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PRE-HISPANIC MINING ERGOLOGY OF NORTHERN CHILE: AN ARCHAEOLOGICAL PERSPECTIVE

ERGOLOGÍA MINERA PREHISPÁNICA DEL NORTE DE CHILE: UNA PERSPECTIVA ARQUEOLÓGICA

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Mines, spoils, retention walls and pads are the most cohmon material remains of pre-Hispanic mining activity studied by archaeologists. In this paper we will focus on yet another category, the mining ergology, defined as the material artefacts associated with day to day mining activities. Mining ergology seeks to document the technological equipment of the pre-Hispanic miner, which is seldom found in archaeological contexts due to poor preservation of organic materials. The arid conditions of the Atacama desert offer unique conservation possibilities which have shown a varied mining ergology that includes hafted stone hahmers bound to wooden handles with rawhide and wool, lithic hahmer heads, lithic and wooden shovels, baskets and *capachos* (rawhide sacks). The study of these components complements our knowledge of pre-Hispanic mining technologies and increases our understanding of the organization of mining operations, the diachrony of mining activity, the variability and continuity of the material record, and therefore of mining and its development in the Andes in general.

Key words: Pre-Hispanic mining, Atacama Desert, ergology, copper.

Minas, desmontes, muros de contención y canchas son los principales restos materiales de la actividad minera prehispánica. En este trabajo abordaremos otra categoría, complementaria a las anteriores, que definiremos como ergología minera, es decir, aquellos artefactos relacionados con el trabajo cotidiano minero. Se ha buscado documentar el equipamiento tecnológico propio del minero prehispánico, el cual rara vez se encuentra en el registro arqueológico debido a la conservación diferencial de restos orgánicos. El desierto de Atacama ofrece en este sentido condiciones únicas de preservación, a partir de las cuales ha sido posible reconocer una ergología minera variada, que incluye martillos de piedra enmangados mediante ligaduras de cuero y lana a mangos de madera, cabezales de martillos líticos, palas líticas y de madera, cestería y capachos de cuero. Este estudio complementa nuestro conocimiento sobre las tecnologías mineras prehispánicas del desierto de Atacama, permitiéndonos una mejor comprensión de la organización de las operaciones mineras, de la diacronía de las explotaciones, de la variabilidad y de las persistencias del registro artefactual, y, en consecuencia, de la minería en general y de su desarrollo en los Andes.

Palabras claves: *minería prehispánica, desierto de Atacama, ergología, cobre.*

Minerals and metals were one of the most important goods (Núñez 1987, 1999, 2006) traded during pre-Hispanic times in the South Central Andean Area (Browman 1984; Núñez and Dillehay 1995 [1979]; Núñez 1987). Beginning in the Late Archaic, but mainly from the Formative Period to the Inka Horizon, the production of copper-mineral beads (Rees 1999; Soto 2010), pigments (Sepúlveda and Laval 2010) and metallic objects (Letchman and MacFarlane 2005; Núñez 1987, 2006, 2012; Figueroa, Montero et al. 2010; Figueroa 2012; Maldonado et al. 2010; Salazar, Figueroa et al. 2011) drove a significant demand for the mining of copper ores, while regional caravan trade played a crucial role in circulating these goods (Berenguer 2004; Lecoq 1987).

The earliest mining operations in South America have been recorded on the coast of Antofagasta Region in Northern Chile (Salazar, Jackson et al. 2011). Iron oxides have been extracted from this

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site since the Early Holocene. Although copper mining appears much later in the Andes, these ores were mined much more intensely. The highlands of the Atacama Desert not only contain some of the richest copper deposits in the world, but also house significant archaeological evidence of ancient mining operations. Several mining districts (Figure 1), including El Abra, Chuquicamata and El Salvador, are known to have had mining operations as early as the Formative Period, if not before (Núñez 2006; Figueroa, Salinas et al. 2010; González and Westfall 2008; Salazar 2002; Salazar and Salinas 2008; Salazar, Salinas et al. 2010). Others, such as Collahuasi and probably San Bartolo, contain Late Intermediate mines that were still in use during Inka times (Aldunate et al. 2008; Lynch and Núñez 1994). When the Spaniards arrived in what is today Northern Chile, they found a copper mining tradition nearly 5000 years old, most notably in the Atacama Region (Núñez et al. 2005).

Despite the critical value of copper production over the last 5000 years of prehistory in Northern

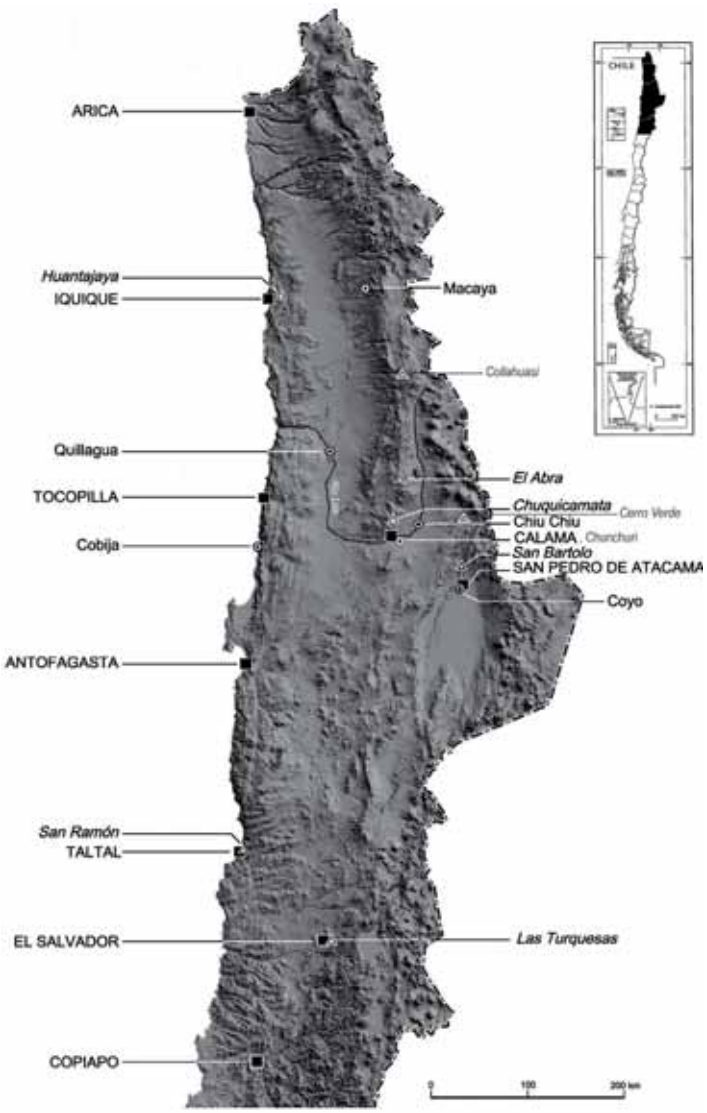

Figure 1. Map of Northern Chile's mining districts and localities mentioned in the text.
Mapa de los distritos mineros y de las localidades del Norte de Chile mencionados en el texto.

Chile and the South Central Andes in general, mining archaeology began fairly recently in these territories, as it did in the rest of South America (Salazar 2003-2004). This is mainly due to the lack of direct evidence of prehistoric mining, which was often destroyed by colonial and modern mining operations. Studies of mining ethnohistory (Bakewell 1989; Berthelot 1978; Bouysse-Cassagne 2005, 2008; Platt et al. 2006; Cruz 2009) and the anthropology of mining (Absi 2003; Godoy 1985; Nash 1979; Salazar-Soler 2002) have been more prosperous for systematic research in the Andes.

However, not all archaeological evidence was destroyed by later mining activity; a few prehistoric copper mines have been recorded and studied in the Andes (e.g. Westfall and González 2010; Iribarren 1972-73; Núñez 1999; Salazar 2002, 2008; Salinas and Salazar 2008; Salazar and Salinas 2008; Salazar, Salinas et al. 2010). These studies, however, have focused mainly on describing the sites themselves and their archaeological contexts, while the technology that enabled their operation has not been lent the same attention (but see Salinas 2007; Salinas et al. 2010).

In this paper we attempt to complement our understanding of prehistoric mining in the Andes through an archaeological examination of the mining ergology in use in Northern Chile before the Spanish arrival. "Mining ergology" refers herein to the corpus of everyday technical instruments and artefacts used by pre-Hispanic miners (Figure 2). Within this corpus we can distinguish between the

Figure 2. Prehispanic mining ergology from the Atacama Desert. 1. Copper Man (Chuquicamata), (AMNH); 2. *Capacho* (Taltal), (Museo Augusto Capdeville de Taltal); 3. Shovel (Calama), (Musée du quai Branly); 4-5. Shovel (Chiu-Chiu), (Museo América); 6. Hafted stone hahmer (Chiu-Chiu), (Museum of World Cultures, Goteborg); 7. Hafted stone hahmer (Chuquicamata), (Musée du quai Branly); 8. Basketry (Chuquicamata) (Musée du quai Branly).
Ergología minera prehispánica del desierto de Atacama.1. Hombre de Cobre (Chuquicamata, AMNH); 2. Capacho (Taltal), (Museo Augusto Capdeville de Taltal); 3. Pala (Calama), (Musée du quai Branly); 4-5. Palas (Chiu-Chiu), (Museo de América); 6. Martillo enmangado (Chiu-Chiu) (Museum of World Cultures, Goteborg); 7. Martillo enmangado (Chuquicamata) (Musée du quai Branly); 8. Cestería (Chuquicamata) (Musée du quai Branly).

Mining set, which corresponds to formal shaped tools adapted to the functional requirements of mining activity, and the *Personal Effects* of agents directly involved in mining. Following Shepperd (1980), the Mining set can be further classified into *Working Tools* and *Transport Materials*. Since these items have rarely been found all together in archaeological contexts, we will analyze evidence from different sources-including museum collections, archaeological and bioanthropological remains from excavations, and ethnohistorical information- in order to propose a model (Figure 3) of the pre-Hispanic mining ergology of Northern Chile to complement the study of prehistoric mining sites themselves, which in turn are part of larger production systems (Salazar and Salinas 2008)[1]. We believe this model may be of interest beyond Northern Chile, as it will help to conceptualize the variability of instruments and practices associated with mining operations in other areas of the world as well.

Indigenous Mining Ergology in Ethnohistorical Documents

Research on prehistoric mining has been especially fruitful over the past 15 years in Northern Chile, owing in large measure to environmental impact assessments (contract archaeology) in mining districts. Today, the identification and contextualization of mining landscapes and their associated artefacts has contributed to the extensive record that exists for Northern Chile, and especially the Atacama Region, which has enabled the reconstruction of a more comprehensive characterization of copper mining in the past (Aldunate et al. 2008; Corrales 2003; Westfall and González 2010; Figueroa, Salinas et al. 2010; Núñez 1999, 2006; Núñez et al. 2003; Salazar 2002, 2003-2004, 2008; Salazar and Salinas 2008; Salazar et al. 2007; Salazar, Salinas et al. 2010; Salinas 2007; Salinas and Salazar 2008; Salinas et al. 2010).

However, although much has been discovered about the archaeology of mining in Northern Chile and the Andes in general, there is still a lot to learn about the artefacts associated with pre-Hispanic mining activities. Thus, from an archaeological perspective, understanding the technological variability or areas of expertise of mining workers still present challenges (Salinas et al. 2010). In this respect, ethnohistorical data provides complementary information that is valuable for understanding pre-Hispanic mining ergology, even despite the fact that colonial sources were more interested in metallurgical processes than in mining itself (Gil Montero 2012).

Early testimonies such as those of Pedro Sancho de la Hoz (1938 [1534]) referring to cervid antlers and rawhide *capachos* are vital for reconstructing the traditional indigenous mining artefact assemblage as these artefacts have rarely been found in archaeological contexts: *'Mining is done with deer antlers and the ore and other material is taken from the mines in sacks sewn from leather or sheepskin'* (Sancho de la Hoz 1938 [1534], in Petersen 2010: 41).

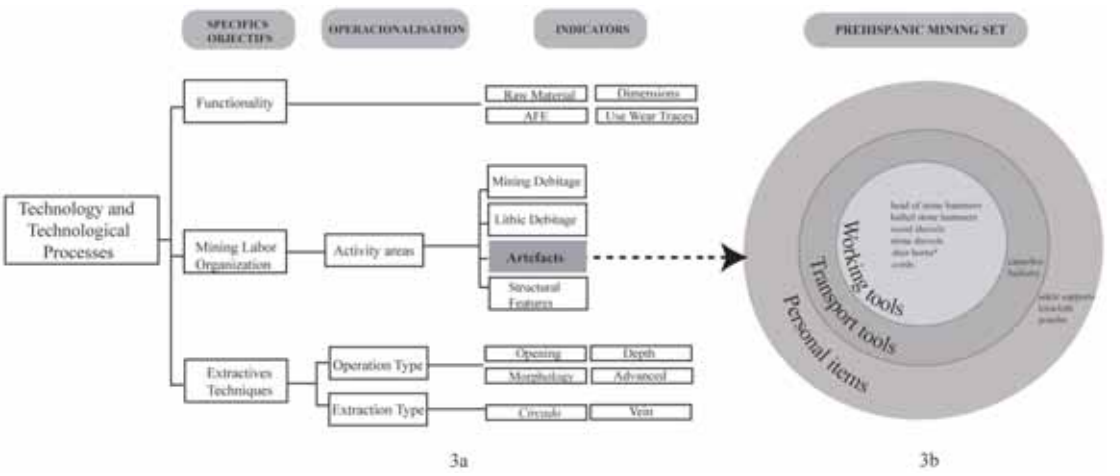

Figure 3. (3a) Mining production model following Salazar and Salinas (2008); (3b) Mining set according to archaeological evidence.
(3a) Modelo de la producción minera según Salazar y Salinas (2008); (3b) Conjunto minero acorde con las evidencias arqueológicas.

Additionally, in 1590 Father José de Acosta described other important aspects of early colonial indigenous mining ergology (cited by Gil Montero 2012):

> Trabajan con velas siempre los que labran, repartiendo el trabajo de suerte que unos labran de día y descansan de noche y otros al revés les suceden. El metal es duro comúnmente y sácanlo a golpe de barreta quebrantándole que es quebrar un pedernal. Después lo suben a cuestas por unas escaleras hechizas de tres ramales de cuero de vaca retorcido como gruesas maromas, y de un ramal a otro puestos palos como escalones, de manera que pueden subir un hombre y bajar otro juntamente. Tienen estas escalas de largo diez estados, y al fin de ellas está otra escala del mismo largo, que comienza de un releje o apoyo, donde hay hechos de madera unos descansos a manera de andamios, porque son muchas las escalas que se suben. Saca un hombre carga de dos arrobas atada la manta a los pechos y el metal que va en ella, a las espaldas; suben de tres en tres. El delantero lleva una vela atada al dedo pulgar, para que vean[2].

However, given the fact that major transformations in indigenous economies and technologies occurred from the beginning of the Spanish colonial administration (Varón 1978; Bakewell 1989; Gil Montero 2012), caution should be taken with these sources when reconstructing the pre-Hispanic mining ergology of Northern Chile. Furthermore, the bulk of 16th and 17th century mining descriptions refer to Potosí, Porco, Chuquiabo, Carabaya or Huancavélica, which cannot be compared to pre-Hispanic mining sites in Northern Chile, either in terms of the organization and scale of production or the ores extracted.

Nevertheless, we agree with Mendoza (1983:35), who stated in reference to García de Llanos ([1609] 1983) mining dictionary that, although '*it has been largely conceived and intended for the silver ores of Potosí, it can be applied to other metals and other geographical areas through analogy*'. This dictionary is especially relevant because of its early date, as the introduction of gunpowder in Andean mining operations in the 17th Century dramatically changed the indigenous technologies thereafter (Gil Montero 2012). The dictionary therefore contains valuable information about pre-Hispanic mining technologies that were implicit in indigenous concepts alluding to the different phases and categories of the mining process (Mendoza 1983:35). Indeed, one notable aspect of the above mentioned dictionary is the quantity of indigenous terms that it contains: 160 of the 258 terms defined are native, and deal with all the phases of the mining process. Figure 4 offers a comprehensive list of mining sets in the Potosí context according to the dictionary compiled by García de Llanos (1983 [1609]) as an example, regarding working artefacts the dictionary states:

> *Comba* comes from the word *cumpa*, which in Quechua means big hahmer, and the Indians gave this name to very round, ball-like stones of every size that they use for their tasks. Thus in the old working areas of Oruro and other mines, many have been found from that period (…), and here people are said to *combear* with this instrument, which is the same as hitting (García de Llanos 1983 [1609]:54)[3]. [Translate by the authors].

Complementary information can be found in the Quechua dictionary of the Spanish priest González Holguín, who mentions the use of the word *jutcuna* to refer to a sort of drill (barreno), the *circana* to a

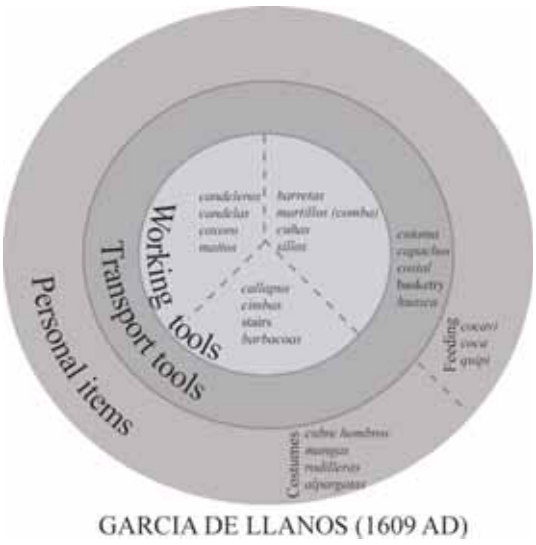

Figure 4. Mining set from the Early Colony according to García de Llanos (1983 [1609]).
Conjunto minero de la Colonia Temprana según García de Llanos (1983 [1609]).

chisel and the *cotama* to the bag used for transporting the ore out of the mine (Money 2004).

In addition to the instruments themselves, García de Llanos (1983 [1609]) describes different workers-*cateadores, ayciris, pirquiris, apiris, pailliris, carnereros, candelacamayoc*-with very specific tasks within the mine, shedding a light on the level of specialisation of mining work (Table 1). In this regard, it is interesting to compare the theoretical stages of the mining productive process-from extraction to selection, through the different phases of crushing and milling (Salazar 2003-2004, Salinas and Salazar 2008), with the different mining activities and specialists described by García de Llanos (Figure 5).

All of these dictionaries, as well as Father Bertonio's on the Aymara language (see Money 2004) provide information on the different minerals and mineral deposits developed by pre-Hispanic miners and the techniques they used for extracting ores. Nevertheless, this information is of secondary importance to this article.

Table 1. Mining occupations described by García de Llanos (1983 [1609]).
Oficios mineros descritos por García de Llanos (1983 [1609]).

Finding information Context	Locality	Reference	Mummy	Rawhide bag	Shovel	Head stone hammer	Hafted stone hammer	handle/ rawhide cords	Handle	Sticks	Basketry
Huantajaya mine	Huantajaya	Brown and Craig 1994	2	1			1				
Copper Man	Chuquicamata	Morgan 1899	1	1	1		1				2
Chile Exploration Company 1	Chuquicamata	Sullivan 1921/ Mead 1921	1	1	2		4		2		
Chile Exploration Company	Chuquicamata	Camus 2003	1		1		3				
AMNH 1912 (US National Museum)	Chuquicamata	Bird 1979		1	4		4			5	4
AMNH 1914 (US National + Guggenheim)	Chuquicamata	Bird 1979			4	17	17			9	2
Anaconda Company	Chuquicamata	Craddock et al. 2003					1				
Sénéchal de la Grange (1902)	Chuquicamata	Chervin 1902	1	1		4		1			1
Mission Scientifique Française (G. Courty 1903)	Chuquicamata	Boman 1908					2				
Ricardo Latcham	Chuquicamata	Latcham 1938					1				
Thompson Collection	Chuquicamata	Salinas 2007		1			3				
Peabody Musem	Chuquicamata	Archive Peabody Museum				1		1			
Alfred Métraux (Goteborg)	Chiu-Chiu	Archives Goterborg Museum					1				
Aureliano Oyarzún	Chiu-Chiu	Archives Museo Histórico Nacional (Santiago)					2		1		
Museo Geológico de Chiu-Chiu	Chiu-Chiu	Archives Museo Chiu-Chiu					1				
El Abra District	El Abra	Salinas 2007			2	503					
Rodulfo Philippi	San Bartolo	Philippi 1860			1		1				
Ricardo Latcham	San Bartolo	Latcham 1938					1				
Ricardo Latcham	Quillagua	Latcham 1938					1				
Llagostera and Costa	Coyo 3	Llagostera and Costa 1994				8					
Gustavo Le Paige	Coyo Oriental	Le Paige 1972-1973, Le Paige notes				40	1				
Museo Augusto Capdeville (Taltal)	Taltal	Archive Museum Taltal		2							
El Salvador (Atacama)	Las Turquesas	Kuzmanic and Sanhueza 1984	1								

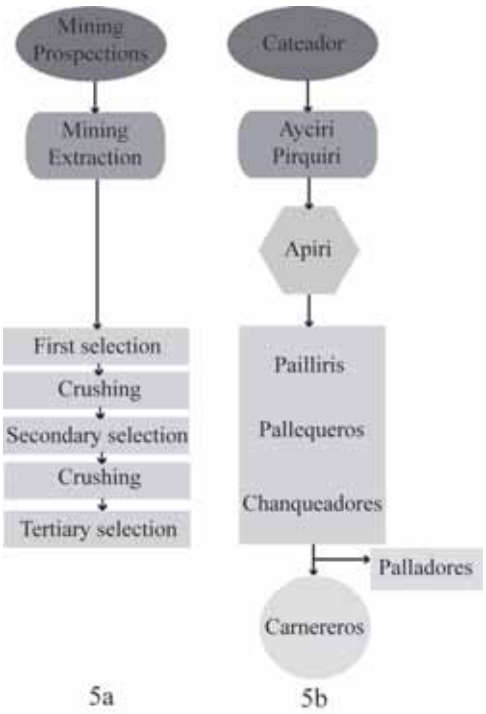

Figure 5. (5a) Schematic model of the mining *chaîne opératoire* as defined by Salazar (2003-2004) and Salinas and Salazar (2008) compared to García de Llanos (1983 [1609]) description of miners (5b). *(5a) Modelo esquemático de la cadena operativa minera definida por Salazar (2003-2004) y Salinas y Salazar (2008) comparado con la descripción de los oficios mineros realizada por García de Llanos (1983 [1609]) (5b).*

Mining Ergology of Northern Chile

Northern Chile is one of the richest areas of the Andes for pre-Hispanic mining ergology. Artefacts made of perishable materials and even the human remains of miners have been preserved here by the hyperarid conditions in the Atacama Desert. Even so, only a small portion of this evidence has been studied and/or reported in publications. We have identified evidence of pre-Hispanic mining ergology from Northern Chile housed in museums both in Chile and abroad, and have complemented this information with the results of our own research on prehistoric copper mines in the Atacama Region. The results presented herein therefore represent the most thorough review of pre-Hispanic mining ergology ever published.

The most significant evidence gathered to date comes from the main mining districts of Northern Chile such as Chuquicamata, San José del Abra, Salar de Atacama, San Bartolo, El Salvador and Huantajaya (a silver mine). We will review that evidence below.

The general inventory of mining objects from Northern Chile that is considered in this paper includes approximately 650 archaeological objects related to mining production and seven human bodies (Table 2). Most of the archaeological objects described have been analyzed in museum collections

Table 2. Archaeological objects and seven individuals related to mining production from Northern Chile.
Objetos arqueológicos y siete individuos relacionados con la producción minera del Norte de Chile.

Occupation	Task	Tool	Qualities
Cateador	Seeking and discovering mineral veins	Hammer	"Buscón" (seeker), surveyor
Barretero, Ayciri, llamador	Cutting the mineral	Pole Wedge Hammer	Strong and skilled
Pirquiris	Putting supports within the mines	HammerC	Dextrous, highly estimated, and rightly so
Apiri / sacador	Taking out and loading the mineral extracted from the mine	*Capacho* Sack	Indians less able to work or beginners
Pailliri	Cleaning the mineral in the *canchas,* separating poor quality material and disposing of it	Sledgehammer	Youth and elders
Pallaqueros	Fine separation of high-grade ores from the rock	Sledgehammer Crusher	Skilled, young
Chanqueadores	"Chanquean" el material "pallaqueado" (Crushing the finely separated material)	Sledgehammer	Skilled, young
Palladores	Re-detaching	Sledgehammer	Uruquillas
Candelacamayos	Making candles for the labours in the depths of the pit	Candles Wax	
Carnerero, arriero	Transporting the mineral from the mine to the working areas	Sack Animals of burden	

and/or field campaigns, while some of the organic artefacts (i.e. wooden) have been dated and studied for taxonomic identification. This complementary analysis was performed mainly on shovels and hahmers that were selected according to criteria such as context, reliable chronological associations, type of object and state of conservation.

The sections below present a review of the main finds by mining district:

Chuquicamata

Between the first foreign mining works and the large-scale operations of US firms like the Chile Exploration Company and the Anaconda Company, at least three muhmies of miners and several associated tools such as hahmers and hafted shovels were found in this world-renowned district: the so-called *Copper Man* (muhmy nº 1, AMNH) and two other bodies (muhmies nº 2 and nº 3) were discovered by the Chile Exploration Company in Chuquicamata (Figure 6). In 1903, the *Mission Scientifique Française en Amérique du Sud*, led by Georges de Créqui-Montfort and Eugène Sénéchal de la Grange, explored the mining districts of the Atacama Desert, finding several artefacts related to mining and metallurgical production, particularly in the area of Chuquicamata (Boman 1908; Chervin 1902; Léjeal 1904), as well as a fourth body (muhmy nº 4), bringing the total number of muhmies of miners from Chuquicamata to four. All four were found in mineshafts that were in use in pre-Hispanic times, and three of them have been positively associated with their mining ergology.

US Companies

The Copper Man muhmy and his mining ergology were discovered in 1899 in the Restauradora mine of Chuquicamata and have been exhaustively described and cohmented on in numerous publications (Bird 1977-1978, 1979; Craddock et al. 2003; Figueroa, Salinas et al. 2010; Mead 1921; Medina 1901, 1919); Núñez 1999, 2012; Petersen 2010; Philippi 1901; Stoellner 2011; Sullivan 1921; Weisgerber 2006).

According to the picture taken in 1899, the artefacts found alongside *Copper Man* included a hahmer, a shovel, basketry and a *capacho*. The miner also was found with personal items such as braids, ankle supports and a loincloth. According to

Figure 6. Four photographs of two pre-Hispanic muhmies from Chuquicamata (6.1. Sutulov 1975; 6.2. Camus 2003; 6.3. Camus 2003; 6.4. Weisberger 2006).
Cuatro fotografías de dos momias prehispánicas de Chuquicamata *(6.1. Sutulov 1975; 6.2. Camus 2003; 6.3. Camus 2003; 6.4. Weisberger 2006).*

Bird (1979:112) the American Museum of Natural History (AMNH) only acquired some of the objects found with the miner and other hafted stone hahmers from Chuquicamata in 1912. In 1914, new objects were entered into the Museum's records, these ones donated by the Guggenheim brothers[4].

Because the archaeological context and cultural affiliation of the numerous (ca. 50) and diverse array of objects found in the district of Chuquicamata remain unclear, the importance of the radiocarbon dates published by Bird (1979) cannot be underestimated, as they revealed for the first time the antiquity of mining operations in the Atacama region (Table 3). In regard to dating, while human tissue fragments and alpaca wool have been dated to the 6th century AD, the hahmerstone handle found was dated 500 years later (Bird 1979:132; Craddock et al. 2003:62; Salazar, Figueroa et al. 2011:143). These divergent dates may be explained by the fact that the artefacts associated with the find were obtained separately by the U.S. National Museum (Washington D.C.) and only entered the American Museum of Natural History (AMNH) collection in 1912 as part of a set of hafted hahmers from Chuquicamata, in which hahmerstones and handles may have been mismatched (Bird 1979:112).

Mead (1921) refers to a second miner muhmy acquired by the AMNH in 1921 as a donation from the Guggenheim brothers. The body of the miner was exhumed from the Restauradora mine in Chuquicamata in 1914 while '*a cross-cut was being cleared out in their mine*' (Mead 1921:453). According to Mead (1921:353) *"A poncho, several stone hahmers, and wooden shovels, or scrapers, were found with it; but the workmen who dug it out were not interested in these things and they were not preserved"*[5]. However, Sullivan's report (1921) describes two hafted shovels, one with a lithic blade –that appears to be the Copper Man's shovel– and the other with a wooden blade, which may have belonged to this second muhmy.

Four photographs of the body were taken (Figure 6). The first is captioned *"Muhmy dug up at the mine"* (Figure 6.1) and shows an individual in flexed position covered by a textile (Sutulov 1975:4). The right hand is resting above the head while the left is bent in a 'v' shape. The left clavicle is visible, and the feet are flexed so that the soles are almost vertical. It is not possible to describe the hair in detail. A one-piece wooden shovel with a long handle can be observed in the background.

The second photo (Figure 6.2) is entitled "*Muhmy found in one of the mine dumps"* (Camus 2003) and shows the same individual in the former picture from another angle. The body and artefacts appear to have been organised and cleaned expressly for this new shot, which suggests it was taken after the first. On the left side of the body are the same wooden shovel observed in Figure 6.1 and three different hahmers not shown in the previous photo.

There is a third picture that bears the inscription '*Chile exploration Co. Mine Department. Accession*

Table 3. Radiocarbon dates of artefacts from archaeological mining contexts of the Atacama Desert.
Fechas radiocarbónicas de artefactos provenientes de contextos arqueológicos mineros del desierto de Atacama.

Locality	Sample Material	Reference	Lab Code	^{14}C date	Calibrated date (B.P.)	Range (B.P)	Calibrated date (AD)	Range (AD)
Chuquicamata	Human tissue	Bird 1979	LJ3947	1400 ± 40 BP	**1274 BP**	(1178-1329)	676	(621-772)
Chuquicamata	Llama or alpaca wool cloth (treated with acetone)	Bird 1979	LJ3948	1650 ± 130 BP	**1503 BP**	(1288-1813)	447	(137-662)
Chuquicamata	Llama or alpaca wool cloth (untreated)	Bird 1979	LJ3949	1350 ± 80 BP	**1208 BP**	(1009-1347)	742	(603-941)
Chuquicamata	Wood shavings from the hammer handle	Bird 1979	LJ3950	840 ± 150 BP	**742 BP**	(516-1042)	1208	(908-1434)
Chuquicamata	Wood shavings from the hammer handle	Craddock et al. 2003	AA18886	1804 ± 48 BP	**1659 BP**	(1546-1812)	291	(138-404)
Chuquicamata	Wood shavings from the hammer handle	this paper	POZ 37208	1505 ± 30 BP	**1340 BP**	(1297-1394)	610	(556-653)
Chuquicamata	Wood shavings from the hammer handle	this paper	POZ 37209	890 ± 30 BP	**753 BP**	(683-895)	1197	(1055-1267)
Chuquicamata	Wood shavings from the hammer handle	this paper	POZ-37207	895 ± 30 BP	**757 BP**	(685-897)	1193	(1053-1265)
El Abra (AB-83)	Wood shavings from the shovel blade	Salazar, Salinas et al. 2010	Beta 217771	910 ± 50 BP	**777 BP**	(682-907)	1173	(1043-1268)
El Abra (AB-22/39)	Wood shavings from the shovel blade	Salazar et al. this volume	Beta 287255	830 ± 40 BP	**708 BP**	(664-767)	1242	(1183-1286)

Nº 20. Indian muhmies taken from underground workings. July 16, 1920' (Camus 2003) (Figure 6.3). Two individuals were photographed. On the left is a body in poor state of preservation and to the right is a flexed body. The individual on the left is the same one seen in Figures 6.1 and 6.2 (muhmy 2). The position of the arms, legs and clavicle are the same in all three pictures, the only difference being that in Figure 6.3 the individual appears with no clothing, as he also does in Figure 6.4 (Weisberger 2006). There are no records of the individual on the right (Figure 6.3, the third miner muhmy) at the AMNH.

As mentioned above, the second muhmy from Chuquicamata was found in 1914 and acquired by the AMNH around 1921. Picture 6.3 bears the date July 1920, and in that photo the muhmy appears without artefacts. It is likely that the muhmies' artefacts were taken to the US in 1914, the same year of the finding and 7 years before the muhmy itself. Indeed, there was significant traffic of mining instruments at the time, making the reconstruction of contexts vital. In 1986, for example, W.B. Wray bought a miner's hahmer at the offices of the Anaconda Copper Mining Co. (1915-1971) in New York. The hahmer had a handwritten tag attached that read '*Stone hahmer from old workings at extreme South end Bench D-2'*, and another one glued to the hahmer with the same information (Craddock et al. 2003:57) (Figure 7.1). Craddock et al. (2003) performed an exhaustive study of this artefact. His studies on the handle demonstrated that it was made of *Prosopis chilensis* (algarrobo) wood, and the ligatures were lama or alpaca rawhide. Its radiocarbon date of 138-404 cal AD (1804 ± 48 BP) (Craddock et al. 2003:62) makes this the oldest mining instrument found in Chile to date (Table 3). The authors attempted to situate the hahmer from 'Bench D-2' both temporally and geographically in one of the mining sites, cohmenting that '*We believe that the hahmer which is the subject of this report may have been found in 1915 when actual mining cohmenced, or perhaps within a few years after 1915*' (Craddock et al. 2003:58-59). Another hahmer (nº 44-4-30/4256) associated with a handle (nº 44-4-30/4256.1) is housed in the Peabody Museum, with the only reference indicating that the object came from Chuquicamata (Figure 7.2).

Mission Scientifique Française en Amérique du Sud

In 1903 the *Mission Scientifique Française* led by Georges de Créqui-Monfort and Sénéchal de la Grange explored Northern Chile, Argentina, Peru and Bolivia. Two members of the Mission, Eugène Sénéchal de la Grange and Georges Courty, surveyed the Chuquicamata district. The year before, Sénéchal de la Grange had travelled to Chuquicamata and found the muhmy of a miner covered by a textile,

Figure 7. Hafted stone hahmers from Chuquicamata: (7.1) Anaconda Company (Craddock et al. 2003); (7.2). Peabody Museum; (7.3-5). Thompson Collection (Salinas 2007).
Martillos líticos enmangados procedentes de Chuquicamata: (7.1) Anaconda Company (Craddock et al. 2003); (7.2). Peabody Museum; (7.3-5). Thompson Collection (Salinas 2007).

with assembled braids and different artefacts unique to the tool-set of a miner. According to Chervin's (1902: 704) description, the body presents evidence of suffering a violent death: "The woman worked in the mines of Chuquicamata; her head was smashed by a mine collapse of date unknown"[6]. The body is associated with numerous objects of the mining ergology (hafted stone hahmers, lithic hahmer heads, basketry, a rawhide *capacho*). The current location of this muhmy is unknown[7] and of its mining set only the whereabouts of a wooden handle and its ligatures, three lithic hahmerheads and one basket are known: they are currently housed in the Musée du quai Branly in Paris[8] (Figure 8.1-4).

Léjeal (1904) and Boman (1908) later referred to this same find, confirming the existence of the muhmified miner. In an essay on the '*Exposition de la Mission Française de l'Amérique du Sud au Palais du Trocadéro*', Léjeal (1904:326) refers to the muhmy and the work implements, stating:

> the muhmy, now in its final sleep amongst the collections of Mr. de Créqui is that of a miner surrounded by its specialised instruments. The work in the mines was a usual occupation of all those antique peoples and the beautiful set of axes collected in Salinas Grandes in Argentina confirms an exploitation from the oldest of times [translated by the authors].

Boman (1908:757) also describes the objects that accompanied the female miner muhmy, pointing out that:

> Mr. Sénéchal de la Grange brought from Chuquicamata the muhmified cadaver of a woman in 1902, described by Dr. A. Chervin (98, p. 705). Close to her was a lithic hafted-hahmer (…) a rawhide bag containing two stones and finally the same

Figure 8. Hafted stone hahmers and basket from Chuquicamata. 8.1-4. Mining set associated with the body of a miner found by Sénéchal de la Grange in 1902 (Musée du quai Branly); 8.5-6. Two hafted stone hahmers found by Courty in 1903 (Musée du quai Branly).

Martillos líticos enmangados y cestería procedente de Chuquicamata. 8.1-4. Conjunto minero asociado con el cuerpo de un minero encontrado por Sénéchal de la Grange en 1902 (Musée du quai Branly); 8.5-6. Dos martillos líticos enmangados encontrados por Courty en 1903 (Musée du quai Branly).

> type of basketry we have described for Calama. This woman may have worked in the Chuquicamata mines where her head might have been smashed by a collapse [translated by the authors].

Two other hafted-hahmers were collected during the 1903 MSF expedition by Georges Courty (Figure 8.5-6). Courty found a heavy stone hahmer with its handle and a lithic shovel fragment inside a *llampera*[9] (Boman 1908; Courty 1907)[10]. A second hahmer appears without a handle, but wood fragments can be observed within the rawhide netting. We recorded these objects and obtained microsamples for radiocarbon dating (AMS), and the results for both pieces associated with the miner muhmy are coherent with prior evidence of copper mining in the Chuquicamata District. The hahmer associated with the miner (Figure 8.1) was dated to 556-653 cal AD (1505 ± 30 BP), contemporary with *Copper Man*. The other two correspond to the Late Intermediate Period, with dates between 1055-1267 cal AD (890 ± 30 BP) and 1053-1265 cal AD (895 ± 30 BP) (Figure 8.5-6, Table 3)[11].

Other findings from Chuquicamata

Other mining artefacts have also been mentioned for the Chuquicamata District. Latcham (1938) mentions the presence of a lithic hafted-hahmer, while Salinas (2007) documented three hahmers from the Thompson Collection, likely also from Chuquicamata (Figure 7.3-5). The evidence from site CHU-2 also needs to be added. Located 1,500 m from the current Chuquicamata site, CHU-2 has been interpreted as a mining camp dated *ca.* 780-1,020 cal AD, and was a place from which miners such as *Copper Man* may have accessed their work areas (Núñez et al. 2003). Although no complete pieces were reported, the finds included possible lithic shovel blades, a few threads and fleece interpreted as the remains of sacks and/or work clothes, *Prosopis* wood fragments that could have been haftings of work instruments, and small unhafted lithic hahmerstones (Núñez et al. 2003).

San José del Abra

The San José del Abra mining district, located around 50 km northeast of Chuquicamata, was being worked by local indigenous cohmunities from the Late Formative Period onwards, and perhaps even earlier. The first studies of this area were conducted by Núñez and focused specifically on the main Inka mines and a sample of more than 300 lithic hahmerstones (Núñez 1999). Beginning in 1999, investigations led by Salazar and colleagues have continued research on the Inka mines and on other prehistoric copper and turquoise mines ranging from the Late Formative (ca. 200 AD) to the Inka periods (1,400-1,550 AD) (Salazar 2002, 2008; Salazar and Salinas 2008; Salinas and Salazar 2008). Regarding mining artefacts, two categories have been found *in situ*: lithic hahmerstones and wooden shovels. No other artefacts related to mining work have been found, with the exception of cactus needles, which could have been used in the weaving or sewing of *capachos* (Salazar 2008:64).

The most recurrent of the two elements of the mining set found at El Abra are lithic hahmerstones; although none of the handles remained due to the poor conditions, many of them display notches for hafting. Using different analytical techniques (petrography, use-wear analyses and morphometrics) more than 500 hahmerstones from 3 different mines located in San José del Abra have been studied (Salinas 2007; Salinas et al. 2010). A functional approach to the study of these artefacts was developed (Salinas et al. 2010) as a step up from preliminary typologies based on the morphology of the hahmerstones (Craddock 1990; Espérou 1992; Núñez 1999; Pickin 1990; Thorburn 1990; Timberlake 1990). This approach considered three main variables: the morphology of the "functional active edge", the lithic raw material and the dimensions of the hahmers (i.e., size, volume and weight). Use-wear traces were considered complementary data as an experimental approach has not yet been developed. The results of these analyses showed an interesting variability in the hahmerstone ensemble, including the occurrence of both hafted and unhafted hahmerstones. Two main groups of raw materials were identified in both types of hahmers, namely andesites and granodiorites. Variability was also detected in the shape of the active edge of the instruments and their overall dimensions. Furthermore, hahmerstone variability was seen to change over time as mining activities became more specialized and intensive (Salinas 2007; Salinas et al. 2010; Salazar and Salinas 2008). These are interesting results inasmuch as they demonstrate that the typological category of "mining hahmerstone" needs to be further divided into subcategories of specimens. Indeed, a more precise typology of lithic mining instruments

could help us to understand the organization of production in prehistoric times and how it changed over time, both topics which cannot be addressed from etnohistorical data or from a morphological classification of the hahmerstones.

The second type of pre-Hispanic mining artefact from San José del Abra are the shovels. According to Latcham (1938), there are two types of shovels in the Atacama region: wooden and slabs. Among the wooden shovels three kinds of blades can be identified: elongated, pseudo-oval and quadrangular. It is interesting to note that, unlike what is usually assumed, Salazar (2008) has reported that lithic shovels so typical of this region are virtually absent from all mining contexts in San José del Abra. However, two wooden shovels were found in excavations within this district. The first has an elongated blade and short haft made from *Prosopis chilensis* (algarrobo) wood and has been dated between 1043-1268 cal AD (910 ± 50 BP) (Figure 9.1). The second has a quadrangular blade, though it is fractured. Histological analysis shows that it also is made of *P. chilensis* (algarrobo) and its radiocarbon date (1183-1286 cal AD (830 ± 40 BP)) is very similar to the former one (Figure 9.2). The typology of both mining shovels is identical to that of pre-Hispanic agricultural shovels found in the oases of Chiu-Chiu and Calama, thus supporting a link between these instruments, as other authors have previously suggested (Bird 1979; Latcham 1938; Núñez 1999).

Other mining districts in Northern Chile

Chiu-Chiu

Four hafted hahmers and a haft without its hahmerstone have been found in the oasis of Chiu-Chiu. The museum at Chiu-Chiu houses a distinct double-hafted piece (Figure 10.1). This is another interesting specimen as it displays the variability of mining hahmers (single and double hafted), a distinction that has yet to be interpreted functionally and/or technologically. A second specimen is housed in the Museum of World Cultures in Goteborg and was probably donated by Alfred Métraux in 1941 while he was director of the Instituto de Etnología of the Universidad Nacional de Tucumán, in Argentina (Figure 10.2). Lastly, two hahmers and one handle with the tag Chiu-Chiu are located at the Museo Histórico Nacional in Santiago, Chile and may have been part of the Aureliano Oyarzún Collection.

Huantajaya

It is said that in Tarapacá there was a vein of precious white silver that belonged to the Sun, which the indigenous miners did not want the Spaniards to discover because '*their conjurers told them they would all die and their sown fields would dry if they discovered it'* (Pizarro [1571] 1963 [XXXX]: 222 in Bouysse-Cassagne 2005). Huantajaya was an Inka mine renowned for its native silver veins that

Figure 9. Wooden shovels from San José del Abra. (11.1) AB-83; (11.2) AB-39.
Palas de madera de San José del Abra. (11.1) AB-83; (11.2) AB-39.

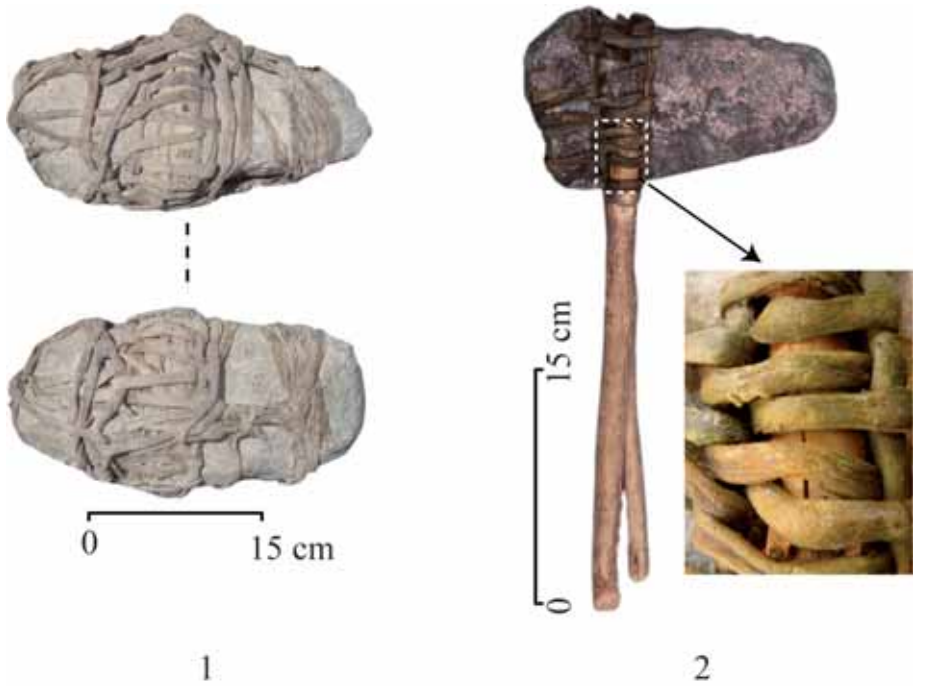

Figure 10. Hafted stone hahmers from Chiu-Chiu: (11.1) Museo Chiu-Chiu; (11.2) Collected by Alfred Métraux (Museum of World Cultures, Goteborg).
Martillos líticos enmangados de Chiu-Chiu: (11.1) Museo Geológico de Chiu-Chiu; (11.2) Recolectado por Alfred Métraux (Museum of World Cultures, Goteborg).

was worked in the Early Colonial period (Berthelot 1978; Bouysse-Cassagne 2005; Gavira 2005; Platt et al. 2006). Although the treasured silver mine of Huantajaya was well known –it was even associated with the *capacocha* child- sacrifice ceremony at Cerro Esmeralda (Checura 1977)– there is little direct evidence of pre-Hispanic or Early Colonial mining operations in the area. The Huantajaya mine was reactivated in the late 18th century, which in turn triggered the opening of several mining contexts in the Pampa del Tamarugal, where the main resources to process the ores, namely water and firewood, were to be found. However, mining activity had declined by the early years of the 19th century (Hidalgo and Castillo 2004, Gavira 2005), and today the only visible evidence at the site are the 18th- and 19th-century mineshafts and trenches. Nonetheless, Brown and Craig (1994) describe the bodies of two pre-Hispanic miners that were found in an ancient mineshaft along with a hahmer and a rawhide *capacho*. The hahmer and its broken haft are currently housed at the Museo Chileno de Arte Precolombino; the bodies, however, were not preserved.

Atacama Salt Flat

Le Paige mentions 40 mining hahmers found in 33 tombs associated with materials from the Middle Period at the Coyo Oriente site (Le Paige 1972-73; Llagostera 2004; Salazar, Figueroa et al. 2011; Núñez 1999). In fact, in his field notes about the cemetery Le Paige draws one of the hafted hahmers (Figure 11), adding:

> The cemetery of Coyo Oriental brings us new things: 1/ tomb with stone "mallet-hahmer", sometimes copper *caliche*, but painted green, with a central circular canal where the bended haft ensembles (See plate). The only cemetery in the area with this work equipment. Maybe because there is a copper vein in the foothills? [translated by the authors].

On the other hand, eight mining hahmers have been reported from site Coyo-3 (Costa and Llagostera 1994). There have been no systematic studies of these objects up to now.

Figure 11. Hafted stone hahmer from Coyo Oriente (unpublished notes from R.P. G. Le Paige, Museo Arqueológico R.P.G. Le Paige). *Martillo lítico enmangado de Coyo Oriente (notas inéditas de R.P. G. Le Paige, Museo Arqueológico R.P.G. Le Paige).*

San Bartolo

As mentioned above, Philippi (1860) refers to the discovery of a hahmer and a wooden shovel in the San Bartolo district (Aldunate et al. 2008; Núñez et al. 2003), and Latcham (1938: 118, 124) later mentions that the Museo Histórico Nacional housed a hahmer from San Bartolo, which was probably the same item described by Philippi.

El Salvador

Initially explored by Iribarren (1972-73), Las Turquesas mine and the nearby cemetery of the same name have been recently reassessed. Las Turquesas is a turquoise mine with interior galleries associated with a mineral crushing and processing area, with occupations presumably from the Formative (500 BC) to the Inka Period (1400 AD) (González and Westfall 2008). The mine contains three pits, a gallery, and structures such as a stairway carved out of the rock, a wood-and-stone slab bridge and an adit for light and ventilation. According to former Codelco miners, vessels, *capachos*, ropes, cords and rawhide sandals could be seen inside the mine, items that have since disappeared (Westfall and González 2010) even though Iribarren (1972-73) was able to record some of them. Recently, González and Westfall (2008) analysed and reinterpreted a funeral bundle from Las Turquesas cemetery (Late Intermediate Period) that was first described by Kuzmanic and Sanhueza (1984), also from the El Salvador mining district. The evidence of multiple trauma revealed by radiographic analyses and the presence of turquoise in small pouches, necklaces and other objects associated with the body point to the '*Atacameño caravanning and mining orientation of the individual'* (González and Westfall 2008:56).

A Model For Pre-Hispanic Mining Ergology

The exceptional conditions for preservation in many parts of the Atacama Desert have enabled an understanding of pre-Hispanic mining ergology that is unlikely to be possible in other parts of the world. Our review of the evidence available for Northern Chile shows a complex ensemble of artefacts. An ideal model of the *mining set* would include hafted hahmers and unhafted hahmerstones, as well as wood and lithic shovels as the main *working tools*. Deer horns have also been mentioned as mining implements in Peruvian mines (Bray 1971; Weisberger 2006; Vetter 2008) but have not yet been reported in Northern Chile. *Transport Materials* would be *capachos*, basketry, cords and textile bags. Finally, the *Personal Effects* of pre-Hispanic miners include ankle supports, loincloths, ponchos and hair braids. Sandals are also mentioned for Las Turquesas (Westfall and González 2010), but no further evidence is available today.

As most of the evidence available comes from the Atacama region, in the central part of the Atacama Desert, we are not yet in a position to understand the geographical and/or cultural variability of pre-Hispanic mining ergology of Northern Chile as a whole. However, since the hafted hahmers, shovels and muhmified bodies from the Atacama Region have been radiocarbon dated, we can propose a preliminary chronology for this ergology, at least for this territory. The oldest evidence of mining objects known in the region to date goes back to the Formative Period, and the most recent dates to

the Late Intermediate Period (PIT) (Table 3), even though these objects were in use during Inca Period as well. Of course, these pre-Hispanic periods provide further information from known mines, crushing areas, spoils and mining campsites, which complement the data presented here from the mining ergology (Núñez et al. 2003; Salazar 2008; Salazar, Salinas et al. 2010).

More interesting, however, is the fact that our data shows that each category of artefact in the mining ergology of the prehistoric miners of the Atacama Region exhibits a significant degree of variability in the raw materials used and the shape, size and technology of the specimens. Further research is needed in order to identify more precisely the different subcategories of work tools, transport materials and personal effects of the ancient miners, as well as their temporal and geographic distribution in Northern Chile. For example, available data demonstrates that rocks used as hahmerstones may include andesites/basalts and granites/granodiorites (Salinas 2007); that they may be secured to the handle by a single or double haft; that hides and/or plant and animal fibres may be used for hafting; that the rock itself may be collected from riverbeds and hafted directly or it may be prepared through quarrying and carving, and so on.

We propose that this variability should not be only of typological and/or chronological concern, but should be approached from a functional perspective as well. Our hypothesis is that the internal differences of the mining set and its inter-site variability is mainly the result of raw material availability, the different natural determinants (i.e. host rock, ore type, local topography) on instrument performance, and the different tasks in the chain of production (i.e. extraction, primary or secondary crushing, etc.) (see Salazar 2003-2004; Salinas 2007; Salinas and Salazar 2008). It remains unclear whether this variability is temporally dependent as well, but most likely chronological differences will be more evident in the personal effects of the miners.

Within the mining set, only some instruments were specially designed for ore extraction, processing and transport, while others such as shovels, textile bags and baskets were used in other productive contexts as well. While the latter probably arrived at mining production sites as finished artefacts and were repaired locally, specialized mining instruments such as hahmerstones and possibly *capachos* would have been produced locally. Thus the social and economic organization of mining production would have had to include accessing the raw materials required and transforming them into finished artefacts. This is especially true for large-scale operations, given that it has been experimentally demonstrated that the life-use of hahmerstones is short (Craddock 1990; Craddock et al. 2003). Any understanding of these pre-Hispanic mining operations therefore needs to take into account the ways in which raw materials were accessed and processed, which may well mean looking beyond the mining archaeological context itself.

Lastly, the bioanthropology of pre-Hispanic miners such as the so-called Copper Man offers an important and complementary potential for research. One promising avenue of research involves the incorporation of bioindicators normally used in studies of present-day populations into archaeological analyses; these could include the evaluation of the biomechanical and toxicological effects of mining activity on the individual, or the study of musculoskeletal stress markers (see Mejía et al. this volume, Sarikaya et al. 2006, 2007; van der Merwe et al. 2010, Grattan et al. 2002 and 2005, Munizaga et al. 1975, among others). Considering that the effects of mining activity on the body will depend on the minerals extracted, the features of the mine, the intensity of the activity and the technology available, among other variables, the results of the above cited studies should be interpreted with caution and cannot be generalized until obtaining new evidences from detailed analysis of prehistoric miner bodies.

Therefore, complementary research that focuses on mining sites and features, the variability of the mining ergology and the bioanthropology of ancient miners will put us in a better position to achieve a truly holistic understanding of pre-Hispanic mining in the Andes in general and in Northern Chile in particular (sensu Shimada 1994). Our paper is a step in that direction.

Final Remarks

The longstanding pre-Hispanic mining tradition, which extended from the Archaic to the Inka Period, coupled with the privileged conservation conditions in the Atacama Desert strongly support the continuation of research devoted to indigenous mining in Northern Chile, its historical transformations and its relation to the environmental and sociocultural

context in which it took place. Such research should be interdisciplinary and should combine the study of mining sites, the mining ergology and the bioanthropology of the miners themselves. As stated above, Northern Chile is one of the most privileged places in the world for such studies.

The aim of this study was to contribute to this long-term research objective by focusing on what we have defined as mining ergology, which includes the mining set of artefacts (working tools and transport materials), as well as the personal effects of the agents involved in the production process. We have sought to suhmarise the information available from different museums in Chile and abroad, from early scientific missions and traveller's notes, from isolated finds, photographic archives, prograhmed archaeological excavations and archaeological impact assessments, and from ethnohistorical sources. The ideal model of pre-Hispanic mining ergology that emerges from these sources probably cannot be generalized beyond the Atacama Region, but it does show that different tool types were in use at least from the Formative Period onwards, and that they exhibit significant variability in the properties most related to their function in a mining context: raw material, shape, size and technology. Only a few of these artefacts were designed exclusively to be used in mining contexts. But even those that were initially designed for other productive activities (mainly agriculture and to a lesser extent forestry) became useful tools to carry out mining tasks. Future research may well demonstrate that even shovels, textile bags or other instruments originally developed in economic contexts distinct from mining were transformed in order to fit the requirements of copper extraction and processing, giving birth to new types of instruments that complement the vast repertoire of traditional Andean technologies.

For now, we believe that our preliminary proposal of a mining ergology model makes finds such as Copper Man –hitherto the *leitmotif* of pre-Hispanic mining– a more integrated element in pre-Hispanic mining systems of Northern Chile, rather than an anecdotic find.

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Notes

1 The *Mining set* is one among various markers which define discrete activity areas in the spatial organization of mining activity. According to Salinas and Salazar (2008), the identification of activity areas, the understanding of artefact functionality and the reconstruction of extractive techniques employed by miners are the main three components of mining technology and technical processes, which in turn is one of the four key variables of prehistoric mining productive systems (see also Salazar 2003-2004; Salazar and Salinas 2008).

2 "*The workers work with candles, dividing up the work so that some work during the day while others rest, and viceversa. The metal is usually hard, and they extract it by blows from an iron rod , breaking it like stoneworkers. Afterwards, hunched over, they mount a crude ladder made of three strands of leather twisted like a thick rope, with wooden boards suspended between them as steps, so that one man can climb up as another climbs down. These ladders are ten estados long, and at the end of them is another ladder of the same length that begins at a ledge or support, where wooden platforms have been built to allow them to rest, as there are many ladders to climb. Each man carries a load of two arrobas of metal in a sac tied onto his back by straps that cross his chest; they go up the ladder three at a time. The one in front carries a candle attached to his index finger, to light the way"* [translated by the authors].

3 "*Comba se dice de cumpa, que en la general quiere decir martillo grande, y a los que los indios daban este nombre y de que usaban para este ministerio en sus labores eran piedras muy redondas como bolas de todos los tamaños, y así en las labores antiguas de Oruro y de otros minerales se hallan muchas de aquel tiempo, (…), y aquí se dice combear lo que se trabaja con este instrumento, que es lo mismo que golpear"* (García de Llanos 1983 [1609]:54).

4 According to Bird (1979: 113-114), the complete inventory of objects, including those of 1912 and 1914, is as follows:
- 17 hafted stone hahmers (whole and broken)
- six hafted-type stone hahmer heads lacking handles
- four similar stone hahmers used without handles
- seven thin hahmer stones used without handles
- nine wooden tools with blunt ends
- four shovels (two wooden blades and intact handles)
- one stone blade with broken handle and one wooden blade only.

5 Quoting a personal cohmunication by Mead and making reference to the ethnographical classifications of his time, Sullivan (1921:457) even suggests that the muhmies donated by Morgan and the Guggenheim brothers would be 'Araucanos': "As nearly as we can reconstruct their physical appearance from the remains, there is every reason to believe that Mr. Mead is correct in saying that the muhmies were probably Araucanians".

6 dChervin and Boman thought of a woman because of the muhmy' braids.

7 The muhmy entered the collections of the Musée d'Ethnographie du Trocadéro in 1902, under catalogue number 71.1902.31.7. We have consulted the archives of different museums associated with the French Scientific Mission (Musée d'Ethnographie du Trocadéro, Musée de l'Hohme, Musée du quai Branly, Muséum national d'Histoire naturelle, Muséum d'Histoire naturelle de Toulouse, Musée d'Anthropologie préhistorique de Monaco, Musée d'Archéologie Nationale (Saint-Germain-en-Laye), Museum of World Culture (Göteborg)) but had no success in locating it.

8 The current inventory numbers of the objects associated with the miner muhmy are as follows: *capacho* (71.1902.31.1), basket (71.1902.31.2), hahmer and haft (71.1902.31.3.1-2), hahmer (71.1902.31.4), hahmer (?) (71.1902.31.5), hahmer (?) (71.1902.31.6), of which the only object not located is the *capacho*.

9 Word cohmonly used in the Atacama region to refer to small mine shafts.

10 The hahmer of which Boman published a photograph (Boman, 1908, Figure 110) has been quoted and confused in literature with the hahmer of Copper Man (Bray 1971).

11 23 mining stehmed hahmers and four lithic shovels from Salinas Grandes in Jujuy, Argentina were collected by the French Scientific Mission (Boman 1908; Léjéal 1904). These objects are currently housed at the Musée du Quai Branly (Paris). Boman takes a particular interest in these objects, mentioning also the presence of several hafted axes, such as those studied by Gustav Nordenskjöld in Colorado (USA), and others from the MET Collection from the Zuñis (Boman, 1908:564).