Fuday wreck dendrochronological / dating: Assessment report

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AOC Archaeology Group

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Assessment report

On Behalf of:	**Historic Scotland**
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Abstract

This report concerns the dating potential of samples from an unprotected shipwreck in the intertidal zone on the island of Fuday, Barra This ship is thought to be of Dutch origin from the period AD1500-1650. The assessment considers the suitability of the few *ad hoc* timber samples for dendrochronological analysis, and the degree of precision which might be obtained. Assessment of the radiocarbon dating potential of these samples and of a sample of organic luting was also undertaken.

The report makes a number of recommendations for the way forward. Radiocarbon dating is fraught with difficulties due to a combination of problems with the radiocarbon calibration curve at AD1500-1650 and the nature of the existing samples. It would be worthwhile attempting a dendrochronological analysis of the few existing samples, as this would be rapid and inexpensive. However, the samples are really too few and not of best dating quality, and obtaining a result is a longshot. At best, this analysis may provide a felling date range for the hull planking, which might not be original, a TPQ for felling of the internal framework and an indication of the provenance of the timber. It may also reveal any inter-relationships between the age and provenance of the different samples. At worst it provides data in the bank to assist analysis as more samples become available.

By far the strongest recommendation is to undertake a thorough dedicated recording and sampling programme at the site with the dendrochronologist present. This would maximise the dating potential for dendrochronology, which is by far the most promising dating method for achieving precision for this wreck. In the unlikely event that dendrochronology should not work with a larger, better assemblage, the same sampling exercise would provide much better material for any 'wiggle-matching' or other 'multiple samples' approach to refining radiocarbon dating.

The luting merits further specialist study, ideally with fresh material, and it may be possible to geo-provenance the clayey matrix with appropriate geological expertise. The putative moss component may also indicate provenance.

1. Introduction

1.1 This report concerns the dating of an unprotected wreck (NMRS Number: NF70NW 8004) in the intertidal zone on the island of Fuday, Barra, which is thought to be of probable Dutch origin and likely to date to the period AD1500-1650 (Prescott & Atkinson 2008). This dating assessment report was commissioned by Philip Robertson, Senior Inspector of Marine Archaeology, at Historic Scotland. The objective of the assessment is to consider the suitability of the existing *ad hoc* samples (Appendix 1) for dendrochronological analysis, and the degree of precision which might be obtained if dating proves possible. If the timbers have the potential to be dated, then they have the potential to be provenanced as well. The client also requested the assessment of the radiocarbon dating potential of the timber samples and of an additional organic sample of luting material (FHSU-08/04).

1.2 The samples were not purposefully taken for dating. The timbers are items which have been obtained in an *ad hoc* manner; three samples were pieces of timber collected by local crofters intending to use them for firewood (FHSU-01/01, 01/02 and 01/03) and a fourth was a detached piece of framing collected by the investigators during a visit in 2008 (Prescott *et al* 2008). In 2000 academic staff from the University of Sheffield had also recovered a fragment of loose planking. While they subsequently disposed of the sample, Ian Tyers, a dendrochronologist at Sheffield, did record the tree-ring sequence. The assessment aimed to discover if the tree-ring measurement data survived, as this would add a fifth 'virtual' sample to the ad hoc assemblage.

2. Method

2.1 An assessment visit was undertaken, with the investigators (Dan Atkinson and Robert Prescott), to inspect the samples and record some key characteristics. The samples were viewed at Headland Archaeology and University of St Andrews in early February 2009, and have since all been moved to Headland Archaeology. The characteristics are given in Appendix 2.

2.2 Advice was taken from Dr Gordon Cook regarding the potential for obtaining meaningful radiocarbon dates from this material, assuming a likely date range of AD1500-1650 for the vessel.

3. Assessment results

3.1 Four timber samples were visually assessed for dendrochronological potential (Appendix 2). At least two types of timber are present: squared timbers of fast-grown oak and a plank cut from a larger, slower grown oak. The possibility of obtaining dendro-dates from the squared timbers is marginal although not entirely impossible. They do not contain many rings; they are on the cusp of what is feasible to date using tree-ring dating methods. None of them appears to retain any sapwood, so even if they were dendro-dated, the year attributed to the outermost ring would allow a loose *Terminus Post Quem* (TPQ) for felling to be estimated. The plank sample FHSU-01/03 is a much more promising dendro-dating candidate. It has more rings (estimated at 95-100) and is probably of similar type to the timber previously retrieved by Sheffield University academic staff. Although that

sample is lost, fortunately the tree-ring sequence was measured and retained by Ian Tyers who has kindly forwarded a copy of the data to C Mills. If the two planking sequences prove to match each other, this improves the signal and increases the chance of dendro-dating and provenancing them. This is better than trying to date a single sequence, given these timbers may come from any number of countries. The planking Sample FHSU-01/03 appears to retain a few sapwood rings; this is important because it allows a much closer estimate of the felling date. If dated, this timber would yield a felling date range within a few decades, rather than the looser TPQs which would be derived from dating any of the assessed squared timbers. All this said, dating small numbers of timbers is always difficult; ideally dendrochronologists work with 10-20 samples per phase and sequences over 100 rings, and in any case some timbers just don't 'work'.

3.2 The context of the timbers and the meaning of any dates should also be considered. A ship can be a complex artefact, made up of original structure with later repairs and replacements. This issue was discussed with Robert Prescott and Dan Atkinson. In terms of pure sample quality, the best dendro-dating sample is FHSU-01/03 which is thought to be part of the hull planking and which could provide a fairly close felling-date range. However, the hull is far more likely to require repair and replacement work than the internal framework of the ship from which the squared timbers derive. Therefore, a dendro-date for the planking does not necessarily date the ship, although it would give an idea of the date before which (*Terminus Ante Quem*, TAQ) the ship was constructed. At this stage, it would probably be best to undertake a dendrochronoloigical analysis of all four timbers plus the Sheffield sequence. This is a smallish pieces of work and could be undertaken quite quickly, and thus inform decisions about future stages of investigation. This MIGHT provide dendro-date(s) but it would also allow comparison of the plank sequences with the squared timber sequences. It is just possible some inter-relationships could be revealed in terms of respective ages and sources. This could help guide future sampling strategies.

3.3 Advice was obtained on radiocarbon dating potential for the likely period of the ship's construction (AD1500-1650) from Dr Gordon Cook of SUERC. Dr Cook states that the calibration curve 'is a mixed bag' here. If lucky, one might hit a good linear part of the curve with a single sample but it would need to be a little earlier than 1500 AD. Dr Cook provided four calibrations to illustrate this (Appendix 4). At 450 +/- 30 BP there is a tight calibrated range of 1410-1480 AD (95% confidence). As younger ages are entered, one starts to hit the wiggles and flat spots and the calibration gets progressively worse. For example, calibration at 320+/-30 BP provides calendar date ranges of AD1480-1650 at 95% confidence limits (Appendix 4.4).

Dr Cook advises there are several possibilities for radiocarbon dating here:
A. If dating a single sample, go for a few outer rings which gives you the best estimate of the construction age . *(NB CM notes we have no intact outer edges of timbers in existing samples).*
B. Multiple analyses of the same sample would tighten the error and could help the calibration but not necessarily. *(NB CM notes we do not have outer rings preserved in existing samples so this would not be very meaningful)*
C. One could go for a sample of outer rings and a sample of inner rings in the hope that one of them hits a good bit of the curve and might help tie down the age. *(NB CM notes we do not have outer rings preserved, and the only sequence sufficiently long to provide a useful interval between inner and outer rings is the plank FHSU-01/03 which may be a replacement)*
D. If there were sufficient rings, one could try a wiggle match, ie make a number of measurements on decadal or sub-decadal increments and match the shape of the little bit of floating curve to the master C-14 curve. Dr Cook has done this successfully with a couple of building timbers for English

Heritage and also with a timber from Oakbank crannog. Single measurements for dating the crannog fell on the Iron Age plateau of the curve and gave a calibrated range covering c. 800-400 BC but with wiggle matching he reduced this to 520-465 BC. However, this is really expensive because one needs multiple measurements to achieve high precision. *(NB CM notes that the same comment as for Point C above applies – the current samples are not very suitable for wiggle matching)*

This advice is considered further in the discussion below.

4. Discussion

4.1 Given that it would not be expensive and it would be quick, it is worth attempting a dendro-dating exercise on the few *ad hoc* samples available at this stage, before deciding a next step. However, it is a very small assemblage, not taken with dating in mind, and there is only an outside chance of obtaining information on date and provenance at this stage. At best, a felling date range could be estimated for the plank FHSU-01/03, if dated, but the plank may or may not be from the original construction, it could be a repair. If it is dated, then at least a broad region of timber origin should be indicated by the statistics, if reference chronologies exist for its homeland, as they do for much of N Europe and Scandinavia. However, pinpointing source closely usually requires larger numbers of samples, to strengthen that 'home' signal. If dated at all, only TPQ dates could be ascribed to the other timbers from the 'ribs' of the ship, which are marginal candidates given how few rings they contain. All that said, any dendro-dates are likely to give much more precise dating information than any radiocarbon dates, given the severe problems with the calibration curve in the period AD1500-1650.

4.2 The best way to obtain precise and meaningful dating for this vessel is to undertake a proper and extensive sampling and recording programme in the field, with the requirements of dendrochronology firmly in mind. This would also provide better fall-back material should a radiocarbon wiggle-matching approach be called for, in the unlikely event the dendro-dating did not work on a larger assemblage. The dendrochronologist should attend on site with the investigators, and examine the entire assemblage of timbers. A much larger number of better quality samples would be required to provide precise information on date of construction and source of timber. The key criteria to identify in the field are: (1) number of rings; (2) presence of sapwood and ideally bark-edge; and (3) originality/security of context. Ideally one would want 10-20 high-scoring timbers each for the frame and for the hull planking. Any internal repaired areas should similarly be treated as a separate sample group. A trained chainsaw operative should be present, and permission granted to allow such slice samples to be taken judiciously.

4.3 Trying to date the existing samples through radiocarbon dating is probably the worst option. The radiocarbon calibration curve will probably produce such wide error ranges that it will not advance understanding of the age of the vessel at all. The problem is worse because none of the timbers retain the bark edge, with an unknown number of rings removed from most, and hence any radiocarbon date, even of outer rings, will not be precise and will not be all that close to the construction age. Only the planking contains enough rings that, if some of the innermost rings were radiocarbon dated, as well as some of the outermost, the inner ones might just get back far enough in time to be in the better part of the calibration curve. But, as noted above, the planking may not be original, and if a later repair then these inner rings may still be too late for good calibration, and they

still may not date the original construction in any case. The squared timbers, while less likely to be replacements, have only *circa* 50-60 rings and an unknown number of missing outer rings. So the inner rings are probably too late to hit the good part of the calibration curve, and the outer rings are an unknown number of years from the construction date. Only the luting sample contains organic material (probably moss) likely to have grown in the year of construction: but the sample has dried out and has evidence of post-depositional fungal growth, and therefore may be unreliable for dating. Advice has been sought from Dr Gordon Cook on the suitability of this sample fro radiocarbon dating, and he advises that with modern fungal growth and tar present, it might not be possible to obtain a true age for this material. In any case, if the ship was built between AD1500 and AD1650, the error range on any radiocarbon date for this sample will probably be no narrower than that date estimate in any case. So really we are back to the desirability of obtaining new samples, even for radiocarbon dating. Radiocarbon dating would only be a fall-back if dendro-dating of the framework did not work, but it would need the same sort of samples: long lived timbers with the outer edges as close to the felling date as possible.

4.4 In addition, obtaining more fresh luting sample(s) would be desirable, not just for any dating but also for specialist analysis of the material's composition. The plant material, possibly moss, may be identifiable to species which might in turn indicate the region of origin. The clayey matrix may be suitable for geol-provenancing, and would make an interesting comparison with any dendro-provenancing information for the timbers with respect to the place of construction. Of course, timber was subject to long-distance trading in the late medieval and early post-medieval period and so the timber source may not reflect the place of the ship's construction. For example, if Dutch built, there was very little domestic timber resource there at the period in question, and the timber would most probably be either Scandinavian or Baltic in origin. The clay luting, however, would be more likely to be obtained locally. The existing sample is somewhat too degraded for dating and probably for species identification but it may be suitable for geological investigation of the mineral component, given this would not be affected by post-depositional decay.

5. Recommendations

5.1 The first step should be to attempt dendro-dating of the existing timber samples. At best this provides a felling date range for the hull planking, TPQ dates for felling of the squared timbers and an idea of timber provenance. At worst, it provides guidance for future sampling and some data-sets in the bank for future comparisons when more samples become available. It is the quickest, cheapest thing to try. A cost for this can provided rapidly; it is not as the price would vary depending whether commissioned in this financial year or next financial year. Also, Historic Scotland may wish to diiscuss or tweak options before scoping any commission.

5.2 The best dating evidence would come from a dedicated sampling and recording programme, with the dendrochronologist in attendance with the investigators to identify and working with a chainsaw operative to retrieve the best samples. A much larger sample assemblage with more intact outside edges and more secure contextual information is highly desirable.

5.3 The calibration curve problems in the period AD1500-1650 render radiocarbon dating almost useless at this stage with the available material. It is never going to achieve the precision possible through

dendrochronological analysis of a decent purposive sample set. Radiocarbon could be a useful fall-back, in the unlikely event dendro-dating did not work with a larger and better sample set. The same sorts of timber samples, longer-lived and with more intact outer edges, could also provide better material for sophisticated wiggle matching or other multiple interval dating approaches. This would of course require a large number of assays and would be expensive.

5.3 The luting material should be investigated further. A suitable geologist should be asked whether analysis of the clayey matrix could allow its provenance to be identified. The organic component is somewhat degraded, and it would be preferable to obtain fresh sample(s) for identification and for any radiocarbon accelerator dating down the line. Any such samples should be retained in field-moist condition and held in cool storage to preserve the organic matter. That said, the ship has wetted and dried so many times since it was wrecked, that post-depositional decay may have occurred a long time ago.

6. Acknowledgements

The author is grateful to Philip Robertson of Historic Scotland for commissioning this work, and to Robert Prescott (University of St Andrews) and Dan Atkinson (Headland Archaeology Ltd) for their generous help during the assessment. I am very grateful to Ian Tyers for making the 'lost' Sheffield tree-ring sequence available for study. This is an important addition to a small assemblage.

7. References

Prescott, RGW & Atkinson, D 2008 *Preliminary survey and assessment of a wreck on the island of Fuday.* Unpublished report by headland Archaeology Ltd for Historic Scotland.

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Appendices

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Appendix 1: Fuday sample catalogue provided by investigators (Robert Prescott /Dan Atkinson)

The samples examined for this assessment were: Timber Samples FHSU-08/01, FHSU-01/01, FHSU-01/02, and FHSU-01/03, and Luting Sample FHSU-08/04

Find Number	Context	Description
FHSU-08/01	-	Futtock, bored for treenails (location: Headland Arch)
FHSU-08/02	-	Iron concretion
FHSU-08/03	-	Shingle (ballast?) from within stern area
FHSU-08/04	-	Fibrous luting from scarf at fwd stem
" /05	-	Yellow brick(s), with mortar adhering
" /06	-	Tile, with mortar adhering
" /07	-	Metalliferous slag
FHSU-08/08	-	Sheet of lead, margin pierced for nails
FHSU-01/01	Croft house	Futtock, oak, 42 x 13 x 13 cm. (location: St Andrews)
FHSU-01/02	Croft house	Floor rider, oak, 44 x 20 x 18.5 cm. (location: St Andrews)
FHSU-01/03	Croft house	Plank, oak, 82 x 32 x 5.5 cm. (location: St Andrews)

Appendix 2: Assessment characteristics of Fuday wreck timber samples and luting sample

Find No	Element	Species / ID	No. rings	Proximity to centre of tree	Outer edge	Condition	Comment on sampling required
FHSU-08/01	Futtock	Oak	c. 50 Fast grown	Centre probably present	Eroded edge, no sapwood visible. Possible Heartwood/sapwood boundary on one corner	Eroded, cracked.	Sub-sampling would involve sawing slices in 2 locations to maximise rings
FHSU-08/04	Luting from near stern post	Moss (?) mixed in clay (?) matrix	NA	NA	NA	Sample dried out and evidence of fungal growth. Est 1g organic matter out of total 5g dry weight. Tiny inclusions of pitch or tar droplets present.	Sufficient O.M. for AMS but may be unacceptable or require pre-treatment due to condition / fungal growth. Fresh sample would be preferable
FHSU-01/01	Futtock	Oak	c.52 Fast Grown	Centre present	No sapwood or bark edge identifiable, probably all heartwood. Eroded surface	Eroded surface but sound interior	A single slice from larger end of sample would provide best dendro sequence
FHSU-01/02	Floor rider	Oak	c.64 fast grown, narrower to edge	Close, c.10 rings away	No sapwood or bark, appears to be all heartwood. Eroded surface.	Eroded surface, sound interior	A slice from larger end, in exactly 5 cm from edge, would capture most rings for dendro
FHSU-01/03	Plank	Oak	c.95-100	c. 20-30 away	One edge appears to retain a few rings of sapwood, although sub-sampling and surface-prep required to confirm.	Eroded surface but sound interior	The best sample for dendro dating. Could give a felling date range May be same timber source as Sheffield sequence, which would increase chance of dendro-dating and provenancing. Would need to take 3c slice at the position of the stepped back face (see App 3 photos) to capture sapwood and maximise rings
Sheffield (Tyers pers comm.)	?Plank	Oak	118	>10 rings away	Burnt surface, no sapwood.	Burnt surface	Tree-rings recorded, sample not extant.

Appendix 3: Record photographs of assessed samples

NB These photographs are taken as memory jogs and are not intended to be of publication standard.

Appendix 3.1 FHSU-08/01 Futtock (Top: full view of timber, note cracks. Bottom - end grain w c 20 wide rings here)

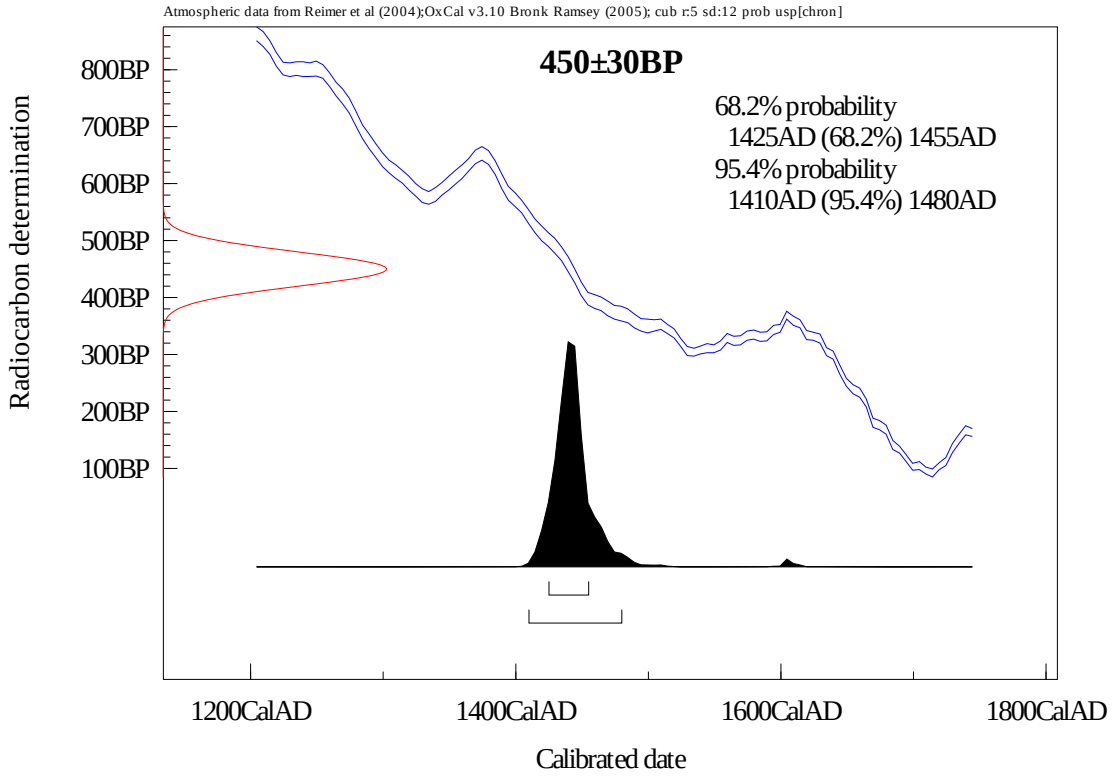
Appendix 3.2 FHSU-01/01 Futtock (Top: Full view, note trenail with grain at angle and narrow rings . Bottom – end grain, note wide rings)

Appendix 3.3 FHSU-01/02 Floor rider (Top: Full view, note trenail with grain at angle. Bottom – end grain, note wide rings)

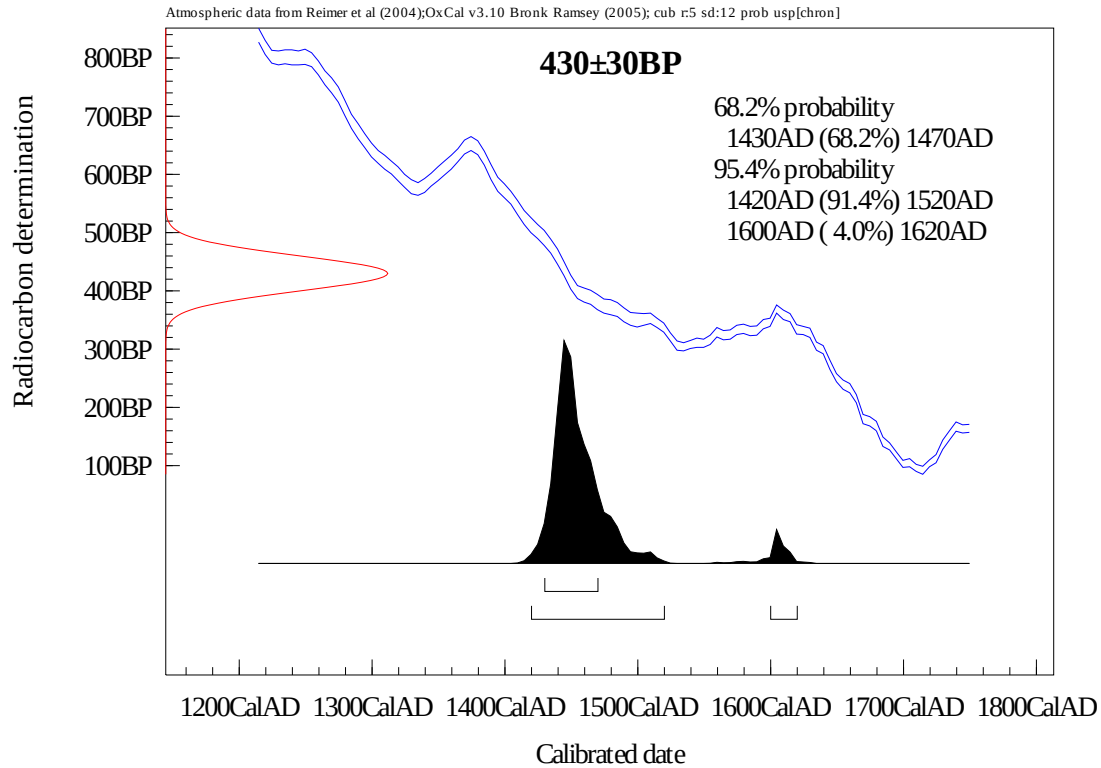
Appendix 3.4 FHSU-01/03 Planking from hull (Top: full view, note bumpy curved edge on RHS which probably retains a little sapwood. Bottom - end grain, note narrow rings compared to other samples. Note curved edge to bottom Right Hand Corner, this is where a few rings of probable sapwood survive)

Appendix 4: Radiocarbon calibration examples for selected radiocarbon ages within the likely period of the ship's construction (*G Cook pers comm)*

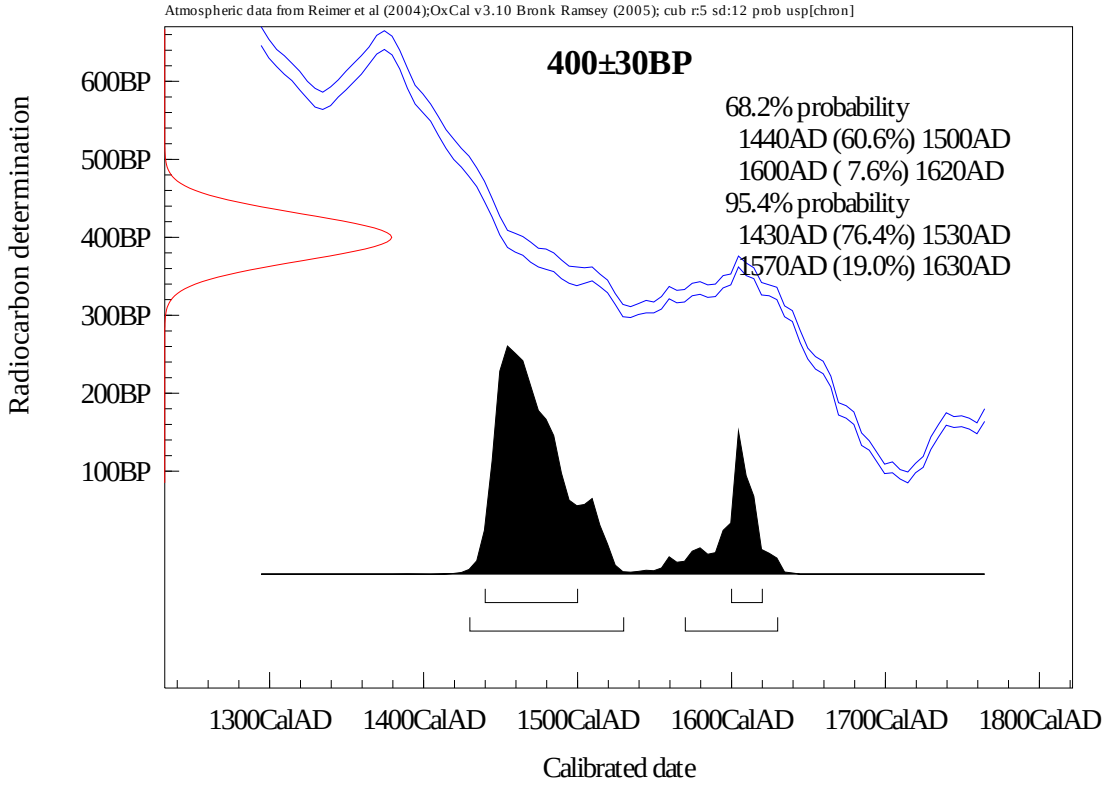
4.1 Calibration at 450+/-30 BP provides a calendar date range of AD1410-1480 at 95% confidence limits



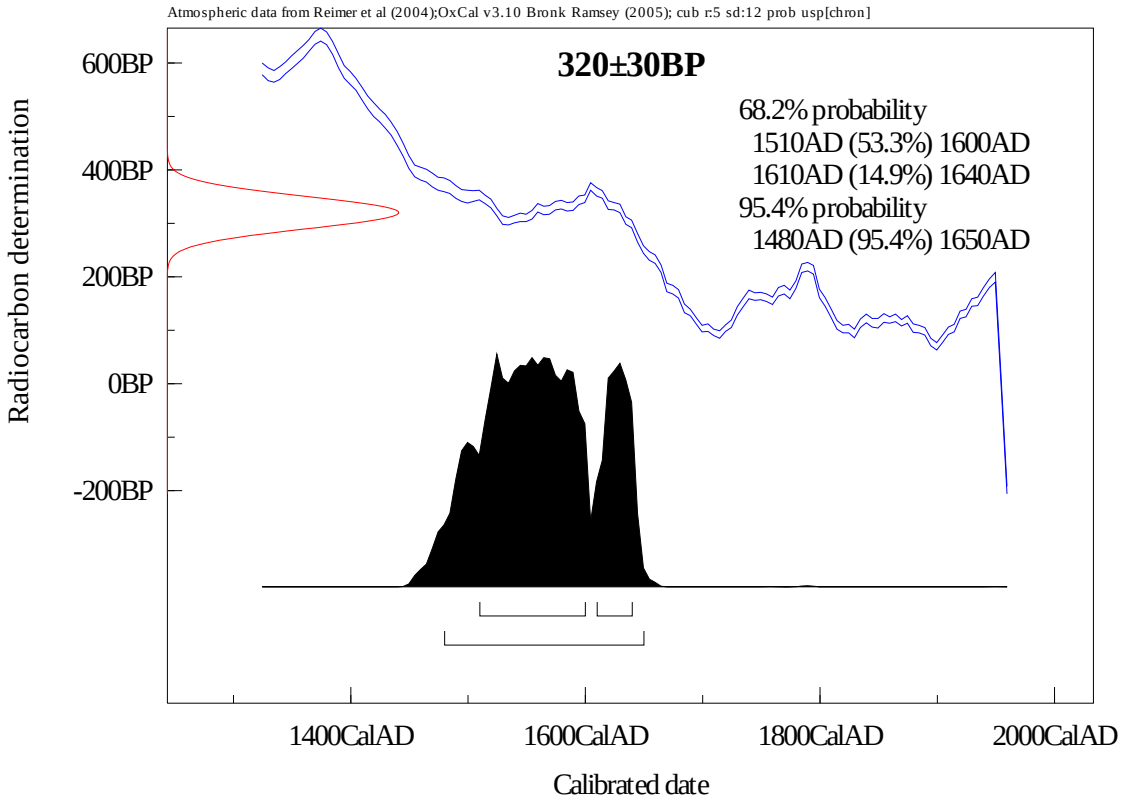
4.2 Calibration at 430+/-30 BP provides calendar date ranges of AD 1420-1520 **AND** AD1600-1620 at 95% confidence limits



4.3 Calibration at 400+/-30 BP provides calendar date ranges of AD 1430-1530 **AND** AD1570-1630 at 95% confidence limits



4.4 Calibration at 320+/-30 BP provides calendar date ranges of AD1480-1650 at 95% confidence limits



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