RADIOCARBON, Vol 48, Nr 2, 2006, p 243–252

COMMENTS ON SVEINBJÖRNSDÓTTIR ET AL. (2004) AND THE SETTLEMENT OF ICELAND

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ABSTRACT. Radiocarbon dates on samples aimed to date the settlement of Iceland are given together with comments by the laboratory, since many of the results and descriptions given by Sveinbjörnsdóttir et al. (2004) in *Radiocarbon*, together with new results, are in error. The intention of this paper is to present correct dates and further relevant information regarding samples used earlier and to discuss possible complications inherent in the method of Sveinbjörnsdóttir et al. (2004). Examples are given of how critical the collection, treatment, and interpretation of samples may be. An age difference between birch charcoal and grains for a site is expected due to various reasons. If the difference amounts up to ~100 yr, as reported by Sveinbjörnsdóttir et al. (2004), it must only to a small degree be due to biological age. Reference to an excavation report, details regarding stratigraphy, and discussions of the risk for displacement and contamination are missing in their paper. A final evaluation of the time for settlement should not be done until more research is completed and other possible or earlier suggested or even dated sites are discussed. A summary is given of the research on the island and volcanic effects on the ^{14}C activity of the atmospheric CO_2, especially over Iceland.

INTRODUCTION

The Settlement Layer

The authors (Sveinbjörnsdóttir et al. 2004) briefly relate, with references, the opinion that the settlement layer may be of almost the same age as a tephra layer deriving from the Vatnaöldur eruption.

Sample Quality

Origin Discussed by Various Authors

The risk for erroneous results because of driftwood, shipped wood, biological age, and time difference between death and subsequent use must be considered (Sveinbjörnsdóttir et al. 2004:389; Olsson 1981, 1990:216, 1997). Because of inconsistent results from the Stockholm Laboratory (see Vilhjálmsson 1991:109), on a few samples from Papey, a separation into species was suggested, and the 2 new results, from 1971, on charred birch were 980 ± 100 BP (St-3604) and 935 ± 100 BP (St-3605). A sample sent to the Uppsala Conventional Laboratory was separated into species by Eric Åberg, Uppsala, and birch charcoal was dated as U-4014 to 1090 ± 80 BP (Olsson 1974:313). Other aspects were briefly discussed by Olsson (1981, 1997) and Simonsen (1983). *Larix*, *Pinus*, and *Picea* are suspect when driftwood is used in hearths and as building material, although driftwood has often been used for shore displacement studies (e.g. on Spitsbergen). Birch and willow easily sink in water, but when frozen into ice, these species may be transported over long distances.

Errors due to biological age can often be avoided by the choice of twigs or certain tree rings, preferably counted from the bark when visible, but such precautions were mostly not possible for the Reykjavík samples dated in Uppsala. Even if Icelandic birch trees may reach an age of 100 yr, the mean age of samples recovered at excavations will not be 100 yr but only a few decades.

Branches and the lower parts of the stem naturally can yield dates that are too old, if the tree was killed by tephra from a volcanic eruption. Such wood may be burnt and collected for dating. There is no guarantee that small samples have no or negligible biological ages. Different possibilities for age differences between charcoal and grains must be considered.

Small samples such as small charcoal pieces and grains may be displaced by biological activity, e.g. worms, upfreezing, and mechanical displacements, for example at frost cracks and cavities after

https://doi.org/10.1017/S0033822200066455 Published online by Cambridge University Press

roots. Reused constructions, burnt discarded tools, and mistakes at excavations cannot always be excluded.

Different Fractions Considered in Uppsala

If possible, wood and charcoal samples are scraped to remove contaminated surface layers. The laboratory procedure then involves a treatment to remove any contaminating carbonate by leaching with an acid and, for the organic samples, a step to separate the fraction soluble in a basic solution (SOL) from the insoluble fraction (INS). Careful washings between the steps are included. The SOL fraction may be humic acid and may derive from other layers. An estimate of the content of the different fractions is made. Sometimes more than 1 SOL extraction is necessary; sometimes both fractions are measured to judge the risk for contamination. The fraction to be dated is always slightly acidified shortly before combustion to avoid CO_2 adsorption during the treatment with the basic solution or during storage. This was demonstrated to the technicians in connection with the dating of the Gardsendi, Heimaey samples (Olsson et al. 1967:458). Peat (0.1-m-thick layer) collected in 1964 and described by Kjartansson (1966) contained small pieces of *Salix*, determined by Thorleifur Einarsson. These samples were in good condition and dated to 5110 ± 200 BP (U-521). The peat was dated after 2 separate pretreatments to 5310 ± 170 and 5760 ± 120 (U-519 and -539), respectively. A third time, we deliberately added HCl without stirring and did not burn the sample until some months later. The result was 4120 ± 90 BP (U-517), indicating the necessity of a final proper HCl treatment. The statistical spread for the 3 other dates may indicate a risk for peat samples like these to be dated older than wood because of some contamination in nature. Kjartansson expressed concern about whether the wood was stems or roots, but writes “stems” in Figure 3. If the samples are roots, the date would be younger than that of the peat. Thus, context, choice of sample, treatment, and fraction should be stated. The same activity for 2 fractions does not guarantee freedom from contamination. The bark derives from several years and should appear older than the outermost tree rings. Thus, it is removed before the chemical treatment.

No ^{13}C normalization was performed for some samples dated in other laboratories. The present author prefers discussing uncalibrated results in the actual tables because of the author’s investigations indicating a lower activity over Iceland, at least for certain periods of time, compared to the activity over the continents where wood for calibration is growing (see below).

REMARKS ON TEXT AND TABLES

Text

Sveinbjörnsdóttir et al. (2004:389) refer to Vilhjálmsson (1991) and write that he criticized various researchers for misinterpreting ^{14}C dates. Indeed, Vilhjálmsson (1991) has numerous errors in his tables and questionable statements in the text. Olsson (1992) criticized Vilhjálmsson and included these opinions in a lecture given in Reykjavík in 1990—a survey intended to be popular and read by anybody interested in Iceland. Due to unlucky circumstances, the manuscript was not published until 1997. There and in Olsson (1992) lists from the Uppsala laboratory are given.

Missing ^{13}C Normalization

Sveinbjörnsdóttir et al. (2004: Figure 1) includes 2 results from Thórarinsson (1977:669): St-4891 as 1190 ± 90 BP and St-5704 as 1150 ± 80 BP, respectively. Since the activities overlap, it would be natural to calculate a mean value and to calibrate that date. The result is given (Sveinbjörnsdóttir et al. 2004:387) as AD 845 ± 45. The mimeographed list from Stockholm indicates that no ^{13}C normalization is done, checked, or confirmed by correspondence. The age should thus be discussed as if it was about 25 ^{14}C yr younger or still younger, since many Icelandic birch charcoal samples have δ^{13}C values hovering around –26.8‰ (Sveinbjörnsdóttir et al. 2004) or deviating more from –25‰.

Results Given in Sveinbjörnsdóttir et al. (2004) from Non-Archaeological Sites

The value given on birch wood 1155 ± 75 BP (U-2809) from Lágafell (immediately below the Landnám tephra layer) was discussed together with 12 other samples from the Markarfljót area by Haraldsson (1981:34–8). The wood was reported by the authors as a bog sample. Five peat samples (Hallsdóttir 1987) collected from a hillside bog, S of Mosfell farm (64°08′N, 20°36′W), were dated by Håkansson (1977:432). Two samples derive from the peat above, and 2 samples derive from peat below the layer with the main part of the Landnám tephra layer dated on plant remains; all layers are 1 cm thick. The lowermost sample, Lu-1170, was dated to 1290 ± 50 BP, although the date is given as 1170 ± 50 by Sveinbjörnsdóttir et al. (2004: Figure 1), who also calibrated that erroneous value. They also refer to Theodórsson (1993) who gave the value AD 835 ± 20 for the ash layer after wiggle-matching. Olsson (1990:215) preferred to calculate a mean and concluded that the ash layer derived from a time with intercepts on the calibration curve shortly after AD 800 and in the range of AD 880 to 890. Earlier, Hallsdóttir (1987:23–5) presented another calibration. The section from Mosfell was considered suitable because of the high rate of peat growth. The samples got a "mild pretreatment with NaOH and HCl" (Håkansson 1977). There is a marked step in the δ^{13}C values of the 2 lower samples (Lu-1170 and Lu-1169), from about –22‰ to that with the ash, dated to 1180 ± 50 BP (Lu-1168), –25.3‰. The higher layers had values of –25.5 and –26.0, respectively.

Archaeological Sites in Reykjavík and on Vestmannaeyjar (Heimaey)

Laboratory dates are given by Olsson (1997) as tables with comments and according to the archaeologists Nordahl (1988) and Hermanns-Audardóttir (1989) responsible for the 2 respective extensive excavations. Unfortunately, some errors are found in their reports and some information given by the laboratory is missing. Vilhjálmsson's list (1991) was apparently used by Sveinbjörnsdóttir et al. (2004). Thus, it seems appropriate to include a catalog in this Comment with notes on misprints and divergent or missing information, edited according to the U-numbers, to allow for easy comparison (see Tables 1 and 2). Two dates from Tjarnargata 4 (Grimsson and Einarsson 1969; Olsson et al. 1969, 1972) are included.

In the conclusions of the excavation report for Reykjavík, Nordahl (1988:110) writes that the oldest building was the house at Adalstræti 14/Grjótagata and that the area was settled before the eruption that caused the Landnám tephra. Nordahl refers to Hallsdóttir (1987:20), who documented *Hordeum* pollen in Vatnsmyri in Reykjavík below the Landnám tephra. A new building was built at Adalsstræti 18 after the eruption. The first houses at Sudurgata were a longhouse (dwelling house) and a smithy (Håkansson 1977:55–81). Below these, several samples were collected from the bottom layers (Håkansson 1977:39–55). The samples should thus derive from a period of a few decades.

The granary contained seeds (Nordahl 1988:103), but the sample dated as U-2674 was barley, according to the form given to the laboratory that accompanied the sample. Since much SOL was extracted, a 2nd complete extraction was performed. The weights of the SOL fractions, although the samples were carefully washed, were not reported because of suspected salt contamination. Out of 8.5 g burnt, submitted, and sampled, we derived about 3.8 g INS.

Table 1 ¹⁴C dates from Uppsala on Reykjavík samples with comments by the laboratory. Dates on samples for Else Nordahl from 1974 to 1978, except for U-4030 dated in 1973. All samples were measured in proportional counter 4, except for U-4030, measured in number 1.

U-	^{14}C age	±	$\delta^{13}C$ ‰ –	Material[a,b]	Sp.[c]	Local[d]	Nr	Fraction remark[e]	P.[f]	Lab. remark	Deviating "information"[g]
2082	1140	70	26.8	W 3	L	T	4		7		[h]
2167	1190	90	27.2	W 4, 5	B	T	4		7	Not *nana* acc. to Åberg	[h]
2530	1330	80	27.9	C 4	B	A	18	SOL*	32	$\delta^{13}C$ ass. cf. U-2617	V & S: A *14*
2534	970	75	26.9	C 2	B	S	5		39 63		V: 970 & *1000* ($T_{1/2}$ 5730!)
2535	810	70	27.0	C 2	B	S	5		92		
2592	1140	80	27.8	C 4	B+	A	18		32	2 NaOH extr.	V & S: *Birch & ± 90*
2593	960	90	25.9	C 4	B	A	18	Part 1**	29	Very little yield 2 NaOH extr. cf. U-2618	
2617	1280	120	27.9	C 4	B	A	18	INS*	32	2 NaOH extr. cf. U-2530	
2618	685	110	26.2	C 4	B	A	18	Part 2**	29	cf. U-2593	
2671	1150	55	25.9	C 3	B	S	5		57		
2672	1345	60	24.4	C 3	B	S	5		55		
2674	1060	55	23.0	G	H	S	3		103	Much SOL 2 NaOH extr.	V: barley *and other seeds* S: *grains*
2675	1640	270	25.4	W 3	B	S	5	INS***	56	cf. U-2682. Bad condition Much SOL Small yield	N, V & S: *not included*
2676	1260	55	27.9	C 3	B	S	5		62	Much SOL	
2677	1250	100	25.6	W 6	B	S	3		83	Small yield	
2678	1210	260 250	26.1	W 3	B	S	5		57	Much SOL Very small yield	
2679	1080	60	24.6	C 3	B	S	5		62		
2680	1375	70	26.5	W 2	B	S	5		39	Much SOL Small yield Adherent bark	
2681	1255	65	25.8	C 3	B	S	3		62		
2682	1090	80	26.6	W 3	B	S	5	SOL***	56	cf. U-2675	
2719	1360	60	24.0	W 3	B	S	3		57	Much SOL	
2720	1270	90	27.1	W 3	B	S	3		39	Much SOL	
2721	1050	85	25.6	C 4	B	S	5		57		
2739	1310	70	25.5	C 3	B	S	3		90	Very little SOL	
2740	1280	65	25.1	C 6	B	S	3		92		
2741	1330	40	26.9	C 3	B	S	3		39	Very little SOL	
2742	1150	60	26.2	C 5	B	S	3		92		
2743	1140	65	28.3	W 1	B	S	5		39		
2744	1245	60	26.1	C 3	B	S	5		63		
2745	1275	60	27.4	C 4	B	S	5		60		
2746	1090	65	26.2	C 5	B	S	5		63		
2747	1245	80	26.2	C 5	B	S	5		60		
2748	1205	80	26.2	C 5	B +S	S	5		60	Very little SOL $\delta^{13}C$ ass.	N, V & S: *B & 1250 ± 65*

https://doi.org/10.1017/S0033822200066455 Published online by Cambridge University Press

Table 1 ^{14}C dates from Uppsala on Reykjavík samples with comments by the laboratory. Dates on samples for Else Nordahl from 1974 to 1978, except for U-4030 dated in 1973. All samples were measured in proportional counter 4, except for U-4030, measured in number 1. *(Continued)*

U-	^{14}C age	±	δ^{13}C ‰ –	Material[a,b]	Sp.[c]	Local[d]	Nr	Fraction remark[e]	P.[f]	Lab. remark	Deviating "information"[g]
4030	305	100	25.4	C 4	?	A	14		23	N: Displaced	

[a]Material: W stands for wood; C for charcoal; G for grain.
[b]1 = large piece; 2 = part of branch; 3 = piece; 4 = irregular pieces; 5 = small pieces; 6 = small fragments.
[c]Sp stands for species: L for *Larix* (Larch); B for *Betula* (birch); B+ for *Betula* plus other species; H for *Hordeum* (barley); S for *Sorbus.*
[d]Local and no. for street number: T for Tjarnargata; A for Adalstrœti.
[e]Same number of stars indicate the same origin of sample.
[f]P. indicates page number for result in Nordahl (1988).
[g]N stands for Nordahl (1988); V for Vilhjámsson (1991); S for Sveinbjörnsdóttir et al. (2004).
[h]For the 2 samples from Tjarnargata, see Grimsson and Einarsson (1969) and Olsson et al. (1969, 1972).

Table 2 ^{14}C dates from Uppsala on Heimaey (Vestmannaeyjar) samples with comments by the laboratory. Dates on samples for Margrét Hermanns-Audardóttir from 1973 to 1976, except for U-4402, ready in 1980; U-4403 in 1982; and U-4549 in 1991. All samples were measured in proportional counter 4, except for U-4402 and 4403, measured in number 1, and 4549 in number 5. Hermanns-Audardóttir (1989) has tables and discussions of the dates on p. 45–59 and of the wood analyses on p. 126–7 and also in an appendix by Bartholin on p. 178. Hermanns-Audardóttir states (p. 47) that as a rule the samples derived from small branches with a low own age.

U-no	^{14}C age	±	δ^{13}C ‰ –	Material[a]	Sp.	Locality identification acc. to M. H.-A.[b]	Lab. remarks	Deviating "information"
2529	1260	60	27.3	C		A:I pit 1 (13)	No wood analysis	
2531	1060	65	26.0	C	B	A:I pit 1 (13)		
2532	650	60	27.1	C	B	A:II secondary pit (23)		
2533	1240	60	24.3	C	Mostly *Picea* some *Larix*	A:III pit 5 (8)	Wood analysis on remaining material after dating	V: *not analyzed*
2660	1390	60	25.4	C	B	A:I pit 3 (25)	cf. U-4549 2 NaOH extractions	
2661	1340	65	24.9	C	B	A:II pit 4 (31)	2 NaOH extractions	V & S: ± *60*
2662	1240	60	26.0	C	B	A:III pit 6–7 (8)	2 NaOH extractions	
2663	1300	60	25.8	C	B	A:V floor, benches, pit (30)	2 NaOH extractions	
4402	1035	65	25.6	C	B	A;VIII pit 8 (364)	cf. U-4403	
4403	1070	75	23.5	C	Coniferæ	A;VIII pit 8 (364)	cf. U-4402	S: *Larix*
4549	1235	55	26.2	C	B	A:I pit 3 (25)	cf. U-2660 Remains from treatment of U-2660 acidified	S: *not included*

[a]Material: C stands for charcoal; Sp. for species.
[b]V stands for Vilhjálmsson (1991); S for Sveinbjörnsdóttir et al. (2004).

The only sample from Adalstræti 14 big enough to be measured apparently had fallen down from an upperlying layer (Nordahl 1988:23). Similarly, Hermanns-Audardóttir (1989:45, 53) has a sample to be excluded, U-2532, due to secondary charcoal.

Hermanns-Audardóttir (1989:45, 47, 126–7) writes that pollen diagrams indicate that the birch remains hardly can derive from trees grown on Heimaey or the Vestmannaeyjar Archipelago at the time of the settlement. She also stresses that the samples derive from small branches with low bio-

https://doi.org/10.1017/S0033822200066455 Published online by Cambridge University Press

logical ages. She gives details about the wood analysis. A misprint on p. 126 indicates that U-2532 derived from *Picea* and *Larix.* The correct sample number is U-2533.

As a result, U-2660 was stressed by Hermanns-Audardóttir as her oldest date (1390 ± 60 BP). I wanted to check this dating. In 1991, I had a new independent determination ready on material from the same batch with birch remains (U-4549: 1235 ± 55 BP), indicating a more recent age limit. The difference between the results is outside 1 σ but within 2 σ. This result (Olsson 1997) is not included by Sveinbjörnsdóttir et al. (2004).

Another result (U-4402), on birch (ready in 1980), seemed to be the youngest sample, next to the suspect sample U-2532, which was excluded due to secondary carbon. A real pair of different species sorted from one sample was searched for in the hope that the sample was well mixed and that the coniferæ would be dated differently from the birch. Icelandic samples were accessible. Within the statistical uncertainty, coniferae (U-4403) had the same age as birch (U-4402) dated 2 yr earlier (see Table 2).

A problem similar to that for Icelandic transported samples, and once proved to be the case for coastal sites in Sweden, was that pine for hearths apparently was collected from dead, often still standing, trees from rather distant mountains.

Normally, birch lying on the ground easily rots, creating a fuel of low quality. Branches with a biological age of 20 yr may be dated more than 20 yr too old if recovered from sites such as bogs or ash layers where the wood has been protected from rotting. The age may then turn out to be much older. Using fossil wood from bogs is said to have been a common practice on the Norwegian coast (Kaland 1991:11), but Hermanns-Audardóttir (1991:25) argues that there still were enough birch trees at the time of the settlement to use living trees for charcoal instead of bog samples. Stranded driftwood may, however, be well preserved for a long time under Arctic conditions, as seen from shore displacement studies for Spitsbergen.

Hermanns-Audardóttir (1989:146–50) has a useful table on the sites, with traces indicating settlement, including Hrafnseyri (#22), where, however, U-4299 (Olsson 1992) was incorrectly given as U-2099, and Mosfell (#35), where Lu-1166 is wrongly given the age 1100 ± 50 BP instead of 1100 ± 45 BP. For Reykjavík, Hermanns-Audardóttir included 1 date on SOL (U-2682) without remarking that it was SOL, although U-2530 was not included (dates to be used only for discussions of possible contamination). U-2748 has, as in Nordahl (1988), the result 1250 ± 65, calculated with a $\delta^{13}C$ value that apparently was wrong and thus was recalculated with an assumed value to 1205 ± 80 BP. The authors mistakenly transposed the sample numbers: U-2678 was wrongly given as U-2768, and U-2517 from Smidjuskógur (Olsson 1992) was listed incorrectly as U-2157.

ABNORMAL CONDITIONS IN ICELAND

Volcanic Effect on Iceland in Lacustrine Samples

Sveinbjörnsdóttir et al. (2004:391) write that in only 1 case, an anomalously high ^{14}C age (older than 8000 yr) has been reported, and that age can be explained by volcanic activity (Sveinbjörnsdóttir et al. 1992), namely aquatic moss samples grown in geothermal water. This case is also summarized by Olsson (1995:215) in the paper intended as a continuation of the delayed paper (Olsson 1997), with more detailed discussions of some of the ^{14}C dating problems. The lacustrine fossil mosses yielding too-old ^{14}C ages from Markarfljót area were briefly discussed by Kaldal and Vilmundardóttir (1989) and Vilmundardóttir and Kaldal (1992). Strongly depressed activity for modern mosses and water (e.g. from Reykjadalur) is detected. Our modern samples collected in 1990 from the Hveragardi area yielded ages of about 14,000 and 7500 yr, and the sample collected in 1989 from Flúdir yielded an age of about 1000 yr (Olsson 1997:35). Details regarding the collection are needed for quantitative results because of the expected exchange with the atmosphere and the stream.

Volcanic Effect in the Icelandic Atmosphere

Two "grass" samples were collected from Heimaey on 19 August 1973, after the eruption in January 1973, yielding excess activities of 442.6 ± 7.0‰ and 425 ± 8‰, respectively. The SOL fraction corresponding to the first result yielded 450.3 ± 7.4 (Olsson 1997:50). The excess activity is, for these recent samples, the difference between the atomic bomb effect and a volcanic effect. During the eruption until March that year, Nydal and Lövseth (1983) obtained 4 values from Nordkapp that were about 450‰ in excess; the lowest value was 444 ± 9‰. Considering the seasonal variations, our values indicate a slightly depressed atmospheric ^{14}C activity in autumn 1973 related to the values, mostly higher than 460‰, at Nordkapp for a corresponding later time of the year. During the eruption, a sample was collected (Olsson 1979:615, 1997:49–50) on 20–23 February in the basement of a house and yielded an activity of 3% of Modern. Another, collected 2–4 February in another house, had an excess activity of 410 ± 8‰.

I collected CO_2 from 2 places on the lava on Heimeay in August 1978. These samples had an excess activity close to 300‰ and 233‰, respectively. We can compare these results to other dates from about the same time from the mainland of Iceland in the neighborhood of a hot spring, Deildartunguhver, and from Abisko, northern Sweden. Close to the spring, the excess was between about 270 and 340‰, depending on the distance. For the mainland, the values are 340‰: from Abisko >350‰ and from Svalbard <350‰ (Olsson 1997).

The Atomic Bomb Effect

The atomic bomb effect has proven to be a tool for detecting activity differences all over the globe. Initially, the mixing over the tropopause and subsequent spreading north- and south-ward was discussed. We observed a minor delay of the increase and slightly lower activity for the peaks in 1963 and 1964 for Svalbard compared to Abisko, where the activity rose to a maximum double the normal value (Olsson and Karlén 1965; Stenberg and Olsson 1967; Olsson and Klasson 1970; Olsson 1989, 1993, 1997, 1999, 2003). The excess has now leveled out to less than 1/10th of the normal activity, mainly by absorption of CO_2 in the seawater; to describe this phenomenon, a Japanese team coined the expression "island effect" (Kigoshi and Hasegawa 1966:1071). The mean difference between Abisko and Svalbard approached a value slightly less than 1% for many years, although with considerable variations from year to year (Olsson 1997:59, 1999:102).

In 1978, plants were collected by the author, not only to measure the volcanic effect but also to check the activity at various places on Iceland. Similarly, plants were collected in collaboration with Elsa G Vilmundardóttir and Gudrún Larsen in 1989 and 1991.

Tree Rings and Global Activity Variations

Old tree rings from Argentina were made available in the 1960s and measured, mainly in Groningen but also in Uppsala. These and other samples clearly indicated lower ^{14}C activity in the atmosphere of the Southern Hemisphere than in the Northern Hemisphere. Upwelling water can cause the activity to decrease especially in connection with ENSO events. Theodórsson (1998) claimed that there was no depressed activity over Iceland, but Olsson (1999, 2003) summarized her results together with those available in literature (e.g. McCormac et al. 1998), and critically compared contemporaneous wood from the USA, the British Isles, and Germany using long chronologies. There were long periods with no activity differences but also intervals with considerable differences. Short periods with differences up to 50 yr were seen in spite of the general, excellent agreement (see Stuiver et al. 1986 and others in *Radiocarbon* Volume 28). German oak seems to give older dates than the Irish oak. The difference may not be the same from time to time but is mostly below 1%, as far as we know today. Exchange (which is wind dependent) with the ocean, seasonal variations of CO_2 and isotopic fractionation related to the vegetation, supply of newly produced ^{14}C to the tropopause, and emanation are geophysical phenomena to be considered when explaining global or regional differences.

Plants from Scotland and Iceland

The plants from Scotland and Iceland, determined by Shore et al. (1995) to have the same activity, were collected 1994 and 1993, respectively. The global decrease of the activity from 1993 to 1994 was ~1%. Each of the activities were given for the collection year; thus, that for Iceland should be reduced by ~1% to be comparable to that for Scotland. The statement in Sveinbjörnsdóttir et al. 2004) about no difference between Scotland and Iceland is not supported.

DISCUSSION AND CONCLUSIONS

The activity spread for the grains, each sample with given uncertainties of 35–40 yr, should also be explained. The real statistical spread of the ^{14}C ages for the various charcoal sample sets is about 2 to 4 times greater, from the given uncertainties, than the expected ones if samples are of the same age. One question is how the new site is archaeologically related to the earlier ones in Reykjavík. Barley has been cultivated on Iceland, as seen in pollen diagrams. Is there any *Hordeum* pollen found at the actual excavation related to the actual remains?

The age difference between charcoal and grains is about 75 ^{14}C yr for these new results. The spread of the values for the difference is surprisingly small. The bidecadal calibration curve indicates more or less a plateau for the activity from AD 780 to 880, at 1200 ^{14}C yr, with ^{14}C ages within a range of 20 yr. The decadal curve exhibits greater variations especially at about AD 790 and 920. The mean values for each set of charcoal to be used in the discussion fall in a range of ~1210 to 1246 ^{14}C yr (Olsson 1997:57), except for samples from Adalstræti 18 and Tjarnargata 4, ~1170 ^{14}C yr. There is much evidence showing that the atmospheric ^{14}C activity is lower over Iceland than over areas from where material for calibration is taken. The settlement samples may have been dated a few decades too old in ^{14}C yr, and this apparent difference has to be subtracted before calibration. The fine structure of the calibration curve may be different for Iceland than for Irish and German curves.

One can see that the portion of the calibration curve preceding AD 890 indicates a steep decrease of ~70 ^{14}C yr in about 10 yr. Thus, a charcoal sample, exhibiting an apparent age deriving from biological age plus an own age from death to usage as small as 20 to 40 yr, will be dated more than 70 ^{14}C yr older than a grain sample from AD 890 if these 2 samples are a pair at a specific stratigraphic position. A small real age difference can thus amount to about 75 ^{14}C yr when dating. A greater difference may correspond to the same ^{14}C age because of the plateau. The real statistical spread for grains will be greater than the mathematical one from the given values if the grains derive from about AD 900, where a minimum is seen in the calibration curves. Any fine structure on the plateau may be the reason for an increased spread. For the charcoal samples, there may be a mixture of samples with different biological and own ages.

In 1990, Olsson (1997: Figures 26 and 27) calibrated her results in 4 ways: as such, after increasing the sigma values, and after subtraction of 30 and 60 yr because of the lower activity (and in another case 40 and 80 yr). Then, she wrote that 10 yr or a few decades should be subtracted because of the combined biological and own age.

The real spread of the dates for each set, including the grains, indicates that further analysis is needed. The context for this new set of dates must be detailed and accessible to a broad team of scientists to judge what the new results really can date. Sveinbjörnsdóttir et al. (2004) state that the grains are later than the eruption seen as the tephra layer. Their calibration probability diagrams yield a range about AD 900 to 1000. Wood, even birch, may have been transported to Iceland, but grains may also have been transported.

Possible contamination and displacement remain to be discussed. The barley dated as U-2574 derived from a granary with much seed and is judged, from an archaeological point of view, to be younger than the first settlement. Its uncalibrated age is younger than the grain dates from Aarhus. Uncalibrated results allow us, in this case, to consider the possibility of a small difference in calendar years. Many other results intending to date the settlement or to limit the time range for the settlement should be discussed.

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