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***Kami Fumi-e*: Japanese paper images to be trampled on, a mystery resolved**

Riccardo Montanari^{(1)*}, Philippe Colombar⁽²⁾, Maria Francesca Alberghina⁽³⁾, Salvatore Schiavone⁽³⁾, Claudia Pelosi⁽⁴⁾

(1) *Independent Researcher, Certified Specialist, Rome, Italy, ckrm97@yahoo.com*

(2) *MONARIS UMR8233, Sorbonne Université, CNRS, Campus P.-et-M. Curie, 4 Place Jussieu, 75005 Paris, France ; philippe.colombar@sorbonne-universite.fr*

(3) *S.T.Art-Test sas – Italy*

(4) *University of Tuscia, Laboratory of Diagnostics and Materials Science, Largo dell'Università, Viterbo, Italy*

Abstract: There has been a long debate as to whether *Kami Fumi-e* (paper images to be trampled on) had actually been used in the image trampling sessions as part of the 250-year persecution of Christianity enforced by the Tokugawa Shogunate. Sacred images of Christianity officially recorded to have been trampled on are housed in the permanent collection of the Tokyo National Museum and are almost uniquely made of metal alloy. The controversy regarding paper images, apart from the medium being considered unsuitable for such an extreme use, was fueled by the appearance of a significant number of them in museum collections and institutions worldwide in the 20th century. Most of the prints bear dates from different eras of the Edo period, sometimes hundreds of years apart, so a long-standing argument regarding their authenticity marked the last century. In order to distinguish later copies from potentially original pieces, if ever existed, XRF, Raman and FTIR analytical techniques were used to study the materials characterizing them. In addition, a detailed observation of the main visual features (overall design composition, inscriptions, paper support, etc.) was carried out to highlight potential discrepancies that could pair with scientific evidence and lead to a definitive conclusion.

Keywords: *Kami Fumi-e, XRF, Raman spectrometry, inks, indirect dating, Japan, Jesuit, trampling on images, Christianity in Japan, FTIR*

1. Introduction

There has been a long debate as to whether *Kami Fumi-e* (paper images to be trampled on) (Figure 1, Table 1) had actually been used in the image trampling sessions held annually throughout Japan from 1688 (1st year of the *Genroku* period) as part of the 250-year persecution of Christianity enforced by the Tokugawa Shogunate (1603-1868) [1]. Such sessions consisted of gatherings where villagers were asked to commit blasphemy against Christianity by stepping on sacred images. Had any villager refused or hesitated to do so, authorities would have immediately relied on torture to obtain apostasy [1].

The few images officially recorded to have been used in those yearly sessions are housed in the permanent collection of the Tokyo National Museum. They are almost uniquely made of metal alloy such as brass [2]. Some of them had originally been confiscated from Jesuit priests and/or Japanese Christians and enclosed in wooden frames to withstand being stepped upon (Figure 2).

The controversy regarding paper images, apart from the medium being considered unsuitable for such an extreme use, was fueled by the appearance of a significant number of them in the 20th century (Figure 1, Table 1). Most of these images bear dates from different eras of the Edo period, sometimes hundreds of years apart, so a long-standing argument regarding their authenticity marked the last century.

The alleged *Kami Fumi-e* herein studied consist of woodblock impressions depicting the head of a *Bateren* (a corrupt Japanese word for the Portuguese *Padre*: Priest) placed over a cross (section 4), in one or two colors, that is, plain black (Type A and Type B) or black and red (Type C and Type D) (Figure 1, Table 1). Additional inscriptions can also report edicts, places, authorities' names and dates to which they supposedly referred. The seal of the Kuroda family appears in red ink on many of them (Type D) and is sometimes accompanied by other random inscriptions and seals of unclear meaning and origin.

TABLE 1. Paper prints representing the head of a *Bateren* (Priest) categorized in four TYPES by stylistic and morphological features.

TYPE	Woodblock printing technique	Dimensions (cm)
TYPE A	Woodblock print in black ink (single impression) and accompanying letter with calligraphy dated 1791.	28 x 26.5
TYPE B	Woodblock print in black ink (single impression).	37.5 x 25
TYPE C	Woodblock print in black and red colors (two impressions, one for each color).	37.5 x 26.5
TYPE D	Woodblock print in black and red colors with seal (two impressions, one for each color). Dated 1673 (1 st year of the Enpō Era).	34.5 x 23.5



Figure 1. The four analyzed prints as categorized and listed in Table 1, from left to right: TYPE A; TYPE B; TYPE C; TYPE D (Private collection).



Figure 2. A modern reproduction of the *Fumi-e* image depicting the deposition of Christ used in the *E-fumi* sessions (trampling upon the sacred image of Christianity) throughout the Edo Period (1603-1868). Private collection.

The objective of the work is not an exhaustive characterization of the different phases and their proportions per unit volume but to identify differentiation criteria - and implications as dating tools - using mobile and non-invasive techniques. The present study focuses on the materials (paper support, black ink and red pigments) used to produce such prints in order to offer criteria upon which a distinction between later copies and potentially original pieces, if ever existed, can be made. In addition, a detailed observation of the main visual characteristics of the images (overall design composition, inscriptions, Raman microphotographs and visible-and-ultraviolet microscopy on selected points of analysis) is presented to highlight potential discrepancies that could pair with scientific evidence and lead to a definitive conclusion.

One crucial point to report here is that even though there have been repeated suggestions that examples made in the 20th century form the group of items presently on display in museum collections and institutions worldwide, the firm proof of their modern production has never been provided on scientific grounds: no examples have either been scientifically analyzed or recognized as originals until the present work.

1.1. Short summary of woodblock print production

A brush drawing of the image outline is pasted face down onto a cherry wood block. The cutter then chisels line by line in order to leave intricate ridges that form the outline of the print. The wood block bearing the chiseled outline is called the *Key Block*. Key blocks are essential to creating black and white impressions of the outline: sumi ink (carbon black) is applied onto the block and a sheet of paper is laid on it. The sheet is then rubbed with a circular motion using a *baren* (small wooden pad) to create the impression of the outline [3].

Colors are subsequently applied using separate blocks made from cherry tree, one for each color. Lighter colors are applied first [3]. All blocks are used repeatedly to create multiple impressions of each print and are therefore subject to extensive wear.

2. Materials and Method

2.1. Analyzed Prints

The four prints analyzed in this study (Figure 1, Table 1) belong to the most extensive private collection of alleged *Kami Fumi-e* extant today, located in Europe. Their selection has been based on the relevant characteristics they share with prints displayed in museums and institutions around the world such as the British Library (London, UK), the Seinan Gakuin University Museum (Fukuoka, Japan), the Ricci Institute for Chinese-Western Cultural History (Boston, USA), and the 26th Martyrs Museum (Nagasaki, Japan).

2.2. XRF Spectrometer: Experimental and Measurement Parameters

The employed XRF portable instrument consists of a miniature X-ray tube system (Amptek, X-123 SDD, Mini-X X-ray tube, USA), which includes the X-ray tube (max voltage of 50 kV, max current of 0.2 mA, target Rh, collimator 1 or 2 mm), the power supply, the control electronics, and the USB communication for remote control; a silicon drift detector with a 125 to 140 eV FWHM @ 5.9 keV Mn K α line energy resolution (depends on peaking time and temperature); 1 keV to 40 keV detection range of energy; max rate of counts to 5.6×10^5 cps; software for acquiring and processing the XRF spectra. Primary beam and detector axis form an angle of 0 and 40° respectively with the perpendicular to the sample surface. Measurement parameters were as follows: tube voltage 35 kV; current 80 μ A, acquisition time 100 s; no filter was applied between the X-ray tube and the sample; distance between sample and detector around 1 cm. The setup parameters were selected to have a good spectral signal and to optimize the signal-to-noise ratio. Measurement data were processed using the factory provided data reduction DPPMCA software, which enables the acquisition, display, and control for Amptek signal processors and allows the automatic peak recognition supported by manual peak selection and checking. The software further enables curve fitting based on chosen elements to ensure a match between the measured spectra and theoretically predicted spectra calculated from fundamental parameters. Finally, XRF spectra have been graphically provided by Origin Pro 8.5.

2.3. RAMAN Spectrometer: Experimental and Measurement Parameters

Raman spectra were recorded using:

- i) a HE785 mobile spectrometer (HORIBA Scientific Jobin-Yvon, Palaiseau, France) excited with a 785 nm diode laser (Process Instrument) with power of illumination ranging between about 5 (colored area) and 300 mW ('white' area), fiber optic coupled with a remote Superhead[®] equipped with a long working distance (LWD: 7 mm, NA: 0.45) 40 \times (Leica, Germany). Counting times vary between 0.1 second and 50 second with 100 to 3 accumulations.
- ii) a HR 800 benchtop spectrometer excited with an Inova high power Ar⁺ ion laser (Coherent, USA) and (LWD: 13 mm, NA: 0.45) 50 \times (Olympus, Japan) objective. The 457nm lines was used. The illumination power at the sample ranges between 0.6 ('white' area) and 0.1 mW (red or black areas).

Focusing is controlled to the nearest micron by 3 dimensional XYZ stage with micrometric movements. The analysis spot is optimized visually by observing the optimal focus of the laser at very low laser power. A black cloth is then placed to cover the object and the Superhead[®]; then, the laser power is increased to the desired value and the focus is optimized by observing the spectrum, first by maximizing the signal of the fluorescence background and then by maximizing that of the silicate matrix or pigments/opacifiers. At least 5 spots on areas appearing visually identical were collected to ensure representativeness. Many spectra were also recorded but not saved. Only the spectra that appear very representative are saved.

The 685 g/mm grating of HE785 allows recording a spectrum with a large spectral range ($\sim 100\text{--}3300\text{ cm}^{-1}$) and a $\sim 4\text{ cm}^{-1}$ spectral resolution. The HR800 is equipped with a 600 g/mm grating that give similar resolution and large spectral window.

Analyzed spots are smaller than $\sim 15 \times 15$ (HE785) and $4 \times 4\ \mu\text{m}^2$ (HR800), respectively; the in-depth penetration is rather similar for the colorless and poorly colored glazes, but much smaller for darker colored areas.

Microphotographs were obtained using the optics of the Raman HR 80 instrument.

2.4. FTIR Spectrometer: Experimental and Measurement Parameters

The contactless infrared spectroscopy analyses were performed in a specular reflectance (SR) mode with a FTIR portable R-Alpha spectrometer (Bruker Optics, Germany). This spectrometer is based on an interferometer with a KBr beam splitter associated to a Globar source (SiC) and a DLATGS (Deuterated Lanthanum α -alanine doped triglycine sulphate) detector. Within this SR module a built in video-camera gives a magnified view of the measurement area and allows exact positioning of the spectrometer in front of the sample by displacing the whole instrument (Figure 2). The IR beam is focused and collected by a set of mirrors with a 45° incidence angle, promoting the collection of the specular reflection. The beam diameter focused at the sample is about 5 mm at the working distance of 15 mm. The distance to the object to be analyzed is achieved by gradually moving the instrument with the hands or with a microscopic stage until the video image is focused. Typically 128 scans were made per spectrum ($650\text{--}3600\text{ cm}^{-1}$ range, spectral resolution 4 cm^{-1}). In the SR-FTIR analyses, the reflectance spectra showed a large amount of bands with a pole shape profile. Pseudo-absorbance spectra are calculated from SR spectra by applying the Kramers-Kronig Transformation (KKT) algorithm included in the OPUS software (Bruker Optics, Germany).

3. Results and Discussion

Analytic results are presented first. A thorough discussion on the origin and purpose of the prints, along with the identification of the timeline of production and further remarks on scientific evidence follow for each print type.

3.1. Paper supports

The significant differences in luminescence background revealed by Raman analysis (Figure 3) enabled the identification of two broad groups: Group 1 consisting of TYPE A and TYPE B; and Group 2 consisting of TYPE C and TYPE D. The luminescence band of Group 1 shows a main component at $\sim 820\text{ nm}$ ($\sim 400\text{ cm}^{-1}$ using relative wavenumber scale) with a shoulder at $\sim 855\text{ nm}$ ($\sim 1100\text{ cm}^{-1}$). For Group 2, the main component shifts down to $\sim 805\text{ nm}$ ($\sim 300\text{ cm}^{-1}$). Type C also shows the $\sim 855\text{ nm}$ (1100 cm^{-1}) and the low energy band is shifted to 250 cm^{-1} (800 nm). Although the intensity is lower we can relate the fluorescence signature to Group 2.

This broad background of luminescence is common in Raman analysis of graphic works and is attributed to the sizing agents binding the fibers [4-6].

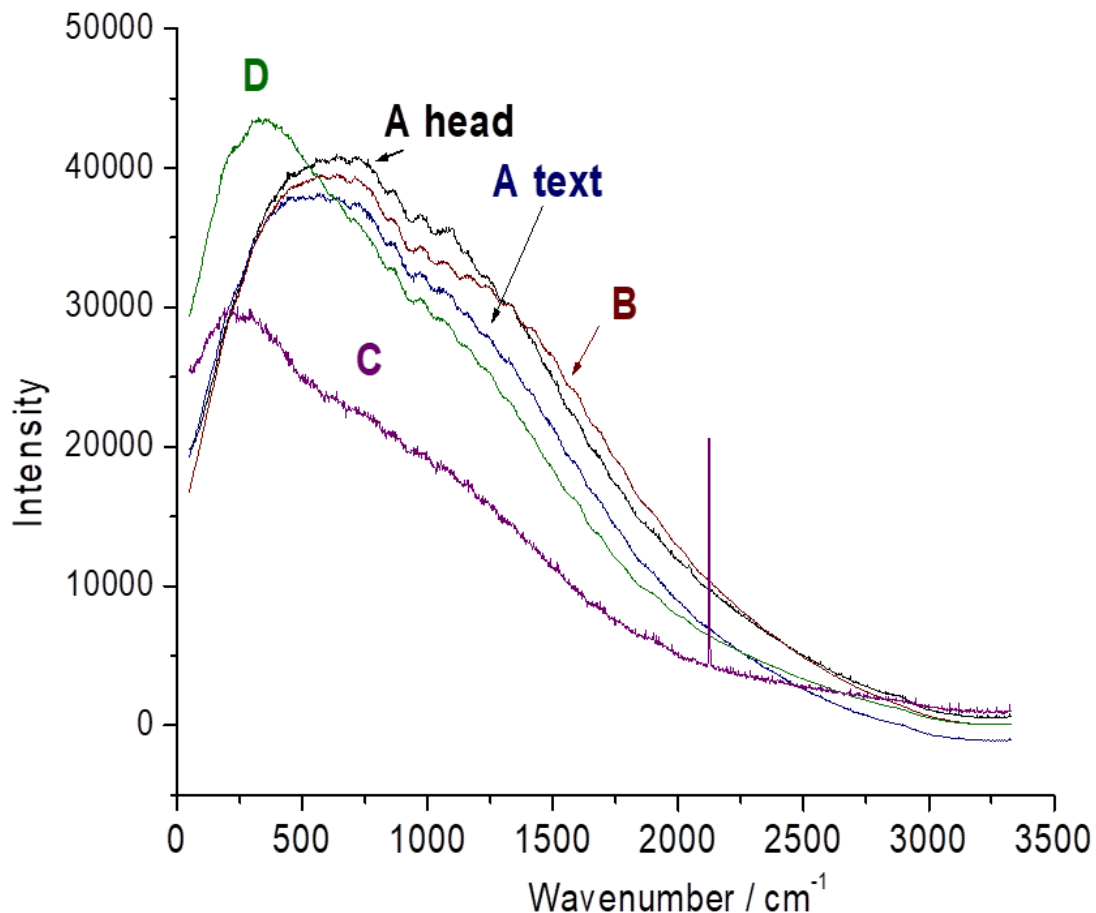


Figure 3. Comparison of the luminescence background of the paper supports of TYPE A (impression of Christ head – labeled Ahead; and accompanying letter – labeled A text), TYPE B, Type C and TYPE D recorded with 785 nm laser excitation.

FTIR spectra (Figure 4) showed the presence of water (large components stretching and bending H₂O modes at 3300 and 1645 cm⁻¹ respectively), organic/proteic matter (C-H_n stretching modes around 3000 cm⁻¹, CH bending and CN/Amide modes between 1200 and 1800 cm⁻¹) and inorganic phases (narrow peaks below 600 cm⁻¹).

Comparison with the spectra of cotton fibers [10] confirms the presence of cellulose fibers: the wave numbers underlined in the figure correspond respectively to CH₂ scissoring (1425 cm⁻¹), CH₂ wagging (1380 cm⁻¹), C-O-C mode (1160 cm⁻¹), C-O modes (1105, 1055, 1030 and 990 cm⁻¹), and the very characteristic out of plane OH bending mode (665 cm⁻¹). The presence of components of the amide modes around 1635 and 1535 cm⁻¹ indicate addition of animal glue as expected for paper [11]. The ca. 440 cm⁻¹ band well observed on TYPE D is consistent with the presence of MnO₂ [12]. [7-9]

Overall, FTIR analysis (Figure 4) confirmed the clear distinction between Group 1 and Group 2. A visual summary of the broad groups is reported in Table 2.

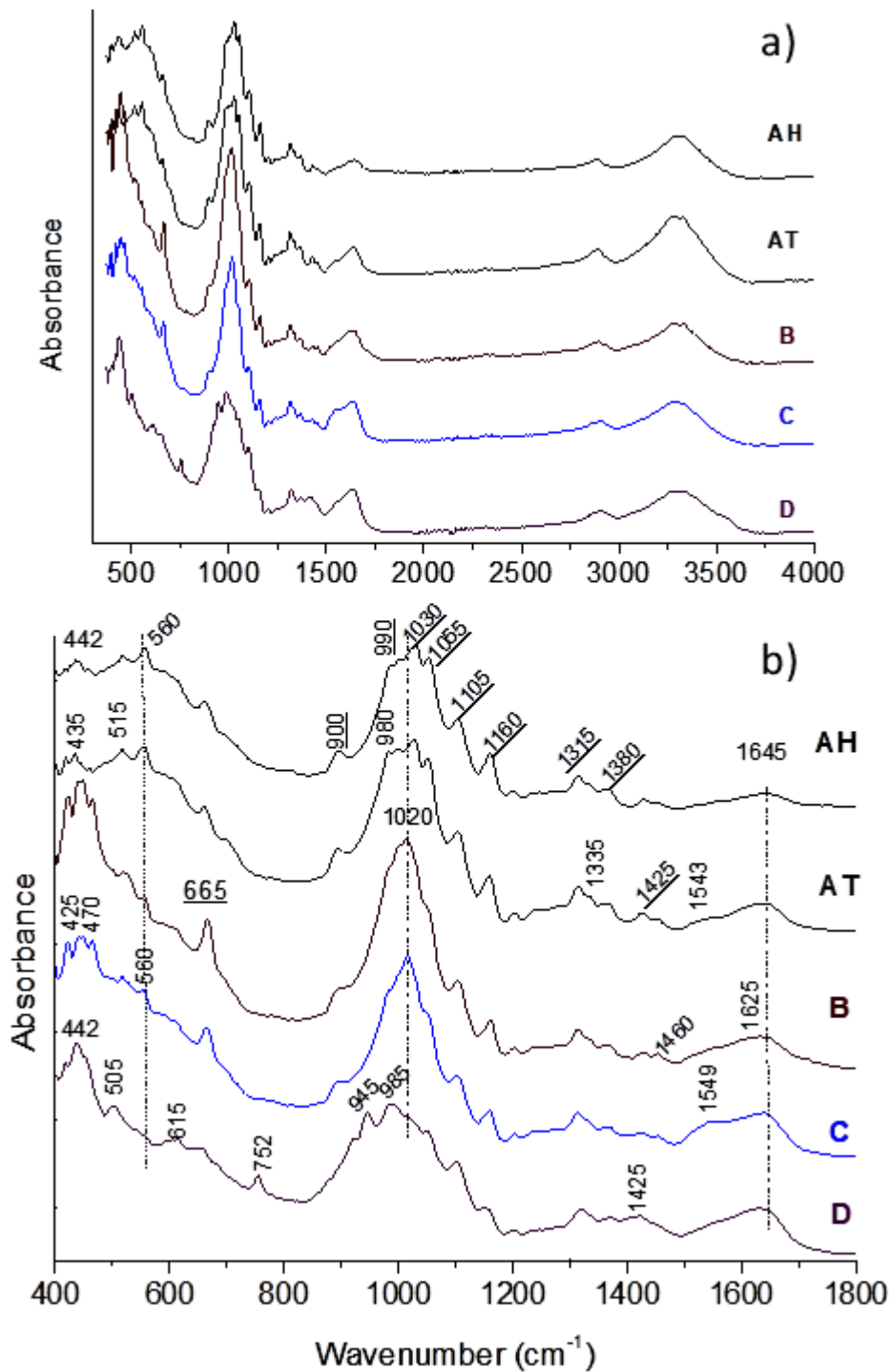


Figure 4. FTIR spectra obtained from the paper supports of TYPE A (both impression – labeled AH; and accompanying letter – labeled AT), TYPE B, TYPE C and TYPE D. Bands related to cellulose are underlined.

Table 2. Paper types based on both Raman and FTIR analyses.

Technique	Classification	
	GROUP 1	GROUP 2
Luminescence	TYPE A, TYPE B	TYPE C, TYPE D
FTIR	TYPE A, TYPE B	TYPE C, TYPE D

Additional evidence regarding the sizing agents used for the production of all print types comes from XRF analysis (Figure 5). As observed in the spectra, both the impression and accompanying letter – TYPE A – are characterized by negligible counts of Mn (trace element). TYPE B, in perfect agreement with FTIR spectra (Figure 4), shows a very slight increase in Mn content compared to TYPE A, while TYPE C and TYPE D bear sizing agents with significantly higher Mn counts. These findings have deep implications on the timeline of production of the alleged *Kami Fumi-e* and will be discussed for each of the print type in their respective sections.

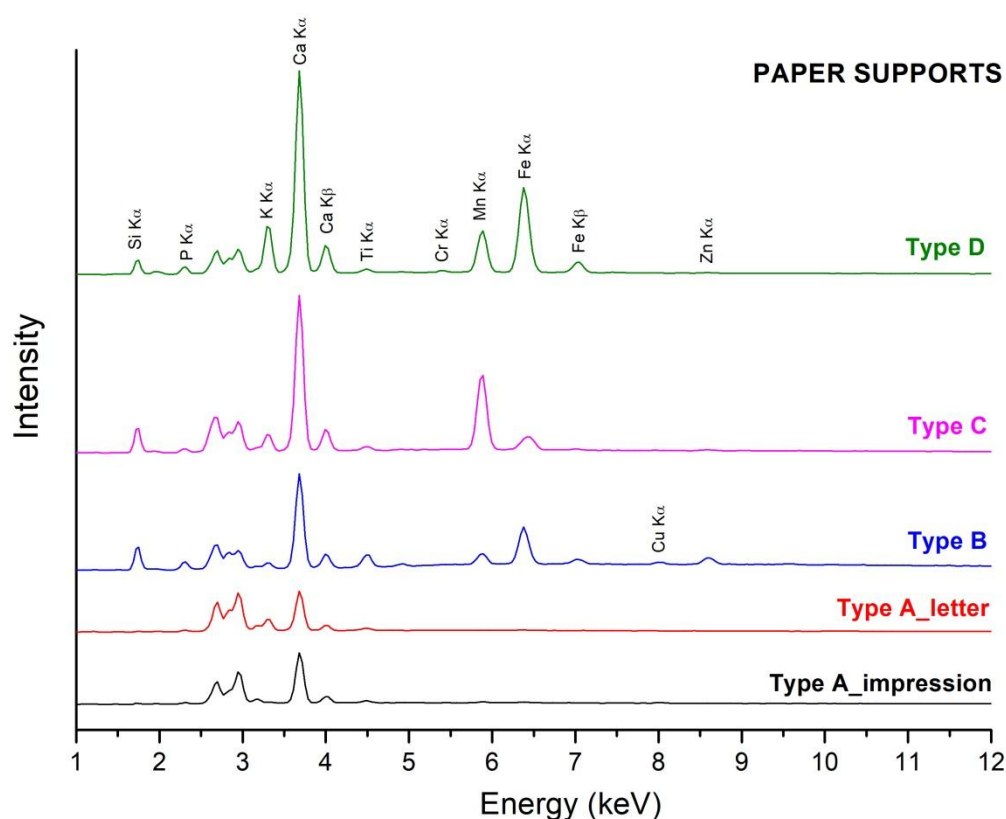


Figure 5. XRF spectra obtain from the paper supports of TYPE A (both impression and accompanying letter), TYPE B, TYPE C, and TYPE D.

3.2. Red color

Concerning the red color, various spectra were collected from different areas to have a wider panorama about variability. Raman spectra obtained on the red pigments are shown in the Figure 6. They clearly prove consistent with the presence of hematite (alpha Fe_2O_3). The relative intensities of the peaks at $\sim 225, 295, 415, 505, 445, 615$ and 1315 cm^{-1} [7] depend slightly on the

excitation laser due to the resonance character of the Raman scattering under green laser excitation..

TYPE C presents weak shoulders at 300 and 380 cm^{-1} or a slight band broadening in agreement with the presence of additional goethite (αFeOOH) [10]. Moreover, a band around 665-670 cm^{-1} indicates the presence of a spinel phase, either $\gamma\text{Fe}_2\text{O}_3$ or a spinel of more complex composition. These characteristics can be explained by the use of *Bengara* powder, traditionally used by Japanese potters [11] and prepared from heat-treated natural ocher. Raman spectra are intense when the spectrum is recorded on grains which are therefore well crystallized (Figure 7). We note contamination by grains of black ink.

TYPE D presents additional phases of calcite (symmetrical stretching mode at 1085 cm^{-1}) [12] and a spinel with a peak at a relatively low wavenumber (615 cm^{-1}) which is compatible with a high MnO_2 content. The lesser quality of the spectra indicates a less dense texture of the hematite, compatible with the chemical synthesis of fine powder (Figure 7).

The two broad bands at 1355 and 1605 cm^{-1} may be attributed to amorphous carbon; some black particles are visible in the Figure 7.

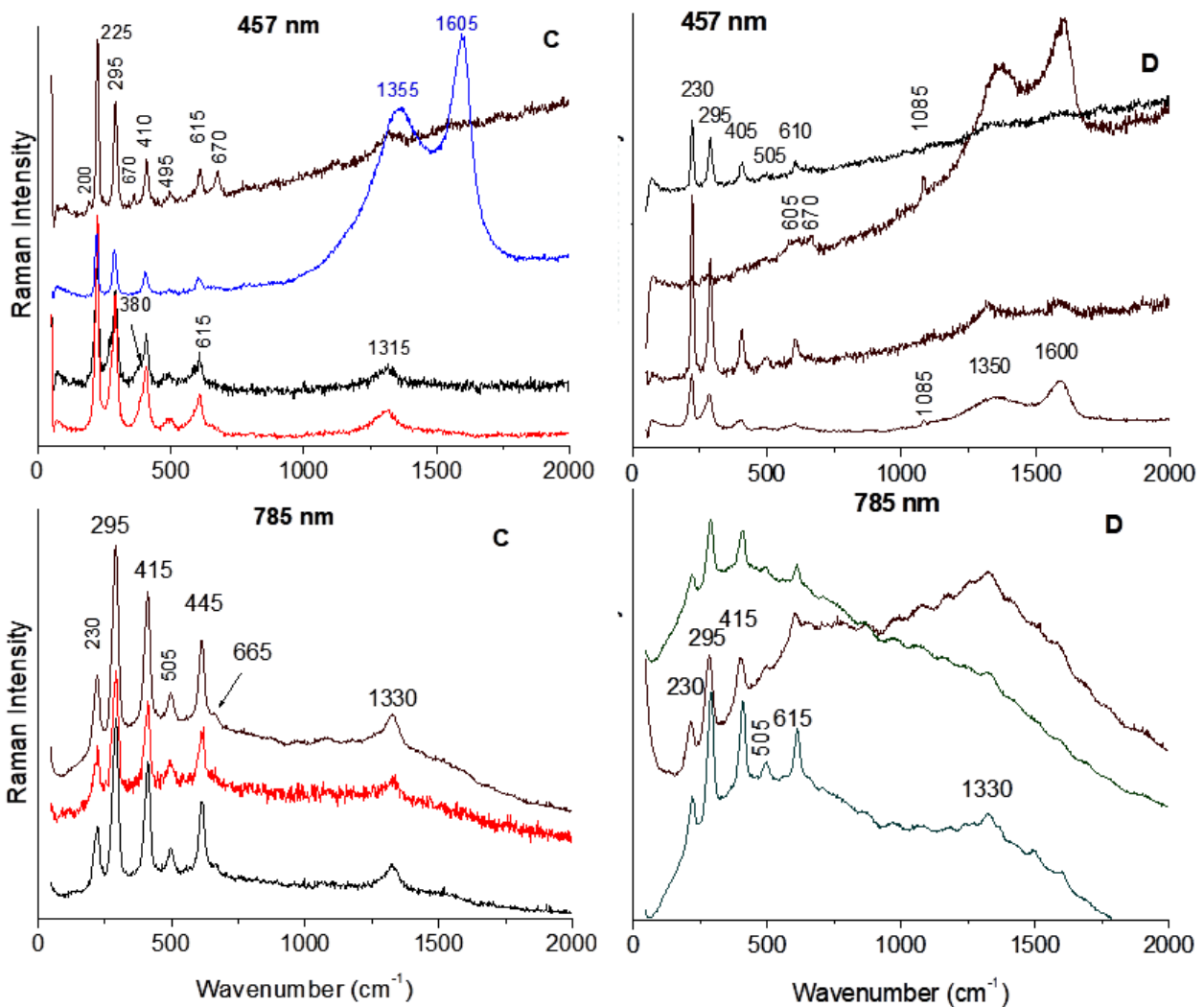


Figure 6. Comparison of representative Raman spectra for the red areas of TYPE C and TYPE D prints recorded with 457 nm (top) and 785 nm (bottom) laser excitation.

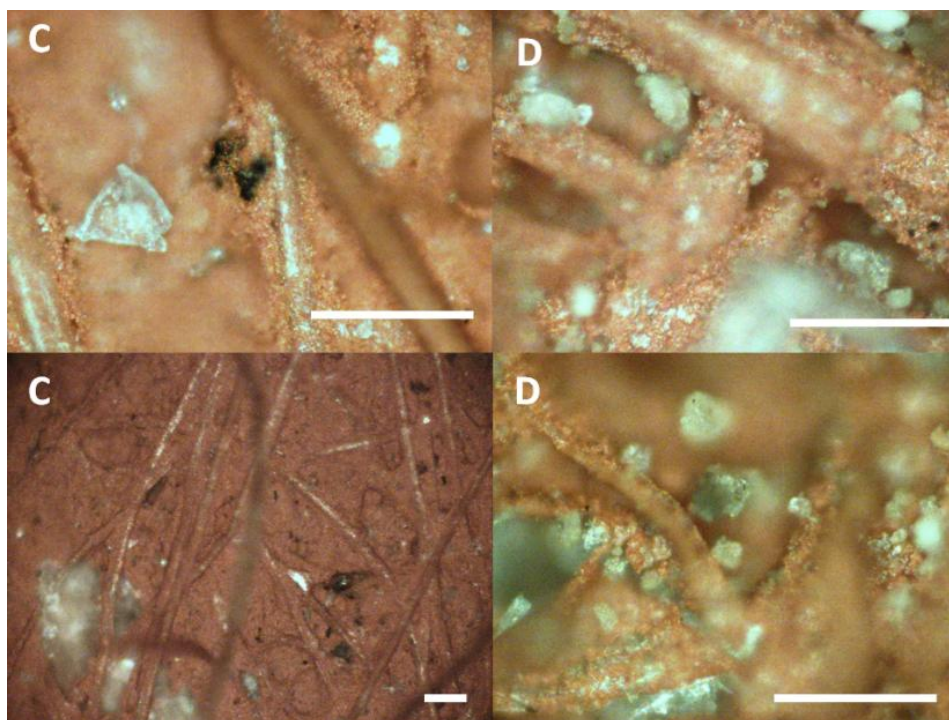


Figure 7. Comparison of optical microphotographs of the red areas on TYPE C and TYPE D prints. Bar: 50 μm .

3.3. Black areas

Raman spectra (Figure 8) are characterized by significant differences in their quality as a consequence of the variable densities of the black pigments, especially in relation to the porous microtexture of the paper supports (Figure 9). Few differences instead are observed on the nature of the carbon Raman fingerprint.

The $1350\text{-}1600\text{ cm}^{-1}$ doublet is characteristic of amorphous carbon obtained from a non-animal source (no phosphate detected). The very broad stretching band of sp^3 (around 1350 cm^{-1}) and sp^2 ($\sim 1600\text{ cm}^{-1}$) carbons, as expected, vary slightly with laser excitation [13].

For TYPE A and TYPE D we observe a complementary band around 1100 cm^{-1} which might come from the cellulose fibers. Even though a 1100 cm^{-1} component is usually observed in hydrogenated carbons [14], the contribution of the paper is expected to be dominant.

The black pigment on TYPE C, excited under 785 nm , shows a broad band around 640 cm^{-1} which is compatible with a spinel phase (probably based on iron or manganese oxide).

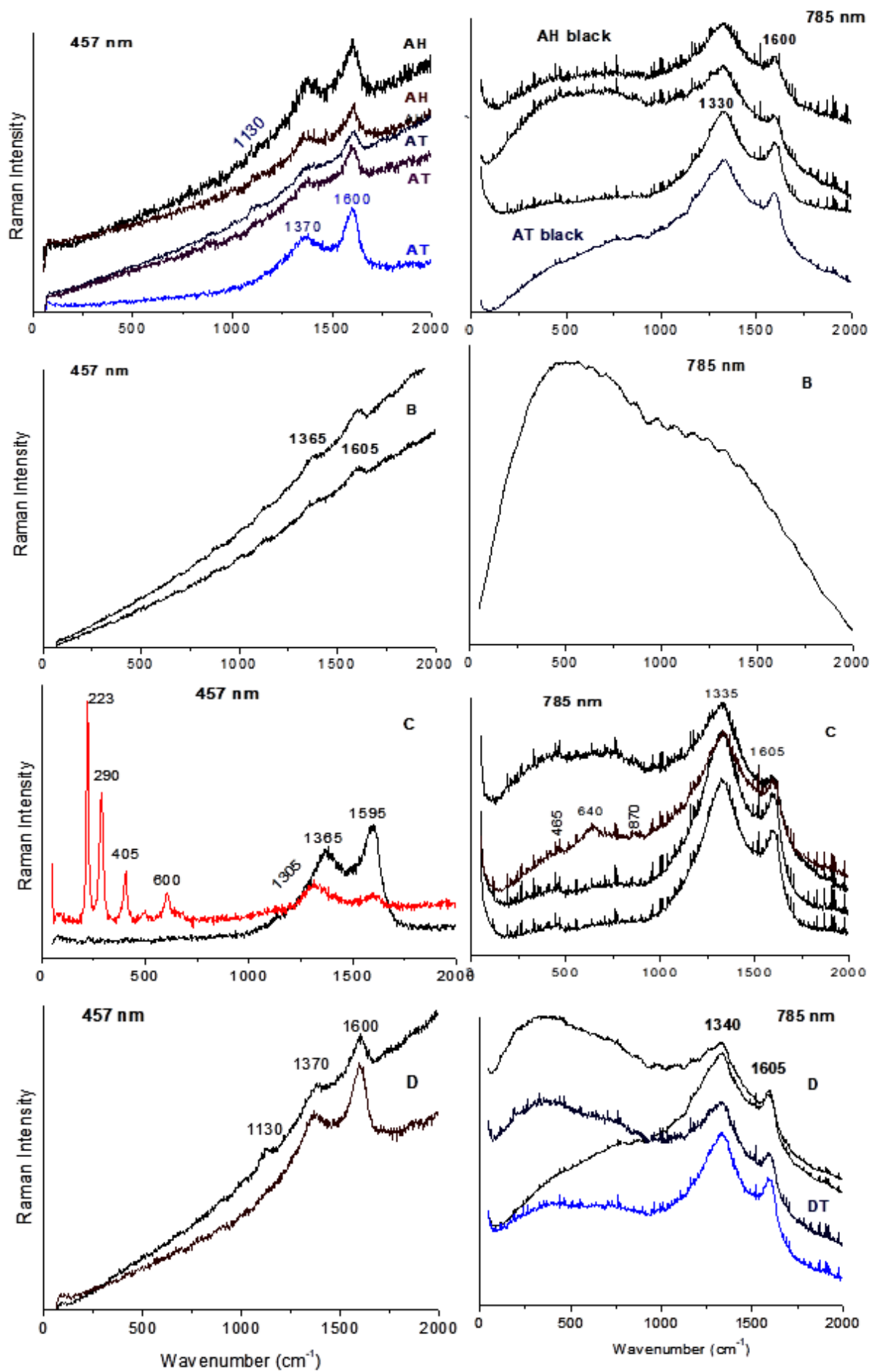


Figure 8. Comparison of Raman spectra for the black pigment analyzed on TYPE A (both impression – labeled AH; and accompanying letter – labeled AT), TYPE B, TYPE C and TYPE D, recorded with 457 (left) and 785 nm (right) laser excitation. Counting times are very short (a few tenths of seconds for spectra recorded with 457 nm and 0.1 seconds for 785 nm) in order to avoid degradation of the colored area under the laser beam.

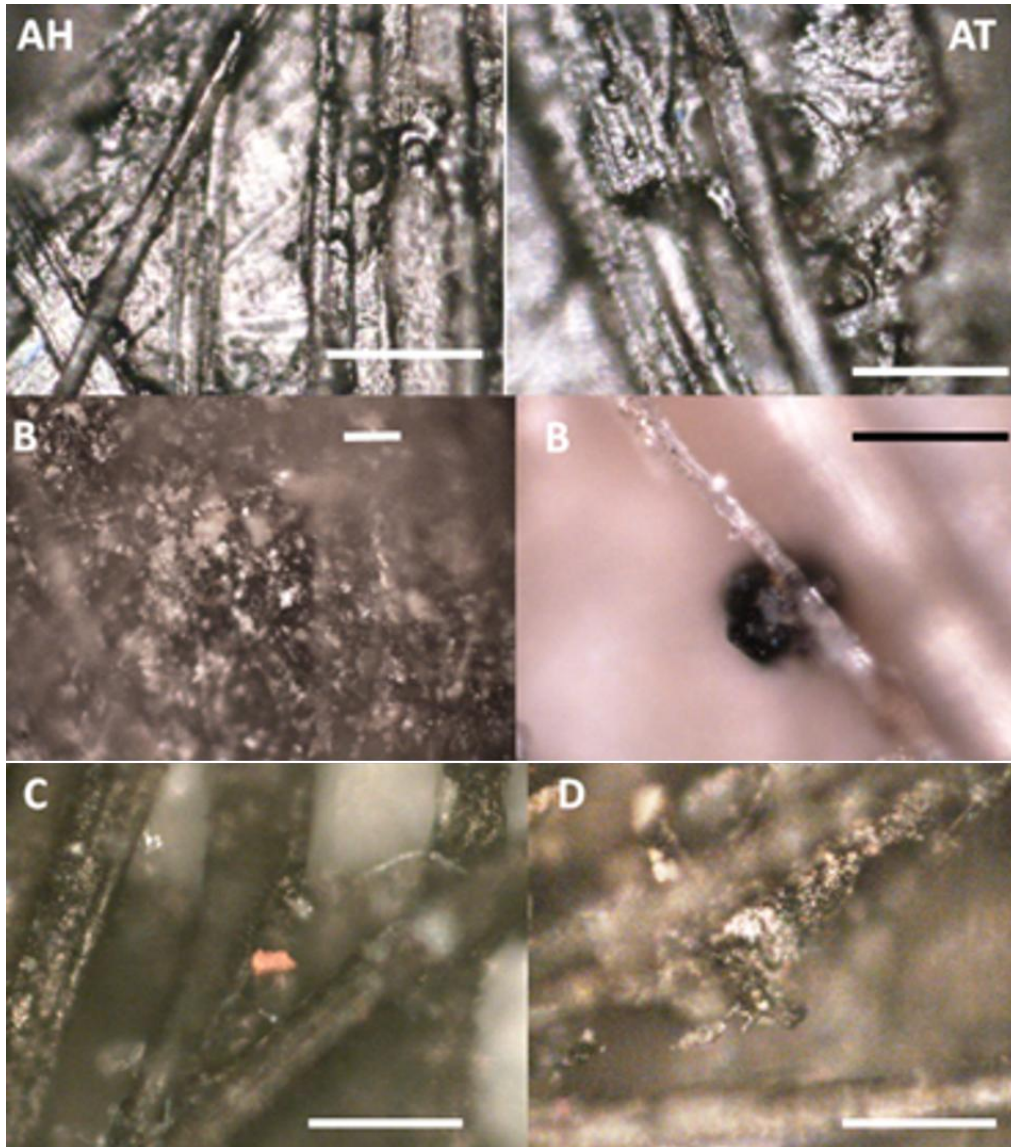


Figure 9. Comparison of optical microphotographs: black areas on TYPE A (both impression – labeled AH; and accompanying letter – labeled AT), TYPE B, TYPE C and TYPE D. Bar: 50 μm .

3.4. TYPE D – Materials and design

TYPE D appears to be the most common type with several examples extant today. Prints from this group are housed in the British Library (London, UK) (Figure 10), the Seinan Gakuin University Museum (Fukuoka, Japan), the Ricci Institute for Chinese-Western Cultural History (Boston, USA), the 26th Martyrs Museum (Nagasaki, Japan) and the European Private Collection herein presented. The prints are clearly the result of the use of two wood blocks: the *Key Block* for the black outline and a second block for the red-colored hair and red seal. Following is a thorough discussion on paper support and colors for TYPE D.

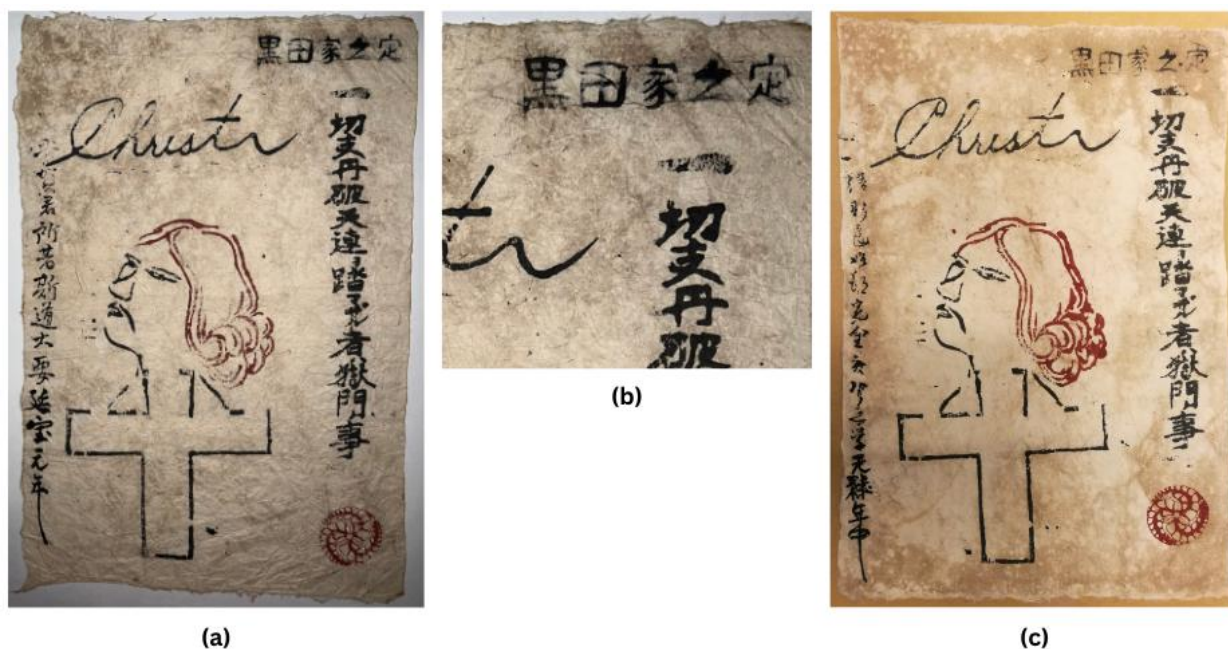


Figure 10. TYPE D: (a) Private collection, dated 1681; (b) detail of the placement of the *Christi* inscription; (c) British Library collection, dated 1697 (British Library, ORB.40/1061).

3.4.1. Paper support: further remarks

The XRF spectrum reported in Figure 5, apart from the main elements commonly observed on paper supports used for paintings and woodblock-print production throughout the Edo period (Si, P, S, K, Ca, Fe) [15-17], revealed the presence of chromium.

Introduced in Europe as a coloring agent in the early 19th century, chromium made its appearance in Japanese art, painting pigments and porcelain enamels, in the late 19th century [18-20]. Its use for the production of calligraphy implements such as ink sticks and paper became widespread in the 20th century [21]. Its detection, therefore, places the production of TYPE D well into the 20th century.

Relevant, to conclude, is also to report here the high Mn content detected in the sizing agent used for the paper support by XRF (Figure 5).

3.4.2. Print composition and design layout

Let's now focus briefly on the overall composition of the print. The design layout of Type D (Figure 10) features a *Christi* lettering delimited on both sides (left and right) by vertical inscriptions. The top-right section of the print hosts the Kuroda family inscription.

Furthermore, the head of the *Bateren* (Priest) is positioned asymmetrically in the squared space created by the lateral inscriptions and by the red Kuroda-family seal located to the bottom right.

3.4.3. Red color: further remarks

The XRF spectrum reported in Figure 11 revealed the use of a Fe-based pigment. Raman analysis identified it as synthetic hematite (section 3.2). Such evidence proves perfectly consistent with the Japanese practice of incorporating cheaper synthetic pigments for artistic use, be it locally produced or imported from Europe, that spread from the late 19th century onward [22-24]. Along with the detection of chromium in the paper support, results safely place the production of TYPE D well into the 20th century.

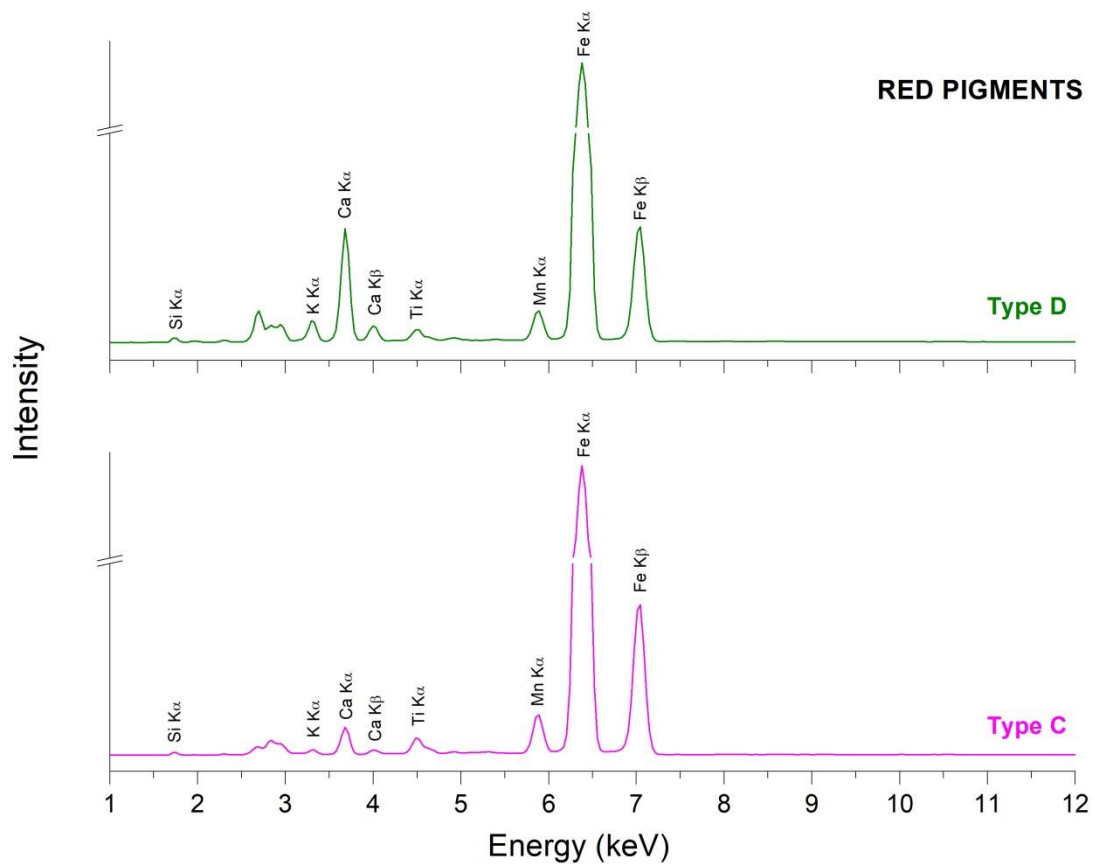


Figure 11. XRF spectra of the red pigments analyzed on TYPE C and TYPE D.

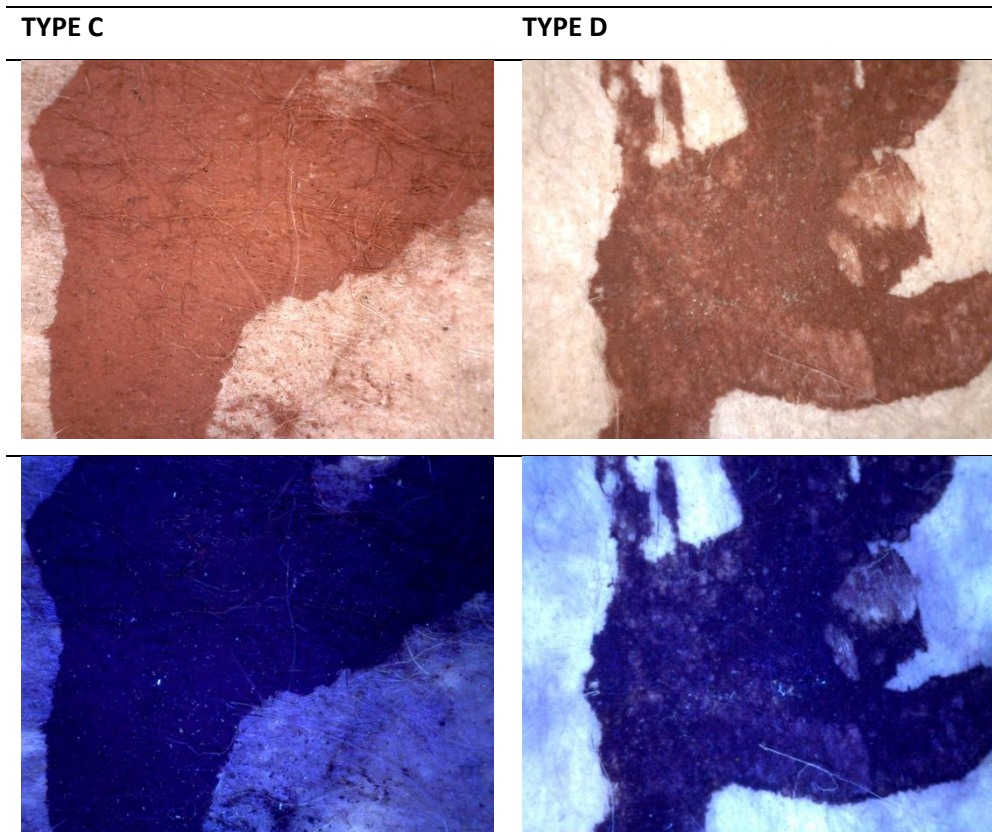


Figure 12. Visible and ultraviolet microscopy observation (50 ×) of the red hair.

3.4.4. Black color: further remarks

The XRF spectrum in Figure 13 reveals the presence of a Mn-rich compound in the black pigment analyzed on TYPE D. Such instance is completely inconsistent with the use of Japanese traditional *sumi* ink (carbon black) for woodblock printing and paintings [22,25-30]. On the contrary, the evidence is perfectly in line with the European use of manganese as a chromophore for pigments and enamels and as a siccative agent for mixed blacks – i.e. manganese oxide mixed with carbon black [31-34]. The latter, in consideration of the identification of carbon black by Raman analysis (section 3.3) appears to be the case.

This first-time-ever finding pairs with the aforementioned first-time-ever detection of chromium in the paper support (section 3.1) and the identification of synthetic hematite for the red color (section 3.2): the late Meiji (1900s) and early Showa (1930s-1950s) periods proved to be characterized by the use of imported pigments from Europe as a consequence of the strong Westernization that had started in the late 19th century under Emperor Meiji and that had led to the introduction of preparative chemistry in Japan [22].

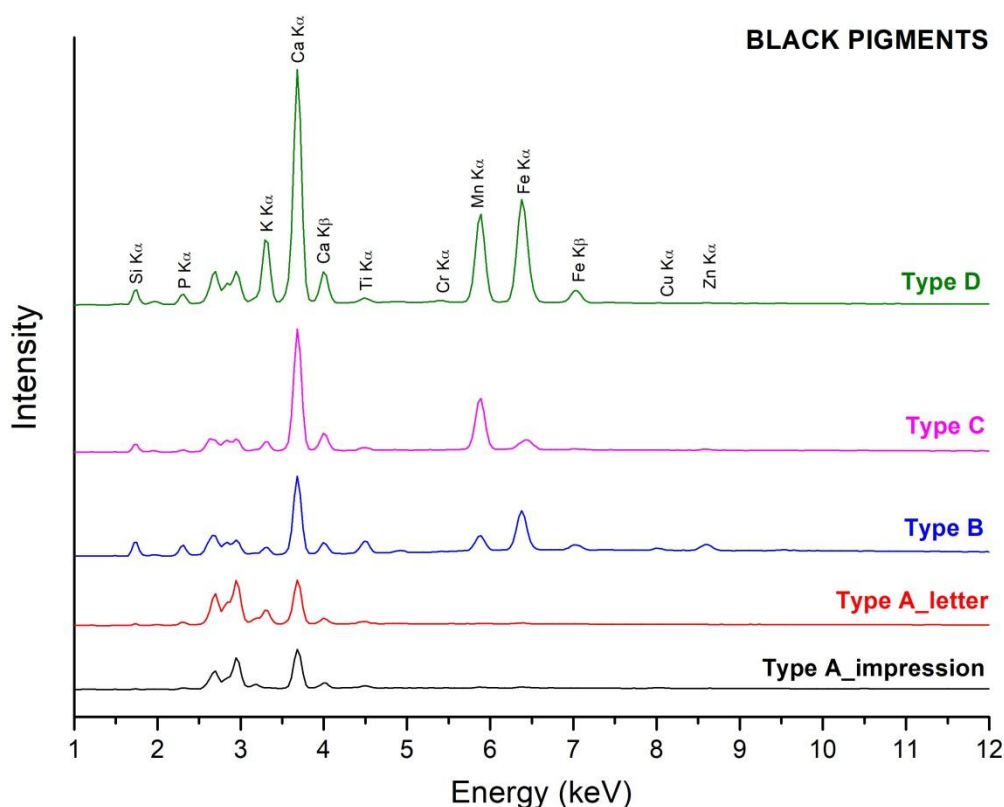


Figure 13. XRF spectra of the black pigments analyzed on TYPE A (both impression and accompanying letter), TYPE B, TYPE C and TYPE D.

N.B. The Mn content observed in the spectra of TYPE B and TYPE C comes from the paper support beneath the black pigment layer. The Mn detected on the black pigment of TYPE D belongs instead to the black pigment layer. The variable P content observed in all spectra belongs to the paper support beneath the black pigment. The Cr content observed in the spectrum of TYPE D comes from the paper support beneath the black pigment layer.

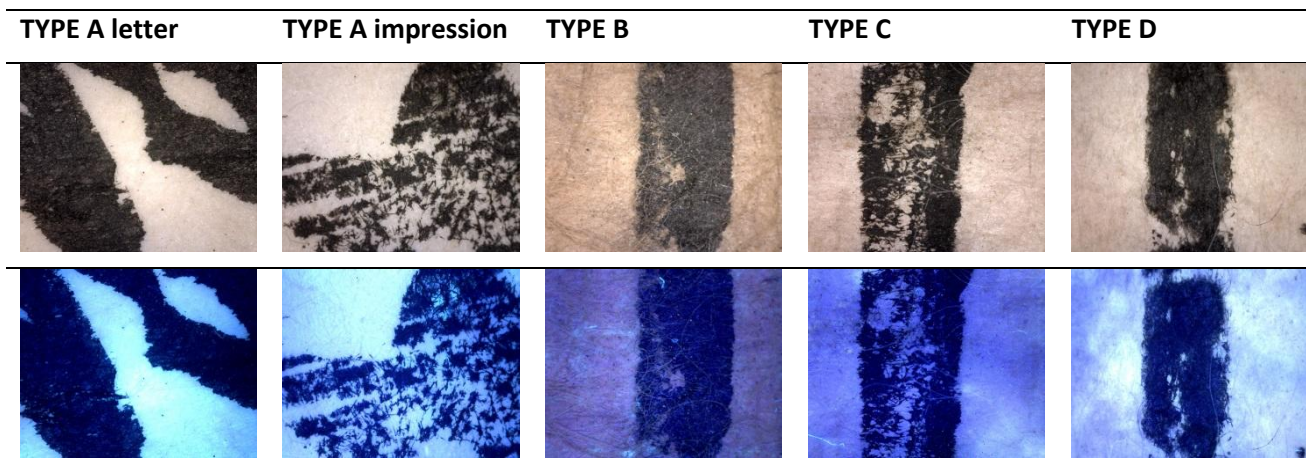


Figure 14. Visible and ultraviolet microscopy observation (50 ×).

3.4.5. TYPE D: conclusive remarks

The first-time-ever evidence herein presented provides the definitive answer regarding the origin of TYPE D: starting from the first half of the 20th century – late Meiji period (1900s) to the early Showa Period (1950s) – TYPE D prints were made to meet the strong demand for Christian relics, a frenzy that had originally taken the West by storm after the discovery of Hidden Christians by Father Bernard Petitjean in Nagasaki in 1865 (Figure 15) [35]. Such demand was intensely fueled by Westerners throughout the Meiji period, by American servicemen during the Occupation of Japan (1945-1952), and by Japanese academics as a result of the systematic interest in the history of Christianity that had spread countrywide from the mid-20th century onward.

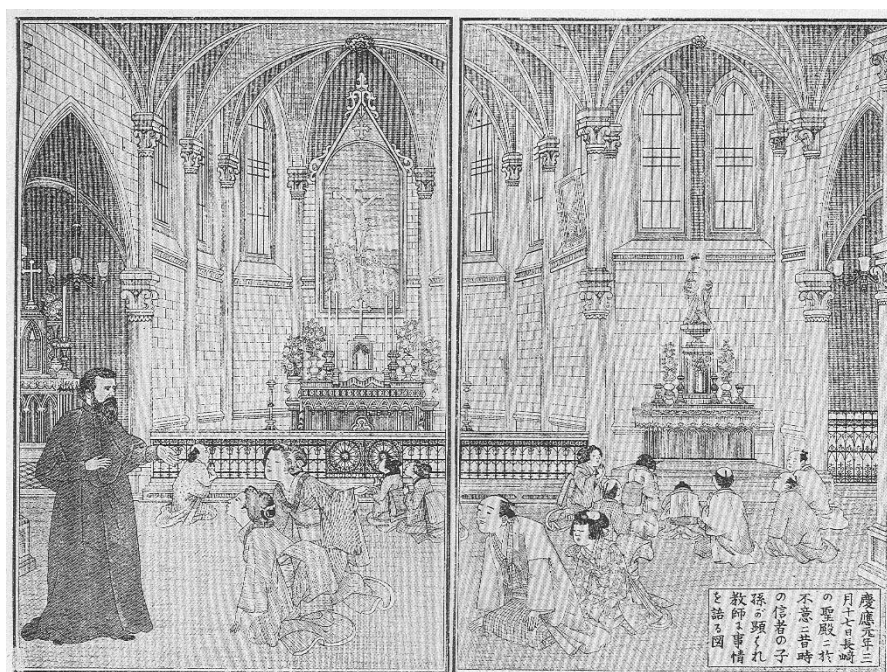


Figure 15. Father Bernard Petitjean approached by the Hidden Christians at the Oura Cathedral in Nagasaki on March the 17th, 1865.

3.5. TYPE A – Materials and design

This rare variant (Figure 16) belongs to the European Private Collection. Both the print and the accompanying letter have been analyzed. Following is a thorough discussion on paper support and color for TYPE A.

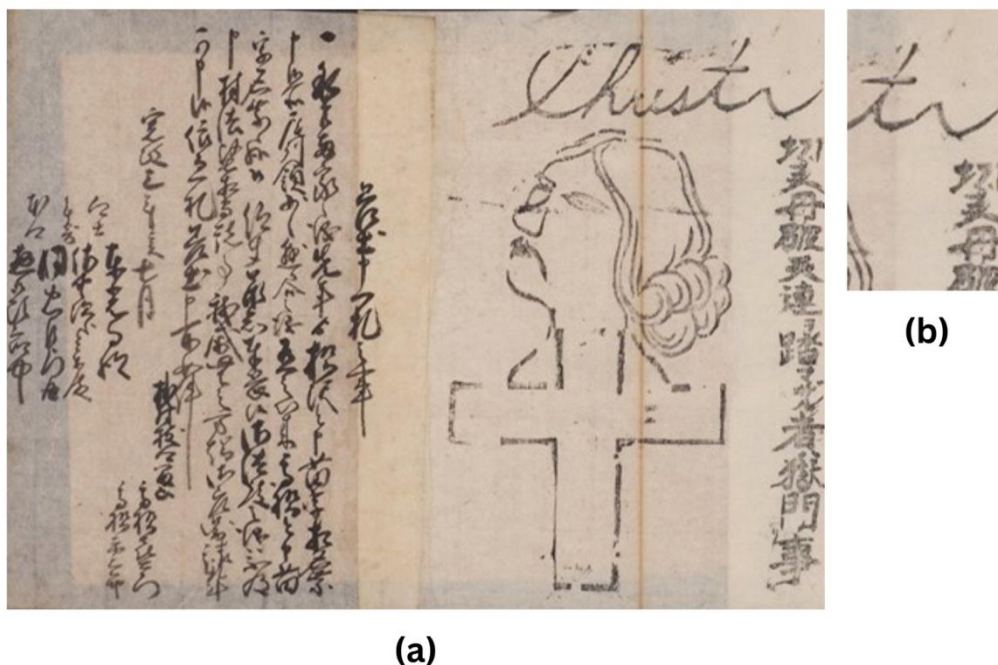


Figure 16. (a) TYPE A: impression (right) and accompanying letter (left) glued together; (b) Detail of the print.

3.5.1. Paper support: further remarks

TYPE A arrived to the present day glued to another sheet of paper (Figure 16). The right sheet bears the woodblock impression, while the left sheet features a calligraphic inscription reporting an incident relating to Christianity that occurred in 1791 (discussed in section 4).

The XRF spectra in Figure 5 show for both sheets the main elements commonly detected on paper supports used for paintings and woodblock-print production throughout the Edo period (Si, P, S, K, Ca, Fe) [15-17]. No Cr was detected.

Overall, Raman, FTIR and XRF spectra (Figures 3,4,5) all showed a perfect consistency between the left and right sheets, thus confirming their concurrent production and use [3].

Relevant, to conclude, is to note here for TYPE A the negligible content of Mn (trace element) that characterizes both the impression and accompanying letter (Figure 5).

3.5.2. Print composition and design layout

TYPE A is characterized by a distinctive design: the lettering 'Christi' extends above the vertical inscription on the right-hand side (Figure 16b), and the figure of the *Bateren* (Priest) is perfectly centered as the predominant feature to be emphasized.

TYPE A basically lacks all those additional inscriptions and seals that take up a lot of the compositional and visual space in TYPE D, and presents different relative design proportions compared to TYPE B and TYPE C.

To conclude, this rare example was obviously produced using a different *key Block* compared to all the other versions. In addition, the presence of the accompanying document

dated 1791 adds to its rarity and, most importantly, reveals crucial information regarding the actual purpose and true significance of the sacred image (discussed in section 4).

3.5.3. Black color: additional remarks

The XRF spectra reported in Figure 13 show no distinctive elements for the black chromophore. This instance is perfectly consistent with the use of carbon black, which appears as a transparent compound to x-ray. Raman analysis (section 3.3) confirmed that both the impression and the accompanying letter bear a carbon-black-based pigment as by Japanese traditional artistic practice [22,25-30].

3.6. TYPE B – Materials and design



Figure 17. (a) TYPE B; (b) Detail of the print.

3.6.1. Paper support: further remarks

The XRF spectrum in Figure 5 shows the main elements commonly detected on paper supports used for paintings and woodblock-print production throughout the Edo period (Si, P, S, K, Ca, Fe) [15-17]. No Cr was detected.

It is relevant to report here that the sizing agent used for TYPE B bears a slightly higher Mn content compared to TYPE A and the accompanying letter (Figure 5): such evidence, as in the case of TYPE C and TYPE D (Figure 5), strongly points to a later production period for TYPE B, most likely the second half of the 19th century, as also confirmed by historical evidence (section 3.6.2).

3.6.2. Print composition and design layout

TYPE B (Figure 17) bears a design composition similar to TYPE D (Figure 10), yet some of the features observed on the 20th-century impressions (section 3.4.2) are missing here. In particular the left-hand inscription, the top Kuroda family inscription, and the Kuroda family seal are not part of the design. The *Christi* lettering and the head of the *Bateren* (Priest) are placed in the same confined space as observed in TYPE D (Figure 17b).

Crucial is to report here that this very same type of print was found by Kataoka in the house of the Kiyama family in the city of Hondoshi (Kumamoto Prefecture) in 1965 [36]. The then

head of family told Kataoka that the print had belonged to the household since its creation, and that their ancestors were village headmen who carried out the *E-fumi* (trampling) sessions in the premises of the family residence (further discussed in section 4). Such fundamental instance places the production and use of TYPE B in the second half of the 19th century as consistently suggested by the analytical evidence herein presented.

The implication is clear: this variant was made using a different *Key Block* as a result of the overall change in design composition, marking a new stage in the production of these prints. The consistent use of the black color only, as also observed on TYPE A, indicates, from a timeline perspective, that TYPE B came to be produced after TYPE A, thus testifying to a change in print design as production moved into the second half of the 19th century. Overall, it can be safely asserted that scientific evidence is in full agreement with the historical facts reported by the Kiyama family to Kataoka.

3.6.3. Black color: further remarks

The XRF spectrum reported in Figure 13 shows no distinctive elements for the black chromophore. This instance is perfectly consistent with the use of carbon black which appears as a transparent compound to x-ray. The presence of carbon black has been confirmed by Raman analysis (section 3.3), thus proving perfectly in line with Japanese traditional artistic practice [22,25-30].

3.7. TYPE C – Materials and design

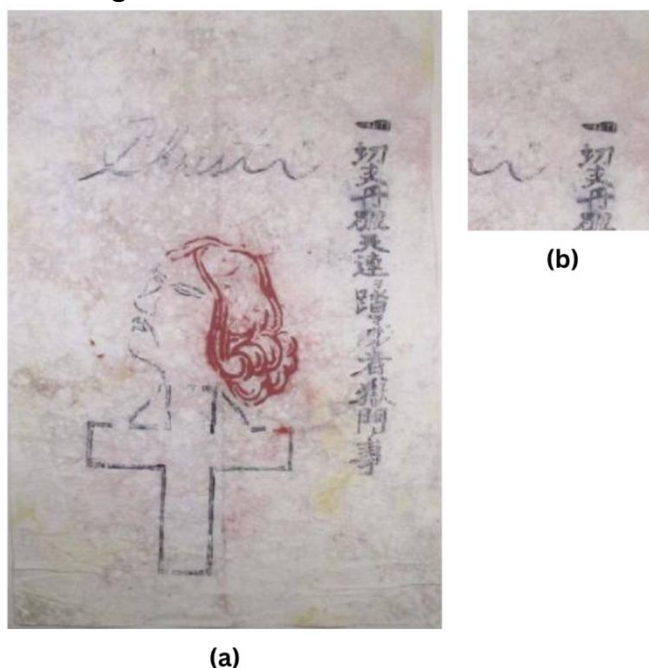


Figure 18. (a) TYPE C; (b) Detail of the print.

3.7.1. Paper support: further remarks

The XRF spectrum reported in Figure 5 shows the main elements commonly detected on paper supports used for paintings and woodblock-print production throughout the Edo period (Si, P, S, K, Ca, Fe) [15-17]. No Cr was detected.

Luminescence and FTIR results confirmed the similarity between TYPE C and TYPE D, both belonging to Group 2 (section 3.1). Moreover, XRF analysis revealed that TYPE C and TYPE D bear progressively higher contents of Mn in their sizing agents compared to TYPE A, the accompanying

letter and TYPE B (Figure 5). The implication is clear: higher Mn content in sizing agents marked print production of the second half of the 19th century.

To conclude, the latter half of the 19th century can be safely identified as the period of production of both TYPE B and TYPE C.

3.7.2. *Print composition and design layout*

TYPE C (Figure 18) appears to share all the basic features of TYPE B (Figure 17), yet a significant difference can be observed: the color of the hair of the *Bateren* (Priest) is now red.

It is relevant to note here that TYPE C, as in the case of TYPE B, lacks some of the features that characterize 20th-century impressions such as TYPE D (section 3.4.2): the left-hand inscription, the top Kuroda family inscription, and the Kuroda family seal. Instead, the placement of both the *Christi* lettering and the head of the *Bateren* (Priest) is the same.

The implication is clear: red hair marked a new stage of print production in the late 19th century under the influence of colored prints such as *Nagasaki-e* (discussed in section 5). Overall, the novel feature points to the earliest years after the lifting of the ban on Christianity (1873) as the timeframe for its systematic introduction. It can therefore be safely asserted that TYPE C followed TYPE B.

To conclude, the presence of the red hair is a testament to the creation of a relic-type of image that would appeal to a broader audience, much like the colored depictions of foreigners known as *Nagasaki-e* prints (discussed in section 5).

The inception of TYPE C, therefore, originated from the entrepreneurial initiative of Japanese artisans who aimed at feeding the strong interest Westerners had developed toward religious relics after the ban on Christianity had been lifted in 1873 and the shocking discovery of the Hidden Christians had occurred in 1865.

These reproductions will take their final form in the 20th century bearing all the additional features (various inscriptions, Kuroda seals, etc.) observed on TYPE D.

3.7.3. *Black color: further remarks*

The XRF spectrum reported in Figure 13 shows no distinctive elements for the black chromophore. This instance is perfectly consistent with the use of carbon black which appears as a transparent compound to x-ray. The presence of carbon black has been confirmed by Raman analysis (section 3.3), thus proving perfectly in line with Japanese traditional artistic practice [22,25-30].

3.7.4. *Red color: further remarks*

The XRF spectrum reported in Figure 11 revealed the use of a Fe-based pigment for the red color. Raman analysis identified natural hematite as the coloring agent (section 3.2). Such evidence proves perfectly consistent with the Japanese printing and painting tradition of the Edo and early Meiji periods [26,37].

The implication is clear: the detection of a high Mn content in the sizing agent of TYPE C (section 3.7.1) points to the latter half of the 19th century as the period of its production. In addition, the use of natural hematite for the red color places the production of TYPE C between 1873 (end of persecutions) and the earliest years of the 20th century, when the use of chromium, mixed black pigments and synthetic hematite became predominant as detected on TYPE D. It can therefore be safely asserted that TYPE C preceded TYPE D.

4. Origin and purpose of the Kami Fumi-e prints

A conclusive explanation of the origin and purpose of the analyzed prints comes from the letter accompanying TYPE A. The document bears the date 1791 (the seventh lunar month of the third year of the Kansei Era) and provides a detailed description of an incident relating to the Christian religion.

The document reports that the *Matsuzawa* family had been forced to change its surname to *Takahashi* following the intervention by the Oshu Clan (Owari – present-day Nagoya, once the domain of Oda Nobunaga). Such change proved the consequence of the noncompliance by the family with the laws enforced by the Shogun, the Clan and the Village.

The letter was submitted to both the local Buddhist Temple (Honko-ji) and the Village Self-Governing Authority. Such crucial detail reveals the historical and social context into which the prints are to be put: according to the anti-Christian legislation, all people had to be affiliated with a Buddhist temple [1]. The indication of the local Parish Temple (Honko-ji) in the document confirms that a new certification of religious affiliation was needed in order for the now-called-*Takahashi* to be formally acknowledged as Parishioners at Honko-ji.

Rarely did duplicates of such kind of documents survive in village archives [1], yet, in this case, the document had been preserved together with the image of the *Bateren* (Priest) head. This exceptional circumstance, along with the content of the letter, reveals that both the print and the letter dealt with the enforcement of the anti-Christian laws as also confirmed by the vertical inscription located on the right-hand side of all the impressions (Figure 19 – same inscription on all the analyzed prints, encircled in red):

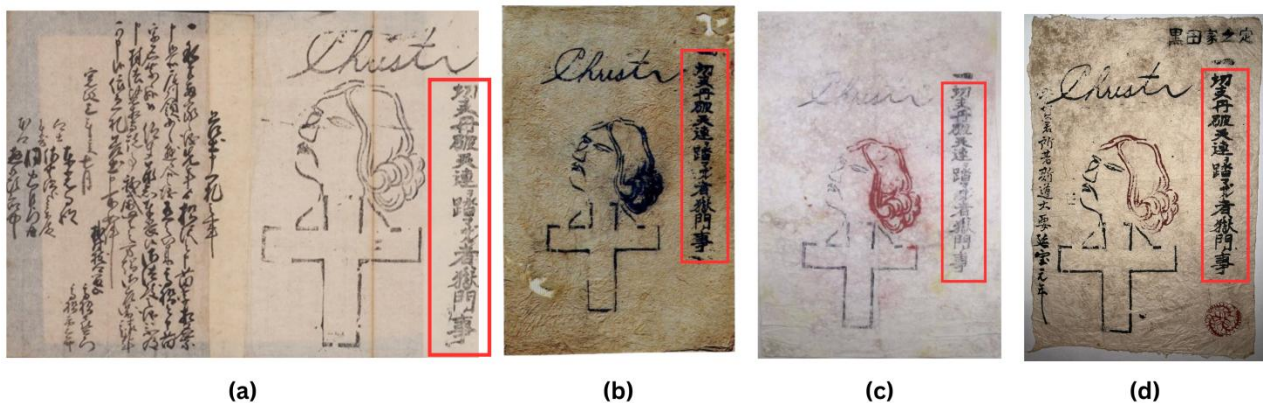


Figure 19. Paper prints representing the head of a *Bateren* (Priest): the right-hand side inscription, framed in red, is the same on all the print types.

切支丹破天連ヲ踏マザル者獄門ノ事: “Those who do not step on the *Bateren* (Priest) picture must be punished by *gokumon* (exposure of the severed head)”.

The detail of the Japanese painting in Figure 20, encircled in yellow, shows the severed heads of executed Christians being mercilessly exposed on a stand as by *gokumon* punishment in Japan from the 17th century.



Figure 20. Detail of the Japanese painting *Martyrdom of the 52 Christians at Nagasaki in 1622* showing the severed heads of the executed Christians being mercilessly exposed on a stand (encircled in turquoise). Color on paper, cm. 127 x 170, © Chiesa del Gesù, Rome. Adapted from [38].

The image of the head of the *Bateren* (Priest), apparently depicted as having been placed over a cross-shaped stand as by *gokumon* punishment, served therefore as a reminder of the horrific consequences to be faced had anyone failed to trample on the *Fumi-e* on the occasion of the yearly session. For unspecified reasons, most likely reported in additional documents lost to history, the *Matsuzawa* family must have failed either to undergo the *E-fumi* ceremony or to affiliate with the local Buddhist temple, so suspicion arose that Christians could be hiding within the household.

The change of family name, along with the oath to obey the laws of the Shogun, Clan and Village – mandatory requirements for the now-called-*Takahashi* to be added to the list of parishioners – were recorded and stored in the Village Headman archive and the Parish Temple.

The image of the head of the *Bateren* (Priest), therefore, was not an actual *Kami Fumi-e* but rather a cruel propaganda tool that would remind villagers of the mandatory obedience to the anti-Christian laws of the Shogun, Clan and Village, much like the *Kousatsu* (Notice Boards) mounted in each domain throughout Japan after the *Shimabara* Rebellion in Kyushu (1637-1638) to encourage accusers to report individuals suspected of being Christians to the authorities in exchange of monetary rewards (Figure 21) [1].

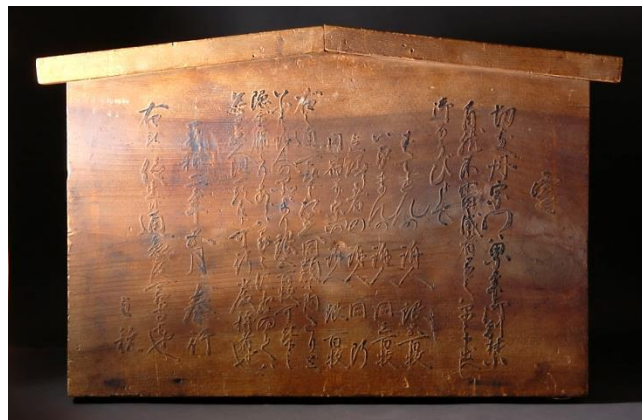


Figure 21. *Kousatsu* (Notice Board) listing monetary rewards for accusers of Christians. Lacquer and ink on wood, one of the few examples extant today bearing the date 1682 (Private collection).

Excerpts from the *Kousatsu* (Figure 21) reveal the distinctive consistency with the image of the *Bateren* head and the accompanying letter, in terms of both wording and hierarchic responsibilities (Self-Governing Authority and Village Headmen):

*“As a reward, we offer 500 silver coins for the accuser against a **Bateren** (a corrupt Japanese word for the Portuguese *Padre*: Priest)”*;

*“If the fact that you had hidden a **Bateren**...is revealed, the *Nanushi* (Village Headman) of your village, the *Goningumi* (the Self-Governing Authority consisting of a five-family group for the purpose of mutual assistance and responsibility) and your relatives, indeed your whole Clan will be punished. Please obey. The fifth lunar month of the second of the *Tenna Era* (1682)”*.

The image of the *Bateren* (Priest) would therefore be put on display as a harsh warning to all villagers on the occasion of the *E-fumi* sessions held at the Village-Headman residence on a yearly basis or as any official occasion required.

The details reported in the letter accompanying TYPE A also explain, for the first time ever, the presence of TYPE B (Figure 17) in the residence of the *Kiyama* family (discussed in section 3.6.2): the headman of the *Kiyama* family told Kataoka that their ancestors held the *E-fumi* sessions in the premises of their residence. Therefore, consistently with the letter herein analyzed, the *Kiyama* family ancestors, in their capacity of Village Headmen, kept in the village archive a copy of the official papers pertaining to the mandatory administrative duties each group of villages had to comply with in order to provide proof of the anti-Christian measures in the domain [1]. The paper images of the *Bateren* head, better identified here as *Warning Signs*, along with the *Kousatsu* (Notice Boards), were amongst the tools available for such purpose.

4.1. Reproductions: additional remarks.

In light of the scientific evidence and historical facts herein presented, the reason why the alleged *Kami Fumi-e*, better identified here as *Warning Signs* bearing the Image of the *Bateren* head (Priest), became reproduced is now clearer: after 1873, when the ban on Christianity had finally been lifted, the lengthy documental production stored in Village-Headmen households became useless. Thrown away and/or left exposed to the elements, the abandoned documents and prints became free for the taking. Moreover, from a technical standpoint, woodblock printing posed no impediment to any averagely-skilled artisan as the printing method had been widely practiced during the 19th and 20th centuries.

Furthermore, a compelling explanation for the additions of the Kuroda family inscription and seal in the 20th century (TYPE D) is offered by the evidence unveiled so far: the alleged *Kami Fumi-e* or *Warning Signs* must have also been stored – and found – in the Kuroda family household archive, which, as previously discussed, had become useless after the end of the persecutions in 1873. The Kuroda was an influential Clan during the Edo period, so the family crest would add to the credibility of these reproductions. It is relevant to mention here that before the present study was carried out, curators at the Seinan Gakuin University Museum had emphasized that TYPE D was in all probability a fake because it would have been unacceptable for anyone to trample on the Kuroda family crest during the Edo Period (1603-1868) as it would have been an unbearable outrage to such an important Clan [39]. This historical consideration matches the origin of TYPE D as identified in the present study on the basis of scientific results: forgers targeted Westerners and American servicemen during the Meiji and Occupation periods because these

audiences would not be capable of making a refined and erudite distinction between legitimate documents and later reproductions.

5. Origin of Bateren-head design

In order to identify the origin of the physical traits that characterize the head of the *Bateren* as depicted in the analyzed prints, some brief historical facts need to be mentioned here.

The presence of Jesuit Missionaries and merchants from Portugal, Italy and Spain in the late 16th century gave birth to a series of representations of Westerners on different art media in Japan. The phenomenon came to be known as *Nanban* frenzy (*Nanban-jin* or Southern Barbarians was the epithet used for Europeans at the time). A frantic interest toward all things European took Japanese society by storm: balloon pants, Western clothing, long noses and other exotic physical traits became widely depicted on paintings, lacquerware, clothing, ceramics and all sorts of accessories, playing cards included [40].

This fascinating development of Japanese history came to a bitter end with the prohibition of Christianity and the resulting harsh persecutions that started in 1614 by Tokugawa order. Such hostility toward Christianity culminated in the expulsion of all Europeans from Japan in 1639 [40].

After 1639 the Dutch, lay people only and no priests, became the sole Europeans allowed to set foot on Japanese soil for the following two hundred years – until Japan reopened to the outside world in the mid-19th century. As a consequence, Dutch nationals represented what all Westerners would look like in the imaginary of the Japanese people, and came to be commonly portrayed on paintings, prints and porcelain from the 18th century onward (Figure 22).



Figure 22. Details of a porcelain cup bearing the depicting of a Dutch with assistant and a Dutch falconer, Imari ware, overglaze enamels, late 18th-early 19th century (Private collection).

This distinctive dynamic in Japanese art, fueled by the recurrent curiosity toward the West, gave birth to the *Nagasaki-e*: depictions of foreigners based in Dejima, an artificial island located in Nagasaki (Kyushu) where foreign merchants were forced to stay when arriving in Japan. The Westerners portrayed were exclusively Dutch nationals [41].

Nagasaki-e boomed and created a sensational art trend in the mid-18th century. Overall, the production of those prints lasted until the late 19th century [41]. A direct comparison between the physical traits and poses observed on *Nagasaki-e* and the alleged *Kami Fumi-e* or *Warning Signs* herein analyzed provides an obvious match (Figure 23).



Figure 23. (a) TYPE A (impression); (b) Detail of the hand-colored print ‘Picture of a Hollander’, mid-18th century*; (c) Detail of the woodblock print ‘A Hollander with his Attendant and Dog’, late 18th-early 19th century*; (d) Detail of the woodblock print ‘A Dutch Dinner Party’, 18th century*.
* Adapted from [41]

The implication is clear: the source of the facial traits upon which the alleged *Kami Fumi-e* or *Warning Signs* came to be designed were Dutch nationals depicted on *Nagasaki-e* from the 18th century onward. The date 1791 reported on the letter accompanying TYPE A (discussed in section 4) proves perfectly consistent with the spreading of *Nagasaki-e* throughout Japan.

To conclude, the creation and production of the prints herein studied, based both on scientific evidence and Japanese historical facts, started with TYPE A around the mid-18th century to switch to TYPE B around the mid-19th century and last until 1873 (end of the persecutions). Reproductions started to flood Japan after 1873 with TYPE C to peak around the mid-20th century with a switch to TYPE D. The first-time-ever identified timeline is shown in Figure 24.

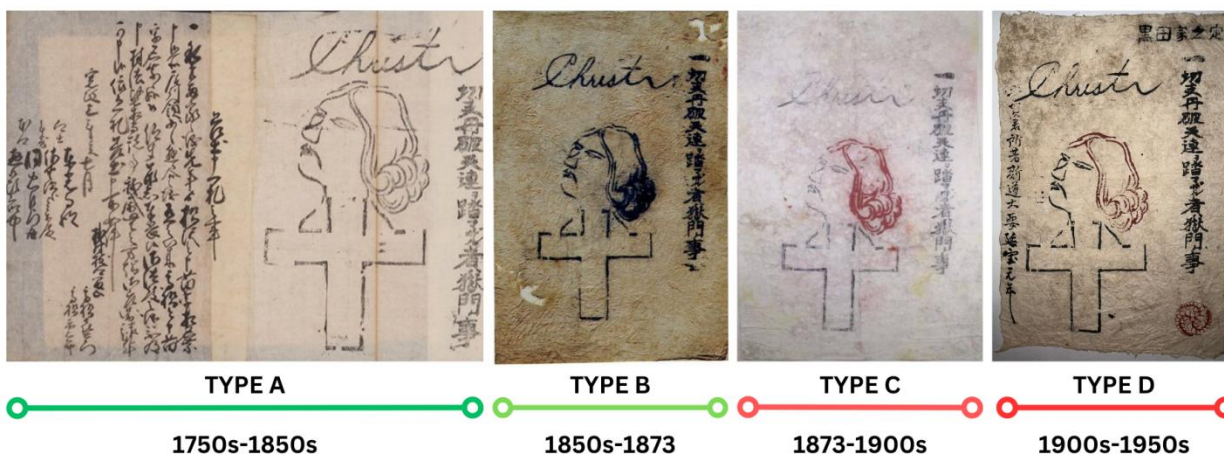


Figure 24. Timeline of production of all print types.

6. Conclusions

Analytical evidence obtained through XRF, Raman (Luminescence background) and FTIR analyses has enabled, for the first time ever, the identification of the origin, purpose and timeline of production of the alleged *Kami Fumi-e* or better labeled here as *Anti-Christian Propaganda Warning Signs*. The successful distinction between authentic images from the Edo period and later reproductions dating to the late 19th and 20th centuries was also possible.

In particular, scientific results have revealed that the production of the prints started in the mid-18th century through the incorporation into the original design of the distinctive traits of Dutch nationals portrayed in the *Nagasaki-e* colored prints. The Dutch were the only Westerners allowed to trade with Japan after the isolation policy (*sakoku*) had gone into effect in 1639. The Dutch will therefore become what all Westerners would look like in the common imaginary of the Japanese people and will be depicted on paintings, prints and porcelain.

The legitimate production of the *Kami Fumi-e* or *Warning Signs* prints lasted until 1873 (end of the persecutions) with slight changes in the overall design as testified by TYPE B.

After the lifting of the ban on Christianity in 1873, reproductions such as TYPE C started to flood Japan in order to meet the demand for Christian relics that had boomed after the discovery of the Hidden Christians in 1865.

The craze for such relics peaked in the 20th century as interest toward Christianity spread to the Japanese society and American servicemen during the occupation period after WWII, and TYPE D satisfied the demand.

From a materials standpoint, synthetic pigments and mixtures of compounds of European origin marked the production of the prints in the 20th century.

Historical facts revealed that the prints' original purpose was not to be used as actual *Fumi-e* (images to be trampled on) but rather as cruel propaganda tools aimed at reminding of the mandatory obedience to the anti-Christian laws enforced throughout the Edo period (1603-1868) and Meiji period (1868-1912) until 1873 when the ban on Christianity will finally be lifted.

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Conflicts of Interest: The authors declare no conflicts of interests.

Refereces

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