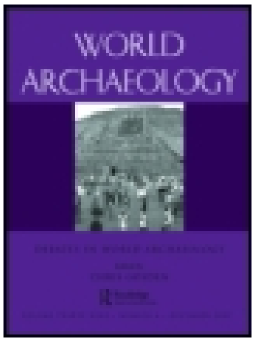

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Longquan celadon: a quantitative archaeological analysis of a pan-Indian Ocean industry of the 12th to 15th centuries

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ABSTRACT

This paper examines the Longquan celadon industry, located in Zhejiang province in China, which flourished mainly between the Southern Song and early Ming dynasties. The products of this industry are found on archaeological sites across China and the Indian Ocean. This paper attempts a quantified analysis of the development of the industry based on archaeological data, focussing on four aspects: production, domestic consumption, overseas consumption and, to a lesser degree, workshop organisation. Although much of the data is still problematic, and many of the conclusions drawn are necessarily, therefore, tentative, these are the only data available. They allow us at least to demonstrate the value and timeliness of the approach by charting the development of this industry and by arguing that the close integration of the four aspects examined indicates that the Longquan celadon industry was an industry of considerable economic significance across much of the Indian Ocean.

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Chinese trade ceramics; Indian Ocean trade; medieval economy; economic history

Introduction

From the 8th/9th centuries onwards the maritime trade routes of the Indian Ocean superseded the overland routes (the 'Silk Road') to become the main forum for economic and cultural interaction between China, Southeast Asia, South Asia, the Islamic world, East Africa, and, to a more limited degree, the Mediterranean and Europe (e.g. Von Glahn 2016, 216–7, 270–73). The advantages of cost and scale that maritime trade had over land trade allowed increased interaction and led to the Indian Ocean becoming the key catalyst in an increasingly integrated Eurasian-African economy. The effects of this on the economic, cultural, and social development of the regions surrounding the ocean were profound and far-reaching (e.g. Von Glahn 2016, chapter 6; Abu-Lughod 1989; Park 2012; Chaudhuri 1985, 1990; Clark 1991; Reid 1993; Christie 1998).

The degree to which the economies and societies of these regions engaged, the effect the engagement had, and the precise mechanisms through which it occurred, are in most cases still poorly understood. Before about 1600 AD relatively little historical evidence is

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recorded of the activities of merchants, especially medium- and small-scale merchants, the function of coastal emporia and seasonal fairs, or of the activities of manufacturers and consumers of traded products. Certainly, too little information is available to allow a coherent reconstruction of the interaction. This is partly because most mercantile activities occurred far outside the narrow street light of written history, and partly because, where historical records are available – specifically for China, which is the focus of this paper – they come from a historical tradition that is culturally, politically, and institutionally highly centralised, and does not necessarily reflect the full range of relevant activities (e.g. Wilkinson 2017, 15–20). It is certainly true that China's relationship with the sea and with maritime commerce – in all periods – has been substantially revised in recent years and is increasingly understood to have been a significant aspect of the Chinese economy (Po 2018; Lo 2012; Zheng 2012).

The lack of detailed historical documentation is to some degree compensated for by the extraordinary ceramic archaeological record, in particular of Chinese 'trade' or 'export' ceramics. These ceramics were one of the primary trade commodities from the later Tang to the Qing periods, and were widely traded for their own intrinsic value rather than simply as containers or 'piggy-back' commodities (e.g. Chaudhuri 1985, 39, 185–186; Chaudhuri 1990, 333–336). The broken sherds of these ceramic vessels are found, sometimes in huge quantities, around most of the Indian Ocean coasts. They occur on large and small sites, urban and rural sites, coastal and inland sites, and high- and low-status sites (e.g. Zhang 2016; Heng 2005; Krahl 1986; Rougeulle 1996). They survive well in the archaeological record. In many cases, they can be precisely dated and provenanced (Zhang 2016; Kennet 2004, 59–70; Priestman 2021, 164–196). As a 'dataset', these sherd assemblages contain a wealth of largely untapped information on the extent and the ebbs and flows of trading networks through time. Archaeologists are only now beginning to exploit this dataset effectively in order to reconstruct patterns of trade. In an area of study that has traditionally been dominated by an art-historical, object-focussed approach developed for museum objects, new methods of archaeological classification, including quantified assemblage-focussed approaches are needed if the value of this Chinese ceramic dataset is to be fully exploited (Miksic 2022, 179; Zhang 2016; Priestman 2021; Rougeulle 1996; Horton 1996; Kennet 2004).

The aim of this paper is therefore to examine some of this material using such a methodology with two aims: 1) to attempt to map the development of trade volume through time, and 2) to investigate the relationship between Chinese domestic production/consumption and Indian Ocean trade in order to understand what the effects of this interaction were. The chronological focus will be from the later Northern Song to the earlier Ming period (12th to 15th century).

The framework of China's developing relationship with maritime trade from the later Tang period onwards has been established from historical sources and seems to tally broadly with the archaeological evidence that presently exists. The received wisdom envisages a significant development in maritime trade, marked by the export of ceramics, during the later Tang era (9th/10th century AD), which increased again during the Song 'commercial revolution', in particular after the Southern Song move to the south in the early 12th century, and then rapidly again during the Yuan period (1279–1368 AD), which is viewed as a period of markedly increased maritime trade, before undergoing a period of decline during the early Ming period (1368–1560 AD) (e.g. Harrisson 1958, 270–273, 278–284; Brown 2009, 67; Miksic 2022, 184–204; Yoshinobu 1983; Beaujard 2019, 155, 159; Lin 2006; Rossabi 2014, 274–283; Von Glahn 2016). However, this framework has never been tested in detail against measurable archaeological data. It remains possible that very significant geographical and diachronic fluctuations occurred that are not visible through historical sources alone.

Despite the large numbers of export-ceramic kilns that have been excavated across China, little research has been undertaken using methodologies capable of investigating the organisation and development of this production and its significance to the Chinese economy. The most important exception to this was based in South Fujian Province and focussed on 11th to 14th century ceramics manufactured for export (Ho 2000). This work mapped out the development of production over 200 years, suggesting a dynamic, highly-organised industry with high levels of skill and investment, which catered largely to overseas markets but which had a profound effect on the regional economy (Ho 2000, 255–274). Billy K.L. So expanded this analysis further to the south, and reinforced the idea of a strong integration into the regional economy of overseas ceramics trade, in which he suggests a high proportion of the population was engaged (So 2000, 186–201). Despite the indications of the important effect that export production had on parts of the Chinese economy, this has not been followed up by research that examines this topic in detail.

The present paper will attempt to take this topic further, focussing on the Longquan greenware or 'celadon' industry – located about 400 km to the north and 150 km inland – from the Song to the Ming periods. When 'Longquan celadons' are referred to here, the implication is that these were manufactured at the Longquan kilns (which are described below), and some effort has been made to check this, although it is inevitable that some misidentifications and imitation wares from other locations may have been included.

The predominance of Longquan celadons amongst Chinese export ceramics in the Indian Ocean during this period has already been noted by a number of scholars (e.g. Carswell [1976] 1977; Carter et al. 2020; Brown 2009; Morgan 1991; Qin 2017; Zhao 2012) but a synthetic, quantified analysis has never been attempted. The present analysis will take a first step towards rectifying this. It will be carried out at a less precise chronological scale, but at a broader geographic scale than Ho Chuimei's South Fujian work mentioned above and will attempt to build on the studies listed above to make concrete comparisons between production, export consumption, and domestic consumption.

Some of the data on which this analysis is based is quite basic, the chronology is still imprecise in places, and the analysis is still in its early stages, but enough can be said to describe the existence of a massive production industry closely linked to domestic consumption across China, but also to the Indian Ocean as far as East Africa and the Middle East, on a scale that is unparalleled anywhere in the world at this time.

Development of Longquan celadon production

The Longquan kilns represent one of the key sources of the ceramic products which supplied the maritime trade routes during the Song, Yuan and early Ming periods. These kilns, located in the mountainous Longquan region of Zhejiang province, produced a type of green-glazed stoneware that is referred to here as 'Longquan celadon'. About 400 such kilns are known (Qin and Liu 2012, 445), dispersed along 120 km of the Longquan River (龙泉溪), a tributary of the Ou River which discharges into the sea at Wenzhou (Figure 1). These kilns can be subdivided into two main groups, one located to the south-west and the other to the east (Figure 1). Within the Southwestern Group, archaeological investigations have been published from a relatively small number of kilns – most notably Dayao Fendongyan (ZPICRA, SAMBU, and LCM 2015) and a group of 30 between the villages of Jincun and Shangyang (Zhang 1989). More complete data is available for the Eastern Group. In preparation for the construction of the Jinshuitan Reservoir between 1981–1988, a survey and some small-scale excavation were carried out at 218 kilns. The data were published in 2005 (ZJSWWKGYJS 2005, 47–57) and provide information relating to the location and period during which production

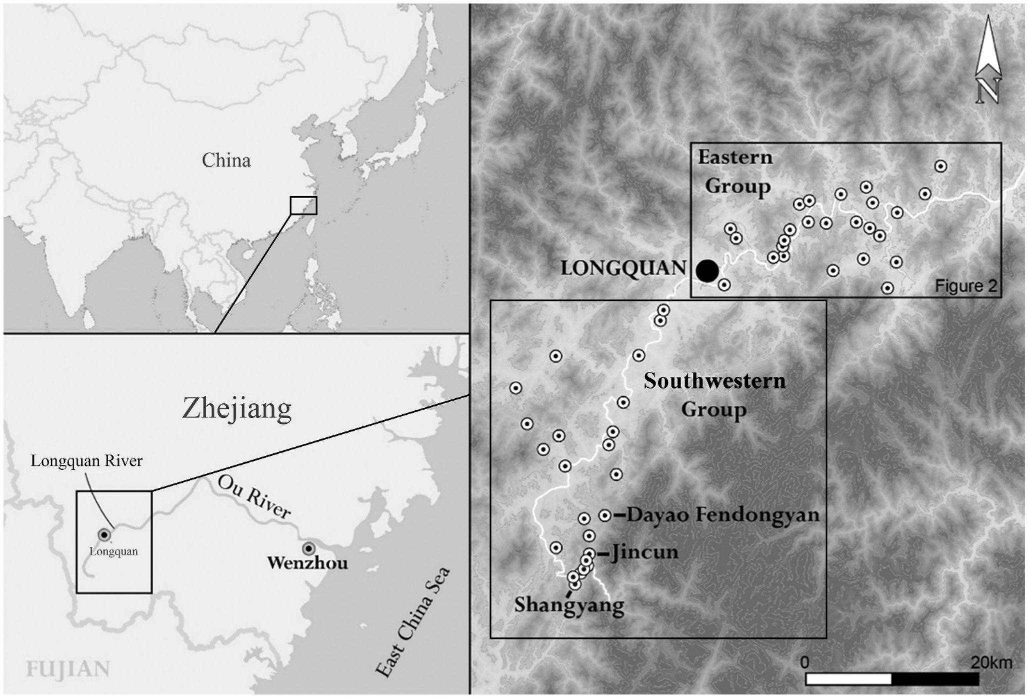

Figure 1. The geographical setting of the Longquan celadon industry in Zhejiang Province, China.

occurred. The dating is based on a fairly crude, three-phase periodisation by dynasty (Song, Yuan and Ming) and is derived entirely from ceramics found in association with each kiln (no distinction was made by the survey between Northern and Southern Song). More precise celadon chronologies do exist, but they were not employed in this case (Ho 1994b, x-xvii; Kamei 1994; Ren 1994). Unfortunately, not enough detail is given in the 2005 publication to allow a more detailed evaluation and it is therefore impossible to assess fully the reliability of the chronology. It was followed up at the excavated sites, from which finds were compared to objects from dated tombs and was shown to be reliable in these cases (ZJSWWKGYJS 2005, 393–407). Despite these problems, this data is a very significant advance over what was available before (Ho 1994a, 199) and presents us with the first real opportunity to chart the development of this industry.

For the Song Dynasty (AD 960–1279), only 34 kilns were identified, which, with only a few outliers, were dispersed along the Longquan River in three main clusters around the villages of Anfu, Shantouyao and Xiaobai'an (Figure 2 top; Figure 3). By the Yuan Dynasty (AD 1279–1368), this picture had altered dramatically with a marked intensification of both kiln numbers and their spread across the landscape (Figure 2 middle). Without exception, during the Yuan period, production continued within the Song-period clusters although in some cases individual kilns fell out of use to be replaced by new kilns nearby. Some areas experienced very significant growth – as occurred in the vicinity of Anfu village where a 221% rise in the number of kilns occurred. On the other hand, Xiaobai'an does not appear to have experienced an increase in the number of kilns at all, while just to the south and across the river a new cluster of 18 kilns was established around Shangyan'er. Overall, the number of active kilns saw a 423% increase from the Song to the Yuan period, by which time almost all areas of the flattest agricultural land in the valley bottoms had a kiln reasonably close by. Under the Ming

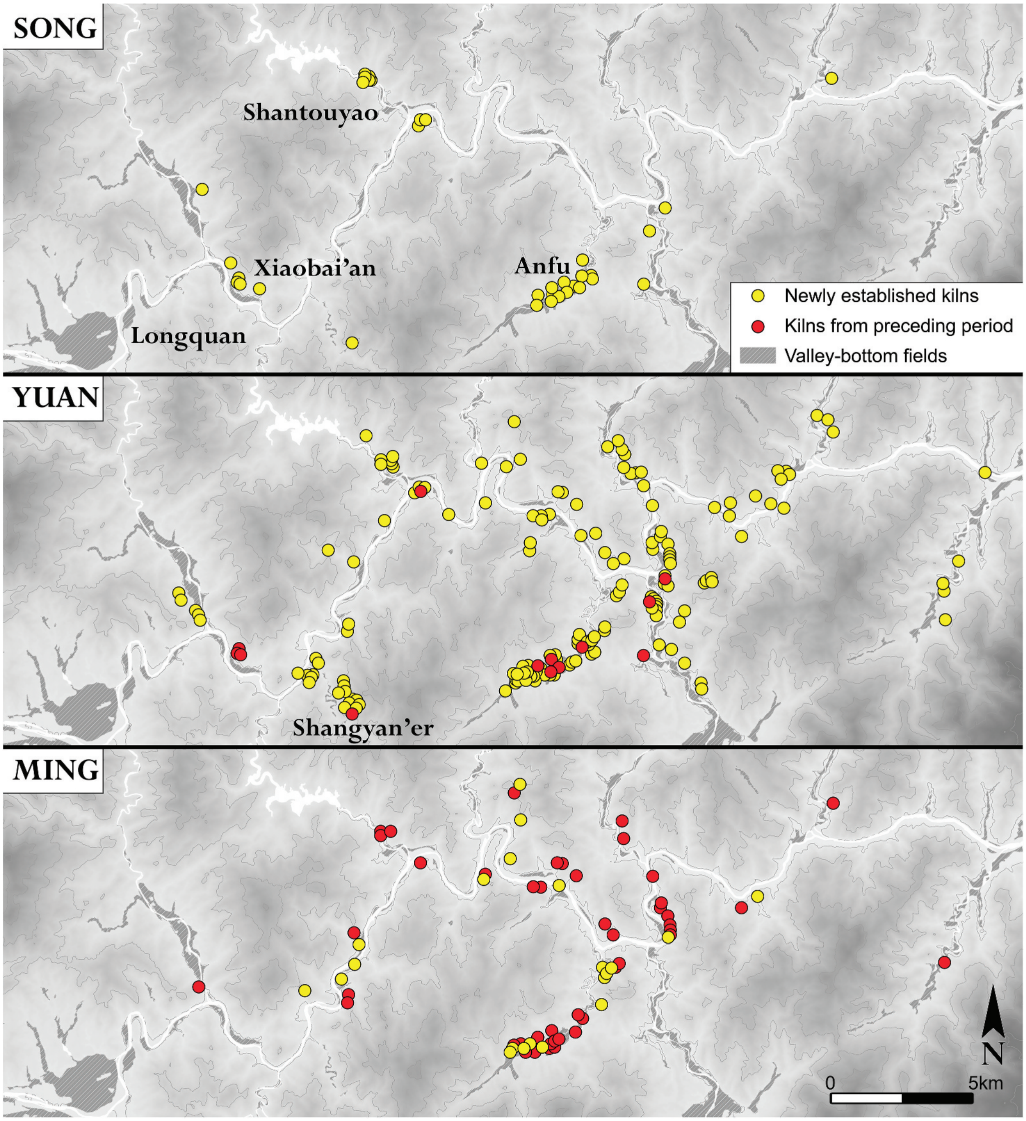

Figure 2. Kiln distribution by period within the Eastern Group of Longquan kilns (based on: ZJSWWKGYJS 2005, 47–57).

dynasty (AD 1368–1644) this pattern changed markedly once again (Figure 2 bottom). Throughout the area a 60% decrease in the number of kilns occurred, with many of the more isolated kilns that had been established during the Yuan period being abandoned. The area around Anfu and the closest villages on the Longquan River became the densest concentration of kilns with half of the Ming-period foundations being located in this area. While overall production almost certainly contracted during the Ming period, it is possible that the decline in kiln numbers may partly reflect increasingly centralised production in fewer areas.

The 30 kilns in the Southwestern Group between Jincun and Shangyang (Figure 1) (OSM-Part 1) challenge the interpretation suggested by the Eastern Group. Among these kilns, the Song dynasty

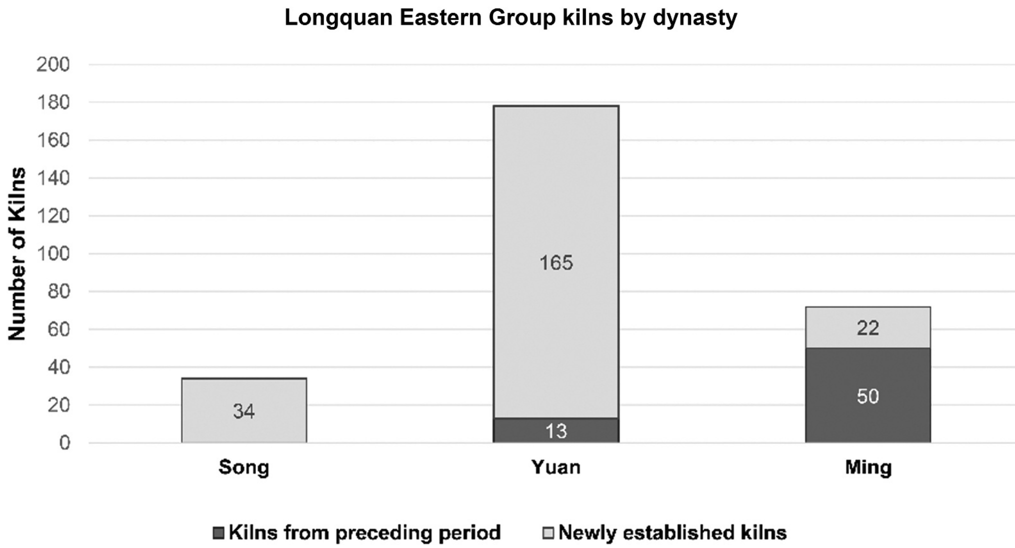

Figure 3. Kiln numbers by period within the Eastern Group of Longquan kilns (based on: ZJSWWKGYJS 2005, 47–57).

was the period during which most kilns were in operation – with all 30 being active at this time. Under the Yuan, all of those around Shangyang fell out of use while only eight of the Jincun kilns remained in operation. Ming rule saw a further drop in the number of active kilns around Jincun to three. In this relatively small cluster, therefore, production appears to have declined over time, with no expansion under the Yuan comparable to that seen amongst the Eastern Group.

This interpretation of the broader pattern of development is not without problems: data for the kilns in the Southwestern Group comes only from one small cluster while, for the more numerous kilns from the Eastern Group, the reliability of the dating evidence given by the Zhejiang Provincial Institute of Cultural Relics and Archaeology (ZJSWWKGYJS 2005, 47–57) cannot be fully evaluated. More fundamentally, the changing kiln numbers illustrated in Figures 2 and 3 cannot necessarily be taken as reliable proxies for the overall output of this area. Fewer, more intensively used and/or larger-scale kilns could, theoretically, achieve higher productivity than a larger number of smaller, less intensively operated kilns. The decline between the Song and Ming periods in the Jincun-Shangyang cluster in the Southwestern Group raises the possibility that production developed along different lines between the Southwestern and Eastern Groups. But the low number and limited geographic spread of the Southwestern Group make it difficult to gauge whether this was a minor local anomaly or part of a wider trend. The pattern of growth and decline given by the more comprehensive data from the Eastern Group closely parallels other strands of evidence for the long-term trajectory of the Longquan industry explored elsewhere in this paper, and this might be taken as some degree of confirmation of reliability. As more precise information becomes available, it may be possible to enhance or revise the picture of production set out here.

Workshop and labour organisation

An important question is whether the organisation of production and labour in the Longquan industry was affected by the massive increase in output indicated by the analysis of kiln numbers. In theory, smaller kilns may have been operated by a single household or hamlet but it seems likely that most of the Longquan kilns were too large to have been operated in this way. For larger kilns more generally, two 'modes of operation' have been proposed (though there may have been more); one based on a single owner employing a large number of workers; and a second which envisages kilns being joint ventures by a number of smaller workshops (So 2000, 193). Each of these modes is likely to have involved a labour force with greater or lesser degrees of task specialisation. Workshops have been identified at Longquan. Their identification is based on the fact that they are situated in close proximity to kilns and/or kiln debris and they contain evidence for ceramic production such as facilities for clay washing and pugging, clay storage, wheel turning, drying, and glazing. The size and arrangement of the Longquan workshops, and the facilities that they contain, can be expected to reflect their organisation (on this topic see: Peacock 1982, 12–52; Arnold 1991; Van der Leeuw 1977).

Seven structures identified as kiln workshop sites have been excavated in Longquan, dating from the Song to the Ming dynasty. Of these five (Dabaian, Yuankou, Shantou, Anfu and Shangyaner) are located in the Eastern Group amongst whom the layouts of the Dabaian and Yuankou workshops are the most clearly published and present a good insight into the organisation of ceramic production. Figure 4(a) shows that the Yuankou workshops were located around a multi-phase dragon kiln (K1- K8) that was in use from the late Southern Song to the late Yuan dynasty. The workshop facilities used for specific activities tend to be grouped together in defined areas (Workshops 1 to 7), suggesting a degree of task-specialisation amongst the labour force. In the Southwestern Group, five workshops have been excavated. Excavations of the Shantou, Anfu and Shangyaner workshops have shown similarly structured layouts, although the workshop structures themselves are not well-preserved (Jiang 1981; Li, Li, and Yu 1986; ZJSWWKGYJS 2005, 79). The Dayao 'kiln 37' and Dayao Fengdongyan kiln sites in the Southwestern Group also have workshops that were distributed around the kilns and were divided into different functional areas or buildings. In these cases the quality of the structures themselves appears to be higher than in the Eastern Group (ZPICRA, SAMBU, and LCM 2015, 27–38; ZJSQGYT 1989, 38). Interestingly, by the early Ming dynasty, the quality of the ceramics and the type of kiln furniture found in these three kilns suggest that they incorporated the most advanced level of ceramic making in Longquan, producing ceramics for the royal family and nobles (ZPICRA, SAMBU, and LCM 2015, iii). Indeed, some scholars have suggested that imperial-quality production may have begun in the Southwestern Group from as early as the late Northern Song period (Wang 2009).

Each of the seven excavated Longquan workshop sites looks to be reasonably large and carefully structured with defined areas for specific tasks, suggesting an organised labour force who were mainly focussed on specialised tasks.

By comparison, imitation Longquan celadons, which were of lower quality and less widely traded, were manufactured in Fujian, Guangdong, Jiangxi and Hunan in South China, over 400 kilometres to the south of Longquan (Zeng 1962, 1964; Yu et al. 1995; FJBWY and JJBWG 2011). In these areas the layout of excavated workshops is different from Longquan. For example, the workshop at Linjiang kiln at Ji'an in Jiangxi (Figure 4(b)) is on a much smaller scale and the different functional facilities are grouped together in a single enclosure (Yu et al. 1995). This is in marked contrast to the system in Longquan, suggesting that this workshop involved less carefully structured production and a labour force who carried out a wider range of tasks.

These differences may reflect a development in the organisation of production with the growth of the Longquan industry. Further work is needed, but it seems possible that the layout of the Longquan workshops became more organised and structured and that the expansion of Longquan production may have brought with it changes to the way in which production and labour was organised. This question is the focus of an on-going study by Xiaohang Song.

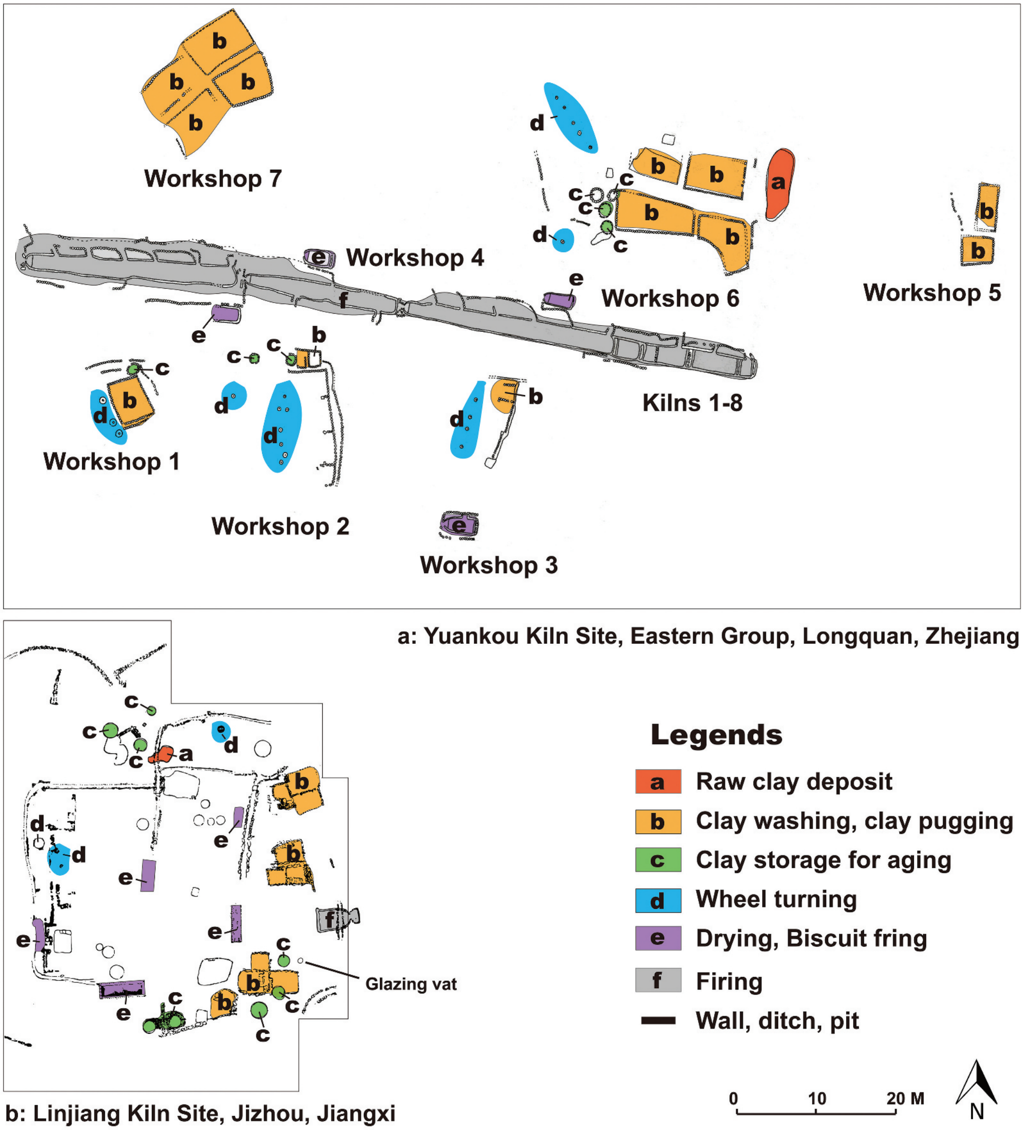

Figure 4. Plans of the Yuankou kiln and workshop from the Longquan Eastern Group and the Linjiang kiln and workshop from Ji'an (to scale).

Domestic Chinese consumption of Longquan celadons

As Miksic has noted, very little coherent evidence related to the consumption of ceramics in domestic Chinese contexts through the Tang to Ming periods and later has been published (Miksic 2022, 206). What is published is not quantified, which makes it extremely problematic to make a comparative assessment of the level of domestic consumption of Longquan celadons. To solve this problem an alternative methodology was developed, which uses the comparative extent of distribution and the comparative number of sites on which such wares occur as a rough proxy for comparative levels of consumption. Although this provides very useful insights, more precise methods need to be developed once data becomes available through publication.

A total of 201 published assemblages (in some cases individual objects) of Longquan celadons dated between the 11th and 16th centuries were collected from across China to support the analysis (Table 1 and OSM-Part 2). This dataset is not comprehensive, but it is large enough to provide a robust insight into outline trends. The 201 assemblages come from 28 Chinese provinces (Figure 5) and can be divided into A) tomb assemblages ($n = 74$); and B) domestic assemblages ($n = 127$), which include hoards as well as assemblages from occupation contexts. Of the 74 tomb assemblages, 47 are associated with absolute dating evidence such as tombstones or inscriptions on the ceramics, giving dates ranging from 1091 to 1594 AD. Other assemblages are dated by the excavators based, in most cases, on associated material or parallels with dated material from elsewhere. For the purposes of the present analysis, the published dates have been accepted without evaluation.

The results of the analysis are shown in Figure 5. The pattern of development is very clear and is indicative of rapidly expanding domestic consumption accompanied by a distribution system that was capable of moving ceramics over large distances overland or by river.

In the late Northern Song period (up to 1127 AD), distribution appears to have been limited in quantity and extent (Figure 5-1). However, it should be noted that it is very difficult to distinguish Longquan products from those of the Yue kilns at this time. Based on the identification given in the publications, half of the Longquan discoveries are from Zhejiang province itself and were focused close to the kilns. A few discoveries come from the provinces of Jiangsu, Sichuan and from the Northern Song capital Kaifeng in Henan province.

In the Southern Song period (1127 to 1279 AD), the number and distribution of Longquan finds increased in the south (Figure 5-2). In Zhejiang province itself the distribution can be divided into two groups: one near the Longquan kilns, which must be related to local consumption; and the other scattered around present-day Hangzhou and Ningbo, the capital and the major port of the Southern Song. This seems to suggest that the products of the Longquan kilns during this period were not yet widely consumed but were considered a valuable commodity and when traded far from the kilns were mainly for elite consumption. In 1127 AD the territory north of the Huai River (north of the borderline in Figure 5-2), was lost to the Jurchen Jin and trade across the border after this time is thought to have been limited due to military tensions (Qi 1987, 1014–1030; Qin 2000, 33). This is reflected in the fact that the tombs in the north dating from the 12th to 13th centuries mainly contain northern Chinese stonewares, for example from the Ding and Cizhou kilns, whilst there was a general absence of southern Chinese ceramics (Qin 2000, 33). Figure 5-2 indicates that only two assemblages north of the border in Shangdong and Henan provinces yielded a small number of Longquan celadons.

Table 1. A summary of Longquan celadon objects and assemblages from across China by period, based on 201 published objects and assemblages, 74 from tombs and 127 from domestic contexts (see OSM-Part 2).

Dynasties	Assemblages	Provinces
Northern Song	8	4
Southern Song	46	14
Yuan	111	28
Ming	36	13

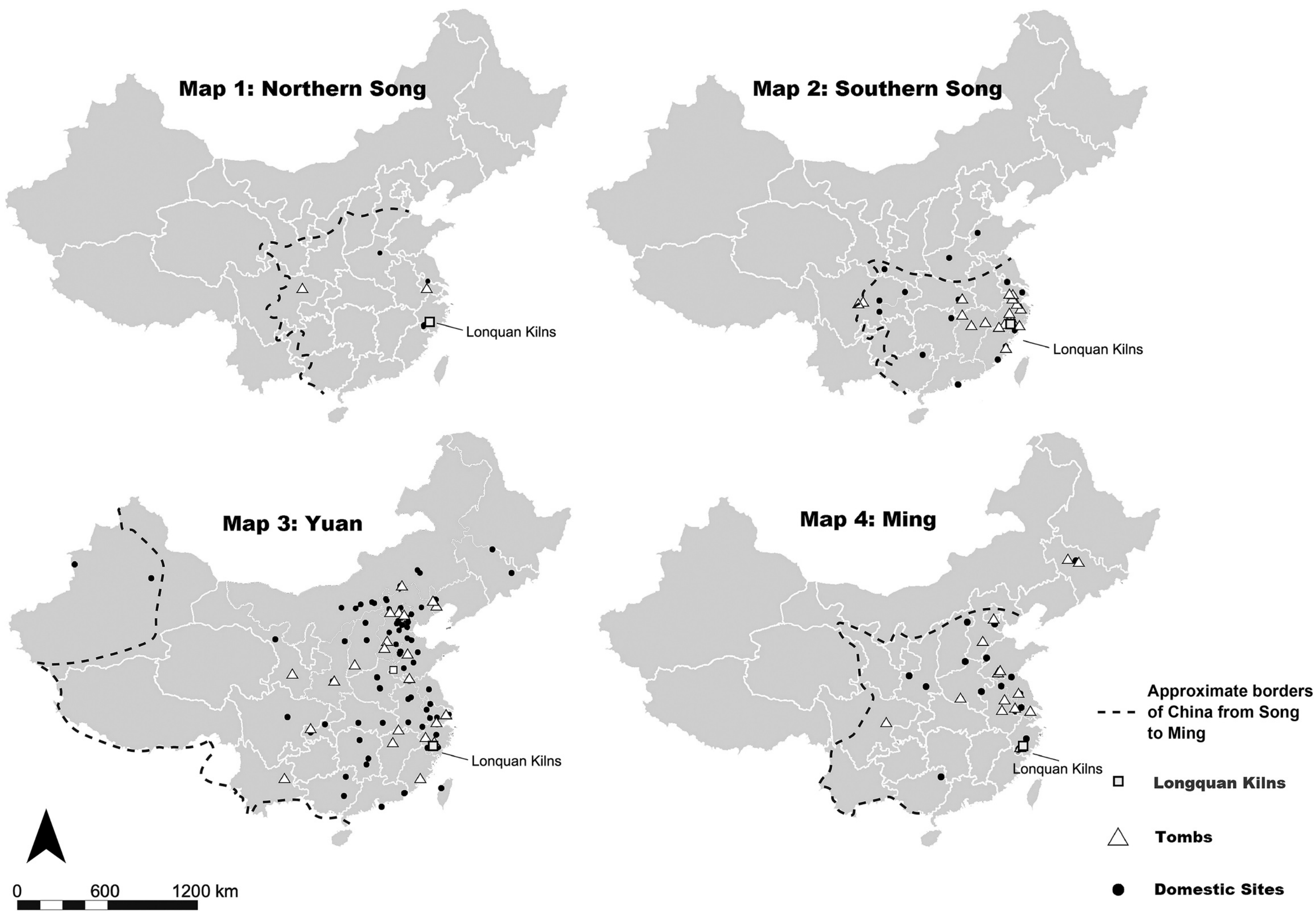

Figure 5. Distribution of Longquan celadon finds across China by period (based on OSM-Part 2).

In 1279 AD the Yuan dynasty reunified China. Against this backdrop, it can be seen in Figure 5-3 that the consumption of Longquan celadons grew markedly across the whole of China to reach its maximum in both the number (111 assemblages) and distribution (28 provinces) of finds. The distribution of both domestic and tomb contexts, whilst being focussed mainly on the east, covered most areas of China, including – in small numbers – the west, for example, Xinjiang, and the north, for example, Jilin. Many finds were concentrated around the capital Dadu (modern Beijing) as well as in Hebei and Inner Mongolia. These modern provinces were the core of Yuan China and may indicate that the consumption of Longquan celadons was focussed on Yuan elites.

During the Ming period, Longquan celadon finds are fewer (36 assemblages), but were still quite widely distributed across China (Figure 5-4), although the distribution declined from 28 provinces under the Yuan to 13 provinces. Most of these finds can be dated to the early and middle Ming period and it is interesting that they are concentrated in Jiangsu province, where the Ming capital was located from 1368 to 1420.

These data demonstrate that Chinese domestic consumption of Longquan celadons may have started during the Northern Song, from quite limited beginnings, after which it began to increase through the Southern Song period, to reach a remarkable peak in both the quantity of finds and their geographical extent during the Yuan period, before tailing off during the Ming period. This outline of developments is obviously only a very poor reflection of the actual numbers of finds and their geographical range, but, with the available published information as limited as it presently is, this is the clearest objective insight that is possible.

Export of Longquan celadons: evidence from the western Indian Ocean and Iran

The western Indian Ocean

One aspect of the development of the export trade in Longquan celadons to the western Indian Ocean from the 12th to the 15th century AD can be investigated through the analysis of 8,989 sherds published or reported from 131 archaeological sites in South Asia, Iran, Eastern Arabia, Yemen, Egypt, East Africa and South Africa, which have been inspected, or information on which has been collected, by the present authors (Table 2, and see OSM-Part 3 where references are provided). Most of the sites yielded only a few sherds, but there are some with large assemblages such as Kish and Minab in Iran, Julfar in the UAE, Fustat in Egypt, and Shanga and Gedi in Kenya. Many of the sherds from the western Indian Ocean region are published, but many are not. In such cases, either unpublished reports are available or the sherds have been inspected.

Where it has been possible to inspect the sherds the dating is based on their intrinsic qualities, following the classification established by Zhang (Zhang 2022, 2016, 2018). Where this has not been possible, it has been necessary to rely on the dating given by the excavators, which obviously introduces the possibility of varying interpretations and definitions in the analysis. In addition, quantification depends in most cases on figures provided in the published or unpublished reports,

Table 2. Occurrence of Longquan celadons in the western Indian Ocean as number of sherds and number of sites where they have been found (see OSM-Part 3).

	Northern Song	Southern Song	Yuan	Ming	Total
LQC	30	747	4643	3569	8989
%	0.30%	8.30%	51.70%	39.70%	100%
Sites	14	56	94	92	131
%	10.60%	42.40%	72.00%	69.70%	100%

which it has not always been possible to verify. These limitations need to be born in mind. Nonetheless, it is believed that the data is reliable enough to form the basis of a working outline of trade development at the dynasty-level of chronological precision used. The proviso remains that adjustments might be necessary if and when better data becomes available.

The earliest possible circulation of Longquan celadons in the western Indian Ocean dates to the Northern Song period, as evidenced on 14 sites from southern India, Sri Lanka, the entrance to the Gulf, the Red Sea, and East Africa (Figure 8-1). Quantities are very low, on average each site yielded only around 2 sherds (30 sherds total). There is some doubt about all of these sherds, none of which has been seen by the present authors. Many of the reports state the presence of Longquan celadons in contexts dated to this time, but do not provide a detailed description of the sherds (e.g. Karashima 2004; Hou & Mikami's reports, see in Qin 1995, 87: note 1; Horton 1996, 273). The problem is that there are some sherds which have a thin (0.2 mm), yellowish-green glaze, which is different from the thicker, greener, jade-like glazes produced in Longquan from the late Southern Song (Figure 6(a,b)). In such cases, it is often very difficult to be certain whether the vessels were produced by the Longquan kilns or at kilns in the south Chinese provinces of Fujian and Guangdong (Lin 1990, 391; Zeng 2001, 163; Huo and Lin 2004, 11; ZJSWWKGYJS 2005). The already low numbers for this period are, therefore, likely to be somewhat exaggerated and it is possible that there was very little or no circulation of Longquan celadon in the western Indian Ocean at this time.

Longquan celadons with high-quality, thicker, green, jade-like glaze began to be produced around the middle of the Southern Song period (cf. Zhu 1998; ZJSWWKGYJS 2005; ZJSWWKGYJS, BEDXKGWBXY, and LQQCBWG 2009). Such wares were immediately popular in both the domestic and export markets (Ho 1994b, xiv-Table 2; Heng 2005, 82) and are commonly found on coastal sites in the western Indian Ocean, in particular in south India and Sri Lanka, the Red Sea and East Africa. A total of 747 sherds from 56 sites are recorded from this period, marking a very significant increase. It is also notable that some inland sites quite distant from the coast in Iran, India and Africa have yielded examples. Figures 7 and 8 and Table 2 show how the number of sherds and sites then increased more than six times to 4,643 sherds which come from nearly double the number of sites (94) in the Yuan period, at which time the distribution reached its greatest numerical and geographical extent. Indeed, sherds of Longquan celadon have been reported from as far as Spain (Guttierrez et al. 2021).

There are 92 known archaeological sites from the western Indian Ocean with Longquan celadon sherds dating to the Ming period. The site count is only slightly lower than for the Yuan period, but the number of sherds is almost 25% lower, which seems to indicate that the trade in Longquan celadon continued, but that it had passed its peak and started to decline (Figures 7 and 8-4). The decline is partly explained by the fact that Jingdezhen blue-and-white porcelains gradually became the preferred Chinese import in many parts of the region (see below) although it seems that a wider decline in the Chinese export trade also occurred during the Ming period due to government restrictions – the so-called 'Ming gap' (Harrisson 1958; Brown 2009, 67; Miksic 2022, 184–204).

It has been possible to establish a working outline of the development of the trade in Longquan celadon to the western Indian Ocean based on quantified evidence. This is very much a provisional model and may need to be revised if the data that supports it is updated or as new evidence emerges. However, the overall pattern seems to be clear and fairly robust and can be compared to the growth and decline of the Longquan kilns discussed above.

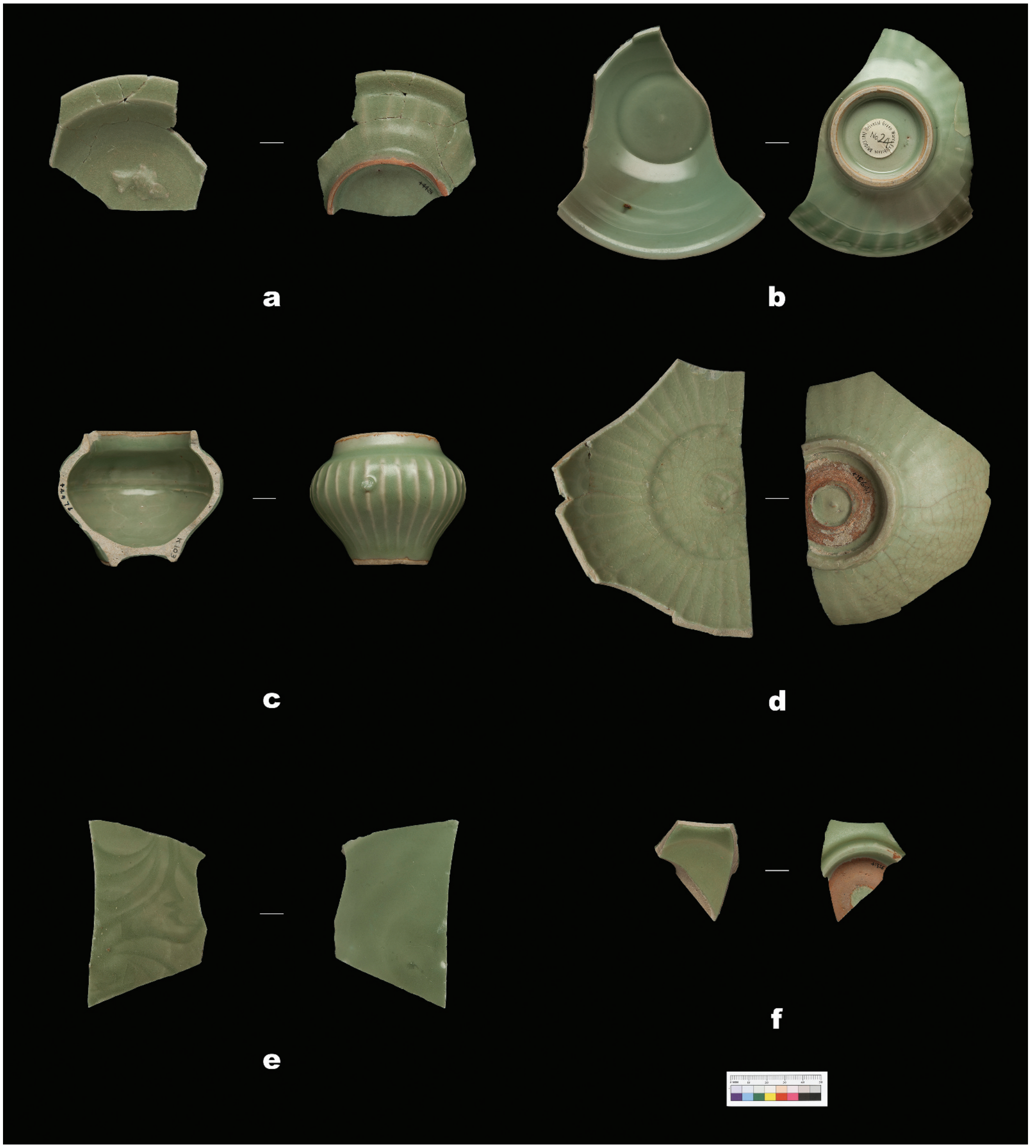

Figure 6. Longquan celadon sherds from southern Iran, the Williamson Collection (a, c-f) and Kush in Ras al-Khaimah, UAE (b).

Southern Iran and the Williamson collection

The Williamson Collection from southern Iran, presently housed in the Department of Archaeology at Durham University, provides an opportunity to build on the above conclusions by setting out a more nuanced analysis, which takes into consideration the relative proportion of Longquan celadons compared to other Chinese imported wares.

The Williamson Collection consists of around 17,000 sherds of local coarse wares, Islamic glazed wares and Chinese imported wares, from surface collections from 479 mainly small, rural

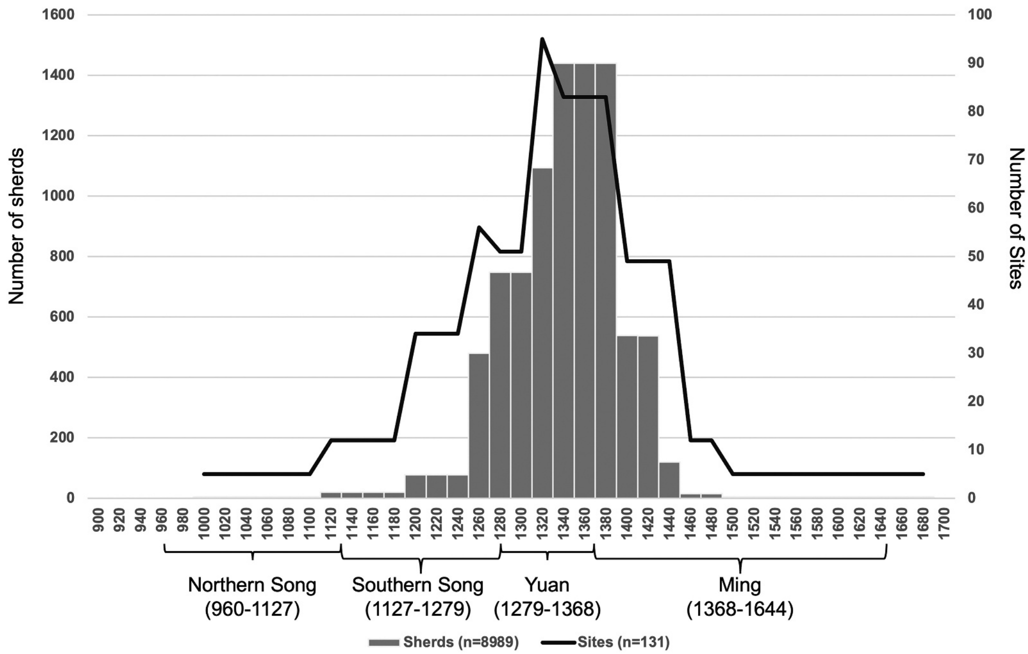

Figure 7. Weighted averages of Longquan celadon finds (columns) and sites with Longquan celadon finds (line) from the western Indian Ocean, 900 to 1700 AD (based on OMS-Part 3).

archaeological sites across southern Iran (Figure 9). The material was collected by Andrew Williamson in the course of a regional survey in the late 1960s and early 1970s (Priestman and Kennet 2002; Priestman 2005).

Of the 17,000 sherds 2,598 are Chinese imports dated from 900 to 1660 AD. Among them 2,458 are dated between the Northern Song and the Ming periods, of which 1,028 are Longquan celadons. These sherds have been inspected and classified by the present authors and the data is presented in OSM-Part 4. Identification as Longquan products was based on visual inspection and comparison with sherds and wasters from the Longquan kilns themselves. Figure 9 shows the number of Chinese imports and the proportion of Longquan celadons by period, whilst Figure 10 shows the distribution of the 87 sites with Chinese ceramics and Longquan celadons across the survey area by period.

No Longquan celadons dating to the Northern Song period were identified amongst the Williamson material, although 160 sherds of other Chinese imports of this period are found distributed between Minab and Bushehr along the coast and inland as far as Sirjan, in each case in very low numbers (Figure 10-1).

During the Southern Song period, in particular from the early 13th century, low quantities of Longquan celadons began to circulate, making up around 15% of Chinese imports (Table 3-a) (Figure 6(a)). These sherds are found mainly at sites along the Iranian coast between Minab and Bushehr, in particular around Minab and Kish, although they also occur on two inland sites. At this time the distribution of Longquan celadon is no more widespread than other Chinese ceramics from the same period.

The proportion of Longquan celadons stayed at roughly the same level until the late 13th century, around the beginning of the Yuan period, at which point it rose very rapidly and continued to increase, apparently in stages, until the second half of the 14th century, by which time made up

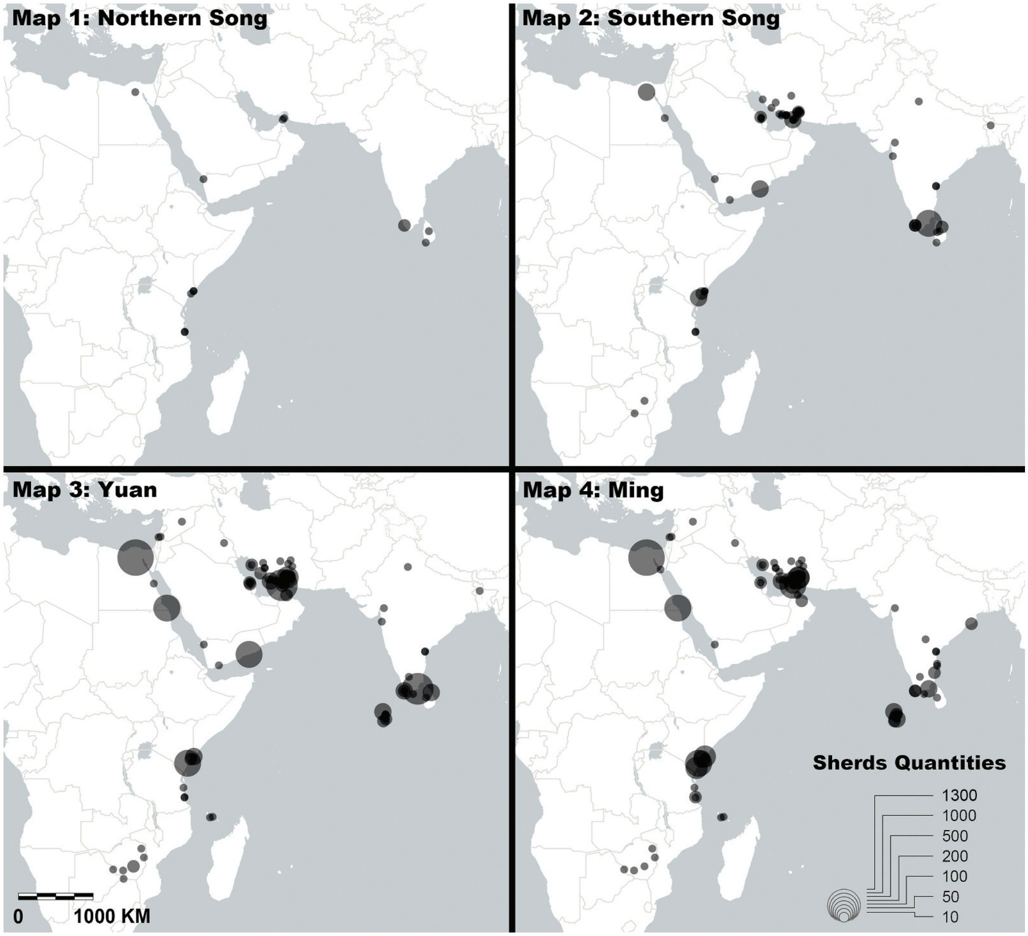

Figure 8. Distribution of Longquan celadon in the western Indian Ocean, Northern Song to Ming Dynasties (based on Table 2).

almost 79% of Chinese imports (Table 3-a, Figure 9). Figure 9 shows that there was an increase in the number of Chinese imports more generally from the late 13th century onwards. Longquan celadons, although not the only component of this, were clearly the most significant component. Figure 10–3 shows that although the distribution of Longquan celadons (Figure 6(c,d)) remained concentrated around Minab and Kish, there were notably more sherds inland at this time, possibly indicating that local land-based distribution networks carried these ceramics to a wider range of consumers, many of whom were located in small rural villages.

From around the beginning of the 15th century, the proportion of Longquan celadon began to decline and dropped steadily to about 34% of Chinese imports (Table 3-a), thereafter disappearing from southern Iran completely by about the 1460s. Although a very small number of sherds of imperial-quality Longquan celadon dated between 1400 and 1430 AD have been discovered at Hormuz (Lin and Zhang 2015) (Figure 6(e,f)), this period also saw what is thought to be a decline in the general quality of imported Longquan celadon found in the survey area. This is manifested by rougher surface finishing; thinner, less translucent glazes; and less precise decoration, and may

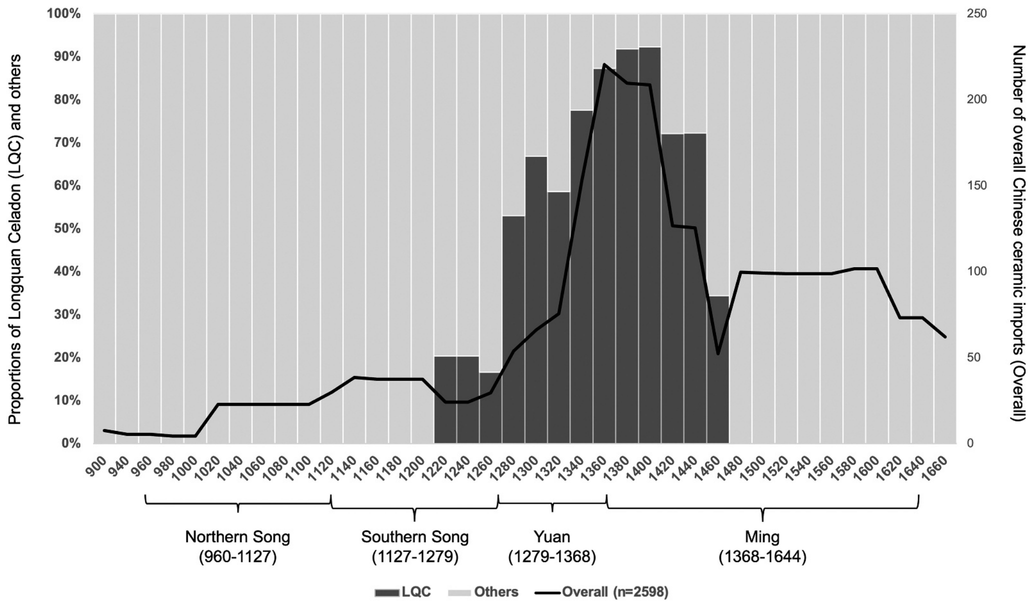

Figure 9. Weighted averages of Longquan celadon imports (LQC) against other Chinese ceramic imports (Others), and the overall quantities of Chinese ceramic finds (Overall) from the Williamson Collection survey area in southern Iran, 900 to 1660 (based on OMS-Part 4).

Table 3. A summary of Longquan celadon (LQC) and other Chinese ceramic (Others) sherds (a) and the sites where they were found (b) from the Williamson Collection survey area in southern Iran (see OSM-Part 4).

	Northern Song	Southern Song	Yuan	Ming	Finds without unearthed location	Finds dated before Northern Song (960 AD)	Finds dated after Ming (After 1644 AD)	Total
a: Chinese ceramic finds								
LQC	0	40	458	492	38	0	0	**1028**
Others	160	218	123	967	38	18	46	**1570**
LQC %	0.0%	15.5%	78.8%	33.7%	50.0%	0.0%	0.0%	**39.6%**
Others %	100.0%	84.5%	21 .2%	66.3%	50.0%	100.0%	100.0%	**60.4%**
Total	**160**	**258**	**581**	**1459**	76	18	46	**2598**
	Northern Song	Southern Song	Yuan	Ming	Total			
b: Sites with Chinese ceramic finds								
LQC	0	19	36	37	38			
Others	35	34	22	58	67			
LQC %	0.0%	52.8%	87.8%	56.9%	43.7%			
Others %	100.0%	94.4%	53.7%	89.2%	77.0%			
Total	**35**	**36**	**41**	**65**	**87**			

reflect changes in the manufacture, supply, or demand for Longquan celadon. This is a subject that is being investigated by further study.

The distribution of Longquan celadon sherds continued to be concentrated around the coast at the entrance to the Gulf at this time, as well as continuing to find its way inland in small amounts. However, it is clear that, along the coasts in particular, other Chinese imports are found more commonly than in the Yuan period.

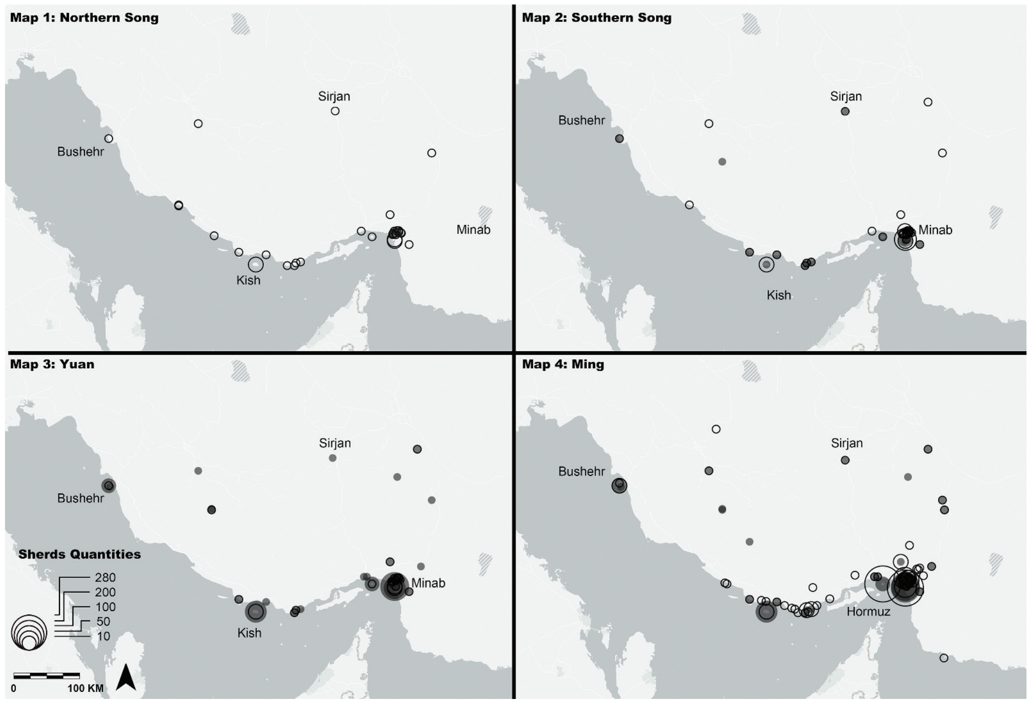

Figure 10. Distribution of Longquan celadon (grey dots) and other Chinese ceramic imports (black circles) in southern Iran, Northern Song to Ming Dynasties (based on Table 3. Note that 18 sherds of Chinese ceramic imports dated before the Northern Song, 46 dated after Ming Dynasty, and 76 without locations are not included in these maps).

As is shown in Figure 9, the final, 15th-century decline in Longquan celadon occurred at the same time as a marked decline in all types of imported Chinese wares, which itself continued until the late 15th century, before recovering slightly and stabilising. As touched on above, this decline, which may reflect Ming prohibitions on maritime trade, is one of two possible reasons for the decline in Longquan celadon. The other is that products of the Jingdezhen kilns in China became more popular than Longquan celadons, perhaps pushing them out of the market. Kennet has suggested that by the mid-14th century, Longquan celadon had begun to occupy what he believes was a 10%-20% ‘quality-table-ware niche’ in the glazed ware assemblage of the Hormuz/Gulf region, that had previously been occupied until the late 13th century by Iranian-manufactured green-glazed sgraffiatos, and which later went on gradually to be occupied by Jingdezhen blue-and-white porcelain from around the 15th century (Kennet 2004, 102–3, Figure 53).

One view is that in many cases Longquan celadon vessels, once they had been shipped across the Indian Ocean with all the additional costs of transportation that had been added to them, were expensive, elite artefacts that found their way mainly to palaces, places of high ritual status, major cities, upper-class households, and key trading ports. The most obvious example would be the Topkapı Palace collection in Istanbul, although the nature of elite contexts varied across the ocean (Krahl 1986; Ho 1994b, xxi; Prickett-Fernando 1994; Srisuchat 1994, 225–226; Miksic 2022, 189). Whilst this is true for many of the sites in the western Indian Ocean, for example, Hormuz, Julfar, and Fustat, the evidence from the Williamson Collection suggests that it was not always the case. In the Williamson survey area Longquan celadons, of the Yuan period in particular, occur on small, rural sites on the coast and inland. How much these vessels cost once they had reached these locations and how they were paid for, exactly who used them and in what context, and what meaning they carried, are all important questions that require further investigation.

Conclusion

Although this analysis is exploratory, and although the chronology still imprecise in some places and the data is still patchy, enough has been set out here to demonstrate the phenomenal scale of production at Longquan through the 12th to 14th/15th century, and the significance of this production to trade and consumption, not only across China but extending into the smallest rural communities across the whole of the Indian Ocean. It has also been possible to demonstrate synchronism in the patterns of expansion and contraction in production, trade, and domestic and overseas consumption, suggesting a degree of economic integration that certainly merits further investigation. It is clear that Longquan was a truly global industry – to the extent of the Old World at least, which operated on a scale of production and distribution that must have been as large as anything that existed at that time; certainly anything that is so well documented in the archaeological record.

It is not only the scale that is significant, but the fact that it is possible to demonstrate a level of integration between the Chinese domestic economy and overseas trade and consumption. Understanding which of the domestic or overseas ‘markets’ was the larger consumer, and which of the two may have played the more significant role in stimulating Longquan production is unfortunately not possible in the present analysis. Investigating such questions would require greater precision in chronology and provenance but would potentially lead to a much clearer understanding of the relationship between overseas trade and the Chinese domestic economy.

A further question is to what degree increased demand for these ceramics – in China and overseas – led to the restructuring of workshop and labour organisation in China to increase production. This is a question that it was only possible to address very tentatively here and is the subject of on-going research. It seems likely that the organisation of ceramic production did undergo a general shift across China through this period, but further work is needed before a definitive conclusion can be reached.

The Williamson Collection material was inspected personally by the authors and therefore represents the most reliable and carefully analysed of the material in this analysis. It presents a picture of long-distance trade and consumption of Chinese trade ceramics more detailed and nuanced than anything else available at the present time. It suggests, amongst other things, that the decline in Longquan celadon consumption may have been slightly later overseas than it was in China – a conclusion supported by the western Indian Ocean material. It also opens up the possibility of fluctuating (probably declining), quality of manufacture. How to measure this objectively and how it might be used to examine more precisely the relationship between production and consumption at opposite ends of the Indian Ocean still needs to be established.

The data presented in this paper convincingly demonstrate that the Longquan industry was the most significant producer of Indian Ocean export ceramics during the later 13th and 14th centuries. This is, however, far from certain in relation to Chinese domestic consumption, for which, ironically, evidence is more difficult to come by. If we are to understand better the economic relationship between China and the Indian Ocean, more detailed quantified evidence of this sort will be needed from excavations in China and the Indian Ocean, alongside analysis of other Chinese ceramic industries that came before, after, and were contemporary with Longquan production.

It is hoped that the analysis presented here has demonstrated the value of large-scale data collection alongside comparative, quantified analysis at a broad geographical scale as a means to understand better the development of the Indian Ocean mercantile economy and, in particular, China's role in that development.

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No potential conflict of interest was reported by the author(s).

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Author contributions

RZ and DK conceived and directed the research; RZ collected and analysed the main data and developed methodology with input from DK and WG; PB collected and analysed kiln data; XS collected and interpreted workshop evidence; WG, YZ, MW assisted with identification and classification of sherds. RZ and DK wrote the paper with contributions from PB, XS, and WG. All authors contributed ideas. RZ made Figures 1, 3, 4, 5, 6, 7, 8, 9, 10; XS Figure 4; PB Figures 1, 2.

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