THE INFLUENCE OF GLASS TECHNOLOGY ON CHINESE CERAMICS

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One of the most important and enduring differences between the ceramics of China and the Near East lies in the role that glass has played in the establishment of their respective ceramic traditions. In the ceramics of Mesopotamia, Persia, Egypt, and Syria glass technology proved vital for the development of glazed ceramics. Following the appearance of glazed stone-based ceramics in the fourth millennium BC, the first glazes applied to ordinary clays in the Near East were made from powdered glass, apparently in the mid 2nd millennium BC in Iraq, a process still practised in the region for making earthenware glazes.[1,2] Near Eastern and Mediterranean glassmakers also anticipated potters in such decorative techniques as lustre-painting and on-glass enamelling[3], while the colours associated with Near Eastern ceramic production (copper-turquoise blue, cobalt blue, calcium-antimonate white, and lead-antimonate yellow) were used for centuries to colour glass before they were exploited in the glazing of ordinary clays.[4] In Near Eastern clay technology too, glass has played an important role. The first fine white bodies of the Islamic world were made from mixtures of quartz, clay and powdered glass – an approach to body-design that has lasted from the 11th century AD into modern times.[5]

In China, by contrast, ceramic glazing began in the early Bronze Age with stoneware compositions, often fired to a couple of hundred degrees higher than contemporary Near Eastern wares. These glazes seem first to have appeared spontaneously when vessels made from the common refractory clays of southern China were exposed to high temperatures in wood-burning kilns – again in the mid second millennium BC. The natural 'kiln gloss' that developed during firing, through some interactions between fly-ash and the incandescent wares, soon led to successful deliberate glazing with wood-ash before firing, and then to glazing with clay and wood-ash mixtures.[6] Combinations of siliceous clays with wood ash provided the basis for south Chinese glaze technology until about the 10th century AD, when blends of crushed igneous rocks with limestone began to displace these traditional clay-and-ash techniques.[7] In cases where low-fired glazes were made in China (from about the 5th-4th century BC onwards) these seem to have been mechanical mixtures of lead-, barium-, and lead-barium-ores with powdered rocks and clays.[8] The technique of fritting (that is pre-melting to glass, followed by grinding to dust) saw little use in Chinese earthenware glazes before the 18th century.[9] Historically, glass has been a very minor production in China, compared with the country's vast and successful ceramics industry.

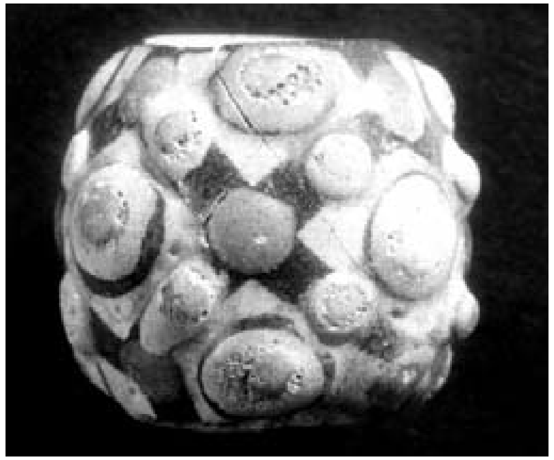

Figure 1: Large glazed bead with stonepaste body and red, blue and yellow glazes on a white ground. Warring States period. Probably 4th-3rd century BC (length: 2 cm). Author's collection.

In the light of the above, an argument that claims an important role for glass as an influence on Chinese ceramic technology might seem hard to sustain. However as both analytical data and excavated material accumulate a new picture is gradually emerging that seems to involve glass with some significant developments in China's ceramic history. These include China's first earthenware glazes, China's first use of cobalt blue and copper-green colourants and, possibly, China's first alkaline glazes. Glass has also played an important role in the development of the *famille-rose* palette of Jingdezhen overglaze enamels, in later Chinese copper-red glazes, as well as a range of mid-temperature glazes used at Guangzhou (formerly Canton). Although glass has never enjoyed the central role in ceramic development in China that it has in the Near East, its contributions to the evolution of China's ceramic technology are still significant, if relatively unknown.

The first earthenware glazes in China

It now seems that the first earthenware glazes in China's ceramic history were applied not to pottery vessels nor to ceramic figurines, but to beads made in imitation of imported glass.[10] The original models were eye-beads of a style produced at numerous sites around the Mediterranean, in Central Asia and also in southern Russia, and current in the Near East since about 1500 BC.[11] A few polychrome glass beads found their way to China in the later Bronze Age, including one example excavated from a Spring and Autumn period (770-476 BC) site in Henan province.[12] This particular blue and white eye bead was of a style current in the eastern Mediterranean in the 6th to 3rd century BC and proved to have been coloured by such sophisticated, but typically Near Eastern, chromophores as calcium-antimonate-white, cobalt-blue and a copper-turquoise, while its glass was of the soda-lime type, common in the ancient world.[13]

These 'western' beads would have been wonders in China in the later Bronze Age, when ceramic colours were restricted to the subdued browns, greens and yellows from the natural impurities (mainly iron and titanium oxides) in the clays and wood ashes used to make Chinese stoneware glazes. The concept of deliberate silicate colourants was new to China – as was glass itself as a distinct material. These imported beads seem to have stimulated China's first essays in glass production, and with this new technology came approaches to glass composition and glass colouration quite different from those practised elsewhere in the ancient world. It now seems that these early experiences with glass making in China may have lead in turn to the creation of China's first low-fired glazes.

Chinese-made eye-beads

Early eye-beads made in China were of two types: those made entirely from glass, and those where ceramic glazes were applied to non-glass substrates, which in one case appears to have been sintered siliceous plant ash – an approach to body-construction so far unique in world ceramics.[14] Strong compositional parallels are evident between the compositions of these early bead-glazes and the first Chinese glasses, as both were based on lead-oxide/baria silicates.[15] The use of mixtures of lead and barium oxides as prime fluxes in glasses and glazes seems confined to China at this time, although the origins of this unusual technology remain obscure.[16]

Figure 2. Earthenware jar with weathered glazes. Warring States period. Probably 3rd century BC (height: 9.5 cm). The British Museum. OA 1968.4-22. 18.

Besides devising entirely new styles of glass for their eye-beads and bead-glazes the Chinese approach to colour showed many differences from the imported originals, particularly for the glazes used on the faience-bodied examples. For example iron oxide was used in early Chinese bead-glazes at varying concentrations to give both red and yellow colours, probably to copy the cuprite reds, and the lead-antimonate yellows used to colour imported glass. A new pale blue ceramic colour

Table 1 – Analyses of Chinese glass beads and bead glazes, 5th-1st century BC. (Data from Wood et al 1999, p.31; Brill et al, 1991 p.45; Shi et al, 1992, p.25)

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	CuO	CaO	MgO	K_2O	Na_2O	BaO	PbO	CoO
White bead glaze	58.4	0.2	4.8	0.5	<0.1	0.7	0.4	1.0	2.6	11.2	19.1	
Blue bead glaze	49.9	0.9	4.4	0.5	2.4	0.9	0.4	1.2	2.2	14.8	21.9	
Yellow bead glaze	27.0	0.4	8.6	4.7	<0.1	1.5	0.7	0.7	0.8	20.1	35.0	
Red bead glaze	42.3	<0.1	2.0	17.8	<0.1	2.2	0.4	0.7	1.1	8.9	24.2	
Black bead glaze, 4th-1st cent. BC	41.7	n.t	1.9	5.0	0.04	2.9	0.5	0.6	2.0	10.1	34.5	0.05
Black bead glaze, 4th-1st cent. BC	46.9	n.t.	1.9	4.6	0.02	2.7	0.7	0.7	3.0	3.1	35.2	0.08
1. Blue bead	41.4	0.01	0.89	0.27	2.07	1.37	0.16	0.16	5.94	9.7	37.4	
2. Black bead	37.3	0.05	1.19	7.35	0.42	1.89	0.61	0.37	3.75	9.4	37.5	
3. Colourless bead	51.3	0.01	0.46	0.1	0.01	0.37	1.5	0.08	6.12	11.4	28.3	
4. Blue bead	52.4	0.03	1.21	0.28	1.31	1.48	2.62	0.16	10.1	11.1	19.2	

Figure 3. Wine Jar. Low-fired stoneware body with earthenware glazes in fahua style over a white slip. Ming dynasty 16th century (height: 27 cm). Victoria and Albert Museum, London. C.118-1938. Formerly Eumorfopoulos Collection.

was also devised in China for these early experiments in low temperature glaze-technology – in the form of an artificial copper-barium tetra-silicate analogous to the natural mineral effenbergerite, a material also exploited in China as a synthetic blue paint pigment.[17] A purple version of this colour (a copper-barium di-silicate) was also developed.[18] This was a chemical cousin to the barium-blue and appears on some faience beads as a glaze colourant and, later as a paint pigment on the terra cotta warriors (3rd century BC).[19] A strong green colour, characteristic of cupric oxide dissolved in a lead glaze, also appears on some Warring States glazed beads, as can various cobalt-blues and iron-cobalt blacks.[20] A white glaze was also devised for bead making that was opacified by undissolved quartz and albite grains – an approach to silicate opacification quite different from the calcium-antimonate whites traditionally used for Near Eastern glasses and glazes.[21]

Thus, in these early bead-glazes, eight entirely new colours were introduced into Chinese ceramics: - an iron-cobalt black, a cobalt-blue, a barium-copper blue, a barium-copper purple, a translucent iron-yellow, an opaque iron-red, an opaque white, and a high-lead copper-green. Largely because of the rarity and comparative insignificance of the objects concerned, this revolution in Chinese glaze technology remains little known.

Quantitative analysis

An early example of a Chinese glazed ceramic bead, dated stylistically to the 4th to 3rd C BC, was analysed recently at the British Museum's Department of Scientific Research.[22] When results from this study are combined with examples of cobalt-black bead-glazes from the same period, something of the variety of this early palette can be seen.[23] Also, when these bead glaze compositions are placed with analyses of Warring States and Han beads made entirely from glass it becomes evident how closely related glass and low-fired glaze technologies were in north China during this experimental period *(table 1)*.

These radical glass-related advances in Chinese ceramic technology saw some minor use on ceramic vessels, of which four are known at present. These are small jars (9-11 cm high) from the later Warring States period, but with their glazes applied to red-firing clays rather than to the faience materials used for beads.[24] The jars are glazed outside with four of the eight bead-glaze colours described above, namely white, red, blue and yellow. As with the faience beads, their patterns are constructed by superimposing one coloured glaze upon another, with the greatest thicknesses showing the series white-red-white-blue.[25] Although often described as 'glass-paste' decorated wares, our work on related bead technology suggests that the glazes on the jars may have been unfritted and, in most cases, not fully melted.[26] This last condition was useful for preventing the thick superimposed glazes from running at full heat from the effects of gravity.

However one important exception to this controlled fusibility appears in the yellow glaze, used as a dotted final detail to the ornament on both the beads and the jars. This yellow glaze seems fully melted, and the one analysis made so far of its composition shows a relatively fusible mixture, much closer in fact to the Han lead glazes that succeeded it.[27] This suggests that Warring States yellow bead glazes – and the related, but as-yet unanalysed, copper-green glazes that also appear on some Warring States beads – may have been the forerunners to most high-lead glazes made subsequently in China.[28] These include Tang *sancai* glazes, Ming architectural glazes, and most Chinese overglaze enamels made before the late 1720s *(Table 2)*.[29]

After this interesting and creative episode, Chinese low-fired glazes became far more conservative in their colours and compositions, with Western Han lead glazes on pottery vessels and figurines consisting largely of transparent iron-browns and copper-greens. Thus the innovative iron-cobalt blacks, the copper-barium blues and purples, and the unusual opaque white all disappeared from the Chinese earthenware glaze-palette as the Han dynasties progressed. Low temperature cobalt blue glazes reappeared in Shanxi province in the 6th century AD – but in the case of the barium-based colours these were permanent losses to Chinese ceramics, and rare examples of Chinese ceramic technology becoming less, rather than more, sophisticated with time.

Table 2. Warring States yellow bead-glaze and later Chinese lead glazes compared. (Data from Wood et al 1999, p.31; Wood et al 1992, pp.131-134; and Kingery & Vandiver, 1985, p.370)

	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	BaO	PbO	BaO+PbO	CuO	SnO_2
Warring States bead glaze	27.0	8.6	4.6	0.7	1.5	0.8	0.7	20.1	35	(55.1)	<0.1	
Eastern Han jar glaze	29.5	3.7	1.3	0.5	1.9	0.2	0.9	0.2	59.7	(59.7)	1.2	0.2
Eastern Han ding glaze	33.4	3.9	2.0	0.7	2	0.4	0.5	7.7	43.5	(51.2)	3.0	1.2
Tang sancai green glaze	33.6	5.8			1	3.0		0.5	55.6	(55.6)	2.0	
Liao sancai green glaze	33.3	3.4	1.5	1.4	0.9				57.2	(55.7)	2.1	
Song green glaze	32.2	4.8	1.1	0.6	2.5				54.8	(54.8)	2.8	
Ming green glaze	30.3	5.2	0.2	0.1	0.4		0.2		60.0	(60.0)	3.4	
Kangxi porcelain enamel	31.5	1.0	1.0	0.05	0.4	0.06	0.1		62.7	(62.7)	3.1	

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_20	MnO	CoO	PbO	CuO	SnO_2
Han mid-temperature glaze fromChangsha[31]	75.8	6.9	1.9	1.6	0.4	9.7	2.1	n.t.	n.t		0.7	n.t

Table 3. Eastern Han mid temperature glaze from Changsha

Glass in glazes

The beads and small jars described above seem to have been made in north China, but some use of ground glass in Chinese ceramic glazes might be suspected in some unusual Eastern Han wares, made in the south of China, in Hunan and Guangdong provinces and also in northern Vietnam. These contain no lead or barium oxides and may be China's first truly alkaline glazes (that is glazes fluxed largely with sodium and/or potassium oxides). However data at present are sparse and their implications ambiguous: for instance the use of kiln-ash slag may be another explanation for their unusual compositions. One sample tested proved high in potassium oxide – anticipating the use of potassa as a major glaze flux in Chinese ceramics by some five hundred years *(Table 3)*.[30]

The extent to which these remarkable high-potassium glazes continued to be used in the southern provinces of China remains unclear, as no post-Han examples are known at present. When alkaline glazes reappear in China they are in the north of the country and found on some rare turquoise *sancai* wares of the late 7th century-early 8th century – which implies a long break in this particular technical tradition.[32] Tang *sancai* turquoise-blue glazes have yet to be studied analytically, but some 14th/15th century turquoise earthenware glazes of Cizhou style from north China were analysed as part of major survey of Chinese alkaline-glazed wares, carried out in Oxford in 1986, a study that also examined some coloured glasses used in 17th century Chinese cloisonné enamels.[33] This work demonstrated

Table 4. 15th-16th cloisonné glasses and 15th-16th century fahua ware glazes of a similar type

Code	Colour	PbO	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	K_2O	Na_2O	CuO	CoO	MnO	SnO_2
15th-16th century Cloisonné glasses														
5a	Transparent enamel	29.5	47.5	0.3	0.3	0.1	6.0	-.-	12.7	0.6	-.-	-.-	-.-	-.-
5b	Turquoise enamel	29.0	49.0	0.3	0.2	-.-	6.0	-.-	12.6	1.0	2.6	-.-	-.-	0.1
Cloisonné-glass related Glazes used on a 15th-16th century fahua jar														
4a	Trans. Turquoise	32.5	51.1	0.9	0.2	-.-	5.0	0.3	7.4	1.0	2.2	-.-	-.-	-.-
4b	Transparent	30.0	54.1	0.7	0.2	-.-	6.1	-.-	8.4	0.9	-.-	-.-	0.1	-.-
4c	Pale mauve	30.1	54.1	0.7	0.1	-.-	6.5	-.-	8.5	0.9	-.-	-.-	-.-	-.-
4d	Translucent yellow	36.2	48.2	1.6	2.5	-.-	3.1	-.-	6.2	1.5	-.-	-.-	-.-	1.8

Vessel 4 15th/16th century northern fahua ware jar
Vessel 5 Cloisonné enamels on a 15th/+16th century incense burner

Figure 4. Cloisonné incense burner, 15th/16th century AD. The enamel compositions on this cloisonné vessel are very similar to those used on the fahua wine jar (diameter 11 cm). Victoria and Albert Museum, London.

that the early alkaline glazes on Cizhou wares from north China used lead-potassia fluxes. Truly alkaline glazes, where the flux was almost wholly potassium oxide, and the glazes nearly free from lead, were also used to glaze some northern figurines and southern porcelains in the 15th and 16th centuries.[34]

Glaze colouration in northern alkaline glazes developed from the familiar turquoise-blues from cupric oxide, to inky-blues and aubergines produced by additions to the glazes of high-manganese Chinese cobalts.[35] True purples were also achieved by mixing copper-tin colourants with the cobalt-bearing asbolites. These new colours made possible the imitation in ceramics of cloisonné enamelling on metal – but with the glaze-colours separated with lines of trailed slip, rather than by metal cloisons. The style began in north China (probably in Shanxi province in the early 15th C) and then spread to some southern porcelain kilns. These ceramics are known by the comparatively modern Chinese name of *fahua* ware, sometimes translated as 'designs within boundaries'.

On the basis of later ceramic practice in China it is assumed that most Chinese alkaline glazes were made not from ground glass, but from raw mixtures of quartz, crude potassium nitrate, the glaze colourant(s) and, sometimes, powdered lead ores.[36] This straightforward approach was facilitated by the low solubility of potassium nitrate, particularly in cold water.[37] Despite the visual parallels between *fahua* and cloisonné wares, the compositions of most *fahua* glazes appear quite distinct from cloisonné glasses in their essential compositions.

Another glass-ceramic connection

The word 'most' has been used here advisedly as one important exception to this principle emerged from the Oxford study in the form of an unusual fahua-ware jar in the Victoria and Albert Museum, London, dated to the late 15th - early 16th century. The glazes on this ceramic jar appeared very similar to some cloisonné coloured glasses found on a metal incense burner of the same date. This suggests that, in this particular case, true cloisonné-type coloured glasses may have been used to glaze a ceramic form.[38]

The presence of tin in the yellow *fahua* pottery glaze may be a relic of a lead-stannate yellow pigment used to colour the original glass. Lead-tin yellows were used in Chinese cloisonné glasses as early as the Xuande period, but not, apparently, in Chinese ceramic glazes until this point.[39] Where this unusual type of 15th-16th century *fahua* ware was made is still not known, although its body material and general style appear northern.

Later glass and ceramics connections in southern China

This rare example of glass influence on Chinese ceramics seems isolated and short-lived. Important glass-ceramic correspondences do not appear again in China until the Kangxi period, this time at the Jingdezhen kilns in Jiangxi province, and in the form of blue overglaze enamels. The French Jesuit missionary-scientist Father Francois Xavier d'Entrecolles describes a material called *tsiu* in his 1722 letter from Jingdezhen that was applied as a '…form of an enamel to works in silver'. This *tsiu* was powdered and mixed with water and '...a little animal glue if desired' to make an overglaze '*violet*' enamel for porcelain.[40] The more typical Jingdezhen overglaze enamel recipes described in Father d'Entrecolles' two letters were simple unfritted mixtures of white lead and quartz with oxide colourants – that is iron oxide for reds and yellows, copper oxide for greens, and a high-manganese cobalt ore for the aubergine colours.[41]

In this use of a lead-potassia ground glass, the Kangxi overglaze blue seems a technological forerunner of the *famille rose* palette that transformed the appearance of Jingdezhen porcelain in the Yongzheng period. Although the *famille rose* palette takes its name from the use of a translucent gold-pink colour two equally important contemporary innovations were the use of a lead-arsenate white and a lead-stannate yellow, together with the newly introduced cobalt-blue. All the *famille rose* enamels used lead-potassia glass bases, and the yellow and white colours were opaque. Our 1989 study showed that the lead-stannate yellow and the lead-arsenate white had been used in Chinese cloisonné technology in the 17th century before being adopted by enamellers of Jingdezhen porcelains.[42] This suggests that Chinese craftsmen could well have drawn on established Chinese coloured-glass traditions for some aspects of their new opaque enamel palette.[43] However, the first source for the eponymous pink may well have been European, before the colour was manufactured successfully in China.[44] These translucent and opaque colours transformed the appearance of Jingdezhen porcelain in the Yongzheng and Qionglai periods, and remain the basis of the Chinese overglaze porcelain enamelling today.

Other later uses of glasses in Chinese ceramics

The radical changes that occurred in the Jingdezhen overglaze-enamel palette, initiated in the late Kangxi period and consolidated during the Yongzheng era (1723-35), were paralleled by some important advances in high temperature glazes, such as the imitations (made to imperial order) of Song Jun wares at Jingdezhen. These seem to have been first commissioned by the Beijing court in 1729 and qualitative analysis suggests that they were high-temperature glazes coloured with copper, but with small lead oxide additions.[45] Some examples resembled copper-red glazes of the *flambé* style, and this hybrid technology seems to have been adopted later at Jingdezhen to make the plain but very glossy monochrome copper-reds, characteristic of the later Qing dynasty. Glazes of this style are still made at Jingdezhen where they known to their makers as 'Jun reds'.[46] Through the agency of Consul F. Scherzer in the late 19th century the French scientist Georges Vogt analysed the raw materials used for late Qing copper-red monochromes, together with samples of prepared glazes and the fired copper-red porcelains themselves. Vogt's work at the Sèvres National Factory at the end of the 19th century showed how four types of glass had been used in the copper red glazes' construction – one of which ('glass beads') was directly comparable to a fluoride-opacified 17th century- cloisonné enamel glass, analysed at Oxford in 1986 *(Table 5)*.[47]

Figure 5. Left, porcelain vase with imitation Jun glaze. Jingdezhen kilns, Qianlong Period, mid 18th century (height: 20.3 cm). Victoria and Albert Museum. C.407-1910. Right, porcelain vase with flambé glaze. Jingdezhen kilns, Qianlong Period, mid 18th century (height: 24 cm). Victoria and Albert Museum, London. C. 413-1910

Guangzhou glazes

The last 'case study' in this survey of the involvement of glass in Chinese ceramic history concerns the use of soda-lime glass with small additions of clay. This approach to glaze making has been shown to have been practised at the Guangdong kilns of Shiwan and Foshan in the later Qing dynasty – although the origins of the technique may pre-date this time considerably. This

Table 5. Late 19th century Jingdezhen copper red glaze and some of its Chinese glass ingredients (Data from Vogt, 1900, and Henderson et al, 1990.)

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	MnO	CuO	F	PbO
1882 Cu-red glaze, before firing	61.5	4.4	0.85	7.4	1.6	5.8	2.8	0.25	0.6	1.7	12.7
1882 Cu-red glaze, after firing	70.2	6.5	0.9	8.0	1.65	4.8	2.7	0.15	0.5	-.-	3.9
Low-lead glasses 1882											
Artificial jade	57.8	2.6	0.5	18.2	4.5	9.3	2.5	0.02	0.06	4.6	0.9
'Pa-li' Bottle glass	60.5	4.4	1.75	20.4	4.2	1.1	5.4	0.45	-.-	-.-	0.3
Higher-lead glasses 1882											
'Ting-leao' Lead glass	57.7	1.4		0.65	0.3	7.6	0.5				32.0
Glass beads	54.7	1.4	0.6	5.4	1.0	7.9	5.5	0.04	0.08	1.0	21.0
Chinese white cloisonné enamel 1625-1650	54.6	2.2	0.1	6.7	0.1	6.9	8.3			found	21.0

Table 6. Analyses of Shiwan glass-based glazes, early Qing dynasty[48]

	SiO_2	Al_2O3	Fe_2O_3	TiO_2	CaO	MgO	K_2O	Na_2O	CuO	ZnO
Shiwan 'Cucumber green'	72.0	1.3	0.7	-.-	12.7	0.8	1.55	7.2	2.3	1.1

Figure 6. Shiwan green-glazed jar. Late 19th century Stoneware with a mid temperature glaze (height: 15 cm). Author's collection.

approach to glaze construction was essentially that pioneered in Mesopotamia in the mid second millennium BC – and practised thereafter in the Near East to the present day. However more clay (c. 20%) was used in the Chinese glazes than the Near Eastern examples, which took the maturing temperatures of the Chinese glazes towards the stoneware range (c. 1200°C). Such glazes were often made from mixtures of powdered glass and mud from the Pearl River, and were used particularly at Guangzhou to make white and green glazes, the latter being coloured with oxidised brass. The low alumina levels of these glazes, a result of their high glass contents, pre-disposed their compositions to glass-emulsion effects in cooling, creating milky-white and milky-green colours where the glazes were thick.

Conclusion

China is essentially a country of high-temperature ceramics, with the main course of its ceramic development depending on high-temperature firings and the processing of insoluble materials such as igneous rocks, clays and prepared wood-ashes. Nonetheless, glass can now be associated with some important advances in China's ceramic history. These include China's first low-fired glazes in northern China, the major revolution in overglaze enamel technology that occurred at Jingdezhen in the 18th century and the glass-clay mixtures used in more modern times in south China, at stoneware centres such as Shiwan and Foshan. Although much remains to be clarified on this subject, glass can now be seen to have played a number of significant roles in China's ceramic history – despite the relative rarity of the material in China's material culture.

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