BERLIN ^{14}C DATES OF ARCHAEOLOGICAL SITES IN VIETNAM

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ABSTRACT. In 1968, H. Quitta, J. Herrmann, G. Kohl and P. H. Thong initiated cooperation between the Archaeological Institute in Hanoi and the Radiocarbon Dating Laboratory in Berlin. Since 1969, the Berlin ^{14}C laboratory has measured 215 ^{14}C dates from 65 archaeological sites in Vietnam. As a result, important problems in Vietnamese archaeology have been recognized and partially solved with the aid of a secure chronological framework.

INTRODUCTION

Cooperation between the Archaeological Institute in Hanoi and the Radiocarbon Dating Laboratory in Berlin began in 1968 with the help of H. Quitta, J. Herrmann, G. Kohl and P. H. Thong. Since 1969, 215 ^{14}C dates from 65 sites in Vietnam have been recorded, but until recently, the dating results had only been partly published (Quitta 1975; Diem and Chinh 1976; Kohl and Quitta 1978; Chinh *et al.* 1988). Thus, we compiled a date list of Vietnamese archaeological sites (Görsdorf, Kohl and Viet 1995). We briefly describe here the sites and sample types featured in that date list.

THE SITES

The dates cover the early Paleolithic to the Middle Ages. We dated four groups of sites:

1. 23 caves and rock shelters from the late Upper Pleistocene to the beginning of the Holocene, with so-called pebble cultures—Sonvian, Hoabinhian, Nguomian and Bacsonian.
2. 9 coastal sites from the middle Holocene, with Neolithic cultures—Da But, Quynh Van and Cai Beo.
3. 26 Metal Age sites from northern, central and southern Vietnam. Most of the sites are in the north, where the Bronze Age began with the Phung Nguyen culture at the end of third millennium BC. The Iron Age began with the Dong Son culture in the eighth century BC, according to dates from Quy Chu and Dong Ngam.
4. Early Historical period and Middle Ages sites, with dates of the Oc Eo culture from Nen Chua.

These dates contribute to the early history of Vietnam. The beginning Hoabinhian in Vietnam was dated as early as 20 ka BP. Electron spin resonance (ESR) measurements (Görsdorf 1990) on terrestrial mollusk shells (*Cyclophorus*) of Tham Khuon, Nguom and Phung Quyen confirm these results.

Special investigations were necessary for mollusk shells. We measured outer (fraction 1) and inner (fraction 2) layers of mollusk shells to detect contamination. Figure 1 shows the results. We observed significant differences of >500 yr in samples from Tham Khuong (site 1), Phung Quyen (site 6), Lang Vanh (site 7), Nui Mot (site 9), Soi Nhu (site 10), Hang Pong (site 12) and Hang Muoi (site 17). The outer parts of these mollusk shells were contaminated with foreign and much younger carbon. Only the samples from Sung Sam (site 15) and Tham Hoi (site 16) were possibly contaminated with old carbon.

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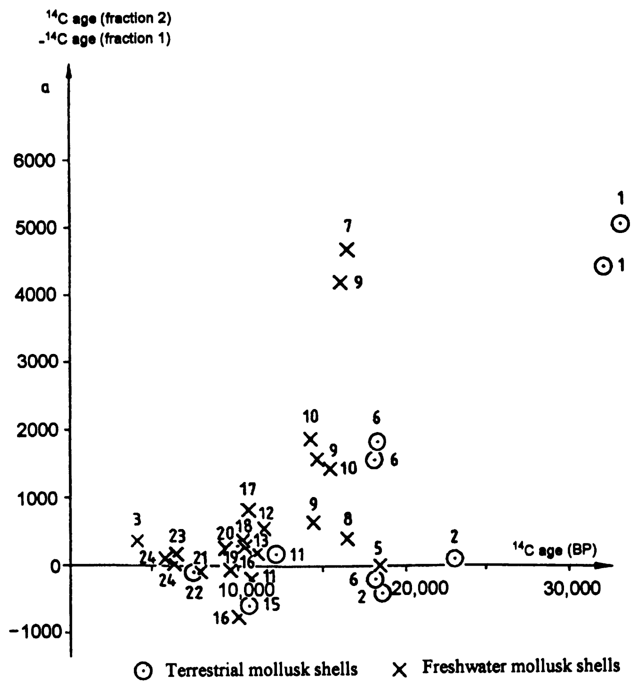

Sites

1 Tham Khuong	10 Soi Nhu	18 Bo Lum
2 Nguom	11 Con Moog	19 Tham Hai
3 Mieng Ho	12 Hang Pong 1	20 Hang Chua
5 Xom Trai	13 Hang Doi	21 Bo Nam
6 Phung Quyen	15 Sung Sam	22 Hang Dang
7 Lang Vanh	16 Tham Hoi	23 Ha Lung
8 Xom Tre	17 Hang Muoi	24 Da But
9 Nui Mot		

Fig. 1. Differences in dating results between fraction 2 (inner layers) and fraction 1 (outer layers) of mollusk shells as a function of the ^{14}C age of the inner part.

Reservoir ages were determined for the prehistoric caves of Con Moong and Xom Trai by comparing dates on limnic mollusk shells and terrestrial material found in the same strata. Tables 1 and 2 show the results. Mean reservoir ages were 800 ± 300 yr for Con Moong and 50 ± 200 yr for Xom Trai.

The conditions in the Xom Trai limestone cave are not typical for the other Hoabinhian sites in Vietnam. Therefore, we used a reservoir age of 800 yr as the reservoir correction of freshwater mollusk shells from other excavation sites as a first approximation. For marine mollusk shells, we used a reservoir correction of 400 ± 100 yr as a first approximation (Stuiver and Braziunas 1993). We calibrated all our measurements using the programs CALIB 3.0.3 (Stuiver and Reimer 1993) and the Groningen Calibration Program (van der Plicht 1993).

We obtained information about climate change by investigating the frequency of plant and animal remains from several Hoabinhian sites (Viet, Görsdorf and Kohl 1988). Figure 2 shows the excavation profile of the Con Moong site and the frequency of plant and animal remains.

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TABLE 1. Reservoir Ages for Con Moong

Stratum	Lab no. (Bln-)	Sample material	$\delta^{13}C$ (PDB)	Conv. ^{14}C age ± 1 σ (yr BP)	Reservoir age R (yr)
A2	3486	Terrestrial mollusk shells (*Cyclophorus*)	(−10‰)*	8750 ± 70	
A2	3482	Charred fruit stones (*Canarium*)	−26.0‰	8480 ± 60	
A2	3491	Freshwater mollusk shells (*Antimelania*)	−12.0‰	9440 ± 60	950
A4a	3487	Terrestrial mollusk shells (*Cyclophorus*)	−9.9‰	9440 ± 70	
A4a	3497	Charred fruit stones (*Canarium*)	−26.9‰	9080 ± 60	
A4a	3492	Freshwater mollusk shells (*Antimelania*)	−13.3‰	10,090 ± 60	1010
B2a	3485	Charred fruit stones (*Canarium*)	−27.0‰	10,300 ± 70	
B2a	3493	Freshwater mollusk shells (*Antimelania*)†	−12.0‰	11,080 ± 70	780
B3a	3488	Terrestrial mollusk shells (*Cyclophorus*)†	−10.5‰	12,170 ± 70	
B3a	3494	Freshwater mollusk shells (*Antimelania*)†	−10.9‰	12,340 ± 70	470‡
B4a	3489	Terrestrial mollusk shells (*Cyclophorus*)†	(−10‰)	12,140 ± 80	
B4a	3495	Freshwater mollusk shells (*Antimelania*)†	−11.0‰	12,660 ± 70	820‡
B5	3490	Terrestrial mollusk shells (*Cyclophorus*)†	(−10‰)	12,590 ± 80	
B5	3496	Freshwater mollusk shells (*Antimelania*)†	−12.0‰	13,070 ± 70	780‡

*$\delta^{13}C$ values in parentheses are estimated.
†Sample taken from fraction 2 (inner layer of mollusk shell)
‡We consider these terrestrial mollusk shells to be dated *ca.* 300 yr too old, as realized from Strata A2 and A4a.

TABLE 2. Reservoir Ages for Xom Trai

Stratum, depth (cm)	Lab no. (Bln-)	Sample material	$\delta^{13}C$ (PDB)	Conv. ^{14}C age ± 1 σ (yr BP)	Reservoir age R (yr)
G (120–140)	3473	Charred fruit peels	(−25‰)*	17,160 ± 80	
G (120–140)	3478	Freshwater mollusk shells (*Antimelania*)†	−10.2‰	17,060 ± 70	−100
G (160–170)	3475	Charred fruit peels	(−25‰)	17,010 ± 80	
G (160–170)	3480	Freshwater mollusk shells (*Antimelania*)†	−11.1‰	17,170 ± 80	+160
G (170–180)	3476	Charred fruit peels	−25.2‰	17,390 ± 70	
G (170–180)	3481	Freshwater mollusk shells (*Antimelania*)†	−10.7‰	17,460 ± 80	+70

*$\delta^{13}C$ values in parentheses are estimated
†Sample taken from fraction 2 (inner layer of mollusk shell)

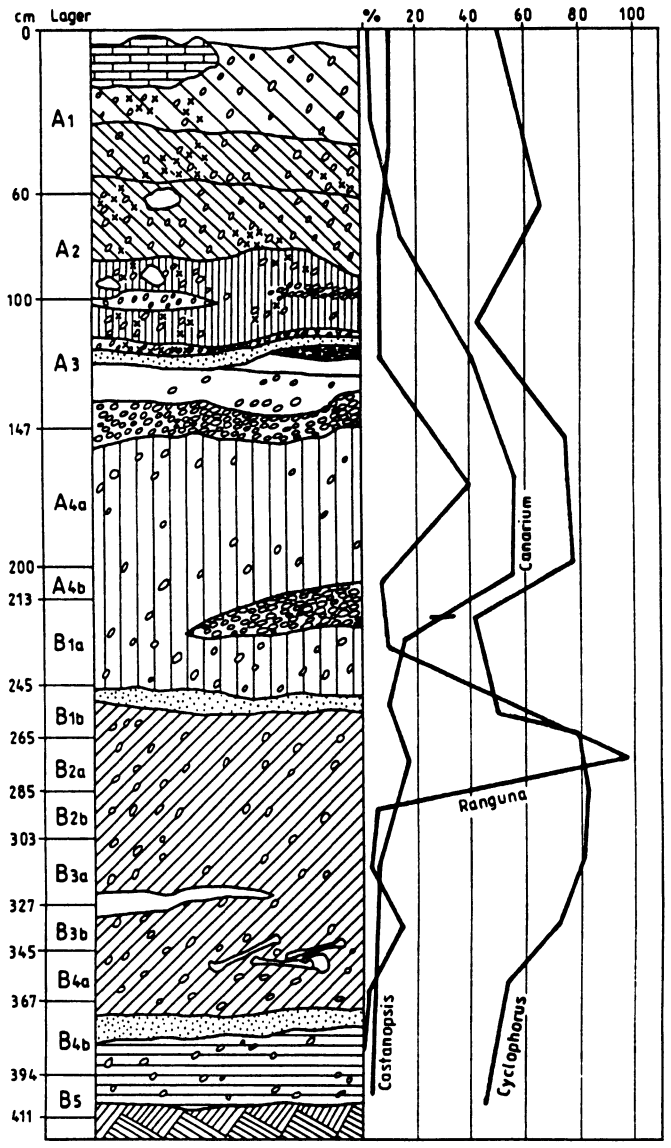

Fig. 2. Stratigraphy of the Hoabinhian cave Con Moong together with the frequency of plant and animal remains as indicators of climate change

We detected two wet intervals by the change in frequencies of terrestrial mollusk shells (*Cyclophorus fulguratus*) and shellfish (*Ranguna kimboiensis dang*). These periods range from 12,000 to 10,500 BP (12,000 to 10,500 cal BC) and from 9500 to 9200 BP (8600 to 8100 cal BC). We also detected climate change by the variation in plant remains. Charred fruit stones from *Canarium* indicate present-day warm climate, whereas charred fruit peels from dominant *Castanopsis* and *Juglans* indicate a cooler climate. The change in climate from cool to warm occurred *ca.*10 ka BP (9500 to 9100 cal BC) and exists to the present. Figure 3 shows the variation of plant remains for Hoabinhian sites in Vietnam.

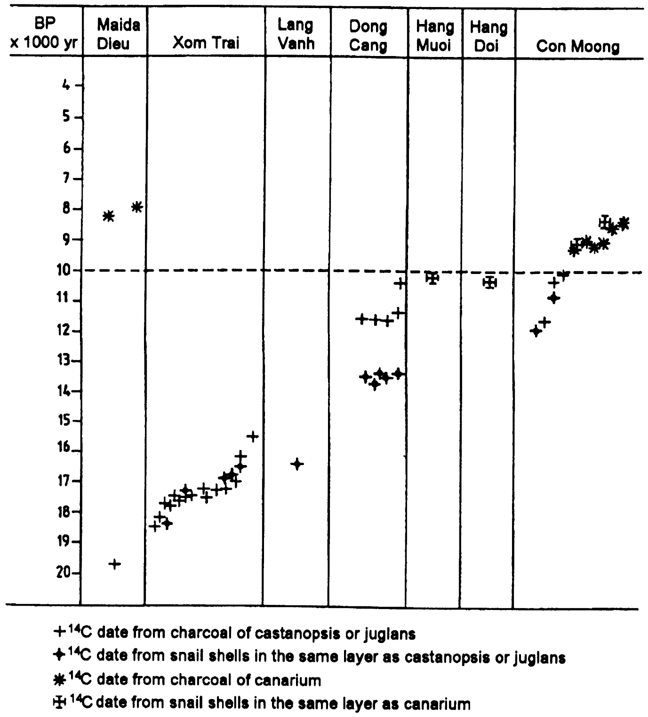

Fig. 3. Variation of plant remains as an indicator of climate change during the Hoabinhian in different caves in Vietnam

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