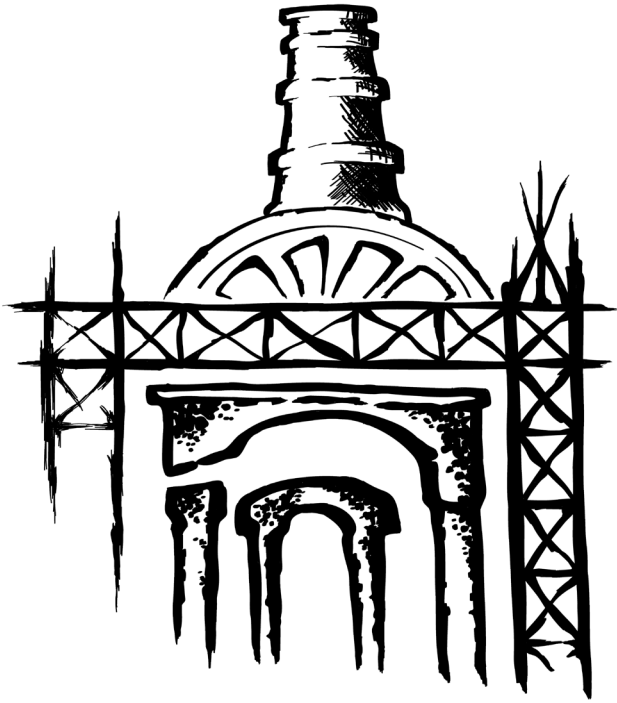


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## **THEORETICAL SUMMARY FOR ANDEAN MINING CONTEXTS: APPROACHES FROM INDUSTRIAL ANTHROPOLOGICAL ARCHAEOLOGY**

### ***Revisión teórica para contextos de minería andinos: un acercamiento desde la arqueología antropológica industrial***

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#### **ABSTRACT**

Throughout the Andes, there were similar technological and socio-environmental transformations and transitions in the rise and consolidation of industrial capitalism in the nineteenth to twentieth centuries. These are manifested in historically particular cases that make up the socio-environmental universe of Andean mining. This essay exposes theoretical and methodological guidelines for archaeological–historical research projects in Andean mining contexts. These guidelines make it possible to interpret the material conditions of the lives of the workers who inhabited the mining settlements as well as to identify sources toward a holistic view of each case study's historical particularities. This paper addresses the relationship between methodological concepts and the empirical sources that should be taken into account for the purpose of proposing a research framework for industrial mining in the Central-South Andes.

**KEYWORDS:** Industrial anthropological archeology; Andean mining landscapes; Methodological assumptions; empirical sources; ways of life.

#### **RESUMEN**

A lo largo de los Andes, hubo transformaciones y transiciones tecnológicas y socioambientales similares en el surgimiento y consolidación del capitalismo industrial en los siglos XIX al XX. Estos se manifiestan en casos históricamente particulares que conforman el universo socioambiental de la minería andina. Este ensayo expone lineamientos teórico-metodológicos para ser aplicados en proyectos de investigación arqueológico-históricos en los contextos mineros andinos. Estas directrices permiten interpretar las condiciones materiales de la vida de los trabajadores que habitaban los asentamientos mineros, así como identificar las fuentes para una visión holística de las particularidades históricas de cada estudio de caso. Este artículo aborda la relación entre los conceptos metodológicos y las fuentes empíricas que deben tenerse en cuenta a los fines de proponer un marco de investigación para la minería industrial en los Andes Centro-Sur.



**PALABRAS CLAVE:** Arqueología antropológica industrial; paisajes mineros andinos; propuestas metodológicas; fuentes empíricas, modos de vida.

## 1. INTRODUCTION

Diverse approaches such as historiography, ethnography, and anthropology have made valuable contributions to our understanding of the articulation of mining with historical development of national state economies in the Andes. However, archaeological investigations remain extremely scarce, mostly limited to the archeology of industrial mining. This is a limitation to our understanding of the history of mining in the Andes, not only because archeology can reveal the oldest and longest history of this activity in the region, but for the contribution it can make from the study of materiality to an understanding historical mining and their impacts on current sociocultural processes (Salazar & Vilches 2014).

This article proposes a general theoretical-methodological framework that is applicable to any Andean industrial mining context which presents stamp mills, furnaces, smelters and barracks houses from the 1850s. The first section describes theoretical concepts used to interpret the material conditions of existence of the workers who inhabited mining and metallurgy settlements. The second section identifies empirical references and sources that offer a holistic view of the historical particularities of the mining landscape for each case study. The third section suggests techniques for analyzing historical documents and artifacts, which comprise the empirical corpus for corroborating or refuting hypotheses.

## 2. THEORETICAL APPROACHES FOR AN INDUSTRIAL ANTHROPOLOGICAL ARCHEOLOGY OF ANDEAN MINING

### 2.1. Historical background of the Industrial Mining in the Central and Southern Andes

After the various independence revolutions in the central and southern Andes – modern Peru, Bolivia, Chile, and Argentina – attempts to continue mining generated a flow of foreign capital for mining, which was endorsed by nascent nation-states within the framework of a neocolonial order (Halperin Donghi 2005, Brown 2012). All Andean nations were led by liberal oligarchies that established economic models based on mineral extraction and agricultural exports. These groups also owned a large part of the land and controlled trade. They had the capacity to intervene in political decisions by dominating the principal elected offices (Castro Herrera 2002, Ansaldi & Giordano 2012, Brown 2012).



This extractive economic model was further supported by the California Gold Rush in 1849. This led to significant immigration mobility in Andean countries as well as the arrival of European immigrants. Immigration was promoted by governments for its positive effect on the economy through new technologies and knowledge. This generated diversified enterprises and larger workforces (Halperin Donghi 2005). As a result, mineral extraction was driving ethnogenesis (Barth 1969, Bartolomé 2006). This is reflected in the mining industrial proletariat of the Andes, who helped make possible mining in the Andes (Sironi 2013).

Around 1880, modern states were consolidated and great changes began as they entered the international capitalist circuit. Beginning in the middle of the nineteenth century, technological advances of the industrial revolution led colonial empires to establish new markets that consumed manufactured goods and provided raw materials. In the international market, Latin American countries were oriented toward productive specialization according to the model of the international division of labor: those who contributed raw materials and those who refined them (Halperin Donghi 1993, O'Connor 1998, Harvey 2004). In other words, this international division of labor is developed mainly by the transformation promoted by the industrial revolution in the mining operations, since it was present, and in some places was especially relevant during the nineteenth century. It should be noted that there is a significant difference between the extraction of small amounts of precious minerals such as silver and/or gold and the extraction of huge quantities of ore for industrial processes, such as copper and/or tin. This enormous transformation influenced the whole organization of mining work, technology, etc. In Peru, Bolivia, Chile, and Argentina, this new colonial pact was backed by an innovative elite, who held a fervent belief in order and progress. Their economic liberalism and fierce political conservatism allowed them to maintain power (Ansaldi & Giordano 2012).

Mining in the Republican Period comprised a fixed chain of essential operations *-chaîne opératoire-* (Lemmonier 1992) to obtain metals and nonmetals. These activities were carried out for long periods, which varied by the type and quantity of ore and the rate of exploitation. The different stages of the mining mode of production make it possible to identify permanent choices that the miner performed in the search, extraction, and exploitation of minerals as well as the sociocultural makeup of the workers. These stages involve exploration and exploration to determine the quality and characteristics of the mineral deposit and preparation of equipment (Alonso 1995, Lavandaio 2008) as well as establishing smaller and larger sites that are more or less permanent, with segregated housing and administration areas, etc.



## 2.2. Toward an Anthropological Archeology of Industrial Mining in Andean Peripheral Capitalism

The extractive production matrix varies within the Andes, notably the historical particularities of consolidation of the dominant oligarchic classes and their dominated classes (proletarians, peasants, etc.). Historical Materialism and its concepts of mode of production, means of production, alienation, and modes of life (Marx 1999; Veloz Maggiolo 1984; Vargas Arenas 1998) allow us to address the technological and material developments and changes that operated dialectically in socio-environmental relationships. Through this approach, we see the mode of production in various organizational aspects of a society (economic, ideological, cultural, etc.). Technological changes and modes of production, manifest in archaeological and historical records, were the main factors in social change as they have a dialectical contradiction with legal and political structures. The ultimate causes of these changes must be sought in these factors: “The sum total of these relations of production constitutes the economic structure of society – the real foundation, on which rise legal and political superstructures and to which correspond definite forms of social consciousness. The mode of production in material life determines the general character of the social, political, and spiritual processes of life” (Marx 1904: 11).

The concept of mode of production would allow us, among other things, to organize and characterize past societies in relation to ownership of the means of production, appropriation of the economic surplus, development of the division of labor, and productive forces. Based on these concepts, we see Andean mining sites as the construction of a space formed by two types of social actors: a) domestic economies and, b) the ‘industrial proletariat’ (mining communities and/or cooperatives). These actors were forming diverse cultural and productive relations entrenched in a particular social–economic formation of peripheral capitalism.

Peripheral capitalism is the mode and relations of production, the direct control of labor processes, and market exchange imposed by the dynamics of capital in domestic production to survive in non-urban or rural areas. Through the transformations and transitions generated in domestic economies and modern productive systems, the social actors involved in these activities must subsume the logic of Andean peripheral capital for their reproduction and existence through the proletarianization of labor. This is basically the “subordination and exploitation of the labor process and its inclusion within the process of increasing capital” (Gordillo 1992: 50).

Following Hocsman (2003), we use the thesis of indirect subordination of labor to capital, which states that domestic production with non-capitalist features is





subordinated to the capitalist mode of production. This refers to the fact that 'domestic economies' are not totally separated from their means of production, reproducing themselves and their families in a consumption unit linked to its economic unit. The domestic sector is part of the capitalist accumulation through its insertion in mercantile circuits through the sale of its labor. In this way, surplus labor is transferred to capital but not directly, as Marx suggests, but through indirect mechanisms that respect the non-capitalist character of the domestic labor process (Gordillo 1992).

West (1949) and Bulmer (1975) suggests that mining communities have the following characteristics: a) physical isolation and dispersed settlements, b) economic predominance of mining, c) demanding and dangerous work, d) occupational homogeneity and isolation, e) shared pastimes (religion, drunkenness) where work is the main topic of conversation, f) significant segregation of family and gender roles, g) political and economic conflicts between miners and managers, and h) multiple and complex communal social relationships such as solidarity and shared histories of work and life. However, one can see in the Andes some different realities compared to the model, for example regarding the gender segregation. The literature today is broad and one can complete West and Bulmer's models.

These categories should be supplemented with the contributions of the Annales School toward a holistic understanding of historical archaeology. This historiographical line of thinking aims to explain social facts based on three levels of spatial-temporal structures in historical change (Braudel 1995): traditional history (*histoire événementielle*) of events and individuals, the average duration (*moyen durée*) of economic, social, and political structures of human groups, and the long duration (*longue durée*), the history of relationships between humans and their environment, which is the dimension that privileges archeology (Last 1995). The Annales School rearticulates the conception of time and space in the notion of landscape, since the elements that make up future and historical contexts are based on all aspects and actors of the socio-cultural system. The landscape object would thus be placed in the articulation between space and time in the indiscriminate junction of the world of ideas and the material world. Accordingly, a "landscape is not merely the world we see, it is a construction, a composition of that world" (Cosgrove 1985: 13). Landscapes represent "a way in which ... people have signified themselves and their world through their ... relationship with nature, and through which they have underlined and communicated their own social role and that of others with respect to external nature" (Cosgrove 1985: 15).

Our approach to mining towns and their social configurations is through the knowledge of landscape as a cultural construction, as a significant set of norms and conventions inserted in space-time relationships through which social



subjects make sense of their universe. We aim to study historical–archaeological materiality along two categorical axes: sociocultural and socio-environmental. These axes derive from comparative situations of social life between groups, since they approach “the historical reality of lived conditions and how these conditions produce and are products of social action” (Mc Guire 2008: 74). An historical–archaeological analysis, with this sociocultural framework demands the specification of visible and measurable categories in the material record and selecting analytical units that vary by scale (Figure 1).

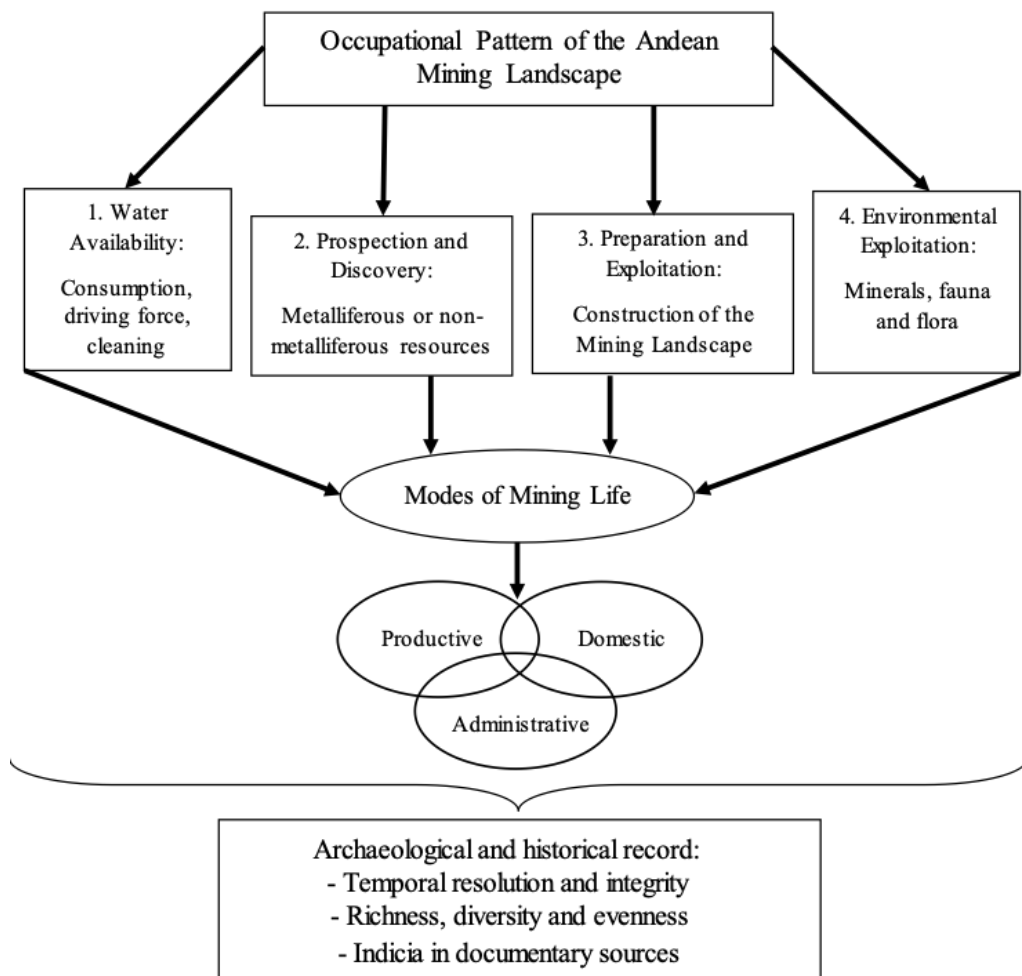


Figure 1. Proposed model for historical–archaeological analysis of mining sites associated with extraction and processing. Based on Chiavazza & Prieto Olavarría (2012).



The concept of mode of life (Vargas Arenas 1998), as seen in Figure 1, is central to our approach. This category is a means of integrating the concepts of mode of production and social-economic training. Mode of life is “a social expression of the organization of the productive forces in relation to a specific medium, with a view to the objectification of production, which undoubtedly generates a specific cultural response” (Veloz Maggiolo 1984: 11). In other words, a mode of life seeks to satisfy biological and social needs that the subject must first guarantee for their survival and secondly to make life more than survival.

From this, industrial archeology can offer an anthropological view of the socio-cultural structures of the mining community, that is, it can reconstruct the history of mining groups and how they developed their modes of life in particular environments. This discipline builds analytical links between written, oral, and material expressions. Interweaving history and anthropology (Little 1994) makes possible a dialectic investigation between socio-economic and geographical structures as well as historical events (Cerdà Pérez 2011; Last 1995; Palmer & Neaverson 1998.). Industrial archeology also allows us to reconstruct the relationship between technological innovation and the consequences that it has on the way of organizing and relating to each other and to the environment. That is to say, it allows us to understand how production systems, with their historical and technological peculiarities, have repercussions “on the cultural, social, economic, and environmental aspects that lead to a radical change in the way men and women thought and lived” (Cerdà Pérez 2011: 94).

### 3. SOURCES, METHODS, AND ANALYTICAL TECHNIQUES

The integral analysis of Andean mining sites requires two research strategies: one historical, based on the analysis of published and unpublished documents, and archaeological, based on the material record produced by mining activities. Both approaches can be carried out simultaneously and enrich each other. Documentary analysis sheds light on the technologies used in mining facilities, as well as who built and ran them. It is also the basis for building a chronology of mining operations. Archaeological research contributes to aspects that are not detailed in documentation such as the scale and characteristics of the mine and the organization and distribution of architectural structures, among others. In order to develop a logical sequence of historical–archaeological research (Bate 1998; Roskams 2001; Schaff 1976; Topolsky 1971), we suggest the following steps.



### 3.1. Archival Research and Published Sources

Primary documents are used for a first approximation for the mid-nineteenth century to the middle of the twentieth century. Documents reveal some information about the *histoire éventuel* (Braudel 1995). A bibliographic search can identify relevant documents for our own questions and approach. This involves cited documents as well as parts of Ginzburg's suggested method, which makes it possible to describe the productive activities and the agents involved (Ginzburg 1986). The Ginzburg's indiciary paradigm prioritizes the unrepeatable, the singular, and the original. Therefore, its intervention is qualitative, insofar as it deals with the exceptional particular cases, that is, microhistory (Ginzburg 1993).

#### 3.1.1. Written sources

We should take into account primary sources housed in national or provincial archives (AGN: Argentina; ANB: Bolivia; ANCh: Chile; AGNP: Peru; among others), as well as the mining records found in the archives of official mining organizations (SEGEMAR: Argentina; SERGEOMIN: Bolivia; SERNAGEOMIN: Chile; INGEMMET: Peru; etc.). There are official bulletins, protocols (creation of companies, wills, sales), and legal cases can reveal the details of administrative, economic, and social organization as well as the means of production involved. Documentary information is used as background research, as a source of hypotheses, and as a means to refine the material expectations of the archaeological record.

#### 3.1.2. Accounts of travelers and naturalists

Archival documentation should be complemented with accounts of travelers that refer to environmental conditions, characteristics of minerals, and mining activities during the Independence and Republican Periods (Bond Head 1826; D'Orbigny 1835-1847; Forbes 1861; Gerstacker 1854; Hoskold 1889; Raimondi 1929; Temple 1830; Treutler 1882; Vicuña Mackenna 1856; among many others). These accounts have information on ways of life and mining production as well as material remains. Particular attention should be paid to references of work in mines and their organization, the tools and technologies used, and the changes and innovations introduced by foreign countries to the traditional techniques of the domestic economies. These accounts offer overviews, but they must be understood in historical context. We should characterize the reliability and accuracy of their descriptions. Their descriptions could be in response to pressure from national or provincial governments, which encouraged mining.



### **3.1.3. Historiographical and archaeological publications**

Archaeological publications are fundamental, besides those referring to concrete deposits with evidence of mining or metallurgical activities. General works of significant value are those of Rix (1967), Hardesty (1988), Knapp (1998), Palmer & Neaverson (1998), Lawrence (2005), Cerdà Pérez (2011) and Pozo-Antonio et al. (2017), among others.

For the southern Andes, we can add some of the principal anthropological, historiographical and archaeological contributions that gives us an idea of the general context and the relevant socio-economic context, that is, the *moyen durée* (Braudel 1995). These texts help us to reflect critically on research hypotheses when analyzing the archaeological evidence, establish comparisons with adjacent areas, and account for the historical particularities of a region and its inhabitants.

In Argentina, work has focused on mining practices and the occupation of territory in multiethnic mining contexts (Becerra 2012; Delfino et al., 2014; Sironi 2013). In Bolivia, there are studies on transfers of technology and methods for smelting minerals in large mining centers (Cruz et al., 2012; Gil Montero & Nielsen 2010; Platt 2000), as well as about environmental conflicts and the social and labour configuration around tin mining (Contreras 1985; Hillman 1988; Mitre 1993; Moeller Schroeter et al., 2002; Nash 1979). In Chile, there are interdisciplinary studies of mining sites on the recovery, conservation, preservation, and communication to the public of this material heritage (Castro et al., 2012; García Albarido et al., 2010; Salazar 2003-2004). The main studies linked to political and union conflicts in cupriferous landscapes stand out the works of Barrera (1978), Deshazo (1983), Culver & Reinhart (1989), Pinto Vallejos (1992), Klubock (1998), among others. In Peru, there are analyses of social and spatial organization based on mining architecture and material culture (Lechtman 1976; Shimada & Craig 2013) and socioenvironmental impact on the mining population (Alarcón Aliaga 1994; Balvin Díaz et al., 1995; Deustua 2000). Likewise, the comparative historiographical studies between Bolivia, Peru and Chile focused on socio-political, economic and/or environmental issues (Contreras 1999; McMahon et al., 1999; TePaske 2010; Zapata 2002).

### **3.1.4. Oral, pictographic, and photographic sources**

Asking people who are knowledgeable about the land and the area (rangers, shepherds, stake holders, mountain guides, etc.) can lead to the discovery of unpublished mining sites. Sometimes it is practically impossible to detect a mine, even if it appears on maps, unless guided by someone who knows its exact position (Hunt Ortiz 1996).



With semi-structured or non-directive interviews (Guber 2004), the accounts and experiences of former workers, relatives, or people linked to mining operations make it possible to record and recover histories and lifestyles. Together, they can help reconstruct the collective memory of mining settlements. These dialogue-based accounts are a necessary complement to documentary and archaeological information because they can be the basis for ethnoarchaeological analogies specific to industrial archaeology (González Ruibal 2003).

Photographic and pictographic sources, supplemented with oral sources, offer information on behavioral patterns such as clothing, food, tools, etc. and help establish relative chronologies of mining sites (Absi & Pavez 2016).

### **3.1.5. Geological and mineralogical publications**

These journals have information on geology and minerals: *Mining Journal* (London), *Engineering and Mining Journal* (New York), *Quarterly Journal of the Geological Society* (London), journals of the *Asociación Geológica Argentina* (Buenos Aires) and the *Sociedad Nacional de Minería* (Chile), among others. Older issues usually have short historical reviews that mention the most significant archaeo-metallurgical finds. Other useful publications are dictionaries, manuals, and encyclopedias for long-term mines. Likewise, the technical reports of countries' national and military geographic institutes have detailed data. These institutes have often done thorough explorations, mapping, and mineralogical studies. Their reports provide accurate data on the types of work done and the available minerals (Hunt Ortiz 1996).

### **3.1.6. Geological and metalogenic maps**

A fundamental first step is the study of geological and metalogenic maps (Hunt Ortiz 1996). Geological maps (produced by the geological and mining institutes of the each country on a scale of 1:50,000) are accompanied by an economic and geological introduction to the study areas. Much more interesting are the metalogenic maps (scale 1:200,000), which show mineral clusters and geological strata. Metallographic maps are a primary source for classifying the types and properties of areas with minerals. This gives us an idea of the potential spatial distribution of the different mining settlements in the area (Hunt Ortiz 1996).



### 3.1.7. Topographical and land registry maps: symbols and toponymy

After delimiting the area, it is advisable to study topographic maps, since metalogenic maps do not show all minerals areas. Two collections of topographic maps are very useful, those from national armies and national geographic institutes. They occasionally indicate mining with a specific symbol. When this symbol is not used, toponymy can be helpful. Other maps of great interest are the mining land registries, which indicate changes in owners of the land and mining rights.

## 3.2. Archaeological field work

Revealing *chaîne opératoire* and lifestyles in mining contexts require study of architectural installations, minerals, tools, and artifacts of everyday life. Fieldwork can reveal spatial patterns of discard, which provide chronological and functional information for residential and production buildings (Roskams 2003).

a) Survey: Pedestrian surveys allows us to locate open pit mines and underground mines as well as human and natural evidence of mining activities (tailings, structures, slag). Likewise, satellite remote sensing – through the use of Google Earth – allows us to detect underground mines that could be buried or covered by vegetation, etc. Botanical survey involves identifying plants associated with a type of mineralization or mining. Its use for archaeological purposes has been termed phytoarchaeology (Hunt Ortiz 1996).

b) Surface collections and excavations: systematic surface collection and topographic survey of the study aims to map archaeological elements or groups of artifacts. These elements are marked by flags with an optical level or total station and then collected. Units are then excavated in architectural structures with standard techniques and methodologies. The information is recorded in drawings, photographs, and forms for each stratum.

c) Topographic and architectural survey: Using templates prepared for topographic survey allows us to process these data with the SURFER 3.0 program and visualize mining landscapes in 3D. Basic architectural analysis has arisen from the concept of *structure*. For this reason, we treat structures as architectural–archaeological niches such as stone circles or buildings made of any construction material. Structures are described based on architectural attributes: dimensions, forms, functions, construction materials, and construction techniques.



### 3.3. Laboratory work

Laboratory work consists of analyzing field records and the material evidence. Laboratory procedures include cleaning, labeling, reassembling, quantifying, measuring, making observations with the naked eye and a 10× binocular loupe, and general and specific analyses. These analyses are done for each type of artifact with the aim of establishing artifacts' technological and morphological features, typology, function, and relative or absolute chronology. These data allow us to infer the characteristics of consumption and disposal in different periods of a site's occupational history.

Archaeozoological analysis reveals habits of meat consumption and discards. We can infer patterns of consumption from canned foods and beverages, in addition to health practices based on medicinal products (Haro Encinas 2000). The analyzes of archaeological coals allow us to identify the woody resources used in the mining sites (Mafferra et al 2018). Therefore, identify the circuits of obtaining and distributing the resources to observe the level of dispersion and impact of the deforestation of the mining area and adjacency zones. Analysis of construction materials can be used to create typologies and the variability of elements used in the Andean mining architecture based on raw material, dimensions, and survey techniques. Ceramic studies aim to define the typological, formal, chronological, and functional aspects of fragmentary assemblages. These can lead to inferences on the modes of eating and social hierarchies based on the use of ceramic vessels (Marschoff 2014). Metal artifacts provide us with information about the work and daily life of the industrial mining proletariat as well as social hierarchies (Voss 2008). This is based on systematic analyses of patterns of consumption of canned food, discarded metal tools such as chisels, crowbars, and hooks in addition to ornamental elements on workers' clothing, ballistic evidence of hunting or violent social repression, etc.

Next, artifact analysis is more focused. Artifacts are organized based on technological, morphological, and compositional characteristics and in terms of representation and participation in miners' ways of life. To do this, we suggest working with the following categories: work, energy, food, architecture, medicine, education, and cosmetic, among others.

These analytical categories can be assessed with richness, diversity, and evenness indices (Bobrowsky & Ball 1989; Weissel 2008), based on Shannon & Weaver (1949) and Simpson (1949). The richness index considers the number of classes or variables that a set of artifacts has in relation to the sample size. This index is an important first step for assessing the utility of the sample in relation to its size and artifact functionality. The diversity index provides more information about the composition of a set. The evenness index reinforces the diversity index





through intra-site and inter-site comparisons, since it represents the distribution of relative proportions in different classes or categories. The diversity and evenness indices inform us about the structure of the archaeological record that lead to inferences about human behavior (Sironi 2018; Weissel 2008). These indices, based on grounded theory, allow us to establish a dialogue between data and theory instead of *grounded theory* and the hypothetical-deductive method. The data goes from being used to verify and falsify to being the source of the theory. The data then proceed from testing the process to constructing theory. Grounded theory proposes an inductive method, in which statistical sampling is replaced by theoretical sampling. The observation units are selected according to criteria formulated from the researcher's perspective, and the sample size is reached when no further observation adds new relevant information (Glaser & Strauss 1967; Scribano 2000).

The architectural configurations of mining sites are treated as constituent elements of the human landscape. The built environment dynamically interacts with the social subject, since it constitutes a physical medium that organizes interpersonal relationships by restricting movements, favoring or limiting encounters, and ensuring group reproduction. In an architectural complex of enclosures with connections, the logical and syntactic position of rooms creates hierarchies. In this way, different ways of organizing spaces with architecture generate information on the social structure of the group. It is an alternative way of studying the social world (Leone 1995; Samson 1990).

In order to understand the structure and sociocultural logic in the Andean mining area, we perform comparative studies between different architectural structures using space syntax –Gamma analysis– (Hillier & Hanson 1984). This model was extended by Richard Blanton (1994), who generated three indices to deepen the analysis: scale, integration, and complexity.

The use of Hillier & Hanson's (1984) proposal involves expressing the spatial organization in graphs and diagrams to clarify the connectivity of housing complexes. This method represents spaces and access paths in graphs of nodes and connectors. Nodes are spaces determined by walls or other boundary markers. Connectors are the passages between nodes such as openings and passages.

Gamma analysis is based on movement through spaces, quantifying depth and permeability (ease of access), assessing the degree of dependence of some spaces on others, access control, and the movements they allow. It also addresses the relationship between exterior and interior space because "space creates special relations between function and social meaning" (Hillier & Hanson 1984: 1–2).



The key elements in this analysis are the thresholds that separate and connect spaces, based on each space being interior or exterior and its relationship to adjacent spaces, that is, spatial permeability: symmetry and distribution. Symmetry implies that two or more spaces have the same type of control, that is to say that there is no subordination. A space is distributed if there is more than one possible route to access it, i.e., more than one control locus (Hillier & Hanson 1984).

The scale index shows difference between structures based on the composition and size of the set of structures, enclosures, and surface areas. The integration index addresses the relationship between the number of connections, structures, and enclosures, and reflects the overall circulation and restriction of the system. The complexity index reveals differences in the number of existing connections and the functional variation that the spaces have, in addition to the degree of control and access to and from the exterior. The variables that guide this analysis are restriction, control, and spatial segregation, which assume that an increase of control and privacy is materialized in greater spatial restrictions and fewer connections (Blanton 1994; Funari & Zarankin 2003).

### **3.4. Action research in the heritage of mining sites**

It is known that the establishment of large mining operations in the region brings conflicts in different areas such as the economy, identity, and society, which generate internal community contradictions and tensions. These often arise from the use, and in many cases, the abuse of water and chemicals that result in systemic ecological destruction. Given this background, it is necessary to carry out participatory action research (Freire 1985; Katzer & Samprón 2011; Kemmis & McTaggart 1988) that involves teachers, researchers, government employees, farmers, etc., with the goal of developing a plan to increase awareness of both heritage and environment.

Educational workshops are one means of creating a space for constructive dialogues that touch on the meaning and conservation of tangible and intangible heritage and also to highlight its symbolic and material capacity to reflect peoples' identities. This can be done through many different activities such as the interpretation of site maps, presentations on the state of conservation and agents that damage architectural structures, characterizations of natural resources and the environment, oral histories of the workers, etc. The goal is to generate participants' interest and engagement and make them capable of demanding policies that conserve and valorize archaeological heritage. Even though the heritage of archaeological mines can be considered an economic resource and can be exploited as such, it is important that people conserve it, because in doing



so, they protect the history of their own people and foster sustainable cultural, ecological, and economic development.

A community museum is suggested as a social space for heritage gatherings, which will create a sense of community and establish roots. A museum would have multiple social functions, supporting processes of cultural identification and the improvement of quality of life. Through a participatory process, with a commitment of cooperation, financing, and agreements with governmental institutions – provincial and/or municipal – it will be possible to value what the community defines as relevant and meaningful, which will create regional memories intimately connected to local identities. In economically vulnerable places, cultural tourism is an economic alternative that promotes local development and is in harmony with community identity (Fernández 1999) through the creation of reserves for archaeological mining sites. This process makes it possible to learn about the predominant attitudes, perceptions, conflicts, and social norms related to the topics at hand, to begin to create a museum script with distinct voices and perspectives. In this sense, participatory management makes it possible to integrate, delegate, and work with people, sharing decisions about the management of local cultural resources.

Finally, we should clarify that these suggestions are not finalized, nor do they comprise a “recipe” to be followed, but instead seek to create a baseline document to be worked on by local researchers and the community. We believe that the enrichment of any management plan developed for this type of archaeological reserve should be based on the engagement of the various groups that are involved in identity construction and the oral and/or material history of each archaeological mining site.

#### 4. FINAL CONSIDERATIONS

Despite the diversity of the post-Conquest South America, there is a common historical substratum: colonized areas were condemned to produce resources for the benefit of the colonial powers. In the Andean region, minerals played a prominent role. Independence gave rise to the republics of Peru, Bolivia, Argentina and Chile. These geopolitical distinctions only fostered the invisibilization of cultural particularities, practices, and discourses that resist such cartography. But at the same time, the Republican Period inserted South America, and the Andean zone, into global processes like capitalism, by virtue of the presence of new and more diverse foreign powers. Again, mining is key in the relationships that are generated between nation-states, local communities, and foreign powers.



In order for archeology to contribute to an understanding of the history of South American mining in the long term and its links with environmental, technological, economic, social, political, and cultural contexts in which it was developed, it is essential to base contributions on studies of direct evidence, that is to say, from the materials themselves, which in the end is its object of study par excellence. It is worth noting that we do not consider archaeological materiality to be a direct and univocal reflection of the complex universe of mining lifestyles, since they have historical particularities and the archaeological–historical records have their limitations. With each analysis and study, the importance of material culture is manifested in the conditioning of social practices as relations of power and of archeology itself, which develops as a machinery of techniques and methods. Material culture of mining is becoming a powerful instrument in the analysis of subaltern stories, which allow to consolidate the postulates of Political Ecology (Castro Herrera 2002; Galafassi & Zarrilli 2002; Gallini 2004) based on patrimonial identity claims.

Along with new lines of research in post-contact periods, it becomes necessary to discuss the implications of definitions such as Historical Archeology. The arbitrary separation between an archeology of prehistoric and historical times is questionable, and this definition has the disadvantage of hindering detailed studies of the historical particularities of the sociocultural system. In the case of research on mines, there is a need for appropriate theories and methods based on an interdisciplinary approach to cultural remains from capitalist societies.

It is important to bear in mind that identifying evidence of industrial mining is only the beginning of the process to understanding mining as a historical phenomenon in the Andes. We must draw attention to the fact that research of both prehispanic and historic periods has focused on the study of isolated and dispersed cases, with a few exceptions of sustained projects. Hence it is urgent to develop long-term research aimed at understanding the social processes that underlie the material manifestations of mining.

Thus we propose a reinterpretation of the industrial material record that takes into account the organic (non-unidirectional) relationship between the mode of production, social relations, forms of perception, constructions of space, different experiences, and social consciousness at the individual level. Based on this we believe it necessary to use microhistory to study the Andean mining world. This approach reveals socially significant relationships between material remains and particular forms of production and reproduction of capital (the dialectical relationship between capital–labor and capital–nature). This approach has the flexibility to include all the reflections that have become important to archaeological practice. We refer, fundamentally, to the theoretical categories presented throughout this article: peripheral Andean capitalism, subordination of



labor to capital, material conditions of habitability, means of production, ways of life, mining landscapes, ethnogenesis, historical particularities, and microhistory. These themes make it possible to evaluate the architectural, archaeological, and historical evidence associated with mining because they emphasize data from documents and those in the analytical categories of material culture.

It is evident that each discipline has its own biases and therefore microhistory archaeology does not have the role of “correcting” other approaches. But examples such as those mentioned above demonstrate that from material remains it is possible to identify alternative and complementary discourses that are capable of dialoguing with and enriching the written and oral record, approaching a more complete reconstruction of historical mining processes (Cruz et al., 2012). In these terms, the social function of archaeological microhistory is to democratize the past, giving us the possibility of approaching the ways of life of ordinary people, which are not visible in the documentary records, and not only of social elites. This requires delving into each site’s and region’s historical particularities, ruptures, and symbolic and cultural continuities without losing sight of the larger socio-cultural context. In this way, a dialectical relationship is established between the local and the regional, through the combined study of archaeological records (attributes of richness, diversity, and evenness), textual and visual records (indicia method), and oral traditions (interviews and analogies).

We insist that contributions from the study of materiality are not limited to confirming historical documentation, identifying non-documented holdings, or documenting the technical and technological features of historic mining in the southern Andes. On the contrary, microhistory archeology provides a dialogue with other disciplines to understand daily activities in mining communities, the organization and distribution of public and private space, symbolic–ritual practices, socioeconomic differentiation of classes, ethnogenesis, and even strategies of domination, discipline, and resistance as well as an understanding of the technological organization of production systems and their integration into regional economies.

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