

AMS DATING FROM ARCHAEOLOGICAL SITES IN VIETNAM

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Introduction

The land of Vietnam is dotted with archaeological sites, covering a prolonged period from palaeolithic to recent historic times. However, age determination of many important archaeological sites is yet to be made. From 2002, with supports from the Korea Research Foundation, the Seoul National University team, in close co-operation with their Vietnamese colleagues, started a 4-year project which attempts to accumulate more accurate chronometric information. While the primary goal of the project was to provide information for Hoabihnian sites, whose ages are only vaguely known, samples from many archaeological sites throughout Vietnam will also be collected. Thus, by the end of the year 2006, we expect to provide as many as four to five hundred AMS dates for various archaeological periods. In this report, we would like to make a summary presentation for the results so far obtained.

AMS Dating

As well known, radiocarbon dating is a fairly reliable chronometric technique commonly and widely adopted for archaeological research. By analyzing the content of radioisotope Carbon 14 in the sample, it provides information about the time when the sample stopped functioning as an organism. Nevertheless, the conventional radiocarbon dating technique

has a shortcoming. That is, due to the limited quantity of ¹⁴C in samples, it needs a rather large amount of sample for successful dating. By the same token, the conventional method is not applicable for samples older than about 40,000 years at best.

Accelerator mass spectrometry, or AMS in short, provides a more efficient method for detecting ¹⁴C by measuring the number of atoms present, or a proportion of them. The term mass spectrometry indicates the technique by which atoms of specific elements are detected according to their atomic weights. While normal mass spectrometers cannot detect ¹⁴C and reject other isotopes with nearly the same weight, AMS technique developed in the late 1970s made it possible to detect ¹⁴C separately from other similar isotopes.

Introduction of AMS technique also made it possible to date samples with very small amount of ¹⁴C as it counts directly the number of ¹⁴C molecules within the sample. For example, charcoal sample as small as 20 mg or wood sample of 25 mg in weight can be dated. By the same token, it allows to date samples much older than previously possible. Especially, by applying isotopic enrichment technique, samples as old as 75,000 years may be dated. At the same time, the accuracy of dating is much improved as it directly counts the number of ¹⁴C particles in the sample. In AMS dating, the age limit for dating is determined by factors such as machine stability and the degree of modern contamination introduced in the

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processing of samples. Thus, sample treatment both in the field and lab becomes more important than for the conventional carbon dating.

For AMS, cyclotrons have been used during the initial phase of development of the technique, but now tandem accelerator is commonly used. In 1998, the Seoul National University established the most advanced AMS facilities by acquiring the Model 4130-AMS manufactured by High Voltage Engineering Europa B. V. The AMS laboratory of the Seoul National University represents the fifth in the world which operates the second generation Tandemron AMS facilities.

Samples and dates

The total number of ^{14}C samples submitted to the AMS lab totals to about 150. However, during the pre-treatment process, many of the samples turn out to be inappropriate for analysis, thus, discarded. Especially, collagen was not extracted from many of the bone samples, thus, impossible to date. So far, dates were obtained for limited number of samples, which are summarized below. All the radiocarbon ages were calculated on the basis of Libby half-life of 5568 years, and presented with an error range of $\pm 1\sigma$, i.e., 67% of probability. They are presented below as uncalibrated radiocarbon dates.

A. Go Hoi

Excavated in 2002, Go Hoi site is located at $21^{\circ} 28' 30''$ N and $105^{\circ} 20' 50''$ E. The site is of Phung Nguyen Culture of late Early Bronze Age. Its age was estimated to be around 3,500 BP. Nine charcoal samples were submitted for analysis. Sample Numbers 1, 2, 3, 5, 7 and 8 are from Pit 2 and Number 4, 6 and 9 and from Pit 1, each measuring 30 and 90m² in size. So far, dates from three

samples of Numbers 2, 4, 6, 8 and 9 are reported. Dates obtained from these samples are 3180 ± 50 (SNU 03-138), 3590 ± 50 (SNU 03-140), 3590 ± 30 (SNU 03-588), 3370 ± 80 (SNU 03-142), and 3820 ± 30 BP (SNU 03-589). Their $\text{C}^{13}/\text{C}^{12}$ ratios are -24.9, -27.7, -30.0, -23.6 and -32.0‰, respectively.

B. Dinh Trang

Dinh Trang site is in Dong Anh District of Ha Duong Province, at $21^{\circ} 07' 56''$ N., $105^{\circ} 54' 55''$ E. Tested in 2002, there were identified layers of Phung Nguyen, Dong Dau and Go Mun Culture. These layers were disturbed by tombs of Dong Son period. Seven charcoal samples were dated. Samples numbered 1, 3, 4, 6 and 7 may be from Dong Dau layer. They were dated to be 2530 ± 30 BP (SNU 03-143), 2520 ± 40 (SNU 03-144), 3140 ± 80 (SNU 03-145), 2950 ± 60 (SNU 03-592), and 2910 ± 70 BP (SNU 03-593), with $\text{C}^{13}/\text{C}^{12}$ ratios of -27.2, -27.3, -25.2, -28.2 and -28.1‰, respectively. Sample Number 2, possibly from a Phung Nguyen layer is dated to be 3440 ± 40 (SNU 03-590) with a $\text{C}^{13}/\text{C}^{12}$ ratio of -27.2‰. Sample Number 5 appears to be from Go Mun layer, and dated to be 2880 ± 40 BP (SNU 03-591) with a $\text{C}^{13}/\text{C}^{12}$ ratio of -27.1‰.

C. Dinh To

Dinh To is in Bac Ninh Province and a Dong Dau Culture site excavated in 2001. Previously, two radiocarbon dates are known from the lower units, 3890 ± 160 BP (ANU-11118) and $3,060 \pm 60$ BP (ANU-11117). Four charcoal samples were collected and there are available dates from three samples so far. Sample Number 1 is from Section B5, Layer 2-2 and obtained at the depth of 87.5cm from the surface. The second sample is from Section C3, Layer 1-3 and obtained at the depth

46cm from the surface. The third one is from Section D5, Layer 1-5. Their radiocarbon ages turned out to be 2960 ± 60 (SNU 03-146), 2890 ± 60 (SNU 03-147) and 2920 ± 40 BP (SNU 03-294) with C^{13}/C^{12} ratios of -26.6, -23.8 and -28.4 ‰, respectively.

D. Xom Oc

From the site of Xom Oc in Ly Son Island in Quang Ngai Province, two charcoal samples from Pit 1 were submitted for analysis. Result was obtained for the one from Layer 4. Its age is 2090 ± 60 BP (SNU 03-597) with a C^{13}/C^{12} ratio of -26.3 ‰.

E. Go Cam

Go Cam in Quang Nam Province is located nearby Tra Kieu- a site of the ancient kingdom of Champa. Two charcoal samples obtained from excavation in 2001 were submitted, and a date was obtained for the one from Pit 2 Section A5. Its C-14 date turns out to be 2000 ± 40 BP (SNU 03-598) with a C^{13}/C^{12} ratio of -24.1 ‰.

F. Vuon Chuoi

Vuon Chuoi is in Ha Tay Province, and two charcoal samples collected from holes dug into the basal layer were dated. The one from Pit II is dated to be 3010 ± 40 BP (SNU 03-600) with a C^{13}/C^{12} ratio of -26.2 ‰, while the other from Pit III, Layer 5, Section B3 is with a date of 2950 ± 40 BP (SNU 03-601) with a C^{13}/C^{12} ratio of -26.1 ‰.

G. Man Bac

Man Bac site is of Phung Nguyen Culture in Ninh Binh Province. Two samples of charcoal and shell were forwarded for dating, the former from Layer 5-7, Section A1, the latter from Layer 5-8, Section A1, Feature 29. The former is with a date of 3400 ± 60 BP (SNU 03-149) with a C^{13}/C^{12} ratio of -40.4

‰, well within the expected range. But, the shell turned out to be 5540 ± 70 BP (SNU 03-129) with a C^{13}/C^{12} ratio of -1.1 ‰. It may be more prudent to disregard the date from the latter date for consideration of the 'true' age of the site.

H. Xom Ren

Xom Ren is an early Phung Nguyen site made of settlements and burials in the Gia Thanh District, Phu Tho Province, at $21^{\circ} 26' 58''$ N., $105^{\circ} 19' 59''$ E. Four charcoal samples were obtained in 2002 were dated, all from the excavation unit 2 (Pit 2). Sample Number 1 is from the bottom of Layer 2, Section A6, Number 2 from Section AB1, near the Tomb Number 2, Number 3 from the bottom of Layer 2, Section B1, and Number 4 from the bottom of Layer 2, Section B4. Their dates turned out to be 3450 ± 70 (SNU 03-150), 3770 ± 60 (SNU 03-151), 3360 ± 40 (SNU 03-152) and 3370 ± 40 BP (SNU 03-153), with C^{13}/C^{12} ratios of -25.5, -28.3, -25.8 and -26.4 ‰, respectively.

I. Ma Uoi

Ma Uoi cave is a faunal locality in Hoa Binh Province at $20^{\circ} 37' 22''$ N and $105^{\circ} 16' 40''$ E, and a testing was conducted in November 2001. While four samples were given for C-14 dating, result was obtained only from a piece of shell collected from the excavation unit N17. Lacking collagen, others were not suitable for dating. Its age was determined to be 33500 ± 500 BP (SNU 03-128) with a C^{13}/C^{12} ratio of -12.1 ‰.

J. Hang Cho

Hang Cho is a Hoabinhian site in Luong Son District, Hoa Binh Province, at $20^{\circ} 50' 24''$ N and $105^{\circ} 30' 11''$ E. 14 samples were collected on January 25, 2003, from the 1.2 m-high 'scarp' which defines the front and rear part of the

deposit. Five layers were identified from this section, which were labeled as Layers I to V from top to bottom. More samples were collected during the joint Vietnamese-Japanese-Korean testing of the site made in January and February, 2004. So far, there are obtained 11 radiocarbon dates from the samples collected in 2003, as summarized in the table below. C-14 dates obtained are relatively stable, and the deposit appears to have been formed some time between ca. 10,000 to 14,000 BP. Although charcoal

samples are of later age than shells, whose maximum difference of some 1,750 years is shown between samples collected from the Layer II(SNU 03-132 vs. SNU 03-156), the so-called 'old carbon' problem does not seem to be prominent in this case. It may be said with some confidence that Hoabinhian levels at Hang Cho are indeed of late Pleistocene/early Holocene in age. More confident conclusion will be made about the age of this Hoabinhian site when results are reported for the samples collected in 2004.

Table. Radiocarbon dates from Hang Cho by AMS

Layer	Material	Radiocarbon Age (BP)	Lab Number	C ¹³ /C ¹² Ratio (‰)
I	shell	10,300 ± 200	SNU 03-130	-8.1
I	shell	9,990 ± 50	SNU 03-131	-10.8
I	shell	9,710 ± 180	SNU 03-137	-9.6
II	shell	12,200 ± 250	SNU 03-132	-9.6
II	charcoal	10,450 ± 250	SNU 03-156	-26.4
III	shell	14,400 ± 300	SNU 03-133	-12.3
IV	charcoal	13,190 ± 190	SNU 03-157	-24.4
IV	shell	14,000 ± 300	SNU 03-134	-11.0
IV	charcoal	12,580 ± 220	SNU 03-158	-24.0
V	shell	14,100 ± 300	SNU 03-135	-9.8
V	shell	13,700 ± 80	SNU 03-136	-9.9

Concluding Remarks

We believe that the current project will help to have an improved understanding of the archaeology of Vietnam. However, it must be emphasized that, while the AMS dating is a valuable tool, it is merely a tool. Although it provides very accurate age of given samples, it does not resolve archaeological problems by itself, nor guarantees the 'real' age of a given layer, feature or site. For example, by accurately dating the ages of recycled, old materials,

it may provide an impression that the site is much older than its real age. In other words, interpretation of the AMS dates is a totally different matter from the dating itself, thus, it is up to the users how to utilize the results for accurate reconstruction of the archaeology of Vietnam.

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