Petrological and chemical analysis of clay object from Pode Hole Quarry, Thorney, Cambridgeshire

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A clay object excavated at Pode Hole Quarry by Network Archaeology Ltd in 2000 was submitted for identification and assessment. The function of the object was unknown, nor was it clear whether it was locally produced or imported to the site. For these reasons, it was recommended that the object be examined in thin-section and chemical analysis.

Methodology

A thin-section of the object was produced at the Department of Earth Sciences, University of Birmingham and given the identifier V1224. A sample of the uncontaminated core of the object was powdered and submitted to Royal Holloway College, London for analysis using Inductively Coupled Plasma Spectroscopy.

Results

Thin-section analysis showed that the object was composed of poorly mixed clay and sand. The clay was fine-textured and contained few large inclusions apart from sparse voids indicating the presence at one time of thin-walled shell up to 2.0mm long, possibly from marine bivalves or freshwater mollusca, both of which have thinner walls than species living in the inter-tidal zone. The sand was rich in quartzose inclusions, including subangular monocrystalline quartz grains, finegrained quartz siltstones or sandstones, subangular chert all up to 0.3mm. Sparse angular flint and rounded quartz grains, up to 1.0mm across, were also present. Angular quartz silt was present in the sand lenses.

The colour and appearance of the clay indicates that it was formed by firing a calcareous marl at a sufficiently high temperature for the calcium carbonate and clay minerals to form a yellowish ceramic. Similar clays have been noted on various sites in south Lincolnshire and Cambridgeshire. They include samples of Kimmeridge Clay from Ely and shell-tempered wares of Iron Age and Romano-British date which were probably produced from a shelly facies of the Oxford Clay. The sparse, thin-walled shells are similar in frequency and appearance to those found in the Ely Kimmeridge Clay samples.

The sand contains no calcareous fragments or voids where such inclusions might have been leached out. The range and relative frequency of the inclusions in the sand show that it is typical of those found in Lincolnshire and the Trent valley.

The petrological evidence therefore suggests that the object was produced from a Jurassic clay, possibly the Kimmeridge Clay, poorly mixed with a superficial detrital sand.

Chemical analysis

The percentage of the following major elements were measured as percentage oxides: SiO_2, Al_2O_3, Fe_2O_3, MgO, CaO, Na_2O, K_2O, TiO_2, P_2O_5, MnO. The following minor elements were measured as parts per million: Ba, Co, Cr, Cu, Li, Ni, Sc, Sr, V, Y, Zn, Zr, La, Ce, Nd, Sm, Eu, Dy, Yb. The measurement of Zr is possibly too low because of the difficulty in dissolving Zr.

These results were compared with those from various south Lincolnshire and Cambridgeshire clays and pottery fabrics. Extreme variations in the quantity of CaO in these samples (ranging from 0.6% to 27.9%) makes statistical comparison difficult since this major variation will mask other differences. Using Principal Components Analysis, the first two components (ie those accounting for the most variation between samples in the dataset) show that the PHQ sample is most similar to those from Ely. However, the third and fourth components separate the PHQ and Ely samples and instead plot the PHQ sample close to those of Roman kiln products from Cambridgeshire. Component 5 separates the PHQ sample from all the rest, mainly on the basis of its high NaO content.

The Na_2O content of the sample at 0.57% is quite low. Samples containing abundant feldspars can have upwards of 2% Na_2O. However, the PHQ value is higher than that of any of the comparanda. No feldspars were noted in thin-section but small grains can be extremely difficult to distinguish from quartz unless they exhibit twinning or cleavage. The Ba content of the PHQ sample is also higher than in any of the comparative samples. Ba values typically show a wide variation within one fabric and this probably indicates that the Barium occurs as stray grains, possibly of Barytes.

The chemical composition does not significantly alter or amplify the results of the thin-section analysis in this case.

Conclusion

The PHQ clay object was probably produced from a mixture of Jurassic marl and a superficial quartzose sand. Such raw materials are widely distributed around the western Fen edge and there is no reason to suppose that the object was imported to the site from any distance.

There is no evidence from either analysis for the function of the object, although the degree of firing shown in thin-section suggests that the object was subjected to significant heat, not merely accidentally burnt.