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## pXRF Sourcing of Obsidian from Pallaucha, Vilcashuaman: Insights into Exchange Patterns in South-Central Peru during the Early Horizon

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### Abstract

Recent archaeological research demonstrates that the south-central highlands was a region of important sociocultural developments during the Early Horizon (ca. 800-200 BC). One reason for the prominence of this region was the local availability of obsidian, a widely exchanged lithic material. In this paper, we discuss the results of a portable X-ray fluorescence (pXRF) sourcing study of a sample of 26 obsidian artifacts from the site of Pallaucha, an Early Horizon civic ceremonial center located near Vilcashuaman in the Department of Ayacucho, Peru. PXRF analysis demonstrates that the Quispisisa source was the most commonly exploited locality to acquire obsidian at Pallaucha even though other sources were in closer proximity. Our results complement the results of a study of a large sample of obsidian from the nearby, and partially contemporary, civic-ceremonial center of Campanayuq Rumi.

**Keywords:** *pXRF, obsidian, exchange and interaction, Paracas, south-central highlands, Peru*

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## **Detección de fuentes de procedencia de la obsidiana de Pallaucha, Vilcashuamán, mediante pXRF: una visión de los patrones de intercambio en el centro-sur del Perú durante el Horizonte temprano**

### **Resumen**

Recientes investigaciones arqueológicas demuestran que la sierra centro-sur experimentó importantes desarrollos socioculturales durante el Horizonte temprano (ca. 800-200 a. C.). Una de las razones de la importancia de esta región fue la disponibilidad local de obsidiana, un material lítico con el que se comercia frecuentemente. En este artículo, presentamos y discutimos los resultados de un estudio de detección de fuentes de obsidiana mediante espectrometría de fluorescencia de rayos X portátil (pXRF) en una muestra de 26 artefactos provenientes del sitio de Pallaucha, un centro cívico-ceremonial del Horizonte temprano ubicado cerca de Vilcashuamán en el departamento de Ayacucho, Perú. El análisis pXRF muestra que la obsidiana de Quispisisa era la más explotada, a pesar de la existencia de otras fuentes en las cercanías de Pallaucha. Este resultado complementa y concuerda con el estudio de la obsidiana obtenida en Campanayuc Rumi, un centro cívico-ceremonial contemporáneo con Pallaucha.

**Palabras claves:** *pXRF, obsidiana, intercambio e interacción, Paracas, sierra centro-sur, Perú*

## **Détection des sources de provenance de l'obsidienne de Pallaucha (Vilcashuaman) par pXRF : Un aperçu des modèles d'échange dans le centre-sud du Pérou au cours de l'Horizon Ancien**

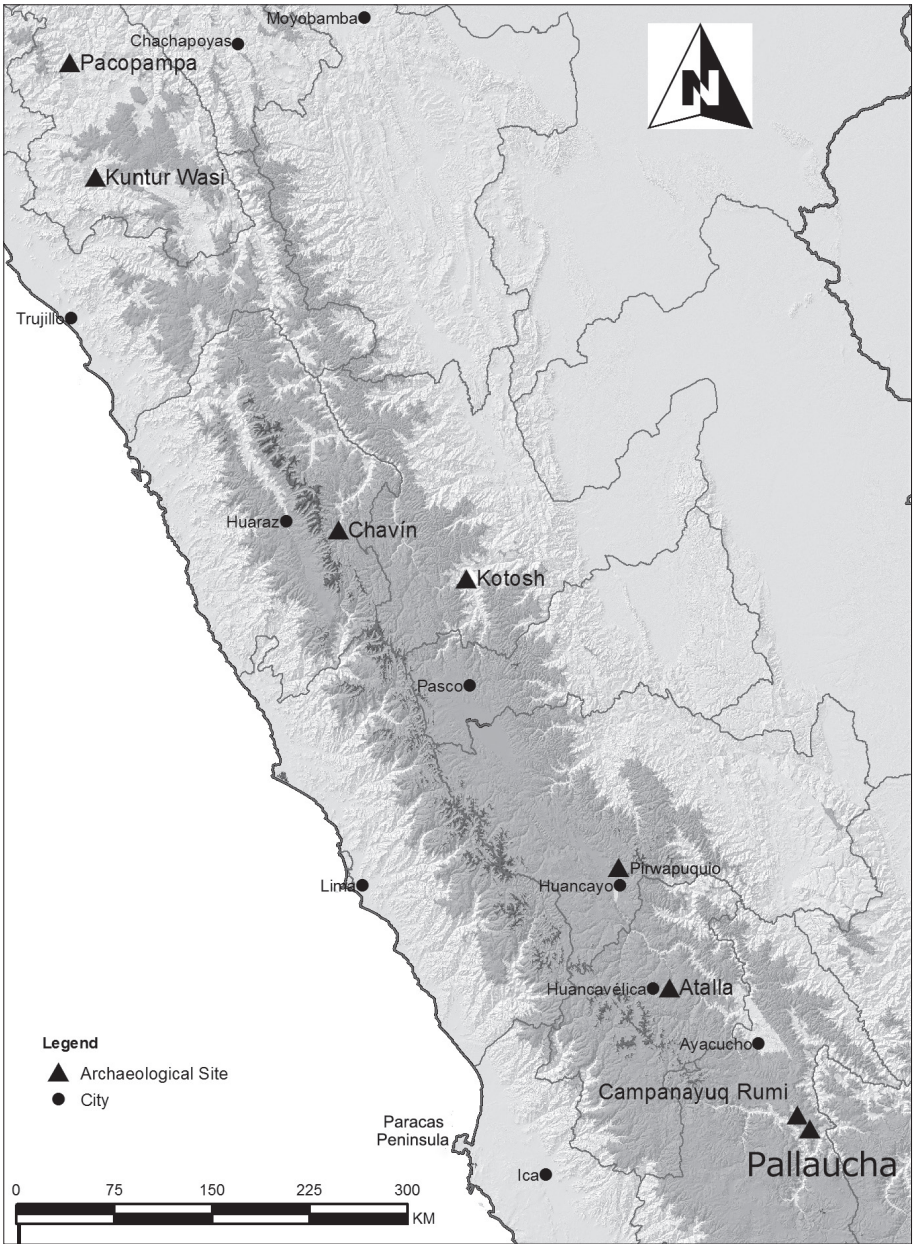
### **Résumé**

Des recherches archéologiques récentes montrent que les hautes terres de la région sud-centrale ont connu d'importants développements socioculturels au cours de l'Horizon Ancien (vers 800-200 av. J.-C.). L'une des raisons de l'importance de cette région était la disponibilité locale de l'obsidienne, un matériau lithique fréquemment échangé. Dans cet article, nous présentons et discutons des résultats d'une étude de détection des sources de provenance de l'obsidienne par spectrométrie de fluorescence X portable (pXRF) sur un échantillon de 26 artefacts provenant du site de Pallaucha, un centre cérémoniel civique de l'Horizon Ancien situé près de Vilcashuaman dans le département d'Ayacucho, au Pérou. L'analyse pXRF démontre que l'obsidienne de Quispisisa était la plus couramment exploitée, malgré l'existence d'autres sources dans les environs de Pallaucha. Nos résultats complètent ceux d'une étude portant sur un large échantillon de l'obsidienne provenant du centre civique et cérémoniel de Campanayuc Rumi, situé à proximité et partiellement contemporain.

**Mots-clés :** *pXRF, obsidienne, échange et interaction, Paracas, hautes terres du centre-sud, Pérou*

## **INTRODUCTION**

During the first millennium B.C. or Early Horizon (ca. 800-200 B.C.) (Figure 1), obsidian figured prominently as a prized economic resource that was widely circulated throughout the Peruvian highlands and coast (Burger & Glascock, 2009; Burger, Lau et al., 2006). As an exotic, obsidian was of importance to both the political and ritual economy of highland centers like Chavín de Huántar and



**Figure 1 – Map of Peru, showing the locations of Pallaucha and other important Early Horizon sites**

Map produced by Bebel Ibarra Asencios

Campanayuq Rumi (Burger, 1984; Nesbitt, Johnson *et al.*, 2019; Matsumoto *et al.*, 2018; Rick, 2017). Geochemical sourcing studies demonstrate that most of the known obsidian quarries were distributed over a large area of the south-central highlands of Peru (e.g. Glascock *et al.*, 2007; Figure 2). Of these, the most frequently circulated obsidian geochemical type came from the Quispisisa quarry located near the town of Huancasancos in the Department of Ayacucho (Burger & Glascock, 2000a; Contreras *et al.*, 2012; Tripcevich & Contreras, 2011; 2013). While Quispisisa obsidian was widely exchanged to Early Horizon ceremonial centers and settlements in the north-central and northern highlands (Burger & Glascock 2009; Burger, Lau *et al.*, 2006; Matsumoto *et al.*, 2018), its local exploitation in the south-central highlands has been largely understudied (but see Kellett *et al.*, 2013; Matsumoto *et al.*, 2018).

To this point, it is relevant that recent archaeological study in the south-central highlands of Ayacucho has documented multiple large archaeological sites that are positioned near several obsidian sources (e.g. Matsumoto, 2010; Matsumoto & Caveró, 2009; Mendoza Martínez, 2010; Mendoza Martínez & Vivanco Pomacanchari, 2019; Nesbitt, Matsumoto *et al.*, 2019) (Figure 2). The presence of these sites demonstrates that the south-central highlands, like its neighbors to the north, was a center of major cultural development during the late second and early first millennia B.C. Among these sites, the best understood is Campanayuq Rumi, a site situated just above the town of Vilcashuaman. Archaeological investigations of Campanayuq Rumi suggest that it emerged as a small village settlement around 1300 B.C. (all dates in this paper are calibrated), before transforming into a large civic-ceremonial center that was occupied between ca. 950 and 450 B.C. (Matsumoto, 2010; Matsumoto & Caveró, 2009; Matsumoto *et al.*, 2016; Caveró *et al.*, 2019). Various lines of data suggest that Campanayuq Rumi was embedded in long-distance exchange relationships with the north-central highlands and south coast of Peru (Matsumoto, 2010; 2019a; 2019b; Matsumoto & Caveró, 2009; Nesbitt & Matsumoto, 2014). The nature of long-distance exchange relationships was further supported by a Portable X-Ray Fluorescence (pXRF) study that established that Campanayuq Rumi obtained obsidian from as many as 7 different obsidian sources during the Campanayuq II Phase (700-400 B.C.). It was at this time that the site was integrated into a pan-regional network referred to as the “Chavín Interaction Sphere”, a “cosmopolitan system of interacting polities spread over a large area of the north and central Peruvian highlands, coastal areas, and tropical forest regions” (Matsumoto *et al.*, 2018: 46). This study further showed that throughout its history, Quispisisa was the most important source, constituting 83.5% of the obsidian at Campanayuq Rumi (Matsumoto *et al.*, 2018: 54).

However, survey and archaeological research in the Ayacucho region have also documented a series of newly discovered sites with public architecture that also date to the Early Horizon (Mendoza Martínez, 2010; Mendoza Martínez & Vivanco Pomacanchari, 2019; Nesbitt, Matsumoto *et al.*, 2019). One of these is Pallaucha, a multi-platform complex located just to the southeast of Campanayuq Rumi (Mendoza Martínez, 2017; 2018). Although Pallaucha has a long sequence lasting



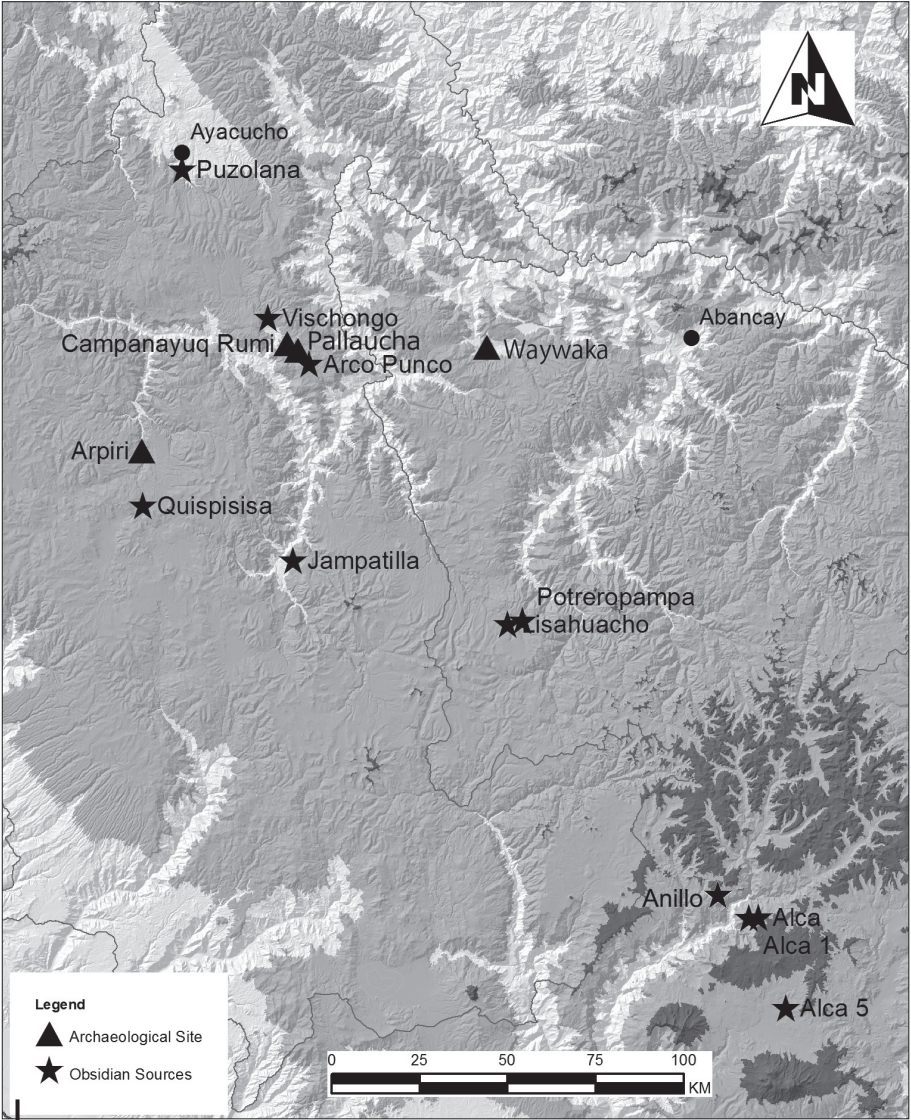


Figure 2 – Map showing obsidian sources and Early Horizon site locations including Pallaucha  
Map produced by Bebel Ibarra Asencios

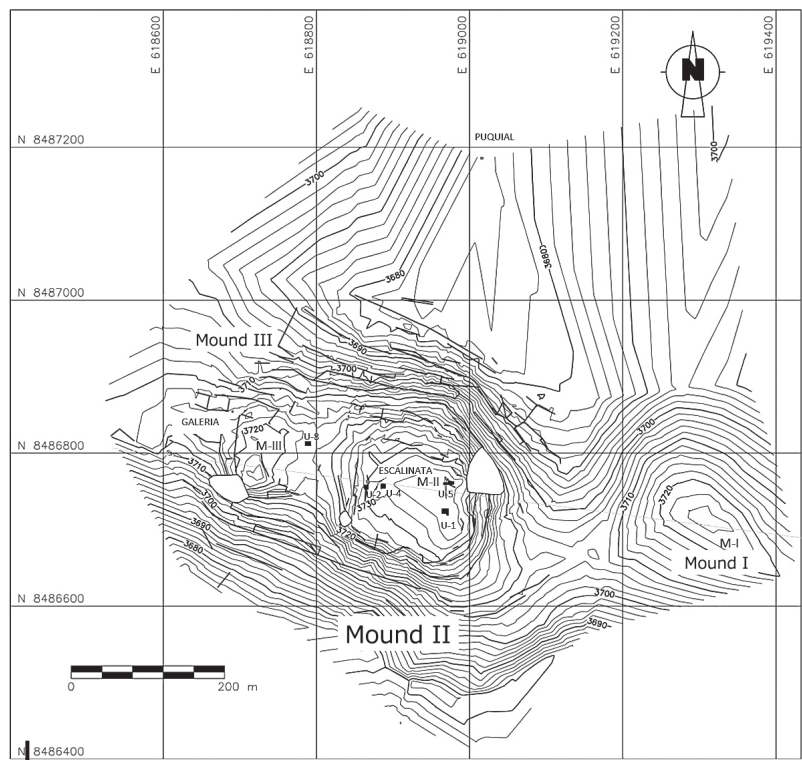
from the Early Horizon until the Late Intermediate Period (ca. AD 1000-1430), its earliest phase is when the site functioned as a village and ceremonial center with public architecture. Although no absolute dates are currently available, the pottery style at Pallaucha indicates that its earliest occupation is contemporary with the Campanayuc II Phase (ca. 700-450 B.C.) at Campanayuc Rumi. Importantly, it also appears that Pallaucha continued to be occupied after Campanayuc Rumi ceased to function as a civic-ceremonial center by ca. 500-450 B.C.

In this paper we report on the results of a pilot pXRF provenience study of 26 obsidian artifacts from Pallaucha. Our objective was to determine if Pallaucha was embedded in similar interaction networks to those of Campanayuc Rumi. Furthermore, we were also interested in determining how procurement patterns changed after the abandonment of Campanayuc Rumi, and the “collapse” of the Chavín Interaction Sphere around ca. 500-450 B.C. Our results suggest that like Campanayuc Rumi, the Quispisisa obsidian source was of long-term importance to the inhabitants of Pallaucha. This result is unsurprising given that the Quispisisa source is located approximately 65 km to the west of Pallaucha. Yet unlike Campanayuc Rumi, which obtained obsidian from several sources, the patterns from Pallaucha suggest that the site was embedded more strongly in localized interaction networks in the south-central highlands, as well as intermittent connections with the Paracas archaeological culture of the Peruvian south coast (Mendoza Martínez, 2017; see discussion below).

## 1. THE ARCHAEOLOGICAL SITE OF PALLAUCHA

Pallaucha is located 6.3 km to the southeast of the town of Vilcashuaman and Campanayuc Rumi. At an altitude of approximately 3762 m asl the site is situated in the high elevation *suní* grasslands. While Pallaucha has been reported briefly in the archaeological literature (Carrera *et al.*, 2014 [1945-1946]: 32; Pérez *et al.*, 2007: 126), it was only recently that it was subjected to more intensive archaeological investigation directed by Edison Mendoza (Mendoza Martínez, 2017; 2018).

Pallaucha consists of a complex of four terraced platform mounds, distributed over an area of 44 hectares (Mendoza Martínez, 2017: 42). Three of these platforms form a possible alignment oriented along an east-west axis (Figures 3 and 4). In this sense, the spatial organization of Pallaucha differs from nearby civic-ceremonial centers in the region such as Campanayuc Rumi or Arpiri, which exhibit U-shaped layouts that seemingly emulate architectural conventions at Chavín de Huántar (Matsumoto, 2010; Matsumoto & Caveró, 2009). The platforms that make up Pallaucha consist of natural hills that have been modified by the creation of artificial terraces that are faced with stone retaining walls (see Mendoza 2017 for details) (Figure 5). This technique of modifying the natural landscape was a widespread practice exhibited at many Early Horizon civic-ceremonial centers in the south-central highlands (Matsumoto, 2010; Mendoza Martínez, 2010; Nesbitt, Matsumoto *et al.*, 2019).



**Figure 3 – Map of the site of Pallaucha showing the locations of Mound I-III and the location of excavation units**  
Map produced by Edison Mendoza Martínez



**Figure 4 – General view of Pallaucha from the south**  
Photo by Edison Mendoza Martínez





**Figure 5 – Stone retaining wall of Pallaucha, Mound I**

Photo by Edison Mendoza Martínez

Archaeological research at Pallaucha focused primarily on Mound II (Mendoza Martínez, 2017; 2018) (see Figure 3 for the location of excavation units), which consists of two stone-faced terraces that each measure roughly 3 m in height. Towards the west side of the building there is a central stone staircase that leads to the summit of the mound. On the top of Mound II is a complex of circular buildings that measure between 3 and 5 m in diameter. The foundations of these structures were built from rounded, locally available fieldstones. It should be noted that the circular buildings at Pallaucha are similar to Early Horizon structures excavated in the domestic sector of Campanayuq Rumi (Matsumoto *et al.*, 2016; Caveró *et al.*, 2019), as well as other contemporary sites in the Ayacucho region (Ochatoma Paravicino, 1998; Pérez Calderón & Paredes Huarcaya, 2016). Excavation of the circular structures at Pallaucha recovered abundant domestic refuse, suggesting that these buildings functioned as houses and that the site was a small village-sized settlement in the Early Horizon (Mendoza Martínez, 2017; 2018).

The obsidian that is the focus of this article came from Mound II (Table 1), which was where most of the excavations were undertaken (Mendoza Martínez, 2017; 2018). Archaeological investigations of Mound II were aimed at determining the chronology of this building. An 8 x 12 m excavation was placed on the summit of Mound II of Pallaucha. This excavation uncovered a superimposed sequence of circular structures that were separated stratigraphically by intentional construction fills (Figure 6). The contexts from which the obsidian was recovered consist of the floors and fills associated with these structures.

**Table 1 – Sample context of obsidian artifacts from Mound II of Pallaucha**

Sample*	Obsidian Source	Phase	Contextual association
PAL-001	JAMPATILLA/USAHUACHO	Phase 1	Architectural fill, probably part of a platform construction
PAL-002	QUISPISISA	Phase 3	Fill of a circular structure of the Late Paracas Period
PAL-003	QUISPISISA	Phase 3	Fill of a circular structure of the Late Paracas Period
PAL-004	QUISPISISA	Phase 3	Associated with a probable ceremonial trash context inside of a circular structure
PAL-005	QUISPISISA	Phase 3	Associated with a probable ceremonial trash context inside of a circular structure
PAL-006	QUISPISISA	Phase 3	Associated with a probable ceremonial trash context inside of a circular structure
PAL-007	QUISPISISA	Phase 3	Associated with a probable ceremonial trash context inside of a circular structure
PAL-008	QUISPISISA	Phase 3	Layer covering a circular structure of the Late Paracas Period
PAL-009	QUISPISISA	Phase 3	Layer covering a circular structure of the Late Paracas Period
PAL-010	QUISPISISA	Phase 1-2	Fill of the probable main platform construction
PAL-011	QUISPISISA	Phase 1	Associated with the first floor of platform construction
PAL-012	QUISPISISA	Phase 1-2	Fill of the probable main platform construction
PAL-015	QUISPISISA	Phase 2	Associated with a floor of a circular structure
PAL-016	QUISPISISA	Phase 1	Architectural fill, probably part of a platform construction
PAL-017	PUZOLANA	Phase 3	Associated with a context of probable lithic workshop located in a circular structure
PAL-018	QUISPISISA	Phase 1	Architectural fill, probably part of a platform construction.
PAL-020	QUISPISISA	Phase 3	Associated with a floor of a circular structure in which a “wanka” stone is located
PAL-021	QUISPISISA	Phase 3	Associated with a floor of a circular structure in which a “wanka” stone is located
PAL-022	QUISPISISA	Phase 2	Layer between the first and second floor a circular structure
PAL-023	QUISPISISA	Phase 2	Layer between the first and second floor a circular structure
PAL-024	PUZOLANA	Phase 2	Associated with the second floor of a circular structure
PAL-025	QUISPISISA	Phase 1-2	Fill of the probable main platform construction
PAL-026	QUISPISISA	Phase 3	Architectural fill in association with a trash context
PAL-027	PUZOLANA	Phase 1	Architectural fill, probably part of a platform construction
PAL-028	QUISPISISA	Phase 1	Architectural fill, probably part of a platform construction
PAL-029	QUISPISISA	Phase 2	Fill covering a patio structure associated with a circular structure

\* Three samples from the contexts post-dating the Early Horizon (PAL-013, PAL-014, PAL-019) are eliminated from this table  
Table produced by Edison Mendoza Martínez and Jason Nesbitt



Figure 6 – Early Horizon circular structure at Pallaucha, Mound II

Photo by Edison Mendoza Martínez

2. THE CHRONOLOGY OF PALLAUCHA

Mendoza Martínez (2017; 2018) divided Mound II’s occupation into three ceramic phases, which span the period between approximately 700 and 250 B.C. At present this chronology is based on associated ceramic materials, which can be tied to the well-established relative and absolute chronology of Campanayuc Rumi (Matsumoto, 2010; Matsumoto & Caveró, 2009), as well as cross-dated with the Paracas sequence on the south coast of Peru (Unkel *et al.*, 2012) (Figure 7).

	Chavín de Huántar (Burger, 2019)	Chavín de Huántar (Rick <i>et al.</i> , 2009)	Campanayuc Rumi (Matsumoto <i>et al.</i> , 2018)	South coast sequence (Unkel <i>et al.</i> , 2012)	Pallaucha (Mendoza, 2017)
Cal. B.C.					
250	Huaraz	Huaraz		Initial Nasca	
				Late Paracas	Phase 3
500	Janabarriu		Campanayuc II	Middle Paracas	Phase 2
800	Chakinani	Janabarroide		Campanayuc I	Early Paracas
1000	Urabarriu				
1200				Pre-platform	
1500					

Figure 7 – Chronology of Pallaucha and its relationship to other sites and regions discussed in the text

Figure produced by Yuichi Matsumoto

## **2. 1. Phase 1 (ca. 700-450 B.C.)**

The earliest phase of Mound II suggests that this building was founded sometime in the middle part of the Early Horizon (700-450 B.C.). Phase I is defined by the presence of distinctive pottery styles, including vessel fragments with incised circle and dot motifs (Mendoza Martínez, 2017: 106) (Figure 8). This motif is a common element of the Early Horizon contemporary Janabarriu Phase at Chavín de Huántar (Burger, 1984) and is radiocarbon dated between approximately 800/700 and 400 B.C. (c.f. Burger, 2019; Rick *et al.*, 2009). Furthermore, this pottery becomes common at other archaeological sites associated with the Chavín Interaction Sphere at this time (e.g. Burger, 1988).

In addition, there is also a small sample of pottery with negative painting that exhibits brown decoration on a red-colored base. Painted designs include dots and circles, and bands with zig-zag forms (Mendoza Martínez, 2017: 106). These vessels are stylistically identical to pottery from the south coast of Peru, closely matching styles of the Ocucaje 4 and 5 Phases that comprise the early component of the Paracas sequence (Menzel *et al.*, 1964; see also Carmichael, 2019). The presence of Paracas related pottery suggests some interaction with the south coast and south-central highlands of Peru (DeLeonardis, 1997; 2005; Dulanto, 2013; Matsumoto, 2019a; 2019b; Mendoza Martínez, 2017; Young, 2017), a topic that we will return to later in the paper.

While there are no absolute dates available for Pallaucha, the pottery associated with this phase closely resembles the ceramic styles present in the Campanayuc II Phase from Campanayuc Rumi (Matsumoto, 2010; Matsumoto & Cavero, 2009). In the case of Campanayuc Rumi, the pottery of this phase includes Janabarriu-related pottery, as well as numerous imported vessels from the south coast (Matsumoto, 2019a). Radiocarbon dates place the Campanayuc II Phase in the period between 700 and 450 B.C. (Matsumoto, 2010; Matsumoto & Cavero, 2009; Matsumoto *et al.*, 2018). This date is also in general agreement with the absolute chronology of the Early Paracas Phase in Palpa (Unkel *et al.*, 2012).

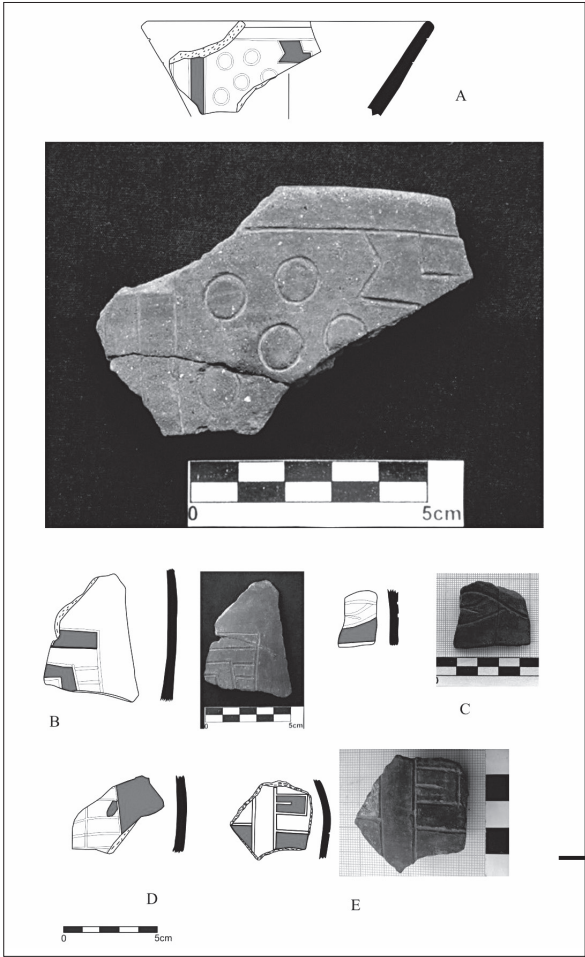
## **2. 2. Phase 2 (ca. 450-350 B.C.)**

The second phase of Pallaucha witnesses the disappearance of incised circle and dot pottery and vessels with negative painting. Instead, there is a shift in pottery style to include temporally diagnostic pottery exhibiting red and white post-fire painting and thin, incised lines, as well as stamped incised circles (Mendoza Martínez, 2017: Figure 16A) (Figure 9). Decorative motifs include geometric designs and religious iconography such as eccentric eyes (Mendoza Martínez, 2017: figures 16B-E). During this phase, stylistic features of decorated pottery specimens show a mixture of Middle and Late Paracas, or Ocucaje 5-8 (Menzel *et al.*, 1964).





**Figure 8 – Phase 1 pottery from Pallaucha**  
Photo by Edison Mendoza Martínez



**Figure 9 – Phase 2 pottery from Pallaucha**  
Photo by Edison Mendoza Martínez

## **2. 3. Phase 3 (ca. 350-250 B.C.)**

During Phase 3 there is another change in pottery styles at Pallaucha, particularly with respect to the Paracas-related materials. Designs included interlocking bands and incision and cane stamped circles. Mendoza Martínez (2017) also describes sherds that resemble motifs exhibited in the Ocucaje 8 Phase (e.g. Menzel *et al.*, 1964) (Figure 10), which has recently been radiocarbon dated to ca. 380-260 B.C. (Unkel *et al.*, 2012: 2299).



**Figure 10 – Late Paracas pottery from Phase 3 at Pallaucha**

Photo by Edison Mendoza Martínez

## **2. 4. Summary**

The relative chronological sequence indicates that Pallaucha was occupied throughout the middle and later parts of the Early Horizon, or between ca. 700 and 250 B.C. Although Phase 1 corresponds to the Campanayuc II Phase and can be tied to Early Paracas (ca. 700-450 B.C.) (Matsumoto, 2010; Matsumoto & Caverio, 2009), Phases 2 and 3 correspond to the time of abandonment at Campanayuc Rumi and are thus difficult to relate to the Campanayuc sequence. The general stylistic traits show an affiliation to Late Paracas in the south coast and the Chupas type in the Ayacucho basin (Lumbreras, 1974; Ochotoma Paravicino, 1998) and can be defined as Janabarriu-related pottery (Burger, 1992: 213).

The earliest phase (Phase 1) of Pallaucha is significant because it is contemporary with the nearby, larger, civic-ceremonial center of Campanayuc Rumi. However, unlike Campanayuc Rumi, which was largely abandoned by ca. 500- 400 B.C., Pallaucha continued to function as an Early Horizon settlement until as late as 250 B.C. Therefore, using the radiocarbon dates and ceramic sequences from

Campanayuc Rumi and south coast (Unkel *et al.*, 2012; Matsumoto, 2010; Matsumoto & Caverro, 2009), we tentatively estimate the dates of each phase as follows; Phase 1: ca. 700-450 B.C.; Phase 2: ca. 450-350 B.C.; Phase 3: ca. 350-250 B.C.

### 3. pXRF ANALYSIS OF OBSIDIAN FROM PALLAUCHA

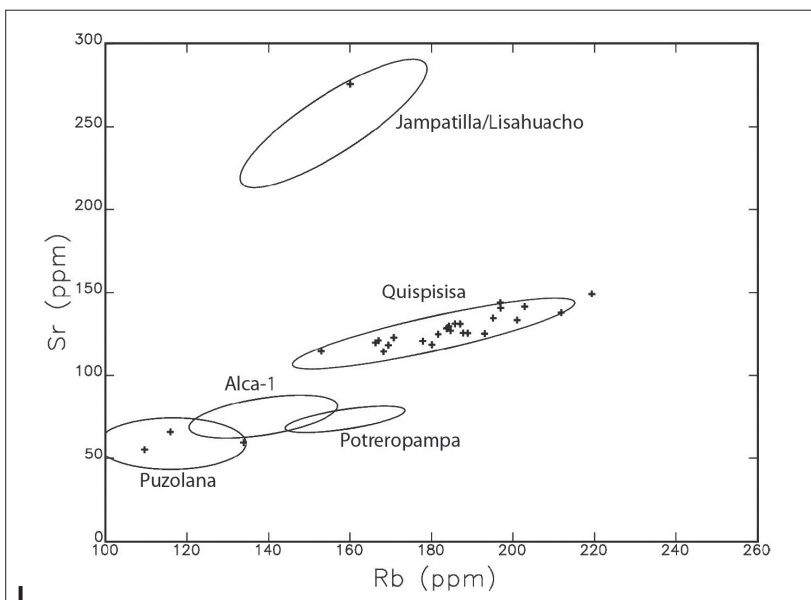
Obsidian was a common artifact material at Pallaucha and constituted the vast majority of the lithic assemblage. Like other south-central lithic assemblages of the Early Horizon, the obsidian tools were primarily characterized by flake tools (Nesbitt, Johnson *et al.*, 2019), though scrapers and bifaces were also recovered. A total of 26 obsidian flakes from Pallaucha were analyzed by pXRF for this study. This constitutes approximately 2.4% of the overall obsidian assemblage ( $n=1091$ ). The analysis was undertaken in August of 2014 at the UNSAAC-Yale International Center for the Study of Machu Picchu and Inca Culture in Cuzco, Peru, as part of a larger study of diachronic patterns of obsidian utilization during the Initial Period and Early Horizon in the south-central highlands (Matsumoto *et al.*, 2018). Obsidian samples were selected from Phase 1 ( $n=9$ ), Phase 2 ( $n=5$ ), and Phase 3 ( $n=12$ ) contexts. While this sample is small, it does provide insight into important trends in obsidian procurement patterns during the Early Horizon. Furthermore, this data is useful for preliminary comparison with the nearby site of Campanayuc Rumi.

Obsidian artifacts from Pallaucha were analyzed using a Bruker Tracer Series III-SD pXRF spectrometer. Measurements with the pXRF were undertaken with an operating voltage of 40keV and current of 30 microamps. Measurement times were 60 seconds per sample. The XRF was calibrated for analysis of obsidian by using the Missouri Research Reactor (MURR) suite of 40 obsidian source specimens and their associated concentration data (Glascock & Ferguson, 2012). The elements for which the concentrations could be determined in obsidian include Mn, Fe, Zn, Ga, Rb, Sr, Y, Zr, Nb, and Th.

### 4. RESULTS

The results of the obsidian study are presented in Figure 11 and Table 2. Obsidian came from three, or possibly four, geochemical sources: Quispisisa, Puzolana, and either Jampatilla or Lisahuacho (discussed below). However, the Quispisisa source dominates, comprising nearly 85 percent of the overall assemblage ( $n=22$ ). This result closely matches the proportion of obsidian acquired from Quispisisa for all chronological phases at Campanayuc Rumi (Matsumoto *et al.*, 2018).

Though the sample is small ( $n=9$ ), it is during Phase 1 that Pallaucha exhibits the most diversity in terms of exploited sources. Seven of the obsidian flakes can be sourced to the Quispisisa source. Located near the towns of Sacsamarca and Huancasancos in the Department of Ayacucho, Quispisisa was a large quarry known for high quality obsidian (Burger & Glascock, 2000a; 2002; Contreras *et al.*, 2012;



**Figure 11 – Bivariate scatterplot of Rubidium versus Strontium for obsidian artifacts from Pallaucha compared to sources in Peru. Sources are displayed as 90% confidence ellipses**

Figure produced by Michael D. Glascock

**Table 2 – Obsidian counts from Pallaucha by phase**

Obsidian Counts Overall (n=26): Phases Combined			
Quispisisa	22 (84.62%)		
Jampatilla/Lisahuacho	1 (3.85%)		
Puzolana	3 (11.54%)		
Total	26 (100%)		
Obsidian Counts Overall by Phase (n=26)			
	Phase 1	Phase 2	Phase 3
Quispisisa	7 (77.78%)	4 (80.00%)	11 (91.67%)
Jampatilla/Lisahuacho	1 (11.11%)	0	0 (3.51%)
Puzolana	1 (11.11%)	1 (20.00%)	1 (8.33%)
Total	9	5	12

Table produced by Jason Nesbitt



Tripcevich & Contreras, 2011; 2013). Survey of the Quispisisa source documented numerous large quarrying pits, which attest to the intensity of ancient exploitation of this locality (Tripcevich & Contreras, 2011; 2013).

A single flake pertains to the Puzolana geochemical source. While originally located in the region just to the south of the city of Ayacucho (Burger & Glascock, 2000b), recent research indicates that Puzolana was a more diffuse source that was distributed over a wide area (Giesse *et al.*, 2020), including localities in Vischongo and Vilcashuaman (Matsumoto *et al.*, 2018). Furthermore, there is another locality, known as Arco Punco, that is located just over 2 km to the south/southeast of Pallaucha that has obsidian that geochemically matches Puzolana (Matsumoto *et al.*, 2018: 55). Arco Punco is a high hill with natural deposits of obsidian nodules within an ash/tephra matrix. Nodules from these deposits measure up to 7 cm in diameter, which is of adequate size for manufacturing flake tools. Given its proximity to Pallaucha, we hypothesize that the Puzolana obsidian was probably obtained from Arco Punco, rather than the immediate vicinity of Ayacucho which is roughly 65 km to the north of Pallaucha.

Finally, one flake pertains to either the Lisahuacho or Jampatilla source. Unfortunately, these two sources cannot be distinguished utilizing a pXRF (see also Matsumoto *et al.*, 2018: 55 for a discussion of this issue). Lisahuacho is located near Chalhuanca in Apurímac (Burger, Fajardo *et al.*, 2006) and is approximately 95 km to the south of Pallaucha, while Jampatilla is situated 57 km to the south (Burger, Schreiber *et al.*, 1998).

In Phase 2 ( $n=5$ ) Quispisisa continues to be the most common source ( $n=4$ ) with one sample from Puzolana. This pattern continues in Phase 3 ( $n=12$ ) in which eleven obsidian artifacts come from Quispisisa, while a single flake is from Puzolana.

## 5. OBSIDIAN PROCUREMENT AT PALLAUCHA IN A WIDER GEOGRAPHIC CONTEXT

The pXRF analysis presented above illustrates that throughout its history, the inhabitants of Pallaucha relied on a limited number of obsidian sources. In overall terms, the most common source area for obsidian at Pallaucha was the Quispisisa source, which constituted nearly 85 percent of the assemblage ( $n=22$ ). This result demonstrates the long-term importance of Quispisisa obsidian throughout Pallaucha's history. Quispisisa is roughly 65 km to the west of Pallaucha. As noted earlier, this quarry was one of the most important sources of obsidian in highland Peru during the Early Horizon. A round-trip journey from Pallaucha to Quispisisa would consist of 8-12 days travel time (see Matsumoto *et al.*, 2018: 58 for a discussion).

The results are also instructive when compared to a study of a much larger sample of obsidian ( $n=370$ ) from Campanayuc Rumi. In the case of Campanayuc Rumi, obsidian from the Quispisisa source comprises just under 84 percent of the sample

(Matsumoto *et al.*, 2018). Therefore, Pallaucha, like Campanayuc Rumi, was closely tied to the Quispisisa area. Yet there are apparent differences between obsidian consumption at Pallaucha and Campanayuc Rumi. For instance, during the Campanayuc Rumi II Phase, which is contemporary with Phase I at Pallaucha, Campanayuc Rumi was obtaining small amounts of obsidian from far more distant regions, including the Alca obsidian source, which is roughly 200 km to the west (Burger, Asaro *et al.*, 1998; Rademaker *et al.*, 2013). Additionally, a total of 6, and perhaps 7, sources were exploited at Campanayuc Rumi (Matsumoto *et al.*, 2018).

Matsumoto and colleagues argued that this diversity of sources indicated that Campanayuc Rumi was a type of cosmopolitan center that was a major community for the circulation of obsidian within the Chavín Interaction Sphere. It may be that in the contemporary Phase 1 that Pallaucha was involved in more localized obsidian exchange networks, given the limited number of sources present. Similar patterns of more restricted exchange in obsidian have also been noted elsewhere in the south-central highlands (Kellett *et al.*, 2013). The pattern throughout Pallaucha's history seems to focus on procurement from the relatively nearby Quispisisa source. In this sense, Pallaucha follows a pattern akin to the Middle Horizon centers of Huari and Conchopata, as well as Inca settlements in the Vilcashuaman region, in which obsidian was procured virtually exclusively from the Quispisisa obsidian source (Burger *et al.*, 2016; Hu & Shackley, 2018).

In the case of Pallaucha, the low proportion of Puzolana obsidian is somewhat surprising given that Puzolana obsidian was available from multiple sources within very short distances from the site. As noted earlier, the nearby quarry at Arco Punco has nodules up to 7cm in diameter that are large enough for working into the types of flake tools and points that are found at Pallaucha. That said, and as observed by Burger and Glascock (2000b: 293), the people of the south-central highlands generally preferred Quispisisa obsidian because of the much larger, high-quality nodules. The presence of Quispisisa suggest that throughout its history, Pallaucha had reliable ties with this area and source.

In this context, it is important to emphasize that Pallaucha continued to function after the abandonment of Campanayuc Rumi, which demonstrates that Pallaucha survived the collapse of the Chavín Interaction Sphere around ca. 500-450 B.C. (Burger, 2019; Nesbitt *et al.*, 2020; Rick *et al.*, 2009). The presence of Paracas pottery at Pallaucha demonstrates that even after the collapse of this pan-regional network, interregional ties between the south coast and south-central highlands remained active. This observation is interesting considering that their ties were initially consolidated through the emergence of the Chavín Interaction Sphere through the expansion of a shared religious ideology and formation of religious network (Burger, 1988; 2008; Matsumoto, 2010; 2019b; Matsumoto *et al.*, 2018). The obsidian provenience data from south coast cultures indicate that the importance of Quispisisa obsidian continued into Late Paracas times and even afterwards (Burger, 2007; DeLeonardis & Glascock, 2013; Van Gijseghem, 2006; Vaughn & Glascock, 2005). This pattern of sustained interaction between the south coast and the south-central highlands contrasts with the case of the north-central

highlands where the disintegration of the Chavín Interaction Sphere resulted in a substantial reduction in the obsidian trade (Burger, Lau *et al.*, 2006). In other words, it appears that after ca. 500-450 B.C, the south-central highlands become largely cut off from the north-central and northern Peruvian highlands. Applying arguments concerning the Chavín Phenomenon and expansion of the “Chavín cult” (Burger, 1988; 1992; 1993), Matsumoto argues that the Early Paracas cultures of the south coast were connected by pilgrimage to Campanayuc Rumi’s identity as a branch shrine of Chavín de Huántar (Matsumoto, 2010; 2019a: 57; 2019b). In accordance with the disappearance of the centripetal force of Campanayuc Rumi as a node of interregional interaction, other local centers such as Pallaucha could have emerged or transformed into independent agents and their relationships were not based on the foreign religion related to Chavín. Instead, this change might be related to the emergence of Late Paracas societies along the south coast that developed regional centers with unprecedented population densities (e.g. Bachir Baccha & Llanos, 2015; DeLeonardis, 1997; Massey, 1986; 1991; Reindel *et al.*, 2015; Silverman, 1994; 1996; Sořna, 2015). This change can be regarded as the apex of Paracas culture, though the impact of highland societies such as those that inhabited Pallaucha remains to be explored (Young, 2017). However, the provenience data from Pallaucha suggests that the trade of Quispisisa obsidian continues to be a key factor to consider this issue.

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