Response to Comment by Poinar et al. on “DNA from Pre-Clovis Human Coprolites in Oregon, North America”

M. Thomas P. Gilbert,1 Dennis L. Jenkins,2 Thomas F. G. Higham,3 Morten Rasmussen,1 Helena Malmsröm,1 Emma M. Svensson,4 Juan J. Sanchez,5 Linda Scott Cummings,6 Robert M. Yohe II,7 Michael Hofreiter,8 Anders Götherström,4 Eske Willerslev1*

The arguments of Poinar et al. neither challenge our conclusions nor would contribute to the verification of our data. We counter their questions about the authenticity of our ancient DNA results and the reliability of the radiocarbon data and stand by the conclusion that our data provide strong evidence of pre-Clovis Native Americans.

In our study of the Paisley Cave coprolites, we applied some of the most comprehensive controls yet applied to ancient DNA. These controls were stricter than those used by our critics in related studies on coprolites, ancient humans, or both (e.g., 2–5). Nevertheless, Poinar et al. (6) challenge our study on several grounds. Although ancient human DNA results can rarely be 100% certain, and studies presenting noteworthy conclusions should be challenged, the arguments presented in (6) do not undermine our claims.

Our arguments present another scenario. Although our results have not been nullified, we restate that our claims have been corroborated. The arguments of Poinar et al. (6) do not undermine our conclusion that the Paisley Cave coprolites are of human origin. We disagree with several of their conclusions.

Poinar et al. (6) also raise questions about the Paisley Caves site, assemblages, and 14C dating. Direct dating indicates that the pre-Clovis assemblage includes a stemmed point, five nondiagnostic chipped stone tools, debitage, a hand stone with horse protein residues, and a butcher-cut grousse sternum. The assemblage is not Clovis but is Paleoindian (9). Obsidian pre-Clovis artifacts were subjected to hydration dating (OH). OH rate variability is caused by a combination of inherent characteristics and environmental variables (10). Controlling for effective hydration temperature (EHT) and employing mean group OH measurements rather than individual measurements often greatly improves OH rate accuracy and concordance between 14C and OH results (11–14). EHT has been calculated for multiple microsettings at the site by recording temperatures every 45 min between 2005 and 2008. Although more work needs to be done, we have observed good concordance between matched OH and 14C dates. With regard to sedimentary disturbances, these were generally traceable in Cave 5 (13). Sediments dip and thicken differentially toward the cave center, causing substantial elevational variation among peneccontemporaneous specimens. Site formation processes caused occasional intrastratigraphic age reversals. However, the general
integrity of deposits is well supported by the majority of stratigraphically correct dates obtained on artifacts, bone collagen, and human coprolite dates.

Our dated samples from Paisley Caves consisted only of identifiable fibrous plant matter carefully extracted from the human coprolites, as stated in (1) [see the materials and methods and figure S2 in the supporting online material for (1)]. In their previous published work [e.g., (4)], on the other hand, Poinar and colleagues homogenized coprolite remains before accelerator mass spectrometry (AMS) dating. We suspect this to be the source of their misinterpretation and confusion over our results. The \( \delta^{13}C \) values we published do not relate to bulk coprolitic carbon, and it is, therefore, impossible to infer general characteristics of human diet from them and to then link this with possible lacustrine reservoir effects. The C3 plant \( \delta^{13}C \) values do not provide evidence that the humans are herbivores, as Poinar et al. (6) imply. We selected only plant matter from the coprolites for dating to avoid potentially problematic bulked samples, which could conceivably include carbon from soil or sediment of different age. The variation in the two \( \delta^{13}C \) values for specimen 1374-PC-5/5D-31-2 may well reflect small amounts from two different types of plant matter being extracted and included in the analysis, for example C3 (\( \delta^{13}C \) ranging from \(-20\) to \(-35\) per mil) and C4 plants (\(-11\) to \(-15\) per mil). Further material from 1294-PC-5/6B-40 is currently being AMS dated to confirm which of the two ages thus far obtained (Beta-2134231 and OxA-16376) is more reliable. We consider this difference, or to have a major effect on the other results, but we will report new dating results for this specimen in due course. We contend that the radiocarbon results are (i) reproducible between two independent laboratories (with the exception of the 1294-PC-5/6B-40 sample noted previously); (ii) not subject to a reservoir effect because they yield \( \delta^{13}C \) values, which are predominantly indicative of terrestrial C3 plant remains; and (iii) of fibrous plant material which ought to give reliable AMS determinations when effectively pretreated.

In summary, although we accept that the sample contamination makes our data set far from perfect, we feel that the arguments presented in (6) would neither help resolve the data nor seriously challenge our conclusions. Ultimately, perhaps the only resolution may come from new, sterile excavations at this unique site.

References