THE CHRONOLOGY OF THE GHASSULIAN CHALCOLITHIC PERIOD IN THE SOUTHERN LEVANT: NEW ^{14}C DETERMINATIONS FROM TELEILAT GHASSUL, JORDAN

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ABSTRACT. This article reports on ten new accelerator mass spectrometry (AMS) dates from the Chalcolithic period (fifth millennium BC) archaeological type-site of Teleilat Ghassul in Jordan. Early radiocarbon assays from the site proved difficult to integrate with current relative chronological formulations. The ten new AMS dates and follow-up enquiries connected with the early assays suggest that the original dates were up to 500 years too early. A necessary reformulation of regional relative chronologies now views the Ghassul sequence falling between Late Neolithic Jericho and the Beersheban Chalcolithic.

INTRODUCTION

Traditionally, the Jordan Valley Chalcolithic cultures are seen to develop relatively smoothly out of the preceding Late Neolithic around 5000 BC (6100 BP) (Stager 1992). Over the course of an approximately thousand year sequence current radiometric evidence would suggest a series of overlapping but essentially smooth transitions from Early to Late Chalcolithic assemblages around 4500 BC (5700 BP). The latest Chalcolithic strata within the Jordan Valley date to 3900 BC (5100 BP) (Levy 1992; Gilead 1994). This cultural phasing is delimited by radiocarbon determinations from a series of atypical but recognizably Late Neolithic horizons at Wadi Ziqlab 200 (Banning et al. 1996) and Abu Hamid Lower (Lovell et al. 1997), and a comparable suite of earliest EB I dates from North Shuna (Philip, in press) and Tell Magass (Kerner, personal communication). This view of the Jordan Valley Chalcolithic enjoys broad consensus (Joffe and Dessel 1995). The major anomaly was Hennessy's five (SUA 732–739) very early ^{14}C determinations from the Chalcolithic type site of Teleilat Ghassul (Weinstein 1984; Joffe and Dessel 1995). Joffe and Dessel noted the anomalous early position of Hennessy's Ghassul dates, but as these were first published without any contextual details, it remained unclear how anomalous they actually were.

EARLY ^{14}C DATES FROM TELEILAT GHASSUL

Before the current assays, 12 ^{14}C dates were known from Teleilat Ghassul—one taken from the very early Pontifical Biblical Institute (PBI) excavations (Lee 1973), eight deriving directly from J Basil Hennessy's University of Sydney excavations (Hennessy 1982; Weinstein 1984), and three taken from standing sections several years after Hennessy's excavations had ceased (Neef 1990). Whilst Hennessy's (SUA) assays come from reliable contexts, the PBI (RT) and Groningen (GrN) assays derive from uncertain contexts that can only be very approximately equivalenced with known strata (Table 1, below).

The five Early Chalcolithic dates (1–5 below) are relevant to our immediate concerns. A number of publications have acknowledged Hennessy's early dates, but generally without comment. Gilead (1988) was first to note the implications for long-term in-situ cultural development, a view Hennessy (1989) subsequently emphasized. Levy (1992) outlined a similar claim for the length of occupation at Shiqmim, a view Perrot (1993) attempted to support for Beersheba, although Gilead (1994) was largely successful in rebutting both claims. A comprehensive synthesis of southern Levantine Chal-

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colithic ^{14}C data has recently been published by Joffe and Dessel (1995). Although they position Hennessy's assays within their "Early Chalcolithic" phase, they noted the anomalous early date of the samples. As it was generally assumed that these samples derived from the earliest (and little-known) horizons at the site (Stager 1992), such readings were not seen as particularly problematic. However, Bourke's (1997) observation that the early Hennessy assays did not derive from the earliest strata threw their problematic status into high relief. Lovell's (1999) comprehensive review of all the contexts in question emphasized the need to revisit the early readings. One aim of renewed excavations at Teleilat Ghassul (1994–99) was to explore this problem (Bourke et al. 1995; Bourke et al. 2000). Ten new short-life samples were obtained from strata equivalent to those sampled in Hennessy's assays and processed at the ANSTO AMS Centre in 1997.

Table 1 Early dates from Teleilat Ghassul

	Reference	Lab	Date BP	Cal BC	Material	Context
1.	Weinstein 1984	SUA–732	6550 ± 160	5440	Wood	Early Chalco
2.	Weinstein 1984	SUA–734	6370 ± 105	5280	Wood	Early Chalco
3.	Weinstein 1984	SUA–736	6430 ± 180	5370	Wood	Early Chalco
4.	Weinstein 1984	SUA–738/1	6300 ± 110	5260	Wood	Early Chalco
5.	Weinstein 1984	SUA–739	6070 ± 130	4950	Wood	Early Chalco
6.	Hennessy 1982	SUA–511a	5507 ± 120	4350	Wood	Late Chalco
7.	Hennessy 1982	SUA–511b	5796 ± 115	4650	Wood	Late Chalco
8.	Hennessy 1982	SUA–511c	5661 ± 120	4480	Wood	Late Chalco
9.	Lee 1973	RT–390A	5500 ± 110	4350	Wood	Late Chalco
10.	Neef 1990	GrN–15194	5330 ± 25	4190	Wood	Late Chalco
11.	Neef 1990	GrN–15195	5270 ± 100	4060	Wood	Late Chalco
12.	Neef 1990	GrN–15196	5110 ± 90	3940	Dung	Late Chalco

TECHNICAL DATA: PREPARATION AND PROCESSING

A standard AAA (acid/alkali/acid) method of pretreatment was used for all samples (all were charcoal); hot 2M HCl for 2 hr, then hot 2% NaOH for 2 hr, followed by 2M HCl for 2 hr. Pretreated samples were combusted to CO_2 using the sealed tube technique. A small portion of this CO_2 was collected for the determination of $\delta^{13}C$ at the University of Wollongong (using a Stable Isotope Ratio Mass Spectrometer), while the remainder was graphitized using the Zn/Fe method. The technical aspects of these processes have been described elsewhere (Hua et al. 2000). The graphite masses were in the range 1.70–2.63 μg carbon, except sample OZD030, which had a mass of 90 μg carbon (see Table 2).

The graphite derived from the samples was loaded into cathodes and measured by AMS using the ANTARES tandem accelerator (Lawson et al. 2000). The $^{14}C/^{13}C$ ratio of each sample was measured relative to the NIST standard of HOxI and sample ^{14}C ages were calculated after correcting for backgrounds (accelerator and chemistry) and isotopic fractionation using $\delta^{13}C$. The results were then converted to calendar ages using INTCAL 98, the most recent data set (Intcal98 1998), and the calibETH calibration program (Niklaus 1992). The cumulative probability distribution was used and the one standard deviation (1σ) range is reported here in Table 2.

Table 2 Ten new AMS dates from Teleilat Ghassul

ANSTO code	Graphite mass (µg C)	$\delta^{13}C$ per mil	Radiocarbon age (BP)	Calibrated Age (BC)
OZD024	2.04	–22.2	5791 ± 86	4723–4559 BC
OZD025	1.87	–20.4	5902 ± 71	4845–4726 BC
OZD026	2.29	–22.4	5851 ± 117	4794–4600 BC
OZD028	1.78	–23.8	5581 ± 67	4461–4370 BC
OZD029	2.20	–21.3	5524 ± 88	4435–4290 BC
OZD030	0.09	–23.2 *	5552 ± 163	4496–4295 BC
OZD031	2.63	–24.7	5605 ± 80	4490–4376 BC
OZD032	2.32	–22.7	5577 ± 71	4461–4368 BC
OZD033	2.15	–24.8	5454 ± 58	4338–4262 BC
OZD034	1.70	–23.8	5342 ± 71	4274–4085 BC

*This value is the average $\delta^{13}C$ of the remaining 9 samples because of insufficient sample for the measurement of both $\delta^{13}C$ and ^{14}C

DISCUSSION

The new determinations derive from two well separated but equivalent stratigraphic profiles (Areas A and G) at Teleilat Ghassul and both returned equivalent results, which suggest that Hennessy's Early Chalcolithic dates (SUA 732–739) were as much as ±500 years too early. The SUA Ghassul dates were measured in 1977, several years before a non-systematic error was discovered by the laboratory. The error was probably due to non-uniformities in the shape of the hand made glass vials used for measurements in one of the liquid scintillation counters and revisions of up to several hundred years proved necessary for samples measured between December 1978 and November 1980 (Temple and Barbetti 1981). For the Teleilat Ghassul samples it was not possible to calculate appropriate corrections due to vial changes made between 1977 and 1979, but the error from this source could be up to ±400 years.

CULTURE SEQUENCING AND RELATIVE CHRONOLOGY

The broad assemblage sequencing provided by the new ^{14}C dates allow us to suggest several modifications to the accepted relative chronological placement of problematic assemblages, particularly the basal Hennessy H-I 'Neolithic' assemblages from Ghassul. The new dates go some way towards

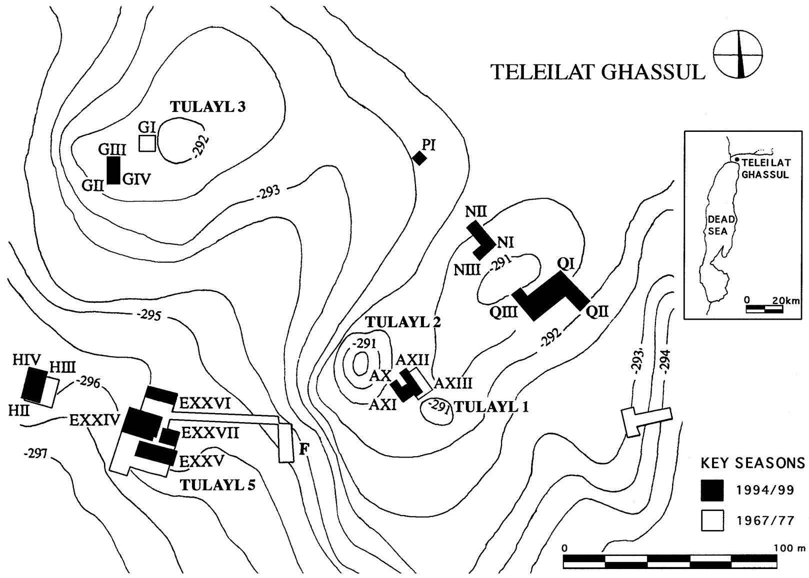

Figure 1 Plan of the University of Sydney excavation areas at Teleilat Ghassul

Table 3 Archaeological contexts and phasing

Site context	ANSTO code	BP age	Calibrated age	Site phasing
AXI 10.15	OZD 025	5902 ± 71	4845–4726 BC	Hennessy “Neolithic” Phase H-I
AXI 9.37	OZD 026	5851 ± 117	4794–4600 BC	Hennessy “Neolithic” Phase H-I
AXI 13.7	OZD 024	5791 ± 86	4723–4559 BC	Hennessy “Neolithic” Phase H-I
GII 66.55	OZD 031	5605 ± 80	4490–4376 BC	Early Chalco Hennessy Phase E-G
AXI 11.14	OZD 028	5581 ± 67	4461–4370 BC	Early Chalco Hennessy Phase E-G
GII 64.4	OZD 032	5577 ± 71	4461–4368 BC	Early Chalco Hennessy Phase E-G
QI 13.1	OZD 030	5552 ± 163	4496–4295 BC	Late Chalco Hennessy Phase A-D
N I 11.7	OZD 029	5524 ± 88	4435–4290 BC	Late Chalco Hennessy Phase A-D
GII 55.11	OZD 033	5454 ± 58	4338–4262 BC	Late Chalco Hennessy Phase A-D
GIII 10.10	OZD 034	5342 ± 71	4274–4085 BC	Late Chalco Hennessy Phase A-D

explaining the lack of parallels between the geographically proximate Jericho Late Neolithic and early Ghassulian assemblages (Hennessy 1989) as it now seems probable that Ghassul was not occupied during the Jericho Late Neolithic. Recent study of the basal levels at Abu Hamid (Lovell et al. 1997) suggests that this assemblage contains elements contemporary with Late Neolithic Jericho, and similarities with both the Ghrubba (Mellaart 1956) and Beth Shan (Fitzgerald 1935) assemblages (Lovell 1999). Also, ^{14}C data (Lovell 1999) suggests that the Abu Hamid “Early” levels precede the basal (Hennessy H-I) levels at Ghassul. The Abu Hamid “Middle” levels would seem to be broadly contemporary with the “pre-Ghassulian” Early Chalcolithic (Hennessy G-E) phases at Teleilat Ghassul.

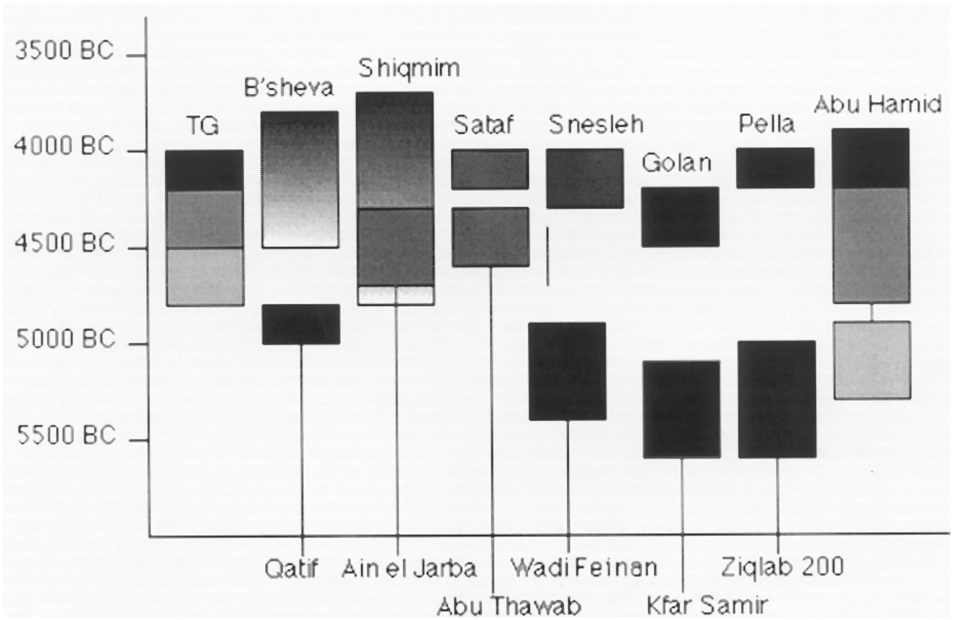

Figure 2 Revised relative chronology for southern Levantine Chalcolithic assemblages

CONCLUSION

The new AMS dates from Teleilat Ghassul clarify our understanding of both the origins and cultural contemporaries of the various phases of the Ghassul Chalcolithic sequence. It is likely that the earliest occupation at Ghassul postdates Neolithic exemplars and that significant occupation at Ghassul had ended by the floruit of the Beersheban Chalcolithic (Joffe and Dessel 1995). These possibilities have revolutionary significance for our understanding of the development of Chalcolithic culture in the southern Levant.

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REFERENCES

Banning E, Rahimi D, Siggers J, Ta'ani H. 1996. The 1992 Season of Excavations in Wadi Ziqlab, Jordan. *Annual of the Department of Antiquities Jordan* 40: 29–50.

Bourke S. 1997. The 'pre-Ghassulian' sequence at Teleilat Ghassul. In: Gebel HG, editor. *The prehistory of Jordan II: perspectives from 1997*. Berlin: Ex Oriente. p 395–417.

Bourke S, Seaton P, Sparks R, Lovell J, Mairs L. 1995. Preliminary report on the first season of renewed excavations at Teleilat Ghassul by the University of Sydney, 1994. *Annual of the Department of Antiquities Jordan* 39:31–64.

Bourke S, Lovell J, Sparks R, Seaton P, Mairs L, Meadows J. 2000. Preliminary report on the second and third season of renewed excavations at Teleilat Ghassul by the University of Sydney, 1995/1997. *Annual of the Department of Antiquities Jordan* 44:37–89.

Fitzgerald G. 1935. The earliest pottery of Beth Shan. *Museum Journal* 24:1–36.

Gilead I. 1988. The Chalcolithic period in the Levant. *Journal of World Prehistory* 2/4:397–443.

Gilead I. 1994. The history of the Chalcolithic settlement in the Nahal Beer Sheva area: the radiocarbon aspect. *Bulletin of the American Schools of Oriental Research* 296:1–13.

Hennessy JB. 1982. Teleilat Ghassul and its place in the archaeology of Jordan.*Studies in the History and Archaeology of Jordan* I:55–8.

Hennessy JB. 1989. Ghassul, Teleilat. In: Homes-Fredericq D, Hennessy JB, editors. *Archaeology of Jordan. Vol. II.1 field reports. Surveys and sites A-K*. Peeters. p 230–41.

Hua Q, Jacobsen G, Zoppi U, Lawson E, Williams A., Smith A, McGann M. 2001. Progress in radiocarbon target preparation at the ANTARES AMS centre. *Radiocarbon* 43(2).

Joffe A, Dessel JP. 1995. Redefining chronology and terminology for the Chalcolithic of the southern Levant. *Current Anthropology* 36:507–18.

Lawson E, Elliott G, Fallon J, Fink D, Hotchkis M, Hua Q, Jacobsen G, Lee P, Smith A, Tuniz C, Zoppi U. 2000. AMS at ANTARES - the first 10 years. Proceedings, 8th International Conference on AMS, 6–10 September 1999, Vienna, Austria.

Lee J. 1973. *Chalcolithic Ghassul: new aspects and master typology.* Unpublished doctoral dissertation. Hebrew University, Jerusalem.

Levy T. 1992. Radiocarbon dating of the Beersheba culture and Predynastic Egypt. In: Van dem Brink E, editor. *The Nile Delta in transition: 4th–3rd Millennium BC.* Jerusalem: Israel Exploration Society. p345–56.

Lovell J. 1999. *The Late Neolithic and Chalcolithic periods in the southern Levant: new data from Teleilat Ghassul, Jordan* [Unpublished doctoral dissertation]. University of Sydney.

Lovell J, Kafafi Z, Dollfus G. 1997. A preliminary note on the ceramics from the basal levels at Abu Hamid. In: Gebel HG et al., editors. *The prehistory of Jordan II: perspectives from 1997*. Berlin: Ex Oriente. p 361–70.

Mellaart J. 1956. The Neolithic site of Ghrubba. *Annual of the Department of Antiquities Jordan* 3:24–40.

Neef R. 1990. Introduction, development, and environmental implications of olive culture. In: Bottema S et al., editors. *Man's role in the shaping of the eastern Mediterranean landscape*. Rotterdam: Balkema. p 295–306.

Niklaus T, Bonani G, Simonius M, Suter M, Wölfli W. 1992. CalibETH—an interactive computer program for the calibration of radiocarbon dates. *Radiocarbon* 34(3):483–92.

Perrot J. 1993. Beersheva the Chalcolithic settlement. In: Stern E, editor. *New encyclopaedia of archaeological excavations in the Holy Land.* New York: Israel Exploration Society. p 161–3.

Philip G. In press. The Early Bronze age I-III periods. In: MacDonald B et al., editors. *The archaeology of Jordan.* Sheffield.

Stager L. 1992. The periodisation of Palestine from the Neolithic through Early Bronze times. In: Ehrich R, editor. *Chronologies in Old World archaeology.* Third edition. Chicago: University of Chicago. p 22–60.

Stuiver M, Reimer P, Bard E, Beck J, Burr, G, Hughen K, Kromer B, McCormac G, van der Plicht J, Spurk M. 1998. INTCAL98 radiocarbon age calibration 24,000–0 cal BP. *Radiocarbon* 40(3):1041–83.

Temple R, Barbetti M. 1981. Revisions to radiocarbon dates from the Sydney University Radiocarbon Laboratory. *Australian Archaeology* 13:28–9.

Weinstein J. 1984. Radiocarbon dating in the southern Levant. *Radiocarbon* 26(2):297–366.