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Tool production processes in lithic quarries from the Central Plateau of Santa Cruz, Argentina

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ABSTRACT

Lithic resources at the Central Plateau of Santa Cruz (Argentina) are abundant, ubiquitous and of very good quality for knapping. They have been exploited by hunter–gatherer societies since the latest Pleistocene until the Late Holocene. The study of their distribution, availability, and ways of exploitation at the quarries, together with the information stemming from the archaeological sites, enable the understanding of the first stages of tool production and consumption.

In this paper, two quarries from La María Archaeological Locality (Cantera de Sílex de CDM and Cantera Bosque Petrificado) are studied and compared. Their geomorphologic location is described. The lithological characteristics of the outcrops, the size of the stones, and the variability of raw materials available at them are also addressed. The accessibility and visibility of the quarries are analyzed. The way raw materials were exploited at the sources is evaluated taking into consideration their relationship with the local and regional structure of lithic resources. The information generated for the quarries is complemented and compared with the local trends identified for the habitation sites. This enabled the formulation of a general model about the first stages of production.

Although the quarries have different types of raw materials (flint and silicified wood), results show that similar technological strategies were implemented in them. These are in agreement with the general trend at the local and regional levels. Both sources are easily accessible from the surrounding landscape. They are visible from nearby areas. Probably, they were exploited mainly from nearby sites. At the quarries, the first stages of tool production were performed: core decortication and preparation and the production of blanks. The acquisition of raw material involved the selection of good quality nodules and boulders and the production of polyhedral cores knapped in multiple directions. These cores could be transported to the habitation sites or could be discarded in situ while still presenting active platforms. On the other hand, differences in some procurement practices might be related to decisions and variations linked to the particular characteristics of the resources in both outcrops.

1. Introduction

In the last decades, the study of the lithic archaeological assemblages in Argentina has shifted from being exclusively focused on tools, to incorporating the analysis of raw materials and debitage. This has enabled the discussion about diverse aspects of the production and use of the artifacts. In this context, researchers have paid special attention to the regional availability of lithic resources and the lithological attributes of the raw materials. The analysis of the assemblages found at the workshops where tool production was finished is also regularly performed. In contrast, the technomorphological study of lithic sources, focused on the understanding of the first stages of tool production, is underrepresented in the specialized literature.

Tool production involves several steps. The selection and procurement of raw material is the first stage of this process (Ericson, 1984; Collins, 1989-90; Nelson, 1991; Aschero et al., 1995; Andrefsky, 2005). Many different factors intervene in this stage. From a functional point of view, tools require certain morphologies, types of edges, and attributes of the raw material in order to achieve a desired function. These characteristics influence the way rocks are selected (Bamforth, 1986). At the same time, the regional lithic resource base (sensu Ericson, 1984) conditions the decisions regarding the selection of raw materials, the amount of energy invested in their curation and the transport strategies implemented (Mansur, 1999; Risch, 2002; Andrefsky, 2005). In this sense, many characteristics are considered relevant: the distribution, availability

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Fig. 1. Map of the Central Plateau of Santa Cruz with the main archaeological localities.

and quality of the raw materials (both for knapping and for fulfilling determinate tasks), the lithological diversity of a region and the attributes of the outcrops, as well as the visibility and accessibility of the sources (Ericson, 1984; Gould and Saggers, 1985; Bamforth, 1986; Beck and Jones, 1990; Andrefsky, 1994; Franco and Borrero, 1999; Escola, 2002; Andrefsky, 2009; Hermo, 2009).

Hence, lithic sources are the first context in which the technological strategies are applied (Ericson, 1984; Collins, 1989-90). These strategies are linked to the regional structure of lithic resources (availability, quality and characteristics of the raw materials), the needs related to the functionality of the tools, the specific activities in which these tools are going to be used as well as to different socio-economic and environmental variables (Cueto, 2013; Cueto et al., 2013). Therefore, in order to understand the way in which the craftsmen managed the transformation of the rocks into tools, it is very important to carry out specific analyses of the procurement sources (Ericson, 1984).

This paper seeks to contribute to the understanding of the different ways of tool production and consumption that were developed in the past in the Central Plateau of Santa Cruz (Argentine Patagonia), an area which was inhabited by indigenous populations from the final Pleistocene until the late Holocene. For this, it is important to analyze the practices that the human groups implemented during the exploitation of the sources of lithic raw materials. This information is different and complementary to that obtained throughout many years of lithic research in the stratigraphic contexts of the region (Paunero, 2009a; Frank, 2011; Skarbun, 2011; Cueto et al., 2012).

In this context, two lithic quarries from La María Archaeological Locality are analyzed and compared: Cantera de Sílex de CDM (CSCDM) and Cantera Bosque Petrificado (BP). Some features of these sources will be presented: geomorphological location, visibility, accessibility, characteristics of the outcrops and of the raw materials, and size of the rocks. Besides, the technomorphological analysis of the remains found at both sources will be performed. Similarities and differences in the practices of selection, acquisition, and knapping at both quarries are scrutinized. The information will be used to discuss and rethink the ideas about local production strategies that have been proposed during the research of local habitation sites. This will enable discussion about some of the decisions the ancient knappers made in regards to the selection and exploitation of raw materials and, more generally about different aspects of the organization of lithic technology on the Central Plateau.

2. Previous research at the Central Plateau of Santa Cruz

2.1. General features

The Central Plateau is located in the Province of Santa Cruz in Argentina (Fig. 1). The plateau landscape is cut by ravines which hold seasonal streams. There are also basaltic mantles and endorheic lake basins which can become temporary lagoons. The typical vegetation is a dwarf shrub steppe and plant cover is low (less than 30%). Shrubs are lower than 30 cm high. There are very few grasses (Paruelo et al., 2005; de Porras, 2010). There is a height gradient from west to east. In the area where La María is located, heights commonly range between 150 and 250 m.a.s.l. and slopes are usually gentle, lower than 40°. However, the basaltic mantles can be higher and show more abrupt slopes.

The plateau is a landscape with high concentrations of resources. Lithic raw materials are abundant, readily available and of very good quality for knapping. The geological formations present in the area are those prevalent in the geological province Deseado Massif (Panza, 1994). Volcanic rocks from the Middle–Upper Jurassic are predominant. According to their composition, two groups have been defined. The Bahia Laura Group is made up of acid rocks while the Bajo Pobre Formation consists of basic to intermediate rocks (Guido et al., 2006).

The initial peopling of the area took place during the final Pleistocene, between *ca.* 11,200 and 10,000 BP. Occupations that span the entire Holocene have been recorded (Cardich, 1987; Aguerre, 2003; Durán et al., 2003; Miotti and Salemme, 2004; Paunero, 2009b; among others).

2.2. Previous research regarding the procurement of rocks

Although archaeological research has been carried out at the Central Plateau for more than half a century, during many decades the investigations were focused on the archaeological sites. The regional landscape in which these sites were located was not taken into consideration (Menghin, 1952; Cardich et al., 1973).

Mansur-Franchomme (1984) analyzed lithic sources from El Ceibo Archaeological Locality. She established their location and distance to the archaeological sites. She evaluated the properties of the raw materials as well as the technological characteristics of the remains found at these sources. Based on these observations, she made a brief outline about the way the procurement of raw material was performed in the region. However, in most of the articles from the last decades of the 20th century, observations about the sources were generally isolated, and systematic studies were uncommon. The high availability and distribution of lithic raw material of good or very good quality for knapping near the sites was mentioned. Researchers noted that in the Central Plateau outcrops of flint, chalcedony and opal were abundant. In many cases, the presence of sources is made explicit in the papers, but their location or distance to the sites is not specified. Apart from that, research established through macroscopic observations that the tools made at the sites were manufactured with raw materials found in their vicinities (Paunero, 1993-94; Cardich et al., 1993–1994). Mansur-Franchomme (1984) stated that some of the raw materials from the site El Ceibo 7 came from the immediate surroundings, while others came from sources located between 4 and 8 km from the cave. She interpreted that the first stages of reduction took place at the quarries and the last ones at the site. Mansur-Franchomme (1984) stated that some of these quarries were exploited during every occupation of the site.

Since the end of the 1990s and during the first decade of the 21st century, systematic investigations were developed (Cattáneo, 2002, 2004; Hermo, 2008a, 2009; Ambrústolo, 2010; Skarbun, 2011). These authors tried to establish the procurement potential and the availability of rocks in certain areas within the plateau and the relationship between sources and excavated sites. However, these investigations did not try to understand the technological strategies involved in the exploitation of the quarries.

These investigations (Cattáneo, 2002, 2004; Hermo, 2008a, 2009; Ambrústolo, 2010; Skarbun, 2011) highlight that the geological formations Bajo Pobre, La Matilde, and Chön Aike, originating during the volcanic events of the Jurassic, are the most relevant for archaeology since they provide potential primary sources of raw material (flint, chalcedony, silicified wood, silicified tuff, basalt, andesite). Quaternary deposits were identified as areas in which siliceous cobbles accumulated (Cattáneo, 2002, 2004; Hermo, 2008a, 2009). Ambrústolo (2010) underlines the significance of secondary sources for the area near the Atlantic coast.

However, the methods and goals of this research show some differences. Cattáneo (2002, 2004) used geological maps to assess the surface that each formation occupies in the Piedra Museo Archaeological Locality. Afterwards, she made field surveys in this area. She also looked at the thin sections of samples taken from these formations and compares them with archaeological samples from the site AEP-1 (Cattáneo, 2002, 2004). She studied the availability and variability of knappable stones and reached the conclusion that there is a homogeneous distribution of lithic resources in the area.

Hermo (for La Primavera Locality), Ambrústolo (for the southern part of the Río Deseado Inlet) and Skarbun (for La María Locality) believe that the study of the surface that covers each geological formation is just a first step in the research, which is necessary for the understanding of the base of lithic resources and the potential availability of raw materials (Hermo, 2008a, 2009; Ambrústolo, 2010; Skarbun, 2011). These authors consider it is also important to locate the outcrops in the field and confirm whether or not they were quarried by making surveys, sampling, and analyzing the potential sources. Therefore, they are able to understand the real availability of raw materials in an area, overcoming the limitations of a methodology focused on the study of geological formations. Furthermore, they indicate that although there is a high availability of sources, these do not have a uniform distribution on the landscape. In order to evaluate the origin of the raw materials found at the archaeological sites, they also compare the microscopic characteristics of the stones from the sites and the outcrops though thin section analyses. However, Hermo (2008a, 2009) and Skarbun (2011) state that different sources have similar petrologic attributes and therefore the methodology is by itself not appropriate to establish the provenience of the archaeological remains. Hermo (2008a, 2009) suggests that other technical and analytical avenues (landscape studies, use of GIS) might help overcome this limitation. Using this approach, he postulates that the raw materials found at the site Cueva Maripe came from local sources.

Among other issues discussed by this author, he states that the sources from the locality have different degrees of visibility. Although all of them can be seen from nearby spots (no more than a few hundred meters) some sources can be spotted from more distant areas. However, in order to identify the sources, in certain cases it is necessary to have a specific knowledge about their location.

3. Previous research at La María Archaeological Locality

3.1. Distribution and availability of raw materials

La María Archaeological Locality (Fig. 2) is located at the central part of the plateau. There, different studies regarding the regional structure of lithic resources were performed (Frank et al., 2007, 2013; Skarbun, 2011; Skarbun, 2013). Based on the Tres Cerros geological Map (Panza, 1994), digital maps were made. The geological formations and outcrops which possibly had knappable stones were identified (Skarbun, 2013). Field surveys were carried out to recognize the outcrops and the surrounding landscape. After this initial inspection, a *contextual study* (sensu Ambrústolo, 2010) of the different outcrops began. Sixteen potential primary sources were identified. As the locality covers an area of 226 km^2, this implies there is a potential source every 14.13 km^2. However, there is an uneven distribution of sources within the locality; the northern part has more availability and variability of rocks. Most of the sources are outcrops of the Chon Aike Formation, but there are also other belonging to the Baqueró, Bajo Pobre and La Matilde formations. All the potential sources were geopositioned and their size and boundaries were recorded. In each, the lithological variability was determined macroscopically. The type of outcrop and the size of the stones were recorded. In addition, potential secondary sources were recorded in Cenozoic and Quaternary deposits (Paunero et al., 2005).

Every archaeological site from the locality has at least one quarry less than 5 km distant. Thirteen out of sixteen sources were

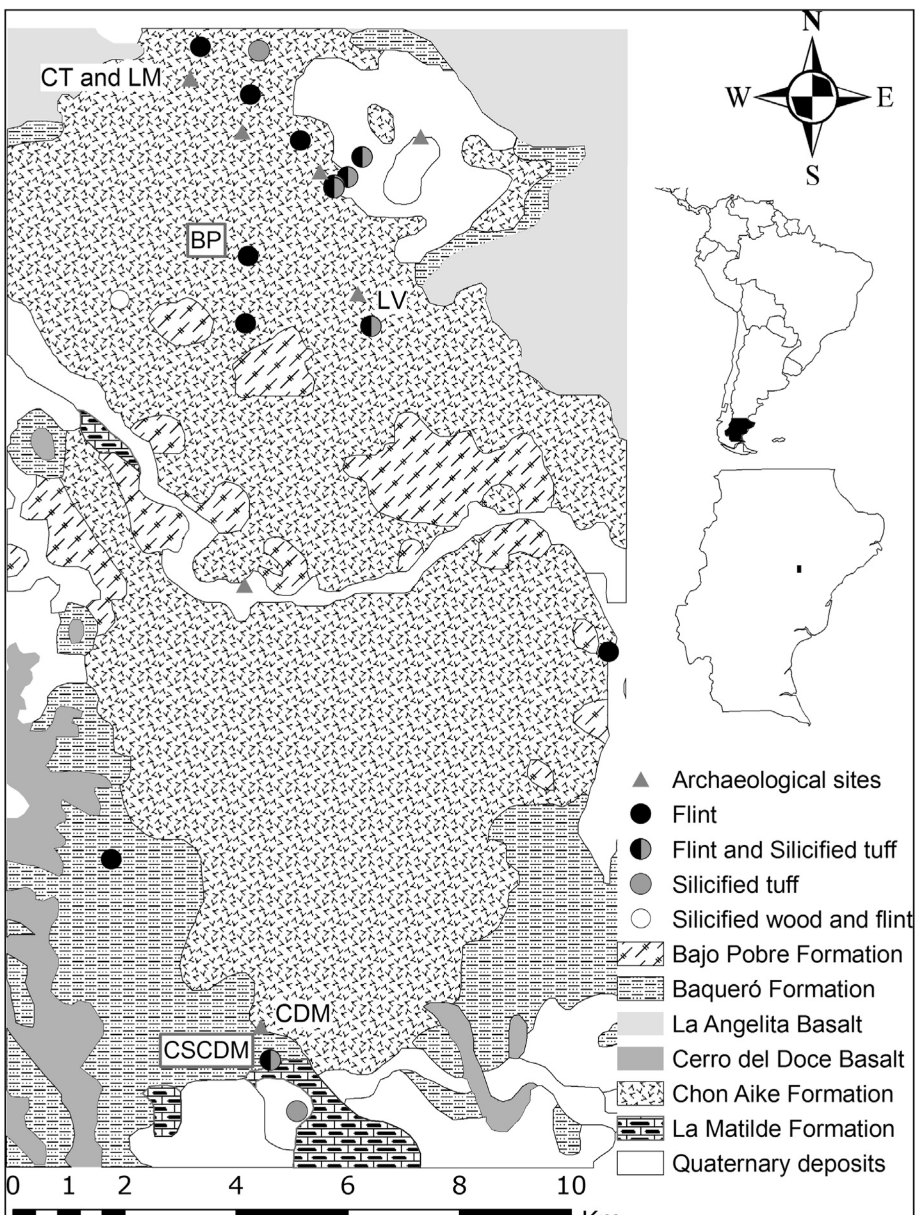

Fig. 2. La María Archaeological Locality. Geological formations and location of potential sources of raw material including CSCDM and BP.

accessible throughout the whole occupation period of the area. The sources hold an assemblage of stones with a varying degree of silicification. Flint is the raw material most widely distributed and abundant, both when doing inter and intra-source analysis (Skarbun, 2013). Silicified tuff is also an abundant raw material. Both flint and silicified tuff are usually exposed in nodules and boulders. However, they also occur as silicified crests (in which silicification can be uneven). Although usually they are found in concentrated areas, sometimes they also occur in isolated spots within the landscape. Twelve of these sources were analyzed to confirm human exploitation (Skarbun, 2013). All showed evidence which indicated their use as quarries and/or quarry-workshops (sensu Nami, 1992).

Based on this initial examination, two lithic sources (BP and CSCDM) were selected in order to evaluate the characteristics of the surrounding landscape, their relationship with the excavated sites and the exploitation strategies implemented on them. The differences in the distribution of raw materials within the outcrops were identified and information was gathered concerning types of archaeological remains and their distribution.

BP is 13 km from CSCDM (Fig. 2). CSCDM is a primary source, located 160 m.a.s.l. The raw material available consists of flint (from the primary precipitation of silica) and silicified tuff. According to the Tres Cerros geological map, this outcrop is part of the Baqueró Formation (Panza, 1994). This quarry covers an area of approximately 0.4 km^2, but there is an area of 0.15 km^2 in which higher concentrations of nodules and lithic artifacts occur (Fig. 3). There are two other sources located less than 5 km from CSCDM. Cerro el Morro is an outcrop of silicified tuff located 1 km away; La María Sur Oeste is a flint source situated 4.58 km from CSCDM. Furthermore, in the surroundings of the quarry there are abundant sources of pigments which were probably used for rock paintings commonly found at the locality. The nearest excavated site to this outcrop is Casa del Minero 1, which is located 0.62 km away (Paunero et al., 2007).

BP is a primary source of silicified wood. It is situated on the northern part of the locality, 230 m.a.s.l.. According to the Tres Cerros geological map (Panza, 1994), this outcrop is part of the Chon Aike and Bajo Pobre formations. It covers an area of 2.45 km^2. In this source (Fig. 4) there are "patches" of raw material and debris; most of the artifacts are gathered around large silicified trunks. There are nine other sources located less than 5 km from BP. Most consist of flint and silicified tuff stones. The nearest one is a source of red flint which is situated 2.3 km from BP. The nearest excavated site is La Ventana (Paunero, 2000a), located 3.6 km away. No settlement sites have been found less than 1 km away from this source.

Thin section analyses were performed for raw materials from both sources. Results indicate there are different lithologies in each (Skarbun and Páez, 2012). In CSCDM, lavas and ignimbrites from Chon Aike, reworked pyroclastic rocks from La Matilde and opals stained with ferric oxide were recognized (Fig. 5). In BP, fossilized vegetable remains, lavas and ignimbrites from Chon Aike and chalcedonies with varying degrees of opal staining were identified (Fig. 5). However, the geographic extension of the geologic formations in the Central Plateau and the amount of outcrops at a regional level, hinder the utility of thin section analyses in the exact definition of the provenance of the raw materials found at the archaeological sites (Hermo, 2008a; Skarbun and Páez, 2012).

3.2. Data stemming from the archaeological sites

In this section, relevant information about the relationship between the analyzed archaeological sites from the locality and the procurement sources is presented. The data is the result of grouping the lithic assemblages of four multistratified sites (Casa del Minero 1, Cueva Túnel, La Mesada and La Ventana) excavated in caves and rock shelters from La María Archaeological Locality. The occupations recorded at these sites span a wide range of chronological periods (from the latest Pleistocene to the late Holocene). However, the information presented here represents the general technological trends which are constant throughout time in the locality. Peculiarities of determinate time periods will also be highlighted. This synthesis provides a good idea of the sort of activities that were carried out for the production and use of lithic tools in the habitation sites. Although it is not the goal of this paper to make a direct link between the analyzed quarries and specific sites, it is important to understand what kind of practices were performed at the sites, as they are influenced by the tasks developed at the sources of raw material and vice versa. For more detailed information, the reader is referred to the many published papers which address these sites (Paunero, 2000b; Paunero et al., 2005; Paunero et al., 2007; Skarbun et al., 2007; Frank, 2011; Skarbun, 2011; Cueto and Castro, 2012; Cueto et al., 2012; Frank, 2012; Skarbun, 2012; Cueto, 2013, 2014; Cueto et al., 2013).

The prevailing raw material at these habitation sites is flint (78.33% of the lithic remains). The second most common raw material is chalcedony (10.94%). Obsidian, which probably comes from sources located 200 km away, represents 3.93% of the stone artifacts. The use of this type of raw material took place mainly during

Fig. 3. Panoramic view of CSCDM.

Fig. 4. Panoramic view of BP.

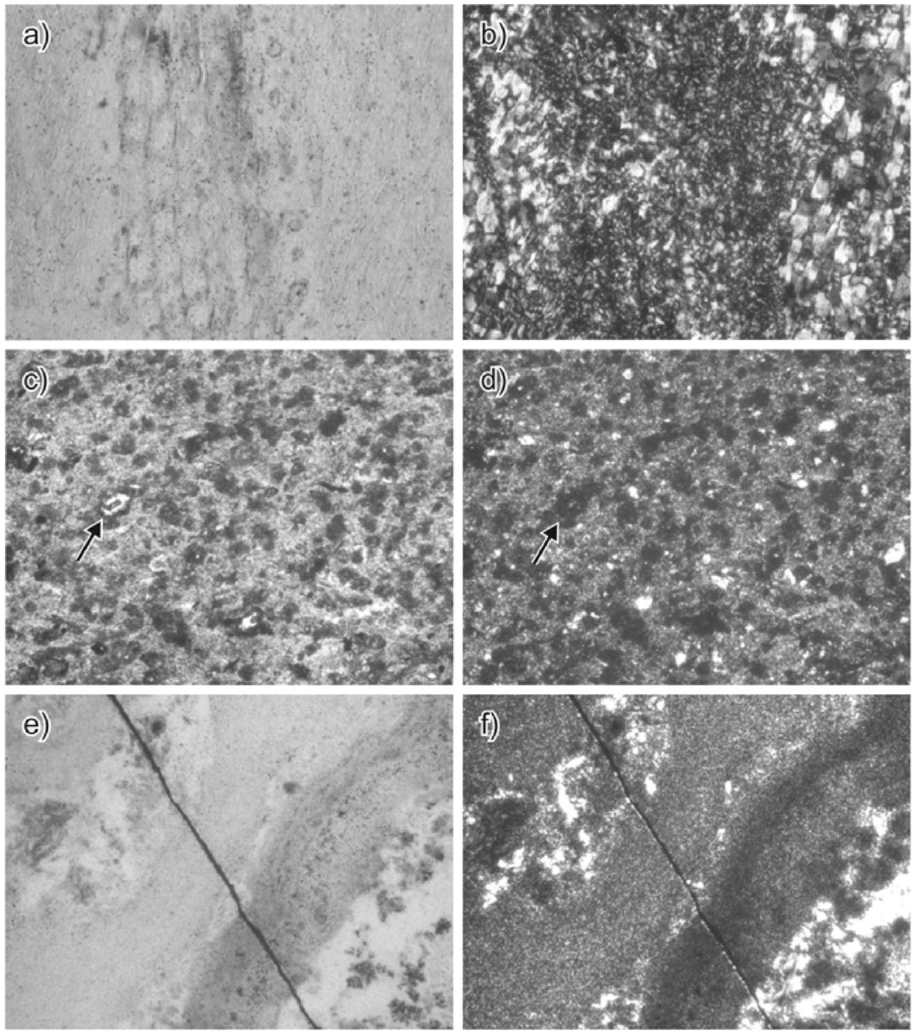

Fig. 5. Microphotographies of studied lithologies. Capture under normal light and polarized light respectively. 50× magnification. a and b. general appearance of silicified plant remains. c and d. recognized textures of Chon Aike's volcanic rocks, in this case lithophysae (arrow). e and f. arrangement of banded chalcedony. Photos taken by Dr. Páez, Laboratorio de Microscopía Óptica del Instituto de Recursos Minerales (INREMI/UNLP).

middle and late Holocene occupations. Silicified wood remains are found in every multistratified site, but in very low proportions (0.89%). When analyzing the tools, flint is also the most abundant raw material (68.18%), followed by chalcedony (12.63%). The proportion of tools made on silicified wood (3.54%) is higher than the proportion of remains in this raw material in the whole assemblage. 2.53% of the tools were made on obsidian.

Macroscopic characteristics such as type of raw material, texture, color, presence of impurities and quality for knapping, indicate that, for all the occupations, the prevailing raw material comes from sources near the sites, probably located less than 5 km away. For example, the prevalent raw material in the occupations from Casa del Minero 1 (CDM1) is the red flint which comes from CSCDM (Frank et al., 2007).

The structure of the assemblages shows a clear prevalence of debitage (96.97%). Tools (2.46%), undetermined fragments (0.41%) and cores (0.16%) are scarce. In this sense, 76.92% of the cores come from middle Holocene contexts.

Most of the debitage was produced during core reduction for blank manufacture (62.88%). There are also abundant remains produced during the final trimming of the tools (33.51%), whereas debris generated during the decortication of the cores is scarce (3.61%). Platforms are usually flat (34.88%) but there are also punctiform (15.3%), faceted (14.59%) and prepared (14.12%) platforms. Only 7.59% of the flakes have cortical platforms. This evidence shows that the prevailing knapping activities at the sites were focused on the production of blanks and the final shaping of tools. The initial stages of production such as the decortication and the preparation of the cores were performed outside the caves.

Endscrapers are the most abundant tools (24.75%). Retouched flakes (19.19%), knives (15.15%) and sidescrapers (10.61%) are also common to find. Their size usually lies within the range between 0.1 and 4 cm (48.99%) or else between 4.1 and 8 cm (46.96%). Only 4.04% are larger than 8 cm. Among the platform bearing tools, the prevailing platforms are faceted (26.92%). There are also tools with flat (24.04%) and prepared platforms (21.15%). Flakes are the most common type of blank for these tools (38.38%), followed by blades (35.86%). The high values of blades are mainly due to the characteristics of the lithic technology during the middle Holocene. There is, during this time period, a preference for the manufacture of tools on blades, both in the analyzed sites and as a regional trend (Crivelli Montero, 1980; Cardich et al., 1993-1994; Castro, 1994; Hermo, 2008a; Skarbun, 2009).

Most of the tools were made on flint ($n = 135$) and only very few were manufactured on silicified wood ($n = 7$). There is more diversity of classes of tools made on flint (18) than in silicified wood (4), although probably this difference is due to the size of the sample in the latter raw material. In this sense, silicified wood was used to manufacture sidescrapers (42.86%), retouched flakes (14.29%), scrapers/sidescrapers (14.29%) and undetermined tools (14.29%). Among flint tools, endscrapers predominate (24.44%), followed by retouched flakes (21.48%), knives (14.81%) and sidescrapers (9.63%). At a general level, the techniques applied in the production of tools are similar for both raw materials. Unifacial tools made by percussion predominate. However, for both raw materials, some tools were made by pressure and bifacial thinning.

Regarding the kinds of activities developed with the tools made on both raw materials, at the moment the information available is restricted to six assemblages dated to the latest Pleistocene and early Holocene. In these occupations, 27 tools were made on flint and five with silicified wood. Of the flint tools, 20 (74.07%) have evidence of use, while only two (40%) silicified wood tools have use-wear evidence.

Flint tools were used to process a greater diversity of materials than were those made on silicified wood. Flint tools processed mostly hide (40%) followed by wood (15%), bone (10%), meat (5%), hard (20%) and indeterminate materials (10%). On the other hand, tools made on silicified wood only worked on hide (100%). Flint tools were used either in transversal (55%) or longitudinal actions (45%), while silicified wood tools were used for transversal actions (100%).

4. Methodology

The study of CSCDM and BP was carried out following two approaches. Characteristics and peculiarities of each source were examined. Among them, the accessibility and visibility of the quarries and the way raw material occurs in them were evaluated. As well, technomorphological studies were performed to analyze tool production and hence, the way raw material was exploited.

Accessibility to the quarries was evaluated taking into consideration the local topography, hydrology and vegetation. Visibility was analyzed in two different ways. First, the theoretical area from which the sources can be seen was determined. Using GIS, a viewshed of 5 km around these sources was defined, in which no obstacles for visualization exist. However, the theoretical possibility of seeing something is not equivalent to actually being able to identify it today. Furthermore, visibility is a part of perception, intrinsically human, and bodily and culturally conditioned (Wheatley and Gillings, 2000). Because of this, during fieldwork the maximum distance from which the surveyors were able to see the sources was evaluated. The analysis developed in the field takes into consideration several features: size and characteristics of the raw materials, color of the stones, their contrast with the soil or the surrounding landscape, and the topography of the sector.

The technomorphological classification of the lithics was performed in situ. Sampling was made by setting grids on the areas with high density of artifacts. This sort of approach developed in the field is a suitable way of analyzing quarries, as it enables analysis of abundant material and does not damage the natural and archaeological landscape. At the same time, it is possible to carry out more refined studies in restricted areas or in smaller samples afterwards. The sampling strategy varied according to the specific attributes of each quarry: topography, distribution of high density areas, and way in which the raw materials occur in the landscape.

At CSCDM a sector of 1600 m^2 was defined. It was located on the central part of the quarry (in which the higher density of lithics was found), following the Z–Z′ transect which linked site Casa del Minero 1 with a nearby lagoon (Frank et al., 2007). A grid was set, which was subdivided in 400 quadrats of 4 m^2; 113 (28.25%) of these quadrats were selected through systematic sampling. As well, 21 other quadrats of the same size were set every 50 m along the transect. Although the density of nodules and archaeological remains in them is lower, the material was also classified. The total analyzed area was 536 m^2.

At BP, four grids of 10 m × 10 m each were set. These were located at the part of the outcrop with the highest concentration of boulders (Frank et al., 2013). The gridded area was 400 m^2. As there are "patches" of raw material, each grid was set using a large trunk as a central point and was subdivided in 25 quadrats of 4 m^2. Ten quadrats were selected from each grid (40%) and the material found in them was classified. The total analyzed area was 160 m^2.

Due to the type of methodology, and taking into account the questions which guide the research, a selection of the classificatory criteria was made among those traditionally used in our investigations (Cardich et al., 1993-1994; Paunero and Castro, 2001; Frank, 2011; Skarbun, 2011; Cueto, 2012; Cueto et al., 2013). Techno-morphological study is performed on all the artifact groups, as each offers different information regarding production and consumption practices. Only the maximum size was recorded from each element, as it was necessary to speed up the classification process.

Regarding the quality of the raw material, a qualitative approach was performed. Hand samples were evaluated and experiments were developed (Cueto and Frank, 2008–2010; Frank, 2011; Cueto, 2012). The quality of the raw material was analyzed in relation to its potential to produce tools by knapping as well as to its performance and alterations during use activities. Macroscopic variables were taken into account, such as grain size and homogeneity, presence of inclusions, and type of fracture (Bamforth, 1992; Nami, 1992; Franco and Aragón, 2004). Raw materials were then classified as having excellent, very good, good, fair, or bad quality. Based on all the collected information, the sequences of tool production were analyzed.

This approach will be discussed together with information stemming from the stratigraphic assemblages. This allows understanding of the variability of the procurement strategies in the study area.

5. Results

Both sources are located in an easily accessible landscape, with soft slopes which are generally lower than 40°. Both are situated in endorheic basins: CSCDM at the lowest part of a basin and BP at the top of internal hillocks. Local vegetation (mainly low bushes and grasses) and streams (narrow, shallow and usually seasonal) do not complicate access. The palaeoenvironmental conditions known for the area, together with their topographical location (de Porras, 2010; Skarbun, 2013), show that these factors did not hinder access in the past.

At CSCDM there is almost no vegetation cover which could hide the materials. The remains are generally on the surface or else very shallowly buried. Artifact density (in the area with the highest concentration) is 4.06 remains/m^2 (Table 1). The area of the viewshed is 4.40 km^2. There are spots 5 km away from the quarry from which, theoretically, the outcrop could be visualized (Fig. 6). However, in the field the maximum distance at which the outcrop could be seen was 670 m. This was achieved in some high spots in the surrounding, in which it was possible to identify the color contrast between the stones and the substrate.

Table 1
Structure of the lithic assemblage at each quarry.

Group	BP			CSCDM		
	%	Total	Density/m^2	%	Total	Density/m^2
Debitage	70.59	5476	34.23	66.96	1457	2.72
Nodules	12.21	947	5.92	6.66	145	0.27
Cores	4.91	381	2.38	23.02	501	0.93
Undetermined fragment	11.02	855	5.34	0.23	5	0.01
Tools	0.32	25	0.16	2.90	63	0.12
Boulders	0.94	73	0.46	0.23	5	0.01
Total	100	7757	48.48	100	2176	4.06

BP has scarce vegetation cover and burial of lithic remains is virtually nonexistent. There is a very high density of stone materials (48.48 remains/m^2, Table 1). The area of the viewshed is 8.40 km^2. As with CSCDM, BP can be theoretically seen from certain spots 5 km away (Fig. 6). However, the possibility of visualizing the outcrop in the field is less than for CSCDM, as it can only be seen from 100 m away. This is due to the topographical characteristics of the location: some of the intervening hillocks block the visualization of the outcrop. The color of the raw material does not contrast with the substrate.

Regarding chronology, it was not possible to establish when both quarries were used in a direct way. Both places are surface sites and lack organic remains, so it was not possible to make radiocarbon dates. However, it was possible to infer that their exploitation began during the initial occupations of the region, as the raw materials found at these quarries were used for the production of tools in the habitation sites.

5.1. Structure of the assemblage

The amount of analyzed remains is 7757 for BP and 2176 for CSCDM. In both assemblages, debitage prevails. However, at BP nodules and undetermined fragments are the most abundant categories following debitage, while cores and nodules follow debitage at CSCDM (Table 1).

The density of remains at BP is much higher that at CSCDM (Table 1). Although the density values for each category are higher in BP than in CSCDM, the largest difference is recorded for debitage. On the other hand, although the proportion of cores is lower in BP than in CSCDM, their density is higher in the former (2.38 cores/m^2 in BP, 0.94 cores/m^2 in CSCDM). The density of tools is similar in both quarries.

CSCDM has 651 nodules/boulders/cores; 77.73% are cores. There are 3.48 cores for every un-worked unit of raw material. At BP, there are 1401 nodules/boulders/cores. Of these, 28.97% are cores or knapped boulders. Hence, there are 0.41 cores or boulders for every un-worked unit of raw material.

5.2. Raw material

There is a clear prevalence of silicified wood (98.9%) at BP; very low percentages of other raw materials are recorded (Table 2). The quality of the silicified wood fluctuates between fair and good. Although it has microcrystalline structure and good silicification, part of the vascular system structure remains, creating a tabular cleavage. This cleavage sometimes guides the direction of the fracture, which can take undesired planes. The raw material can have microporosities. At CSCDM, flint (76%) is prevalent. Its quality varies between very good and good. Usually, it has conchoidal fracture, microcrystalline structure, and a fine-grained homogeneous composition. However, the nodules are not entirely silicified and can have inclusions. The thickness and quality for knapping of the cortex fluctuates. There is raw material with a fine-grained thin cortex (such as red flint) and raw material with a rough, grainy, and thick cortex (such as yellow flint). At CSCDM, there are also silicified and non-silicified tuffs. Other raw materials are very sparsely represented. The quality of tuff usually is bad, while silicified tuff is generally fair to good, depending on the size of the grain and the homogeneity of the nodules.

Table 2
Raw materials at each source.

	BP		CSCDM	
	%	Total	%	Total
Slicified wood	98.90	7672	0.05	1
Flint	0.14	11	76.38	1662
Silicified tuff	0.62	48	13.79	300
Tuff	0.18	14	8.46	184
Other	0.15	12	1.33	29
Total	100	7757	100	2176

Experimentally, both flint and silicified wood can be knapped using direct percussion and pressure, with soft and hard hammer (Cueto, 2012, 2014). There is little difference between both raw materials when it comes to the macroscopic damage generated during use processes (fractures, roundings, and microscars). In both, the damage occurs more abundantly during the processing of bone and hide. With regards to the fragility of the edges (natural and retouched ones), in both lithologies fractures and micro-cracks can be seen commonly in acute edges used for longitudinal actions on hard substances (Cueto, 2012, 2014).

Considering silicified wood at BP, brown debitage, cores and tools are prevalent, while red is the second most abundant category, and there are low proportions of other colors (Table 3). However, the category "other colors" has a higher proportion in nodules. It is very common to find boulders and nodules with a combination of many different colors. At CSCDM there is also variability in the color and tones of the raw material: 34.42% of the flint remains are red, 31.17% are yellow, and 15.64% are brown (Table 3). Although red flint remains are prevalent among nodules, cores and tools, yellow flint is more abundant in debitage (34.83%, Table 3). Yellow remains are more abundant than red and brown ones in all the categories for the tuff and the silicified tuff (except among tuff nodules, as no yellow ones have been found).

Table 3
Structure of the assemblage on silicified wood (BP) and flint (CSCDM), according to their color.

		Boulders	Nodules	Cores	Debitage	Tools	Undetermined fragments	Total
		% (*n*)	% (*n*)	% (*n*)	% (*n*)	% (*n*)	% (*n*)	% (*n*)
BP	Yellow	6.94 (5)	5.64 (53)	1.60 (6)	0.28 (15)	4.17 (1)	1.78 (15)	1.24 (95)
Silicified wood	Other	26.39 (19)	39.19 (368)	20.32 (76)	7.71 (418)	12.50 (3)	18.13 (153)	13.52 (1037)
	Brown	33.33 (24)	37.81 (355)	54.28 (203)	73.57 (3987)	54.17 (13)	54.86 (463)	65.76 (5045)
	Red	33.33 (24)	17.36 (163)	23.80 (89)	18.44 (999)	29.17 (7)	25.24 (213)	19.49 (1495)
Total BP		100 (72)	100 (939)	100 (374)	100 (5419)	100 (24)	100 (844)	100 (7672)
CSCDM	Yellow	0.00	13.82 (17)	27.06 (105)	34.83 (381)	25.00 (13)	50.00 (2)	31.17 (518)
Flint	Other	100 (1)	13.82 (17)	15.98 (62)	20.29 (222)	17.31 (9)	25.00 (1)	18.77 (312)
	Brown	0.00	8.13 (10)	10.82 (42)	17.92 (196)	23.08 (12)	0.00	15.64 (260)
	Red	0.00	64.23 (79)	46.13 (179)	26.97 (295)	34.62 (18)	25.00 (1)	34.42 (572)
Total CSCDM		100 (1)	100 (123)	100 (388)	100 (1094)	100 (52)	100 (4)	100 (1662)

5.3. Nodules

In both sources, raw material occurs mainly as nodules. The size of the nodules varies to 20 cm. Size distribution is similar in both sources, although at BP nodules tend to be larger (Table 4). In BP, raw material has also other morphologies including pebbles, large silicified trunks, and boulders. 68.5% of the boulders are between 20 and 50 cm long, but they can be up to 400 cm long. At CSCDM, only five boulders were found and their size is not larger than 30 cm. Therefore, raw material is bulkier in BP than in CSCDM. 34.5% of the boulders from BP and all the boulders from CSCDM have flake scars. Percussion cones and splinters have been identified in boulders from both quarries.

Table 4
Size distribution of nodules, cores and debitage.

	Size (cm)	BP		CSCDM	
		%	*n*	%	*n*
Nodules	0.1–4	23.76	225	30.07	43
	4.1–8	42.97	407	44.06	63
	8.1–20	28.51	270	21.68	31
	20.1–50	4.75	45	4.20	6
Total nodules		100	947	100	143
Cores	0.1–4	3.15	12	20.44	102
	4.1–8	40.16	153	41.28	206
	8.1–20	50.39	192	33.67	168
	20.1–50	6.3	24	4.61	23
Total cores		100	381	100	499
Debitage	0.1–4	79.39	4346	60.58	879
	4.1–8	17.94	982	34.11	495
	8.1–20	2.65	145	5.31	77
	20.1–+	0.02	1	0	0
Total debitage		100	5474	100	1451

5.4. *Cores*

As with nodules, cores tend to be larger at BP than at CSCDM. While most of the cores from BP are between 8.1 and 20 cm long, at CSCDM the cores are usually between 4.1 and 8 cm (Table 4). This difference is probably due to the size of the unworked raw material in both outcrops. However, cores between 0.1 and 4 cm long are less abundant (in both quarries) than the nodules of this size. Hence, there was some selection of the size of the nodules.

At both sources there are more than 90% of polyhedral cores with multi-directional strikes (Fig. 7). From most of these cores, flakes were knapped (Table 5). There is more diversity of core classes in BP than in CSCDM, although values for most of these classes are very low.

Table 5
Class distribution of cores and debitage.

	Class	BP		CSCDM	
		%	*n*	%	*n*
Cores	Polyhedral	91.08	347	99	496
	Bifacial	0.52	2	0.2	1
	Dihedral	0.26	1	0	0
	Globular	0.26	1	0.4	2
	Undetermined	3.67	14	0	0
	Prismatic	1.57	6	0.2	1
	Tested nodule	1.84	7	0	0
	Piramidal	0.52	2	0.2	1
	Tabular	0.26	1	0	0
Total cores		100	381	100	501
Debitage	Fragments	60.08	3290	21.14	308
	Flakes	35.41	1939	71.04	1035
	Blades	0.79	43	3.64	53
	Microdebitage	1.48	81	0.69	10
	Long flakes	1.22	67	1.10	16
	Wide flakes	0.64	35	1.65	24
	Bladelets	0.31	17	0.75	11
	Triangular flakes	0.07	4	0	0
Total debitage		100	5476	100	1457

Furthermore, at both sources cores were abandoned while they were still active. A lesser number of cores left behind with partial decortications or already exhausted (sensu Mansur-Franchomme, 1984; Frank et al., 2007) were found (Table 6). Most of the cores from BP have less than seven scars. This information strengthens the idea that the reduction of the cores did not involve a lot of work. 18% of the cores from this quarry have just one or two flake scars. Cores with one or two flake scars were also found at CSCDM, but this information was not recorded.

Table 6
Distribution of cores by stage of production.

Stage	BP		CSCDM	
	%	*n*	%	*n*
Initial reduction	21.00	80	25.15	126
Active	58.53	223	51.7	259
Exhausted	15.75	60	15.97	80
Undetermined	4.72	18	7.19	36
Total	100	381	100	501

9.97% cores from BP and 3.56% of the cores from CSCDM were made on nodular flakes. A higher proportion of cores manufactured on nodular flakes could be expected for BP, taking into consideration the abundance of large boulders, which are difficult or impossible to handle. Nevertheless, the exploitation of boulders was not performed solely for the acquisition of nodular flakes. Abundant flakes scars were found in some boulders, which can be more directly linked to the production of blanks (Fig. 8).

5.5. *Debitage*

In both sources, but especially in BP, small debitage (shorter than 4 cm) are prevalent. Unlike nodules and cores, debitage from CSCDM tends to be larger than debitage from BP (Table 4). This evidence shows that the size of flakes is not totally determined by the initial size of nodules and cores. In this sense, although unworked raw material (nodules, boulders) is bulkier in BP, the size of the debitage from this quarry is smaller. The lower quality of the raw material from BP and the fracture properties of the silicified wood probably affect these results. Whereas in CSCDM flakes are prevalent among debitage, in BP undetermined knapping fragments are more abundant (Table 5). In both quarries, a very low amount of blades was found.

The amount of flakes produced during core reduction is high in both sources (Table 7). The amount of remains generated during the final trimming of tools is very low. In contrast, at the habitation sites remains of the final shaping of tools are as abundant as, or more abundant than those remains generated during the manufacture of blanks. Furthermore, in habitation sites the amount of remains produced during the decortication of cores is always low.

Table 7
Distribution of debitage by stage of production.

Stage	BP		CSCDM	
	%	*n*	%	*n*
Decortication	16.15	353	37.16	427
Core reduction	77.81	1701	58.31	670
Final trimming	4.76	104	1.57	18
Undetermined	1.28	28	2.96	34
Total	100	2186	100	1149

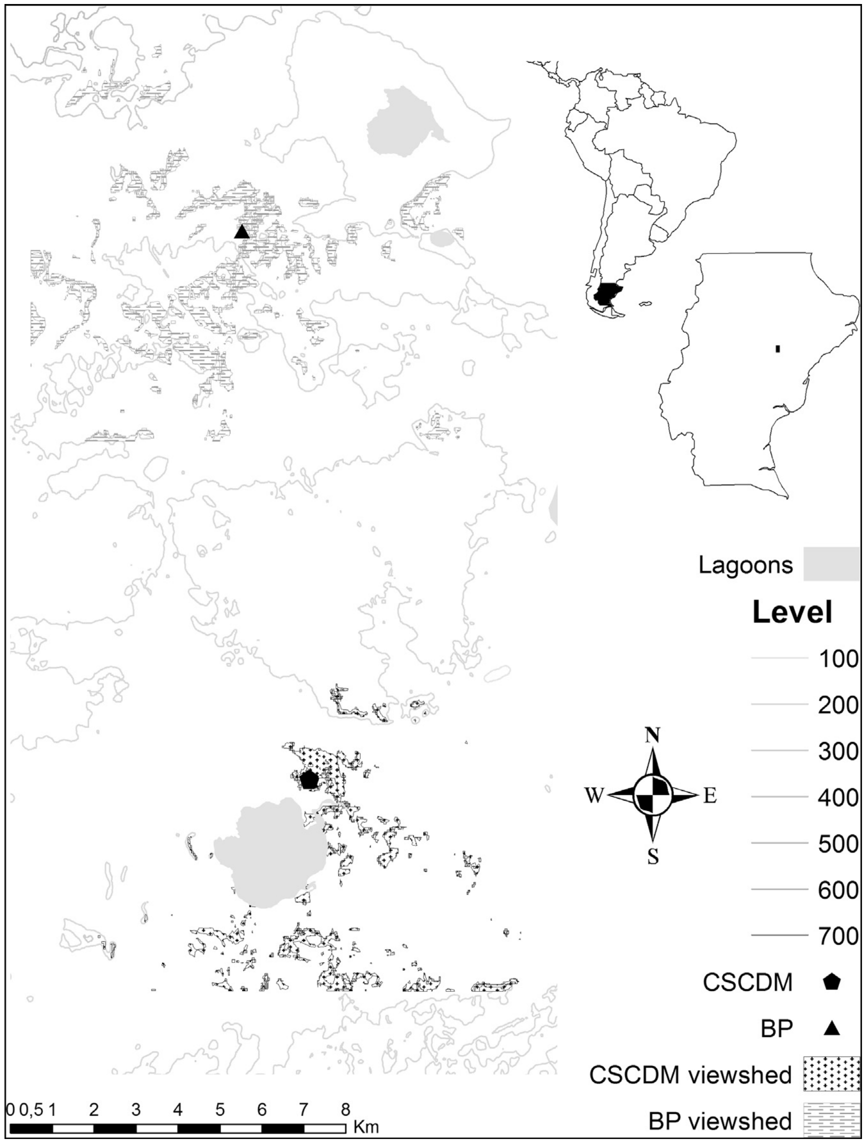

Fig. 6. Five km viewshed for each source.

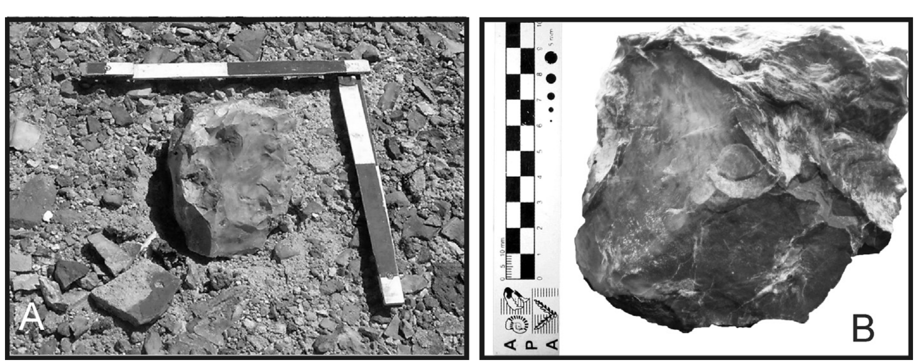

Fig. 7. A: Yellow flint core. CSCDM. B: Silicified wood core, BP.

The analysis of percussion platforms shows similarities between both sources. Flat platforms are the most abundant and are prevalent during the reduction of cores, while during core decortication platforms tend to be cortical (Table 8). Probably, this is due to the high frequencies of core decortication and reduction activities that took place in the quarries. Prepared platforms, or with more than one facet (dihedral, faceted), which are typical of the final stages of production, are scarce. This contrasts to what can be seen in the stratigraphic sites of the region, in which these kinds of platforms are frequent.

Table 8
Distribution of flake platforms in each stage of production. Punct.: punctiform; Undet.: Undetermined; Decort.: Decortication.

Platform	BP				CSCDM			
	Decort.	Core reduction	Final trimming	Total	Decort.	Core reduction	Final trimming	Total
	% (*n*)	% (*n*)	% (*n*)	% (*n*)	% (*n*)	% (*n*)	% (*n*)	% (*n*)
Flat	22.10 (78)	37.51 (638)	25.00 (26)	34.38 (742)	25.94 (110)	42.27 (276)	44.44 (8)	35.98 (394)
Cortical	49.58 (175)	15.46 (263)	1.92 (2)	20.39 (440)	47.88 (203)	19.91 (130)	5.56 (1)	30.50 (334)
Absent	11.89 (42)	18.64 (317)	15.39 (16)	17.37 (375)	12.97 (55)	19.30 (126)	27.78 (5)	16.98 (186)
Faceted	3.68 (13)	7.29 (124)	5.77 (6)	6.63 (143)	2.59 (11)	3.83 (25)	0	3.29 (36)
Lineal	1.70 (6)	7.17 (122)	27.88 (29)	7.28 (157)	0.24 (1)	2.60 (17)	0	1.64 (18)
Dihedral	4.53 (16)	5.70 (97)	4.81 (5)	5.47 (118)	2.36 (10)	2.91 (19)	0	2.65 (29)
Punct.	3.68 (13)	3.17 (54)	12.50 (13)	3.71 (80)	0.94 (4)	2.30 (15)	0	1.74 (19)
Prepared	0.57 (2)	4.35 (74)	2.88 (3)	3.66 (79)	0.71 (3)	2.14 (14)	5.56 (1)	1.64 (18)
Undet.	2.27 (8)	0.71 (12)	3.85 (4)	1.11 (24)	6.37 (27)	4.75 (31)	16.67 (3)	5.57 (61)
Total	100 (353)	100 (1701)	100 (104)	100 (2158)	100 (424)	100 (653)	100 (18)	100 (1095)

Flint debitage from CSCDM includes more yellow than red remains. Table 9 shows that yellow flint is more frequent than red flint among decortication remains. However, yellow flint flakes are less frequent than red flint flakes produced during core reduction. Probably, this shows that there is more yellow flint debitage because of a greater need of decortication activities for this type of raw material, which has a thick and grainy cortex of bad quality for knapping. On the other hand, there are no clear correlations between the color of the artifacts and the stage of production among BP remains (Table 9).

Table 9
Distribution of silicified wood (BP) and flint (CSCDM) flakes by stage of production and color.

	Color	Decortication	Core reduction	Final trimming	Total
		% (*n*)	% (*n*)	% (*n*)	% (*n*)
BP	Yellow	66.67 (8)	33.33 (4)	0	100 (12)
Silicified wood	Other	21.68 (31)	77.62 (111)	0.70 (1)	100 (143)
	Brown	17.65 (267)	78.72 (1191)	3.64 (55)	100 (1513)
	Red	9.35 (46)	80.49 (396)	10.16 (50)	100 (492)
Total BP		16.34 (352)	78.77 (1702)	4.89 (106)	100 (2160)
CSCDM	Yellow	45.17 (131)	52.76 (153)	2.07 (6)	100 (290)
Flint	Other	26.22 (43)	73.17 (120)	0.61 (1)	100 (164)
	Brown	32.50 (52)	65.63 (105)	1.88 (3)	100 (160)
	Red	30.30 (70)	67.10 (155)	2.60 (6)	100 (231)
Total CSCDM		35.03 (296)	63.08 (533)	1.89 (16)	100 (845)

5.6. Tools

There are scarce tools in both sources (Table 1). Among them, the most frequent are retouched flakes (Table 10). However, there is higher variability of tool classes at CSCDM. There, sidescrapers and hammerstones were found, among other tools which are absent in BP.

Table 10
Distribution of tool types.

Clase	BP		CSCDM		Total	
	%	*n*	%	*n*	%	*n*
Retouched flakes	88.00	22	68.25	43	73.86	65
Retouched blades	4.00	1	9.52	6	7.95	7
Hammerstones	0	0	9.52	6	6.82	6
Sidescrapers	0	0	6.35	4	4.55	4
Undetermined	4.00	1	3.17	2	3.41	3
Bifaces	0	0	1.59	1	1.14	1
Knives	0	0	1.59	1	1.14	1
Notched points	4.00	1	0	0	1.14	1
Total	100	25	100	63	100	88

At BP, tools were made on silicified wood (mostly brown); only one tool was made on silicified tuff. There is evidence of raw material selection for tool production, as most of the tools from BP were made on good quality raw material. At CSCDM, tools were made mainly on flint (generally red and yellow). However, there is also more variety of raw materials (Table 11). This is probably related to the function of certain tools, as hammerstones made on granite, rhyolite, and basalt were found.

Table 11
Distribution of raw material types in tools.

Raw material	Color	BP		CSCDM		Total	
		%	*n*	%	*n*	%	*n*
Basalt		0	0	3.17	2	2.27	2
Granite		0	0	1.59	1	1.14	1
Rhyolite		0	0	3.17	2	2.27	2
Flint	Red	0	0	28.57	18	20.45	18
	Yellow	0	0	20.63	13	14.77	13
	Brown	0	0	19.05	12	13.64	12
	Other	0	0	14.29	9	10.23	9
Total flint		0	0	82.54	52	59.09	52
Tuff		0	0	1.59	1	1.14	1
Silicified tuff		4	1	4.76	3	4.55	4
Silicified wood	Red	28	7	0	0	7.95	7
	Yellow	4	1	0	0	1.14	1
	Brown	52	13	0	0	14.77	13
	Other	12	3	1.59	1	4.55	4
Total silicified wood		96	24	1.59	1	28.41	25
Undetermined		0	0	1.59	1	1.14	1
Total		100	25	100	63	100	88

Fig. 8. Flake-scars on a large silicified wood boulder, BP.

In both quarries, tools have usually cortical or flat platforms (Table 12). This is similar to what is seen on the debitage. In contrast, tools found at the excavated sites from the locality have a higher prevalence of faceted and prepared platforms. This (together with their expedient nature and the fact that tools were made with the same raw material available at the quarries) indicates that these artifacts were manufactured at the sources. Table 13 shows that at both quarries tools are generally between 4.1 and 8 cm long, which indicates selection of blanks for tool production among the debitage generated at the sources.

Table 12
Distribution of platforms in tools.

Platform	BP		CSCDM		Total	
	%	*n*	%	*n*	%	*n*
Flat	31.25	5	47.06	16	42.00	21
Cortical	37.50	6	32.35	11	34.00	17
Faceted	12.50	2	8.82	3	10.00	5
Dihedral	12.50	2	5.88	2	8.00	4
Prepared	6.25	1	2.94	1	4.00	2
Undetermined	0.00	0	2.94	1	2.00	1
Total	100.00	16	100.00	34	100.00	50

Table 13
Size distribution of tools.

Size (cm)	BP		CSCDM		Total	
	%	*n*	%	*n*	%	*n*
0.1–4	40	10	26.98	17	30.68	27
4.1–8	44	11	61.90	39	56.82	50
8.1–20	16	4	11.11	7	12.50	11
Total	100	25	100	63	100	88

Tools from both sources were made mostly on flakes (Table 14). This coincides with the trend observed at the excavated local sites. 11.11% of the tools from CSDM were made on blades, and only one tool (4%) was made on a blade at BP. This implies a difference between the productive tasks performed at both quarries.

Table 14
Distribution of blanks in tools.

Blank	BP		CSCDM		Total	
	%	*n*	%	*n*	%	*n*
Flake	76	19	63.49	40	67.05	59
Blade	4	1	11.11	7	9.09	8
Nodule	0	0	9.52	6	6.82	6
Undetermined	4	1	6.35	4	5.68	5
Decortication flake	0	0	4.76	3	3.41	3
Undetermined flaking fragment	8	2	0	0	2.27	2
Nodular flake	4	1	1.59	1	2.27	2
Core rejuvenation flake	4	1	0	0	1.14	1
Wide flake	0	0	1.59	1	1.14	1
Long flake	0	0	1.59	1	1.14	1
Total	100	25	100	63	100	88

6. Discussion and conclusions

6.1. Issues concerning the search and selection of raw material

The current research shows that similar technological strategies were implemented at BP and CSCDM. These strategies are in agreement with what is seen on a local level (La María Archaeological Locality) and for the Central Plateau as a region (Mansur-Franchomme, 1984). These sources share some attributes such as visibility and accessibility and differ on other features such as the prevailing lithologies found at the outcrops and the way these raw materials occur in the landscape. In this sense, the availability and distribution of each raw material at a local level could be regarded as factors which created differences in the practices of resource selection and circulation.

Flint and silicified tuff are highly available and disseminated throughout the locality. The former usually is of very good quality for knapping while the latter generally is of lesser quality. Silicified wood is found only at BP, that is to say, it is located on a restricted spot. Both CSCDM and BP have other sources of flint and/or silicified tuff nearby. Due to the way resources are distributed at the locality, all habitation sites have raw material readily available in their surroundings. This means that, since the initial occupation of the area, knappers had a variety of sources available.

Regarding viewshed analysis, there are no theoretical interferences for the visualization of the outcrops from places located 5 km away. However, on the field they could be identified only from nearer spots. A preliminary and qualitative observation (because systematic studies are still being developed) indicates that the remaining quarries from the locality share this characteristic with BP and CSCDM. Research carried out by Hermo (2008a) shows a similar situation with the sources from La Primavera locality. Hence, taking into account that the quarries are located within the territory used daily by these groups, visualization from large distances was not necessary during the search for the raw material.

In the Central Plateau outcrops are usually easy to access, taking into consideration the topography, hydrology, and phytogeography of the region. This can be seen in BP and CSCDM as well as in the other quarries from the locality. The fact that all the sources from the locality have cores and debitage indicates that they were known and exploited by the societies that inhabited the region.

In other words, the early inhabitants of the region generally selected, as part of their tool production strategies, good quality raw materials which came from sources located near the sites. All these sources were, due to the characteristics of the landscape, easy to access and visible from the surroundings. The circulation of their raw material to more distant places must have been secondary, involving small amounts of materials. The presence, in low proportions, of silicified wood in all the occupations from the locality shows that some technological strategies involved raw materials which were not immediately available. Furthermore, the presence of obsidian indicated that exotic raw materials were also exploited.

Procurement from nearby quarries could have been done by direct access to the sources. Groups probably visited the quarries deliberately, whenever they needed raw material. At the same time, procurement practices could also have been embedded (sensu Binford, 1979) to other daily tasks of these societies, such as hunting, gathering firewood and edible vegetables or procuring pigments. In this context, both deliberate visits and embedded procurement are not contradictory practices, but possibilities that are a consequence of the proximity and abundance of raw material sources.

The preference of flint seen in the stratigraphic contexts would be due to a group of reasons: on the one hand its availability and abundance, on the other hand the fact that this raw material fulfilled the technological and functional requirements (regarding quality for knapping as well as to be used for different tasks). In this sense, other raw materials which are highly available at the locality, but which are of lower quality (such as silicified tuff) were not used with the same intensity as flint. At the same time, the low amount of silicified wood remains does not mean that the ancient inhabitants were not aware of this source. There are remains of this raw material in all the occupations of the sites, notwithstanding the time period. It is probable that the exploitation of BP took place mainly from the immediate vicinity (less than 1 km), as at a larger distance other sources of flint are nearer to the habitation sites and would therefore be preferred. However, there are no excavated sites in the immediate vicinity of the quarry. Possibly, this explains the absence of contexts in which silicified wood is prevalent among the remains.

The technological needs for the production of lithic tools by the ancient inhabitants, as well as the functional requirements for the development of different tasks, are also important to understand the selection of raw materials. The technomorphological analysis of the tools from the habitation sites shows that the same kinds of techniques were applied when exploiting both raw materials. There is a high prevalence of unifacial tools retouched by percussion. Bifaciality and pressure retouch are infrequent. Although there is a higher diversity of tools made with flint, this may be due to the size of the sample in silicified wood. The functional analysis of tools is still being developed, and the available data is restricted to latest Pleistocene/early Holocene occupations. Flint was used for a wider variety of activities, while silicified wood was used only to scrape hide. Experimentally, both raw materials show similarity in knapping quality and in the functionality of their edges. However, silicified wood is slightly of lower quality due to the way it fractures. This fact complements the differential availability of both types of stone to explain why flint was preferred by the ancient inhabitants of La María.

6.2. Exploitation of the raw materials

The evidence from both quarries shows similar strategies regarding procurement technology. Broadly speaking, the techniques applied at BP and CSCDM and the knapping activities implemented are similar. At these quarries, the first stages of tool production took place: core decortication and preparation and blank manufacture. This inference is based on the abundance of cores, the high level of decortication remains and the high proportion of flakes made during core reduction (which, at BP, have high percentages of cortex), as well as the abundance of natural and flat platforms. The low amount of flakes created during the final trimming of tools and the scarcity of finished tools also support this statement.

Furthermore, the intensity of exploitation seems to be similar in both quarries. The fact that there is higher density/m^2 of knapped raw material at BP can be explained by the larger volume of stones available at this quarry (higher density of boulders/nodules/cores of a larger size) which at the same time is of lesser quality. These features probably played a part in the generation of more flakes per core in BP. Although the amount of cores in BP is less than in CSCDM, their density is higher.

The similitude of both quarries, together with the information stemming from the stratigraphic sites, are enough to create a general model about the first stages of production which took place at the quarries. Evidence shows that procurement probably did not involve heavy work. Acquisition of raw material was made procuring nodules and boulders which were dispersed and available on the surface. Usually, good quality stones were selected. In order to find suitable raw material, sometimes nodules were tested (there are in the quarries cores with one or two flake scars). Afterwards, cores were decorticated with a hard hammerstone. Sometimes it was not necessary to remove the whole cortex, but it was sufficient to remove part of it. Subsequently, flat or faceted percussion platforms were generally prepared or selected from the pre-existing surfaces, in order to produce suitable blanks. Thus, flakes with different morphologies were usually created. These flakes were probably not longer than 8 cm, considering the size of the tools recovered from the sites. The first stages of the productive process did not demand a rigid or standardized sequence: instead, the surfaces, edges and ridges which best suited the needs of the knapper were used. During this reduction sequence, polyhedral cores with multi-directional strikes were shaped. As with blanks, these cores were not standardized. Usually, the cores could be transported to the habitation sites or else be discarded in situ after having obtained the desired products. These cores were still useful, as can be seen in the abundance of active cores found at the sources.

The results from the research made on the sources are in accordance with the observations made on the lithic artifacts from the sites. As proposed in previous investigations, it can be observed that an intersite organization of knapping activities took place, as part of the strategies involving regional technology (Cardich et al., 1981-82; Mansur-Franchomme, 1984; Paunero and Castro, 2001; Frank et al., 2007; Skarbun, 2011). The lithic assemblages from stratigraphic sites have very few cores, rare decortication flakes, abundant remains generated during core reduction, blank production, and/or the final trimming of tools. It can be inferred that cores (or fragments of cores) without cortex, nodular flakes and blanks were transported towards the places where the final shaping of the tools was performed. The amount of energy invested on the final stages of production, fulfilled at the sites, varied according to different factors (Frank, 2011; Skarbun, 2011; Cueto, 2013).

With regards to certain specific techniques, a low proportion of bifacial artifacts at the habitation sites is also observed at the quarries. In contrast, in some contexts of the Central Plateau, during the middle Holocene a technological change occurred, which involved the increase in the production of blades (Durán, 1986-1987; Castro, 1994; Skarbun, 2009; Hermo and Magnin, 2012). This diachronic variation of the technological strategies is not observed at the quarries, where there is a low proportion of blades and cores do not show recurrence of blade production. This observation means that a more thorough inspection of blade production strategies (including the spatial distribution of the activities) is needed.

On the other hand, certain procurement practices are characteristic of each quarry. Probably, these typical features are related to the way raw material occurs in each quarry as well as to differences in quality. In BP, the abundance of large boulders probably affected the procurement practices. Boulders were used for the production of nodular flakes, but also to create blanks, they worked as cores. It is possible that quality also played a role in some minor differences recorded in both quarries. The fact that there is a larger amount and density of debitage and fragments at BP is probably related to the fair quality of the silicified wood and its tabular cleavage. At CSCDM, the fact that there is more decortication remains on yellow flint than in red flint is probably linked to the traits of the cortex (thick and grainy) in the former. Therefore, these differences and specific attributes from the quarries are probably showing aspects and variations related to decisions made with regards to the specific attributes of each resource. From this point of view, these differences do not signify that there are changes in the technology of raw material exploitation at a local level.

In addition, evidence from both quarries shows distinct behaviors regarding to color. While at BP this attribute did not play a significant role for knapping activities, at CSCDM (and site CDM1), color was taken into account when craftsmen chose raw material. At BP no correlations have been detected, which would imply a differential treatment of the stones due to their color. Nodules and boulders of silicified wood show a greater variability of color than debitage. In this sense, this raw material is bulkier than flint and silicified tuff. Hence, each remain has a larger surface. On the other hand at CSCDM, at a general level the proportions of yellow and red flint are similar. Yellow flint is prevalent within debitage, and red flint is more abundant in all the other categories. This difference might be due to the presence of a coarse cortex on the yellow nodules, which demanded more work to remove. In the lithic assemblage from CDM1, red flint is the more abundant raw material. Evidence indicates that red flint was preferred to yellow flint. This selection could be due to the fact that color indicated a better quality for knapping, but may also be related to other factors or preferences of these societies (Taçon, 1991; Hermo, 2008b).

The presence of tools at the quarries allows another perspective of analysis. Very few tools were found. Flakes were used as blanks, and a marginal retouch was performed on most of them. The frequency of retouched flakes is higher at the quarries than at the stratigraphic sites. Their size is larger than the size of the tools from the sites. Besides, these artifacts have a high proportion of cortical platforms. These evidences suggest an expeditive and/or opportunistic production of tools at the sources. Probably, these tools were manufactured to solve immediate needs. This means that, although in a low frequency, other activities besides raw material procurement took place at the quarries. Hence, instead of considering the sources as isolated or decontextualized entities, this analysis shows that it is possible to consider them as places which are part of the local landscape in which many different activities were performed.

As a final comment, a comparative analysis of the sources, together with the information stemming from the stratigraphic sites, sheds a clearer light on the general characteristic of lithic technology, on the procurement strategies implemented at the Central Plateau and on the differential use of space in productive tasks. It allows exploring the causes of the differences in procurement practices, by taking into account the quality of the raw material, the way it fractures, the functional potentialities, the attributes of the outcrops, and the characteristics of the landscape in which these sources are located.

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