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Investigating the deterioration of English Heritage glass collections

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Introduction

The deterioration of glass happens mostly through its interaction with water, which leaches out the alkali that were used for fluxing and leaves behind a vulnerable, hydrated corrosion crust. The speed and expression of this degradation largely depend on the degree of the material's polymerisation as well as surrounding environmental factors[1]. However, the understanding of the exact mechanisms of this phenomenon is incomplete. Weathered glass surfaces often carry crucial information on the items' production, decoration, use and significance, but their interventive conservation is challenging. Thus, in collaboration with English Heritage collections, improvements to the existing preventive conditioning procedures will be developed.

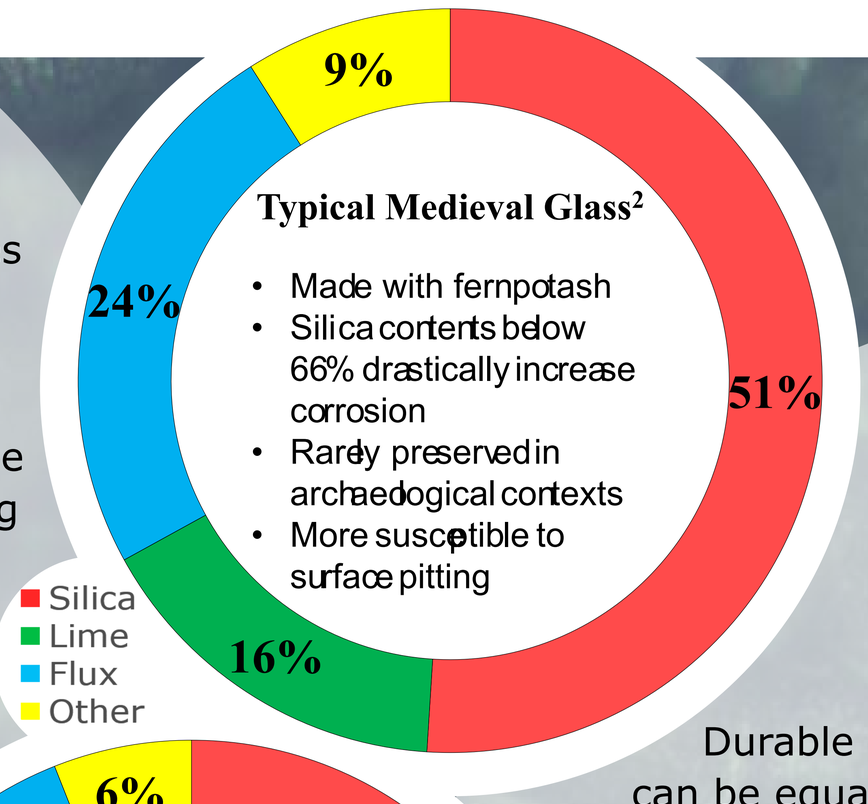


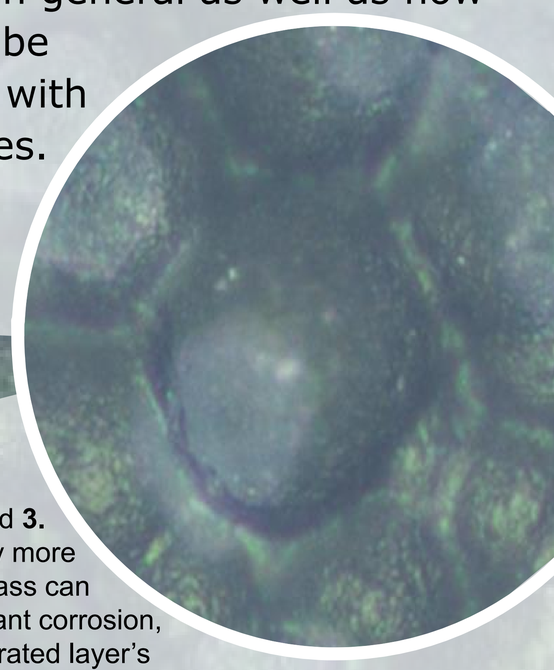
Fig 1. Medieval colourless glass drinking horn. Note the relatively good state of its preservation despite a less reliable composition.

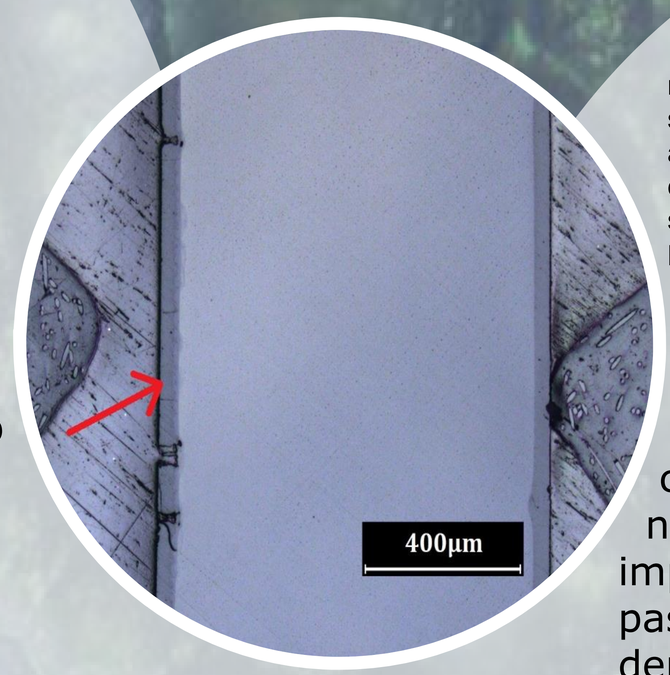
The Problem

Durable glass corrosion in adverse conditions can be equally or more serious than that of well preserved weak glasses. Hence, surface appearance can mislead condition surveys in heritage institutions. Although this issue can usually be overcome if dealing with historical glasses of known backgrounds, the changes through taphonomic processes add another degree of complexity to archaeological material. Hence, it is crucial to know how the properties of the glass bulk and surface relate to each other and to its weathering in general as well as how this information could be employed in surveys with restricted timescales.

Objectives and approaches

- English Heritage collection material will be visually surveyed and at-risk specimens identified.
- pXRF will be employed to pinpoint the trace element 'fingerprints' of vulnerable glasses. The data will then be analysed to observe whether patterns and groupings can be detected for the purpose their rapid, instrumental identification in the future.
- The composition and morphology of the parent glass and the corrosion layers of select specimens will be studied with SEM-EDS to understand the relationship between the two as well as to compare them with those of healthy glass objects.
- Raman spectroscopy will be used to determine the aforementioned glasses' polymerisation indices to investigate their relationship to the state of decay. This results of this approach will also be compared to a mathematical one, which defines glass polymerisation using its composition.





Figs. 2 and **3.** The purportedly more resilient Roman glass can still exhibit significant corrosion, as seen in the hydrated layer's cross-section (left, arrow) and the heavily pitted, opaque surface (right; background) of an archaeological specimen from Basinghall, London.

Expected outcomes

It is posited that this coupling of collection survey, invasive analysis and non-destructive methods will produce an improved and empirical framework for passive conservation of glass and its derivatives in both English Heritage and external collections. The knowledge gained will also aid the understanding of glass surface behaviour as well as the effectiveness of applied analytical techniques by observing the overlaps in their respective outputs.

References

1. Kunicki-Goldfinger, J. J., 2008. Unstable historic glass: symptoms, causes, mechanisms and conservation. *Studies in Conservation* 53, 47-60.
2. Freestone, I. C., 2001. Post-depositional Changes in Archaeological Ceramics and Glass. In: D. R. Brothwell and A. M. Pollard (eds.), *Handbook of archaeological sciences*, 615-625. Chichester, New York: Wiley and Sons.

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