EXPLORING INTER-ZONAL CONNECTIONS THROUGH A CONSTRUCTED PROJECTILE POINT TYPOLOGY FROM CUNCAICHA ROCK SHELTER

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ABSTRACT

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Cuncaicha rock shelter and the Pampa Colorada (PC) coastal archaeological sites demonstrate evidence of an inter-zonal settlement system in southern Peru. Cuncaicha rock shelter (4480 masl), located in the Pucuncho Basin of the Central Andes, contains multiple, well-stratified components and initial occupation sequences dating to the Terminal Pleistocene. Many of the hundreds of projectile points contained within the site are made primarily of local Alca obsidian. On the Pacific Coast, undated Pampa Colorada sites contain lithic evidence of a highland connection, through obsidian sourced to the highland Alca source. The intent of this thesis is to investigate the relatedness of the coastal and highland sites through a constructed projectile point typology, and to propose a relative dating method for coastal sites.

The results from this thesis show that these sites are strongly related through a shared projectile point material culture in the Early Holocene and Late Holocene but interrupted during the Middle Holocene. Point types (n=17) that are shared between the sites are morphologically and metrically similar. Additionally, Pampa Colorada projectile points that are typable using the Cuncaicha typology are frequently made from Alca obsidian (n=80, 62.9%). Five types or 32 points from Pampa Colorada have been identified that are not found at Cuncaicha. These types are also primarily made from Alca obsidian (n=20, 62.5%). Overall, this study shows that the inter-zonal connection in southern Peru can be characterized by shared projectile point types and usage of highland Alca obsidian in the highlands and at the Pacific coast.

This thesis is dedicated to my friends who I’ve met recently, known since I was young, and those who are not with me anymore.

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CHAPTER ONE

INTRODUCTION

Cuncaicha rock shelter, located in the Pucuncho Basin of the southern highlands of Peru, is key for understanding high-altitude (> 4000 meters above sea level (masl)), Terminal Pleistocene (12.5-11.2 thousand years ago (ka)) settlements of Peru (Rademaker et al. 2012, Rademaker et al. 2014). Located at 4480 (masl), hypoxia and intensive exposure to UV-B radiation make settlement difficult in high-altitude areas of the Andes mountain region (Baker and Little 1976). Continued research at this archaeological site has increased our knowledge about high-altitude adaptations and the settlement of the Americas (Rademaker et al. 2014). Prior to the discovery of Cuncaicha, high-altitude areas (>4000 masl) of Peru lacked Terminal Pleistocene archaeological sites (Santoro and Nunez 1987, Aldenderfer 1989). Other archaeological sites, Pachamachay and Telarmachay, have returned Pleistocene radiocarbon ages, but are generally rejected by the original investigators themselves (Rick 1980, Lavallee et al. 1985).

Cuncaicha is one of the best dated and well-stratified sites in the New World, with over 40 accelerator mass spectrometry (AMS) radiocarbon dates that have identified four distinct occupation components from the Terminal Pleistocene to Late Holocene (Rademaker et al. 2014). The oldest occupation at Cuncaicha dates to 12.5-12.0 ka, making the rock shelter one of the oldest sites in South America (Rademaker et al. 2014. All components (12.5-11.2 ka, 9.5-9.0 ka, 5.7-5.0 ka, and <4.0 ka) from Cuncaicha provide evidence for intense use of the site. Abundant faunal material shows evidence of time-intensive activities, such as preparation and crushing for marrow extraction (Rademaker et al. 2014). Nearly entire carcasses of local camelids (taruka, vicuna, guanaco) have been found at the site, indicating that butchering occurred at Cuncaicha. Also, due to Cuncaicha's close proximity to local Alca obsidian resources, groups occupying the site throughout its history have created a variety of formal tools such as scrapers, projectile points, and flake tools. The entire chaine operatoire has been found through the dense amount of debitage, further providing evidence of intense occupation of Cuncaicha. All of the above-stated factors make Cuncaicha vital for understanding both the early settlement of Peru and its material culture (Rademaker et al. 2014).

Alca obsidian has also been found at other early Peruvian archaeological sites. Quebrada Jaguay (QJ-280) is located on the desert coast of Peru and is 150 kilometers (km) south of Cuncaicha and is also securely dated to the Terminal Pleistocene (Sandweiss et al. 1998). Quebrada Jaguay is important because of its evidence of a marine subsistence pattern and initial radiocarbon dates of ~13 ka (Sandweiss et al 1998.). Evidence from Quebrada Jaguay is critical for understanding the initial settlement of South America and may provide evidence for a coastal migration route (Sandweiss et al. 1998, Erlandson et al. 2007). Recent re-excavation, re-dating, and seasonality studies have shown that QJ-280 was only occupied during the austral summer (Gruver 2018) when freshwater was flowing through the quebrada and that the oldest occupation is temporally statistically indistinguishable from Cuncaicha (12.4 ka) (Rademaker personal communication). This indicates that whoever was occupying QJ-280 was elsewhere throughout the rest of the year. The presence of obsidian at QJ-280, which could not reach the coast through natural means, and contemporaneity of the highland and coastal sites indicates that there is an early interzonal connection. This interzonal connection can also be seen with possible coastal materials, such as chert, petrified wood, quartzite, and chalcedony, being used to manufacture formal tools at Cuncaicha beginning in the Early Holocene.

Shared raw material usage between both sites is only a single line of evidence for the interzonal connection between the highlands and coast. In order to better understand the nature of this connection, one avenue of research would be to compare material culture between both regions. A shared material culture, such as projectile points, would indicate that the same cultural ideas are being used to manufacture similar formal tools, further illustrating a connection (Wiessner 1983). QJ-280, however, lacks formal tools. This then means that an early coastal archaeological site with Alca obsidian and formal tools are needed to understand this aspect of the inter-zonal connection.

Pampa Colorada (PC) is also located on the desert coast of Peru and is 30 kilometers west of QJ-280. In addition, Pampa Colorada is also 150 kilometers southwest of Cuncaicha. PC sites have been dated to the Early Holocene through the Late Holocene using both absolute (^{14}C) and relative dating methods throughout temporally diagnostic projectile points (McInnis 2006). Important characteristics of these sites (n=100) are that they contain large assemblages of formal tools, including projectile points, that are manufactured from local materials (chert, chalcedony, etc.) and Alca obsidian. Also, many sites have provided evidence of subsistence practices through large shell middens. Human burials have also been recovered from Pampa Colorada site 343 (PC-343), further providing evidence of this area's archaeological importance.

The cultural chronology at Pampa Colorada (11.2-0.8 ka) was established based on temporally diagnostic projectile points (Klink and Aldenderfer 2005) collected during surface survey and 12 radiocarbon dates obtained on shell (n=10) and botanical remains (n=2) (Mcinnis 2006). Pampa Colorada currently lacks an accepted Terminal Pleistocene component. The projectile point typology that was used to relatively date the sites at Pampa Colroada (Klink and Aldenderfer 2005) lacks Terminal Pleistocene types, so this typology cannot identify Terminal

Pleistocene forms, even if present. Additionally, the shell that yielded the single Terminal Pleistocene radiocarbon date (13.5-12.8 ka), possibly has incorporated an unknown marine revisor effect, making this date unreliable.

Pampa Colorada is an ideal area for exploring the material culture aspect of the interzonal connection between the highlands and the coast and for additional archaeological research. Alca obsidian has been used to manufacture various formal tools in both highlands and coast, both areas are occupied contemporaneously (Early Holocene through the Late Holocene), and the various Pampa Colorada sites' relative age assignments potentially could be updated through a new projectile point typology that contains Terminal Pleistocene forms.

The following thesis explores this aspect of interzonal connection through shared usage of raw material and projectile points. Projectile points were chosen for this study because they are found in both the highlands and coast, are manufactured from the same material, can convey stylistic and cultural information, and are abundant at both Cuncaicha (n=429) and Pampa Colorada (n=171). Scrapers or debitage were not chosen for the following study because they do not carry the same information as projectile points. Scrapers can be made from a single flake, which can make them lack stylistic and cultural information (Andrefsky 2010). Debitage is important for lithic analysis but will not be used for this study due to flakes lacking identifiable diagnostic features, such as stems (Andrefsky 2010). Projectile points are unique, complex, and have replicable features that make creating groups of morphologically related objects possible for archaeological research (Whittaker 1994, Andrefsky 2010).

Thus, creating a projectile point typology from Cuncaicha's well-dated and stratified deposits makes it possible to compare points from Cuncaicha and Pampa Colorada to assess cultural connections. The proposed typology will be also helpful for identifying possible Terminal Pleistocene archaeological sites at Pampa Colorada.

Research Questions

The following questions will address and explore the interzonal connection between the highlands and coast of Peru through a constructed projectile point typology from Cuncaicha rock shelter.

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1. Are projectile points types from the Early Holocene to Late Holocene components of Cuncaicha morphologically similar to forms from contemporary archaeological sites at Pampa Colorada? Or, how many projectile types are shared between the two regions throughout the Early and Late Holocene?
2. Are there projectile point types that are exclusive to either the coast or the highlands region?
3. Are metric attributes and ratios of projectile point types common to both regions statistically distinguishable?
4. Are projectile point types manufactured in the highlands made with the same material at the coast? For example, are highland types made from Alca obsidian also made with obsidian at Pampa Colorada? If not, are specific types at the coast manufactured from a different material?

In addition to addressing these research questions, a secondary objective for this study is to improve the chrono-stratigraphy of Cuncaicha. This will be done by examining temporally diagnostic projectile point types from both my typology and Klink and Aldenderfer's (2005) typology in comparison with associated stratigraphic layers at Cuncaicha. Although it is already well known that Cuncaicha is a well-stratified archaeological site, radiocarbon dating every layer of every unit is unrealistic due to monetary and time constraints. Further improving the chrono-stratigraphy of Cuncaicha will allow us to explore spatial arrangements of artifacts throughout the site.

Chapter Overviews

Chapter Two contains further background information on Cuncaicha, Pampa Colorada, and Quebrada Jaguay. Histories of investigation and other relevant information will be discussed. Also, in this chapter, there will be an examination of the previously proposed typologies for the greater Andean region. Chapter Three presents theory surrounding typology, culture history, evolutionary theory and lithics, and projectile points, interzonal connections, and lithics. Following this chapter is the methods section, which will explain how the Cuncaicha typology was created and how points from Pampa Colorada were compared to the established types. This section will also contain information on the creation and curation of 3D models for archaeological research. Chapter Five presents the Cuncaicha projectile point typology and results of the projectile point comparison with Pampa Colorada. Chapter Six discusses the results, and Chapter Seven concludes with statements on the nature of the interzonal connection, along with future research directions.

CHAPTER TWO

BACKGROUND

This study is based on excavated materials from Cuncaicha rock shelter and projectile points collected during surface survey of Pampa Colorada. Excavations from Cuncaicha occurred in 2010, 2012, 2014, and 2015. Pampa Colorada has been surveyed multiple times (McInnis 2006), with the most recent being in 2017 (Rademaker and Mauricio 2018). Ecological information about both the highlands and southern desert coast of Peru will be provided for additional context. This will include information on natural resource availability and environmental stressors, such as hypoxia at high altitude.

Background information will be provided for other highland and coastal Terminal Pleistocene archaeological sites in the south-central Andean region. These sub-sections will also examine previously proposed typologies for this region of Peru and northern Chile. A cohesive typology that represents an Andes-wide settlement system has yet to be created and needs to be addressed in future research and publications.

Study area: Pucuncho Basin

Cuncaicha rock shelter (4480 masl) is in the Pucuncho Basin of southern Peru, which sits in the center of a wide volcanic plateau in the Andean Puna (Brush 1976, Rademaker et al. 2014, Rademaker and Moore 2018). The plateau is comprised of andesites and pyroclastic rocks that overlie a dissected erosional surface of basalt (Gregory-Wodzicki et al 2000, Garzione et al. 2014). The plateau is flanked by the Cotahausi and Colca canyons that drain towards the coast (Gregory-Wodzicki et al 2000). The Pucuncho Basin is only 132 km^2 but supports herds of both domesticated and non-domesticated camelids. This includes the domesticated *llama* and *alpaca* and their non-domesticated extant ancestors, the *vicuña* and *guanaco* (Franklin 1981). Other local fauna includes ungulates, such as sheep and the Andean *taruka* deer and small mammals, such as the vizcacha, and birds (Rademaker and Moore 2018). Ranching and herding of camelids is the primary economic activity for residents of the Pucuncho Basin today (Richardson 1992). Freshwater resources are also abundant and readily available through streams and bofedal wetlands (Franklin 1981). Arguably, the areas above 4000 masl have overall higher resource abundance and productivity than adjacent lower ecological zones (Rick 1988).

Being located above 3500 masl, both grasslands and wetlands are present and are highly productive (Brush 1976, Vidal 1979, Rademaker et al. 2014). This ecologic zone, known as the "high puna", is one of eight located in southern Peru (Troll 1968, Vidal 1979, Santoro and Nunez 1987). Pucuncho is considered semi-arid. Precipitation is low, with less than 800 mm of rainfall occurring yearly (Lenters and Cook 1997, Grosjean et al. 2007). Precipitation mostly occurs during the wet season, which begins in December and ends in March (Vuille et al 2003). Even though this area is considered semi-arid, the Pucuncho Basin receives more precipitation than the dry desert coast, which is the northern extent of the Atacama Desert. Aridity in this region is partially caused by the Andean rain-shadow effect (Grosjean et al. 2007)

Seasonal temperature variation is relatively constant in the basin, with the average fluctuation being ~3º Celsius (C). Temperatures are more variable throughout the day. During the nighttime, temperatures typically reach below freezing (Baker and Fritz 2015, Rademaker and Moore 2018). Throughout the late Quaternary, temperature fluctuations related to climate change have affected the areas outside the basin (Grosjean et al. 2007, Baker and Fritz 2015). Floral community changes and the appearance of glacial lakes were common during the late Quaternary throughout southern Peru outside of Pucuncho. Additionally, ice sheets never reached into the basin, making Pucuncho habitable for human colonization during the Terminal Pleistocene (Bromley et al. 2009).

Lithic resources are abundant throughout the basin. Volcanic glass, known as obsidian, andesite, and chalcedony are viable tool stones that have been utilized to manufacture stone tools (Rademaker et al. 2014). Obsidian is widely considered the best knapping material because of its predictable conchoidal flaking pattern and lack of crystalline structure (Whittaker et al. 1994). Obsidian is chemically like rhyolite, but because of the rapid cooling process and escape of gases, crystals cannot form. Obsidian is brittle and easily weathers, therefore deposits utilized by prehistoric peoples are generally younger in age than other tool stones, such as andesite. This brittle quality also does not allow for obsidian to survive river transport over long distances in this region.

The Alca obsidian source region is over 330 km^2, with the highest concentration of obsidian occurring along the eastern rim of the Cotahuasi Canyon and in the Pucuncho Basin (Rademaker 2006, Rademaker et al. 2013). Obsidian occurs in eroded rhyolite domes, ignimbrite sheets deposited by vents located on the edge of the basin, and pyroclastic and fluvial deposits throughout the source area above ~2700 masl (Rademaker et al. 2013). Alca obsidian is exposed as a result of ~2 km of erosion due to rapid uplift during the Late Miocene and Pliocene (Gregory-Wodzicki et al. 2000). Strata that bear obsidian were dissected by the Cotahuasi and Arma canyons beginning around nine million years ago, which exposed obsidian outcrops. In addition, Pleistocene glaciations of Nevados Firura, Solimana, and Coropuna further exposed Alca obsidian resources (Rademaker et al. 2013). Finally, pyroclastic materials that include obsidian, are further exposed by wind and deflation on the surface are found throughout the Pucuncho basin (Gregory-Wodzicki et al. 2000)

Obsidian is also important because it can be characterized geochemically. Obsidian takes on the geochemical composition of the source magma chamber, which has a unique geochemical "fingerprint" that is identifiable through x-ray fluorescence (XRF) (Shackley et al. 2005, Glascock et al. 2007) Through this characterization, six types of Alca obsidian (1,2,3,4,5, and 7) were discovered (Rademaker et al. 2013). Each Alca sub-source is only distinguishable through geochemical analysis due to the homogenous nature of the material. The only exception is Alca-4, which contains visible phenocrysts (Rademaker 2006, Rademaker et al. 2013).

Andesite is also common throughout the basin. It is another igneous rock that forms as a result of volcanic activity. Andesite is a lower quality material than obsidian and chalcedony because of its larger grain size and crystalline structure.

Despite being ecologically viable and rich in raw materials, the highlands of Peru are still challenging for human colonization. These challenges make understanding the settlement of high-altitude areas important for researching human adaptations to extreme environments. Hypoxia, or the low partial pressure of oxygen, begins around 2500 masl (Frisancho 2013)

“High-altitude sickness” is the resulting condition for non-acclimatized people visiting these areas. Symptoms include vomiting, headaches caused by dehydration, and diarrhea that can be possibly fatal (Frisancho 2013). Other high-altitude environmental stressors are increased exposure to UV-B radiation and cold temperatures (Blumthaler and Ellinger 1997).

Cultural and Environmental History of the Central Andean Highlands

Following a coastal route, initial settlers entered Peru by at least 13.0 ka (Sandweiss et al. 1998). Huaca Prieta (13.7 ka) located on the north coast of Peru and Monte Verde (18.5-14.5 ka) in central Chile are possible pre-Clovis archaeological sites in South America that provide evidence for an even earlier migration into the continent (Dillehay et al. 2012, Dillehay et al. 2015). Regardless of when people entered South America, the continent was almost entirely settled by the end of the Terminal Pleistocene, with people following either a coastal or inland route (Dillehay et al. 2015). Accepted evidence for a high-altitude settlement path has been sparse until recently.

Prior to the discovery of Cuncaicha, there was a lack of accepted Terminal Pleistocene archaeological sites in the high-altitude areas of Peru (>3500 masl) (Lynch 1986, Engel 1970Santoro and Nunez 1987, Aldenderfer 1989). However, other high Terminal Pleistocene sites (n=12) have been identified from surrounding ecological zones. Three sites, Inca Cueva-4 (12.7-12.0 ka) (Aschero 1984), Cueva de Yavi (12.5-12.0 ka) (Kulemeyer et al. 1999), and Pintoscayoc-1 (12.4-11.8 ka) (Hernandez Llosas 2000) are located at high elevation in Argentina and have dates statistically indistinguishable from Cuncaicha’s oldest occupation. These sites should be treated with caution, however, because they all have single dates (Rademaker and Moore 2018). In addition, Cueva Bautista has nine AMS radiocarbon dates that place its oldest occupation 500 years earlier than Cuncaicha (Capriles et al. 2016). This site should also be viewed with caution because the bones that the dates were taken from are possibly not of an anthropogenic origin (Rademaker and Moore 2018).

Terminal Pleistocene dates have been obtained from the following Peruvian sites: Guitarrero Cave and Pan-12-58 (Lynch 1971, 1980), Tres Ventanas (Engel 1970), Pikimachay, and Jaywamachay (MacNeish et al. 1980). Other singular Terminal Pleistocene radiocarbon dates were obtained at the high-elevation sites of Telarmachay and Pachamachay but are generally rejected by the authors themselves (Rick 1980, Lavallee et al. 1985). I will examine each of the following sites and discuss why these Terminal Pleistocene dates can be considered unreliable or should be accepted. In general, these dates have large 1-sigma ranges that exceed 300 ^{14}C years or are singular basal ages that are stratigraphically or chronologically out of order.

Telarmachay and Pachamachay have singular ^{14}C dates that exceed 12.0 ka. These dates are unreliable because of their late 1-sigma ^{14}C ranges (>300). Specifically, the Terminal Pleistocene date from Pachamachay from obtained from a small sample of the stratigraphy that is near a much younger uncalibrated date of ~9.0 ka.

Guitarrero Cave has been repeatedly dated throughout the history of investigations at the site. Conventional radiocarbon methods on charcoal samples place the initial occupation of Guitarrero cave at ~12.7-11.9 ka (Lynch 1971, 1980). Recent AMS ages have redated the site's initial occupation to ~12.1 ka, with much of the sequence dating later to between 11.3-10.3 ka (Jolie et al. 2011). In addition, Tres Ventanas (Engel 1969, 1970) has a single radiocarbon date from charcoal that suggests an initial occupation of the site starting around 11.9-11.2 ka (Engel 1969, 1970). These two sites are considered the only other accepted highland cave sites in Peru with Terminal Pleistocene radiocarbon dates (see below for the rejection of Pikimachay)

The environmental and climatic conditions of the Terminal Pleistocene were different from today. Paleoclimatic reconstructions that have occurred throughout the central Andes have indicated that both cold and ice were not impassible barriers for settlement of high-altitude areas (Borrero 2012, Rademaker et al. 2014). Temperatures began to slowly increase after the Last Glacial Maximum ~25 ka (Bromley et al. 2016), and by ~13 ka, the Central Andean Pluvial Event (Quade et al. 2008) created ideal conditions for settlement. The Central Andean Pluvial Event is a period of increased summer monsoonal rainfall that is partially evidenced by high levels of Lake Titicaca (Geyh et al. 1999) known as the "Coipasa phase", the presence of increased grassland growth in high-altitude areas of the Atacama desert (Latorre et al. 2013), and from proxy records obtained from rat middens (Betancourt et al. 2000). Increased rainfall and grasslands provided freshwater resources and flora that were utilized by fauna throughout the region. This created an abundance of plants to gather and animals to hunt for colonizing populations in addition to productive lake ecosystems (Geyh et al. 1999).

It is understood that the increased precipitation could be the result of the intertropical convergence zone being displaced to the south by colder conditions in northern latitudes (Peterson et al. 2000). It is important to note that this period of increased precipitation coincides with the Younger Dryas and ended ~11.5 ka (Quade et al. 2008). Overall, the Terminal Pleistocene was wetter and cooler than today, making it an ideal period to begin biogeographic expansion into high-altitude areas.

Following the Terminal Pleistocene into the Early Holocene (EH) (11.4-8.2 ka), the number of highland archaeological sites in the Wet and Dry Puna ecological zones of Peru and northern Chile greatly increased (Santoro and Nunez 1987, Rademaker et al. 2014). Archaeological sites in southern Peru, such as Asana (Aldenderfer 1998), Caru (Ravines 1967), and Toquepala (Ravines 1972), represent Early Holocene occupations. Pachamachay (Rick 1980), Panaulauca (Rick and Moore 1999), and Telarmachay (Lavallee et al. 1985) are contemporary and are located in central and north-central Peru. Las Cuevas (Santoro and Chacama 1984), Patapatane (Santoro et al. 2011), and Hakenasa (LeFebvre 2004) are Early Holocene sites located in northern Chile that share a similar style of material culture known as the “Patapatane pattern” (Santoro and Nunez 1987). This is a distinctive set of lithic tools and projectile points that have an identifiable morphology that is temporally diagnostic to this period. In addition, patterns of seasonal hunting and possible exchange between the coast and highlands begin to occur in the Early Holocene, with a shark tooth at Las Cuevas and *Choromytilus* shells at Patapatane being found at these sites (Santoro and Nunez 1987).

The overall increase of archaeological sites during the Early Holocene could be a result of demographic increases and the expansion of exploitation of highland zones (Aldenderfer 2006). It is important to note that the difference in the number of sites between the Terminal Pleistocene and Early Holocene could be the result of sampling bias through inadequate investigation of the earlier period (Rademaker 2012).

Although the earliest portion of the Early Holocene was not as wet as the Terminal Pleistocene, this period was more humid compared to today (Geyh et al. 1999). At about 9.0 ka, the Central Andean Pluvial Event ended, and aridity began to increase steadily throughout the region, with paleolake levels falling between 8.8-8.1 ka. By about 8.0 ka, paleolakes that once were frequent throughout the central Andean landscape disappeared (Grosjean et al. 1994, Geyh et al. 1999). In addition, vegetation and animal resources that were once abundant began to decrease (Grosjean et al. 1994). Although many of these records were collected in northern

Chile, they may be applicable to southern Peru, making them important in understanding the environmental history of this area.

During the Middle Holocene (MH) (8.2-4 ka), climatic aridification continued and intensified throughout the central Andes of northern Chile (Nunez et al. 2002, Grosjean et al. 2007, Nunez et al. 2013). This event is characterized as the *Silencio Arqueológico* (Grosjean et al. 1994) and is defined based on the lack of occupations throughout the region apart from well-watered areas (Santoro and Nunez 1987, Nunez et al. 2013). Dry conditions are suggested by the complete disappearance of paleolakes, torrential fluvial sedimentation episodes that are diagnostic of sporadic rainfall, and greatly increased erosion (Grosjean et al. 1994). A northward shift of the summer circulation, a strengthening of the Humboldt current, and an increasing influence of the southeast Pacific cyclone are inferred to be the cause of the increased aridity in the region (Rollins et al. 1986, Enfield 1989). Hunter-gatherer behavior and mobility patterns were greatly affected because areas that were once habitable no longer supported their subsistence practices, causing sites with environmentally sensitive bases to be abandoned (Grosjean et al. 1994, Nunez 2002).

Increased aridity had a “domino effect” for the region, which forced people into ecological refuges (Grosjean et al. 1994). Plant species that once covered areas such as the Atacama no longer were able to support faunal species who relied on them as a constant source of subsistence (Grosjean et al. 1994, Nunez et al. 2002, Grosjean et al. 2007). This then forced these faunal species to seek oases or refugia that were not as greatly affected by the decreased precipitation. With the decreased abundance of both plants and animals, hunter-gatherers were forced to move away from previously exploited areas in favor of valley bottoms or springs where fauna was concentrating (Grosjean et al. 1994). This then decreased hunter-gatherer mobility because they were forced to stay in areas with sustainable resources. This is reflected in the archaeological record because sites with stable water resources in the Atacama (Rio Loa and Rio Puripica), Southern Peru (Asana) (Aldenderfer 1989), and in the highlands near Arequipa (Neira 1990) have occupation sequences dated to the Middle Holocene (Grosjean et al. 1994). Stable water resources are natural springs, constantly flowing streams that have their sources in the highlands, and low-lying basins that collect rainfall (Nunez et al. 2002).

Intense aridification ended towards the Late Holocene (<4.0 ka), marked by the introduction of ceramics into the archaeological record. Climatic conditions were analogous to modern-day conditions and intensive utilization of different ecological sectors increased in this period (Santoro and Nunez 1987). It is possible that because of technological changes, such as the transition to horticulture and domestication of camelids, repopulation of previously abandoned areas could occur (Grosjean and Nunez 1994, Grosjean et al. 2005). In highland areas, except for the puna, domesticated plants such as maize, grains, tubers, squash, and fruit begin to be heavily exploited during the Late Holocene (Rick 1988). In general, groups become larger, less mobile, and more dependent on the exchange of resources to maintain populations (Rick 1988). As populations increased, social complexity increased, which eventually led to the rise of civilizations throughout Peru.

Previous Highland Projectile Point Typologies

Previous projectile point typologies have been proposed from the following highland sites: Caru (Ravines 1967), Toquepala (1972), Pachamachay (Rick 1980), Ayacucho sites (MacNeish et al. 1980), Telarmachay (Lavallee et al. 1985), Tuina, Las Cuevas, Patapatane, and Hakenasa (Santoro and Nunez 1987), Sumbay (Neira 1990), Asana (Aldenderfer 1998) and Quelcatani (Klink and Aldenderfer 2005). Rogger Ravines is a Peruvian archaeologist who attempted to create the first regional projectile point typologies for Peru and should be considered highly influential in this area. Each site listed above either lacks a Terminal Pleistocene component or has unreliable dates, which creates a gap in the cultural chronological record for this period (Rademaker et al. 2013). Additionally, some of these typologies (Caru, Toquepala, Sumbay) have poor absolute chronologies, with the sites only having a single radiocarbon date or basal ages that are not associated with cultural material (Rademaker et al. 2013). This is a common problem for the preceramic period of Peru.

The following section will discuss and examine the historical developmental sequence of projectile point typologies for the central Andes. I will highlight advancements of each typological scheme but also identify limitations starting with Rogger Ravines' typologies and ending with the Cynthia Klink and Mark Aldenderfer scheme. For the purpose of this chapter, scheme and typology are interchangeable terms.

Rogger Ravines' work at Caru (1967) and Toquepala (1972) was transcendent for Peruvian archaeology. These Early Holocene archaeological sites were well excavated, and the cultural materials were placed into a typological scheme with the intention of being used as diagnostic time-markers that are applicable throughout Peru (Klink and Aldenderfer 2005). Rogger Ravines' role in the overall historic development of projectile point typologies is that his work served as a basis for future archaeologists. The Toquepala typology was the first attempt at creating a scheme that connected different parts of Peru through shared material culture. Previous typologies (Cardich 1958) and future typologies (see below) are only site-level, which means that the authors provided limited discussions on the applicability of their schemes to areas outside their site (Rademaker, personal communication).

The limitations of the Toquepala projectile point typology are that the publications (Ravines 1967, 1972) do not provide stratigraphic breakdowns of each stratum with cultural materials. Ages are estimated for these strata and are based on only two radiocarbon dates obtained from basal deposits at the site (Klink and Aldenderfer 2005). Only one of the two dates were found in association with cultural material. The chronology of projectile points from Toquepala should be considered unreliable, but it is important to recognize its historical importance for the region.

Shortly following Ravines' work, Richard MacNeish began publishing on the archaeological sites he had excavated in the Ayacucho Valley of highland Peru (MacNeish et al. 1980). He excavated various cave sites through the Ayacucho Valley, but arguably his publications on Pikimachay (Flea Cave) were the most impactful. Radiocarbon dates on extinct sloth bone yielded pre-Clovis ages that pushed back the initial colonization of Peru back to ~20 ka (MacNeish et al. 1980). Crude unifacial stone tools were found in association with sloth bones and would represent the oldest stone tools in South America. This unifacial typology was a major historical development for Peru because it provided evidence for ice-age occupation of South America. However, this archaeological site is contentious. Many authors (Lavallee et al. 1985, Rick 1988, Lynch 1990) call into question or reject the antiquity of Pikimachay based on poor dates and questionable anthropogenic origin of the unifacial tools. In addition, MacNeish rejects three out of four radiocarbon dates from Pikimachay and has said that the stratigraphy is "jumbled" (MacNeish et al. 1980, Lynch 1990). Finally, the unifacial tools are made from the same material as the cave itself, which further calls into question the origin of the artifacts (Lynch 1990).

The typology of Guitarrero Cave is important because it was one of the first schemes that have accepted Terminal Pleistocene radiocarbon dates in the highlands of Peru (Lynch 1980, Rademaker et al. 2013). Guitarrero Cave has four cultural complexes. Complex I dates to 12.7-11.8 ka according to the original publication, which is based on aggregate charcoal samples (Lynch 1971). Recent redating of the oldest contexts suggests an initial occupation date of 12.1 ka with the majority of the sequence dating between 11.3-10.3 ka (Jolie et al. 2011). Guitarrero Cave provides a well-dated chronology that extends into the Terminal Pleistocene, making its typology more holistic than other schemes that lack this period.

Limitations of the cultural complexes from this site are that the overall excavated lithic inventory is small, it is difficult to distinguish between Complexes I and II, and complexes III and IV may have mixed intrusive materials from younger stratigraphic sequences. (Lynch 1980, Stothert 1980). This calls into question the validity of these complexes. In addition, Lynch proposes a "Central Andean Preceramic Tradition," which postulates that the sites of Pachamachay (Rick 1980), Lauricocha (Cardich 1964), and Guitarrero Cave all share similar projectile point styles and are culturally connected (Lynch 1980, Rick 1988).

The "Central Andean Preceramic Tradition" proposes that archaeological sites in the North-Central and Central Sierra of Peru share a similar material culture tradition between 11-3.8 ka (Lynch 1980, Rick 1988). Chipped stone tools are inferred to be of the same technology and function but are only similar on a general level based on morphology (Rick 1988). Projectile points are small, scrapers and knives are generally unifacial and produced from flakes, and choppers are larger core tools. Other flake tool morphologies such as notched, denticulate, and pointed are common throughout this tradition, along with utilized flakes (Rick 1988). Overall, this commonly held Central Andean Preceramic Tradition was one of the first systematic attempts at connecting geographically separated archaeological sites (Lynch 1980, 1988).

Included in the Central Andean Preceramic Tradition is the archaeological site of Pachamachay, which was excavated by John Rick (1980) and dates to the Early Holocene to the Ceramic period. Pachamachay is artifact-rich, with thousands of projectile points, making this site viable for the creation of a typology. The typology itself has many well-defined types that are found at other sites throughout the Andean region. This helps to constrain and refine the temporal ranges for types that are not from directly dated stratigraphic layers. Pachamachay's typology has many limitations. The site is poorly dated, with fewer than seven radiocarbon dates. The oldest age is rejected by Rick himself because it is stratigraphically anomalous and has a large (930) one-sigma range. Additionally, the original publication lacks provenience information on the illustrated projectile points, which makes the scheme lack transparency. Finally, Pachamachay has cultural chronological gaps between the Early Middle Holocene and Ceramic periods (Patterson 1981). This makes the Pachamachay typology not applicable to sites dating to this period (~8.0 ka). Although Pachamachay is vital for understanding Peruvian highland occupations during the Early Holocene, its typology is of limited use due to poor dating control.

Telarmachay is one of the most well excavated preceramic sites in Peru and possibly provides evidence of domestication of camelids by at least 4 ka (Patterson 1981, Lavallee et al. 1985, Rick 1987). In addition to the dense amounts of faunal material excavated from the site, Telarmachay has a large lithic inventory of projectile points with types similar to other regional sites such as Pachamachay (Klink and Aldenderfer 2005). Telarmachay is a well-dated archaeological site but has a singular basal radiocarbon date that is stratigraphically inconsistent and is rejected by the authors (Lavallee et al. 1985). The projectile point typology from this site is important because the artifacts come from well excavated and dated contexts and seem to fit within the larger “Central Andean Preceramic Tradition”. In addition, the authors provide as much detail as possible for the associations of their artifacts, which includes provenience information, maps, and photographs of the site (Lavallee et al. 1985, Rick 1987). Finally, the author’s lithic analysis of their chipped stone tool assemblage was unmatched at the time and provided information on use-wear and different stone tool classes (Rick 1987). Overall, the typology from Telarmachay was an important step in the evolution of archaeological research in the Peruvian Andes due to meticulous reporting and excavation techniques. Limitations for this typology is that it lacks a reliable Terminal Pleistocene (>12 ka) component and it was not applied regionally by the authors.

Although their scheme is based on sites in northern Chile, Santoro and Nunez (1987) proposed a multi-component projectile point typology that is applicable to the southern Peruvian highlands. The authors identified multiple cultural patterns in both the salt and dry punas that range from the incipient Early Holocene (~11 ka) to the Late Holocene (~4 ka). Points that defined the types for the typology were excavated from many archaeological sites, including Tuina-1, Patapatane, Las Cuevas, Hakenasa, Tulan-52, and Puripica (Santoro and Nunez 1987). Each site is well-excavated, stratified, and has multiple radiocarbon dates.

The Santoro and Nunez typology’s importance is that it shows the applicability of region-level integrations of material culture. This allows for a more holistic scheme. For example, if their typology was based only on artifacts from Patapatane, Las Cuevas, and Tuina-1, the Late Holocene portion of this scheme would be completely absent. By including later sites (Puripica and Tulan-52), the authors created a more holistic and complete cultural chronology for northern

Chile (Santoro and Nunez 1987). The limitations of this typology are that some sites included (Tuina-1 and Tulan-52) in the scheme have only two or fewer radiocarbon dates from basal strata and they lack a Terminal Pleistocene component (Santoro and Nunez 1987, Klink and Aldenderfer 2005).

Maximo Neira published a refined typology from his archaeological investigations of the Sumbay caves, located in the highlands north of Arequipa (Neira 1990). These cave sites are important because they provided evidence that the hunter-gatherer populations that occupied these areas were fully adapted to the high altitude puna environment (4127 masl) during the Middle Holocene. Additionally, populations made use of the Chivay obsidian source (50 km north) to manufacture stone tools, which shows intensive regionalization of this area (Neira 1990, Burger 1998). The typology itself helps to fill a cultural chronological gap in the Middle Holocene (7.0-3.3 ka) that was somewhat lacking for this region (Klink and Aldenderfer 2005). It is important to note that the Sumbay caves are not the only sites with Middle Holocene dates in southern Peru. Dates from this period are considerably rarer in this region compared to earlier and later times, making Middle Holocene ages from secure contexts important archaeologically. Asana is another site with Middle Holocene radiocarbon dates (Aldenderfer 1998).

One of the highlights from Neira's typology is that the types are easily identifiable. Sumbay types are long (~70 mm), wide (~26.25 mm), and hafted projectile points with easily identifiable basal morphologies (rectangular haft with shoulder spines) (see S3T3 in Chapter 5 for an example). Measurements presented above are averages from the Klink and Aldenderfer typology (2005). This unique and identifiable morphology makes these types excellent diagnostic time-markers for the Middle Holocene. One limitation is that there were only two radiocarbon dates reported from SU-3, the cave that yielded the points that were used to define the Sumbay types. In addition, Sumbay type points have only been found from excavated contexts from three other sites: Hakenasa (5.2-4.8 ka), Camorones-14 (7.6-7.2 ka), and Huiculunche (7.1-6.7 ka) (DeSouza 2004). The majority of Sumbay types have been found in surface sites throughout the Lake Titicaca Basin (Klink and Aldenderfer 2005). This limits the applicability of the Sumbay types from discriminating between the early Middle Holocene and late Middle Holocene due to small sample size.

Cynthia Klink and Mark Aldenderfer published a projectile point typology in 2005 that incorporated their own sites (Asana and Quelcatani) and others listed above. The Klink and Aldenderfer typology represents one of the first successful attempts at creating a systematic region-wide typology for the Lake Titicaca region that incorporates previously published typologies. Their typology has five series that are based on shared morphological characteristics, not chronology. This means that within series, different types can be diagnostic to the Early Holocene or Late Holocene. Series Four is an example of this where Type 4A dates between 11.2 -8.5 ka and Type 4C dates between 3.7-3.2 ka. Both styles are placed into the same series because they are broad contracting stemmed forms with triangular blades. Although their work lays the foundation for the region, the Klink and Aldenderfer typology is problematic because of the lack of a Terminal Pleistocene component and low applicability outside the Lake Titicaca region.

The current state of projectile point typologies for the Peruvian Andean region is better than it was prior to the Klink and Aldenderfer publication, but a cohesive scheme that is applicable for the entirety of Peru is still lacking. Even though the authors compared their types to other regionally known styles, Klink and Aldenderfer acknowledge that their typology is spatially restricted to the Lake Titicaca basin region. This is not a critique of their work but rather an acknowledgment that there is an opportunity to create a more comprehensive projectile point typology for the Peruvian Andes.

History of Site Investigations: Cuncaicha

Cuncaicha was discovered in 2007 by Kurt Rademaker during survey and mapping of rock shelters throughout the Pucuncho Basin. Cuncaicha was one of nine rock shelter sites that were selected as possibly having a Paleoindian presence. Seven shelters were then selected based on specific criteria, such as the location of the site in the puna. In 2010 Cuncaicha was geophysically surveyed using ground-penetrating radar (GPR). After GPR determined that Cuncaicha had deep anthropogenic sediments, test excavations were conducted to determine the age of the shelter (Rademaker 2012). Once Cuncaicha was reliably dated to the Terminal Pleistocene, further excavations occurred at the site in 2012, 2014, and 2015. Human burials were discovered in 2014 and were excavated in 2015 (Rademaker et al. 2016).

Over 40 accelerator mass spectrometry (AMS) radiocarbon dates have been obtained on faunal and botanical remains (Rademaker et al. 2014). As stated in chapter one, these dates correspond to four intermittent components that span from the Terminal Pleistocene (12.5-11.2 ka) to the Late Holocene (<4.0 ka) (Rademaker et al. 2014, Rademaker and Hodgins 2018). Twenty-one of the dates from Cuncaicha are older than 11.5 ka (Rademaker et al. 2014). Due to the excellent preservation of organic remains at Cuncaicha, radiocarbon dating of bone collagen is possible (Rademaker et al. 2014). This has allowed Cuncaicha to be one of the best-dated sites in the New World.

Study Area: Pampa Colorada and the Southern Peruvian Coast

Pampa Colorada is a hyper-arid (<10 mm precipitation annually) desert plain located on the southern Peruvian coast at about 250 masl and 38 km northwest of Camaná. The plain is 12 km long and about two km wide. Modern sea level was established along this area of the southern Peruvian coast by ~5.0 ka (Richardson 1981). Cerro Ruano (668 masl) borders Pampa Colorada and Quebrada de la Chira incises this area. The plain itself is mostly composed of sand, silt, and other aeolian sediments (McInnis 2006). Water and vegetation resources are limited, but lithic resources such as clear-quartz crystal, chert, and chalcedony abundantly outcrop here (McInnis 2006). Apart from ephemeral quebrada streams, brackish springs are the only freshwater resource for Pampa Colorada. This area has two seasons: austral winter (June to November) and summer (January to May) (Carre et al. 2009). Southern coastal Peru has a temperate climate which means that extreme heat or cold temperatures are rare or non-existent, but humidity and dense fogs, known as *garua,* are common. Most precipitation for this area occurs during the wet season between November and December (Dillon 2003). The shoreline of this area is mainly comprised of sandy beaches mixed with foothills that extend towards the sea. About 90 species of marine birds and mammals, including pinnipeds, sea lions, and seals, are common along the shorelines of the southern Peruvian desert coast (McInnis 2006). Crustaceans, a large variety of small and large fish, sea urchin, and bivalves including *Mesodesma Donacium* are found in intertidal zones also located along the coast near Pampa Colorada (McInnis 2006).

Unlike the Pucuncho Basin, the desert coast of Peru is hyper-arid due to the rain-shadow effect created by the Andes mountains. Floral resources are limited in this area due to the aridity, but the offshore marine ecological resources are abundant (Hastenrath 1991). Sea surface temperatures (SST) are cool along the coast and are ecologically productive due to the Humboldt

Current, which forces deeper ocean nutrients to the surface through northern flows of Antarctic water (Huyer et al. 1987). The Humboldt Current is driven by easterly trade winds that form as a result of differential pressure between warmer (west) and cooler (east) air systems known as the Walker Circulation. This system is also influential in the amount of rainfall and vegetation growth patterns across the Pacific Ocean region (Power and Smith 2007).

Coastal southern Peru also experiences El Niño/La Niña Southern Oscillation (ENSO) events. ENSO events are periods of greater rainfall and warmer temperatures (El Niño) or drier and cooler conditions (La Niña). These separate conditions are climatically and atmospherically driven where the Intertropical Convergence Zone, the Earth's equatorial low-pressure belt, is shifted north (La Niña) or the Walker Circulation is weakened (El Niño) (Taylor et al. 2008). In addition, El Niño events are heavily influenced by the development of warmer waters in the Indian ocean. This causes the weakening of the Walker circulation and drives westerly winds that move warmer waters from the west into the eastern Pacific Ocean (Taylor et al. 2008). This can disrupt the productivity of marine ecosystems by affecting the Humboldt Current.

Peru's southern desert coast's terrestrial environments are divided into three areas: Coastal desert plains that are characterized by marine terraces dried quebrada foothills also known as "*Lomas zones"* (150-1000 masl), and river valleys (Sandweiss et al. 1998, Carre et al. 2009). "*Lomas zones*" support plants known as *Lomas*, which bloom when moisture forms dense fogs during the austral winter months (Dillon 2005, Carre et al. 2009). The species within *Lomas* communities vary depending on local topography, climate, available environmental moisture, and the soil matrix in which the plants grow (Dillion 2005).

Onshore winds push Humboldt Current-cooled eastern Pacific air masses onto land, which condense and form *garua* fogs that provide moisture for *Lomas* communities (Dillon

2005). It is estimated that 815 species across 85 different families of plants occupy the "*Lomas zone*," and plant communities are highly variable with different mixtures of flowering periods (annual, perennial, and seasonal) (Dillon 2003). Distribution patterns of *Lomas* species are grouped into four large categories: Weedy or pan-tropical, long-distance communities between Baja California and the Sonora Desert, distinct from the Andean Cordillera, and coastal desert-restricted species (Dillon et al. 2003, 2005). It has been inferred that *Lomas* communities could have been important sources of food, residential construction materials, and freshwater for prehistoric hunter-gatherer populations on the coast (Keefer et al. 1998, Dillon et al. 2003). Additionally, terrestrial animals such as deer, camelids, birds, and foxes are attracted to these areas (Dillon et al. 2003). Six formations of *Lomas* are currently known for southern Peru, with only the *Lomas* of Ocoña extending into Pampa Colorada (McInnis 2006). *Lomas* communities are not protected outside of large nature conservatories such as the Preserva Nacional de Paracas and are threatened due to increased urbanization of the southern coast, by the introduction of non-native plants such as *Eucalyptus*, and through over-exploitation for grazing and firewood collection (McInnis 2006).

Lomas formation is environmentally sensitive. Plant diversity within *Lomas* communities is affected by El Niño, sea-level changes, increased aridity in the environment, and glacial cycles (Dillon 2005). This allows researchers to use change in *Lomas* as a proxy for paleoenvironmental reconstructions. For example, an increase of *Lomas* plant diversity can be used as possible evidence for increased moisture during a geologic epoch (Dillon 2005, McInnis 2006).

River valley environments provide access to freshwater, flora, and fauna that are critical for survival in the area. Alluvial sediments from rivers and river valleys are also fertile and provide land that is exploitable for agriculture. Corn, rice, cotton, and manioc are commonly grown in these areas. River shrimp (*Camarones*) is a viable economic and subsistence resource that are caught in river valleys. Particularly, the Majes, Ocoña, and Camaná valleys account for about 70% of the total catch of river shrimp for southern Peru (McInnis 2006). River valleys are ecologically abundant year-round and serve as oases from the harsh arid conditions of the desert coast (Moseley 1992).

Due to the constant tectonic uplift of this area, shorelines have become displaced and river valleys (quebradas) form throughout the region (Abad 1995). Loose aeolian sediments aggregate and form large star, barchan, and transverse dunes. Dune formation is constantly occurring in this area.

History of Site Investigations: Quebrada Jaguay

The following section will detail and explore important prehistoric archaeological sites from the southern Peruvian coast that are crucial for understanding Pampa Colorada and my study.

Quebrada Jaguay (QJ-280) is one of the oldest coastal archaeological sites (13.2-8.0 ka) in the New World with evidence of a marine subsistence pattern. The site is located 30 km to the east of Pampa Colorada (Sandweiss et al. 1998, McInnis 2006). QJ-280 is commonly used as evidence for a coastal migration route in Peru, as people were following a “kelp-highway” down the west coast of North and South America (Erlandson et al. 2007). Coastal hunter-gatherers used nets to catch fish and subsisted on *Mesodesma donacium*, a wedge clam commonly found in shallow water (McInnis 1999). Currently, the site is located only two km from the modern coastline but was seven km away during the Terminal Pleistocene (Sandweiss et al. 1998). QJ-280 currently sits on an alluvial terrace near the Quebrada Jaguay canyon. The stream that runs through the canyon is ephemeral and only provides freshwater during the austral summer for a few weeks to months in total time (Sandweiss et al. 1998, 2008). *Lomas* ecosystems are found near this area as well.

QJ-280 was first discovered, excavated, and radiocarbon dated by Frederic Engel in 1970 (Engel 1981) where excavations yielded an age of ~12.3-11.2 ka from a piece of charcoal (Jones et al. 2017). Engel recorded maps, dug three test pits to date the site, and noted the abundance of archaeological fish and shell remains throughout the area. QJ-280 was then further excavated and re-dated in 1996 and 1999 by Daniel Sandweiss, along with an intensive survey of the nearby area between Quebrada de la Chira and the Camaná River (Sandweiss et al. 1998, 2008).

In total, 41 radiocarbon dates were obtained from excavations at QJ-280 and an additional 20 ages were obtained from various sites discovered during a survey of the adjacent canyon. Using artifact assemblages from survey sites and the absolute radiocarbon chronology, Sandweiss defined three occupation phases and one abandonment phase for this region of the southern Peruvian coast (Sandweiss et al. 1998, 2008). The oldest phase, known as *Jaguay*, dates to 13.0-11.4 ka. The time-range for this phase is based on basal ages from QJ-280, which is the only site included for this phase. During this Terminal Pleistocene phase, QJ-280 is inferred to be a domestic center for fishermen who subsisted on drum fish and the wedge clam *Mesodesma donacium*. Evidence of house modification, food remains, and lithic debitage was found in the basal levels at QJ-280. Few formal tools were found, and the lithic debitage was primarily composed of local materials (Tanner 2001). It is important to note that highland Alca obsidian was found in basal levels at QJ-280 (Sandweiss et al. 1998). This provides evidence for a coast-highland connection either through the exchange of obsidian or direct procurement. Additionally, horsetail (*Equisetum),* prickly pear cactus seeds (*Opuntia),* and reeds are associated with the

Jaguay phase at QJ-280. It is important to note that prickly pear rarely grows below 1000 masl and provides further evidence of a connection between the coast and higher elevations.

Sandweiss argues that QJ-280 during the Terminal Pleistocene had a domestic function. The site provided shelter, an area for food preparation and consumption, and a tool manufacturing area (Sandweiss et al. 2008). QJ-280 was a coastal base camp that was part of a larger seasonal mobility system that included sites in the highlands and along river valley floors (Sandweiss et al. 2008).

Following the Pleistocene component at QJ-280, the Early Holocene is split into two phases. EH I dates between 11.0-9.7 ka and EH II dates between 9.0-8.0 ka. Obsidian, petrified wood, drum fish, and shells have been found in levels dated to the Early Holocene. Fishermen living at the site during this phase built rectangular houses with central hearths and are immediately below stratum dated to 10.8-10.5 ka (Sandweiss et al. 1999). Although obsidian is present in these levels, non-local resources are less abundant. This information, along with evidence of permanent structures, Sandweiss argues that during the Early Holocene, occupation of QJ-280 became more permanent as compared to the Terminal Pleistocene even though subsistence is somewhat similar (Sandweiss et al. 1999).

All other sites that were surveyed belong to either the *Machas* (10.6-8.0 ka) or *Manos* (~3.5 ka) phases. The *Machas* phase sites have an increased frequency of lower-quality raw materials, such as sandstone from the local quebrada bed, being used to manufacture lithics. Also, cordage that possibly came from nets, bottle gourd rinds (*Lagenaria Siceraia*), and net weights were found in *Machas* phase deposits at QJ-280. Regardless of phase, people at QJ-280 preferentially subsisted on marine resources. Specifically, Peruvian drum fish (*Sciaenae*, which is 97% of the total fish assemblage, and *Mesodesma donacium* (99.5% of total mollusk assemblage) were preferred (Reitz et al. 2015, 2016). Crustaceans were infrequently utilized at QJ-280, and intrusive mice have been found throughout the stratigraphy (Sandweiss et al. 1998, Reitz et al. 2016). The Quebrada Jaguay canyon is abandoned from 8.1-3.5 ka representing the first evidence of *Silencio* in southern Coastal Peru (Sandweiss 2003). Occupations at QJ-280 cease at ~8.0 ka and the oldest Early Holocene radiocarbon date from a site in the adjacent foothills is ~8.1 ka. Reoccupation of the Jaguay canyon does not occur until 3.5 ka which is associated with the Manos phase (Sandweiss 2003, 2008).

Manos phase archaeological sites all date to ~3.5 ka and have more diversity in species of mollusks exploited. Additionally, Manos phase sites have distinctive ground-stone grinders (manos) made from basalt. These grinders are flat and oval and mark a technological transition from Machas phase sites that have a complete lack of ground-stone tools (Sandweiss 2003). Finally, all Manos phase sites are located above 250 masl in the foothills adjacent to QJ-280 (Sandweiss 2003)

Further excavations and seasonality studies at QJ-280 conducted by Rademaker and team in 2017 have revealed new information about the site. The oldest date at QJ-280 (~13.0 ka) could not be replicated. New AMS radiocarbon dates on short-lived botanical remains have shown that QJ-280 was occupied at least ~500 years later than previously thought (Rademaker, personal communication). It has been inferred that an old-wood effect caused some of the original dates to appear older than the actual occupational period (Jones et al. 2017). Additionally, seasonality studies on *Mesodesma donacium* by Stephanie Gruver (2018) using stable oxygen isotope values obtained from shells have shown that the oldest occupations at QJ-280 occurred during the austral summer. Also, Gruver provided evidence for El Niño events occurring during the Terminal Pleistocene at QJ-280 (Gruver 2018).

History of Site Investigations: Pampa Colorada

Pampa Colorada was first defined and surveyed as an archaeological region in the 1960s and 1970s (Vescelius 1963, 1968, Engel 1980, 1981). Previous researchers identified 65 archaeological sites based mostly on shell middens and obtained radiocarbon dates (~5.5-3.3 ka) from the Middle Holocene (PC-500) and the Late Holocene (PC-725) (Engel 1980). Frederic Engel's team from the Centro de Investigaciones de Zonas Áridas (CIZA) created maps and photographs to document the locations of archaeological sites throughout the southern coast of Peru including Pampa Colorada. Engel documented in detail the ecological settings of the archaeological sites. He also documented temporal and spatial distributions of sites. He noted that the southern coast of Peru was intensively occupied during the Early Holocene but relatively abandoned during the Middle Holocene (Engel 1980, McInnis 2006). Engel suspected that this was due to changing climatic conditions. Artifacts and shells were recovered during the initial survey of this area. These initial surveys were the only systematic analyses of Andean maritime traditions for Pampa Colorada until Heather McInnis' dissertation fieldwork (2006).

The area was reinvestigated by Heather McInnis for her Ph.D. research between 2000 and 2004. McInnis chose Pampa Colorada for several reasons: Pampa Colorada had some of the only known Middle Holocene dates for Peru outside of the Paracas peninsula, artifacts collected during the 1970 survey suggested a deep and old (possible Terminal Pleistocene) but sporadic occupation history and shell middens suggested a marine subsistence pattern. Additionally, the location of the area was between the coast and Lomas ecological zones. This could lead to diverse settlement behaviors. (McInnis 2006). McInnis' dissertation addressed chronology, subsistence patterns, and paleoenvironment in Pampa Colorada. McInnis also investigated whether the cultural pattern from Pampa Colorada was similar to the phases defined by Sandweiss et al. (1996, 1999) for the adjacent Quebrada Jaguay canyon.

Pampa Colorada 343 was resurveyed by Dr. Rademaker's team in 2017. Human burials were discovered and partially excavated. Lithic artifacts such as projectile points and cores were recovered as well. Dates on the human burials have not yet been determined due to poor collagen preservation (Rademaker, pers comm).

. The following section will summarize the conclusions that McInnis observed from her dissertation research. This includes information on subsistence practices based on faunal, material culture and settlement trends.

Conclusion Summary

The sites at Pampa Colorada are almost all open-air shell midden sites with evidence of food processing and lithic repair that was periodically occupied throughout the Holocene (McInnis 2006). Permanent occupation is rare with only three sites (PC-333, 343, 728) having either structures, human burials, or dense cultural accumulations indicative of sedentism. Rocky promontories were more densely and intensively occupied at Pampa Colorada when compared to the western portion of the area (6.3 sites per km vs 6.0). Strategic locations (summits, hillsides, and areas with access to Quebrada de la Chira, etc.) have sites with multiple components dating throughout the Holocene. Palimpsests have been created at multiple sites throughout Pampa Colorada. Bioturbation, deflation, taphonomic, and other site formation processes are inferred to be the cause of the surface palimpsests. These processes have possibly obscured or destroyed evidence for a larger Middle Holocene occupation at Pampa Colorada.

Chipped stone tools are the most common artifact found at Pampa Colorada and are manufactured from a wide variety of local and non-local materials (chert, chalcedony, petrified wood, jasper, and obsidian). McInnis infers that the southeastern survey zone near Cerro Ruano was a manufacturing locus for stone tools due to the number of artifacts recovered from this area. McInnis also states that these sites could have had either intensive or longer occupations that would also deposit large lithic assemblages. Debitage is somewhat rare at Pampa Colorada, but flakes that were analyzed are indicative of late-stage manufacture of stone tools. The author argues that tools are being initially produced elsewhere and brought into the region.

The overall concentration of ceramics indicates that the rocky shorelines of Pampa Colorada were intensively occupied during the Late Holocene. Hachas style pottery comprises 30% of the entire assemblage. This is important because this style of pottery belongs to the first ceramic producing agriculturalists in the region and refines the timing of the agricultural revolution for the southern Peruvian coast.

The chronology of Pampa Colorada begins in the Terminal Pleistocene and continues through the Late Holocene. Radiocarbon dates (n=21) were obtained from 12 sites mostly on shell (n=10) and charcoal (n=2). Ten sites were dated to the Terminal Pleistocene and Early Holocene, one site to the Middle Holocene (PC-737), and a single site to the Late Holocene (PC-333). See below table for time ranges. McInnis identified three settlement transitions at Pampa Colorada. Settlement during the end of the Terminal Pleistocene and Early Holocene concentrated along the southeastern slope of Cerro Ruano, but people dispersed to the base of the western slope by 8.9 ka. Pampa Colorada is presumed to either be completely abandoned or heavily depopulated between 7.4-5.5 ka. The author states that this could be due to deflation of archaeological sites. Middle Holocene site designations (n=12) are primarily based on diagnostic projectile points and show a similar settlement pattern to the Early Holocene. The author later states that while the radiocarbon dates mimic the *Silencio* pattern, Pampa Colorada was not completely abandoned during the late Middle Holocene because the western survey zone is settled during this time. Ceramics are utilized starting in the Late Holocene and are continually used until European contact. Recovered pottery styles are similar to upland river valley styles and show a continued cultural connection with these areas throughout the Late Holocene. The western survey zone was the most intensively settled area during this period.

Sites	^{14}C range	Number of dates	Material dated	Assigned Temporal Period
333	0.8-0.3	1	Shell	Late Holocene
339	13.5-8.4	3	Shell	Terminal Pleistocene/Early Holocene
343	8.9-8.2	2	Shell	Early Holocene
355	7.8-7.4	1	Shell	Early Holocene/Middle Holocene
358	10.7-8.3	2	Shell	Early Holocene
425	8.4-7.9	1	Charcoal	Early Holocene
491	10.1-9.8	1	Shell	Early Holocene
493	10.3-9.8	1	Charcoal	Early Holocene
494	10.7-10.1	1	shell	Early Holocene
498	9.6-9.0	3	Shell	Early Holocene
500	10.1-8.8	2	Shell	Early Holocene
737	5.5-4.9	2	Charcoal, Shell	Middle Holocene

Table 2.1 Summary of Pampa Colorada radiocarbon dates (McInnis 2006)

Subsistence in Pampa Colorada is primarily based on species from sandy and rocky intertidal zones with a preference for the environmentally sensitive wedge-clam *Mesodesma Donacium*. Zooarchaeological research on faunal remains provides evidence that subsistence patterns and dynamic cultural adaptions were affected by fluctuating environmental conditions throughout the Holocene. During the Middle Holocene, marine and *Lomas* resources helped to buffer people from the disadvantageous hyper-arid climate during this period (McInnis 2006).

Overall, McInnis dissertation shows that Pampa Colorada continues many cultural and subsistence patterns from the nearby *Jaguay* canyon but is not completely abandoned during the

Middle Holocene. Pampa Colorada’s cultural chronology could be used to create a more holistic understanding of the coast of southern Peru during the Middle Holocene.

CHAPTER THREE

THEORY

In this chapter, I will summarize and discuss theoretical concepts that are important to my thesis. Typology, projectile point reduction, hunter-gatherer mobility, and evolutionary theory in lithic analysis are central to my overall methodology and results. Theory is an important aspect of all archaeological research and has influenced the way I perceive and interpret data. I argue, without an explanation and examination of theoretical concepts used, important contexts for readers are obscured. Archaeology, or science in general, cannot exist without foundational theoretical concepts that are used as guiding principles while examining the past. In this chapter, I will illuminate for the reader the theories that influenced me during my data collection, interpretation, and discussion of my results.

This chapter will cover a large body of literature. Some theories will be from archaeology's "culture history" period, while other articles could be considered "post-processual." I think it is important that when examining theory, all paradigms are examined. Foundational publications, such as Alex Krieger's "The Typological Concept"(1944), provided structure for future authors to critique. Without exploring older publications, modern theories lack the appropriate context that is required for a complete understanding of important concepts.

Questions that I will answer throughout this section are: Why can objects such as projectile points be used as markers of cultural identity? Are there problems with this assumption? What is typology and what constitutes a projectile point type? What changes the morphology of projectile points through time? Are proximal or distal portions of points more viable for building a typology? What is curation? Are defined projectile point types based on arbitrary divisions? Should point types be viewed on a spectrum? What is the role of evolutionary theory in lithics? Many more questions will be answered throughout the following section.

Prior to the discussion, important terms need to be defined. *Culture* for this thesis is defined as shared ideas (Dunnell 1971). I have decided on this short definition because I reject a normative view of culture. For the purposes of this thesis, *artifact typology* is a methodological tool designed to date sites relatively and explore shared material culture. By having a short and simple definition of culture, I will be able to better understand how typology can be used for exploring inter-zonal connections.

Normative culture

Projectile points are functional (Binford 1962), stylistic (Weissner 1983), and cultural (Tomka and Prewitt 1993). Points, or artifacts in general, do not fully represent boundaries that divide people into groups of different "cultures" (Furholt 2007). Normative culture theory asserts that culture is constrained only to a set of ideas, practices, and norms that are shared by group members (Johnson 2010). Although a normative view of culture is useful for my analysis, I acknowledge some of the limitations that are associated with this viewpoint. For example, a normative view of culture is reductionist and disregards the individual. Also, although a normative view of culture acknowledges that change occurs, it ignores causational underlying processes. Additionally, normative culture is akin to the culture history paradigm in archaeological theory, which has been shifted away from as a solely held theoretical paradigm. Culture history today is used as a foundational building block from which larger processual questions can be addressed. Data based on the geographic and temporal patterns of material culture is vital for understanding the more complex processes of human behavior. Due to the above-stated reasons, I reject this view of culture. I do argue, however, that a normative view of culture can be used as a functional tool to define areas that have similar artifact styles.

Describing areas where types of projectile points are found can be informative in terms of evolutionary diffusion of type design. If a point type is more widely spread and more commonly used than others, this could be the result of a functional adaptation or the cultural selection of this type (Dunnel 1971). It can be a powerful foundation that is built upon by asking questions about the cultural process or the relationships between groups (Trigger 2006). Caution must be used, however, because a normative view of culture can be reductionist if used only to describe boundaries between people (Johnson 2010).

Groups of people cannot be defined by a singular difference in artifact style. This would cause intragroup variation to be lost or ignored. Individualism, class, social ranking, and general inequality between people are completely ignored when applying a normative view of culture to archaeology (Johnson 2010). This would be akin to claiming every different sports team in the United States belongs to a separate culture because the symbols on their jerseys are different. In addition, Polly Wiessner's ethnographic studies on three separate Kalahari San groups have provided evidence that the most important indicators of group affiliation and individual style were located on their arrow shafts as opposed to the points themselves (Wiessner 1983). In some archaeological contexts where organic preservation is poor, wooden arrow shafts generally do not survive. A normative view of culture would assert that the three groups from this study were a part of a single, larger clade. In reality, all groups speak a separate language and consider themselves to be different entities entirely (Wiessner 1983). This may not be the case for all of humanity, but what is found in an archaeological site does not fully represent the people who inhabited that area. It is only a fragment of the total cultural landscape and social environment that people used to define themselves and others (Trigger 2006).

Artifacts themselves are products of the human mind but only represent a small portion of that total culture (Andrefsky 2009). Archaeological peoples should not be defined based on artifacts alone, but rather on a collection of objects, practices (subsistence, for example), and genetic ancestry. If pots are not people (Binford 1963), projectile points are not any different. The complexity of human social interactions, between and within groups, cannot be defined using a normative view of culture.

Typology

Artifact typology theory is one of the most important contributions that archaeology has made to anthropology (Sørensen 2015). Typology theory is constantly salient in archaeological theoretical discussions. When a new paradigm shift occurs, typological theory changes. The need to classify objects or sites into categories is prevalent in nearly all archaeological research (Sørensen 2015). Typology theory has helped archaeologists compress large amounts of data, define research objectives, and provide more theoretical discussion in archaeology.

Classifying archaeological artifacts into types has been part of the discipline since the antiquarian period of the European Renaissance (Trigger 2006). Collecting items and artifacts from antiquity and displaying them in curio-cabinets influenced people to start organizing their items by similarity. Christen Jurgen Thomson and his “three-age system” is the first major example of typological thinking (Trigger 2006). Artifacts made of stone were displayed together in the Danish museum he curated, while artifacts of bronze and iron were respectively grouped together. Even though this system was used to argue for the evolutionary advancement of technology, it is important to note that this can be considered an early typology. Artifacts that looked similar and were made from the same material were considered related (Trigger 2006).

Another first attempt to describe typology scientifically was performed by Oscar Montellius throughout his studies of the Bronze Age of Sweden (Sørensen 2015). His work, otherwise known as the "Swedish typology," explains that artifacts gradually change over time, similar to biological evolution (Montelius 1885). He also asserted that single objects can be used as temporally diagnostic tools regardless of their context (Montelius 1885, Sørensen 1997). Montelius used evolutionary theory to describe the direction of change in artifacts and as a classifying tool throughout his studies (Sørensen 1997). He built upon the work of Thomson and is generally credited with creating the first "true typology." Montelius' methodology of classifying and describing objects is still used today (Sørensen 1997, 2015). Although Thomson did create the first recognized "typology," Montelius' approach was the closest to what I consider a modern scheme.

Following this advancement, the theoretical paradigm known as "culture history" became dominant in archaeology. This paradigm is widely known for setting the foundations of modern archaeological theory (Trigger 2006, Johnson 2010). Culture history was interested in classifying and describing "cultural areas" that were designated by diagnostic artifacts such as projectile points or pottery (Trigger 2006). Discussions on typology begin to diverge and become more numerous in the archaeological literature. Every point or pottery type was either an entirely separate group of people, a genetically related ancestor or a descendant population (Trigger 2006). As previously mentioned, a normative view of culture was used to describe these types.

Types were traditionally described as organized masses of artifacts that were grouped together to show cultural change or describe cultural complexes (Kluckhohn 1939). Time and space were considered important variables despite the characteristics of the artifacts (Rouse 1939, Krieger 1944). This original definition for types was considered only one medium for describing cultural relationships (Krieger 1944). This then led to a semantic and methodological problem. What really is a type?

"The Typological Concept" published in 1944 attempted to solidify the definition of a type (Krieger 1944). Krieger explains that the purpose of a type should be consistent with a "cultural trait" from cultural anthropology. If a cultural trait can be learned and passed down through generations, the same should be true of artifact types. Types should be used as a tool that organizes artifacts that have a historical meaning related to behavioral patterns (Krieger 1944). Artifact types are not just assemblages of similar objects, but rather, they are remnants of mental processes that archaeologists can use to organize past behavior. Types also must be somewhat consistent in morphology, although variation is expected.

Another important concept from this publication is that divisions between types are based on objective, historical factors or descriptions from the lithic analyst. This means that types are arbitrarily divided into categories by the analyst if direct historical events cannot be linked as the sole reason for the observed variation between artifacts. This could be considered "discrete variation" as seen in genetics (Gould 1980).

Krieger's work is important because he defined type and describes a replicable methodology for creating typologies. Krieger also states that artifact typology based on both qualitative and quantitative measurements is more accurate than using only one or the other. Qualitative measurements group artifacts together by appearance or absence of characteristics that are not measurable with calipers. Quantitative measurements provide numbers and statistical evidence for relatedness that confirms qualitative assessments. One without the other is not tenable for lithic analysis. Krieger also called for constant refinement and adjustment of typologies (Krieger 1944). Artifacts from sites outside of where the original typology was defined will help to either refine, confirm, or deny types and groups. (Krieger 1944). For example, if point type “B” is always above point type “A” at archaeological site “C” and the same is true for sites “D” and “E”, the category is confirmed (Krieger 1944)

Typology was based on the idea that projectile points or other artifacts represent distinct cultural ideas and chronologies (Krieger 1944, Weissner 1983, Willey 1953). Artifacts not only carry meaning for the people who made them but for archaeologists as well (Read 1982). Artifact and site typologies can also be used to describe settlement patterns as seen with Gordon Willey’s work in the Viru Valley of Peru (Willey 1953). Different types of sites are defined and described with each example having observable patterns within a larger system.

With this distinct establishment of typology, critique and readjustment were needed. If every artifact type was equivalent to a separate culture, why can multiple groups exist in one area or have a shared space? (Binford 1963). Typological theory changed with the paradigm shift that occurred in the 1960s. The processual movement altered how archaeologists interpreted artifacts. Simply explaining and classifying artifacts was insufficient, and focus moved to why cultures changed through time (Trigger 2006, Johnson 2010). Recognition of patterns within large data sets (Hill and Evans 1972), comparison between sites and cultures (Clarke 1970), and ecological explanations for why cultures change (Binford 1980) became vital for this time period. Typology became a tool for archaeologists to explore deeper questions (Sørensen 2015).

Throughout both periods, researchers argued whether typologies were products of the minds of the original flintknappers (Sackett 1973) or if they only existed because archaeologists created them as a classification tool (Hill and Evans 1972). I would like to highlight the stance provided by David Clarke, who states that typologies are influenced by random variation that inherently occurs during the production of artifacts (Clarke 1970). This a powerful notion because types no longer must perfectly fit into assigned categories. Krieger and Montelius allow for some inherent variation within their typological schemes, but only as an end-product, not occurring during production (Montellius 1885, Krieger 1944). If artifacts are influenced by random variation during production, that means that typology is both a product of the archaeologist and the flintknapper (Clarke 1970). Specific, purposeful design shapes the overall morphology of the artifact, but random events that occur during production influence the final product that archaeologists can identify as either a sub-type or a variant (Clarke 1970)

Typology considered in this way influenced the next period of archaeological theory. The post-processual critique of archaeology was influenced by the over-reliance on empirical data and lack of agency in the processual movement (Johnson 2010). While being far from ecological determinists, the processual movement was heavily reliant on using the environment to explain why cultures change. Individuals, power relations, gender, and class were either ignored or were relegated into small sections of discussion (Johnson 2010). Post-processual critiques of archaeology sought to change this and bring identity into the discussion of theory. Some of the most important post-processual critiques of archaeology are that archaeologists cannot purely be objective and are influenced by the political present. Additionally, symbols and artifact styles can have multiple meanings or non-functional components. These critiques were important in the discussion about typology and continue to be incorporated into archaeological theory today (Trigger 2006, Johnson 2010).

Dwight H. Read is an important figure to highlight because he argues that our "objective and empirical measures" of statistical analyses may be flawed. Statistical analyses, such as chi-square and principal components analysis (PCA), are used to group and cluster variables to show relatedness. Previous archaeologists argued that the more measurements, regardless of their accuracy in terms of group clustering, the better the results. Read counters this by postulating that adding more measurements and variables achieves the opposite effect. If imprecise measurements and data are used to identify relatedness, the clusters become more difficult to define (Read 1982).

Read also argues that archaeologists have been too reliant on etic approaches when defining types and creating typologies. If types have no saliency in the minds of the people that created them, how can they be used as a classifying tool? They would represent the archaeologist's mental constructions, not the past peoples' culture. Emic considerations should be taken in terms of individuality in style (Weissner 1983) and functionality of the artifact itself (Read 1983). Read also postulates that the definition of a projectile point is a recent creation with arbitrary characteristics that were not viable in the past. What makes a projectile point is defined by modern scientists and not by past flintknappers (Read 1983). Read claims that the definition of projectile points is teleological. Artifacts are considered points because they look like projectile points. Further, the definition of projectile points is based upon morphology. He argues that past definitions of projectile points can be summarized as "points are points because they are." Interestingly, Read does not provide a definition of his own but concludes by repeating that emic considerations should be taken more seriously for typology.

Evolution and lithics

Evolutionary theory has been prevalent in archaeology since the work of Gordon Childe (1953) and Robert Dunnell (1971). More recently, authors have borrowed memetic theory from genetics to explain the evolution of lithics in archaeology (Riede 2008, Tostevin 2012). Cultural style, like genetic inheritance, can be passed between generations through vertical transmission or the transfer of genes and ideas from parent to offspring (Dawkins 1976, Boyd and Richardson 1985). Transfer also occurs in a transverse direction. Elders, such as aunts or uncles, contribute some of their genes through indirect transmission and also spread their cultural ideas (Boyd and Richardson 1985). A major difference between organic and cultural evolution in meme theory is that genetic transmission cannot occur horizontally or among peers. Horizontal transmission is exclusive to cultural transmission through processes such as imitation or diffusion (Dawkins 1976).

The modern evolutionary theory differs from previous uses in archaeology because it does not imply an inherent hierarchy (Trigger 2006, Riede 2008). Copper tools are not inherently superior to stone because they are metal (Binford 1963). Technology and style do not have an end goal and are not moving in a pointed direction toward modernity. Evolution in lithics today examines how “memes” or style is propagated in the archaeological record (Riede 2008, Shott 2011).

Artifact style is subject to forces such as natural selection (Blackmore 2003). Whichever tool style functionally performs the best will most likely be used rather than a less efficient tool. Style is also subject to cultural selection, where non-functional requirements affect which tool shape is preferred (Riede 2008, Dibble 2017). This is heavily influenced by culture and variables that may not preserve in the archaeological record. Style is influenced by imitation. Groups may attempt to copy others’ style, but subtle variation occurs in the final morphology of the artifact due to perfect replication not being possible (Sholts et al. 2012).

A modern example of imperfect imitation comes from a flintknapper who attempted to sell replica Clovis style projectile points on the internet. Apart from being made from a Brazilian chert, the points were nearly indistinguishable from authentic points. By using geometric morphometrics, Sholts et al. (2012) were able to demonstrate that when various 3D shape variables from the replicas were compared to authentic points, the fakes did not group with the originals (Sholts et al. 2012). Even though the imitation points were nearly perfect, they did not match with actual Paleoindian projectile points when compared statistically.

Overall, modern evolutionary theory in lithics attempts to explain why types persist and provide a framework for understanding change in lithic technology.

Modern interpretations of typology

I have relied heavily on the reduction thesis while designing my typology (Shott 2005). The reduction thesis states that distal portions, or blades of projectile points, are not useful for the creation of typologies. Throughout their use life, blades are rejuvenated through resharpening, also known as retouch, which changes the final morphology (Whittaker 1994, Andrefsky 2006). Proximal portions, or stems and hafts, do not experience heavy reworking. This is because they are safely secured onto the shaft of an atlatl dart or arrow with sinew or other lashing material (Andrefsky 2009). Blades are exposed and contact the animal during hunting, which causes the blade to either fracture or become dull (Shott 2005). If the blade is reworkable, retouch occurs. A reworked and retouched blade can be distinct from a freshly produced point even though they were manufactured to have the same morphology. In general, stems or hafts will retain their original morphology throughout their lifetime (Shott 2005).

Understanding this principle is vital for the creation of a typology. As Read (1983) argues, the more measurements put into a chi-square analysis does not necessarily provide better results. By examining measurements that do not accurately portray cultural relatedness, such as blade length or width, the resulting clusters will be more varied (Read 1983). Thus, it is important to understand that measurements based on the haft will be more important for the creation of a typology than data from blades (Shott 2005, Andrefsky 2006).

This principle has been challenged recently using geometric morphometrics (Buchanan et al. 2009). Paleoindian-age projectile points from the Southern Plains of the United States (Clovis, Folsom, and Plainview) were examined using advanced geometric morphometric techniques. This methodology involves examining the morphology of a projectile point in relation to a designated centroid (Buchanan et al. 2009, Maguire et al. 2018). Variations in shape profile are extrapolated into Euclidian space, which allows for the use of multivariate statistical tests to interpret the data.

Buchanan et al. (2009) found that when examining these points, reduction was not significant in point misidentifications. This refuted the reduction thesis for large, lanceolate projectile points. I would argue that this is an interesting and unique case because of the general morphology of Clovis, Folsom, and Plainview projectile points. North American Paleoindian projectile points are characteristically known to be large with concave bases and "flutes" (Whittaker 1994, O'Brien 2016). Due to the lack of a shoulder or spine, the transition between blade and haft is unknown. I would argue that the entirety of the body should be considered a haft (Ahler and Geib 2000). The presence of large fluting flake scars also agrees with this statement. Flutes would allow the flintknapper to haft a larger portion of the point into a split shaft, preserving much of the body (Ahler and Geib 2000). Reduction and retouch could only occur along the lateral margins where they are exposed. Folsom points are known to be ultra-thin because of the large flutes, so rejuvenating this surface could easily cause breakage if they are flaked further into the interior of the body (Ahler and Geib 2000).

Reduction only along the lateral margins would then bias the results of a significance test. In stemmed projectile points where the entirety of the blade is exposed, retouch can occur anywhere on the distal surface (Whittaker 1994, Shott 2005). Blade rejuvenation would be more impactful on the final morphology of these types' projectile points because more surface area is available to alter. I argue that North American Paleoindian projectile points, specifically Clovis, Folsom, and Plainview types, have a unique morphology that is not like most archaeological assemblages. Thus, resulting significance tests may not be applicable to other projectile point types. This is not a critique but an acknowledgment that the above-mentioned tests and case examples have such a particular morphology that subsequent research needs to consider these variables

I would also argue that the reduction thesis is still viable for the assemblage at Cuncaicha. The projectile points included in my typology share little to no morphological characteristics with Clovis, Folsom, and Plainview projectile points. It is an interesting variable to consider because it forces archaeologists to question not just how points are hafted, but also the results of differing hafting strategies. Another theoretical implication from this study needs to be discussed because it questions what designates a type.

As previously discussed, types must include idiosyncratic variation but have logical, historical consequences (Krieger 1944). Types should then be discoverable by archaeologists in the present and be significant in the minds of the people in the past. This designation could be arbitrarily placed (Shott 2009) or based upon empirical and analytical statistical tests (Read 1983). In the previously mentioned study, the authors test the previous typological assignments of Paleoindian projectile points. They did this by using both MANOVA and ANOVA tests on the various shape variables to determine significance. Shape variables are akin to morphology for the purposes of this study. It was found that by inputting these shape variables into a computer program designed to designate types, Clovis and Folsom points were misidentified less than 5% of the time. Folsom points were misidentified at about a 21% rate when compared to Plainview types. A similar rate was found when Plainview was identified as Folsom. The authors argue that these results show that Clovis and Folsom points are not the same type. Clovis points are statistically distinguishable from Folsom points with a 95% confidence rate. Plainview points were then argued as being a possible variant of Folsom, not their own unique type (Buchanan et al. 2009).

I found this section of this study to be intriguing because it calls into question how types should be defined in archaeology and what they mean. Types should reflect the inherent variability within the continuous variation of material culture but are also categorization tools that are discrete. Arbitrary barriers between types, definitions created by archaeologists to distinguish between types (Shott 2009), are subjective and need to be tested for consistency (Whittaker et al. 1998). Artifact style, which is part of defining types, should be thought of as a spectrum rather than as discrete categories. *Style* for this thesis is defined as the cultural information that projectile points carry, which is bound by morphological characteristics (Wiessner 1983)

Viewing types on a spectrum make typology flexible. The archaeological record will always be incomplete and will change as new information becomes available. Variants of types or new methodology will cause a change in type designation. If rigid, discrete variation is used for typology, a complete rework of the scheme will be required to reflect new data accurately. With continuous variation based on a spectrum, new data will only enhance and make typology more accurate (Shott 2009). By understanding that types are not final and are subject to change over time, archaeologists can create a better relative dating system.

Morphological influences

Artifact style can be both purposeful and influenced by the natural environment. Style can carry markers of group affiliation and individual identification (Wiesner 1983). Style can also be used to show status in non-egalitarian populations. Also, the “final” morphology of projectile points seen in the archaeological record today has changed through various site formation processes (Dibble 2017). How the point appears today could be different from how the original flintknapper envisioned it. Erosion, water transport, bioturbation, faunal trampling, and human scavenging could be influences on morphology during site formation (Dibble 2017). Points that appear as contemporary in an archaeological site’s stratigraphy could be separated by hundreds of years. Archaeological resolution is fine, but the Pompeii premise, or the idea that archaeological sites represent “snapshots” in time, is false (Dibble 2017). Expecting that points found on the same level or surface are contemporaneous does not allow for more morphological variation in point styles and types (Dibble 2017). If all artifacts are deposited at the same time, they should have been exposed to a similar amount of natural processes. Decades could separate depositional events, which then causes uneven amounts of weathering on artifacts (Dibble 2017).

Projectile point morphology and style can also be influenced by other environmental factors. Quality of raw material affects how easily flaking surfaces can be prepared and worked (Whittaker 1994, Andrefsky 1994). In general, the better the quality of the raw material, the easier it is for the flintknapper to create their desired end-product. Obsidian is widely considered one of the best raw materials because of its sharp edge, predictable flaking pattern, and lack of a crystalline structure (Whittaker 1994). Lower-quality material, such as andesite, can have coarse grain size, which makes flaking unpredictable. In general, crystal size determines flaking quality. Micro and cryptocrystalline structures are preferred over larger sizes (Whittaker 1994)

Distance (Andrefsky 2009) and availability (Binford 1979) of raw materials are influential as well. Hunter-gatherers will either rejuvenate broken bifaces or use lower-quality raw materials if better resources are not within reasonable foraging distances. Lithics then would not be discarded as soon as they were unusable, but rather, retouch would occur (Andrefsky 2006, Andrefsky 2009).

The alternative to this situation is discarding the broken tool and replacing it with local material of lower quality. Lower-quality material, as previously stated, affects morphology by being more difficult to work with (Whittaker 1994, Andrefsky 1994). It is also possible that the local raw materials are of an equal or higher quality. Broken tools would be discarded more readily and replaced by new versions because of the abundance of quality material (Binford 1979, Andrefsky 2006). Little to no retouch would be present on these tools. Tools made from lower-quality material could be abandoned for better resources once they become available for knapping (Andrefsky 1994).

Other modes of behavior, such as expedience and curation, are important factors that shape projectile point morphology. Artifacts themselves are not "expedient" or "curated" and should not be labeled as such (Binford 1979, Andrefsky 2009). These are specific behaviors that produce the tools, which are influenced by the physical environment. Expedient behavior produces tools that are cruder and generally lack characteristics that are time-consuming to produce, such as deeply notched shoulders. These tools are made quickly and have short use-lives, with retouch being mostly absent. If resources are abundant in the local foraging area of hunter-gatherers, expedient behavior is expected (Binford 1979). This only occurs if the local material is of a workable quality and better resources are not within foraging distance. If high-quality resources are not immediately available but are within a reasonable distance, curation behavior is expected (Binford 1979).

Curation behavior is characterized by higher levels of craftsmanship and much longer use-lives. Better raw materials will be preferentially selected for and will be completely exhausted. Curated tools will exhibit a greater amount of retouch because the flintknappers will want to use the tool as much as possible before they are forced to discard it (Binford 1979). Lower-quality resources can also be curated if they are the only available materials. It is also important to note that anthropogenic lithic landscapes, such as workshop sites, can be used as raw material sources (Dibble 2017). Hunter-gatherer populations can discover large amounts of cores and flakes from workshop sites that belonged to a population that predated their own by hundreds, if not thousands of years (Dibble 2017). This is important in understanding how scavenged projectile points can be used without carrying any social meaning of the group who is doing the scavenging (Dibble 2017).

As mentioned previously, typological consistency needs to be considered. A consistent typology would have low rates of inter-observer error (Andrefsky 2009), be plastic in type variation (Shott 2005), and be usable on sites outside of where the original typology was defined (Whittaker et al. 1998, Fox 2015). Lower inter-observer error rates when identifying types would be a result of type definitions being clear and concise. Type definitions that are too vague or not well defined can cause confusion when identifying artifacts. Categories or types can also be too narrow, causing a typology to have an excessive number of types. This makes artifact identification inefficient; misidentification rates increase and limits the potential of using typology as a relative dating technique (Whittaker et al. 1998).

Lumper or splitter behavior needs to be mitigated when constructing a consistent typological scheme. Publications and types need to be re-evaluated frequently as the archaeological record becomes denser. As more artifacts are excavated, larger data sets become available. My typology for Cuncaicha is the first of many iterations that will be revised as more high-altitude Terminal Pleistocene archaeological sites are discovered in the South-Central Andes.

Settlement Mobility and Theoretical Expectations for Research Area

Settlement mobility affects tool use-lives and morphology by placing constraints on toolkits through carrying costs (Torrence 1983, Shott 1986). Mobile hunter-gatherer populations cannot carry an unlimited amount of raw-materials and tools. Therefore, decisions need to be made on what is taken along during foraging trips (Shott 1986). In general, increased settlement mobility decreases tool and toolkit sizes, making them less specialized. Instead of carrying many unifunctional tools, groups such as the Kalahari San prefer multifunctional and less specialized objects (Lee 1979).

Settlement mobility places many constraints on the technological toolkits of hunter-gatherer populations. It is important to note that there is a difference in constraints placed on the toolkit between magnitude and frequency of mobility (Shott 1986). Technological diversity constraints are more closely related to how frequently a group moves, rather than the magnitude of their movement. Specifically, winter mobility, or the length of occupation of a winter camp in days (Kell 1983), has a positive correlation with an increase of technological diversity (Shott 1986). The longer that a group stays at a winter camp, the greater amount of technological diversity is seen in their toolkit. Mobility magnitude, or the total distance of moved per year, affects toolkit complexity. The farther a group moves per year, the more complex their toolkit becomes (Shott 1986). Mobility also affects the total use-life of an object. Curation behavior has been shown to increase when groups are highly mobile (Shott 1986). Instead of discarding their points after a few uses, mobile groups consistently rework and retool their artifacts. This preserves the artifacts, uses less raw material because new tools are not being created, and results in less time being dedicated to the manufacture of new objects.

Another important factor impacting this behavior is access to fresh raw material. Less mobile groups could possibly exhibit more expedient behavior because they frequently visit the same resource outcrops and know the amount and quality of the tool stone. This would prompt them to be more liberal with their resource usage because restocking their inventories is lower risk. Groups with higher mobility may interact with more resource outcrops, but the quality of the stone could be more variable. This then would prompt groups to curate their tools because restocking of quality flaking material could be less frequent (Shott 1986).

Using the theory stated above, my theoretical expectations for the projectile point assemblages at Cuncaicha and Pampa Colorada are important to discuss briefly to conclude this chapter. I expect that the projectile points from Cuncaicha will not exhibit curation characteristics for artifacts made from obsidian. As stated in the background section, Cuncaicha is located in the heart of the Alca obsidian source (Rademaker et al. 2013). This makes obsidian abundant throughout the landscape. Therefore, projectile points would not need to be curated and could be discarded after a single-use. In addition to the lithic resources, floral, faunal, and freshwater are regularly available year-round (Rademaker et al. 2016). This would then prompt decreased mobility and intense usage of the site, which would lead to expedient manufacturing behavior on locally available lithic resources. This intense usage of Cuncaicha also suggests that it was used as a residential base camp. Evidence for this is inferred through large amounts of tools, high artifact diversity, reliance on local animal, lithic, and botanical fuel resources, and the site's location in the middle of the large Pucuncho Basin (Rademaker et al. 2014). If Cuncaicha functioned as a residential base camp, manufacturing behavior for projectile points should not similar to curation because time would be allocated for other activities. Apart from cultural reasons, there would be little incentive to curate and carefully craft a projectile point when procuring new obsidian, and manufacturing points take virtually no time. Instead of providing constant upkeep on projectile points, the artifacts could be made in a single bulk event. This would allow for the time that would be spent on curating projectile points to be allocated to other tasks.

I do not expect expedient behavior to be utilized for non-local lithic resources at Cunciacha. Cuncaicha has some lithic resources (petrified wood, for example) that have been sourced to lower elevations (<2500 masl) that crop out over 50 km away (Rademaker et al. 2014). Regardless of how the material arrived at Cuncaicha (direct procurement or exchange), I would expect projectile points manufactured from resources sourced to lower elevations to exhibit evidence of curation due to lower availability, as compared to obsidian. These resources would be limited and would be exhausted much more quickly, making people conserve their tools as much as possible.

For Pampa Colorada, I would also expect projectile points made from local resources to be more expediently manufactured than artifacts made from obsidian, but other factors may affect hunter-gatherer behavior. Unlike the landscape that Cuncaicha is in, Pampa Colorada is lacking immediate access to freshwater (McInnis 2006). In addition, tool stone such as cherts, chalcedony, and quartz crystal is abundant but cannot compare to the flaking quality of obsidian. I then expect that most Pampa Colorada projectile points, regardless of which material that they were manufactured from, would show more signs of curation than Cuncaicha’s artifacts of a similar type. Lack of freshwater would increase mobility, causing hunter-gatherers to carry their lightweight and mobile toolkits farther and for longer amounts of time. Also, when obsidian is available either through direct procurement or exchange, it will be the preferred material for projectile points and will be heavily curated. Obsidian has a sharper edge than any locally available material, making it a better resource for manufacturing projectile weapons (Whittaker 1994, Andrefsky 2009).

Finally, because petrified wood is a mid-elevation resource and does not necessarily crop out in Pampa Colorada, it should be utilized less frequently than obsidian or local materials. I suspect that petrified wood would be used as an emergency option and would be discarded once other materials are available. Therefore, I suspect that projectile points made from petrified wood will also lack curation characteristics. Even though the process of creating formal tools, such as projectile points, is a time-intensive procedure, many factors affect how much time is dedicated to the manufacture and continued use of each artifact. I suspect that points made from petrified wood at Pampa Colorada were made quicker with less care and discarded after higher quality materials became available.

CHAPTER FOUR

METHODS

The projectile points examined for this thesis were accessed through a museum collections project authorized by the Peruvian Ministry of Culture Resolución Directoral #900016-2018 and were initially studied between June and August 2018 and again in December 2018. The collections from Cuncaicha were excavated from 2010-2015. Points from Pampa Colorada were collected during survey and excavation by Heather McInnis between 2002-2004 and by Rademaker and team in 2017 and 2018 (Rademaker and Mauricio 2018)

Definitions

The following definitions were used during the creation and examination of the projectile point typology. A **projectile point** is a bifacially flaked stone tool that is hafted onto either an atlatl or arrow shaft using sinew (Whittaker et al. 1998). **Hafts (1)** or **stems (1)** begin below the spine or shoulder if present. Hafts can have notches that extend into the body of the projectile point. **Basal ears (2)** are projections that are located on the margins of the stem or haft and are sometimes defined as barbs (Whittaker 1994, Andrefsky 2010). **Shoulders (3)** are extensions of the lateral margins with a measurable angle. **Spines (4)** are similar to shoulders but lack measurable angles.

The **blade (5)** is defined as the distal portion of the tool from the shoulders, with the **tip (6)** being located at the furthest extent on this portion. This section is located distal to the shoulders and can feature serration, which is an undulating lateral margin with defined “teeth” (Andrefsky 2010). Other features of projectile points such as **basal concavities (7)** are depressions that extend into the body of the tool that begins at the **base (8).** See Figure 4.1 below for a visual example of each of the above-described characteristics.

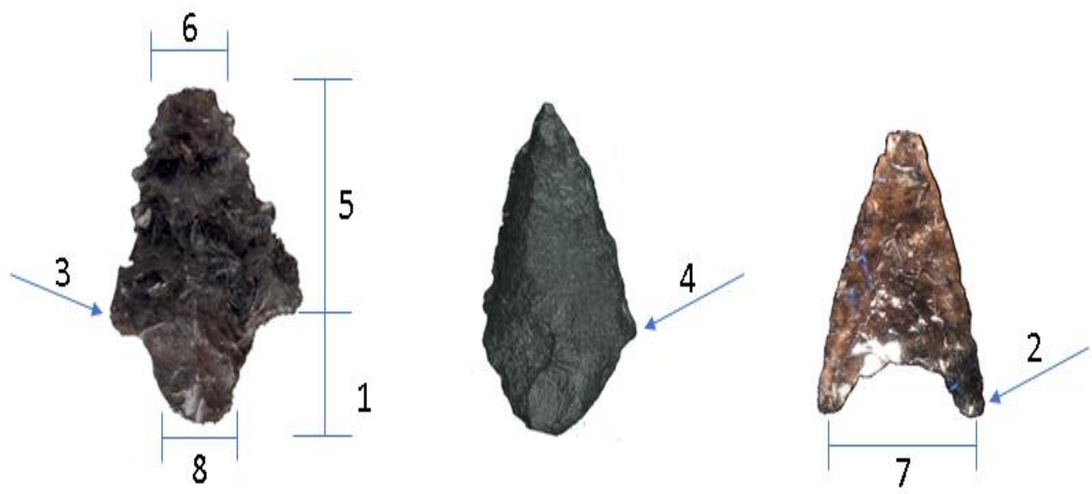

Figure 4.1 Characteristics of a Projectile Point.

The legend for the above figure is as follows: 1=Stem, 2=Basal Ear, 3=Shoulder, 4=Spine, 5=Blade, 6=Blade Tip, 7=Basal Concavity, 8=Base.

A **typology** is a logical categorization of artifact "types" (Krieger 1944). Artifact "**types**" are groups of artifacts that have consistent morphological and temporal characteristics. For the purpose of this thesis, "groups" are "prototypes" that need to be further refined (Krieger 1944). "**Variants**" are artifact "types" that are temporally and morphologically similar to their parent type but are not exact matches. These are defined to show variation in types. "Types" are understood to be discrete categories but encompass continuous variation of morphology.

Diagnostic artifacts are easily identifiable or typable and can be related to a specific time period. For this thesis, diagnostic features of projectile points are located primarily on the proximal end following the reduction thesis (Shott 2005). Non-diagnostic artifacts are missing portions primarily due to fracture. Artifacts can be non-diagnostic due to their manufacture as well. Expedient tools or tools made quickly that lack stylistic attributes can be complete but non-diagnostic (Binford 1980, Whittaker 1994).

Preliminary Steps Prior to Entering the Field

The methodology followed for establishing the typology for Cuncaicha was partially based on previous work. The Klink and Aldenderfer (2005) book chapter was used as a guide, but subtle changes were made for the study of Cuncaicha's materials. Retouch was considered a factor in the morphology of the projectile points and was assumed to be expressed in the ratio between total length and total width (Andrefsky 2006). Due to the proximity of Alca obsidian outcrops to Cuncaicha, resource procurement and available package size were not considered a contributor to overall morphology of the projectile points (Andrefsky 1994, Brantingham 2003, Andrefsky 2009). Other considerations from Klink and Aldenderfer (2005), such as haft morphology, presence or absence of a shoulder, and presence of barbs or a spine were used while establishing the typology.

For establishing types, I utilized Andrefsky's (2010) "flow-chart" methodology. Prior to beginning the flowchart, the total collection of projectile points was sorted into diagnostic vs non-diagnostic points. Projectile points were considered diagnostic if they were complete, had morphological characteristics such as shoulders, or a complete proximal portion. Artifacts are considered complete if they do not show any breaks that would indicate a portion is missing. This process is inherently subjective, but using the advice from Andrefsky (2010), classification of projectile points was done on a standardized basis across all specimens. According to Andrefsky, if a projectile point or hafted biface is going to fracture, it will break along a line between the distal and proximal ends of the point. Distal ends will either stay with the prey, be discarded, or lost. Thus, broken artifacts are more likely to be representative of proximal and not distal fragments. Understanding this concept helps to eliminate inconsistency and allows for standardization of the typology by disregarding distal fragments that are not considered diagnostic (Whittaker et al. 1998). Another preliminary step was creating preliminary groupings based solely on digital images. The digital images that were used were taken during the 2015 and 2018 field seasons. Using these images, the projectile point collection was sorted into groups based on similar morphological traits. Due to the small scale, these first sorts were not consistent with the total collection of over 1100 projectile points and the final typological groups. This step served as practice prior to entering the field in the summer of 2018.

Another preliminary step prior to entering the field was to examine and compile primary sources cited in the Klink and Aldenderfer chapter. Each figure that was referenced in the chapter was compared to the original source publications. Variation was found within the types that the authors defined. This new information was used as a visual cross-comparison tool when applying their classifications to the projectile points at Cuncaicha.

Artifact photos from the Cuncaicha collections were taken during 2010 and 2012 by Rademaker, and by Erica Cooper during the December 2018 field season. Each artifact was photographed twice (once on each side) with a metric scale bar and edited afterward in Adobe Photoshop by Erica Cooper. The camera that was used for the 2010 and 2012 projectile point collections was a Canon G10 14.7-megapixel digital camera using a macro setting. A 24.3-megapixel Sony α6000 with a model standard E PZ 16–50 mm F3.5–5.6 OSS lens was used during the December 2018 field season for the 2014 and 2015 Cuncaicha collections and for the projectile points from Pampa Colorada.

Typology Creation

Projectile points were classified as diagnostic or non-diagnostic. Each diagnostic group was then separated into two subgroups of complete and fragmentary because time constraints prioritized complete projectile points over diagnostic but fragmentary artifacts. Each group was then further sorted by temporal period using the dated stratigraphic sequence. For example, one group was comprised of Terminal Pleistocene complete projectile points and one group comprised of fragmentary Terminal Pleistocene projectile points. Excel catalogs were provided which contained provenience information. A similar methodology was used for sorting the projectile points obtained from Pampa Colorada

Measurements

Tools used for the measurements are standard equipment for lithic analysis. Electronic-calipers precise to the nearest $1/100^{th}$ of a mm, a clear plastic ruler, and graph paper separated into 1 mm boxes were utilized. Each tool was used to either obtain measurements or used to aid in precise data collection. Figure 4.2 below provides a graphic representation of all the measurements taken for the study.

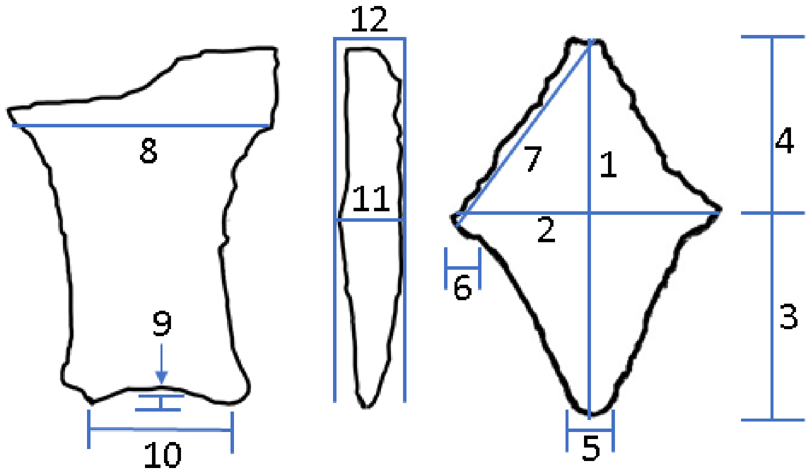

Figure 4.2 Diagram of all Measurements Taken

1=Maximum Length, 2=Maximum Width, 3=Stem/Haft Length, 4=Blade Length, 5=Basal Width, 6=Shoulder Notch Depth, 7=Blade Curvature, 8=Maximum Shoulder Width, 9= Basal Concavity Depth, 10=Basal Concavity Width, 11=Basal Thickness, 12=Maximum Thickness

Step one was deciding which measurements would be the most useful. Similar methodology used by Klink and Aldenderfer (2005) and information published in Andrefsky (2010) was utilized. Overall, 12 measurements were taken: maximum length, maximum width, haft length, blade length, basal width, weight, max basal thickness, maximum thickness, basal concavity depth, blade curvature, shoulder width, notch depth, and maximum basal concavity width. Some measurements could not be obtained because projectile point specimens did not have the correct characteristics, such as lacking a basal concavity. Also, metric measurements were combined into different ratios: Blade length to maximum width, haft length to blade length, maximum length to maximum width, and basal thickness to maximum thickness.

Specific measurements that are not associated with the maximum size of a metric attribute were standardized. Blade length measurements began directly superior to the point's shoulder or spine. Haft or stem measurements were considered to begin directly inferior to the shoulder or spine. On points where this transition was not visible, the measurements were not taken to avoid subjective error. Basal concavity depth was measured by placing a projectile point flat on a sheet of graph paper and penciling a mark on the deepest section of the concavity and at the base of a basal ear. Each 1 mm square between the two marks would be counted for the measurement. Using this methodology has both positive and negative attributes. Accurate measurements could be produced but should not be considered as precise as other measurements.

Blade curvature was determined by tracing an outline of the projectile point with a standard #2 pencil and drawing a straight line using a ruler from a projection to the tip of the tool. A projection could be a spine, shoulder, or the end of a basal ear. The final step for calculating blade curvature was measuring the greatest distance between the drawn line and the edge of the blade. This measurement could not be used if the tip of the tool was broken or if the blade could not be distinguished between the haft or stem. Cross-section drawings were also traced during this step by tracing the base of the artifact against a blank paper. Weight was recorded using an electronic scale that measured to 0.1 gram.

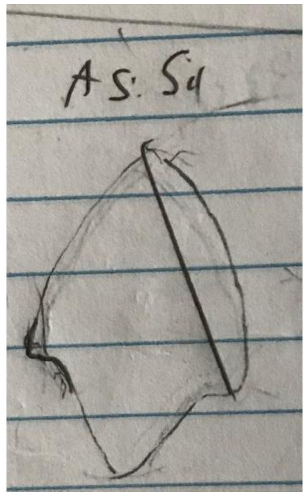

Figure 4.3 Pencil Drawn Outline of AS 54 with Blade Curvature Measurement

TpsUtil64 was used to supplement record measurements not taken in the field. This program scales images using known distances between two markers. Metric scale bars were utilized to scale the images as accurately as possible. Additional markers can then be placed on scaled images to obtain measurements that were not taken in the field.

In summer 2018 data were collected on 385 projectile points from Cuncaicha and Pampa Colorada. During the second field season in December 2018, data were collected on 136 points from Pampa Colorada and an additional 37 artifacts from Cuncaicha. In total, measurements were collected on 585 projectile points.

Description

Descriptions were made for every point measured. These descriptions included information on flaking quality, color, and appearance of the material used to manufacture the point, completeness of the artifact, and other characteristics such as patination. Klink and Aldenderfer (2005) types would also be assigned during this step by comparing the point from

Cuncaicha to their metric data, figures, and type descriptions. If the point did not fit within their scheme, no type was assigned.

Morphology

Prototypes were then created based on morphology. Initial groups were based on gross characteristics such as the presence of a basal concavity or a confident Klink and Aldenderfer type assignment. Types were then further refined based on specific morphological characteristics such as the presence or absence of a shoulder notch. These types were preliminary and were refined throughout the study.

Metric Measurements

The refined types were then described and measured. Metric data were used to compare points within a type. Each type was examined, and relatedness was determined based on metric attributes. If projectile points within a defined type shared a similar morphology but varied considerably in metric measurements and ratios, these points were not considered to be of the same type but were noted as possible variants. In addition, 2σ ranges for each type were established by calculating the mean and standard deviations of each measurement. For example, if projectile point AS XXXX measured 28.21 mm in maximum length and the calculated 2σ range of maximum length for morphologically similar points were 17.78-27.98 mm, the point's typological assignment would be revaluated. Depending on the morphological characteristics of the point, the artifact would be either assigned to a more appropriate type or be used to extend the maximum length range of the first type.

Stratigraphy

Each point's type assignment was then examined based upon its position within Cuncaicha's stratigraphy. Cuncaicha is a well-stratified site with minimal mixing between layers and because projectile point types can be used as temporally diagnostic time markers, points of the same type should cluster stratigraphically. Prototypes were flagged for reevaluation if points were found in widely separated strata If only one point was found to have an anomalous stratigraphic position, it would be reevaluated and compared against points found near the artifact using metric data. It is important to note that metrics were weighted heavier than stratigraphic position when refining groups for this step. However, translocation is possible due to bioturbation. If points within groups were suspected to have been translocated, they would be evaluated individually. However, this is a rare occurrence at Cuncaicha.

At the end of the 2018 summer field season, more than 80 projectile point types had been defined. From these 80+ types, only 42 types had at least two specimens. The remaining 47 types had only a single specimen and were considered unique.

Further Refinement

Prior to the statistical tests to confirm group membership, the refinement process began with photos, 3D models, and metric variables. Prototypes that were previously created were rearranged by combining and splitting types based on morphological similarity and metric data. Photos were then stitched together to create a single image of the newly refined type using GIMP photo editor. 3D models were then used to supplement the photos for attributes that cannot be seen in the 2D photos, such as maximum thickness. The 3D models are accurate enough to compare gross morphological characteristics and were helpful when edited artifact photos were not available. If points within a type did not match the others, they would be removed and placed into the correct type. By cross-referencing metric and stratigraphic data, the first refinement of the Cuncaicha typology had 20 distinguished types. In addition, descriptive statistics were used to create ranges for each type's measurements. These data were then used to type points that were considered "unique" or only had one specimen to see if they fit within any of the newly established types. Four separate refinement phases occurred throughout Fall 2018 and Spring 2019.

Comparison Between Pampa Colorada Points and Cuncaicha Types

The first step in this comparison was identifying projectile points from Pampa Colorada that are morphologically similar to Cuncaicha's identified types. This was done using photos, 3D models of projectile points, and the artifacts themselves. Early Holocene sites from Pampa Colorada were initially targeted because they are the oldest sites in the region and were superficially thought to have the most similar types of points. Points from Pampa Colorada were then assigned a prototype. These original type destinations were not final and would change throughout the following steps. In addition, Klink and Aldenderfer types were assigned if applicable.

Descriptive statistics were generated for the Pampa Colorada. Averages and 2σ ranges were then compared to the means and ranges from similar Cuncaicha types. If vital measurements such as basal width, haft length, and the various ratios overlapped for the Pampa Colorada points, they would be flagged. Throughout this process, references would be made to the original source material for Pampa Colorada if applicable (McInnis 2006). Comparisons were then made between the original Klink and Aldenderfer type assignments made by McInnis and my new Klink and Aldenderfer type assignments. If there was disagreement between the original and new assignments, the point would be flagged as a possible type misidentification.

Following this step, Mann-Whitney nonparametric statistical tests were performed to examine the Pampa Colorada and Cuncaicha points as separate entities. Mann-Whitney tests were used because of the ability to test small sample sizes of non-normally distributed data and because previous authors have used similar methodologies for projectile points (Hockett 1995). This test is useful to detect differences between two populations where a significant result signifies that the samples are not from the same group. Mann-Whitney tests require that sample sizes are > five, the samples are independent of each other, and the data are continuous (Hockett 1995). Following the methodology described by Hockett (1995), I calculated the U-scores for each applicable measurement from both projectile point populations with the following equation:

$$U = NM + \frac{N(N+1)}{2} - \sum_{x_i} Rank(x_i)$$

where: U=Mann-Whitney U test, N = sample size, M= median.

Results were considered significant at p > .05. The equation then yielded U-scores which were compared to a table of critical values and then converted into a Z-score. This Z-score then provides a p-value that shows statistical significance. An online calculator was used to aid in the application of the calculations to my data. Measurements from both populations were entered into the calculator and the results entered into an excel document(Stangroom 2019).

Finally, discriminant function analysis (DFA) was performed to test individual points' type membership following the methodology from Kevinsen (2013) using the statistical software package SPSS version 24. For this analysis, the "leave one out" option was used in SPSS. DFA is used to classify individuals who have unknown group membership and provide group classification probabilities (Kevinsen 2013). This option performs DFA for each individual projectile point against the group to which they are originally assigned, without the individual point's data being a part of the groups. The output of this analysis provides a probability percentage of which group an individual (projectile point) belongs to. These estimations were used as a final refining step for the typology. It is important to note that group membership estimations can only be produced on points that are complete or nearly complete. If a point was missing more than two measurements, SPSS would not output a probability of group membership for that individual.

The following measurements and ratios were included in the analysis: maximum width, haft length, basal width, maximum thickness, basal thickness, maximum length, blade length, shoulder width, and maximum length to maximum width. Measurements such as basal concavity depth and basal concavity width were not included in this analysis. This is because the types with basal concavities are easily recognized types (Sumbay or Late Holocene triangular points). See Appendix D for the full list of group membership probabilities.

3D models

A three-dimensional model (3D) is a graphical representation of an object in digital space. 3D models were created using Agisoft Photoscan version 1.5.0 and photogrammetric techniques. Agisoft is a modeling program that detects similarities between photos to render points in a three-dimensional space. Photogrammetry is the process of taking photos of an object at different angles to capture every face. Agisoft creates sparse and dense clouds, meshes, and textures. A sparse cloud is the initial rendering of data points that shows the basic outline of the object. Dense clouds are similar but contain thousands of data points. Meshes are a collection of polygons that connect the data points from the dense cloud and are solid 3D objects. Textures are photographic files applied to the solid mesh object and show more detail of the surface. A 24.3-megapixel Sony α6000 with a standard E PZ 16–50 mm F3.5–5.6 OSS lens was used to take the photographs for the photogrammetric models.

The creation of 3D models followed the methodology described by Porter et al. (2016) for a field-ready photogrammetry rig that is durable, portable, and inexpensive. The following section details the rig's components.

The photogrammetry rig is comprised of the following components: 2x2 foam tiles, black cloth, a lazy Susan with equally spaced highlighter markings, a black rubber eraser stand, a medium to high-end camera, and a tripod. The foam tiles form the base of the rig and are covered in black cloth. Markings on the lazy Susan are equally spaced 10° apart the rubber eraser holds the artifacts in place.

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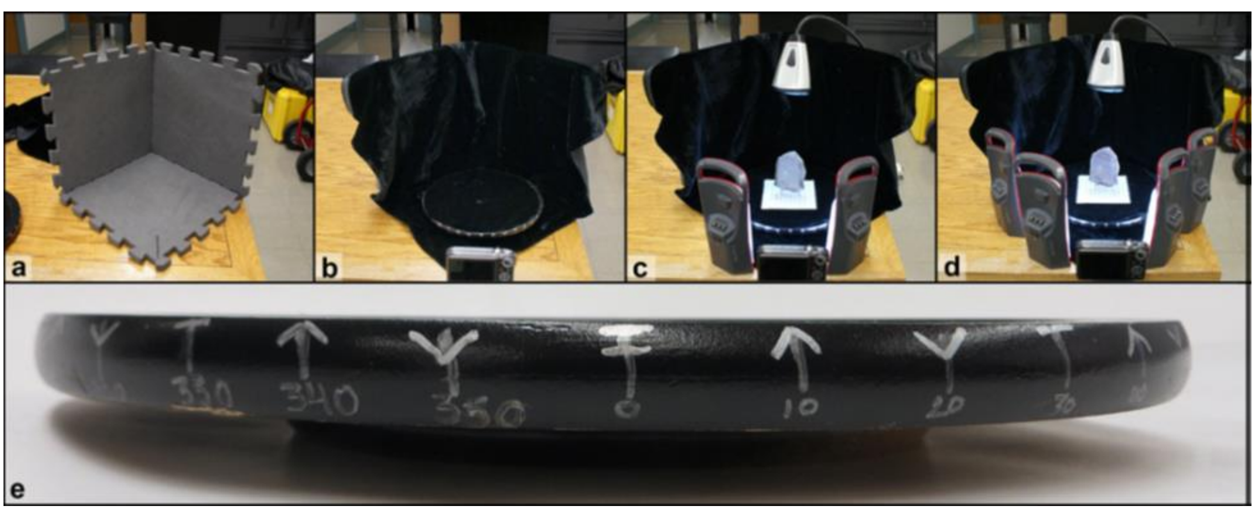


Figure 4.4 An Example of a Completed Photogrammetry Rig. From Porter et al. 2016

The lighting apparatuses were detachable Coleman lamps that are 190 lumens and a clip-on LED light that was attached to the back wall of the rig. Coleman lamps lit the front and sides of the object while the LED clip-on light lit the top. Talcum powder was applied to the surface of all obsidian artifacts to reduce reflectance and increase the chances of rendering a successful model. Non-obsidian artifacts did not require talcum powder to be applied.

Basic standard photogrammetry procedure was followed during the photographing process, with 12 photos being taken from three different heights and the camera being one foot away from the artifact. Once 36 photos were taken, the artifact was flipped along its vertical axis and the process was repeated. The camera settings used for photography were dependent on the room that the photos were taken in and the color of the projectile point. F-stops ranged from 4 to 8 and ISO used ranged from 100 to 800. The darker the material, higher ISOs and F-stops were required. If the room where the rig was located had abundant natural light, lower settings were used. All camera settings were manually set and autofocus was utilized.

The complete set of photos were then uploaded onto a computer and imported into Agisoft. Basic photogrammetry procedure was used to create the models (Mason 2017). All sparse and dense clouds were rendered on the “high” setting along with the meshes and textures. Each set of 36 photos was rendered separately and combined using masks created in GIMP photo editor.

In total, 121 3D models of excavated material from Cuncaicha and 57 from various sites in Pampa Colorada were created from over 10,000 photos. Points were chosen to be modeled based on completeness, size of the object, and similarity to other artifacts. Complete projectile points were prioritized because they are the best representations of their type. Larger objects are generally easier to model and take less time to create, and if a point had a nearly exact duplicate, both artifacts were prioritized to show similarity in material culture.

CHAPTER FIVE

RESULTS

Chapter Five is divided into multiple sections. Section One explains the typology for Cuncaicha rock shelter and includes figures and tables that provide examples of each type and variant. Tables provide averages and standard deviations for diagnostic metric measurements. Raw material and provenience information are provided in this section as well. I intend for this section to be used as a guide for archaeologists working in the South-Central Andes when relatively dating new sites. I also evaluate whether previously described point types are consistent with my types from Cuncaicha.

Section Two describes the Pampa Colorada projectile point assemblage and how these points compare with Cuncaicha's typology. In this section, I also compare how the new projectile point type assignments correspond with those reported in Heather McInnis' dissertation (2006). Raw material data are also presented in this section.

Section Three includes types only found at Pampa Colorada. Raw material and metric data are also provided in this section.

Section One: Typology of Cuncaicha Rock Shelter

I measured 365 projectile points from Cuncaicha rock shelter, and 231 were used to construct the typology. Many points (n=134) were measured but not used in the typology because they were considered non-diagnostic fragments upon reexamination. Three-dimensional models were created for 121 points. The typology consists of three series, 17 types, and eight variants.

Series and Types are ordered sequentially and will be referred to by their series number, then their type number (S1T1 for example). Variants will follow their parent assignment but will be differentiated by the addition of "v" at the end of the title (S1T1v). Variants are always lower-case. When a type has multiple variants, a Greek letter will be used to identify the specimen (S1T1vα). Other previously established typologies for the region follow a general scheme that occasionally overlaps with my scheme. This system is flexible and if revisions need to be made, type names can be changed, or new types can be added to create a more accurate typology.

Series are in chronological order, with Series 1 being the oldest and Series 3 is the most recent. Types within series follow roughly the same pattern, for example, S1T1 is older than S1T4. This is not always consistent in Series 3 because of the stratigraphic constraints of Cuncaicha's Late Middle Holocene and Late Holocene layers.

Table 5.1 shows how many specimens were defined for each type, the 2σ range for various diagnostic measurements, and ratios for each type. The types and series are sorted in general stratigraphic and chronologic order. All measurements reported in all tables in this chapter are in mm. Figure 5.2 shows the temporal ranges (ka) for each type, and Figure 5.3

presents the ranges for the Klink and Aldenderfer (2005) types that are similar to the Cuncaicha types. Appendix A provides a complete list of each measurement for every projectile point from Cuncaicha included in this study. Date ranges presented for the Klink and Aldenderfer (2005) types have been calibrated to be comparable with the Cuncaicha radiocarbon dates (Rademaker 2012).

Type Descriptions

At Cuncaicha rock shelter and the surrounding workshop sites, two Fishtail bases and one fluted fragment have been found. The Fishtail type is S1T0. Artifact specimen (AS) 150918 was excavated in 2015 by Dr. Rademaker and represents the only Fishtail point from a stratified sequence at Cuncaicha. AS 150918 is made from a cream-colored, vitreous chalcedony. It is fragmented, with the haft remaining intact and the distal portion of the blade missing, which has yet to be recovered. A fluting flake removal is present on one face.

Figure 5.1 Photo of AS 150908 Fishtail Projectile Point

AS 1129 is another confirmed Fishtail projectile point. This example was found during surface survey of the Pucuncho workshop site (Rademaker et al. 2014). AS 1129 is fragmented similarly to AS 150918, but it is made from local andesite. AS 1129 also has a deeper basal concavity, a larger “flute” flake scar, and has a larger section of blade remaining. Both specimens are expertly manufactured with flake scars that would require skill and experience to produce. Although both specimens display the iconic characteristics of the Fishtail projectile point, comparing the artifacts is an interesting exercise in variation of point type. AS 801 was found 5 meters from AS 1129 at the Pucuncho workshop and is made from obsidian (Rademaker et al. 2014). I would not classify AS 801 as a Fishtail projectile point because it is too fragmentary to be typed. I include it in this discussion because of the large “flutes” on both faces. The flutes are located centrally on both faces and are nearly as wide as the artifact. Without the flaring basal ears, I cannot confidently say that this artifact is a Fishtail, but because of the flutes, it may be Terminal Pleistocene in age.

Summary of Cuncaicha Projectile Point Assemblage

Type	# of Specimens	Max Length	Max Width	Haft Length	Basal Width	Blade Length	Blade Length to Max Width	Max Thickness	Basal Thickness	Basal Concavity Depth
S3T6v	10	15.11-30.91	13.20-20.88	-	10.67-20.15	-	-	2.88-6.12	-	-
S3T6	73	11.42-33.02	10.90-22.22	-	-	-	-	2.40-6.24	-	-
S3T5	7	23.22-37.82	14.99-24.37	7.96-19.54	-	13.60-20.19	0.68-1.01	5.54-8.76	4.83-6.96	-
S3T1v	10	19.84-38.01	17.89-25.55	5.88-14.07	1.28-4.79	-	-	4.73-7.21	2.00-6.37	-
S3T1	8	-	20.00-27.28	2.95-11.17	3.53-8.15	-	-	4.48-8.41	2.22-7.30	-
S3T4	8	-	19.99-30.18	-	10.41-19.14	-	-	4.33-8.75	2.98-4.00	1.25-5.37
S3T2	11	-	15.08-26.25	6.13-14.64	8.30-14.76	16.53-31.77	0.78-1.52	5.95-9.76	3.11-7.24	-
S3T3v	12	-	19.55-28.39	-	14.52-26.52	-	-	4.30-6.90	-	0.61-5.29
S3T3	5	-	20.59-36.05	7.71-19.48	16.94-25.35	-	-	6.06-11.15	3.50-7.98	2.17-7.83
S2T6	9	19.37-44.89	12.87-23.95	6.74-20.66	5.13-11.05	9.87-26.99	0.60-1.40	7.34-9.88	4.62-6.86	-
S2T5	7	22.60-48.41	15.65-24.36	-	-	1.50-22.53	-	5.01-9.55	6.37-7.33	-
S2T4v	6	26.91-36.43	22.04-24.78	-	-	-	-	4.87-6.71	2.72-6.4	-
S2T4	4	28.35-35.48	15.25-28.07	8.30-12.76	-	16.31-25.45	0.81-1.21	3.97-8.03	2.91-6.43	-
S2T3	6	14.40-52.25	12.65-25.50	13.40-23.81	1.29-15.95	-	0.06-1.39	4.50-8.97	4.51-7.51	-
S2T2	15	23.57-36.24	12.46-20.38	9.85-21.82	2.26-9.58	9.20-19.17	0.51-1.28	4.66-8.21	3.33-7.8	-
S2T1	2	22.32-31.64	10.35-14.27	6.33-17.69	2.96-5.32	13.97-15.97	0.94-1.50	4.32-5.48	2.93-4.65	-
S1T5	4	34.94-45.45	15.60-22.80	7.63-18.76	3.29-6.92	20.47-33.52	1.02-1.87	4.70-8.84	2.86-6.66	-
S1T4v	2	20.17-23.13	19.31-19.99	6.20-8.68	3.19-3.27	13.94-14.42	0.72-0.72	5.24-5.28	1.83-6.23	-
S1T4	2	23.08-23.84	14.94-23.54	9.09-15.01	-	8.85-13.97	0.34-0.86	4.80-5.40	4.07-4.47	-
S1T3v	3	18.73-31.49	11.55-23.39	8.15-14.95	-	10.30-16.82	0.69-0.85	3.14-6.74	1.79-6.43	-
S1T3	8	19.02-40.38	11.60-25.08	4.10-18.66	4.09-9.53	12.10-24.54	0.71-1.31	4.37-6.89	3.02-7.10	-
S1T2	4	26.32-44.00	17.24-22.72	7.78-14.62	0.27-8.43	17.86-30.06	0.82-1.66	4.17-8.97	3.29-7.13	-
S1T1vα	3	18.50-38.18	14.64-24.52	2.96-16.92	-	9.58-27.26	0.34-1.58	3.80-7.28	3.44-6.72	-
S1T1v	7	17.68-48.04	13.18-28.70	10.14-22.46	0.35-6.35	4.97-28.37	0.24-1.52	3.77-8.29	2.55-7.43	-
S1T1	4	24.99-31.31	13.81-20.09	10.26-16.18	1.99-6.39	13.12-17.32	0.62-1.26	3.01-7.53	2.60-6.00	-
Fishtail	1	28.90	22.13	21.81	15.40	-	-	3.61	3.61	2.00
Total	231	-	-	-	-	-	-	-	-	-

Table 5.1 Summary Table of Cuncaicha Typology with 2σ Ranges and Units in mm

Figure 5.2 Time Range of Cuncaicha Types in ka

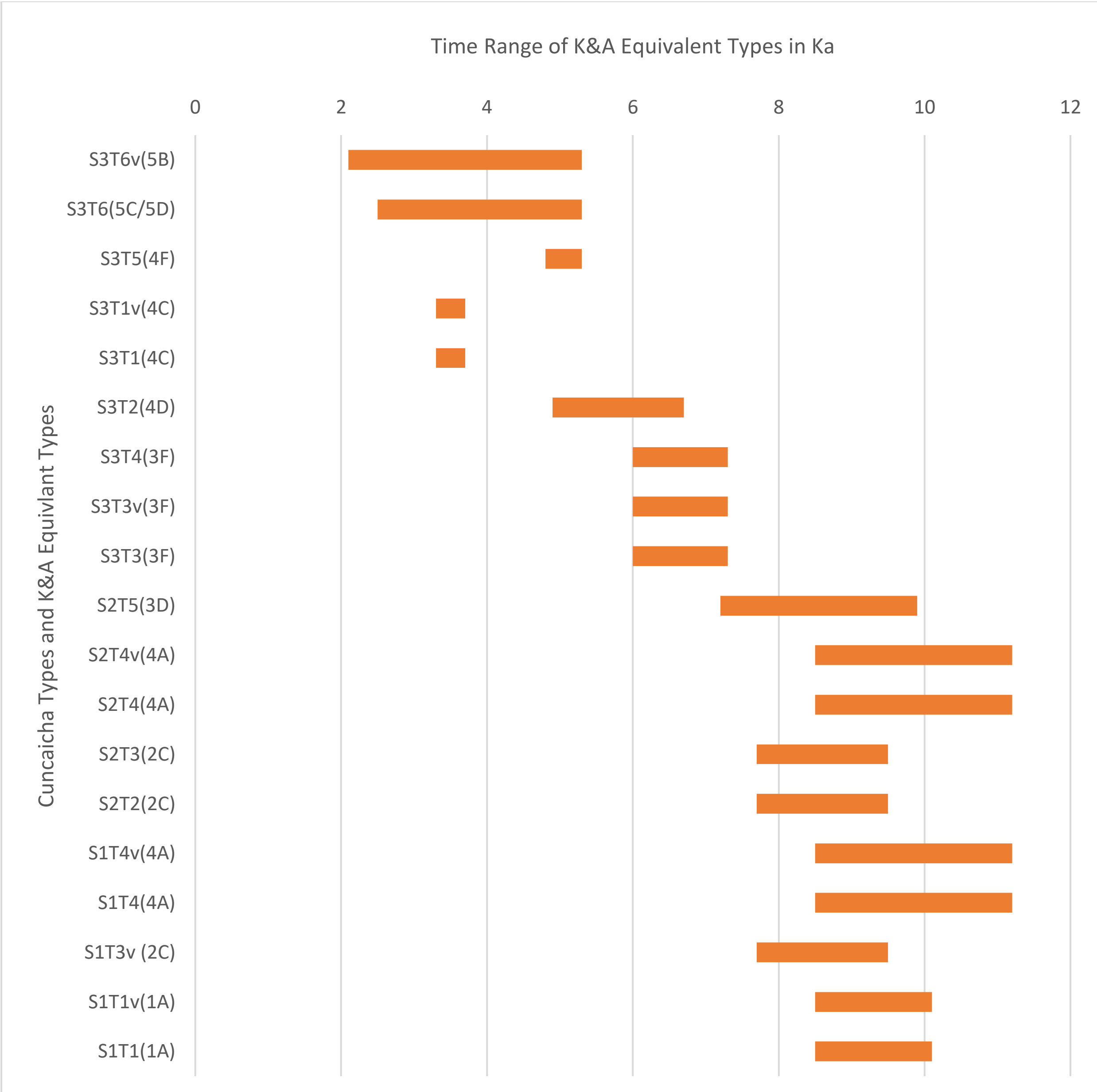


Figure 5.3 Time Range of Klink and Aldenderfer (2005) Types Similar to Cuncaicha Types

Series One (12.5-9.0 ka)

Series One contains forms that are diagnostic to the Terminal Pleistocene and Early Holocene. The AMS date range for the Terminal Pleistocene at Cuncaicha is 12.5-11.2 ka, and 23 separate dates contributed to this range. The AMS date range for the Early Holocene is 9.5-9.0 ka and is based on seven dates (Rademaker and Hodgins 2018). Series One spans the Terminal Pleistocene to Early Holocene because the types within the series have specimens that were found in layers dating to both time periods. All types within this series are stemmed with contracting hafts and lack basal concavities. Straight lateral haft margins are common throughout this series as well. Most of the types within Series One, with the exception of S1T2, have geometrical morphologies (pentagon, square, triangle, etc.). Within Series One there are five types, three variants, and one sub-variant.

S1T1

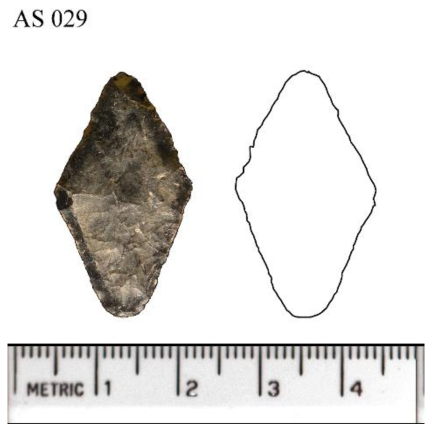


Figure 5.4 Example of S1T1 and Outline of the Opposite Face

Series One Type One (S1T1) is defined based on four examples from Cuncaicha's Terminal Pleistocene layers. Overall morphology is diamond-shaped with a contracting stem. All examples have straight to slightly concave stemmed lateral margins that extend to a narrow (<5 mm) rounded base. All specimens that were used to define this type were complete and show minimal damage or fractures. AS 29 shown in Figure 5.4 is the prototypical example for S1T1. All specimens are longer (~28 mm average) than they are wide (16.9 mm average). One artifact defined for this type, AS 140455, has a concave blade with heavy retouch. This is an example of morphological variation within S1T1.

AS#	Total # of Specimens	Raw Material	Max Length	Max Width	Haft Length	Basal width
29	1	Obsidian	30.04	16.73	13.91	5.40
150492	1	Obsidian	26.35	15.1	11.00	4.81
140455	1	Obsidian	27.71	17.04	14.00	3.02
151652	1	Obsidian	29.70	18.95	14.00	3.54
Mean	-	-	**28.45**	**16.95**	**13.22**	**4.19**
STDEV	-	-	**1.73**	**1.57**	**1.48**	**1.10**
RANGE 2σ	**4**	-	**24.99-31.91**	**13.81-20.09**	**10.26-16.18**	**1.99-6.39**

Table 5.2 Metric Data for S1T1 Specimens

Similar point forms to S1T1 can be found at the following sites: Asana (Aldenderfer 1987), Patapatane (Santoro and Nunez 1987), Caru (Ravines 1967), Toquepala (Ravines 1972), Acha-2 (Munoz Ovalle et al. 1993), Sumbay-2 (Neira 1990), Pachamachay (Rick 1980), and Telarmachay (Lavallee et al. 1985).

S1T1v

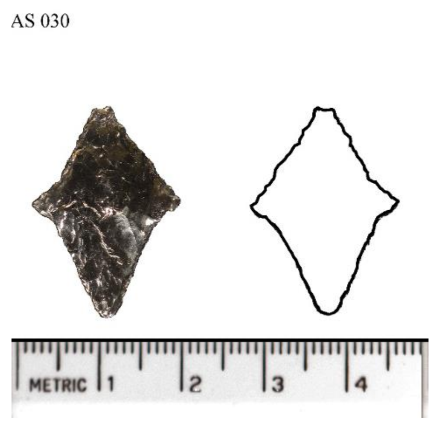


Figure 5.5 Example of S1T1v and Outline

Series One Type One variant (S1T1v) is based on seven examples and is defined as being shouldered and diamond-shaped with a contracting stem. Blade shape is an isosceles triangle. Shoulders are occasionally spined, but because this feature can be easily broken during use or deposition, it was not considered as diagnostic for this variant. S1T1v differs from its parent type in multiple ways. The presence of a defined shoulder is considered the most diagnostic. Metrically, S1T1v is wider than its parent type (mean=20.94 mm, std dev (σ)=3.88 mm) vs (mean=16.90 mm, std dev=1.57 mm)) and has a higher standard deviation in haft length (3.08 mm). The difference in width is due to the horizontal flaring shoulder. Because of the narrow and rounded base and diamond-shaped morphology, I consider these types as related

S1T1v also differs from S1T1 temporally. Unlike the parent type, three variant specimens were excavated from Early Holocene layers at Cuncaicha dating to 9.5-9.0 ka. This indicates that both styles of diamond, shouldered and non-shouldered, were used in the Terminal Pleistocene, but the shouldered versions had a longer span of use. diamonds most likely are

S1T1v is morphologically more similar than S1T1 to Klink and Aldenderfer's Type 1A due to the presence of the spine or shoulder, which has been found at the following sites: Asana (Aldenderfer 1989), Patapatane (Santoro and Nunez 1987), Caru (Ravines 1967), Toquepala (Ravines 1972), Acha-2 (Munoz Ovalle et al. 1993), Sumbay-2 (Neira 1990), Pachamachay (Rick 1980), Telarmachay (Lavallee et al. 1985), and Guitarrero Cave (Lynch 1980).

AS#	Total # of Specimens	Raw Material	Max Length	Max Width	Haft Length	Blade Length	Blade Length to Max Width
151966	1	Obsidian	34.90	22.80	18.00	16.90	0.74
12261	1	Obsidian	43.68	18.38	17.00	26.68	1.45
30	1	Obsidian	24.48	17.45	12.20	12.28	0.70
151857	1	Obsidian	26.80	17.16	12.74	14.06	0.81
12460	1	Obsidian	-	27.40	15.52	-	0.49
12355	1	Obsidian	34.42	19.38	20.97	13.45	0.69
151864	1	Obsidian	-	24.03	17.64	-	0.63
Mean	**-**	**-**	**32.86**	**20.94**	**16.30**	**16.67**	**0.88**
STDEV	**-**	**-**	**7.59**	**3.88**	**3.08**	**5.85**	**0.32**
Range 2σ	**7**	**-**	**17.68-48.04**	**1 3.18-28.70**	**10.14-22.46**	**4.97-28.37**	**0.24-1.52**

Table 5.3 Metric Data for S1T1v Specimens

S1T1vα

Figure 5.6 Example of S1T1vα and Outline

Series One Type One Variant Alpha (n=3) is the only sub-variant within the Cuncaicha typology. Morphologically, S1T1vα is similar to S1T1v but differs due to a shorter body plan for the stemmed portion. Both variants of S1T1 have clear spines that extend horizontally away from the point's body and have stems that are wide and pointed. Temporally, S1T1vα overlaps with S1T1v but is younger than S1T1 due to AS 150748 being excavated from an Early Holocene layer. This type is interesting because it showcases the morphological variation within diamond-shaped body plans that are common to the Terminal Pleistocene and Early Holocene.

AS#	Total # of Specimens	Raw Material	Max Length	Max width	Haft Length	Blade Length	Blade length to Max Width
156	1	Obsidian	22.88	19.04	9.00	13.88	0.73
150758	1	Obsidian	29.72	17.42	7.00	22.72	1.30
32	1	Obsidian	32.43	22.28	13.77	18.66	0.83
Mean	-	-	**28.34**	**19.58**	**9.92**	**18.42**	**0.96**
STDEV	-	-	**4.92**	**2.47**	**3.48**	**4.42**	**0.31**
RANGE 2σ	3	-	**18.50-38.18**	**14.6-24.52**	**2.96-16.92**	**9.58-27.26**	**0.34-1.58**

Table 5.4 Metric Data for S1T1vα Specimens

S1T2

AS 054

Figure 5.7 Example of S1T2 and Outline

Type S1T2 is defined based on four examples from Terminal Pleistocene (n=2) and Early Holocene (n=2) layers. This type has a contracting stem to a pointed base with basally notched shoulders that form a less than (<) 90º angle. Type S1T2 differs from S1T1v due to the downward sloping shoulder angle and lack of diamond-shaped morphology. AS 054, as shown above, is the prototypical example of S1T2. While the distal portion is inferred to be heavily retouched (convex lateral blade margins and asymmetrical blade), the stem and shoulders are completely intact. Apart from the lack of large flake scars or missing portions on the lateral margins, the barb located on the left shoulder is further evidence for the completeness of this point.

Variability in this type comes from the fragmentary nature of the other specimens. For example, AS 150550 is one of the Terminal Pleistocene specimens but lacks shoulders. By examining the point, I was able to determine that this was not a stylistic choice but rather this was due to breakage during or after the use life of the object.

S1T2 is somewhat morphologically similar to Klink and Aldenderfer's Types 4A and 4C. The most important distinction is based on the morphology of the base. Types 4A and 4C have parallel-sided stems that only contract if the bases are pointed. Types 4A and 4C are shown occasionally to have flat bases. Type S1T2 stems begin to contract immediately below the shoulder and only have pointed bases. Temporally, 4C is diagnostic to the Late Holocene (3.7-3.2 ka) and 4A to the Early Holocene (11.2-8.5 ka). S1T2 chronologically predates all 4C examples and has only some overlap with 4A. This could be due to the lack of Terminal Pleistocene sites in the Klink and Aldenderfer (2005) publication or that the types are distinct.

Points morphologically similar to S1T2 have been found at Asana, Hakenasa and Las Cuevas (Santoro and Nunez 1987), El Panteon (Aldenderfer 1998), Yara (Rasmussen 1998), Tojo-Tojone (Dauelsberg 1993), Pachamachay (Rick 1980), and Toquepala (Ravines 1972).

AS#	Total # of specimens	Raw Material	Max width	Haft Length	Blade Length	Blade Length to Max Width	Max Thickness
140183	1	Obsidian	21.41	-	-	-	7.71
150550	1	Obsidian	19.21	13.16	26.74	1.39	7.70
54	1	Obsidian	20.82	10.43	20.7	0.99	4.83
150904	1	Quartzite	21.89	15.53	18.49	1.32	6.05
Mean	-	-	**19.98**	**11.20**	**23.96**	**1.23**	**6.57**
STDEV	-	-	**1.37**	**1.71**	**3.05**	**0.21**	**1.40**
RANGE 2σ	**4**	-	**17.24-22.72**	**7.78-14.62**	**17.86-30.06**	**0.82-1.66**	**4.17-8.97**

Table 5.5 Metric Data for S1T2 Specimens

S1T3

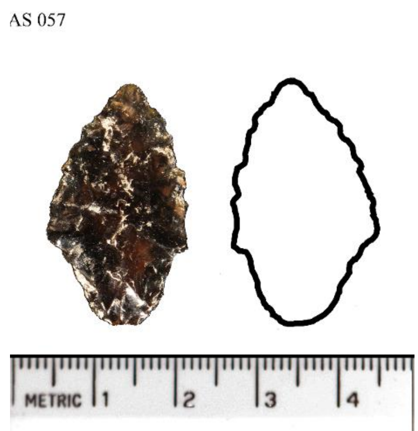


Figure 5.8 Example of S1T3 and Outline

S1T3 is defined based on eight specimens from both Terminal Pleistocene (n=5) and Early Holocene (n=3) layers. AS 074 was excavated from a contact layer between the Terminal Pleistocene and Early Holocene and AS 150594 comes a unit that has a burial dated to ~9.0 ka. I cannot confirm that S1T3 is a diagnostic Terminal Pleistocene type, but I can infer that it is at least Early Holocene in age.

Points defined as S1T3 are stemmed with uneven shoulders. Shoulder angles are about 90º with one being located above the other on the lateral margins. Bases are flat to slightly rounded but do not come to a point as seen in S1T2. Stems are broad and contract less steeply than both previously defined types in this series. Blades are roughly triangular with no lateral modifications. AS 057, as shown above, is the prototypical example of this type because of the completeness of both the proximal and distal portions. S1T3 has fine flaking scars, which is a common attribute found within all types and variants in Series One.

Variation in this type is seen in the base with examples AS 031 and AS 150499 contracting more to a point. S1T3 is the first type in Series One that does not have a roughly diamond-shaped morphology or pointed base. I infer that this could represent a change in material culture towards the Early Holocene.

Klink and Aldenderfer Type 4F is most like S1T3 and could be confused with the Cuncaicha type. Both types have shorter stems compared to their blades and rounded to flat bases. Other than these superficial similarities, there are more differences between the types. Type 4F points have straight and parallel-stemmed lateral margins, while all examples defined for S1T3 have contracting hafts. The final and most distinct morphological difference between the types is the location of the shoulders along the lateral margins. In Type 4F, shoulders are horizontal and are roughly parallel to each other. As mentioned previously for Type S1T3, one shoulder is always superior to the other, making the blades appear to be a crooked triangle. Type 4F has equilateral triangles for blades.

It is also important to note that 4F points are diagnostic to the Late-Middle Holocene (5.3-4.8 ka). S1T3 types from Cuncaicha always occur in stratigraphic layers that have radiocarbon dates from the Early Holocene (9.5-9.0 ka) or Terminal Pleistocene (12.5-11.2 ka).

Specimens similar to S1T3 or 4F have been found at various sites. These include Hakenasa and Asana (Santoro and Nunez 1987, Aldenderfer 1987), Jiskairumoko (Aldenderfer 1999), Tulan-54 (Nunez Atencio 1992). Only Hakenasa (5.2-4.8 ka) has a radiocarbon date associated with the 4F example. This further confirms that these types are not the same.

AS#	Total # of Specimens	Raw Material	Max Length	Max Width	Haft Length	Blade Length	Basal Width
74	-	Obsidian	21.19	13.05	7.29	13.90	-
12290	-	Obsidian	30.04	19.60	11.11	18.93	7.66
57	-	Obsidian	29.10	17.26	9.24	19.86	8.16
55	-	Obsidian	36.70	24.14	17.60	19.10	6.39
56	-	Obsidian	32.96	20.57	15.00	17.96	8.04
31	-	Obsidian	35.88	18.34	12.30	23.58	5.84
150499	-	Obsidian	25.74	15.12	11.50	14.24	-
150594	-	Obsidian	26.05	18.65	7.00	19.05	4.79
Mean	-	-	**29.70**	**18.34**	**11.38**	**18.32**	**6.81**
STDEV	-	-	**5.34**	**3.37**	**3.64**	**3.11**	**1.36**
RANGE 2σ	**8**	-	**19.02-40.38**	**11.60-25.08**	**4.10-18.66**	**12.1-24.54**	**4.09-9.53**

Table 5.6 Metric Data for S1T3 Specimens

S1T3v

AS 12112

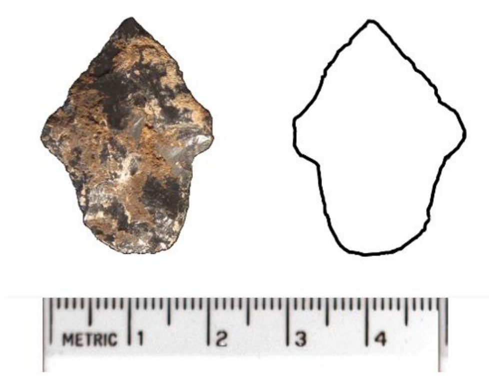


Figure 5.9 Example of S1T3v and Outline

The only variant for type S1T3 is defined based on three specimens that were excavated from exclusively Terminal Pleistocene layers. S1T3v has straighter and more parallel-sided lateral stem margins that extend towards a round (n=1) or flat base (n=2). A diagnostic characteristic that separates S1T3v from its parent type is the rounded spines located on the shoulders and short non-geometric morphology. S1T3 could be described as pentagonal as well but is more elongated with blade lengths on average 7 mm longer than its variant. S1T3v blade (mean=18.32mm, std dev=1.63 mm)and stem lengths (mean=11.55 mm, std dev=1.70 mm) are more even on average as opposed to S1T3 blade (mean=18.32 mm, std dev=3.11 mm) and stem lengths (mean=11.38 mm, std dev=3.64 mm). Another diagnostic characteristic is that while both types have contracting stems, the degree to which S1T3v contracts is lower angle than the parent type. I argue that based on these morphological characteristics, S1T3v is related to S1T3, but it does not constitute the same type. Also, it is important to note that the temporal ranges for both types and variants completely overlap.

AS #	Total # of Specimens	Raw Material	Max Length	Max Width	Haft Length	Blade Length	Blade Length to Max Width
12112	1	Obsidian	28.42	20.68	13.00	15.42	0.74
151555	1	Obsidian	24.88	16.90	12.00	12.88	0.76
12334	1	Obsidian	22.05	14.84	9.67	12.38	0.83
Mean	-	-	**25.11**	**17.47**	**11.55**	**13.56**	**0.77**
STDEV	-	-	**3.19**	**2.96**	**1.70**	**1.63**	**0.04**
RANGE 2σ	**3**	-	**18.73-31.49**	**11.55-23.39**	**8.15-14.95**	**10.30-16.82**	**0.69-0.85**

Table 5.7 Metric Data for S1T3v Specimens

S1T4

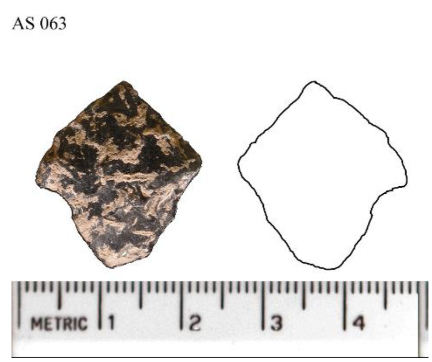


Figure 5.10 Example of S1T4 and Outline

S1T4 is defined from two specimens from a single layer radiocarbon dated to the Terminal Pleistocene. This makes S1T4 one of the only types from Cuncaicha's typology exclusively temporally diagnostic to the Pleistocene. S1T4 has a broad contracting stem to a flat but angled base, with an overall shouldered and contracting stem morphology. Shoulders extend horizontally. Blades are equilateral triangles nearly as long as the haft (mean=11.41 mm, std dev= 1.28 mm) vs (mean=12.05 mm, std dev=1.48 mm). Both examples for this type are made from patinated obsidian. AS 063 was chosen to be the prototypical version of S1T4 because this specimen is less fragmentary than AS 062.

In almost every measurement that I took on both specimens, they are nearly equal, with the maximum width on AS 062 being about 3 mm narrower (17.72 mm vs 20.77 mm). Blade curvature is higher on AS 062 (3.1) with AS 063 having nearly concave blade lateral margins (0.1). It is also important to note that in comparison with the other types in Series One, S1T4 has larger flake scars and appears to exhibit greater amounts of retouch.

Klink and Aldenderfer Type 4A is somewhat like S1T4 but has a narrower stem and better-defined shoulders. The overall morphology of S1T4 is more akin to S1T1v due to the base contracting to a rounded point. The types differ because of the wider stem on S1T4. Blade shapes differ as well, with S1T4 having a more equilateral triangle and S1T1v having an isosceles triangle.

AS#	Total # of Specimens	Raw Material	Max length	Max width	Haft Length	Blade Length	Blade length to Max width
62	1	Obsidian	23.32	17.72	11.00	12.32	0.69
63	1	Obsidian	23.60	20.77	13.01	10.50	0.50
Mean	-	-	**23.46**	**19.245**	**12.05**	**11.41**	**0.60**
STDEV	-	-	**0.19**	**2.15**	**1.48**	**1.28**	**0.13**
RANGE 2σ	**2**	-	**23.08-23.84**	**14.94-23.54**	**9.09-15.01**	**8.85-13.97**	**0.34-0.86**

Table 5.8 Metric Data for S1T4 Specimens

S1T4v

Figure 5.11 Example of S1T4v and Outline

This variant is defined based on two examples from both Terminal Pleistocene and Early Holocene stratigraphic layers. S1T4v has a contracting stem with notched, semi-circular shoulders. Blade morphology is an equilateral triangle. Stem bases are round and narrow with straight lateral margins that have very fine flaking scars. S1T2 shares many morphological characteristics with S1T4v but differs in important ways with haft length being the most diagnostic characteristic. As seen above, S1T2 has an average haft length of 11.79 mm and a σ of 1.71 (n=4). S1T4v has an average haft length of 7.44 mm and a σ of 0.62 (n=2). On average, S1T4v points have short hafts, but formal statistical tests will need to be done once sample sizes are large enough to confirm that these means are statistically distinguishable. On a superficial level, the hafts of these types appear to be different. Another important distinction is that S1T4v has a semi-circular notch that extends into the body of the projectile point. S1T2 lacks this feature due to its shoulders being horizontal and extending laterally. The final difference is that the base of S1T2 extends to a point.

Klink and Aldenderfer's Type 4A is very similar to S1T4v. In terms of morphology, both types share almost all traits, with the exception that type 4A has an angle between the shoulder and haft that is closer to 90º than S1T4v. These types are not the same but are variants of a general morphology

AS#	Total # of Specimens	Raw Material	Max Length	Max width	Haft Length	Blade Length	Basal Width
140171	1	Obsidian	21.10	19.53	7.00	14.10	3.21
151818	1	Obsidian	22.15	19.78	7.88	14.27	3.25
Mean	-	-	**21.62**	**19.655**	**7.44**	**14.18**	**3.23**
STDEV	-	-	**0.74**	**0.17**	**0.62**	**0.12**	**0.02**
RANGE 2σ	**2**	-	**20.17-23.13**	**19.31-19.99**	**6.20-8.68**	**13.94-14.42**	**3.19-3.27**

Table 5.9 Metric Data for S1T4v Specimens

S1T5

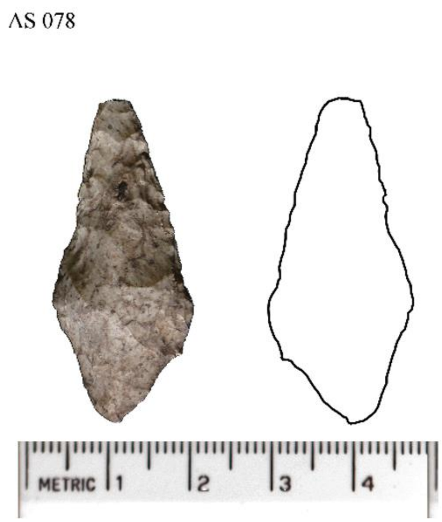


Figure 5.12 Example of S1T5 and Outline

S1T5 is based on four examples that were excavated from both the Terminal Pleistocene (n=1) and Early Holocene (n=3) stratigraphic layers. This type is the last in Cuncaicha's assemblage that has examples from the oldest strata. S1T5 types have contracting stems with rounded lateral midsections extending into long but narrow blades. Stems are pointed, making the general morphology to appear diamond-shaped. Due to the rounded shoulders, however, I would say that a “coffin-shaped” morphology is a more accurate description for this type.

AS 078 is the prototypical example of this type because it is the least fragmentary example. Another interesting feature of S1T5 is that half (n=2) of the points from this type are made from non-obsidian materials, with one example (AS 150905) being securely from Terminal Pleistocene contexts. There appears to be a trend through time with this type becoming stouter and narrower, with the Early Holocene example (AS 078) having the shortest blade and haft. This variability is inherent within material culture and shows that even though morphology can be similar, replication of a type can be vastly different between points.

Regionally, S1T5 is similar to Klink and Aldenderfer Types 2A and 4B. Type 2A is defined as foliate with a contracting stem and no shoulders. The general morphology is diamond-shaped, with the widest point being near or at the mid-section. Rounded shoulders and longer haft lengths are the diagnostic features that separate Type 2A from Type S1T5. Temporally these types overlap, with both types being securely dated to at least the Early Holocene (S1T1=12.5-9.0 ka, 2A=11.1-9.3 ka). Points similar to Type 2A and S1T5 have been found at Asana, Quelcatani, Toquepala (Ravines 1972), Patapatane (Santoro and Nunez 1987), Pachamachay (Rick 1980), and Telarmachay (Lavallee et al. 1985).

Type 4B has been defined as small and narrow, with broad contracting stems. This definition is somewhat like Type S1T5 but lacks a rounded shoulder and has a rounded base. Temporally, Type 4B (11.2-8.5 ka) dates to the Early Holocene. 4B points have been found at Asana, Las Cuevas (Santoro and Nunez 1987), and Pachamachay (Rick 1980).

Based on these differences, I argue that both Types 2A and 4B are not the same type as S1T5 but could be related due to temporal overlap. S1T5 could be the genetic ancestor to the Klink and Aldenderfer types

AS#	Total # of Specimens	Raw Material	Max length	Max width	Haft Length	Blade Length to Max Width	Max Thickness
78	-	Chert	33.16	14.51	8.00	1.73	6.04
150905	-	Chert	45.37	18.29	12.79	1.78	6.44
150261	-	Obsidian	42.68	22.38	11.00	1.41	9.72
150	-	Obsidian	39.56	21.63	21	0.85	4.89
Mean	-	-	**40.19**	**19.20**	**13.20**	**1.44**	**6.77**
STDEV	-	-	**5.26**	**3.60**	**5.56**	**0.43**	**2.07**
RANGE 2σ	**4**	-	**34.94-45.45**	**15.60-22.80**	**7.63-18.76**	**1.02-1.87**	**4.70-8.84**

Table 5.10 Metric Data for S1T5 Specimens

Series Two (9.5-9.0 ka)

The second series within Cuncaicha's typology contains forms that are diagnostic only to the Early Holocene, based on seven AMS radiocarbon dates that range between 9.5-9.0ka. Almost every form has a contracting stem that extends towards either a flat or rounded base. Raw material usage is more diverse in this series, with the introduction of petrified wood and other non-local material. There are six types in Series Two and only one variant. Unlike Series One, Series Two has more non-geometrical morphologies. These are general body plans that are not easily recognizable shapes such as diamonds, pentagons, or squares. S2T2 and S2T3 are exceptions because they are roughly pentagonal.

S2T1

Figure 5.13 Example of S2T1 and Outline

Series Two Type One has a stem that contracts towards a narrow base. This type is willow-leaf shaped, with one lateral margin being convex and one being concave, with a shoulder spine. S2T1 was defined based on two examples from Cuncaicha's Early Holocene layers. AS 140104 is considered the prototypical example for this type because of the completeness of the specimen and easy to observe diagnostic features. These points are narrow (<12.31 mm on average, std dev= 0.99 mm). The single spine and shoulder are located at the mid-section of the point. Both specimens are manufactured from obsidian, with AS 151945 showing more patination than AS 140104. S2T1 is unlike any other type previously discussed for this typology because of its single shoulder and angled base.

S2T1 has similar characteristics to Klink and Aldenderfer Types 2C and 3A. Type 2C is defined as pentagonal with angular to rounded shoulders. S2T1 is roughly pentagonal, but the narrow base, single-spined shoulder, and concave lateral margin make this point more akin to a willow-leaf or a human footprint. 2C points also lack a defined shoulder. Type 2C points have been found at Quelcatani and Asana (Klink and Aldenderfer 2005).

Klink and Aldenderfer's Type 3A is defined as having a wide haft that contracts towards a straight base. The only morphological similarity between S2T1 and Type 3A is the straight or angled base with a contracting stem or haft. Both lateral margins on Type 3A are concave and form a rectangular proximal portion. Temporally, both 2C and 3A overlap with S2T1. Overall, I would argue that these types are alike but cannot be grouped into the same type due to the differences in morphology.

Type 3A has been found at: Quelcatani and Asana (Klink and Aldenderfer 2005), Caru (Ravines 1967), Toquepala (Ravines 1972), Patapatane (Santoro and Nunez 1987), Caru (Ravines 1967), Sumbay-2 (Neira 1990), Pachamachay (Rick 1980), and Telarmachay (Lavallee et al. 1985).

AS#	Total # of Specimens	Raw Material	Max Length	Max Width	Haft Length	Basal Width
140104	1	Obsidian	28.63	13.01	14.02	4.56
151945	1	Obsidian	25.33	11.61	10.00	3.72
Mean	-	-	**26.98**	**12.31**	**12.01**	**4.14**
STDEV	-	-	**2.33**	**0.98**	**2.84**	**0.59**
RANGE 2σ	**2**	-	**22.32-31.64**	**10.35-14.27**	**6.33-17.69**	**2.96-5.32**

Table 5.11 Metric Data for S2T1 Specimens

S2T2

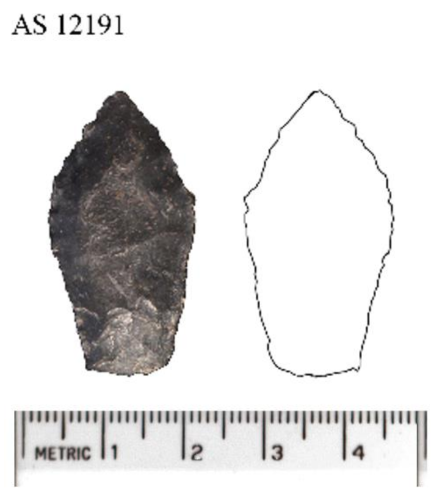


Figure 5.14 Example of S2T2 and Outline

Series Two Type Two is defined based on 15 examples from throughout Cuncaicha's Early Holocene layers. S2T2 is notable because these point forms include the first examples of petrified wood and jasper in the site. S2T2 is pentagonal with a contracting stem, rounded shoulders, and a flat or rounded base. Two examples, AS 151703 and AS 151805, appear to have spines extending horizontally from their shoulders. This is due to fracture unintentional along the lateral margin of the blade. Contracting stems of S2T2 are long and narrow and contract at a steep, sloping angle. AS 150576 and AS 12272 both have serrated blades, which tends to be a diagnostic feature of the Late-Middle Holocene or Late Holocene. This is one of the first examples of blade edge modification at Cuncaicha and could be one of the earliest examples in the region.

AS 12191 (pictured above) is considered the prototypical example of S2T2 because it is a complete projectile point and has easily observable diagnostic features, such as the flat to semi-rounded base and rounded shoulders.

S2T2 differs from S2T1 because of the lack of spined shoulder, contracting stem with only one concave lateral margin, and lack of an angled base. Type 2C is the most similar Klink and Aldenderfer type, with little to no difference between the types and some temporal overlap. S2T2 is an example of a point type found elsewhere in Peru and possibly represents a shared material culture. Table 5.12 below does not have every specimen from S2T2 listed. See appendix A for a complete list.

AS#	Total # of Specimens	Raw Material	Max Length	Max Width	Haft Length	Basal Width
151703	1	Petrified Wood	24.66	13.65	12.00	4.31
12191	1	Obsidian	34.38	17.74	20.00	10.07
12193	1	Obsidian	26.13	14.72	15.00	4.51
151805	1	Obsidian	29.54	20.93	17.5	5.90
150755	1	Jasper	30.90	13.95	14.00	5.85
Mean	-	-	**29.90**	**16.42**	**15.84**	**5.92**
STDEV	-	-	**3.17**	**1.98**	**2.99**	**1.83**
RANGE 2σ	**15**	-	**23.57-36.24**	**12.46-20.38**	**9.85-21.82**	**2.26-9.58**

Table 5.12 Metric Data for S2T2 Specimens

S2T3

Figure 5.15 Example of S2T3 and Outline

Series Two Type Three is related to S2T2 but varies drastically in overall morphology. S2T3 is defined based on six examples from the Early Holocene layers from Cuncaicha. This wide pentagonal type has a contracting stem with slightly contracting lateral margins, a flat or rounded base, and a shoulder spine just inferior to the blade. One diagnostic difference between the types is rectangular stem morphology and shoulder spines. It is also important to note that the stem lateral margins are straight to convex. One similarity between the types is that both have specimens with rounded bases. Even though there are differences between a flat and rounded base, both variants are within the acceptable range of variation for this type. Flake scar patterns on this type appear to be larger than on S2T2.

AS 12221 was chosen as the prototypical example because it is the only complete specimen for this type from the Cuncaicha assemblage. Other examples are either missing most of the distal portion or have fragments missing from the stem. AS 12221 has a long stem that is widest just below the blade, with one visible spine. The lateral blade margins of AS 12221 appear to be formerly serrated but have been ground down from either use or retouch. It is possible that the blade margins have been reworked into a perforator or burin, which makes defining this type based on blade morphology impossible. S2T3 is like Type 2C and could be considered a correlate of that type.

AS#	**Total # of Specimens**	**Raw Material**	**Max length**	**Max width**	**Haft Length**	**Basal Width**
150907	-	Obsidian	20.68	18.08	-	11.19
12502	-	Obsidian	33.37	17.91	17.50	4.73
12221	-	Obsidian	24.66	15.90	15.00	6.44
12501	-	Obsidian	24.97	16.65	19.77	13.62
140106	-	Obsidian	35.94	18.05	18.57	-
151888	-	Obsidian	47.69	24.20	18.76	7.11
Mean	-	-	**33.33**	**19.08**	**18.61**	**8.62**
STDEV	-	-	**9.46**	**3.21**	**2.60**	**3.67**
RANGE 2σ	**6**	-	**14.40-52.25**	**12.65-25.50**	**13.40-23.81**	**1.29-15.95**

Table 5.13 Metric Data for S2T3 Specimens

S2T4

AS 1213

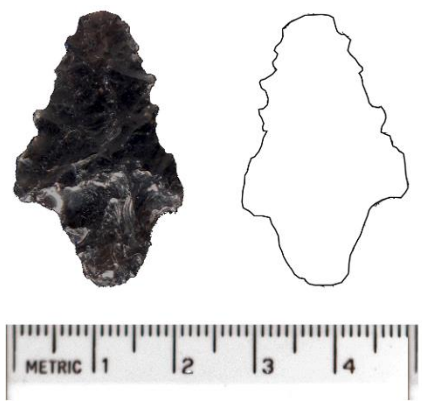


Figure 5.16 Example of S2T4 and Outline

Series Two Type Four is defined based on four examples and is temporally diagnostic to the Early Holocene. S2T4 has a narrow stem that contracts towards a rounded base. S2T4 shoulders are horizontal and lack a notch, which is seen in the variant S2T4v. Haft lengths on this type are generally short (mean=10.53 mm, std dev=1.11 mm). Overall blade morphology is roughly equivalent to an isosceles triangle. One diagnostic feature of this type is the sweeping lateral margins that form >90º angles between the stem and shoulder. Also, the stem contracts at a shallow angle, almost comparable to S2T3. AS 1213 is the prototypical example of this type because it is complete.

S2T4 differs from previously described types, such as S1T2 and S1T4v, because of the morphology of the stem base and shoulders. Both Series One types have stems that contract more steeply towards the base, with S1T2 coming to a point. S1T4v has semi-circular notches that extend vertically into the body of the blade.

Regionally, Klink and Aldenderfer Type 4A share some similarities with S2T4. Both types are shouldered, stemmed forms without notches that contract towards a non-pointed base. One distinguishable difference is that Type 4A has a straight base, as opposed to S2T4, which has a rounded base. Blade morphology is different between the types, with 4A having an equilateral triangle.

AS#	Total # of Specimens	Raw Material	Max Length	Max Width	Haft Length	Blade Length
12263	-	Obsidian	33.02	24.27	11.00	22.02
1213	-	Obsidian	32.87	20.22	10.50	22.37
140111	-	Obsidian	-	24.33	9.00	-
151861	-	Quartzite	29.86	17.81	11.61	18.25
Mean	-	-	**31.92**	**21.66**	**10.53**	**20.88**
STDEV	-	-	**1.78**	**3.21**	**1.11**	**4.57**
RANGE 2σ	**4**	-	**28.35-35.58**	**15.25-28.07**	**8.30-12.76**	**16.31-25.45**

Table 5.14 Metric Data for S2T4 Specimens

S2T4v

AS 155

Figure 5.17 Example of S2T4v and Outline

Series Two Type Four variant is very similar to its parent type but differs in both the stem base and shoulders. S2T4v is defined as a semi-circular notched, shouldered, contracting stem type with a flat base. To differentiate the two types, the shoulder must be intact, otherwise, it may be difficult to separate the types. This variant is defined based on six specimens. It is important to note that no specimens of this type are complete and AS 155 was chosen as the example because it is only missing the distal portion. It is also important to note that one specimen, AS 100, is made from petrified wood.

AS#	Total # of Specimens	Raw Material	Max Length	Max Width	Basal Thickness
84	1	Obsidian	-	24.22	-
12260	1	Obsidian	29.98	23.02	5.05
12271	1	Obsidian	33.35	24.47	5.67
140187	1	Obsidian	-	24.93	4.42
100	1	Petrified Wood	-	22.56	3.16
155	1	Obsidian	-	21.29	4.51
Mean	1	-	**31.67**	**23.41**	**4.56**
STDEV	1	-	**2.38**	**1.37**	**0.92**
Range 2σ	**6**	-	**26.91-36.43**	**22.04-24.78**	**2.72-6.40**

Table 5.15 Metric Data for S2T4v Specimens

S2T5

AS 083

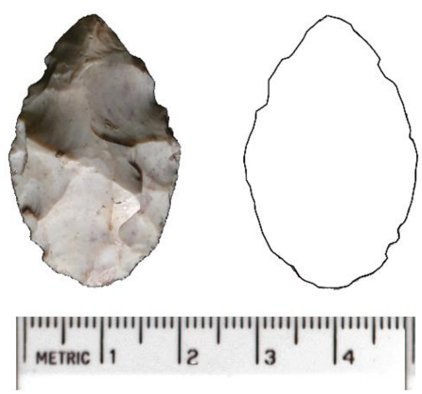


Figure 5.18 Example of S2T5 and Outline

Series Two Type Five is diagnostic to the Early Holocene and is defined based on seven examples. S2T5 is an ovate-shaped, contracting haft projectile point type that lacks both spines and shoulders. Due to the lateral margins being smooth and the widest point occurring close to the rounded base, this type can also be defined as “teardrop” shaped. Blades, if present, are long and thin. In this type, there is no definable boundary between the blade and haft, making both measurements difficult. Also, almost every specimen is made from obsidian. Two specimens are made from possibly non-local chert. Lateral edge modification is common in this type, with four examples having serrated blades.

Variation in S2T5 is most commonly seen in maximum width and basal width. Examples such as AS 150579 are still “teardrop” shaped but have their widest point just superior to the proximal portion of the base. This is also seen with AS 083 pictured above. AS 083 still has the general ovate morphology but is widest along the mid-section of the point.

S2T5 is very similar to Klink and Aldenderfer Type 3D, which has been found at many sites throughout the region. These include Asana (Aldenderfer 1998), Toquepala (Ravines 1972), Tojo-Tojone (Dauelsberg 1983), Hakenasa (Santoro and Nunez 1987), near Arequipa during survey (Neira 1990), Lauricocha (Cardich 1958), and Telarmachay (Lavallee et al. 1985). S2T5 and 3D may be so common because the type is simplistic compared to other types, such as S1T2 or 4A. I argue that these are related forms and can be considered the same type.

AS#	Total # of Specimens	Raw Material	Max Length	Max Width	Basal Width	Max Thickness
83	1	Chert	34.03	21.44	4.26	8.37
12214	1	Obsidian	41.43	23.01	17.69	6.90
12462	1	Obsidian	25.24	16.55	16.87	6.80
150579	1	Obsidian	37.29	18.89	11.87	6.41
12173	1	Chert	-	21.18	-	6.30
150567	1	Obsidian	32.32	20.56	13.77	6.84
151653	1	Obsidian	42.72	18.42	7.64	9.34
Mean	-	-	**35.51**	**20.01**	**12.02**	**7.28**
STDEV	-	-	**6.45**	**2.18**	**5.26**	**1.13**
Range 2σ	**7**	-	**22.60-48.41**	**15.65-24.36**	**1.50-22.53**	**5.01-9.55**

Table 5.16 Metric Data for S2T5 Specimens

S2T6

AS 12177

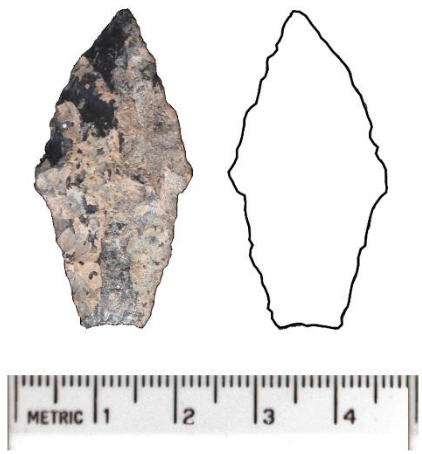


Figure 5.19 Example of S2T6 and Outline

Series Two Type Six, also known as “the other fish type”, is defined based on nine examples from Cuncaicha’s uppermost Early Holocene layers. S2T6 has a contracting stem with straight to slightly concave lateral margins, a slightly concave or flat base, rounded shoulder spines located near the midsection of the projectile point, and an isosceles triangular blade. Variation in this type occurs along the base. Some examples (n=5) have a flat base and others (n=4) have a very slight basal concavity. This would represent the first appearance of basal concavity in Cuncaicha’s assemblage apart from the Fishtail projectile point.

Contracting stems, narrow basal widths, and rounded shoulder spines are the most diagnostic features of this type. AS 12177 was chosen as the prototypical example for this type because it is complete and has a unique feature of small basal thinning flake scars.

Klink and Aldenderfer Types 4D and 2C are the most similar types to S2T6. Type 2C lacks shoulders, rounded spines, and concave bases. Type 4D is temporally diagnostic to the

Late-Middle Holocene (6.7-4.9 ka), which does not overlap with the S2T6 time range (9.5-9.0 ka). S2T6 has steeply contracting stem lateral margins, as opposed to 4D types, which have parallel margins that form rectangular bases. The shoulders on Type 4D also do not have spines and extend horizontally. Type 4D also never have concave bases. Type 4D has been found at Asana and Quelcatani (Klink and Aldenderfer 2005), Hakenasa (Santoro and Nunez 1987), Toquepala (Ravines 1972), Ichuña (Menghin and Schroeder 1967), and Sumbay II-E (Neira 1990).

AS#	Total # of Specimens	Raw Material	Max Length	Max Width	Haft Length	Basal Width	Basal Thickness
95	1	Obsidian	28.31	16.78	11.50	5.86	8.06
140214	1	Obsidian	27.51	21.13	16.00	8.82	6.39
12177	1	Obsidian	40.84	19.90	18.50	8.34	6.10
12256	1	Obsidian	40.77	19.22	19.00	9.07	7.00
12459	1	Chalcedony	23.05	15.68	9.00	6.43	3.55
12279	1	Obsidian	38.51	19.62	14.00	7.79	6.13
150577	1	Obsidian	31.71	22.86	10.5	10.84	5.61
12242	1	Obsidian	28.97	14.96	12.85	7.31	5.17
150319	1	Obsidian	29.51	15.57	12.00	8.43	6.18
Mean	**-**	-	**32.13**	**18.41**	**13.70**	**8.09**	**6.02**
STDEV	-	-	**6.38**	**2.77**	**3.48**	**1.48**	**1.23**
Range 2σ	**9**	-	**19.37-44.89**	**12.87-23.95**	**6.74-20.66**	**5.03-11.05**	**4.79-7.25**

Table 5.17 Metric Data for S2T6 Specimens

Series Three (<5.7 ka)

The final series of the Cuncaicha typology is diagnostic to the Late-Middle Holocene and Late Holocene. Common morphological characteristics are basal concavities and short proximal portions. Raw material usage diversity continues to increase in this series. There are six types and three variants in this series. Series Three almost completely lacks geometrical morphologies, with S3T6v being the only type or variant with a body plan comparable to a geometric figure (triangle).

S3T1

Figure 5.20 Example of S3T1 and Outline

Series Three Type One is based on eight examples. S3T1 is shouldered with a broad-contacting stem that extends towards a rounded to flat base. This type is temporally diagnostic to both the Late-Middle (5.7-5.0 ka) and Late Holocene (< 4.0ka). This type is like S2T4 because of the contracting stem but differs in both base and shoulder morphology. S2T4 shoulders do not have large and wide, rounded ears and have exclusively rounded bases. It is also important to note that the angle of S3T1 shoulders is less than 90º, and these forms have a broader stem. Another characteristic that separates the types is based on manufacture. S3T1 specimens appear to have undulating lateral margins, which I infer to reflect a more expedient type of manufacture or an earlier stage of manufacture. This differs from S2T4 points, which have very fine flaking patterns that lack undulation along the stem lateral margins and different shoulder morphologies.

AS 140142 was chosen as the prototypical example of this type because of the intact base and shoulders. AS 140142 also has an undulating blade and stem lateral margins. Variation in this type occurs mostly in the shoulder, with some examples having a less steep angle between the rounded shoulder ear and broad stem. Bases can also have rounded corners but a flat bottom section.

S3T1 shares morphologic characteristics with Klink and Aldenderfer Types 4D (6.7-4.9 ka) and 4F (5.3-4.8 ka). Type 4D, as previously discussed, has a short, broad stem with parallel sides that extends towards a flat base. This creates a proximal haft with a square or rectangular morphology. Because S3T1 has a contracting stem, the overall morphology is cone-shaped. Type 4D shoulders extend horizontally and do not have rounded ears. Type 4F has a similar morphology, but with a rounded base and notched shoulders that extend into the base of the projectile point. Overall, due to the temporal similarity, all three types are related but have distinct differences.

AS#	Total # of Specimens	Raw Material	Max width	Haft Length	Max Thickness
151785	-	Obsidian	24.04	-	7.04
150484	-	Obsidian	21.89	4.78	6.57
140142	-	Obsidian	26.66	7.90	6.20
150269	-	Obsidian	24.60	3.74	6.34
140105	-	Obsidian	22.91	9.00	6.82
151736	-	Obsidian	20.79	8.00	4.41
150696	-	Obsidian	23.47	9.00	6.31
140109	-	Obsidian	24.77	7.00	7.86
Mean	-	-	**23.64**	**7.06**	**6.44**
STDEV	-	-	**1.82**	**2.06**	**0.98**
Range 2σ	**8**	-	**20.00-27.28**	**2.95-11.17**	**4.48-8.41**

Table 5.18 Metric Data for S3T1 Specimens

S3T1v

AS 1240

Figure 5.21 Example of S3T1v and Outline

The variant for S3T1 shares almost every morphological characteristic, apart from having a narrow to broad contracting stem that extends towards a rounded point. Maximum basal width is on average much smaller for S3T1v (mean=3.03 mm, std dev=0.88 mm) relative to the parent type (mean=5.84 mm, std dev=1.16 mm). S3T1v also displays undulating stem lateral margins. AS 1240 is the prototypical example of this type because of its relative completeness and pointed base. Variation in this type occurs in the shoulder angle, with some examples closer to 90º, as well as variable basal widths. Some specimens have blunted points for bases that are wider than non-blunted versions. Temporally (5.7-5.0 ka, <4.0 ka), both types completely overlap, but because of the variation in basal morphology, they are not the same type.

AS#	Total # of Specimens	Raw Material	Max Length	Max Width	Haft Length	Basal Width
150416	1	Obsidian	28.78	18.16	7.50	2.46
150407	1	Obsidian	22.58	23.14	9.00	2.60
151844	1	Obsidian	25.28	22.51	13.00	2.60
1286	1	Obsidian	33.94	22.62	12.40	
150256	1	Obsidian	23.17	19.65	8.00	2.55
150330	1	Obsidian	33.33	22.85	10.00	4.68
Mean	-	-	28.93	**21.72**	**9.98**	**3.03**
STDEV	-	-	4.54	**1.91**	**2.05**	**0.88**
RANGE 2σ	**10**	-	**19.84-38.01**	**17.89-25.55**	**5.88-14.07**	**1.28-4.79**

Table 5.19 Metric Data for S3T1v Specimens

Additionally, I performed a Mann-Whitney test (see methods for test description) to determine if S2T4(v) and S3T1(v) have a measurement or ratio that can statistically distinguish the types with metrics. This is important because even though there are morphological differences between the types, they are difficult to distinguish visually. Also, they do not co-occur stratigraphically, but if these types are found in surface contexts, they could be easily confused. To meet the minimum sample size requirement of five, I combined S2T4 and S2T4v into one type and did the same for S3T1/S3T1v.

The results of the Mann-Whitney test were inconclusive. No measurements or ratios can statistically distinguish between S2T4(v) and S3T1(v). The table below shows the p-values for each measurement tested. Results were considered significant if the value was < 0.5.

S2T4(v) VS S3T1(v)	Max Length	Max Width	Haft Length	Basal Width	Max Length to Max Width	Blade Length to Max Width	Max Thickness	Max Thickness to Basal Thickness
P-Value	.42	.61	.39	.70	.28	.81	.46	.23

Table 5.20 P-Values for S2T4(v) VS S3T1(V) Mann-Whitney Test

I suspect that the combination of my types and variants into two super-groups increased the total range of metric variation, therefore allowing for more overlap between the newly formed groups. Additionally, even though I did not compare broken and complete projectile points, the Series Two types have many more broken examples than the Series Three types, and these could not be used in the test. Also, the Series Three super-group has seven more specimens than the Series 2 group. This could skew the results of the Mann-Whitney test. In small sample sizes (17 vs 10), individuals are more influential because their data points will more greatly affect averages and standard deviations. This issue will be resolved once more points from securely dated contexts are available.

It is important to note that even though these types cannot be distinguished metrically, they are separated by five thousand years of time and have distinct basal and shoulder morphologies. To distinguish between the earlier (S2T4, S2T4v) and later forms (S3T1, S3T1v), notched shoulders are diagnostic to the Early Holocene. Pointed bases are diagnostic to the Middle and Late Holocene. Differentiation of S2T4(v) and S3T1(v) should be based on morphology and stratigraphy until larger sample sizes can further refine these types.

S3T2

Figure 5.22 Example of S3T2 and Outline

Series Three Type Two is based on eight examples from Cuncaicha’s Late-Middle Holocene layers and is temporally diagnostic to this period (5.7-5.0 ka). S3T2 has a single shoulder that is superior to a semi-contracting stem with a flat base. The proximal portion of this type has an overall square or rectangular morphology. Shoulder angle is >90º and does not have a lateral notch. S3T2 is similar to S2T1 because of the single shoulder characteristic but has different unshouldered lateral margins. On S3T2, the unshouldered lateral margin has a wide area where the stem begins to contract. This is typically the widest point on the tool. S2T1 has smoother lateral margins with a gentler slope that contracts towards an angled base.

S3T2 is similar to Klink and Aldenderfer Type 4D. Both types have short and rectangular proximal portions with flat bases. Both types overlap temporally as well.

AS#	Total # of Specimens	Raw Material	Max Length	Max Width	Haft Length	Basal Width
150908	-	Obsidian	37.78	21.01	12.5	9.31
1214	-	Obsidian	34.84	21.45	9.00	11.77
12142	-	Obsidian	37.24	21.72	10.00	10.76
140164	-	Obsidian	31.49	20.12	12.00	-
12135	-	Obsidian	29.76	14.76	-	-
140466	-	Obsidian	34.79	20.02	7.00	11.39
1287	-	Obsidian	-	21.54	11.80	14.25
151790	-	Obsidian	30.63	24.71	-	11.71
Mean	-	-	**33.79**	**20.67**	**10.38**	**11.53**
STDEV	-	-	**3.20**	**2.79**	**2.13**	**1.61**
Range 2σ	**8**	-	**27.39-40.19**	**14.08-26.25**	**6.13-14.64**	**8.30-14.76**

Table 5.21 Metric Data for S3T2 Specimens

S3T3

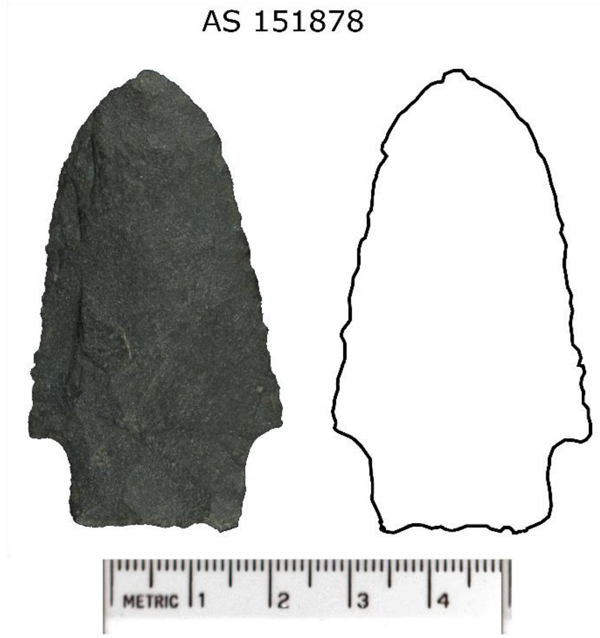


Figure 5.23 Example of S3T3 and Outline

The third Type in Series Three is based on five examples from the Late-Middle Holocene (5.7-5.0 ka) layers at Cuncaicha. Primarily made from andesite (n=3), these large points have flat to slightly concave bases with straight and parallel lateral haft margins. Shoulders on S3T3 are barbed with notches that expand into the body of the proximal portion. Blade morphology is straight to convex. Whether a basal concavity is present or not, bases have rounded or pointed ears. This type is the largest in terms of mean maximum length (58.96 mm), maximum width (28.32 mm), and basal width (21.14 mm). In comparison to the blades, overall haft length is short, with ratios averaging 0.32. Although size is not generally a diagnostic characteristic, these examples are an exception to the rule. It is also important to note that blade edge modification is common in this type (n=3). Variation in S3T3 is seen in the presence or absence of a basal concavity and shoulder morphology. Two examples similar to AS 151878 have well defined semi-circular notches. Two other specimens defined for this type have notched shoulders with a V-shaped morphology.

The Klink and Aldenderfer equivalent is Type 3F (7.3-6.0 ka), also known as the "Sumbay" type defined from the archaeological site of the same name (Neira 1990). S3T3 could be typed as Sumbay Type II-B. Sumbay forms share common characteristics, such as large size, andesite usage, wide basal widths, and wide basal concavities, if applicable. S3T3 and its equivalents have been found at the following sites: Camarones-14 (Schiappacasse and Niemeyer 1984), Hakenasa (Santoro and Nunez 1987), Toquepala (Ravines 1972), and Huiculunche (deSouza 2004).

AS#	Total # of Specimens	Raw Material	Max Width	Haft Length	Basal Width	Max Thickness
12223	1	Andesite	22.14	15.48	18.82	7.30
151878	1	Andesite	30.83	14.00	20.45	7.19
151809	1	Obsidian	31.81	17.00	24.23	9.12
150565	1	Andesite	29.65	12.00	20.05	9.56
150590	1	Obsidian	27.17	9.5	22.17	9.86
Mean	-	-	**28.32**	**13.60**	**21.14**	**8.61**
STDEV	-	-	**3.87**	**2.94**	**2.10**	**1.27**
Range 2σ	-	-	**20.59-36.05**	**7.71-19.48**	**16.94-25.35**	**6.06-11.15**

Table 5.22 Metric Data for S3T3 Specimens

S3T3v

AS 1296

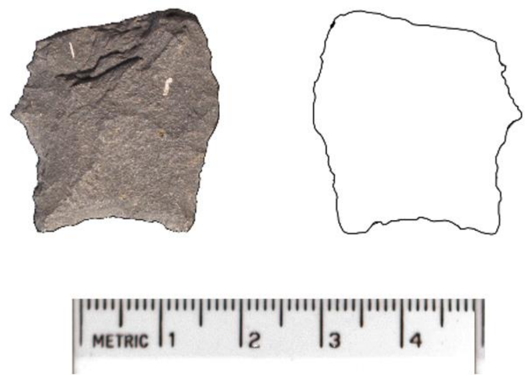


Figure 5.24 Example of S3T3v and Outline

S3T3’s variant is defined based on 12 examples and is temporally diagnostic to the Late-Middle Holocene (5.7-5.0 ka). S3T3v has a slightly contracting haft with lateral margins that are concave, a shallow but wide basal concavity, and shoulder spines that extend horizontally. One diagnostic difference between the parent type and its variant is the morphology of the base. While S3T3 has straight and parallel lateral haft margins, the variant shows a slight contraction to the base, which is always concave. Basal ears that are lateral to the concavity for S3T3v are identical to the parent type. Shoulder morphology is slightly different as well, with the variant replacing the semi-circular notch with a short spine. Apart from these morphological differences, both S3T3 and S3T3v can be considered Sumbay Types.

AS#	Total # of Specimens	Raw Material	Max Width	Basal Width	Max Thickness	Basal Concavity Depth
150217		Andesite	21.81	18.23	5.61	2.00
158		Obsidian	24.67	24.67	5.84	3.80
12175		Andesite	25.47	19.80	6.30	2.10
150273		Obsidian	24.05	24.05	5.45	2.50
140567		Andesite	28.99	-	4.90	6.00
12115		Obsidian	21.60	-	6.00	2.50
1296		Andesite	25.66	-	6.1	2.10
151586		Andesite	21.93	-	4.61	2.50
151720		Obsidian	22.57	21.02	4.41	3.00
140112		Andesite	25.61	24..76	5.93	4.10
151621		Obsidian	22.06	19.55	5.66	2.90
151710		Andesite	23.3	16.35	6.49	2.00
Mean		-	**23.97**	**20.52**	**5.60**	**2.95**
STDEV		-	**2.21**	**3.00**	**0.65**	**1.17**
Range 2σ	**12**	-	**19.55-28.39**	**14.52-26.52**	**4.30-6.90**	**0.61-5.29**

Table 5.23 Metric Data for S3T3v Specimens

S3T4

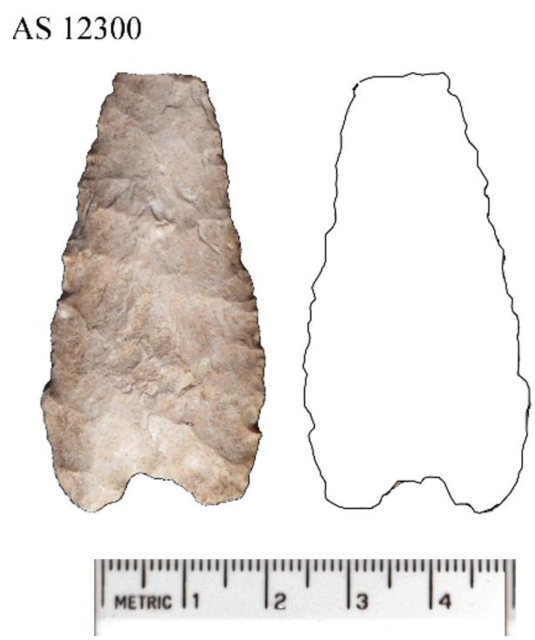


Figure 5.25 Example of S3T4 and Outline

Series Three Type Four is defined based on 11 examples from both Late-Middle Holocene (n=10, 5.7-5.0 ka) and Late Holocene layers (n=1, <4.0 ka). S3T4 is a hafted type with rounded or blunt pointed basal ears that have straight to slightly contracting lateral margins and a deep, circular, and narrow basal concavity. S3T4 lacks shoulders, which makes defining a haft impossible but also distinguishes it from S3T3 and S3T3v. Another distinguishing characteristic is that no specimens for this type are made from andesite, and only one example, AS 12300 pictured above, is made from a non-obsidian raw material. Blade edge modification is absent from this type and basal thinning flakes are found just superior to the round concavity.

Morphological variation in this type is limited. Basal concavity widths and depths are slightly different between each specimen but are still rounded and narrow. Basal ears can be either rounded or slightly pointed, but I suspect this variance is due to fragmentation. S3T4 is important for Cuncaicha's assemblage because it is the first type that has its widest point being located near the base. This is a trend that is continued into the Late Holocene. I suspect that S3T4 could be ancestral to later triangular types.

AS#	Total # of Specimens	Raw Material	Max Width	Basal Width	Basal Concavity Depth	Max Thickness
150251	1	Obsidian	28.19	18.31	4.00	7.40
151595	1	Obsidian	21.58	13.21	1.50	5.55
12147	1	Obsidian	26.13	14.23	3.00	5.90
12183	1	Obsidian	23.24	15.5	2.00	7.80
150450	1	Obsidian	22.87	16.27	4.00	6.49
150449	1	Obsidian	26.27	13.86	3.50	5.44
150464	1	Obsidian	27.20	13.58	4.00	5.89
150597	1	Obsidian	21.08	14.55	3.00	6.60
108	1	Obsidian	25.27	11.81	3.10	5.40
1284	1	Obsidian	28.44	12.67	-	6.60
12300	1	Chert	25.68	18.54	5.00	8.90
Mean	-	-	**25.09**	**14.77**	**3.31**	**6.54**
STDEV	-	-	**2.55**	**2.18**	**1.03**	**1.11**
Range 2σ	**11**	-	**19.99-30.18**	**10.41-19.14**	**1.25-5.37**	**4.33-8.75**

Table 5.24 Metric Data for S3T4 Specimens

S3T5

AS 1288

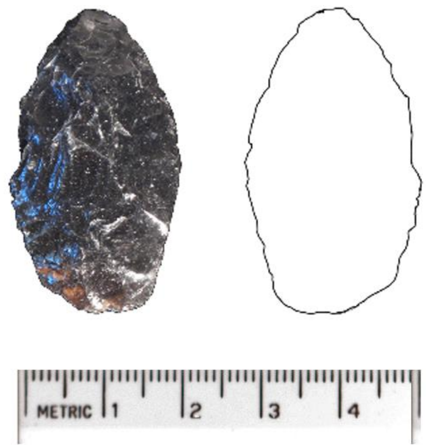


Figure 5.26 Example of S3T5 and Outline

Series Three Type Five is based on seven examples from Cuncaicha’s Late-Middle Holocene layers (5.7-5.0 ka). S3T5 is defined as having a contracting haft to a blunt and pointed base. S3T5 lacks shoulders and blade edge modification. The lack of shoulders and basal morphology distinguish this type from S3T2. Similar to S3T1 and S3T1v, the lateral margins of S3T5 are undulating, which is evidence for expedient manufacturing behavior or an earlier stage of manufacture. S3T5 could also be confused with S2T5 because of its roughly pentagonal morphology, but the base is more rounded. S2T5 has its widest point near the blade, which makes the stem longer on average (15.98 mm, std dev=2.18 mm) than S3T5 (13.75 mm, std dev= 2.35 mm). Temporally, there is no overlap between these two types and are separated by at least 3,300 years. S3T5 shares similarities with Klink and Aldenderfer type 4F but lacks shoulders. There is no equivalent type in the Klink and Aldenderfer typology.

AS#	Total # of Specimens	Raw Material	Max length	Max width	Haft Length	Blade Length
140103	1	Obsidian	29.95	18.75	15.00	14.95
151711	1	Obsidian	25.86	17.83	10.00	15.86
150456	1	Obsidian	32.53	23.01	14.50	18.03
140463	1	Obsidian	28.21	18.34	11.00	17.21
12122	1	Obsidian	29.92	21.76	14.00	15.92
185	1	Obsidian	29.76	16.73	-	-
1288	1	Obsidian	37.42	21.36	18.00	19.42
Mean	1	-	**30.52**	**19.68**	**13.75**	**16.90**
STDEV	1	-	**3.66**	**2.35**	**2.89**	**1.65**
Range 2σ	7	-	**23.22-37.82**	**14.99-24.37**	**7.96-19.54**	**13.60-20.19**

Table 5.25 Metric Data for S3T5 Specimens

S3T6

Figure 5.27 Example of S3T6 and Outline

Series Three Type Six is based on 73 examples excavated from Cuncaicha's Late-Middle Holocene (5.7-5.0 ka) and Late Holocene layers (<4.0 ka). These points generally occur with ceramics. S3T6 has a roughly triangular morphology with a wide, but variably deep basal concavity. Blade edge modification is common for this type. Basal ears lateral to the basal concavity can range from rounded to pointed. I suspect that this could be a stylistic choice but could also be caused by fragmentation during use or deposition. S3T6 points are thin (<4.5 mm on average) and are usually made from a flake.

Basal concavity morphology can vary from wide and shallow to narrow and deep. The widest point on all specimens is located on the base of the artifact. Lateral margins contract towards the tip of the distal end. Some specimens are heavily retouched along the margins, while others appear to completely lack rejuvenation. It is important to note that while basal concavity morphology is variable, it is usually nearly as wide as the maximum width.

S3T6 is similar to Types 5C (5.2-3.9 ka) and 5D (5.2-2.1 ka) from the Klink and Aldenderfer typology. All points are defined as being triangular with a concave base and are temporally diagnostic to the Late-Middle Holocene and Late Holocene. One diagnostic difference between 5C and 5D is the size of the point. I argue that this an arbitrary division based on overlapping time ranges and have decided to group all concave triangular points from Cuncaicha into one group. This was also done because of the low resolution of radiocarbon dating control in Cuncaicha's Late Holocene layers. Concave triangular points have been found at Jiskairumoko (Aldenderfer 1999), Toquepala (Ravines 1972), Tambillo, Tocone, and Tulan (Nunez Atencio 1992).

AS#	Total # of Specimens	Raw Material	Max length	Max width	Max Thickness	Basal Concavity Depth
12123	-	Obsidian	16.71	9.84	3.00	3.00
44	-	Obsidian	14.37	14.01	2.55	3.50
150359	-	Obsidian	22.49	17.39	4.72	1.00
157	-	Obsidian	19.33	15.78	2.93	1.00
150682	-	Obsidian	26.29	16.21	4.55	3.00
140509	-	Obsidian	25.75	16.37	3.43	2.00
151840	-	Obsidian	22.69	16.77	3.92	3.00
MEAN	-	-	**22.22**	**16.56**	**4.32**	**2.62**
STDEV	-	-	**5.40**	**2.83**	**0.96**	**1.45**
RANGE 2σ	**73**	-	**11.42-33.02**	**10.9-22.22**	**2.4-6.24**	-

Table 5.26 Metric Data for S3T6 Specimens

S3T6v

Figure 5.28 Example of S3T6v and Outline

The variant for S3T6 is based on 10 specimens from Cuncaicha's Late-Middle Holocene (5.7-5.0 ka) and Late Holocene (<4.0 ka) layers. Retaining the triangular morphology, this variant lacks a basal concavity and has a flat base. I infer that this is a stylistic choice because, as pictured above, most specimens (n=8) are complete. If the lack of basal concavities was due to fragmentation, I would expect that most points from this type would have short maximum lengths. Because of the lack of basal concavity but retention of all other diagnostic features, such as edge modified lateral margins that contract towards the tip, I decided to classify this as a flat-triangular variant. This relation is inferred by similar metric measurement averages being nearly identical including Maximum length (22.22 mm vs 23.01 mm), maximum width (16.56 mm vs 17.04 mm), basal width (15.60 mm vs 15.41 mm), and maximum thickness (4.32 mm vs 4.50 mm).

S3T6v is similar to Klink and Aldenderfer's Type 5B (5.2-2.1 ka). Type 5B is a flat-based, triangular point that is temporally diagnostic to the Late-Middle Holocene and Late Holocene. Type 5B and S3T6v points have been found at Las Cuevas (Santoro and Nunez 1987), Inca-Cueva (Aschero 1984), Tambillo and Tuina (Nunez Atencio 1992), and Pachamachay (Rick 1980).

AS#	Total # of Specimens	Raw Material	Max Length	Max Width	Basal Width	Max Thickness
151874	-	Obsidian	29.29	16.59	14.79	4.62
140525	-	Obsidian	21.07	18.99	18.99	3.7
150277	-	Obsidian	22.86	15.2	15.22	4.16
12230	-	Obsidian	23.22	17.46	15.88	4.7
12510	-	Obsidian	17.32	17.35	NA	4.4
150540	-	Obsidian	29.31	17.92	14.05	5.57
150688	-	Obsidian	23.22	14.55	NA	5.22
151969	-	Obsidian	18.75	19.69	12.27	5.69
150305	-	Obsidian	22.79	14.01	13.47	3.5
151793	-	Obsidian	22.36	18.65	18.65	3.46
MEAN	-	-	**23.01**	**17.04**	**15.41**	**4.50**
STDEV	-	-	**3.85**	**1.92**	**2.37**	**0.81**
Range 2σ	**10**	-	**15.11-30.91**	**13.2-20.88**	**10.67-20.15**	**2.88-6.12**

Table 5.27 Metric Data for S3T6v Specimens

Section Two: Description of the Pampa Colorada Assemblage

In total, I measured 171 projectile points from Pampa Colorada. Each point was described and outlined, and 35 were 3D modeled using photogrammetry. One hundred twenty-two points were classifiable using Cuncaicha’s typology. The remaining points were either considered non-diagnostic after reexamination (n=17) or did not fit within the typological scheme (n=32). These points will be described in the following section. Every type and variant from Cuncaicha were represented at Pampa Colorada apart from S1T1vα, S1T4, S1T4v, S3T3, S3T3v, S3T4, and S3T5.

Table 5.28 summarizes the projectile point assemblage from Pampa Colorada that was classifiable using the Cuncaicha typology. Sites where the points were collected, 2σ ranges for diagnostic measurements and ratios, and the total number of specimens per type are provided in this table. Measurements are in mm. Appendix B provides a complete list of measurements and sites for the Pampa Colorada assemblage.

Type	# of Specimens Found at Pampa Colorada	Sites	Max Length	Max Width	Haft Length	Basal Width	Blade Length to max width	Max Thickness	Basal Thickness
S3T6v	10	301, 336, 337, 343, 344, 400,493,494,498	12.66-43.78	8.43-26.75	-	8.27-21.15	-	3.62-8.34	2.16-5.16
S3T6	12	307, 336, 339, 343, 415, 492, 725, 737, TR9	19.64-48.00	9.87-25.91	-	8.32-24.92	-	4.92-6.16	1.86-5.98
S3T5	0	-	-	-	-	-	-	-	-
S3T1v	1	490	45.2	23.07	8.35	2.49	1.59	9.42	4.65
S3T1	5	309,343,425,494,PCSE	15.51-39.59	11.85-24.77	6.36-12.52	2.65-9.37	0.6-1.36	3.06-7.94	3.12-4.88
S3T2	1	PCSE	26.94	20.60	11.40	7.25	0.75	7.89	6.39
S3T4	0	-	-	-	-	-	-	-	-
S3T3v	0	-	-	-	-	-	-	-	-
S3T3	0	-	-	-	-	-	-	-	-
S2T6	9	343,348,425,465,492,493,737	23.12-51.60	11.47-24.83	3.45-26.89	2.48-9.32	0.63-1.83	3.08-11.12	2.95-6.15
S2T5	7	342,343,344,475,485	15.92-63.96	10.45 24.41	-	4.01-12.97	-	3.68-10.32	4.10-7.66
S2T4v	7	300,303,343,344,PCSE	16.85-44.41	15.99-28.03	4.55-17.67	0.46-12.54	0.60-1.20	3.65-7.29	2.97-6.21
S2T4	6	303,343,344,470,480	19.33-46.61	15.74-28.62	4.19-18.23	3.12-6.96	0.74-1.18	2.11-9.43	2.31-4.91
S2T3	14	307,343,348,430470,490,491,493,498,500	23.63-55.55	17.02-27.90	-	2.73-14.89	0.54-1.18	4.84-9.08	3.64-7.92
S2T2	10	343,344,490,493,494,499	17.07-56.63	12.14-26.02	3.70-32.86	3.56-9.06	0.36-1.56	4.09-8.81	3.20-6.84
S2T1	7	343,344,415,470,492,493	5.89-69.89	5.25-32.25	4.8722.87	1.01-8.61	0.56-2.32	4.2-8.96	3.38-5.92
S1T5	2	343,494	22.59-88.23	21.44-30.04	27.82	-	0.66	2.04-16.08	4.82-5.82
S1T4v	0	-	-	-	-	-	-	-	-
S1T4	0	-	-	-	-	-	-	-	-
S1T3v	2	470,500	27.45	8.80-24.08	8.32-13.52	3.39-8.79	0.11-1.83	4.03-8.03	4.22
S1T3	3	480,493,498	13.06-53.46	18.91-20.19	0.73-26.85	1.20-6.44	0.60-1.24	4.69-8.05	2.99-7.27
S1T2	1	491	34.02	21.89	15.53	5.0	0.84	7.43	5.03
S1T1v	13	343, 348,475,490,493,496,499,500,725	24.50-44.90	14.48-23.40	6.63-22.07	2.10-5.89	0.71-1.47	4.08-8.40	3.48-7.08
S1T1	12	303,310,342,343,425,490,491,492,494,498,500	21.00-46.52	11.12-22.00	3.57-23.45	2.86-4.63	0.78-1.98	4.88-6.66	3.20-6.08
Total	122	35	-	-	-	-	-	-	-

Table 5.28 Summary Table of Pampa Colorada Points Typed Using the Cuncaicha Typology with 2σ ranges and Units in mm

Based on the presence of diagnostic projectile points, every temporal period from Cuncaicha is represented at Pampa Colorada. Interestingly, only one projectile point could be typed exclusively to the Late-Middle Holocene (S3T2). Other known Late-Middle Holocene types, S3T3, S3T3v, S3T4, and S3T5, which include the “Sumbay” types, are absent from Pampa Colorada. Ninety-three points from 26 sites have been dated to the Terminal Pleistocene or Early Holocene. Twenty-nine points from 18 sites have been dated to either the Late-Middle Holocene or Late Holocene. Twenty-two of those 29 points is triangular with a flat or concave base indicating a Late Holocene occupation.

I have identified 19 sites with projectile points dating from the Terminal Pleistocene or Early Holocene based on the occurrence of these forms in the absolutely dated Cuncaicha sequence. Of these, 16 sites also have points from the Early Holocene (Series Two), so these sites may be Early Holocene age. Three remaining sites, PC 310, 496, and 725, do not have Series Two projectile points. PC-310 has a point that is similar to S1T1 (12.5-11.2 ka). Both PC 496 and 725 have a single S1T1v (12.5-9.0 ka).

At Pampa Colorada, obsidian was used to manufacture 80 projectile points (62.9%) that were typable using the Cuncaicha typology (Rademaker, pers comm). Of those 80 points, 27 were typable within Series One, 33 to Series Two, and 20 to Series Three. Sixteen Pampa Colorada points were made from chert, 13 from chalcedony, five from petrified wood, three from quartzite, one from clear crystal quartz, and one from rhyolite. Of these raw materials, I can only confidently say where the obsidian and petrified wood can be sourced. Obsidian has been sourced to the highlands, and petrified wood crops out in mid-elevation areas 30 km away from Pampa Colorada.

Of the 122 projectile point type identifications in the Pampa Colorada assemblages, more than half (56.6%, n=69) disagreed with McInnis' classifications using the Klink and Aldenderfer scheme.

The most common point disagreements were: Types 4A (n=19), 1A (n=16), 2A (n=12), and 2C (n=6). For example, Types 4F, 1A, and points that could not be assigned to Klink and Aldenderfer types were commonly identified as Type 4A. Additionally, points that I identified as Type 1A were not assigned a type or were Types 2A and 2C. Type 2A points were commonly misidentified as Type 1A.

Points that McInnis assigned to Type 2C are interesting because this type was used as a temporally diagnostic marker of the boundary between the Early and Middle Holocene. Five types within the Klink and Aldenderfer have temporal ranges that either extend into the Middle Holocene (2C) or only date to the Middle Holocene: 2C (9.5-7.7 ka 2B (8.1-6.4 ka), and 3B (8.0-7.2 ka) dates extend into the early Middle Holocene while 3F (7.3-6.0 ka) and 4D (6.7-4.9) are later. In total, there were six 2B, six 2C, and three 3B originally defined. Type 3F or "Sumbay" types are not found at Pampa Colorada. It is important to note that the above numbers only reflect points that could be confidently identified as a certain type. If the points were thought to be multiple types, McInnis would not assign a type

In addition to the incorrect Type 2C assignments, I found three 2B and one 3B misassignment. Type 4D only has one specimen within the entire Pampa Colorada projectile point assemblage, but I have identified a 4B example that should be reclassified as 4D. I also identified 28 points that were given a type from the Klink and Aldenderfer typology that does not fit within that scheme. Table 5.29 summarizes the possible Middle Holocene disagreements.

CAT#	ESP#	Site	Sector	Original Type ID	Original Time Range	New Type Identification	Cuncaicha or Pampa Colorada Type?	New time range (K&A)	Cuncaicha Time Range
544	1	491	2b	2B	8.2-7.7	Not in K&A Typology	S1T2	-	12.5-9.0
2542	1	493	1	2B	8.2-7.7	2C	S2T2	9.5-7.7	9.5-9.0
540	4	499	2	2B	8.2-7.7	2C	S2T2	9.5-7.7	9.5-9.0
574	8	492	1b	2C	9.5-7.7	Not in K&A Typology	S2T6	-	9.5-9.0
513	1	491	4	2C	9.5-7.7	Not in K&A Typology	PCT3	-	9.5-9.0 (Est.)
839	1	303	1	2C	9.5-7.7	1A	S1T1	10.1-8.5	12.5-9.0
1430	1	310	1	2C	9.5-7.7	1A	S1T1	10.1-8.5	12.5-9.0
1427	3	344	3	2C	9.5-7.7	Not in K&A Typology	S2T1	-	9.5-9.0
574	7	492	1b	3B	8.0-7.2	2A	PCT5	11.1-9.3	9.5-9.0 (Est.)
474	1	PCSE	TNE	4B	11.2-8.5	4D	S3T2	5.6-4.4	5.0-4.0

Table 5.29 Table of Misidentified Middle Holocene Projectile Points with Time Ranges in ka

Section Three: Points Not in Cuncaicha Typology

Overall, 32 points from Pampa Colorada were not classifiable using the typology from Cuncaicha. I was able to group these points into five new types. These points were also collected by McInnis (2006) during survey from 17 different sites. Each type description will provide information on morphology, raw material, and site provenience. Figures will show an example of each type and tables will provide metric data. Each type will be compared to Klink and Aldenderfer types for cross-comparison and temporal information.

Of the 32 points not in Cuncaicha's typology, 20 are made from obsidian and two are manufactured from andesite. Figure 5.29 below summarizes the raw material distribution for the non-Cuncaicha types. Table 5.30 provides further information on where the points were found, the total number defined for each type, and 2σ ranges for diagnostic measurements and ratios. Each measurement is in mm.

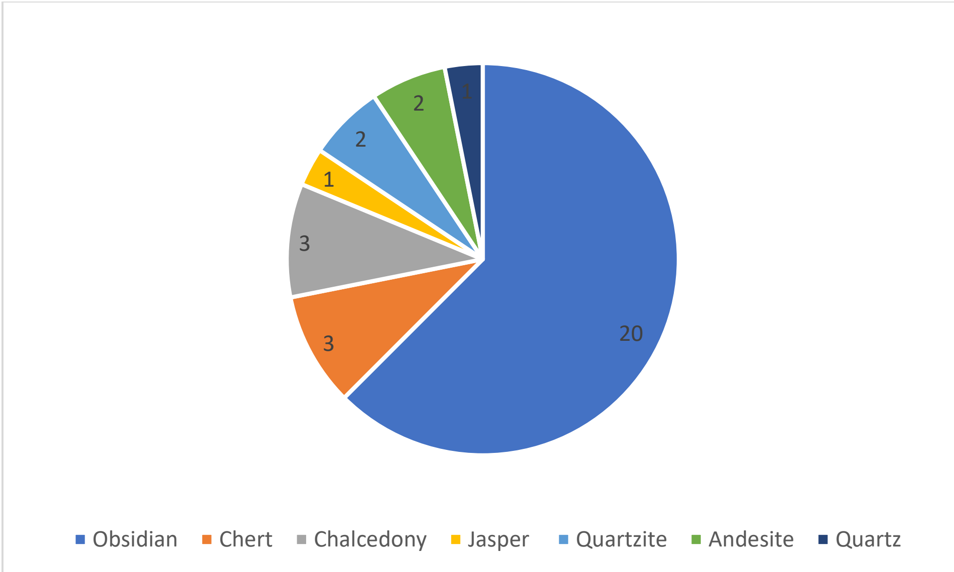


Figure 5.29 Raw Materials used for Non-Cuncaicha Projectile Points at Pampa Colorada

Type	Sites	# of Specimens	Max Length	Max Width	Basal Width	Max Thickness
PCT5	TR4,343,344,400,491,492,494,737	9	23.07-52.19	8.87-21.03	1.17-7.29	3.91-10.43
PCT4	325,343,490,737	4	20.27-39.99	9.65-19.17	3.23-4.67	3.14-9.50
PCT3	342,400,425,491,493,494,500	9	25.52-48.12	13.56-24.72	2.54-6.50	3.92-8.76
PCT2	308, 343, 485	4	22.87-55.91	17.04-22.68	5.93-15.50	4.53-8.45
PCT1	303, 325, 343, 400, 435, 493	6	19.36	12.07-21.31	3.11-6.63	3.12-8.04
Total	17	32	-	-	-	-

Table 5.30 Summary of Pampa Colorada Points not Within the Cuncaicha Typology

Pampa Colorada Type One

838-1

Figure 5.30 Example and Outline of PCT1

PCT1 is defined based on six examples from six sites and is stemmed with straight and parallel lateral margins that extend towards a flat or rounded base. The distal portion of this type is short and has a triangular morphology. Superior to the stem are shoulder spines that extend horizontally. Although the morphology of this type appears to be shouldered similar to S2T4 or S1T4v, I argue that it is “cruciform” due to its rounded or flat base. Blade edge modification is completely absent from this form, which leads me to infer that it is possibly Early Holocene.

PCT1 is thickest at the mid-point or centrally between the shoulder spines. Basal widths are generally narrow, with the average being < 5mm, and haft lengths are short (<14 mm average). I argue that this type falls somewhere between S1T1v or S2T4 because of the shared shoulder morphology but differs due to the lack of a drastically contracting stem.

Klink and Aldenderfer Type 4A is somewhat like PCT1 but is wider (mean21.00 mm vs mean 16.69 mm) and has a contracting stem. Shoulder morphology is different as well, with

Type 4A having fully defined shoulders as opposed to PCT1. I argue that PCT1 could be considered a variant of 4A and the various Cuncaicha types, but due to its diagnostic characteristics, it should be considered a unique type.

CAT#	ESP#	Site	Total # of Specimens	Raw Material	Max Length	Haft Length	Basal Width
838	1	303	-	Chalcedony	29.24	10.67	4.29
319	2	400	-	Quartzite	31.53	13.52	5.29
1027	1	325	-	Chert	42.44	19.6	6.26
172050	-	343	-	Obsidian	23.61	8.82	4.39
100	1	435	-	Obsidian	32.06	13.62	3.8
532	4	493	-	Obsidian	30.75	15.8	5.23
Mean	-	-	-	-	**31.60**	**13.67**	**4.87**
STDEV	-	-	-	-	**6.12**	**3.80**	**0.88**
Range 2σ	-		**6**	-	**19.36-43.84**	**6.07-21.27**	**3.11- 6.63**

Table 5.31 Metric Data for PCT1 Specimens

Pampa Colorada Type Two

Figure 5.31 Example and Outline of PCT2

PCT2 is defined based on four examples from three sites. Made primarily from andesite (n=2), this type has a wide round base with a single basal spine. The overall morphology of

PCT2 is “teardrop” shaped or an upside-down ice cream cone with the lateral margins contracting towards the distal end. Defining this type was difficult because of its similarity to S2T5. Shoulder spines can be confused with fracture patterns or the remnants of blade edge modification, such as serration. Due to the consistency of the location of spines on the lateral margins, I suspect that they are intentional and indicative of the overall type. Spines extend horizontally.

Variation in this type occurs in the base. AS 172064 is prototypical of the semi-flat base variant (n=2). The other version of the type has a rounded base. Basal widths are consistent and this single difference in morphology does not warrant an entire separate variant to be defined. Interestingly, this type has no examples made from obsidian, but two specimens are made from andesite. I infer that this type is Early Holocene based on co-occurrence with other forms of Early Holocene age.

CAT#	ESP#	Site	Total # of Specimens	Raw Material	Max Length	Max Width	Basal Width
801	7	308	-	Quartzite	47.47	21.04	14.01
172064	NA	343	-	Andesite	40.14	19.88	9.54
173067	NA	343	-	Chalcedony	42.07	17.87	11.1
225	1	485	-	Andesite	27.9	20.65	8.42
Mean	-	-	-	-	**39.39**	**19.86**	**10.76**
STDEV	-	-	-	-	**8.26**	**1.41**	**2.42**
Range 2σ	-	-	**4**	-	**22.87-55.91**	**17.04-22.68**	**5.92-15.50**

Table 5.32 Metric Data for PCT2 Specimens

Pampa Colorada Type Three

1418-5

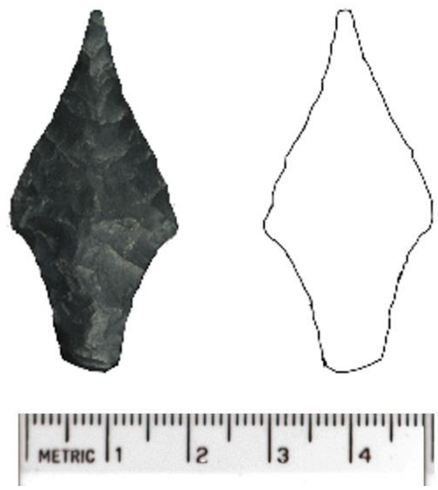


Figure 5.32 Example and Outline of PCT3

PCT3 is based on nine examples from seven sites. PCT3 is shouldered with a thin contracting stem that extends towards a bluntly pointed base. PCT3 have narrow basal widths (<4.55 mm on average). The angle between the stem and shoulder is > 90º and lacks a notch. The notches have a sweeping morphology and do not extend into the body of the projectile point. Blade morphology is similar to a wide, equilateral triangle or diamond.

PCT3 shares characteristics with PCT1, S1T1, and its variant, and S1T2. One diagnostic difference between PCT3 and the above-mentioned types is the bluntly pointed base and swooping shoulders. If the angle between the stem and shoulder was closer to 90º, I would argue that this type is a variant of S1T2. Also, the bluntly pointed base is unique between both assemblages. Overall, the shoulder and base morphology represents a unique combination that represents a type not seen at Cuncaicha. It is interesting because this type appears to be a combination of different characteristics spread across the types mentioned above.

Klink and Aldenderfer type 4F has similar shoulders and blade morphologies but has a completely different proximal portion. Type 4F points have short and parallel hafts with a rounded base, while PCT3 points have contracting stems to blunted bases. These differences are distinct enough that I would argue that the points found at Pampa Colorada are not related to Type 4F.

CAT#	ESP#	Total # of Specimens	Site	Raw Material	Max Length	Max Width	Haft Length
118	1	-	400	Quartz	40.52	21.22	16.11
1418	5	-	342	Obsidian	38.50	17.90	15.00
65	5	-	425	Obsidian	40.75	17.87	17.00
513	1	-	491	Chalcedony	33.28	17.71	14.46
577	1	-	493	Chert	36.83	16.19	14.35
532	5	-	493	Obsidian	40.61	19.7	14.00
532	7	-	493	Obsidian	41.25	25.47	18.00
520	2	-	494	Obsidian	36.11	19.04	15.00
493	1	-	500	Obsidian	23.53	17.21	8.00
Mean	-	-	-	-	**36.82**	**19.14**	**14.65**
STDEV	-	-	-	-	**5.65**	**2.79**	**2.82**
Range 2σ	-	**9**	-	-	**25.52-48.12**	**13.56-24.72**	**9.01-20.29**

Table 5.33 Metric Data for PCT3 Specimens

Pampa Colorada Type Four

84-6

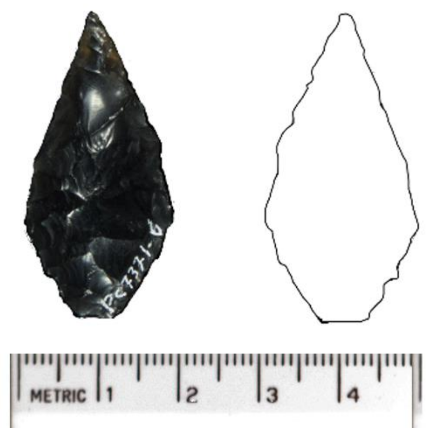


Figure 5.33 Example and Outline of PCT4

PCT4 has a short contracting stem with wide lateral margins. While the contracting stem extends downwards towards a flat base, the lateral margins of the proximal portion are convex. Convex lateral-stemmed margins are a stylistic choice and are diagnostic for this type. This type was defined based on four specimens from four separate sites. Three examples were manufactured with highland obsidian, and one specimen is made from jasper. Variation in this type is seen in tool width and along the lateral blade margins. Cat#1029 Sp#1 is the narrowest example (11.08 mm), and Cat #84 Sp#6 is the widest (16.55 mm).

PCT4 is similar to Klink and Aldenderfer Type 4F, 3D, and S2T5. Major differences between PCT4 and the previously mentioned types is the diagnostic flat base and lack of spined shoulders. Interestingly, PCT4 shares many traits of previously defined types such as 4D, 4F, and S2T5 but does not completely emulate each type. PCT4 is a unique type not found in the Cuncaicha assemblage nor within the Klink and Aldenderfer typology. Based on morphological similarity to Type 4D (6.7-4.9 ka) and 4F (5.3-4.8 ka), it is possible that this type is diagnostic to the early Late-Holocene.

CAT#	ESP#	Site	Total # of Specimens	Raw Material	Max Length	Max Width	Basal Width
172014	NA	343	-	Obsidian	28.2	14.42	3.96
525	1	490	-	Jasper	33.27	15.60	3.90
84	6	737	-	Obsidian	34.96	16.55	4.43
1029	1	325	-	Obsidian	24.11	11.08	3.54
Mean	-	-	-	-	**30.13**	**14.41**	**3.95**
STDEV	-	-	-	-	**4.93**	**2.38**	**0.36**
Range 2σ	-	-	**4**	-	**20.27-39.99**	**9.65-19.17**	**3.23-4.67**

Table 5.34 Metric Data for PCT4 Specimens

Pampa Colorada Type Five

460-4

Figure 5.34 Example and Outline of PCT5

The final type in the Pampa Colorada “typology” was defined based on nine specimens from eight different sites. Eight specimens are made from highland obsidian, while one specimen, Cat# 574 Sp#7, is made from local chert. PCT5 is an unshouldered, contracting stemmed projectile point type that is reminiscent of S1T1 and Klink and Aldenderfer Types 3D, or 2A. Most specimens lack a discernable transition between haft and blade, making stem measurements difficult. Along the lateral margins near the midsection of the point, the width remains constant, making this portion of the artifact appear flat. This flat area where shoulders, spines, or a breakage point between the blade and haft should be is the diagnostic characteristic of this type. Overall, the morphology is an elongated diamond or “missile” shape.

Basal morphology is similar to S1T1, S1T1v, and Klink and Aldenderfer Type 1A, with the lateral margins meeting to form a narrow point. Determining the proximal from the distal haft was difficult. The methodology used to determine the difference was that blade tips are more likely to fragment than hafted bases. One specimen, Cat#529 Sp#1, appears to have lateral edge modification. Based on morphological similarity to the above-mentioned types and the appearance of lateral margin modification, I infer that this type is from the Early Holocene.

CAT#	ESP#	Site	Total # of Specimens	Raw Material	Max Length	Max Width	Basal Width
172025	NA	343	-	Obsidian	32.02	13.75	-
1427	1	344	-	Obsidian	45.17	17.37	2.89
596	2	400	-	Obsidian	41.3	16.64	5.14
460	4	491	-	Obsidian	46.4	13.11	3.87
529	1	491	-	Obsidian	41.78	14.25	6.14
574	7	492	-	Chert	-	20.88	5.72
520	4	494	-	Obsidian	35.41	12.89	1.73
2789	3	737	-	Obsidian	25.15	10.39	3.31
2667	1	PC-TR4	-	Obsidian	33.82	15.30	5.11
MEAN	-	-	-	-	**37.63**	**14.95**	**4.23**
STDEV	-	-	-	-	**7.28**	**3.04**	**1.53**
RANGE	-	-	**9**	-	**23.07-52.19**	**8.87-21.03**	**1.17-7.29**

Table 5.35 Metric Data for PCT5 Specimens

CHAPTER 6

DISCUSSION

Overall, there is a clear inter-zonal connection demonstrated by a shared projectile point material culture between Cuncaicha and Pampa Colorada. The strength of this connection remained stable throughout the Early Holocene and Late Holocene but lessened during the Middle Holocene. There appeared to be a depopulation of Pampa Colorada during the Middle Holocene. Also, I have identified 19 archaeological sites from the Pampa Colorada region that have projectile points whose age ranges span the Terminal Pleistocene-Early Holocene transition. This chapter will summarize the results of my study and restate my research questions. I will also provide synthesizing statements to conclude the chapter.

Restatement and Discussion of Research Questions

Question One

5. Are projectile point types from the Early Holocene to Late Holocene components of Cuncaicha morphologically similar to forms from contemporary archaeological sites at Pampa Colorada? Or, how many projectile types are shared between the two regions throughout the Early and Late Holocene?

I have found that Cuncaicha and Pampa Colorada share 18 formal projectile point types between the Early and Late Holocene. Out of the 18 shared types and variants, 13 are diagnostic to the Terminal Pleistocene or Early Holocene, one possibly from the Middle Holocene, and four from the Late Holocene. Specifically, four types and two variants extend into the Terminal Pleistocene, meaning that 19 archaeological sites from Pampa Colorada possibly have a much earlier component than previously thought. It is important to note that 16 of these sites also have other projectile point forms diagnostic to the Early Holocene. Pampa Colorada (PC) sites 310, 496, and 725 are the best candidates for having a Terminal Pleistocene component. The lack of radiocarbon dates and absence of other Early Holocene forms possibly make these sites viable Terminal Pleistocene candidates. Only PC-725 had another type of projectile point found on the surface (S3T6), which dates to the Late Holocene (<4.0 ka). Nearly every projectile point type defined from Cuncaicha rock shelter occurs at the coast. Table 6.1 shows group type membership of the points from Pampa Colorada with Cuncaicha age ranges.

Type	# of Specimens Found at Pampa Colorada	Sites	Age Range
S3T6v	10	301, 336, 337, 343, 344, 400, 493, 494, 498	<4.0
S3T6	12	307, 336, 339, 343, 415, 492, 725, 737, TR9	<4.0
S3T5	0	-	<4.0
S3T1v	1	490	<5.7
S3T1	5	309, 343, 425, 494, PCSE	<5.7
S3T4	0		<5.7
S3T2	1	PCSE	5.7-5.0
S3T3v	0	-	5.7-5.0
S3T3	0	-	5.7-5.0
S2T6	9	343, 348, 425, 465, 492, 493, 737	9.5-9.0
S2T5	7	342, 343, 344, 475, 485	9.5-9.0
S2T4v	7	300, 303, 343, 344, PCSE	9.5-9.0
S2T4	6	303, 343, 344, 470, 480	9.5-9.0
S2T3	14	307, 343, 348, 430, 470, 490, 491, 493, 498, 500	9.5-9.0
S2T2	10	343, 344, 490, 493, 494, 499	9.5-9.0
S2T1	7	343, 344, 415, 470, 492, 493	9.5-9.0
S1T5	2	343, 494	12.5-9.0
S1T4v	0	-	12.5-9.0
S1T3v	2	470, 500	12.5-9.0
S1T3	3	480, 493, 498	12.5-9.0
S1T2	1	491	12.5-9.0
S1T1vα	0	-	12.5-9.0
S1T1v	13	343, 348, 475, 490, 493, 496, 499, 500 ,725	12.5-9.0
S1T4	0	-	12.5-11.2
S1T1	12	303, 310, 342, 343, 425, 490, 491, 492, 494, 498, 500	12.5-11.2
Total	122	35	-

Table 6.1 Pampa Colorada Cuncaicha Type Distribution with Age Ranges (ka)

As stated in the introduction to this chapter, the strength of the inter-zonal connection between Pampa Colorada and Cuncaicha is strong during the Early and Late Holocene but wanes during the Middle Holocene. I found that the Early Holocene has the greatest number of projectile points (n=60) and types (n=13) shared between the two regions. In addition, 33 of 93 points (35%) from Pampa Colorada were types that are found in the Terminal Pleistocene and Early Holocene deposits at Cuncaicha.

The number of points shared during the Terminal Pleistocene and Early Holocene is not strictly a marker of cultural connection. Many points could simply be the result of a single flint-knapping event or caching behavior, but the fact that 13 types across 26 separate sites also occur at Cuncaicha is interesting. Compare this to 29 points made from five types that were found at 18 Pampa Colorada sites dating to the Middle and Late Holocene. This suggests that during the Terminal Pleistocene and Early Holocene, variation in projectile point form was greater than during the Middle or Late Holocene. If inter-zonal connection strength is based on the number of shared types, the number of shared points, and number of sites with similar types, then the earlier periods have the greatest connection.

Another indicator of the strength of the connection is through comparing the total number of shared (n=18) and unshared types (n=7) between Pampa Colorada and Cuncaicha through time. During the Terminal Pleistocene and Early Holocene, 13 types or 73% of the total number of types were shared between Pampa Colorada and Cuncaicha. Throughout the Middle Holocene and Late Holocene, five types or 27% of the total number of types were shared. A two-sample t-test between proportions was performed to determine whether there was a significant difference between the percentage of shared types from the Terminal Pleistocene and Early Holocene (72%types shared) versus the Middle and Late Holocene (27% types shared) from Pampa

Colorada and Cuncaicha. The t-statistic ($t=2.20$) was significant at a critical level of $p< 0.5$ ($p=0.04$). This suggests that more types were being shared between Cuncaicha and Pampa Colorada during the Terminal Pleistocene and Early Holocene. Connection strength during the Terminal Pleistocene and Early Holocene was stronger than during later periods.

Three or 19% of total ($n=16$) types for the Terminal Pleistocene and Early Holocene and four or 44% of total types ($n=9$) for the Middle and Late Holocene were not shared. A two-sample t-test between proportions was performed to determine if there was a significant difference between the total percentage of types that were not shared between Pampa Colorada and Cuncaicha through time. The t-statistic ($t=1.33$) was not significant at a critical level of $p< 0.5$ ($p=0.19$). The results of the t-test show that there is not a significant difference in the percentage of unshared types between the two periods, suggesting a consistent connection during both the Early and Late Holocene.

This pattern possibly represents an overall increase of landscape knowledge after initial settlement until the Middle and Late Holocene. As populations increased and people became more aware of their landscape in the Early Holocene, more variation in projectile point form occurred. After the Early Holocene, fewer types were shared between Cuncaicha and Pampa Colorada and fewer types have been identified that are diagnostic to the Middle and Late Holocene.

Cuncaicha and Pampa Colorada also follow a similar pattern of the number of types per period. Two types (S1T1, S1T4) found at Cuncaicha are possibly diagnostic to the Terminal Pleistocene. The Fishtail projectile point is the only Terminal Pleistocene type at Cuncaicha that has an absolute temporal range (12.8-12.1 ka) based on other archaeological sites (Waters et al. 2015). Fourteen types have temporal ranges that extend into the Early Holocene. Three types are exclusive to late-Middle Holocene, three types span the boundary between the Middle and Late Holocene, and three types are diagnostic to the Late Holocene.

At Pampa Colorada, there is one type that is possibly diagnostic to the Terminal Pleistocene (S1T1). Thirteen types are diagnostic to the Early Holocene, one to the late-Middle Holocene, one type spans the boundary between the Middle and Late Holocene, and two types are exclusive to the Late Holocene. Figure 6.1 below illustrates this pattern with the temporal period on the x-axis and number of types identified on the y-axis. The Early Holocene has the greatest number of types at both sites, which is followed by a decline in the number of types during the late-Middle and Late Holocene (See Table 6.1 for age ranges).

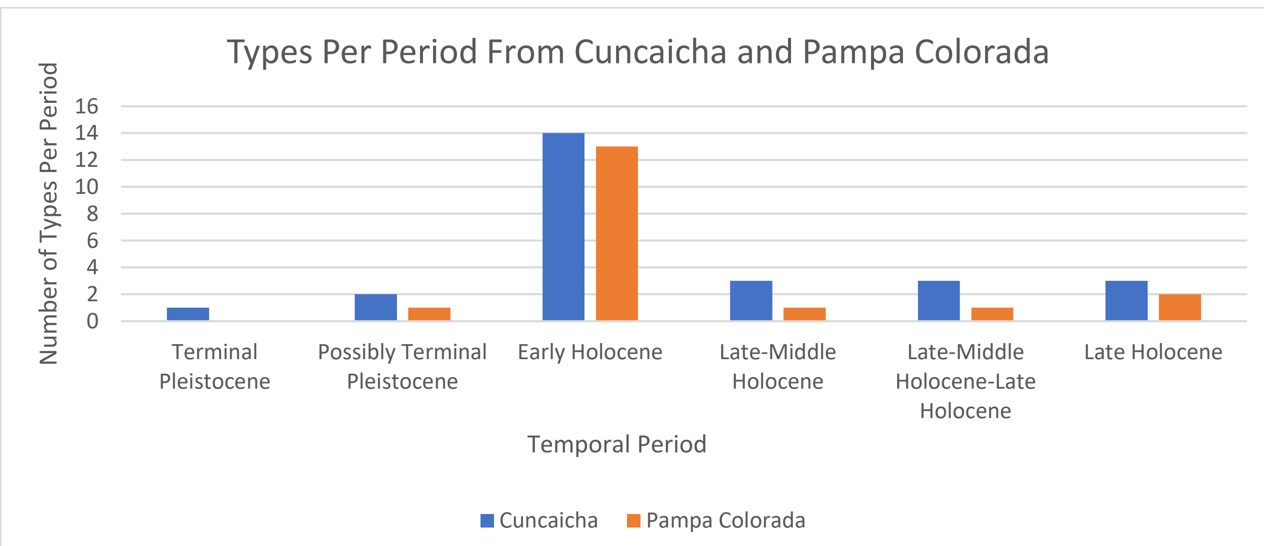


Figure 6.1 Types Per Period at Cuncaicha and Pampa Colorada

After the Pleistocene ended (~11.7 ka), projectile point style diversified due to increased landscape knowledge, an overall population increase, and somewhat favorable climatic conditions (Nuñez et al. 2013). Although not as humid as the Terminal Pleistocene, conditions continued to be favorable for hunter-gatherer populations in southern Peru. The Central Andean Pluvial Event, which provided increased precipitation for the region, remained strong until ~9.0

ka (Geyh et al. 1999). This allowed lake levels in the Lake Titicaca basin to remain somewhat productive and be a stable source of subsistence for local populations (Grosjean et al. 1994, Blard et al. 2011, Nunnery et al. 2018). However, lake levels were not as high as the Pleistocene and began to lower once the Central Andean Pluvial Event ended (Geyh et al. 1999, Blard et al. 2011). Also, paleoclimatic reconstructions from Northern Chile show increased plant diversity and grass coverage in the Atacama Desert area when compared to later periods (Geyh et al. 1999). These favorable conditions and an increased population allowed for an increase in stylistic invention. Although environmental conditions were not as favorable as they were during the Terminal Pleistocene, the time and energy constraints placed on hunter-gatherer populations would have been lower than during the hyperarid conditions of the succeeding Middle Holocene period (Grosjean et al. 1994, 2007). It is important to note that data and climate reconstructions from the Atacama for the Terminal Pleistocene, Early Holocene, and Middle Holocene may be only partially applicable to Pampa Colorada and Cuncaicha. These records were collected in the core of the Atacama and could only be partially indicative of how the local environment responded to changing climatic conditions. Lake-level records from the Lake Titicaca basin could be a more accurate reflection of the environment in Pucuncho and Pampa Colorada (Blard et al. 2011) (See chapter two for review). Climatic studies from other southern Peruvian sites, such as Quebrada Jaguay (Sandweiss et al. 1998, 2007), Quebrada Tachauay (Keefer et al. 1998, deFrance et al. 2001), and Quebrada de los Burros (Lavalle et al. 1999, Carre et al. 2005, 2009, Reitz et al. 2015), provide information on sea surface temperatures throughout the Terminal Pleistocene (~13.0-11.0 ka) to the Middle and late Holocene (~9.0-3.0 ka).

The climatic record from Quebrada Jaguay is the most applicable to Pucuncho and Pampa Colorada due to proximity. Sandweiss et al. (1998, 2007) identified cooler sea-surface temperatures as compared to modern during the Terminal Pleistocene and Early Holocene. Beginning at ~8.1 ka, increased aridity in the highlands was inferred which resulted in less freshwater being available in coastal quebradas. However, a lack of independent, empirical evidence for a highland arid episode has been identified. Future paleoclimatic studies in the highlands of Peru where the freshwater streams originate could illuminate this period in Peru's environmental history. Also, this record could more accurately reflect the paleoenvironment of southern Peru than data from Lake Titicaca.

A similar pattern then emerged after the Middle Holocene when people abandoned or depopulated the area. This pattern is not unique to Pampa Colorada and is seen regionally during the Middle Holocene. Known as the "*Silencio Arqueológico,*" areas within and the boundaries of the Atacama during the Middle Holocene were either abandoned or depopulated compared to the Early Holocene (Grosjean et al. 1994, Sandweiss et al. 1998, Nunez et al. 2002, Grosjean et al. 2007, Nunez et al. 2013). Evidence for this pattern comes from both a lack of archaeological sites during this era and paleoenvironmental reconstructions that show increased aridity in the core of the Atacama Desert and in the region in general. Lakes located in … that formed during the Terminal Pleistocene due to a relatively increased amount of precipitation began to dry due to prolonged droughts that frequently occurred between 9.0 to 4.5 ka (Nunez et al. 2002, Grosjean et al. 2007). Grass and plant diversity where …. that flourished after the Last Glacial Maximum began to decline during this period. In addition, in the Atacama Desert …. other flora and fauna concentrated along valley floors and in microhabitats where flowing freshwater was abundantly available. Once the Middle Holocene ended, climatic conditions became somewhat less arid in the Atacama and its exterior regions, and many archaeological sites were repopulated (Nunez et al. 2002, Grosjean et al. 2007, Nunez et al. 2013).

Early Holocene settlements were concentrated along paleo-lakeshores but were largely abandoned during the Middle Holocene for more favorable areas (Nunez et al. 2013). Human occupational behavior changed in response to climatic fluctuations that made their lakeside settlements either turn into wetlands or dry along with a loss of grass and floral diversity. Pampa Colorada is in the northernmost extent of the Atacama Desert, and my results possibly show that Pampa Colorada was mostly depopulated during the Middle Holocene. This would mirror the pattern seen in other southern Peruvian coastal archaeological sites where occupational hiatuses follow Early Holocene occupations. For example, Quebrada Jaguay-280 (13.2-8.0 ka) and the surrounding canyon archaeological sites (Machas phase 10.6-8.0 ka, Manos Phase ~4.0 ka) all have dense Early Holocene occupations but lack Middle Holocene ^{14}C dates (Sandweiss et al. 1996, 1998. Although Sandweiss et al. 1998 provide ^{14}C for both Early Holocene (Machas phase) and Late Holocene (Manos phase) sites, they found no intervening Middle Holocene sites surrounding Quebrada Jaguay based on both absolute and relative dates.

The Ring Site (12.0-7.5 ka) is another Pleistocene site that has a dense occupation that was abandoned during the Middle Holocene (Sandweiss et al. 1989, Reitz et al. 2015).

Quebrada Tacahuay (deFrance et al. 2001, 2005) has three separate occupation events (12.9-10.3 ka, 9.5-8.5 ka, and 4.5 ka) that do not extend into the Middle Holocene. Finally, Quebrada de los Burros (9.7-6.6 ka) (Carre et al. 2005, 2009, Reitz et al. 2015) has an Early Holocene occupation but is abandoned during the middle Middle Holocene. This pattern appears to be region-wide. Quebrada Tacahuay and the Jaguay canyon sites are most similar to Pampa Colorada because unlike Quebrada Jaguay-280, the Ring Site, and Quebrada de los Burros, these sites were reoccupied during the terminal Middle Holocene or the beginning of the Late Holocene after abandonment during the earlier portion of the period. This is interesting because the occupational history of Pampa Colorada follows a similar pattern to sites found in the canyon ~30 km east and to a site that is over 230 km to the south (deFrance 2001). Pampa Colorada appears to be following the "Silencio" pattern as seen throughout the southern coastal region of Peru and northern Chile (Grosjean et al. 1994, Sandweiss et al. 1998, Nunez et al. 2002, Grosjean et al. 2007, Nunez et al. 2013, Reitz et al. 2015). Future research at Pampa Colorada will help to fill in important knowledge gaps of the local paleoenvironment and will help archaeologists to better understand the Middle Holocene of southern Peru.

My data suggest that based on the number of sites, types, and the total number of points, Pampa Colorada during the Early Holocene seems to have a more intense occupation relative to later periods. More sites have Series Two points than any other series. Nineteen sites have Cuncaicha Series One points, but 16 sites also have specimens from Series Two. Pampa Colorada 310, 496, and 725 are the only sites with Series One points but lack Series Two examples. This means that these sites have the best possibility of having a Pleistocene occupation (see Table 6.1 for age ranges). In total, 25 sites from Pampa Colorada have Series Two points. Out of these 25, 19 also have Series Three projectile points. Series Two types (9.5-9.0 ka) occur at the greatest number of sites of any point type represented in the Pampa Colorada assemblage. Again, the pattern remains constant that Early Holocene types are the most frequent projectile point types in the region (see Table 6.1 for age ranges).

Sites containing both Series Two and Series Three projectile points are less numerous than sites containing both Series One and Two. In total, 19 sites have both Series Two and Three types. Seven sites have Series Three points but do not have Series Two types. Following the Middle Holocene, people resettled Pampa Colorada in the Late Holocene with only a few types of projectile points. While the Late Holocene occupation of Pampa Colorada is not as intense as the Early Holocene, land-use patterns during more recent periods are different. Sites more commonly have both Series One and Series Two points because this represents a continuous use of land by related groups. Sites less often have Series Two and Series Three points found together because there are possibly new, unrelated groups of people resettling Pampa Colorada after the Middle Holocene depopulation. To further illustrate this point, only eight sites have both Series One and Series Three types: 343, 425, 490, 492, 493, 494, 498, and 725. Of these eight sites, only Pampa Colorada 725 has only Series One and Series Three types. The seven other listed sites have all three series found within their assemblages.

McInnis identified Pampa Colorada-737 as the most intensively occupied site in Pampa Colorada. Pampa Colorada-737 was the only site that was radiocarbon dated to the Middle Holocene (5.5-4.9 ka) and provided evidence of on-site food and tool processing, which is rare in Pampa Colorada. Additionally, many of the Late Holocene sites have pottery that is associated with the first agriculturalists in the region (Hachas style), but this does not provide evidence for agriculture being practiced in Pampa Colorada. McInnis does not address changes in site occupation intensity through time but discusses changing land-use patterns.

McInnis inferred that the increased diversity and density of both invertebrate and vertebrate faunal remains and integration of agricultural products such as squash meant that during the Late Holocene, subsistence patterns had changed from previous periods. Additionally, sites with Late Holocene diagnostics (Series 5 projectile points and Hachas style pottery) are exclusively located along the rocky shore of Pampa Colorada. This is a marked change from the Terminal Pleistocene, Early Holocene, and Middle Holocene. Sites from these periods are located in more diverse locations such as along the slopes and peaks of various hills located in

Pampa Colorada. Finally, McInnis stated that Late Holocene sites provided evidence that year-round occupations began to occur in Pampa Colorada (McInnis 2006).

Overall, Late Holocene sites at Pampa Colorada differ in intensity and land-use patterns as compared to earlier settlements. The repopulation of Pampa Colorada after the Middle Holocene hiatus brought a different behavior to the region. My data, although preliminary, provides evidence that there was a resumption of the interzonal connection during the Late Holocene, but its overall character was somewhat different.

By examining how many projectile point types were shared between Pampa Colorada and Cuncaicha, I have been able to discover that while the strength of the inter-zonal connection remained stable possibly throughout the Terminal Pleistocene and Early Holocene, it weakened during the Middle Holocene, but was re-established during later periods. This connection was strongest in the Early Holocene. Pampa Colorada appears to almost completely lack a Middle Holocene occupation, so the strength of the connection during this period is unknowable. During the Late Holocene, a pattern seems to emerge that is similar to the Terminal Pleistocene where a few types were being shared. This differs from the Early Holocene where many types were being shared and were represented evenly in the regional assemblage. It is important to note that I did not set out to discover a Middle Holocene depopulation of Pampa Colorada. My data sets have possibly pointed me in this direction, and future archaeological and paleoenvironmental work will help further understand the depopulation phenomenon.

Question Two

6. Are there projectile point types that are exclusive to either the coast or the highlands region?

As presented in the Results chapter, I found that four types, two variants, and one sub-variant from Cuncaicha's typology were not found at Pampa Colorada. Of the missing types, three types and one variant are from Series Three, which dates to 6.0-5.0 ka. These are S3T3, S3T3v, S3T4, and S3T5, which includes the entire "Sumbay" category. This is significant because according to Klink and Aldenderfer (2005), "Sumbay" projectile points are diagnostic to the Middle Holocene. In addition, other than S3T6 and S3T6v (Late-Holocene diagnostics), which date to less than 4 ka, only seven Pampa Colorada points could be identified to Series Three types that date to 5.0-4.0 ka. These seven points were from seven separate sites, with three also having S3T6 or S3T6v points. Pampa Colorada 309, 425, 490, and Sureste could possibly be Middle Holocene sites based on my data. These sites could also be Late Holocene sites because the period technically begins at 4.2 ka (Walker et al. 2012).

From the above list, Pampa Colorada Sureste is the only site with a projectile point (S3T2 or Klink and Aldenderfer Type 4D) that cannot be confused with the "Anjasaya" type. Anjasaya points come from a surface site that is known to be ceramic in age (<4.0 ka) (Salcedo 1997). If the other six points are Late Holocene types, that means that only Pampa Colorada Sureste could be a Middle Holocene site, applying the Cuncaicha typology.

McInnis (2006) argues that while Pampa Colorada had a smaller population during the Middle Holocene compared to the Early Holocene, the area was not completely abandoned. Apart from her single late Middle Holocene radiocarbon date from Pampa Colorada-737 (5.5-4.9 ka), all other Middle Holocene sites were dated using diagnostic projectile point types from the Klink and Aldenderfer (2005) typology. While this typology is foundational and important for the history of archaeology in southern Peru, it is somewhat confusing and uses a few drawings instead of photos to illustrate types. This can lead to point type misidentifications.

Additionally, McInnis identifies the shortcomings of the Klink and Aldenderfer typology (2005) throughout her dissertation, citing that the scheme is not temporally sensitive enough to be used as a reliable relative dating tool. McInnis also recognizes that only a single coastal site was used to construct the typology, which further limits its applicability to the Pampa Colorada assemblage. Finally, Klink and Aldenderfer state that their typology may not be applicable outside the Lake Titicaca region (2005). This creates a need for a more applicable projectile point typology to be created and applied to Pampa Colorada.

The typology from Cuncaicha is much more applicable to the Pampa Colorada assemblage. Both sites are within the Arequipa region (~150 km apart) and share the usage of Alca obsidian (McInnis 2006). Also, age ranges for the Cuncaicha types are constrained by multiple AMS ^{14}C dates that create reliable temporal components (see Table 6.1). This makes each type a reliable and accurate tool to date sites from Pampa Colorada.

By combining the results of my cross-comparison study and re-identifications of McInnis' type assignments (see Chapter Five for point misidentifications), the maximum number of Middle Holocene sites at Pampa Colorada is three. These sites are Pampa Colorada Sureste, 491, 737. The point from Pampa Colorada-491 could be a drill, but the identification (Type 4D) is likely correct. Pampa Colorada-737 was directly dated on charcoal (5.1-5.0 ka) and shell (5.5-4.9 ka). I cannot directly reject the charcoal date because McInnis selected small-diameter botanicals to avoid an "old-wood effect" (McInnis 2006). The shell date may have incorporated an unknown marine reservoir effect. In addition, the temporal range for the shell date is much larger than the charcoal date. The shell date could be considered less reliable than the charcoal date.

S1T1vα, S1T4, and S1T4v are the only other Cuncaicha types that were not found at Pampa Colorada (See Chapter Five for descriptions of the types). S1T4 and its variant could be highland-exclusive types, along with S1T1vα. Only obsidian was used to manufacture these types at Cuncaicha. It is also possible that the “Sumbay” types found at Cuncaicha are exclusive to the highlands. Similar points have been found at Camarones-14 (Schiappacasse and Niemeyer 1984), which is a coastal site in northern Chile. This makes the absence of “Sumbay” points at Pampa Colorada anomalous.

I found that five types from Pampa Colorada are not found at Cuncaicha, but they appear to be morphologically related to types at other central Andean sites such as Asana (Aldenderfer 1998). For example, PCT2 and S2T5 share many characteristics, such as an overall “teardrop” morphology and wide, rounded bases. These two types appear to be related but distinct cousins. I also found this pattern with PCT5, which appears like a slender S1T1 but with a lack of a discernible break between the stem and blade. It is important to note that just because I was unable to find these types at Cuncaicha, this does not mean they are exclusive to Pampa Colorada. PCT1 and PCT3 are similar to Klink and Aldenderfer’s Type 4A, which has been found at both highland and coastal sites - Las Cuevas (Santoro and Nunez 1987) and Yara (Rasmussen 1998). PCT2 and PCT5 are similar to Klink and Aldenderfer’s Type 3D, which has also been found at other highland sites, such as Hakenasa (Santoro and Nunez 1987) and Telarmachay (Lavallee et al. 1985). The final “type” not found at Cuncaicha, PCT2, is similar to Klink and Aldenderfer’s Type 2A, which has been found at Toquepala (Ravines 1972).

All “Pampa Colorada types” share some similarity with Cuncaicha types. There are many different reasons why this pattern could be occurring. One is that the PCT points were poorly made imitations of the highland types. If these points were imitations, I would expect the points to be crudely manufactured and not have easily distinguishable features from the highland versions. By examining the PCT specimens, I have found that they are commonly finely flaked and show a high level of craftsmanship. Additionally, all types appear to have easily distinguishable features, such as basal spines (PCT2). This would suggest the points are not imitations of highland types.

Another reason could be that there were two separate groups exchanging raw materials and points. The unique types at Pampa Colorada could be manifestations of a related, but separate, cultural identity from their exchanging partners in the highlands. If a single group was moving seasonally between sites, I would expect total overlap in terms of projectile point style because the same flint-knappers would be manufacturing the tools. What has been observed is that both regions have types only found in their area, six for the highlands and five for Pampa Colorada. This means that total stylistic diversity in both areas is nearly equal (24 Cuncaicha vs 23 Pampa Colorada types). Because there is not total overlap of projectile point style, and there is an equal number of unique regional types, potentially there were two separate groups exchanging as opposed to a single seasonally migrating band. This concept will be further discussed in the conclusion of this chapter.

Types found at Cuncaicha but not at Pampa Colorada come from Series One and Series Three, which represent all temporal periods found at the rock shelter. One type (S1T4) and one variant (S1T4v) are missing from Pampa Colorada, and these are diagnostic to the Terminal Pleistocene (S1T4) and Early Holocene (S1T4v). As discussed above, the Sumbay types are not found at Pampa Colorada and are diagnostic to the Middle Holocene. S3T5 is also missing, and this type is diagnostic to the Late Holocene. This means that Cuncaicha has at least one unique type per period.

Most types found at Pampa Colorada but not at Cuncaicha (n=4) are inferred to be Early Holocene. This is based on co-occurrence with other Early Holocene points, morphological similarity to other types dated to this period, and radiocarbon dates (McInnis 2006). One type, PCT4, is inferred to be Late Holocene based on manufacture and similarity to other temporally diagnostic types of this period. Point types that are shared between the two regions are remarkably similar in terms of morphology.

Many of the Pampa Colorada points that could be typed using Cuncaicha's typology share more similarities than differences but also showcase the inherent variation within material culture. One example of this would be Pampa Colorada points typed to S2T3. Although they share basic morphological characteristics (wide pentagonal morphology with a long stem), Pampa Colorada points appear to have larger spines than the Cuncaicha versions. It could be argued that this is a diagnostic difference and represents a unique type to Pampa Colorada. I would disagree because of the location of the spines on the point. As discussed in the methods and theory chapters, the most likely portion of a projectile point to break is the distal end. The blade is exposed, while the haft is protected and obscured by either the arrow or atlatl shaft. Barbs and spines are then also equally exposed and as likely to break as blades if they are located on the distal portion. Due to their propensity to break, spines are not particularly useful characteristics for archaeologist assigning and creating typological assignments. Points from Pampa Colorada generally have intact or partial spines. This could be due to lack of use or other external factors such as the spines being added after they reached Pampa Colorada, possibly through exchange. Further research in this area should be conducted as more specimens are discovered and analyzed.

Even though Cuncaicha has more typable points and more types, Pampa Colorada has more examples of certain types. For example, S2T3 has six specimens defined from Cuncaicha. I have found 14 points from Pampa Colorada that were typable to S2T3. This pattern is found in two types and two variants: S1T1, S1T1v, S2T1, and S2T4v. It is important to note that S2T6 and S3T6v have an equal number of specimens defined between the two regions (n=9 and n=10). Six out of 18 total types shared (33%) have the same or more points found at Pampa Colorada than are defined for Cuncaicha.

Additionally, the six above mentioned types are generally widely distributed throughout Pampa Colorada. S1T1 is the most widely distributed point type at Pampa Colorada and was collected from 11 sites. S2T3 (n=10) and S1T1v (n=9) are also commonly found throughout the region. Both S2T1 (n=7) and S2T4v (n=6) are less widely distributed than the previously mentioned types.

It is difficult to infer why this pattern exists because there are multiple scenarios where this can occur. One possibility is that the manufacturing location of artifacts should have more examples present than where the points are moved to post-production. This could be due to the discarding of points that did not meet the flint-knappers' standards but were not necessarily unusable. Points were broken during manufacture and then discarded, or possibly a mass production event of one specific type of artifact occurred. Future research on the spatial distribution of points and types at Pampa Colorada could help to resolve this issue.

Another possibility is that the points found at Pampa Colorada were cached for later use or were lost. It is also possible that points were arriving in Pampa Colorada mostly finished, either through exchange or seasonal movement. McInnis inferred that points were not being manufactured at Pampa Colorada due to the relatively low amounts of obsidian debitage (n=83, 4.28% of total), obsidian cores (n=3), and little evidence for on-site manufacture found during survey and excavation (McInnis 2006). If points were being exchanged into Pampa Colorada from the highlands, they were arriving nearly finished or already complete. In addition, this pattern is not restricted to a single temporal period but is found in both the Early Holocene and Late Holocene. To fully understand the technological process of either tool exchange or manufacture at Pampa Colorada, research would have to be conducted on the cores and debitage. Additionally, the analysis of projectile point reduction indicators would be important in understanding if the points were being manufactured in Pampa Colorada. My data for this thesis cannot completely answer this question. This represents the next step in my analysis of the Pampa Colorada lithic assemblage.

Overall, the results of my study adequately answer this research question. I found 18 types of projectile points shared between the two regions. Seven types and variants from Cuncaicha are not found at Pampa Colorada, and five types are exclusive to the coast.

Question Three

7. Are metric attributes and ratios of projectile point types common to both regions statistically distinguishable?

Using the same 12 measurements for both sets of projectile points, I have found that most types are statistically indistinguishable between Cuncaicha and Pampa Colorada. Diagnostic characteristics such as haft length, maximum width, basal width, and concavity width and depth were prioritized when comparing numbers. The following section will summarize each metric from the 15 shared types and provide summary data tables. Overall trends and patterns will be briefly discussed towards the end of the section. Three types (S1T2, S3T1v, and S3T2) have been excluded because only one point from Pampa Colorada could be assigned a Cuncaicha type.

Type	Total # of specimens at Cuncaicha	Total # of Specimens at Pampa Colorada	Max Length	Max Width	Haft Length	Blade Length	Blade Length to Max Width	Haft Length to Blade Length	Basal Width	Max Length to Max Width	Max Thickness	Basal Thickness
S3T6v	10	10	0.10	0.84	-	-	-	-	0.56	0.18	0.01	-
S3T6	73	12	0.00	0.48	-	-	-	-	0.45	0.00	0.01	-
S3T1	8	5	-	0.05	0.03	.-	-	-	0.04	-	0.10	0.38
S2T6	9	9	0.11	0.93	0.57	0.22	0.22-	0.93	0.02	0.08	0.54	0.01
S2T5	10	7	0.69	0.04	-	-	-	-	0.22	0.09	-	-
S2T4v	6	7	-	0.23	-	-	-	-	-	-	0.28	0.42
S2T2	15	10	0.11	0.10	0.30	0.08	0.52	0.49	0.71	0.56	0.83	0.17
S1T1v	10	13	0.57	0.19	0.30	0.20	0.19	0.11	0.69	0.28	0.63	0.71

Table 6.2 P-values of Mann-Whitney Tests with Highlighted Significantly Different Values

For shared types that have a sample size larger than five from both Pampa Colorada and Cuncaicha, I performed Mann-Whitney U nonparametric statistical tests. The online calculator (www.socscistatistics.com) was used to perform the Mann-Whitney U tests and provides a U-value (sample size for each group is <10) and Z-score (sample size for each group is >10). U/Z-values are compared to critical U/Z-values to determine significance at p<0.05. If the test returns a U-value less than or equal to the critical U-value, the independent groups that were tested are inferred not to be from the same population. If the test returns a U-value or Z-value greater than the critical value the tested groups are inferred to be from the same source population.

Mann-Whitney U-tests provided p-values that show whether specific metric measurements from two independent groups are derived from the same population. This was difficult to perform due to low sample sizes (< 5). Fragmentary projectile points were not included in the Mann-Whitney U tests, which contributed to low sample sizes. Table 6.2 presents the p-values of the Mann-Whitney U tests (see Appendix F for complete Mann-Whitney test results). Table 6.3 below indicates which types from Pampa Colorada and Cuncaicha with large enough sample sizes to perform Mann-Whitney tests.

Type	# of Specimens from Cuncaicha	# of Specimens from Pampa Colorada	Mann-Whitney performed
S3T6v	10	10	Yes
S3T6	73	12	Yes
S3T5	7	0	No
S3T4	10	0	No
S3T3v	8	0	No
S3T3	8	0	No
S3T2	11	1	No
S3T1v	12	1	No
S3T1	5	5	Yes
S2T6	9	9	Yes
S2T5	7	7	Yes
S2T4v	6	7	Yes
S2T4	4	6	No
S2T3	6	14	No
S2T2	15	10	Yes
S2T1	2	7	No
S1T5	4	2	No
S1T4v	2	0	No
S1T4	2	0	No
S1T3v	3	2	No
S1T3	8	3	No
S1T2	4	1	No
S1T1vα	3	0	No
S1T1v	7	13	Yes
S1T1	4	12	No
Total	231	122	8

Table 6.3 Summary Table of Types Tested Using Mann-Whitney U Nonparametric Tests

For all other shared types and measurements that did not meet the sample size requirement of five, I used two-sample T-tests that assume unequal variances to determine if there was a significant difference between the two measurement means. There was a minimum sample size of two for the t-tests. If the t-test returned a p-value <0.05, there was a significant difference between means. See Appendix F for a summary of descriptive statistics for both Pampa Colorada and Cuncaicha types. This includes the number of specimens measured for each site, means and standard deviations for each measurement, relative standard deviation for each measurement, and the range of each measurement. The following notation will be utilized for the next section: Cuncaicha (C), Pampa Colorada (PC) for each table

Type	C n=	PC n=	C mean ± σ	PC mean ± σ	M-W U-score	M-W U-score critical	M-W Z-Score	MW p-value	T-test t=	T-test p-value
S3T6v	10	10	23.02 ± 3.86	28.22 ± 7.75	28	23	No Data	0.10	-1.89	0.08
S3T6	73	12	22.22 ± 5.41	33.82 ± 7.10	7	20	-4.43	0.00	-4.98	<0.01
S3T5	7	0	30.52 ± 3.65	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T4	8	0	25.93 ± 10.34	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3v	12	0	17.22 ± 4.99	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3	5	0	58.96 ± 11.62	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T2	7	1	33.79 ± 3.20	26.94	No Data	No Data	No Data	No Data	No Data	No Data
S3T1v	17	1	28.93 ± 4.54	45.20	No Data	No Data	No Data	No Data	No Data	No Data
S3T1	2	5	31.80 ± 1.61	27.56 ± 6.03	No Data	No Data	No Data	No Data	1.45	0.21
S2T6	9	9	32.13 ± 6.39	37.36 ± 7.12	22	17	No Data	0.11	-1.64	0.12
S2T5	6	6	35.51 ± 6.45	39.94 ± 12.01	15	5	No Data	0.69	-0.80	0.45
S2T4v	2	5	31.92 ± 1.78	32.97 ± 6.82	No Data	No Data	No Data	No Data	0.27	0.80
S2T4	4	5	31.67 ± 2.38	30.63 ± 6.90	No Data	No Data	No Data	No Data	0.37	0.72
S2T3	5	14	33.33 ± 9.46	39.59 ± 7.98	No Data	No Data	No Data	No Data	-1.42	0.19
S2T2	15	10	29.90 ± 3.17	36.85 ± 9.89	46	39		0.11	2.15	0.06
S2T1	2	7	26.98 ± 2.33	38.98 ± 16.00	No Data	No Data	No Data	No Data	-1.76	0.13
S1T5	4	2	40.19 ± 5.26	55.41 ± 16.42	No Data	No Data	No Data	No Data	-1.27	0.42
S1T4v	2	0	21.63 ± 0.74	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T4	2	0	23.46 ± 0.20	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T3v	3	1	25.12 ± 3.19	27.45	No Data	No Data	No Data	No Data	No Data	No Data
S1T3	8	2	29.71 ± 5.34	33.26 ± 10.10	No Data	No Data	No Data	No Data	-0.48	0.71
S1T2	3	1	35.16 ± 4.43	34.02	No Data	No Data	No Data	No Data	No Data	No Data
S1T1vα	3	0	28.34 ± 4.92	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T1v	5	11	32.86 ± 7.59	34.70 ± 5.10	22	9	No Data	0.57	-0.51	0.62
S1T1	4	12	28.45 ± 1.74	33.76 ± 6.38	No Data	No Data	No Data	No Data	-2.60	0.02

Table 6.4 Mann-Whitney (MW) and T-test Results Comparing Maximum Length (in mm) for Cuncaicha (C) vs Pampa Colorada (PC) Projectile Points, by Type. Highlighted cells Indicate Significant Differences Between the Two Groups.

Maximum length is influenced by the total amount of resharpening and by the original available size of raw material to craft the projectile point (Andrefsky 2009). A significant difference in maximum length could be evidence for a difference in flintknapping behavior.

Although many of the points from Pampa Colorada have larger maximum length averages, only S1T1 and S3T6 points are statistically different. Both Pampa Colorada types are longer than the highland versions. Notably, the average maximum length differs by less than six mm for 13 (72.2%) shared types. Maximum length measurements from both regions are remarkably similar (see Table 6.4 for measurements).

Type	C n=	PC n=	C mean ± σ	PC mean ± σ	M-W U-score	M-W U-score critical	M-W Z-Score	MW p-value	T-test t=	T-test p-value
S3T6v	10	10	17.04 ± 1.92	17.58 ± 4.58	47	23	0.19	0.84	-0.35	0.73
S3T6	73	12	16.56 ± 2.84	17.89 ± 4.01	48	27	-0.70	0.48	-1.10	0.29
S3T5	7	0	19.68 ± 2.35	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T4	8	0	25.09 ± 2.55	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3v	12	0	23.98 ± 2.22	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3	5	0	28.32 ± 3.87	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T2	11	1	20.67 ± 2.79	20.60	No Data	No Data	No Data	No Data	No Data	No Data
S3T1v	10	1	21.72 ± 1.91	23.07	No Data	No Data	No Data	No Data	No Data	No Data
S3T1	8	5	23.64 ± 1.82	18.31 ± 3.24	17	17	No Data	0.05	3.36	0.02
S2T6	9	9	18.41 ± 2.78	18.15 ± 3.35	39	17	No Data	0.93	0.18	0.86
S2T5	7	7	20.01 ± 2.18	17.43 ± 3.49	8	8	No Data	0.04	1.66	0.13
S2T4v	6	7	21.66 ± 3.21	22.18 ± 3.23	12	6	No Data	0.23	-1.53	0.30
S2T4	4	6	23.42 ± 1.38	22.01 ± 3.02	No Data	No Data	No Data	No Data	-0.24	0.82
S2T3	6	14	19.08 ± 3.21	22.46 ± 2.72	No Data	No Data	No Data	No Data	-2.41	0.03
S2T2	15	10	16.42 ± 1.98	19.08 ± 3.48	45	39	-1.63	0.10	-2.19	0.05
S2T1	2	7	12.31 ± 0.99	18.76 ± 6.25	No Data	No Data	No Data	No Data	-2.61	0.04
S1T5	4	2	19.20 ± 3.60	25.74 ± 2.15	No Data	No Data	No Data	No Data	-2.77	0.07
S1T4v	2	0	19.66 ± 0.18	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T4	2	0	19.25 ± 2.16	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T3v	3	2	17.47 ± 2.96	16.44 ± 3.83	No Data	No Data	No Data	No Data	0.42	0.71
S1T3	8	3	18.34 ± 3.38	19.55 ± 0.32	No Data	No Data	No Data	No Data	-1.00	0.35
S1T2	4	1	19.98 ± 1.37	21.89	No Data	No Data	No Data	No Data	No Data	No Data
S1T1vα	3	0	19.58 ± 2.47	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T1v	7	13	20.94 ± 3.88	18.94 ± 2.24	31	22	No Data	0.19	1.43	0.19
S1T1	4	12	16.96 ± 1.58	16.56 ± 2.73	No Data	No Data	No Data	No Data	0.35	0.73

Table 6.5 Mann-Whitney (MW) and T-test Results Comparing Maximum Width (in mm) for Cuncaicha (C) vs Pampa Colorada (PC) Projectile Points, by Type. Highlighted Cells Indicate Significant Differences Between the Two Groups.

Maximum width could be influenced by resharpening if the widest area on the projectile point is at the shoulder or along the blade. This measurement should not be affected by resharpening if the widest point is on the haft. As seen with maximum length, significant measurement differences between regions could be evidence for differing flintknapping behavior.

Four (26.7%) projectile point types have significantly different maximum width measurements. S2T1 and S2T3 Pampa Colorada types are wider than the highland versions. S2T5 and S3T1 Cuncaicha types are significantly wider than their coastal counterparts. The S2T5 measurements were significantly different using a MW test but statistically indistinguishable using a t-test. This is due to MW tests being more accurate with smaller sample sizes as compared to t-tests. For most types, there does not appear to be a significant difference in maximum width measurements between the coast and highlands.

Type	C n=	PC n=	C mean ± σ	PC mean ± σ	M-W U-score	M-W U-score critical	M-W Z-Score	MW p-value	T-test t=	T-test p-value
S3T6v	0	0	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T6	0	0	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T5	6	0	13.75 ± 2.89	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T4	8	0	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3v	3	0	13.95 ± 0.92	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3	5	0	13.60 ± 2.94	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T2	6	1	10.38 ± 2.13	11.40	No Data	No Data	No Data	No Data	No Data	No Data
S3T1v	9	1	9.98 ± 2.05	8.35	No Data	No Data	No Data	No Data	No Data	No Data
S3T1	7	5	7.06 ± 2.06	9.44 ± 1.55	10	12	No Data	0.03	-2.28	0.04
S2T6	9	9	13.71 ± 3.49	15.17 ± 5.86	33.5	17	No Data	0.57	-0.64	0.53
S2T5	2	1	16.08 ± 0.11	13.54	No Data	No Data	No Data	No Data	No Data	No Data
S2T4v	2	7	10.53 ± 1.12	11.21 ± 3.53	No Data	No Data	No Data	No Data	-0.44	0.68
S2T4	4	6	7.50 ± 2.12	11.11 ± 3.28	No Data	No Data	No Data	No Data	No Data	No Data
S2T3	5	12	18.61 ± 2.60	20.56 ± 10.60	No Data	No Data	No Data	No Data	-0.60	0.56
S2T2	15	10	15.84 ± 2.99	18.28 ± 7.29	73	39	-0.08	0.30	-1.00	0.34
S2T1	2	4	12.01 ± 2.84	13.87 ± 4.50	No Data	No Data	No Data	No Data	-0.65	0.56
S1T5	4	1	13.20 ± 5.56	27.82	No Data	No Data	No Data	No Data	No Data	No Data
S1T4v	2	0	7.44 ± 0.63	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T4	2	0	12.05 ± 1.48	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T3v	3	2	11.56 ± 1.71	10.92 ± 1.30	No Data	No Data	No Data	No Data	0.47	0.68
S1T3	8	3	11.38 ± 3.65	13.81 ± 6.52	No Data	No Data	No Data	No Data	-0.69	0.54
S1T2	4	1	11.20 ± 1.72	15.53	No Data	No Data	No Data	No Data	No Data	No Data
S1T1vα	3	0	9.92 ± 3.48	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T1v	7	12	16.30 ± 3.08	14.35 ± 3.86	32	20	No Data	0.30	1.24	0.23
S1T1	4	11	13.23 ± 1.49	13.51 ± 4.97	No Data	No Data	No Data	No Data	0.17	0.87

Table 6.6 Mann-Whitney (MW) and T-test Results Comparing Haft Length (in mm) for Cuncaicha (C) vs Pampa Colorada (PC) Projectile Points, by Type. Highlighted Cells Indicate Sgnificant Differences Between the Two Groups.

Haft length should be unaffected by resharpening and should reflect more accurately the original intended design of the projectile point (Andrefsky 2009). Using both MW and t-tests, the haft length of Pampa Colorada S3T1 types is significantly longer than Cuncaicha types. All other shared types with large enough sample sizes showed no significant differences. My data show that projectile points with measurable hafts (a discernable difference between haft and blade) are similar between the coast and highland

Type	C n=	PC n=	C mean ± σ	PC mean ± σ	M-W U-score	M-W U-score critical	M-W Z-Score	MW p-value	T-test t=	T-test p-value
S3T6v	0	0	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T6	0	0	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T5	6	0	16.90 ± 1.65	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T4	1	0	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3v	2	0	11.13 ± 0.31	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3	4	0	46.65 ± 15.12	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T2	6	1	24.15 ± 3.81	15.54	No Data	No Data	No Data	No Data	No Data	No Data
S3T1v	5	1	18.88 ± 6.35	36.85	No Data	No Data	No Data	No Data	No Data	No Data
S3T1	2	5	23.80 ± 3.03	18.11 ± 5.32	No Data	No Data	No Data	No Data	1.77	0.17
S2T6	9	9	18.43 ± 4.29	22.20 ± 6.12	26	17	No Data	0.22	-1.51	0.15
S2T5	1	1	18.03	13.25	No Data	No Data	No Data	No Data	No Data	No Data
S2T4v	0	4	20.88 ± 2.28	21.20 ± 3.27	No Data	No Data	No Data	No Data	No Data	No Data
S2T4	3	5	No Data	19.93 ± 3.99	No Data	No Data	No Data	No Data	-0.16	0.87
S2T3	5	12	14.73 ± 8.97	19.40 ± 3.83	No Data	No Data	No Data	No Data	-1.12	0.32
S2T2	15	10	14.18 ± 2.49	18.58 ± 7.15	43	39	-1.74	0.08	-1.00	0.34
S2T1	2	6	14.97 ± 0.51	27.94 ± 13.58	No Data	No Data	No Data	No Data	-2.33	0.07
S1T5	4	1	27.00 ± 6.42	15.98	No Data	No Data	No Data	No Data	No Data	No Data
S1T4v	2	0	14.19 ± 0.12	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T4	2	0	11.41 ± 1.29	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T3v	3	1	13.56 ± 1.63	17.45	No Data	No Data	No Data	No Data	No Data	No data
S1T3	8	3	18.33 ± 3.11	17.91 ± 3.27	No Data	No Data	No Data	No Data	0.19	0.86
S1T2	3	1	23.96 ± 3.05	18.49	No Data	No Data	No Data	No Data	No Data	No Data
S1T1vα	3	0	18.42 ± 4.42	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T1v	6	11	16.67 ± 5.85	19.98 ± 3.71	19	12	No Data	0.20	-1.35	0.21
S1T1	4	11	15.22 ± 1.06	22.37 ± 6.53	No Data	No Data	No Data	No Data	-3.85	0.01

Table 6.7 Mann-Whitney (MW) and T-test Results Comparing Blade Length (in mm) for Cuncaicha (C) vs Pampa Colorada (PC) Projectile Points, by Type. Highlighted Cells Indicate Significant Differences Between the Two Groups.

Blade length should be primarily influenced by resharpening. A shorter blade length for one population is indicative of greater amounts of retouch occurring (See Chapter Three for review). Due to many projectile points being fragmentary and low sample sizes, this measurement is difficult to compare statistically. As seen with maximum length, S1T1 Pampa Colorada points are longer than the highland versions. All other shared types' blade lengths are statistically indistinguishable.

Non-shouldered, diamond-shaped projectile points from Pampa Colorada are significantly longer and have larger blade lengths. There appears to be less retouch occurring at

Pampa Colorada compared to Cuncaicha, but future studies utilizing reduction indices are required to confirm this preliminary result.

Type	C n=	PC n=	C mean ± σ	PC mean ± σ	M-W U-score	M-W U-score critical	M-W Z-Score	MW p-value	T-test t=	T-test p-value
S3T6v	0	0	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T6	0	0	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T5	6	0	0.84 ± 0.08	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T4	1	0	1.26	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3v	2	0	0.50	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3	4	0	1.58 ± 0.55	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T2	6	1	1.15 ± 0.19	0.75	No Data	No Data	No Data	No Data	No Data	No Data
S3T1v	5	1	0.89 ± 0.30	1.60	No Data	No Data	No Data	No Data	No Data	No Data
S3T1	2	5	0.99 ± 0.09	0.98 ± 0.19	No Data	No Data	No Data	No Data	0.09	0.93
S2T6	9	9	1.00 ± 0.21	1.23 ± 0.30	26	17	No Data	0.22	-1.88	0.08
S2T5	1	1	0.84	0.82	No Data	No Data	No Data	No Data	No Data	No Data
S2T4v	0	4	1.01 ± 0.10	0.96 ± 0.11	No Data	No Data	No Data	No Data	No Data	No Data
S2T4	3	5	No Data	0.90 ± 0.15	No Data	No Data	No Data	No Data	0.66	0.99
S2T3	5	12	0.73 ± 0.33	0.86 ± 0.16	No Data	No Data	No Data	No Data	-0.84	0.44
S2T2	15	10	0.90 ± 0.19	0.96 ± 0.30	63	39	-0.63	0.52	-0.56	0.59
S2T1	2	6	1.22 ± 0.14	1.44 ± 0.45	No Data	No Data	No Data	No Data	-1.07	0.33
S1T5	4	1	1.44 ± 0.43	0.65	No Data	No Data	No Data	No Data	No Data	No Data
S1T4v	2	0	0.72	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T4	2	0	0.60 ± 0.13	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T3v	3	1	0.78 ± 0.05	1.27	No Data	No Data	No Data	No Data	No Data	No Data
S1T3	8	3	1.01 ± 0.16	0.92 ± 0.16	No Data	No Data	No Data	No Data	0.92	0.39
S1T2	3	1	1.24 ± 0.21	0.84	No Data	No Data	No Data	No Data	No Data	No Data
S1T1vα	3	0	0.96 ± 0.30	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T1v	5	11	0.88 ± 0.32	1.06 ± 0.18	17	11	No Data	0.19	-1.18	0.31
S1T1	4	11	0.95 ± 0.16	1.38 ± 0.30	No Data	No Data	No Data	No Data	-3.64	<0.01

Table 6.8 Mann-Whitney (MW) and T-test Results Comparing the Ratio of Blade Length to Maximum Width for Cuncaicha (C) vs Pampa Colorada (PC) Projectile Points, by Type. Highlighted Cells Indicate Significant Differences Between the Two Groups.

The ratio of blade length to maximum width is used to evaluate if the overall blade width is being affected by resharpening. Changes in the ratio of blade length to maximum width can also be indicative of where resharpening is occurring on the point. If both blade length and maximum width are being reduced proportionally, both variables are affected by tool reduction. If maximum width remains unchanged, tool retouch is only affecting blade length (Andrefsky 2009) (See Chapters Three and Four for review).

The pattern of Pampa Colorada points being generally larger than their highland counterparts continues with the ratio of blade length to maximum width. Although average maximum width is nearly identical between the regions (16.96 mm (C) vs 16.56 mm (PC) with similar standard deviations (see Table 6.5), the difference in blade length is large enough to make the associated ratio significantly different between the two areas. Highland blades were being more heavily reduced or were designed to be smaller than the coastal versions

Type	C n=	PC n=	C mean ± σ	PC mean ± σ	M-W U-score	M-W U-score critical	M-W Z-Score	MW p-value	T-test t=	T-test p-value
S3T6v	0	0	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T6	0	0	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T5	6	0	0.81 ± 0.15	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T4	0	0	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3v	1	0	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3	4	0	0.32 ± 0.18	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T2	6	1	0.45 ± 0.15	0.73	No Data	No Data	No Data	No Data	No Data	No Data
S3T1v	5	1	0.62 ± 0.44	0.22	No Data	No Data	No Data	No Data	No Data	No Data
S3T1	2	5	0.34 ± .10	0.55 ± 0.14	No Data	No Data	No Data	No Data	-2.22	0.11
S2T6	9	9	0.77 ± 0.26	0.74 ± 0.36	39	17	No Data	0.93	0.27	0.79
S2T5	1	1	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S2T4v	0	5	No Data	0.63 ± 0.14	No Data	No Data	No Data	No Data	No Data	No Data
S2T4	3	5	0.54 ± 0.09	0.54 ± 0.10	No Data	No Data	No Data	No Data	-0.15	0.99
S2T3	5	12	1.74 ± 1.22	1.08 ± 0.31	No Data	No Data	No Data	No Data	1.30	0.25
S2T2	15	10	1.11 ± 0.34	1.16 ± 0.73	62	39	0.08	0.49	-0.20	0.84
S2T1	2	5	0.81 ± 0.22	0.59 ± 0.24	No Data	No Data	No Data	No Data	1.16	0.23
S1T5	4	1	0.55 ± 0.39	1.74	No Data	No Data	No Data	No Data	No Data	No Data
S1T4v	2	0	0.52 ± 0.04	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T4	2	0	1.07 ± 0.25	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T3v	3	1	0.85 ± 0.08	0.79±0.37	No Data	No Data	No Data	No Data	No Data	No Data
S1T3	8	3	0.63 ± 0.20	0.57	No Data	No Data	No Data	No Data	-0.83	0.46
S1T2	3	1	0.47 ± 0.05	0.84	No Data	No Data	No Data	No Data	No Data	No Data
S1T1vα	3	0	0.56 ± 0.23	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T1v	5	11	1.03 ± 0.34	0.77 ± 0.26	13	9	No Data	0.11	1.58	0.17
S1T1	4	10	0.87 ± 0.13	0.62 ± 0.20	No Data	No Data	No Data	No Data	2.69	0.02

Table 6.9 Mann-Whitney (MW) and T-test Results Comparing the Ratio of Haft Length to Blade Length for Cuncaicha (C) vs Pampa Colorada (PC) Projectile Points, by Type. Highlighted Cells Indicate Significant Differences Between the Two Groups.

The ratio of haft length to blade length should be primarily influenced by resharpening (Andrefsky 2009). As seen with all other measurements associated with blade length, there is a significant difference between coastal and highland points. Highland blades are shorter compared to their hafts, which creates an overall larger ratio. All other ratios from types that are shared between regions are indistinguishable.

Type	C n=	PC n=	C mean ± σ	PC mean ± σ	M-W U-score	M-W U-score critical	M-W Z-Score	MW p-value	T-test t=	T-test p-value
S3T6v	8	10	15.42 ± 2.37	14.71 ± 3.22	33	17	No Data	0.56	-0.54	0.60
S3T6	61	12	15.60 ± 3.17	16.62 ± 4.15	No Data	No Data	-0.75	0.45	-0.80	0.43
S3T5	6	0	8.15 ± 0.15	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T4	8	0	14.78 ± 2.18	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3v	8	0	20.52 ± 3.00	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3	5	0	21.14 ± 2.10	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T2	6	1	11.53 ± 1.61	7.25	No Data	No Data	No Data	No Data	No Data	No Data
S3T1v	7	1	3.03 ± 0.88	2.49	No Data	No Data	No Data	No Data	No Data	No Data
S3T1	8	5	5.84 ± 1.16	6.01 ± 1.68	17	6	No Data	0.71	-0.19	0.85
S2T6	9	9	8.10 ± 1.49	5.91 ± 1.72	11	15	No Data	0.02	-2.90	0.01
S2T5	6	7	12.02 ± 5.26	8.49 ± 2.25	12	6	No Data	0.22	1.63	0.14
S2T4v	2	7	5.76 ± 3.47	5.04 ± 0.96	No Data	No Data	No Data	No Data	No Data	No Data
S2T4	4	6	4.59 ± 1.99	6.50 ± 3.03	No Data	No Data	No Data	No Data	0.40	0.71
S2T3	5	14	8.62 ± 3.67	8.81 ± 3.05	No Data	No Data	No Data	No Data	-0.10	0.92
S2T2	15	10	5.92 ± 1.83	6.26 ± 1.39	68	39	0.36	0.71	-0.51	0.61
S2T1	2	6	4.14 ± 0.59	4.81 ± 1.90	No Data	No Data	No Data	No Data	-0.76	0.48
S1T5	2	2	5.11 ± 1.82	5.48 ± 3.81	No Data	No Data	No Data	No Data	-0.13	0.92
S1T4v	0	0	3.23 ± 0.03	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T4	2	0	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T3v	3	2	7.26 ± 4.49	6.09 ± 1.35	No Data	No Data	No Data	No Data	0.42	0.71
S1T3	6	3	6.81 ± 1.36	3.82 ± 1.32	No Data	No Data	No Data	No Data	3.17	0.03
S1T2	3	1	4.35 ± 2.04	5.00	No Data	No Data	No Data	No Data	No Data	No Data
S1T1vα	3	0	2.92 ± 1.67	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T1v	6	12	3.35 ± 1.50	3.95 ± 0.97	34	16	No Data	0.69	-0.89	0.39
S1T1	4	12	4.19 ± 1.10	3.75 ± 0.88	No Data	No Data	No Data	No Data	0.74	0.50

Table 6.10 Mann-Whitney (MW) and T-test Results Comparing Basal Width (in mm) for Cuncaicha (C) vs Pampa Colorada (PC) Projectile Points, by Type. Highlighted Cells Indicate Significant Differences Between the Two Groups.

Similar to haft length, basal width should be unaffected by resharpening and is a more accurate reflection of the original intended design of the projectile point. Two (13.3%) types have significantly different basal widths. S1T3 and S2T6 types from Cuncaicha have significantly wider basal widths than coastal types (see Table 6.10 for measurements). Pampa Colorada S2T6 types lack basal concavities but share all other morphological traits that are diagnostic for this type (rounded spines, slightly contracting haft, and narrow base). This represents a difference in stylistic choice between the highlands and coast. S1T3 Pampa

Colorada types do not differ morphologically from Cuncaicha types but have narrower bases (see Chapter Five for type description)

Type	C n=	PC n=	C mean ± σ	PC mean ± σ	M-W U-score	M-W U-score critical	M-W Z-Score	MW p-value	T-test t=	T-test p-value
S3T6v	10	10	1.37 ± 0.29	1.66 ± 0.47	32	23	-1.32	0.18	-1.66	0.11
S3T6	73	12	1.36 ± 0.35	1.93 ± 0.39	2	10	-4.14	0.00	-5.09	<0.01
S3T5	7	0	1.56 ± 0.16	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T4	8	0	1.05 ± 0.46	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3v	12	0	0.72 ± 0.20	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3	5	0	2.12 ± 0.48	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T2	7	1	1.67 ± 0.24	1.31	No Data	No Data	No Data	No Data	No Data	No Data
S3T1v	7	1	1.31 ± 0.25	1.95	No Data	No Data	No Data	No Data	No Data	No Data
S3T1	2	5	1.32 ± 0.02	1.51 ± 0.23	No Data	No Data	No Data	No Data	-1.93	0.15
S2T6	9	9	1.76 ± 0.31	2.06 ± 0.21	20	17	No Data	0.08	-2.40	0.04
S2T5	6	6	1.80 ± 0.31	2.30 ± 0.54	7	5	No Data	0.09	-1.92	0.09
S2T4v	2	5	1.33 ± 0.04	1.38 ± 0.19	No Data	No Data	No Data	No Data	-0.56	0.59
S2T4	3	5	1.55 ± 0.17	1.48 ± 0.20	No Data	No Data	No Data	No Data	0.54	0.61
S2T3	5	14	1.71 ± 0.20	1.76 ± 0.21	No Data	No Data	No Data	No Data	-0.47	0.66
S2T2	15	10	1.84 ± 0.22	1.92 ± 0.30	64	39	-0.58	0.56	-0.72	0.49
S2T1	2	7	2.19 ± 0.01	2.00 ± 0.32	No Data	No Data	No Data	No Data	1.57	0.18
S1T5	4	2	2.13 ± 0.46	2.13 ± 0.46	No Data	No Data	No Data	No Data	0.00	0.99
S1T4v	2	0	3.23 ± 0.03	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T4	2	0	1.23 ± 0.13	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T3v	3	1	1.44 ± 0.06	1.62 ± 0.36	No Data	No Data	No Data	No Data	No Data	No Data
S1T3	8	3	1.63 ± 0.17	1.99	No Data	No Data	No Data	No Data	0.05	0.97
S1T2	3	1	1.81 ± 0.29	1.55	No Data	No Data	No Data	No Data	No Data	No Data
S1T1vα	3	0	1.45 ± 0.25	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T1v	5	11	1.73 ± 0.39	1.85 ± 0.27	67	48	No Data	0.28	-0.67	0.52
S1T1	4	12	1.68 ± 0.11	2.06 ± 0.37	No Data	No Data	No Data	No Data	-3.16	0.01

Table 6.11**.** Mann-Whitney (MW) and T-test Results Comparing the Ratio of Maximum Length to Maximum Width for Cuncaicha (C) vs Pampa Colorada (PC) Projectile Points, by Type. Highlighted Cells Indicate Significant Differences Between the Two Groups

Maximum length to maximum width ratios are possibly influenced by resharpening. Three types (26.7%) are significantly different between regions. Pampa Colorada S1T1, S2T6, and S3T6 types have higher ratios than Cuncaicha types. Both Pampa Colorada S1T1 and S3T6 types are longer than Cuncaicha types, so a significant difference in this ratio follows the previously established pattern (see Tables 6.4 and 6.5 for measurements). The significant difference in this ratio for S2T6 points could be due to the slight morphological difference between the regions. Overall, the majority of shared types are statistically similar using this ratio.

Type	C n=	PC n=	C mean ± σ	PC mean ± σ	M-W U-score	M-W U-score critical	M-W Z-Score	MW p-value	T-test t=	T-test p-value
S3T6v	10	10	4.50 ± 0.82	5.98 ± 1.19	16	23	-2.53	0.01	-3.24	0.01
S3T6	73	12	4.32 ± 0.96	5.54 ± 0.31	No Data	No Data	-4.15	0.01	-8.49	<0.01
S3T5	7	0	7.15 ± 0.53	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T4	8	0	6.54 ± 1.11	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3v	12	0	5.61 ± 0.66	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3	5	0	8.61 ± 1.27	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T2	11	1	7.86 ± 0.95	7.89	No Data	No Data	No Data	No Data	No Data	No Data
S3T1v	10	1	5.97 ± 0.62	9.42	No Data	No Data	No Data	No Data	No Data	No Data
S3T1	8	5	6.44 ± 0.98	5.51 ± 1.22	21.5	17	No Data	0.10	1.45	0.19
S2T6	9	9	6.94 ± 1.42	7.10 ± 2.02	33	17	No Data	0.54	-0.19	0.85
S2T5	7	7	7.28 ± 1.13	7.01 ± 1.67	No Data	No Data	No Data	No Data	0.35	0.73
S2T4v	6	7	6.00 ± 1.01	5.77 ± 1.84	13	6	No Data	0.28	0.65	0.55
S2T4	4	6	5.79 ± 0.47	5.47 ± 0.91	No Data	No Data	No Data	No Data	0.25	0.81
S2T3	6	14	6.73 ± 1.12	6.96 ± 1.07	No Data	No Data	No Data	No Data	-0.43	0.68
S2T2	15	10	6.43 ± 0.89	6.45 ± 1.18	72	29	-0.13	0.83	-0.02	0.98
S2T1	2	7	4.90 ± 0.29	6.58 ± 1.19	No Data	No Data	No Data	No Data	-3.39	0.01
S1T5	4	2	6.77 ± 2.07	9.06 ± 3.51	No Data	No Data	No Data	No Data	-0.85	0.06
S1T4v	2	0	5.26 ± 0.02	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T4	2	0	5.10 ± 0.10	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T3v	3	2	4.95 ± 0.91	6.03 ± 1.00	No Data	No Data	No Data	No Data	-1.22	0.35
S1T3	8	3	5.64 ± 1.14	6.37 ± 0.84	No Data	No Data	No Data	No Data	-1.16	0.30
S1T2	4	1	6.57 ± 1.40	7.43	No Data	No Data	No Data	No Data	No Data	No Data
S1T1vα	3	0	5.54 ± 0.87	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T1v	7	13	6.03 ± 1.13	6.24 ± 1.08	42	22	No Data	0.63	-0.40	0.70
S1T1	4	12	5.27 ± 1.13	5.77 ± 0.44	No Data	No Data	No Data	No Data	-0.88	0.44

Table 6.12 Mann-Whitney (MW) and T-test Results Comparing Maximum Thickness (in mm) for Cuncaicha (C) vs Pampa Colorada (PC) Projectile Points, by Type. Highlighted Cells Indicate Significant Differences Between the Two Groups.

Maximum thickness should not be affected by resharpening but could be indicative of differences in culture, raw material characteristics, and skill. Raw material will be discussed in the following section, but in general, Alca obsidian was primarily used to manufacture points at both Cuncaicha (n=210, 90.9 %) and Pampa Colorada (n=80, 65.5%). Three types, S2T1, S3T6, and S3T6v are significantly different between the highlands and coast. All three Pampa Colorada types are thicker than Cuncaicha versions.

Differences in raw material flaking quality could be influencing the maximum thickness values for S2T1. For S2T1 types, there are two (chert and andesite) non-obsidian projectile points from Pampa Colorada and zero from Cuncaicha. When comparing exclusively obsidian

S2T1 types, the points are statistically indistinguishable (t=2.56, p=0.06) (see Appendix A and B for measurements). Only when the two non-obsidian examples from PC are added into the equation, the two regions have significantly different maximum thicknesses.

This pattern does not hold with S3T6 types. Every Cuncaicha type (n=73) was manufactured from obsidian but only eight (66.6%) of Pampa Colorada types are obsidian. Cuncaicha S3T6 types have an average maximum thickness of 4.50 mm (σ=0.82 mm) and Pampa Colorada types average thickness is 5.57 mm (σ=0.37 mm). Interestingly, there is a significant difference in maximum thickness between highland and coastal obsidian S3T6 points (t=-6.60, p=<0.01). This indicates that regardless of raw material used to manufacture S3T6 points, Pampa Colorada types are thicker than Cuncaicha types. The same is true for S3T6v examples because only one (10%) Pampa Colorada point is non-obsidian (chert).

Type	C n=	PC n=	C mean ± σ	PC mean ± σ	M-W U-score	M-W U-score critical	M-W Z-Score	MW p-value	T-test t=	T-test p-value
S3T6v	12	10	3.54 ± 0.21	3.66 ± 0.75	No Data	No Data	No Data	No Data	-0.31	0.79
S3T6	10	12	3.28 ± 0.65	3.92 ± 1.03	No Data	No Data	No Data	No Data	0.09	<0.99
S3T5	6	0	5.90 ± 0.53	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T4	4	0	3.49 ± 0.26	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3v	3	0	4.36 ± 0.92	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T3	5	0	5.74 ± 1.12	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S3T2	6	1	5.17 ± 1.03	6.39	No Data	No Data	No Data	No Data	No Data	No Data
S3T1v	9	1	4.19 ± 1.09	4.65	No Data	No Data	No Data	No Data	No Data	No Data
S3T1	8	5	4.76 ± 1.27	4.00 ± 0.44	26.5	15	No Data	0.38	-0.21	0.84
S2T6	9	9	6.02 ± 1.23	4.55 ± 0.81	12	20	No Data	0.01	2.98	0.01
S2T5	2	6	6.85 ± 0.24	5.99 ± 0.89	No Data	No Data	No Data	No Data	2.42	0.05
S2T4v	5	7	4.67 ± 0.88	3.61 ± 0.66	14	6	No Data	0.42	-0.06	0.96
S2T4	4	6	4.56 ± 0.93	4.59 ± 0.81	No Data	No Data	No Data	No Data	2.05	0.10
S2T3	5	14	6.01 ± 0.75	5.78 ± 1.08	No Data	No Data	No Data	No Data	0.52	0.61
S2T2	14	10	5.57 ± 1.12	5.02 ± 0.91	46	36	1.37	0.17	1.32	0.21
S2T1	2	7	3.79 ± 0.44	4.64 ± 0.63	No Data	No Data	No Data	No Data	-2.17	0.16
S1T5	4	2	4.76 ± 1.90	5.32 ± 0.25	No Data	No Data	No Data	No Data	-0.57	0.60
S1T4v	2	0	4.03 ± 1.10	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T4	2	0	4.27 ± 0.10	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T3v	3	2	4.11 ± 1.17	5.13 ± 1.07	No Data	No Data	No Data	No Data	-0.16	0.90
S1T3	8	3	5.06 ± 1.02	5.03	No Data	No Data	No Data	No Data	-0.10	0.93
S1T2	3	1	5.21 ± 0.96	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T1vα	3	0	5.08 ± 0.82	No Data	No Data	No Data	No Data	No Data	No Data	No Data
S1T1v	7	13	4.99 ± 1.22	5.28 ± 0.90	44	22	No Data	0.71	-0.55	0.59
S1T1	4	12	4.30 ± 0.86	4.64 ± 0.72	No Data	No Data	No Data	No Data	-0.71	0.52

Table 6.13 Mann-Whitney (MW) and T-test Results Comparing Basal Thickness (in mm)

Basal thickness should also not be influenced by resharpening but can be indicative in differences in skill, culture, or raw material flaking quality. Only a single type (S2T6) was significantly different between the regions. S2T6 highland types are thicker than their coastal equivalents. This could be due to the previously discussed morphological difference or because more Pampa Colorada types (n=3, 33.3%) were manufactured using non-obsidian materials than Cuncaicha types (n=1, 11.1%) (see Appendix A and B for raw material information). When comparing obsidian S2T6 types, basal thickness is nearly identical (7.29 mm, σ=0.71 mm (Cuncaicha) vs 7.32 mm, σ=2.31 mm (Pampa Colorada). These types are statistically similar using a t-test (t=-0.03, p=0.98).

The single chalcedony Cuncaicha S2T6 point is very thin (3.70 mm) and the three non-obsidian Pampa Colorada points are on average thinner (6.64 mm, σ=1.58 mm) than their obsidian counterparts. The non-obsidian Pampa Colorada S2T6 are not significantly thinner than the obsidian versions (t=-0.51, p=0.63). A larger sample of non-obsidian highland S2T6 specimens is required to assess if there is a distinct difference in basal thickness caused by different manufacturing material.

Overall, points from both Pampa Colorada and Cuncaicha have similar metric measurements with few notable exceptions. S1T1 points from Pampa Colorada appear to be longer and have larger blade lengths, while Cuncaicha equivalents have more evidence of retouch. In measurements that are not affected by retouch, such as maximum width, haft length, basal width, and maximum thickness, S1T1 points from the coast and highlands are statistically indistinguishable. This is evidence for a difference in flintknapper behavior as opposed to a cultural difference that would affect the intended design of the artifact. It is possible that highland points were being purposefully manufactured smaller to hunt smaller game. Another scenario is that smaller cobbles could have actively been selected in the highlands for the manufacture of points, and larger packages were being transported out of the basin. This would have allowed for coastal points to be manufactured larger, which makes reduction affect overall length less. Obsidian S1T1 points could also have been exchanged as symbolic artifacts and not used as functional tools at Pampa Colorada (ideotechnic vs technomic)(Binford 1962). This is the least likely scenario because Pampa Colorada points show some signs of retouch and fracture from use. Future research using reduction indices are required to fully explore this question.

Also, the slight morphological difference between S2T6 types, a lack of a basal concavity for coastal points, affects some metric measurements, but points are similar overall between the coast and highlands. Late Holocene triangular points (S3T6 and S3T6v) also have many significantly different metric measurements (maximum length, maximum length to maximum width, and maximum thickness). These measurements provide some evidence that the character of the interzonal connection between the highlands and coast slightly changed following the repopulation of the area after the Middle Holocene.

Additionally, there are trends in projectile point variance at both Cuncaicha and Pampa Colorada. Appendix E presents relative standard deviation as a measure of variance. Table 6.14 presents the relative standard deviations of three measurements (maximum width, haft length, and maximum thickness) of all shared types between the highlands and coast. Series averages and standard deviations are bolded. Total assemblage averages and standard deviations are located on the bottom-most lines.

Type	Maximum Width Relative Standard Deviation (Cuncaicha)	Maximum Width Relative Standard Deviation (Pampa Colorada)	Haft Length Relative Standard Deviation (Cuncaicha)	Haft Length Relative Standard Deviation (Pampa Colorada)	Maximum Thickness Relative Standard Deviation (Cuncaicha)	Maximum Thickness Relative Standard Deviation (Pampa Colorada)
S3T6v	11.27%	26.05%	No Data	No Data	15.22%	19.90%
S3T6	17.15%	22.41%	No Data	No Data	22.22%	5.60%
S3T1	7.70%	17.70%	29.18%	16.42%	18.22%	22.14%
Series Mean	**12.04%**	**22.05%**	**29.18%**	**16.42%**	**18.55%**	**15.88%**
Series Standard Deviation	**4.77%**	**4.19%**	**No Data**	**No Data**	**3.51%**	**8.98%**
S2T6	15.10%	18.46%	25.46%	38.63%	20.46%	28.45%
S2T5	10.89%	20.02%	0.68%	No Data	15.52%	23.82%
S2T4v	14.82%	14.56%	10.64%	31.49%	16.83%	31.89%
S2T4	5.89%	13.72%	28.27%	29.52%	8.12%	16.64%
S2T3	16.82%	12.11%	13.97%	51.56%	16.64%	15.37%
S2T2	12.06%	18.24%	18.88%	39.88%	13.84%	18.29%
S2T1	8.04%	33.32%	23.65%	32.44%	5.92%	18.09%
Series Mean	**11.95%**	**18.63%**	**17.36%**	**37.25%**	**13.91%**	**21.79%**
Series Standard Deviation	**3.68%**	**6.56%**	**8.95%**	**7.41%**	**4.77%**	**5.91%**
S1T5	18.75%	8.35%	42.12%	**No Data**	30.58%	38.74%
S1T3v	16.94%	22.30%	14.79%	11.90%	18.38%	16.58%
S1T3	18.43%	1.64%	32.07%	47.21%	20.21%	13.19%
S1T1v	18.53%	11.83%	18.90%	26.90%	18.74%	17.31%
S1T1	9.32%	16.49%	11.27%	36.79%	21.44%	7.63%
Series Mean	**16.39%**	**12.32%**	**23.83%**	**30.70%**	**21.87%**	**18.69%**
Series Standard Deviation	**4.02%**	**8.18%**	**12.91%**	**15.03%**	**5.02%**	**11.84%**
Total Mean	13.46%	17.91%	23.45%	31.65%	18.11%	18.78%
Total Standard Deviation	4.16%	7.20%	10.93%	12.04%	4.43%	8.91%

Table 6.14 Relative Standard Deviations of Maximum Width, Haft Length, and Maximum Thickness of Shared Types Between Cuncaicha and Pampa Colorada

These three measurements were selected because they should reflect distinct differences in flintknapper behavior or culture (see associated tables in the section above for further descriptions). One pattern that has emerged is that Series Two (9.5-9.0 ka) types from Cuncaicha generally have lower relative standard deviations compared to similar points from Pampa Colorada. Cuncaicha variances in maximum width ($t=-2.35$, $p=0.04$), haft length ($t=-4.38$, $p=<0.01$), and maximum thickness ($t=-2.75$, $p=0.02$) all are statistically lower than the variance in equivalent Pampa Colorada types.

This pattern is also seen within Cuncaicha itself. The average variance for Series Two is consistently lower than for any other series. Although the averages are lower for Cuncaicha Series Two, there is only a significant difference between Series One and Series Two haft length variance ($t=-2.58$, $p=0.04$). Finally, when combining all series' average relative standard deviations for each region, Cuncaicha has a lower average variance for each measurement. Statistically, however, these values are indistinguishable between Cuncaicha and Pampa Colorada.

Overall, although Pampa Colorada types appear to be more variable using relative standard deviation as a measure of variance, shared types between the regions are similar. Series Two types from Cuncaicha have less variance than Pampa Colorada equivalents. Based on previously discussed data, the Early Holocene is inferred to represent the period with the greatest interzonal connection strength (total percentage of types shared, number of points, etc.). These data agree because, with an increase in the number of artifacts being exchanged, the more likely artifacts are going to appear slightly different. A large number of flintknappers involved in the tool making process, human errors occur when creating a large number of tools, perfect replication of an intended design is unlikely, and variability in raw material (microfractures in obsidian for example) could drive this variability.

Additionally, if this interzonal connection was based on separate groups exchanging artifacts, more variance in metric attributes would be expected than if this connection was based a single, seasonally migrating band. As seen with meme theory, intragroup translation is more successful than intergroup diffusion (Dawkins 1976). It is easier to replicate objects that are from within your own personal groups than mimic artifacts from a more distant culture. Future research using 3D morphometrics on reduction patterns or flake scars could be helpful for understanding the differences in projectile point shape variation between the coast and highlands.

Metrically, most types from Pampa Colorada and Cuncaicha are statistically indistinguishable. Low sample sizes (<5) limit the applicability of comparing types metrically between Cuncaicha and Pampa Colorada. Late Holocene types appear to be more distinct between the assemblages but still share many morphological characteristics. This suggests that people were intentionally attempting to manufacture similar-looking and sized objects.

Question Four

8. Are projectile point types manufactured in the highlands made with the same material at the coast? For example, are highland types made from Alca obsidian also made with obsidian at Pampa Colorada? If not, are specific types manufactured from a different material?

Figure 6.2 below shows the total raw material frequency of Pampa Colorada points that were typable using the Cuncaicha typology. In total, 65.50% (n=80) of all typable Pampa Colorada points are made from obsidian (Rademaker 2019, personal communication). Chert is the second most commonly used material (n=16, 13% of total) and chalcedony is third (n=13, 11% of the total). Petrified wood only accounts for 4% of projectile points (n=5). This result is surprising because petrified wood is a mid-altitude raw material that crops out between Pampa Colorada and Cuncaicha. I would expect petrified wood to have a larger presence at Pampa Colorada because of its proximity to the area and relatively high flaking quality. Also, petrified wood projectile points are only found starting in the Early Holocene and co-occur with possible Terminal Pleistocene or Early Holocene points at two sites in Pampa Colorada. These sites are Pampa Colorada 343 and 494. Both sites have points from every period, making the areas palimpsests. This pattern is also found at Cuncaicha, with no projectile points being manufactured from petrified wood until the Early Holocene. Petrified wood points (n=2) are exclusively found in Early Holocene contexts at Cuncaicha, which accounts for 0.0005% of the total projectile point assemblage.

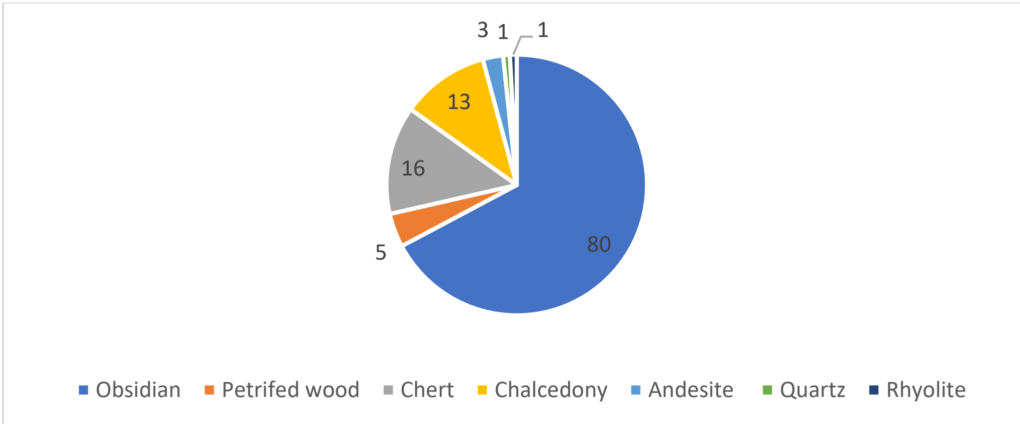


Figure 6.2 Total Raw Materials Used for Typable Projectile Points from Pampa Colorada

Type	# of Examples	Obsidian	Chert	Chalcedony	Andesite	Petrified wood	Rhyolite	Quartz	Quartzite
S3T6v	10	9	1	0	0	0	0	0	0
S3T6	12	8	1	1	0	2	0	0	0
S3T2	1	1	0	0	0	0	0	0	0
S3T1v	1	0	0	1	0	0	0	0	0
S3T1	5	2	0	1	0	2	0	0	0
S2T6	9	6	1	1	0	0	0	0	1
S2T5	7	2	3	1	1	0	0	0	0
S2T4v	7	5	1	1	0	0	0	0	0
S2T4	6	3	0	2	0	0	1	0	0
S2T3	14	8	3	1	0	1	0	0	1
S2T2	10	4	3	2	1	0	0	0	0
S2T1	7	5	1	0	1	0	0	0	0
S1T5	2	0	1	0	0	0	0	0	1
S1T3v	3	3	0	0	0	0	0	0	0
S1T3	2	2	0	0	0	0	0	0	0
S1T2	1	1	0	0	0	0	0	0	0
S1T1v	13	11	0	1	0	0	0	1	0
S1T1	12	10	1	1	0	0	0	0	0
Total	**122**	**80**	**16**	**13**	**3**	**5**	**1**	**1**	**3**

Table 6.15 Cuncaicha Types Represented and Raw Material Usage at Pampa Colorada

Table 6.15 above summarizes which raw materials were used for projectile points at Pampa Colorada. It is possible that the relatively low usage of petrified wood for projectile points at Pampa Colorada and Cuncaicha is because the area where this material crops out was bypassed intentionally. Another possibility is that if an exchange was occurring frequently between the coast and the highlands, obsidian no longer became an "exotic" resource. Exchange locations became anthropogenic sources of highland obsidian, making the need for semi-local materials, such as petrified wood, diminish. Petrified wood was used as a backup resource only when obsidian, chert, or chalcedony was no longer available.

Although the petrified wood resource is not “local,” people did not appear to change their behavior while working with the material. Points were not curated, nor were they expediently made; petrified wood appears to be a “filler” resource that was used to supplement tool kits. As more projectile points are discovered and more data become available, I would expect that petrified wood will not be the primary resource and will metrically be closer to the mean than other raw materials, such as chert, which could provide evidence of specialized behaviors (expedient vs curation).

Furthermore, the lack of petrified wood prior to the Early Holocene at both Cuncaicha and Pampa Colorada could be due to a variety of reasons. One possibility is that population pressure was more intense during the Early Holocene, which forced people to explore new areas and use other resources. Procurement of coastal material and exchange of highland obsidian no longer was able to fulfill the economic requirements to maintain a viable lithic toolkit. This would have forced people to supplement their supplies with petrified wood.

Chert and chalcedony are the only two non-obsidian raw materials used for projectile points (n=4) in the Terminal Pleistocene layers at Cuncaicha (Series One). At Pampa Colorada, clear crystalline quartz, quartzite, chert, and chalcedony are also found at sites with Series One projectile points. The exact sources of these raw materials are unknown and need to be identified in future research. Interestingly, S1T5 (12.5-9.0 ka) is the only type found at both Pampa Colorada and Cuncaicha that has ≤ 50% of the points manufactured from obsidian for both areas. The Pampa Colorada points are made from chert (n=1) and quartzite (n=1). Cuncaicha examples are made from chert (n=2) and obsidian (n=2). I am unsure if the same chert was used for both the Pampa Colorada and Cuncaicha points, but all examples appear to be the same color and texture (eggshell white, smooth surface texture). This is notable because every other shared type for this period is primarily made from obsidian. S1T4 and S1T4v (12.5-9.0 ka) are not found at Pampa Colorada and are exclusively made from obsidian at Cuncaicha. Future research into discovering the source outcrops for these materials will be vital for better understanding this aspect of the interzonal connection between the highlands and coast.

Raw material variety increased in the Early Holocene (Series Two, 9.5-9.0 ka). At Cuncaicha, petrified wood (n=2) was introduced, along with orange jasper (n=1). The assemblage was still largely dominated by obsidian (n=42, 86.3%). For Pampa Colorada, andesite (n=3), petrified wood (n=1), and rhyolite (n=1) were being utilized for projectile points. Obsidian usage still dominated, with 55% of points (n=33) made of the material. Chert (20%, n=12) and chalcedony (13%, n=8) are the other most commonly used materials at Pampa Colorada. Interestingly, every type from this period at Cuncaicha has at least one non-obsidian projectile point, and Pampa Colorada points typed to S2T2, S2T4 and S2T5 have 50% or more non-obsidian usage.

To test whether the increase in raw material diversity during the Early Holocene seen at Pampa Colorada is a factor of large sample size, I performed Kruskal-Wallis (KW) non-parametric tests for all three Cuncaicha series found at Pampa Colorada. KW tests do not assume a normal distribution and test whether two or more samples originate from the same distribution (Hefner, personal communication). The results (X^2=18.1, df=8, p=0.02) indicate that there was a significant increase in diversity of raw material types at Pampa Colorada during the Early Holocene that occurred alongside an increase of archaeological sites and the number of projectile points.

During the Late-Middle Holocene and Late Holocene (Series Three, <5.7 ka), a decrease in raw material variety occurred at both Pampa Colorada and Cuncaicha. Cuncaicha has only 11 non-obsidian projectile points (8% of total Series 3 assemblage). With the inclusion of the Sumbay types, andesite (n=10) became more prevalent. This is interesting because the points themselves are different morphologically from all other previous types and because this is the only type where andesite is used as frequently as obsidian. Andesite and obsidian are both locally available near Cuncaicha, but obsidian is widely considered a better flaking material due to its lack of crystal structure. The only other non-obsidian projectile point is an S3T4 type made from chert. Chalcedony, jasper, and petrified wood were no longer utilized during this period.

S3T1 points from Pampa Colorada (n=5) are mostly made from non-obsidian materials, such as petrified wood (n=2, 40%) and chalcedony (n=1, 20%). The only S3T1v specimen from Pampa Colorada is made from white chalcedony.

Types from this series that are only found at Cuncaicha (S3T3, S3T3v, S3T4, S3T5) are almost exclusively made from obsidian (n=24, 69%) or andesite (n=10, 29%). Type S3T6 (<4.0 ka) has the largest sample size (n=73) of any type found at Cuncaicha and only has points made from obsidian.

S3T6 points from Pampa Colorada are made from obsidian (n=8, 66.6%), petrified wood (n=2, 16.6%), chalcedony (n=1, 8.3%), and chert (n=1, 8.3%). S3T6v points from Pampa Colorada are primarily obsidian (n=9, 10%) with a single chert (10%) specimen. Unlike Cuncaicha, there were multiple types of raw materials being used to manufacture triangular projectile points at Pampa Colorada.

In total, there are 32 points from Pampa Colorada that were not classifiable using the Cuncaicha typology. Figure 6.3 below graphically presents the total raw material frequency for these points. Obsidian is the most prevalent (n=20, 63%), followed by chert (n=3, 9.4%) and chalcedony (n=3, 9.4%), or 18.8% of the total assemblage combined. Notably absent is petrified wood because almost every other raw material used for projectile points at Pampa Colorada is represented. PCT2 is interesting because it is the only type that does not use obsidian. Even though I could not type these 32 points using the Cuncaicha typology, obsidian is the primary material used. These types are related to similar highland types through the shared usage of highland raw material.

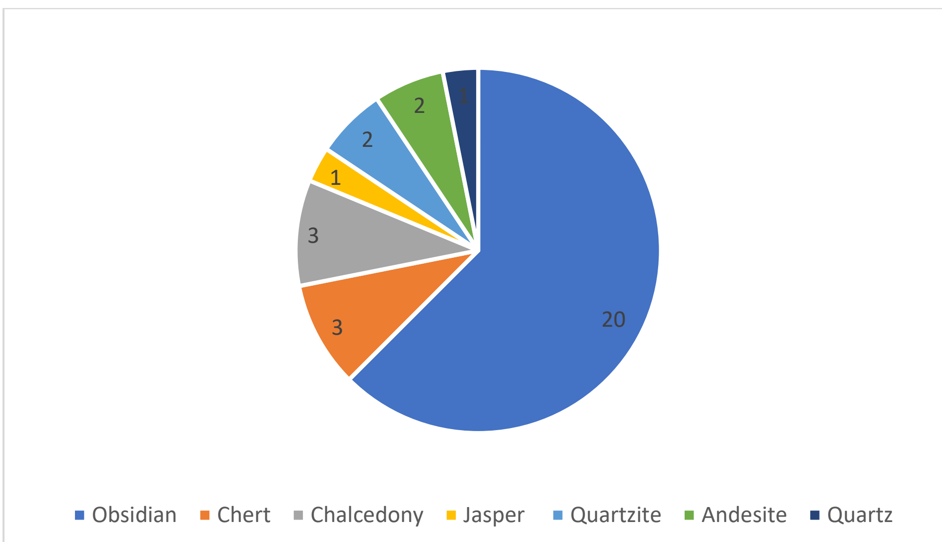


Figure 6.3 Raw Material Frequencies for Non-Cuncaicha Typable Projectile Points

Overall, if types are shared between the two regions and obsidian is used to manufacture the type at Cuncaicha, Pampa Colorada has an equivalent example. Exceptions are S1T5 and S2T4v, but this could be due to low sample sizes. Types are only exclusively made from one material (obsidian) during the Terminal Pleistocene and Late Holocene at Cuncaicha. For Pampa Colorada, S1T3 (n=3) and S1T3v (n=2) are the only types made exclusively from obsidian with sample sizes greater than one. Raw material usage for projectile points at Pampa Colorada is more diverse than Cuncaicha but is largely dominated by obsidian.

Synthesis

The interzonal connection between Cuncaicha rock shelter and Pampa Colorada is detected through a shared projectile point material culture and use of highland Alca obsidian. Point types are inferred to be shared by having similar morphological characteristics and statistically indistinguishable metric measurements. Interzonal connection strength peaked during the Early Holocene based on the percentage of total shared types. This is evidenced by a wide variety of types being shared by the two regions and reliance on obsidian as the primary projectile point raw material in both locations. During the Middle Holocene, the strength of the connection decreased and was nearly absent. Point types diagnostic to this period are absent from Pampa Colorada or were manufactured from exclusively obsidian or andesite at Cuncaicha. The absence of Middle Holocene projectile points suggests a depopulation of Pampa Colorada during the Middle Holocene. This somewhat disagrees with McInnis' (2006) previous research from the area.

Two ^{14}C dates from Pampa Colorada-737 were obtained on shell (5.5-4.9 ka) and charcoal (5.1-5.0 ka). As stated above, the shell date could have incorporated an unknown marine reservoir effect, which could make the date appear older than it actually is. The charcoal date is more reliable than the shell date but needs to be met with some considerations. Although a possible hearth feature was identified during test pit excavations, a locus for the hearth was never identified during the subsequent excavations of Pit A or B (McInnis 2006). Lenses of wood ash and small pieces of charcoal were noted and recovered from all five levels of Pampa Colorada-737. Additionally, the two dates that were recovered from stratified sequences for this site are out of stratigraphic order and are not associated with cultural material. Level 2 was dated to 5.5-4.9 ka and only contained small fragments of *Mesodesma donacium*, crustacean remains, and burned chiton. Level 5a has nearly identical faunal remains but includes *Scutalus* and is dated to 5.1-5.0 ka. Finally, projectile point Types 2A (11.1-9.3 ka), 4A (11.1-8.5 ka), and 5D (5.2-2.5 ka) were recovered from the surface.

Stratigraphic inversions, lack of cultural material associated with radiocarbon dates, no hearth locus, and possibly natural wood ash lenses covering the entire unit warrant further investigation into the absolute chronology of Pampa Colorada-737. Until new dates are obtained from this site, Pampa Colorada-737 is the best evidence for a Middle-Holocene occupation of Pampa Colorada, but the site needs to be revisited.

Following the Middle Holocene, the reestablishment of the connection occurred during the Late Holocene and is evidenced by both shared raw materials and projectile point types, though not at the same level as during the Early Holocene.

Obsidian was the preferred manufacturing material for projectile points in both regions. Chert, chalcedony, and andesite were frequently used but rarely dominated specific point types. Petrified wood is inferred to have been used as supplemental material, as other resources were preferred. Obsidian was the most frequently used raw material for points that were not classifiable using the Cuncaicha typology.

I argue that the nature of the inter-zonal connection is based upon exchange between multiple groups. When people migrated into Peru, they possibly settled three sites at Pampa Colorada and began exchanging with the highlands. These sites possibly have a Terminal Pleistocene component because I have found projectile points recovered from these areas to be morphologically and metrically similar to artifacts from Cuncaicha's oldest radiocarbon dated levels. In addition, Alca obsidian was used to manufacture the projectile points in both regions.

Obsidian cannot be transported to the coast through natural processes. It is fragile and could not survive river transport. People would have had to have carried obsidian procured from the highlands prior to settling Pampa Colorada and Quebrada Jaguay during the Terminal Pleistocene or would have received it through exchange. Obsidian also makes up 82% (n=27) of the projectile points that have time ranges that extend into the Terminal Pleistocene at Pampa Colorada. This means that this exchange network would have had to have begun very soon after initial settlement.

Exchange could have begun occurring as early as the Terminal Pleistocene and intensified during the Early Holocene. Exchange between two related but separate groups is based on points manufactured from similar raw materials and metrically indistinguishable. Only two types, one variant, and one sub-variant are not shared between Cuncaicha and Pampa Colorada that date to the Terminal Pleistocene, including the Fishtail projectile point. The remaining types are that missing from Pampa Colorada could be due to a depopulation event during the Middle Holocene. Four "types" that are found at Pampa Colorada but not at Cuncaicha are morphologically similar to other Early Holocene types at sites where absolute dates are available, such as Hakenasa and Asana (Klink and Aldenderfer 2005). These points typically occur with other Early Holocene points and on sites where all periods are represented (PC-343, 344, and 494). PCT points only occur exclusively with a Late Holocene type (S3T6v) at Pampa Colorada-400. On this basis, these types should be provisionally considered Early Holocene. Until points that are morphologically similar are excavated from datable contexts within the Arequipa region, this assignment should be considered tentative. Also, Pampa

Colorada points are generally statistically indistinguishable from similar Cuncaicha specimens with a few exceptions (S3T1, S3T6, and S3T6v).

If a single group was moving between the highlands and coast, points made from “exotic materials” (obsidian at the coast for example), should be smaller due to resharpening during movement between areas. My results cannot distinguish similar type points metrically. Due to the small number of cores (n=3) and obsidian debitage (n=83, 4.26% of total debitage collected by McInnis) from Pampa Colorada, I also cannot say that the obsidian points were being manufactured on-site (Mcinnis 2006). This differs from Cuncaicha where the entire reduction sequence has been found (Rademaker et al. 2014). I suspect then that obsidian projectile points were being exchanged to Pampa Colorada as finished objects or preforms that needed minimal flaking to finish. Obsidian at Pampa Colorada sites was also used to manufacture retouched flake tools (n=18, 19,6% of McInnis total) (Rademaker, pers comm). Other tools such as endscrapers (n=8, 4.10%), side scrapers (n=1, 7.69%, and perforators (n=2, 4.76%) are rarely made from obsidian (Rademaker, pers comm). Obsidian possibly was being used preferentially to manufacture projectile points. If raw obsidian was being carried into Pampa Colorada, large flakes were being further modified into other types of tools. Future research on the cores, obsidian debitage, and projectile point retouch will further illuminate this issue.

The early settlement system of the South-Central Andes could be characterized by an exchange system of obsidian that moved between the highland and coastal regions. Points largely were made from obsidian and are metrically indistinguishable, but total stylistic overlap does not occur. This indicates a similar and shared cultural idea but also shows that two separate identities existed with their own unique types. I speculate that these two groups were parts of a single, colonizing force that initially reached Peru but soon fissioned to settle both the coast and highlands. Evidence supporting this claim can be seen in subtle differences in material culture. Groups maintained cultural continuity through the exchange of resources but slowly began drifting apart during the Early Holocene. This connection was eventually severed due to an increase of aridity during the Middle Holocene. A cultural connection was then reestablished in the Late Holocene, and exchange once again continued after Pampa Colorada was reoccupied by either a related or completely different group.

CHAPTER SEVEN

CONCLUSION

My study contributes to the archaeological knowledge of the Central Andes and desert coast of southern Peru in multiple ways. I have built upon and reexamined previously established projectile point typologies that were temporally and geospatially restricted (Rick 1980, Lavallee et al. 1985, Santoro and Nunez 1987, Klink and Aldenderfer 2005) by constructing a new typology for Cuncaicha rock shelter. I have identified two types and one variant at Cuncaicha that only occur in radiocarbon-dated Terminal Pleistocene levels (S1T1, S1T3v, and S1T4). These are probably diagnostic to the Terminal Pleistocene. Previously defined Early Holocene types (1A and 4A) (Klink and Aldenderfer 2005) are reminiscent of these Cuncaicha types but are morphologically and metrically distinct. This increases the number of types that are diagnostic to the Pleistocene for this area. In addition, the typology from Cuncaicha rock shelter shares other forms with previously published typological schemes (Rick 1980, Lavallee et al. 1985, Santoro and Nunez 1987, Klink and Aldenderfer 2005) and should be used to refine and constrain time ranges for these types. My typology should serve as a foundational tool for future archaeologists working in the Central Andes. The geographic range of my typology is limited to south-central Peru but can be expanded through future revisions.

While comparing projectile points from Pampa Colorada with the Cuncaicha typology, I have identified 19 sites with projectile points (n=33) that have age ranges (12.5-9.0 ka) that extend into the Terminal Pleistocene. Pampa Colorada-310, 496, and 725 have projectile points that share morphological and metric characteristics with Types S1T1 and S1T1v.Based on associated AMS dates at Cuncaicha, S1T1 dates to 12.5-11.2 ka and S1T1v dates to 12.5-9.0 ka. At Pampa Colorada these points do not co-occur with other Early Holocene forms. Pampa

Colorada-310 is the most likely candidate to have a Pleistocene occupation due to the lack of radiocarbon dates and zero co-occurrence of other Early Holocene forms. Additionally, this point from PC-310 is a Type S1T1 and is not found in other Early Holocene sites regionally.

Also, I have found that the strength of the inter-zonal connection between the coast and highlands peaked during the Early Holocene, nearly diminished during the Middle Holocene, and was re-established during the Late Holocene based on the number of types shared between the region and percentage of total types shared. The lower strength in the Middle Holocene is possibly due to a depopulation event occurring at Pampa Colorada caused by regional climatic changes (Grosjean et al. 1994, Sandweiss et al. 1998, Nunez et al. 2002, Grosjean et al. 2007, Nunez et al. 2013). This pattern is seen regionally and is known as the "*Silencio Arqueológico*" where hunter-gatherer groups no longer concentrated along lake shorelines and moved to valley bottoms or microenvironments where fresh water was available. Groups did not disappear but moved away from this area until environmental conditions similar to today began after 4.0 ka (Nunez et al. 2002, Grosjean et al. 2007, Nunez et al. 2013). I have found that Pampa Colorada is not an exception to this pattern based on the lack of Middle Holocene diagnostic projectile point types.

Many previously defined types (Klink and Aldenderfer 2005) have time ranges that extend into the Middle Holocene and were used to argue for an intensive occupation of the region during the late-Middle Holocene by previous authors (McInnis 2006). By reexamining previous point identifications from Pampa Colorada, I have identified multiple (n=69) misidentifications based on metric and morphological data. This suggests previous research overestimated the Middle Holocene occupation of Pampa Colorada. A radiocarbon date (5.5-4.9 ka) from Pampa Colorada-737 provides reliable evidence for a late-Middle Holocene occupation but warrants further investigation. Overall, Pampa Colorada almost completely lacks projectile point types that are diagnostic to the Middle Holocene.

In addition, Middle Holocene points found at Cuncaicha are almost made exclusively from obsidian or andesite. Types that are regionally known to be diagnostic to the Middle Holocene, also known as “Sumbay” types (S3T3, S3T3v, and S3T4), are made from obsidian and andesite, and these types are not found at Pampa Colorada. Additionally, Late Holocene (<4.0 ka) Types S3T6 (n=73) and S3T6v (n=10) are exclusively manufactured from obsidian at Cuncaicha and are the most numerous types found at the site.

The final contribution of my study is that I have discovered that obsidian usage for projectile points at Pampa Colorada remains constant throughout time. More than 55% (n=) of the total projectile point assemblage at Pampa Colorada is manufactured from obsidian regardless of temporal period (Rademaker, pers comm). Point types that are found at Pampa Colorada and not at Cuncaicha are still primarily made from obsidian (63%, n=), suggesting that obsidian was being preferentially used for point production.

Prospects for research in this area would be excavating and dating other highland archaeological sites with robust Middle Holocene occupations. Cuncaicha does not have a continuous Middle Holocene occupation and lacks dates from between 9.0-5.7 ka. This then makes the early Middle Holocene portion of my typology weak. To strengthen the cultural chronology of my typology, additional assemblages must be incorporated. I would recommend creating a sub-series with Series Three of the Cuncaicha typology that would accurately reflect this temporal period. In order to avoid creating a confusing typological scheme, I recommend naming this section of the typology “Series 3α” or Series Three Alpha.

Other future research opportunities are sourcing the chert used to manufacture the non-obsidian projectile points seen in S1T5, which are found in both Terminal Pleistocene and Early Holocene contexts at Cuncaicha. Along with the chalcedony fishtail projectile point, these are the earliest possible non-local raw materials used to manufacture points at Cuncaicha. If the raw materials are found to be coastal in origin, this would provide evidence for the inter-zonal connection flowing both ways, with raw material being exchanged or carried into and out of the Pucuncho basin.

Other coastal sites and areas with Alca obsidian need to be analyzed using the Cuncaicha typology. Increasing the sample size of obsidian projectile points will further explore the inter-zonal connection. I have provided some preliminary discussion inferring that exchange was occurring between the highlands and coast, but more sites from both regions with similar raw material and projectile points need to be added to the sample. I suspect that the settlement system of the South-Central Andes is much more complex than what is currently known. I estimate that the exchange, movement, and total settlement system is dendritic and includes an entire array of highland and coastal sites that have yet to be discovered. Cuncaicha and Pampa Colorada are only one branch of this tree.

The three possible Terminal Pleistocene archaeological sites from Pampa Colorada (Pampa Colorada-310, 496, and 725) need to be resurveyed, dated, and analyzed to further confirm the antiquity of these areas. Specifically, Pampa Colorada-310 would be the highest priority because just say it here. Pampa Colorada-737 also warrants reinvestigation due to the possible stratigraphic inversions, lack of radiocarbon dates from direct association with cultural material, and unreliable shell dates that could have incorporated an unknown marine reservoir effect.

Finally, the incorporation and evolution of digital archiving techniques need to be continued for this area of archaeological research. I plan on developing photogrammetric techniques that can be used during excavation that utilize sunlight as a primary lighting source. This will hopefully encourage digital archiving to be used for every project and provide better record-keeping techniques.

Projectile point typologies are still useful foundational tools for understanding settlement systems. Projectile point typology and lithic analysis will continue to evolve as the field of archaeology changes throughout time but will always be an integral part of any research project.

APPENDICES

APPENDIX A

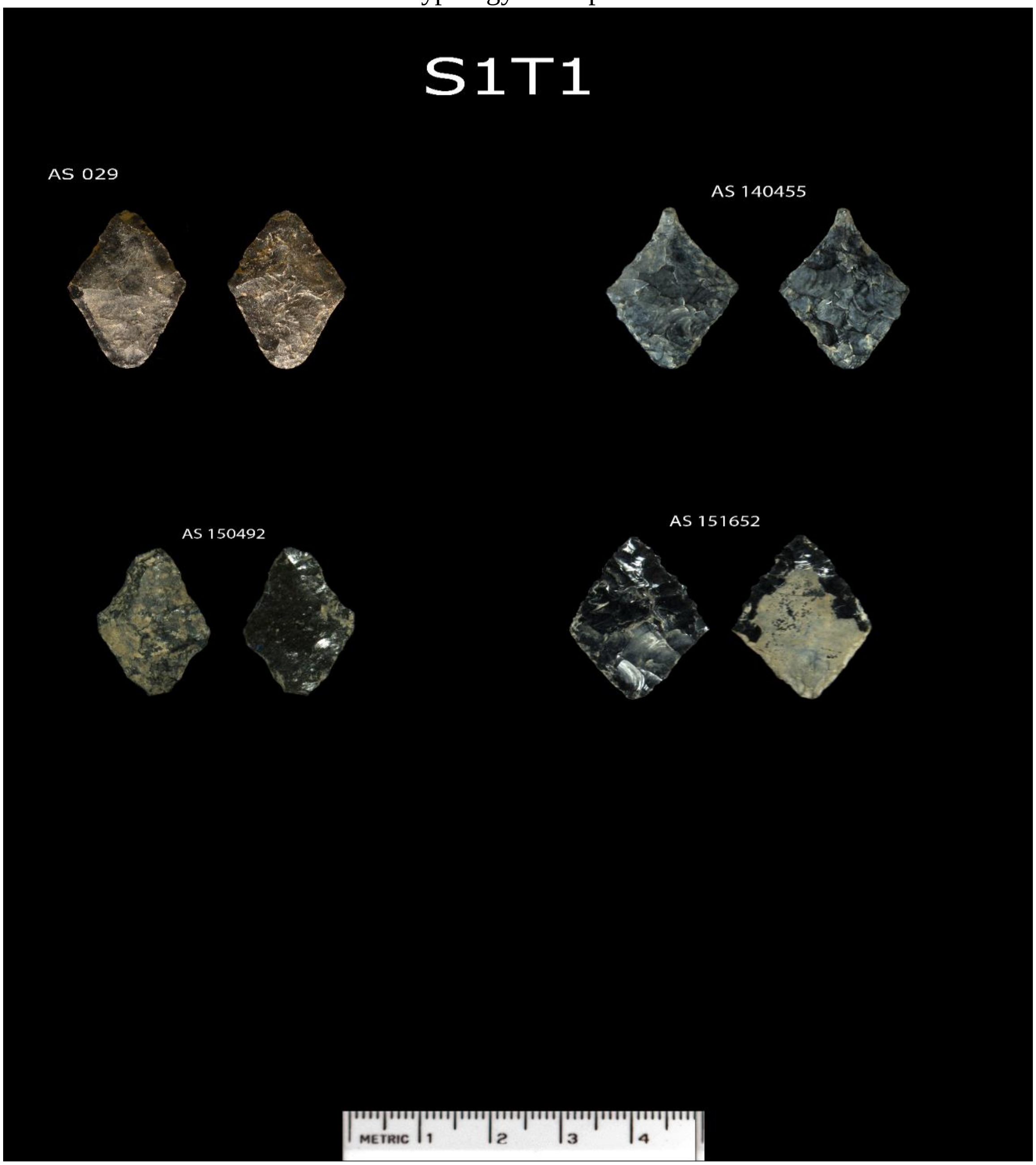
Cuncaicha Measurements

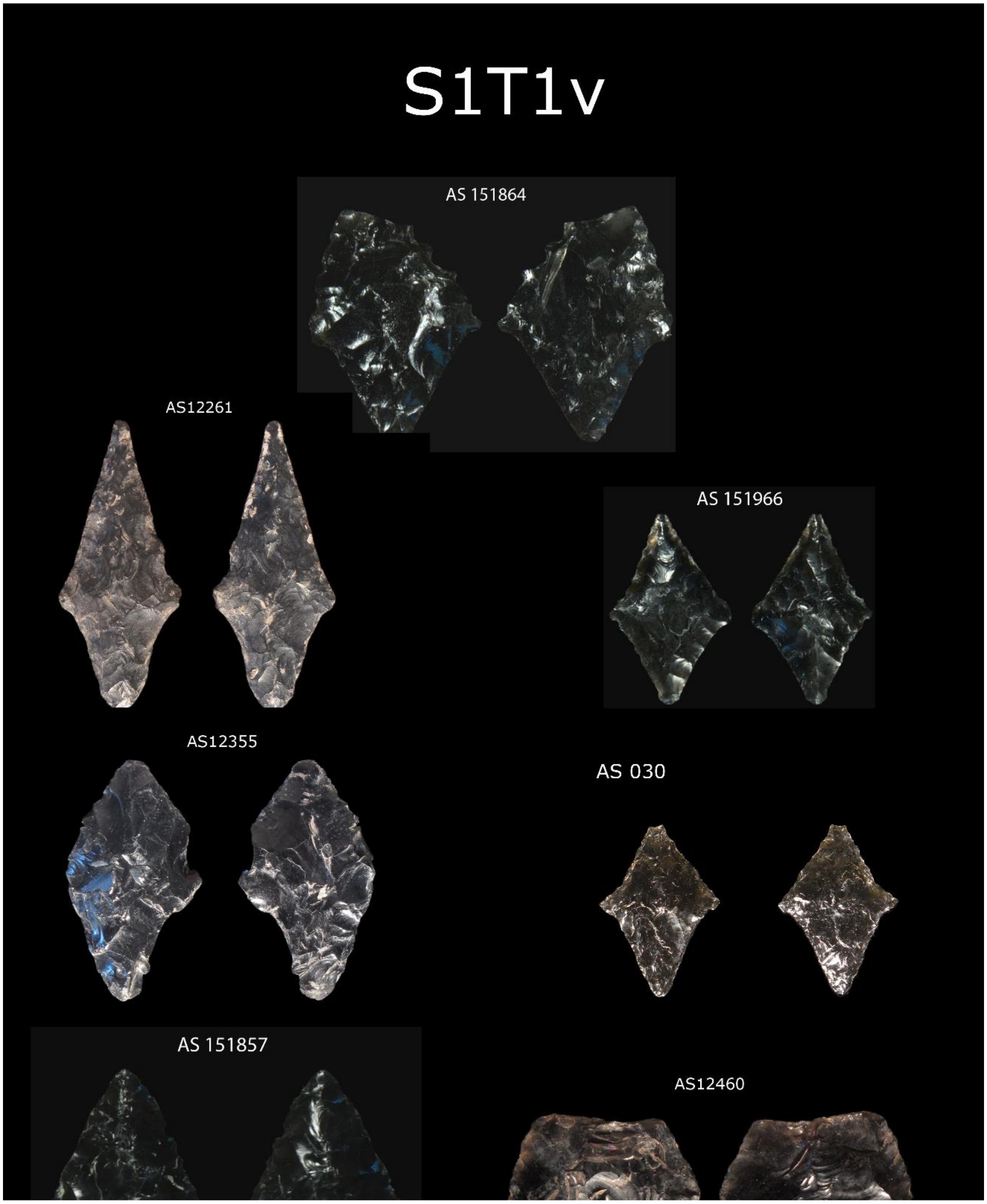
APPENDIX B

Pampa Colorada Measurements

APPENDIX C

Typology Examples

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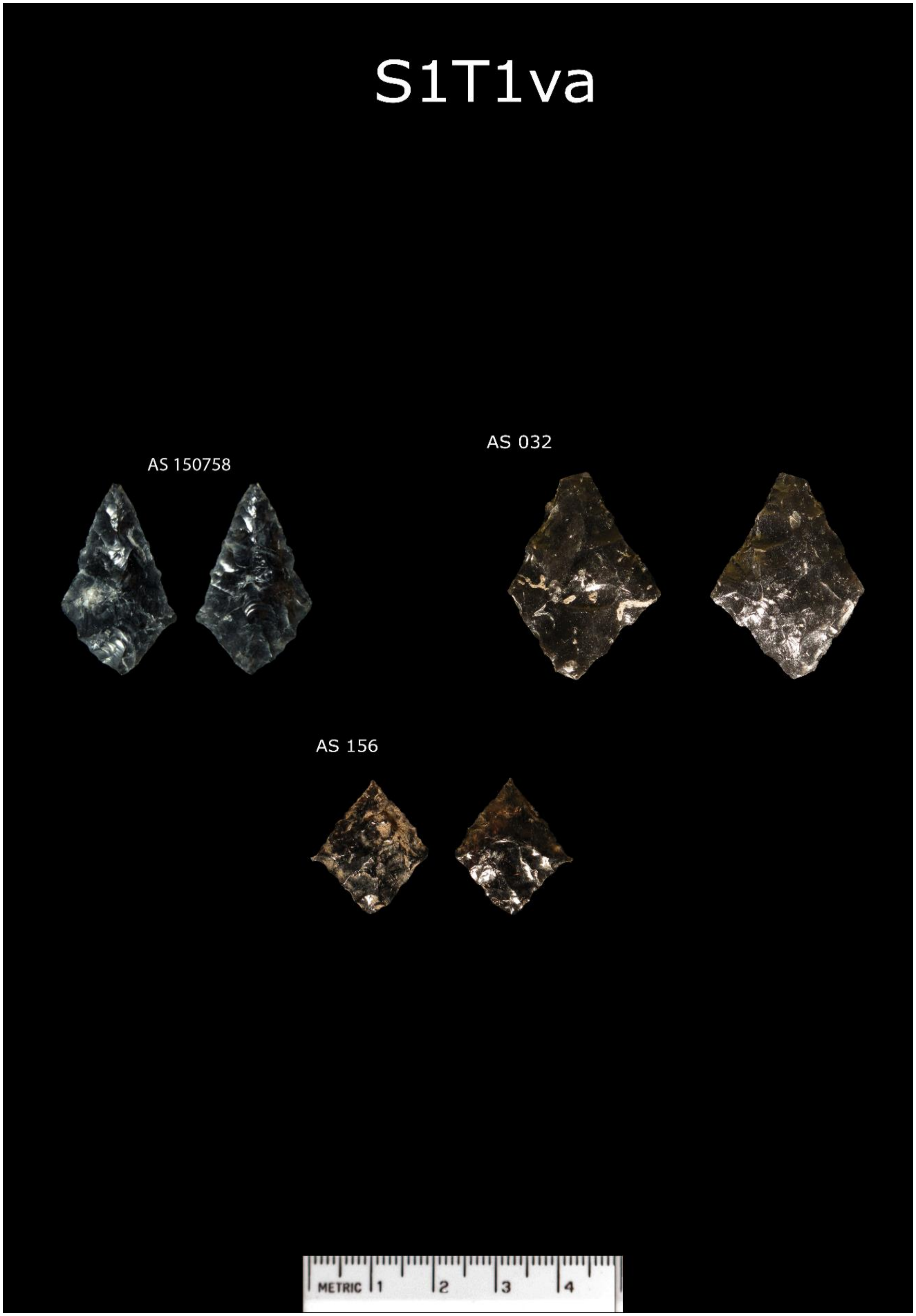
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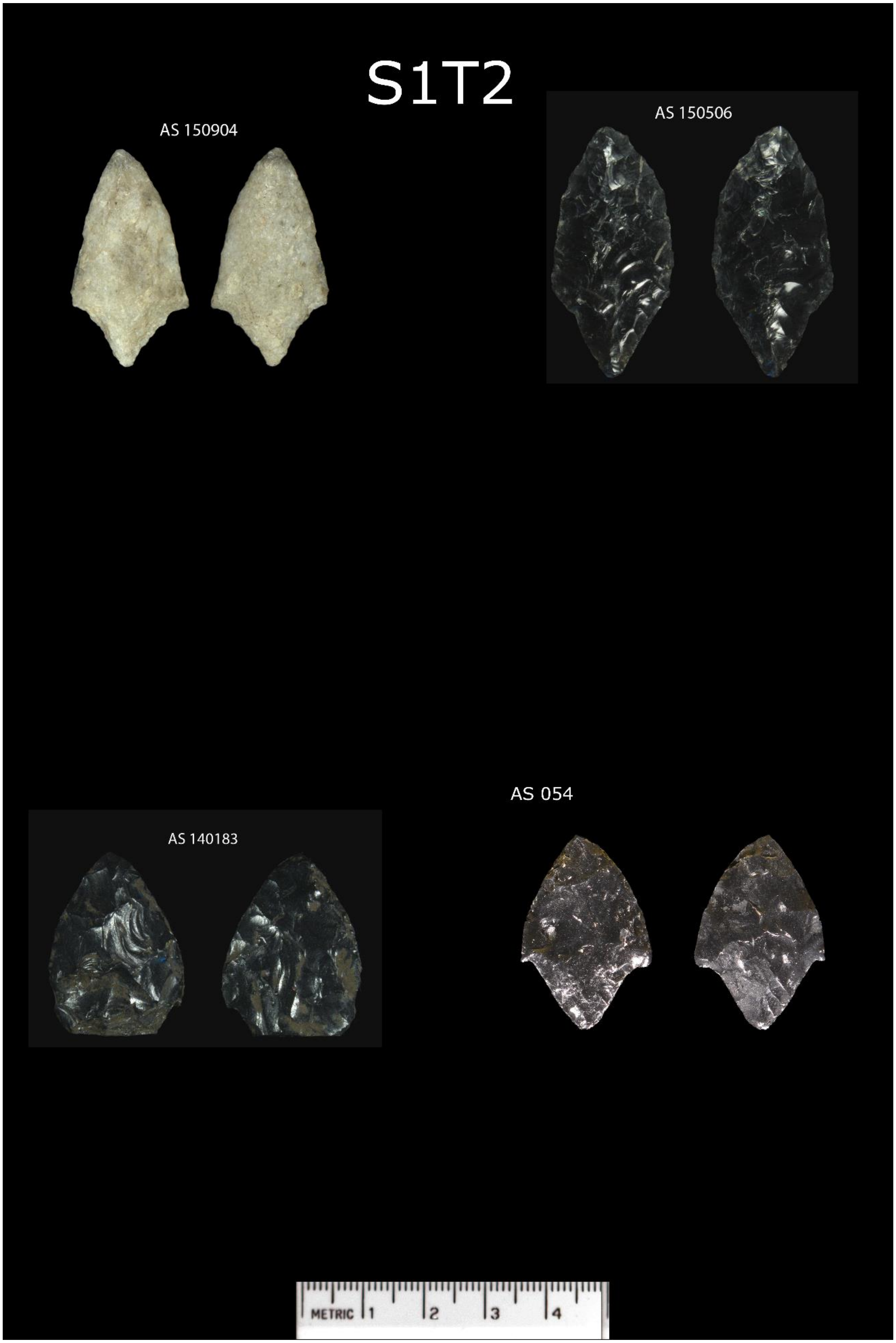
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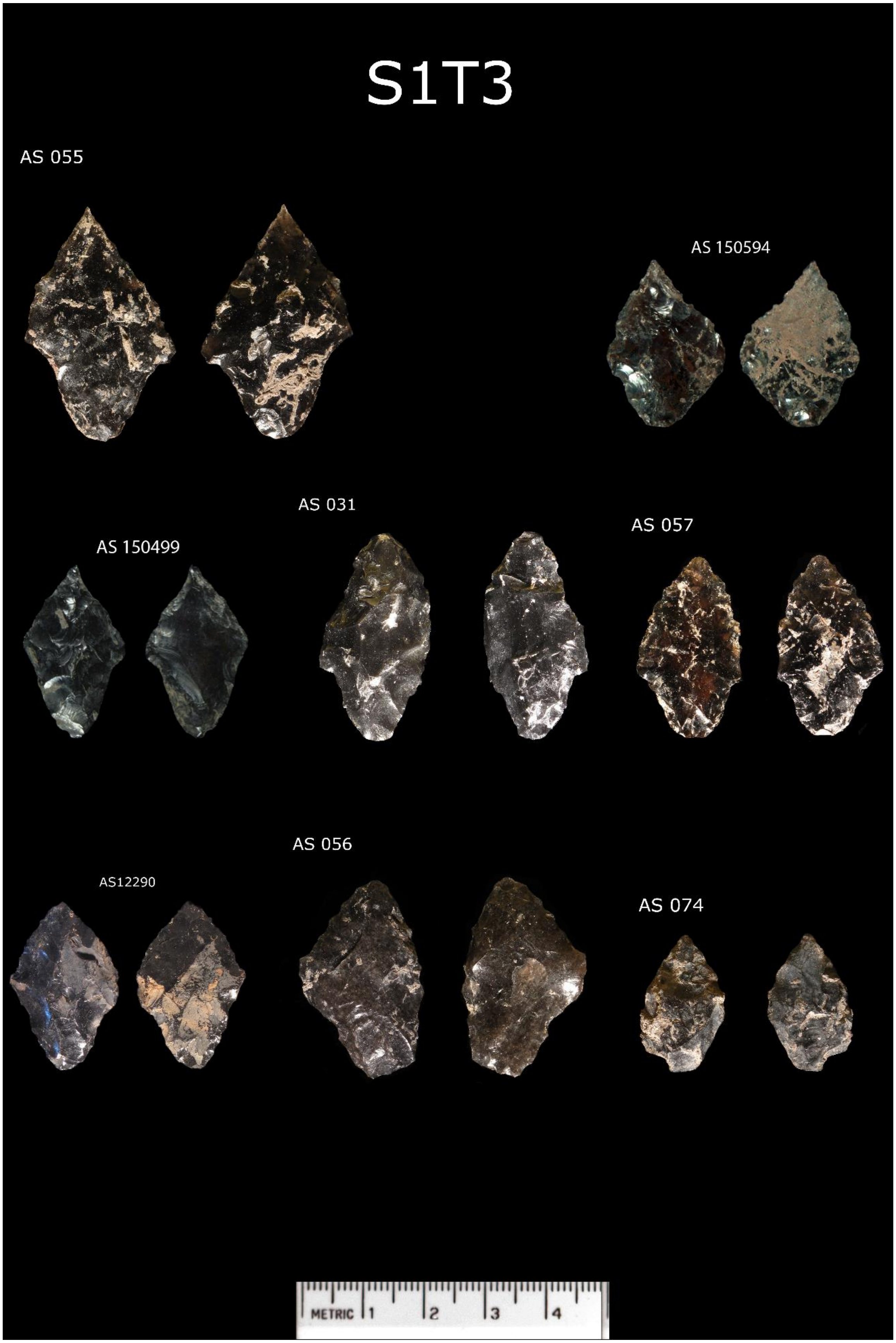
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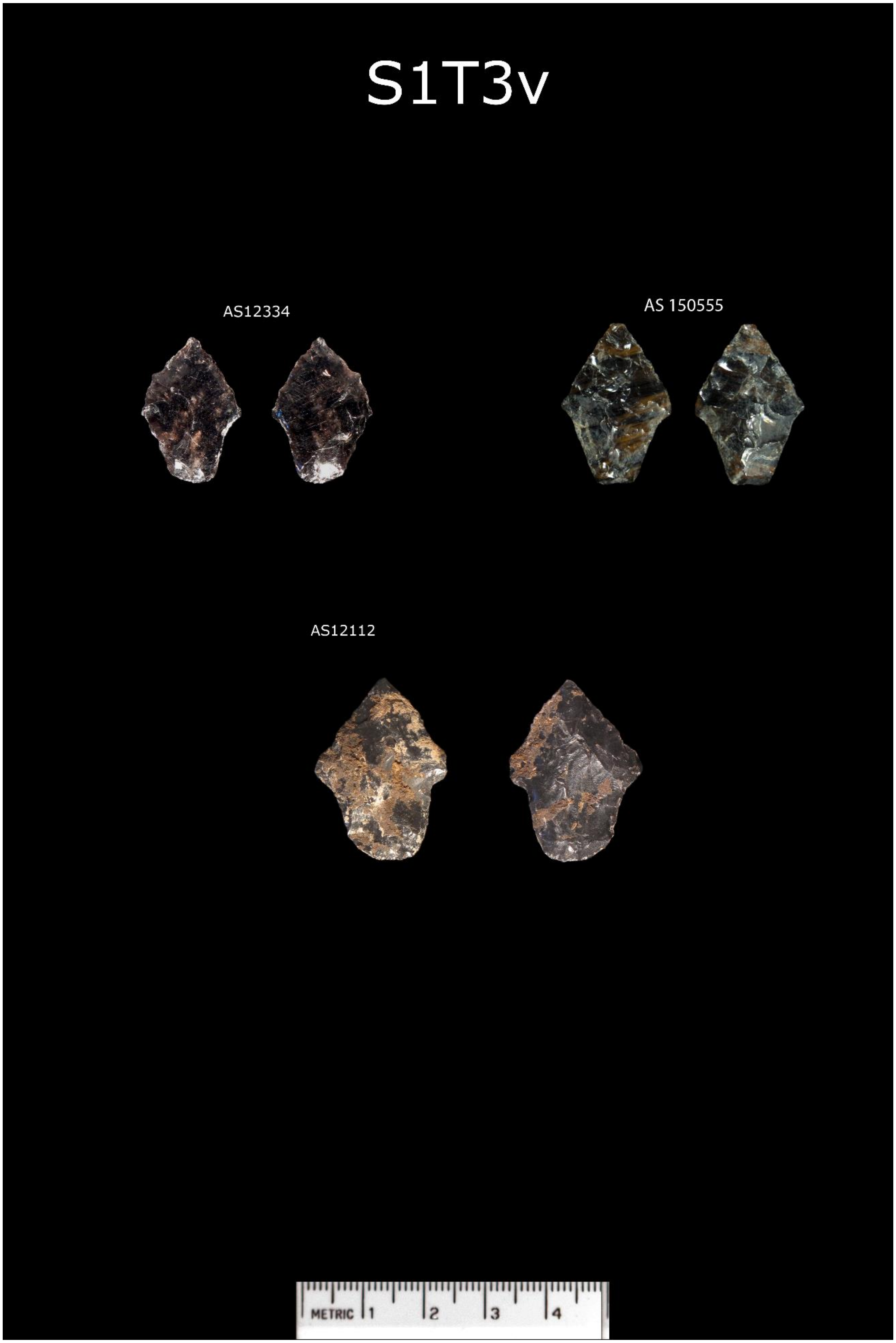
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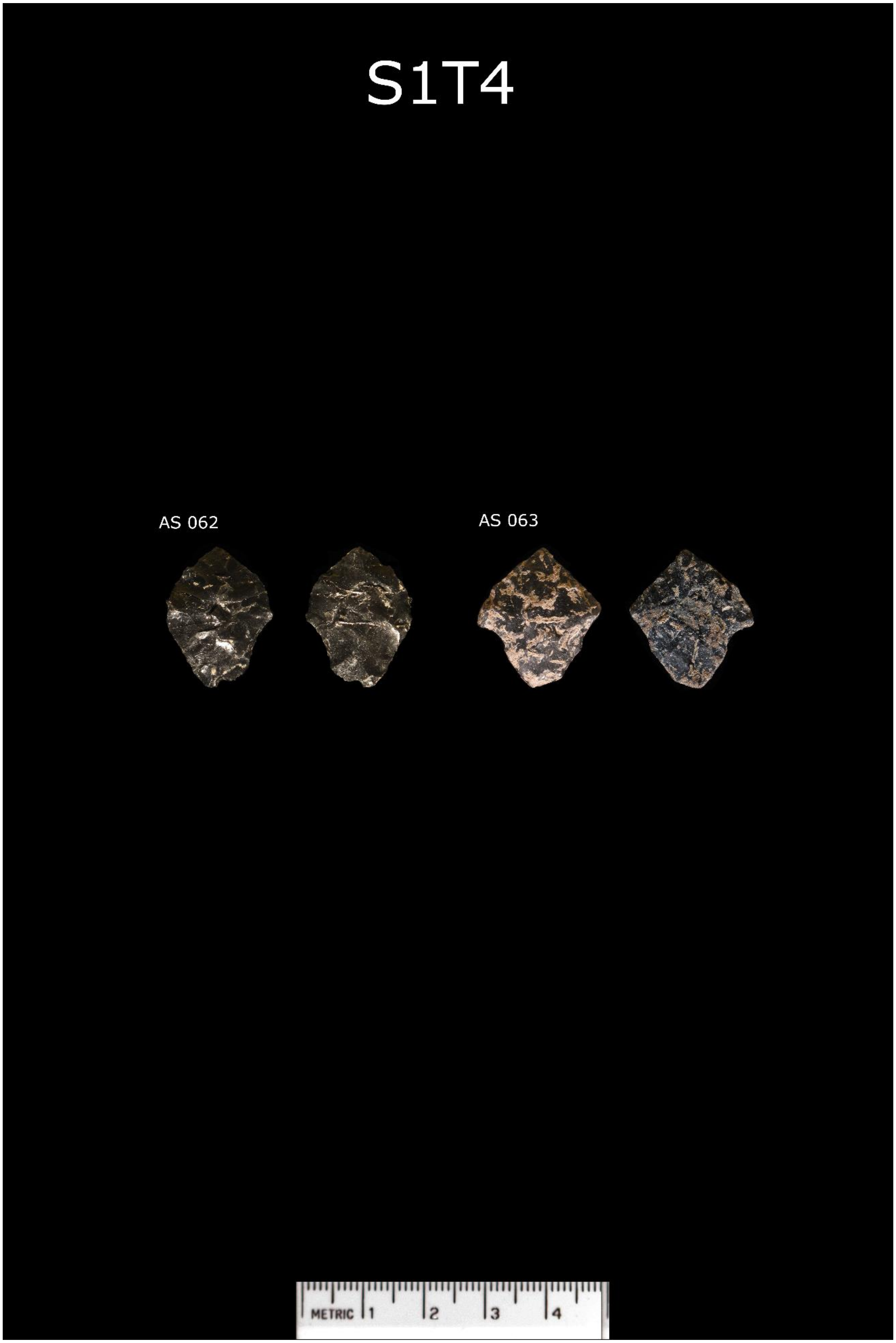
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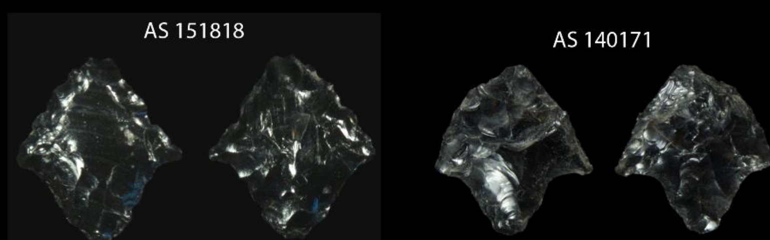

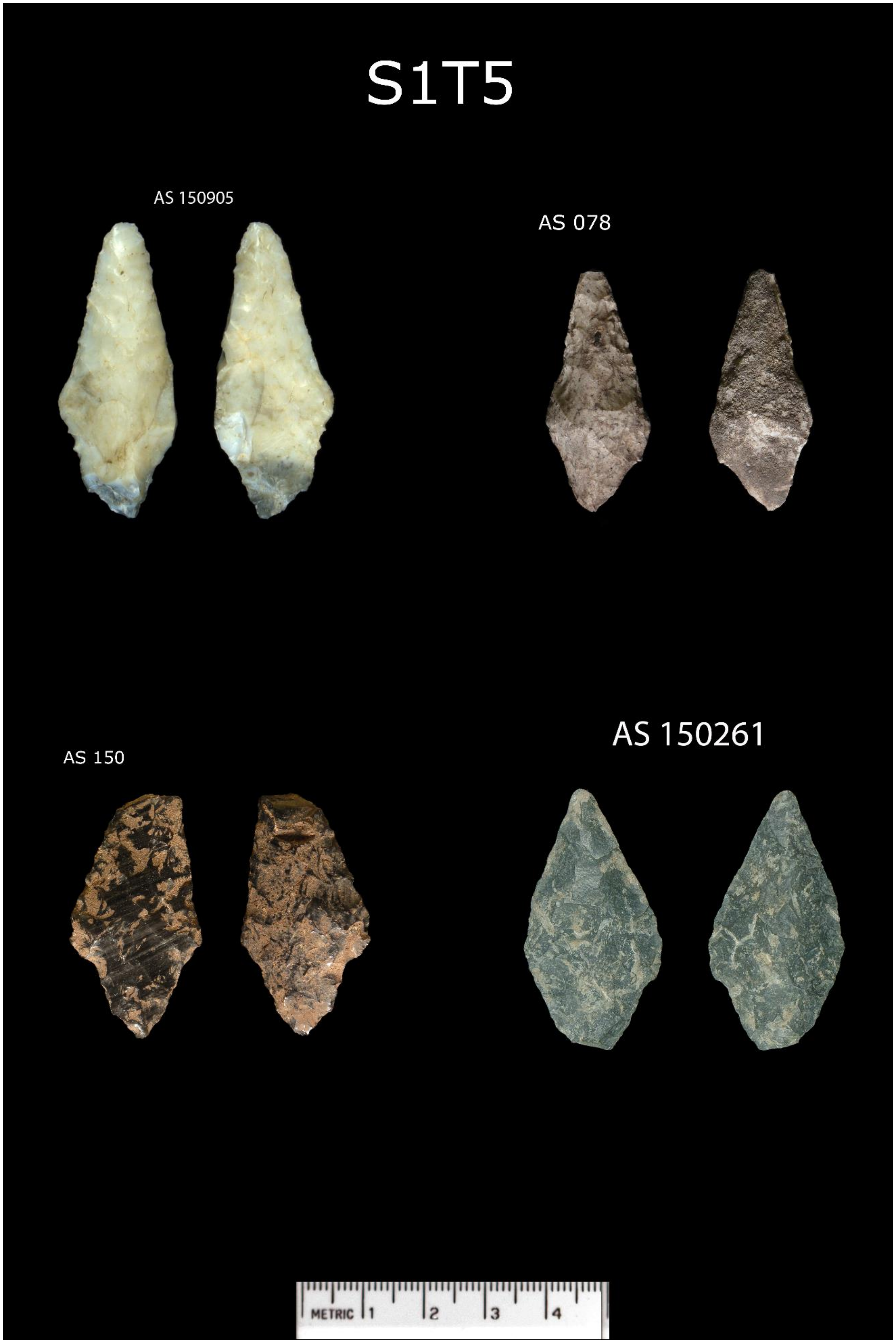
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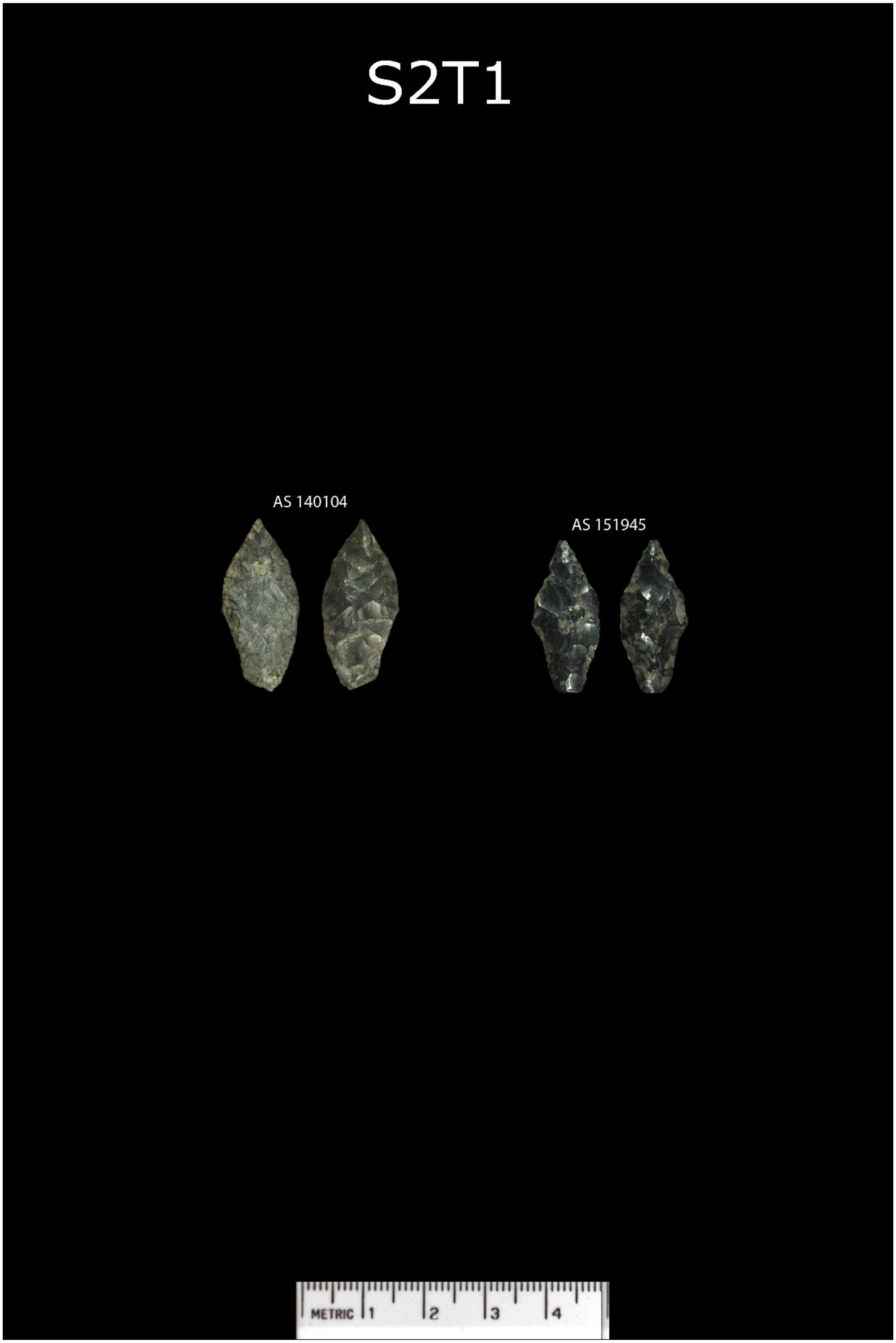
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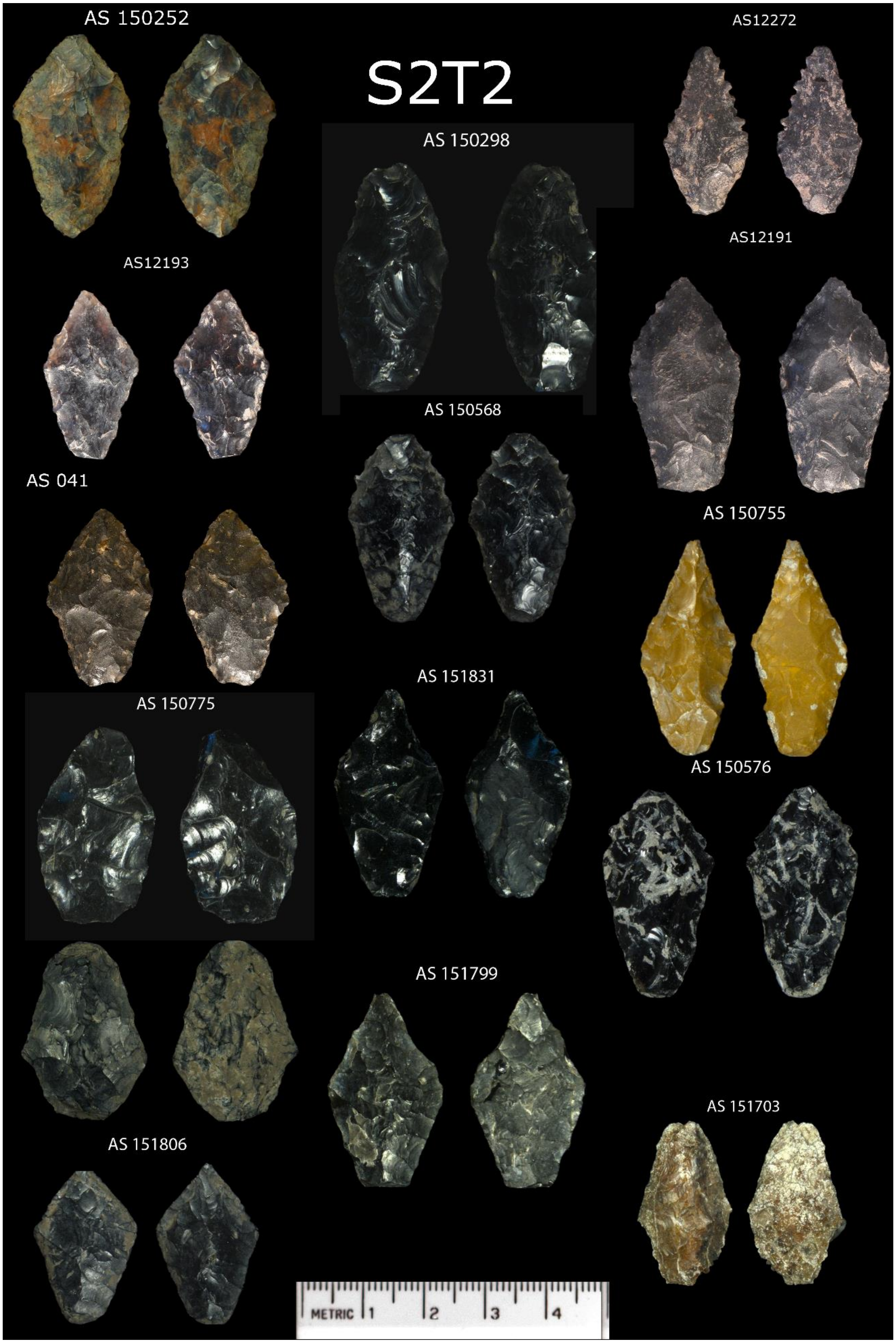
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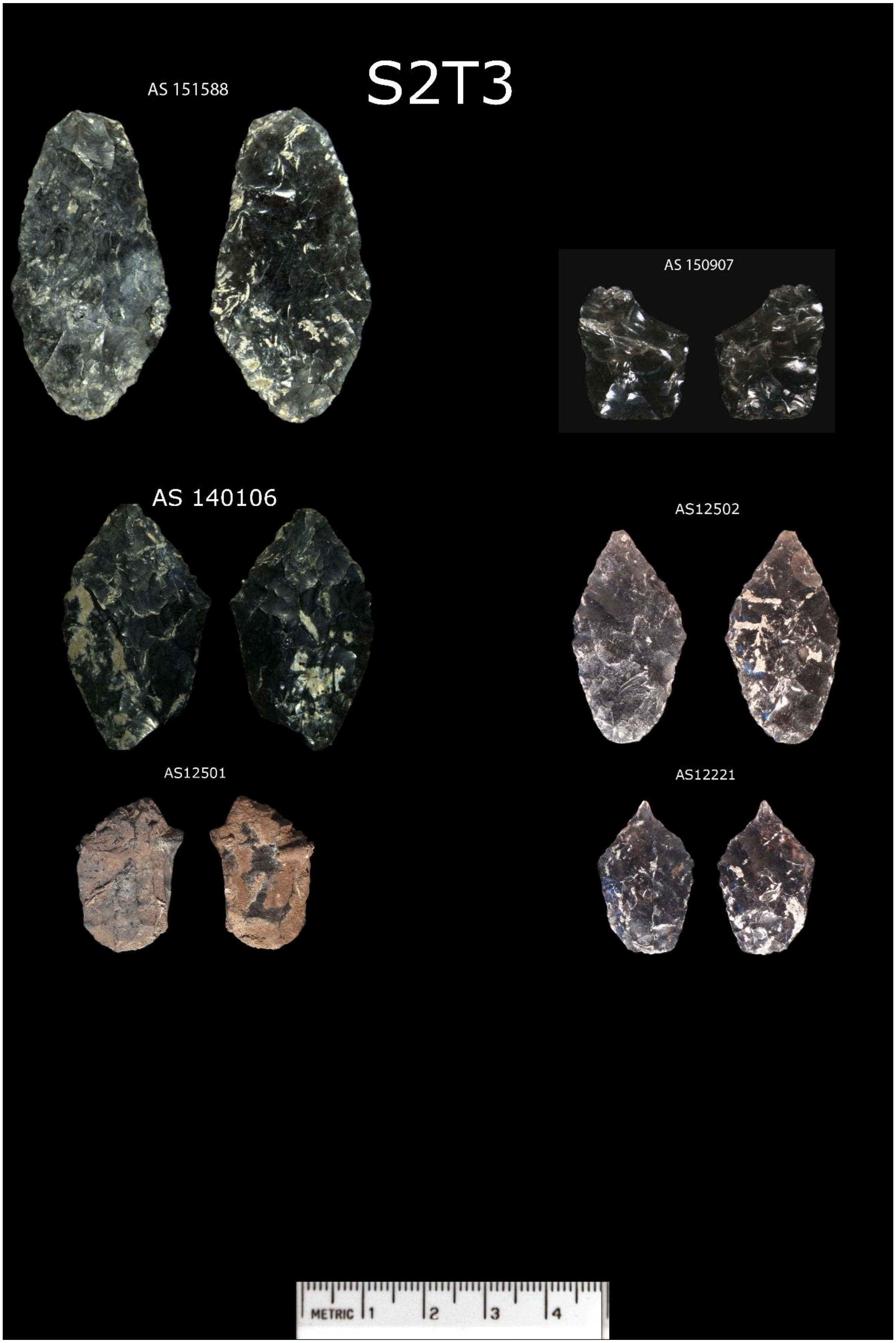
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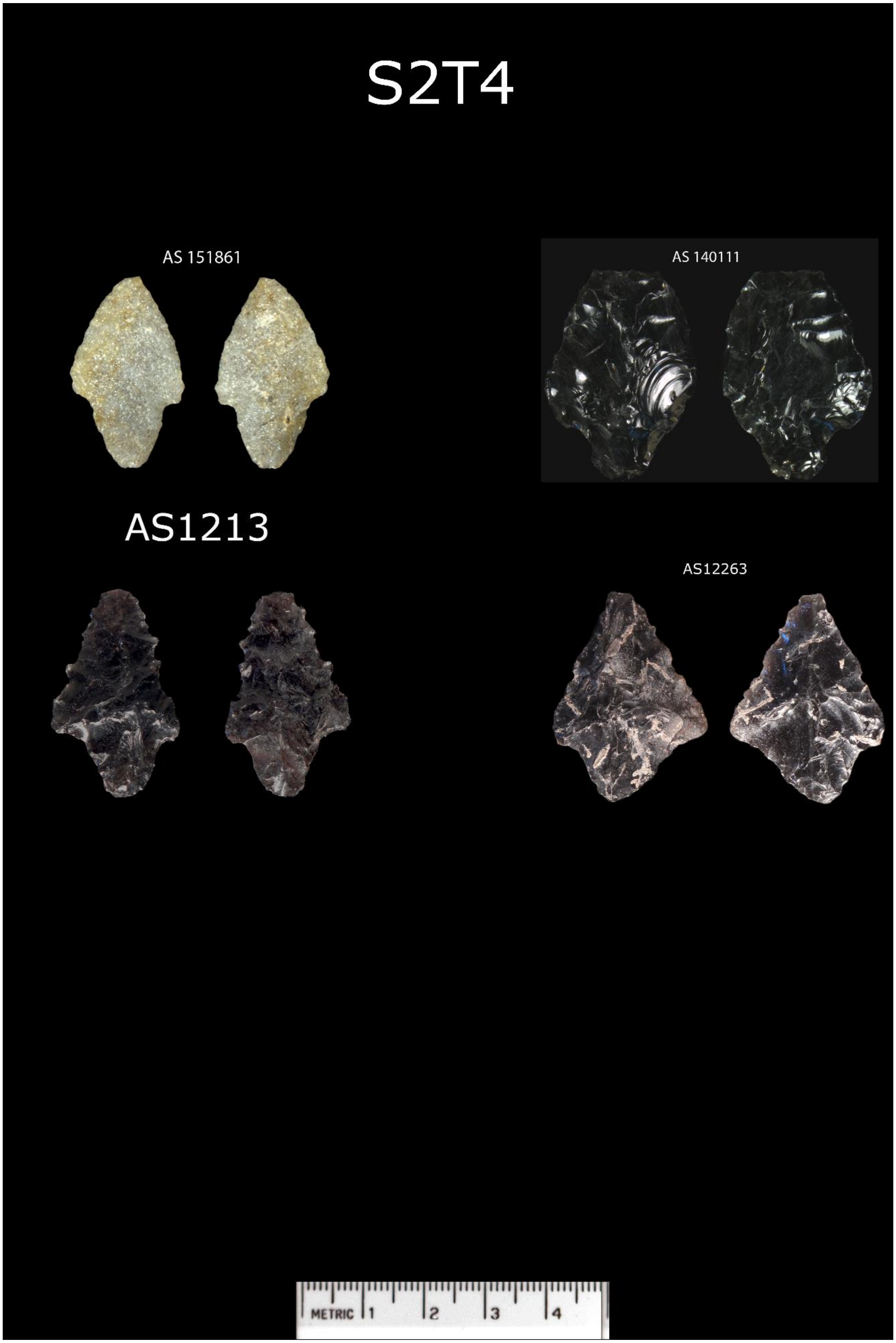
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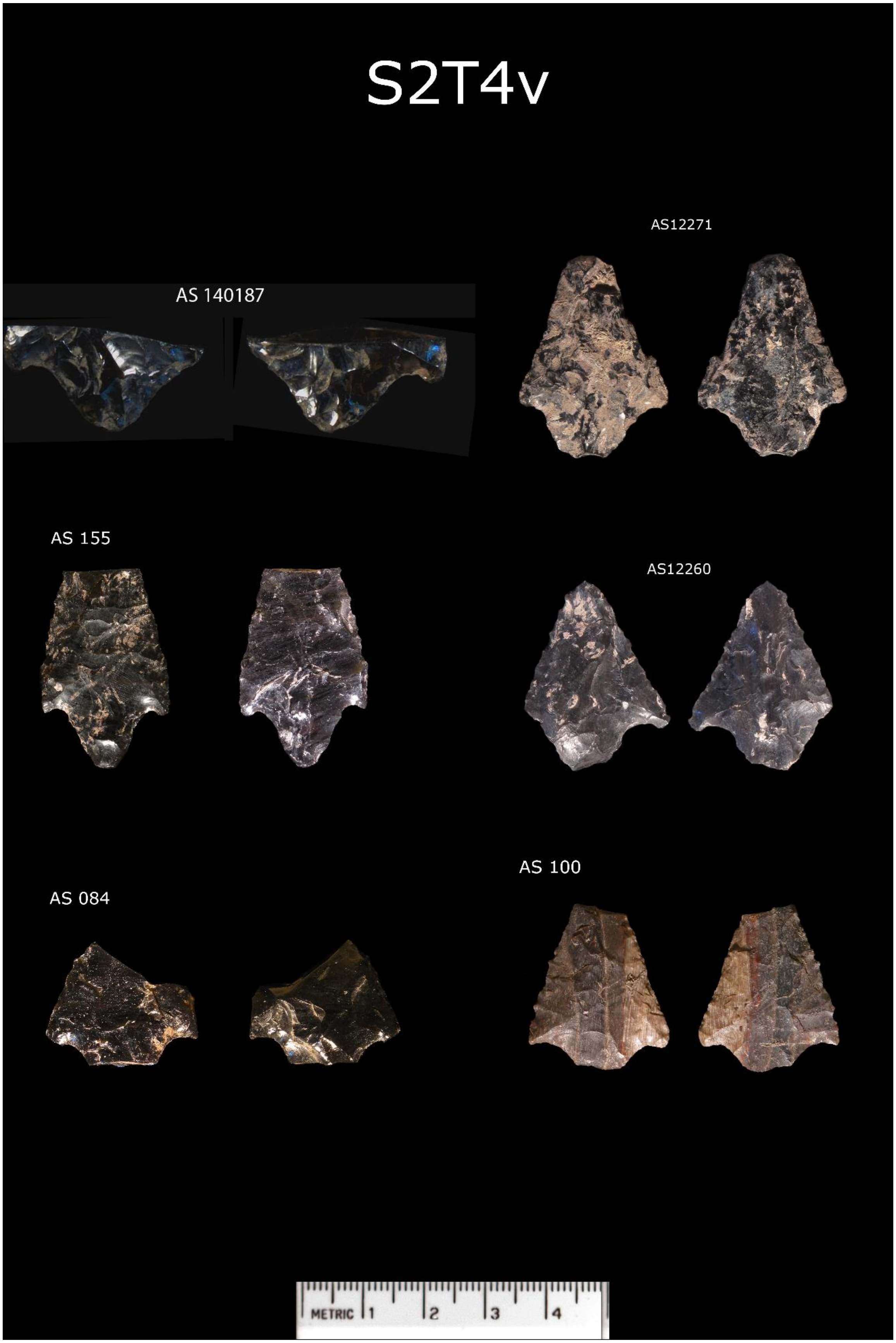
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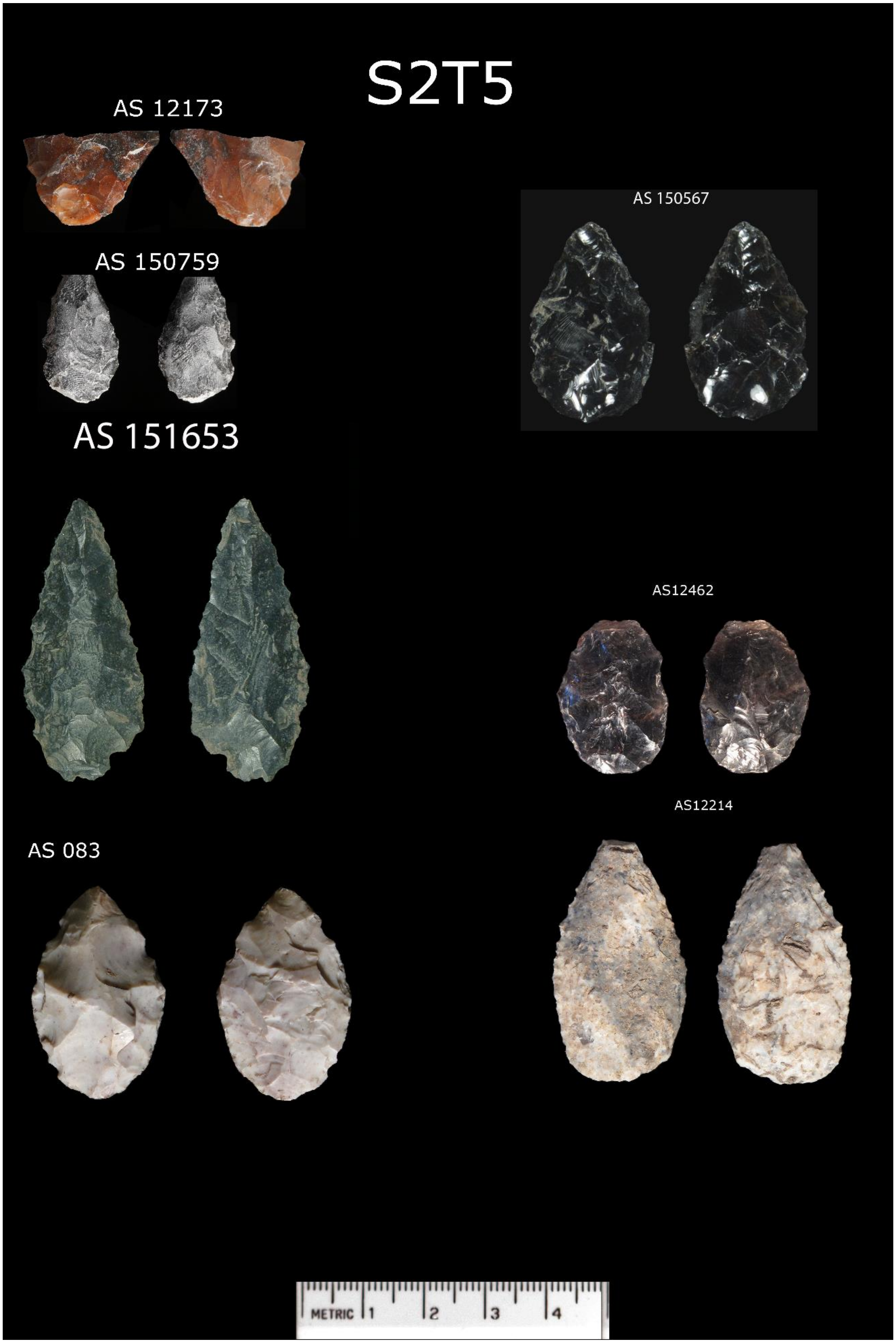
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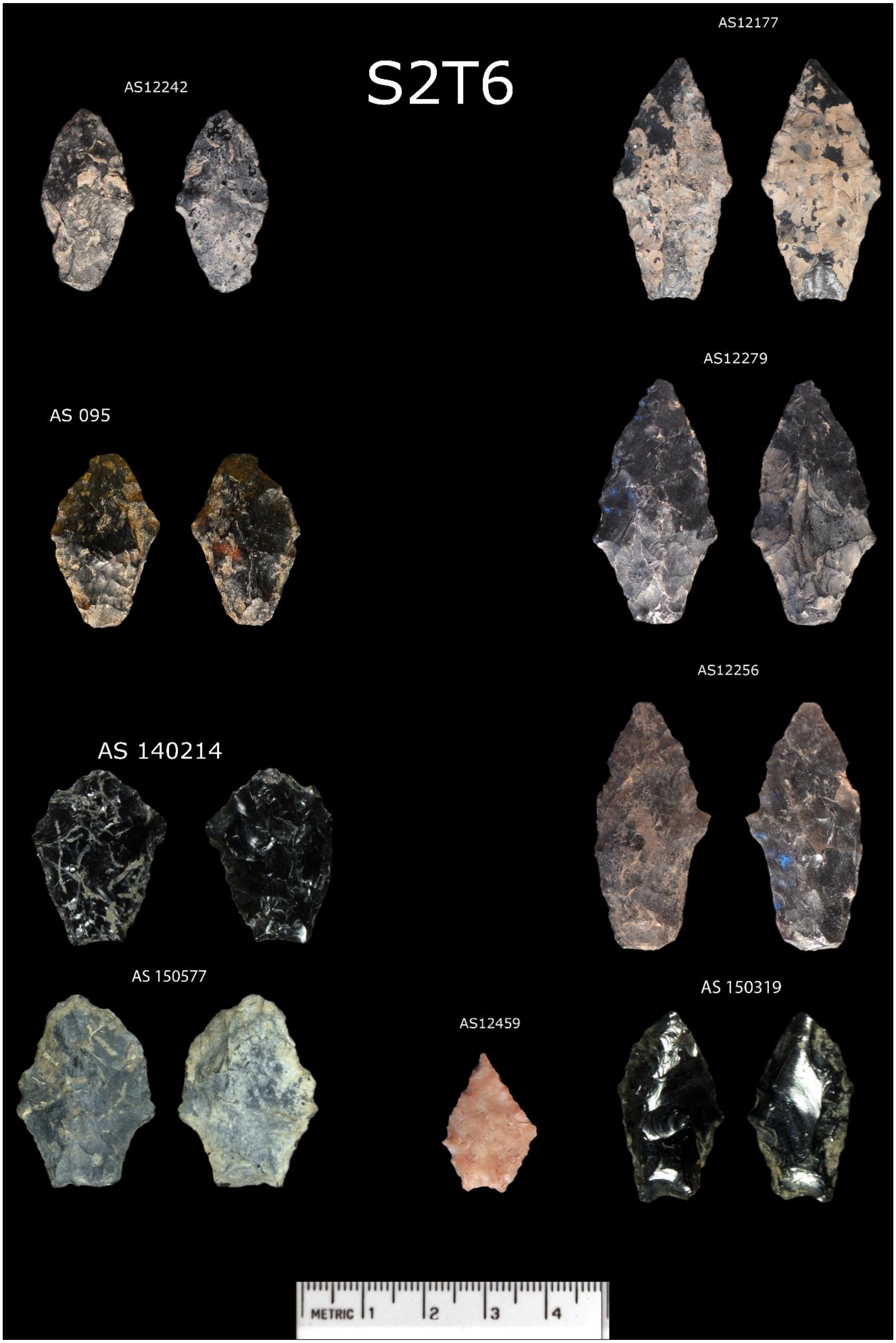
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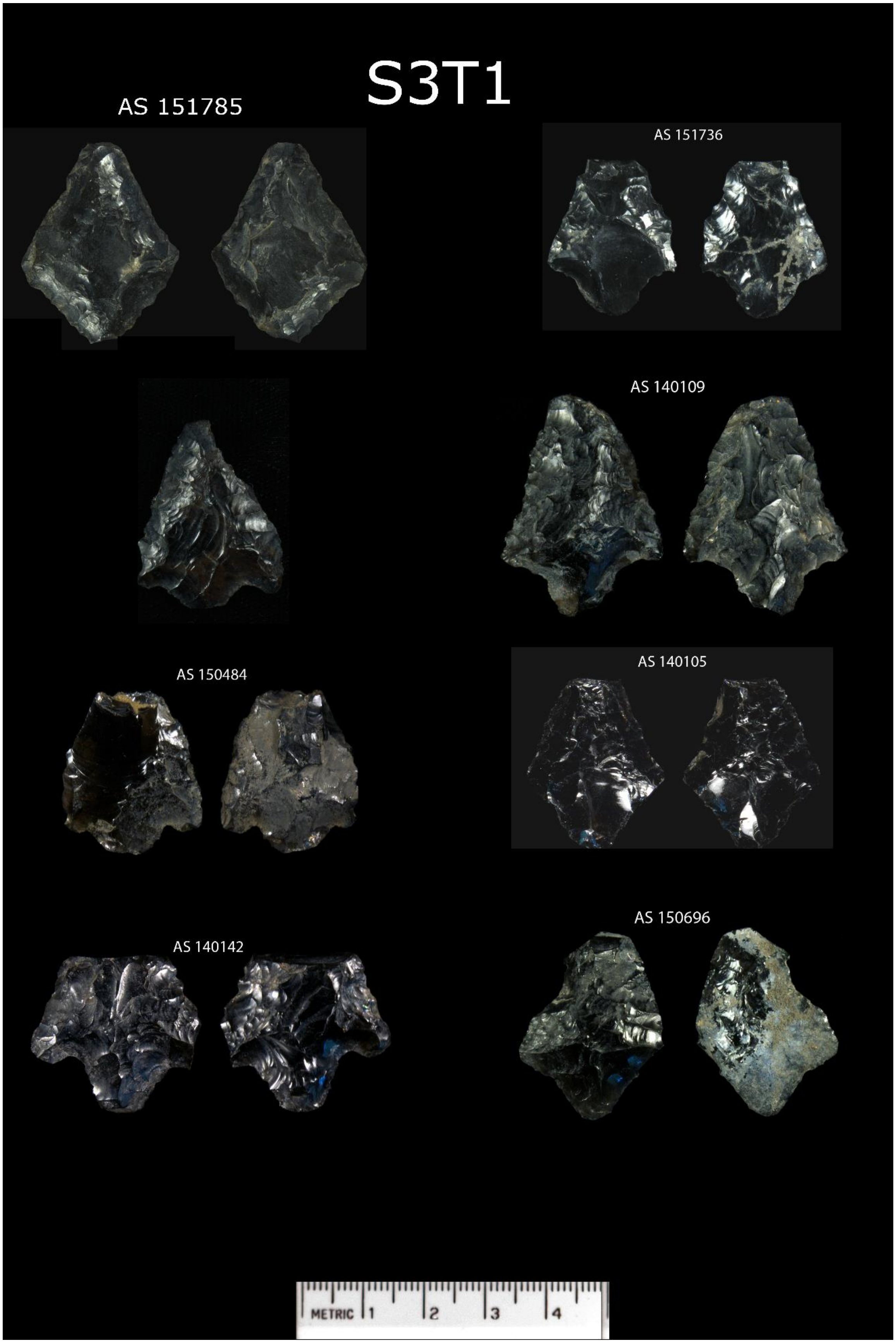
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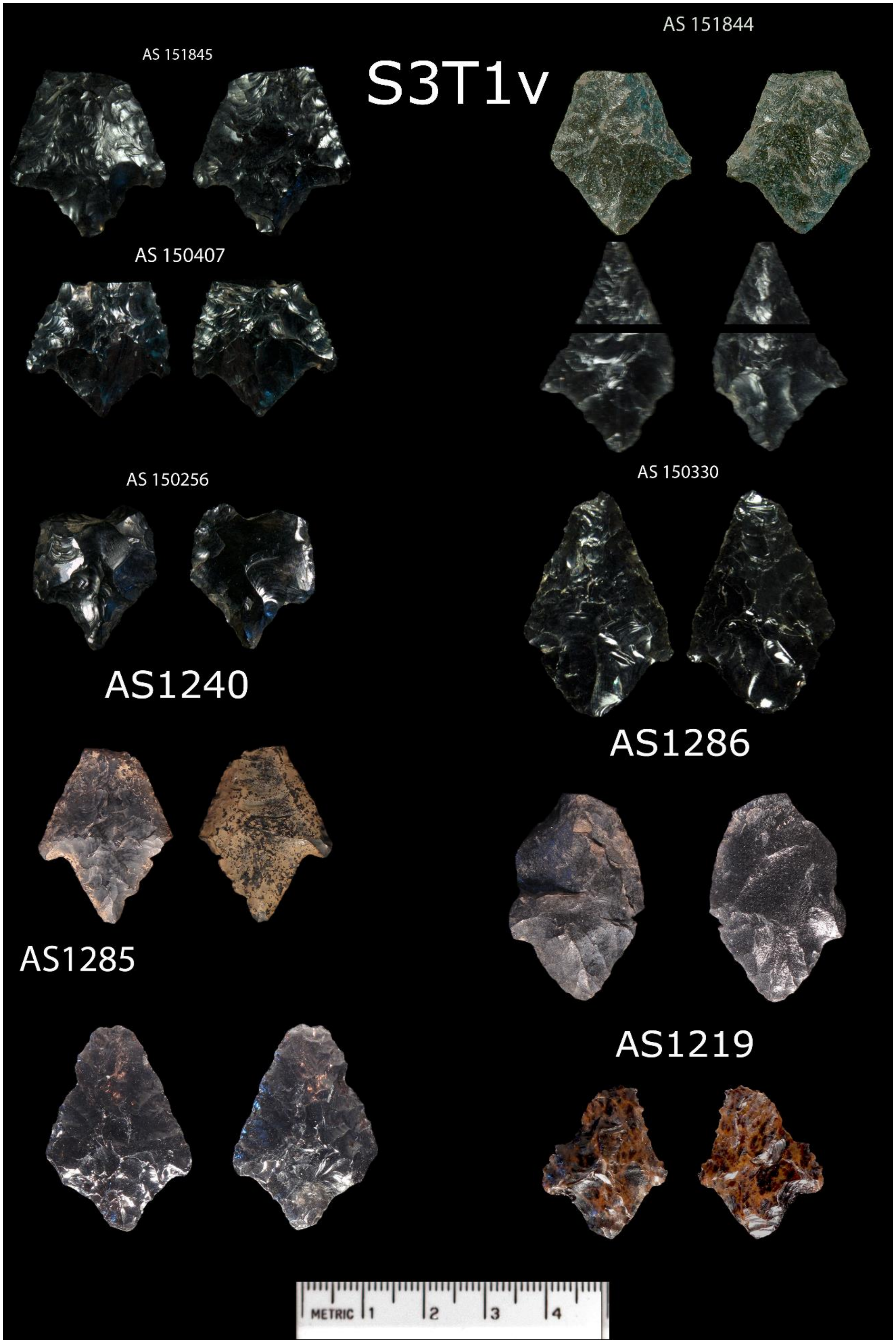
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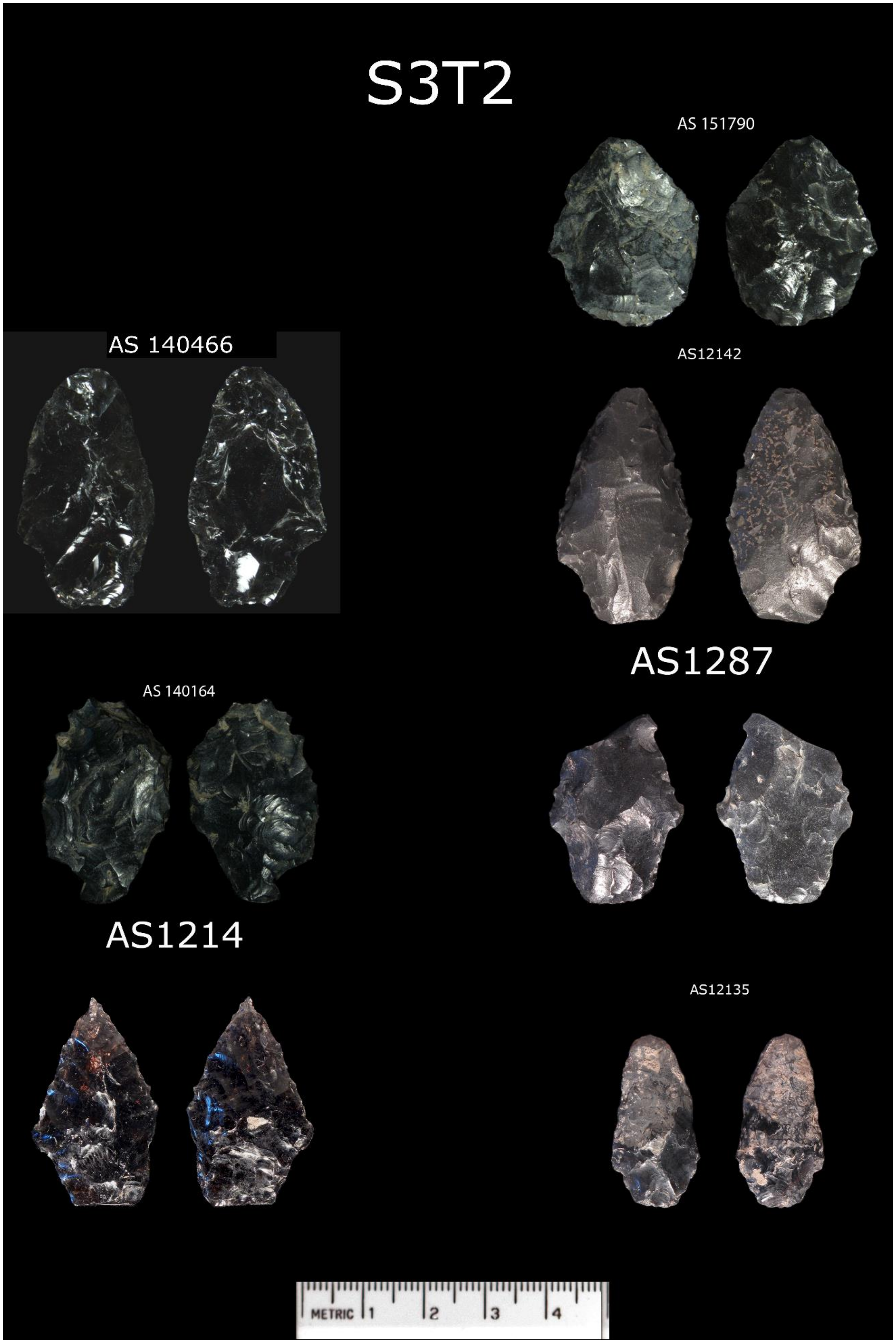
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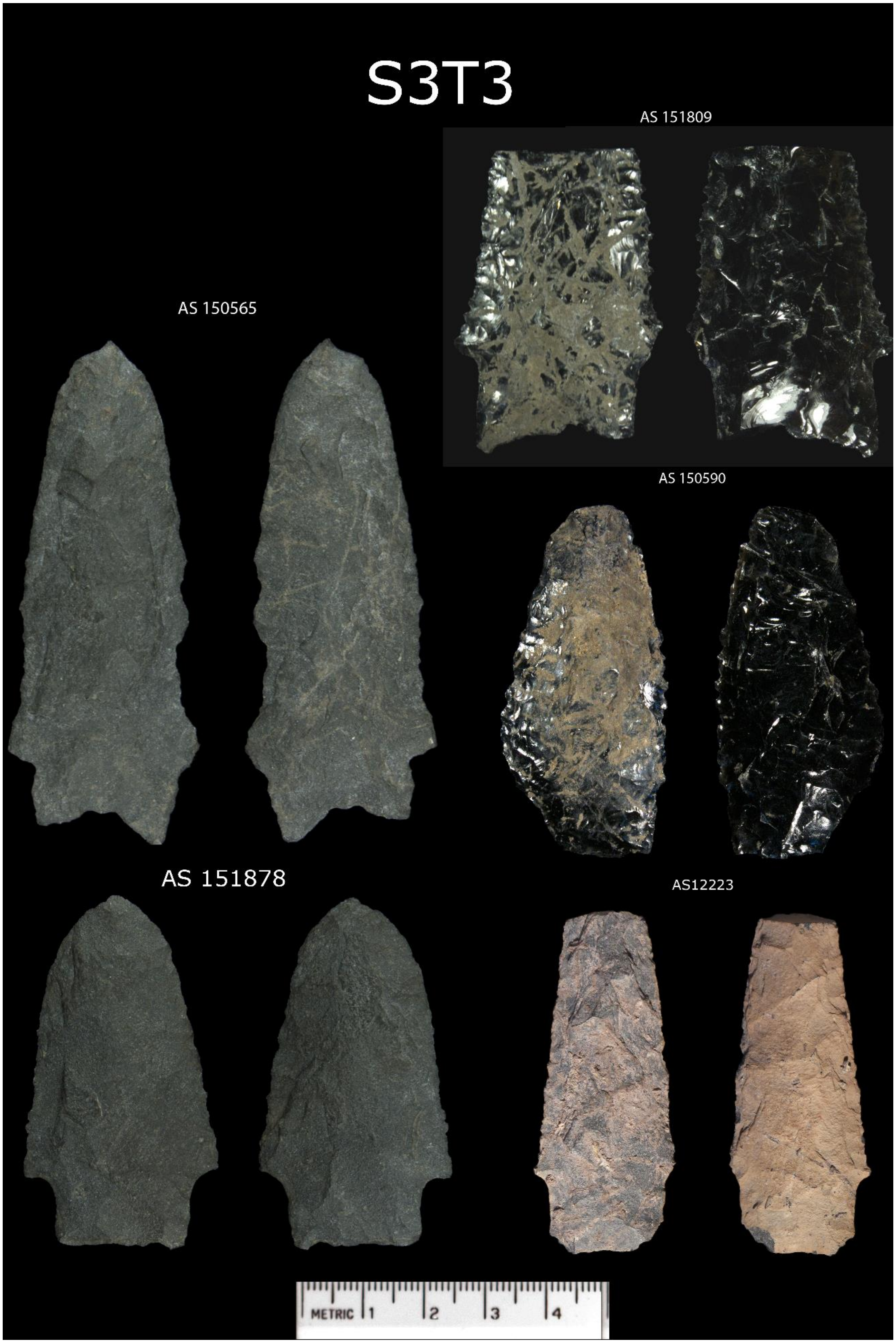
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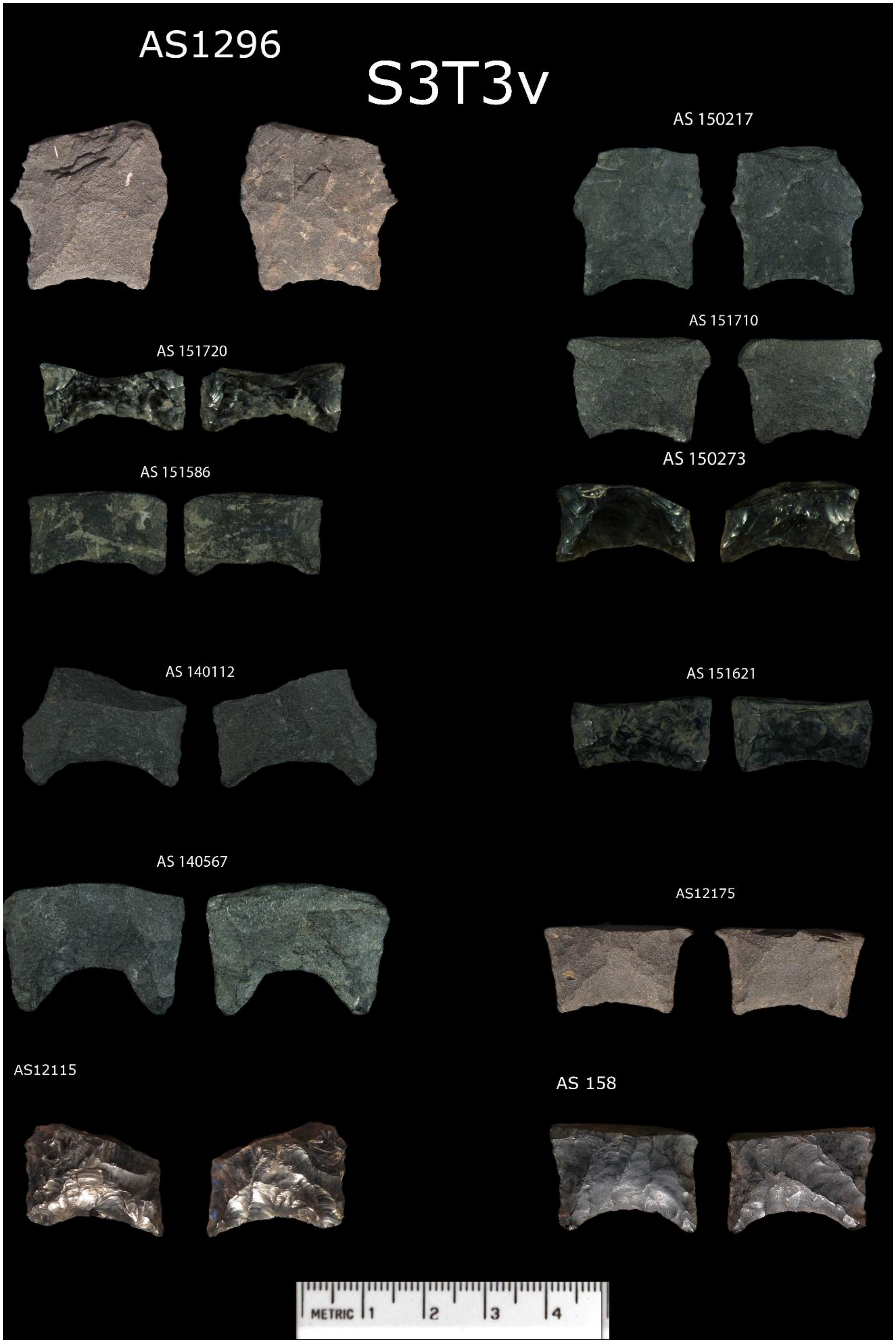
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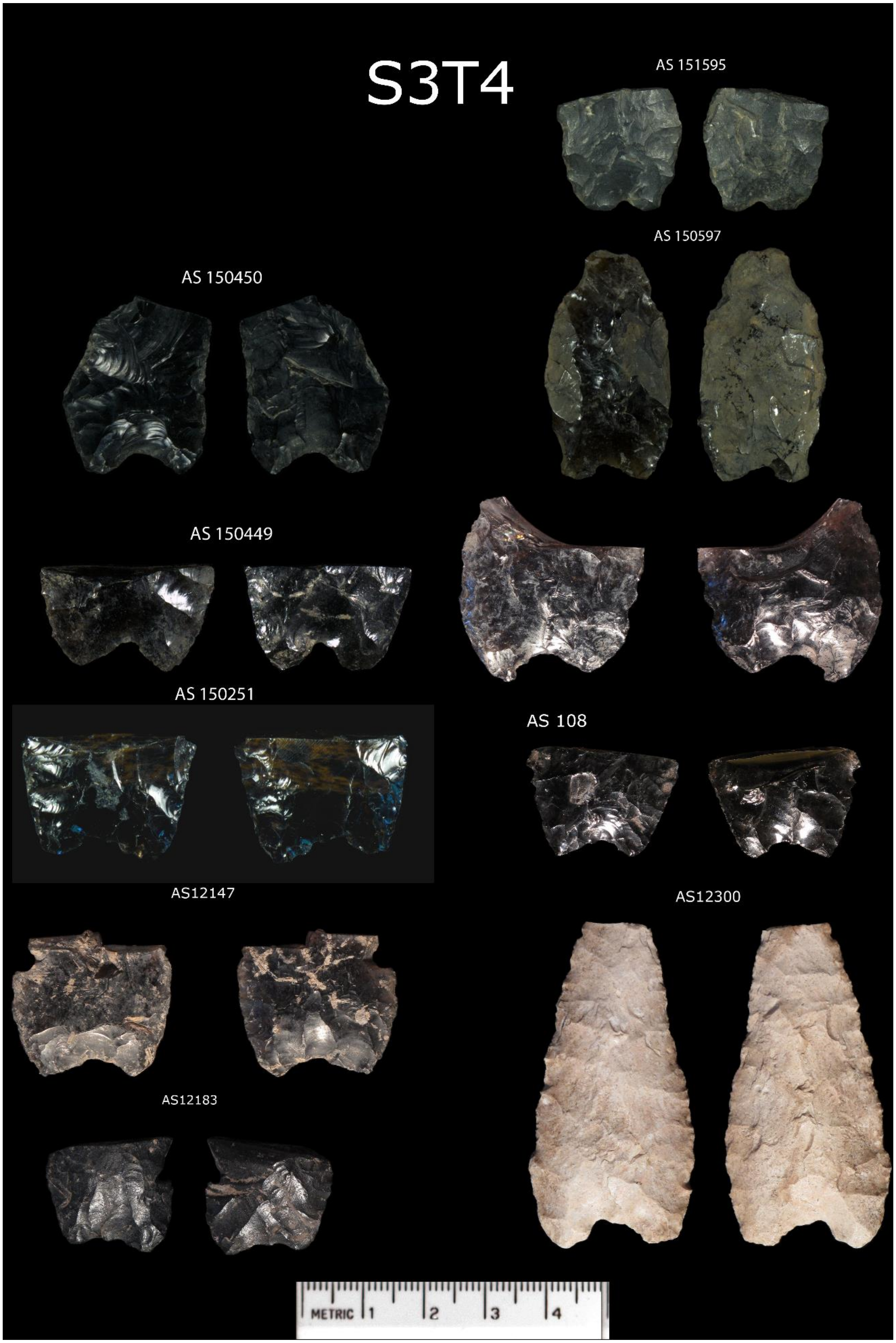
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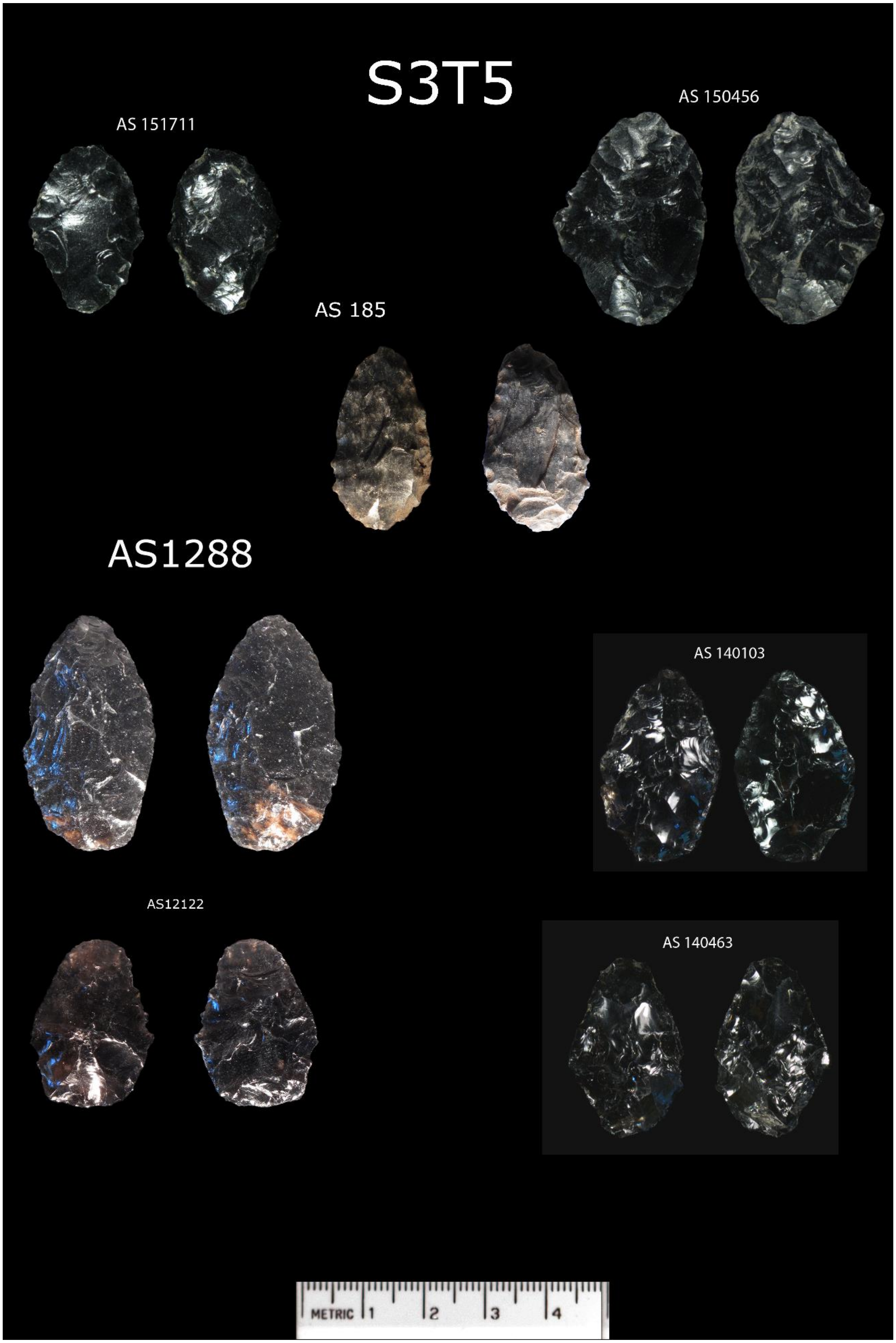
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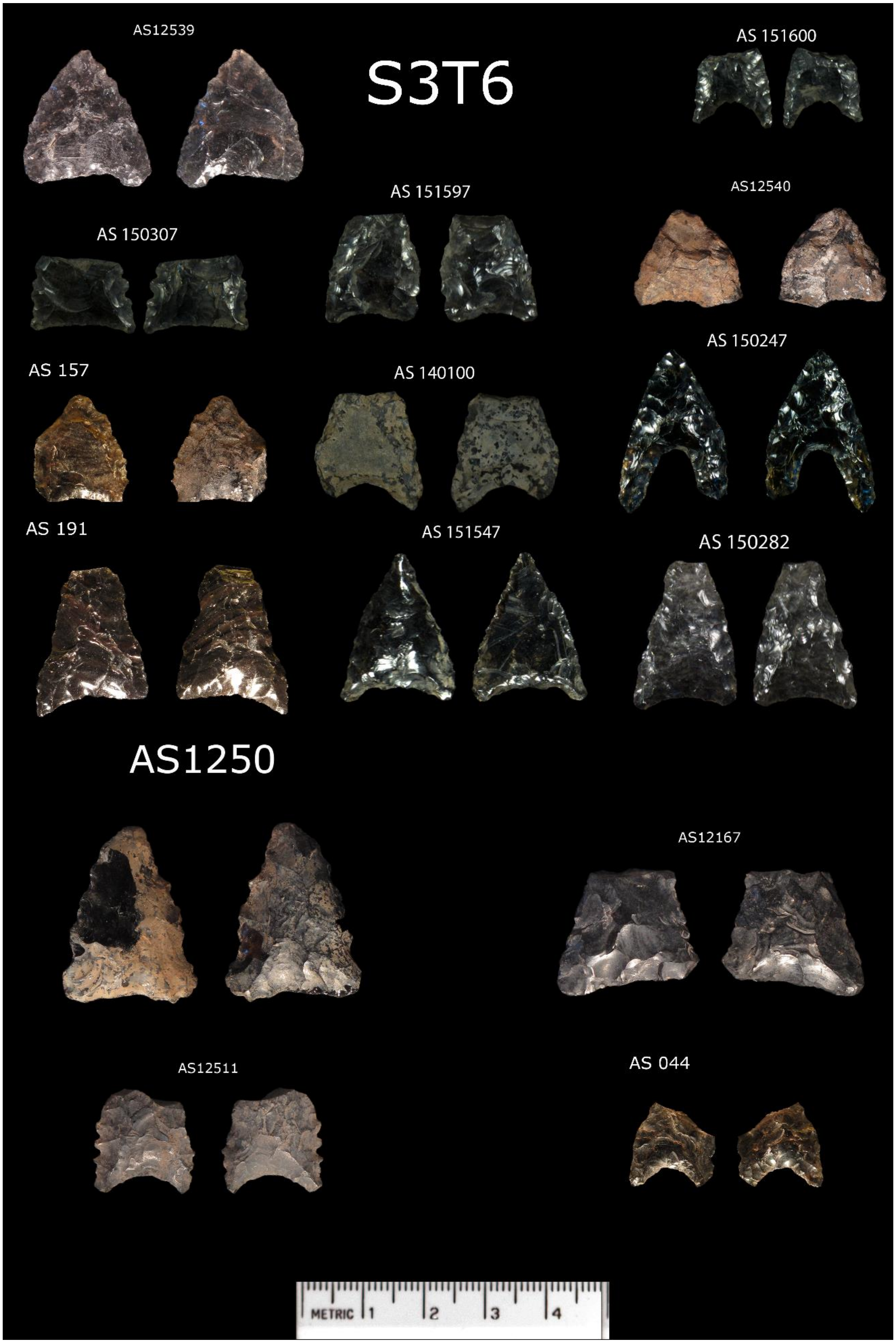
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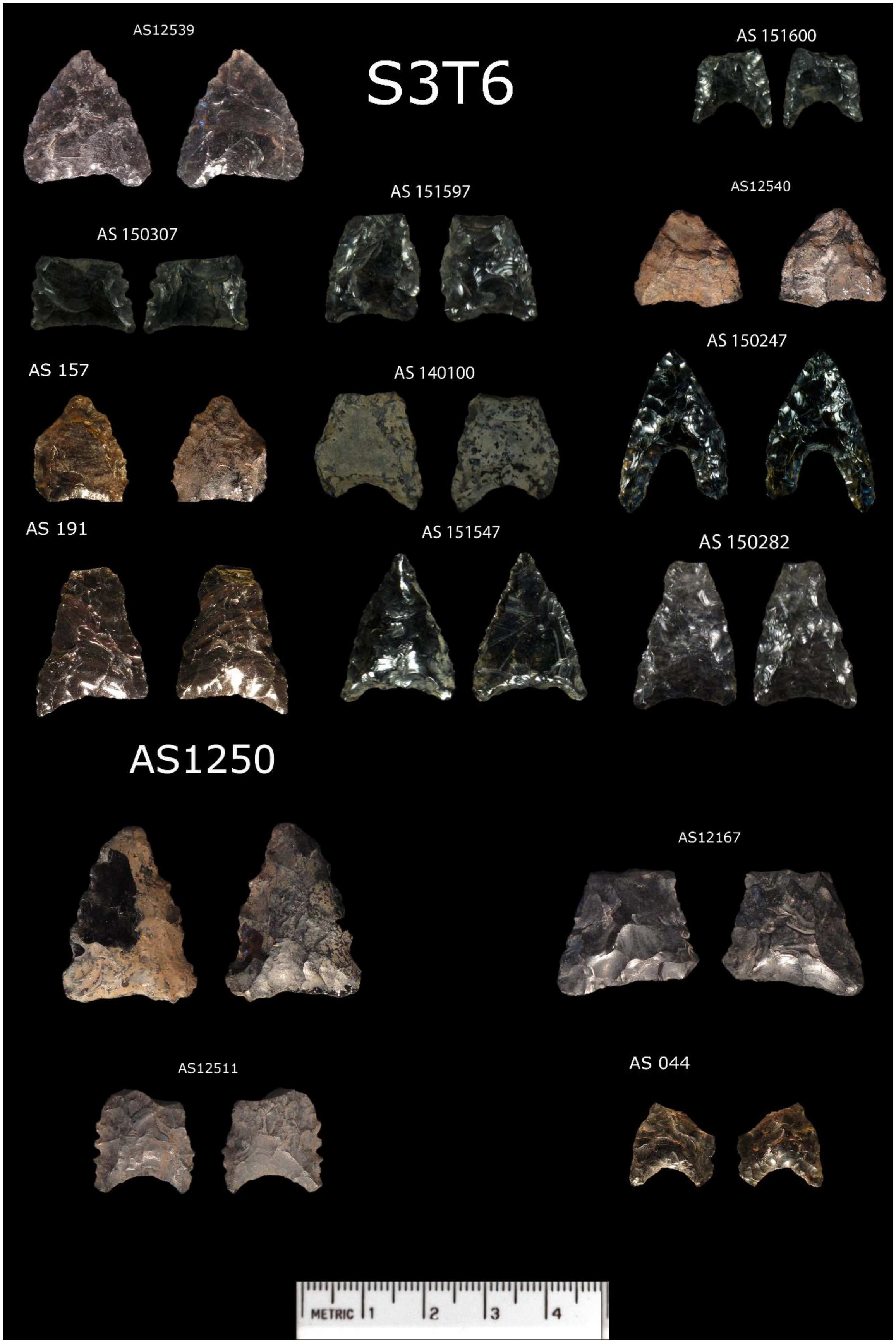
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METRIC 1 2 3 4

APPENDIX D

DFA Results

APPENDIX E

Descriptive Statistics Summary

APPENDIX F

Summary of Mann-Whitney U Test Results

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