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REPORT

Owl Cave Revisited: Examining the Evidence for a Folsom-Bison Association

L. Suzann Henrikson[1], Joshua G. Clements[1], Shannon L. Loftus[1], and Daron Duke[2]

[1]Idaho National Laboratory, Idaho Falls, ID, USA; and [2]Far Western Anthropological Research Group, Desert Branch, Henderson NV, USA

Corresponding authors: L. Suzann Henrikson; Email: l.henrikson@inl.gov; and Daron Duke; Email: daron@farwestern.com

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Abstract

The discovery of green-fractured mammoth bone in Owl Cave in the 1970s inspired the original investigators to focus primarily on the possible association between these remains and Folsom points recovered from the same stratum. With the Museum of Idaho's recent acquisition of the complete Owl Cave collection, we have gained a better understanding of the periglacial processes that appear to have displaced and mixed mammoth remains with a younger Folsom component. New efforts to date bison bone also recovered from the lowest levels of the cave have produced radiocarbon dates that fall within the accepted age range of Folsom technology. These results have prompted efforts to investigate the potential for an association between the lithic assemblage and bison, a scenario that is much more plausible given our current understanding of the Folsom archaeological record.

Resumen

El descubrimiento de huesos de mamut con fracturas frescas en Owl Cave en los años 1970s instó a los investigadores originales a enfocarse principalmente en una asociación posible entre estos restos y puntos de proyectil Folsom encontrados en el mismo estrato. Con la adquisición reciente de la colección completa de Owl Cave por parte del Museo de Idaho, hemos ganado un mejor entendimiento de las condiciónes periglaciales que posiblemente desplazaron y mezclaron los restos óseos de mamut con el componente Folsom de menor antiguedad. Esfuerzos recientes para fechar restos óseos de bisonte también encontrados en los nivéles más profundos de la cueva han producido datacion por radiocarbono que corresponden de acuerdo al rango aceptado de antiguedad para la tecnología Folsom. Estos resultados han motivado esfuerzos para investigar el potencial para una asociación entre el conjunto lítico y bisonte, una situacion hipotética que es mucho más plausible dado nuestro entendimiento actual del record arquéologico Folsom.

Keywords: mammoth; Folsom; bison; Owl Cave; Idaho

Palabras clave: mamut; Folsom; bisonte; Owl Cave; Idaho

Recent research by Henrikson and colleagues (2017) to evaluate the stratigraphic context of Folsom fluted points and mammoth remains recovered from the lower levels in Owl Cave raised concerns regarding the previous claim of a Folsom–mammoth association (see Miller 1982, 1983, 1989; Miller and Dort 1978). These concerns stem from the absence of unambiguous evidence of bone tool manufacture or marrow extraction, given other viable explanations for the surface modifications on the mammoth bone. These include noncultural causal agents such as carnivore gnawing and impacts from roof fall.

During the past year, additional documents, maps, profiles, field notes, and photographs created during the last three field seasons at Owl Cave (1975 through 1977) were gifted to the Museum of Idaho (MOI). These records, combined with the donation of the Owl Cave archaeological collections

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to MOI in 2019, have allowed us to further assess the relationship between the Folsom assemblage and mammoth from Layer 18 at a much higher resolution. In this report, we present a series of new radiocarbon dates and other evidence demonstrating that postdepositional periglacial processes occurring in the cave during the terminal Pleistocene mingled a Folsom assemblage—temporally associated with bison remains—with an older event involving the deposition of mammoth remains.

The Formation of Layer 18

Owl Cave and adjacent Coyote and Dry Cat Caves are collapsed lava tubes located in one of many expansive Pleistocene-aged lava fields on the eastern Snake River Plain (Figure 1). These lava fields originated from periodic eruptions of shield volcanoes, with molten lava spreading across the terrain as pā-hoe-hoe flows or transported via tubes (Keszthelyi and Self 1998; Kuntz et al. 1992; Pawar et al. 2015; Wentworth and Macdonald 1953). Lava tubes are created when the surface of a cooling pā-hoe-hoe flow inflates from trapped gases, forming a hollow conduit within the flow. As a tube-fed flow subsides, sections of the tube may form an unstable dome prone to collapse (Kempe et al. 2010; Lockwood et al. 2022; Pawar et al. 2015). Owl, Coyote, and Dry Cat Caves represent three closely spaced collapses of the same lava tube dome; these are often referred to collectively as the Wasden site. Although the age of the flow and each cave's collapse is unknown, it appears that sediment only began accruing in Owl Cave's interior very late in the Pleistocene (Miller and Dort 1978).

Owl Cave's southwest aspect created an ideal setting for the accretion of aeolian sediments, resulting in more than 6 m of stratified loess deposits beneath the cave overhang (see Henrikson et al. 2017). By 1978, roughly 400 m^3 had been excavated in the eastern half of the cave, revealing cultural occupations

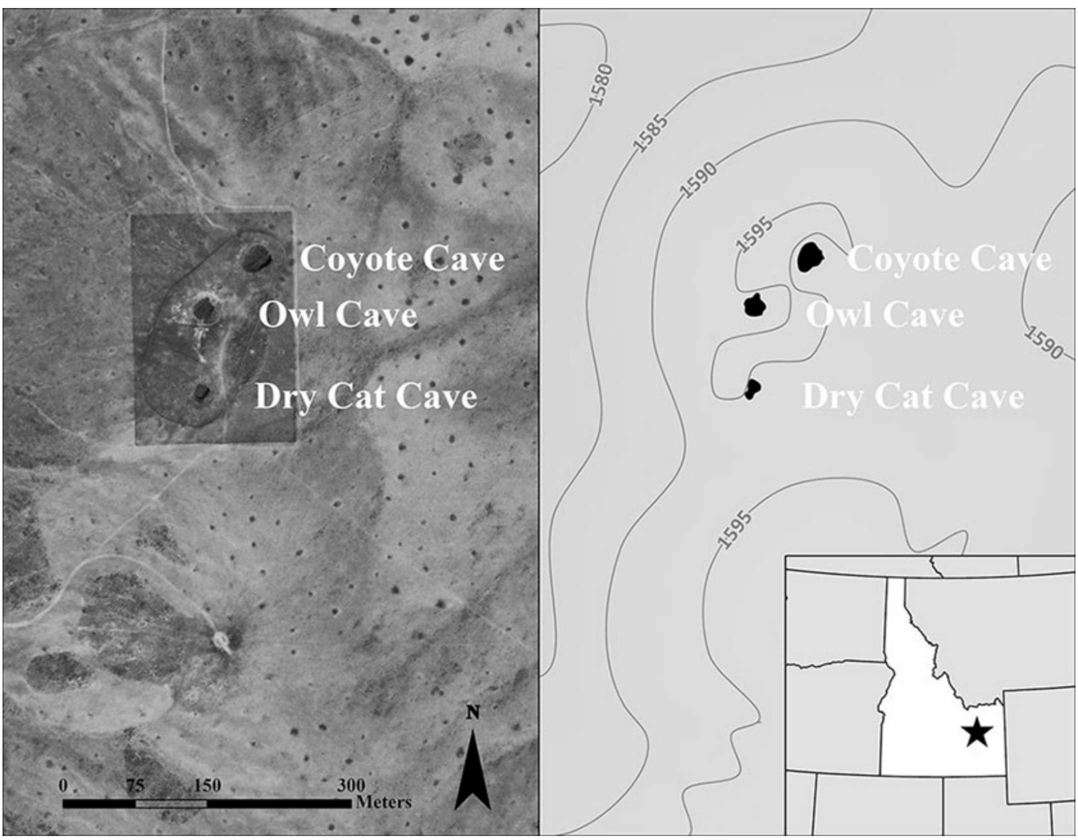

Figure 1. Aerial and topographic view of the Snake River Plain Wasden Site, including Dry Cat Cave, Owl Cave, and Coyote Cave.

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reportedly spanning the last 13,000 years (Figure 2). Folsom points and modified mammoth bone, argued to represent the earliest cultural assemblage in the cave, were recovered from Layer 18 (Figure 3), which was "capped" or "sealed" by a catastrophic roof fall event that occurred after the Folsom occupation (Miller 1982:84; Miller and Dort 1978:131). Layer 18 was characterized as a "discrete" 50–80 cm thick deposit of highly organic "dark-colored silt with a high fraction of basalt grit" between lighter carbonate-rich silts and clays resting above and below (Miller 1982:84). The cave floor, described as decomposing basalt matrix, rests below a 35 cm deposit of culturally sterile "yellow clay" beneath Layer 18 (see Figure 3).

Periglacial Conditions

As early as 1967, Dort (1968:33) recognized a variety of deformations in the Owl Cave strata, including numerous vertical intrusions in the profile (Figure 4). Dense concentrations of these deformations appear both above and below the early Holocene bison bone bed (Butler 1968). Dort (1968:31) surmised that, prior to the deposition of the bison bone, dramatic seasonal freeze-thaw cycles within the cave allowed for the formation of ice wedges. As these wedges melted during spring thaw, their cavities filled with wind-blown debris and slump, forming what Dort described as ice wedge "casts." As deeper strata were excavated, evidence of ice wedges became intermixed with distorted sediments (Dort 1968:35; see Figure 4), which he interpreted as periglacial "involutions." (It is unclear if Dort was involved in the 1970s excavations at Owl Cave, or if he had the opportunity to examine the alcove deposits exposed between 1975 and 1977.)

Although Miller (1983:41) does acknowledge that the deepest strata in Owl Cave were "deformed" after deposition, she asserts that "very little mixing of the distorted sediments at the upper and lower contacts was observed" (Miller 1982:84). The results of a sediment analysis prompted the conclusion that Layer 18 had retained sufficient "integrity" to demonstrate that the lithics and faunal remains were restricted to this stratum and are therefore "contemporaneous" (Miller 1982:89). However, Figure 5 shows the variegated floor of the alcove at a depth of roughly 6.4 m below main datum (BMD).

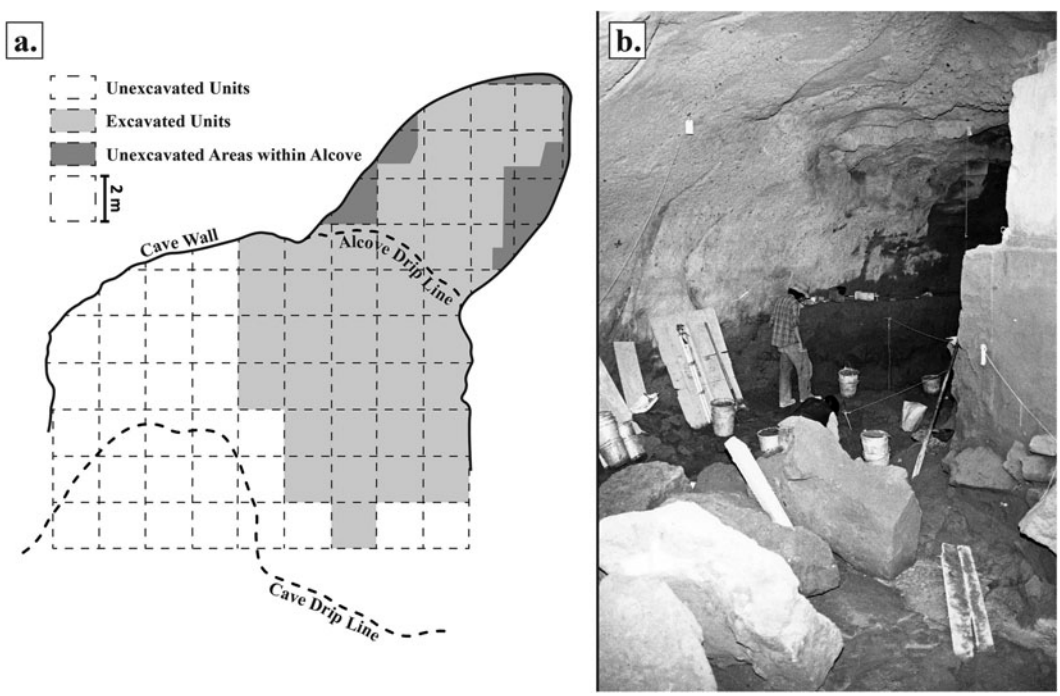

Figure 2. (a) Plan view of the excavated and unexcavated units in Owl Cave; (b) View of alcove during 1977 excavations of the lowest levels in Owl Cave. (Courtesy of the Museum of Idaho.)

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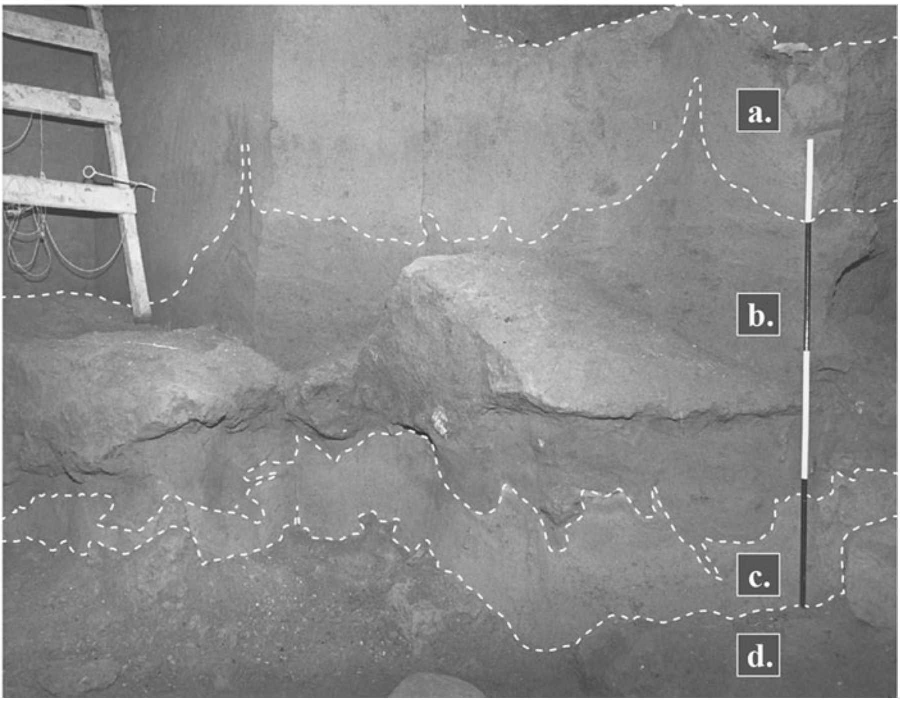

Figure 3. North wall profile of Layer 18, unit E4G, with layers labeled: (a) Layer 16; (b) Layer 18; (c) sterile yellow clay; (d) Intermixed gravels on the cave floor. (Courtesy of the Museum of Idaho.)

This mottled surface suggests that the contacts between Layer 18 and the strata above and below were far from well defined. Field notes also indicate that each 2 × 2 m unit in this area of the cave was excavated in arbitrary 10 cm levels, which would eliminate the stratigraphic controls required to recognize the context of individual artifacts or their relationship to the faunal assemblage. It is also unclear how roof rubble and boulders were removed during the excavations. If the rubble was not excavated cautiously, the provenience of individual artifacts and bones within or below the roof fall would have been difficult to ascertain.

The Roof Fall Episode

The deepest sediment deposits in Owl Cave were clearly altered by a range of postdepositional cryogenic processes, including freeze-thaw cycles (see Anketell et al. 1970; Butrym et al. 1964; French 1986). However, the terminal Pleistocene roof fall event that dislodged the massive basalt boulders encountered between 5.0 and 6.0 m BMD (Figure 6) would have likely resulted in further, even catastrophic, impacts to any cultural deposits resting below. The removal of the roof fall was considered imperative, given the discovery of a mammoth bone fragment wedged between boulders during the 1967 field season (Butler 1968). Because the deeper portions of the cave contained more manageable rock "rubble" (see Figures 2 and 6), the last phase of excavation focused on this area rather than expanding toward the exterior dripline (Miller 1989). Although Miller (1982:84, 1989:384) described the roof fall as "capping" or "sealing" Layer 18, she does acknowledge that this event likely occurred "during or just after deposition" of sediments that were likely "saturated" from periglacial conditions. Field profiles from the alcove reveal boulders and cobbles clearly within Layer 18 (Figure 7), and plan views from the same units show a substantial amount of basalt rubble at the same depth (see Figure 7). Oddly, Miller (1982:42) maintained that the fractured mammoth bone was the result of human modification rather than damage from roof fall, arguing that the "bulk of the bone" had likely been "well-preserved by cushioning in the wet sediment" (Miller 1982:87). This assertion is not supported, given

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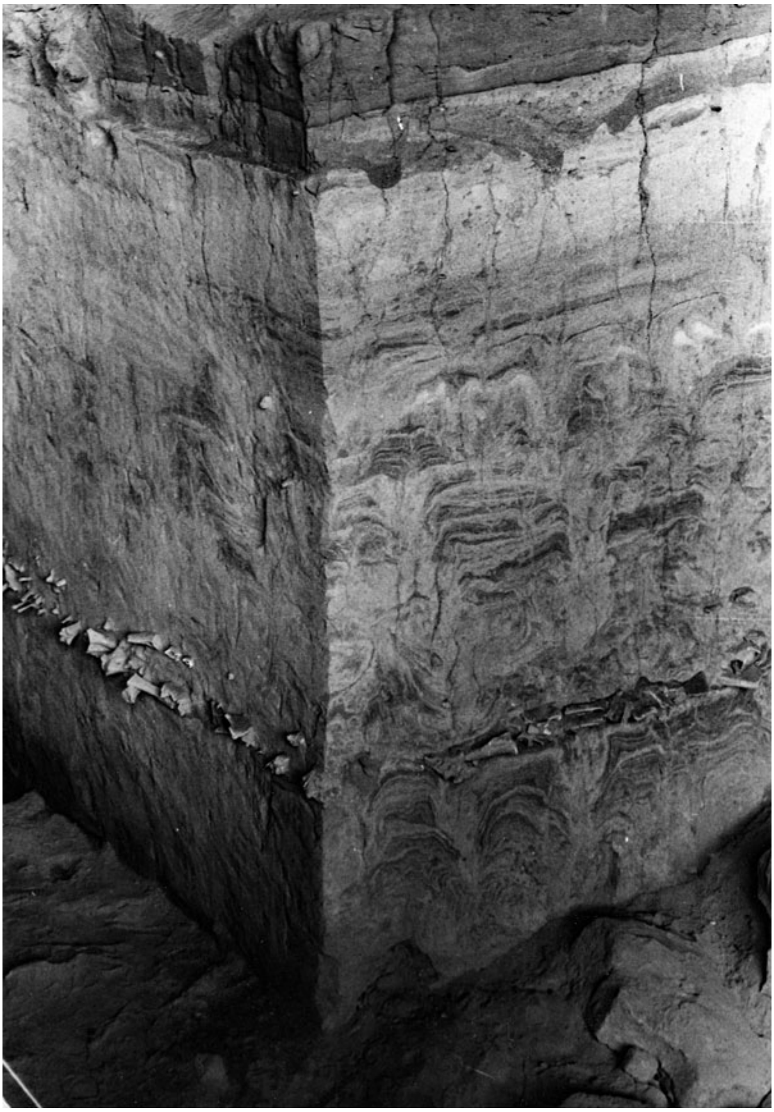

Figure 4. Owl Cave profile showing ice wedges and involutions above and below the early Holocene bone bed. (Courtesy of the Museum of Idaho.)

the extensive abrasions and visible impacts on most of the mammoth bone recovered from Owl Cave (see Henrikson et al. 2017).

Deciphering Layer 18 Spatial Relationships

With the entire Owl Cave assemblage now at MOI, we have been able to evaluate some of the scenarios presented by Henrikson et alia (2017:588), including the argument that the fluted points and mammoth, despite reportedly being from the same stratum, are not associated. Newly acquired images of the alcove excavations (Figure 8) emphasize the postdepositional processes at work in Owl Cave, including what appears to be extensive sediment deformation.

Under periglacial conditions, deformations occur when unfrozen course-grained sediments—such as sand, resting above a frozen, impermeable layer—become saturated (Vandenberghe 2013). During the next cold cycle, as the upper portion of the saturated active layer freezes, unfrozen sediments below

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Figure 5. Variegated floor of Layer 18 during excavation of the alcove. (Courtesy of the Museum of Idaho.)

Figure 6. North wall profile of units in alcove. (Courtesy of the Museum of Idaho.)

are contorted, deformed, or "squeezed" between the frozen mass above and the impermeable layer below (Bertran et al. 2017; McArthur and Onesti 1970; Sharp 1942). During thaws or cycles involving saturation, fine-grained sediments (including silts and clays), as well as objects, can move vertically through a soil profile (Pollard 2018; Wood and Johnson 1978). Wood and Johnson (1978:343) observed particle sorting during an experiment involving saturated sediments. When subjected to repeated freeze-thaw conditions, "coarse particles" migrated upward in the profile, whereas "fines"

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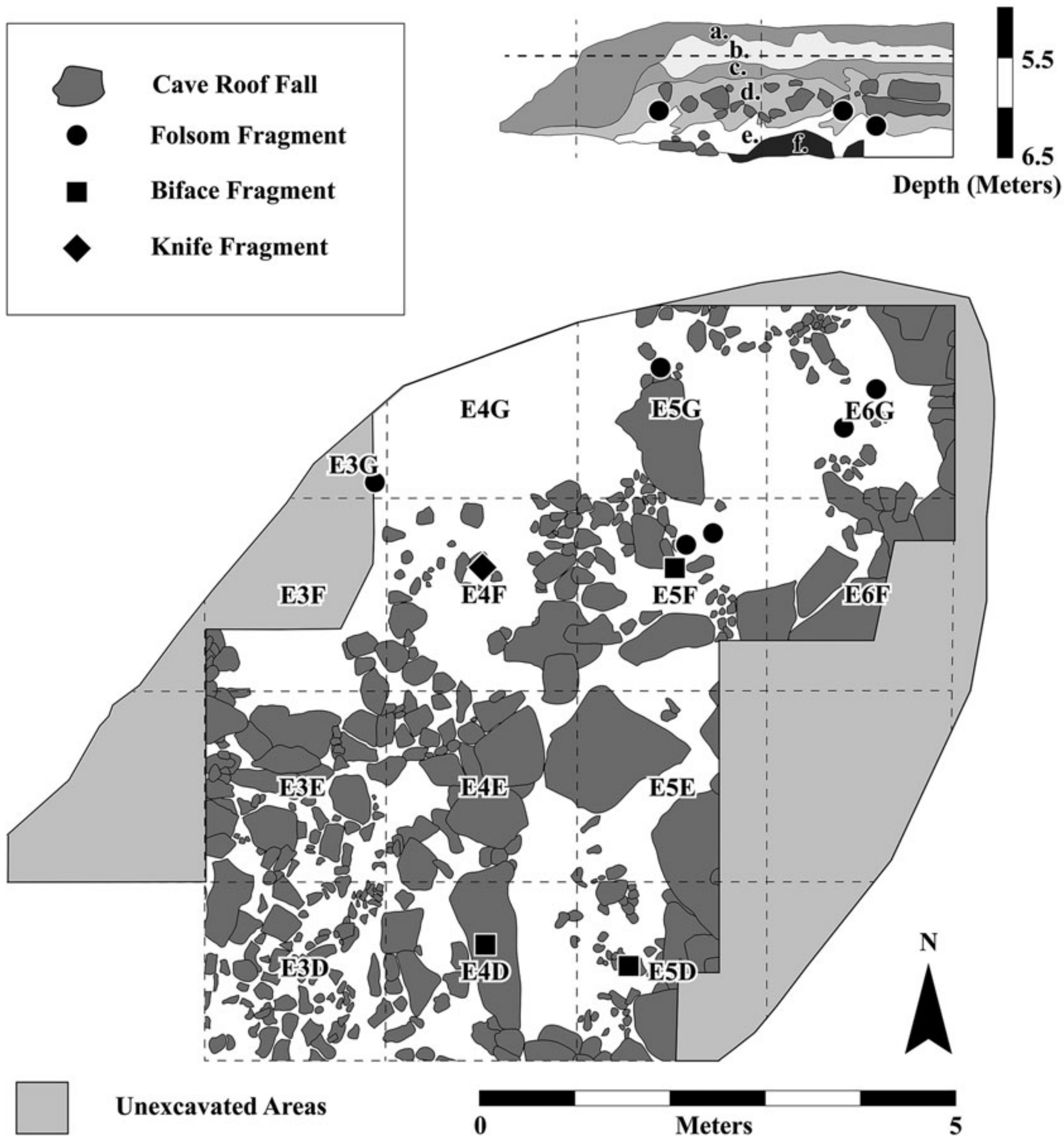

Figure 7. Plan view of Layer 18 in Owl Cave, Level 620 BMD, showing rubble. Plan view and profile redrawn from the 1977 field notes.

moved downward. Silts and clays, which are particularly susceptible to frost heaving due to their high porosity, can also form "segregated ice lenses" (Pollard 2018:542). As fine sediments refreeze, "frost-jacking" may force objects upward "when an ice lens preferentially forms beneath" (Pollard 2018:542; Wood and Johnson 1978). Figure 8 shows mammoth ribs in situ on the floor of the lava tube well below the boundary of what was identified as Layer 18, clearly indicating that faunal remains were not confined to this stratum. The pronounced involutions also visible in the profile show the magnitude of the periglacial processes occurring in Owl Cave during the terminal Pleistocene. If saturated sediments were subjected to freeze-thaw cycles, there is the possibility that the "stratigraphy" encountered in the bottom of the cave is the product of particle sorting, with coarse-grained sediments (Layer 18) resting above yellow clay.

Although the mammoth took center stage in previous investigations, Miller (1982:88, 1983:40) did acknowledge that bison, as well as camel, were also recovered from beneath the roof fall. However, it

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Figure 8. Mammoth bones in situ on the floor of the alcove, with the dark sediments (Layer 18) visible in the profile. (Courtesy of the Museum of Idaho.)

appears that the bison bone, along with other potentially diagnostic faunal remains, received limited attention at that time. The bison remains were briefly described as "isolated teeth, ribs, long bones and pelves" assigned to *Bison antiquus* (Miller 1982:91). However, most of the "Layer 18" faunal assemblage acquired by MOI in 2019 is still in gallon-sized bags labeled as "scrap bone." There is no documentation to suggest that these remains have been inventoried or analyzed before now. Table 1 presents the new AMS assays generated from diagnostic bison and highly fragmentary mammoth specimens recovered from these bags. The associated provenience information (Figure 9) underscores the extensive vertical and horizontal displacement of artifacts and faunal remains recovered from the lowest levels of Owl Cave, likely as a result of recurring freeze-thaw cycles, frost-heaving, and frost-jacking (see Wood and Johnson 1978). The mammoth and bison are not contemporaneous; they are mixed throughout the deformed sediments below the roof fall.

The new AMS assays on ultrafiltered collagen from Layer 18 bison remains (see Table 1) correspond to those previously generated by Miller (1989:383). The possibility that the bison could be associated with the Folsom lithics was only briefly mentioned (Miller 1982:89, 1983:40; Miller and Dort 1978:137) but not pursued in favor of the more sensational mammoth bone "quarry" (Miller 1989). Figure 10 shows the summed probability distributions of the calibrated AMS assays on bison and mammoth from the lowest levels of Owl Cave, confirming that the mammoth is pre-Clovis in age, whereas the bison dates fall neatly in line with the age range of Folsom technology recently presented by Buchanan and colleagues (2022).

Discussion

Despite having a temporal association between the Folsom assemblage and bison remains, we find ourselves in a position similar to that of the original Owl Cave researchers. We currently lack the evidence to demonstrate an unequivocal association. However, there is additional circumstantial evidence in the form of other stone tools recovered from the deepest sediments within the alcove (see Figure 7). Bifaces and debitage were briefly mentioned in early reports (Miller 1983:41; Miller and Dort 1978:131), but

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Table 1. Recent Owl Cave Radiocarbon Ages on Mammoth and Bison from Layer 18.

Lab No.	Taxa	Material	Depth (cm)	Unit	^{14}C Age BP	Median Cal BP	2σ Cal BP	$\delta^{13}C$	$\delta^{15}N$	C/N
ACRF-4364	Bison	Collagen	605	E4F	10,438 ± 44	12,326	12,118–12,530	−19.1	6.6	3.2
ACRF-4365	Bison	Collagen	582	E3D	10,482 ± 41	12,455	12,233–12,567	−18.8	6.9	3.2
ACRF-4366	Bison	Collagen	630	E4D	10,566 ± 45	12,551	12,419–12,657	−19.3	5.1	3.2
ACRF-4369	Bison	Collagen	560	E5F/E6F/E5G/E6G	10,653 ± 48	12,631	12,552–12,709	−18.8	8.0	3.3
ACRF-4370	Bison	Collagen	635	E5F	10,435 ± 44	12,319	12,111–12,529	−19.6	4.9	3.2
ACRF-4373	Bison	Collagen	638	E5E/E5F	10,426 ± 47	12,304	12,094–12,440	−20.0	5.9	3.2
ACRF-4374	Bison	Collagen	648	E4E	10,581 ± 42	12,572	12,424–12,672	−19.5	4.6	3.2
ACRF-4379	Bison	Collagen	450	E1E	10,488 ± 47	12,456	12,230–12,576	−18.8	7.0	3.3
ACRF-4362	Mammoth	Collagen	510	E4F	11,535 ± 68	13,373	13,222–13,492	−19.2	6.4	3.1
ACRF-4367	Mammoth	Collagen	640	E5F	11,647 ± 51	13,505	13,404–13,590	−19.9	6.6	3.2
ACRF-4368	Mammoth	Collagen	634	E5F	11,525 ± 44	13,367	13,279–13,454	−19.7	6.5	3.2
ACRF-4372	Mammoth	Collagen	627	E5E/E5F	11,572 ± 47	13,404	13,290–13,487	−19.6	6.5	3.2
ACRF-4381	Mammoth	Collagen	510	E4F	11,609 ± 51	13,439	13,321–13,557	−19.6	6.5	3.2
ACRF-4382	Mammoth	Collagen	590	E5D	11,545 ± 47	13,382	13,286–13,467	−19.8	6.2	3.2

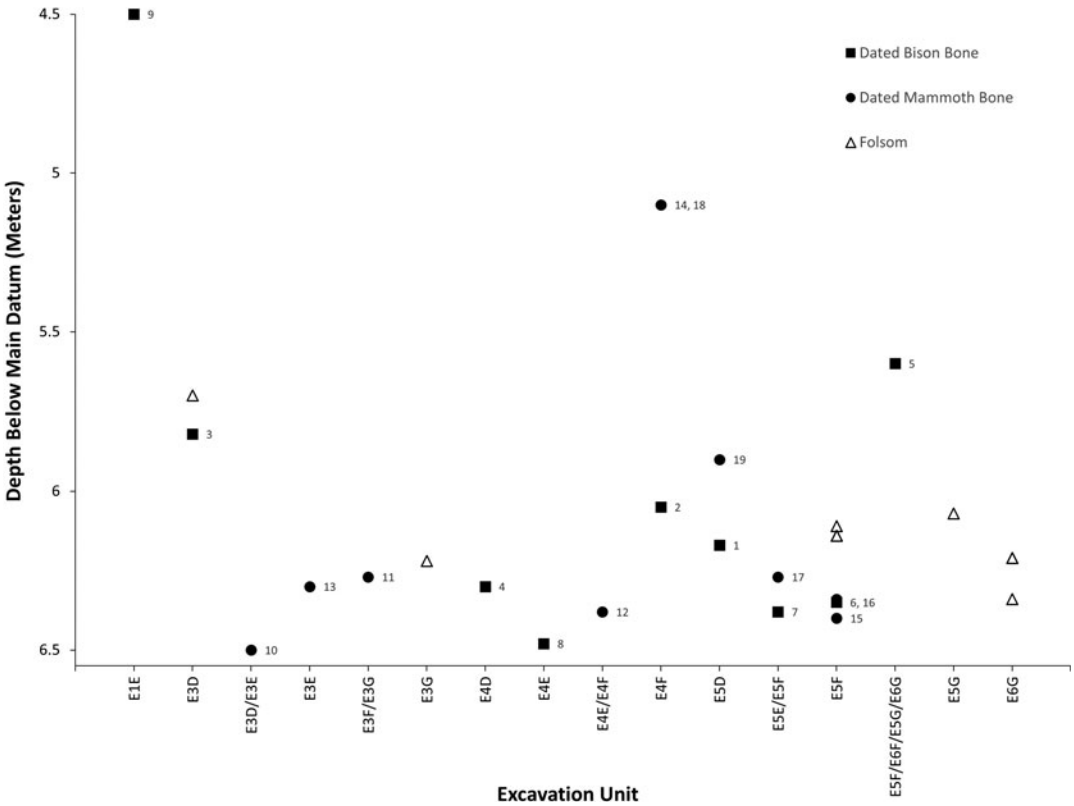

Figure 9. Comparison of the vertical distribution of AMS-dated bison and mammoth bone and Folsom projectile points by excavation unit in Owl Cave. Numbers identify AMS-dated bison and mammoth bone (see also Table 1): (1) UGAMS-25078, (2) ACRF-4364, (3) ACRF-4365, (4) ACRF-4366, (5) ACRF-4369, (6) ACRF-4370, (7) ACRF-4373, (8) ACRF-4374, (9) ACRF-4379, (10) Aeon-1182, (11) ISGS-A2303, (12) Beta-322088, (13) Beta-322087, (14) ACRF-4362, (15) ACRF-4367, (16) ACRF-4368, (17) ACRF-4372, (18) ACRF-4381, and (19) ACRF-4382.

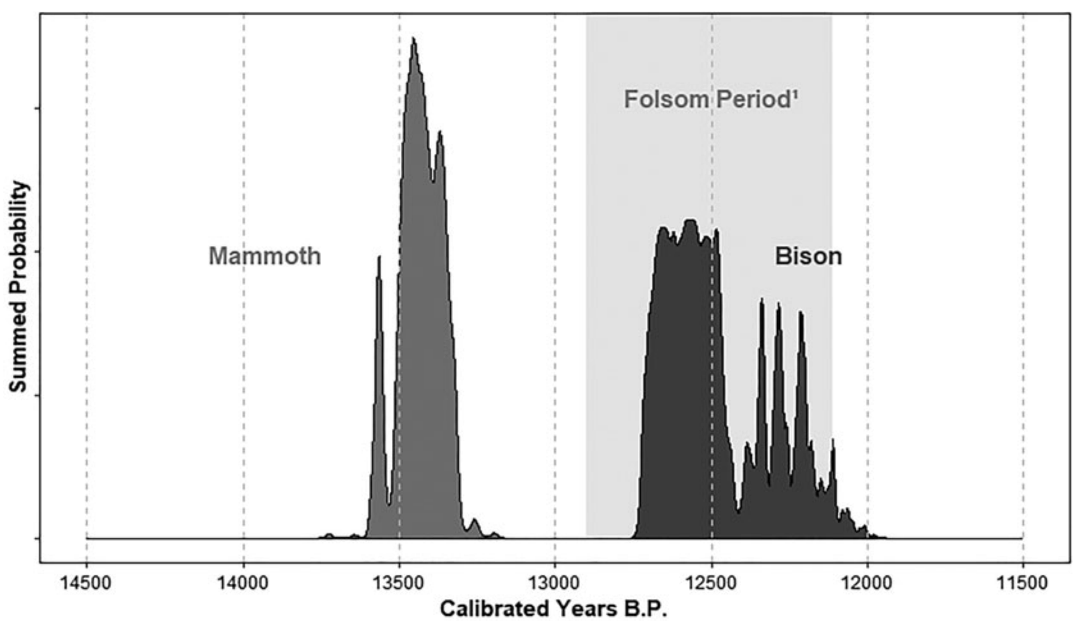

Figure 10. Summed probability distribution (SPD) of calibrated Layer 18 mammoth and bison AMS dates. SPD was created using rcarbon (Crema and Bevan 2021) and R package ggplot2 (Wickham 2008).

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their association with the points was never described in detail. As with the faunal remains, these items were assumed to provide further evidence of human predation on "extinct fauna" (Miller and Dort 1978). Although Henrikson and colleagues (2017) proposed that the fragmentary Folsom artifacts recovered from the alcove might be in a secondary context (i.e., deposited via slope wash), their presence in proximity suggests that this part of the cave was not under perpetual periglacial conditions during the Younger Dryas. If seasonal thaws occurred, Owl Cave may have been suitable for short-term human activity.

At this point, there is no compelling evidence to suggest human involvement with the mammoth in the bottom of Owl Cave (Haynes 1991; Henrikson et al. 2017; Karr 2015). However, previously reported positive reactions for elephant and horse on two Folsom specimens (see Henrikson et al. 2017) merit attention. Although horse remains were not previously identified in the assemblage, the scrap-bone bags contain a large volume of highly fragmentary bone that has yet to be analyzed. As stated in Henrikson et alia (2017), periglacial conditions in the deepest parts of the cave could potentially slow the decomposition of a mammoth, allowing for the contamination of stone tools in proximity to the remains (see Popp 2024). Because the western half of Owl Cave has yet to be excavated, we can only report on mammoth bones recovered from the alcove. These remains include highly fractured long bones and ribs, a partial scapula, and a molar (Miller 1989:384). Many of southern Idaho's lava tubes were occupied by large carnivores during the terminal Pleistocene, leaving behind fragmentary postcranial remains of extinct ungulates (see Henrikson and Long 2007). Although the scapula, long bone, and ribs are suggestive of a den, the isolated molar is harder to explain, unless the rest of the mammoth is still under roof fall in unexcavated portions of the cave. At this point, we only know that mammoth bones were in the cave when the roof fall episode occurred, likely causing the breakage patterns and characteristics initially used as evidence for human modification.

Conclusions

Owl Cave is now typically excluded from lists of North American sites with compelling evidence of archaeological materials in direct association with terminal Pleistocene megafauna based on concerns initially raised by Haynes (1991:238) and Grayson and Meltzer (2002:331). These concerns include the disparity between the known age of Folsom points and the radiocarbon ages associated with the mammoth, the plausibility of other causal agents to explain the physical condition of the mammoth bone, and the absence of heavy tools that would have been required to break thick, cortical bone. We would also add that the original reports (see Miller 1982, 1983, 1989) inadequately documented the stratigraphic context of artifacts and fauna, making it extremely difficult to assess the relationship between archaeological materials and the remains of Pleistocene mammals.

Although the remaining intact deposits in Owl Cave likely retain important evidence regarding Folsom activity and its possible association with the faunal assemblage, it is critical to recognize, evaluate, and exhaust the data potential of the existing MOI collections prior to considering further excavations at the site. This is an essential step in the development of well-defined, ethical research objectives and advanced excavation techniques that also recognize and embrace the necessity of preservation, especially for National Register properties such as Owl Cave.

Our ongoing research with the curated assemblage will focus on the lithic debris and tools recovered from within and below the roof fall to decipher possible associations with the Folsom material, with consideration given to potential vertical displacement (see Henrikson and Long 2007). The stone tools can also be evaluated for functional evidence that could be associated with butchery activity. The contents of the scrap bone bags will be cataloged and analyzed. Although the bulk of the faunal material in the bags appears to be highly fragmented mammoth bone, there is no indication that these fragments were previously examined for evidence of butchery or modification. Bison and other faunas have already been identified, including extinct taxa. Given the possibility that Owl Cave may also have functioned as a carnivore den during the terminal Pleistocene, it will be important to conduct morphometric analyses as well as obtain additional AMS assays on these specimens.

Owl Cave is the only known site in the Desert West with a Folsom assemblage in a buried context (Henrikson et al. 2017; Rondeau 2023). We now know that the age of the bison bone from the lower

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levels is consistent with Folsom. The locality also contains evidence of a 9,000-year-old mass bison kill that closely resembles Paleoindian kill sites on the Great Plains (Butler 1968; Clements 2023; Frandson and Henrikson 2023), hinting at the possibility that the cave could have been utilized for the same purpose for several thousand years. If a strong association can be demonstrated between the Folsom assemblage and the bison remains, Owl Cave will represent the only known site of its kind west of the Rocky Mountains.

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Data Availability Statement. The original field notes and associated documentation used to support the findings of this study are available at the Museum of Idaho, Idaho Falls. Recently generated AMS assays are available at the Cultural Resource Management Office, Idaho National Laboratory, Idaho Falls.

Competing Interests. The authors declare none.

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