Quaternary Research (2018), **90**, 244–247.

doi:10.1017/qua.2017.114

LETTER TO THE EDITOR

A chronostratigraphic model for the Hell Gap Paleoindian site and methods for refining chronologies at open stratified sites – Comment to the published paper by Pelton et al., Quaternary Research 88 (2017), 234–247

C. Vance Haynes*
Department of Anthropology, University of Arizona, Tucson, Arizona 85721-0030, USA
(Received November 21, 2017; Accepted December 7, 2017)

In a recent paper, Pelton et al. (2017) have presented a statistical procedure for evaluating radiocarbon (^{14}C) dates from a complex stratified cultural sequence with numerous ^{14}C dates at Locality I of the Hell Gap site in Wyoming. There are so many stratigraphically controlled ^{14}C dates, some conflicting, from Locality I that interpretations can vary significantly. Their procedure provides a useful approach to avoiding, or at least reducing, subjectivity. However, before presenting a qualitative approach to assessing the same radiocarbon dates at Locality I, there are several caveats that perhaps should be mentioned.

My chief criticism of their study is that they have assumed that the earliest dated cultural strata, their Mode 11, is a Goshen level, yet all of the excavations at Locality I since those of Henry Irwin (1968) have failed to yield any Goshen diagnostics in stratigraphic context. Haynes and Hill (2017) pointed out that the stratigraphic provenance of the original Goshen points is so close to that of the lower Folsom level that their relative ages are equivocal. The age of ca. 12,800 cal yr BP (11,000 ^{14}C yr BP) for Mode 11 could well be for a Clovis occupation that has yet to be defined via diagnostics.

Their assumption "that a date's relative position within a stratum is more accurate than its absolute depth below the top of that stratum" (Pelton et al., 2017, 235) is, of course, true provided that deposition at both locations is during the same increment of time as is typical for floodplain overbank aggradation, whereby increments of deposition are typically made up of widespread layers deposited one after another in layer-cake fashion (Fig. 1, lower strata 1–3). This mode of deposition at Locality I is believed to apply to the lower cultural strata (E_1 through E_5) (Haynes, 2009).

However, many of the higher strata (F through G) are derived from slopewash from the adjacent hillside whereby an increment of deposition in one area represents a different increment of time than in another area (Fig. 1, upper strata 1–10). Here increments 2 through 10 are all younger than increment 1, such that a sample from the middle of the stratum at A is in increment 6 and is considerably younger than a sample from the middle at B, which is in increment 1.

However, in spite of this caution, the fact that their statistical results show clustering within strata (i.e. their modes of figs. 3 and 4) suggests that increments of deposition making up a particular stratum are small enough and frequent enough that their assumption is valid for strata derived via slopewash at Locality I.

I do not know how it affects their statistical manipulation, but their standard stratigraphic section (SSS) at the southwest corner of the Witness Block does not contain three strata (i.e., G_1, F_1, and D_1), present elsewhere at Locality I. However, one of their dates, 7840 ± 62 ^{14}C yr BP (AA-65328), is from substratum F_{1g}, which occurs only in the east wall of Locality I East, yet another date in this wall (i.e., 5719 ± 97 ^{14}C yr BP [AA-65326]) in stratum G_1 is omitted, presumably because G_1 is not present at the SSS. But neither is stratum F_1 present in the SSS. It seems to me that for a stratigraphic section to be a standard, it needs to contain all of the strata at that locality.

In spite of their reluctance to vet dates any more than they did, a selection based on the elimination of anomalous ones and ones of dubious quality, from my point of view, might be worth examining. Their table 1 lists, in stratigraphic order, all radiocarbon dates from Locality I determined from 1993 to 2005. What appear to be anomalous results in this list may be

* Corresponding author at: 1009 E. South Campus Drive, Department of Anthropology, University of Arizona, Tucson, Arizona 85721-0030, USA. E-mail address, c/o Vance T. Holliday: vthollid@email.arizona.edu.

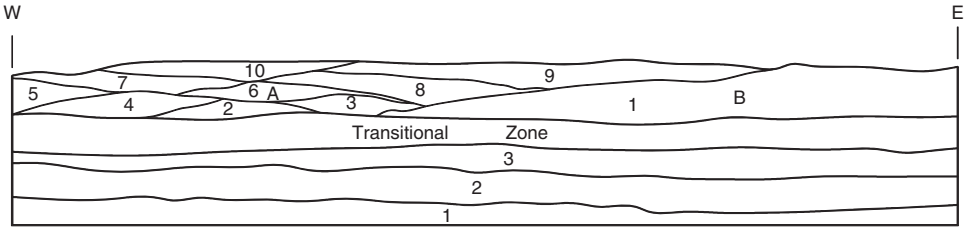

Figure 1. A hypothetical stratigraphic cross section parallel to the channel of Hell Gap Creek showing laminar bedding of overbank aggradation of early strata (1–3) and lensoidal bedding for slopewash sedimentation of later strata (1–10). The microstratigraphic contacts within the lensoidal bedding of the upper zone may not be discernable in the field, making it difficult to tell that sample A is significantly younger than sample B even though both are at the same depth below the surface. No scale.

discerned and eliminated by qualitative reasoning, as explained next, and so indicated by an "X" placed before the date in Table 1.

Of the three values for stratum F_2, the charcoal date of 7700 ± 120 cal yr BP (AA-35653) is rejected in favor of the humate age of 8728 ± 73 ^{14}C yr BP (AA-38274) for two reasons. First, the humate age is within 1 standard deviation (1σ) of the next older sample of 8820 ± 60 ^{14}C yr BP (AA-28776) in stratum F_2. The second reason is that the humate age, being significantly older than the charcoal date, is probably less contaminated than the charcoal value. Humate ages from charcoal, if different from the charcoal ages from which they are mostly derived, are usually younger because of contamination by extraneous mobile humic acids in the geochemical environment. This is especially so if the samples are from within the zone of fluctuation of the water table, which these are not. It is unlikely that a high water table with potentially older humic acids ever reached stratum F_2.

The single charcoal date for stratum F_1 (7840 ± 62 ^{14}C yr BP [AA-65328]) is rejected because it is significantly younger than the ^{14}C ages above and below. It is, therefore, probably either translocated via bioturbation or contaminated.

The third date rejected is the humate date of 8630 ± 370 cal yr BP (AA-38210) in favor of the charcoal age of 9030 ± 260 ^{14}C yr BP (AA-38209) at the top of stratum E_5 even though they overlap at 2σ. Also, the 9920 ± 950 ^{14}C yr BP (AA-27677) date for middle E_5 is rejected because the standard deviation is more than 10% of the indicated age. The value is simply too imprecise to be useful.

For stratum E_4, the humate date of 8770 ± 120 ^{14}C yr BP (AA-13373) is rejected in favor of the charcoal age of 9250 ± 75 ^{14}C yr BP (AA-14433) above it and the humate age of 9360 ± 85 ^{14}C yr BP (AA-13372) below it. Also, the charcoal date 8190 ± 100 ^{14}C yr BP (AA-27676) is rejected because it is too young by comparison with the ages above and below. Its age is more like that of upper stratum F from which it may have derived via bioturbation.

Both of the charcoal dates, $12{,}100 \pm 830$ ^{14}C yr BP (AA-28773) and $11{,}250 \pm 140$ ^{14}C yr BP (AA-20546), from stratum E_2 are rejected as being anomalously old compared with values above and below.

Much confusion about the stratigraphic positon and age of sample 6HG93 is because of the inadvertent misplotting of it on the profile of the east wall of Locality I West (Haynes, 2009, fig. G.2), which is the west wall of the Witness Block. The sample is actually from a deep test pit about 2 m south of Locality I West and about 4 m to the west of the west wall of the Witness Block. This was excavated in 1993 to determine the strata below D_2. A single piece of charcoal within stratum D_2 was collected from the north wall of the pit and provided the charcoal and humate ages $10{,}955 \pm 135$ ^{14}C yr BP (AA-14434) and $11{,}440 \pm 120$ cal yr BP (AA-33671) in table 1. The position projected to near the center of the north wall of Locality I West (Haynes, 2009, fig. G.2) is closer to being the true positon than that plotted at the east wall. The charcoal date of $10{,}955 \pm 135$ ^{14}C yr BP (AA-14434) is for the bottom of the upper one-third of stratum D_2.

All three dates from stratum D_2 in Table 1 may be too young because they would be more appropriate for stratum D_3, which is not present at Locality I. There the basal contact of stratum E_1 rests on an erosional surface at Locality I that would be the Clovis occupation surface if Clovis was ever present at Locality I (Haynes, 2009). The samples may be intrusive having come from the E_1/D_2 contact via bioturbation.

Both values for stratum C are probably too young in that the overlying date of $12{,}170 \pm 160$ ^{14}C yr BP (AA-27646) for the E_1/C contact is probably a minimum age for upper stratum C based on ^{14}C dates at localities elsewhere in the Hell Gap area. This qualitative procedure for vetting, as presented here, should be done for all of the radiocarbon dates in the Hell Gap site area (Haynes, 2009, Appendix F: 336–340). If time permits, this will be attempted in the future.

Although the vetting process employed here may be considered to involve a degree of subjectivity, it is conducted with the sole intent of arriving, as near as possible, to the truth and may be more realistic than the statistical procedure of Pelton et al. (2017).

ACKNOWLEDGMENTS

This manuscript was improved by constructive comments from Matthew E. Hill Jr. and Vance T. Holliday. Word processing was provided by Barbara Fregoso, and the line drawing of Figure 1 was prepared by Jim Abbott. Electronic submission was graciously provided by Vance Holliday.

Table 1. Hell Gap Locality I Radiocarbon Dates Arranged in Stratigraphic Order

Cultural Complex	Stratum	^{14}C Age Yrs BP	Radiocarbon Lab. No.	Sample No.	Stratigraphic Position	†	Remarks
	G_4-G_5	—					No ^{14}C dates at Locality I
	G_{3a}-G_{3b}	1265 ± 45	AA-20535	1HG95	Basal G_3	C	Hearth on basal contact
Archaic	G_2	—					No ^{14}C dates at Locality I
	G_1	5719 ± 97	AA-65326**	2HG05	Basal ⅓ of G_1	C	Omitted by Pelton et al.
	F_3	—					No ^{14}C dates at Locality I
Frederick	F_2	X 7700 ± 120	AA-35653	1HG99A	Middle of upper ½ of F_2	C	Same sample as below
		8728 ± 73	AA-38274	1HG99B	…	H	*P. et al. reject, CVH accepts
		8820 ± 60	AA-28776	45HG97	Middle of F_2	C	…
	F_1	X 7840 ± 62	AA-65328	31HG05	Upper ⅓ of F_1	C	Translocated charcoal
Scottsbluf		9030 ± 260	AA-38209	78HG97A	Top of E_5 (uppermost E)	C	*P. et al. reject, CVH accepts
		X 8630 ± 370	AA-38210	78HG97B	…	H	Same sample as above
Eden	E_5	9885 ± 90	AA-13371	2HG93	Middle of E_5	C	*P. et al. reject, CVH accepts
		X 9920 ± 950	AA-27677	102HG97	…	C	On weak stratigraphic break
		9120 ± 490	AA-29675	116HG97	Base of E_5	C	Scottsbluff point
	Contact	8880 ± 65	AA-35639	2_aHG99B	E_5/E_4 contact	H	Humates from Bulk Sed.
		9410 ± 260	AA-35641	2_bHG99B	…	H	Humates from 2 charcoal flecks
		9250 ± 75	AA-14433	7HG93	Upper ⅓ of E_4	C	Single Particle
Alberta	E_4	X 8770 ± 120	AA-13373	4HG93B	…	H	*Rejected by all
		9360 ± 85	AA-13372	3HG93B	Basal upper ⅓ of E_4	H	
		X**8190 ± 100	AA-27676	105HG97	Lower ⅓ of E_4	C	*Single particle, rejected by all
Hell Gap	E_3	9410 ± 95	AA-28774	18HG97	Upper E_{3b} (Middle Upper E_3)	C	Pelton et al. 2017 place in E_4
		9355 ± 75	AA-28775	39HG97	Lower E_{3b} (Lower Upper E_3)	C	…
Agate Basin	E_2	X 12,100 ± 830	AA-28773	7HG97	Middle E_2	C	P. et al. accept, CVH rejects
		X 11,250 ± 140	AA-20546	19HG95	Basal E_2	C	*Rejected by all
	Contact	X 10,520 ± 100	AA-28777	75HG97	E_2/E_1 contact	C	Basal E_2 or top of E_1
		10,655 ± 105	AA-13370	1HG93	Upper E_1	C	
Plainview		10,560 ± 80	AA-20545	18HG95	Middle of upper ½ of E_1	C	Middle of E_{1b}
Midland	E_1	10,885 ± 90	AA-33041	234HG96	Top of Middle ⅓ of E_1	C	Upper E_1
Folsom		10,940 ± 440	AA-38211	156HG96	Middle E_1	R	Feature 2, hearth (?) on E_{1a}
Goshen		10,700 ± 110	AA-33045	236HG96	Basal E_1	C	
		11,040 ± 190	AA-33042	235HG96	Basal E_1	C	
	D_3	—			Not present at Locality I		
		X 11,340 ± 80	AA-28778	210HG97	Upper ⅓ of D_2	C	Probably too young for upper D_2
	D_2	X 10,955 ± 135	AA-14434	6HG93A	Bottom of upper ⅓ of D_2	C	*shown twice on Fig. g-2, value at East Wall of Locality I West should be omitted. Value of North wall of Locality I is stratigraphically correct.[x]
		X 11,440 ± 120	AA-33671	6HG93B		H	Same sample as above. This sample, 6HG93, is from a deep (~1.3m) test pit placed ~ 2 m south of the Locality I West to determine depth of substrata C, B, & A.
	D_1				Not present at Locality I		
	Contact	12,170 ± 160	AA-27646	163HG97	E_1/C contact	R	Probably minimum for top of C
	C	X 9935 ± 70	AA-27644	16HG97A	Upper stratum C	R	*
		X 11,480 ± 70	AA-27647	16HG97B	…	H	*same sample as above
	B	X 9100 ± 500	A-748A	—	Uppermost stratum D_2	R	Obviously too young
	A						No ^{14}C dates at Locality I
	Bedrock						

*Rejected by Pelton et al. 2017
**Not listed in Table 2 of Pelton et al. 2017
†Material analyzed: C = charcoal, H = humates, R = residue of bulk sediment sample
X = Value eliminated for reasons explained at the top of page 2.

https://doi.org/10.1017/qua.2017.114 Published online by Cambridge University Press

REFERENCES

Haynes, C.V. Jr., 2009. Geochronology. In: Larson, M.L., Kornfeld, M., Frison, G.C. (Eds.), *Hell Gap: A Stratified Paleoindian Campsite at the Edge of the Rockies*. University of Utah Press, Salt Lake City, pp. 39–52.

Haynes, C.V. Jr., Hill, M.E., 2017. Plainview-Goshen-Midland typological problems. In: Holliday, V.T., Johnson, E., Knudson, R. (Eds.), *Plainview: The Enigmatic Paleoindian Artifact Style of the Great Plains*. University of Utah Press, Salt Lake City, pp. 249–273.

Pelton, S.R., Kornfeld, M., Larson, M.L., Minckley, T., 2017. Component age estimates for the Hell Gap Paleoindian site and methods for chronological modeling of stratified open sites. *Quaternary Research* 88, 234–247.

https://doi.org/10.1017/qua.2017.114 Published online by Cambridge University Press