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Variability of the phytolith record in fisher-hunter-gatherer sites: an example from the Yamana society (Beagle Channel, Tierra del Fuego, Argentina)

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Abstract
Phytoliths were analysed from shell-midden samples from the Yamana site Túnel VII, located on the northern shore of the Beagle Channel, in Tierra del Fuego. A detailed and intensive sampling strategy was applied to understand the variability and distribution of
phytolith assemblages in the hut occupation layer, which resulted from both taphonomy and the working processes carried out in the dwelling.

This investigation has demonstrated that a proper sampling strategy must take into consideration the research questions. It also must be capable of indicating the inherent variability of the phytolith record, related to both natural and social causes. The use of a single sample to represent the entire archaeological context should not be considered a standard practice for phytolith analysis, especially when the studied context is a milieu of several, and sometimes unrelated, social actions.

**Key words:** Phytolith, shell-midden, fisher-hunter-gatherer, social space, Yamanas, Tierra del Fuego.

1. Introduction

The present work is a theoretical and methodological contribution to the understanding of the use of phytolith analysis in fisher-hunter-gatherer sites. From the methodological point of view, the main aim is to corroborate the hypothesis that the phytolith record of an occupation layer is heterogeneous and that this heterogeneity is related to the activities carried out during the occupation, as for any other archaeological material (Wilk and Rathje, 1982; Ashmore, 2002). Depositional and post-depositional taphonomy can play a role in shaping the deposited assemblages (Madella and Power-Jones, 1996; Madella, 1999). However, it is clear that, at least in pastoral and agricultural settlements (Shahack-Gross *et. al.* 2003, 2004), its effect does not obliterate the original phytolith signature.

The analysis of space is fundamental for understanding past societies (e.g., Allison, 1999; Ashmore, 2002; Binford, 1983; Rigaud and Simek, 1991). Undeniably, social practices (both production and consumption) cannot be understood without a spatial perspective because space is socially constructed (e.g. Brumbach and Jarvenpa, 1997; Hendon, 1996; Wünsch, 1996 a, 1996b). The analysis of space is even more critical to the understanding of social organization in those situations, such as past fisher-hunter-gatherer societies, where it is often more difficult to interpret the archaeological record due to the scarceness of remains and/or preservation (Wünsch, 1991). Also, the apparent absence of certain resources in the archaeological record is often interpreted as indicating non-use. However, this absence can be related to the “invisibility” of the materials (e.g. microscopic) or because the appropriate recovery technique was not
applied (e.g. flotation, chemical analyses, etc.). The case of plant resources in fisher-hunter-gatherer sites can be considered a typical example of this problem. In Palaeolithic or Mesolithic archaeology, there has been very often what we would consider a biased interpretation of the use of resources. The focus was frequently on those resources that were easily and routinely recovered, namely lithics and bone remains (Warren and Conneller, 2006). Lithics and bones have been interpreted as representing all aspects of the social and economical life of fisher-hunter-gatherer societies, creating a biased picture of these prehistoric people. Recent works have began to show that, where preserved or when the proper technique is applied, plant remains in prehistory can be an important component of the archaeological record (e.g., Mason and Hather, 2002; Robinson and Harild, 2002; Nadel et al., 1994; Nadel and Werker, 1999; Madella et al., 1998; Kubiak-Martens, 1996, 2002; Zapata, 2000).

Phytoliths, for their chemical and physical characteristics, are the most robust plant remains, and become part of the archaeological record without the need of any previous preservational process (Piperno, 1988). It is also important to stress that the significance of phytoliths exceeds the mere taxonomic identification, providing paramount information on the general utilization of plant resources (Zurro, 2002, 2006 and references therein; Harvey and Fuller, 2005). The Yamana settlements of the Beagle Channel (Estévez et al., in press) offer the possibility to apply phytolith studies in strictly controlled conditions. There is an extensive ethnographical record, the plant taxonomic variability is low, and some of the taphonomical effects (e.g. diagenesis) are reduced because of the young age of the sites.

As a first step towards an understanding of Yamana social activities, there is a need to resolve a sub-set of archaeological questions that will allow evaluation of the viability of this approach:

- Are phytoliths part of the archaeological deposits of the Yamana sites?
- Is it possible to use phytoliths to identify the production processes that imply plant resources in Yamana sites?
- Is it possible to identify the taxa involved in these production processes by using a reference collection of local plants?
- Is the phytolith evidence supporting or refuting the ethnographical record?
2. Regional setting

The southernmost part of Argentina and Chile is a maze of channels and islands crossed by the Beagle Channel (Figure 1). This area is characterised by a widely fluctuating sub-Antarctic climate, with the constant presence of wind, rain and low temperatures (annual mean temperature between 1°C and 9.3°C; Iturraspe and Schroeder, 1999). The vegetation cover is a patchwork mostly composed of tundra and Nothofagus forests (Heusser, 1989; Markgraf, 1993; Romanyà et al., 2005). This area was inhabited by groups of fishers-hunters-gatherers from ca. 6500 BP to the first half of the XX century (Orquera and Piana, 1999a). These groups, initially called Yaghanes, became known as Yamanas from the work of the Austrian ethnographer Gusinde (Vila, 2000). The Yamana were a nomadic society, which moved around a small territory using canoes (Gusinde, 1937; Orquera and Piana, 1999b), and whose subsistence was mainly based on the consumption of molluscs, fish and sea mammals (Juan-Muns, 1992; Estévez and Martinez, 1997; Orquera, 1999; Estévez et. al., 2001; Mameli and Estévez, 2004). There is extensive ethnographic information regarding the everyday life of Yamana people and their subsistence activities (Gusinde 1937, Hyades, 1885, Hyades and Deniker 1891) as well as a thorough archaeological record (see for example, Estévez and Vila 2006, Álvarez 2004, Orquera and Piana 1999a, 1999b, Zurro et al. 2006). Vegetable food has been ethnographically documented. However, this had a secondary role in the diet, which is centred on animal proteins. Indeed, in Tierra del Fuego there are only a few species that produce edible fruits or roots and, generally, these are of small size and are produced with a marked seasonality. The major use of plant resources by the Yamanas was for fuel (wood) and as raw material for tool and utensil production (wood, bark, mosses, grasses and sedges, etc.).

Since the mid-1980s there have been several archaeological projects carried out by Spanish and Argentinean teams along the north shore of the Beagle Channel (Vila et al., in press). These sites are shell middens that were formed by the social activities of human groups exploiting the coastal and maritime resources, including large amounts of molluscs (Orquera, 1999; Orquera and Piana, 2000). The middens are very evident features of the landscape because of their typical crater-like shapes, which originate from the accumulation of waste material (mainly shells) around the huts. Orquera and Piana (1992, 2000) describe these deposits as packs of interlocked valves that are
separated from each other by stratigraphically discordant surfaces and, occasionally, by very thin layers of organic-rich sediments. One of the major and better-studied sites is Túnel VII, on the coast about 12 km east of Ushuaia (Estévez and Vila, 1996; Vila et al., 1997) in Cambaceres Bay (54° 49' 15" S, 68° 09' 20" W), and dated to the XVIII - XIX centuries (Figure 2). The structure was composed of a central depression ca. 3.5 metres in diameter with a hearth sequence located in the centre of the hut. The site was excavated in its full extension (105 m²) to investigate the several occupational phases and the inter-relationship of the occupational layers and waste lenses that composed the shell midden (Orquera and Piana, 1996; Orquera, 1996). The applied excavation methodology allowed identification of very thin deposits that separated the superimposed hearths, each one representing a single occupation (Estévez and Vila, 2000). In Tunel VII was possible to identify ten re-occupations of the hut (Estévez and Vila, 2006; Briz et al., in press). A combination of dendrochronology, radiocarbon dates and European material found during the excavation dated the length of occupation from the end of the XVIII to the end of the XIX century (Piana and Orquera, 1996). The anthracological analysis identified two predominant species in the charred assemblage: evergreen beech (Nothofagus betuloides, “guindo”) and pickwood (Maytenus magellanica, “leña dura”) (Piqué, 1999).

3. Materials and methods

3.1. Archaeological material

The present work investigated one of the lowermost sub-units (B355) of Túnel VII, which is associated with the third occupation episode (Estévez and Vila, 2006). This layer was unambiguously related to a single hearth episode (assumed to be the marker of one occupation episode) and it was clearly separated from other sub-units. The presence of several large charcoal fragments allowed dating this sub-unit by dendrochronology to between 1776 and 1898 AD (Piana and Orquera, 1996). Sub-unit B335 was visible during the excavation as a dark sediment layer (which included shell fragments, ash as well as shell and charcoal dust) laying approximately in the centre of the hut and surrounded by shell midden sub-units (Orquera, 1996). A total of 10 random samples were analysed (Table 1 and Figure 3). The sediment was dry sieved with a 0.5 mm sieve to remove all shell fragments of larger dimension. Phytoliths were then extracted using the Madella et al. (1998) protocol with an added step (the samples were calcinated at 500 °C for one hour before starting the process) to remove the high
quantity of organic matter, in the form of animal fat, that imbibed the deposit and that created an over-reaction when in contact with hydrogen peroxide. The acid insoluble fraction (AIF - the residue left after sediment acid treatment that eliminates carbonates and all other acid-soluble minerals) was calculated according to Albert et al. (1999). The phytolith residues were mounted in Styrolite™ and observed with an Olympus BX-50 microscope at 400x and 1000x magnifications. All phytoliths in each slide were counted and their frequency per gram of AIF and gram of sediment (excluding shells) calculated (Table 2). The Tunel VII deposits are very recent (XVIII-XIX century), and pedogenesis was not very advanced.

3.2. Reference collection
Reference collections play an important role for the identification of phytoliths. Several collections from many parts of the world are available (e.g. Piperno 2006, Ball 2002, Tsartsidou et al. 2007). For this research, a small, preliminary set was made from the most common taxa of the Beagle Channel area with the intention of recognizing the morphological (qualitative) variability of phytoliths in these plants. This collection is by no means exhaustive. However, the flora of Tierra del Fuego is composed of few major taxa that tend to be rather repetitive in the landscape (Heusser, 1989; Markgraf, 1993; Romanyà et al., 2005). The reference collection (Table 3) made for the present work comprises the most common taxa of the area (both herbs and wooden plants) including the plants that, according to the ethnographic and anthracological records, might have had an economic role in the Yamana society (Gusinde, 1937; Piqué, 1999) (see Fig. 5). This collection, which represents at least 50% of the autochthonous genera, fulfilled the aims of this preliminary analysis while it was still being developed, expanding the number of species and tissues involved as well as the quantitative information.

The plants were washed in a ultrasound bath with distilled water and a few drops of dishwashing liquid. The wash was followed by a rinse in distilled water, and then the material was dried in an oven at 60°C. The extraction of phytoliths from modern material was carried out by dry ashing (Pearsall, 2000) and a treatment with a 10% HCl solution (to eliminate carbonates and oxalates) and H₂O₂ to eliminate any possible organic matter. Finally, the opal silica residue was rinsed in distilled water 3 times, dehydrated with ethanol and mounted in Styrolite™.

4. Results
Phytoliths were extracted from all Tunel VII samples. All show a very fresh, undamaged look (Table 2 and Table 4). However, the concentration of phytoliths per gram of AIF is not very high and varies considerably between samples, from only 14.000 phytoliths/gram of AIF in sample TVII 3 to 585.833 phytoliths/gram of AIF in sample TVII 7. The phytolith assemblages are fairly repetitive, with only a few morphologies identified, together with a significant proportion of non-identified (Table 4). In all the samples, grass phytoliths are the dominant types (short and long cells), followed, with very variable frequencies, by phytoliths from woody taxa (Table 4), with two samples of the samples related to the hearth (TVII 1 and TVII 9) showing the highest frequency of woody taxa. Silica skeletons were almost absent, and only one was recovered in each of the samples TVII 5, TVII 6, TVII 7. A Principal Component Analysis (PCA) was performed using the complete phytolith assemblages as listed in Table 4. The PCA plot (Figure 4) shows little correspondence between context (e.g. the hearth) and assemblage composition, with the possible exception of the samples TVII 1, TVII 7 and TVII 10.

The reference collection provided a general view of the diagnostical possibilities of these microfossils in the regional context of study. Most of the phytolith types extracted so far do not present levels of characteristics to make them significant at taxonomic level. Schleroids were found in Nothofagus, jigsaw pieces in Blechnum, and grasses presented the various typical phytolith morphotypes. At the present stage, only the typologies encountered in Blechnum are of taxonomic importance (Figure 5 and Figure 6).

5. Discussion
Notwithstanding the preliminary stance of the present work, there are several important points that emerged from the sediments analysis of the Yamana dwelling. Phytoliths were well preserved and have been recovered from all the archaeological samples. The variability of concentration of phytolith per gram of AIF indicates a highly heterogeneous input, which is also emphasized by the PCA results (Fig. 4). This heterogeneity is further supported by the relative frequencies of phytoliths composing the assemblages. The input variability should relate to the spatial variability of the anthropic actions carried out in the dwelling. It is possible to eliminate most taphonomic processes either because it can be assumed that their effect was constant in all the dwelling sediments (e.g. trampling, chemistry, amount of organic matter, etc.) or
because taphonomy did not act (e.g. diagenesis). Furthermore, it is expected that in such a small surface (ca. 7 m²) the phytolith assemblages related to the natural vegetation input, which was deposited previously to the anthropic presence, would have had a much more consistent distribution. However, the phytolith evidence does not show any direct relationship with spatial features that could be intuitively considered as possible areas of phytolith concentration. For instance, a high concentration of phytoliths around the hearth might be expected, but this is clearly not always the case: different samples from around this structure may or may not have high concentrations of these microfossils (Table 2). All the evidence suggests that the anthropic phytolith input resulted from the different social actions carried out during the hut occupation but that these actions were not unequivocally associated with one location only. This means that the sequence of actions modified previous inputs and created a blending effect on the final phytolith assemblages. Furthermore, because of the peculiarity of the plant assemblage available to Yamana people (low floristic variability), and as the productive processes involving plant materials probably do not generate unambiguously diagnostic phytolith signatures, there is little chance of an unambiguous match between social action and phytolith record. These remarks about the Yamana dwelling makes clear that a random sub-set of samples from a living space or an activity area, in general, cannot represent the entire phytolith variability. To link the observed phytolith data to social activities, there is need for extensive and systematic sampling that can make clear the phytolith signature of the whole so to be able to deconstruct the single processes that intervened. From this theoretical standpoint it is also apparent that a single sample collected from a context cannot be taken as representative of the whole context and that the sampling must be planned according to the working hypotheses.

In the case of the Yamana archaeological sediments, the low phytolith concentration might be associated with two major reasons: firstly, the low evapo-transpiration level of Fuegian plants due to the sub-Antarctic climate of Tierra del Fuego (Iturraspe and Schroeder, 1999); and secondly, to taxonomic reasons. In the light of this, the amount of wood phytoliths observed in the samples is even more remarkable and stresses the importance of wood input, probably connected to the use of wood as fuel. Fire was a fundamental constituent of the Yamana life. A fire was always carried on the canoe when people moved, and a hearth made up a primary element of the dwelling with the fire kept alive at all the time (Gusinde, 1937). Phytoliths from grasses are also common,
and at this stage it is difficult, on the basis of the available evidence, to determine the proportion related to the natural vegetation and the one related to social actions. However, the high concentration of grass phytolith in some of the samples from the area close to the entrance (samples TVII 5, TVII 6 and TVII 8) might suggest some kind of use of grasses in this area of the hut; for instance for conditioning the floor to insulate it from the ground humidity, as documented in the ethnographic sources (Gusinde, 1937).

From the data collected from the reference collection, it is clear that redundancy and multiplicity, together with low production only allow identification of a few of the Fuegian taxa (e.g. ferns). However, it is possible to recognize plant parts and tissues that can be of tremendous importance to understand resource choice, production processes and social use of space. Finally, in respect of an archaeological evaluation of the ethnographic record for the use of plant resources, the project is at too early a stage to properly assess this. The reference collection needs to be expanded to include all the Fuegian species, and more archaeological sites must be investigated for their phytolith content.

6. Conclusions
The phytolith analysis from a Yamana dwelling in Tierra del Fuego has clearly shown that it is of paramount importance in archaeological sediments to construct a proper sampling strategy that must take into consideration the research questions and that is capable of clearly unveiling the phytolith record inherent variability, related to both natural and social causes. The use of a single sample for representing a whole archaeological context should not be considered a standard practice for phytolith analysis, especially when the studied context was the milieu of several, and sometimes unrelated, social actions.

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(CADIC), Ushuaia for help with the plant collection. The fieldwork was carried out thanks to a joint research project (Society and ritual of the last hunter-gatherers of the Beagle Channel, Tierra del Fuego, Argentina - 2002AR0015), between the Spanish National Research Council (CSIC) and the Scientific and Technological Argentina National Commission (CONICET). The authors are members of the AGREL Excellence Research Group (2005SGR00829) of the Generalitat de Catalunya.

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Table 1: List of samples from Tunel VII site that have been analyzed. All samples are from the same layer, which is composed by a dark, humic sediment very rich in organic matter, with presence of small (ca. 1 cm on average) fragments of marine shell and coarse sand.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Location</th>
<th>Sub-location</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVII 1</td>
<td>II-III</td>
<td>2 NW</td>
</tr>
<tr>
<td>TVII 2</td>
<td>III</td>
<td>6 NW</td>
</tr>
<tr>
<td>TVII 3</td>
<td>II-III</td>
<td>3 SE</td>
</tr>
<tr>
<td>TVII 4</td>
<td>II</td>
<td>2 SW</td>
</tr>
<tr>
<td>TVII 5</td>
<td>II-III</td>
<td>1 SW</td>
</tr>
<tr>
<td>TVII 6</td>
<td>II</td>
<td>1 SE</td>
</tr>
<tr>
<td>TVII 7</td>
<td>II</td>
<td>3 SW</td>
</tr>
<tr>
<td>TVII 8</td>
<td>II-III</td>
<td>1 NW</td>
</tr>
<tr>
<td>TVII 9</td>
<td>II</td>
<td>3 SE</td>
</tr>
<tr>
<td>TVII 10</td>
<td>II-III</td>
<td>2 NE</td>
</tr>
<tr>
<td>Sample</td>
<td>Location</td>
<td>Original sample weight</td>
</tr>
<tr>
<td>--------</td>
<td>----------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>TVII 1</td>
<td>II-III B355 s.2 NW</td>
<td>4,4774</td>
</tr>
<tr>
<td>TVII 2</td>
<td>III B355 s.6 NW</td>
<td>4,4290</td>
</tr>
<tr>
<td>TVII 3</td>
<td>II-III B355 s.3 SE</td>
<td>4,3908</td>
</tr>
<tr>
<td>TVII 4</td>
<td>II B355 s.2 SW</td>
<td>4,1860</td>
</tr>
<tr>
<td>TVII 5</td>
<td>II-III B355 s.1 SW</td>
<td>4,3102</td>
</tr>
<tr>
<td>TVII 6</td>
<td>II B355 s.1 SE</td>
<td>4,1438</td>
</tr>
<tr>
<td>TVII 7</td>
<td>II B355 s.3 SW</td>
<td>4,5144</td>
</tr>
<tr>
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<td>II B355 s.2 SE</td>
<td>4,1433</td>
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<tr>
<td>TVII 10</td>
<td>II B355 s.3 SE</td>
<td>4,4703</td>
</tr>
</tbody>
</table>

Table 2: Table with the weights of the samples in the different steps of the procedure and the number of phytoliths counted.
<table>
<thead>
<tr>
<th>Species</th>
<th>Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marsippospermum grandiflorum (L.)</td>
<td>stem</td>
</tr>
<tr>
<td>Sphagnum sp</td>
<td>whole plant</td>
</tr>
<tr>
<td>Taraxacum gilliesii (syn. <em>T. magellanicum</em> Comm. Ex Sch. Bip.)</td>
<td>stem and leaves</td>
</tr>
<tr>
<td>Nothofagus pumilio (Poepp. and Endl.)</td>
<td>leaves</td>
</tr>
<tr>
<td>Drimmys winteri Forst.</td>
<td>leaves</td>
</tr>
<tr>
<td>Poa scaberula Hook. f.</td>
<td>culm and leaves</td>
</tr>
<tr>
<td>Blechnum Penna-marina (Poir.) Kühn</td>
<td>leaves</td>
</tr>
<tr>
<td>Berberis ilicifolia L. f.</td>
<td>leaves</td>
</tr>
<tr>
<td>Berberis buxifolia Lam.</td>
<td>wood and leaves</td>
</tr>
</tbody>
</table>

Table 3: List of species selected for the reference collection.
<table>
<thead>
<tr>
<th></th>
<th>GRASS CELLS</th>
<th>HERBS</th>
<th>ARBOREAL</th>
<th>INDET.</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Short cells</td>
<td>Trichomes</td>
<td>Trich. bases</td>
<td>Bulliform</td>
<td>Long cells-</td>
</tr>
<tr>
<td>a.n.</td>
<td>%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TVII 1</td>
<td>3 19 00 1 6 0 0 0 0 0 0 0</td>
<td>0 0</td>
<td>1 6 0 0 1 7 1 7</td>
<td>0 0</td>
<td>2 8 0 0 2 8 4 20 4 20</td>
</tr>
<tr>
<td>TVII 2</td>
<td>4 16 0 0 0 2 8</td>
<td>0 0</td>
<td>0 0 0 0 0 0 0 0</td>
<td>0 0</td>
<td>0 0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>TVII 3</td>
<td>6 40 0 0 0 0 0 0 0 0 0 0</td>
<td>0 0</td>
<td>1 7 1 7</td>
<td>0 0</td>
<td>0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>TVII 4</td>
<td>10 50 0 0 0 0 0 0 0 0 0 0</td>
<td>0 0</td>
<td>0 0 0 0 0 0 0 0 0 0 0 0</td>
<td>0 0</td>
<td>0 0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>TVII 5</td>
<td>7 23 4 13</td>
<td>0 0 0 0 0 0 0 0</td>
<td>0 0</td>
<td>0 0 0 0 0 0 0 0 0 0 0</td>
<td>0 0</td>
</tr>
<tr>
<td>TVII 6</td>
<td>27 15 9 5</td>
<td>0 0 0 0 0 0 0 0</td>
<td>25 14 7</td>
<td>1 7 1 7</td>
<td>0 0</td>
</tr>
<tr>
<td>TVII 7</td>
<td>254 35 117</td>
<td>16 7 1 2 0 194 27 34 5</td>
<td>1 0 0 0 0 0 0 0 0 0</td>
<td>0 0</td>
<td>0 0 0 0 0 0 0 0 0 0</td>
</tr>
<tr>
<td>TVII 8</td>
<td>96 47 3</td>
<td>1 0 0 0 0 0 0 0</td>
<td>41 20 0 0 0 0 0 0 0 0</td>
<td>0 0</td>
<td>0 0 0 0 0 0 0 0 0 0</td>
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<tr>
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<td>1 5 1 5</td>
<td>0 0 0 0 0 0 0 0</td>
<td>9 45 2 10</td>
<td>0 0</td>
<td>0 0 0 0 0 0 0 0 0 0</td>
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<tr>
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<td>52 55 5 5</td>
<td>0 0 0 0 0 0 0 0</td>
<td>13 14 0 0</td>
<td>1 1</td>
<td>1 2 2 0 0 0 0 0 0 0</td>
</tr>
</tbody>
</table>

Table 4: Phytolith assemblages from the Tunel VII samples. In the first column (a.n.) are the absolute number values, in the second column (italics) are the percentage values.
FIGURE AND TABLE CAPTIONS

FIGURES

Figure 1: Map of Tierra del Fuego.
Figure 2: Photograph of Tunel VII site, courtesy of J. Estévez.
Figure 3: Distribution of the samples chosen from sub-unit B355. The excavation was carried out on the basis of two trenches (II and III), that were separated by a witness (II-III), which was excavated later. The small squares represent the grid and the circles the samples analyzed in this study. The dark grey line shows the limits of the hut, and the light grey line the limits of the hearth. The arrow points the geographical north.
Figure 4: Results of the PCA performed on the samples from TVII, showing a high heterogeneity of the phytolith composition of the samples.
Figure 5: Image from the reference collection (*Blechnum Penna marina* (Poir.) Kühn). Bar is 10 μm.
Figure 6: Image of a *Blechnum Penna marina* (Poir.) Kühn phytolith found in sample TVII 7. Bar is 10 μm.

TABLES

Table 1: List of samples from Tunel VII site that have been analyzed. All samples are from the same layer, which is composed by a dark, humic sediment very rich in organic matter, with presence of small (ca. 1 cm on average) fragments of marine shell and coarse sand.
Table 2: Table with the weights of the samples in the different steps of the procedure and the number of phytoliths counted.
Table 3: List of species selected for the reference collection.
Table 4: Phytolith assemblages from the Tunel VII samples. In the first column (a.n.) are the absolute number values, in the second column (italics) are the percentage values.