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Innovations in Colonial Andean Ritual Vessels: Keros and Pacchas

Innovaciones en vasijas rituales andinas coloniales: keros y pacchas

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ABSTRACT

This article explores innovations in the design and production of two types of colonial ritual vessels from the Peruvian and Bolivian Andes: keros and pacchas. The production of wooden keros with metal incrustations and ceramic pacchas with green glass inlays occurs in Cusco during the Early Colonial period (AD 1532-1783), and there are no prehispanic antecedents. Our archaeometric analyses show that short tin, silver and *paktong* rods were used as inlays, with the tin and *paktong* probably being imported from Europe. Similarly, the glass inlays are argued to be from repurposed beads and vessels likely brought from Venice, Italy. A study of these insets reveals the development of unprecedented techniques to attach the exotic materials to the ritual vessels. The ontological and cosmological rationale for the creation of these new classes of objects during this time is considered within the context of our understandings of colonial indigenous worldview. The two case studies are interpreted as testaments to the continued vitality of Andean culture after the Spanish conquest.

Keywords: ritual instruments, colonial art, technological innovation, *paktong*, metal and glass inlays, Andes.

RESUMEN

Este artículo explora las innovaciones en el diseño y la producción de keros y pacchas, dos tipos de vasijas rituales coloniales de los Andes peruanos y bolivianos. La manufactura de keros de madera y pacchas de cerámica con incrustaciones metálicas y de vidrio verde, respectivamente, se produjo en Cusco durante el período Colonial Temprano (1532-1783 DC) y no tiene antecedentes prehispánicos. El análisis arqueométrico muestra que se utilizaron varillas de estaño, plata y paktong *en las incrustaciones de estos objetos, siendo el estaño y el* paktong *probablemente importados de Europa. De igual manera, se demuestra que el vidrio proviene de cuentas y vasijas de este material reutilizadas, traídas posiblemente de Venecia, Italia. El estudio de estos engastes revela el desarrollo de técnicas sin precedentes para fijar los materiales exóticos a estos contenedores rituales. La justificación ontológica y cosmológica para la creación de estas nuevas clases de objetos durante este período, se considera en el contexto de nuestra comprensión de la cosmovisión indígena colonial. Los dos casos de estudio presentados aquí se interpretan como testimonios de la continua vitalidad de la cultura andina después de la conquista española.*

Palabras clave: *instrumentos rituales, arte colonial, innovación tecnológica,* paktong, *incrustaciones de metal y vidrio, Andes.*

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INTRODUCTION

The material culture of the colonial Andes has attracted increasing attention as scholars come to appreciate the complex ways in which the collision of Andean and Spanish culture expressed itself in the objects created between the late 16th and early 19th centuries AD. Numerous insights into the process of hybridity have come from studies by art historians who are particularly interested in the manner in which new inter-cultural relationships were conveyed through style in the objects first introduced by the Spanish conquerors (Esteras 2004). These were decorated according to European conventions using Old World technologies, but they bear the imprint of Andean artisans who expressed their backgrounds and creativity in numerous ways. For example, some European-style colonial oil paintings of the Virgin show her in a large pyramidal gown suggestive of the mountains worshipped in traditional Andean rituals (Phipps et al. 2004: 257-260, fig. 80). An unintended consequence of these analyses is that the artistic creations of colonial Andean peoples frequently are viewed as primarily reactive despite conscious efforts to highlight their crafting skills and artistic contributions (Phipps et al. 2004).

This article offers a different perspective by focusing on innovations that native craftspeople introduced in the fabrication of wood keros and ceramic pacchas, two types of Andean ritual vessels that continued to be utilized for centuries after the Spanish invasion (Lothrop 1956). Technological innovation has rarely been associated with the Andean peoples subjugated by the Spaniards. Nonetheless, even without a comprehensive survey of colonial art, examples of indigenous technological innovation can be identified. This article will focus on two cases: 1) the embellishment of incised and lacquered wood keros with silver-colored metal rod inlays, and 2) the adornment of ceramic pacchas with inlays of green-colored glass. These classes of decorative techniques have no analogs either in the pre-Hispanic world or in 16th century AD Europe, and it appears that these innovations emerged in early colonial times after the Spanish conquest in AD 1532 (Rowe 1961: 329; Thomas Cummins in Phipps et al. 2004: 176-177, fig. 29; Burger 2021). Their sudden appearance is related to the presence of new materials that were introduced into the New World by the Iberian invaders. The exotic materials, however, were utilized in original and unprecedented ways. Despite their anthropological significance, these artistic innovations have attracted relatively little scholarly attention, and this article seeks to remedy the oversight by describing, illustrating, and analyzing examples of the anomalous objects. We hypothesize that these innovations are illustrative of the larger phenomenon of ongoing Andean creativity, and this subject will be explored at the conclusion of the article.

THE TECHNOLOGY OF KEROS WITH METAL INLAYS

Keros are wooden tumblers that were used for the consumption of corn beer, which was known as *chicha* in Spanish, *aqha* in Quechua, and *kusa* in Aymara. In 1653, the Jesuit historian Bernabé Cobo (Lothrop 1956: 233) described them as follows:

> The most common of these [drinking cups] are of the shape of our glass tumblers, wider at the top than the bottom. They hold a pint of wine. They are painted outside with a kind of lacquer, very relucent in various colors and with different raised figures and paintings. The wood vessels are queros.

Most keros had an hourglass form with the circumference widest at the lip and tapered toward the base. Wooden keros were extensively used throughout the Inca empire in civic and religious ceremonies at the household, village, and regional levels (Cummins 2015). Despite their association with the Inca state and religion, keros continued to be produced and used until modern times. While traditional kero shapes persisted after the Conquest, new elements were added, including stemmed bases reminiscent of Old-World goblets (fig. 1) (Flores et al. 1998: 40-47, 56-59).

The indigenous elite utilized metal keros, made of gold and silver, that were known as *aquillas* during Inca and Early Colonial periods (Cummins 2015). Much more common in post-Conquest times were decorated wooden drinking vessels that were highly valued by people belonging to a wide range of social statuses. As a consequence, keros were frequently passed from one generation to another by inheritance.

Wooden keros and *aquillas* were made in pairs to symbolize the principles of reciprocity and balance. As Thomas Cummins (2015: 171) notes:

> The vessels were always made in nearly identical pairs so that they could be used to offer a toast in equal amounts to a companion or a divinity, such as the sun. Each one of the pair was also recognized as being either hanan or hurin [...] and they were used together in community feasts to express social and political solidarity through a series of exchanged toasts.

In Inca times, wooden keros were engraved with geometric or stylized figurative motifs (Rowe 1961; Cummins 2002; Martínez 2020). In colonial times, however, incised geometric designs were often combined with horizontal registers filled with a range of polychrome scenes depicted using a distinctive lacquering technique with resin from the mopa mopa tree (genus *Elaeagia*) (Newman et al. 2015). The "painted" scenes on these colonial keros constitute the first indigenous use of pictorial painting in the Cusco region. Flowers, battle and hunting scenes, royal ceremonies, tropical forest animals, and people are frequently represented. Numerous examples of keros have survived because of the esteem with which they were held and the care with which they were kept by people of indigenous descent in Cusco and the Lake Titicaca region. Today, hundreds of wooden keros with lacquered decoration are found in museums throughout the world, and have attracted the most scholarly attention.

In his pioneering article on kero chronology, John Howland Rowe (1961) notes the existence of another type of colonial wooden kero which is decorated with metal inlays. Examples of this kind of vessels are found in the museums and private collections of Peru, Europe, and North America. Although they are not as common as the better-known lacquered drinking vessels, neither are they scarce. The Museo Inka in Cusco has eight examples, the private collection of José Ignacio Lambarri in the Urubamba Valley has at least a dozen, The Metropolitan Museum of Art in New York has three, and the American Museum of Natural History in New York has one. Despite the mention of keros with metal inlays in Rowe's article, major syntheses on keros by Jorge Flores and Thomas Cummins barely mention them (Flores et al. 1998; Cummins 2002). Moreover, the descriptions of colonial keros with metal inlays that appear in catalogs and books are usually brief and sometimes misleading (e.g., Gálvez 2020: 73-74).

Although wooden keros with metal inlays have not captured the imagination of modern scholars, they were of importance to the Andean colonial population. Indigenous words for this vessel appear in the colonial Quechua dictionary compiled by Diego González Holguín in AD 1608 and the Aymara dictionary produced by Ludovico Bertonio in AD 1612. These men were Jesuit priests who mastered the major indigenous languages and who traveled in the highlands of Peru and Bolivia beginning in AD 1591. González Holguín identifies one type of "*qqeru*" which was "studded with lead." He writes that this kind of kero was called *titinchascca qqeru* or *titiwawan morochacca qerun* (González Holguín 1952 [1608]: 205, 305). *Titi* is the Quechua word for lead, while the term *yurak titi* or "white lead" refers to tin. The word *chassca* in *titichascca* refers to something that is very tangled up ("*muy enredada o enmarañada*").

Ludovico Bertonio (1879 [1612]) provides Aymara vocabulary for wooden cups with metal inlays, which parallel those in Quechua. Unlike González Holguín (1952 [1608]), Bertonio (1879 [1612]: 204) specifies that the inlays are tin rather than lead, and he includes additional information about their production. Since wood keros with inlayed metal are mentioned in the works of González Holguín, Bertonio, and Cobo, all of whom collected information at the end of the 16th and early in the 17th centuries AD, there can be little doubt that this class of keros was in use during early colonial times and that they were sufficiently important for there to be Quechua and Aymara terms for them. Rowe (1961: 340) concluded that the technique of decorating keros with metal inlays appeared to be a "purely colonial development" and that it was already popular by the late 16th century AD.

The information in colonial sources leave many questions unanswered. Were the inlays composed of lead, tin, or some other metal alloy, and how were the inlays applied? Some of the confusion stems from inconsistency in the early historical sources. Fortunately, these questions can be resolved using standard archaeometric techniques on a sample of colonial keros in museums and private collections. In our study, we focused on eleven such keros with metal inlays: six from the Museo Inka (UNSAAC) in Cusco, one from

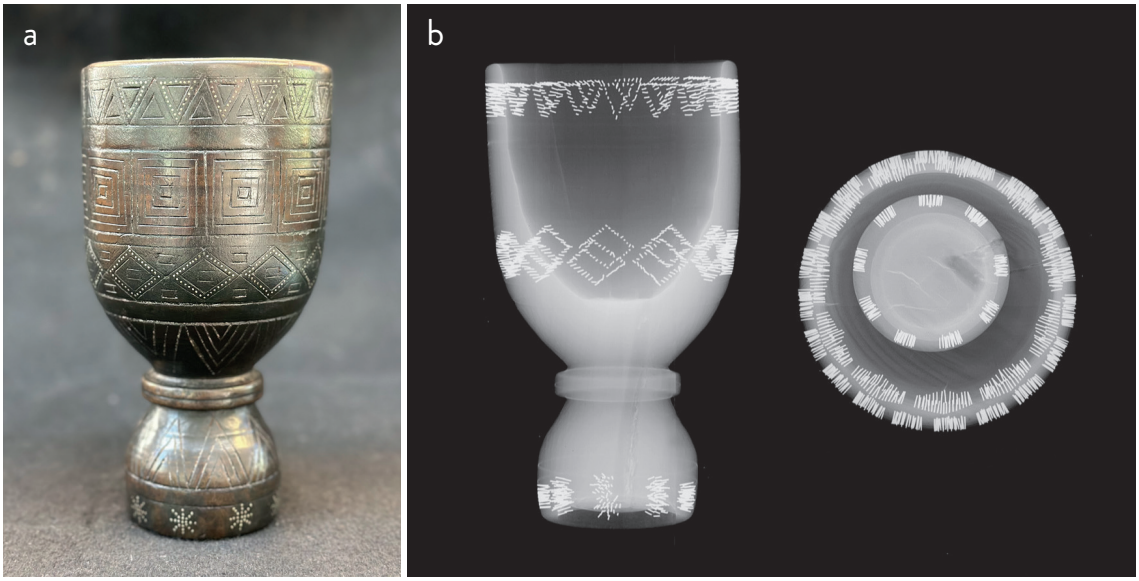

Figure 1: **a)** kero with a pedestal base, finely incised geometric designs and metal inlays forming diamonds and pendant triangles (PCL-1, private collection, purchased in Lima and is said to have been acquired in Cusco; height 11.5 cm, width 10 cm); **b)** X-ray images of the kero PCL-1 highlighting its metal rod inlays (photos taken in the Yale University Art Gallery Conservation Laboratories) (all photos by the authors, unless otherwise stated). ***Figura 1**: **a)** kero con base de pedestal, finamente inciso con diseños geométricos e incrustaciones de metal en formas de rombos y triángulos colgantes (PCL-1, colección privada, comprado en Lima, pero se dice adquirido en Cusco; alto 11,5 cm, ancho 10 cm); **b)** imágenes radiográficas del kero PCL-1 destacando sus incrustaciones de metal (fotografías tomadas en Yale University Art Galley Conservation Laboratories) (todas las fotografías son de los autores, excepto cuando se indica).*

the American Museum of Natural History (AMNH) in New York, three from The Metropolitan Museum of Art (MET) also in New York, and one, now in a private collection, that was purchased in Lima at a store specializing in "arte popular" from Cusco, Peru. None of the 11 objects came from archaeological contexts, and while ages can be suggested based on their styles, these have not been confirmed using scientific methods such as radiocarbon dating.

All of the keros were elementally analyzed where housed (e.g., the Museo Inka in Cusco, the MET in New York) using a portable X-ray fluorescence (pXRF) instrument (an Olympus Vanta VMR) following the same series of procedures (see Frahm 2024 regarding pXRF). The focus was on metal inlays and, if present, metal used in repairs, and were measured in situ, without their removal from the keros. The beam diameter of the pXRF instrument was ca. 8 mm, so most measurements reflect multiple inlays (usually two to four but occasionally as many as six) and include the surrounding wood which contains carbon (C), oxygen (O), hydrogen (H), nitrogen (N), magnesium (Mg), potassium (K), calcium (Ca), sulfur (S), phosphorus (P), silicon (Si), chlorine (Cl) elements, etc., which are not common in metal alloys. Therefore, for the purposes of these tests, it was assumed that elements lighter than titanium (Ti) reflect the wood, not the metal, and tests of the wood itself showed no major or minor elements heavier than Ti. As a result, for Ti and above, the measurements were normalized to better reflect the inlays alone, and this limitation of the data should be kept in mind during their interpretation. Fortunately, staff at the MET had analyzed the inlays of their objects using a micro-XRF system (a Bruker ARTAX), and their results were consistent with our findings.

In addition, radiography was used at Yale University and the MET for four of the keros to get a better sense of the form and size of the inlays (fig. 1a). The resulting X-ray images revealed rod-shaped inlays that do not have heads or pointed ends (fig. 1b). Given their form, it would be incorrect to refer to them as nails or tacks. Rods (or *varillas* in Spanish) would be a better term. Many of

INLAY TYPE	OBJECT		Ti	Mn	Fe	Ni	Cu	Zn	As	Ag	Sn	Pb
Tin (Sn)	Museo Inka: MOMAC 250	Ave	4	1	6	–	1	<1	<1	–	86	1
		St Dev	1	<1	4	–	0	–	–	–	25	<1
	MET: 1994.35.18	Ave	–	<1	9	–	<1	<1	<1	1	88	2
		St Dev	–	–	13	–	–	–	–	1	15	1
	MET: 1994.35.19	Ave	–	–	16	–	<1	<1	<1	1	76	4
		St Dev	–	–	8	–	–	–	–	<1	9	4
	AMNH: B/1847	Ave	<1	3	12	–	1	–	–	<1	82	<1
		St Dev	–	1	3	–	1	–	–	–	4	–
Paktong (Cu alloy w/ Ni and Zn)	Private collection, Lima: PCL-1	Ave	<1	<1	3	18	67	11	–	–	–	<1
		St Dev	–	–	1	2	6	1	–	–	–	–
	Museo Inka: MOMAC 524	Ave	1	<1	7	17	64	10	–	–	–	<1
		St Dev	1	–	3	4	16	3	–	–	–	–
	Museo Inka: MOMAC 526	Ave	<1	<1	2	19	64	14	–	–	–	<1
		St Dev	–	–	1	1	4	1	–	–	–	–
	Museo Inka: MOMAC 531	Ave	5	3	25	11	39	8	–	–	–	<1
		St Dev	1	2	6	4	13	3	–	–	–	–
	Museo Inka: MOMAC 535	Ave	5	3	40	10	37	8	–	–	–	<1
		St Dev	1	1	7	2	10	2	–	–	–	–
Silver (Ag w/ Cu)	Museo Inka: MOMAC 530	Ave	7	2	38	–	10	<1	<1	43	–	<1
		St Dev	1	<1	16	–	2	–	–	13	–	–
	MET: 1994.35.20	Ave	–	2	20	–	21	1	–	50	6	–
		St Dev	–	<1	8	–	3	<1	–	5	1	–

Table 1. Percentages (%) of the elemental data for the metal inlays in the analyzed keros, with contributions from the surrounding wood subtracted from the totals (MET, New York, USA; AMNH, New York, USA; Ave, average [mean] values from measurements of multiple inlays; St Dev, standard deviations of measurements of multiple inlays). ***Tabla 1***. *Porcentajes (%) de los componentes elementales de las incrustaciones de metal de los keros analizados, con contribuciones de la madera circundante restadas de los totales (MET, Nueva York, EEUU; AMNH, Nueva York, EEUU; Ave, valores promedio [media] de mediciones de las múltiples incrustaciones; St Dev, desviaciones estándar de las mediciones de múltiples incrustaciones).*

the rods are 2-3 mm in diameter and vary in length even within the same kero. Variability in the rod lengths in the MET keros can be seen from the following measurements: 2-3 mm (N° 1994.35.18), 2 mm (N° 1994.35.19), and 3-5 mm (N° 1994.35.20). The rods in the Lima kero are longer, running 5.7-6.2 mm in length (fig. 1b).

The metallurgical compositions of the rods are similarly variable (table 1). Even the matching keros of a pair do not have rods with identical compositions. In some cases, the alloy consisted of two incompatible metals, suggesting that some degree of metallurgical experimentation was underway. The differences in the composition and length of the metal inlays suggests that their production was not standardized, and it is possible that the rods were clipped from different batches of metal wire without great care concerning their exact dimensions. Such a technique would parallel the manner in which chevron glass trade beads were produced in Venice, Italy (Fonseca & Bauer 2015: 116).

Our study of the keros revealed that the Aymara dictionary prepared by Bertonio provided some dubious information. He claims that the metal inlays were produced by melting tin and then pouring it into holes made in the exterior of the kero: "*Tambien adorner los vasos derretiendo estaño en los huecos que hazen para ello* [...]" (Bertonio 1879 [1612]: 204). This description of the decorative process was repeated by Rowe (1961: 328). It is, however, highly unlikely. As table 2 indicates, the melting point of tin and other metals are all higher than the temperature at which wood burns. If molten metal was poured onto the surface of a wooden kero, the surface would be scorched if it had not burst into flames. Contrary to expectations, there is no evidence of heat or fire damage on any of the keros.

How then could the inlays have been made? The most likely procedure would be to make small holes in the kero surface with a finely pointed instrument such as a carpenter's gimlet. This hand tool was used in

MATERIAL	°F	°C
Wood	400	200
Pure tin (Sn)	450	232
Lead glass	1110-1290	600-700
Pure silver (Ag)	1763	962
Paktong	1930-2030	1055-1100
Soda-lime glass	2550-2910	1400-1600

Table 2. Melting points of relevant metals and the ignition temperature of wood. ***Tabla 2***. *Puntos de fusión de los metales relevantes y temperatura de combustión de la madera.*

Peru during the 16th and 17th centuries AD for drilling small holes in wood, particularly for creating pilot holes for nails. The gimlet was known for its ability to bore cleanly without splitting the wood (Brendan Weaver, personal communication, March 2025). If this idea is correct, once the holes were made by a gimlet, the rods could be inserted into the small depressions. Bertonio's statement that the metal was placed in the holes that they make for them (*"en lo huecos que hazen para ello"*) is consistent with this scenario (Bertonio 1879 [1612]: 24), as are small circular holes visible where rods have fallen out of some keros. The relative softness of the metal rods and the lack of a pointed end would have prevented the artisans from hammering rods into an unprepared wooden surface.

With rare exception, the rods (*varillas*) were inserted so that their top ends were flush with the outer surface of the keros, and the bottom end of the rods remained unseen deep in the side walls of the kero (fig. 1b). Rods were never inlaid in the interior or bottom of the vessels.

Most of the *titinchascca qqerus* were decorated with only a limited number of designs. Among the most common of these was the arrangement of the rods to form repeating geometric patterns, such as pendant triangles (fig. 1a), zigzags (fig. 2a and b), cross-hatching (fig. 3a and b), and interlocking diamond shapes (fig. 4a and b). Horizontal lines of silver-colored rods sometimes encircled the mouth and the base of the keros (fig. 2b). The geometric ornamentation was sometimes confined to horizontal registers at the top, middle, or bottom of the vessel, although sometimes it covered the entire outer surface (fig. 5). In some cases, the inlays were positioned in conjunction with other kinds of decoration such as incised monochrome geometric motifs (fig. 6) or polychrome lacquers (fig. 3b). Rowe (1961: 539)

Figure 2: **a)** kero with raised band and metal inlays forming cross-hatching and zigzag motifs (MMA1994.35.19, MET, New York, USA; height 21.6, diameter 18.4 cm); **b)** kero with raised bands and metal inlays forming cross-hatching, zigzag and diamond designs (MMA1994.35.18, MET, New York, USA; height 21.9 cm, diameter 19.1 cm); part of a matching pair with the kero in figure 2a. ***Figura 2***: ***a)*** *kero con bandas en relieve e incrustaciones de metal que forman motivos de líneas cruzadas y zigzag (MMA1994.35.19, MET, Nueva York, EEUU; alto 21,6 cm, diámetro 18,4 cm);* ***b)*** *kero con bandas en relieve e incrustaciones de metal que forman motivos de líneas cruzadas, zigzag y diseños de rombos (MMA1994.35.18, MET, Nueva York, EEUU; alto 21,9 cm, diámetro 19,1 cm); parte de un par coincidente con el kero en la figura 2a.*

Figure 3: **a)** kero with metal inlays and polychrome lacquer decoration (B/1847, acquired in 1896 by Adolf Bandelier on "Titicaca Island", Bolivia, AMNH, New York, USA; height 21.8 cm, diameter 19 cm); **b)** closeup of the Bandelier kero showing lacquer painting of parrots. Metal inlays form a cross-hatching pattern and unlike the other keros studied are incrusted so that the rods project from the kero surface. ***Figura 3**: **a)** kero con incrustaciones de metal y decoración polícroma lacada (B/1847, adquirido en 1896 por Adolf Bandelier en "Isla Titicaca", Bolivia, AMNH, Nueva York, EEUU; alto 21,8 cm, diámetro 19 cm); **b)** detalle de la pintura lacada de loros del kero Bandelier. Las incrustaciones de metal forman un patrón de tramas cruzadas, y a diferencia de otros keros estudiados, estas están engastadas de manera tal que las varillas sobresalen de la superficie de la vasija.*

Figure 4: **a)** kero with metal inlays decorating the outer surface with finely incised concentric diamonds and geometric motifs formed by inlays (MOMAC 526, Museo Inka, Cusco, Peru; height 14.3 cm, diameter 12.1 cm); **b)** kero with metal inlays decorating the outer surface with interlocking diamonds (MOMAC 524, Museo Inka, Cusco, Peru; height 13.3 cm, diameter 10.2 cm). ***Figura 4**: **a)** kero con incrustaciones de metal en la superficie exterior, decorado con finas incisiones de rombos concéntricos y motivos geométricos formados por los engastes (MOMAC 526, Museo Inka, Cusco, Perú, alto 14,3 cm, diámetro 12,1 cm); **b)** kero con incrustaciones de metal que decoran la superficie exterior con rombos entrelazados (MOMAC 524, Museo Inka, Cusco, Perú; alto 13,3 cm, diámetro 10,2 cm).*

Figure 5. Kero with metal inlays decorating the entire outer surface with cross-hatching designs (MOMAC 250, Museo Inka, Cusco, Peru; height 17.4 cm, max. diameter 14.21 cm). ***Figura 5***. *Kero con incrustaciones de metal que decoran toda la superficie exterior con diseños de tramas cruzadas (MOMAC 250, Museo Inka, Cusco, Perú; alto 17,4 cm, diámetro máx. 14,21 cm).*

Figure 6. Kero incised with concentric squares and other complex geometric designs complemented with isolated metal inlays (MOMAC 531, Museo Inka, Cusco, Peru; height 16.8 cm, diameter 12.01 cm). ***Figura 6***. *Kero con decorados incisos de cuadrados concéntricos y otros motivos complejos complementado con incrustaciones de metal aisladas (MOMAC 531, Museo Inka, Cusco, Perú; alto 16,8 cm, diámetro 12,01 cm).*

has suggested that keros with monochrome geometric motifs and lacquer designs constitute a Transitional stage from the late 16th century AD; it is possible that the similar combination of monochrome geometric motifs and metal inlays may be coeval with the Transitional keros. Other ones with metal inlays have raised circumferential bands (fig. 2a and b) and/or colorful lacquered scenes (fig. 3a and b). Rods also were used to represent the eyes or pelage markings on the carved felines that appear on the outer mouth of keros, known from the Bertonio dictionary as *qeru katari* (fig. 7) (Bertonio 1879 [1612]: 209, 290). One unusual pair of keros from the Museo Inka shows a series of incised lizards with insets decorating its body (fig. 8a and b); these appear alongside monochrome geometric motifs, parallel hatching and stylized faces.

The creation of designs from the silver-colored rods would have been a time-consuming undertaking, probably no less taxing than producing the lacquered scenes. The number of rod inlays utilized to create the lines and geometric patterns on the *titinchascca qqerus* is often very large. For example, on the pair of matching keros from the MET the number of rods used to decorate each exceeds one thousand (fig. 2a and b).

An unexpected finding of this study was that several different metals were used for decorative inlays. As can be seen in table 1, which summarizes the pXRF results, the rod inlays in four (36%) of the keros were made of tin (Sn), two (18%) had rod inlays made from silver (Ag) with variable copper (Cu) and iron (Fe) contents, and five keros (45%) had rod inlays made of an alloy of nickel (Ni), zinc (Zn), and copper (Cu). The nickel, zinc, and copper alloy is known by a variety of terms including *paktong*, nickel silver, German silver, and alpaca. *Paktong* had the look of silver but did not tarnish. Contrary to information in González Holguín's dictionary, none of the inlays studied

Figure 7. Kero in Katari style with metal inlays and a carved handle in the form of a feline (1994.35.20, MET, New York, USA, height 27.6 cm). ***Figura 7****. Kero de estilo Katari con incrustaciones de metal y asa tallada en forma de felino (1994.35.20, MET, Nueva York, EEUU; alto 27,6 cm).*

here was lead, and two of the metals that were utilized for them – silver and *paktong* – were not mentioned in the Bertonio and González Holguín dictionary descriptions of keros with metal insets.

THE MEANING AND SIGNIFICANCE UNDERLYING THE *TITINCHASCCA QQERUS*

The diversity in the composition of the metal inlays is a good place to begin to understand the meaning underlying the incrustation of *titinchascca qqerus*, particularly if they are viewed in relation to Andean values and notions of the sacred (Burger 2012). The three metals utilized for rod inlays (tin, silver alloy, and *paktong*) are chemically distinct from each other, but they share important qualities –their surfaces all have a silvery appearance and reflect light. In that sense, these three materials form a distinctive class of raw material.

Figure 8: **a)** kero decorated with metal inlays and fine incision forming chevrons, diamonds, zigzags, and concentric squares as well stylized lizards (MOMAC 535, Museo Inka, Cusco, Peru; height 14.11 cm, max. diameter 12.25 cm); **b)** kero decorated with fine incisions and metal inlays forming triangles, cross-hatching, concentric squares, lizards and anthropomorphic faces (MOMAC 530, Museo Inka, Cusco, Peru; height 19.3 cm, diameter 16.5 cm). Despite differences in form and decoration, we believe that it may be part of a matching pair with the kero in figure 8a. ***Figura 8****: **a)** kero decorado con incrustaciones de metal y finas incisiones formando diseños de chevrones, rombos, zigzags, cuadrados concéntricos, y lagartijas estilizadas (MOMAC 535, Museo Inka, Cusco, Perú; alto 14,11 cm, diámetro máx. 12,25 cm); **b)** kero decorado con finas incisiones e incrustaciones de metal con motivos de triángulos, líneas cruzadas, cuadrados concéntricos, lagartijas y rostros antropomorfos (MOMAC 530, Museo Inka, Cusco, Perú; alto 19,3 cm, diámetro 16,5 cm). A pesar de las diferencias en la forma y decoración, creemos que puede ser parte de un par coincidente con el kero de la figura 8a.*

From a purely aesthetic perspective, the visual difference between the dark brown color of the wooden keros and the silver color of the rod inlays is striking. This contrast in the *titinchascca qqerus* is not limited to color, since the reflective properties of the metal inlays differs from the matte surface of the wooden vessels. Dualism underlies Andean cosmology and has been one of its features since deep in prehistory (Isbell 1979; Burger & Salazar 1993), and it seems reasonable to interpret the differences in hue and reflection in the *titinchascca qqerus* as an embodiment and expression of this principle. This interpretation is consistent with the existence of kero pairs, which are said to represent *hanan* and *hurin* (Quechua terms for opposing but complementary parts of a village). Two pairs of matching keros with metal inlays were included in this study: one from the MET and the other from the Museo Inka.

In addition, we believe that the materials selected for the rod inlays were chosen because they were made from metals considered to have exceptional value in the colonial Andes. Although systems of values differ radically among cultures in time and space, there are some general principles that often determine special value, and these principles characterized many ancient and historic Andean cultures as well (Burger 2012). One of them is that items brought from great distances are often associated with sacred power and knowledge. As Mary Helms notes, such goods do not merely come from great physical distances, but they also come from "outside" in a cosmological sense. Thus, rather than reflecting local interpersonal relations, they point to a different spatial/temporal order of things. Unlike commodities acquired by trade, these metals were brought from beyond the everyday socio-cultural realm. They have meanings shaped by the transformative powers of cosmic spirits and deities (Helms 2013: 96-108). Another principle drawn from economic theory is that scarcity is linked to high valuation.

Both principles are illustrated by the great value attributed to *Spondylus princeps* in the Central Andes (Paulsen 1974). This distinctive shell with its thorny exterior and "coral red" banding is not found in the cold current off the Peruvian coast, and it could only be acquired by diving deep into the warm waters of the Ecuadorian littoral. This source area was located more than two thousand kilometers to the northwest, far from the Inca heartland in an area outside the Central Andes. Not surprisingly, *Spondylus* shell was highly valued in Peru's southern highlands both before and after the Spanish conquest.

These principles are especially relevant when considering the value of *paktong* in colonial Cusco. It was the most popular material used for the metal inlays in our sample. *Paktong* is an alloy of copper, nickel, and zinc that was discovered in ancient China. It was smelted from unprocessed ore as early as the 4th century AD. The Chinese imperial authorities attempted to control its mining and export, but it began to be marketed to Europe by the early 16th century AD, continuing into the early 19th century AD (Mei 1995: 44; Pinn 1999). *Paktong* was only reproduced in Europe during the late 18th century AD, so the rod inlays of this material used in the *titinchascca qqerus* were examples of Chinese imports to the colonial Andes. This is consistent with the observation that Chinese trade goods reached Peru with galleons from Manila which stopped at the port in Callao by AD 1572. According to Elena Phipps (2004: 97), the colonial appetite in Peru for Chinese goods was enormous, and the traffic in Chinese imports persisted despite Spanish attempts at intervention. It seems reasonable to conclude that *paktong* was rare as well as being brought from distant lands.

Rod inlays of tin were also common in our sample. Tin does not occur geologically in what now is Peru, and the production of tin-bronze did not occur in the Inca heartland until Pachacuti's conquests incorporated the rich cassiterite fields in Bolivia and Northwest Argentina. Even then, the scale of tin-bronze production remined small (Lechtman 2007: 330). After the collapse of the Inca empire, tin-bronze production declined. The mining of tin continued around Oruro, Bolivia but was supplemented by tin imported from Europe in the form of tin sheets referred to as "placas de lata". The latter suggests a relative scarcity of tin in colonial times, and it is likely that tin sheets imported from Bohemia, England, or somewhere else in Europe were the origin of the metal inlays. Interestingly, imported tin was often referred to as "oro de Florencia" because it was silver in tone (Kris E. Lane, personal communication, April 2025). In a recent volume summarizing the artifacts from an Early Colonial site in coastal Peru, there were items of copper-zinc alloy and copper-arsenic alloy, but

no metal artifacts of tin or tin-bronze (Lorey & Quilter 2020). Thus, the tin used in kero inlays can be considered as a material that was both rare and brought from outside of the Cusco region.

The exceptional value of silver was established long before the Spanish Conquest. It had powerful religious associations with females and the moon (Silverblatt 1987; Lechtman 2007), and its use was a royal prerogative. Like gold, in Inca times silver was circulated by gift exchange. Its rarity outside of the elite population and religious institutions continued during colonial times (Lechtman 2007). It was used by the Catholic church to adorn altars and saints. Early silver coins minted by the Spanish authorities in Potosí and other centers of the Andes were treasured as *illas*, objects of sacred power that promoted health and fertility. The continued high valuation of silver at this time was linked to its enduring association with celestial and religious activities (Salomon 2004: 121). Silver coins were treasured as valuables, not for their resale value, but because of this sacred quality. Frank Salomon (2004: 116) also notes that colonial silver miners in the Andes believed that silver, like tubers, grew underground, so it made sense to perform ceremonial honors for amulets of silver the same way they would for herd or crop amulets.

TECHNOLOGICAL INNOVATION AND ANNULAR PACCHAS IN THE COLONIAL ANDES

Another example of the creativity and vitality of indigenous artisans during colonial times is found on a group of ceramic pacchas produced in Cusco or Puno. Like keros, the ceramic pacchas were used for ceremonial libations in Andean rituals, and like them, they evolved from earlier ritual vessels utilized in Inca and pre-Inca times. In the Colonial period, some pacchas were made from wood and silver, but most were ceramic (Carrión 1955; Lothrop 1956). As a class of objects, the forms of pacchas are distinctively Andean. Their survival after the Conquest and the campaigns of the Catholic church to extirpate idolatries is a testament to the cultural resilience that has characterized the Andes for centuries and that still flourishes in some parts of the Peruvian and Bolivian highlands (Flores et al. 1998: 38-41). Among the many types of ceramic pacchas, there are some whose chambers have the form of a torus or doughnut; these have been referred to as annular pacchas (Burger 2021). The form of these pacchas guarantee the circulation in the vessel of the liquid libation before it is poured onto the earth to ensure health and fertility. During colonial times, annular pacchas sometimes incorporated technologies and vessel elements introduced by the Spaniards, such as the use of ceramic glaze and the addition of curvilinear strap handles (figs. 9-11) (Burger 2021).

In an earlier study of annular pacchas, Richard Burger (2021: 141-147) identified three examples with glass incrustations that can be dated to Early Colonial period (e.g., late 16th and 17th centuries AD) based on stylistic and seriational arguments. These embody the hybrid nature of colonial material culture in the Andes by modeling a bas-relief cherubic head with its Christian associations alongside of a representation of the *amaru*, a supernatural serpent associated with water and fertility in Andean cosmology (figs. 9-11).

The unprecedented innovation that makes these three annular pacchas relevant to the focus of this article is the incorporation of colored glass into the ceramic vessels. In two cases (PC-1 and MI-1), the body of the *amaru* is adorned by green glass incrustations (figs. 9 and 10), and in the third (MNCP-1), fragments of green glass embellish the head and shawl pins (tupus) of the cherub (fig. 11). Our first impression was that the vessel's green incrustations might be semi-precious stones such as turquoise or chrysocolla, but closer examination suggested that these inlays could be colored glass. To evaluate these possibilities, we adopted two lines of analysis: 1) by low-power reflected-light microscopy (e.g., a handheld Dino-Lite digital microscope with 20x magnification), and 2) by pXRF (e.g., the same instrument and the same general procedures for testing the kero inlays) in the Yale University Archaeological Laboratories. Using this dual nondestructive approach allowed us to determine whether the inlays were turquoise, glass, or a combination of both. Vitreous (glass-like) traits were present on many of the inlays, including conchoidal fracture, bubbles with a transparent matrix, and friable corrosion (figs. 12b, 13a-d). The bright lighting under microscopic examination also revealed a greater variety of green-yellow-blue colors among the inlays than is

Figure 9: **a)** frontal image of a ceramic annular paccha with the modeled head of a cherub and the depiction of the *amaru* decorated with glass incrustations (PC-1, private collection, purchased in Cusco, Peru; height 11.5 cm, diameter circular chamber 18.5 cm); **b)** the annular paccha in figure 9a, photographed from above to show the low relief *amaru* and the glass inlays, which are annotated with numbers corresponding to the elemental analytical data. ***Figura 9**: **a)** imagen frontal de una paccha anular de cerámica con cabeza de querubín modelada y representación de* amaru *decorada con incrustaciones de vidrio (PC-1, colección privada, adquirida en Cusco, Perú; alto 11,5 cm, diámetro cámara circular 18,5 cm); **b)** paccha anular de la figura 9a, fotografiada desde arriba para mostrar a* amaru *en bajo relieve y las incrustaciones de vidrio señaladas con números correspondientes a los datos analíticos de los elementos.*

Figure 10: **a)** ceramic annular paccha with a modeled head of a cherub and the depiction of the *amaru* decorated with green glass inlays (MI-1, Museo Inka, Cusco, Peru; height 13 cm, diameter 20 cm); **b)** image from above of the annular paccha MI-1. Despite differences in detail, we believe that it is part of a matching pair with the paccha in figure 9a. ***Figura 10**: **a)** paccha anular de cerámica con cabeza modelada de querubín y representación de* amaru *decorada con incrustaciones de vidrio verde (MI-1, Museo Inka, Cusco, Perú; alto 13 cm, diámetro 20 cm); **b)** imagen superior de la paccha anular MI-1. Fuera de las diferencias en los detalles, pensamos que esta pieza es el par coincidente de la paccha de la figura 9a.*

Figure 11. Ceramic annular pacca with small green glass inlays adorning ear ornaments of the cherubic face and tupus of his shawl (47-26 AP-14, Museo Nacional de la Cultura Peruana, Lima, Peru; height 10 cm, max. width 19.5 cm). ***Figura 11***. *Pacca anular de cerámica con pequeñas incrustaciones de vidrio verde decorando las orejeras del rostro del querubín y los tupus de su manta (47-26 AP-14, Museo Nacional de la Cultura Peruana, Lima, Perú; alto 10 cm, ancho máx. 19,5 cm).*

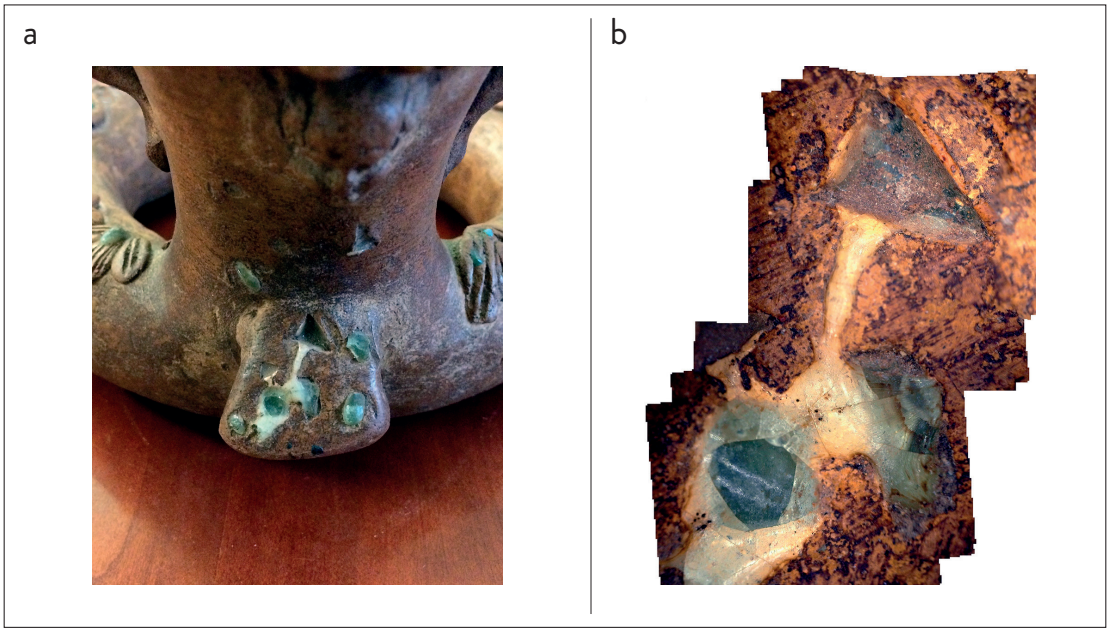

Figure 12: **a)** protruding "tablet" area of PC-1, showing glass inlays deformed from firing; **b)** a closeup of the glass inlays in the protruding "tablet" area showing molten glass running down the sides of the pacca. ***Figura 12***: ***a)*** *área de la "tableta" que sobresale de PC-1, que muestra incrustaciones de vidrio deformadas por la cocción;* ***b)*** *primer plano de las incrustaciones de vidrio en la zona de la "tableta" que sobresale, mostrando el vidrio fundido que corre por los lados de la pacca.*

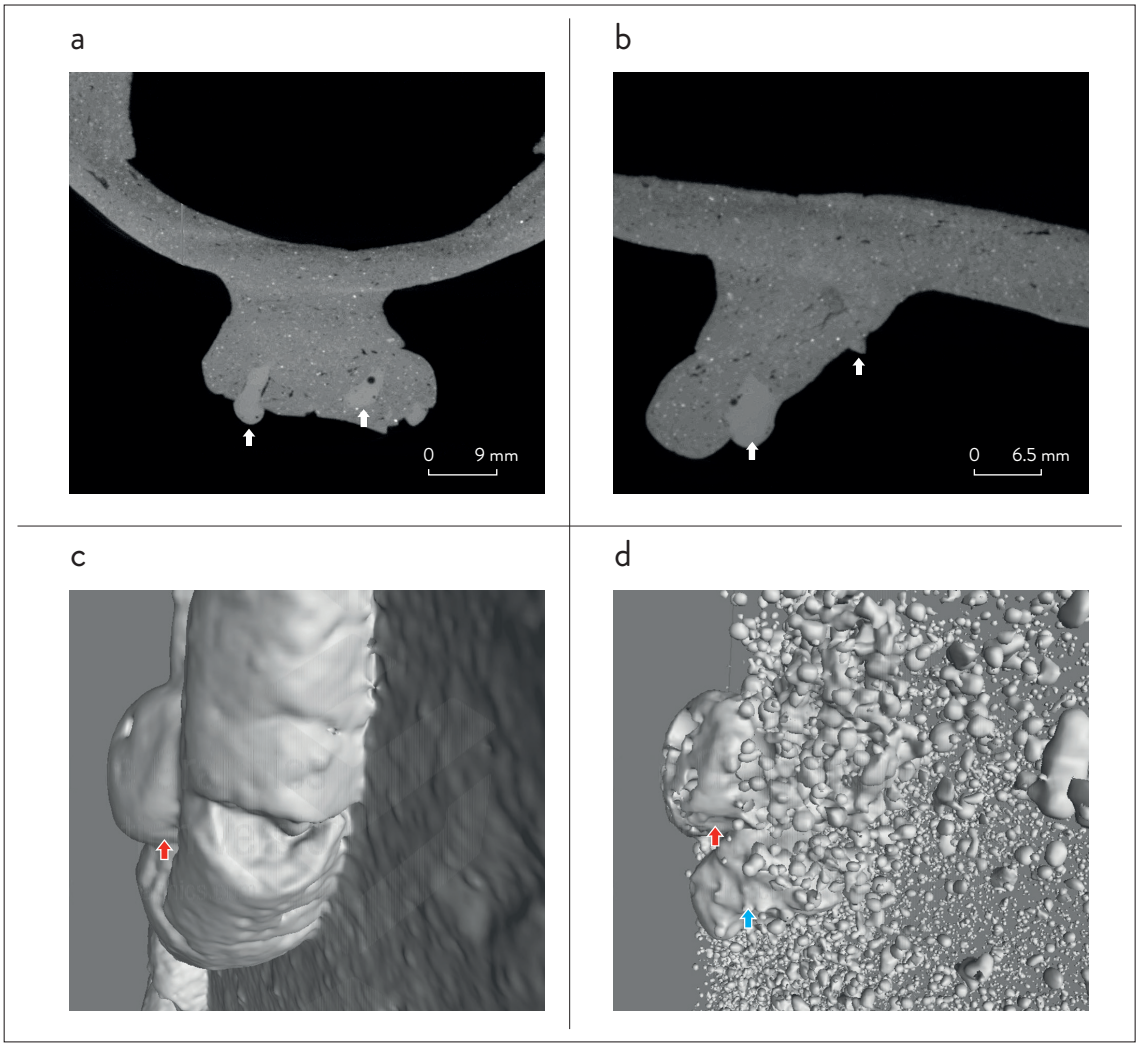

Figure 13. Micro-CT scans, of the PC-1 pacchа showing cross-sections of the protruding "tablet" area (conducted in the Yale Structural Science Facility): **a)** from above; **b)** from the side, showing the glass inlays that had been pressed into the clay (white color arrows); **c)** a glass inlay protruding from the clay surface (red color arrow); **d)** when the clay is subtracted based on density, there is a second inlay that appears inside the clay, like it was pushed in too far (blue color arrow). The visible one also appears to have bubbles inside; this was also observed in visible-light images. ***Figura 13***. *Tomografías computarizadas microscópicas de secciones transversales del área de la "tableta" que sobresale en pacchа PC-1 (realizadas en Yale Structural Science Facility):* ***a)*** *desde arriba;* ***b)*** *desde el lado que muestra las incrustaciones de vidrio que habrían sido presionadas en la arcilla (flechas blancas);* ***c)*** *incrustación de vidrio que sobresale de la superficie de la arcilla (flecha roja);* ***d)*** *cuando se sustrae la arcilla en función de la densidad, aparece una segunda incrustación dentro de la arcilla, como si la hubieran empujado demasiado (flecha azul). El vidrio parece tener burbujas en su interior; esto también se observó en imágenes de luz visible.*

readily apparent to the naked eye under typical lighting. Certain insets had such brilliant turquoise-like colors that we followed through with pXRF analyses.

The goal of the pXRF analyses was primarily to test for the presence of copper (Cu) in the inlays because the chemical formula for turquoise is $CuAl_6(PO_4)_4(OH)_8{\cdot}4H_2O$ and chrysocolla, commonly mistaken for turquoise, is $(Cu,Al)_2H_2Si_2O_5(OH)_4{\cdot}nH_2O$. By weight, turquoise is ca. 8% copper and chrysocolla is ca. 34% copper. The pXRF instrument's internal camera was used to posi-

tion the measurement window directly over the inlays, one at a time. None of these analyses measured copper above 200 parts per million (ppm; that is, 0.02%), so the inlays cannot be turquoise or chrysocolla. Both the elemental and microscopic results indicate that the inlays are glass rather than turquoise or another stone.

Glass was unknown in the Andes prior to the arrival of the Spaniards. Francisco Pizarro knew from his experiences in Central America that native American populations were unfamiliar with glass and were impressed by its unusual qualities. For this reason, the conqueror included glass beads in his initial gift to the Inca emperor Atahualpa (Donnan & Sillton 2011: 215 in Menaker 2016: 90), and when Diego Rodríguez de Figueroa visited Vilcabamba as an emissary to Titu Cusi Yupanqui he brought glass vessels as gifts (Bauer & Aráoz 2015: 148). In the Andes, glass remained scarce throughout early colonial times, and there is only a single known historical reference to local Andean glass production: a small workshop on Peru's south coast in the year AD 1613. Almost all of the glass in Peru of this period was imported from the Old World, especially Venice. Other colonial glass-making centers, such as the ones in Antwerp, Belgium and Mexico City, could have provided glass to Peru, but there is no documentary or archaeological evidence of this (Menaker 2016; 2020: 191). Thus, in the Central Andes, glass was a rare material brought from far away, and like silver, tin, or *paktong*, it was considered to be a material of exceptional value.

Beads seem to be the predominant form in which glass found its way into provincial Andean communities. Glass beads were recovered in the excavations of the neo-Inca capital of Vilcabamba (Fonseca & Bauer 2015: 117, fig. 5.53). Nueva Cadiz beads in particular are often used as an index of early colonial exchange networks in the Americas, and these beads continued to circulate during the late 16th and 17th centuries AD. Both types of Nueva Cadiz beads are of the drawn cane variety (Wernke 2013; Menaker 2020: fig. 7-3). A single shard of clear glass was also encountered at Vilcabamba (Bauer & Aráoz 2015: 148-149, fig. 7.6). Given the scarcity of glass in Peru at these times, how and why was colored glass used to adorn ceramic pacchas of this period? A more detailed study of the glass incrustations assists in answering this question.

One of the annular pacchas (denoted here as PC-1) encrusted with glass was loaned to the authors for analysis in the Yale University Archaeological Laboratories, Yale University Art Gallery Conservation Laboratories, and Yale Structural Science Facility (fig. 9a and b). This paccha, now in a private collection, was purchased in the early 1990s in Cusco. An almost identical paccha exists in the collection of the Museo Inka. The latter was accessioned in year 1941 by Museo Inka's director, the Cusqueño archaeologist Luis Pardo (fig. 10a and b). Pacchas, like keros, were created in matching pairs, and the Museo Inka paccha together with PC-1 constitutes one such pair. The matching annular pacchas display a fusion of pre-Hispanic and Iberian elements, but the vessel's ability to serve as ritual equipment in Andean religious ceremonies remained unhindered (Burger 2021: 140-145). The damage visible on the spout rims of both vessels indicates that they had been used. The tubular form of the chamber in both vessels leaves no doubt about their pre-Hispanic roots, but the applique lip bands show European influence, as do the curvilinear strap handles. A modeled face in bas-relief appears in the center of the spout on both vessels, and these faces resemble the Baroque cherubs that appear on the bronze door ornaments and oil paintings of saints that adorn Cusco's churches (Burger 2021: 141-144, figs. 5 and 6). An appliqué zigzag motif representing the *amaru* serpent was placed on top of the tubular chambers and stylized icons in the form of marine shells hang from the *amaru*'s body. Small pieces of green glass are set into the shells and the interstices of the *amaru*'s undulating body (figs. 9b, 10b). Additional pieces of glass are present on the "bib" that extends from below the cherubic face (figs. 9a, 12a). A minimum of 25 fragments of glass were incorporated into annular paccha PC-1.

The problem of determining the method used to attach the glass incrustations to the annular pacchas was approached using a battery of scientific techniques, including micro-CT scanning in Yale's Structure Science Facility. Initially we suspected that the glass had been set into depressions after firing and secured to the ceramic pacchas using an adhesive. This technique was used on the north coast of Peru where inlays of green stone in gold earspools, tumis (sacrificial knives), and cups were produced for the Moche culture elite (Pillsbury et al. 2017: figs. 22, 23, 32, 33, 64). However, examination

of glass fragments on the annular pacchas found no evidence of resin or other adhesive.

This led us to consider an alternative scenario. Perhaps the glass was pressed into the pacchas while the clay was still soft so that the firing of the piece would secure the glass in place. According to potter Maishe Dickman (personal communication, April 2025), earthenware vessels like the pacchas are fired at temperatures sufficient to deform glass without fully liquifying it. Subsequent scientific tests confirmed this hypothesis. The very idea of firing pottery as a way of keeping inlays in place is itself an original solution to a difficult problem. The fact that colored glass fragments remain attached in all three pacchas is testimony to the utility of this approach, especially when compared to artifacts like Moche earspools that attempted to secure their position with adhesives. There are one or two spots on the pacchas that look like an inlay fell out, but with handheld microscopy, it can be seen that when inlays had broken off, they left firmly implanted glassy fragments behind (fig. 13).

Examining the paccha in the laboratory setting gives a few more clues about its manufacture. We propose the following sequence of events. First, different fragments of greenish glasses were pushed into the clay (fig. 13a and b). The vessel was then fired. For inlays laying more or less flat, some (depending on the glass composition) became rather vitreous and more rounded as a result, and some also exhibit bubbles or crazing (fig. 13c and d). For inlays that were more inclined or vertical, firing temperatures melted some, causing them run down the side of the vessel rather than remaining in place and becoming more rounded. It appears that one or two of the glass inlays have melted and run down around a lower inlay (fig. 12a and b). Nearby inlays, though, must have had sufficiently different compositions so that they did not melt. The glass inlays are close in density to the clay, so they are harder to isolate clearly, but micro-CT imaging gives us some idea of their morphology. They are like icebergs with more volume beneath than above the surface. The light gray features in some images (fig. 13a and b) are the inlays, and these appear to have simply been pressed into the clay while still soft. We note that in some cases the inlay was pressed into the applied decorations. Images showing the less-dense clay subtracted reveal that the hidden end of the glass inlay is pointed, suggesting that it was pushed about halfway into the clay this way.

The micro-CT scans also indicate that the glass encrustations are small angular shards, that is, pieces of irregular flakes of broken glass with sharp edges. These shards vary in size and shape. This indicates that the glass insets were not manufactured for this purpose. It would have been unlikely in any case given the underdeveloped state of local glass production in the early colonial Andes. Probably the glass utilized came from repurposed glass beads and vessels which had been shattered. The most common glass beads dating to this time were the Nueva Cadiz beads, most of which were imported from Europe. These objects have been found in the excavations of colonial sites in the Andes, and many of them are green in color (Menaker 2020: 200, fig. 7.3). The possibility that the glass inlays come from multiple glass beads and vessels would explain the diversity in composition and color of the glass inclusions, even among shards coming from the same paccha (fig. 14).

Using pXRF analysis, it is possible to evaluate the hypothesis that the shards come from several shattered glass artifacts and that some of these might be Nueva Cadiz beads imported from Venice. The results of our analysis are summarized in the elemental scatterplot in figure 14. This analysis shows the major chemical differences between the lighter-hued glass inlays and the darker-hued ones and how those measurements compare to the clay composition. As this plot shows, the major difference is the amount of calcium in the inlays, likely reflecting two major types of glass: one with high lime (calcium oxide) content and one with low. Lime was added to glass to reduce its solubility and increase its hardness and chemical durability. Note that the measurements were limited to the glass inlays by using the pXRF instrument's built-in collimator to restrict the X-ray beam size to a diameter of 3 mm (down from the usual 8 mm). Figure 15 compares the two lighter-hued inlays to historical glass, showing the similarity to Venetian glasses.

In summary, the analyses show that there are two main types of glass incrustations in paccha PC-1: one with high lime (similar to Venetian glass), and one with low lime. This compositional contrast corresponds to their colors. Moreover, there is variability among the

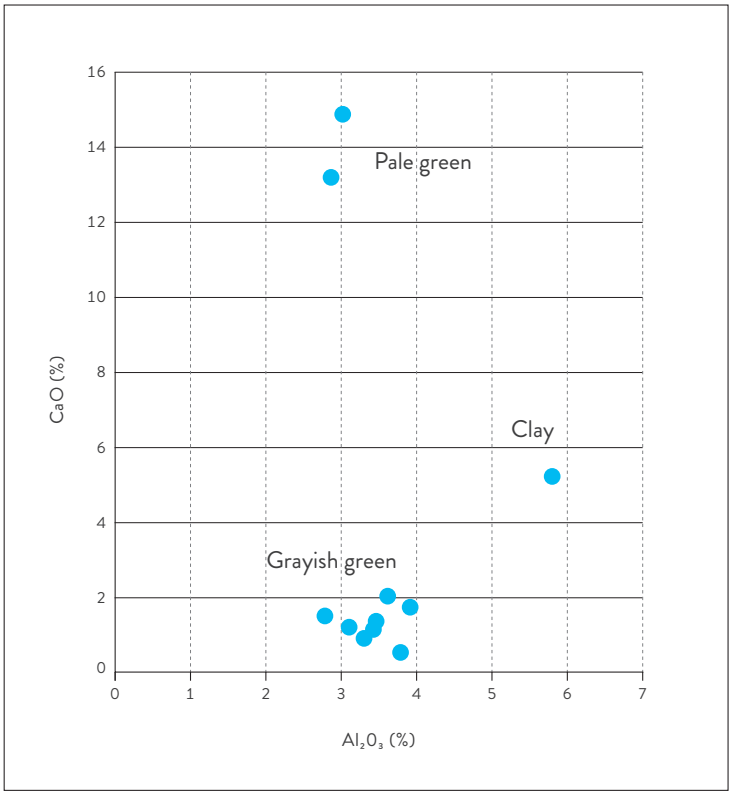

Figure 14. This aluminum oxide (Al_2O_3) vs. calcium oxide (CaO) scatterplot shows the major elemental differences between the lighter pale-green glass inlays and darker grayish-green ones and how the measurements compare to the clay composition. A key difference is the amount of calcium in the inlays, likely reflecting two main types of glass, one with high lime (calcium oxide) content and one with low. Lime was added to glass to reduce its solubility and increase its hardness and chemical durability. ***Figura 14***. *Este diagrama de dispersión de óxido de aluminio (Al_2O_3) vs. óxido de calcio (CaO) muestra las principales diferencias elementales entre las incrustaciones de vidrio de colores verde pálido más claro y verde grisáceo más oscuro, y cómo se comparan las mediciones con la composición de la arcilla. Una diferencia clave es la cantidad de calcio en las incrustaciones, lo que probablemente refleja dos tipos principales de vidrio, uno con alto contenido de cal (óxido de calcio) y otro con bajo. Se añadió cal al vidrio para reducir su solubilidad y aumentar su dureza y durabilidad químicas.*

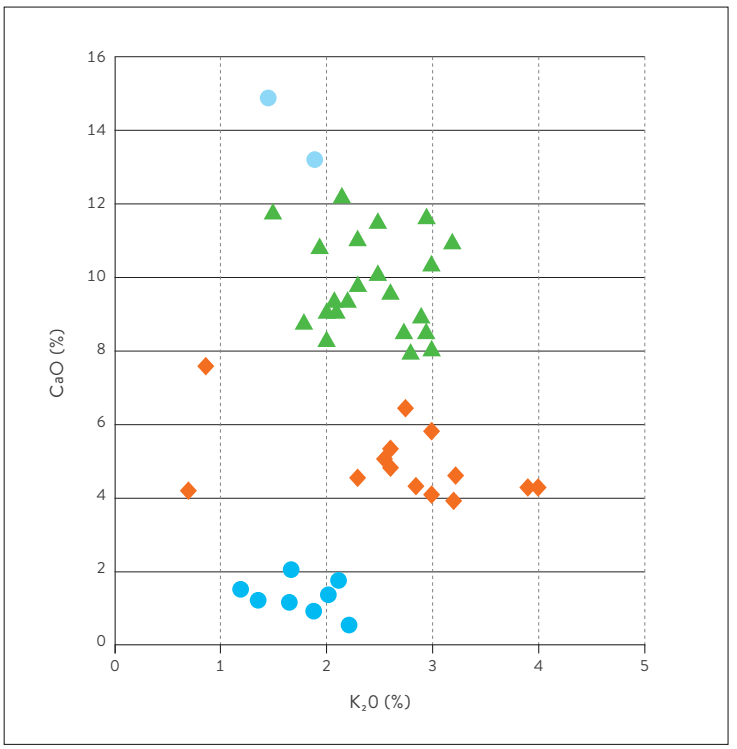

Figure 15. A potassium oxide (K_2O) vs. calcium oxide (CaO) scatterplot in the annular paccha PC-1 (fig. 9a). It shows how the two main types of glass inlays (light blue circle, the pale-green glass, and blue circle, the grayish-green glass) compared to two varieties of Venetian glass (orange diamond, the cristallo, and green triangle, the vitrum blancum) (modified from Henderson [2013: 108, fig. 4.7]). ***Figura 15***. *Diagrama de dispersión de óxido de potasio (K_2O) vs. óxido de calcio (CaO) en la paccha anular PC-1 (fig. 9a). Se comparan los dos tipos principales de incrustaciones de vidrio (círculo celeste, vidrio verde pálido, y círculo azul, vidrio verde grisáceo) con las dos variedades de vidrio veneciano (rombo naranja, el cristallo, y triángulo verde, el vitrum blancum) (modificada desde Henderson [2013: 108, fig. 4.7]).*

low-lime inlays (eight out of the 11 inlays analyzed). Of the two glass groups differing in color (one light, one dark), one is similar to Venetian glass, and the other is unknown. Using a Munsell Color Rock-Chart, a typical glass inlay from the lighter group is classified as Pale Green 10G6/2, and a typical darker one is identified as Grayish Green 10G4/2. Variation within these two subdivisions also suggests that they are made from different batches of glass and/or from different glass beads or vessels. Thus, these results are consistent with the hypothesis that source of some of the glass inlays in paccha PC-1 were Nueva Cadiz beads from Italy. The findings also suggest that there are glass shards incorporated in the inlays that come from at least one additional source (and perhaps more than one). Whether this other source or sources were workshops in Europe cannot be determined at this time.

THE MEANING AND SIGNIFICANCE OF COLONIAL PACCHAS WITH GLASS INLAYS

The reasons for incorporating colored glass shards parallel those already discussed for the incorporation of silver-looking metal rods into colonial wooden keros. The visual contrast between the colorful green shards and the brown earthenware ceramic vessel was probably significant, as was the difference between the highly reflective glass surfaces with the matte ceramic vessel. Moreover, the magical translucency of the glass must have been intriguing and resonated with a more general attraction to materials that reflect light in unusual ways. The British anthropologist Nicholas Saunders has referred to this as the "aesthetic of brilliance" and argued that this sensibility was shared across indigenous Amerindians (2003: 14-16). He summarizes this worldview as follows (Saunders 2003: 16):

> A wealth of ethnohistorical and ethnographic evidence suggests that indigenous Amerindians throughout the Americas perceived the world as infused with "spiritual brilliance". This view manifested itself across a range of natural phenomena-sun, moon, water, shells and ceramics, textiles and metals. Despite a range of differing cultural conventions and significances, each of these objects held an inner sacredness displayed as shiny surfaces.

The inlays of silver-colored rods and green glass fragments fit well within this aesthetic and broader cosmological understanding.

For the indigenous individuals using these pacchas in their rituals, it was unlikely that the source of the glass was known, and it was imagined (correctly in this case) to be from distant lands. The rarity of glass in general and the fact that it came from afar would have led to these glass shards being considered highly valuable, and consequently they would have increased the potency of the ritual vessels. Finally, the green color of the glass shards was associated with vegetation, fertility, and the earth. In earlier times, these links had led to the inclusion of stone inlays of turquoise and chrysocolla in ritual objects from Peru's north coast. The color associations of the inlays were consistent with the purpose of the paccha for ritual libations, and the depiction on the colonial pacchas of a low-relief *amaru* covered with plant life and marine symbols.

The rarity of pacchas with glass inclusions suggests that their production was abandoned after a short time. Whether this was because of the excessive value of the glass, the difficulty of acquiring it, or some other reason is not known. Notwithstanding the limited production of the annular pacchas with glass incrustations, they were innovations which had no antecedents among the many pre-Hispanic cultures of the Central Andes or in the earlier or coeval cultures of Iberia and the rest of Western Europe.

DISCUSSION AND CONCLUSIONS

This article has focused on two groups of colonial ritual objects that were produced by Andean people for use in their religious rituals. The innovations in ritual equipment discussed here were introduced during the reorganization of Tawantinsuyu into a Spanish colony. Pre-Conquest keros and pacchas were transformed by the incorporation of materials that had not existed in the Andes before the European invasion, and the manner in which these were incorporated was completely original. Nothing similar is known from the Old World, and the keros and pacchas documented here should be understood as examples of the continued vitality of indigenous Peruvian culture during the 16th and 17th centuries AD.

The decision to introduce metal inlays into incised wooden keros and to add colored glass shards to ceramic pacchas was not arbitrary. For the keros, the silver-looking rods of *paktong*, tin, and silver that were used as inlays can be understood as a function of the long-term lunar or celestial associations of silvery metal. The silver rods used in the *titinchascca qqerus* reflects their special valuation, and this motivation probably extended from the rods made of silver to those insets made with other silver-colored metals such as *paktong* and tin. The reflective qualities of silver, *paktong*, and tin metal rods used in these keros further linked them to the sacred since the indigenous peoples of South America identified luminous objects as having special power, hence the favored place held by precious metals, feathers, and crystals (Saunders 2003; Burger 2012). Consequently, the small silvery rods set into the wooden keros were not only visually stunning and consistent with the dualistic cosmology that characterized the indigenous Andes, but also because the silvery rods were treasured within the hierarchy of Andean values during colonial times, and their addition would have increased the power of these ritual vessels.

Similarly, the insertion of green glass shards into earthenware pacchas transformed these ritual instruments as a result of glass's scarcity in the colonial Andes, its acquisition from far away, its unusual reflective qualities, and the association of the green color of the glass shards with fertility and vegetation. In both the keros and pacchas discussed here, the color and reflectivity of the materials used in the inlays contrasted with the matte brown color of ritual object into which they were embedded. Symbols are multi-valent, and as noted, the powerful visual contrasts of the inlays with the ritual vessel itself also can be seen as embodying the principle of dynamic dualism that pervades Andean religious thought.

The creativity of the artisans who produced these ritual vessels went beyond the inclusion of valued materials brought to the Andes by the European invaders. It also involved inventing new ways to incorporate the inlays in a manner that ensured their permanence. Adhesives were apparently inadequate to achieve this end. In the case of the *titinchascca qqerus,* the technique developed involved the drilling hundreds of tiny pilot holes and then pressing metal rods cut from silver-colored metal wire into them. In the case of the pacchas, the angular flakes of green-colored glass were inserted into the unfinished soft clay vessel and then fired, thereby fixing the glass in place as part of the structure of the pacchas.

Innovation by indigenous craft specialists in colonial times was not limited to keros and pacchas. Among these other innovations were the adoption of colored lacquers made using mopa mopa resin to decorate wooden keros (Newman et al. 2015). These eventually replaced the incised geometric decoration popular in Inca and early colonial times. Significantly, the earliest known use of polychrome lacquering technique on keros comes from this period in Peru's southern highlands (Rowe 1961: 340). Another case of indigenous innovation in the 16th century AD can be found among the fine textiles of early colonial Cusco. In Inca times, the most prestigious cloth was produced from alpaca, cotton or, in rare cases, vicuña fiber. Following the Conquest, specialized weavers continued using traditional materials, techniques, and motifs to create high quality cloth for the indigenous elite. However, the weavers also began incorporating imported silk, silver, and gold thread into some textiles. Metallic thread was made of cut sheets of silver foil wound around a silk, linen, or cotton core (Phipps 2004: 87). Their inclusion gave the resulting textiles new reflective qualities which, as we have seen, were greatly valued among the indigenous population.

Finally, to better understand the ontological framework behind the creation of keros with metal inlays and pacchas with colored glass inlays, it may be helpful to consider the indigenous concept of opulence or treasure discussed by ethnohistorian Frank Salomon (2004: 115). He observes that there is no word in Quechua for treasure and that the closest word for it is *illa*. In colonial times, this word referred to the bezoar stones from camelids and other mammals; these were thought to bring luck, health, and fertility. Accordingly, the term *illa* also can be applied more widely to valuable things that belong to the community and that cannot be bought or sold. In pre-Hispanic and Colonial periods, it was believed that *illas* like huacas had agency, so it was important for people to enter into a reciprocal relationship with an *illa* by gifting to it things that it liked and valued such as coca leaves, maize, and animal fat.

In the case of a bezoar stone sent by the Inca emperor to the king of Spain, the *illa* in question had gold straps around it. Salomon (2004) reiterates that silver and gold were valued because of their associations with celestial and religious activities, and he interprets the placement of the gold straps around this object as an offering or gift to the bezoar stone and the supernatural forces associated with it. In Salomon's words (2004: 115), the gold bands encircling the bezoar stone were "homages of reciprocity honoring their essential value." The silver-colored rods and the green-colored glass shards can be understood as the equivalent of the gold bands on the bezoar stone. Like the gold bands encircling Atahualpa's bezoar stone, the metal and glass inlays encircle the keros and pacchas, and like the gold bands, the metals used for the rod inserts reflect light in a distinctive way and have symbolic associations with females and the moon. Similarly, the green glass shards reflect light and have associations with fertility. Thus, Salomon's interpretation of the Inca's gift to Charles V may help to answer the question of why Andean artisans added the exotic glass and metal fragments to vessels made from local wood and clay. The addition of these precious materials can be understood as a prestation of valued materials to the keros and the pacchas in order to reinforce the relationship between the ritual object and the worshipper and, thus, influence the success of the libations. This prestation would complement the associations of these precious inlays, as well as with the esoteric power that is linked to reflective materials brought from distant lands.

Sixty-four years ago, John Howland Rowe (1961: 340) concluded that the flowering of 16th and 17th centuries AD wooden cups demonstrated that the Andean artistic tradition not only survived the Spanish conquest, but that it grew and developed. As described here, some of the keros and pacchas produced during colonial times were stylistically and technologically innovative, and the manner in which Andean craftsmen incorporated previously unknown materials brought by the Spaniards was original and unprecedented. The Andean ritual equipment described in this essay provides convincing examples of the vitality of Inca artistic traditions during the centuries after the collapse of Tawantinsuyu.

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