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# Pecked and polished materials from southern Patagonia: An experimental techno-functional approach

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ABSTRACT

The archaeological contexts of different periods from Southern Patagonia (Chile and Argentina) frequently include materials showing evidence of pecking and polishing techniques. Functional analysis of these materials is essential in order to identify traces of manufacture and use, and therefore to help us understand the techno-economic organization of these hunter–gatherer societies.

This paper presents the results of an experimental program on manufacture and use wear traces on pecked and polished artefacts. This analysis allowed us to recognize natural, taphonomic, and technological traces and to build a methodological framework for the analysis of archaeological artifacts. These results are relevant for the analysis of the archaeological record, since they imply that it will be possible to recognize these traces on tools made by polishing techniques that have subsequently been used with other types of materials.

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## 1. Introduction

In South America, more specifically in the Patagonian regions of Argentina and Chile, the pecking and polishing techniques appear in hunter–gatherer contexts since the late Pleistocene to the early twentieth century. Archaeological research has shown that these societies knew the pecking and polishing techniques, and that they used them to make many different tools: sometimes to make stone artifacts, such as weights or bolas, some others to manufacture tools in different raw materials such as wood, shells or bone (beads, knives, retouchers, harpoons, drills, etc.). In the 1980s, Mansur, Orquera and Piana made the first research that presents a review and synthesis on the characteristics and significance of pecked and polished materials from hunter–gatherer contexts from the southern part of South America (Mansur-Franchomme et al., 1987/1988). In that research, they reviewed ethnographic and archaeological literature and materials; they also presented a first approach to the techno functional analysis of this type of materials.

The main goal of our investigation is to analyze pecked and polished materials from hunter–gatherers form Tierra del Fuego and the Magellan strait region, in order to understand their contexts of manufacture and use, as well as their signification in the techno-economic systems. These materials belong to stages of two different adaptive strategies. One was dependent on littoral resource exploitation, based on pinniped hunting and coastal fauna harvesting, and including some forest exploitation for wood, bark and plants, developed along the coasts of the Beagle Channel, the Magellan Strait and islands extending south to the Cap Horn (c.f. Piana and Orquera, 2009). The other was specialized in inland resources, based on the exploitation of the guanaco (*Lama glama guanicoe*), the largest mammal of Tierra del Fuego, along with some exploitation of forest and steppe plant resources (see Mansur and Piqué, 2009).

In both cases, pecked and polished artifacts are frequently made on volcanic rocks and they are not always easy to recognize. While it is not difficult to identify those showing characteristic shapes (such as bolas, clubs, pendants), that is not the case when they do not have well defined morphologies. Sometimes it is difficult to differentiate tools with intentional polishing from artifacts bearing sectors that are polished because of use, as well as to differentiate taphonomical traces from technological stigmata (Mansur, 1997).

The analysis of these types of materials has usually been done from the standpoint of a descriptive approach, due to the lack of a techno-morphological and functional analytical framework that would enable their analysis and interpretation. Consequently, up to now it was also difficult to assess the role that these materials played within the technological strategies implemented by

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hunter–gatherer societies. In order to approach the study of these technologies, we believe that it is necessary to develop a solid techno-morphological and functional framework, by means of experimentation and the application of systematic techniques for microscopic analysis. In this way, it will be possible to record, on the tools surfaces, macro and micro wear traces produced by manufacturing which in many cases constitute the only way to differentiate natural from pecked or polished artifacts.

Studies on polished materials, such as polished axes, from a functional perspective, have already been done in other parts of the world, since the pioneer research by S. Semenov (1964, 2005). They mostly correspond to artifacts made on flint belonging to Neolithic contexts from Europe and the Middle East (Rodenberg, 1983; Risch, 1995; De Beaune, 1997, 2000; Procopiou, 1998; Dubreuil, 2002; Roberts and Otaway, 2003; Hamon, 2006; Delgado Raack, 2008). There are also others concerning ornaments or axes on different semi-precious stones, such as the case of variscite and others (Gibaja Bao, 2002; Borrell and Bosch, 2012; Oliva Poveda, 2012; Gurova et al., 2013). As for North and South America, research concerns mostly materials from food production contexts, as metates and manos (Adams, 2002a,b; Babot, 2004; Pérez, 2004, 2008), or the analysis of pecked and polished tools associated with fishing techniques in coastal southern Patagonia (Torres Elgueta, 2007, 2009, 2011). In these cases, the analytical approach normally does not include the analysis with high magnification optical equipment.

For our study area, Mansur developed an approach based on microwear analysis, which includes both low and high magnification microscopic analysis, and discussed microwear traces produced by natural erosion, intentional polishing (manufacture) and post depositional phenomena (Mansur, 1997). She made experiments with different types of rocks and demonstrated that it was possible to identify different types of traces. On this basis, she analyzed materials from sites from the Beagle Channel region (Mansur and Srehnisky, 1996; Mansur, 1997).

Consequently, in order to undertake this study of pecked and polished materials from a techno-functional perspective, we decided to develop a long-term experimental program, where we characterize the traces produced during experimental tool manufacture and traces produced by tool use on different materials. We also seek to distinguish them from natural traces on rock surfaces produced by natural phenomena, as fluvio-glacial and marine erosion/transport and by taphonomic processes.

The aim of this paper is to present the first results of the experimental program. One of the first steps was trying to characterize the traces produced during the manufacture of polished surfaces, as well as those produced by utilization of natural or polished surfaces on different raw materials such as wood, leather and shell. The results of this program have helped to start building a methodological framework for our research on the use of these technologies by hunter–gatherer societies in contexts of southern Patagonia.

## 2. Materials and methodology

The archaeological materials taken as reference for the first part of this experimental collection belong to Offing 2, an archaeological site located on an island in the Magellan strait, that is being studied now (cf. Legoupil et al., 2011), and to different archaeological sites from the Beagle Channel northern coast (Orquera and Piana, 1996, 1999a). These artifacts are glacial pebbles and they characterize by the presence of polished and pecked faces.

Ethnographic materials and literature of the area (see references in Orquera and Piana, 1999b) inspire the types of actions included in the experimentation. We especially considered the case of artifacts made on shell, like necklace pendants and shell knives, where lithic polishers were used (cf. Mansur and Clemente Conte, 2009). In most cases these lithic polishers were fix on the ground, as anvils, and shells were rubbed on the lithic surfaces. The first step of the experimental program consisted in identifying the raw materials used in the archaeological sites in the area, followed by evaluation of the geological contexts and then fieldwork in order to collect the raw materials.

The experimental collection was made with rocks collected from the shores of the Beagle Channel. These are pebbles found on the beaches, which were originally carried on by glacial action and then reworked by marine erosion. The determination of raw materials was made on the basis of macroscopic analysis, with assistance of the CADIC Andine Geology Laboratory. It led to identification of medium-grained volcanic rocks, showing variability in their geological composition.

At this first step of the investigation, we tried to identify and differentiate the traces present on glacial pebble surfaces corresponding to at least three different stages: 1- pebbles with natural surfaces without human modification, 2- surfaces anthropically manufactured, and 3- surfaces modified by use on different materials. In order to conduct the experiments, we decided to start using pebbles not exceeding 10 cm in length, because this allowed us to render streamline the manufacturing process and moreover the microscopic analysis. In these cases it is possible to place the artifacts directly on the microscope plate, without needing to make casts, a process that is relatively time consuming.

We would also like to insist on the fact that this is a preliminary experimental series conceived to characterize the macro and microscopic traces. As many archaeological materials exceed these sizes, further observations and analyses will be performed using the casting technique with acetate peels.

During the experimentation to produce polished surfaces, it was decided not to incorporate water or additives, in order to observe the traces that are produced by direct contact between the two stone surfaces, without any intermediate substance. However, we know that the manufacturing of polished pieces has several steps, which may include use of other substances such as water or abrasives (e.g. ashes or pigments). According to ethnographic data, these manufacturing steps, which are done with dry materials and without any additive, are interdependent and they alternate between them to achieve the final finish (Procopiou et al., 2013).

Observation of use wear traces and image capture were done following the standard methodology for determination of micro and microwear traces (Plisson, 1985; Mansur-Franchomme, 1986, 1997; Adams et al., 2009). The optical equipment used for this investigation consisted mainly of a Leica S6D stereomicroscope (40×) and an Olympus BH2 metallographic reflected light microscope (200–400×). Observations were made at various intervals throughout the experimental work, which allowed recording the appearance of surfaces before and during all the working process.

An interesting approach to the analysis of polished surfaces is that of tribology (Dowson, 1998). It takes into account the existence of different tribological mechanisms involved in wear that occur during polishing processes on lithic surfaces: adhesive wear, abrasive wear, fatigue wear, and tribochemical wear (Adams, 1988, 1993). These four mechanisms are not mutually exclusive concerning the modifications that they produce on the surfaces. They are not the result of a single independent event: they interact, and it is even possible that one of them will become dominant over the others depending on the characteristics of the contact surfaces and the nature of the intermediate substances.

Considering that each of these processes leave distinct patterns on the lithic surface, such patterns can be used to reconstruct the environment of contact associated with the tool's context of use. These patterns of use wear traces depend on the intrinsic variables of rocks, including mineralogical composition, as well as contact with the material in a friction system. They can be classified as residues, fractures, cracks or pits, striations and scratches, grain edge rounding, leveling, and polish and shine (Procopiou, 2004; Adams et al., 2009; Dubreuil et al., 2015). An interesting application of this type of analysis can be seen in the study of the threshing sledge (Anderson et al., 2006).

In our investigation, we could not use the tribological approach, but we expect to do it in the near future. We undertook our microscopic study using the criteria for analysis and the different variables employed in techno functional analysis (including edge scarring and/or rounding, striations, micro polishes and residues), according to the approach developed for raw materials from Patagonia and Tierra del Fuego (*sensu* Mansur, 1997, 1999). These criteria are almost the same as those used in tribological analyses; they principally concern damage (in the form of fractures, scars, abrasion, etc), striations (different types), and polish.

In order to explain polished and used surfaces, we adopted the model of wear traces formation on lithic surfaces that takes into account an interplay of mechanical and chemical processes (Mansur, 1997). We believe that the changes that occur on the lithic surfaces throughout their history, from artifact production, through use and taphonomic history, can be explained in terms of the principles of materials science. We especially refer to formation of interfaces between the lithic surface and the contact surface. This contact surface can certainly be the instrument being used for manufacture (polisher, hammer, retoucher, etc.) or the material being worked. However, it can also be the environment and the erosion/transport processes in the formation of blank (pebbles, slabs, etc) as well as taphonomic (physico-chemical) phenomena (Mansur, 1997).

## 3. Experimental framework

The experimental protocol included the following activities:

Characterization of natural surfaces consisted of observation of lithic surfaces without use, in this case, the surfaces of pebbles in their natural condition. Observation was first macroscopically, through the stereomicroscope, with magnifications between 6× and 40×, and then microscopically, using the metallographic microscope with magnifications of 50×, 100× and 200×. This observation allows identifying natural traces on the pebble surface, produced by glacial and marine erosion processes.

Production of polished surfaces consisted of the production of a smooth surface, through intentional polishing, working stone on stone performing an action of rubbing. In all cases, the maximum utilization time was one hour. Work intervals of 15, 30, 45 and 60 min were used in order to record the progression of use wear traces formation.

Natural pebbles without modification of the surfaces were used to work on fresh sheep hide (*Ovis aries*). The maximum working time was 30 min. Observation and analysis of traces was also carried out gradually in intervals of 5, 15, and 30 min.

Experimentally modified tools (with previously polished surfaces) were used to work on sheep hide (*Ovis aries*) and fresh lenga wood (*Nothofagus pumilio*). The maximum working length was 30 min. Observation and analysis of traces was carried out in intervals of 5, 15 and 30 min.

Use of pebbles as fix polishers consisted of use of unmodified lithic surfaces as polishers, in order to make shell tools, by rubbing the shells on the lithic surface. Shells of limpets (*Fissurella* sp.) were used for the production of necklace beads, and a type of mussel (*Aulacomyaater*) was used to make shell knives. The work was carried out in a maximum of 30 min.

The experiments were recorded by macro and microscopic observation, with image capture at fixed points, before use and then during and after use, respecting the intervals mentioned before. The data were recorded by means of an experimental check sheet for each piece.

In this first stage of the experimental program, nine (9) specimens have been used. Three of them were unmodified pebbles, whose surfaces were used to work on fresh sheep hide (*Ovis aries*). Two other specimens were unmodified pebbles used as fix polishers to make beads with limpet shells (*Fissurella* sp.) (Fig. 1) and to make shell knives with mussel shells (*Aulacomya ater)* (Fig. 2).

The other four specimens were firstly polished and then used. The first action is what we called stone on stonework. It consisted of a rubbing motion, in order to produce a polished surface. The action was done in dry conditions, without water of abrasives added. The largest pebble was used as a passive support (fix polisher, like an anvil), while the remaining three others worked as active instruments, performing an action of rubbing (Fig. 3). Then, these three active tools were used to work on fresh lenga wood *(Nothofagus pumilio)* and on sheep hide (*Ovis aries)*. During the work, the hide was soaked with water (Fig. 4).

## 4. Results

### 4.1. Work “stone on stone”: manufacture or technological polishing

Rubbing of the pebble surface, stone on stone, produced clearly identifiable traces. At a macroscopic level, it was possible to distinguish quickly a levelling of the surface with slight modification of rock crystals. This process can be very clearly seen after 30 min of work; from that point, the traces of technological polishing continue emphasizing: the worked surface becomes flatter and shows linear traces.

These linear traces can be identified both in microscopy and in macroscopic observation. They are parallel to the direction in which the movement was performed, and they appear from the first 15 min of work. In none of the cases were there fractures or scarring of the rock surface.

At a microscopic level, the micropolish in the flattened area is weak and without distinctive features. Striations are present from the first working interval, and their thickness increases as the work progresses (Fig. 5).

### 4.2. Hideworking

The activity of working hide was done with the two types of tools: unmodified pebbles, and pebbles with polished areas that had been previously prepared and analyzed. As to the unmodified pebbles, the general morphology of the active support, with regular slightly convex faces, was very useful to rub the leather. Microscopic analysis shows a micropolish that is relatively opaque, more than micropolish generated by woodworking. It develops covering both high and low sectors of the microtopography. This micropolish has striations that become more accentuated as work progresses; after 30 min of work, dark linear features can be distinguished, possibly by the drag of the worked material.

In the case of pebbles with polished surfaces, the appearance of technological polishing traces is modified rapidly as work starts. The surfaces develop use wear traces in the form of a dark or opaque micropolish, covering all parts of the microtopography. This micropolish is associated with deep and large striations running in the direction of use. When they are well developed, these use wear traces produced by hide working show no differences with those formed on unpolished pebble surfaces (Fig. 6C and D).

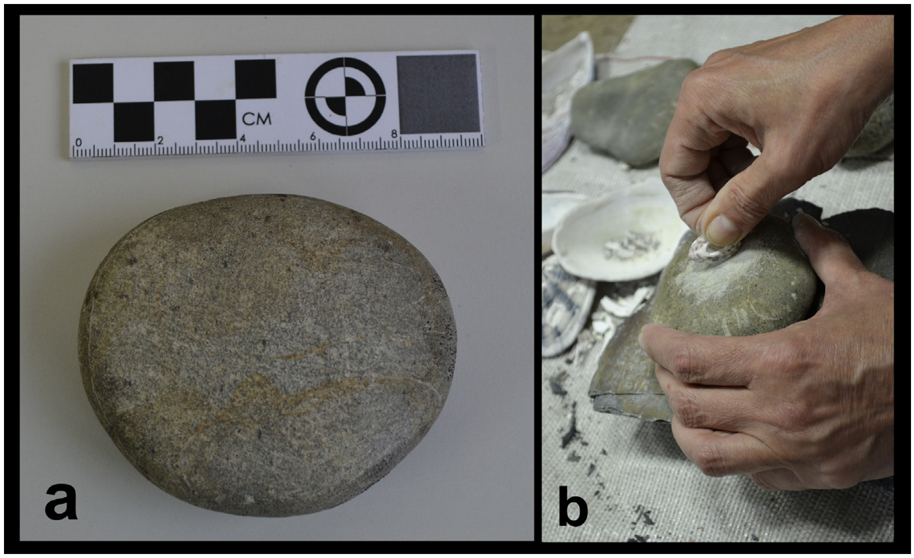


**Fig. 1.** a) Pebble used to polish beads made of limpet shells (*Fissurella sp.*); b) Action of bead making with *Fissurella sp.*

Work on leather alters rapidly the aspect of the surface of technological polishing. In the case of woodworking, the technological traces are distinguishable for a relatively long time. After 30 min work technological traces were already visible, altogether with wood-working polish; this last one was principally distributed onto the higher parts of the microtopography. However, in the case of hide working, the technological polishing traces were already modified after five minutes of work, and they disappeared as work progressed.

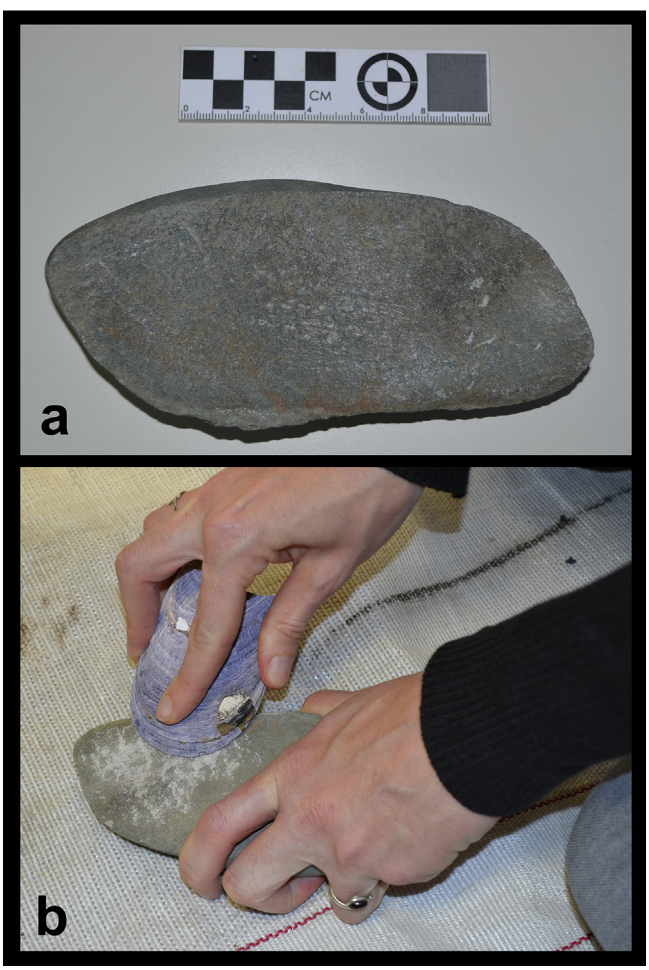


**Fig. 2.** a) Pebble used to polish edges of mussel shell (*Aulacomya ater*); b) Manufacture of shell knife by regularizing natural edges by rubbing.

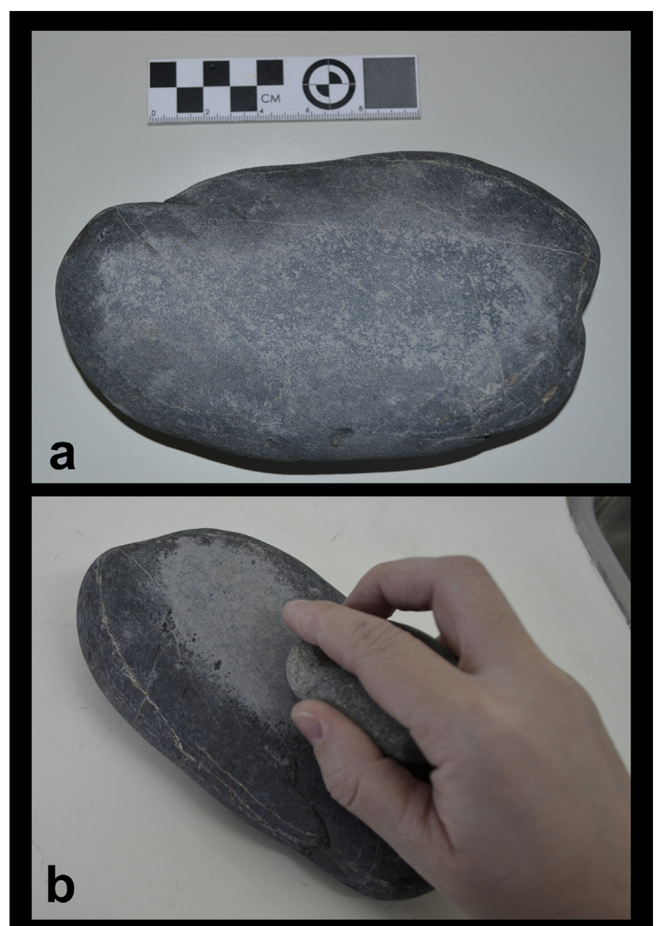


**Fig. 3.** a) Pebble used as passive polisher; b) Work stone on stone in order to make polished surfaces.

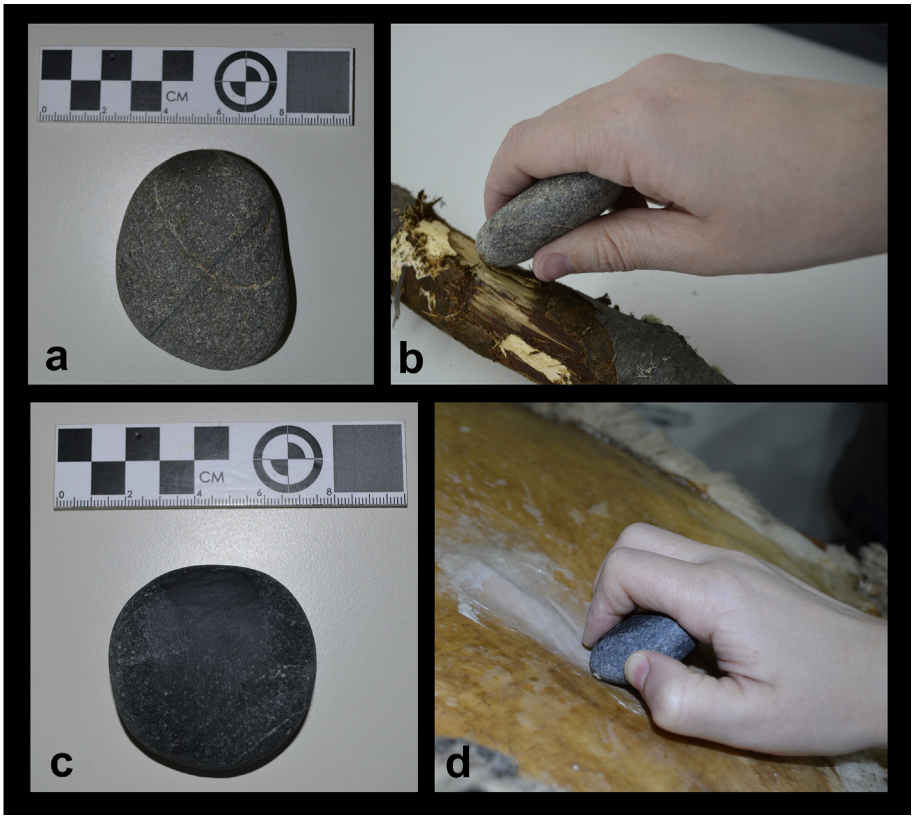


**Fig. 4.** a) Pebble with a polished surface, used to work wood; b) work on wood; c) Pebble with a polished surface, used to work hide; d) work on sheep hide.

### *4.3. Wood working*

The activity consisted of scraping on lenga wood. This work was done using the area previously polished of the pebble as contact surface. This activity was effective for the work to be done, allowing extraction or surface portions of the worked material.

The microscopic analysis revealed microwear polish with specific characteristics: bright, relatively smooth, with dark striations;

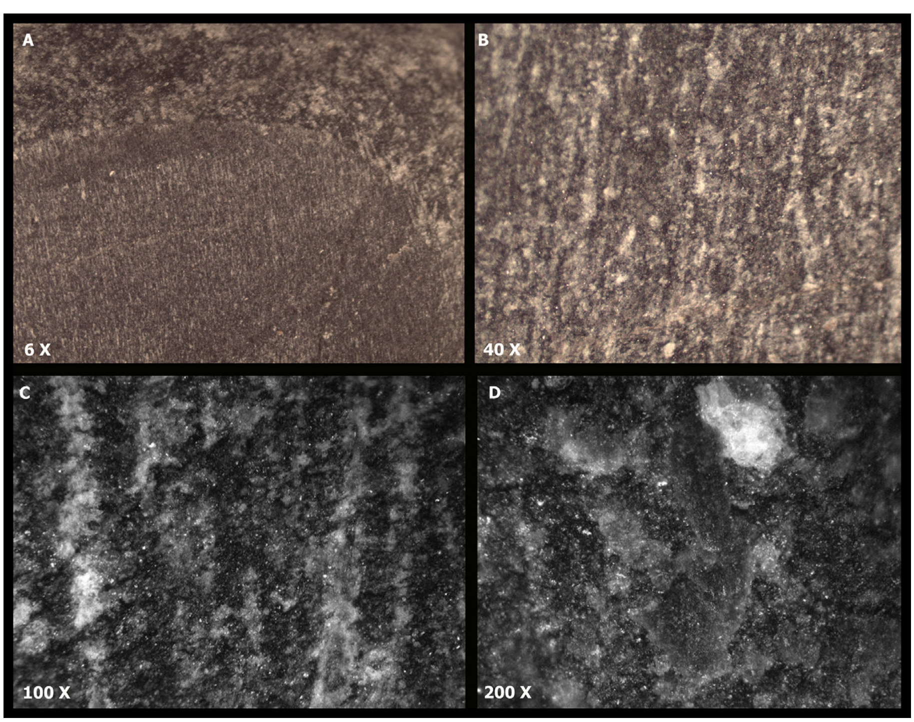


**Fig. 5.** Stonework. Stereomicroscope: A, 30′; B, 60′. Reflected light microscope: C, 15′; D, 45′.

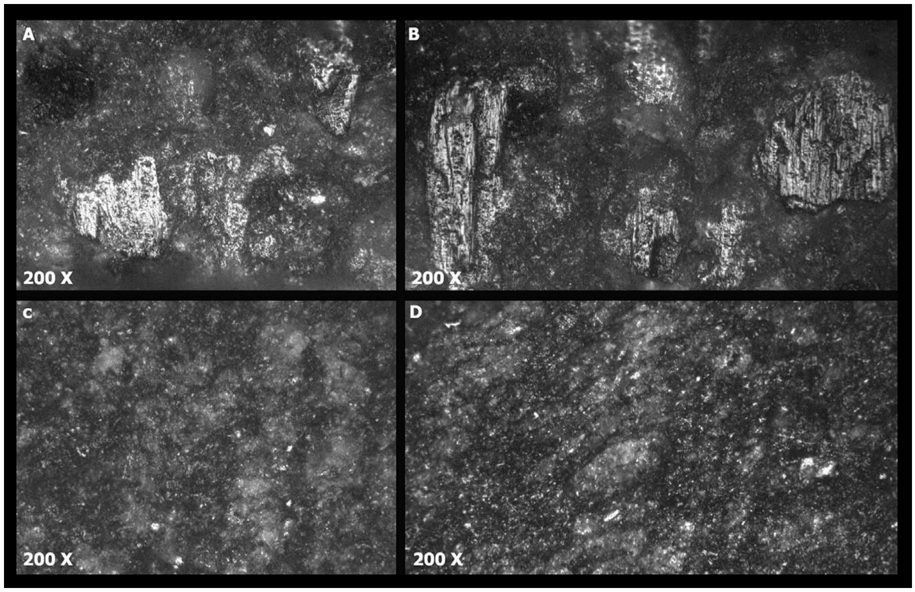


**Fig. 6.** Reflected light microscope. Woodworking: A, 15′; B, 30′. Hide working: C, 5′; D, 30′.

these are short and deep. These microwear traces develop principally on high sectors of the microtopography. They become progressively more intense as work progresses.

Micropolish development is slow. During the first intervals of analysis, we could verify that the traces of technological polishing were present together with utilization wood polish. Then, slowly the wear traces of woodworking obliterated the previous traces of technological polishing. This is very clear after 30 min of work (Fig. 6A and B).

### 4.4. Work on shell

Experimentation with shells consisted of two activities. One of them was polishing of limpet shells that were being used to make necklace beads. The shells (*Fissurella* sp.) were first reduced by direct percussion on a fix anvil in order to separate the apex; then they were polished on a flat pebble. We wanted to see the wear traces produced on the lithic surface. Work lasted a maximum of 30 min.

The other activity was manufacture of shell knives. For these, large mussel shells (*Aulacomya ater*) were first regularized by direct percussion with stone hammer, on an anvil; then the edges were polished on the surface of a flat pebble, in order to see the wear traces produced. Work did not exceed 30 min.

When analyzed with the stereomicroscope, the contact surface of the lithic pebble appears regularized. The leveling of the crystals is observed mostly in the higher parts of the microtopography. At the reflected light microscope, there is a clear polish, more brilliant than polish produced by work with other materials, associated with thin and shallow striations (Fig. 7).

## 5. Discussion

This is the first part of a long-term experimental program conceived in order to distinguish technological polishing and use wear traces from a series of modifications produced by different actions on volcanic rocks used by the hunter–gatherer societies of the Southern cone. This first series of experiments let us analyze the modifications produced on the surfaces of pebbles due to manufacturing of a polished area, and then after its subsequent use for working other materials. Considering the lack of a large analytical framework for studying pecked and polished artifacts on volcanic rocks, the observations done so far should be considered as preliminary. However, we believe that the results obtained are already highly promising.

The experimental program let us recognize the traces generated by intentional polishing of the lithic surface, and to differentiate these traces from those already known produced by natural phenomena, e.g. glacial and marine erosion, etc. Then, it let recognize the traces of use produced by contact with other materials, e.g. hides, wood, shell.

The wear traces produced by manufacturing of polished areas by means of rubbing on another stone, are evident even macroscopically, shortly after beginning work. At the microscopic scale, micropolish in the flattened area is weak and associated with striations whose thickness increases as the work progresses.

The use wear traces tend to cover the manufacturing traces; in the case of hide working, this modification is very rapid. The microwear polish produced, with its striations, is indistinguishable from that formed on a natural pebble surface.

In order to explain polished and used surfaces, we adopted the model of wear traces formation on lithic surfaces that takes into account an interplay of mechanical and chemical processes (Mansur, 1997). The analysis of the different types of wear traces (striations, rounding of crystals or grains, micropolish) corroborated the interaction between all of them, thus confirming again their formation mechanisms.

We believe that the results obtained with the experimental material are relevant for the analysis of the archaeological record, since they imply that it will be possible to recognize instruments made by techniques of polishing that have subsequently been used with other types of materials. It has been established experimentally that it is possible to distinguish the use wear traces from technological traces produced by manufacture.

Progress in the study of pecked and polished materials contributes to investigations that are going on in the last few decades, within the approach of techno-functional analysis. Although many of these studies have been carried out with low magnification optical equipment (De Beaune, 2000; Prous et al., 2003; Roberts and Otaway, 2003), there are also lines of research applying high

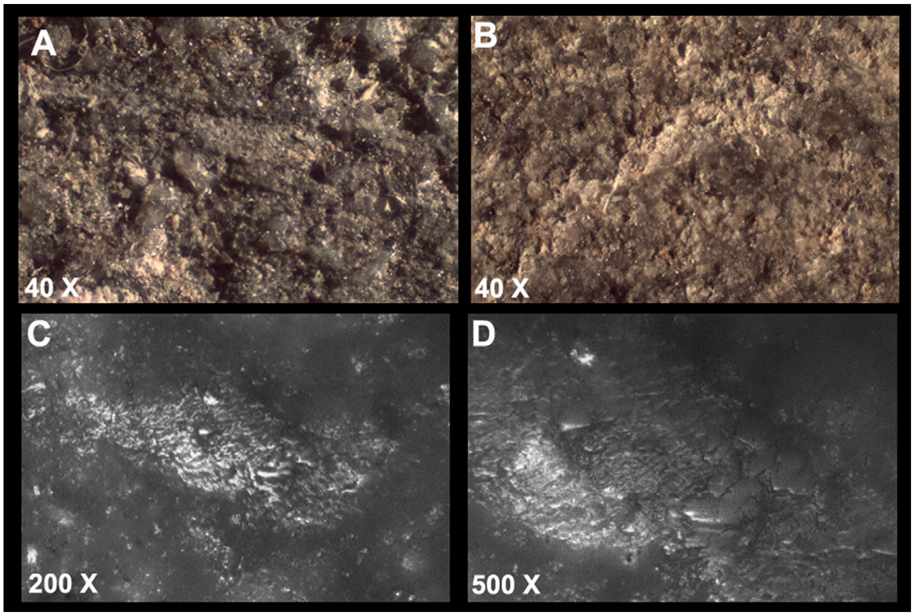


**Fig. 7.** Shell work. A and B: Stereomicroscope. C and D: Reflected light microscope.

magnification techniques, although most of the studies concern Neolithic contexts (Boffil et al., 2013). For all these reasons, we believe that our research can contribute to incentive the study of use of the pecking and polishing techniques by hunter–gatherer societies. In the specific case of hunter–gatherer societies of Patagonia and Tierra del Fuego, we believe that the experimental program that starts will be an important contribution for the interpretation of the contexts of tool production and use.

Future work will enable us to expand this experimental program, extending it to the study of other polished supports that are present in archaeological sites of Patagonia, such as slabs of sedimentary rocks (Orquera and Piana, 1999a; Legoupil, 2003), and to preparation of acetate peels for the analysis of large-sized specimens. At present, the first results obtained with the experimental pebbles are being evaluated with the analysis of different materials from archaeological contexts.

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## References

Adams, J.L., 1988. Use-wear analysis of handstones used to grind corn and process hides. Journal of Field Archaeology 15 (3), 307–315.

Adams, J.L., 1993. Technological development of manos and metates on the Hopi Mesas. Kiva 58 (3), 331–344.

Adams, J.L., 2002a. Ground Stone Analysis: a Technological Approach. University of Utah Press, Salt Lake City.

Adams, J.L., 2002b. Mechanisms of wear on groundstone surfaces. In: Procopiou, H., Treuil, R. (Eds.), Moudre et broyer, Vol. I – MéthodesCTHS, Paris, pp. 57–68.

Adams, J.L., Delgado Raack, S., Dubreuil, L., Hamon, C., Plisson, H., Risch, R., 2009. Functional analysis of macro-lithic artefacts. In: Sternke, F., Eigeland, L., Costa, L.J. (Eds.), Non-Flint Raw Material Use in Prehistory: L'utilisation préhistorique de matières premières lithiques alternatives: Old prejudices and new directions, Anciens préjugés, nouvelles perspectives, pp. 43–66.

Anderson, P., Georges, J.M., Vargiolu, R., Zahouani, H., 2006. Insights from a tribological analysis of the tribulum. Journal of Archaeological Science 33 (11), 1559–1568.

Babot, M.P., 2004. Tecnología y utilización de artefactos de molienda en el noroeste prehispánico (Ph.D. thesis). Facultad de Ciencias Naturales e I.M.L, Universidad Nacional de Tucumán.

Boffil, M., Procopiou, H., Vargiolu, R., Zahouani, H., 2013. Use wear analysis of near Eastern prehistoric grinding stones. In: Anderson, P., Cheval, C., Durand, A. (Eds.), Regards croisés sur les outils liés au travail des végétaux, Actes du XXXIII[e] Colloque international d'archéologie et d'histoire d'Antibes, pp. 225–242.

Borrell, F., Bosch, J., 2012. Las minas de variscita de Gavà (Barcelona) y las redes de circulación en el neolítico. Congrés Internacional Xarxes al Neolític – Neolithic Networks. Rubricatum Revista del Museu de Gavà 5, 315–322.

De Beaune, S., 1997. Les galets utilisés au Paléolithique Supérieur. Approche archéologique et expérimentale. XXXIIème supplément à "Gallia Préhistoire". CNRS Éditions, Paris.

De Beaune, S., 2000. Pour une Archéologie du geste: broyer, moudre, piler. Des premiers chasseurs aux premiers agriculteurs. CNRS Éditions, Paris.

Delgado Raack, S., 2008. Prácticas económicas y gestión social de recursos técnicos en la Prehistoria Reciente (III-I Milenio AC) del Mediterráneo Occidental (Ph.D. thesis). Universitat Autònoma de Barcelona, Bellaterra.

Dowson, D., 1998. History of Tribology, second ed. Professional Engineering Publishing, London.

Dubreuil, L., 2002. Etude fonctionnelle des outils de broyage natoufiens : nouvelles perspectives sur l'émergence de l'agriculture au Proche-Orient (Ph.D. thesis). Université Bordeaux 1, Bordeaux.

Dubreuil, L., Savage, D., Delgado Raack, S., Plisson, H., Stephenson, B., De La Torre, I., 2015. Chapter 7. Current analytical frameworks for studies of use–wear on ground stone tools. In: Figueira Marreiros, J.M., Gibaja Bao, J.F., Ferreira Bicho, N. (Eds.), Use-Wear and Residue Analysis in Archaeology (Manuals in Archaeological Method, Theory and Technique), pp. 105–158.

Gibaja Bao, J.F., 2002. La función de los instrumentos líticos como medio de aproximación socio-económica. Comunidades del V-IV milenio cal BC en el noreste de la Península Ibérica (Ph.D thesis). Universitat Autonoma de Barcelona. Departament d'Antropologia Social de Prehistoria.

Gurova, M., Bonsall, C., Bradley, B., Anastassova, E., 2013. Approaching prehistoric skills: experimental drilling in the context of bead manufacturing. Bulgarian E-Journal of Archaeology 3, 201–221.

Hamon, C., 2006. Broyage et abrasion au Néolithique ancien. Caractérisation technique et fonctionnelle des outils en grès du Bassin parisien. In: BAR International Series 1551. Archaeopress, Oxford.

Legoupil, D., 2003. Cazadores-recolectores de Ponsonby (Patagonia austral) y su paleoambiente desde VI al III milenio A. C. Magallania 31, 215–224.

Legoupil, D., Christensen, M., Morello, F., 2011. Una encrucijada de caminos: el poblamiento de la Isla Dawson (Estrecho de Magallanes). Magallania (Punta Arenas) 39 (2), 137–152.

Mansur, M.E., 1997. Functional analysis of polished stone-tools: some considerations about the nature of polishing. In: Bustillo, M.A., Ramos Millán, A. (Eds.), Siliceous Rocks and Culture. Univ. de Granada, pp. 465–486.

Mansur, M.E., 1999. Análisis funcional de instrumental lítico: problemas de formación y deformación de rastros de uso. In: Actas y Trabajos, XII Congreso Nacional de Arqueología Argentina. La Plata, pp. 355–366.

Mansur, M.E., Clemente Conte, I., 2009. Tecnologías invisibles? Confección, uso y conservación de instrumentos de valva en Tierra del Fuego. In: Oliva, F., de Grandis, N., Rodríguez, J. (Eds.), Arqueología Argentina en los Inicios de un Nuevo Siglo, vol. 2. Laborde Libros, pp. 359–368. Rosario T.

Mansur, M.E., Piqué, R., 2009. Between the forest and the sea: hunter–gatherer occupations in the sub Antarctic forests in Tierra del Fuego (Argentina). Arctic Anthropology 46 (1–2), 144–157.

Mansur, M.E., Srehnisky, R., 1996. El alisador basáltico de Shamakush I: microrrastros de uso mediante el análisis de imágenes digitalizadas. Relaciones de la Sociedad Argentina de Antropología XXI, 267–288.

Mansur-Franchome, M.E., Orquera, L.A., Piana, E.L., 1987/1988. El alisamiento de la piedra entre cazadores-recolectores: el caso de Tierra del Fuego. Runa XVII-XVIII (1987–1988), 111–205.

Mansur-Franchomme, M.E., 1986. Microscopie du matériel lithique préhistorique: traces d'utilisation, altérations naturelles, accidentelles et technologiques. Cahiers du Quaternaire 286 ninth Ed du C.N.R.S, Bordeaux.

Oliva Poveda, M., 2012. Los adornos, producto de intercambio de ideas, materias y tecnología. Contactos e influencias entre las comunidades prehistóricas en el noreste Peninsular entre el VI-IV milenios ane. Congrés Internacional Xarxes al Neolític – Neolithic Networks. Rubricatum Revista del Museu de Gavà 5, 257–264.

Orquera, L.A., Piana, E.L., 1996. El Sitio Shamakush I. Relaciones de la Sociedad Argentina de Antropología XXI, 215–265. Buenos Aires, Argentina.

Orquera, L.A., Piana, E.L., 1999a. Arqueología de la Región del Canal Beagle. In: Tierra del Fuego, República Argentina. Soc. Arg. Antropología, Buenos Aires.

Orquera, L.A., Piana, E.L., 1999b. La vida material y social de los Yámana. Eudeba-IFIC, Buenos Aires, Argentina, p. 567.

Pérez, S., 2004. Experimentación de uso con palas y/o azadas líticas. Intersecciones en Antropología 5, 105–117.

Pérez, S., 2008. La organización de la tecnología lítica en el noroeste argentino. Aproximación a través de experimentación, análisis tecno-morfológico y de microdesgaste por uso de palas y/o azadas líticas. Comechingonia Virtual 186–222 n° 3.

Piana, E.L., Orquera, L.A., 2009. The southern top of the world: the first peopling of Patagonia and Tierra del Fuego and the cultural endurance of the Fuegian Sea-Nomads. Arctic Anthropology 46 (1–2), 103–117.

Plisson, H., 1985. Etude fonctionnelle d'outillages lithiques préhistoriques par l'analyse des micro-usures: recherche méthodologique et archéologique (Ph.D. thesis). Université de Paris I. Panthéon Sorbonne.

Procopiou, H., 1998 (Ph.D. thesis). L'outillage de mouture et de broyage en Crête Minoenne, vol. 2. Université de Paris I – Sorbonne, Paris.

Procopiou, H., 2004. Le broyage des matières minérales : l'apport de la tribologie à l'identification de la transformation des matières minérales. Dossiers d'Archéologie: La Tribologie 290, 58–61.

Procopiou, H., Morero, E., Vargiolu, R., Suarez-Sanabria, M., Zahouani, H., 2013. Tactile and visual perception during polishing: an ethnoarchaeological study in India (Mahabalipuram, Tamil Nadu). Wear 301, 144–149.

Prous, A., Alonso, M., Piló, H., Xavier, L.A., Lima, A.P., Neves de Souza, G., 2003. Os machados pré-históricos no Brasil. Descrição de coleções brasileiras e trabalhos experimentais: fabricação de lâminas, cabos, encabamento e utilização. Canindé Revista do Museu de Arqueologia de Xingó 2, 161–236.

Risch, R., 1995. Recursos naturales y sistemas de producción en el Sudeste de la Península Ibérica entre 3000 y 1000 ANE (Ph.D. thesis). Universitat Autònoma de Barcelona, Bellaterra.

Roberts, B., Otaway, B., 2003. The use and significance of socketed Axes during the late Bronze age. European Journal of Archaeology 119–140 n° 6.

Rodenberg, A., 1983. Traces d'utilisation sur les haches polies de Bouqras (Syrie). Actes de la Table Ronde de Lyon. Travaux de la Maison de l'Orient. CNRS, Paris, pp. 177–188.

Semenov, S.A., 1964. Prehistoric Technology. Adams & Dart, London.

Semenov, S.A., 2005. The development of abrasive technology and its meaning in ancient economy. In: Longo, L., Skakun, N. (Eds.), The Roots of Use-Wear Analysis: Selected Papers of S.A. Semenov, 7, Memorie del Museo Civico di Storia Naturale di Verona (2. serie), Sezione Scienze Dell'Uomo. Museo Civico di Storia Naturale, Verona, Verona, pp. 26–31.

Torres Elgueta, J., 2007. Redes o líneas de pesca ? El problema de la asignación morfofuncional de los pesos líticos y sus implicancias en las tácticas de pesca de los grupos del extremo austral de Sudamérica. Magallania 35 (1), 53–70.

Torres Elgueta, J., 2009. Bolas líticas y sus procesos de manufactura, en contextos de cazadores recolectores terrestres del norte de Tierra del Fuego. Evidencias desde el Holoceno Medio hasta 1500 años AP. In: Salemme, M., Santiago, F., Álvarez, M., Piana, E., Vázquez, M., Mansur, M.E. (Eds.), Arqueología de la Patagonia, Una Mirada desde el último confín. Editorial Utopías, vol. 1. Tomo, Ushuaia, pp. 393–412.

Torres Elgueta, J., Morello, F., 2011. Bolas, manijas y guijarros piqueteados de la laguna Thomas Gould (XII región de Magallanes, Patagonia meridional). In: Borrero, L.A., Borrazzo, K. (Eds.), Bosques, montañas y cazadores: investigaciones arqueológicas en Patagonia Meridional. Editorial CONICET-IMHICIHU, Buenos Aires, pp. 211–238.