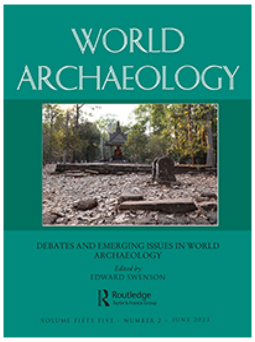

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Chinese ceramics as global commodities: a thousand years of production and trade of Chinese ceramics in the Western Indian Ocean

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ABSTRACT

This paper analyses the production and distribution of Chinese trade ceramics from AD 800 to 1900 to understand how these ceramic products became global commodities and how their production and exchange in the Western Indian Ocean evolved. Through a comparative examination of 15 well-identified product types of Chinese ceramics from 216 sites in the Western Indian Ocean, their production kilns, market circulations, and trading quantities have been identified and statistically analysed. The results suggest that the global status of Chinese ceramics in trade from China to the Western Indian Ocean depended on quality, aesthetics, utility, and the ability to navigate challenges such as logistics, production, and market barriers, highlighting the significance of market-adaptive designs in achieving global commodity success.

KEYWORDS

Chinese trade ceramics; Indian Ocean Archaeology; ancient global trade

Introduction: massive trade of Chinese ceramics in the Western Indian Ocean

Maritime interactions between China and the Indian Ocean date back to the 2nd century AD (Guy 1986, 1–2; Priestman 2016), but Chinese ceramics only emerged as significant trade items in the Western Indian Ocean by the 9th century AD (Lin and Zhang 2018; Qin 2013). From 800 to 1000 AD, there was a substantial influx of ceramic products from China to the Indian Ocean, demonstrating the expansion of maritime trade, symbolizing the ceramic products' global commodity status and marking a new phase in maritime long-distance trade. Many perishable trade cargoes – silks, species food, textiles, metals, incense, wood and slaves (Zhang and Lin 2022) – have all vanished from the archaeological record. Chinese trade ceramics, which were traded largely for their intrinsic value, can be found in 9th-century archaeological sites, towns and rural settlements from inland China, across the shores of the Indian Ocean, through Sri Lanka to India, the Persian Gulf, the Red Sea and East Africa, and even as far as the Mediterranean (Guttierrez et al. 2021; Lin and Zhang 2018). These sherds represent a hugely significant dataset, the only evidence capable of providing a quantified, diachronically-comparative analysis. This dataset is not only crucial for understanding the scope and scale of early maritime trade but also for gaining insights into the economic and cultural exchanges that shaped the medieval world from China to the western Indian Ocean.

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Historically, the surge in Chinese ceramic trade in the Indian Ocean largely reflects political and economic shifts. In the 8th century, upheaval along the Silk Road, coupled with turmoil in northern China, disrupted traditional trade routes. Faced with these challenges, the Tang dynasty redirected its focus to maritime ventures, leveraging southern ports to access broader international markets (DeBlasi 2001, 7; Franke and Twitchett 1994, 5–6; Lewis 2009, 42–44, 157–158). Concurrently, Sasanian and Islamic merchants explored maritime routes to regions including the Mediterranean Sea, Red Sea, South Asia and China (Chaudhuri 1985, 37; Hourani 1995, 38; Piacentini 1992, 124–125; Whitehouse and Williamson 1973). Meanwhile, in Tang China, technological advancements enhanced Chinese ceramics, particularly Yue celadon, which is renowned for its quality (Krahl et al. 2010). These ceramics gained prominence in literature and society, often serving as tribute items to the Tang court, reflecting a tiered production system (Hsieh 2010, 174; Wang 2004, 45).

The study of Chinese ceramics as global commodities is useful because the archaeological finds from both ceramic kilns in China and archaeological sites in the Indian Ocean can provide information about the merchants and economic aspects of trading activities in a global context. These wares are abundant, resilient, widely used in the Indian Ocean, and have been accurately dated by tomb and kiln excavations in China. They present us with a unique key to unlocking the story of the medieval Indian Ocean trade. Studies based on Chinese ceramics are traditionally discussed from an art historical perspective (Feng 2009; Medley 1989; Vainker 1991), and these studies normally focus on complete and high-quality museum collection pieces (cf. Kennet 2004, 60). However, a systematic overview of the development of Chinese ceramics as a global commodity in long-distance trade from the 9th century onwards in the Western Indian Ocean has not yet been written.

This paper aims to analyse the dynamics of Chinese ceramic production in China and its consumption in the Western Indian Ocean. The goal is to propose a new framework for interpreting types of ceramic trade by considering market acceptance and functions of Chinese ceramic products in long-distance trade from AD 800 to 1900. By examining 12 different product types across 55 classes of Chinese ceramic artefacts within 869 assemblages from 216 sites in the Western Indian Ocean, both production in China, and the distribution of these items in the Western Indian Ocean are investigated. The study posits that the long-distance transport of ceramics from kiln sites through port cities to export markets posed significant logistical challenges that impacted the development of maritime trade routes to the Western Indian Ocean. Additionally, shifts in political and economic power provide a general backdrop to the extensive trade of Chinese ceramics in the Western Indian Ocean. Based on these findings, the discussion compares different ceramic product types and suggests that factors like ceramic quality, decorative appeal, and utility are vital for achieving global-commodity status. These factors will be challenged by mismatched designs for artistic appeal and market orientation, even when the products are of high quality. Although the innovative methods employed in this study are quantitative, they carry uncertainties and thus the conclusions drawn are still somewhat preliminary and open to revision with the addition of more data. Nonetheless, this analysis makes a significant contribution by proposing a model that is grounded in archaeological evidence, enhancing our understanding of the topic and encouraging further investigation and discussion.

Sites, artefacts and classification

This study will be based on the analysis of 31,729 accurately identified sherds that have been published or reported from 216 archaeological sites across South Asia, Iran, Eastern Arabia, Yemen, the Red Sea, East Africa, and South Africa. The sites and their references are listed in the online supplementary material (OSM Part 1 - Sites). These Chinese ceramic finds have been either directly inspected and classified by the author or gathered from published information. Although many sherds from the Western Indian Ocean have been described in publications, others remain unpublished but are accessible through reports or have been personally inspected and classified. While most sites yielded only a few sherds, significant assemblages were found at locations such as Kish and Minab in Iran, Julfar in the United Arab Emirates, Fustat in Egypt, and Shanga and Gedi in Kenya (cf. Horton 1996; Kennet 2004; Liu, Qin, and Kiriama 2012; Yuba 2014; Zhao 2013, 2015; Zhao, Carter, and Velde 2014).

In this study, well-identified Chinese ceramic finds refer to those that can be precisely dated with a clear provenance (OSM Part 2 -Classification): their dating, manufacturing kilns, and sherd counts have been inspected by the author or reported in publications. The sherds from the 216 archaeological sites (Figure 1(a,b)) in the Western Indian Ocean have been identified as coming from 13 different kilns and are classified into 15 different product types and dated to different eras from AD 800 to 1900 (Figures 1(c) and 2). Details on these sites and their ceramic assemblages are available in the online supplementary materials (OSM Part 3 - Chinese Ceramic Finds).

As shown in Figure 2, this classification highlights the rich diversity of kilns, product types and durations of manufacturing circulations of Chinese ceramic products exported to the Western Indian Ocean. For instance, Class 001 represents the white porcelain products manufactured at the Ding kilns, dating from AD 907 to 1115 (Northern Song Chinese Dynasty). This class is distinct from the similar Class 002 product type, which shares the same product type and kiln but dates from AD 1115 to 1234 (Jurchen Jin Dynasty). It is important to note that the product type, such as white porcelain, is not exclusively manufactured at the Ding kilns; it can also be produced at Xing kilns, Jingdezhen

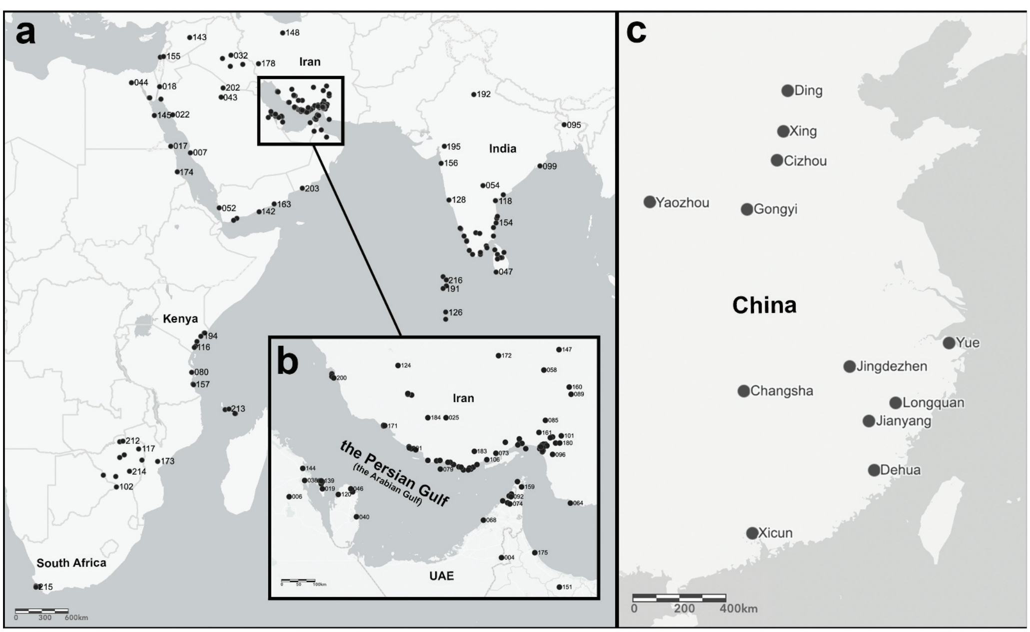

Figure 1. Site locations in this study: (a) a map of the Western Indian Ocean, showing sites with Chinese ceramic finds mentioned in this study; (b) a zoomed-in map of the Persian Gulf, showing sites with Chinese ceramic finds; (c) a map of China, showing sites where Chinese ceramic products identified in this study are located. The names and information of these sites can be found in OSM Parts 1 & 2.

Class ID	Kiln Name	Product Type	Dating (AD)		Fabric Quality	n2	p2	n3	p3	Images
			From	To						
Class 001	Ding	White Porcelain	907	1115	High	27	0.09%	10	1.12%	
Class 002		White Porcelain	1115	1234	High	3	0.01%	2	0.22%	Fig 3-1
Class 003	Xing	White Porcelain	800	907	High	260	0.82%	17	1.90%	Fig 3-2
Class 004	Cizhou	Sgraffiato Ware	1200	1368	Low	10	0.03%	4	0.45%	Fig 3-3
Class 005	Yaozhou	Celadon	960	1127	High	29	0.09%	5	0.56%	
Class 006	Gongyi	Green-splashed Ware	800	907	Low	88	0.28%	19	2.12%	Fig 3-4
Class 007	Yue	Celadon	800	907	High	619	1.95%	22	2.46%	Fig 3-5
Class 008		Celadon	907	960	High	7	0.02%	5	0.56%	Fig 3-6
Class 009		Celadon	960	1127	High	986	3.11%	19	2.12%	Fig 3-7
Class 010	Longquan	Celadon	1120	1268	High	118	0.37%	7	0.78%	Fig 3-8
Class 011		Celadon	1268	1330	High	2128	6.71%	35	3.91%	Fig 3-9; Fig 4-1
Class 012		Celadon	1330	1400	High	4824	15.20%	69	7.70%	
Class 013		Celadon	1400	1444	High	1146	3.61%	42	4.69%	
Class 014		Celadon	1403	1435	High	4	0.01%	4	0.45%	Fig 3-10; Fig 4-3
Class 015	Changsha	Polychrome Ware	800	907	Low	529	1.67%	22	2.46%	Fig 3-11; Fig 4-2
Class 016	Jingdezhen	Qingbai Porcelain	1000	1127	High	21	0.07%	11	1.23%	Fig 3-12
Class 017		Qingbai Porcelain	1120	1270	High	96	0.30%	25	2.79%	Fig 3-13
Class 018		Qingbai Porcelain	1270	1368	High	339	1.07%	9	1.00%	
Class 019		Qingbai Porcelain	1274	1368	High	18	0.06%	11	1.23%	Fig 3-14
Class 020		Red and White Porcelain	1300	1400	High	2	0.01%	2	0.22%	
Class 021		Blue and White Porcelain	1330	1368	High	874	2.75%	25	2.79%	Fig 3-15
Class 022		White Porcelain	1368	1644	High	68	0.21%	9	1.00%	Fig 3-16
Class 023		Blue and White Porcelain	1368	1460	High	216	0.68%	19	2.12%	Fig 3-17
Class 024		Enameled Porcelain	1368	1430	High	4	0.01%	2	0.22%	
Class 025		Blue and White Porcelain	1403	1435	High	11	0.03%	4	0.45%	Fig 3-18; Fig 4-4
Class 026		White Porcelain	1403	1435	High	4	0.01%	3	0.33%	
Class 027		Enameled Porcelain	1430	1644	High	60	0.19%	9	1.00%	Fig 3-19
Class 028		Blue and White Porcelain	1460	1560	High	1766	5.57%	54	6.03%	
Class 029		Yellow Glazed Porcelain	1500	1600	High	3	0.01%	1	0.11%	
Class 030		Blue Glazed Porcelain	1500	1700	High	1	0.00%	1	0.11%	
Class 031		Blue and White Porcelain	1560	1644	High	1793	5.65%	60	6.70%	
Class 032		White Porcelain	1644	1900	High	63	0.20%	10	1.12%	
Class 033		Blue and White Porcelain	1644	1817	High	4945	15.59%	62	6.92%	
Class 034		Enameled Porcelain	1644	1817	High	148	0.47%	9	1.00%	
Class 035		Blue Glazed Porcelain	1660	1750	High	1039	3.27%	16	1.79%	
Class 036		Brown Glazed Porcelain	1660	1750	High	99	0.31%	16	1.79%	
Class 037		Imari Type Porcelain	1700	1817	High	1006	3.17%	3	0.33%	
Class 038		Yellow Glazed Porcelain	1700	1800	High	1000	3.15%	1	0.11%	
Class 039		Blue and White Porcelain	1817	1900	High	610	1.92%	21	2.34%	
Class 040		Enameled Porcelain	1822	1900	High	115	0.36%	7	0.78%	
Class 041	Jianyang	Black Glazed Stoneware	1000	1300	High	41	0.13%	2	0.22%	
Class 042	Dehua	White Porcelain	1200	1368	High	221	0.70%	9	1.00%	
Class 043		Qingbai Porcelain	1250	1350	High	207	0.65%	32	3.57%	
Class 044		White Porcelain	1368	1644	High	17	0.05%	4	0.45%	
Class 045		White Porcelain	1644	1900	High	131	0.41%	11	1.23%	
Class 046		Blue and White Porcelain	1750	1900	High	1109	3.50%	59	6.58%	
Class 047		Blue Glazed Porcelain	1750	1900	High	12	0.04%	3	0.33%	Fig 3-20
Class 048		Brown Glazed Porcelain	1800	1900	High	5	0.02%	1	0.11%	Fig 3-20
Class 049	Xicun	Polychrome Ware	1000	1200	Low	50	0.16%	4	0.45%	
Class 050	South China	Blue and White Porcelain	1560	1644	Low	1	0.00%	1	0.11%	
Class 051		Brown Glazed Stoneware	800	1000	Low	1629	5.13%	23	2.57%	
Class 052		Brown Glazed Stoneware	1000	1300	Low	497	1.57%	13	1.45%	
Class 053		Brown Glazed Stoneware	1300	1600	Low	865	2.73%	24	2.68%	
Class 054		Blue and White Porcelain	1750	1900	Low	1821	5.74%	36	4.02%	Fig 3-22
Class 055		Enameled Porcelain	1822	1900	Low	44	0.14%	2	0.22%	
					n1	**31729**	**100%**	**896**	**100%**	

Figure 2. Summary statistics of sherd numbers for different classes of Chinese ceramics from archaeological sites in the Western Indian Ocean, AD 800–1900. This table presents the statistics derived from datasets on Chinese ceramics discovered at archaeological sites across the Western Indian Ocean from AD 800 to 1900. It categorizes 55 classes of Chinese ceramics found within 896 assemblages across 216 archaeological sites (detailed in OSM Parts 1 and 3. For site locations, see Figure 1). 'Class ID' on the left designates the code for these classes, with corresponding names and dating evidence references in OSM Part 2. 'Kiln Name' identifies their manufacturing locations in China. 'Product Type' refers to the common appearance of the ceramic products, which is distinguished by the colours of the glaze and/or decorative patterns. 'Fabric Quality' assesses the visual quality of these materials, ranging from low to high. 'Images' refers to the examples in Figures 3 and 4. In the table's lower section, 'n_1' is the total quantity of Chinese ceramic sherds and assemblages, with 'p_1' showing the percentage of 'n_1'. 'n_2' indicates the total number of ceramic sherds attributed to each class, with 'p_2' reflecting the percentage of n_2. 'n_3' is the total number of assemblages attributed to each class across the 216 sites, thus illustrating the distribution of each class. 'p_3' provides the occurrence rate, indicating the percentage of 'n_3'.

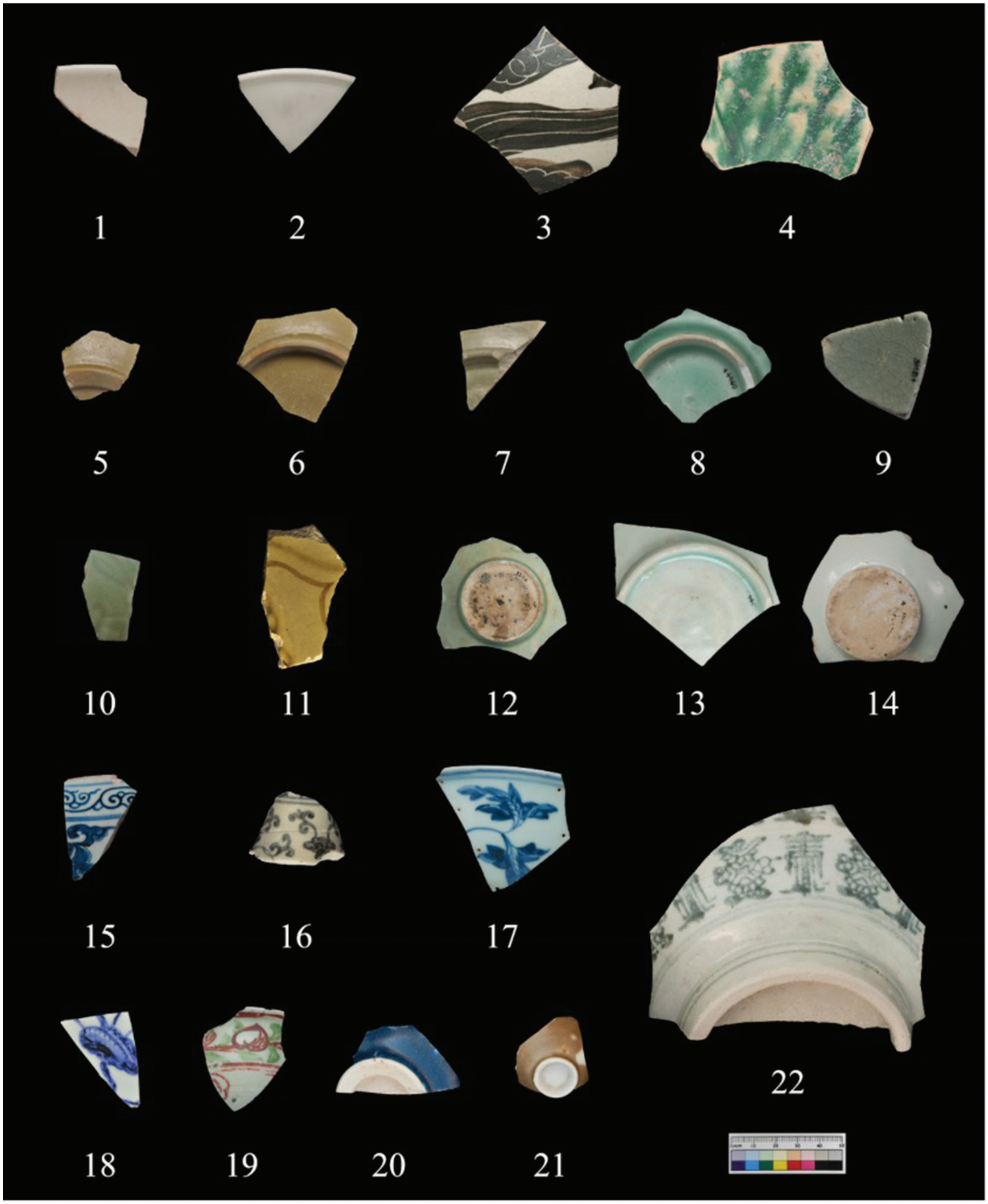

Figure 3. Selected samples of Chinese sherds from southern Iran, the Williamson Collection (1–9, 11–17 and 19), Julfar (10 and 18) and Rustaq in Oman (20–22). Class ID and Names can be found in Figure 2.

kilns or Dehua kilns. The classification used here identifies 55 classes of Chinese ceramics from the Western Indian Ocean, each with different kilns, product types, and dates. Selected samples from these 55 classes are illustrated in Figure 3.

In terms of manufacturing location, the vast majority of these ceramic artefacts emanate from 13 principal ceramic industries distributed throughout China (see Kiln Names in Figure 2), including a significant concentration in the southern provinces of Fujian and

Figure 4. Examples of fabric qualities: 1 and 3–4 = high quality (see Figure 3, sherds 9, 10 and 18) and 2 = low quality (see Figure 3, sherd 11).

Guangdong (classes 50–55, identified as South China in Kiln Names in Figure 2). This area is known for producing lower-quality and imitation ceramic products that originate from inland China. For example, the Middle Tang to Northern Song South China Transportation Jar (Class 051), which includes roughly made coarse green/brown iron glazed wares/jars that were used for transport, also known as Dusun Jars, probably originated from a wide range of locations that spanned what is now Guangdong, Fujian and Jiangxi provinces in China and even extended into Southeast Asia (Zhang 2016, 225–260). These 13 principal ceramic industries all have a substantial number of archaeologically evidenced kiln sites, which attests to the scale of these industries. For instance, the Yue kilns encompass over 200 sites (CXSBWG 2002) and the Longquan kilns encompass more than 400 sites (Zhang et al. 2022), underscoring their scale for the domestic and export of ceramic commodities. It is worth noting that imitation Longquan celadon wares, produced from the 15th century in kilns across Burma, Thailand, and Islamic regions, closely resemble the lower-grade Chinese originals and have been introduced into the Indian Ocean market (Brown 2009; Wood and

Doherty 2015; Zhang 2018). As presented in Figure 2, it is also worth noting that, apart from Jingdezhen kilns, which produce nine different product types, and Dehua kilns and South Chinese kilns, each with three different product types, all other kiln groups produce only a single type of traded product.

In this study, the different qualities of ceramic fabrics are as follows (see Fabric Quality in Figures 2 and 4): Classes identified as 'low quality' are characterized by body fabrics that are loose, porous, rough and contain black inclusions, with a colour that may be grey, brown-grey or white-grey (Figure 4, fabric 2). If decorated, the patterns are typically applied quickly and freely, covered with a thin glaze that often only partially covers the upper part of the ware. 'High quality' products, on the other hand, have bodies that are dense, hard, smooth and fired at high temperatures without inclusions (Figure 4, fabrics 1 and 3–4), whilst the decoration is carefully-designed and executed (Lin and Zhang 2015).

Methodology

To investigate the trading and usage patterns of Chinese ceramics from a statistical perspective, aoristic analysis is employed. This method, regularly used for evidence-based analysis (Ratcliffe 2000) and applied in archaeological studies (Crema, Bevan, and Lake 2010; Johnson 2004), is particularly suitable for analysing artefacts or archaeological sites with imprecise dates. Unlike some probabilistic methods requiring precise dates, aoristic analysis effectively deals with date ranges, making it more suitable for imprecise data such as ceramic classifications with varied lengths of dating ranges.

As indicated in the classification above (Figure 2), the provenance, dating, and distribution of these ceramics are clearly identified, providing reliable start and end dates that may cover varying lengths of time. Instead of arbitrarily choosing a specific point within these date ranges, aoristic analysis distributes the probability of occurrences evenly across the entire period. This approach helps reveal the probability of ceramics imports in production and trade, evenly distributed for each interval (100 years in this analysis). The production patterns in China and distributions in the Western Indian Ocean are analysed, producing statistical outcomes that show the proportional and relative probability over the time span of AD 900–1900 (OSM Part 4 - Aoristic Results).

In this study, the total sherd count is used as a proxy for ceramic abundance, which, while recognizing the possibility of multiple sherds belonging to the same vessel, provides a robust dataset for statistical analysis. Aoristic analysis, suited for handling imprecise dates, distributes the probability of occurrences evenly across the time periods, ensuring a more accurate representation of ceramic import patterns. This approach, combined with rigorous classification and cross-referencing of site reports, ensures the reliability of the results despite potential overrepresentation.

Discussion

Production pattern trends in China

In an aoristic analysis of export ceramic production in China, Figures 5 and 6 illustrate the changing dominance of various Chinese kiln sites from AD 800 to 1900 based on 31,729 sherds of Chinese ceramic finds from 216 Western Indian Ocean sites. This change highlights significant shifts in production centres over time, particularly noting the rise of kiln sites at Longquan in Zhejiang and

	Province	Kiln Name		800-900 AD	900-1000 AD	1000-1100 AD	1100-1200 AD	1200-1300 AD	1300-1400 AD	1400-1500 AD	1500-1600 AD	1600-1700 AD	1700-1800 AD	1800-1900 AD	Total
North China	Hebei	Ding	qty		12	13	4	1							30
			%		1.0%	1.5%	0.8%	0.05%							0.1%
		Xing	qty	243	17										260
			%	11.0%	1.4%										0.8%
		Cizhou	qty					6	4						10
			%					0.3%	0.1%						0.03%
	Shaanxi	Yaozhou	qty		7	17	5								29
			%		0.6%	2.1%	1.0%								0.1%
	Henan	Gongyi	qty	82	6										88
			%	3.7%	0.5%										0.3%
South China	Zhejiang	Yue	qty	579	284	590	159								1612
			%	26.1%	24.2%	70.2%	32.4%								5.1%
		Longquan	qty				64	1153	5854	1150					8220
			%				13.0%	66.7%	77.5%	48.9%					25.9%
	Hunan	Changsha	qty	494	35										529
			%	22.3%	2.9%										1.7%
	Jiangxi	Jingdezhen	qty			17	56	154	1209	908	1970	3131	5461	1396	14301
			%			2.0%	11.3%	8.9%	16.0%	38.6%	87.0%	99.0%	84.1%	40.4%	45.1%
	Fujian	Jianyang	qty			14	14	14							41
			%			1.6%	2.8%	0.8%							0.1%
		Dehua	qty					235	195	6	6	31	425	804	1702
			%					13.6%	2.6%	0.3%	0.3%	1.0%	6.5%	23.2%	5.4%
		Xicun	qty			25	25								50
			%			3.0%	5.1%								0.2%
	South China (mainly Fujian and Guangdong)		qty	815	815	166	166	166	288	288	289	1	607	1258	4857
			%	36.8%	69.3%	19.7%	33.7%	9.6%	3.8%	12.3%	12.8%	0.0%	9.3%	36.4%	15.3%
Total			qty	2213	1175	842	492	1727	7550	2353	2265	3163	6492	3458	31729
			%	7.0%	3.7%	2.7%	1.6%	5.4%	23.8%	7.4%	7.1%	10.0%	20.5%	10.9%	

Figure 5. Aoristic analysis (OSM Part 4) of Chinese ceramic artefacts ($n = 31,729$) in this study correlated with their respective production kilns, based on quantitative ('qty') and percentage (%) data distribution from AD 800 to 1900, referencing 'Kiln Name' as classified in Figure 2.

Jingdezhen in Jiangxi in southern China from the 13th century onwards. These changes can be detailed in three key phases of Chinese ceramic production patterns:

(1) Early Export Ceramic Production (800–900 AD) (Map 1 in Figure 6): Initially, export ceramic production was widely distributed in a few key areas in both the north and south of China before the 10th century AD. The Yue kilns of Zhejiang accounted for 26.1%, the Changsha kilns of Hunan province for 22.3%, and the kilns of Fujian and Guangdong for 36.8% of the ceramic trade, indicating their early significance. Northern Chinese ceramic industries (Xing and Gongyi kilns) comprised about 14.7% of Chinese ceramic finds at that time.

(2) Transition and Growth (1000–1400 AD) (Maps 2 to 4 in Figure 6): From the post-AD 1000 era, North Chinese ceramic finds declined to lower than 2.1% (specifically Ding and Yaozhou kilns). In contrast, Zhejiang province saw a surge in prominence, with Yue kilns capturing 70.2% of the trade from AD 1000 to 1100 and Longquan kilns an impressive 77.5% from 1300–1400 AD. Northern China's modest production did not demand specialized labour, which may have limited the development of specialized workshops. In contrast, in South China, a vast output from efficient, diversified workshops and kilns was common (Song, Zhang, and Kennet 2024). The emergence of Longquan and Jingdezhen kilns significantly stimulated the ceramic trade industry for both domestic use and international trade (Zhang et al. 2022). It is worth noting that Ding kilns also had a wide range of production and markets in northern China in terms of scale and consumption during the 10th to 13th centuries (Liu 2023), but they were less frequently traded overseas in large quantities, especially in the

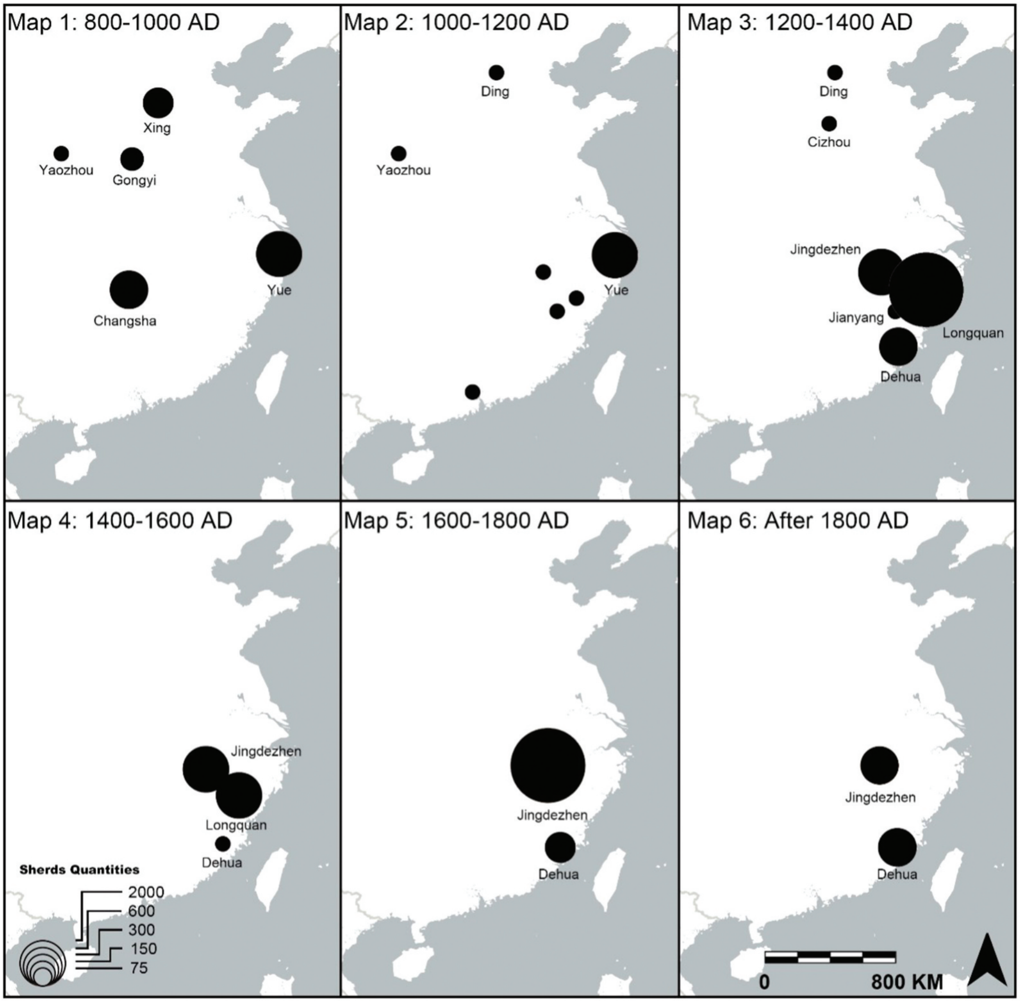

Figure 6. Geographical distribution of 12 kiln sites of Chinese ceramic artefacts exported to the Western Indian Ocean sites from AD 800 to 1900. Circle sizes indicate quantities. The South China kiln sites are excluded because their exact locations are uncertain. This visualization is derived from the quantitative data presented in Figure 4.

Western Indian Ocean. This question deserves to be addressed in future quantitative research, and the Chinese ceramics research team led by author at the Department of Archaeology at Durham University is currently studying related topics and hopes to advance our understanding of this issue.

(3) Dominance of Jingdezhen (1600–1700 AD) (Maps 5 and 6 in Figure 6): Jingdezhen kilns in Jiangxi province dominated from the 13th century, culminating in an unparalleled 99% share of the export market in the AD 1600–1700 period. This trend reflects the expansion of production capacities within China, especially as Jingdezhen became the porcelain capital of China (Finlay 2010; Gerritsen 2020; Song, Zhang, and Kennet 2024).

Based on Figure 5 it can also be suggested that the kilns in Fujian and Guangdong provinces (referred to as South China in the figure) developed into stable centres of production for export ceramics, such as classes 53 (brown glazed stoneware) and 54 (blue-and-white porcelain). These kilns predominantly catered to the demand for imitations and lower-quality ceramics, fostering an industry primarily producing lower-quality porcelain due to the lack of high-quality clay and local fine-porcelain traditions (Meng 2017; Zhang 2016, 38).

This analysis shows that the changing pattern of Chinese export ceramic kiln sites closer to the coast and trading ports over time suggests a strategic but natural movement to facilitate easier access to maritime trade routes and key traditional trading ports, such as Hangzhou, Ningbo and Wenzhou in Zhejiang, Quanzhou in Fujian, and Guangzhou in Guangdong of South China (cf. Chaudhuri 1985, 34–62; Ho 2000; Ni 1998). This shift, especially notable in Guangdong and Fujian, highlights the importance of reducing the distance between production centres and export points to streamline logistics and reduce transportation costs. The rise of kilns like Longquan and Jingdezhen kilns reflects how maritime trade influenced large-scale, high-quality production for both domestic and Indian Ocean markets. This strategic positioning and varied production quality allowed the Chinese ceramic trade to naturally meet the different market demands for ceramic products across high and low customer and social classes in the Western Indian Ocean.

Distribution patterns of different Chinese ceramic product types in the Western Indian Ocean

Regarding the general distribution of Chinese ceramic finds in the Western Indian Ocean, Figure 7 illustrates the patterns divided by celadon, blue-and-white porcelain, and other types. This shows that at the beginning of Chinese ceramic trade in the western Indian Ocean, all Chinese ceramic wares were concentrated in key trading ports like Siraf and Suhar, with Mantai acting as an intermediary, because there were fewer sites in India and Sri Lanka and these had lower consumption of Chinese ceramic imports (Figure 7, Map 1). From 1000 to 1200 AD, the trade dynamics changed and the trade centres moved from the Gulf to the Red Sea where Chinese ceramics are concentrated, and many other widely distributed sites in the Western Indian Ocean had fewer Chinese ceramic imports (Figure 7, Map 2). From 1300 to 1400 AD, the widespread dissemination of Chinese ceramic imports across various ports in the Western Indian Ocean (from Minab in southern Iran and Aydhab in Egypt to the Swahili Coast at Shanga and Gedi in Kenya) highlights a period of intensified long-distance trade from China to the Western Indian Ocean (Figure 7, Map 3). In particular, Longquan celadon wares (Classes 10–14 in Figure 2) were particularly prominent in this trade (Zhang et al. 2022). The 'Ming Gap Hypothesis', which suggests a lull in the trade of Chinese ceramics from AD 1400 to 1500 (Brown 2009; Harrisson 1958), is contested by the continuous distribution across key strategically-located sites, such as Hormuz, Julfar and Kinolhas, showing a decline rather than a complete gap in Chinese ceramic trade (Figure 7, Map 4). Figure 8 shows evidence that the quantities of traded Chinese ceramics in the 14^{th} century dropped from 7,550 sherds (23.8% of the total) to 2,353 sherds (7.4%) but recovered to 3,163 sherds (10%) from 1600 AD, then doubled to 6,492 sherds (20.5%) from 1700 AD. During this period, European traders shifted dynamics (cf. Steensgaard 1974) and introduced new sites and market demands for Chinese ceramics in Hormuz in Iran, Julfar in the UAE, Rustaq in Oman and Dabarare in Zimbabwe.

During this long-term trade from 800 to 1900 AD, 15 different types of Chinese ceramic commodities were found in the Western Indian Ocean. Not all these product types were long-lasting or widely distributed. Figure 8 provides several insights into the different popularities of Chinese ceramic commodities in the Western Indian Ocean: (1) celadon and blue-and-white porcelain were the most dominant commodities in long-term trade. Figure 8

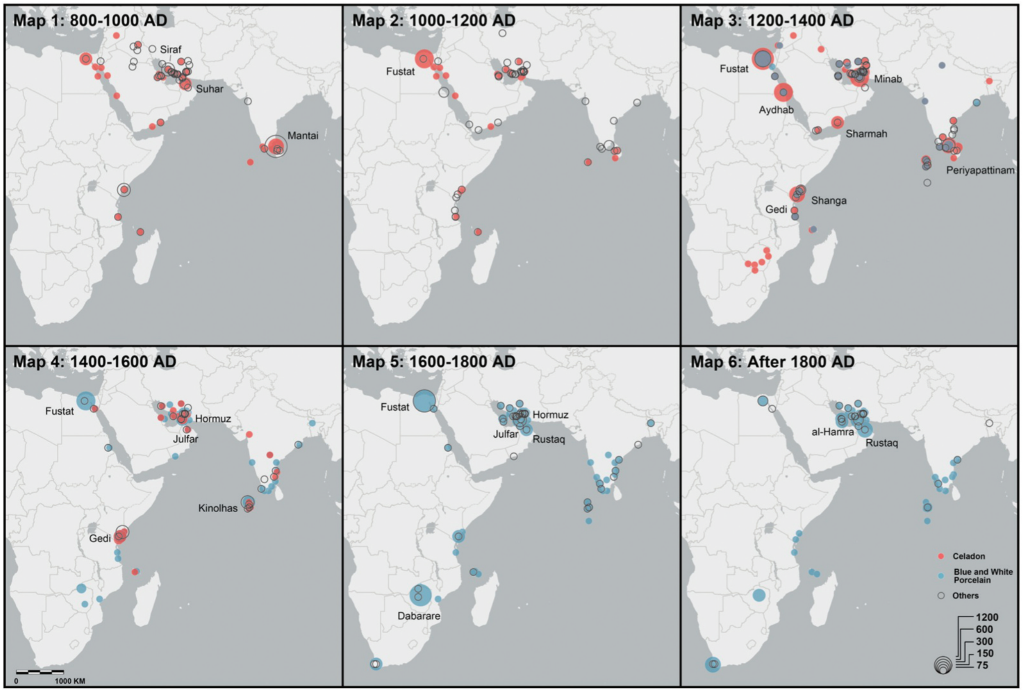

Figure 7. Geographical distribution of sites with Chinese ceramic artefacts in the Western Indian Ocean from AD 800 to 1900. Circle sizes indicate quantities. Orange dots refer to celadon, blue dots refer to blue-and-white porcelain wares, and black circles refer to other types of Chinese ceramics. This visualization is derived from the quantitative data presented in OMS Part 4 and Figure 8.

indicates that celadon ($n = 9861$, 31.1% of the total 31,729 sherds) and blue-and-white porcelain ($n = 13,146$, 41.4% of the total) from Yue, Longquan, and Jingdezhen kilns were the predominant types traded from China. The other 13 types accounted for just over a quarter of the total (27.5%). These products dominated the trade, reflecting their popularity and value in this long-distance trade. Notably, these high-quality ceramics were accessible even to remote places and small settlements or ports, particularly from the 13th century (Zhang et al. 2022). Their switching patterns in detail will be explained in the following section; (2) The next popular group is the brown glazed stoneware, referring to coarse transportation jars that mainly circulated from 800 to 1500 AD. This type constituted about 9.4% ($n = 2991$) of all ceramic finds, making it the third-largest group of product types in trade. These lower-quality brown glazed jars played crucial roles in packaging and transporting other goods, as demonstrated by different shipwrecks such as the Belitung Shipwreck (10th century) (Krahl et al. 2010) and the Witte Leeuw Shipwreck (16th century) (Van Der Pijl-Ketel 1982), ensuring their widespread distribution and mass export via maritime trade routes; White porcelain trade was also popular and lasted longer compared to the other product types, enduring throughout the entire period and comprising 2.5% of the total ($n = 794$). (3) the limited trade of black and white sgraffito and black glazed stoneware suggests that Islamic markets did not favour these types of ceramics. As shown in Figure 2, types such as Sgraffito ware (Class 004) ($n2 = 10$, 0.03% of the total 31,729 sherds; $n3 = 4$, 0.45% of total 896 assemblages) and black glazed stoneware (Class 041) ($n2 = 41$, 0.1%; $n3 =$

Product Types		800-900 AD	900-1000 AD	1000-1100 AD	1100-1200 AD	1200-1300 AD	1300-1400 AD	1400-1500 AD	1500-1600 AD	1600-1700 AD	1700-1800 AD	1800-1900 AD	T
White Porcelain	qty	243	29	13	4	132	99	35	31	56	76	76	794
	%	11.0%	2.5%	1.5%	0.8%	7.7%	1.3%	1.5%	1.4%	1.8%	1.2%	2.2%	2.5%
Sgraffiato	qty					6	4						10
	%					0.3%	0.1%						0.03%
Celadon	qty	579	291	608	228	1153	5854	1150					9861
	%	26.1%	24.7%	72.2%	46.3%	66.7%	77.5%	48.9%					31.1%
Green-splashed ware	qty	82	6										88
	%	3.7%											0.3%
Polychrome ware	qty	494	35	25	25								579
	%	22.3%											1.8%
Qingbai Porcelain	qty			17	56	257	352						681
	%			2.0%									2.1%
Red and White Porcelain	qty						2						2
	%						0.0%						0.0%
Blue and White Porcelain	qty						949	858	1914	2540	3835	3049	13146
	%						12.6%						41.4%
Enameled Porcelain	qty						2	22	28	60	86	174	371
	%						0.0%						1.2%
Yellow Glazed Porcelain	qty								3		1000		1003
	%								0.1%		15.4%		3.2%
Blue Glazed Porcelain	qty								1	462	581	8	1052
	%								0.02%				3.3%
Brown Glazed Porcelain	qty									44	55	5	104
	%									1.4%			0.3%
Imari Type Porcelain	qty										860	146	1006
	%										13.2%	4.2%	3.2%
Black Glazed Stoneware	qty			14	14	14							41
	%			1.6%	2.8%	0.8%							0.1%
Brown Glazed Stoneware	qty	815	815	166	166	166	288	288	288				2991
(Transportation Jars)	%	36.8%	69.3%	19.7%	33.7%	9.6%	3.8%	12.3%	12.7%				9.4%
	T	**2213**	**1175**	**842**	**492**	**1727**	**7550**	**2353**	**2265**	**3163**	**6492**	**3458**	**31729**

Figure 8. Aoristic analysis (OSM Part 4) of Chinese ceramic finds ($n = 31{,}729$) in this study correlated with their respective product types, based on quantitative ('qty') and percentage (%) data distribution from AD 800 to 1900, referencing 'Product Types' as classified in Figure 2. 'T' means total.

2, 0.33%) indicate that the Islamic markets were not keen on these monotonous black-glazed and Chinese Sgraffito wares, as evidenced by their high-fired quality but very limited trade. This preference highlights the cultural and aesthetic considerations that influenced market demands.

The consistent and wide distribution of Chinese ceramics in the Western Indian Ocean, along with their varying popularity, demonstrates that Chinese ceramics as global commodities were shaped by a complex interplay of quality, functionality, and cultural preferences. High-quality ceramics like celadon and blue-and-white porcelain dominated the market, reflecting their value among affluent customers and their accessibility to remote locations from the 13th century onwards. This widespread distribution suggests their transition from luxury to semi-luxury commodities, particularly after the 17th century worldwide (such as trade to Europe, see Berg 2005). Coarse ceramics, such as brown glazed stoneware, were essential for packaging and transporting goods, ensuring extensive distribution through maritime routes. In terms of aesthetic preferences in the western Indian Ocean market, the limited trade of black and white sgraffito and black glazed stoneware indicates a misalignment with Islamic aesthetic preferences, underscoring the influence of cultural and aesthetic considerations on market demands.

True global commodities: celadon vs. blue-and-white porcelain

This concluding section of the discussion highlights two of the most prominent global commodities among Chinese ceramics in the Western Indian Ocean, thus illustrating the dynamics of global competition and the potential rivalry behind their success. As mentioned above, celadon wares and blue-and-white porcelain wares account for more than three-quarters of the total Chinese ceramic artefacts in the region.

The replacement and competitive trading of celadon and blue-and-white porcelain was first observed by Kennet (2004). In a case study from Kush and Julfar in Ras al-Khaimah, Kennet showed that glazed tablewares, including Iranian Sgraffito earthenwares, Longquan celadon, and Jingdezhen blue-and-white porcelain wares, can be analysed to show the most common glazed tableware in each period from the 12th century to the 17th century (Kennet 2004, 103). Kennet's data show that, initially, local Iranian Sgraffito earthenwares of good but not exceptional quality were common at the sites. Then, possibly quite abruptly, high-quality Longquan celadon from China replaced these wares, which is particularly evident in Phase K-VII in Kush (Kennet 2004, 103). This sudden demise might reflect a significant event, such as the influx of higher quality and exotic products into the local market or the destruction of manufacturing infrastructure in Iran (Zhang 2022; Zhang et al. 2022). By Phase M-II of Julfar, Sgraffito had vanished, with Longquan wares prevailing. However, this dominance was brief as Jingdezhen's blue-and-white porcelains soon emerged, mostly replacing Longquan Celadon in Julfar by Phase M-VI. This case offers an intriguing glimpse into the intricate dynamics of fashion trends, manufacturing, consumer behaviour, trade practices and competitive markets.

In this wider study covering the whole of the Western Indian Ocean, Figure 9 provides a statistical overview of Chinese ceramic product types traded from AD 800 to 1900. Celadon wares are depicted with a red dashed line, peaking between AD 1300 and 1400. Blue-and-white porcelain, represented by a blue dotted line, saw a substantial surge in presence during the AD 1400–1500 period, eventually surpassing the others in dominance after AD 1600. Figure 7 shows that, from AD 800–1000, Celadon was widespread,

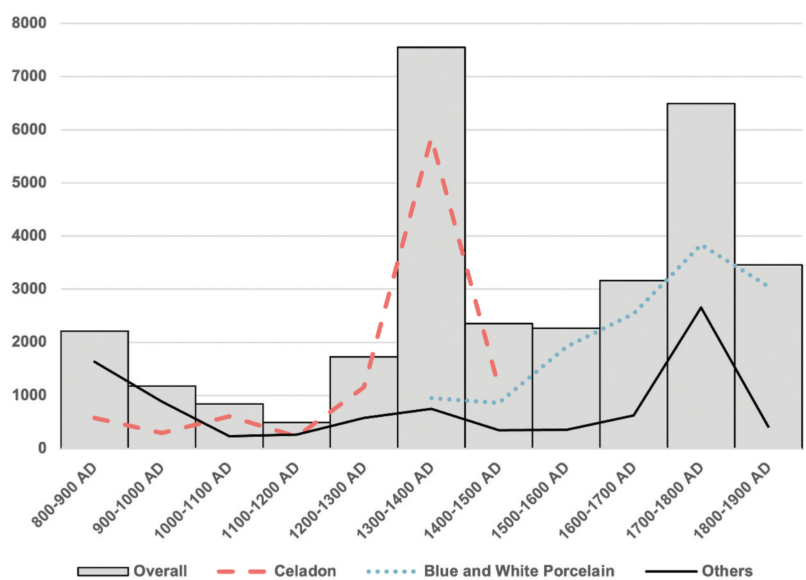

Figure 9. Proportions of celadon, blue-and-white porcelain, and others (other product types) from AD 800 to 1900 (by sherd count). This result is derived from the quantitative data presented in Figure 8.

particularly around Siraf and Mantai, and by AD 1000–1200, the prominence of celadon grew significantly, especially in Fustat. The AD 1200–1400 period shows a continuation of celadon's presence but also the emergence of Blue-and-white porcelain, particularly around Fustat, Aydhab, Minab and Sharmah. During AD 1400–1600, blue-and-white porcelain began to appear more prominently, notably in Hormuz and Julfar, while celadon remained present. By AD 1600–1800, blue-and-white porcelain became more dominant, with large concentrations in Fustat and Hormuz, whereas celadon's presence had diminished. After AD 1800, blue-and-white porcelain was predominantly found in regions like al-Hamra and Rustaq, indicating a significant shift in production or trade routes.

The competition, therefore, between ceramic classes was not a local phenomenon but one that affected the entire Western Indian Ocean. Green glazed wares, which had been the dominant ceramic product since AD 800, were gradually supplanted by blue-and-white porcelain starting from around AD 1300. In comparison, other types of Chinese ceramics played only a minor role relative to the dominance of celadon and Blue-and-white porcelain. This examination provides insights into the complex interplay of fashion trends, manufacturing processes, consumer behaviour, trading practices and market competition. While the quantity of ceramic production and trade was significant, the exotic and intricate patterns of the blue-and-white porcelain wares were particularly attractive to the Western Indian Ocean market. Both the Longquan celadon kilns and Jingdezhen, as the inventor and primary production centre for blue-and-white porcelain wares, boasted large-scale ceramic industries. Their proximity to coastal areas provided more convenient access to trading ports compared to the northern Chinese kilns, which were known for their high-quality ceramics. Ultimately, the high quality and exquisite designs of blue-and-white porcelain triumphed, as illustrated in Figure 10, turning these wares into true global commodities

Figure 10. (1) A Longquan celadon jar unearthed in southern Iran, from the Williamson Collection and (2) a blue-and-white porcelain gourd-shaped vase unearthed in Julfar, UAE.

that conquered ceramic markets from China to the Indian Ocean and even to Europe and America by AD 1800 (Canepa 2010; Meng 2017).

Conclusion: how to become a global commodity

This exploratory analysis acknowledges the occasional imprecision in the chronology and the slightly intermittent nature of Chinese ceramic find data. Despite these limitations, it indicates the development of sophisticated trade networks linking China with the Western Indian Ocean. The significant share of export ceramics from specific regions underscores the role of organized production and distribution systems that facilitated long-distance trade.

The transition of Chinese ceramics into global commodities was shaped by several key factors: high-quality production, strategic geographical positioning, adaptation to market preferences, and evolution of trade dynamics. High-quality production from kilns like Longquan and Jingdezhen, which produced famed celadon and blue-and-white porcelain, was crucial due to their superior quality and aesthetic appeal, especially for blue-and-white porcelain with cobalt patterns for both Chinese and Islamic markets. The strategic geographical positioning of production centres near coastal areas and major trading ports facilitated access to maritime trade routes, reducing transportation costs and improving logistics. Adaptation to market preferences by offering a wide variety of ceramic types, from luxury items to practical goods, ensured broad market penetration. The dynamic nature of global trade, illustrated by the competition between celadon and blue-and-white porcelain, highlighted the importance of innovation and adapting to changing consumer preferences to maintain market dominance.

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