The Use of Soil Micromorphology for Investigating Site Formation Processes

by Hal Dalwood

Introduction

This paper concerns the impact of the application of modern techniques of soil micromorphology to the interpretation of stratified archaeological deposits. The focus is the use of the technique in the city of Worcester. The method has proved extremely useful in checking and correcting interpretation of archaeological soils made in the field, especially of extensive deposits interpreted as 'buried soils' or 'dark earth'. Field interpretations were based on data observable in the field, such as the density, fragmentation and abrasion of artefacts contained in soils. Such interpretations have obvious weaknesses when they are not based on empirical studies or experimental data.

There is a widespread but largely undocumented problem in interpreting extensive and uniform archaeological deposits. The terminology used in describing and interpreting such deposits is limited; they may be called 'layers', 'dumps' or 'soil accumulations'. The definition of these deposit categories is inexact, generally being based on the morphology of the deposit (ie its extent or thickness) or on the analysis of the artefacts and ecofacts contained within the soil, rather than on an analysis of the soil structure itself. The analysis of artefacts and ecofacts is often inconclusive, which may lead to the assumption that these deposits contain no definitive information. In some instances, such deposits have been excavated without being fully and carefully recorded, in order to reach the more comprehensible archaeological deposits below, thus losing important information. Anecdotal evidence suggests that this still occurs.

Elsewhere extensive layers have been the basis for interpretations of the development of a settlement as a whole. Dark earth deposits have been interpreted as natural soils and therefore evidence of prolonged periods of settlement abandonment. It can be argued that it is not possible to make direct inferences about the origin of such soils from the presence or absence of artefacts alone, without a firm basis in the analysis of soil micromorphology.

There is a small but growing literature on the application of soil micromorphology in Britain. The major reference for the range of current applications is Courty et al (1989). The present paper is derived from the writer's work on projects in Worcester with Dr Richard Macphail (Macphail 1992; forthcoming a). A summary of the results of recent work in Worcester and other towns is in press (Macphail forthcoming b), and the utility of the technique in investigating the origin of dark earth deposits in London has also been described (Yule 1990). The application of the technique to different types of sites in Scotland has been reviewed in a recent paper (Davidson et al 1992).

Soil micromorphological analysis in Worcester

Work in Worcester since 1988 has provided examples of the type of interpretation problem that can be addressed through analysis of soil micromorphology. The technique has been formally applied to two excavations, at Deansway and Farrier Street, although observations of archaeological sediments have been made at a number of other sites by soil scientists. Large-scale excavations were carried out at Deansway between 1988 and 1989, in advance of redevelopment as a shopping centre (Fig 1; Dalwood et al forthcoming). Soil micromorphology was used widely to address a number of questions (Macphail forthcoming b), mainly regarding the nature of the soil predating Roman occupation deposits, and the origin and nature of the dark earth that separated the Roman and Late Saxon deposits over a wide area of the excavation.

Pre-Roman soils

A thin soil deposit was truncated by the earliest Roman features on the site (late 1st century). This deposit contained no artefactual material. The soil micromorphology indicated that this was the remnant of a cultivated soil, predating evidence of intensive occupation. It is likely that this soil represents prehistoric tillage. A similar interpretation of this soil was made in the field, largely based on an absence of data. No plough marks were found, and the soil produced no environmental evidence. There is evidence of Iron Age settlement at Worcester, and it could be anticipated that the site was agricultural land in this period, when the gravel terraces of the River Severn are known to have been intensively occupied.
In this instance the soil micromorphology helped to confirm an archaeological hypothesis, and thus the interpretation of settlement origins is based on a wider range of data.

**Early Roman soils**

Early Roman soils were shown to contain evidence of agricultural activity in the form of burned organic material. This evidence was corroborated by environmental evidence of crop processing on the site.

**Late Roman soils**

There were extensive spreads of homogeneous soil, described in the field as 'dark earth', which overlay earlier Roman deposits. These soils contained large quantities of fragmented Roman pottery and other artefacts. Analysis of the soil micromorphology indicated that these soils originated from the penning of herbivores, and large quantities of silty soil and other materials brought in from the nearby river. Mixed with these ingredients were human and dog coprolites. These deposits in some places underlay Roman trackways, as well as overlying them. The stabling of animals was not detected from other analyses, although evidence of rubbish deposition (middens) was found in the form of pottery and animal bone.

This evidence for stabling of stock can be used to support the interpretation of some of the archaeological features, such as small post-built structures that may have functioned as animal pens. It is thought that cattle were grazed at meadows on either side of the River Severn, fordable at Worcester. Furthermore, this evidence may be understood within the context of the interpretation of Worcester as a small town in the Roman period, acting as the market centre for the local region. The soil micromorphological data is thus important in constructing models of the economic role of the Roman town.

**The reworked dark earth**

The soil deposits produced by stabling were reworked by enchytraeids (wire worms) and earthworms to produce a grassland soil. Gradual accumulations of organic material led to the formation of a dark earth 250-300 mm thick. The distinctive dark colour of the soil was due to the biological reworking of the later Roman deposits. Soil micromorphology indicated no direct human activity in this formation process - except probably pastoralism. The interpretation of this phase of site formation is particularly clear because the dark earth was sealed by a clay, earth and turf rampart that formed part of the defences of the late Saxon burh.

Other archaeological evidence datable to the period between the 4th century and the late 9th century is limited. A single archaeomagnetic date, AD 717-792, was obtained from a hearth and a single sceat was found dating to c AD 715. This evidence postdates the foundation of the See of Worcester c AD 680. The only evidence of possible earlier activity was a small sherd of a samian vessel bearing a runic inscription, but this is a problematic inscription.

Soil micromorphology therefore provides some basis for understanding the development of Worcester between the fourth and the ninth centuries. There is good reason for believing in the continuity of sub-Roman and post-Roman Christian communities in Worcester, based almost entirely on documentary rather than archaeological evidence (Bassett 1989). It is likely that the hypothesised post-Roman Christian community was contained within the small area of the later Roman defences. The evidence of continuity of pasture from the late Roman period to the ninth century thus takes on a new significance: rather than evidence of abandonment, dark earth at Worcester is interpreted as evidence of continued use as farmland. Other excavated evidence suggests that Roman boundaries were maintained through the post-Roman period, probably in the form of hedges, that eventually were fossilised as boundaries and building lines in the late Saxon and medieval town.

The occasional evidence dating to the eighth century can be understood as the gradual spread of occupation areas beyond the Late Roman defences after the creation of the see c AD 680. The Bishop of Worcester had a haga or enclosure, recently located west of the Deansway excavations adjacent to the river (Baker et al 1992). In this instance soil micromorphology can be integrated with historical interpretations of the settlement development.

**The transformation of dark earth into urban soils**

The dark earth was sealed by the construction of the late Saxon burh defences, dated to c AD 890. Here, soil micromorphology showed that the clay and turf ramparts were erected on a green-field site, comprising the pasture fields outlying the occupied area. In other areas the dark earth was transformed by intensive human activity. Much organic material was trampled into the soil, including midden spreads, wood and grass ash, charcoal, bone, human and dog coprolites. There was also evidence of building material, in the form of alluvial silt probably used for floors. Fen peat was used for fuel or for walls.

The onset of human activity post-dating the construction of the burh rampart was dramatically demonstrated by soil micromorphology. The modification of the soil was also demonstrated by other kinds of data, with many artefacts trampled into the dark earth in areas not protected by the burh
Fig 1: Location of sites 1-4 at Deansway excavation, Worcester (drawing by L Templeton, HWCC Archaeological Services)
rampart. Buildings were constructed and cess pits dug, truncating the soil layer. In this instance soil micromorphology added detail to an archaeological interpretation based on other kinds of data.

Conclusions
In Worcester the main application of soil micromorphology has been to the enigmatic dark earth deposits. The results of analysis demonstrate the fundamental importance of soil micromorphology in understanding these deposits, which are found on many urban sites. The human and natural agencies at work in the formation of dark earth deposits are not necessary the same at any two sites, even within the same town (Macphail 1992; forthcoming b). The apparent similarity is due to the biological reworking of anthropogenic soils containing charcoal, but this often masks disparate depositional histories.

A dark earth type of deposit once seen is immediately recognisable in the field. This has perhaps fostered a blasé attitude to dark earth that should be rejected. It would seem necessary to carry out soil micromorphological work wherever this type of deposit is encountered, in order to determine both the human and biological factors involved in its formation. It is also important to use the technique at different locations within a settlement, because it may be possible to detect different types of human activity concealed within visually similar deposits.

Even from small excavations useful results can be obtained. It is perhaps a more reliable measure of the broad processes of site formation than some other types of data from small excavations. The technique has great potential in the assessment of the archaeology of small towns and other sites that are not well known archaeologically. Soil micromorphology has proved valuable at numerous sites in determining the nature of the 'natural soil' overlying or truncated by archaeological deposits. It has also been important in determining the origin of both localised and continuous deposits on urban sites, and can be used to determine whether these soils are formed by dumping or natural accretion.

Soil micromorphology's strength lies in its ability to detect human and natural processes that contribute to site formation, but do not leave evidence that can be detected through other analytical procedures currently in use. The technique is capable of testing and confirming interpretations of soils and sediments made in the field, since it is firmly based in experimental data. It is likely that in the future archaeologists will continue to make informed interpretations of stratified soils and other deposits based on correlations between, for example, characteristics of artefact assemblages and depositional activity. These interpretations should be based on the evidence of soil micromorphology, or there is a danger that interpretations will only be based on the archaeologists' own expectations.

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