Short Contribution: Strategies and Techniques in Collecting Micromorphology Samples

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Micromorphology plays an important role in understanding the context and formation of archaeological deposits and soils. However, little information about the strategies and considerations for collecting samples for micromorphological analysis has been published. This is especially so for stony or crumbly deposits that are difficult to remove while preserving their undisturbed nature. We present several techniques and strategies to facilitate the collection of micromorphological samples by people with limited experience. © 2003 Wiley Periodicals, Inc.

INTRODUCTION

Micromorphological investigations have played an increasingly prominent role in geoarchaeological research, ranging from investigations of soil genesis to establishing the nature, origin, and significance of geogenic and anthropogenic deposits and their associated environments (Courty et al., 1989; Macphail and Cruise, 2001). Micromorphological techniques directed to soil sampling and analysis have been published (e.g., Kubiena, 1938; Bullock and Murphy, 1983; Douglas, 1990). Micromorphological sampling procedures for soils, however, are different from those used in geoarchaeological contexts, where deposits can be very loose, heterogeneous mixtures of mineral and organic materials that range in size from clay to boulders. Moreover, inclusions of bones, pottery, lithics, and construction debris (e.g., rocks, plaster) make it difficult to collect undisturbed blocks that are requisite for micromorphological analysis. In this note, we outline some of the sampling techniques and strategies that we have developed as a result of our micromorphological studies at various archaeological sites where the use of aids such as the Kubiena box (see Josephs and Bettis, this issue) are not practical.

PROCEDURES

Table I provides a list of some of the most useful materials for collecting micromorphology samples. In the field, for individual, small samples, we have found that good results come from the use of small 8 × 7 cm metal boxes (the so-called

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Table I. Materials for micromorphological sampling.

Waterproof notebook (crucial notes should be copied for the archive, ideally typed and saved electronically)	Plastic wrap
Pencil (ink runs and is not stable over time)	Black indelible marker pens
Munsell Color Chart	Self-sealing plastic bags of various sizes
Dilute HCl	Masking tape
Sturdy knife	Parcel tape (5 cm wide plastic/cello tape)
Sharp trowel	Spray bottle
Hacksaw	Distilled water
Spatula	Kubiena or plastic gang boxes
3 m and 10 m tapes	Square plastic down-pipe
Paper towel/tissue paper	Plaster of Paris and mixing bowl
	Water glass (sodium silicate solution)

Kubiena box; Figure 1). However, as Josephs and Bettis (this issue) point out, plastic electrical outlet boxes (gang boxes) are also effective for collecting small samples. For obtaining undisturbed monolith-type samples, we have used square section PVC down-pipe or downspouting. The down-pipe is cut into convenient lengths (e.g., 10 to 20 to 40 cm) (Figure 1). These undisturbed samples are taken exactly alongside bulk samples of the stratigraphic units and layers. The bulk samples provide usually 2–10–20–50–200–1000 g of material, depending on the technique to be applied, the smallest amounts for microfossils, the largest amounts for mollusks and finds recovery. Needless to say, all the geoarchaeological contexts of interest must be sampled. Such situations vary according to the needs of the site study and should include adequate coverage of the vertical stratigraphic changes, and all lateral variations. During sampling, there must also be good communication with the site's project director in order to insure that archaeological sampling for artifacts and ecofacts is coordinated across the site. For example, radiocarbon dating, phasing by pottery analysis, and contextual interpretation based on charred seed and/or bone analysis can all become crucial elements during the post-excavation phase.

Examination of block samples in the laboratory allows a second and more relaxed chance to examine the stratigraphy. Undisturbed samples with their preserved stratigraphic integrity can be first subsampled for pollen (1–4 g) and chemical analysis (10–20 g) before being impregnated for thin section soil micromorphology.

We stress that the overall goal is the collection of an undisturbed sample that is brought to the laboratory in one piece. This goal can be achieved to varying degrees of success depending on a number of factors. These factors include (1) the sampling strategy and geoarchaeological goals and (2) the nature of the material being sampled. These factors are addressed in the following discussion.

Sampling Strategy and Geoarchaeological Goals

The sampling strategy and geoarchaeological goals are conceptual and must be in line with the research design, archaeological questions pertaining to the site,

Figure 1. Multiple sampling of Early Medieval (A.D. 1060–1120) deposits at the London Guildhall. The deposits are essentially organic but contain wood, bone, and stones. Two pieces of 40-cm-long plastic down-pipe, an 8 × 7 cm Kubiena box, and a 20-cm-long metal column have been carefully inserted to provide both vertical and lateral control samples.

and budgetary constraints. For example, *systematic sampling* may permit a full stratigraphic sequence to be completely sampled and allow sufficient lateral samples to ensure complete coverage of variations in context. On the other hand, *selective sampling* may involve individual samples of specific context and boundaries relating to crucial archaeological questions. Unlike bulk samples where stratigraphic boundaries are avoided, micromorphological samples are effective in precisely documenting transitions from one layer to another. Although a soil micromorphologist need not do the sampling itself, the sampling strategy should be part of the interdisciplinary effort that has already involved the soil micromorphologist.

Regardless of what technique is used in sampling, documenting the context of the block in the field is critical; it should include a photograph of the sample in the section, as well as recording it on a section drawing. What may be especially useful is the marking of stratigraphic boundaries or other stratigraphic information on the back of the down- pipe or sample block. Pertinent notes should be made, along with the field description. Samples that are recorded in 3D may eventually contribute to GIS reconstructions of sites.

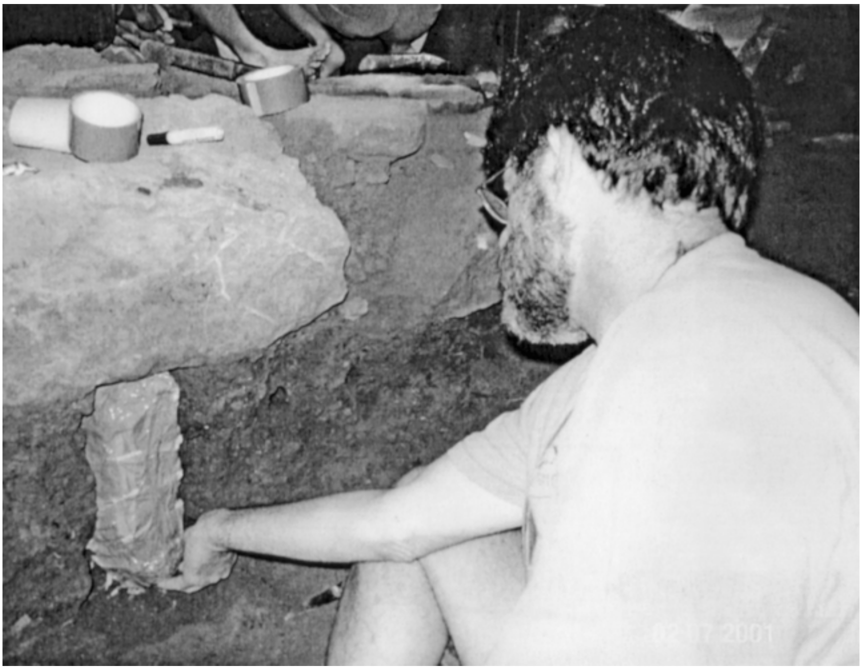

Figure 2a. Elongated block of sediment being collected from the Palaeolithic site of Pech de l'Azé IV, southwestern France. To prevent the block from collapsing or crumbling, it was stabilized on the outside with tissue paper and packaging tape, rolls of which can be seen poised on the piece of bedrock above the sample.

Nature of Material

Archaeological sediment/soils are highly variable, and it is difficult to prescribe a uniform approach to sampling them. This is particularly true for materials with coarse inclusions (rocks, pottery, bone, shells), which makes it difficult to remove intact blocks. In some cases, it is a matter of simply carving out a measured block from the profile. Loess constitutes an ideal material for this approach, because it is compact, but not hard, and can be easily cut. For homogeneous material, the size of the block should be approximately that of the finished thin section size. In cases with thicker, more varied deposits, a larger size block can be collected (Figure 2). The removed block is wrapped securely with tissue paper, paper towel, or in certain instances plastic wrap (Saran wrap or Clingfilm). The sample is then wrapped tightly with plastic tape (used to seal packages); our experience has shown that the thinnest tape (usually least expensive) works best because it stretches, enabling the wrapper to enclose the sample as tightly as possible. At this stage, one has to be sure to preserve the "up" direction, which is marked along with the sample number on the wrapped block. It is not normally necessary to keep

Figure 2b. The block in Figure 2a after having been extracted from the profile. This clayey, organic-rich material was suitably dense and compact to enable the removal of such a large intact block. The block is partially cushioned with the backing of tissue paper and packaging tape seen in Figure 2a.

track of the compass direction on the sample itself, just the sample number and stratigraphic boundaries.

For samples that contain coarse inclusions, there are many strategies that can be applied to recover an intact block. One of these is to employ plastic semiflexible downspouting (down-pipe; Figure 1) cut in different ways depending on the specific sampling problem. This material is available at a low cost in most hardware stores in 3–4 m lengths. It is more convenient to prepare the plastic down-pipe before entering the field, which saves weight during transport. Lengths of 20 or 40 cm can be carried in one's luggage and then can be sawed into appropriate lengths in the field with a hacksaw.

Down-pipe can also be used as a core. A 50 cm length can be hammered vertically into a soft sediment, and then recovered after excavation; shorter lengths can be used as appropriate, as in the case of sampling occupation surfaces that would be no thicker than 10 cm. Alternatively, down-pipe can be used in collecting a monolith. One side of the down-pipe is removed, leaving an open side that is inserted into the profile, usually to a depth of 6–8 cm, depending on the dimensions of the downspouting. The plastic edges can also be sharpened with a knife to facilitate penetration into the soil or sediment. Plastic down-pipe can be cut down to fit stratigraphy between stony, indurated, and other hard layers. With care and patience, the block of sediment can be slowly carved out of the section, with the downspouting being gently eased over it; roots, stones, wood, and bones can be removed or even cut through with a hacksaw blade. In delicate sediments, vibrations should be kept to a minimum; and hammering in the down-pipe will likely result in disaggregated samples.

When the plastic down-pipe or metal/plastic box is completely full of the undisturbed sediment and is flat with the section face, its removal should not be rushed. As noted above, its location should be recorded on a section drawing, along with its 3D coordinates or at least its relative (e.g., depth below surface) or absolute elevation (Ordinance Datum). One way of ensuring that the complementary bulk samples relate to the block sample/thin section is by collecting bulk sample as the sample is cut out from the section. Always support the monolith and make sure that plenty of sample is collected from both the base, top, and back of the monolith. DO NOT trim this extra sample off, because this additional material helps protect the sample and can also be used for bulk sampling later.

Sampling loose deposits constitutes one of the greatest challenges to collecting intact samples. Under arid conditions, for example, sediments can be very fragile, and a gentle spraying of water generally permits a more cohesive sample to be collected. Water glass (solution of sodium silicate) has been used to coat and stabilize the outer surfaces of some loose samples (Goldberg, 1976).

In many prehistoric caves containing poorly sorted mixtures of rockfall (*éboulis*) and finer interstitial material, plaster jacketing is an appropriate method to take an undisturbed sample. This is carried out by covering ca. 10 × 10 cm areas of sediment with cheese cloth or burlap dipped in Plaster of Paris (Figure 3). After the exposed part of the plaster jackets harden, the block can be carefully removed from the profile and the rear portion similarly covered with plaster-impregnated cloth. Plaster can commonly be mixed with small amounts of acrylic polymer (Polyfilla in Europe) in order to increase hardness.

Sometimes if the material to be sampled is fragile, very large pieces can be dug out from a profile and supported on a board before careful (with padding) transport to the laboratory. Once the sample is at the laboratory, it can be examined and subsampled without the pressures induced by excavation timetables or weather. Samples can be carefully cut down with a hacksaw to fit containers that can then be used for resin impregnation.

CONCLUDING REMARKS

Time constrains the number of samples that can be taken at a site, especially if they are being collected under difficult conditions. A flexible approach and the

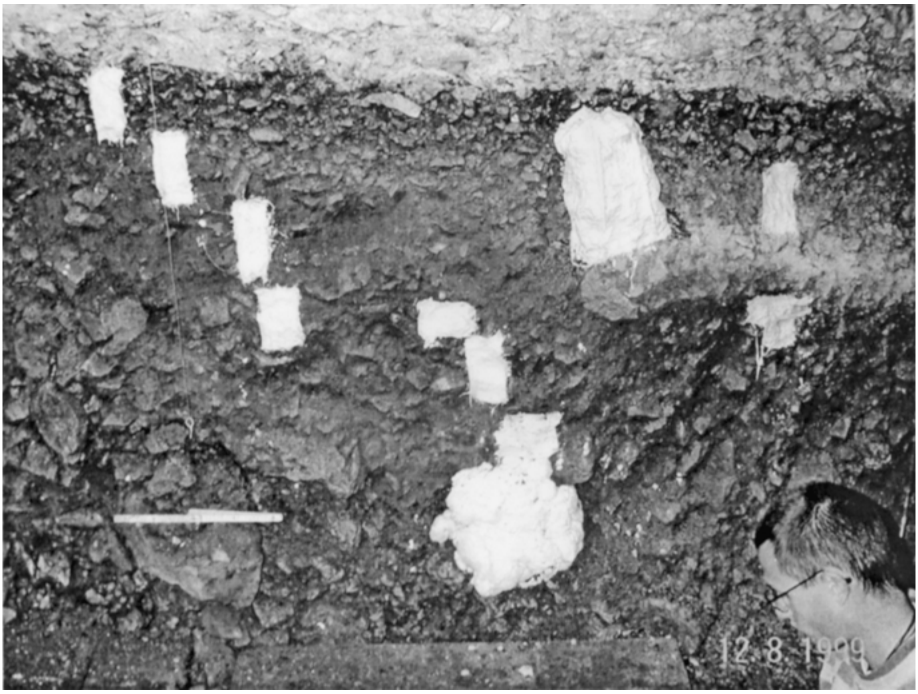

Figure 3. Strategy used to collect samples consisting of mixtures of clay and rock fall. This photograph from Hohle Fels Cave in Germany shows various stages of sample collection that involve first stabilizing an exposed surface with a plaster-impregnated patch of burlap. After hardening, it is possible to excavate around this stabilized area resulting in a raised area that can be plastered and stabilized. The end result is a large block of undisturbed sediment encased in plaster.

ability to adapt to circumstances are always needed, and the sampler must be willing to try different approaches in order to find the one that is right for the job. The main objective is to have an intact sample to study. This may involve removing a larger than necessary sample from the field. In the case of so-called reusable Kubiena boxes, it is better to impregnate the Kubiena tin and sample than ruin a sample by attempting to recover the tin prior to impregnation.

All of the above considerations may vary on a day-to-day basis and from context-to-context, and the above schemes are meant to represent a basic set of guidelines for collecting micromorphological samples from a variety of archaeological sites. In the end, with properly collected undisturbed samples with their contextual information in tact, the geoarchaeologist is in a strong position to make definitive statements about the complexity of processes that produces sediments and soils associated with archaeological sites.

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