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Ancient Monuments Laboratory
Report 32/98

ANALYSIS OF ROMAN PEWTER TABLEWARE AND DEBRIS FROM ICKHAM, KENT

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Summary

Over 500 samples from 39 kg of pewter and lead material of Roman date from excavations at Ickham, Kent, were analysed by XRF to look for evidence of recycling and manufacture of artefacts. A calibration curve was calculated from known standards so the percentage of tin in each sample could be estimated. A small number of artefacts provided clear evidence for manufacture on site.

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Analysis of Roman pewter tableware and debris from Ickham, Kent

Rebecca Sutton

This report aims to supplement our knowledge of Roman pewter by investigating the composition of pewter objects and waste from Ickham; and to positively identify and classify any evidence for manufacture of pewter and lead artefacts from the site.
Ickham is a predominately late Roman site, with the majority of the finds dated to the late 4th century AD (I. Riddler, pers. comm), though there is evidence of occupation from the late 1st century onwards. A major feature of the site is the construction or two or three water mills. It is in the mill channels that most of the pewter/lead/tin material was found. It remains an open debate whether this represents a systematic clearance of the site or some kind of votive offering.

The amount of pewter material found at Ickham (39 kg), suggests that it was a familiar material on the site. Most sites which have well documented pewter finds, such as the Appleford hoard (Pollard, 1983), consist of hoards of finished pewter vessels. However the pewter and lead artefacts found at Ickham encompass a wide range of different objects. In addition to tableware there are also pendants, pins, hooks and fishing weights. This implies that there was a large quantity of pewter available if objects not normally made of it were being crafted. Coupled with this, the amount of pewter production debris found on the site suggests that pewter artefacts were probably manufactured there.

Method

As much material as possible, in the time available, was analysed. In total 570 analyses of separate objects were made. Analysis was used to identify correlations between composition and different categories of material. The material was split into six different categories, relating to processes in the manufacture of pewter. The seventh category was the material which Quita Mould had identified as being tableware (see below). Any groupings within individual categories were also examined. The total weight of all the pewter/lead material from Ickham was approximately 39 kg. All of this material, apart from 50% of the fragments (which only account for 5% of the all the pewter material from the site), was sorted, and a representative sample analysed. As some of the small finds bags contained over 100 pieces of metal, a sampling strategy was devised.

Table 1: sampling strategy

no. of objects in small finds bag	Size of the sample
less than five objects	Analyse all material
more than five, less than thirty objects	Analyse five representative pieces if they all look to be similar. If they seem to be different, split into groups and analyse three in each group.
more than 100 objects	The same as for bags with more than five, less than thirty objects, but if the material is very similar, take up to 10 samples

The finds

The material had originally been split into seven different classes. These were; dross, runoff, offcuts, fragments, scrap, tableware and other artefacts. Some classes were found to overlap and be ambiguous in meaning (ie. dross, runoff and scrap). Therefore, the classes were redefined in order to give them a meaning which relates more to the role they played in pewter manufacture (see figure 1, pewter manufacture diagram) and so give the analysis a greater significance.

Tableware (3.75 kg)
This represents all the material identified by Quita Mould as tableware, vessels, or pieces of tableware and vessels, such as handles and flanges. This includes recognisable fragments and whole vessels.

Artefacts (5.8 kg)
These are finds which are identifiable as finished artefacts made of lead or pewter, which are neither tableware or waste from manufacturing process. Examples include fishing and loom weights.

Fragments (4.42 kg)
Material described as fragments refers to pieces of pewter or lead which are fragmented sheet material that cannot be identified as tableware. Fragments differ from offcuts in that they lack discernable cut edges.

Offcuts (4.8 kg)
This is defined as sheet material which shows evidence of being cut, most probably for reuse.

Spillages (12.59 kg)
This includes the two former categories of "runoff" and "dross". These are very similar in appearance and are difficult to separate in terms of which technical process they derive from. Spillages are fused masses which have formed during uncontrolled solidification.

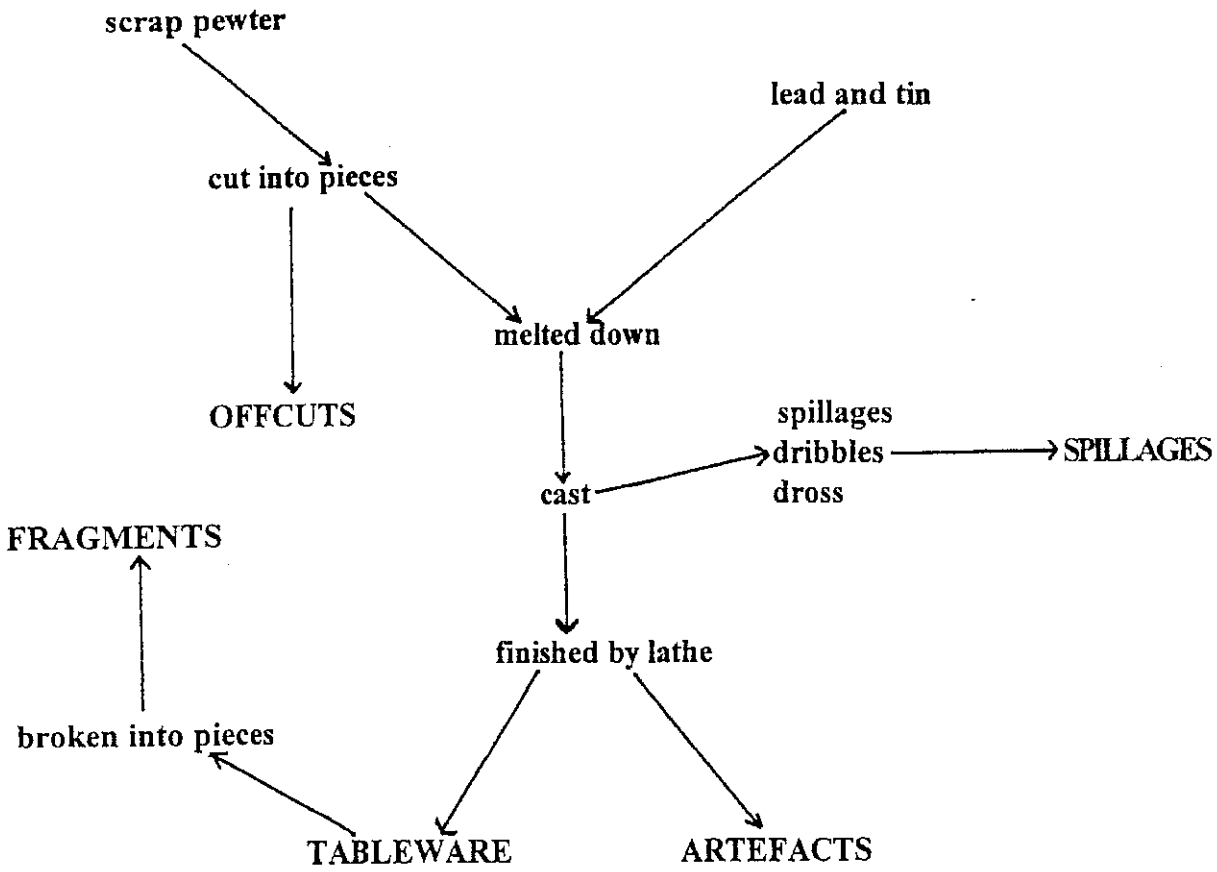


Figure 1: Roman pewter production flow diagram

Undiagnostic waste (7.71 kg)
This was originally defined as "scrap"; however, this definition does not make the nature of the material clear. It is better described as material which is waste from a manufacturing process, but cannot be given a clear diagnostic term, due to its ambiguous nature. The material is fused but it is unclear whether it is the result of an unintentional fire or a deliberate manufacturing process.

The analyses and their calibration

The analysis was carried out using a Link XR200 X-ray fluorescence spectrometer (XRF). The analytical conditions selected were a tube voltage of 40kV and a current of 0.02mA, an air path for the X-rays and a detector live time of 50 seconds. A 3 mm collimator was used. The range of the detector was 0-40 keV. In order to gain a reasonable estimate of the percentage of tin in each sample analysed, a calibration curve was drawn based on pewter standards of known composition. The standards for 50% tin and 63% tin were commercially produced certified standards, whereas the others were made in the laboratory.

All of these standards were then analysed by scanning electron microscope (SEM), to check that the quoted compositions were accurate. Although the standards were made to specific tin/lead ratios some loss was encountered because of oxidation during melting. The SEM calculated the actual compositions of the standards to be:

Table 2: composition of the pewter standards

standard number	1	2	3	4	5	6	7
%Sn (quoted)	5	15	30	50	62.9	75	95
%Pb (quoted)	95	85	70	50	37.1	25	5
%Sn (calcuated)	5	21	41	51	63	81	98
%Pb (calculated)	95	79	59	49	37	19	2

Using these standards of known composition the ratio of the tin peak height to the lead peak height for each of these standards was plotted (figure 2), and the equation of the best fit line calculated to be:

$$\%Sn = \frac{(\log(Sn/Pb))+1.557}{0.021}$$

Multiple analyses of the standards were made (Table 3) so the calibration error could be estimated. This can be seen to run from 3% at the centre to 5% at below 15% tin and above 85% tin. Through replicate XRF analyses of the pewter standards, the standard deviation and co-efficient of variation could be determined and 99% confidence bands calculated for the equation of the line by plotting a line 2.576 standard deviations either side of the regression line. Figure 2 shows this with the average measurement for each standard and it's standard deviation. Each standard falls within the 99% confidence level for the equation of the line.

Calibration curve for XRF analysis with 99% confidence bands.

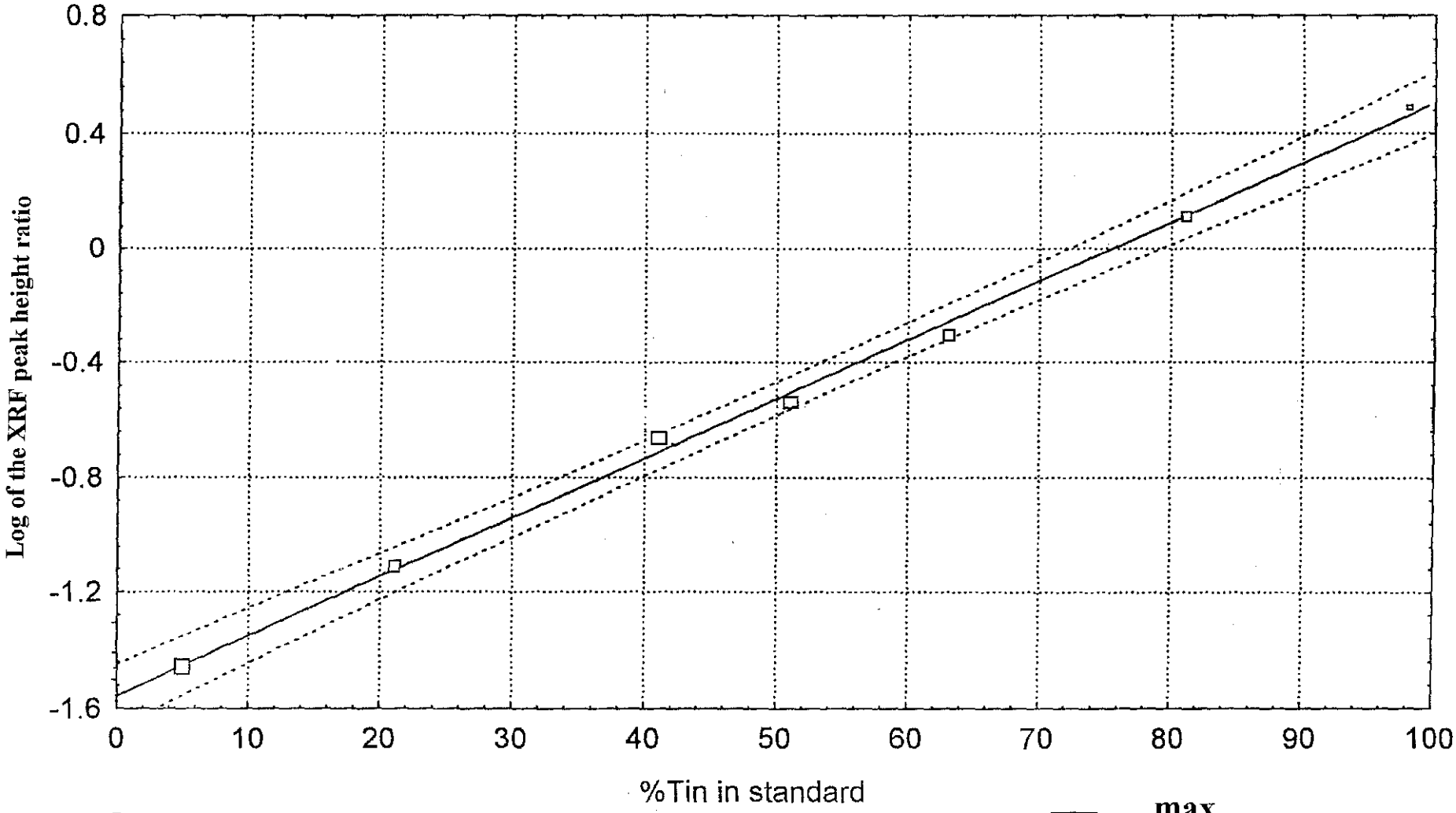


Figure 2

□ = $\frac{\text{max}}{\text{min}}$ +/- SD

This means that there is a very low error on the precision of the results.

Table 3: The log Sn/Pb values gained from multiple analyses of pewter standards and their standard deviation

standard number	1	2	3	4	5	6	7
	-1.457	-1.113	-0.673	-0.548	-0.298	0.112	0.49
	-1.489	-1.104	-0.687	-0.515	-0.321	0.112	0.48
	-1.467	-1.136	-0.652	-0.545	-0.301	0.119	0.486
	-1.43	-1.121	-0.662	-0.550	-0.313	0.096	0.494
	-1.441	-1.098	-0.638	-0.520	-0.294	0.119	0.492
average	-1.458	-1.115	-0.662	-0.536	-0.306	0.11	0.489
SD	0.0206	0.0147	0.0187	0.0167	0.011	0.009	0.006

By applying this equation to the data gained from the XRF analyses, each sample could be given an approximate percentage composition for the archaeological finds (see Table 6). The archaeological samples were neither cleaned nor had they been polished. This would have been too time consuming with the number of samples being analysed. The standards from which the equation was calculated were polished and cleaned, so there will be a margin of error in the results from this. A number of the tableware samples had a small piece cut off and the clean, uncorroded metal was analysed and compared with the corroded surface. In all cases there was no distinguishable different in the ratio produced.

In order to establish the variability of XRF analysis of a sample with an unknown tin content, five small finds were selected, of differing compositions, and repeatedly analysed to gain the standard deviation for each one (Table 4). The average of these measurements were plotted onto the calibration curve (Figure 3).

Calibration curve for XRF analysis with 99% confidence bands.

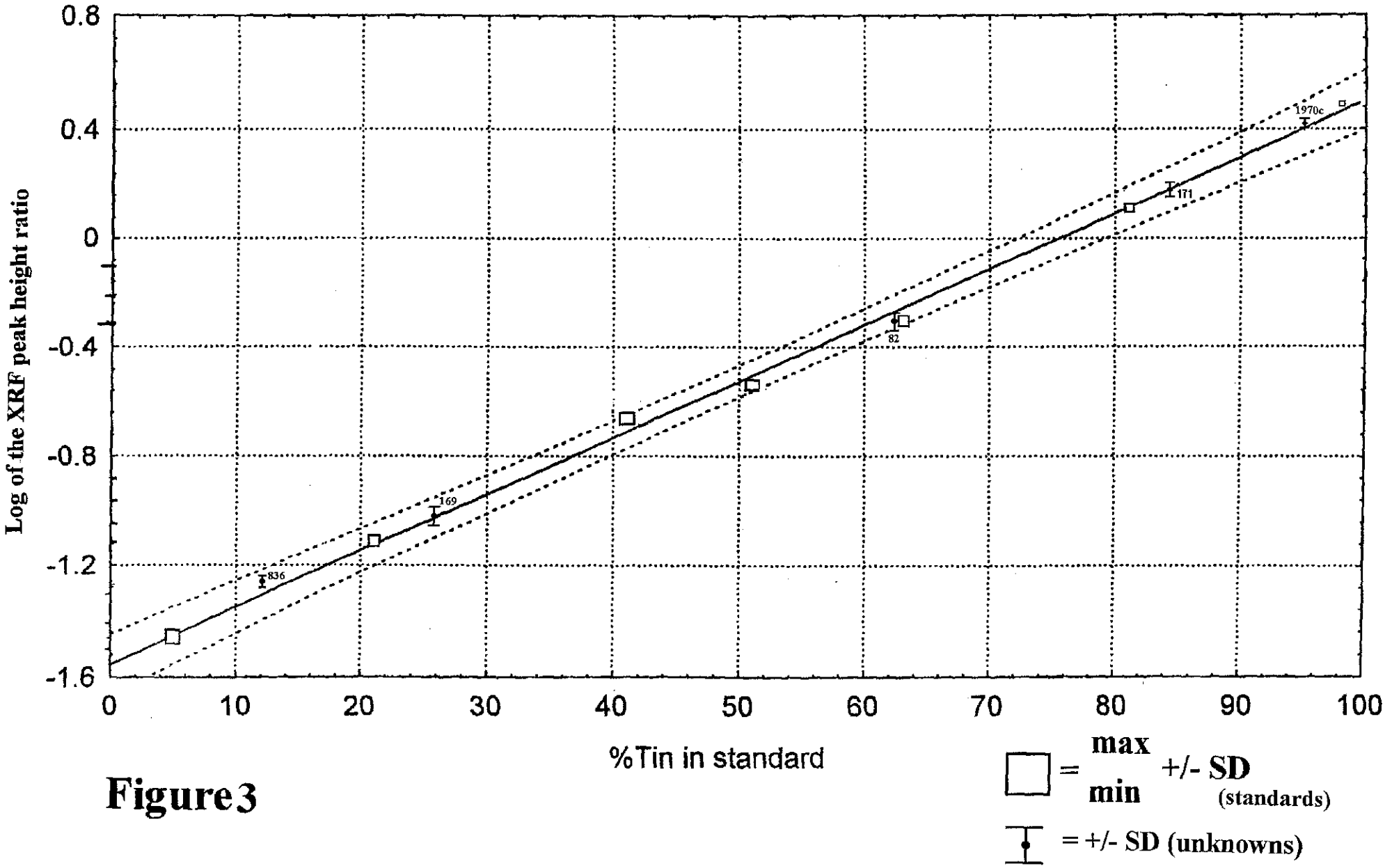


Figure3

Table 4: The log Sn/Pb values gained from multiple analyses of an unknown

small finds number	82	1970c	169	171	836
	-0.238	0.467	-0.992	0.223	-1.29
	-0.235	0.435	-1.051	0.195	-1.284
	-0.249	0.46	-0.984	0.201	-1.341
	-0.267	0.399	-1.029	0.241	-1.348
	-0.28	0.414	-1.059	0.242	-1.253
average	-0.254	0.435	-1.023	0.221	-1.305
SD	0.019	0.029	0.034	0.022	0.0396

The unknowns all fall within the 99% confidence bands on the calibration curve, therefore it can be assumed that the error bands are correct. The +/- percentage error for five different composition was then worked out from figure 3, (Table 5)

These show the +/- percentage error to be approximately 3%, in the centre of the calibration, increasing by a few percent in the extremities.

Table 5: errors on the calibration curve

percentage composition	+/- % error
10	5
30	3.5
50	3
70	3
90	4

Results

Description of plots (see appendix)

Plot 1
This shows the calculated percentages of tin for all the analyses of the Ickham material undertaken. The plot illustrates that there is a large amount of material in the 0- 10% tin range which indicates that a substantial proportion of the material is either lead or high lead alloy. It appears that there are two main groups, one with below 30% tin, tending towards 0% tin, and one which is of more than 50% tin, which indicates pewter of a reasonable quality on the site. The higher tin group seems to have two concentrations, one at the low end of the

range, and one at the top.

Plot 2
This depicts the percentages of tin calculated for the tableware, it is highly significant because it seems to correspond to Beagrie's groupings and Pliny's recipes (see below). The percentage of tin in pewter tableware can give an insight into the wealth of certain groups who once inhabited the site, as high tin pewter was a more expensive and prestigious material than pewter with a greater lead content (Bailey 1932: Book 34, 161).
The plot shows a small number of results in the 0-50% tin range which may have been mis-interpreted as tableware or bases of higher tin content vessels, sometimes bases were of a higher lead content than the rest of the vessel. The plot then shows a peak between 50-70% tin, a smaller number between 70-90% tin, and a large peak at 90-100% tin. These peaks are similar to those described by Beagrie (1989), which is to be expected.

Plot 3
The plot for the percentage of tin in the artefacts is quite similar to that for all the material analysed (plot 1). There is a large peak between 0-10% tin, representing the lead and high lead alloy artefacts, and a broad peak over the 50-100% tin range representing pewter artefacts. From this plot it can be seen that pewter is being used to manufacture other artefacts than tableware.

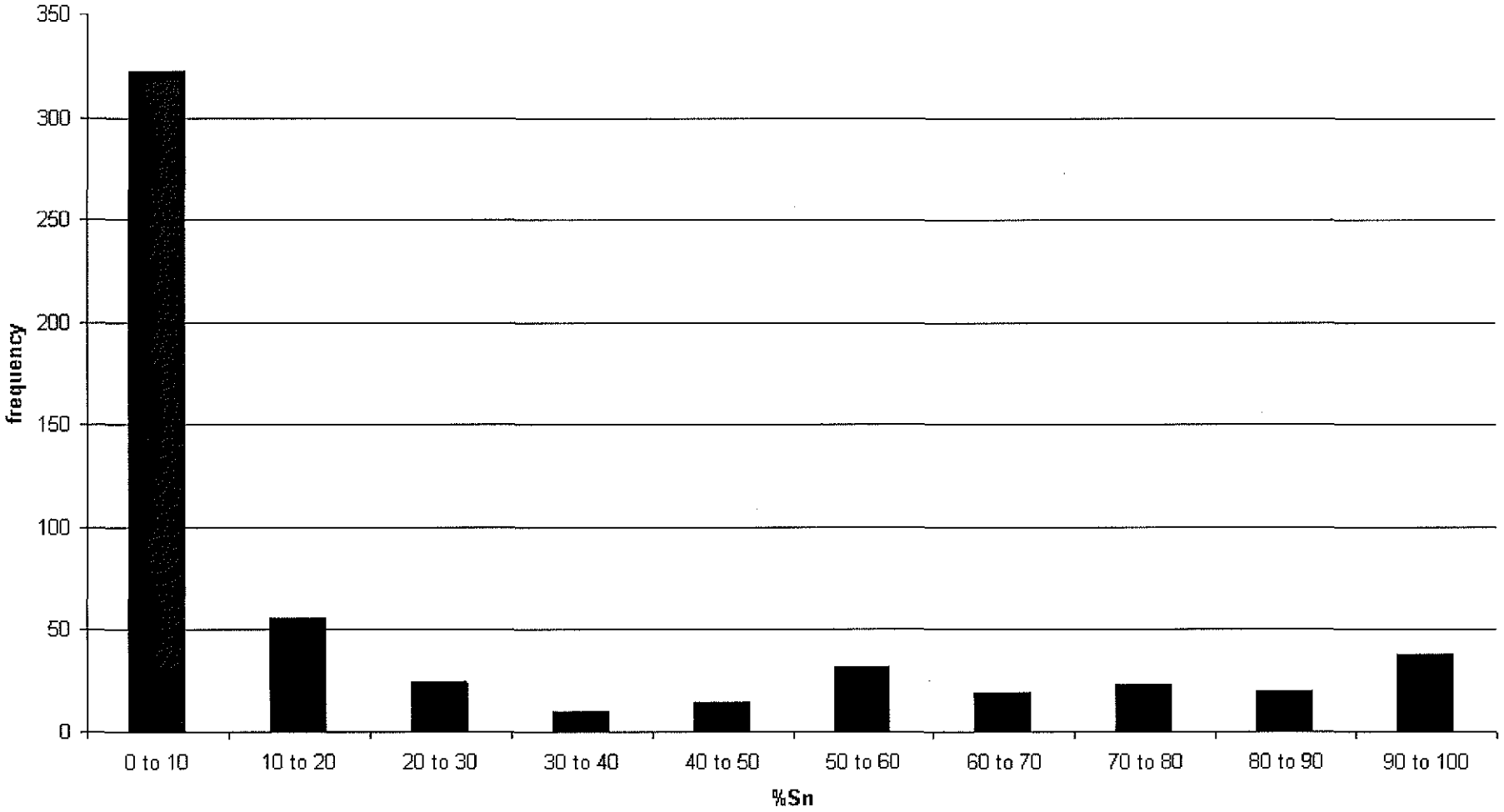
Plot 4
The plot for the offcuts, again shows a large peak in the lower percentage range at 0-10% tin. This indicates the presence of cut lead or high lead alloy sheet. The rest of the plot shows a small even range but no noticeable peaks. These small numbers may correspond to cut pewter vessels or sheet. There is an absence of analyses in the range 60-70% tin, which may indicate that there are two of more separate groupings in the plot. However from the small number of analyses in the 10-100% tin range it is hard to attach any great significance to this, as the amount of data is so small.

Plot 5
The plot for the fragment analyses follows similar patterns to plots 1 and 3, but with some significant additions. there is a large peak in the 10-20% tin range, which is a greater range of high lead alloy than in other classes. Again there is a smaller concentration ranging from 50-100% tin, with a slight dip at 70-80%. The fragments in the 0-20% tin range could be pieces of lead or lead alloy sheet but as samples in this class show no signs of being cut, they may be from broken artefacts. The 50-100% tin range may be broken tableware, but the small number of analyses in this class cannot confirm this.

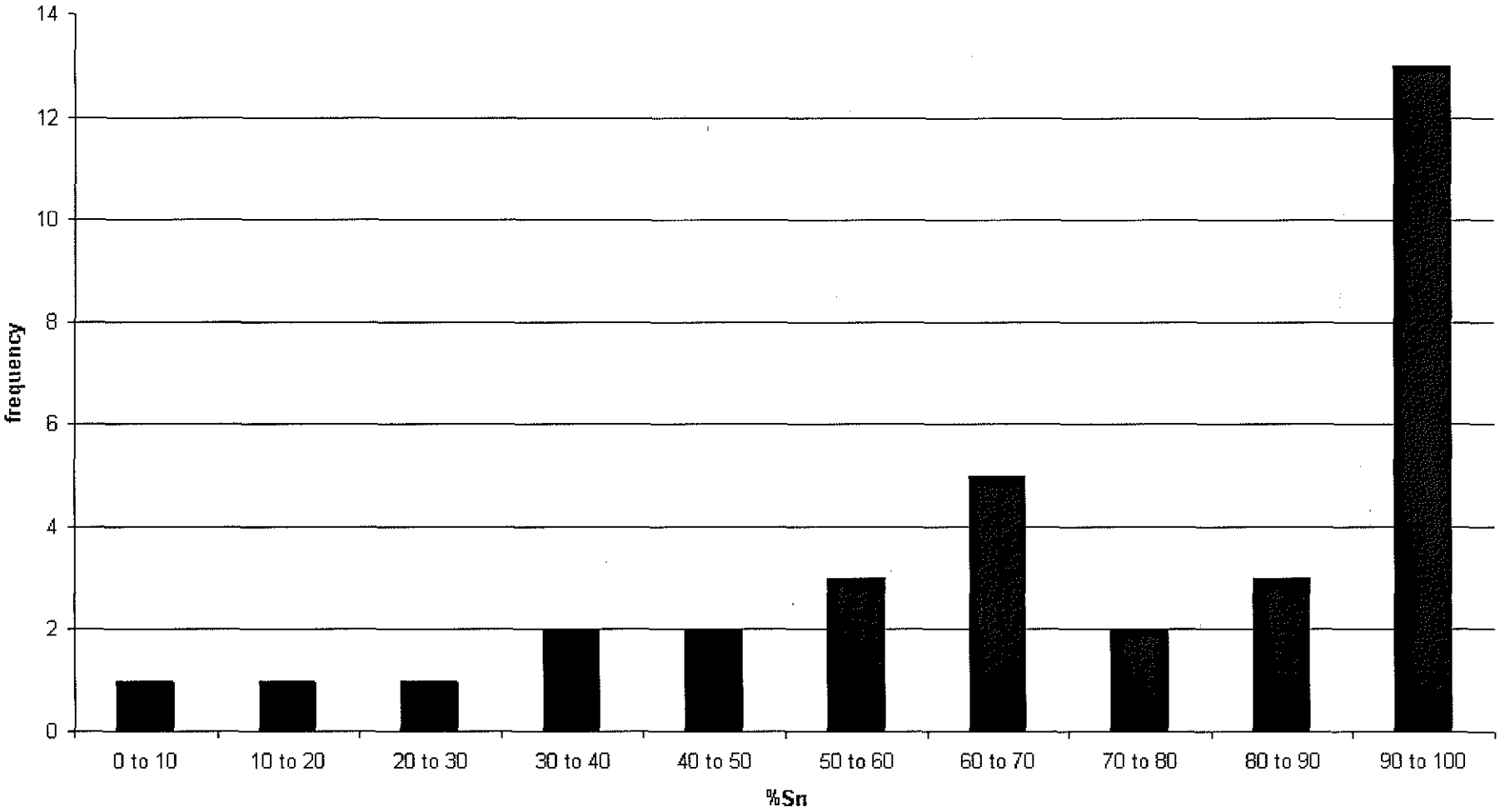
Plot 6
The plot for the spillages class shows them to be mainly lead or high lead alloys. There are however a small number of spillages of all other compositions.

Plot 7
This shows a similar pattern to plot 6, suggesting that the spillages class and the undiagnostic waste class are of similar material. The bulk of the results fall in the 0-10% tin range with small number of most other compositions.

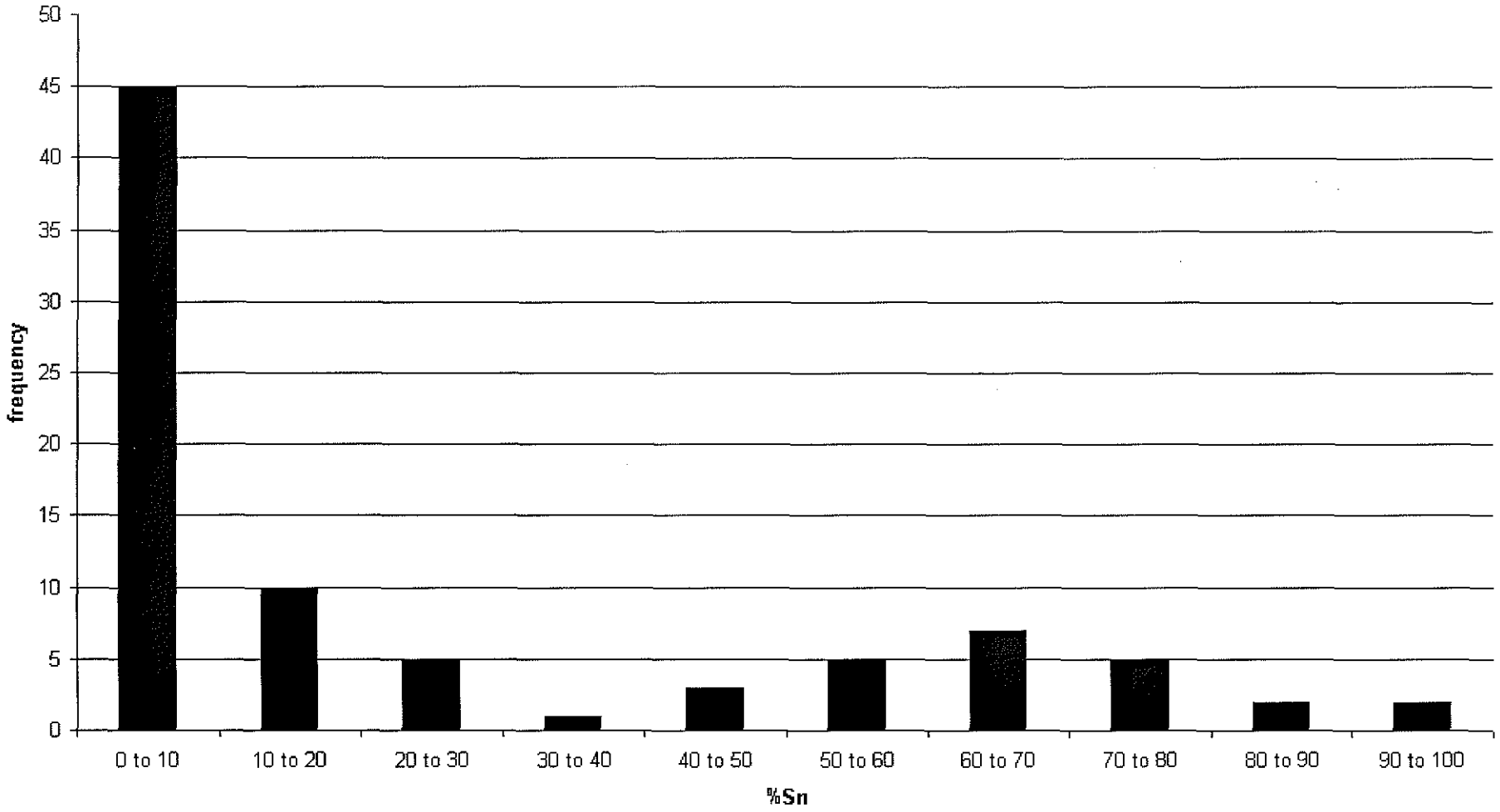
plot 1: percentage of tin in all analyses undertaken



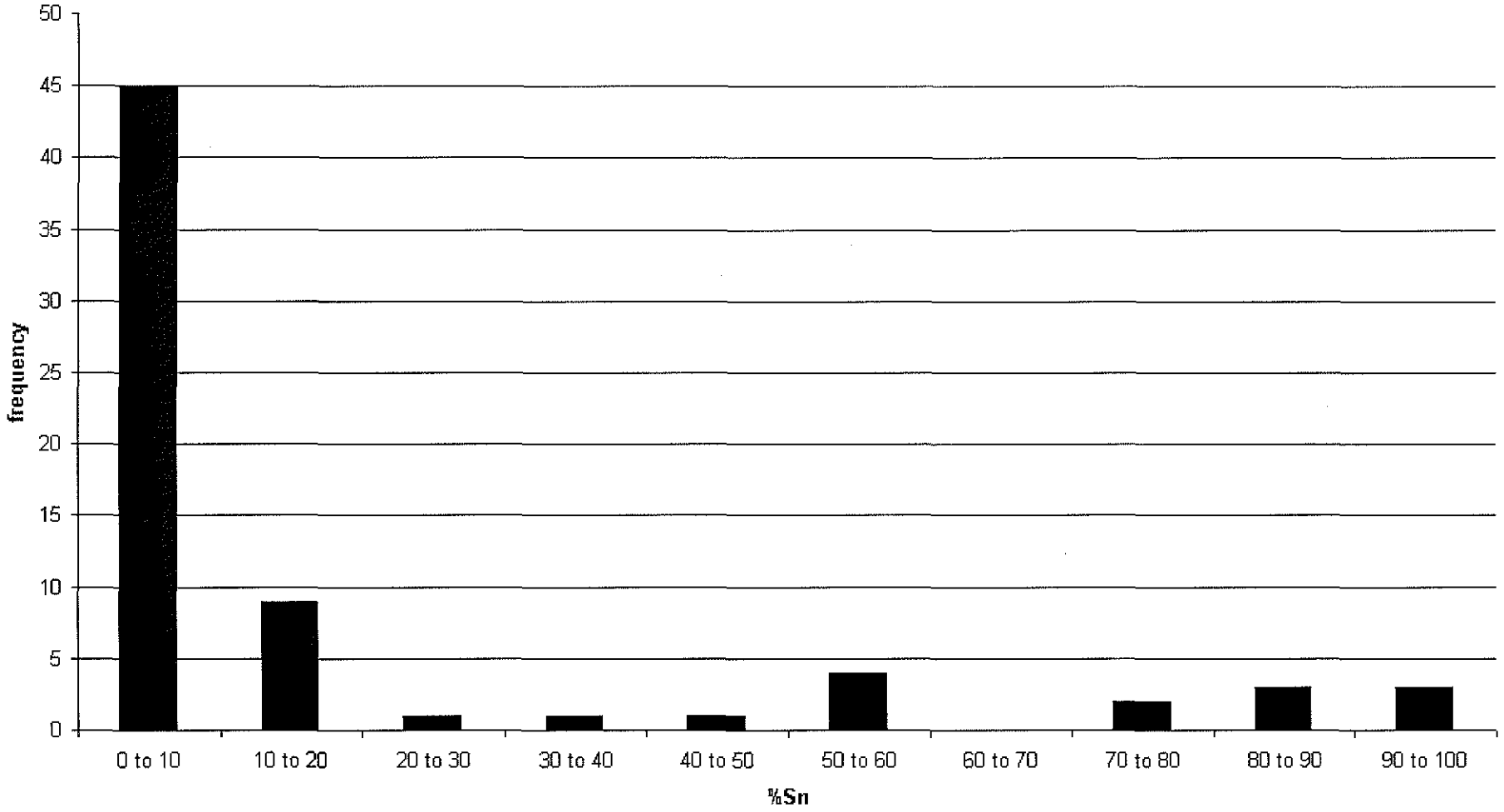
plot 2: percentage of tin in tableware



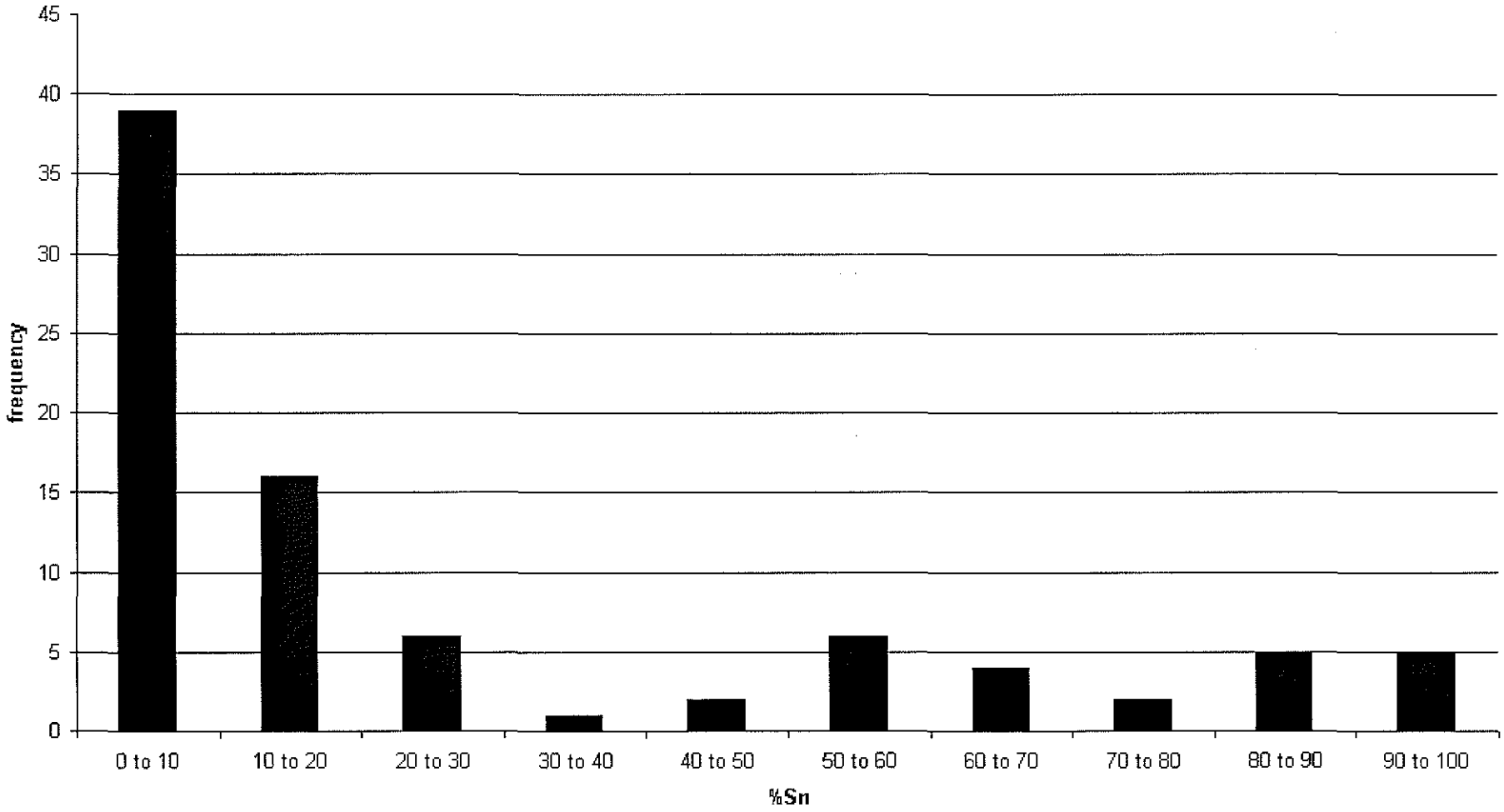
plot 3: percentage of tin in artefacts

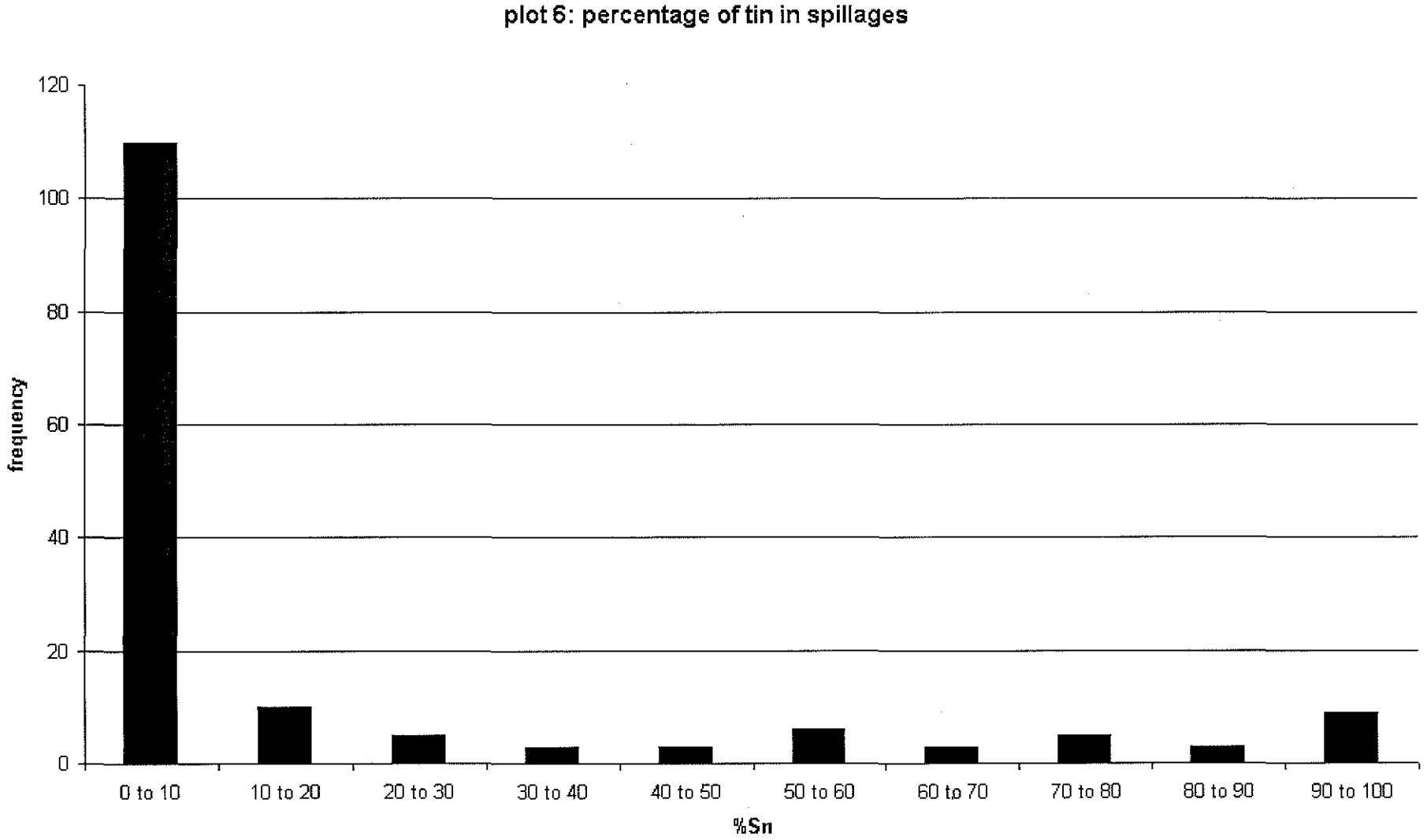


plot 4: percentage of tin in offcuts

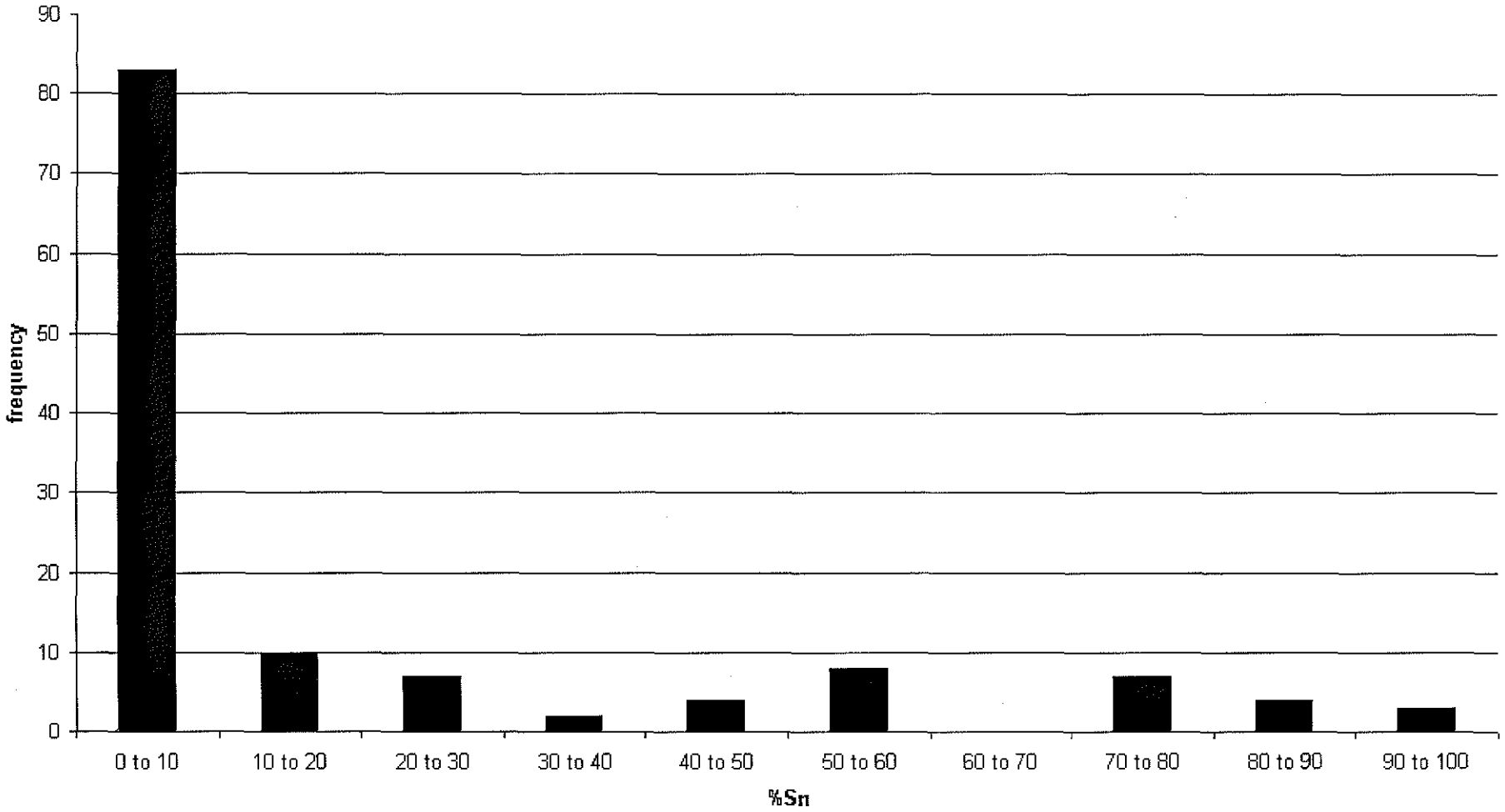


plot 5: percentage of tin in fragments




plot 6: percentage of tin in spillages
120
100
80
60
40
20
0
frequency
0 to 10
10 to 20
20 to 30
30 to 40
40 to 50
50 to 60
60 to 70
70 to 80
80 to 90
90 to 100
%Sn

plot 7: percentage of tin in undiagnostic waste



Results for individual diagnostic pieces

Certain finds were paid special attention, because of the extra information they can provide about the site, and possible manufacturing of pewter and lead objects there. These finds are described below.

sf 1970
This find consists of three large plates, roughly the size of modern dinner plates, which were thought to be all found together in a large iron "frying pan". For convenience, they were labelled a, b, and c. 1970a is a reasonably poor quality pewter, with a tin content of 45%. It seems to have been folded in half and deliberately cut up, possibly for reuse. It is though to be either a Peal type 1 or type 3d, though it is difficult to tell which due the condition of the artefact (Peal 1967). 1970b is of a better quality, with a tin content of 85%. It is also folded over, though it is hard to tell if it has been cut up, as it is partially melted. From the way it has melted, it would seem that it was exposed to heat after the folding had occurred. 1970c is a good quality pewter, with an 99% tin content. It is also folded in half, and shows some signs of being exposed to heat, around the edges, where it is very slightly melted. Both 1970b and 1970c are though to be of Peal type 4. (Q. Mould, pers. comm.)

sf 772 sample number 1
This seems to be a piece of tableware, that has been folded into four. This seems to have been deliberate. It is of a poor quality pewter, with a tin content of 46%. It shows no sign of being exposed to high temperatures, after casting.

sf 1918
This is a object fragment made of pure lead, but shows signs of being deliberately cut up. This may be evidence for recycling and reuse of material on the site.

sf 1150
This is made of pure tin and shows some decoration around the rim, but also some very clear cut marks around the edge of the piece. This is a deliberately cut piece of tableware. Again it may be a sign of reuse and recycling of tin and pewter on the site.

ik75 -sf 169
This is semi-circular and has a composition of around 20% tin. It is quite possibly a casting head or sprue. It can be identified as such by the eight small knobs or runners found across the curved side. These would have fed molten metal down into a mould in order to create an object, or more than one object. This find is good evidence of metal casting on the site.

ik75 -sf 171
This is a plano convex lump, with a tin content of 72%. Its shape suggests that it was once melted and allowed to solidify in an enclosed environment perhaps a crucible. If this was the case, then it would be evidence for pewter production or remelting on site

Romano-British Pewter

The first evidence for the Romano-British pewter industry comes from the 1st or 2nd century AD (Beagrie 1989). Evidence is rare, and this may be because early examples only tend to

survive in waterlogged conditions. Most pewter which has been found on Roman sites dates to between AD 250 and around the early 5th century, with the majority being dated to the 4th century (Beagrie 1989: 175). During this time pewter was used widely for the production of tableware. This would have resembled silver, but at a much cheaper cost. Evidence for the association of pewter and silverware comes from a piece of pewter tableware which was found in a hoard of looted silver, from Traprain Law, East Lothian, dating to the 5th century AD (Tylecote 1962: Table 25). This illustrates that in this period pewter may have been mistaken for silver or used in place of it. Relatively little analysis of Roman pewter debris has been done; analysis has tended to concentrate on hoards of pewter and complete vessels, such as Pollard's work on the Appleford hoard (1983).

An early large scale study of Romano-British pewter was that of Wedlake (1958) in his report on the excavations at Camerton which discussed the possibility that pewter casting took place at there. This was based on finds of pewter tableware, stone moulds and a possible furnace on the site (*ibid* :82-95) which all date to the mid-third century AD. Wedlake's date for the first manufacture of pewter (*c*.250 AD), is generally accepted as the start of the Romano-British pewter industry. His report also reviews the other finds of similar stone moulds, and finds of pewter reported in Britain up until that date. This was done using information about the amount of pewter in museum collections of the time. However, there is no data on the composition of these finds.

Peal (1967) produced a typology of pewter plates and examined their distribution. This included a small amount of work on composition. Peal argued that no separate groupings can be determined from composition. He sees the composition of pewter as generally falling between 62% and 79% tin, and that the proportions of tin to lead "vary in a haphazard way" (Peal 1967: 20). It is worth noting that Peal's references to the composition of pewter rest upon the 18 results from his table 6 (Peal 1967: 36). These pieces of pewter come from a variety of sites from all over England.

A number of compositional studies have since been carried out on Roman pewter tableware. A recent and notable is one Pollard's (1983) work on the Appleford hoard which consisted of 24 different vessels, including a flagon, bowls and plates. He found three separate groupings of composition, at approximately 50%, 75%, and >95% tin (*ibid*: 83). This is analogous to the results summarised by Tylecote (1962). These show three groupings at 30-50%, 60-80% and >90% (Tylecote 1962: 68-69, tables 25 and 26). These can be seen plotted by Hughes (1980:43, fig 1). These studies are useful for comparison against the results gained from the Ickham material.

Beagrie (1989) summarises all these results and looks at the composition and distribution of Romano-British pewter vessels in some detail. His groupings centre on 50%, 75% and 90% tin. He gives three main reasons why Romano-British pewter had such a wide range of varying compositions:

a) The deliberate addition of other metals to the tin to improve its hardness, casting properties or cost.
b) Impurities deriving from the original tin ores or fluxes, and their incomplete removal during smelting.
c) The recycling of tin and its accidental contamination.

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(After Beagrie, 1989: 172)

Beagrie also gives an overview of the evidence for pewter manufacture in England, and compares finds of pewter from the continent with English evidence. However, very few of these pewter finds have been analysed.
More work on the manufacture of pewter has been done by Brown (1985). He looks at the production and finishing of objects. This is done by examination of the pewterware and pewter moulds, which have been found on a number of sites around the country. However, little work has been done on other evidence for manufacture, such as the study of scrap metal.

Physical properties of pewter

Roman pewter is almost always an alloy of tin and lead. The reason for adding the lead to tin was that it increased its hardness, and improves its casting properties. Tylecote (1962) believes that pewter with a few percent of lead may have been produced because even that small amount can increase the hardness of the material noticeably. The lead-tin eutectic point is at 61.9%tin, 38.1% lead, at with a melting point of 183°C (see figure 4). From looking at this equilibrium diagram for the tin-lead system, it is clear to see how the composition groupings defined by Beagrie and others compare (see above). The eutectic composition is the one which would give the best castings because the pewter solidifies quickly, with no pasty range. This composition may have been aimed for by the pewterers, even though they did not know the exact percentages they were putting in, they would roughly know what would give the best casting. Hughes (1980) suggests that this accounts for the 60-80% range found by Tylecote (1962), because these alloys would have a narrow semi-solid range and produce higher quality castings. Hughes also refers to Pliny's "recipes" for pewter which consist of two parts of tin to one part of lead (67% tin/33% lead), one part tin to one part lead, (50% tin/50% lead), and two parts lead to one part tin (67% lead/33% tin) which is described as solder. (Hughes 1980: 43-44). These recipes may also explain the groupings found.
However for soldering you would expect a different composition as the optimum would be at around 19% tin. This is because the temperature difference between the liquidus and the solidus is the greatest here (approximately 100°C), creating a large "pasty" range, ideal for allowing the manipulation of the material (Thwaites 1977). Therefore if solder was found on the site, it would be expected to have a composition in the range approximately 15% to 35% tin.

Pewter working at Ickham

There is a variety of evidence for pewter manufacture at Ickham. Small finds number 169, 171, and 1057 (see descriptions above), are all indicators of manufacturing on site. However there is no evidence of exactly what was being made. Small find number 821 is a small golf-ball sized lump of galena, a lead ore. This may indicate an input of raw material into the site, and perhaps trade. However this is only one small piece, if pewter was being smelted on the site, greater quantities would be expected.
The amount and variety of pewter artefacts found on the site indicates an abundance of the

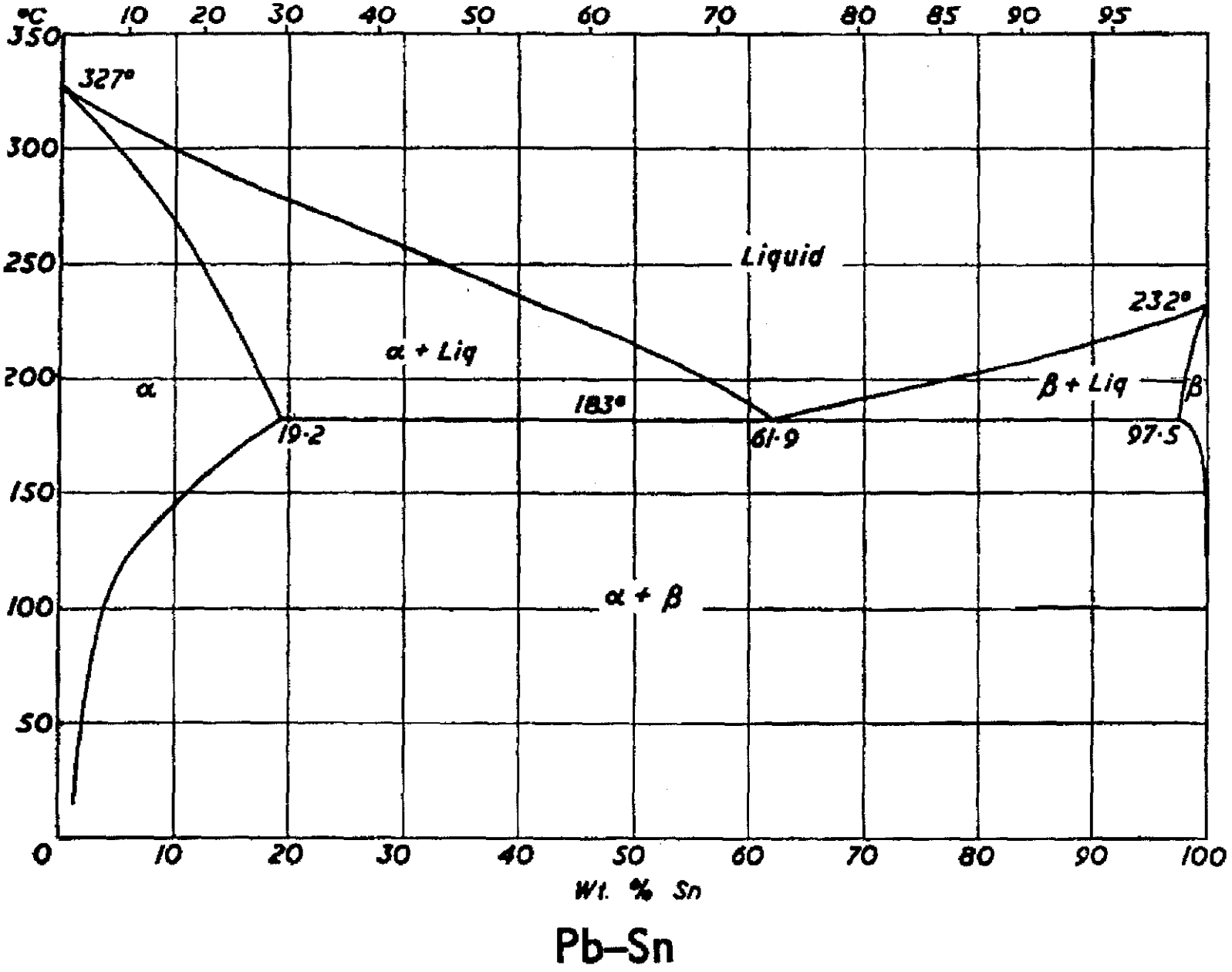

Figure 4 : Lead/Tin phase diagram

metal on the site, but that alone does not point to manufacture. The amount of debris, especially that which shows signs of having once being molten such as the spillages and undiagnostic waste, can be taken as a possible indication of manufacturing. However, some of the material could have formed during a fire, accidental, votive or otherwise. But the artefacts such as the casting sprue and the plano convex pewter lump, give clear evidence that casting took place on more than one occasion on the site.

There is also substantial evidence for the reuse of pewter on the site. This is provided by the offcuts which show clear cut edges that cannot have been made without tools. There is also the example of the three pewter plates (sf 1970), two of which where partially melted along one edge. This could have been due to a fire, or intentional melting for recycling. It appears that 1970b, was melted after folding. These are the most complete pewter vessels from the site, and 1970a seem to have been deliberately cut and folded. Other finds show signs of deliberate folding, such as sf 772 sample 1. Some finds also exhibit deliberate cut marks, such as sf 1918 and sf 1150. Therefore there is a possibility that some recycling of pewter took place at the site or there was some ritual reason for folding the plates, perhaps at the end of a special meal. The evidence does not point either way.

There are some measrements around 0-10% tin, which could be lead artefacts (see above). There are a variety of reasons for the addition of lead to tin. The fact that there are reasonably defined groupings, which give reason to believe that this was not a hit-and-miss process, but carefully considered, taking into account the properties of the metal to create differences in the alloy produced. One reason for differences in lead-tin ratios may be cost, as lead was a considerably cheaper metal than tin in the Roman period. This idea is given weight by Beagrie (1989), who also sees casting properties and the increase in hardness from the alloy of these two relatively soft metals, as a reason. Pliny describes an alloy known as *argentarium,* which is composed of "pale [tin] and dark lead in equal amounts" (Bailey 1932: Book 34, 160), and an alloy called *tertiarium*, which is "an alloy of two parts dark lead with one of pale [tin]." (*ibid*). This suggests that the Romans had alloy recipes for lead-tin alloys, and it is possible that the pewterers at Ickham were also following set recipes, to get the desired result. The 75% tin peak corresponds with a composition of 3 parts tin to 1 part lead.

Conclusions

From the analysis of the pewter/lead/tin it can be concluded that recycling of pewter and some casting took place at Ickham. The higher tin alloy compositions match those which are generally known for Roman pewter reinforcing the suggestion that Roman-British pewterers used "recipes". There is no evidence for smelting of tin and lead on the site, though a small piece of lead ore was found. There are no moulds for casting pewter on the site, though these may have been removed, lost or destroyed.

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Table 6: Results of XRF analysis of the sampled Ickham material

year	SF no.	sample no.	bag description	class	Pb La	Sn Ka	Sn/Pb	%Sn	
ick74	62		pewter plate frag	T	2969	6364	2.1435	89.9	
ick74	73		lead nail/rivet (2)	A	12839	812	0.0632	17	
ick74	79		pewter disc	A	10864	496	0.0457	10.3	
ick74	82		lead strip	A	5030	2591	0.5682	62.5	
ick74	83		pewter bowl frag	T	4969	3579	0.7203	67.4	
ick74	84		pewter bowl frag	T	10349	4378	0.423	56.4	
ick74	91		pewter ferrule	A	10632	5945	0.5592	62.1	
ick74	92		pewter/lead obj (2)	A	3108	3499	1.1258	76.6	
ick74	93		rolled lead sheet	A	14517	468	0.0322	3.11	
ick74	103		lead weight/obj (2)	A	7508	0	0	0	
ick74	112		lead weight	A	13677	937	0.0685	18.7	
ick74	129	1	lead/pewter frag (4)	F	1399	12374	8.8449	100	*
ick74	129	2	lead/pewter frag (4)	F	2013	2013	1	74.1	
ick74	129	3	lead/pewter frag (4)	F	5623	2952	0.525	60.8	
ick74	129	4	lead/pewter frag (4)	F	3297	3377	1.0243	74.6	
ick74	134		lead obj	A	2720	734	0.2699	47.1	
ick74	144	1	lead/pewter frag (7)	F	10341	37	0.0036	0	*
ick74	144	2	lead/pewter frag (7)	F	7539	187	0.0248	0	*
ick74	144	3	lead/pewter frag (7)	F	13188	55	0.0042	0	*
ick74	144	4	lead/pewter frag (7)	F	11528	64	0.0056	0	*
ick74	144	5	lead/pewter frag (7)	F	12298	84	0.0068	0	*
ick74	144	6	lead/pewter frag (7)	F	13655	334	0.0245	0	*
ick74	144	7	lead/pewter frag (7)	F	11461	142	0.0124	0	*
ick74	147	a1	lead/pewter frag (12)	F	3382	6538	1.9332	87.8	
ick74	147	a2	lead/pewter frag (12)	F	1778	5811	3.2683	98.6	
ick74	147	a3	lead/pewter frag (12)	F	7328	3602	0.4915	59.5	
ick74	147	b1	lead/pewter frag (12)	F	13916	390	0.028	0.22	
ick74	147	b2	lead/pewter frag (12)	F	6367	371	0.0583	15.4	
ick74	147	b3	lead/pewter frag (12)	F	9269	442	0.0477	11.2	
ick74	155	a1	lead scrap (21)	U	4284	1976	0.4613	58.1	
ick74	155	a2	lead scrap (21)	U	17312	245	0.0142	0	*
ick74	155	a3	lead scrap (21)	U	14479	92	0.0064	0	*
ick74	155	b1	lead scrap (21)	U	10174	286	0.0281	0.28	
ick74	155	b2	lead scrap (21)	U	14114	59	0.0042	0	*
ick74	155	b3	lead scrap (21)	U	9761	109	0.0112	0	*
ick74	159	1	lead/pewter frag (8)	F	10583	116	0.011	0	*
ick74	159	2	lead/pewter frag (8)	F	13745	379	0.0276	0	*
ick74	159	3	lead/pewter frag (8)	F	15160	289	0.0191	0	*
ick74	159	4	lead/pewter frag (8)	F	13886	126	0.0091	0	*
ick74	159	5	lead/pewter frag (8)	F	9593	165	0.0172	0	*
ick74	160	a1	lead dross (6)	S	16269	158	0.0097	0	*
ick74	160	a2	lead dross (6)	S	8990	157	0.0175	0	*
ick74	160	a3	lead dross (6)	S	5578	4764	0.8541	70.9	
ick74	160	b1	lead dross (6)	S	8363	3176	0.3798	54.1	
ick74	160	b2	lead dross (6)	S	8943	236	0.0264	0	*
ick74	160	b3	lead dross (6)	S	10677	174	0.0163	0	*
ick74	161	1	lead/pewter frag (3)	F	7621	378	0.0496	12	
ick74	161	2	lead/pewter frag (3)	F	14671	697	0.0475	11.1	
ick74	161	3	lead/pewter frag (3)	F	15989	825	0.0516	12.8	
ick75	169		lead disc frag	A	40811	2912	0.0714	19.5	
ick74	170	1	lead/pewter frag (3)	F	14639	156	0.0107	0	*
ick74	170	2	lead/pewter frag (3)	F	5004	3579	1.188	67.2	

Table 6: Results of XRF analysis of the sampled Ickham material

year	SF no.	sample no.	bag description	class	Pb La	Sn Ka	Sn/Pb	%Sn	
ick74	170	3	lead/pewter frag (3)	F	10694	6105	0.5709	62.5	
ick75	171		lead disc	A	7139	6587	0.9227	72.5	
ick74	178	1	lead frag (6)	F	10914	425	0.0389	7.02	
ick74	178	2	lead frag (6)	F	9774	4302	0.4678	58.4	
ick74	178	3	lead frag (6)	F	6156	3171	0.5455	61.6	
ick74	178	4	lead frag (6)	F	16352	123	0.0161	0	*
ick74	178	5	lead frag (6)	F	16139	313	0.0294	1.23	
ick74	178	5	lead frag (6)	F	7046	1724	0.2739	47.4	
ick74	180		rolled lead object	A	5472	8562	1.5647	83.4	
ick74	181		rolled lead obj (2)	A	12653	442	0.0349	4.77	
ick74	186		lead dross (6)	S	18119	129	0.0071	0	*
ick74	189	1	pewter offcut (3)	O	14090	444	0.0315	2.64	
ick74	189	2	pewter offcut (3)	O	7180	3512	0.4891	59.4	
ick74	189	3	pewter offcut (3)	O	10279	279	0.0271	0	*
ick74	191	1	pewter scrap(5)	U	13779	3824	0.2775	47.6	
ick74	191	2	pewter scrap(5)	U	5410	5328	0.9848	73.8	
ick74	191	3	pewter scrap(5)	U	18943	65	0.0034	0	*
ick74	191	4	pewter scrap(5)	U	22052	630	0.0286	0.61	
ick74	191	5	pewter scrap(5)	U	14053	398	0.0283	0.43	
ick74	207		lead weight	A	13482	5581	0.414	55.9	
ick74	211		pewter frag	F	2777	12431	4.5448	100	*
ick74	272		pewter bowl frag	T	1680	11075	6.8458	100	*
ick74	276	a	lead frag (11)	F	7049	10740	1.5869	83.7	
ick74	276	b	lead frag (11)	F	7337	130	0.0473	11	
ick74	276	c	lead frag (11)	F	14982	457	0.0421	8.61	
ick74	276	d	lead frag (11)	F	15106	732	0.0583	15.4	
ick74	276	e	lead frag (11)	F	9446	1538	0.1882	39.6	
ick74	284		pewter bowl frag	T	15349		0.0941	25.3	
ick74	285		lead weight	A	15710	825	0.0525	13.2	
ick74	286		pewter bowl frag	T	2663	9994	3.8475	100	*
ick74	288		lead weight	A	16224	427	0.0263	0	*
ick74	289		lead weight	A	14441	511	0.0354	5.04	
ick74	290		lead weight	A	8895	638	0.0717	19.7	
ick74	291		lead frag (3)	F	3030	4521	1.5607	83.3	
ick74	293		pewter frag	F	12883	471	0.0543	13.9	
ick74	295		pewter bowl frag	T	10396	3046	0.3199	50.6	
ick74	302	a1	lead runoff (27)	S	5443	6919	1.2712	79.1	
ick74	302	a2	lead runoff (27)	S	8580	178	0.0207	0	*
ick74	302	a3	lead runoff (27)	S	16089	1305	0.0811	22.2	
ick74	302	b1	lead runoff (27)	S	8227	4001	0.4863	59.2	
ick74	302	b2	lead runoff (27)	S	17051	441	0.0259	0	*
ick74	302	b3	lead runoff (27)	S	14655	172	0.0117	0	*
ick74	302	c1	lead runoff (27)	S	21482	568	0.0264	0	*
ick74	302	c2	lead runoff (27)	S	14507	178	0.0123	0	*
ick74	302	c3	lead runoff (27)	S	19869	398	0.02	0	*
ick74	303	a1	pewter frag (10)	F	14697	369	0.0385	6.79	
ick74	303	a2	pewter frag (10)	F	11030	452	0.054	13.8	
ick74	303	a3	pewter frag (10)	F	9249	223	0.0441	9.6	
ick74	303	b1	pewter frag (10)	F	8767	3369	0.4094	55.7	
ick74	303	b2	pewter frag (10)	F	2232	12149	5.6134	100	*
ick74	303	b3	pewter frag (10)	F	13942	951	0.0811	22.2	
ick74	310		lead pipe section	A	9027	148	0.0164	0	*

Table 6: Results of XRF analysis of the sampled Ickham material

year	SF no.	sample no.	bag description	class	Pb La	Sn Ka	Sn/Pb	%Sn	
ick74	320	a1	lead offcut (14)	O	17449	319	0.0183	0	*
ick74	320	a2	lead offcut (14)	O	12564	387	0.0308	2.17	
ick74	320	a3	lead offcut (14)	O	2826	3486	1.2335	78.5	
ick74	320	b1	lead offcut (14)	O	23544	157	0.0067	0	*
ick74	320	b2	lead offcut (14)	O	21741	812	0.0373	6.16	
ick74	320	b3	lead offcut (14)	O	20499	138	0.0067	0	*
ick74	355	a	lead dross (12)	S	12298	298	0.0242	0	*
ick74	355	b	lead dross (12)	S	19649	355	0.0181	0	*
ick74	355	c	lead dross (12)	S	11256	291	0.0259	0	*
ick74	355	d	lead dross (12)	S	19222	428	0.0223	0	*
ick74	355	e	lead dross (12)	S	25191	352	0.014	0	*
ick74	356		lead weight	A	17173	209	0.0122	0	*
ick74	381		lead weight	A	9399	241	0.0256	0	*
ick74	383		lead weight	A	14096	1332	0.0945	25.4	
ick74	437		pewter rim frag	T	871	14985	17.635	100	*
ick74	438		pewter rim frag	T	2146	6254	3.0387	97.1	
ick74	440		pewter rim frag	T	3681	8245	2.3276	91.6	
ick74	449		tubular lead obj	A	13001	771	0.0593	15.7	
ick74	461		cylindrical lead obj	A	5054	1045	0.2068	41.5	
ick74	481		pewter handle frag	T	10105	7310	0.7598	68.5	
ick74	513		pewter bowl rim frag	T	8785	2743	0.3417	51.9	
ick74	515		pewter rim frag	T	1057	7303	7.1618	100	*
ick74	522		pewter scrap frag	S	10840	2704	0.2494	45.4	
ick74	565		biconical leadweight	A	15806	272	0.0172	0	*
ick74	707		pewter/iron obj	A	12355	367	0.0297	1.42	
ick74	722	1	lead offcut (5)	O	11647	528	0.0453	10.2	
ick74	722	2	lead offcut (5)	O	18682	413	0.0221	0	*
ick74	722	3	lead offcut (5)	O	8085	9245	1.1435	76.9	
ick74	722	4	lead offcut (5)	O	13866	120	0.0087	0	*
ick74	722	5	lead offcut (5)	O	22296	269	0.0121	0	*
ick74	723	1	pewter frag (5)	F	12420	436	0.0527	13.3	
ick74	723	2	pewter frag (5)	F	15544	555	0.0513	12.7	
ick74	723	3	pewter frag (5)	F	4700	6107	1.3572	80.5	
ick74	723	4	pewter frag (5)	F	17748	756	0.0529	13.3	
ick74	723	5	pewter frag (5)	F	14612	316	0.0321	3.02	
ick74	726	a1	lead dross (36)	S	14814	299	0.0202	0	*
ick74	726	a2	lead dross (36)	S	19078	390	0.0204	0	*
ick74	726	a3	lead dross (36)	S	15399	154	0.01	0	*
ick74	726	b1	lead dross (36)	S	6689	7689	1.1495	77	
ick74	726	b2	lead dross (36)	S	10698	3211	0.3001	49.3	
ick74	726	b3	lead dross (36)	S	22510	436	0.0194	0	*
ick74	727	1	lead offcut (8)	O	1409	2618	1.8581	87	
ick74	727	2	lead offcut (8)	O	8660	2572	0.297	49	
ick74	727	3	lead offcut (8)	O	8921	120	0.0135	0	*
ick74	727	4	lead offcut (8)	O	2739	9168	3.3472	99.1	
ick74	727	5	lead offcut (8)	O	10076	385	0.0382	6.63	
ick74	729	1	lead scrap (44)	U	7400	398	0.0538	13.7	
ick74	729	2	lead scrap (44)	U	9963	0	0	74.1	
ick74	729	3	lead scrap (44)	U	10133	72	0.0071	0	*
ick74	729	4	lead scrap (44)	U	7366	720	0.0977	26.1	
ick74	729	5	lead scrap (44)	U	8263	0	0	0	
ick74	729	6	lead scrap (44)	U	6329	2074	0.3277	51.1	

Table 6: Results of XRF analysis of the sampled Ickham material

year	SF no.	sample no.	bag description	class	Pb La	Sn Ka	Sn/Pb	%Sn	
ick74	730	a1	lead dross (21)	S	9524	64	0.0067	0	*
ick74	730	a2	lead dross (21)	S	7268	143	0.0197	0	*
ick74	730	a3	lead dross (21)	S	24164	245	0.0101	0	*
ick74	730	b1	lead dross (21)	S	3221	144	0.0447	9.87	
ick74	730	b2	lead dross (21)	S	9351	3092	0.3307	51.3	
ick74	730	b3	lead dross (21)	S	3568	199	0.0558	14.4	
ick74	731	a	lead scrap (10)	U	7520	991	0.1318	32.2	
ick74	731	b	lead scrap (10)	U	8382	561	0.0669	18.2	
ick74	731	c	lead scrap (10)	U	8946	310	0.0347	4.61	
ick74	731	d	lead scrap (10)	U	10303	943	0.0915	24.7	
ick74	731	e	lead scrap (10)	U	7410	336	0.0453	10.2	
ick74	732	1	pewter frag (8)	F	14214	755	0.0635	17.1	
ick74	732	2	pewter frag (8)	F	13365	899	0.0823	22.5	
ick74	732	3	pewter frag (8)	F	13868	938	0.0829	22.7	
ick74	732	4	pewter frag (8)	F	16757	106	0.0195	0	*
ick74	732	5	pewter frag (8)	F	13933	335	0.0362	5.54	
ick74	733	1	lead offcut (5)	O	13592	81	0.006	0	*
ick74	733	2	lead offcut (5)	O	8767	184	0.021	0	*
ick74	733	3	lead offcut (5)	O	15474	792	0.0512	12.7	
ick74	733	4	lead offcut (5)	O	6303	135	0.0214	0	*
ick74	733	5	lead offcut (5)	O	13899	428	0.0308	2.16	
ick74	734	1	lead dross (3)	S	11798	117	0.0099	0	*
ick74	734	2	lead dross (3)	S	18547	205	0.0111	0	*
ick74	734	3	lead dross (3)	S	14563	173	0.0119	0	*
ick74	735	1	lead scrap (3)	U	11788	159	0.0135	0	*
ick74	735	2	lead scrap (3)	U	13723	926	0.0675	18.4	
ick74	735	3	lead scrap (3)	U	16832	26	0.0015	0	*
ick74	736	1	lead frag (5)	F	9032	5322	0.625	64.4	
ick74	736	2	lead frag (5)	F	12076	124	0.0201	0	*
ick74	736	3	lead frag (5)	F	12595	426	0.0458	10.4	
ick74	736	4	lead frag (5)	F	19248	199	0.0236	0	*
ick74	736	5	lead frag (5)	F	16282	132	0.0225	0	*
ick74	737	1	lead scrap (2)	U	13487	4861	0.3604	53	
ick74	737	2	lead scrap (2)	U	15002	121	0.0081	0	*
ick74	738	1	lead dross(2)	S	16034	445	0.0278	0.02	
ick74	738	2	lead dross(2)	S	4438	216	0.0487	11.6	
ick74	739	a	lead/pewter frag (7)	F	10008	3224	0.3469	52.2	
ick74	739	b	lead/pewter frag (7)	F	6889	43	0.0327	3.38	
ick74	739	c	lead/pewter frag (7)	F	12396	162	0.0318	2.82	
ick74	739	d	lead/pewter frag (7)	F	18985	56	0.0109	0	*
ick74	739	e	lead/pewter frag (7)	F	19194	220	0.0215	0	*
ick74	740		lead offcut	O	16196	1122	0.0693	18.9	
ick74	741	a	lead/pewter frag (7)	F	15997	86	0.0181	0	*
ick74	741	b	lead/pewter frag (7)	F	11102	373	0.0549	14.1	
ick74	741	c	lead/pewter frag (7)	F	7085	45	0.0356	5.15	
ick74	741	d	lead/pewter frag (7)	F	12711	472	0.0534	13.6	
ick74	741	e	lead/pewter frag (7)	F	2549	63	0.1067	27.9	
ick74	742	1	lead offcut (2)	O	11595	179	0.0154	0	*
ick74	742	2	lead offcut (2)	O	13882	351	0.0253	0	*
ick74	743	1	lead runoff (3)	S	20760	133	0.0064	0	*
ick74	743	2	lead runoff (3)	S	18541	40	0.0022	0	*
ick74	743	3	lead runoff (3)	S	21190	481	0.0227	0	*

Table 6: Results of XRF analysis of the sampled Ickham material

year	SF no.	sample no.	bag description	class	Pb La	Sn Ka	Sn/Pb	%Sn	
ick74	744	1	lead runoff (2)	S	10365	231	0.0223	0	*
ick74	744	2	lead runoff (2)	S	19749	291	0.0147	0	*
ick74	745	1	lead/pewter frag (6)	F	10862	4173	0.4063	55.5	
ick74	745	2	lead/pewter frag (6)	F	14487	136	0.0208	0	*
ick74	745	3	lead/pewter frag (6)	F	5536	9116	1.7092	85.2	
ick74	745	4	lead/pewter frag (6)	F	9776	3825	0.4156	56	
ick74	745	5	lead/pewter frag (6)	F	11990	953	0.0973	26	
ick74	745	6	lead/pewter frag (6)	F	12413	93	0.0227	0	*
ick74	746	1	lead/pewter frag (7)	F	14859	972	0.0793	21.7	
ick74	746	2	lead/pewter frag (7)	F	14991	71	0.0155	0	*
ick74	746	3	lead/pewter frag (7)	F	9822	197	0.0409	8.05	
ick74	746	4	lead/pewter frag (7)	F	14780	135	0.0196	0	*
ick74	746	5	lead/pewter frag (7)	F	10958	242	0.0372	6.09	
ick74	747		tubular lead obj	A	9323	3324	0.3565	52.8	
ick74	748		flat lead disc	A	14765	258	0.0175	0	*
ick74	750		lead dross w/wood	S	11431	456	0.0399	7.52	
ick74	752		lead plug	A	9296	296	0.0318	2.86	
ick74	753		lead openwork disc	A	3823	4569	1.1951	77.8	
ick74	755		rolled lead sheet	A	18026	616	0.0342	4.32	
ick74	763		lead run off (2)	S	14115	306	0.0217	0	*
ick74	764		pewter scrap frag	U	11420	917	0.0803	22	
ick74	765		lead offcut	O	18920	220	0.0116	0	*
ick74	766	1	lead run off (2)	S	11928	68	0.0057	0	*
ick74	766	2	lead run off (2)	S	13560	40	0.0029	0	*
ick74	772	1	pewter bowl frag (15)	T	10082	2302	0.2541	45.8	
ick74	772	2	pewter bowl frag (15)	T	7648	4292	0.5931	63.3	
ick74	772	3	pewter bowl frag (15)	T	14654	2347	0.1762	38.2	
ick74	772	4	pewter bowl frag (15)	T	10577	533	0.0633	17.1	
ick74	789	a1i	lead dross (80)	S	495	4966	10.032	100	*
ick74	789	a1ii	lead dross (80)	S	1391	8596	6.1797	100	*
ick74	789	a2	lead dross (80)	S	1723	3313	1.9228	87.7	
ick74	789	a3	lead dross (80)	S	865	2840	3.2832	98.7	
ick74	789	b1	lead dross (80)	S	11703	221	0.0189	0	*
ick74	789	b2	lead dross (80)	S	1702	79	0.0464	10.7	
ick74	789	b3	lead dross (80)	S	13476	203	0.0151	0	*
ick74	789	c1	lead dross (80)	S	13520	562	0.0416	8.37	
ick74	789	c2	lead dross (80)	S	12870	170	0.0132	0	*
ick74	789	c3	lead dross (80)	S	9935	171	0.0172	0	*
ick74	789	d1	lead dross (80)	S	14620	559	0.0382	6.64	
ick74	789	d2	lead dross (80)	S	4179	7820	1.8713	87.1	
ick74	789	d3	lead dross (80)	S	10166	128	0.0126	0	*
ick74	789	e1	lead dross (80)	S	17714	222	0.0125	0	*
ick74	789	e2	lead dross (80)	S	12428	114	0.0092	0	*
ick74	789	e3	lead dross (80)	S	10254	133	0.013	0	*
ick74	791	1	lead offcut (80)	O	14217	130	0.0091	0	*
ick74	791	2	lead offcut (80)	O	12086	710	0.0587	15.5	
ick74	791	3	lead offcut (80)	O	7999	3428	0.4286	56.6	
ick74	791	4	lead offcut (80)	O	16123	552	0.0342	4.36	
ick74	791	5	lead offcut (80)	O	12237	552	0.0451	10.1	
ick74	792		pewter rim frag	T	5346	8942	1.7475	85.7	
ick74	793		semicircular leadobj	A	11292	347	0.0307	2.12	
ick74	794	1	lead offcut (3)	O	17479	200	0.0114	0	*

Table 6: Results of XRF analysis of the sampled Ickham material

year	SF no.	sample no.	bag description	class	Pb La	Sn Ka	Sn/Pb	%Sn	
ick74	794	2	lead offcut (3)	O	19469	2096	0.1077	28	
ick74	794	3	lead offcut (3)	O	15329	147	0.0096	0	*
ick74	796		pewter handle	T	5697	0	-0.036	0	*
ick74	811		lead dross (9)	S	9787	139	0.0142	0	*
ick74	812	a	lead offcut (15)	O	17529	366	0.0209	0	*
ick74	812	b	lead offcut (15)	O	13713	712	0.0519	13	
ick74	812	c	lead offcut (15)	O	11248	750	0.0667	18.1	
ick74	812	d	lead offcut (15)	O	13610	302	0.0222	0	*
ick74	812	e	lead offcut (15)	O	14695	372	0.0253	0	*
ick74	813	a	lead offcut (8)	O	727	16980	23.356	100	*
ick74	813	b	lead offcut (8)	O	12668	286	0.0226	0	*
ick74	813	c	lead offcut (8)	O	13449	195	0.0145	0	*
ick74	813	d	lead offcut (8)	O	5194	9909	1.9078	87.5	
ick74	813	e	lead offcut (8)	O	17807	202	0.0113	0	*
ick74	814	a	lead offcut (25)	O	15522	769	0.0495	12	
ick74	814	b	lead offcut (25)	O	16736	86	0.0051	0	*
ick74	814	c	lead offcut (25)	O	9714	3391	0.3491	52.4	
ick74	814	d	lead offcut (25)	O	10197	1795	0.176	38.2	
ick74	814	e	lead offcut (25)	O	11108	472	0.0425	8.82	
ick74	815	a	lead runoff (24)	S	18361	327	0.0178	0	*
ick74	815	b	lead runoff (24)	S	1280	14672	11.463	100	*
ick74	815	c	lead runoff (24)	S	14720	2451	0.1665	37.1	
ick74	816	1	lead dross (13)	S	10601	406	0.0383	6.68	
ick74	816	2	lead dross (13)	S	13053	76	0.0058	0	*
ick74	816	3	lead dross (13)	S	10624	52	0.0049	0	*
ick74	816	4	lead dross (13)	S	3780	4614	1.2206	78.3	
ick74	816	5	lead dross (13)	S	piece of bone			0	
ick74	818	1	lead dross (10)	S	9030	221	0.0245	0	*
ick74	818	2	lead dross (10)	S	12644	510	0.0403	7.75	
ick74	818	3	lead dross (10)	S	8211	157	0.0191	0	*
ick74	818	4	lead dross (10)	S	18226	116	0.0064	0	*
ick74	818	5	lead dross (10)	S	3839	147	0.0383	6.67	
ick74	819	a1	lead runoff (36)	S	12639	893	0.0707	19.3	
ick74	819	a2	lead runoff (36)	S	10888	92	0.0084	0	*
ick74	819	a3	lead runoff (36)	S	15658	177	0.0113	0	*
ick74	819	b1	lead runoff (36)	S	14446	2243	0.1553	35.6	
ick74	819	b2	lead runoff (36)	S	19943	560	0.0281	0.26	
ick74	819	b3	lead runoff (36)	S	18649	486	0.0261	0	*
ick74	819	c1	lead runoff (36)	S	7825	27	0.0035	0	*
ick74	819	c2	lead runoff (36)	S	11607	106	0.0091	0	*
ick74	819	c3	lead runoff (36)	S	11317	374	0.033	3.63	
ick74	820	a1	lead offcut (25)	O	16278	441	0.0271	0	*
ick74	820	a2	lead offcut (25)	O	14924	676	0.0453	10.1	
ick74	820	a3	lead offcut (25)	O	18460	590	0.032	2.93	
ick74	820	b1	lead offcut (25)	O	14859	4688	0.3155	50.3	
ick74	820	b2	lead offcut (25)	O	16988	293	0.0172	0	*
ick74	820	b3	lead offcut (25)	O	6888	17121	2.4856	93	
ick74	820	c1	lead offcut (25)	O	21404	174	0.0081	0	*
ick74	820	c2	lead offcut (25)	O	19491	289	0.0148	0	*
ick74	820	c3	lead offcut (25)	O	27998	190	0.0068	0	*
ick74	820	d	lead offcut (25)	O	23745	156	0.0066	0	*
ick74	820	e	lead offcut (25)	O	9679	17139	1.7707	86	

Table 6: Results of XRF analysis of the sampled Ickham material

year	SF no.	sample no.	bag description	class	Pb La	Sn Ka	Sn/Pb	%Sn	
ick74	821		lead ore	A	9073	0	0	0	*
ick74	824		lead offcut	O	14051	310	0.0221	0	*
ick74	836	1	pewter cylinder (18)	A	4443	149	0.0335	3.93	
ick74	836	2	pewter cylinder (18)	A	6959	191	0.0274	0	*
ick74	836	3	pewter cylinder (18)	A	7890	170	0.0215	0	*
ick74	836	4	pewter cylinder (18)	A	9550	166	0.0174	0	*
ick74	849		lead ring	A	10454	552	0.0528	13.3	
ick74	914		lead weight	A	12009	474	0.0395	7.3	
ick74	915		lead weight	A	11189	343	0.0307	2.07	
ick74	916		lead weight	A	7936	2900	0.3654	53.3	
ick74	1002		pewter bowl rim frag	T	2489	9742	4.049	100	*
ick74	1004		pewter strip	A	5025	3813	0.8119	69.8	
ick74	1051	a1	lead dross (28)	S	11051	404	0.0366	5.71	
ick74	1051	a2	lead dross (28)	S	10258	281	0.0274	0	*
ick74	1051	a3	lead dross (28)	S	12860	377	0.0293	1.15	
ick74	1051	b1	lead dross (28)	S	4558	1826	0.4006	55.2	
ick74	1051	b2	lead dross (28)	S	8824	431	0.0488	11.7	
ick74	1051	b3	lead dross (28)	S	11641	344	0.0296	1.31	
ick74	1052		lead lump (2)	A	8699	152	0.0175	0	*
ick74	1094		pewter bowl rim frag	T	1955	15208	8.0061	100	*
ick74	1103		pewter socket	A	9530	4298	0.451	57.7	
ick74	1128		oval piece of lead (2)	A	9250	0	0	0	
ick74	1129		lead object	A	12326	397	0.0322	3.09	
ick74	1135	a1	lead runoff (44)	S	12965	449	0.0346	4.59	
ick74	1135	a2	lead runoff (44)	S	12397	522	0.0421	8.64	
ick74	1135	a3	lead runoff (44)	S	14361	234	0.0163	0	*
ick74	1135	b1	lead runoff (44)	S	14836	312	0.021	0	*
ick74	1135	b2	lead runoff (44)	S	14914	100	0.0067	0	*
ick74	1135	b3	lead runoff (44)	S	18664	419	0.0224	0	*
ick74	1149		lead plug (3)	A	17934	2685	0.1497	34.9	
ick74	1150		pewter bowl rim frag	T	1568	10158	6.7168	100	*
ick74	1151		pewter/lead strip (2)	A	6914	745	0.1078	28.1	
ick74	1166		lead runoff	S	18085	1366	0.0755	20.7	
ick74	1219		lead weight/plug	A	16236	252	0.0155	0	*
ick74	1220	2	pewter rim frag (2)	T	6433	4369	0.7207	67.4	
ick74	1220	1	pewter rim frag (2)	T	8132	5828	0.7498	68.2	
ick74	1236		lead scrap (2)	U	4168	6416	1.5393	83.1	
ick74	1310		lead socket	A	7806	4936	0.6323	64.7	
ick74	1327	a i	lead dross (21)	S	17571	521	0.0297	1.38	
ick74	1327	a ii	lead dross (21)	S	19708	244	0.0124	0	*
ick74	1327	b1	lead dross (21)	S	16838	363	0.0216	0	*
ick74	1327	b2	lead dross (21)	S	11442	289	0.0253	0	*
ick74	1327	b3	lead dross (21)	S	10713	589	0.055	14.2	
ick74	1327	c1	lead dross (21)	S	4185	117	0.028	0.17	
ick74	1327	c2	lead dross (21)	S	9445	281	0.0298	1.45	
ick74	1327	c3	lead dross (21)	S	15435	133	0.0086	0	*
ick74	1327	d	lead dross (21)	S	7213	2686	0.3724	53.7	
ick74	1328	1	lead scrap (18)	U	6901	211	0.0306	2.02	
ick74	1328	2	lead scrap (18)	U	7642	170	0.0222	0	*
ick74	1328	3	lead scrap (18)	U	9802	0	0	0	
ick74	1328	4	lead scrap (18)	U	615	0	0	0	
ick74	1328	5	lead scrap (18)	U	1801	2827	1.5697	83.5	

Table 6: Results of XRF analysis of the sampled Ickham material

year	SF no.	sample no.	bag description	class	Pb La	Sn Ka	Sn/Pb	%Sn	
ick74	1328	6	lead scrap (18)	U	11550	0	-0.014	0	
ick74	1330	1	pewter waste frag (9)	U	6566	2818	0.4292	56.6	
ick74	1330	2	pewter waste frag (9)	U	15229	83	0.0055	0	*
ick74	1330	3	pewter waste frag (9)	U	14888	218	0.0146	0	*
ick74	1330	4	pewter waste frag (9)	U	5646	316	0.056	14.5	
ick74	1330	5	pewter waste frag (9)	U	19936	107	0.0054	0	*
ick74	1332		pierced lead strip	A	14786	269	0.0182	0	*
ick74	1333		small lead bar	A	8160	458	0.0561	14.6	
ick74	1334		pewter bowl rim frag	T	4117	4512	1.1601	77.2	
ick74	1335	1	lead offcut (3)	O	13265	361	0.0272	0	*
ick74	1335	2	lead offcut (3)	O	15367	195	0.0127	0	*
ick74	1335	3	lead offcut (3)	O	15750	491	0.0312	2.42	
ick74	1337	1	lead dross (8)	S	10365	795	0.0767	21	
ick74	1337	2	lead dross (8)	S	9304	339	0.0364	5.64	
ick74	1337	3	lead dross (8)	S	9881	219	0.0222	0	*
ick74	1337	4	lead dross (8)	S	12031	323	0.0268	0	*
ick74	1337	5	lead dross (8)	S	14714	402	0.0273	0	*
ick74	1338		pierced lead disc	A	8175	1628	0.1991	40.8	
ick74	1635		lead runoff	S	3620	381	0.1052	27.6	
ick74	1712	i	pewterfragw/iron nail	A	2554	3745	1.5709	83.5	
ick74	1712	ii	pewterfragw/iron nail	A	489	1	0.5481	61.7	
ick74	1793	1	lead scrap (3)	U	18108	386	0.0213	0	*
ick74	1793	2	lead scrap (3)	U	8941	205	0.0229	0	*
ick74	1793	3	lead scrap (3)	U	14902	353	0.0237	0	*
ick74	1837		lead dross	S	16289	248	0.0152	0	*
ick74	1842		lead dross	S	13474	563	0.0418	8.48	
ick74	1843		lead runoff	S	12137	485	0.04	7.55	
ick74	1864		pewter bowl base	T	2682	2718	1.113	76.4	
ick74	1884		lead ferrule w/wood	A	13238	404	0.0305	1.98	
ick74	1885		lead weight	A	7354	4372	0.5945	63.4	
ick74	1886	1	lead runoff (7)	S	9931	1202	0.121	30.5	
ick74	1886	2	lead runoff (7)	S	12104	369	0.0305	1.96	
ick74	1886	3	lead runoff (7)	S	11996	346	0.0288	0.81	
ick74	1886	4	lead runoff (7)	S	10384	160	0.0154	0	*
ick74	1886	5	lead runoff (7)	S	16331	1051	0.0644	17.4	
ick74	1887	a	lead scrap (10)	U	10158	138	0.0136	0	*
ick74	1887	b	lead scrap (10)	U	11582	299	0.0258	0	*
ick74	1887	c	lead scrap (10)	U	15246	106	0.007	0	*
ick74	1887	d	lead scrap (10)	U	5938	5899	0.9934	74	
ick74	1887	e	lead scrap (10)	U	11380	55	0.0048	0	*
ick74	1888	1	lead dross (2)	S	3491	6866	1.9668	88.1	
ick74	1888	2	lead dross (2)	S	9910	4423	0.4463	57.5	
ick74	1917		folded pewter sheet	A	13610	600	0.0441	9.59	
ick74	1918		lead/pewter obj frag	A	11313	51	0.0281	0.28	
ick74	1922		lead scrap	U	9157	967	0.1056	27.7	
ick74	1924	1	lead scrap (2)	U	3764	595	0.1581	36	
ick74	1924	2	lead scrap (2)	U	10859	199	0.0183	0	*
ick74	1925		pewter bowl rim frag	T	15698	2129	0.1519	35.2	
ick74	1931	a	lead scrap (4)	U	19444	128	0.0066	0	*
ick74	1931	b	lead scrap (4)	U	19474	307	0.0158	0	*
ick74	1931	c	lead scrap (4)	U	10401	333	0.032	2.97	
ick74	1931	d	lead scrap (4)	U	15385	68	0.0044	0	*

Table 6: Results of XRF analysis of the sampled Ickham material

year	SF no.	sample no.	bag description	class	Pb La	Sn Ka	Sn/Pb	%Sn	
ick74	1971		lead obj	A	12604	208	0.0165	0	*
ick74	1978		pewter ferrule	A	6315	7508	1.1889	77.7	
ick74	1979		lead tube	A	22725	318	0.014	0	*
ick74	1984	1	lead/pewter slag (5)	U	8780	454	0.0517	12.9	
ick74	1984	2	lead/pewter slag (5)	U	614	11657	18.985	100	*
ick74	1984	3	lead/pewter slag (5)	U	8404	624	0.0743	20.4	
ick74	1984	4	lead/pewter slag (5)	U	10536	239	0.0227	0	*
ick74	1984	5	lead/pewter slag (5)	U	469	4579	9.7633	100	*
ick74	1987		pewter disc	A	385	4983	12.943	100	*
ick74	1997		lead roll w/wood	A	19151	1037	0.0541	13.8	
ick74	2001		rolled lead scrap	U	7519	1463	0.1946	40.3	
ick74	2012		pewter melt frag	S	9251	6722	0.7266	67.5	
ick74	2025		pewter frag	T	4654	12150	2.7024	94.7	
ick74	2030	1	twisted lead wire (3)	A	1954	0	0	0	
ick74	2030	2	twisted lead wire (3)	A	3380	0	0	0	
ick74	2030	3	twisted lead wire (3)	A	14643	0	0	0	
ick74	2032		pewter bowl frag	T	3675	8302	2.3344	91.7	
ick74	2036		lead offcut	O	12598	243	0.0193	0	*
ick74	2049		lead roll/weight	A	18213	682	0.0374	6.21	
ick74	2067		lead ball	A	15418	208	0.0135	0	*
ick74	2070		lead/pewter scrap	U	10019	4298	0.429	56.6	
ick74	2075	1	lead/pewterscrap(8)	U	11025	321	0.0291	1.01	
ick74	2075	2	lead/pewterscrap(8)	U	15052	639	0.0425	8.81	
ick74	2075	3	lead/pewterscrap(8)	U	14202	154	0.0108	0	*
ick74	2075	4	lead/pewterscrap(8)	U	12613	216	0.0171	0	*
ick74	2075	5	lead/pewterscrap(8)	U	18944	414	0.0219	0	*
ick74	2076		pewter obj	A	8642	6365	0.7365	67.8	
ick74	2083		pewter pulley block	A	2481	11179	4.5058	100	*
ick74	2088		pewter bar/handle	T	2488	7126	2.9715	96.7	
ick74	2091		lead slab	A	8186	196	0.0239	0	*
ick74	2093		lead strip	A	3150	7437	2.361	91.9	
ick74	2100	i	lead weight	A	10251	802	0.0782	21.4	
ick74	2100	ii	lead weight	A	14668	1364	0.093	25	
ick74	2102		lead spindle whorl	A	16152	308	0.0191	0	*
ick74	2105		pierced lead frag	A	6009	2332	0.3881	54.6	
ick74	2113	i	lead roll (2)	A	11084	284	0.0256	0	*
ick74	2113	ii	lead roll (2)	A	8157	768	0.0942	25.3	
ick74	2128		lead scrap	U	10594	369	0.0348	4.71	
ick74	2146		lead frag	F	1791	274	0.2691	47	
ick74	2231		iron slag		no tin or lead present			0	
ick74	2338		pewter roll	A	13493	590	0.0437	9.42	
ick74	2339		rolled lead scrap	U	7392	1658	0.2243	43.2	
ick74	2356	1	pewter scrap (3)	U	8252	8930	1.0822	75.8	
ick74	2356	2	pewter scrap (3)	U	16000	464	0.029	0.92	
ick74	2356	3	pewter scrap (3)	U	9673	171	0.0177	0	
ick74	2426	1	lead scrap (32)	U	9692	87	0.009	0	
ick74	2426	2	lead scrap (32)	U	16463	121	0.0073	0	
ick74	2426	3	lead scrap (32)	U	5844	6630	1.1345	76.8	
ick74	2426	4	lead scrap (32)	U	3600	13027	3.6186	100	*
ick74	2426	5	lead scrap (32)	U	11109	94	0.0085	0	
ick74	2427	1	lead runoff (7)	S	12444	1303	0.1047	27.5	
ick74	2427	2	lead runoff (7)	S	10692	158	0.0148	0	*

Table 6: Results of XRF analysis of the sampled Ickham material

year	SF no.	sample no.	bag description	class	Pb La	Sn Ka	Sn/Pb	%Sn	
ick74	2427	3	lead runoff (7)	S	8787	102	0.0116	0	*
ick74	2427	4	lead runoff (7)	S	16600	72	0.0043	0	*
ick74	2427	5	lead runoff (7)	S	10343	112	0.0108	0	*
ick74	2428	1	lead scrap/slag (3)	U	4961	213	0.0429	9.04	
ick74	2428	2	lead scrap/slag (3)	U	13702	97	0.0071	0	*
ick74	2428	3	lead scrap/slag (3)	U	14842	278	0.0187	0	*
ick74	2448	1	lead scrap (3)	U	5921	0	-0.002	0	*
ick74	2448	2	lead scrap (3)	U	8974	1975	0.2201	42.8	
ick74	2448	3	lead scrap (3)	U	17379	111	0.0064	0	*
ick74	2451		round lead binding	A	2522	9844	3.9033	100	*
ick74	2452		lead dross	S	7293	364	0.0499	12.2	
ick74	2453		lead strip/fitting	A	3475	3827	1.1013	76.1	
ick74	2471		rolled lead scrap	U	17789	497	0.0279	0.15	
ick74	2493		lead cylinder	A	12467	261	0.0209	0	*
ick74	2494	1	lead scrap (10)	U	7766	2618	0.3371	51.7	
ick74	2494	2	lead scrap (10)	U	10395	423	0.0407	7.93	
ick74	2494	3	lead scrap (10)	U	17083	116	0.0068	0	*
ick74	2494	4	lead scrap (10)	U	16510	428	0.0259	0	*
ick74	2494	5	lead scrap (10)	U	19693	130	0.0066	0	*
ick74	2532		folded lead scrap	S	10799	443	0.041	8.1	
ick74	2535		lead roll	A	15069	654	0.0434	9.26	
ick74	2539		lead dross	S	13318	170	0.0128	0	*
ick74	2540		lead runoff (2)	S	16431	231	0.0141	0	*
ick74	2541		lead offcut	O	13335	380	0.0285	0.56	
ick74	2626	1	lead runoff (31)	S	15286	163	0.0107	0	*
ick74	2626	2	lead runoff (31)	S	12204	428	0.0351	4.85	
ick74	2626	3	lead runoff (31)	S	412	16047	38.949	100	*
ick74	2626	4	lead runoff (31)	S	11154	2355	0.2111	42	
ick74	2627	1	lead dross (21)	S	15060	328	0.0218	0	*
ick74	2627	2	lead dross (21)	S	11164	226	0.0202	0	*
ick74	2627	3	lead dross (21)	S	17338	220	0.0127	0	*
ick74	2627	4	lead dross (21)	S	20124	223	0.0111	0	*
ick74	2627	5	lead dross (21)	S	13810	505	0.0366	5.72	
ick74	2636		pewter plug	A	2677	9696	3.622	100	*
ick74	2637		lump of lead(hollow)	A	11650	297	0.0255	0	*
ick74	1017a	a1	lead runoff (75)	S	3073	11582	3.769	100	*
ick74	1017a	a2	lead runoff (75)	S	6114	6499	1.063	75.4	
ick74	1017a	a3	lead runoff (75)	S	3643	12486	3.4274	99.6	
ick74	1017a	b1	lead runoff (75)	S	15124	1058	0.07	19.1	
ick74	1017a	b2	lead runoff (75)	S	15052	331	0.022	0	*
ick74	1017a	b3	lead runoff (75)	S	19395	386	0.0199	0	*
ick74	1017a	c1	lead runoff (75)	S	14724	181	0.0123	0	*
ick74	1017a	c2	lead runoff (75)	S	2228	11597	5.2051	100	*
ick74	1017a	c3	lead runoff (75)	S	14190	114	0.008	0	*
ick74	1329a	a	pewter runoff (12)	S	922	14584	15.818	100	*
ick74	1329a	b	pewter runoff (12)	S	12968	588	0.0453	10.2	
ick74	1329a	c	pewter runoff (12)	S	10641	47	0.0044	0	*
ick74	1329a	d	pewter runoff (12)	S	9533	6730	0.706	66.9	
ick74	1329a	e	pewter runoff (12)	S	8631	5163	0.5982	63.5	
ick74	146a	a1	lead scrap (30)	U	3083	4609	1.495	82.5	
ick74	146a	b1	lead scrap (30)	U	14976	262	0.0175	0	*
ick74	146a	b2	lead scrap (30)	U	20118	319	0.0159	0	*

Table 6: Results of XRF analysis of the sampled Ickham material

year	SF no.	sample no.	bag description	class	Pb La	Sn Ka	Sn/Pb	%Sn	
ick74	146a	b3	lead scrap (30)	U	6906	241	0.0349	4.75	
ick74	146a	c1	lead scrap (30)	U	14630	819	0.056	14.5	
ick74	146a	c2	lead scrap (30)	U	11384	225	0.0198	0	*
ick74	146a	c3	lead scrap (30)	U	13411	941	0.0702	19.2	
ick74	1970a		pewter plate frag	T	2584	373	0.2477	45.3	
ick74	1970b		pewter plate frag	T	3339	5268	1.6577	84.6	
ick74	1970c		pewter plate frag	T	894	2656	3.2696	98.6	
ick74	273a		pewter frag	F	4512	9747	2.2491	90.9	
ick74	790a	a i	lead run off (>100)	U	6444	7680	1.1918	77.8	
ick74	790a	a ii	lead run off (>100)	U	4482	4664	1.0406	75	
ick74	790a	b i	lead run off (>100)	U	21402	142	0.0066	0	*
ick74	790a	b ii	lead run off (>100)	U	10270	50	0.0049	0	*
ick74	790a	c	lead run off (>100)	U	5149	8096	1.5723	83.5	
ick74	790a	d	lead run off (>100)	U	14822	157	0.0106	0	*
ick74	790a	e	lead run off (>100)	U	10652	182	0.0171	0	*
ick74	836	5	pewter cylinder (18)	A	8574	359	0.0419	8.52	
ick74	836	6	pewter cylinder (18)	A	7370	188	0.0255	0	*
ick74	rs1	ob1	lead obj/scrap (103)	U	14044	601	0.0428	8.97	
ick74	rs1	ob2	lead obj/scrap (103)	U	15900	254	0.016	0	*
ick74	rs1	ob3	lead obj/scrap (103)	U	16881	238	0.0141	0	*
ick74	rs1	ob4	lead obj/scrap (103)	U	5416	102	0.0188	0	*
ick74	rs1	ob5	lead obj/scrap (103)	U	9500	2991	0.3148	50.2	
ick74	rs1	ob6	lead obj/scrap (103)	U	15523	208	0.0134	0	*
ick74	rs1	ob7	lead obj/scrap (103)	U	8248	2894	0.3509	52.5	
ick74	rs1	ob8	lead obj/scrap (103)	U	17944	107	0.006	0	*
ick74	rs1	ob9	lead obj/scrap (103)	U	5800	23	0.004	0	*
ick74	rs1	ob10	lead obj/scrap (103)	U	13898	1428	0.1027	27.1	
ick74	rs1	ob11	lead obj/scrap (103)	U	15090	98	0.0065	0	*
ick74	rs1	a1 -	lead obj/scrap (103)	U	10969	362	0.033	3.6	
ick74	rs1	a2	lead obj/scrap (103)	U	8160	112	0.0137	0	*
ick74	rs1	a3	lead obj/scrap (103)	U	8574	101	0.0118	0	*
ick74	rs1	a4	lead obj/scrap (103)	U	12253	675	0.0551	14.2	
ick74	rs1	a5	lead obj/scrap (103)	U	5825	78	0.0134	0	*
ick74	rs1	b1	lead obj/scrap (103)	U	9479	751	0.0792	21.7	
ick74	rs1	b2	lead obj/scrap (103)	U	12373	182	0.0147	0	
ick74	rs1	b3	lead obj/scrap (103)	U	10889	159	0.0146	0	*
ick74	rs1	b4	lead obj/scrap (103)	U	9674	326	0.0337	4.03	
ick74	rs1	b5	lead obj/scrap (103)	U	17177	158	0.0092	0	*
ick74	rs1	c1	lead obj/scrap (103)	U	19465	169	0.0087	0	*
ick74	rs1	c2	lead obj/scrap (103)	U	15643	93	0.0059	0	*
ick74	rs4		lead runoff	U	6233	339	0.0544	13.9	
ick74	rs5		lead runoff	U	9395	258	0.0275	0	*
ick74	rs6		lead runoff	U	8478	173	0.0204	0	*
ick74	rs7		lead offcut (3)	O	17753	687	0.0387	6.89	

Key to column 5	
T	tableware
A	artefact
O	offcut
F	fragment
S	spillage
U	undiagnostic waste

* these results were calculated as being below 0% and above 100%, due to the nature of the calibration and have been adjusted accordingly