Micromorphological perspectives on the stratigraphical excavation of shell middens: a first approximation from the ethnohistorical site Tunel VII, Tierra del Fuego (Argentina)

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Key words: Ethnoarchaeology, Geoarchaeology, Micromorphyology, Shell middens, Yamana, South America, Tierra del Fuego

Abstract

Due to their problematic stratigraphy, shell middens have traditionally been excavated by artificial stratigraphical cuts. This approach has often led to the obliteration of the original depositional sequence, removing important information regarding depositional and post-depositional processes, and human frequentation. Since the 1970s, an Argentinian team has been excavating archaeological shell middens in the Beagle Channel with a detailed stratigraphic approach, based on the excavation of actual depositional units (peeling), rather than artificial cuts. In the 1980s, Spanish archaeologists joined the Argentinean and launched a series of new projects involving
the excavation of ethnohistorical Yamana fisher-hunter-gatherer sites. The first excavated midden site was Tunel VII, from which two monolith columns of about 50 cm each (C11 and C12) that spanned the whole stratigraphy were extracted. The two columns were consolidated with resin, and two series of thin sections produced to corroborate stratigraphical observations made in the field, and to verify hypotheses related to the formation of archaeological shell midden sites. We present here the first results obtained from the microscopical observation of seven thin sections from Column 11 (West column), extracted from a portion of the profile originally described as corresponding to the hut entrance and associated floor. The observation of microscopic features invisible in the field has provided supplemental information about the depositional and post-depositional processes affecting shell midden sites. We have also preliminarily defined a number of micromorphological characteristics identifying human activities such as discrete shell deposition events, phases of preparation of the hut floor, and compression by repeated trampling. Finally, we have explored the possibility of establishing some guidelines to characterise the length and character of frequentation phases of the site previous to its final abandonment at the beginning of the 20th century.
1. Introduction

An international team of researchers from the CONICET, the CSIC, and the UAB, have been excavating archaeological and ethnohistorical shell middens in Tierra del Fuego since 1988 (Estévez et al., 2007, Vila, 2004). The sites of Alashauaia, Lanashuaia and Tunel VII were excavated in extension, and following actual, rather than artificial, stratigraphical units (Orquera, 1995, Orquera and Piana, 1992). One of the best documented of these sites was the ethnohistorical site Tunel VII, occupied by Yamana groups during the 19th century (Estévez and Vila, 1995, Piana and Orquera, 1995). Thanks to the contribution of ethnographical and historical information, and to the limited time elapsed between site abandonment and excavation, Tunel VII offered a unique opportunity to test archaeological methods employed to study the formation and use of shell middens. Micromorphology is used here in an ethnographical context (Taulé i Delor, 1995), to develop a microstratigraphic approach to the excavation of archaeological shell middens (Goldberg and Macphail, 2006, Homsey and Capo, 2006, McEwan et al., 1997, Simpson and Barrett, 1996, Stein, 1992). Only microscopical observation in thin section provides the level of definition needed for characterise stratigraphical units using evidence not visible to the naked eye in the field.

Tunel VII is an open-air site located along the northern coast of the Beagle Channel (Tierra del Fuego). The site is situated between 0 and 5 m above the present-day line of high tide, on the slope of a moraine facing the sea to the south. The archaeological evidence from the excavation of Tunel VII agrees with the ethnographic description of the site. The formation of Tunel VII is considered the result of repeated occupations of a round hut with the deposition of shells and other consumption residues around its perimeter (Estévez and Vila, 2006). This process produced a ring with a central depression and an entrance facing the sea (Figure 1). The site was excavated between 1988 and 1993, following a grid system subdivided in areas of

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four by two metres, separated by 1-m wide baulks that were later removed (Orquera and Piana, 1995). Tunel VII was excavated in extension, recording each unit in a three-dimensional grid system. The units were excavated using a detailed stratigraphical approach. Their classification was based on the identification, during the excavation, of stratigraphic discontinuity surfaces, and on the systematic recording and quantification of over ten variables, such as matrix, shells, bones and lithic artefacts (Estévez et al., 2001). However, the level of fragmentation, inter-connection, compaction and distribution of the shells, which is unambiguous under the microscope, was not systematically recorded in the field. In 1993, two monolith columns were taken from the southernmost profile, closest to the shore. Column 12 (East column) was taken from sector III, while column 11 (West column) was taken between sectors II and III, after removing the baulk between sectors II and III. Micromorphological samples from column 11 are used here to examine the details of stratigraphical observations made in the field, and to test some of the original working hypotheses put forward to explain shell midden formation and use in Tierra del Fuego (e.g. the stratigraphical changes noticed during field work, and the intercalation of occupation and abandonment episodes).

2. The application of micromorphology to the excavation of shell middens

Two contiguous series of thin sections (A and B) were originally obtained from column 11, and numbered from 1 (uppermost) to 7 (lowermost) (Solé Benet, 1991). It was not possible to analyse all thin sections from both series because some of the units rich in organic matter were over-grinded during production. Therefore, thin sections from both series were selected to obtain the complete stratigraphy (Figure 2). A high-resolution scan of the impregnated monolith was used to locate the thin sections, and to draw a first macroscopical stratigraphy of this portion of the site. Each microscopical sedimentological unit was defined using an alphanumerical coding (e.g. T7C11TS5AU22), indicating site name (T7), column number (C11), thin section number (TS5A), and unit number (U22). The actual boundaries and main characters of each unit were defined using a Leica MZ 95 stereomicroscope, and the fine groundmass was described using a Leica DM 2500. Thin sections were observed under plain-polarized light (PPL) and cross-polarized light (XPL), following

3. Thin section description

Throughout column 11 the dominant fine groundmass is made of microfaunal faecal pellets organised in porous spheroidal sub-round crumbs, composed of more or less humified sub-millimetric plant tissues and charcoal fragments (Vera et al., 2007). The coarse component is mainly made of shell, charcoal, gravel and sand, with occasional bone fragments and sharp clasts (possible tools). Stratigraphical units have been grouped on the basis of their microstructure as spongy and blocky. The most common is the spongy type that relates to the main phases of shell accumulation, and is characterised by spongy microstructure, enaulic c/f related distribution, aggregation in porous crumbs, weak separation, and is unaccommodated with packing voids. The blocky type, which relates to phases of incipient soil development, is characterised by sub-angular blocky microstructure, porphyric c/f related distribution, aggregation in sub-angular blocky peds, moderate separation, and is partially accommodated with planar voids.

The fine groundmass being homogeneous throughout the profile, stratigraphical units have been differentiated based on the characterization of the coarse fraction. Most relevant to the microscopic differentiation of units were the concentration and size of shell fragments and clasts together with the degree of shell compaction, fragmentation, inter-connection, species variation and distribution. These characteristics were used to infer on the extent and modality of the different phases of site frequentation and abandonment:

- Low species variation and fragmentation, with linear or banded distributions represent single tossing events.

- High species variability and fragmentation together with random distribution, represent longer frequentation, with repeated reorganisation of the unit by different activities, e.g. floor cleaning.

- Higher compaction of the unit represents continuous site frequentation.
Lower compaction and incipient soil development associated with scarce anthropogenic features represents temporary abandonment.

The observation of specific pedofeatures, such as soil aggregates and sand lenses, provided information on the processes involved in the preparation of the hut floors (Table 1).

4. Microstratigraphy

The stratigraphic sequence of Tunel VII can be broadly divided according to the incipient edaphic features observed. These were present in only three layers: at the bottom of the profile (unit 1A), at the top of the profile (unit 19) and in units 11 and 12, situated between c. 20 and 25 cm below the ground (Figure 2). Unit 11 corresponds to field units B355 and B365 described by Orquera (1995), and it has been used as a marker to correlate the field and laboratory stratigraphies.

Units 1A to 2

The lowermost portion of the profile shows soil aggregates in unit 1A (Figure 3). The soil aggregates advocate for the presence of a shallow soil before the first occupation of the site and the construction of the hut. The occurrence of an admixture of soil aggregates with the earliest midden deposits suggests that Yamana people prepared the hut floor, creating a shallow depression as the base of the hut, breaking the original soil that had formed over the beach deposits.

Units 3 to 10 (below unit 11 — (field units B355 and B365)

Layers below unit 11 represent a sequence of occupation surfaces alternating with sediments deposited during periods of short abandonment. These episodes of abandonment were probably too brief to allow soil development and vegetation growth, resulting in the lack of explicit edaphic features. The earliest frequentation of the site, coinciding with the preparation of the hut base, seems to have been short, leading to the formation of thin layers characterised by the presence of randomly distributed, partially fragmented and partially interconnected shells of various species (units 1B and 3). Gravel found in unit 4, added after the occupation had started,
suggests its possible use for draining the hut floor. The last moments of these early phases of frequentation are constituted by the accumulation of units with fewer shell species, which are less fragmented, better oriented and interconnected.

The main continuous phases of occupation of the hut correspond to units 6, 8, and 10. The coarse component is here made of highly fragmented, randomly distributed and disjointed fragments of several species of shells (Figure 4). These phases of occupation alternate with short abandonments (units 7 and 9).

Unit 11

Incipient edaphic traits were observed in unit 11 (field units B355 and B35) that represent the longest gap in the occupation of the site (Figure 5). This unit is a little developed soil characterised by the presence of abundant parental materials from the underlying anthropic shell midden.

Units 12 to 17

The soil aggregates found in unit 12 suggest the deepening of the abandoned surface (unit 11) when frequentation starts again. However, this new episode of site occupation (the discrete depositional events) is less clear to identify, as the centre of the hut seems to have been displaced laterally. Deposits representing unequivocal occupation floors are absent above unit 12 because this area apparently became part of the peripheral ring where the shells were tossed. The discrete tossing events are made explicit by the rapid accumulation of interconnected and partially fragmented single-species shells, following a linear or banded distribution (units 12, 13 and 14) (Figure 6). A more refined quantitative approach to be applied in the future will allow furthering differentiation of the single depositional events that were intuitively recognized during field work. Isolated accumulation (tossing) events can be recognised up to unit 17, which represents the last moment of frequentation of the site. This unit has then been exposed to trampling after the formation of the modern soil and, as a consequence, the shells are sub-horizontally distributed, compacted and highly fragmented, but still interconnected.

Unit 18 and 19
The topmost units 18 and 19 (present-day topsoil) also show incipient edaphic traits, typical of the little-developed modern soils of this area. The lower soil horizon (unit 18) has abundant parental materials from the underlying shell midden (shells and charred wood). Both this and the little developed soil of unit 11 could be defined as middensols (Figure 7).

5. Conclusion

The production of thin sections allowed the observation of stratigraphical features that are difficult or impossible to define in the field, due to their microscopical size (structure and components of the fine groundmass), or to the looseness of the sediment during excavation (distribution, compaction and interconnection of the shells). The application of micromorphology to ethnohistorical shell middens produced a further set of observations that complement and add to those made in the field during excavation, also contributing to verify observational hypotheses, justify accurate excavation methods, and solve central questions about site formation. Through the micromorphological approach it was possible to clearly determine the cyclical history of the site, preliminarily characterise the intensity of different occupation and abandonment phases, and gather important clues relative to the construction technology of Yamana huts (Figure 8).

A key question in Yamana archaeology has been related to the processes of settlement preparation, and specifically to whether the original surface was somehow prepared before constructing the hut. There is now evidence attesting that the Yamana people at Tunel VII prepared a shallow depression before constructing the structure, breaking the pristine shallow soils that had developed on the gravel and sand at the edge of the storm line. This procedure seems to have been repeated after the longest time of abandonment, represented by unit 11. Furthermore, the bringing in of gravel in unit 4 suggests the preparation of a structure to enhance drainage in the hut’s floor.

The combined micro- and macrostratigraphic approach is a much powerful tool to investigate shell middens formation and taphonomy, and can supply important clues on space organization and economic processes of prehistoric hunter-fisher-gatherers. Indeed, features such as the degree of fragmentation, interconnection and distribution...
of the shells can be used to complement field observations to construct more comprehensive site histories.
References


Figure 1. Site location and overview (a), showing the position of column 11 (b)

Figure 2. Monolith and thin sections from column 11

Figure 3. Soil aggregates in unit 1A (a, the rectangle shows the area covered in b), with an example of blocky microstructure (b)

Figure 4. Coarse fraction in unit 8, representing one of the main occupational phases (a), with an example of spongy microstructure from the same unit (b)

Figure 5. Edaphic traits in unit 11 (a), with detail of the blocky microstructure (b)

Figure 6. Interconnected mono-specific shell deposits exemplifying shell deposit derived from a single tossing event in units 13 (a) and 15 (b)

Figure 7. Topsoil. Trampling and fragmentation lead to the development of a middensoil over the units deposited during occupation of the shell midden. The upper horizon (a) is less compact than the lower (b), and shows worm burrows and partially decomposed plant tissues. Shell fragments are the main coarse component (c), while humified organic matter and charcoal fragments dominate the groundmass

Figure 8. Proposed reconstruction of the shell midden stratigraphy, with position of column 11 shown in the bottom figure
Table 1. Microscopic description of the thin sections
Figure 1
Figure 2
Figure 3
Figure 4
Figure 5
Figure 6
Figure 7