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## Did Pre-Clovis People Inhabit the Paisley Caves (And Why Does It Matter)?

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**Abstract.** The date and processes of initial human colonization of the Americas are crucial issues for the understanding of human biological and cultural development. For example, Soares et al. (2009) cited the American archaeological record to validate their proposed revision of the human mitochondrial molecular clock. Their suggested mutation rate puts the date of rapid expansion of Native American clades at around 13,500–15,000 cal BP. Similarly, Poznik et al. (2013) have used the “high-confidence archaeological dating” of the initial peopling of the Americas to calibrate the rates of both Y-chromosome and mtDNA mutation and thereby to reconcile the ages of the common ancestors of human males and females. They use a date of ca. 15,000, based on purported archaeological evidence from Monte Verde, Chile, dated to 14,600 cal BP.

Until recently, the consensus of archaeologists was that the Americas were populated after 13,400 cal BP (11,500 <sup>14</sup>C yr BP) by a rapid expansion of people bearing the Clovis culture. Clovis ancestors, originating in southern Siberia, had crossed Beringia around 14,500 cal BP and subsequently migrated through a corridor between the receding Laurentide and Cordilleran ice sheets. This “Clovis-first” model has been challenged continually by advocates for various allegedly pre-Clovis sites. As the evidence for one set of ostensibly promising sites fails to

withstand close critical scrutiny (e.g., Tule Springs, Pikimachay, Pendejo Cave, Pedra Furada, Shriver, etc.), pre-Clovis enthusiasts pin their hopes on the latest contenders. Currently, their favorites are Monte Verde in southern Chile (Dillehay 1997; Dillehay et al. 2008), the Debra L. Friedkin site in Texas (Waters et al. 2011), and the Paisley Caves in southern Oregon. The evidence from both Monte Verde and Paisley Caves has been deployed both by archaeologists (e.g., Beck and Jones 2010; Erlandson and Braje 2011) and geneticists (e.g., Bodner et al. 2012) in support of a model of pre-Clovis migration along the Pacific coast—this despite the continuing absence of any sites older than 13,200 cal yr BP along the entire coast from Alaska to Tierra del Fuego (Dickinson 2011).

The Paisley Caves pre-Clovis evidence is unique in that it consists of both artifacts and directly-dated ancient feces that have yielded human DNA. Gilbert et al. (2008) reported coprolites containing human (but also canid) mtDNA dating to ca. 14,300 cal BP. Poinar et al. (2009) noted chronological and stratigraphic problems and suggested that contamination by leaching might account for possibly exogenous human DNA in the coprolites, while Goldberg et al. (2009) (who had actually examined and sampled the coprolites) asserted that their morphology was inconsistent with human derivation.

Jenkins et al. (2012a) report results of meticulous excavations and analyses designed to verify their previous claims. This research was focused particularly on demonstrating that the radiocarbon dates are accurate and the coprolites have not been contaminated by leaching. Jenkins et al. now assert that diagnostic Western Stemmed Tradition (WST) lithic artifacts and associated human coprolites date between 11,070 and 11,340  $^{14}\text{C}$  yr BP (ca. 13,000–13,300 cal yr BP). The artifact-associated radiocarbon dates overlap with dates for Clovis elsewhere (11,550–10,800  $^{14}\text{C}$  yr BP), while additional purported human coprolites are of pre-Clovis age

(older than 11,600  $^{14}\text{C}$  yr BP). This entire assemblage is interpreted as conclusive evidence that “the colonization of the Americas involved multiple technologically divergent, and possibly genetically divergent, founding groups” (Jenkins et al. 2012a: 223).

Close examination of the reported data shows that three stratigraphically and chronologically discrete components are present in the deep strata. The deepest deposit attributed to human activity consists entirely of coprolites with no associated lithic or organic artifacts. These purported “human” coprolites (dated to ca. 14,000–14,400 cal yr BP) are intermixed with others attributed, based on DNA, to late Pleistocene animals, i.e., camelids and lion (*Panthera leo*, presumably the extinct American lion, *Panthera leo atrox*). Previous claims (reported by Dalton 2009) that bone tools were present in this zone apparently have been abandoned; however, Hockett and Jenkins (2013) now assert that anthropogenic cut marks are present on two bones from the deepest strata: a mountain sheep mandible dated to 12380 $\pm$ 70  $^{14}\text{C}$  yr BP and an artiodactyl rib dated to 11930 $\pm$ 25  $^{14}\text{C}$  yr BP.

“Human” coprolites dated between 11,625 and 11,190  $^{14}\text{C}$  yr BP continue to occur upward in the sediments that are capped by a sloping “compact silt lens formed by a brief pooling of water on the cave floor” (Jenkins et al. 2012a). One of the WST point fragments was encased within this lens. The silt lens also incorporated an *Artemisia* twig dated to 11,070 $\pm$ 25  $^{14}\text{C}$  yr BP. Although a “lower bracketing age” of 11,340 $\pm$ 50  $^{14}\text{C}$  yr BP is proposed for the lens and point, a sample dated slightly later, 11,205 $\pm$ 25  $^{14}\text{C}$  yr BP, also lay below the lens (see Figures 2 and 3 in Jenkins et al. 2012a). A filled rodent burrow at the edge of the lens contained *Artemisia* twigs dated between 10,145 and 10,580  $^{14}\text{C}$  yr BP. A date of 10,855 $\pm$ 30  $^{14}\text{C}$  yr BP was obtained for plant tissue in the sand/silt sediments capping the lens; from the same depth, in the same sediment, in an adjacent unit, a younger date of 10,000 $\pm$ 25  $^{14}\text{C}$  yr BP is reported for

plant tissue. This date suggests that material may have been transported downward in this part of the cave by agents other than rodents from the third relevant component, an unambiguous WST occupation (Jenkins et al. 2012b) replete with preserved, culturally modified organic materials and dated to ca. 10,000–10,400  $^{14}\text{C}$  yr BP (11,600–12,500 cal yr BP) by multiple assays. This occupation zone generally corresponds to a stratigraphic discontinuity between lithostratigraphic units 1 and 2 (but not in the vicinity of the critical point-containing silt lens, where the LU 1-2 break is dated to ca. 9450  $^{14}\text{C}$  yr BP). Immediately below this ca. 10,200  $^{14}\text{C}$  yr BP zone, the dates increase dramatically, both in Caves 2 and 5, to ca. 11,600  $^{14}\text{C}$  yr BP.

The interpretive problem posed by this abrupt discontinuity is exemplified by hearth 2/6-4 in Cave 2. A charred twig at the top of this feature was dated to 10,020 $\pm$ 30  $^{14}\text{C}$  yr BP, while twigs at the bottom dated to 11,005 and 11,055  $^{14}\text{C}$  yr BP; these older dates are the “accepted” dates for the hearth (Jenkins et al. 2012a). Despite intensive efforts to find early cultural items, all of the directly dated artifacts made of organic materials (e.g., cordage and a possible wooden dart fragment) from the deepest strata still date later than 10,550  $^{14}\text{C}$  yr BP and appear to be derived by downward drift from the WST assemblage.

Although Jenkins et al. (2012a) assert that “The Paisley Caves rarely experienced wetting events that could transport aDNA into older strata”, the silt lens attributed to pooled water is a glaring exception. Indeed, Jenkins et al. (2012a: SOM p. 18) suggest that the water that formed this lens may also have saturated a camelid coprolite that was found 12 cm below it; this may account for a date on water-soluble organic matter (11,315 $\pm$ 25  $^{14}\text{C}$  yr BP) that is 900 years younger than the remaining organics (12,215 $\pm$ 30  $^{14}\text{C}$  yr BP) in this coprolite. A later saturation episode might perhaps explain the previously noted (Poinar et al. 2009) 900-year discrepancy between the dates for split samples of coprolite 1294-PC-5/5B-40-6 (Jenkins et al. 2012a: Table

S11). Jenkins et al. (2012a) assert that water did not leach into other, deeper samples, but they admit candidly that “Younger DNA contamination is not indicated but could exist”. Jenkins et al. (2012a) state that, in a test for leaching, “no human DNA was detected” in sediment around the coprolites, but in the SOM (p. 28) one finds the contradictory admission that “Of the 10 soil samples processed, three tested positive for human DNA . . . we do not discount the possibility that in these 30% of the cases it could also be the result of DNA movement between the different strata”.

They state that “Previous DNA findings of mitochondrial founding haplogroup A were confirmed by obtaining matching sequences from coprolites in blind test experiments at two independent laboratories” (Jenkins et al. 2012a: 227) ; only in the SOM (p. 26–27) is it disclosed that a third lab (at Washington State University) failed to extract *any* human DNA from eight coprolites. The WSU lab did, however, recover canid (wolf, coyote, or dog) DNA from three specimens (8/07, 10/07, and 17/09) that “previously tested positive for Native American DNA at the Copenhagen lab”. Specimens 8/07 and 10/07 are early Holocene age, but 17/09 was dated to 12,265±25 <sup>14</sup>C yr BP. Among the explanations offered in the SOM for the failure to extract human DNA are these: “the possibility that these coprolites are nonhuman; or . . . that the ratio of contaminant to endogenous DNA was too great for endogenous mtDNA detection using these techniques” (Jenkins et al. 2012a: SOM ). This disappointing result appears to validate the concerns expressed by Poinar et al. (2009).

In view of the problematic DNA findings and the disputed morphology of the oldest “human” coprolites, another analytical strategy may be probative. Several studies have demonstrated the long persistence in arid conditions, both in the Great Basin (Lin et al. 1978) and elsewhere (Shillito et al. 2011), of sterols (particularly coprostanol) that are distinctive

markers of human (vs. canine and herbivore) feces. Sistiaga et al. (2014) used gas chromatography and mass spectrometry to analyze the steroids in a sample of coprolite 1374-5/5D-31-2 from Paisley Caves. This putatively human specimen, assigned to mtDNA haplogroup B, previously yielded radiocarbon dates of 12,400±60 <sup>14</sup>C yr BP (Beta-213424) and 12,275±55 <sup>14</sup>C yr BP (OXA-16498) (Gilbert et al. 2008). Sistiaga et al. report that the predominant stanol in this specimen is 5β-stigmastanol; such a high percentage is typical of herbivore manure. The low percentages of coprostanol and cholesterol in the sample would not be expected in human feces. Sistiaga et al. (2014:815) conclude that “. . . the presence of Paleoindian mitochondrial DNA is most probably derived from an undetermined contamination pathway.” Jenkins (personal communication) informs me that his team also intends to analyze the sterols of the Paisley Caves coprolites. This research may provide definitive answers to some of the questions raised here.

Even if the human mtDNA is truly endogenous to the coprolites, it provides no basis for the assertion that the occupants of Paisley Caves represent a distinct “genetically divergent” population. Coprolites dated from ca. 12,300 to 2300 <sup>14</sup>C yr BP all yielded the common Native American mitochondrial DNA haplogroups A and B. Two salient oddities warrant comment, however.

First, 8 of 21 samples typed as haplogroup A also had the 9 base-pair deletion after nucleotide 8281 that is diagnostic of haplogroup B. Of course, if exogenous contamination is precluded, the human mtDNA in each feces can be assigned to only one person, who could not belong to two distinct haplogroups. The 9 base-pair deletion does occur rarely in individuals of haplogroup A, but mainly in a clade (A2d1) that seems to be of recent origin and today is restricted to Mexico and Central America (Kemp et al. 2005). This “highly derived” clade has been identified in skeletal specimens dating from ca. 600 cal yr BP; Kemp et al. (2005)

hypothesize that its modern distribution may result from the expansion of the Aztec empire in the 15<sup>th</sup> century. The Paisley Caves samples assigned to this rare Mexican clade include specimens dated to 12,165±25, 11,270±30, and 11,625±35 <sup>14</sup>C yr BP (Jenkins et al. 2012a: SOM Table 12). This clade ostensibly survived in the local population for 7,000 years, as a coprolite dated to 6155±15 <sup>14</sup>C yr BP also has the 9 bp deletion. If this peculiar clade has been correctly identified in these ancient specimens, it would seem to have been one of the original founding lineages of Native Americans. In that case, one would expect it to be common throughout both continents today. Or, given the supposed connection of the WST population to a purported early coastal migration wave, one would at least expect this A2d1 clade to occur in high frequency in populations of the Pacific coast. In fact, haplogroup A is very rare in coastal populations south of British Columbia, except the Chumash, who may be an isolate descended from the earliest coastal settlers. However, the A2d1 clade has not been identified in modern Chumash (Johnson and Lorenz 2006).

The second odd fact is that haplogroup A is completely absent in the Northern Paiute and other recent Uto-Aztecan (Numic)-speaking natives of the Great Basin (Eshleman et al. 2004). One might plausibly attribute the evident discontinuity between the Paisley Caves population and the recent groups to a nearly complete population replacement in the Basin caused by the Late Holocene expansion of the Uto-Aztecan Numic-speaking peoples. However, haplogroup A is also very rare (ca. 8%) in previously sampled ancient Native Americans of the Great Basin (Kaestle and Smith 2001, Table 3). Haplogroup D was predominant in the pre-Uto-Aztecan population, the presumed descendants of WST people, so its absence from even the later Holocene samples from Paisley Caves is peculiar and begs an explanation.

Naïve readers of the 2012 article might suppose that the WST tradition developed ca. 14,300 cal yr BP in the northern Great Basin and persisted there and more broadly “in the far western United States” in isolation, while the unrelated Clovis culture “developed independently in the Plains and Southeast” (Jenkins et al. 2012a). any classic Clovis spear points (as well as WST points) have been found at the Dietz site, only 55 km northeast of Paisley Caves (Pinson 2011), and Clovis hunters must have regularly traversed the territory of whoever occupied the caves. Neither Jenkins et al. (2012a) nor Beck and Jones (2010) have explained how two distinct groups with very similar lake-oriented foraging adaptations and tool kits (apart from the spear points) could have co-existed for several centuries without competitive exclusion.

The “human” coprolites raise another perplexing question: why, over the course of a millennium, did people defecate regularly, yet conduct no other quotidian activities such as tool repair, in a small cave that was frequented by both herbivores and dangerous predators? These conundrums are avoided if we reject the still-ambiguous evidence of pre-12,800 cal yr BP human occupation of Paisley Caves, and postulate instead a rapid region-wide transition from Clovis to WST at the onset of the Younger Dryas (Goebel et al. 2011).

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