the climate cooled "(King 1999, 21). More recently, and in a parallel line of reasoning, Elizabeth Chilton proposed the same correlation for New England: "I find it likely that maize became more prevalent in New England by AD 1300 because of cultural choices and/or possibly the environmental conditions as a result of the Medieval Warm period, which may have improved the environmental conditions for the growing of maize."(Chilton 2010, 173).

It is also possible that the drop off of dates associated with maize at the Little Wood Creek site after the mid-15th century AD have had to do, as King suggested for Pennsylvania, with the onset of the Little Ice Age between ca. 1300 -1850 AD. Pederson et al. 2005 have also investigated the impact of the Medieval Warm Period in the Hudson Valley and while warmth, drought, and fire is implicated 800 – 1350 AD, the succeeding LIA forest conditions were indicative of a cooler and moister environment at this time (2005, 246).

The onset of the Little Ice Age varied by region. Penna (2010) placed it at ca. 1300 AD in Europe.

Pederson et al. placed the onset of the LIA in the Hudson at ca. 1400 AD (Pederson et al 2005). If climate conditions and food production in contemporary Europe can be taken as analogues to the conditions of the Northeast, it is worth noting that commensurate with the onset of the Little Ice Age, ... "overall food production plummeted in pre-industrial Europe...." (Penna 2010, 285). The same anomalies and shift to cold conditions suggest that a comparable drop in agricultural output might have been the case for the prehistoric corn horticulturalists in northeast New York State after 1440 AD.

This suggestion is in turn supported by the fact that the Little Wood Creek Late Woodland period AMS dates cluster between cal AD 1270 and 1440. and that there was little evidence for either intensive occupation or corn at the site after the 15th century AD. However, this argument must be tempered by the fact that corn has been documented in Maine at six sites during the Little Ice Age (Sidell 1999, 214). Therefore, the apparent demise of corn and Late Woodland dates at Little Wood Creek after the mid-fifteenth century AD may have had to do with other factors that are yet to be identified. It may be a site-specific event which will be proven as localized with additional radiocarbon dates from other Late Woodland sites in the immediate region. This hypothesis fits with the suggestion that there was little of evidence for Late Woodland occupation after ca. the mid-1400's and that the site may have been largely abandoned by then. No prehistoric artifacts were identified that suggested 16th to 17th century activity. However the same is not true for historic artifacts.

Contact Period Evidence

In addition to the AMS evidence, the recovery of a single spherical brass bell indicated that at least one

pit feature (Context 945.01) suggested Contact Period exchanges (Figure 17). It is suggested here that contact may have been derived from 16th French trade and survey expeditions along the east coast of North America in contrast to 17th century Dutch or British endeavors. Bellenger, the captain of several 16th century sailing expeditions, boasted to Hakluyt that he traded small bells (Turgeon 2004: 105). Turgeon generalized that...."among the merchandise were other sorts of body ornaments, earrings, spherical bells and hand bells"(Turgeon 2004:105-106). Small spherical bells were common in 16th century sites and have been used to date archaeological deposits. Turgeon also indicated that"...brass bells and glass beads....were common in [archaeological] sites dating to the second half of the sixteenth century...."(2004:107).

"French trade extended well beyond New England" (Turgeon 2004:107). "Not only were the Norman, Basque and French contacts with 'the Aborigines' early (mid-late 16th century), but also they were broad-based and extended south to the mid-Atlantic states and Virginia. Sixteenth century French expeditions to map the North American coast included the Middle Atlantic region (Turgeon 2004: 102). The Spanish reported trade at the entrance to Chesapeake Bay: "In 1565, the Spanish governor of Florida complained that French fishing boats had tradedin Chesapeake Bay and took more than six thousand pelts to New Rochelle" (Turgeon 2004:107). The trade was robust; 23 ships in the second half of the 16th century were sent for a mix of trade and cod fishing (Turgeon 2004: 101). The busiest period for Basque ships was 1583-1587, when 12 ships were fitted out (Turgeon 2004: 108). In 1614 John Smith, governor of Virginia, visited the coasts of his colony without landing because he had been told the French had already exhausted the supply of fur there...." (Turgeon 2004: 110). Turgeon also suggested that...."... French merchandise made its

way into the interior of the continent and reached Iroquoian groups, notably via the Hudson and Susquehanna rivers" (2004:107). In sum, Turgeon concluded that"When French explorers returned to the northeast coast in the early 17th century, they encountered Indian groups who had been trading with Europeans for more than half a century (2004: 110).

Accordingly, assuming that the bell represents an artifact of European origin, as we suggest, it can be used as a chronological proxy which could date to the mid or late 16th century. This in turn strongly suggests that while most of the identified Late Woodland Period features dated to between the 13th to 15th centuries AD, at least one feature indicates that the site of Little Wood Creek may have been occupied or visited as late as the 16th century.

Summary of Findings

Transitional Period:

- The new AMS dates refined the buried Transitional Period occupations down to a four hundred year time span.
- The new AMS determinations documented an occupation between cal 1120 and 1500 BC with a short plus or minus 30 year error factor.
- The revised Transitional Period Dates correlate well with other radiocarbon determinations from the Hudson and Susquehanna drainages and now suggest strongly that the Transitional Period was well represented between the 16th century and 12th centuries cal BC.
- The new AMS age ranges suggested strongly that half of the earlier 1980's era determinations were either very much too

recent or too late and that even for those that overlapped with the AMS range, they recorded non-AMS ages that were at least one to three hundred years too early.

- The short (400 year) duration of the Transitional Period occupation at Little Wood Creek supports the argument that the BROADSPEAR culture represent a short-lived but broad-based "Horizon" versus a long-term multi-millennium tradition (Sassaman 1999).
- The revised chronology for the Transitional Period at Little Wood Creek suggests an ecological correlation with the development of the Oak-Chestnut forest. Work by palynologists now documents that the American Chestnut (*Castanea dentata*) arrived in the Hudson Highlands between 4000 and 3700 cal yr BP (Menza-Gmelch 1997, 33-34; Menking et al., 2012). Near the Sky Lakes region of NY (42 N) Menking et al. suggest the chestnut may have increased in response to the drought which was responsible for the hemlock decline, as chestnut is shade intolerant but quite drought-tolerant. This spread in turn is prior to the earliest cal BC 1500 date for BROADSPEAR occupation at the site. As such, it is possible that the onset of BROADSPEAR culture in New York State followed the arrival of the American Chestnut as an important high canopy element of the formerly pervasive Oak-Chestnut forest (prior to the chestnut blight) in this region. This potential correlation in turn supports the previously argued association of the BROADSPEAR culture in general with mast

forest habitats (Truncer 1999, 2004a, 2004b, 2006).

- Similar pollen work at a variety of New York and New England sites suggests that the emergence of the BROADSPEAR culture in northeastern New York State may have also correlated with the advent of cooler conditions and prior to a period of Late Holocene drought which ended close to 1000 BP (Menking et al. 2012; Newby et al. 2011).
- Dr. Peteet's review and inspection of the original seed collection resulted in the realization that what was originally (in the 1980's) thought to have been an early cultivar, sumpweed or *Iva sp.*, was probably misidentified and was mistaken for another plant.

Late Woodland Period:

- Of the six Late Woodland samples, two pits returned high resolution dates between cal AD 1270 to 1380; one pit returned an AMS age range of cal AD 1320 to 1440.
- The six Late Woodland determinations with maize dated to between 1270 and 1440 AD.
- Together, these six assays suggest that the Little Wood Creek occupation may have been both short and late within the chronology of Late Woodland culture history.
- Each of the six Late Woodland Period AMS assays was limited to between 110 and 120 years in duration and the total span for all of the samples was only 170 years, instead of ca six and a half centuries as was implied by the older, non-AMS results.

- This limited time span implies in turn that the diversity of Owasco series pottery types may not reflect chronological differences, but instead stylistic or regional ones of relative contemporaneity.
- The post-1270 AD determination indicates that maize (corn) was in fact not early, but instead late at the site.
- The new dating has negated the previous 8th century date initially returned by Context 1063.01 in association with corn that the original 1987 radiocarbon date had indicated. A minute charcoal sample from the same context subjected to AMS dating returned a now credible age of post-1270 AD.
- The post-late 13th century dates for maize suggests that the agricultural patterns at the site may have been closer to those in New England, than New York State (cf. Chilton 2010; Little 2002). However, given that these are dates for only one Late Woodland Period site one can only talk about the occupation of this site; people may have arrived with maize that they had been using for a while.
- The clustering of the Late Woodland Period AMS ages between the late 13th and 14th centuries, and the apparent disappearance of evidence for occupation after the mid-15th century, suggest a possible correlation with the end of the Medieval Warm Period and/or the beginning of the Little Ice Age.
- The recovery of a single brass bell suggests the possibility of at least some 16th century exchange with French or Basque explorers and traders.

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IV. New Insights into Prehistoric Environmental Conditions

IV. Regional Paleoclimate and Paleoecology – New Insights

Dorothy M. Peteet, Ph.D.

The regional pollen stratigraphy for the past 3000 years was first defined by Deevey (1939) in southern Connecticut who described the oak-chestnut zone (Zone C-3) including a rise in hemlock around 3000 years ago and concurrent increases in chestnut, with a climatic interpretation of cooling and increased moisture. At Sutherland and Spruce Ponds in the Hudson Highlands (41 N), (Maenza-Gmelch, 1997), late Holocene cooling is suggested by an increase in spruce as oak declines. Closer to Ft. Edward, palynological analysis at Balsam Lake (42 30 N) in the Catskills, NY records the increase in spruce as well as chestnut (Ibe, 1985). At Ballston Lake near Saratoga (43 N) just south of Ft. Edward, Toney et al. 2003 summarize the late Holocene regional cooling indicated by increases in spruce and hemlock, similar to the more northern New England regional records. At 44 N in the south-central Adirondacks, the late Holocene cooling is even more apparent as well, with marked increases in fir and spruce (Overpeck, 1985). No indications of drought in these lake records are noted in the late Holocene, and sedimentation rates and dating resolution in lakes are so low that intervals such as the Medieval Warm Period (MWP) are not addressed. However, in some sites such as the Adirondacks, fluctuations in hemlock and beech pollen around the turn of the millennium are apparent, suggesting shifts in moisture.

Much higher depositional sites such as that of Piermont Marsh, NY at 41 N (Pederson et al., 2005) indicate a strong MWP signal dated with AMS chronology between 800 AD and 1300 AD, visible in both the pollen record as a shift from oak to pine-hickory and in the large amount of charcoal signifying fire from regional drought. Upriver, the Tivoli Bays marsh (42 N) record (Sritrairat et al., 2012) echoes this

drought signal with increases in charcoal and declines in oak. Across the Hudson Valley at Davis Pond (Newby et al., 2011) in Massachusetts (42 N), the sedimentary stratigraphic record indicates a low stand roughly between 1600 and 600 cal BP (400 and 1400 AD), one of many Holocene droughts. Recent sedimentological, palynological, and macrofossil investigation of a site in the drought-sensitive Sky Lakes region (Menking et al., 2012), Lake Mohonk (42 N), reveals replacement of organic strata with a sand layer in the lake close to the last millennium, suggesting a marked drought at this time, with at least 3 other major droughts visible in the record throughout the Holocene. In this Mohonk record, the chestnut increase is related to shade intolerance with the demise of hemlock (Menking et al., 2012). In sum, the low resolution lake paleorecords in the Ft. Edward region coupled with higher resolution marsh peats further south in the Hudson Valley indicate that further detailed chronology is needed to link the Ft. Edward occupation to regional moisture shifts, but the trend toward cooling in the region is well-established.

The Transitional Period (cal BC 1120-1500)

The Transitional period around 1500 BC is marked in palynological regional history by a shift towards cooler, wetter conditions compared to previous millennia, marked by increases in spruce (Maenza-Gmelch, 1997), fir (Overpeck, 1985; Ibe, 1985), and sometimes hemlock (Maenza-Gmelch, 1997). Chestnut migrated into the region by about 4000 to 3700 cal yr BP (cal BC 2050 to 1750) (Maenza-Gmelch, 1997; Menking et al., 2012) and remains dominant over hemlock at some sites such as Lake Mohonk (Menking et al., 2012) until its demise in the twentieth century.

The Late Woodland Period (1270-1440 AD)

Regional pollen records indicate the sustained increases in spruce and hemlock of the last few millennia, indicative of a wetter, cooler, climate.

However, most lake records in the northeastern US lack high-resolution chronology and stratigraphy that can address fluctuations in moisture in recent centuries. Nevertheless, two regional lake records suggest drought – the Davis Pond record in Massachusetts (Newby et al., 2011) which records a stratigraphic sedimentary shift between 400 and 1400 AD, as well as the Lake Mohonk sand layer (Menking et al., 2012) around 1000 AD. Comparing these records with those of much higher resolution further south in the Hudson Valley (Pederson et al., 2005) suggest that they reflect the same Medieval Warm Period drought 850-1350 AD that was responsible for increased pine and charcoal due to fires. The occupation thus marks either the end of this drought interval or the beginning of the Little Ice Age which followed.

V. Appendices - The BETA Analytic Calibration Plots

Appendix I: Transitional Period Age Range Patterns

Contents: a) Table I: Summary plot of Transitional Period correlation tables - a seriation of clusters or patterns of chronologically associated age ranges.

b) Compilation of annotated Transitional Period BETA Analytic "Calibration of Radiocarbon Age to Calendar Years" data sheets.

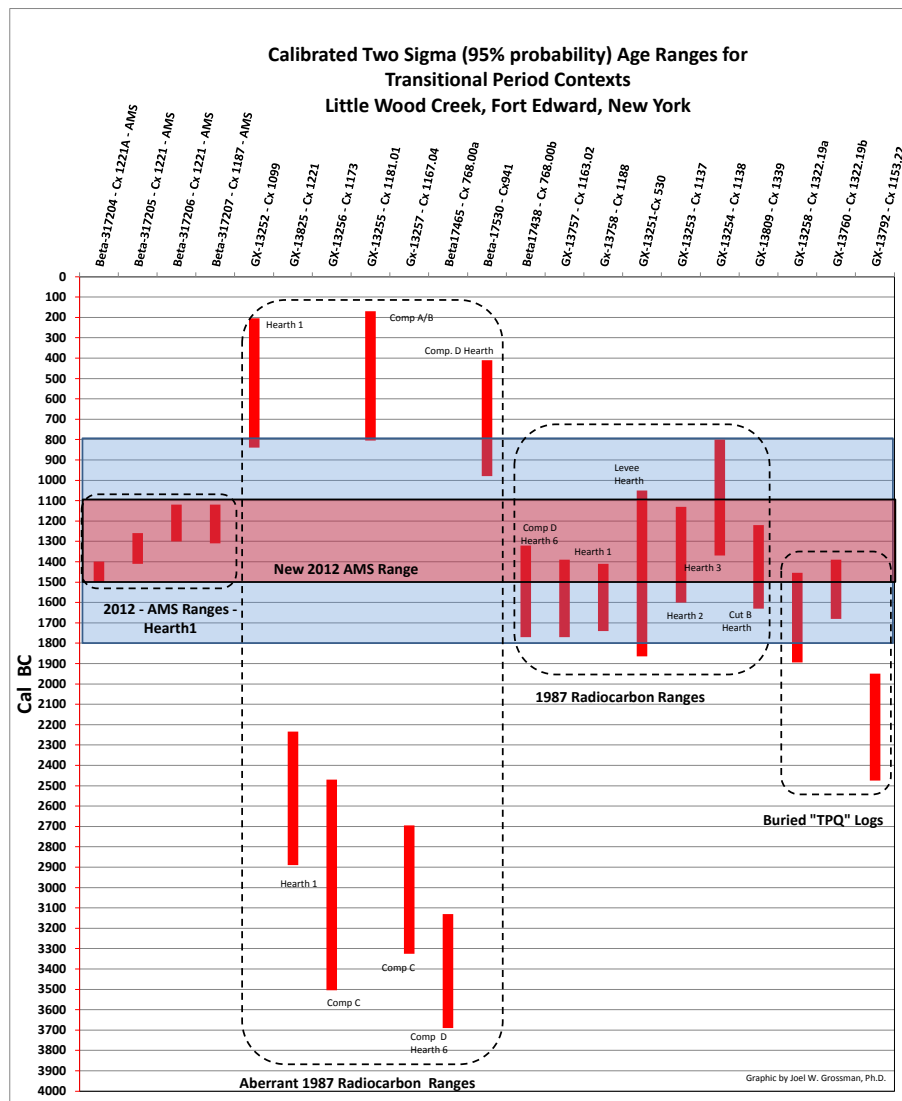
- The data sheets are divided into two chronological groups: the early Transitional Period (Appendix I) and the later Late Woodland Period (Appendix II).
- Each chronological grouping is in turn subdivided into two data sets: 1) the 2012 recalibrations of the original 1987 scintillation determinations and 2) the seven new AMS 2012 date ranges.
- All data plots are arranged in sequential order by laboratory sample number, regardless of the laboratory identifier prefix.
- Each group is introduced by a summary plot of age range patterns as clusters of chronological highs and lows.
- All age calibrations and new AMS listings are presented not as individual dates, but instead as ranges with a two-Sigma (95%) probability that the feature dates to within early to late, Cal BC or Cal AD, scale of calendar years.
- Each numbered data sheet is annotated and listed with its stratigraphic context number and larger component associations.

Table I
Calibrated Two Sigma (95% probability) Age Ranges for Transitional Period Contexts
Little Wood Creek, Fort Edward, New York

* All Calibrations by Beta Analytic Radiocarbon Dating Laboratory

Context-Feature	Sample No. - Context	Conventional		High	Low
		Age - BP	SD	(Cal BC)	(Cal BC)
Cx-1221A - Hearth 1	Beta-317204 - Cx 1221A - AMS	3160	30	1500	1400
Cx-1221 - Hearth 1	Beta-317205 - Cx 1221 - AMS	3070	30	1410	1260
Cx-1221 - Hearth 1	Beta-317206 - Cx 1221 - AMS	2970	30	1300	1120
Cx-1187 - Hearth 1	Beta-317207 - Cx 1187 - AMS	2980	30	1310	1120
Cx-1099 - Hearth 1	GX-13252 - Cx 1099	2455	130	840	205
Cx1221 - Hearth 1 (1099)	GX-13825 - Cx 1221	4045 *	110	2890	2235
Cx1173.00 - Comp C	GX-13256 - Cx 1173	4320 *	185	3505	2470
Cx1181.01 - Comp A/B	GX-13255 - Cx 1181.01	2380	130	805	170
Cx1167.04 - Comp C	Gx-13257 - Cx 1167.04	4320 *	90	3325	2695
Cx768.00a CompD Hearth-6	Beta17465 - Cx 768.00a	4710 *	100	3690	3130
Cx 941 - Comp D	Beta-17530 - Cx941	2620 *	100	980	410
Cx768.00b CompD Hearth-6	Beta17438 - Cx 768.00b	3270 *	100	1770	1320
Cx 1163.02 - Comp C Surf.	GX-13757 - Cx 1163.02	3280	95	1770	1390
Cx1188 - Hearth 1	Gx-13758 - Cx 1188	3275	75	1740	1410
Cx. 530.1-Levee Hearth	GX-13251-Cx 530	3185 *	150	1865	1050
Cx1137 - Hearth 2	GX-13253 - Cx 1137	3115	85	1600	1130
Cx1138 - Hearth 3	GX-13254 - Cx 1138	2840	110	1370	800
Cx1339-CutB Hearth	GX-13809 - Cx 1339	3170	90	1630	1220
Cx1322.19a-LogB	GX-13258 - Cx 1322.19a	3380 *	90	1895	1455
Cx1322.19b-LogB	GX-13760 - Cx 1322.19b	3230 *	70	1680	1390
Cx1153.22-Log A	GX-13792 - Cx 1153.22	3795	95	2475	1950

* - Multiple ranges on tree ring curve
See calibration charts



CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: **GX-13251**

Cx530.1 - Levee Hearth

Conventional radiocarbon age¹: **3185±150 BP**

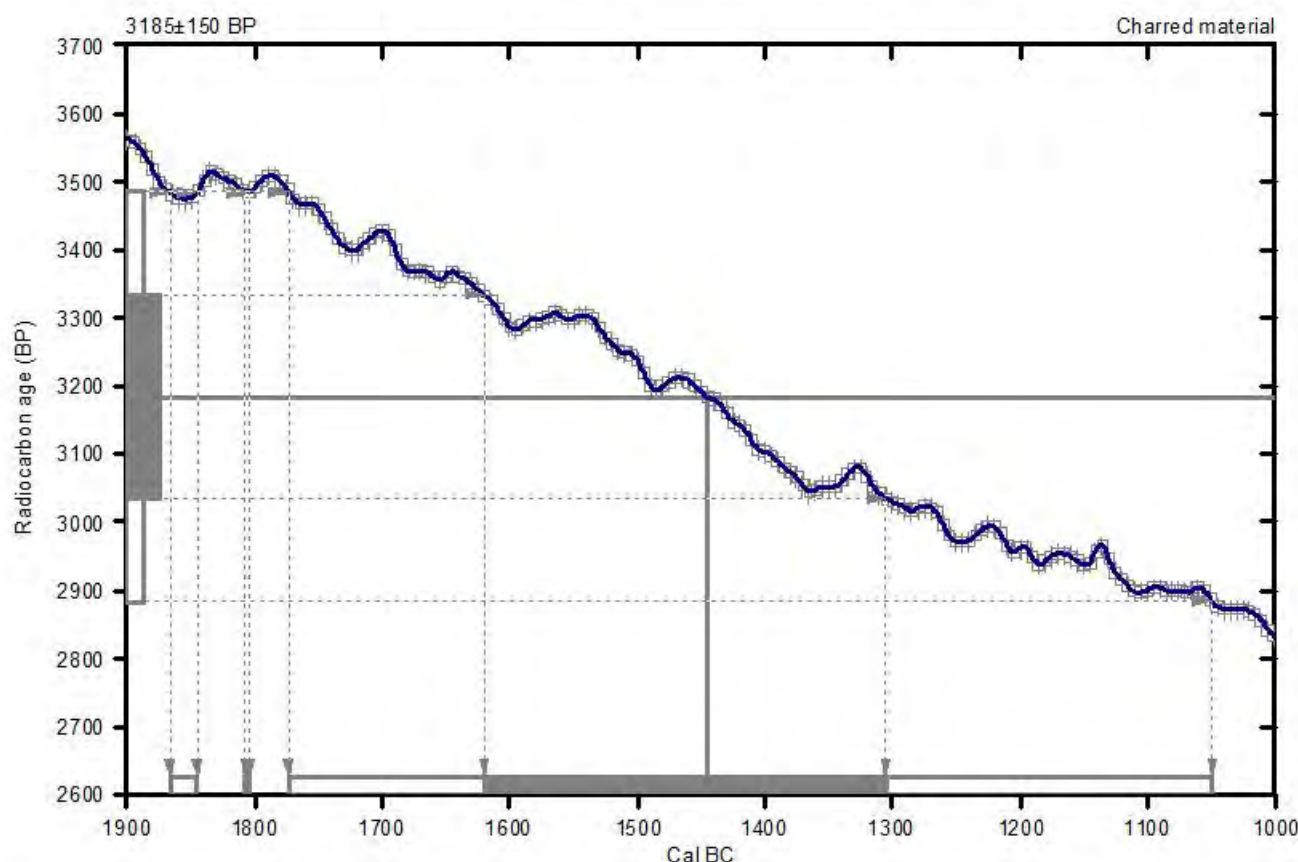
2 Sigma calibrated results: Cal BC 1865 to 1845 (Cal BP 3815 to 3795) and
(95% probability) Cal BC 1805 to 1805 (Cal BP 3755 to 3755) and
Cal BC 1775 to 1050 (Cal BP 3725 to 3000)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 1445 (Cal BP 3395)

1 Sigma calibrated result: Cal BC 1620 to 1305 (Cal BP 3570 to 3255)
(68% probability)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150,
Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

Beta Analytic Radiocarbon Dating Laboratory⁵⁷

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25:lab. mult=1)

Laboratory number: **GX-13252**

Cx1099 - Hearth 1

Conventional radiocarbon age¹: **2455±130 BP**

2 Sigma calibrated results: Cal BC 840 to 350 (Cal BP 2790 to 2300) and
(95% probability) Cal BC 315 to 205 (Cal BP 2265 to 2155)

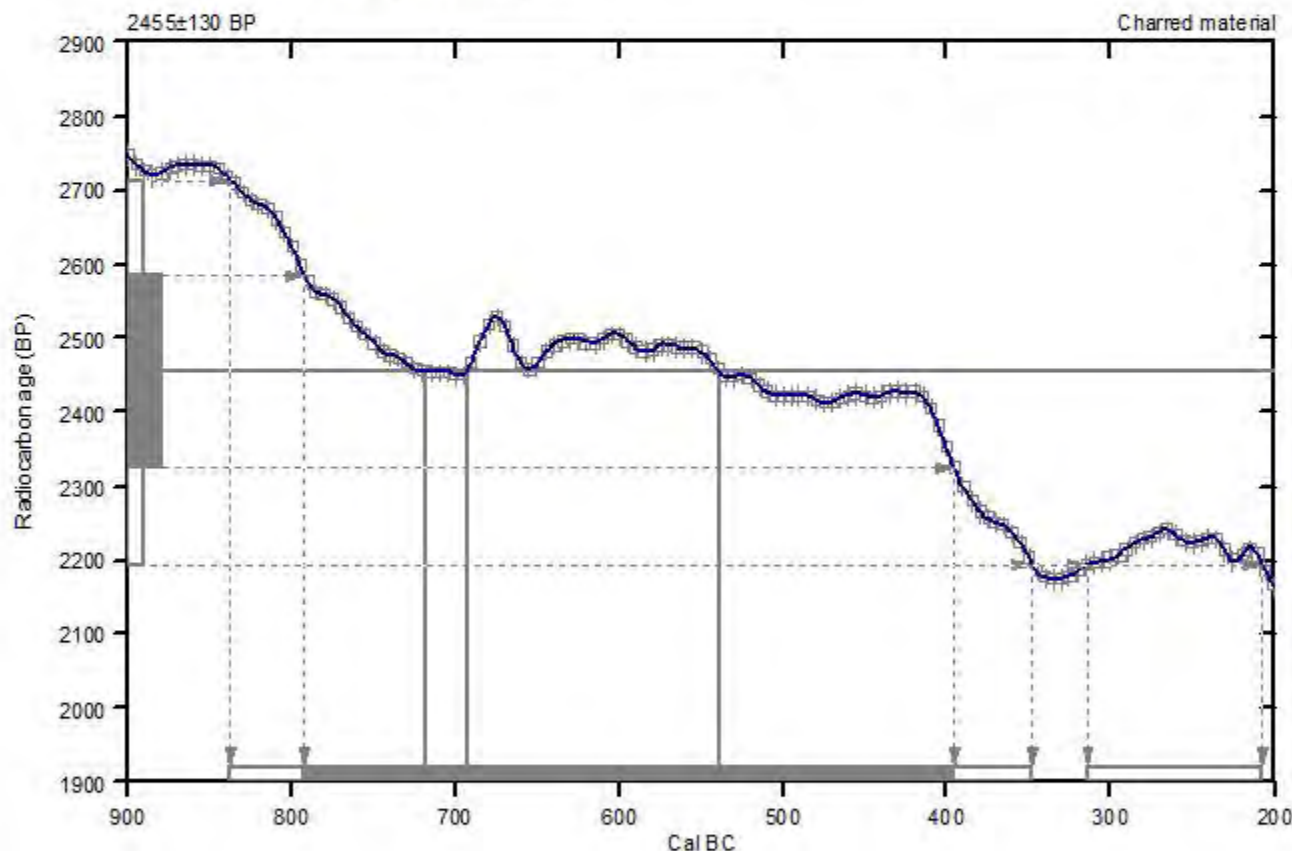
¹ C13/C12 ratio estimated

Intercept data

Intercepts of radiocarbon age
with calibration curve:

Cal BC 720 (Cal BP 2670) and
Cal BC 695 (Cal BP 2645) and
Cal BC 540 (Cal BP 2490)

1 Sigma calibrated result: Cal BC 790 to 395 (Cal BP 2740 to 2345)
(68% probability)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150,
Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: **GX-13253**

Cx1137 - Hearth 2

Conventional radiocarbon age¹: **3115±85 BP**

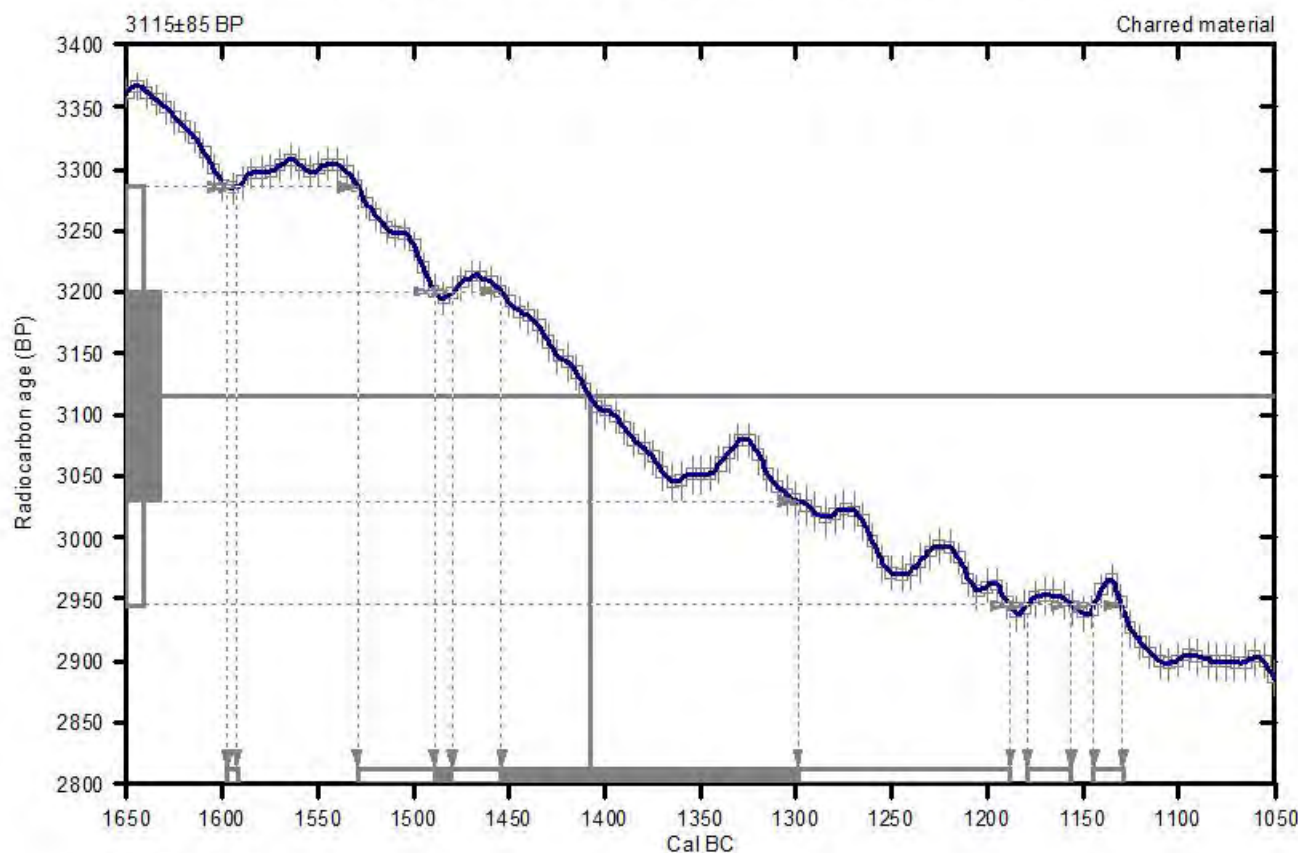
2 Sigma calibrated results: Cal BC 1600 to 1595 (Cal BP 3550 to 3545) and
(95% probability) Cal BC 1530 to 1190 (Cal BP 3480 to 3140) and
Cal BC 1180 to 1155 (Cal BP 3130 to 3105) and
Cal BC 1145 to 1130 (Cal BP 3095 to 3080)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 1410 (Cal BP 3360)

1 Sigma calibrated results: Cal BC 1490 to 1480 (Cal BP 3440 to 3430) and
(68% probability) Cal BC 1455 to 1300 (Cal BP 3405 to 3250)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, Radiocarbon 51(4):1151-1164, Reimer, et al., 2009, Radiocarbon 51(4):1111-1150,
Stuiver, et al., 1993, Radiocarbon 35(1):137-189, Oeschger, et al., 1975, Tellus 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: **GX-13254**

CX-1138 - Hearth 3

Conventional radiocarbon age¹: **2840±110 BP**

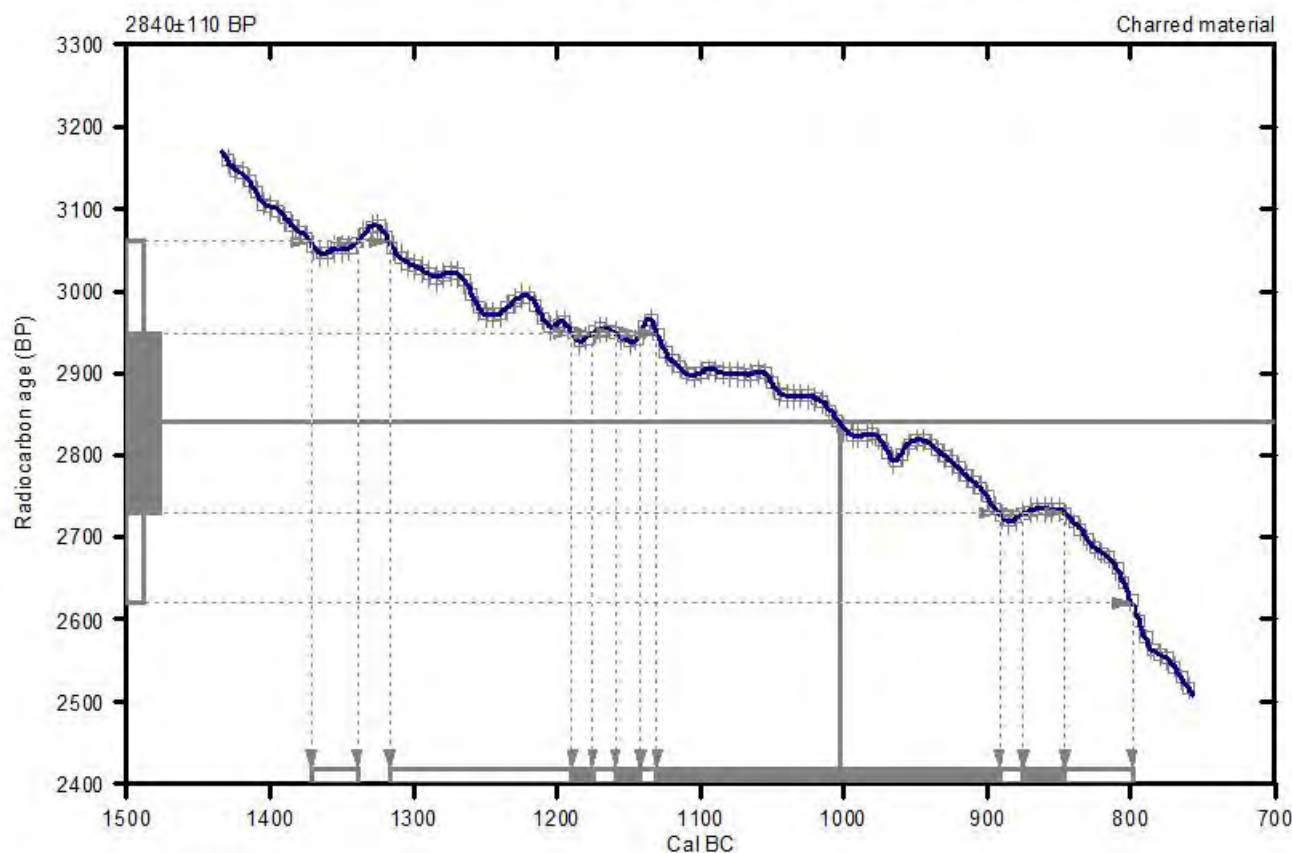
2 Sigma calibrated results: Cal BC 1370 to 1340 (Cal BP 3320 to 3290) and
(95% probability) Cal BC 1315 to 800 (Cal BP 3265 to 2750)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 1005 (Cal BP 2955)

1 Sigma calibrated results: Cal BC 1190 to 1175 (Cal BP 3140 to 3125) and
(68% probability) Cal BC 1160 to 1140 (Cal BP 3110 to 3090) and
Cal BC 1130 to 890 (Cal BP 3080 to 2840) and
Cal BC 875 to 845 (Cal BP 2825 to 2795)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, Radiocarbon 51(4):1151-1164, Reimer, et al., 2009, Radiocarbon 51(4):1111-1150,
Stuiver, et al., 1993, Radiocarbon 35(1):137-189, Oeschger, et al., 1975, Tellus 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: **GX-13255**

Cx1181.01 -Comp A/B

Conventional radiocarbon age¹: **2380±130 BP**

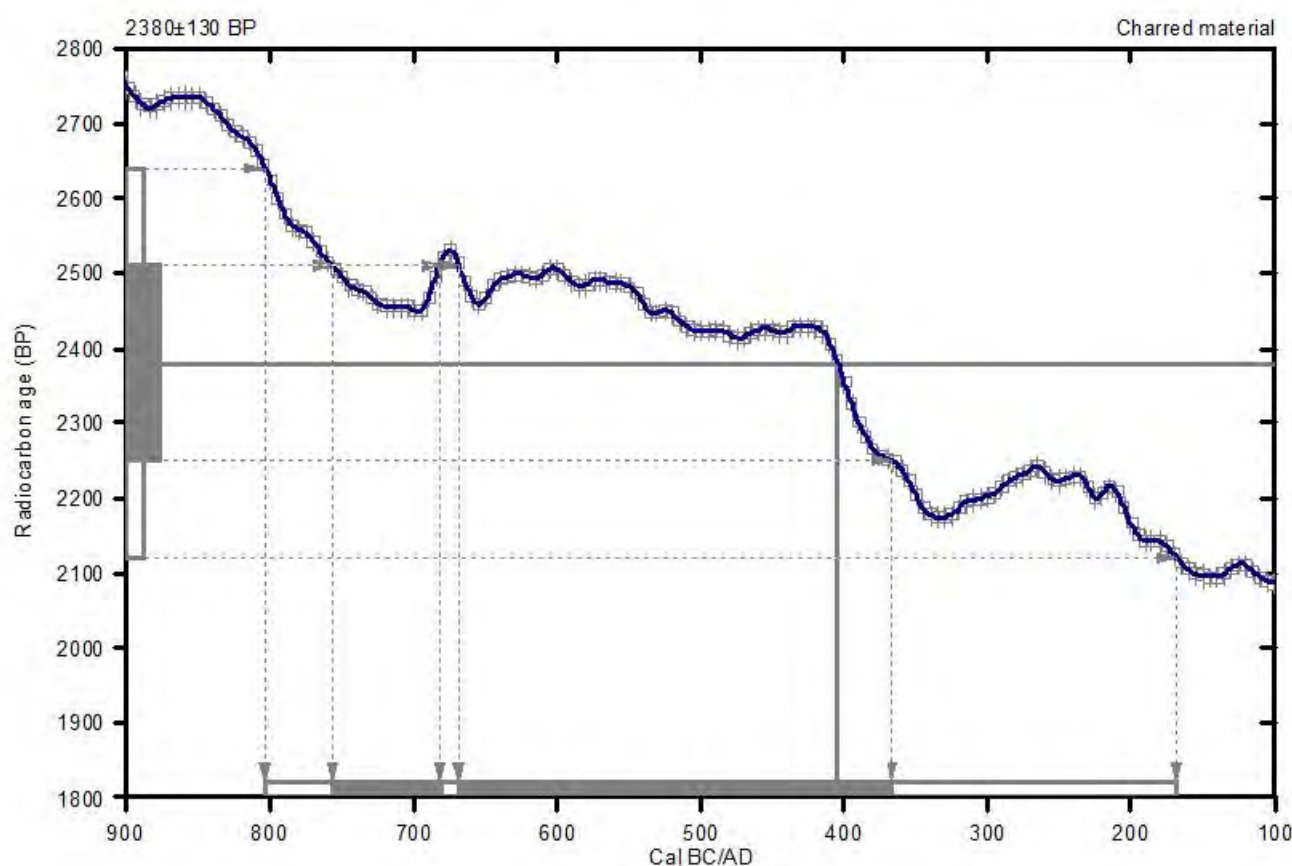
2 Sigma calibrated result: Cal BC 805 to 170 (Cal BP 2755 to 2120)
(95% probability)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: **Cal BC 405 (Cal BP 2355)**

1 Sigma calibrated results: Cal BC 755 to 680 (Cal BP 2705 to 2630) and
(68% probability) Cal BC 670 to 365 (Cal BP 2620 to 2315)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150, Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: **GX-13256**

Cx1173.00 - Comp C

Conventional radiocarbon age¹: **4320±185 BP**

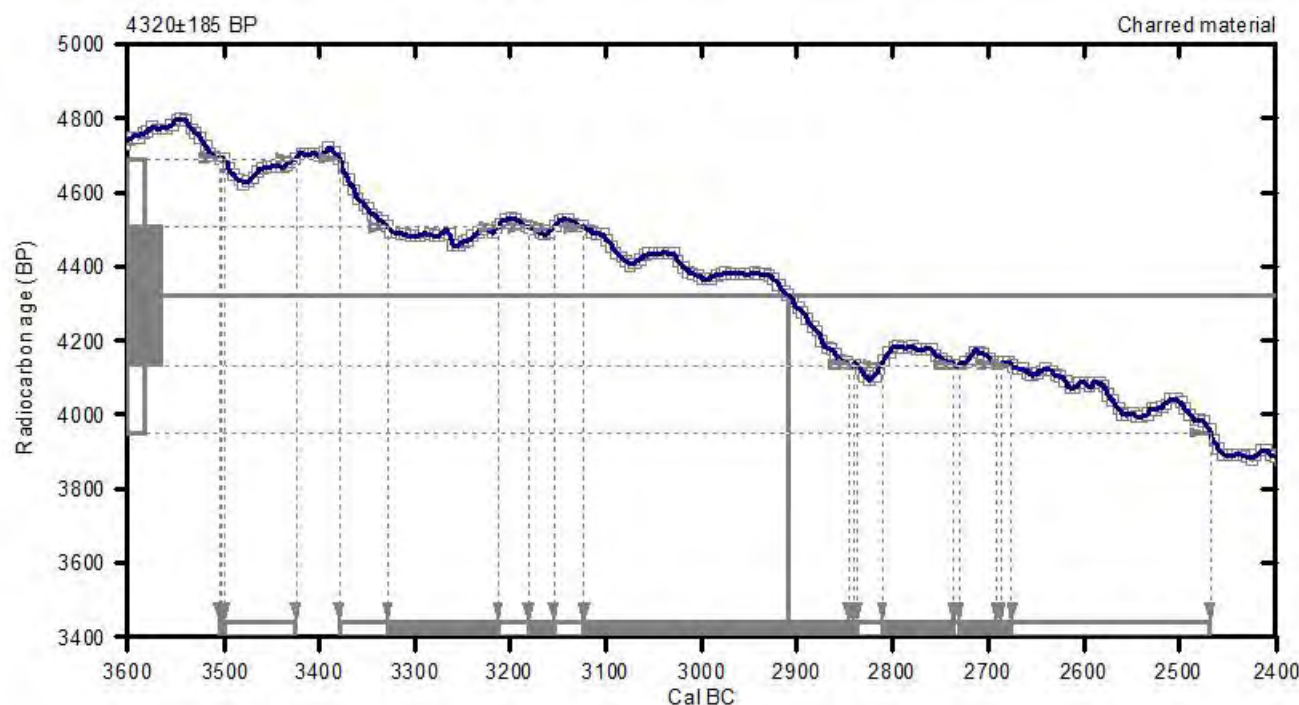
2 Sigma calibrated results: Cal BC 3505 to 3505 (Cal BP 5455 to 5455) and
(95% probability) Cal BC 3500 to 3425 (Cal BP 5450 to 5375) and
Cal BC 3380 to 2470 (Cal BP 5330 to 4420)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 2910 (Cal BP 4860)

1 Sigma calibrated results: Cal BC 3330 to 3215 (Cal BP 5280 to 5165) and
(68% probability) Cal BC 3180 to 3155 (Cal BP 5130 to 5105) and
Cal BC 3125 to 2845 (Cal BP 5075 to 4795) and
Cal BC 2845 to 2840 (Cal BP 4795 to 4790) and
Cal BC 2810 to 2735 (Cal BP 4760 to 4685) and
Cal BC 2730 to 2690 (Cal BP 4680 to 4640) and
Cal BC 2690 to 2675 (Cal BP 4640 to 4625)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150,
Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: **GX-13257**

Cx1167.04 - Comp. C

Conventional radiocarbon age¹: **4320±90 BP**

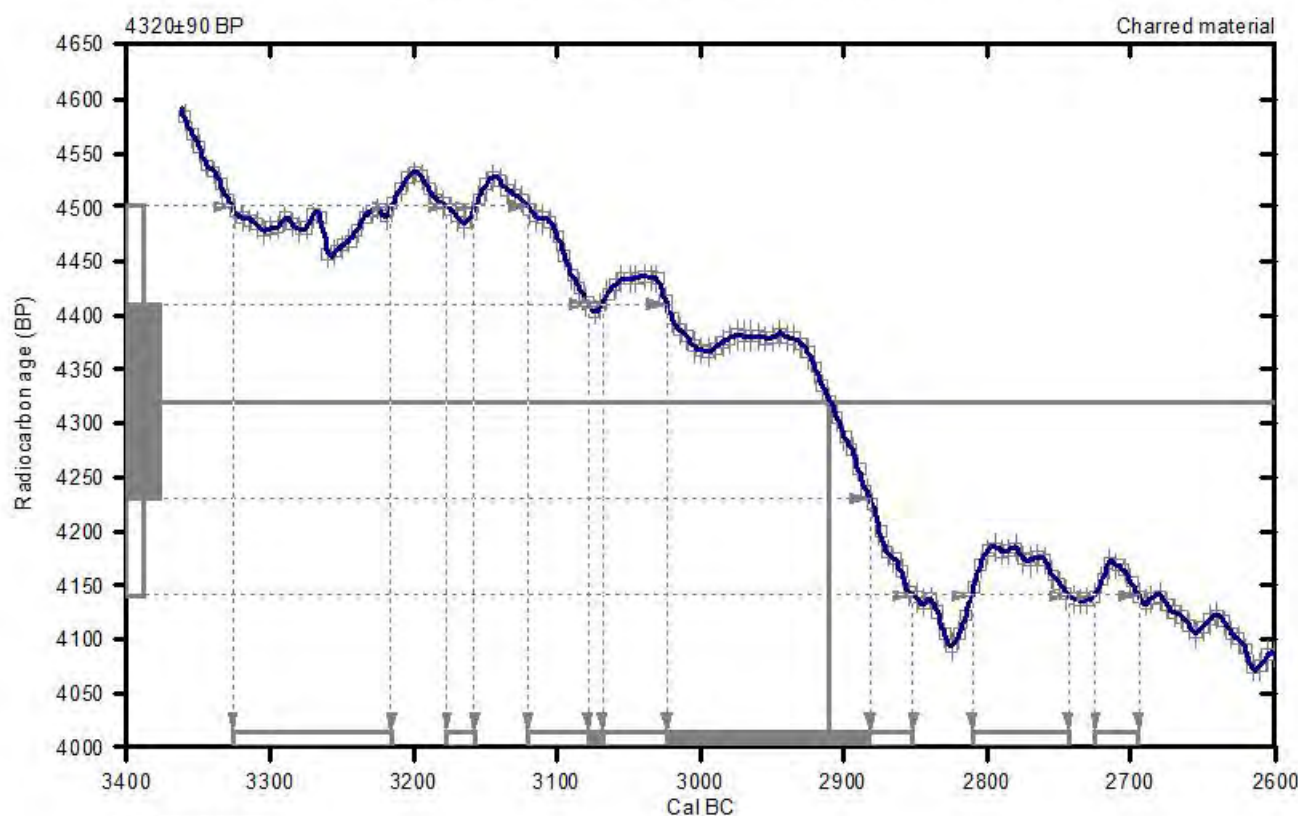
2 Sigma calibrated results: Cal BC 3325 to 3215 (Cal BP 5275 to 5165) and
(95% probability) Cal BC 3175 to 3160 (Cal BP 5125 to 5110) and
Cal BC 3120 to 2850 (Cal BP 5070 to 4800) and
Cal BC 2810 to 2745 (Cal BP 4760 to 4695) and
Cal BC 2725 to 2695 (Cal BP 4675 to 4645)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 2910 (Cal BP 4860)

1 Sigma calibrated results: Cal BC 3080 to 3070 (Cal BP 5030 to 5020) and
(68% probability) Cal BC 3025 to 2880 (Cal BP 4975 to 4830)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, Radiocarbon 51(4):1151-1164, Reimer, et al., 2009, Radiocarbon 51(4):1111-1150, Stuiver, et al., 1993, Radiocarbon 35(1):137-189, Oeschger, et al., 1975, Tellus 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: **GX-13258**

Cx1322.19a Log B

Conventional radiocarbon age¹: **3380±90 BP**

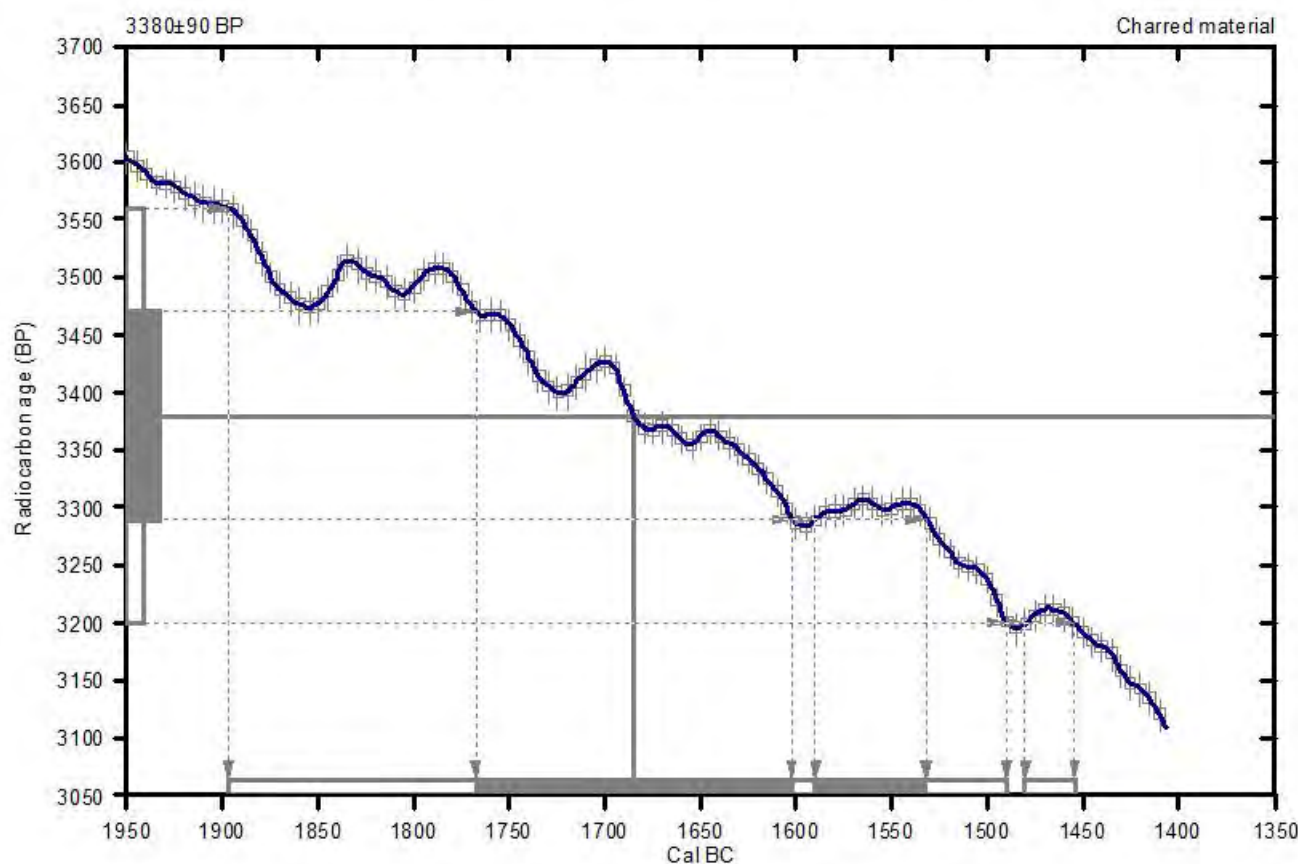
2 Sigma calibrated results: Cal BC 1895 to 1490 (Cal BP 3845 to 3440) and
(95% probability) Cal BC 1480 to 1455 (Cal BP 3430 to 3405)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 1685 (Cal BP 3635)

1 Sigma calibrated results: Cal BC 1770 to 1600 (Cal BP 3720 to 3550) and
(68% probability) Cal BC 1590 to 1530 (Cal BP 3540 to 3480)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150, Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

Beta Analytic Radiocarbon Dating Laboratory⁶⁴

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: **GX-13757**

Cx 1163.02 - Comp C Surf.

Conventional radiocarbon age¹: **3280±95 BP**

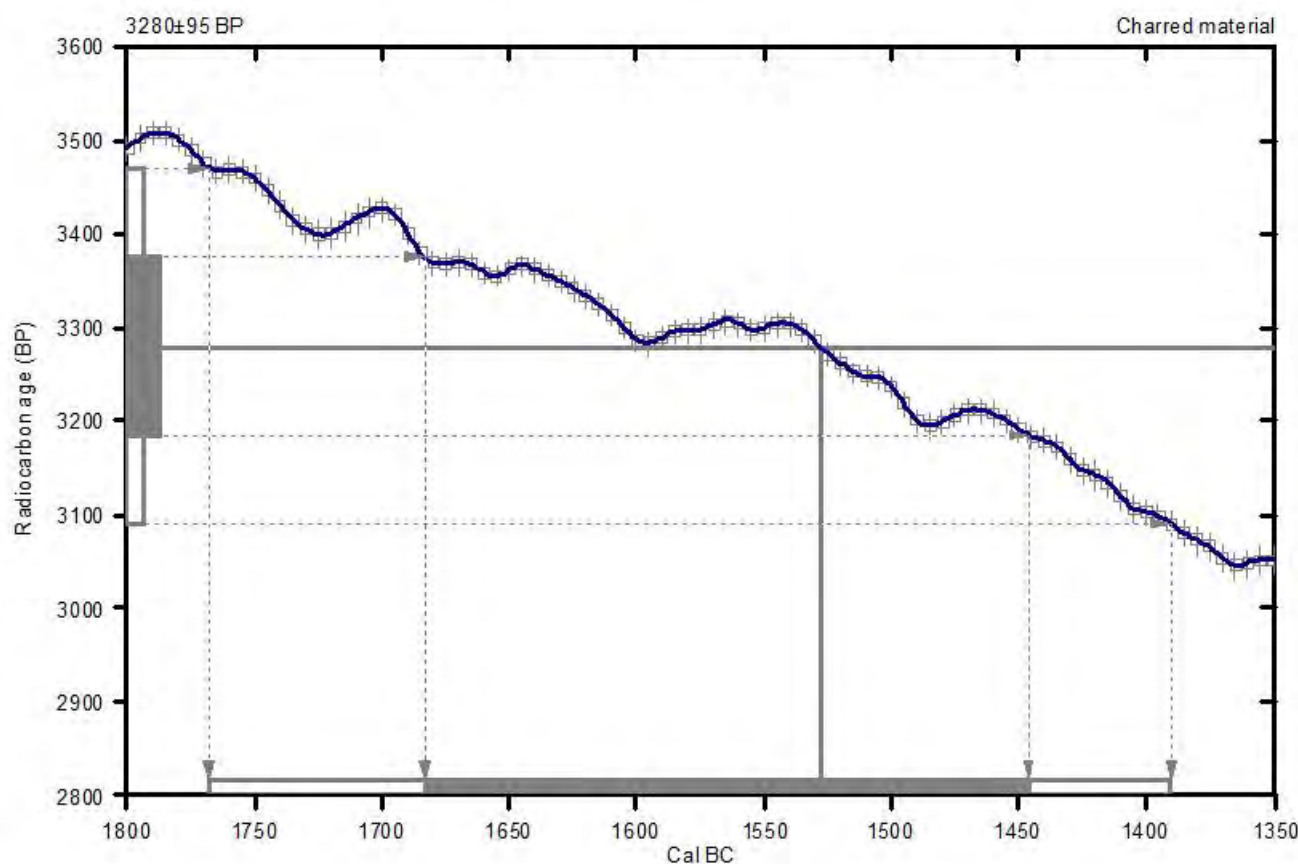
2 Sigma calibrated result: Cal BC 1770 to 1390 (Cal BP 3720 to 3340)
(95% probability)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: **Cal BC 1530 (Cal BP 3480)**

1 Sigma calibrated result: Cal BC 1685 to 1445 (Cal BP 3635 to 3395)
(68% probability)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150, Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: **GX-13758** Cx 1188 - Hearth 1

Conventional radiocarbon age¹: **3275±75 BP**

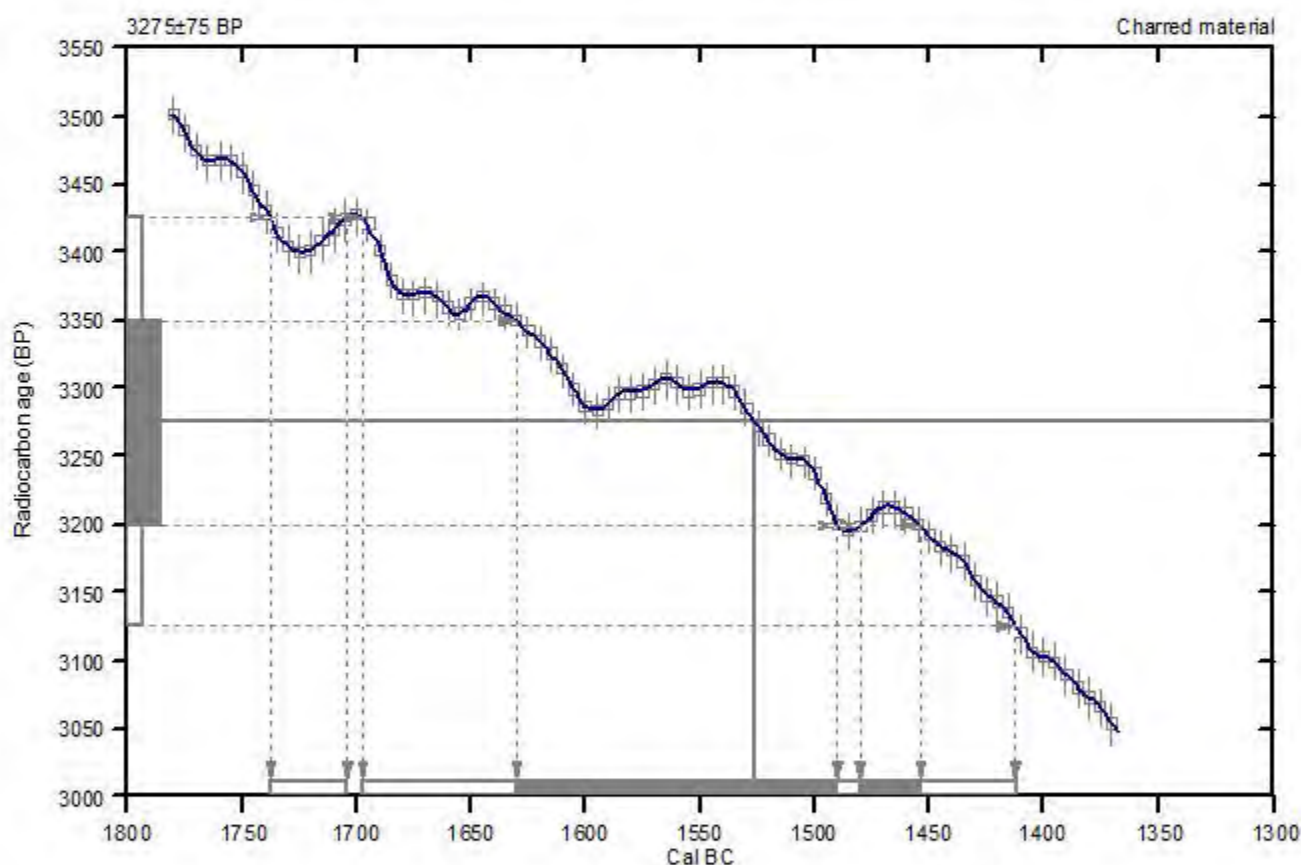
2 Sigma calibrated results: Cal BC 1740 to 1705 (Cal BP 3690 to 3655) and
(95% probability) Cal BC 1695 to 1410 (Cal BP 3645 to 3360)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 1525 (Cal BP 3475)

1 Sigma calibrated results: Cal BC 1630 to 1490 (Cal BP 3580 to 3440) and
(68% probability) Cal BC 1480 to 1455 (Cal BP 3430 to 3405)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150,
Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: **GX-13760**

Cx1322.19b - Log B

Conventional radiocarbon age¹: **3230±70 BP**

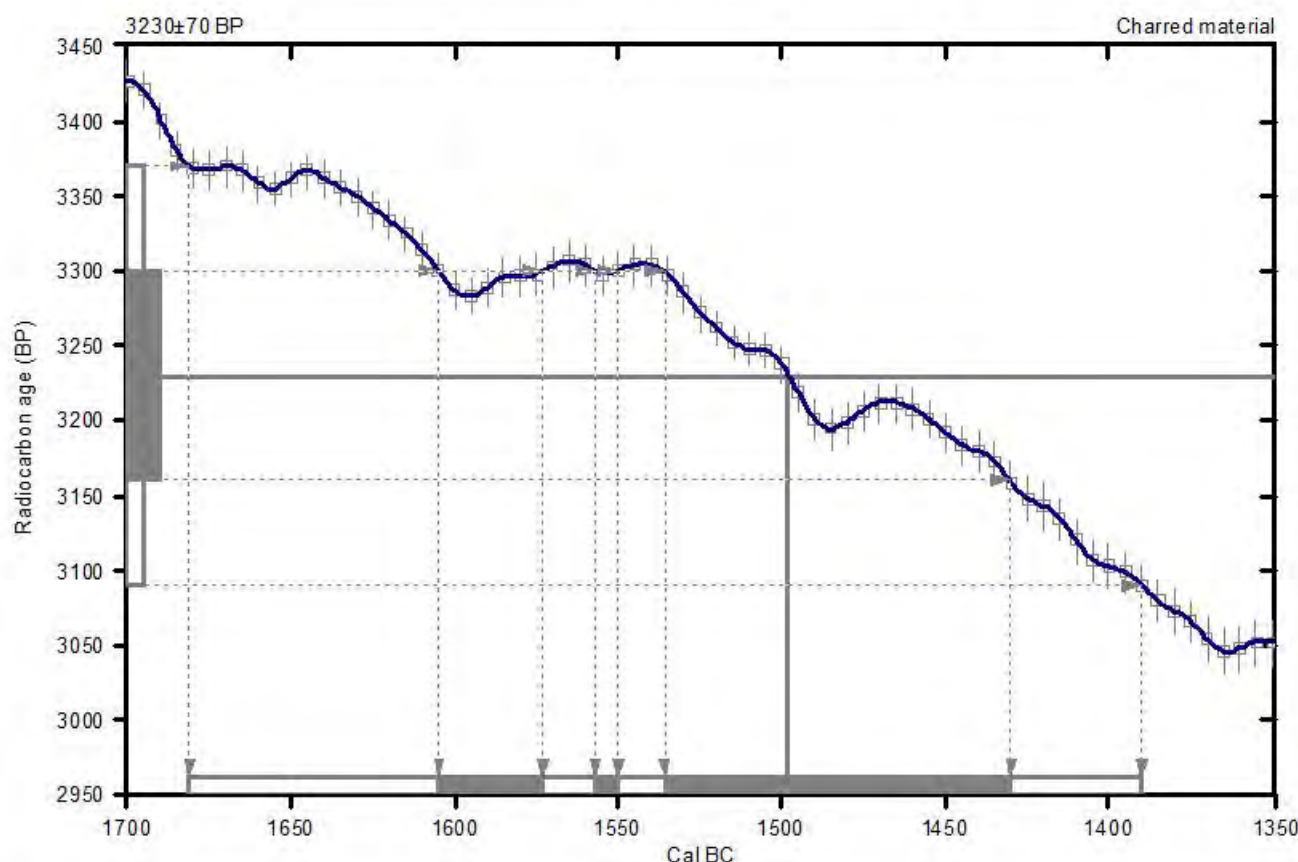
2 Sigma calibrated result: Cal BC 1680 to 1390 (Cal BP 3630 to 3340)
(95% probability)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: **Cal BC 1500 (Cal BP 3450)**

1 Sigma calibrated results: Cal BC 1605 to 1575 (Cal BP 3555 to 3525) and
(68% probability) Cal BC 1555 to 1550 (Cal BP 3505 to 3500) and
Cal BC 1535 to 1430 (Cal BP 3485 to 3380)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150, Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: **GX-13792**

Cx1153.22 - Log A

Conventional radiocarbon age¹: **3795±95 BP**

2 Sigma calibrated result: Cal BC 2475 to 1950 (Cal BP 4425 to 3900)
(95% probability)

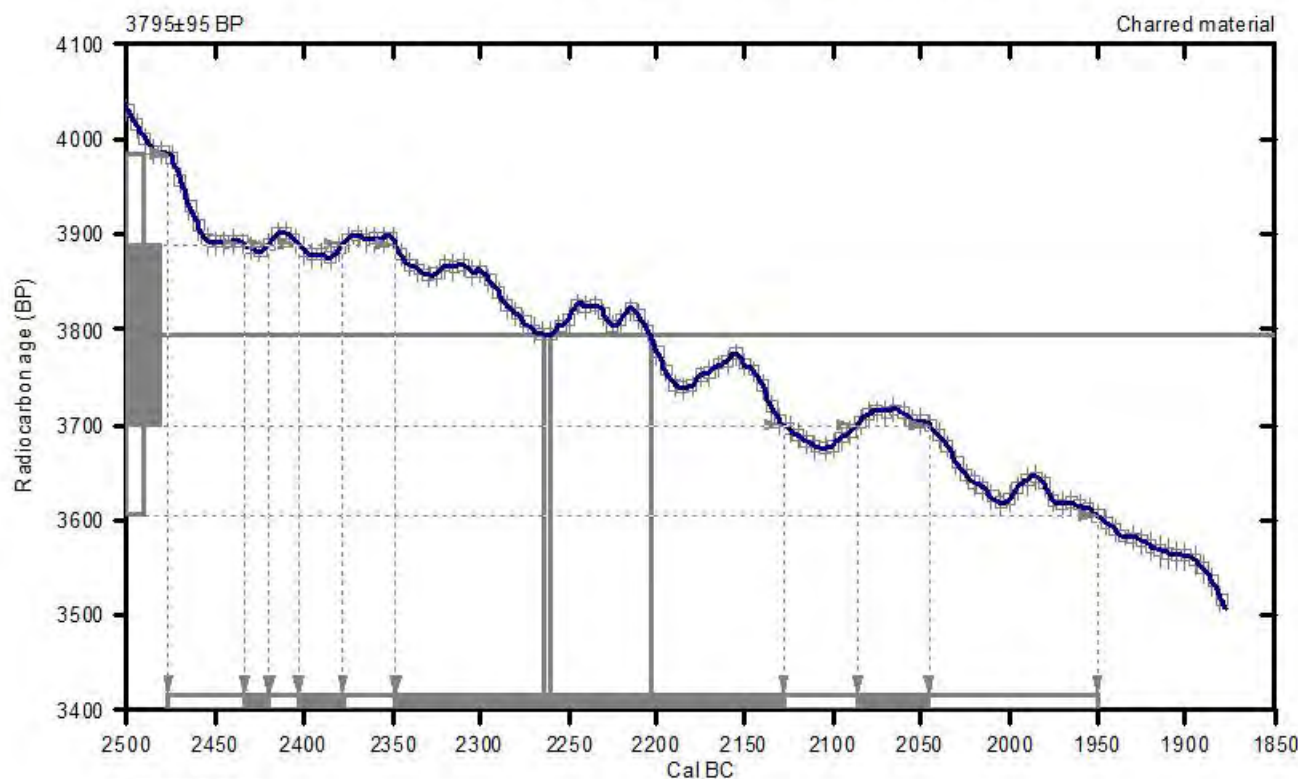
¹ C13/C12 ratio estimated

Intercept data

Intercepts of radiocarbon age

with calibration curve: Cal BC 2265 (Cal BP 4215) and
Cal BC 2260 (Cal BP 4210) and
Cal BC 2205 (Cal BP 4155)

1 Sigma calibrated results: Cal BC 2435 to 2420 (Cal BP 4385 to 4370) and
(68% probability) Cal BC 2405 to 2380 (Cal BP 4355 to 4330) and
Cal BC 2350 to 2130 (Cal BP 4300 to 4080) and
Cal BC 2085 to 2045 (Cal BP 4035 to 3995)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, Radiocarbon 51(4):1151-1164, Reimer, et al., 2009, Radiocarbon 51(4):1111-1150, Stuiver, et al., 1993, Radiocarbon 35(1):137-189, Oeschger, et al., 1975, Tellus 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Cx 1339 - Cut B Hearth

Laboratory number: **GX-13809**

Conventional radiocarbon age¹: **3170±90 BP**

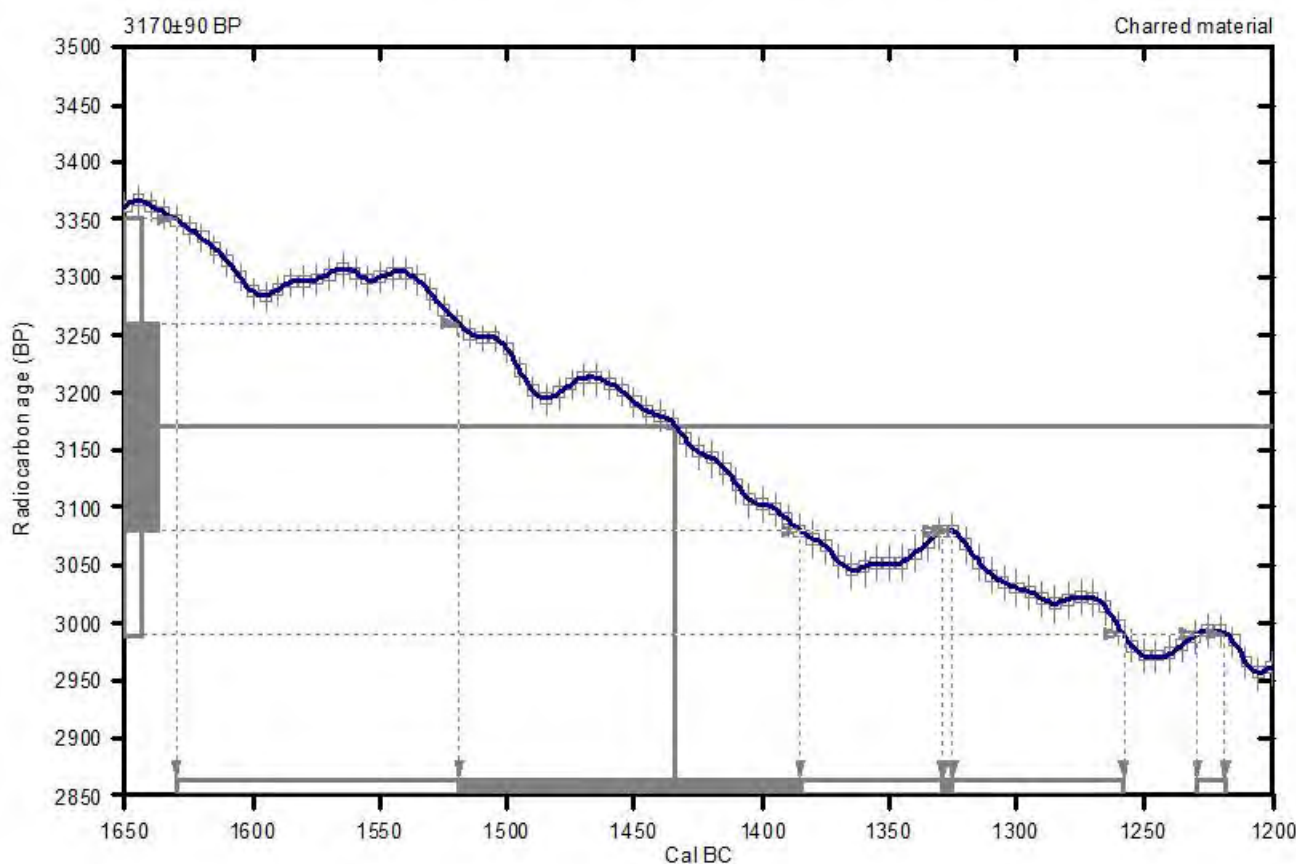
2 Sigma calibrated results: Cal BC 1630 to 1260 (Cal BP 3580 to 3210) and
(95% probability) Cal BC 1230 to 1220 (Cal BP 3180 to 3170)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 1435 (Cal BP 3385)

1 Sigma calibrated results: Cal BC 1520 to 1385 (Cal BP 3470 to 3335) and
(68% probability) Cal BC 1330 to 1325 (Cal BP 3280 to 3275)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150,
Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Cx1221 - Hearth 1

Laboratory number: **GX-13825**

Conventional radiocarbon age¹: **4045±110 BP**

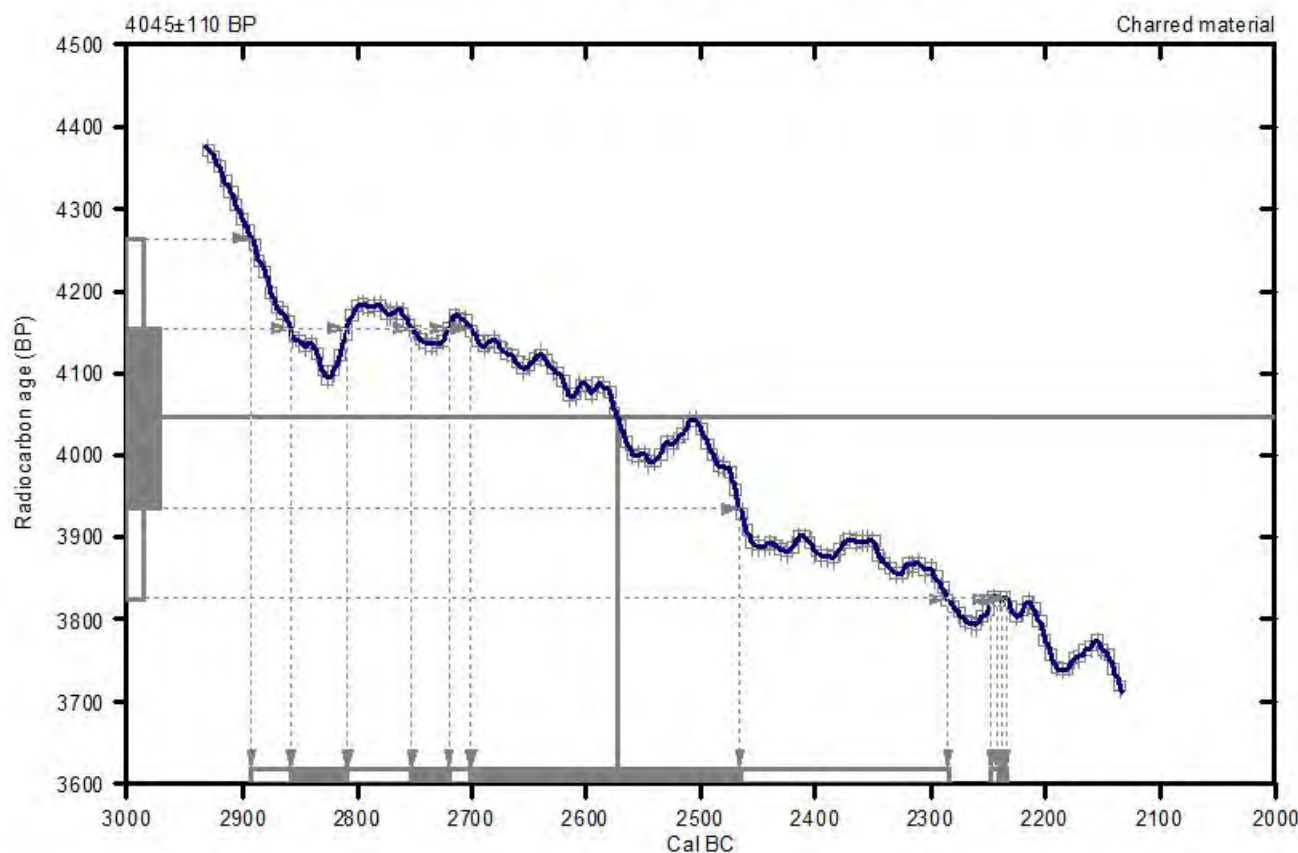
2 Sigma calibrated results: Cal BC 2890 to 2285 (Cal BP 4840 to 4235) and
(95% probability) Cal BC 2245 to 2240 (Cal BP 4195 to 4190) and
Cal BC 2235 to 2235 (Cal BP 4185 to 4185)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 2575 (Cal BP 4525)

1 Sigma calibrated results: Cal BC 2860 to 2810 (Cal BP 4810 to 4760) and
(68% probability) Cal BC 2750 to 2720 (Cal BP 4700 to 4670) and
Cal BC 2700 to 2465 (Cal BP 4650 to 4415)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150, Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Cx 768.00b -

Laboratory number: Beta-17438

Hearth 6

Conventional radiocarbon age¹: 3270±100 BP

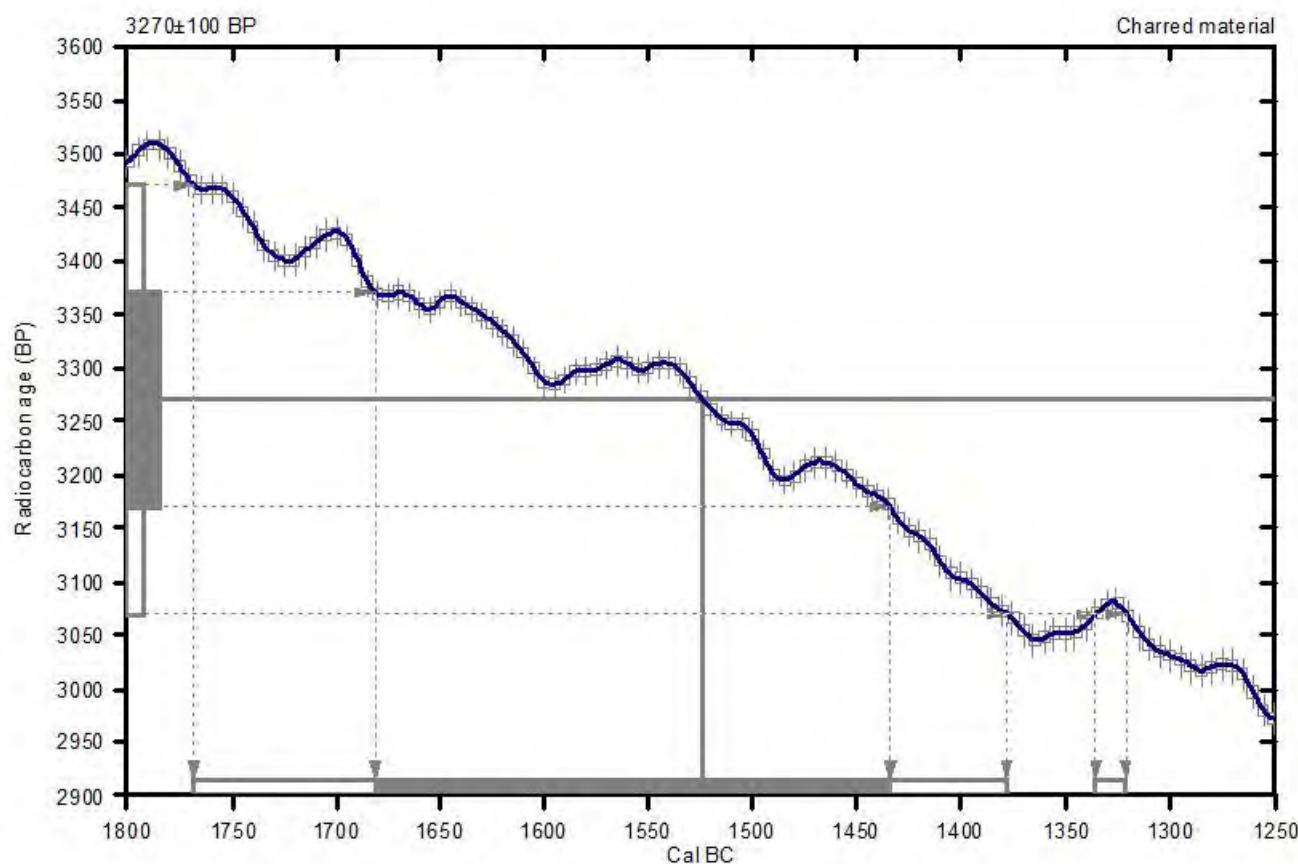
2 Sigma calibrated results: Cal BC 1770 to 1380 (Cal BP 3720 to 3330) and
(95% probability) Cal BC 1340 to 1320 (Cal BP 3280 to 3270)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 1520 (Cal BP 3470)

1 Sigma calibrated result: Cal BC 1680 to 1430 (Cal BP 3630 to 3380)
(68% probability)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150,
Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

Beta Analytic Radiocarbon Dating Laboratory⁷¹

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Cx768.00a - Hearth 6

Laboratory number: Beta-17465

Conventional radiocarbon age¹: 4710±100 BP

2 Sigma calibrated results: Cal BC 3690 to 3680 (Cal BP 5640 to 5630) and
(95% probability) Cal BC 3660 to 3330 (Cal BP 5610 to 5280) and
Cal BC 3210 to 3190 (Cal BP 5160 to 5140) and
Cal BC 3150 to 3130 (Cal BP 5100 to 5080)

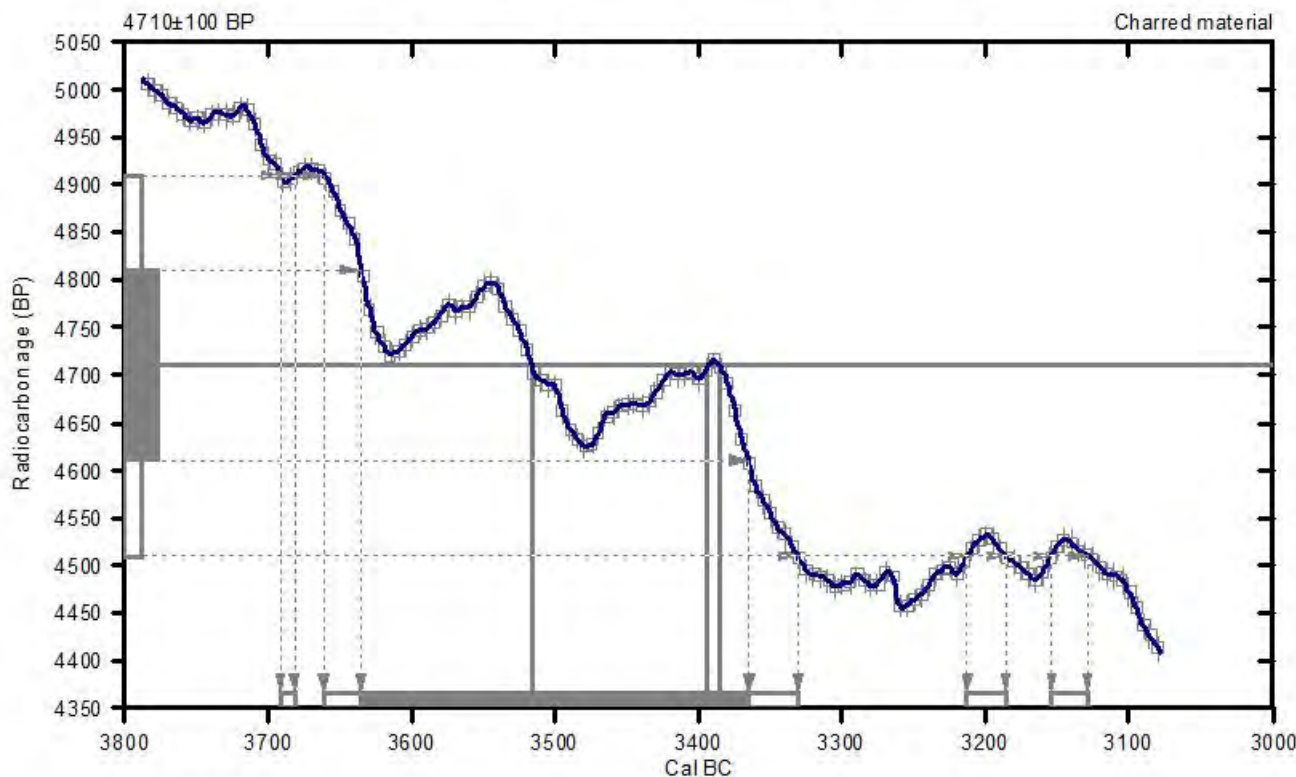
¹ C13/C12 ratio estimated

Intercept data

Intercepts of radiocarbon age
with calibration curve:

Cal BC 3520 (Cal BP 5470) and
Cal BC 3390 (Cal BP 5340) and
Cal BC 3390 (Cal BP 5340)

1 Sigma calibrated result: Cal BC 3640 to 3360 (Cal BP 5590 to 5320)
(68% probability)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, Radiocarbon 51(4):1151-1164, Reimer, et al., 2009, Radiocarbon 51(4):1111-1150,
Stuiver, et al., 1993, Radiocarbon 35(1):137-189, Oeschger, et al., 1975, Tellus 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Cx941- Comp D

Laboratory number: Beta-17530

Conventional radiocarbon age¹: 2620±100 BP

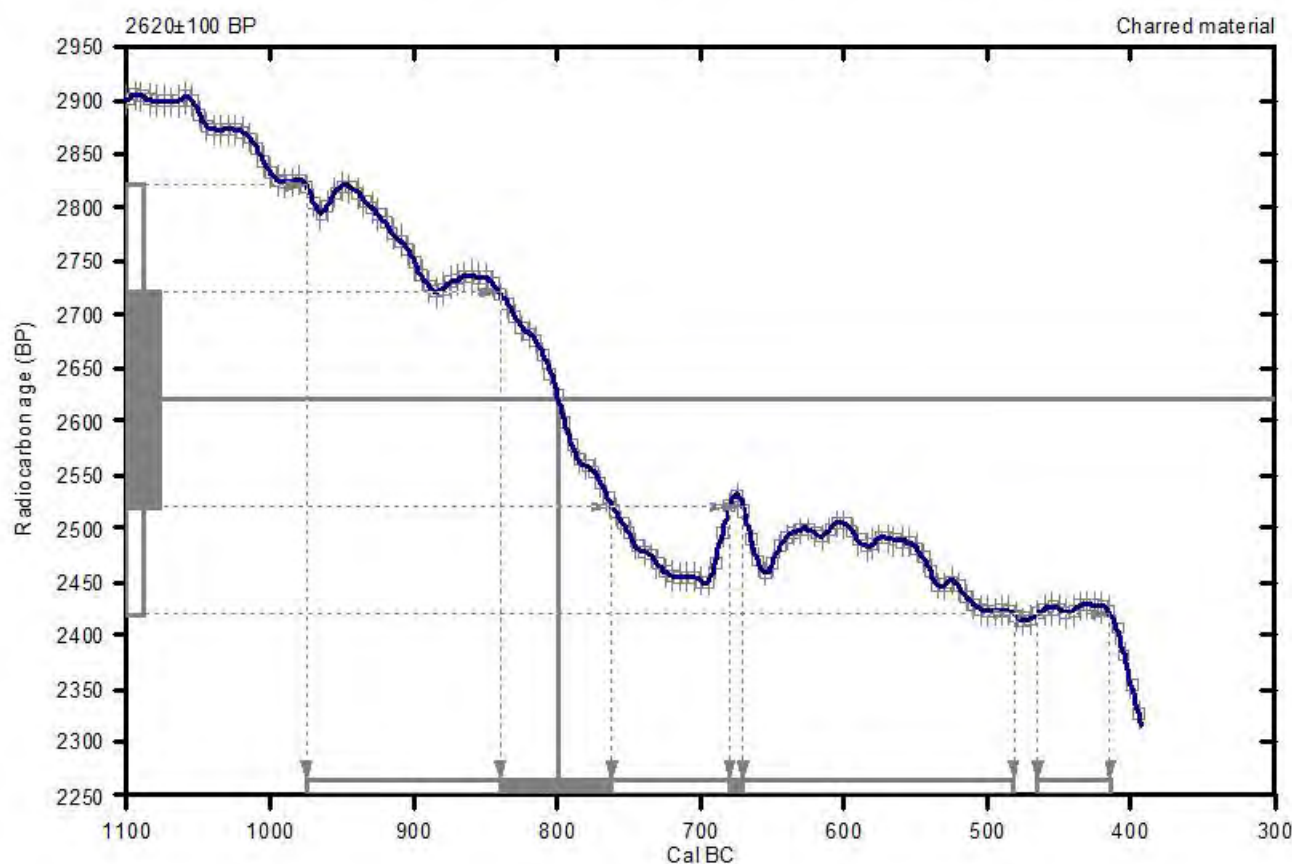
2 Sigma calibrated results: Cal BC 980 to 480 (Cal BP 2920 to 2430) and
(95% probability) Cal BC 460 to 410 (Cal BP 2420 to 2360)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 800 (Cal BP 2750)

1 Sigma calibrated results: Cal BC 840 to 760 (Cal BP 2790 to 2710) and
(68% probability) Cal BC 680 to 670 (Cal BP 2630 to 2620)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150,
Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

Beta Analytic Radiocarbon Dating Laboratory⁷³

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.6;lab. mult=1)

Laboratory number: Beta-317204

Cx 1221A - AMS Hearth 1

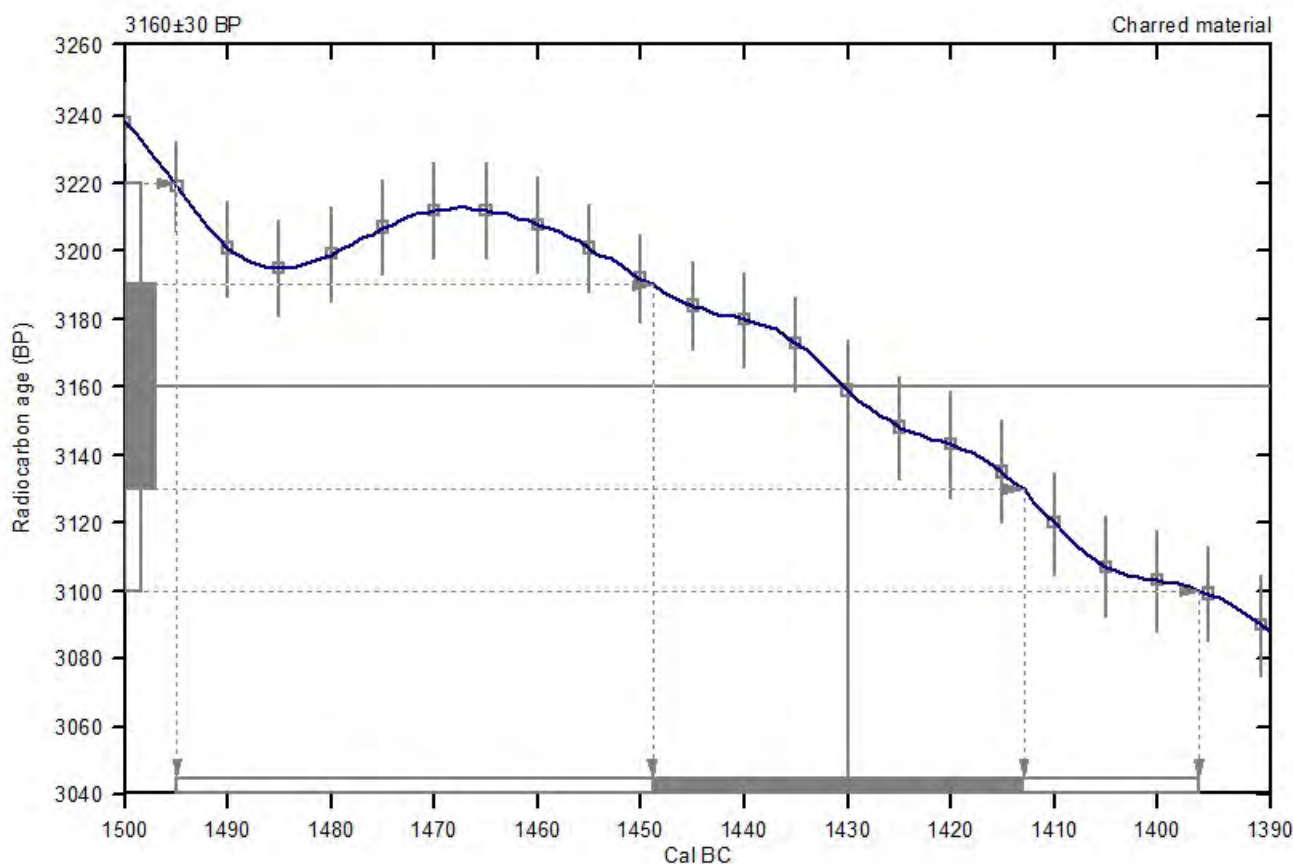
Conventional radiocarbon age: 3160±30 BP

2 Sigma calibrated result: Cal BC 1500 to 1400 (Cal BP 3440 to 3350)
(95% probability)

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 1430 (Cal BP 3380)

1 Sigma calibrated result: Cal BC 1450 to 1410 (Cal BP 3400 to 3360)
(68% probability)



References:

Database used
INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4): 1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4): 1111-1150, Stuiver, et al., 1993, *Radiocarbon* 35(1): 137-189, Oeschger, et al., 1975, *Tellus* 27: 168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talman, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2): 317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.9;lab. mult=1)

Laboratory number: Beta-317205

Cx1221 Hearth 1 AMS

Conventional radiocarbon age: 3070±30 BP

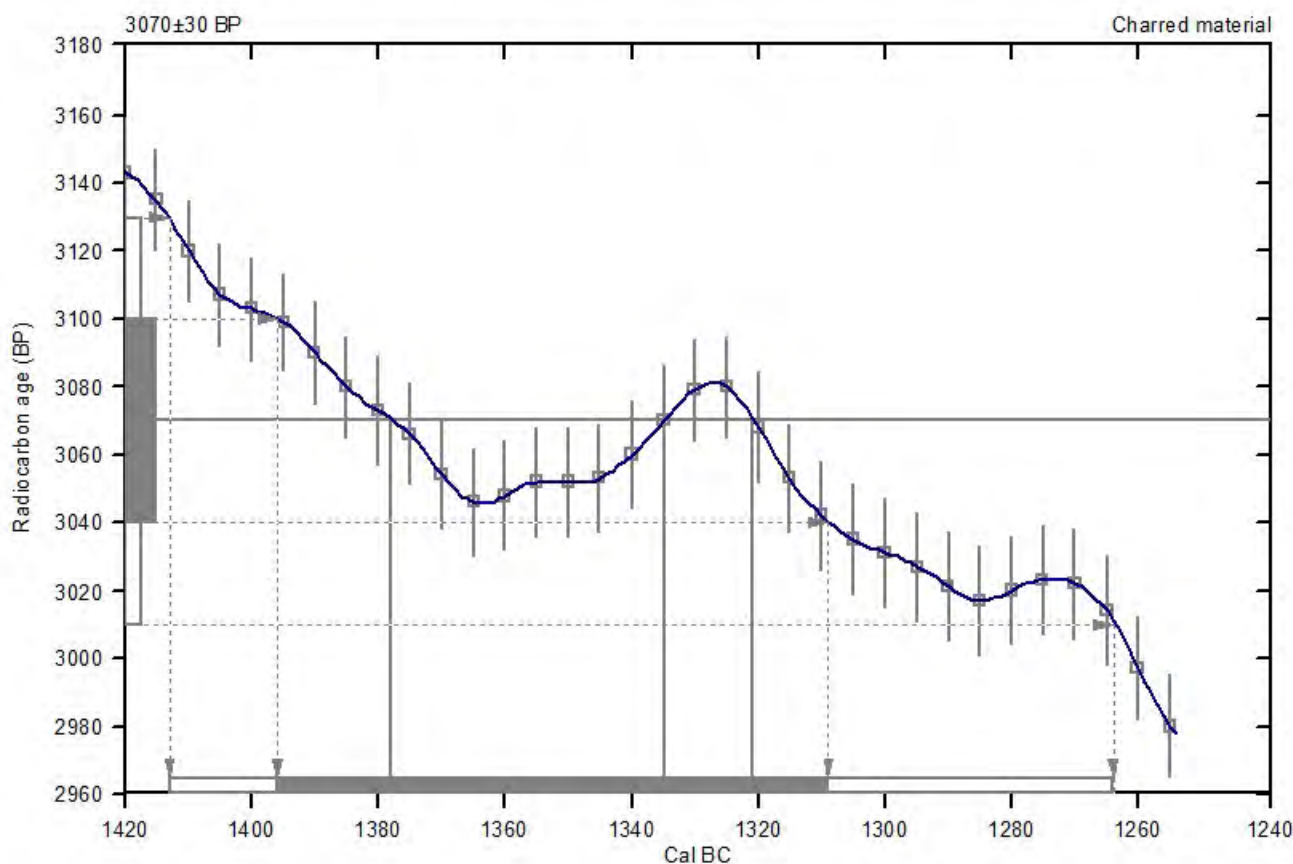
2 Sigma calibrated result: Cal BC 1410 to 1260 (Cal BP 3360 to 3210)
(95% probability)

Intercept data

Intercepts of radiocarbon age

with calibration curve: Cal BC 1380 (Cal BP 3330) and
Cal BC 1340 (Cal BP 3280) and
Cal BC 1320 (Cal BP 3270)

1 Sigma calibrated result: Cal BC 1400 to 1310 (Cal BP 3350 to 3260)
(68% probability)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4): 1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4): 1111-1150, Stuiver, et al., 1993, *Radiocarbon* 35(1): 137-189, Oeschger, et al., 1975, *Tellus* 27: 168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talman, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2): 317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.4;lab. mult=1)

Laboratory number: Beta-317206

Cx 1221 - Hearth 1 AMS

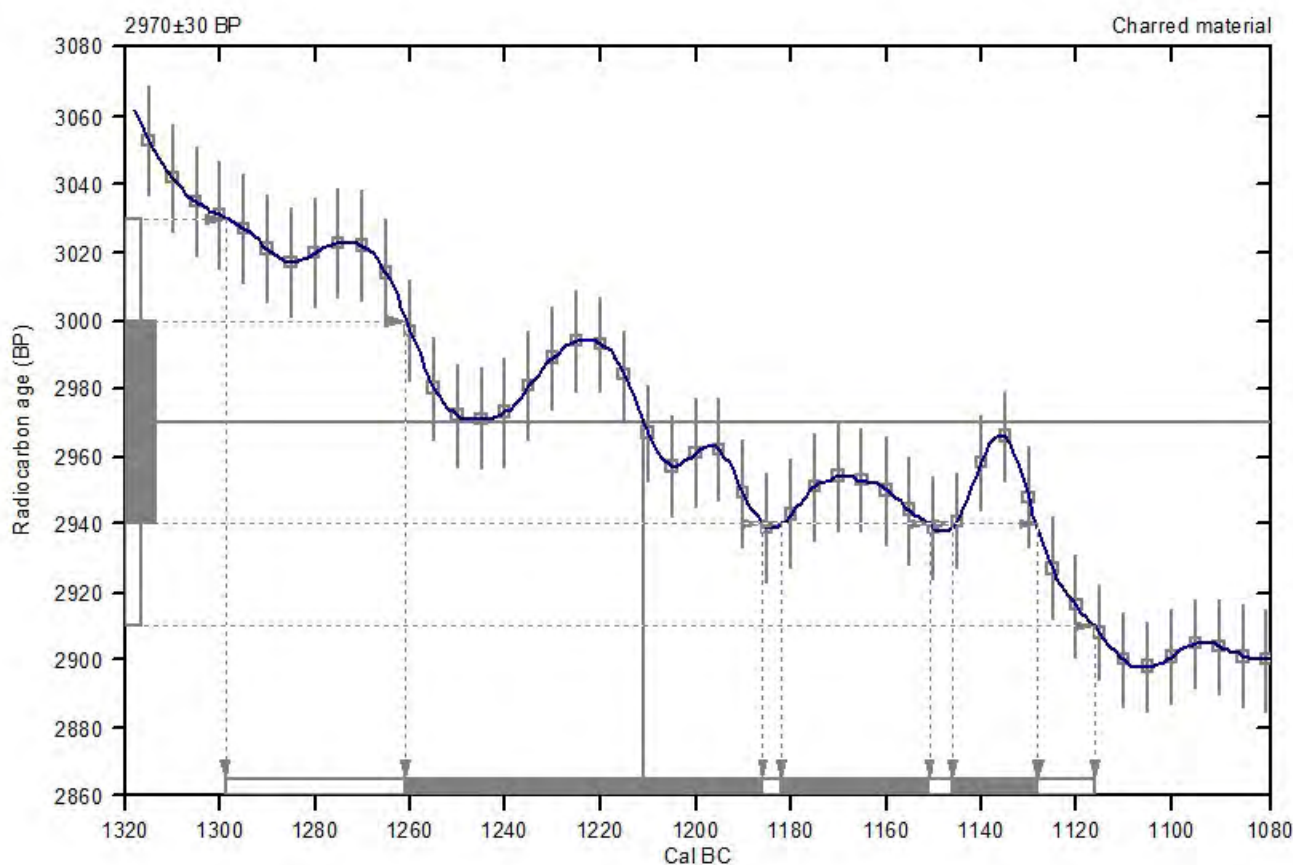
Conventional radiocarbon age: 2970±30 BP

2 Sigma calibrated result: Cal BC 1300 to 1120 (Cal BP 3250 to 3070)
(95% probability)

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 1210 (Cal BP 3160)

1 Sigma calibrated results: Cal BC 1260 to 1190 (Cal BP 3210 to 3140) and
(68% probability) Cal BC 1180 to 1150 (Cal BP 3130 to 3100) and
Cal BC 1150 to 1130 (Cal BP 3100 to 3080)



References:

Database used
INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4): 1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4): 1111-1150, Stuiver, et al., 1993, *Radiocarbon* 35(1): 137-189, Oeschger, et al., 1975, *Tellus* 27: 168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talman, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2): 317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-31.8;lab. mult=1)

Laboratory number: Beta-317207 Cx 1187 - Hearth 1 - AMS

Conventional radiocarbon age: 2980±30 BP

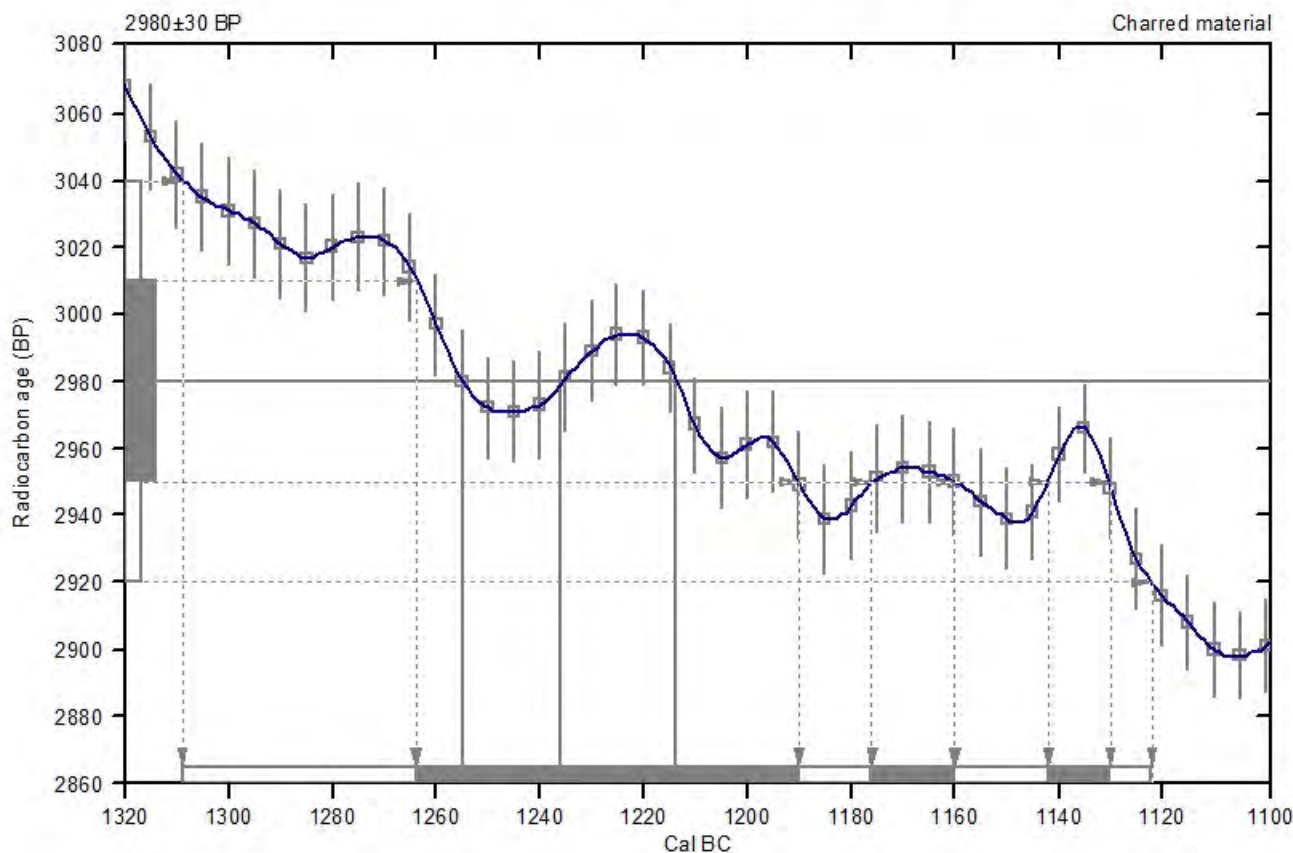
2 Sigma calibrated result: Cal BC 1310 to 1120 (Cal BP 3260 to 3070)
(95% probability)

Intercept data

Intercepts of radiocarbon age

with calibration curve: Cal BC 1260 (Cal BP 3200) and
Cal BC 1240 (Cal BP 3190) and
Cal BC 1210 (Cal BP 3160)

1 Sigma calibrated results: Cal BC 1260 to 1190 (Cal BP 3210 to 3140) and
(68% probability) Cal BC 1180 to 1160 (Cal BP 3130 to 3110) and
Cal BC 1140 to 1130 (Cal BP 3090 to 3080)



References:

Database used
INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4): 1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4): 1111-1150,
Stuiver, et al., 1993, *Radiocarbon* 35(1): 137-189, Oeschger, et al., 1975, *Tellus* 27: 168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talman, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2): 317-322

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Appendix II: Late Woodland Period Age Range Patterns

Contents: a) Table II: Summary plot of Late Woodland Period correlation tables - a seriation of clusters or patterns of chronologically associated age ranges.

b) Compilation of annotated BETA Analytic Late Woodland "Calibration of Radiocarbon Age to Calendar Years" data sheets.

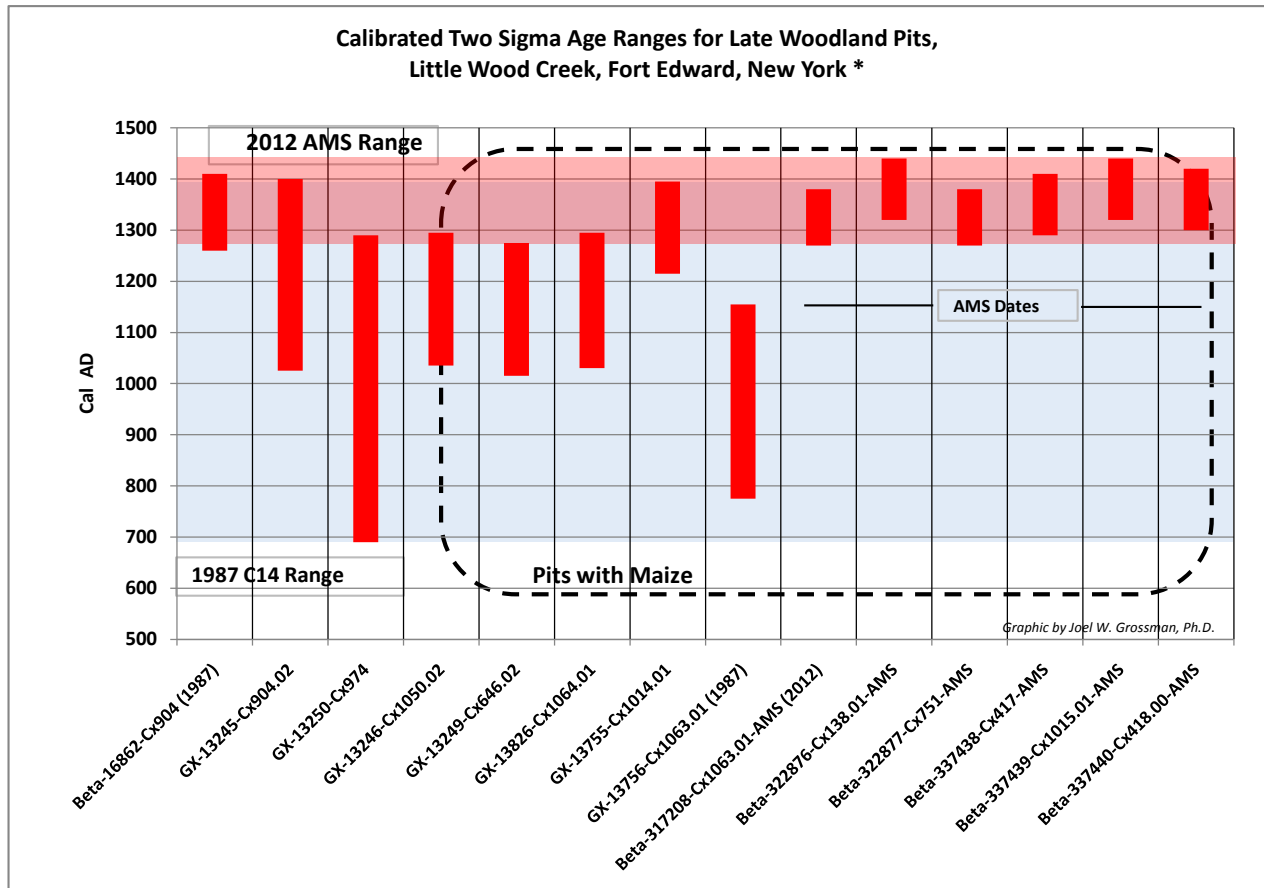
- The data sheets are divided into two chronological groups: the early Transitional Period (Appendix I) and the later Late Woodland Period (Appendix II).
- Each chronological grouping is in turn subdivided into two data sets: 1) the 2012 recalibrations of the original 1987 scintillation determinations and 2) the seven new AMS 2012 date ranges.
- All data plots are arranged in sequential order by laboratory sample number, regardless of the laboratory identifier prefix.
- Each group is introduced by a summary plot of age range patterns as clusters of chronological highs and lows.
- All age calibrations and new AMS listings are presented not as individual dates, but instead as ranges with a two-sigma (95%) probability that the feature dates to within an early to late, Cal BC or Cal AD, scale of calendar years.
- Each numbered data sheet is annotated and listed with its stratigraphic context number and larger component associations.
- Late Woodland Period plots list the ceramic associations of each dated pit.

TABLE II

Calibrated Two Sigma (95% probability) Age Ranges for All Dated Late Woodland Pits *

Context	Lab. Sample No. - Context No.	Dates BP	SD	Low (Cal AD)	High (Cal AD)	Pit Association (Maize=Mz)
904	Beta-16862-Cx904 (1987)	650	60	1260	1410	burial pit fill
904.02	GX-13245-Cx904.02	780	105	1025	1400	burial pit fill
974	GX-13250-Cx974	975	150	690	1290	Pit - Castle Creek
1050.02	GX-13246-Cx1050.02	805	75	1035	1295	Mz - Castle Creek
646.02	GX-13249-Cx646.02	890	75	1015	1275	Mz - Castle Creek
1064.01	GX-13826-Cx1064.01	815	75	1030	1295	Mz - Owasco
1014.01	GX-13755-Cx1014.01	710	65	1215	1395	Mz - Castle Creek / Bainbridge
1063.01	GX-13756-Cx1063.01 (1987)	1075	80	775	1155	Mz - Owasco
1063.01	Beta-317208-Cx1063.01-AMS (2012)	700	30	1270	1380	Mz - Owasco
138.01	Beta-322876-Cx138.01-AMS	530	30	1320	1440	Mz - Castle Creek / Bainbridge
751	Beta-322877-Cx751-AMS	690	30	1270	1380	Mz - Castle Creek
417.01	Beta-337438-Cx417-AMS	600	30	1290	1410	Mz
1015.01	Beta-337439-Cx1015.01-AMS	530	30	1320	1440	Mz
418.00	Beta-337440-Cx418.00-AMS	570	30	1300	1420	Mz

* - All Calibrations of radiocarbon age to calander years by Beta Analytic Radiocarbon Dating Laboratory



CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: **GX-13245**

Cx904.02 - Burial pit fill

Conventional radiocarbon age¹: **780±105 BP**

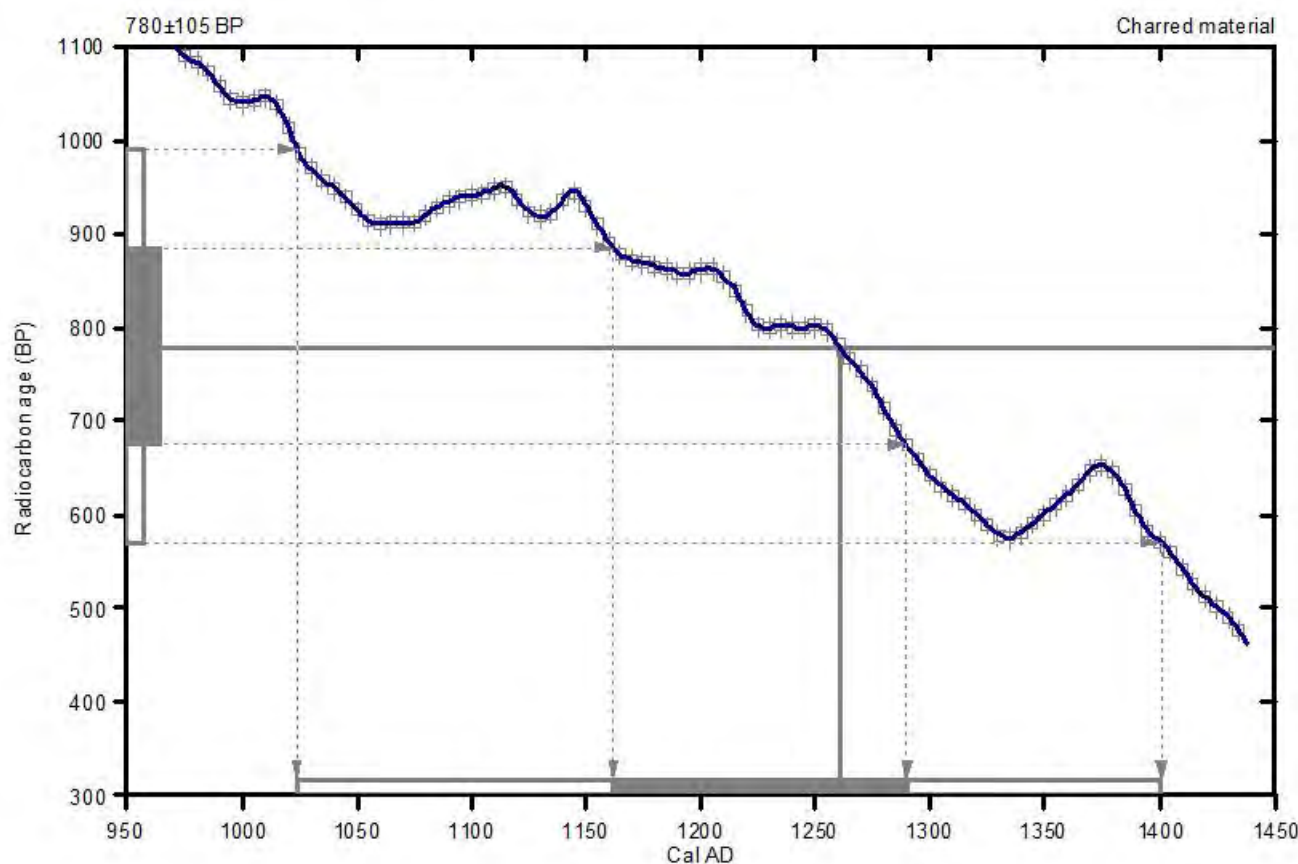
2 Sigma calibrated result: Cal AD 1025 to 1400 (Cal BP 925 to 550)
(95% probability)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: **Cal AD 1260 (Cal BP 690)**

1 Sigma calibrated result: Cal AD 1160 to 1290 (Cal BP 790 to 660)
(68% probability)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150, Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: **GX-13246**

Cx1050.02 Castle Creek Ceram.

Conventional radiocarbon age¹: **805±75 BP**

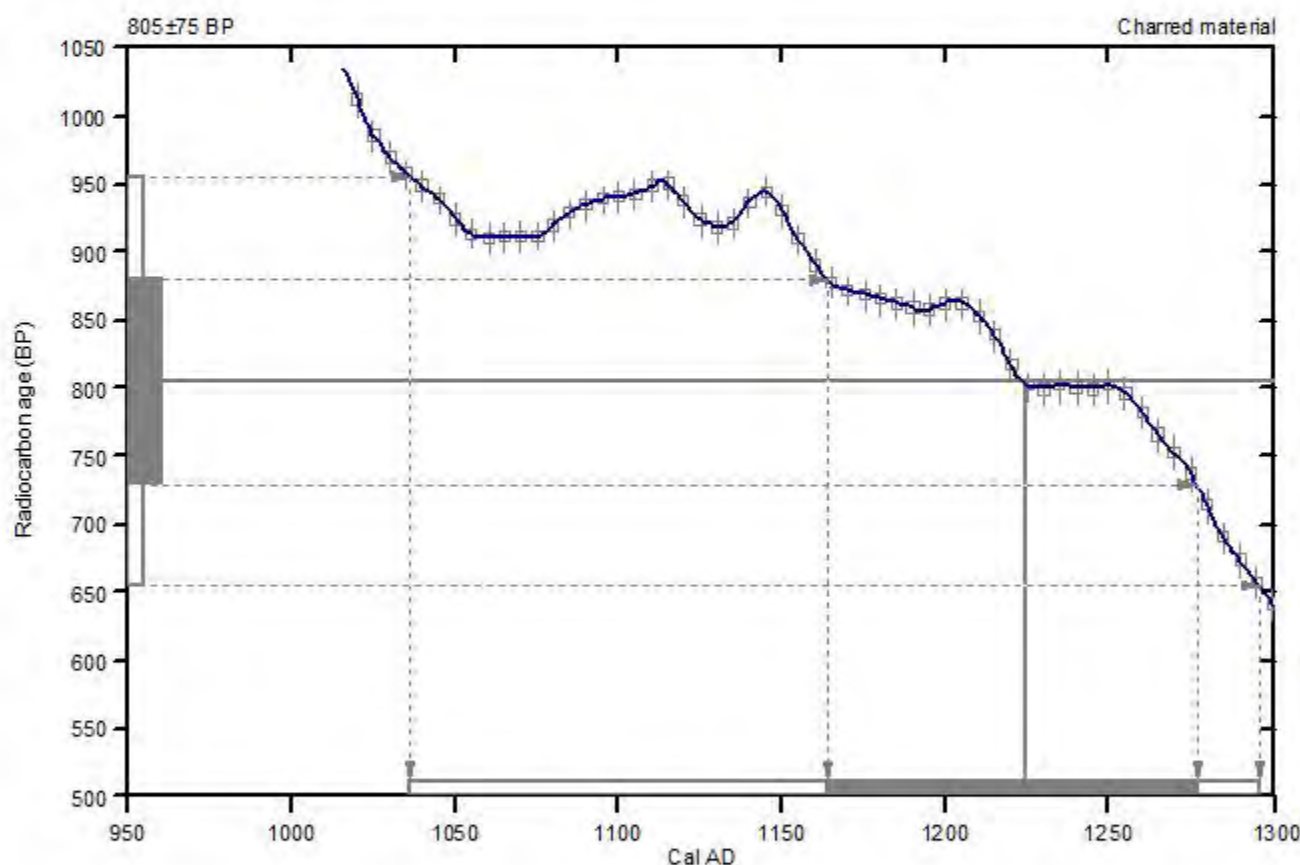
2 Sigma calibrated result: Cal AD 1035 to 1295 (Cal BP 915 to 655)
(95% probability)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: **Cal AD 1225 (Cal BP 725)**

1 Sigma calibrated result: Cal AD 1165 to 1275 (Cal BP 785 to 675)
(68% probability)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150,

Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25:lab. mult=1)

Laboratory number: **GX-13249**

Cx646.02 - Castle Creek

Conventional radiocarbon age¹: **890±75 BP**

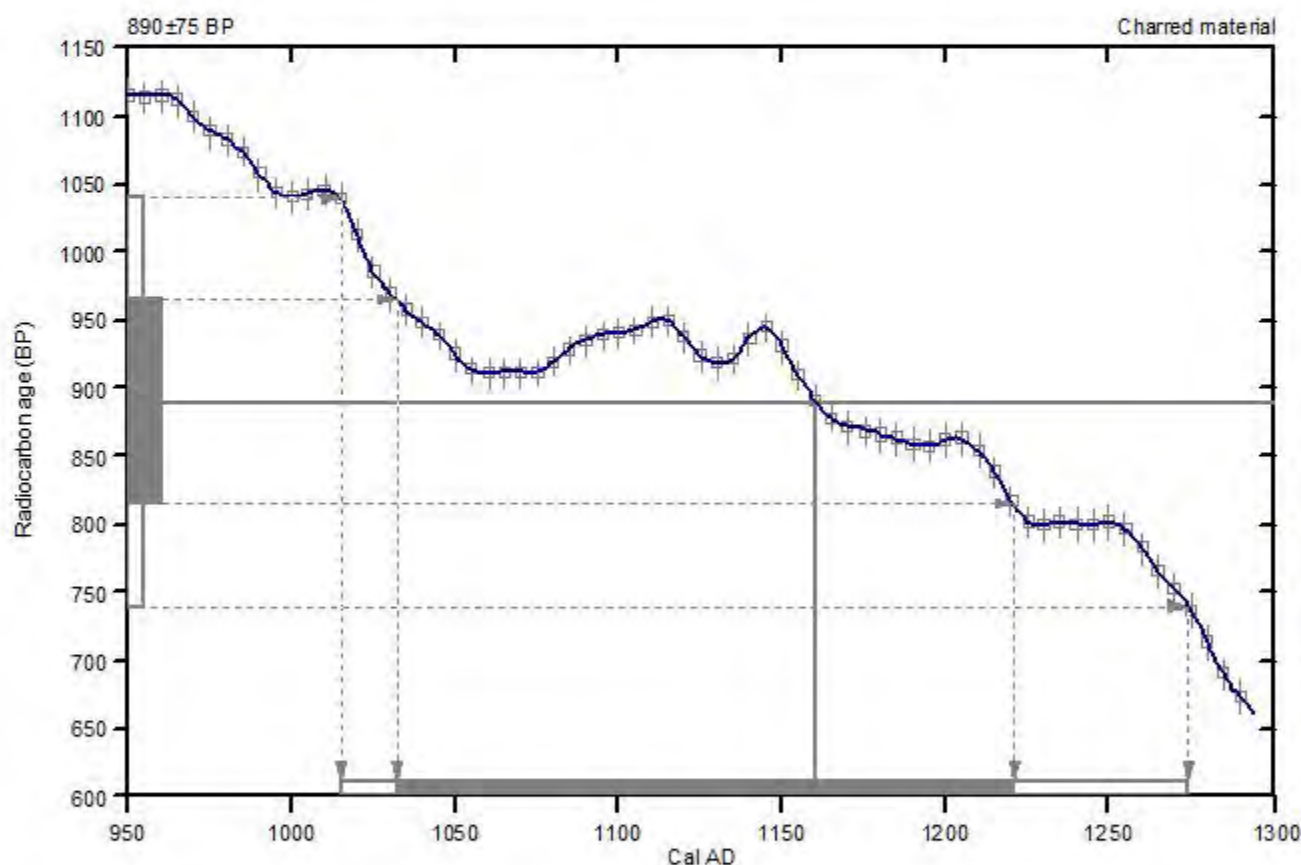
2 Sigma calibrated result: Cal AD 1015 to 1275 (Cal BP 935 to 675)
(95% probability)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 1160 (Cal BP 790)

1 Sigma calibrated result: Cal AD 1030 to 1220 (Cal BP 920 to 730)
(68% probability)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150,
Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: GX-13250

Cx 974 Pit Feature - Castle Creek ceram.

Conventional radiocarbon age¹: 975±150 BP

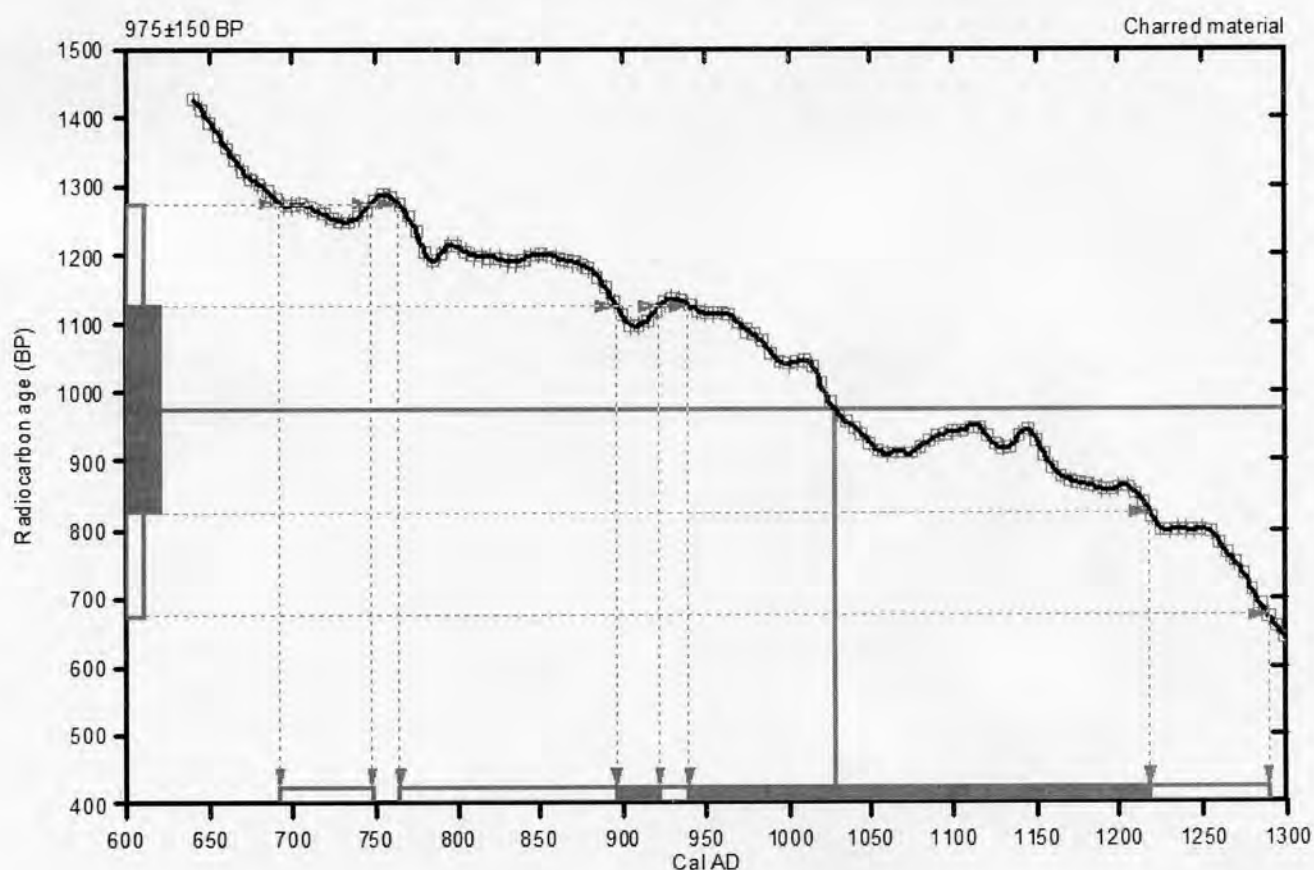
2 Sigma calibrated results: Cal AD 690 to 750 (Cal BP 1260 to 1200) and
(95% probability) Cal AD 765 to 1290 (Cal BP 1185 to 660)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 1030 (Cal BP 920)

1 Sigma calibrated results: Cal AD 895 to 920 (Cal BP 1055 to 1030) and
(68% probability) Cal AD 940 to 1220 (Cal BP 1010 to 730)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, Radiocarbon 51(4):1151-1164, Rebner, et al., 2009, Radiocarbon 51(4):1111-1150, Stuiver, et al., 1993, Radiocarbon 35(1):137-189, Oeschger, et al., 1975, Tellus 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: **GX-13755**

Cx1014.01 Castle Creek/
Bainbridge

Conventional radiocarbon age¹: **710±65 BP**

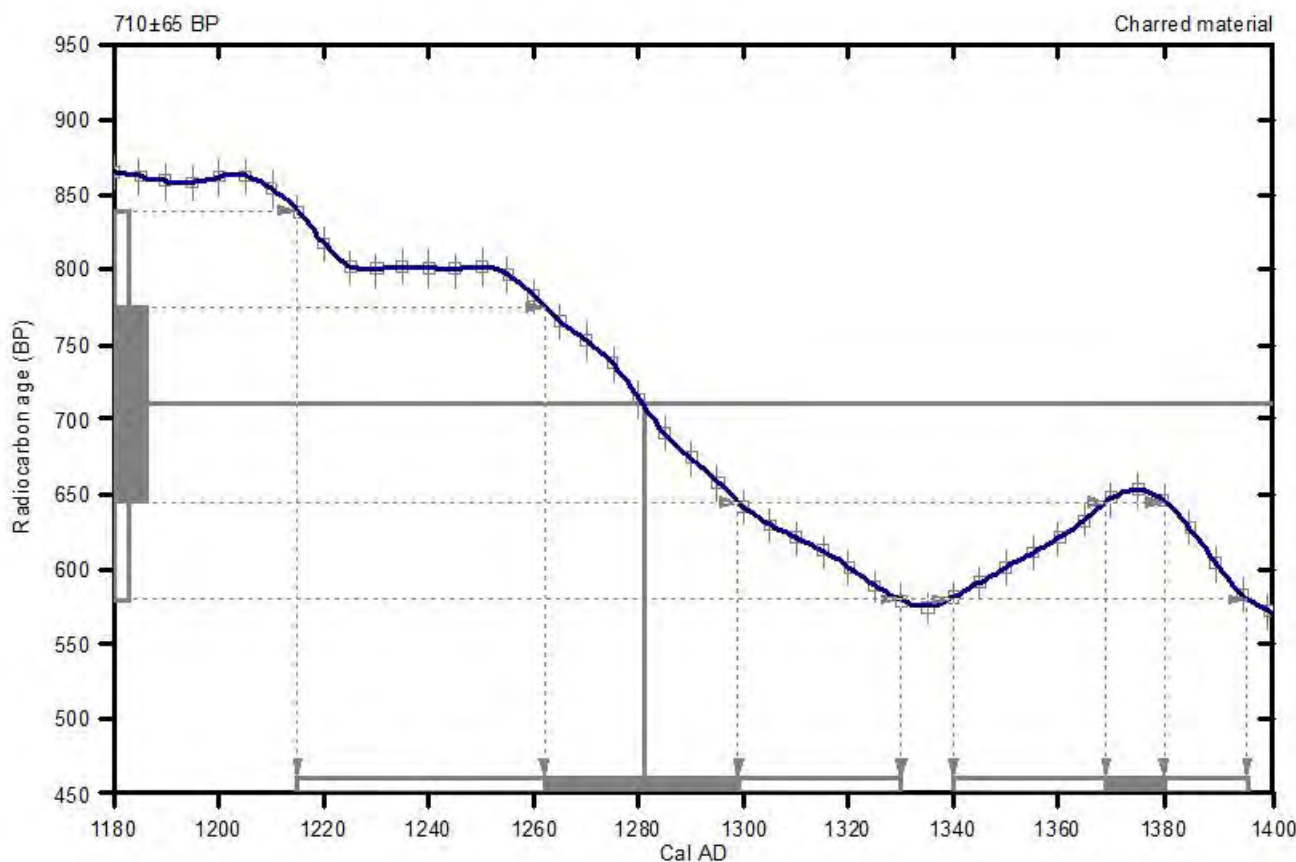
**2 Sigma calibrated results: Cal AD 1215 to 1330 (Cal BP 735 to 620) and
(95% probability) Cal AD 1340 to 1395 (Cal BP 610 to 555)**

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: **Cal AD 1280 (Cal BP 670)**

**1 Sigma calibrated results: Cal AD 1260 to 1300 (Cal BP 690 to 650) and
(68% probability) Cal AD 1370 to 1380 (Cal BP 580 to 570)**



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150, Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: GX-13756

Cx1063.01 (1987) -Mz
Owasco

Conventional radiocarbon age¹: 1075±80 BP

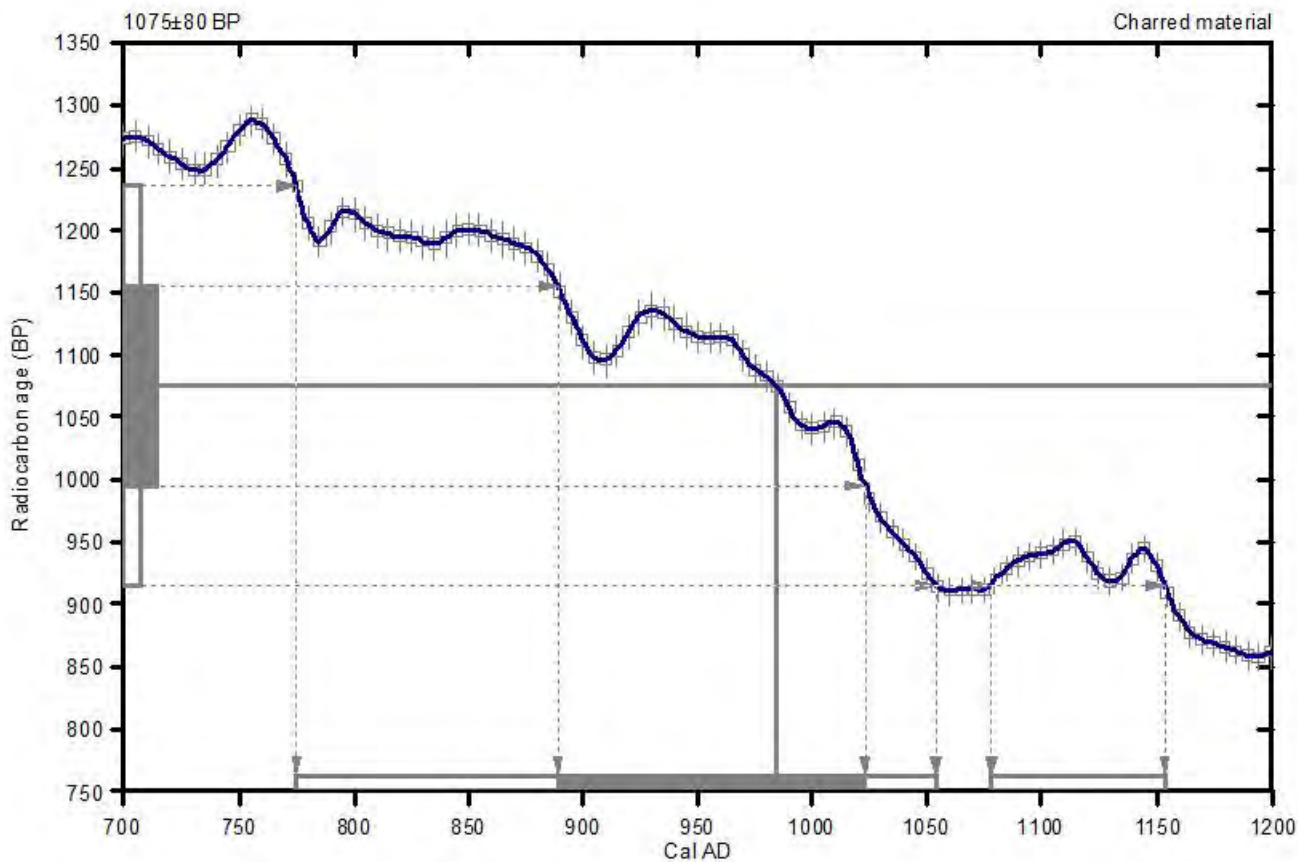
2 Sigma calibrated results: Cal AD 775 to 1055 (Cal BP 1175 to 895) and
(95% probability) Cal AD 1080 to 1155 (Cal BP 870 to 795)

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 985 (Cal BP 965)

1 Sigma calibrated result: Cal AD 890 to 1025 (Cal BP 1060 to 925)
(68% probability)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150, Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Cx. 1064.01 Owasco

Laboratory number: GX-13826

Conventional radiocarbon age¹: 815±75 BP

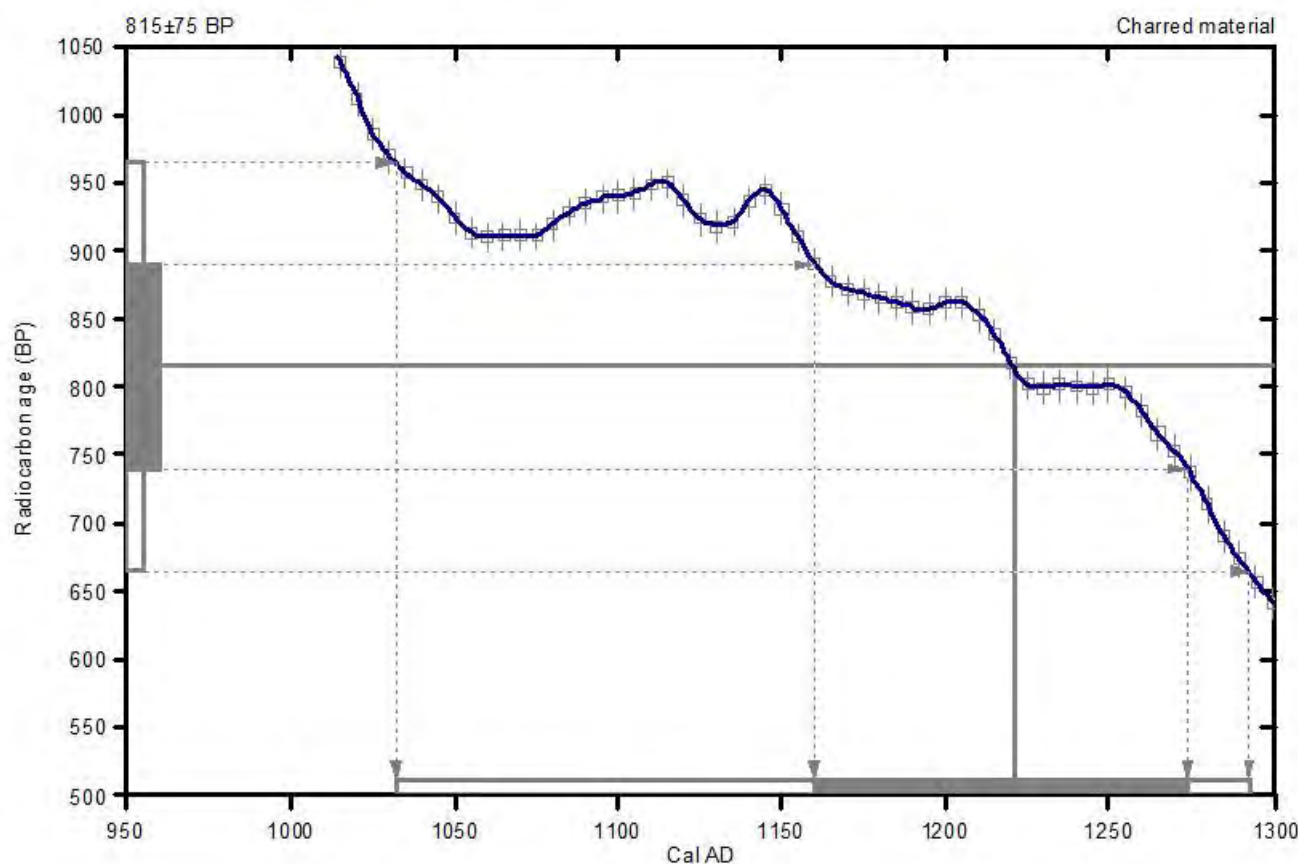
**2 Sigma calibrated result: Cal AD 1030 to 1295 (Cal BP 920 to 655)
(95% probability)**

¹ C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 1220 (Cal BP 730)

**1 Sigma calibrated result: Cal AD 1160 to 1275 (Cal BP 790 to 675)
(68% probability)**



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150, Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25:lab. mult=1) Cx 904 - Burial Pit

Laboratory number: Beta-16862

Conventional radiocarbon age¹: 650±60 BP

2 Sigma calibrated result: Cal AD 1260 to 1410 (Cal BP 690 to 540)
(95% probability)

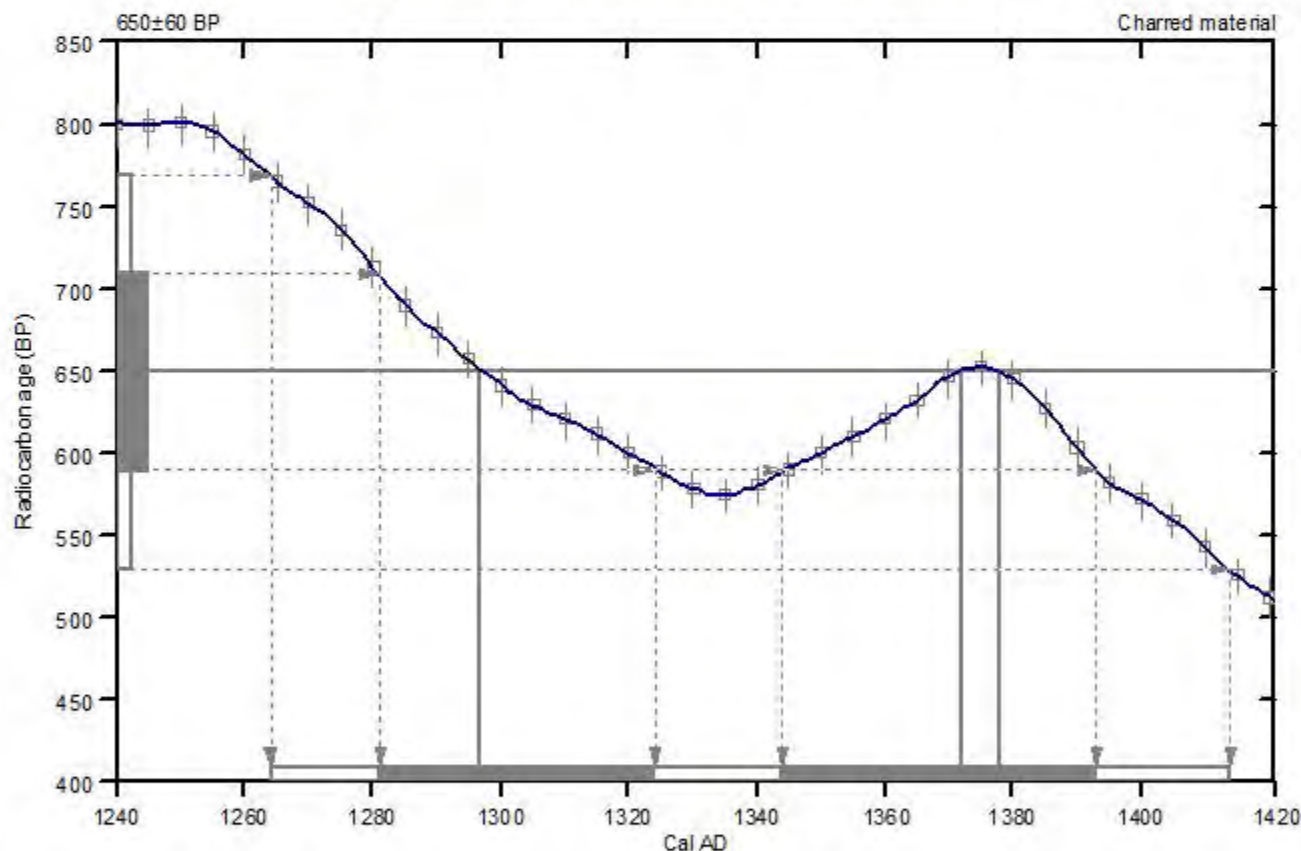
¹ C13/C12 ratio estimated

Intercept data

Intercepts of radiocarbon age
with calibration curve:

Cal AD 1300 (Cal BP 650) and
Cal AD 1370 (Cal BP 580) and
Cal AD 1380 (Cal BP 570)

1 Sigma calibrated results: Cal AD 1280 to 1320 (Cal BP 670 to 630) and
(68% probability) Cal AD 1340 to 1390 (Cal BP 610 to 560)



References:

Database used
INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4):1111-1150,
Stuiver, et al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-27;lab. mult=1)

Laboratory number: Beta-317208

Cx1063.01- Mz -AMS (2012)
Owasco

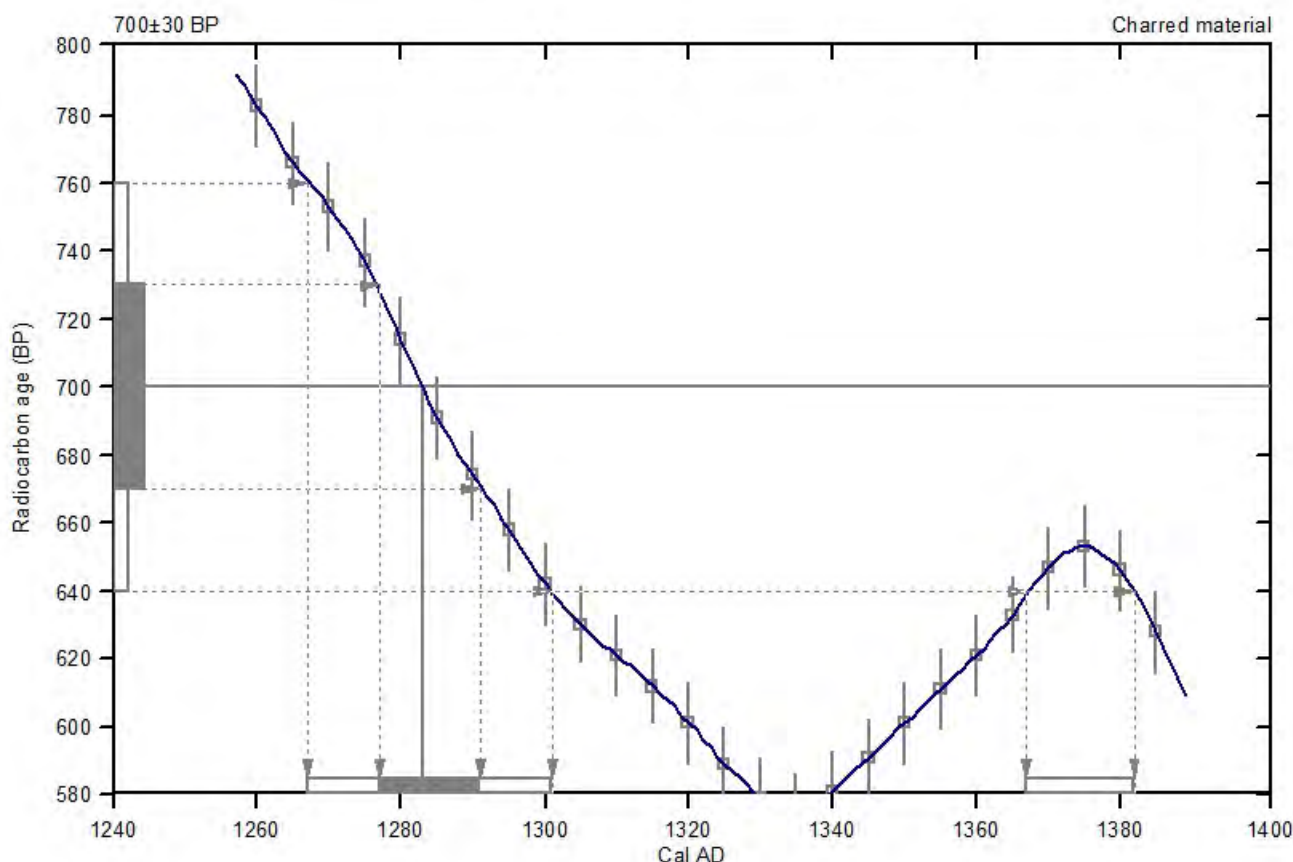
Conventional radiocarbon age: 700±30 BP

2 Sigma calibrated results: Cal AD 1270 to 1300 (Cal BP 680 to 650) and
(95% probability) Cal AD 1370 to 1380 (Cal BP 580 to 570)

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 1280 (Cal BP 670)

1 Sigma calibrated result: Cal AD 1280 to 1290 (Cal BP 670 to 660)
(68% probability)



References:

Database used
INTCAL09

References to INTCAL09 database

Heaton, et al., 2009, *Radiocarbon* 51(4): 1151-1164, Reimer, et al., 2009, *Radiocarbon* 51(4): 1111-1150, Stuiver, et al., 1993, *Radiocarbon* 35(1): 137-189, Oeschger, et al., 1975, *Tellus* 27: 168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talman, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2): 317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.7:lab. mult=1)

Laboratory number: Beta-322876

Cx138.01-MZ-AMS

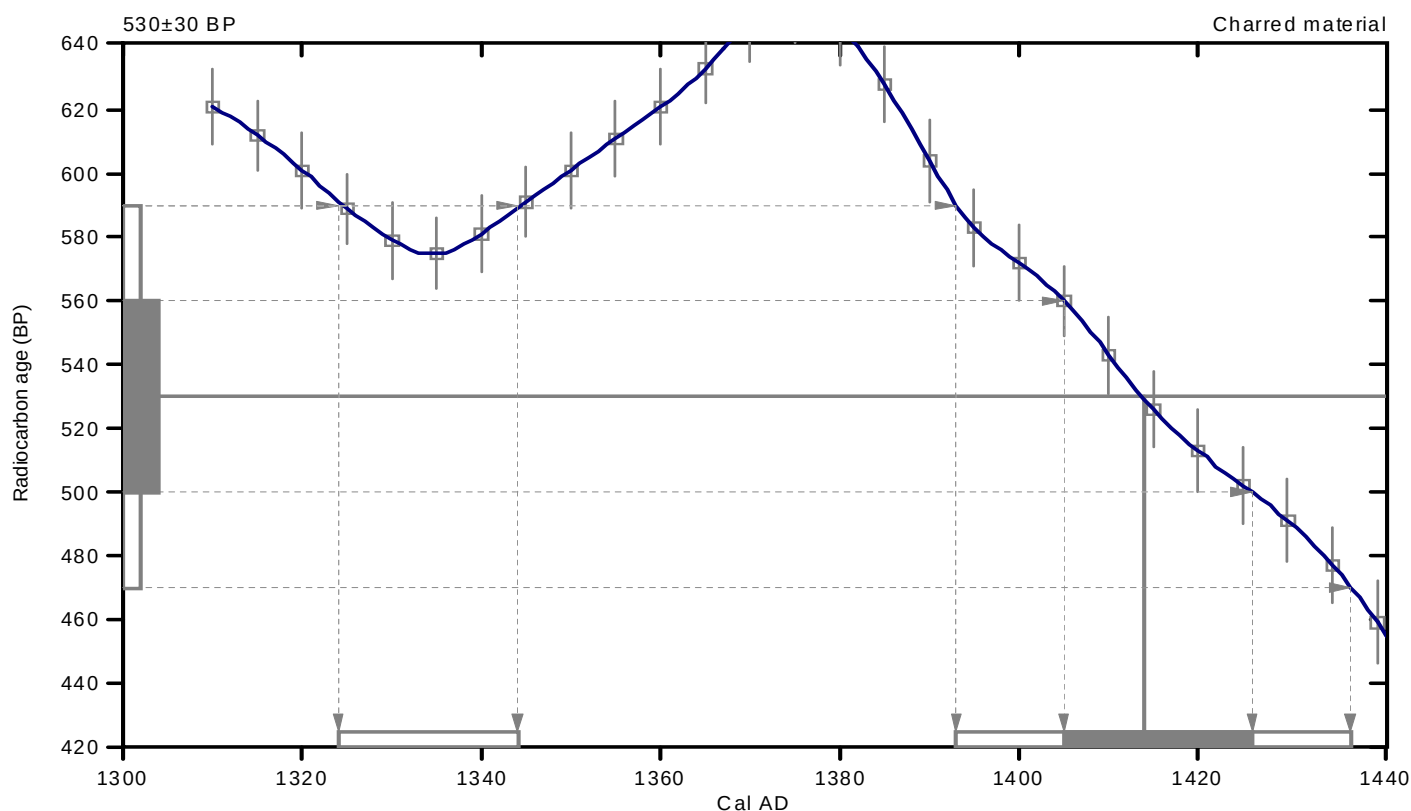
Conventional radiocarbon age: 530±30 BP

2 Sigma calibrated results: Cal AD 1320 to 1340 (Cal BP 630 to 610) and
(95% probability) Cal AD 1390 to 1440 (Cal BP 560 to 510)

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 1410 (Cal BP 540)

1 Sigma calibrated result: Cal AD 1400 to 1430 (Cal BP 540 to 520)
(68% probability)



References:

Database used
INTCAL09

References to INTCAL09 database

Heaton, et.al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et.al., 2009, *Radiocarbon* 51(4):1111-1150, Stuiver, et.al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et.al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-9.5:lab. mult=1)

Laboratory number: Beta-322877

Cx751-MZ-AMS

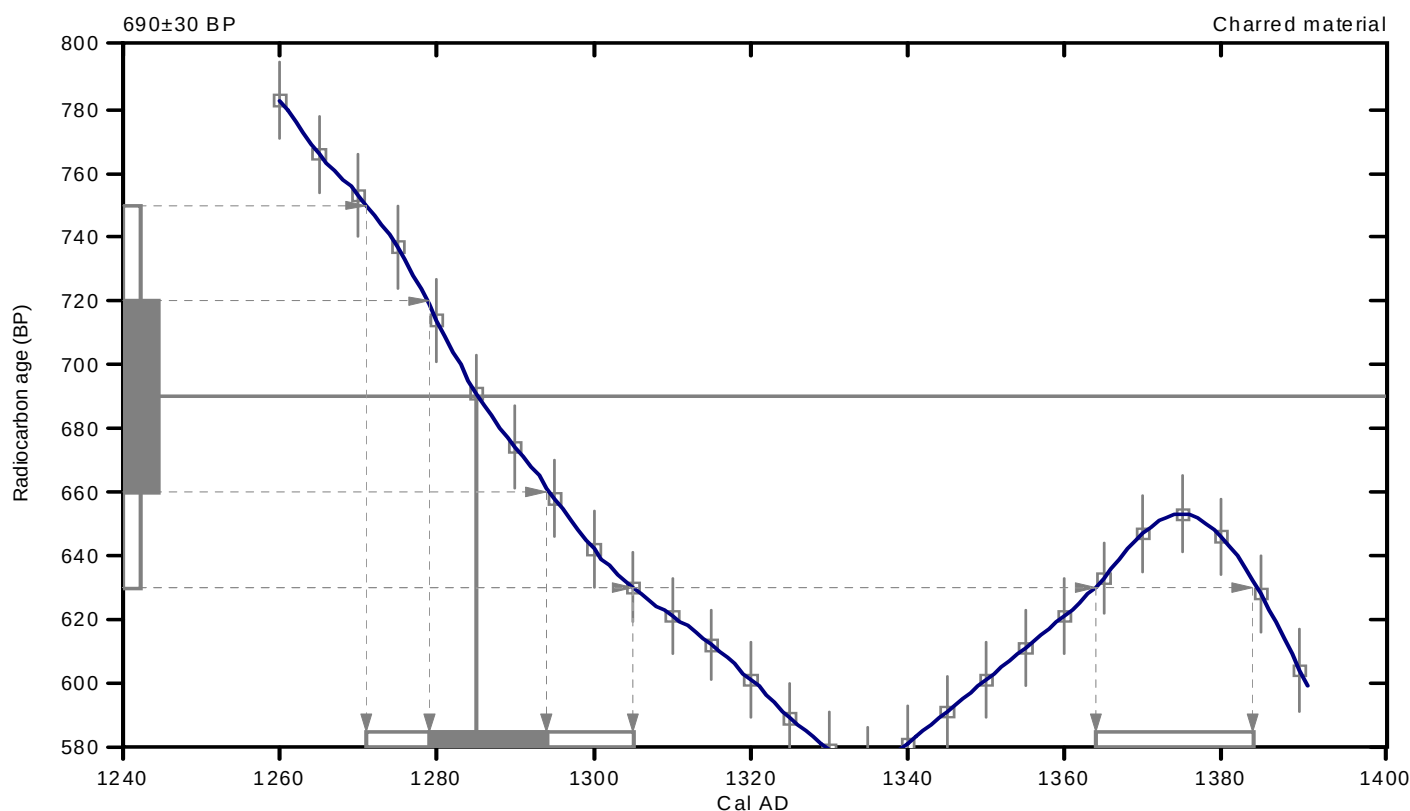
Conventional radiocarbon age: 690±30 BP

2 Sigma calibrated results: Cal AD 1270 to 1300 (Cal BP 680 to 640) and
(95% probability) Cal AD 1360 to 1380 (Cal BP 590 to 570)

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 1280 (Cal BP 660)

1 Sigma calibrated result: Cal AD 1280 to 1290 (Cal BP 670 to 660)
(68% probability)



References:

Database used
INTCAL09

References to INTCAL09 database

Heaton, et.al., 2009, *Radiocarbon* 51(4):1151-1164, Reimer, et.al., 2009, *Radiocarbon* 51(4):1111-1150, Stuiver, et.al., 1993, *Radiocarbon* 35(1):137-189, Oeschger, et.al., 1975, *Tellus* 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-25.1:lab. mult=1)

Laboratory number: Beta-337438

Cx 417.01 - -AMS-Mz

Conventional radiocarbon age: 600±30 BP

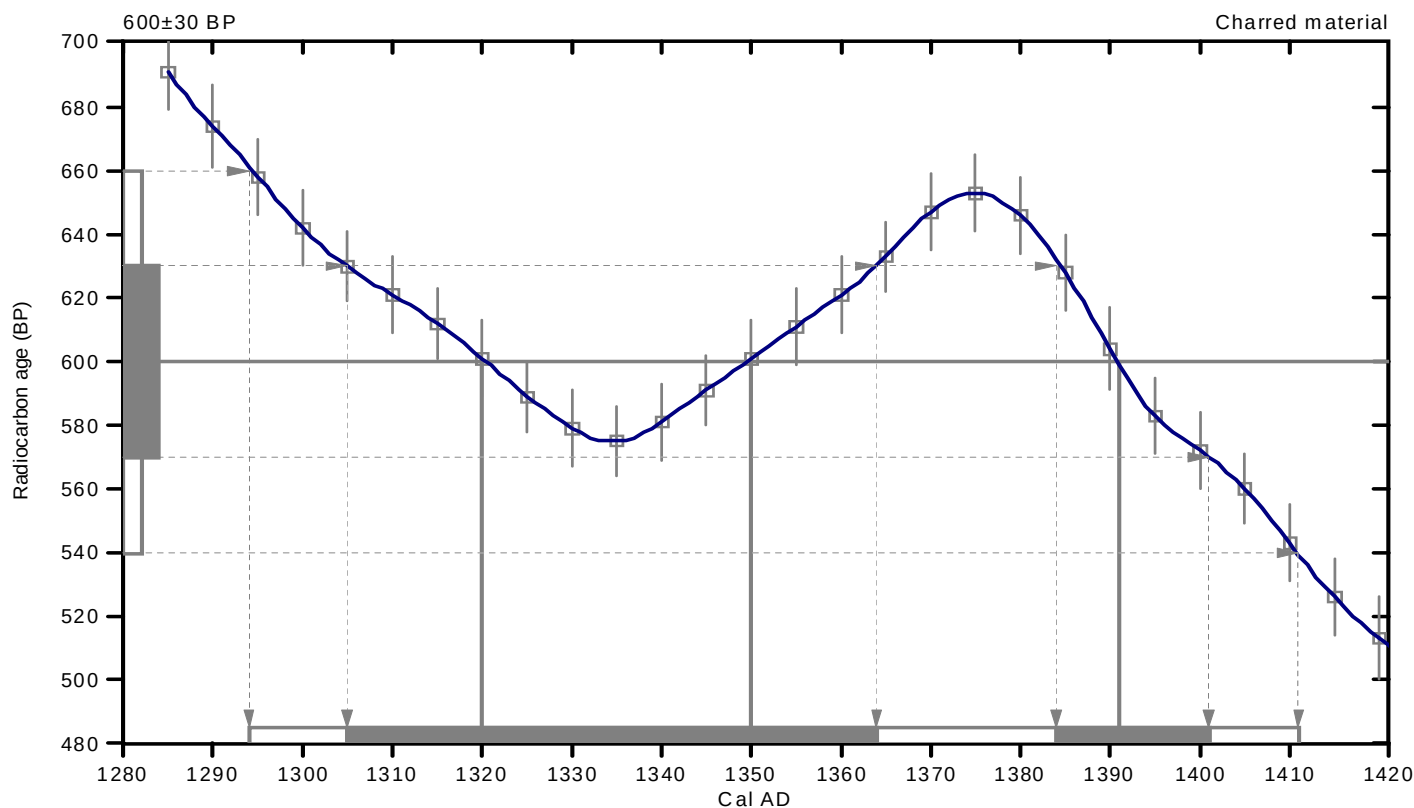
**2 Sigma calibrated result: Cal AD 1290 to 1410 (Cal BP 660 to 540)
(95% probability)**

Intercept data

Intercepts of radiocarbon age
with calibration curve:

Cal AD 1320 (Cal BP 630) and
Cal AD 1350 (Cal BP 600) and
Cal AD 1390 (Cal BP 560)

**1 Sigma calibrated results: Cal AD 1300 to 1360 (Cal BP 640 to 590) and
(68% probability) Cal AD 1380 to 1400 (Cal BP 570 to 550)**



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et.al., 2009, Radiocarbon 51(4):1151-1164, Reimer, et.al., 2009, Radiocarbon 51(4):1111-1150, Stuiver, et.al., 1993, Radiocarbon 35(1):137-189, Oeschger, et.al., 1975, Tellus 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-27.2:lab. mult=1)

Laboratory number: Beta-337439

Cx 1015.01 - Mz -AMS

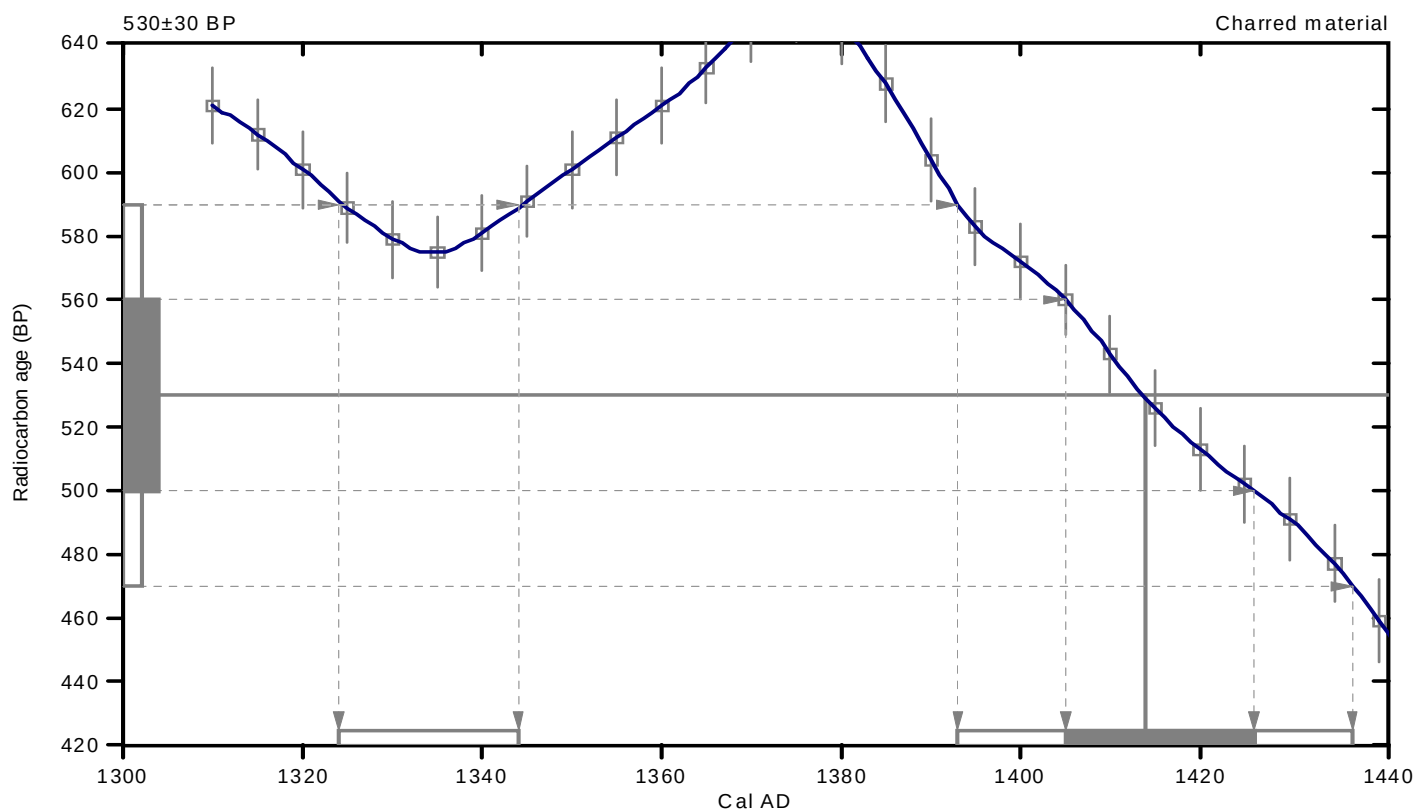
Conventional radiocarbon age: 530±30 BP

2 Sigma calibrated results: Cal AD 1320 to 1340 (Cal BP 630 to 610) and
Cal AD 1390 to 1440 (Cal BP 560 to 510)

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 1410 (Cal BP 540)

1 Sigma calibrated result: Cal AD 1400 to 1430 (Cal BP 540 to 520)
(68% probability)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et.al., 2009, Radiocarbon 51(4):1151-1164, Reimer, et.al., 2009, Radiocarbon 51(4):1111-1150, Stuiver, et.al., 1993, Radiocarbon 35(1):137-189, Oeschger, et.al., 1975, Tellus 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.7:lab. mult=1)

Laboratory number: Beta-337440

Cx 418.00 - Mz -AMS

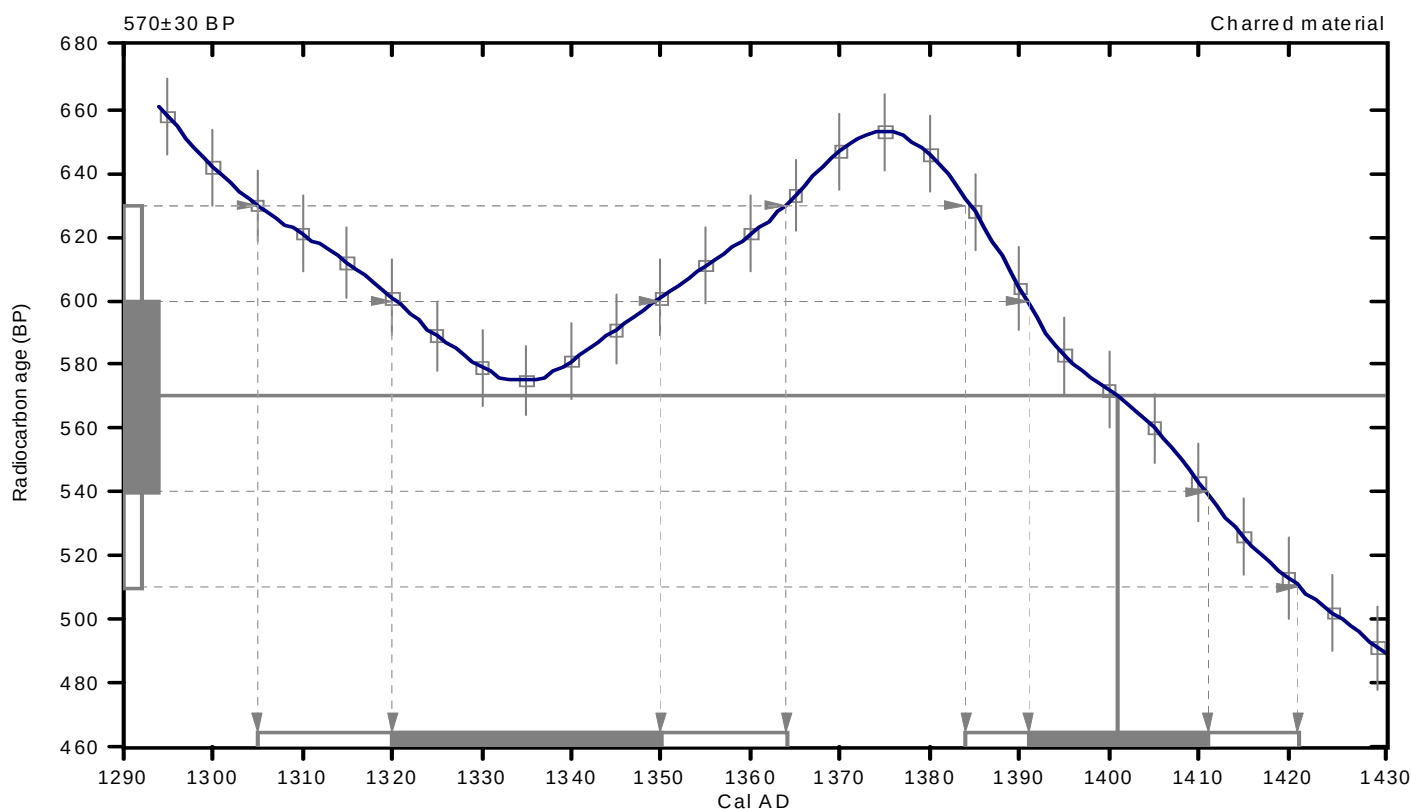
Conventional radiocarbon age: 570±30 BP

2 Sigma calibrated results: Cal AD 1300 to 1360 (Cal BP 640 to 590) and
(95% probability) Cal AD 1380 to 1420 (Cal BP 570 to 530)

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal AD 1400 (Cal BP 550)

1 Sigma calibrated results: Cal AD 1320 to 1350 (Cal BP 630 to 600) and
(68% probability) Cal AD 1390 to 1410 (Cal BP 560 to 540)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton, et.al., 2009, Radiocarbon 51(4):1151-1164, Reimer, et.al., 2009, Radiocarbon 51(4):1111-1150, Stuiver, et.al., 1993, Radiocarbon 35(1):1-244, Oeschger, et.al., 1975, Tellus 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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