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Investigating the deterioration of English Heritage glass collections

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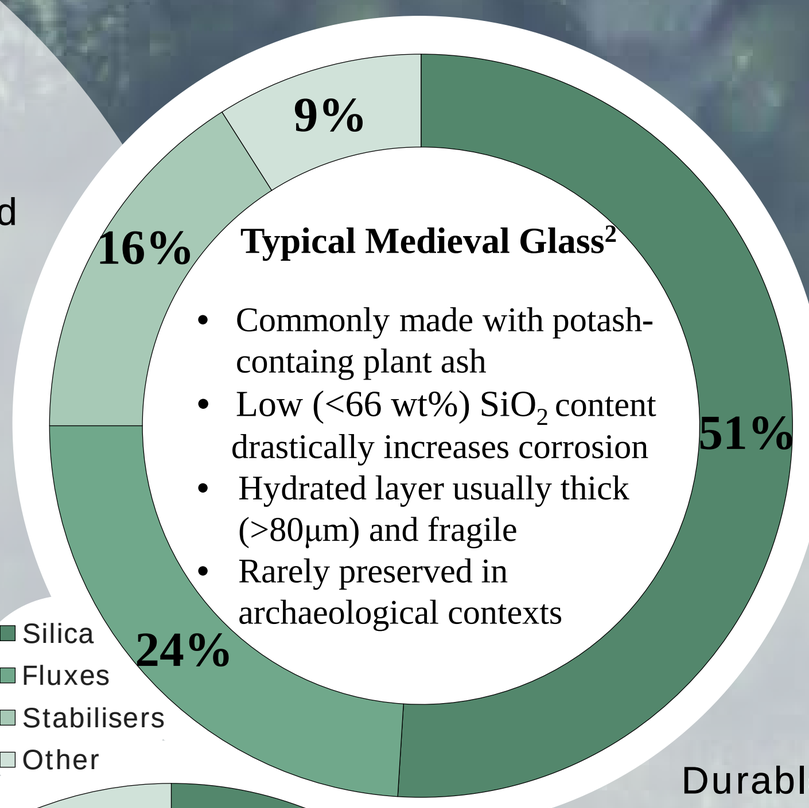
Introduction

The deterioration of glass occurs mostly through its interaction with water, which leaches out the alkali that were used for fluxing and leaves behind a vulnerable, hydrated corrosion layer. The speed and expression of this degradation likely 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, improvements to the existing preventive conditioning and collection survey procedures will be developed to aid the early identification of vulnerable glass specimens, especially the ones belonging to large assemblages.



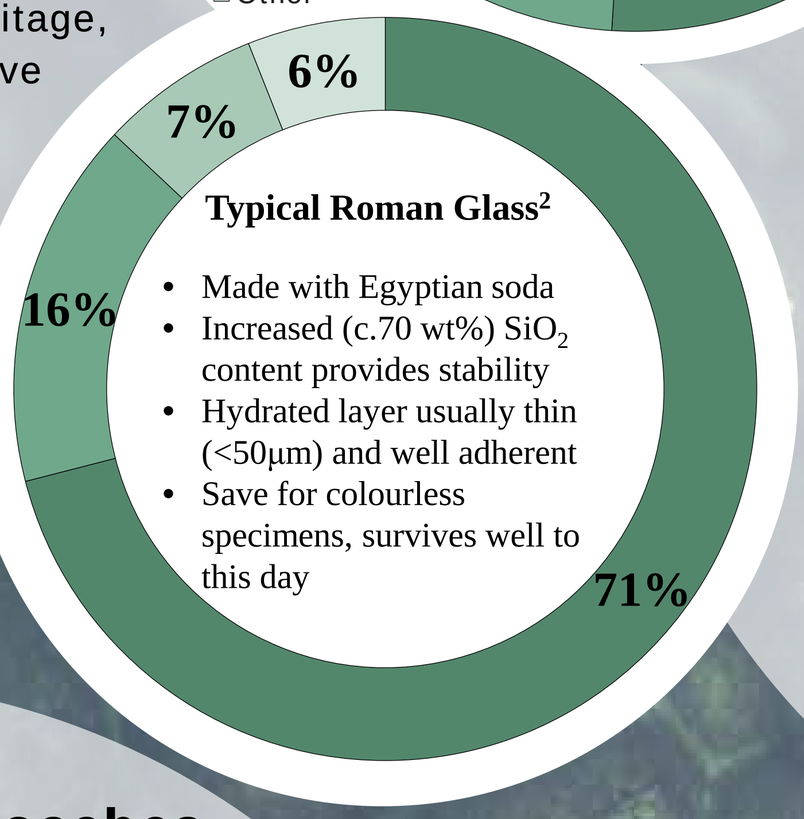


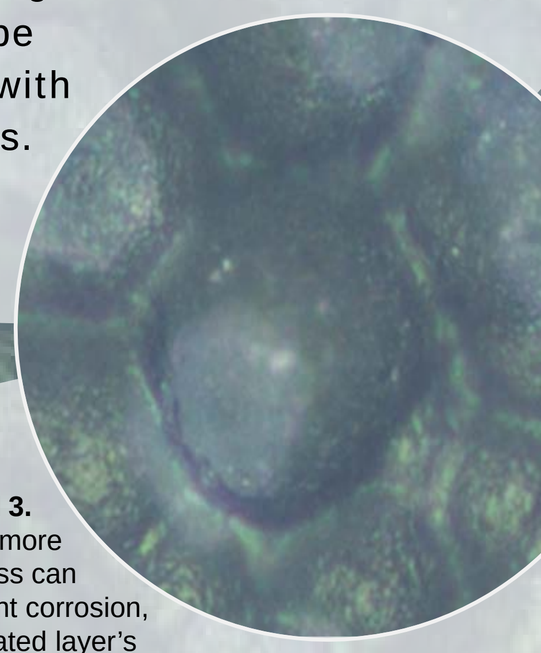
Fig 1. Medieval colourless glass drinking horn. Note the relatively good state of its preservation despite a less reliable composition.

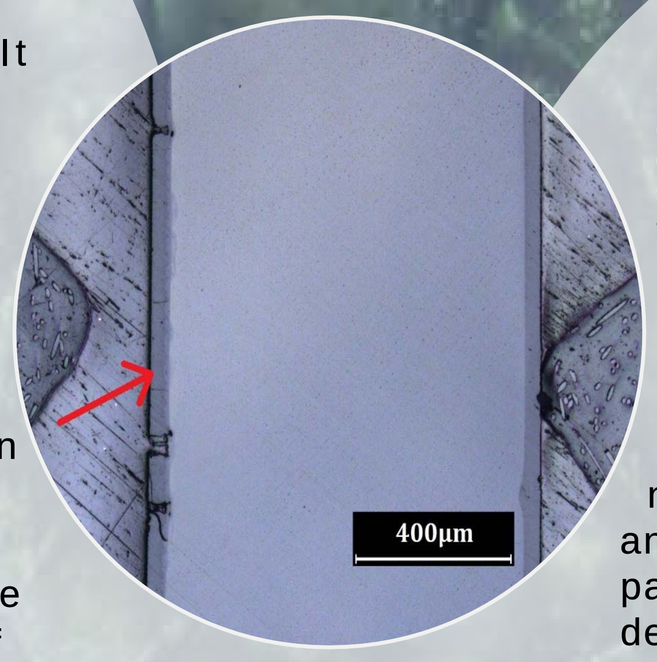
The Problem

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 when 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 Medieval collection material will be visually surveyed and at-risk specimens identified.
- The composition of the bulk glass of the selected specimens will be studied with SEM-EDS to observe its relationship with the present features of deterioration. It will also be compared to that of healthy objects to understand whether and how it would be able to characterise ancient glass survival and the formation of the corroded surfaces.
- Raman spectroscopy and theoretical stability modelling calculations will be used to determine the glasses' polymerisation indices and investigate whether they can be consistently related to their state of decay.
- Portable X-Ray fluorescence spectroscopy (pXRF) will be employed to pinpoint the trace element 'fingerprints' of sampled glasses. The data will be analysed to observe whether the resulting compositional groupings are analogous to those identified using other approaches and consequently evaluate the potential for their rapid, non-destructive identification in collection surveys.





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

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