A Chinese bowl, probably 700 years old

The connoisseurs of ceramics in Song dynasty China (roughly from the 11th to 13th centuries AD) used to divide pottery into two types – Imperial wares, which were made under order for the imperial palaces and were delicate, refined and often exquisitely made, and more solidly made pottery made for everyday use by more ordinary (although often wealthy) people. The whole focus of their attention was the Imperial wares. Later, in the Ming dynasty (around the 15th and 16th centuries) connoisseurs talked about the 'five great wares' of the Song dynasty. Four of these were Imperial wares, but one was actually a popular ware, admired for its beautiful glaze. That was Jun pottery (previously spelt Chun), of which this bowl, 18 cm wide, is an example.

The glaze on Jun pottery is typically pale blue, often with a lavender hue. It is thick and has a milky appearance, with fine details that can make you feel that you are looking into its depths. Sometimes, though not on this bowl, swipes of deep red were added by brushing on something containing copper oxide. Surprisingly, the source of the blue colour in the Jun glaze was only discovered in the 1970s. Books before that date stated with apparently complete confidence that the blue colour came from iron in the glaze. However, examining the glaze at very high magnifications, using electron microscopes, revealed a completely different cause.

Researchers found that the glassy layer which made the glaze consisted of a mixture of two different components (or phases) with different compositions. Blobs of one phase were effectively suspended in the other and these blobs were less than a ten thousandth of a millimetre in size, which is smaller than could be seen in an ordinary microscope. Particles this small, distributed throughout the glaze, are effective in scattering light through a process known as Rayleigh scattering. This is the same process that causes the sky to appear blue – in Rayleigh scattering the amount of light scattered is greater at shorter wavelengths, so the blue parts of white light are scattered more than the red.

This separation into two phases happens in many types of glass, depending on the proportions of the different oxides that the glass is made of. It takes place on such a fine scale due to an effect with the rather nice name of spinodal decomposition. I remember learning about spinodal decomposition

at university, little thinking I would be talking about it fifty years later in the context of ancient pottery. Maybe you will be relieved that I have resisted the temptation to explain the effect here.

In glasses alumina tends to inhibit this effect and this is probably the reason that the Jun glazes contain slightly less alumina than Song dynasty celadon glazes from the same region. Tests on glasses of different compositions have shown that this change in alumina content is enough to cause the phase separation and the blue colour. It is also likely that the effect is amplified by the presence of phosphorous, which came from ash in the original glaze mixture. Without understanding any of this the Song potters must have maintained very close control of their glaze compositions to produce their Jun glazes reliably. The effect is so sensitive to composition that if the glaze is too thin then extra alumina diffusing into the glaze from the clay body is enough to stop it. This can be seen in my bowl at the rim (see photo at start of this note) and in thin areas of glaze near the foot, where the glaze becomes a translucent brown colour.

As the Jun glaze effect required a thick layer of glaze, experts used to presume that the Song dynasty potters achieve this thickness by building up multiple layers when they were applying the glaze material. However, microscopic analysis has since shown that the thick Jun glaze was all applied in one layer. Excavations of the Jun kilns have found shards of biscuit-fired pottery, indicating that Jun pottery tended to be fired twice (before and after application of the glaze material). It seems likely that one reason for this was that you can immerse biscuit-fired pottery in a glaze suspension and leave it there long enough to build up a thick layer of glaze. With an unfired bowl the absorption of water from the glaze suspension would cause it to disintegrate.

In fact the body of my bowl is still quite porous after its glaze firing, as is quite common in Jun pottery. The porosity of much Jun ware led to the suggestion that it was fired below 1100^{o}C, more like earthenware, but we now know this can’t be true as the Jun phase separation effect occurs on

cooling from higher temperatures than this. The solution to this conundrum came when the clay of Jun pottery was analysed chemically. It turns out that it has more alumina and less flux than typical stoneware clays, meaning that it would probably not vitrify fully at the higher temperatures.

The other important component of this complex glaze is bubbles, probably generated from gases formed when phosphates from the ash in the glaze decompose during firing. A Jun glaze is full of tiny bubbles which contribute to its opacity and help to give it a sense of depth. In most glazes, bubbles which form during firing rise to the surface and burst, leaving a momentary hole which heals over. However, if the glaze layer is thick and it is viscous during firing the bubbles can't move easily towards the surface. If fact, the Jun potters did tend to have a problem with pits caused by larger bubbles bursting at the surface. My bowl has a couple of these.

Pottery which exploited these opalescent glaze effects had been made in China before Jun ware was made, but this had always been done by splashing ash-based glaze in patches on pots. In fact the potteries in northern China which made Jun ware had previously made black pottery with these distinctive opalescent splashes. It appears that in the Song dynasty, with its increased aesthetic interests, the potters decided to try making pots which were completely covered with this sort of glaze. The north of China was always susceptible to invasions from tribes on the northern borders and in the middle of the 12th century one such tribe invaded, destroying the potteries and taking control of the region for a hundred years. It seems that the Jun pottery was to the taste of the new rulers, for many of the potteries were active again by the end of the 12th century, producing similar wares but with slight differences in design details. When the Mongols swept through all of China in the 13th century Jun pottery became even more popular and it continued to be made until at least the late 14th century.

My bowl has a very characteristic shape for Jun pottery, and this shape of bowl was made over a long period. It has a number of features which suggest that it was made after the 12th century, mostly to do with the foot of the bowl, which is unglazed, flares out slightly and has concentric turning marks inside the foot-ring. The foot of an old pot can often provide information on when and where it was made and can sometimes be a good check on authenticity.

You can see that there is some Chinese writing faintly visible inside the foot-ring of my bowl. If any of you can decipher this please let me know. One possibility is that this identifies the maker so that the pot can be fired in a communal kiln without any confusion.

As I mentioned at the start, in the Ming dynasty admiration grew for the Jun ware made in earlier times. This enthusiasm really took off in the subsequent Qing (pronounced Ching) dynasty (broadly from the 17th to 19th centuries) and many potters attempted to re-create the Jun glaze. In fact in the 18th century the imperial factory at Jingdezhen had a workshop dedicated to recovering the art of making Jun glazes. At various places in China this led to the development of new brightly coloured opalescent glazes, such as the flambe glaze, subsequently used extensively at Sevres in the 19th century and by Royal Doulton in the 20th century. The flambe glaze can be viewed as a development of the red copper-coated areas found on some Jun pots. One place in China where this glaze was developed was Shiwan, near Guangzhou. About ten years ago I visited Shiwan and I remember standing in a huge pottery showroom surrounded by many different shapes of pot, all covered in bright flambe glaze in different shades of blue, purple and red.

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