CHAPTER 3

THE GEOCHEMISTRY OF 'HOUSE 1' IN PERIODS 3 AND 4

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INTRODUCTION

Since 2002, in the context of the Insula IX project, a programme of soil material sampling has been undertaken with the aim of using simple geochemical analyses to complement and interrogate possible archaeological evidence for metalworking. The soil material analyses may also reveal areas of human activity (e.g. industrial activity or animal husbandry) for which there is no macroscopic archaeological evidence.

Residues can accumulate in soil from a great range of organic and inorganic materials used in food, clothing, buildings, household utensils and industrial activity as well as human and animal waste products, and many soils are capable of holding elements in relatively immobile forms (James 1999). Soil geochemical data can provide important information on activities within a given area, especially when interpretation has been difficult to determine from artefact data alone (e.g. Ball and Kelsey 1992; Lippi 1988). In previous archaeological studies elsewhere soil analysis has been used to distinguish different functions or land-use activities over a site and to aid identification and interpretation of settlement features (e.g. Aston and Gerrard 1999; Aston *et al.* 1998a).

The purpose of this study was, therefore, to use soil geochemical analyses to interrogate the archaeological evidence, particularly with reference to potential non-ferrous metalworking at the site. Effort was initially concentrated across the footprint of 'House 1' and the adjacent timber building MRTB 1/ERTB 1 (= former ERTB 4), where hearths and areas of burning had been observed, but where there was a notable absence of the commoner detritus of Romano-British precious metal and copper alloy working such as droplets, off-cuts, slags, crucible or mould fragments, as have been found previously at Silchester, but without supporting, associated evidence in the form of hearths, etc. for the precise location of activity (cf. Boon 1974, 272–7; Gowland 1900; Northover and Palk 2000; Richards 2000). In the course of the preparation of this excavation report, however, remains of crucibles have been identified among the ceramic material (J.R.L. Allen, below, Ch. 11) and of one unfinished copper-alloy artefact among the copper-alloy finds (Crummy, below, Ch. 6). Macroscopic and microscopic evidence for ferrous metalworking, however, in the form of hammer-scale and slag masses has been recovered across the excavation (J.R.L Allen below, Ch. 11; Tootell, below, Ch. 11). The question for the sequence of town-houses on the 'House 1' footprint was whether it would be possible to distinguish between a domestic or metalworking function for the associated hearths and burnt areas. To this end samples were taken and analysed using x-ray fluorescence spectroscopy (XRF). Initial results have already been published (Cook *et al.* 2005).

The trace metals (copper, zinc, lead) which were analysed were chosen on the basis of the information they would offer on possible metalworking at the site. During the Roman period habitual use was made of copper as an alloy with lead (Pb) and tin (Sn), with zinc (Zn) often occurring as an impurity. A variety of copper alloys were used in the Roman Empire, from traditional tin bronze to brass and combinations of these alloys, known by the modern term gunmetal (Cu, Zn and Sn) (Dungworth 1997a). Lead was often added to cast objects to decrease the melting point of the alloy and facilitate pouring (Dungworth 1997a).

Major elements were also investigated with special emphasis on strontium (Sr), calcium (Ca) and phosphorus (P) as indicators of human habitation. Phosphorus leaches from bones and organic tissues and concentrates in locations where organic materials were left to decay (Sarris *et al.* 2004). As phosphate phosphorus is relatively immobile and can be used to distinguish between living areas and middens, pits, stalls and pasture (see, for example, Bethell and Máté 1989; Conway 1983). Strontium and calcium can be an indication of bone deposition whether as rubbish disposal, ritual burial, or for use in cupellation.

METHODS

The samples were dried and disaggregated before being passed through a 1mm sieve, then ground and pressed into pellets for analysis by x-ray fluorescence (XRF) using a Philips PW1480 XRF with Philips X40 analytical software. All the material was clay-loam to sandy loam in character, in many cases with large (of several centimetres in size) flint pebbles. Samples were also taken from each of the major local lithologies, namely, the Silchester Gravels, the Bagshot Sands and the London Clay, to determine background elemental concentrations.

RESULTS

COPPER, ZINC, LEAD, STRONTIUM, CALCIUM AND PHOSPHORUS

Samples were taken from a variety of contexts within the 'House 1' footprint (Table 1), FIGS 44–45 show the concentrations of copper, zinc, lead and strontium found in samples taken from

TABLE 1. ARCHAEOLOGICAL CONTEXTS SAMPLED FOR CHEMICAL ANALYSIS

	Context no.	Context description
Period 3 *c.* A.D. 125–150 – A.D. 200	1718	Occupation deposit
	3210	
	3281	NE aisle
	3375	Clay levelling deposit
	3385	
	3701	Hearth
	3707	Soft black charcoal with nails
	3709	Ash layer in hearth 3681
	3946	Levelling deposit
	4170	Large clay floor associated with large hearth 1433
	4189	Layer of burning on top of hearth 4216. Set in the house clay 4152 along with tiles. Above 4199
	4199	Chalk deposit from burning within hearth 4216 under layer of charcoal/silt (4189)
	4201	Soft, reddy brown/dark grey clayey silt, burnt clay on top of yellow clay (4202) and underneath CBM tile
	4210	Red burning of clay around hearth 4216
	4209	Yellow clay within hearth 4216
	4203	Gravel under hearth 4216
	4204	Clay between gravel layers within hearth 4216
	4205	Gravel layer under hearth 4216
	4207	Greyish clay under yellow clay (4204)
	4213	Hard, black charcoal, partially destroyed hearth probably associated with larger hearth
	7061	Clay levelling deposit

	Context no.	Context description
Period 4 *c.* A.D. 200–250	1544	Large hearth with nails
	4084	Levelling deposit
	3259	Levelling deposit NE aisle
	3282	Clay deposit in NE aisle

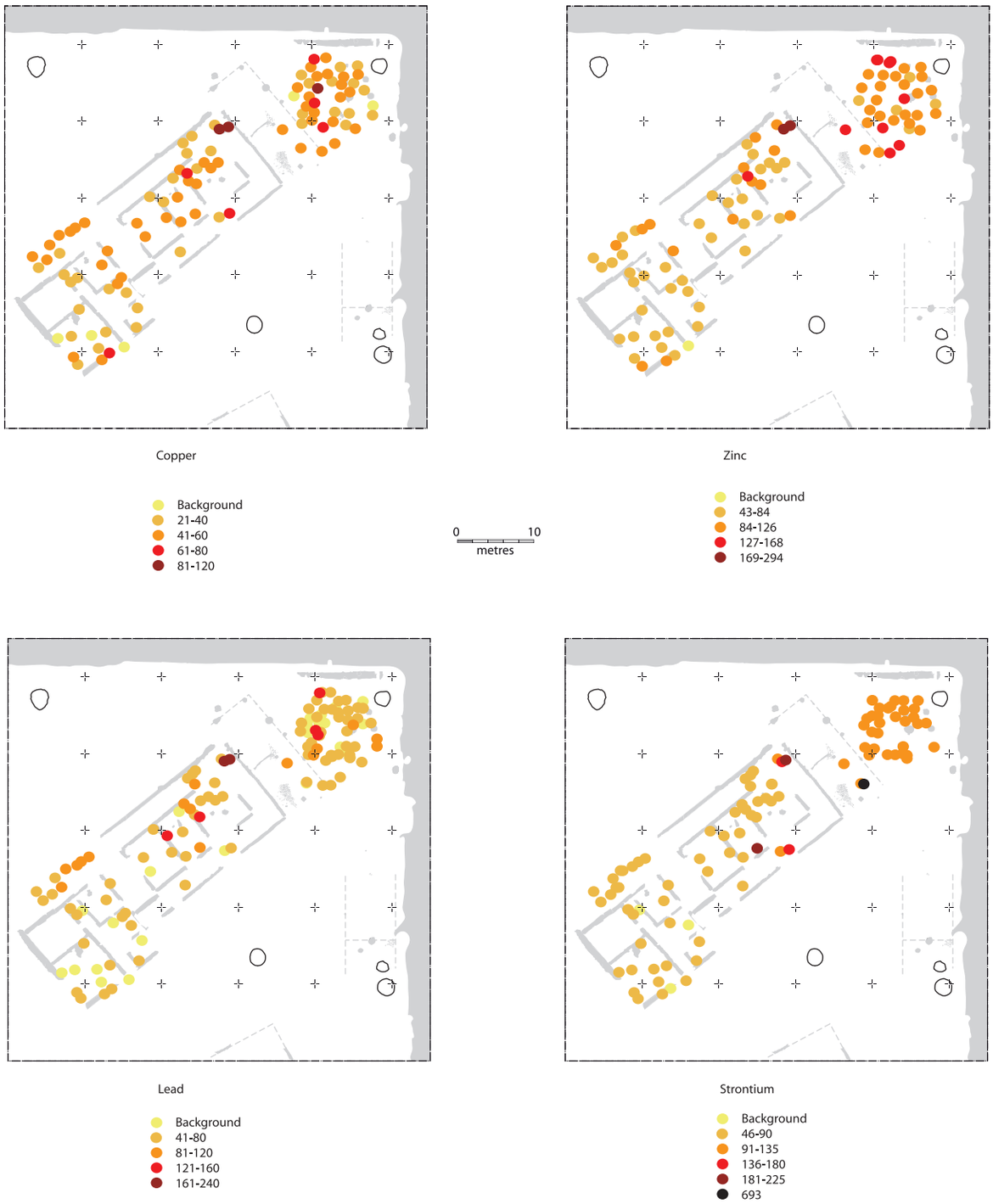

FIG. 44. Concentrations (mg/kg dry weight) of copper, zinc, lead and strontium from Period 3 contexts.

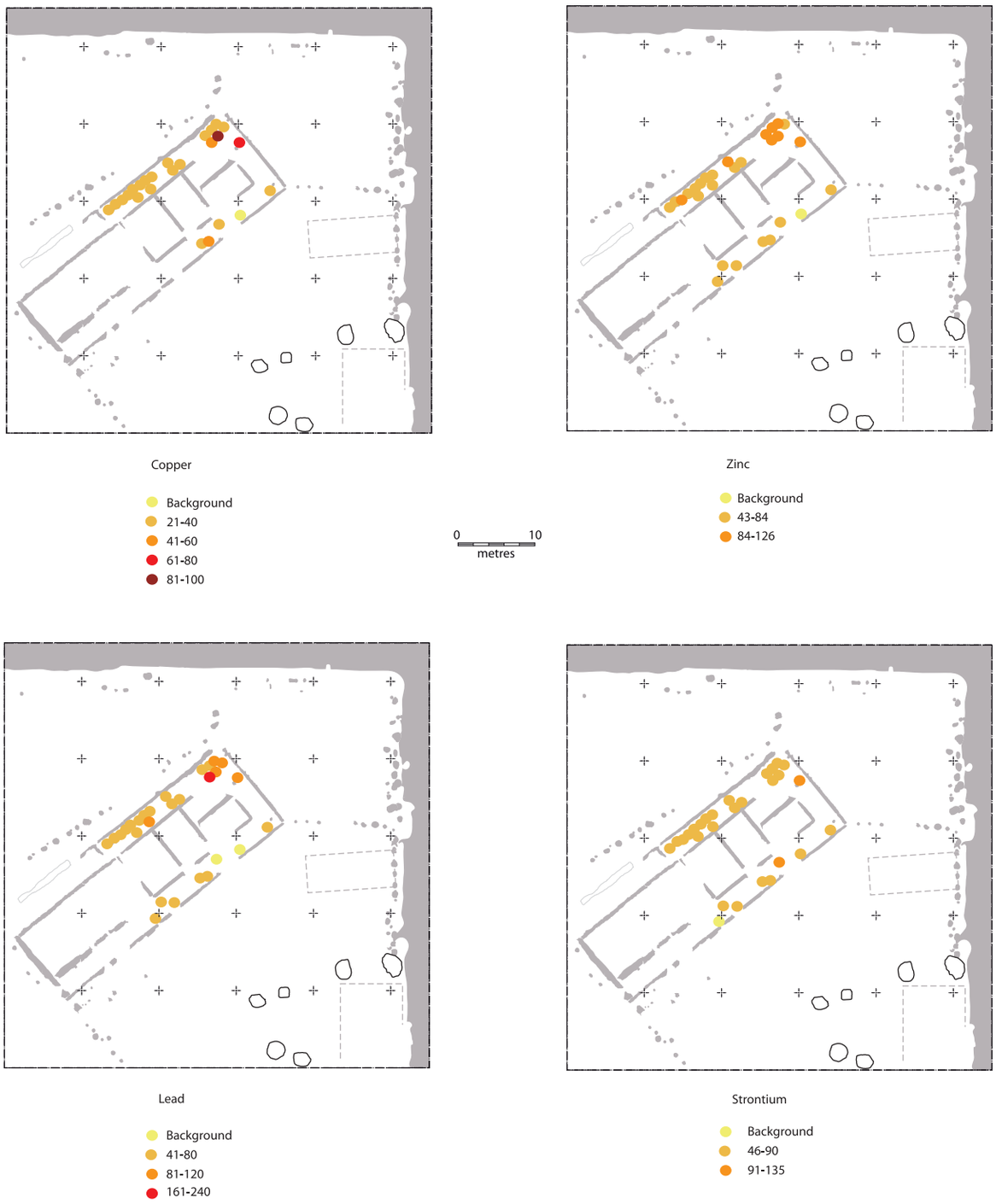

FIG. 45. Concentrations (mg/kg dry weight) of copper, zinc, lead and strontium from Period 4 contexts.

Period 3 and 4 contexts respectively. The results have been ranked by concentrations relative to average background concentration (2 x background, 3 x background etc.); this allows an easy comparison of 'hot spot' locations, the darker reds corresponding to higher concentrations. Tables 2 and 3 show the 'hot-spot' concentrations of Ca and P in selected contexts.

Period 3

High concentrations of strontium were found in the contexts associated with ERTB 4, now

redefined as MRTB 1 and an initially retained ERTB 1, to the north-east of the building at the junction of the north–south and east–west streets (FIG. 44). This area also has high concentrations of copper and zinc with scattered hot-spots of lead (FIG. 44). Notably elevated Zn, Cu and Sr concentrations are associated with hearth 4216, the smaller of the two hearths and located within MRTB 1 (FIG. 16). Relatively high phosphate concentrations (analysed as phosphate but recorded here corrected as elemental concentration) were also found in samples from context 4170 within ERTB 1 (approx 16 x background) and 7061 (FIGS 16 and 46). Unsurprisingly context 4199, a chalk deposit associated with hearth 4216, contains elevated concentrations of Ca (24.9mg/kg cf. 0.2mg/kg average background concentration) (FIG. 46). However, this sample also contains high concentrations of Zn.

The geochemical evidence presents a clear picture of elemental distribution for MB 1 with a combined 'hot spot' for Sr, Cu, Pb and Zn at the north-east corner (FIG. 44), which coincides with hearth 3681 (FIG. 8). Copper concentrations are also elevated in Room 2 with coincidently high concentrations of Sr (FIG. 44). High P concentrations are also recorded from context 3709 which is associated with hearth 3681 (Table 2).

TABLE 2. CONCENTRATIONS OF PHOSPHORUS AND CALCIUM FOUND IN PERIOD 3 CONTEXTS
(Concentration in mg/kg dry weight: only those contexts with concentrations significantly over background are shown here)

Context	**Easting**	**Northing**	**P**
7061	540.3	548	1.07
4170	543.089	536.942	1.00
3709	528.668	539.277	0.92
4170	541.886	547.9	0.79
1718	528.994	527.759	0.72
			Ca
4199	536.3	538.76	24.9
3375	524.900	527.793	6.49
3946	524.799	531.915	3.32
3946	524.882	532.706	2.76
3709	528.668	539.277	1.97

Period 4

The contexts which relate to Period 4 and MB 3 also contain elevated elemental concentrations (Cu, Zn, Pb and Sr) at one 'hot spot' location at the north-east end of the building (FIG. 45), coincident with hearth 1544 and context 3259 which overlies hearth 3681 (Period 3) (FIG. 30). Elevated P is also found in both context 1544 (a hearth) and context 4084 which runs along the south-east-facing corridor of the building (Table 3, FIG. 46).

TABLE 3. CONCENTRATIONS OF PHOSPHORUS AND CALCIUM FOUND IN PERIOD 4 CONTEXTS
(Concentration in mg/kg dry weight; only those contexts with concentrations significantly over background are shown here)

Context	**Easting**	**Northing**	**P**
1544	530.208	537.524	0.45
4084	527.568	526.933	0.35
			Ca
1544	530.208	537.524	1.15

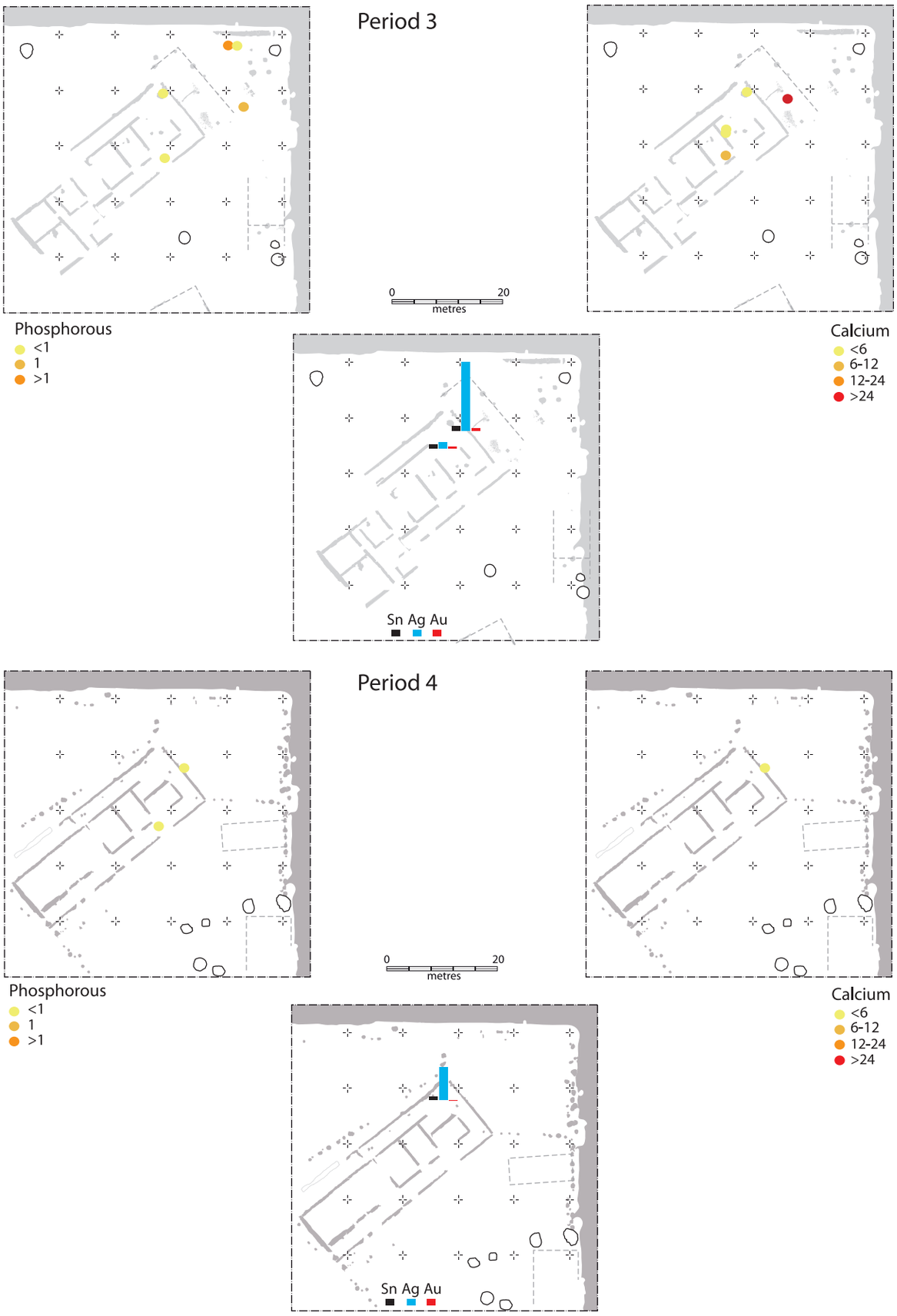

FIG. 46. Concentrations (mg/kg dry weight) of phosphorus and calcium, and of gold, silver and tin, from Periods 3 and 4.

GOLD, SILVER AND TIN

Of the samples taken for analysis using x-ray fluorescence three were also analysed for gold, silver and tin (Table 4). The low concentrations and tendency for gold, in particular, to exist as nuggets in soil meant that only those samples with high metals (Cu, Zn and Pb) were analysed for these elements. The analysis was carried out at the NERC ICP-MS facility at Kingston University.

Measurable concentrations of all three elements were found in three contexts (FIG. 46). From Period 3 elevated silver, tin and gold were found associated with contexts 3707 and 3281, which are associated with hearth 3681 (FIGS 8 and 46). Context 3259 (Period 4) also contained measurable concentrations of all three elements. This context overlies the Period 3 hearth (3681 and associated deposits) and it is, therefore, perhaps not surprising that this deposit also contains elevated levels of these metals.

TABLE 4. CONCENTRATIONS OF GOLD (AU), TIN (SN) AND SILVER (AG)

	Context			Ag	Sn	Au
Period 3	3707	528.102	539.090	6.15	90.14	3.41
	3281	524.102	536.036	6.31	9.53	2.40
Period 4						
	3259	527.458	538.356	5.81	52.94	0.68

DISCUSSION

PERIOD 3

MRTB 1: hearth 4216 (FIG. 16)

This suite of samples is associated with hearth 4216, a small hearth consisting of layers of gravel and clay interspersed with small tile-settings. Elevated Zn concentrations were found in these contexts, notably for contexts 4189, 4199, 4210 and 4213 (the distribution of these 'hot spots' is shown in FIG. 44). The micromorphology of 4189 shows that this context comprises reworked material, rubbish (including dung) and hearth debris (Banerjea, below, Ch. 4). The high Zn concentrations in this accumulation deposit may derive from zinc working, but are more likely to be a result of accumulated waste, both animal and hearth sweepings. This is further supported by the lack of other elevated metal concentrations as is seen for other hearths (e.g. context 3681).

Context 4199 is a chalky layer which is high in calcium. Micromorphological analysis (p. 72) suggests that this deposit was lime slurry used to level the floor once the small hearth was no longer in use. Since zinc is often enriched in carbonate deposits via substitution of the Zn^{+2} ion into the calcium carbonate mineral lattice, the elevated Zn observed here is therefore unlikely to be a result of metalworking activity. There is also considerable incorporation of domestic rubbish, such as animal bone, pottery sherds, charcoal, etc., from the above deposit via trampling, which supports the hypothesis that Zn enrichment has occurred via secondary deposition.

The group of samples from contexts which comprise floor surface 4152 (4201, 4202, 4209) and are associated with hearth 4216 do not contain elevated concentrations of Cu or Pb and only slightly elevated Zn. These results are certainly not indicative of any substantial metalworking activity. Indeed, the micromorphology (Banerjea, below, Ch. 4) indicates that, consistent with a domestic purpose, the area around hearth 4216 was kept clean.

Eastern side of ERTB 4 (= former ERTB 1): hearth 1433 (FIG. 16)

The samples taken from this area are associated with the larger of the two hearths (1433) and comprise contexts 4170, 5848 and 5870. Context 4170 contains high levels of strontium, copper and zinc spread across the entire floor surface of this building; this is consistent with the use of the

industrial hearth for metalworking activity. Micromorphology has shown that this floor surface is made up of trampled deposits containing demolition debris and animal dung. The ubiquitous nature of these elements across the entire floor may suggest that this floor was not kept clean. Micromorphology has also revealed the presence of melted silica, ashes and fire-affected flint with an absence of wood charcoal. It is therefore likely that high temperatures were being employed during the lifetime of this hearth (Banerjea, below, Ch. 4). The presence of Sr is an indication of human activity as it is present in bones, whilst the high P levels recorded in two of the samples from this context relate to the deposition of animal and human waste as well as bones (Banerjea, below, Ch. 4, for more discussion on P accumulation). Context 5848 is also a trampled re-worked accumulation deposit and contains relatively high concentrations of Pb (160mg/kg cf. 30mg/kg background). The re-worked nature of this deposit and the presence of only elevated Pb precludes a definitive interpretation of this concentration as being evidence of metalworking.

The geochemical results for this building, ERTB 1, reinforce the evidence from micromorphology that suggests that animals were once kept here. The spread of elevated elemental concentrations in this area may suggest that the decaying building, ERTB 1, was also used as a low-status store-room or workshop whose floor was not regularly swept, allowing the accumulation of occupation debris. Indeed the remains of the building may have been used for the disposal of general household waste.

Town-house 1 (MB 1) (FIG. 8)

The most north-easterly of the combined lead, zinc and copper 'hot spots' within the walls of MB 1 coincides with the location of hearth 3681 in the corridor of the house. This feature was 0.94m in diameter with a shallow depth of 0.05m and a flat base. It was oriented north-east/south-west and produced within it an ash layer which contained numerous iron nails and some iron-smithing slags. A layer of charcoal overlay the ash and a red-burnt clay layer measuring *c.* 1.28m in diameter covered the entire hearth. Adjacent to this were the trampled and fragmentary remains of a large, Silchester ware jar. On the basis of the nails, the slag and the interpretation of the pottery jar as a quenching vessel, this hearth had been provisionally interpreted as associated with iron-working (Clarke and Fulford 2002, 139). However, Timby (below, Ch. 8) speculates that the vessel may have been used for cooking.

Elevated gold, silver and tin concentrations were also found within this building, tin in particular showing elevated levels associated with the same hearth contexts as the other metals. This is not surprising as tin is frequently found in Roman alloys (54 per cent of alloys have more than 5 per cent tin) (Dungworth 1997a).

It is difficult to say, in the absence of *prima facie* evidence, with any certainty what type of metalworking activity was being carried out in the north-east corner of MB 1; however, the combination of metal 'hot-spots' in this location is good evidence that some industrial activity was indeed occurring during this period. The scarcity of iron-working slag and significant hammerscale (Tootell, below, Ch. 11) suggests that, although it is likely that this area was being used as a workshop, the industrial activity was light: the casting and working of non-ferrous metal rather than iron-working.

Elevated levels of metals recorded in Room 2 of MB 1 have no obvious association with a hearth. However, we can postulate that, as metalworking was occurring in the building, it may have had several working areas and metal sweepings, off-cuts, etc. are likely to have been distributed throughout the house.

Town-house 2 (MB 2) (FIG. 8)

The only 'hot-spot' which relates to this building occurs to the south-east of the building and is only seen for copper. Zinc levels are slightly elevated at approximately 3 x background. It is possible that these metal concentrations relate to sweepings from the building as they occur outside the building walls. Altogether this suggests a different emphasis of function for this building, domestic rather than industrial. It is noticeable that lead concentrations in particular are lower in this building compared with MB 1.

In summary, the area originally defined as ERTB 4, but now divided between a small, newly defined building MRTB 1 and the decaying remains of ERTB 1, also appears to have been divided in function. While the former was kept relatively clean, the latter appears to have been used for a variety of purposes including as a barn or byre, a workshop, and for the storage of household waste. MB 1 was the centre of metalworking activity and functioned as a workshop for at least part of its lifetime with a large hearth (3681) in the north-east aisle.

High phosphorus concentrations found in the charcoal layer of hearth 3681 (context 3709) may indicate the use of bones in cupellation, but it may also be a result of the presence of higher organic matter (food remains or wood from the fire), since P is known to accumulate where organic matter decays (Sarris *et al.* 2004). MB 2 had limited or no industrial or craft function and was more likely to have been devoted completely to domestic purposes.

PERIOD 4 (FIG. 30)

The elevated metal concentrations seen across the footprint of 'House 1' during Period 3 are not recorded by the time the two stone buildings (MB 1 and 2) become the one town-house (MB 3) in Period 4. Contexts from this period show elevated metal concentrations only in association with hearth 1544, the large industrial hearth from which there is associated evidence in the form of nails. The other observed 'hot-spot' locations sit directly above the Period 3 contexts associated with hearth 3681 in the corridor to the north-east of the building. It is possible that this represents continuity of the use of this hearth during Period 4.

Other than the activity situated in and around hearth 1544, the floors appear to have been swept clean, since in surrounding contexts and along the aisles of the building elemental concentrations are close to background levels. Only lead and copper show elevated concentrations similar to those seen in Period 3.

CONCLUSIONS AND SUMMARY

The value of the analysis of soils from archaeological sites is in the combination of their results with the archaeology to aid the interpretation of the use and evolution of space, particularly where function is ambiguous owing to the lack of finds.

In the case of Town-house 1 (MB 1) we clearly see evidence for human activity in Period 3 (*c.* A.D. 125/150–200) in the form of elevated metal concentrations in the corridor at the north-east corner. Whilst it is difficult to say with certainty what this 'hot-spot' represents, the coincidence of several metals at levels well above an average background concentration leads us to suggest that metalworking of some form was indeed being carried out in this building. The 'hot-spot' associated with the Period 4 context 3259 is difficult to interpret. It lies directly above hearth 3681 (Period 3) and, although it is possible that this location retained its industrial function into Period 4, we must also consider the possibility that this 'hot-spot' is a ghost or shadow of previous activity caused by re-working of underlying contexts. Certainly the industrial or craft activity in Period 4 is situated around hearth 1544, but metal levels are not as high as those for the Period 3 hearth 3681. This may indicate a change in function and usage to smaller-scale or less intensive craft activities.

The difficult interpretation of ERTB 4 = MRTB 1 and former ERTB 1 is aided using a combined approach with micromorphology where the geochemical evidence again shows human activity altering the chemistry of the deposits present. In this case the evidence comprises not only copper, lead and zinc (perhaps as a result of metalworking/industrial activity), but also the presence of elevated phosphate, suggesting animal husbandry. The elemental chemistry also allows us to differentiate between possible domestic use of the smaller hearth 4216 and the larger, possibly industrial (at least in part) hearth 1433. The most obvious difference between the town-houses and the location of the decaying ERTB 1 is the spread of elevated metal concentrations across the floor surfaces of the latter. The town-houses appear to have been kept much 'cleaner' whilst the spread of elevated metal concentrations in former ERTB 1 is possibly indicative of a re-worked or unkempt floor consistent with the micromorphological evidence and suggestive

of multiple functions, including use for animal penning as well as for metalworking and the accumulation of household waste.