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Staten Island Bridges Program - Modernization and Capacity Enhancement Project
Goethals Bridge Phase 1B/3 Geomorphological Analysis
Report on Coring and Additional Radiocarbon Dating

Prepared for
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N-CEQR

February, 1997

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Staten Island Bridges Program-Modernization and Capacity Enhancement Project

Goethals Bridge Phase IB/3 Geomorphological Analysis

Report on Coring and Additional Radicarbon Dating

by Geoarcheology Research Associates

February 6, 1997

Introduction

The following report summarizes the most recent stage of geomorphological field investigations for the Goethals Bridge Enhancement Project. The research corroborates previous findings that archeological sensitivity is minimal in the vicinity of the proposed bridge alignments and alternatives (GRA 1996a, 1996b). However, detailed coring in the vicinity of Old Place Creek necessitates revision to previous interpretations of shoreline stratigraphy. The revision is based on radiocarbon dating of six (6) new samples from four (4) new borings into the Holocene substrate. Previous field efforts had routinely probed to depths of up to 9 ft. (<3 m) and encountered dense and compacted fill sediments. The present investigations utilized a hydraulic coring device with 4" wide split spoon to extract cores to depths extending well into Late Quaternary sediments.

Investigations demonstrated that the Late Holocene rise in sea level promoted active estuarine sedimentation coupled with stream migration and incision. The collective effects of these processes have been selective erosion of formerly intact deposits that may have been associated with the previously reported Old Place site (Ritchie and Funk 1971). Evidence also implicates reworking of the underlying terminal Woodfordian till (Fullerton 1992), although the limited stratigraphic "window" on these locations inhibits more comprehensive explications. Finally, it is proposed that the stratigraphic context of the Old Place site may need to be re-assessed in light of the absolute dates and refinements in the archeological chronology since the site was initially reported.

Project History

In August, 1996 GRA submitted a report to Parsons Brinckerhoff (PB) entitled*Staten Island Bridges Program-Modernization and Capacity Enhancement Project: Phase IB Geomorphological Analysis Final Report of Field Investigations* (GRA 1996b). That report identified an "archeologically sensitive window" along the Goethals South Crossing (GSC). Field relations suggested subsurface preservation of potential Archaic period deposits in the vicinity of AT-1 at the crossing of Old Place Creek (GRA 1996b: Figure 1 and 6). The original Old Place archeological site was reported to contain artifact assemblages spanning the duration of the Archaic period extending to ca.9000 B.P. (Ritchie and Funk 1971). The provisional stratigraphy developed for the Goethals Crossing (GRA 1996b: Figure 2) postulated that the geological deposits likely to contain Archaic period artifacts would be the marine sands underlying or interfingering with the estuarine organics, laid down after 8000 B.P. The report concluded that "......(if) planned impacts are to extend beneath 9 feet (2.7 m), there is a possibility that the marine sands will be reached in several locations on the Staten Island side" (GRA 1996b: 18). In the earlier phase of work, GRA's subsurface testing extended beyond 9 feet (ca. 3 m) at only one location (AT-4); mechanical probing (with a hand powered augur) was unable to penetrate fill at other locations.

On September 18, 1996 PB requested that GRA present a Scope of Work (SOW) to finalize investigations along the GSC contingent on "removal of limitation on depth of trenching". GRA submitted a proposal to PB on September 26 that proposed deep boring and dating of deposits extending into the marine sands in the vicinity of location AT-1. Six (6) borings and six (6) radiocarbon samples were to be excavated and dated. A second component of the original proposal involved backhoe trenching for historic deposits at three pier locations in New Jersey and New York. The proposal was modified re-submitted on October 30 because the historic testing component was eliminated from the SOW as it is proposed to be done after completion of the FEIS and prior to constructions of the proposed project. At a meeting between representatives of PB, the Port Authority of New York and New Jersey (Port Authority), and GRA on November 4, 1996 a final SOW was established. Principal changes to the SOW included: reduction of the number of boring locations from six (6) to four (4) (because of accessibility concerns); separate subcontracting by the Port Authority with Warren George, Inc. (Jersey City, NJ) for hydraulic boring equipment; and separate subcontracting by the PA with Beta Analytic laboratories (Coral Gables, FL) for processing of the radiocarbon dates. The Port Authority approved the project in a letter to PB dated November 7, 1996.

The finalized SOW entailed:

(1) Definition of the boring program, including selection of four (4) boring locations;

(2) Field supervision, analysis, and recording of the boring program;

(3) Analysis of cores for selection of samples for radiocarbon dating; and

(4) Analysis of radiocarbon dating results and revision of the Phase IB Geomorphological Analysis report (GRA 1996b)

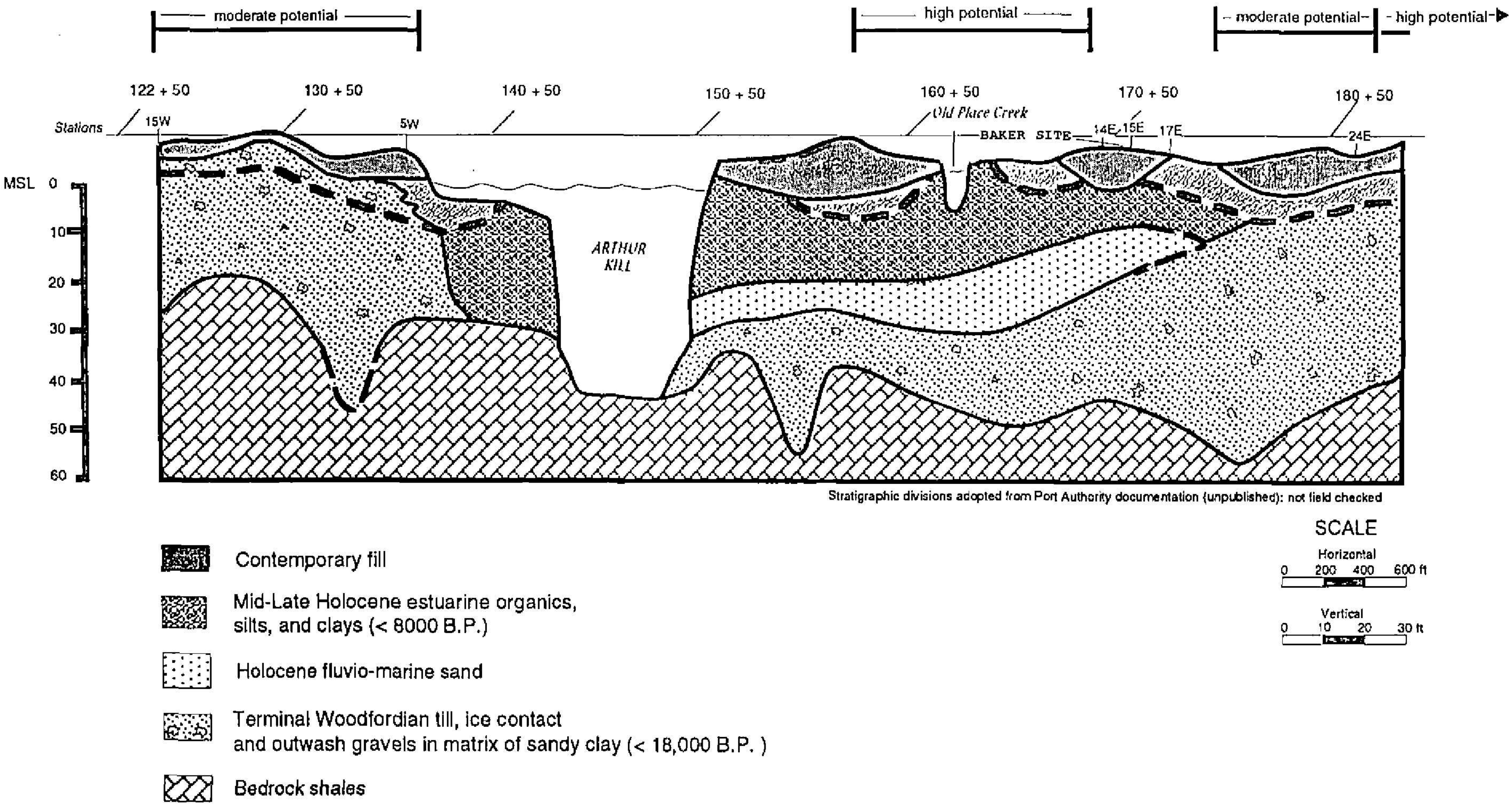
Field work began on December 2 and proceeded for three (3) consecutive days. Results of the radiocarbon dates were received on January 4.

Methods and Field Investigations

Field efforts were directed at exploring archeological potential of the buried "marine sands"; accordingly, borings were spaced to isolate those locations along the **GSC** that were both accessible and which were sufficiently landward to have constituted elevated, and thus preferred, settings in the prehistoric past. Optimal locations were initially identified as "High Potential" in the stratigraphic and archeological sensitivity model developed for the Report on Field Investigations (Hartgen 1996; GRA 1996b). **Figure 1** duplicates that model which served as the baseline for structuring the present investigations. As discussed in earlier reports (GRA 1996a,1996b), the model was originally developed from cores obtained by the PA for this study and projected onto regionally dated sequences for the lower Hudson valley (see Dineen 1986; Newman et al 1969; Schuldenrein 1995b; Thieme and Schuldenrein 1996).

In accordance with the methodology stipulated in the Scope of Work (SOW), continuous sampling and retrieval was performed at four (4) boring locations with a 4-inch diameter split-spoon sampling device. Sampling

Figure 1: Preliminary Model of Late Quaternary Stratigraphy and Archeological Sensitivity for Goethals Bridge Crossing mapped on Port Authority Geological Profile (GRA 1996b)



commenced at the bottom of the miscellaneous fill, extended through layers of peat and sand, and penetrated more than five (5) feet into a deposit previously described as glacial till. All borings were supervised by GRA's supervisory geoarcheologist and an assistant. The team also prepared a detailed log of stratigraphic units. The revised stratigraphic model is shown in **Figure 2** and descriptions and stratigraphic relations for each of the borings are illustrated in **Figures 3** through **6**).

Borings were spaced at 200-300 ft. intervals beginning at the gate to the Baker Site (**G1**) and continued southeast along the **GSC** alignment to just west of the Western Avenue underpass (**G4**). Boring locations **G1** to **G4** are plotted on **Figure 2** in relation to the existing bridge and to the auger tests performed during the previous phase of fieldwork (June-July 1996) (GRA 1996b). To supplement the three (3) radiocarbon dates obtained previously, six (6) samples from the most recent borings were dated using accelerator mass spectrometry (AMS) by Beta Analytic, Inc. of Coral Gables, Florida. **Table 1** presents the measured ^{14}C ages along with $\Delta^{13}C$ correction, and tree-ring calibration information for all nine (9) samples obtained for the project. Appendix A presents the radiocarbon ages, measurements, and calibration data.

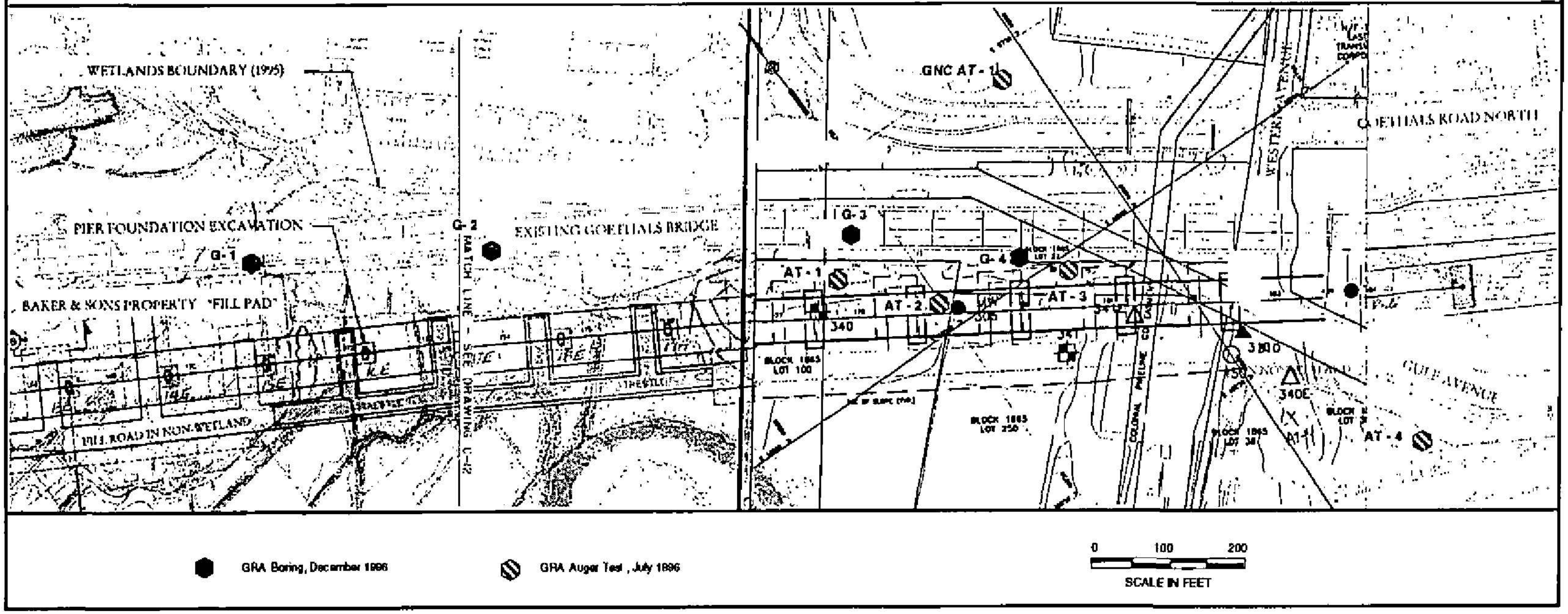
Figures 3 through **6** document the detailed stratigraphy for borings **G1-G4**. Absolute elevations in the project area ranged from 0-5 feet AMSL and total boring depths reached 22-26 ft. in the deepest cores (**G1 and G3; Figures 3,5**). Beginning with the top of the profiles, variable depths of fill cap the estuarine peat (predominantly *Phragmites*) in all of the borings. Remains of a brick structure underlie the asphalt pavement at **G1** but relatively little disturbance of the natural stratigraphy was evident in the vicinity of **G2** and **G3**. The land surface at **G4** has been recognizably augmented by more than five (5) feet of overburden, forming an artificial ridge 10 feet above sea level between the existing bridge and Old Place Creek. This artificial ridge was previously investigated with a power auger but could not be initally penetrated beneath the overburden (GRA 1996b: 11-13).

Factoring out the overburden, the base of the peat grades up from -5 to -1 feet below mean sea level (AMSL) between **G1** and **G4**. The peat also appears to thin landward with three to four (3-4) feet observed in **G2** and **G3** compared to less than two (2) feet of peat in **G4**. The upper peat in **G1** has been truncated and replaced by gravelly fill. Radiocarbon dates on the peat

Table 1: Inventory of Radiocarbon Dates for the Goethals Bridge Enhancement Project

Alternative	Provenience	Material	Lab No.	meas.14-C	del 13-C	correct 14-C	cal Intercept
North Crossing	AT-1, 2 ft. b.s.	Wood charcoal	95082	190 +/- 60	-27.1	150 +/- 60	AD 1670 to 1950
South Crossing	AT-4, 10 ft b.s.	Peat	95083	590 +/- 60	-13.9	770 +/- 60	AD 1270
South Crossing	G4, 10-11 ft b.s.	Peat	100257	870 +/- 60	-27.4	830 +/-60	AD 1225
South Crossing	MW #305, 13 ft b.s.	Peat	92924	2250 +/- 80	-25.0	2250 +/- 80	BC 365
South Crossing	G2, 11-12 ft b.s.	Plant parts	100255	2140 +/- 50	-27.5	2100 +/- 50	BC 100
South Crossing	G2, 10-11 ft b.s.	Soil humate	100253	2570 +/- 60	-26.1	2550 +/- 60	BC 780
South Crossing	G1, 13-13.5 ft b.s.	Peat	100256	2490 +/- 60	-21.8	2540 +/- 60	BC 780
South Crossing	G1, 14 ft b.s.	Soil humate	100252	2750 +/- 60	-23.4	2770 +/- 60	BC 905
South Crossing	G1, 16.5-17 ft b.s.	Plant parts	100254	3220 +/- 50	-24.5	3230 +/- 50	BC 1500

Figure 2: Location of GRA Borings and Auger Tests, Goethals Bridge Enhancement Project, South Crossing (GSC) and North Crossing (GNC) Alternatives, Staten Island, N.Y.



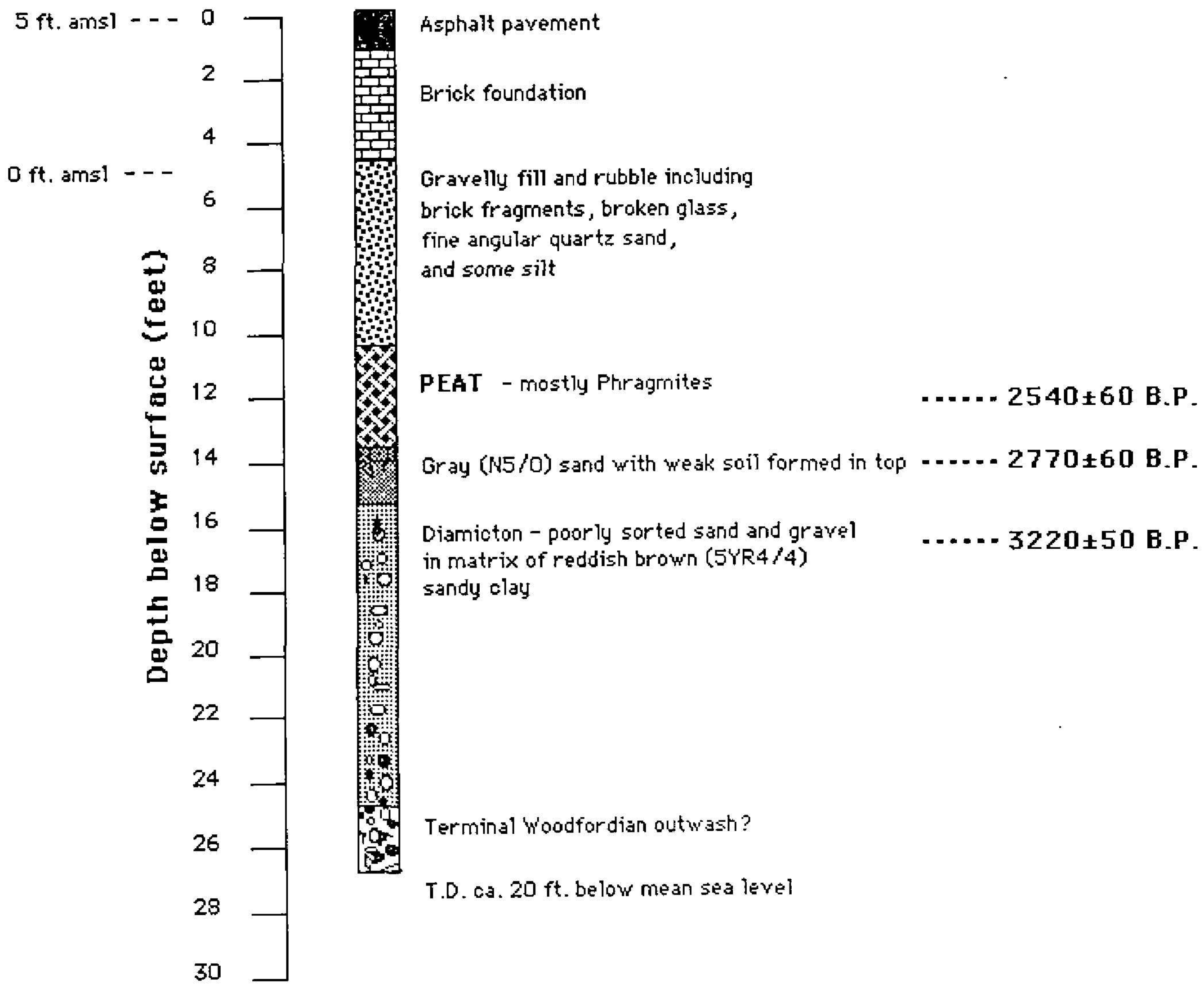


Figure 3: Boring Log of G-1, GSC Alternative

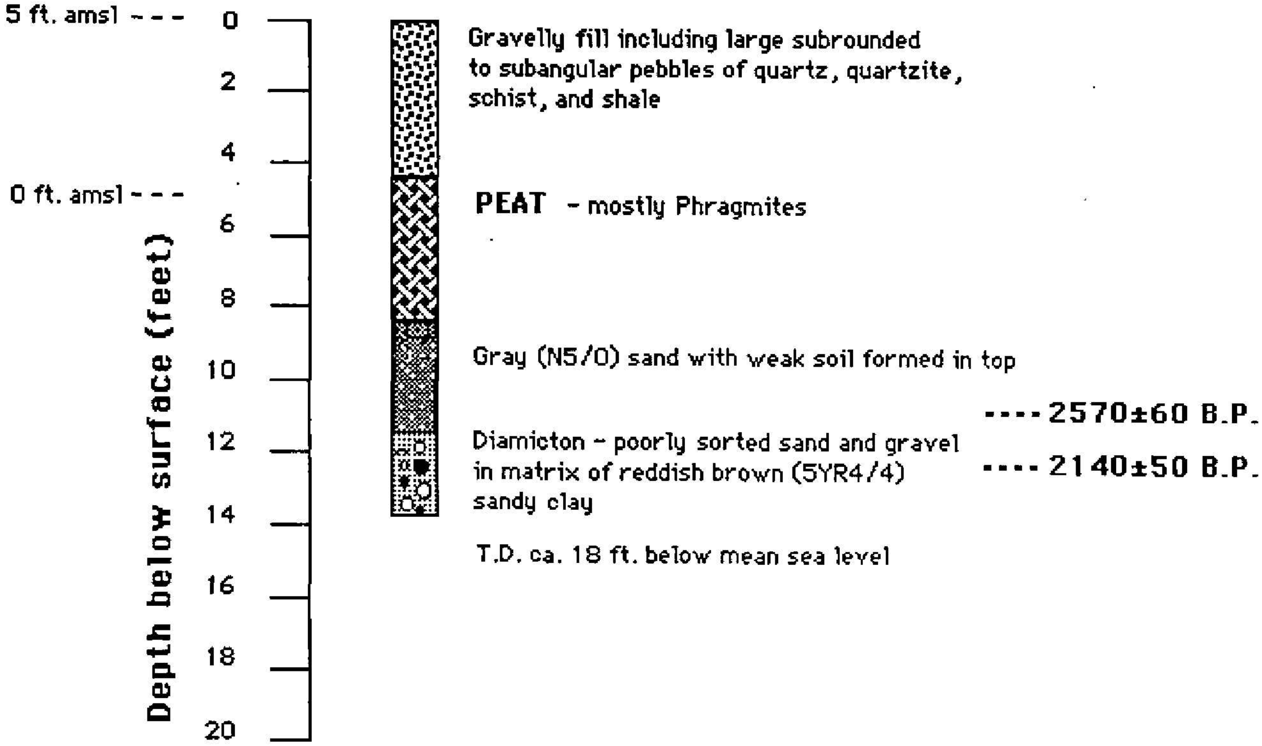


Figure 4: Boring Log of G-2, GSC Alternative

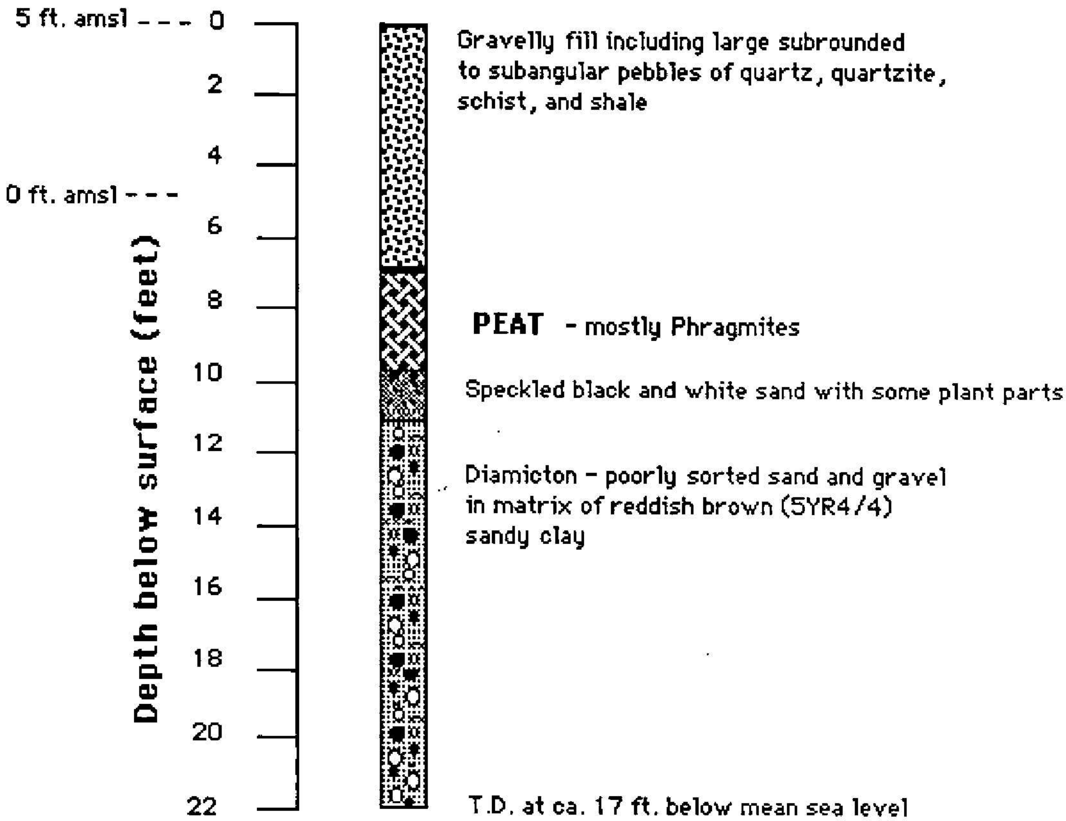


Figure 5: Boring Log of G-3, GSC Alternative

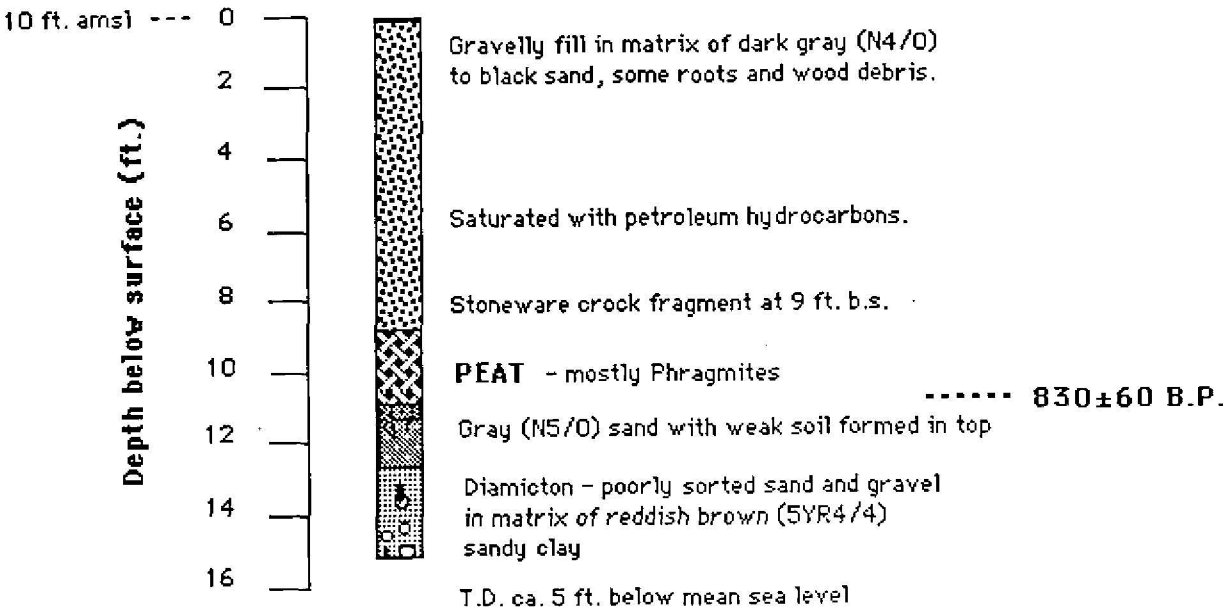


Figure 6: Boring Log of G-4, GSC Alternative

range between 2770 to 830 B.P., and only one of the $\Delta^{13}C$ values is characteristic of salt marsh plants such as *Spartina*.. This suggests that brackish conditions have predominated, and estuarine incursions began at least 2500 years ago in the vicinity of **G4**. Significantly, however, salt marsh appears to have built up quite rapidly in the past 800-1000 years along the Old Place Creek channel.

The sandy sediments underlying the peat were the main focus of the present investigations. These were considered to be archeologically sensitive based on analogous deposits on nearby archeological sites (Kraft 1977; Ritchie and Funk 1971; Schuldenrein 1995; Thieme and Schuldenrein 1996). Examination of peds in cores **G1, G2,** and **G4 (Figures 3, 4, and 6)** disclosed a weak, but intact paleosol characterized by mottling and subangular blocky peds. Radiocarbon dates presented in Table 1 converge around a date of 3250-2250 B.P. This is considerably younger--by a factor of 2000-5000 years--than hypothesized in our provisional shoreline stratigraphy. These dates are too young to contain intact cultural remains associated with the previously reported Old Place site, considered to be of possible Middle Archaic age (Ritchie and Funk 1971).

A diamicton of reddish brown (5YR4/4) sandy clay with clasts ranging from small pebbles and granules to large cobbles was encountered at depths where "glacial till" was noted in previous borings by the PA. The abrupt irregular contact with the overlying sand trends up from 10 to 3 feet below sea level between **G1** and **G4**, to ca. 6 feet below sea level in both **G2** and **G3**. Two (2) dates were obtained from plant parts embedded in the sandy clay matrix of this diamicton. A late glacial age was anticipated, but the resultant dates of 3230±50 B.P. (BETA-100254) and 2100±50 B.P. (BETA-100255) may implicate either extensive reworking of the upper part of the original Woodfordian till during mid- to late-Holocene transgressions (Appendix A). Alternatively, this segment of the landscape may have been overridden with younger surficial veneers which were dated by the radiometric assay. In either scenario, the regional marine transgression and local fluvial incision differentially eroded deposits of late Pleistocene through early-Holocene age in the vicinity of the Old Place site.

Interpretations and Reassessments

As noted in our previous summary (GRA 1996b), the archeological potential of most of the tracts included in the proposed Goethals Bridge alignments and alternatives has been compromised by extensive landfilling and/or by disposal of hazardous materials. A linear stretch of sandy sediment undisturbed by these modern impacts has now been subsurface tested along the archeologically sensitive **GSC** and it is clear that these sediments themselves were subject to reworking during the Holocene evolution of the local landscape.

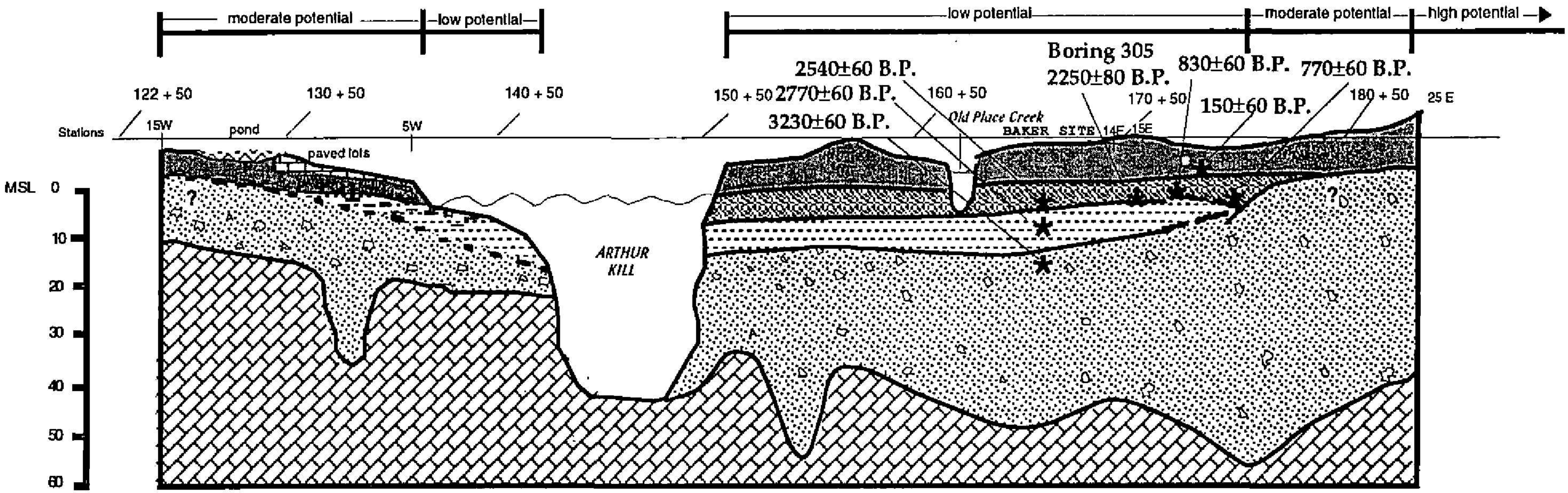
Radiocarbon dating of six (6) samples from the four (4) borings suggests that the Middle to Late Holocene rise in sea level coupled with fluvial incision have selectively eroded deposits of late Pleistocene through early-Holocene age. Although relatively intact late-Holocene sand and peat deposits have been documented by these studies, evidence for archeological material was not encountered in the borings and confirmation of prehistoric manifestations related to the Archaic Old Place site were not established. Significantly, however, a paleosol (buried intact soil) was identified that records the presence of a late Holocene stable surface dated to the interval 2500-3000 B.P. While there remains a possibility of preservation of Woodland or Archaic manifestations in the area (Kraft 1977), all indications are that distributions are sparse and/or that integrity has been compromised. Archeological sediments were reworked either by fluvial or estuarine processes over the past several thousand years or by accelerated landscape modifications brought about by industrial development during the past century.

This first systematic dating of the deposits along Staten Island's northwestern shore has produced the most current stratigraphic framework for establishing broad associations between shoreline environments and potential occupation. These field investigations have produced refinements that will help address contexts for:

(1) Late Quaternary stratigraphy and landscape evolution;

(2) Prehistoric site chronology and expectations

Figure 7: Revised Model of Late Quaternary Stratigraphy and Archeological Sensitivity for Goethals Bridge Crossing



Stratigraphic divisions adopted from Port Authority documentation (unpublished), field checked with hand auger and four borings

KEY - GENERAL STRATIGRAPHY

- Contemporary fill
- Late Holocene estuarine peat (< 2500 B.P.)
- Holocene fluvio-marine sand showing weak soil development
- Diamicton - eroded and reworked till, ice contact and outwash gravels and sandy clay
- Terminal Woodfordian till, ice contact and outwash gravels and sandy clay (< 18,000 B.P.)
- Bedrock shales

SCALE

Horizontal: 0, 200, 400, 600 ft

Vertical: 0, 10, 20, 30 ft

Note: Question Marks indicate areas where the extent or continuity of a horizon is inferred or it has not been demonstrated.

Baseline radiometric dates presently demonstrate that the regional Quaternary succession is, in fact, *younger* than previously assumed. Perhaps even more critical for archeological and cultural resource planning concerns is the need to re-examine the antiquity and context of the Old Place site, the main prehistoric locus in the project area. Each of these domains--geological stratigraphy and archeology--warrants separate consideration.

Figure 7 presents the revised stratigraphy for the **GSC** corridor based on the detailed sedimentological sequences and radiocarbon dates of the four (4) borings **(see Figures 3-6)**. When compared to the initial stratigraphic model that initiated these investigations (**Figure 1**), the revision underscores several critical differences as follows:

(1) Semi-continuous horizontal and vertical distribution of the capping historic fills across New York and New Jersey portions of the crossing;

(2) Thinner depths and younger ages of the estuarine deposits (<10 ft.; <3000 B.P.) than initially mapped;

(3) More uniform distribution and shallower disposition of marine sands; presence of a weak paleosol heretofore unrecognized; considerably younger age of deposition (ca. 3000 B.P.)

(4) Pervasiveness of terminal Woodfordian tills across the eroded bedrock surfaces;

(5) Erosional contact and reworked context of upper Woodfordian tills attesting to changing fluvial-estuarine balances in the lower Hudson Valley during the middle Holocene.

These stratigraphic relations have important ramifications for the archeological record. Re-examination of the published account of the Old Place site confirms some of the doubts raised by Ritchie and Funk (1971) in their review of the site data. Ritchie and Funk (1971: 49) initally questioned correlations made by the site's amateur excavators--the Andersons--linking the lone radiometric date (5310 B.C.±140; I-4070, purportedly from a hearth) to assemblages containing Snook Kill and purported earlier Archaic Kirk, Stanly and LeCroy points. It was reported that ".....data from the site leave much to be desired, rendering dubious the interpretation of a Snook Kill component (Ritchie and Funk 1971: 49 citing Ritchie 1969: 147)". At the time, Snook Kill was considered to be the earliest and deepest component at the site. Subsequently, Funk (1976, 1993) updated the cultural chronology for the Hudson Valley and dated the Snook Kill component closer to 3500 B.P., which would articulate more directly with the date of the paleosol encountered in probes of the marine sands (**Figures 3-6**). Funk's own observations call into question first, the presumed Early-Middle Archaic antiquity of the location, and more generally, the chrono-stratigraphic associations between the presumed dated hearth materials at Old Place and the artifacts collected from the general site area. Since the site excavators did not recognize discrete soils or artifact horizons the preservation of the site and its contexts remain uncertain.

It can be argued, however, that the recognition of the paleosol in cores **G1, G2,** and **G4** may correspond with a possible Late Archaic or Woodland age "yellow brown sand" recognized at the Ward's Point and Hollowell sites (Ritchie and Funk 1971) and more recently at the "AKFOC" project area (Schuldenrein 1995). In all of these cases the upper soils are either truncated by modern fills or were not sufficiently dated to establish unequivocal soil-cultural associations. There is no question that portions of the soil were disturbed in the vicinity of the Goethals Bridge crossing (at Old Place Creek) and the absence of any indications of anthropogenic sediment in the cores mitigates against high preservation potential at the locations that were tested.

Recommendations

Systematic testing of an archeologically sensitive alignment of the **GSC** has resulted in a revision of the Holocene chronology of the shoreline history of northern Staten Island. Archeological sediments, potentially housed in the marine sands underlying capping estuarine peats, were demonstrated to be 3000-5000 years younger than previous regional reconstructions suggested. The preservation potential for rare, Early-Middle Archaic deposits is therefore obviated by the radiocarbon chronology.

Borings disclosed, neverthess, that these sands preserved an ancient stable surface--registered as a paleosol--dated to the interval 2500-3000 B.P. The soil may correspond with nearby Late Archaic and/or Woodland site settings in Staten Island. However, at the **GSC** location Holocene fluvial erosion, estuarine sedimentation, and, more dramatically, historic landfilling, have sufficiently disturbed the natural setting to minimize the possibility of site preservation in the area of projected impact.

Finally, these investigations have demonstrated that previous accounts of the Old Place site were inaccurate with respect to the preservation context of that site. Revisions to the prehistoric chronology and updates of the radiometric data base necessitate a re-appraisal of the geoarcheology of the region.

Appendix A:

Radiocarbon Dating Results for Samples from the Goethals Bridge Enhancement Project

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

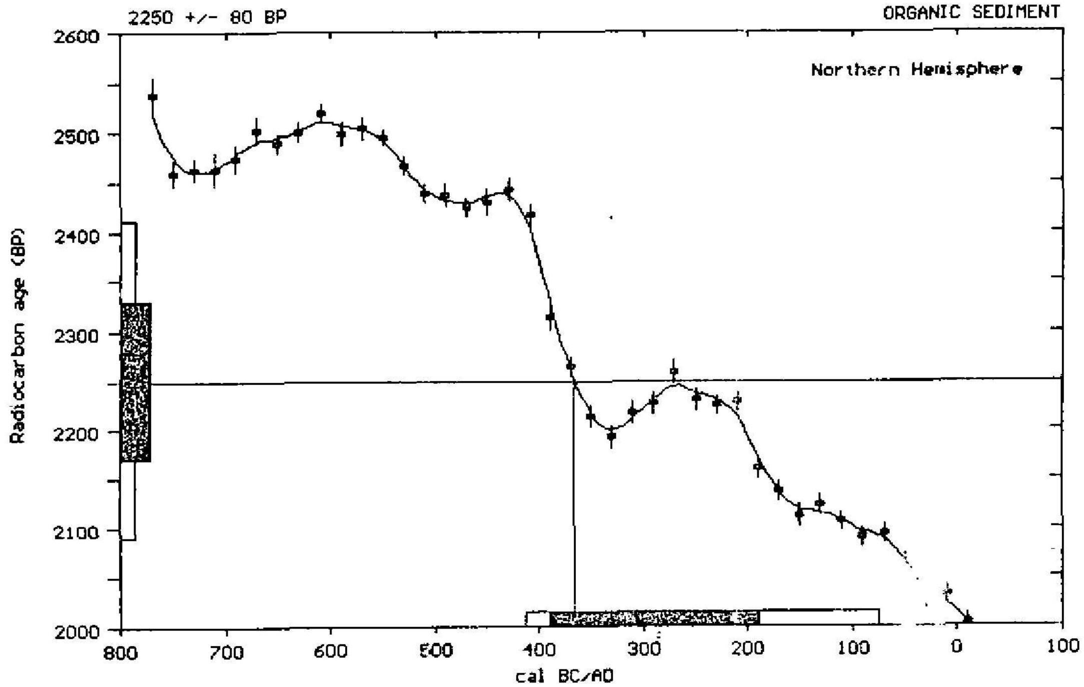
(Variables:estimated C13/C12=-25:lab mult.=1)

Laboratory Number:	Beta-92924
Conventional radiocarbon age*:	**2250 +/- 80 BP**
Calibrated results: (2 sigma, 95% probability)	**cal BC 415 to 75**

* C13/C12 ratio estimated

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal BC 365
1 sigma calibrated results: (68% probability)	cal BC 390 to 190



References:

Pretoria Calibration Curve for Short Lived Samples
Vogel, J. C., Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86
A Simplified Approach to Calibrating C14 Dates
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322
Calibration - 1993
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., 1993, Radiocarbon 35(1)

Beta Analytic Radiocarbon Dating Laboratory

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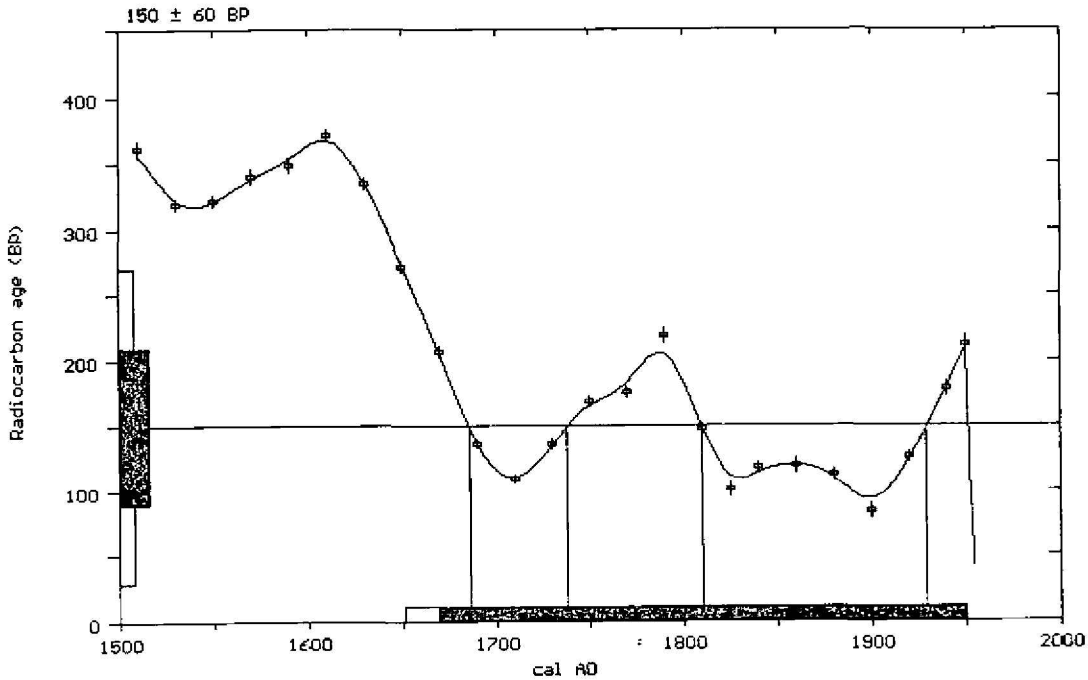
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables:C13/C12=-27.1:lab mult.=1)

Laboratory Number:	Beta-95082
Conventional radiocarbon age:	**150 ± 60 BP**
Calibrated results: **(2 sigma, 95% probability)**	**cal AD 1650 to 1950**

Intercept data:

Intercepts of radiocarbon age with calibration curve:	cal AD 1685 and cal AD 1740 and cal AD 1810 and cal AD 1930
1 sigma calibrated results: (68% probability)	cal AD 1670 to 1950



References:

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A Simplified Approach to Calibrating C14 Dates
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Calibration - 1993
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables:C13/C12=-13.9:lab mult.=1)

Laboratory Number: Beta-95083

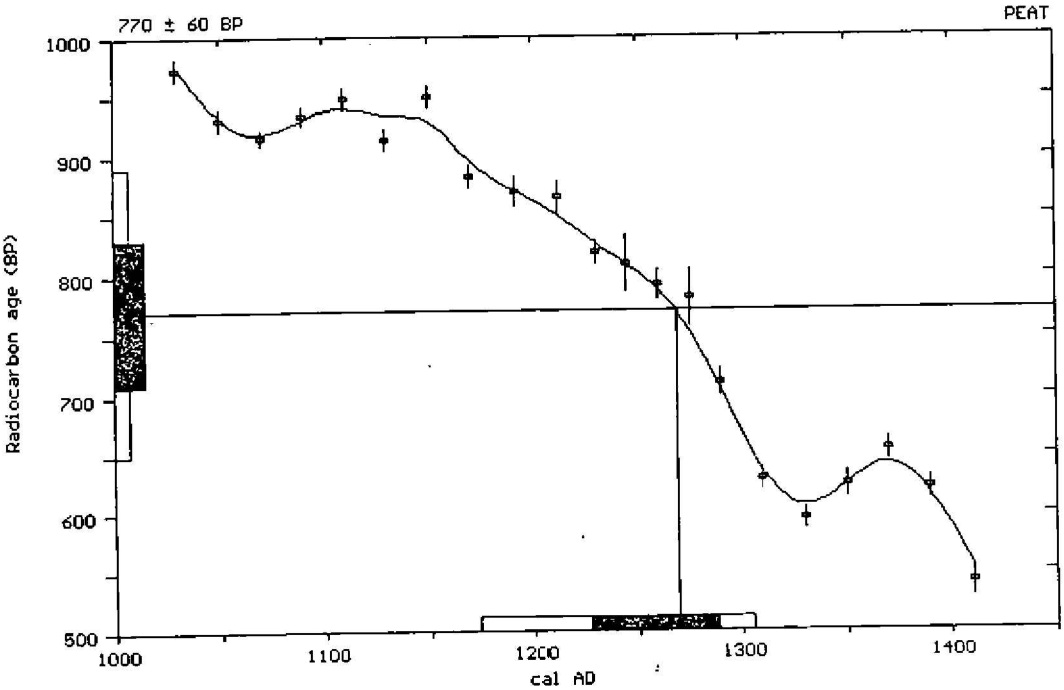
Conventional radiocarbon age: **770 ± 60 BP**

Calibrated results: (2 sigma, 95% probability) **cal AD 1175 to 1305**

Intercept data:

Intercept of radiocarbon age with calibration curve: cal AD 1270

1 sigma calibrated results: (68% probability) cal AD 1225 to 1290



References:

Pretoria Calibration Curve for Short Lived Samples
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A Simplified Approach to Calibrating C14 Dates
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322
Calibration - 1993
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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.4:lab. mult=1)

Laboratory Number: Beta-100252

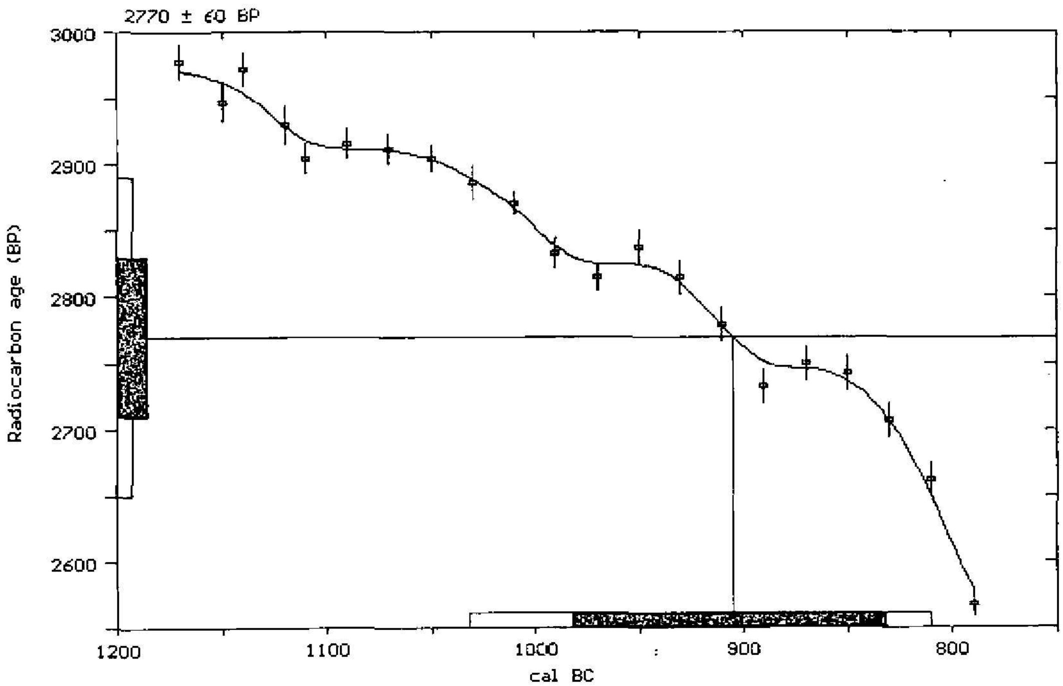
Conventional radiocarbon age: **2770 ± 60 BP**

Calibrated results: **cal BC 1030 to 810**
(2 sigma, 95% probability)

Intercept data:

Intercept of radiocarbon age with calibration curve: cal BC 905

1 sigma calibrated results: cal BC 980 to 830
(68% probability)



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A Simplified Approach to Calibrating C14 Dates
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322
Calibration - 1993
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., 1993, Radiocarbon 35(1)

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables:C13/C12=-26.1:lab mult.=1)

Laboratory Number: Beta-100253

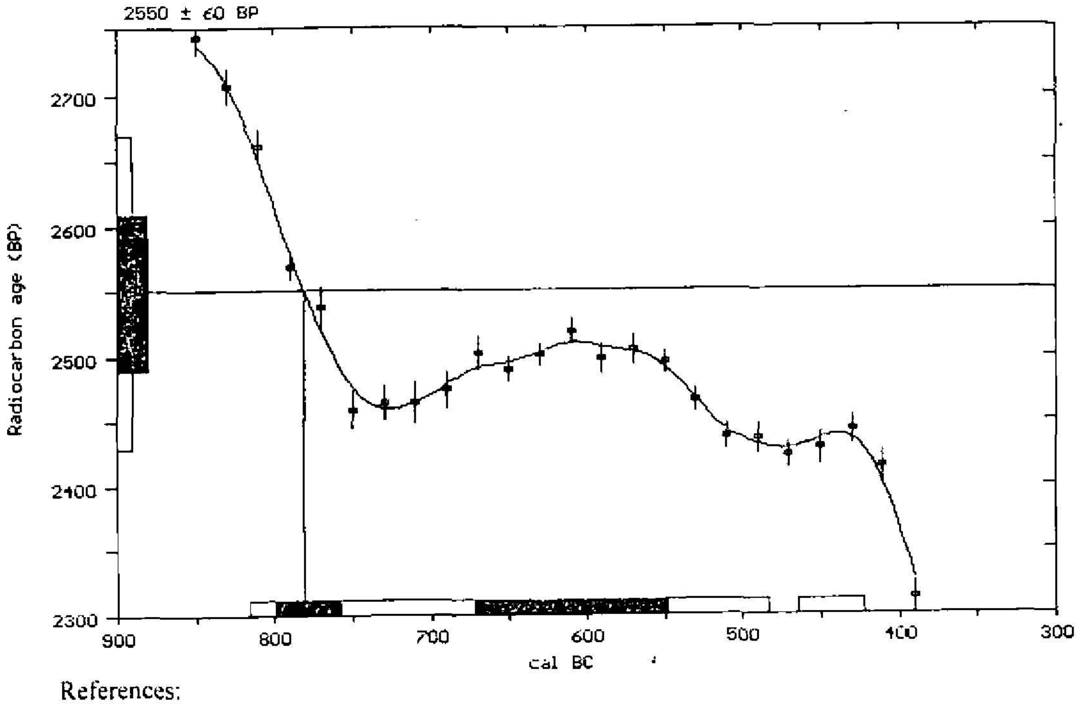
Conventional radiocarbon age: 2550 ± 60 BP

Calibrated results: cal BC 815 to 485 and
(2 sigma, 95% probability) cal BC 465 to 425

Intercept data:

Intercept of radiocarbon age
with calibration curve: cal BC 780

1 sigma calibrated results: cal BC 800 to 760 and
(68% probability) cal BC 670 to 550



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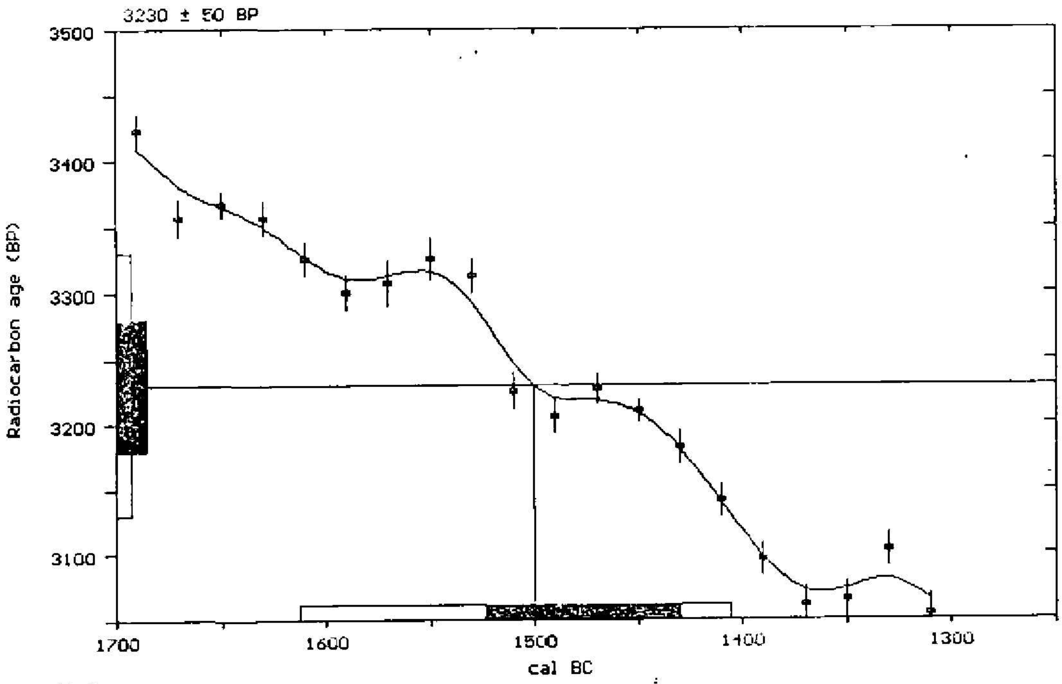
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables:C13/C12=-24.5:lab mult.=1)

Laboratory Number:	Beta-100254
Conventional radiocarbon age:	**3230 ± 50 BP**
Calibrated results: (2 sigma, 95% probability)	**cal BC 1615 to 1405**

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal BC 1500
1 sigma calibrated results: (68% probability)	cal BC 1525 to 1430



References:

Pretoria Calibration Curve for Short Lived Samples
Vogel, J. C., Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86

A Simplified Approach to Calibrating C14 Dates
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Calibration - 1993
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., 1993, Radiocarbon 35(1)

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables:C13/C12=-27.5:lab mult.=1)

Laboratory Number: Beta-100255

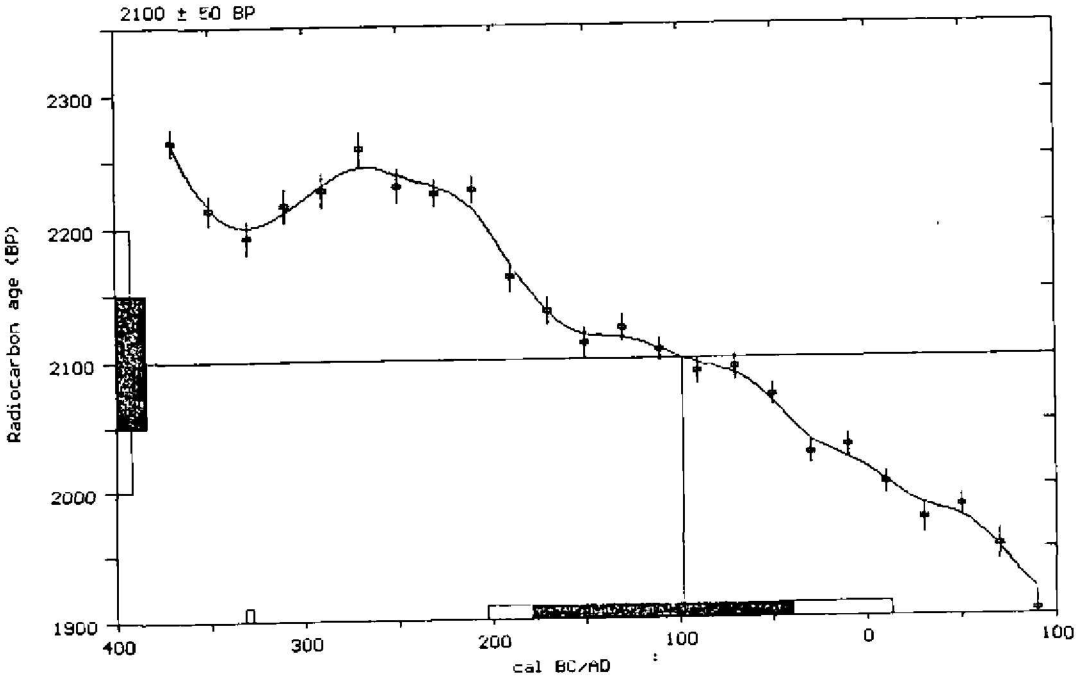
Conventional radiocarbon age: **2100 ± 50 BP**

Calibrated results:
(2 sigma, 95% probability)
cal BC 330 to 330 and
cal BC 205 to cal AD 15

Intercept data:

Intercept of radiocarbon age with calibration curve: cal BC 100

1 sigma calibrated results: (68% probability) cal BC 180 to 40



References:

Pretoria Calibration Curve for Short Lived Samples
Vogel, J. C., Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86

A Simplified Approach to Calibrating C14 Dates
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Calibration - 1993
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., 1993, Radiocarbon 35(1)

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables:C13/C12=-21.8:lab mult.=1)

Laboratory Number: Beta-100256

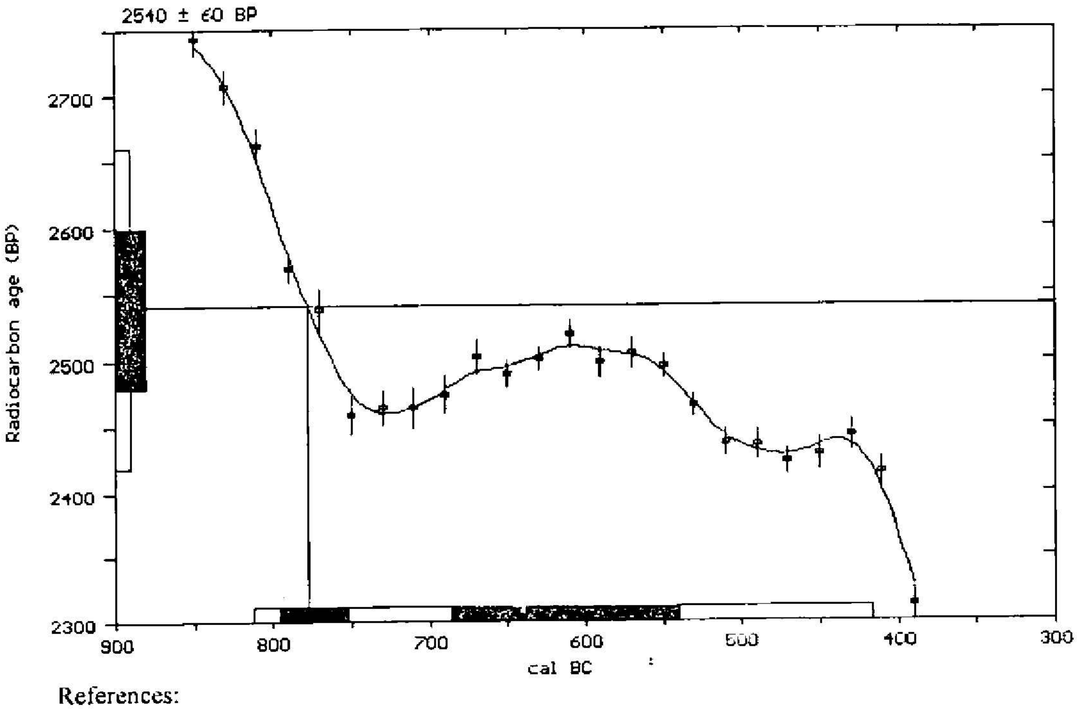
Conventional radiocarbon age: **2540 ± 60 BP**

Calibrated results:
(2 sigma, 95% probability) **cal BC 815 to 415**

Intercept data:

Intercept of radiocarbon age
with calibration curve: cal BC 780

1 sigma calibrated results:
(68% probability) cal BC 795 to 755 and
cal BC 685 to 540



References:

Pretoria Calibration Curve for Short Lived Samples
Vogel, J. C., Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86
A Simplified Approach to Calibrating C14 Dates
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322
Calibration - 1993
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., 1993, Radiocarbon 35(1)

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CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables:C13/C12=-27.4:lab mult.=1)

Laboratory Number: Beta-100257

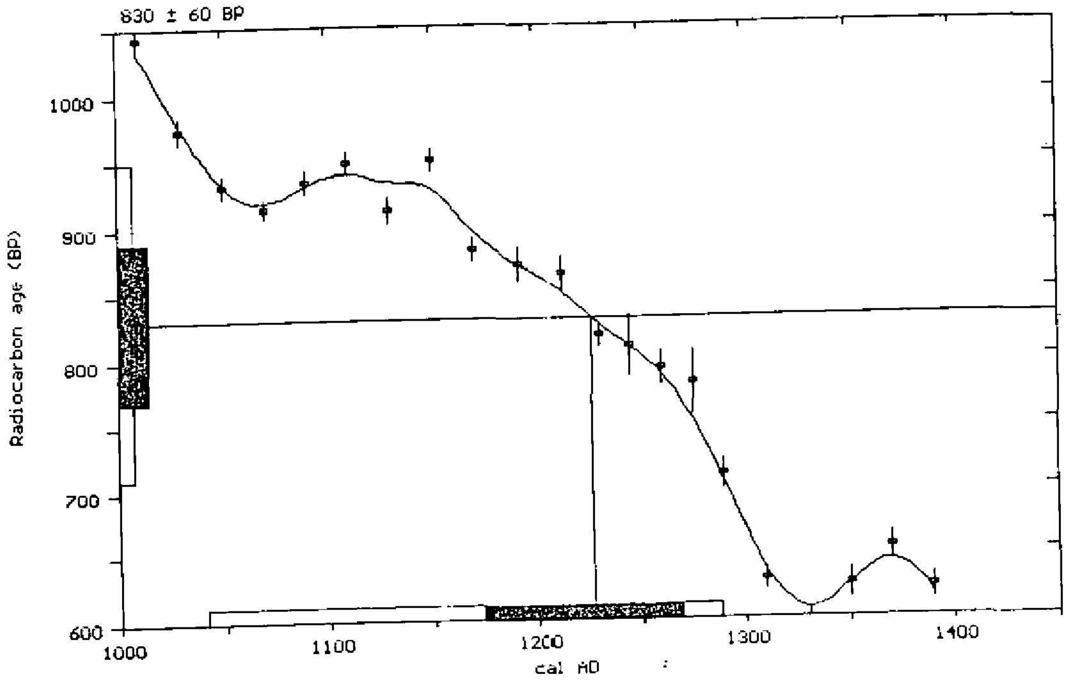
Conventional radiocarbon age: **830 ± 60 BP**

Calibrated results: **cal AD 1040 to 1290**
(2 sigma, 95% probability)

Intercept data:

Intercept of radiocarbon age with calibration curve: cal AD 1225

1 sigma calibrated results: cal AD 1175 to 1270
(68% probability)



References:

Pretoria Calibration Curve for Short Lived Samples
Vogel, J. C., Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86

A Simplified Approach to Calibrating C14 Dates
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Calibration - 1993
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., 1993, Radiocarbon 35(1)

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