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HIGH-PRECISION CALIBRATION OF THE RADIOCARBON TIME SCALE, 500–2500 BC

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INTRODUCTION

This paper is a twin paper to that of Stuiver and Pearson (1986) which covers the time period AD 1950–500 BC. The combined radiocarbon ages of dendrochronologically dated wood presented in this paper covers the time period 500–2500 BC.

Specific discussion of detail effecting only one of the two laboratories is given in the paper which has, as the premier author, the person responsible for the particular laboratory's measurement. Factors effecting both laboratories can be in either paper, but are carefully referenced to the other; outline details are given in both papers.

The construction of a calibration curve from ^{14}C ages with statistically limited precision is not a simple matter. Not only should the standard error in the determination be as small as possible, but the calculation of this error also has to be realistic in that it should account for all variability encountered in the laboratory procedures. Independent dendrochronologic calibration of the samples is also a must. Proof of accuracy has to come from a comparison of the results obtained in two or more facilities. It will be shown that the results obtained in Seattle and in Belfast on wood of the same age, but from different regions, give consistent replication within the quoted error over the entire interval. The aspects of replication are first discussed, and are followed by the details of calibration (Fig 1, Tables 1, 2).

The problems of quoted errors and the use and limitations of error multipliers are discussed, and recommendations are given for the inclusion of such errors in the reported ^{14}C age.

DENDROCHRONOLOGY AND SAMPLE TREATMENT

The wood samples used for the Belfast radiocarbon calibration came from deciduous oaks (*Quercus petraea* and *Quercus robur*) growing at altitudes <200m, in Ireland, Scotland, and England (Pilcher *et al*, 1984). The 7272-year Belfast chronology consists of the ring patterns of 1035 trees. Replication was the keystone to the production of the absolute dates for the radiocarbon samples; no year is spanned by <6 trees; most years are spanned by 20–30 trees. External cross-dating between the Irish chronology and those from England and Germany provided independent checks on its validity (Brown *et al*, 1986). The samples measured by the Seattle Laboratory were either Douglas Fir from the northwestern United States, Sequoia from California, or German Oak (Table 2) (Stuiver & Pearson, 1986, twin paper).

The treatment of oak wood samples at Belfast was to first plane the 20-year blocks of wood (some 180g) into thin shavings. These were then bleached using sodium chlorite in 0.018N HCl raised to a tempertaure of ca 70°C. This treatment left the samples free from tannins and lignins and close to pure cellulose. Following cellulose preparation samples were charred at 500°C to leave a carbon-rich residue ready for combustion to CO_2.

The treatment of the Seattle samples (mainly pine) followed one of two different methods detailed in Stuiver and Pearson (1986, twin paper).

TECHNIQUE AND LABORATORY REPRODUCIBILITY

Two different techniques were employed at the Belfast and Seattle laboratories. In Belfast, the oak wood samples were converted to CO_2 by combustion and sub-sampled for mass spectrometric measurement of the stable carbon isotope ratio. Benzene was then synthesized from sample CO_2 following the conversion path CO_2—LiC→C_2H_2—C_6H_6 using the method of Barker (1953). The benzene was then measured using a Philips PW4510 automatic liquid scintillation counter set up as previously described in Pearson (1979, 1983). Various corrections were applied to the observed count-rates based on the careful monitoring of internal and external parameters. The application of these corrections simulate a constant counting efficiency such that only one reference standard count-rate was used for the calculation of all the ^{14}C ages reported herein although measured over a period of 10 years. The system did not allow a constant background to be used over this period but corrections applied to the observed background count-rate gave an inaccuracy of $< \pm 0.5‰$ when used to evaluate a ^{14}C age of about one half-life.

The method used in Seattle was the proportional counting of CO_2 and is described more fully in Stuiver and Pearson (1986, twin paper).

The reproducibility of Belfast data is proven by a set of 55 replicate analyses measured over a period of 10 years, some replicates being done within months, others repeated years later. The actual standard deviation $\hat{\sigma}$ in a single measurement (assumed to be all of equal weight) based on 55 replicate analyses was calculated using the relationship $\hat{\sigma} = \sqrt{SS/2(n-1)}$ where SS = Sum of the (difference between duplicates)^2, n = 55, and $\hat{\sigma}$ is the derived single measurement standard deviation which can then be compared to the mean standard deviation ($\bar{\sigma}$) quoted on the 110 individual measurements. The actual calculated standard deviation value was $\hat{\sigma} = 19.0$ yr. The mean quoted error on the individual measurements was evaluated from $\bar{\sigma} = \Sigma_{i=1}^{n} \sigma_i/n$, and gave a value of $\bar{\sigma} = 15.4$ yr, thus suggesting that the

quoted error is underestimated by ca 23%, or an error multiplier of 1.23 is required.

The error multiplier of the Seattle laboratory was also determined experimentally in two ways: 1) from the comparison of 30 pairs of wood samples from different trees giving an error multiplier of 1.53, and 2) repeated measurement on outlying samples yielded an error multiplication of 1.62. Both of these values were demonstrated to be maximum values, and a value of 1.60 was taken to be a reasonable estimate and perhaps still rather generous. Additional details are given in Stuiver and Pearson (1986).

SYSTEMATIC DIFFERENCES BETWEEN LABORATORIES AND COMPARISON OF VARIANCE

The systematic ^{14}C age differences between the Belfast and Seattle laboratories have a maximum difference of only a few years (Stuiver & Pearson, 1986, twin paper). The weighted mean ^{14}C age difference of the Belfast and Seattle bi-decadal data set is 0.6 ± 1.6 yr (number of comparisons n = 214). For the AD interval the difference is 2.6 ± 2.3 yr (n = 90) and for the BC portion it is 3.4 ± 2.1 (n = 124).

The ^{14}C ages of wood of the same age for Ireland, south Germany and northwestern United States differ on average by only a few years (Stuiver & Pearson, twin paper).

It is shown (Stuiver & Pearson, 1986, twin paper) that the quoted laboratory standard deviations account for almost all the differences found between the two data sets.

CONSTRUCTION OF RADIOCARBON AGE CALIBRATION CURVES

The calibration curves were constructed from the set of ^{14}C ages obtained for samples each spanning a 20-yr interval, with some exceptions as noted in the Table 1 heading. The cal AD/BC (or cal BP) ages follow the mid-points of the Belfast bi-decadal series whenever possible, starting in AD 1840. The AD 1940–AD 1860 data set is based on the Seattle data alone; all other ^{14}C ages are based on the weighted Belfast/Seattle averages except when Belfast skipped a decade. Here the gaps were filled by averaging 30-yr blocks of Seattle data (see Table 1).

As discussed previously, the standard deviations in the ^{14}C age determinations of each laboratory are based on the reproducibility of the measurements within each laboratory and are larger than the errors usually quoted by both laboratories. For Belfast, where additional factors are used to calculate the routinely reported standard deviation beyond the counting statistics, the reproducibility tests indicate an error multiplier of 1.23. For Seattle, where the routinely reported standard deviations include only the error derived from counting statistics, the error multiplier is 1.6.

The standard deviation assigned to the curve (the vertical difference between center and outer curve) accounts for nearly 90% of the demonstrated standard deviation in the ^{14}C age differences of both laboratories. The mean standard deviation reported with the curves is 12.1 yr and is solely based on the Belfast and Seattle measuring reproducibility. The variance in the differences in ^{14}C ages of contemporaneous samples measured independently in Belfast and Seattle indicate a measure of uncertainty that is equivalent with an average standard deviation of 13.4 yr.

The wood used for the ^{14}C measurements came from the western United States, Ireland, and southern Germany (Table 2). Oak wood was used for the European chronologies (Becker, 1983; Pilcher *et al,* 1984) and Douglas Fir and Sequoia for the US portion. In the preceding sections it was shown that contemporaneous wood from these trees differed, on average, by only a few ^{14}C years. Thus, although the curves are based on wood from different trees, identical results would have been obtained if all measurements had been made on a single tree from one locality.

THE AGE ERROR REPORTED WITH THE RADIOCARBON DATE

The international ^{14}C community follows strict calculation procedures when determining a conventional ^{14}C age (Stuiver & Polach, 1977). Unfortunately, age error calculations are much less bound by rules.

The error in any laboratory determination is a composite of 1) The Poisson statistical error based on the number of counts observed for sample and standards, assuming constant counting conditions, and 2) the errors associated with factors that cause deviation from the above constant counting conditions and other non-systematic errors which affect the reproducibility of the laboratory results. The latter can be derived from replicate sample measurements. Attempts to determine systematic errors are rarely made by the ^{14}C community. The reported sample age error (one standard deviation) is often based solely on Poisson statistics in the number of registered sample and standard counts. Such a substitute for a repeat-measurement derived standard deviation leads to an underestimate because it neglects other factors that add to the variance (Pearson, 1979, 1983).

When identical tree-ring samples (with approximate ages of ca 5000 ^{14}C yr) were measured by 20 laboratories (International Study Group, 1982) it was found that the reproducibility standard deviations in the submitted data set were substantially higher than the age errors reported by the laboratories. Systematic errors ranged from <20 yr (3 laboratories) to 200 yr (1 laboratory).

When comparing the reproducibility standard deviation (obtained after removal of off-sets from the data set) with the laboratory reported error σ it was found that σ has to be multiplied with 1.3 for $\sigma < 20$ yr, with ca 2.0 for σ in the 20- to 80-yr range, and with 1.0 for $\sigma > 80$ yr (International Study Group). These multipliers are strictly laboratory-related and in principle independent of the magnitude of σ. Additional information on systematic errors is available for a set of samples in the 7000 to 8000 ^{14}C yr range measured in Seattle, La Jolla, Heidelberg, and Tucson (Stuiver *et al,* 1986). Off-sets of 29 ± 10, 27 ± 12 and 52 ± 8 yr were found, respectively, for Seattle-La Jolla, Seattle-Heidelberg, and Seattle-Tucson comparisons.

The above studies indicate that systematic errors may exist, and that the reported standard deviation of a ^{14}C age measurement is usually too low. The degree of under-reporting has only been determined so far for 20

odd laboratories for samples ca 5000 ^{14}C yr old. Unfortunately, the error multipliers determined in the above international group study cannot be applied to all age ranges because the multiplier values are age dependent (Stuiver *et al,* 1986). Error multipliers also may change from year to year (or even day to day) at a specific laboratory with improving (or deteriorating) experimental conditions. It is recommended that the user of a ^{14}C date obtain additional information on reproducibility and systematic error determinations from the reporting laboratory. This information should lead to a realistic standard deviation in the age (based on repeat measurements of test samples) although care must be taken in its use particularly when determining 2σ and 3σ probabilities. Limitations on systematic error size also should be provided. A systematic error, of course, should not be part of the regular ± reported with the date.

In the absence of the above information, the user can only take as the ^{14}C age error the actual reported σ, with the understanding that this error is usually too small. In case the user would take twice the reported standard deviation it should be realized that 1) for some laboratories the actual error may be smaller than 2σ, and 2) statistical rules (such as stating that only 1 event out of 20 would be outside 2σ bounds) are not valid because, after all, the original σ is not a properly defined standard deviation in many instances.

CALIBRATION INSTRUCTIONS

The Figure 1 calibration curves consist of three lines. The center line is the actual calibration curve whereas the outer lines indicate the one sigma (standard deviation) uncertainty in the calibration curve. The calibration curve depicts the (non-linear) transformation of ^{14}C ages to calibrated AD/BC (or BP) ages. The nomenclature adopted for the dendro (calendar) year time scale is cal AD/BC or cal BP. The cal AD/BC ages are plotted along the lower horizontal axis and the cal BP ages along the upper one.

Cal BP ages are relative to the year AD 1950, with 0 cal BP equal to AD 1950. The relationship between cal AD/BC and cal BP ages is simple: cal BP = 1950 − cal AD, and cal BP = 1949 + cal BC. The switch from 1950 to 1949 when converting BC ages is caused by the absence of the zero year in the AD/BC chronology (when progressing from 1 BC to 1 AD, the cal BP ages should be without a gap).

The conversion of a ^{14}C age to a cal age is straightforward: 1) Draw a horizontal (parallel to the bottom axis) line (A) through the ^{14}C age to be converted, and 2) draw vertical lines through the intercept(s) of line A and the calibration curve (center line). The cal AD/BC ages can be read at the bottom axis, the cal BP ages at the top. A single ^{14}C age can correspond with multiple cal ages, due to past changes in atmospheric ^{14}C levels (see Stuiver, 1982 for illustration).

The user has to determine the calibrated ages from the Figure 1 graphs by drawing lines. An alternate approach is the use of Table 2, where the cal ages are listed for ^{14}C ages that increase by 20-yr steps. Obviously, the user has to interpolate between the 20-yr steps of ^{14}C ages and sigmas if further fine tuning is desired.

The conversion of the standard error in the ^{14}C age into a range of cal AD/BC (BP) ages is more complicated. The user should first determine whether he/she wants to use 1) the laboratory quoted error (see previous section for a discussion) or 2) increase the quoted error by a known "error multiplier." Once the sample σ has been targeted, the curve σ (one standard deviation) should be read from the calibration curve by taking the difference in radiocarbon years between center curve and outer curve(s) in Figure 1. The curve σ and sample σ should then be used to calculate total $\sigma = \sqrt{(\text{sample } \sigma)^2 + (\text{curve } \sigma)^2}$ (Stuiver, 1982).

Horizontal lines should now be drawn through the ^{14}C age + total σ, and ^{14}C age − total σ value. The vertical lines, drawn through the intercepts with the CENTRAL curve, yield the outer limits of possible cal AD/BC (or BP) ages that are compatible with the sample standard deviation.

The above procedure was used to derive the "ranges" of cal AD/BC (BP) ages listed in Table 2.

The conversion procedure yields 1) single or multiple cal AD/BC (BP) ages that are compatible with a certain ^{14}C age, and 2) the range(s) of cal ages that corresponds to the standard deviation in the ^{14}C age. The probability that a certain cal age is the actual sample age may be quite variable within the cal age range. Higher probabilities are encountered around the intercept ages. Low, or near zero probabilities are encountered when part of the calibration curve 'snakes' outside the total σ boundaries. The non-linear transform of a Gaussian standard deviation around a ^{14}C age into cal AD/BC (BP) ages leads to a very complex probability distribution that can only be calculated with the aid of computers. We are currently developing suitable programs for these probability calculations, and plan to make these programs available in the near future.

The calibration data presented in this paper are to be used for samples formed in isotopic (^{14}C) equilibrium with atmospheric CO_2. Although the wood samples were collected from specific regions (Ireland, Germany, and western USA) the calibration data can be used for a large part of the Northern Hemisphere (Stuiver, 1982). However, systematic age differences are possible for Southern Hemispheric samples where ^{14}C ages of wood samples tend to be ca 30 yr older (Lerman, Mook & Vogel, 1970; Vogel, Fuls & Visser, 1986). Thus, ^{14}C ages of Southern Hemispheric samples should be reduced by 30 years before being converted into a cal AD/BC (BP) age.

SMOOTHING OF THE CALIBRATION CURVE

The Figure 1 points have a 20-yr time separation, *ie,* the calibration points are the mid-points of wood samples spanning 20 years. Samples submitted for dating may cover shorter (eg, seed samples) or longer intervals (eg, lake sediment samples). The decadal calibration results of the Seattle laboratory are available when better time resolution is needed (Stuiver & Becker, 1986). If less resolution is desired, the Figure 2 curves can be used. Here, a 5-point moving average (usually identical with a 100-yr moving average of the Figure 1 data set) was used to construct the curves. A single line is given in Figure 2 because the uncertainty in the 5 point moving average is only a few radiocarbon years. The instructions for determining the

cal AD/BC (BP) ages are listed in the preceding section. Samples falling outside the ranges covered by the twin papers (Stuiver & Pearson, 1986; Pearson & Stuiver, 1986) can be provisionally converted using the curves provided by Pearson *et al* (1986) employing the same method outlined above.

MARINE SAMPLE AGES

The calibraton curves should be applied only for age conversion of samples that were formed in equilibrium with atmospheric CO_2. Conventional ^{14}C ages of materials not in equilibrium with atmospheric reservoirs do not take into account the off-set in ^{14}C age that may occur (Stuiver & Polach, 1977). This off-set, or reservoir deficiency, has to be deducted from the reported ^{14}C age before any attempt can be made to convert to cal AD/BC (BP) ages. The reservoir deficiency is time dependent for the mixed layer of the ocean. Model calculated calibration curves for marine samples are listed separately in this volume (Stuiver, Pearson & Braziunas, 1986).

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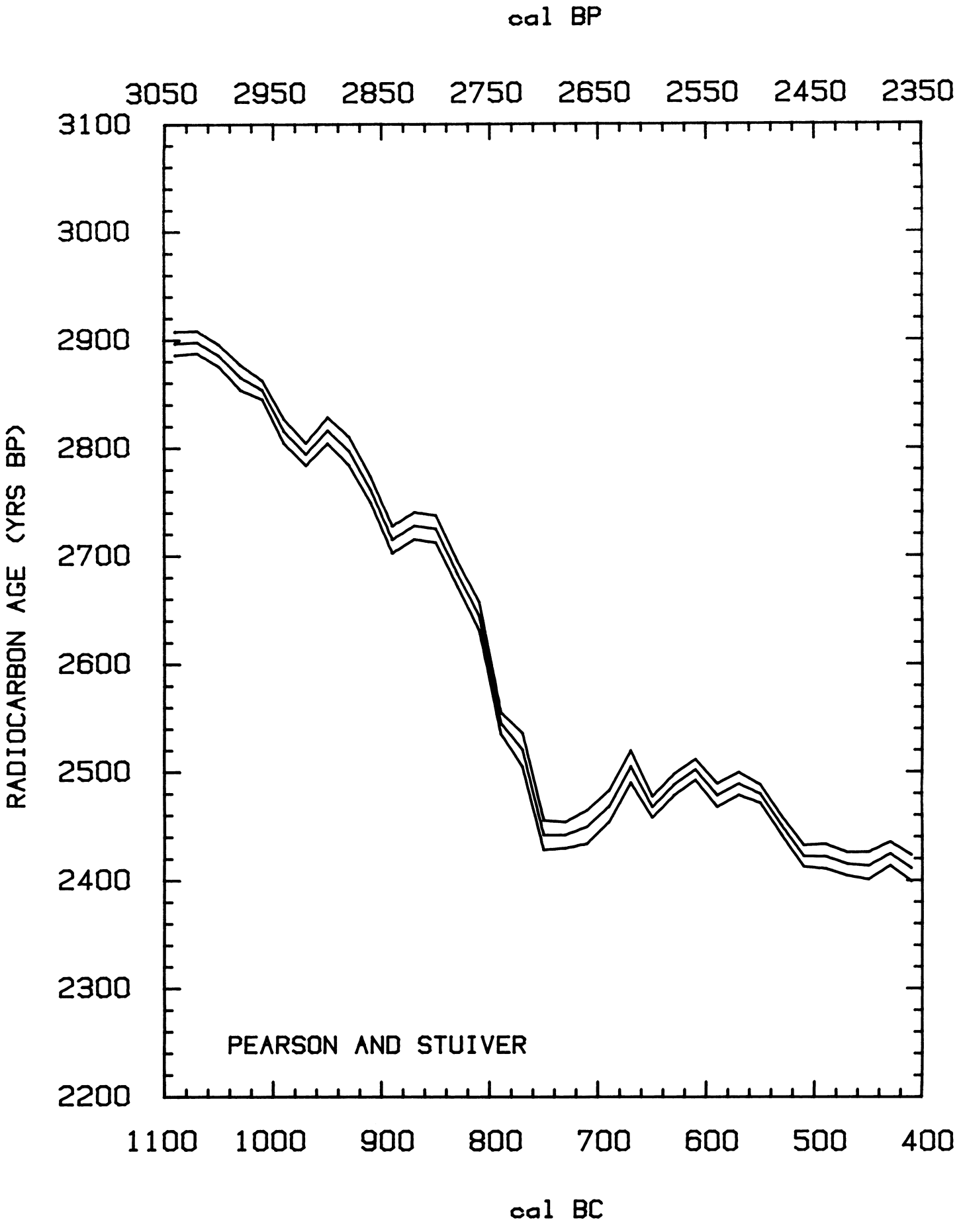

Fig 1A

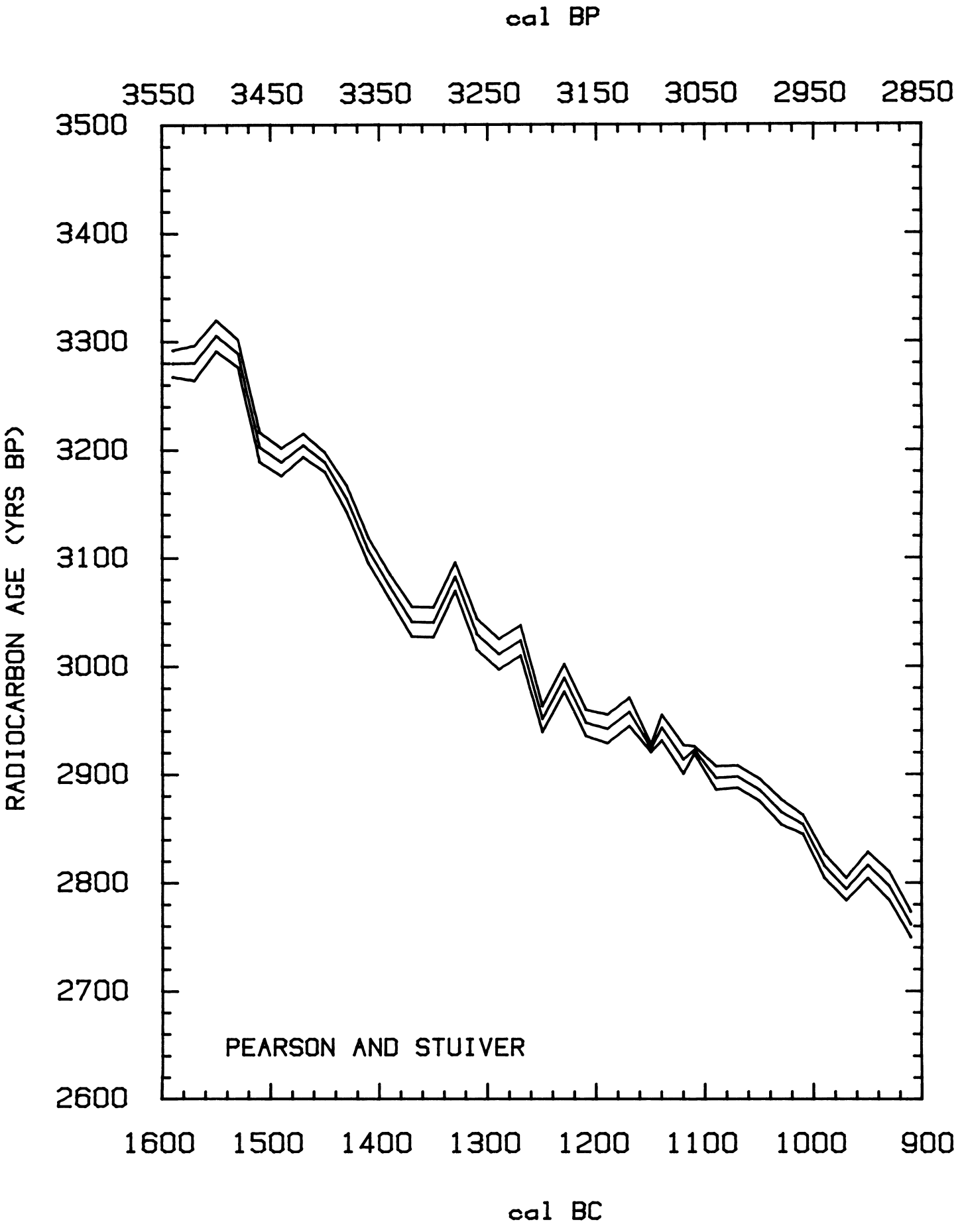

Fig 1B

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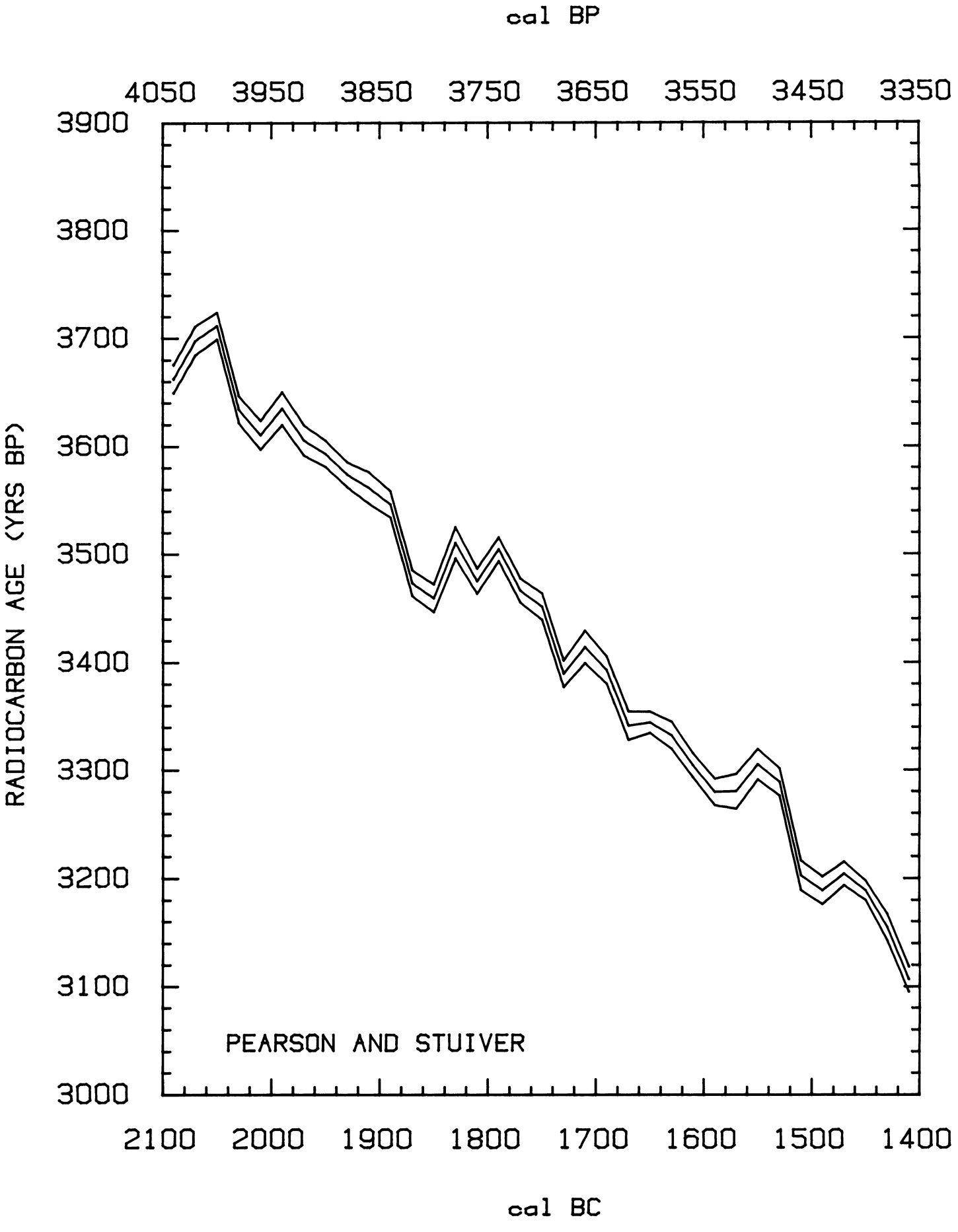

Fig 1C

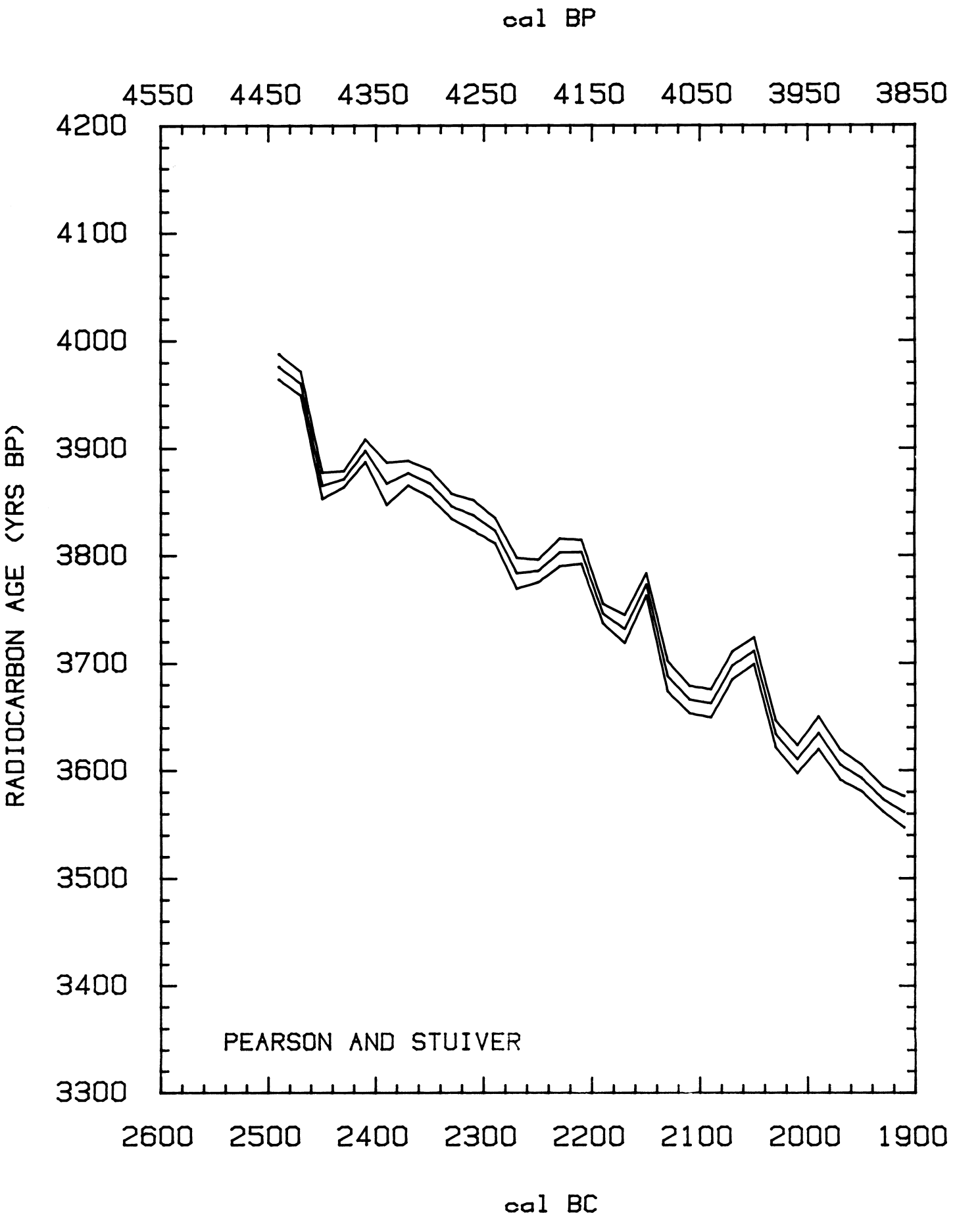

Fig 1D

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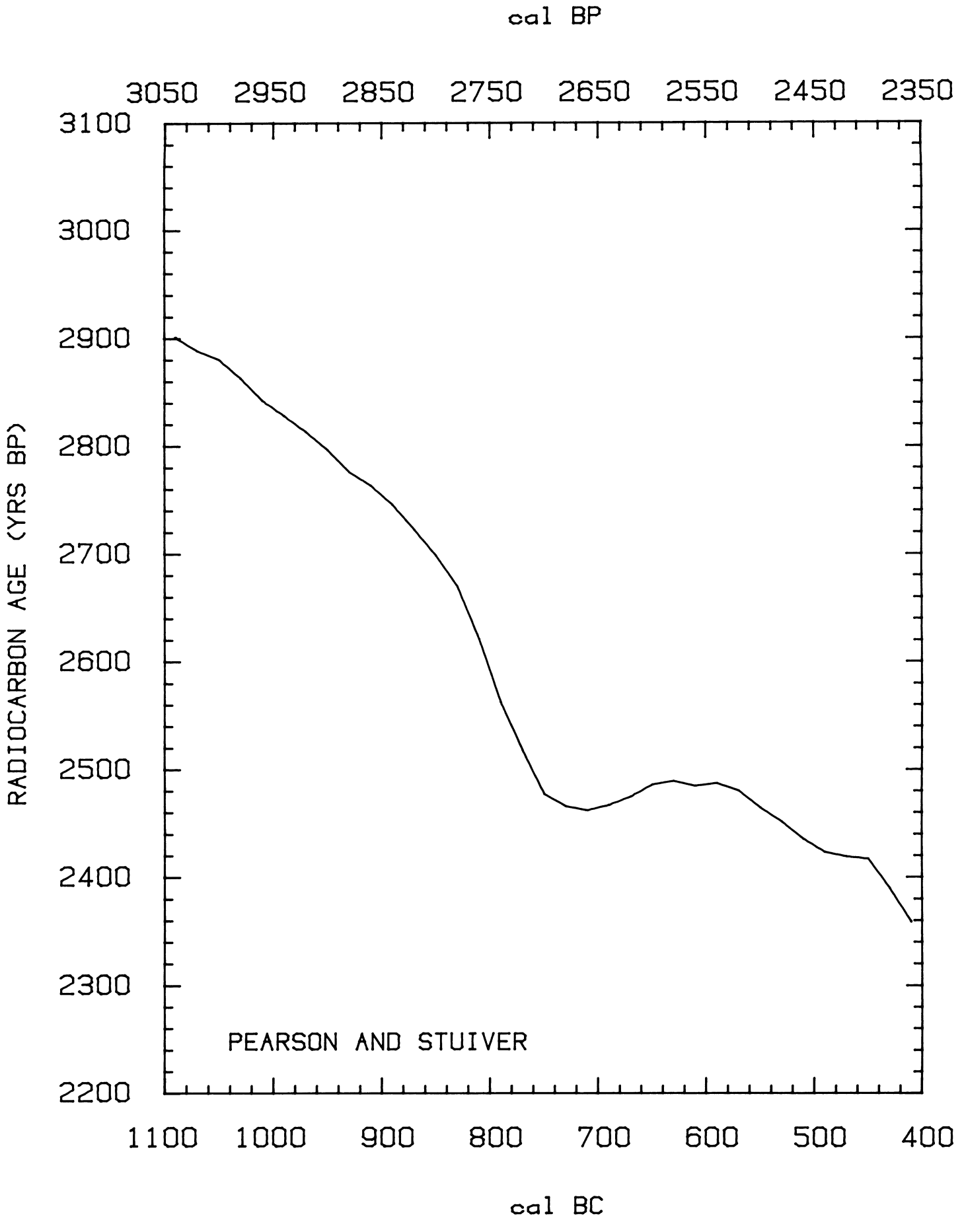

Fig 2A

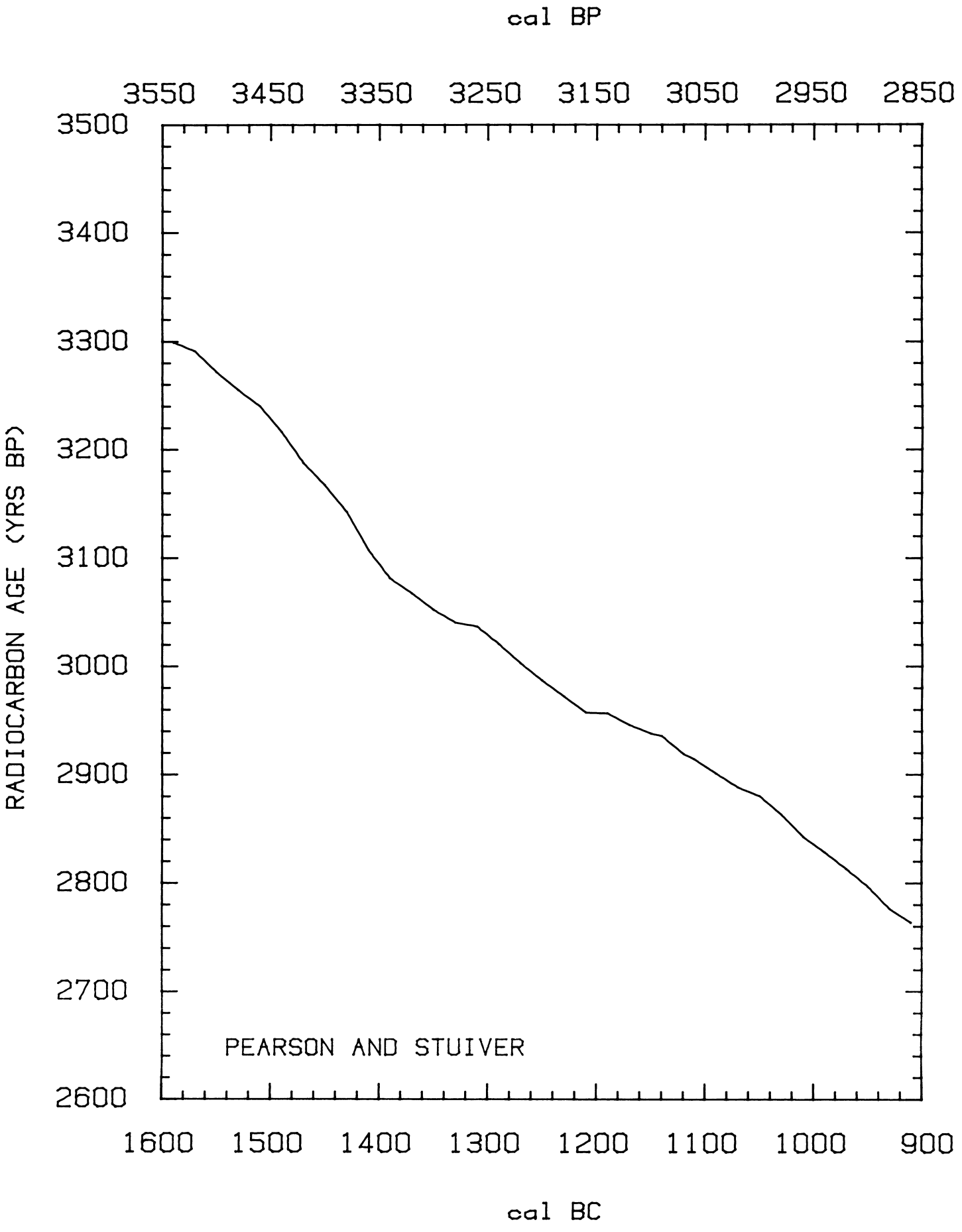

Fig 2B

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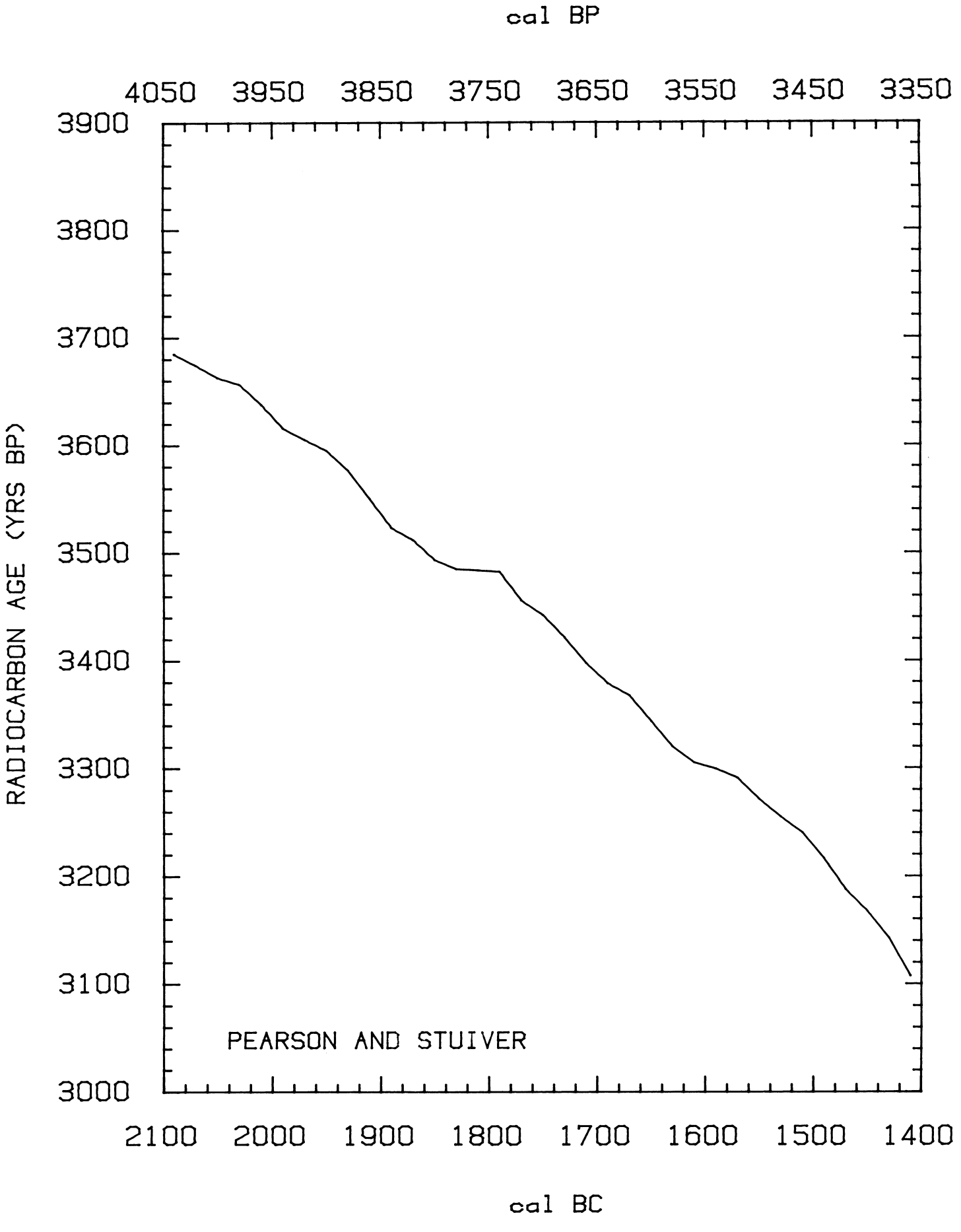

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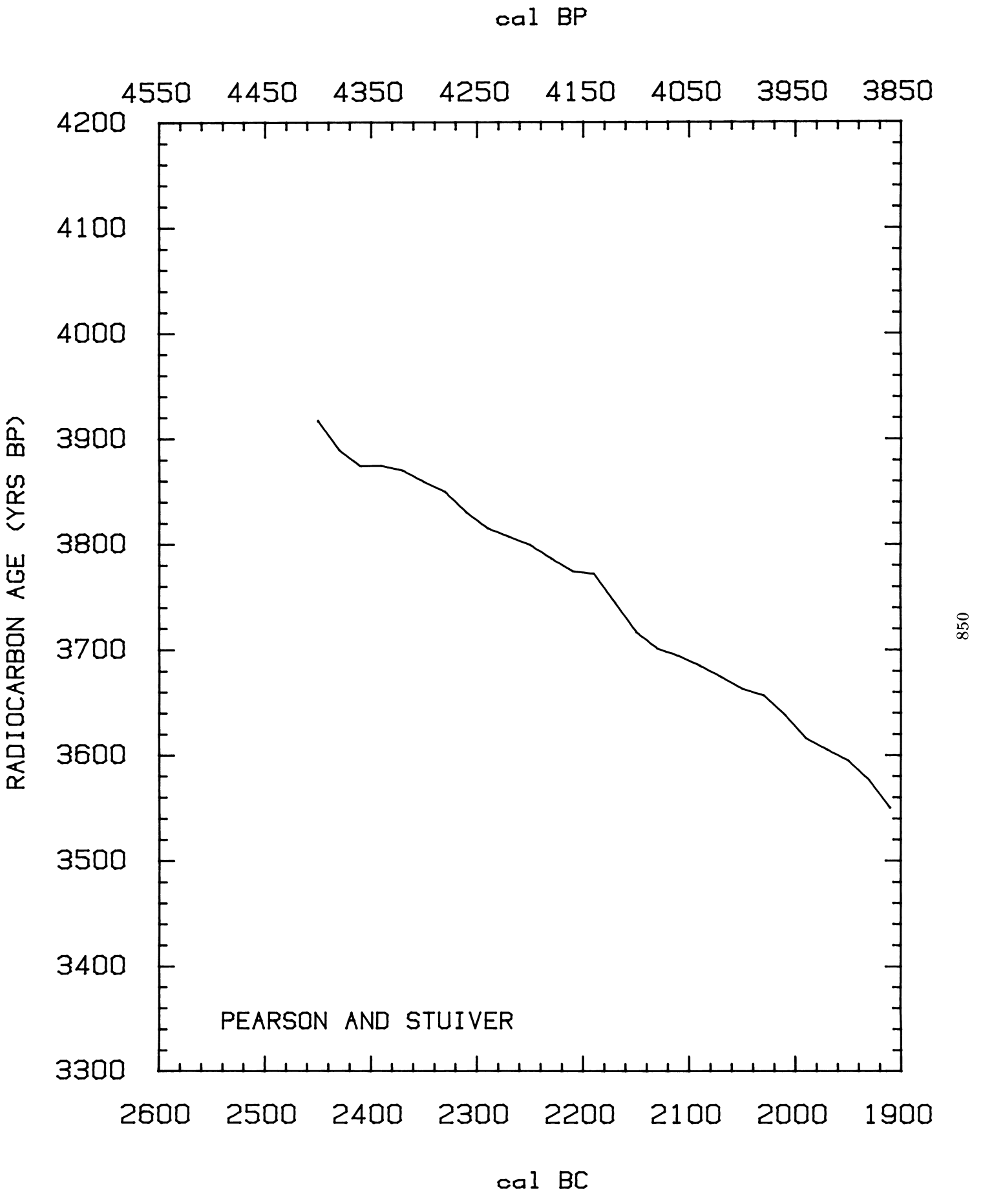

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Fig 2D

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TABLE 1-A

The radiocarbon ages are the averages of age determinations made at the University of Belfast and the University of Washington (Seattle). The cal AD/BC (or cal BP) ages represent the mid-points of bi-decadal wood sections. Belfast data only were used for 670 BC, 690 BC, 2390 BC, and 2450 BC because Seattle decade measurements were incomplete for these ages.

The cal AD/BC ages follow the mid-points of the Belfast bi-decadal series whenever possible, starting at 510 BC. The actual midpoints of the averages were occasionally slightly different. The differences have been neglected because the mid-points of the Seattle sample were always within 1.5 years of the mid-point of the corresponding Belfast sample. The standard deviation in the ages and Δ values include lab error multipliers of 1.23 for Belfast and 1.6 for Seattle. The trees used and sample treatments are listed in Table 2 (Stuiver & Pearson, 1986).

cal AD/BC cal BP	$\Delta^{14}C$	Radiocarbon age BP	cal AD/BC cal BP	$\Delta^{14}C$	Radiocarbon age BP
BC 510 BP 2459	-4.1 ± 1.2	2422 ± 10	BC 870 BP 2819	1.5 ± 1.6	2728 ± 12
BC 530 BP 2479	-5.0 ± 1.1	2450 ± 9	BC 890 BP 2839	5.5 ± 1.6	2715 ± 12
BC 550 BP 2499	-6.3 ± 1.0	2480 ± 8	BC 910 BP 2859	2.1 ± 1.5	2761 ± 12
BC 570 BP 2519	-5.1 ± 1.3	2489 ± 10	BC 930 BP 2879	.1 ± 1.6	2797 ± 13
BC 590 BP 2539	-1.4 ± 1.3	2478 ± 11	BC 950 BP 2899	.1 ± 1.5	2816 ± 12
BC 610 BP 2559	-1.9 ± 1.2	2502 ± 10	BC 970 BP 2919	5.3 ± 1.3	2794 ± 10
BC 630 BP 2579	2.3 ± 1.2	2488 ± 10	BC 990 BP 2939	5.1 ± 1.4	2815 ± 11
BC 650 BP 2599	7.3 ± 1.2	2468 ± 10	BC 1010 BP 2959	2.7 ± 1.1	2854 ± 9
BC 670 BP 2619	5.0 ± 1.8	2505 ± 15	BC 1030 BP 2979	3.7 ± 1.4	2865 ± 12
BC 690 BP 2639	12.1 ± 1.8	2468 ± 15	BC 1050 BP 2999	3.6 ± 1.3	2886 ± 10
BC 710 BP 2659	16.9 ± 1.9	2449 ± 15	BC 1070 BP 3019	4.5 ± 1.3	2898 ± 10
BC 730 BP 2679	20.4 ± 1.5	2442 ± 12	BC 1090 BP 3039	7.1 ± 1.4	2897 ± 11
BC 750 BP 2699	22.8 ± 1.7	2442 ± 14	BC 1110 BP 3059	6.3 ± .4	2923 ± 3
BC 770 BP 2719	15.3 ± 1.9	2521 ± 16	BC 1120 BP 3069	8.6 ± 1.6	2914 ± 13
BC 790 BP 2739	14.6 ± 1.2	2545 ± 10	BC 1140 BP 3089	7.3 ± 1.5	2943 ± 12
BC 810 BP 2759	4.6 ± 1.6	2644 ± 13	BC 1150 BP 3099	11.0 ± .4	2924 ± 3
BC 830 BP 2779	2.2 ± 1.4	2683 ± 12	BC 1170 BP 3119	9.2 ± 1.6	2958 ± 13
BC 850 BP 2799	-.6 ± 1.6	2725 ± 13	BC 1190 BP 3139	13.6 ± 1.7	2942 ± 13

TABLE 1-B

cal AD/BC cal BP	$\Delta^{14}C$	Radiocarbon age BP	cal AD/BC cal BP	$\Delta^{14}C$	Radiocarbon age BP
BC 1210 BP 3159	15.3 ± 1.5	2948 ± 12	BC 1710 BP 3659	17.8 ± 1.8	3414 ± 15
BC 1230 BP 3179	12.5 ± 1.6	2989 ± 13	BC 1730 BP 3679	23.4 ± 1.5	3389 ± 12
BC 1250 BP 3199	19.8 ± 1.5	2951 ± 12	BC 1750 BP 3699	18.0 ± 1.5	3452 ± 12
BC 1270 BP 3219	13.1 ± 1.7	3024 ± 14	BC 1770 BP 3719	18.6 ± 1.4	3466 ± 11
BC 1290 BP 3239	17.1 ± 1.8	3011 ± 14	BC 1790 BP 3739	16.2 ± 1.4	3505 ± 11
BC 1310 BP 3259	17.3 ± 1.8	3030 ± 14	BC 1810 BP 3759	22.4 ± 1.4	3475 ± 11
BC 1330 BP 3279	13.0 ± 1.6	3083 ± 13	BC 1830 BP 3779	20.3 ± 1.8	3511 ± 15
BC 1350 BP 3299	20.8 ± 1.7	3041 ± 14	BC 1850 BP 3799	29.4 ± 1.6	3459 ± 13
BC 1370 BP 3319	23.2 ± 1.7	3041 ± 14	BC 1870 BP 3819	30.1 ± 1.5	3473 ± 12
BC 1390 BP 3339	21.6 ± 1.4	3073 ± 12	BC 1890 BP 3839	23.2 ± 1.5	3546 ± 12
BC 1410 BP 3359	19.8 ± 1.5	3107 ± 12	BC 1910 BP 3859	23.8 ± 1.8	3562 ± 15
BC 1430 BP 3379	16.2 ± 1.5	3155 ± 12	BC 1930 BP 3879	24.7 ± 1.4	3574 ± 12
BC 1450 BP 3399	14.3 ± 1.1	3189 ± 9	BC 1950 BP 3899	24.7 ± 1.5	3593 ± 12
BC 1470 BP 3419	14.8 ± 1.3	3204 ± 11	BC 1970 BP 3919	25.6 ± 1.7	3606 ± 14
BC 1490 BP 3439	19.3 ± 1.6	3189 ± 13	BC 1990 BP 3939	24.3 ± 1.9	3635 ± 15
BC 1510 BP 3459	20.0 ± 1.7	3203 ± 14	BC 2010 BP 3959	30.0 ± 1.6	3610 ± 13
BC 1530 BP 3479	11.5 ± 1.6	3289 ± 13	BC 2030 BP 3979	29.4 ± 1.5	3634 ± 12
BC 1550 BP 3499	11.9 ± 1.8	3305 ± 14	BC 2050 BP 3999	22.0 ± 1.5	3711 ± 12
BC 1570 BP 3519	17.5 ± 2.0	3280 ± 16	BC 2070 BP 4019	26.2 ± 1.6	3698 ± 13
BC 1590 BP 3539	20.1 ± 1.5	3280 ± 12	BC 2090 BP 4039	33.2 ± 1.6	3662 ± 13
BC 1610 BP 3559	19.4 ± 1.4	3304 ± 11	BC 2110 BP 4059	35.3 ± 1.6	3666 ± 13
BC 1630 BP 3579	18.3 ± 1.6	3333 ± 13	BC 2130 BP 4079	35.0 ± 1.8	3688 ± 14
BC 1650 BP 3599	19.2 ± 1.2	3344 ± 10	BC 2150 BP 4099	26.5 ± 1.3	3773 ± 10
BC 1670 BP 3619	22.1 ± 1.6	3341 ± 13	BC 2170 BP 4119	34.3 ± 1.6	3732 ± 13
BC 1690 BP 3639	18.0 ± 1.6	3393 ± 13	BC 2190 BP 4139	35.0 ± 1.1	3746 ± 9

TABLE 1-C

cal AD/BC cal BP	$\Delta^{14}C$	Radiocarbon age BP
BC 2210 BP 4159	30.1 ± 1.4	3803 ± 11
BC 2230 BP 4179	32.7 ± 1.6	3803 ± 13
BC 2250 BP 4199	37.4 ± 1.3	3786 ± 10
BC 2270 BP 4219	40.2 ± 1.8	3784 ± 14
BC 2290 BP 4239	37.6 ± 1.5	3823 ± 12
BC 2310 BP 4259	38.2 ± 1.8	3838 ± 14
BC 2330 BP 4279	39.6 ± 1.4	3846 ± 12
BC 2350 BP 4299	39.4 ± 1.6	3867 ± 13
BC 2370 BP 4319	40.7 ± 1.4	3877 ± 12
BC 2390 BP 4339	44.5 ± 2.4	3867 ± 20
BC 2410 BP 4359	43.0 ± 1.3	3898 ± 11
BC 2430 BP 4379	49.0 ± .9	3871 ± 8
BC 2450 BP 4399	52.4 ± 1.5	3865 ± 12
BC 2470 BP 4419	42.5 ± 1.4	3960 ± 11
BC 2490 BP 4439	43.0 ± 1.5	3976 ± 12

TABLE 2

The conversion of the radiocarbon ages to a series of ranges of cal AD/BC (*and* BP) dates is determined by the AD/BC intercepts of the sample radiocarbon age ± $\sqrt{(\text{sample } \sigma)^2 + (\text{curve } \sigma)^2}$ and the calibration curve. Intercepts of the radiocarbon age with the calibration curve are listed to the right. Sample σ is the standard error in the radiocarbon age.

For sample sigmas and ranges larger or equal to 100 years the data were rounded to the nearest decade. When the gap between two successive ranges was less than 10 years, the two ranges were combined to a single one.

Illustrations of the above are given below.

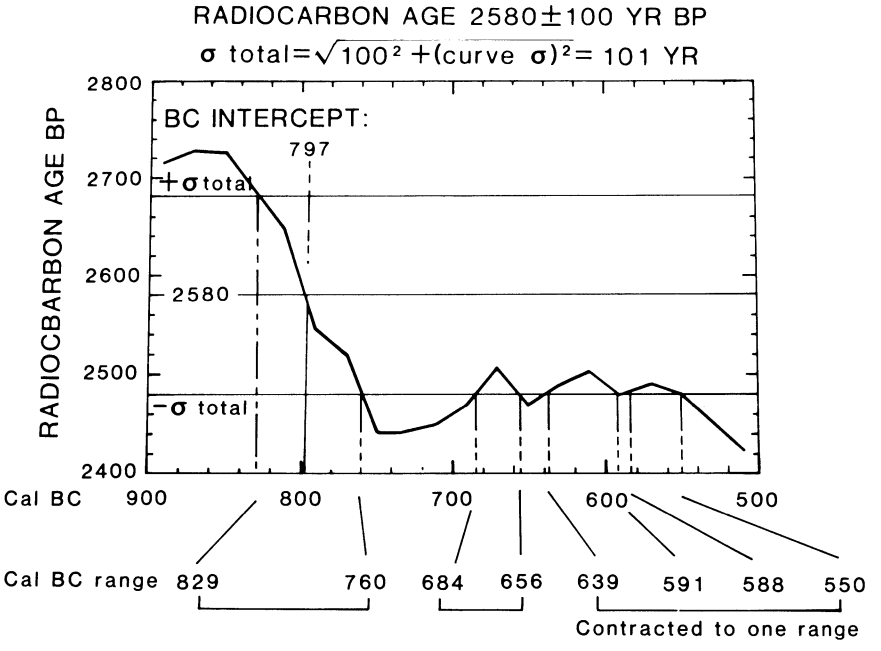

TABLE 2 (continued)

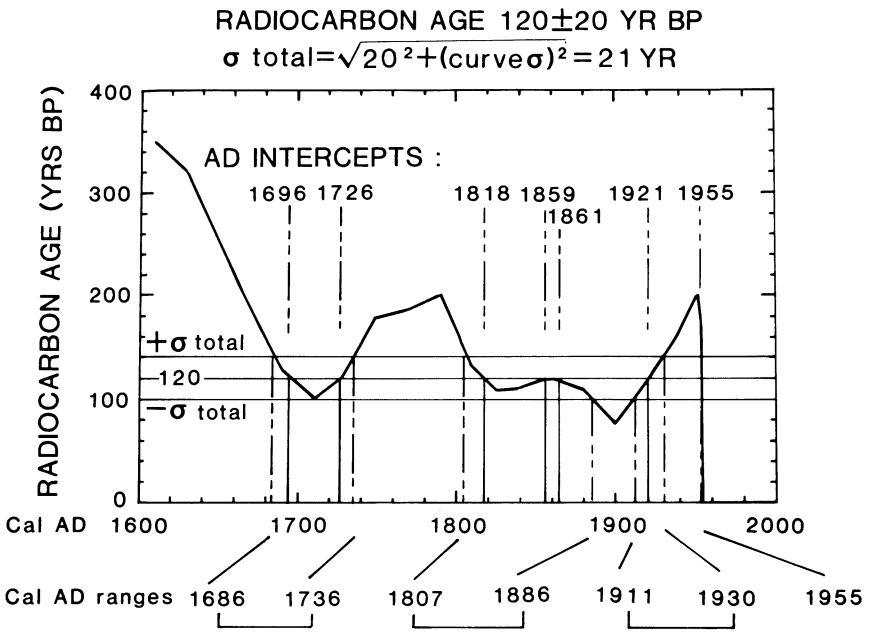

TABLE 2-A

```
RADIOCARBON AGE BP 2460   CALIBRATED AGES:  cal BC  755,  699,  537
                                            cal BP 2704, 2648, 2486
Sample σ and cal BC(cal BP) ranges:
σ =  20   761-682(2710-2631)    659-634(2608-2583)    594-580(2543-2529)
          559-520(2508-2469)
σ =  40   765-478(2714-2427)    442-420(2391-2369)
σ =  60   771-408(2720-2357)
σ =  80   787-405(2736-2354)
σ = 100   790-400(2740-2350)
σ = 120   800-400(2750-2350)
σ = 160   810-390(2760-2340)
σ = 200   820-380(2770-2330)

RADIOCARBON AGE BP 2480   CALIBRATED AGES:  cal BC  760,  684,  657,  638,  591,
                                                    587,  551
                                            cal BP 2709, 2633, 2606, 2587, 2540,
                                                   2536, 2500
Sample σ and cal BC(cal BP) ranges:
σ =  20   766-754(2715-2703)    702-535(2651-2484)
σ =  40   771-522(2720-2471)
σ =  60   787-481(2736-2430)    440-422(2389-2371)
σ =  80   793-408(2742-2357)
σ = 100   800-400(2750-2350)
σ = 120   800-400(2750-2350)
σ = 160   810-400(2760-2350)
σ = 200   830-390(2780-2340)

RADIOCARBON AGE BP 2500   CALIBRATED AGES:  cal BC  765,  673,  667,  613,  608
                                            cal BP 2714, 2622, 2616, 2562, 2557
Sample σ and cal BC(cal BP) ranges:
σ =  20   772-759(2721-2708)    685-655(2634-2604)    641-548(2590-2497)
σ =  40   787-754(2736-2703)    700-536(2649-2485)
σ =  60   793-522(2742-2471)
σ =  80   797-481(2746-2430)    440-422(2389-2371)
σ = 100   800-410(2750-2360)
σ = 120   810-400(2760-2350)
σ = 160   820-400(2770-2350)
σ = 200   840-390(2790-2340)

RADIOCARBON AGE BP 2520   CALIBRATED AGE:   cal BC  770
                                            cal BP 2719
Sample σ and cal BC(cal BP) ranges:
σ =  20   790-764(2739-2713)    675-665(2624-2614)    620-604(2569-2553)
σ =  40   793-759(2742-2708)    685-655(2634-2604)    640-548(2589-2497)
σ =  60   797-754(2746-2703)    700-536(2649-2485)
σ =  80   801-522(2750-2471)
σ = 100   810-480(2760-2430)    440-422(2389-2371)
σ = 120   810-410(2760-2360)
σ = 160   830-400(2780-2350)
σ = 200   892-881(2841-2830)    850-400(2800-2350)
```

TABLE 2-B

RADIOCARBON AGE BP 2540 CALIBRATED AGE: cal BC 786
cal BP 2735

Sample σ and cal BC(cal BP) ranges:

σ = 20	794-769(2743-2718)		
σ = 40	797-764(2746-2713)	674-666(2623-2615)	616-607(2565-2556)
σ = 60	801-759(2750-2708)	684-656(2633-2605)	639-549(2588-2498)
σ = 80	805-754(2754-2703)	700-536(2649-2485)	
σ = 100	810-520(2760-2470)		
σ = 120	820-480(2770-2430)	439-422(2388-2371)	
σ = 160	840-400(2790-2350)		
σ = 200	900-400(2850-2350)		

RADIOCARBON AGE BP 2560 CALIBRATED AGE: cal BC 793
cal BP 2742

Sample σ and cal BC(cal BP) ranges:

σ = 20	798-783(2747-2732)		
σ = 40	801-769(2750-2718)		
σ = 60	805-765(2754-2714)	673-667(2622-2616)	615-607(2564-2556)
σ = 80	809-760(2758-2709)	684-656(2633-2605)	639-550(2588-2499)
σ = 100	818-754(2767-2703)	700-540(2650-2490)	
σ = 120	830-520(2780-2470)		
σ = 160	892-882(2841-2831)	850-410(2800-2360)	
σ = 200	910-400(2860-2350)		

RADIOCARBON AGE BP 2580 CALIBRATED AGE: cal BC 797
cal BP 2746

Sample σ and cal BC(cal BP) ranges:

σ = 20	802-792(2751-2741)		
σ = 40	805-784(2754-2733)		
σ = 60	809-770(2758-2719)		
σ = 80	819-765(2768-2714)	673-667(2622-2616)	614-608(2563-2557)
σ = 100	829-760(2778-2709)	684-656(2633-2605)	639-550(2588-2499)
σ = 120	838-755(2787-2704)	700-540(2650-2490)	
σ = 160	900-480(2850-2430)	439-423(2388-2372)	
σ = 200	920-400(2870-2350)		

RADIOCARBON AGE BP 2600 CALIBRATED AGE: cal BC 801
cal BP 2750

Sample σ and cal BC(cal BP) ranges:

σ = 20	806-796(2755-2745)		
σ = 40	809-793(2758-2742)		
σ = 60	819-785(2768-2734)		
σ = 80	829-770(2778-2719)		
σ = 100	838-765(2787-2714)	673-667(2622-2616)	614-608(2563-2557)
σ = 120	892-881(2841-2830)	848-760(2797-2709)	684-656(2633-2605)
	638-550(2587-2499)		
σ = 160	910-520(2860-2470)		
σ = 200	976-964(2925-2913)	930-410(2880-2360)	

TABLE 2-C

RADIOCARBON AGE BP 2620 CALIBRATED AGE: cal BC 805
cal BP 2754

Sample σ and cal BC(cal BP) ranges:

σ = 20	810-800(2759-2749)		
σ = 40	819-797(2768-2746)		
σ = 60	829-793(2778-2742)		
σ = 80	838-785(2787-2734)		
σ = 100	892-881(2841-2830)	848-770(2797-2719)	
σ = 120	900-760(2850-2710)	673-667(2622-2616)	614-608(2563-2557)
σ = 160	920-750(2870-2700)	700-540(2650-2490)	
σ = 200	990-480(2940-2430)	439-423(2388-2372)	

RADIOCARBON AGE BP 2640 CALIBRATED AGE: cal BC 809
cal BP 2758

Sample σ and cal BC(cal BP) ranges:

σ = 20	820-804(2769-2753)		
σ = 40	829-801(2778-2750)		
σ = 60	839-797(2788-2746)		
σ = 80	893-881(2842-2830)	848-793(2797-2742)	
σ = 100	900-790(2850-2740)		
σ = 120	910-770(2860-2720)		
σ = 160	976-964(2925-2913)	930-760(2880-2710)	684-656(2633-2605)
	638-550(2587-2499)		
σ = 200	1000-520(2950-2470)		

RADIOCARBON AGE BP 2660 CALIBRATED AGE: cal BC 818
cal BP 2767

Sample σ and cal BC(cal BP) ranges:

σ = 20	830-808(2779-2757)		
σ = 40	839-805(2788-2754)		
σ = 60	893-880(2842-2829)	848-801(2797-2750)	
σ = 80	901-797(2850-2746)		
σ = 100	910-790(2860-2740)		
σ = 120	920-790(2870-2740)		
σ = 160	990-760(2940-2710)	673-667(2622-2616)	614-608(2563-2557)
σ = 200	1020-750(2970-2700)	700-540(2650-2490)	

RADIOCARBON AGE BP 2680 CALIBRATED AGE: cal BC 828
cal BP 2777

Sample σ and cal BC(cal BP) ranges:

σ = 20	840-816(2789-2765)		
σ = 40	893-879(2842-2828)	848-809(2797-2758)	
σ = 60	901-805(2850-2754)		
σ = 80	910-801(2859-2750)		
σ = 100	920-800(2870-2750)		
σ = 120	976-964(2925-2913)	930-790(2880-2740)	
σ = 160	1000-770(2950-2720)		
σ = 200	1040-760(2990-2710)	684-656(2633-2605)	638-550(2587-2499)

TABLE 2-D

RADIOCARBON AGE BP 2700 CALIBRATED AGE: cal BC 838
cal BP 2787

Sample σ and cal BC(cal BP) ranges:

σ = 20	894-877(2843-2826)	849-827(2798-2776)
σ = 40	902-817(2851-2766)	
σ = 60	910-809(2859-2758)	
σ = 80	921-805(2870-2754)	
σ = 100	976-964(2925-2913)	930-800(2880-2750)
σ = 120	990-800(2940-2750)	
σ = 160	1020-790(2970-2740)	
σ = 200	1090-760(3040-2710)	673-667(2622-2616) 614-608(2563-2557)

RADIOCARBON AGE BP 2720 CALIBRATED AGES: cal BC 892, 882, 848
cal BP 2841, 2831, 2797

Sample σ and cal BC(cal BP) ranges:

σ = 20	902-836(2851-2785)	
σ = 40	910-827(2859-2776)	
σ = 60	921-817(2870-2766)	
σ = 80	976-964(2925-2913)	934-809(2883-2758)
σ = 100	990-800(2940-2750)	
σ = 120	1000-800(2950-2750)	
σ = 160	1050-790(3000-2740)	
σ = 200	1120-770(3070-2720)	

RADIOCARBON AGE BP 2740 CALIBRATED AGE: cal BC 901
cal BP 2850

Sample σ and cal BC(cal BP) ranges:

σ = 20	911-846(2860-2795)	
σ = 40	921-837(2870-2786)	
σ = 60	977-964(2926-2913)	934-828(2883-2777)
σ = 80	993-818(2942-2767)	
σ = 100	1000-810(2950-2760)	
σ = 120	1020-800(2970-2750)	
σ = 160	1090-800(3040-2750)	
σ = 200	1160-790(3110-2740)	

RADIOCARBON AGE BP 2760 CALIBRATED AGE: cal BC 909
cal BP 2858

Sample σ and cal BC(cal BP) ranges:

σ = 20	922-899(2871-2848)	
σ = 40	977-963(2926-2912)	935-847(2884-2796)
σ = 60	993-837(2942-2786)	
σ = 80	1003-828(2952-2777)	
σ = 100	1020-820(2970-2770)	
σ = 120	1050-810(3000-2760)	
σ = 160	1120-800(3070-2750)	
σ = 200	1252-1245(3201-3194)	1220-790(3170-2740)

TABLE 2-E

RADIOCARBON AGE BP 2780 CALIBRATED AGE: cal BC 920
cal BP 2869

Sample σ and cal BC(cal BP) ranges:

σ = 20	979-961(2928-2910)	937-908(2886-2857)
σ = 40	993-900(2942-2849)	
σ = 60	1004-847(2953-2796)	
σ = 80	1023-838(2972-2787)	
σ = 100	1050-830(3000-2780)	
σ = 120	1090-820(3040-2770)	
σ = 160	1160-810(3110-2760)	
σ = 200	1260-800(3210-2750)	

RADIOCARBON AGE BP 2800 CALIBRATED AGES: cal BC 976, 965, 933
cal BP 2925, 2914, 2882

Sample σ and cal BC(cal BP) ranges:

σ = 20	994-919(2943-2868)	
σ = 40	1004-909(2953-2858)	
σ = 60	1023-900(2972-2849)	
σ = 80	1045-847(2994-2796)	
σ = 100	1090-840(3040-2790)	
σ = 120	1120-830(3070-2780)	
σ = 160	1252-1245(3201-3194)	1220-810(3170-2760)
σ = 200	1260-800(3210-2750)	

RADIOCARBON AGE BP 2820 CALIBRATED AGE: cal BC 992
cal BP 2941

Sample σ and cal BC(cal BP) ranges:

σ = 20	1004-931(2953-2880)	
σ = 40	1023-920(2972-2869)	
σ = 60	1045-909(2994-2858)	
σ = 80	1093-901(3042-2850)	
σ = 100	1120-850(3070-2800)	
σ = 120	1160-840(3110-2790)	
σ = 160	1260-820(3210-2770)	
σ = 200	1300-810(3250-2760)	

RADIOCARBON AGE BP 2840 CALIBRATED AGE: cal BC 1003
cal BP 2952

Sample σ and cal BC(cal BP) ranges:

σ = 20	1025-991(2974-2940)	
σ = 40	1046-932(2995-2881)	
σ = 60	1093-920(3042-2869)	
σ = 80	1125-909(3074-2858)	
σ = 100	1160-900(3110-2850)	
σ = 120	1252-1245(3201-3194)	1220-850(3170-2800)
σ = 160	1260-830(3210-2780)	
σ = 200	1310-810(3260-2760)	

TABLE 2-F

RADIOCARBON AGE BP 2860 CALIBRATED AGE: cal BC 1021
cal BP 2970

Sample σ and cal BC(cal BP) ranges:

σ = 20	1047-1002(2996-2951)	
σ = 40	1094-992(3043-2941)	
σ = 60	1125-932(3074-2881)	
σ = 80	1160-920(3109-2869)	
σ = 100	1253-1245(3202-3194)	1220-910(3170-2860)
σ = 120	1260-900(3210-2850)	
σ = 160	1300-840(3250-2790)	
σ = 200	1382-1341(3331-3290)	1320-820(3270-2770)

RADIOCARBON AGE BP 2880 CALIBRATED AGE: cal BC 1045
cal BP 2994

Sample σ and cal BC(cal BP) ranges:

σ = 20	1095-1016(3044-2965)	
σ = 40	1125-1002(3074-2951)	
σ = 60	1160-992(3109-2941)	
σ = 80	1253-1245(3202-3194)	1216-932(3165-2881)
σ = 100	1260-920(3210-2870)	
σ = 120	1260-910(3210-2860)	
σ = 160	1310-850(3260-2800)	
σ = 200	1390-830(3340-2780)	

RADIOCARBON AGE BP 2900 CALIBRATED AGE: cal BC 1093
cal BP 3042

Sample σ and cal BC(cal BP) ranges:

σ = 20	1125-1043(3074-2992)	
σ = 40	1160-1020(3109-2969)	
σ = 60	1252-1245(3201-3194)	1216-1003(3165-2952)
σ = 80	1258-992(3207-2941)	
σ = 100	1260-980(3210-2930)	965-933(2914-2882)
σ = 120	1300-920(3250-2870)	
σ = 160	1382-1341(3331-3290)	1320-900(3270-2850)
σ = 200	1410-840(3360-2790)	

RADIOCARBON AGE BP 2920 CALIBRATED AGES: cal BC 1124, 1113, 1108
cal BP 3073, 3062, 3057

Sample σ and cal BC(cal BP) ranges:

σ = 20	1161-1091(3110-3040)	
σ = 40	1253-1245(3202-3194)	1216-1044(3165-2993)
σ = 60	1258-1020(3207-2969)	
σ = 80	1264-1003(3213-2952)	
σ = 100	1300-990(3250-2940)	
σ = 120	1310-980(3260-2930)	965-933(2914-2882)
σ = 160	1390-910(3340-2860)	
σ = 200	1420-850(3370-2800)	

TABLE 2-G

RADIOCARBON AGE BP 2940 CALIBRATED AGES: cal BC 1159, 1142, 1138
cal BP 3108, 3091, 3087

Sample σ and cal BC(cal BP) ranges:

σ = 20	1253-1244(3202-3193)	1217-1106(3166-3055)
σ = 40	1258-1092(3207-3041)	
σ = 60	1264-1044(3213-2993)	
σ = 80	1300-1020(3249-2969)	
σ = 100	1310-1000(3260-2950)	
σ = 120	1382-1341(3331-3290)	1320-990(3270-2940)
σ = 160	1410-920(3360-2870)	
σ = 200	1420-900(3370-2850)	

RADIOCARBON AGE BP 2960 CALIBRATED AGES: cal BC 1252, 1245, 1216
cal BP 3201, 3194, 3165

Sample σ and cal BC(cal BP) ranges:

σ = 20	1259-1157(3208-3106)	1144-1135(3093-3084)
σ = 40	1264-1107(3213-3056)	
σ = 60	1301-1092(3250-3041)	
σ = 80	1357-1350(3306-3299)	1314-1044(3263-2993)
σ = 100	1382-1340(3331-3289)	1320-1020(3270-2970)
σ = 120	1390-1000(3340-2950)	
σ = 160	1420-930(3370-2880)	
σ = 200	1430-910(3380-2860)	

RADIOCARBON AGE BP 2980 CALIBRATED AGES: cal BC 1258, 1235, 1226
cal BP 3207, 3184, 3175

Sample σ and cal BC(cal BP) ranges:

σ = 20	1264-1214(3213-3163)	1172-1169(3121-3118)
σ = 40	1302-1158(3251-3107)	1143-1136(3092-3085)
σ = 60	1368-1350(3317-3299)	1314-1107(3263-3056)
σ = 80	1382-1340(3331-3289)	1322-1092(3271-3041)
σ = 100	1390-1040(3340-2990)	
σ = 120	1410-1020(3360-2970)	
σ = 160	1420-990(3370-2940)	
σ = 200	1450-920(3400-2870)	

RADIOCARBON AGE BP 3000 CALIBRATED AGE: cal BC 1263
cal BP 3212

Sample σ and cal BC(cal BP) ranges:

σ = 20	1304-1257(3253-3206)	1237-1224(3186-3173)	
σ = 40	1370-1349(3319-3298)	1315-1215(3264-3164)	
σ = 60	1383-1340(3332-3289)	1322-1159(3271-3108)	1142-1137(3091-3086)
σ = 80	1395-1107(3344-3056)		
σ = 100	1410-1090(3360-3040)		
σ = 120	1420-1040(3370-2990)		
σ = 160	1430-1000(3380-2950)		
σ = 200	1507-1475(3456-3424)	1470-980(3420-2930)	965-933(2914-2882)

TABLE 2-H

RADIOCARBON AGE BP 3020 CALIBRATED AGES: cal BC 1300, 1276, 1269
cal BP 3249, 3225, 3218

Sample σ and cal BC(cal BP) ranges:

σ = 20	1372-1348(3321-3297)	1316-1262(3265-3211)	
σ = 40	1383-1340(3332-3289)	1322-1257(3271-3206)	1236-1224(3185-3173)
σ = 60	1395-1215(3344-3164)		
σ = 80	1407-1159(3356-3108)	1142-1137(3091-3086)	
σ = 100	1420-1110(3370-3060)		
σ = 120	1420-1090(3370-3040)		
σ = 160	1450-1020(3400-2970)		
σ = 200	1510-990(3460-2940)		

RADIOCARBON AGE BP 3040 CALIBRATED AGE: cal BC 1314
cal BP 3263

Sample σ and cal BC(cal BP) ranges:

σ = 20	1384-1339(3333-3288)	1323-1295(3272-3244)	1283-1268(3232-3217)
σ = 40	1395-1263(3344-3212)		
σ = 60	1407-1257(3356-3206)	1236-1225(3185-3174)	
σ = 80	1416-1215(3365-3164)		
σ = 100	1420-1160(3370-3110)	1142-1137(3091-3086)	
σ = 120	1430-1110(3380-3060)		
σ = 160	1510-1040(3460-2990)		
σ = 200	1520-1000(3470-2950)		

RADIOCARBON AGE BP 3060 CALIBRATED AGES: cal BC 1382, 1341, 1321
cal BP 3331, 3290, 3270

Sample σ and cal BC(cal BP) ranges:

σ = 20	1397-1312(3346-3261)		
σ = 40	1407-1297(3356-3246)	1280-1268(3229-3217)	
σ = 60	1416-1263(3365-3212)		
σ = 80	1424-1258(3373-3207)	1236-1225(3185-3174)	
σ = 100	1430-1220(3380-3170)		
σ = 120	1450-1160(3400-3110)	1142-1137(3091-3086)	
σ = 160	1510-1090(3460-3040)		
σ = 200	1520-1020(3470-2970)		

RADIOCARBON AGE BP 3080 CALIBRATED AGES: cal BC 1394, 1331, 1329
cal BP 3343, 3280, 3278

Sample σ and cal BC(cal BP) ranges:

σ = 20	1408-1379(3357-3328)	1343-1320(3292-3269)	
σ = 40	1416-1313(3365-3262)		
σ = 60	1424-1298(3373-3247)	1278-1268(3227-3217)	
σ = 80	1434-1263(3383-3212)		
σ = 100	1450-1260(3400-3210)	1235-1225(3184-3174)	
σ = 120	1510-1220(3460-3170)		
σ = 160	1520-1120(3470-3070)	1113-1108(3062-3057)	
σ = 200	1591-1570(3540-3519)	1530-1040(3480-2990)	

TABLE 2-I

RADIOCARBON AGE BP 3100 CALIBRATED AGE: cal BC 1406
cal BP 3355

Sample σ and cal BC(cal BP) ranges:

σ = 20	1417-1392(3366-3341)	1333-1328(3282-3277)	
σ = 40	1425-1381(3374-3330)	1342-1321(3291-3270)	
σ = 60	1434-1313(3383-3262)		
σ = 80	1445-1299(3394-3248)	1278-1269(3227-3218)	
σ = 100	1510-1260(3460-3210)		
σ = 120	1510-1260(3460-3210)	1235-1225(3184-3174)	
σ = 160	1520-1160(3470-3110)	1142-1137(3091-3086)	
σ = 200	1607-1554(3556-3503)	1540-1090(3490-3040)	

RADIOCARBON AGE BP 3120 CALIBRATED AGE: cal BC 1416
cal BP 3365

Sample σ and cal BC(cal BP) ranges:

σ = 20	1425-1404(3374-3353)		
σ = 40	1434-1393(3383-3342)	1332-1328(3281-3277)	
σ = 60	1446-1381(3395-3330)	1341-1321(3290-3270)	
σ = 80	1508-1314(3457-3263)		
σ = 100	1510-1300(3460-3250)	1277-1269(3226-3218)	
σ = 120	1520-1260(3470-3210)		
σ = 160	1591-1570(3540-3519)	1530-1220(3480-3170)	
σ = 200	1620-1120(3570-3070)	1113-1108(3062-3057)	

RADIOCARBON AGE BP 3140 CALIBRATED AGE: cal BC 1424
cal BP 3373

Sample σ and cal BC(cal BP) ranges:

σ = 20	1435-1414(3384-3363)		
σ = 40	1446-1405(3395-3354)		
σ = 60	1508-1393(3457-3342)	1332-1329(3281-3278)	
σ = 80	1514-1381(3463-3330)	1341-1321(3290-3270)	
σ = 100	1520-1310(3470-3260)		
σ = 120	1520-1300(3470-3250)	1277-1269(3226-3218)	
σ = 160	1610-1260(3560-3210)	1235-1225(3184-3174)	
σ = 200	1640-1160(3590-3110)	1142-1138(3091-3087)	

RADIOCARBON AGE BP 3160 CALIBRATED AGE: cal BC 1433
cal BP 3382

Sample σ and cal BC(cal BP) ranges:

σ = 20	1446-1423(3395-3372)		
σ = 40	1508-1415(3457-3364)		
σ = 60	1514-1405(3463-3354)		
σ = 80	1519-1394(3468-3343)	1332-1329(3281-3278)	
σ = 100	1520-1380(3470-3330)	1341-1321(3290-3270)	
σ = 120	1591-1570(3540-3519)	1530-1310(3480-3260)	
σ = 160	1620-1260(3570-3210)		
σ = 200	1680-1220(3630-3170)		

TABLE 2-J

RADIOCARBON AGE BP 3180 CALIBRATED AGE: cal BC 1445
cal BP 3394

Sample σ and cal BC(cal BP) ranges:

σ = 20	1510-1432(3459-3381)		
σ = 40	1514-1423(3463-3372)		
σ = 60	1519-1415(3468-3364)		
σ = 80	1523-1406(3472-3355)		
σ = 100	1591-1570(3540-3519)	1530-1390(3480-3340)	1332-1329(3281-3278)
σ = 120	1610-1380(3560-3330)	1341-1321(3290-3270)	
σ = 160	1640-1300(3590-3250)	1277-1269(3226-3218)	
σ = 200	1690-1260(3640-3210)	1235-1225(3184-3174)	

RADIOCARBON AGE BP 3200 CALIBRATED AGES: cal BC 1506, 1476, 1464
cal BP 3455, 3425, 3413

Sample σ and cal BC(cal BP) ranges:

σ = 20	1515-1443(3464-3392)		
σ = 40	1519-1432(3468-3381)		
σ = 60	1524-1423(3473-3372)		
σ = 80	1591-1570(3540-3519)	1528-1415(3477-3364)	
σ = 100	1610-1410(3560-3360)		
σ = 120	1620-1390(3570-3340)	1332-1329(3281-3278)	
σ = 160	1680-1310(3630-3260)		
σ = 200	1734-1721(3683-3670)	1700-1260(3650-3210)	

RADIOCARBON AGE BP 3220 CALIBRATED AGE: cal BC 1514
cal BP 3463

Sample σ and cal BC(cal BP) ranges:

σ = 20	1520-1500(3469-3449)	1481-1459(3430-3408)	
σ = 40	1524-1444(3473-3393)		
σ = 60	1591-1569(3540-3518)	1528-1432(3477-3381)	
σ = 80	1607-1423(3556-3372)		
σ = 100	1620-1420(3570-3370)		
σ = 120	1640-1410(3590-3360)		
σ = 160	1690-1380(3640-3330)	1341-1321(3290-3270)	
σ = 200	1740-1300(3690-3250)	1277-1269(3226-3218)	

RADIOCARBON AGE BP 3240 CALIBRATED AGE: cal BC 1519
cal BP 3468

Sample σ and cal BC(cal BP) ranges:

σ = 20	1524-1513(3473-3462)		
σ = 40	1592-1569(3541-3518)	1528-1503(3477-3452)	1478-1462(3427-3411)
σ = 60	1608-1444(3557-3393)		
σ = 80	1622-1433(3571-3382)		
σ = 100	1640-1420(3590-3370)		
σ = 120	1680-1420(3630-3370)		
σ = 160	1734-1721(3683-3670)	1700-1390(3650-3340)	1332-1329(3281-3278)
σ = 200	1750-1310(3700-3260)		

TABLE 2-K

RADIOCARBON AGE BP 3260 CALIBRATED AGE: cal BC 1523
cal BP 3472

Sample σ and cal BC(cal BP) ranges:

σ = 20	1593-1567(3542-3516)	1529-1518(3478-3467)	
σ = 40	1608-1514(3557-3463)		
σ = 60	1622-1504(3571-3453)	1477-1463(3426-3412)	
σ = 80	1644-1444(3593-3393)		
σ = 100	1680-1430(3630-3380)		
σ = 120	1690-1420(3640-3370)		
σ = 160	1740-1410(3690-3360)		
σ = 200	1852-1850(3801-3799)	1760-1380(3710-3330)	1341-1321(3290-3270)

RADIOCARBON AGE BP 3280 CALIBRATED AGES: cal BC 1590, 1579, 1528
cal BP 3539, 3528, 3477

Sample σ and cal BC(cal BP) ranges:

σ = 20	1610-1522(3559-3471)		
σ = 40	1623-1518(3572-3467)		
σ = 60	1645-1514(3594-3463)		
σ = 80	1678-1505(3627-3454)	1477-1463(3426-3412)	
σ = 100	1690-1440(3640-3390)		
σ = 120	1734-1721(3683-3670)	1700-1430(3650-3380)	
σ = 160	1750-1420(3700-3370)		
σ = 200	1872-1842(3821-3791)	1813-1806(3762-3755)	1780-1390(3730-3340)
	1331-1329(3280-3278)		

RADIOCARBON AGE BP 3300 CALIBRATED AGES: cal BC 1607, 1554, 1543
cal BP 3556, 3503, 3492

Sample σ and cal BC(cal BP) ranges:

σ = 20	1624-1527(3573-3476)		
σ = 40	1670-1665(3619-3614)	1646-1523(3595-3472)	
σ = 60	1678-1518(3627-3467)		
σ = 80	1685-1514(3634-3463)		
σ = 100	1734-1721(3683-3670)	1700-1500(3650-3450)	1477-1463(3426-3412)
σ = 120	1740-1440(3690-3390)		
σ = 160	1852-1849(3801-3798)	1760-1420(3710-3370)	
σ = 200	1880-1410(3830-3360)		

RADIOCARBON AGE BP 3320 CALIBRATED AGE: cal BC 1621
cal BP 3570

Sample σ and cal BC(cal BP) ranges:

σ = 20	1671-1604(3620-3553)	1557-1540(3506-3489)	
σ = 40	1678-1528(3627-3477)		
σ = 60	1685-1523(3634-3472)		
σ = 80	1734-1721(3683-3670)	1698-1518(3647-3467)	
σ = 100	1740-1510(3690-3460)		
σ = 120	1750-1510(3700-3460)	1476-1464(3425-3413)	
σ = 160	1872-1842(3821-3791)	1813-1806(3762-3755)	1780-1430(3730-3380)
σ = 200	1880-1420(3830-3370)		

TABLE 2-L

RADIOCARBON AGE BP 3340 CALIBRATED AGE: cal BC 1643
cal BP 3592

Sample σ and cal BC(cal BP) ranges:

σ = 20	1678-1619(3627-3568)		
σ = 40	1686-1605(3635-3554)	1556-1542(3505-3491)	
σ = 60	1734-1721(3683-3670)	1698-1528(3647-3477)	
σ = 80	1740-1523(3689-3472)		
σ = 100	1750-1520(3700-3470)		
σ = 120	1852-1850(3801-3799)	1760-1510(3710-3460)	
σ = 160	1880-1440(3830-3390)		
σ = 200	1890-1420(3840-3370)		

RADIOCARBON AGE BP 3360 CALIBRATED AGE: cal BC 1677
cal BP 3626

Sample σ and cal BC(cal BP) ranges:

σ = 20	1686-1636(3635-3585)		
σ = 40	1734-1720(3683-3669)	1699-1620(3648-3569)	
σ = 60	1740-1605(3689-3554)	1555-1542(3504-3491)	
σ = 80	1747-1528(3696-3477)		
σ = 100	1852-1849(3801-3798)	1760-1520(3710-3470)	
σ = 120	1872-1842(3821-3791)	1813-1806(3762-3755)	1780-1520(3730-3470)
σ = 160	1880-1510(3830-3460)	1476-1464(3425-3413)	
σ = 200	1910-1430(3860-3380)		

RADIOCARBON AGE BP 3380 CALIBRATED AGE: cal BC 1685
cal BP 3634

Sample σ and cal BC(cal BP) ranges:

σ = 20	1735-1718(3684-3667)	1700-1676(3649-3625)	
σ = 40	1741-1639(3690-3588)		
σ = 60	1747-1620(3696-3569)		
σ = 80	1853-1849(3802-3798)	1763-1606(3712-3555)	1555-1542(3504-3491)
σ = 100	1872-1842(3821-3791)	1813-1806(3762-3755)	1780-1530(3730-3480)
σ = 120	1880-1520(3830-3470)		
σ = 160	1890-1510(3840-3460)		
σ = 200	1940-1440(3890-3390)		

RADIOCARBON AGE BP 3400 CALIBRATED AGES: cal BC 1733, 1721, 1697
cal BP 3682, 3670, 3646

Sample σ and cal BC(cal BP) ranges:

σ = 20	1741-1683(3690-3632)		
σ = 40	1747-1676(3696-3625)		
σ = 60	1853-1849(3802-3798)	1763-1640(3712-3589)	
σ = 80	1872-1842(3821-3791)	1813-1806(3762-3755)	1778-1620(3727-3569)
σ = 100	1880-1610(3830-3560)	1555-1542(3504-3491)	
σ = 120	1880-1530(3830-3480)		
σ = 160	1910-1520(3860-3470)		
σ = 200	1960-1510(3910-3460)	1476-1464(3425-3413)	

TABLE 2-M

RADIOCARBON AGE BP 3420 CALIBRATED AGE: cal BC 1740
cal BP 3689

Sample σ and cal BC(cal BP) ranges:

σ = 20	1747-1693(3696-3642)		
σ = 40	1854-1849(3803-3798)	1764-1684(3713-3633)	
σ = 60	1872-1841(3821-3790)	1813-1806(3762-3755)	1778-1677(3727-3626)
σ = 80	1878-1641(3827-3590)		
σ = 100	1880-1620(3830-3570)		
σ = 120	1890-1610(3840-3560)	1555-1543(3504-3492)	
σ = 160	1940-1520(3890-3470)		
σ = 200	2019-2002(3968-3951)	1980-1510(3930-3460)	

RADIOCARBON AGE BP 3440 CALIBRATED AGE: cal BC 1746
cal BP 3695

Sample σ and cal BC(cal BP) ranges:

σ = 20	1856-1848(3805-3797)	1766-1739(3715-3688)	
σ = 40	1872-1841(3821-3790)	1814-1805(3763-3754)	1778-1695(3727-3644)
σ = 60	1878-1685(3827-3634)		
σ = 80	1883-1677(3832-3626)		
σ = 100	1890-1640(3840-3590)		
σ = 120	1910-1620(3860-3570)		
σ = 160	1960-1530(3910-3480)		
σ = 200	2030-1520(3980-3470)		

RADIOCARBON AGE BP 3460 CALIBRATED AGES: cal BC 1851, 1850, 1761
cal BP 3800, 3799, 3710

Sample σ and cal BC(cal BP) ranges:

σ = 20	1873-1841(3822-3790)	1815-1804(3764-3753)	1779-1745(3728-3694)
σ = 40	1878-1739(3827-3688)		
σ = 60	1883-1733(3832-3682)	1722-1696(3671-3645)	
σ = 80	1889-1685(3838-3634)		
σ = 100	1910-1680(3860-3630)		
σ = 120	1940-1640(3890-3590)		
σ = 160	2019-2002(3968-3951)	1980-1610(3930-3560)	1555-1543(3504-3492)
σ = 200	2040-1520(3990-3470)		

RADIOCARBON AGE BP 3480 CALIBRATED AGES: cal BC 1872, 1842, 1813, 1807, 1777
cal BP 3821, 3791, 3762, 3756, 3726

Sample σ and cal BC(cal BP) ranges:

σ = 20	1878-1757(3827-3706)		
σ = 40	1883-1746(3832-3695)		
σ = 60	1889-1739(3838-3688)		
σ = 80	1909-1733(3858-3682)	1722-1696(3671-3645)	
σ = 100	1940-1680(3890-3630)		
σ = 120	1960-1680(3910-3630)		
σ = 160	2030-1620(3980-3570)		
σ = 200	2123-2080(4072-4029)	2040-1530(3990-3480)	

TABLE 2-N

RADIOCARBON AGE BP 3500 CALIBRATED AGES: cal BC 1877, 1834, 1824, 1793, 1788
cal BP 3826, 3783, 3773, 3742, 3737

Sample σ and cal BC(cal BP) ranges:

σ = 20	1884-1871(3833-3820)	1843-1775(3792-3724)	
σ = 40	1889-1759(3838-3708)		
σ = 60	1909-1746(3858-3695)		
σ = 80	1937-1740(3886-3689)		
σ = 100	1960-1730(3910-3680)	1722-1696(3671-3645)	
σ = 120	2019-2002(3968-3951)	1980-1680(3930-3630)	
σ = 160	2040-1640(3990-3590)		
σ = 200	2133-2066(4082-4015)	2050-1610(4000-3560)	1555-1543(3504-3492)

RADIOCARBON AGE BP 3520 CALIBRATED AGE: cal BC 1883
cal BP 3832

Sample σ and cal BC(cal BP) ranges:

σ = 20	1889-1876(3838-3825)	1835-1822(3784-3771)	1795-1786(3744-3735)
σ = 40	1910-1871(3859-3820)	1843-1776(3792-3725)	
σ = 60	1938-1760(3887-3709)		
σ = 80	1962-1746(3911-3695)		
σ = 100	2019-2002(3968-3951)	1980-1740(3930-3690)	
σ = 120	2030-1730(3980-3680)	1722-1696(3671-3645)	
σ = 160	2123-2080(4072-4029)	2040-1680(3990-3630)	
σ = 200	2140-1620(4090-3570)		

RADIOCARBON AGE BP 3540 CALIBRATED AGE: cal BC 1888
cal BP 3837

Sample σ and cal BC(cal BP) ranges:

σ = 20	1913-1882(3862-3831)		
σ = 40	1938-1877(3887-3826)	1835-1823(3784-3772)	1794-1787(3743-3736)
σ = 60	1963-1872(3912-3821)	1842-1776(3791-3725)	
σ = 80	2019-2001(3968-3950)	1980-1760(3929-3709)	
σ = 100	2030-1750(3980-3700)		
σ = 120	2040-1740(3990-3690)		
σ = 160	2133-2066(4082-4015)	2050-1680(4000-3630)	
σ = 200	2182-2166(4131-4115)	2140-1640(4090-3590)	

RADIOCARBON AGE BP 3560 CALIBRATED AGE: cal BC 1908
cal BP 3857

Sample σ and cal BC(cal BP) ranges:

σ = 20	1941-1887(3890-3836)		
σ = 40	1964-1882(3913-3831)		
σ = 60	2019-2001(3968-3950)	1981-1877(3930-3826)	1835-1823(3784-3772)
	1794-1787(3743-3736)		
σ = 80	2032-1872(3981-3821)	1842-1777(3791-3726)	
σ = 100	2040-1760(3990-3710)		
σ = 120	2123-2080(4072-4029)	2040-1750(3990-3700)	
σ = 160	2140-1730(4090-3680)	1722-1696(3671-3645)	
σ = 200	2190-1680(4140-3630)		

TABLE 2-O

RADIOCARBON AGE BP 3580 CALIBRATED AGE: cal BC 1936
cal BP 3885

Sample σ and cal BC(cal BP) ranges:

σ = 20	1966-1904(3915-3853)			
σ = 40	2020-2001(3969-3950)	1981-1888(3930-3837)		
σ = 60	2032-1882(3981-3831)			
σ = 80	2037-1877(3986-3826)	1835-1823(3784-3772)	1794-1787(3743-3736)	
σ = 100	2123-2080(4072-4029)	2040-1870(3990-3820)	1842-1777(3791-3726)	
σ = 120	2133-2066(4082-4015)	2050-1760(4000-3710)		
σ = 160	2182-2166(4131-4115)	2140-1740(4090-3690)		
σ = 200	2200-1680(4150-3630)			

RADIOCARBON AGE BP 3600 CALIBRATED AGE: cal BC 1961
cal BP 3910

Sample σ and cal BC(cal BP) ranges:

σ = 20	2022-1999(3971-3948)	1982-1932(3931-3881)	
σ = 40	2032-1905(3981-3854)		
σ = 60	2037-1888(3986-3837)		
σ = 80	2124-2079(4073-4028)	2042-1883(3991-3832)	
σ = 100	2133-2065(4082-4014)	2050-1880(4000-3830)	1834-1824(3783-3773)
	1794-1787(3743-3736)		
σ = 120	2140-1870(4090-3820)	1842-1777(3791-3726)	
σ = 160	2200-1750(4150-3700)		
σ = 200	2278-2233(4227-4182)	2210-1730(4160-3680)	1722-1696(3671-3645)

RADIOCARBON AGE BP 3620 CALIBRATED AGES: cal BC 2018, 2002, 1980
cal BP 3967, 3951, 3929

Sample σ and cal BC(cal BP) ranges:

σ = 20	2033-1954(3982-3903)		
σ = 40	2037-1934(3986-3883)		
σ = 60	2124-2079(4073-4028)	2042-1906(3991-3855)	
σ = 80	2133-2065(4082-4014)	2047-1888(3996-3837)	
σ = 100	2140-1880(4090-3830)		
σ = 120	2183-2166(4132-4115)	2140-1880(4090-3830)	1834-1824(3783-3773)
	1794-1787(3743-3736)		
σ = 160	2200-1760(4150-3710)		
σ = 200	2290-1740(4240-3690)		

RADIOCARBON AGE BP 3640 CALIBRATED AGE: cal BC 2032
cal BP 3981

Sample σ and cal BC(cal BP) ranges:

σ = 20	2096-2089(4045-4038)	2038-2015(3987-3964)	2005-1977(3954-3926)	
σ = 40	2125-2079(4074-4028)	2042-1958(3991-3907)		
σ = 60	2133-2065(4082-4014)	2047-1935(3996-3884)		
σ = 80	2138-1907(4087-3856)			
σ = 100	2182-2166(4131-4115)	2140-1890(4090-3840)		
σ = 120	2200-1880(4150-3830)			
σ = 160	2278-2233(4227-4182)	2210-1870(4160-3820)	1842-1777(3791-3726)	
σ = 200	2320-1750(4270-3700)			

TABLE 2-P

RADIOCARBON AGE BP 3660 CALIBRATED AGE: cal BC 2037
cal BP 3986

Sample σ	and cal BC(cal BP) ranges:		
σ = 20	2126-2078(4075-4027)	2043-2031(3992-3980)	
σ = 40	2133-2064(4082-4013)	2048-2017(3997-3966)	2004-1978(3953-3927)
σ = 60	2138-1959(4087-3908)		
σ = 80	2183-2166(4132-4115)	2142-1935(4091-3884)	
σ = 100	2200-1910(4150-3860)		
σ = 120	2200-1890(4150-3840)		
σ = 160	2290-1880(4240-3830)	1834-1824(3783-3773)	1794-1787(3743-3736)
σ = 200	2340-1760(4290-3710)		

RADIOCARBON AGE BP 3680 CALIBRATED AGES: cal BC 2123, 2080, 2042
cal BP 4072, 4029, 3991

Sample σ	and cal BC(cal BP) ranges:		
σ = 20	2134-2061(4083-4010)	2048-2036(3997-3985)	
σ = 40	2138-2031(4087-3980)		
σ = 60	2183-2165(4132-4114)	2143-2017(4092-3966)	2003-1979(3952-3928)
σ = 80	2195-1959(4144-3908)		
σ = 100	2200-1940(4150-3890)		
σ = 120	2279-2233(4228-4182)	2210-1910(4160-3860)	
σ = 160	2320-1880(4270-3830)		
σ = 200	2453-2423(4402-4372)	2400-1870(4350-3820)	1842-1777(3791-3726)

RADIOCARBON AGE BP 3700 CALIBRATED AGES: cal BC 2133, 2067, 2047
cal BP 4082, 4016, 3996

Sample σ	and cal BC(cal BP) ranges:		
σ = 20	2138-2119(4087-4068)	2082-2041(4031-3990)	
σ = 40	2184-2165(4133-4114)	2143-2036(4092-3985)	
σ = 60	2195-2031(4144-3980)		
σ = 80	2202-2017(4151-3966)	2003-1979(3952-3928)	
σ = 100	2279-2232(4228-4181)	2210-1960(4160-3910)	
σ = 120	2290-1940(4240-3890)		
σ = 160	2340-1890(4290-3840)		
σ = 200	2460-1880(4410-3830)	1834-1824(3783-3773)	1793-1787(3742-3736)

RADIOCARBON AGE BP 3720 CALIBRATED AGE: cal BC 2138
cal BP 4087

Sample σ	and cal BC(cal BP) ranges:		
σ = 20	2186-2164(4135-4113)	2143-2132(4092-4081)	2071-2046(4020-3995)
σ = 40	2195-2121(4144-4070)	2081-2041(4030-3990)	
σ = 60	2202-2036(4151-3985)		
σ = 80	2279-2232(4228-4181)	2209-2031(4158-3980)	
σ = 100	2290-2020(4240-3970)	2003-1979(3952-3928)	
σ = 120	2320-1960(4270-3910)		
σ = 160	2453-2423(4402-4372)	2400-1910(4350-3860)	
σ = 200	2460-1880(4410-3830)		

TABLE 2-Q

RADIOCARBON AGE BP 3740 CALIBRATED AGES: cal BC 2181, 2166, 2142
cal BP 4130, 4115, 4091

Sample σ	and cal BC(cal BP) ranges:		
σ = 20	2196-2137(4145-4086)		
σ = 40	2202-2132(4151-4081)	2069-2047(4018-3996)	
σ = 60	2279-2232(4228-4181)	2209-2122(4158-4071)	2081-2042(4030-3991)
σ = 80	2289-2037(4238-3986)		
σ = 100	2320-2030(4270-3980)		
σ = 120	2340-2020(4290-3970)	2003-1979(3952-3928)	
σ = 160	2460-1940(4410-3890)		
σ = 200	2470-1890(4420-3840)		

RADIOCARBON AGE BP 3760 CALIBRATED AGES: cal BC 2195, 2156, 2147
cal BP 4144, 4105, 4096

Sample σ	and cal BC(cal BP) ranges:		
σ = 20	2203-2142(4152-4091)		
σ = 40	2279-2232(4228-4181)	2209-2137(4158-4086)	
σ = 60	2289-2133(4238-4082)	2068-2047(4017-3996)	
σ = 80	2317-2122(4266-4071)	2081-2042(4030-3991)	
σ = 100	2340-2040(4290-3990)		
σ = 120	2453-2423(4402-4372)	2400-2030(4350-3980)	
σ = 160	2460-1960(4410-3910)		
σ = 200	2470-1910(4420-3860)		

RADIOCARBON AGE BP 3780 CALIBRATED AGE: cal BC 2202
cal BP 4151

Sample σ	and cal BC(cal BP) ranges:		
σ = 20	2279-2231(4228-4180)	2210-2194(4159-4143)	2158-2146(4107-4095)
σ = 40	2289-2180(4238-4129)	2167-2142(4116-4091)	
σ = 60	2318-2137(4267-4086)		
σ = 80	2344-2133(4293-4082)	2068-2047(4017-3996)	
σ = 100	2453-2423(4402-4372)	2400-2120(4350-4070)	2080-2042(4029-3991)
σ = 120	2460-2040(4410-3990)		
σ = 160	2470-2020(4420-3970)	2002-1980(3951-3929)	
σ = 200	>2490-1940(>4440-3890)		

RADIOCARBON AGE BP 3800 CALIBRATED AGES: cal BC 2278, 2233, 2209
cal BP 4227, 4182, 4158

Sample σ	and cal BC(cal BP) ranges:		
σ = 20	2290-2201(4239-4150)		
σ = 40	2320-2194(4269-4143)	2157-2146(4106-4095)	
σ = 60	2344-2180(4293-4129)	2167-2142(4116-4091)	
σ = 80	2453-2423(4402-4372)	2399-2137(4348-4086)	
σ = 100	2460-2130(4410-4080)	2068-2047(4017-3996)	
σ = 120	2460-2120(4410-4070)	2080-2042(4029-3991)	
σ = 160	2470-2030(4420-3980)		
σ = 200	>2490-1960(>4440-3910)		

TABLE 2-R

RADIOCARBON AGE BP 3820 CALIBRATED AGE: cal BC 2288
cal BP 4237

Sample σ and cal BC(cal BP) ranges:

σ = 20	2325-2276(4274-4225)	2238-2207(4187-4156)
σ = 40	2345-2201(4294-4150)	
σ = 60	2453-2422(4402-4371)	2399-2194(4348-4143) 2157-2147(4106-4096)
σ = 80	2458-2180(4407-4129)	2167-2142(4116-4091)
σ = 100	2460-2140(4410-4090)	
σ = 120	2470-2130(4420-4080)	2068-2047(4017-3996)
σ = 160	>2490-2040(>4440-3990)	
σ = 200	>2490-2020(>4440-3970)	2003-1979(3952-3928)

RADIOCARBON AGE BP 3840 CALIBRATED AGE: cal BC 2316
cal BP 4265

Sample σ and cal BC(cal BP) ranges:

σ = 20	2347-2286(4296-4235)	
σ = 40	2454-2422(4403-4371)	2400-2277(4349-4226) 2236-2208(4185-4157)
σ = 60	2458-2201(4407-4150)	
σ = 80	2462-2194(4411-4143)	2157-2147(4106-4096)
σ = 100	2470-2180(4420-4130)	2166-2142(4115-4091)
σ = 120	2470-2140(4420-4090)	
σ = 160	>2490-2120(>4440-4070)	2080-2042(4029-3991)
σ = 200	>2490-2030(>4440-3980)	

RADIOCARBON AGE BP 3860 CALIBRATED AGE: cal BC 2343
cal BP 4292

Sample σ and cal BC(cal BP) ranges:

σ = 20	2454-2421(4403-4370)	2401-2309(4350-4258)
σ = 40	2458-2287(4407-4236)	
σ = 60	2462-2278(4411-4227)	2235-2208(4184-4157)
σ = 80	2466-2201(4415-4150)	
σ = 100	2470-2190(4420-4140)	2157-2147(4106-4096)
σ = 120	>2490-2180(>4440-4130)	2166-2142(4115-4091)
σ = 160	>2490-2130(>4440-4080)	2067-2047(4016-3996)
σ = 200	>2490-2040(>4440-3990)	

RADIOCARBON AGE BP 3880 CALIBRATED AGES: cal BC 2453, 2423, 2398
cal BP 4402, 4372, 4347

Sample σ and cal BC(cal BP) ranges:

σ = 20	2458-2340(4407-4289)	
σ = 40	2462-2311(4411-4260)	
σ = 60	2466-2288(4415-4237)	
σ = 80	2471-2278(4420-4227)	2234-2208(4183-4157)
σ = 100	>2490-2200(>4440-4150)	
σ = 120	>2490-2190(>4440-4140)	2157-2147(4106-4096)
σ = 160	>2490-2140(>4440-4090)	
σ = 200	>2490-2120(>4440-4070)	2080-2042(4029-3991)

TABLE 2-S

RADIOCARBON AGE BP 3900 CALIBRATED AGE: cal BC 2457
cal BP 4406

Sample σ and cal BC(cal BP) ranges:

σ = 20	2462-2452(4411-4401)	2426-2396(4375-4345)
σ = 40	2466-2342(4415-4291)	
σ = 60	2471-2313(4420-4262)	
σ = 80	>2490-2288(>4439-4237)	
σ = 100	>2490-2280(>4440-4230)	2234-2209(4183-4158)
σ = 120	>2490-2200(>4440-4150)	
σ = 160	>2490-2180(>4440-4130)	2166-2142(4115-4091)
σ = 200	>2490-2130(>4440-4080)	2067-2047(4016-3996)

RADIOCARBON AGE BP 3920 CALIBRATED AGE: cal BC 2462
cal BP 4411

Sample σ and cal BC(cal BP) ranges:

σ = 20	2466-2457(4415-4406)	2411-2409(4360-4358)
σ = 40	2472-2453(4421-4402)	2425-2397(4374-4346)
σ = 60	>2490-2342(>4439-4291)	
σ = 80	>2490-2314(>4439-4263)	
σ = 100	>2490-2290(>4440-4240)	
σ = 120	>2490-2280(>4440-4230)	2234-2209(4183-4158)
σ = 160	>2490-2190(>4440-4140)	2157-2147(4106-4096)
σ = 200	>2490-2140(>4440-4090)	

RADIOCARBON AGE BP 3940 CALIBRATED AGE: cal BC 2466
cal BP 4415

Sample σ and cal BC(cal BP) ranges:

σ = 20	2474-2461(4423-4410)	
σ = 40	>2490-2457(>4439-4406)	
σ = 60	>2490-2453(>4439-4402)	2424-2398(4373-4347)
σ = 80	>2490-2342(>4439-4291)	
σ = 100	>2490-2310(>4440-4260)	
σ = 120	>2490-2290(>4440-4240)	
σ = 160	>2490-2200(>4440-4150)	
σ = 200	>2490-2180(>4440-4130)	2166-2142(4115-4091)

RADIOCARBON AGE BP 3960 CALIBRATED AGE: cal BC 2470
cal BP 4419

Sample σ and cal BC(cal BP) ranges:

σ = 20	>2490-2465(>4439-4414)	
σ = 40	>2490-2461(>4439-4410)	
σ = 60	>2490-2457(>4439-4406)	
σ = 80	>2490-2453(>4439-4402)	2424-2398(4373-4347)
σ = 100	>2490-2340(>4440-4290)	
σ = 120	>2490-2310(>4440-4260)	
σ = 160	>2490-2280(>4440-4230)	2234-2209(4183-4158)
σ = 200	>2490-2190(>4440-4140)	2157-2147(4106-4096)