The Sussex Declaration

Technical report for Add Mss 8981

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11/29/2017

Technical report of scientific analysis held at the British Library 1-3 August 2017 of Add Mss 8981 (The Sussex Declaration) in collaboration with Harvard University, West Sussex Record Office and the Library of Congress. This report covers technical details and specifications of X-ray fluorescence.

X-Ray Fluorescence Analysis of the Sussex Declaration

As per the Memorandum of Understanding (section 1.d), X-ray fluorescence (XRF) analysis of the Sussex Declaration, from the West Sussex Record Office, was carried out using a *Bruker 'Tracer III-SD'* handheld device. Data were recorded from a variety of regions of interest (including iron gall ink text, erasures, stains and residues left around nail holes), as detailed in *Table 1*. The resulting data were then processed and analysed to assess elemental compositions.

The data derived from the technique can only be used in a qualitative, or at most a semi-quantitative, manner for materials of this type, for a variety of reasons. For optimal results the sample should be homogeneous, 'infinitely' thick (i.e., the sampling volume from which X-rays are derived is completely contained within the bulk of the sample) and have a flat, smooth, uniform surface which can be presented at right angles to the device. Parchment, like most natural materials, is inherently variable and inhomogeneous, and presents a surface which lack smoothness on both a macroscopic (bulk cockling and irregularity) and microscopic scale (the fibrillar nature of collagen), which prevents exact alignment unless the document is physically constrained, and will introduce scattering effects. The document also has a very limited depth in comparison with the potential sampling volume. Furthermore, the sampling area of the technique is roughly 5mm in diameter, which means that for small areas of interest, such as individual iron gall ink lines, the data will also include contributions from other components, particularly the substrate (parchment in this case) and potentially other nearby aspects of the document as well. In addition, a true quantitative assessment of the data requires calibration samples; given the inherent variability of both the component materials and their distribution, this cannot be readily achieved.

Methodology

XRF analysis was carried out using a *Bruker 'Tracer III-SD'* handheld XRF device running under *Bruker 'S1PXRF'* software (version 3.8.30). Data were recorded at 30 kV and 30 μA, with a small (<5mm) air gap between the device and the document, to avoid direct contact. The sampling areas are given in *Table 1*, along with the number of replicate data sets gathered at each location. The data were then analysed using *Bruker 'ARTAX'* software (version 7.2.5.0), as detailed below.

Results and Discussion

XRF traces of the data recorded at the various sampling position are presented in *Figures 1* to *15*.

Parchment will provide the principal contribution to all of the data sets. The initial analysis of the data assumed that this contribution was uniform in each case. The spectra were normalised with respect to the calcium $K\alpha_{1,2}$ line (3.7 KeV); parchment contains a relatively significant quantity of calcium, and for the purpose of analysis it was assumed that this derived solely from the parchment, and was uniform throughout the material. Spectral subtraction was then used to remove the parchment contribution, and the data then assessed.

There is evidence of elevated levels of iron in the three spectra of iron gall ink on the recto; there appear to be no other significant elements detected in these regions (both copper and zinc, common impurities in iron gall ink, are no more prevalent than in the bulk parchment).

Elevated iron levels are also seen in the spectra from the regions of the two nail holes. As above, there appear to be no other notable elemental contributions in these areas.

There are slightly higher level of iron found in the 'Erasure, Centre Title' data (both recto and verso), but not in those from 'Erasure, 'Themselves', Line 28'.

The data from the 'Large Stain' and 'White Stain' regions from the recto are little different from those of the parchment itself. The 'Red Stain' and 'Large Stain' from the verso, on the other hand, exhibit elevated iron levels.

Table 1:

Face	**Area**	**Replicates**	**Figure**
Recto	Parchment	3	*Fig. 1*
	Erasure, Centre Title	2	*Fig. 2*
	Erasure, ‘Themselves’, Line 28	1	*Fig. 3*
	Iron Gall Ink, Top Left W	2	*Fig. 4*
	Iron Gall Ink, Centre Title I	1	*Fig. 5*
	Iron Gall Ink, Centre Title T	1	*Fig. 6*
	Large Stain, Top Right, Line 11	2	*Fig. 7*
	Large Stain, Top Right, Line 19	1	*Fig. 8*
	Nail Hole, Bottom Left	1	*Fig. 9*
	Nail Hole, Bottom Right	1	*Fig. 10*
	White Stain, Top Left	2	*Fig. 11*
	White Stain, Destructive	1	*Fig. 12*
Verso	Erasure, Centre Title	2	*Fig. 13*
	Large Stain, Top Left	2	*Fig. 14*
	Red Stain, Centre	3	*Fig. 15*

Figure 1: Parchment XRF data, recto.

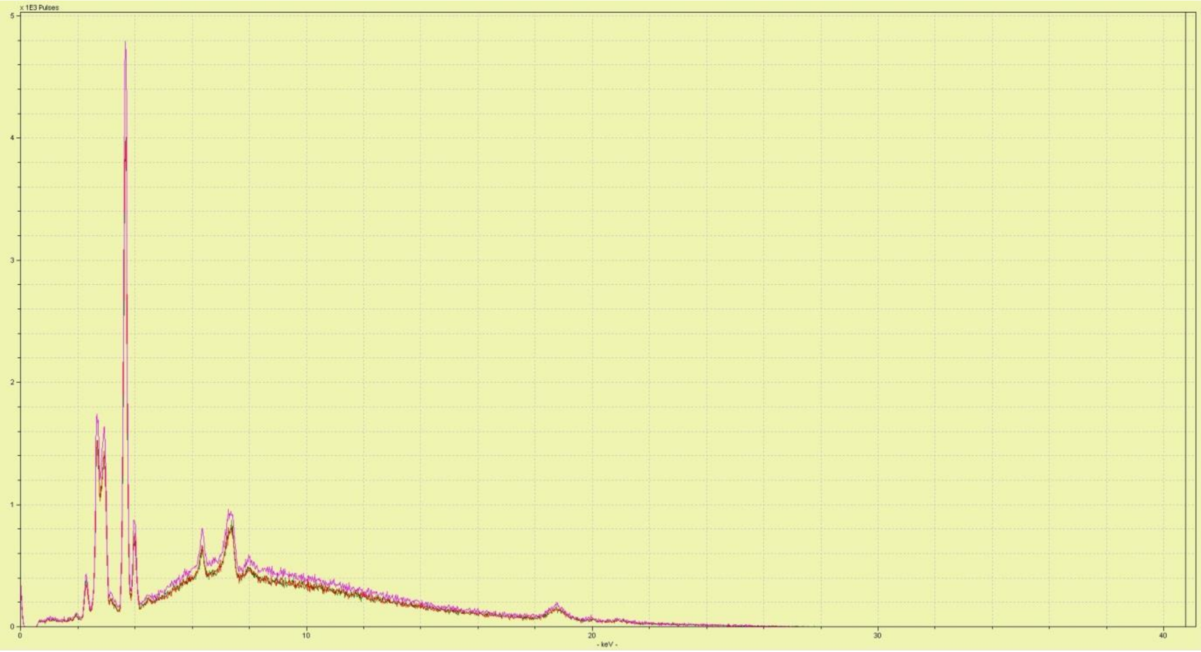

Figure 2: Erasure (centre title) XRF data, recto.

Figure 3: Erasure ('Themselves', line 28), XRF data, recto.

Figure 4: Iron gall ink (top left 'W') XRF data, recto.

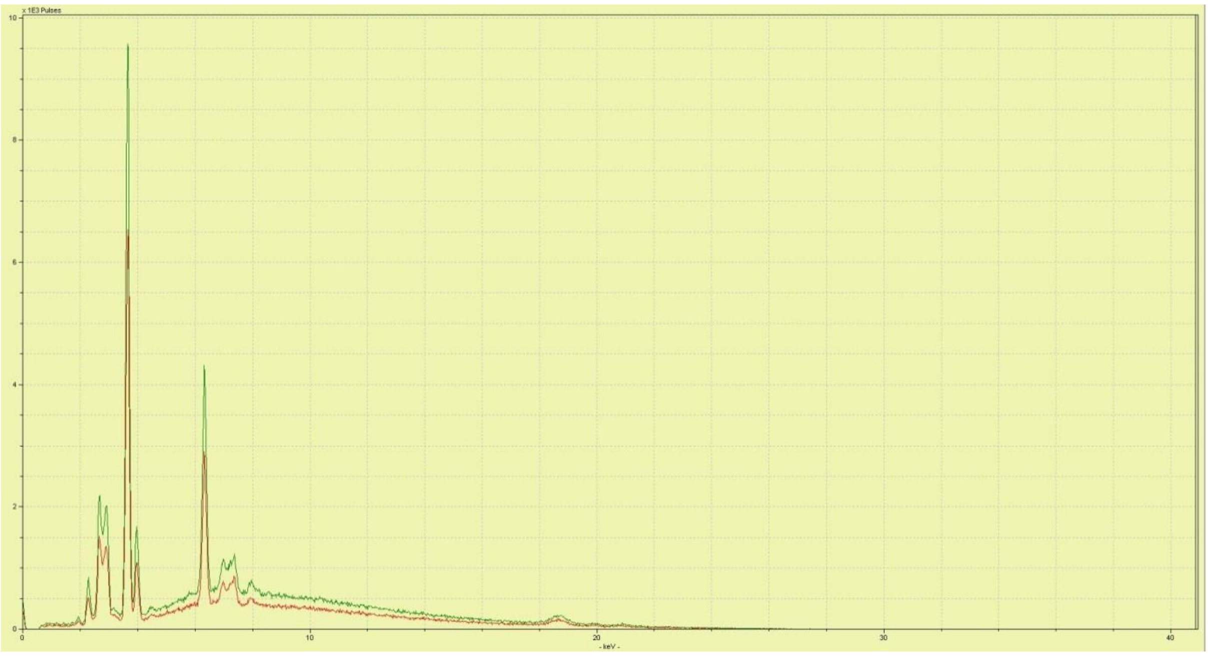

Figure 5: Iron gall ink (centre title 'I') XRF data, recto.

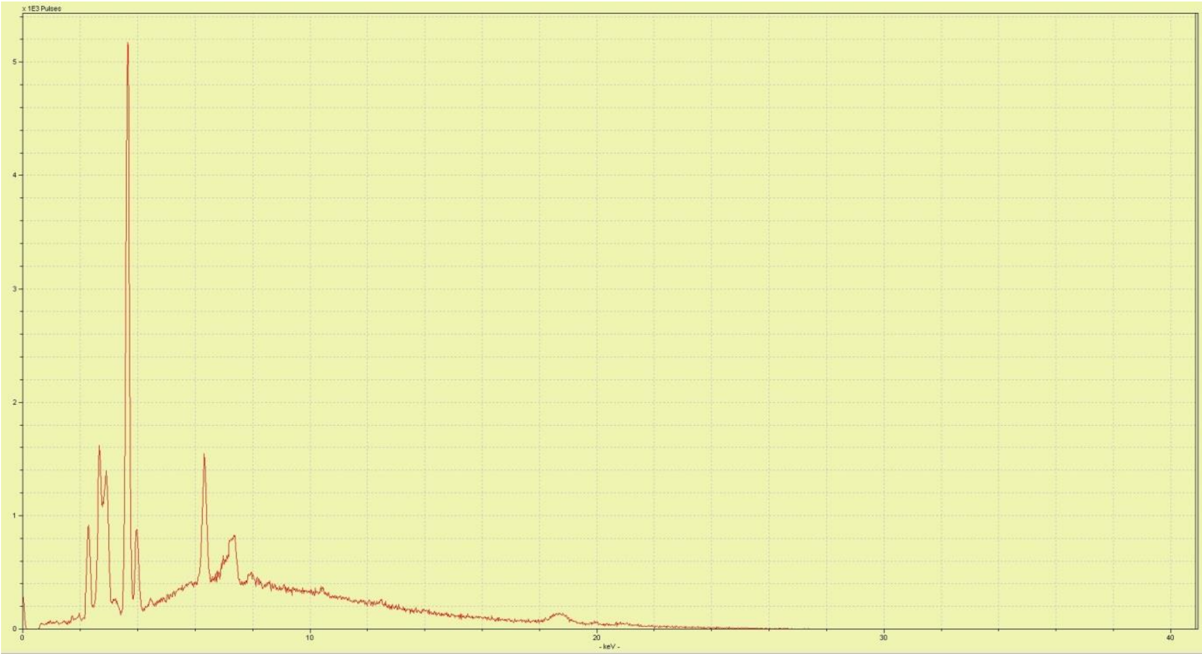

Figure 6: Iron gall ink (centre title 'T') XRF data, recto.

Figure 7: Large stain (top right, line 11) XRF data, recto.

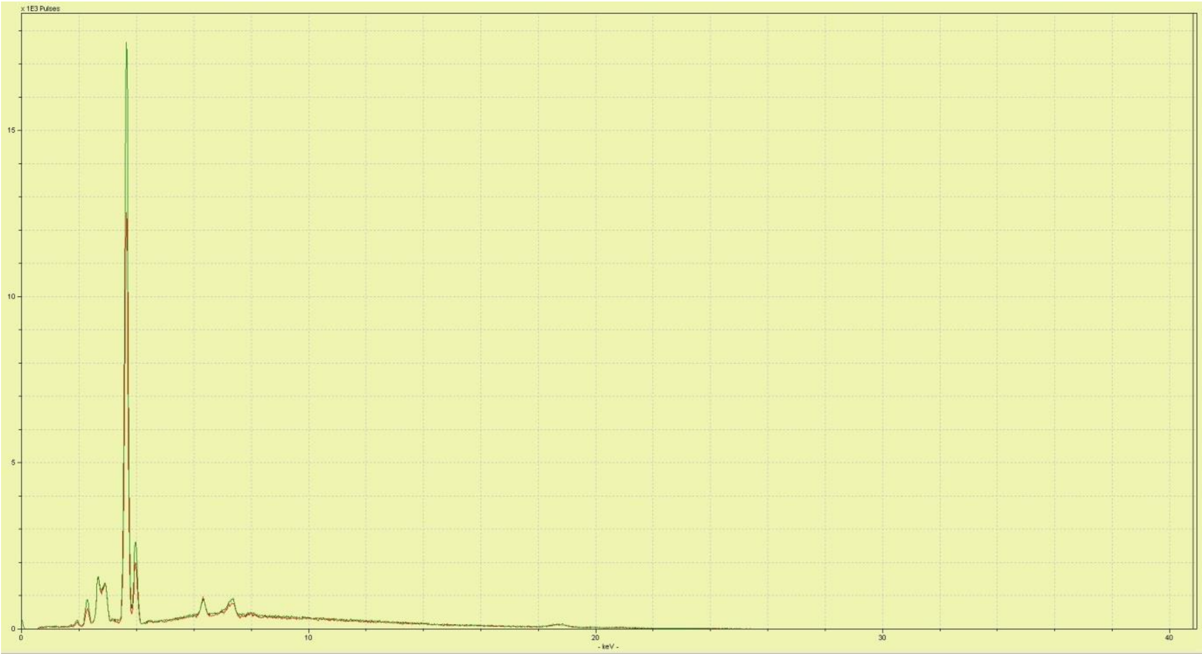

Figure 8: Large stain (top right, line 19) XRF data, recto.

Figure 9: Nail hole (bottom left) XRF data, recto.

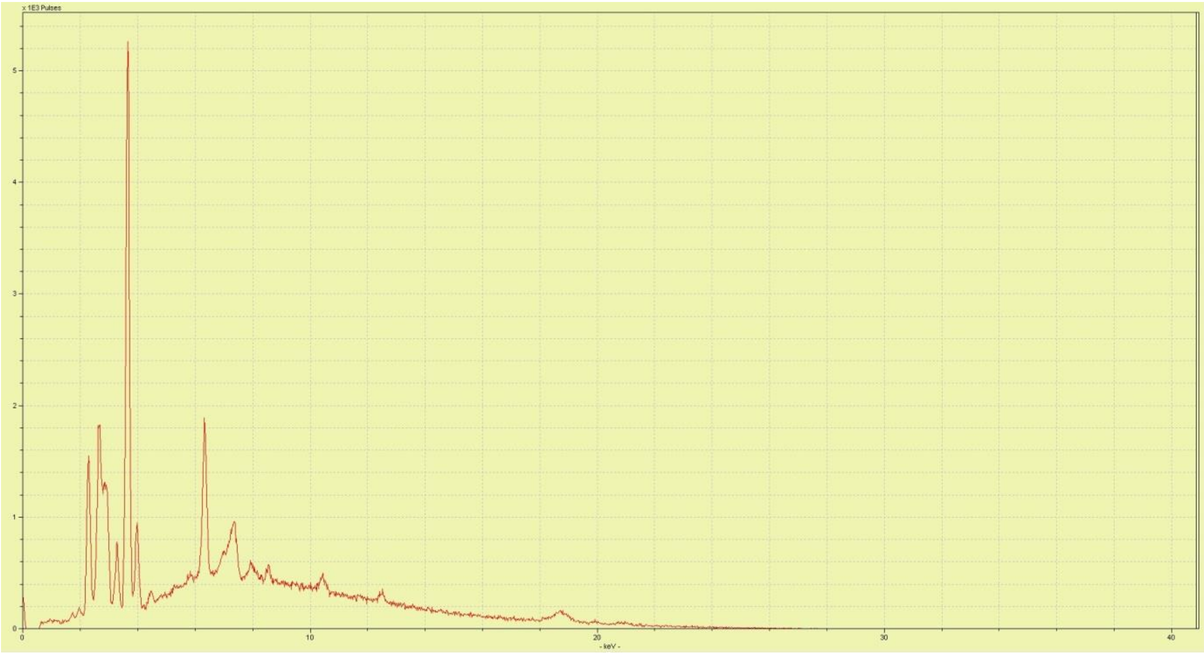

Figure 10: Nail hole (bottom right) XRF data, recto.

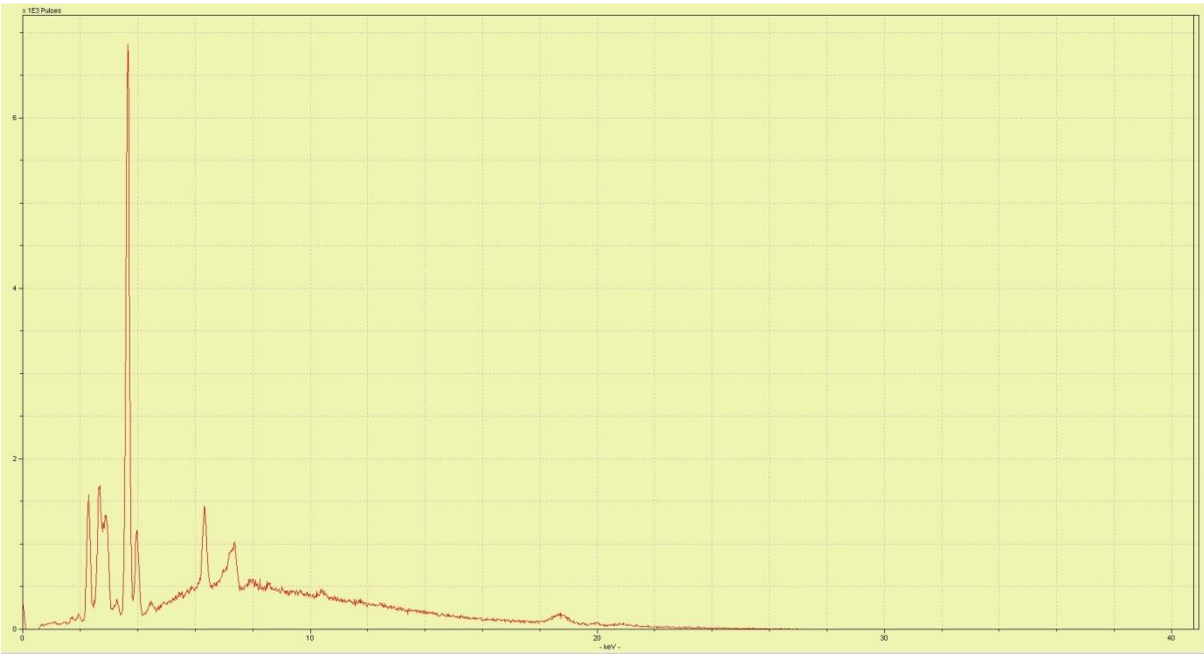

Figure 11: White stain (top left) XRF data, recto.

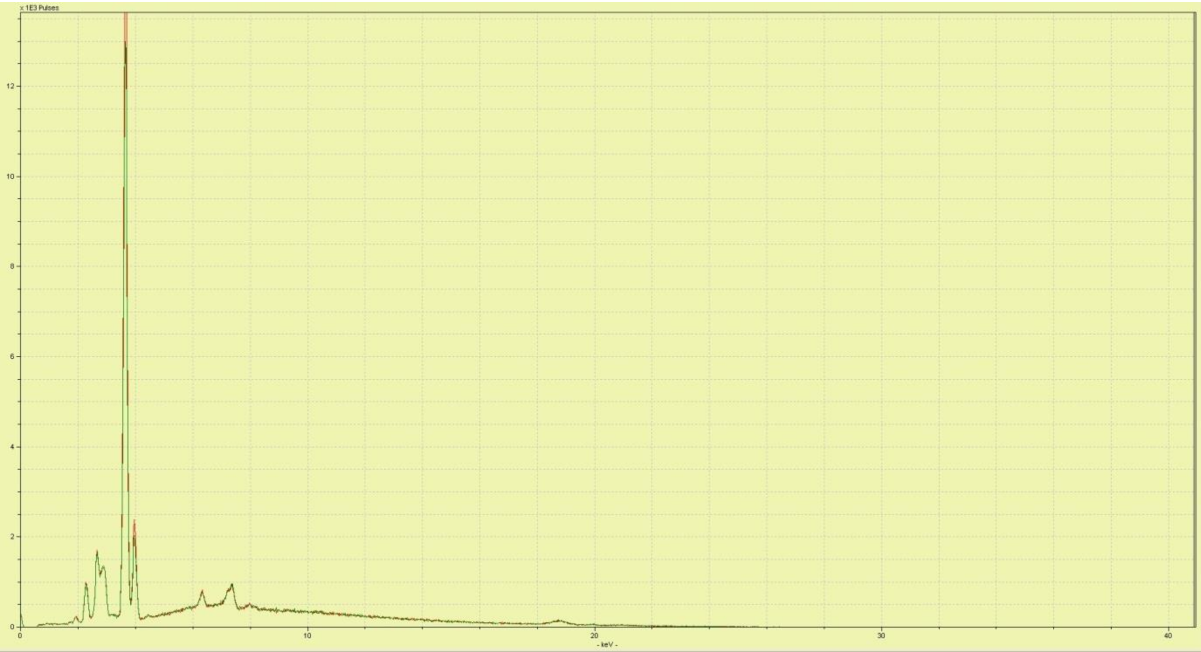

Figure 12: White stain (destructive) XRF data, recto.

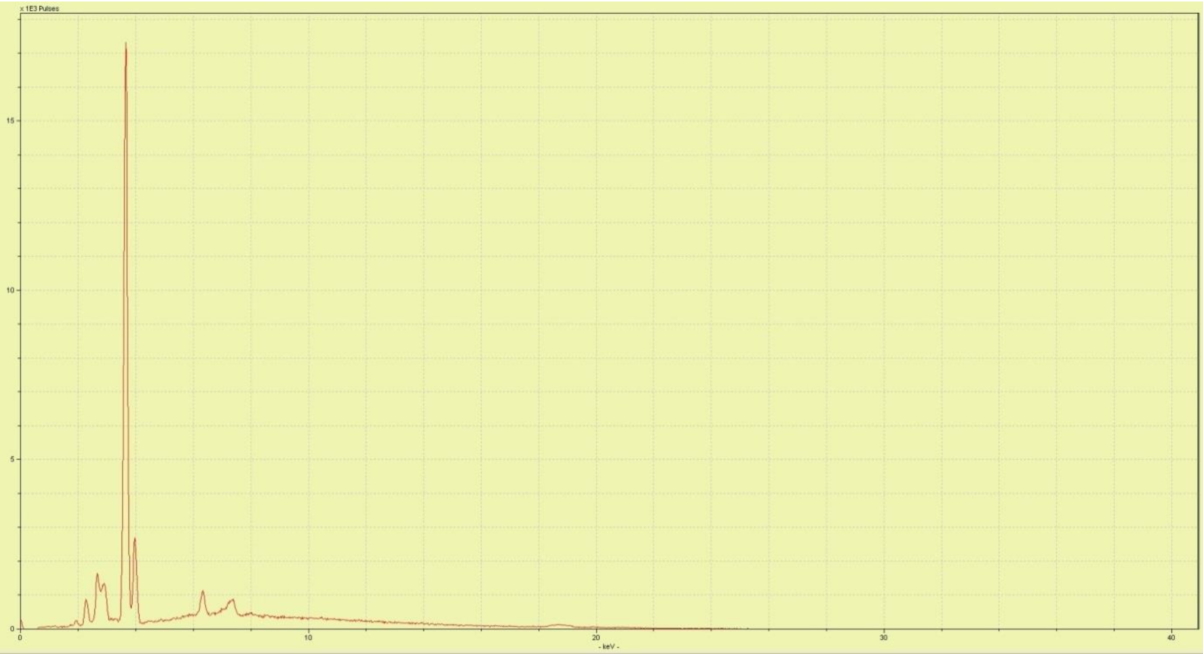

Figure 13: Erasure (centre title) XRF data, verso.

Figure 14: Large stain (top left) XRF data, verso.

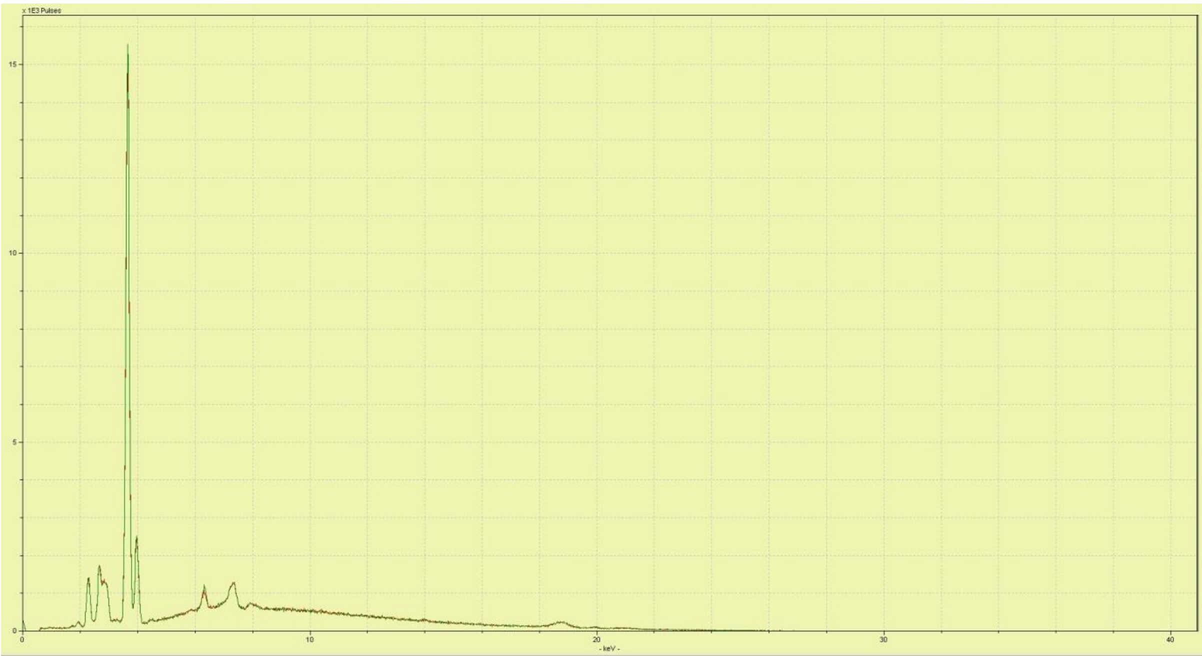

Figure 15: Red stain (centre) XRF data, verso.