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The Origin of KO-KUTANI Porcelain—Part II: The Unearthed Secrets of the *Hakuji* Shallow Bowl

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Abstract

The present work aims at completing our previous comprehensive study on Ko-Kutani ware through the analysis, for the first time ever, of the renowned *Hakuji* bowl (white porcelain shallow bowl) excavated at the Noborigama kiln site in Kaga. The bowl had never been made available for such a purpose prior to this study owing to its absolute rarity, exceptional importance and fragile condition. Its shape and potting techniques, along with its materials, enabled both a direct comparison with the magnificent Ko-Kutani masterpieces belonging to the Ishikawa Prefectural Museum of Art collection and the groundbreaking identification of a definitive firing timeline marked by two distinct production stages: the Pre-*Hakuji* and Post-*Hakuji* phases. The crucial influence of the *Hakuji* bowl on Ko-Kutani production as a whole has been revealed for the first time ever, providing unprecedented and definitive evidence of the origin of the renowned and iconic porcelains. In consideration of the strict requirements and the absolute prohibition to sample or even touch any of the works of art, portable Energy-Dispersive X-Ray Fluorescence spectroscopy (pED-XRF) was selected as the most suitable technique for the type of materials to be investigated.

Keywords: Ko-Kutani; Japanese porcelain; overglaze enamels; excavated shards; XRF; Jesuit mission; glaze; body; element ratio; XRF

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1. Introduction

The century-long debate regarding the origin of Ko-Kutani porcelain has recently been resolved by the first-ever systematic study of the most extensive museum collection of Ko-Kutani wares extant today (Ishikawa Prefectural Museum of Art, Kanazawa, Ishikawa Prefecture) [1]. The study also reported the groundbreaking evidence obtained through the analysis of some of the very scarce overglaze-enameled shards excavated at the Kaga kiln site (Ishikawa Archaeological Foundation) and two celebrated works by Nonomura Ninsei (National Treasure and Important Cultural Properties of Japan—Ishikawa Prefectural Museum of Art) [1].

In consideration of the strict requirements and the absolute prohibition to sample or even touch any of the works of art, portable Energy-Dispersive X-Ray Fluorescence spectroscopy (pED-XRF) was selected as the most suitable technique for the type of materials to be investigated.

The previously published study aimed at identifying the inception and creation of the iconic Aode style, the distinctive porcelain decoration that features the covering of the entire body with polychrome enamels [1], much like European paintings on canvas in the Renaissance period. Not only did the results confirm that Ko-Kutani wares originated in the Kaga domain (present-day Ishikawa Prefecture) ruled by the Maeda Clan (sympathizers of Christianity) but it also unveiled the involvement of both potters from Arita (the main Japanese porcelain production center located in Kyushu) and Christian artisans who had trained at the painting Seminario supervised by the Italian Jesuit painter Giovanni Cola [1]. The latter, after arriving in Japan in 1583 by request of Alessandro Valignano (the Supervisor of the Jesuit Mission in Japan), established a painting school and a glass workshop in Arie (Kyushu) in 1595 under the patronage of the Christian Samurai Takyama Ukon and Naito Tokuan Johan [2–4].

The present study, with respect to the previous work, went one step further by analyzing the renowned Ko-Kutani *Hakuji* bowl (white porcelain shallow bowl) (Figure 1) excavated at the Noborigama (high-firing-climbing kiln) kiln site in Kaga (Ishikawa Archaeological Foundation). The bowl had never been made available for such a purpose prior to this study owing to its absolute rarity, exceptional importance and fragile condition: it is the only excavated and recomposed bowl to have arrived to us in an almost complete form. Its shape and potting technique, along with its materials, enabled both a direct comparison with the magnificent examples belonging to the Ishikawa Prefectural Museum of Art collection and the identification of a definitive firing timeline marked by two distinct production phases: the Pre-*Hakuji* and Post-*Hakuji* phases.

Figure 1. *Hakuji* bowl (#12-9) (white shallow bowl), front, back and detail of small foot. Excavated at the *Noborigama* kiln site 1 (high-firing-climbing kiln), Kaga (Ishikawa Prefecture), dimensions H. 10 × D. 30 cm.

Lastly, additional Ko-Kutani masterpieces from the Ishikawa Prefectural Museum of Art collection were analyzed and included in the definitive and comprehensive Ko-Kutani firing timeline for the first time ever. Consistent with the previous study, in order to meet the requirements for the analysis to be authorized, portable ED-XRF was selected as the most suitable technique to investigate all the examples and shards.

2. Materials and Methods

2.1. Analyzed Porcelains and Excavated Hakuji Bowl

The *Hakuji* (white porcelain) shallow bowl (Figure 1) was made available by the Ishikawa Archaeological Foundation. It was excavated at kiln 1—the Noborigama (high-firing-climbing kiln) kiln site in Kaga [5]. The Ishikawa Archaeological Foundation also provided shard #430 [6] for the analysis.

Table 1 presents a comprehensive list of all the examples investigated in the present and previous work [1], including the newly analyzed Ko-Kutani bowls belonging to the Ishikawa Prefectural Museum of Art collection.

Table 1. Chemical elements detected by X-ray fluorescence (XRF) on the multiple points analyzed for each color, along with the corresponding hypothesized pigments: **Major elements** and (minor or trace elements); underlined elements identify the chromophore. **Red frames and red lettering indicate the newly analyzed porcelains and shards**.

Analyzed Porcelains		**Historical Period**	**XRF Results: Enamel Matrix, Chromophores and Glazes**	**Identified Pigments**
	Shard #310	Early 1640s	Green Enamel **Pb**, **Cu**, **Si** (Ca, Fe, K, Zn, Ni, Ti, Al)	**Cu-Zn Green**
Main Characteristics: Earliest Ko-Kutani enameled porcelain. Arita-based transparent glaze with Rb/Sr ratio of 0.19.				
	Shard #493	Mid-1640s	Green Enamel **Pb**, **Cu**, **Si**, **K** (Fe, Ca, Zn, Ti, Mn, Ni, Al)	**Cu-Zn Green**
Main Characteristics: Earliest Ko-Kutani enameled porcelain. Arita-based transparent glaze with Rb/Sr ratio of 0.28.				
	Shard #22	Mid-1640s	Green Enamel **Pb**, **Cu**, **K**, **Si** (Fe, Ca, Zn, Ni, Mn, Ti, Al)	**Cu-Zn Green**
Main Characteristics: Earliest Ko-Kutani enameled porcelain. Arita-based transparent glaze with Rb/Sr ratio of 0.29.				

Table 1. *Cont.*

Analyzed Porcelains		Historical Period	XRF Results: Enamel Matrix, Chromophores and Glazes	Identified Pigments
	Shard #430	Late 1640s	Glaze **Ca, Si, K, Fe, Sr** (Mn, Ti, Rb, Al, Pb) Red Enamel **Ca, Fe, Si, Pb, K** (Sr, Mn, Ti, Rb, Al)	**Fe-based Red**
Main Characteristics: Earliest Ko-Kutani enameled porcelain. Arita-based transparent glaze with Rb/Sr ratio of 0.31.				
	*Hotei*	Early Period (1648–1650)	Green Enamel **Pb**, **Cu**, K, Si (Fe, Ca, Zn, As, Ni, Mn, Ti, Ca)	**Cu-Zn-As Green**
Main Characteristics: Early Period enameled body type with large foot. Kaga-incepted decoration style based on Tawaraya Sotatsu's painting composition. Kaga opaque glaze with Rb/Sr ratio of 0.8.				
	*Phoenix*	Early Period (1648–1650)	Blue Enamel **Pb**, **K**, Si (Cu, Fe, Co, Ni, As, Ti, Ca) Green Enamel **Pb**, **Cu**, K, Si (Fe, Ca, Zn, As, Ni, Mn, Ti)	**Smalt Blue** **Cu-Zn-As Green**
Main Characteristics: Early Period enameled body type with large foot. Decoration style with its inception in Kaga based on Tawaraya Sotatsu's painting composition. Kaga opaque glaze with Rb/Sr ratio of 0.91. **Notable Features:** - Introduction of Smalt-based overglaze-blue enamel. - Underside fully enameled with Smalt-based blue.				
	***HAKUJI*bowl (#12-9)**	Middle Period (1650)	Glaze **Ca**, **K**, **Si**, **Fe**, **Sr** (Mn, Ti, Rb, Al) Body **K, Fe, Si** (Ti, Ca, Rb, Al, Zn, Cu)	–
Newly Introduced Body Prototype: - Shallow bowl with Korean-based small foot. - Introduction of the new *Hakuji* glaze: Rb/Sr = 0.40.				

Table 1. *Cont.*

Analyzed Porcelains		**Historical Period**	**XRF Results: Enamel Matrix, Chromophores and Glazes**	**Identified Pigments**
 	*Lobster*	Middle Period (1650)	Green Enamel **Pb, Cu, Ca, K, Fe** (Si, Mn, Zn, Ti, As, Ni)	**Cu-Zn-As Green**
Transitional piece (Early-to-Middle Period): - *Hakuji*-type body with small foot. - Decoration style with its inception in Kaga based on Tawaraya Sotatsu's painting composition. - New *Hakuji* glaze: Rb/Sr = 0.46.				
 	*Scattered Treasures and Heron*	Middle Period (1650)	Green Enamel **Pb**, **Cu**, K, Si (Fe, Ca, Zn, As, Ni, Ti, Ca)	**Cu-Zn-As Green**
Transitional piece (Early-to-Middle Period): - *Hakuji*-type body with small foot. - Initial form of Proto-Aode decoration style. - New *Hakuji* glaze: Rb/Sr = 0.43. - Stabilization and standardization of production.				
 	*Quail*	Middle Period (1651)	Blue Enamel **Pb**, **K**, Si (Cu, Fe, Co, Ni, As, Ti, Ca) Green Enamel **Pb**, **Cu**, K, Si (Fe, Zn, As, Ni, Mn, Ti, Ca)	**Smalt Blue** **Cu-Zn-As Green**
Shallow bowl with large foot, decorated in Proto-Aode style. **Transitional features**: - Return to initial Kaga opaque glaze: Rb/Sr = 0.70. - Introduction of large foot in Proto-Aode decoration style after production stabilization and standardization. - Introduction of Smalt-based overglaze-blue in the Middle Period.				
 	*Paving Stone Pattern*	Middle Period (1651)	Blue Enamel **Pb**, **K** (Cu, Fe, Co, Ni, As, Si, Zn, Ti, Al, Ca) Green Enamel **Pb**, **Cu**, **K** (Fe, Zn, As, Ni, Mn, Ti, Si, Ca)	**Smalt Blue** **Cu-Zn-As Green**
Main Characteristics: Shallow bowl with large foot, decorated in Proto-Aode style. Kaga opaque glaze: Rb/Sr = 0.84.				

Table 1. *Cont.*

Analyzed Porcelains		**Historical Period**	**XRF Results: Enamel Matrix, Chromophores and Glazes**	**Identified Pigments**
 	*Peony (Iro-e)* (*Iro-e Botan*)	Middle Period (1651)	Green Enamel **Pb**, **Cu, K** (Fe, Zn, As, Ni, Mn, Ti, Si)	**Cu-Zn-As Green**
Main Characteristics: Shallow bowl with large foot, decorated in Proto-Aode style. Kaga opaque glaze: Rb/Sr = 0.65.				
 	*Flowers and Birds Inside Jar*	Middle Period (1651)	Blue Enamel **Pb**, **K** (Cu, Fe, Co, Ni, As, Si, Zn, Ti, Ca) Green Enamel **Pb**, **Cu, K** (Fe, Zn, As, Ni, Mn, Ti, Si, Ca)	**Smalt Blue** **Cu-Zn-As Green**
Main Characteristics: Shallow bowl with large foot, decorated in Proto-Aode style. Kaga opaque glaze: Rb/Sr = 0.77.				
 	*Stream and Mandarin Duck*	Middle Period (1651)	Blue Enamel **Pb**, **K** (Cu, Fe, Co, Ni, As, Zn, Si, Ti, Ca) Green Enamel **Pb**, **Cu, K** (Si, Fe, Zn, As, Ni, Ti, Mn, Ca)	**Smalt Blue** **Cu-Zn-As Green**
Main Characteristics: Shallow bowl with large foot, decorated in Proto-Aode style. Kaga opaque glaze: Rb/Sr = 0.87.				
 	*Scattered Flowers and Twin Birds*	Middle Period (1651)	Blue Enamel **Pb**, **K** (Si, Cu, Fe, Co, Ni, As, Ti, Zn, Ca) Green Enamel **Pb**, **Cu, K** (Fe, Si, Zn, As, Ni, Mn, Ti, Ca)	**Smalt Blue** **Cu-Zn-As Green**
Main Characteristics: Shallow bowl with large foot, decorated in Proto-Aode style. Kaga opaque glaze: Rb/Sr = 0.61.				

Table 1. *Cont.*

Analyzed Porcelains		**Historical Period**	**XRF Results: Enamel Matrix, Chromophores and Glazes**	**Identified Pigments**
 	*Karuta and Cranes*	Middle Period (1651)	Green Enamel **Pb**, **Cu**, **K** (Si, Fe, Zn, As, Ni, Mn, Ti, Ca)	**Cu-Zn-As Green**
Main Characteristics: Shallow bowl with *Hakuji*-type body and small foot, decorated in Proto-Aode style. Kaga opaque glaze: Rb/Sr = 0.70.				
 	*Old Tree and White Cloud*	Middle Period (1651)	Blue Enamel **Pb**, **K**, **Fe ****, **Cu** (Zn **, Mn **, Co, Ni, As, Ti, Si, Ca, Al) ** from black decoration layer Green Enamel **Pb**, **Cu**, **K** (Fe, Zn, As, Si, Ni, Ti, Si)	**Smalt Blue** **Cu-Zn-As Green**
Transitional piece (Middle-to-Late Period): - Shallow bowl with large foot decorated in Proto-Aode style. - Return to *Hakuji* glaze: Rb/Sr = 0.44. - Introduction of green washed underside.				
 	*Shochikubai*	Late Period (1651)	Green Enamel **Pb**, **Cu**, **K** (Fe, Zn, As, Ti, Ni, Si)	**Cu-Zn-As Green**
Transitional piece (Middle-to-Late Period): - Shallow bowl with *Hakuji*-type body and small foot. - Unwashed base. - Decorated in initial form of Full-Aode style.				
 	*Peony*	Late Period (1651–1652)	Green Enamel **Pb**, **Cu**, **Zn**, **K** (Fe, As, Mn, Si, Ti, Ni, Ca)	**Cu-Zn-As Green**
Main Characteristics: Shallow bowl with *Hakuji*-type body and small foot, decorated in Full-Aode style. **Notable feature:** Introduction of the iconic snowflake design on the underside.				

Table 1. *Cont.*

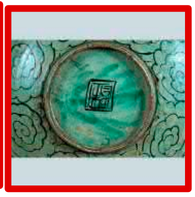
Analyzed Porcelains		**Historical Period**	**XRF Results: Enamel Matrix, Chromophores and Glazes**	**Identified Pigments**
 	*Aged Pine Tree*	Late Period (1651–1652)	Green Enamel **Pb**, **Cu, K, Zn** (As, Fe, Si, Mn, Ni, Ti, Ca)	**Cu-Zn-As Green**
Main Characteristics: Shallow bowl with *Hakuji*-type body and small foot, decorated in Full-Aode style. Snowflake design on the underside.				
 	*Bamboo Leaves*	Late Period (1651–1652)	Green Enamel **Pb**, **Cu, Zn, K** (Si, As, Fe, Ca, Ti)	**Cu-Zn-As Green**
Main Characteristics: Shallow bowl with *Hakuji*-type body and small foot, decorated in Full-Aode style. Snowflake design on the underside.				
 	*Camellias*	Late Period (1651–1652)	Green Enamel **Pb**, **Cu, K, Si** (Fe, Zn, Ca, Ni, Ti, Mn, As, Al)	**Cu-Zn-As Green**
Main Characteristics: Shallow bowl with *Hakuji*-type body and small foot, decorated in Full-Aode style. Snowflake design on the underside.				
	Shard #595	Late Period (1652)	Blue Enamel **Pb**, **Cu, K** (Si, Fe, Co, Ni, As, Zn, Mn, Ti, Al, Ca) Green Enamel **Pb**, **Cu, K, Si** (Fe, Ca, Zn, Ni, Ti, Mn, Al)	**Smalt Blue** **Cu-Zn Green**
Transitional piece (Middle-to-Late Period): - Enameled porcelain with *Hakuji*-type glaze: Rb/Sr = 0.45. - Experimentation with Smalt-based overglaze-blue enamel.				
 	*Poppy*	Late Period (1652)	Blue Enamel **Pb**, **K, Fe** (Si, Co, Ni, As, Ca, Ti) Green Enamel **Pb**, **Cu, K** (Ca, Si, Fe, Zn, Ni, Mn, Ti)	**Smalt Blue** **Cu-Zn Green**
Main Characteristics: Shallow bowl with *Hakuji*-type body and small foot, decorated in Full-Aode style. **Notable features**: - Introduction of systematic Smalt-based overglaze-blue enamel decoration in the Late Period.				

Table 1. *Cont.*

Analyzed Porcelains		**Historical Period**	**XRF Results: Enamel Matrix, Chromophores and Glazes**	**Identified Pigments**
	*Pine Tree and Peacock*	Late Period (1652)	Blue Enamel **Pb**, **Cu, K** (Si, Fe, Co, Ni, As, Zn, Ti, Ca) Green Enamel **Pb**, **Cu, K** (Si, Fe, Zn, Ni, Ti, Mn, Ca)	**Smalt Blue** **Cu-Zn Green**
Main Characteristics: Shallow bowl with large foot in Full-Aode style. **Notable features**: Introduction of large foot with fully washed base in the Late Period.				
	*Chestnuts and Waves*	Late Period (1652)	Blue Enamel **Pb**, **Cu, K** (Si, Fe, Co, Ni, As, Zn, Ti, Ca) Green Enamel **Pb**, **Cu, K** (Si, Fe, Zn, Ni, Ti, Mn, Ca)	**Smalt Blue** **Cu-Zn Green**
Main Characteristics: Shallow bowl with large foot in Full-Aode style. **Notable features**: Introduction of floral scroll design on the underside to replace the iconic snowflake design.				
	***Bamboo and Chrysanthe-mum***	Late Period (1652–1653)	Green Enamel **Pb**, **Cu, K** (Fe, Ca, Si, As, Zn, Ti, Ni, Al, Mn)	**Cu-Zn-As Green**
Main Characteristics: Shallow bowl with large foot in Full-Aode style. **Notbale features**: - Introduction of yellow-washed underside on large-footed bowls. - Unwashed base.				
	*Scattered Cherry Blossoms*	Late Period (1652–1653)	Blue Enamel **Pb**, **K, Cu** (Si, Fe, Co, Ni, As, Zn, Ti, Ca, Al, Mn) Green Enamel **Pb**, **Cu, K** (Si, Fe, Zn, Ni, Ti, Ca)	**Smalt Blue** **Cu-Zn Green**
Main Characteristics: Shallow bowl with large foot decorated in Full-Aode style. **Notable features**: Introduction of yellow wash to cover both underside and base.				

Table 1. *Cont.*

Analyzed Porcelains		Historical Period	XRF Results: Enamel Matrix, Chromophores and Glazes	Identified Pigments
 	*Grapevine*	Late Period (1653–1654)	Green Enamel **Pb**, **Cu, K** (Fe, Zn, Si, Ti, Ni, Ca)	**Cu-Zn Green**
Main Characteristics: Shallow bowl with large foot in Full-Aode style. **Notable features**: Underside bearing two different washes, brown and green.				
 	*Jumokuzu (Big Tree)*	Late Period (1654–1655)	Green Enamel **Pb**, **Cu, K** (Si, Fe, Zn, Ni, Ti, Ca)	**Cu-Zn Green**
Main Characteristics: *Hakuji*-type body with small foot in Full-Aode style. **Notable features**: Latest example of small-foot recurrence before Ko-Kutani kiln shut down.				

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, Bedford, MA, USA), which includes an X-ray tube (max voltage of 50 kV, max current of 0.2 mA, target Rh, collimator 1 or 2 mm), power supply, control electronics and USB communication for remote control; a silicon drift detector with a 125 to 140 eV FWHM @ 5.9 keV Mn Kα 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 $\times$ 105 cps; and software for acquiring and processing the XRF spectra. The primary beam and detector axis form an angle of 0 and 40°, respectively, perpendicular to the sample surface. Measurement parameters were as follows: tube voltage 35 kV; current 80 µA, acquisition time 100 s. No filter was applied between the X-ray tube and the sample; the distance between the sample and detector was 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 (Version1,0,0,22), which enables the acquisition, display and control of Amptek signal processors and allows for 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. Lastly, XRF spectra were graphically provided by Origin Pro 8.5.

3. Results and Discussion

In consideration of the exceptional importance of some of the examples included in this study, results are presented on a piece-by-piece and comparative basis, with spectra of the most relevant materials reported in each of the respective sections.

The wares are listed in the order of their firing, from earliest to latest. Two further subperiods, the Pre-*Hakuji* (pre-1650) and Post-*Hakuji* (post-1650) phases, have been added to the main timeline, which consists of the three periods of production previously established, that is, the Early Period (1648–1650), the Middle Period (1650–1651) and the Late Period (1651–1655) [1].

Moreover, Table 1 summarizes the main characteristics and notable features for all the masterpieces and excavated shards analyzed in the present paper and the previous published study for an easy yet comprehensive reference: images, periods of production, pivotal roles in period-to-period transitions, relevant stylistic features and glaze recipes, along with the chemical compositions of overglaze enamels. The newly investigated examples are reported in red lettering for quick identification.

The Hakuji Shallow Bowl and the Massive Body of Ko-Kutani Enameled Wares: Origin of Potting Style in Kaga

The *Hakuji* shallow bowl (Figure 1) presents one of the most distinctive features that makes it an iconic example of Ko-Kutani's massive enameled wares fired in Kaga: the small foot. Such a foot is unquestionably the result of the strong influence exerted by Korean technology on Kaga potters.

In order to better comprehend how the small foot came into use in Kaga, let us focus very briefly on some important historical facts. In 1637, the Nabeshima Clan (the clan controlling porcelain production in Arita, Kyushu) ordered the expulsion of 826 potters [7]. Moreover, after a comprehensive reorganization of the kilns in Arita, the authorities decided in 1647 to limit the number of licenses for Master Potters to 155 [7]. Therefore, some of the unemployed artisans needed to move from Arita to Kaga to survive in the business [1]. Clearly, these potters transferred to Kaga the same techniques they had been employing for the successful firing of porcelain bodies in Arita [1].

The Korean small foot had in fact formed the basis upon which Shoki-Imari Sometsuke (early wares decorated in underglaze blue) had been successfully developed in Arita in the early 1600s [8–10] (Figure 2). It has been firmly established that the crucial transfer of Korean technology to Japanese potters in Arita enabled the first-ever production of porcelain in Japan at the Komizo kiln in the early years of the 17th century [8,11,12] (Figure 2).

Figure 2. Shoki-Imari dish, front and back, Tengudani kiln, Arita, 1630–1640, D. 19 cm, private collection.

It is important to note here that although the Korean small foot had played such a crucial role in the development of porcelain bodies in Arita from the early 1600s, a new foot type of Chinese origin had gained popularity among Arita potters at the time of the mass expulsion: this type, imported from the Jingdezhen kilns (China), featured a much wider foot radius. Its incorporation into porcelain making in Arita is testified by the bodies excavated at the Yanbeta kiln site [13,14] (Figure 3). The newly introduced Chinese foot became both the potting standard at the kilns of Arita from the early 1640s, causing the complete abandonment of the Korean small foot, and the principal feature of overglaze-enameled porcelains fired in Arita from the 1640s onward [13,14].

Figure 3. *Shoki Iro-e* dish with underglaze-blue outlining for enamel decoration, front and back, fired at Yanbeta kiln, Arita, early 1640s, Arita History and Folklore Museum, Arita, Japan.

To conclude, the techniques to which Arita potters had been exposed since the early 1600s were of Korean and Chinese origin. This instance clearly explains how the use of both foot types was transferred to Kaga after the expulsion of the potters from Arita in 1637.

4. The *Hakuji* Bowl and Excavated Shards: Rb/Sr Ratios and Preliminary Considerations on Glazes

XRF spectra of the glazes analyzed on the *Hakuji* shallow bowl and the newly investigated shard #430 are reported in Figures 4 and 5. Table 2 lists their respective Rb/Sr ratios along with those detected on the scarce enameled shards analyzed in the previously published study [1] for a direct comparison.

Table 2. Ratios of Rb and Sr detected on the glazes of the excavated Ko-Kutani *Hakuji* bowl and shards.

Example	Shard #310	Shard #493	Shard #22	Shard #430	*Hakuji* Bowl	Shard #595
Rb/Sr ratio	0.19	0.28	0.29	0.31	0.43	0.45
						
	Early 1640s	Mid-1640s	Mid-1640s	Late 1640s	1650 Middle Period	1652 Late Period

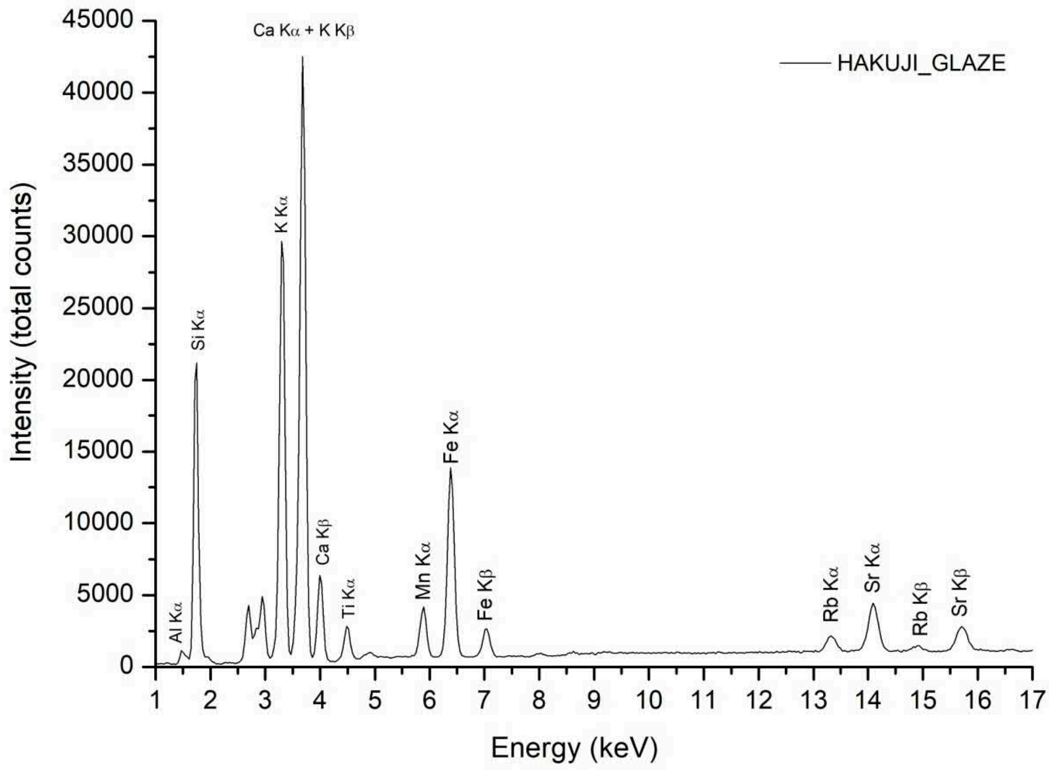


Figure 4. XRF spectrum of the glaze analyzed on the *Hakuji* bowl.

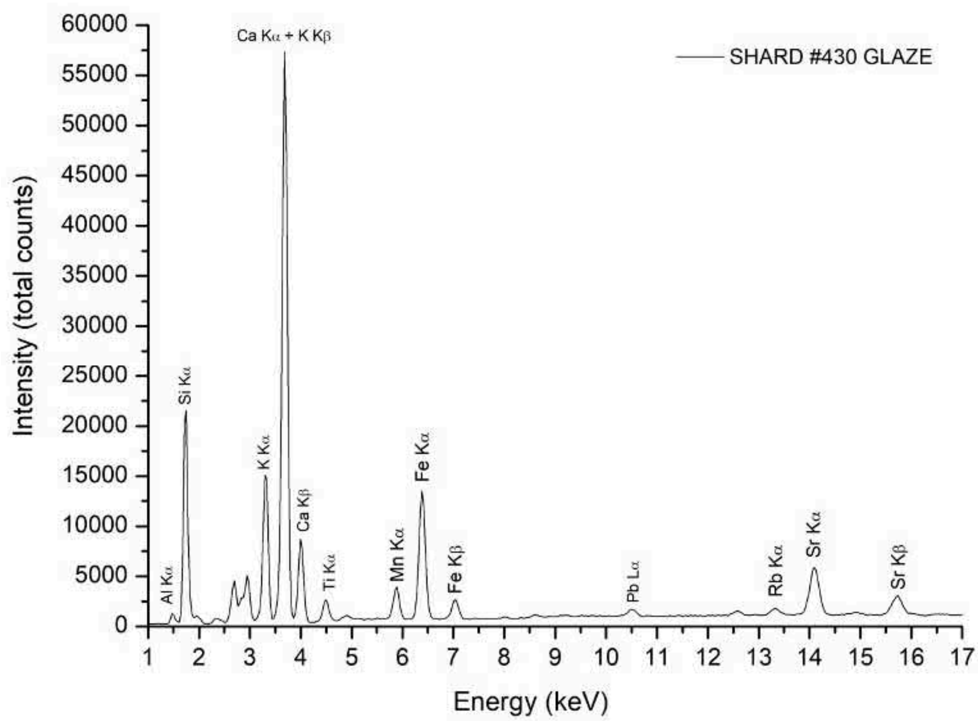


Figure 5. XRF spectrum of the glaze analyzed on shard #430 glaze.

The analytical evidence in Table 2 reveals that Kaga potters paired a specific body type with a specific glaze opacity: the *Hakuji* bowl is in fact coupled with a glaze recipe characterized by a Rb/Sr ratio of 0.43.

In order to fully understand the groundbreaking nature of this finding and its deep implications on Ko-Kutani production as a whole, the bar graph in Section 5 (Figure 6) provides a detailed focus on both the Rb/Sr ratios and the timeline of Ko-Kutani firing.

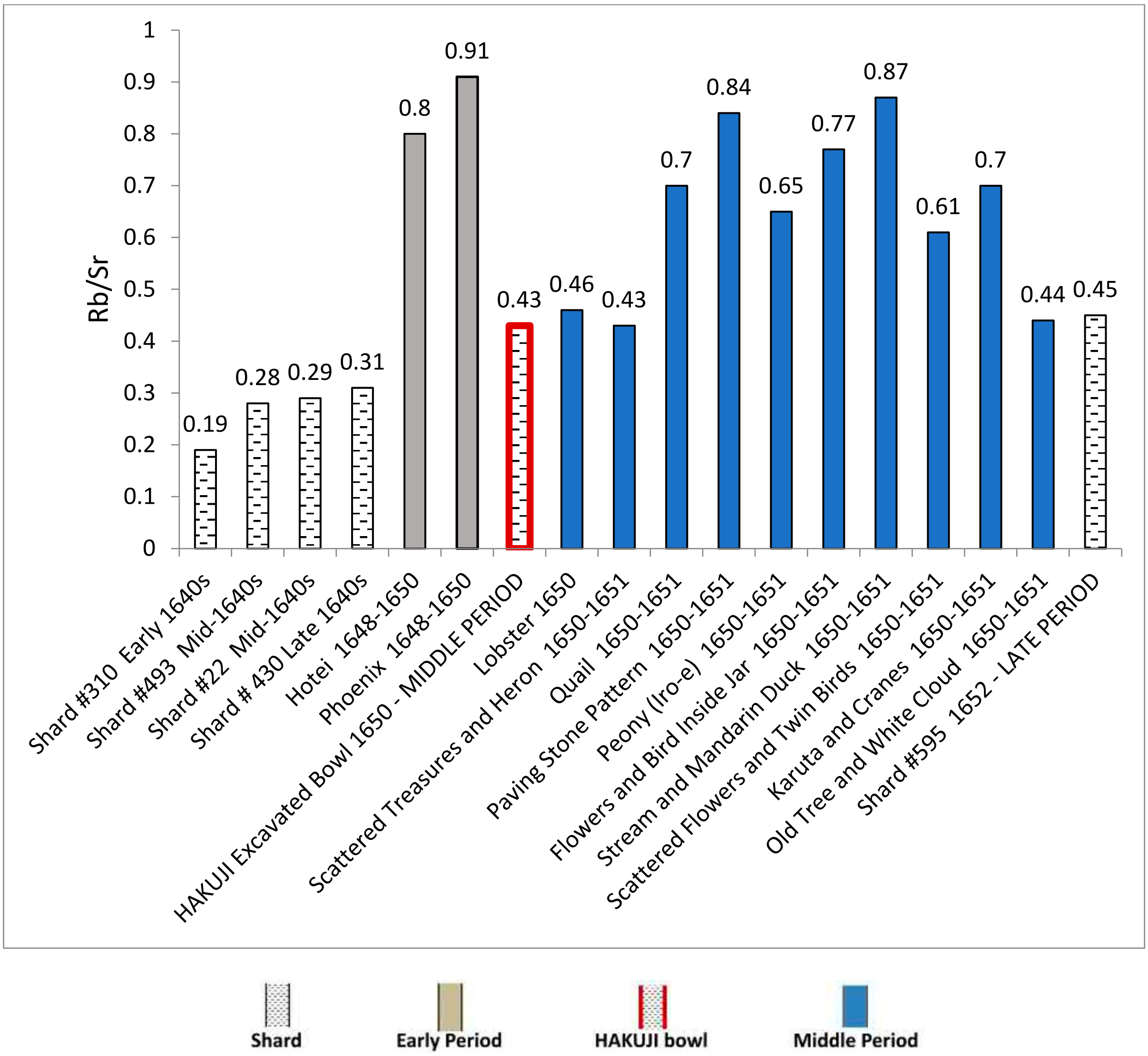


Figure 6. Rb/Sr ratios detected on the analyzed Ko-Kutani porcelains and excavated shards in all three periods of production.

5. PRE-*HAKUJI* PHASE: Initial Experimentation with Glazes in the 1640s

The bar graph in Figure 6 shows that the initial experimentation with glazing materials throughout the 1640s—excavated shards #310 (early 1640s), #493 (mid-1640s), #22 (mid-1640s) and #430 (late 1640s) (Tables 1 and 2)—was characterized by a recipe aimed at obtaining a fundamentally transparent glaze by adding botanic ash (higher Sr content) to the clay used for the body (Rb content) [10,15–17], with Rb/Sr ratios of 0.19, 0.28, 0.29 and 0.31, respectively. This recipe type is in line with the production of Arita wares (Shoki-Imari) [1,8,10,16] and therefore confirms the initial strong influence of potters from Kyushu on Ko-Kutani early development as discussed in the PRE-*HAKUJI* PHASE: The Early Period (1648–1650) Section.

Moreover, as it clearly emerges from the chart in Figure 7, the early experimentation phase (1640s) is characterized by Ti and Sr fluctuations, while Rb basically doubles in count as production moves into the Middle (*Hakuji* bowl) and Late (shard #595) periods with the introduction of the Proto-Aode and Full-Aode styles [1].

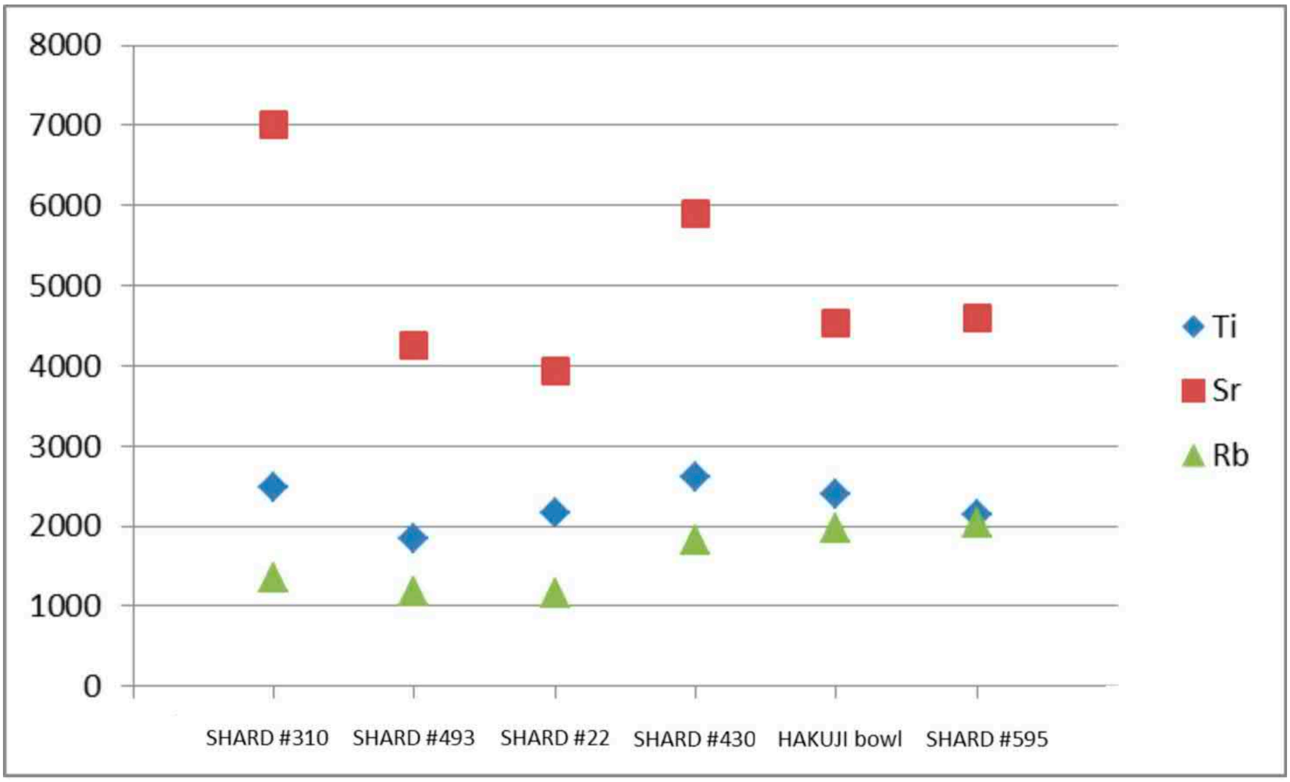


Figure 7. XRF counts (at the used measurement setup) for the elements Ti, Sr and Rb detected on the glazes of all the analyzed shards and *Hakuji* bowl.

Furthermore, Sr appears to settle above the four thousand count mark in the Middle (*Hakuji* bowl) and Late (shard #595) periods, revealing how the *Hakuji* recipe proved instrumental to the experimentation phases that followed its firing in 1650.

PRE-HAKUJI PHASE: The Early Period (1648–1650)

A crucial insight into the Kaga potters' mindset in the *Pre-Hakuji* phase comes from the Rb/Sr ratios detected on the *Hotei* and *Phoenix* bowls fired in the Early Period (1648–1650) (Figure 8): the ratios are close to the value of 1—0.8 and 0.91, respectively—thus testifying to the Kaga potters' aim of achieving a 1:1 ratio of porcelain stone to wood ash in order to greatly reduce the transparency of the glaze and exploit the visual impact of overglaze enamels [1,10]. The effect they managed to achieve was a subdued yet uniform white color upon which polychrome enamels would stand out, much like the appearance of the lead–tin opacified glazes of European origin [1].

It is relevant to note here that the blank space left in the design of the *Hotei* and *Phoenix* bowls is an integral part of the overall decoration, and it does testify to the influence of Tawaraya Sotatsu's style on Kaga potters in the first half of the 17th century (composition characterized by the use of plenty of blank space) (Figure 8) [18].

To conclude, analytical evidence reveals that although the newly incepted opaque glaze (Rb/Sr ratios 0.8–0.91) enabled Kaga potters to distance themselves from the transparent glaze of Arita (shards #310, #493, #22, #430—Rb/Sr ratios 0.19–0.31), their reliance on the Chinese large foot (Figure 8) characterized the Early Period (1648–1650) of Ko-Kutani production.

Figure 8. (**a**) Front of shallow bowl with design of *Hotei*. (**b**) Underside of shallow bowl with design of *Hotei*. (**c**) Front of shallow bowl with design of *Phoenix*. (**d**) Underside of shallow bowl with design of *Phoenix*. Collection of Ishikawa Prefectural Museum of Art. (**e**,**f**) Wind God and Thunder God Screens by Tawaraya Sotatsu, Japan, 17th century, pair of two-fold screens, ink and color on gold-foiled paper, each H. 154.5 cm, W. 169.8 cm, Kennin-ji Temple, Kyoto; public domain via Wikimedia Commons; (https://commons.wikimedia.org/wiki/File:Wind_God_and_Thunder_God_Screens_by_Tawaraya_Sotatsu_hi-res.png) (accessed on 26 August 2025).

6. *Hakuji* Prototype Development in 1650: Implications on Ko-Kutani Production

A further fundamental step that marked the development of the iconic Ko-Kutani enameled wares can be identified by observing the firing timeline and the associated Rb/Sr ratios reported in the bar graph in Figure 6.

For the first time ever, the groundbreaking nature of the *Hakuji* bowl becomes manifest: not only did its massive body break the technological reliance on China through the incorporation of the Korean small foot (Figure 1) but it also proved instrumental to the establishment of a glaze recipe that would serve as an indispensable guide to potters throughout the subsequent stages of experimentation and Ko-Kutani production.

Specifically, the substantial decrease in the Rb/Sr ratio (0.43) reversed the process established in the Early Period (1648–1650), when ratios were in the 0.8–0.9 range. This new recipe suggests that Kaga potters had devised a methodical experimentation process instrumental to carrying out major changes in both potting techniques and decoration style.

The *Hakuji* bowl, therefore, marks the commencement of the Middle Period and served as the prototype upon which the development of the iconic Ko-Kutani enameled wares would be completed with the application of the European-based Proto-Aode style [1].

7. Post-*Hakuji* Phase: The Middle Period (1650–1651)

As discussed in the previous sections, the *Hakuji* shallow bowl proved instrumental to the introduction of the Korean small foot and the Rb/Sr ratios in the 0.40s range. This prototype, therefore, presented distinctive characteristics that deeply set it apart from the Ko-Kutani porcelains fired in the Early Period (1648–1650).

This pivotal role clearly emerges from the scheme presented in Figure 9, where a visual summary of the influence exerted by the *Hakuji* prototype on all stages of porcelain production in Kaga is presented for the first time ever.

A thorough comparison between the firing timeline, the Rb/Sr ratios (Figure 6) and the visual scheme in Figure 9 enables a deeper comprehension of the crucial impact the *Hakuji* prototype had on Ko-Kutani production as a whole: the *Hakuji* (Rb/Sr ratio of 0.43), *Lobster* (Rb/Sr ratio of 0.46) and *Scattered Treasures and Heron* (Rb/Sr ratio of 0.43) bowls belong to the same category of massive bodies featuring the Korean small foot. They also bear Rb/Sr ratios in the range 0.43–0.46, proving the earliest Ko-Kutani wares fired after the successful development of the *Hakuji* prototype in 1650 (Table 3).

Table 3. Ratios of Rb and Sr detected on the glazes of Ko-Kutani porcelains, *Hakuji* bowl and shard #595.

Example	***Hakuji* Bowl**	***Lobster***	***Scattered Treasures and Heron***	***Old Tree and White Cloud***	***Shard #595***
Rb/Sr ratio	0.43	0.46	0.43	0.44	0.45
	 1650 Middle Period	 1650 Middle Period	 1650 Middle Period	 1651 Middle Period	 1652 Late Period

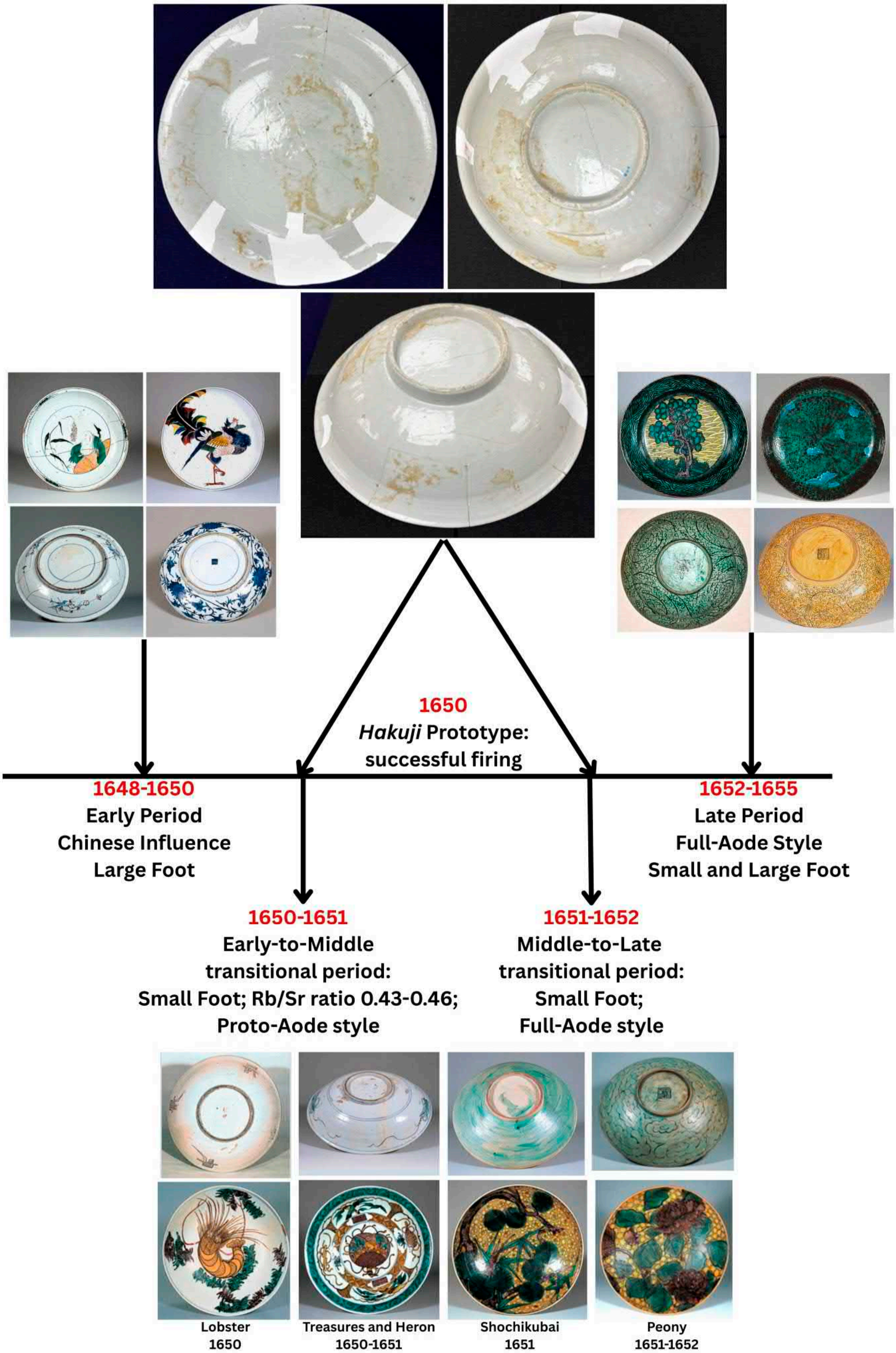


Figure 9. Visual summary of the influence exerted by the *Hakuji* prototype on all stages of Ko-Kutani production.

Moreover, the Rb/Sr ratios in the range 0.43–0.46 marked also the transition between the Middle and Late Periods as shown by the *Old Tree and White Cloud* bowl (Rb/Sr ratio of 0.44—Middle Period) and shard #595 (Rb/Sr ratio of 0.45—Late Period) (Figure 6), as summarized in Table 3.

7.1. Post-Hakuji Phase: Ko-Kutani Glazes in the Middle Period (1650–1651)

The bar graph in Figure 6 shows that after the successful firing of the earliest wares in the Middle Period (*Lobster* and *Scattered Treasures and Heron* bowls), Kaga potters reverted to their initial opaque glaze once again: as the Proto-Aode style reached its mature form (*Paving Stone Pattern*—Rb/Sr ratio of 0.84, *Flowers and Birds Inside Jar*—Rb/Sr ratio of 0.77 and *Stream* and *Mandarin Duck*—Rb/Sr ratio of 0.87, all bearing European–*Smalt* overglaze-blue enamel) (Figure 10), the Rb/Sr ratios returned to the range 0.61–0.87 (Figure 6). This choice was determined by the need to make the enamels applied on the underside (blank space) of the Proto-Aode bowls stand out, with ratio variability being a function of both the type of decoration (underglaze-blue or polychrome enamels) and its richness (Figure 10).

Figure 10. Ko-Kutani shallow bowls fired in the Middle Period (1650–1651): (**a**) *Paving Stone Pattern*—Rb/Sr ratio of 0.84; (**b**) *Flowers and Birds Inside Jar*—Rb/Sr ratio of 0.77; (**c**) *Stream* and *Mandarin Duck*—Rb/Sr ratio of 0.87.

This first-ever analytical evidence unveils Kaga potters' loyalty to their own developed recipes, and it also emphasizes their continued detachment from the strong influence Arita had exerted in the 1640s (Rb/Sr ratios in the range of 0.19–0.31).

7.2. Post-Hakuji Phase: The Late Period (1651–1655)

The glaze type introduced with the *Hakuji* bowl (Rb/Sr ratio range 0.43–0.46), as discussed in Section 7, proved also crucial in the Middle-to-Late Period transition, as evidenced by the Rb/Sr ratio of 0.44 detected on the Old Tree and White Cloud bowl (1651) and the Rb/Sr ratio of 0.45 detected on the excavated shard #595 (1652) (Table 3, Figure 6). The implication is clear: Ko-Kutani porcelains, be they excavated shards, kiln test pieces or presentation wares (Densei), fired during the transitional Early-to-Middle and Middle-to-Late periods all inherited one or more of the technological characteristics of the *Hakuji* prototype. Further confirmation of this instance is provided by the Shochikubai and Peony bowls

(Figure 9, Table 1): they are the earliest porcelains fired in the Late Period (1651–1655), and both bear the Korean small foot and the Full-Aode style.

Scientific results, therefore, have shown that the Rb/Sr ratios detected on Ko-Kutani glazes after the firing of the *Hakuji* prototype in 1650 fall always into specific ranges of values: 0.43–0.46 and 0.61–0.87. Such ranges reveal that Kaga potters never returned to the transparent glaze of Arita (Rb/Sr ratio range 0.19–0.31) upon which they had relied in the 1640s. This definitive and irreversible detachment from Arita's porcelain tradition is a consequence of the deep influence the *Hakuji* prototype exerted on all experimentation phases, allowing Kaga potters to introduce innovative decoration styles (Proto-Aode and Full-Aode) incepted under the far-sighted and refined cultural vision of the Maeda Clan [1].

To conclude, from a potting standpoint, the Korean and Chinese foot types started coexisting after the successful firing of the *Hakuji* prototype in 1650, when potters managed to stabilize and standardize the overall production process. The integration of the Chinese large foot followed potters' design and shaping needs on a case-by-case basis, in an all-embracing and all-encompassing approach to technology and culture.

7.3. Post-Hakuji Phase: Body Recipe for the New Decoration Styles

As discussed in the previous sections and firmly evidenced in Figure 9, the *Hakuji* prototype introduced a major switch in Kaga potting practice, from the early bodies (1648–1650) based on the Chinese large foot to the Korean small foot employed to support the massive enameled bodies fired from 1650 onward (Middle and Late periods). The small foot, therefore, reveals how Kaga potters relied on Korean technology to develop a body shape that would be instrumental to the introduction of a new decoration style, from the early subdued motifs with plenty of blank space based on Tawaraya Sotatsu's painting composition (*Hotei* and *Phoenix* bowls—Figure 8) to the overdecorated "Western-Style Painting on Porcelain" developed under European influence (Figure 11).

Figure 11. Ko-Kutani shallow bowls: (**a**) *Karuta and Cranes*—1651 (Middle Period); (**b**) *Scattered Cherry Blossoms*—1652–1653 (Late Period).

It is extremely relevant to report here that the "Western-Style Painting on Porcelain" involved a porcelain body that would serve as a mere canvas upon which polychrome enamels would be applied [1]. It now appears to be evident how any distracting distortion, warping or imprecise body shaping would alter the visual effect of the overall decoration. The implication is clear: the *Hakuji* prototype represented the type of body that would become a function of the visual effect potters wanted to achieve. This crucial circumstance proves to be perfectly in line with the first-ever analytical evidence reported in both the present and previous study: the recipe of the porcelain body underwent changes that led to an increase in Ti content (Figures 12–14). This distinctive chemical composition clearly differentiated Ko-Kutani bodies from Arita ones, the latter bearing a much lower Ti content on average, and from the Arita-influenced bodies fired in the Early Period (Figure 14) [1,8].

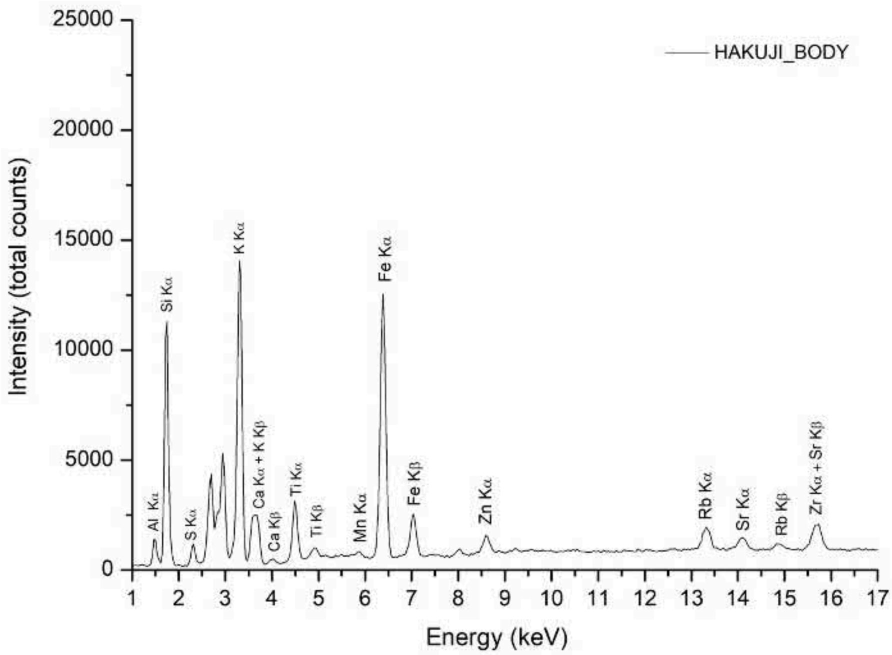


Figure 12. *Hakuji* bowl: XRF spectrum of the body.

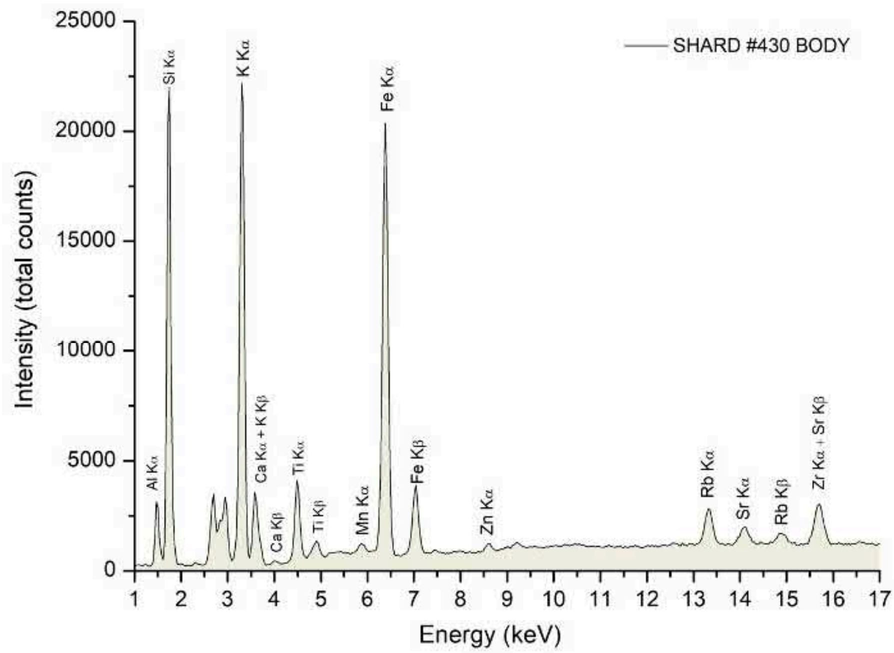


Figure 13. Shard #430: XRF spectrum of the body.

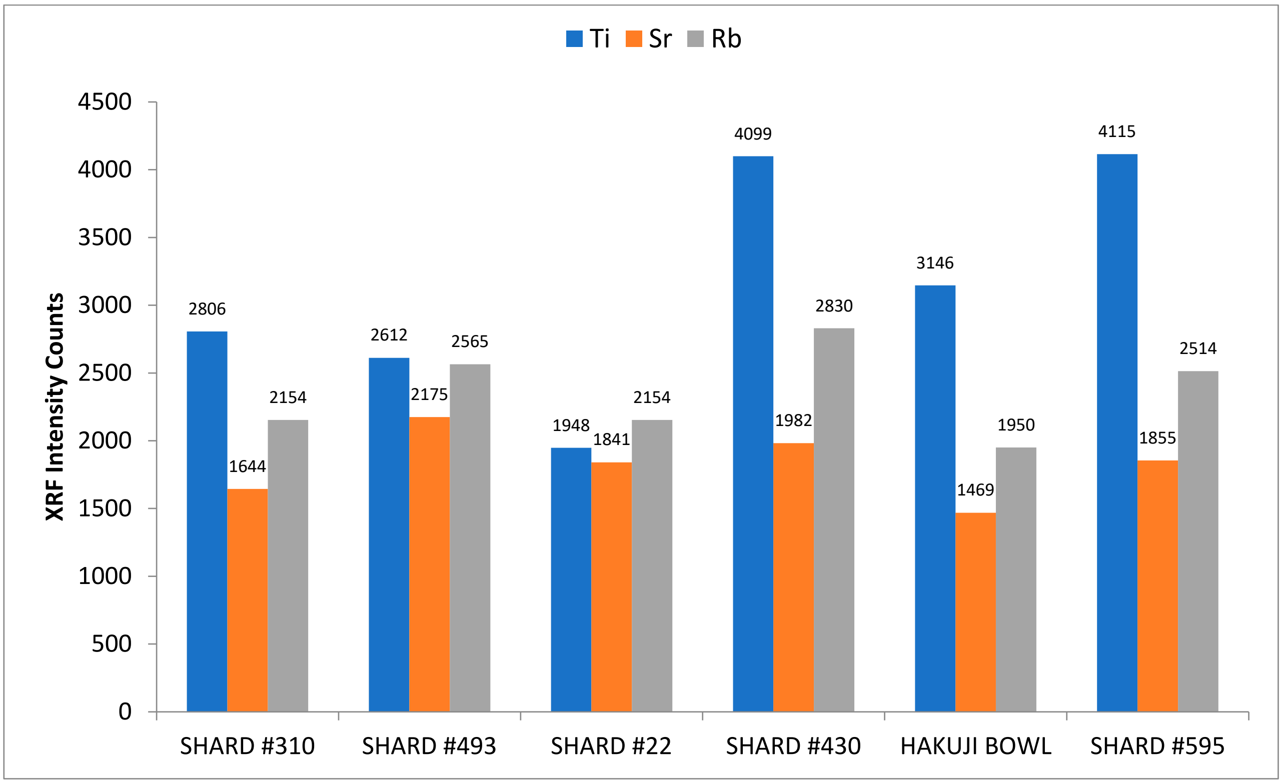


Figure 14. Bar graph with Ti and Rb counts detected (at the used measurement setup) on the porcelain bodies of all the analyzed shards and *Hakuji* bowl.

Furthermore, as shown in Table 4, the *Hakuji* bowl and shard #595, fired in the Middle and Late periods, bear similar element ratios: Ti/Rb ratios of 1.61 and 1.63, respectively, for the bodies and Rb/Sr ratios of 0.43 and 0.45, respectively, for the glaze (Table 2).

Table 4. Ratios of Ti and Rb detected on the bodies of the excavated *Hakuji* bowl and shards.

Example	Shard #310	Shard #493	Shard #22	Shard #430	*Hakuji* Bowl	Shard #595
Ti/Rb ratio	1.30	1.02	0.9	1.45	1.61	1.63
	 Early 1640s	 Mid-1640s	 Mid-1640s	 Late 1640s	 1650 Middle Period	 1652 Late Period

To conclude, the potting choice proves to have been connected to the inception of the *Hakuji* prototype as a canvas for the application the new overdecorated enameling style (Figures 9–11); the bar graph in Figure 14 reveals that as Ko-Kutani production moved from the late 1640s into the 1650s, the Ti content in the bodies reversed its pattern and increased steeply to reach its overall highest in the body of shard #545.

7.4. Post-Hakuji Phase: Body Recipe for the New Decoration Styles—Additional Remarks

The firing of the *Hakuji* prototype and the introduction of the "Western-Style Painting on Porcelain" led to a type of Ko-Kutani body characterized by a progressively grayish tint due to an increased content of titanium in the clay (Figure 14). The shift to the lavish decorations of the Proto-Aode and Full-Aode styles led potters to focus mainly on enameling, and the glaze therefore lost the role of background enhancer it had played in the Early Period (opaque glaze—Rb/Sr ratio of 0.8–0.9 (Figure 6)) and limitedly in the Middle Period for the underside of the wares (0.61–0.87) (Figure 6). Ratios finally settled in the 0.40s range of values in the Late Period (1651–1655) as testified by shard #595's Rb/Sr ratio of 0.45 (Figure 6).

To conclude, the glaze had basically become merely instrumental to the newly developed decoration scheme, and there was no longer a need to keep experimenting with glaze opacity and body whiteness throughout the whole Late Period (1651–1655). As a consequence, the overall purification process became less labor-intensive and less costly [1].

8. *Hakuji* Shallow Bowl—Overall Influence on Ko-Kutani Production—Further Remarks

One major point to emphasize here is the complete absence of any underglaze-blue decoration on the *Hakuji* body. This crucial detail, along with the analytical evidence herein presented, confirms its inception as an actual prototype. The implication is clear: underglaze-blue designs, be they geometric, stylized or floral, made their appearance only after a final body type suitable for enamel decoration had been obtained by Kaga potters.

Moreover, the *Hakuji* prototype is the only example excavated at the *Noborigama* (high-firing-climbing kiln) kiln site in Kaga. This outstanding potting success reveals how the techniques transferred from Arita to Kaga (see the PRE-*HAKUJI* PHASE: The Early Period (1648–1650) Section) had actually proven extremely efficient in giving birth to the iconic Ko-Kutani wares: the low firing wastage peculiar to Ko-Kutani porcelains is a very rare occurrence, and it was in fact observed only in the cases of the celebrated Nabeshima and Kakiemon wares [8,10,17,19].

One additional point to be discussed here lies in the firing date of the *Hakuji* bowl: scientific and stylistic evidence (Figures 6, 7, 9 and 14) led to the definitive conclusion that the *Hakuji* bowl was fired in the year 1650, thus predating all the Proto-Aode and Full-Aode bodies. This first-ever finding, along with the conclusions presented in the previous study [1], enables a precise dating of all Ko-Kutani enameled bowls (Table 1). One evident example comes from the first-ever comparison between the *Hakuji* and the *Lobster* bowl (Figure 15): not only does the Lobster bowl show a strict adherence to the body type of the *Hakuji* prototype but it also features a very limited, almost negligible, underglaze-blue decoration. This detail places its firing in 1650, right after the *Hakuji* bowl. This conclusion is also confirmed by the observation of the *Lobster* decoration: the overall design retains some of the stylistic elements of the Early Period (*Hotei* and *Phoenix* bowls, Figure 8), that is, the subdued motifs with plenty of blank space based on Tawaraya Sotatsu's painting composition. Yet, the bowl also bears the Korean small foot and a Rb/Sr ratio of 0.46 (Figures 6, 9 and 16), both inherited from the *Hakuji* body.

Furthermore, the Cu-Zn-As chemical composition of the green enamel (Figure 17) also proves consistent with the expected recipe used for the production of Early-to-Middle Period transitional pieces [1] as reported in Table 1, thus confirming the firing of the *Lobster* bowl in the very beginning of the Middle Period (1650–1651), that is, in 1650, right after the successful firing of the *Hakuji* bowl.

To conclude, the scientific investigation of the *Hakuji* bowl has unveiled the very efficient process of body development triggered by the introduction of the distinctive "Western-Style Painting on Porcelain" decoration in 1650. Moreover, the early decoration style based on Tawaraya Sotatsu's painting composition and the incorporation of the European-inspired Proto-Aode style first and Full-Aode style later reveal how Kaga potters aimed at distancing themselves from any major influences by Chinese aesthetics and Arita decoration practices from the very first inception of Ko-Kutani wares.

Figure 15. (**a**) *Hakuji* shallow bowl, front and underside. (**b**) Shallow bowl with design of *Lobster*, front and underside. Collection of Ishikawa Archaeological Foundation and Ishikawa Prefectural Museum of Art.

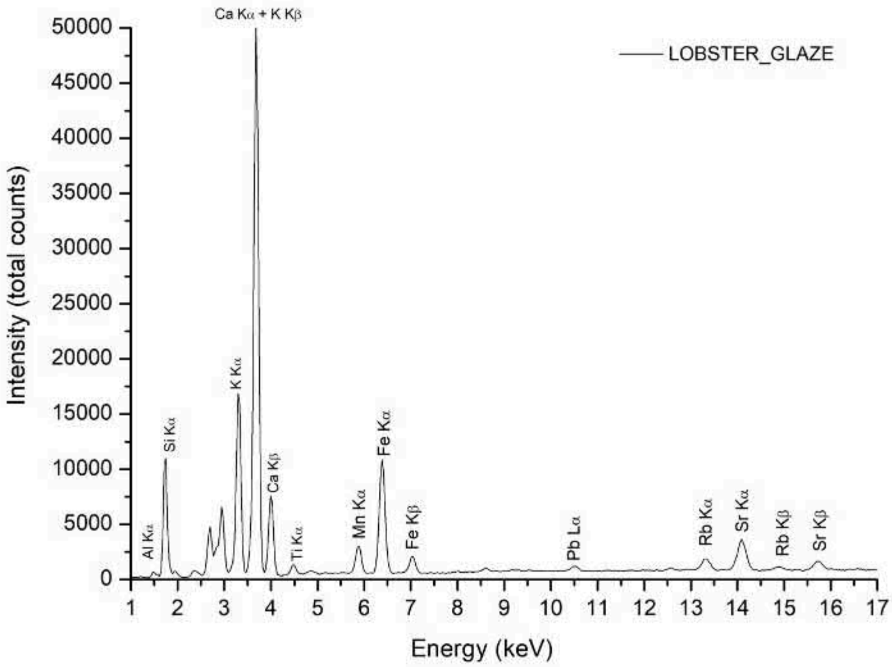


Figure 16. *Lobster* bowl (1650): XRF spectrum of the glaze.

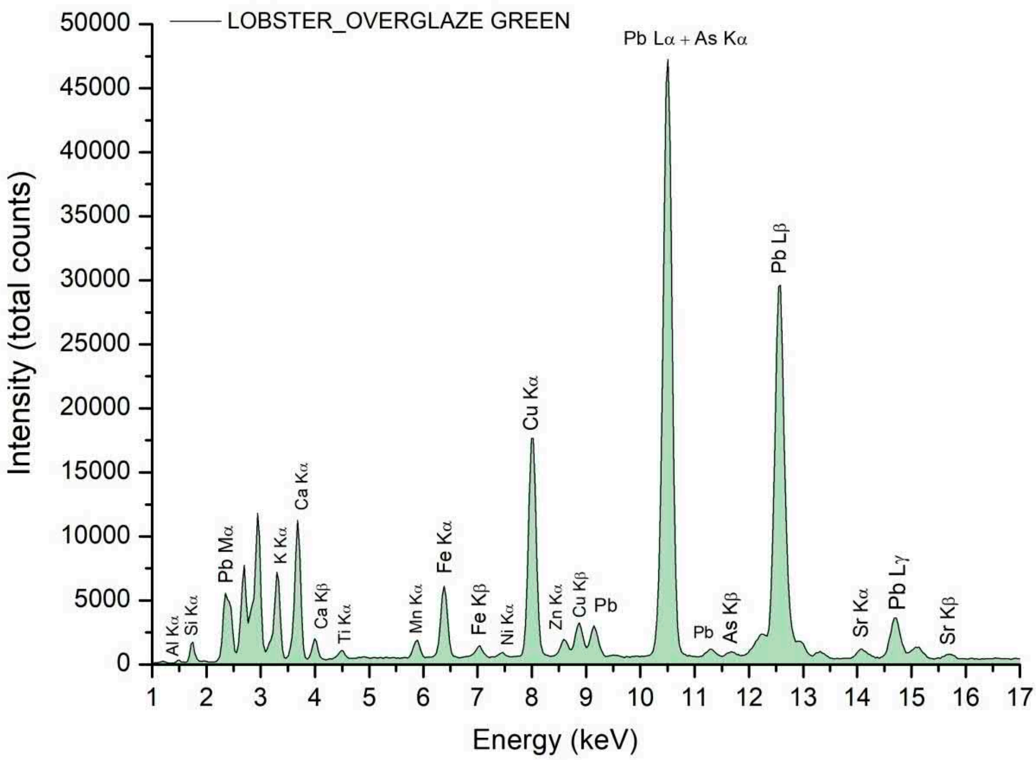


Figure 17. *Lobster* bowl (1650): XRF spectrum of the overglaze-green enamel (Cu-Zn-As chemical composition).

9. Conclusions

Scientific analysis of the *Hakuji* bowl enabled the first-ever understanding of the crucial role the vessel played as the prototype upon which the stylistic transitions from the Early-to-Middle and Middle-to-Late periods were carried out. It represents a testament to a body development aimed at the introduction of the distinctive Ko-Kutani decoration techniques, the Proto-Aode and the Full-Aode styles.

The *Hakuji* bowl demonstrates how its creation followed a specific potting principle in Kaga, the strong reliance on the small foot of Korean origin. The overall experimentation process proved successful and a suitable shape for the newly developed "Western-Style Painting on Porcelain" was achieved.

The first-ever identification of the *Pre-Hakuji* and *Post-Hakuji* production phases has provided incontrovertible proof that Ko-Kutani ware originated in Kaga through the collective effort of local potters and artisans from Arita.

As the development of Ko-Kutani porcelain reached its final stage, one of the most iconic traits of the Maeda heritage, strongly recognized today on a global scale as one of the most influential in the history of Japanese art, fully blossomed into the mature Full-Aode style, a porcelain decoration technique unrivaled in either Japan or China.

Author Contributions: The research project was conceived by R.M. and H.M. R.M. prepared the manuscript. The shards were selected by H.M. and R.M. The analyses were carried out by R.M. The results were interpreted by R.M., M.F.A., S.S. and C.P. C.P., M.F.A. and H.M. also revised the manuscript. All authors have read and agreed to the published version of the manuscript.

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References

1. Montanari, R.; Murase, H.; Alberghina, M.F.; Schiavone, S.; Pelosi, C. The Origin of Ko-Kutani Porcelain: New Discoveries and a Reassessment. *Coatings* **2024**, *14*, 1146. [CrossRef]
2. NHK Publishing Inc. *NHK歴史ドキュメント6 (NHK Historical Documents 6)*; NHKPublishing Inc.: Tokyo, Japan, 1987; pp. 18–54. (In Japanese)
3. Montanari, R.; Alberghina, M.F.; Schiavone, S.; Pelosi, C. The Jesuit painting Seminario in Japan: European Renaissance technology and its influence on Far Eastern Art. *X-Ray Spect.* **2022**, *51*, 64–85. [CrossRef]
4. Montanari, R. The Art of the Jesuit Mission in 16th-Century Japan: The Italian Painter Giovanni Cola and the Technological Transfer at the Painting Seminario in Arie. *Eikón Imago* **2022**, *11*, 119–127. [CrossRef]
5. Ishikawa Prefecture Board of Education. *Kutani Old Kiln Excavation Report*; Ishikawa Prefecture Board of Education: Kanazawa, Japan, 2007. (In Japanese)
6. Ishikawa Prefecture Board of Education; Ishikawa Prefecture Archaeological Foundation. *Kaga City Kutani Kiln-Site AII Excavation Report*; Ishikawa Prefecture Board of Education; Ishikawa Prefecture Archaeological Foundation: Kanazawa, Japan, 2006. (In Japanese)
7. Nishida, H. Japanese Export Porcelain During the 17th and 18th Century. Ph.D. Thesis, Oxford University, Oxford, UK, 1974.
8. Montanari, R.; Nobuyuki, M.; De Bonis, A.; Colomban, P.; Alberghina, M.F.; Grifa, C.; Izzo, F.; Morra, V.; Pelosi, C.; Schiavone, S. The early porcelain kilns of Arita: Identification of raw materials and their use from the 17th to the 19th century. *Open Ceram.* **2022**, *9*, 100217. [CrossRef]
9. Kyongshin Koh Choo, C.; Kil Choo, W.; Ahn, S.; Eun Lee, Y.; Ho Kim, G.; Sook Lee, Y. A study of the chemical composition of Korean traditional ceramics (III): Comparison of punch'ŏng with Koryŏ ware and chosŏn whiteware. *J. Conserv. Sci.* **2011**, *27*, 75–90.
10. Impey, O. *The Early Porcelain Kilns of Japan*; Clarendon Press: Oxford, UK, 1996.
11. Murakami, N. *Excavated Ceramics, Exhibition Guidebook*; Arita History and Folklore Museum: Arita, Japan, 2021. (In Japanese)
12. Murakami, N. *The Origin of Imari Porcelain—Excavated Shards from Komizo Kiln*; Sojusha Art Publishing: Kyoto, Japan, 2020. (In Japanese)
13. Arita City Board of Education. *Yanbeta Kiln Excavation Report*; Arita City Board of Education: Arita, Japan, 2015. (In Japanese)
14. Arita City Board of Education. *Excavation at the Workshop Related to the Yanbeta Kiln Site, A Nationally Designated Historic Site*; Arita City Board of Education: Arita, Japan, 2017. (In Japanese)
15. Ma, H.; Henderson, J.; Evans, J. A new method of identifying the flux in ancient Chinese high fired glaze—Sr Isotopic composition analysis. In *Recent Advances in the Scientific Research on Ancient Glass and Glaze (Series on Archaeology and History of Science in China)*; Li, Q., Henderson, J., Gan, F., Eds.; World Scientific Publishing Company: Singapore, 2016; Volume 2, pp. 353–373.
16. Kondo, T. On the Chemical Constituents of the Heart Wood of Distylium Racemosum S. et Z. *J. Fac. Agric. Kyushu Univ.* **1951**, *10*, 1. [PubMed]
17. Fitski, M. *Kakiemon Porcelain—Handbook*; Leiden University Press: Leiden, The Netherlands, 2011.
18. Murase, H. 総合知の観点から古九谷を捉え直す(Rethinking Ko-Kutani from the perspective of Convergence Knowledge). In 石川県九谷焼美術館紀要『九谷を拓く』(第7号) *(Bulletin of the Kutaniyaki Art Museum, "Pioneering Kutani" (Kutani wo Hiraku)*; 2025; Volume 7, pp. 5–35. (In Japanese and English). Available online: https://researchmap.jp/alleukeinen/published_papers/50460974?lang=en (accessed on 26 August 2025).
19. Montanari, R.; Murakami, N.; Colomban, P.; Alberghina, M.F.; Pelosi, C.; Schiavone, S. European ceramic technology in the Far East: Enamels and pigments in Japanese art from the 16th to the 20th century and their reverse influence on China. *Herit. Sci.* **2020**, *8*, 48. [CrossRef]