IGNEOUS AND METAMORPHIC ROCK EXPLOITATION BY THE LAST ABORIGINES IN FUEGUIAN CHANNELS

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Abstract
This paper presents the results of a study of lithic materials from the Lanashuaia site, located on the northern coast of the Beagle Channel (Tierra del Fuego, Argentina) and belonging to the time of contact with Europeans. The analysis of the raw materials has shown the use of igneous (e.g. rhyolite and cinerite) and metamorphic (schist) rocks, which can be found along the faces of moraines and beaches in the Beagle Channel, to manufacture most of implements in the knapped lithic tool kit. Equally, the functional analysis has enabled the documentation of use-wear marks produced by working with these tools in different production processes. The data on the raw materials and functional and technological analysis obtained at Lanashuaia is compared with the information derived from earlier studies at Tunel VII (Clemente 1997, Clemente and Terradas 1993, Terradas 1996 and 1997). This site is attributed to the same human group (Yamana) with a similar age, when the native population was in direct contact with European colonisers (Vila and Estévez 1996).

Key words: rhyolite, cinerite, schist, raw materials, use-wear analysis, Tierra del Fuego

Resumen
En este trabajo presentamos los resultados del estudio de los materiales líticos del sitio de época del contacto con los europeos Lanashuaia, en la costa norte del Canal Beagle (Tierra del Fuego, Argentina). El análisis de las materias primas nos permite observar el uso de rocas ígneas, como la riolita y cinerita, y metamórficas (esquistos) que se encuentran a lo largo de frentes de morrena y playas del Canal Beagle, para la manufactura de la mayoría de los instrumentos de trabajo líticos tallados. Del mismo modo, el análisis funcional nos ha permitido documentar los rastros de uso debidos a la participación de los mismos en diferentes procesos de producción. Estos datos de materias primas, análisis funcional y tecnológico obtenidos en Lanashuaia los confrontamos con los obtenidos en trabajos anteriores en Túnel VII (Clemente 1997, Clemente y Terradas 1993, Terradas 1996 y 1997), yacimiento atribuido también al mismo grupo humano (Yamana) y de cronología similar ya en pleno contacto con pobladores europeos (Vila y Estévez 1996).

Palabras clave: Riolita, Cinerita, Esquisto, Materias Primas, Análisis Funcional, Tierra del Fuego.
Introduction

The practical absence of siliceous rocks in the geological structure of Tierra del Fuego (Fig. 1) is reflected at archaeological sites in the use of other raw materials to manufacture part of the tools that were used to prepare the different items to be consumed.

Fig. 1 - Map of Tierra del Fuego with the positions of Tunel VII and Lanashuaia on the northern shore of Beagle Channel.

The complete tool kit did not only consist of lithic implements but also instruments made from bones, wood and mollusc valves. With animal bones (from whales, sea lions, guanacos, birds, etc) they manufactured weapon-heads, harpoons, bone wedges, punches, etc. “Cholga” valves (Mytilus edulis) were modified to produce a cutting edge and hafted; according to ethno-historical sources they were used for a large number of activities. It seems that these mollusc “knife-scrapers” were so common that every adult owned at least one of them (Gusinde 1986, Hyades and Deniker 1891, Lothrop 1928). This led some scholars, such as J. B. Bird, to consider that these implements were so typical as to refer to a “shell-knife culture” (cited by Ortiz-Troncoso, 1984: 121). Microscopic analysis has been carried out on ethnographic specimens of valves, deposited in museums (Mansur 1983 and
1984). However, it has not been possible to analyse similar archaeological objects because of their state of conservation (Clemente 1995/2008, Clemente 1997, Mansur and Clemente in press).

In contrast, it appears that the activities related with obtaining lithic raw materials, their transformation in tools and their use in other activities, did not strike the attention of travellers, colonizers and scholars of these southern lands (Terradas et al. 1999).

The most abundant quaternary sediments on Isla Grande at Tierra del Fuego are the glacial deposits. These are found along the whole shore of Beagle Channel as far as Nueva and Lennox Islands and show that all or most of Isla Grande was covered by an ice-cap during the Pleistocene. Therefore, the area of the Beagle Channel would have acted as a large glacier which would receive tributary glaciers entering from side valleys. The disappearance of the main glaciers in the early Holocene allowed the sea to penetrate the glacial valley between 9400 and 8200 BP, according to radiocarbon determinations, and the marine environment would have been fully established along the channel by about 7900 BP (Rabassa et al., 1986 and 1990). Erosion caused by wave action in the channel and by the different rivers has cut through part of the glacial deposits, leaving sections of their composition on view. The deposits contain the remains of clasts transported from all the geological formations crossed by the glaciers.

Most of the raw materials procured by Yamana groups at the Tunel VII site, in order to manufacture their implements, correspond to rocks in the Lemaire formation (rhyolite, cinerite and ignimbrite). This formation is found in a band parallel to the coast, about 10-15km away from the area being studied.

A series of reasons suggests that the provenance of the raw materials was the coastal glacial deposits and the associated beaches, rather than their original position in outcrops of this formation.

a.- the presence of Lemaire formation material in the glacial deposits. The lithological analysis of the clasts found in the basal till in the Arroyo Grande area showed that 14% of them came from the Lemaire formation (Coronato, 1990). This material has also been seen sporadically on the Tunel beaches and adjacent moraines, and in greater quantities in the glacio-fluvial deposits located further to the east, although they never amount to over 12% of the total number of clasts.

b.- the distance to the outcrops in their primary position in the Lemaire formation. The nearest outcrops are located about 10-15km from Tunel VII (Illustr. 4) towards the interior of the island. It is necessary to cross the steep-sloped mountains in the Sierra de Sorondo in order to reach them.

c.- the subsistence and mobility of the Yamana. These, inhabitants of a coastal environment, were able to travel by canoe longer distances than they could over land, as well as transport large quantities of the raw material with greater ease (Clemente and Terradas, 1993).
In the same way, the metamorphic rocks used to make implements (schist and aplite) appear in abundant outcrops in the Yahgan formation, characterized by black-grey radiolarite slate, with a banded structure and strongly marked transversal lamination, associated with greywacke and sandstone in the same colour, containing fragments of volcanic rocks together with quartz, feldspar and pyroxene grains (Caminos, 1980; Olivero and Malumián, 2008).

The materials of the Yahgan formation are found on the northern shore of the Beagle Channel, from the Ushuaia area to Port Harberton. Both the Tunel VII and Lanashuaia sites are located within the area of this formation, so the procurement of these types of rocks would not cause any difficulty or additional economic costs.

For the above reasons, the different raw materials are believed to have been brought to the settlement by the Yamana from the area surrounding the site, where they were gathered from the Quaternary glacial deposits which are found along the shores of the Beagle Channel (Terradas et al. 1991, Clemente and Terradas 1993, Terradas 1997) and on the beaches themselves.

Analysis of the lithic assemblage from the Lanashuaia site

The total number of lithic remains recovered at Lanashuaia during the 1995 and 1996 excavations comes to 2,218. As the excavated area is located on a beach with numerous schist clasts, we have excluded from the analysis all those pieces with similar characteristics to the ones seen on the modern beach. That is, all those rounded and abraded schist slabs or blocks with no signs of any technological modification and/or use. Two groups of cobble-stones are also excluded from the analysis. These are small or medium-sized with clear signs of thermal alteration. They are found in groups at the front and back of the cabin, together with a dark, greasy sediment. Although no analysis of the fatty acids has been carried out, we suppose that these cobbles were employed as “thermal stones” and may have been used for cooking.

Once the “noise” had been removed from the database, we examined a total of 1,675 lithic remains (Table 1). The raw materials used for these are: schist, (758 remains or 45.25%), cinerite (216, 12.8%), rhyolite (187, 11.16%) and quartz (29, 1.73%) (Fig. 3).

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1 The Tunel VII site was excavated within a Spanish-Argentinean research project directed by E. Piana and A. Vila, from 1988 to 1992, funded by CONICET in Argentina and MEC in Spain. The Lanashuaia site was excavated within an ALAMED Spanish-Argentinean project funded by the EU.
A number of remains have been classified as indeterminate materials (485, 28.95%), of which a small part corresponds to a granular green rock. However, most of these indeterminate rocks must be igneous types (cinerite/rhyolite), but because of specific problems in the transport of these materials to our laboratory, it has not been possible to study the assemblage as a whole. If this is the case, the numbers of these rocks would be doubled and would make up almost 50% of the rocks used to make part of the working implements at the Lanashuaia site. As we were unable to distinguish between the two igneous rocks, we have opted to consider them indeterminate materials.

If we compare the percentages of these raw materials exploited at Lanashuaia with those recorded for the last two periods of occupation at Tunel VII (Clemente and Terradas 1993, Clemente 1995/2008 and 1997, Terradas 1996 and 1997) significant differences can be seen between the two sites in the management of these resources. Therefore, while schist and slate from the Yaghan formation are exploited intensively at Lanashuaia (46%), at Tunel VII these rocks only make up 0.6% of the assemblage corresponding to the penultimate stage of the occupation and 1.5% of the last stage. In contrast, rocks...
from the Lemaire formation (rhyolite, cinerite and ignimbrite) are the majority raw materials at Tunel VII. Rhyolite in particular is the most common raw material (85.8% and 84.4% respectively), followed by cinerite (8.8% and 8.9%) and ignimbrite with only 4.6% and 3.9% in each stage of the occupation.

Another noticeable aspect at Lanashuaia, in comparison with Tunel VII is the use of quartz as a raw material to be knapped and create edges. This raw material was hardly seen at Tunel VII, although it was used many years before in the same area, at least in the IV component at Tunel I, in a high proportion of the implements and more specifically for the manufacture of scrapers (Mansur and Lasa 2005).

**Transformation of the raw materials into lithic implements**

The explanation of the knapping techniques has already been given in previous publications (Clemente 1995/2008 and 1997, Terradas 1996), so we do not need to enlarge too much on the topic on this occasion, apart from noting a few points about this question. It should be highlighted that primordially two technological contexts have been observed at both Tunel VII and Lanashuaia:

1 - aimed at obtaining flakes, as the main cutting element, whose edges may be modified either by percussion to fashion implements such as end-scrapers and side-scrapers², or by pressure to shape arrow-heads.

2 - aimed at obtaining bifacial products such as foliate side-scrapers and larger weapon-heads than as above, used mainly as daggers or knives. The production process begins with the acquisition of a block or slab of the raw material, or a large flake of the same material, from which bifacial extractions are made by percussion. The bifacial product that is obtained is then further reduced by percussion until another slimmer bifacial object is shaped. The final manufacturing phase, to format the artefact, is carried out by pressure, until the required thickness is achieved, and finishes with the shaping of the point, the two lateral wings and the tang.

However, a third technological context has been documented at Lanashuaia that has not been seen at Tunel VII. This is bipolar knapping over an anvil. This knapping technique has been recorded for the same raw materials, particularly cinerite, and is mainly used to obtain smaller products. Occasionally, when the negatives of the counter-blow at the distal end are numerous and in line, they may be confused with intentional retouching as if it was a distal end-scraper.

Schist deserves a more precise explanation as a raw material and in relation with its knapping to produce

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² Some cases have also been documented, typologically side-scrapers, where the retouch has not been produced to use the edge, but to blunt it so that it acts as protection and not hurt the user's hands. The opposite edge has been used as a knife. In other cases, elongated flakes with direct retouch on their edges have been used in longitudinal cutting movements to separate animal skins, in such a way that the unretouched face enters in contact with the part of the animal (flesh, fibres, etc) while the retouched face is in contact with the skin, thus avoiding damaging it in a false move and therefore remove it whole and without cuts (Clemente 1995 and 1997).
objects for its use. We have noted above the percentage differences in the use of this rock at both sites. Although it was very rare at Tunel VII, an unfinished “arrow-head” has been documented. This was made in a very rough way, and because of its deviation and thickness, it does not appear to be functional. In contrast, at Lanashuaia, the schist displays various qualities both for knapping and for its use (see below). Some of the rocks have a structure with fewer internal fissures and are therefore better for directing the knapping and obtaining the desired products. However, most of the pieces of schist pose many difficulties in technological studies. The structure of this rock in layers or sedimentary beds, as well as the oxidization of some them as a consequence of local metamorphism, makes it very difficult to direct the knapping to obtain regular-shaped objects. In addition, the climate conditions of humidity and freeze/thaw action, may also cause fracturing of the rock, and the sedimentary conditions allow plant roots to penetrate along the fissure planes and finally split them. In the same way, these natural alterations often make it difficult to recognize the intentional knapping of the schist fragments. Similarly, the stepped flaking of some of the edges may also have the same cause and hide intentional retouching (Fig. 4). If all these factors are not taken into account when the lithic remains from a site of this type are classified, we could find ourselves with a high percentage of “retouched items”, when in reality it is not so. The macro and microscopic observation of these materials has enabled us to understand some of these factors.

In general, schist fractures in the form of slabs of rock following the exfoliation planes, resulting in flat pieces, although they may sometimes be thicker or nodular in shape. All the cases of intentional fracturing have been associated with direct percussion and it has been possible to make a number of refits. In the example given in figure 5, it can be observed how the five fragments fit together, yet only one of them (no. 2171) has been seen to possess use-wear marks caused by working wood with a transversal action.
Fig. 5 - Lanashuia: re-fit of several schist fragments. Only no. 2171 displays use-wear marks on one of its edges.

**Functional analysis of the lithic implements from Lanashuia**

To date, the only scientific way of determining the use made of prehistoric implements is by analyzing the use-wear marks present on their surfaces (Semenov 1957/64/81, Vila 1977 and 1980, Keeley 1980, Estévez, Vila and Yll 1980, Anderson 1980, Mansur 1983, Plisson 1985, González and Ibáñez 1994, etc.). At Tierra del Fuego, functional analysis has been carried out at several sites on the northern shore of Beagle Channel. These have succeeded in discovering specific details of how use-wear marks developed in heterogeneous lithic raw materials, like rhyolite and cinerite (Clemente and Terradas 1993, Clemente 1995/2008, Clemente 1997, Clemente 2005, Clemente et al. 1996, Clemente and Gibaja in press, Vila and Mansur 1993, Álvarez 2003 and 2004, Mansur 1999, Mansur and Lasa 2005). However, hardly any studies have been made specifically related with the formation of marks on schist implements.

As on previous occasions we have analysed all the lithic remains from the site with a binocular magnifying glass in order to note whether any shine, scarring, striations, rounding or any other stigma can be observed on the edges or surfaces which might suggest that the object was used as a working implement.

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3 These raw materials like schist and slate can be considered the most “forgotten” types, not only from the functional point of view but also at the level of technological analysis. This may be because these rocks are rare at archaeological sites in the Old World, where traceology has been applied most intensively, and/or because of the “specialization” of most analysts in the study of flint, which in many cases is the only raw material to be studied.
The selected remains are then analysed with a metallographic microscope to attempt the identification of the material that was worked and the activities carried out with the implement.

All the knapped and unknapped lithic remains from Lanashuaia (n=1675) collected by archaeological excavations in 2005 and 2006, have undergone a microscopic examination. The great majority of the objects (n=1295, or 77.3%) display no use-wear marks. These, within the productive context, can be classified as Residual objects or Rejects. In contrast, 15.6% of the lithic materials from Lanashuaia enter within the group of Working Implements (tools) (n=262). However, out of this latter group, in 90 cases we have been unable to determine either the material worked or the kinematics, and they have been classified as Possible Use (PO). The other 172 objects have been classified as Certain Use and Probable Use. Some 119 objects (7.1%) could not be analysed microscopically because of serious post-depositional alterations to their surfaces (Fig. 6).

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4 Following the proposal in earlier papers (Clemente 1997, Briz et al. 2005) we consider as Working Implement (or tool): any lithic remains with wears of having been used in a certain productive process; Reject: any object with similar morphological characteristics as the tools but which was not used in any productive process; Residual object: any object produced involuntarily, although sometimes as a necessary consequence of lithic production.

5 It is significant that of these 90 objects, 53.3% (n=48) are made from schist, 22 are in indeterminate raw materials, 11 in cinerite and 9 in rhyolite.

6 For further details of these classifications see Clemente 1995/2008 and 1997, Mansur and Lasa 2005.
Among the lithic remains that have been classified as working instruments we have included 3 foliate points (two in rhyolite and one in cinerite) and 38 macrolithic implements (or components of implements). These make up 22% of the total number of implements with certain or probable use-wear. They include a cobble-stone with probable wears produced by working leather; an elongated pebble used as a retoucher; five anvil-stones, one of which had previously been used as a core from which a number of flakes had been extracted; and six “fishing-weights”, five of which are waisted and one with notches. In addition three cobble-stones have been recorded that were used passively to abrade upon them, in the way of polishing-stones; another upon which an unknown substance leaving greasy, violet-coloured residue had been crushed; and a polyfunctional tool which was first used actively around its whole perimeter to strike/crush an indeterminate substance and later passively as an anvil-stone on several of its faces (Fig. 7).
Finally the most numerous group of these “macrolithic implements” are cobble-stones with wears of having been used as hammer, mostly on hard mineral matter (n=20, two fragmented). These are of varying sizes and shapes, between 32 and 596g in weight. Some of them were used intensively around their whole perimeter, and others appear to have been used very little. Except for one in rhyolite and another in a type of granite, it has not been possible to determine the raw material of these stones. One of these cobble-stones, with a flat cross-section, displays percussion marks at its two ends, while the rest of the perimeter shows the marks of having interacted with a mineral substance in a longitudinal abrading action (Fig. 8).
Perhaps this was used to produce the waists on the fishing-weights, where this kind of action has been documented.

The use of macrolithic tools appears to have played a more important role at Lanashuaia than at Tunel VII, where our study only recorded the presence of two anvil-stones and a few hammers.

**Use-wear analysis and the “knapped” implements**

The other implements with certain and probable use-wear marks come to a total of 131. However, as many as 159 edges have been seen to have use-wear; this is because more than one edge was used in the case of 25 objects. Two edges were used on 22 implements and three edges were used for some productive activity in the case of the other 3 implements. Apart from two exceptions, they were normally used to work the same material and generally in the same activity. However, in a few specimens (n=4), it has been seen that one edge was used in a longitudinal/cutting action, whereas the other was used in a transversal scraping/planning action. In the case of the implements with three used edges, they follow the same trend of working the same material with the same action: two implements for scraping/planning wood and the third, two edges used in a cutting action and the other in a transversal action on a soft-medium substance of animal origin. The two exceptions mentioned above, numbers 8 and 2,485, both possess one edge used to cut fresh skins and the other to scrape wood. Most (n=20) of these implements used on more than one edge had been shaped in some way by retouching.

The results for the functional analysis of the knapped implements given below always refers to the total number of edges used (n=159) and not the number of objects (n=131). Some 34% of these edges (n=54) were used to exploit a woody plant resource (wood/bark), 21 edges (13%) were used to work an indeterminate medium-hard substance,
which could have been either a plant resource (wood) or animal (bone). The exploitation of animal resources with lithic tools has been clearly seen on 72 edges, which makes up 45.2% of the uses identified at the site. Of these, 35 (22%) were in contact with a soft animal substance (meat, fish...), 24 (15%) worked a more abrasive, soft-medium animal substance (skins/hides...) and 13 edges (8%) took part in some stage of the transformation of a hard animal matter (bone). We have only identified one edge, on a cinerite implement, used to work shell in a longitudinal action and for 11 edges we have been able to identify the kinematics or movement of the tool, but we have not been able to recognize the substance being worked (see Fig. 9).

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7 When the micro use-wears are not sufficiently well-developed for an accurate identification, either because of the short duration of the use or because of taphonomic problems that have removed the marks, we can only make an approximate estimate of the hardness of the substance that was worked.
If we analyse the lithic implements from Lanashuaia in more detail, it can be seen how these were manufactured from the different raw materials at the site (Fig. 10). However, the proportion of one raw material or the other, and the activity carried out, differs depending on the substance that was worked. Thus, for example, to cut soft animal matter, schist is the most common raw material with 19 edges, making up 54% of the implements used for this activity. In the case of some ten edges we have also been able to determine, through the use-wears, that these implements were used in a butchery process, as they display marks caused by the contact with both meat and bone (Fig. 11).

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8 In this case, the use of schist as a raw material for implements agrees with the little ethno-historical information that is available about the use made of lithic implements by the Yamana. For more details about this point see Terradas et al. 1999.
Fig. 11 - Schist implement used to butcher an animal. In the upper photographs use-wear marks can be seen produced by the contact with soft matter or meat (2 on the left) and marks made by contact with a hard substance or bone (2 on the right).

This use has also proven by the find of two schist fragments lodged in the rib-bone of a Minke whale (*Balaenoptera acutorostrata*) (Fig. 12).

Fig. 12 - Lanashuaia site: Minke whale rib with two schist fragments lodged in it.
As a result of this, we can propose the hypothesis that other artefacts made from this raw material may have been used for the same activity, but as the edges fracture when they come in contact with bones, they have lost those parts of the edge where use-wear would have developed previously.

The other edges ascribed to this productive activity are related with igneous rocks (8 in rhyolite, 5 in cinerite and 3 in an indeterminate raw material). Most of these implements appear to have been used for some kind of cutting action, although three or four show signs of more complex activities, involving both longitudinal and transversal movements. In addition to more developed, “reticular” micro-polish, they display a larger number of striations in different direction, which could be related to de-scaling, cutting and cleaning fish (Clemente 1997, Clemente and García 2008).

Some 24 implements were used to work with animal skins. Practically all these (21) are in relation with working fresh skin, in both transversal and longitudinal movements, but with clear differences and a choice of raw material depending on whether it was to be used to cut or scrape (Fig. 13).

![Fig. 13 - Lanashuaia: working with skins: implement raw material and the activities performed. TR – transversal (scraping), LO – longitudinal (cutting).](image)

Thus, for example, the four edges belonging to three schist implements were only used for cutting activities, which would correspond to skinning the animal before it was butchered\(^9\). The remaining implements used to cut skins were made in: rhyolite (4), indeterminate rock (3) and cinerite (1). It is noticeable that eight of these twelve implements used in relation with cutting skins had been retouched. This circumstance has already been observed at the Tunel VII object no. 8, made from an indeterminate raw material.

\(^9\) One of these implements (no. 2485) has another edge that was used to scrape/rasp wood, in a similar way to
site (Clemente 2005) and we attribute it to the need to remove the animal skins without damaging them, as the implement is used in such a way that the retouched side comes in contact with the skin and the other side with the animal’s flesh. In this way, even in the case of a false movement occurring during the process, the skin would not be broken. We also suggest the hypothesis that the animals skinned with these implements may have been birds with delicate skins (penguins or cormorants) or sea lions. We do not believe that these implements were used to skin guanacos for several reasons: first because it is easier to stretch the skin with blows made with the fist on the internal side, just as the modern natives of Patagonia do with guanacos and lambs, and second because the archaeological record shows that only certain parts of the skeleton are found at the site. The guanacos were skinned at the killing-site, normally inland, unlike the sea lions that were transported whole by canoe to the beach, where they were butchered near the hut (Gusinde 1986, Estévez 1996).

As regards the processing of skins, at Lanashuaia twelve implements have been seen that were used to scrape the skins, of which ten were retouched. Again, fresh skins have been documented most frequently (ten cases). Working with fresh skins has been recorded ethno-historically as an activity to clean and remove the fat, before the skin is dried (Gusinde 1986, Mansur 1984). Most of the implements that were used in this stage of skin-processing are made from cinerite (n=7)\textsuperscript{10}, while three are of rhyolite and two of an indeterminate raw material. It can be highlighted that schist appears to have been rejected for this scraping action, which seems logical as it is an activity requiring hard pressure and schist is a material that flakes and fractures easily and would not be effective for this task.

This may also be the reason for the discrete presence of schist among the implements used to work with bone, as only one edge out of the thirteen used for this activity were made from schist. In all cases the action performed with bones has been a transversal movement to scrape/smooth their surface. The other implements that have worked bone were cinerite (6), rhyolite (5) and one indeterminate rock.

The exploitation of woody plant matter (wood/bark) has been recorded for 54 edges (Fig. 9). These correspond to implements made from the various raw materials: cinerite (16), rhyolite (6), schist (16), quartz (2) and in fourteen cases the raw material could not be identified (Fig. 14).

\textsuperscript{10} One of them (no. 1540) possesses two edges used for the same activity.
As seen in working with hard animal matter (bone) and indeterminate medium-hard substance (bone or wood?)\textsuperscript{11}, most of the activities carried out with them are in relation with transversal movements to scrape and/or rasp (49 edges). Consequently, only two edges of implements made from an indeterminate raw material were used to saw wood (longitudinal action) and another two edges (one in cinerite and the other in rhyolite) were used to cut away or trim wood, in an action that begins as transversal and finishes as longitudinal, for example as we would use a knife to make a point on the end of a piece of wood.

As a result of using two schist tools in a transversal action, notches were produced in the middle of the edge. The largest one of these is 30mm long. These implements could have been used to smooth a branch (a wooden handle?) that would have been nearly three centimetres in diameter.

The only two quartz implements on which use-wear marks have been identified are two un-retouched flakes that were used to scrape or rasp wood.

\textbf{Discussion on the results of the functional analysis at Lanashuaia and Tunel VII}

The substances worked with lithic implements at Lanashuaia and Tunel VII are practically the same: soft animal matter (meat/fish), hides (fresh and dried), bone, wood and an indeterminate medium-hard substance that could be either wood or bone (Tables 2 and 3). The only small differences between both sites is seen in the exploitation of non-

\textsuperscript{11} Out of the eleven edges used to work an indeterminate medium-hard material, only one was used to cut or saw, the others took part in transversal actions. All these transversal movements are related with a high proportion of retouching of the edges being used. About 65% of the identified implements have been classified as artefacts shaped by secondary knapping or retouch.
woody plants at Tunel VII (4 implements), a substance not identified at Lanashuaia and, inversely, the action of cutting a mollusc shell recognized on a cinerite flake from Lanashuaia, while this activity was not seen at Tunel VII. However, at Tunel VII, four knapped tools were documented that would have been used to scrape ochre (2) and cutting mineral (2). This labour of a longitudinal action on mineral resources has only been seen at Lanashuaia on a small cobble-stone, as described above (Fig. 8)12.

The percentages of raw materials worked at the two sites coincide quite well, with few statistically significant differences. Thus, for instance, implements related with cutting soft animal matter at Lanashuaia make up 23.6% of the total number of tools, whereas at Tunel VII they come to 22%. For the use-wear marks of these edges used to work with soft animal matter, we also differentiated a certain number with use-wear marks representing more complex movements resulting in striations and micropolish that we associate with working with fish (Clemente 1995/2008, 1997, Clemente et al. 2002, Clemente and Gyria 2003, and Clemente and Díaz 2008). At Tunel VII this type of edge makes up 17.5% of those implements (n=16), whereas at Lanashuaia it represents 22% (n=8).

Working with woody plant resources (wood and/or bark) also displays similar percentages at both sites. At Lanashuaia this activity is represented by 34.6% (n=54) of the implements and at Tunel VII by 37.5% (n=160). However, a difference exists in the kind of activity carried out, as at Lanashuaia 88.8% of these implements were used with transversal movements (scraping), whereas at Tunel VII transversal movement was only performed with 68% of the edges, as the actions of cutting/sawing (n=36) and planing (n=15) are more common than at Lanashuaia. (Compare Tables 2 and 3).

12 At both sites implements have been documented that were used in relation with the production of lithic artefacts, such as percussors, retouchers and anvil-stones.
<table>
<thead>
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<th>Worked mat.</th>
<th>No. used edges</th>
<th>% worked mat</th>
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</tr>
<tr>
<td>Skin/hide</td>
<td>42</td>
<td>9.8</td>
<td>14</td>
<td>28</td>
<td>0</td>
</tr>
<tr>
<td>Bone</td>
<td>70</td>
<td>16.4</td>
<td>46</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Wood</td>
<td>160</td>
<td>37.5</td>
<td>109</td>
<td>36</td>
<td>15</td>
</tr>
<tr>
<td>Wood/Bone?</td>
<td>52</td>
<td>12.2</td>
<td>44</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Others</td>
<td>8</td>
<td>1.8</td>
<td>2</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>426</td>
<td>99.7</td>
<td>215</td>
<td>175</td>
<td>34</td>
</tr>
</tbody>
</table>

**Tab. 2** - Number of edges, activities and worked matter identified at several occupations at Tunel VII (Clemente 1997)\(^{13}\).

<table>
<thead>
<tr>
<th>Worked mat.</th>
<th>No. used edges</th>
<th>% worked mat</th>
<th>TR action</th>
<th>LO action</th>
<th>TL action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft animal</td>
<td>35</td>
<td>22</td>
<td>0</td>
<td>35</td>
<td>0</td>
</tr>
<tr>
<td>Skin/hide</td>
<td>24</td>
<td>15</td>
<td>12</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Bone</td>
<td>13</td>
<td>8.2</td>
<td>13</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wood</td>
<td>54</td>
<td>33.9</td>
<td>48</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Wood/Bone?</td>
<td>21</td>
<td>13.2</td>
<td>20</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Others</td>
<td>12</td>
<td>7.5</td>
<td>11</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>159</td>
<td>99.8</td>
<td>104</td>
<td>53</td>
<td>2</td>
</tr>
</tbody>
</table>

**Tab. 3** - Number of edges, activities and worked matter identified at the occupation or occupations at Lanashuaia

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\(^{13}\) These knapped tools that were occasionally used to work with these other resources, such as the eleven edges that at Lanashuaia were used in a transversal action, generally with an indeterminate substance, have been grouped in "Others" in Tables 2 and 3.
A similar trend is also seen in working indeterminate medium-hard substances (wood/bone?), as at Tunel VII it has been identified on 12.2% of the used edges and at Lanashuaia on 13.2%.

However, certain differences in the percentages can be seen in working skins and bones. Although at both sites fresh skins were worked above all\(^{14}\) as the activity is documented on 88% (Tunel VII) and 87.5% (Lanashuaia) of these implements, the general percentages of the actions of skinning and cutting, or scraping and cleaning vary between the two sites. While at Lanashuaia they are represented by 16.2% of the used edges (n=24), at Tunel VII by only 9.8% (n=42). Of these implements, at Tunel VII two side-scrapers were identified that had worked skins with abrasive, and this type of tool was not documented at Lanashuaia. Although the specific use-wear marks on the surfaces of these implements suggest the working of fresh skins, it is also possible that some type of lubricant (grease, fish oil) was used, as well as an abrasive. This use has also been documented in written sources\(^{15}\).

This process could be aimed at softening a skin used to make some kind of clothing, such as a cloak or loincloth (Clemente 1997 and 2005).

In the working of bone, some statistically significant differences can be seen \((\chi^2=0.001)\). At Lanashuaia bone was only worked by scraping or grating, and this has been observed on 8.7% of the edges used at that site. At Tunel VII, however, the percentage is larger as it reaches 16.4% with a greater number of activities being documented (Tables 1 and 2). This is also related with the bone assemblages recovered at each site. Tunel VII has yielded a larger number of harpoons, wedges, spatulas and beads made from birds’ bones, for example, and to manufacture these it is necessary to cut, saw, thin down and scrape to smooth and even out the surface. At Lananshuaia, only the latter activities, connected with finishing or repairing the objects, are represented by the marks on the lithic tools.

One aspect that needs to be commented on is the relationship between the use of the implements and the raw material with which they were manufactured. At Tunel VII, in the last two stages of its occupation, it had already been seen how cinerite was the most often used raw material to make and use productive tools (Clemente and Terradas 1993, Clemente 1997, Terradas 2000). For example, in the final occupation stage this rock was procured in a proportion of 8.8%, and yet it was used for 29.3% of

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\(^{14}\) Although the working of dry hides or leather has also been documented in smaller percentages. In the ethno-historical sources, this activity is associated with thinning down leather (Clemente 2005).

\(^{15}\) No data is available about the way skins were treated to preserve them, especially those that were used for the few clothes worn by the Yamana, as the fats existing in the cloaks and those which they absorbed from the human body (they were normally covered by fish or whale oil) fulfilled this lubricating function on the leather (Gusinde 1986). However, occasionally “… they took a piece of hide or a certain leather object and they covered it with grease; even more rarely they mixed fish oil with the red dust from burnt clay to make an agglutinative mass which was spread over the surface of the leather by pressing with the palm of the hand. If they wanted to make smaller pieces of leather soft and flexible, they impregnated them with abundant fish oil for a length of time. Only frequent use stopped the leather from becoming hard and stiff” (Gusinde 1986 (2): p. 400).
the working implements\textsuperscript{16}. It can be said that the situation at Lanashuaia is similar, as cinerite makes up 12.9\% of the raw materials brought to the hut, yet the rock is used for 32\% of the lithic implements at the site (Fig. 15).

\textsuperscript{16} This raw material can be compared with flint at other sites where this material can be in a minority as regards the number of pieces, but which is most often chosen to be worked.
Of the igneous rocks exploited in these contexts, cinerite has the finest granulometry, greatest homogeneity and smallest number of internal fissures. When it is knapped, this results in more regular fracturing (more conchoidal), enabling the production of more regular-shaped objects with straighter and sharper edges, and a smaller number of waste products.

Rhyolite was also exploited quite intensively at Lanashuaia, and although it is represented by 11% of the raw materials brought to the site, it was used to manufacture 18.6% of the implements. Above all it is the abundant use of schist at the site that is remarkable in comparison with Tunel VII, where it was rarely exploited. Schist is very abundant on the beach in Cambaceres Bay, where Lanashuaia is situated. Consequently it makes up 45.2% of the raw material recorded at the site, although its use drops to 29.8% of the implements. In addition, it was generally used for working with soft animal resources and wood, in relation with activities involving animal butchery and cutting up meat, and with scraping and planning pieces of wood. The type of fracturing affecting this raw material results in large amounts of waste being produced during knapping, as described above.

**In conclusion**

The results obtained in this study enable us to conclude that it is necessary to analyse all the lithic remains at an archaeological site without exceptions, for example, without discriminating certain raw materials. Only by carrying out full studies can we gather all the information needed to approach an understanding of the social organization of the human groups being studied. In this way, we can propose how mineral resources were managed and how, in their relationship with the technological development they had reached, they were able to exploit the different natural resources that the environment offered. In this case, the sites being studied here,
although they are both located on the same north shore of the Beagle Channel and are of similar chronology, display similarities and differences in the management of raw materials and the use of working implements. Differences have also been seen in the number of faunal remains (Mameli 2004, Mameli and Estévez 2004). Thus, at Lanashuaia for example, although the remains of sea lion predominate, guanaco is proportionally more common than at Tunel VII; at the latter site the remains of sea lion and birds are relatively more frequent. The biotopes surrounding the two sites may be the cause of this circumstance: Lanashuaia is situated in a more open environment, with less steep slopes and areas of open woodland where the guanacos would find better areas of pasture, and with better communications towards inland valleys (Piana et al. 2000).

In the course of this study we have seen how the exploitation of schist is far more significant at Lanashuaia than at Tunel VII. The lithological clasts on the beaches themselves are also different. At Tunel VII there are more cobble-stones with a greater abundance of igneous rocks and although schist outcrops next to the excavated hut, it contains many fissures and planes, and is not suitable for knapping. At Lanashuaia, schist slabs and clasts are very common, are more varied and suitable for the manufacture of implements. In any case, at each site we have seen how cinerite was the most highly valued rock and the most frequent raw material used for working implements. Because of its mineralogical structure and composition it is easier to knap, and was therefore chosen to manufacture end-scrapers and other retouched artefacts, as well as for general uses at both sites.

At the technological level, bifacial knapping is less common at Lanashuaia; there is a smaller number of points and other foliate products than at Tunel VII. However, bipolar percussion over an anvil-stone has been documented, and this had not been seen at Tunel VII.

At both sites we have seen that practically the same substances were worked and in very similar proportions. Apart from working with non-woody plants, not recorded at Lanashuaia, and working shells, not seen at Tunel VII, at both sites a high percentage of the implements were used for wood-working and another large group of tools was involved in the exploitation of animal resources. However, if it is true, as ethno-historical sources state, that mollusc valve knifes/scrapers were used intensively for different productive activities, and these have not been preserved well in the archaeological record, a clear bias exists in studies of the general production carried out by these groups. The same can be said for the metal implements that the Yamana certainly used during the historical times of contact with Europeans, and which have been documented by butchery striations seen on bones (Estévez and Piana 1996). Similarly, no functional analysis has been undertaken for the working implements made from bone. The analysis of all these tools will help to complete a more general view of the productive means and the technological development of these human groups.
within an overall study of their subsistence.

References


