Appendix 3 – Soil thin sections

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1 ABSTRACT

Soil thin-section samples were taken from Trench 3 at St Patrick's Church, Cowgate. The samples were analysed in order to investigate the processes of formation of the lower deposits on the site. The lower deposits have accumulated by slope wash, with one demonstrable episode of flash flooding. The deposition of the lower deposits probably represents the impact of the extension of settlement upslope in the Old Town.

2 INTRODUCTION

The objectives of the excavation included furthering our understanding of the development of the Cowgate during the medieval period, specifically through investigating the deposit formation processes at the site. Of the excavated trenches, it was determined that samples from Trench 3 offered the greatest opportunity for undertaking this investigation.

3 METHODOLOGY

The samples for thin-section analysis were taken in Kubiena tins from the side of Trench 3. Thin sections were prepared from three soil blocks. Resin impregnation and thin-section preparation were undertaken by the Department of Geography, Royal Holloway University of London, and followed standard procedures (Murphy 1986). The thin sections were recorded under a variety of lighting techniques using the descriptive scheme and terminology recommended by Bullock *et al* (1985), as supplemented and modified by Courty *et al* (1989).

4 RESULTS

Descriptions of the thin sections are given in Table 3.2. Particularly salient points are noted below.

4.1 Sample 111

Sample 111 was taken from Context [070]. The sample comprises two zones. Zone 1, the upper zone, is predominantly composed of fine material, with thin laminae of fine sand, 500–2000μm thick distributed across most of the depth of the zone. Fragments of plant tissue, with a thin 'filament' shape are found throughout the fine fraction, with an orientation that matches that of the sand laminae.

Zone 2 has a similar composition to Zone 1, but has no sand laminae. The plant tissue fragments are shorter, and show only partial orientation. Ferruginous impregnative pedofeatures appear to 'shadow' the boundary between the zones.

4.2 Sample 112

This sample has a similar composition to that of sample 111 and was also taken from Context [070]. Sample 112 has fine sand laminae, although these decline in frequency and then cease by the base of the sample. The laminae exhibit upward grading from sand to silt. The organic component is partially orientated with respect to the sand laminae. A group of fragments of calcite-containing mineral and organic particles was noted. These are interpreted as fragments of mortar.

4.3 Sample 114

Sample 114 comprises two zones. The sample was taken from a deposit identified in the field as a single context [142]. Zone 1 is composed of a chaotic mass of coarse particles and fragments of soils and sediments. The coarse mineral fraction includes rock fragments not observed in the overlying samples. The organic components mostly occur in highly humified and compressed aggregates. The red-brown organo-ferruginous impregnative pedofeatures only occur in a few aggregates of fine material, in contrast to the orange ferruginous impregnative pedofeatures, which occur more widely across the zone. Soil/sediment fragments are composed of areas of organic-rich clay, which exhibits laminar extinction patterns, and of concentrations of coarse sand with organo-mineral fine material. Fragments of mortar were recovered from this context during wet sieving for small finds and environmental remains.

Zone 2 is composed of fine organic-rich material similar to that of the other samples, but has a void space comprising channels and chambers and a much more homogenous fabric than the other samples. The plant fragments do exhibit partial orientation, but this disappears in areas of higher porosity. There are occasional areas of vivianite: these are mostly associated with bone fragments.

An AMS radiocarbon date from a seed extracted from Context [142] yielded a date of AD 1020–1210 (Table 3.1).

Table 3.1 Radiocarbon dates

Lab code	Sample material	Lab.Age BP δC13	Conventional Radiocarbon Age	Calibrated dates 2σ
Beta-241080	Burnt seed from context [142], sample 110	N/A *	920 ± 40 BP	AD 1020–1210

* The original sample was too small for a 13C/12C ratio measurement. However, a ratio including both natural and laboratory effects was measured during the 14C detection to derive a Conventional Radiocarbon Age, suitable for applicable calendar calibration.

5 DISCUSSION

5.1 Depositional sequence

Field observations of the base of the sequence noted the presence of till, which would be the expected sub-soil in this area of Edinburgh. No buried soil deriving from the till was noted in the field. Overlying the till is Context [142]. On the basis of the thin-section analysis this context can be divided into two distinct deposits. The lower deposit is represented by Zone 2 of sample 114. This deposit is characterised by the fine, organic-rich nature of the sediment. The partial survival of sedimentary structure, ie the orientation of plant fragments, and the limited nature of the biological reworking, suggests that this deposit accumulated relatively rapidly in low-energy conditions. The survival of identifiable fragments of organic material and the formation of vivianite crystals indicate accumulation in damp conditions. The position of the deposit in the landscape suggests that slope wash was the most likely mechanism by which the moisture developed. The fine and relatively well-sorted texture of the deposit demonstrates that the deposit is not directly derived from the local till, which would be unsorted, and contains a much wider range of fraction sizes. Given the apparent absence of a buried soil derived from the till, and the medieval date of Context [142], it may be speculated that this area of the Cowgate was subject to erosional processes that periodically removed earlier soils and sediments. This interpretation is lent weight by the nature of Zone 1 of sample 114 and its relation with Zone 2.

The boundary between Zone 1 and Zone 2 is abrupt but highly irregular in shape, indicating an erosive contact. Zone 1 represents the upper deposit of sample 114. The deposit is characterised by the chaotic mass of unsorted sand and rock fragments, with fragments of soil and sediment, some resembling the fabric of Zone 2, suggesting that the deposit was formed in high-energy conditions, an interpretation corroborated by the erosive contact with the underlying deposit. This indicates that the process of deposition of the upper sandy layer (Zone 1) has caused the scouring and partial truncation of the lower, organic-rich, silty layer (Zone 2). That there is a single layer of this kind in the overall profile suggests an unusual event, which may have been rapid and local, such as a flash flood. Such a process may also explain the absence of either substantial sediment deposits or a mature buried soil of prehistoric date at the base of the sequence, as alluded to above. There are fine textural infillings of some of the voids within the deposit, indicating the disturbance and deposition of fine material: given the general lack of fine material in the deposit it is probable that these infillings represent the effect of the renewed deposition of fine material by low energy processes. There are traces of biological activity in the form and distribution of voids in the deposit, and the presence of earthworm excrement. This activity was insufficient to disrupt the sedimentary structure of the deposit, or the fine-textured infillings, indicating such activity was relatively shortlived.

Overlying this deposit was Context [070]. This context is predominantly of fine, organically rich sediment. It contains sedimentary structures, notably graded laminations. The survival of sedimentary structures indicates accumulation sufficiently rapid to prevent the reworking of the deposit by biological activity. The graded laminations from fine sand to organo-mineral fine material indicate pulses of deposition, each pulse diminishing in energy as it occurs. This pattern is characteristic of deposition by slope wash. No reliably datable material has been recovered from this context. From the overlying deposit (Context [140]) pottery datable to the 12–14th centuries has been recovered. This gives the relatively short period from under 100 years to 300 years for the accumulation of Context [070].

5.2 Archaeological implications

The first implication of the medieval date for the lower part of Context [142] is that there is no survival of prehistoric material in the vicinity of the site, probably as a result of scouring by flood events such as created the upper part of Context [142]. It should be noted that this effect may be highly localised and should only be regarded as affecting the lowest-lying parts of the Cowgate.

The deposition of contexts [142] and [070] is the result of natural processes. During the period of deposition, this area of Edinburgh was not an area of intensive human activity. This is not to argue an absence of human impact on the area. The initiation of sediment accumulation implies changes in the run-off regime and/or the supply of sediment available for deposition. Clearance or disruption of local soil profiles upslope of the site would explain this, the most likely cause being the extension of settlement towards the area in the medieval period. The presence in these contexts of fragments of bone, mortar pottery and a piece of prill corroborates the likely anthropogenic cause. The rapid accumulation of Context [070] and the cessation of deposition indicate rapid changes in the sediment supply. The deposition probably reflects the initial disturbance occasioned by trampling and disruption of soil profiles upslope of the site during the extension

Table 3.2 Thin-section descriptions from Trench 3

Sample no.	Context no.	Coarse mineral components	Coarse organic components	Fine fraction and fabric	Microstructure	Pedofeatures
111 Zone 1	070	Dominant moderately sorted sub-angular to sub-rounded quartz grains (40–200 μm).	Common tissue fragments (15–25 μm × 150–375 μm, filaments) and rare to frequent charcoal fragments (400 μm and less), chipped and rounded.	Organo-mineral, mineral component principally silt-sized quartz. C/F limit 40 μm, C/F ratio 1:4, porphyric. Some lamination of coarse fraction.	Massive, with occasional channels and cracks, porosity 5–15%.	Many to abundant organo-ferruginous hypocoatings and linear groundmass amorphous impregnative pedofeatures.
111 Zone 2	070	Dominant moderately sorted sub-angular to sub-rounded quartz grains (40–120 μm).	Common tissue fragments (25–50 μm × 80–150 μm) and rare to frequent charcoal fragments (60–120 μm), chipped and rounded.	Organo-mineral, mineral component principally silt-sized quartz. C/F limit 40 μm, C/F ratio 1:8, porphyric.	Massive, with occasional channels and cracks, porosity 5–20%.	Rare fabric pedofeatures. Common orange ferruginous linear groundmass amorphous impregnative pedofeatures. Rare vivianite amorphous impregnative pedofeatures.
112	070	Dominant poorly to well sorted (in laminae) sub-angular to sub-rounded quartz grains (50–250 μm).	Frequent tissue fragments (50–100μm) and rare charcoal fragments (100–250μm), chipped and rounded.	Organo-mineral, with significant content of humified organic. Mineral fraction principally clay. C/F limit 50 μm, C/F ratio 1:2 porphyric. Some lamination of coarse fraction.	Massive, with occasional channels and cracks, porosity 15–25%.	Abundant diffuse linear/curvilinear red-brown ferruginous amorphous impregnative pedofeatures in groundmass.
114 Zone 1	142	Abundant to dominant poorly sorted quartz (70–500 μm), with rare to common fragments of sedimentary and basic igneous rocks (3000–6000 μm).	Occasional charcoal fragments (up to 350 μm), rounded and chipped. Occasional to common tissue fragments (400–500 μm, up to 3500 μm), degraded and compressed.	Organo-mineral, mineral fraction varies between being principally of clay and of silt. C/F limit 50 μm, C/F ratio 1:2–1:5 chitonic to porphyric.	Variable: from granular to intergrain microaggregate to channel and chamber. Porosity approx. 40%.	Many to abundant orange ferruginous amorphous impregnative pedofeatures, occasional red-brown organo-ferruginous amorphous impregnative pedofeatures.
114 Zone 2	142	Dominant poorly to moderately sorted quartz (50–300 μm), with trace fragments of sedimentary and basic igneous rocks.	Common tissue fragments (500–800 μm), occasional to common charcoal fragments (400–750 μm), chipped, but not rounded.	Organo-mineral, silty clay with common to dominant organic staining and punctuation. Areas of abundant phytoliths. C/F limit 50 μm, C/F ratio 1:8 porphyric.	Massive, channel and chamber, porosity 15–20%.	Occasional vivianite infills, often associated with bone. Rare calcite infills.

of the Old Town, without the laying down of hard surfaces or the efficient control of wastewater. This was followed by the paving of the Old Town, which would have protected the remaining soil profiles from continued disruption, massively reducing the sediment supply available for deposition on the Cowgate, thus ending the deposition of Context [070].