Pre-Inca mining in the Southern Nasca Region, Peru

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Guided by modern miners of the region the authors track down pre-Inca mining sites in the Southern Nasca Region of Peru. In the hinterlands away from both modern and ancient roads they find a surprising number of small sites serving the pre-Inca industry, principally in the Nasca period. Drawing analogies from modern practice they are able to distinguish the ancient sites dedicated to exploration, extraction or production.

Keywords: Peru, Nasca, pre-Hispanic, mining

Introduction

Godoy (1985) has suggested that mining, as a process, is composed of three phases: exploration, development and production. *Exploration* is the most important and involves the search for and discovery of deposits used later in production (Godoy 1985: 200). *Development* involves extracting deposits, as well as establishing infrastructure for housing and transportation, if necessary. *Production* is the phase in which raw materials are processed (e.g. transformed, for example, through smelting) and turned into value-added goods.

The scale of mining greatly affects the nature and organisation of activities comprising these phases. Knapp (1998: 4) and Knapp and Piggot (1997) make a distinction between capital-intensive and what they refer to as 'informal' mining. In a contemporary context, capital-intensive mining is state- or company-run, requires significant capital investment and involves a high degree of labour specialisation (see also Bulmer 1975). The scale of capital-intensive mining particularly affects the development and production phases, including their spatial organisation (e.g. whether production sites are next to or spatially removed from mines), and social relations among miners.

Informal mining, on the other hand, is smaller-scale, part-time, often kin-based and characterised many pre-industrial activities. This form of mining is usually carried out by people living in agrarian-based communities who mine on a part-time basis, especially during seasons when demands for farming labour are low (Knapp 1998: 4; Shaw 1998). Goods are produced on a smaller scale, though can be reduced and moved over long distances.

In Peru, colonial mines such as the well-known Potosí silver mines of southern Bolivia (Bakewell 1984) and the cinnabar mines of Huancavelica (Burger & Matos 2002) were

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large, extensive operations controlled by the Spanish crown. Most evidence suggests that Inca mining was fairly extensive as well. At the Porco mines near Potosí there is documentary evidence for state control of mining and mining related activities (Bakewell 1984). Additionally, in north-west Argentina the Inca initiated exploration of tin and gold mines and enjoyed greater mining efficiency when they occupied the region in the latter part of the fifteenth century (Gonzalez 1979: 195). These bits of historical data imply large-scale and capital-intensive development and production in Inca mining.

By contrast, there is little evidence to suggest that any of the three phases of mining in the pre-Inca Andes was capital-intensive. The presence of metal artefacts (Lechtman 1991, 1994; Shimada & Griffin 1994; Gordon & Knopf 2007), smelting sites (e.g. Lechtman 1994; Graffam *et al.* 1996), and mineral pigments used on wall murals, textiles and pottery (e.g. Phipps 1989; Scott *et al.* 1998; Vaughn *et al.* 2005) implies, indirectly, that exploration, development and production of mineral resources must have taken place. While the extraction of gold, silver and copper has a long history in the Andes, extending back to at least 2000 BC (e.g. Aldenderfer *et al.* 2008), current evidence suggests that pre-Inca mining for metals was small-scale and informal (see, for example, Lechtman 1976: 41; Fuller 2004). As well, the use of obsidian and other flaked and ground stone materials far back in prehistory suggests at least informal mining for these resources (e.g. Burger *et al.* 1998; Burger & Glascock 2000; Jennings & Glascock 2002). However, the conclusion of informal mining may be biased by an absence of evidence for pre-Inca mining that was obliterated by Inca, Spanish, and more recent activities. For example, indirect evidence suggests that mining may have been extensive and state-controlled in pre-Inca times in the Titicaca Basin and in Central Peru (Abbott & Wolfe 2003; Cooke *et al.* 2007).

In this paper we aim to bring attention to ancient mining activities for metals in the Southern Nasca Region (SNR) of Peru (Figure 1). Hitherto research in this area has found little evidence for mining, perhaps because it has been focused on river valleys and their margins (e.g. Silverman 1993, 2002; Schreiber 1999; Conlee 2003; Vaughn 2004; Reindel & Isla 2006; Vaughn & Linares Grados 2006; Van Gijseghem 2006). In the course of our surveys and limited test excavation between 2002 and 2007 we recorded a range of pre-Hispanic sites at varying distances from the main river valleys and found considerable evidence for mining and mining-related activities. In order to interpret these activities, we draw on analogies with modern-day mining activities, geological settings and the distribution of material remains. In this way we hope to distinguish the phases of mining defined by Godoy, and the degree of industrialisation achieved in the pre-Inca period.

Contemporary mining in the Southern Nasca Region

Today, Peruvian mines are among the world's leaders in the production of copper, gold and zinc, mostly for export, and mining accounts for approximately 6 per cent of the gross national product (Gurmendi 2001). The vast majority of mining assets have been privatised and worked by foreign multi-national companies. Because many mineral resources are located in remote areas, mining companies have historically hired itinerant miners to work local deposits.

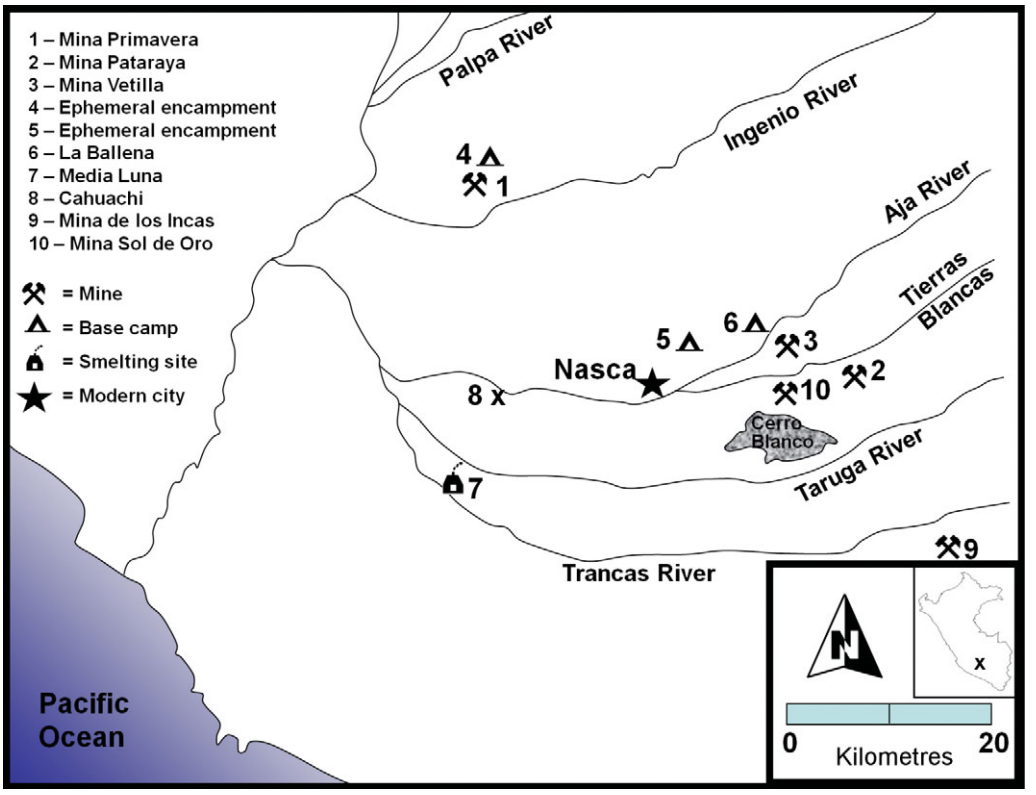

Figure 1. Regional map showing distribution of sites and locations mentioned in text.

We consulted with itinerant miners who work the SNR and are familiar with the landscape; they explained mining organisation and practices and took us to active, recently abandoned and ancient mines. In concert with our informants, we developed a typology of contempory mining-related sites reflecting their size and function. Sites fall into two general categories, those related to prospecting (exploration in Godoy's scheme) and extraction (development and production). Below we discuss this typology and its relevance to archaeological research.

Extraction sites

The contemporary mines range in scale from large (covering square kilometres) to test trenches quickly abandoned after failing to produce desired materials. The most visible are capital-intensive operations owned by multi-national mining corporations. Anyone who has travelled from the highlands (Puquio) into the Nasca Region has passed by the impressive gold mine called Mina Sol de Oro (now owned by a Canadian mining company) near the small hamlet of Orcona (Figure 1, no. 10). Off the beaten path, Mina de los Inkas is another large gold mine (Figure 1, no. 9). Such large mines are probably at a scale that far exceeded pre-Inca operations. With the exception of minerals which had little pre-Hispanic importance such as barite ($BaSO_4$; used as a weighting agent, particularly in petroleum

Figure 2. Contemporary short-term encampment next to mine. Note temporary nature of structure and assaying refuse on far right.

production), locations of large-scale mining today are also likely areas where pre-Hispanic mining, especially for gold and copper, took place. The scale and nature of operations at these modern mines, including the use of bulldozers, dynamite, construction of paved access roads, building of permanent offices and houses, and extensive tailings and terraces, would have obliterated any evidence of pre-Hispanic mining activity or associated encampments (something local informants told Caley and Easby (1959) almost 50 years ago).

The second type of mine in our typology is smaller in scale, usually covering between 100 and 1000m^2. These mines are typically operated by independent or contract itinerant miners or small-scale partnerships. Temporary housing structures made from reed matting are commonly found within a few hundred metres. Generators and mining equipment are usually present, as well as small piles of mining debris and chemicals for in-field assaying. Habitation debris, such as plastic bottles, glass shards, tin cans and food refuse commonly lie around these encampments. Figure 2 shows a temporary habitation associated with such a modern mine. A range of features and artefacts are represented, including an area where preliminary assaying has taken place. All of the pre-Hispanic mines we have recorded are in this medium size range.

The third type of mine usually covers less than 100m^2 and was probably used for short periods of time (several days to several weeks). It typically comprises a series of small pits or open tunnels that did not produce enough mineral to warrant continued and/or more extensive use. Debris at such mines, if any, is typically limited to isolated metal and plastic items. If such mines were used in pre-Hispanic times, evidence would probably survive

intact to the present. However, given that these mines today had only limited minerals, most were unlikely to have been used in the past, given the presence of richer mines falling into the larger categories, and we have not yet found pre-Hispanic materials at such mines.

All three mine types clearly include extraction activities, according to the Godoy scheme. Interesting to us is that initial production is also quite visible. For example, many of the camps attached to the medium- and large-scale mines had areas where ores had been crushed into powders and/or treated with various chemicals.

Prospecting sites

The second major class comprises small encampments not directly associated with a mine, and represents exploration in the Godoy scheme. According to informants, such encampments are constructed by lone or small groups (n = 2-3) of itinerant miners and serve as base camps for surveying and prospecting. They are often centrally located, for example at the confluence of *quebradas* (valleys), providing easy hiking access to a large area. They are typically found several kilometres up dry *quebradas* that run perpendicular to the main river valleys, at some distance (10km+) from the city of Nasca. Such sites allow miners to carry in and cache food, water and other supplies at a central location from where daily surveying and prospecting trips can be staged.

The size and permanence of these sites vary widely, ranging from very ephemeral camps comprising little more than a campfire and a few metal cans in a *quebrada* bottom (Figure 3), to more substantial locations up and out of the *quebrada* bottom (e.g. rockshelters). At the latter, arrangements of stone to support bedding and/or posts supporting temporary roofs are also often present. Minor amounts of habitation debris, such as plastic and metal containers, are usually present.

Occasionally such sites also contain rocks and/or small piles of crushed minerals where prospectors assayed materials from prospective mining locations. In one case, a hammerstone made of local material was noted in association with these assayed materials. Such assaying represents more intensive exploration activities on the part of miners, seeking to evaluate the quality in addition to the geographic location, of potential mineral resources.

Pre-Inca sites

Based on analogies with modern mining, we have interpreted a number of the sites found in our surveys as ancient mines and attached camps and/or prospecting encampments. Several of the sites represent extraction sites. Among the more impressive is Mina Primavera (see Vaughn *et al.* 2007) (Figure 1, no. 1). The site comprises a 20 × 30 × 2m (width × depth × height) human-made cave in a cliff-side of a narrow *quebrada* off the Ingenio Valley within a small seam of hematite (Fe_2O_3) in the local rock. Food, pottery and other habitation refuse suggested that miners had camped in the cave while removing iron oxides. Stone mortars found in the floor indicated some processing of the ore prior to transportation. Several AMS radiocarbon dates on maize cobs as well as temporally diagnostic pottery suggest most mining took place during the Early Nasca and Middle Horizon periods, probably to supply pigment raw material for potters and other artisans (Table 1).

Figure 3. Modern ephemeral prospecting camp, with hearth and scatter of modern artefacts and food refuse.

Table 1. Culture historical periods, ages, and median age.

Horizons/Periods	Local period	Culture	Approximate calendar years
Late Horizon	*–Inca–*	Inca	AD 1476-1532
LIP	*–Tiza–*	Tiza	AD 1000-1476
Middle Horizon	*–Loro–*	Loro, Wari	AD 750-1000
		Late Nasca	AD 550-750
EIP	*–Nasca–*	Middle Nasca	AD 450-550
		Early Nasca	AD 1-450
Early Horizon	*–Formative–*	Proto Nasca	100 BC-AD 1
		Paracas	800-100 BC
Initial Period	*–Initial–*		1800-800 BC

Mina Pataraya (Figure 1, no. 2) and Mina Vetilla (Figure 1, no. 3) are copper mines. Here direct evidence on the surface was obscured by contemporary mining activities, but stone retaining walls, pre-Hispanic pottery, flaked stone debitage and hammerstones demonstrate use during more ancient times. Most of these materials were carried up to these locations as they are not available in the geological deposits immediately surrounding the mines. Diagnostic pottery indicates use during the Nasca period, while a radiocarbon date of 2724 ± 38 BP (AA78042) on charcoal from a small hearth in one of the habitation terraces

Table 2. Radiocarbon dates from Media Luna.

AA Lab no.	Material	Date	Calibrated 2-sigma
AA78037	Charcoal within slag	199 ± 41	AD 1651-1951
AA78038	Surface charcoal from burned trees	57 ± 34	AD 1699-1955
AA78039	Charcoal from burned sediment in western mound	781 ± 35	AD 1219-1378
AA78040	Charcoal from burned sediment in large mound	16 526 ± 91	17 914-17 540 BC
AA78041	Charcoal from burned sediment in large mound	15 850 ± 180	17 467-16 863 BC

indicates use during the Early Horizon. Nearby artificial habitation terraces with small amounts of ancient refuse indicate miners camped near the mines while removing ores.

Our surveys have also produced examples of exploratory camps that miners utilised to stage prospecting in the surrounding region, again quite similar in location, layout and content to modern prospecting encampments. These sites range in size, permanence and degree of investment in the construction of features. An example of a more permanent encampment is the site of La Ballena, located 2.5km up a dry *quebrada* off the Aja River Valley (see Eerkens *et al*. 2008) (Figure 1, no. 6). The site consists of a medium density scatter of pot sherds, flaked stone and shell and includes at least four stone circular features 2-4m in diameter, which we interpret as the foundations of houses and storage facilities, and two medium-sized (approximately 4-8m on a side) rectangular patios. Excavations indicated low intensity but continuous occupation between the Early Nasca and Late Horizon periods. Large bifacial tools, along with percussion flaking debris, indicate on-site production of robust tools from local stone, probably used in prospecting activities.

An example of a smaller and more ephemeral camp includes a small site near Mina Primavera (Figure 1, no. 4). The site is comprised of one, possibly two, small artificial terraces lacking stone foundations and a very sparse scattering of hammerstones, percussion flaking debris and undecorated pot sherds. The lack of major investment in terracing and the minimal numbers of artefacts indicate temporary and short-term occupation, and the lack of temporally diagnostic artefacts precludes determination of age. An even more temporary encampment is represented by a site consisting only of a sparse scattering of pot sherds, including several diagnostic of the Late Nasca period, in a *quebrada* off the Aja River Valley (Figure 1, no. 5). Its location among boulders above the *quebrada* bottom suggests a place where food and/or water resources were cached.

A final example, Media Luna, is a production site, associated with smelting ores. Media Luna is in the Trancas River Valley (Figure 1, no. 7) and contains several mounds covered with ash, slag, lithic and ceramic artefacts. We believe this area was chosen to smelt ores due to its proximity to resources known to be important to metallurgists (Petersen 1970). Those resources include: limestone deposits (used as a flux), permanent water, wood for fuel and wind that funnels down the canyon (Bakewell 1984; Lechtman 1991: 44; Van Buren & Mills 2005). Radiocarbon evidence also suggests use of ancient Pleistocene-aged wood, probably from the river bottom (see Graffam *et al.* 1996 for similar activities in northern Chile). Diagnostic sherds and radiocarbon evidence suggest use from the Nasca to the Colonial periods (Table 2).

Figure 4. Pre-Hispanic mining features and artefacts. Left-hand side shows retaining wall overlain with modern tailings and mine shaft in background (Mina Pataraya; no. 2 in Figure 1). Right-hand side shows materials from exploration sites including stone foundation for small house (top; La Ballena; no. 6 in Figure 1), unpainted pot sherd and hammerstone (middle; no. 4 in Figure 1), and large flaked stone implements (bottom; La Ballena).

Certain tools and artefacts characterise the sites we have surveyed. Plainware ceramics, hammerstones and large and robust unifaces and bifaces made from coarse-grained volcanic materials are commonly present (examples in Figure 4). These tools are very similar to descriptions and photographs of tools associated with the 'Copper Man' in Chile (Bird 1979), and tools described by Shimada *et al.* (1982) associated with the copper mine next to Batán Grande. In the better-preserved Mina Primavera we also found textile remains of bags (also found with 'Copper Man'). Organic remains are less likely to survive in open-air sites, particularly at the slightly higher elevations we have been working (*c*. 1000-2000m), but were probably also part of the typical mining toolkit. Painted sherds and Spondylus shell are less common, and other higher-status goods are absent.

There is also evidence of primary production of mining-related tools at many of the ancient sites, especially prospecting encampments. Thus, large primary cortical flakes fashioned from nearby materials are usually present. Rather than bringing finished implements with them, miners appear to have fashioned mining tools from local materials at such base camps before

carrying them to the actual mines. Spent tools appear to have been replaced at some of the base camps as well.

Discussion

Is modern Peruvian mining a good model for understanding and interpreting pre-Inca activities? Certainly, aspects of mining have changed with the use of generators, mechanised equipment, dynamite and other capital-intensive equipment. New techniques in smelting and mineral separation, a globalised marketplace and great demand for resources such as copper make for vastly different economic incentives for mining. Similarly, mining of minerals of no use to pre-Hispanic populations such as barite and tungsten, have no pre-Hispanic analogue.

At the same time, the basic activity, the extraction of mineral resources to meet certain technological needs, has not changed. Much of the landscape, especially away from the valley bottom still lacks electricity and water, and paved roads are still not present in most regions. Even today, with the notable exception of dynamite, the principal means of extracting minerals and transporting mining tools, minerals and other resources to and from roadways is human and animal labour. It is clear that there are many more modern mines and encampments than ancient ones. Some of this may be attributed to decomposition, erosion, and removal of the pre-Hispanic record. However, the major reason, we believe, is due to more intensive prospecting and extraction in recent times due to larger populations and increased demand for mineral resources to meet Peruvian and global needs.

Large mines today often have permanent and impressive architecture, guard stations to keep out unwanted individuals and have greatly modified the surrounding landscape through the deposition of tailings and/or massive terraces. Although there is always the possibility that these modern large-scale extractions have obliterated evidence for large-scale extraction in pre-Inca times, no analogous prehistoric evidence was found at any of the large mines we visited. In other words, though pre-Inca populations did invest significantly in the modification of the landscape, as seen in monumental architecture at Cahuachi and the Nasca Lines (e.g. Silverman 1993; Isla & Reindel 2005; Lambers 2006), mines and prospecting camps did not apparently receive similar investment. There is no overt evidence for any high-level political or economic control over the exploration and development of the mines and mining camps we have investigated. On the other hand, loci of processing and production, such as Media Luna (for metals) and Cahuachi (for pottery; Vaughn *et al.* 2006), witnessed significant investment in infrastructure, and by extension greater pre-Inca political and economic control.

Our sample of pre-Inca mines and prospecting camps, while still small, has been growing with every field season since 2002. We feel we have now recorded enough of these sites to identify some emerging patterns regarding their location, composition, and diversity. Although temporal information at many sites is, at present, limited to surface remains, the Nasca period is especially well represented in ancient sites. Middle Horizon artefacts are slightly less common, the LIP and Late Horizon only minimally represented, and outside of a radiocarbon date at Mina Vetilla, the Early Horizon and earlier periods not at all. Part of this pattern may be a product of the length of the Nasca period (e.g. 750 years *vs.* 250,

476, 100 and 800 years respectively). However, even taking this factor into account, and assuming some attrition of the archaeological record through later mining activities, it is our impression that the Nasca period is prominent. This suggests that significant mining activities in the SNR, at least organised along the lines discussed below, began around 2000 years ago and decreased slowly thereafter.

The size and density of artefacts on the sites we have investigated suggests small-scale activities. This is not surprising as most historical mining enterprises have grown out of small-scale exploration (Godoy 1985: 200; MacMillan 1995; Knapp 1998). Godoy further suggests that promising locations discovered during exploration are slowly developed by such small groups, with investment in the mines proportional to yields and demands. Richer mines are prime targets for confiscation and additional development by more powerful organisations (Godoy 1985: 202). None of the mines we visited suggest either large-scale extraction or association with a political organisation beyond small groups of miners. Among the larger sites, Mina Primavera is only 20 × 30m in size and does not have any associated habitation terraces. It is unlikely that more than approximately 10-15 miners could have simultaneously lived and worked in this mine. Similarly, Mina Vetilla contains only 25 small artificial habitation terraces. If half of these terraces were occupied at any one time, by an average of three miners, this suggests only 35-40 miners simultaneously working the mines. Mina Pataraya contains only two adjacent terraces, indicating even smaller-scale operations. This can be compared to the 4000 labourers working at the cinnabar mines in Huancavelica in early Colonial times (Burger & Matos 2002).

Our findings, then, are consistent with most previous assessments of the scale of pre-Inca mining in the Andes (e.g. Lechtman 1976; Shimada *et al.* 1982). We believe that the statements of Abbot and Wolfe (2003) and Cooke *et al.* (2007) who suggest that pre-Inca mining was probably extensive and state controlled, should be taken cautiously. While most of the mines and mining related sites that we have recorded relate to the Nasca culture, a pre-state society (Schreiber & Lancho-Rojas 2003), we do have some evidence for mining by the Wari state at Mina Primavera. Given the importance of hematite in pottery production to the Wari (see Vaughn *et al.* 2007: 19), we feel that if the Wari state had had direct control over the operations at Mina Primavera, their presence would be more visible. Excavations at additional mines should clarify this hypothesis.

Conclusions

Our research in the SNR has recovered pre-Inca data pertaining to all three of the phases described by Godoy (1985): exploration, development and production. The best surviving evidence for pre-Hispanic mining generally comes in parts of the modern landscape that are distant (greater than 0.5km) from water and roads. Such locations are more expensive to work today, thus retain ancient signatures. Of course, such mines were probably more difficult to exploit in ancient times as well because food and water would have to be carried in. As a result, it is likely that we somewhat underestimate the extent of pre-Inca mining activities because we lack evidence from the most obvious and easiest to access places on the landscape, that is, the locations of large modern capital-intensive mines. Excavation under modern tailings at such mines might reveal buried and preserved pre-Hispanic materials.

However, given the sensitive and economic nature of gold, silver and copper resources, it may be difficult to gain safe access for such investigations. Nevertheless, with the cooperation and collaboration of local miners and officials, and the Peruvian government, we hope to conduct such research in the near future. It may also be possible to uncover more indirect evidence for mining at these locations by investigating nearby habitation sites and/or deposits of sediments downstream or in nearby lakes (e.g. Abbott & Wolfe 2003; Cooke *et al.* 2007).

We believe that pre-Inca mining activities retain many structural similarities to modern ones, excepting the capital-intensive mines operated by multinational corporations. The scale and organisation of pre-Inca activities, like modern exploration and prospecting, was small, and could be referred to as 'informal mining'. Groups of miners (n = 1-5), perhaps kin-related, probably prospected in the broader SNR, particularly in intrusive volcanic and sub volcanic geological formations (see Sillitoe 2003). They worked veins and deposits in hopes of finding concentrations of copper, gold, silver, hematite and other mineral resources. At more promising locations, additional effort was expended to develop minimal infrastructure (e.g. terraces and housing). Even then, we estimate that only small groups (e.g. 10-40) of miners worked these mines.

There is no obvious evidence for overt control over such mines or prospecting camps, such as capital-intensive construction of roads, guard stations or elite housing to oversee activities. This suggests that, like today, itinerant miners, perhaps under contract or commission by a larger political entity, operated independently in the SNR. As in other regions of the world, we believe that this informal mining probably occurred during seasons when people were free from agricultural labour – a time that was probably used to pursue craft production as well.

What is particularly interesting to us is the continuity of informal mining in the region over the millennia despite the political hegemony of three empires (Wari, Inca and Spanish) demonstrating the resilience of this economic and social activity. Testing our proposed model of pre-Inca mining will require additional survey and excavation and the posing of harder questions. Who were the miners? How were they related to each other? To what degree were their social relations impermanent and ephemeral? Addressing such issues will also require additional excavation in valley-bottom villages adjacent to potential mines to determine their role, if any, in mining activities. Unfortunately, one of the greatest challenges in this work is the destruction of ancient evidence caused by contemporary mining undertakings. This destruction has been accelerated over the last decade due to the marked global increase in the price of copper, which has brought many miners back to small copper mines, some of which were used in pre-Inca times. Thus, there is some sense of urgency in investigating the sites we have found and in finding new ones.

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