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Loma de los Pedernales, a local raw material source in the North of Pampa Seca, Argentina

Guillermo Heider [a, *], Alejandro Demichelis [b]

[a] CEH Centro de Estudios Históricos "Prof. Carlos S. A. Segreti", CONICET, Córdoba, Argentina
[b] Dpto. Geología, Univ. Nacional de Río Cuarto, Río Cuarto, Argentina

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ABSTRACT

This paper presents archaeological research carried out in the archaeological micro-region of Santa Paz. This is part of a wider area being researched by the authors that covers a vast area (25,700 km^2) in southern Córdoba and San Luis provinces in Argentina and belongs to the geographical sub-region of Pampa Seca (North part). We also describe microscopic petrographic studies carried out to compare the stones used to manufacture a set of lithic tools with those rock clasts from a local source detected during the research. The results allow us to describe and compare the main petrographic characteristics of tools and clasts of raw material recovered during the survey. Its usage by local hunter gatherer groups suggests implications about raw material circulation and home ranges in the northern Pampa region during the Holocene. The distributions of water and high-quality stones for the manufacture of archaeological artifacts were critical factors that directly influenced hunter–gatherer groups mobility, settlements, and technological choices. Recent surveys, aimed to create a Regional Lithic Resources Base, in addition to the lithic material diversity, indicate that this area served as a border zone for the Pampean macro-region with Cuyo and Sierras Centrales (Córdoba and San Luis provinces).

1. Introduction

From the beginnings of Argentine archaeology in the late 19th century, the research, both in number and theoretical and methodological diversity, did not include the whole extent of the Argentine Pampa Macro-region. Only in the late 20th century, starting in the 1970s, did a new period of research expansion and intensification of new regions began, using new theories and methodologies. Raw material source and procurement was one of the main topics in this period, influenced by the preliminary work by Nelson in 1991 and many other researchers (Oliva and Barrientos, 1988; Flegenheimer, 1991, 2004; Madrid and Salemme, 1991; Berón et al., 1995; Pupio, 1996; Bayón and Flegenheimer, 1998, 2003, 2004; Bayón et al., 1999, 2006; Moirano, 2000; Berón and Curtoni, 2002; Charlin, 2002; Franco and Aragón, 2003; Armentano, 2004; Barros and Messineo, 2004; Messineo et al., 2004; Oliva et al., 2004; Berón, 2006, 2007; Carrera Aizpitarte, 2007).

Our research started in 2009, and included the east-central region of the General Roca district in Córdoba Province, and a similar region in Dupuy, Pedernera and Capital districts in San Luis Province (Heider, 2010). The approach to the archaeological record and the scale of analysis were determined by the absence of preliminary archaeological data. One of the main goals was the creation of the Regional Lithic Resource Base (*sensu* Ericson, 1984). Raw material sources and consequences on procurement are the main questions we want to address from the regional archaeological record.

This paper describes some of the activities carried out to determine the topographic, lithological, environmental and archaeological features of the micro-region of Santa Paz (Fig. 1). It also communicates the results that allowed the first detection of locally sourced lithic raw material. Thus, macroscopic descriptions and petrographic thin studies on a set of srock and archaeological artifacts were performed. The combination of the evidence lines can provide an initial overview of the presence and use of a local rock at least at the micro-region scale of Santa Paz (San Luis, Argentina).

* Corresponding author.
E-mail addresses: guillermoheider@hotmail.com (G. Heider), ademichelis@exa.unrc.edu.ar (A. Demichelis).

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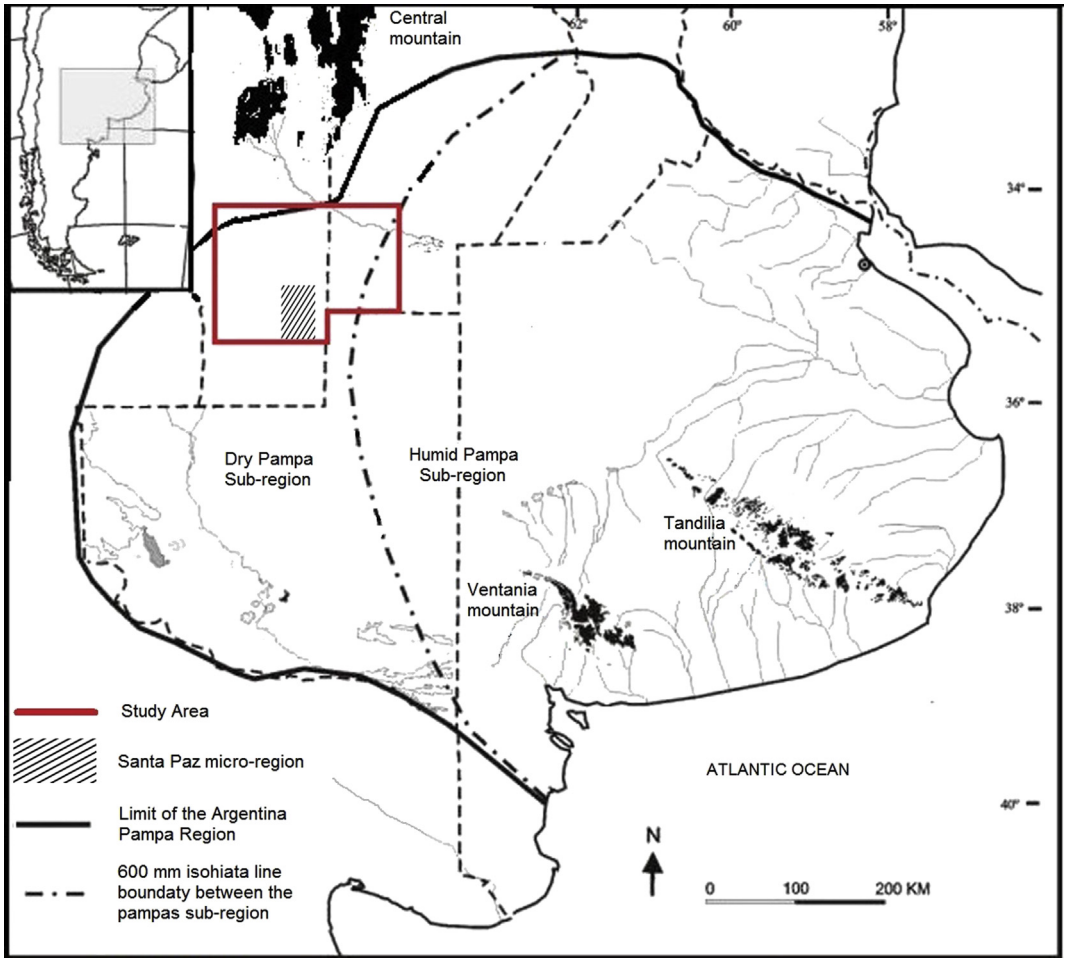

Fig. 1. Pampa Region, study area and Santa Paz micro-region.

2. Regional context

2.1. Environment

The study area has an ecotonal biogeographic position between the Pampa, Spinal, and Monte phytogeographical provinces (*sensu* Cabrera, 1976). This transitional area combines, from east to west, Pampa grassland from Humid Pampa, Xerophitic forest from the Spinal district of Caldén (*Prosopis caldenia*), and particular grassland from Monte province.

Tree vegetation is lusher in the central Spinal province. Caldén dominate in areas where a mantle of coarse limestone is near the surface. Other species seen in the area are Algarrobo (*Prosopis flexuosa*) and Sombra de Toro or Peje (*Jodina rhombifolia*). In sandy soils, Chañar (*Geoffroea decorticans*), Tala (*Celtis tala*) and Molle Negro (*Schinus fasciculatus*) dominate among other xerophitic species.

The western area has bushes forming an open forest that clusters in small islands in humid areas. Piquillin (*Condalia microphylla*), Jarilla (*Larrea divaricata*) and Alpataco (*P. flexuosa var. Depresa*) are found in this area (Morello, 1958). The area is populated by Flor Amarilla (*Diplotaxis teniofolia*), Olivillo (*Hyalis argentea*), Paja Vizcachera (*Stipa ambigua Spegazzini*), Cebadilla Pampeana (*Bromus brevis*), and Pasto Crespo (*Aristida subalata*). The eastern area has an impoverished native flora, due to anthropic actions, including direct seeding agriculture, razing and clearing. However, grasses from the humid Pampa such as Poaceae *Piptochaetium*, *Aristida*, *Stipa* and *Melica Brasileana* and also non-grasses *Vicia*, *Daucus*, *Cynara* and *Chaetrotopis* occupy banks of small lakes (Soriano et al., 1992).

The decline and extinction of native fauna in the area, such as guanaco (*Lama guanicoe*), the largest sized animal in the region and also the most frequent in the entire archaeological record (Mengoni Goñalons, 1999; Martínez and Gutiérrez, 2004; Politis and Pedrotta, 2006) and the venado de las pampas (*Ozotoceros bezoarticus*) took place in the first half of the 20th century. The venado de las pampas only survive in western San Luis Province along with liebre mara (*Dolichotis patagonum*), Puma (*Felis concolor*) and Ñandu (*Rhea americana*).

2.2. Geomorphology

The study area is commonly described as a slightly undulating plain, without good quality rock flaking. and the Río Quinto as the only permanent water course located on its northern end. During the last two decades, geological and geomorphological investigations in northern Pampa Seca have been intensified. Initial researches were carried out by Iriondo who describes the region as "Wind Pampeano System" or "Pampean Sand Sea" (Iriondo and Kröhling, 1996; Iriondo, 1999).

The research area is call "Western Pampean dunefields" (Zárate and Tripaldi, 2012: 403). This was geomorphologically characterized as: "includes diverse dunes surrounded by discontinuous aeolian mantles. This unit is mainly formed by vegetated and mostly stabilized dunes; the most conspicuous landforms are

blowouts and parabolic dunes that rise above a general rolling landscape of likely aeolian origin" (Zárate and Tripaldi, 2012: 409–410).

The High Structural El Cuero, located in the east sector, has a relief relict plateau with rough limestone outcrops (not the ideal to craft stone-tools) and a slight aeolian cover (Degiovanni, 2005). To the north, in General Roca county (Córdoba, Argentina), deflationary processes and the paleochannel of the Quinto River led to the formation of permanent and temporary lagoons.

Geomorphologically, the Pampa Region can be described as: "… a broad, low-relief plain, covered by a widespread late Quaternary aeolian mantle, consisting of mostly loess and loessoid deposits across the eastern Pampas that grade into sandy mantles and dune fields in the western Pampas" (Tripaldi et al., 2013:1731). The hill located inside the "pampean sand field" (Iriondo and Kröhling, 1996) constitutes exceptions to the general geomorphological landscape. Descriptions, knoll Lonko Vaka (La Pampa province), Los Cerrillos de las Salinas, and Cantera de los Cuatro Pozos (San Luis province) were conducted by different research teams (Linares et al., 1980; Criado Roque et al., 1981; Párica, 1986).

However, none of the described elevations is located within the research area. The only hill existing inside is known as the "Loma de los Pedernales" or "Loma Green". The geological descriptions are scarce and partial. The lithic outcrops in the Green quarry, Santa Paz micro-region, show medium-grain quartz-feldspar biotite schists (muscovite, apatite and zircon) and quartz-feldpathic injections (Kostadinoff et al., 2006; Chernicoff et al., 2007). Among the described rocks, only quartz has suitable conditions for stone-tools manufacture, but it represents only 1% of the regional archaeological samples (Heider, 2013).

2.3. Santa Paz micro-region

Northern Pampa Seca was divided in five areas. For this sectoring, phytogeography, human impact and distinct landforms on satellite photos and field were considered. Sub-area IV, entitled "Monte Xerófilo y Altos Estructurales" (5000 km^2) has permanent and temporary lagoons with different degrees of salinity, a small number of partially stabilized dunes, and "El Cuero" and "Loma de los Pedernales".

In turn, sub-region IV was divided into an east part (micro-region El Cuero) and west part (micro-region Santa Paz). Fieldwork showed a total absence of stones used for manufacture in El Cuero (Heider, in preparation). The micro-region of Santa Paz covers about 2100 km^2, and it is a relatively limited location, where both water and lithic raw material for the manufacture of instruments were available. Inside is the hill Lomas de los Pedernales, providing good visibility of the landscape. The landform is an elevation 12 km long and 2.5 km wide in its centre, and a maximum altitude of 376 masl. Currently, there are three arid-extraction companies exploiting the quarry, which have created a high impact on the landscape. However, discrete coarse limestone outcrops, gneisses, schists, and smoky quartz can be observed. Located on the east coast of the lagoon of Santa Paz, this hill is the only exception in a landscape without rocky outcrops over 25,000 km^2. Therefore, in order to create a regional basis of lithic resources, this orographic positive is especially considered.

There are three main water bodies of different sizes and with different evaporation regimens. "Los Pedernales" and "Las Martinetas" are the two smallest lagoons that dry out during the winter. The third water body is the larger lagoon that gives its name to the micro-region. Currently known as "El Salitral de Santa Paz", it covers 1900 ha, and is 12.7 km long by 3.5 km wide. It has highly saline water that forms a salt layer up to 5 cm thick during the dry season (Fig. 2).

The other sites are located in the south and southwest of the region. They are a group of active and stabilized dunes and some flooding lowlands. The adjacent areas are used for farming and cattle raising, or they are covered by dense forest.

3. Methods and materials

Theoretical elements from Landscape Archaeology (Rossignol and Wandsnider, 1992) and Distributional Archaeology (Ebert, 1992) were applied. In general terms, the concept of landscape was taken from landscape ecology as "… a heterogeneous land area composed of a cluster of interacting ecosystems that is repeated in similar form throughout" (Forman and Godron, 1986:11).

The concept of landscape element treated as "… the basic, relatively homogeneous, ecological elements or units on land" (Forman and Godron, 1986:12) is used to define the elements of the archaeological landscape as homogeneous patches of space that can be archaeologically characterized (Wandsnider, 1998). Formal analysis was performed on the structural aspects of the physiographic landscape. The various landforms detected (dunes, lagoons, hillock, low flood) are landscape elements, which were prospected individually.

If archaeological evidence of location and distribution patterns were recognized, certain recurrences in the use of discrete landforms could be inferred. In this sense, the possibility of relating landforms and archaeological features or artifacts allows inferences about the use of the landscape in the past (Zvelebil et al., 1992).

The raw materials are very important elements in the settlement and mobility strategies of hunter–gatherers. The existence of a link between a raw materials and mobility was postulated by Kelly and Todd (1988). Detecting a raw material source in northern Pampa Seca is a contribution to solve problems of interest to regional and macro-regional level. In this sense, the determination of transport scales of raw materials is a methodological tool used to evaluate sourcing plans, rock movements, and ranges of action.

To address problems of distance of stone acquisition, various categories have been used in Argentina (Gil, 2002; Bayón and Flegenheimer, 2004; Franco, 2004; Berón, 2007, among others). In the absence of previous studies, it is pertinent to explain the scale used in northern Pampa Seca. In this sense, we consider as Rocks Immediately Available those found in a radius of 10 km from the source; Local Rocks are those that at a distance of 70 km; from this distance to 100 km raw materials are considered as Medium Range; and from the latter the rocks will be classified as Long Distance.

Fieldwork was completed following two research stages. In the first, a wide spatial scale was used for detecting, geo-referencing and mapping the archaeological sites. The second stage used a micro spatial scale, approaching and making transects to determine the possible spatial limits of each site.

Each stage included additional phases of work, with different strategies. The first pedestrian research (FPR) had as its main aim to cover the greatest possible area of land and identify sites (Dunnell and Dancey, 1983; Zvelebil et al., 1992.). Regardless of the landform selected, a "classical or opportunistic" strategy (Aldenderfer, 1998) was applied in all the "FPR".

The work was performed by a group of people which fluctuated between one and five individuals. Findings were photographed, recorded and positioned using coordinates obtained from GPS (Global Positioning System). Archaeological data were supplemented by observations aimed at identifying the geomorphological and anthropogenic processes that may have modified the archaeological record.

The results obtained in the "FPR" allowed a ranking of the most likely to continue research landforms. In the second stage of work or second pedestrian research (SPR), a prospectively stratified

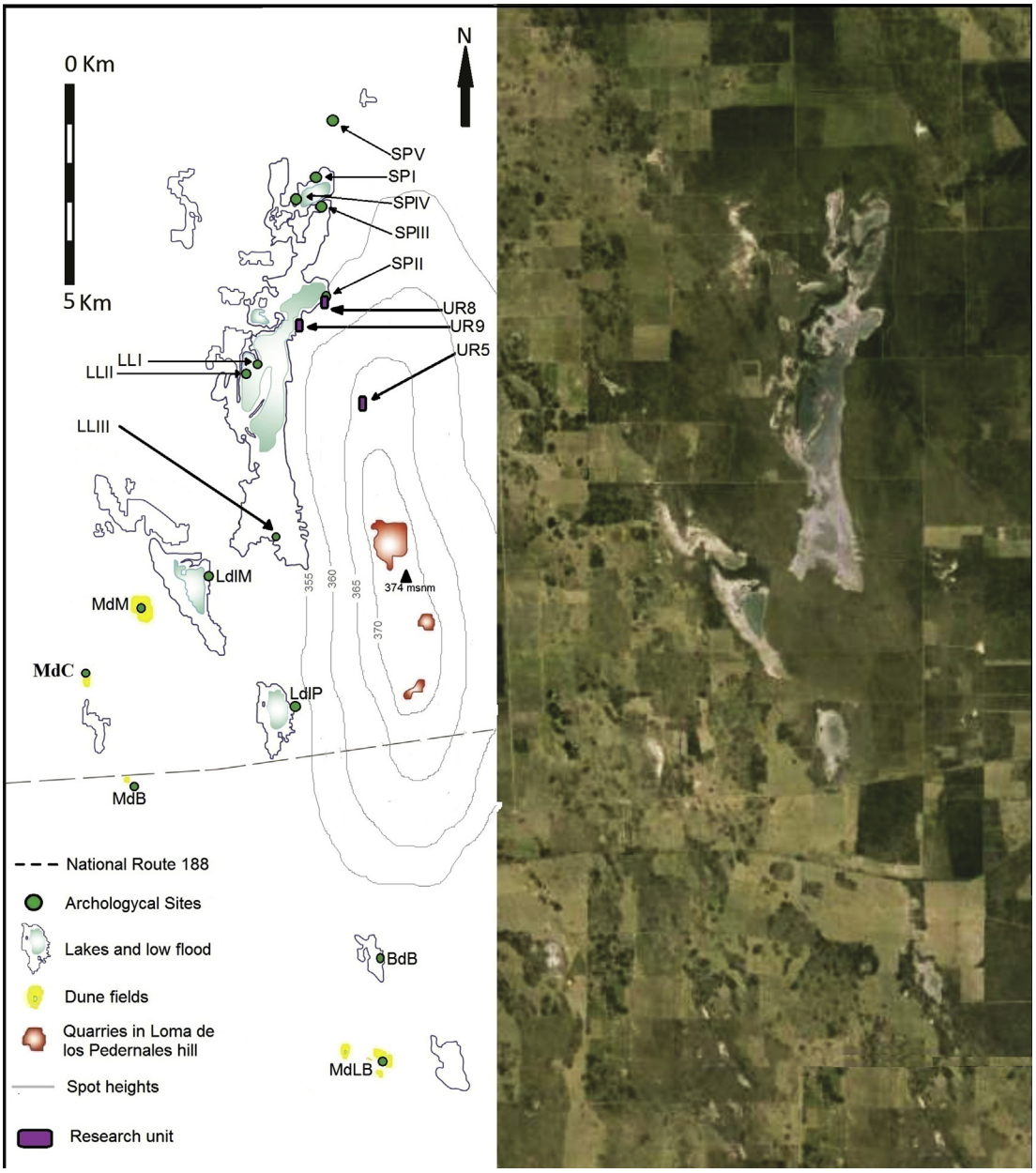

Fig. 2. Santa Paz micro-region, landscape elements and archaeological sites. SP: Santa Paz; LL: La Lonja; LdM: Laguna de las Martinetas; MdM: Médano del Marcelo; MdC: Médano del Cementerio; LdP: Laguna de los Pedernales; MdB: Médano de Bagual; BdB: Bajo del Bagualito; MDLB: Médano de la Laguna de Bagual.

probability sampling method was chosen (Plog, 1976; Renfrew and Bahn, 1998). The distributional perspective (Ebert, 1992) was used to address the surface distribution of artifacts. Transects were conducted in different sectors of each landform following proposals made by various authors, with modifications to suit the region and the technical and logistical possibilities available (Borrero et al., 1992; Wandsnider and Camilli, 1992; Borrero and Nami, 1996; Orton, 2000).

The Loma de los Pedernales hill had a particular planning field activity in the SPR, attempt to cover different sectors of orographic positive (hill, slope, base). The FPR was similar to the one described previously. However, the difficulties precluded transects throughout this landscape, and therefore sampling units of 100 × 100 m were raised, arranged to cover a percentage of not less than 15% of the total. Inside the units, the collection method was opportunistic or ad hoc, trying to cover the entire selected area, through walks of four people per unit (Fig. 3).

The main focus to guide the laboratory analysis were the technological organization studies (Nelson, 1991), including the study of the choices and the integration of strategies to obtain, manufacture, use, transport and discard tools as well as the required materials for its manufacture and maintenance (Fig. 4). These technological strategies are influenced by the resource conditions and also those imposed by social and economic strategies (Parry and Kelly, 1987; Torrence, 1989; Nelson, 1991; Hayden et al., 1996; Bamforth and Bleed, 1997; Andrefsky, 1998). Technomorphological analysis of the artifacts followed the general typology for lithic typology made by Aschero (1975, 1983) and Aschero and Hocsman (2004) with a few changes considering the particular aspects of the lithic groups.

Petrographic studies were carried out using 30 micron thin sections in the Geology laboratory at the Universidad Nacional de Rio Cuarto. These sections were studied using a transmitted light polarizing microscopy, allowing classification and comparing the

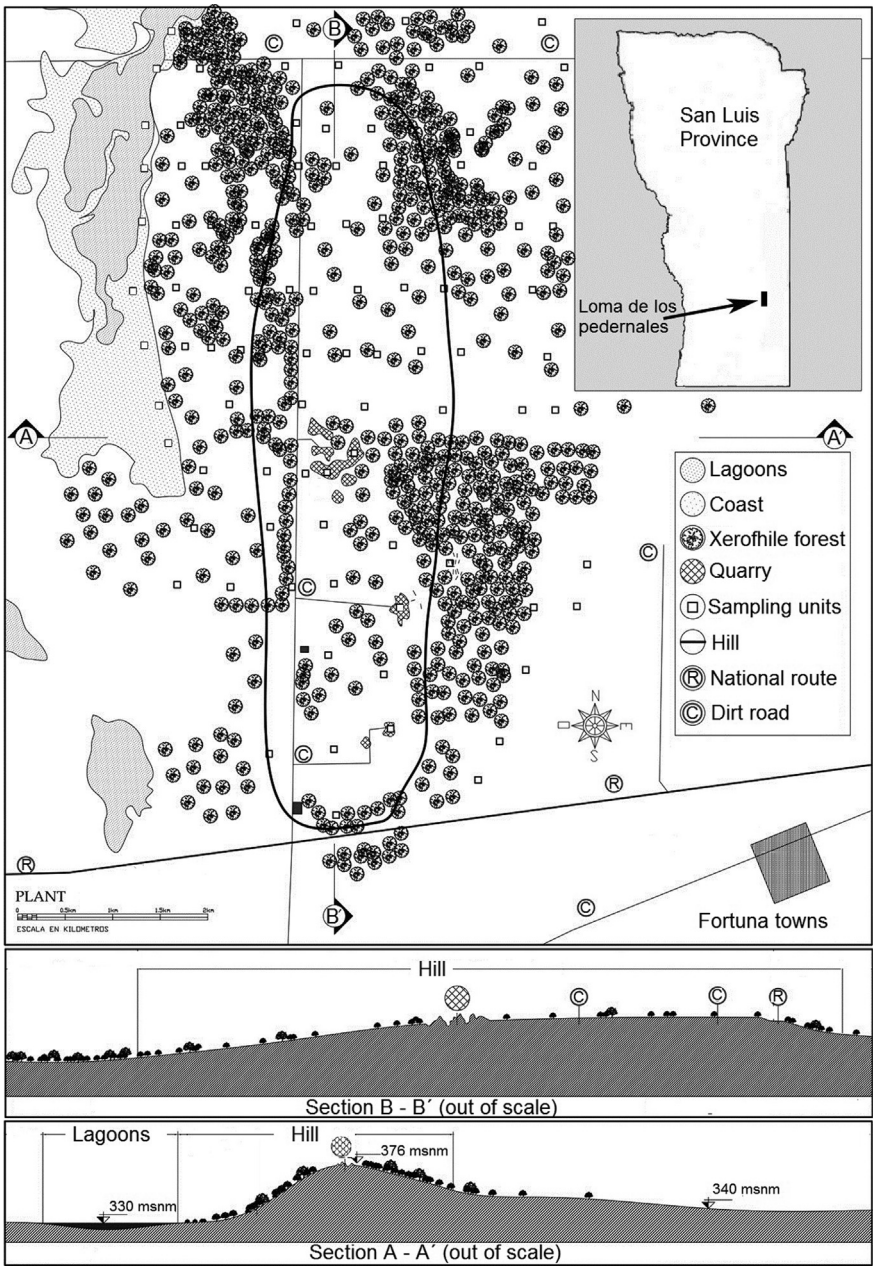

Fig. 3. Second pedestrian research scheme in Loma de los Pedernales.

mineralogical and lithological properties of the samples. Forty thin sections were analyzed: La Lonja I (n = 3), La Lonja III (n = 5), Santa Paz I (n = 3), Santa Paz II (n = 3), Las Martinetas (n = 5), Laguna de Bagüal (n = 3), Médano Bagüal (n = 3) and Médano de la Laguna de Bagüal (n = 3), unit or research 5 (n = 5), unit of research 9 (n = 5) and unit of research 8 (n = 2). In the latter case, the sampling unit coincided with the presence of the Santa Paz II archaeological site. Fig. 5.

The last 12 items correspond to lithic raw material without anthropic traces. The remaining thin sections (n = 28) were made from one external and one internal flake, and one archaeological artifact per site (in Santa Paz I no artifacts was included because none was recovered in the survey, so in this case another internal flake was added). In La Lonja III and Las Martinetas, internal chalcedony flakes with different macroscopic characteristics were added to the default sample (two for each site).

4. Results

Almost 95% of the recovered sample (n = 864) was chalcedony, in some locations the only rock present. The remaining 5% of the archeological record is divided into raw materials of various non-local origins as quartz (n = 31), rhyolite (=3), sandstone (n = 1), quartzite (n = 2), granite (n = 2) conglomerate (n = 2), glass (n = 2) and undifferentiated (n = 2). As a result of the fieldwork, the dominant presence in the archaeological record of a rock initially characterized as “chalcedony” was checked. The techno-morphological studies were performed on the full set, while petrographic analyzes focused on those initially mentioned.

Fifteen archaeological sites were located and recorded, plus thirty isolated findings. More than 50% of the archaeological sites were detected in “Santa Paz” lagoon micro-region (n = 8). They were named Santa Paz I, II, III, IV and V (in the north) and La Lonja I,

Fig. 4. Loma de los Pedernales, current quarry "Green", line the lagoon of Santa Paz observed (top), calcareous rock mantle in on top of the hill (down left), quartz inside the calcareous rock (down middle), secondary chalcedony deposit, in research Unit V(down right).

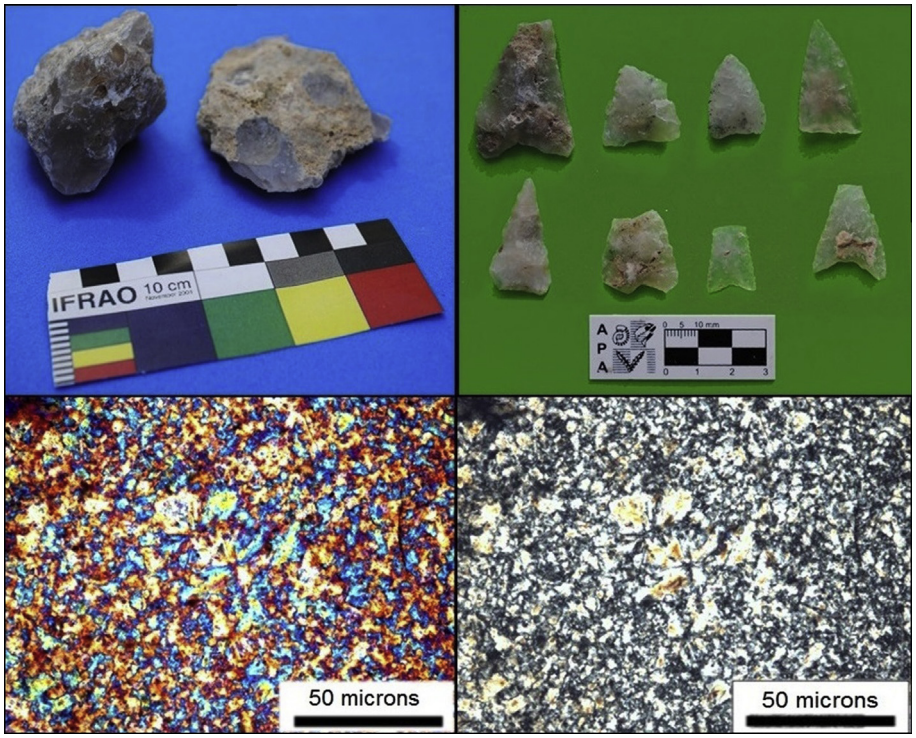

Fig. 5. First line: core and nodule tested (top left); projectile point of La Lonja I, Santa Paz II, III and IV (top right); plane polarized light with gypsum accessory (down left); plan polarized light (down right).

II and III -a and b- (in the south). The number of recorded sites in "Las Martinetas" and "Los Pedernales" lagoons was one for each landscape unit. Other archaeological sites were recorded in the dune systems of "Médano de la Laguna del Bagual", "El Bagüalito", "Médano de Bagüal", "Médano del Marcelo" and "Médano del Cementerio". The lithic material analyses results are presented in Tables 1 and 2.

Fieldwork, besides trying to detect archaeological sites, was aimed at the detection of a local rock source, possibly compatible

with the chalcedony which is dominant in archaeological lithic assemblages, both in instruments and debris. A limited supply in the Loma de los Pedernales and east coast of the lagoon Santa Paz was observed. This was recovered only in increments of the western sector of orographic positive and the adjoining coastal sector (sampling unit 5 on slope of hill; units 8 and 9 coastal water body).

Clasts of chalcedony nodules are available at low frequencies and with different proportions. In the slope of the Loma de los Pedernales, the ratio is 1:46 compared to other rocks. On the coast of Santa Paz, it is 1:3, while the total material present on the surface is low compared to the slope (1 in 100 m^2 vs. 1 in 25 m^2). The anthropic impact in the micro-region (agriculture, fires, recent increase in the bush and active quarries) makes it difficult to make a correct description of the secondary sources. To clarify this poin,t interdisciplinary studies are being performed. The presence of chalcedony was found inside the calcareous mantle of peripheral sectors of the current quarries. Despite the recognition of in situ material source, the effects of erosion and transport throughout the Holocene were not yet comprehensively determined (Marcelo Zarate pers. com.).

This chalcedony can be characterized on a macroscopic level as nodular concretions, sub-spherical to elliptic, maximum 24 cm diameter, with a high proportion of lamellar fragments 1–2 cm in thickness, with maximum lengths of 6 cm. The predominant color is gray cloud with milky white tones. Empty holes (microgeodes) are located in the central parts of the nodules. Very fine color banding with the white on the inner faces of the holes and the gray in the outer part is observed. The outer surface is rough chalcedony and botryoidal (kidney shaped). The growth habit and the results of the thin section analysis indicate that its origin is linked to the chemical precipitation of silica.

Table 2
Flakes with cortex, percentage and total of flakes in Santa Paz micro region. Archesite: Archeological Site; EF: External flakes; TF: Total flakes; PC: Percentage of cortex.

Archeological site	E.F.	T.F	P.C
La Lonja I	27	36	72%
La Lonja II	3	4	75%
La Lonja III	79	161	49%
Santa Paz I	105	106	99%
Santa Paz II	56	61	91%
Santa Paz III	47	61	77%
Santa Paz IV	22	22	100%
Santa Paz V	8	10	80%
Santa Paz (aislados)	14	18	78%
Bajo del Bagualito	6	11	54%
Lg. Las Martinetaz	20	49	41%
Lg. Los Pedernales	13	24	54%
Med. de Bagual (RN 188)	40	86	46%
Med. Lag Bagual	18	18	100%
Med. del Marcelo	8	8	100%
Med. del Cementerio	4	5	80%
Total	470	680	69%

The presence of chalcedony in slopes with traces of water erosion and on the shores of the Lagoons de Santa Paz, indicate that it is a secondary source of supply (*sensu* Nami, 1992). Accessibility of the resource is good in Santa Paz and bad in Los Pedernales due to the thorny vegetation. However, it is likely that accessibility was better in the past because the thorn scrub vegetation is of recent origin.

Macroscopic data were compared with studies at the microscopic level. The results show that the analyzed sections have the same characteristics. Under polarized light microscopy, samples are composed of micrograin aggregates of quartz-chalcedony. They

Table 1
Distribution of archeological tool in the Santa Paz micro-region. Sites: LoI (La Lonja I); LoII (La Lonja II); LoIII (La Lonja III); SPI (Santa Paz I), SPII (Santa Paz II); Santa Paz III (Santa Paz III); SPIV (Santa Paz IV); Spa (Santa Paz no-sites research); BdB (Bajo de Bagüalito); LM (Las Martinetas); LP (Los Pedernales); MB (Medano de Bagüal); MLB (Médano de Laguna de Bagüal); MM (Médano del Marcelo; MC (Médano del Cementerio).

Archeological tools	LoI	LoII	LoIII	SPI	SPII	SPIII	SPIV	SPV	SPa	BdB	LM	LP	MB	MLB	MM	MC	Total
Nodulo testeado	7		2								1		2				12
Flake core	2	4			6	3									1		16
Core n/i					1	9						1					11
Exhausted core			1										1	2			4
Natural edge	9	3	5		6	5		1	4	2	4	3	11	1		2	56
End-retouched flake					1												1
Transverse-retouched flake					1												1
Side-retouched flake	1				1												2
Retouched flake					1												1
Uniface n/d					1												1
Retouched notch			1														1
Notch	1				1												2
Point between notches	1											1	2	1			5
Knife	1				1												2
Retouched knife	2					1											3
Side-retouched knife	2																2
Cuchillo de filo fronto-lateral						1				1							2
Denticulated											1	1					2
Choppers			1		1												2
Side scrapers	1	1			2												4
Transverse-side scrapers	2		1								1						4
Transverse-scraper		1	2							1						1	5
End-scraper		1	3		2			1	1		1	1					10
Convex end-scraper	1		1		1						1	1	1		1		7
Rbo			2														2
Composite			1														1
Glass					2												2
n/d											2						2
Polished artifacts							1										1
Bola					1					1		1		1			4
Projectile points	2	2	4		1	4	1				1		1				16
Total	32	12	24	0	30	23	2	2	5	5	12	9	18	5	2	3	184

show two different textures: mainly single anhedral grains with irregular and truncated crystal faces, which form micro-radial aggregates as mosaics consisting of ecuant and polygonal sections. Fibers in the micro-radial aggregates are length-slow (C-Z). Grain sizes vary between 5 and 50 microns but usually the size is 15 microns. Fiber-radial aggregates size can reach 70 microns in length.

The combination of techno-morphological analysis, macroscopic and microscopic studies confirmed the local provenance of the lithic material. In this regard, high cortex percentage was observed in the flakes, waste, and instruments of different sizes. The cortex color is the same as the raw material. The overall size of flakes is in all cases small (Aschero, 1975, 1983). The only exception is the presence of a large flake of rhyolite recovered in Santa Paz II. As shown in Table 2, flakes with cortex residues originating from the early stages of manufacture predominate in the whole sample. However, the final stages of the development of appliances are also represented from the presence of retouch flakes in La Lonja III, Santa Paz III, and Las Martinetas.

From a number of previous expectations, the analysis of artifacts allowed corroboration of some direct provisioning situations (Franco, 2006). The comparison of the shape, size, color and cortex between chalcedony and cores indicates high similarity of some of the features mentioned. Predominance of tested nodules and not exhausted cores was observed in the coasts of Santa Paz lagoon. In contrast, the presence of exhausted cores is greater in other landscape elements (almost 50% of total). Moreover, the size of the flaked negatives (less than 60 mm long) corresponds to the characteristics of the flakes recovered at archaeological sites, and the size of a high percentage of artifacts made on chalcedony.

The predominance of natural edges with complementary tracks in most sites influences the ratios of raw material. The growth habits of chalcedony make it difficult in some cases to obtain percussion platforms. The low total fracture set (14%), and the major presence of simple edges, suggest an expeditious use and disposal strategy (c.f. Nelson, 1991).

We understand that the presence of tested nodules (mainly in La Lonja I) would be related to collection activities rather than activities of raw material supply. This line of evidence may be deepened with functional studies.

The variety of appliances present in the majority of the sites is indicated by the use for multiple activities. The diversity of typological classes is higher in La Lonja I and III, Santa Paz II, and Las Martinetas. In Santa Paz I, no artifacts were detected, although we understand that this may be related to taphonomic selection processes produced by water.

Polished artifacts are mostly located outside the Lagoon of Santa Paz. They are in all cases milling artifacts, broken and not made on local raw materials. In general, it can be postulated that they were part of the equipment of sites for processing plant resources (Binford, 1978; Franco, 2002).

Santa Paz II has specific characteristics, the first of which is its location on the eastern margin of the lagoon in front of the Loma de los Pedernales. In addition to the seven cores, 23 artifacts with 13 different types (dominated by scrapers) were detected. There is also a high percentage of external flakes and chalcedony nodules without traces of use. In this sense it can be postulated that this site represents the only case where both residential activities as well as those related to sourcing and lithic manufacturing process of artifacts were carried out.

A particular group of instruments to analyze are projectile points, especially because of their chronologic diagnostic value (Rondeau, 1996), considering that there are no radiocarbon dates for the area. The whole (n = 16) belong to the small triangular typological group, associated across the Pampas with Late Holocene occupation (Gil, 2000; Berón, 2004; Valverde and Martucci, 2004). Moreover, half of the projectile points are broken. One of them has perverse fractures (Crabtree, 1972). The impact fracture is the most common within the sample (n = 8) and it is present in Lonja III sites and Santa Paz III in equal numbers. Replacement activities on the fractured ends were carried out.

Within the study area, the distribution of local chalcedony is not uniform. Its presence decreases towards the west and north and disappears in the sectors of El Tala (34°47′00″S and 66°09′35″W) and El Lindero (34°24′28″S and 66°09′35″W). In the east and south it remains prevalent in the archaeological record (Heider, 2015). Researchers in neighboring areas of eastern and southern mention the abundant presence of chalcedony in the archaeological record. In none of the cases have researchers conducted petrographic studies to relate it to Loma de los Pedernales (Aguerre, 1996; Oliva et al., 2004; Carrera Aizpitarte, 2007; Ávila et al., 2009).

5. Discussion

Research in the micro-region of Santa Paz generated a series of new information, tested from contributions of different scales of analysis. However, surface data results imply that this is an averaged archaeological record. On a regional scale, macroscopic studies were aimed at the detection of archaeological sites and the techno-typological characterization of artifacts and flakes. Microscopic observation was aimed at conducting petrographic studies of selected samples, comparing the results of the archaeological remains with the local raw material.

Thus, the results of the petrographic analysis verified the presence of microcrystalline silica characterized as “long-slow chalcedony”, all with the same characteristics in both instruments as nodules and clasts. The correspondence of size classes and cortex color between natural clasts, concretions and nodules recovered in the east coast of “Santa Paz” lagoon and the slopes of Loma de los Pedernales, with stone tools located in archaeological sites, allows us to infer the local origin of chalcedony. The studies provide detail about the high percentage of silica present in the mineralogical composition of the material providing the necessary features to present conchoidal fracture. These materials have a very good physical behavior for knapping archaeological artifacts. Despite this feature, the presence of the material in situ in some cases normally takes the form of tablets or thin tabular nodules with rough surfaces and impurities, making the task of obtaining percussion platforms appropriate for extracting flakes and shaping edges difficult.

An archaeological scale laboratory analysis shows that the early stages of production instruments is clearly evident in the peripheral area of the lagoons of Santa Paz (Santa Paz II, III, La Lonja I and II). Flakes on hinges and negatives in core and nodes were observed, tested in tool-stone, strengthening the idea of one or more initial stages of lithic production. The archaeological signal is clearly oriented to the presence of direct procurement and use of local chalcedony. The presence of similar rind raw material, cores, flakes, and tools is clear. We found a high percentage of cortex in all these items.

There may be a differential use of space within the micro-region. There is a notable absence of archaeological sites on the Loma de los Pedernales. The lagoon of Santa Paz has the highest concentration of archaeological sites. From its stone-tool variety and the percentage of core, we believe that flaking activities were developed there. The degree of exploitation of the cores is probably related to the wide availability of raw material.

There are two significant differences between the typological classes of artifacts present at sites located in the margins of Santa Paz and other landscape elements. At this stage of work it is not

possible to ensure that the differential use of space was indicated by the low number of archaeological material and ignorance of some taphonomic processes (mainly in the south and southwest dunes sector).

Research conducted in the study area shows a distribution of chalcedony, with main vectors directed to the east and south. From the studies presented in this work, we could make comparisons with the center and north of La Pampa, west of Buenos Aires and southern Santa Fe. With increasing research in these areas, the range of actual distribution of the rock in the Pampa Region and the possible reasons for their absence in the southern Sierras Central and eastern Cuyo could be determined.

6. Final considerations

The main focus of this work was put on the raw material on which instruments and rocks recovered in the micro-region of Santa Paz were prepared. The results of petrographic analysis showed the correlation between the two, suggesting the presence of locally sourced raw materials for making instruments in the Northern Region of Pampa Seca. In some situations, the high frequency of such materials in archaeological sites, representing all stages involved in the production sequence of artifacts, the presence of cores, and a high percentage of cortex were corroborated, and the use of the chalcedony is not restricted to a particular type of artifact. The convergence in a small landscape, within a semi-arid region, of both water and rocks with good quality indicate “Santa Paz” as a key place to understand the procurement of lithic raw materials in the northern Pampa Seca. This assertion is correct at least in restricted regions and possibly during the Late Holocene. Over a wider territorial scale, we will attempt petrographic studies to identify chalcedony described here in other archaeological contexts. The identification and quantification of the same in these will be useful for studying the home range, studies of the organization of lithic technology, and other issues of interest.

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