Chapter 1
An Introduction to Mining and Quarrying in the Ancient Andes: Sociopolitical, Economic and Symbolic Dimensions

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Introduction

Geological resources have long contributed in significant ways to economic, social, political, and ritual life in Andean communities. From the first mobile forager groups to the vast Inca empire, raw materials from mineral resources such as architectural, lapidary, ornamental, and knappable stone; clay for pottery, mineral ores for prized metals such as gold, silver, and copper; minerals for pigments such as hematite, cinnabar, and manganese; and salt have all had a profound—if sometimes unacknowledged—role in the Andean world. While archaeologists have used a number of analytical techniques on the materials that people have procured from the earth, these materials all have one thing in common: they were extracted from a mine or quarry, and despite their importance, comparative analyses of mines and quarries have been exceptionally rare in the New World, especially in the Andes. The papers in the current volume focus on archaeological research at primary deposits of raw materials extracted through mining or quarrying in the Andean region (Fig. 1.1).

In recent decades, the study of ancient mining and quarrying has seen increased interest by archaeologists worldwide, and a number of synthetic treatises on mining have appeared, although many have an emphasis on European or Mediterranean prehistory (Abu-Jaber et al. 2009; Boivin and Owoc 2004; Brewer-La Porta et al. 2010; Craddock 1995; Craddock and Lang 2003; Ericson and Purdy 1984; La Niece and Craddock 1993; La Niece et al. 2007; Stöllner 2008b; Topping and Lynott 2005a).

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Fig. 1.1 Map showing locations by chapter

In comparison, the study of mining and quarrying has not been a topic of significant archaeological discourse in the New World. Indeed, detailed study of ancient mining has been lacking in the Andes, and there are few synthetic treatments of the topic. One exception is Cruz and Vacher's (2008) volume presenting recent research on colonial and precolonial mining and metallurgy in the southern Andes, with a particular emphasis on the rich evidence from Potosí. Beyond this significant work, there have been few attempts to evaluate mines and quarries in the Andes from a synthetic and comparative perspective. In the 1990's, Craig and West (1994) published a valuable treatise on mining and metallurgy in the New World in their volume "In Quest of Mineral Wealth: Aboriginal and Colonial Mining and Metallurgy in Spanish America." While much of the focus in this volume was on post-conquest mining and metallurgy, several important papers including those of Shimada and Ramirez evaluated the topic from archaeological and ethnohistoric perspectives, respectively. Shimada's paper has proven to be especially valuable to scholars studying Prehispanic mining and metallurgy in the Andes, as it provided a comparatively early effort to evaluate actual mines in the archaeological record. Another exception has been the work of Núñez (2006) who has recorded and worked at many mining sites in northern Chile and is one of the few researchers in the Andes to have a long-term research program considering these archaeological sites.

Earlier treatises on mining and metallurgy in the Andes include Lechtman's (1976) "A metallurgical site survey in the Peruvian Andes." In this seminal work, Lechtman surveyed on the North Coast of Peru and the Titicaca Basin focusing on sites (both mining and smelting sites) related strictly to metallurgy. The work of Georg Petersen (1970), recently translated into English by Brooks (Petersen 2010), was a comprehensive effort to describe known metallurgical and mining sites in the Andes; however, the sites were not archaeologically evaluated by the author.

These efforts laid the foundation for the research that is presented in this volume. Lechtman paved the way for future scholars by asking fundamental questions about mining such as "who were the miners?" and "how was mining organized?," while Petersen demonstrated the ubiquity of mining and metallurgy sites in the Andes. Focusing on North Coast data and sites in northern Chile, Shimada and Nuñez, respectively, provided actual evidence from ancient mines and attempted to place these sites into a broader archaeological and Andean context. The papers presented in this volume attempt to build on these original studies to bring the topic of mining and quarrying in the ancient Andes to the forefront by evaluating primary evidence for these activities.

On Studying Mining and Quarrying in the Archaeological Record

Using these preceding efforts as a springboard, our goal in preparing this volume was to bring together a number of archaeologists investigating the primary evidence for mining and quarrying in the Prehispanic Andes. Beyond this, however, previous

efforts to explore this topic (including our own research) had revealed that mining was deeply embedded in Andean life and had significant dimensions beyond the strictly economic. We therefore felt it was imperative that the scholars who contributed to our volume made an attempt to go beyond simply documenting primary evidence for raw material extraction. Indeed, we asked them to consider how this activity was embedded in other aspects of Prehispanic Andean life. Thus, our volume's principal goal was to place the activity of mining and quarrying into an archaeological and Andean context, rather than aiming to be geographically and chronologically comprehensive. Even so, the papers in this volume cover Early Holocene hunter gatherers through the Inca Empire and geographically span from Central Ecuador through Chile including coastal and highland Peru and the Titicaca Basin. The geographic and temporal scope of these papers is consistent with the pervasiveness of mining-associated activities for many people in the Andean past.

While in theory evidence for ancient mines should be exceptionally rare because of contemporary (and even Prehispanic) mining activities (see Eerkens et al. 2009; Stöllner 2009), the papers in this volume demonstrate that ancient mines, while certainly not common, are nevertheless present in the archaeological record. Perhaps not surprisingly, one exception is that we still lack direct evidence for ancient gold mines. Gold as a raw material was clearly important for Prehispanic cultures including the Inca Empire, but nothing matched the Spanish appetite for the metal. The acceleration of gold mining in colonial and recent times has surely obliterated most traces of ancient gold mining from the archaeological record, and we still lack direct evidence for this past activity in many regions. Petersen (2010: 23–24) does list several locations in the Andes where there have been reported evidence for pre-Colonial mining of gold including Cotabamba, Cajamarca, the south coast, Pataz, and Paucartambo. Despite this, the direct evidence of mining is mostly unsubstantiated.

Dimensions of Mining and Quarrying

Of course, mining is only the first stage in what is a long and complex *chaîne opératoire*. As important as evaluating how materials were mined is determining how they were processed and then eventually used in production. This is best exemplified by Shimada's work on mining and metallurgy, work that he calls the "holistic approach" to craft production (Shimada 2007). While we recognize that it is difficult to separate any of these "stages" of craft production (from extraction to production), our focus in this volume is on a comparative view of the extraction of raw materials that we believe has been largely overlooked in Andean archaeology. We therefore structure the remainder of our discussion around several themes that are explored by the papers in this volume (1) the raw materials mined and the problems miners faced when extracting those materials, (2) the processing and transport of raw materials, (3) the symbolic dimensions of mining and quarrying, and (4) the organization of Prehispanic mining and how mining was embedded into other realms of Prehispanic life.

The Raw Materials: Technological Considerations

Many previous treatises of our topic have focused almost exclusively on the materials necessary for metallurgy. However, in its broadest sense mining includes the various processes for extracting solid resources from the earth's crust and it comprises a variety of procurement methods including quarrying, tunneling, trenching, and placer mining. Thus, excluding a consideration of non-metallurgical materials is rather arbitrary. Indeed, virtually all crafts in the Prehispanic Andes (with the notable exception of textiles[1]) required mining or quarrying of raw materials. These raw materials included stone of all kinds including lapidary, architectural, sculptural, knappable, and ornamental stone; minerals for pigments such as cinnabar (HgS), hematite or red ochre (Fe_2O_3), yellow ochre or limonite ($FeO(OH)\cdot nH_2O$), manganese; clays and tempers; salt; and the by-now-familiar metals of copper, silver, and gold. Each of the papers in this volume considers at least one of these raw materials in their analysis.

Regardless of the materials that originate in mines and quarries, many of the technological considerations that an ancient miner must face are shared. One must decide where best to dig and which minerals are worth recovering and processing. There are broad engineering issues such as preventing mines from collapsing, contending with water seepage, reducing poisoning effects on miners, and finding tools suitable for digging in the surrounding matrix. Are these minerals combined with other materials in order to be useful? How are the target minerals to be transported away from the source area, and how does one conduct some form of processing adjacent to the source? Mining requires a sophisticated knowledge of the properties of raw materials as Roddick and Klarich's paper in this volume (Chap. 5) clearly shows, but as their paper and other chapters demonstrate, considerations beyond geological or technical properties were oftentimes critical in the selection of raw material. For Janusek and colleagues (Chap. 4), a change in raw material from sandstone to andesite at Tiwanaku between AD 500 and AD 700 underscores the importance of the materiality of stone for articulating a broad suite of changes as Tiwanaku grew into an expansive urban center. Their paper provides original data identifying the primary sources of sandstone and andesite at Tiwanaku and notes that the shift in material type corresponds with a larger change in color and durability from sandstone to andesite. Further, the spatial provenance of the andesite, originating at a more distant volcanic peak, corresponds with the expanding sphere of Tiwanaku influence.

Another technological consideration was the accessibility and composition of an ore deposit (see Stöllner 2008a). In the quarrying of architectural stone and material for tool production, size and material properties of the stone are limiting factors. The tools involved in extraction are sometimes found in archaeological contexts, with one of the most well-known cases being the Chuquicamata miner's tool set

[1] While mining was not required for the extraction of the raw materials used in weaving (e.g., cotton and wool), textile production often needed colorants and tools (e.g., for cutting and shearing) requiring initial mining of raw materials.

(Bird 1979: Figs. 3 through 10; Craddock et al. 2003). Indeed, as the papers here by Salazar and colleagues, Vaughn and colleagues, and Cantarutti (Chaps. 7–9) demonstrate, one of the most common artifacts found at well-preserved ancient mines are the stone, and sometimes wooden, tools used to extract raw material from mines themselves (see also Salazar et al. 2011; Vaughn et al. i.p.).

One theme apparent in many of the papers in this volume is that mining technology appears to have remained fairly simple (and conservative) through time in the Prehispanic Andes. Hard minerals in the Andes were extracted using a remarkably similar technology. Stone tools from the Peruvian north coast (Shimada 1994) to the south coast (Chaps. 8 and 14), to Chile (Chaps. 7 and 12) all bear a resemblance to each other, and all bear resemblance to the Chuquicamata "Copper Man's" tool kit referenced above (Bird 1979: Figs. 3 through 10; Craddock et al. 2003). Given that Salazar et al. (2011) have recorded very similar tools at an early Holocene mine in North-Central Chile (see also Chap. 7), the geographic and temporal scope of this toolkit is quite impressive. Today, much of the toolkit of the itinerant miner consists of iron tools (that replicate the stone tools used in the past) and sometimes dynamite (see Eerkens et al. 2009; Chap. 8).

While the toolkit and mining technology appeared to be similar across a broad swath of the Andes, a range of techniques were employed to allow access to deposits, prevent erosion or collapse, and reduce the risk associated with mining. In their paper, Jennings and colleagues (Chap. 6) describe structural columns in a salt mine that are today painted with a skull and crossbones. There are examples of mines for building stone that were highly dangerous due to roof collapses and only by using modern machinery they are safely exploited as open-cast mines (Stöllner 2008a). Among the earliest mining evidence in the new world, it was found that lateral buttressing allowed for the exploitation of trench mines (Salazar et al. 2011; see also Chap. 7).

One final consideration is that mines often require regular maintenance and with neglect shafts and quarries may become blocked by collapsed or colluviated material, or by material that has simply been moved by previous miners. Such concerns may bracket the viability of exploiting specific deposits, particularly surface works subject to erosion, because when a mine is abandoned the effort involved in restoring the location to productivity may be prohibitive.

From Source to Region

Once materials are mined, they are either processed at the site as shown in the papers by Vaughn and colleagues (Chap. 8), Cantarutti (Chap. 9), Salazar and colleagues (Chap. 12), and Van Gijseghem and colleagues (Chap. 13), or the materials need to be moved to other sites for processing. This is especially the case when the raw material is cumbersome or difficult to manage (an obvious case being architectural stone). Evidence for the porting of mined material from the quarry site to processing areas or onwards to the sites where the material was utilized is sometimes apparent archaeologically, as shown in the papers by Tripcevich and Contreras

(Chap. 2), Ogburn (Chap. 3), Janusek and colleagues (Chap. 4), and Salazar and colleagues (Chap. 12). Additionally, the determination of where the material was utilized may need to come from further geochemical studies as Tripcevich and Contreras (Chap. 2) discuss in the use of obsidian throughout the Andes, Janusek and colleagues (Chap. 4) show in the use of andesite and sandstone in Tiwanaku, Vaughn and colleagues (Chap. 8) show in the use of hematite in Nasca, and Reindel and Stöllner (Chap. 14) show in the use of obsidian and copper in the Palpa region.

While movement of extraneous and heavy raw material was generally avoided by initial processing near the geological source area, there are exceptions to this pattern. Architectural blocks may be fashioned into rough approximations, although in anticipation of some damage during transport, the fine dressing occurred in the immediate vicinity of the final placement of the stone (Protzen 1983: 185). Obsidian nodules of predictably high knapping quality appear to have often been transported with the cortex intact, as edges of stone tools may be fractured during travel and the cortical flakes may be in themselves useful, sharp cutting implements (Beck et al. 2002; Tripcevich and Contreras 2011). Large and heavy materials like architectural stone particularly require road construction, stream crossings, and other facilities (Protzen 1983), though depending on the level of infrastructure in place (and state apparatus), even relatively portable materials such as copper ores and chrysocolla may have required road building as Salazar and colleagues (Chap. 12) and Shimada (1994) demonstrate.

On an economic level, the characteristics of the material being extracted largely determine the geography of mine siting. The specific mine locations and adjacent processing areas may be preferentially located close to facilities like grazing for herds and sheltered locations for residence, or along routes used regularly by pastoralists (Stöllner 2008a: 71; Tripcevich and Contreras 2011; Tripcevich and Mackay 2011). Salazar and colleagues (Chap. 12) offer compelling evidence for mine siting to be determined, on the contrary, by ritually determined geographical concerns. Indeed, one of the commonalities that we found in many of the papers is that authors are beginning to acknowledge that mines were sacred in the Andes as Shimada (1994) and Nuñez (1999) have pointed out before. We return to this element of mining in further detail below.

Mineral Essence and the Symbolic Dimensions of Mines in the Andes

The power inherent in material from the earth to simultaneously contain physical presence, social linkages to places where mining occurs, and sacred power derived from an animated landscape brings the materiality of mined substances to foreground in many of these studies (Topping and Lynott 2005b). Underlying this is a perspective that humans inhabit a landscape with a moral obligation to relationships not just to other people, but towards the lands within which they dwell, the surrounding mountains, and the entities that permeate the environment (Ingold 2006, 2011). The presence of shrines and offerings at mining sites serves as empirical evidence for their ritual significance, but at a basic level the discovery and

exploitation of the mine may have been intertwined with a conception of geological formation processes that diverges from current scientific understanding. Is gold or copper found in a particular seam because it lies in a cosmologically auspicious location (despite our tendency to infer the reverse)? In Chap. 3, Dennis Ogburn discusses the evidence for quarry areas being revered as *huacas,* but further suggests that stones were quarried in some contexts because they were adjacent to pre-existing shrines at sacred landforms. In Chap. 12, Salazar and colleagues find similar links to regional cosmological patterns in the siting of Inca mine features in the Atacama region. While empirical evidence in the form of offerings or ritual structures are important to support claims of sacred power at mine sites, the essential power of the material may derive from its location or other characteristics. Citing ethnohistoric sources, Dean (2010) explores the transubstantial nature of sacredness in stone in the Inca empire. "The challenge here is to understand rocks not as a mineral matter of variable composition that the Inca and other Andeans mistakenly (or even charmingly) endowed with life force, but as ancient Andeans saw them—potentially animate, transmutable, powerful, and sentient." (Dean 2010: 5). While not *all* rocks were considered sacred, Dean argues that the Inca recognized that some rocks were simultaneously standard mineral composites and potentially imbued with power, making them much more than simple rocks. While Dean's book draws principally on ethnohistoric accounts of the contact period and focuses principally on architectural stone among the Inca, it provides an insight into the richness of Prehispanic relationships with the mineral world.

Indeed, ethnohistoric and ethnographic sources demonstrate that mines and quarries were often considered sacred in the Andes. Cobo and Jiménez de la Espada (1890 [1653]) described mines as *huacas* and ethnographic work by sociocultural anthropologists (discussed below) have shown that this conception is still pervasive. Many studies contend that the positioning of mines on the landscape and the act of mining often has ritual and symbolic dimensions that may not be a direct reflection on the geological deposit or the most economical way of extracting the material.

For the Inca, mined materials including metals and ores were considered a product of the earth, analogous to harvested crops (Nuñez 1999). People could "intervene in their emergence to the surface of the earth by mining, thus influencing the sacred power that had engendered them" (Berthelot 1986: 82). Today mines are still considered sacred in the Andes (Nash 1979). The most well-known ethnographic example of the symbolic importance of mines is in Oruro, Bolivia where, despite conquest by the Spanish and centuries of forced labor with institutional attempts to destroy belief systems (e.g., see Nash: 136 and Taussig 1980: 144), miners believe they penetrate the world of *Supay* (sometimes referred to as *Hahuari*, *Huari*, or in Peru, *Muqui* (Salazar Soler 2006), often translated as the "spirit of the hills," and called the "Devil" or "Tío" by the Spanish) when entering mines. Supay (or Hahuari in this telling of the legend) was a

> powerful ogre…believed to live in the hills and was identified with the "Devil" or "Uncle" of the mines. It was he who persuaded the people to leave their work in the fields and enter the caves to find the riches he had in store. They abandoned the virtuous life of tilling the

> soil and turned to drinking and midnight revels paid for by their ill-gained wealth from the mines…Hahuari lives on in the hills where the mines are located, and is venerated in the form of the Tio, or Devil, as the owner of the wealth of the mines. Llama pastoralists say they have seen him at night carrying the mineral on teams of llamas and vicunas into the mines where the animals deposit it and where it is found by the miners, who give their thanks in offerings of liquor, cigarettes and coca. The Tio controls the rich veins of ore and reveals them only to those who give him offerings
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> (Nash 1972: 223–224).

Supay is propitiated with several kinds of rituals. This was most famously expressed by a Bolivian miner who said to June Nash in her ethnographic fieldwork: "We eat the mines and the mines eat us. For that reason, we have to give these rituals to the spirit of the hills so that he will continue to reveal the veins of metal to us and so that we can live" (Nash 1979: ix). In one ritual called *K'araku*, offerings of a live llama are made to *Supay* for luck and to gain his good will (Nash 1979: 123). These rituals take place inside large gallery mines; in smaller mines, the sacrifice is offered at the mine's entrance. Other rituals called *Ch'alla* involve offerings of liquor, coca, cigarettes, the playing of music on a *chiranga* or guitar, and dancing within the mines (Nash 1979: 137). Clearly, these rituals incorporate elements of Catholicism and are in part due to the legacy of oppressive colonial mining (Nash 1979). We are certainly not suggesting that these provide direct analogies for possible rituals that took place in the Prehispanic Andes; however, the practice is at least consistent with Andean beliefs toward the sacred with roots in the Prehispanic period (Gil García and Fernández Juárez 2008: 106; Harris 2000; MacCormack 1984; MacCormack 1991).

Despite these associations, the remains of ancient rituals and offerings are found, though infrequently, in connection with Prehispanic Andean mines. One example was reported by Shimada (1994: 54) who found a cache of *Spondylus princeps* shells in structures associated with the Cerro Mellizo copper mines. Shimada argues that this cache along with other artifacts strongly suggest evidence for the symbolic importance of this particular mine. Others are reported here for the first time. Vaughn and colleagues as well as Salazar and colleagues (Chaps. 8 and 12) report finding *Spondylus princeps* shells in excavations of mines and their associated infrastructure. For example, Salazar and colleagues recovered spondylus remains in platform complexes at San Jose del Abra that they interpret to indicate that El Abra was a *huaca* in Prehispanic times. For their part, Vaughn and colleagues find the remains of finished and unfinished Spondylus within Mina Primavera and suggest that the mine itself had ritual importance and that ritual practice likely occurred within the mine.

Beyond evidence for ritual taking place within mines, several of the papers presented here suggest that archaeological evidence supports the notion that the essence of the mined materials had symbolic importance. For example, in Chap. 4, Janusek and colleagues find evidence for the primacy of stone in shaping native identities in the contemporary Tiwanaku region and argue that the shift from sandstone to andesite resonated with the broad political and religious transformation of Tiwanaku into an expansive polity. The ceremonial importance of minerals excavated from the earth is evident from the earliest times. As described by Salazar and

colleagues (2011), and expanded upon here in Chap. 7, the hematite mine of San Ramón 15 near Taltal in the Antofagasta region of coastal Chile contains the oldest evidence of mining in the New World with hammerstones found in layers dated to over 12,000 cal. BP. While hematite is known to have practical utility (e.g., in hide processing), the clearest local use is in ritual practices where hematite was used in abundance in an Archaic period mortuary tradition that even had resonance 10 millennia later in the Colonial period where ochre continued to be used in burials.

In Chap. 6, Jennings and colleagues report several chunks of salt possibly from the Huarhua salt mine found in tombs from sites 20 and 30 km away from the mine. While the evidence is not direct, the authors believe that their placement in tombs at least raise the possibility of the symbolic significance of the salt. Cantarutti in his paper (Chap. 9) suggests evidence for Inca state ritual on a ceremonial platform constructed at the summit of Mt. Los Puntiudos in Chile (including a possible *capacocha*) offered to ensure success of mining operations there. Salazar and colleagues (Chap. 12) describe three "administrative/ceremonial" sites in Atacama with common elements (Inca imperial pottery, part of sacred geography, and all associated with administration of mining centers).

Furthermore, when archaeologists find evidence for preferential use of particular materials, especially at some distance from the geological source, despite the availability of reasonable alternatives, these may be understood to represent social or essential ties to that source area. Regarding the Quispisisa obsidian quarry Tripcevich and Contreras (Chap. 2) reference the concept of "pieces of places" (Bradley 2000: 88) in recognition that non-local artifacts are not simply objects with their own history; these exotic goods may also impart references to people and places and to the power of the landforms where such materials are originally found. This notion is consistent with the Andean *pacarisca* considered by Ogburn in Chap. 3. He discusses quarries as sacred spaces [first identified as such by Cobo and Jiménez de la Espada (1890 [1653])] and that they were most likely worshipped as huacas. Ogburn also makes the important point echoed by many authors in this volume that if the quarries were *huacas*, their "essence" was incorporated into the major temples of the Inca Empire.

While mined materials are linked to the power of the landscape from which they derived, they may simultaneously communicate social links across space with regions where those items originate (Boivin 2004). Andean archaeologists have long used stylistic features to detect cultural affiliation across long distances, and stylistic motifs and exotic raw materials may both serve as vehicles for communicating social information across distance. However, while style communicates affiliation, motifs can be replicated using local materials. An item made from visually distinctive, exotic raw material may contain both the power inherent in the landscape, and be presented in a way that is palpable and communicative, and it cannot be reproduced using local materials if the use of distinctive exotics was crucial. Thus, access to particular materials and the circulation of goods may be tied to social identity, territorial rights, and an established relationship between social group and the material. In Chap. 5, Roddick and Klarich focus on the "social history of exploitation" of a material and to the persistence of particular pastes and tempers across centuries

despite changes in environment that may cause clay sources to disappear. The social context and technological choice involved in ancient mining were likely primary reasons for procuring those materials, and it is also a central puzzle for archaeologists seeking to parse the episodes of use of a particular source. These issues are incorporated into a holistic approach to quarries advocated by Bloxam (2011). Her approach evaluates mines, mining facilities, and the distribution system (to the extent that they are visible and preserved) in seeking socially constructed landscapes of particular use episodes of ancient source areas.

The Organization of Prehispanic Mining in the Andes

Colonial mines such as the well-known Potosí silver mines of southern Bolivia (Bakewell 1984; Platt and Quisbert 2008) and the cinnabar mines of Huancavelica (Burger and Matos Mendieta 2002) were large, extensive operations controlled by the Spanish Crown. The character of mining and concomitant metallurgy obviously changed drastically when the Spanish crown took control of the production process (see Van Buren and Mills 2005: 4), and unfortunately chroniclers are not liberal in their descriptions of the actual organization of Prehispanic mining.

Certainly, the ubiquity of a particular raw material, and the ways in which it was distributed across a landscape, would have had an effect on how efforts to control the resource were mediated. For example, in Chap. 5, Roddick and Klarich demonstrate that clays and tempers—both ubiquitous and widely available in the Andes—may have been difficult if not impossible to control. Other resources that had restricted distribution, especially those related to metallurgy, were much more amenable to state control. Indeed, ethnohistoric documents suggest that the Inca Empire had a fairly high level of authority and administration over mines in Tawantinsuyu.

For example, it is clear that the Sapa Inca's personal property included mines and mining operations (D'Altroy 2002: 301). Additionally, the Inca monopolized the richest mines of the Empire such as the silver mines of Porco, Bolivia (Bakewell 1984; Barba 1923) and Tarapacá (in Iquique, Chile; see Brown and Craig 1994; Cobo 1979 [1653]; Zori and Tropper 2010) and also (Berthelot 1986), and that the mines were exploited through mit'a labor. But, the Inca did not have a claim to all mines as some were exploited under the auspices of local *caciques* so that they would have appropriate gifts to give to the Inca:

> …Some of these mines were worked at the expense and under the auspices of the Inca himself, and others, constituting the majority, were worked at the expense of the caciques [lords] of the districts in which the mines were located. This was so that they would have things to give as presents to the Inca
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> (Cobo 1979 [1653]: 249).

Because of this, the largest mines and the most productive sources were reserved for the Inca, while smaller "community" mines were scattered around the empire and had various levels of control (Berthelot 1986: 72). Even with this ostensible autonomy given to local lords, the Inca installed supervisors in the provinces who were responsible for monitoring mining and to collect and weigh ore (D'Altroy

2002: 301) and ultimately, the Inca had absolute authority when the size of the work force and the collection of the minerals were concerned (Berthelot 1986: 74).

Mining seems to have been a seasonal activity (Van Buren and Presta 2010). Rowe (1946: 246) states "(gold mines) were worked only 4 months a year…All the gold was taken by the government, which kept inspectors at the entrance to the mining area to see that none was stolen." In high altitudes, mining was done in the summer, while Berthelot (1986: 74) states that mining was done year round where the weather permitted (e.g., in Huánuco and probably at Carabaya). Polo [(1940 [1561]): 165; cited in Berthelot 1986: 75)] also states:

> When the Indians went to the mines, there were persons who accompanied them in order to collect the gold that they found, no matter how large or small the quantity, since they were solely obliged to supply their labor, and the Indians therefore did not even know how much gold had been amassed, and no one dared to take the smallest piece for himself.

While chroniclers offer some tantalizing clues as to the importance of mining as well as to the extent that mining was controlled by the Inca, direct evidence for how mining was organized in the Andes has been limited. Some argue that one reason for this is that mining was a small-scale itinerant activity (Lechtman 1976: 41). Indeed, small-scale itinerant mining is a pattern seen in many indigenous cultures throughout the world (e.g., Ballard and Banks 2003; Knapp et al. 1998). However, recent indirect evidence for mining in the Andes has suggested that in some contexts it (and related activities such as metallurgy) may have been large scale and possibly state controlled.

For example, in Chap. 11, Carol Schultze (also discussed in Schultze et al. 2009) argues based on excavations at a metallurgical center in the Titicaca Basin that metallurgy was complex and large scale prior to the Middle Horizon Tiwanaku and well before the Inca Empire. Abbot, Cooke and colleagues (Abbott and Wolfe 2003; Cooke et al. 2008, 2009) have argued from indirect evidence (i.e., levels of lead and other metals in lake sediments) for increased metallurgical activities that metallurgy—and by inference mining—increased after the Middle Horizon with the advent of the Tiwanaku state and the Wari Empire. Missing from these arguments, however, is actual evidence for ancient mining. Many of the papers presented here present direct evidence for the organization of mining in the archaeological record.

For one, many papers in this volume demonstrate that mines were clearly an important part of the political economy of states from Tiwanaku to the Inca. Salazar and colleagues (Chap. 12), for example, show that the Inca radically changed the organization of copper mining in the Atacama desert by adding administrative facilities and by controlling the distribution of food and water in the region. Furthermore, these drastic changes to the region's landscape were probably managed by large-scale, state-sponsored feasting as the authors present compelling evidence for this activity in the El Abra complex. In Chap. 9, Cantarutti also presents persuasive evidence for state organization of mining in Chile. While not providing direct evidence for state organized labor, in Chap. 3, Ogburn makes the point that cut stone—a critical imperial commodity—demanded organization of labor for extraction, reduction, and transportation that greatly exceeds the requirements of other materials. Van Gijseghem and colleagues (Chap. 13) suggest that the organization and

control of mining in the Ica Valley peaked during the Late Intermediate Period when not only were populations at their highest, but polities were also at their most socio-politically complex. That these increases in social, political, and economic complexity correlated with an increasing concern for the control of the extraction of raw materials through mining is not surprising.

In contrast, Jennings and colleagues (Chap. 6) argue for a *lack* of state control in the organization of mining at the Huarhua salt mines. The disparity here may in fact be the differences in the raw material being mined. The demand for salt, while certainly highly valued and a necessity, created a different circulation pattern than that of copper and architectural stone. There may also be an element of "materialization" here that is inherent in the raw material being exploited. Copper, gold, pigment, and stone (to name a few) are raw materials used in crafts that can be materialized to convey a particular political or religious ideology (whether it is used to paint on ceramics, made into monuments, or crafted into luxury and ceremonial objects). Rather than being primarily a display item or emphasizing status differences, salt is a widely available—though irregularly distributed—necessity, like an "ordinary good" reflecting ethnic ties (Smith 1999). It was therefore likely to have circulated within networks moving staples and other basic goods.

It is important to note, however, that many of these minerals elude archaeologists' attempts at clear classification. While Huarhua salt extraction does not appear to have been organized by state institutions, Jennings and colleagues observe that salt seems to have been ascribed symbolic importance in certain times and places as it was found in Middle Horizon (ca. AD 600–1000) burial contexts in Cotahuasi. Similarly, Tripcevich and Contreras (Chap. 2) discuss the varied associations of obsidian, where fl discarded in middens and yet it also is found in ritual contexts and burials as early as 2000 BC. In sum, the materiality of a substance entangles many factors. We may generalize about the potential for control of a raw material source, and about the processing steps required, but strong evidence for the social and ceremonial importance of a given substance often derives from close attention to variability in the archaeological contexts in which it is found.

Furthermore, with smaller scale societies, not surprisingly, there is far less evidence for administrative control of activities in mines; one possible exception may be at Mina Primavera reported in Chap. 8 by Vaughn and colleagues. They link an intensification of mining and processing of hematite contemporaneous with the emergence of the Nasca polity that correlates with activities taking place at the region's ceremonial center to a demand for the mine's material. Another possible exception is with obsidian where Tripcevich and Contreras in Chap. 2 report on a number of sizable quarry pits at Quispisisa. These may be evidence of large-scale mining or of low levels of excavation sustained over millennia. Quantities of obsidian are exposed in gullies through natural erosion processes, which raises the question: *why dig quarry pits when it is abundantly available in gullies*? This leads the investigators to speculate that intensive procurement that may have occurred during particular times depleted the material exposed naturally in gullies, and hence the quarries are probably due to large-scale or state-sponsored mining when naturally available stone was unavailable.

Imperiled Resources

Ultimately, the papers presented in this volume demonstrate the importance of evaluating ancient mines and quarries in the Andes. These sites do not provide evidence merely of the economic and pragmatic aspects of Prehispanic life, they were important loci in the ancient Andes where sociopolitical, economic, and symbolic aspects of Prehispanic life in the Andes intersected.

As we stated earlier, ancient mines and quarries are exceptionally rare. With rapid development in the Andean countries coupled with an increase in transnational mining industries targeting raw material sources that have been exploited for millennia, we expect to see an increase in the destruction of ancient mines and quarries. One example of immediate concern is that a large portion of the river valley containing the Quispisisa obsidian source is slated to be flooded under a 2,500 million m^3 reservoir as part of the "Pampas Verdes" hydroelectric project (Electropampas 2003). It is this destruction of sites and the rarity of Prehispanic mines and quarries that make their study all the more urgent. Of course, we are not the first to declare urgency in the study of these sites (see, for example, Bloxam 2011 who also makes a broad appeal), but we hope that this volume is the first of many efforts to evaluate the importance of mines and mining in our study of the past.

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