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Base glazes

Glossy and matt glazes

When silica, fluxes and alumina are combined in a eutectic mixture and fired to a high enough temperature, a glossy transparent glaze results. In a eutectic, the melting temperature is lower than that of either of the component materials (silica or alumina) alone. A combination of several different fluxes also helps to melt the glaze. In glossy glazes, the alumina to silica ratio should be around 1:9. A stiff, stable glaze with a ratio of around 1:7 is preferable for painting with oxides or underglazes. To make the glaze matt, excess alumina can be added so that the alumina to silica ratio is around 1:5. The addition of any of the alkaline earths (calcia, magnesia or baria) can also cause the glaze to become matt. Any excess material not involved in the melt remains suspended in the glass or crystallizes out on cooling. Crystals form in fluid glazes with low alumina. More crystals grow if the glaze is cooled very slowly. These crystals are often calcium or magnesium silicate and can cover the surface forming a smooth, matt texture. When there are only a few crystals in an otherwise glossy glaze, they are called 'floating crystals' and are often a different colour from the glaze in which they are growing

LEFT: *Wavy spiral*, Roger Lewis, 2006. Slab-built stoneware, layered dolomite glazes with rutile and zirconium, nickel and chromium oxides, height 50cm. *Photo: Roger Lewis*.

RIGHT: Extruded stoneware vase, Tom Butcher, 2009. Reduction-fired with matt glaze, showing crystals on the rim. *Photo: Rosie Brown*.

Lidded jars, Sue Ure, 2009. Thrown jars with glossy and matt glazes and lustre, height 17cm, fired to 1260C. *Photo: Evan Brett*.

Adding rutile to a runny glaze can encourage streaking and mottling. The rutile acts as an opacifier and appears blue, particularly on stoneware fired in reduction. Phosphorus, found in bone ash and wood ash, and calcium borate can also cause opalescence.

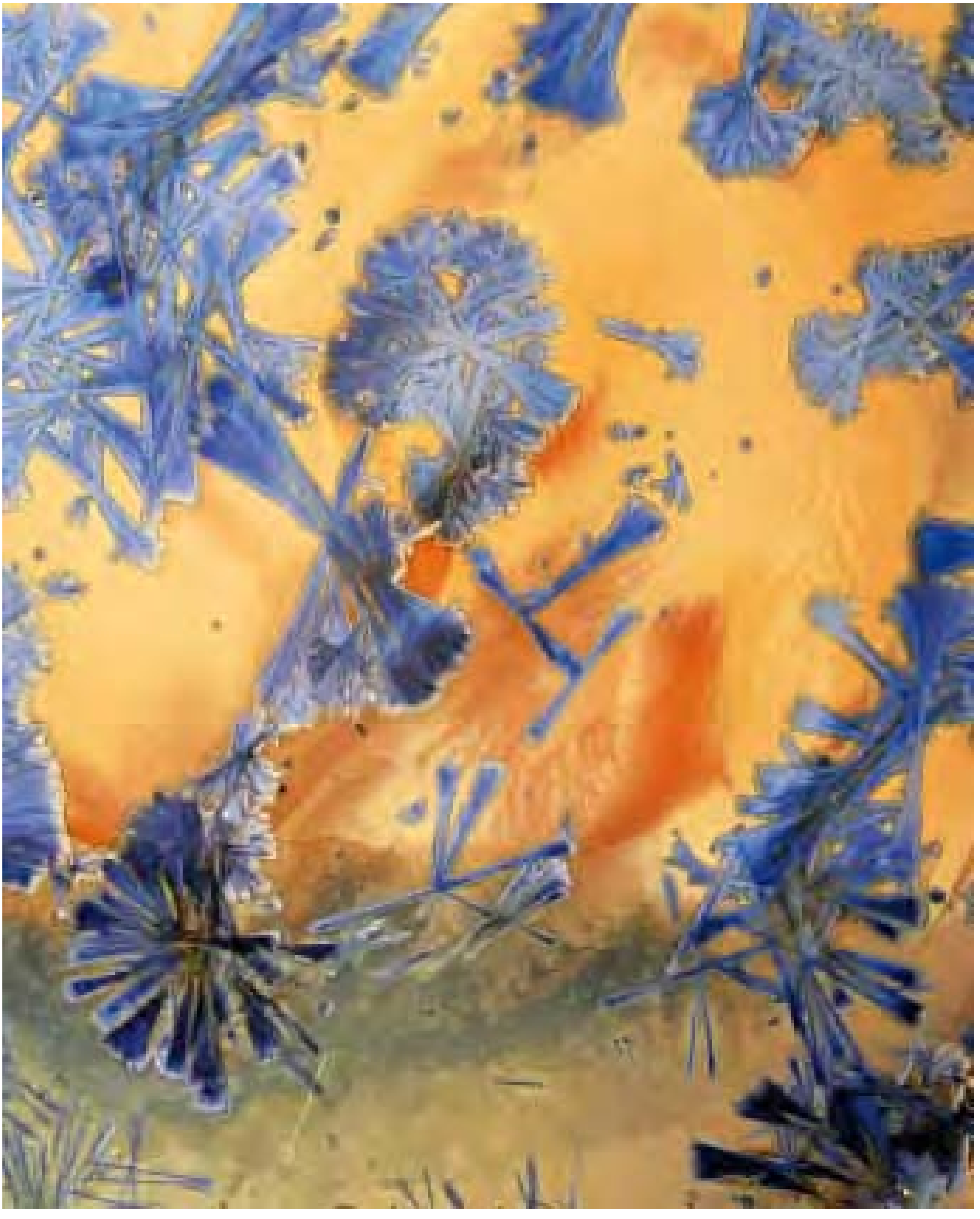
Crystalline glazes

In glazes containing excess zinc oxide and very low alumina, large zinc silicate crystals can be grown on cooling by holding the glaze at 1100°C for several hours. These glazes are very runny and often contain titanium to help seed the crystals. The crystals are coloured with oxides, and usually take up certain oxides in preference to others. For example, cobalt and copper will give blue crystals on a green background. Nickel oxide colours the crystals steel blue, and manganese colours the crystals pink in the absence of cobalt or nickel. Chromium oxide is not used in zinc silicate glazes, as it turns brown in the presence of zinc. Crystalline glazes are fired on specially made dishes to catch the runny glaze. These are removed after firing and the foot ring ground until smooth.

Crystalline glaze, 1260°C (cone 8) oxidation (Avril Farley)

Ferro frit 3110	47
Calcined zinc oxide	23
Calcined china clay	3
Flint	23
Titanium dioxide	4

RIGHT: Crystalline glaze detail, Avril Farley, 2004. Zinc silicate glaze with cobalt and erbium oxide, fired to 1255°C, then re-fired to 800°C to change the background colour from lavender to orange. *Photo: Martin Avery*.



Slip glazes

Colourants are sometimes added to slips, which can be applied to unfired ware. This is less expensive than colouring the entire clay body. The colouring oxide in the slip causes the overlying glaze to become coloured. The amount of colouring oxide or stain required to colour slips is relatively high, around 10%. Slip glazes, sometimes called engobes, are vitreous slips that contain some feldspar and can be applied to biscuit ware.

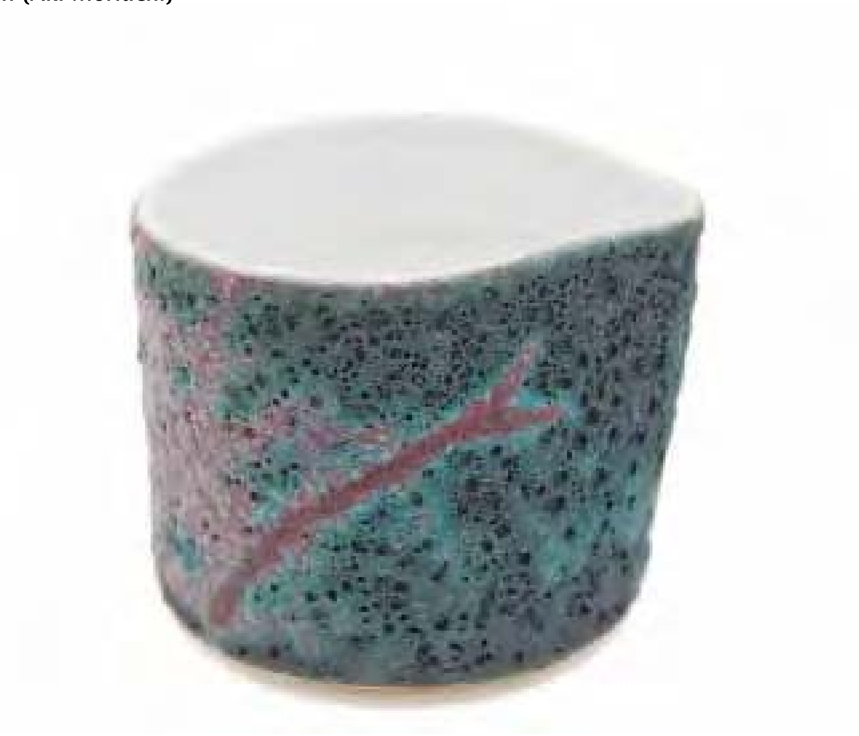
Potters can make other types of 'special effects' glazes by enhancing various types of glaze faults, such as crazing, crawling or pinholes. Crazing occurs in glazes high in sodium and potassium where the glaze shrinks more than the clay body on cooling. This forms a network of fine cracks called crackle glaze. Crawling occurs in glazes high in alumina, zinc oxide or magnesium carbonate, and is often a feature of wood-fired Shino glazes. Pinholes are caused when bubbles of gas escape from the molten glaze without healing over. They can occur in thickly applied matt glazes, or those containing zinc oxide.

Crater glazes

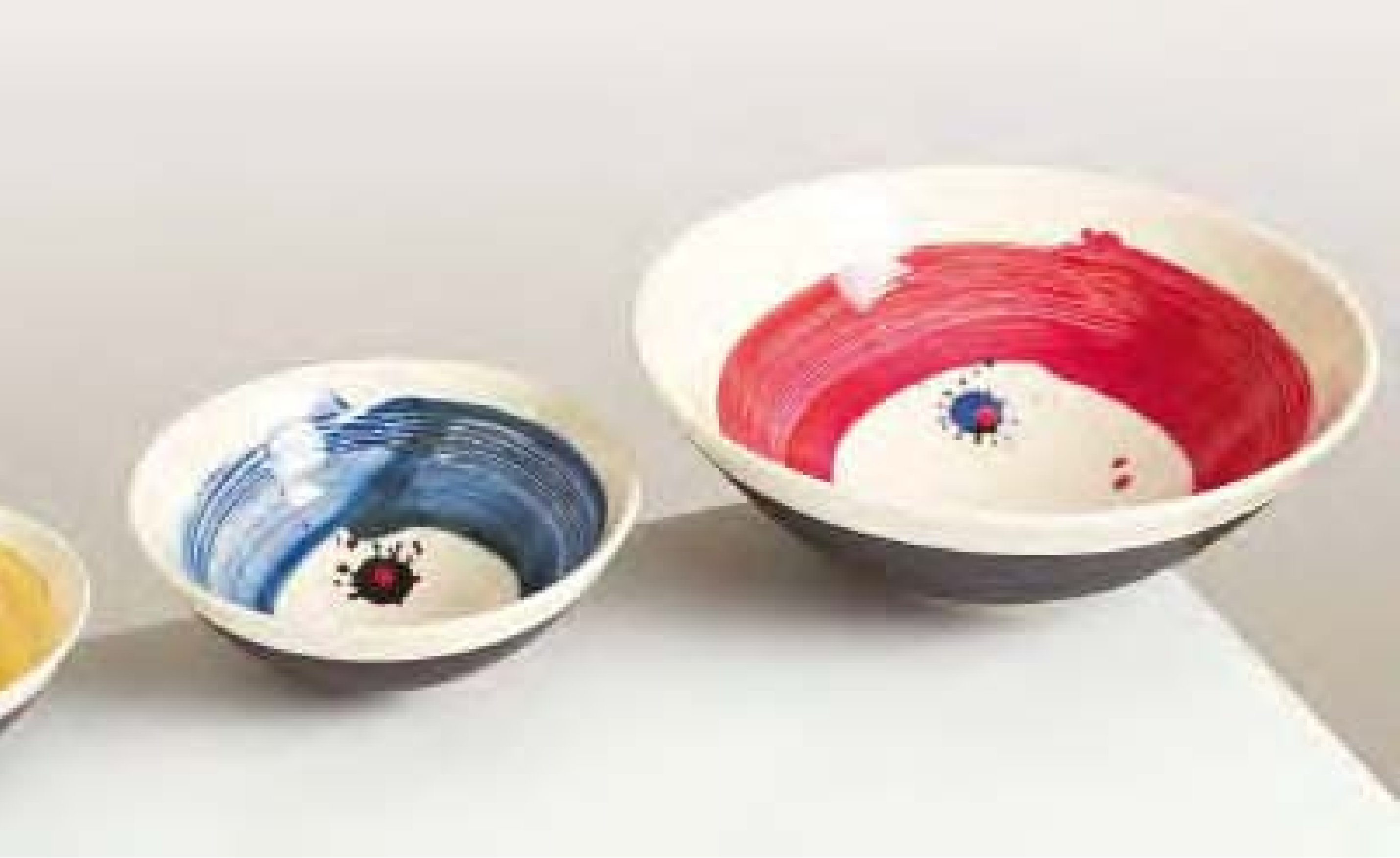
If silicon carbide is added to a viscous matt glaze, craters form when carbon dioxide is given off during firing. Silicon carbide also causes local reduction in the glaze, causing copper to turn red owing to the lack of oxygen available

Crater glaze 1280°C, cone 9 oxidation (Aki Moriuchi)

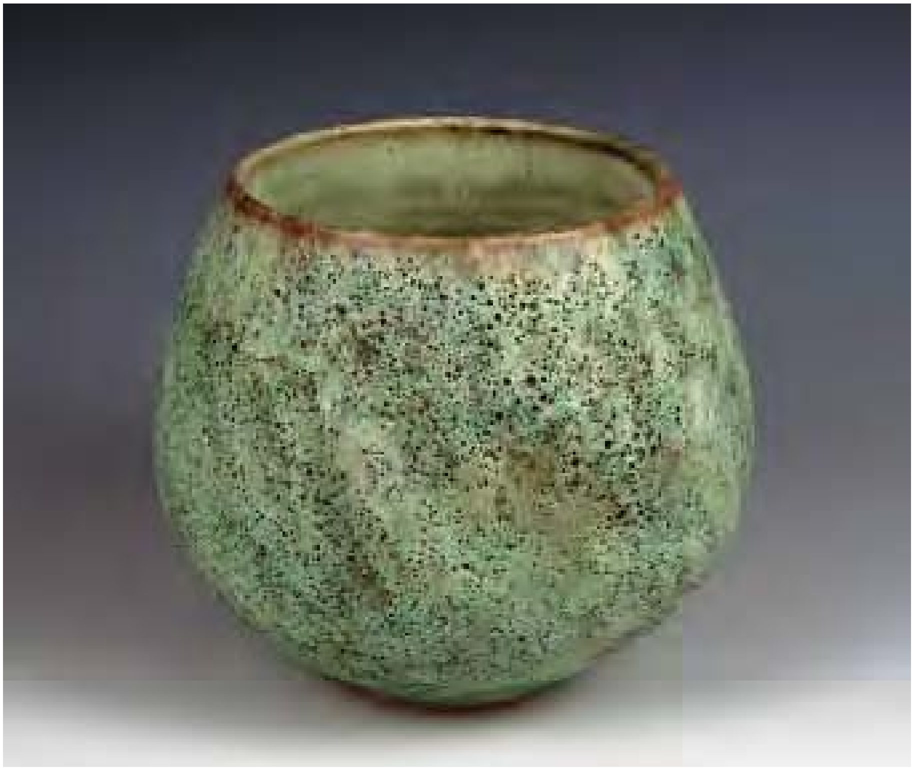
Nepheline syenite	60
Barium carbonate	18
China clay	11
Flint	13
+	
Silicon carbide	4



Moss jug, Carys Davies, 2010. Copper carbonate slip under crater glaze on porcelain, height 5cm. The copper turns red where reduced by the silicon carbide in the glaze. *Photo: Carys Davies*.



Three bowls, Chris Taylor, 2009. Thrown earthenware, coloured slip glazes, black slip, red underglaze, clear leadless glaze, bisque-fired to 1115°C, then glaze-fired to 1055°C, with a two-and-a-half-hour soak and slow cool. *Photo: Nick Clark*.



Volcanic vessel, Andrew Palin, 2008. Stoneware with copper, manganese, iron oxide and silicon carbide slip and matt glaze, fired to 1260°C, height 14cm ($5^1/_2$in). *Photo: Andrew Palin*.

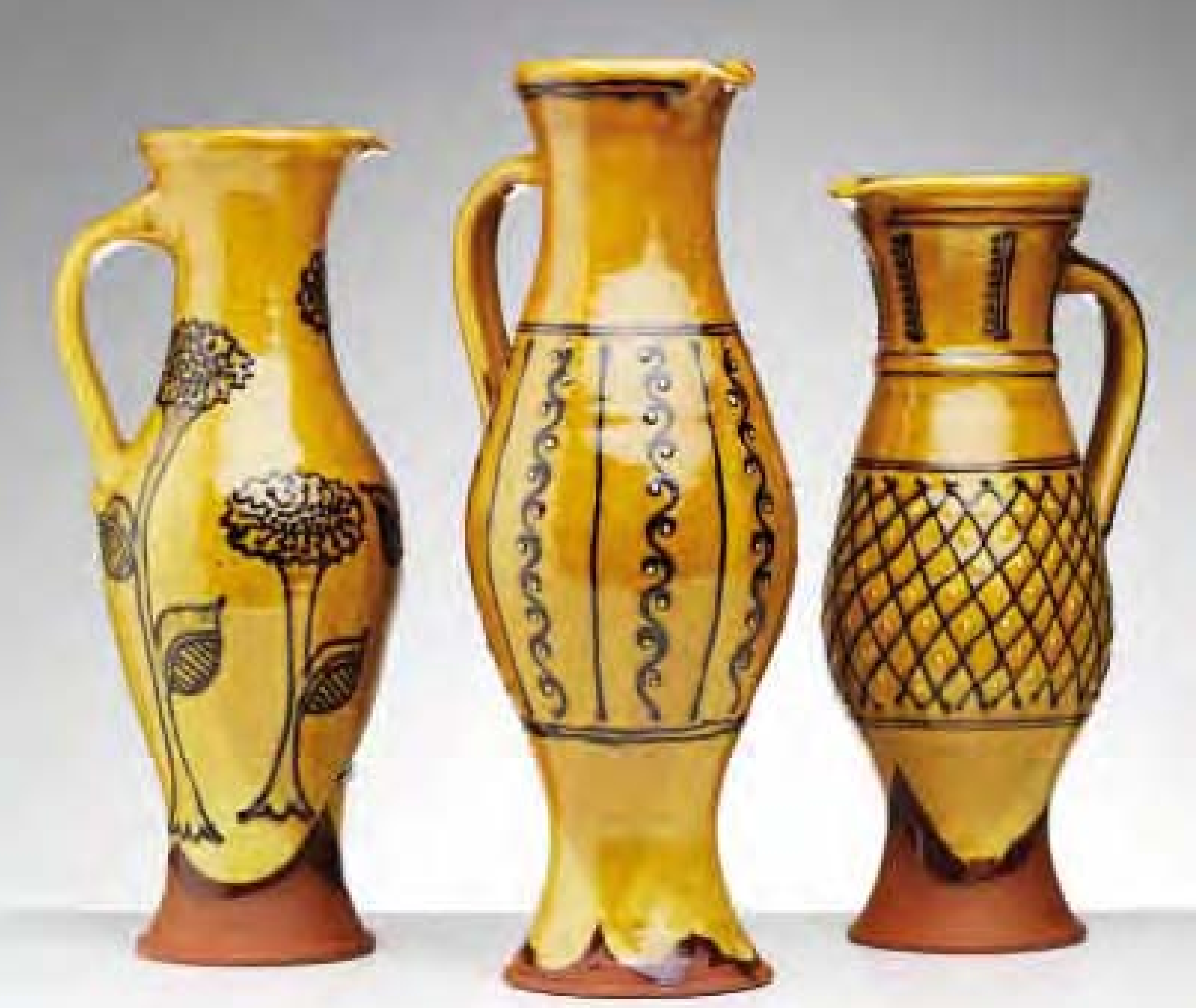
Yellow glazes

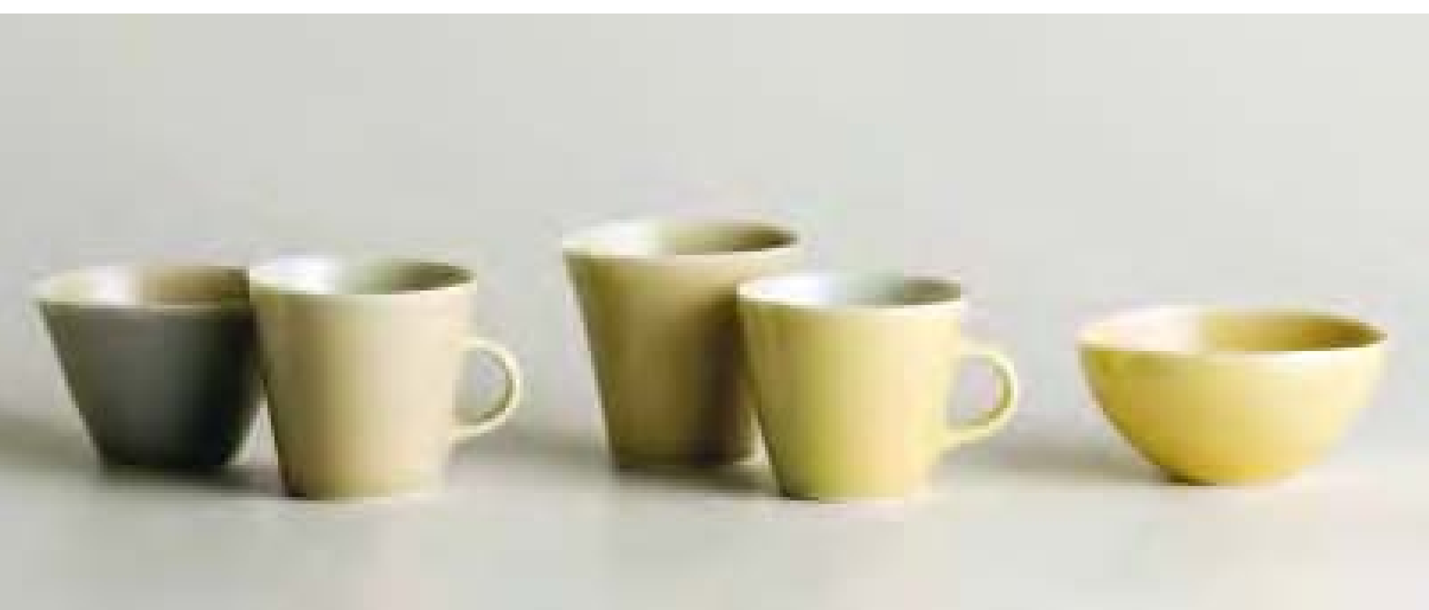
When fired in oxidation, a small amount (1–5%) of iron oxide gives a honey- or amber-yellow colour. Iron oxide in a barium glaze high in zirconium will also give a yellow colour in reduction. Iron oxide was used in low-fired yellow porcelain glazes in Imperial China, and also in lead slipware glazes in 17th-century England and France. Lead antimonate was used to give a bright yellow on low-temperature Maiolica ware made in Renaissance Italy. Vanadium and tin oxide are also used to make a yellow stain that can be used at higher temperatures than antimony, but which does not give such a bright yellow. Chromium oxide gives yellow in low-temperature lead glazes fired to around 1050°C (1922°F). Uranium oxide was used as a high-temperature yellow colourant in the early 20th century, but it is now unavailable owing to its radioactivity. Cerium and titanium give a creamy yellow, as does rutile. A small amount (1–3%) of nickel and 10% titanium can produce a mustard yellow.

To obtain bright yellows, it is necessary to use a commercial stain. Praseodymium oxide and zirconium silicate are often used to make yellow stains, although they are not as strong as cadmium-sulphide yellows, which are bright orange-yellow. Zinc sulphide is added to cadmium sulphide to make light primrose-yellow stains.

Slip Trailed Baluster Jugs, Hannah McAndrew, 2010. Earthenware covered with white slip and lead glaze. The decoration is trailed with a black slip containing iron and manganese. *Photo: courtesy of Shannon Tofts*.

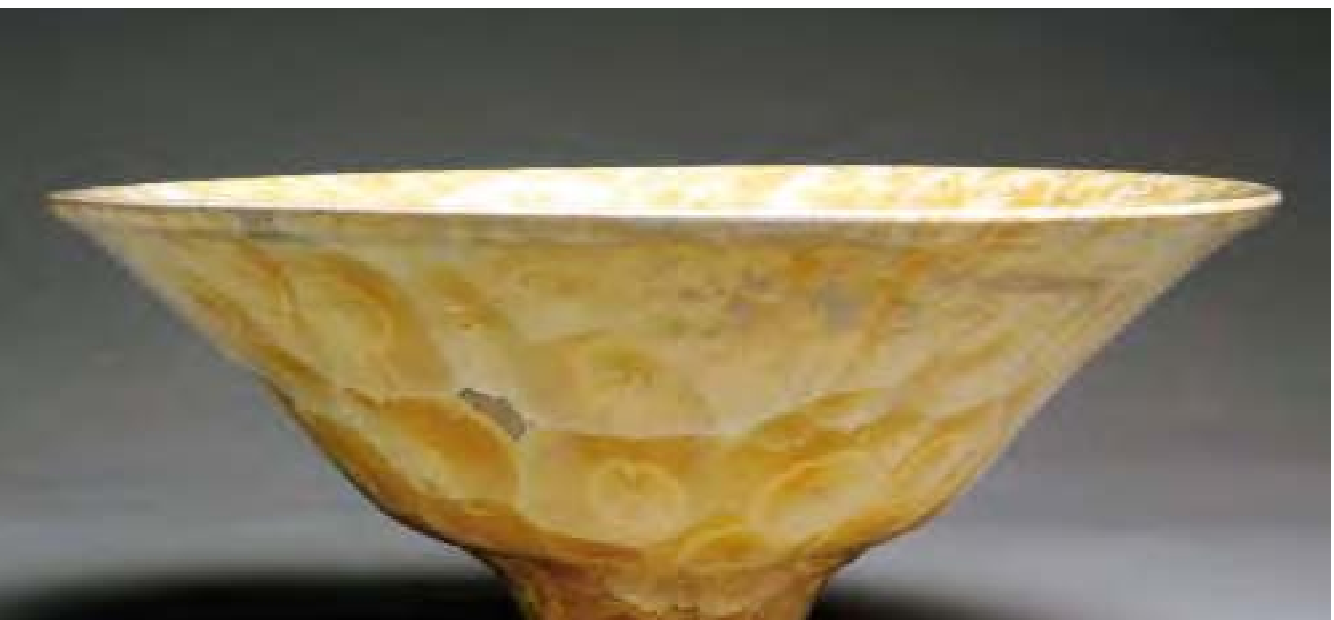
BELOW: *Yellow parade with grey bowl*, Gwyn Hanssen Pigott, 2008. Reduction-fired porcelain. *Photo: courtesy of Brian Hand*.





Bowl, Lucie Rie, 1970s. Uranium-yellow porcelain bowl with manganese on rim. Private collection. *Photo: Henry Bloomfield*.

BELOW: *Porcelain bowl*, Avril Farley, 2005. Zinc-silicate crystalline glaze, cerium oxide and rutile glaze. *Photo: Martin Avery*.



Yellow glazes for earthenware 1000-1100°C/1832–2012°F (cone 06-02)

Cadmium yellow glaze, 1060°C/1940°F (cone 04) oxidised (John Solly)

Calcium borate frit	39
Soda feldspar	27
Whiting	5
China clay	6
Quartz	23
+	
Yellow stain	5

Cadmium sulphide zirconium silicate stain ($CdSZrSiO_4$)

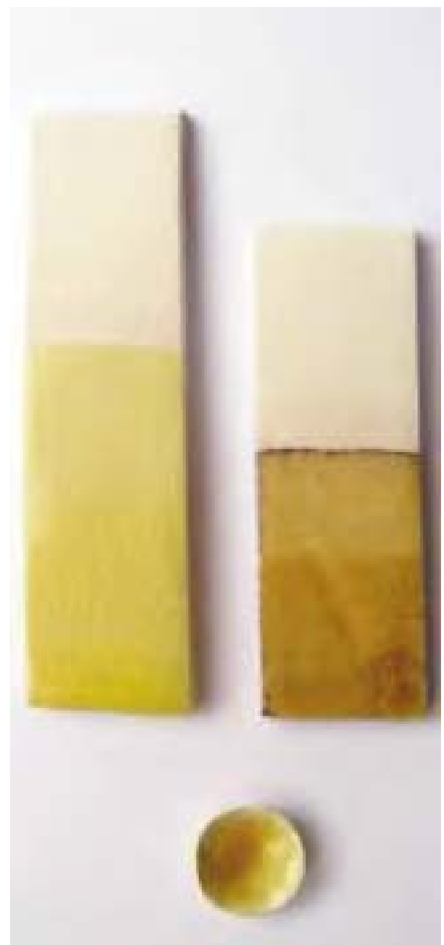
Praseodymium-zirconium yellow, 1060°C/1940°F (cone 04) oxidised (Lok Ming Fung)

High-alkaline frit	75
China clay	15
Flint	10
+	
Yellow stain	5

Zirconium praseodymium silicate stain ($ZrPrSiO_4$)
(Potterycrafts Canary yellow P4140)

Iron honey-yellow, 1060°C/1940°F (cone 04) oxidised

High-alkaline frit	75
China clay	15
Flint	10
+	
Red iron oxide	10



Praseodymium-zirconium yellow, from Lok Ming Fung. Left to right: stain yellow, iron yellow. Disc: iron yellow over stain yellow, showing glazes overlapping.

Yellow glazes for stoneware and porcelain, 1240-1280°C/2264–2336°F (cone 6-10) oxidised

Yellow-cream transparent, 1280°C/ 2336°F (cone 9) oxidised

Potash feldspar	26
Whiting	20
China clay	19
Quartz	30
Calcium borate frit	5
+	
Rutile	2.5

Bright yellow, 1280°C/ 2336°F (cone 9) oxidised

Potash feldspar	27
Whiting	21
China clay	20
Quartz	32
+	
Yellow stain	4

(Cadmium sulphide zirconium silicate stain ($CdSZrSiO_4$))

Orange-yellow opaque, 1260°C/2300°F (cone 8) oxidised

Potash feldspar	34
Talc	22
Whiting	12
China clay	15
Quartz	16
+	
Rutile	7
Tin oxide	5

Barium yellow matt, 1240–1260°C/ 2264–2300°F (cone 6–8) oxidised (John Britt)

Nepheline syenite	42.5
Dolomite	15.5
Barium carbonate	24
China clay	9
Quartz	9
+	
Zirconium silicate	19
Red iron oxide	3.5

Tan-yellow transparent, 1280°C/ 2336°F (cone 9) oxidised

Potash feldspar	27
Whiting	21
China clay	20
Quartz	32
+	
Rutile	5

Nickel-titanium yellow matt, 1260°C/2300°F (cone 8) oxidised

Potash feldspar	33
Talc	21
Whiting	12
China clay	15
Quartz	16
Zinc oxide	3
+	
Nickel oxide	3
Titanium dioxide	10