

Reevaluating the MacNeish Legacy Collections: Late Pleistocene/Early Holocene Archaeology from the Ayacucho Basin, Peru

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Abstract

A ground-breaking endeavor led by Richard MacNeish between 1966 and 1972 was the “Ayacucho Archaeological-Botanical Project” in south-central Peru. For more than ten years, we have reviewed the lithics recovered in this field-work. As part of this research, we carried out detailed reevaluations of the lithic remains from the lower strata of three caves excavated in this project. Presented here are the artifacts from the lower levels of Pikimachay, Jaywamachay, and Puente. Careful laboratory analysis of the artifacts enabled the distinction between humanly modified and naturally formed items. This process identified 9760 anthropogenic pieces, including bifacial and unifacial points, scrapers, and cores. Modified faunal bones, used as tools and displaying polishing and cut marks, were also among the findings. We present an overview of the lithic analysis performed, as well as a morpho-technological description of the archaeological remains witnessing the material culture of the hunter-gatherers living in the Ayacucho basin during the terminal Pleistocene and early Holocene.

Keywords

Material Culture, Late Pleistocene/Early Holocene, Ayacucho Basin, Andean Region, South America

1. Introduction

Peru is situated in the Central Andes region of western South America and has an extraordinary archaeological record representing a long cultural process of development from hunter-gatherers to sedentary societies (Aldenderfer, 1998; Bonavia, 1982, 2007; Briceño, 2011; Chauchat, 1982; Chauchat & Pelegrin, 1994; Chauchat

et al., 2004; Dillehay, 2017; Lavallée et al., 1995; Lynch, 1980; MacNeish et al., 1980, 1981, 1983; Malpass, 1983; Rick, 1980; Sandweiss & Rademaker, 2011; Uceda, 1992; Yataco, 2011, 2020; Yataco & Nami, 2016; Yataco et al., 2021). It has been known for a long time that, throughout the history of human evolution, the Central Andean region was one of the global centers of agricultural development and complex society development (Sauer, 1950). Through many years of research, archaeological evidence has demonstrated that this process started in several places (Mann, 2005). It is for this reason that, between 1966 and 1972, an interdisciplinary team of archaeologists led by Richard MacNeish conducted the “Ayacucho Archaeological-Botanical Project” in highland Peru (MacNeish, 1969, 1971; MacNeish et al., 1970a, 1970b, 1980, 1981, 1983). MacNeish conceived the research in South America based on his previous work in Tehuacán, Mexico, reaching conclusions concerning the origins of agriculture and social complexity in Mesoamerica (MacNeish, 1967; MacNeish et al., 1967, 1972). In order to compare these results, MacNeish searched for a nuclear area that shared similar socio-cultural and ecological characteristics, with the primary goal of conducting paleo-botanical investigations in order to refine the origin of agriculture in the Andean region as the second center for the domestication of plants and animals in the Americas. This project—which became seminal in American archaeological history (Dillehay, 1985)—allowed the excavation of many sites. They revealed a remarkable archaeological record spanning the Late Pleistocene to historical times.

MacNeish’s research significantly transformed New World archaeology through innovative fieldwork, emphasizing interdisciplinary collaboration. His lasting contributions to field archaeology included goal-oriented, large-scale projects, meticulous excavation and recording, and the integration of specialists from diverse scientific fields. The extensive collections from his integrative research are a significant legacy (King & Samford, 2019; St. Amand et al., 2020). After nearly four decades of limited attention, for the past fifteen years an inventory, rearrangement, and research effort has been underway on the MacNeish collections, primarily housed at the Archaeology and Anthropology Museum of San Marcos National University in Lima, Peru, with some finds at the Peabody Museum in Andover, Massachusetts. Extensive research on preserved field notebooks has facilitated the relocation of individual finds.

Despite the seminal importance of MacNeish’s project, it is crucial to recognize that the primary goal was to find paleobotanical evidence, and as a result, the analysis of the lithic and bone tool collections received limited attention at the time. The reassessment of these collections is therefore of great importance for the archaeology of the Central Andes, as they offer critical information on the earliest hunter-gatherer occupations. Through these reanalysis efforts, we re-evaluate the vestiges from various caves in the Ayacucho Basin. This paper presents an initial reappraisal of the MacNeish legacy collections, highlighting results and updated perspectives on materials attributed to the earliest occupations in the region (Yataco, 2011, 2020; Yataco & Nami, 2016, 2022, 2023; Yataco et al., 2021; Nami

et al., 2023), as well as new materials from the lower levels of the Puente, Jaywamachay, and Pikimachay sites (**Figure 1**).

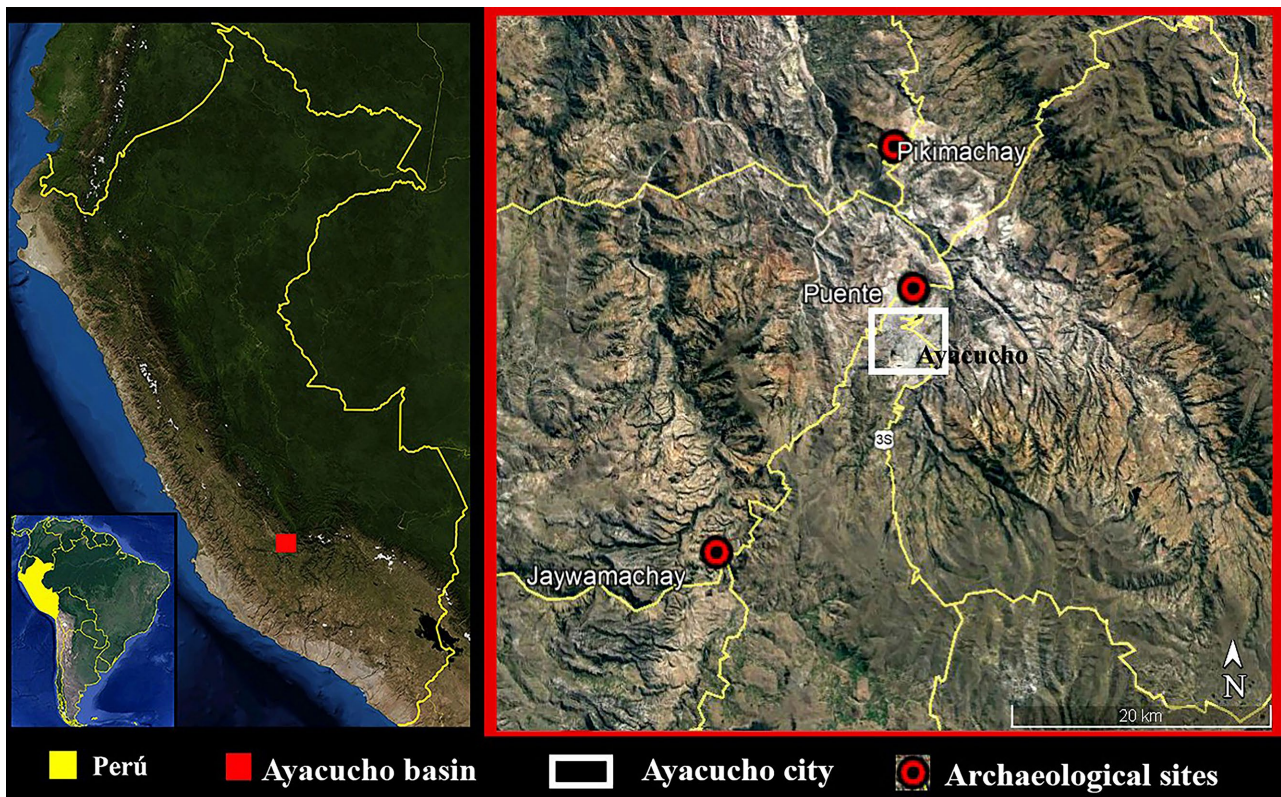


Figure 1. Location of Pikimachay, Jaywamachay, and Puente archaeological sites, Ayacucho basin, Perú (<http://www.google.com/earth/>).

2. General Background

As part of our efforts to re-evaluate and build on previous investigations, we carefully analyzed the remains collected by MacNeish and his team. In the Central Andes, these sites are in the inter-Andean basin of Ayacucho, flanked by the Marahuilca Cordillera, which constitutes part of the Eastern Cordillera. The drainage is primarily comprised of the Cachi River, whose route is preferentially northward. The temperature ranges between 13°C to 15°C, and the height of the mountains ranges from 2500 to 4500 masl. In this region, the terrain is rugged, and the geomorphology is the result of successive volcanic events that were then subjected to fluvial erosion processes (Morche et al., 1995: pp. 7-8, 15-19). The landscape modeled by glacial action shows moraine, erosive features, and glacio-fluvial deposits. It also presents several geotectonic and geodynamic processes (**Figures 2(A)-(F)**).

During the surveys, MacNeish and his team recorded open-air and cave sites. Several caves showed sedimentary fills with interesting potential for archaeological digs. The excavations were planned using one-square-meter grids and were sensitively carried out mostly with trowels and brushes, leaving the materials in the place of discovery, documenting the items by a variety of methods, and care-

fully mapping and recording from datum (MacNeish, 1969; MacNeish et al., 1970b; MacNeish et al., 1980, 1981, 1983). Finally, the sediments were carefully screened. The excavators designated the stratigraphic layers as “zones” (MacNeish et al., 1981: pp. 88-89). The locations, stratigraphy, and chronology of the study sites are described below.

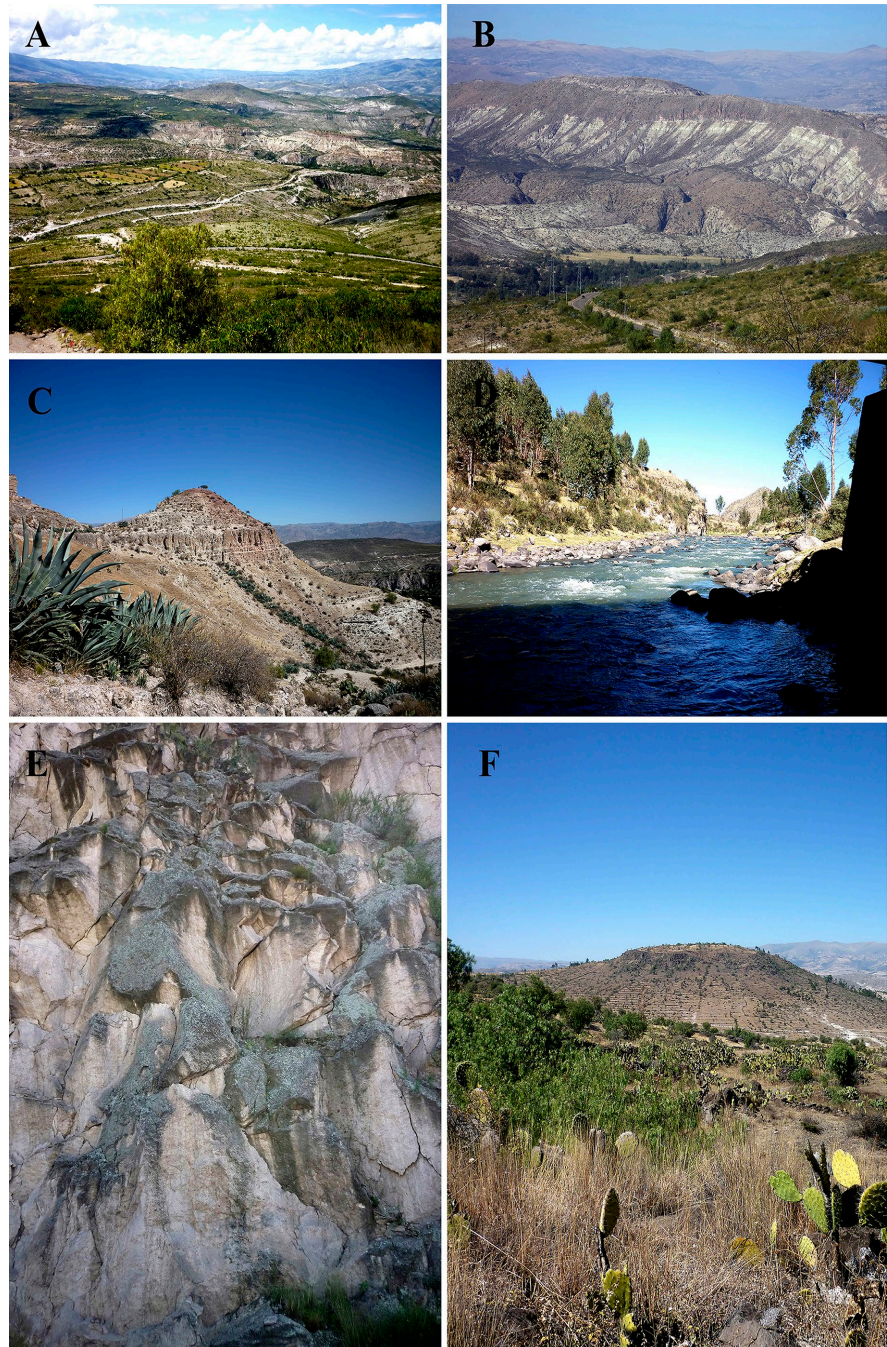


Figure 2. Geology and geomorphology of the Ayacucho basin. (A) Plateau with geomorphological features of ravines and canyons, products of glacial erosion. (B) Detail of glacial striations. (C) Tectonic fault zones indicating rock displacement. (D) Vinchos River. (E) Sediment layers modified by glacial action. (F) Presence of eroded volcanic cones.

3. Chronological Remarks

The radiocarbon assays obtained during the course of the project were processed with the standard methods used during the 1970s. They were never published in detail; and, lacking calibration curves at the time, they were reported as calendar years BC (MacNeish et al., 1981: pp. 51-54, 74-75, 104-106, 227). However, the original dates have been published in the Andean Radiocarbon database available on the Web by Ziolkowski and colleagues (1994). **Table 1** depicts salient unpublished data regarding the samples and dates obtained at the three sites under consideration. The radiocarbon results obtained from the sites described here were then calibrated using the OxCal v4.4 program and the SHCal20 southern hemisphere calibration curve (Hogg et al., 2020). **Table 1** depicts the results of eight radiocarbon assays on the processed samples. Since the \pm sigma of the sample came from layer *h* from Pikimachay, we rejected it for this study. The majority of the dates ($n = 7$) span the $\sim 8.9 - 10.3$ kya period, and they agree with their stratigraphic provenance. The sample I-5057 from Puente and the sample I-5277 from Jaywamachay clearly overlap (**Figure 3**). The early Holocene is represented by one date from the Puente site and four from Jaywamachay; two from that site belong to the Pleistocene-Holocene transition/initial Holocene, and the date from the Pikimachay cave to the terminal Pleistocene (Yataco & Nami, 2016, 2022; Yataco et al., 2021; Nami et al., 2023). The radiocarbon assays revealed that the earliest hunter-gatherers lived in Ayacucho during the Late Pleistocene and early Holocene.

Uncertainty remains regarding the human origin of material layer *h* from Pikimachay. Debates, previously addressed, mainly revolve around the chronology and nature of remains from Pikimachay's oldest strata. Lynch (1974, 1983, 1990a, 1990b, 1992) and MacNeish (1979, 1992a, 1992b) engaged in fervent discussions on this topic. Rick (1987, 1988) provided a brief overview of lithic materials but did not delve into detail. Until new data emerge, a review and calibration of MacNeish's existing radiocarbon dates are necessary to establish a provisional reference point for the stratum's age. The estimated age range for Pikimachay's layer *h* ($\sim 9.0/10.0$ to 14.0 kya) is a preliminary hypothesis derived from two lines of evidence: the earlier boundary is set by the 14 kya radiocarbon dates previously published by MacNeish et al. (1970a, 1970b)¹ for layer *h*. The more recent boundary is based on stratigraphic superposition, as the overlying layer *g* contains diagnostic stone tools dated to approximately 9.0/10.0 kya, a range also suggested by an obsidian end-scraper and side-scraper found in layer *h* itself (see below). While MacNeish's early dates have historically anchored the discussion, these recent ar-

¹We note the historical context of the *Science* report (MacNeish et al. 1970a), specifically that R. Protsch was a co-author. Subsequent academic reviews have raised concerns regarding the reliability of certain C14 dates published by this co-author, who was later implicated in the systematic falsification of radiocarbon dates in his research (Archaeology News, 2005: p. 15; Harding, 2005, <https://www.theguardian.com/science/2005/feb/19/science.sciencenews>). This historical fact is necessary to consider when assessing the dating of early assemblages presented in the 1970 report.

tifactual observations hypothetically suggest the possibility of a more recent maximum age for the layer h occupation than previously assumed. Given the Byzantine discussion surrounding the existing C14 dates—which were conducted using older methods—it is crucial to secure new, reliable data. We have attempted to date bone samples from layer h twice using modern methods but were unsuccessful due to insufficient collagen. Consequently, continued efforts to obtain new, high-quality C14 dates remain a critical priority for confirming the true antiquity of the assemblage. Therefore, the current chronology should be treated as provisional until new radiocarbon data are available (Yataco & Nami, 2022: p. 319).

Table 1. Radiocarbon dates obtained at the lower levels of Pikimachay, Jaywamachay and Puente sites. *Identification by R. Hoffstetter, **This date was processed at the UCLA facilities (Ziółkowski et al., 1994: p. 323), but mistakenly reported as I-1464 (MacNeish, 1969: p. 23).

Site	Material Dated	Grid	Layer	Depth (m)	Lab. Id.	Date (yr BP)	Calibrated range (yr BP) (95.4%)	Comments
Puente	Charcoal	S7	XIIA	-	I-5057	8860 ± 125	10,190 - 9553	Sample take from a hearth
	Charcoal and ash	S5E6	H	5; 6	I-5277	8980 ± 140	10,377 - 9556	Sample dug out of the wall of square S5E6 above the specimen from zone J
	Charcoal and ash	S3E3	I	5; 6	I-5695	9560 ± 170	11,240 - 10,305	-
Jaywamachay	Charcoal and ash	S5E6	J	5; 6	I-5276	8645 ± 140	10,154 - 9306	Date not consistent with the stratigraphy, sample probably contaminated? (cf MacNeish, 1981).
	Charcoal	S6E7	J1	5; 6	I-5275	9460 ± 145	11,150 - 10,291	-
	Charcoal	S5E6	J2	5; 6	I-5683	9890 ± 310	12,480 - 10,499	-
	Charcoal and ash	S5E6	J3	5;6	I-5699	10280 ± 170	12,603 - 11,320	This is the earliest date from this site (cf MacNeish, 1981).
Pikimachay	Bone Fragment of humerus of Megatheridae or <i>Scelidotherium</i> *	S19.1E3	h	2.67	I-1464**	14,150 ± 180	17,781 - 16,633	-

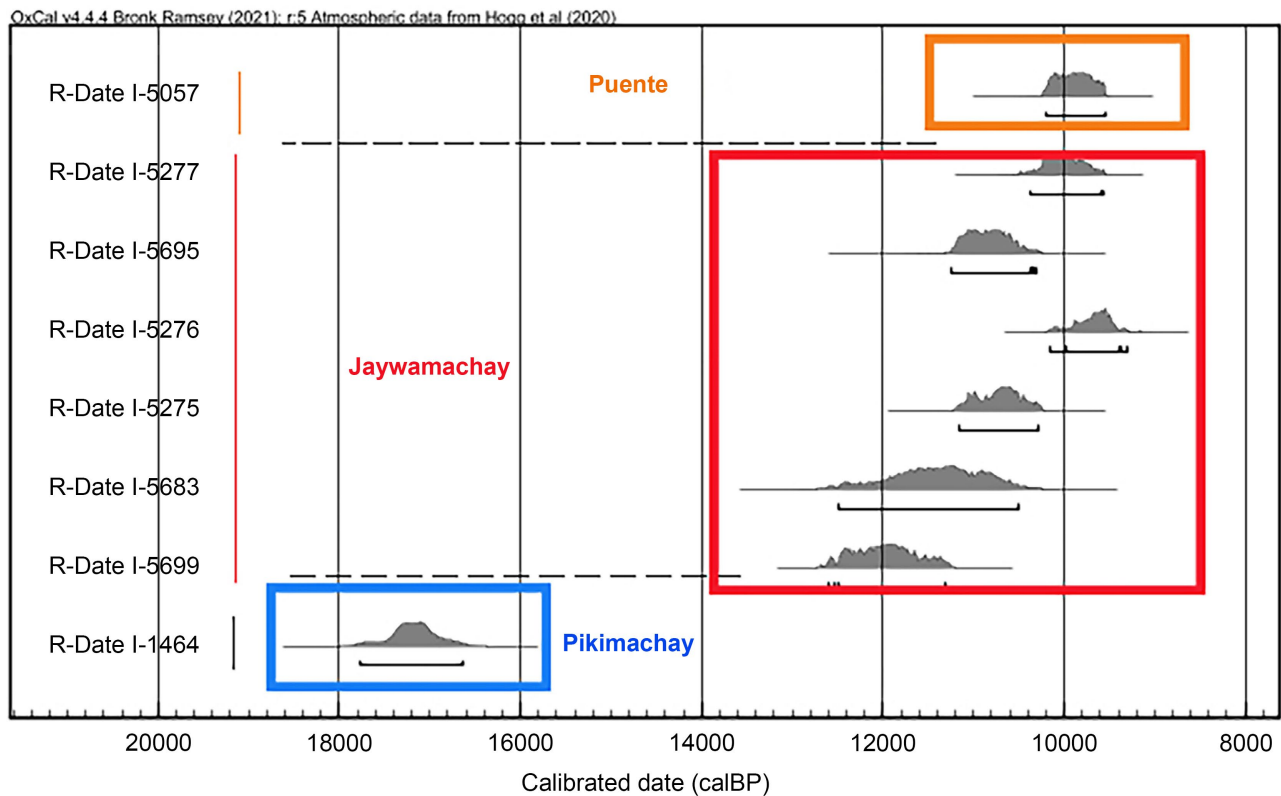


Figure 3. Plots of radiocarbon data calibrated by the OxCal v.4.4 program with the SHCal20 Southern Hemisphere calibration curve.

4. Analysis and Observations

Our research primarily focused on the analysis of lithic artifacts; however, we also observed and documented osseous modified objects and bone remains as part of our investigation. In this section, we present an overview of the surviving material culture of the early hunter-gatherers inhabiting Ayacucho during the period under consideration, including general information about newly documented pieces not previously published. A comprehensive analysis of these new findings will be provided in future publications.

The analyzed artifacts are curated in the Museum of Archeology of San Marcos University (Lima, Peru). Also, there are a few objects in the Environmental Archaeology Program of the Florida Museum of Natural History (FLMNH), Gainesville, Florida, USA. The study of field notes and some collections taken by MacNeish and his team at the Robert S. Peabody Institute of Archaeology (formerly the Robert S. Peabody Foundation for Archaeology in Andover, Massachusetts, USA) complemented this research. A total of 9,760 human-made artifacts were studied and recorded, whose distribution by strata is described in previous literature; also, detailed analyses, methods, documentation, and recent fieldwork in the area have supplemented the legacy collection from the aforementioned project (Giesso *et al.*, 2020; León & Yataco, 2008; Yataco, 2011, 2020; Yataco & Nami, 2016, 2022, 2023; Yataco *et al.*, 2021; Nami *et al.*, 2023). We based our study on the updated approaches to lithic analysis now developed (e.g., Andrefsky, 2005; Odell, 2003).

The lithic remains from three sites underwent detailed macro- and, when possible, microscopic morpho-technological analysis, guided by general (Andrefsky, 2005; Bordes, 1981; de Sonneville-Bordes & Perrot, 1956; Inizan et al., 1995; Merino, 1994) and specific literature on prehistoric lithic technologies (Callahan, 1979; Nami, 1986). Special attention was paid to differentiating human-made artifacts from natural objects in Pikimachay cave (Ellen, 2011; Grayson, 1986; Patterson, 1983; Peacock, 1991; Raynal et al., 1995). Materials were documented with photographs and technical drawings (Yataco & Nami, 2022; Yataco et al., 2021). Lithic categories and variables were previously described (Yataco & Nami, 2016, 2022; Yataco et al., 2021; Nami et al., 2023). Raw materials were macroscopically examined (10 - 35 × magnification) and sometimes microscopically (up to 250×) (Yataco, 2020; Yataco et al., 2021). Geologist C. Toledo provided a petrological analysis of a Pikimachay sample (Ortiz & Toledo, 2022). A site-specific summary of our study follows.

4.1. Puente Rockshelter

Particularly at Puente (Figure 4(A), Figure 4(B)), the deposit's depth varied according to its location in the site, and each stratum is labeled with Roman numerals I to XIV (Figure 4(C)). The analyzed material comes from strata XIIIA to XIV, located in the front part of the rock shelter talus and indicated with colors in Figure 4(C). XIIIA is ~8 cm thick and formed of yellowish-brown sediment. Covering a surface of ~87 square meters, layer XIII is light brown sediment with yellowish spots ~15 cm thick. Finally, XIV is the deepest stratum, deposited over the bedrock. It is composed of light-yellow sediments mixed with volcanic ash. Archaeological finds primarily come from layers XIIIA-XIII, while XIV yields the smallest numbers from grids S4, S5, S4E1, S6E1, and S7E1.



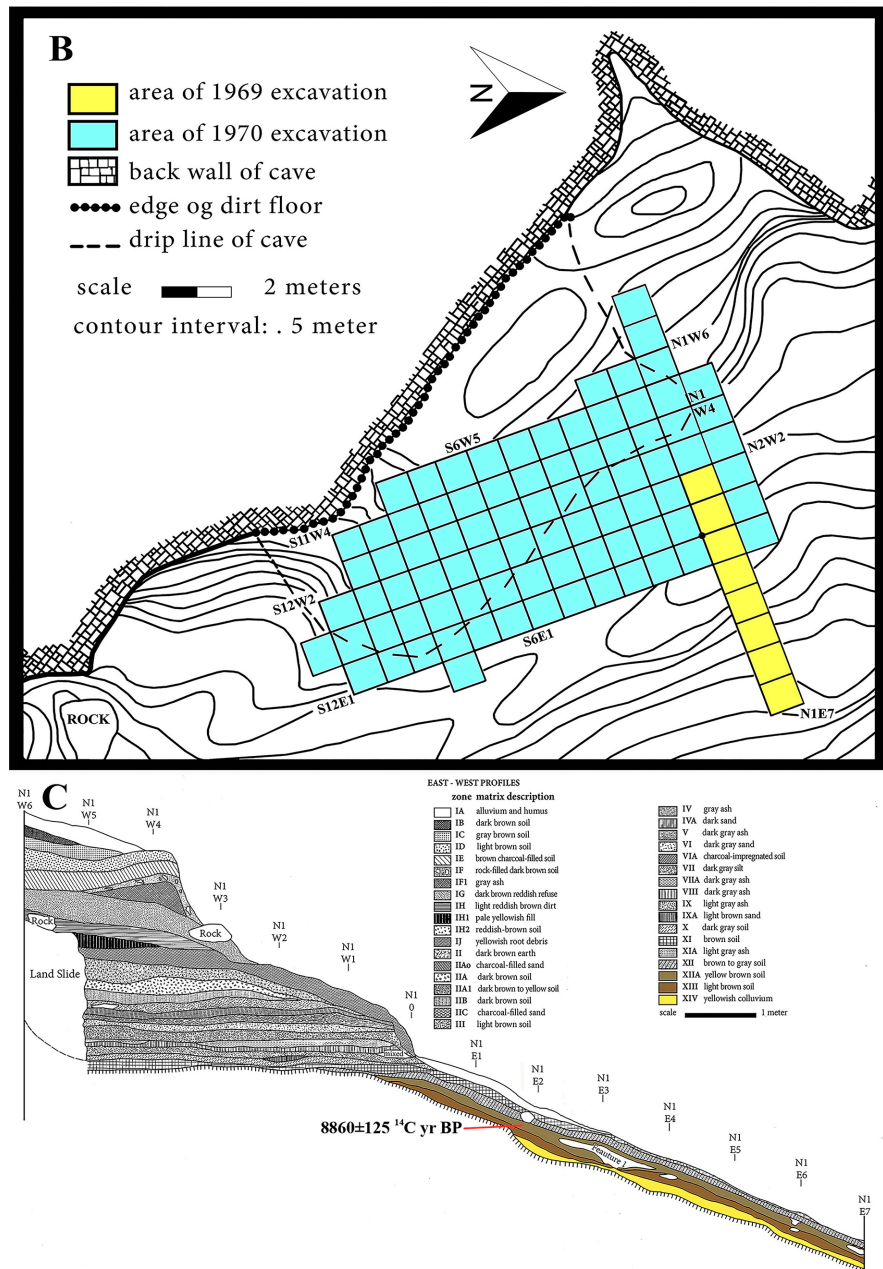


Figure 4. (A) General view of Puente site from the Wichqana creek. (B) Puente site floor plan of excavations. (C) Detailed stratigraphic sequence recorded in the east-west section of the Puente rock shelter (Figure 3(B), Figure 3(C), Redrawn from García Cook and Mac-Neish, 1981: p. 81, fig. 4-1, 4-10, 88-89).

Analysis

The analyzed sample (n = 4052) from El Puente, spanning levels XIIIA to XIV (XIV: n = 38, XIII: n = 1810, XIIIA: n = 2204), is detailed by typological list, raw materials, and average measurements in Yataco et al. (2021: Tables 1-3). Unifacial tools are primarily end-scrapers (Figure 5(U), Figure 5(X), Figure 5(Y), Figure 5(C')) and marginally retouched flakes (Figure 5(W), Figure 5(B')), with fewer side-scrapers and denticulates (Figure 5(V), Figure 5(Z), Figure 5(A')). Records

indicate unifaces were mainly crafted from tertiary flake blanks (**Figures 5(U)-(Z)**, **Figures 5(A')-(C')**) with some use of primary and secondary flakes (**Figure 5(D')**). Retouch was predominantly direct (**Figures 5(U)-(D')**), with inverse retouch occurring less frequently. Rhomboidal points, along with three complete lanceolate, bi-pointed examples with impact-fractured tips and bases (**Figures 5(A)-(P)**), originate from levels XIIA-XIII. Some points retain evidence of the flake blank due to short retouch (**Figure 5(D)-(H)**). Bifacial implements, typically exhibiting resharpening and reworking (e.g., Ahler, 1971, Callahan, 1981; Nami, 2013), show significant rejuvenation in specimens displayed in (**Figures 5(I)-(K)**, **Figure 5(M)**, and **Figure 5(P)**), a pattern observed in other Peruvian sites (e.g., Lynch, 1967: fig. 2a-h; Rick, 1983: fig. 44k-l and n-o). Additionally, five bifacial pieces from layer XIII were discarded due to flaking errors like hinges, steps, and oblique fractures (**Figures 5(Q)-(T)**; Callahan, 1979). It is important to note that the majority of the sample consisted of sedimentary rocks, primarily sandstones and calcareous materials; however, igneous rocks were predominant in layers XIIA to XIV (Yataco et al., 2021: figures 9 and 11). These rocks can be found in the ravines of a seasonal creek located approximately 50 meters from the site, which serves as a secondary source (Luedtke, 1979). The creek contains pebbles of quartzite, basalt, granodiorite, rhyolite, and volcanic tuff. Additionally, various types of flint-like materials and cherts, derived from unknown sources, were identified. Concerning obsidian, four samples from layers XII-XIII were analyzed using XRF and NAA methods. The analysis revealed that two artifacts originated from the known sources Quispisisa and two from Puzolana (Burger & Asaro, 1977, 1993: table 12; Burger & Glascock, 2000: pp. 293-293). From layer XIII, the manuports and ecofacts included a hammerstone and pebbles obtained from the nearby Wichqana Creek. The shapes of these pebbles varied, ranging from circular to elliptical and oblong. The hammerstone shows percussion marks on one of its sharp sides, while one of the pebbles has traces of soot, likely indicating some combustion activity.

Twenty-six bone remains were identified from the analyzed strata, of which six were modified by grinding and polishing, and twenty were altered by fire. Two well-made awls from XIIA are shown in **Figure 6(A)**, **Figure 6(B)**, previously reported as “Split and Conical awls” and a “Polished bone fragment and Tubular bone bead” (**Figure 6(G)**, **Figure 6(L)**). From layer XIII come ten burned specimens; seven are well-crafted objects, while the remainder are small bone fragments (**Figure 6(F)**, **Figure 6(H)**, **Figure 6(J)**, **Figure 6(K)**). Remarkable pieces were classified as “Pierced base netting needles” (**Figure 6(I)**) and “Triangular Pendants” (**Figures 6(C)-(E)**) (MacNeish et al., 1980: fig. 7-12, 8-14). The latter were achieved by grinding on some abrasive material that left striae visible to the naked eye; finally, polishing was employed to finish them. The materials are promising and show the skill of the pre-Hispanic settler in making beads with the remains of fauna. We continue to record other bone artifacts from the following level XII (**Figure 6(M)**), which will be addressed in another report.



Figure 5. Projectile points in different conditions recovered in stratum XIII (A)-(O) and XIIA (P) of the Puente site. Bifacial stages of manufacture from layer XIII (Q)-(T). Examples of unifacial tools from layer XIIA (U)-(D'). The arrows in this figure point to the close-up pictures of the edges depicted on the right of each specimen.



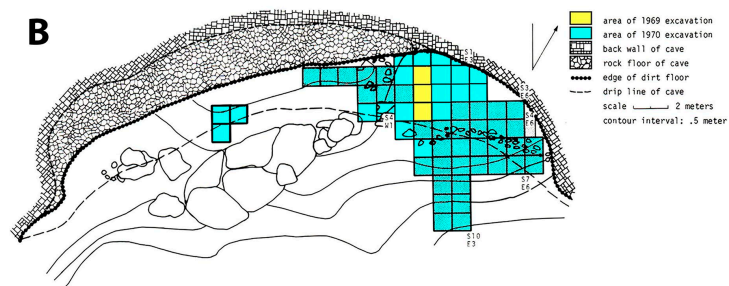
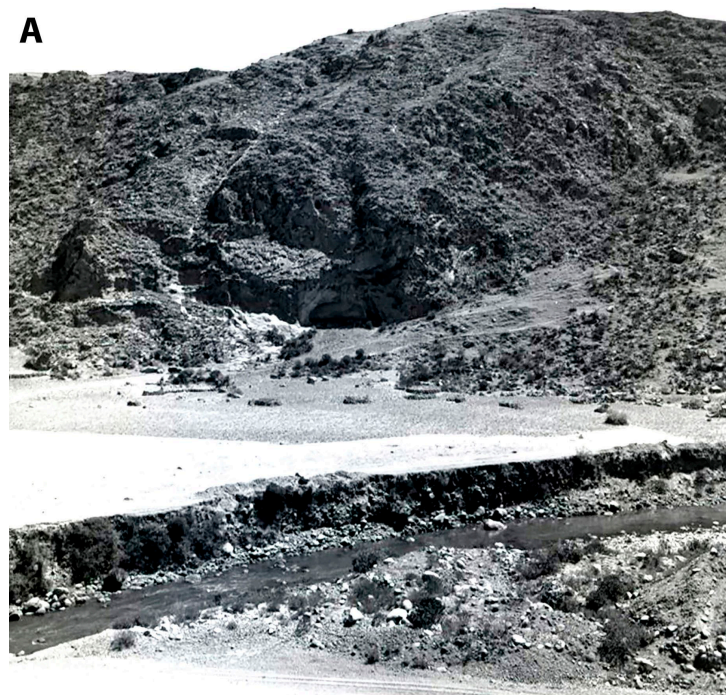
Figure 6. Bone specimens from level *XIII* in Puente: Triangular pendants (C)-(E), unclassified fragment ((F), (H), (J), (K)), pierced base netting needles (I); *XIIIA*: Conical bone awls (A), Split bone awl (B), Polished bone fragment (G), Tubular bone bead (L); *XII*: Tubular bone bead (M).

4.2. Jaywamachay

The Jaywamachay rockshelter (13° 18' 55.96" S, 74° 21' 15.60" W, 3350 m.a.s.l) is located on the lower side of a rocky mountain, 200 m from the Cachi river bridge. It is situated on the side of the mountain, where a concavity was formed that is ~27 m wide and an average of 5 m deep (**Figure 7(A)**), covering a surface of ~72 square meters (MacNeish et al., 1981: pp. 57-79). The cave in question was excavated by the Mexican archaeologist Ángel García Cook during two seasons, carried out in 1969-1970 (**Figure 7(B)**). During the first intervention, three grids were established (S2E1, S3E1, and S4E1) in which the archaeological potential was evaluated (MacNeish, 1969: pp. 26-28). In 1970, the fieldwork included a larger excavation (MacNeish et al., 1970b: pp. 23-28) in which a series of detailed records were made of the finds, and the stratigraphy of the site was defined (**Figure 7(C)**).

At Jaywamachay, nineteen strata were identified, labeled A to N. The archaeological excavation showed that the site was inhabited by different occupations, from early hunter-gatherers to agricultural societies (MacNeish et al., 1983: pp.

188-218). This paper focuses on the earliest twelve layers: H, I, J, J1, J2, J3, K, K1, L, L1, M, and N (**Figure 7(D)**). The archaeological sequence recovered there spanned the Terminal Pleistocene to the Middle Holocene (MacNeish et al., 1981: pp. 57-79, figure 3-10). Stratum H consisted of reddish-brown sandy sediment, 5 - 12 cm thick, covering $\sim 23.8 - 27.35 \text{ m}^2$. Stratum I, light gray to dark brown, covered $\sim 32.4 - 36.8 \text{ m}^2$ with thickness varying from 5 - 14 cm. Stratum J, light gray, was 12 cm thick, ranging from 7 - 18 cm towards the cave wall. Stratum J1 was 6 - 10 cm thick, covering $7.43 - 8.75 \text{ m}^2$. J2, brown to dark gray with a thickness of 9 - 22 cm, covered 9.95 m^2 . J3, light gray to brown, with a thin layer of charcoal, was 10 - 15 cm thick, covering $8.3 - 10.05 \text{ m}^2$. Stratum K, brown sandy in nature, covered $\sim 36.7 \text{ m}^2$, with a width ranging from 25 - 54 cm. K1, yellowish sandy, covered 18.2 m^2 with a thickness of 17 - 60 cm. Stratum L, yellowish and difficult to define, covered $\sim 40 \text{ m}^2$, 50 cm thick, with long fallen rocks. L1 had the same characteristics and dimensions as L. Stratum M was 20 - 118 cm thick, composed of fallen rocks surrounded by yellowish to gray sand. Finally, above the bedrock, Stratum N was archaeologically sterile, composed of gravel and sand deposited by water displacement.



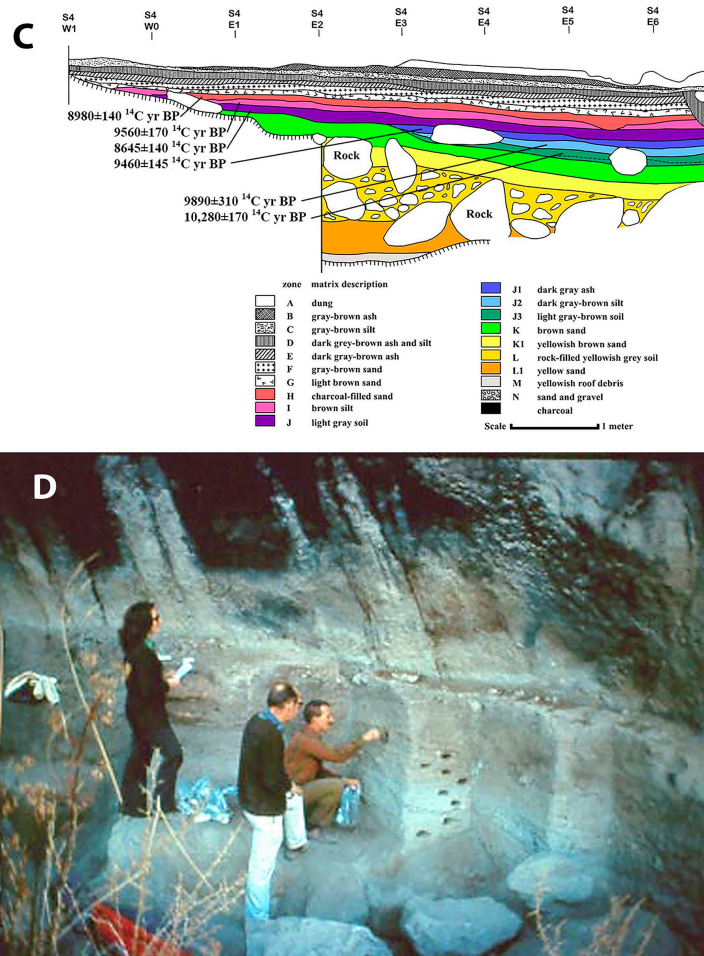


Figure 7. (A) View of the mouth of the Jaywamachay shelter facing the Cachi River (Copyright: Robert S. Peabody Institute of Archaeology, Phillips Academy). (B) Puente site floor plan of excavations: In yellow, a detail of the first trench excavated at the site in 1969. In sky blue, the excavated area during 1970 (MacNeish et al., 1981: p. 61). (C) Jaywamachay stratigraphic sequence from profiles S4W1 to S4E6 (redrawn by Juan Yataco). (D) Richard MacNeish and Bryan Vaughn collecting pollen samples at Jaywamachay cave from different layers (photo by Bryan Vaughn).

Analysis

The remains studied and recovered from the twelve aforementioned strata comprise a total of 4388 anthropic lithic pieces. Their stratigraphic distribution is as follows: H (n = 1510), I (n = 1035), J (n = 860), J1 (n = 128), J2 (n = 33), J3 (n = 258), K (n = 155), L (n = 177), and M-N (n = 232). Detailed information regarding artifact class and their discrimination by count and strata is provided elsewhere (Yataco & Nami, 2023: p. 32, Table 2). Materials such as basalt, followed by flint and obsidian, were the most frequently selected by prehistoric flakers throughout the early occupational history of the site (strata H to M-N) (Figure 8(A), Figure 8(B), Figure 8(D), Figure 8(E), Figures 8(G)-(Q), Figures 8(U)-(X)). According to our fieldwork, basalt is locally available in the ravines and surroundings of Jaywamachay. Likewise, this raw material is transported by the Cachi

River, which also contains boulders of quartzite, sandstone, volcanic tuff, andesite, granodiorite, among others. The sources of this group of rocks are unknown with certainty. However, with respect to obsidian, we know with precision of the existence of natural deposits in Pozzolana, Quispisisa, Vischongo, and Orco Puncu, all of these sources located at a distance that approximately ranges between 20 to 85 km in a straight line from Jaywamachay. A sample of obsidian artifacts ($n = 31$) recovered from different strata of prehistoric sites within the Ayacucho basin was subjected to X-ray fluorescence and neutron activation analysis by [Burger and Asaro \(1993: pp. 189-231\)](#). Five specimens within this sample originated from Jaywamachay, specifically from layers N-M, K, J2, I, and H. Their analysis indicated that the geological source of this obsidian is Quispisisa, located 85.4 km southeast of Jaywamachay ([Burger & Asaro, 1977](#); [Burger & Asaro, 1993: p. 219, table 12](#); [Burger & Glascock, 2000](#); [Matsumoto et al., 2018](#); [Giesso et al., 2020](#)).

The analysis of the shaped lithic artifacts allowed for the identification of two distinct lithic assemblages characterized by different techno-morphological attributes. Based on the similarities of the tools and their association with consistent calibrated dates, we interpret the archaeological remains from strata H to J as having been deposited by Early Holocene hunter-gatherers between ~ 10.1 and 9.0 kya. These strata yielded biconvex bifacial artifacts exhibiting foliaceous and rhomboidal forms with well-executed finishes achieved through pressure flaking and occasional soft percussion ([Figures 8\(A\)-\(L\)](#)). There are fractured ([Figure 8\(A\)](#), [Figure 8\(C\)](#), [Figure 8\(G\)](#), [Figure 8\(I\)](#)) and complete specimens that were highly resharpened ([Figure 8\(B\)](#), [Figures 8\(D\)-\(F\)](#), [Figure 8\(H\)](#), [Figures 8\(J\)-\(L\)](#)). Due to the characteristics of the flake scars, other bifacial pieces might have been flaked using direct hard hammer percussion techniques. Also, the presence of cortex in some specimens suggests that they are from early stages of bifacial reduction. In addition, there is a significant number of debitage ($n = 3010$) indicating different stages of bifacial and unifacial reduction from roughed out blanks to the finished products ([Yataco & Nami, 2023: tables 2 and 4](#)). In these layers, both the morpho-technology of bifacial points ($n = 53$) and a large amount of flaking debris suggest the repair and modification of weapons used for hunting; additionally, with the making of unifacial tools ($n = 296$). These specimens are related to the documented unifacial artifacts; for example, a uniface on a pressure-retouched basalt flake ([Figure 8\(V\)](#)), an obsidian perforator ([Figure 8\(U\)](#)), and scrapers made of flint and quartz ([Figures 8\(R\)-\(S\)](#)). Basalt in these strata was the most recurrent material ($n = 2153$), followed by silicified and sharp raw materials such as flint ($n = 392$), obsidian ($n = 310$), quartz ($n = 248$), volcanic tuff ($n = 113$), and jasper ($n = 88$), among the favorites. Added to these lithic findings are faunal remains with a total of 139 pieces, presenting in some cases obvious traces of modification; some have been reported as “conical bone awl,” “abrasion modified bones,” “bone fragment,” “tubular bone beads,” and “sawed phalange” ([Figures 9\(A\)-\(C\)](#), [Figures 9\(G\)-\(K\)](#); [MacNeish et al., 1980: pp. 314, 317, 319, fig. 8-7, 8-13, 8-16](#)).



Figure 8. Projectile points recovered from the strata *H* in Jaywamachay: (A)-(F); *J*: (G) (H); *J*: (I)-(L); *J*2: (M) (N); *J*3: (O) and *K*: (P) (Q). Unifacial artifacts from strata *H*: Scraper; *J*: Perforator (U); *J*: Unifacial tools (S), (V); *J*3: Scraper (T); *K*: Knife (W); and *M*-*N*: flake with marginal retouch (X).

The next temporal moment defined by the radiocarbon dating and the character of the remains consists of the findings from J1 to J3. They correspond to hunter-gatherers who lived during the Pleistocene/Holocene transition between $\sim \geq 12.6 - 10.2$ kya. At least in strata J2 and J3, three fishtail or Fell points of typical shape made of obsidian were documented. Two of them were fractured in their middle portion (**Figure 8(M)**, **Figure 8(O)**), and there is one almost complete piece that is missing only the meso-basal portion of the peduncle stem (**Figure 8(N)**). These were shaped by pressure with irregular parallel retouches on a blade

whose edges have a convex form. Although there are three specimens, they are in fact chronological markers that indicate human presence in the Pleistocene/Holocene transition, a phenomenon supported by radiocarbon dating (Yataco & Nami, 2016).

The flaking debitage constitutes a numerically significant component in these strata ($n = 376$), complementing the recorded manufacturing processes of unifacial and bifacial artifacts. Based on their dimensions and weights, these lithic remains appear to be the products of manufacturing tools generally composed of retouched flakes ($n = 10$), scrapers ($n = 4$), and a well-made uniface ($n = 1$). Additionally, a series of geofacts and miscellaneous objects, including manuports, pebbles, and tablets ($n = 23$), suggests their transport from the Cachi River bed. The predominant raw material utilized was locally sourced basalt, followed by obsidian, quartz, and flint of undetermined origin. Among the 21 animal bones recovered between strata J1 and J2, stratum J2 yielded three well-crafted tools tentatively identified by MacNeish based on morphological similarities as a “long bone flesher,” a “weaving sword fragment,” and a “cylindrical bone pin” (Figures 9(D)-(F); MacNeish et al., 1980: p. 316, figures 8-10, 8-11). The latter measures 5 mm in diameter and 42 mm in length, with a cylindrical cross-section and a partially broken tip (Figure 9(F)). The possible flesher is a fragmented diaphysis (89 mm long, 20 mm wide, and 6 mm thick), exhibiting a flattened broken tip with several striae, potentially from manufacturing (Figure 9(D)). The potential weaving sword fragment measures 73 mm in length, 14 mm in width, and 5 mm in thickness (Figure 9(E)). We consider a necessary future revision of these identifications.

A significant number of projectile points ($n = 58$) have been identified from levels H to K (Figures 8(A)-(Q)). Points from strata H and I are rhomboidal to lanceolate, shaped by soft direct percussion and finished by pressure flaking (Figures 8(A)-(H)). The symmetry of some specimens indicates well-configured pieces, and their shapes, sizes, and weights suggest reshaping and reworking, reflecting careful material economy (Figures 8(C)-(E), Figure 8(H)). As observed at the Puente site (Yataco et al., 2021), the retouches show a change in the original flaking pattern, forming rounded or concave edges. This type of repair typically occurs when the piece remains hafted (Callahan, 1981; Nami, 2013).

In the lower strata K to M-N, small unclassified bone fragments have been registered ($n = 14$), in association with a significant amount of debitage ($n = 550$), along with unifacial ($n = 11$), core ($n = 1$), and bifacial ($n = 2$) artifacts. These strata lack radiocarbon dates. Based on the shape of the projectile points, we speculate these are from a later period. Their presence suggests potential stratigraphic alterations and material mixing not thoroughly documented. While it is possible that these artifacts represent pre-Fell occupation, we are skeptical. Considering findings from other rock shelters in the region (Yataco & Nami, 2016, 2023), it is crucial to conduct specialized archaeological, geo-archaeological, and taphonomic investigations to understand the complex burial processes and site formation.



Figure 9. Bone objects from strata *H* at Jaywamachay: Conical bone awls (A), abrasion-modified bones (B) (C), sawed phalanges (K); *H-I*: tubular bone beads (H)-(J); *J*: bone fragment (G); *L*: long bone fleshers (D), weaving sword fragment (E), cylindrical bone pins (F) (MacNeish et al., 1980: pp. 316-319).

4.3. Pikimachay Cave

Flea Cave or Pikimachay is located at 2,925 masl on the eastern slope of Marcahuilca Hill (13° 02' 18.93" S. Lat., 74° 13' 41.27" W. Long.), a volcanic cone ~2 kilometers northwest of Paccaicasa town. Geologically, it is located in the Molinoyoc formation, consisting of a sequence of dark lavas arising from several volcanic cones, among which five stand out, made up of lava, slag, and ash spills reaching altitudes of approximately 3400 meters above sea level (Giesso et al., 2020). In the Paccaicasa surroundings, there is evidence of whitish breccias and tuffs, and colored lava streams ranging from gray to dark gray, with plagioclase and lapilli strata.

The cave measures 25 m long by 55 m wide, and 10 m in height at the entrance (Figure 10(A)). For excavation purposes, the floor was divided into three sectors called the north, central, and south “rooms” (MacNeish et al., 1970a: p. 10). From

the cave's mouth and the drip line, they are located from right to left respectively, around and behind the large blocks mostly found in the north-central portion of the entrance, and partially in the southern portion of the south sector (**Figure 10(A), Figure 10(B)**). In these "rooms", three excavation sectors named as North, Central, and South "trenches" were independently excavated, with different notation in record and stratigraphy (MacNeish, 1979; MacNeish et al., 1981: pp. 19-56; MacNeish et al., 1983: pp. 133-170). During the first field season between June and September 1969, the team excavated the central and northern sectors. The main excavation was done in the southern portion during the second field season in 1970 (**Figure 10(B)**). The grids were oriented along the north-south and east-west axes, and labeled according to parallel lines of stakes; units south of this 0 axis were called E1, then E2, etc.; while those 1 m south were S1, S2. Thus, all were crossed by axis lines and had a double number; for example, S14E10.

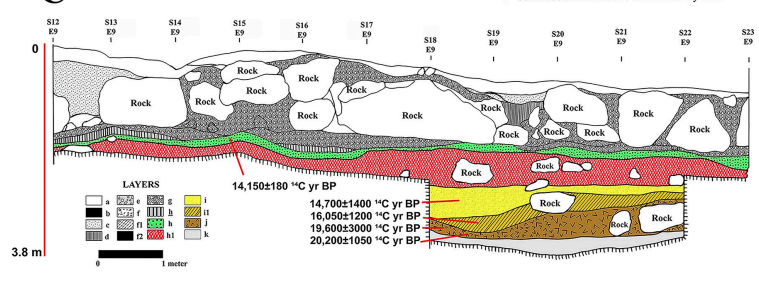
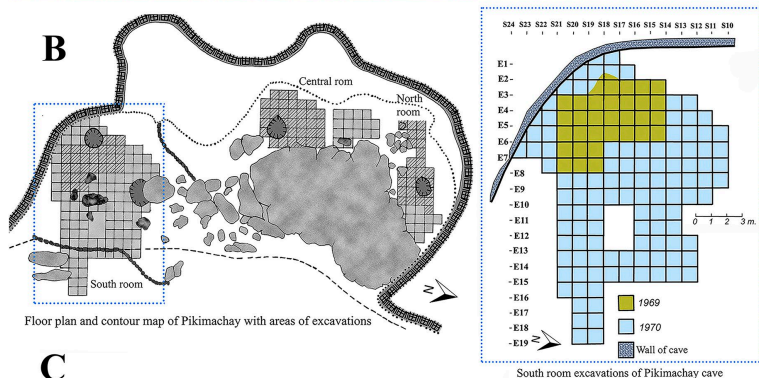




Figure 10. (A) R. MacNeish and a visitor at Pikimachay cave. Observe the large rockfalls located at the entrance of the central room (photo by Bryan Vaughn). (B) Floor plan of the site and locations of the excavated sectors: in yellow color the excavated grids in 1969 and in sky-blue color the 1970 field-seasons. (C) Stratigraphic sequence of Pikimachay cave from S12E9 to S23E9 and S23E5 to S12E5 (MacNeish et al., 1981: pp. 46-47). (D) Bryan Vaughn collecting pollen samples at Pikimachay cave from layers h to k (photo courtesy of Bryan Vaughn).

The remains discussed here come from the south room, so here we describe only the strata from this area. There, the sedimentary deposit showed sixteen layers identified with the letters “a” to “k” (Figure 10(C)). Some remarkable features are in the sequence. The blocks fallen in the collapse of the cave’s ceiling constituted a clear-cut layer in the stratigraphy (MacNeish et al., 1981: p. 49). Strata “g,” about 1.5 m in thickness, is composed of rodent-deposited plant remains and blocks of varying sizes. The blocks are mostly concentrated in the north-central region, and partly in the southern sector (Figures 10(A)-(C)). Because they overlie an occupation level with projectile points dated at about 10,000 - 9000 uncalibrated years (~10-9 kya, hereafter) (MacNeish, 1979: pp. 29-40; MacNeish et al., 1981: pp. 51-54), these rock-falls were possibly caused by a catastrophic episode that happened during the terminal Pleistocene/Early Holocene, and covered the seven earliest strata (MacNeish, 1969: pp. 17-23). The stratigraphy overlying this debris is confusing and showed disturbances and intrusions due to modern human action, such as looter holes, the construction of corrals, and animal activity (MacNeish, 1979: pp. 4-8). Due to its thickness, some significant unconformities may have occurred, mainly above the blocks (Yataco & Nami, 2022). However, the underlying strata show a moderately uniform horizontal deposition forming a deposit ≥ 1.5 m thick. We will describe these strata due to the goal of our investigation (Figure 10(C)).

Layer h, 20 cm thick, formed by dust and soft reddish-brown sediment, is the last deposit before the cave’s ceiling collapses. It occupied a small triangular surface of 21.75 m², approximately 6 × 6 m, at the north end of the excavation. The

most extensive stratum below the rock fall was h, formed by slightly compact reddish-orange sediment. Its thickness varies from 5 to 10 cm along the cave wall to greater than 30 cm near the cave's mouth and extends over 119.13 m². Below is the h1 stratum, a highly compact yellowish deposit with a maximum thickness of ~40 - 50 cm, and an average ranging from 25 to 35 cm. It covers a surface of 122 m², and only 104 m² was excavated. Covering a surface between 50 to 60 m², i was a dark brown layer reaching a maximum of ~30 cm in thickness. Measuring ~7 - 8 meters in an east-west direction, i1 was a compacted reddish-brown stratum of ~30 cm maximum thickness. The excavation consisted of an area of 20.5 m², and the unexcavated surface was 3.13 m². Extending between 8 to 14 m from east to west, stratum j is dark reddish-gray sediment which reached a maximum thickness of 40 cm. It covered an approximate area of 50 to 65 m², of which only 33.42 m² was exposed. Finally, overlaying the bedrock, k is a brownish-gray level with a maximum thickness of 30 cm. It covered a surface of 10 by 4 meters long and wide, with an excavated surface of 27.71 m².

In summary, two features are crucial in the lower levels of the Pikimachay sedimentary deposit. They are the collapse of the cave's roof, which in several places sealed the oldest strata that showed a reasonably horizontal and uniform deposition, only disturbed by falling roof blocks in some places of *h* and *h* (MacNeish, 1979: pp. 33-41). The rockfalls from the cave walls and ceiling occurred in strata related to tabular volcanic flows and weak areas associated with tectonics and seismic activity (MacNeish et al., 1981: pp. 27-28, 49). Another notable feature is that layers *h* to *k* (Figure 10(C), Figure 10(D)) show a highly compacted structure, almost lithified, and practically reaching a cemented stage in the sedimentary rock formation process (Blatt et al., 1980; Tarbuck & Lutgens, 1999; Yataco & Nami, several personal observations). As the layers thickened, this part of the stratigraphy became harder (MacNeish, 1979: p. 18). For that reason, chisels were used for excavation (Figure 10(D)), and their signatures are still visible in the remaining sections. These sorts of hard layers seem to be present in other sites, such as the Puente rockshelter. There, to excavate them, chisels were also used (MacNeish, 1969, fig. 37; Yataco et al., 2021, fig. 5 a-d). These kinds of highly compacted strata might have acted as a matrix sealing the embedded artifacts.

Analysis

The re-study and analysis of the archaeological materials from layers h, h1, and i1 at this site yielded a total of 67 anthropogenic artifacts. Because the field notebooks at the RSPIA help identify artifacts curated at the MAA-UNMSM (Yataco & Nami, 2022), we added fifteen new pieces to the previously reported sample (n = 52, Yataco, 2011: pp. 257-265). The sample may be classified as follows: tools (n = 33), bifaces (n = 2), lithic waste (n = 21), cores (n = 8), as well as manuports and ecofacts (n = 3). The total and detailed data regarding each specimen's location in the stratigraphic sequence, catalog numbers, excavation squares, and their individual figures are given in published and unpublished literature (Yataco, 2011, 2020; Yataco & Nami, 2022). In making the flaked artifacts, sedimentary, meta-

morphic, and igneous rocks in various colors are used. The most used raw materials in the h and h1 layers were volcanic rocks, mainly tuff (n = 25), basalt (n = 5), minerals like quartz (n = 13), and chert (n = 13). Three waste flakes were detected in layer h, made of basalt with a black coloration (**Figure 12(E)**), pebble debris (**Figure 12(M)**), a chopper that exhibits a strongly rounded and ground edge (**Figure 11(K)**), among others. Remarkable are nine shaped tools, among which are two made from flake-blanks of volcanic rock (**Figure 12(G)**, **Figure 12(M)**). Two multipurpose tools (Jodry, 1999; Nami, 2019) were probably used as knives or side scrapers (**Figure 11(B)**, **Figure 11(L)**); additionally, there is a denticulate tool (**Figure 12(K)**). Five cores were made from chert and dacitic metavolcanic material (**Figure 11(O)**; **Figure 12(A)**, **Figure 12(H)**); flake fragments, a knife, and shatter (**Figure 11(S)**) are made of chert. All the described specimens seem exhausted, and the flake-scars' concavities and flake shapes indicate that they were flaked by direct hard percussion. We also examined seven tools, including a scraper that stands out by its shape (**Figure 11(M)**), two modified flakes (**Figure 11(E)**, **Figure 11(F')**), and three denticulate tools (**Figure 11(D)**, **Figure 11(N)**, **Figure 11(I)**); finally, a perforator (**Figure 11(A)**). Remarkable is an end-scraper manufactured on a small tertiary angular flake of smoky black obsidian (**Figure 11(H)**). This example is significant because it shows the early presence of obsidian use in Ayacucho. What is more, another scraper on volcanic tuff is from the same context (**Figure 11(J)**). Two partially flaked bifaces (**Figure 11(C)**, **Figure 11(G)**) were flaked on a moderately yellow-green andesitic volcanic tuff rock with microfractures filled with milky quartz. Due to the raw material flaws and the fracture patterns, both were possibly rejected during the reduction process (Callahan, 1979; Nami, 1986, 1988, 2017; among others).

Most debitage consists of secondary and tertiary flakes of different materials (n = 14). Two are primary flakes on basalt (**Figure 11(P)**; **Figure 12(C)**), and four pieces of shatter on volcanic tuff (**Figure 11(Q)** and **Figure 12(B)**). In at least six of these pieces, the cortex suggests that they were removed from pebbles and result from the initial stages of reduction chipped with hard percussion flaking (**Figure 11(Q)**, **Figure 11(T)** and **Figure 12(E)**, **Figure 12(G)**, **Figure 12(I)**, **Figure 12(M)**), and one, due to its morphology, was obtained using soft percussion (**Figure 11(R)**) (Callahan, 1979; Nami, 2017; Whittaker et al., 1998). This waste may indicate that, on certain occasions, the flaking of volcanic tuff, flint-like material, diabase, and basalt may have been carried out inside the cave, as suggested by several archaeological and actualistic investigations (Ericson & Purdy, 1984; Callahan, 1979; Toth et al., 1992). It is important to note that a substantial portion of the sample is waste (44%), which includes cores (11%) and debitage (33%). The most used materials were basalt, diabase, volcanic tuff, and granodiorite, followed by quartzite; also, sandstone, quartz, jasper, flint-like materials, and obsidian were used to a lesser extent (**Figure 11**, **Figure 12**). Local sources for lithic materials are possible; a small primary outcrop of silicified material was found near Moli-noyoq volcano, ~300 meters from Pikimachay. However, regional landscape

changes over millennia due to agriculture may have obscured some resources. Our analysis showed a dominant use of volcanic rocks, mainly silicified tuff ($n = 21$), with less basalt ($n = 3$) and diabase ($n = 1$). These rocks are still found in secondary deposits near the cave or along the Cachi River, given the widespread volcanic materials from at least three nearby volcanoes (Yataco et al., 2021). Due to past controversies and the lack of detailed review (Dillehay, 1985; Lynch, 1983; Rick, 1988), the precise origin, descriptions, quantities, and context of these finds are detailed in Yataco and Nami (2022: Table 3).



Figure 11. Stone tools from layers *h* (A)-(T); *h1* ((U)-(Z), (A')-(J')) and *j* (K') in Pikimachay.

Five pieces of volcanic chipping waste were identified (**Figure 11(U)**, **Figure 11(V)**, **Figure 11(C')**, **Figure 11(E')**, **Figure 11(G')**). Shaped artifacts include tools (n = 8) and cores (n = 2), mostly in **Figure 11(A)**, **Figure 11(H)**. Two scrapers (**Figure 11(X)**, **Figure 11(H')**) of bluish flint-like material and white quartz exhibit short, irregular parallel retouches with an abrupt angle and a continuous distribution on their distal or perimeter edges. Among shaped specimens on secondary flakes are three denticulate tools on flint (**Figure 11(Y)**), marbled quartz (**Figure 11(J')**), and quartzite (**Figure 11(I)**), with continuous abrupt to semi-abrupt retouch, sometimes perimetric. Two of these were previously noted by MacNeish (1979: fig. 22, 5, 6). A likely exhausted trapezoidal core of marbled volcanic tuff with ~50% cortex and facets suggests selection of an angular nodule (**Figure 11(A')**). MacNeish's files also identified three waste flakes from layer h1 with possible soot stains, soot, or fire exposure, one cracked (**Figure 11(V)**, **Figure 11(B')**) (Purdy, 1975).

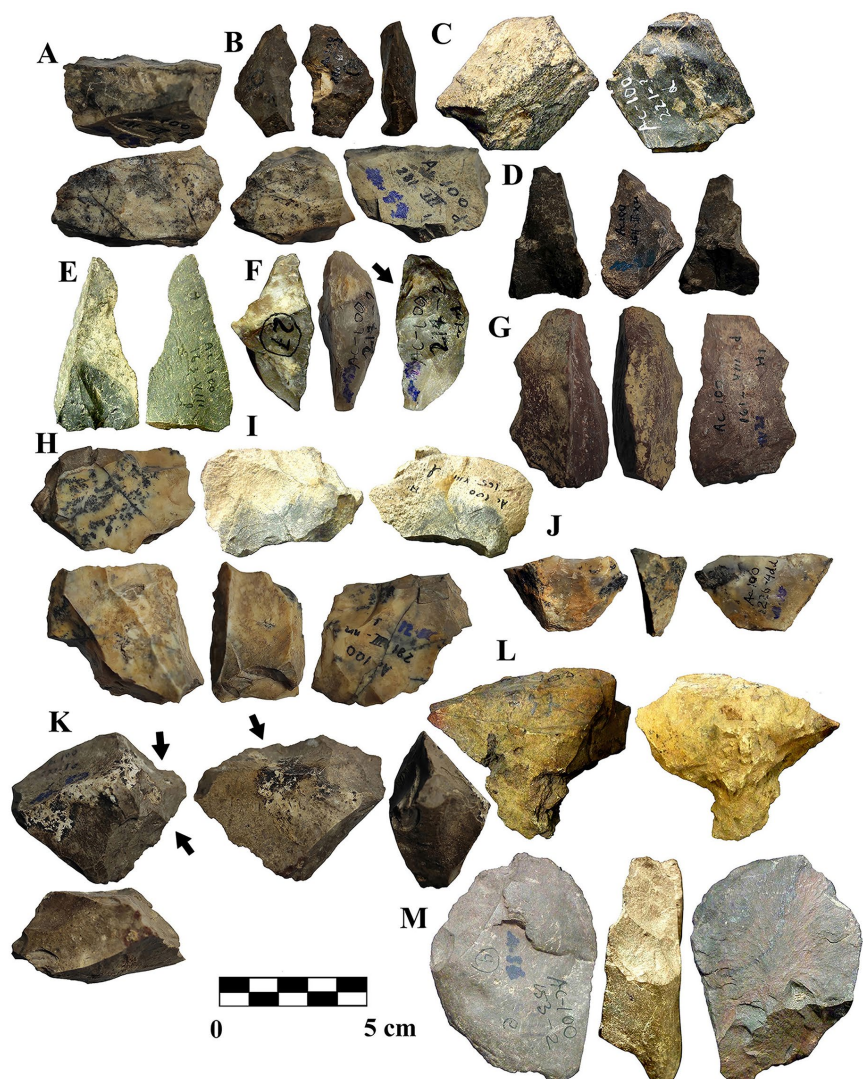


Figure 12. Lithic artifacts from layer *h* (A)-(M) at Pikimachay.

The artifacts described above allow for some remarks regarding their reduction sequence. The cortex of some nodules remains on the dorsal face, suggesting that they were detached from pebbles (**Figure 11(A')**), or even nodules with angular surfaces (**Figure 11(E')**). Because of the material's workability, they may have been detached by hard hammer percussion flaking (Callahan, 1979, 2016; Nami, 1986, 2000, 2015), among others. Also, several large flake-blanks on the ventral face display flat or diffuse force cones (**Figure 11(U)**, **Figure 11(Y)**, **Figure 11(C')**, **Figure 11(H')**). Flaking experiments on similar South American materials showed that this attribute results from using hard hammerstones (Nami, 2015). Due to the features observed on the dorsal faces, percussion was randomly applied to different kinds of cores, including the bifacial and amorphous cores observed in the collection (**Figure 11(A')**, **Figure 11(E')**). The percussion was applied to unmodified or previously flaked surfaces, which can be observed in the flakes as natural, plain, and dihedral butts of striking platforms (**Figure 11(W)**, **Figure 11(D')**). It is highly probable that after the blank was obtained, the final shaping was performed by simply retouching its edges using the same technique, but with another variant and/or holding position, and using hard, soft, or semi-soft hammer-stones (e.g., Nami & Civalero, 2017; Civalero & Nami, 2020). In some circumstances (**Figure 11(X)**, **Figure 11(Y)**, **Figure 11(D')**, **Figures 11(H')-(J')**), the tools' edges were possibly shaped by pressure flaking or by percussion with a soft implement, probably of an organic nature, with high-density osseous tissue, like deer antler (Nami & Elkin, 1994). The retouch forms vary from short parallel (**Figure 11(X)**, **Figure 11(Y)**, **Figure 11(C')**) to scaliform (**Figure 11(B')**, **Figure 11(F')**, **Figure 11(J')**), and when the dorsal and ventral faces are visible, most retouches are direct (**Figure 11(W)**, **Figure 11(X)**, **Figure 11(Y)**, **Figure 11(B')**, **Figure 11(J')**), and inverse in a few cases (**Figure 11(U)**, **Figure 11(C')**, **Figure 11(H')**).

MacNeish and colleagues (MacNeish et al., 1979: pp. 21-41; MacNeish et al., 1983: pp. 141-143) also reported from layer i supposed activity areas containing bones, burned sectors, and lithic artifacts. To determine their possible human modification, each piece was reviewed with special care and detail (e.g., **Figure 13(D)**, **Figure 13(F)**, and **Figure 13(G)**); their edges were carefully examined for striking platforms and impact points to assess their true human-made nature. Although it was difficult to determine the cause of the fractures, we concluded that the rocks fell down the cave walls and roof, and they are without intentional human modification. Some have natural fractures on the edges, thus constituting nature artefacts or geofacts (Manninen, 2007; Preston, 2019). We consider them to be rocks that exhibit a series of apparently morpho-technological features whose origin is due to geological processes (Eren et al., 2023). During our case study, we observed chunks and flake-like pieces detached from the cave outcrop and chemically altered by natural agents, sometimes showing continuous, non-continuous, or random flake scars. Thus, no evidence of human activity can be seen in this stratum, and hence, we reject them as anthropogenic. One piece exhumed from layer i1 is curated at the MAA-UNMSM and described as a core on

quartzite with angular surfaces (**Figure 11(K')**); it is an artifact showing flake detachments from hard hammer-stones. As we previously discussed, this core may come from the upper levels (Yataco & Nami, 2022: p. 315; Yataco, 2011: p. 258), and there is no human activity. About layers j and k (MacNeish, 1979: pp. 21-25. fig. 21; MacNeish et al., 1980: fig. 3-1, 5-3). MacNeish reports a possible stone tool as a “tufa flake chopper,” “large denticulate,” and “a tufa slab spokeshave” (**Figures 13(A)-(C)** and **Figure 13(E)**). After reviewing these pieces, we concluded that they were natural rocks.

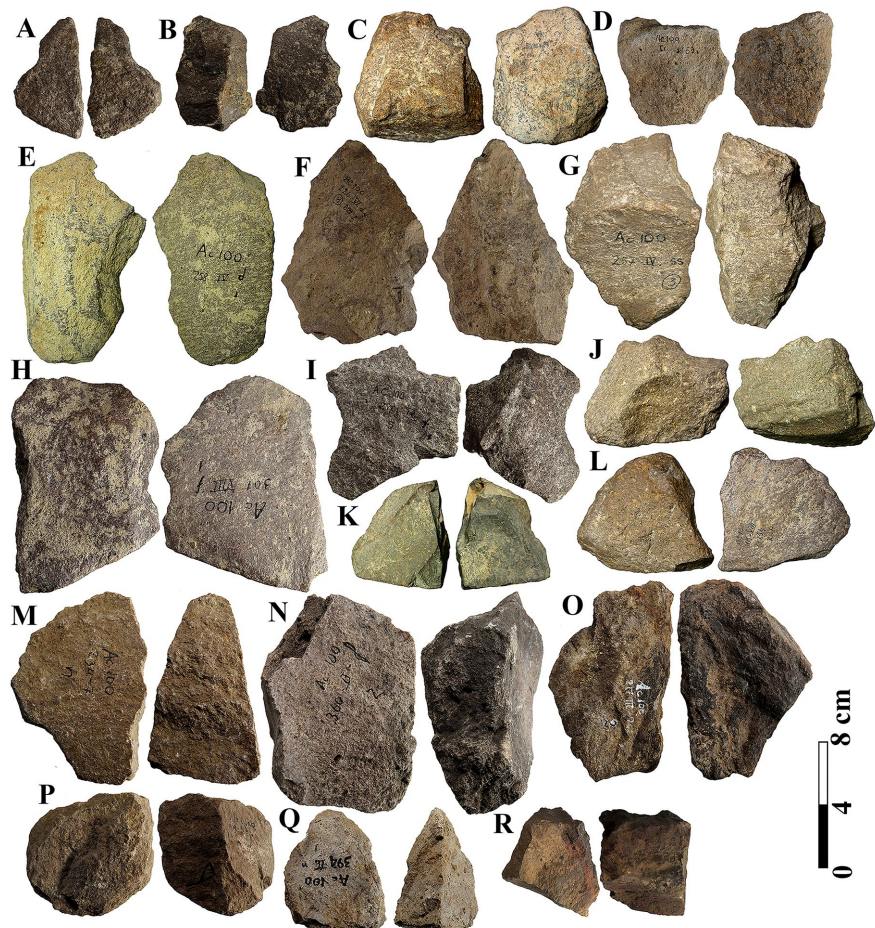


Figure 13. Chunks and geofacts from south room layers *k* ((A), (B)); *j* ((C), (E)); *i* ((D), (F), (G)); *h1* ((H), (I), (J)); *h* ((K), (L)); *g* ((M), (N)); *e* (O); *d* (P); *b* (R); *a1* (Q).

Remarkably, MacNeish also unearthed similar apparent pseudo-artifacts in the same south section across late Pleistocene, Middle, and Late Holocene contexts (layers *h1*, *h*, *g*, *e*, *d*, *b*, and *a1*; **Figures 13(H)-(R)**). Our meticulous examination of the cave and its debris-strewn surroundings, searching for pseudo-artifacts akin to those in Pikimachay’s lower levels, yielded several pieces published as “tufa slab spokeshaves” (**Figure 13(H)**, **Figure 13(I)**, **Figure 13(K)**), “large denticulate” (**Figure 13(J)**), “pebble side scraper” (**Figure 13(L)**), and other undetermined items from later levels (**Figures 13(M)-(R)**) (MacNeish, 1979: pp. 21-

25; MacNeish et al., 1980: fig. 5-1, 5-3). As **Figure 13** illustrates, these exhibit dimensional and shape similarities to those from the lower layers. Furthermore, our recent visit to the cave resulted in the recovery of comparable items among the fallen debris. Based on these observations, we strongly reiterate our interpretation that certain stones from layers h, h1 (**Figures 13(H)-(L)**) and others from i, i1, j, and k, classified by MacNeish as “artifacts” (**Figures 13(A)-(G)**), are of natural origin and not humanly modified.

5. Results and Discussion

At the Puente site, the raw materials utilized to make lithic artifacts indicate that the groups living there exploited a variety of local sources. However, the presence of obsidian from Quispisisa indicates that, since the terminal Pleistocene, Andean societies have made long-distance interregional movements or exchanges (Burger & Asaro, 1993; Matsumoto et al., 2018). Similarly, its use for making stone tools in the early hunter-gatherer occupations at Ayacucho was also recorded in the Pikimachay cave, and the Jaywamachay rock shelter (MacNeish et al., 1981, 1982, 1983; Yataco, 2011; Yataco & Nami, 2016, 2022, 2023). Shaped tools in layers XIIA-XIII of Puente show morpho-technological similarities, and belong to an Early Holocene hunter-gatherer population living at 10.3-9.5 calibrated kya. The low frequency of lithic artifacts in layer XIV suggests that they may have been derived from the upper layer. They may also testify to an older occupation, probably of Paleoindian origin.

In the analysis of shaped artefacts from the three sites, we found small sizes and standardized shapes. At Puente, the highly resharpened points suggest significant behavior regarding the curation of some artifacts (Binford, 1983: pp. 227-254; Nami, 2013: pp. 5-9; Nami, 2014a: pp. 279-336). The lithic inventory displays features in common with several sites of the Central and Southern Andes, and the projectile point morphology and unifacial tools agree with those registered at early Holocene sites: for example, Lauricocha (Cardich, 1958: Fig. 11: a-f, fig. 12, fig. 25-27; Cardich, 1964: fig. 79-86); Quisqui Puncu (Lynch, 1967), Guitarrero (Lynch, 1980: pp. 178-225, Fig. 9.1: c-d, h-j, Fig. 9.2: o, Fig. 9.3: a, h, j); Pachamachay (Rick, 1980: pp. 107-189, Fig. 6.13-6.14, Fig. 7.2-7.11; Rick, 1983: pp. 156-161, Fig. 44a-o, Fig. 45g-h); Uchkumachay (Kaulicke, 1999: pp. 307-324, fig. 3-12); Telarmachay and Quebrada de los Burros (Lavallée et al., 1995, 127-129; Lavallée et al., 2012, 223-224); Tres Ventanas, Kiqche sites (Chauchat, 1972: pp. 126-132, fig. 4-5); Toquepala (Ravines, 1972: pp. 133-184), and Paiján with the unifacial instruments (Chauchat, 1982: pp. 178-182; Chauchat, 2022: pp. 2-11) as well as other Andean countries (e.g., Sandweiss & Rademaker, 2011); Chile (Osorio et al., 2011), Bolivia (Aldenderfer, 1998; Lizarraga-Mehring, 2000: pp. 124-138, 156-161; Rivera Casanovas & Calla Maldonado, 2011: p. 449, fig. 8a-p), and Argentina (González, 1960; Gradín, 1984; Fernández, 1990). Based on the lithic waste's dimensions, these are the results of manufacturing tools, suggesting that toolmaking was an active activity at the sites. They are mainly by-products of bi-

facial thinning, final shaping, and uni- or bifacial rejuvenation. In this endeavor, the knappers may have used hard-percussion flaking and soft precursors according to the reduction technique (Flenniken, 1984: p. 191) and steps in the process (Callahan, 1979; Nami, 2017). Some of the smallest flakes were produced by pressure flaking as judged by their size and punctiform striking platforms (Andrefsky, 2005; Nami, 2017). The most used materials were local basalt, followed by chert and jasper, but the quarries are still unknown. Obsidian comes from the Quispisisa and Puzolana sources. The former is located at a distance of ~120 km, while the latter is located nearby at a distance of ~10-15 km (Burger & Glascock, 2000; Giesso et al., 2020). In Ayacucho, diverse projectile point types were defined based on their morphological variations (MacNeish et al., 1983: pp. 50-57). Several reflect different shapes with little or no resharpening (MacNeish et al., 1980: pp. 53-64). However, some of these might result from the rejuvenation of the same specimens, and the points from layers XIIA–XIII at Puente reflect this case. It is worth mentioning that in the lower levels of Guitarrero Cave, Jaywamachay rockshelter, and Pikimachay cave, with a similar chronology, the case of Guitarrero Cave is special, because the lithic artefacts were associated with well-preserved remains of wood, bone, antler, twine, and vegetable fibre textiles (Lynch & Kennedy, 1970: pp. 1307-1309; Lynch, 1980: pp. 233-290). Like other hunter-gatherers in the world (Schier & Pollock, 2020), these elements suggest an early textile development in the Central Andes, almost coincident with the oldest evidence of Andean agriculture and the origin of the well-known socio-cultural complexification in the Central Andes (Dillehay et al., 2007).

At Puente, weaponry repair was an activity performed in layers XIIA-XIII to replace worn and broken points with brand-new ones. Although there are entire specimens, most are rejuvenated and fractured pieces, either tips or basal portions. The finding of extremely resharpened points, fractured bases, and early bifacial stages of reduction suggests this fact. In addition to waste, there is a profusion of debris that evidences final shaping by pressure flaking. Under the actualistic baseline generated by replicative experiments on materials similar to those recovered at Puente—especially basalt—and other rocks (Callahan, 1979; Nami, 1986, 2015, 2017), it is possible to suggest that the waste flakes resulted from hard and soft percussion flaking. These results are consistent with those of early bifaces, which have flake-scars with sharp ridges and deeply concave initiations due to pronounced percussion bulbs (Figures 5(A)-(F), Figures 5(I)-(K)). Others show flat initiations resulting from flake detachment from diffuse bulbs (Crabtree, 1972; Callahan, 1979; Nami, 1986, 2017). A great deal of debris exhibits thin, angular flakes with multidirectional ridges and a curved longitudinal cross section. In addition, the flakes show narrow and abraded faceted—or filiform—platforms, and sometimes lips. Experiments made with similar lanceolate pieces (Nami, 1990) suggest that the rejected bifacial specimens are early manufacturing stages and preforms. On these bases, their flake-scar features indicate that they were probably flaked with hammer-stones (Figure 5(G), Figure 5(H), Figure 5(L)) and organic

precursors, possibly antler or bone (**Figures 5(i)-(K)**). Flakes from layer XIV at Puente are predominantly represented by diverse small tertiary flakes. By their characteristics, they may result from bifacial thinning stages and final shaping (Callahan, 1979; Nami, 1986, 2017; Whittaker & Kaldahl, 2001; Purtil, 2012). Random multidirectional flakes significantly reduced the cores, suggesting material maximization. Traditional technologies use pebbles and cobbles as multipurpose implements (De Beaune, 1989). One was used as a hammer-stone, while the other ecofacts were probably employed in diverse ways. Those with soot traces may have been caused by combustion or culinary action.

Artifacts from Jaywamachay layers H-J resemble the Puente lithic assemblage. Their foliaceous and rhomboidal bifaces, finished with pressure and soft percussion (**Figures 8(A)-(L)**), include fragmented (**Figure 8(A)**, **Figure 8(B)**, **Figure 8(G)**) and resharpened complete specimens (**Figure 8(B)**, **Figures 8(C)-(F)**, **Figure 8s(H)-(L)**), similar to Puente layers XIII and XIIA. Abundant primary/secondary flakes and small waste (n = 3010) indicate *in situ* bifacial and unifacial flaking. These layers show evidence of hunting weapon repair/modification (n = 53 bifacial points) and unifacial tool production (n = 318), including pressure-retouched flakes, knives, denticulates, perforators (**Figure 8(U)**), scrapers (**Figure 8(H)**), and uniface (limances) on flakes reminiscent of Paiján and Telarmachay (**Figure 8(S)** and **Figure 8(V)**; Chauchat, 2022: pp. 2-12, figures: 4 A-B and 7-8; Lavallée et al., 1995) manuports (Yataco & Nami, 2023: p. 32, table 2).

Finds from J2-J3 at Jaywamachay include late Pleistocene Fell points (Nami, 2014a), with obsidian “Fishtail Points” (Yataco & Nami, 2016; MacNeish et al., 1980: p. 51, fig. 2-3): two fractured medially (**Figure 8(M)**, **Figure 8(O)**) and one nearly complete narrow-bladed lanceolate variant lacking the stem base (**Figure 8(N)**), similar to finds across Central and South America (Nami, 2021). It is well known that some Fell points were fluted (Nami, 2014b); therefore, the flute on the preform is another clue confirming that the artifacts from layers J2 and J3 of Jaywamachay represent Paleoindian hunter-gatherers. Fishtail fluted points and preforms have been identified in several places across Peru as well as in other locations in South America (Yataco & Nami, 2016, Nami, 2021 and references cited there). The piece Ac335 46-6 aa16, illustrated by MacNeish and colleagues (MacNeish et al., 1980: p. 51, figure 2-3, left) cannot be found in the collection; however, by virtue of the illustration, it is consistent with the Fell points variation named “El Inga broad stemmed” identified in Ecuador and other places in South America (Mayer-Oakes, 1986; Nami, 2014a, 2014b; Nami, 2021: p. 53: fig. 7-9; Nami & Yataco, 2020: p. 5, figure 2). The above-described lithic and bone artifacts support the conclusion of MacNeish and colleagues (1980) that the remains from levels J2 and J3 at Jaywamachay belong to the “fishtail point” makers. Similar diagnostic remains were found from the north in Chiapas state in southern Mexico (García-Bárcena, 1980) and Belize (Pearson & Bostrom, 1998) south to the southern tip of South America (Bird, 1946; Massone, 1987). Moreover, the dates from both layers are consistent with those obtained at Fell point sites along the Andean Cordillera

(e.g., Jackson et al., 2007; Maggard & Dillehay, 2011; Nami & Stanford, 2016; Nuñez et al., 1994; Nami, 2021) and other places in South America (Nami, 2007). In addition, there are unifacial tools accompanying the aforementioned weapon tip. In general, they are similar to lithic assemblages observed in other areas of South America (Nami, 2019). In addition, the well-made bone tools from Jaywamachay reinforce the assertion that these early foragers also had well-developed bone technology (Nami, 2010; Yataco & Nami, 2023). In summary, this study provides further data about human groups living in western South America during the last millennium of the Pleistocene. Excavating in a period with scarce evidence on the subject, we have confirmed that Jaywamachay is one of the few dated sites that provide evidence of hunter-gatherers who used fishtail points in highland Peru during those times.

Our analysis confirms the anthropogenic origin of lithic objects from Pikimachay cave layers h and h1, indicating both production and consumption through the presence of cores, blanks, tools, and debitage. While the site's precise function remains unclear, it was not solely a workshop, as evidenced by multi-scarred blanks detached from cores, unambiguously shaped tools, and bifacial flaking. Notably, ancient knappers selectively sourced raw materials. The morpho-technological homogeneity observed in both layers suggests repeated cave re-occupations over time, which are indistinguishable from each other. Alongside these lithics were Late Pleistocene fossil bones; taphonomic analysis (Nami et al., 2023) revealed human modifications on some bones from layer h, reinforcing the anthropogenic nature of the lithic assemblage (Yataco & Nami, 2022). Having established the morpho-technological characteristics of the Pikimachay stone tools, a comparison with the Puente lithic assemblage in the Ayacucho Basin reveals initial similarities. For instance, both early hunter-gatherer assemblages relied on similar fine-grained rocks. Scrapers from Puente (Figure 5(V), Figure 5(X), Figure 5(Z), Figure 5(A'); layers XIII and XIIA) show a close morpho-technological relationship to those from Pikimachay (e.g., Figure 11(H), Figure 11(Y); layers h and h1). Furthermore, obsidian and chert were selectively used at both sites, and quartz was also significant, with retouched flakes forming sharp edges (Figure 5(Y), Figure 5(B'), layer XIIA, Puente; Figure 11(D') and Figure 11(M), Pikimachay). Nodules of the same raw materials from Pikimachay (Figure 11(X), Figure 11(A') and Figure 12(H)) clearly indicate the use of hard or semi-hard hammer-stones. In contrast, the lithics from layers i through k are fractured stones coming from the underlying layers, which are simple chunks and naturefacts or geofacts. In other words, they were the product of natural actions (Peacock, 1991; Raynal et al., 1995), mainly chunks coming from the cave's walls and roof. Most of these objects show no flaking, and only some may have apparent flake-scars. They are isolated, however, lacking attributes that could indicate their human origin, including distinct patterns or continuity in their flaking distribution. Hence, we consider these pieces geofacts or naturefacts. Hence, they do not represent evidence of an earlier human occupation. As previously mentioned, similar

natural pieces were registered in the upper layers and on the cave's surface.

In summary, the Puente, Jaywamachay, and Pikimachay sites are significant because they contain archaeological material from hunter-gatherers living in the Ayacucho Basin during the terminal Pleistocene to the early Holocene.

6. Conclusion

In light of the fact that these legacy collections have never been re-evaluated after they were acquired, and only after our interventions and publications, we feel it is our responsibility to report on the reevaluation we are undertaking until we have new data addressing excavations and obtaining modern radiocarbon dates. MacNeish's investigations were remarkable for the sheer volume of data collected, but this prolific output and the varying accounts in his subsequent publications also created a degree of ambiguity and a lack of credibility. The original analyses, especially those on stone tools, were often brief and lacked the detailed, systematic approaches used in modern archaeology. As a result, many questions about the earliest occupations in the Ayacucho Basin remain unanswered. This re-evaluation not only clarifies the record from three of the most prominent sites excavated by MacNeish but also opens the door for future research by providing a modern, systematic analysis of the collections. Specifically, our morpho-technological analyses of the lithic assemblages and bone implement studies provide a refined understanding of the hunter-gatherer occupations in the region. Our work demonstrates the value of revisiting these legacy collections to address new questions and refine our understanding of this critical period in Andean prehistory.

When the Ayacucho Basin project was carried out, the prevalent archaeological paradigm responded to a cultural history perspective. Hence, MacNeish and associates proposed a long regional sequence segmented into several "phases." They were mostly named after traditional Quechua names, including "Huanta," "Jaywa," "Piki," "Chihua," and "Cachi," among others. The archaeological vestiges of layers XIIA-XIII and XIV from the Puente site were attributed to some of the oldest phases called "Jaywa" and "Puente" (MacNeish et al., 1981: pp. 87-94; MacNeish et al., 1983: pp. 50-55). From our viewpoint, levels XIIA-XIII at Puente belong to Early Holocene hunter-gatherers who shared similar technological features in the Southern Andes (Yataco et al., 2021), despite the projectile points being called by different names (e.g., Capriles et al., 2010; Santoro et al., 2011). Those from layer XIV may come from the upper layer, or they may also testify to a short occupation event by an older Paleoindian group living at ~11.0 - 10.0 uncalibrated kya. The low number of remains is consistent with the characteristics of some early South American records (e.g., Politis & Prates, 2019). A similar conclusion can be drawn from the remains of layers J to J2 and J3 of the Jaywamachay rock shelter. The Fell projectile points recorded at this site are significant, as are similar findings in other Peruvian locales (e.g., MacNeish et al., 1981; Rademaker et al., 2014; Maggard, 2015; Yataco & Nami, 2016). This iconic Paleoindian artifact is widely distributed from southern Mexico to southernmost South America and re-

veals the Andean/Pacific route taken by foragers involved in South American colonization (Nami, 2021).

With the exception of some pieces, we concluded that the specimens from h-h1 of Pikimachay were artifacts made by humans. However, our opinion is that more research needs to be done regarding chronology and geoarchaeology to verify the true antiquity of the assemblages (Haynes, 2015; Borrero, 2016). However, leaving open the possibility that the artifacts correspond to Late Glacial occupations, in a previous report we compared the lithics from h-h1 with other lithic remains from other early postglacial sites in the Southern Andes (Yataco & Nami, 2022). They are characterized by simple comparable lithic artifacts, but virtually all of the oldest lithic assemblages lacked clearly identifiable stone projectile points. Maybe they have not been found yet, or perhaps weapon points were made of perishable materials in that early era. The widespread appearance of distinctive styles of stone projectile points in the later postglacial is likely due to the expansion of networks within the increased population of hunter/gatherer groups throughout the continent as the climate ameliorated (Eriksson et al., 2012). On the other hand, we concluded that the claimed “artifacts” from layers j to k are naturally fractured rocks due to diverse natural processes (Eren et al., 2023), mainly chunks falling down the cave’s wall.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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