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Author(s): J. Henderson and J. Raby

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The technology of fifteenth century Turkish tiles: an interim statement on the origins of the Iznik industry

J. Henderson and J. Raby

There are few ceramic traditions which can rival the tiles and pottery of Ottoman Iznik in the sixteenth century. The tiles provide a fitting accompaniment to the mosques and pavilions of the capital, Istanbul, and both pottery and tiles reflect the successive stylistic phases of Ottoman court art, from the tight, introverted arabesque compositions of the first decade, to the bold naturalism of the second half, of the sixteenth century. The changes in motifs and compositions are matched by changes in colouring, from blue-and-white, to a subtle palette of two blues, purple and sage green, to a vibrant polychromy characterised by relief-red. Yet throughout these changes the technical features of body and glaze remained the same – a silica body, a finely ground silica slip, underglaze pigments, and a colourless, transparent glaze (Lane 1957a; 1957b).

The body, as Julian Henderson explains in more detail below, was an artificial compound of ground silica, a small proportion of white clay and a glass 'frit'. It was the finest fritware body produced in the Islamic world since the ceramics of thirteenth century Kashan in Iran. The technique of the Kashan potteries is fully described in a treatise written in 700/1301 by Abū'l Qāsim al-Qāshānī, a member of the most prominent tile-making family of Kashan (Allan 1973). No equivalent treatise survives for Ottoman Iznik, and it is only recently that laboratory analysis has established the characteristics of the Iznik body and glaze (Kiefer 1956a, 1956b; Kingery and Vandiver 1986; Tite n.d.). The crucial discovery is that the Iznik body differs from all other known Islamic fritware traditions in using an alkaline-lead, rather than alkaline-lime, frit. This distinction raises questions about the genesis of the Iznik fritware tradition, and with it questions about the relationship between tile and pottery production in the fifteenth century.

Tiles

For our present purposes we can divide tile production in Turkey into four phases, each corresponding roughly to a century.

The first corresponds to the rule of the Anatolian Seljuks. Although there are a few tiled monuments from the twelfth century, the period of greatest activity was the

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Table 1 Date, site and characteristics of tiles analysed.

No.	*Date*	*Site*	*Frit type*	*Inclusions lead*	*Inclusions tin*	*Glaze*
1	1271	Sivas, Gök Medrese	Frit NF	–	–	soda-lime silica (purple)
2	1425–26	Bursa Murad II Camii (ceramic mark from outside entrance)	Alk-lime	–	–	N/A
3	c.1433	Edirne, Muradiye	Alk-lime	+	+	N/A
4	c.1433	Edirne, Muradiye (blue and white border tile)	Frit NF	–	–	N/A
5	1440–1	Edirne, Imaret-i Mezid Bey (Yeşilce) Cami	Alk-lime	+	–	Lead oxide -soda-silica+ tin (turquoise)
6	1473	Istanbul, Çinili Köşk	Alk-lime	–	–	Lead oxide-soda-silica+ tin (turquoise)
7	1479	Bursa, Cem Sultan Türbesi (gilded tile)	Alk-lime	+	–	N/A
8	1474	Istanbul, Mahmud Paşa Türbesi	Frit NF	–	–	Lead oxide-soda-potash-silica+tin and lead oxide -silica+tin (turquoise and black).
9	1496	Amasya, II Bayezid Camii	Alk-lime	+	–	N/A
10	1506–7	Bursa, Şehzade Mahmud Türbesi	Lead-alk	+	–	Lead oxide-soda-silica+ tin (dark blue)
11	c.1512–13	Bursa, tomb of Şehzade Ahmed (hexagonal monochrome tile)	Alk-lime	+	–	Lead oxide-soda-silica + tin (turquoise).
12	c.1512–13	Bursa: tomb of Şehzade Ahmed (blue-and-white border tile)	Alk-lime	+	–	Lead oxide-soda-silica + tin (blue and white)
13	1520	Istanbul Yavuz Selim Türbesi	Lead-alk	–	–	N/A
14	c.1600	Iznik tile	Lead-alk	+	–	Lead oxide-soda-silica + tin (polychrome)

Alkali-lime (Alk-lime) frits are poorly developed in comparison with lead-alkali (Lead-alk) frits; where the tile analysed is shown as having no frit (NF = not found) this means that no glassy phase was detected in the tile body.

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thirteenth century, which saw the importation of Iranian techniques and styles. One of the most accomplished groups of tileworkers working in Seljuk Anatolia was connected with an architect who was originally from Tus in Turkestan (Meinecke 1976). There is evidence that some of the tiles produced in Seljuk Anatolia used a frit technique comparable to that employed in contemporary Iran, that is, an alkaline-lime frit, with no trace of lead, and an alkaline glaze (Kiefer 1956a; Meinecke 1976: I,156–7). Even this was not standard, however, because analysis of a fragment from the Gök Medrese in Sivas dated to 1271 reveals that it had a clay body, with no trace of frit, let alone the lead inclusions which characterise the Iznik body (Table 1, no.1).

The end of the thirteenth century saw the collapse of Anatolian Seljuk power and the rise of small principalities, from among which the Ottoman was to prove triumphant. The last major monument to be decorated in the Anatolian Seljuk tile tradition was in Beyşehir for the dynasty of the Eşrefoğulları between 1296 and 1301 (Meinecke 1976: I, 74–5). In the early fourteenth century the Ottomans occasionally used tiles, but these were unrelated to the Anatolian Seljuk tradition. They appear to have been made by potteries which otherwise produced lead-glazed earthenware, because they used a red clay body, and were fired horizontally, separated by tripod stilts, which have left tell-tale cockspur marks, a feature which is not otherwise found on Islamic tilework, but which is typical of fourteenth and fifteenth-century earthenware pottery (Meinecke 1976: I, 99–100; Aslanapa 1964–5).

Although the tiling of the minaret of the Green Mosque in Iznik sometime between 1378 and 1391 indicates a more ambitious approach to tilework by the end of the fourteenth century, the great change took place in the 1410s with the arrival of a group of artists from Iran who styled themselves the 'Masters of Tabriz' (Fig.1). Ottoman tilework in the fifteenth century was to be dominated by the workshop of the Masters

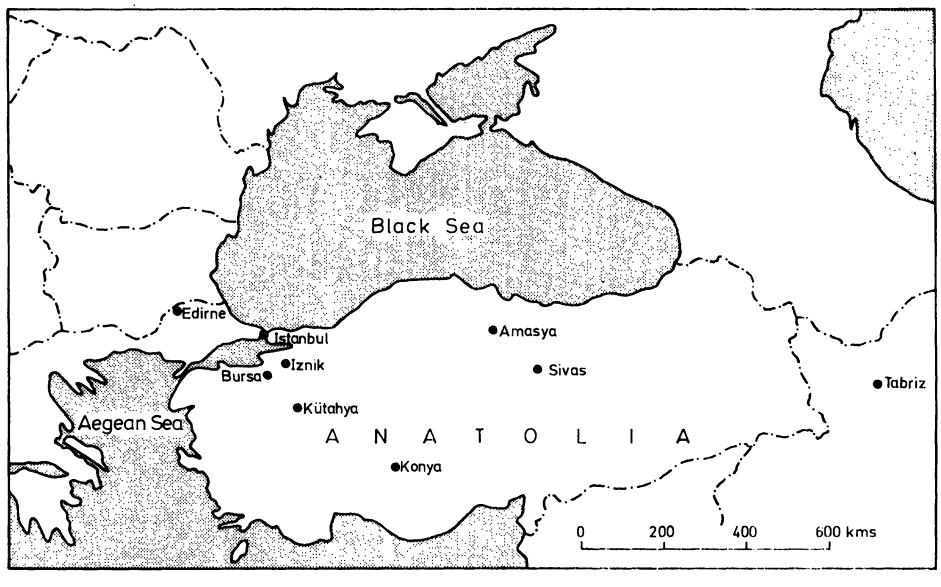

Figure 1 Location map of sites mentioned in the text.

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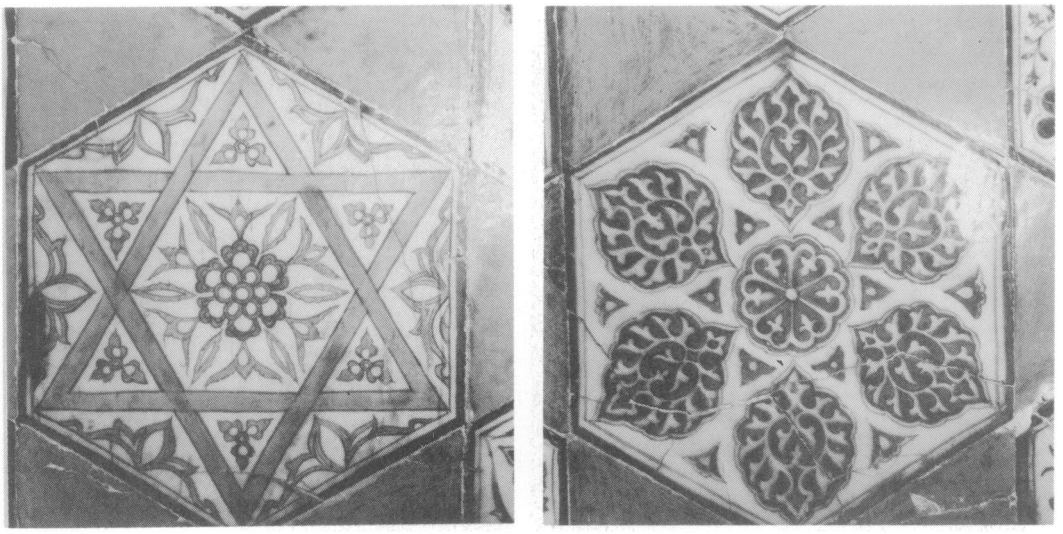

Plate 1A and 1B Underglaze blue-and-white tile by the Masters of Tabriz, from the Muradiye Mosque in Edirne, c.1433.

of Tabriz, not only because it tiled a sequence of imperial buildings between 1420 and 1474, but because it displayed consummate mastery in a variety of techniques. In their earliest monuments, the Yeşil (Green) Mosque, Medrese and Tomb in Bursa, (1419–24), the techniques ranged from gilded monochrome tiles, to cut-tilework and *cuerda seca*. By the 1430s the Masters of Tabriz were employing, alongside brilliant polychrome *cuerda seca*, underglaze blue-and-white, much of it in a chinoiserie style (Meinecke 1976: I, 102–14; Carswell 1972a, 1972b) (Pls 1A and 1B).

The colour range of the *cuerda seca* tiles affected the approach of the Masters of Tabriz to underglaze tiles, because they gradually added colours, including purple and yellow, to the underglaze repertoire in tiles for the Üç Şerefeli Mosque of Murad II in Edirne (1437–48) and the Fatih Mosque in Istanbul (1463–70). The last work attributable to this workshop are the tiles in what is traditionally called the tomb of Sultan Cem, a monument which was in fact built as the tomb of Cem's elder brother Şehzade Mustafa in 1479. Here there are underglaze purple tiles which echo the blue-and-white designs of forty years previously; and there are polychrome underglaze border tiles which copy the standard *cuerda seca* border tiles the Masters of Tabriz produced for earlier buildings. The quality of drawing, and more especially of the colouring and glaze, of these underglaze tiles shows a decline in standard which is understandable in a workshop which had been active so long under the Ottomans (Raby in press). By 1474, in other words, the Masters of Tabriz were a spent force.

The Masters of Tabriz seem to have been the artists who reintroduced the fritware technique into Turkey, but the body composition they used was not consistent. It differed visibly in colour, ranging from a brick red colour in the 1420s to a buff white for their underglaze tiles in the 1430s. Laboratory analysis has shown that there was considerable technical variation, and, most significantly, that they did not use a lead frit.

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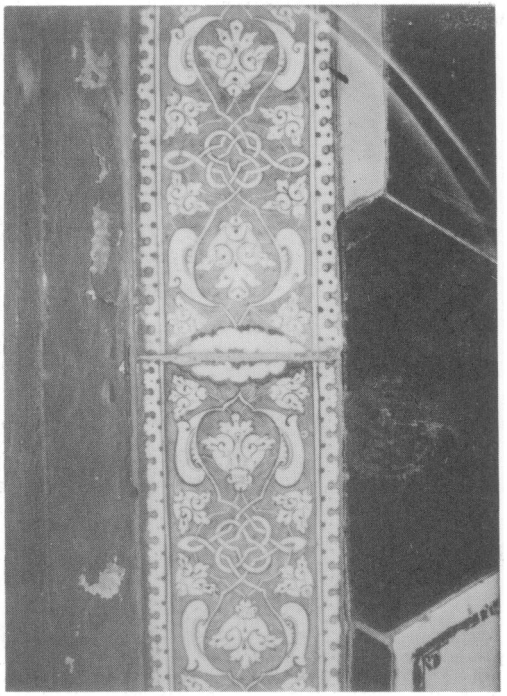

Plate 2 Underglaze blue-and-white border tile from the tomb of Şehzade Mahmud, Bursa, 1506–7.

Plate 3 Underglaze blue-and-white border tile from the tomb of Şehzade Ahmed, Bursa, c.1512–13.

In the last quarter of the fifteenth century the Ottomans almost entirely abandoned tilework (pace, Amasya, Bayezid Camii 1496; Yüksel 1983:15:26). This is despite the fact that in 1473 a talented group of Iranian artists, this time from Khurasan in northeastern Iran, completed the Çinili or 'Tiled' Köşk in Istanbul. What became of them after this commission in not known, but a petition which they wrote to the Sultan asking for payment suggests that they were far from satisfied with conditions, and it is possible that they left Ottoman employ soon after (Kırımlı 1981). Certainly, there is no further trace of their influence after 1475.

The fourth phase of Ottoman tilework does not begin until the sixteenth century. There is thus a gap in tile production in the late fifteenth century of some thirty years, which is all the more remarkable because the same period sees the emergence of Iznik fritware pottery, which is technically accomplished, decoratively complex, and innovative in its shapes. This pottery has long gone under the misleading name of 'Abraham of Kütahya' ware (Lane 1957a, 1957b; Raby in press).

When tilework was resumed, in the tomb of Şehzade Mahmud in Bursa of 1506–7, and in Sehzade Ahmed's tomb of about 1512, it was related to the pottery decoratively (Pls 2 and 3). There was a technical relationship too, but, Julian Henderson explains, the body of the tiles was not yet fully identical to that of the pottery, and the slip layer was yet to be introduced into the tile technology. This was soon to change, because from the second quarter of the sixteenth century until the seventeenth century, that is,

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Plate 4 Iznik dish, c.1575, painted in blue, green and relief-red. Collection of the Fundação Calouste Gulbenkian, Lisbon, inv.no.843.

through the hey-day of Ottoman tile production, the same techniques were used for the body material and the glazes of both tiles and pottery (Pl.4).

In the late fifteenth and early sixteenth century pottery production assumed a new importance, while tilework declined. Pottery usurped the fritware technology which had previously been the prerogative of tilework, and a question which arises is whether this new fritware pottery, the so-called Abraham of Kütahya ware, was technically dependent on the fritware tilework of the fifteenth century. In order to assess this, we need to look in more detail at the technical characteristics of these tiles.

Technical analyses

The chemical and structural investigation of tile fragments of fifteenth and sixteenth-century Turkish provenance has provided an insight into how the technology developed and how it relates to the rise of Iznik pottery technology. This study involved an examination of the chemical composition of the glaze, and the structure and composition of the bodies of Turkish tiles ranging from 1271 to 1600.

The tile fragments selected for analysis were chosen in order to establish the relationships between the fifteenth-century tile tradition of the Masters of Tabriz and the Iznik fritware pottery tradition which begins in the fifteenth century. Another study, of Iznik ceramics, by one of the authors (Henderson in press) also approaches the subject from the point of view of its origins in the late fifteenth century and its decline in the seventeenth century.

One of the more important structural features of Ottoman Turkish ceramics noted by

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Kiefer (1956a and 1956b) was the development of an alkali-lime frit in fifteenth-century tiles, and the change to a lead-rich frit in both tiles and pottery in sixteenth-century Turkey. The term 'frit' is used here in the sense that it is sometimes also used in glass technology – to describe a powdered glassy mass which has the beneficial property of a high surface area to volume ratio allowing it to fuse more readily than larger fragments. In the context of glaze production the use of a frit avoids potential blistering of the glass caused by gas which evolves from the decomposition of carbonates and sulphates in the raw materials. Another advantage of making a frit is to incorporate soluble oxides, such as sodium and potassium oxides, which might otherwise be absorbed by the body (Hodges 1964: 46).

When mixed with silica and clay and then fired, frit eventually forms a kind of glue which can bind the components of the ceramic together. Since the frit combines chemically with the clay minerals present, it can have a variable composition. When polished sections of pots are examined, the difference between lead-rich and alkali-lime frits is normally that the lead-rich frits tend to envelop the silica more completely, as they have remained fluid for longer and at lower temperatures during firing.

In order to establish whether late fifteenth and early sixteenth-century Ottoman fritware technology was related to the fritware tile tradition of thirteenth-century Anatolian Turkey, the sequence of tiles examined starts with a sample from Gök Medrese in Sivas dated 1271 (see Table 1 for the gross characteristics of the tiles and Figure 1 for the locations of their sites of origin). This has a pale manganese purple glazed surface. The glaze composition was found to be of a soda-lime-silica composition similar to the high magnesium glass which was introduced in the Islamic world in the eighth century AD (Sayre and Smith 1967) and which contributed to Islamic glass production in the thirteenth century. The close similarity between glaze and glass composition at the time is important since it illustrates a close link between the two technologies. Another study of glazes on Islamic 'faience' pieces dating back to the ninth century AD have demonstrated the use of a lead-alkali-silica composition and the presence of tin (Kleinmann 1986: Table 7.1).

In the fifteenth-century-tile bodies examined where a frit was detected it was found to be poorly developed (see p.126), with the alkali-rich glassy phase only partly coating the silica crystals. The pattern of alkali-lime frits discovered by Kiefer (1956b, Table 1) in fifteenth-century tiles has been confirmed here by the analyses of tiles of reliable provenance from a range of Turkish sites. However, a further feature of tile bodies, which would not have been detectable using the technology available to Kiefer in the 1950s, is the existence of discrete sporadic lead-rich and sometimes tin-rich inclusions (see Pl.5). Today a scanning-electron microscope can provide a photographic record of individual inclusions, which can be individually analysed down to a 3 micron spot (the minimum diameter of the analysed volume).

Since a lead-frit is found in typical sixteenth-century Iznik ceramics (Kingery and Vandiver 1986: 126; Tite n.d.; and Henderson in press), the occurrence of discrete, randomly distributed, lead-rich inclusions in fifteenth-century Turkish tiles may be a significant feature in the development of Turkish ceramic technology.

In the case of the tile fragment shown in Pl.5, from the Muradiye in Edirne, pale glassy inclusions of high average atomic number of lead-tin and lead-silica-tin

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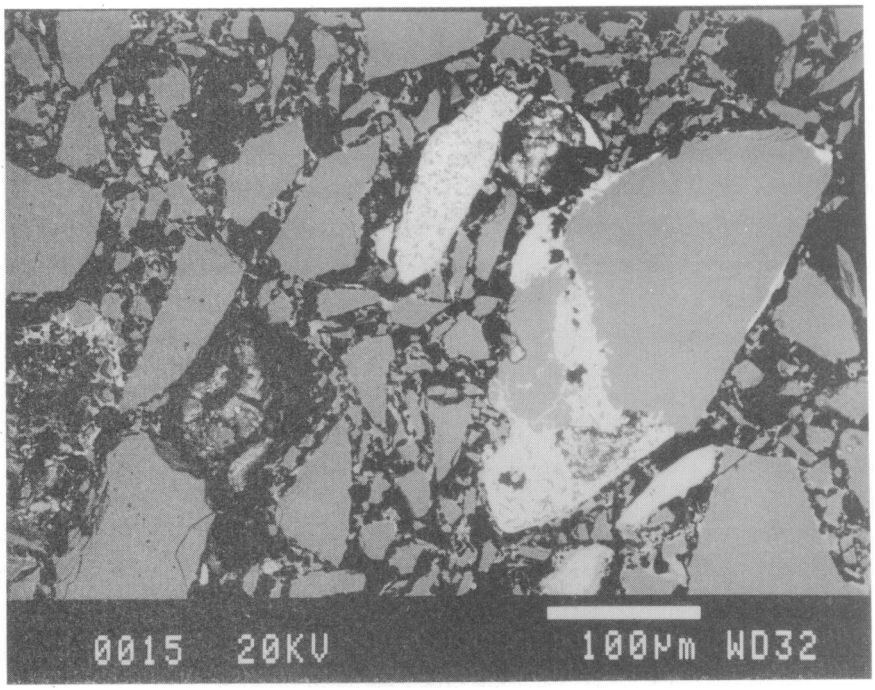

Plate 5 Backscattered electron micrograph of a polished section of a tile body from Edirne, Muradiye dated 1433 (Table 1, no.3). The limited development of the alkali-lime frit is visible, covering some of the (grey) silica crystals forming a limited glassy network, particularly on the left hand side of the figure. The bright areas have lead-tin, lead-silica-calcium and lead-silica-tin compositions (x200).

compositions can be seen, but they do not form part of the glassy network. This is significant since, in general, the glazes used were of a lead-silica-soda-tin composition, typically containing SnO_2 levels of between 5 per cent and 9 per cent. It is therefore very likely that the sporadic lead and tin-rich inclusions detected in the body of the tile shown in Pl.5 are in fact the same substances that were used in the preparation of the glaze – the tin content firmly suggests this. One can therefore suggest that the raw materials which were used for the body and the glaze of the tiles were prepared in the same environment, but the question remains as to whether the lead-rich inclusions were deliberately added so as to modify the properties of the tile body in some way. Although the lead-rich and tin-rich glassy inclusions are small in number their presence would certainly help to 'glue' the fabric together. This practice can be explained by the potter throwing scrap glass, or the remnants of glaze scraped from the vessel in which it was prepared into the clay and silica mix. This practice was carried out in the manufacture of Delft wares (pers. comm. Alan Caiger-Smith). There are, however, tiles of fifteenth-century date which have no detectable lead inclusions (Table 1, nos 2, 4, 6, and 8), so evidently the technique of adding a small amount of lead-rich glass to the tile fabric was not standard practice.

Indeed the examination of a number of fifteenth-century tile samples revealed that no detectable glassy phase has formed at all (e.g. Table 1, no. 4). This highlights the

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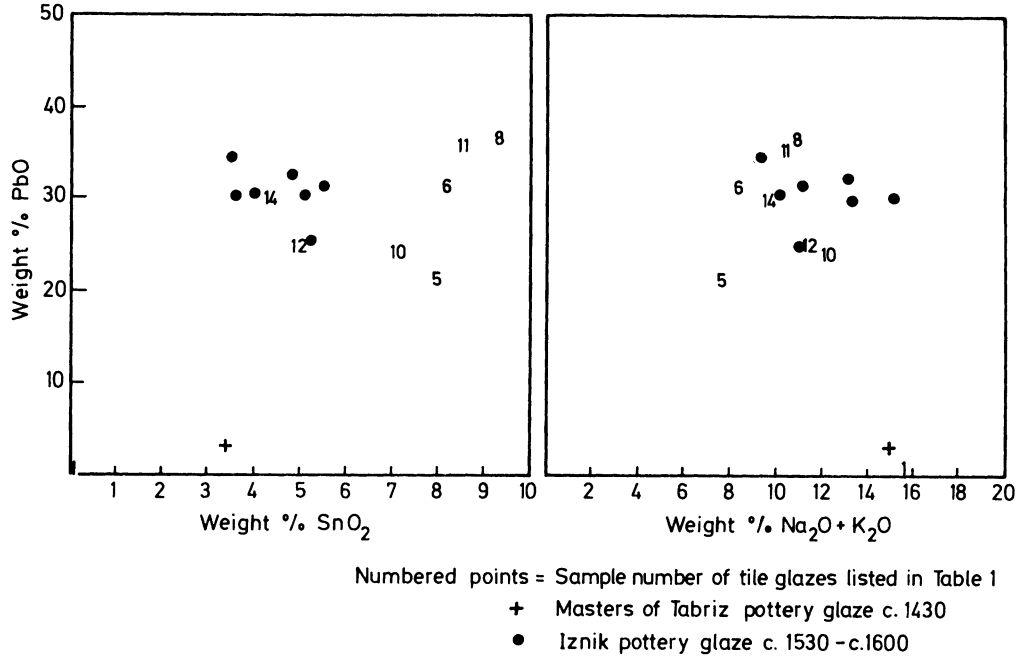

Figure 2 Scatterplots of a) weight % lead oxide (PbO) vs weight % tin oxide (SnO_2) and b) weight % lead oxide (PbO) vs weight % sodium oxide (Na_2O) + potassium oxide (K_2O) mainly in fifteenth-century Turkish tile glazes and sixteenth-century Iznik pottery glazes.

fact that compared to pottery fabric, which may have undergone stresses when in use, once the tile had been manufactured and attached to a wall, it would not have experienced the same forms of mechanical or chemical stress (apart from extremes of temperatures).

It is significant that sporadic lead-rich inclusions are found at a time immediately before the appearance of a full lead-frit in early sixteenth-century Iznik tiles and pottery. It suggests that the tile-makers observed the beneficial effect of lead-rich or lead-tin inclusions in the fabric. This information may then have been fed into production of sixteenth-century pottery and tiles.

The other feature of the tile technology which must be considered is the chemical characterisation of the glazes used in tile decoration (see Pl.3). A single example of thirteenth-century soda-lime-silica glaze was found from the Gök Medrese in Sivas as mentioned above. It was not possible to examine many samples of fifteenth-century tile glazes, but the few analysed suggest that the predominant glaze technology used a high lead oxide component, (see Fig.2). This feature of the technology can be seen as a continuation of the use of a high lead glaze since the ninth century when it was introduced into the Islamic tradition and continued in Iznik pottery production. It is also worth remembering that the Romans used a lead glaze for the decoration of ceramics probably dating to Ptolemaic times (Caley 1947). Evidently the soda-lime-silica glaze found at Sivas provides a variation from the high lead recipe often used in the Islamic world.

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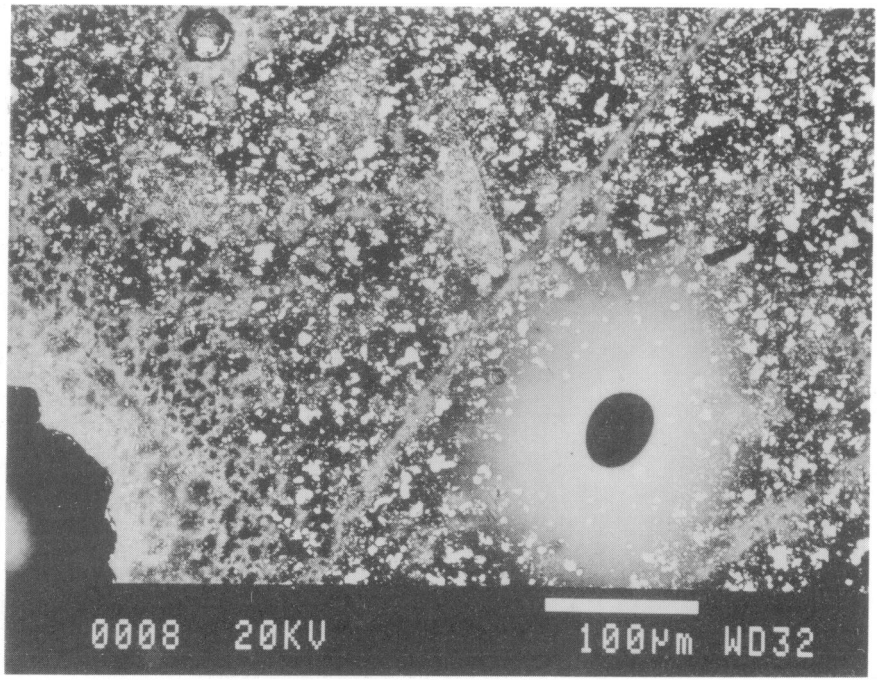

Plate 6 Backscattered electron micrograph of a polished section of a pale blue glaze from Istanbul, Mahmud Pasa Turbesi dated 1474 (Table 1, no. 8). The glaze is full of tin oxide and lead oxide crystals which appear white. The white zone around the sectioned blow hole is the remains of lead oxide-silica-soda-potassium oxide glass. The presence of metallic lead indicates that the glaze has failed (x200).

Much of fifteenth-century Turkish tile production was of tiles with monochrome glaze; and the most common colour was a turquoise, the lead-alkali-silica composition of the glaze producing a (cupric) turquoise-green colour. A very deep purpley-blue colour in the glaze on a tile datable to 1506–7 (Table 1, no.10) was found to be coloured by 1.5 per cent manganese oxide (Mn0), 0.4 per cent iron oxide (Fe_20_3), 0.6 per cent cobalt oxide (Co0), 0.1 per cent nickel oxide (Ni0) and 0.1 per cent copper oxide (Cu0). The apparently 'black' glaze used in no. 8 from Mahmud Paşa Türbesi, Istanbul was coloured by an excessive amount of cobalt (1.5 per cent) in a basically lead oxide-silica glaze with about 3 per cent alkali. The basic compositional characteristics of the latter link it with the manufacturing tradition of glaze found at Mamluk Fustat and earlier fifteenth-century Turkish tiles (Kleinmann 1986: Table 7.2). However, the complexity of the situation is revealed by the composition of the opaque pale turquoise glaze used for decoration of a separate tile from the same monument.

In the opaque pale turquoise glaze, metallic lead crystals were found to have come out of solution (see Pl.6). High levels of tin oxide (8 per cent) were detected in the glaze and together with the lead crystals would cause opacification of the glaze. A zone of the glaze where the lead still remains in solution is to be seen around the sectioned blow hole visible in the bottom right hand corner of Plate 6. The atomic contrast of Plate 6 also shows how much of the glass between the pale crystals has a low average

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atomic number composition (showing as a very dark grey). The lead and tin crystals are visible as white crystals.

A reason why the lead crystals precipitated from the glaze solution was that firing occurred under reducing conditions. Other notable compositional features are 1.6 per cent zinc oxide accompanying 0.9 per cent copper oxide in the glaze and the fact that the glaze is of a mixed-alkali (soda and potassium oxide) composition. In compositional terms the two categories of glazes used in tiling the monument are therefore enigmatic, showing that the opaque turquoise glaze had failed and that both the blue and 'black' glazes have compositions which are departures from the tradition found in glaze compositions used at the contemporary site of Çinili Köşk. The Çinili Köşk glaze composition is very similar to that of pottery glaze used at Iznik in the sixteenth-century.

Figure 2a is a simple presentation of the relative lead and tin oxide levels in the tile glazes analysed compared to typical Iznik pottery glazes c. 1530–1600. One notable feature is that the tile glazes of c. 1512–13 and earlier contain higher tin oxide contents than typical Iznik glazes of the later sixth century. A tile glaze also datable to 1512–13 and another from about 1600, on the other hand, contain comparable levels of tin oxide to the Iznik pottery glazes. Although based on a small set of tile glaze analyses this indicates that a tin glaze was used in both fifteenth-century tiles and sixteenth-century Iznik pottery but that there was a slight difference in the recipe used. The single analysis of a pot glaze datable to c. 1430 is quite distinct from the analyses of fifteenth-century tile glazes, as is an earlier tile glaze from the Gök Medrese in Sivas, dated 1271. More analytical work is therefore necessary in order to examine any possible links between these discrete glaze technologies.

In the lead oxide-silica-alkali glaze, typical of sixteenth-century Iznik glazes, tin oxide would mainly have remained in solution. In earlier tile glazes the transparency is sometimes impaired by the development of tin oxide crystals as shown in Plate 7, a micrograph of a polished section of fifteenth-century tile glaze from the Yeşilce Cami in Edirne. Here the tin oxide crystals suspended in the glaze have been successfully photographed by reducing the contrast setting of the SEM; in the atomic contrast in this backscattered electron micrograph the lead glaze would normally appear white, making the tin oxide crystals invisible. Plate 7 shows other features of interest as well: the outer part of the glaze is riven with horizontal cracks showing that it has undergone structural stress and is a darker grey colour than the inner part. The inner part of the layer contains larger conglomerates of white tin oxide crystals than the outer part and analysis of the two glaze layers shows that the darker shade of the outer glaze layer is due to a lower lead content; weathering of the outer layer would have been indicated by leaching of alkalis but this has not been found. The outer layer contains all the visible blow holes and is cracked. These compositional and structural differences suggest that the outer layer is, in fact, a separate application of glaze.

From these few glaze analyses the 1470s appears to have been a period when a range of glaze recipes was in use. Not only was a lead oxide-silica glaze used but also a lead oxide-soda-silica composition. By 1506–7 the composition of the purpley-blue glaze decorating a tile from Şehzade Mahmud Türbesi in Bursa (Pl.2) was of the typical lead oxide-soda-silica composition and the body contained a full lead frit, both features

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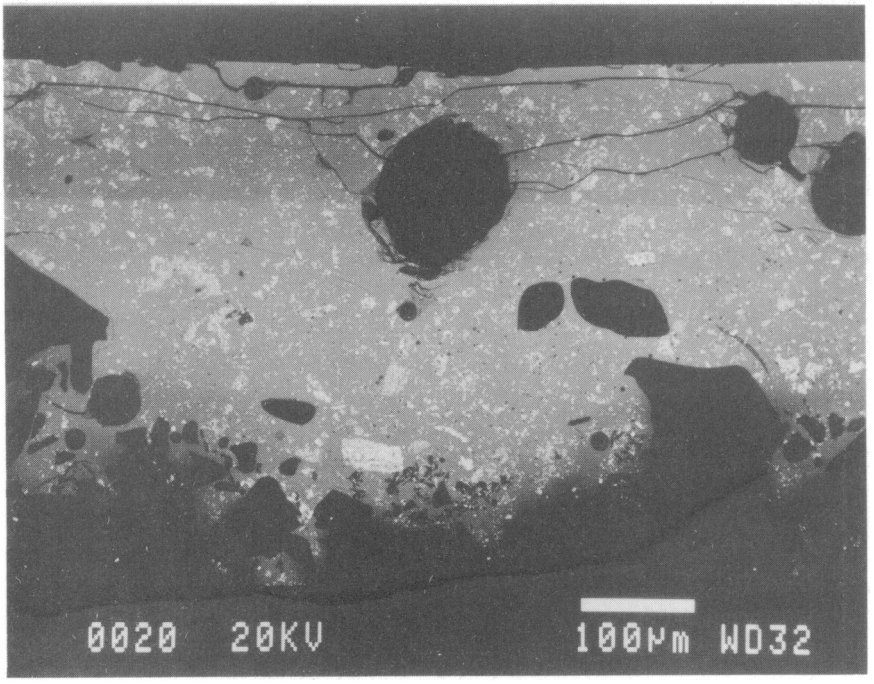

Plate 7 Backscattered electron micrograph of a polished section of turquoise glaze from the Edirne Yeşilce Cami dated 1440–1 (Table 1, no.5). The agglomerated white crystals are tin oxide. Note the two 'layers' of glaze; the upper, darker surface layer contains less lead oxide than the inner one and would therefore remain fluid for a slightly shorter period. Because the upper layer contracted faster than the inner one this has lead to cracks developing in the outer layer which connect many of the blow holes, seen here as circular sections.

which were found throughout the sixteenth century (see Table 1 and Kingery and Vandiver 1986).

While this glaze composition was used on pottery from c. 1480, and the same compositions were found in the tiles datable to 1512–13 from Bursa (from the tomb of Şehzade Ahmed) (Pl.3), the consistency of the glaze recipe used in the earlier part of the sixteenth-century was not found in the compositional characteristics of the bodies.

Based on the fifteenth-century tiles examined here (Table 1), either an alkali frit with or without lead inclusions or no detectable frit at all is found between c. 1426 and c. 1479. The tile bodies datable to 1512–13 from Bursa were both found to contain a poorly-formed alkali-lime frit (Table 1, nos 11 and 12). Although no. 12 also contains lead-silica inclusions, these were very few in number and found to be randomly distributed. As noted in Table 1 this same feature was found in earlier tiles examined.

The use of a poorly-formed soda-lime-silica frit as late as 1512–13 shows that variation in the basic technology was still possible at this date, although a shortage of lead oxide was evidently *not* the explanation. That the glazes used on these tiles with alkali-lime frit were of the lead oxide-soda-silica compositions used in typical sixteenth-century Iznik ceramics illustrates the complexity of the technology: the glaze recipe follows that established for the period whereas the technology of the body is closer to a technique which was in use some 20–40 years earlier.

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Plate 8 Backscattered electron micrograph of a polished section of a tile body and glaze from Bursa dated 1512–13 (Table 1, no.12). The multiple layers of ceramic raw materials (mainly silica) appear to be unnecessary: the second thin layer would be suitable as a slip but is sealed by the one overlaying it. This technology is quite obviously in 'flux', unlike the Iznik tile tradition (x50).

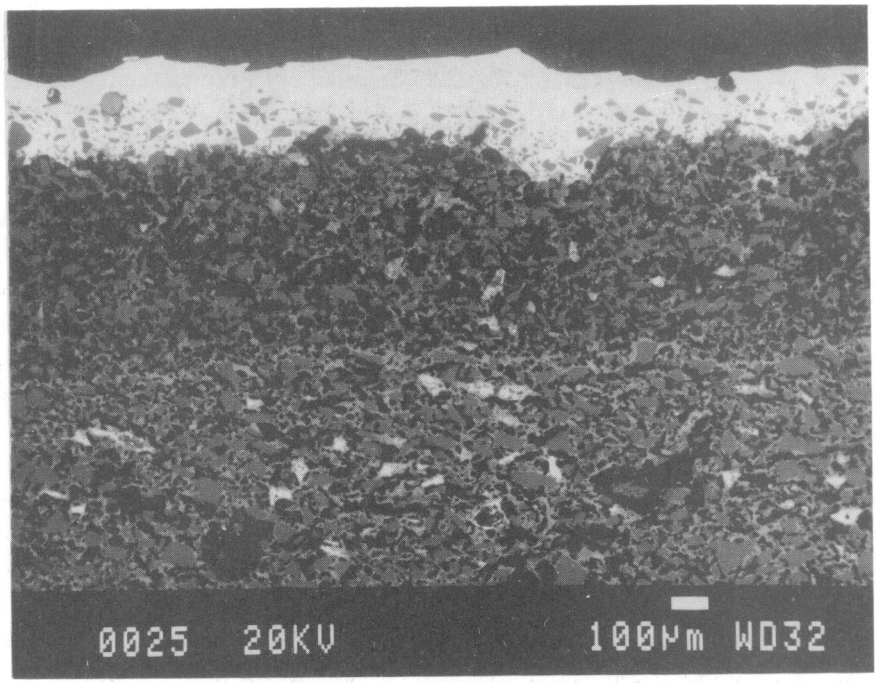

Plate 9 Backscattered electron micrograph of a polished section of body, slip and glaze from a late blue and white Iznik pot dated c. 1580. The layers consist of a (white) surface glaze, interaction layer (glaze and silica crystals), a slip layer, and the lowest (body) layer consists of grey silicon crystals bathed in a lead-rich frit with concentrations of (white) lead-rich glass (x50).

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Indeed, Plate 8, a polished section of no.12, shows how multiple layers of ceramic raw materials were built up. The layer beneath the glaze cannot be considered as a slip layer because the silica inclusions which are up to 0.3mm across, are more massive than the thin layer immediately beneath it, which would be suitable as a slip layer. It is evident that the production of these tiles datable to 1512–13 constitute interesting technological exceptions to the trends established for pottery production; by the mid-sixteenth century tile technology was as refined as pottery technology and incorporated a fine slip layer (see Pl.9), providing a brilliant opaque white background for the polychrome underglaze decoration.

Overall technical implications

In sum, up to about 1470 the tile bodies exhibit a mixture of structural features. The occurrence of sporadic lead-rich frit inclusions in *some* tile bodies probably anticipates the emergence of the fully-fledged lead-rich frit tradition adopted in pottery and tile production in the sixteenth century at Iznik. However, wide variation in both glaze compositions and body structure between c. 1475 and 1513 indicates that a number of changes were taking place. The use of an excessive level of cobalt producing a black rather than a blue glaze, and the occurrence of metallic lead which would result from the lead oxide in the glaze being reduced in tiles from the Mahmud Paşa Türbesi, dated 1474, represent failures or a lack of understanding in the technology. This may be a reflection of the decline of the Master of Tabriz tile production.

A nearly contemporary successful glaze from Çinili Köşk, however, showed that the glaze recipe used on the piece was very similar to the formula used, with little change, throughout the sixteenth-century for the production of Iznik ceramics. The 1512–13 tiles from the tomb of Şehzade Ahmed are enigmatic. The blue and white decoration is poorly drawn from the artistic point of view (Pl.3). They do not have the alkali-lead frit typical of the pottery of the period and the 1506–7 tile (Pl.2); instead they have alkali-lime fritted bodies with no apparent slip. There are two possible explanations for this anomaly: one is that they come at the end of a long period of technical transition; the other is that they come from a different manufacturing centre. A rival to Iznik was Kütahya and proof that it was active in this period is provided by the Abraham of Kütahya ewer dated 1510. Certainly, eighteenth-century Kütahya pottery did not use an alkali-lead frit (Kiefer 1956a & b), but only further analyses will reveal if the presence of lead distinguished the products of Iznik from that of Kütahya in the sixteenth and seventeenth centuries.

Relationships with the Iznik pottery industry

To recapitulate, the first Iznik fritwares date from the 1470s. They are exclusively vessels, and related blue-and-white tilework does not appear until 1506–7. The extraordinary aspect of the pottery is that the earliest datable examples are fully

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accomplished in technique and decoration, and there seem to be no obvious antecedents from which they spring.

This is all the more remarkable because the only pottery produced in fifteenth-century Turkey until then was a red earthenware which is known traditionally as 'Miletus ware', but which, as excavations have proved, was produced in Iznik, as well as other centres such as Kütahya and Akçaalan (Aslanapa 1965; Sahin 1979–80). Miletus ware bears no relationship to the first blue-and-white Iznik fritwares in technique, decoration, or shape, and the relative costs of production meant that Miletus ware was a mass-market pottery compared to the earliest Iznik fritwares, which are first recorded in Palace inventories from the last decade of the fifteenth century (Raby in press).

Two possibilities arise, therefore. Either the first Iznik fritwares were produced by craftsmen newly arrived in Turkey, or they represent an Ottoman development which was unrelated to the preceding pottery production. The foreign craftsmen theory is not, however, a sufficient explanation. In the first place, Iznik fritware pottery is patently superior to quartz fritwares produced in Iran, Syria or Egypt in the late fifteenth century (Tite n.d.). Secondly, it is indebted to Ottoman Court influence. These earliest Iznik fritware vessels have decoration which is derived from Court illumination, and shapes whose sharp articulations and torus mouldings betray a relationship with precious metalwork, which was much appreciated at the Ottoman Court. The sudden emergence of this fritware pottery can, therefore, be best explained, in terms of patronage, style and form, by a Court initiative in the 1470s to produce blue-and-white pottery of a refinement and grandeur to match the Yuan and Ming Chinese blue-and-white porcelains reaching Turkey (Raby and Yücel 1983; Raby in press).

The question is where the pottery technique first introduced in the 1470s came from. An obvious, and traditional, explanation is that the fritware technology was derived from the Masters of Tabriz, who had, albeit in the 1430s, produced underglaze blue-and-white tiles (Pls 1A and B).

This is unlikely, however, on both historical and technical grounds. In the first place, as we have seen, the workshop of the Masters of Tabriz was not capable in the 1470s of producing tiles to the same quality that they had achieved previously, and it is not therefore conceivable that in the same decade it would have been able to originate a new pottery of such technical perfection as the first Abraham of Kütahya wares. Secondly, from the technical point of view, there would have had to have been a fundamental modification, because analysis demonstrates that the Masters of Tabriz did not use a lead frit. Admittedly, their technique does not appear to have been consistent even in the same building, but they tended to use, as one would expect with Iranian potters, an alkaline-lime frit. There is, however, evidence of sporadic lead inclusions, though these do not constitute a fully developed lead frit of the sixteenth-century Iznik type.

It was not previously known if the Masters of Tabriz ever made vessels, but it is now certain that at least on occasion they did. A misfired fragment of blue-and-white pottery, which was discovered among a large cache of sherds illegally excavated in Iznik and now deposited in the Bursa Museum, was without doubt produced by the same potters who produced the blue-and-white underglaze tiles in the Muradiye

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Mosque in Edirne in the 1430s, that is, the Masters of Tabriz (Raby in press). Its alkaline-lime fritware body, with random lead inclusions, is related to the tilework body used by the Masters of Tabriz, while the glaze is principally alkali-silica with a low lead oxide level (Henderson in press). Thus both pottery and tiles by the Masters of Tabriz differed substantially in glaze and body from the classic Iznik fritware.

An alternative technical source for the Iznik alkaline-lead frit might have been the men who tiled the Çinili Köşk. But they did not bring a lead-frit tradition with them either. Analysis of a sample kindly supplied by the Director of the Istanbul Archaeological Museum has shown that it too had an alkaline-lime frit, although with some lead inclusions.

The final possibility is that the lead-frit technique was not introduced into Iznik as an established technology, but was developed locally. This seems to be confirmed by the fact that the earliest Iznik fritwares analysed by Henderson are not as consistent as the Iznik wares after about 1520. The earliest fragment tested is from a vessel datable to the 1480s: it has a distinct lead frit, but the level of lead is lower than the level that was typical in the sixteenth century (Henderson in press). What is more, the earliest tiles in this Iznik fritware tradition do not reveal a consistent technique, even though they date from 1506–7 and 1512–13 (Pls 2 and 3).

With the *caveat* that only a few samples have been tested, this suggests two conclusions: first, that the period between about 1475 and 1520 was a transitional period which saw a more gradual development of the classic Iznik fritware technology than has previously been realised; and, second, that in this initial stage pottery took precedence over tilework.

This leaves unanswered the question of where the idea of introducing lead into the body frit first came from. It was a development which had clear structural benefits. As there were links between the composition of the body frit and the glaze, one might suggest that glaze lead-frit was mixed in with the body paste, by initial accident or deliberate experimentation. Either way the credit for the discovery must go to the potters at Iznik.

The great vessels of the last quarter of the fifteenth century cannot be explained, though, simply as the products of a gradual, empirical evolution of the fritware technique and of a transfer of technology from tilework to pottery. It was Court patronage which demanded a pottery which was completely new in quality and intention.

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J.H.
Research Laboratory for Archaeology
and the History of Art
Oxford University
J.R.
The Oriental Institute
Oxford University

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Abstract

Henderson, J. and Raby, J.

The technology of fifteenth-century Turkish tiles: an interim statement on the origins of the Iznik industry

Study of the technology of Turkish tiles and pottery during the fifteenth and sixteenth centuries reveals a complex of technical features. The variation, particularly in the technology of tile bodies in the fifteenth century, contrasts with the consistent use of an alkali-lead frit and a slip layer for the Ottoman pottery of Iznik from about 1475 until the seventeenth century. This paper considers what the development of the ceramic technology in the fifteenth century reveals about the genesis of the Iznik pottery.

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