Present Status of AMS ^{14}C facility of Nagoya University and its applications to archeology and geology

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A ^{14}C AMS system built by HVEE, B.V., the Netherlands, was delivered to Nagoya University in 1996, finished final acceptance tests in January of 1999, and started routinely ^{14}C measurements in 2000. The standard deviation (1sigma) of the $^{14}C/^{12}C$ ratios is around ±0.3% to ±0.4% (a bit larger than the uncertainty of about ±0.3% calculated from ^{14}C counting statistics) and that of the corresponding $^{13}C/^{12}C$ ratios is ±0.03% to ±0.07%, as are tested for HOxII targets. The number of targets measured was 330, 1430, 2077, 1003, 1,979, 1679, 1771 and 1115 in each year from 1999 to 2006, respectively, and total number of measured targets of 11,384 is achieved in eight years. Since we have repeated three- or four-times measurements (each 30 min.) on each target, rather longer years were needed to attain it. However, the quality of each measurement could be one of the best compared with the world level of quality, as shown by the results of FIRI and VIRI competitions. We had a big machine trouble from June to October in 2006, which forced to reduce the number of measured targets.

International radiocarbon intercomparison has been conducted four times already. The most recent one, the Fifth International Radiocarbon Intercomparison (VIRI) was fulfilled in 2004-2005.The Nagoya AMS group participated in the forth one (FIRI) for the first time and VIRI is the second case. According to a report by Prof. Scott of the Glasgow University, Scotland, a chairperson of this program, 66 organizations (the number in FIRI program was 92) have participated in, and out of them, AMS groups were 32 (25), liquid scintillation groups (LSC) were 31 (49), and gas proportional counter groups (GPC) were10 (18). Participations by AMS groups have increased relatively this time compared with those in FIRI program. The samples distributed were four. Two of them (sample A and sample C) were barley mash with rather high ^{14}C concentration harvested in recent year. Other two (sample B and sample D) were charred seeds excavated at archeological sites. To us AMS

group, 2g of each barley mash and 4 grains each charred seed sample were delivered for ^{14}C analysis. From each four sample, two graphite targets were prepared and analyzed for carbon isotope ratios, i.e., ^{14}C /^{12}C and $^{13}C/^{12}C$, as stated previously. The results are summarized in Table 1.

The results by Nagoya group are consistent with the averages or median values of the results by all participants. However, we may notice that the values by Nagoya group are a bit higher values in ^{14}C concentration and younger ones in ^{14}C age, in particular, one of the ^{14}C ages on sample B. We need more tests to check this tendency.

Table 1 Comparison of the VIRI results and the relevant values measured by Nagoya AMS group

Sample No	Average	Median	1 sigma	Minimum value	Maximum value	Nagoya AMS (±1σ)
A (pMC)	108.6	109.1	2.78	92	113.0	109.6±0.3 109.7±0.3
B (BP)	2825	2821	198.7	2460	3979	2752±25 2803±28
C (pMC)	109.8	110.6	2.35	98.6	112.6	110.7±0.3 110.9±0.3
D (BP)	2859	2835	185.2	2580	3998	2811±25 2832±25

Precise estimation of age for not only archeological but also historical events is getting more and more important in Japan. For example, the timing of introducing rice farming, along with agricultural tools for rice farming to Japan, is re-examined by ^{14}C dates with high precision. To provide accurate age to the events, age estimation by ^{14}C wiggle matching techniques for wood samples is quite promising. Therefore, we are conducting accuracy and precision tests by measuring ^{14}C age for each annual ring of a big tree, in particular, a Japanese tree, whose age was determined by dendrochronology, for the tests that the established IntCal98 and IntCal04 ^{14}C data sets are really consistent with the ^{14}C-concentration records in Japanese trees.