

## Appendix Supplementary Material

Table S1, Table S2

Fig. S1, Fig. S2

### Development and validation of an analytical protocol for the sampling and quantitative analysis of ions on the surface of unstable historic glass in museum collections using ion-exchange chromatography

Guus Verhaar<sup>a,b,c,\*</sup>, Maarten R. van Bommel<sup>d,e</sup>, Norman H. Tennent<sup>b</sup>

<sup>a</sup> Rijksmuseum, Conservation and Science Department, Amsterdam, Netherlands

<sup>b</sup> University of Texas at Dallas, The Edith O'Donnell Institute of Art History, Dallas TX, United States

<sup>c</sup> Corning Museum of Glass, Corning NY, United States

<sup>d</sup> University of Amsterdam, Faculty of Humanities, Amsterdam School for Memory, Heritage and Material Culture, Department of Conservation and Restoration of Cultural Heritage, Amsterdam, Netherlands

<sup>e</sup> University of Amsterdam, Faculty of Science, Van 't Hoff Institute for Molecular Sciences (HIMS), Amsterdam, Netherlands

\* Corresponding author: [g.verhaar@rijksmuseum.nl](mailto:g.verhaar@rijksmuseum.nl)

**Table S1.** Ion concentrations (mg/L, prior to sampling and extraction) of the standard solutions used for the experiments.

Analyte	Standard solution concentrations (mg/L)								
	For calibration curve experiments								For repeatability experiments
	1 (Blank)	2	3	4	5	6	7	8 (stock)	
Lithium	0	0.10	0.50	1.0	2	5	10	50	10
Sodium	0	0.40	2.00	4.0	8	20	40	200	40
Ammonium	0	0.40	2.00	4.0	8	20	40	200	40
Potassium	0	0.80	4.00	8.0	16	40	80	400	80
Magnesium	0	0.40	2.00	4.0	8	20	40	200	40
Calcium	0	2.0	10.0	20	40	100	200	1000	200
Fluoride	0	0.33	0.67	1.33	2.67	5	10	13.3	6.67
Acetate	0	1.80	3.50	7	14	26	53	70	35
Formate	0	1.50	3.00	6	12	23	45	60	30
Chloride	0	0.50	1.00	2	4	7.5	15	20	10
Nitrite	0	1.67	3.33	6.67	13.33	25	50	66.7	33.3
Bromide	0	1.67	3.33	6.67	13.33	25	50	66.7	33.3
Nitrate	0	1.67	3.33	6.67	13.33	25	50	66.7	33.3
Carbonate	0	1.80	3.50	7.0	14	26.5	53	70	35
Sulfate	0	2.50	5.00	10	20	37.5	75	100	50
Phosphate	0	2.50	5.00	10	20	37.5	75	100	50

Fig S1. Anion calibration curves.

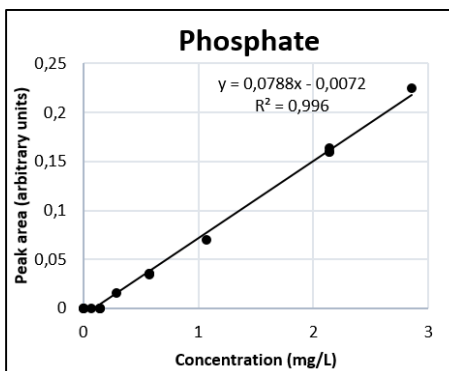
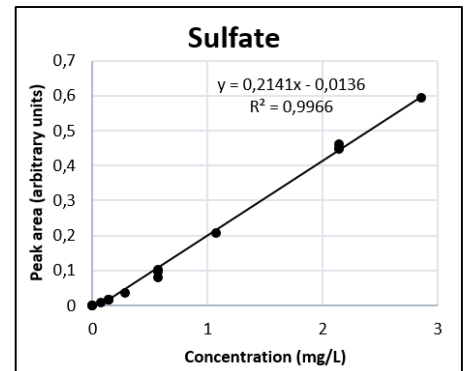
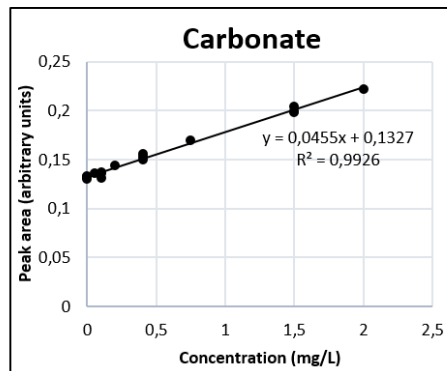
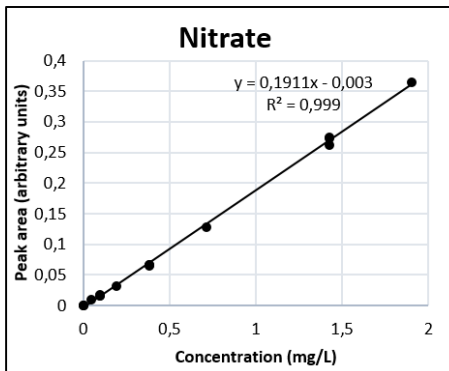
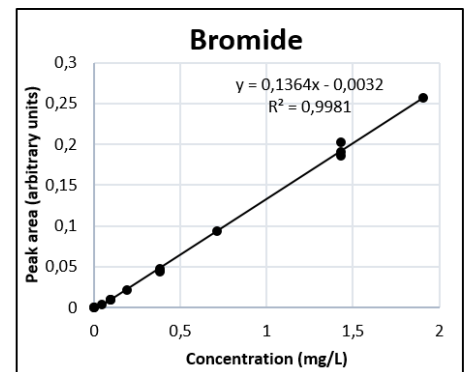
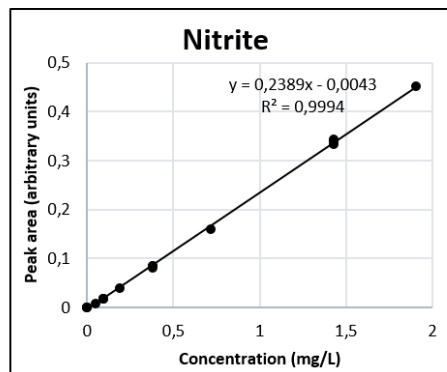
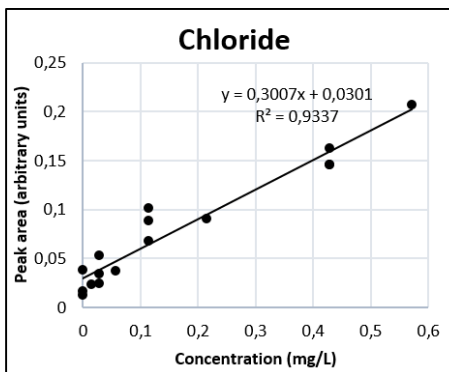
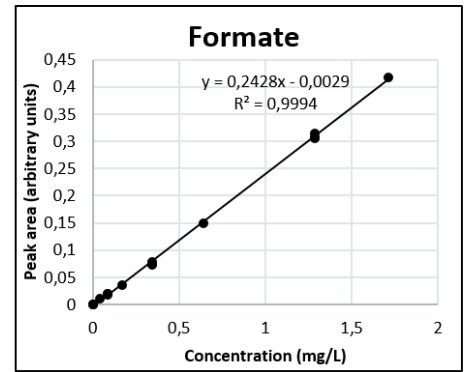
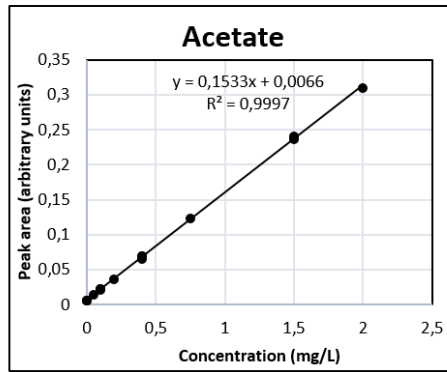
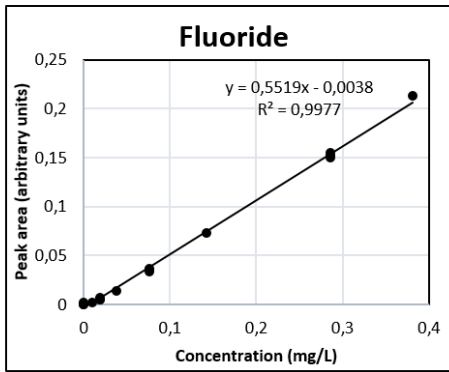
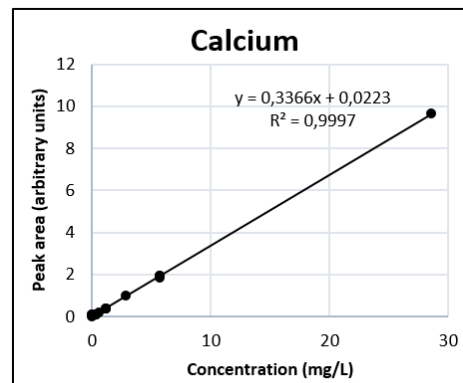
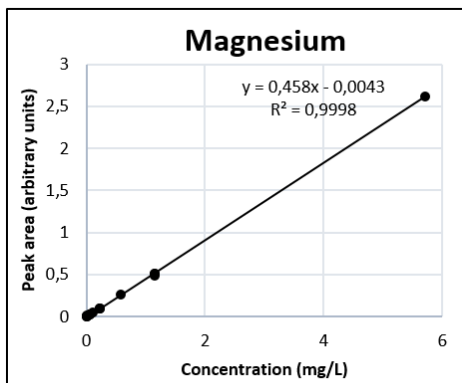
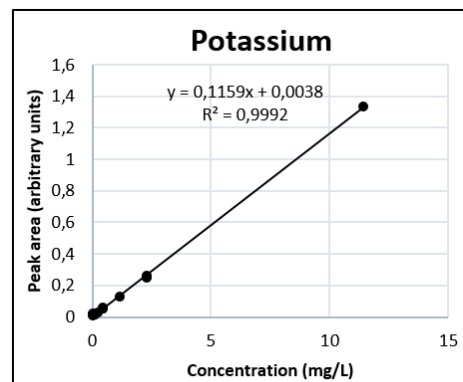
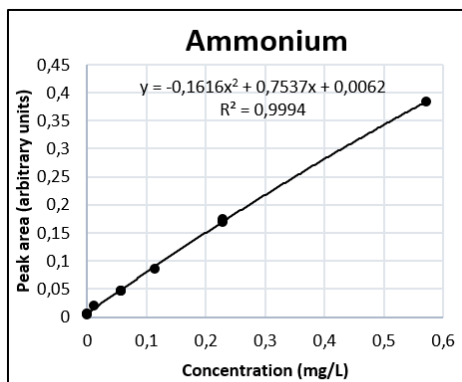
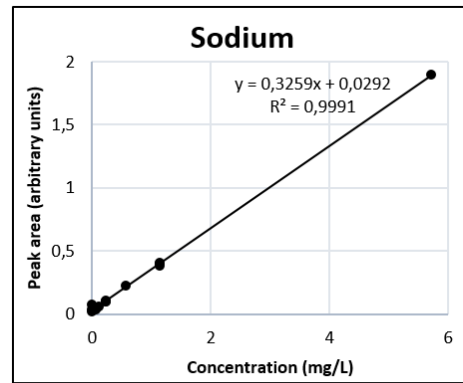
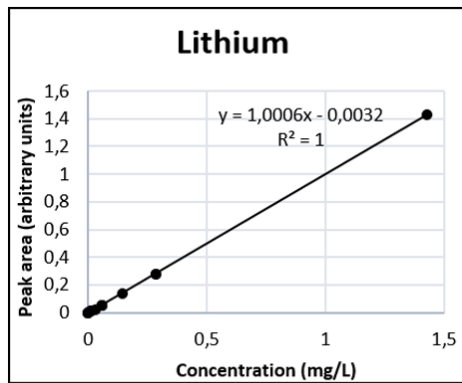


Fig S2. Cation calibration curves



**Table S2.** List of objects investigated

<b>Object number</b>	<b>Description</b>	<b>Date</b>	<b>Category</b>	<b>Deterioration pattern</b>
BK-1987-18-A	Decanter	1900 - 1925	B	Lightly greasy, dirty, fingerprints
BK-1987-18-B	Cup	1900 - 1925	B	Lightly greasy, dirty, fingerprints
BK-1987-18-C	Cup	1900 - 1925	B	Lightly greasy, dirty, fingerprints
BK-KOG-1541	Wineglass	1795	B	Non removable light haze
BK-KOG-1570	Wineglass	1750 - 1775	B	Very light haze + dirt
BK-KOG-1572	Chalice	ca. 1775	B	Very light haze
BK-KOG-1607	Wineglass	ca. 1850 - 1863	B	Lightly greasy, dirty, fingerprints
BK-KOG-180	Wineglass	1725 - 1750	B	Lightly greasy, dirty
BK-KOG-207	Wineglass	1725 - 1750	B	Non removable light haze
BK-NM-10754-264	Cup	ca. 1800 - 1810	B	Dirt, fingerprint
BK-NM-10754-80	Cup	ca. 1795	B	Very light haze
BK-NM-10754-96	Goblet	ca. 1750	B	Light haze, fingerprint
BK-NM-716	Cup	ca. 1725 - 1750	B	Light haze, fingerprint
BK-NM-7999	Wineglass	ca. 1760 - 1780	B	Light haze
NG-NM-10754-83	Wineglass	ca. 1780-1798	B	
BK-KOG-206	Wineglass	ca. 1700 - 1725	B/C	Mild pink colour, lightly greasy, light haze
BK-KOG-209	Wineglass	ca. 1725 - 1775	B/C	Light haze, lightly greasy
BK-NM-3468	Wineglass	ca. 1750 - 1775	B/C	Dirty, greasy
BK-NM-733	Wineglass	ca. 1750	B/C	Lightly dirty, greasy, hazy
BK-18970	Mocking glass	ca. 1725 - 1775	C	Lightly greasy, slight pink discolouration
BK-1966-62	Cup	ca. 1800 - 1900	C	Lightly greasy, light haze
BK-1978-33	Wineglass	ca. 1815 - 1830	C	Lightly greasy, some dirt
BK-NM-10754-103	Wineglass	ca. 1725 - 1750	C	Greasy (dirty?), light haze
BK-NM-10754-152	Wineglass	ca. 1750 - 1775	C	Lightly greasy/dirty
BK-NM-10754-156	Wineglass	ca. 1725 - 1750	C	Lightly greasy, light haze
BK-NM-10754-349	Wineglass	ca. 1725 - 1775	C	Lightly greasy, light haze
BK-NM-13178	Wineglass	ca. 1725 - 1750	C	Slightly pink, lightly greasy
BK-NM-2146-1	Wineglass	ca. 1700-1725	C	Lightly greasy, light haze
BK-NM-2146-2	Lid	ca. 1750-1800	C	Light haze
BK-NM-5809	Passglass beaker	ca. 1675 - 1700	C	Lightly greasy, light haze
BK-NM-10754-14A	Goblet	1800-1900	C/D	Greasy, light haze
BK-NM-10754-14B	Goblet	1800-1900	C/D	Lightly greasy
BK-NM-10754-65	Roemer	ca. 1700	C/D	Greasy (dried up droplets?), Haze, Dirty
BK-NM-789-A	Saltcellar	ca. 1600 - 1699	C/D	Haze, dried up droplets?
BK-NM-789-B	Saltcellar	ca. 1600 - 1699	C/D	Haze, dried up droplets?
BK-NM-9714	Fluteglass	ca. 1650 - 1675	C/D	Greasy, small droplets
BK-1980-56	Bottle	ca. 1800 - 1900	D	Large drops on inside, small drops on outside
BK-KOG-127	Filigree glass pitcher	1600-1700	D	Droplet, moist, greasy
BK-16476-B	Lid	1688	E	Crizzled, Haze, Greasy, Small droplets
BK-18941	Goblet	1650-1700	E	Crizzled