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# A PETROLOGICAL NOTE ON THE CRUCIBLE FABRICS FROM MEDIEVAL AND POST-MEDIEVAL GLASSMAKING FURNACES AT WOLSELEY, STAFFS AND OTHER SITES

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Summary

A petrological examination was made of a number of ceramic crucibles used at two separate glassworking furnaces at Little Birches during the Medieval and post-Medieval periods. Also submitted were furnace linings and samples of local stone, as well as comparative samples of crucibles from other glassworking sites of the same period. The main objective of the analysis was to see if the same fabric had been used for the crucibles from both furnaces, additionally if an estimation of the firing temperature could be made. Thin sectioning suggests that the same clay had been used for the majority of crucible samples from both kilns, quite possibly a local fireclay from Cannock Chase. Similarities were also noted between the fabric of the crucibles from Little Birches and those from nearby Bagot's Park and Cattail Pool. The formation of glass and mullite crystals in most of the crucibles from Little Birches suggests that a minimum temperature of 1100-1200C degrees was reached in the furnace.

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# A PETROLOGICAL NOTE ON THE CRUCIBLE FABRICS FROM THE TWO MEDIAEVAL AND POST-MEDIAEVAL GLASSMAKING FURNACES AT LITTLE BIRCHES, WOLSELEY, RUGELEY, STAFFORDSHIRE AND OTHER SITES

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## INTRODUCTION

A number of clay crucibles used in the glassworking process at the production site of Little Birches, Rugeley, during the Mediaeval and post-Mediaeval periods, were submitted for thin sectioning and petrological examination of the fabrics under the polarizing microscope. The samples chosen, some of which display a variety of form, were representative of the large quantities of broken crucible fragments found at the two furnace complexes located at the site, and had previously been divided into provisional fabric types by eye. Also submitted were furnace linings and samples of local stone. The Lower Furnace at Little Birches provisionally dates to the thirteenth or perhaps fourteenth centuries A.D., while the Upper Furnace is more closely dated to around the middle of the sixteenth century A.D.

All of the crucible fragments from Little Birches are in a hard, coarse, sandy clay, ranging in colour from a lightish red to a light grey, and occasionally they have a thick coat of glass covering the internal surface of the vessel. The main object of the petrological analysis was to characterize the fabric of the crucible samples and see if any significant variation could be noted. For comparative purposes a smaller batch of crucible samples were submitted from five roughly contemporary glassworking sites. Two of these are located in Surrey, Blunden's Wood, Hambledon, and Knighton's, Alfold, dated to the fourteenth century A.D. and the 1560's A.D. respectively [Wood, 1965; 1982]. With material from the remmaining three sites coming from Staffordshire, Bagot's Park, Abbot's Bromley [Crossley, 1967], and Red Street, dated to the 1530's A.D. and the ?1620's A.D. respectively. While two crucibles were also submitted from a glass furnace site at Cattail Pool, one mile east of Little Birches and dated to the fifteenth/sixteenth century A.D.

PETROLOGY

Little Birches: Lower Furnace Site

[1]. Fabric Type 1 (116).

A groundmass of abundant silt-sized quartz grains, together with moderately frequent slightly larger-sized subangular quartz grains normally below 0.30mm across but with a few grains reaching 0.50mm. Many of these larger quartz grains are often cracked in appearance, possibly due to exposure to high temperatures followed by rapid cooling. Also present are some small shreds of mica.

[2]. Fabric Type 2 (116).

A clean clay matrix containing frequent subangular to subrounded ill-sorted quartz grains ranging up to 0.80mm in size, but with the majority of grains smaller than this, together with a little quartzite, some strands of mica, chert/flint, a few clay pellets and some small pieces of quartz-rich sandstone.

[3]. Fabric Type 3 (86).

[4]. Fabric Type 4 (116).

[5]. Fabric Type 5 (116).

[9]. Fabric Type 9 (116).

[10]. Fabric Type 10 (116).

It is possible that this might be a higher-fired version of no. [2]. It has a fairly clean, dense clay matrix, although with more frequent grains of quartz than are present no. [2]. Most noticeably, scattered throughout the section are small fragments of glass, generally rounded or subrounded. In some of these glass fragments small accicular crystals of mullite can be seen, commonly in fibrous aggregates and sometimes arranged around spherical pores. On occasions these can be seen "flowing" around and encapsulating, or partially encapsulating, quartz grains. The section for no. [5] shows the glass on the internal surface of the crucible penetrating the core of the vessel up to a depth of 70mm.

[6]. Fabric Type 6 (86).

[7]. Fabric Type 7 (116).

Frequent subangular quartz grains generally under 0.40mm in size, but with a few slightly larger grains, together with shreds of mica, some quartzite, quartz-rich sandstone and common inclusions of glass, some pieces containing mullite crystals. The groundmass is not as clean as it is in Nos. [2-5].

[8]. Fabric Type 8 (116).

Somewhat similar to No. [2], with a clean clay matrix predominantly containing quartz grains and no sign of glass within the clay body.

Little Birches, Upper Furnace Site

[11]. Fabric Type 101 WTIP S1/4.

[12]. Fabric Type 101 ETIP NW1/4.

[13]. Fabric Type 102 (11).

[15]. Fabric Type 104 WTIP N1/4.

[16]. Fabric Type 106 ETIP NW1/4.

[17]. Fabric Type 107 ETIP NW1/4.

[18]. Fabric Type 108 (64).

Frequent ill-sorted subangular quartz grains ranging up to 0.80mm across set in a fairly clean dense clay matrix. Scattered throughout are flecks of mica and some small pieces of quartz-rich sandstone and chert, together with a number of small pieces of glass, some of which contain radiating crystals of mullite. This group appears somewhat similar to the fabric of the crucibles from the Lower site nos. [3]-[5] and [9]-10], although in general the clay matrix is a little denser, perhaps indicating exposure to a slightly higher temperature.

[14]. Fabric Type 103 WTIP S1/4 (45).

This fabric could be similar to those of the above group, although it is not as high fired and there is no sign of any glass in the clay matrix.

CATTAIL POOL

[19]. Crucible from Cattail Pool: surface coll. 120/230. This sample appears somewhat similar to nos. [11]-[13] and [15]-[18].

[20]. Crucible from Cattail Pool: surface coll. 110/200. This is a distinctive fabric, with the non-plastic inclusions comprising frequent well-sorted subangular quartz grains generally below 0.20mm in size, flecks of mica and some small fragments of a quartz-rich sandstone.

LITTLE BIRCHES

[21]. Furnace fragment from Upper site: context 21. Probably burnt Bunter sandstone with some glass fragments containing mullite crystals. ?Local.

[22]. Furnace fragment from Lower site: context 116 [from within trough of Lower furnace]. As for no. [21].

[23]. Furnace fragment from Lower site: context 116. As for no. [21].

[24]. Burnt stone from Upper site: WTip N1/4 ctxt 41. A much finer-grained sandstone than the other sandstone material submitted. Difficult to provenance.

[25]. Burnt stone from Lower site: 120-125/240-245, F2. Burnt Lower Keuper sandstone. Very similar to no. [26]. ?Local.

[26]. Local Keuper sandstone collected from SK023198.

[27]. Clay from Lower site: context 116, in F2. Lining to furnace arch?

A very clean, hard fired clay matrix with moderately frequent quartz grains and fragments of glass, some of which contain radiating mullite crystals. This sample of clay appears similar to crucible samples nos. [3-5] and [9-10] from the Lower Furnace site, except that there are slightly less quartz grains present and the clay matrix is denser.

[28]. Clay from Upper site. ETip NW1/4.

The clay matrix contains frequent small quartz grains, with a moderate scatter of larger [?added] grains and some small fragments of glass.

[29]. Glasswaste lumps from Upper site: context 45 WTip S1/4

Many of these samples of glass waste contain small white quartzite pebbles, presumably added instead of, or in addition, to quartz sand. These small pebbles appear to be the same as the white quartzite pebbles collected from the site [see sample 45].

BLUNDEN'S WOOD, SURREY [Thirteenth century A.D.]

[30]. Crucible comparable with LBW type 1 [sample 1].
Access. no. AS3477.

[32]. Crucible comparable with LBW type 6 [sample 6].
Access. no. AS3479.

[33]. Crucible comparable with LBW type 7 [sample 7].
Access. no. AS3470.

[34]. Crucible comparable with LBW type 7 [sample 7].
Access. no. AS3470.

Frequent fairly well-sorted subangular quartz grains, average size below 0.30mm, with some flecks of mica and a few small fragments of glass, some containing radiating mullite crystals, set in a dense clay matrix.

[31]. Crucible comparable with LBW type 3 [sample 3].
Access. no. AS3500.

Similar to nos. [30] and [32-34] but with a less dense clay matrix and no sign of any glass fragments.

[35]. Crucible comparable with LBW type 10 [sample 10].
Access. no. AS3465.

Similar to nos. [30] and [32-34] but with slightly more quartz grains present.

[36]. Furnace fragment comparable with LBW [sample 22].

Medium-grained sandstone.

KNIGHTON'S, ALFOLD, SURREY [Early sixteenth century A.D.]

[37]. Crucible. Access. no. AS4847.

[38]. Crucible. Access. no. AS4920.

[40]. Crucible. Access. no. AS4847.

A groundmass of silt-sized quartz grains together with moderately frequent larger quartz grains, average size below 0.30mm, flecks of mica and sparse small fragments of glass, set in a dense clay matrix.

[39]. Crucible. Access. no. AS4956.

Similar to nos. [37]-[38] and [40] but in a less dense, lower fired, clay matrix with no sign of glass fragments.

RED STREET, NORTH STAFFORDSHIRE [SJ8351]

[41]. Crucible. Access. no. RS82 1000.

Frequent subangular grains of quartz generally under 0.20mm in size, together with a few flecks of mica and some quartz-rich sandstone. This fabric appears very similar to Cattail Pool no. [20].

BAGOT'S PARK, ABBOT'S BROMLEY, STAFFORDSHIRE [Crossley, 1967]

[42]. Crucible comparable with LBW type 101 [sample 11]. Access. no. BP66 4C 88.

[43]. Crucible comparable with LBW type 102 [samples 12 and 13]. Access no. BP66 4C 72.

Moderately frequent subangular quartz grains, average size around 0.30mm-.40mm, across but with some slightly larger grains, together with flecks of mica, some chert/flint, quartz-sandstone and fragments of glass, set in a dense clay matrix. Some pieces of the glass display radiating mullite crystals [see also Holdridge, 1967]. The fabric of these two crucibles is not too unlike those from Little Birches Upper site nos. [11-13] and [15-18], although the latter tend to be slightly sandier.

LITTLE BIRCHES

[44]. Bunter sandstone collected from the site.

This appears to be generally the same as the sandstone from samples nos. [21]-[26].

[45]. White pebbles collected from the site.

These are small quartzite pebbles that seem to have been used in the glass making process - see sample [29].

COMMENTS

Little Birches is situated in an area of Triassic formations, and lies on Lower Keuper Sandstone, near Bunter Pebble Beds and Keuper Marl [1" Map Geological Survey of Gt. Britain Sheet no. 140]. It seems unlikely that any of the local clays would have been suitable for use as glassworking crucibles, which would be expected to withstand high temperatures. Instead, a fireclay such as those of the Coal Measures of the nearby Cannock Chase area should perhaps be considered.

In recent times these clays have been widely used for lining furnaces and making crucibles, due to their especial refractory properties [Highley, 1982]. Moreover, they contain a high amount of kaolinite, which converts to mullite on heating and forms a glass on cooling, which increases the strength of the fired product [*ibid.*, 7]. Bearing this in mind, it may be significant that small fragments of glass containing crystals of mullite have been noted in the majority of crucible samples examined above. These would have formed due to a chemical reaction within the clay matrix upon exposure to great heat, rather than any "seepage" of the manufactured glass from the external surfaces of the crucibles. They have also been noted in some of the furnace fragments from Little Birches. These glass and mullite inclusions have previously been recognized in a fragment of crucible from Bagot's Park, where attention was drawn to the fireclays of the Cannock coalfield as a possible source for the clay [Holdridge, 1967]. Two samples of crucible from

Bagot's Park have been included in the present programme. and the points of similarity with many of the crucibles examined from nearby Little Birches and also one from at Cattail Pool, suggests that they may share a common source of clay.

Some of the crucible samples from the two Surrey sites of Blunden's Wood and Knighton's were also found to contain fragments of glass in the clay matrix. At both sites a non-local source for the clay was ruled out [Wood. 1965. 70; 1982. 58]. However, it is difficult to suggest on purely petrological grounds that fireclays were also used in both cases, given the common range of non-plastic inclusions present. though it is worth consideration.

It is difficult to estimate with any degree of accuracy the likely temperature, or temperatures, that the above crucibles would have been exposed to in the furnace. However, taking into account the formation of glass and mullite inclusions within many of the crucible clay bodies, a minimum temperature of between 1100-1200C degrees might perhaps be expected. However. a smaller number of crucible fragments were not seen to contain any visible glass, and in these cases this high temperature may well not have been reached. It is possible, for example. that these vessels may have been used for a slightly different function from those crucibles which contain glass fragments, or that they collapsed before this temperature was reached.

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