Data XRF analysis (Röntgenfluorescentiespectrometrisch onderzoek)

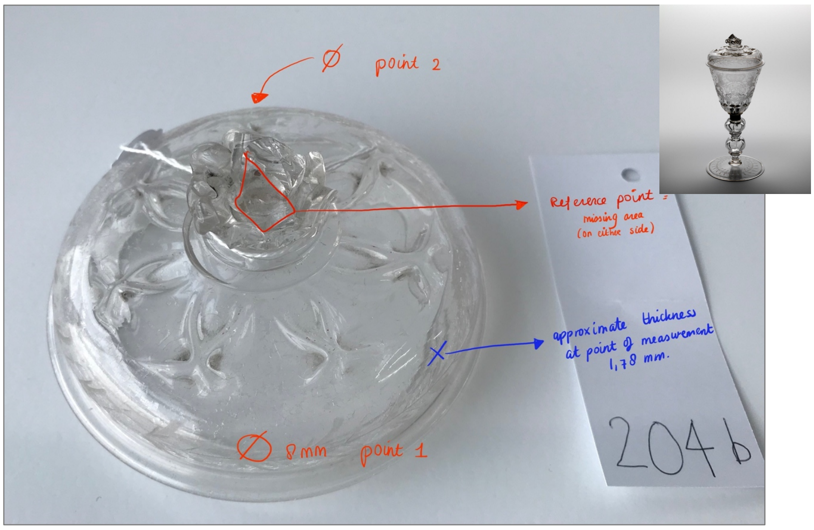
Object :	**204 b (KN&V)**
Artist :	Anoniem
Title and date :	Deksel - dekselbokaal - radgravure — 1675-1700
Conservator :	Mandy Slager - Restaurateatelier
Analyst :	Luc Megens - sr. Researcher RCE
Date analysis :	21-03-2024 12:35:46

Visual examination - microscopy		Ion - Chromatography		pXRF - analysis (relative to objects in the project)	
Date:	30-08-2023	Date:	16-09-2020	Date:	21-03-2024
Very poor		**Unknown**		**Further reserch needed**	

Specific research question
What type of glass? Which elements are detected by pXRF that might be related to the stability of the glass? Does comparison of all the objects analysed in this project reveal particular information? Can we identify any correlations between the *p*XRF results and the visual and IC results relating to the condition of an object? Would it be possible to carefully work towards condition categorization based on non destructive *p*XRF analysis of composition in combination with visual and IC analysis? Additional analysis needed: what are the options? Does the current information give impetus to further (non destructive) research to support the monitoring of condition?

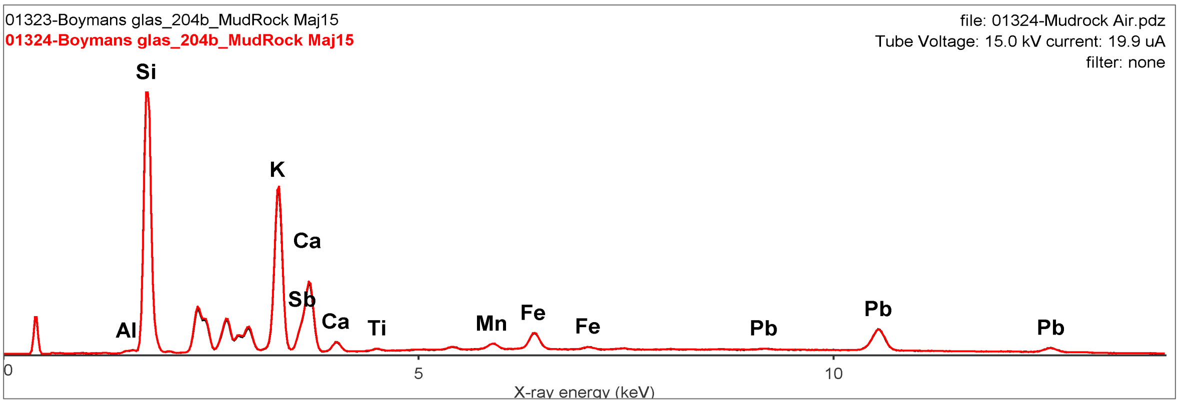
Examination and analysis	
Instrument	Bruker Tracer 5g
Instrument settings	MudRock Application in ambient air, 8 mm collimator 1: 50 kV, 14.7 µA, filter Ti 25 µm/Al 300 µm, 45 s 2: 15 kV, 19.9 µA, no filter, 60 s
Additional information	Setting 1 for heavier elements and setting 2 to better detect the lighter elements (from Mg). Automatic quantification, average of 2 measurements. DualMudrock_Air version 730.0646.

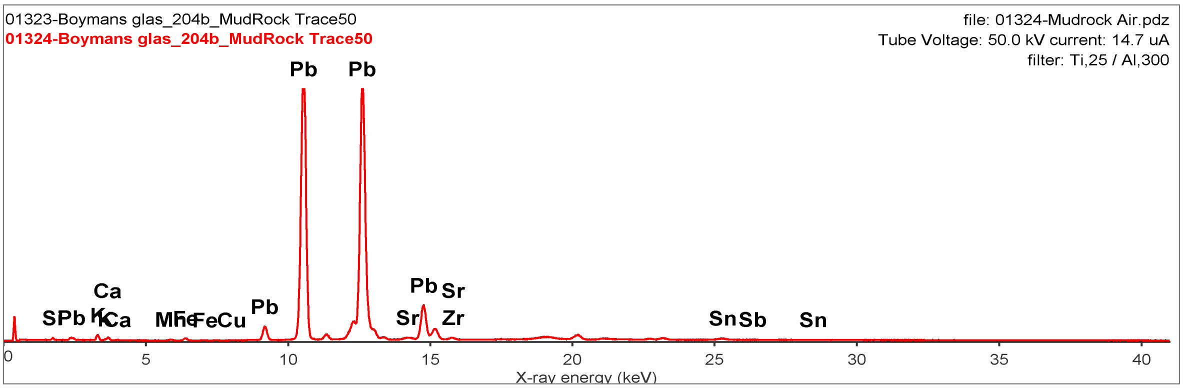
Location mapping of compositional analysis and measurement of approximate glass thickness



Practical limitations	Surface morphology or shape did not allow for really accurate measurements to be taken
App. thickness in mm.	**1,78** (at location of measurement)

Spectra





Results

Results												
Limitations	Na2O can not be accurately quantified (underestimated). Sn and Sb are not quantified with the MudRock application. As isn't quantified properly in Pb glass. Quantitative results give an indication of composition, but not exact concentrations.											
Main elements in wt%	**Na2O**	**MgO**	**Al2O3**	**SiO2**	**P2O5**	**SO3**	**K2O**	**CaO**	**ZnO**	**BaO**	**PbO**	**UO2**
	0,65	1	< LOD	59,61	0,2	3,3	3,73	1,13	0,02	0.01	12,94	< LOD
Trace elements in ppm	**Cl**	**Ti**	**V**	**Cr**	**Mn**	**Fe**	**Co**	**Ni**	**Cu**	**As**	**Rb/Sr**	**Zr/Mo**
	1746	156	43	< LOD	358	660	1	49	93	23841	280/208	149/7
Type of glass I	**Lead- alkali -Lime**											
Type of glass II												

Related object(s)	

Discussion of results

In absolute and relative comparison a larger spreading of the K2O and PbO measures can be detected. This is mostly due to the fact that the energy the fluorescent radiation of K emits is lower than of Pb. De subsequent percentage calculations derive from this. With greater distance of the detector to the surface the radiation of K is abosrbed much stronger by the air than is the case with Pb.

1. Not yet possible to draw conclusions on sensitivity of glass to instablility by means of pXRF. But in combination with the visual and IC results it might be possible to group objects or determine correlations between the diagnostic data.
2. Quantitative XRF results on composition are not the same as the components of a recipe.
3. Presence of Mn might be related to sensitivity to degradation
4. <LOD - Below Limit of Detection - element might be present but in a smaller amount than can be detected by means of *p* XRF;
5. Because lead is present in high concentration values for As and SO3 are very overestimated, due to overlapping peaks, and should be ignored.
6. In 2017 204a was considered likely unstable. Very likely this chategorization also applies to 204b, but for some reason this was not analysed by means of IC (not in 2017 and not in 2020).
7. The amount of lead (> 10%) would classify this as Sonoorglas (NL), Kristallijnglas (B), Kristallglas (D), Cristallin or Verre Sonore (F).

Object in relation to other objects in this project

See also: RCE Report:

Megens, L., 2025, Verkenning van de samenstelling van verschillende types glas in Museum Boijmans van Beuningen in relatie tot het risico op degradatie, RCE projectnummer 2023-099, Amsterdam, Rijksdienst voor het Cultureel Erfgoed, Rijkserfgoedlaboratorium which can be found in Conservation Studio under *verwante media* .

Suggestions for further research

1. Further *p* XRF analysis on comparable objects
2. Search for (archival) information on manufacturing process or recipes
3. Correlations to be found by comparing data to reflectance spectral images with Optical Coherence Tomography? U of Nothingham
4. Correlations to be found by comparing current data with info acquired by means of Tetra Herz examination? U of Eindhoven
5. Further research by means of Raman Spectroscopie or Inductively Coupled Plasma Mass Spectrometrie (ICP-MS) or Scanning Electron Microscopy (SEM) - possible in situations where sample fragments are available. Many more analytical examination can then be explored, but usually analysis on museum objects is limited due to non invasive requirements and practical complications when having to move objects to lab facilities.

Literature

1. Shelby, J.E., Introduction to Glass Science and Technology, Cambridge 2005, p.30.
2. Megens, L., 2021, Verkenning van de samenstelling van verschillende types glas in het Nationaal Glasmuseum Leerdam in relatie tot het risico op degradatie, RCE projectnummer 2020-110, Amsterdam, Rijksdienst voor het Cultureel Erfgoed, Rijkserfgoedlaboratorium.
3. Burghout, F. en M. Slager, Cloudy Patches and Misty Glass: Early Signs of Glass Disease? In: Roemich H. and K. van Lookeren Campagne (eds.) Recent Advances in Glass, Stained-Glass and Ceramics Conservation, Amsterdam, the Netherlands, 7-10 October 2013, pp. 327-329.