A PRELIMINARY NOTE ON CORE REDUCTION METHODS AT THE OPEN-AIR SITE OF VADOPAMPA, AYACUCO, PERU

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ABSTRACT

Following a systematic survey of the site at Vadopampa, in the south-central highlands of the central Andes, several concentrations of debitage were identified. Lithics collected from one such concentration were subjected to technological analyses aimed at identifying the core reduction methods. The results reveal aspects of human activity and the manipulation of the available raw material. The chaîne opératoire approach permitted a dynamic reconstruction of the reduction processes used. The preliminary results allow the first stage of lithic reduction within the assemblage to be identified.


Keywords: Central Andes, south-central highlands, chaîne opératoire, débitage

INTRODUCTION

With the exception of rescue archaeology reports, no technological study sensu stricto (see, for example, Tixier et al. 1980: 7) has been carried out within the southern part of the Ayacucho region for either hunter-gatherer or agro-pastoralists occupations. The northern regions, however, have been the subject of a greater amount of archaeological research and technological studies (MacNeish 1969, 1979; MacNeish et al. 1970, 1980, 1981, 1983; Ccencho 1991; Vivanco 1994; León & Yataco 2008; Contreras et al. 2012). It is in this context that the open-air site of Vadopampa is presented. The site consists of a large surface concentration of artefacts attributable to different phases of the human occupation within the south central highlands. Taking into account the various taphonomic changes that have occurred at the site, the objective of the current work was to identify the methods of reduction utilised by applying the chaîne opératoire approach to the study of the assemblage. It is hoped that the results will contribute to the future recognition of techno-cultural units in this sparsely studied region.

THE STUDY AREA

The site of Vadopampa is located on a small mound within the alluvial plain on the southern side of the Vado River, the main water course of the sub-basin of Parinacochas, in the upper part of the Ocoña River basin. It lies in the rural settlement of Lacaya, district of Puyusca, province of Parinacochas, Ayacucho region (Figure 1). At 3401 metres above sea level, it is adjacent to the Chaquicocha plateau and 14.5 km from Lake Parinacochas, at the foot of the volcanic mountain known as Sara Sara (Figure 2). The UTM coordinates are 18S 6557768323130.

A wide river beach is associated with the site, where abundant cobbles were observed (Figure 3). It is possible that this beach, which is now dry, was covered by water in the past, forming a seasonal or permanent lake. This is suggested by the presence of a sedimentary environment composed of clayey-silt, sandstones and conglomerates, and also due to a marked difference in the presence of grasslands that dominate the area. On its surface, Vadopampa features a large concentration of lithic artefacts, with no associated ceramic material (Figure 4).

Vadopampa is located in a very small ecological zone (3500–4000 metres above sea level), traditionally called Suni and defined by the presence of cold grassland and shrub in the Peruvian highlands (Dollfus 1981); more recently it has been referred to as the Subtropical Mountainous Forest area (Holdridge 2000). The extensive grassland is characterised by medium-sized woody grasses and shrubs, such as Peruvian feathergrass (Stipa ichu) and broom brushes (Cassia reticulata Wild) (Figure 3). The present animal population is
Figure 1. Geographic location of the Vadopampa site in the upper Ocoña River basin. Source: modified by the author based on SIGMED 2.0 base mapping.

Figure 2. Altitudinal location of the Vadopampa site, on the right bank of the Vado river. Source: modified by the author based on leaves 31o and 31p, Coracora y Pausa, from SIGMED 2.0 base mapping.
goats and South American camelids, which are part of a seasonal grazing system that takes place on the lands surrounding the site. Other areas beyond the site are subject to non-industrial, irrigated agriculture.

**MATERIALS AND METHODS**

**Fieldwork**

The fieldwork closely followed the guidelines applied at the open field site of Campo Blanco, northwest Argentina (Hocsman et al. 2003: 327–329). The work began with the systematic exploration of the upper Ocoña River basin. When the Vadopampa site was located, its surface was delimited by the arrangement of radial transects from the highest point and recording the presence or absence of lithic artefacts. After identifying the extent of the site, we selected a 410 m² area for analysis, representing approximately 10% of the total area, taking into account the distribution of the
Table 1. Frequency and weight of technological categories

<table>
<thead>
<tr>
<th>Technological categories</th>
<th>Number</th>
<th>Percentage</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cores</td>
<td>28</td>
<td>13.15</td>
<td>3601.45</td>
</tr>
<tr>
<td>Flakes</td>
<td>90</td>
<td>42.25</td>
<td>2280.24</td>
</tr>
<tr>
<td>Flake fragments</td>
<td>54</td>
<td>25.35</td>
<td>522.62</td>
</tr>
<tr>
<td>Casson</td>
<td>41</td>
<td>19.25</td>
<td>902.1</td>
</tr>
<tr>
<td>Total</td>
<td>213</td>
<td>100.00</td>
<td>7306.41</td>
</tr>
</tbody>
</table>

The sample studied and the surface state

The total sample analysed consisted of 213 lithic artefacts (Table 1). Flakes represented the majority of the assemblage, followed by flake fragments and casson. Cores were present in smaller numbers.

The raw materials selected for the manufacture of the lithic artefacts were mainly siliceous sedimentary rocks, which were generally of good quality. Fine-grained quartzites were the most prevalent within the sample, followed by flint (Figure 5); these were both mainly represented by flakes (Table 2). These data can be indicative of two different operation chains, but it is not possible to confirm this until further samples have been studied. As for the condition of the artefacts, they were predominantly slightly abraded (54%) and abraded (39%) (Figure 6). In this geomorphological context, the abrasion is most likely to have been related to aeolian action, the wind-borne particles rounding edges and softening the typical relief of fresh fractures. For all cases, the degree of abrasion was not necessarily an impediment to assessing the manufacturing marks.

Laboratory work

Laboratory work started with the petrographic identification of the different types of raw materials present in the sample, and was based largely on macroscopic observation (Hurlbut & Klein 1986). This was followed by the technological analysis, with a concentration ondebitage. The cores were studied according to Boëda’s (2013) proposal, which recognises six core reduction systems (A–F) each corresponding to a particular core or structure. The definition of these systems results from the diacritical reading of each piece and from the qualitative and quantitative analysis of the perceptible characteristics of the cores, such as the nature of the striking platform and flake surfaces; the platform/positive face angle; arrises; percentage of cortex; and the organization of dorsal flake scars (see YinghuaTable 2. Technological categories and raw materials present in the sample studied.

<table>
<thead>
<tr>
<th>Raw material</th>
<th>Category</th>
<th>Cores</th>
<th>Flakes</th>
<th>Flake fragments</th>
<th>Casson</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine-grained quartzite</td>
<td></td>
<td>16</td>
<td>47</td>
<td>38</td>
<td>15</td>
<td>116</td>
</tr>
<tr>
<td>Chalcedony</td>
<td></td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Jasper</td>
<td></td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Cryptocrystalline flint</td>
<td></td>
<td>10</td>
<td>37</td>
<td>15</td>
<td>26</td>
<td>88</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>28</td>
<td>90</td>
<td>54</td>
<td>41</td>
<td>213</td>
</tr>
</tbody>
</table>
2014: 48). Once the core reduction methods were identified, we proceeded to the hypothetical-deductive reconstruction of flakes produced from the cores. Afterwards, these were compared with the debitage recovered from the survey, with the aim of identifying the technical correspondence between them.

**MATERIALS AND METHODS**

**Provenance of raw materials**

To determine the sources for lithic material procurement, we used information from geological maps for the Coracora and Pausa areas (Instituto Geológico Minero y Metalúrgico 1980, 1983). Two geological formations and two groups, each of which have outcrops within 15 km of Vadopampa, are considered to be the most likely sources of raw material (Figure 7). These are:

1. the eastern border of the *Para Formation* ends within the area of the site. In the most immediate part of Vadopampa, the formation has an approximate width of 3.5 km;
2. the *Tacaza Group*, which passes longitudinally through the area, and extends beyond it to the north and south;
3. the *Sencca Volcanic Formation*, which is distributed irregularly; and
4. the upper and lower *Barroso Volcanic Group*, which is ubiquitous in the area.

The less important formations are the *Volcanic Sedimentary Pausa* and a series of clastic, morrenic and glaciofluvial deposits. Only one formation is found just outside the 15 km radius from the site: the *Volcanic Mollebamba*. Table 3 summarises the geological composition of each of these formations and characterises their presence in relation to Vadopampa.

The preliminary conclusion was that the raw materials used likely originated within the region surrounding the site, probably constituting a primary outcrop due to the lack of rolled blocks, which provides evidence for the absence of redeposited materials. If this view is substantiated by fieldwork, the inhabitants of the site probably followed a ‘direct acquisition’ strategy, making relatively short trips to the raw materials sources to acquire resources for knapping.

**Core reduction methods**

**Cores**

Twenty-five cores were recovered from the site. They were predominantly produced on fine-grained quartzite (*n* = 16; 64%), and vary in size and weight as shown in Table 4. They frequently displayed plano-convex (40%) or prismatic forms (32%). Almost all of the cores are unipolar (*n* = 23; 92%), with only two bipolar cores present (8%). All have percussion angles between 70° and 80°, and retained between 50% and 70% cortex. However, flake removals were relatively few and generally unidirectional, arranged on one or two surfaces. Where two flaking surfaces were used, they may or may not share a single

![Figure 7. Location of the main geological formations in relation to Vadopampa. Source: modified by the author, based on leaves 31o and 31p, Coracora y Pausa, from GEOCATMIN Instituto Geológico Minero y Metalúrgico database.](image)
Table 3. Potential sources of lithic raw material in the area surrounding Vadopampa (after Instituto Geológico Minero y Metalúrgico 1980, 1983).

<table>
<thead>
<tr>
<th>Formation or Group</th>
<th>Raw material</th>
<th>Distance from Vadopampa</th>
<th>Type of Procurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Para</td>
<td>Pyroclastic (volcanic tephra), sedimentary (shale, limonite and limestone), volcanic (tuffs, andesite).</td>
<td>0-2 km</td>
<td>x</td>
</tr>
<tr>
<td>Tacaza</td>
<td>Pyroclastic, sedimentary (chert, flint nodules associated with limestone), volcanic (andesite, rhyolite, dacite), plutonic (tonalite), metamorphic (quartzite).</td>
<td>0-2 km</td>
<td>x</td>
</tr>
<tr>
<td>Volcanic Sencca</td>
<td>Dacite, rhyolite, andesite.</td>
<td>10.5 km to the north.</td>
<td>x</td>
</tr>
<tr>
<td>Volcanic Barroso</td>
<td>Dacite, andesite.</td>
<td>0 km</td>
<td>x</td>
</tr>
<tr>
<td>Volcanic Sedimentary Pausa</td>
<td>Detrital sedimentary (sandstones and tuff clays, lapillitic sands), volcanic (tuff and cinerites).</td>
<td>11 km to the east</td>
<td>x</td>
</tr>
<tr>
<td>Volcanic Mollebamba</td>
<td>Basalt.</td>
<td>22 km to the east</td>
<td>x</td>
</tr>
<tr>
<td>Clastic deposits</td>
<td>Volcanic igneous rocks</td>
<td>0-5 km</td>
<td>x</td>
</tr>
<tr>
<td>Morrenic deposits</td>
<td>Conglomerates, volcanic igneous rocks</td>
<td>2-5 km</td>
<td>x</td>
</tr>
<tr>
<td>Glaciofluvial deposits</td>
<td>Volcanic igneous rocks</td>
<td>2-5 km</td>
<td>x</td>
</tr>
</tbody>
</table>

Table 4. Core measurement.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Range</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (g)</td>
<td>31.4–432.5</td>
<td>133.0</td>
<td>113.3</td>
</tr>
<tr>
<td>Length (mm)</td>
<td>6.8–84.1</td>
<td>62.4</td>
<td>18.8</td>
</tr>
<tr>
<td>Width (mm)</td>
<td>29.6–79.0</td>
<td>48.1</td>
<td>12.4</td>
</tr>
<tr>
<td>Thickness (mm)</td>
<td>16.7–80.2</td>
<td>39.2</td>
<td>18.8</td>
</tr>
<tr>
<td>Number of flake scars</td>
<td>2–9</td>
<td>6</td>
<td>2.3</td>
</tr>
</tbody>
</table>

SD = standard deviation

platform. In the case of a single flaking surface, the platforms were adjacent. Removals are generally deep, suggesting the use of hard-hammer percussion with internal gesture. Where it was possible to identify flake-scar length, this varied between 35 and 40 mm. The largest flake removal recorded was ca 60 x 50 mm. Two other attributes are noteworthy: the presence of negatives with elongated morphologies; and the fact that all cores were abandoned before being exhausted. The latter allowed the identification of the initial nodule shape, namely plano-convex and elliptical (Figure 8).
Core initialisation methods: block selection
In the entire sample, initialisation is represented only by the selection of a surface that included enough technical characters to afford flake production. The main technical character was to seek a platform consisting of two secant surfaces, which were always cortical (Table 5).

Core production methods: two unipolar or bipolar series on one or more planes
Two production methods (Mp) have been identified: MpA and MpB. The first, MpA, includes two series of removals on different surfaces, but flakes were extracted following the same sequence (1–2/1–3–1′). With the exception of a piece that features a single unipolar series, 17 pieces produced two series of unipolar removals on the same plane (MpA), five cores produced two bipolar series with the same volumetric distribution (MpB), and two cores produced two unipolar series on different planes (MpA) (e.g. Figure 9). Table 6 displays these production methods and the technical characteristics associated with them.

Table 5. Core initialisation method and technical character researched.

<table>
<thead>
<tr>
<th>Support (Nodule)</th>
<th>Core (useful volume)</th>
<th>Selection</th>
<th>Technical character</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram" /></td>
<td><img src="image2" alt="Diagram" /></td>
<td><img src="image3" alt="Diagram" /></td>
<td>A platform formed by two convex surfaces (Surf. Cx.), and adjacent plane (flat) surface (Surf. Pl.).</td>
</tr>
<tr>
<td><img src="image4" alt="Diagram" /></td>
<td><img src="image5" alt="Diagram" /></td>
<td><img src="image6" alt="Diagram" /></td>
<td></td>
</tr>
</tbody>
</table>

Figure 8. Example of a core found on the surface at Vadopampa that was originally a plano-convex nodule. Source: the author.
Table 6. Core production methods and technical characters of the cores studied.

<table>
<thead>
<tr>
<th>Core (useful volume)</th>
<th>Operative Scheme</th>
<th>Technical characters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Series</td>
<td>Chronology of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>removals</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two unipolar series on the same plane (MpA). Once selected, the flake-release surface contains at most three negatives in each series, where the sequence can be linear (taking advantage of the platform created by the previous negative) or interrupted by independent negatives.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two bipolar series on the same plane (MpB). At most, there are two linear negatives, where the second takes advantage of the platform created by the first. This series is after an original one, with a single negative.</td>
<td></td>
</tr>
</tbody>
</table>

Determination of flake techno-types (removals from the cores)

According to the hypothetical-deductive analysis of negatives present in the cores, we identified six techno-types of flakes, closely linked to the predominant production methods discussed above. Table 7 shows the relationship between the predominant production methods and the flakes, and their comparison with the pieces from our survey. The six techno-types are as follows.

1. Natural dorsal surface and butt of striking platform (hereafter, butt). The dorsal surface might be convex or flat. Techno-type associated with MpA (Flake 1 of Series 1 and 2) and MpB (Flake 1 of Series 1).
2. Natural butt. Dorsal surface with a natural (convex or flat) area and a single negative from the previous flake. Techno-type associated only with MpA (Flake 2 of Series 1).
3. Natural butt. Dorsal surface with a flat area due to the two diagonal flakes from previous series. Techno-type associated only with MpA (Flake 1’ of Series 2).
4. Natural butt. Dorsal surface with a flat area due to the two diagonal flakes from another series, and a convex area due to the two negative from previous flakes. Techno-type associated only with MpA (Flake 3 of Series 2).
5. Natural butt. Dorsal surface with a natural flat area created by the flake of the previous series, with an opposite orientation to the flake axis. Techno-type associated only with MpB (Flake 1 of Series 2).
6. Natural butt. Dorsal surface displays two negatives with opposing orientations. This area is flat and the other one is convex. Techno-type associated only with MpB (Flake 2 of Series 2).

**Flakes**

Based on their predominant technological characteristics, the following categories were identified in our sample: cortical flakes ($n = 48$); backed flakes ($n = 15$); quadrangular

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### Table 7. Hypothetical-deductive reconstitution of core negatives at Vadopampa sites and comparison with the observed pieces.

<table>
<thead>
<tr>
<th>Core (useful volume)</th>
<th>Flakes</th>
<th>Technical characters of flakes reconstituted</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hypothetical-deductive reconstitution</strong></td>
<td><strong>Observed pieces</strong></td>
<td><strong>Series 1</strong></td>
</tr>
</tbody>
</table>
| (MpA)                | ![Diagram] | Flake 1: Natural dorsal surface and butt. The dorsal surface might be convex or flat.  
Flake 2: Natural butt. Dorsal surface with a natural (convex or flat) area and a negative from flake 1. |
| (MpB)                | ![Diagram] | **Series 2**  
Flake 1: Natural dorsal surface (convex) and butt.  
Flake 1’: Natural butt. Dorsal surface with a flat area due to the two diagonal flakes from Series 1.  
Flake 3: Natural butt. Dorsal surface with a flat area due to the two diagonal flakes from Series 1, and a convex area due to the two negative from flakes 1 and 1’.

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flakes \( (n = 18) \); and elongated flakes \( (n = 9) \). In all these categories, fine-grained quartzite accounts for an average of 60% of the pieces. All flakes have well-preserved planar or dihedral platforms, and well-marked bulbs. In addition, the length of the platforms is greater than the thickness. Platform thickness varies between 8 and 12 mm, measured from the edge of the percussion plane. Furthermore, a percussion angle of 70° is predominant. These facts, and the position of the maximum width and maximum thickness in the proximal sector, indicate the application of a hard hammer percussion technique of internal gesture. As for the attributes of the distal section, the flake termination is irregular, with only one flake displaying a truncation. As a last attribute common to all flakes, the length/width index was calculated, obtaining values between 0.5 and 2.5, corresponding to relatively wide and quadrangular removals (Table 8).

First, all cortical flakes (e.g. Figure 10d and i) are complete, except for one piece that has a small fracture in its distal end, probably associated with weathering or as a result of the knapping process. Their lengths vary between 20 and 70 mm. On the ventral surface, the pronounced bulb predominates and, due to the nature of the raw materials used, ripple marks are mostly absent, though striations are generally present. The dorsal surface of these flakes is either partially or totally cortical. Where flake scars are present, they follow a pattern parallel to the percussion axis. These flake types typically represent the first phase of the chaîne opératoire, as they do not have any usable cutting edges or opposing blunted edge. Their cross-sections vary in shape, although a triangular form is predominant.

Secondly, backed flakes (e.g. Figure 10a, c, e and f) are complete and always feature a triangular section. All of those recovered are at least partially cortical due to the presence of a negative parallel to the percussion axis, prior to the removal of the flake. In addition, they have a sharp edge on one side and a lateral or distal cutting edge of 30 to 45°. They vary between 20 and 50 mm in length.

Thirdly, the quadrangular flakes (e.g. Figure 10b) have a predominantly irregular section. On the dorsal surface, they display a maximum of one negative parallel to the percussion axis, indicating the exploitation of convexities. They vary between 30 and 60 mm in length.

Finally, all the elongated flakes (e.g. Figure 10g and h) are complete, except for two pieces with simple fractures in the distal end. They feature triangular cross-sections and, in five cases, two negatives parallel to the percussion axis. Their lengths vary between 50 and 70 mm.

**Flake fragments**

There are 54 flake fragments, 38 of which are made on fine-grained quartzite, 15 on flint and one piece on chalcedony. Their lengths vary between 20 and 30 mm (Table 9). Generally they are medial fragments that present either one or two negatives parallel to the morphological axis of the piece. In addition, they display a simple fracture with straight termination and a concave-convex cross-section, the curved fracture with straight termination of Weitzel (2012: 49). In our sample, there are no internal differences in this classification relative to the thickness of the piece that allowed us to define the cause of

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (g)</td>
<td>2.3</td>
<td>113.0</td>
<td>25.3</td>
<td>22.7</td>
</tr>
<tr>
<td>Length (mm)</td>
<td>16.3</td>
<td>73.0</td>
<td>41.2</td>
<td>13.5</td>
</tr>
<tr>
<td>Width (mm)</td>
<td>18.7</td>
<td>93.0</td>
<td>39.6</td>
<td>14.4</td>
</tr>
<tr>
<td>Thickness (mm)</td>
<td>5.3</td>
<td>28.3</td>
<td>13.1</td>
<td>5.4</td>
</tr>
<tr>
<td>Length x Width</td>
<td>427.2</td>
<td>6444.2</td>
<td>1714.1</td>
<td>1035.6</td>
</tr>
<tr>
<td>Length / Width</td>
<td>0.5</td>
<td>2.5</td>
<td>1.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Length x Width / Thickness</td>
<td>51.3</td>
<td>329.8</td>
<td>131.5</td>
<td>58.9</td>
</tr>
</tbody>
</table>

SD = standard deviation
Figure 10. a, c, e, f: backed flakes; b: quadrangular flake; g, h: elongated flakes; d, i: cortical flakes. R signifies a recent fracture/break due to taphonomic agents.
these fractures. However, we suggest the action of human or animal trampling as a probable cause, considering that the thickness of the sections where the fracture occurs varies between 5 and 10 mm.

**Casson**

There were 41 pieces of casson, of which 26 are of flint, the remainder of fine-grained quartzite. All were large fragments between 16 and 58 mm in length (Table 10). Unfortunately, we do not know where these pieces sit within the reduction of the cores; however, it is possible that they are products of initial nodule testing and preparation, probably resulting from the removal of angular surfaces, given that almost all the pieces have well-defined edges.

**DISCUSSION AND CONCLUSIONS**

In this paper, we analysed a small sample of the lithic artefacts recovered during surface collection at the Vadopampa site. We have suggested potential sources of the corresponding raw material from within a 15 km radius of the site by considering information in geological maps. Our preliminary hypothesis is that the artefact sample corresponds to a primary outcrop; however, further work incorporating systematic field survey is essential if this proposition is to be confirmed. Since the small sample consists only of core reduction products, we have been obliged to study the methods of initialisation and production associated with a variety of removed flakes. In this respect, the fine-grained quartzite and flint components of the sample show considerable homogeneity according to the C-type core reduction system (Boëda 2013: 105):

1) initialisation method: selection of a platform between two flat surfaces;
2) production methods: two unipolar or bipolar series on the same or different planes; and
3) production objective: cortical, backed, quadrangular and elongated flakes.

The number of flake removals, the percentage of cortex present on the cores, and the presence of primary and secondary flakes, allow us to tentatively characterise a first stage of lithic reduction, composed of two phases: (1) selection of the cores with specific technical characteristics; and (2) obtaining primary flakes.

This evidence allows us to shed light on the degree of knowledge involved in the local acquisition of nodules that would have had sufficient technical characteristics to allow the production of specific kinds of flakes. For us, this is the best way to explain the existence of two production methods that allow for the
manufacture of six different types of flakes. These enabled the cortex removal and the exposure of suitable surfaces to obtain more flakes. Lightweight cores could then be transported to another activity area, where they would probably be used to manufacture tools.

With respect to the flakes, by applying a hypothetical-deductive approach to the core negatives, we have identified six techno-types with different patterns on their dorsal surfaces. When comparing these techno-types with the flakes obtained from Vadopampa, we observed that we have recovered only a small amount ofdebitage from the site, which does not account for the variability suggested by the cores analysed. More work is required to be able to propose more elaborate conclusions. However, it is possible to point out that the people at Vadopampa obtained only two series of removals from the same core, producing on average five flakes per core. This analysis has been successful because the cores do not present many superimposed removals (methods of production are difficult to determine when it is necessary to read diacritically older negatives). We currently do not have a larger sample to characterise the relationship between these flake techno-types and hypothetical tools, although it is possible that backed flakes have been used as tools due to their sharp edges.

Finally, we wish to make two important statements. First, no chronological markers were recorded amongst the studied material; further work is required to establish its antiquity. The complete absence of pottery might indicate an early occupation, as has been suggested for other sites in the Ayacucho region. Huiquchú (29o-6B5), a site on the right bank of the Sondondo River, is located in the province of Lucanas, north of Vadopampa. The lithic material recovered from there by prospection corresponds to a single projectile point and debitage. In the same area, other sites such as Tucunpiaqa (29o-6B7), Teqoy Pata (29o-6B8) and Qaqapaqui (29o-7C1) contain abundant surface scatters of lithic debitage. These sites are considered likely to be preceramic (Ccencho, 1991: 120). In the area bordering the Pampa and Qaracha rivers, in the district of Sarhua, Cirilo Vivanco examined 17 sites, including both caves and rock shelters, but only excavated Kunyaqumachay cave. All of the sites featured abundant surface scatters of debitage and fragmented projectile points that have been associated with a long occupation from 7000 BC (Vivanco 1994: 96).

As far as the northern part of the Ayacucho basin is concerned, the only previous investigations have been those in the inter-Andean valley carried out at the end of the 1960s by the Ayacucho Archaeological-Botanical Project, directed by Richard MacNeish. This project recovered lithic material from a wide variety of sites dating from 12000 BC (Ayacucho Complex; MacNeish 1979: 29–40; see also Yataco 2013) to 1000 AD (Late Intermediate Period). In this context, large flakes, one edge of which was utilised (SS6), and small flat retouched flakes (SS16) appear from the Ayacucho Complex and throughout the rest of the sequence. Particularly, the large blade flakes type (SS27) belongs to the Cachi period (2800–1700 cal BC) and lasts until the ceramic periods (MacNeish et al. 1980: 179). Clearly, we are reduced to relying on very poor chronological markers. It is also important to note that the few cores and flakes analysed in the Ayacucho Complex have displayed evidence of centripetal (Yataco, 2009: 78–80) and bifacial reduction (ibid.: 88), strategies that are completely different to those seen at Vadopampa.

The presence of projectile points and debitage within almost all other sites is also markedly different to the assemblage from Vadopampa, as we have not yet recorded any type of retouched tool there. If we consider that crude blades and flakes ‘have an early temporal distribution from Huanta to probably as late as Piki times [and also] similar ones occur early in Lauricocha, Tres Ventanas and the Junín region’ (MacNeish et al. 1980: 202), we would have to estimate a possible date range of between 9000 and 2800 cal BC for these artefacts. However, we prefer to be cautious. We do not yet have a stratigraphic profile that allows us to infer such temporal depth. Raw material can provide important information about this. We have recorded raw material from good to regular quality, and when we compare it with those rocks generally used throughout the Andean sequence, we know that artefacts made from volcanic igneous
rocks lose importance in comparison with industries produced using plutonic rocks, at least since the Early Horizon, in a context of reduced mobility of human groups. Based upon these indicators, we tentatively propose a temporal range for our sample between the Late Preceramic and Early Horizon (3500 to 1700 BC).

Secondly, we regard the technical homogeneity at Vadopampa as a product of sample size. According to our observations of the area surrounding the site, it is possible that we are facing a quarry complex. Only one similar situation has been reported for the Quispisisa area in the province of Huancasancos (Contreras et al. 2012: 190–191), but in this case no recognition of production methods was forthcoming, nor was there any statistical analysis of the sample. We believe that future collection and excavation campaigns in Vadopampa will provide evidence of other reduction methods and most likely tools, which may indicate a palimpsest series of management and manufacturing chains.

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ENDNOTES

[1] Here, casson is defined as a waste product that is thick in profile with an irregular morphology that does not present the typical accidents of debitage (cf. chunk) (Merino 1994: 325).

[2] Originally, the French term débitage refers to a fractionation action (Tixier et al. 1980: 59), a technical act of knapping (ibid.: 61), a principle of tool manufacture (Boëda et al. 1990: 45) and a mode of production (Boëda, 2013: 58). The other mode of production is façonnage. In addition, following Boëda's proposal, the French term débitage (and also façonnage) is a system that includes concepts, methods, techniques, procedures and structures (cores). Thereby, the methods can be initialisation methods or production methods. Our work focuses on méthodes de débitage, within a given concept. Now, in English terminology debitage is used to refer to the by-products of stone tool production or core reduction (Andrefsky, 2005: 16), often considering only flakes (Ballin, 2000: 10) within knapping ‘waste’ (Shea, 2013: 17). For this reason, for example, core technology has often been used as an equivalent for système de débitage (Moncel et al. 2016). To avoid confusions, we will use the following equivalences throughout the text:

- systèmes de débitages = core reduction systems (see also core reduction strategies sensu Leder 2016)
- méthodes de débitage = core reduction methods, to refer to core-flaking, thus both cores and flakes.
- méthodes d'initialisation = core initialization methods
- méthodes de production = core production methods.
- ‘core’ = synonymous of ‘structure’.
- débitage or removals = synonymous of flaking waste: flakes, chips, indeterminate fragments (casson and/or chunks).
- surface de plan de frappe = striking platform surface (Shea 2013: 28).
- surface de debitage = flake-release surface (ibid.).

[3] With an internal gesture, we mean the type of percussive action that allows for the removal of the flake-support. Its counterpart is a marginal percussion or a marginal gesture (Boëda, 1997: fig. 4).

[4] Here, the apostrophe means that we cannot establish the removal sequence between the two possible initial flakes; that is, flakes 1 and 1’ do not overlap (see Table 6).
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REFERENCES


