# Characterisation studies of Anglo-Saxon pottery from Lundenwic: 3) Chaff-tempered wares

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One of the main wares found in the earlier phases of occupation at Lundenwic is chaff-tempered ware. These vessels are in the main crudely made and have abundant organic inclusions present. These have carbonised during firing and the carbon is usually diffused into the surrounding clay body so that the core, and often the surfaces, of the vessels are black. Sometimes the surfaces, especially the external surfaces, are oxidized and rarely the whole of the vessel is oxidized, although it is likely that in some of these instances the vessels, or broken sherds, have been accidentally burnt.

Vessels which are visually identical in appearance are found not only on Lundenwic sites but also on sites in the surrounding area. In this paper, the evidence from analysis of vessels from Lundenwic and sites to the east, north, south and west of the settlement is surveyed in an attempt to see whether or not the Lundenwic vessels were made in the settlement or imported from production sites in its hinterland.

A second strand to this study is to establish whether or not the parent clay used for the Lundenwic chaff-tempered vessels is the same as that used for other wares found there, in other words whether the potters of the chaff-tempered wares might have also been producing other fabrics.

Samples from six Lundenwic sites are studied here, together with material from Barking Abbey, Clapham, Enfield, Hammersmith and Harmondsworth (Table 1).

**Table 1**

| locality | Sitecode | TSNO | Total |
|---|---|---|---|
| Barking | ARP97 | AG348 | 1 |
| | | AG349 | 1 |
| City of Westminster | BOB91 | V1837 | 1 |
| | BRU92 | V1838 | 1 |
| | | V1839 | 1 |
| | KIN88 | V1840 | 1 |
| | lgc00 | V1490 | 1 |
| | rop95 | V1111 | 1 |
| | | V1112 | 1 |
| | sot89 | V1841 | 1 |
| | | V1842 | 1 |
| Clapham | LAM448 | V1126 | 1 |
| | | V1127 | 1 |
| Enfield | AYL90 | V1121 | 1 |
| Hammersmith | HAM90 | V1114 | 1 |

| | | | |
|---|---|---|---|
| | | V1115 | 1 |
| | | V1116 | 1 |
| Harmondsworth | M4M84 | V1122 | 1 |
| | | V1124 | 1 |
| | MFH88 | V1117 | 1 |
| | | V1118 | 1 |
| | | V1119 | 1 |
| Grand Total | | | 22 |

## Petrological analysis

These wares contain, by definition, very few large inclusions other than burnt-out chaff. Angular flint fragments were noted in 6 sections but their occurrence is probably random. In one case the flint was brown-stained and probably from a Tertiary deposit. Further sections of the sample samples might well have revealed flint in other samples. Similarly, rounded quartz grains with polished surfaces were noted in five samples, and subangular quartz grains up to 1.0mm across were noted in two others. These inclusion types are ubiquitous in the Thames basin and unless the relative frequency of these grains to each other and to other quartz sand grains in a sand can be estimated there is little that can be inferred about the source of the pottery from their occurrence.

The character of the groundmass, however, shows more potential. The groundmass can be divided into those with abundant fine quartz sand, with illsorted angular grains up to 0.2mm across, those with moderate quartz and muscovite silt. In addition, one of the samples has a groundmass with virtually no quartz inclusions at all and one contains grains of glauconite, alongside rounded, polished quartz grains up to 1.0mm across. These groups are coded here as FS (fine sand), SM (micaceous silt) , UN (inclusionless) and GL (glauconitic). Their distribution by site indicates that the fine sandy group occurs to the west of Lundenwic, but not in samples from the settlement itself, and that the glauconitic groundmass occurs to the east (Table 2). The silty micaceous groundmass, however, occurs on every site. One interpretation of this distribution would be that the four groundmass types indicate four separate sources for the pottery but the scarcity of inclusions over 0.2mm across makes it impossible to differentiate between vessels made from the same widely-distributed parent clay at one site from pots made locally on sites on or near the findspots.

**Table 2**

| Locality | FS | S | UN | GL | Grand Total |
|---|---|---|---|---|---|
| Barking | | 1 | | 1 | 2 |
| Hammersmith | 1 | 2 | | | 3 |
| Harmondsworth | 4 | 1 | | | 5 |
| City of Westminster | | 8 | 1 | | 9 |
| Clapham | | 2 | | | 2 |
| Enfield | | 1 | | | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Grand Total | 5 | 15 | 1 | | 1 | | | | 22 |

The fine sand groundmass probably either indicates the use of brickearth or an alluvial clay derived from reworking the brickearth. The silty micaceous clay is typical of the upper beds of the London clay, which outcrop to the east of London as well as forming the higher hills in the London area and further west. The inclusionless clay is more typical of the London clay in the area of the settlement itself. For the most part the clay would not have been exposed at Lundenwic itself but would have outcropped along the shoreline and the Fleet valley.

Thus, we can say that the presence of micaceous silt in the majority of the chaff-tempered pottery from Lundenwic is inconsistent with a source in the settlement itself but that suitable clays can probably be found widely, in every direction from Lundenwic.

## Chemical analysis

The 22 samples were analysed using Inductively Coupled Plasma Spectroscopy. The samples were cut off the main sherd and the surfaces were mechanically removed to lessen the possibility of contamination. However, it was impossible to completely remove this possibility because of the porous nature of the fabric. In thin section the voids that once contained chaff were filled with plant ash, mineral soil, phosphate concretions and calcareous concretions.

In order to ascertain which elements might be contaminants the correlation of all the measured elements with Al2O3, CaO, P2O5 and "silica" was calculated (Table 3). This shows that "silica" is correlated to some extent with Na2O. This is probably as a result of feldspar grains in the quartz sand fraction. Other than this, there is a slight correlation with Sm, but this is more highly correlated with Al2O3. CaO is strongly correlated with Sr, with P2O5, Fe2O3 and Ba. P2O5 is correlated with Sr, Ba, CaO and Fe2O3. Some of the minor elements are not closely correlated with any of these four groups and a decision was taken to include them in the study if they were more closely correlated with Al2O3 than with any of the other three groups. This produced a list of 20 elements which seem to have been present in the parent clay to a greater extent than in any contamination or tempering.

**Table 3**

| | Included? | "Silica" | Al2O3 | CaO | P2O5 |
|---|---|---|---|---|---|
| SiO2 | N | 1 | -0.805549398 | -0.735202061 | -0.548716763 |
| Al2O3 | Y | -0.805549398 | 1 | 0.300286391 | 0.090109132 |
| Fe2O3 | N | -0.821419864 | 0.46522584 | 0.675885689 | 0.47755864 |
| MgO | Y | -0.565613313 | 0.733860605 | 0.120981434 | -0.192075206 |
| CaO | N | -0.735202061 | 0.300286391 | 1 | 0.716677995 |
| Na2O | N | 0.188273408 | 0.042955886 | -0.350150068 | -0.442346897 |
| K2O | Y | -0.694368292 | 0.753854066 | 0.40852238 | -0.018923931 |
| TiO2 | Y | -0.550168008 | 0.810992868 | 0.010481504 | -0.038494358 |
| P2O5 | N | -0.548716763 | 0.090109132 | 0.716677995 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| MnO | Y | -0.106417329 | 0.049881551 | 0.036983834 | -0.101290658 |
| Ba | N | -0.334338504 | 0.013053463 | 0.559124117 | 0.844651095 |
| Cr | Y | -0.766712772 | 0.91217182 | 0.190344409 | 0.141314118 |
| Cu | N | -0.041346317 | -0.031908131 | -0.079126719 | 0.076487408 |
| Li | Y | -0.108816938 | 0.510849427 | -0.293575809 | -0.48246042 |
| Ni | Y | -0.602457756 | 0.653437435 | 0.28760916 | -0.014823509 |
| Sc | Y | -0.7546764 | 0.926354636 | 0.204558643 | 0.138303737 |
| Sr | N | -0.590022736 | 0.144199309 | 0.795402947 | 0.917094268 |
| V | Y | -0.785005902 | 0.844333683 | 0.286824069 | 0.104454307 |
| Y | N | -0.256933642 | 0.161223794 | 0.286095005 | 0.252253497 |
| Zr* | Y | -0.462235162 | 0.686129143 | 0.098229521 | 0.079817069 |
| La | Y | -0.240158372 | 0.391549357 | 0.149186388 | -0.076959616 |
| Ce | Y | -0.162346015 | 0.222673862 | 0.159385826 | 0.048050729 |
| Nd | Y | -0.276243356 | 0.41246116 | 0.199905921 | 0.009631439 |
| Sm | Y | 0.07928796 | 0.151444865 | -0.214397643 | -0.175547468 |
| Eu | Y | -0.21684081 | 0.268983425 | 0.122194717 | 0.061306268 |
| Dy | Y | -0.29618633 | 0.322083473 | 0.225991465 | 0.100402342 |
| Yb | Y | -0.434718355 | 0.472622935 | 0.276107545 | 0.164219001 |
| Zn | Y | -0.565841695 | 0.493779375 | 0.311949849 | 0.238246177 |
| Co | Y | -0.563026364 | 0.452957642 | 0.247061781 | 0.019568106 |

Factor analysis was then carried out on the reduced dataset. Three factors with eigenvalues above 1 were found and in total these account for 76% of the variance in the dataset.

A plot of Factor 1 (F1) scores against those for Factor 2 (F2) distinguishes the fine-textured sample from Lundenwic from the remainder (Fig 1) but there is no distinction between the fine sand and silty groups. The glauconitic sample is peripheral, but plots alongside one of the fine sandy samples from Hammersmith. However, a plot of F1/F3 separates the glauconitic sample but makes no distinction between the fine-textured, silty micaceous and fine sandy groups.

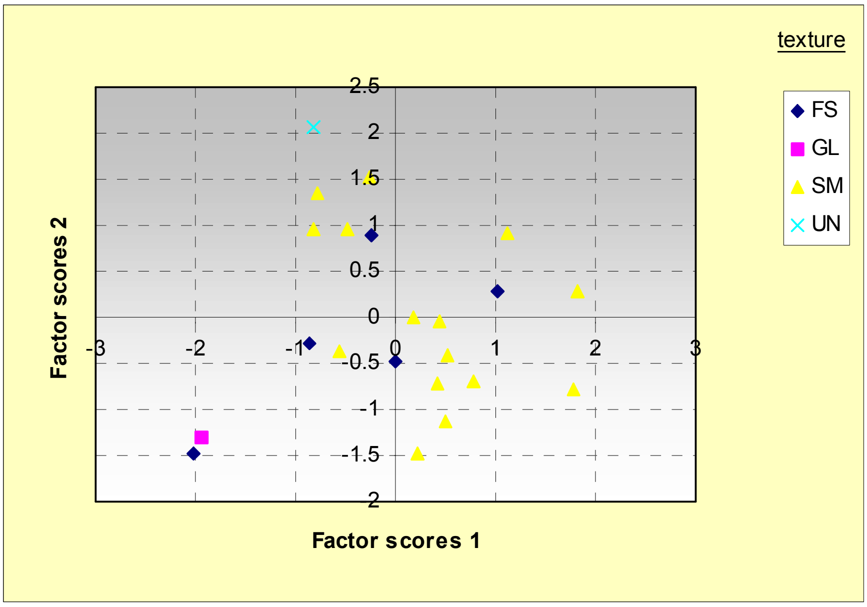


**Figure 1**

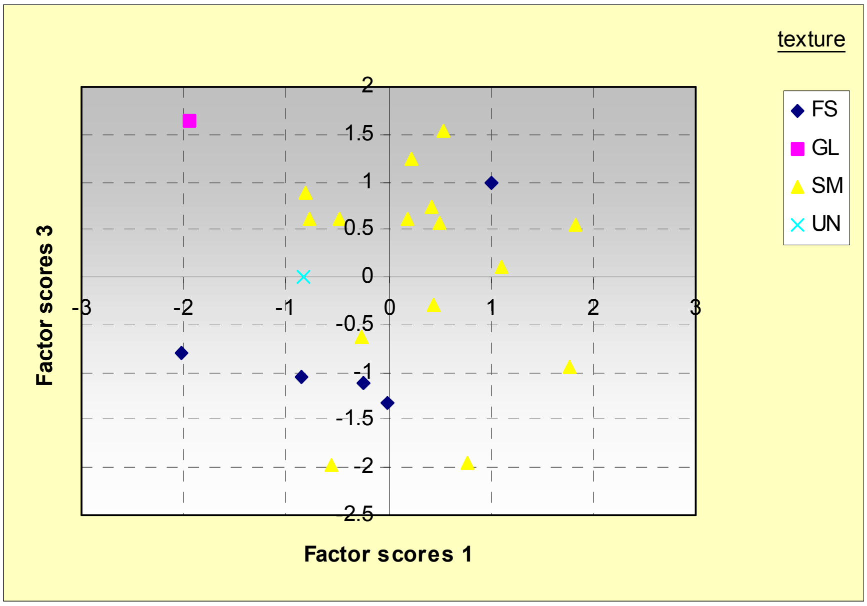


**Figure 2**

Thus, the chemical analysis fails to confirm the significance of these three groups. The same F1/F2 plot grouped by locality (Fig 3) shows that the single Enfield sample is peripheral but that the Clapham, Hammersmith and Harmondsworth samples cannot be chemically separated. Clearly, one or two samples from a site is in any case insufficient to characterise the chemical composition of the chaff-tempered ware but even this study has shown that there is no clear evidence for separate sources.

The next stage in the study was to take the same restricted dataset for other wares found at Lundenwic to compare the compositions of their parent clays. A large amount of comparative data is now available for the composition of Roman and medieval wares in the Thames basin. From this, material from three whiteware production sites/waster dumps from Kingston and Southwark, a group of greyware wasters from the Fleet valley and material from the early Roman production site at Sugar Loaf Court in the City of London were chosen for comparison. The clays used in these three industries appear to be the Reading Beds, London clay with sand temper and untempered London clay respectively. The results of this show that neither the chaff-tempered pottery nor the other sampled coarsewares from Lundenwic were comparable with any of the kiln products. One notable feature is that there is a higher degree of variation in the chaff-tempered and other coarsewares than in any of the waster assemblages except for the group of Lundenwic coarseware sherds containing ooliths.

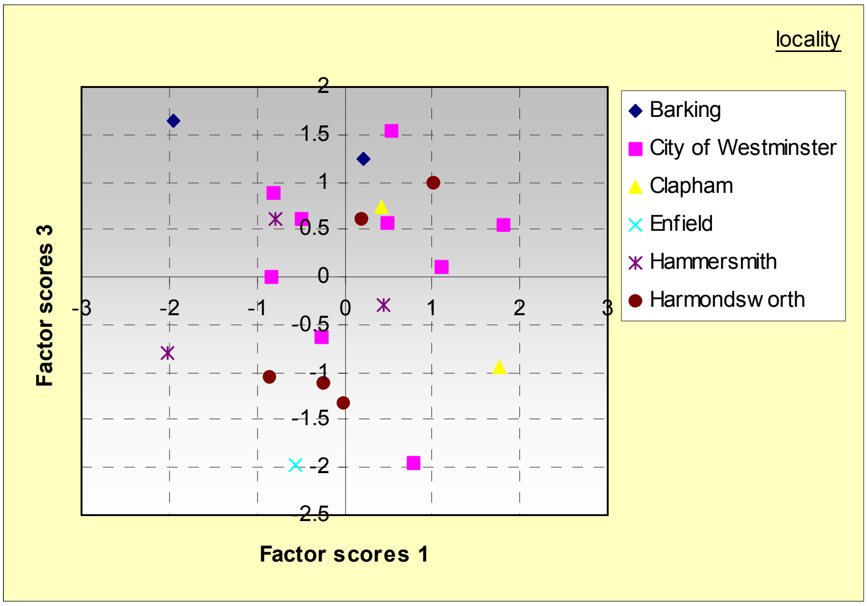


**Figure 3**

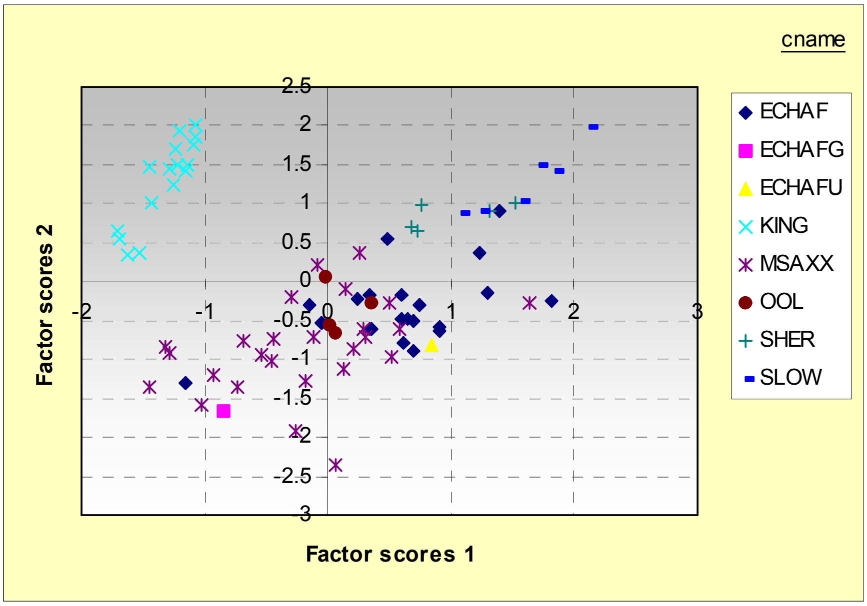


**Figure 4**

The conclusion of this analysis is that some of the tempered coarsewares from Lundenwic have a chemically similar groundmass to the chaff-tempered wares whilst others (principally those with haematite-coated quartz sand temper) are clearly made from a different clay.

To conclude, there are only four significant fabric groups within these chaff-tempered wares, and the most common two fabric groups share the same chemical composition. The main group appears to have been made from a silty micaceous clay unlike the London Clay which underlies the Lundenwic site and which would have been available wherever the brickearth covering was absent. Therefore, it is likely that the vessels were made outside of the settlement. However, from the evidence presented here it is unlikely that they were made to the east but might have been made to the north, west or south, utilising a silty outcrop of the London clay. The one sample which on petrological grounds might have been made from local London Clay has a chemical composition which is distinct from that of locally made Roman and medieval pottery.

# Appendices

## Appendix 1a. Major elements (percent oxides)

| TSNO | SiO2 | Al2O3 | Fe2O3 | MgO | CaO | Na2O | K2O | TiO2 | P2O5 | MnO |
|---|---|---|---|---|---|---|---|---|---|---|
| AG348 | 80.01 | 10.87 | 3.83 | 0.91 | 1.03 | 0.26 | 1.9 | 0.54 | 0.47 | 0.18 |
| AG349 | 71.17 | 13.46 | 8.06 | 1.29 | 1.44 | 0.42 | 2.26 | 0.74 | 1 | 0.16 |
| V1111 | 73.76 | 13.06 | 6.41 | 1.21 | 1.44 | 0.47 | 2.09 | 0.66 | 0.83 | 0.07 |
| V1112 | 73.54 | 14.06 | 4.83 | 1.7 | 1.1 | 0.46 | 2.93 | 0.8 | 0.45 | 0.13 |
| V1114 | 72.45 | 13.29 | 6.34 | 1.39 | 1.51 | 0.38 | 2.4 | 0.6 | 1.62 | 0.02 |
| V1115 | 71.35 | 14.56 | 5.87 | 1.68 | 1.59 | 0.18 | 2.47 | 0.76 | 1.51 | 0.03 |
| V1116 | 76.55 | 10.35 | 6.01 | 0.78 | 1.88 | 0.1 | 1.46 | 0.57 | 2.29 | 0.01 |
| V1117 | 69.31 | 14.44 | 5.72 | 0.94 | 2.25 | 0.3 | 2.21 | 0.77 | 4.01 | 0.05 |
| V1118 | 61.42 | 16.58 | 9.11 | 1.48 | 2.8 | 0.33 | 3.42 | 0.77 | 3.98 | 0.11 |
| V1119 | 67.09 | 14.6 | 7.08 | 1.37 | 2.19 | 0.32 | 2.79 | 0.77 | 3.69 | 0.1 |
| V1121 | 71.81 | 13.27 | 6.82 | 0.77 | 1.23 | 0.33 | 1.38 | 0.74 | 3.61 | 0.04 |
| V1122 | 76.49 | 12.19 | 5.42 | 0.94 | 1.07 | 0.41 | 1.93 | 0.76 | 0.76 | 0.03 |
| V1124 | 74.16 | 13.83 | 5.88 | 1.27 | 1.11 | 0.48 | 2.12 | 0.81 | 0.3 | 0.04 |
| V1126 | 65.63 | 16.68 | 8.23 | 1.9 | 1.79 | 0.19 | 2.79 | 0.88 | 1.84 | 0.07 |
| V1127 | 66.88 | 14.13 | 9.29 | 1.38 | 1.96 | 0.18 | 2.38 | 0.73 | 2.97 | 0.1 |
| V1490 | 66.69 | 14.57 | 8.34 | 1.75 | 2.38 | 0.24 | 3.29 | 0.74 | 1.92 | 0.08 |
| V1837 | 71.263 | 16.07 | 5.28 | 1.76 | 0.92 | 0.371 | 3.13 | 0.9 | 0.28 | 0.03 |
| V1838 | 67.32 | 16.52 | 7.25 | 2.16 | 1.56 | 0.323 | 3.01 | 0.88 | 0.83 | 0.15 |
| V1839 | 70.747 | 13.41 | 7.06 | 1.3 | 2.09 | 0.466 | 2.74 | 0.74 | 1.37 | 0.08 |
| V1840 | 71.758 | 14.65 | 6.66 | 1.04 | 1.49 | 0.57 | 2.67 | 0.68 | 0.4 | 0.08 |
| V1841 | 70.043 | 16.09 | 6.43 | 1.41 | 1.66 | 0.285 | 2.55 | 0.84 | 0.66 | 0.03 |
| V1842 | 72.301 | 14.39 | 6.56 | 1.13 | 1.53 | 0.399 | 2.07 | 0.7 | 0.82 | 0.1 |

**Appendix 1b. Minor and trace elements (parts per million)**

| TSNO | Ba | Cr | Cu | Li | Ni | Sc | Sr | V | Y | Zr* | La | Ce | Nd | Sm | Eu | Dy | Yb | Zn | Co |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AG348 | 550.00 | 85.00 | 87.00 | 36.00 | 54.00 | 11.00 | 105.00 | 92.00 | 22.00 | 57.00 | 33.00 | 59.00 | 29.00 | 5.80 | 0.90 | 2.80 | 1.50 | 89.00 | 11.00 |
| AG349 | 551.00 | 113.00 | 86.00 | 42.00 | 55.00 | 16.00 | 139.00 | 153.00 | 27.00 | 77.00 | 38.00 | 62.00 | 25.00 | 5.50 | 0.90 | 3.00 | 1.90 | 137.00 | 26.00 |
| V1111 | 430.00 | 96.00 | 28.00 | 71.00 | 54.00 | 15.00 | 142.00 | 111.00 | 51.00 | 101.00 | 53.00 | 106.00 | 57.81 | 11.84 | 2.79 | 8.50 | 4.00 | 144.00 | 20.00 |
| V1112 | 701.00 | 110.00 | 30.00 | 58.00 | 53.00 | 16.00 | 143.00 | 126.00 | 23.00 | 86.00 | 28.00 | 57.00 | 30.64 | 5.67 | 1.31 | 4.60 | 2.50 | 172.00 | 20.00 |
| V1114 | 725.00 | 104.00 | 27.00 | 64.00 | 56.00 | 15.00 | 178.00 | 122.00 | 41.00 | 76.00 | 47.00 | 106.00 | 50.95 | 9.86 | 2.39 | 7.20 | 3.50 | 135.00 | 19.00 |
| V1115 | 766.00 | 114.00 | 37.00 | 51.00 | 59.00 | 16.00 | 171.00 | 141.00 | 34.00 | 100.00 | 41.00 | 74.00 | 43.71 | 7.25 | 1.73 | 5.50 | 3.10 | 171.00 | 18.00 |
| V1116 | 775.00 | 79.00 | 19.00 | 26.00 | 35.00 | 11.00 | 239.00 | 92.00 | 21.00 | 70.00 | 30.00 | 53.00 | 31.21 | 2.90 | 0.82 | 3.20 | 2.00 | 107.00 | 12.00 |
| V1117 | 1,251.00 | 107.00 | 41.00 | 52.00 | 50.00 | 16.00 | 281.00 | 122.00 | 39.00 | 107.00 | 52.00 | 102.00 | 54.90 | 8.31 | 1.94 | 6.40 | 3.20 | 162.00 | 15.00 |
| V1118 | 1,022.00 | 131.00 | 38.00 | 44.00 | 67.00 | 18.00 | 256.00 | 155.00 | 37.00 | 94.00 | 44.00 | 80.00 | 47.28 | 7.56 | 1.97 | 6.30 | 3.50 | 150.00 | 22.00 |
| V1119 | 887.00 | 115.00 | 37.00 | 39.00 | 65.00 | 16.00 | 248.00 | 130.00 | 34.00 | 90.00 | 43.00 | 72.00 | 45.97 | 7.07 | 1.73 | 5.90 | 3.00 | 143.00 | 17.00 |
| V1121 | 868.00 | 107.00 | 54.00 | 42.00 | 42.00 | 16.00 | 215.00 | 120.00 | 30.00 | 95.00 | 37.00 | 69.00 | 39.57 | 6.37 | 1.65 | 5.10 | 3.00 | 145.00 | 11.00 |
| V1122 | 488.00 | 106.00 | 33.00 | 54.00 | 48.00 | 14.00 | 85.00 | 108.00 | 27.00 | 83.00 | 39.00 | 65.00 | 41.17 | 6.73 | 1.67 | 4.80 | 2.50 | 90.00 | 12.00 |
| V1124 | 433.00 | 107.00 | 30.00 | 55.00 | 50.00 | 15.00 | 84.00 | 120.00 | 25.00 | 106.00 | 40.00 | 68.00 | 41.74 | 6.15 | 1.43 | 4.40 | 2.50 | 145.00 | 14.00 |
| V1126 | 506.00 | 134.00 | 62.00 | 63.00 | 54.00 | 19.00 | 174.00 | 174.00 | 27.00 | 111.00 | 38.00 | 65.00 | 40.04 | 5.71 | 1.44 | 4.60 | 2.80 | 175.00 | 20.00 |
| V1127 | 616.00 | 117.00 | 67.00 | 33.00 | 61.00 | 16.00 | 236.00 | 143.00 | 29.00 | 97.00 | 36.00 | 61.00 | 38.54 | 5.08 | 1.46 | 5.00 | 2.90 | 157.00 | 27.00 |
| V1490 | 686.00 | 106.00 | 41.00 | 49.00 | 61.00 | 16.00 | 216.00 | 151.00 | 34.00 | 74.00 | 42.00 | 84.00 | 44.84 | (0.09) | 1.58 | 5.70 | 2.90 | 207.00 | 21.00 |
| V1837 | 500.00 | 129.00 | 31.00 | 67.00 | 66.00 | 18.00 | 135.00 | 160.00 | 34.00 | 96.00 | 54.00 | 86.00 | 56.78 | 9.92 | 2.03 | 6.40 | 3.30 | 101.00 | 24.00 |
| V1838 | 535.00 | 128.00 | 40.00 | 79.00 | 65.00 | 18.00 | 163.00 | 163.00 | 27.00 | 114.00 | 47.00 | 78.00 | 50.01 | 7.93 | 1.79 | 6.20 | 3.40 | 233.00 | 24.00 |
| V1839 | 516.00 | 102.00 | 27.00 | 53.00 | 58.00 | 14.00 | 174.00 | 126.00 | 33.00 | 90.00 | 52.00 | 76.00 | 55.37 | 9.78 | 2.11 | 6.90 | 3.40 | 93.00 | 21.00 |
| V1840 | 391.00 | 101.00 | 24.00 | 59.00 | 61.00 | 14.00 | 107.00 | 107.00 | 28.00 | 76.00 | 55.00 | 95.00 | 56.96 | 8.90 | 1.83 | 5.60 | 2.80 | 109.00 | 16.00 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| V1841 | 408.00 | 117.00 | 53.00 | 53.00 | 52.00 | 18.00 | 147.00 | 140.00 | 23.00 | 116.00 | 42.00 | 62.00 | 43.33 | 5.37 | 1.15 | 4.10 | 2.70 | 109.00 | 11.00 |
| V1842 | 608.00 | 110.00 | 26.00 | 55.00 | 54.00 | 17.00 | 138.00 | 129.00 | 39.00 | 107.00 | 51.00 | 95.00 | 55.65 | 11.53 | 2.34 | 8.20 | 4.20 | 135.00 | 16.00 |