March, 2005

Spatial and Temporal Variation in Stone Raw Material Provisioning Around the Chivay Obsidian Source.

Nicholas Tripcevich, University of California, Berkeley
Alex MacKay, Australian National University

Available at: http://works.bepress.com/tripcevich/12/
Research into the prehistoric procurement of widely circulated raw materials provides an opportunity to investigate changes in the mechanisms of exchange through time and the impacts of regional demand on local provisioning systems. Raw material sources are often exploited to meet local and regional demands, and relationships between artefacts at raw material source workshops and local sites can inform archaeologists about the nature of the exploitation of the source on the whole. In this talk we will focus on flaked stone artefacts found at an obsidian source workshop and those found in sites within a day’s travel of the source area. The Chivay obsidian source is located in a high altitude volcanic caldera at 4900 m above sea level on the edge of the Colca Valley in southern Peru.
Regional Consumption of Chivay Obsidian

- Over 90% of Titicaca Basin obsidian is from Chivay.
- Obsidian is distinctly sought after despite the availability of good quality local cherts.

The data to be presented reveal the operation of both targeted and embedded procurement systems relating to Chivay obsidian. Data from a workshop at the obsidian source indicates that targeted long distance procurement of large obsidian nodules for non-local consumption increased during the Terminal Archaic and Early Formative periods. At this time, the regional distribution of Chivay obsidian was at its peak, and the exchange value of obsidian was presumably at its greatest.

The Chivay / Cotallaulli source was first documented in the mid 1990s by Richard Burger and Sarah Brooks. A series of chemical provenancing studies dating back to the 1970s had identified a single obsidian source for over 90% of the tested obsidian found in archaeological sites in the Lake Titicaca basin.

This is despite the local availability of high quality cherts, indicating a significant demand for non-local material. The Chivay source was eventually located over 200km to the west in the Colca Valley, some 20 years later.
Human use of the Chivay source appears to date to at least 8000 years ago with our discovery of 12 obsidian projectile points in styles typologically diagnostic of the Early Archaic period adjacent to the obsidian source. Additionally, flakes of Chivay obsidian were found by Mark Aldenderfer 200 km to the south at the site of Asana in levels dating between 6300 and 9000 years ago.

The existing obsidian sourcing literature indicates that the distribution of Chivay obsidian increases through time until the Middle Formative when it reaches its largest geographical extent, and then it occurs in diminishing proportions in subsequent time periods with reduced evidence of use in the Late Horizon.
Relevant Research Themes

1. Role of obsidian in local economy.
2. Comparison of local consumption with workshop production.
3. Contexts of demand guiding workshop production

With this brief review we can posit the following questions:
1. what is the role of obsidian within the local economy?
2. how does consumption of obsidian at local sites compare with production at the source workshop?
3. what were the contexts of demand that guided production at source workshop through time?
We will describe local use of obsidian in terms of contrasting ecological zones. Agro-pastoral land use patterns common in the Andes are apparent in the Colca valley in both prehispanic and modern subsistence activities. Intensive agriculture in the lower elevation valley grades into pastoral herding in the higher altitude puna ecozone.
Colca valley communities typically have access to higher altitude areas and move between ecozones regularly. This may involve movement of individuals between valley and puna residences, and also transportation of goods between zones. Such systematic local movement creates an excellent context for embedded procurement of raw materials between points of residential occupation.
This embedded system of procurement during local travel between valley and puna can be contrasted with targeted procurement by inter-regional caravan networks. At least one ethnohistorically known caravan route passes near the Chivay obsidian source, shown on this map.
For the purposes of field research in 2003 the study area was divided into three principal zones. The nature and distribution of resources in the three zones are as follows:

Zone 1 is the volcanic caldera where the largest and highest quality obsidian nodules are located. In general the caldera zone is a rocky and barren high altitude environment but it also contains a productive bofedal that currently supports a herder and approximately 200 animals.

Zone 2 is a puna environment at 4400 meters of elevation featuring a very large bofedal and intensive pastoralism.

Zone 3 is an upper river valley environment around 3900 meters with several towns and limited agriculture.

Each zone was investigated through systematic survey and test excavations. Using mobile GIS, 1100 separate archaeological loci were located and mapped during the survey.

A quarry pit and workshop associated with large, high quality obsidian nodules were located in the volcanic caldera (Zone 1) at an altitude of around 4900 meters. A prehispanic road, 4m wide leads directly to the quarry pit from the south. The quarry pit is now mostly filled in, but remains 2m deep and 4mx5m across. The quarry is exposed on a ridge and is a difficult place to work. A workshop site was found 600m downslope in a warmer, sheltered location and close to the only water source in the caldera. It is important to note that this is not the only source of obsidian, smaller nodules of variable quality obsidian also occur around the shoulders of the central volcano.
2003 FIELDWORK

- 1100 archaeological loci were mapped using mobile GIS.
- Test units excavated in each zone.

Testing at the obsidian quarry

Obsidian was not, however, available in either Zone 2 or Zone 3, though cherts, chalcedonies, quartzites and volcanics did occur locally.
2003 FIELDWORK

Periods and c14 dates on charcoal from test excavations
(uncalibrated radiocarbon years BP)

Dates from the three zones are from different periods with no overlap.

1. Quarry Zone
   Term Archaic / Early Formative
   Lvl 4: 3149±53
   Lvl 7: 4160±43

2. Puna Zone
   Late Formative
   Lvl 3: 1822±37
   Lvl 5: 1698±31

3. Valley Zone
   Middle Horizon
   Lvl 4: 1265±31

Test Units were excavated in each of the three zones. Lamentably, none of the dates so far returned from these test-pits overlap. The workshop pit returned Terminal Archaic and Early Formative dates, those from the Puna were Late Formative, while those from the valley were Middle Horizon.
Research Question 1:
What was the role of the Chivay obsidian in the local economy?

The first question we posed earlier in this paper was, what was the role of the Chivay obsidian in the local economy?

Due to the lack of temporal overlap noted above we are unable to control for time in our spatial distributions. Thus, our spatial analysis will be atemporal.
The first pattern explored relates to the local consumption of obsidian, specifically in the Zone 2 (puna) and Zone 3 (upper valley). The graph presents relative prevalence of obsidian and non-obsidian in the two local consumption zones. In both instances obsidian, though non-local, accounts for at least 50% of raw material used. Notably, however, the prevalence in the puna, zone 2, is considerably higher – about 80%. We can therefore suggest that obsidian did in fact play an important role in local raw material consumption.
Research Question 2:
How does local consumption of obsidian compare with workshop production?

The second question posed involved relating local consumption to production at the source workshop. To approach this we need to know first, if cobbles of obsidian were being reduced in Zones 2 and 3, and second, if such reduction could be traced to the workshop area or to the smaller, more easily accessed cobble around the mountain.
This first slide presents scatterplots of key size indicators for early stage reduction flakes – taken here as those with more than 20% cortex. Such flakes account for about 5% of obsidian flakes in zones 2 and 3. The presence alone of such flakes indicates that, indeed, cobbles were being brought to the site and reduced there. However, what is immediately apparent, is that there is a relatively clear distinction between the upper size limits of these early stage reduction flakes from the caldera, and those appearing in Zone 3, and, more strikingly, in Zone 2. These data suggest that initial reduction in the puna and upper valley zones was restricted to small cobbles and rarely featured the larger cobbles available in the quarry workshop. It might reasonably be argued that this only precludes initial reduction of larger cobbles in these zones, however, if we open the data to all flakes.
It might reasonably be argued that this only precludes initial reduction of larger cobbles in these zones, however, if we open the data to all flakes we find that these limits on flake size are reinforced, again most markedly in the puna, zone 2. Thus there are no flakes discarded in Zones 2 or 3 that approach the flake size potential offered by the quarry source. We preclude distance decay as an explanation of this pattern for two reasons. The first is that the early stages of cobbles reduction are present on site. The second is the lack of significant intermediary consumption zones between the source and our puna and valley consumption zones.
Implications of spatial data

• Large cobbles from the caldera have minimal presence in the local economy.

• Extraction at the workshop specifically for purpose of export

These results have an important implication for the relationship between the quarried source and the local consumption of obsidian – specifically, that there doesn’t appear to have been one. The data appear to preclude local consumption of the larger obsidian cobbles available in the caldera. Such nodules appear to have played a minimal role in the local raw material consumption economy. This suggests to us that the extraction at the quarry was being carried out by non-locals specifically for the purposes of export.
Research Question 3:
What were the contexts of demand guiding production at the source workshop through time?

To explore this, we turn to the excavated data from the workshop site. The 1mx1m pit at this location reached a depth of 70cm and produced 750kg of cultural debris – exclusively chipped stone.
Analysis of a sample of flakes and cores from each level revealed three important patterns.
• Bifaces and bifacial thinning flakes occur in all levels.

• Relatively consistent prevalence ~5%

Conclusion:

• Artifacts leaving the workshop in biface form throughout time.

The first relates to mode of production. Broken bifaces and bifacial thinning flakes are a relatively consistent feature of all levels. Combined they account for about 5% of artefacts examined in each level. This indicates both that non-local consumers were commonly being provisioned with artefacts in biface form, and that this system was relatively consistent through time.
The second pattern relates to numbers of cores per level. The basal level of the pit, dated to about 4150 uncal BP, contains relatively few artefacts in general and cores specifically, as does the subsequent level, level 6. From level 5 the number of cores increases considerably, reaching a peak in level 4 and subsequently tailing off, albeit in a stochastic fashion. The peak in level 4 is important because it dates to about 3150 years BP – and is thus contemporaneous with a known peak in Chivay obsidian frequency in at least one non-local consumption site, namely Quelcatani. This gives us reason to believe that this particular workshop site is in fact one source of the Chivay obsidian manufactured for use in distant locations. A second conclusion we can draw from this is that subsequent fluctuations in core prevalence per level may be indicative of changing demand for obsidian in other non-local consumption areas. Further dates are required to explore this.
The final pattern of note from the workshop site is that the level 4 peak in core prevalence correlates with an increase in size of early stage reduction flakes. The three error bar figures present size data on flakes with more than 50% cortex from the last 5 levels of the pit. Again, we take such flakes to be a reasonable indicator of initial cobble size.

We see clear peaks in the size of early stage reduction flakes in levels 4, 2 and 1. In all instances, early stage reduction flakes from these three levels are significantly larger, statistically speaking, than those in Levels 5 and 3. These data indicate that at certain times either demand or quarrying techniques led to the acquisition and reduction of larger cobbles. Again, further dating would help tie these patterns into non-local consumption.

So, how do we explain the patterns observed?
Conclusions

So, how do we explain the patterns observed?

We consider the local consumption needs of obsidian to be met by embedded procurement. Regular traffic between the Puna zone investigated and valley locations such as Yanque would have facilitated a consistent supply of small cobbles from the shoulders of the volcano between these zones. This would explain both the high prevalence and the small size of obsidian artefacts in the Zone 2 assemblage.

Reduction of small nodules was also an influence on the assemblage in Zone 3, though the supply appears to have been either less considerable or less consistent. We note the occasional appearance of flakes apparently derived from larger cobbles in the Zone 3 assemblage, and consider it pertinent to mention that the current occupant of the caldera also resides in Zone 3. It may thus be that during movements between caldera and Zone 3, individuals occasionally transported larger cobbles, though this was clearly not a focus of activity.

Why the two local zones differ is unclear, but may ultimately be explained by different behaviours. Projectile points, by far the dominant implement type made on obsidian, are abundant in Zone 2 and comparatively infrequent in Zone 3.

The direct procurement of large cobbles of Chivay obsidian for non-local use evident in some levels of the workshop test unit suggests that the supply of Chivay obsidian disseminated regionally by distribution mechanisms was inadequate for particular consumers. The greater investment in procurement of large cobbles from Chivay appears to coincide with a time of incipient social and political differentiation during the Early Formative in the Titicaca Basin. If we accept the argument that the possession and display of large obsidian artefacts confers prestige on the owner of these items, we may speculate about the possible connections between this kind of investment in large obsidian nodule procurement and early social inequalities in the obsidian consumption zone. A few possible questions follow.

1. Was it aggrandizers in Titicaca basin who were commissioning the quarrying and production of the larger cobbles? The lack of ceramics diagnostic to the Titicaca Basin in the study area does not support this explanation and Down-the-line exchange (i.e., reciprocity) or perhaps caravan middle-men appear to be more viable explanations for the observed distribution of material to the Titicaca Basin.

2. With increased power in the Lake Titicaca basin emergent leaders may have wanted to guarantee themselves access to large obsidian pieces. By commissioning such extraction directly from the source, these emergent leaders may have been able to cut out the geographical middle man, thus securing for themselves access to the largest nodules from the raw material source. There is no evidence of walls or other means of restricting access to the source, however, there is clear and significant investment in quarrying, road clearing and maintenance, and transportation associated with the extraction of larger nodules. That they may have been prepared to incur such additional costs for the purpose of circumventing those located between themselves and the source, suggests that these emergent leaders not only valued Chivay obsidian highly, but valued direct access specifically.
Explaining Local Procurement and Provisioning

• Local procurement embedded

• Regular traffic between Zone 2 and valley residential locales (eg., Yanque)
  – Potential for consistent, regular supply to Zone 2

• Occasional traffic between Zone 3 and the Caldera
  – Less consistent supply of obsidian to Zone 3
  – Includes occasional large nodules

• Projectile point manufacture a possible explanation for differences between zones
Changing non-local demand for Chivay Obsidian

- Targeted procurement at the Chivay source carried out by non-locals.

So …

- Who was responsible for the quarry and the workshop found at the Chivay source?
Acknowledgements

Thanks to:
The people of Chivay and Callalli
The crew of the Upper Colca Project
C.I.A.R.Q, Arequipa
The National Science Foundation
UC Santa Barbara
Australian National University

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