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MIECZYSŁAW F. PAZDUR

Evaluation of radiocarbon dates of organic samples from Uan Muhuggiag and Ti-n-Torha, Southwestern Libya

Introduction

Twelve samples were submitted to the Radiocarbon laboratory in Gliwice in order to supplement the series obtained earlier and reported by Barich *et al.* (1984: 413). Samples were submitted as very clean, botanically identified remnants. Site Uan Muhuggiag was represented by eleven samples: 8 samples of fruits of *Balanites aegyptiaca* (layers 1a, 2, 2c in Sector A and layers 1, 1a, 2a and 2b in Sector B), 2 samples of coprolites (layer 2a, Sector A, and layer 1, Sector B) and one small sample of uncharred seeds of *Citrullus colocynthis* from layer 1, Sector B. Site Ti-n-Torha was represented by uncharred plant detritus from layer I, western sector. Results in form of conventional C-14 dates are quoted in Tables 3 and 4 of the source article, together with dates obtained earlier on charcoals in radiocarbon laboratories in Rome and Udine.

Laboratory methods

Age determinations were performed using CO_2-filled proportional counters of different volumes. Since the mass of samples available for dating was relatively low, they were pretreated only with 2% HCl at 80°C for 1 hour. No alkali treatment was applied in order to avoid loss of mass during this step. Relatively large error of date Gd-4290 (2,220 ± 220 B.P.) is connected with very low amount of carbon dioxide obtained from combustion of seeds of *Citrullus colocynthis*. Sample was counted on the smallest proportional counter after dilution with inactive CO_2 (71% of inactive CO_2 was added to fill the counter). Dates Gd-4288 (2,770 ± 80 B.P.) and Gd-4358 (5,780 ± 80 B.P.) were obtained as a mean values from independent measurements performed on two or three counters. Dates ob-

tained on coprolites and fruits of *Balanites aegyptiaca* were corrected for isotopic fractionation by measuring $\delta^{13}C$ values. Obtained $\delta^{13}C$ values are listed in Table 1. Corrections were applied according to recommendations of Stuiver and Polach (1977: 355).

Table 1

Conventional and calibrated ^{14}C dates from site Uan Muhuggiag.

Sector/layer	M	Lab. no.	C	$\delta^{13}C$ %	Age ^{14}C conv. B.P.	Calendric age B.C.	Interquartile range B.C.
A/1a	Ch	Ud-224	–	–25[a]	3770 ± 200	2220	2410–2040
A/1a	B	Gd-2962	3	–25.52	3720 ± 90	2140	2250–2050
A/1a	*	Gd-4363	6	–25.52	3800 ± 140	2260	2390–2130
A/2	Ch	Ud-225	–	–25[a]	6035 ± 110	4940	?–4840
A/2	B	Gd-4362	4	–23.98	5290 ± 110	4130	4220–4050
A/2a	Co	Gd-2853	3	–21.66	6030 ± 80	4940	?–4840
A/2c	B	Gd-4358	m	–24.05	5780 ± 80	4660	4720–4590
B/1	Ci	Gd-4290	5	–25[a]	2220 ± 220	290	490– 110
B/1	Co	Gd-4288	m	–20.98	2770 ± 80	940	1000– 880
B/1	B	Gd-2854	3	–23.38	3810 ± 80	2270	2360–2190
B1/1a	B	Gd-2958	3	–24.39	4980 ± 70	3790	3880–3730
B1/1a	*	Gd-4357	5	–24.39	4980 ± 110	3790	3890–3710
B/2	B	Gd-2959	3	–24.36	5340 ± 120	4180	4270–4080
B/2a	B	Gd-2960	3	–24.99	5420 ± 100	4260	4330–4170
B/2a	*	Gd-4361	6	–24.99	5480 ± 120	4330	4430–4230
B/2b	Ch	Ud-226	–	–25[a]	5350 ± 200	4190	4330–4040
B/2b	B	Gd-5337	1	–24.43	5420 ± 50	4280	4320–4250

M – sample material: Ch – charcoal, Ci – seeds of *Citrullus colocynthis*, Co – coprolites, B – fruits of *Balanites aegyptiaca*, * – measurements repeated on the same gas using different counter, C – counter number in Gliwice Radiocarbon Laboratory: m – results obtained as mean from determinations on three or two counters, [a] – values of $\delta^{13}C$ assumed equal to –25.00 permille.

Discussion: evaluation of individual C-14 dates

All dates from site Uan Muhuggiag were converted to the calendric time scale using procedure for probabilistic calibration of C-14 dates, described by Pazdur and Michczyńska (this volume). The results are listed in Table 1 and are presented in graphical form in Fig. 1. For clarity of the picture the youngest samples from layer 1, Sector B, are not shown in Fig. 1. Conventional C-14 dates Ud-225 (6,035 ± 110 B.P.) and Gd-2853 (6,030 ± 80 B.P.) cannot be calibrated by the computer procedure and are not shown in Fig. 1. However, it is possible to read approximate values of calendric age of those samples directly from calibration curves of Pearson *et al.* (1986: 928). Obtained values are given in Table 1, though the estimates of uncertainties of the calendric age are not available.

Chronology of Sector A is based on 7 dates obtained from 6 different samples. Dates of charcoal and fruits of *Balanites aegyptiaca* from layer 1a are in excellent agreement, the age of this layer can be therefore estimated as close to 2,200 B.C. Two C-14 dates of charcoal and *Balanites* fruits from layer 2 are not consistent and differ by *ca.* 1000 years. There are two possibilities to explain this

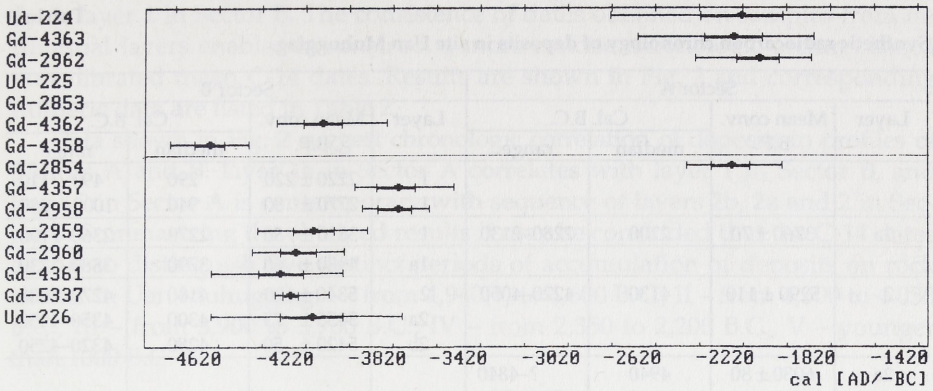

Fig. 1. Calibrated ^{14}C dates from site Uan Muhuggiag (dots); bold lines show interquartile ranges and normal lines show 95% confidence intervals of calendric age. Two youngest dates from layer 1, Sector B, are not included; dates Ud-225 and Gd-2853 are out of range of calibration curve.

difference: either the charcoals were produced by combustion of much older subfossil wood, or the sample of *Balanites* fruits contains admixture from overlying layer. The first possibility seems to be much more probable, and can be additionally supported by significant scatter of C-14 dates of charcoal from the same area (site Ti-n-Torha, *cf.* Barich *et al.* 1984: 413). A second discrepancy in this profile is revealed by C-14 dates obtained from coprolites in layer 2a and *Balanites* fruits in layer 2c. The difference of these dates is equal to 250 years and cannot be regarded as highly significant when compared with dating errors, equal to ± 80 years. Such a small inversion may be caused either by disadvantageous combination of laboratory errors, or by chemical contamination, which was not removed because of insufficient treatment of samples in laboratory (only HCl treatment was applied – *cf.* chapter on laboratory methods), or by mechanical admixtures of some materials from adjacent horizons. Taking into account those probable explanations it may be concluded that C-14 dates from layers 2, 2a and 2c are in relatively good stratigraphic order.

Chronology of deposits in Sector B is based on 10 dates of 8 samples of different type. Layer 1 was dated using three different samples; the results are not consistent. Difference between youngest date on seeds of *Citrullus colocynthis* and the oldest one, obtained on fruits of *Balanites aegyptiaca*, is *ca.* 1600 years. Explanation of this difference by contamination of dated samples with foreign carbon or by laboratory errors seems not probable; it should be therefore assumed that either this layer is not homogeneous, or some fruit of *Balanites* from underlying layer were included during sampling. C-14 dates obtained from repeated measurements of samples from layers 1a, 2a and 2b are consistent, and the sequence of dates in the whole profile of Sector B is in good stratigraphic order. The inversion of dates from layers 2a and 2b (*cf.* Table 1) is insignificant and may be interpreted as the result of counting errors during measurement of C-14 activity.

Table 2

Synthetic radiocarbon chronology of deposits in site Uan Muhuggiag.

Sector A				Sector B			
Layer	Mean conv. B.P.	Cal. B.C.		Layer	Mean conv. B.P.	Cal. B.C.	
		median	range			median	range
				1	2220 ± 220	290	490– 110
				1	2770 ± 80	940	1000– 880
1a	3760 ± 70	2200	2280–2130	1	3810 ± 80	2270	2360–2190
				1a	4980 ± 60	3790	3880–3730
2	5290 ± 110	4130	4220–4050	2	5340 ± 120	4180	4270–4080
				2a	5450 ± 75	4300	4350–4250
				2b	5420 ± 50	4280	4320–4250
2a	6030 ± 80	4940	?–4840				
2c	5780 ± 80	4660	4720–4590				

Significant difference occurs between dates on charcoals from layer I in Ti-n-Torha shelter (8,520 ± 60 and 8,840 ± 60 B.P.) and date on plant detritus (Gd-2855: 5,210 ± 90 B.P.). As indicates by dates listed in Table 2 of source article, charcoals from this site are of different ages and, moreover, the C-14 dates of samples collected from individual layers are not in stratigraphic order. This may suggest that dated charcoals were produced by ancient man by the combustion of subfossil (dead) wood; if this explanation is true the date obtained on plant detritus may be regarded as the most reliable indicator of the time of deposition of layer I. Such conclusion seems to be confirmed additionally by C-14 dates from eastern sector, where layer I was dated as 6,230 ± 50 B.P. (R-1403) and age of layer II is *ca.* 2000 years older, and is close to dates obtained on all charcoal samples from layers I to III in western sector.

Calendric C-14 chronology of site Uan Muhuggiag

The above presented detailed discussion of individual C-14 dates leads to the conclusion that the set of available C-14 dates gives a consistent chronologic picture of formation of deposits in both excavated sectors, with the only exception of outlying results obtained on charcoal from layer 2 (Ud-225) and set of dates

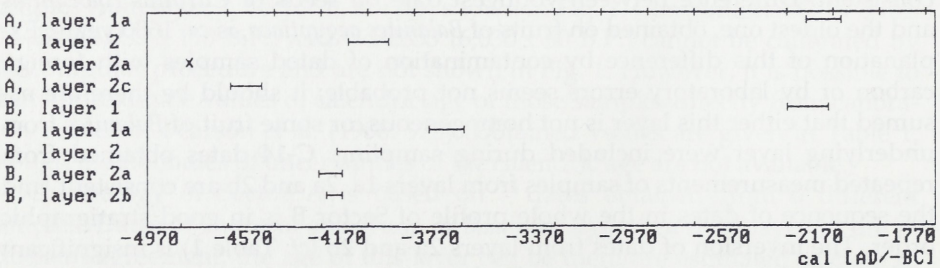

Fig. 2. Syn.thetic calendric chronology of deposits in Uan Muhuggiag rock shelter. Bars denote interquartile ranges of mean calendric ages of individual layers. Approximate value of calendric age of layer 1a, Sector A, is indicated by cross.

from layer 1 in Sector B. The consistence of dates obtained on samples from individual layers enables to construct a more concise chronologic picture, based on calibrated mean C-14 dates. Results are shown in Fig. 2 and corresponding numeric data are listed in Table 2.

Data shown in Fig. 2 suggest chronologic correlation of deposits in profiles of Sectors A and B: layer 1a in Sector A correlates with layer 1 in Sector B, and layer 2 in Sector A is contemporary with sequence of layers 2b, 2a and 2 in Sector B. Summarizing the obtained results it may be concluded that the C-14 dates enable to distinguish five distinct periods of accumulation of deposits on rock shelter in Uan Muhuggiag: I – from 4,940(?) to 4,600 B.C., II – from 4,300 to 4,050 B.C., III – from 3,900 to 3,700 B.C., IV – from 2,350 to 2,200 B.C., V – younger than 1000 B.C.

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