THE PROVINCIAL ORGANIZATION OF INKA CERAMIC PRODUCTION

Terence N. D'Altroy and Ronald L. Bishop

The Inka empire was supported by goods and services provided by both generalized and specialized labor. To gain insight into how goods were produced and distributed in the imperial economy, 173 sherds from Cuzco, Lake Titicaca, the upper Mantaro Valley, and Tarma were analyzed (INAA) for materials composition. Results show that production and consumption of Inka ceramics were focused within regions, although two plates probably made in Cuzco were among the Titicaca and Mantaro samples. Inka ceramics from the upper Mantaro were made from at least two sources of raw materials, both distinct from those used in local Wanka ceramics. Evidence suggests that the Inka provincial capital (Hatun Xauxa) and two Wanka towns obtained most of their Inka pots from either one or the other source. These results imply that the state controlled production of its ceramics regionally, starting at the source of the raw materials, and distributed the products of separate sources selectively.

El imperio Inka fue mantenido con bienes y servicios proveidos por mano de obra generalizada y especializada. Para comprender como se distribuían y producían los bienes dentro de la economía imperial, fueron analizados (AINA) 173 tiestos de cerámica de Cusco, del Lago Titicaca, del valle del Río Mantaro Superior, y de Tarma para determinar su composición material. Los resultados meustran que la producción y el consumo de las cerámicas incaicas se realizaban dentro de cada region, aunque fueron encontrados dos platos probablemente hechos en Cusco en las mestras del Lago Titicaca y del Río Mantaro. La alfarería Inka del Mantaro Superior era producida con materiales de, al menos, dos fuentes de materias primas, distintas de las usadas para producir la cerámica Wanka local. La evidencia sugiere que el centro provincial Inka (Hatun Xauxa) y dos pueblos Wankas conseguían la mayoría de sus cerámicas de una u otra de estas fuentes. Estos resultados implican que el estado controlaba regionalmente la fabricación de su cerámica, empezando por las fuentes de materias primas, y distribuía los productos de cada fuente selectivamente.

The political and economic relations between the central powers and subject territories of early expansionist states is a key issue in the study of complex prehistoric society. This paper examines some aspects of imperial–provincial relations in the Inka empire, with a focus on the native Wanka populations of the central Peruvian highlands. The specific questions addressed concern the production and distribution of Inka ceramics, goods of both utilitarian and symbolic significance in the imperial political economy. Examination of this issue is intended to provide insight into political relations, the organization of labor, and access to resources within and among subject territories.

The Inka empire comprised one of the most extensive of the archaic states, incorporating over 12 million subjects in a territory covering almost 1 million km^2 of western South America (Figure 1). During the century of Inka rule (A.D. 1438–1532), the empire integrated over eighty subject polities, centered at the capital of Cuzco. The strategies of Inka rule were flexible, varying over time and space according to the complexities and capacities of indigenous societies, diversity in regional resources, and logistical and security considerations. In general, the government consisted of a superstructure that heavily depended on indigenous elites to enact its policies at the local level. Subject groups in some regions, such as the central and southern highlands, extensively were integrated into the state political system (de Toledo 1940; Diez de San Miguel 1964; Ortiz de Zúñiga 1967, 1972). Polities more marginal to state interests or conquered late in the empire's reign, such as in northern Ecuador, were ruled more indirectly through client native elites (Salomon 1986).

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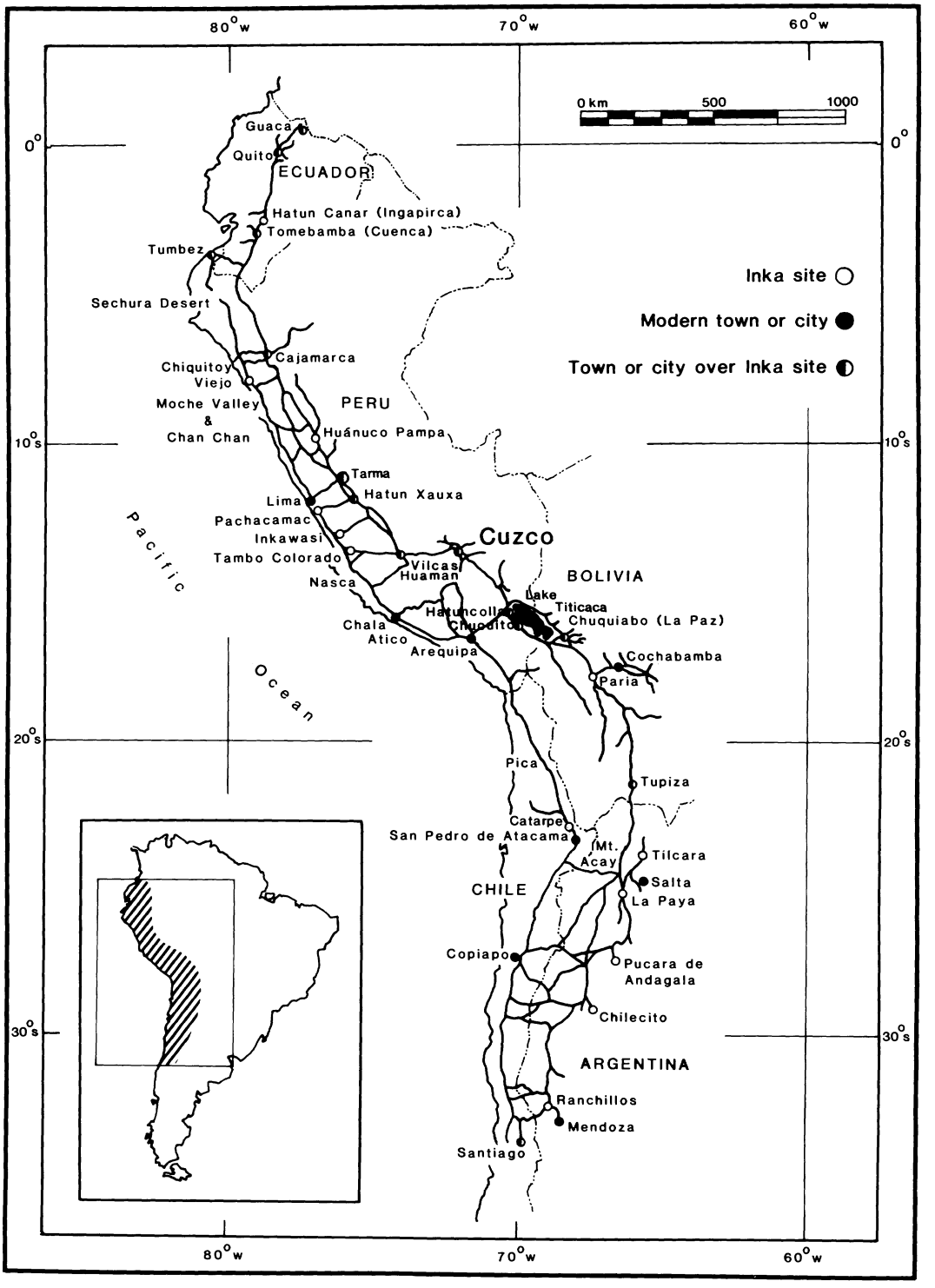

Figure 1. Map of the Inka empire, showing the main roads, after Hyslop (1984:frontispiece).

Most analyses of the Inka political economy emphasize the labor-tribute system as the principal means of exacting support from subject populations (e.g., Murra 1975, 1980; Rowe 1946). Both generalized corvée and specialized labor were required for such services as military duty, herding, agricultural labor, road maintenance, and craft manufacture. Local communities were taxed according to the number of heads of household present, as determined by periodic censuses. During the latter decades of the empire, a series of specialized labor institutions was developed, primarily staffed by forcibly resettled colonists and enclaves of specialized producers. These institutions were the principal means of producing the subsistence goods, raw materials, and craft products used to support the state political economy.

While the organization of labor was a critical part of the system of production, it is important to recognize that labor input was, to a great extent, dependent on the desired output and could be expected to vary according to state needs or goals. A complementary approach to studying the Inka political economy therefore focuses on the state's strategies in producing and distributing goods. Textiles were central to the Inka economy, for example in daily and ceremonial life and in status legitimation (Murra 1962), but are highly perishable in the highland environment. For archaeological study, ceramics are a more appropriate choice for study of the role of goods in the economy, because they are readily recoverable and their physical and chemical properties make them amenable to studies of production and distribution. Ceramics additionally qualify as both utilitarian and sumptuary goods. Ceramic vessels were used extensively in state activities, from support of laborers and permanent state personnel to underwriting state-sponsored political and religious festivities.

In the region of prime interest for this paper—the upper Mantaro Valley—political control had been decentralized prior to the Inka conquest, with local polities competing for land and labor. Under Inka rule, the native Wanka populations, who numbered close to 200,000, largely were resettled from their defensive hilltop communities into smaller towns and villages on the valley flanks and floor. Native elites were appointed as officials in the imperial decimal hierarchy. The Inkas constructed the provincial center of Hatun Xauxa, along with about 50 storage complexes and other support facilities on the main sierra highway that ran through the valley on the road from Cuzco to Quito (Figures 1 and 2) (D'Altroy 1987; see also LeBlanc 1981; LeVine 1979).

This province was key to imperial control, because of its large population, agricultural productivity, and central location. While the domestic economy of the Wanka populations did not change radically under Inka domination (Costin et al. 1989; Earle et al. 1987), significant changes were introduced into the political economy with the imposition of state demands for labor and more centralized control over production and distribution of sumptuary goods. The most notable changes resulted from the intensification of production of agricultural and craft goods. For instance, the state appears to have set up specialized agricultural communities (e.g., J74 on Figure 2), probably to produce maize. The manufacture of metal goods, some of which (especially silver) may have been removed from Wanka control, also was increased markedly. In this context of selective reorganization, study of the production and distribution of Inka ceramics may provide insights into the relations between the state and a key subject population.

RESEARCH QUESTIONS

Previous research on the Inka economy has outlined the organization of imperial ceramic production. At least two forms of production were established: levies on the labor of local artisans in their home communities and manufacture by newly created craft specialist communities. For instance, villages populated by potters from the Chupachu and Yacha ethnic groups were recorded in the early Spanish inspections of the Huánuco region of the Peruvian central highlands. Potters also made vessels for the state in their native villages and transported them to the provincial center at Huánuco Pampa (Helmer 1955–1956:41–42; Ortiz de Zúñiga 1967:25–27; see Julien 1982; LeVine 1987). Among their many duties for the state, native elites of the Guancayo area (Chillón Valley) similarly were required to produce ceramics (Martínez 1963:63). The Inkas created a more specialized enclave at Wayakuntu, near Cajamarca, where members of at least 14 ethnic groups were resettled to make pottery (Espinoza Soriano 1970). Another multiethnic community of at least 100

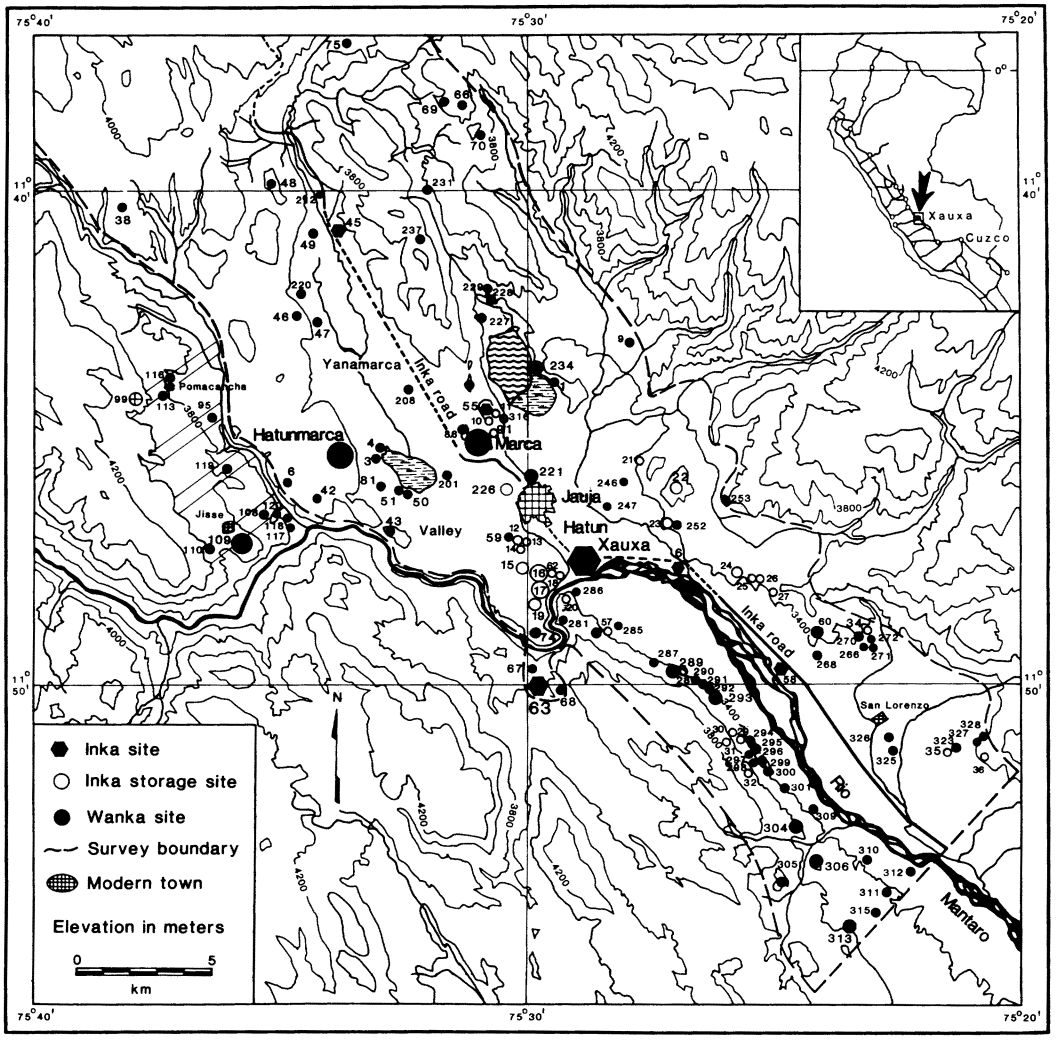

Figure 2. Map of the northern end of the upper Mantaro Valley, showing the settlements occupied under Inka rule.

potters was set up at Hupi, in territory controlled by the lords of Guancané on the north side of Lake Titicaca; here, transplanted colonists (*mitmaqkuna*) were settled with local ceramists to produce for the state (Murra 1978; Spurling 1987). In northwest Argentina, the Inkas set up a similar *mitmaq* settlement at Tucumán (Lorandi 1984).

Stylistic analyses provide two additional lines of evidence suggestive of the organization of manufacture. First, Inka pottery readily is recognizable as a standardized ware, decorated primarily with geometric designs in polychrome slips (e.g., Alcina Franch et al. 1981; Costin 1986; D'Altroy 1981; Julien 1982; Meyers 1975; Morris and Thompson 1985). Standardization in vessel shape and decoration provided an unambiguous stamp of imperial manufacture and facilitated production by local potters. Second, despite the standardization, regional variants can be distinguished; the Inka pottery from Cuzco, for example, is visibly different from that of Huánuco, Pachacamac, or Xauxa. This implies that, while the state's pottery was made to its specifications, the execution varied regionally.

These regional variants often are referred to as provincial types, though no conclusive evidence exists to show that political provinces and economic regions coincided. In using the term political province, we are referring to a territory occupied by about 20,000–30,000 households—often corresponding to one or more ethnic groups—governed by an Inka administrator. An economic region refers to a zone within which most labor was recruited, manufacturing conducted, and/or products distributed around a given focus of imperial control, such as a provincial center (e.g., Hatun Xauxa, Huánuco Pampa).

Two aspects of Inka policy lead to the expectation that political and economic units may have corresponded well. First, the Inkas may have tried to limit coordinated relations among subjects, largely to discourage threatening alliances. For instance, much of the population was resettled as internal colonists, who were required to maintain their regional speech and dress. Additionally, multiple ethnic groups were encouraged to exploit localized resources independently, in contrast to specializing and exchanging between groups (Murra 1972). Second, early native testimony indicates that some material goods—particularly sumptuaries—were distributed along the lines of the political hierarchy. The combination of these practices would have encouraged spatial coordination of political and economic regions.

Alternatively, it may have been more strategic for production centers to serve more than one province and for one province to have more than one pottery manufacturing source, because of labor availability, transport costs, and the distribution of natural resources. It is therefore of interest to determine the spatial relation between political and economic regions, a task with which analysis of production and distribution of state ceramics can be of assistance.

Taking this contextual information into account, this paper addresses three issues concerning Inka state ceramic production and distribution.

1. How were the systems of production and circulation of Inka ceramics integrated? Were areas of highly localized distribution coordinated with single production centers? Were manufacture and distribution coordinated more broadly within the province or among several provinces?
2. How closely was the production of imperial pottery controlled? Did the Inkas monopolize the resources used in the production and circulation of goods with their stylistic imprimatur or was some license allowed or taken in producing and using goods in the imperial style?
3. How were lines of access to Inka state pottery defined in the provinces? How extensively were state pots distributed, who had access, and how was access provided?

The complexities of the relations raised in these questions clearly are too extensive to be resolved through a small study. However, insights that we can gain through addressing them will help us understand how the Inkas resolved a number of potentially conflicting goals: integrating provincial populations into the imperial system, discouraging interaction among subject groups, centralizing control over labor and manufacture, and keeping production and transportation costs within reasonable bounds. In the following two sections, we discuss the research methods used to analyze the pottery and the results of the ceramic-paste compositional analyses. We then return to these questions, to see how these analyses can be used to complement historic evidence on Inka provincial rule.

RESEARCH METHODS

The Sample

To address the questions outlined above, we analyzed 173 sherds from four regions: Cuzco, the imperial capital; the Island of the Sun in Lake Titicaca; the upper Mantaro Valley of the central Peruvian highlands; and Tarma, the next province to the north (Table 1). The Mantaro region was chosen because it is the principal study area of one of this paper's authors; Tarma lies adjacent to this region and thus was accessible for limited sampling. The material from Cuzco and Lake Titicaca, intended to provide a comparative sample from the imperial core and from another province in the imperial heartland, was made available by the American Museum of Natural History from their existing collections.

Cuzco and Lake Titicaca. The ceramics were chosen to provide a judgmental cross-section of

the available collections. The sherds from the Cuzco basin were surface collected from the sites of Qota Kalli and Sacsahuaman, outside modern Cuzco. This pottery includes both Killke (pre-imperial Inka) style ceramics and imperial Inka pottery (see Rowe 1944, 1946:199–200). The imperial pottery included 11 flared-rim jars and 1 plate, while the 10 jars and 2 plates in the Killke style provided a comparison to the imperial ceramics.

The Lake Titicaca collections were recovered in Bandelier's excavations in a residential complex at the site of Kasapata at Llaq-aylli, a promontory on the northern end of the Isle of the Sun (Bandelier 1910:203–205, 211–212). This site lay less than one kilometer from the Titi-Kala, the sacred rock from which some myths said the Inkas originated, making the location one of the most sacred in the empire. The Lake Titicaca materials (16 jars, one plate) contained six jars in the Chucuito style, 10 Urcosuyu jars, and one Pacajes plate (Tschopik 1946; see Julien 1983).[1]

Because of the limitations of the field methods used to recover these ceramics, we cannot argue that these sherds provide a representative sample of pottery from the two areas. For questions of interprovincial production and distribution, however, site provenience should be adequate.

Upper Mantaro Valley and Tarma. The upper Mantaro Valley and Tarma pottery was selected from the materials surface collected and excavated by the Upper Mantaro Archaeological Research Project (UMARP), during fieldwork from 1977 through 1983. The sample includes ceramics from a range of Inka sites, including the provincial capitals Hatun Xauxa (J5) and Tarmatampu, road stations (J6, J45, J60), storage depots (J16, J17), and a small settlement adjacent to an unusual hydrologic feature (J4) (Figure 2). Ceramics also were selected from indigenous Wanka communities: Hatunmarca (J2)—a regional center continuously occupied from at least A.D. 1000 until 1572; Marca (J54)—a town newly settled under Inka rule; and Huancas de la Cruz (J59)—a new small village adjacent to Inka storage facilities above the Inka capital (Figure 2).

The Inka pottery included three basic vessel forms: large jars, plates, and enclosed vessels. Because different vessel forms often have different technical requirements, such as a need to withstand heat or a need for porosity, an effort was made to include forms that would be compositionally dissimilar.

Ceramics from indigenous styles also were included in the upper Mantaro sample. These provided a local-materials baseline against which to compare the Inka ceramics and helped determine if patterning in the distribution of Inka pottery could be correlated with that of local types. The Wanka sherds belonged to the Mantaro Base Roja, Base Clara, and Wanka Red styles. While both Base Clara and Wanka Red were produced and used throughout the northern Mantaro, the more broadly distributed Base Roja appears to have been imported from further south in the valley (Costin 1986). Ceramics that appeared stylistically to be local imitations of Inka ceramics also were included. The final set of materials from this region was a small series of ceramic wasters, including one in the Inka style. All of the wasters were recovered from Hatunmarca and Marca, the latter being a principal ceramic-producing settlement for Base Clara and Wanka Red during the Inka occupation (Costin 1986). The sources of Inka ceramic production in the region have yet to be determined, however.

Analytical Methods

Approximately 50 mg of a 400 mg homogenized sample from each ceramic sample was dried to a constant temperature, weighed, and encapsulated. Samples were packed along with standard reference material of known elemental concentration and irradiated at the High Flux Beam Reactor of Brookhaven National Laboratory. Specific details of the irradiation and counting procedure follow those given in Bishop et al. (1982). Reliable concentration determinations were obtained for Na, K, Rb, Cs, Ba, Sc, La, Ce, Eu, Lu, Hf, Th, Cr, Fe, Co, Sm, and Yb.[2]

RESEARCH RESULTS

The chemical characterization of the materials described above provided insight into several aspects of the Inka system of production and distribution of its ceramics. The most notable results in interprovincial variation show clear compositional differences among the Inka ceramics recovered from the central highlands (Mantaro Valley and Tarma), Cuzco, and Lake Titicaca, with some evidence for interprovincial transport of state pottery. The Inka and non-Inka pottery from the

Table 1. Sherds Chemically Characterized from the Upper Mantaro Valley, Tarma, Cuzco, and Lake Titicaca.

	Stylistic type									Posterior Reclassification of Imperial: Inka Ceramics[a]					
										Core Groups					
Provenience[b]	Vessel Form	Imp. Inka	Local Inka	Wanka–Inka	Killke	Base Roja	Base Clara	Wanka Red	Indet.	Mod-ern	J2	J5	J54	Cuzco	L.T.	$p < .25$
Hatunmarca	jar	10		2		2	1		3		9					1
(J2)	plate	2									2					
	bowl	2					1				2					
Hatun Xauxa	jar	14	4								1	7	2			4
(J5)	plate	7										4		1		2
	bowl	3	1									2	1			
Marca (J54)	jar	16		8		1	2		2		1	3	10			2
	plate	3	2									2				1
	bowl	2	2										2			
J4	jar	5	1	1							1		4			
J6	jar	3									2		1			
J16	jar	2										1	1			
	bowl	2									1					1
J17	jar					2										
	plate	2											1			1
J45	jar	4											4[c]			
	plate	1											1			
J47	jar	1	2	1							1					
J48	bowl	1											1			
J50	bowl	1									1					
J59	jar	2									1					1
	plate		1					1								
J60	jar	1											1			
	bowl	1														1
J61	jar			1												
Concho	jar									2						
Tarma	jar	3									1	1	1			
	plate	1														1
	bowl	1											1			
Cuzco	jar	10			10									8		2
	plate	1			2									1		
Lake Titicaca	jar	16													14	2
	plate	1												1		

central highlands were distinct compositionally, even though there were at least two sources of Inka pottery within the upper Mantaro Valley. In this section, we describe the procedures used to recognize these patterns, and follow with a discussion of the implications of the patterning.

Interprovincial Variation

The principal question of interest here is the extent to which the ceramics in the Inka style consumed in each region were obtained from distinct production facilities. The most straightforward way to address this was to determine the degree to which the state pottery recovered from each province was (a) internally homogeneous and (b) distinct from that of the other provinces. Two numerical approaches were used to address the problem: average-linkage cluster analysis and stepwise discriminant analysis.

Average-linkage cluster analysis, based upon a matrix of Euclidean intersample distances, provided an initial presentation of clustering tendencies in the data set (Sneath and Sokal 1973:114–308).[3] The suite of 15 log-transformed (Harbottle 1976) elemental concentrations for 173 analyzed ceramic samples was used as input for this procedure. The main partitions of the dendrogram revealed that clear compositional distinctions were present among the ceramics from the three principal regions (Mantaro, Cuzco, Titicaca). Significantly less patterning was visible among the materials from the central highlands, though one set of 17 Xauxa Inka sherds, one sherd identified a priori as a Local Inka (i.e., a probable imitation of the state style), and a waster (style indeterminate) formed a tight cluster. Five Base Roja sherds also were found to group among themselves within a loose cluster that contained a variety of other ceramics. Bandelier's Lake Titicaca ceramics, with one exception (a plate), formed a tight cluster clearly separated from the ceramics from the other provinces. The samples from the Cuzco region also generally were well separated from the other materials.

Discriminant analysis was used to address the question of interregional variations from the alternative perspective of reclassifying cases into groups (rather than building groups from similarities among cases).[4] In this procedure, the 115 ceramics in the imperial Inka style from the Mantaro, Cuzco, and Lake Titicaca regions were treated as reference groups; the ceramics from Tarma were treated as unknowns. Each sherd then was assigned a posterior probability of membership in each category, based on its compositional similarity to the group centroid. For this analysis, a subset of eight elements was used: La, Ce, Sm, Eu, Yb, Lu, Hf, and Th. A jackknife procedure was used to eliminate each sherd's contribution to the composition of the group from which it came, as that sherd's probabilities for group membership were determined.

In an initial discriminant analysis, 105 of the 110 (95.5 percent) regional reference-group sherds were reclassified into their original groups; the five Tarma sherds all fell within the Mantaro group. The exceptions included two outliers from the Mantaro group, a sherd recovered from Cuzco that closely resembled the Titicaca group, and three sherds from Titicaca that lay at a distance from the Titicaca group. The Mantaro outliers had been identified a priori as probable imports into the region, on the basis of their stylistic characteristics and macroscopic examination of their pastes. It was therefore not surprising to find them classed as outliers in this analysis. None of the Cuzco or Lake Titicaca outliers was identified a priori as being distinctive, but this may be attributed to a lack of detailed familiarity on our part with the stylistic nuances of the Inka pottery specific to these regions.

The five outliers were then eliminated from the analysis, with the result that the three main groups (Mantaro, Cuzco, Titicaca) became totally separable from one another, although five of the remaining sherds were reclassified from their original groups into one of the other groups. That is, 102 (97.1

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[a] These columns show the posterior reassignment of each sherd in the imperial Inka style to each of five groups of ceramics, based on Mahalanobis D^2 distance from the group centroid: the J2, J5, and J54 core groups, and all Cuzco and Lake Titicaca imperial Inka. Samples with a $p < .25$ of membership in any group are tabulated in the last column.

[b] Sites with a prefix of "J" (e.g., J2) are located in the upper Mantaro Valley, as is the modern town of Concho.

[c] One of these four sherds had a probability of membership of $p = .99$ for both the J5 and J54 core groups.

Table 2. Discriminant (Jackknifed) Classification of All Imperial Inka Style Sherds into Regional Groups, Deleting Five Outliers.

Group	Percent Correct	Mantaro	Cuzco	Titicaca
Mantaro	97.5	79	2	0
Cuzco	100.0	0	9	0
Titicaca	93.3	0	1	14
Tarma	0.0	5	0	0
Total	97.1	84	12	14

percent) of the 105 remaining reference group sherds were reclassified correctly (Table 2). The five Tarma sherds were again assigned to the Mantaro group. The results of this analysis are displayed in Figure 3, in which it can be seen that the ceramics recovered from each region group together well and do not tend to overlap with those of the other regions.

Because the discriminant procedure assigns each case to a reference group, the classification of the Tarma sherds as members of the Mantaro group does not necessarily imply that the former are compositionally indistinguishable from the latter. Similarly, the assignment of a few Titicaca and Mantaro sherds to the Cuzco group does not necessarily imply that these vessels came from Cuzco. It simply indicates that they were more similar to the Cuzco group than to either of the other two reference groups. Further analyses discussed below, however, indicate that perhaps two of these sherds may well have been made in Cuzco and transported to the provinces. We also should note that the choice of regions as reference groups masks variations among the pottery within any given region. This problem will be examined in greater detail for the Mantaro Inka ceramics.

In sum, the cluster and discriminant analyses provide complementary support for the proposition that distinct sets of pottery were produced and consumed in the three principal regions. Virtually none of the imperial Inka pottery tested from the upper Mantaro or Lake Titicaca areas was produced at Cuzco and shipped out. It seems very likely at present that the imperial pottery consumed in each area was produced locally. These results are not especially surprising, but they do underscore the regional focus of the production and distribution of goods of imperial manufacture. Whether the three areas of production and consumption distinguished here corresponded to provincial political territories, however, remains to be determined.

Intraregional Variations in Inka Ceramic Composition

In order to investigate intraregional ceramic production and distribution, Inka and Wanka pottery from the upper Mantaro Valley was examined for compositional patterning. These analyses, while limited in scope, indicate that (1) the Inka and non-Inka pottery was manufactured from mutually exclusive source materials; (2) at least two sources produced Inka pottery within the province; and (3) the different production sources preferentially provided finished products to the inhabitants of different settlements.

In this attempt to assess the extent of stylistic and ceramic paste compositional covariation at the intraregional level, a core, or trial, set of Inka ceramics was assembled for each of the two major Wanka towns—Hatunmarca and Marca—and the Inka provincial center of Hatun Xauxa. These sherds included the high quality imperial Inka from the Mantaro area and the lower quality Local Inka, which were either poor quality imperial Inka or local imitations. In an exploratory approach, each site's ceramics were treated as if they included a stylistically and compositionally homogeneous core group, distinguishable from the core sets from the other two sites. The possibility that such core groups might be created was brought to our attention by apparent correlations between the visual characteristics of the paste and variations in decoration among ceramics from these sites.

To create the core groups, the ceramics from each of the three sites were initially examined for outliers. In this procedure, characteristic vectors (eigenvectors) were extracted from the variance-

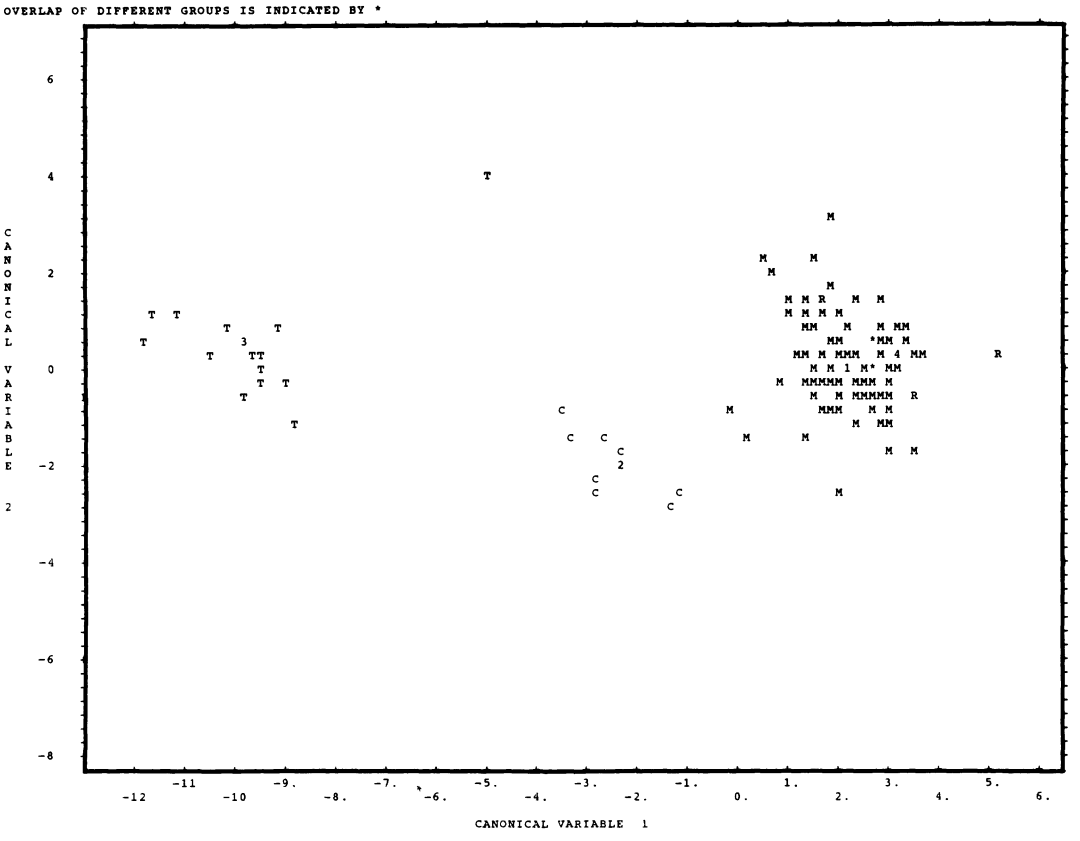

Figure 3. Discriminant plot of imperial Inka pottery with five outliers removed (105 samples). The symbols M, C, T, and R refer to the Mantaro Valley, Cuzco, Lake Titicaca, and Tarma group samples, respectively.

covariance matrix of the Inka ceramics from each site; these vectors are linear combinations of the logged data measurements that are uncorrelated with one another. Any sample outside a 95 percent confidence interval was removed, based on a Mahalanobis distance from the multivariate group centroid; the group's characteristics were then recalculated until no additional specimens could be removed. The T^2 statistic, the multivariate extension of the better-known Student's *t*, was used to compensate for small sample size (Bishop et al. 1982). For Hatunmarca, the refined or core set of state ceramics retained all 13 imperial Inka sherds out of the original 22 sherds tested. Of the 26 Inka sherds tested from Marca, 5 were removed as outliers, leaving 21 in the core set (80.8 percent). At Hatun Xauxa, 20 of the original 29 sherds were retained in the core group (70 percent).

The distributions of concentrations of each element were then compared among the three sites' core groups to determine whether the core groups could be distinguished from one another. The core groups from Marca and Hatun Xauxa were found to be quite similar to one another and distinct from the core group from Hatunmarca, across the Yanamarca Valley. Figure 4, a bivariate plot of the thorium and barium concentrations (ppm) of the core groups of Inka pottery from Hatunmarca and Hatun Xauxa, shows the separation of the materials from the two sites. To judge from data derived from ceramic compositional investigations carried out in Mexico and Central America (Bishop and Rands 1982:311–314; Rice 1978), the variation illustrated here may be indicative of the relative concentrations of volcanic glass in the two sets of sherds. At this time, it is unclear if the compositional patterns result from temper-influenced variation or from variation within the clay component of the ceramic matrix. Regardless of the source of the variation, it appears that

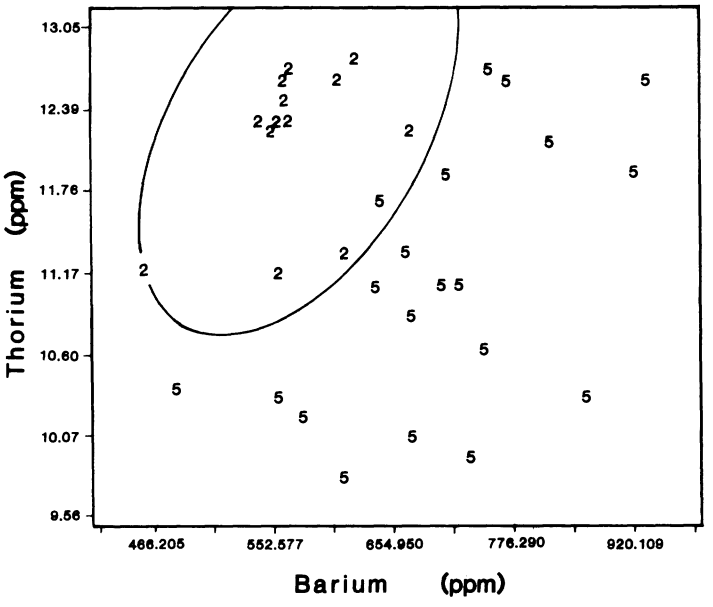

Figure 4. Thorium/Barium plot of core-group Inka ceramics from (5) Hatun Xauxa, the Inka provincial capital, and (2) Hatunmarca, a principal Wanka town; a 95 percent confidence interval is drawn around the Hatunmarca samples.

much of the Inka pottery supplied to Hatunmarca was produced from different source materials than those used to make the pottery consumed at Marca and Hatunxauxa, both of which lay less than 10 km away.

The 3 core sets of sherds were then used as reference groups for reclassification of each of the 173 sherds (Table 1). The probability of membership of each sherd was considered in turn, again using Mahalanobis D^2 as the measurement of distance from the core group centroid.[5] For example, the 13 core sherds from Hatunmarca were established as a group and the compositional distance from the group centroid was determined for each of the 173 sherds analyzed. Not surprisingly, the ceramics from Cuzco and Lake Titicaca showed virtually no probability of membership in the Hatunmarca core ($p \leq .01$ for 38 of 39 sherds; $p = .17$ for 1). Similarly, most of the sherds analyzed from the Inka provincial center, Hatun Xauxa, generally showed low probabilities of membership in the Hatunmarca group ($p < .25$ for 21 of 28 sherds). Only 1 sherd from Hatun Xauxa was assigned to the Hatunmarca group and only 4 of the 28 sherds from Hatun Xauxa have a probability of membership in the Hatunmarca group of $p > .50$. In all 4 of the last cases, the probability of membership in the Hatunmarca group is exceeded by its probability of membership in either the Marca or Hatun Xauxa group.

A comparable pattern can be seen in the sherds analyzed from Marca. Of the 25 imperial or Local Inka sherds tested, only 4 had probabilities of membership in the Hatunmarca group exceeding .25; only one of these, a flared-rim jar, had a very high probability ($p = .80$) of being from the Hatunmarca group.

When the core ceramics from Hatun Xauxa, the Inka provincial capital, were used as the group against which to evaluate the probability of membership, a complementary pattern resulted. The ceramics from Cuzco and Lake Titicaca were distant compositionally, as expected. The Inka ceramics from Hatunmarca showed low to moderate probabilities of membership. In contrast, the Inka ceramics from Marca that are not outliers with respect to all 3 core groups generally show a strong similarity to the Hatun Xauxa pottery. For instance, 18 of 25 Marca sherds had probabilities of membership in the Hatun Xauxa group of $p \geq .25$. When the core ceramics from Marca were used

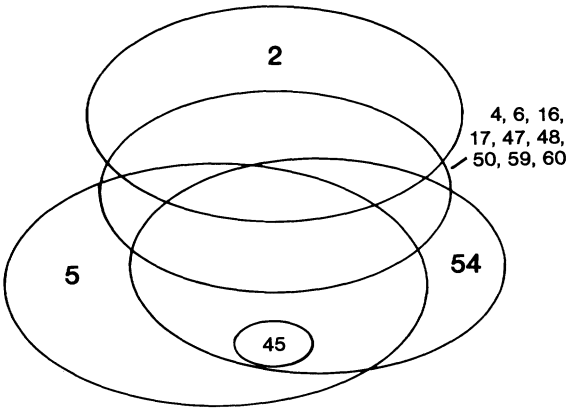

Figure 5. Venn diagram of compositional overlap of Inka pottery from sites in the upper Mantaro region.

as the standard group for comparison, the Inka sherds from Hatunmarca again showed a low degree of similarity, while many of the sherds from Hatun Xauxa had high probabilities of group membership, regardless of vessel form.

The compositional patterning visible in the Inka sherds from the remaining sites in the region is complex, but some patterns can be elicited. The clearest association between sites can be seen by examining the probabilities of group membership of the pottery from site J45, an imperial road station at the northern end of the Yanamarca Valley (Figure 2). These five sherds showed virtually no similarity to the Hatunmarca ceramics, but exhibited high probabilities ($.62 \leq p \leq .99$) of membership in the Marca and Hatun Xauxa core groups. This pattern is especially striking because J45 lies slightly closer to Hatunmarca than to either of the other two sites. Conversely, some of the Inka sherds from site J47, a couple of kilometers southwest of J45, show greatest similarity to the Hatunmarca group. This indicates that neighboring settlements were receiving Inka pottery from different production sources. None of the sets of sherds from the remaining sites shows this degree of similarity to any of the three core groups, as sherds from more than one source often were recovered from the smaller settlements.

The results of the compositional variability of Inka pottery from the Upper Mantaro region are summarized schematically in Figure 5. This figure illustrates the compositional homogeneity of Inka pottery within each of the two sets of sites and the partial overlap of the two sets. Two possible explanations may be advanced to account for this patterning. One tentative conclusion is that the distribution system separated settlements on the eastern side of the Yanamarca and Mantaro drainages from those on the west. The Inka pottery from J45, Marca, and Hatun Xauxa (east) generally is compositionally homogeneous and distinct from the Inka pottery from Hatunmarca (west). These two consumption groups do not separate state and subject communities, as had been anticipated as a possibility. Instead, the Wanka villagers on the eastern side of the valley had access to state pottery made from the same source materials as were used to produce the state pottery used at the provincial capital and some support facilities.

An alternative explanation is that status differences existed between the residents of Hatunmarca and Marca, and perhaps some of the smaller settlements. If the Inkas considered the ceramics produced from the different materials sources to be of different statuses, then the dominant presence of ceramics from one source or the other could imply differences in status between the members of the communities. Given Marca's proximity to Hatun Xauxa and the similarity of their ceramics, this might have been the case in this instance.

The question remains as to whether the Inka ceramics were produced from sets of materials distinct from those of the native styles or whether the Inkas simply required production from native sources, by native artisans. These analyses show decisively that the ceramic compositions of the

sampled indigenous Wanka and imperial Inka styles were distinct, regardless of the form of the vessels, their proveniences, or the social status of the archaeological context. Inka ceramics apparently were made from raw materials to which the northern Wanka population did not have access or chose not to use. In all cases, the probability of membership of Base Clara, Base Roja, or Wanka Red polychrome vessels in the Inka core groups is virtually nil (in one case, $p = .23$; in 10 other cases, $p \leq .07$). This indicates clearly that the Wanka and Inka ceramics were made from different materials. These results correspond well with petrographic and paste analyses conducted by Costin (1986), which indicated that the Inka, micaceous (e.g., Micaceous Self-Slip), Base Roja, and Base Clara/Wanka Red ceramics were made from distinct materials.

The Local Inka and Wanka–Inka ceramics present a different problem. These styles have been defined, respectively, as sherds (1) that may be imitations of or poor quality imperial pottery or (2) that combine style, morphology, or slips from Wanka and imperial Inka types. Five of the 13 examples of the Local Inka pottery exhibited virtually no probability of membership in the characterized imperial Inka compositional groups ($.00 \leq p \leq .01$). Alternatively, seven other sherds classed a priori as Local Inka compositionally were quite similar to groups of sherds identified as imperial Inka ($.69 \leq p \leq .99$). One Local Inka sherd from Marca showed a $p = .36$ for the Hatun Xauxa group.

Comparable variations of similarity and distinction were visible in the Wanka-Inka ceramics. As might be expected from types defined by such criteria, there are judgments to make in classification that will likely result in some errors; the compositional analysis may thus help refine stylistic classifications. Whether the mixed patterning can be attributed partially to use of imperial sources by local potters imitating imperial pottery or to stylistic misclassification must await further analyses.

A final point concerns those sherds in the imperial style that exhibited a low probability ($p < .25$) of membership in all groups (14 of 85 samples; 16.5 percent). Among these are samples from 7 sites, including Hatunmarca, Hatun Xauxa, and Marca, and all 3 basic vessel forms. A lack of similarity between these sherds and those groups that currently are defined suggests (1) that more production sources were used for Inka pottery in this region or (2) that more pottery was being imported than we have been able to recognize thus far.

Upper Mantaro and Tarma Ceramics

The five sherds examined from Tarma, the provincial center north of Hatun Xauxa, show an interesting relation to those of the upper Mantaro region. The Tarma sherds often are distinguishable by differences in paint color (e.g., lighter red slip, more like a wash) and by the presence of much higher proportions of andesite temper (Costin 1986:491–505). However, one of the Tarma sherds has a moderate probability ($p = .52$) of membership in the Hatunmarca group, while two others are very similar to the Hatun Xauxa ($p = .96$ for one sherd) and Marca ($p = .96$ for the other) groups. These relations suggest the possibility that a limited set of production sources was used to service state ceramic needs in more than one political/ethnic province. The partial provisioning of Tarma from the upper Mantaro may have been part of an interprovincial strategy, since Inka ceramics were distributed far less widely among subject communities in the Tarma region than in its southern neighbor (Hastings 1985:554). The critical link here may have been between Hatun Xauxa and Tarma and not between the imperial elites and the subjects of Tarma.

DISCUSSION

The patterning shown in the composition and distribution of ceramics analyzed provides insight into the questions posed earlier. A central issue concerns the degree to which production of state pottery was centralized or dispersed throughout the empire. At the inception of this study, we expected that most Inka pottery was manufactured and used provincially, because of the stylistic differences among provinces and because of economic efficiency. Storage and utilitarian ceramics, in particular, should have been restricted in their spatial distribution because of a relatively low ratio of value to weight. Ceramics treated as sumptuary goods may have been transported over greater distances because (1) they have a higher ratio of value to weight and (2) they provided a

standardized means of legitimation and of underwriting relations between the state core and subordinate populations. We expected that small, fancy ceramics, such as plates, should have comprised most of the goods transported long distances. We also expected that those goods moved great distances should have been recovered from more restricted contexts than those consumed in bulk within a smaller region. For example, most imported ceramics should be found in imperial facilities, such as Hatun Xauxa, or in the most elite areas of Wanka settlements.

The analytic results presented here support these expectations. The compositional distinctions among the imperial ceramics recovered from Cuzco, Lake Titicaca, and the upper Mantaro Valley are in agreement with a model of regionally focused production and distribution. Although consumption regions may have corresponded in part to imperial provinces, the existence of more than one ceramic manufacturing source within the upper Mantaro Valley indicates that multiple sources were used within some provinces, even if strong control was exerted over the style of the finished product.

Conversely, the compositional data provide evidence for transport of some Inka ceramics between adjacent provinces and between Cuzco and subject regions. The recovery of pottery from both known Mantaro Valley source groups in neighboring Tarma suggests that some production centers supplied fairly broad regions of consumption. This pattern further indicates that ceramic consumption regions were not neatly consonant with political divisions identified through historic sources (e.g., de Vega 1965). With respect to longer-distance transport, it is surely no coincidence that two of the vessels imported into the Mantaro Valley and Lake Titicaca were apparently manufactured in Cuzco. That these vessels were plates fit our expectations as well, because their high ratio of value to weight would have made their shipment cost-efficient. Neither is it a surprise that the Cuzco vessel recovered from the Mantaro Valley was found at the provincial capital, Hatun Xauxa. Sixteenth-century native witnesses testified to the Spaniards that massive amounts of raw materials and sumptuary goods—such as feathers, metals, and cloth—were shipped to the capital for manufacture and subsequent imperial redistribution (see Julien 1982:137; Ortiz de Zúñiga 1967: 47). Ceramics made in Cuzco, perhaps distributed by the Inkas as part of imperial political largess or as part of support to provincial centers, undoubtedly would have been valued highly.

The second major question of interest, control over imperial ceramic manufacture, is related closely to specialization of craft production. Prior analyses of the state economy have shown that, over time, the Inkas favored policies that promoted labor specialization in agriculture, craft production, and services (La Lone and La Lone 1987; Murra 1980). This formed part of a broad strategy of high control and high investment in key provinces (see Hassig 1985). Two of the immediate benefits of such a strategy are increased efficiency and control of production.

Within the limitations of the ceramic sampling and analytical error, the compositional data obtained for the upper Mantaro ceramics are consonant with a model of specialized craft production for state consumption. The evidence clearly shows that the Inkas restricted access to the raw materials used to make imperial pottery, thus controlling its circulation at the source. The clear distinction between imperial Inka and Wanka points to tight state control over the quality of materials used and restriction of access to the raw materials of manufacture. These features, combined with the spatially focused production and distribution systems, would be expected under a system of specialized production controlled by regional authorities.

This practice is consonant with documentary sources, which report that the state declared its ownership of all resources within its territory. Access to these resources was then allocated back to subject communities, providing legitimacy for state demands for labor and productive output (see Murra 1975, 1980). In practice, of course, most resources remained in the hands of the subject societies, but many lands and raw materials, such as metal ores, were taken over directly by the state. To obtain craft goods, the state supplied raw materials to its subjects for conversion into finished products. This point was especially important in state–subject relations, since it was a central tenet of imperial ideology that the taxpaying population owed only labor, not goods.

It is therefore probable that the Inkas reserved sources of materials for pottery manufacture, specifying where the pots were to be transported (see, for example, Ortiz de Zúñiga 1967:47). For the Mantaro Valley, we cannot yet say whether the sources used for Inka ceramic production

previously were used by the Wankas or other subject groups, even though the data show a clear distinction under Inka rule. A broader spatial and temporal examination of the region's materials sources and finished ceramics will be necessary to address this problem.

Turning to the third major question—definition of the lines of access to pottery of state manufacture—we can say a bit more. At the heart of this problem lies the issue of horizontal and vertical integration of subject provinces. As suggested at the beginning of the paper, several state policies suggest that it was a prime imperial strategy to restrict interaction among ethnic groups subject to the state, while emphasizing vertical integration with the overarching imperial organization (Schaedel 1978). Conversely, the Inkas undertook extensive programs to indoctrinate native peoples in Inka culture—training scion of native elites at Cuzco, granting honorary citizenship to subject groups, incorporating subject religions into the state religion, and disbursing imperial paraphernalia of legitimation (Rowe 1982).

Early written sources recount that elites at various levels of the provincial bureaucracy were entitled to a variety of material perquisites, including cloth and other craft objects (e.g., de Toledo 1940; Diez de San Miguel 1964; Ortiz de Zúñiga 1967). These goods served as means of status legitimation and perhaps as political currency in elite–elite relations. Additionally, the local lords conducted ceremonial hospitality as part of their obligations to the populations that supported them. In some areas, such as the Huánuco region (Morris and Thompson 1985), the state at least partially underwrote these political festivities by supplying the jars in which the *chicha* was brewed. In the upper Mantaro Valley, Inka flared-rim jars supplanted local jars and deep basins in the Wanka domestic assemblages, particularly in elite households (Costin 1986:305; Earle et al. 1987:89). The distribution of these vessels suggests that the Inkas assumed the role of sponsoring ceremonial hospitality within Wanka communities.

State pottery therefore likely reached the hands of ethnic elites through at least two mechanisms: gifts or payments for status and services and support for state activities conducted at local communities. The question remains, however, as to whether systematic, recognizable distinctions existed in the kinds of ceramics to which subject populations and imperial staff had access.

In the upper Mantaro region, present data show that Inka ceramics were not just an imperial perquisite. Over 125 sites in the area have yielded Inka pottery, including state facilities and scores of native settlements (Browman 1970; D'Altroy 1981; Parsons and Hastings 1977). Residents of Hatunmarca and Marca consumed thousands of state-manufactured pots; at these sites, densities of Inka pottery recovered from the surface and from excavations attain upwards of 20 percent of the Inka period ceramics. The extensive provisioning of imperial pottery to the Wanka underscores the importance of the Mantaro region to the empire and the integration of its elites into the imperial bureaucracy. In marked contrast is the pattern among the native communities in Tarma, where it is rare for a site to yield more than a few sherds of Inka manufacture (Hastings 1985:554).

Because of the heavy emphasis on vertical ties in Inka policies, we had anticipated that access to Inka pottery might have been defined along status lines and that distribution would have been centrally regulated. Contrary to our expectations, the clearest distinctions in distribution of Inka pots did not lie between imperial and subject settlements. Instead, the provincial capital and a major town shared a source of imperial ceramics, while another subject town obtained most of its Inka pottery from elsewhere.

We need to be careful not to exaggerate the lines of distinction so as to suggest no interaction or exchange occurred between the inhabitants of the east and west valley sites. There was some overlap of consumption among the major sites and most smaller communities received ceramics from both core sources. What is so marked is the separation of the core sets of state pottery from Hatunmarca, on the one hand, and Marca and Hatun Xauxa, on the other. This suggests that specific sets of settlements may have been serviced by specific production sources and that not all sources provided large quantities of ceramics to the provincial capital.

SUMMARY

The intent of this paper has been to examine aspects of the Inka political economy through analysis of the materials used in imperial ceramics. Bearing in mind the exploratory nature of the research

and the limitations of the sample, we may sum up our current understanding of the situation. Most production and consumption of state ceramics was focused regionally, with relatively little movement of goods between provinces. This pattern fits both expectations derived from documentary sources and a model of transport efficiency and separation of interaction between subject provinces. Some ceramics apparently were transported from one province (in the upper Mantaro Valley) to an adjacent one (Tarma), but the extent of this movement is not clear from current data. This calls into question the concordance of political province and economic regions and directs attention to a potentially fruitful area of future research.

As had been expected from reports of largess emanating from the imperial capital, the ceramics that were transported long distances were likely made at the capital and shipped out; they were small (plates) and lightweight. It appears likely that interprovincial imperial distribution of Inka ceramics followed a dendritic pattern, with few horizontal links at low levels between regions. This seems to be in partial contrast with the distribution system found within the upper Mantaro region, in which spatial or status divisions fit the data. As sources for the unprovenienced Mantaro ceramics are identified, we may be required to revise this conclusion, but present information indicates that the Inkas set up a series of production centers to provision relatively localized areas through a hierarchical network. The province itself was not the level around which the system was organized, but appears to have been only one element in a complicated system of imperial rule.

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NOTES

[1] Catherine Julien (personal communication 1987) has pointed out that the stylistic rationales for making this division are not necessarily well-founded. We have therefore treated the Titicaca pottery as comprising a single collection for the present analyses.

[2] Elemental concentrations are available from R. Bishop.

[3] While the type of dendrogram that was formed provides a quick expression of the grouping tendencies in a data matrix, it is prone to several types of distortion and thus was used only as a starting point for further analyses. These distortions arise from distance-averaging processes, the formation of unbreakable linkages, and the imposition of a structure onto the data matrix by the selection of the measure of sample-to-sample similarity.

An example of the latter consideration is found in the use of Euclidean distances with average linkage. This forces the formation of spherical clusters of samples when, in fact, the shape of the natural clusters in a compositional data set tend to be more elliptical because of interelemental correlation (Bishop and Neff 1987; Sayre 1977). The lower branches of the dendrogram tend to reflect close compositional similarity more accurately; however, the relations among higher-linked clusters should be determined by supplemental approaches.

[4] For the stepwise discriminant analysis, the BMDP routine BMDP7M was used, with a jackknife procedure (Dixon et al. 1983).

[5] The precise probabilities of membership in each group for each of the 173 sherds may be obtained from the authors.

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CACAO RESIDUES IN ANCIENT MAYA VESSELS FROM RIO AZUL, GUATEMALA

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Results of chemical analyses on residues collected from ceramic vessels found in an Early Classic period Maya tomb revealed that certain of the residues contained theobromine and caffeine, a clear indication that the corresponding vessels once contained cacao in some form. One of the vessels yielding cacao residues is decorated with hieroglyphs, two of which we believe have the phonetic values for the word "cacao" in the Mayan language. These findings are significant for three reasons: (1) a new method for recognizing ancient cacao use is demonstrated, (2) a novel way of verifying glyph interpretations is presented, and (3) data are generated that indicate what contents certain Maya vessels actually held, thus permitting useful functional interpretations.

Se comentan los resultados de análisis químicos efectuados sobre residuos recogidos de vasijas ceramicas encontradas en una tumba maya del período Clasico Temprano. Estudios revelaron que ciertos de los residuos contenían theobromina y cafeina, lo cual es una indicación clara que dichas vasijas alguna vez contuvieron cacao en alguna forma. Una de las vasijas que contiene residuos de cacao esta decorada con glifos, dos de los cuales pensamos tienen los valores fonéticos para la palabra "cacao" en la idioma maya. Estos descubrimientos son significantes por tres razones: (1) un nuevo metodo de reconocer la utilización antigua de cacao es demonstrado, (2) una manera de verificar las interpretaciónes de glifos es presentada, y (3) estan presentados datos que indican el contenido actual de ciertas vasijas Mayas, asi permitiendo interpretaciónes funcionales útiles.

Usage by the Maya Indians of beans from the cacao (chocolate) tree, *Theobroma cacao*, as a form of currency and as the principal ingredient of a beverage at the time of the Spanish Conquest is well attested in the historic literature (Tozzer 1941). That cacao also was utilized by prehistoric Maya peoples in Mesoamerica is evidenced by the discovery of whole cacao beans (Kidder 1947:71) and cacao wood fragments (Hammond and Miksicek 1981:260–269; Miksicek 1983:94–104; Turner and Miksicek 1984:179–193), as well as by depictions of cacao beans or pods modeled in clay as adornments on ceramic vessels (Morley et al. 1983:210). These vestiges and representations of cacao

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