January, 2006

Production and Exchange of Obsidian from the Colca Valley, Arequipa Perú

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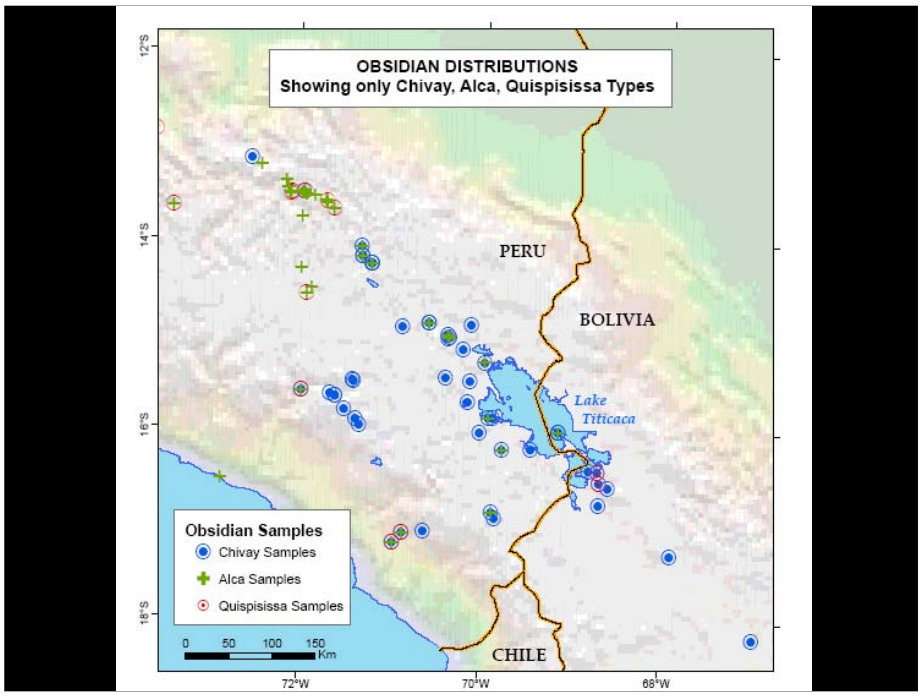
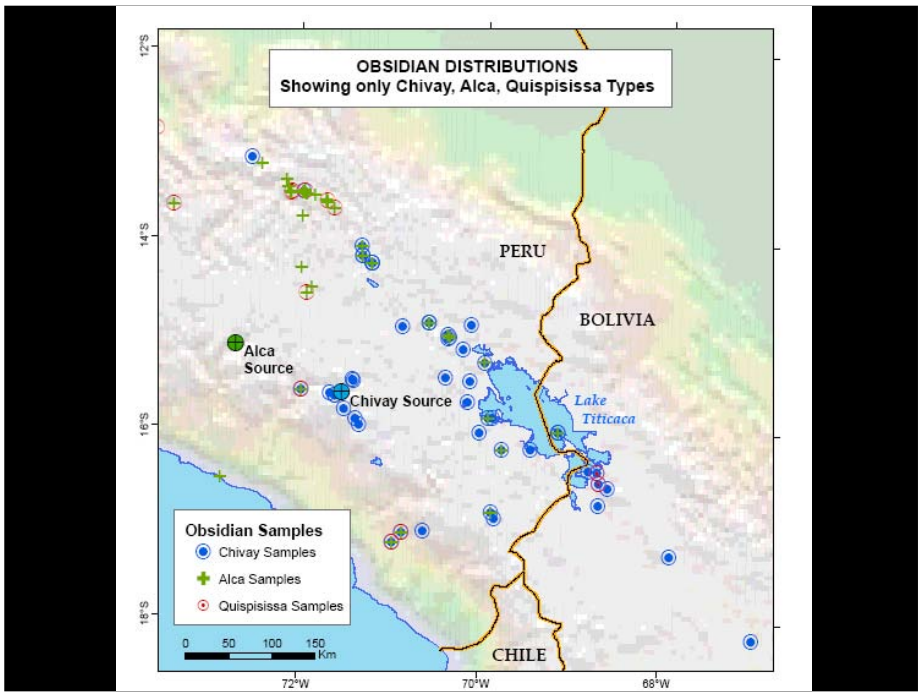
Tripcevich, Nicholas, 2006. Production and Exchange of Obsidian from the Colca Valley, Arequipa Perú. Paper presented at the 46th Annual Meeting of the Institute for Andean Studies, Berkeley, CA.

In Andean archaeology, it is stylistic evidence that form the basis for many investigations of long-distance relationships and evidence of regional interaction. From hunter-gatherer projectile point type distributions to evidence of expansive states like Wari and Tiwanaku, the basis of much of the inference regarding prehistory in the Andes is stylistic relationships in workmanship, architecture, or iconography. In the past fifty years chemical characterization studies have permitted a second basic form of regional evidence to emerge: provenancing studies.

Provenancing studies complement stylistic evidence because chemical provenance provides unqualified evidence of contact between two regions. With provenancing studies: We know that a material was transported from one area to another, we just don't necessarily know much about how it got there, or who brought it, except through context. So stylistic approaches and chemical provenancing complement one another in allowing us to describe the prehistoric geography of cultural influences and economic relationships. In this presentation, I will discuss our research at the Chivay obsidian source and some of the implications of Chivay obsidian distributions in the prehistory of the south-central Andes.

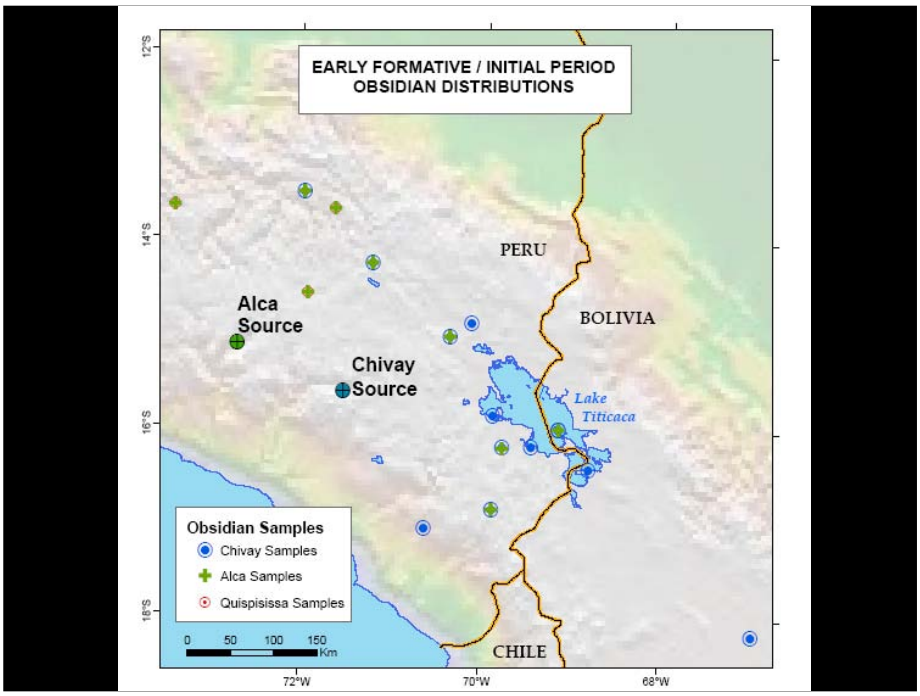


As described by Richard Burger at this conference last year, major obsidian sources are often identified by tracing backwards from the consumer sites to the geological sources. For twenty years, from the 1970s until the 1990s the Chivay source type was known as the "Titicaca Basin Type" because it represented over 90% of the obsidian artifacts found by Burger and colleagues among samples from the Lake Titicaca Basin.

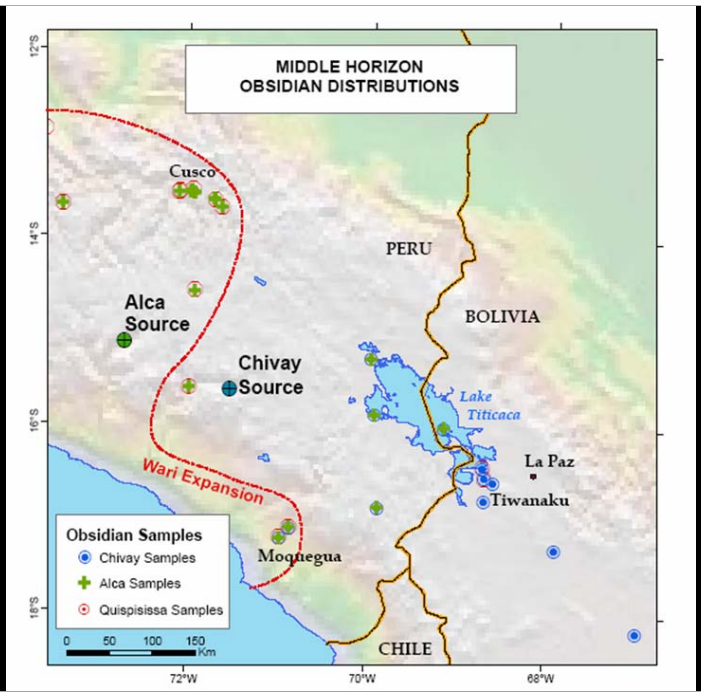


The actual location of the geological source above the Colca Valley of Arequipa, hundreds of kilometers to west of Lake Titicaca, was documented by two investigators working separately: Sarah Brooks who named it “Cotallaulli” and Richard Burger who calls it “Chivay”. Before describing our work at the source area I will highlight a couple of interesting patterns in Chivay obsidian distributions that demonstrate how obsidian data can be compared with other regional archaeological data, and how research at the source can shed light on Andean historical processes.

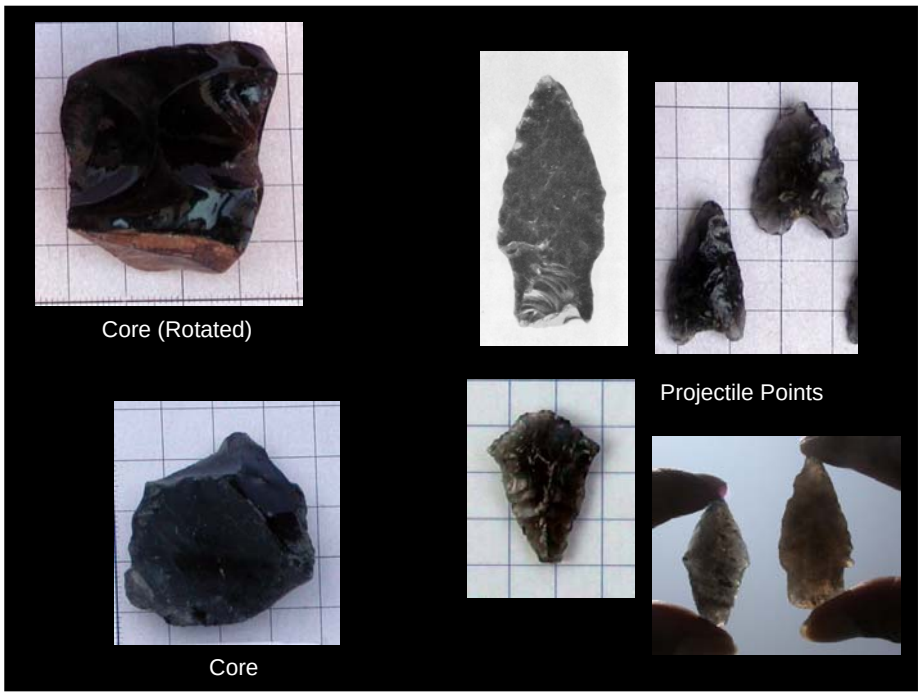
As Burger observed early on: compared with other widely distributed obsidian types in the central Andes, the Alca and the Quispissa types, the Chivay obsidian distribution is remarkably altiplano focused. From Middle Archaic levels in Moquegua, 200 km to the south, through to a Late Horizon distribution that includes Machu Picchu, Chivay obsidian has only once been documented below 2000 m in elevation, at the Tiwanaku site of Omo.



A second notable pattern is that obsidian distributions show substantial regional interaction in the Terminal Archaic and Early Formative, around 2000BC, prior to stylistic evidence of interaction from ceramic traditions. During this time period, also known as the "initial period", Chivay obsidian is found in quantity at Quelcatani far to the south, and it appears in the Cusco valley; and Alca obsidian is also found in larger geographic distributions than during subsequent periods. The projectile point forms change to concave based forms. The evidence from obsidian distributions lends support to the decentralized caravan mobility model of early Andean cultural development proposed by Nunez and Dillehay.



Finally, the Middle Horizon distributions of obsidian contrast in some ways with other regional data concerning the development of pristine states in the Andes, and these can contribute to understanding state economy and the role of state peripheral areas during the Middle Horizon. Specifically, distributions of Chivay obsidian conform closely to expansive Tiwanaku's limits, but remarkably, no stylistically Tiwanaku materials have been located at the Chivay source or in the Colca more generally. There are Wari influences in architecture and ceramics, and the Colca appears to have acted as a frontier zone between the states, but one that exclusively exported obsidian to Tiwanaku. Multiethnic access to sources of raw materials such salt and stone that fall between territorial zones have been documented ethnographically, and perhaps multiethnic access is the situation during the Middle Horizon at the Chivay source.



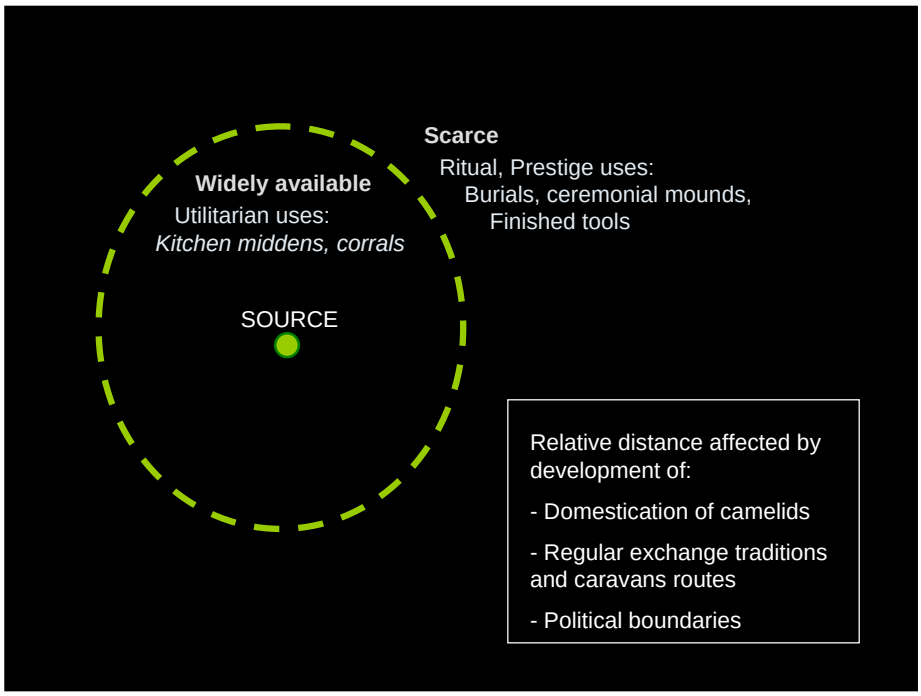
In order to explore the role of obsidian in prehispanic economies, we must consider the form and the value assigned to obsidian in the past. Obsidian is a natural glass that forms from silica-rich magma with unique geochemistry that permits provenancing. From a practical standpoint, its conchoidal fracture permits obsidian to be flaked into tools relatively easily – tools that can have extremely sharp edges. However, there are also functional disadvantages to obsidian because it is a comparably brittle material that splinters and fractures with impact, and yet the vast majority of formal tools produced from obsidian in the Andes were projectile points. In a utilitarian sense, obsidian knives and simple flakes are also valuable among pastoralists for butchering and for sheering wool. As obsidian flakes are brittle but sharp, wool shearing was an important utilitarian application of obsidian.

The visual properties of obsidian set it apart from other stone materials because the natural glass reflects light, highlighting the knapping workmanship and sharp edges. As Heather Lechtman observes in her discussions of Andean metallurgy, color symbolism plays a significant role in Andes in visual manifestations of status and power. Obsidian tools in the Andes are typically a translucent grayish black, exhibiting a purity of material and sharp edges. Yet, given the brittleness of obsidian such weapons are perhaps better *seen*, representing the threat of violence, than actually used, since they can break easily. Perhaps this explains why hunters must hunt to survive often use andesite or chert points, while obsidian points predominant during later times when projectiles were probably used to against human targets.

Obsidian is sometimes interpreted by archaeologists as having had ritual power, particularly in the “consumption zone” far from the source, as obsidian flakes and points are often found in burials.

Black-tipped darts, perhaps obsidian, are common in Paracas and Nasca iconography, and they are sometimes depicted in association with trophy heads.

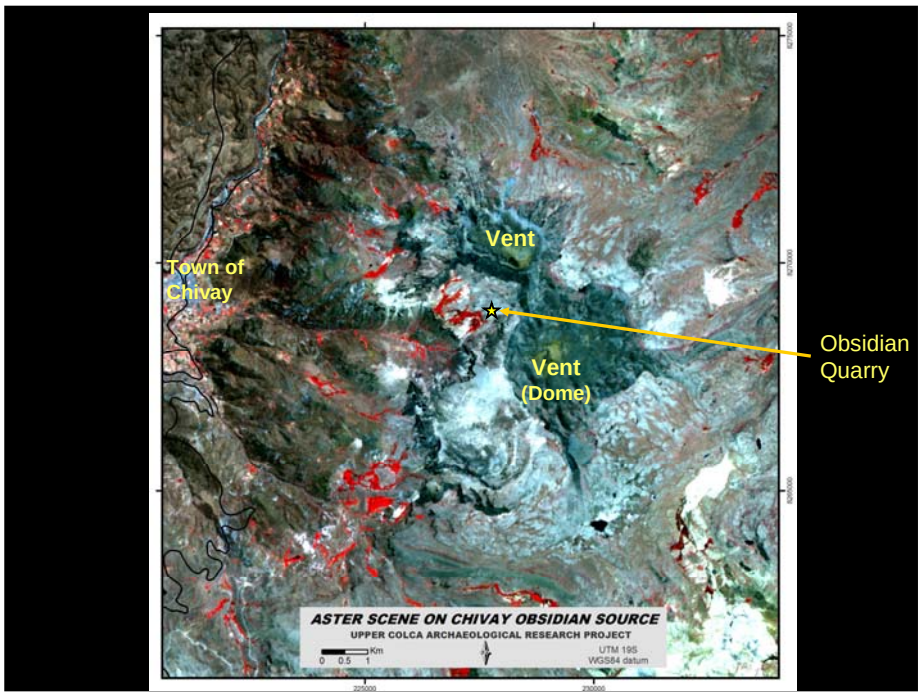
As a means of comparison I’d like point out that crafts specialists in stratified societies such as Mesoamerica, used obsidian to produce elaborate flaked and ground pieces as well as prismatic blades, a very efficient technology for producing cutting edges. In the south-central Andes obsidian was used only for bifacial tools and simple flakes for cutting.



Over the course of Andean history obsidian was widely available – obsidian flakes seem to turn up both in residential middens and in ritual contexts. Close to obsidian sources the material was probably not seen as extraordinary, indeed it doesn't appear in burials close to the Chivay source, but following the classic distance-decay pattern the material seems to acquire increasing potency with distance from the source. Thus, close to the geological source the distributions of obsidian are probably comparable to those of relatively utilitarian products like salt or ch'arki. However, with distance from sources of obsidian the material appears to gain greater ritual importance and to be associated with leadership and power, particularly during the later parts of the Archaic and the Early Formative period before the elaboration of other forms of crafts production.

Developments in prehistory, like the domestication of camelids, the establishment of regular caravan routes, and changing political boundaries, would have also altered the relative cost of transporting obsidian to a given consumer site.

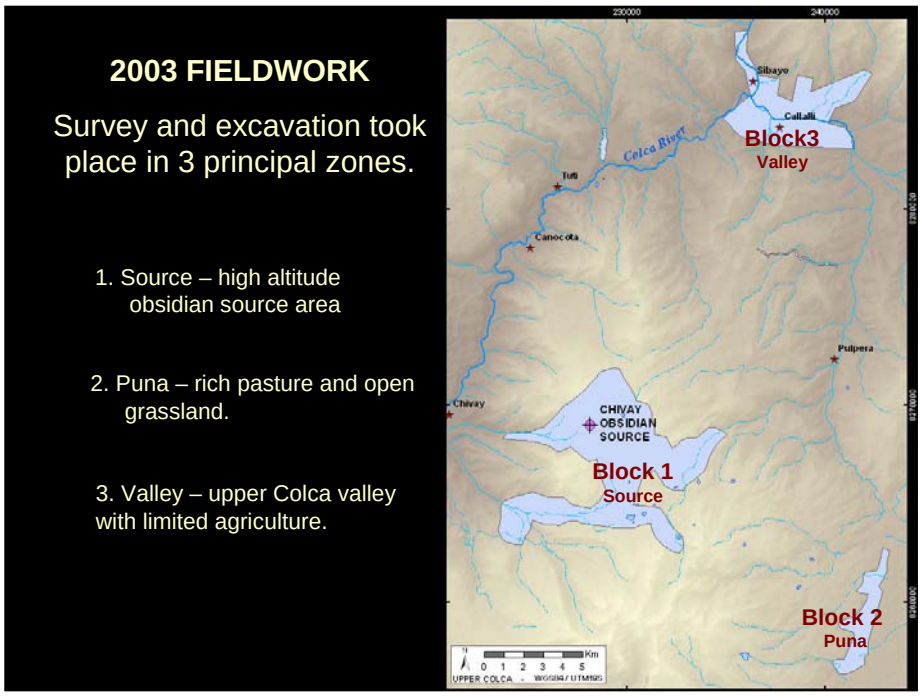
At this point I will describe our work at the Chivay obsidian source and I will subsequently return to discuss distributions of the Chivay type obsidian in the prehispanic Andes.



In the Colca valley of western Peru the largest and most homogeneous nodules of obsidian can be found in a volcanic depression high above the town of Chivay. It appears that sometime near the end of the Tertiary the eruption from the two vents, produced lava flows to the north and east as well as ignimbritic ash fall. One interpretation is that a rhyolitic dome formed from the southern vent on edge of the ring fracture and flows of Chivay type obsidian are found at the contact zone between this southern rhyolitic dome, which subsequently collapsed, and the underlying Tacaza layer. After millennia of human exploitation of this source, the best remaining nodules of obsidian can be found in unconsolidated flows by digging into the tephra ash mantle. Nodules up to 30cm on a side have been found in the area.

Two surveyors at ~5000m (16,400') above sea level.

Our goal was to document not just the obsidian flows and associated archaeological sites, but also to survey adjacent terrain in order to evaluate local subsistence and the patterns of obsidian use by people who resided close to the source. The problem presented to our research design was that the source is at nearly 5000 meters elevation and vast areas consist only barren talus slopes and tephra. How were we to evaluate this large and roadless region at a sufficiently fine scale to detect small lithic scatters?



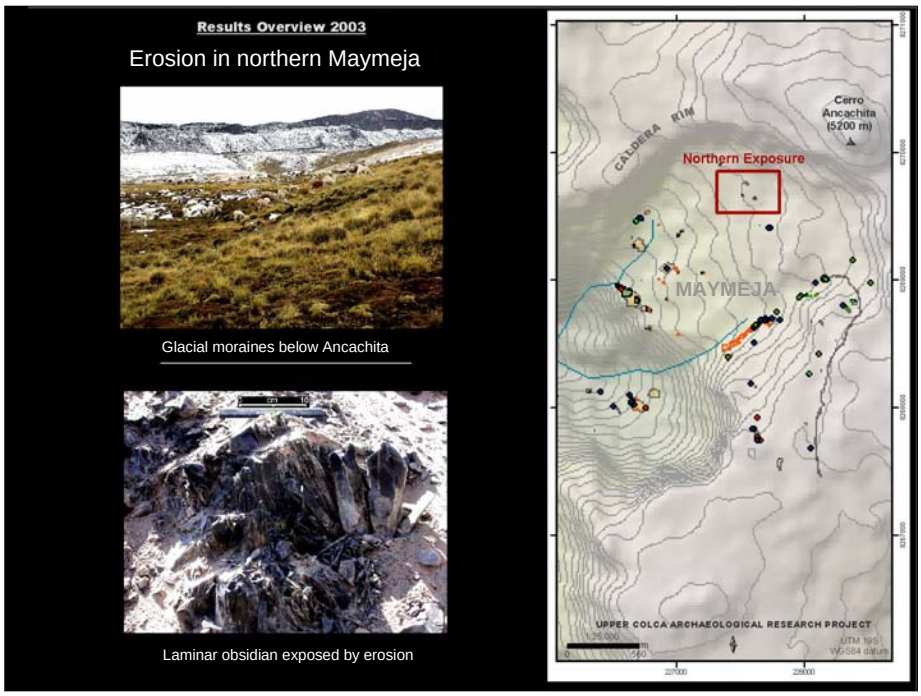
I designated three survey blocks for intensive survey using a surveyor interval of no more than 15 meters, and the areas between these survey zones that I judged to have a “high likelihood” of obsidian quarries or archaeological sites were visited on targeted reconnaissance trips.

Block 1 is the source area itself,

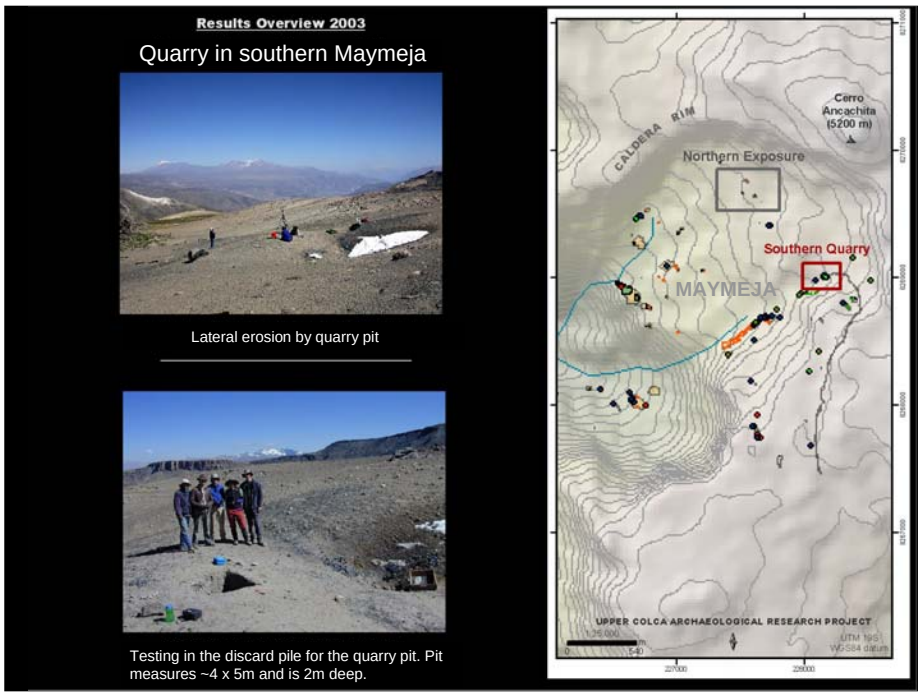
Block 2 parallels a large puna grazing area where the rugged volcanic terrain opens to the altiplano, a natural route towards Lake Titicaca, and

Block 3 is around a confluence in the upper Colca river valley at 3900m, just above the altitude of modern intensive agriculture in the valley.

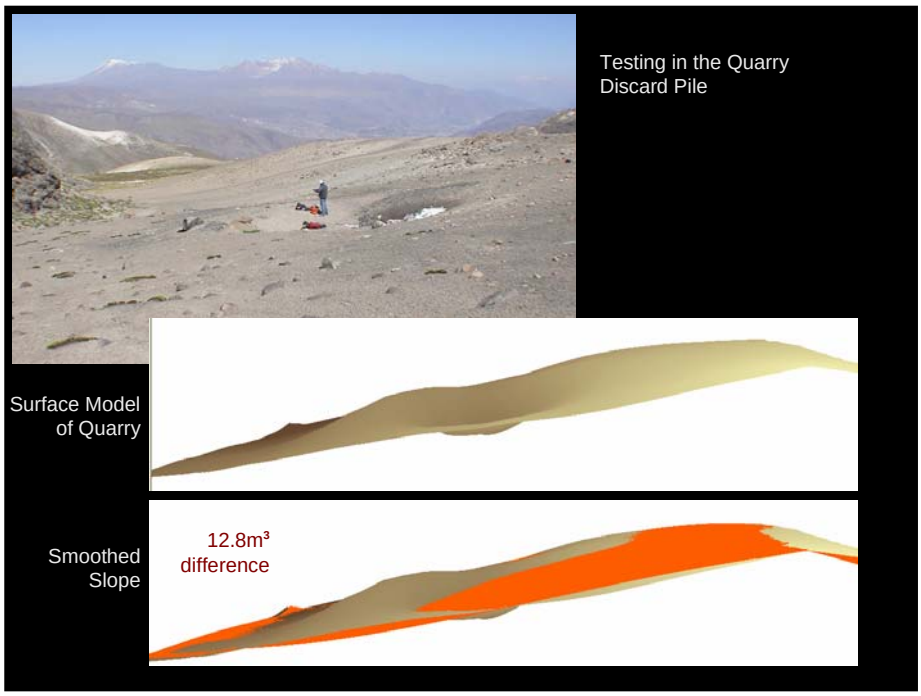
The work at Block 1, involving six weeks of survey and excavation at the obsidian source, was the most arduous stage. It took a whole day to climb the 1200 vertical meters from Chivay even with donkeys to carry our supplies. After the first week of fieldwork these donkeys also began carrying down bags of obsidian artifacts and soil samples that added up to 450 kilos by the end of this stage of the project. We worked at the obsidian source in August during the dry season and we had tremendous views of the Colca, Nevado Ampato and Coropuna, but as it was winter we also had nighttime temperatures of minus 12 centigrade. I didn't think to get a large kitchen tent, so during the mornings and evenings preparing meals outdoors at over 4800 m it was miserably cold. These conditions gave us a great respect for the people who worked at the obsidian quarry in ancient times!



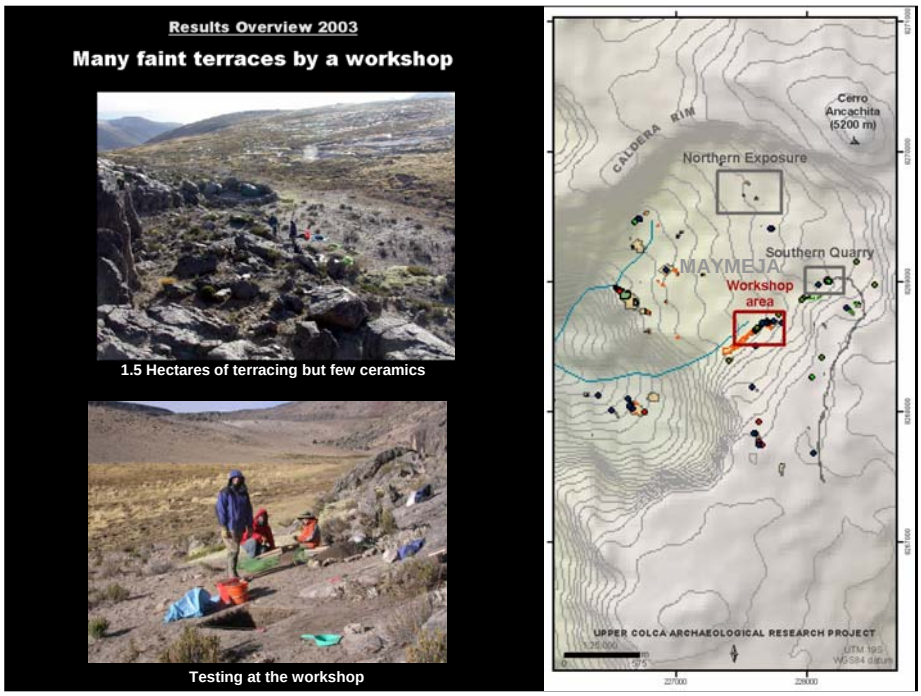
Our research at the obsidian source showed that the only remaining obsidian flow to strike the surface, on the north side of the large, circular volcanic depression that herders refer to as “Maymeja” is jointed and fractured and poorly suited for tool making. Perhaps the material was fractured from the erosive action of Pleistocene glaciers that occupied the Maymeja area.



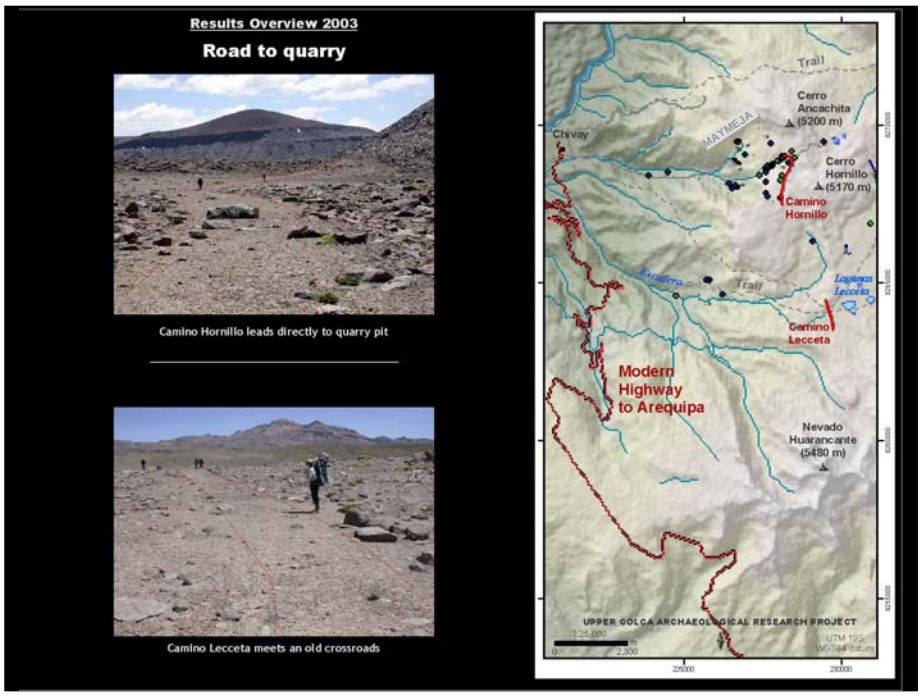
On the south side of the volcanic depression we located a quarry pit in the ashy soil that measures 4 by 5 meters and is 2 meters deep despite having been filled in over the years. A test unit was placed in the discard pile below the quarry hole, but it produced no datable carbon and less evidence of actual obsidian knapping than we anticipated at the quarry. Nodules from this quarry pit were from a disarticulated obsidian flow that was covered with a meter of tephra ash, but this tephra probably protected the obsidian from erosion and thermal fluctuations that can fracture the glass and hence the obsidian in this area was worth excavating for. The nodules were relatively large with a very thin cortex, and the material was uniformly good for tool making. It seemed likely that a significant portion of the nodules could have been immediately loaded onto the panniers of cargo animals without further reduction in the source area.



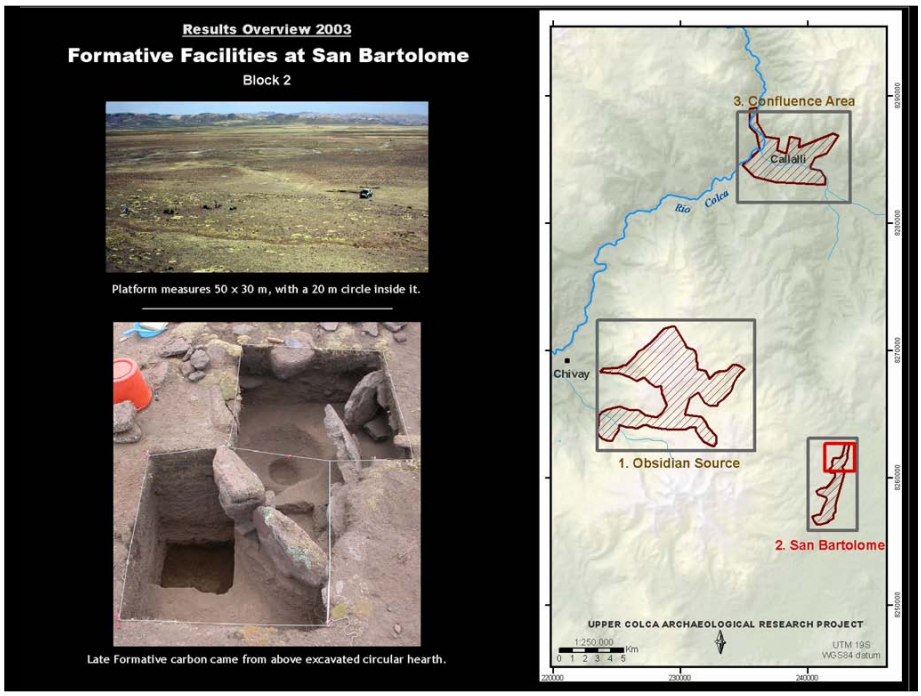
In 2004 I brought a total station to the quarry pit and a calculation from our surface map against a hypothetical slope suggests that a volume of 12.8 cubic meters has been removed in the process of quarrying.



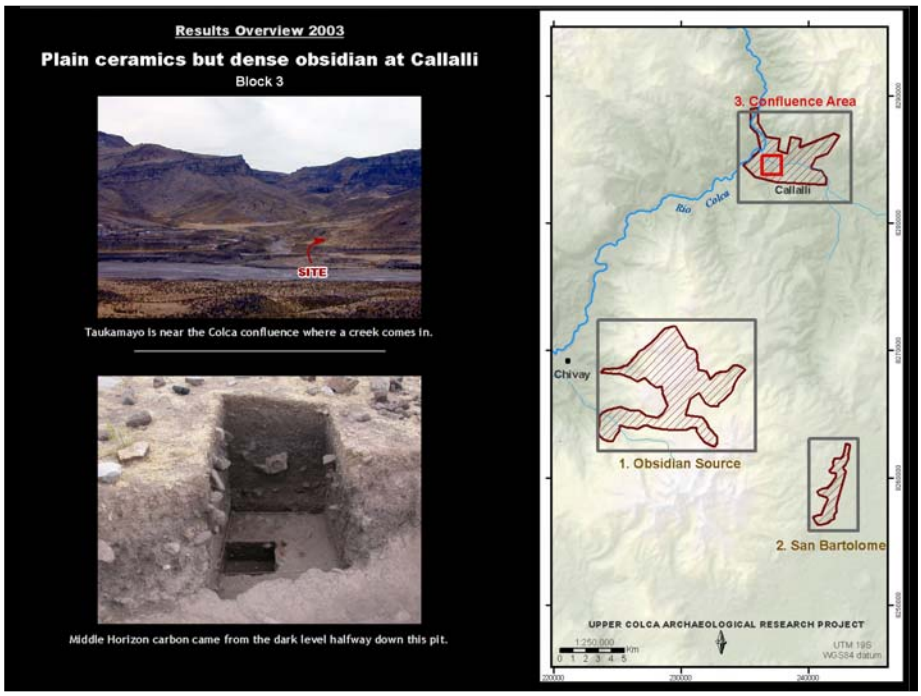
Additional evidence from our research at the obsidian source was found 600m downslope from the quarry pit in a more sheltered area and close to the best source of water. Here we mapped 1.5 Hectares of eroded residential terracing with virtually no ceramic sherds. At the base of the terraced area a workshop consisting of a dense mound of flaked obsidian measuring 3x4 m was identified, and a larger region measuring approximately 10 by 20m is blanketed in obsidian to unknown depth. In a test unit placed in the mound we identified a possible clay floor surface at 1 m depth as well as ash stains, and three c14 dates place our levels at the workshop between the Terminal Archaic and the Middle Formative periods, or between 2880BC and 1260BC.



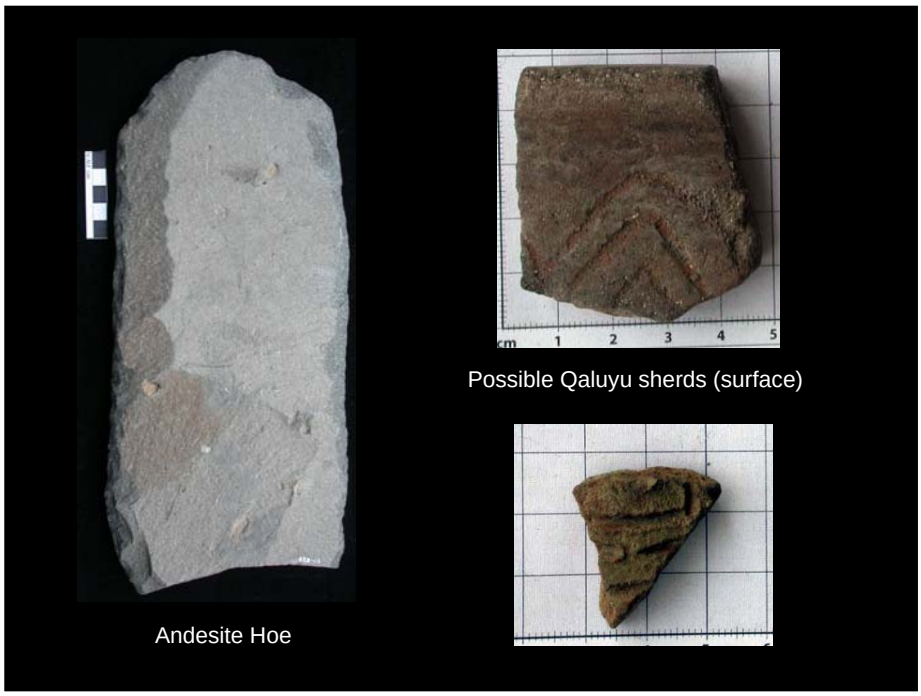
In the course of our survey of the Maymeja area a probable pre-Columbian road was located that leads directly to the quarry pit previously described. While roads are notoriously hard to date, this route is a swath 2-4m wide that is consistently cleared of all but the largest rocks for a distance of 3 kilometers. Here I've highlighted the route in red. No ceramics were found in association with this road, though a terminal archaic projectile point was found adjacent to it.



Our research in blocks 2 and 3, away from the obsidian source, showed marked contrasts in the different ecological zones. Block 2, the gateway to the altiplano, is the natural route to Lake Titicaca and we thought that if Tiwanaku artifacts were to be found in the Chivay source area it would be in this puna zone. What we did find was dense concentrations of obsidian reduction activities in our surface survey and large numbers of archaic projectile points as well as extensive pastoralist facilities covered with mostly local Collagua LIP and Late Horizon sherds and a non-diagnostic utilitarian ware as well as some LIP Colla sherds from the Titicaca Basin. In our four test units we found a probable domestic hearth and calibrated dates ranging from AD100 to AD570, the time period between the apex of Pukara and the ascendancy of Tiwanku in the south-central Andes. But no sherds from either Pukara or Tiwanku were identified here, despite the quantities of obsidian that were going from this zone to those consumption areas in the Titicaca Basin.

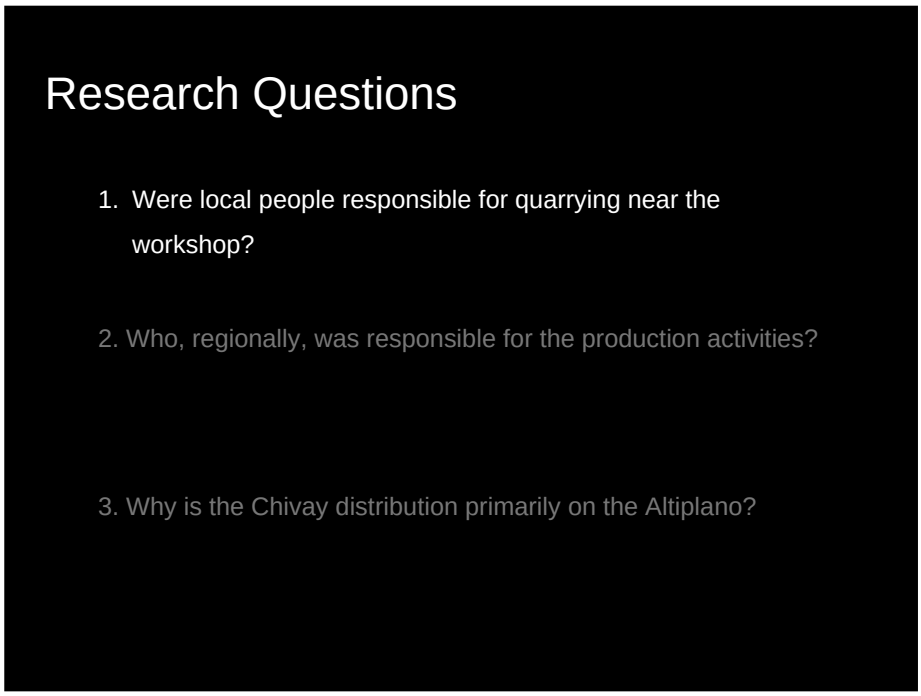


Finally in Block 3, in the Upper Colca valley, we found a dense occupation with Collagua LIP and LH ceramics and architecture and abundant evidence of agricultural terracing, although today the area, at 3900m, is dedicated to pastoralism. Our test unit in a dense obsidian scatter produced Middle Horizon dates, around AD700 but only utilitarian ceramics and …



an abundance of andesite hoes. The only definitively Titicaca Basin artifacts found in the entire survey were several probable Qaluyu sherds were found on the surface of this site, and Colla sherds in Block 2.

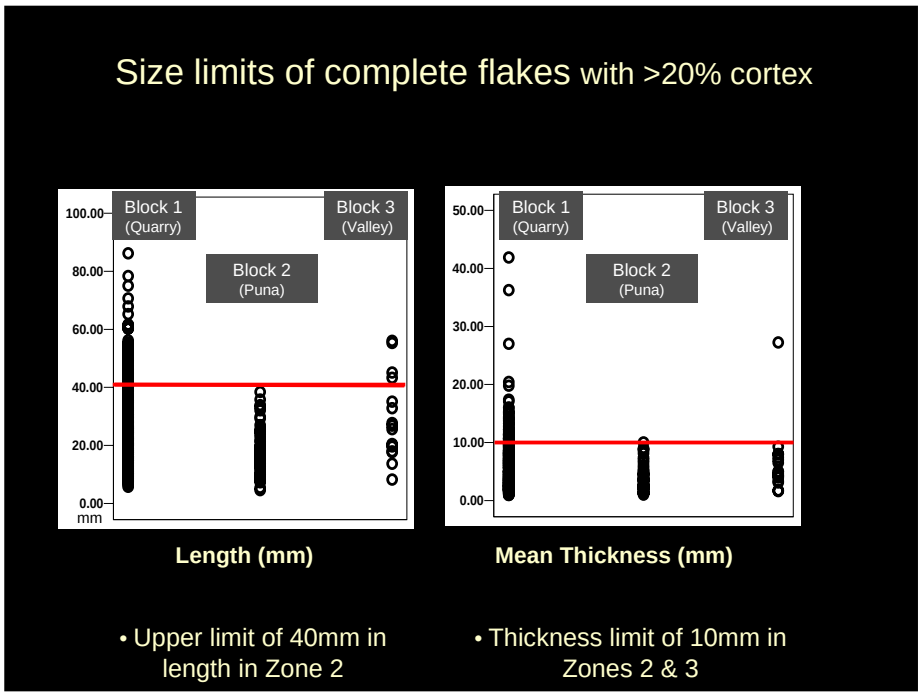
In sum we intensively surveyed 33km^2, dug 8 test units, and located 236 sites and one large quarry pit with an associated workshop. For the quarry area itself, our radiocarbon dates indicate that a significant level of procurement was occurring during the Archaic and early Ceramic period.



With our findings I would like to propose some tentative explanations to regional obsidian distributions.

1. We may ask: Were local people responsible for activities at the quarry and workshop?

Recall that nodules from the quarry pit were larger and more homogeneous than anything else we located in the Chivay source area. If local people were excavating and maintaining this quarry, we might expect them to bring some large nodules back to their residential zones in Blocks 2 and 3 from the source for local production activities.



Our technical analysis of lithics from surface and from excavated contexts show that cortical, early stage reduction flakes at the obsidian quarry were significantly longer and thicker than those found in survey blocks 2 and 3. The pattern is reinforced when the analysis is conducted on all complete flakes found in the research area. Whoever was procuring and knapping obsidian at the workshop, it doesn't appear to have been local people living in the Block 2 puna or Block 3 valley sectors of our survey area. At least we can conclude that the products of large obsidian nodules did not play a significant role in the local economy.

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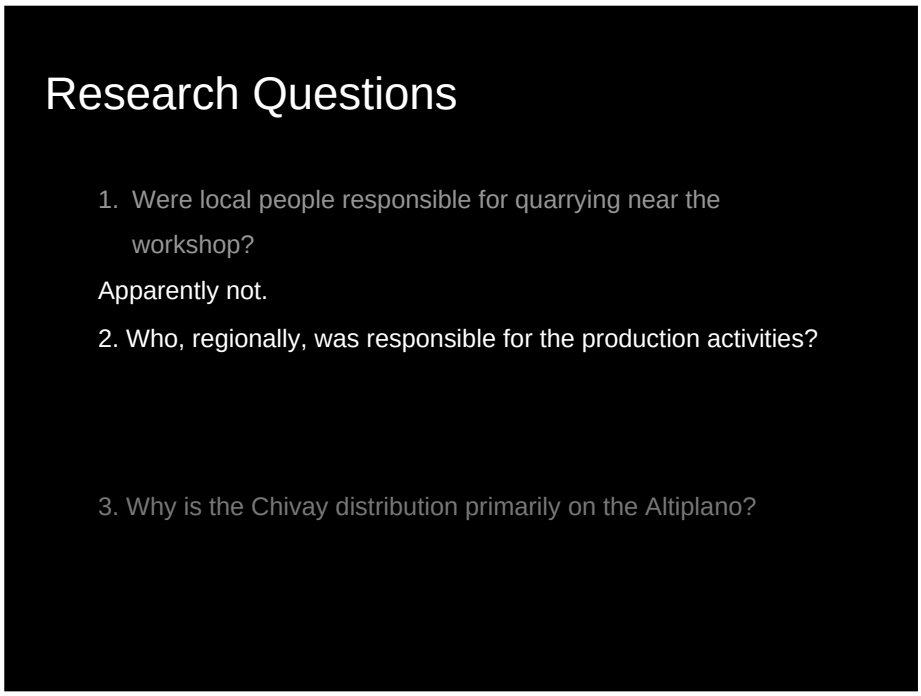
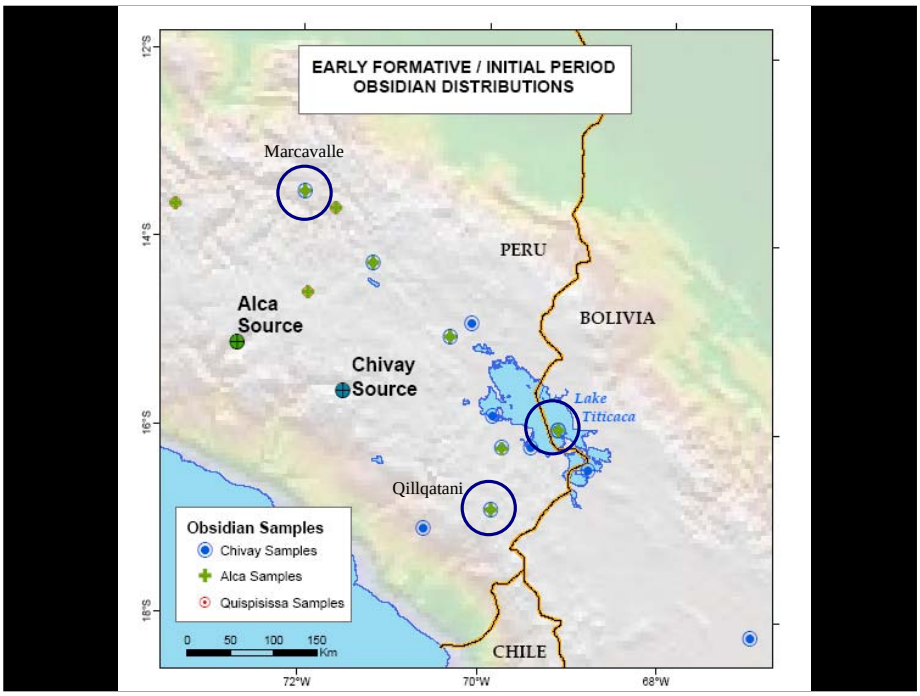
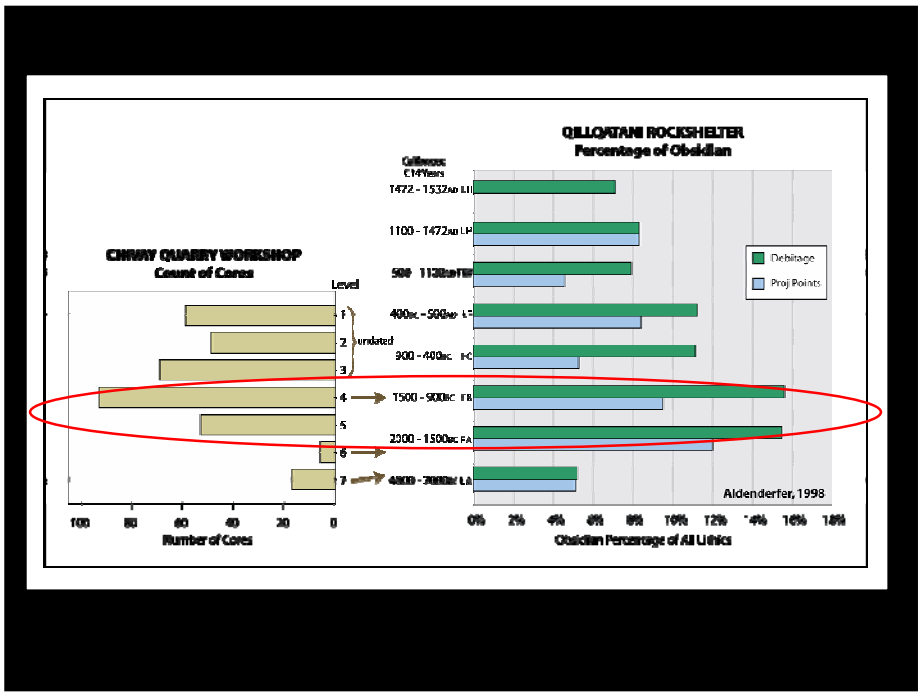


2. Who then was responsible for the production activities?

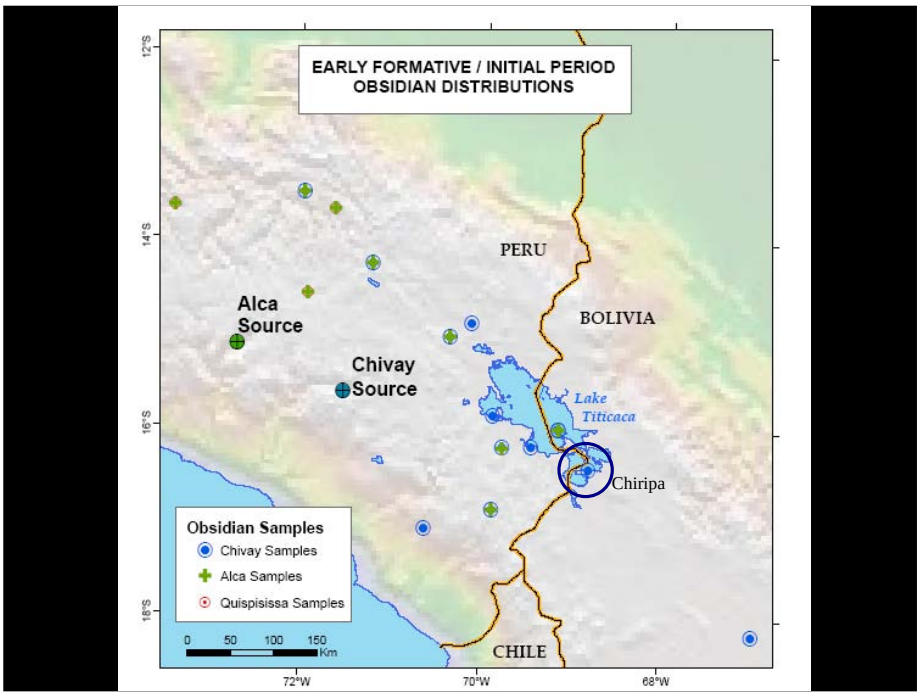
Previously I mentioned that Early Formative obsidian distributions in the south-central Andes are extensive. Alca obsidian is found in quantities never again matched inside the Titicaca Basin.



Chivay obsidian occurs in pre-Chanapata levels in the Cusco valley, it is encountered on the Island of the Sun in Bolivia, and, strikingly, it makes up 15% of the entire lithic assemblage at the Quelcatani rockshelter 200 km to the southeast, where 80% of the obsidian analyzed came from Chivay. This prevalence of obsidian at Quelcatani continues into the Middle Formative and then declines.



In the course of our 1x1 m excavation at the Chivay workshop we found 339 cores, so this was not your average 1x1. We take the discard these cores, cores with an average length of 5 centimeters, as evidence of abundance of material at the source. When the three radiocarbon dates from the workshop test unit are placed on the same calibrated time scale as Mark Aldenderfer's data from Qillqatani, the peak in core discard at the Chivay quarry corresponds with a peak in the relative percentage of obsidian debitage at Qillqatani in the Early Formative. Why did the pastoralists living in Qillqatani have non-local obsidian in such abundance? The area of Qillqatani is replete with high quality cherts, as are many parts of the Titicaca basin where Chivay obsidian is regularly found. Therefore the demand for obsidian in the Titicaca Basin is not for lack of useable stone, but for some quality of this natural glass that makes it a worth quarrying and transporting from afar. As mentioned, obsidian is of great utility for shearing wool so with an intensification on wool production one would expect greater circulation of obsidian for use as sharp flakes for shearing.



It is thought that Qillqatani herders participated in region caravan networks and transporting quantities of stone on caravan animals is much less costly.

For the site of Chiripa in the southern Titicaca Basin Matt Bandy reports very small quantities of finished obsidian tools in these periods, and relatively few non-local goods like shell and sodalite beads, and on this basis he discounts an early start date for a kind Altiplano mode of economy proposed by David Browman. However, given the data from Qillqatani, there is evidence for long-distance exchange of stone, a relatively cumbersome material, on the western periphery of the Titicaca basin. Perhaps this supports a more decentralized model of caravan circuit transport, such as that proposed by Nunez and Dillehay, with population centers in the Titicaca Basin not extending their influence over regional caravans until later in the Formative period. Long distance exchange has been characterized as “administered, non-market trade” in the south-central Andes, but what preceded administered trade when there weren’t yet significant elites to administer regionally? The quarrying at Chivay and the spike in regional consumption appear too distinctive to be explained by reciprocity networks alone. If camelids were domesticated during the late or terminal Archaic, there is ample time for caravan exchange to develop prior to the appearance of elite administrated trade. What is needed is further archaeological research using household level data from a variety of small sites during the terminal archaic and early formative, and the proveniencing of materials from these sites. The roots of the social ranking in the Titicaca Basin lie in the Terminal Archaic and early formative when political differentiation first appears. Evidence of social differentiation such as gold pendents in burials, and special-use architecture are surely related with other forms of prestige such as the participation in regional exchange networks that include obsidian and the possession of growing herds of camelids that are required for caravan operation.

Research Questions

1. Were local people responsible for quarrying near the workshop?

Apparently not.

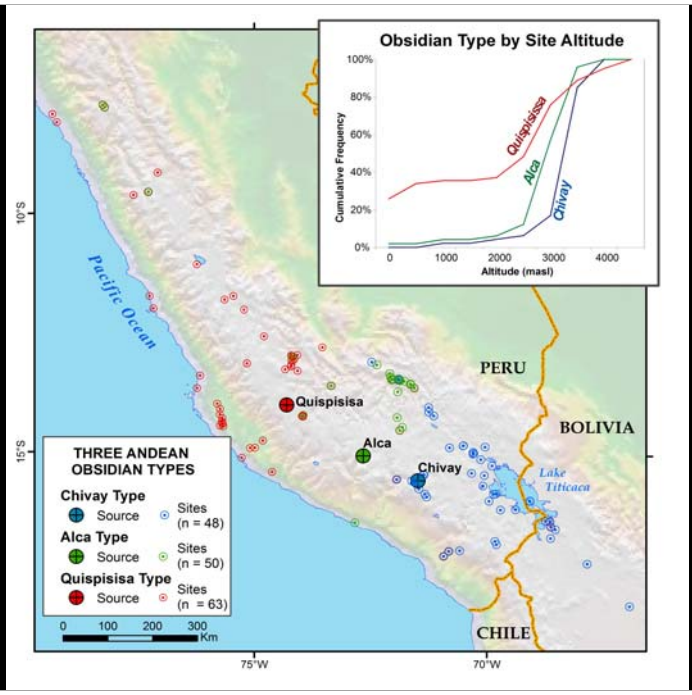
2. Who, regionally, was responsible for the production activities?

Perhaps non-local caravaners

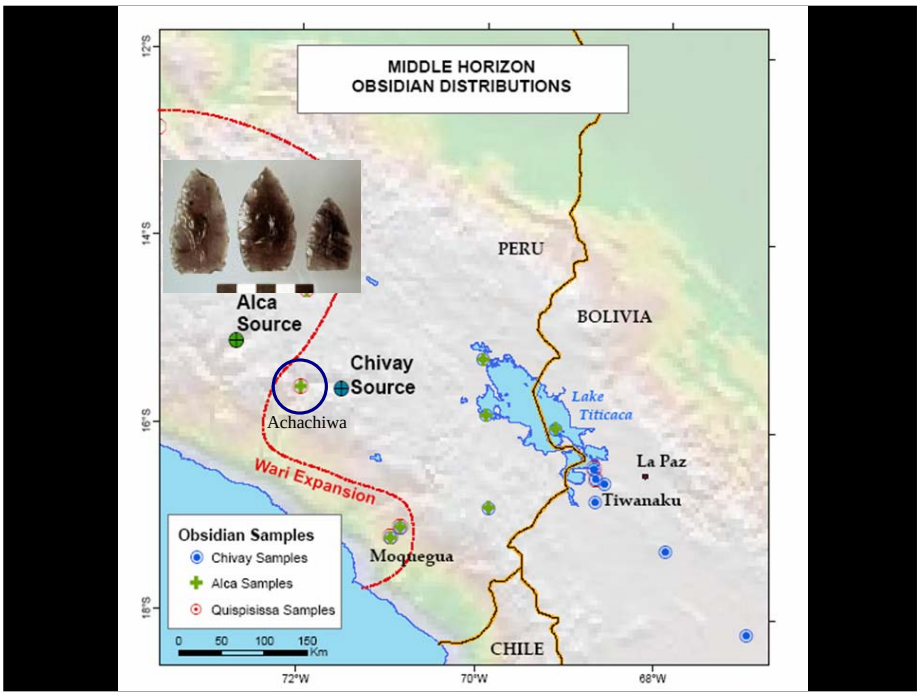
3. Why is the Chivay distribution primarily on the Altiplano?

Finally, 3. Why is the Chivay distribution confined to the Altiplano?

I've compiled a GIS database of all published obsidian provenancing work in the central Andes and comparing the distributions of the three most widely traded obsidian types is instructive.



As you can see on this chart, the Chivay obsidian distributions are very much confined to the high altitude areas. During the Middle Formative the Yaya-Mama religious tradition emerges in the Lake Titicaca basin and the Chivay obsidian distributions appear to conform strongly to this stylistic distribution. Subsequently, Chivay materials no longer occur in Cusco, and Alca type obsidian becomes rare in the Titicaca Basin. The Chivay type distributions conform largely to the altiplano domains of the Pukara polity and …

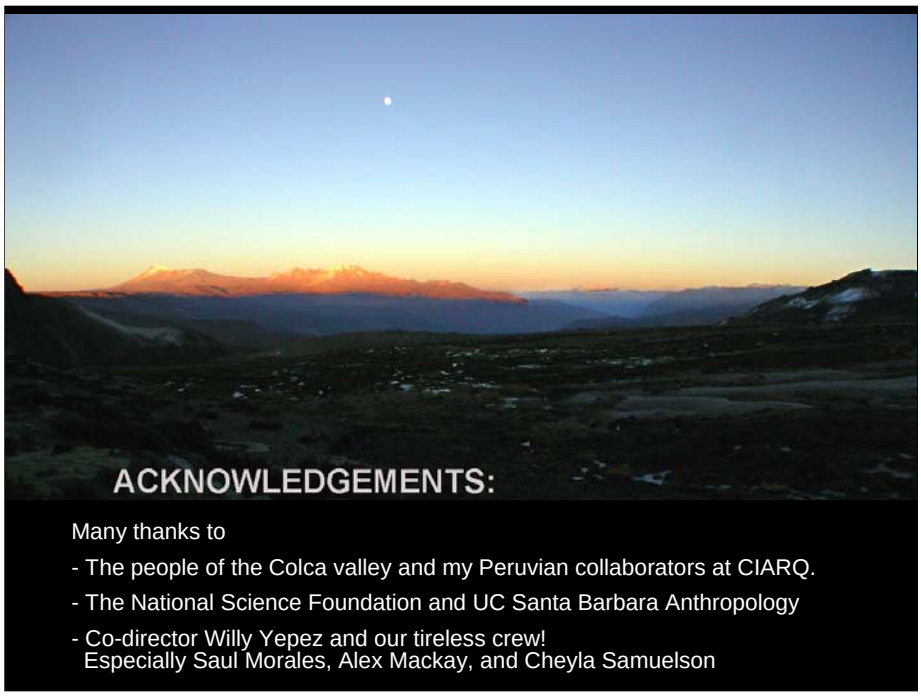


in the Middle Horizon, to Tiwanaku, thereby keeping it in the vicinity of the Titicaca Basin. The Middle Horizon distributions of obsidian from the Colca valley and the nature of Wari and Tiwanaku relationships with the Colca can shed light on the political economy of the Middle Horizon. During this period obsidian appears to have lost some of the prestigious associations that it had in earlier time periods and Andean crafts production emphasized other materials like metals, textiles, and pottery. This is not a black-and-white contrast but rather a subtle shift in the role of obsidian artifacts and in sources of prestige in different cultural periods.

However, obsidian continued to circulate and large obsidian projectiles seem to have been an instrument of Wari intimidation and conquest.

Our knowledge of the nature of the Tiwanaku relationship with the Colca is hampered by a lack of sourcing data from Middle Horizon sites in the north Titicaca Basin, where Chivay obsidian is usually more abundant and is found in larger nodules than in the southern basin. At the site of Tiwanaku Martin Giesso reports that obsidian from a variety of sources, though predominantly from the Colca, is found in great concentrations in ceremonial mounds. However obsidian is widely available and appears largely utilitarian as quantities of obsidian flakes are found in middens regionally. So perhaps Middle Horizon obsidian distributions inform us about the economic context of circulating common-place items like salt, coca, or aji peppers. This being the case, north Titicaca Basin Middle Horizon sites should have quantities of obsidian in this period. Obsidian distribution data also allows us to look at the economic separation between Wari and Tiwanaku, because economic integration within these state territories appears relatively distinct.

For example, from the Wari-influenced site of Achachiwa in Cabanaconde, only 50 kilometers down valley to the west of the Chivay source, Sarah Brooks sourced seven obsidian flakes from the surface and found that six were from Alca and one was from Quispisissa. The lower Colca valley area emphasizes agriculture and produces fruits and other lower altitude crops, and one would expect exchange complementarity with high altitude tuber and meat producers in the upper Colca valley. However, contrary to expectation, none of the Achachiwa obsidian came from the neighboring high altitude source of Chivay but rather came from sources approximately 100 and 300 kilometers away. Thus, it appears that the people of the Upper Colca lived between two powerful states and yet, surprisingly, they provided obsidian exclusively to the regional exchange sphere of Tiwanaku with no reciprocating goods or evident cultural affiliation. At present, the Middle Horizon is poorly understood in the Colca valley, and further work between the Colca and the Titicaca Basin should result in a better understanding of the frontier relationship between the people of the Middle Horizon Colca and Wari and Tiwanaku.



Obsidian distributions and quarry research can inform us about a variety of processes in the prehispanic Andes, and these data complement the stylistic evidence of interregional relationships. When obsidian serves as a utilitarian product, it provides a steady and quantifiable measure of regional interaction through time. Products like obsidian can tell us about the changing availability of non-local commodities that were important to common people. In some contexts obsidian artifacts also represented status items that demonstrated participation in far flung networks, distant alliances. Obsidian sourcing can be examined in conjunction with cultural historical evidence for clues about the chaging role of obsidian in prehistory, though conclusions presented here are speculative. With further research into obsidian distributions and sourcing of artifacts already in collections we will better understand the far flung geographical relationships that distinguish the ancient developments in the prehispanic Andes.

Further acknowledgements:

I would like to acknowledge that it is thanks to the sourcing efforts of Richard Burger and Sarah Brooks that the Colca valley obsidian was analyzed in the first place. Also, I'm indebted to the many researchers in the south-central Andes who have contributed to this study by having their obsidian artifacts provenienced.