MINING AND THE INCA ROAD IN THE PREHISTORIC ATACAMA DESERT, CHILE

by

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Traditionally, treatments of the Inca Empire have sought to document its deep economic and political impact on local populations in the Andes. There has been less study of how subject groups might have independently negotiated opportunistic economic responses to the Inca Empire. This research explores this issue through the investigation of the relationship between the Inca Road and a recently discovered, non-Inca system of mining camps, isolated deep in the Atacama Desert, northern Chile. Study of the development of these camps, and of their relationship with the Road aimed at addressing whether the Atacama Inca Road, served as a linear exchange nexus, or only as a highway servicing Inca imperial needs.

To address this objective, I conducted a one-year project of survey, surface collection, and excavation to investigate: (1) the social organization and chaîne opératoire of turquoise and malachite beads, and red pigment production at the Cachiyuyo de Llampos Mountain camps; and (2) the nature of settlement and associated artifact assemblages along a nearby section of the Inca Road. In contrast to Inca state-ruled mining sites from the Inca epoch, these Chilean camps lacked Inca architecture and production patterns, presenting instead a pattern of artisan household mining and craft production of copper ore beads, iron oxide red pigment, and the crafting of items with distantly acquired raw materials. This craft production predated the Inca, and was not greatly altered following Inca conquest. However, occupation and production did

intensify following Inca conquest, as the Road became a logistical resource for the camps, facilitating provisioning and exchange. Local miners and artisans worked full time in the desert, far from agricultural areas; the Inca Road became their main connection for the acquisition and movement of goods, independent of the Inca Empire's imperial purposes. The data generated on domestic and craft activities, and on local and long distance exchange, contributes to our understanding of the use of the Inca Road and to how populations respond to imperial infrastructure.

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PREFACE

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I dedicate this work to my family and my wife Carol.

1.0 INTRODUCTION

Most literature dealing with the effects of Inca conquest has been concerned with assessing the economic impact of imperial demands on subject households. Although obviously important, the focus on this dynamic obscures alternate causes of household and community level economic changes; ones in which households may act as opportunistic agents, taking advantage of new economic settings stemming from imperial inclusion. Such changes need not be part of imperial strategies, nor those of dominant elites in the region. Instead, these economic changes may represent "bottom-up" responses to contact with the new institutions and infrastructure of the overarching imperial system. While less prominent than centrally-directed economic enterprises, these responses can constitute and significantly shape collective trends of household economic strategies.

This research explores this issue through investigation of the relationship between the Inca Road and a recently discovered, set of non-Inca mining camps, isolated deep in the Atacama Desert, northern Chile. Preliminary research suggested that mining sites within the Chinchilla ravine in Cachiyuyo de Llampos Mountains could not have existed without the use of the nearby Inca Road. Investigation of the relationship between these camps and the Road took aim at two issues: (1) Did the Inca Road functioned as a "growth factor," stimulating local craft industry; and (2) Did the Atacama Inca Road function solely as a highway servicing Inca imperial needs, or did it also form a linear entrepot or exchange nexus for local people? Although my final results showed that the presence of the Inca Road was not the cause of the emergence of mining activities in that area, the mining camps changed in ways that were likely induced by the Inca Road's proximity.

To address the two questions, I conducted a one-year project of survey, surface collection, and excavation to investigate: (1) the social organization and chaîne opératoire of copper ore bead making and iron oxide pigment production at the Cachiyuyo de Llampos mining camps; and (2) roadside settlement and associated assemblages (including a known Inca *tampu* and clusters of informal structures) along a nearby section of the Inca Road. This research constitutes one of the first intensive studies of prehispanic Andean small-scale local mining activities, in contrast to the much better documented, large-scale Inca extraction and metallurgical processing sites. This research also provides an empirically based, contextual, archaeological assessment of the materials actually moving along a section of the Inca Road. Surprisingly, such assessments have been very rare in Inca archaeology. The data generated on domestic and craft activities, and on local and long distance exchange, adds to our understanding of how households and communities negotiate imperial hegemony.

1.1 POLITICAL ECONOMY AND HOUSEHOLD RESPONSE

A central theme of much archaeological study of Inca conquest has been documenting the impact of Inca political economy on local -household and community- patterns of production (a partial list of such studies could include: Acuto 2010, Alconini 2008, Alconini and Malpass 2010, Costin and Earle 1989, D'Altroy and Hastorf 2001, D'Altroy et al. 2007, DeMarrais et al. 1996, Earle 1994, Hastorf 1990, 1993, Malpass 1993, Santoro et al. 2010, Williams 2000). This interest is well justified. Empires, in general, tend to be extractive, and the Inca state was a paragon of surplus mobilization from subject households, as is amply documented both ethnohistorically and archaeologically (D'Altroy 1992, Hastorf 1993, Julien 2004, La Lone 1982, LeVine 1992, Murra 1980, Stanish 1997, Stanish 2001). However, it can be argued that Inca impact on local economies was so manifest that it has eclipsed consideration of potential alternate forms of household and community level economic response, particularly in areas outside of Inca staple finance strategies.

Implicit in many studies of the effects of Inca conquest is a view of subject households or communities as economically passive. Yet households or small corporate units can act as independent economic agents in their own right, taking advantage of shifts in the overarching economic settings that arise from political conquest (Douglass 2002, Gonlin 2012, Falconer 1995, Hendon 1996, Hirth 2009, Netting 1993, Wilk 1989). These changes, then, are autochthonous or 'grass roots', rooted more in local domestic economic strategies than in imperial political economy. Such changes might well be stimulated, or shaped, by the overarching imperial system, perhaps in unanticipated ways. A wealth of studies of households in ancient Mesoamerican document precisely these behaviors (Clark and Blake 1994, Earle and Smith 2012, Feinman and Nicholas 2004, Feinman et al. 1984, Marcus 2006, Smith 1994, Smith et al. 2003, Hirth 1998).

In Andean archaeology, the relative lack of interest in "entrepreneurial-type" household economic change is due chiefly to the long-standing conviction that there was no "market" in the prehispanic Andes (cf. Mayer 2013). As one reviewer put this view, "unlike their counterparts in Central Mexico, the people of the Andes created imperial systems based on an elaborate corvée labor–tax system, avoiding or possibly suppressing market trade" (Stanish 2010:187). However, new perspectives are changing this old view about household economies and market-type behavior in the Inca empire. As Stark and Garraty 2010:56 note, "Evaluation of the Upper Mantaro data from the regional production-distribution perspective raises the possibility of peripheral markets that boosted opportunities for provisioning ordinary households with some domestic gear and assured that specialists maintained access to consumers." Something similar could also have been part of provisioning Lupaca households (Gallardo 2013). Hirth (2010:241) reminds us that, "archaeologists need to remember that market exchange and marketplaces can be found alongside many other non-market forms of exchange that provision both households and institutions with the resources needed for their operation." Such coexistence likely existed in the late prehispanic Andes and within the Inca empire. The lack of classic market activities in the late prehispanic Andes did not preclude forms of barter at the household level (Murra 1980, 1995, Stanish 2010, Stanish and Coben 2013, Gallardo 2013); and Inca scholars have been willing to recognize "entrepreneurial" activity at the margins of the empire (Martin 2010, Murra 1980, 1995, Salomon 1986, Rostworowski 1989).

This research investigated small scale mining in the Atacama Desert as a potential example of such local, entrepreneurial response to change in economic conditions resulting from the Inca conquest.

1.2 IMPERIAL ROADS: USAGE AND LOCAL CONSEQUENCES

In examining roads in ancient states, scholars have tended to emphasize the role played by roads in serving the goals of central authorities. According to Timothy Earle (2009:258), "In the Inka and Roman empires, roads were built to support the long-distance, logistical movement of armies under all weather conditions in addition to moving goods and people." Ancient states may have tried to enforce the official use of state-managed roads, but ways were found to bypass regulations, resulting in their use by private people. In the case of the highly exclusive imperial roads in Japan, the government forbade private traffic, but they were still used by large numbers of private individuals who carried out their own mercantile activities under the excuse of peregrination (Vaporis 2012). In imperial China, roads had primarily official functions but they were also usually unofficially: "Despite the truculent attitude that succeeding realms adopted toward merchants and other itinerant professions, by the fourth century BCE the regional economies in the area we call "China" today were so densely connected that the so-called great families could make hefty profits by setting up private courier stations and transport services, if they were careful not to abuse their statutory privileges" (Nylan 2012:44). The extent to which imperial roads were seen as an official network has been even been called into question for the Roman empire: "More fundamentally, there is cause to question how far even emperors or their better-educated subjects were in the habit of conceptualizing the empire's highways as a 'network.' To be sure, this is a perspective unhesitatingly adopted by modern students of the Roman Empire. To them, both long-distance road travel and global cartographic awareness are routine, while centralized control of a state's infrastructure by its proactive government is to be taken for granted" (Talbert 2012:247).

I would argue that control over roads was likely often not exercised in areas of minimal state administrative presence. In ancient empires without detailed cartographies, central elites probably had an incomplete vision of the extent of their domains. Enforcing road traffic strictures would have been difficult and unimportant, especially in politically and militarily non-critical marginal or provincial zones.

The role of "imperial" roads in spreading domination, or in articulating local peoples to larger economic systems, has been explored in a variety of contexts (Banerjee et al. 2012, Bryceson et al. 2008, Canning and Fay 1993, Kreutzmann 1991, OECD 2002, Speidel 1987, Wiseman 1970, Witcher 1998). For example, Roman roads in North Africa led to improve communication and traffic between distant centers, allowed rural settlements to move their products to larger markets, facilitated migration to urban centers, stimulated tax collection, and promoted "an early and sustained globalization" (Hitchner 2012:232). The great amount of traffic, and the improvements in public safety, the *pax romana*, contributed to produce a cosmopolitan empire, even creating the rise of the phenomenon of private "tourism" in distant provinces (Foubert and Breeze 2014). In western America of the 19th century, railroads acted in the same fashion, producing track side communities and nodal points for urban growth, the inexpensive movement of agriculture commodities, and the generation of surpluses, in what has been labeled as "social saving" (Fogel 1962). Modern studies of the effects of roads in Latin America and Africa have stressed not only the transformative local economic effects roads may have, but also to the "social inclusion" in which formerly isolated communities are drawn into higher level social and political orders (OECD 2002). Overall, the economic opportunities for crafting, services, or exchange for households or small local elites along these roads or rail lines are self-evident. Those economic opportunities arise from: (1) the higher transportation efficiency (and lower costs) that a road can provide; and (2) the very traffic on the road provides a new "market." The road traffic allows local people to interact with newcomers, middlemen, and trading partners from a wider social and economic network. As Snead has pointed out: "Instead of discussing what paths, trails, and roads did, we must examine what they were – places with particular characteristics associated with movement. And movement is not a "neutral" or value-free process. It engages links and boundaries, opportunities and barriers, belonging and exclusion" (Snead 2012:109).

1.2.1 The Inca Road

Surprisingly, however, there has been little comparable theoretical or empirical work on the famous Inca Road. This omission has largely been the result of a top-down perspective that views the road system solely in terms of Inca strategies and as a transport network linking Inca administrative nodes or productive enclaves. As Hyslop (1984:7) wrote "The traditional English meaning (of highway) incorporates the concept of a public road freely open to all passengers. Such was not the case of the Inka roads, which served primarily for travelers on state business." Hyslop's (1984) landmark monograph remains the interpretive and methodological touchstone for archaeological approaches to the Inca Road system, which he saw as a "vast network for the acquisition, management, movement, and protection of labor" (Hyslop 1984:247), becoming "the omnipresent symbol of the empire throughout the Andes" (Hyslop 1990:xiii). Extending more than 23,000 kilometers from Colombia to Central Chile, the Road was the most extensive infrastructure of Inca imperial administration, consisting of multiple routes connected by a series of nodal sites situated for the control of traffic and provisioning of official travelers.

Hyslop's emphasis on the Inca Road's use for state-related business continues to inform contemporary scholarship: "Soldiers, porters, and llama caravans were prime users, as were the nobility and other individuals on official duty…Other subjects were allowed to walk along the roads only with permission…" (D'Altroy 2002:243). For Julien (2012), road construction and the development of the empire were inextricably combined, and they changed the physical and social landscape of the places where they were placed: "The roads were an important part in the conceptualization of the Tawantinsuyu, as well as an important structuring feature of an initial form of imperial administration" (Julien 2012:147).

In order to improve efficiency, the Incas chose in most of the cases the "least demanding route" (Hyslop 1990:276) for the construction of the road, so they could move fast and keep a balance between the necessities of the state and the geographical barriers that had to be surmounted. Due to the importance of state management, administrative centers would have been "inevitable on roads" (Hyslop 1990:276), spaced by about 35 kilometers in the central Andes (Hyslop 1990). In a similar way, the distance between Inca *tambos* in the south of the empire would vary according geographical conditions for about 20 to 40 kilometers (Raffino 1982), although most of them would be spaced between 15 to 25 kilometers apart (Berenguer 2009).

D'Altroy (1992, 2002) argues that the logistics provided by the Inca Road system were fundamental to successful conquest, especially if food resources and cargo animals or porters could be locally supplied at different points along the route. From an economic point of view, Jenkins (2001) proposed the idea of two differentiated networks for the Inca Road: (1) a connection of political centers with massive storage facilities in the central Andes, as a system of staple finance; and (2) a system of wealth finance in distant provinces of the empire, facilitating movement to the center of such things as seashells, feathers, and mining products. The latter system was found in the north of Chile and northwest Argentina, which were dominated by the Inca through hegemonic control, and less direct administrative investment.

Inca Roads were also tied to the religious ideology of the empire, and ritual functions have been ascribed to them because of their association with sacred places. Particular examples are the mountain roads connecting *huacas* in places such as Pariacaca in the mountains of Lima, (Astuhuamán 2004), Nevado de Chañi in Salta (Vitry 2007a), the Paniri and San Pedro volcanos in the border between Chile and Bolivia (Castro et al. 2004), and Cerro Las Palas, El Toro, and Portezuelo Cantarito in the Huasco Valley (Stehberg 1995).

Subsequent research has continued Hyslop's methodology of careful point-to-point tracing of segments of the road while producing an inventory of the kinds of features (*hitos*, *apachetas*), sites (*tampu*, *chaskiwasi*), and structures (*kallanka*, *colcas*, corrals) along it (Castro et al 2004, INC 2005 – 2009 volumes 1-8, Berenguer et al. 2005, Stehberg 1995, Vitry 2000). Hyslop's (1984:254) discussion of the variety of traffic on the road was limited to a single paragraph in the monograph. But Hyslop (1984:254) himself recognized the importance of investigating other dimensions of road usage, noting that, "there was also an undetermined amount of private traffic…about which little is known".

A ubiquitous feature along the Inca Road is the informal (non-Inca) roadside structures, sometimes, but not always, associated with official tambos or *tampu*. Although Hyslop (1984) did not discuss these structures, they can be seen, for example in his (1984:198) plan of Ranchillos, where over 80 small circular or comma shaped structures occur alongside and behind formal Inca *canchas*. In a survey of the Inca Road from Morohuasi to Salta, Vitry (2000) recorded such structures at 7 of 15 roadside sites, including El Cardonal (with 45 of them). These structures are sometimes off-handedly characterized by archaeologists as "overflow" housing for travelers when *tampu* and other official facilities are full, or as storage spaces to support *tampus* and similar installations. Archaeologically, however, these buildings have seen even less investigation than have the formal *tampus*.

But if Inca Roads were not only used for official purposes, what sort of small, local enterprises might develop to take advantage of the Inca Road in prehispanic times? And how would these indigenous enterprises differ (in character and goals) from how such activities were organized as part of the Inca imperial system? While there is information on what the Inca rulers did with their roads (or said they did, as reported by early chroniclers such as Garcilaso), next to nothing is known of how local groups may have exploited the imperial infrastructure for their own economic and social purposes. My preliminary work at the Chinchilla 1 (CH1) mining camp raised the possibility that the use of the Inca Road in the Atacama desert was much more complex and more "local," than portrayed in the existing Inca Road literature. Such local co-option of the Road was likely facilitated by the distance from the Inca heartland and the relatively light Inca administrative presence in the Atacama Desert. The existence of the Road itself could have provided new economic opportunities for local populations, and would have linked them to the Inca world in ways not seen at the nodes of Inca control, nor in ways intended by the Inca Empire.

Comparative investigation of ancient Roman provincial roads (Speidel 1987, Wiseman 1970, Witcher 1998), the spread of modern transportation nets (Fogel 1962), and modern llama caravan activities in the Andes (Nielsen 2000, 2001, 2009, 2013) can guide us in interrogating the Inca Road. These studies reveal the local economic impacts of roads, highlighting that: (a) traffic on roads creates increased opportunities for exchange; and (b) in lowering transport costs, the road itself becomes a "growth factor" stimulating local productive activities. Far from being closed systems, ancient roads should function as loci for roadside marketing and bartering, down-the-line local exchange, and as places of accumulation and distribution. In describing the modern day activities of llama caravans along well-established routes, Nielsen (2000:438-439) notes the importance of "secondary exchange" and "daily swapping" during the journey, with caravaneers taking advantage of local trade opportunities along the route, either in nearby villages or when local people come to the route to barter for goods. Intriguingly, Murra (1980) may have been the first to suggest the possible connection between the Inca Road and "barter" activity. While observing that "Garcilaso's notion that there was little traffic on the road beyond the official business is a widespread one," Murra (1980:147) cites (but does not present) "ample" evidence for commoner traveling folk (including merchant types) who "paid" tolls at bridges and for lodging at tambos.

1.2.2 Models of the Inca Road: Turnpike versus Entrepot

For the sake of analytical convenience, we can posit two highly simplified models for the Inca Road. The *turnpike* construct, emphasizing limited access and official usage, treats the road as the vascular system of the Inca Empire, with crucial materials flowing in impermeable arteries between imperial nodes. In this construct, roadside structures, such as the informal circular structures so often noted along the road, for example, reflect the activities of travelers on the road, providing only transitory housing or storage. In contrast, the *linear entrepot* construct, drawing from llama caravan research and cross-cultural analogy, hypothesizes the road to have been a locus for economic interaction between travelers and local people, perhaps even serving as an economic magnet, and to have been a significant factor in local economic activities. Choosing among these constructs for the Cachiyuyo de Llampos case was based on contextual study of roadside structures, and the close investigation of mining activities around the road.

1.3 LATE PREHISPANIC MINING

As Cantarutti (2013:186) observes, our perspective of Inca Period mining is hampered by: (1) a reliance on ethnohistoric accounts that treat only the most famous mines; and (2), "the scarcity of systematic archaeological studies of Inca mining sites". I would add to these the lack of archaeological studies of Inca-era but non-Inca (local or community) mining sites. These factors have mitigated development of a "comparative understanding of … the degree to which the Inca state was involved in the extractive operations of different mineral resources" (Cantarutti (2013:186). Seen from the other way around, these factors have also prevented an understanding of how *local* mining activity was simulated by, or articulated with, the Inca state. D'Altroy (2002:301) has noted that the references in ethnohistoric accounts to the Inca state laying claim, "to all mineral resources…was more an assertion of sovereignty than reality". This observation is consistent with Berthelot's (1986) ethnohistoric study of the Carabaya and Chuquiabo districts in the Titicaca Basin, showing that although the Inca controlled the most productive mines (especially of gold), there were also many scattered, lesser quality, mines pertaining to local communities. Some of these latter were specifically "allocated" by the Inca to local lords for their own exploitation, without owing tribute for that production.

The Andes generally has seen comparatively little investigation of small-scale mining framed within household or community economies (c.f. Rosen 1997, Stöllner 2009). With some exceptions (Eerkens et al. 2009, González 2004, Graffam et al.1996, Núñez et al. 2003, Núñez 2006), our current picture of prehispanic mining/metal production in the Andes is heavily skewed to centralized, state-controlled economies, and elite activities (Abbott and Wolfe 2003, Berthelot 1986, Cantarutti 2013, Cruz and Vacher 2008, D'Altroy and Earle 1985, Earle 1994, Lechtman and McFarlane 2006, Lechtman 2007, Salazar 2008, Salazar et al. 2010b, Salazar et al.

2013b, Goldstein and Shimada 2007, Shimada and Wagner 2001, Schultze 2013, Van Buren and Presta 2010, Williams 2000, Vaughn and Tripcevich 2013). Yet as archaeological research in Europe and the Eurasian steps is demonstrating, mining and metallurgy is often better understood in the context of domestic economic processes rather than in the dynamics of elite political economy (Hanks 2009, Hanks and Doonan 2009, Pigott 1998, Wright and Garrard 2003, Knapp 1998).

Bernard Knapp (1998) was one of the first to point out that studies about mining have focused more on technological and economic factors than on the social, ideological, and spatial dimensions of industrial communities. For Knapp, studying the mining community as a community is most likely to reveal important issues of social structure and interaction, and the development and transmission of technological practices and knowledge. Communities are the link between households and broader processes (Gerritsen 2006), and in most of the cases of small-scale mining, household units doing joint economic activities as corporate groups. The nature and extent of this corporate dimension of joint economic activity to the activities should be useful in understanding the variability observed in small scale mining in the archaeological record (Hayden and Cannon 1982). In some cases, mining communities may represent the domestic space of people diverse in character and origin working together; their bonding lasts until the activity. Seasonality and isolation are common features of small scale mining communities. Despite their isolation, mining communities also form part of regional imagined and economic communities transcending the local space, integrating constituent groups in broader economic and social ties of interdependence (Knapp 2003).

In a smaller level of social organization, mining can represent a form of household intensification, as it mining/craft working can produce higher return rates than other kinds of domestic production (Shennan 1998, 1999). This makes mining an effective household risk minimization strategy, particularly when it does not conflict with agricultural demands. Like other forms of craft production, mining and metal working can be effectively carried out as a "cottage industry", within the organizational framework of household relationships, and be part of multicrafting activities (Feinman 1999, Hirth 2009, Goldstein and Shimada 2007).

Studies of ethnohistoric and ethnographic small scale mining communities are illuminating, although, as in archaeology, modern mining camps have been understudied by scholars (Douglas 1998; Godoy 1985a, 1985b). Douglas (1998) for example, notes that anthropologists have neglected the importance of mining communities in domestic and regional economies, in the formation of kinship relations, and in socialization of mining knowledge for future generations. These and other ethnographic studies have great relevance in understanding the socioeconomic dynamics of prehispanic small scale mining, which analogy is in many cases strikingly similar.

1.4 THE INCA ROAD IN THE ATACAMA DESERT

The Inca Road through the Atacama Desert has been described as having administrative, rather than economic or military functions, because of the lack of water to support the Inca army or the movement of bulk goods (Hyslop 1984:248, Jenkins 2001). Lynch (1993) has pointed out that the Inca Road in the Atacama Desert was laid out to connect Inca administrative centers, without much relation to local population densities. However, in highlighting the economic function of the Road, a number of scholars, have pointed to a connection between the Road and mineral exploitation, taking note of the copper ore and metal artifacts found at sites along the route (Iribarren 1972, Iribarren and Bergholz 1972, Lynch 1993, Lynch 1994,1995-96, Lynch and Nuñez 1994, Niemeyer and Rivera 1983), and the proximity of the Road to some prehispanic mining operations (Raffino 1982, Adán 1999, Berenguer 2004, 2007, Berenguer et al. 2005). Despite the archaeological attention devoted to the Atacama Inca Road itself, there have only been a few excavations of associated structures such as tambos, and these have been cursory, as at Tambo de Conchuca (Stehberg and Carvajal 1998) or quite limited, as at Tambo Cañapa (Nielsen et al. 2006). Nielsen et al.'s (2006) investigation of roadside sites in highland Lípez is the most relevant of these studies for several reasons. Long distance trade objects including Inca pottery, beads, obsidian, copper items, and marine shell were found in two small test pits, at Tambo Cañapa, and on the surface of Campamento del Inka, Portezuelo del Inka, and Abra de la Lagunita. These findings demonstrate that small amounts of such goods did indeed "leak" from Road traffic into roadside contexts. If similar objects were moving on the Inca Road in my research zone, we would thus expect to find them. In addition, the quantity of lithic debitage revealed in the Cañapa excavations suggests a significant level of tool making; evidence for at least one activity associated with the Inca Road beyond simply Inca administration or sporadic occupation by travelers.

1.5 THE CACHIYUYO DE LLAMPOS MINING SYSTEM

My pilot research (2007, 2011, and 2012) in the desert north of Copiapó revealed a local, non-Inca mode of mining production in the region, first defined at the Chinchilla 1 (CH1) site. This site is described in detail in Chapter 5. My preliminary study of spatial patterning at this isolated mining camp showed it to consist of roughly 1 ha of circular dwelling foundations and productive features. Scattered hearths, ashes, and bones suggested separated food preparation. In the northeast section of the site are two linear structures associated with materials indicative of copper ore grinding and copper bead making. Mining at CH1 employed simple technology, consisting of hammering of copper ores extracted from veins in surface outcrops within 300 m of the camp. The residents were also multicrafting, producing powdered red mineral pigments from nearby, iron oxide rich, rocks. Residents also made ornaments using marine shell. Preliminary work revealed no evidence for Inca involvement in activities at CH1; the site bears no Inca style architecture. Nor is there the Copiapó black on red style pottery characteristic of residential sites in the Copiapó Valley. Instead, all of the diagnostics from my pilot surface collections are Inca Period Diaguita and Inca local styles. The lack of Copiapó wares could indicate that the camp was occupied by miners (perhaps specialized) from the Diaguita population, centered south of the Copiapó Valley.

One of the most striking aspects of CH1 was its isolated location. Although it is near a very small well, it is deep in the Atacama Desert, at least 60 km from the nearest sources of food in the Copiapó Valley. Provisioning of the camp's small population would have presented costs and challenges scarcely commensurate with the low level production involved. Therefore, I originally hypothesized that what made the mining activity at CH1 possible at all was the Inca Road, which passes only some 3 km away. The mining camp could have been provisioned from material moved and stored along the road, with traffic also providing the outlet for mining production. However, my doctoral fieldwork proved this hypothesis to be in error. In fact, there was a significant set of Pre-Inca Period mining camps, as described in Chapter 5. CH1 was just a Late Period manifestation of a long established mining pattern in the area.

1.6 RESEARCH QUESTIONS: THE INCA ROAD AND LOCAL MINING

The overall goals of the research lay in assessing the nature of the Cachiyuyo de Llampos mining system, and how the Inca Road in the vicinity was actually used. If there was any relation between mining camps and the Inca Road, we should also see evidence of local usage on it: that the roadside settlement represents more than way stations or temporary camps for travelers along the highway. The fieldwork, then, focused on: (1) investigating the mining settlement system at the Cachiyuyo de Llampos Mountains along the Chinchilla ravine, including the study of all sites, and examining the spatial organization and range of activities at each; and (2) exploring the nature of the roadside settlement and artifact assemblages in the stretch of Inca Road closest to Chinchilla ravine. From this research, I can evaluate the relationship between Cachiyuyo de Llampos mining system and the Inca Road, and assess the implications for understanding the latter as an economic catalyst. Among the central questions addressed by my research were:

1.6.1 What was the time depth and organization of production at the CH1 (Chinchilla 1) mining camp?

It was important to determine when the site was established, and how production was organized in both social and *chaîne opératoire* terms. Surface materials were all of the Inca/Late Period, but excavation was needed determine the occupational history of the site. I also sought to learn about CH1 as a community. What was the nature of work and residential life at this camp? Part of this goal lay in reconstructing the site's social composition. Preliminary investigation has tentatively identified various areas of food preparation/consumption, but I needed to do additional research to determine if there are features within the site representing individual "household" consumption. Intensive surface collection and excavation of domestic, production, and midden contexts were used to address this issue.

1.6.2 How was the Inca Road used, and what materials actually flowed along it?

Addressing this question required close investigation of a sample of roadside sites, including the Inca Tambo Medanoso, and the clusters of circular structures noted during preliminary fieldwork. Objectives included determining the functions of roadside structures (dwellings, storage, crafting), and comparing artifact assemblages among them to those from the Cachiyuyo de Llampos camps in terms of (i) pottery styles and relative chronology; (ii) domestic activities such as food consumption, grinding activities, stone tool manufacture (lithic debitage); and (iii) exchange (non-local shell and stone). In terms of looking at the relationship between the Road and the mining camps, I was specifically interested in examining the roadside sites for mining/craft products coming from the camps, as well as similarities and differences in ceramic assemblages. Specifically, if the roadside settlement of circular structures helped to support the Cachiyuyo de Llampos sites, we expected to find at them an assemblage of Diaguita pottery very similar to that found at the mining camps, or evidence for the movement of mining products, such as copper ore beads, ore debris, or red pigment. If the Inca Road was used primarily by non-local travelers (turnpike model), I expected to see higher proportions of Inca pottery and long distance trade goods in the roadside settlements than in the mining camps. In that case, I would not expect to find mining products (copper ore beads, ore debris, or red pigment) at the roadside settlements.

1.6.3 How did the Chinchilla mining camps relate to one another?

The pilot research documented several camps in addition to CH1. This was not surprising given that the copper ore deposits are widespread in the area. A surprising result of the dissertation survey was the discovery of *many* other camps, some quite near to CH1, some contemporaneous with CH1, some older, and some that differed in significant ways from CH1. CH1 was part of a settlement system. A goal of the research was to investigate the relationship among these mining camps. Were there site size and functional differences among the sites suggestive of a settlement hierarchy, interdependence, or some centralization/coordination in the mining/crafting activities? Or, does the pattern of many small, similar camps adjacent to one another suggest relatively autonomous activity by small corporate groups or mining households? To answer these questions about how these sites might have articulated with one another, it was vital to compare the spatial organization, features, and artifact assemblages among the camps.

2.0 RESEARCH AREA

2.1 GEOGRAPHICAL SETTING

2.1.1 The southern Atacama Desert

The Atacama desert is the world's driest. The "absolute" desert (between 18°S and 27°S at the elevation of 1000-2000 m), "receives little or no rain, and … any water for plant growth comes from rivers or underground aquifers" (Chester 2008:36). In historical terms, it has been the southern part of this desert that is traditionally defined as the Atacama, which in geographic terms, is the area between the Loa river and Copiapó and Huasco valleys (San Román 1896, Philippi 1860). The area between San Pedro de Atacama and Copiapó has even less sources of water, and is less densely populated in comparison to any section of the Atacama to the north, now and in the past.

The climate of the Copiapó valley and surrounding area in the central geographical strip in between the Pacific Ocean and the Andes Mountains has been classified as "clima desértico marginal bajo" or lower marginal desert climate; characterized by important temperature oscillations between day and night (Cruz and Calderón 2008). Between 1971 and 2000, the average rainfall in Copiapó was only 19.3 mm (Castillo 2001), which is similar to the late 19th century and early 20th centuries. From 1888 to 1913, the average annual rainfall was 22 mm

(Bowman 1924). Precipitation only occurs from June through August. The mean temperature in the summer is 19°C, and in winter 10°C, with a thermal amplitude of 14°C between day and night in every season (Dirección Meteorológica de Chile 2001).

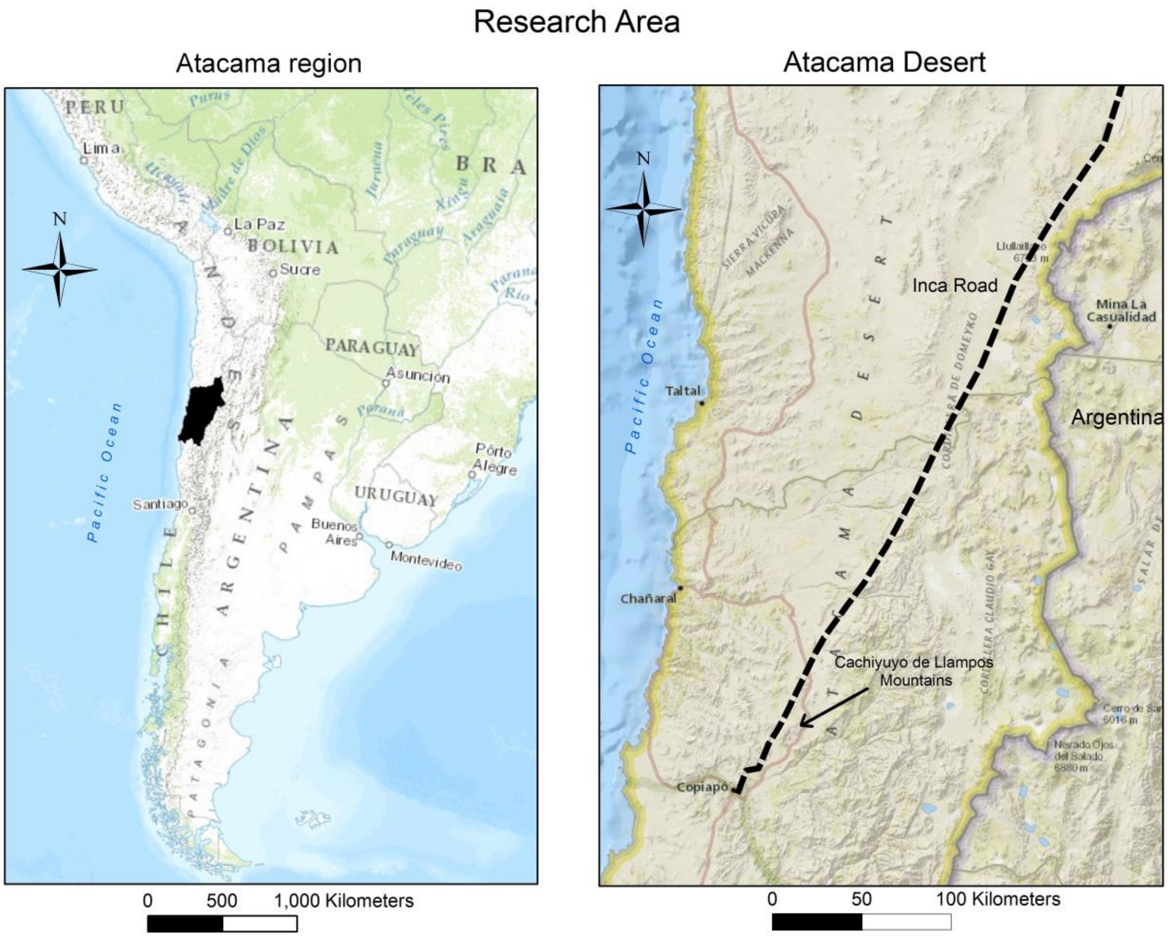

Figure 2-1. General maps of Atacama region

2.1.2 Biodiversity of the Atacama Desert

The hyperarid formation between 18° to 24° south latitudes is nearly devoid of vegetation in the central part of the desert. Closer to the Andes is low scrub vegetation of *Adesmia atacamensis*, *Cistanthe salsoloides*, *Atriplex imbricata*, and *Acantholippia deserticola* (Moreira-

Muñoz 2011). Closer to the Copiapó Valley (26° to 29° south latitude), there are 980 identified native plant species, of which 54.3% are endemic, including the *Asteraceae*, *Poaceae, Fabaceae, Brassicaceae, Cactaceae, Solanaceae, Boraginaceae*, *Portulacaceae, Nolanaceae* y *Apiaceae* families (Letelier et al. 2008).

The main native animal species are the guanaco (*Lama guanicoe*), distributed in all the environments from the Andes to the coast (Torres 1985), and the vicuña (*Vicugna vicugna*), now found only above 3500 meters above sea level (Torres 1983). In the desert are two species of fox, *Lycalopex culpaeus* and *Lycalopex griseus*, and also two large rodents: the Chinchilla (with two species, *Chinchilla lanigera* and *Chinchilla brevicauda*); and the Vizcacha (*Lagidium Viscacia*), all exploited in the past for their fur (Chester 2008). In addition, there are small rodents such as *Phyllotis xanthopygus*, *Akodon andinus*, *Akodon olivaceus*, *Phyllotis xanthopygus*, *Eligmodontia puerulus*, *Phyllotis magister*, *Abrocoma cinerea*, *Ctenomys sp*., and the native marsupial *Thylamys elegans* (Jaksic et al. 1999).

Recent studies of birds have identified about 80 species, mainly insectivores, distributed in 51 genres and 26 families, with at least 12 species present in the continental interior desert (Gantz et al. 2009).

2.2 COPIAPO PREHISTORY

2.2.1 Pre-Inca sedentary groups in Copiapó Valley

The first evidence of sedentary population in the Copiapó Valley is the Molle Culture, at the beginning of the second century BC. Molle material culture includes the tembetá, smoking pipes, and monochrome pottery of simple shapes without handles, sometimes with incised decoration resembling that found in San Pedro de Atacama and northwestern Argentina (Niemeyer 1998a, 1994, Cornely 1956). Molle occupation in the Copiapó Valley consisted of small villages with mound burials. These settlements are not found to the south of the Huasco Valley and may indicate deeper cultural differences between the northern and southern valleys (Troncoso and Pavlovic 2013). In the upper Copiapó Valley, small villages such as Cabra Atada, Carrizalillo Chico, and el Torín with simple architecture of circular/elliptical structure, would have been sedentary, and based on agriculture (Niemeyer 1998a). During the time of Molle period there is also evidence for the use of copper ore beads and pigments as grave goods in child burials, as seen in the El Torín and Cabra Atada mounds (Niemeyer 1998a).

The Middle Period in Copiapó (500-1000 AD) saw the development of the Animas archaeological culture. Animas occupations differ from those of the Molle in exhibiting painted pottery, mainly bowls, and in the absence of smoking pipes and tembetas (Niemeyer 1998b). As during the Molle period, there are differences between the Copiapó Valley and the southern valleys, with the latter lacking villages and mound burials. This north-south divergence would continue with the development of the Animas into the Copiapó culture in the Copiapó Valley, and the origins of the Diaguita culture in the southern (from Elqui to Limarí) valleys (Troncoso and Pavlovic 2013, Garrido 2011). During the Middle Period there are also indications of interaction with Aguada culture populations in northwestern Argentina, as seen in the pottery styles from La Puerta site located in the middle Copiapó valley (Castillo 1997, Niemeyer 1994). The main recognized Animas sites such as Puntilla Blanca, Quebrada Seca, and the large cemetery of La Puerta (Niemeyer 1998b) are located next to cliffs. The latter cemetery has yielded many copper ore (malachite, chrysocolla, azurite, and turquoise) bead necklaces, used as grave goods (see Appendix A).

Around 1000 AD, local populations changed their pottery preferences during the Late Intermediate Period, marking the beginning of the "Cultura Copiapó." This society persisted through Inca times. This population's distinctive pottery include Copiapó black on red bowls and Punta Brava large containers (Iribarren 1958, Castillo 1998, Garrido 2011). Copiapó pottery decoration strongly resembles that of the Animas in terms of symmetrical patterns and motif configurations, indicating a derivation from Animas (Garrido 2011). The Copiapó culture extended mainly through the middle-upper course of the Copiapó Valley, with villages practicing agriculture in the mountain valley tributaries of the Copiapó River (Gaete and Cervellino 2000). Their main sites are the villages of Punta Brava, Manflas, Ojos de Agua del Montosa, and coastal sites such as Bahia Salada (Castillo 1998). Copiapó architecture continued the local tradition of circular/elliptical structures. There is also evidence of exchange relations between groups from the Copiapó Valley with groups in northwestern Argentina, as Copiapó is found as far as the Vinchina Valley in Catamarca (Callegari 1997). Most of the local prehistory has been delineated in cultural historical terms, with the focus on defining cultures based on geographical distribution of typological traits. Thus while we have a wealth of descriptions of archaeological sites, there have been no studies oriented at interpreting sociopolitical organization or change. Presently, we can categorize the Copiapó population as organized as a señorío (Castillo 1998), equivalent perhaps to a simple chiefdom

2.2.2 The Copiapó region during the Inca period

The longstanding interpretation of Inca hegemony in Chile is that in the northern region, from Arica to San Pedro de Atacama, Inca domination was indirect, exercised through the subject Pacajes networks of political alliances. In contrast, the area from Copiapó to the south is thought to have been controlled more directly by the Inca state (Castillo 1998, Llagostera 1976, Niemeyer 1993). This view has been questioned in the last decades as increasing archaeological evidence indicates that the Inca domination in the north was more direct than previously thought (Aldunate 2001, Uribe 2000). To the south, in the Copiapó Valley, Inca rule was not likely implemented by the Inca state alone, but through alliance with Diaguita groups from the valleys to the south of Copiapó. The Copiapó Valley contains Diaguita pottery styles dating to the Inca period, but no pre-Inca Diaguita pottery (Cornely 1956, Ampuero 1978, Niemeyer 1993, Castillo 1998, González 1995, 2000). Therefore, it has been suggested that the Inca conquest moved from south to north in the region, starting with and alliance with the groups of the core area of the Diaguita society between the Elqui and Limarí Valleys (Berenguer 2009, Cornejo 1999, 2001, Uribe 2000).

Inca interest in metal resources may have been central to the Empire's incorporation of the Copiapó region, as witnessed by the famous, well preserved foundry of Viña del Cerro (Niemeyer 1986, Niemeyer 1993, Castillo 1998). This regional copper smelting complex is a classic Inca specialized production center, with a plaza structure, an *ushnu*, and 26 smelters. The site is the best example of centralized, large scale, Inca controlled metal production in the region, and as such, embodies a mode of economic activity coexisting with, but very different from, the household level mining, as seen in the sites of Cachiyuyo de Llampos mountains that is the subject of this research. The labor force for the Viña del Cerro facility presumably came from nearby villages of the Copiapó Valley as *mita* labor. The finished products likely left the area along a section of the Inca Road, especially through mountain passes across the Andes, given that most of the Inca administrative sites such as La Puerta, Iglesia Colorada and El Castaño are located in an area of more agricultural resources in the upper part of Copiapó Valley and along tributary rivers to the Copiapó river (Castillo 1998, Niemeyer 1993, 1986).

2.3 THE INCA ROAD IN THE ATACAMA DESERT

2.3.1 Routes in the desert before the Incas

Desert roads and routes were certainly not initiated by the Incas, and before the Late Period there was a long history of mobility and exchange, including along caravan routes in the Atacama. The model of "movilidad giratoria" (Nuñez and Dillehay 1979) was the first to treat the economic role of caravans and pastoralism in pre-Inca societies from the oases of the Loa River, positing exchange at local levels as part of seasonal mobility cycles beginning in the Formative Period. The model's goal was to explain culturally "mixed" artifact assemblages as manifestations of the interconnection of groups exchanging products while moving their llama caravans to new pasturelands, thus promoting a specialized complementarity, rather than closed self-sufficiency. This model has also been used by Berenguer (2004), who analyzes the case of the upper course of the Loa River during the Late Intermediate Period (AD 950-1450), finding evidence for caravan routes connecting both sides of the Andes during a time of coexistence between "colonizers societies" from the Andean circum-puna area, and local "gyratory societies" specialized in caravan exchange and pastoralism. The kind of economic exchanges would have been based on prestige goods, with particular attention to hallucinogenic substances such as cebil (*Anadenanthera colubrine*) from northwestern Argentina, whose ritual importance increased during the Middle Period because of Tiwanaku influence. On the other hand, the traffic of metal items (pectoral plates, knives, axes, bracelets, bead necklaces), and seashell artifacts, led to the development of exchanges circuits between local caravan systems and societies in the eastern part of the Andes mountains (Bolivia and Argentina). However, Nielsen (2009:30) argues that although there were societies involved in vertical complementarity across both sides of the Andes from the first millennium A.D. in the Atacama oases, "…it was only during the thirteenth and fourteenth centuries that collectives with strong corporate economic strategies capable of achieving relative self-sufficiency based on reciprocity and redistribution formed throughout the Tripartite Frontier".

That elites may have been involved in interregional exchange of prestige goods is often assumed, but there is still a lack of knowledge about the sociopolitical context of this exchange (household, corporate, or chiefly driven), or how prehistoric caravans obtained exchange materials (self-production? interaction with independent producers?). More significantly for the validity of these exchange models, the evidence of exchange is largely not based on archaeological evidence found along the exchange routes, so it is not clear how such exchange really contributed to the social complexity of the area. Ethnographic evidence from Lípez, Bolivia (Nielsen 2001), shows that long distance caravans were a household enterprise that moved products (e.g. salt, dried meat, agricultural products), from different producers and ecological regions, and exchanged them through bartering. The physical remains of that activity can be found in the daily campsites along the route locally known as *jaranas*, which are composed of a few stone windbreaks with hearth remains and fragments of containers and other transported materials. At least some of the transported items found on the campsites exhibiting earlier (prehispanic) occupations are copper ores, although in modern times they are not part of the items transported for exchange.

2.3.2 The Qhapaq Ñan through the Atacama Desert

In the southern part of the empire, the Inca Road generally does not show a high investment in construction when compared to some of the wide and paved sections in the central Andes. The recurrent typology in this region is the category "despejado y amojonado" (Raffino 1982:204) or cleared and delimited, in which the Road consists of a straight and smooth path, free of rocks which were put to the sides to border the road bed. Included within this Road type are regions such as the Atacama desert and northwestern Argentina (Berenguer et. al. 2005, Vitry 2000).

In the Atacama region, the Inca Road (Qhapaq Ñan) faced the challenge of crossing the driest desert in the world; hundreds of kilometers without sedentary populations, agricultural potential (except at a few oases), and almost no water sources. The Inca Road through the Atacama Desert has been seen largely as having an administrative, rather than economic or military function, precisely because the water and food needed to support large scale population movements were lacking along the route (Hyslop 1984:248). Similarly, Lynch (1993, Lynch and Núñez 1994) has observed that the Inca Road in the Atacama Desert was laid out to connect Inca administrative centers, without reference to the densest areas of local population. For Berenguer (2007), the Inca Road connected a series of imperial settlements that created "provinces," independently administrated and adapted for the requirements of local management for the Inca

Empire. Accordingly, stone pyramidal structures associated with the road in Atacama have been interpreted as landmarks built by the Incas to delimit their administrative provinces (Sanhueza 2004).

In highlighting the economic function of the Road, some scholars have pointed to a connection between mineral exploitation and the Inca Road in the Atacama, because copper ores and metal artifacts have frequently been found at sites along the Road (Lynch 1993, Lynch 1994-1995, Lynch and Nuñez 1994, Niemeyer and Rivera 1983, Iribarren 1972, Iribarren and Bergholz 1972). In addition, some Inca sites are located in close proximity to points of mining exploitation, suggesting the importance of the road in metallurgical production (Raffino 1982, Adán 1999, Berenguer 2004, 2007, Berenguer et al. 2005). Some of the evidence for mining along the road shows a pre-Inca time depth, as in the case of Lynch's survey (1993) of the Inca Road at the Punta Negra salt marsh, where he turquoise beads and marine shells at numerous sites along paths paralleling the main Road, which had both Inca and pre-Inca pottery: Lynch (1993: 140) noted that "…there is also another, essentially unstudied, narrower road that runs along the west side of the Salar de Punta Negra, southward from then Salar de Imilac. Considerable quantities of turquoise and sherds of San Pedro Negro Pulido ware are associated with this single-track road and its structures, as well as occasional Inca sherds." Unfortunately, that area has not seen subsequent research on the parallel routes and their economic importance for prehispanic mining and craft production.

Another case for the relation of Inca Road and mining is the turquoise mine of El Salvador, exploited from the Late Formative until the Late Period, and located alongside the Inca Road (Gonzalez and Westfall 2010, Westfall and Gonzalez 2010, Iribarren and Bergholz 1972). It is clear that at this site most of the mining exploitation was done during Pre-Inca times, and

Inca exploitation seems to have been sporadic, probably a side activity fostered by the Road's proximity.

2.3.3 Upper Loa River case studies

At more than 650 kilometers north from Copiapó, most of the recent Inca Road studies have been done in the area of the upper Loa River tributaries, where there is a direct temporal continuity between the Qhapaq Ñan and earlier caravan routes. The road between Cupo and Catarpe in San Pedro de Atacama connects population centers including Topain, Turi, Cerro Verde, Caspana, and Incawasi Inca (Varela 1999, Castro et al. 2004). This road also connects to the Bolivian region of Lípez, a source of obsidian and pigments, as revealed in the materials recovered at the Cañapa tambo site, near the modern Chilean border (Nielsen et al. 2006). Of the 12 sites recorded in the Nielsen et al survey in the road segments of Licancabur-Cholljas and Portezuelo del Inca-Chiguana, 6 sites have yielded blue stone beads on the surface. Interpreted by these researchers as evidence of local rituals with beads symbolic offerings in mountain passes, their presence at a minimum indicates the circulation of these craft products through Inca routes.

The interconnection among centers of pre-Inca population, agro-pastoralist resources, and mining establishments such as Cerro Verde, are the main characteristics of the Road in this segment which was probably managed by the village of Turi. Turi was one of the most important Inca administrative centers in this territory, displaying an Inca plaza and *kallanka* in the middle of the preexisting local urban settlement (Cornejo 1999, Lynch and Núñez 1994).

Thirty kilometers to the east of the road that goes to Turi is a 120 kilometer segment of the Inca Road (between Miño and Lasana) that has to date seen the most intensive field study

(Berenguer 2004, 2007, Berenguer et al. 2005). The Road here runs straight north to south along the terraces of the upper Loa River, and was built by removing surface rock along the roadway, and lining these rocks to delineate the road edges. This segment is associated with sites of typical rectangular Inca architecture (two main administrative sites, and roughly eight more with provisioning functions), and with 14 groups of semicircular, small stone structures with scanty cultural remains, indicating short-term occupations. Apart from those sites, there are 54 road markers consisting of different kinds of stone piles, and transverse alignments of pyramidal landmarks along both sides of the road. In various places the Inca Road crosses and runs parallel to pre-Inca caravan paths, showing the continuity between old local routes and the Inca formalization of those itineraries for their own purposes but without significant alteration of the pastoralist settlement pattern of scattered homesteads in the area (Berenguer 2007).

Pottery analyses on this Road segment (Uribe and Cabello 2005), have shown Inca “local” and other non-local styles (Inca Cuzco, Bolivian altiplano Inca, and types from northwestern Argentina), are present in higher proportions than can be found in residential sites away from the Road. But fragments of local pottery styles from the Formative Period are also found, indicating the earlier use of the route by llama caravans, particularly in the Late Intermediate Period (Uribe and Urbina 2009). Most of the sites associated with the Road exhibit few surface materials suggesting ephemeral occupations. However, there are some sites with denser refuse deposits. These sites have high proportions of local sherds from storage and cooking vessels, including also Inca and Diaguita Inca types related to food serving and drinking. The researchers concluded that there were two systems of mobility on the Inca Road: a local one based on pastoralism and herding, which was overtaken by a second one created by the Incas who bent the first one to their own purposes, including transporting special vessels to be used as political gifts. In the case of the lithic artifacts associated with this segment of the Inca Road, the majority represents tools manufactured for short-term use made from local available raw materials. These artifacts consist mainly of flakes without much retouch, except for the rare projectile points and shovels made of non-local raw materials (Méndez 2007). No lithic artifacts relating to mining activities were found.

In summary, the Qhapaq Ñan in the Alto Loa represents a newly built road constructed over previous paths that could have served to supply the nearby Inca mining activities at El Abra and Conchi Viejo, which were also supported by the nearby agricultural production in the Loa River Valley (Berenguer et al. 2005). Local agropastoralist sites along the road, such as the homesteads around Santa Barbara, Cerro Colorado, and Bajada del Toro, are hypothesized to have been used for logistic support of Inca activities, supplying food and cargo animals for the transit on the road. However, the participation of local population is viewed only in terms of Inca economic and political interest, with people offering their labor and resources in exchange for state sponsored festivities at administrative sites such as Cerro Colorado 1, which includes a *cancha* and an *ushnu* ceremonial platform. In brief, local people are supposed to have interacted with the Road system simply as *mita* laborers for the interest of the Inca Empire.

2.3.4 Inca roadside structures in the Atacama Desert

The most common kind of Inca architecture in the southwestern portion of the Inca Empire is what has been called the R.P.C[1], which is a subdivided rectangular structure present at most of the Late Period sites (Raffino 1982). These structures, along with *canchas, kallankas*,

[1] Rectángulo perimetral compuesto in Spanish.

collcas, and *ushnus* at some administrative centers, are the main diagnostic architectural features for the presence of the Inca Empire in the southern Andes (Stehberg 1995, Hyslop 1984, Raffino 1982). On the Inca Road, the primary official Inca facility was the *tambo* or *tampu*, which served for lodging, storage, and, in many cases, administrative purposes (D'Altroy 2002, Hyslop 1984). *Tambos* on the Road consisted of more or less evenly spaced clusters of one or a few R.P.C. units, accompanied by storage areas, and sometimes corrals (Raffino 1982).

Small circular/elliptical structures are also common along the Inca Road. Despite their abundance along many segments of the Inca Road, these small circular/elliptical roadside structures have never been considered by scholars as an important element of the Inca Road infrastructure. In a survey of 108 kilometers at the south of the Salar de Atacama area this situation is captured as only a one-sentence description is presented for several other still unnamed sites "most of which are composed of only two to four small, nearly circular stone structures" (Hyslop 1984:157). In that survey, 22 out of the 32 sites found in this stretch displayed circular structures and some suggested residential functions. To Hyslop (1984), those structures could have been related to road maintenance, and should have been provisioned from elsewhere considering the lack of water and food resources at their locales. They clearly represent examples of local architectural traditions, and differ from other non-rectangular structures classified as *chasquiwasi* or messenger posts (Hyslop 1984, Niemeyer and Rivera 1983), although this point of view is based mainly on ethnohistoric interpretation rather than on archaeological evidence. Similarly, in the area of the copper mine of El Salvador, in a Road segment of 4 kilometers were found 23 group of circular/non-rectangular structures that did not fit classic Inca architectural canons (Gonzalez and Westfall 2010).

In a survey in 2009 related to the Qhapaq Ñan Project[2] (Garrido 2009), various segments of the Road in the north of Chile were recorded in detail along with their archaeological sites. Most of these sites consisted of small clusters of circular/elliptical structures, reflecting short-term occupations along the route. This survey allowed me to study the distribution of these "informal" circular structures.

The density of these sites is variable along the road, but if we compare 2 of the segments located in the Atacama Desert we can see some important differences. The first segment is located in the southeast part of the Salar de Atacama having a length of 32.4 kilometers between Camar and Peine; the second one is a segment 41.6 kilometers long located at about 350 kilometers south from the first one between Portal del Inca (El Salvador), and Finca de Chañaral[3].

The distribution of sites along the Road in the first segment has a mean value of one site every 1045.6 meters. In contrast, the second Road segment has a mean value of 547.9 meters. This difference is highly significant at about the 95% confidence level as shown in the following bullet graph (Figure 2-2).

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[2] International project for the nomination of the Inca Road as World Heritage by UNESCO. In Chile it is managed by the National Council of Monuments.

[3] This segment is located only 40 kilometers to the north of this dissertation's survey area.

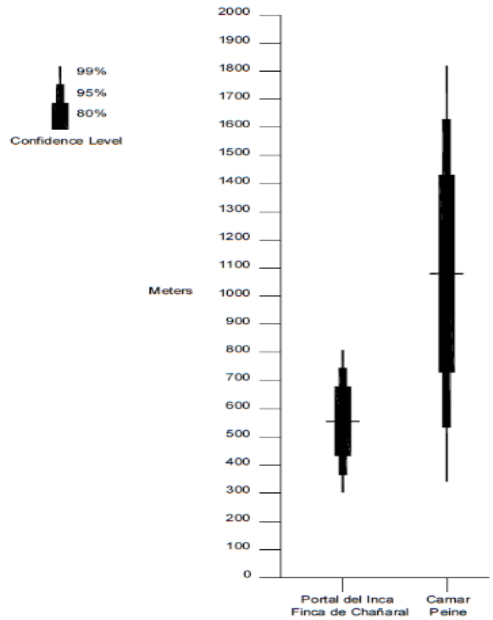

Figure 2-2. Bullet graph showing the mean difference between site distances in two segments of the Inca Road in the Atacama desert.

In both segments, the average distance between the sites (a 10 to 20 minute walk) is obviously far too short to represent daily journey resting spots of the type to be expected if the Road was used primarily for point to point long distance trips. A day's walk might be estimated at 30 km. Therefore, I argue that this density of circular structures indicates that the Road was used for different kinds of activities; activities in which transit in the most efficient manner did not feature. Specifically, activities in which the Road usage and traffic were connected to interaction with its surroundings.

Of a total of 76 sites along the latter Road segment, 59 have only 1 to 2 structures, 13 have 3 to 10 structures and 4 have more than 10 structures. The smaller sites consist of circular or elliptical structures with a diameter of 2 - 3 m. All of these sites are smaller than 1 ha, and none of is associated with a source of fresh water. If sites were only used for lodging while travelling, we would not expect their size to show such wide variation, or we would expect to find larger ones spaced every 15-20 km (see below) in order to lodge the whole group of travelers overnight. In contrast, the variability in site size and distribution of structures along the Road segment is more consistent with differential traffic along specific parts of the Road. I suggest that this pattern indicates that some sections had higher site density and larger site areas in order to serve local, off-road activities.

In Figure 2-3, we can see the relationship between distance and site area for the segment of the Inca Road between Portal del Inca and Finca de Chañaral. Here, site area (in square meters) is remarkably proportional to the distance between the sites over much of the Road segment. However, in a stretch of 9 kilometers between sites PI-20 and PI-45 there is a cluster of larger sites, which suggests that this stretch disproportionally more traffic than elsewhere along the segment. This dense roadside occupation stretch runs parallel to the western slopes of the Vicuña Mountains, and there is at least one detour from the main Road in that direction. Although there has not been archaeological explorations in that area, the Vicuña Mountains are known for the presence of gold, silver, and copper mines exploited in historical times (Risopatrón 1924:929). Prehispanic versions of this mining activity could account for the clustering of larger sites, in a manner similar to that seen in my Cachiyuyo de Llampos survey, as discussed in Chapter 4. Overall, the variability in site sizes and densities can be considered an indicator of differential road traffic, likely reflecting the density of local, off-road activities, rather than simply a pattern of efficient point to point transit.

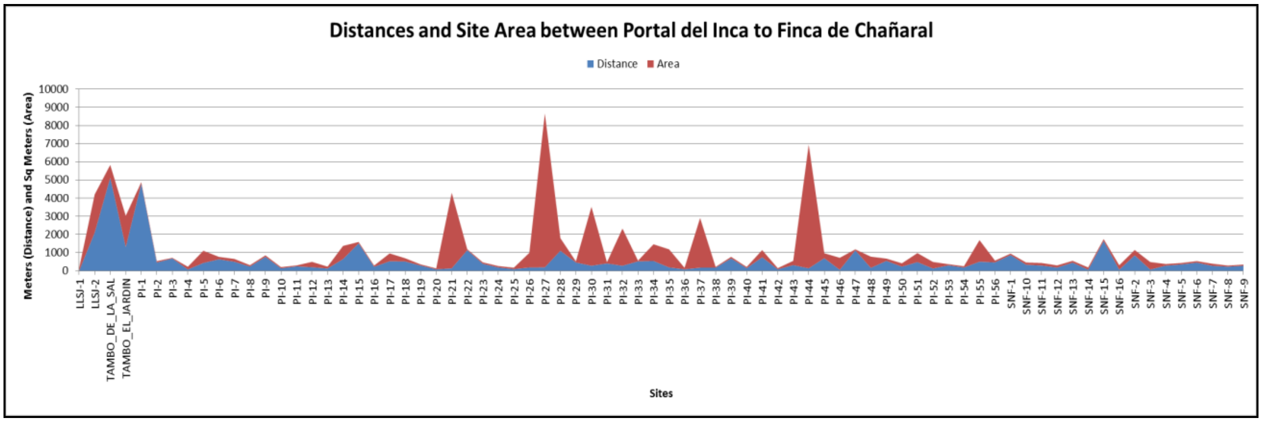

Figure 2-3. Graph of distance and site area in the segment of the Inca Road between Portal del Inca to Finca de Chañaral. In the central segment, note the cluster of large non-Inca structures, spaced less than 1,000 meters from each other.

If the common circular/elliptical structures do not fit with the imperial purpose of administration of the territory, nor supplied resources to official travelers as tambos did, I proposed that they could have served other local functions, independent of what Incas wanted or expected in their new territories. Those structures, therefore, constitute a different kind of roadside activity, particularly related to local mining, crafting, and exchange.

2.3.5 The Ethnohistory and previous archaeological research of the Inca Road to Copiapó

According to ethnohistoric sources, there were two main roads that connected the core of the Inca Empire with the southern provinces in Chile; one running primarily through the Atacama desert, and the other a highland route through Bolivia and northwestern Argentina. Each of these arrived in the Copiapó Valley (Castillo 1998, Regal 1936, Magallanes 1912). In the 19th century remains of the main Inca tambo in Copiapó were still extant, located next to the river on a small hilltop (Sayago 1874). The highland route was the one taken by the first Spanish to arrive in Chile: Diego de Almagro in 1536 (guided by Paulo Inga from the royal family). The desert route was the one utilized by Pedro de Valdivia in 1540 during his campaign of conquest of the territory. The highland route, while passing through populated areas with more water and food resources (Vitry 2007b), is longer than the desert road, and crossing the mountains is particularly difficult. From Shincal, the last big Inca administrative center in Catamarca, there would be 24 days of travel to the Copiapó Valley, crossing at altitudes in between 3,500 to 4,400 meters (Berenguer 2009). The chronicler Mariño de Lobera (1865) described the difficulties faced by Almagro's expedition to Copiapó, with many people dying because of the cold temperatures at high altitude in the mountains, in particular when he entered to Chile by the mountain pass of Pircas Negras or Comecaballos (Vitry 2007b, Cervellino 1994, Magallanes 1912, Bertrand 1885). Despite the environmental risk of the Andes crossing, this route might have been favored by the Incas for the transportation of metals, as is described in the encounter of Diego de Almagro with the Inca official named *Huayllullo* in Tupiza, who was going from the Chilean provinces towards Perú with a tribute caravan loaded with gold ingots (Hidalgo and Aldunate 2001). Regarding the cargo "...It was of fine gold in bars and in the shape of roof tiles by smelting the gold which is taken from the mines where is created… the sum of gold that they carried was almost equivalent to two hundred thousand pesos of gold…"[4] (Mariño de Lobera 1861:21)

The earliest narrative describing the Inca Road to Copiapó by the desert route can be found in the chronicle "Historia general y natural de las Indias, islas y Tierra-Firme del mar Océano" written by Gonzalo Fernández de Oviedo around 1548 (Fernández de Oviedo 1855), in which he narrates the logistic difficulties of the transit through the desert for the return of Diego

[4] The translation is mine

de Almagro's expedition from Copiapó to Perú, He notes how people had to divide into small groups to administer their food and water supplies:

"There (in Copiapó) it gathered the caciques with indians who had experience in the road of Atacama, whom informed him that there were *xagueyes* (water wells) distant in between 7 to 8 and 13 leagues[5], and others 3 and 4, and in each of them could only drink five horsemen with their indians of service… and because of this information (Almagro) started sending people in groups of 6 and 8… and for this they made a great number of containers, pottery and gourds, and also bags made of sheep (llama) skin. The daily trips had to be of 3 to 4 leagues, because if they dare to travel farther, the animals and people would die because of the supplies they carried… To say how disciplined they were in preserving the sheep (llamas) and making shoes for them, and distributing maize for each daily journey, it would be a very long process"[6]. (Fernández de Oviedo 1855[1548]:278-279)

Another early account can be found in the "Relación copiosa y verdadera de los reinos de Chile", written by Geronimo de Bibar in 1558 (Bibar 1966). He discusses the arrival in Chile of the expedition of Pedro de Valdivia, who entered Copiapó in 1540 following the departure route that Diego de Almagro had taken in 1537. In his description, he mentions the corpses of people who died during Almagro's trip back to Perú, which were lying at the many circular structures along the road[7]:

"I saw many of them (dead bodies) in an extension of fifteen leagues[8] lying inside stones structures no taller than half *estado*[9] and of circular perimeter, that the Incas had made when they

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[5] Approximately 5 kilometers in a league
[6] The translation is mine.
[7] The translation is mine.
[8] This section would correspond to an extension of around 75 kilometers in proximity to Finca de Chañaral.
[9] Estado corresponds to the height of a standing man. Therefore, half estado would be around 80-85 centimeters.

used to walk here, and they could fit up to five or six people and their clothes, and the indian women there were tied with a rope to one or two *carneros*[10] that carried their belongings and food, and they seemed to be sleeping… The road that crosses this desert transits in between the sea and the mountains. On the other hand, it is not possible to walk through the big mountains and ravines with big rocks and sand plains, and the people who cross this desert at both seasons face a risk in winter as I have said in these plains, although it does not rain there are winds coming from the snowcapped mountains. It blows so strong and cold that penetrates the body and people die frozen; and in the summer the great heat and the long distance to water make people die of thirst. With all this work is how people walk and cross this desert" (Bibar 1966:18-19).

The importance of having places for protection from cold temperatures and wind at night seems to be Bibar's explanation for the existence of those structures along the road, without providing much information about other possible uses. It is interesting to notice that the number of people Bibar says the circular structures could lodge is similar to what Fernández de Oviedo describes as the maximum size of the group that had to travel together in order to avoid the depletion of the few water wells present along the road.

The increasing number of people moving between Peru and Chile along the Inca Road following the Spanish Conquest could not be supported by the scarce sources of water and lack of food on the desert route following the collapse of the supply logistics of the Inca Empire. Early in Colonial times, this route ceased being used in favor of routes better suited for wheeled vehicles and with more water sources. Correspondingly, ever since, the desert Inca Road was only used sporadically by occasional mining prospectors, and there are some 19th century

[10] Spanish name for llamas due to their association with lambs because of their wool.

written sources describing the route. For example, a brief mention can be found in the report of the U.S. astronomical expedition to South America in between 1849 to 1852, of "…a copper axe, found in a great *quebrada*, in the province of Atacama, Chile, not far from where the *Camino de los Incas* diverges round a hill called Tres Puntas, in latitude 26" 42'. This road commences near the city of Copiapó, proceeds in nearly a straight line in a north by east direction until it reaches the base of Tres Puntas, passes round the hill 7,000 feet high and resumes its former direction. It being one of the great avenues opened by the Incas into their conquered provinces, remains of Peruvian manufactures have frequently been found on it as on others" (Ewbank 1855:12). The German miner Paul Treutler lived in Copiapó in between 1852-59 and had mines in Tres Puntas. He describes the road as isolated and lacking water, and not close to any inhabited places: "From Copiapó to Tres Puntas there was a second road of only 12 German leagues long, called "del Inca" because it was designed in straight line through the desert by the Incas. On it, there was not water anywhere, no houses or posts, and there were no mines being currently worked there, so in order to cross that desert it was necessary to carry the necessary water[11]" (Treutler 1958:144).

The Tres Puntas silver mine was discovered in 1848 and is located along the Inca Road approximately 85 kilometers north from Copiapó. It is not known if there was prehispanic mining at this site, but an association between the Road and prehispanic mining can be seen in the case of the copper mine at El Salvador, which was been exploited in pre-Inca times (Westfall and Gonzalez 2010). Later geographical surveys sponsored by the Chilean government briefly mention the Road segment between the oasis of San Pedro de Atacama and Finca de Chañaral north of Copiapó (Kaempffer 1904, San Román 1896, Philippi 1860), and the engineer Francisco

[11] The translation is mine.

San Román generated a complete, but not detailed, cartography of the Inca Road from the oasis of Tilomonte in the Salar de Atacama to Copiapó city (published in Magallanes 1912).

Despite those early references, there were no scholarly studies of the Copiapó road segments until 1970s, when Jorge Iribarren carried out the first archaeological research on the Inca Road from Copiapó to about 200 kilometers north. The most intensively surveyed part was the northernmost stretch, close to the city of El Salvador and the oasis at Finca de Chañaral. (Iribarren and Bergholz 1972). In general, the Inca Road to Copiapó follows an almost perfect straight line for distances up to 30 kilometers long, and according to the author, could have been laid out using visible mountains tops as reference points. The road is formed by a cleared path of around 60 centimeters wide at most places, crossing ravines and climbing low mountains with a maximum slope of 10% to 35%.

Iribarren's survey (Iribarren and Bergholz 1972) identifies some large sites with clear Inca architecture such as Tambo del Carrizo and Tambo de la Sal (figure 2-4), as well as many small groups of structures that the author classifies generically as *tambillos*, which are not described in any detail. Along the Road, the main pottery styles found in the survey were Diaguita Inca, Inca local, Copiapó black on red, and Punta Brava, which were the most common types during the Late Period in the Copiapó valley. In the area of El Salvador, Iribarren also identified some routes heading to the east that passed in close proximity to flint sources. He hypothesized that these could have been used for acquiring lithic raw materials, and provided routes for interaction with populations on the Argentinian side of the Andes.

Figure 2-4. Tambo de la Sal located at the intersection between the Inca Road and Salado River to the north of Copiapó

Most recently, the Qhapaq Ñan Project aimed at documenting Inca Road as a world heritage feature by UNESCO[12] has continued the survey in the area extending from El Salvador to Finca de Chañaral, generating a better descriptive record of the Road and its associated sites. As discussed above, the presence of roadside circular-elliptical structures is one of the main characteristics of this segment of the Road, a pattern that is not uncommon in other areas.

Little is known about the Inca Road to the south of Copiapó, mainly because of the lack of good preservation or destruction by modern roads. The work of Stehberg (1995, Stehberg and Carvajal 1998) has been the most important attempt to reconstruct the original route of the Inca Road in this area. This work has shown that from Copiapó there were two main routes to the south: one along the upper valleys close to the Andes, and another at lower altitude along the eastern side of the coastal mountains. Because to poor preservation and in many the route being

[12] In 2014, The Inca Road was finally declared World Heritage by UNESCO, including 5 segments in the Chilean territory.

covered by modern highway, few actual road segments can be found today in that area and most of the interpretation is based on hypothetical routes connecting sites with Inca architecture.

2.4 THE RESEARCH AREA

2.4.1 Cachiyuyo de Llampos Mountains

The Cachiyuyo de Llampos Mountains run northeast-southwest between 35-70 kilometers north of Copiapó. The highest peak is Chinchilla hill at 2,450 meters altitude, with the Chinchilla ravine on its slope. Most of the rock formations of the area date to the Cretaceous and Quaternary, and consist of sandstone, limestone, and andesitic lava (Segerstrom 1960). These mountains contain vertical hydrothermal magmatic ore deposits of the breccia pipe type, mineralized with Cu–Mo and formed during the Paleocene (Maksaev et al. 2007). They are formed of granite and syenite, with veins of quartz and iron oxide, with some gold (San Román 1894). The main ores that have been exploited here are copper and gold, although the most abundant ore is hematite, especially in the western side of the mountains (Segerstrom 1960). According to the website mindat.org, in the mines *Carmen* and *Por si Acaso* in the Cachiyuyo de Oro district, there are minerals of atacamite, calcite, chalcopyrite, chrysocolla, gold, hematite, limonite, pyrite, quartz, and wulfenite. In the *Dulcinea* mine in the nearby district of Cachiyuyo de Llampos are brochantite, cerussite, chalcopyrite, native copper, cuprite, diaboleite, djurleite, duftite, fornacite, hemimorphite, malachite, mimetite, molybdofornacite, mottramite, pyrite, rosasite, schwartzembergite, sphalerite, titanite, wulfenite, and zinc (Mindat.org 2014).

In the 18th century, the area at the northeastern margin of these mountains was well-known for the gold mines that fostered the establishment of a small permanent population (Asta-Buruaga 1899). Also, in the same area lay the the gold mine "Cachiyuyo de Oro", established in 1744 by Juan Paqui Lobo, and exploited until the early 20th century (Risopatrón 1924, San Román 1894). According to Sayago (1874), the discovery of this mine resulted from using the Inca Road for mining exploration. During the 18th century, 18 - 47 veins were exploited in the district, helping Copiapó to grow from a village to a city. Today the northeastern part of the Cachiyuyo de Llampos Mountains are covered by remains of old mining activties from colonial and republican times. These probably obliterated many prehispanic mining camps, but there has not yet ben archaeological survey of this area.

The western section of the Cachiyuyo de Llampos Mountains holds two enclosed dry valleys: in the north, the rocky Piedra de Fuego plain, and in the south, the sandy Llampos plain. They are separated by a narrow mountain pass named in local cartography as "Portezuelo del Inca", which is exactly where the Inca Road crosses between the two plains from north to south. Medanoso Mountain is a system of eolic barchans dunes of approximately 10 square kilometers (Segerstrom 1960). These plains have abundant fog at night during the winter, and that moisture stabilizes the eolic sand deposits from heavier erosion.

Due to the lack of vegetation and the distant location of oases, it is unlikely that llama caravans had been used regularly for transportation in this region. There is no ethnographic evidence for that and the routes across the Andes present more potential resources for caravan traffic in prehispanic times, providing enough pasturelands at the end of each daily journey. Probably most of the movement in this section of the Inca Road and the mining activities carried out in the area were based on pedestrian traffic.

2.4.2 Previous research in the survey area

During the 19th century the area was surveyed by various miner explorers, of which the most famous was Paul Treutler, a German miner who visited the area around 1852-1859. In his published travel narratives (Treutler 1882), he identified some archaeological sites relating to mining activities as well as a ravine with a water well that displayed abundant red paint rock art.

In 2007 I rediscovered this ravine and some of the archaeological sites associated to it. The main site was located at the end of the ravine where it opens on to the sandy plain known as "Llano Piedra de Fuego". This site (Chinchilla 1 or CH1, named after the ravine) consists of prehispanic circular structures with copper ore and sherd surface scatter, associated with a copper mine. The Inca Road connecting Copiapó Valley with the northern part of the Atacama Desert is located about 3 kilometers west of CH1. This section of Road had previously been traced in a cursory way (Iribarren and Bergholz 1972; Molina 2007). In June, 2011, initial fieldwork was done to explore CH1. The subsequent work extending to all the sites in the Chinchilla ravine (Figure 2-5) is the basis for this dissertation.

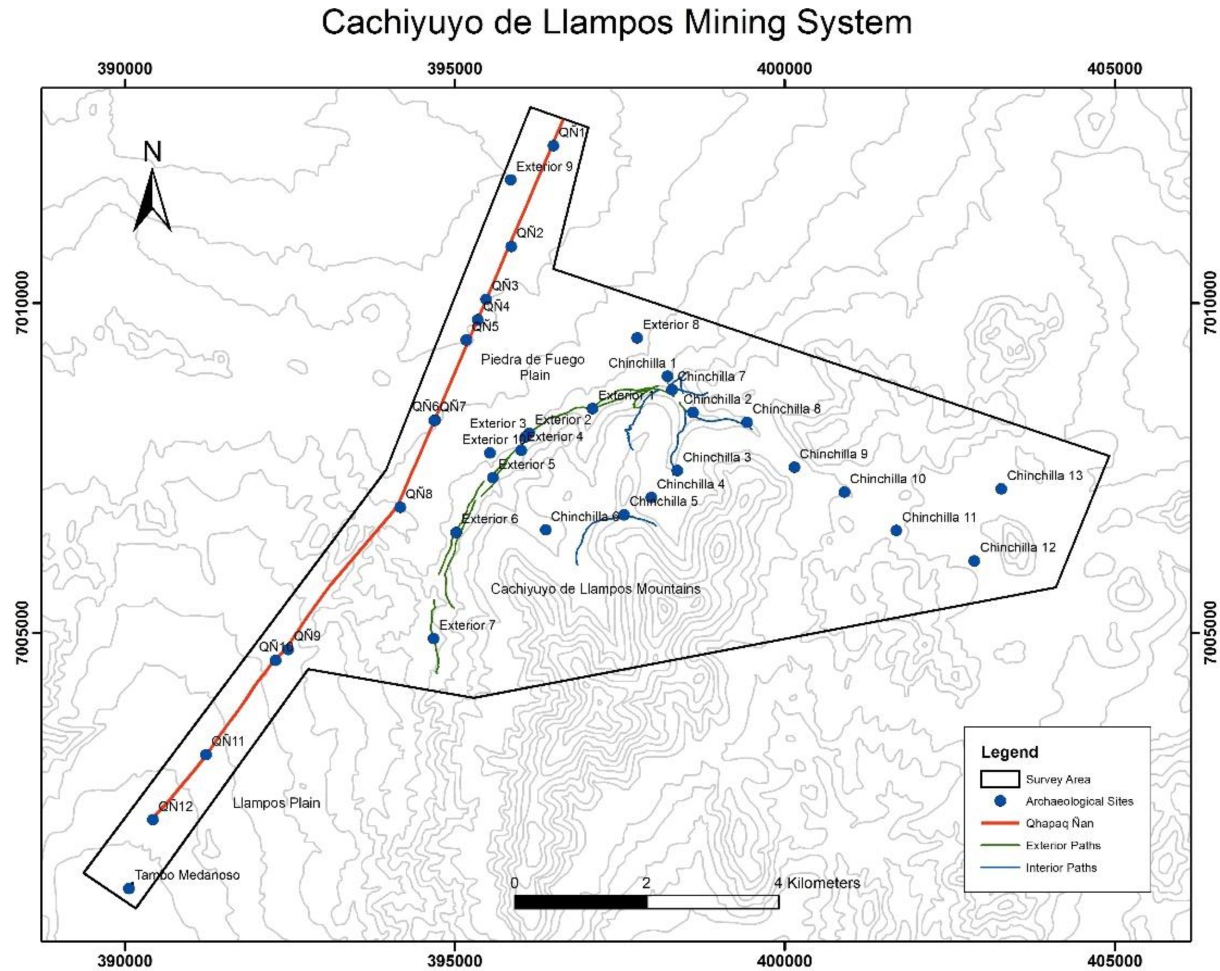

Figure 2-5. Survey area and the Cachiyuyo de Llampos Mountains showing and mining and Inca Road sites

2.4.3 Rock art research in the survey area

At the same time that my research was being conducted in the Cachiyuyo de Llampos Mountains, Gloria Cabello[13], another doctoral student, was studying the rock art – mining relationship of this place and two other sites of the Atacama desert: Finca de Chañaral and

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[13] Cabello, Gloria. "Marcando yacimientos: pinturas rupestres y metalurgia en la región de Atacama (600 - 1.500 d.C.)". Doctorado en Arqueología Facultad de Filosofía y Letras, UBA, Argentina.

Quebrada de las Pinturas.

In the Chinchilla ravine, red paintings are found at sites CH1, CH2, CH3, CH5, CH9, CH10, and CH13. A total of 151 motifs were identified and registered in 46 panels. The most common motifs are the “geometric non symmetric” and “lineal body camelid” types, and their variants (Figures 2-6 and 2-7). The main color used in those paintings is red, with rare cases of combinations of red and white in symmetric geometric motifs (one panel at CH5), and anthropomorphic motifs with tunics (one panel at CH1).

In comparison to other rock art sites of the region, Finca de Chañaral has larger figures and more diversity, with 181 motifs distributed in 57 panels. The main category there is the “composed geometric” motif category (Figure 2-6), representing 27% of the corpus, and greater variability in technique and colors. Over those figures it is common to find superimposition of anthropomorphic motifs which are more homogenous in style. In contrast, site Quebrada de las Pinturas (126 motifs in 46 panels) has a high degree of homogeneity in its visual repertoire, but is more heterogeneous in terms of image composition with more cases of superimposition. Also, in that site the main categories of motifs are lineal camelids and anthropomorphic figures with tunics (Figure 2-8). These motifs are consistently larger than those at the other two sites (in between 2,000 to 15,500 cm^2).

In sum, despite some similarities between the three places, each one has distinguishing characteristics in techniques of drawing, motif size, represented images, and colors. This could relate to the diversity of groups working and transiting through the Desert, with groups visually exhibiting identity distinctions.

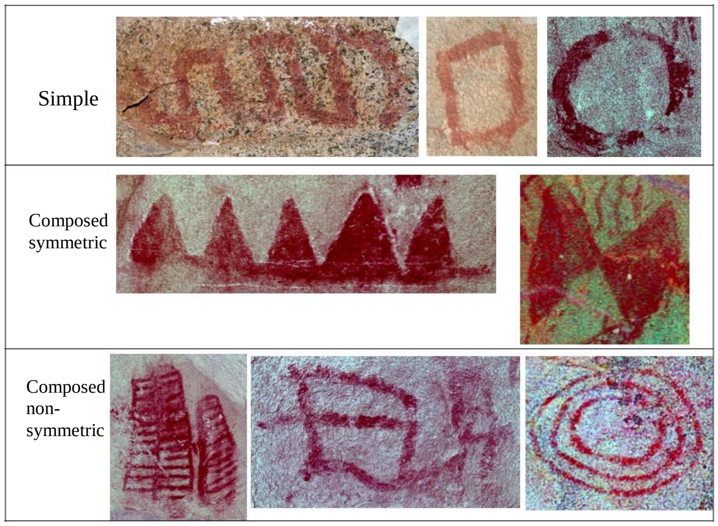

Figure 2-6. Geometric motifs identified in Cabello's research

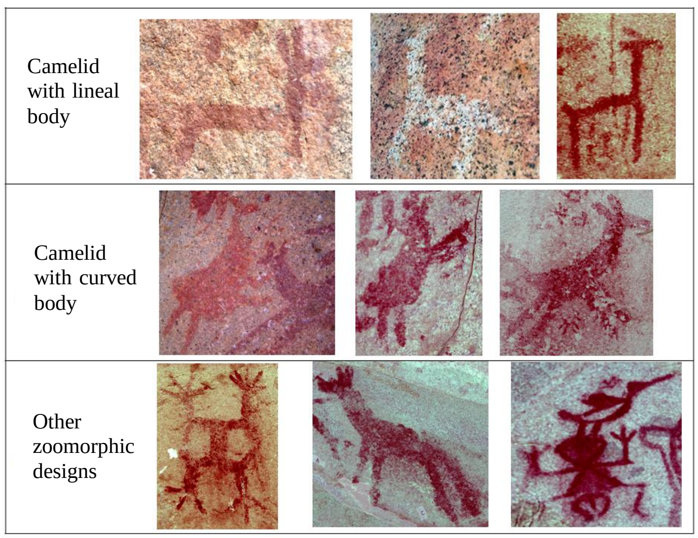

Figure 2-7. Zoomorphic motifs identified in Cabello's research

Figure 2-8. Anthropomorphic motifs identified in Cabello's research

3.0 METHODOLOGY

My 2013-2104 investigation of the Inca Road and its relationship to mining activities in the Cachiyuyo de Llampos Mountains involved three stages of fieldwork: a) archaeological survey of the Inca Road and the nearby Chinchilla ravine; b) excavation at the Chinchilla 1 mining camp and the Tambo Medanoso, and c) analysis of excavation materials and study of museum collections in Copiapó.

3.1 THE SURVEY

The first phase of fieldwork consisted of a full-coverage pedestrian survey of the segment of the Inca Road closest to the Cachiyuyo de Llampos Mountains. The survey covered 12 kilometers of the Inca Road from the UTM coordinates 396640E – 7012770N to 390460E – 7002200N (Zone 19 WGS84). This was followed by the survey of the northern part of the Cachiyuyo de Llampos Mountains including both sides of the Chinchilla ravine. These areas were selected for survey based on preliminary information about CH1, while the segment of the Road surveyed was chosen for its proximity to CH1 and the Cachiyuyo de Llampos Mountains. In total, the survey area comprised roughly 58 square kilometers (Figure 3-1). However, about half of that area consisted of inaccessible steep slopes, not likely to have had archaeological occupation. Surface visibility was excellent due to the lack of vegetation and later disturbance.

Sites generally did not have historic components, an exception being an artisan copper mine next to CH1 that was worked until a few decades ago.

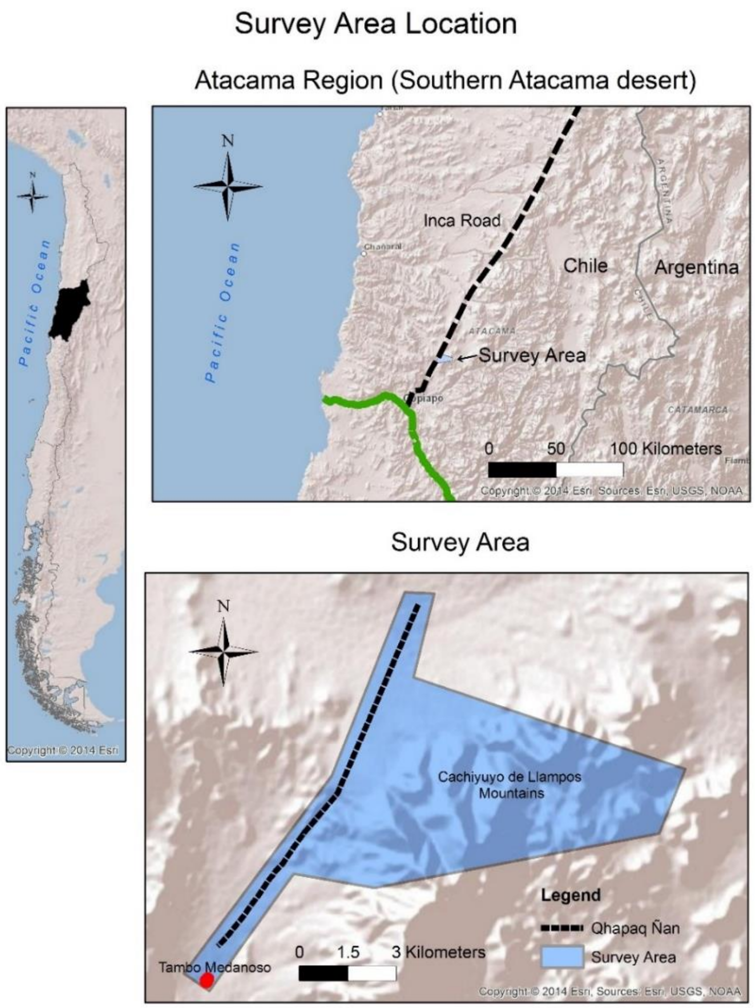

Figure 3-1. Map of the survey area in relation to the regional and national context

3.1.1 Surface collection units

The pedestrian survey was organized in transects spaced at 25 meters. Location of all materials was recorded. When concentration of artifacts were encountered, surface collections were made to capture potential intra-site artifact patterning, and to provide robust artifact samples for gauging the variety and relative proportions of archaeological materials. The location of collection units was recorded with a GPS point, and sketched in a map of the site showing their relation and distance to residential structures. Artifacts of each collection unit were sorted and counted by category, and all artifacts were photographed. Because the aim of the survey was to record all possible surface artifacts, sorting and photographing the artifacts was done on site, and artifacts were not removed from their original site. To do otherwise, would have meant to empty many of the sites of all artifacts, and this would not be allowed by the permit-authorizing institution in Chile, neither would be optimal in terms of the archaeological preservation of the sites.

The spacing between collection units was never greater than 10 meters at any place, including in the mining camps, and at isolated structures. Thus, the maximum collection area consisted of a circle of 5 meters radius encompassing an area of about 78 square meters. However, in areas with high concentration of artifacts and the presence of structures, smaller collection units were delimited. The central point of each collection unit was marked on a map of the site. If the distance between collection units was less than 10 meters, their individual area was delimited by an equidistant boundary between their centroids. For the isolated finds, a circle of 5 meters radius was delimited as a maximum area. For all collection units I recorded their area in square meters, and all the surface artifacts were counted. The survey produced a total of 609 collection units with artifacts.

To interpret artifact patterns in a broad scale across the whole survey area, I adopted a “site-less” approach that treats distributions of materials as representing a continuum of changes in density and proportion (c.f. Drennan et al. 2003; Dunnell and Dancey 1983). However, for generating other perspectives the concept of site was relevant, because it provides a way to interpret particular clusters of structures and artifacts in terms of function and organization. Areas with visible architecture were thus considered as “sites” for practical descriptive purposes. In areas with residential structures, special attention was given to the differentiation of collection units within and outside structures. In this way it was possible to differentiate activities carried out in domestic spaces from external activities.

For example, in my pilot work at the Chinchilla 1 (CH1) mining camp, surface collections were useful for identifying activity areas within the site (Figure 3-2). The location of units was designed to exploit the spatially segregated distributions of artifacts around hearths, residential structures and external areas.

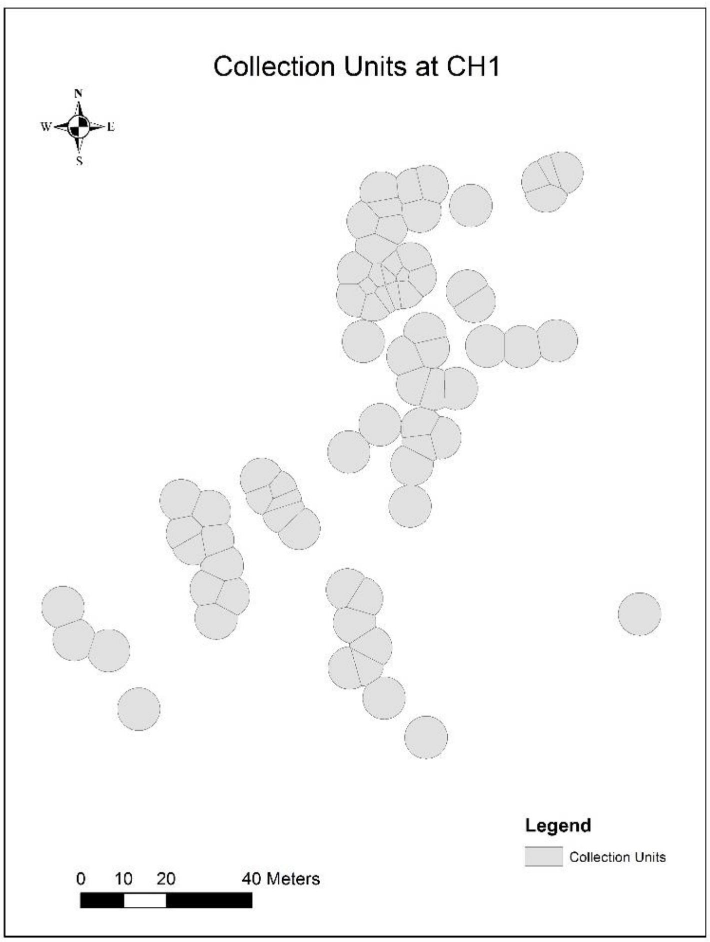

Figure 3-2. The collection unit polygons at CH1. The same collection procedure was done for all sites in the survey area.

3.1.2 Survey goals

For the Cachiyuyo de Llampos Mountains sites, the goal was understanding the prehispanic mining system. Stylistic and chronological affiliations were determined for each site based mainly on pottery classifications, while craft production was assessed through examining proportions of copper ores, red pigment fragments, lithics, marine shells, and other artifacts. Finished and semi-finished artifacts also were important to determine the activities taking place at a site, and, in some cases, the relative chronological position of the occupation.

Detailed maps were made for every structure with measurements in the field, all georeferenced using UTM coordinates in WGS84 datum. Maps were vectorized using the software ArcGis and then converted into polyline vector files. Collection units were converted into point and polygon vector files, and their artifacts counts were included in the attribute table of the shapefile. With this information, it was possible to create maps of frequency and proportion of artifacts for both the total survey area, and each site individually.

3.2 TEST PIT EXCAVATIONS AT TAMBO MEDANOSO AND CHINCHILLA 1

Test pits were dug at Tambo Medanoso and Chinchilla 1 (CH1) to obtain larger artifact assemblages from the two sites, to reveal stratigraphy, and to obtain samples for radiocarbon dating. Tambo Medanoso was selected as the clear "official" Inca site in the survey area, while CH1 was selected as the largest non-Inca mining camp contemporaneous with the Inca Road.

Excavation at Tambo Medanoso consisted of 6 units, 4 of 1 x 1.5 meters and 2 of 1 x 2 meters. At CHI the excavation consisted of 8 units, 7 of 1 x 1.5 meters and 1 of 1 x 2 meters.

Test pits were spread among the different contexts (residential structures, bead production linear structures, open areas, dump, hearths). They were placed in interior and exterior areas, and possible midden deposits (ashy or high surface density loci). Samples for AMS radiocarbon dating were taken from hearths and fill contexts at both sites. Test pits were excavated in artificial levels of 10 centimeters, until reaching sterile soil. Soil samples were taken every 10 centimeters from the whole area of the pit, with special attention to hearths and ashes. Each bag was filled to a weight of about 5 kilograms per level. All fill was sieved using a 3 mm grid, focusing special attention in the collection of small debris from craft production. Test pits were backfilled after excavation using the same sediments extracted from them, but before that, a layer of plastic net was placed at the bottom and sides of the pit.

3.3 ARTIFACT ANALYSIS

Copper ores, pottery, lithics, animal bones, and botanic remains were analyzed to reconstruct activities and to make intra- and intersite assemblage comparisons.

3.3.1 Copper Ores

I use the term "copper ores" to refer to all greenstone including the ones with actual copper content such as malachite, turquoise, and chrysocolla, and also others such as chlorite, which looks physically similar and were extracted from the same veins. At the Cachiyuyo de Llampos sites, these ores were not smelted to extract copper. Instead, these ores were essentially processed as lapidary items. In addition to examining the number and weight of copper ore fragments in any given assemblage, I also analyzed the fragments in terms of stages represented in the bead production process.

3.3.2 Pottery

Ceramic analysis included recording the qualitative attributes of the morphology of the sherd, presence of decoration, type of decoration, and internal and external finish. The primary recorded quantitative attributes were sherd wall thickness and vessel diameter (for rim sherds). Wear marks and particular observations were also recorded. All sherds were photographed with a scale.

3.3.3 Lithics

Lithic analysis included recording attributes of morphology, type of debitage, presence of cortex, raw material, presence of retouch, impact point, and physical dimensions. All pieces were photographed to scale.

3.3.4 Animal Bones

Animal bones were classified taxonomically at the level of the species where possible; otherwise, they were classified to class (e.g. *mamalia*). The taxa were used to determine the Number of Identified Specimens (NISP) per site. Also recorded in classification was anatomical part or section, degree of bone integrity, animal age (when possible), and human modifications (e.g. fire or cut marks).

3.3.5 Botanical Remains

After the excavation, all soil samples for each level of the test pits were floated to separate out a light fraction containing seeds, and plant remains (Figure 3-3). These materials formed the basis for a taxonomic classification and the quantification of botanical specimens. Remains were analyzed with a stereo zoom of 45x, and compared to existing literature for identification purposes. This step was particularly complex due to the fact that there is not much previous information for this region, and some of the recovered seeds were not possible to identify.

Figure 3-3. Flotation machine used to obtain archaeobotanical remains

3.3.6 Museum collection analysis

For comparative study, copper ore beads and necklaces from different sites in the Museo Regional de Atacama, Copiapó were examined to develop a sense of their use and distribution (Appendix A).

4.0 THE CACHIYUYO DE LLAMPOS INCA ROAD AND ITS SITES

This chapter presents the results of the survey and collection of a 12 kilometer segment of the Inca Road in front of the Cachiyuyo de Llampos Mountains. The northern end of this segment is where the Inca Road crosses the modern vehicle road C-261, while the southern end lies in the Llampos plain. The Road here, like elsewhere in the Atacama, was built by moving surface stones to each side, delineating the cleared road surface (Figures 4-1 and 4-2).

For Hyslop (1991, 1984), one of the most important variables for determining the function of different segments of the Inca Road was its width, which he related to traffic flow. The width of the Cachiyuyo de Llampos Road is very uniform at 1 - 1.3 meters, despite what I believe to be differences in use and traffic. Perhaps a greater width only became important above certain thresholds of use. For example, a road that allows a person carrying a load in single-file traffic may be fine for economic purposes, but wider roads would have been desirable for military traffic (Hassig 1991). In the Cachiyuyo de Llampos case, an intermittent and limited use of the road by small groups of people might well have not required a wider road. In the Atacama Desert, much of the Road's role was to delineate a route. Instead of width, I propose that artifact densities, site clustering, and spatial association with special purpose sites, may be better indicators for road functions along specific segments.

Figure 4-1. Inca Road view to the north

Figure 4-2. Inca Road view to the south

The 12 kilometers of surveyed Road, exhibits 300 meters of difference in elevation from north to south (Figure 4-3). Midway in this segment of Road, the Road passes through a narrow pass between two hills called “Portezuelo del Inca”, and then descends continuously to the sandy Llampos plain where Tambo Medanoso is located. The road temporarily disappears (covered by sand and damaged by car tracks) just short of Tambo Medanoso. It reappears 15 kilometers to the south in the Chulo plain, continuing on to the Copiapó Valley.

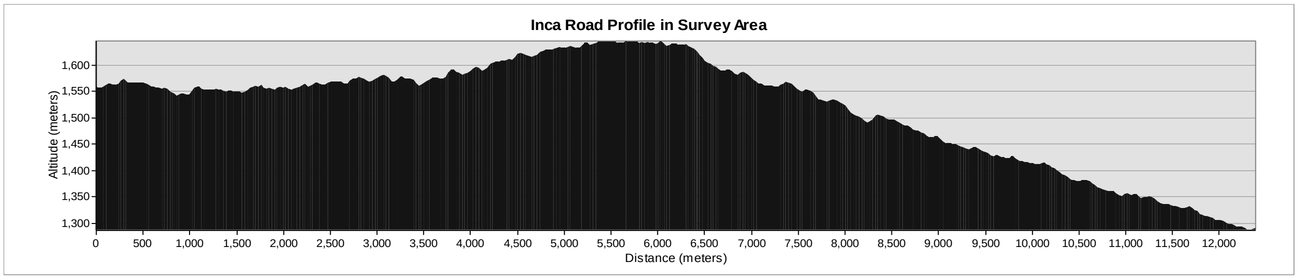

Figure 4-3. Altitude profile of the Inca Road in the survey area from north to south

Surface artifacts on the road were mainly sherds. They are distributed all along the Road, but densest in the 5.5 and 9.8 kilometers stretch (measured from the north; Figure 4-4) to QÑ8, the roadside site closest to the Cachiyuyo de Llampos Mountains (Figure 4-5). This stretch thus evidences more activity and traffic, because, I argue, of the nearby, off-road Chinchilla mining sites.

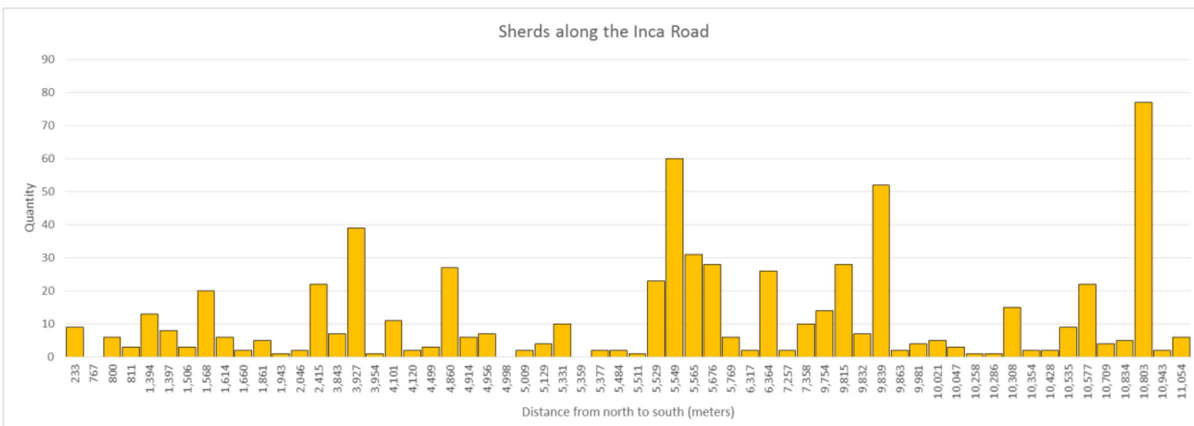

Figure 4-4. Sherd clusters along the Inca Road in the survey area according to distance

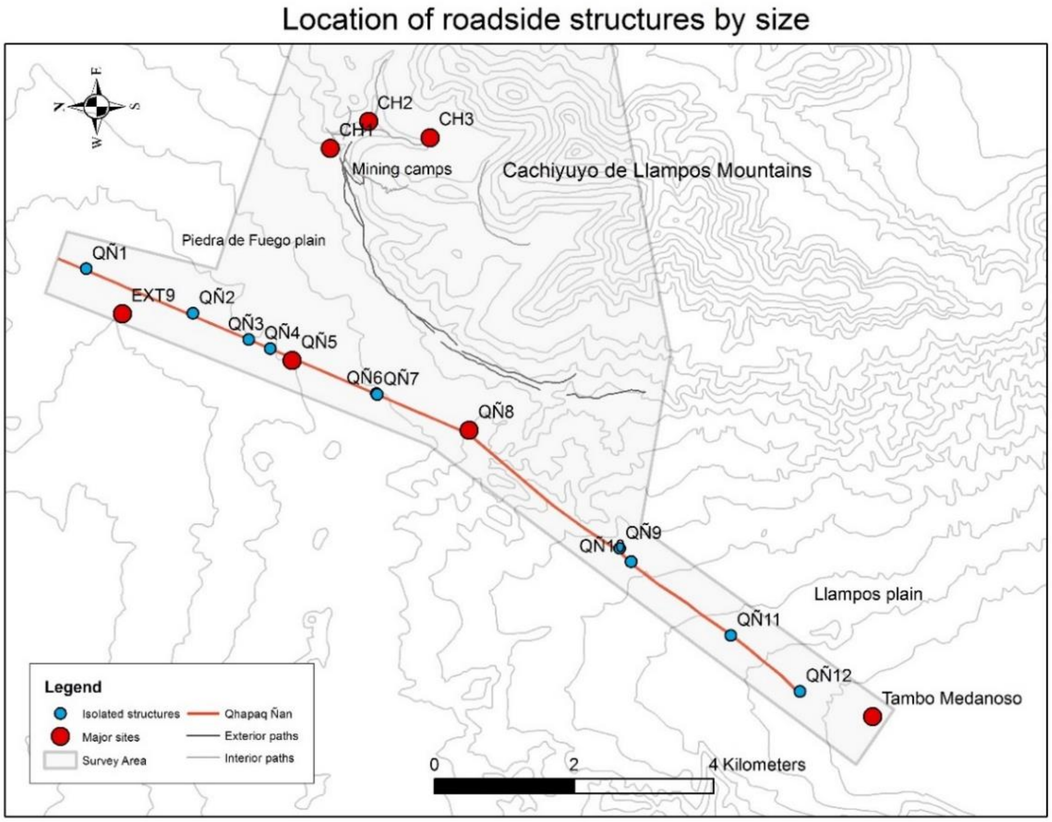

Figure 4-5. Map of roadside sites in the survey area of the Late Period. Note the map is oriented with the east at the top

4.1 ROADSIDE SITES WITH STRUCTURES IN THE SURVEY AREA

A total of 13 sites with structures were recorded on this stretch of Road, including Tambo Medanoso, the site with the clearest Inca architecture in the research area. Most of these sites contained only one or two small circular/elliptical structures. Although sherds are scattered all along the Road, most of the roadside structures were associated with relatively few surface materials. Only two sites, Exterior 9 and QÑ8, have major associated concentrations of copper ore, lithic materials, and red pigment fragments, suggesting that they were the points where those local items entered the Road.

The roadside sites are listed in Table 4-1[14]:

Table 4-1. List of coordinates and distances of roadside sites located in the survey area

Site	East	North	Distance from the north end of surveyed segment (meters)	Distance to the next site (meters)	Area (square meters)
QÑ1	396493	7012390	426	830	52
Exterior 9	395844	7011872	1,215	1,012	518
QÑ2	395852	7010860	2,085	885	141
QÑ3	395474	7010060	2,969	335	7
QÑ4	395346	7009750	3,304	355	7
QÑ5	395173	7009440	3,657	1,300	6,943
QÑ6	394699	7008230	4,956	18	15
QÑ7	394684	7008220	4,971	1,416	7
QÑ8	394171	7006900	6,387	2,743	17,424
QÑ9	392474	7004745	9,060	252	333
QÑ10	392283	7004580	9,294	1,778	540
QÑ11	391227	7003150	11,056	1,275	60
QÑ12	390423	7002160	12,315	1,103	361
Tambo Medanoso	390060	7001118	13,399	-	4,358

In Table 4-1 we can see that after site QÑ8, the distance between sites increases as the Road moves away from the Cachiyuyo de Llampos Mountains and the mining sites. This shift in distance between sites could relate to a difference in how the Road was used in proximity to the mining camps. If we consider that the Inca Road only served official purposes of travel and roadside sites are lodging posts to rest after daily journeys, it does not make sense to have structures roughly every kilometer. Even the larger sites that could have lodge more people (Exterior 9, QÑ5, QÑ8, and Tambo Medanoso), are too close to each other to reflect a kind of pattern where people used the Road just to cross the desert as quickly as possible, as in the traditional "turnpike" model of the Road. In contrast, the actual pattern of roadside sites seems to a different pattern of use.

[14] UTM coordinates in datum WGS84, Zone 19

The roadside structure sites can be divided into two categories: isolated structures and major sites (Figure 4-5).

4.1.1 Isolated structure sites

Sites QÑ1, QÑ9 QÑ10 are small groups of semicircular structures that might have accommodated only a couple of people each. Site QÑ2 is a single structure with internal divisions, and a roughly rectangular layout, possibly reflecting an Inca style of architecture. Those scholars viewing the Inca Road in terms of official use tend to generically refer to almost any small rectangular roadside structure as *chasquiwasis*, that is, as places for lodging of *chasquis* or Inca messengers (Berenguer 2009, Uribe y Cabello 2005, D'Altroy 2002, Vitry 2000, Lynch 1994, Hyslop 1984). However, no distinct archaeological correlates for a *chasquiwasi* have been defined, and there is nothing to suggest that function for any of the Cachiyuyo de Llampos Mountains Road sites. Similarly, structures such those at QÑ 4,6,7,11, and 12, could be said to resemble what Vitry (2000:160-170), describes as "puestos de control" or control points, that in the segment of Road from Morohuasi to Incahuasi in Argentina would be located at distances of between 1 to 7 kilometers. Again, this is an example of interpreting all roadside architecture in terms of administrative control by the Empire. The Cachiyuyo de Llampos Mountains Road sites do not display clear Inca architectural canons, and generally lacked surface materials. There is no reason to believe that they had official functions or any particular connections to the Inca Empire. Rather, they were most served as short-term shelters.

4.1.1.1 Small structures directly attached to the road

4.4.1.1.1 QÑ3

A small subrectangular 2 x 2 meter structure located along the west side of the road, and without surface materials (Figures 4-6, 4-7). Function unclear.

Figure 4-6. General view of structure QÑ3

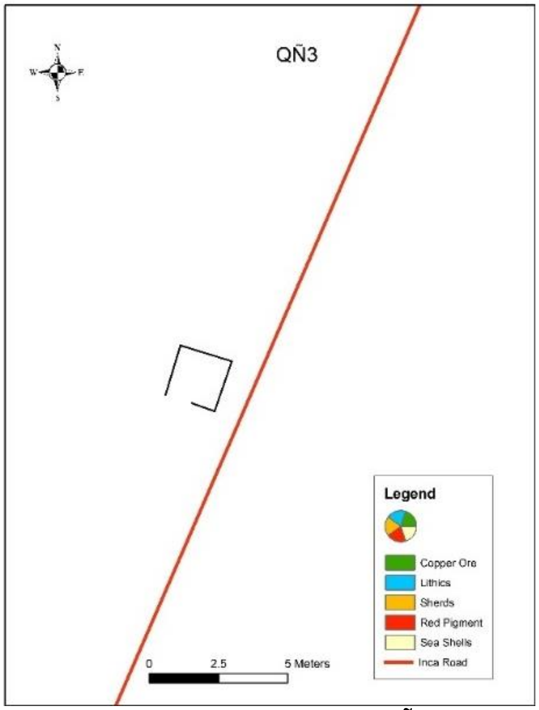

Figure 4-7. Map of site QÑ3

4.4.1.1.2 QÑ4

A subrectangular 2 x 2 meter structure along the east side of the road, without surface materials. The wall segments do not completely connect to one another, and one segment practically forms part of the border of the Road (Figure 4-8, 4-9).

Figure 4-8. General view of structure QÑ4

Figure 4-9. Map of site QÑ4

4.4.1.1.3 QÑ6 and QÑ7

QÑ6 and QÑ7 are located alongside the road. They are 2 x 2 meter structures separated by 20 meters, one to the east and the other to the west side of the Road (Figure 4-13). Next to site QÑ6 was a scatter of sherds from a red slipped bowl with a black rim, and a white slipped jar with a scraped internal finish (Figure 4-11). These correspond to Inca local styles. There was a rock of red pigment in association with the sherds.

Figure 4-10. General view of structure QÑ6

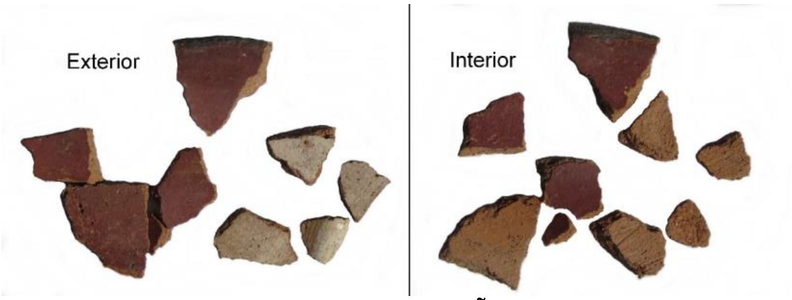

Figure 4-11. General view of site QÑ6 and surface sherds

Figure 4-12. General view of structure QÑ7

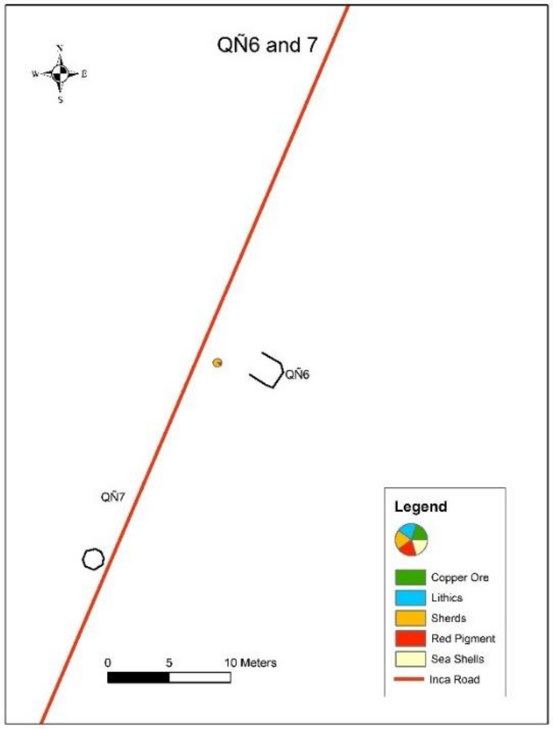

Figure 4-13. Map of sites QÑ6 and QÑ7 indicating location of surface materials

4.1.1.2 Groups of semicircular structures

4.4.1.2.1 QÑ1

This site held a set of structures composed of stone wall alignments ranging from 2 to 4 meters in length. They structures likely functioned as windbreakers for short term lodging. Only 3 monochrome, non-diagnostic, sherds were found on the site surface.

Figure 4-14. General view of the structures of site QÑ1

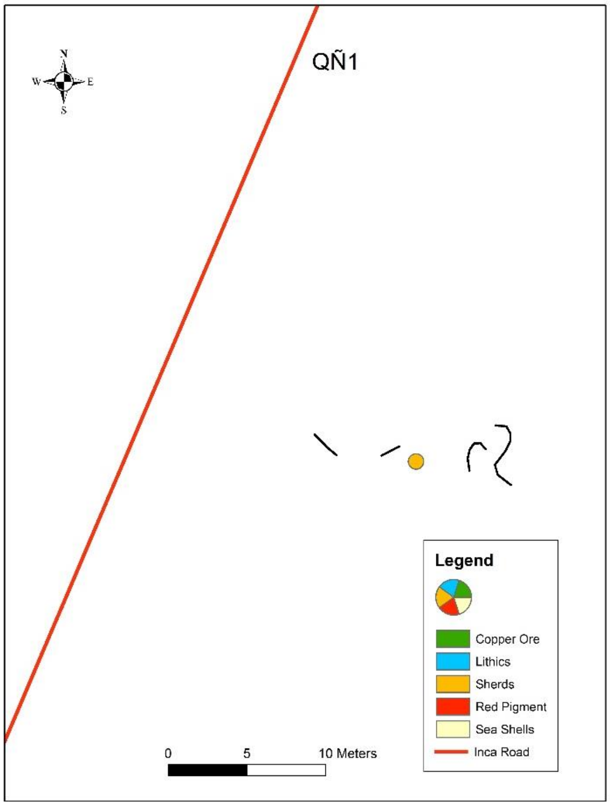

Figure 4-15. Map with the location of surface artifacts from site QÑ1

4.4.1.2.2 QÑ9 and QÑ10

Sites QÑ9 and QÑ10 are two groups of elliptical structures separated by 220 meters, located along the east side of the road (Figure 4-18). No surface artifacts were found apart from one flaked flint piece of debitage in site QÑ9 (Figure 4-16). The individual structures are around 4-5 meters long each, and were probably short-term stopping places along the route.

Figure 4-16. General view of structure QÑ10 and a surface lithic

Figure 4-17. General view of structure QÑ10

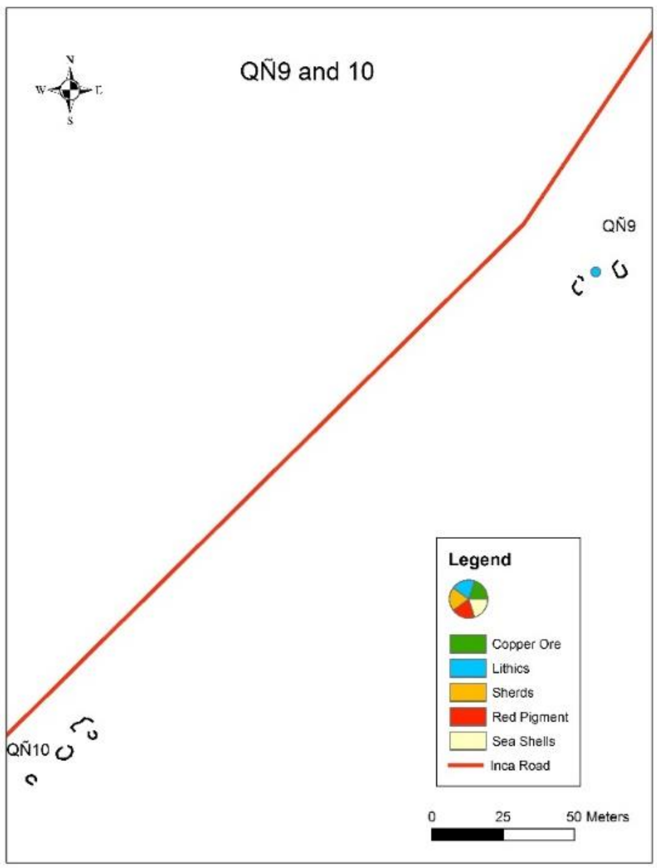

Figure 4-18. Map of sites QÑ9 and QÑ10 with indicating location of surface materials

4.4.1.2.3 QÑ11

A pair of twin rectangular structures, one of them directly astride the road (Figures 4-19 and 4-20). Their function is not clear. Associated artifacts included white slipped Diaguita Inca sherds from to the neck and body of a decorated, asymmetrical vessel (Figure 4-21).

Figure 4-19. General view of site QÑ11

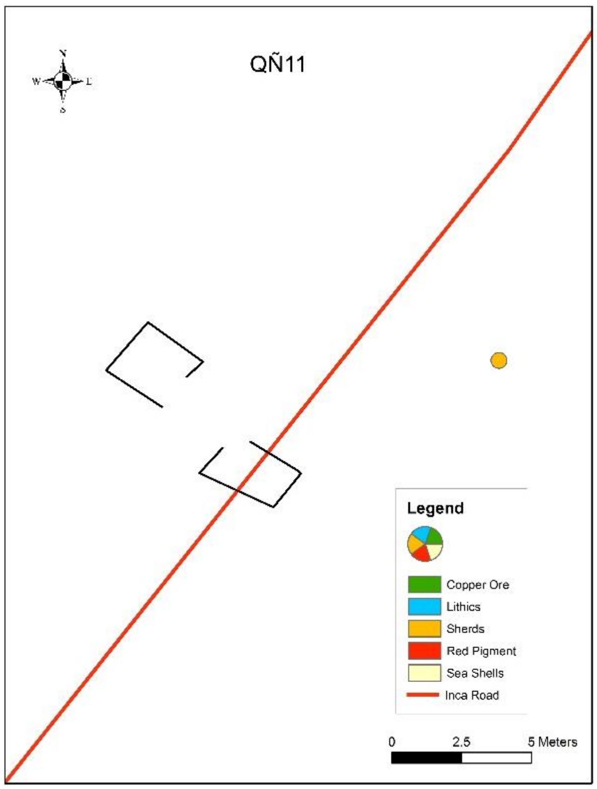

Figure 4-20. Map of site QÑ11 with indicating location of surface materials

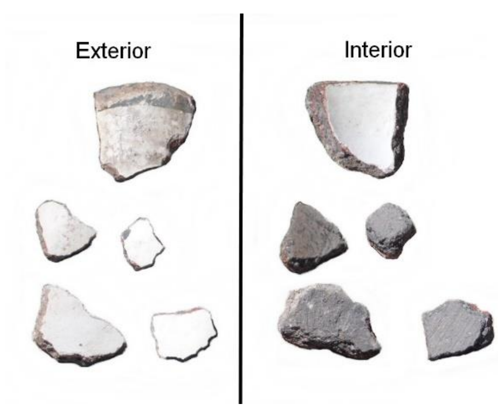

Figure 4-21. Diaguita Inca sherds associated to structure QÑ11

4.4.1.2.4 QÑ12

Circular structure 10 meters in diameter, located just where the Inca Road disappears under the drifting sand in the plain. A scatter of monochrome sherds from an asymmetrical vessel or *jarro pato* with modeled decoration, possibly imitating a bird shape (Figure 4-23) was found 10 meters away from the structure. These local vessels can be commonly found at sites in the Copiapó Valley of the Late Intermediate and Late Periods (Castillo 1998).

Figure 4-22. General view of structure QÑ12 and the sherd scatter

Figure 4-23. Fragments of an asymmetrical vessel on the surface of site QÑ 12. They are similar to Late Intermediate and Late Period examples such as the one at the right, from Iglesia Colorada site (Castillo 1998)

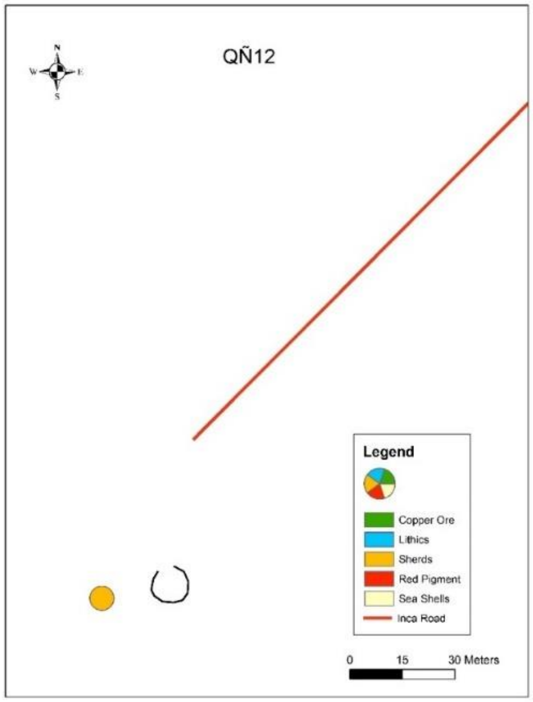

Figure 4-24. Map of structure QÑ12 with location of surface materials. This site is located at the end of the preserved segment of the Inca Road within the survey area. To the south of that point the Road is lost in the sandy Medanoso plain and eroded by multiple vehicle tracks

4.1.1.3 The rectangular structure QÑ2

This site held a rectangular structure with an internal area of roughly 70 square meters, with at least two internal subdivisions, and a clear entrance (Figures 4-25 and 4-27). Along with Tambo Medanoso, and one of the structures of site QÑ8, this architecture might be Inca regional style. This structure is located only 3 km west of the mouth of the Chinchilla ravine. Surface sherds were not Inca diagnostic, but instead were monochrome, with smoothed, scraped finish (Figure 4-26), which is a common trait during the Late Intermediate and Late Periods (Garrido 2007).

Figure 4-25. General view of the rectangular structure of site QÑ2

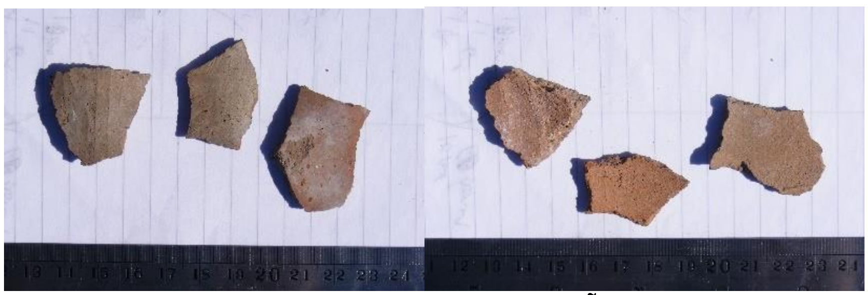

Figure 4-26. Monochrome sherds on the surface of site QÑ2 (exterior and interior view)

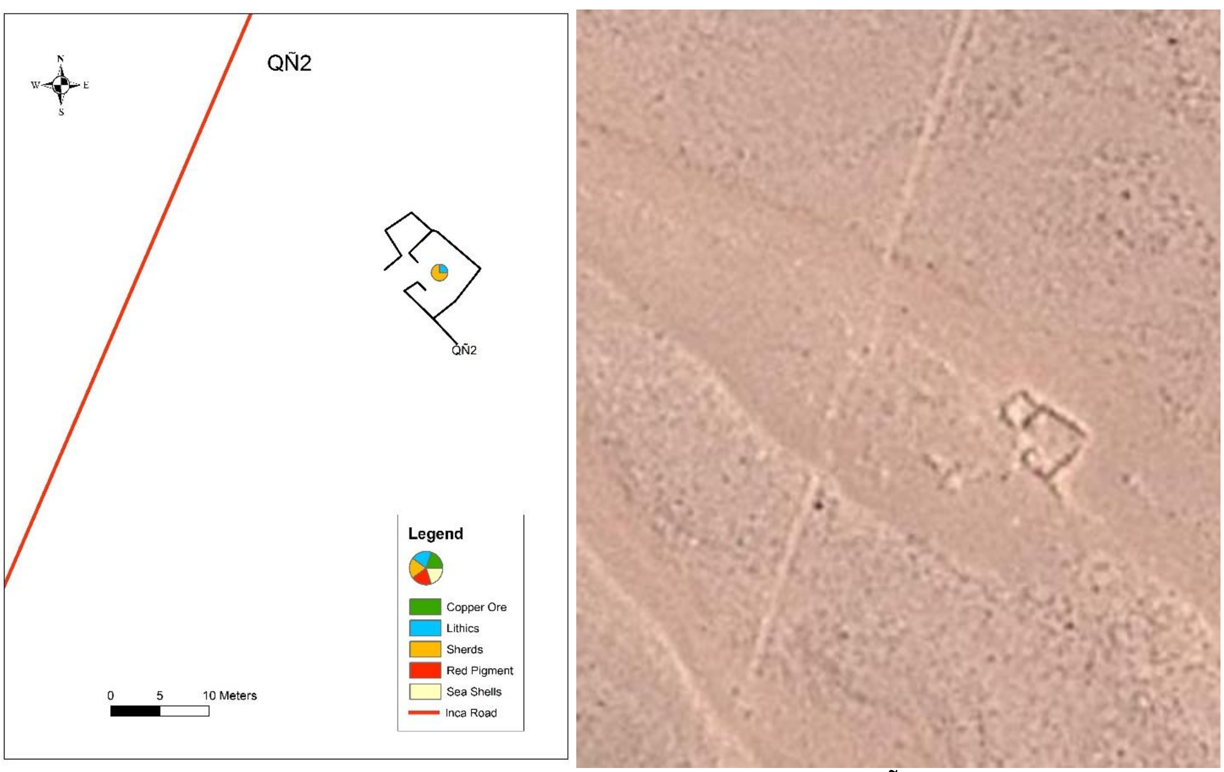

Figure 4-27. Map with surface artifact proportions and satellite image of site QÑ2 (taken from Google Earth)

4.1.2 Major sites

There were four major sites along the Road, each with more structures, larger residential areas, and representing longer occupations. Sites QÑ 5, QÑ8 and Tambo Medanoso are directly alongside the Road, while site Exterior 9 lies a short distance from it. Tambo Medanoso is the main Inca site in this segment with characteristic R.P.C architecture, and the most likely candidate to have had imperial administrative/logistics functions in relation to the Road in this area.

4.1.2.1 Exterior 9

This site is located about 300 meters to the east of the Inca Road, in the northern end of the survey area. The site is composed of two groups of semicircular structures separated by no more than 5 meters. These groups possibly represent two households or residential units. Surface artifact density was highest outside the structures, in the area between them, and to the southwest of the site (Figure 4-28). Surface remains included charred animal bones, indicating food preparation activities and hearths.

Fifteen collection units were made, showing a more or less homogeneous spatial distribution of red pigment fragments, copper ore, and lithics, and, to a lesser extent, marine shell, and sherds. Copper ores and red pigment fragments have their closest source in the Cachiyuyo de Llampos Mountains, 4.3 kilometers to the east. In the histograms for the comparative proportion of surface materials by collection units (Figure 4-29)[15], we can see that

[15] Proportions were obtained dividing the individual value by the sum of sherds, lithics, red pigment fragments, and copper ore, and then multiplying the result by 100 in order to obtain a range in between 0 to 100. Proportions were obtained only for collection units with more than 10 artifacts.

sherds ranged from 0-20% in all but one collection unit, where sherds made up 20-30% of the collection. Copper ore made up between 20-40% of each unit, red pigments 30-40% of each unit, and lithics varied from making up 10 to 60% of the artifacts in any given collection unit.

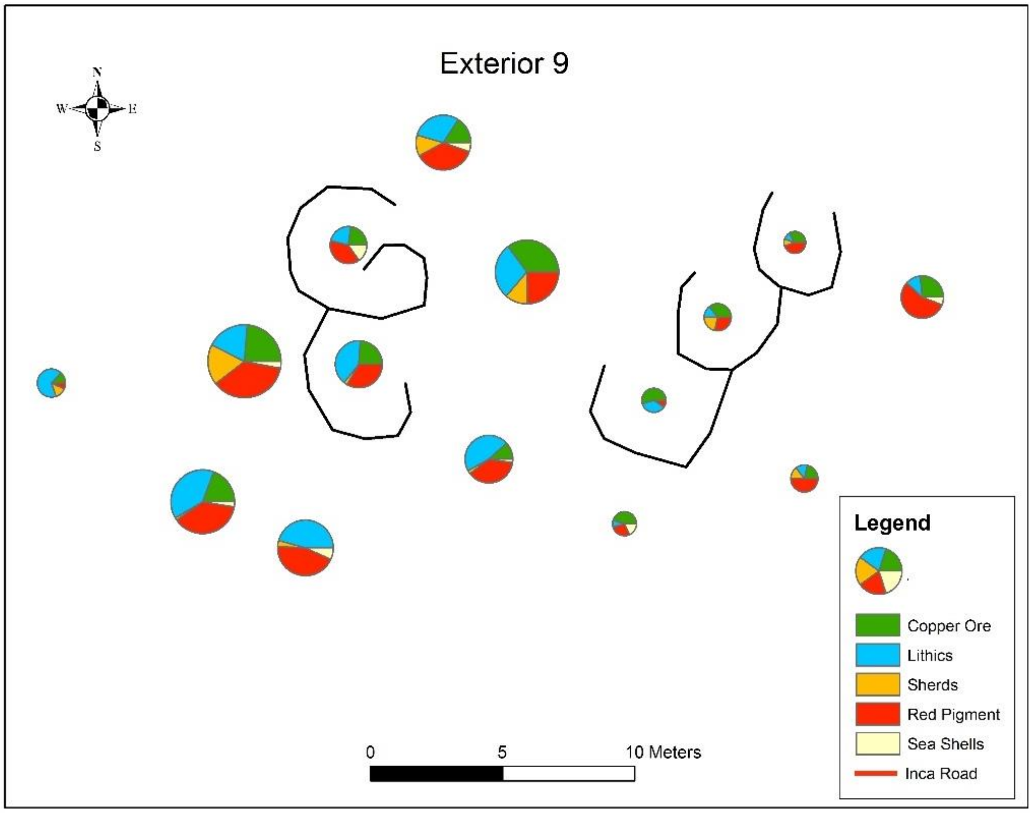

Figure 4-28. Map of site Exterior 9 indicating the location of surface materials and their proportion, based on 15 collection units (circle size represents raw artifact count)

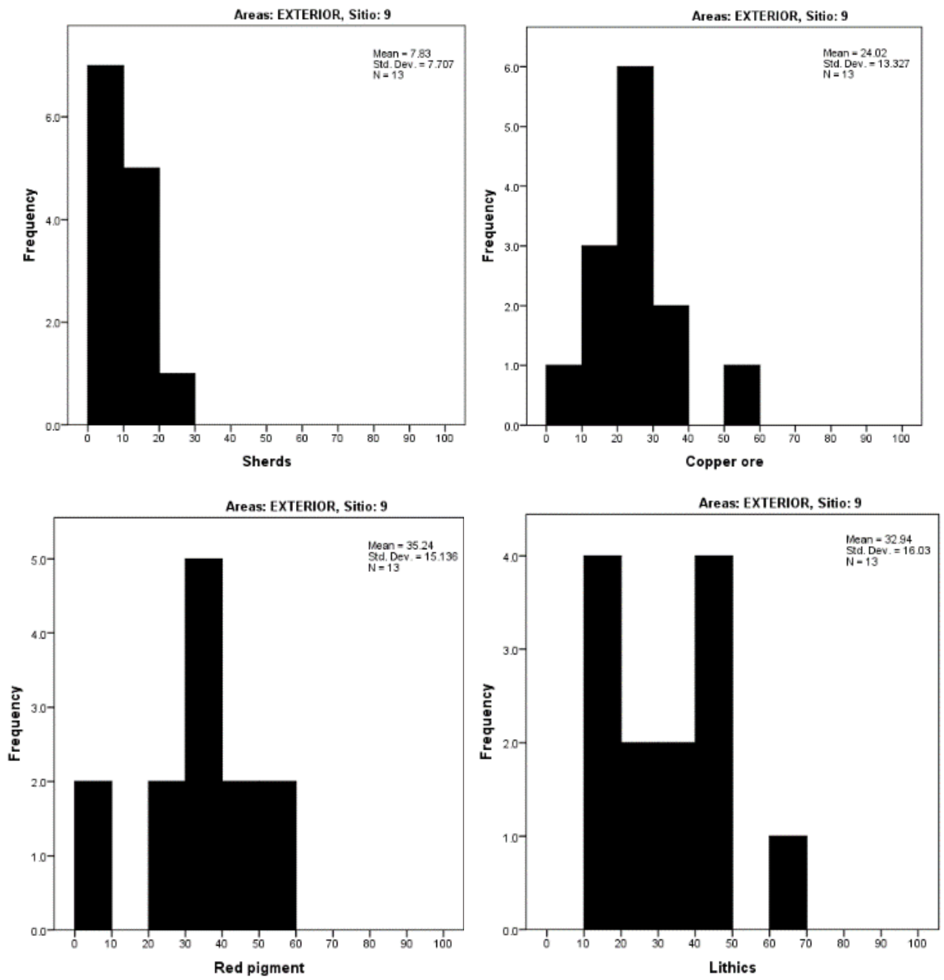

Figure 4-29. Histograms of proportions of surface materials from collection units in site Exterior 9 (EXT 9). Only for collection units with more than 10 artifacts (N=13). The horizontal axis shows the proportion of the item in a collection unit's assemblage, while the Frequency denotes the number of collection units with that proportion range. For example for Lithics (above), in one unit, lithics constituted 60-70% of the artifacts from that unit. There were four units in which lithics made up 10-20% of the assemblage of each respective unit. Lithics constituted 20-30% of two collection units, and 40-50% of another four units.

As shown in Figure 4-28, the collection units with higher proportions of sherds are located closer to residential structures. Although artifact density was higher outside the structures, there is almost no difference between the proportions of artifacts located inside or outside (Figure 4-30), suggesting the lack of spatial separation between craft and domestic activities. In terms of diagnostic pottery styles, the site yielded Copiapó black on red bowls, Punta Brava containers, and other monochrome types with the scraped finish common during the Late Intermediate and Late Periods in the Copiapó valley. At the eastern margin of the site we found an incised monochrome sherd resembling the Ciénaga style from the Late Formative of northwestern Argentina (Figure 4-32). This pottery style also occurred at site Chinchilla 11, and there are other examples known from the oasis of Finca de Chañaral, located about 60 kilometers to the northeast (Cervellino 1992). This sherd suggests that the location of Exterior 9 may have been occupied intermittently since the Late Formative Period. A pre-Inca occupation would also explain its distance from the Road itself.

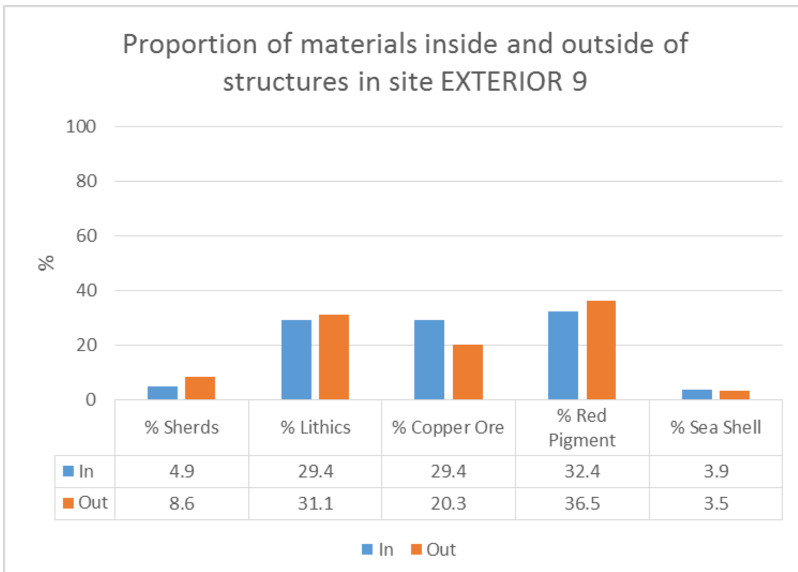

Figure 4-30. Graph of interior versus exterior proportions of artifacts at site Exterior 9

It is very likely that the copper ores and red pigment from this site came from contemporaneous mining sites in the Cachiyuyo de Llampos Mountains, where sources of those materials were located. This site has also evidence for the manufacture of copper ore and marine shell beads (Figure 4-31, 4-33), and the processing of red pigment. Apart from the iron oxide fragments on the surface of the site, there are two pestles clearly stained red that would have been used to grind pigments (Figure 4-34). In addition, the flat grinding stones directly associated with the structures might have featured in pigment grinding, or copper ore reduction and polishing in bead manufacture.

Figure 4-31. General view of the structures of site Exterior 9 and surface artifacts from one of the collection units

Figure 4-32. Diagnostic sherds from site Exterior 9. At the top, exterior and interior view of Punta Brava sherds (note the characteristic scraped finish common to the Late Intermediate and Late Period wares). At the bottom left, a Copiapó black on red bowl fragment from the Late Intermediate or Late Periods; at the bottom right, incised Ciénaga-style sherd

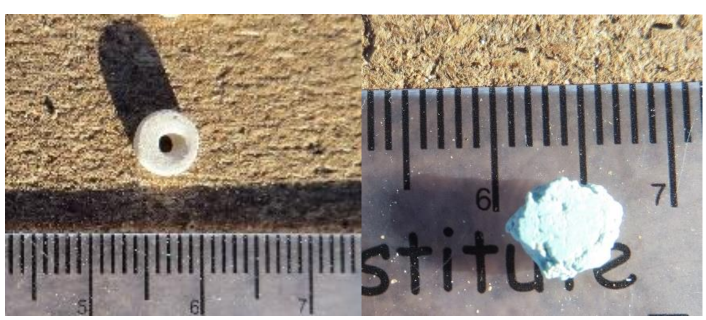

Figure 4-33. Marine shell bead and copper ore bead blank form site Exterior 9

Figure 4-34. At the top, flat grinding stones from site Exterior 9. At the bottom, pestles colored with red pigment from the same site

4.1.2.2 QÑ5

This site is composed of a scatter of 12 or so small, semicircular structures lying in a small drainage depression coming from the nearby mountains (Figure 4-35). The site had few surface materials, a situation that perhaps can be explained by its location at a lower level than the Road, thus possibly protected from the wind and deflation. This site had on the surface a few monochrome prehispanic sherds, copper ore, red pigment, and thick dark glass fragments from a wine bottle belonging to the 19th or early 20th century (Figure 4-36). This site is the largest campsite representing short-term stops along the route.

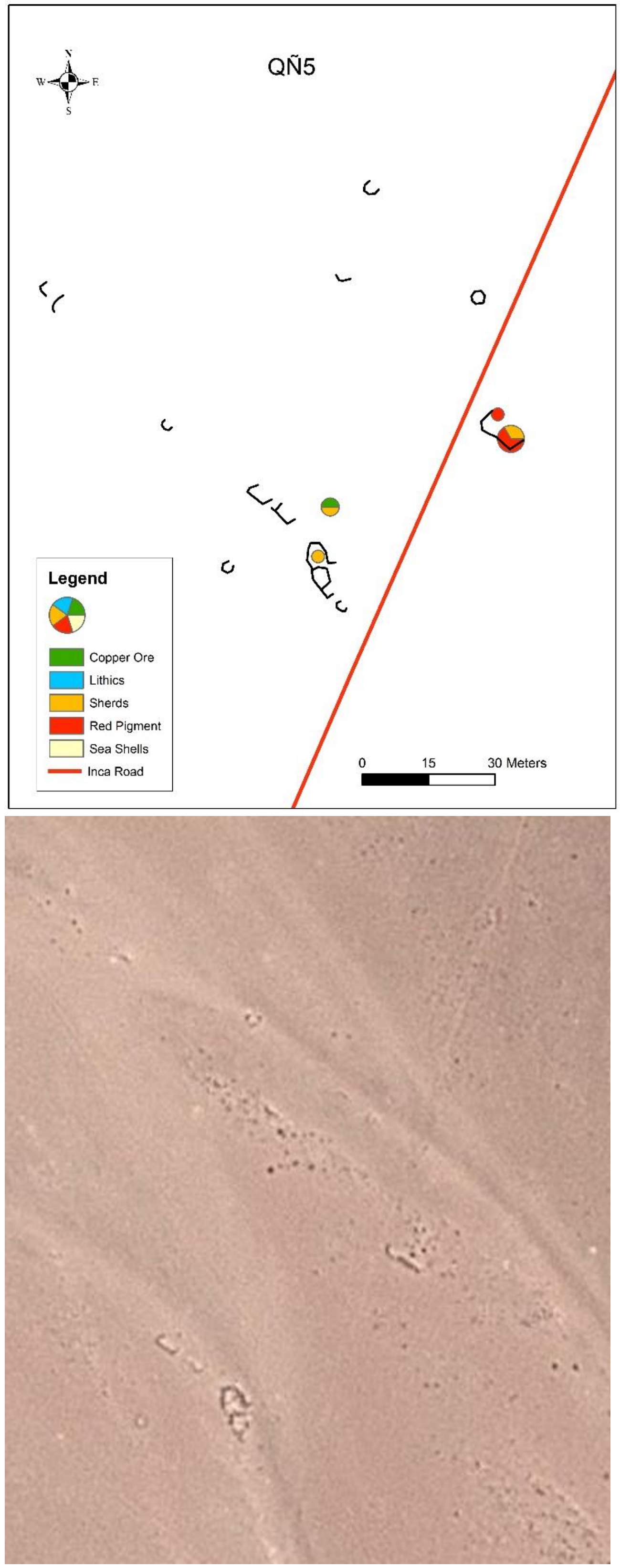

Figure 4-35. Map with surface artifact proportions, based on 4 collection units (chart size represents raw artifact counts), and satellite image of site QÑ5 (taken from Google Earth)

Figure 4-36. General view of site QÑ5 and surface artifacts. The fragment of black glass wine bottle dates to the late 19th or early 20th century

4.1.2.3 QÑ8

This site is located adjacent to the Inca Road, and consists of a cleared circular area of around 60 meters diameter, with 4 small elliptical structures inside. Outside the cleared circle to the southeast is a subrectangular structure with internal divisions. There are three groups of small elliptical structures at both sides of the Inca Road to the south of the main circle (Figure 4-38, 4-39). The circle does not have true walls, but is delineated by a ring of stones, 10-20 centimeters high, made with the stones removed from the interior. The Inca Road crosses through the middle of the circle. It appears that the circle was made after the Road because the route is not well defined inside it; probably erased as part of the clearing process in constructing the circle. The function of the circle is unknown and I know of no similar examples from the literature. There are two other circles similar to this, again with no clues as to function, among the off-road mining sites in the Cachiyuyo de Llampos Mountains (at Exterior 5 and next to Chinchilla 1).

As at Exterior 9, QÑ8 shows an assemblage of artifacts directly relating to mining activities in the Cachiyuyo de Llampos Mountains. In the histograms of proportions of surface artifacts by collection unit, we can see a wider range of variability in the distribution of sherds, copper ores, and lithics artifacts, indicating that some areas of the site have significantly higher concentrations of those artifacts than other areas, thus reflecting a greater degree of spatial segregation of activities (Figure 4-37).

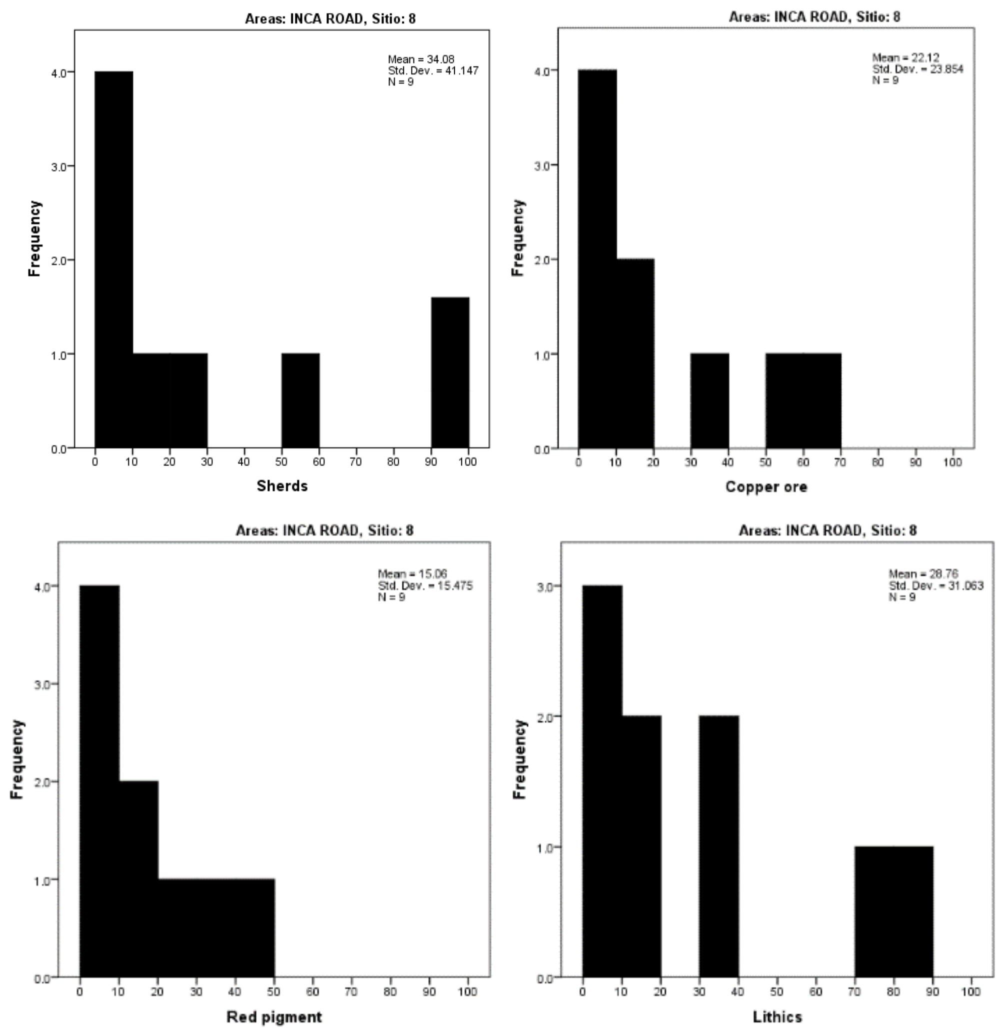

Figure 4-37. Histograms of proportions of surface artifacts from collections units in site QÑ8. Only for collection units with more than 10 artifacts (N=9)

As shown in the site map (Figure 4-38), most of the copper ore and red pigment at the site is associated with the small structures in the southern part of the site, while the higher concentrations of lithic artifacts and sherds are located in the central-eastern part of the site, in proximity to the subrectangular structure with internal divisions.

The proportions of lithic artifacts are highest inside the residential structures of the site, while red pigment and copper ore fragments have higher proportions in external activity areas (Figure 4-40). The spatial segregation of artifact densities and proportions could be an indicator of different agents arriving to the site with differential products, or could reflect specific steps in the chaîne opératoire for the processing of red pigments, copper ore, and manufacture of lithic artifacts, with each step carried out in particular spots. The location of the site in the Inca Road suggests that it was a place from where the aforementioned resources moved onto the Road from the Cachiyuyo de Llampos mining camps before being transported to other destinations.

The pottery styles of this site are characteristic of the Late Period; almost all are Inca local varieties or local monochrome types. This assemblage differs from other Late Period sites where Diaguita Inca sherds are more common (Figure 4-42). The area around the subrectangular structure has more sherds and evidence for residential occupation, but there are no indications that this site had any official Inca status, and its architecture does not differ from that of the mining camps.

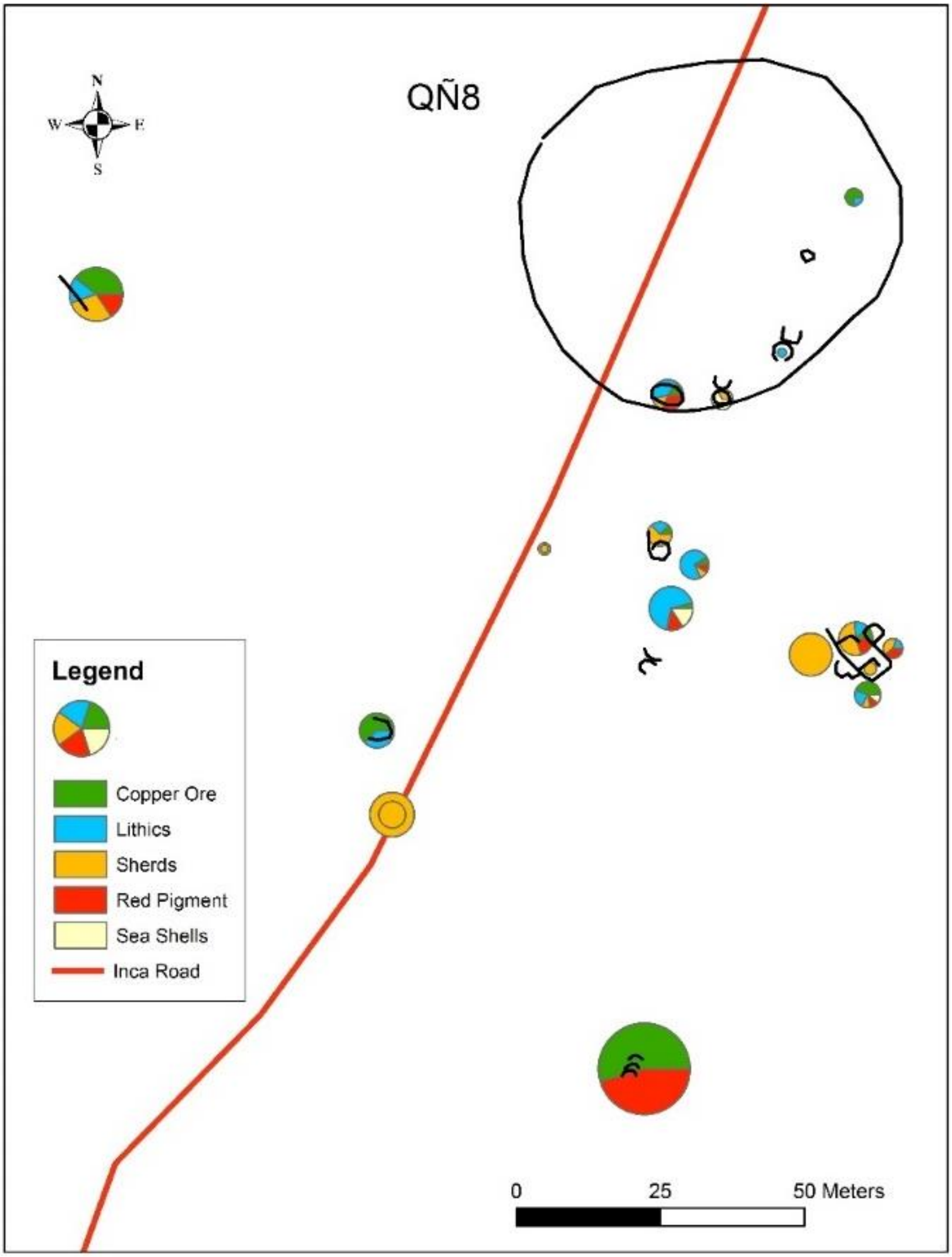

Figure 4-38. Map with surface artifact proportions of site QÑ8, based on 17 collection units (chart size represents raw artifact counts)

Figure 4-39. Satellite image of site QÑ8 (taken from Google Earth)

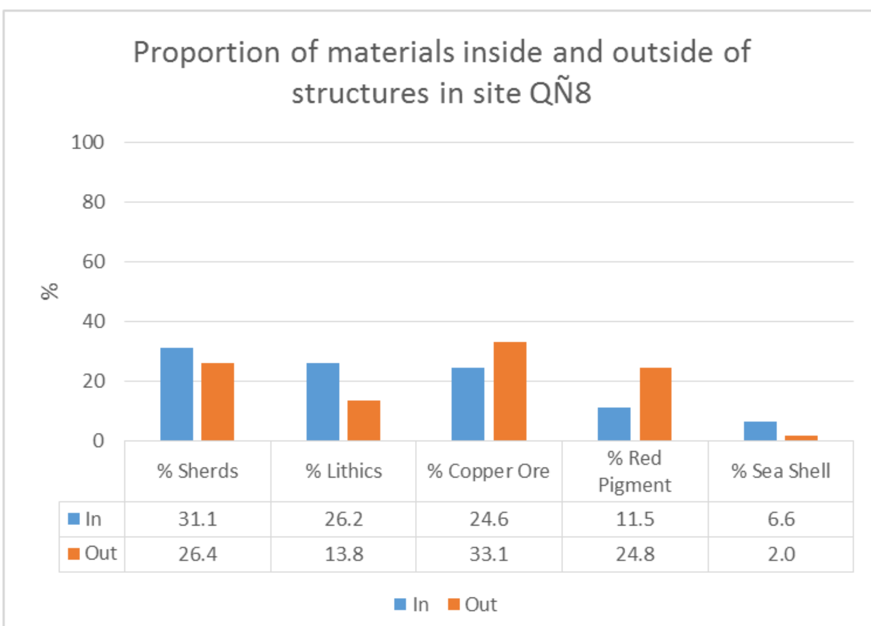

Figure 4-40. Graph of proportions of artifacts in site QÑ8 according to their location inside or outside residential structures

Figure 4-41. General view of site QÑ8

Figure 4-42. Local Inca pottery sherds and projectile point on the surface of site QÑ8

4.2 TAMBO MEDANOSO SURFACE COLLECTIONS AND EXCAVATION

Tambo Medanoso was recognized for a decade ago (Molina 2004), and revisited by myself three years. As part of the research described here, I mapped the site architecture, made surface collections, and excavated six test pits.

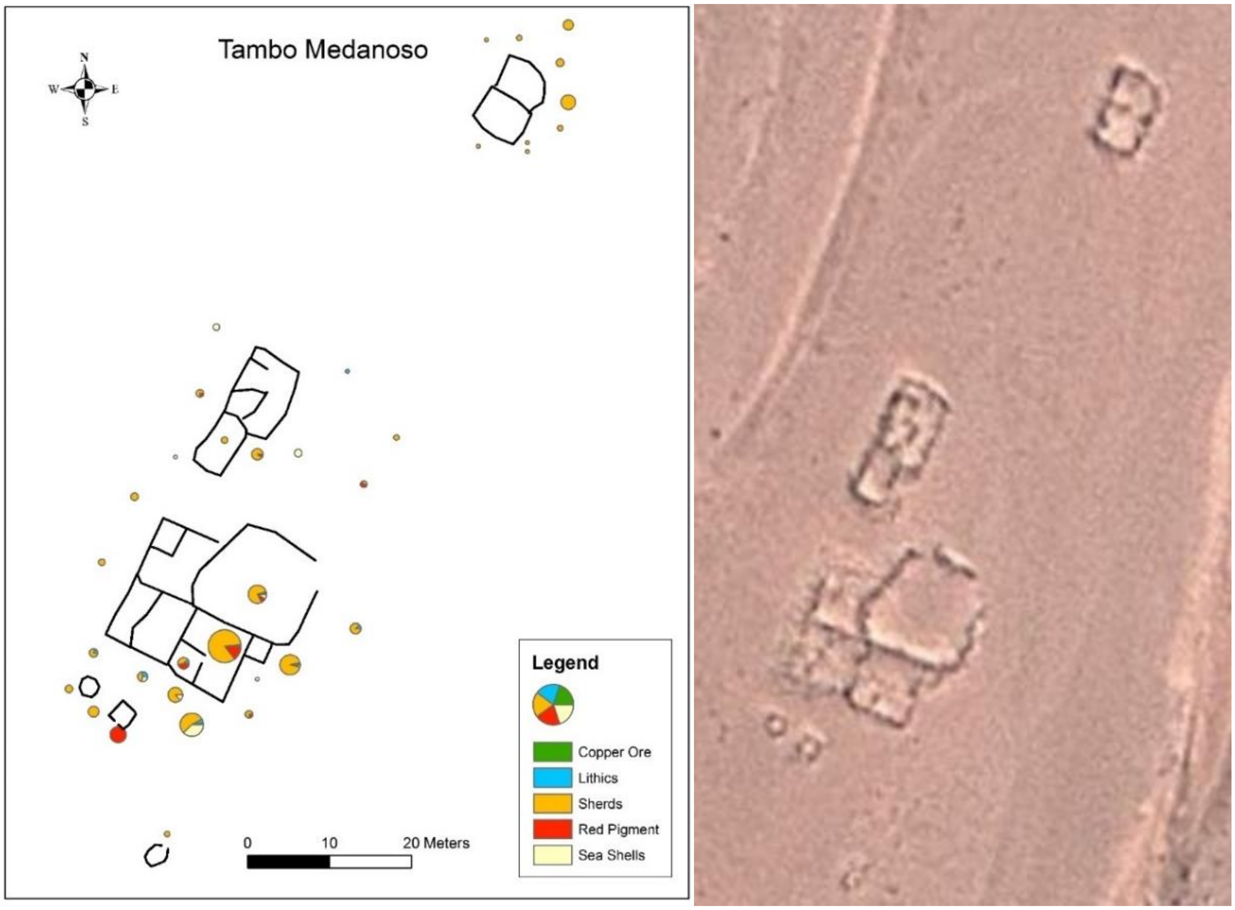

Figure 4-43. Map with surface artifact proportions, based on 36 collection units (chart size represents raw artifact counts), and satellite image of site Tambo Medanoso (taken from Google Earth)

Figure 4-44. General view of Tambo Medanoso

Tambo Medanoso shows the clearest Inca architectural canon (orthogonal layout) of any site along the Inca Road in my survey area. It is the only site I would be confident as identifying as an "Inca" site (as opposed to a local Late Period site). While sites such as QÑ5 and QÑ8 each cover a larger total area than Tambo Medanoso because of the dispersion of their structures, Tambo Medanoso exhibits the greater amount of interior (residential and/or storage) space of the roadside sites. The structures of Tambo Medanoso consist of three main R.P.C. with internal subdivisions, and three small, isolated semicircular structures at the southern end of the site (Figure 4-43). The northern compound has 60 square meters of internal space with two subdivisions. The central compound has 80 square meters of internal space and 3 subdivisions. Finally, the southern compound has 360 square meters of internal space and 8 subdivisions. Although the walls are mostly collapsed, there are indications that they were originally double faced. The walls were constructed with non-dressed stones. Walls segments are best preserved in the internal divisions where they stand a meter high under the sand.

The southern compound has in its northeast corner a large, enclosed square space of 190 square meters that may correspond to a *cancha* surrounded by residential rooms rather than a camelid corral; a possibility that will be further discussed in Section 4.2.4.1. Other rectangular structures can be found 320 meters to the northeast, and 260 meters to the southeast from Tambo Medanoso. These outlying structures are represented by wall foundations, and exhibit a more regular geometry than Tambo Medanoso. The structure to the northeast was associated with porcelain, stoneware sherds, and iron fragments from the 19^{th} and early 20^{th} centuries, while the structure to southeast yielded no surface material and may have been. These outlying structures were probably historic posts for prospecting in the area.

4.2.1 Surface artifact distributions at Tambo Medanoso

Overall, surface artifact variability was lower here than at other sites, because Tambo Medanoso is located in a plain where aeolian sand accumulation takes place. However, the test pitting revealed that areas of higher density on the surface also had higher subsurface densities. As can be seen in Figure 4-45, sherds made up most of the artifacts in most of the collection units. As seen in Figure 4-43, the highest densities of sherds are in the southern part of the site, especially in the internal subdivided structure along the south side of the possible *cancha*. The sherd densities suggest the rest of the compound was residential in function.

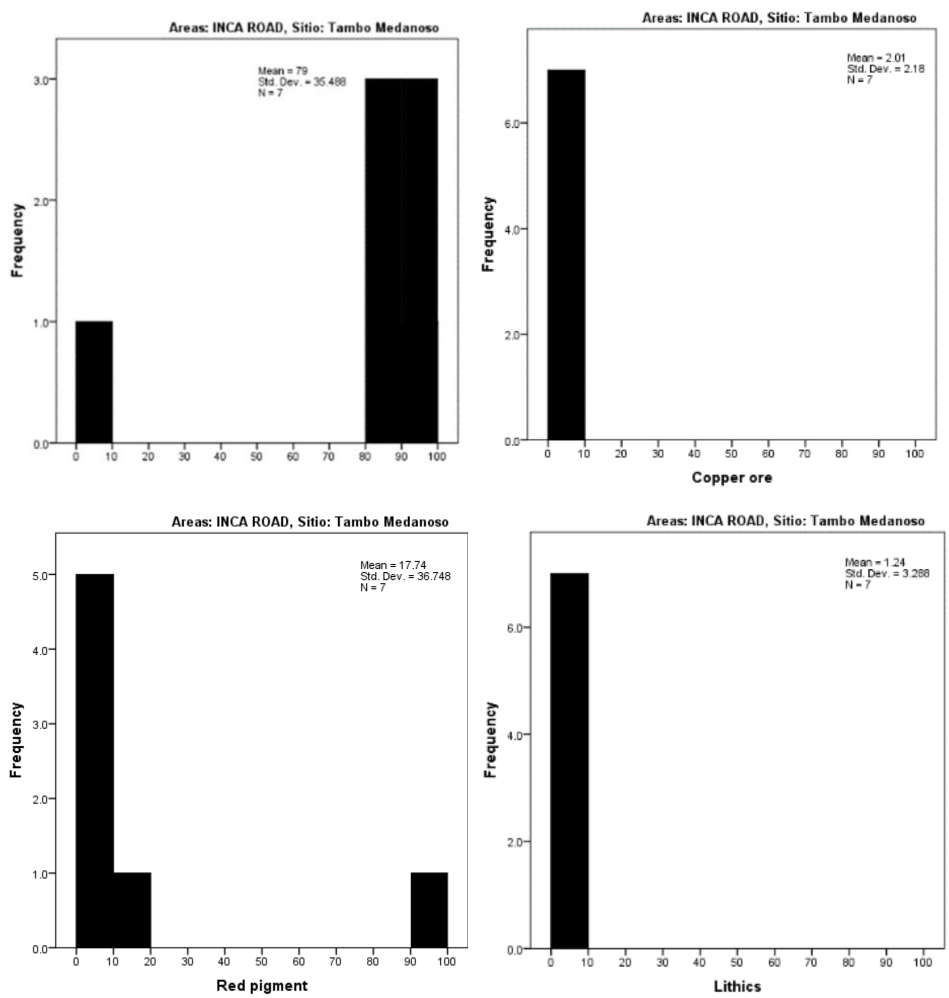

Figure 4-45. Histograms of proportions of surface artifacts from collections units in Tambo Medanoso. Only for collection units with more than 10 artifacts (N=7)

The surface collections yielded a handful of copper ore and red pigment fragments; these were markedly less abundant than at other sites. Figure 4-45 shows that apart from pottery, there is one unit where red pigment fragments constituted most of the unit's assemblage. This was a "doorway" assemblage from a structure in the southern section of the site; a context likely to reflect materials swept from the structure floor, or perhaps from an activity done in the shade of a doorway.

4.2.2 Tambo Medanoso test pit excavations

Test pits were located to explore the main structures, features, and production areas, and were distributed among structure interiors, exterior activity areas, and hearths. In Tambo Medanoso, 6 test pits were excavated; 4 measuring 1 x 1.5 meters, and Units 1 and 2 measuring 1 x 2 meters. Excavation units were located as follows:

Unit 1 was located in the main compound of the site, in the center of an interior space. Artifacts were only found to a depth of 30 centimeters.

Unit 2 was placed in the center of the largest enclosed space at the site. Artifacts were only found to a depth of 20 centimeters.

Unit 3 was located inside of a small square isolated structure at the southern part of the site. Artifacts were only found to a depth of 20 centimeters.

Unit 4 was located inside the central compound of the site. Below the surface we exposed the wall of an earlier structure with radiocarbon dates that pre-date the Inca occupation. Artifacts were only found to a depth of 40 centimeters.

Unit 5 was located in the interior of the northern compound of the site. Artifacts were only found to a depth of 30 centimeters.

Unit 6 was placed inside the main compound of the site in a different room than Unit 1. Unit 6 was laid out parallel to a wall in an area with ashes on the surfaces, associated with a hearth. Artifacts were only found to a depth of 40 centimeters.

Together, the six test pits yielded 62 sherds, 317 animal bones, 9 lithics, 8 copper ore fragments, 29 red pigment fragments, and 50 marine shell fragments (table 4-2). As shown in Figure 4-47, the southern compound yielded the most excavated materials. Here, the main difference between surface and subsurface assemblages was proportionally less pottery (and proportionally more of everything else, especially shell) in the latter (Figure 4-46).

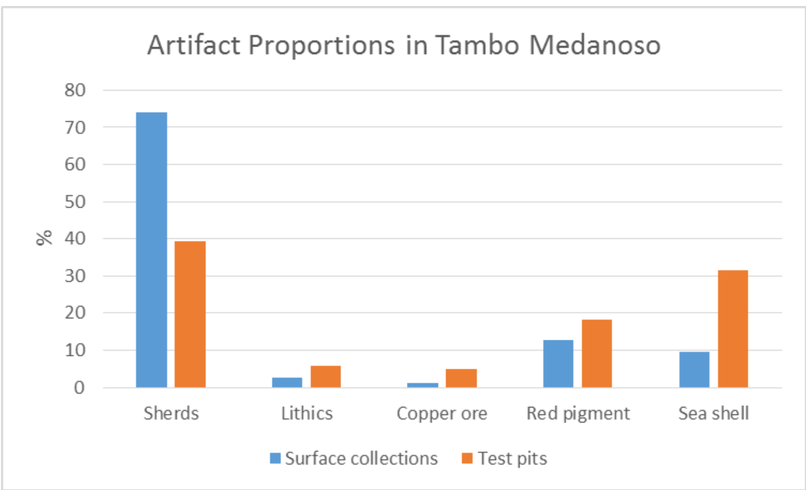

Figure 4-46. Comparison between artifact proportions from surface collection and test pits from Tambo Medanoso

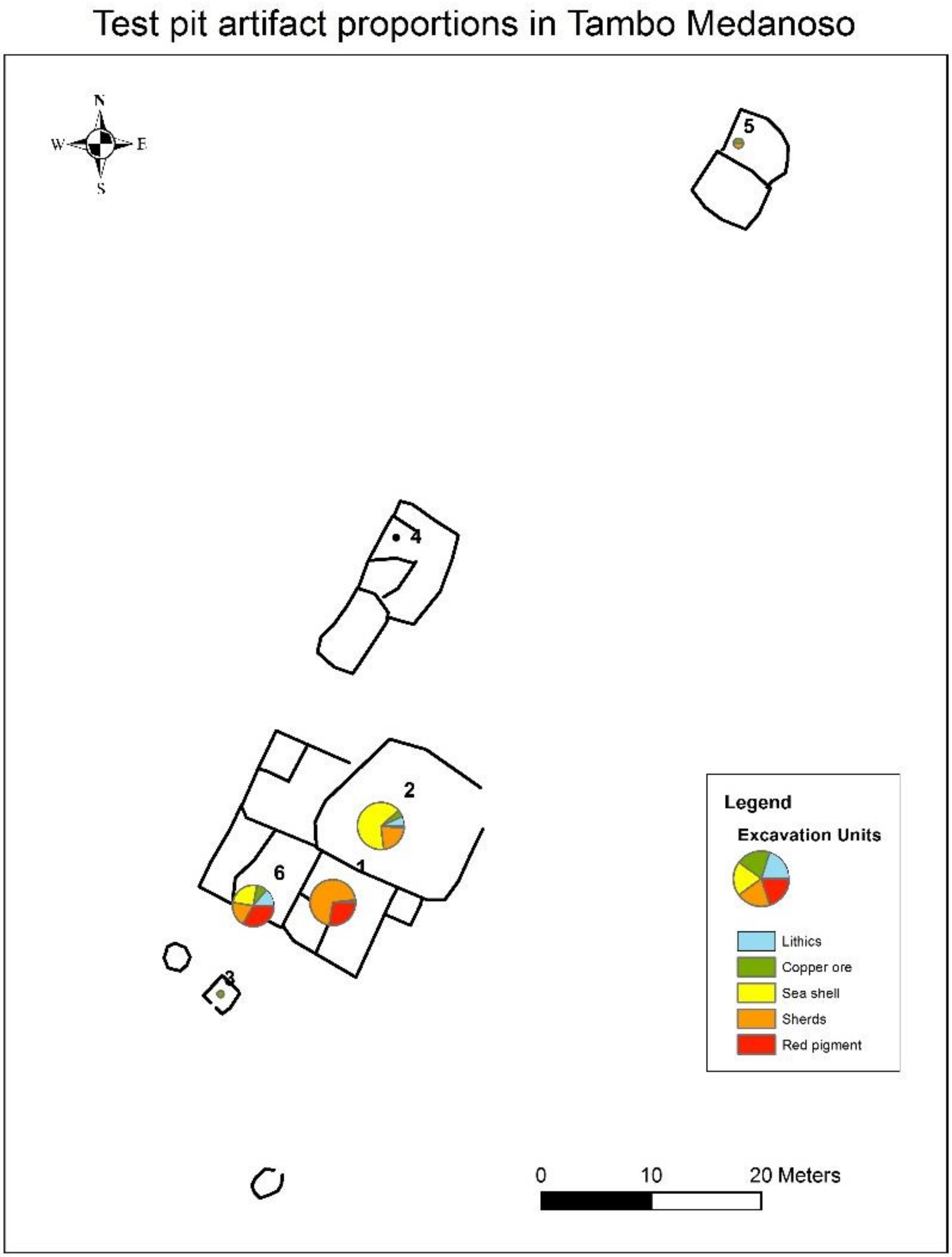

Figure 4-47. Map with excavation artifact proportions at Tambo Medanoso. The chart size represents raw artifact counts. Units 1 and 2 are standardized with the others because they were slightly larger

Table 4-2. Artifact counts from excavation units at Tambo Medanoso

Units and levels	Sherds	Animal bones	Lithics	Copper ore	Red Pigment	Marine shells
Unit 1 (2 x 1 m)	**41**	**7**	**0**	**0**	**16**	**1**
Surface	3	2	0	0	2	0
1	28	5	0	0	13	1
2	5	0	0	0	0	0
3	5	0	0	0	1	0
Unit 2 (2 x 1 m)	**13**	**143**	**4**	**3**	**1**	**40**
Surface	3	13	1	0	1	9
1	9	118	3	0	0	23
2	1	12	0	3	0	8
Unit 3 (1.5 x 1 m)	**0**	**1**	**0**	**1**	**0**	**0**
Surface	0	0	0	0	0	0
1	0	1	0	1	0	0
2	0	0	0	0	0	0
Unit 4 (1.5 x 1 m)	**0**	**22**	**0**	**0**	**0**	**0**
Surface	0	0	0	0	0	0
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	21	0	0	0	0
4	0	1	0	0	0	0
5	0	0	0	0	0	0
Unit 5 (1.5 x 1 m)	**1**	**1**	**0**	**1**	**0**	**0**
Surface	0	0	0	1	0	0
1	0	0	0	0	0	0
2	1	1	0	0	0	0
3	0	0	0	0	0	0
Unit 6 (1.5 x 1 m)	**7**	**155**	**5**	**3**	**12**	**9**
Surface	0	4	0	0	0	0
1	2	58	0	0	5	2
2	5	89	5	3	7	7
3	0	2	0	0	0	0
4	0	2	0	0	0	0
Total	**62**	**329**	**9**	**8**	**29**	**50**

4.2.3 Tambo Medanoso radiocarbon dates

Although the site's surface architecture and artifacts are diagnostic of a Late Period occupation, this site had an earlier occupation dating to the end of the Middle Period, as attested by two AMS radiocarbon dates (Table 4-3). The earliest date is of material from excavation Unit 4, at 30 centimeters deep, and associated with an elliptical stone structure completely buried under the central compound of the *tambo*. The second Middle Period date comes from material 10 centimeters deep in Unit 3. Using the calibration curve SH13 and plotting the dates into a Bayesian model with OxCal 4.2 software, we can see that there is a transition between both occupations from 935 to 1373 A.D. at the 95.4% of probability (Figure 4-48). AMS radiocarbon dates for the Late Period fit with the local chronology, indicating that the site was occupied at the beginning of the 15th century. In sum, it is clear that the Inca built this site over a previous occupation at the time the road was constructed.

Table 4-3. AMS radiocarbon dates from Tambo Medanoso. All dates come from charcoal samples, except for TM U6-N2 that comes from an animal bone

General ID	Sample ID	Mass	d13C value	F (d13C)	dF (d13C)	14 Age BP	d14C Age	Cal Sh Cal 13 Min AD	Cal Sh Cal 13 Max AD	% Cal
AA104029	TM U6-N2	0.77mg	-20.1	0.9327	0.0047	559	41	1325	1452	95.4
AA104030	TM U4-N3	0.81mg	-22.6	0.8581	0.0037	1229	34	766	970	95.4
AA104031	TM U1-N2	1.29mg	-22.6	0.9143	0.0039	719	34	1275	1391	95.4
AA104032	TM U3-N1	0.94mg	-22.9	0.8708	0.0037	1111	34	893	1027	95.4

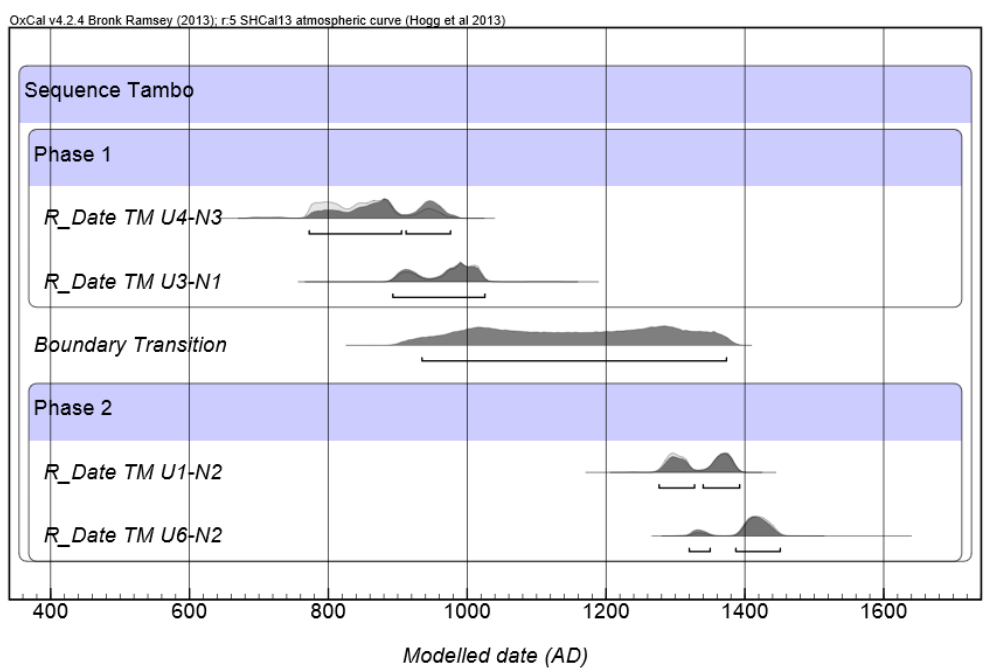

Figure 4-48. Calibrated radiocarbon AMS dates for Tambo Medanoso. Bayesian modeling

4.2.4 Features from Tambo Medanoso

4.2.4.1 A possible *cancha* at Tambo Medanoso

Unit 2 was centrally placed within the largest enclosed space of the southern compound. As seen in the stratigraphy (Figure 4-49), the first 5-10 centimeters was a layer of sand, overlying a hard, homogeneous stratum of relatively level compact gravel and silt. This layer differed in texture from the sandy matrix of the site, and exhibited numerous erosion fractures (Figure 4-50), perhaps caused daily temperature fluctuation, the dense winter fog, and/or human use. This kind of compact layer so close to the surface was not found in other test pits, and it possibly represents an artificially prepared surface (floor). Most of the artifacts were found within the first 10 centimeters, on or directly above this layer.

This large enclosed space possibly corresponded to a small *cancha*. The distinct hard floor (perhaps trampled) and the relative abundance of decorated sherds and animal bones suggest that this area may have been used for special, state sponsored, commensal activities, as is well known from similar architecture at other Inca sites (c.f. Bray 2003, Cantarutti 2013, Salazar et al. 2013b, Uribe and Urbina 2009). Overall, however, the level of this activity does not seem to have been intense, and possibly was quite sporadic, considering that food remains are less dense here than in residential sites such as CH1. Of course, the dimensions of this space are very humble if we compare them with the *canchas* of other Inca sites such as Miño with 1,940 m^2, Cerro Colorado with 3,429 m^2 (Uribe and Urbina 2009), or Viña del Cerro with 3,000 m^2, or the modest central patio at the La Puerta site in the Copiapó Valley with 290 m^2 (Castillo 1998, Niemeyer 1986).

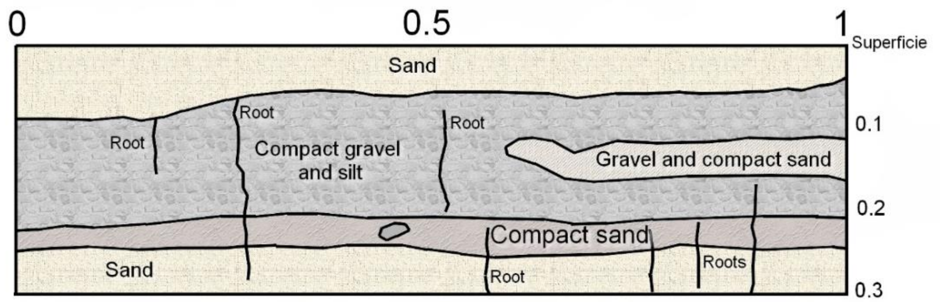

Figure 4-49. West profile of test Unit 2 in Tambo Medanoso


Figure 4-50. View of the possible floor in Unit 2 at Tambo Medanoso

4.2.4.2 A buried pre-Inca structure at Tambo Medanoso

Test pit 4, located in the central rectangular compound of the site, exposed a buried structure, seemingly elliptical in shape, less than 2 meters in diameter (Figure 4-51). A few stones of this structure were visible from the surface.


Figure 4-51. Buried structure under the central compound of the site. View at the surface, Level 1, and Level 4

As visible in the profiles (Figures 4-52 and 4-53) the base of this early structure extends 45 centimeters below ground, and lies on the sterile compact sand which is natural bedrock sediment of the area. The radiocarbon dates from Level 3 of this unit give a calibrated range of 766-970 AD, a similar to the one obtained from excavation Unit 3, and consistent with the pre-Inca occupation of mining sites in the Cachiyuyo de Llampos area. The only artifacts found in this excavation were 22 animal bones in Levels 3 and 4, at the bottom of the wall, and a few pieces of charcoal from an ephemeral cooking fire. Fifteen of the faunal remains were fish bones, making this unit the one with the second most representation of fish.

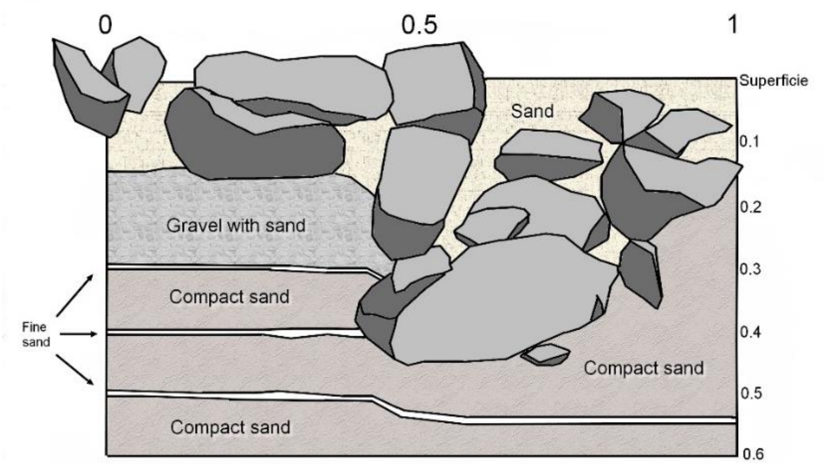

Figure 4-52. North profile of test pit 4 in Tambo Medanoso

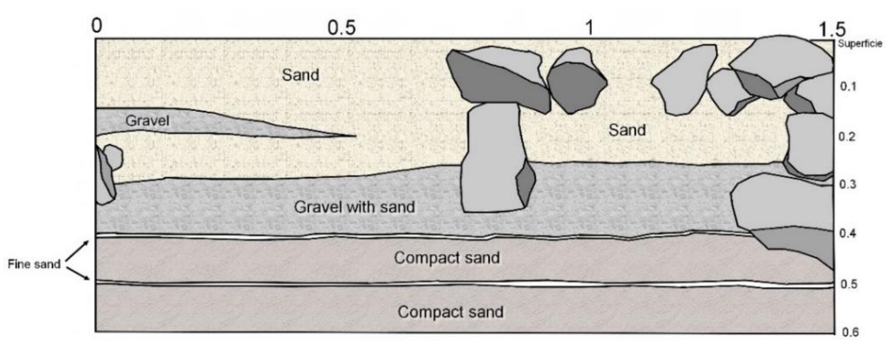

Figure 4-53. West profile of test pit 4 in Tambo Medanoso

4.2.4.3 A hearth feature at Tambo Medanoso

In test Unit 6, in the southern compound of the site (Figure 4-54), we encountered charcoal particles and ash between 5-25 centimeters deep, representing a hearth eroded by wind and mixed with loose sand (Figure 4-55). The unit fill contained a high proportion of animal bones in association with the charcoal, evidence for food preparation. One of the bones was used for a radiocarbon date (calibrated range 1325 – 1452 AD).

Figure 4-54. Location of test pit 6 in the southern compound of Tambo Medanoso

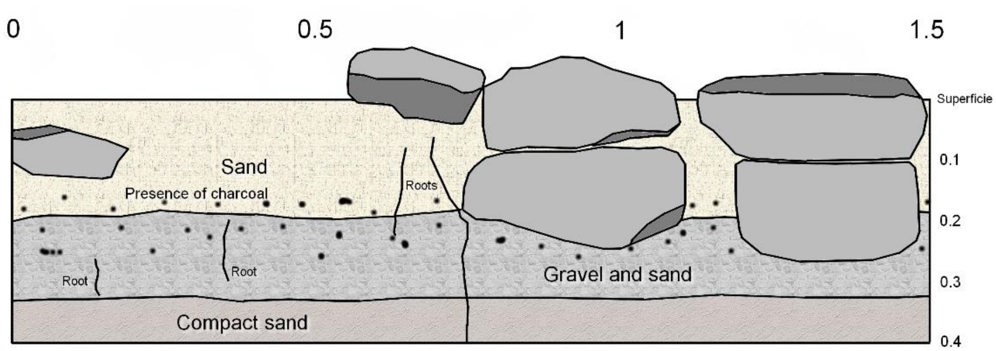

Figure 4-55. South profile of test pit 6 in Tambo Medanoso. Not all the stones of the wall can be seen in the profile because is not totally straight

The presence of two stones with evidence of red pigment (Figure 4-56) suggests some limited grinding of pigment at the *tambo*, perhaps as a casual activity by visitors. Associated with these stones in Level 2 were red pigment fragments, some copper ore, and Inca pottery, including an aryballo neck (Figure 4-56).

An XRD analysis[16] of a sample of red pigment from Level 2 indicated a composition of 55.9% of hematite (Fe_2O_3), 33.5% of quartz (SiO_2), 9.1% of calcite (CaCO3), and 1.5% of microcline ($KAlSi_3O_8$). The presence of hematite was seen in a sample from Unit 6 at CH1 that had a composition of 82.8% of quartz (SiO_2), 15.6% of hematite (Fe_2O_3), and 1.6% of calcite ($CaCO_3$). It is very plausible that the pigments were coming from the mining sites of the Cachiyuyo de Llampos Mountains. Tambo Medanoso shows more involvement in the movement of red pigment than it does of copper ore.

Figure 4-56. At the top, stones with red pigment as they were found during excavation. At the bottom, red pigment fragments and aryballo neck associated in stratigraphy. All of them are from unit 6 Level 2

4.2.5 Tambo Medanoso artifact analysis

4.2.5.1 Pottery

Nearly all the pottery in the excavations came from Units 1, 2, and 6 in the large southern compound. The excavated ceramic assemblage from Tambo Medanoso breaks down into 17.5%

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[16] Analysis done in the geochemical laboratory of Universidad Católica del Norte, Antofagasta, using an XRD machine Siemens model D5000

Diaguita Inca types, 50.9% Inca local types including red slipped, and black-red over red, and cream styles, and 31.6% monochrome sherds. In total, 68.4% of all sherds from the site have some decoration, and all of them are diagnostic of the Late Period.

All pottery types including Diaguita Inca, Inca local, and monochrome types have wall thicknesses of less than 8 millimeters (Figure 4-57). In other words, all vessels from this site were made with relatively light weight, and probably were of small size, making them relatively easy to carry.

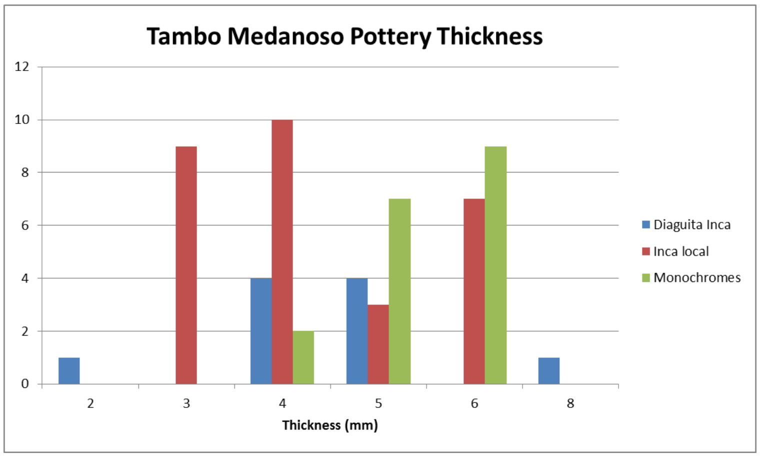

Figure 4-57. Thickness of pottery types in Tambo Medanoso

Bray (2003, 2004, 2009) has identified seven Inca vessel types likely to be present in the core of the Empire and in Inca provinces. Chilean sites during the Inca epoch have yielded the four pottery morphologies shown in Figure 4-58 (Berenguer 2009). Three of these four were found at Tambo Medanoso, together with Inca local bell-shaped bowls (Figure 4-59). These last are distinct from the Diaguita Inca styles, having the shape of local Late Intermediate Period vessels, but with Inca-style decoration. Overall, the assemblage resembles that of Inca associated sites elsewhere in the Inca Empire, with Inca local and Diaguita Inca types, and forms such as bowls, shallow plates, asymmetrical Diaguita vessels, pedestal-base pots, and aryballos.

The Diaguita Inca styles represent mainly bowls and asymmetrical vessels, which are common at other segments of the Inca Road (Niemeyer and Rivera 1983, Uribe and Cabello 2005).

Figure 4-58. Morphological variations of Inca pottery in Chile (Berenguer 2009:91). Inca bowls, a local morphological adaptation, are not included here

Figure 4-59. At the left, pottery styles from Tambo Medanoso. At the right, morphological equivalents (taken from Berenguer 2009, Cornejo 2001, and the collections of Museo Regional de Atacama, and Museo de Historia Natural de Valparaiso)

Proportions of Inca and Inca-style pottery vary greatly at Atacama Desert sites. In the area of Tarapacá, for example (Berenguer and Caceres 2008, Uribe et al. 2007), Late Period villages such as Nama, Camiña, Chusmisa, Jamajunga exhibit less than 5% of Inca diagnostic sherds, while the administrative center of Tarapacá Viejo exhibits 32.6%. In the Tarapacá highlands, along the Inca Road, the proportion is 25% for Collacagua, and 20% in the Huasco salt marsh sector. The Alto Loa area between Miño and Lasana exhibits 44% of Inca diagnostic pottery, if we include both imported and locally manufactured varieties (Uribe and Cabello 2005). In contrast, major Inca sites such as Miño 1 and Miño 2, have percentages of 12,5% and 12.8% respectively, and 11% at Cerro Colorado (Uribe and Urbina 2009). More locally, in the Copiapó Valley, Viña del Cerro presents only 3.5% sherds assigned to clearly Inca styles, with a local Copiapó and Punta Brava styles making up the majority (Niemeyer 1986). Therefore, Tambo Medanoso, at 68.4%), has a very high percentage of Inca pottery compared to other Chilean sites; in fact, one of the most "Inca" assemblages of any Atacama site.

4.2.5.2 Lithic artifacts[17]

The lithics were of basalt (54.5%) or silex (45.5%). One of the main features of the Tambo Medanoso lithic assemblage was the lack of cores. Most of the debitage was small flake fragments (54.5%), flakes derived from cores (27.3%), and secondary flakes as products of bifacial flaking (18.2%). Lithic materials thus were worked primarily at other places, and lithic activities here consisted of expedient and retouch secondary flaking. That tools were not being manufactured here is also supported by the lack of cortex in the assemblage; 80% of the lithics

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[17] The classification of lithic artifacts was done with the help of Daniela Padilla, archaeologist from the University of Chile.

lacked cortex, meaning that they were not primary debitage from cores. However, no finished stone tools were found at Tambo Medanoso.

4.2.5.3 Botanical remains[18]

No carbonized plant remains were found at Tambo Medanoso, suggesting short occupations and minimal fires, without much cooking of vegetables. This may be explained by the lack of fuel in the vicinity. Analysis of botanical remains revealed the abundant presence of *Tiquilia atacamensis* and *Atriplex* sp., together with a few *Cactaceae* seeds (Rable 4-4). The actual use of these local species at the site is not clear, but according to ethnographic sources, the roots of *Tiquilia atacamensis* could be consumed directly or prepared as a tea, and *Atriplex* could correspond to the species Cachiyuyo, have been consumed fresh or in stews (Villagrán and Castro 2004). Ultimately, however, we cannot determine if those seeds arrived to the site naturally via the wind, or were introduced by human consumption.

Table 4-4. Identified botanical remains at Tambo Medanoso

Excavation Unit	Atriplex sp.	Cactaceae	Unknown #1	Tiquilia atacamensis	Total
1	125	1		1,709	1,835
3	107	1	1	954	1,063
4	354			1,156	1,510
5	121			1,187	1,308
6	122			837	959
Total	**829**	**2**	**1**	**5,843**	**6,675**

[18] The classification of botanical remains was done with the help of Valentina Mandakovic, archaeologist from the University of Chile.

4.2.5.4 Animal bones[19]

The largest identified taxa in the faunal assemblage was fish (45.4%), including the genus *Genypterus sp.*; one of the three species of the fish locally known as congrio (dorado, colorado y negro). This site is about 100 kilometers from the coast, suggesting that these marine species arrived here already preserved (salted or dried). Other taxa included: 35,2% of bones from the *Mammalia* class; 16.7% from the group rodentia including the family *Chinchillidae*; 1.9% camelid; and 0.9% bird (Table 4-5).

Table 4-5. NISP of animal bones at Tambo Medanoso

Animal bones		Taxa										
Test pit	**Level**	**Mammalia**	**Small Mammalia**	**Chinchillidae**	**Rodentia**	**Camelidae**	**Large Mammalia**	**Medium Mammalia**	**Genypterus sp.**	**Osteichthyes**	**Passeriforme**	**Total**
1	1							1		2		3
	2				3							3
2	Surface					1			1	1		3
	1				6		1	5	1	4		17
	2								1			1
4	3		2				1	3		15		21
	4					1						1
5	2									3		3
	4				1							1
6	Surface		1					2				3
	1	4	5					2		4		15
	2			2	6		3	8		16	1	36
Total		**4**	**8**	**2**	**16**	**2**	**5**	**21**	**3**	**45**	**1**	**107**

As seen in Figure 4-60, faunal remains were concentrated in two areas, sampled by test pits 2 and 6. Test Unit 6 included a hearth, so that these bones likely related to food preparation/consumption. There was no evidence of fire in Unit 2, with the most animal bones, and this may have been an area of consumption or trash deposition.

[19] The classification of animal bones was done with the help of Cristobal Oyarzo, archaeologist from the University of Chile.

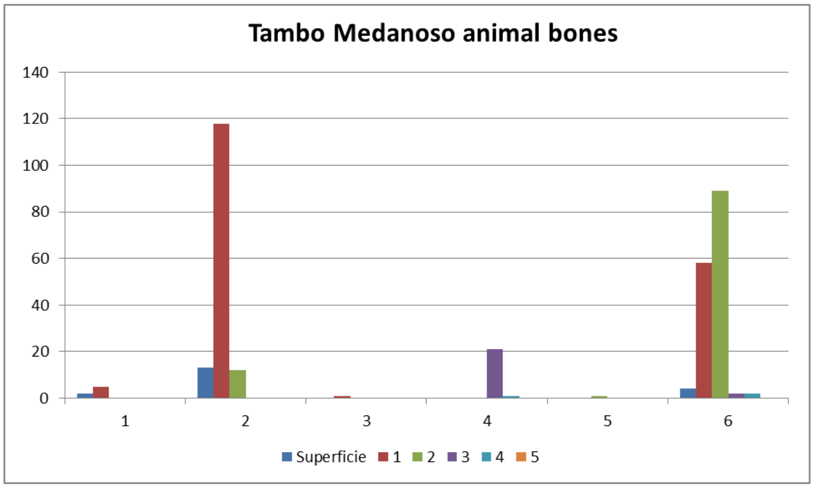

Figure 4-60. Number of animal bones per test pit and excavation level per site

Test pits 2 and 6 are associated with the *cancha*, suggesting that more food consumption took place there than at other portions of the site. This supposition is reinforced by the ceramic assemblage from these units that includes serving vessels such as Inca shallow plates, and Diaguita Inca asymmetrical vessels and bowls.

4.2.6 Comparison to other excavated *tambos* in Chile

Few *tambo* sites comparable to Tambo Medanoso have been investigated in Chile. Sites such as Zapahuira (Santoro et al. 2005), Saguara (Schiappacasse and Niemeyer 2002), Catarpe (Lynch 1977, 1993), La Puerta and Iglesia Colorada (Castillo 1998, Niemeyer 1993) are also associated with the Inca Road, but also seem to have been significant Inca administrative centers in large residential areas. There are only a handful of published reports on isolated, roadside *tambos*, the most complete useful being Tambo Cañapa (Nielsen et al. 2006), and Tambo de Conchuca (Stehberg and Carvajal 1998, Stehberg et al. 1986).

4.2.6.1 Tambo Cañapa and Tambo de Conchuca

Tambo Cañapa is located next to a small lake and pastureland in the highlands, close to the border between Bolivia and Chile (Nielsen et al. 2006). This locale also has materials dating from the Archaic and Formative Periods. The Inca period site consists of two rectangular structures (Figure 4-61). The larger southern one (Sector I) has 4 internal subdivisions, and was partially used as a corral until recent times. Investigators excavated two1 x 1 meters 2 test pits in Sector II of the site, all of Structure R1 in Sector I.

The Inca occupation exhibited a greater diversity of lithic raw material, including obsidian and silex flakes, and fragments of andesite shovels. As with roadside sites in Alto Loa, the site yielded Late Period (Inca Period) style pottery including, Loa-San Pedro de Atacama styles from Chile, and Lípez from southern Bolivia. Inca style ceramics, including Cuzco and regional Pacajes and Lípez variants, represented less than 10% of the total recovered sherds.

The faunal assemblage consisted primarily of camelid (more than 90%), some *Chinchillidae* (around 8%), and a few flamingo bones. Plant remains included maize, chañar, and llareta, this last used probably as fuel. The floor of structure R1, exhibited various spots with red and green pigment, perhaps evidence of the storage of local mineral pigments.

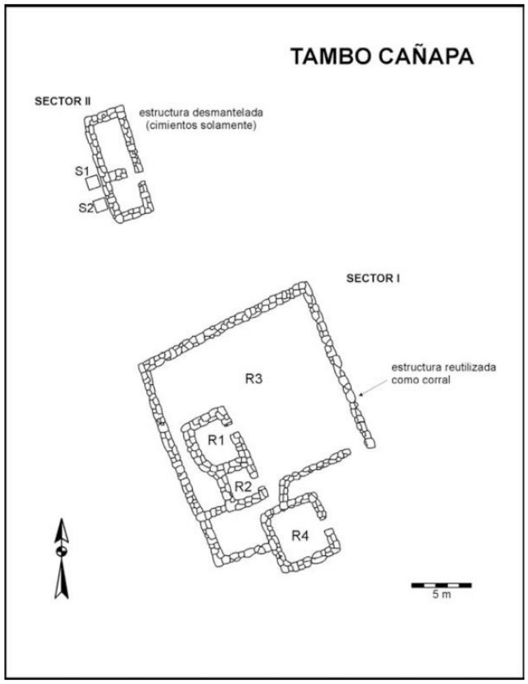

Figure 4-61. Tambo Cañapa (Nielsen et al. 2006)

Tambo de Conchuca lies in the upper Choapa Valley, along a north-south Inca Road section (Stehberg et al. 1986). The site is consists of three architectural units with internal subdivisions (Figure 4-62), built to an orthogonal plan, with double course stone walls typical of R.P.C. Inca structures. Excavation opened up roughly 20 square meters, with test pits distributed in the three main structures of the site. Excavation produced 659 camelid bones, 37 sherds, 3 projectile points, 11 pieces of lithic debitage (flint and jasper), and some fragments of *Concholepas concholepas* marine shell. Of the ceramics, 56.7% were in Diaguita Inca or Inca styles, with the remainder monochrome, including three small bottles stylistically related to the Aconcagua culture of central Chile. No hearths or cooking areas were extant.

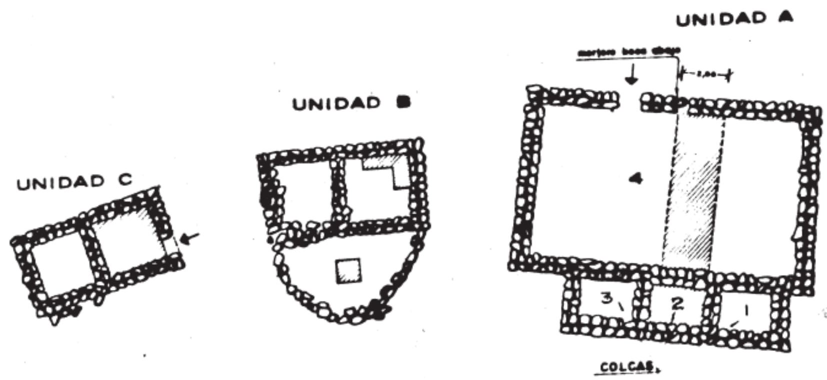

Figure 4-62. Tambo de Conchuca (Stehberg et al. 1986)

4.2.6.2 Comparison with Tambo Medanoso

In comparison with the above *tambos*, Tambo Medanoso has a higher percentage of Inca style sherds. All three sites are composed of R.P.C. configuration, with Tambo Medanoso being about twice as large as the others. Each site possesses a larger enclosed space, which in the case of Tambo Cañapa and Conchuca may have also been used as a corral. Each of them has relatively shallow occupational strata (a maximum of about of 40 centimeters), and none exhibit the hearth features that might be expected in long term residential occupation or intensive food preparation.

In none of the three cases is there much artifactual "residue" of the long distance trade goods one would expect to be moving along the Inca Road as part of the Inca imperial economy.

Like Tambo Medanoso, Conchuca yielded some non-local materials that one might expect to have moved in trade along the Inca Road (marine Pacific shell), and Tambo Cañapa yielded some pigment fragments. Each has indications of only limited, expedient lithic flaking. In sum, the *tambos* are quite similar in artifacts, suggesting similarities in how they were used.

4.3 CONCLUSION

Investigation revealed extensive roadside settlement, including 13 sites with extant architecture. Site density along the Road was greatest where the Road came closest to the Cachiyuyo de Llampos Mountains and its mining camps. Most of the architecture sites consisted of isolated solitary or multiple structures associated with few artifacts, but there were several major sites (Exterior 9, QÑ5, QÑ8, and Tambo Medanoso). The architecture and pottery at the majority of the sites can be described as "local," rather than Inca. The only clearly Inca site (in architectural canons and associated ceramic styles) was the Tambo Medanoso. In general, activities evidenced at Tambo Medanoso are consistent with the temporary support of official travelers. Tambo Medanoso stands out in this regard. The bulk of the sites along the Road display local architectural styles and local ceramic assemblages.

Sites Exterior 9 and QÑ8 show connection to craft activities taking place in the Cachiyuyo de Llampos Mountains, as each exhibited, copper ore and red pigment and/or indicators of its processing. These are the mostly likely places at which the products of the mining camps, or the miners themselves, articulated with the Road. These two sites differ markedly in ceramic assemblages, however. Exterior 9 has local Late Period sherds, but no Inca style ones. In contrast, all QÑ8 decorated sherds belong to Diaguita Inca and Inca local styles.

If we compare the surface proportions of mining/craft products from those sites with Tambo Medanoso (Figure 4-63), we can see that Tambo Medanoso differs in its lower proportion of copper ore and lithics, and higher proportion of marine shell. Perhaps pigment and marine shell figured larger in Inca state traffic than copper beads and non-local lithics.

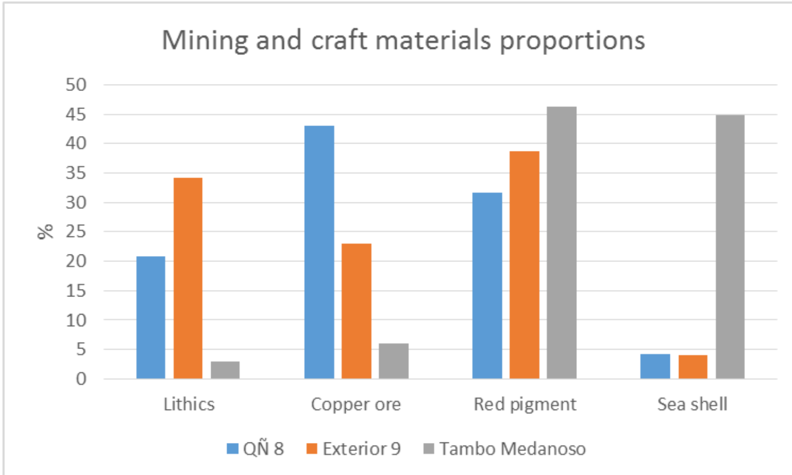

Figure 4-63. Comparison of proportions of mining/craft products at largest Inca Road sites.

5.0 THE CACHIYUYO DE LAMPOS MINING SITES

This chapter describes the layout and internal distribution of artifacts within each of the off-road camps found along the Chinchilla ravine in the Cachiyuyo de Llampos Mountains and the exterior plains. This chapter breaks down the craft activities at each site through analysis of the proportion of surface artifacts, and examines the spatial distribution of these activities and their relationship to residential structures and features.

The chronological place of these off-road sites is based primarily on associated pottery styles. Many sites could be assigned to the Late Period because of the presence of Late Period or Inca style ceramics. Other sites were assigned to the Pre-Inca Period because of the presence of pre-Inca ceramics, and the lack of Late Period diagnostics. Finally, some sites lacking in diagnostic pottery were assigned to the Pre-Inca Period, because it is likely that any Late Period site would have at least one specimen of the ubiquitous Late Period decorative pottery. Sites located in the interior of Cachiyuyo de Llampos Mountains and along the branches of Chinchilla ravine have been named as “Chinchilla” and have a CH prefix. Sites located at the exterior plains and paths have been named Exterior, and have an EXT prefix.

The breakdown of sites per period with number of artifacts and collection units is presented in the following tables (Tables 5-1, and 5-2), and their geographical distribution can be seen in figures 5-1 and 5-68.

Table 5-1. Number of artifact and collection units for Pre-Inca Period sites

Areas and Sites	Collection Units	Collection Units Area (sq meters)	Sherds	Copper ore debris	Red Pigment	Lithics	Marine Shell
EXTERIOR	**53**	**2804**	**123**	**365**	**135**	**448**	**23**
EXT 5	17	878	63	135	39	121	5
EXT 7	7	404	5	8	5	5	1
EXT 8	18	863	55	31	89	266	13
EXT 10	11	659	0	191	2	56	4
CH SITES	**187**	**7997**	**418**	**5343**	**202**	**4931**	**166**
CH 4	15	451	1	209	0	0	0
CH 5	24	918	72	2425	5	43	10
CH 6	12	603	54	41	36	77	6
CH 7	38	1718	14	43	88	1938	38
CH 8	19	918	8	11	23	931	13
CH 10	1	59	2	0	0	0	7
CH 11	27	1159	238	164	35	926	41
CH 12	26	1187	4	1252	3	560	27
CH 13	25	984	25	1198	12	456	24
Total	**240**	**10801**	**541**	**5708**	**337**	**5379**	**189**

Table 5-2. Number of artifact and collection units for Late Period sites

Areas and Sites	Collection Units	Collection Units Area (sq meters)	Sherds	Copper ore debris	Red Pigment	Lithics	Marine Shell
EXTERIOR	**15**	**602**	**47**	**129**	**211**	**182**	**21**
EXT 9	15	602	47	129	211	182	21
Inca Road	**120**	**8309**	**1029**	**111**	**129**	**67**	**39**
QÑ 1	1	78	3	0	0	0	0
QÑ 2	1	78	3	0	0	1	0
QÑ 5	4	287	7	2	8	0	0
QÑ 8	17	1139	86	99	70	51	9
QÑ 9	1	78	0	0	0	1	0
QÑ 12	1	78	25	0	0	0	0
Inca Road	60	4675	673	6	11	6	0
Tambo Medanoso	35	1895	232	4	40	8	30
CH SITES	**172**	**7610**	**1104**	**1509**	**272**	**3666**	**195**
CH 1	72	3479	221	1133	172	131	30
CH 2	18	753	39	36	7	35	3
CH 3	41	1196	674	121	50	194	10
CH 10	41	2181	170	219	43	3306	152
Total	**307**	**16521**	**2180**	**1749**	**612**	**3915**	**255**

5.1 PRE-INCA SITES (~300BC-1400 AD)

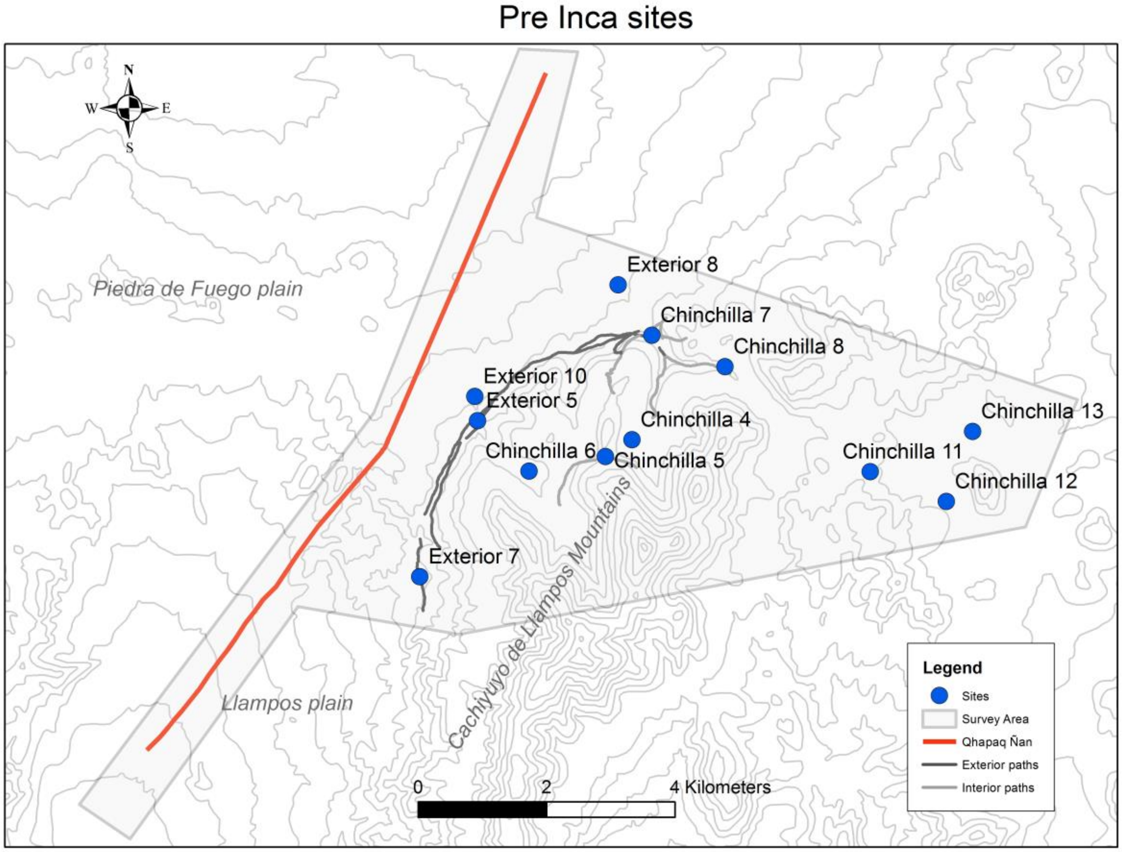

Figure 5-1. Pre-Inca sites within the survey area

5.1.1 Chinchilla 4

This site is located at the bottom of a secondary branch of the Chinchilla ravine and is composed of three semicircular/elliptical structures with abundant green ore debris on the surface (Figure 5-2). CH4 is only about 400 m from a hilltop site, CH5 that is located next to a mine, and it is possible that CH4 site represents a secondary place for processing of the ores extracted from that source. Apart from green ore debris, only a monochrome sherd with a perforation (Figure 5-

3) was found in surface collection. The lack of other artifacts (particularly pottery) and the small size of the site suggests a function as a short-term stopping point for the sorting of ores before transportation.

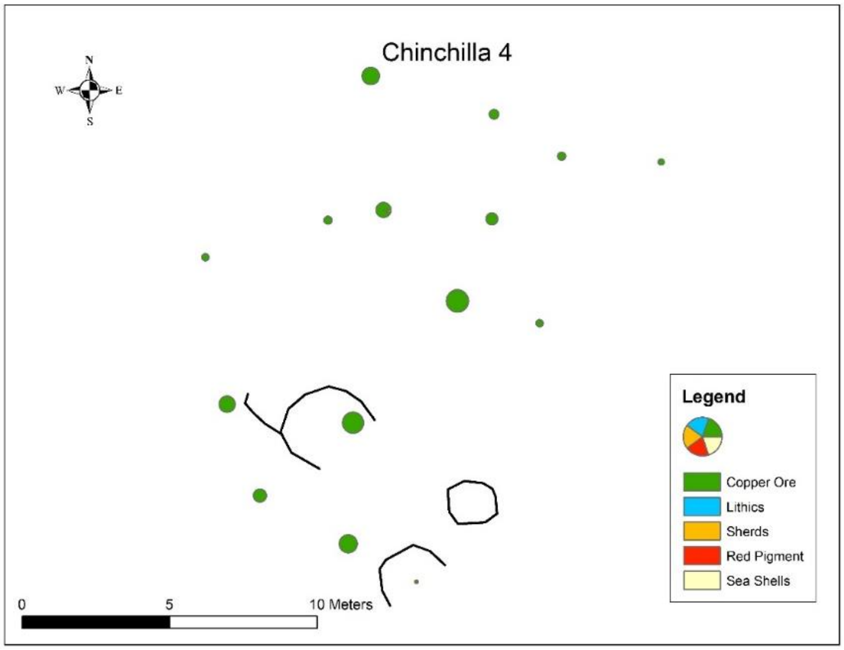

Figure 5-2. Map with surface artifact proportions and satellite image of site CH4, based on 15 collection units (chart size represents raw artifact counts)

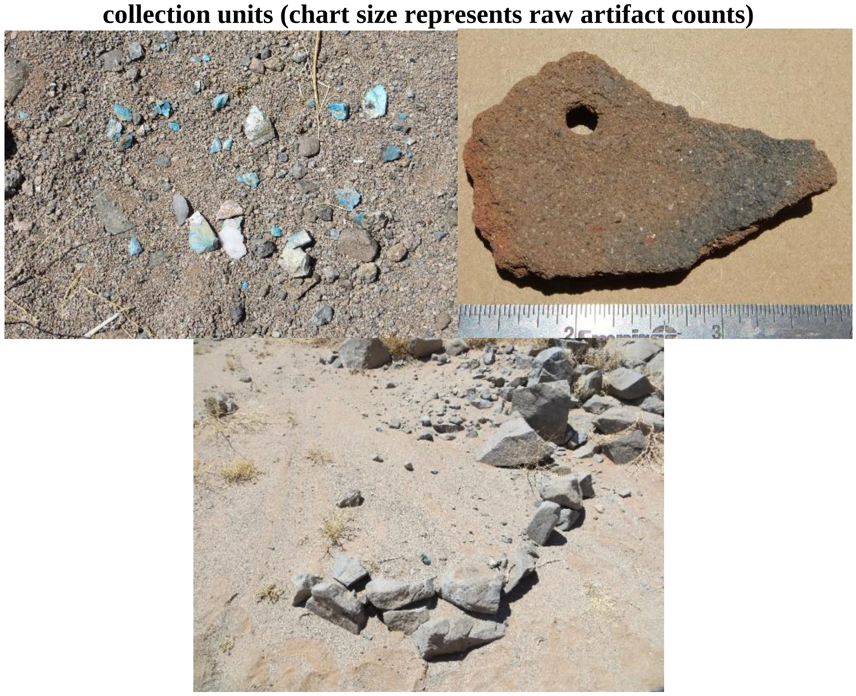

Figure 5-3. At the top, copper ores on the surface of CH4, and a sherd with perforation. At the bottom, view of one of the structures of site

5.1.2 Chinchilla 5

Chinchilla 5 is atop one of the low Cachiyuyo de Llampos Mountains, next to an ore vein with evidence for mining exploitation. The site is also associated with a narrow (60 centimeters wide), sinuous path connecting the site with the bottom of a secondary ravine, close to where CH6 is located (at the opposite side from CH4). The lack of Late Period style pottery, and the presence of a black polished sherd suggest a site occupation of the Late Formative/Alfarero Temprano regional period. CH5 has 3 main clusters of residential structures, with the main compound attached to large natural stone outcrops (Figures 5-4, 5-5). The cluster to the northeast shows the most internal divisions. To the southeast side of these structures is the main concentration of ore and sherds, constituting the main activity area of the site (Figure 5-4). The cluster consists of two elliptical spaces of about 5 by 3 meters, joined by smaller enclosures in the middle. Some of the internal divisions in the structure are too small to have had residential purposes and could have delineated storage areas. All the structures were built with rough stones, laid without mortar. There is no evidence they were roofed, and may have served mainly as windbreakers.

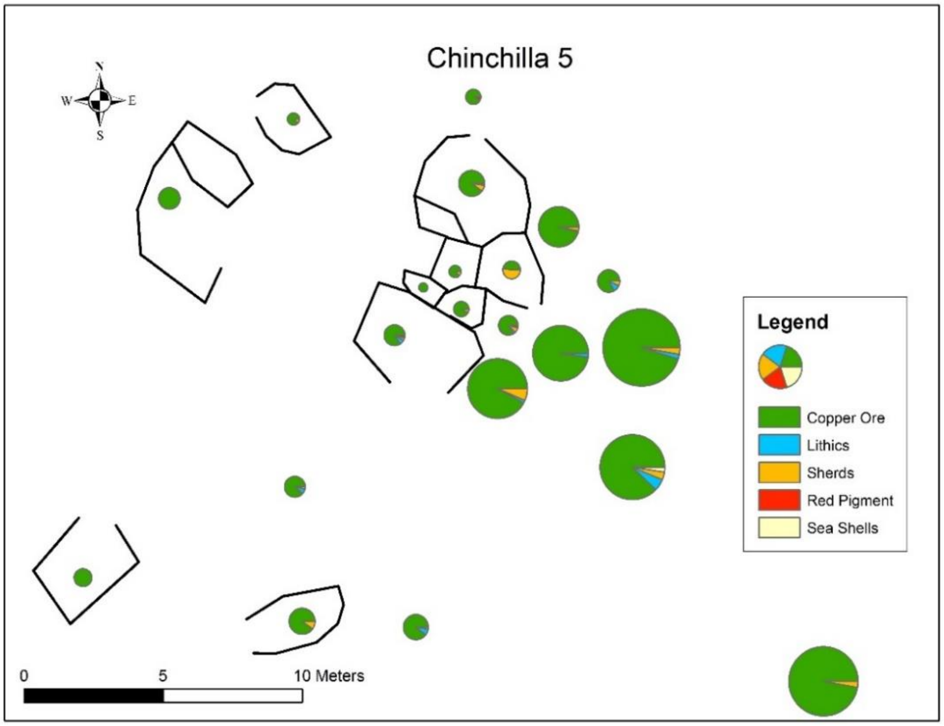

Figure 5-4. Map of proportion of surface materials in site CH5, based on 24 collection units (chart size represents raw artifact counts)

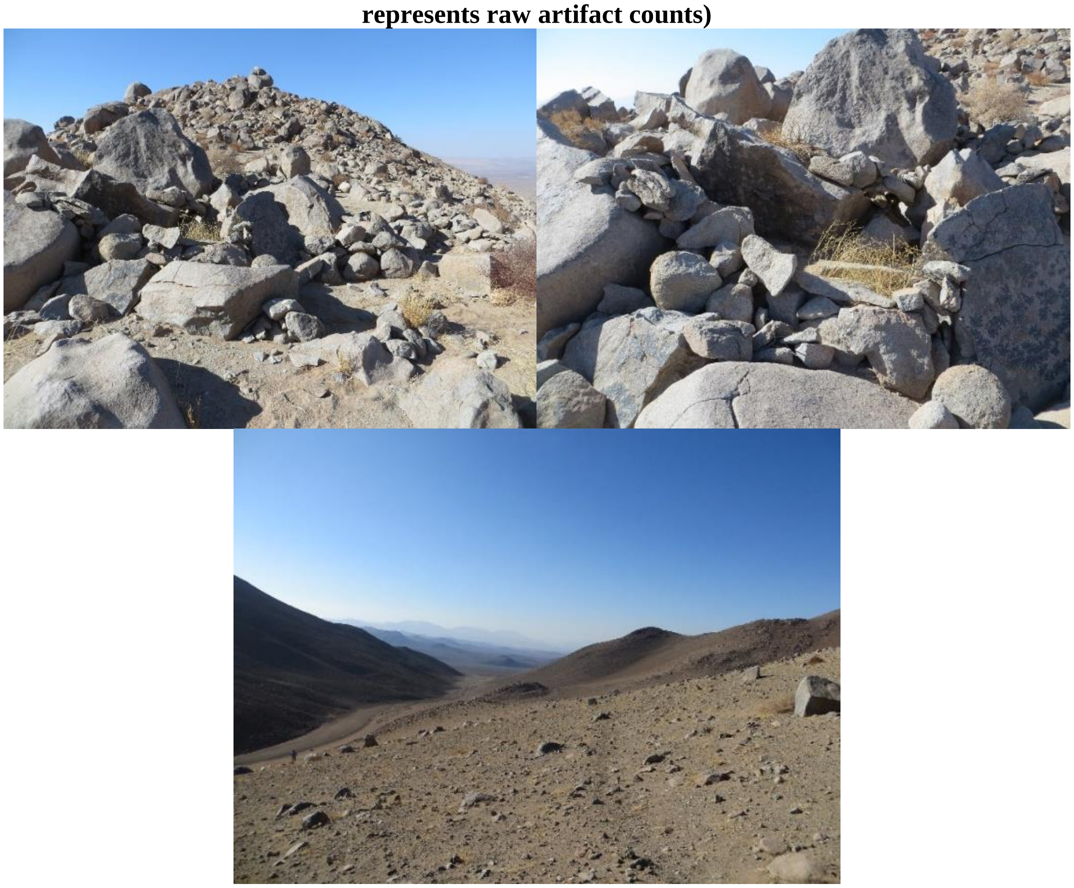

Figure 5-5. At the top, general view of the structures of site CH5. At the bottom, narrow path connecting site CH5 with the bottom of the ravine

Comparison of artifact proportions (Figure 5-6), shows that copper ores represent a high proportion among most collection units. Sherds, lithics and red pigment only constituted more than 20%, in only one unit, for sherds. Although there is a higher density of artifacts outside the structures, the proportion of artifact types is basically the same for internal and external areas (Figure 5-7). This similarity suggests that although more work was done outside, the same kinds of activities were done inside and outside the structures, without much spatial segregation, and that similar discard processes took place inside and outside.

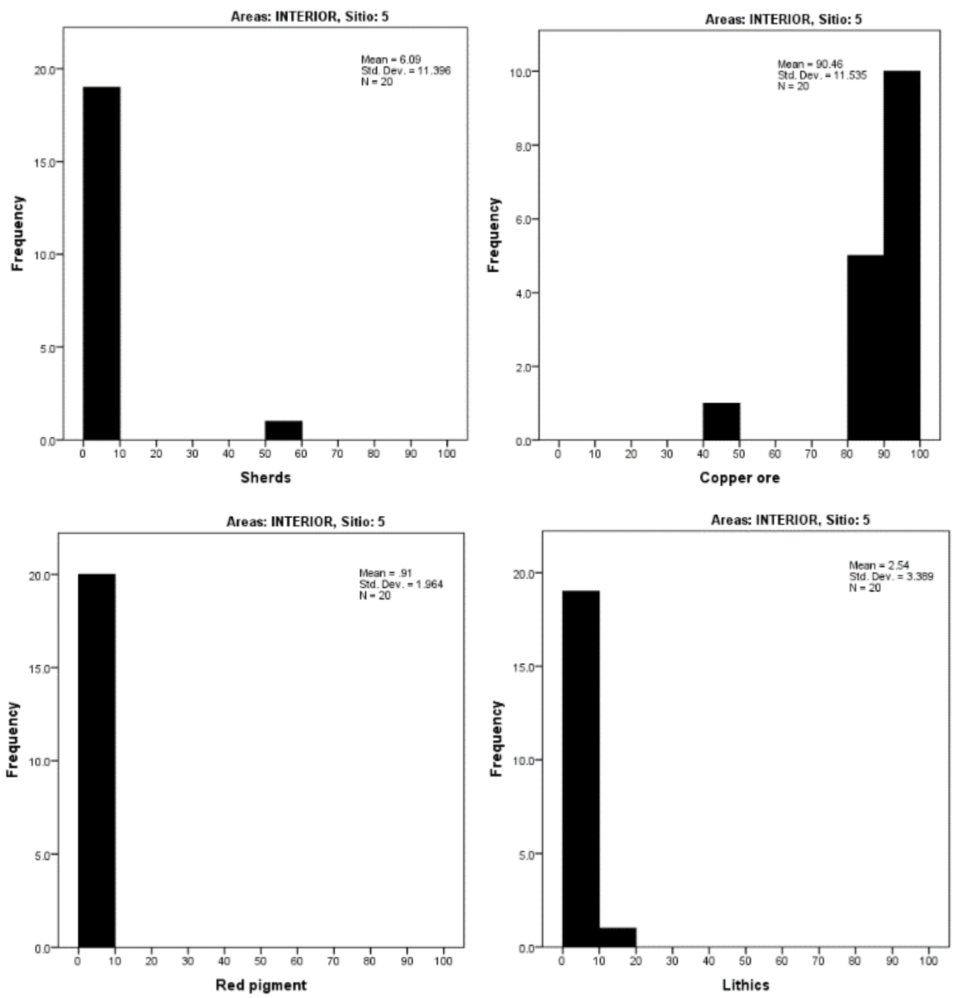

Figure 5-6. Proportion of artifacts from collection units in CH5. Only for collection units with more than 10 artifacts (N=20)

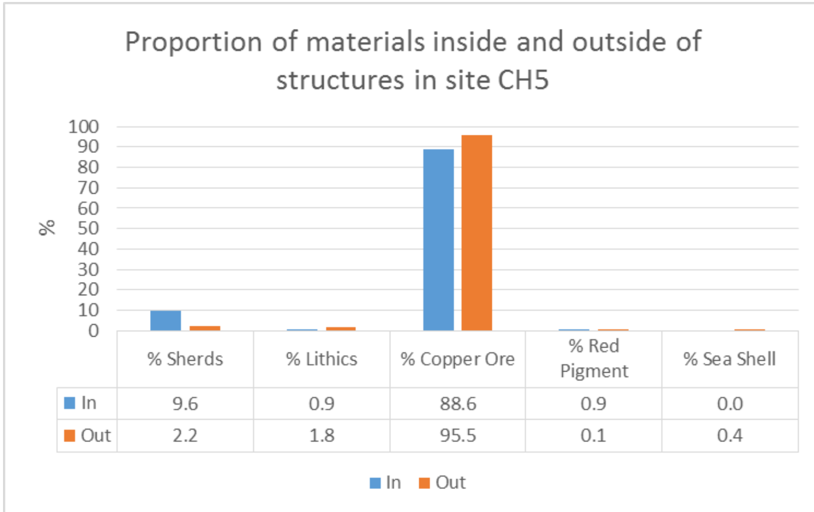

Figure 5-7. Proportion of artifacts inside and outside structures in CH5

Mining at CH5 was carried out through a 10 meter long, 1 meter wide, and 2 meter deep trench (Figure 5-8). The trench followed the mineral vein, which is highly fractured and relatively easy to break with simple hammers. Around the trench is an extensive area covered by ore debris that spills down the slope of the hill to the main group of structures located 90 meters away. No stone mining tools were found around the trench save one hammer. In the residential area of the site were other three round stone hammers, possibly used to crush the extracted ore (Figure 5-9). Ore fragments in this site have an average size of 2 square centimeters, and represent the first stages of processing in bead making. Also found here were bead blanks, and unfinished discarded beads with initial perforation (Figure 5-9). Not all green ores contain copper, and an XRD[20] analysis made to an ore sample from this site shows a composition that is mainly quartz SiO_2 (94.45%), and chlorite $(Mg_5Al)(Si,Al)_4O_{10}(OH)_8$ (5.55%). This is only a single sample, as the mineral composition of the veins is very heterogeneous. To the ancient

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[20] Analysis done in the geochemical laboratory of Universidad Catolica del Norte, Antofagasta, using an XRD machine Siemens model D5000

miners, the exploitation of ores followed from their physical attributes of color and texture, more than copper content. The situation would be otherwise if the ore was being mined for smelting.

Figure 5-8. Mining trench and stone hammer associated with it

Apart from green ore, the surface yielded (Figure 5-9) monochrome sherds, marine shell fragments, fine grain flint, obsidian, and basalt flakes and cores, and a triangular unfinished projectile point. Associated with a hearth were numerous camelid bones.

Figure 5-9. Surface materials from site CH5. At the top from left to right, sherd with external black polishing (exterior and interior view), unfinished projectile point, and unfinished bead with initial perforation. At the bottom left, fractured grinding stone; at the right, three granite hammers

Halfway between the trench and the structures are two rock art panels (Figure 5-10) with abstract geometric figures in red and white pigment, in association with small semicircular structures directly attached to the boulders. They represent local rock art styles, similar to the ones that can be found all through the Cachiyuyo de Llampos Mountains.

Figure 5-10. Rock art panels from CH5. The last image was enhanced using D-Stretch software

5.1.3 Chinchilla 6

This site is located in the slope of a secondary ravine, to the southwest and below site CH5, on a small rocky outcrop, a few meters above the foothills of the ravine. This site is similar in size to CH5 but is less dense in surface materials, which are concentrated at residential structures (Figure 5-11). In contrast to the high proportion of crushed ore at CH5, at CH6 artifacts are distributed more homogeneously, and are not abundant outside the residential structures.

The structures are divided into two clusters visible at the south of Figure 5-11, together with an isolated and smaller structure located to the northeast. The main compound shows some degree of internal symmetry, and is composed of a large elliptical structure with two circular structures attached at either side, plus some open walls at the southern end of the group. The second cluster is composed of three contiguous circular structures, and another circular structure separated by about 4 meters from the others. All the structures were built with rough stones and laid without mortar (Figure 5-12). There is no evidence they were roofed, and probably served as residential spaces with storage areas.

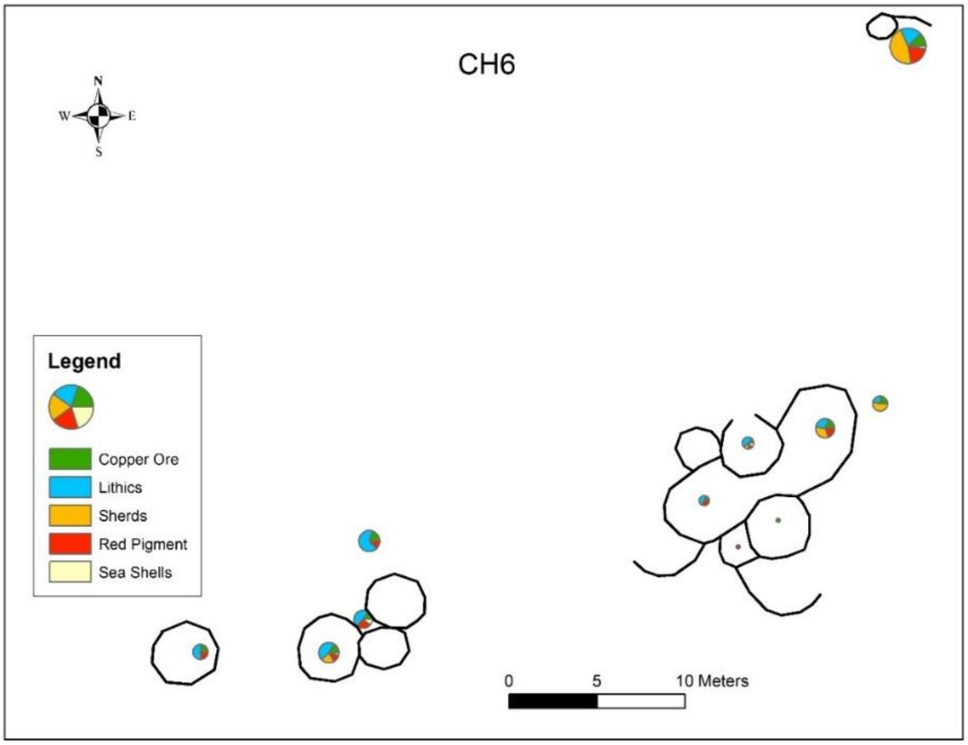


Figure 5-11. Map of proportion of surface materials in CH6, based on 12 collection units (chart size represents raw artifact counts)

Figure 5-12. General view of the architecture of CH6

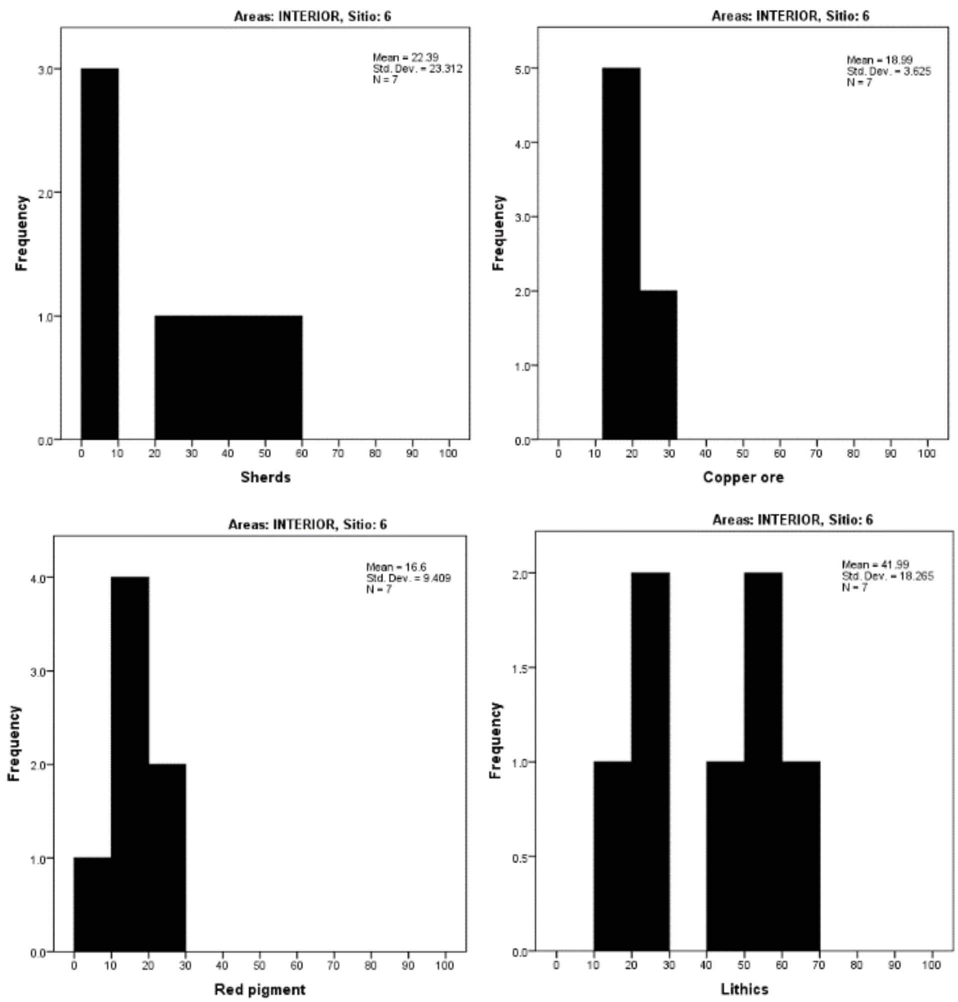


Figure 5-13. Histograms of proportion of artifacts from collection units in site CH6. Only for collection units with more than 10 artifacts (N=7)

As show in Figure 5-13, only lithics represent relatively high proportions in most of the collection units, constituting about half of each assemblage. Copper ore and red pigment were processed in similar, and lower, proportions. At least a dozen flat grinding stones with central polishing on the surface (Figure 5-14) were found associated with the structures. The main group of grinding stones is located in the middle of the main elliptical structure, suggesting that it was a main activity area. Around the grinding stones were a series of pestles that might have been used at the same time as hammers, evidenced by the wear marks at their edges.

Figure 5-14. Flat grinding stones, pestles and hammers from CH6

The main crafts produced at CH6 were beads and red pigment. On the surface was found a finished copper ore bead and a marine shell bead (Figure 5-15) of similar size (4-5 mm), a projectile point with concave base, and monochrome sherds belonging to cooking/container vessels. There was only one decorated sherd: a rim from a highly polished, red slipped jar with an outward projecting rim. This sherd has the same finishing inside and out, and differs morphologically from other red slipped sherds from bowls or jars from the Late Period. There are no other diagnostic elements to assign a more specific date to this site.

Figure 5-15. At the top, general view of some of the surface artifacts from CH6. At the bottom, copper ore and marine shell beads, chert projectile point, and red slipped sherd

The second cluster of circular structures is located in the middle of large boulders and outcrops, and is surrounded by rock art panels (Figure 5-16), representing anthropomorphic figures, camelids, and abstract geometric compositions.

Figure 5-16. Some of the rock art panels associated to CH6, including anthropomorphic, zoomorphic, and abstract motifs. Images were enhanced using D-Stretch software

5.1.4 Chinchilla 7

This site is located at about 150 meters from CH1, on the eastern slope of the hills that surround the Chinchilla ravine (Figure 5-18). It is composed of a scatter of elliptical structures ranging from 2 to 5 meters in diameter. All have an entrance facing to the northeast (Figure 5-17). In contrast to other sites, CH7 does not exhibit a cluster of structures with internal divisions. It is clear that most of the craft activities took place in the southern part of the site, and that this was probably a communal working area for the group residing there. At the terrace in front of the site at the other site of the ravine there is a cleared circular area of 43 meters of diameter, similar to the one in site QÑ8. This area contains two small circular structures and a couple of lithics and monochrome sherds. That area is altered by the modern exploitation of the copper mine located in proximity to site CH1, and its function is not clear.

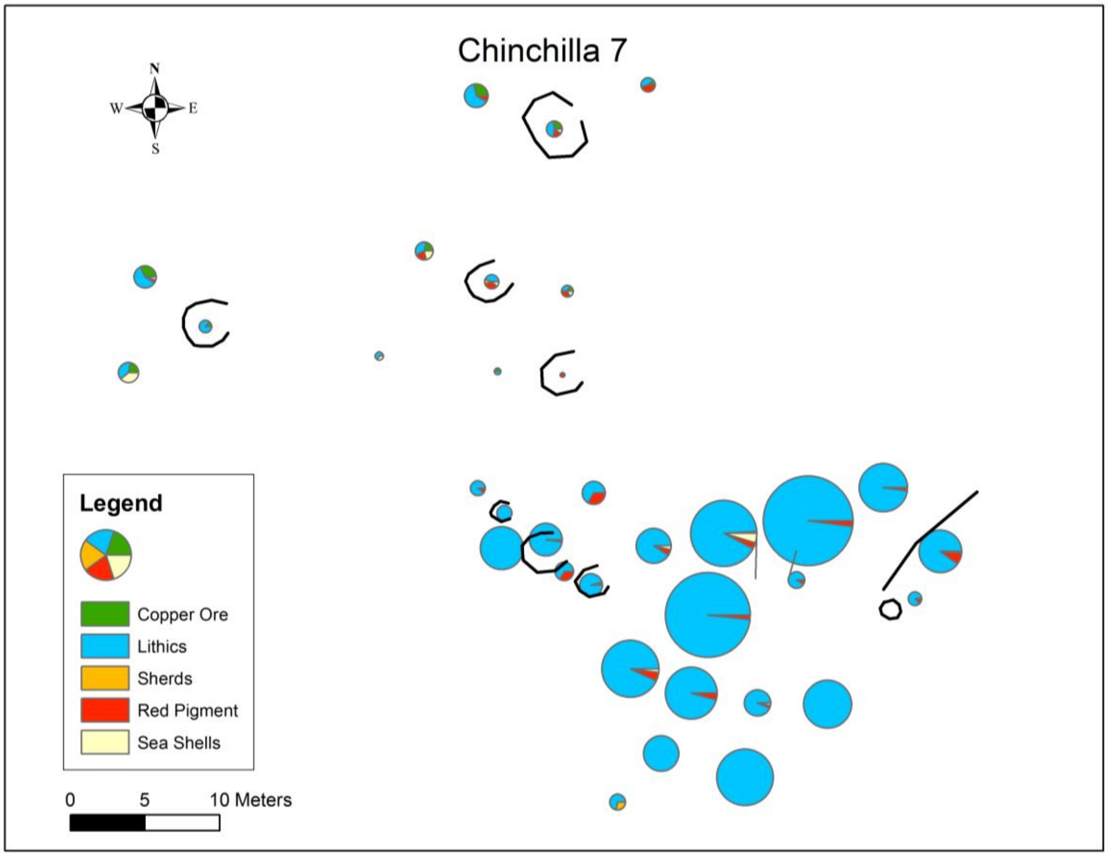


Figure 5-17. Map of proportion of surface materials in CH7, based on 38 collection units (chart size represents raw artifact counts)

Figure 5-18. General view of site CH7

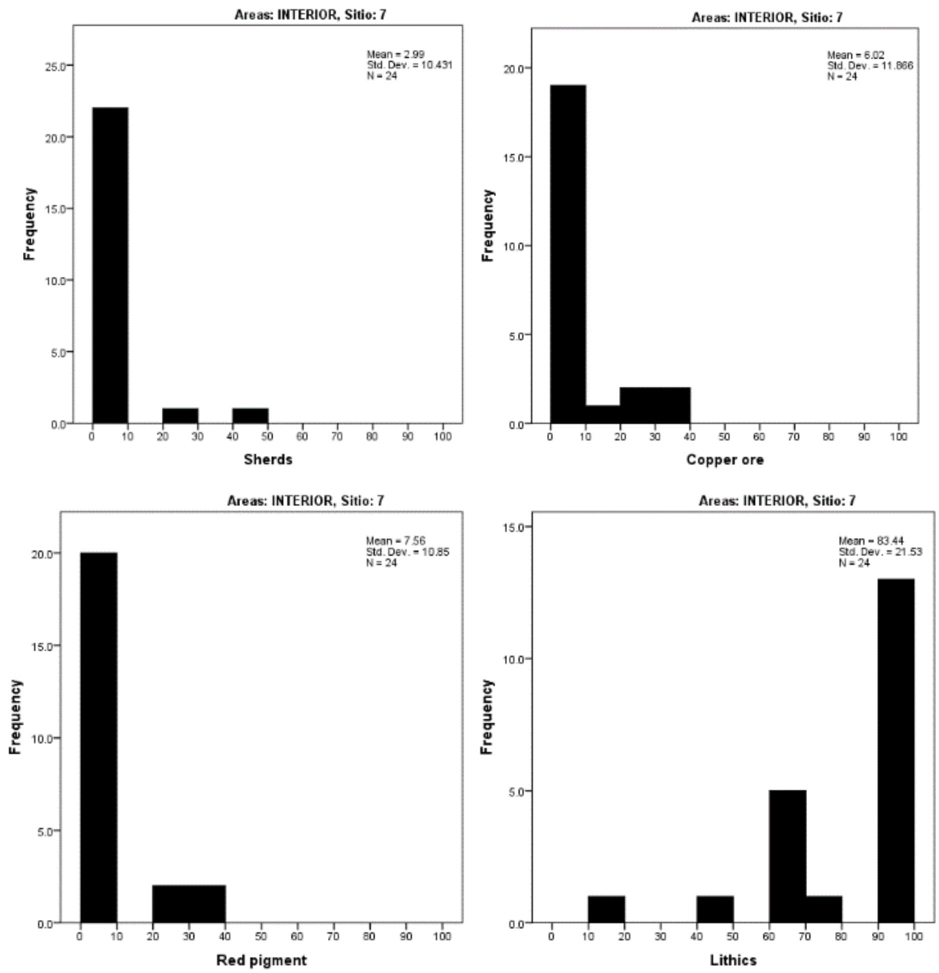


Figure 5-19. Histograms of proportion of artifacts from collection units in CH7. Only for collection units with more than 10 artifacts (N=24)

Figure 5-19, shows that lithics represent a high proportion of most collection units, while distributions of other categories of artifacts do not vary much. Figure 5-20 shows that the difference in interior versus exterior contexts is less than 10% for lithics, and even less for other types of artifacts, suggesting no important division of activities in interior versus exterior spaces.

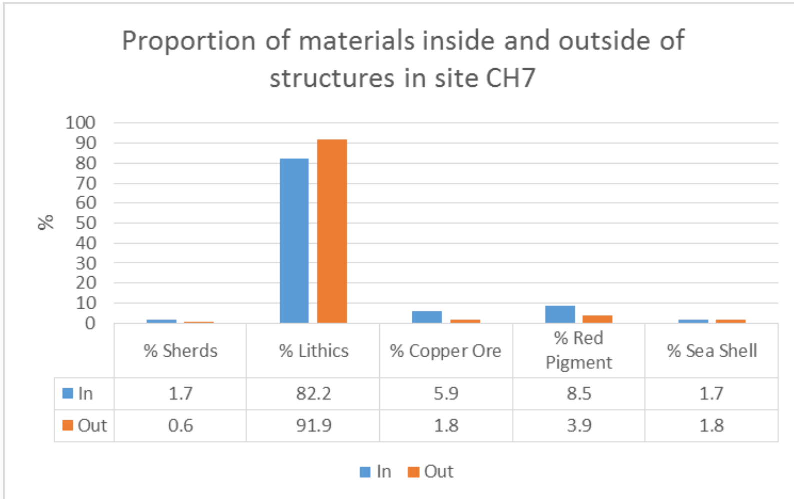


Figure 5-20. Graph of proportion of artifacts inside and outside structures in CH7

The main activity of the site is clearly related to lithic (non-lapidary) manufacture, as evidenced by the high amount of debitage across the surface, especially in the southeast part of the site. The main raw material is a red jasper that is found locally in proximity to the red iron mineral source a few hundred meters to the northeast. Another raw material is white flint from non-local sources (Figure 5-21). There are also basalt cores and flakes, and a few copper ores, but I found no finished artifacts. Iron oxide red pigment rocks occur at various spots on the site, which come from the same source as used later by the CH1 residents. Ceramics were sparse, consisting on undecorated sherds. Despite being so close to CH1, there are no diagnostic sherd from the Late Period.

Figure 5-21. Some of the surface artifacts from CH7

5.1.5 Chinchilla 8

Chinchilla 8 is located inside the Chinchilla ravine about 650 meters from CH7, on a small alluvial cone at the eastern slope of the hills that enclose the area (Figure 5-23). The site consists of two sections, divided by a small drainage in two clusters of structures (Figure 5-22). The southern section has most of the surface artifacts, mainly lithic debitage.

The southern cluster of residential structures is composed of elliptical, contiguous structures creating four internal spaces, and other two small structures next to these. In the north section are two contiguous circular structures, and two other isolated structures. All the structures were built with rough local stones and laid without mortar. There is no evidence they were roofed.

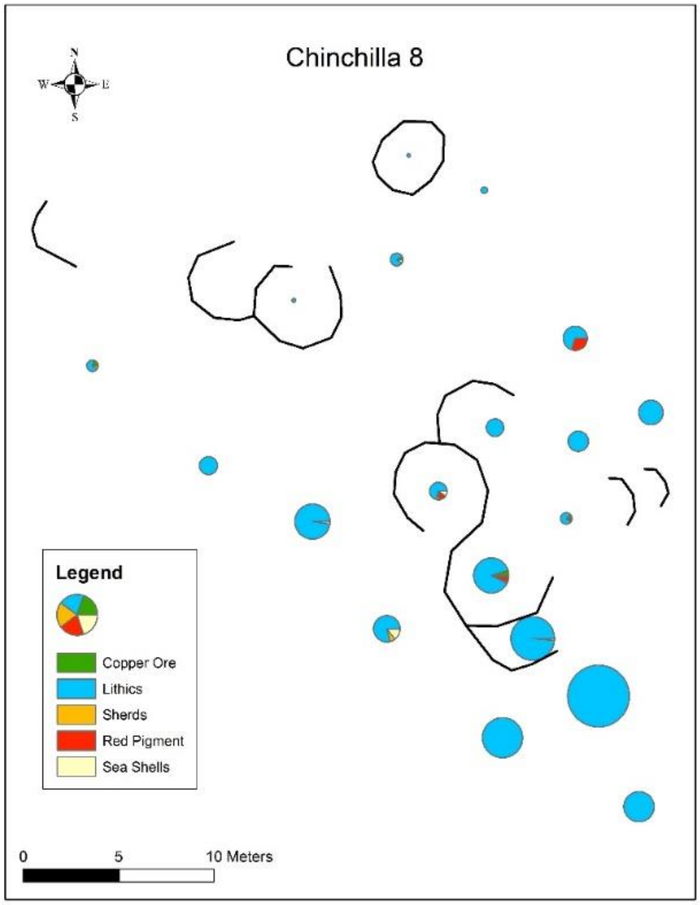


Figure 5-22. Map of proportion of surface materials in CH8, based on 19 collection units (chart size represents raw artifact counts)

Figure 5-23. General view of site CH8

Figure 5-24 shows that lithics formed the highest proportions of each collection unit at the site, while sherds, copper ore, and red pigment correspondingly represent a small share of the assemblage in each portion of the site. The proportion of artifact types is similar for interior and exterior contexts, and there are no indications of separation of activities across the site (Figure 5-25).

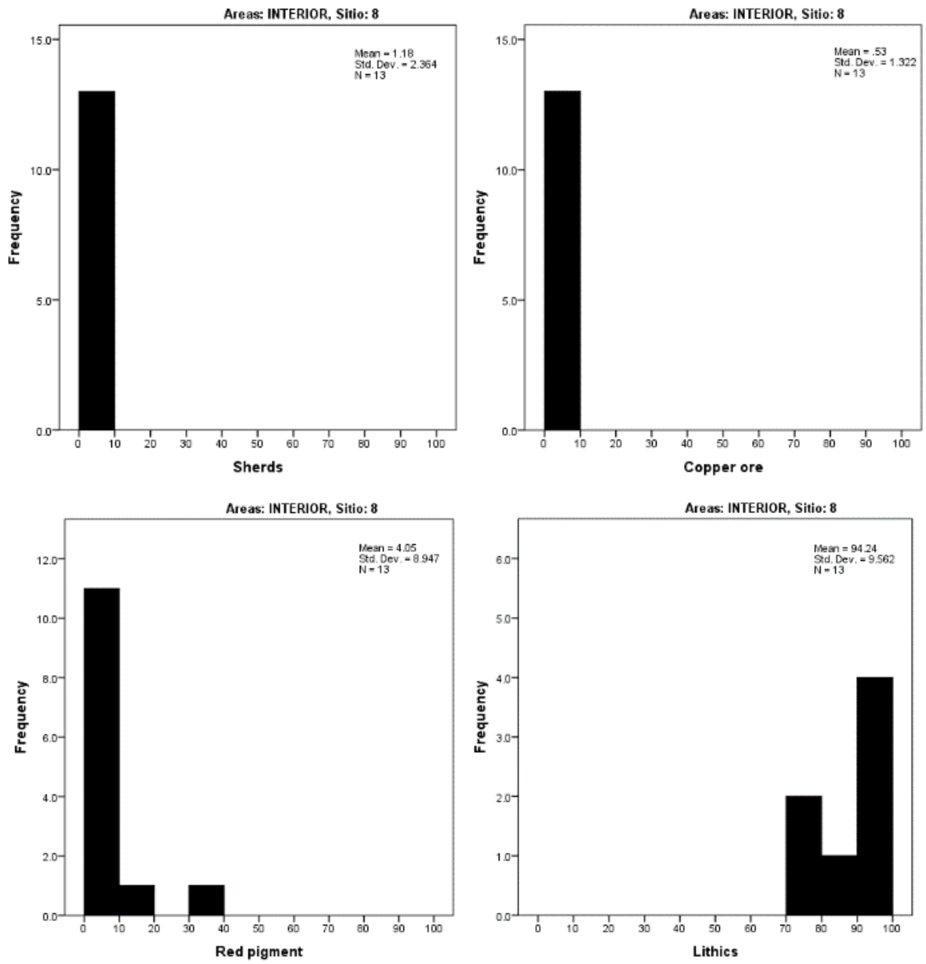


Figure 5-24. Histograms of proportion of artifacts from collection units in CH8. Only for collection units with more than 10 artifacts (N=13)

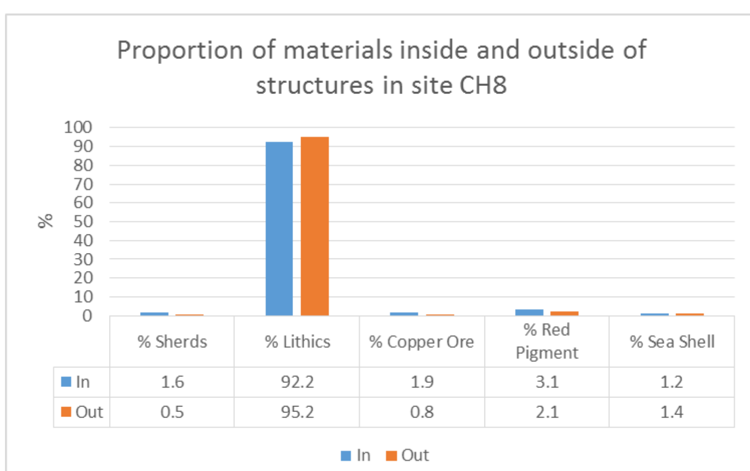


Figure 5-25. Graph of proportion of artifacts inside and outside structures in CH8

The lithic assemblage jasper, basalt, brown flint, and obsidian flakes (Figure 5-26). Collections yielded a few polished monochrome sherds, and an externally red slipped sherd, but there was no diagnostic Late Period ceramics (although there is Late Period pottery on the path that crosses the ravine just a few meters in front of the site. Evidence for bead making includes an unfinished copper ore bead with initial central perforation, and marine shell fragments. As in other sites, there were flat grinding stones (Figure 5-26), most of which were recovered from inside the structure show in Figure 5-23.

Figure 5-26. Some of the surface artifacts from CH8, including an unfinished copper ore bead, and flat grinding stones

5.1.6 Chinchilla 11

This site is located on the eastern slope of the Cachiyuyo de Llampos mountains, about 2.7 kilometers from site CH8, 900 meters from CH10, and 1.1 kilometers from CH12. It is composed of two clusters of structures with internal subdivisions, one to the north and the other to the south (Figure 5-27). The southern compound is the most complex, with more internal divisions, creating internal spaces of 2 - 5 meters of diameter. To the east of this compound is the area with the highest density of surface materials. The northern and southern sectors of the site have similar proportion of artifacts, suggesting the same mix of activities of the same activities in each, but the southern one seems to have been occupied more intensively or longer. All the structures were built with rough local stones and laid without mortar.

In Figure 5-29 we can see that lithic artifacts make up more than half of the assemblages for each collection unit, suggesting that the main productive orientation of the site was related to this kind of non-lapidary lithic crafting.

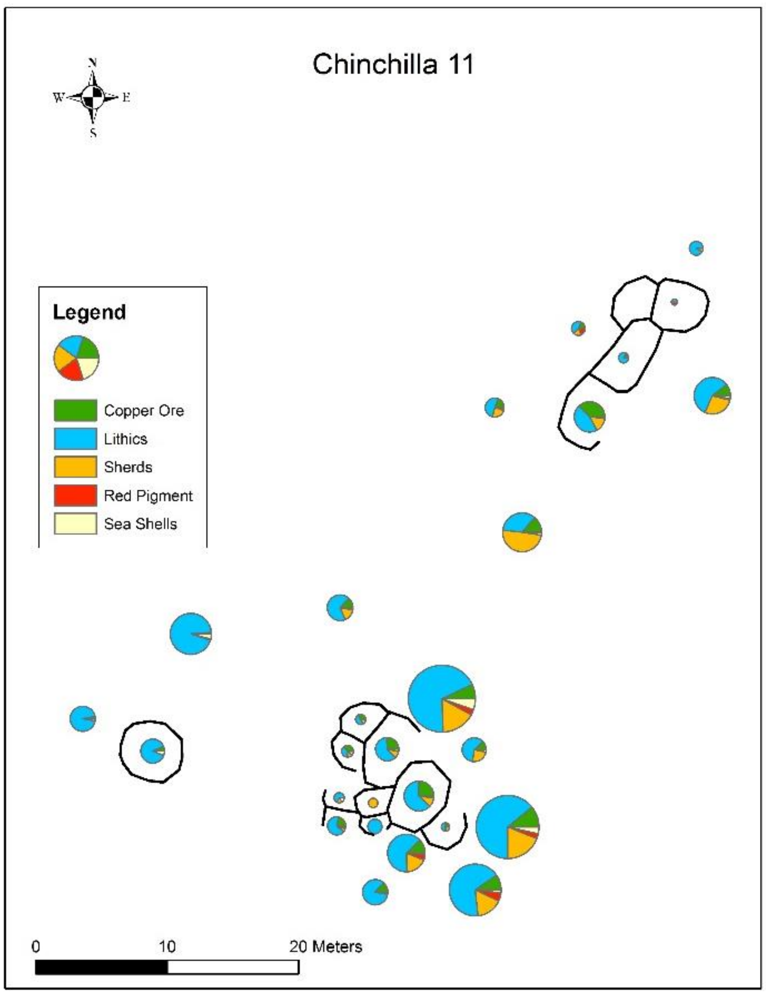


Figure 5-27. Map of proportion of surface materials in CH11, based on 27 collection units (chart size represents raw artifact counts)

Figure 5-28. General view of CH11

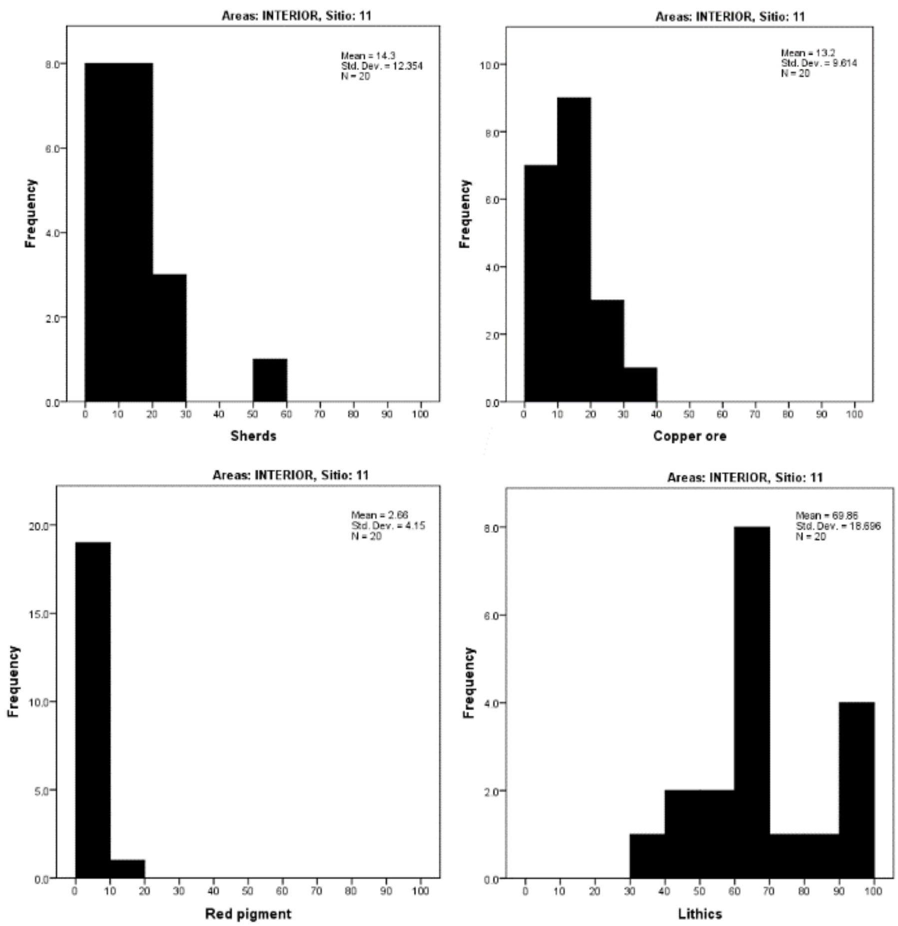


Figure 5-29. Histograms of proportion of artifacts from collection units in CH11. Only for collection units with more than 10 artifacts (N=20)

Despite the abundance of artifacts in the areas outside the structures, as shown in Figure 5-30, the proportions of artifacts inside and outside structures are almost the same. The only exception is the higher proportion of copper ore inside structures, although the difference is just a little bit more than 10%, and may not be significant to distinguish a true difference in activity areas. On the surface were also recorded burned animal bones in association with the residential structures, indicating food preparation activities.

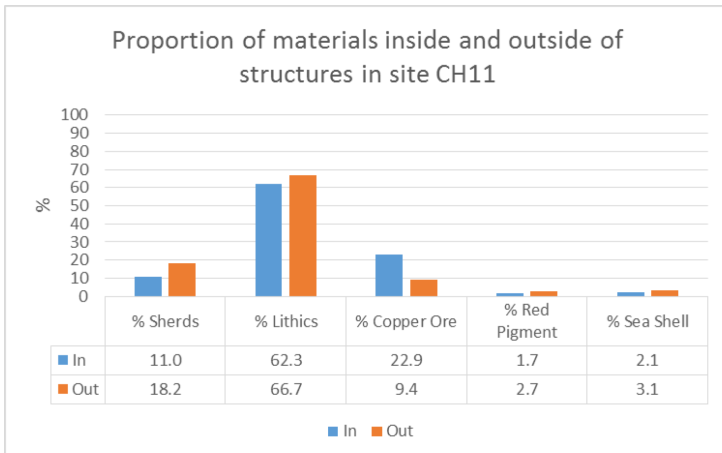


Figure 5-30. Graph of proportion of artifacts inside and outside structures in CH11

Lithic artifacts from CH11 consist primarily of brown and white flint flakes (Figure 5-31). There are also some basalt and granite cores and flakes, and a few obsidian flakes. Copper ores were crushed to a small size, possibly in relation to bead making as at the other sites. We recovered a complete marine shell bead (Figure 5-32) and marine shell fragments; evidence for shell bead crafting for this site. Ceramics consisted of polished and smoothed monochrome sherds, some incised decoration (Figure 5-32). The incised sherds are of the Ciénaga style of Late Formative Period northwestern Argentina. In the residential areas we found pestles and broken grinding stones (Figure 5-32). The flat grinding stones were generally similar to the ones found in the previous sites, but there were also some deeper concavity that may have had a different use.

Figure 5-31. Some of the surface artifacts from CH11

Figure 5-32. Marine shell bead and Ciénaga pottery styles from CH11. At the bottom, grinding stones from site CH11

5.1.7 Chinchilla 12

CH12 is located at the eastern opening of the Chinchilla ravine, in an area between hills and the plain. The site is located on an elevated position in a mountain pass, with a vantage point overlooking two small valleys (Figure 5-34). It is composed of a cluster of circular/elliptical structures. These are less agglutinated than at the previous described sites, although their internal spaces are of comparable size (Figure 5-33). All the structures were built with rough local stones, laid without mortar. The central circular structure is larger than the other structures, and has a diameter of 7 meters, but does not differ in construction pattern or artifacts from the others.

Surface artifact patterns include a concentration of copper ores on the west side of the site, with higher proportions of lithics in the central and eastern areas. This spatial separation suggests that there could have been two task groups pursuing specific craft activities in different parts of the site.

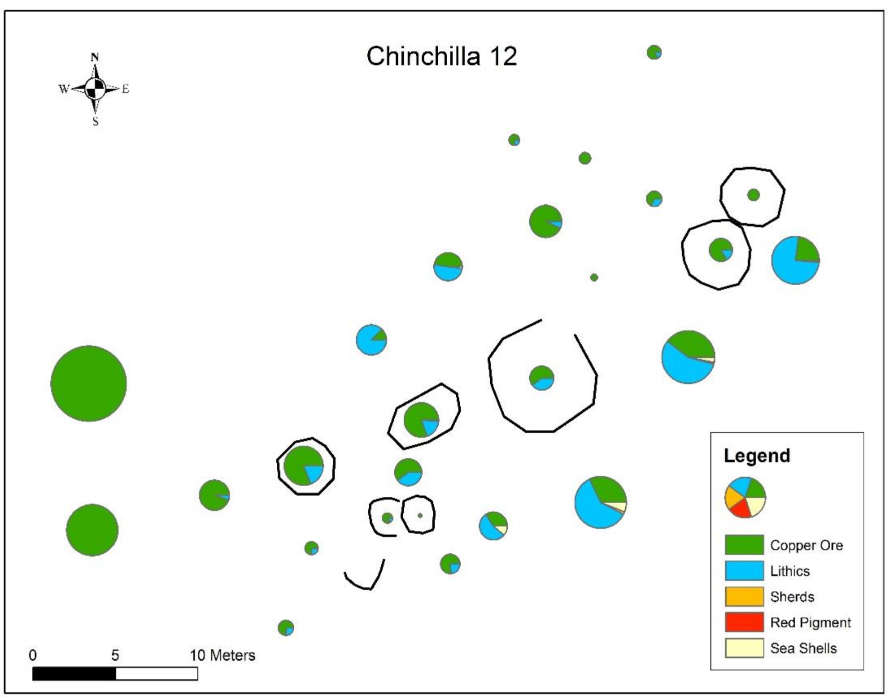


Figure 5-33. Map of proportion of surface materials in CH12, based on 26 collection units (chart size represents raw artifact counts)

Figure 5-34. General view of CH12 and visual perspective from its location

As show in Figure 5-35, copper ore makes up the bulk of most collection units, followed by lithics. Ore processing has an exclusive space for processing, and marine shell may have as well, being limited to the eastern margin of the camp. Despite those differences, as seen in Figure 5-36, there is not a great difference in the use interior versus exterior spaces, and the difference for copper ores and lithics is less than 15%. The crushed ore debris ranged from 5 to 30 mm in size, reduced for bead making. Figure 5-37 shows an example of an unfinished bead with initial perforation.

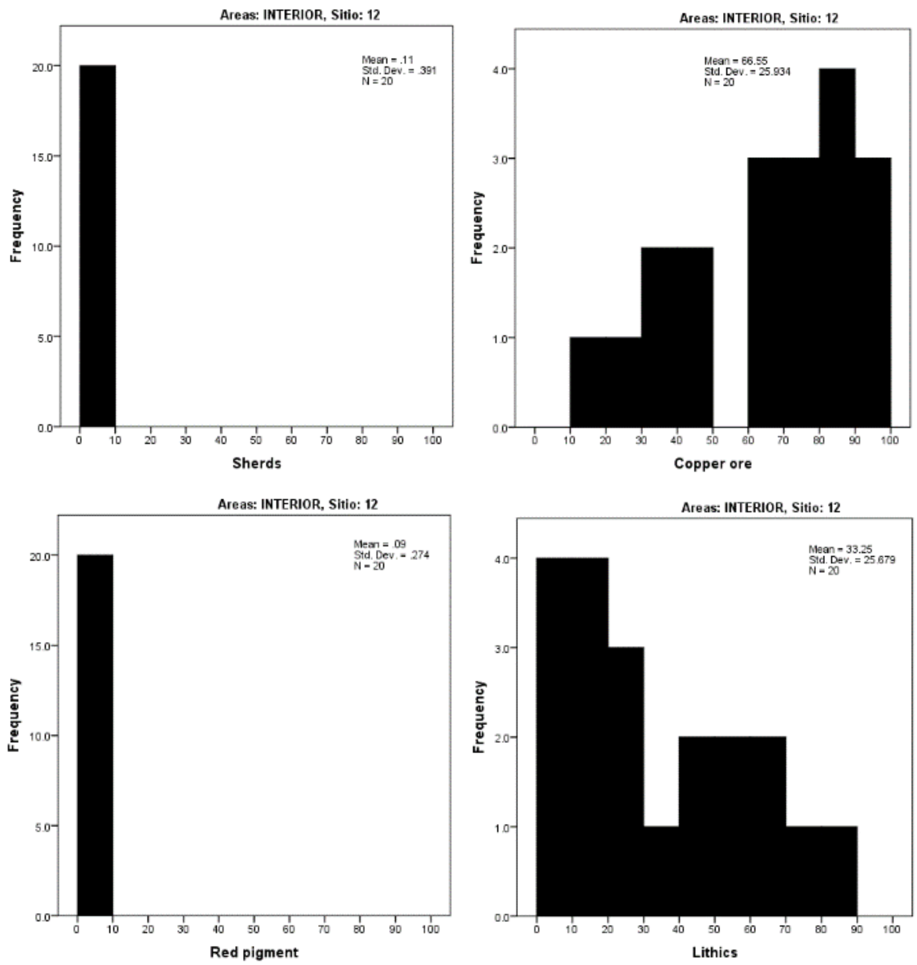


Figure 5-35. Histograms of proportion of artifacts from collection units in CH12. Only for collection units with more than 10 artifacts (N=20)

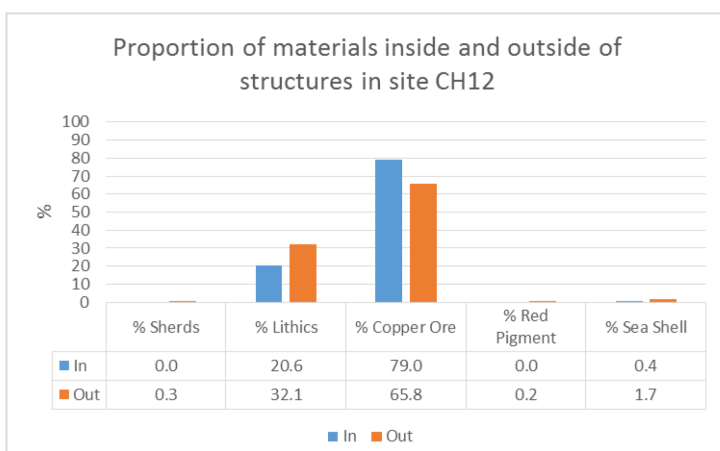


Figure 5-36. Graph of proportion of artifacts inside and outside structures in CH12

Among the lithic artifacts are white, flint, bifacial knives, and a projectile point that was retouched and converted into a possible perforator (Figure 5-37). There are monochrome sherds, including a flat base of a cooking vessel, and also a 2 centimeters long piece of animal bone with rounded corners and a perforation in the center. This may have been intended as an ornament, as were the two marine snail shells found at the site.

Figure 5-37. At the top, same of surface copper ores, lithics, and sherds. At the bottom, two lithic knives, retouched projectile point, bone fragment with perforation, an unfinished bead with initial perforation, and some marine shells. All the artifacts are from CH12

5.1.8 Chinchilla 13

This site is located between some hills along the eastern slope of the Cachiyuyo de Llampos Mountains (Figure 5-39). It is similar in layout and surface artifact distributions to CH12, with a mix of copper ore and lithic artifacts. It is composed of two clusters of elliptical structures separated by only 4 meters, and another isolated semicircular structure at the southwest corner (Figure 5-38). The larger, southern cluster has more internal divisions, and a larger area of surface artifact scatter around it. The structures were built with rough local stones, laid without mortar.

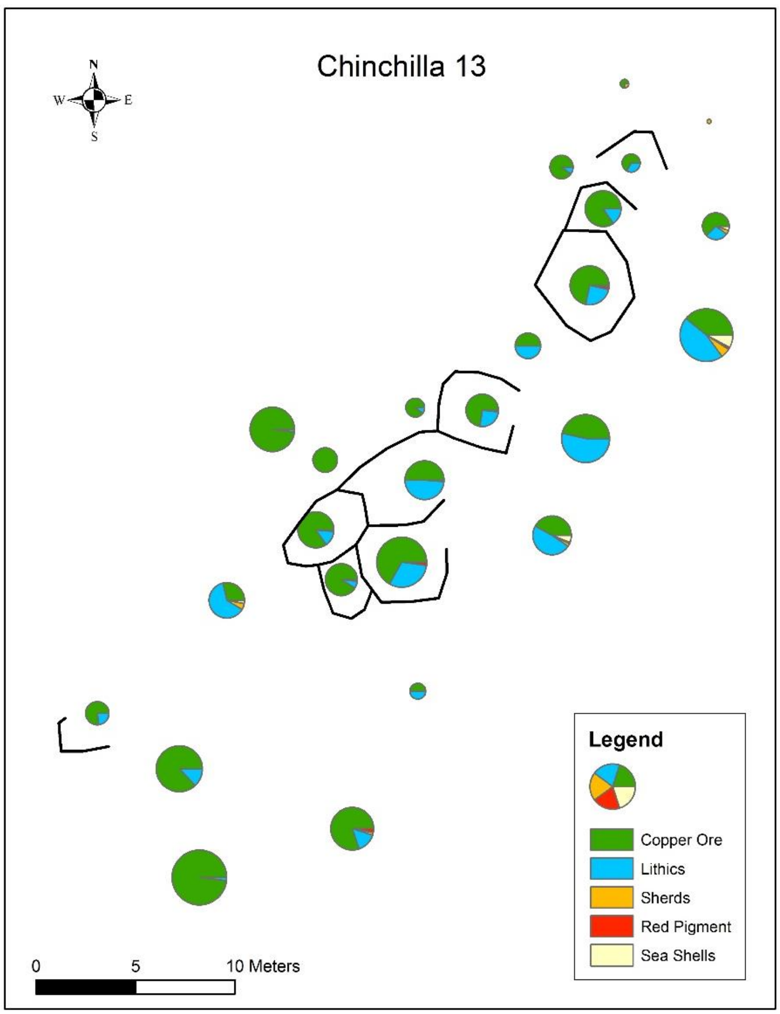


Figure 5-38. Map of proportion of surface materials in CH13, based on 25 collection units (chart size represents raw artifact counts)

Figure 5-39. General view of CH13

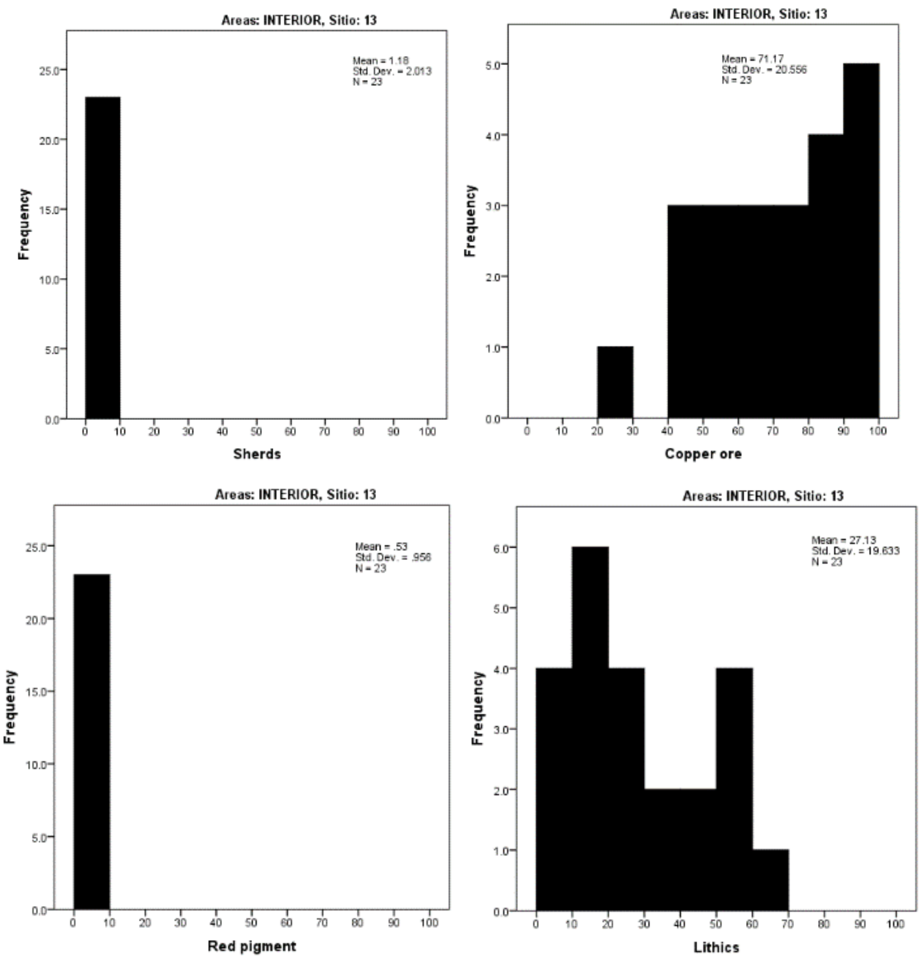


Figure 5-40. Histograms of proportion of artifacts from collection units in CH13. Only for collection units with more than 10 artifacts (N=23)

As shown in Figure 5-40, copper ore makes up the bulk of artifacts from most collection units, followed by lithics. Ceramics and red pigment fragments do not make up more than 10%

in any collection unit. Figure 5-41 shows that there are not differences in the interior and exterior assemblages. There are not significant differences between the assemblages of the northern and southern architectural clusters, and, as at CH12, marine shell working was limited to the eastern margin of the site. Green ores were crushed to similar sizes as at other sites as part of the bead production process (Figure 5-42). Lithic artifacts included white flint flakes, and several of obsidian. Round stone pestles and flat grinding stones were also recovered. Monochrome and black polished sherds make up the bulk of the ceramic assemblage, although there was a single neck sherd from a red slipped jar. No diagnostic Late Period ceramics were recovered. In the southwestern part of the site, a large rock bears some red paintings with camelids and abstract designs (Figure 5-43). The small proportion of red iron oxide fragments likely were for pigment production, and this painting suggests one of its uses.

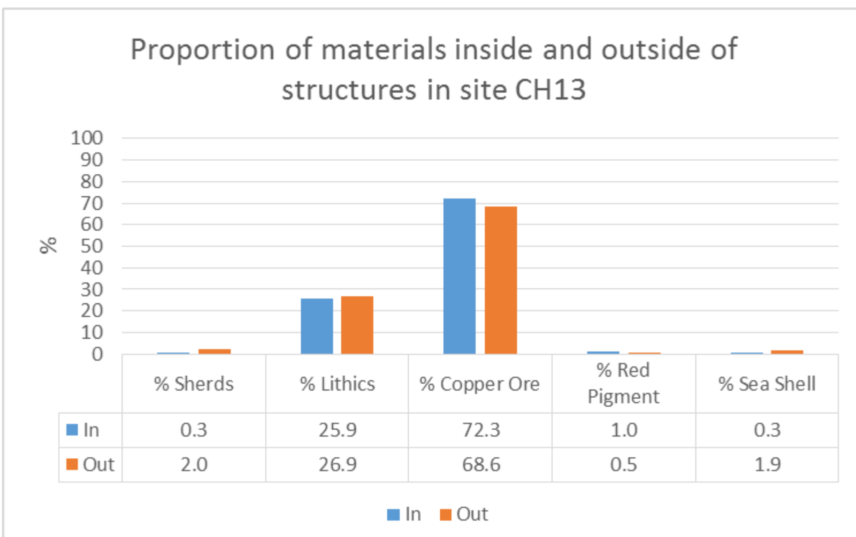


Figure 5-41. Graph of proportion of artifacts inside and outside structures in CH13

Figure 5-42. Some of the surface artifacts from CH13 including copper ores, white flint flakes, pestles and flat grinding stones

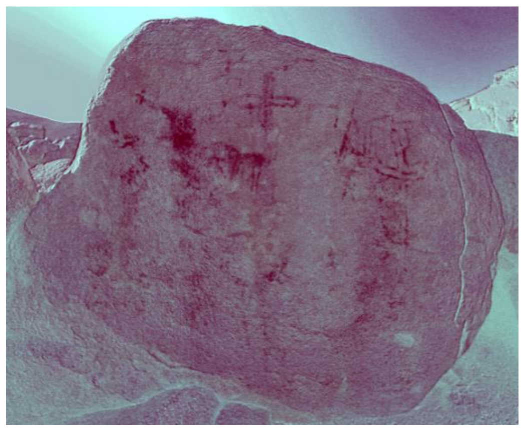


Figure 5-43. Rock art paintings from CH13. Enhanced image using D-Stretch software

5.1.9 Exterior 5

EXT5 is located on a plain at the foothills, in close proximity to a path skirting the base of the mountains (Figure 5-44), only about 1.2 kilometers east of the Inca Road. The site contains three main groups of structures separated by about 6 meters from one another (Figure 5-45). To the north and to the east respectively are two semicircular isolated structures, and to west of the main architecture is a large circular space. This was created removing stones from the surface and piling them at the margins to form the circular cleared area. This circle is very similar to the one at EXT8 and near CH1. The function of these circles, which range from 30 –

60 meters in diameter, is unknown. All the structures were built with rough local stones, laid without mortar, and there is no indication that they were roofed.

Figure 5-44. General view of EXT5

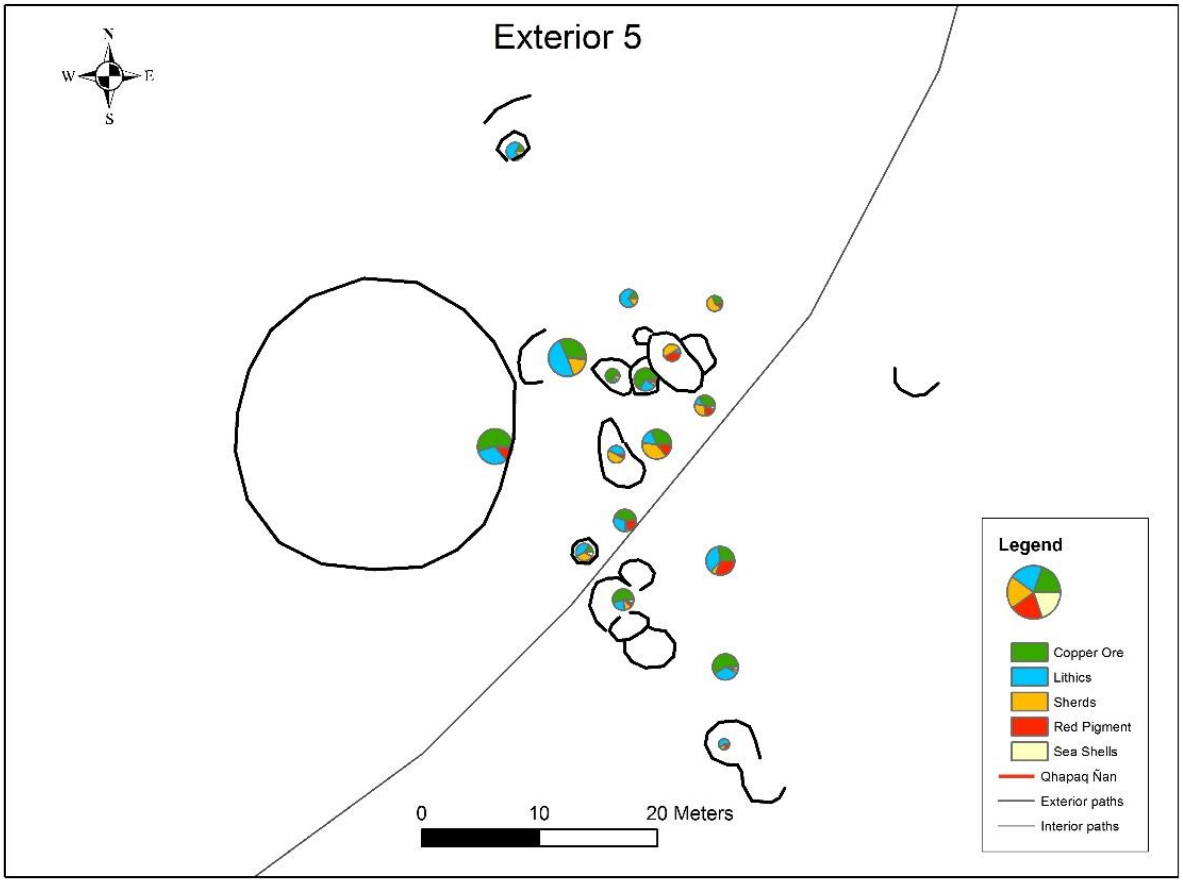


Figure 5-45. Map of proportion of surface materials at EXT5, based on 17 collection units (chart size represents raw artifact counts)

In comparison to other Pre-Inca Period camps, the distribution of artifacts at this site shows less evidence of spatial division of activities. And as can be seen in Figure 5-46, each category of artifact makes up the bulk of some of the collection units, so the camp exhibits more intra-site variability than the previously described sites. In other words, this site shows a more balanced (less specialized) mix of activities than the previous camps, which were heavily focused on either ore or lithic production. The proportions inside and outside of the structures (Figure 5-47) are similar, suggesting no differences in interior and exterior tasks.

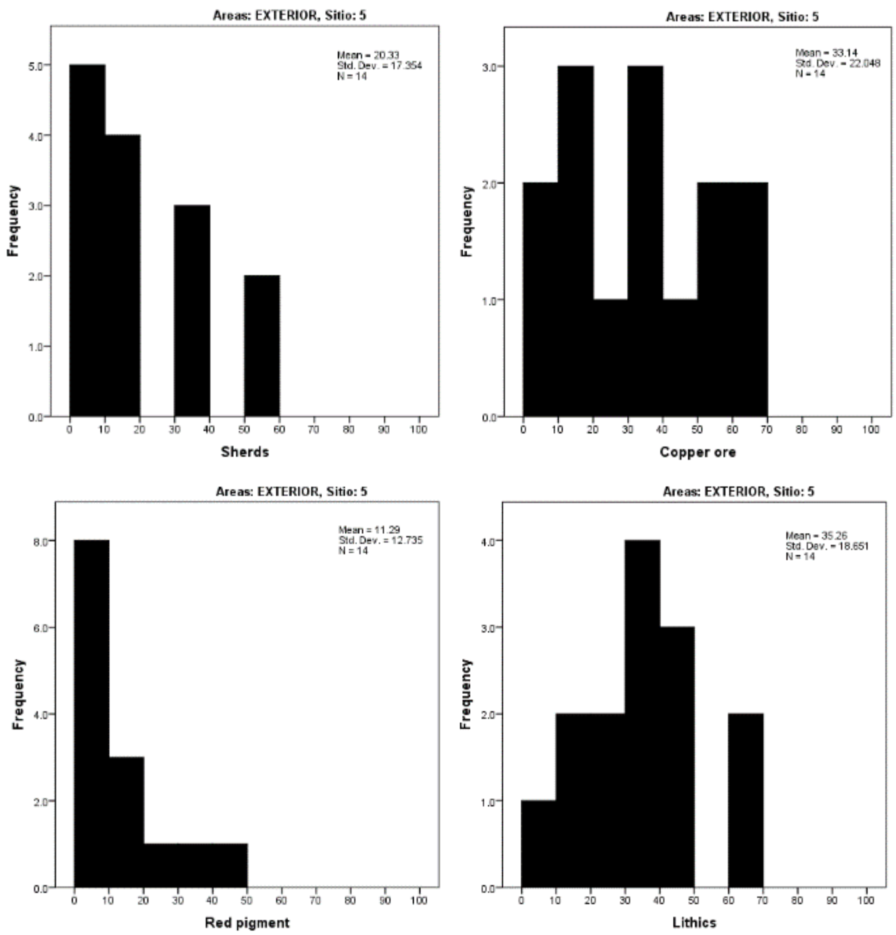


Figure 5-46. Histograms of proportion of artifacts from collection units in EXT5. Only for collection units with more than 10 artifacts (N=14)

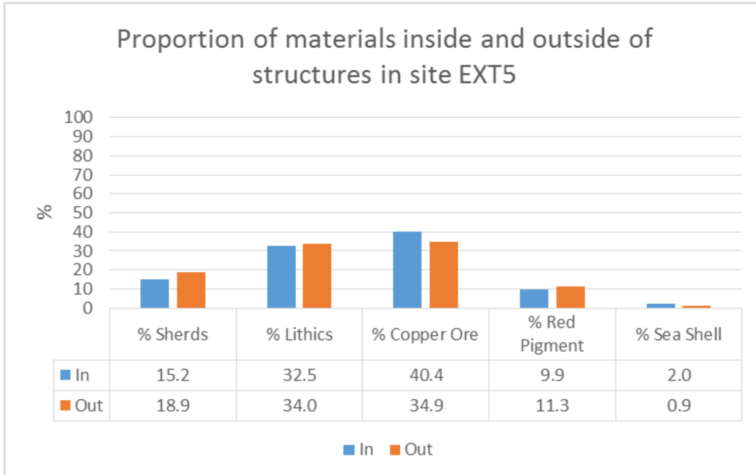


Figure 5-47. Graph of proportion of artifacts inside and outside structures in EXT5

From the surface we recovered monochrome and grey polished sherds, crushed copper ore, white flint flakes, red pigment fragments (Figure 5-48), marine shell fragments, and some animal bones including rodent mandibles. There were also pestles, and some flat grinding stones with polished surfaces, associated with the residential structures (Figure 5-49). These items have been related to pigment grinding or bead polishing.

Figure 5-48. Some of the surface artifacts from EXT5

Figure 5-49. Flat grinding stones from EXT5

5.1.10 Exterior 7

Site EXT7 is 2.5 km from EXT5 and lies along the same path (Figure 5-50). The site consists of a scatter of isolated circular/elliptical structures, only the center one exhibiting secondary divisions (Figure 5-51). All the structures are similar in size (2 to 4 meters in diameter) and are constructed with unmodified stones from the area.

Figure 5-50. Map of proportion of surface materials in EXT7, based on 7 collection units (chart size represents raw artifact counts)

Figure 5-51. General view of EXT7

EXT7 exhibited low artifact densities, with most collection units yielding less than 10 artifacts. Therefore, histograms and graphs were not prepared for this site. Surface remains included monochrome sherds like the ones at EXT5, white flint and quartz flakes, crushed copper ore, red pigment fragments, stone hammers, polished pestles, and flat grinding stones (Figure 5-52, 5-53). A rock forming part of one of the structures bears an abstract red painting (Figure 5-54).

Figure 5-52. Some of the surface artifacts from EXT5

Figure 5-53. Flat grinding stones from EXT5

Figure 5-54. Block with red pigment from EXT5. At the right, enhanced view using the software D-Stretch

5.1.11 Exterior 8

This site is located on a southern alluvial terrace of overlooking the Piedra de Fuego plain. The pass-like location of the site suggests that it could have been an intermediate point for the east-west transportation of products through the Cachiyuyo de Llampos Mountains. The site is composed of a set of circular/elliptical structures. Those to the north are more clustered, and one of them has three internal divisions (Figure 5-55, 5-56). Artifact density was highest in this portion of the site. The structures of the site were built with rough local stones, laid without mortar, and ranging 2 - 4 meters in diameter.

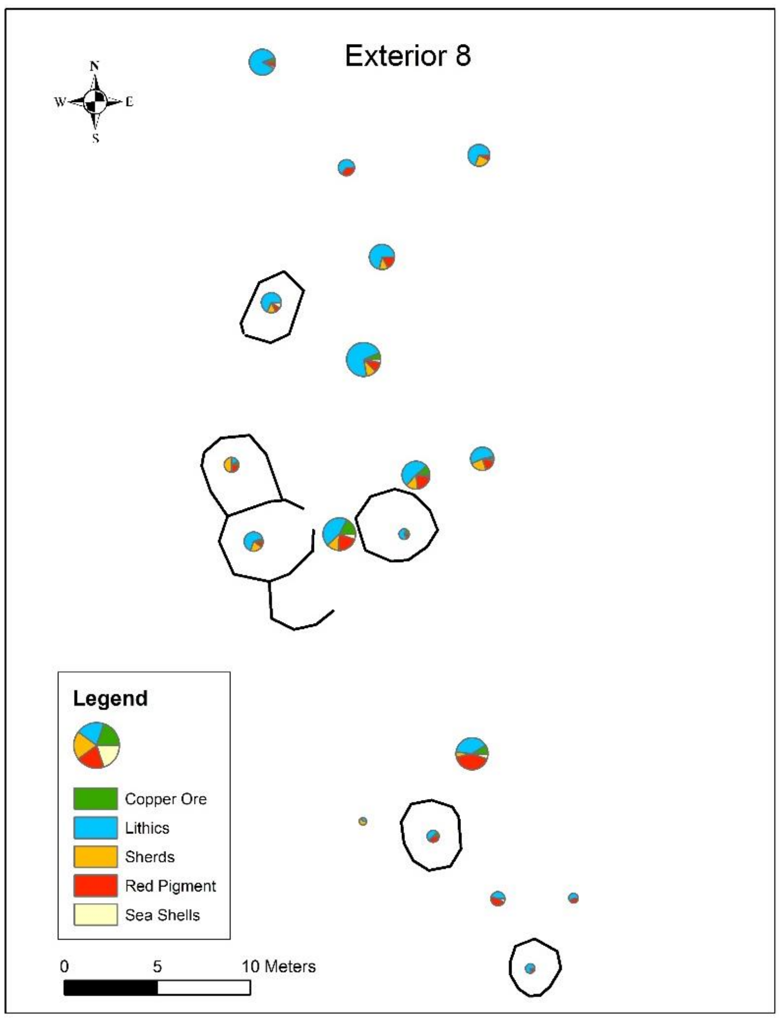


Figure 5-55. Map of proportion of surface materials in EXT8, based on 18 collection units (chart size represents raw artifact counts)

Figure 5-56. General view of EXT8. The circular structure at the bottom left has an internal small stone circle with unknown function

As shown in Figure 5-57, lithics constituted more than 50% of the assemblage in most collection units, followed by red pigment. Unlike other camps, copper ore processing was a minor activity at this site, which emphasized non-lapidary work. Comparing interior and exterior collection assemblages revealed no significant differences (Figure 5-58).

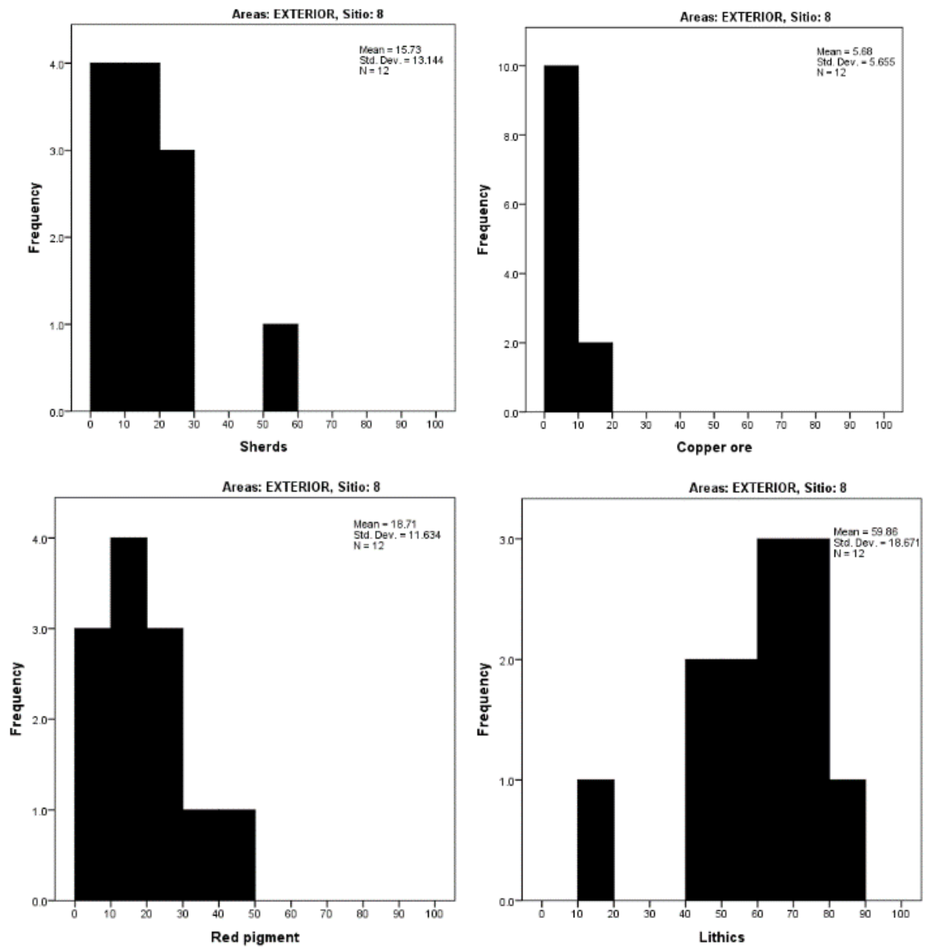


Figure 5-57. Histograms of proportion of artifacts from collection units in EXT8. Only for collection units with more than 10 artifacts (N=12)

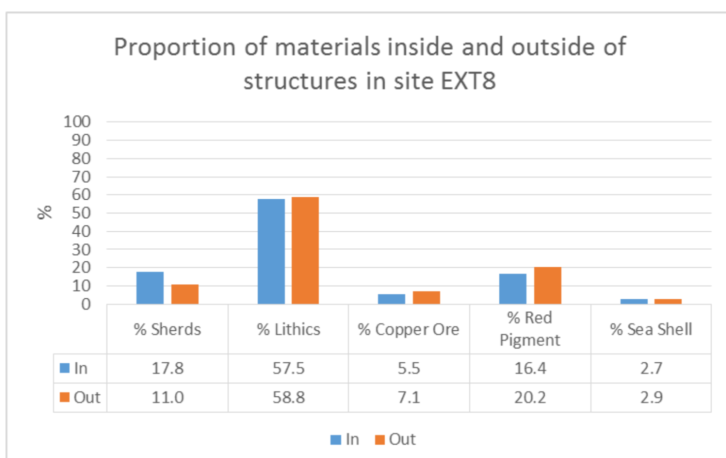


Figure 5-58. Graph of proportion of artifacts inside and outside structures in EXT8

Lithics artifacts at this site included white flint and quartz flakes, granite and basalt cores and flakes, and small hammers (Figure 5-59). Also recovered were red pigment fragments, crushed copper ore, marine shell fragments, animal bones, and smoothed and polished monochrome sherds. One of the sherds has a small perforated handle, which corresponds to the Molle ceramic style, and is identical to a vessel excavated from the El Torín site in the Copiapó Valley, and belonging to the Alfarero Temprano Period (Figure 5-60).

Figure 5-59. Some of the surface artifacts from EXT8

Figure 5-60. At the left, three views of a polished monochrome sherd with a small perforated handle, corresponding to Molle style from the local Alfarero Temprano Period. At the right, a Molle vessel excavated from Mound 21 at El Torin, and now in the collection of Museo Regional de Atacama, Copiapó.

5.1.12 Exterior 10

This site, located on the Piedra de Fuego plain, is composed of a long curved stone alignment and a few semicircular structures. About 100 meters to the west are a set of linear foundations (Figure 5-61, 5-62). The structures to the east are surrounded by lithic artifacts, whereas the western linear one is associated only with ore debris. The structures were built with rough local stones and laid without mortar. Not all of the structures were residential, as the smallest circular structures have a diameter of only 1-1.5 meters. In fact, there is only one structure, with a diameter of 3 meters, big enough to serve as a habitation.

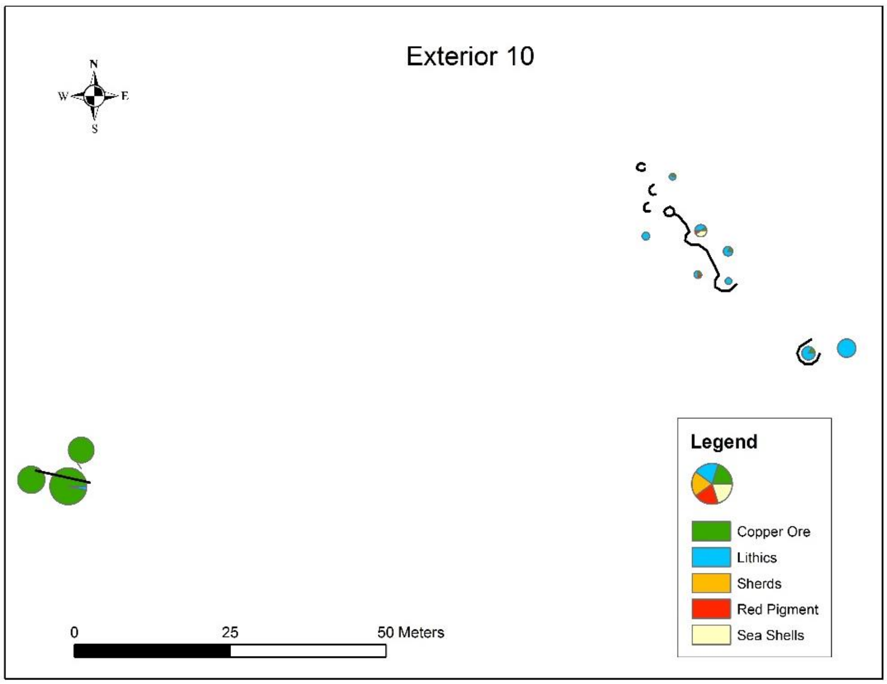


Figure 5-61. Map of proportion of surface materials in EXT10, based on 11 collection units (chart size represents raw artifact counts)

Figure 5-62. General view of EXT10

As shown in Figure 5-63, lithics and copper ores make up the bulk of artifacts at the site, with red pigments and sherds only reach a maximum of 10% at some collection units. Lithic artifacts included white flakes of flint and quartz, and an unfinished, stemmed, projectile point (Figure 5-64). The crushed copper ores were used for bead making, as evidenced by an unfinished bead with initial central perforation. Polished flat grinding stones of the same kind found at other sites were also recovered (Figure 5-65). The relative lack of ceramics suggests that this was a briefly occupied camp.

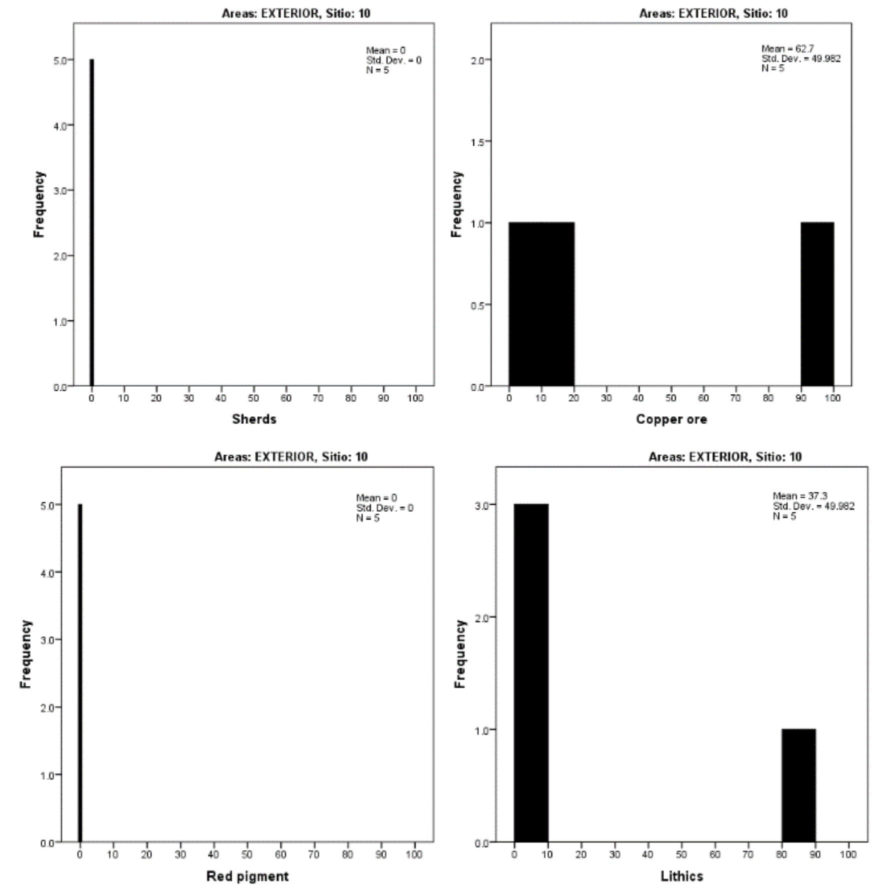


Figure 5-63. Histograms of proportion of artifacts from collection units in EXT10. Only for collection units with more than 10 artifacts (N=5)

Figure 5-64. Some of the surface artifacts from EXT10

Figure 5-65. Flat grinding stones from EXT10

5.2 SPATIAL PATTERNS IN THE PRE-INCA SITES

Survey revealed a set of small, Pre-Inca Period, mining camps at which residents engaged, in differing degrees, in copper ore mining, processing and bead production, red pigment production, non-lapidary lithic production, and marine shell craft production.

A comparative analysis of the spatial layout of the Pre-Inca Period sites can inform us about the nature of the resident social units and how they organized their productive activities (Figure 5-66). If we compare the site area, calculated roughly as the total dispersion of structures and surface materials of each camp, as shown in Figure 5-67 (the area represented here totals all activity spaces outside the residential structures, but does not consider empty spaces in between structures separated by more than 20 meters), we can see that all but one of the sites are smaller than 2,000 square meters. The exception is CH7, which is made larger than the rest only by its large, cleared circle located nearby. The number of structures per site, including both residential and small storage spaces, is show in Figure 5-67. The maximum number is 14, and the median is 8.8 structures per site. Considering the number and size of structures at each site, the size of the group residing and working at each camp likely ranged from 5-15 people, or 1 to 3 households.

Comparing all of the sites at the same scale (Figure 5-66), reveals residential structures of similar size, suggesting the same basal residential unit. We can label this a “household” because of the size and shared habitation, but we do not know if it actually represented a family.

Many of the sites (CH5, CH6, CH8, CH11, CH12, CH13) are composed of two main clusters of residential structures, suggesting two household or corporate units at each site. At most of these dual cluster sites, one cluster is larger and more subdivided than the others, suggesting a “senior” household or corporate unit. However, I found no architectural or artifactual indicators of wealth/status differences within the camps.

Artifacts were not distributed homogenously across the camp. Each camp showed areas of higher and lower artifact densities, corresponding to the spatial loci of activities (and refuse disposal). There was not much evidence for an indoor versus outdoor difference in the range and mix of activities. At some sites, one of the residential clusters, usually the larger and more complex one, was associated with a higher density of material, suggesting a longer or more intense occupation, such as at CH5 or the southern residential cluster at CH11. Intrasite differences in the intensity of occupation might also be reflected in proportions of ceramics (reflecting domestic activities), such as at CH11.

The distribution of different activities, as represented by artifact categories, provides information on how production was organized in these very small communities. Again, productive/craft activities were not homogenously distributed within the Pre-Inca Period camp, although some (EXT8) were more homogenous in this regard than others, such as EXT10, where ore working was limited entirely to one side of the site, and lithic production to the other side. The relationship between architectural units and artifact spatial patterns suggests some differences in household economic focus within camps. For example, at CH6, the western residential cluster has proportionally more materials associated with lithic and red pigment working, than does the eastern cluster, where ore debris predominates. At CH11, the “senior” southern cluster is functionally distinct, as it is only here where red pigment was worked. And at CH12, copper ore debris is concentrated in the southwestern part of the site, while higher proportions of lithics are associated with the residential cluster and area to the northeast.

The architecture highlights the existence of one to three household-size units at each camp. But is there evidence of communal or co-operative activities? In other words, did these constituent households act in a corporate way in particular productive activities or stages of production? CH5 exhibits a large, very dense, exterior locus of ore to the east of the structures. Similarly, CH7 exhibits a large, very dense, exterior locus of lithic manufacture in the southeastern section of the site. These singular deposits suggest that these areas of the camps were used for communal or cooperative productive activities. The variability *among* these camps in these patterns is further explored in Chapter 6.

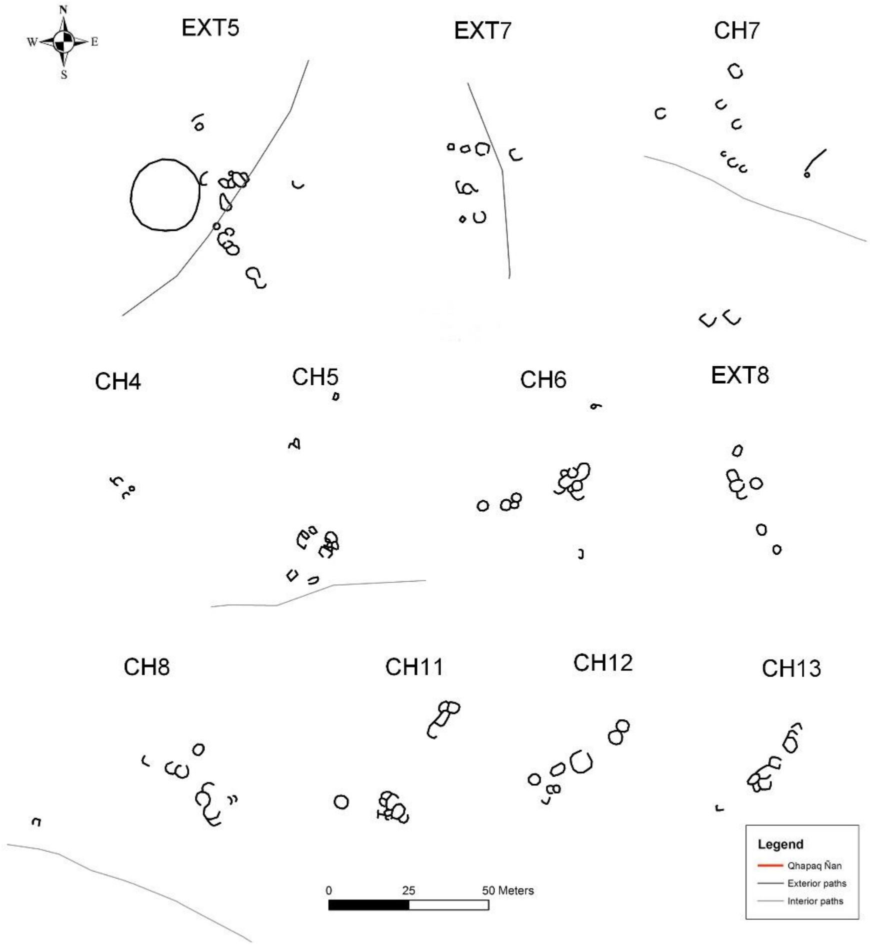


Figure 5-66. Site plans for Pre-Inca Period sites

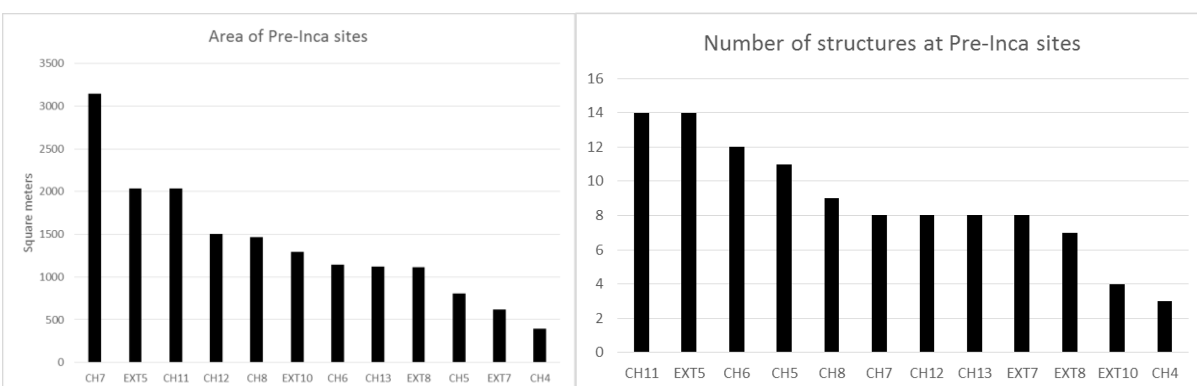


Figure 5-67. Site area and number of structures for pre-Inca sites

5.3 LATE PERIOD SITES (~1400-1540 AD)

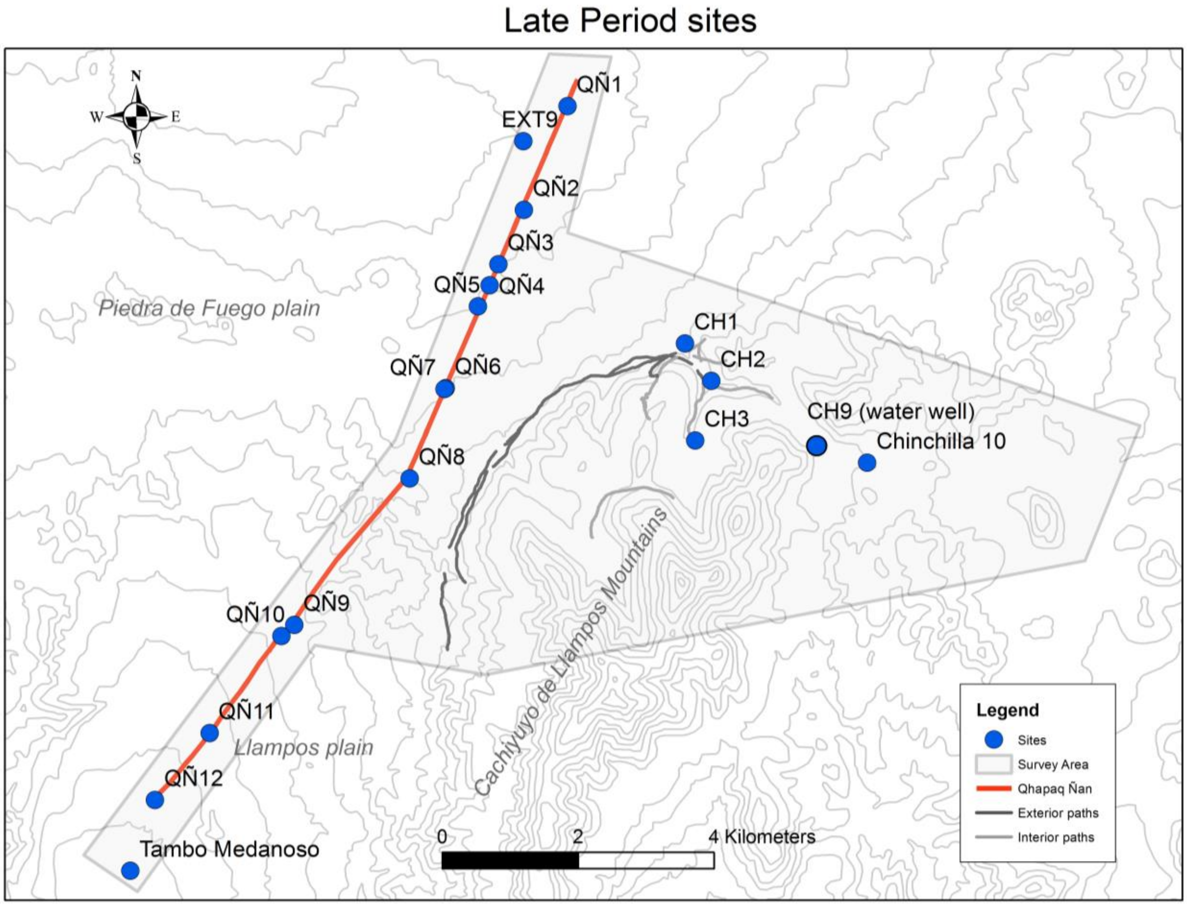


Figure 5-68. Late Period sites

5.3.1 Chinchilla 1

The largest site in the survey area, CH1 lies across both terraces of the drainage of Chinchilla drainage, at the point where the ravine exits the Cachiyuyo de Llampos Mountains. It is 3 kilometers east of the Inca Road. This site is located about 300 meters to the east of an ore source of malachite and turquoise[21], and about the same distance at the west from an iron oxide source that provides red pigment minerals. Small scale exploitation continued at the ore source until the middle of the 20th-century, so the prehispanic workings have been obliterated by the construction of new tunnels, shafts, and rock accumulation (Figure 5-70). Remains of historic/modern occupation are found to the southeast of the site.

The architecture at the site consists of the same type of circular/elliptical subdivided and isolated residential structures seen at other camps in the survey area. All were built with the locally available stones, and without mortar. Surface artifacts (Figure 5-71, 5-72) are dense on the site, including white and brown flint, quartz, and obsidian flakes, camelid and rodent bones, marine shell, and undecorated and decorated sherds. The latter includes Inca local and Diaguita Inca style pottery. The site can be divided into three sectors, based on clusters of architecture separated from each other by about 25 meters. The largest and most subdivided residential cluster is in the northeastern section (Sector 1) of the site and is associated with higher densities of pottery, suggesting the longest or most intensive occupation. There are two main concentrations of crushed copper ore debris, one associated with some linear stone foundations in the northeast, and one in the southwest, surrounding some circular structures.

Occupation at CH1 predates the Late Period (Table 5-3, and Figure 5-69), probably beginning sometime after the 1000 AD, during the Late Intermediate Period. The bulk of the diagnostic ceramics date to the Late Period, and this is clearly the period of the most extensive and intensive occupation at the camp.

[21] XRD analysis by the department of metallurgy of the Universidad de Atacama, Copiapó, and confirmed examination of samples by geologists from the same university.

Table 5-3. AMS radiocarbon dates from CH1. All dates come from charcoal samples

AA	Sample ID	Mass	d13C value	F (d13C)	dF (d13C)	14 Age BP	d14C Age	Cal Sh Cal 13 Min AD	Cal Sh Cal 13 Max AD	% Cal
AA104025	CH1 U5-N2	1.32mg	-16.6	0.8837	0.0043	994	39	1020	1179	95.4
AA104026	CH1 U8-N1	1.15mg	-21.9	0.8921	0.0046	917	41	1043	1261	95.4
AA104028	CH1 U1-N2	2.44mg	-22.6	0.9355	0.0039	536	33	1401	1452	95.4
AA104027	CH1 U3-N1	1.06mg	-23.7	0.9478	0.0043	431	36	1439	1625	95.4

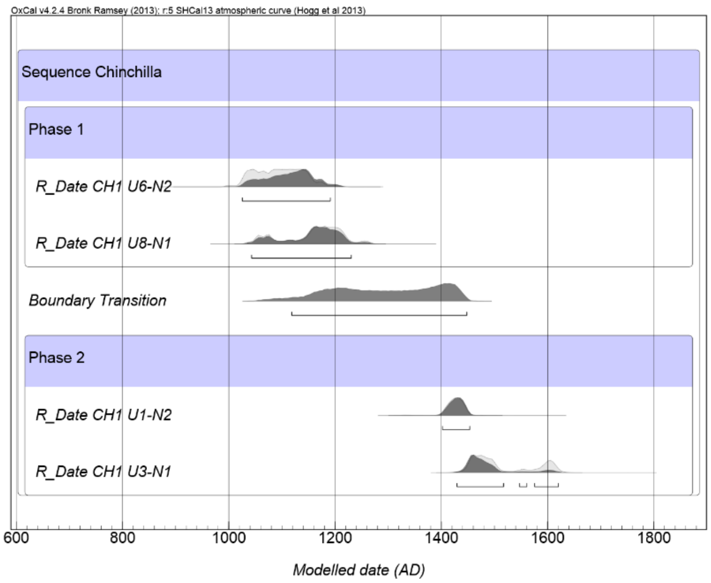


Figure 5-69. Calibrated radiocarbon AMS dates for CH1. Models were made using OxCal software and SHCal13 curve

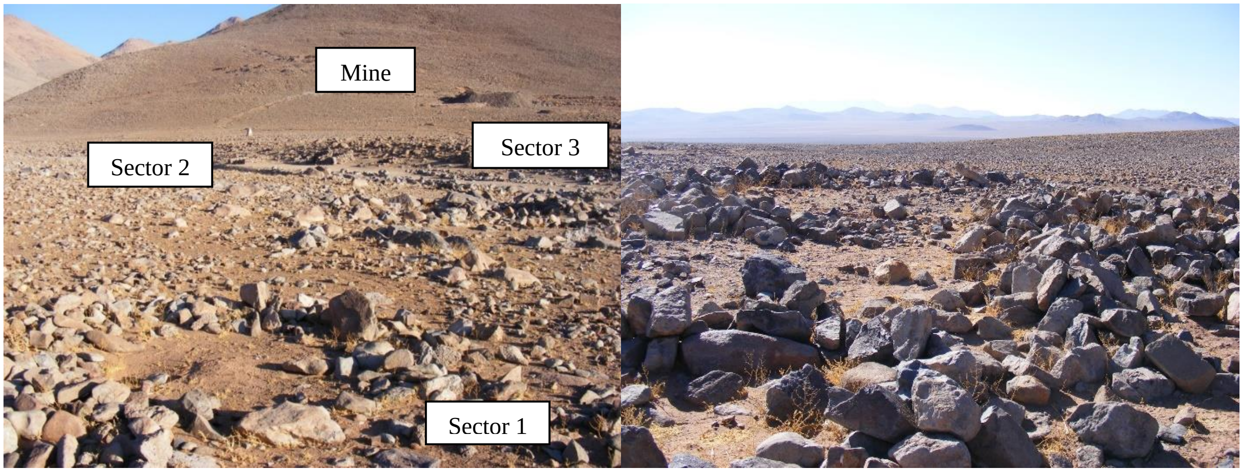


Figure 5-70. General view of CH1 and its residential structures

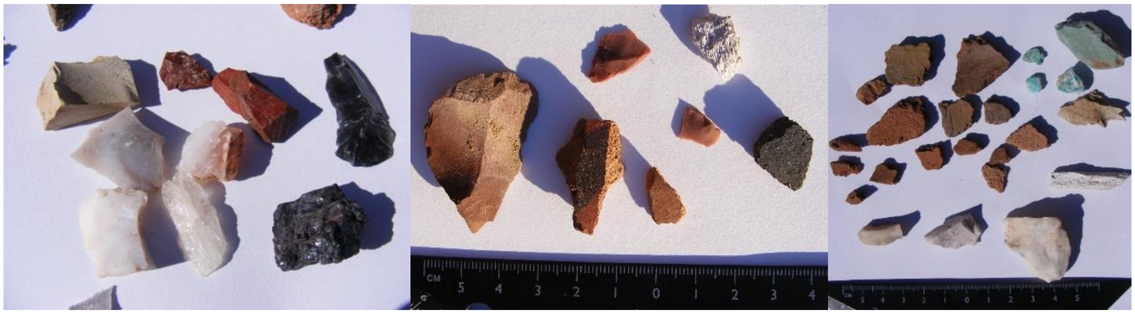


Figure 5-71. Some of the surface artifacts from CH1, including lithics, sherds, bones, and copper ores

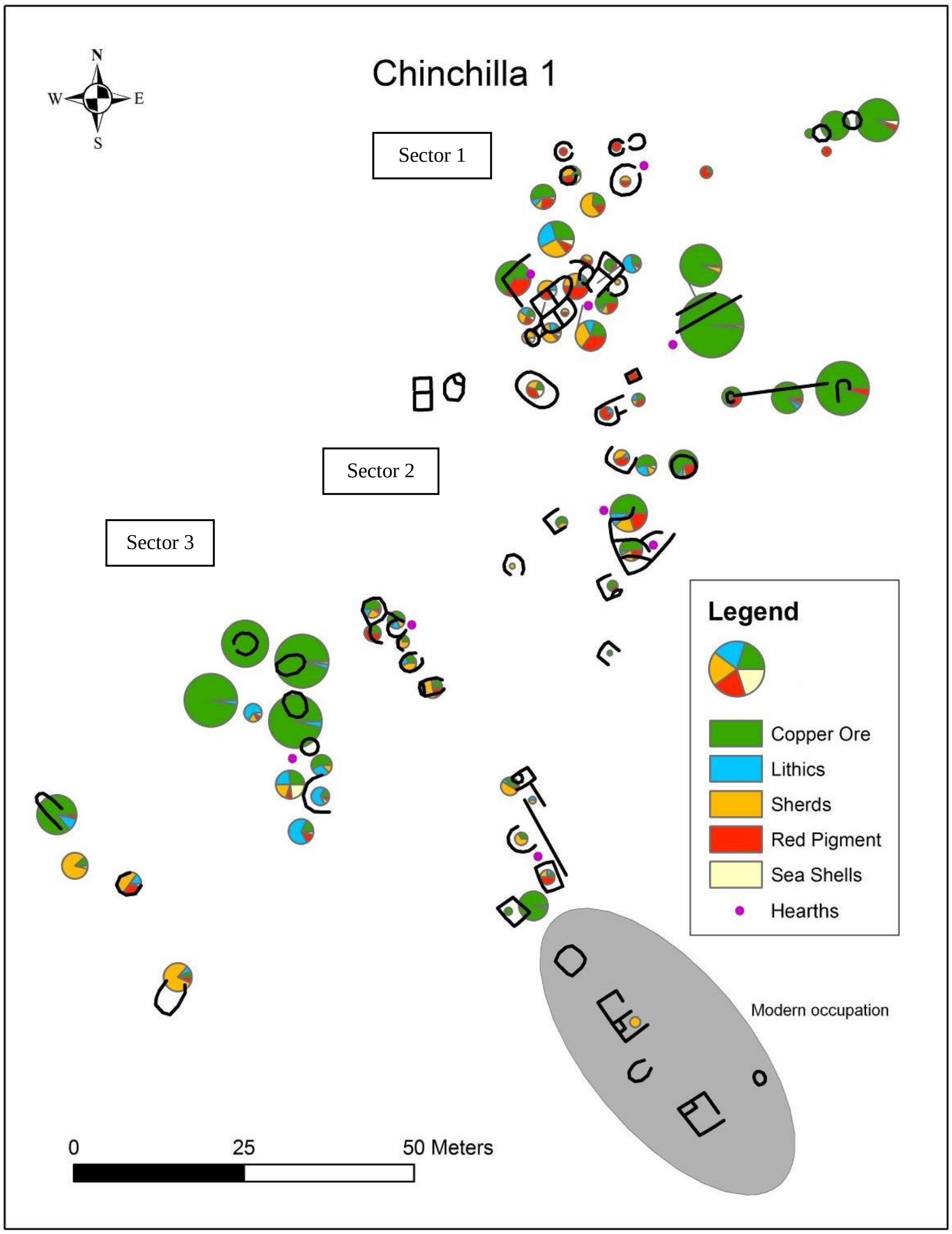


Figure 5-72. Map of proportion of surface materials in site CH1, based on 72 collection units (chart size represents raw artifact counts)

5.3.1.1 Surface artifact distributions at CH1

As shown in Figure 5-73, sherds, lithics, and red pigment are similar in their representation in collection units. Copper ore makes up the bulk of most of the collection units, and some collection unit assemblages consisted of little more than copper ore. These patterns show a greater degree of spatial segregation of activities than at many other Late Period sites. The implications of this use of site space for understanding the productive steps of bead making will be discussed later in this chapter. Red pigment production is concentrated around the northernmost residential structures (Sector 1),

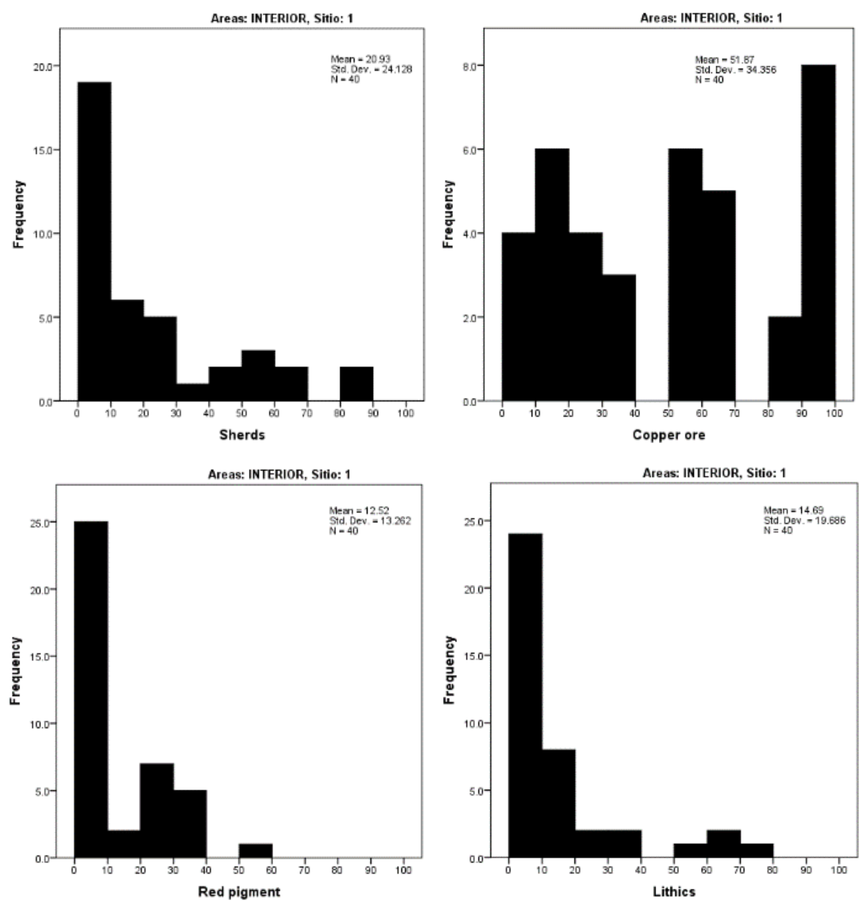
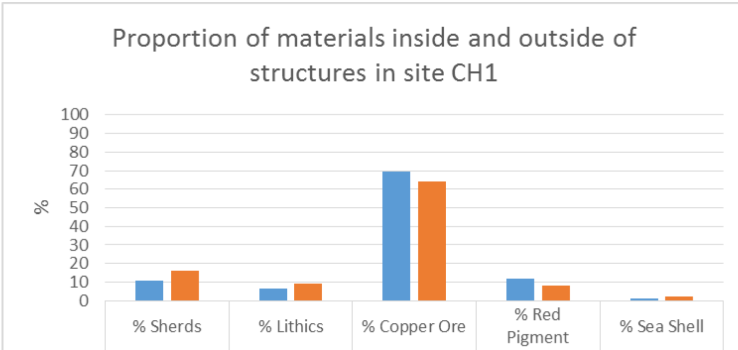


Figure 5-73. Histograms of proportion of artifacts from collection units in CH1. Only for collection units with more than 10 artifacts (N=40)

As shown in Figure 5-74, there is little difference between interior and exterior units in the mix of artifact types, although exterior artifact densities are higher. In the case of copper ores this is potentially a little bit misleading, because as we will see later, the concentrations of ore debris outside of structures could represent different steps in the *chaine operatoire* of bead making.



	% Sherds	% Lithics	% Copper Ore	% Red Pigment	% Sea Shell
In	10.8	6.6	69.5	11.8	1.3
Out	15.9	9.3	64.3	8.2	2.4

Figure 5-74. Graph of proportion of artifacts inside and outside structures in CH1

5.3.1.2 Chinchilla 1 test pits

Test pits were distributed to characterize the main structures, features, and productive areas, and were placed at interior of structures, exterior activity areas, and hearths. In CH1, the main difference with the surface distributions is the high increment in the proportion of lithics and the reduction in the proportion of copper ores, having both of them a similar percentage in the excavated sample (figure 5-75). This situation may be explained by site formation processes where the heavier weight of lithics may have contributed to their underrepresentation on the surface. Red pigments and marine shells have a similar representation, and sherds increased from 13% to 22%. In the map of figure 5-75, we can see that the spatial distribution excavation materials follows a relatively similar pattern than in the case of surface distributions, despite the changes in lithic and copper ore proportions.

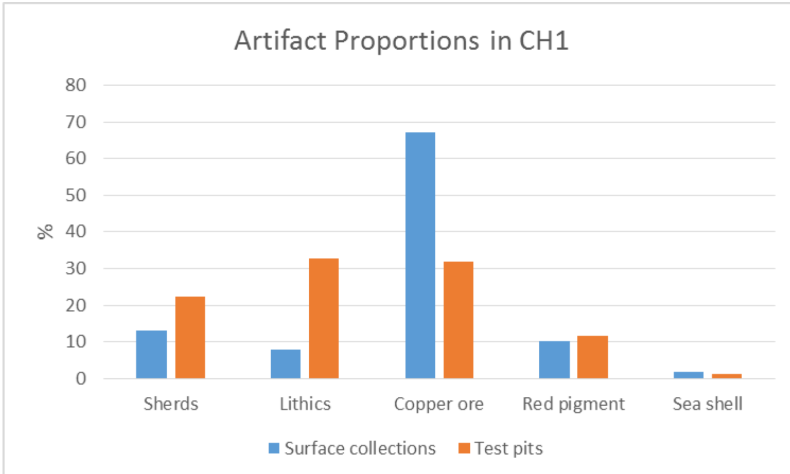


Figure 5-75. Comparison between artifacts proportions from surface collection and test pits from CH1

A total of eight test pits were excavated at CH1, seven measuring 1 x 1.5 meters, and Unit 2 at 1 x 2 meters. The breakdown of artifacts from these excavations is shown in Table 5-4 and Figure 5-76. Excavation units were located as follows:

Unit 1: In an open space next to a wall next of the main architectural compound. Artifacts were found only to a depth of 20 centimeters.

Unit 2: Inside the main architectural compound where surface ashes marked the location of a hearth. Artifacts were found only to a depth of 40 centimeter.

Unit 3: In the entrance of the largest structure in a cluster of three structures. Artifacts were found only to a depth of 20 centimeters.

Unit 4: Next to a linear stone foundation in a concentration of copper ore debris related to bead making. Artifacts were found only to a depth of 20 centimeters.

Unit 5: At the entrance to a circular structure associated with a linear stone foundation surrounded by crushed copper ore. Artifacts were found only to a depth of 30 centimeters.

Unit 6: Outside the second largest compound of structures, in an area with surface evidence for bead making. Artifacts were found only to a depth of 30 centimeters.

Unit 7: At the entrance to a circular structure in Sector 2 of the site. Artifacts were found only to a depth of 10 centimeters.

Unit 8: In an ashy, open space corresponding to a hearth next to the southernmost compound of the site in Sector 2. Artifacts were found only to a depth of 30 centimeters.

Table 5-4. Excavation materials from site CH1

Units and levels	Sherds	Animal bones	Lithics	Copper ore	Red Pigment	Marine shells
Unit 1 (1.5 x 1 m)	**83**	**206**	**136**	**79**	**60**	**2**
Surface	7	29	14	14	8	0
1	73	100	100	60	44	2
2	3	77	22	5	8	0
Unit 2 (2 x 1 m)	**27**	**242**	**92**	**30**	**51**	**2**
Surface	5	10	4	0	6	0
1	18	100	78	23	43	2
2	4	100	6	4	2	0
3	0	29	4	3	0	0
4	0	3	0	0	0	0
Unit 3 (1.5 x 1 m)	**94**	**110**	**22**	**0**	**5**	**0**
Surface	11	16	0	0	0	0
1	83	94	22	0	2	0
2	0	0	0	0	3	0
Unit 4 (1.5 x 1 m)	**133**	**136**	**35**	**157**	**11**	**2**
Surface	25	18	2	4	3	0
1	108	114	33	149	8	1
2	0	4	0	4	0	1
Unit 5 (1.5 x 1 m)	**0**	**0**	**4**	**139**	**15**	**0**
Surface	0	0	0	25	1	0
1	0	0	4	108	7	0
2	0	0	0	5	6	0
3	0	0	0	1	1	0
Unit 6 (1.5 x 1 m)	**27**	**65**	**132**	**152**	**29**	**3**
Surface	3	14	25	44	5	1
1	23	48	101	103	23	2
2	1	2	4	4	1	0
3	0	1	2	1	0	0

Units and levels	Sherds	Animal bones	Lithics	Copper ore	Red Pigment	Marine shells
Unit 7 (1.5 x 1 m)	**12**	**15**	**39**	**18**	**22**	**4**
Surface	4	4	7	8	8	0
1	8	11	32	10	14	4
Unit 8 (1.5 x 1 m)	**42**	**370**	**151**	**22**	**23**	**11**
Surface	7	42	10	3	2	2
1	30	118	90	15	2	9
2	5	200	41	2	19	0
3	0	10	10	2	0	0
Total	**418**	**1144**	**611**	**597**	**216**	**24**

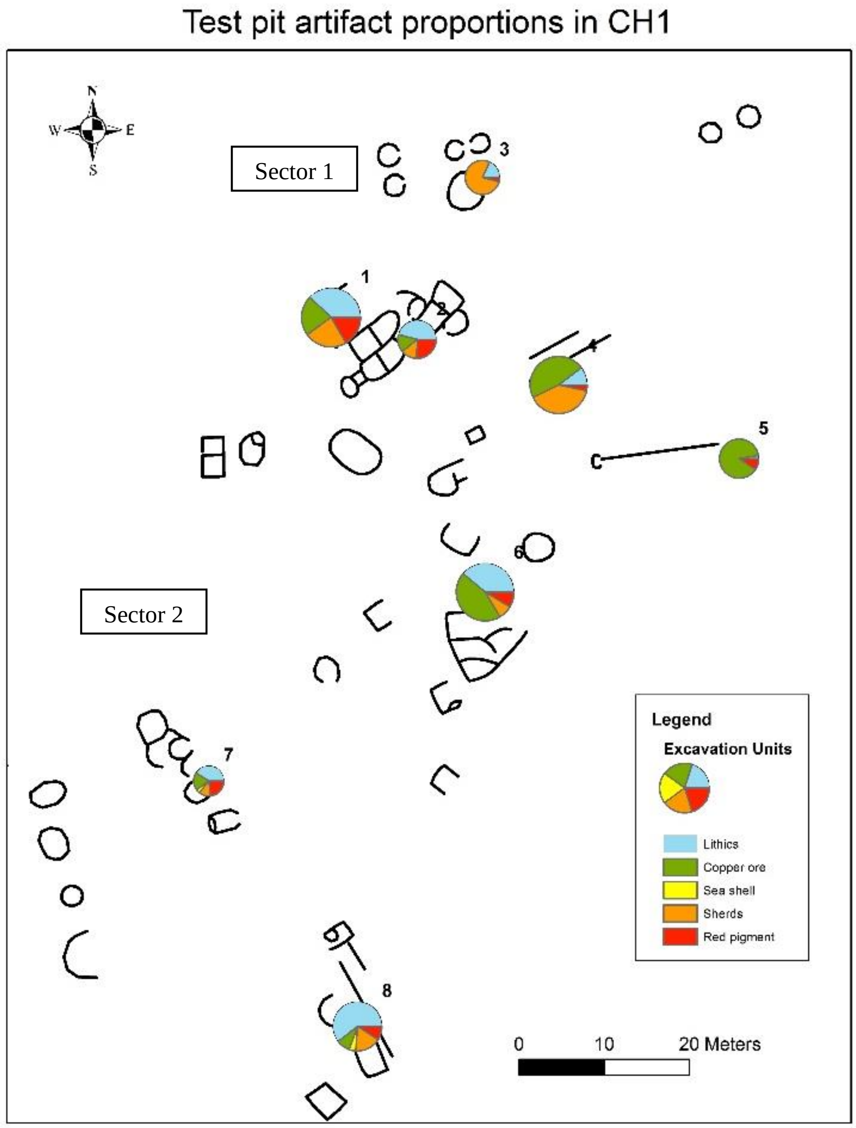


Figure 5-76. Test pit locations at site CH1. The chart size represents raw artifact counts, and test pit 2 was standardized with the others because it had a larger excavation area

5.3.1.3 Excavated Features from CH1

Hearths were the main features recognized during the excavations at CH1. These tended to be very shallow, barely thicker than 10 centimeters. Some were diffuse, closer to ash lenses. Aside from taphonomic factors, the low ash densities may also reflect the lack of fuel availability. The only locally available fuel would have been the scattered, small desert vegetation. Ash lenses or hearths were found in 7 of the 8 test pits, suggesting that cooking was widespread around the site.

5.3.1.3.1 Hearths in Sector 1

Test Pit 1 exposed a diffuse hearth between 5-20 centimeters below the surface, associated with stones (Figure 5-77). This fill contained botanical remains and a few carbon fragments. This test pit produced the highest proportion of Inca local style sherds at the site, and most of the recovered chañar seeds. The radiocarbon date obtained from this feature gives a calibrated range in between 1401-1452 AD, fitting well into the Late Period.

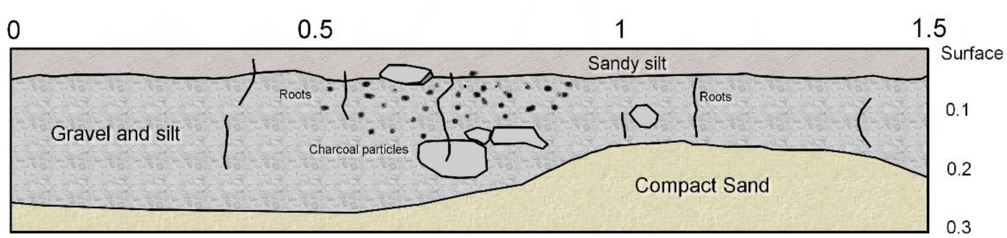


Figure 5-77. West profile of Test Pit 1 in CH1

Test Pit 2, not far from Test Pit 1, exposed part of a large hearth that spread across the excavated area (Figure 5-78). The ash layer here was about 10 centimeters thick, and, in some places, there was a second layer about 5 centimeters below the first stratum. This hearth and the one in Test Pit 8 generated the largest numbers of animal bones at the site. Test Pit 2 also yielded 2 chañar seeds.

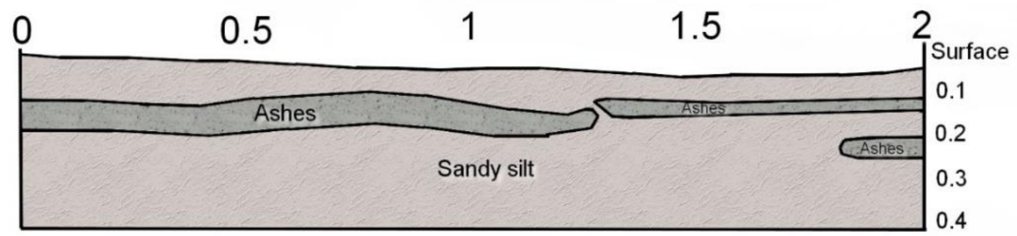


Figure 5-78. Northeast profile of Test Pit 2 in CH1

Test Pit 3 exposed a layer of ash covering a layer of sandy silt and eroded rocks from the soil matrix (Figure 5-79). The fill contained some rodent and non-identified mammal bone, and one chañar seed. The radiocarbon date obtained here gives a calibrated range of 1439-1625 AD.

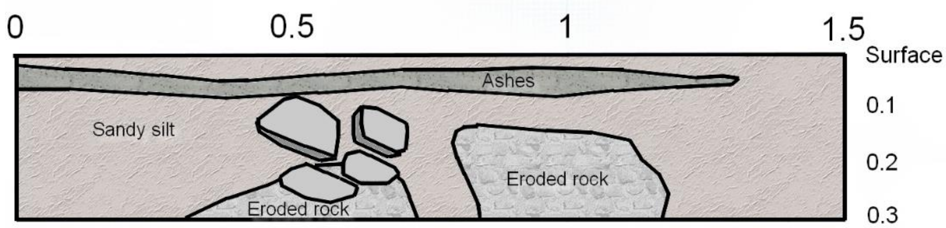


Figure 5-79. North profile of Test Pit 3 in site CH1

Test Pit 4 exposed any ash layer of variable thickness in between 5-15 centimeters below the surface (Figure 5-80). Most animal bones in this layer were very fragmented, representing generic mammal, rodent, and camelid bones. This test pit is the only one that had only undecorated cooking pot fragments.

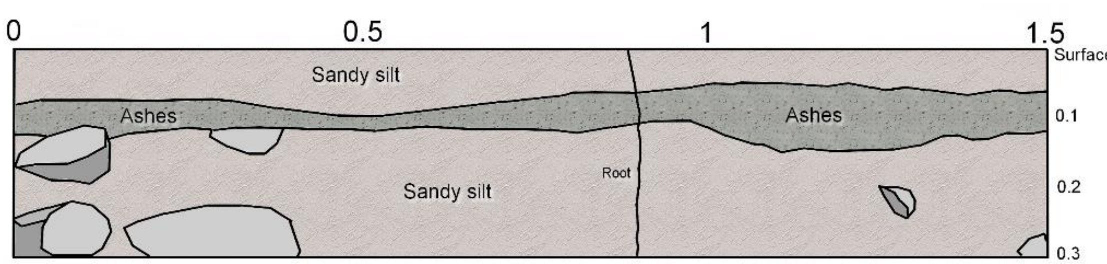


Figure 5-80. East profile of Test Pit 4 in site CH1

Test Pit 6 exposed a small, pit hearth in the center of the excavation area (Figure 5-81). Inside the structures of this compound were scattered ash, carbon, and animal bones, perhaps distributed by past disturbance as there is a large hole in the middle of the structure. The radiocarbon date obtained here gives a calibrated range in between 1020-1179 AD, belonging to the Late Intermediate Period, but immediately this ash were Inca local style sherds, showing a continuity in the use of the space.

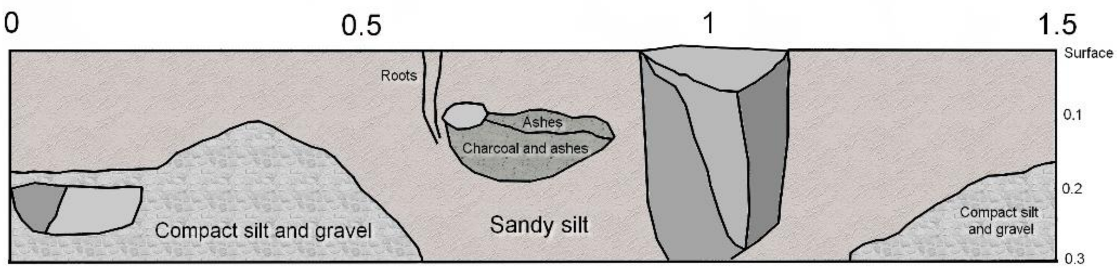


Figure 5-81. South profile of Test Pit 6 in site CH1

5.1.3.2 Hearths in Sector 2

Test Pit 7 exposed a layer of ash and charcoal in the upper 10 centimeters of the excavation, directly overlying the sterile soil matrix of the area (Figure 5-82). This hearth had the fewest animal bones, but contained diagnostic Diaguita Inca and Inca local sherds.

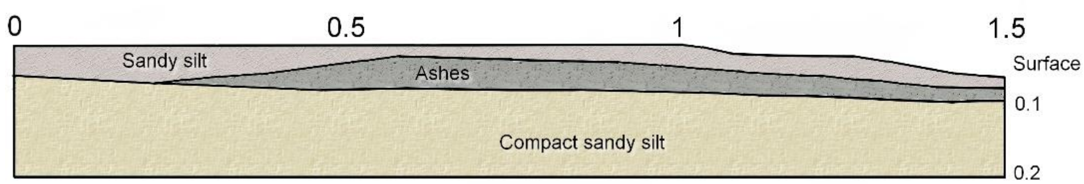


Figure 5-82. Southeast profile of Test Pit 7 in site CH1

Test Pit 8 exposed a hearth between 20 – 30 centimeters below the surface (Figure 5-83). This feature contained almost twice the bones of any other, and probably was repeatedly used. The identified taxa were mammals and rodentia. Half of the identified, non-flake lithic tools at CH1 were found in this unit, along with a complete bead. The radiocarbon date obtained here has a calibrated range in between 1043-1261 AD, with artifacts above the hearth belonging to the Late Period.

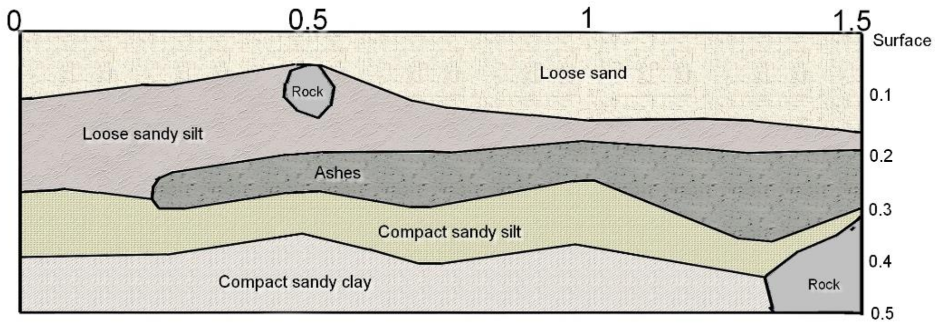


Figure 5-83. Northeast profile of Test Pit 8 in site CH1

5.3.1.4 CH1 archaeological materials

5.1.3.4.1 Pottery

The diagnostic pottery represented at CH1 includes Diaguita Inca and Inca local styles, of the type also found along the nearby Inca Road (Figure 5-84). Decorated sherds made 29.5% of those recovered at CH1, and of these, 2.7% correspond to Diaguita Inca types, and 26.8% are Inca local types. 70.5% of sherds are monochrome. Diaguita Inca is represented in bowls and asymmetrical vessels, and Inca local types take the form of aryballos, shallow plates, and bowls. Only a single diagnostic sherd of the Middle or Late Intermediate Period was found at the site (Figure 5-84). This sherd was in the Animas I culture style, but came from a restricted vessel, rather than the common decorated bowls of the Animas I. No handles were found in the ceramic assemblage from the site, and only 6.3% of the sherds were from necks, indicating simple profile vessel shapes.

Figure 5-84. Pottery styles from CH1

As shown in Figure 5-85, monochrome types are clearly thicker than the decorated types. Monochrome sherds have a normal distribution with a peak at 7 millimeters, and then continue decreasing in frequency up to 15 millimeters. Those sherds would belong to utilitarian cooking/container pots related to food preparation activities. Decorated types decrease dramatically in frequency above 6 millimeters, which suggests that they correspond to relatively small, thin walled vessels.

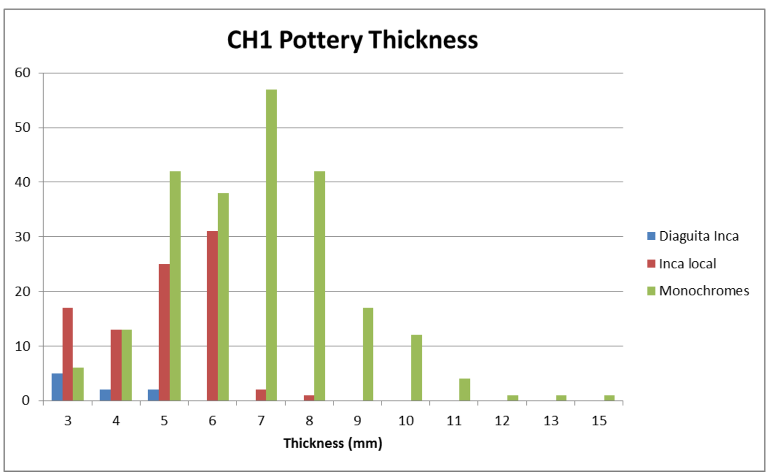


Figure 5-85. Thickness of pottery types in CH1

The distribution of styles per test pit is not homogeneous (Figure 5-86). Test Pits 4 and 8 only yielded monochrome sherds, and proportions of Diaguita Inca and Inca local styles varied among test pits. They were in the highest proportions in Test Pit 1, and very high in Test Pit 2, suggesting a functional difference or more exclusive access to higher value vessels by household/corporate units within this "senior" residential cluster at the site.

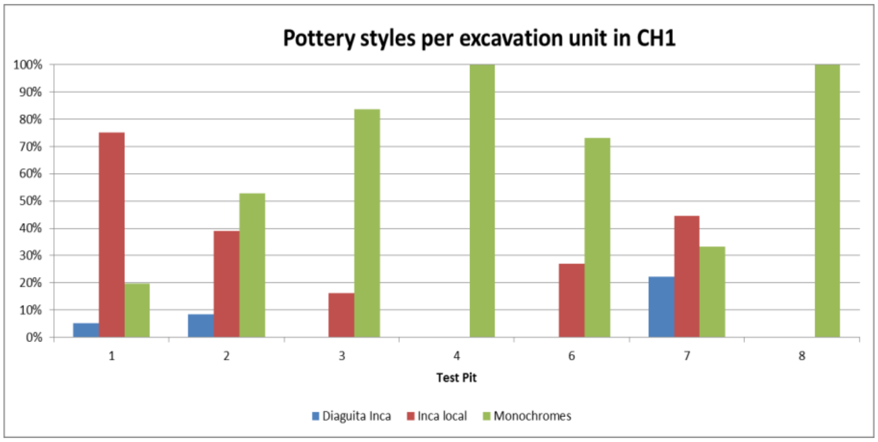


Figure 5-86. Distribution of sherds by test pit at CH1

The main difference in the pottery style preferences at CH1 in comparison to Late Period sites of the Copiapó Valley is the small proportion of large containers at CH1. Large containers such as the Punta Brava type or equivalents compose the major proportion of pottery assemblages in Copiapó Valley sites. Their scarcity at CH1 might be related to difficulties in transportation, differences in storage needs, and the non-agricultural, specialized character of the activities that were carried out in the mining camps.

5.3.1.4.2 Lithic artifacts[22]

The main raw lithic materials are basalt (42.6%), flint (34%), quartz (13.5%), obsidian (4.5%), and transparent quartz (3.6%). The obsidian and most of the fine grain flint is from non-local sources.

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[22] The classification of lithic artifacts was done with the help of Daniela Padilla, archaeologist from the University of Chile.

Lithics from CH1 did not include cores. The debitage consisted of small flake fragments (70.1%), flakes derived from cores (17.8%), and secondary flakes as products of bifacial flaking (11.9%). Raw materials were obtained at other places and then transported here for secondary flaking for manufacture of finished artifacts. The assemblage also includes retouch activities. This conclusion is supported by the fact that 75% of the debitage had no cortex and 24% of had less than 25% of cortex; this was not a primary debitage assemblage.

Finished artifacts collected consisted of five projectile points, including complete, broken, and unfinished ones, and two retouched pieces that may have been used as knives or scrapers (Figure 5-87). The projectile points are similar in shape and raw materials to others found at the Cachiyuyo de Llampos Mountains camps.

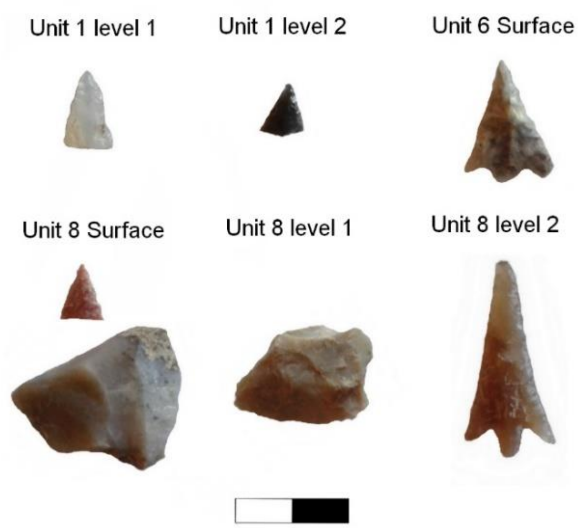

Figure 5-87. Lithic artifacts recovered during the excavation in CH1

5.3.1.4.3 Botanical remains[23]

Carbonized botanical remains were common in many test pits. The list of identified species can is shown in Table 5-5.

[23] The classification of botanical remains was done with the help of Valentina Mandakovic, archaeologist from University of Chile.

The main identified species at CH1 are chañar (*Greoffroeae decorticans*) seeds. The chañar (*Greoffroeae decorticans*) is a native tree of the valleys and oases of northern Chile and northwestern Argentina, and the toponymy of the region is full of references to it. Chañar grows wild and are very common in the Copiapó Valley. Their round small fruit is similar to a date, and it has been traditionally collected during summer to be eaten or converted into *arrope*, which is a sweet syrup used for deserts, and as a cough medicine. Since the arrival of the first Spaniards, there are accounts of the use of chañar fruit as a staple food by the local population, and it was stored together with maize in almost every village (Bibar 1966[1558]). Chañar fruit is a legume with a high percentage of oil, proteins, and sugar (Maestri et al. 2001), and its presence at five test pits from CH1 suggests that it was transported, probably in dry from, from the Copiapó Valley or the Finca de Chañaral oasis, constituting an important part of the miner's diet.

Atriplex sp. is a genus with many native species. One of these is common in northern Chile and is known as *Cachiyuyo*. There are also ethnographic accounts from this plant for the San Pedro de Atacama, where its leaves were used for salad or cooked in stews (Villagrán and Castro 2004). It is also used as animal fodder. *Atriplex sp.* seeds are ubiquitous in all test pits in CH1, but their presence may be the result of wind and other depositional processes rather than human activities.

Alstroemeria sp. is a genus with many flower species. The best known of these is the "Lily of the Incas". Seeds of this plant were only found in Test Pit 6 at CH1. It is unlikely that this is a random distribution; if the seeds were spread by the wind they would have been found in other test pits. There are no known ethnographic uses of this plant as food, and its presence in CH1 may suggest an economic/ornamental rather than subsistence use.

Tiquilia atacamenis is a native desert evergreen that grows in areas lacking of rain and has blue flowers. Ethnographic information from the area of San Pedro de Atacama describes consumption of its sweet roots or preparation as a tea (Villagrán and Castro 2004). This plant is present in small quantities at two units in CH1, but is not clear if the seeds were transported here by natural agents or introduced intentionally as product of human consumption.

Table 5-5. Identified botanical remains at CH1

Test Pit	Alstroemeria	Atriplex sp.	Greoffroeae decorticans	Unknown #1	Unknown # 2	Tiquilia atacamensis	Total
1		198	20				**198**
2		133	2			2	**136**
3		16	1	1	1		**19**
4		42		4			**46**
5		126		1		2	**129**
6	108	150	2	2			**262**
7		105					**105**
8		202	7	2		1	**206**
Total	**108**	**972**	**32**	**10**	**1**	**5**	**1128**

There were also two unidentified seed forms in CH1 (Figure 5-88). The first type was present in 5 test pits, and the second type was present only in one test pit.

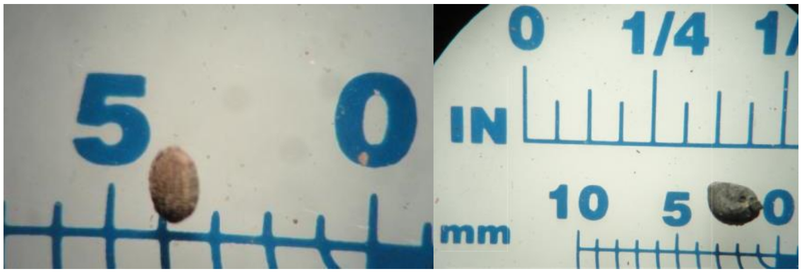

Figure 5-88. Unidentified seeds. At the left #1 (N=10), and at the right, #2 (N=1)

5.3.1.4.4 Animal bones[24]

As seen in Table 5-6, the taxa represented in the test pit samples varied considerably. Dominant in Test Unit 2 were *Rodentia* including the family *Chinchillidae* that includes

[24] The classification of animal bones was done with the help of Cristobal Oyarzo, archaeologist from University of Chile.

chinchillas and vizcachas, and the family *Cricetidae* which includes hundreds of small rodent species. Rodents represent 67.7% of the sample of the total identified animal bones from the site. Hunting of wild chinchillas and vizcachas appears to have been a major source of meat for CH1 residents.

Identified camelid bones only amount to the 2% of the total, although many of the unidentified large fragments of the big and medium *Mamalia* category likely represent camelid. Taken together, these total 20.4% of identified taxa, which is a significant food resource if we consider that they may have amount more calories than the small rodents, even if the latter were more abundant.

There is surprisingly little bird or fish at CH1, less than 1%, must of which came from Test Pit 3.

Table 5-6. Identified animal taxa (NISP) at CH1

Animal bones		**Taxa**										
Test Pit	**Level**	**Mammalia**	**Small Mammalia**	**Chinchillidae**	**Rodentia**	**Cricetidae**	**Medium Mammalia**	**Large Mammalia**	**Camelidae**	**Osteichthyes**	**Birds**	**Total**
1	1	2		2	6		2	8		2		22
	2	2			1		1		2		3	9
2	Surface			1			1		2			4
	1	24	2	10	53		15		4	3		111
	2			2	28							30
	3			1	1		8					10
	4						1					1
3	Surface						2					2
	1	1		17	6					17		41
4	Surface				1		5		1			7
	1			1	7		11		1			20
	2						3					3
6	Surface						2					2
	1			5	2		5					12
7	Surface						1					1
	1						2					2
	Surface						1					1
8	Surface						3					3
	1	1		3	8		4					16
	2			43	105	10	14					172
	3				12							12
Total		**30**	**2**	**85**	**230**	**10**	**80**	**8**	**10**	**22**	**3**	**480**

Faunal remains were found in all but one of the test pits (Figure 5-89). Test Pits 2 and 8 had the largest hearths and the deepest in stratigraphic terms, but in general the evidence suggests that there were multiple independent areas of food preparation/consumption across the whole site.

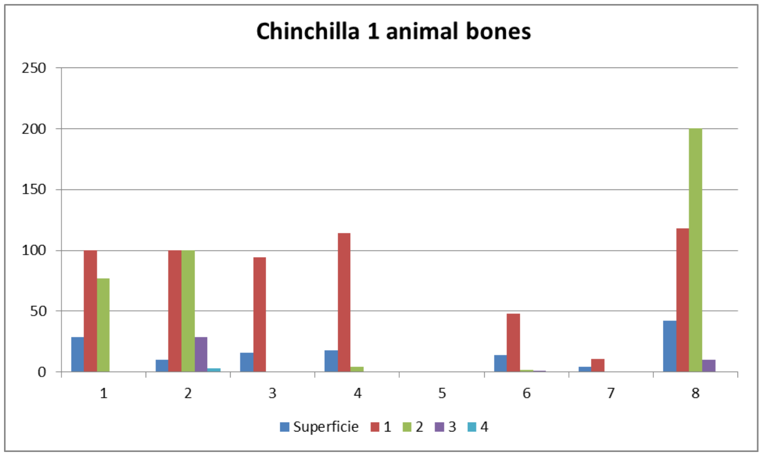

Figure 5-89. Number of animal bones per test pit and excavation levels

5.3.1.5 Bead and pigment production at CH1

The surface and excavations materials from CH1 confirm that the main craft activities carried out here were related to the manufacture of ore beads of turquoise and malachite, and the production of iron oxide based red pigment. Those activities were somewhat spatially segregated across the site. Bead making was done in several stages (Figure 5-90), and a failure at any of those steps would have had as a consequence the discarding of the unfinished bead:

1) The process started with the crushing of the ores to sizes of approximately 2 x 1 centimeters.

2) These pieces were then polished to become flat on both sides and roughly rounded by chopping the edges. Bead blanks have parallel wear marks, showing that polishing was carried out by a linear movement in the same direction over a hard surface.

3) Next came the initial perforation one side in order of the bead blank to define what would be the center of the bead, and continued rounding of the piece edges.

4) The blank was perforated working from both sides, and continued grinding on the sides gave the bead its final round shape. Failure to produce a centered hole would lead to discarding the bead.

5) If the previous steps produced an even shape, the bead was polished again and rounded until reaching final form. The finished bead would have a diameter of about 5 millimeters.

There is not much evidence for the tools that were used for the process, apart from some small stone hammers and flat grinding stones that may have help for smoothing and polishing the beads. Parallel wear marks in bead blank suggest that polishing was done by a linear movement, probably rubbing the piece against a hard but smooth surface. We did not find distinctive perforators at the site. That the perforation was done before the final polishing suggests that this drilling was a critical step in the process. Only if they succeeded with perforating the blank would they move to the more time consuming step of producing the smooth final round shape.

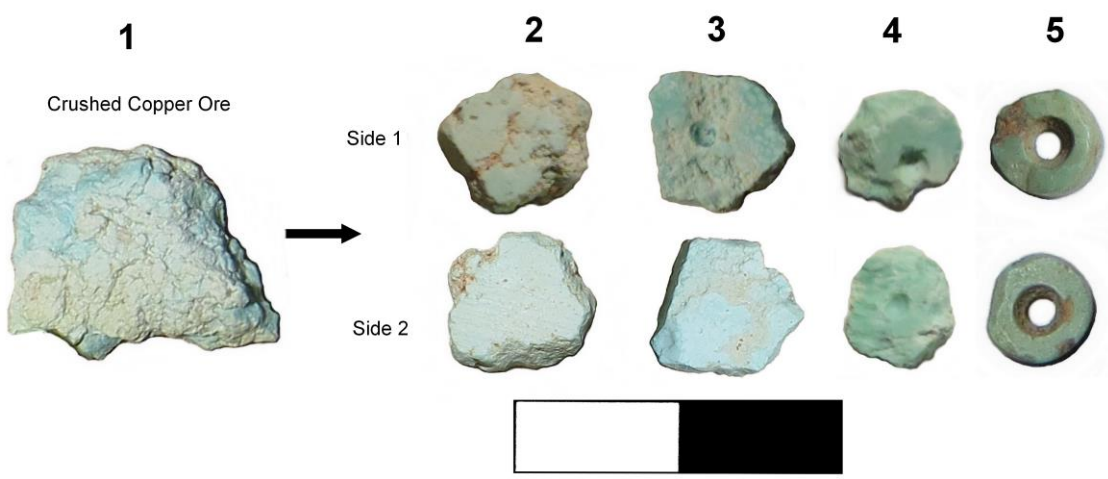

Figure 5-90. Bead blanks from CH1, representing different stages of bead making process

At CH1, Stage 1 took place around the lineal stone structures of Sector 1, and Sector 3, while steps 2 - 5 were carried out in association with all of the residential structures of the site. This spatial patterning suggests that after mining the ore, the residents had a common pool of copper ores from where they could choose the most appropriate ones, crushing them until Stage 1. After that, each labor unit would continue the next final steps in their own residential areas.

The typology of these beads is not unique for this area, and they resemble Formative beads from Tulán oasis at the southern end of the Atacama salt marsh (Soto 2010). There are also abundant examples of similar finished beads dating to the Pre-Inca and Late Periods in the collection of the Museo Regional de Atacama in Copiapó (Appendix A).

Red pigment fragments at CH1 were mainly present in the northern part of the site, in close proximity to the main residential structures, in areas of high sherd frequency. Flat grinding stones and pestles located in residential structures bear red pigment powder. These lines of evidence suggest that pigment production was not segregated from domestic activities (Figure 5-91). The source of red iron oxide rocks is located at an elevated position about 300 meters to the east of CH1, and is easily available through simple quarrying of the outcrops here.

The iron oxide rocks were carried to the site and crushed and ground in flat stones using hammers and pestles, to create a powder to be used as pigment. A direct use of those pigments can be observed at many sites within the Cachiyuyo de Llampos Mountains in rock art paintings, which are also present at CH1 (Figure 5-91). Moreover, pXRF analysis done on site[25] confirmed that the iron oxide pigments are similar to the ones used for pottery decoration, suggesting the major use of these pigments.

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[25] pXRF analyses were done in 2012 thanks to the participation of Professor Wugan Luo from the Academy of Sciences of Beijing, Tao Li and Dong Li from the University of Pittsburgh, and the author.

Figure 5-91. Flat grinding stone associated with a pestle in a structure of Sector 1 of CH1. They show residue from red pigment grinding. At the bottom, rock art panels and rocks with red pigment from CH1. The first rock art image was enhanced using D-Stretch software

5.3.1.6 Site structure and occupation at Chinchilla 1

The spatial patterning of architecture and artifact categories suggests that the site was made up of a handful of households or corporate task groups, perhaps 2 to 4 household/corporate groups in each area of the site. These shared certain common tasks such as the copper ore processing for the initial stage of bead making. The labor for bead production was likely organized into two steps, (1) communal mining and primary selection of ores, where everyone might have shared the ore vein and cooperated in mining and crushing the best ores; and (2) final crafting at each individual residential area. However, they cooked, slept, finished beads, and prepared red pigment in their own residential areas. The pattern of activities across the site is not homogeneous, and shows two main residential/productive areas, one to the north (Sector 1), the other to the south (Sectors 2 and 3), divided by a dry drainage. Both areas have evidence of copper ore processing, but the southern one of the site lacks evidence for red pigment production. Instead, it has a greater amount of lithic debitage on surface.

5.3.2 Chinchilla 2

CH2 is located only 600 meters from CH1, connected by a path. CH2 lies at the entrance to a secondary ravine, and the architecture here was better preserved than at CH1 (Figure 5-92). The site is composed of two semi-rectangular structures with subdivisions, separated from one another by 4 meters. There are also three isolated structures to the east, and one double structure located 30 meters to the north (Figure 5-93). The main structures are not exactly like the other circular/elliptical structures found at other camps, nor do they conform to the Inca orthogonal pattern that can be seen at sites such as Tambo Medanoso. Surface artifact density was low, and concentrated in the area surrounding the main structures.

Figure 5-92. General view of CH2

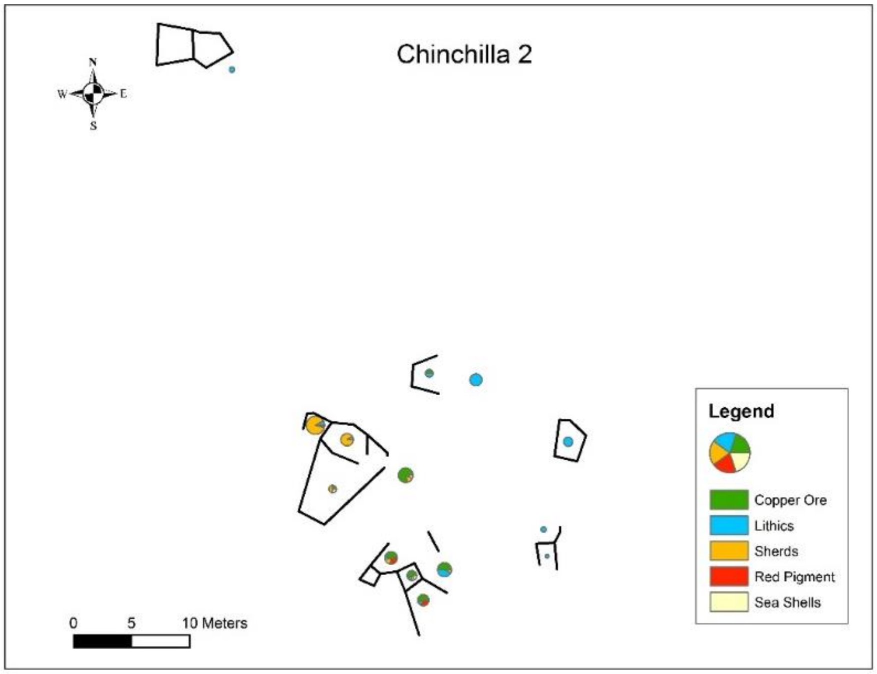


Figure 5-93. Map of proportion of surface materials in CH2, based on 18 collection units (chart size represents raw artifact counts)

From the surface (Figure 5-94), we collected red jasper, and white and brown flint flakes. An unfinished copper ore bead, a marine shell elliptical adornment, and an unfinished projectile point with a stem base, suggest some of the craft activities carried out here. Pottery styles are from the Late Period, of the Diaguita Inca and Inca local styles.

Figure 5-94. Some of the surface artifacts from CH2. At the top, lithic artifacts and Late Period pottery styles. At the bottom, marine shell artifact and unfinished projectile point

About 30 meters in front of the site, at the point where the secondary ravine detours to the south, is an isolated rock art panel that depicts an anthropomorphic figure with two small camelids (Figure 5-95). This is the only rock art panel in the area and at difference to others, is located in a small rock of about 70 centimeters high in the open, instead of the rocky walls of the ravine.

Figure 5-95. Rock art panel with an anthropomorphic figure and a camelid in front of CH2

5.3.3 Chinchilla 3

Site CH3 is located in on a hill terrace overlooking a secondary branch of the Chinchilla ravine. The layout of the structures of the site is relatively symmetrical, with two large elliptical structures, nearly touching one another at one end, and with attached smaller structures at their opposite ends, to form a kind of U shape (Figure 5-96). Most of the surface artifacts of the site were concentrated around three elliptical structures in the mouth of the U (Figure 5-97). Sherds are ubiquitous, and this site has the most sherds of any of the Late Period camps. CH3 also differed from other sites in yielding abundant large grinding stones.

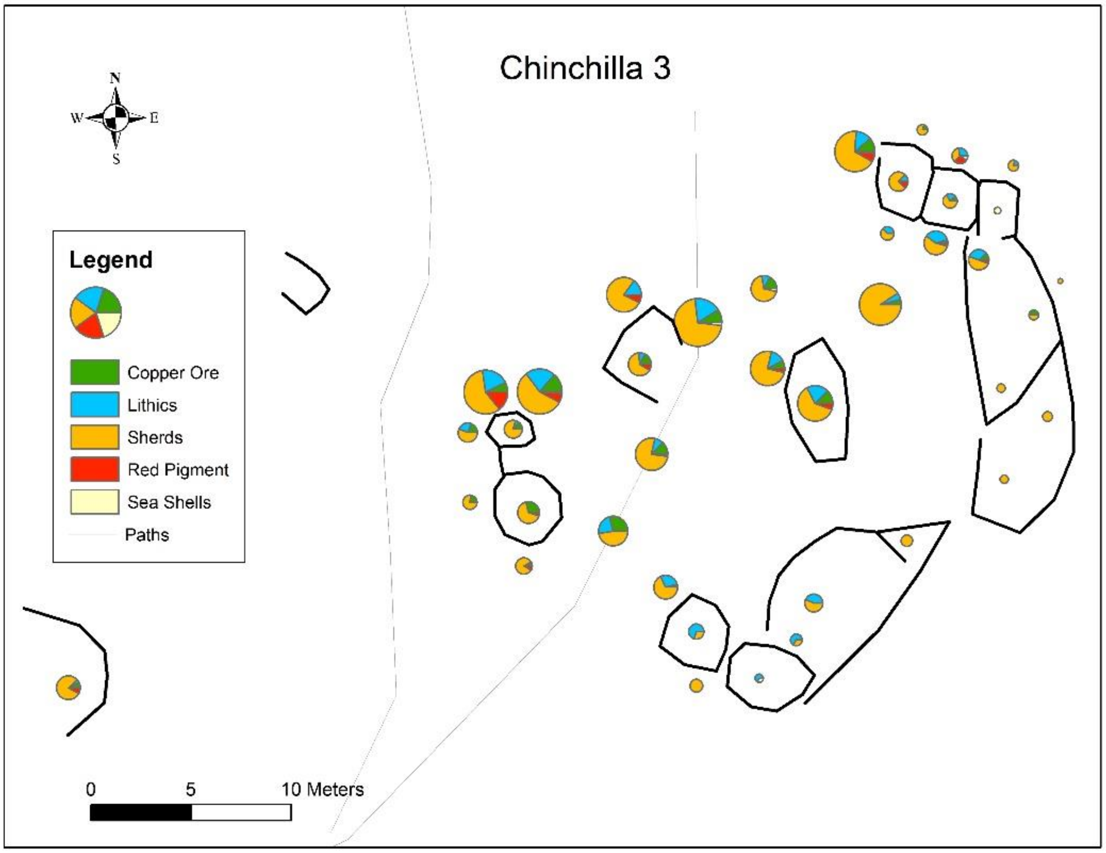


Figure 5-96. Map of proportion of surface materials in CH3, based on 41 collection units (chart size represents raw artifact counts)

Figure 5-97. General view of site CH3. Notice the grinding stones on the surface in relation to the structures

As shown in Figure 5-98, ceramics make up the bulk of most collection assemblages, followed by lithics and copper ore. Unlike at CH1, ore working here was not spatially segregated. Figure 5-99 compares interior and exterior assemblages, revealing that artifacts sherds have higher proportions outside of structures, while lithics and copper ores are better represented inside structures. However, the difference is less than 10%.

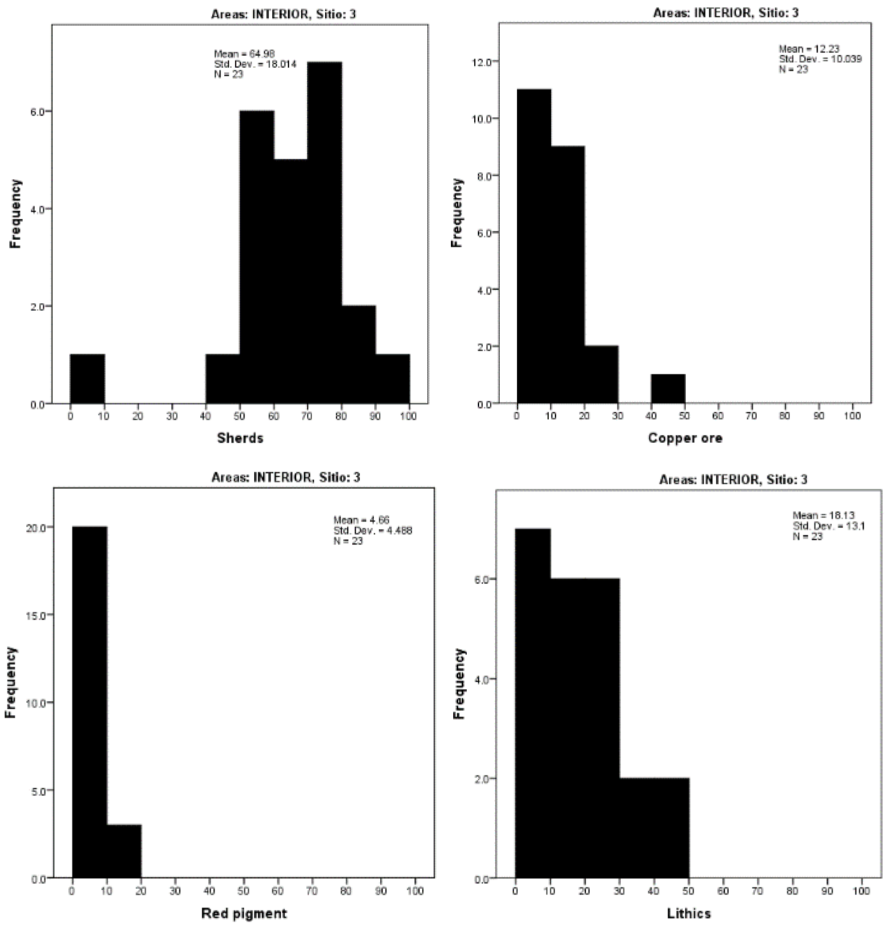


Figure 5-98. Histograms of proportion of artifacts from collection units in CH3. Only for collection units with more than 10 artifacts (N=23)

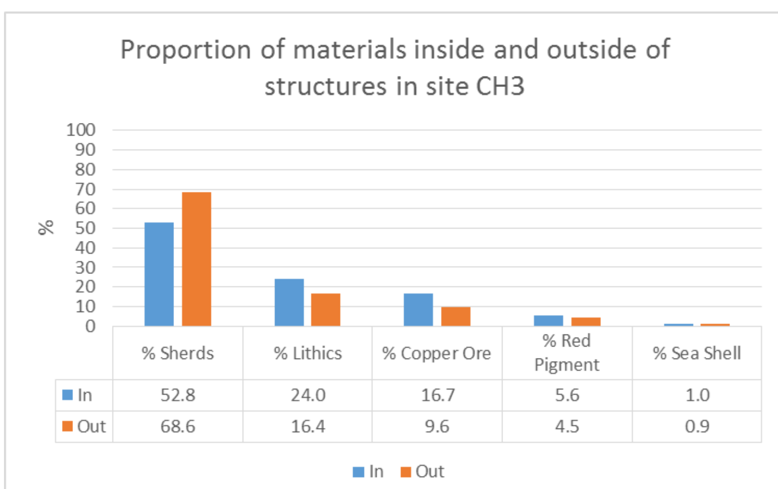


Figure 5-99. Graph of proportion of artifacts inside and outside structures in CH3

Red pigment fragments were rare, and largely restricted spatially to one of the structures. However, scattered around the site were more than 20 large grinding stones, most of them with a deep concavity, unlike the flat ones that are common at the other sites (Figure 5-100). Some of these grinding stones were complete, and others seem to have been broken intentionally or even used as cores to get flakes after their primary use. Many of them, and also pestles, show traces of red pigment inside (Figure 5-101), indicating that their main function was related to pigment powdering. The low proportion of red pigments fragments at CH3 may be explained by the relative distance to the main source located next to CH1. A higher efficiency in the processing would leave less red iron oxide fragments than we might expect at sites closer to the extraction source. On the other hand, it is not clear if every one of the grinding stones were used to grind red pigments, and some of them could have had other uses.

Figure 5-100. Some of the grinding stones from CH3

Figure 5-101. Grinding stone and pestle where can be seen the evidence of ground red pigment. Image enhanced using D-Stretch software

One of the uses of the red pigment can be seen in the rock art located about 40 meters in front of the site on the walls of the ravine. The main figures are camelids and anthropomorphic beings, At least in two panels it is possible to recognize a human holding a camelid by the neck with a rope (Figure 5-102). From CH3 there is a path with Late Period pottery that leads directly to the area of the rock art.

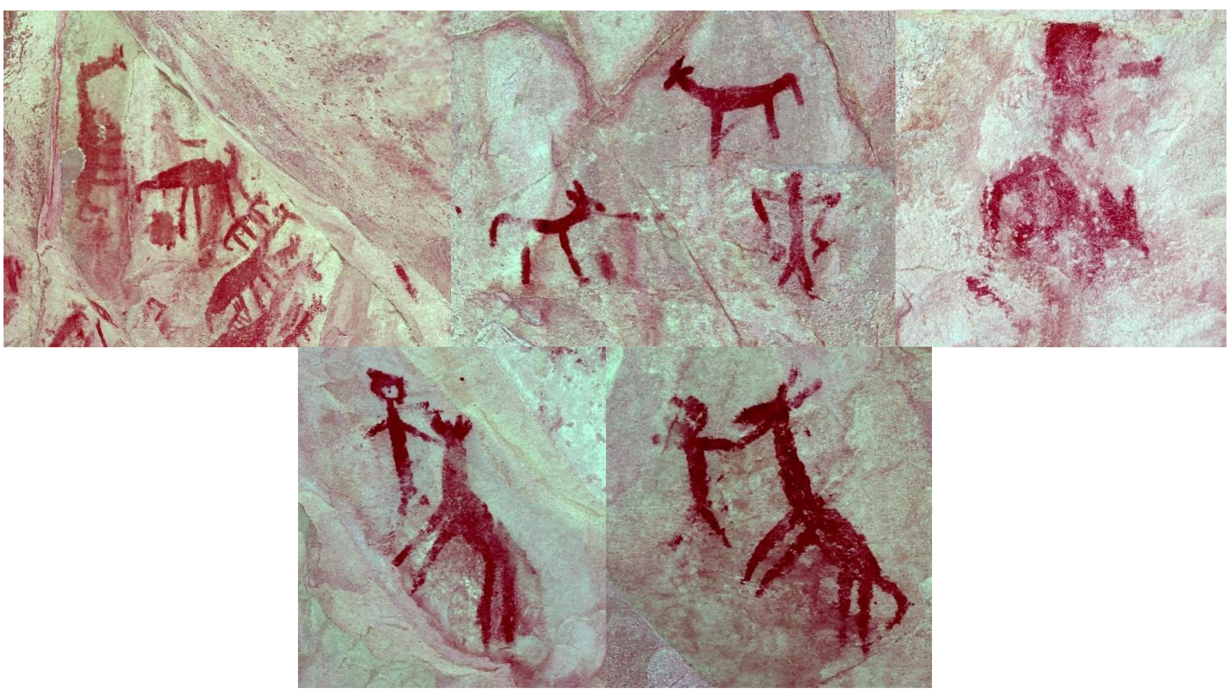


Figure 5-102. Rock art panels located in front of CH3. Images enhanced using D-Stretch software

CH3 surface collections yielded white flint and obsidian flakes, crushed copper ore, marine shell fragments, fish and camelid bones, and red pigment fragments (Figure 5-103). The pottery assemblage included undecorated sherds with smoothed and scraped finish, Copiapó black on red, Punta Brava, Diaguita Inca, and Inca local styles (Figure 5-104). This site is one of only two identified to have Copiapó black on red and Punta Brava sherds. EXT9, close to the Inca Road has a few Copiapó and Punta Brava sherds. These represent the local styles from the Copiapó Valley during the Late Intermediate and Late periods. Taken together, the pottery styles present, the high proportion of pottery in the assemblage, and the unique grinding stones, distinguish this site from other camps.

Figure 5-103. Artifacts from the surface of CH3

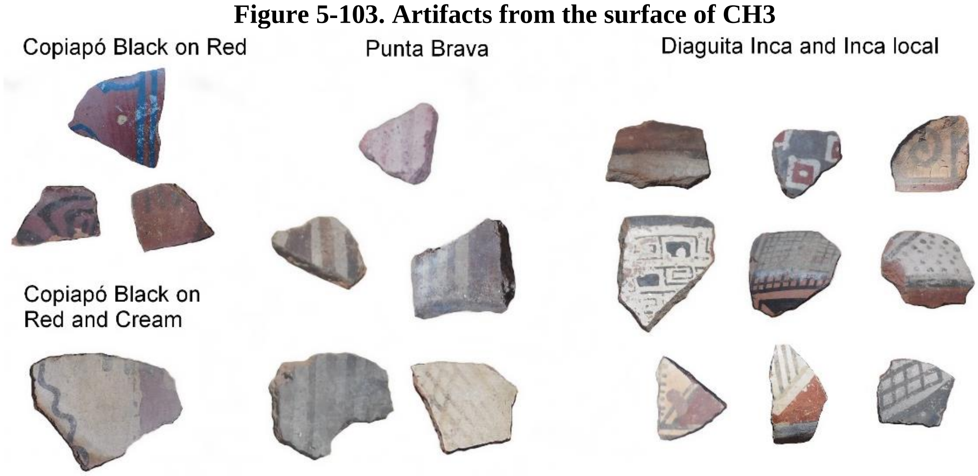


Figure 5-104. Pottery styles from CH3

5.3.4 Chinchilla 9

CH9 is located in the Chinchilla ravine, next to a small water well, the only extant one in the area for many kilometers around. Investigation revealed low surface artifact densities, and relatively homogeneous proportions of artifact types across the site. Not surprisingly, materials were concentrated around the water well (Figure 5-105, 5-106). Unlike other camps, the architecture at CH9 consists of scattered small structures built to adjoin the rocky walls of the ravine, which at this point is very narrow, with a width in between 10-15 meters (Figure 5-105). The water well, about 3 meters in diameter and 2 meters deep was dug at the bottom of the ravine, and is surrounded by a collapsed stone structure. The access to the well is though a rudimentary ramp excavated to one side that leads to the bottom. The amount of water inside the well I observed during various visits over the last 7 years has never been sufficient to cover more than a square meter of the base of the well surface, and even less during the summer. The well is always surrounded by flocks of small birds. On the main panel of rock art next to the water well is a large, black inscription saying "Agua de las Chinchillas 1914", which was the historic name for the water well.

Figure 5-105. General view of CH9 in Chinchilla ravine. The picture at the bottom is the water well

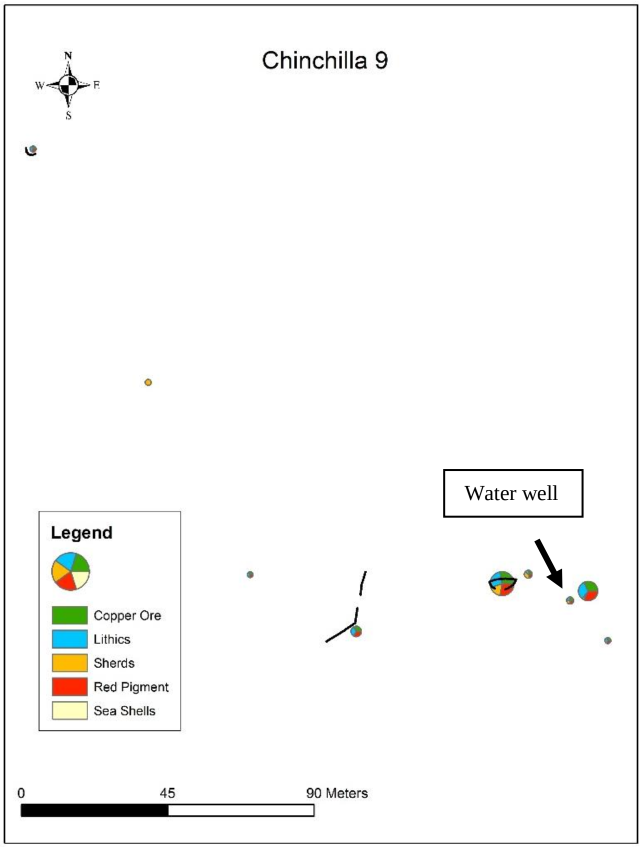


Figure 5-106. Map of proportion of surface materials in CH9, based on 9 collection units (chart size represents raw artifact counts)

Surface remains included white flint and quartz flakes, crushed copper ore, red pigment fragments, and a curved copper bar with broken ends (Figure 5-107). The copper bar was found on a structure associated with prehispanic and some historic materials, so its dating is uncertain. Ceramics include monochrome, and red slipped sherds, with some Diaguita Inca/Inca local sherds (Figure 5-108). This site has the largest concentration of rock art panels in the Chinchilla ravine, all located on the rocky walls of the ravine around the water well. They represent camelid and anthropomorphic figures, plus other geometric motifs (Figure 5-109).

Figure 5-107. Some of the surface artifacts from CH9

Figure 5-108. Diaguita Inca/Inca local sherd from CH9

Figure 5-109. Rock art panels from CH9. Images enhanced by D-Stretch software

5.3.5 Chinchilla 10

Chinchilla 10 is located at the eastern end of the Chinchilla ravine, about 1 kilometer from CH9. The architecture consists of a set of semi-rectangular and circular/elliptical structures aligned parallel to the ravine (Figure 5-110). The structures located to the east have more subdivisions and are associated with the main concentration of artifacts (Figure 5-111). The site also has rock art panels.

Figure 5-110. General view of CH10

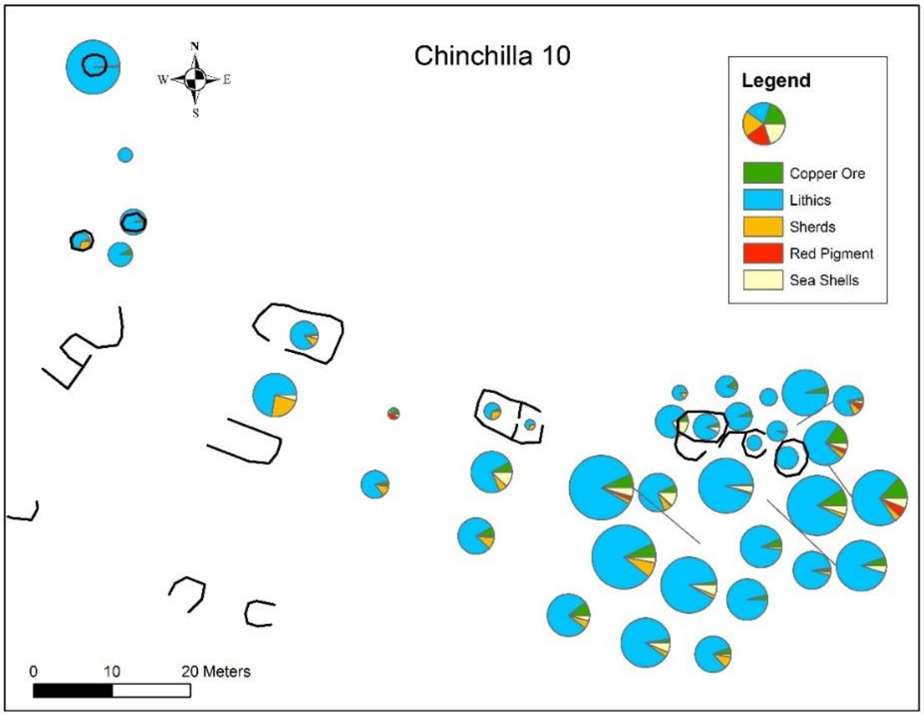


Figure 5-111. Map of proportion of surface materials in CH10, based on 42 collection units (chart size represents raw artifact counts)

As can be seen in Figure 5-111 and 5-112, the residents of CH10 focused heavily on lithic (non-lapidary) manufacture. Lithics comprise more than 60% of all collection units, with all the other artifacts making up 10% of the assemblages or less, except for sherds and copper ore in a few cases. The proportion of activities conducted inside and outside of the structures was similar (Figure 5-113).

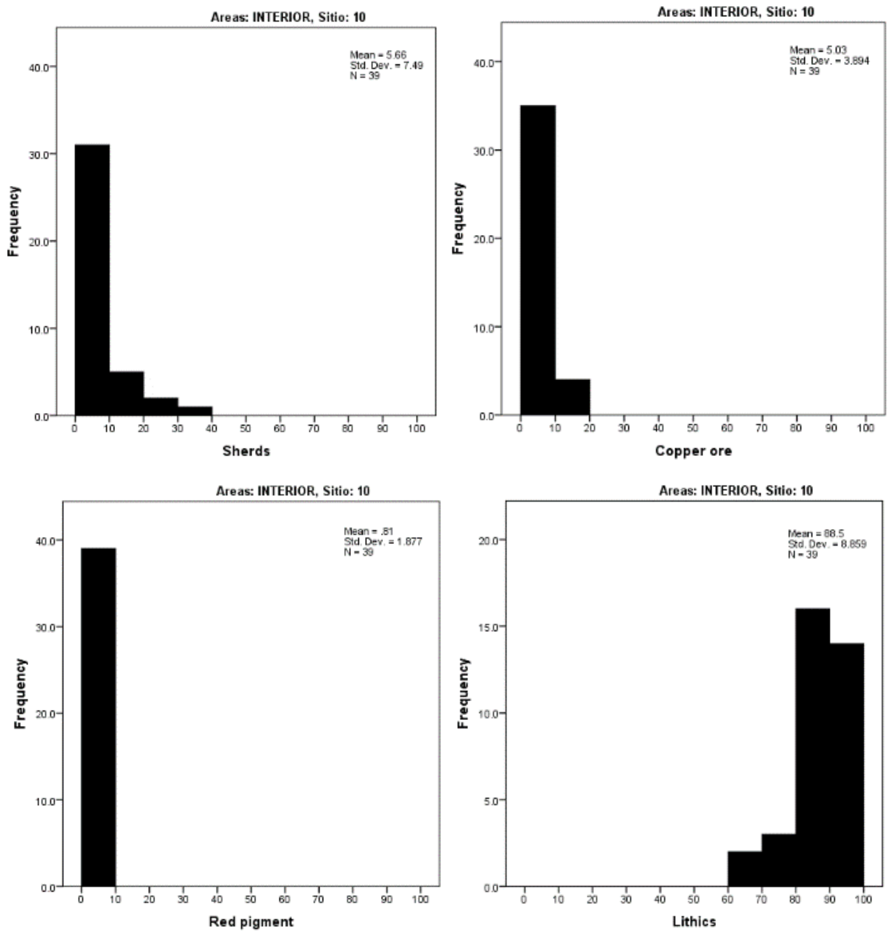


Figure 5-112. Histograms of proportion of artifacts from collection units in CH10. Only for collection units with more than 10 artifacts (N=39)

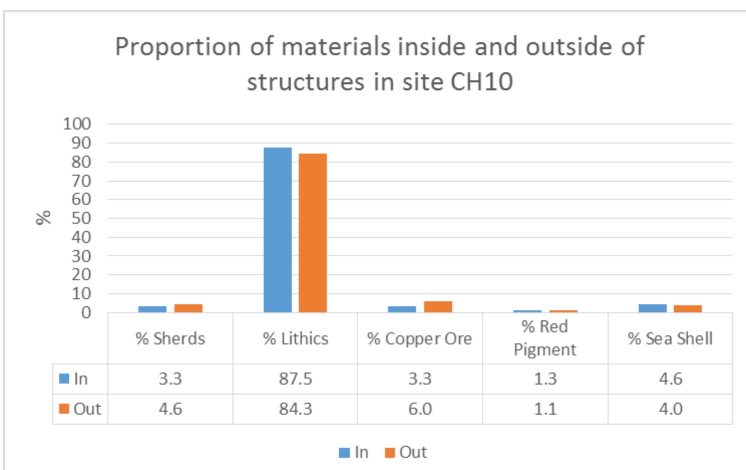


Figure 5-113. Graph of proportion of artifacts inside and outside structures in CH10

Lithic material includes flakes and cores from various raw materials including quartz, white and brown flint, red jasper, obsidian, and basalt (Figure 5-114). Other surface remains were animal bones, including a few rodent skulls and mandibles, marine shells, crushed copper ores, and red pigment fragments. Around the site we found pestles and small hammers (Figure 5-115), some with traces of red pigment. Of all the sites in the survey, this displayed the largest quantity of projectile points in different stages of production and of different typologies, many having a stemmed base (Figure 5-116). The longer ones, with flat bases, might have been hafted as knives, although this determination is not easy to make based only on morphology.

Figure 5-114. Some of the surface artifacts from CH10

Figure 5-115. Stone hammer/pestles from CH10

Figure 5-116. Projectile points and bifacial knives from CH10

Despite the very low proportions of ore, there is some evidence for bead making in terms of a bead blank and unfinished beads, and a possible flint perforator (Figure 5-117).

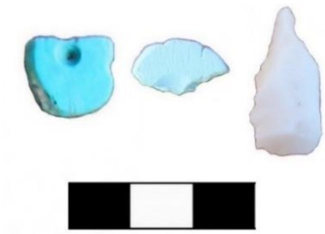


Figure 5-117. Unfinished beads and perforator from CH10

The pottery types represented include undecorated and red slipped sherds, with recognizable Diaguita Inca (Late Period) and Animas La Puerta (Pre-Inca Period) styles. This indicates the site has had a pre-Inca occupation, and the focus on lithic production would be in keeping with continuity of a previous specialization seen at other pre-Inca sites.

Figure 5-118. Some pottery styles from CH10

The site is surrounded by red rock art on the walls of the ravine depicting anthropomorphic, camelid and geometric abstract figures (Figure 5-119).

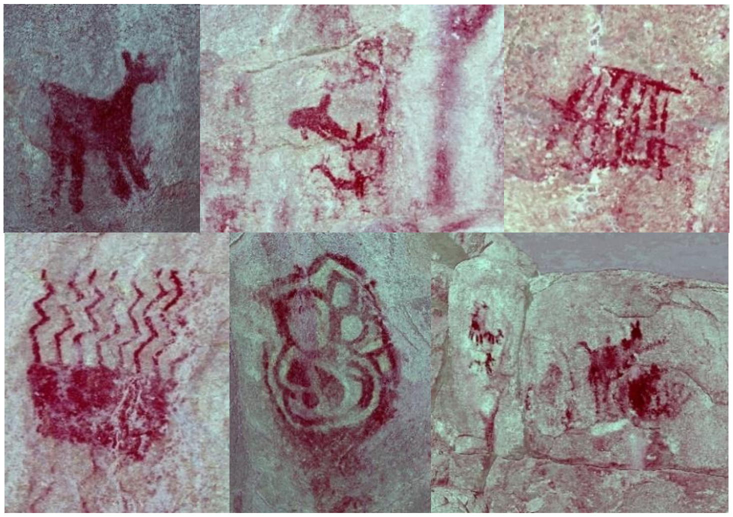


Figure 5-119. Rock art panels from site CH10. Images were enhanced using D-Stretch software

5.4 MINING PATHS

The Cachiyuyo de Llampos Mountains are crisscrossed by a series of paths that are formed (deliberately or through repeated use) of clearing of the path surface of loose stones. These paths follow the contours of the geography (Figure 5-120). They connect many of the sites with one another, suggesting the degree of social interaction among them. Within the survey area, we recorded 10.3 kilometers inside the Cachiyuyo de Llampos Mountains, and another 6.4 kilometers outside them, along the foothills on the western side of the Mountains. In contrast to the Inca Road, these paths are narrower, with a width of 40 - 60 centimeters, and they are sinuous following the topography of the landscape. In contrast, the Inca Road is wider, straight, and crosses the middle of the plains.

Figure 5-120. General view of paths. At the left interior path; at the right, exterior path

Artifacts associated with paths are mainly sherds. As shown Figure 5-121, sherds comprise the highest proportion of most trail collection units. Most are Late Period styles with Inca local/Diaguita Inca as the most common, from bowls, aryballos, and shallow plates. Only one Copiapó black on red sherd was found (Figure 5-122). Copper ores, red pigments, and lithics are present in only very low proportions, with few exceptions.

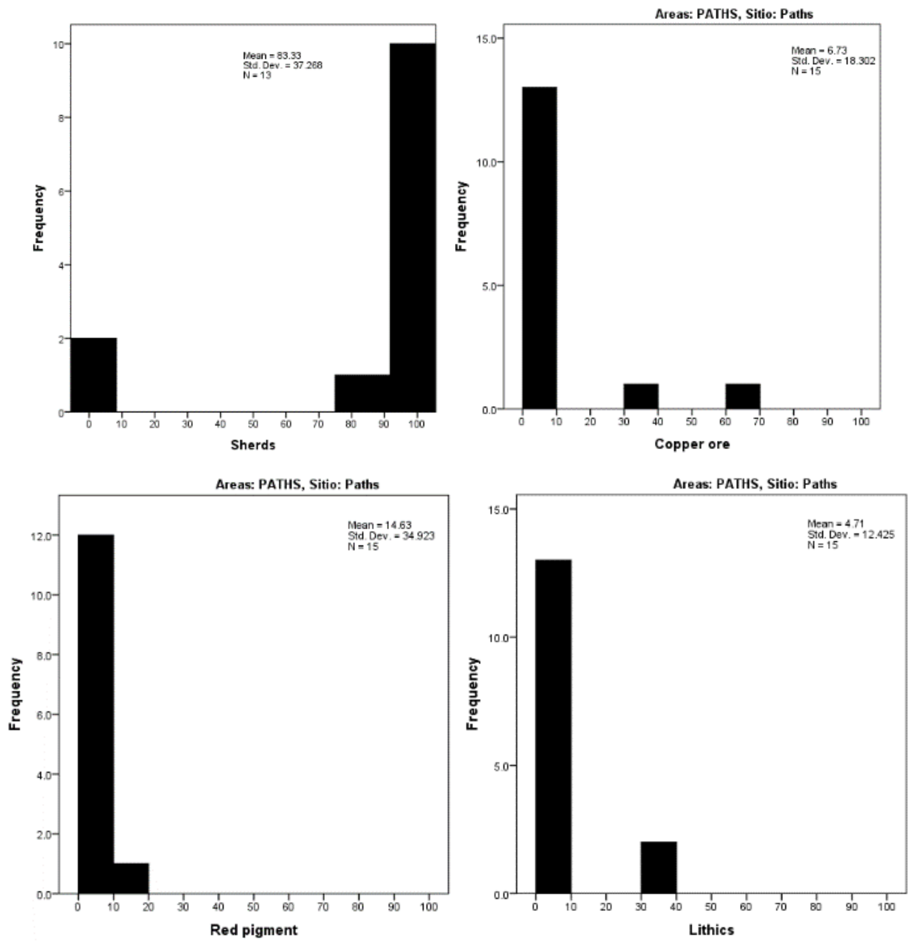


Figure 5-121. Histograms of proportions of artifacts from collection units from paths. Only for collection units with more than 10 artifacts (N=15)

Figure 5-122. Some of the surface artifacts found on the paths

The exterior paths also yielded Late Period style sherds (Figure 5-123, 5-124), including some large portions of vessels. Some Animas II sherds with external decoration and internal black polishing were found on paths in the southern section of the survey area, showing that at least some of these paths were used in pre-Inca times.

Figure 5-123. Inca local shallow plate found in the external path to the south of CH1

Figure 5-124. Pottery styles found in exterior paths including Late Period and Animas II

Apart from the previously described EXT5 and EXT7, located on exterior paths, there are other isolated structures such as EXT1, EXT2, EXT3, EXT4, and EXT6 that lacked chronologically diagnostic artifacts on the surface (Figure 5-125). EXT1 and EXT3 are small groups of semi-rectangular structures with crushed copper ore. These may have been relay sites for the transportation of these minerals. EXT2, EXT4, and EXT6 are isolated semicircular/elliptical structures with little associated material. In general, internal and external paths were the main routes that connected sites, lead to ore sources, and provided the transportation of goods around the Cachiyuyo de Llampos Mountains. Some of these pre-date the Inca Road, but even during the Late Period paths were also an essential element for the traffic in the area, in complementarity to the Qhapaq Ñan.

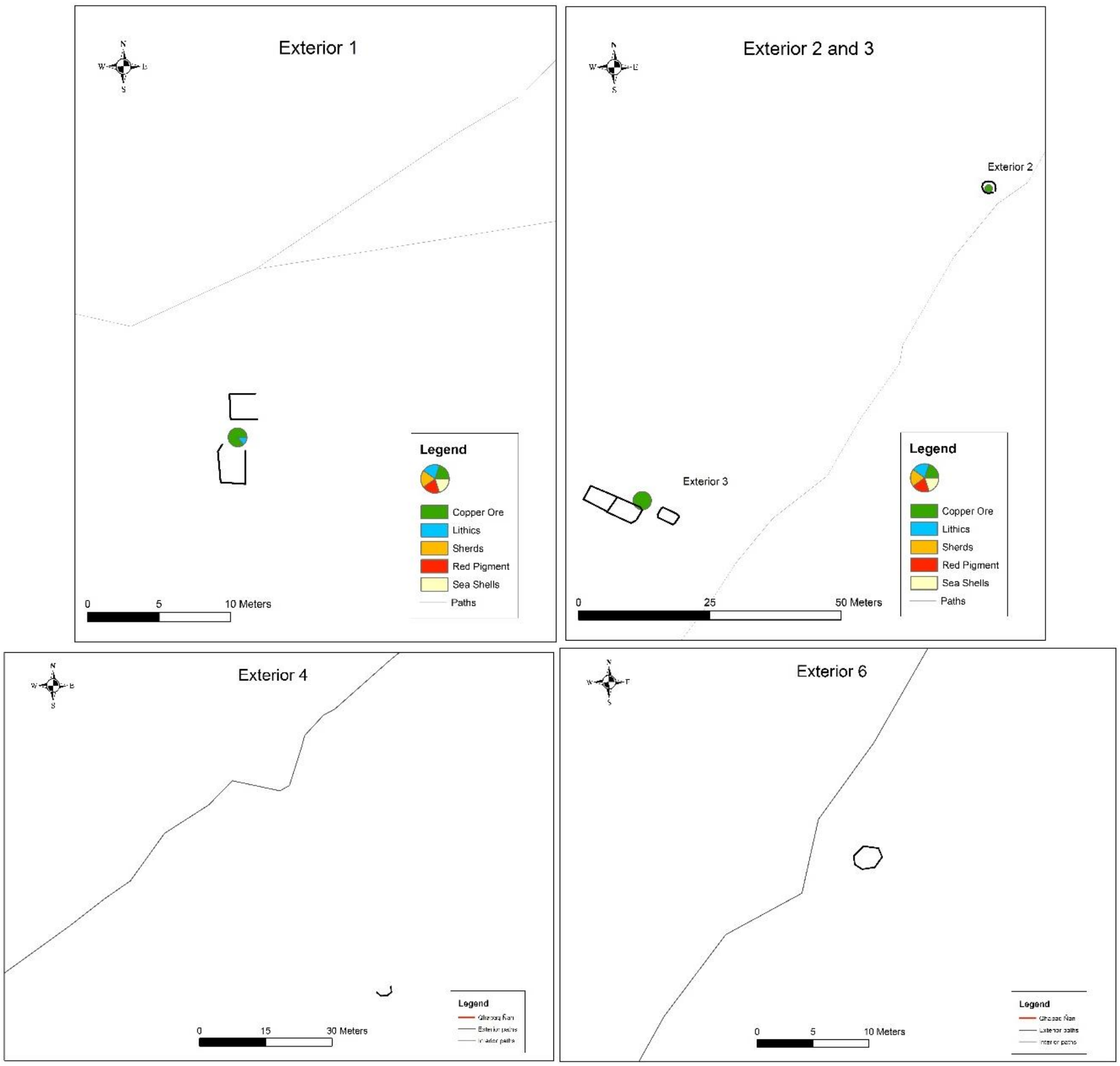


Figure 5-125. Maps of the structures EXT1, EXT2, EXT3, EXT4, and EXT6, located in relation to exterior paths

5.5 SPATIAL PATTERNS IN THE LATE PERIOD SITES

Survey revealed a set of Late Period mining camps at which residents engaged, to differing degrees, in copper ore mining, processing and bead production, red pigment production, non-lapidary lithic production, and marine shell craft production. The architecture at the camps does not differ from that of the Pre-Inca Period camps. Comparison of the Late Period sites shows the most architecture (by a factor of 3) at the largest camp CH1 (Figures 5-126 and Figure 5-127). Note that QÑ8 is larger by virtue of being more dispersed, but this is a roadside site (discussed in Chapter 4).

As with the Pre-Inca Period camps, architectural patterns point to multiple, household-sized constituent residential units at the camps. These units ranged in number from 4 - 7 at CH1 (an estimated population of 20 – 35), to 3 at CH10, and 2 – 3 at CH3. Again, at each site one of the residential clusters is larger and more subdivided than the others, suggesting a "senior" residential group, such as the Sector 1 group at CH1.

Artifacts were not distributed homogenously across any camp. Each camp showed areas of higher and lower artifact densities, corresponding to the spatial loci of activities (and refuse disposal). There was not much evidence for an indoor versus outdoor difference in the range and mix of activities. At some sites, one of the residential clusters, usually the larger and more complex one, was associated with a higher density of material, suggesting a longer or more intense occupation, such as at CH1 or the eastern residential cluster at CH10.

The distribution of different activities, as represented by artifact categories, provides information on how production was organized in these camps. At two of the major camps (CH3 and CH10) activities were distributed rather homogenously distributed across the site. In contrast, CH1 exhibited distinct, segregated activity areas, particular with regard to ore processing and crushing. As discussed earlier, at CH1 these external areas of high ore density may represent a communal stage in the bead production process. The distribution of artifact patterns at CH1 also suggests difference household activity differences within camps, with much more ore processing taking place around the Sector 3 residences than around the Sector 1 and 2 residences. Most of the red pigment production at CH1 took place in Sectors 1 and 2 as well, particularly around the Sector 1 "senior" household cluster in the northern zone of the site. Test pits from this cluster produced relatively higher proportions of decorated pottery than other units at CH1, suggesting a slightly higher level of status or wealth for these occupants. This was the only evidence for social differentiation in the mining camps.

Reconstruction of the steps of production for ore beads at CH1 suggests several stages, with the initial mining, sorting, and crushing being shared or cooperative, but the secondary and finishing stages of bead production being done by individual households.

Relationships among the Late Period sites, and comparisons with the Pre-Inca Period settlement, are further discussed in the following chapter.

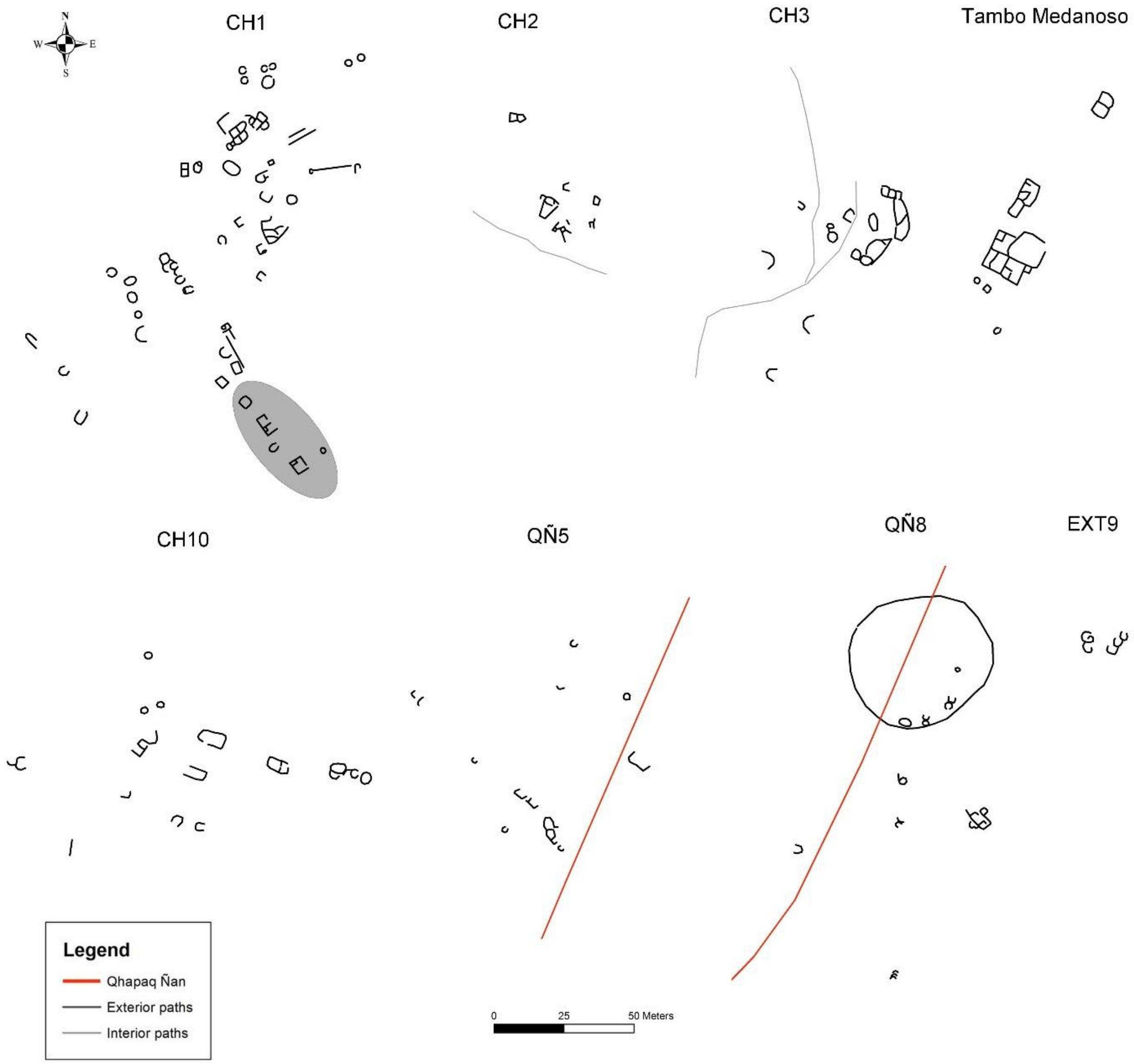


Figure 5-126. Site plans of Late Period sites. Tambo Medanoso and the QÑ sites are discussed in Chapters 4 and 6

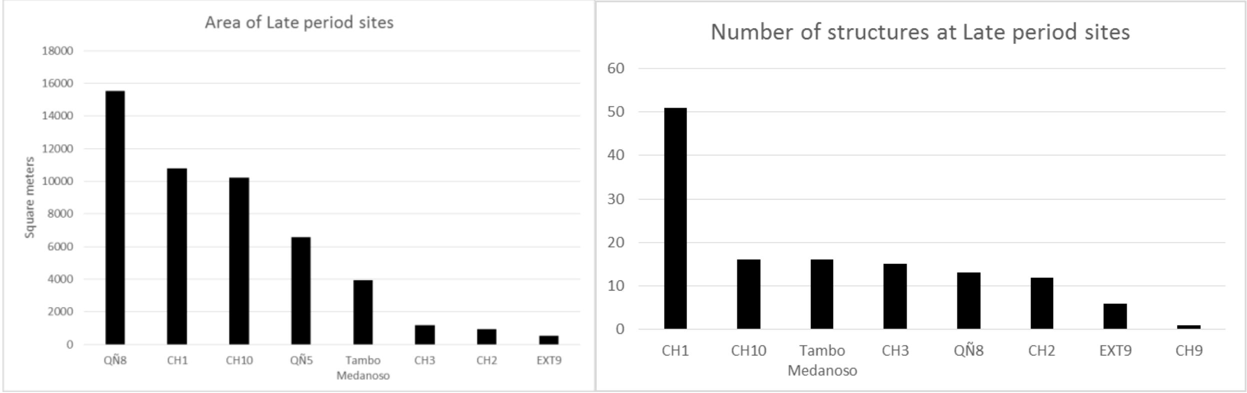


Figure 5-127. Site area and number of structures for Late Period sites

5.6 CONCLUSION

Survey results indicate that mining began in the Cachiyuyo de Llampos Mountains at least two millennia ago, and in prehispanic times was conducted at small, neighboring camps, each occupied by a few household/corporate units. This mode of production was probably driven by the autonomous household nature of the mining, the logistic constraints of the life in the desert, and a relatively low and uneven demand of mining products. The miners at these camps were multicrafting, producing red pigment, shell items, and stone tools in addition to the copper ore beads. In both pre-Inca and Inca periods, camp residents were not only extracting raw material such as ore, and iron oxide rock, but also crafting finished products. Thus these camps were not simply extraction sites. The production of finished products may have been a way to reduce the weight of goods for long distance transport, but also a way to have a product ready for exchange along the Inca Road. Residents also worked non-local materials (marine shell, obsidian, non-local flint) that were brought in partially processed form. In a sense, the camps thus also "imported" materials for crafting.

Occupation at the camps varied in terms of intensity within and between periods. Many of the Pre-Inca Period camps reflect an intermittent or low intensity occupation, while at least three camps of the Late Period (particularly CH1) suggest longer term occupations. Excavations at CH1 suggest that these occupations were supported by imported chañar (a food plant), and rodent hunting.

The social affiliation of the miners is uncertain. Diaguita Inca style pottery is common at the Late Period sites, although the Diaguita population was centered to the south of the Copiapó Valley. In contrast, despite the Copiapó Valley being the nearest agricultural and agricultural center, Copiapó Valley style pottery (Copiapó black on red and Punta Brava) is very rare, only occurring in significant proportions at a single camp (CH3). The almost complete absence of Copiapó Valley pottery both in the camps, and along the Inca Road as well, raises the possibility that, at least in the Late Period, the miners may have been specialist households of Diaguita affiliation. On the other hand, is important to mention that Diaguita-Inca pottery was an item of widespread circulation during the Late Period in the region, and its presence may also reflect the local use of new status and symbolic markers during a time of cultural and political change in the area.

6.0 INTER-SITE RELATIONS IN CACHIYUYO DE LLAMPOS MINING SYSTEM

The previous chapters focused on intrasite patterns in the Roadside sites and in the 23 sites (13 with architecture) involved in mining and craft production found to the east of the Inca Road, in the foothills and associated plain of the Cachiyuyo de Llampos Mountains. This chapter will focus on intersite comparison as a way of reconstructing relationships among these sites and how these relationships changed from the pre-Inca to the Late Periods. This comparison will aid in examining the articulation between the "world" of the Road, and the world of the mining camps.

The main crafts produced at the mining sites were copper ore beads, red pigment, stone tools such as projectile points, scrapers, and bifacial knives, and to a lesser degree, marine shell beads. The earliest sites in the survey had occupations dating to the Late Formative Period/Alfarero Temprano period, related to the Ciénaga culture from northwestern Argentina and the local Molle culture from the Copiapó Valley. However, the bulk of the sites and occupations date to the Late Period (Figure 6-14). The list of sites is shown in Table 6-1:

Table 6-1. Surveyed sites by period

Sites without Late Period diagnostic artifacts	Sites related to the Late Period	Sites with almost no surface artifacts
CH 4 - CH9	CH1, CH2, CH3, and CH10 (which also has evidence of an earlier occupation)	EXT1 to EXT4, and EXT6 (These sites are located along paths that have Late Period materials, but yielded only a few fragments of copper ore). These sites have been excluded from comparative analyses.
CH11 - CH13	CH9 (is considered in the comparison of collection units, but not in the comparative site analysis because it consists of a scatter of isolated structures)	
EXT5, EXT7, EXT8, EXT10	EXT9 (also has evidence of a minor earlier occupation)	
	QÑ 1 - 12 and Tambo Medanoso	

6.1 PATTERNS OF ARTIFACT DISTRIBUTIONS WITHIN THE SURVEY AREA

To examine the settlement distribution and change in the survey area, artifact distributions from collection units are represented through the use of smooth surfaces. The underlying premise is simple: any artifact, even the single sherd, represents human occupation or traffic. The more artifacts, the more intensive, dense, or longer, the occupation/traffic. Sherd densities along the Inca Road and prehispanic paths are used as a proxy for traffic, not communities, because on the Road we are not dealing with sedentary populations.

For this exercise, proportions and distributional data were calculated using sherds, red pigment fragments, lithics, and copper ore. The count of artifacts from the different collections units was used to represent density, and the surface of proportions was made in relation to the four main categories represented. Units yielding 10 or less artifacts were used for the smoothed surface maps, but excluded from analyses or representations involving individual collection units, such as artifact proportion calculations.

As described in Chapter 3, collections units were taken at many spots, including multiple units within many sites, along the Inca Road, and paths, at distances no greater than 10 meters among them. For the representation of the spatial tendencies within the whole survey area, these numbers are averaged by the creation of a raster grid of 50 meters per cell (using the software ArcGis 10.1). Then, those features were interpolated using the inverse distance method at power of 0.25 with Surfer 11 in order to create smoothed surfaces representing density of occupation/traffic, and the proportion of different categories of artifacts representing different craft activities.

The smoothed surfaces in the figures to follow compare Pre-Inca and Late Period distributions of pottery, copper ore, lithics, and red pigment, in terms of artifact density and in terms of proportions of that artifact type relative to other artifact types at that site. Marine shell are only represented as densities, because their rarity prohibited meaningful proportional comparisons. By contrasting the similarities and differences between density and proportion, we are able to assess the degree of overlap between the intensity of a specific craft activity (in relation to other sites), and its relative importance in terms of the activities at a single site. For example, if a site has a great deal of copper ore (high density), and copper ore is a high proportion of the artifacts found at this site, then this site would appear as a tall peak in both the density and proportion maps. Suppose this hypothetical site during the subsequent period appeared as a tall peak in the proportion map, and a small peak in the density map. This change would indicate that the same mix of activities continued at that site as in the prior period, but with less intensity.

6.1.1 Pottery distributions

6.1.1.1 Pre-Inca sherd spatial distributions

As can be seen in Figure 6-1, pottery density and proportion are not quite isomorphic. The highest density of sherds is at CH11, but sherds are higher proportions in the sites to the west. In general, sherds were not particularly abundant at Pre-Inca sites, and the difference between proportion and densities could reflect that the sites to the west were shorter, or more "special purpose," occupations. The sherd peak at CH11 suggests that this locus had the most intensive, or longest, occupation in the area. CH11 has a high proportion of lithic artifacts, suggesting that the residents were focusing their craft production on stone tools.

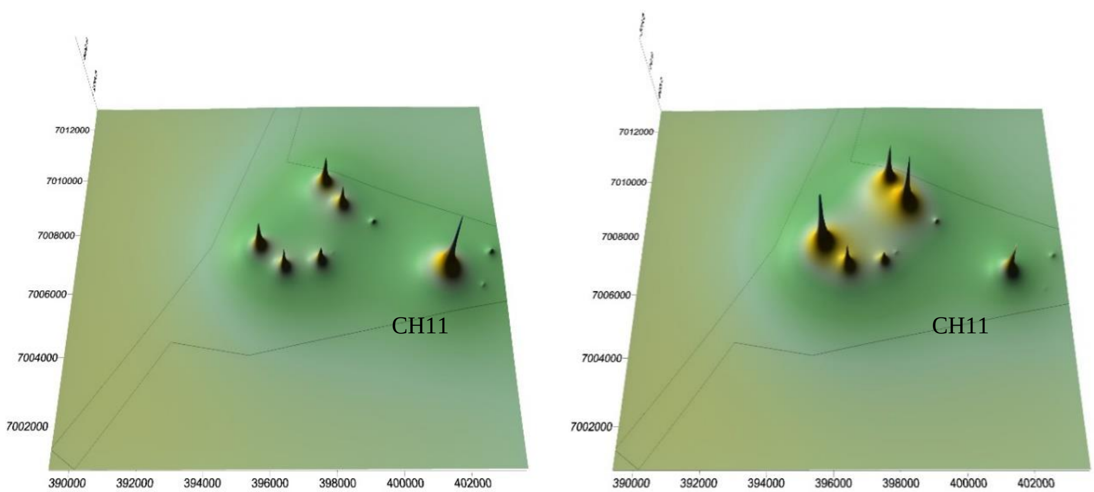


Figure 6-1. Smooth surfaces representing pre-Inca sherd density and proportions within the survey area

6.1.1.2 Late Period sherd spatial distributions

The Late Period witnessed a significant increase in the density of sites in the survey area, including, or course, all of the occupations along the Inca Road (Figure 6.2). The main residential locus within the Cachiyuyo de Llampos Mountains section of the survey area is the cluster composed by the Chinchilla 1, 2, and 3 sites, which are located at the western edge of the

Cachiyuyo de Llampos Mountains, not far from the Inca Road. In the Late Period, densities and proportions do not differ much, with the exception of the low density but high ceramic proportion at Tambo Medanoso. In general, places with high ceramic densities also have high proportions of ceramics, suggesting more intensive or more uniform occupations than in the previous period.

If we interpret sherd scatters along the Inca Road as a proxy of where traffic on the Road is stopping, we can distinguish two main loci, denoted by the yellow in Figure 6.2: one at the QÑ8 - Chinchilla 1, 2, 3 location, and the other location to the south, along the Road itself. The former may reflect the interaction between the Road and the mining camps to the east, while the latter may reflect that activities taking place at the Tambo Medanoso.

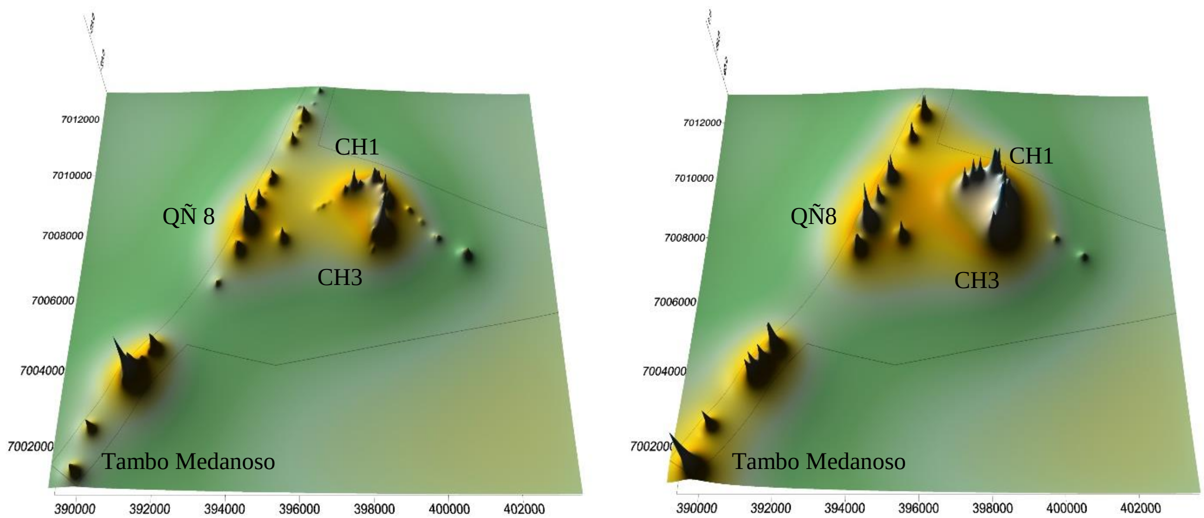


Figure 6-2. Smooth surfaces representing Late Period sherd density and proportions within the survey area

6.1.2 Copper ore distributions

6.1.2.1 Pre-Inca copper ore spatial distributions

Sites with copper ore concentrations are distributed in two clusters organized in an east-west axis across Chinchilla ravine in the Cachiyuyo de Llampos Mountains (Figure 6.3). There are significant differences between densities and proportions of copper ore in the Pre-Inca Period. CH5 has far and away the highest density (Figure 6-3). This is not unexpected, because it is located adjacent to an extraction trench for an ore source. Ore actually makes up more of the assemblage at other sites such as CH4, CH12, CH13, EXT5, and EXT10, suggesting that these may have been shorter term camps, or perhaps had more of an exclusive focus on ore working than CH5.

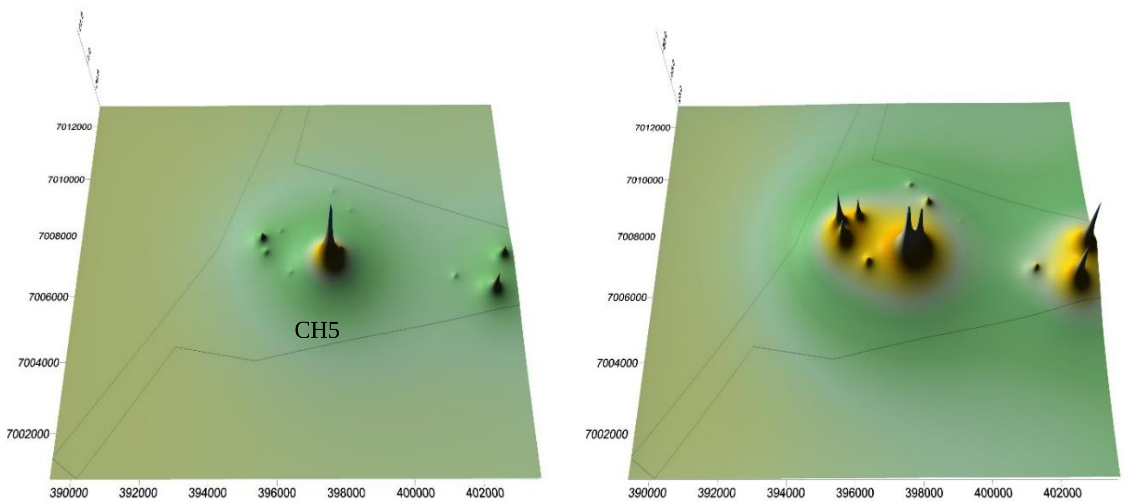


Figure 6-3. Smooth surfaces representing pre-Inca copper ore density and proportions within the survey area

6.1.2.2 Late Period copper ore spatial distributions

Densities and proportions of copper ore for this Inca period are almost identical, with the highest density at CH1, which also exhibits the highest proportion of bead making activity. Among the Inca Road sites, copper ores are found at QÑ8 and EXT9. EXT9 is similar to mining camps in terms of size, architecture, and associated craft activities, while QÑ8 is more spatially segregated but is similar to EXT9 in terms of artifact proportions. These two sites are the most likely locations at which miners and their products accessed the Road.

As noted above, in the Pre-Inca Period, the emphasis on ore working differed between CH5 and other sites, with CH5 residents being more devoted to this activity than those at other sites. In contrast, in the Late Period, the similarity between ore density and proportion suggests equal intensity of ore working (relative to other activities) at each site. Comparing Figures 6.3 and 6.4 reveals the "pull of the Road", with a westward shift in the general location of copper ore working. The copper working sites and sources located at the east end of Cachiyuyo de Llampos Mountains were abandoned in favor to others located in closer proximity to the Inca Road.

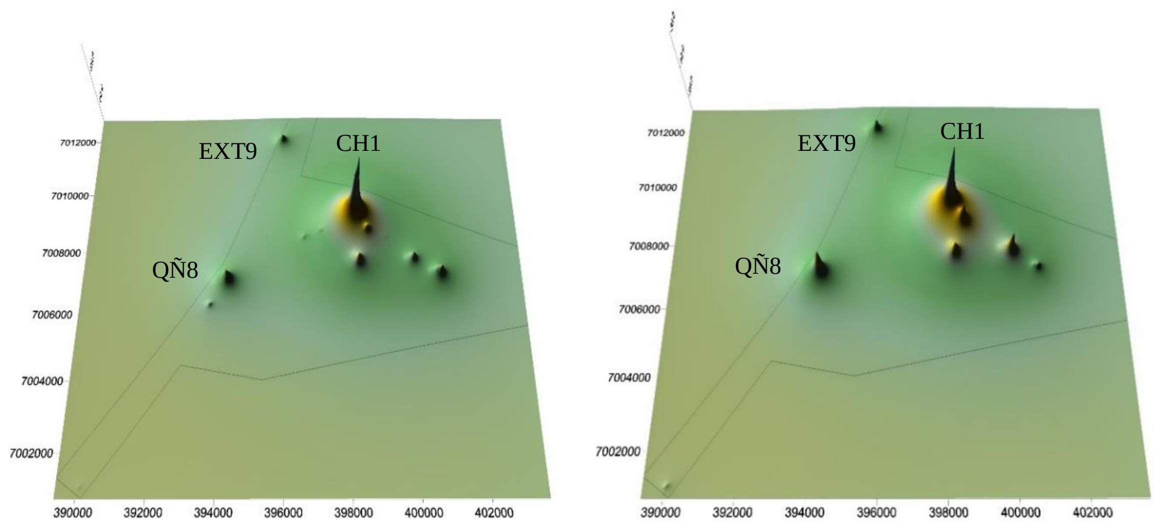


Figure 6-4. Smooth surfaces representing Late Period copper ore density and proportions within the survey area

6.1.3 Lithic artifacts distributions

6.1.3.1 Pre-Inca lithic spatial distributions

Lithics densities and proportions are highest along the east-west axis of the Chinchilla ravine, which is a natural corridor into the Cachiyuyo de Llampos Mountains, and to interior trade networks. As we can see in Figure 6-5, sites that exhibit high proportion of lithic artifacts are also those with the highest density. This indicates specialization at the site level: sites with abundant debitage on the surface were almost exclusively dedicated to lithic artifact manufacture. Lithic raw materials such as obsidian and fine grain silex are not locally obtained at Cachiyuyo de Llampos Mountains, and came from locations closer to the Andes Mountains, almost a hundred kilometers to the east. The presence of Ciénaga pottery styles from northwestern Argentina bespeaks this pre-Inca long distance exchange.

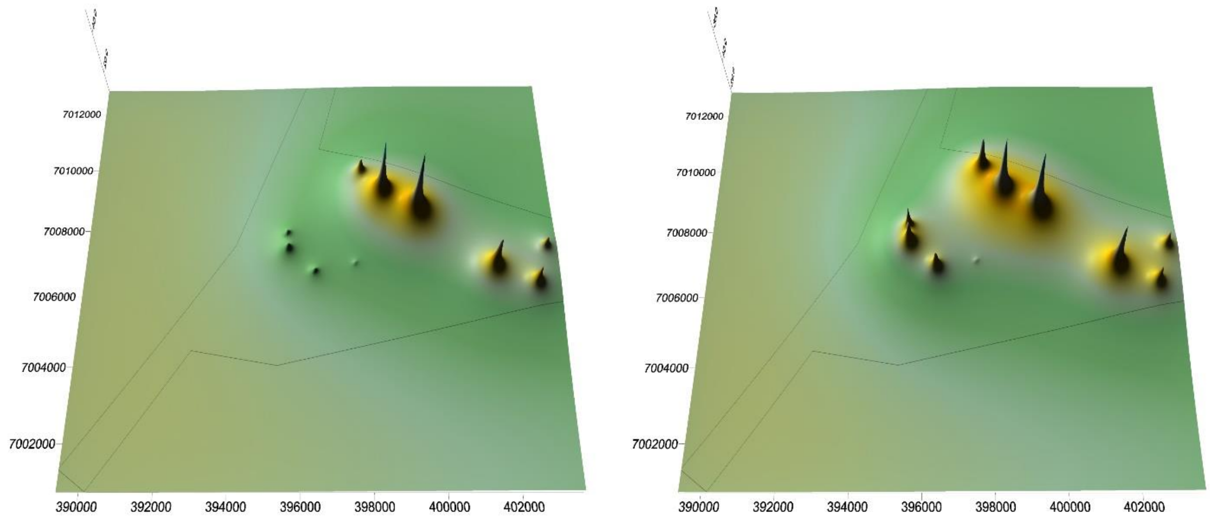
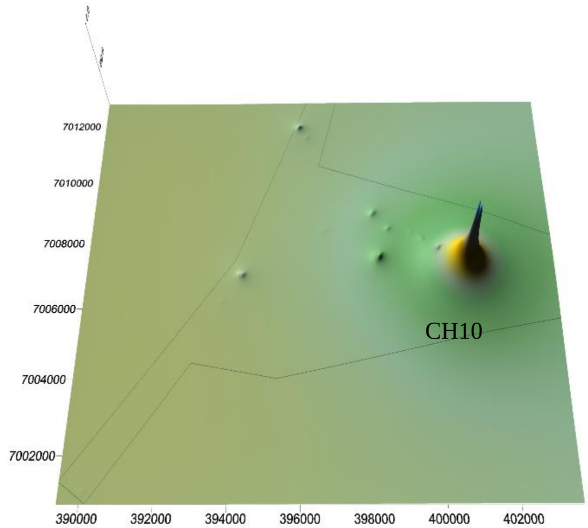


Figure 6-5. Smooth surfaces representing pre-Inca lithic artifact density and proportions within the survey area

6.1.3.2 Late Period lithic spatial distributions

Lithics are found at various sites in the Cachiyuyo de Llampos mining camps and at EXT9 and QÑ8 along the Road. In the Late Period, lithics were concentrated at CH10, located at the eastern end of Chinchilla ravine (Figure 6-6). Proportions and densities of lithic artifacts do not differ significantly among the Late Period sites. However, the importance of lithic crafting greatly declined in the Late Period, with the exception of CH10 where specialized, projectile point production took place. There are no indications that this focus relates to any specialization in hunting or subsistence at this site.



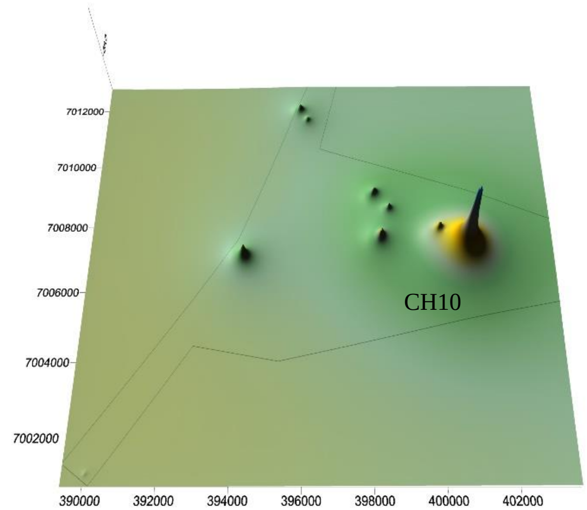


Figure 6-6. Smooth surfaces representing Late Period lithic artifact density and proportions within the survey area

6.1.4 Red pigment distributions

6.1.4.1 Pre-Inca red pigment spatial distributions

Unlike with copper ores and lithic artifacts, the distribution of red pigment fragments is quite similar to pottery distributions. As sherds are the best proxy of residential occupation, this similarity in distribution suggests that processing of pigment was a domestic task, not structured by communal work areas or by interhousehold cooperation. As an activity, it was probably less intensive than copper ore extraction or lithic artifact manufacture. The highest density of red pigment is located at CH1, next to the iron oxide ore source at the west end of Chinchilla ravine.

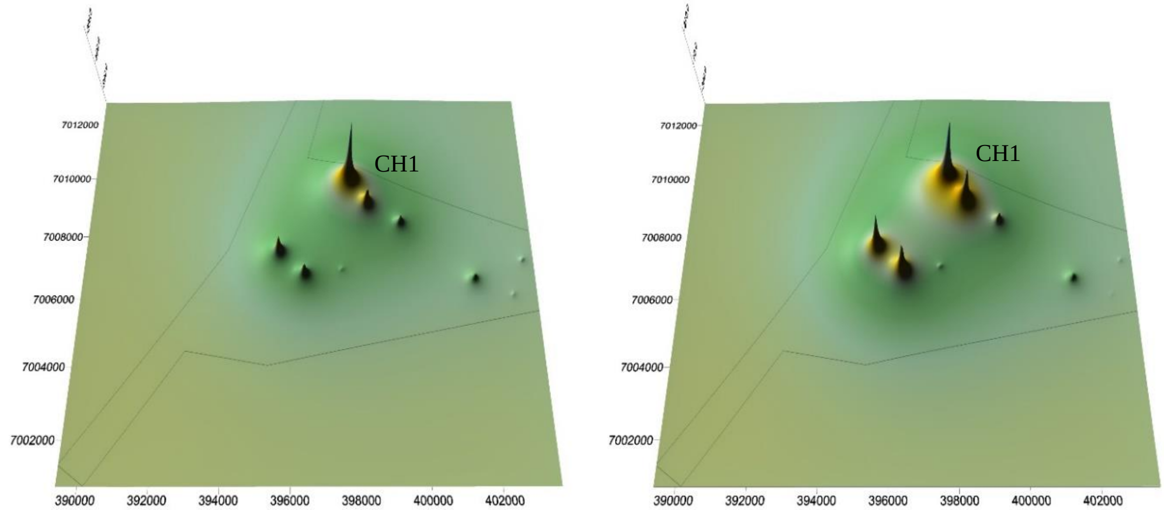


Figure 6-7. Smooth surfaces representing pre-Inca red pigment density and proportions within the survey area

6.1.4.2 Late Period red pigment spatial distributions

In the Late Period, CH1 continued to have the highest density and proportion of red pigment fragments. As in the previous period, pigment manufacture continued to be spatially associated with residential structures and food preparation areas, continuing as a domestic activity. As seen in Figure 6-8, red pigment fragments were arriving at the Inca Road, at EXT9, QÑ8, and Tambo Medanoso. Red pigments were ground at various sites, in particular at CH3, where grinding stones colored with red pigment are abundant.

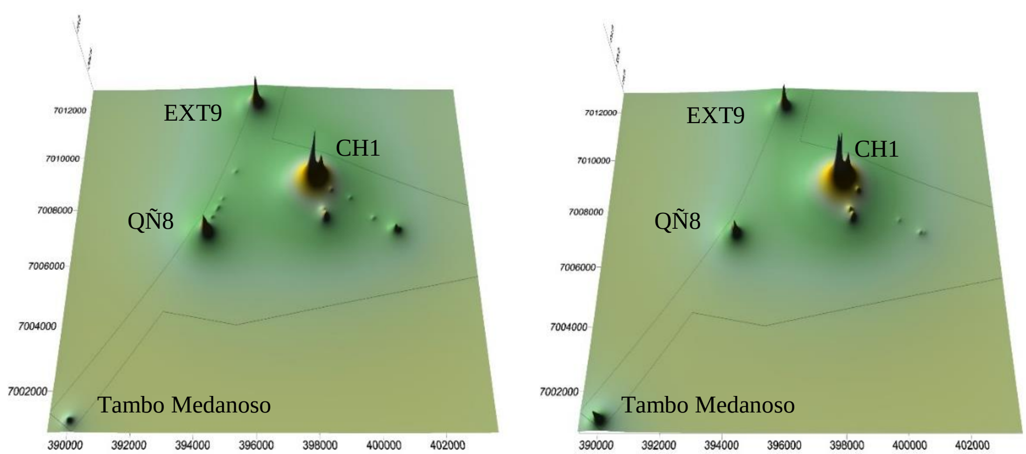


Figure 6-8. Smooth surfaces representing Late Period red pigment density and proportions within the survey area

6.1.5 Marine shell distributions

6.1.5.1 Pre-Inca marine shell spatial distributions

Proportions of marine shell were not used to create smoothed surface maps, because the quantities are smaller than other kind of artifacts, and marine shell is lacking from the majority of the collection units. Marine shell was used to create beads. The main species represented are *Fisurella* sp., *Argopecten purpuratus*, *Ameghinomya antiqua*, *Mesodesma donacium*, *Concholepas, concholepas*, *Choromytilus chorus*, and *Loxechinus albus,* apart from the occasional finding of sea snails such as *Turitella cingulata*. The representation of densities for the pre-Inca Period has certain parallels to the distribution of lithic artifacts, suggesting similar crafting skills were involved, or that these non-local materials were moving together in the exchange system.

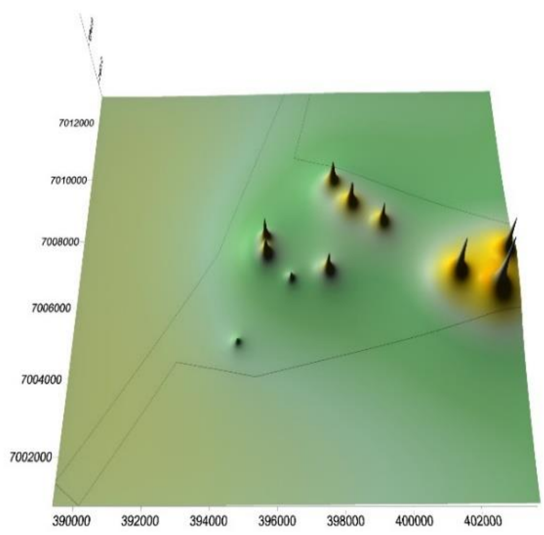


Figure 6-9. Smooth surface representing pre-Inca marine shell density within the survey area

6.1.5.2 Late Period marine shell spatial distributions

In the Late Period, the extent of marine shell working declines, with marine shell occurring only at four mining sites. Shell working is concentrated at CH10 at the eastern end of Chinchilla ravine. This change can be seen as another example of site specialization during the Late Period in the mining site system. Overall, the Late Period distribution of shell parallels the lithic distribution (compare Figures 6-6 and 6-10), as in the prior period. Marine shell is also present at the same sites in the Inca Road where red pigment is found, including Tambo Medanoso.

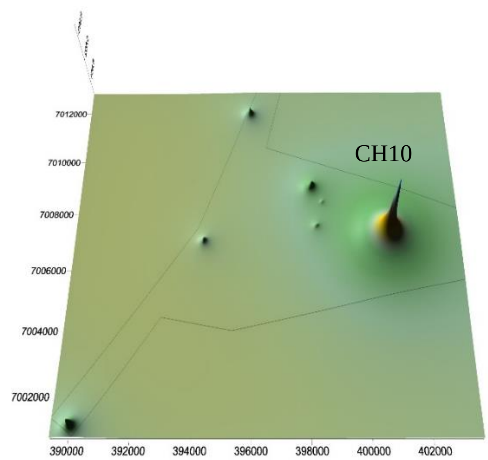


Figure 6-10. Smooth surface representing Late Period marine shell density within the survey area

6.2 ARTIFACT PROPORTION VARIABILITY BY SITE AND PERIOD

6.2.1 Total artifact proportions by sites

6.2.1.1 Pre-Inca Period

To further illuminate changes in craft production from the Pre-Inca to the Late Period, we can examine overall site artifact proportions. The following analyses use the average of proportions from all collection units per site. Excluded are units with 10 or less artifacts in the total sum of sherds, copper ores, lithics, and red pigment.

For the Pre-Inca Period (Figure 6-11), we can see that most of the sites are focused on either copper ore processing or on lithic artifact manufacture. Stone tools, such as perforators, may have been required to a certain extent for bead making, but there is not much evidence of finished lithic tools discarded, which suggests the production of stone tools for export. Only three sites, CH6, EXT5, and EXT8, have a less specialized assemblage, but their general artifact densities are lower in comparison to other sites (Figure 6-12). What is suggested overall is a scenario of sporadic occupations, each focused mainly on a single extractive or craft activity, particularly at sites CH4, CH5, CH7, CH8, CH13, EXT10. In each of these cases, craft activities were concentrated either on copper ore processing or stone tool manufacture, so that broadly, there were two kind of special purpose sites, with some degree of overlapping activities. Also shown in the map (Figure 6-12) is that the sites form three clusters, each cluster made up of sites with similar economic emphases.

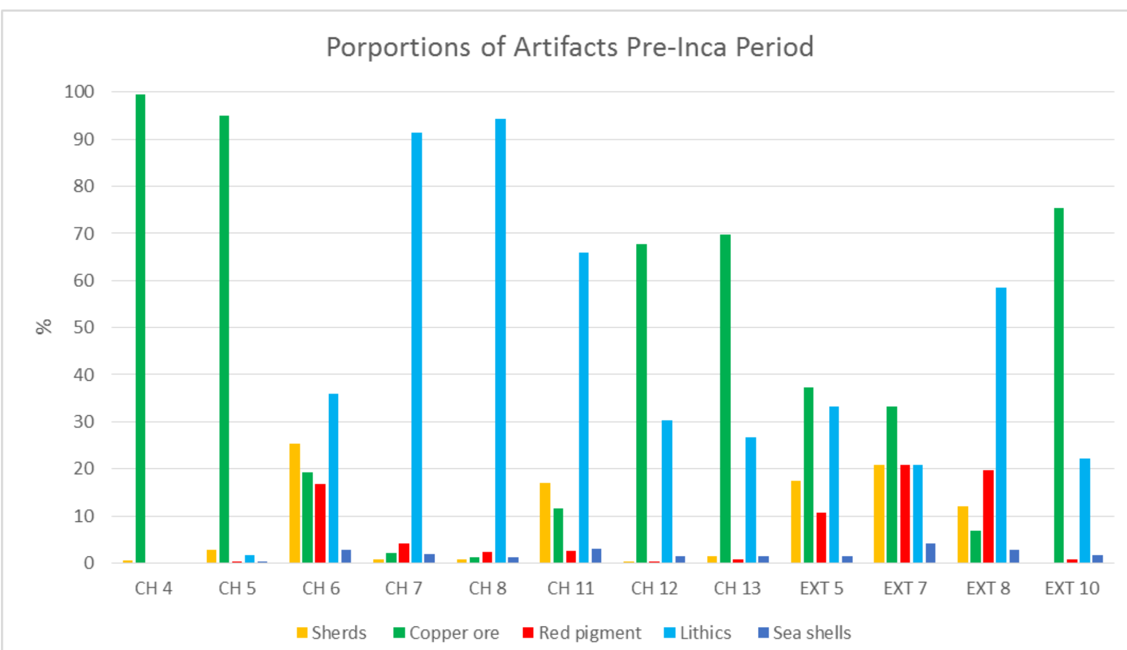


Figure 6-11. Graph of proportion of artifacts for Pre Inca periods

Artifact Proportions for Pre Inca sites

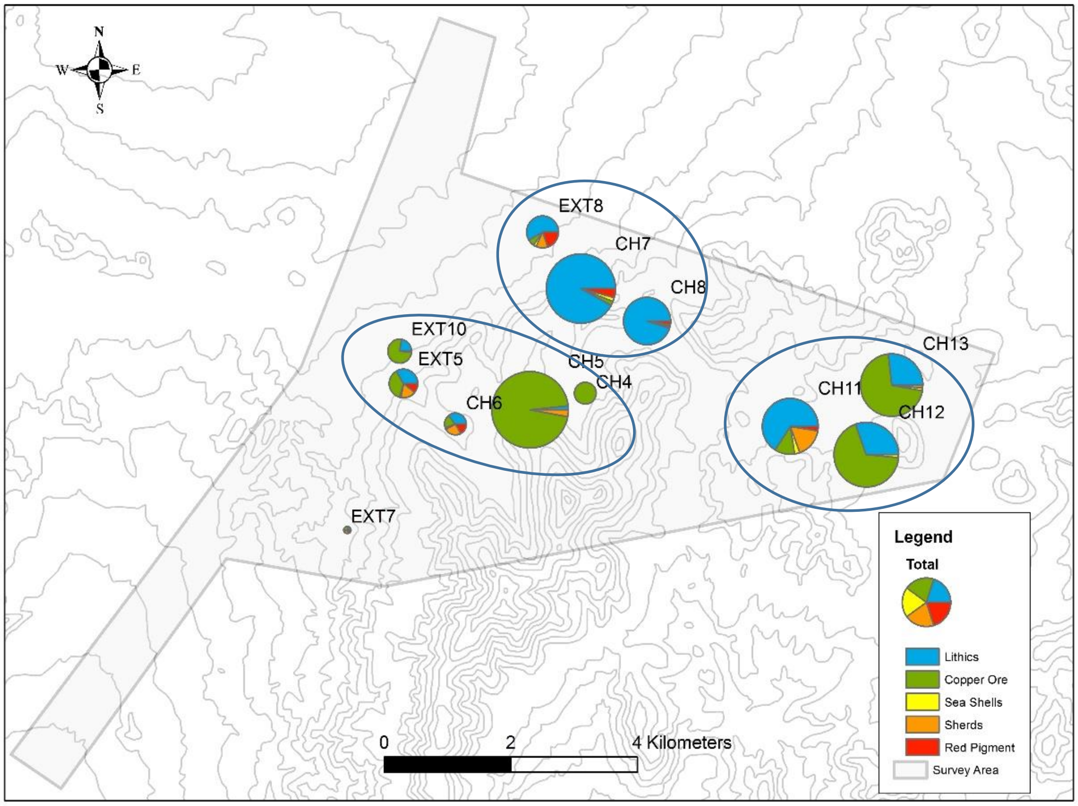


Figure 6-12. Map of artifact proportion and artifact frequency for Pre-Inca Period sites

6.2.1.2 Late Period

In contrast to the Pre-Inca Period, in the Late Period the large sites tended to be less specialized; proportionally there are more activities represented at the same site (Figure 6-13). Only CH10, located at the eastern end of Chinchilla ravine, differs significantly from this pattern and shows a high proportion of lithic artifacts with a special emphasis on the manufacture of projectile points. Sherds proportions increased dramatically at the mining sites and along paths connecting them, indicating increased intensity of occupation of occupation at the mining sites and increased traffic across the desert (Figure 6-14). These paths connecting the mining sites suggest the contemporaneity of their occupations, and longer term occupations than in the previous period.

In the Late Period, the eastern and southern areas of the Chinchilla ravine were not occupied, with occupation concentrated at sites CH1, CH2, and CH3 to the west, closer to the Road. Late Period occupation was likely larger in terms of total number of people, but was also more concentrated and permanent than earlier. The number of larger camps declines from roughly 11 in the Pre-Inca Period, to 5 in the Late Period. In relative terms, there was significant population nucleation at CH1, represented by its 50 total structures, at least 4 corporate residential clusters, and an estimated residential population of 20 – 35 people.

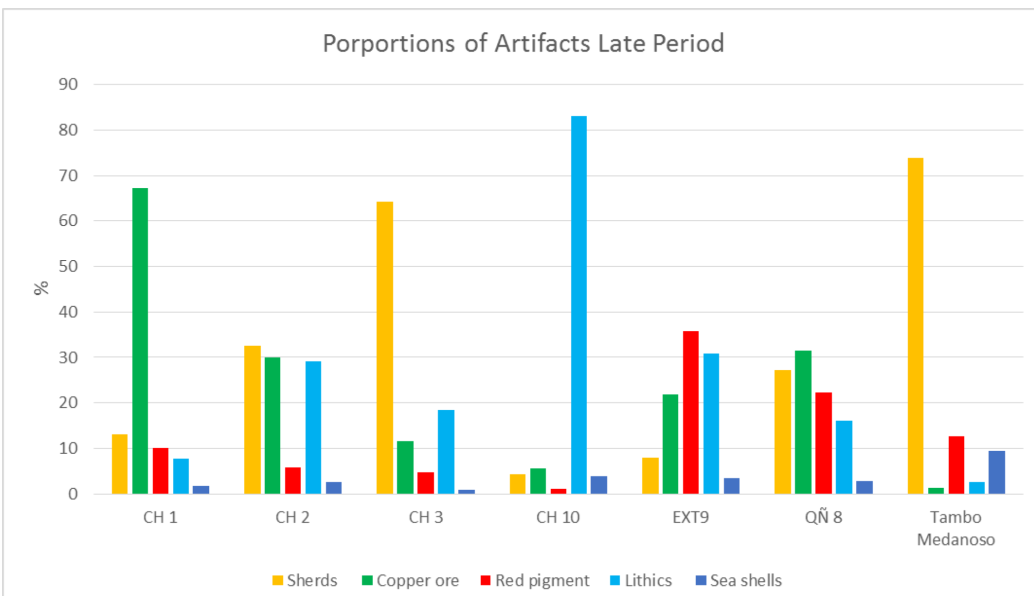


Figure 6-13. Graph of proportion of artifacts during the Late Period

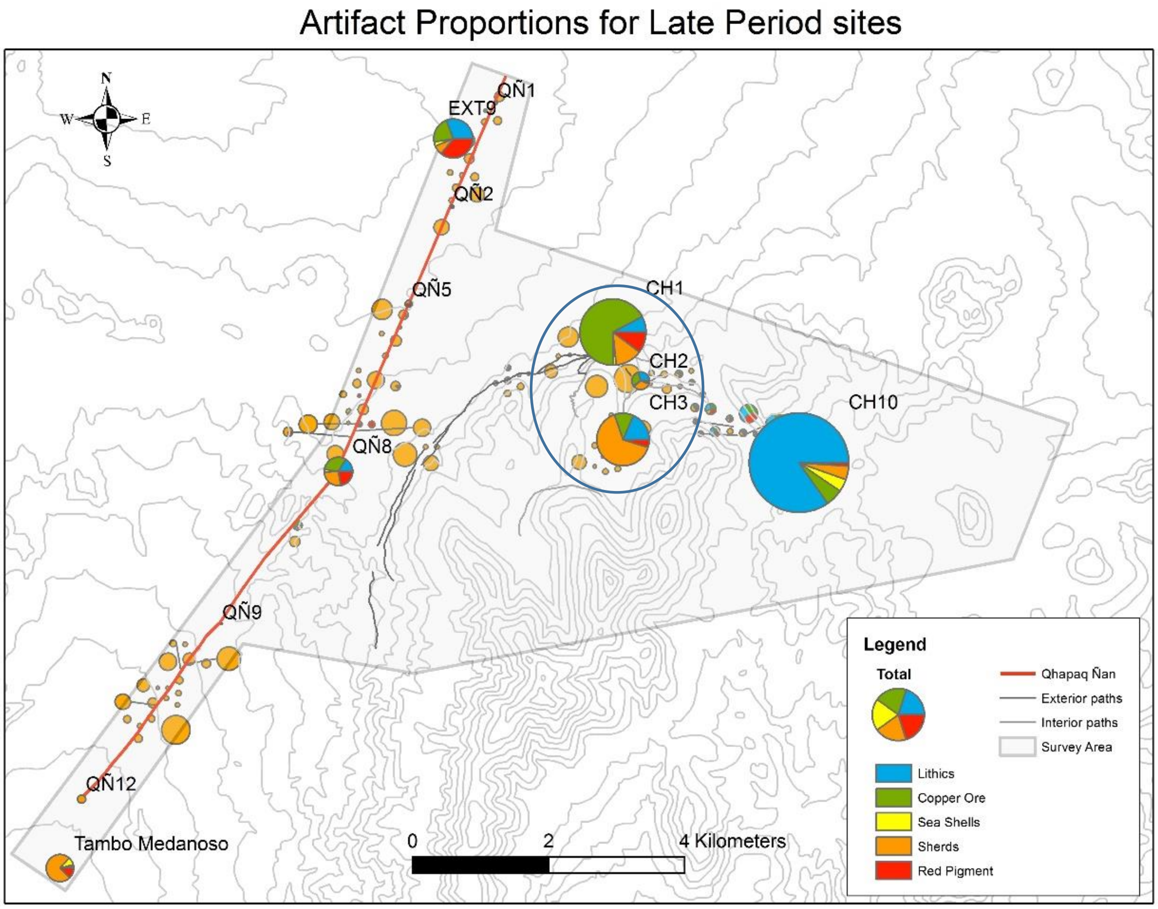


Figure 6-14. Map of artifact proportion and artifact frequency during the Late Period

6.2.2 Simpson's diversity index and artifact proportions

To provide an additional quantitative assessment of the activity differences among sites for both periods, a Simpson's (1-L) diversity index was used to examine the degree of heterogeneity of the collection sample. This analysis was based on proportions among sherds, lithics, copper ores, and red pigment fragments, using the sum of artifacts per site. In this analysis, values range from 0 (homogenous assemblage) to 1 (diverse assemblage). This analysis was done with the software Species Diversity and Richness 4, using the bootstrap procedure to obtain confidence levels at 95% and 99%. The more "specialized" a site in terms of assemblage, the lower the index.

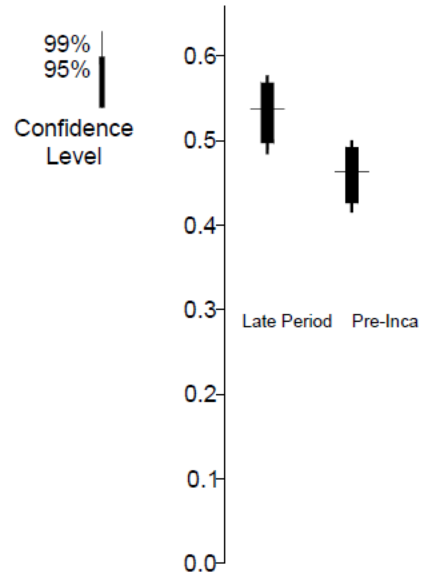


Figure 6-15. Bullet graphs showing Simpson's (1-L) diversity index for all Pre-Inca and Late Period sites

Figure 6-15 shows the average all the individual site scores (including sites in Cachiyuyo de Llampos mountains, the Inca Road and artifact scatters in paths) per period, with a value for the Pre-Inca sites of 0.537, and 0.463 for the Late Period sites. To a high degree of statistical significance, Pre Inca sites are less diverse than those of the Late Period. This finding indicates again that Pre-Inca Period sites tended to be more specialized in craft activities than the more multicrafting Late Period sites.

Overall, craft activities at the Cachiyuyo de Llampos Mountain sites not only expanded during the Inca epoch, but were reorganized as well. To further understand the nature of this reorganization, the following sections look at each period individually.

6.2.2.1 Simpson's diversity index for Pre-Inca Period sites

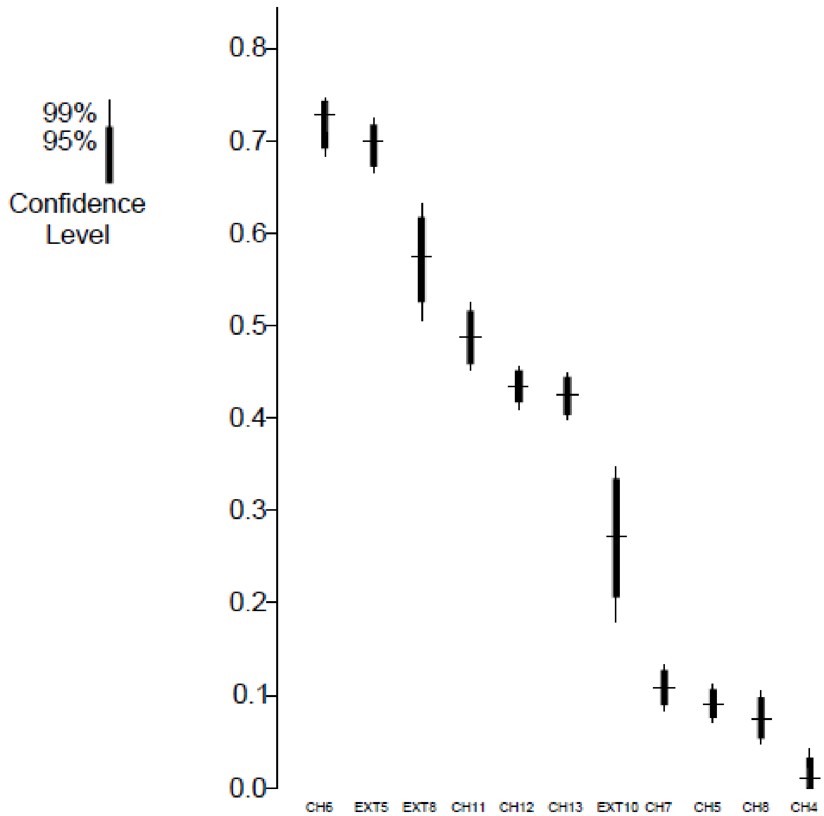


Figure 6-16. Bullet graphs showing Simpson's (1-L) diversity index for all Pre-Inca sites

Again, in the above graph of diversity index values for Pre-Inca sites, the ones with more artifacts in fewer categories score lower, than sites in which artifacts are more evenly distributed among categories. Sites CH4, CH5, CH7, and CH8 are each oriented almost exclusively to one activity: copper ore processing for the first two, and lithic production for the last two. In contrast, CH6, EXT5 and EXT8, located in the western sector of the survey area, show a more even proportion in artifact distributions. The sites with the middle values, CH12, CH13, EXT10 are mainly focused on two activities, copper ore processing and lithic manufacture. Site CH11 is mainly focused on lithic production but also has a high proportion of sherds, unlike the others sites focused on lithic artifact manufacture.

In general, specialization in copper ore processing or in stone tool manufacture are the main factors accounting for the diversity of sites for this period.

6.2.2.2 Simpson's diversity index for Late Period sites

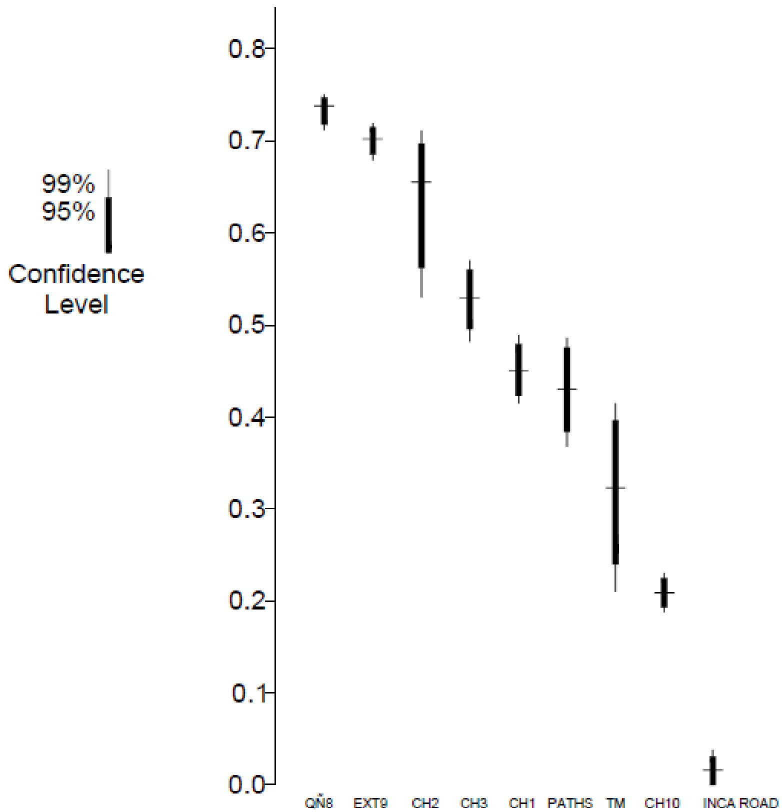


Figure 6-17. Bullet graphs showing Simpson's diversity index (1-L) for Late Period sites

For the Late Period sites (Figure 6-17), the lowest value in the diversity index is shown by the Inca Road collection units, which are composed almost exclusively of sherd scatters. Site CH10 also exhibits a low value of diversity because of its high proportion of lithic artifacts. At the other end of the spectrum, sites QÑ8 and EXT9 are the least "specialized" in terms of assemblages. CH1, in the middle of the chart, has specialized areas relating to copper ore processing. CH3 scores near CH1, but the degree of "specialization" results from the high proportion of pottery across. In other words, while these two sites might exhibit similar levels of activity diversity, they differ in economic emphasis.

6.2.3 Hierarchical clustering

In contrast to a component analysis where variables are evaluated to show their possible correlation, cluster analysis of the sites can be used to evaluate their similarities. The hierarchical clustering of sites and roads was done with the software Systat 12, using the proportions of sherds, lithics, copper ores, and red pigment fragments by collection unit.

6.2.3.1 Pre-Inca Period sites clustering

Clusters for sites from Pre-Inca Period (Figure 6-18) can be interpreted as reflecting common productive activities, especially lithic artifact production and copper ore work for bead making. We can notice that sites geographically close to each other (Figure 6-12) tend to cluster together here as well. This situation suggests some degree of spatial autocorrelation in craft/mining activities, meaning that sites in close geographical proximity are more similar in their artifact proportions.

The first cluster consists of sites CH4 and CH5, which are geographically very close to one another, and have high concentrations of copper ores. The next cluster, sites CH12, CH13 and EXT10, reflects their similar proportions of copper ores and lithic artifacts. Sites CH12 and CH13 are, in fact, geographically near to one another. Sites CH6 and EXT5 are relatively more homogeneous in their internal proportions of artifacts, are geographically close to one another. Sites CH7 and CH8 both have high proportions of lithic artifacts, and are geographically close to one another. Sites CH11 and EXT8 are not geographically close to one another, and in Figure 6-

18, cluster a little bit apart from the previous ones, given their relatively high proportion of lithic artifacts, and more pottery and red pigment than other sites. One interpretation of this clustering is that each cluster represents a corporate task group pursuing a particular mix of activities at adjacent sites.

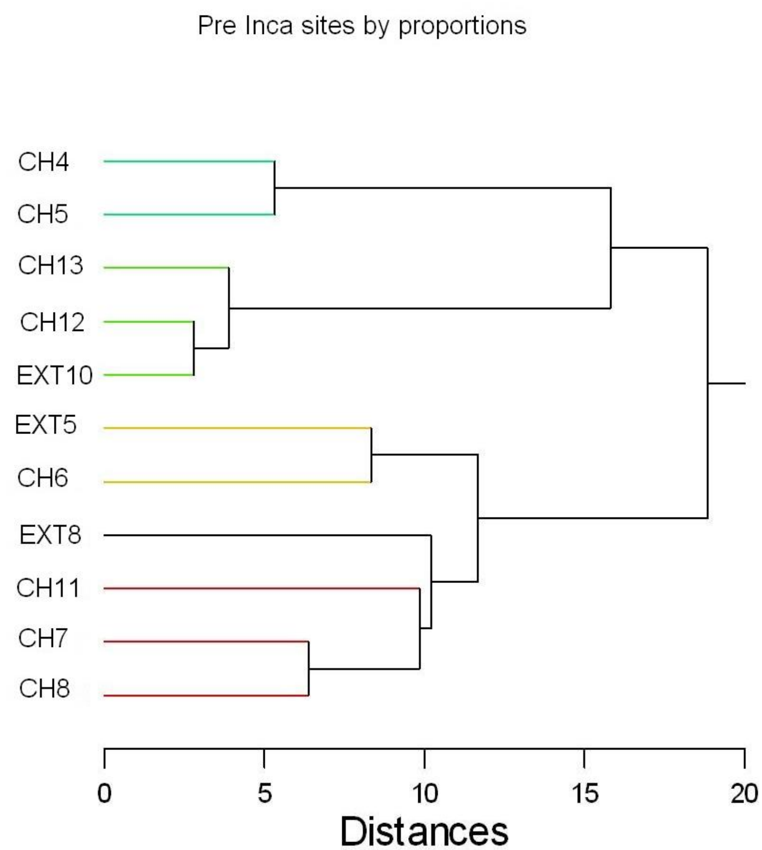


Figure 6-18. Hierarchical cluster graph for Pre-Inca sites

6.2.3.2 Late Period site clustering

The clustering show in the Late Period (Figure 6-19), includes a cluster created by the high proportions of pottery at certain sites including those long the Inca Road and the mining paths, Tambo Medanoso, and CH3. Site CH3 likely had the most intensive occupation in the Late Period, as it displays the highest sherd density of the Period. The clustering of sites QÑ8, CH1, and CH2 reflects their relatively homogeneous proportions of pottery, red pigment, copper ore, and lithic artifacts. While CH1 and CH2 are geographically close to each other, QÑ8 is a roadside site some distance away. That these sites cluster together could indicate that this is a product of the nature of their interaction; that mining products from the former sites entered the Road at the latter.

Site EXT9 lies close to the Inca Road and is graphically positioned in the middle of the two first clusters because of their relative similar proportion of the four categories of artifacts evaluated in the analysis. Finally, site CH10 is the one that clusters completely apart from all the others because of its orientation to lithic artifact manufacture.

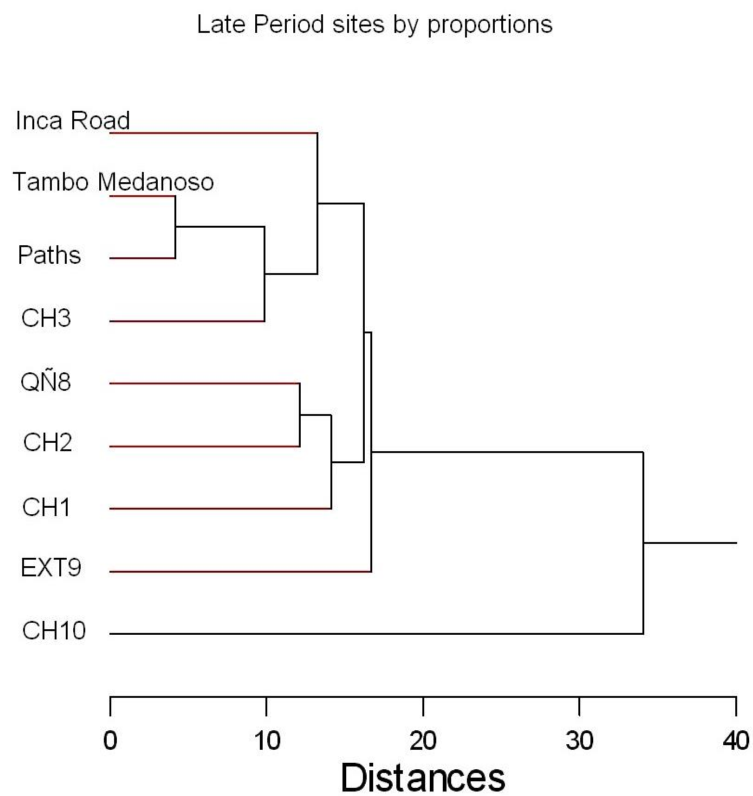


Figure 6-19. Hierarchical cluster graph for Late Period sites

6.3 THE WORLD OF THE INCA ROAD AND THE WORLD OF THE MINING CAMPS

The Inca Road and the mining camps can be viewed as two distinct "worlds" that intersected. Mining in this area started independently long before Inca conquest. And the Inca Road was laid without regard to the set of small mining camps to the east. Nonetheless, the geographical proximity of the two led to an articulation that shaped the use of each. The Inca Road was used by local people, and hosted structures facilitating the procurement and movement of mining/crafting products. The Road itself acted as a magnet, drawing the camps to cluster nearer to the Road. As discussed in Chapter 4, the number of "Inca" structures on the Road (essentially at Tambo Medanoso), were far outnumbered by the structures of local architecture and ceramic affiliation. The larger local architecture sites (EXT9, QÑ5, QÑ8), lie only 2-3 km from one another, rather than the 20-30 km expected of daily stopping points for traffic efficiently transiting the Road. The intersection of these two worlds is further seen in the presence of the Cachiyuyo de Llampos mining/crafting products along the Road, particularly at EXT9 and QÑ8 (as described in Chapter 4). These sites are likely where the miners accessed the Road, and the sites mostly likely to have figured in logistical support for the mining camps.

The bulk of the pottery found at the Road sites represents Late Period local ceramic styles (including Diaguita Inca and local Inca wares) that also predominate at the mining camps. Copiapó black-on-red styles were the most common decorated styles used by the Copiapó Valley population. However, these were only found at certain sites, such as EXT9 and CH3. While pottery is not a good indicator of ethnic identity, the lack of Copiapó black-on-red styles suggests that local miners quickly adopted the new pottery styles that abundantly arrived in the Late

Period in Copiapó Valley, or perhaps they reflect the presence of Diaguita commoners that integrated into a preexistent household mining mode of production.

6.3.1 Tambo Medanoso and CH1 compared

I have argued that my research area contained two "worlds" or systems: that of the Inca state, in the form of the Road and the Tambo Medanoso, and that of local the mining camps, including CH1. To highlight the differences between these two systems, this section will briefly compare excavated assemblages from Tambo and CH1 in terms of occupation, pottery preferences, activities, and food consumption, and role.

Tambo Medanoso exhibited lower artifact densities, both on the surface and in excavation, than CH1, indicating a low intensity occupation, and only a few residents on a more permanent basis.

6.3.2 Pottery

Comparison of the proportions of artifact categories (Figure 6-20) shows relatively more pottery at Tambo Medanoso than at CH1. This difference likely reflects the relative lack of craft production tasks at the Tambo Medanoso, rather than the presence of more serving activities there.

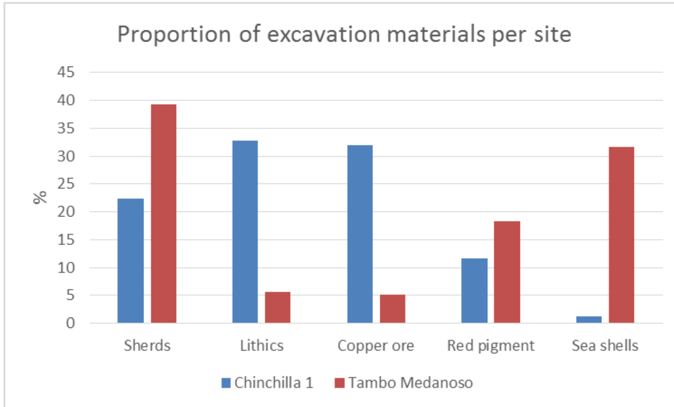


Figure 6-20. Proportion of artifacts from excavation at CH1 and Tambo Medanoso

As shown to the left in Figure 6-21, Tambo Medanoso and Chinchilla 1 represent opposite tendencies in terms of the proportion of decorated sherds, with a ratio of 3:1 for Tambo Medanoso versus 1:3 for CH1. This difference is highly significant under the Chi square test (x^2=25.125, p<0.001). As shown to the right in Figure 6-21, Inca local styles form a larger proportion of the Tambo Medanoso ceramic assemblage. This is not unexpected given the Tambo's official role along the Road. Yet Inca local styles are a significant proportion of the assemblage at CH1 (and other mining camps) as well. There is no evidence that Tambo residents had access to ceramics that the miners did not.

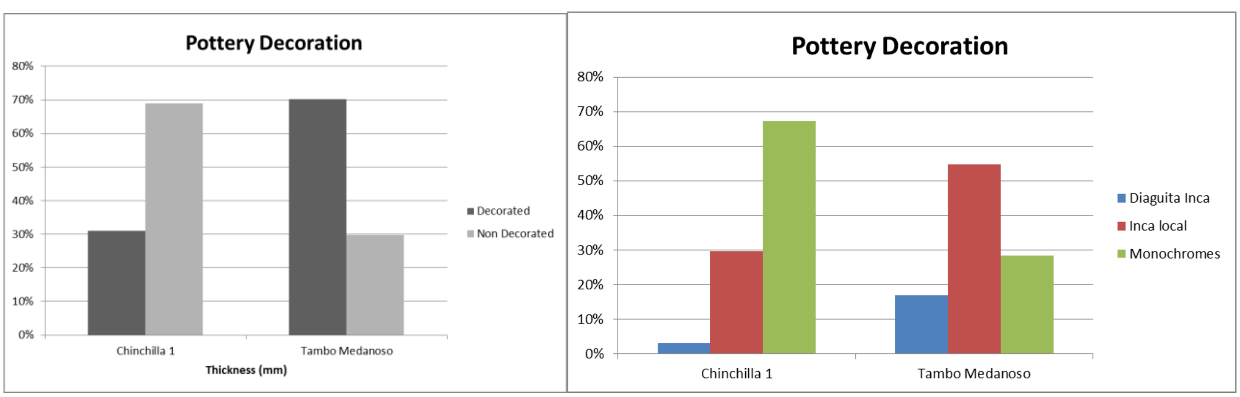


Figure 6-21. Presence of decoration, and styles in CH1 and Tambo Medanoso sherds

There were insufficient diagnostic sherds to meaningfully compare vessel forms between the sites. However, I did measure sherd wall thickness. Overall, CH1 yielded thicker sherds than Tambo Medanoso, especially in the Monochrome types. At Tambo Medanoso, Diaguita Inca, Inca local, and Monochrome types all had wall thickness of 8 millimeters or less. In contrast, at CH1 sherd wall thickness ranged up to 15 millimeters. In comparison to CH1 residents, Tambo Medanoso residents: (1) used somewhat higher value pottery; (2) consumed more thin-walled, decorated, serving vessels (such as the Inca Local styles); and (3) used fewer large, thick-walled containers. The higher proportion of Monochrome sherds belonging to utilitarian cooking/container pots at CH1 is consistent with an intensive domestic occupation incorporating a full range of cooking, storage, and serving activities. At Tambo Medanoso, nearly all the pottery recovered in excavation came from test pits 1, 2, and 6 (see Chapter 4). These units were relatively contiguous, in the southern compound at the site, and could represent an area of serving and consumption activities, separate from cooking and storage loci. At CH1, all test pits yielded ceramics, but the distribution of Diaguita Inca and Inca local of styles was not homogeneous, suggesting that some household/corporate units there consumed relatively more decorated pottery than others. This is the only evidence hinting at social status differences within the CH1 community.

6.3.3 Lithic artifacts[26]

Lithics were sorted into cores, flake fragments, flakes derived from cores, and secondary flakes, a product of bifacial flaking (Figure 6-22). No cores were found at either site. Finished artifacts were found at CH1 but not at Tambo Medanoso. These finished tools consisted of five projectile points, including complete, broken, and unfinished ones, and two retouched artifacts

[26] The classification of lithic artifacts was done with the help of Daniela Padilla, archaeologist from University of Chile.

that may have been used as knives or scrapers. As seen in Figure 6-23, the assemblages at each site contained low proportions of flakes derived from cores, with 75% of the debitage at CH1 and over 80% at Tambo Medanoso lacking cortex.

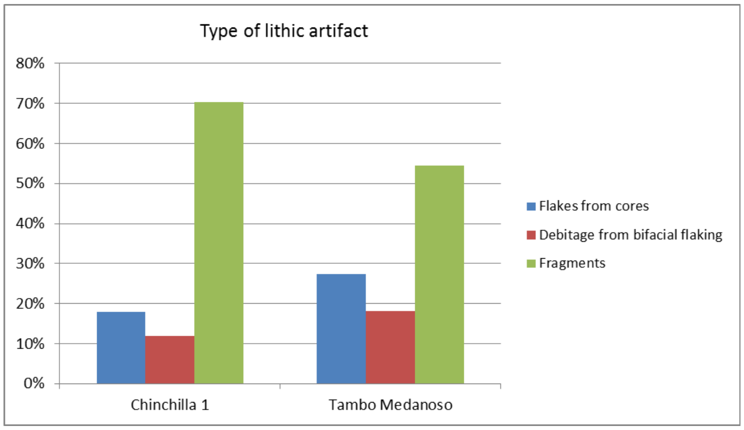


Figure 6-22. Proportion of lithic types per site

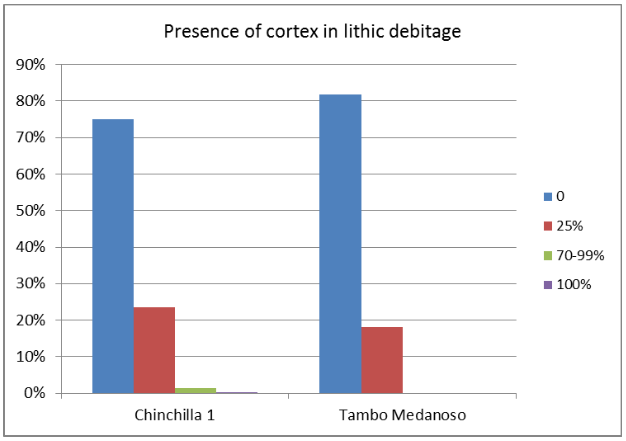


Figure 6-23. Percentage of cortex in lithic debitage per site

A lack of primary cores is common at the Cachiyuyo de Llampos mining sites, indicating the non-local nature of lithic source material, and that primary reduction largely did not take place at these sites. In terms of raw materials, basalt and silex dominated at both sites, but CH1 had a wider diversity of raw materials, including obsidian, and transparent quartz (Figure 6-24). Most of the fine grain silex of both sites is non-local, as, of course, is the obsidian. The greater variety of raw materials at CH1 suggests that its residents were connected to a broader lithic exchange network that the Tambo Medanoso residents.

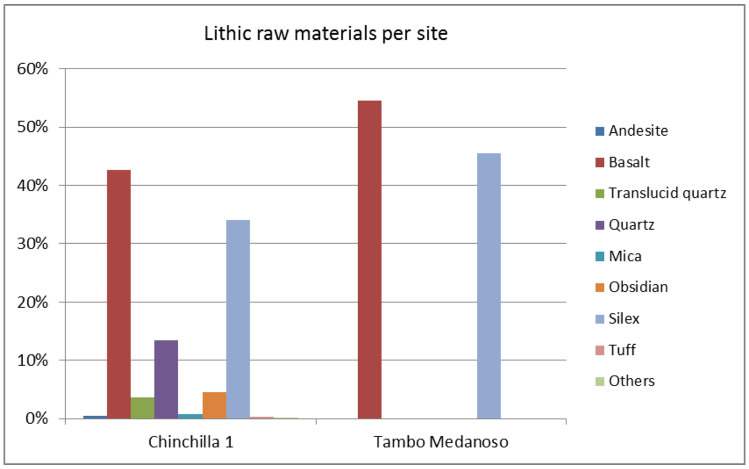


Figure 6-24. Percentage of lithic raw materials per site

6.3.4 Botanical remains[27]

The botanical samples from the two sites are somewhat different. No carbonized remains were recovered from Tambo Medanoso, while such were common in many test pits at CH1. This disparity may be related to the fewer hearths, overall, at Tambo Medanoso, suggestive of shorter occupations, or more consumption there of food that did not require cooking. It is also difficult to distinguish whether plant remains were introduced to the sites as a result of human consumption or natural agents, or, in the case of carbonized remains, as fuel.

Tambo Medanoso showed an abundant presence of *Tiquilia atacamensis* seeds, while these were rare at CH1 (N=5). However, is not clear if the seeds were transported by natural agents or intentionally, as product of human consumption. On the other hand, only CH1 yielded chañares (*Greoffroeae decorticans*), many of the specimens charred. *Alstroemeria sp.* was

[27] The classification of botanical remains was done with the help of Valentina Mandakovic, archaeologist from University of Chile.

recovered from all levels of Unit 6, but this was the only test pit at CH1 with this kind of plant. It is unlikely that this is a random or "natural" distribution; if the seeds were spread by the wind, they would have been found at other test pits. *Atriplex sp.* seeds are ubiquitous in all test pits in both sites, but again, we cannot specify whether this distribution reflects human activity or the action of the wind. Despite the great importance of maize and chicha to the Inca state, no maize was found at Tambo Medanoso (Table 4-4).

Overall, the only clearly diagnostic foodstuff that we can be confident was transported to the research zone were the CH1 chañares. As discussed in Chapter 5, these were likely transported dried from the Copiapó Valley, and were an important item of the miners' diet. Their consumption is one dietary difference between the Tambo residents and the miners.

6.3.5 Animal bones[28]

Figure 6-25, comparing the identified taxa (NISP) at each site, reveals some significant differences. There is a much higher proportion at Tambo Medanoso of the bony fish (*Osteoichteyes*), that includes the genre *Genypterus sp.*; one of the three species of the fish locally known as congrio (dorado, colorado y negro). Fish bones were a much lower proportion of the assemblage at CH1. In contrast, CH1 exhibits a higher proportion of rodents, including the family *Chinchillidae* (chinchillas and vizcachas), and the family *Cricetidae* which includes hundreds of small rodent species.

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[28] The classification of animal bones was done with the help of Cristobal Oyarzo, archaeologist from University of Chile.

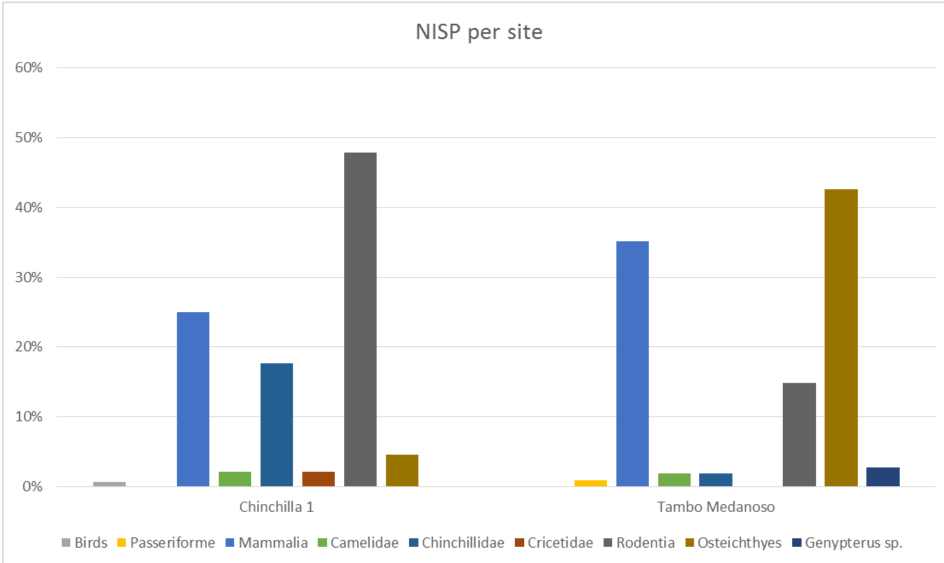

Figure 6-25. Number of identified specimens per site (NISP)

If we group all the fish and rodent bones together, and compare their statistical significance per site using a Chi Square in a two by two table (Table 6-2), the difference is highly significant with a p value <0.001 (x^2=176.332,).

Table 6-2. Frequency of fish and rodent bones at CH1 and Tambo Medanoso sites

Site(rows) by Taxa(columns)	**All Osteichthyes**	**All Rodentia**	**Total**
Chinchilla 1	22	325	347
Tambo Medanoso	49	18	67
Total	**71**	**343**	**414**

At both sites, bird bones (including *Passeriformes*) are a minor part of the assemblage (1%), as is identified camelid bone (2.08% in CH1 vs 1.85% in Tambo Medanoso). There is nothing in the camelid bone proportions to suggest llama caravans frequenting the Road, and possibly those bones refer to wild specimens such as guanacos. The broader *Mamalia* class includes a wide range of species (and non-diagnostic camelid), and represents 25% of the assemblage for CH1, and 35% for Tambo Medanoso.

The faunal data point to another dietary difference (and difference in mechanism of food supply), between the two sites: the greater consumption of fish (likely salted or dried) at Tambo Medanoso, versus the greater reliance on rodent hunting (wild chinchilla or vizcacha) at CH1.

6.4 SUMMARY

An extensive system of mining/crafting settlements existed in the Cachiyuyo de Llampos Mountains prior to the Late Period (and the Inca Road). In both periods, local miners/crafters were not simply extracting raw materials, but also creating final products. The crafting of finished products may have been done as a way to reduce the cost of long distance transportation of the product, thus increasing the value of each load exported. In the Late Period, the crafting of a finished product might also have held the advantage of having a product ready for exchange on the Inca Road. During the Late Period, this system saw four significant changes. The first change was to more intensive settlement, with longer-term occupation at the largest camps. The second change was the nucleation of settlement into fewer large camps, including into a significantly larger camp (CH1). The third change was that the focus of settlement shifted to the west (closer to the Road), and the easternmost Pre-Inca Period sites fell out of use. The total volume of copper ore working may not have increased in the Late Period; there were fewer sites at which ore was processed. However, CH1, the Late Period site at which ore working was concentrated, was larger than any sites of the previous period, and exhibits three times the architecture of any other site of either period. Overall, the Late Period saw increased processing of red pigment. Stone tool manufacture declined, with CH10 the only site in which stone tool production was of great importance. The fourth significant change in the Late Period was the decline of intersite specialization. Pre-Inca Period camps tended to focus on either ore working or lithic production. In contrast, the Late Period camps were, with only a few exceptions, characterized by a greater degree of multicrafting.

For both periods, the pattern of small, nearby camps represent a pattern of autonomous production by small corporate units. There was apparently no impetus to seeking denser communal interaction or economies of scale, by creating larger camps. This may have begun to change somewhat in the Late Period, with the larger CH1. Yet, the camps were not completely independent of one another. As discussed in Chapter 5, they were connected by well-worn paths. There was likely some degree of inter-camp cooperation, particularly in drawing water from the only known well in the area, near CH9. Notably for a water hole in a desert context, there are no indications that the well was the focus of settlement, nor that anyone attempted to control access to it, although it was apparently at some point within a structure at CH9.

As of now, we can also only speculate about the extent to which the intersite productive specialization (particularly strong in the Pre-Inca Period) was the product of deliberate decision making by the miners, or an economic "invisible hand." When this kind of craft specialization is seen by archaeologists at the household level within communities (economic "interdependence"), it is often viewed as something that simply develops "naturally" in creating a more productive economic system built around the efficiencies of specialization. This development is readily explained in microeconomic terms in market contexts. But it is difficult to apply this kind of interpretation to the Cachiyuyo de Llampos case. There is no evidence for (and much to argue against), the existence of a market economy that would select for this kind of efficient specialization. Moreover, there is nothing to indicate that the camps had the integrative relationships among themselves that could take the form of interdependence. Unlike in the classic, village level household specialization pattern, here items were being produced only for export, rather than for consumption by one's neighbors. It is only this intersite specialization itself that suggests the camps may have functioned in some way as an integrated system.

6.4.1 Mining and the Road

Some of these changes in the Cachiyuyo de Llampos camp system can be easily related to the Road, such as the shift of settlement westward, closer to the Road. The CH1 mining camp is located at a strategic position at the entrance of Chinchilla ravine, next to copper and iron oxide ore sources, and closer to the Inca Road than the other sites of this period. That favorable position alone may explain why more people decided to live at this site.

Craft products from Cachiyuyo de Llampos Mountains entered the Inca Road through specific sites (EXT9 and QÑ8). The increased stability and intensity of the camp occupations could also have been fostered by the improved logistics offered by the Road. Certainly, the possibility of resupplying from the Road, rather than from the Copiapó Valley, would have allowed for the more intensive Late Period occupation. Prior to the Road, the lack of predictable traffic or logistical infrastructure may have led to more difficult conditions for task groups, and favored the development of intermittent expeditions focused on the production of specific items. The presence of the Inca Road may have led to a Late Period strategy of each task group producing a wider diversity of goods for exchange, as a result of the increased traffic and better transportation logistics. During the Pre-Inca Period, miners would have had to carry all their supplies into the desert, and it is not very likely that they may have had frequent contact with other people. At the same time, they had to travel all the way to populated places such as Copiapó Valley by informal trails to meet the final consumers of their products. In contrast, the traffic along the Road would have provided more contact with people, and may even have led to the development of “middlemen” figures, that served to make consumption more predictable, and reduce transportation costs.

Overall, presence of the Inca Road did not radically change the pre-Inca pattern and scale of production, but it is clear that the Road did contribute to the geographical shifting of those activities, and a reorganization of inter-site specialization. As of now, we can only speculate about the social and economic arrangements underlying the latter shift.

Comparison of the Tambo Medanoso with CH1 further illustrates the differences between the “world of the Road” and that of the mining communities. These differences underscore the extent to which these sites operated as part of different socioeconomic systems. Overall, CH1 exhibits a more intensive occupation. Multiple hearths at CH1 are consistent with the household socioeconomic organization at the site. In contrast, Tambo Medanoso exhibits centralized or communal food preparation and consumption areas. Although the sites share the same range of pottery styles, Tambo Medanoso displays higher proportions of decorated, thin-walled, and local Inca-style pottery, and lower proportions of large, thick-walled, plainware vessels. Although stone tool maintenance went on at each site, there was more tool making activity, with a wider range of non-local stone, at CH1. This stone, including obsidian, may not have travelled along the Road as part of Inca traffic. There are marked dietary differences between the sites, indicating that they did not share the same mechanism of resource acquisition. Fish consumption was more common at Tambo Medanoso, while wild rodents dominated the animal diet at CH1. Finally, chañares consumption was limited to CH1. In sum, the Tambo Medanoso, and the Inca activities it represents, functioned independently of CH1 and the mining camps: two “systems” using the Road in different ways.

7.0 THE CHINCHILLA SITES AND PREHISPANIC MINING IN THE ATACAMA DESERT

An important goal of this research was to document the nature of non-Inca mining in the Atacama Desert, with a focus on understanding mining camps as communities. In reaching this goal, it is instructive to contrast non-Inca (local) mining with those better known examples of Atacama mining sites organized by the Inca state.

7.1 PRE-INCA PERIOD MINING

Small scale mining has a long prehistory in the Atacama Desert. In the Cachiyuyo de Llampos district there was a significant amount of pre-Inca mining, and very strong continuities in the nature of this mining even following Inca conquest and the construction of the Inca Road.

In general, most of the sites in northern Chile during pre-Inca times show a mode of production based on small household/corporate units that increases in complexity and centralization during the Late Period with the Inca conquest. However, Cachiyuyo de Llampos shows a pattern that shows many continuities with the past, without Inca centralization.

A handful of pre-Inca mining sites in the Atacama Desert have seen some investigation. The Cachiyuyo de Llampos camps have artifact assemblages similar that of CHU-2 in

Chuquicamata (Figure 7-1). CHU-2 is a Middle Period site that consisted of eight dispersed semicircular structures lying near known caravan routes to the Loa oases. Surface materials from CHU-2 include unworked and crushed copper ore, lithic debitage, local style sherds, and marine shell fragments (Nuñez et al. 2003). The small number and size of the structures suggests a small residential group. Despite the evidence for bead making on site, Nuñez et al. (2003) suggest that copper ores of atacamite and chrysocolla may have been processed here for transportation to the Loa valley for smelting. If so, this would be a different scenario to the Cachiyuyo de Llampos sites, which were oriented exclusively to lapidary and pigment production.

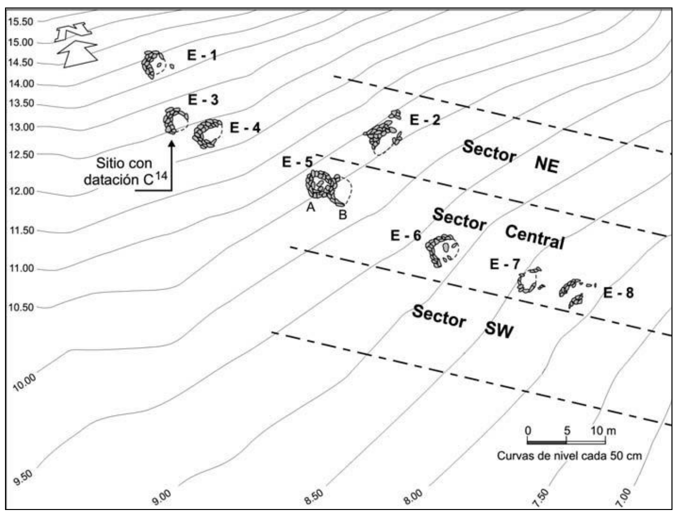

Figure 7-1. Map of site CHU-2 in Loa area (Nuñez et al. 2003)

The characteristics of mining exploitation seen at sites such as CH5, located near a small, open-cut mining trench, are resemble what has been recorded for other pre-Inca sites, such as AB178 and AB200 in El Abra (Salazar and Salinas 2008). At these sites, miners directly excavated superficial ore veins, and crushed and selected ores at nearby sites. Site AB38 (Cerro Turquesa) located also in El Abra area, and occupied mainly between 800-1200 AD, has been described as a seasonal mining camp, focused on copper ore extraction and primary ore crushing

(Salazar et al. 2010, Salazar and Salinas 2008). Food remains here included chañar and maize from the Loa oases, and wild camelids bones. In AB38, and the nearby mining site of Ichunito, the internal space for all the camp's residential structures totals less than 80 square meters, indicating the presence of small working parties. The main difference between the mining sites of San Jose del Abra district and the Cachiyuyo de Llampos camps is that the last steps of the chaîne opératoire -- creating ore beads -- did not take place at the former sites. Beads or other final products were presumably manufactured from the ore elsewhere in the Loa Valley. The San Jose del Abra sites exhibit large numbers of stone hammers that increased continuously in size from the Formative through the Late Period (Salazar and Salinas 2008). In contrast, stone hammers are not that abundant at the Pre-Inca Period Cachiyuyo de Llampos sites.

Unlike the open air mines described above, the pre-Inca epoch also included below ground mining, as exemplified by the famous "copper man" of Chuquicamata (Figure 7-2), Discovered in 1899 that was a miner that was entombed with all his tool kit in a rock fall (Bird 1979). The mummy was preserved by the infiltration of copper oxide in the body, producing the greenish color that persists today. The main tools of the miner were four hafted stone hammers (three of diorite and one of hematite), and two hand spades (one made of wood and the other of stone). The miner also carried a rawhide llama bag, and four rounded coiled baskets to carry the mineral outside the mine shaft. The mine shaft was narrow, and the position of the miner suggests that the exploitation was focused in the selection of ores with the highest mineral concentration in the copper vein. Four radiocarbon dates (Bird 1979) average to about 484 AD, or the Middle Period.

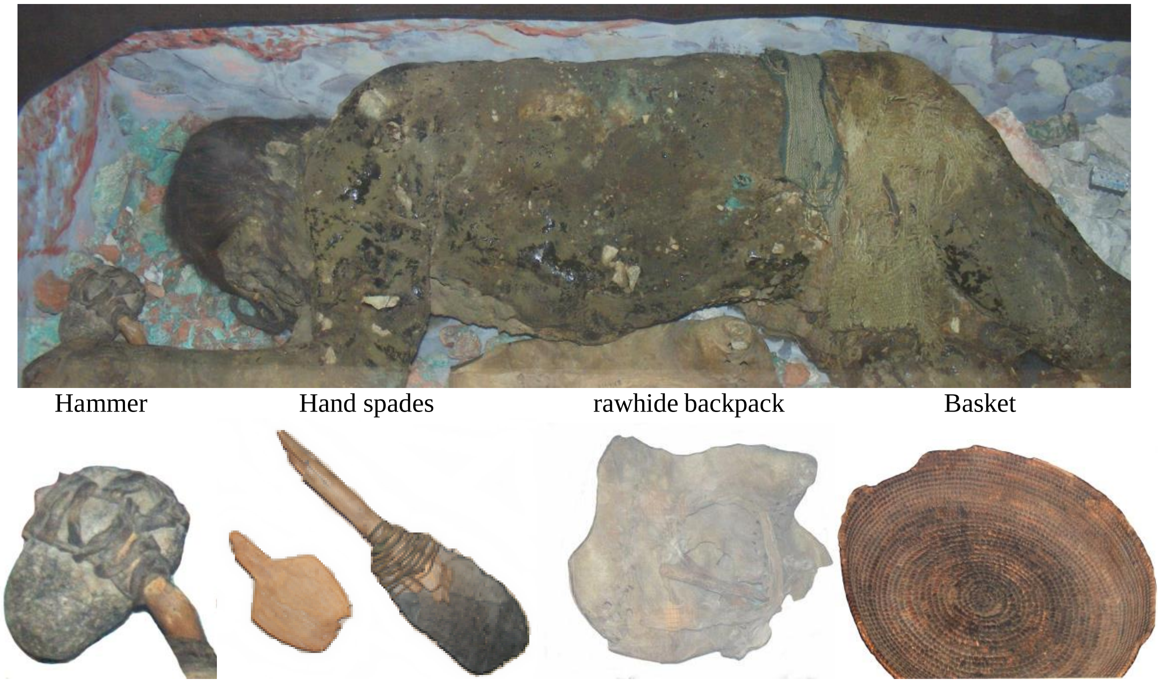

Figure 7-2. The "Copper man" found in Chuquicamata in 1899, is a mummified miner from the Middle Period who died in an accident inside a prehispanic mine shaft. Currently, he and his tools are in the collection of the American Natural History Museum in New York

The Las Turquesas mine in El Salvador area (Westfall and Gonzalez 2010) has evidence for lapidary work and bead making done on site, although this mine is a below-ground one of shafts and galleries. There has not been study of the residential occupation here.

In sum, the Pre-Inca Period Cachiyuyo de Llampos camps are not unique. Like other contemporaneous sites, they represent small-scale household/corporate level production, focused on lapidary work. The Cachiyuyo de Llampos camps differ also from the other known sites in the production of red iron oxide pigment (with the exception of the Archaic Period sites of San Ramón area in Taltal; Salazar et al. 20013a).

7.2 INCA AND LATE PERIOD MINING

There were changes to Atacama mining sites in the Late Period. Inca-affiliated sites of the El Abra display a different architecture pattern from pre-Inca sites, with rectangular structures with internal subdivisions. Examples include AB36 and AB48 (Figure 7-3), where the greater investment in architecture is visible in taller structures, double faced walls, and delineated public spaces for ritual and state sponsored festivities (Salazar et al. 2013b, Salazar 2008). The El Abra zone also saw construction of a ritual platform with spondylus shell offerings, related to the ceremonial control of the population by the Inca state (Salazar et al. 2013b, et al. 2013c). Salazar et al (2013b, 2013c) suggest that here the Inca state took over and reorganized mining, to increase copper ore production.

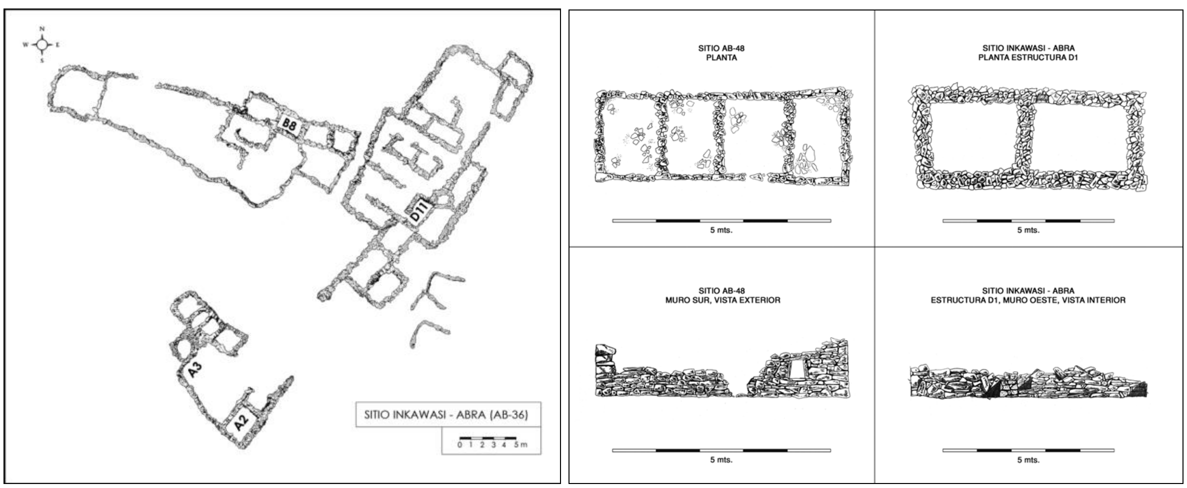

Figure 7-3. Architecture plan of site AB36 Inkawasi-Abra (Salazar et al. 2013c), and site AB48 (Salazar 2008) in El Abra area

Inca mining also took place in the Miño-Collahuasi district in Tarapacá. Sites Miño 1 and 2 feature *kallankas* (the characteristic provincial Inca structure), plazas and structures built to an orthogonal pattern, and evidence for smelting of copper ingots (Salazar et al 2013c, Uribe and Urbina 2009, Berenguer 2007). Yabricoyita, in the same area, also has structures built in an orthogonal pattern, together with corrals, and plazas (Figure 7-4). Here again, copper ores and slags point to smelting, as at the Inca controlled smelting site of Tarapacá Viejo (Zori et al. 2013).

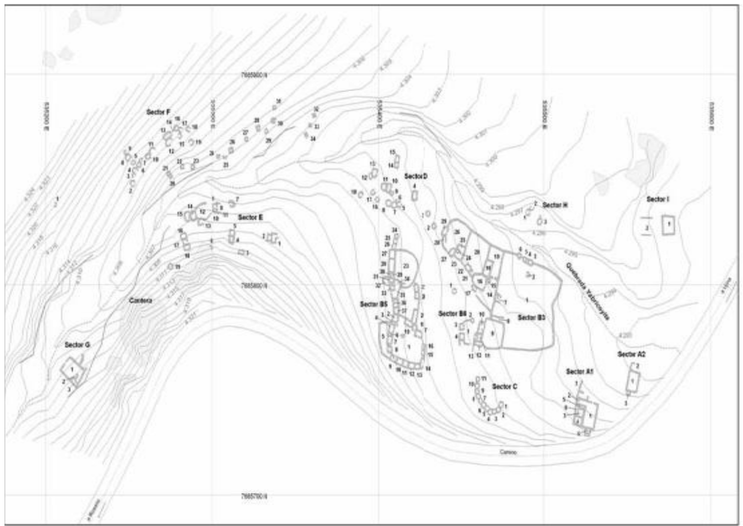

Figure 7-4. Architecture plan of site Yabricoyita in Collahuasi. (Salazar et al. 2013c)

Cerro Verde (Figure 7-5) in the Salado River drainage is adjacent to a copper mine, and has a ritual platform or *ushnu*. The architecture here is Inca-style, composed of contiguous rectangular structures forming U patterns and enclosing *canchas* (Salazar et al. 2013c, Adán 1999). An area of contemporaneous local structures next to this site indicates Inca management of local laborers, likely involving strategies of sponsored ritual and festivities, as suggested for El Abra.

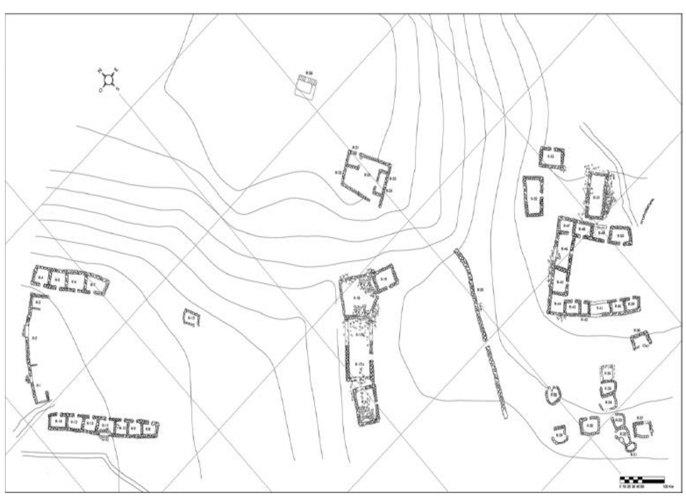

Figure 7-5. Architecture plan of site Cerro Verde in Caspana area (Salazar et al. 2013c)

Cerro Colorado or SBa-162 (Figure 7-6) is similar to Cerro Verde, and is located in the Alto Loa area near the Inca Road. It is argued to have served as an administrative center for the management of surrounding Inca mining activities (Berenguer 2007). The site is composed of a large plaza of 3,439 square meters, and 66 orthogonal structures covering some 4,383 square meters (Uribe and Urbina 2009). Inca commensal ceremonies of state reciprocity for a *mita* labor force is suggested by the large quantity or *aryballos* and serving vessels found in the public plaza.

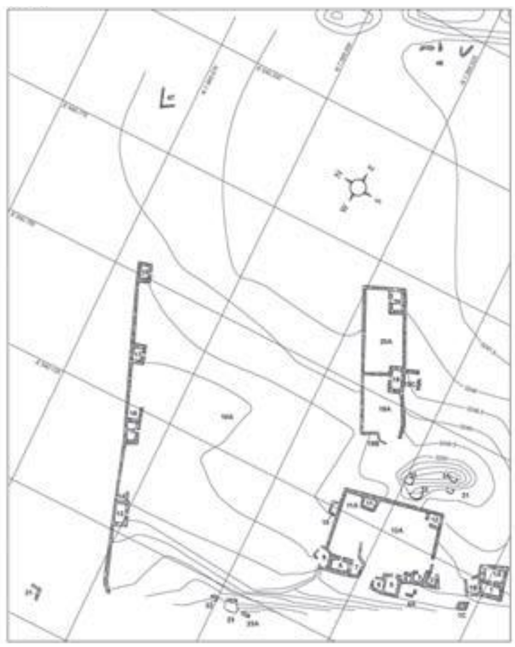

Figure 7-6. Architecture plan of site Cerro Colorado in Alto Loa area (Uribe and Urbina 2009)

The Los Infieles mining complex, lying to the south of the Copiapó Valley, covers an extensive hilltop area, with various locations dedicated to mining of copper ores using open trenches (Cantarutti 2013). A series of sites with orthogonal, subdivided Inca-style architecture such as INF48 (Figure 7-7), and ceremonial platforms with offerings of spondylus figures, are located in close proximity to the mining clusters. The Inca architecture provided a central store for mined ores, a place for imperial rituals, and a locale for feeding *mita* workers. No smelting seems to have taken place at this site, and the crushed and selected ores were carried elsewhere in the Elqui Valley for final processing.

Figure 7-7. Site INF48 from Infieles mining complex (Cantarutti 2013 taken from Stehberg 1995)

7.2.1 The Viña del Cerro Center

The best known of the Inca mining installations in the Atacama is the metallurgical center of Viña del Cerro, located in the Copiapó Valley (Figure 7-8). This site is a large complex with Inca orthogonal architecture, a plaza, a ceremonial *ushnu* (Moyano 2010), and was dedicated to large scale metallurgical production, having 26 smelting furnaces (Castillo 1998, Niemeyer 1986). The 6 square structures at Viña del Cerro may have been residential, but it is likely that most of the workers lived outside the site, in Copiapó Valley villages. The small size of the structures, and their high degree of elaboration, suggests occupation by a small number of individuals of relatively high status that would have had managerial functions at the site. This site exemplifies the Inca pattern of centralized and intensified production, construction of infrastructure, and building of ceremonial structures used in Inca imperial administration.

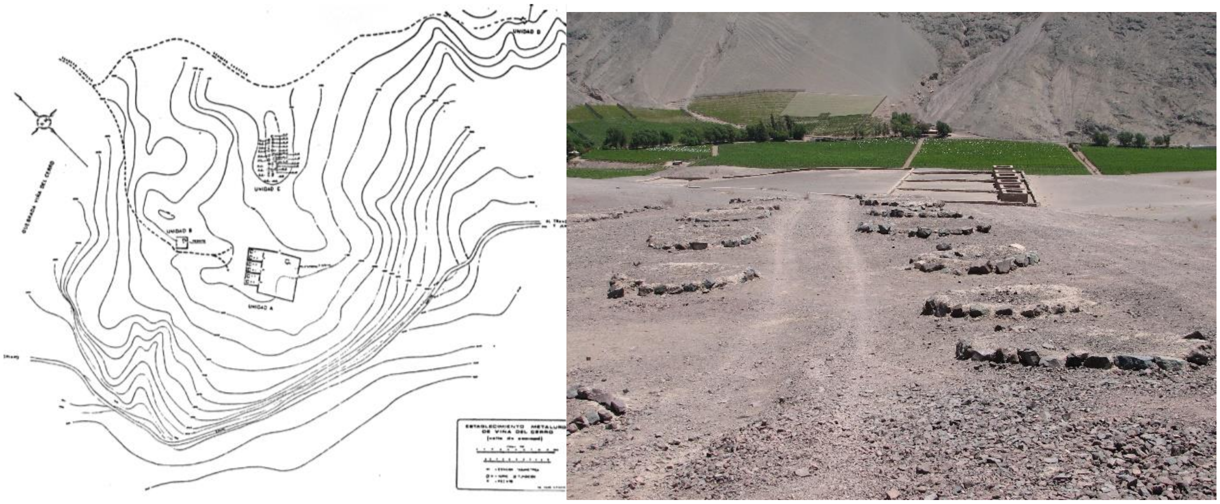

Figure 7-8. Map (Niemeyer 1986), and general view of the Viña del Cerro site

7.3 COLONIAL PERIOD MINING IN THE ATACAMA

Mining continued in the Atacama from colonial through early Republican times, remaining small scale, and highly conservative in technology and organization. The main obstacle faced by miners was the cost of ore transport because of the lack of roads and difficulty in using pack animals (Bowman 1924, Fernández 2000). For much of the early historical period, therefore, most Atacama mining was restricted to silver and gold, as these were the only metals sufficiently profitable to justify the high production costs (Miers 1826, Vicuña Mackena 1883). For small investors, labor was scarce and unpredictable, and difficult to supervise effectively in remote areas. Workers were commonly paid in advance, and it was not uncommon for them to flee or only work for short periods of time before switching to other opportunities, such agricultural labor (Frezier 1902 [1716], Miers 1826, Vicuña Makenna 1883, Fernández 2000).

The small scale nature of mining in the Atacama Desert only began to change in the first half of the 19th century, with the development of large silver mines such as Chañarcillo and Tres Puntas, using very large labor forces. These were the precursors to the large scale, capital intensive mining companies of the future, and their formation was accompanied by legal and economic moves, including the use of institutional violence to manage a "proletarian" labor force (Illanes 1990). Small scale mining, especially of copper, continued fitfully as well, with the seasonality of this activity heavily dependent, from the early 19th century on, on the prices determined by the London Metal Exchange (Ortega 2010, Castro 2006). More recently, there has been some ethnographic study of contemporary small scale mining in the Copiapó zone. In northern Chile currently, 60% of small scale mining is oriented to copper production. This homestead mining can be characterized as high risk, labor intensive, and dangerous, focused solely and extraction, and driven by the hope of rapid wealth accumulation through a lucky strike (Romero 2012). These miners lack mechanization, have little accurate knowledge of the amount of exploitable reserves, and have little or no patrimony. They work in groups of up to eight people and generally are middle-age men (Castro 2006). They excavate galleries and shafts with hammers, chisels, and shovels, and then accumulate the extracted ores outside the mine, where they do the primary grinding and selection (Moya 2004). This mining is not merely a Chilean anachronism. It has been estimated that in the early 1990's, labor intensive, small scale artisan mining with low levels of mechanization represented about 15-20% of the world's non-fuel mineral production (Jennings 1999); an indication that this mining remains a viable economic alternative throughout the world.

The current small scale artisan mining in Chile is well in keeping with the archaeological pattern visible in the Cachiyuyo de Llampos camps. The current and prehistoric mining share a small corporate/household based unit of organization, use of manual tools, and low capital investment and output. The main differences lie in a global economic system that today determines prices and demand, and in the lack of production of final products, whereas in the prehistoric case, such items (beads) were manufactured. In any case, the long term existence of small mining in the region bespeaks a resilient, household level economic coping strategy that has been successful in dealing with the enormous social and political changes of the past five centuries.

7.4 CONCLUSIONS

This chapter aimed at evaluating the Cachiyuyo de Llampos mining camps in a regional comparative context. Such comparison must be limited, because no other mining sites in the Atacama Desert have seen comparable investigation. The Pre-Inca Period camps of the Cachiyuyo de Llampos Mountains are not unique. Similar sites elsewhere indicate that this type of mining represents a broader pattern of pre-Inca economic activity. Unlike in other areas of the Atacama however, in the Cachiyuyo de Llampos case, this pattern of mining and craft production was not transformed by Inca conquest. Instead, Cachiyuyo de Llampos mining intensified in the Late Period, while retaining the same basic social and productive organization.

The pattern seen in the Late Period Cachiyuyo de Llampos camps differs markedly from Late Period mining elsewhere in the Atacama in which Inca control is manifest. Unlike the Cachiyuyo de Llampos camps, these Inca-affiliated Late Period mining sites exhibit: (1) formal Inca-style administrative architecture, including *ushnus*, *kallankas*, or *colcas;* (2) evidence for Inca state ceremonies in the form of ritual platforms and feasting artifacts; (3) a single focus on ore production, rather than multicrafting; (4) an emphasis on producing ore for transport rather than producing a finished product on site, and (5) complex community organization and intra-site site functional differentiation, reflecting large scale production, centralized control, specialization of labor, and corvée, rather than household, labor.

One of the most striking aspects of Cachiyuyo de Llampos camp settlement that it consisted of numerous, very small, presumably contemporaneous, camps located not far from one another. This was particularly the case for the Pre-Inca Period, but is also true for the Late Period, even given the smaller number of large camps and growth of CH1. This small camp settlement pattern cannot be explained by the distribution of ore or iron oxide sources; nor did the miners strive to live as close as possible to the actual mines for these materials. Why not live and work in one or two larger communities? The settlement pattern reflects the extent to which the production was done by strongly autonomous small corporate units (of two to three households). These autonomous production units were not all doing exactly the same thing (there are significant differences in economic emphases among the camps), but for productive and residential purposes, they seem to have operated independently. The local settlement and production pattern seen in the Cachiyuyo de Llampos camps is the antithesis of the centralization, specialization, and economy of scale approaches taken in Inca administered mining. These differences underscore the extent to the mining/crafting at the camps was part of domestic economies, while Inca mining in the Atacama was part of a greater imperial political economy.

8.0 CONCLUSIONS

8.1 CACHIYUYO DE LLAMPOS MINING AND THE INCA ROAD

This research sought to explore how the construction of imperial infrastructure might affect local economic processes by exploring the relationship between the Inca Road and the nearby Cachiyuyo de Llampos mining camps. One research goal was to determine how the Inca Road itself was used. This entailed investigating occupation along the Road. The second research goal was to document the nature of the local mining settlements, and how their activities may have changed following Inca conquest and the construction of the Road.

8.1.1 Turnpike or Entrepot? How was the Inca Road used?

Scholarship of the Inca Road has generally taken a top down perspective, highlighting the imperial purposes served by the Road. Lacking has been any significant archaeological examination of: (1) the informal roadside structures already documented along many sections of the Inca Road; (2) the nature of the materials actually flowing along the Road; and (3) the effects of the Road on neighboring populations. To organize investigation of the how the Inca Road functioned, I presented in Chapter 1 two contrasting models. In the "turnpike model," implicit in the prevailing perspective on the Inca Road, the Road functioned for point to point connecting of

Inca administrative nodes, was controlled and used for official traffic, and provided limited access to local populations. In the "entrepot" model, informed in part by study of ethnohistoric Andean caravan routes, I hypothesized that the Road introduced what was essentially a "linear market" for local exchange, a social and economic magnet that could attract and alter roadside economic activities because of its traffic and because of the logistical benefits it provided.

The "turnpike" model was not borne out by my research. My survey along the Road documented thirteen concentrations of structures or "sites" (Chapter 4). Only one of these, Tambo Medanoso, is clearly Inca affiliated, displaying the Inca architectural pattern (R.P.C.) characteristic of provincial administration sites, such as tambos. Tambo Medanoso also contains higher proportions of Inca style pottery than the other sites. While one might expect a tambo assemblage to reflect the flow of Inca official goods, Tambo Medanoso did not yield Cuzco-style pottery, precious metals, smelted copper, or higher proportions of long distance trade items than some local sites in the survey area, such as CH1. The other 12 sites display local architectural characteristics, and higher proportions of local style pottery. In addition, the location and density of this roadside occupation is not what would be expected if the road use consisted mostly of official traffic in transit. Instead of sites located a day's walk from each other, the distance between the local settlements averages around a kilometer. In addition, roadside occupation (in terms of architecture and sherd densities), is highest where the Road passes closest to the Cachiyuyo de Llampos mining camps. These lines of evidence indicate that actual use of the Road owed more to local than to imperial needs, or, stated differently, that the Road was used more by local people than by Inca official traffic.

The findings of this research are consistent with the "entrepot" model. Not only does the surveyed stretch of Road reflect a preponderance of "local" occupation, but, as described in

Chapters 4 and 6, locally mined materials moved along the Road in significant quantities. We can even identify two sites (EXT9 and QÑ8) as the most likely places where products from the Cachiyuyo de Llampos mining camp entered the Road, rather than at the Inca Tambo Medanoso. The distribution of beads and other items thus reveals that craft items from the Chinchilla camps were entering the Inca Road outside of Inca control, further confirming that the local mining sector operated independently of Inca administration. Mined products such as copper ore and red pigment also occurred in small proportions at several other sites up and down the Road (QÑ5, Tambo Medanoso), suggesting their movement, and perhaps even additional crafting, along the Road. In the Late Period, the local inhabitants of Copiapó and other places were able to make use of a new transportation that brought more people, objects, and improved access to areas previously difficult to travel.

As discussed in Chapter 7, we can see the Inca Road here as serving multiple systems. As part of the Inca Empire, it connected points further north to the Inca enclave in the Copiapó Valley, and held an appropriate administrative way-station (Tambo Medanoso). But much of the activity that took place on it reflected local traffic, connected particularly to the Cachiyuyo de Llampos mining activities which took place outside the Inca sphere. The multifunctionality of roads has been noted by other scholars: "War bands stalk highways that are also traveled by marriage parties. Old roads and paths unmarked by recent footsteps occupy the same landscape as busy routes of trade" (Snead 2012:122).

8.2 THE CACHIYUYO DE LLAMPOS SITES AS MINING COMMUNITIES

Mining and craft production in the surveyed area took place in small camps, each consisting of 2-4 households or similarly-sized corporate unit (Chapters 5, 6). Only CH1 was bigger, containing perhaps 5-7 of such units. The occupation of the area started before the Inca conquest (Late Period), with some sites displaying materials from as early as the Late Formative/Alfarero Temprano period, related to the Ciénaga Culture of northwestern Argentina, or to local Molle culture of the Copiapó Valley. However, the majority of occupation is probably from the Late Period.

8.2.1 Camp social organization

Mining/crafting settlements *may* constitute special kinds of communities, existing as the domestic space of unrelated people working together during a time span determined by their common productive goal (Knapp 1998). As we recognize from comparing modern examples (mining camps, lumber camps, construction camps, hunting camps) to residential settlements such as villages, camps tend to be expedient, of limited duration, occupied by a narrow category of residents (i.e. all adult males), sharing a single purpose governing their activities and social interactions.

The mining camps were composed of comparable, relatively autonomous, household-sized units that slept, cooked, ate, and practiced some craft activities separately from one another. This composition is indicated by the architecture and surface artifact patterns, as detailed in Chapter 5. It is not clear whether these units were actually true households, or, composed only of adult males, as is often the case in ethnographic examples of artisan mining.

There were no clear gender-specific artifacts at these sites, and no human remains. Miners shared the ore veins, and communally performed some tasks relating to the primary crushing and copper ore selection. The other indicator of widespread cooperation was the shared use of the single small source of water in the eastern part of the Chinchilla Ravine.

The social organization of these camps was likely simple and egalitarian. There is no evidence to suggest status/wealth inequalities or status differentiation among these constituent corporate groups, other than some relatively higher proportions of finer pottery associated with a residential cluster at CH1. In nearly all the camps containing residential clusters, one cluster was larger and more subdivided than the other(s). I hypothesized that this was a “senior” household, perhaps the first established at the site.

The social affiliation of the Late Period miners is uncertain. Despite the Copiapó Valley being the nearest agricultural and agricultural center, Copiapó Valley style pottery (Copiapó black on red and Punta Brava) is very rare, only occurring in significant proportions at a single camp (CH3). Diaguita Inca style, pottery, in contrast, is abundant. The absence of Copiapó Valley pottery both in the camps, and along the Inca Road as well, raises the possibility that, at least in the Late Period, some miners may have been specialists of Diaguita affiliation, or that local miners already adopted the new pottery styles widely available in the region as a marker of social status. The Cachiyuyo de Llampos miners may also have incorporated rituals into their mining exploitation and craft production, as is evidenced by the presence of rock paintings at most of the sites. These possibly relate to pre or post extraction rituals (c.f. Herbert 1998, Topping and Lynott 2005).

8.2.2 Production and domestic economy

The Cachiyuyo de Llampos mining camps were occupied by full time miners and artisans during the time when they were in the camps. At present, we do not know when during the year, or for how long, such camps were occupied. It is logical to suppose that the miners/artisans went to the camps perhaps during winter months when agricultural labor demands were at their lowest (and the Atacama was at its coolest).

In small scale societies, craft production may be structured by heterarchical ritual obligations (Spielmann 2002), social storage (Halstead and O'Shea 1982), or low level economic exchange (Flad and Hruby 2007, Smith and Olson 2003). Moreover, it has increasingly been recognized by archaeologists that craft production is an attractive alternative to agricultural intensification for the prehistoric household, offering higher returns, diminished risk, maximization of household productivity, and diversifying household production (Hirth 2009). Intermittent and part-time craft production needs to be seen as a normal aspect of domestic economy, rather than as something households turned to under pressure of elite demands or agricultural inadequacies (Rosen 1997, Costin 2004, Schortman and Urban 2004).

Crafting in the desert may have also been attractive as a household activity because of what now would be termed the “added value” of the items produced. Apart from possible symbolic meanings, distance, and labor investment are qualities that create value in objects for exchange (Dillian and White 2010). In the case of the production of copper ore beads and pigments, these qualities were both present. Even if these products acted as somewhat generic commodities, they were not cheap to produce, and there was sufficient demand to lead to their production at the Cachiyuyo de Llampos locale for over a millennia or more.

A striking aspect of all the Cachiyuyo de Llampos mining camps was that the residents were multicrafting, making stone tools, red pigment, and shell ornaments in addition to copper ore beads (c.f. Mills 2007, Shimada 2007b). A partial explanation for this pattern relates to the spatial proximity of sources of copper ore and iron oxide, although the decision to multicraft may be more related to the "transferability" of some of the mining/crafting skills, and also the possibility of mitigating the productive risks or unstable demand of a single product. Multicrafting may have represented a flexible strategy of householding, in which the deployment of household labor is maximized, but risk is minimized, by spreading the labor across different productive activities (Hirth 2009). This multicrafting may distinguish the Cachiyuyo de Llampos camps from many other examples of prehistoric mining. With the multicrafting and emphasis on producing finished products, the Cachiyuyo de Llampos can be seen as artisan communities, rather than as simple mining camps.

8.2.3 How did the availability of the Inca Road affect local mining?

I initially hypothesized that for logistical reasons, mining settlements could not have existed in the Cachiyuyo de Llampos region before the Inca Road. However, my research revealed an extensive Pre-Inca Period settlement of 13 sites. There was a well-established, if only low-scale and intermittent, pattern of camps occupied by multicrafting miners and connected to supra regional exchange networks, predating the Road by many centuries (Chapter 5). The Road certainly did not make this system of activity possible. Nor did the Inca conquest and the building of the Road disrupt or transform this system (Chapter 6). There were significant changes in Cachiyuyo de Llampos mining following Inca Conquest, but these changes were subtle, and largely in degree rather than in kind. By comparing, the Pre-Inca Period camps with those of the Late Period, we see that the Road was indeed a catalyst for local changes (see the end of Chapter 5 and Chapter 6): (1) more intensive settlement, with longer-term occupation at the largest camps; (2) nucleation, particularly at CH1; (3) a preference for camp locations closer to the Road; (4) an increase in red pigment production, and decline in stone tool production (production of copper beads may have continued at roughly the same volume); and (5) a decline in inter site specialization. The Late Period camps were clustered closer to the Road, while still dominating both ends of the Chinchilla Ravine, and were interconnected by a network of trails. This mining system was driven by independent producers and is evident that the Inca did not seek to control or administer this mining, possibly because of its isolation, low productivity, lack of hierarchical organization, or production of low value items.

Some of the hypothesized effects of the Inca Road are seen in the Late Period Cachiyuyo de Llampos camps, while others are not. I hypothesized that the Road would provide the miners with new economic opportunities derived from two properties of the Road: (1) travelers providing increased opportunity for exchange (essentially, a constant if maybe low volume marketplace in a fixed location), and (2) placement of "depots" along the Road for logistically supporting the desert mining activities. The increase in mining/crafting intensity, the shift of settlement closer to the Road, and the buildup of local occupations along the Road are all consistent with these two hypotheses. The Road acted as a magnet, drawing preexisting activities to itself. The Inca Road attracted and modified the "landscape capital" (c.f. Erickson 2006), of mining communities. However, the Late Period did not see marked increase in the movement or working of long distance exchange materials, nor was crafting in the camps reoriented to produce Inca style items, nor for items for the regional and panregional "marketplaces" served by the Inca Road system. Instead, the miners used the Road to facilitate creating the same, locally consumed, items that they were creating before the Road. In other words, the existence of the Road did *not* connect Cachiyuyo de Llampos activities to a wider economic world in meaningful ways.

While there were some shifts in the Late Period mining camps, it is impressive how little change there was. The Road did not revolutionize how Cachiyuyo de Llampos mining was done. In fact, the Late Period changes show the extent to which the Cachiyuyo de Llampos miners were successful in incorporating use of the Road while maintaining preexisting mining/crafting patterns. This resiliency is as important an aspect of the Late Period pattern as any Road-induced changes.

Finally, an important caveat must be added to the above discussion. Some changes in Late Period Cachiyuyo de Llampos mining, such as the westward shift in the focus of settlement, can facilely and logically be related to the Road. However, in thinking about causality, it must be remembered that the Road was not the only change of the Late Period. The Late Period also saw Inca conquest, and the inclusion of the Atacama population into an overarching sociopolitical order and political economy. Changes stemming from this incorporation into Inca empire may have markedly shifted the value, demand, and use of sumptuary objects such as beads, and raw materials such as pigments. Inca conquest may also have affected (as it did elsewhere in the Empire), local status and wealth differentiation, and domestic economies. These changes, in turn, may have affected Cachiyuyo de Llampos mining and crafting activities.

8.2.4 Dual mining systems in the Atacama during the Late Period and after

As discussed in Chapter 7, the local Cachiyuyo de Llampos mining co-existed with larger scale, Inca administered operations. The best known of these, the large center at Viña del Cerro, deployed Inca management practices (including use of corvée or *mita* labor) for smelting and export of metal. Production at the Cachiyuyo de Llampos sites went from extraction to finished product, entirely within the framework of household production. In contrast, Viña del Cerro represented only the last stages of the chaîne opératoire in the smelting and production of finished metal items/ingots. The economic calculi underlying these systems of mining would have been very different, rooted in the domestic economy in the local system, and an imperial political economy in the Inca case.

In many ways, the dual systems of the Late Period are continued today in the small scale "artisan" mining done by households or collectives versus the large scale industrial mining of multinational corporations. Characteristics of ethnographically studied, contemporary artisan mining include: labor intensive and dangerous; lacking mechanization; done by dispersed production groups; a "hope" of rapid wealth accumulation balanced against the intrinsic productive risk; a strategy of equitable household resiliency rather than profit maximization; little empirical knowledge of the amount of exploitable reserves or control of those reserves; and a social organization based on groups of around 8 people, generally middle-age men (Castro 2006, Godoy 1985a, 1985b, Romero 2012). The prehistoric Cachiyuyo de Llampos mining displays many of these characteristics, and historic and contemporary small scale Andean mining is obviously valuable for ethnographic analogy. However, it is worth pointing out that there are three significant differences between the Cachiyuyo de Llampos case and current artisan mining in the Atacama: (1) the absence of multicrafting by modern artisan miners; (2) today's uncertain demand governed by foreign metal stock markets; and (3) the last steps of the *chaîne opératoire* in mining, because ethnographic miners sell their ores, unprocessed, to private middlemen or state companies without processing. Modern small scale production is directed to single resources (copper, gold, or silver), depending on price and local availability. By not multicrafting, the miners do not diversify production or produce "added value." Instead of multicrafting, cycles of reconversion between mining and agriculture seem to be the main risk coping strategy for ethnographic miners (Miers 1826, Bowman 1924, Godoy 1985a,b). Too, prehispanic production and consumption of lapidary products, pigments, and ore beads would have been locally determined, and the social and physical distance between producers and final users was probably minimal, and limited geographically to neighboring valleys. This changed during colonial times as cold hammered copper beads were replaced as items of adornment by mass produced glass and metal beads. As the "market" for the final products disappeared, the valuation of the ore itself changed, particularly in the 19th century, as the *London Metal Exchange* came to dominate price and demand (Ortega 2010, Castro 2006).

Contemporary artisan miners produce few lapidary artifacts, and smelting requires relatively sophisticated and costly investments. Yet, in northern Chile, until the early 19th century, small-scale miners still did their own copper smelting using simple pit furnaces technology (Miers 1826). Because of the inefficiency of this process, the resultant slags had to be hammered to separate manually the drops of metal from the impurities, and then refined again to obtain a copper ingot. That procedure was labor consuming and actually resembles the prehispanic methods of copper production seen at sites, such as Viña del Cerro. Thus, in many ways, small scale mining in the 16th – 19th centuries resembled Inca production, rather than a continuation of what is documented at the Cachiyuyo de Llampos camps. After the introduction of modern industrial smelting facilities in the mid-19th century, small scale Copiapó miners relinquished the last steps of copper production, and only continued working in primary ore extraction.

8.3 THE INCA ROAD, MARKETS, AND "GLOBALIZATION"

The Cachiyuyo de Llampos camps provide a valuable vantage point from which to consider some of the theoretical issues revolving the role of roads in creating: (1) market activities in the prehispanic Andes; and (2) the kinds of vertical relationships glossed as "globalization."

Although it has long been held that the prehispanic Andes lacked a market economy (Mayer 2013, Stanish 2010), scholars such as Murra (1980) recognized that the Inca Road may have fostered market type behavior. The possibilities of roadside exchange, without goods needing to be moved to larger population centers, may have produced a social savings that would have stimulated "markets as institutions predicated on the principles of market exchange of alienable commodities" (Garraty 2010:6), independent of exchange embedded in sociopolitical relations or kin affinity between trade partners. The extent of market type activity in the Chilean region before and following Inca conquest needs specific research, and this is not the place to consider an issue of such magnitude. However, Cachiyuyo de Llampos we have a case where crafting was done in the absence of immediate production of subsistence goods, which therefore, may well have been obtained by exchange. In the Cachiyuyo de Llampos case, however, the Inca

Road, even with its possibility for congregating people and facilitating the movement of goods over space (Hirth 2010), did not transform the preexisting patterns of craft production. While the Inca Road may have served as a linear entrepot or marketplace, the evidence from the Cachiyuyo de Llampos does not support the idea that it created market activity. The continuities between Pre-Inca Period and Late Period patterns suggests that if this can be viewed as potentially "market" type activity, it preexisted the Inca.

"Globalization" can be glossed as a form of integration of far-flung populations, stemming from the interchange of worldviews, products, ideas, information transfer, social relationships and many other things besides. For Jennings (2011), this process was a common outcome within the context of expansive complex societies in ancient times. Although those processes were not as universal as today, they created a scale of connections in a proportion that did not exist before in local areas. Frachetti (2008:29) defines prehistoric globalization as a process that "…describes how the boundaries of sociopolitical landscapes were transfixed by the development of a network of interaction rooted in localized patterns of land use, in the communication of semiotic forms, in the extension of interactive contexts across territories, and in the non-uniformity of power structures over time." The role of imperial roads (or other transport infrastructure) in globalization has been a subject of study by scholars, and is certainly relevant to any consideration of the impact of the Inca Road. From one contemporary perspective, roads can be seen as focusing "collision points" between diverse categories of people (travelers and locals) producing new social interaction (Bertolini 2006, Kachwalla 2010). The Inca Road, analogous to the Roman frontier (Revell 2009, Wells 1999), may have been a nexus for new forms of social interaction, the emergence of multicultural "middle-men," or even the ethnogenesis of "roadside cultures." The current research on the roadside sites in the survey area was not designed to address this issue, but future, comparative study of the activities and ceramic preferences at these sites might shed light on whether such dynamics took place. As Hassig (1991:18) has pointed out, "roads are selective in the ties they create and are the result of conscious, though often unplanned, decisions. In short, roads can profoundly affect the social world, but they do not do so uniformly."

Globalization is often also seen as entailing "globalizing" a local economy. Typically, this involves a flow of raw materials, exotic commodities, and staples from provincial areas, and a counter flow of finished trade goods and non-local staples from the core (Geraghty 2007). The Cachiyuyo de Llampos case does not fit into this sort of economic globalization for reasons discussed above. There is no evidence that beads or pigments even circulated beyond Copiapó Valley, let alone being consumed in distant regions of the Inca Empire. Nor is there evidence for the flow of imperial core goods, such as Cuzco pottery, into the camps, although these kind of items might well have wound up in the miners' home communities. And finally, the patterns of production simply did not change all that much in the Late Period, and no hint that the mining was now "globalized." Instead, where one can see elements of cultural and economic globalization is in the Copiapó Valley itself, with the arrival of the Diaguita allies of the Incas producing some degree of cultural hybridization, and the large scale metallurgical production at Viña del Cerro directly integrating the region into the political economy of the Inca empire. The differences between how the Cachiyuyo de Llampos camps and the Copiapó Valley residents articulated with the Inca system would not have been due to Inca imperial strategies alone. Instead, whether as miners in the desert or intermediate local elites in the Copiapó Valley, these local social agents would have reacted to the new political setting in accord with their own possibilities, goals, and resources (Elston and Covey 2006).

8.4 NEW RESEARCH QUESTIONS

This research has revealed that the function of imperial roads depends on each agent's perspective, and their existence and traffic can generate unplanned (from the empire's perspective) consequences in local societies. The Inca Road could be investigated under this logic elsewhere to understand how it acted not only as the vascular system for the empire, but also as a place of encounter and opportunity for roadside communities.

More specifically, the research documented a system of desert mining/crafting that pre-dated the Inca conquest establishing of the Inca Road. We now have a good sense of how the craft goods were manufactured, but little is known about their consumption. Although the research ruled out Inca involvement, we still know little about the nature of the demand for these craft goods. The obvious next step in fully understanding this crafting would be to investigate how these items -- sumptuary goods such as beads and utilitarian ones such as red pigments -- were consumed; in other words, their use in a socioeconomic context.

Gaining this knowledge requires investigating their patterns of consumption in the Copiapó Valley. The red pigment from the Cachiyuyo de Llampos sites was very likely used for pottery decoration. In fact, given the general difficulties of identifying household ceramic production sites, red pigment in Copiapó Valley sites may be a useful proxy for such production. It is not known if pottery production and therefore pigment demand was concentrated in the hands of craft specialists, or if it was widespread and decentralized. Mapping the distribution of red pigment in Copiapó Valley settlement could reveal where potters were working, and the extent to which such ceramic manufacture was a widely distributed, household-level activity, or concentrated at larger workshops. As with beads, the consumption pattern should be empirically determined in future research.

It is already known that the copper beads were used as grave goods by Copiapó population, but there is no systematic information about the distribution of the beads in mortuary, domestic, or regional contexts. The goal of future research would be to determine if the beads were important in local political economy of Copiapó leaders or elites. Beads were not the most prestigious objects but could have constituted *intermediate goods* (c.f. Bernier 2010) for the social differentiation of aspiring individuals. Incas depended heavily on intermediate elites to administrate provinces (Morris and Covey 2006), and these elites may have sponsored craft production for their own sumptuary and economic needs. If that is the case and they contributed to increase the demand for those goods, we would expect to see a major concentration of those items at elite residences or burials in Copiapó Valley.

Were the beads very high value items? If so, we would expect them to occur in relatively high proportions in wealthier or higher status houses, in residential sites with leadership/elite households, and in high value burial treatments. This pattern would suggest that Copiapó elites may have been dominating the circulation of beads, if not directly involved in their production through client mining households or corporate groups. Evidence for additional crafting of ore in higher ranking households would indicate such direct involvement, even elite redistribution of beads. Alternatively, the beads may have been a low value item of adornment, with a circulation not strongly reflecting wealth or status differences. If so, we might expect to see a more even distribution of beads in domestic or mortuary contexts, crosscutting wealth and status differences. This pattern would suggest that the beads were exchanged in a widespread fashion among households, perhaps in the same manner as pottery and other mundane craft goods. Diachronic study exploring changes in bead consumption would reveal shifts in "demand" for beads, and these shifts could be compared to the sequence of change at the Cachiyuyo de Llampos sites.

The data to begin addressing these possibilities could be furnished by excavations comparing assemblages from households of different wealth or status, or by systematic surface collection that compares the distribution of beads against such things as decorated pottery, long distance exchange items, and other wealth/status indicators.

The research described above could also make a larger contribution. Reconstructing how items are produced, circulated and consumed is essential to understanding a society's basic economic and social structures. In comparison to other parts of the world, this subject has been stunted in Andean archaeology because of the presumed lack of market phenomena in prehispanic times. There are calls by prehistorians to revisit this assumption (Stanish 2010). As Hirth (2010:241) has pointed out, "…archaeologists need to remember that market exchange and marketplaces can be found alongside many other non-market forms of exchange that provision both households and institutions with the resources needed for their operation." The current research could thus develop as part of a broader theme of exploring the supplying of households. Hirth's distributional approach is one of several promising ones for detecting and markets and studying their operation (Hirth 1998, 2010). In this approach, artifacts obtained through market exchange should present a patchy distribution across different social segments, mainly reflecting household purchasing power. The distribution of Diaguita Inca/Inca local pottery in the Cachiyuyo de Llampos mining camps, for example, present a similar distribution, with these local manufactured vessels occurring in non-elite household assemblages in differential proportions. The present research could thus be a first step in further exploring domestic economy and household provisioning in the prehispanic Andes.

APPENDIX A

BEADS AND NECKLACES FROM MUSEO REGIONAL DE ATACAMA

The beads and assembled necklaces from various periods in the collections of the Museo Regional de Atacama in Copiapó is the basis for our current understanding of bead consumption. Beads are found at sites dating from the Alfarero Temprano Period through the Late Period, although most of the beads in the collection are from the site of La Puerta in the upper Copiapó Valley during the Middle period (~600-1000 AD). In many cases, the beads from a single burial have been reconstructed in necklaces, but this was done arbitrarily, without knowing the exact order, or whether the beads actually have belonged to multiple necklaces. Most of the museum's necklaces are composed of 100-200 beads.

A.1 BEADS OF THE FORMATIVE PERIOD

The El Molle culture pertains to the Formative or Alfarero Temprano Period. At the El Molle site of Carrizalillo Chico a grave offering associated with a neonate consisted of about 20,000 beads of white sedimentary stone, and some chrysocolla beads (Niemeyer 1998). As assembled in the museum, the "necklace" has a length of roughly 20 meters, with the chrysocolla beads at one end, but there is no actual evidence that all the beads were originally part of a single necklace (Figure A-1). The beads are circular, with double sided perforation. Circular disk beads made of copper ore, such as in Figure A-2 from the site El Torín were also present in the Formative Period. These early copper beads do not differ in shape or size from the ones from of later periods, showing the continuity of the bead shape tradition.

Figure A-1. Necklace formed of about 20,000 white disk beads from the site of Carrizalillo Chico

Figure A-2. Necklace formed of 69 beads from El Torín, Mound 21 (02.26)

A.2 BEADS OF THE MIDDLE PERIOD

The Middle Period site of La Puerta, in the upper course of the Copiapó Valley provided the largest representation of beads in the museum collection. Roughly 100 previously looted funerary mounds were excavated, with investigators exposing some undisturbed burials in their lower levels (Niemeyer 1998). The main grave goods associated with the burials were complete camelids. Pottery and items of personal adornment were rare. In the area called the La Puerta Necropolis, 33 burials were excavated in an area of 100 square meters in between mounds, together with an undetermined number of burials in mounds. The published information on these excavations does not record the total number of burials with bead necklaces, or what other grave goods were associated with bead necklaces.

Beads from this site were mainly made of malachite, chrysocolla, turquoise, and azurite, with other brown stones such as combarbalite, and some examples of marine shell. Most of the beads were circular, but there are also tubular (cylindrical) beads, and some anthropomorphic and zoomorphic ones. The reconstructed necklaces in Figure A-3 are of pieces found in association but their final composition is arbitrary.

Figure A-3. Anthropomorphic and cylindrical necklaces from La Puerta A Necropolis 2 Burial 4 (left), and Mound 64 (right)

Other examples of zoomorphic beads were found in other units at La Puerta, such as the examples of the mammal and bird in Figure A-4. Identical bead have been reported in private collections from Caldera, on the coast of Copiapó (Figure A-5), belonging probably to the same period (Ovalle 1968). Also from Caldera is an anthropomorphic bead, similar to others that can be found in La Puerta (figure A-6).

Figure A-4. Zoomorphic beads from La Puerta A, (08.52 - 08.53)

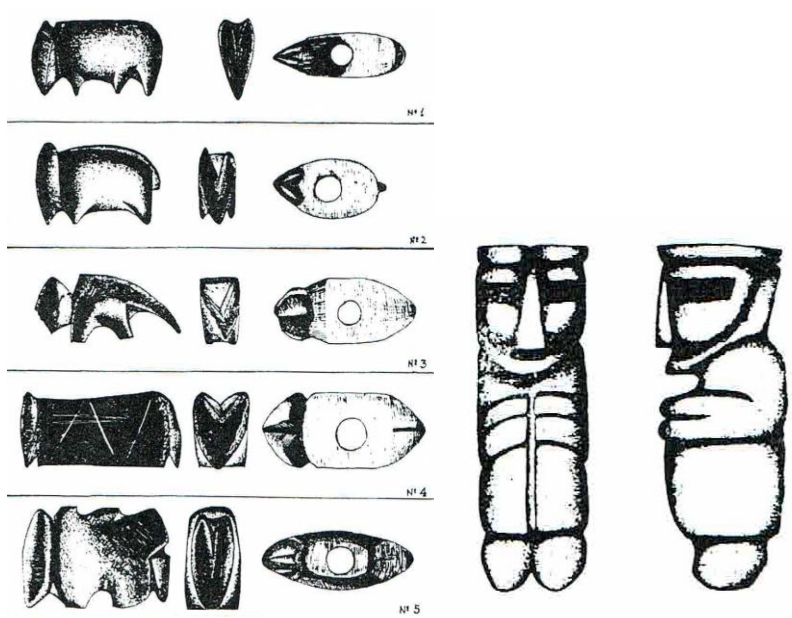

Figure A-5. Zoomorphic and anthropomorphic beads from Caldera, coast of Copiapó (Ovalle 1968:243, 245)

Figure A-6. Anthropomorphic bead from La Puerta A, mound 60 (08.36)

Cylindrical beads are less common than circular disk ones, and apart from the necklace of Figure A-3, in many cases they were found individually (Figure A-7), or as a part of necklaces including disk beads (Figure A-8). At the Cachiyuyo de Llampos sites, only circular disk beads have been recovered to date.

Figure A-7. Cylindrical beads from La Puerta A, Mound 86, Burial 4 (08.51)

Figure A-8. Necklace of 11 beads found in between Mounds 86-87, associated with Individual 10, La Puerta (09.13)

Figure A-9. Necklace of 206 beads from La Puerta A Necropolis 2, Burial 20 (08.88)

Figure A-10. Necklace of 264 beads from La Puerta Burial 24 (08.66)

Figure A-11. Necklace of 61 beads from La Puerta A Necropolis, Burial 19 (08.71)

Figure 8-12. Necklace of 305 beads from La Puerta A, Necropolis 2, Burial 21 (08.67)

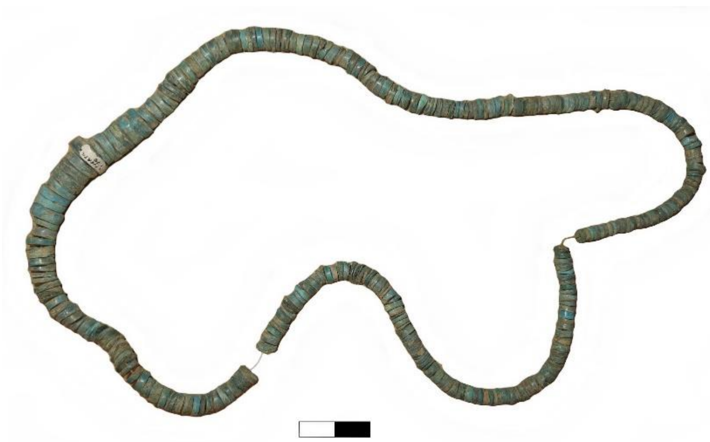

Figure A-13. Necklace of 281 beads from La Puerta A Mound 70 (08.64)

Figure A-14. Necklace of 96 beads from La Puerta A, Necropolis 2, Individual 15 (08.72)

Figure A-15. Necklace of 115 beads from La Puerta A, Necropolis 2, Burial 16 (08.75)

Figure A-16. Beads from La Puerta A, Mound 59, next to a hearth

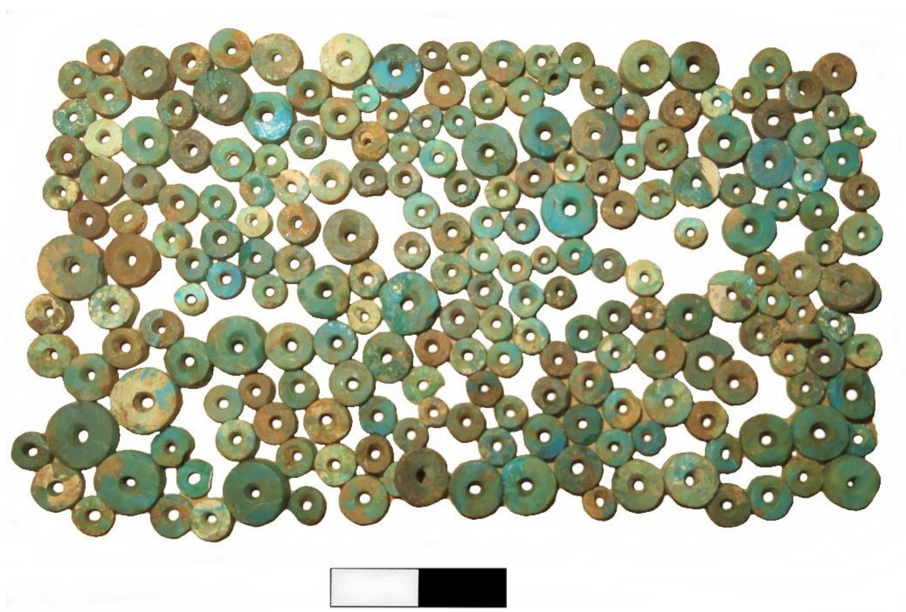

Figure A-17. 219 beads from La Puerta, Mound 86 (08.23)

Figure A-18. Beads from La Puerta A, Burial 23

Figure A-19. Beads from La Puerta A, found in between Mounds 86-87 (08.24)

The disk beads shown in Figures A-8 to A-18 were made from various kinds of copper ores, and there is evidence that there was some degree of manufacture on site at La Puerta, given the presence of bead blanks (Figure A-19) that were discarded before the final shaping. Unfortunately, there is no other information on the extent of bead production at this site. Among other materials at La Puerta were also circular disk marine shell beads, found either in large quantities as part of a possible necklace (Figure A-20), or individually (Figure A-21). Marine shell beads seem to have been assembled alone without being mixed with copper ore beads, at least in the analyzed museum examples.

Figure A-20. Marine shell necklace from La Puerta A, Mound 103, Individual 3 (08.85)

Figure A-21. Marine shell beads from La Puerta Mound 103, Individual 1 (08.87), and Structure 161 (08.86)

A.3 BEADS OF THE LATE PERIOD

The Copiapó museum contains a small number of Late Period beads, most from Iglesia Colorada, a site in the upper Copiapó Valley. It is not clear if the smaller sample of beads for this period is just a bias of the museum collection, or represents an actual decline in popularity during the Late Period. Unlike for earlier periods, metal is the dominant raw bead material. As seen in Figure A-22, beads from Iglesia Colorada are similar to those of La Puerta, with the exception of several larger ones of about 1.5 centimeters diameter. The size of the central hole on these larger examples is the same as for smaller beads. Marine shell beads were also used in the Late Period (Figure A-23), with these two examples from the excavation of the Inca foundry at Viña del Cerro, Copiapó Valley.

The museum also holds other necklaces (Figures A-24, A-25, A-26) obtained in the Copiapó Valley, but these lack provenience.

Figure A-22. 65 beads from Iglesia Colorada (09.200)

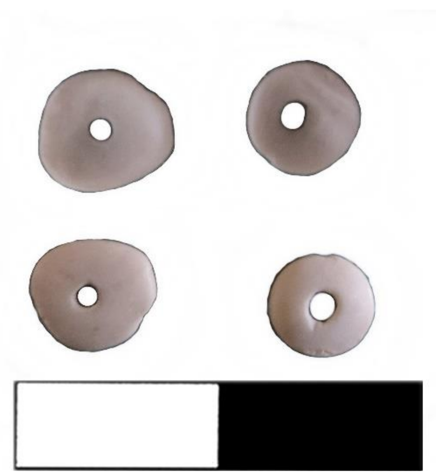

Figure A-23. Marine shell beads from Viña del Cerro, Unit A (interior and exterior view)

Figure A-24. Necklace (100)

Figure A-25. Necklace of 192 beads (77.36)

Figure A-26. Necklace of 204 beads (76.692)

A.4 CONCLUSION

Despite shortcomings in the sample of beads at the museum in Copiapó, it is evidence that bead necklaces were part of the entire temporal sequence of Copiapó prehistory from the Formative Period on. Circular disk beads made of copper ore and marine shell show a remarkable technological and stylistic continuity through time. Judging from the museum collection, it was during the Middle Period when beads reached their peak in diversity in the Copiapó Valley, taking a wide variety of sizes and shapes, including anthropomorphic and zoomorphic forms. The higher abundance of beads during this period in the museum collections cannot be considered indicating an actual higher frequency of use during the Middle Period, because there has been more exploration of Middle Period funerary sites than those of other periods.

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