PART NINE

Posters

Mosaic Icons in Greece: Techniques and Methods of Conservation

Panayota Assimakopoulou-Atzaka, Eleni Chrysafi, Christine Papakyriakou, Magda Parcharidou-Anagnostou, and Anastassia Pliota

Abstract: *In Greece only twelve mosaic icons have survived, dating from between the eleventh and the second half of the fourteenth century. Their iconography includes Christ, the Virgin, saints, and scenes depicting the Twelve Feasts. They originate from Constantinople or northern Greece. The foundation of these icons is a wooden tablet cross-hatched with a lattice pattern to help adhere the applied layer of wax mixed with mastic. In earlier times a wax and mastic mixture was used to conserve and restore the mosaic surface of the icons. Today the most common method is to leave the lacunae without any filling.*

Résumé : *Seules douze icônes en mosaïque ont survécu en Grèce, datant du onzième à la deuxième moitié du quatorzième siècle. Cette iconographie comprend le Christ, la Vierge, des saints et des scènes figurant les Douze fêtes. Elles proviennent de Constantinople ou du nord de la Grèce. Le support de ces icônes est constitué d' une tablette en bois entaillé pour faciliter l'adhésion d'une couche faite d'un mélange de cire et de mastic qui la recouvrait. Par le passé, une couche du mélange de cire et de mastic était utilisée pour conserver et restaurer la surface en mosaïque de l'icône. Aujourd'hui, la méthode la plus couramment employée est de ne pas remplir les lacunes.*

Mosaic icons are luxury objects intended for private worship. According to ancient written sources (Theophanes, Theodoros Metochites, Manuel Philes), they have been in use since the dawn of the Byzantine Empire.[1] In Greece, as far as is known, only twelve mosaic icons have survived, dating from the eleventh to the second half of the fourteenth century. The majority of these are small and meant for private worship; the few larger ones were used as portable kneeling icons (*proskynetaria*) or in the iconostasis (*despotikes*) in churches. These mosaic icons are magnificent objects of high artistic quality, and research has indicated that some of them, originating from Constantinople or workshops in northern Greece, were associated with the imperial family or upper echelons of the aristocracy (Buschhausen 1995: 57–66; Loverdou-Tsigarida 2003: 241–54). Their iconography includes Christ, the Virgin, saints, and, more rarely, scenes depicting the Twelve Feasts.

The foundation of such icons was a wooden tablet cross-hatched with a lattice pattern to help adhere the applied layer of wax mixed with mastic (nos. 7, 10) (fig. 1). The tesserae consist of fine and semiprecious stones, gold, silver, glass, and beaten copper; in the small icons these tesserae are tinier than the head of a pin, proof of the artist's skill. In earlier times a wax and mastic mixture was used to conserve and restore the mosaic surface of the icons. Where a part of the subject was missing, the restorer would fill the lacunae using color mixed with wax (nos. 1, 6, 9, 11) (figs. 2–4) or paint or even engrave the missing section on newly applied wax (nos. 2, 3, 12) (figs. 5–7).

Today the most common method is to leave the lacunae without filling them (nos. 4, 5, 6, 7, 8, 9, 12) (figs. 3, 7, 8). Sometimes the lacunae are filled with a wax and mastic mixture (no. 6) (fig. 3) or, using the method of linear completion, with watercolor (*rigatino*) (nos. 2, 3) (figs. 5, 6); in two cases the lacunae of the background were filled with tesserae (nos. 2, 3) (figs. 5, 6). In cases in which the damage was severe (e.g., nos. 4, 5) (fig. 8), parts of the wooden surface were replaced.

Catalogue of Mosaic Icons in Greece

1. *Saint Nicholas*, *14 × 10 cm, Holy Monastery of Saint John the Theologian, Patmos, eleventh century* (fig. 1). The earlier conservation, although not particularly artistic, fully respected the subject matter. The material used was wax with mastic and red coloring, which stabilized the tesserae and extends across the work without, however, attempting to replace the missing portions. During later conservation, both the wooden base

and the mosaic surface were cleaned and stabilized without moving the red filling (Hellenic Ministry of Culture, conservator Ph. Zachariou) (Furlan 1979: 35–36, pl. 1; Chatzidakis 1995: 44–45, pl. 1, 77).

2. *Saint George, 136 × 65 cm, Holy Monastery of Xenophontos, Mount Athos, ca. 1079* (figs. 2, 3) (Demus 1991: 26–28, pl. 4; Tavlakis 1998: 46–59, 282). Mosaic icons sometimes bear a strong resemblance to wall mosaics, raising many questions about their original use: Were they wall mosaics taken down and reused as portable icons, or did the style of portable icons imitate wall mosaics?[2] Either way recent conservation work has proved that this icon belongs to the second category (Hellenic Ministry of Culture, conservator J. Daglis). As for its earlier conservation, the attempt to restore the missing part of the subject by painting the tesserae in the lower part of the icon was apparent. During recent restoration work, the missing tesserae with the gold background were replaced with new, gold ones, and the painted tesserae were removed (Minos 1999: 248, 252, 255–58).

3. *Saint Demetrios, 136 × 73 cm, Holy Monastery of Xenophontos, Mount Athos, ca. 1079* (Demus 1991: 15–18, pl. 5; Tavlakis 1998: 46–59, 282). This kneeling icon (*ikona proskyniseos*) and the matching icon of Saint George from the monastery of Xenophontos were placed on the facade of the pilaster of the templon in the main church (*katholikon*). During the recent conservation and restoration of both icons, the damage to the lower part of the subject was treated with *rigatino*

FIGURE 1 Saint Nicholas, 14 × 10 cm, Holy Monastery of Saint John the Theologian, Patmos, eleventh century. From M. Chatzidakis, *Εικόνες της Πάτμου. Ζητήματα βυζαντινής και μεταβυζαντινής ζωγραφικής* (Athens, 1995), pl. 1. Used with permission.

FIGURE 2 Saint George, Holy Monastery of Xenophontos, Mount Athos, ca. 1079, drawing. Origin: N. Minos, Η συντήρηση των εικόνων, in Ιερά Μονή Ξενοφώντος. Εικόνες, ed. E. N. Kyriakoudis et al. (Holy Mount, 1998), p. 248. Used with permission.

FIGURE 3 Saint George, 136 × 65 cm, Holy Monastery of Xenophontos, Mount Athos, ca. 1079. Origin: J. Tavlakis, Ψηφιδωτά $11^{ου}$ αιώνα, in Ιερά Μονή Ξενοφώντος. Εικόνες, ed. E. N. Kyriakoudis et al. (Holy Mount, 1998), p. 50. Used with permission.

using linear completion rendered in watercolor on a bedding of wax, mastic, and chalk so that the form of the depiction as well as the modern intervention would be apparent (Hellenic Ministry of Culture, conservator J. Daglis) (Minos 1999: 251, 252, 255–57).

4. *Virgin Hodegetria, 57 × 38 cm, Holy Monastery of Chilandar, Mount Athos, ca. 1200.* This icon was in use at least up to the early twentieth century. During its recent conservation, the overpainted layer was removed and the damaged wooden surface replaced with new wood (Hellenic Ministry of Culture, conservator J. Daglis) (Demus 1991: 19–22, pl. 2; Petković 1997: 21, 65).

5. *Christ the Man of Sorrows (Utmost Humiliation), 17.5 × 13 cm, Holy Monastery of Tatarna, Eurytania, early fourteenth century* (fig. 5) (Furlan 1979: 70, pl. 21; Dositheos 2004: 20, 24, 26). The unstable tesserae of this icon used for private worship were fixed with a mixture of wax and mastic using an infrared lamp at 35°C; missing tesserae were not replaced. The voids in the wood surface were filled with balsa wood (Hellenic Ministry of Culture, conservator Stavros Baltoyiannis) (Chatzidakis 1965: B1 Chronique, 12–13).

6. *Saint Nicholas with the Oyster, 42.5 × 34 cm, Holy Monastery of Stavronikita, Mount Athos, fourth quarter of thirteenth century* (fig. 6). The excellent state of preservation of this icon allowed restoration to be confined to the wood surface, where an area of missing tesserae was substituted with wax, mastic, and color (Karakatsanis 1974: 138–40, figs. 7, 53; Demus 1991: 23–25, pl. 3).

7. *Virgin Eleousa the Episkepsis, 83 × 58 cm, Byzantine and Christian Museum, Athens, end of thirteenth to early fourteenth century.* Earlier conservation work included removing layers of paint and soot and stabilizing the wood surface. During recent conservation, the surface with the lattice pattern for locating the tesserae was revealed (Xenopoulos 1925: 44–53; Demus 1991: 15–18, pl. 1; Acheimastou-Potamianou 1998: 34–35).

8. *The Crucifixion, 19 × 16 cm, Holy Monastery of Vatopedi, Mount Athos, end of thirteenth to early fourteenth century.* The missing parts have never been replaced (Tsigaridas 1996: 368, 369, 371 [fig. 314], 372, 643–44).

9. *Saint John the Theologian, 17 × 12.2 cm, Holy Monastery of Great Lavra, Mount Athos, ca. 1300.* An earlier attempt was made to preserve the icon by mounting it in a metallic frame. The missing parts of Saint John's body were rendered in a colored mixture

FIGURE 4 Christ Pantokrator, 15.5 × 7.2 cm, Holy Monastery of Esphigmenou, Mount Athos, second half of fourteenth century. Origin: St. M. Pelekanides et al., Οι θησαυροί του Αγίου Όρους. Εικονογραφημένα χειρόγραφα, τ. Β΄ (Athens, 1975), p. 205. Used with permission.

FIGURE 5 Icon, for private worship, with Christ the Man of Sorrows (Utmost Humiliation), 17.5 × 13 cm, Holy Monastery of Tatarna, Eurytania, early fourteenth century. Origin: J. A. Koumoulidis et al., Το μοναστήρι της Τατάρνας. Ιστορία και Κειμήλια (Athens, 1991), p. 48. Used with permission.

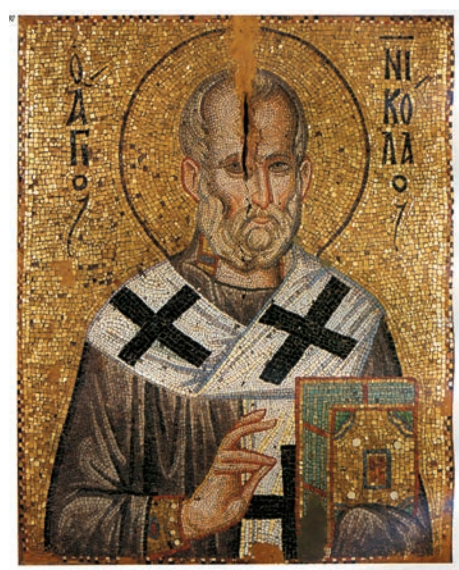


FIGURE 6 Saint Nicholas with the Oyster, 42.5 × 34 cm, Holy Monastery of Stavronikita, Mount Athos, fourth quarter of thirteenth century. Origin: P. Vokotopoulos, Βυζαντινές εικόνες (Athens, 1995), pl. 92. Used with permission.

of wax and mastic; the missing parts of the gold background were left without any filling (Chatzidakis 1972: 73–81, pls. 1–13).

10. *Christ Pantokrator, 18 × 11 cm, Holy Monastery of Great Lavra, Mount Athos, ca. 1300* (fig. 7). The lamentable state of the icon enables us to see the bedding of the mosaic: vertical and diagonal lines were engraved on the wood surface, forming a lattice pattern, each lozenge of which bears a depression connected to a groove, facilitating the adhesion of the subsequent wax layer (Chatzidakis 1973–74, 149–57, pls. 53–56).

11. *Christ Pantokrator, 15.5 × 7.2 cm, Holy Monastery of Esphigmenou, Mount Athos, second half of fourteenth century* (fig. 4) (Pelekanides et al. 1975: 204, 205; Furlan 1979: 89, tav. 35). Areas of missing tesserae can be observed on the lower section and also on other parts of the icon (i.e., Christ's hand). Moreover, other unrestored sections on the lower part of the icon are obvious where the existing wax and tesserae layers have blistered.

12. *Saint Ann and the Virgin, 9 × 15 cm, Holy Monastery of Vatopedi, Mount Athos, end of thirteenth to early fourteenth century* (fig. 8). During earlier conservation work, the missing parts of the subject, especially on the lower left part of the icon, were replaced with wax and mastic engraved to resemble tesserae. The back of the icon was covered with cloth in 1530/32–60, on which an inscription was written (Tsigaridas 1996: 368–69, 370: figs. 313, 643).

FIGURE 7 Christ Pantokrator, 18 × 11 cm, Holy Monastery of Great Lavra, Mount Athos, ca. 1300. Origin: M. Chatzidakis, Ψηφιδωτή εικόνα του Χριστού στη Λαύρα, *Deltion Hristianikes Archaiologikes Etaireias* 7 (1973–74): pl. 53. Used with permission.

FIGURE 8 Saint Ann and Virgin, 9 × 15 cm, Holy Monastery of Vatopedi, Mount Athos, end of thirteenth to early fourteenth century. Origin: E. N. Tsigaridas, Φορητές εικόνες, in *Ιερά Μεγίστη Μονή Βατοπαιδίου Παράδοση – Ιστορία – Τέχνη*, v. B΄ (Holy Mount, 1996), p. 369. Used with permission.

Acknowledgments

Permission for the reproduction of the photographs of the mosaic icons in this paper was given by the respective monasteries, to which we express our gratitude.

Notes

1 For mosaic icons generally, see Furlan 1979; Demus 1991; Effenberger 2004: 209–41.

2 For a discussion of this matter, see Pasi 1995: 245–50.

References

Acheimastou-Potamianou, M. 1998. *Εικόνες του Βυζαντινού Μουσείου Αθηνών.* Athens: Tameio Archaeologikon Poron kai Apallotrioseon.

Buschhausen, H. 1995. Zur frage des makedonischen Ursprungs von Mosaikikonen. In *Vyzantine Makeonia, 324–1430 M.Ch.: Diethnes Symposio, Thessalonike, 29–31 Oktovriou 1992*, 57–66. Thessaloniki: Hetaireia Makeonikon Spoudon.

Chatzidakis, M. 1965. Byzantino kai Xpisianiko Moyzeio. *Archaieologikon Deltion* 20 (B′1): 11–15.

———. 1972. Une icône en mosaïque de Lavra. *Jahrbuch der Österreichischen Byzantinistik* 21: 73–81.

———. 1973–74. Ψηφιδωτή εικόνα του Χριστού στη Λαύρα. *Deltion Hristianikes Archaiologikes Etaireias* 7: 149–57.

———. 1995. *Εικόνες της Πάτμου. Ζητήματα βυζαντινής και μεταβυζαντινής ζωγραφικής.* Athens: National Bank of Greece.

Demus, O. 1991. *Die byzantinischen Mosaikikonen: I. Die Grossformatigen Ikonen.* Wien: Verlag der Österreichen Akademie der Wissenschaften.

Dositheos, A. 2004. *Προσκύνημα στο μοναστήρι της Τατάρνας.* Athens.

Effenberger, A. 2004. Images of personal devotion: Miniature mosaic and steatite icons. In *Byzantium: Faith and Power (1261–1557),* ed. H. C. Evans, 209–41. New York: Metropolitan Museum of Art.

Furlan, I. 1979. *Le icone Byzantine a mosaico.* Milan: Edizioni Stendhal.

Karakatsanis, A. 1974. Descriptive catalogue of the icons. In *Stavronikita Monastery: History, Icons, Embroideries,* ed. C. G. Patrinelis, A. Karakatsanis, and M. Theochare, 61–140. Athens: National Bank of Greece.

Loverdou-Tsigarida, K. 2003. Thessalonique, centre de production d'objets d'art au XIVe siecle. *Dumbarton Oaks Papers* 57: 241–54.

Minos, N. 1999. Conservation of the icons. In *The Holy Xenophontos Monastery: The Icons,* ed. E. N. Kyriakoudes, 247–57. Mount Athos: Holy Xenophontos Monastery.

Pasi, S. 1995. Nota sulla cosiddetta icona musiva conservata nella Chiesa di S. Pietro in Vincoli a Roma. In *Colloque international pour l'étude de la mosaïque antique: Fifth International Colloquium on Ancient Mosaics, Held at Bath, England, on September 5–12, 1987, under the aegis of L'Association Internationale pour l'Étude de la Mosaïque Antique and Organized by the Association for the Study and Preservation of Roman Mosaics, Pt. 2,* ed. R. Ling, 245–50. Journal of Roman Archaeology, Supplementary Series, no. 9. Ann Arbor, Mich.: Journal of Roman Archaeology.

Pelekanides, St. M., et al. 1975. *Οι Θησαυροί του Αγίου Όρους. Εικονογραφημένα χειρόγραφα.* Vol. B΄. Athens.

Petković, S. 1997. *Εικόνες Ιεράς Μονής Χιλανδαρίου.* Mount Athos.

Tavlakis, I. 1999a. Icons of the 17th–18th centuries. In *The Holy Xenophontos Monastery: The Icons,* ed. E. N. Kyriakoudes, 218–33. Mount Athos: Holy Monastery of Xenophontos.

———. 1999b. The mosaic icons. In *The Holy Xenophontos Monastery: The Icons,* ed. E. N. Kyriakoudes, 48–59. Mount Athos: Holy Monastery of Xenophontos.

Tsigaridas, E. N. 1996. Φορητές εικόνες. In *Ιερά Μεγίστη Μονή Βατοπαιδίου. Παράδοση-Ιστορία-Τέχνη.* Vol. B΄. Mount Athos.

Xenopoulos, St. 1925. Ψηφιδωτή εικών η «Επίσκεψις» εν τω Βυζαντινώ Μουσείω Αθηνών. *Deltion Hristianikes Archaiologikes Etaireias* 44–53.

L'*emblema* découvert en mer, au large d'Agde : Technique de fabrication – traitement de conservation

Luc Long, Véronique Blanc-Bijon, Patrick Blanc et Marie-Laure Courboulès

Résumé : *La restauration par l'Atelier de conservation du Musée de l'Arles et de la Provence antiques d'un* emblema *en* opus vermiculatum *découvert au large du Cap d'Agde en 2003 et conservé au Musée de l'Éphèbe, a été l'occasion de premières observations techniques. Réalisé probablement par un atelier œuvrant à Rome au Ier siècle avant J.-C., cet* emblema *présente un certain nombre de spécificités : support en travertin, tesselles en marbre, verre et faïence, traces de peinture. Son excellent état de conservation a permis d'appliquer un traitement léger, sans apport ou surcharge, révélant toutes les qualités esthétiques et techniques de l'œuvre.*

Abstract: *The restoration by the conservation workshop of the Musée de l'Arles et de la Provence antiques of an* opus vermiculatum emblema *discovered off the coast of Cap d'Agde in 2003 and conserved in the Musée d'Ephèbe provided the opportunity for the first technical observations. The* emblema*, probably executed by a workshop in Rome in the first century B.C.E., presents a number of distinctive features: travertine support; marble, glass, and faience tesserae; and traces of paint. In view of its excellent state of conservation, a light treatment was applied with no additions, revealing all the aesthetic and technical qualities of the work.*

Un exceptionnel *emblema* (fig. 1) a été mis au jour par 6 m de fond, le 10 mai 2003, au large du Cap d'Agde (Hérault, France), au voisinage des deux statues en bronze découvertes dans le même secteur en décembre 2001. Des premières recherches effectuées par le Département des recherches subaquatiques et sous-marines (DRASSM) confirment que les trois chefs-d'œuvre pourraient faire partie de la même épave, dont la date du naufrage se situerait dans les dernières années du Ier siècle av. J.-C.

Parmi les différents épisodes du défi musical entre Apollon et Marsyas, le mosaïste a représenté la fin du concours, lorsque, après sa victoire, le dieu prononce la sentence à laquelle Marsyas sera condamné.

Mise en œuvre

Support en travertin

Pour supporter, et transporter, ces tableaux en mosaïque que sont les *emblemata*, deux solutions ont été adoptées par les mosaïstes antiques : soit un caisson en marbre, en pierre ou en céramique avec des bords remontant, visible donc dans le pavement une fois l'emblema mis en en place ; soit un support formé d'une plaque en céramique – brique, *tegula* ou plat réalisé sur mesure – qu'aucune trace n'identifie en surface du pavement.

La mosaïque trouvée au Cap d'Agde s'inscrit dans un bloc mesurant 47,6/48 cm de large pour 48,8/49 cm de haut, en travertin provenant peut-être de la région de Tivoli (fig. 2). D'une épaisseur de 7,5/8 cm, la pierre est grossièrement équarrie sur sa face inférieure ; les côtés et le rebord supérieur ont été travaillés plus finement.

On a pu observer l'emploi de semblable support en travertin sur plusieurs *emblemata* italiens. Les dimensions peuvent en être parfois relativement importantes : l'Académie de Platon de Pompéi, mesurant 86 cm sur 85, semble le plus grand. À l'arrivée du travertin des carrières de Tivoli sur le marché en Italie, et d'abord dans le Latium, ce nouveau matériau fut utilisé par les artisans mosaïstes du Ier siècle av. J.-C. Cependant, cette technique offrait peu de garanties de sécurité : le travertin, fragile, devait être conservé sur une importante épaisseur, aussi l'ensemble était-il relativement lourd. Le travertin paraît avoir été rapidement supplanté par un matériau plus aisé à mettre en œuvre, et d'un poids nettement inférieur : la terre cuite. De dimensions à peine inférieures (44,5 × 45,5 cm), un *emblema* d'Utique sur caisson en céramique[1] pèse environ 10 kg, alors que celui d'Agde pèse 37,5 kg.

Stratigraphie interne

Une lacune fait apparaître la préparation interne. Laissant un rebord de 1,3 cm, le réceptacle en pierre est creusé sur plus de 1,8 cm. Un mortier de tuileau grossier comportant de nombreux fragments de céramique – dont des fragments d'amphores à pâte pompéienne – tapisse le fond du creusement qui a dû être piqueté pour en assurer l'accrochage. Sur cette couche grossière repose un fin mortier ocre, épais de 0,5 cm environ, sur lequel ont été posées les tesselles.

Tesselles

De 3 à 4 mm de côté, les tesselles ont une très grande régularité dans les fonds ; pour les détails, elles affectent des formes plus irrégulières, toujours extrêmement fines. Elles ont une épaisseur de 2 à 3 mm, comme cela est fréquent pour l'*opus vermiculatum*. Les tesselles sont taillées dans des pierres calcaires, du marbre ; nous avons aussi noté la présence de cubes en verre, ainsi qu'en faïence (fig. 3).

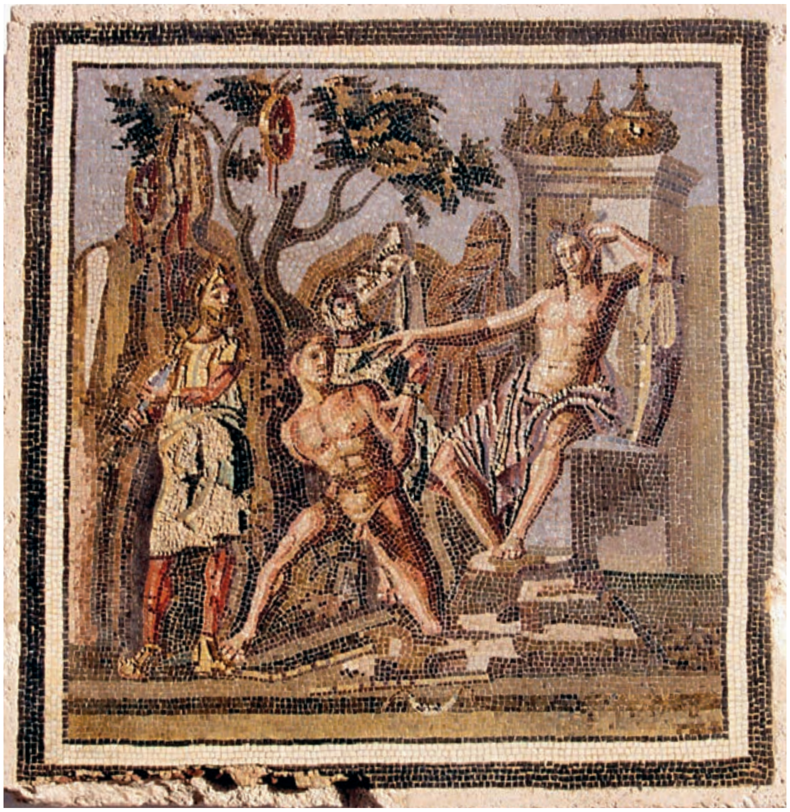


FIGURE 1 L'*emblema*. Photo Michel Lacanaud © MAPA.

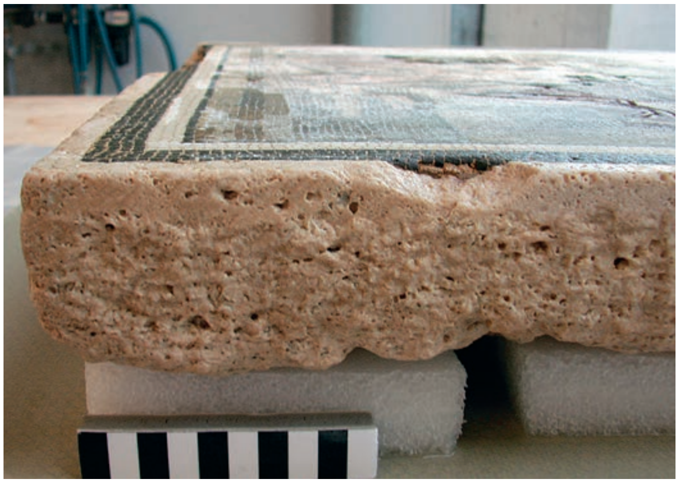


FIGURE 2 Le support en travertin. Photo © ACRM / MAPA.

FIGURE 3 Les tesselles. Photo © ACRM / MAPA.

Verre

Des recherches nouvelles sur la fabrication du verre ont montré que si le sable le plus fréquemment employé est celui du Belus en Syrie-Palestine, d'autres sables sont également utilisés, provenant d'Égypte, de Rome ou de Campanie. Des analyses sont en cours pour tenter d'identifier les sables mis en œuvre dans l'*emblema*. On sait maintenant que le verre est un matériau qui voyage sous une forme brute, importé en lingots, se fond dans des ateliers secondaires et se recycle pour des raisons techniques tout autant qu'économiques. Les tesselles en verre opaque utilisées pour le bleu clair et le mauve dans notre *emblema* présentent ces séries de petits points, signes d'une découpe dans du verre étiré en fil.

Faïence

Quant à la faïence, matière artificielle constituée de pâte siliceuse recouverte d'une glaçure, elle permettait aux mosaïstes de rendre certains bleus et verts n'existant pas dans la nature, voire des jaunes ou des blancs. Sur cet *emblema*, la plupart des tesselles en faïence ne montrent plus que des vestiges de pâte, verdâtre ou jaunâtre ; dans quelques cas, la surface glaçurée a été partiellement ou entièrement préservée lorsque la tesselle avait été basculée sur la tranche.

Si les chemins de sa diffusion ne sont pas encore reconnus, il est vraisemblable que la matière, dont l'origine est assurément égyptienne, devait circuler sous une forme finie ou non. Là aussi, des recherches récentes tendent à démontrer la présence de tesselles en faïence sur une série d'*emblemata* italiens.

Joints peints

Jouant de la multiplicité des matériaux, la palette est accrue encore par l'emploi de peinture. L'*emblema* d'Agde offre aussi cette technique permettant de dissimuler la discontinuité des cubes de pierre en apposant un mortier coloré à la façon de touches de pinceau. Ces traces sont conservées tant dans les joints que sur le dessus de certaines tesselles.

La palette ainsi constituée est riche et diversifiée, offrant une très grande variété de nuances. La mosaïque est alors véritablement une « peinture de pierres ». L'*emblema* d'Agde ne peut rivaliser toutefois avec les plus fins *emblemata* de la maison du Faune ou de la Villa Hadriana ; en revanche, un parallèle proche est l'*emblema* au Chat provenant de la villa de la Cecchignola, au sud de Rome, également sur travertin.

A.-M. Guimier-Sorbets considère le caisson à rebord comme une innovation « à mettre en relation avec le commerce qui en a été fait sur de grandes distances ». Notre *emblema*, s'il provient bien d'une épave antique, tendrait à renforcer ce dernier point. Des analyses en cours sur les matériaux permettront d'en préciser l'origine.

Conservation

État de conservation avant intervention

À son arrivée à Arles, l'*emblema* se présentait dans un état remarquable de conservation. Seule, la pierre en travertin du support avait été érodée par l'eau de mer ; sa porosité s'en est accrue, particulièrement visible au revers du bloc qui était également attaqué par des vers marins tubicoles. Outre la fracture laissant entrevoir le mortier de support, des croûtes calcaires râpeuses produites par des animaux marins (bryozoaires) et quelques fissures sont également visibles. Cependant, dans l'ensemble, le support en pierre est sain et ne présente pas d'altération qui risquerait de le fragiliser.

Quelques tesselles noires de la bordure de 4 files ont disparu à la hauteur de la fracture, ainsi que sur le bord droit où un choc (sur 6 cm) a fait disparaître une petite partie du support de pierre. Des tesselles en verre manquent également dans les vêtements des Scythes, dans le drapé d'Apollon, dans le ruban reliant les deux tubes de la flûte ; leurs empreintes dans le mortier sont très franches, bien conservées. Quant aux tesselles en faïence, la plupart ne sont plus conservées que par la pâte siliceuse retenue dans les alvéoles du mortier du lit de pose.

Traitement de conservation

Pour conserver cette œuvre exceptionnelle, il était nécessaire de lui prodiguer des soins en plusieurs interventions. Tout d'abord, il fallut extraire les sels solubles provenant de l'eau de mer. Si ceux-ci ne sont pas retirés, ils risquent lors de cycles de cristallisations, au séchage, de créer de fortes contraintes qui provoqueraient de nombreuses altérations des matériaux constitutifs de l'*emblema*. Après ce traitement de dessalement et le séchage complet de l'œuvre, il fallut vérifier son homogénéité et pallier d'éventuelles faiblesses par des consolidations ponctuelles.

Dessalement et séchage

L'*emblema* a été disposé dans des bains d'eau déminéralisée, renouvelés plusieurs fois. Avant chaque immersion, il est rincé à l'eau déminéralisée en prenant un soin tout particulier pour la surface du *vermiculatum*. A chaque changement, sont mesurés à température constante la salinité (SAL), les solides totaux dissous (TDS-mg/l) et la conductivité (µS/cm). Quand les mesures furent stables sur plusieurs bains, l'extraction des sels solubles a été considérée concluante et le traitement de dessalement s'est arrêté. L'assèchement progressif de l'*emblema* et sa stabilisation avec le microclimat extérieur se sont faits sous contrôle visuel régulier.

Nettoyage

Un nettoyage sous binoculaire a permis de retirer mécaniquement, au scalpel, les croûtes calcaires produites en surface du *vermiculatum* par les bryozoaires. Dans le mortier du bain de pose, les empreintes de tesselles disparues ont été dégagées, à l'aide d'aiguilles en bois, des résidus marins (algues, micro-coquillages) et du sable agglomérés dans les alvéoles.

Consolidation de surface

Une consolidation des empreintes de tesselles dans le lit de pose a été réalisée par imprégnations au pinceau d'une émulsion acrylique (Primal AC33) à 3 % dans de l'eau déminéralisée. L'ensemble des joints en mortier de chaux a été également consolidé avec cette même émulsion acrylique. Les tesselles les plus altérées, en particulier la pâte siliceuse des tesselles en faïence, ont été consolidées et protégées par une solution acrylique (Paraloïd B72) à 3 % dans de l'éthanol, appliquée localement au pinceau. Enfin, le support en pierre a été imprégné par un consolidant inorganique de type silicate d'éthyle.

Documentation

Une documentation minutieuse a été réalisée sur l'état de conservation de l'*emblema*, les matériaux constitutifs et les interventions de conservation. Ces nombreuses informations ont été enregistrées sur des relevés graphiques (fig. 4) et photographiques.

Le 27 mai 2004, l'*emblema* est retourné au Cap d'Agde où il est présenté depuis au Musée de l'Éphèbe.

Observations techniques

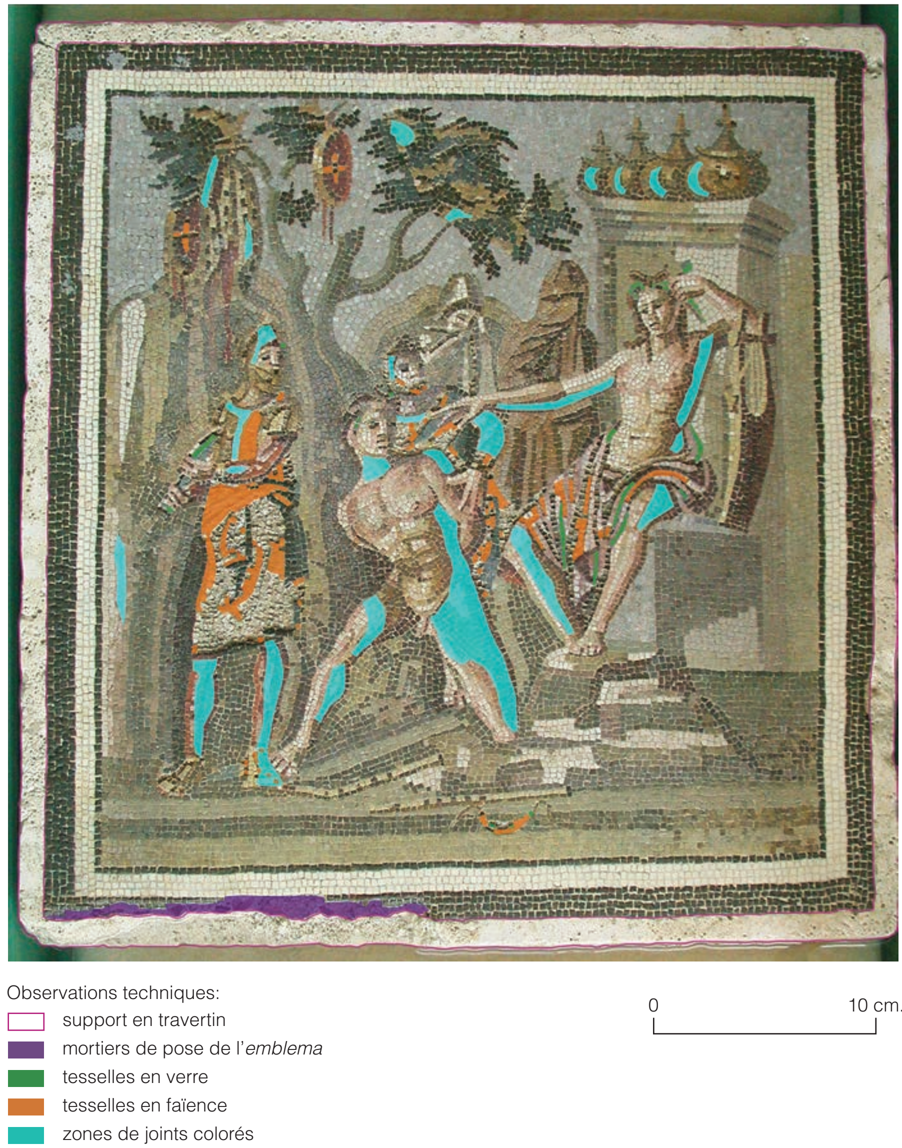


FIGURE 4 Relevé technique de l'*Emblema du supplice de Marsyas* – Musée de l'Ephèbe, Agde. M.-L. Courboulès © ACRM / MAPA.

Notes

1 Conservé par le Musée du Louvre, sa restauration a été présentée sous forme de poster lors de la conférence d'Hammamet par Mmes Laurence Krougly et Magda Monraval Sapiña, que nous remercions ici.

La restauration de la mosaïque du VIe siècle de Qabr Hiram (Liban) par l'Atelier de restauration de mosaïques de Saint-Romain-en-Gal

Évelyne Chantriaux, Marion Hayes, Christophe Laporte, Andréas Phoungas et Maurice Simon

Résumé : *L'un des derniers projets du Musée du Louvre est la création d'une salle où seront regroupées les œuvres de l'Antiquité tardive du bassin méditerranéen, jusqu'alors dispersées dans les différents départements du musée ou entreposées dans les réserves. La programmation a intégré l'aménagement, en sous-sol, d'un vaste espace permettant la présentation de la mosaïque de l'église Saint-Christophe de Qabr Hiram. À la suite des travaux de restauration qui se sont échelonnés sur une dizaine d'années, tout le pavement de l'église est prêt à être installé, près de cent cinquante ans après sa découverte.*

Abstract: *One of the Louvre Museum's latest projects is the creation of a room that will group together works from the Mediterranean basin dating to late antiquity that hitherto had been scattered in various museum departments or stored in the reserves. Planning included fitting out a large space in the basement in order to display the mosaic from the Church of Saint Christopher from Qabr Hiram. Following restoration work that took place over ten years, the complete church pavement is ready to be displayed in its entirety, almost five hundred years after its discovery.*

Présentation de l'opération

Cet ensemble de mosaïques, remarquable par ses dimensions, la qualité de son décor et son état de conservation couvrait, sur une surface de plus de 100 m², le sol de l'église Saint-Christophe de Qabr Hiram, à une quinzaine de kilomètres de Tyr. Découvert en 1861 par Ernest Renan lors de sa mission en Phénicie (Renan 1864–1874), le pavement a été entièrement déposé et transporté au Louvre en 1862. Après son remontage trente ans plus tard sur un support de ciment armé, il est resté en l'état, hormis le tapis de la nef centrale qui a été transféré sur un support de plâtre en 1979 (Bagatti 1963 ; Duval 1977 ; Baratte 1978 ; Donceel-Voûte 1990).

La totalité des tapis de mosaïque, découpés en quatre-vingts panneaux, n'a cependant jamais donné lieu à une présentation globale. Longtemps disposés en désordre dans une galerie du Louvre, puis partiellement assemblés pour l'exposition temporaire des « Arts de la Méditerranée » dans les années 1970, la majeure partie des panneaux a été ensuite mise en réserve et seuls quelques fragments sont restés présentés au public.

C'est à l'initiative de Catherine Metzger, conservatrice au Département des Antiquités grecques, étrusques et romaines au Musée du Louvre, que la reprise du traitement a été envisagée en 1988 à des fins de présentation globale. La restauration, confiée à l'atelier de Saint-Romain-en-Gal a été engagée en 1994. L'achèvement de l'opération en 2004 va permettre la future présentation du pavement dans une salle du Louvre en cours d'aménagement. Dans cet espace qui sera consacré aux civilisations du pourtour méditerranéen, les mosaïques seront visibles dans leur totalité, et dans la configuration qu'elles présentaient au sol de l'église de Qabr Hiram (fig. 1).

Le remontage sur un nouveau support

Après l'enlèvement des anciens supports de ciment et de plâtre (fig. 2, 3), les quatre-vingts éléments de la mosaïque – soit une surface de 100 m² – ont été remontés sur trente panneaux de nid d'abeilles. L'ensemble a été mis en place au sol de l'atelier (fig. 4) selon l'organisation générale du pavement donnée par le plan d'Ernest Renan. La recomposition du chœur a permis de restituer les bandes de fleurettes qui avaient été compactées sur ciment en un bloc. L'opération finale a consisté à réaliser le traitement des espaces correspondant aux bandes de *tessellatum* blanc qui raccordaient initialement les différents tapis de mosaïque.

FIGURE 1 Vue générale de la mosaïque à l'issue de la restauration telle qu'elle sera présentée au Musée du Louvre. Cliché: Alain Basset.

FIGURE 2 Nef nord avant traitement. Cliché: atelier.

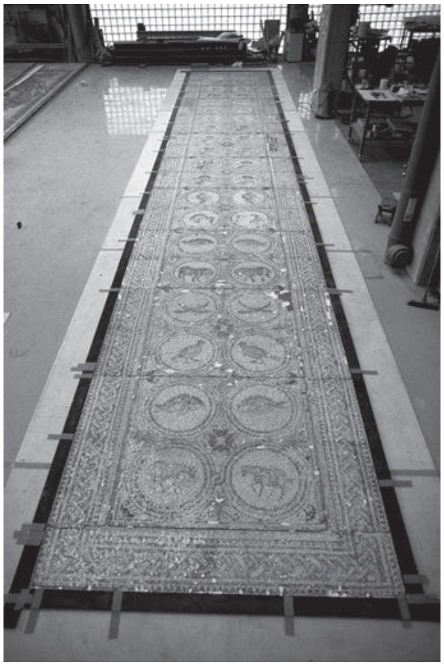


FIGURE 3 Recomposition de la nef nord à l'envers après enlèvement du support de ciment. Cliché: Paul Veysseyre.

FIGURE 4 Mise en place de l'ensemble des panneaux et recomposition du chœur. Cliché: Paul Veysseyre.

Ces bandes de liaison, représentant une surface de 20 m², ont été matérialisées par un enduit de teinte neutre par rapport à la tonalité générale du pavement. Ce revêtement a été appliqué sur des supports de nid d'abeilles comblant tous les vides entre les différents panneaux de mosaïque (fig. 5). Les bases de colonnes séparant les trois nefs sont indiquées par un enduit de teinte plus sombre, avec une légère surépaisseur pour les détacher du niveau du pavement ; des décaissés carrés marquent les emplacements des supports du chancel.

Le rétablissement de la continuité du *tessellatum*

Les cadres de fer correspondant à l'ancien découpage de la mosaïque occupaient la largeur d'une rangée de tesselles. Le comblement de ces vides et des zones périphériques dégradées a été effectué – sur une longueur de 100 m – avec des tesselles taillées dans des calcaires compatibles avec les pierres d'origine et avec celles des restaurations précédentes. Ces interventions successives sont restées localisées dans les filets de bordures (fig. 6) et dans les zones de liaison entre les cercles. La dépose a en effet privilégié la sauvegarde des parties figurées, mais la plupart des motifs géométriques – sans doute partiellement détruits – ont été refaits lors du premier remontage effectué à la fin du XIX^{e} siècle, comme en témoignent la nature différente des tesselles dans ces zones et le fait que des parties brûlées s'arrêtent nettement aux contours de certains médaillons (fig. 7).

FIGURE 5 Vue partielle du pavement après traitement des surfaces de liaison. Cliché: atelier.

FIGURE 6 Repose de tesselles à la jonction des plaques après enlèvement des cadres de fer. Cliché: Paul Veysseyre.

FIGURE 7 Détail d'une zone brûlée et des restaurations anciennes autour du médaillon. Cliché: Paul Veysseyre.

FIGURE 8 Médaillon lacunaire et restaurations anciennes entre les enroulements du rinceau (nef centrale). Cliché: Paul Veysseyre.

Le traitement des lacunes

Bien que la trame ornementale des mosaïques des nefs (rinceaux du panneau central et motifs géométriques entre les médaillons des bas-côtés) ait largement été reconstituée, les restaurations précédentes ont épargné les représentations figurées qui étaient détruites ou endommagées à des degrés divers. Les sujets manquants ou fragmentaires sont ainsi restés dans l'état qu'ils présentaient à leur découverte : notre intervention s'est limitée à remplacer par des enduits de chaux les anciens comblements qui avaient été appliqués dans les lacunes (fig. 8).

Références

Bagatti, B. 1963. Il pavimento musivo di Qabr Hiram (Libano). *Rivista di Archeologia Cristiana della Pontificia Comissione di Archeologia Sacra* XXXIX.

Baratte, F. 1978. *Catalogue des mosaïques romaines et paléochrétiennes du Musée du Louvre.* Paris : Réunion des Musées Nationaux.

Donceel-Voûte, P. 1990. *Qabr Hiram, Église Saint-Christophe – Les pavements des églises byzantines de Syrie et du Liban : Décor, archéologie et liturgie. (Publications d'Archéologie et d'Histoire de l'Art, 69).* Louvain-la-Neuve : UCL.

Duval, N. 1977. Notes sur l'église de Kabr Hiram (Liban) et ses installations liturgiques. *Cahiers archéologiques, fin de l'Antiquité et Moyen-Âge* 26 : 81–104.

Renan, E. 1864–74. *Mission de Phénicie*. Paris : Imprimerie Impériale.

Study of the Mineralogical and Chemical Characteristics of Materials Used in the Construction of Roman Mosaics in Volubilis, Morocco, with a View toward Their Conservation

Abdelilah Dekayir, Marc Amouric, Juan Olives, and Abdelkader Chergui

Abstract: *The Roman city of Volubilis, located 30 kilometers northwest of the city of Meknes, contains many* opus tessellatum *mosaics, some of which have detached tesserae and cracks due to deterioration and aging. Before undertaking the conservation of these mosaics, a thorough knowledge of the structure of the various materials used to construct them had to be obtained. The mineralogical analysis by X-ray diffractometry of the coarse mortar and the bedding mortar taken from the Flavius Germanus mosaic indicates that it was made of quartz and calcite, with a variable quartz/calcite ratio. The white, brown, and pink tesserae show a petrographic facies ranging from micritic limestone to oolitic limestone. The chemical analysis of the limestone using inductively coupled plasma shows that the color of the tesserae depends on the iron content. On the other hand, the black and red tesserae were made respectively from marble and sandy limestone. The other colors, such as yellow, blue, green, and gray, were achieved using glass paste of different chemical compositions.*

Résumé : *La cité romaine de Volubilis, située à 30 km au nord de Meknès, renferme plusieurs mosaïques de type* opus tessellatum*, certaines exhibant des pertes de tesselles et des fissures. Leur conservation requiert une connaissance approfondie de la structure des matériaux constitutifs. L'analyse minéralogique par diffraction des rayons du mortier grossier et du lit de pose de la mosaïque de Flavius Germanus montre une composition de quartz et de calcite avec un rapport quartz/calcite variable. Les tesselles blanches, brunes et roses montrent un faciès pétrographique allant du calcaire micritique au calcaire oolithique. L'analyse chimique des calcaires par ICP révèle que la couleur dépend de la teneur en fer. Les tesselles noires et rouges ont été confectionnées respectivement avec du marbre et du grès rouge. Les autres couleurs, comme le jaune, le bleu, le vert et le gris, ont été fabriquées en pâtes de verre de différentes compositions chimiques.*

In the Mediterranean region Roman mosaics have been the subject of mineralogical and chemical investigations (Bergamini and Fiori 1999; Capedri et al. 2001; Galli et al. 2004; Domínguez-Bella et al., this volume; Boschetti et al., this volume). At the archaeological site of Volubilis, 30 kilometers from the city of Meknes, the mosaics are of the *opus tessellatum* type (i.e., made of tesserae of equal size) (Limane 1998; Panetier and Limane 2002) (fig. 1). The most famous ones portray Orpheus, Ephebus, Venus, Bacchus, and the Four Seasons. These mosaics suffer a great deal from the effects of weathering and aging. The conservation and restoration of the mosaics at Volubilis require a good knowledge of the nature and characteristics of the initial components (stones and mortars) used to build them. The results presented here summarize the previously published study of the petrological, mineralogical, and geochemical characteristics of these materials (Dekayir et al. 2004).

Materials and Methods

The Roman mosaics at Volubilis, like other mosaics in the Mediterranean region, consist of several layers: (a) statumen, a layer of large stones; (b) rudus, a mixture of lime mortar and stone rubble; (c) nucleus, a mixture of thin lime mortar and fine aggregate; (d) bedding layer, a thin coating of lime-rich mortar; and (e) *tessellatum,* the tesserae and the mortar filling the interstices between them. The analyzed mortars of the nucleus (FGMG) and bedding (FGLF) layers were taken from the Flavius Germanus (FG) mosaics; tesserae samples were collected from other mosaics. Mineralogical and chemical analyses were done under both binocular and scanning electron microscopy (SEM). Nucleus and bedding layer mortar samples were analyzed by X-ray diffraction (XRD). Chemical analyses of tesserae and mortars were obtained by inductively coupled plasma (ICP).

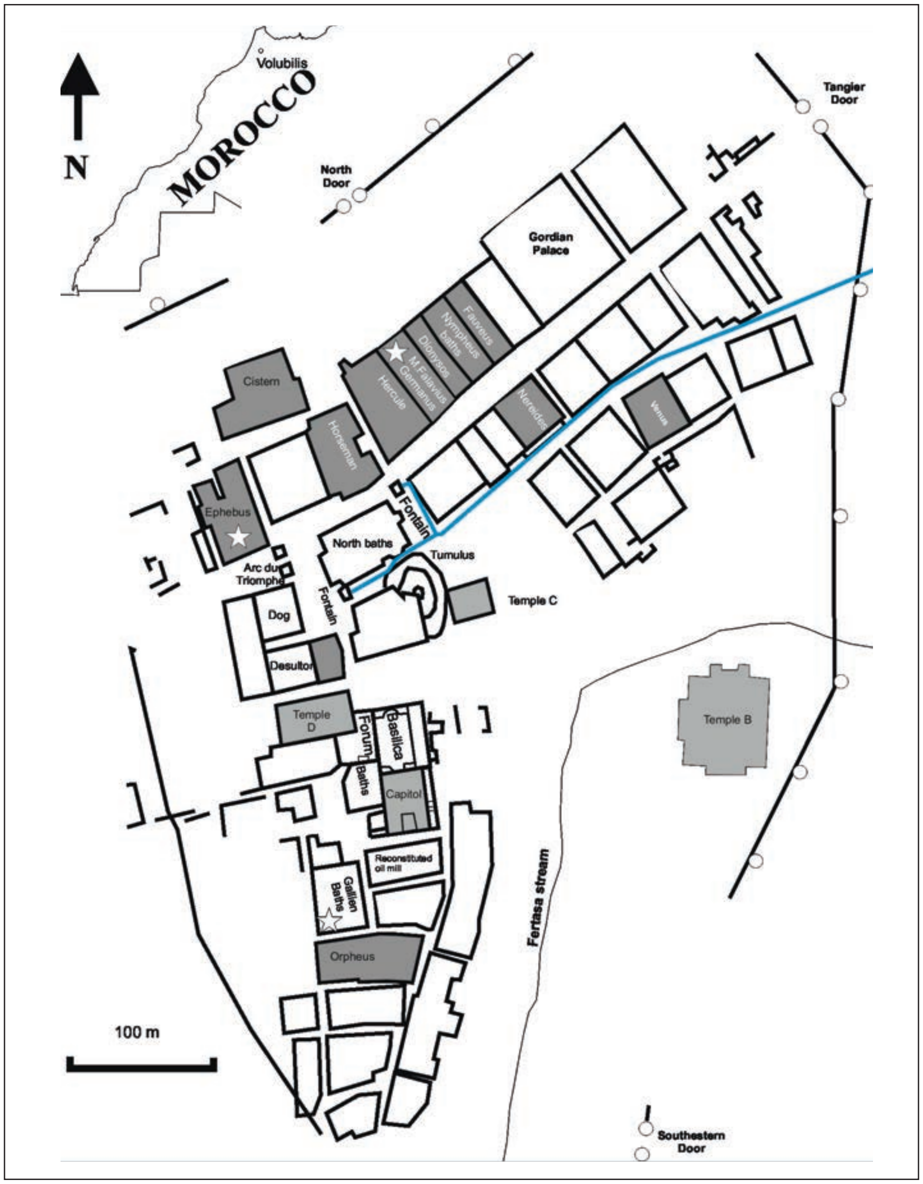


FIGURE 1 Map of Volubilis city, with location of samples.

Results

Mineralogical and Chemical Characterization of Tesserae

In situ observations of Volubilis mosaics reveal that tesserae are divided into two classes: stone, the size of which varies from 1 to 2 centimeters; and glass, of a few millimeters in size.

Stone tesserae. White tesserae (TSW) represent a large percentage of most of the Volubilis mosaics. They are made of limestone, characterized by radial ooliths linked by sparite, with some traces of foraminifera. The pink tesserae (TSP) show ooliths linked by microsparite. In the brown tesserae (TSB), the ooliths are not well individualized and are colored by iron of diagenetic origin. The red tesserae (TSR) are made of sandy limestone (quartz grains cemented by calcite) or fired clay materials. Black tesserae (TSBK) and white onyx tesserae (TSO) are made of marble. Detailed petrographic observations of these tesserae reveal that they consist of calcite with some feldspar minerals. In onyx tesserae, calcite is coarse grained with rare feldspar and muscovite (table 1). XRD spectra of TSW, TSP, TSBK, and TSO tesserae show dominance of calcite, while those of TSR and TSB show the presence of calcite and quartz. (See fig. 2.)

Glass tesserae. As other colors were needed, Roman artists at Volubilis used some yellow, dark blue, dark green, and gray glass tesserae. Observations of these tesserae with SEM show different chemical compositions,

Table 1 Color, facies, and chemical composition of various stone tesserae, nucleus, and bedding layer mortars from Flavius Germanus mosaic (all results from one analysis of each sample)

a)

Chemical Composition wt (%)	FGMG	FGLF	TSW (white)	TSP (pink)	TSB (brown)	TSR (red)	TSO (onyx)	TSBK (black)
Facies	Nucleus mortar	Bedding layer mortar	Oolithic limestone	Oolithic limestone	Oolithic limestone	Sandy limestone	Marble	Marble
Minerals	Calcite, quartz, feld., mica	Calcite, quartz	Calcite	Calcite	Calcite	Quartz, calcite	Calcite, feld., muscovite	Calcite, feld., muscovite
SiO_2	35.63	14.36	6.71	1.25	8.50	13.53	4.77	4.33
Al_2O_3	3.21	2.39	1.85	0.92	2.43	2.21	1.83	1.51
Fe_2O_3	1.19	0.85	0.59	0.29	2.46	4.93	0.52	0.48
MnO	0.03	0.02	0.01	0.01	0.07	0.08	0.02	0.01
CaO	30.29	44.38	51.78	57.23	47.10	43.73	46.71	51.76
MgO	0.56	0.35	1.43	0.41	0.80	0.71	4.45	1.17
Na_2O	0.20	0.15	0.07	0.06	0.12	0.23	0.61	0.09
K_2O	0.93	0.50	0.20	0.11	0.43	0.42	0.28	0.23
TiO_2	0.16	0.10	0.07	0.02	0.11	0.15	0.10	0.05
P_2O_5	0.41	0.55	0	0	0.64	0.20	0.40	0
LOI	26.75	36.98	38.10	39.70	38.15	34.63	40.32	41.93
Total	99.36	100.63	100.81	100	100.81	100.82	100.01	101.56

b)

	Glass Tesserae				
wt (%)	TSVF (dark green)	TSJ (yellow)	TSV (green)	TSB (blue)	TSG (gray)
Si	48.18	57.6	57.62	60.71	40.28
Pb	23.82	10.06	5.56	4.18	2.13
Al	3.47	4.57	3.62	1.53	2.62
Ca	8.91	11.44	11.42	15.29	6.79
Na	15.62	16.32	16.36	13.15	11.06
Cl	-	-	3.11	3.06	1.58
K	-	-	2.3	0.59	0.64
F	-	-	-	-	36.55

- = not detected

as seen in figure 3, dominated by Si with small amounts of Al, Pb, Na, and Ca.

Mineralogy of the Nucleus and Bedding Layer Mortars

XRD analysis of the nucleus mortar (FGNU) shows dominance of quartz, calcite, and some feldspar and probably mica and dolomite, while XRD spectra of the bedding layer mortar (FOBL) show the presence of calcite and quartz without feldspar or mica (fig. 4). This mineralogy is supported by the given chemical data of the two mortars (see table 1).

Discussion and Conclusion

Petrographic, mineralogical, and chemical data show that all the Roman mosaics at Volubilis were built with the same materials. White, pink, and brown tesserae are made of oolithic limestone, red tesserae

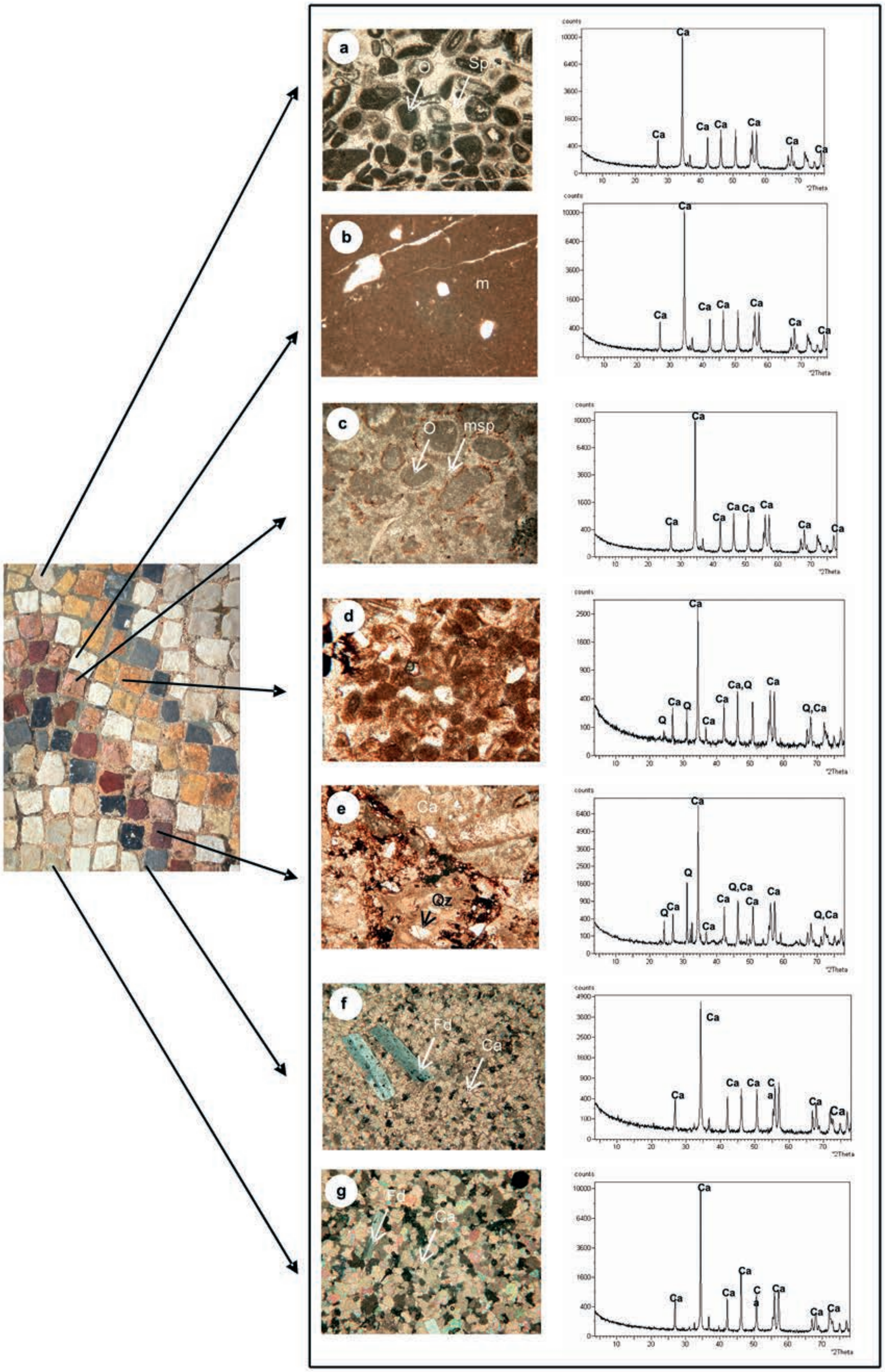


FIGURE 2A–G Petrography and XRD spectra of different stone tesserae: a) TSW (x4); b) TSW bis (x4); c) TSP (x10); d) TSB (x10); e) TSR (x4); f) TSBK (x4); g) TSO (O = oolith; Ca = calcite; Fd = feldspar; M = micrite; Qz = quartz; Sp = sparite; Msp = microsparite).

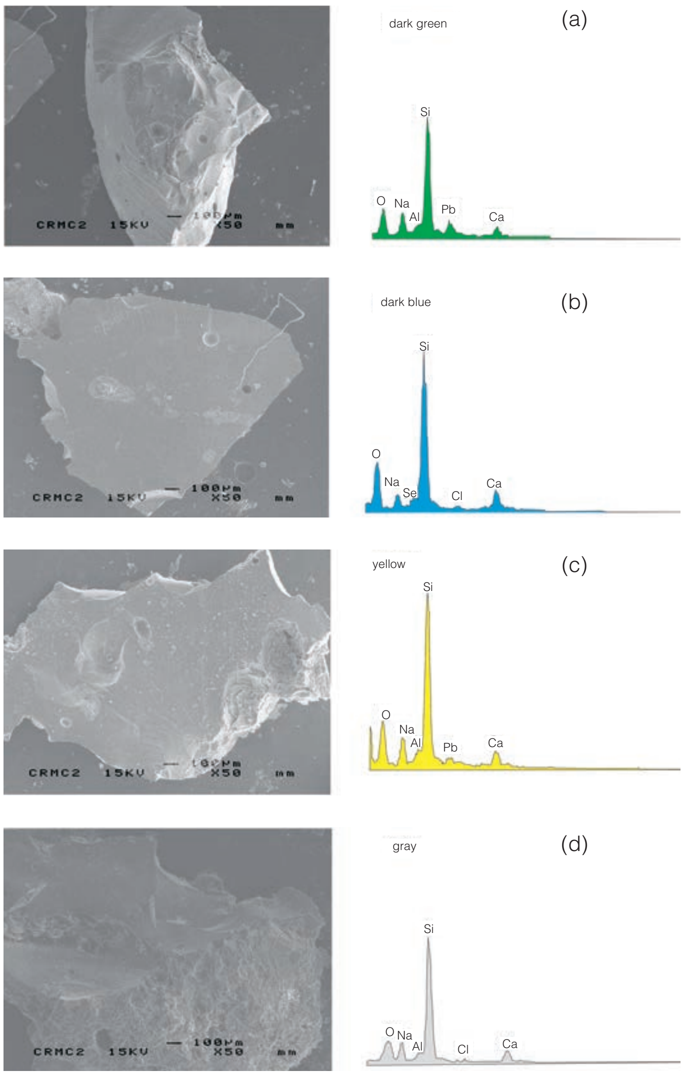


FIGURE 3A–D SEM and EDX analysis of (a) dark green glass tesserae; (b) dark blue glass tesserae; (c) yellow glass tesserae; (d) gray glass tesserae.

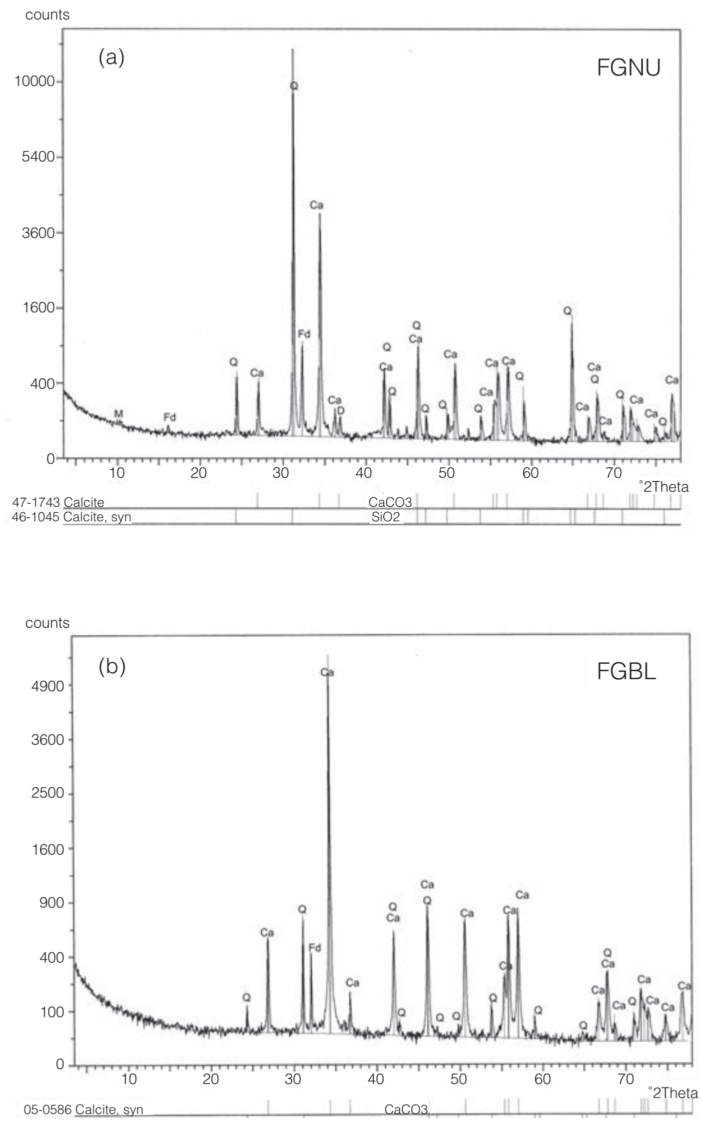


FIGURE 4A, B XRD patterns of (a) nucleus mortar (FGNU) and (b) bedding layer mortar (FGBL). (Q = quartz; Ca = calcite; D = dolomite; F = feldspar; M = Mica.)

of sandy limestone. The quarries of these stones are partly found near Volubilis, in Aalenian and Bajocian geologic formations (Faugères 1978). Since black and white onyx marbles are absent in this region, they were probably imported. In these mosaics, other tesserae (yellow, blue, green, and gray) made from glass and fired clay were used. The mineralogy of the bedding layer and the nucleus mortars is quite similar, with variable quartz/calcite ratios. The mortars that have been studied were made of lime, which sets according to the following process:

$CaCO_3 = CaO + CO_2$ (lime preparation);
$CaO + H_2O = Ca(OH)_2$ (portlandite)

$Ca(OH)_2 + CO_2 = CaCO_3 + H_2O$ (mortar setting and carbonation of the matrix)

Roman mosaics are precious masterpieces. This site has been considered with special care since it was listed as a World Heritage Site by UNESCO in 1997. The results acquired in this study are of great importance, first for improving our knowledge but also for the understanding of the weathering process of these mosaics.

References

Bergamini, M. L., and C. Fiori. 1999. Characterization of limestones, marbles, and other stones used in ancient mosaics. In *Archéomatériaux : Marbres et autres roches : Actes de la IVème conférence internationale de l'Association pour l'étude des marbres et autres roches utilisés dans le passé : ASMOSIA IV, Bordeaux-Talence, 9–13 octobre 1995,* ed. M. Schvoerer, 199–207. Bordeaux-Talence, France.

Capedri, S., G. Venturelli, S. De Maria, M. P. M. Uguzzoni, and G. Pancotti. 2001. Characterization and provenance of stones used in mosaics of *domus dei Coiedii* at Roman Suasa (Ancona, Italy). *Journal of Cultural Heritage* 2: 7–22.

Dekayir, A., M. Amouric, J. Olives, C. Parron, A. Nadiri, A. Chergui, and A. El Hajraoui. 2004. Structure et caractérisation des matériaux utilisés dans la construction d'une mosaÏque romaine de la cité de Volubilis (Maroc). *Geoscience* 336: 1061–70.

Faugères, J. C. 1978. Les rides prérifaines: Évolution sédimentaire et structurale d'un bassin Atlantico-mésogéen de la marge africaine. Thèse ès-sciences, Université de Bordeaux.

Galli, S., M. Mastelloni, R. Ponterio, G. Sabatino, and M. Triscari. 2004. Raman and scanning electron microscopy and energy dispersive X-ray techniques for the characterization of coloring and opaquening agents in Roman mosaic glass tesserae. *Journal of Raman Spectroscopy* 35: 622–27.

Getty Conservation Institute and Israel Antiquities Authority. 2003. *Illustrated Glossary: Mosaic in Situ Project: Definitions of Terms Used for the Graphic Documentation of in Situ Floor Mosaics*. Los Angeles, Calif.: Getty Conservation Institute. Available at www.getty.edu/conservation/publications/pdf_publicationsmosaicglossary.pdf.

Limane, H. 1998. *Volubilis : De mosaïque à mosaïque.* Aix-en-Provence: Édisud.

Panetier, J. L., and H. Limane. 2002. *Volubilis, une cité du Maroc antique.* Paris: Maisonneuve et Larose.

The Lifting Procedure of the Bacchus Mosaic from the Roman Villa in Barrio Jarana, Cádiz, Spain

Salvador Domínguez-Bella, María Luisa Millán Salgado, and Ana Durante Macias

Abstract: *In September 2004 a Roman villa was discovered during the construction of a new lane of the N-IV highway, near Barrio Jarana, Puerto Real, in the Cádiz province of Spain. Only one room with a mosaic pavement was discovered in the excavated area. This mosaic, measuring 4 by 3 meters, represents a central face, which probably depicts Bacchus. The provisional dating of the villa has been estimated as the second century C.E. This poster presents the lifting process and its transportation to the provincial museum where it will be restored.*

Résumé : *En septembre 2004, une villa romaine a été découverte pendant l'aménagement d'une nouvelle voie de l'autoroute N-IV près de Barrio Jarana, Puerto Real, dans la province de Cadix en Espagne. La fouille n'a révélé qu'une pièce comportant un pavement en mosaïques. Celle-ci mesure 4m x 3m et représente une figure centrale, probablement celle de Bacchus. La datation provisoire fait remonter la villa au IIe siècle après J.-C. Cette communication évoque le processus de dépose et son transfert vers le musée provincial où il subira une restauration.*

The ceramic production of amphorae in different areas of the Bay of Cádiz is widely documented and indicates activity from Phoenician times to the Roman era (fourth century C.E.). Cádiz province is situated on the Atlantic coast along the northern side of the Straits of Gibraltar. Gades, founded by the Phoenicians, is one of the oldest cities in western Europe and during the Roman Empire had great commercial and geopolitical importance. In addition to Gades, located in a group of islands in the center of a bay formed by the mouth of the Guadalete River, industrial centers such as Puente Melchor–Barrio Jarana, near the modern city of Puerto Real (fig. 1), had great importance for the Bay of Cádiz area. An important ceramic production center is located in this area, as evidenced by a large number of documented pottery workshops. The existence of local geological outcrops of raw materials necessary for the production of pottery (Gutiérrez Mas 1991: 315) and their proximity to the coastline with a good port for shipping, as well as a rich fishing industry, permitted the installation and development of ceramic production in this area during Roman times (beginning of the first century C.E. to end of the fourth century). Many archaeological sites and pottery workshops such as Torre Alta and Puente Melchor–Barrio Jarana have already been well studied (García Vargas 1998: 408; Millán and Lavado 2000).

From October to December 2004, M. L. Lavado directed a rescue excavation of the villa that had been discovered in September of that year. Up to the present, 2000 square meters have been excavated. This villa may have been part of the great Roman industrial complex in the area, specializing in the production of amphorae used to transport goods such as olive oil, wine, and fish derivatives. This archaeological site is also interesting for its size and luxurious decoration, including polychromatic wall paintings in almost all the rooms, as well as decorative stone pavements and dados.

The Bacchus Mosaic

Only one room with a mosaic pavement has been discovered in the villa. This mosaic presents a central face, probably a representation of Bacchus. It is surrounded by a black-and-white circular design with concentric bands of triangles (fig. 2a) and four small figures. Two are polychromatic representations of birds, and two are black-and-white figures of kraters. A rectangular sector with a line of four small faces appears below this square, which may correspond to representations of the four seasons (fig. 2b). The two scenes present the same iconographic theme. The villa has been provisionally dated to the second century C.E. (M. L. Lavado, pers. comm.). In this poster we present the procedure for lifting and transport-

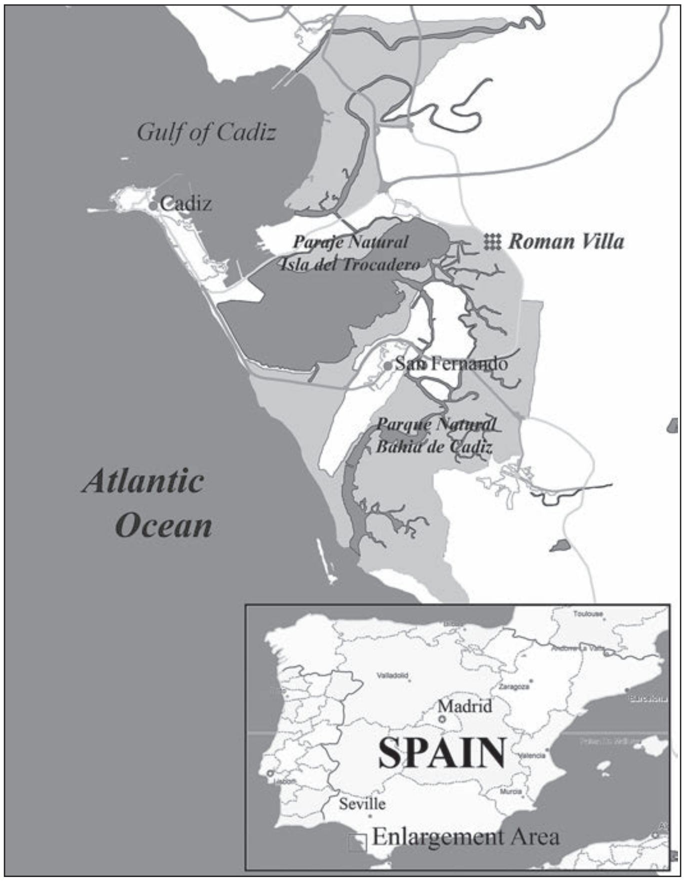


FIGURE 1 The province of Cádiz in southwestern Spain; the Puente Melchor–Barrio Jarana Roman villa is shown in the inner part of the Bay of Cádiz. Map by Emil Askey, GCI © J. Paul Getty Trust.

(a)

(b)

FIGURE 2A The appearance of the Bacchus mosaic surface after in situ removal of mineral encrustations, prior to its transfer to the museum. Photo by Francisco Marin and María Luisa Millán.

FIGURE 2B Upper part of the Bacchus mosaic, with four faces, probably a representation of the four seasons. Photo by Francisco Marin and María Luisa Millán.

ing this mosaic to the provincial museum where it will be restored and where its archaeometric study by the University of Cádiz is now in progress.

Mosaic Description and Condition

The pavement of this small room was decorated with stone tesserae, generally black and white and in many designs, and with glass paste tesserae of various colors bedded in a mortar layer very rich in lime that rests on the *rudus*. The mosaic is in an inverted "T" shape and has a surface area of 28.10 square meters.

On its discovery the mosaic was very fractured. One of the main problems was ten large cuts on the mosaic surface that had been caused by a steel disk plow running over it, a result of agricultural activity in the area. Among the most serious types of damage that this pavement presents, we note the following:

- Cracks in the surface and in the support layers
- Detachment of mosaic bedding layers
- Loose tesserae
- Loss or lacunae in the mosaic in the tesserae layer, especially where the plow passed; in the upper left corner of the pavement; and in the mortar bedding layers, especially in the lower perimeter
- Loss of volume under the tesserae, caused by water dissolution and/or loss of the mortar bedding layer
- Structural movement of the mosaic bedding layers that produced serious deformations in the mosaic surface
- 20-centimeter-deep depression in the pavement (with respect to the rest of the surface) in the lower right corner

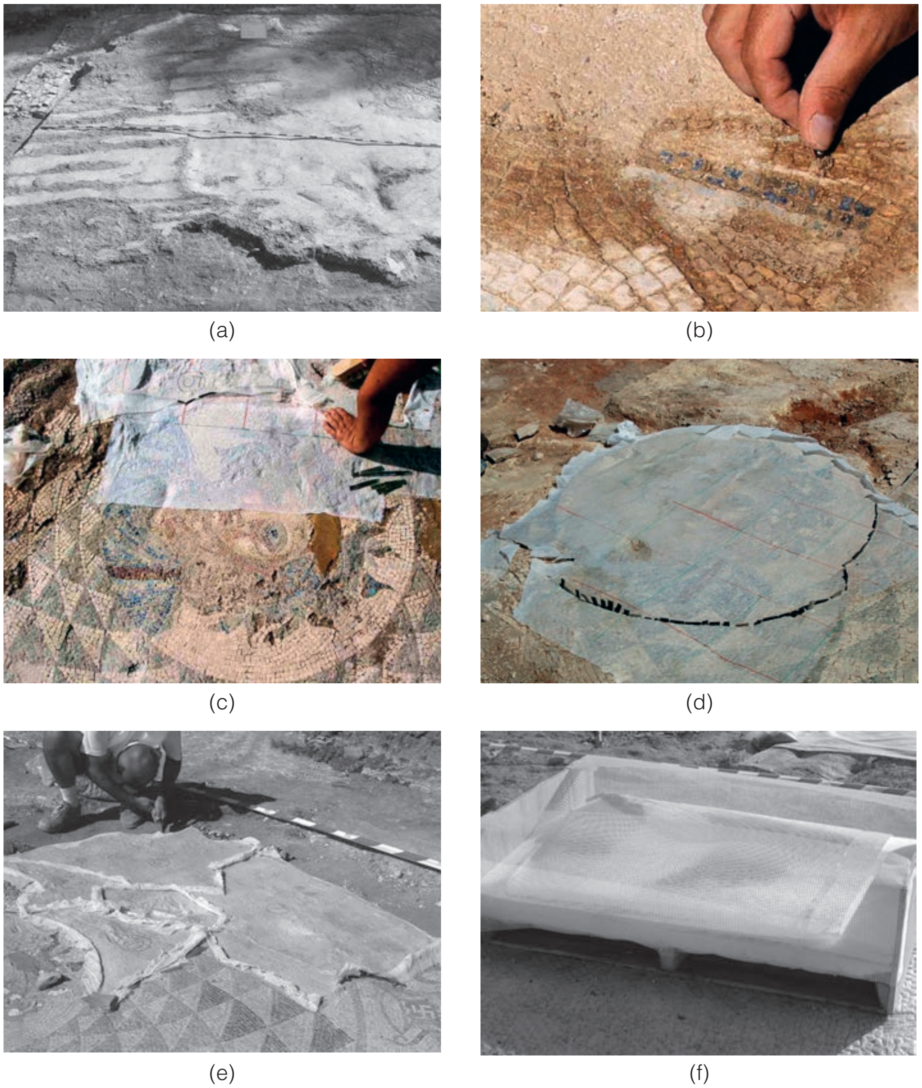


FIGURE 3A–F The steps of the lifting procedure of the Bacchus mosaic: (a) original condition of the mosaic surface with a layer of mineral encrustation; (b) removing the carbonate crust with a scalpel; (c) facing the mosaic with a cotton fabric and PVA adhesive and drawing a square grid for 2-D mapping of sections; (d) cutting the cotton fabric following the section lines and inserting metallic sheets between tesserae; (e) detachment process of the predefined sections under the *rudus*; and (f) final packing of the sections for transport to the museum. Photos by Francisco Marin and María Luisa Millán.

- Separation between the tesserae, produced by roots and seeds, and their subsequent movement
- Disintegrated tesserae, specifically, the black tesserae, which have been reduced to powder and small particles
- Eroded and exfoliating surfaces of the black tesserae
- Numerous fractured tesserae resulting from agricultural activity
- Formation of mineral encrustations on the mosaic surface, which has hidden the pavement design and produced a hard and compact crust on the tesserae surfaces (fig. 3a)

Lifting Procedure

The lifting and cleaning procedures and the condition of the mosaic have been documented photographically. Before the lifting a partial cleaning of the mineral encrustations was carried out by mechanical methods using a scalpel and spatula (fig. 3b), aided by previous wetting of the surface. This work was done very carefully because some tesserae were sensitive to the treatments. The edges of the pavement, which presented a major risk of detachment, were consolidated with a siliceous sand and hydraulic lime mortar in a 3:1 proportion.

Two fabrics were used to face the mosaic (fig. 3c), one made of 100 percent cotton with an open weave of 22 threads per square centimeter, and the other with a more open weave, which was boiled prior to being used. Before proceeding with the facing, some decorative details of the mosaic, made of glass tesserae, were protected with Paraloid® B72, diluted in acetone at 5 percent. The adhesive used for the gauze facing was polyvinyl acetate in emulsion, with polyvinyl alcohol diluted with water to improve the acetate reversibility. For preventive purposes, 2 grams per liter of a fungicide (hipagine) was added to the water.

After covering the mosaic with the fabric, a regular 20-centimeter-square grid was drawn with colored pencils to facilitate the cutting into sections (fig. 3c). All the mosaic sections have been noted in a scale drawing, each fragment numbered and located in the 2-D plan. The mosaic was divided into a total of seventy-six fragments, which completed the lifting preparations. Cutting lines for the lifting were executed following the presence of previous damage to the mosaic surface such as cracks and lacunae and also along the design lines in the pavement, or between different-colored tesserae (fig. 3d). To delimit these lines, many steel strips were introduced in the tesserae interstices. Chisels were introduced under the *rudus* to extract each fragment and to remove all the loose mortar remains from under the tesserae (fig. 3e). Each fragment was marked with the same number that appeared in the plan of the mosaic. Ten numbered wooden cases were constructed to transport the mosaic fragments to the museum. A layer of polystyrene was placed inside the case, and the mosaic fragments were placed upside down on this layer. On the last layer of fragments a plastic net was fixed to the wooden case (fig. 3f).

Conclusion

The lifting and cleaning of seventy-six numbered sections of the mosaic were carried out after the sections were recorded in a 2-D coordinate system. This is probably the biggest and most important Roman mosaic discovered in the Bay of Cádiz area in recent years that has been lifted using a modern methodology. An archaeometric study of the composition of the tesserae is under way for the first time in southern Spain.

Acknowledgments

The authors are grateful to the collaboration of M. L. Lavado, director of the excavation of the villa; L. Aguilera, a member of the archaeological team, and the restorers F. Marin Albadalejo and M. A. Bueno for their participation in the lifting process.

References

García Vargas, E. 1998. *La producción de ánforas en la Bahía de Cádiz en época romana (siglos II a.C.–IV d.C.).* Écija: Editorial Gráficas Sol.

Gutiérrez Mas, J. M. 1991. *Introducción a la geología de la provincia de Cádiz*. Cádiz: Universidad de Cádiz.

Millán León, J., and M. L. Lavado Florido. 2000. El centro productor de Puente Melchor (Puerto Real, Cádiz). In *Congreso Internacional ex Baetica Amphorae: Conservas, aceite y vino de la Bética en el Imperio Romano (Écija y Sevilla, 17 al 20 de diciembre de 1990): Actas*, ed. G. C. *García*, 1:215–26. Écija: Editorial Gráficas.

Comparison of Conventional and Photogrammetric Documentation of Mosaics at the Agora of Perge

Işıl R. Işıklıkaya

Abstract: *A new project on in situ mosaics in Perge has provided an opportunity to study the most efficient method for documenting the largest number of panels within the restricted period of yearly excavation campaigns. In summer 2004 two different methods were used; this paper compares the results. Photogrammetric documentation proved very suitable for the documentation of in situ mosaics, providing such precise results that computer drawings of the panels could be based on them.*

Résumé : *Un nouveau projet sur les mosaïques* in situ *de Perge a permis de rechercher la méthode la plus efficace pour documenter le plus grand nombre possible de panneaux pendant la courte période d'une campagne annuelle de fouille. Au cours de l'été 2004, deux méthodes différentes ont été utilisées et cette communication en compare les résultats. La documentation photogrammetrique s'est avérée très appropriée à la documentation des mosaïques* in situ, *donnant lieu à des résultats si précis qu'ils ont pu servir de base pour les dessins des panneaux réalisés sur ordinateur.*

Situated on the southern coast of modern Turkey, Perge is one of the most prominent ancient cities in Pamphylia. Excavations at the site began in 1946 and are currently being carried out by Haluk Abbasoğlu of Istanbul University. During excavations conducted in the 1970s and 1980s, mosaic pavements were unearthed in three main areas of the lower city (Mansel 1975; Abbasoğlu 2001), the Agora, the north-south Colonnaded Street, and the Southern Baths (fig. 1). These were photographed and conserved according to the methods of the time. In 2004 a new project was initiated to document the mosaics preserved in situ, to make necessary restorations, and to recover them using modern methods.

Objective and Method

The main aim of the 2004 campaign was to find out the most suitable and effective method for a systematic documentation of the mosaics. Various techniques of drawing and photographing (both conventional and modern) were applied. These experimental techniques were carried out mainly at the Agora, where mosaic pavements were known to exist at the porticos as well as at the northern and western entrances (fig. 2). The different methodologies and their results are summarized below using drawings and photographs of panel E2 at the northeast corner of the Agora as a case study (fig. 3).

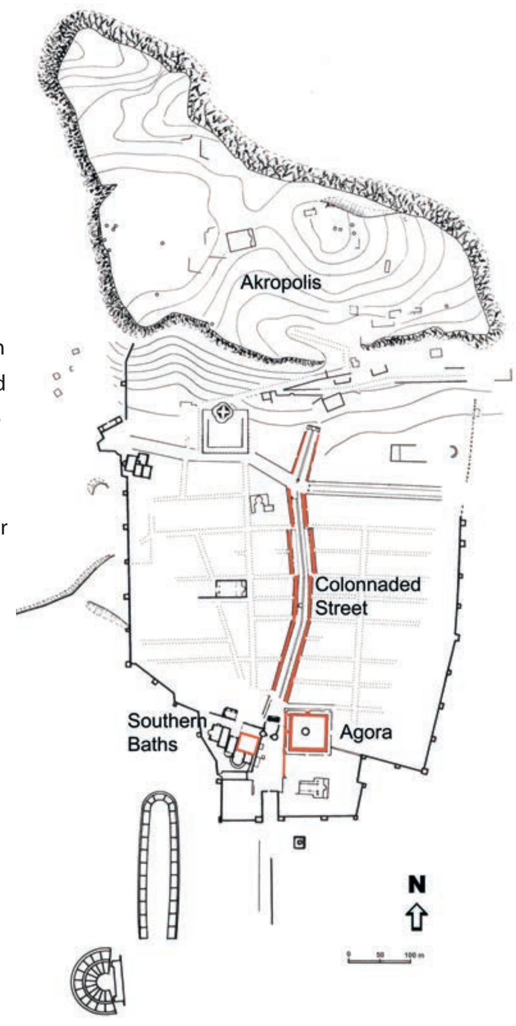


FIGURE 1 Overall plan of Perge. Areas in the lower city where mosaic pavements are known to exist are marked in red. Drawing by A. Şakar, from Perge Archives, İstanbul University. Courtesy of Haluk Abbasoğlu.

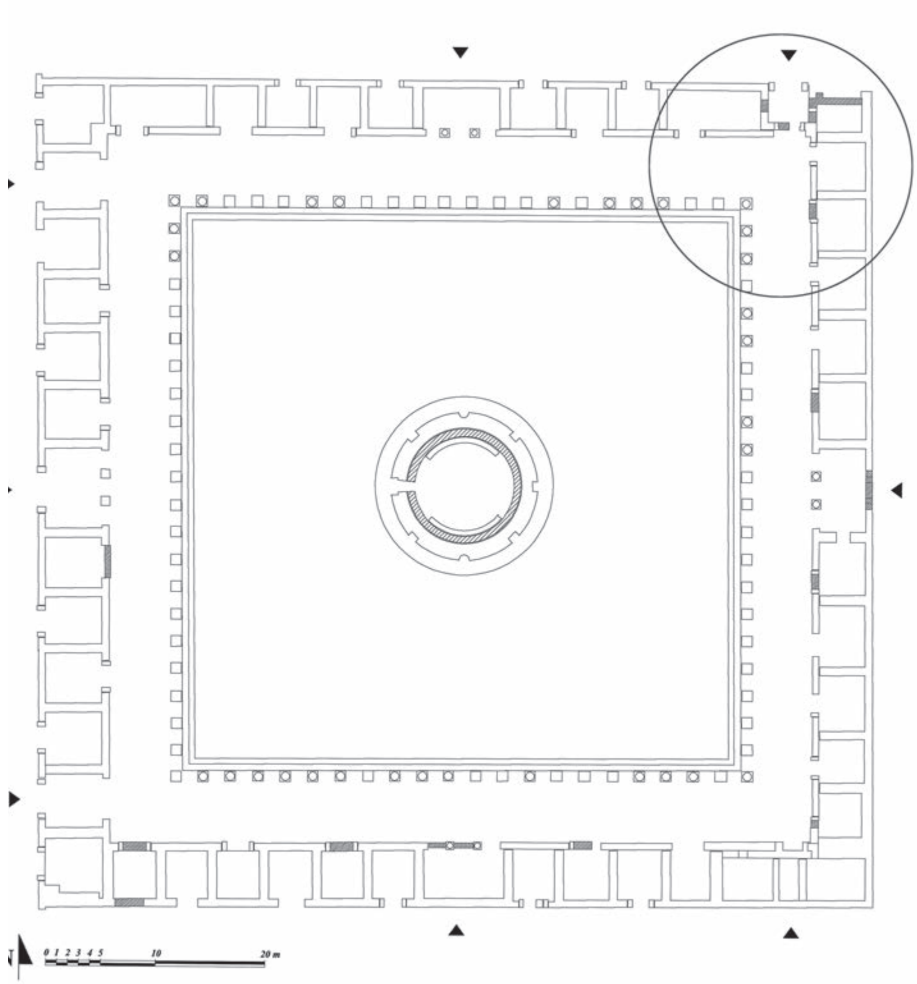


Figure 2 Plan of the Agora of Perge. Panel E2 is situated in the northeast corner of the porticos. Drawing by Ü. İzmirligil, Perge Archives, İstanbul University. Courtesy of Haluk Abbasoğlu.

Figure 3 General view of panel E2 after restoration in 1980 (view from the south). From Perge Archives, İstanbul University. Courtesy of Haluk Abbasoğlu.

Method 1: Conventional Documentation

In the first half of the campaign mosaic panels were drawn manually. First, 1:20 scale ink drawings of the general patterns were made (fig. 4), and then the individual motifs on the panels were drawn in 1:1 scale showing each tessera in color. After being scanned and reduced to 1:20 scale, these tessera drawings were placed on the ink drawings (fig. 5). Although this type of drawing shows the size and color of the tesserae, as well as how they are arranged to form geometric patterns, it had three main disadvantages:

- The time and labor invested in 1:1 tessera drawings make it inefficient to use on a larger number of panels.
- Due to the limited number of colors available in the palette of water-resistant, nonporous surface markers, the true colors of the tesserae cannot be documented.
- The transparent sheet laid on the tesserae to make 1:1 drawings expands in the sun, causing a divergence of 2 percent to 3 percent in the diminished format.

Method 2: Photogrammetric Documentation

In the second half of the campaign the same mosaic panels were documented using photogrammetric methods. Depending on the level and angle from which the photographs were to be taken, measurement points were laid at intervals of approximately 2 meters. The spatial coordinates (X, Y, and Z) of these points were measured by a total station. The mosaic panel was digitally photographed in a series of shots, each bordered by four of the measurement points. These shots were rectified according to the coordinates pre-

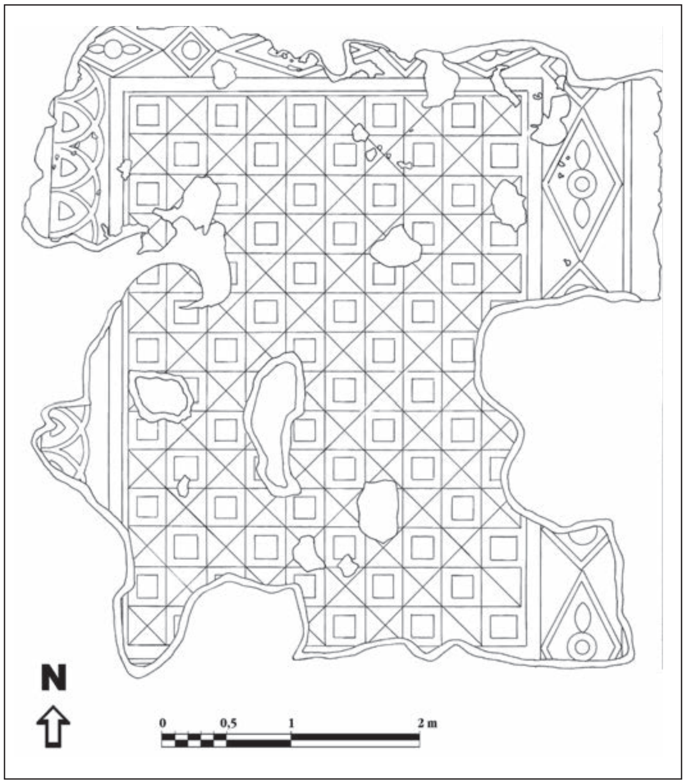


FIGURE 4 Ink drawing of panel E2. From Perge Archives, İstanbul University. Courtesy of Haluk Abbasoğlu.

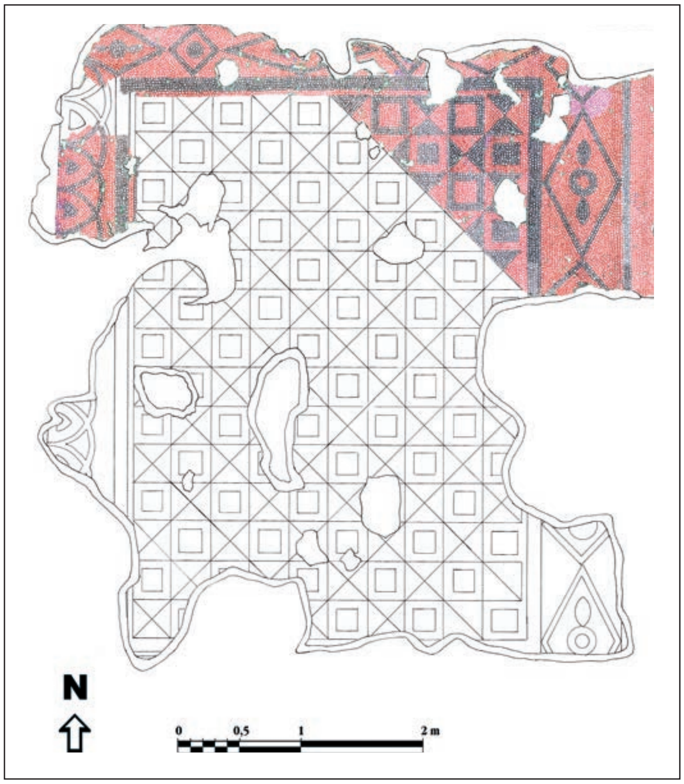


FIGURE 5 Tessera drawing of panel E2 laid on the ink drawing of the panel. From Perge Archives, İstanbul University. Courtesy of Haluk Abbasoğlu.

FIGURE 6 Rectified photogrammetric view of panel E2.

FIGURE 7 CAD drawing of panel E2 based on the rectified photogrammetric view.

viously calculated and combined to provide a 90° bird's-eye view of the whole panel (fig. 6). Following the documentation on-site, the patterns on the mosaic were drawn based on the photogrammetric images using AutoCAD software.

A disadvantage of photogrammetric documentation is that the result is aesthetically not very pleasing, for it is a combination of several photographs taken from different angles, with different shades of color.

The advantages of photogrammetric documentation are as follows:

- It provides 90° bird's-eye documentation of the whole panel. The image is technically exact and can be used to make computer drawings of the mosaics (fig. 7).
- The method is useful for documenting mosaic panels in cases in which it is not possible to shoot large areas in one photograph (e.g., by climbing up high or using a crane).

Conclusion

The documentation of mosaics using photogrammetric methods proved much more efficient than the conventional methods based on hand measurements. This up-to-date method provides scientifically reliable photographs of the panels and therefore also enables the excavator to prepare a precise computer drawing of the panel after the excavation.

References

Abbasoğlu, H. 2001. The founding of Perge and its development in the Hellenistic and Roman periods. In *Urbanism in Western Asia Minor: New Studies on Aphrodisias, Ephesos, Hierapolis, Pergamon, Perge and Xanthos,* ed. D. Parrish and H. Abbasoğlu, 172–88. Journal of Roman Archaeology, Supplementary Series 45. Portsmouth, R.I.: Journal of Roman Archaeology.

Mansel, A. M. 1975. Bericht über Ausgrabungen und Untersuchungen in Pamphlien in den Jahren 1957–1972. *Archaeologischer Anzeiger* 90 (1): 49–96.

Un *emblema* provenant d'Utique conservé au Musée du Louvre

Laurence Krougly et J. M. Monraval

Résumé : *Cette communication évoque le thème des réintégrations partant des caractéristiques techniques de l'*emblema *sélectionné par le Musée du Louvre, pour une exposition aux États-Unis en 2007. La mosaïque a fait l'objet d'un minutieux nettoyage de surface et d'un traitement de consolidation du support d'origine. Lors de notre intervention, le caisson antique demeurait peu visible sous les mortiers appliqués lors de la découverte de l'*emblema *en 1881. La scène mythologique lacunaire, très encrassée, se lisait difficilement. Une fissure importante traversait le tiers supérieur droit de la scène, ainsi que le caisson sur toute son épaisseur. Ces divers « paramètres » ont déterminé les options prises pour le traitement et pour la présentation de cette pièce dans son contexte muséographique particulier.*

Abstract: *This presentation concerns the topic of reintegration, referring to the technical characteristics of the* emblema *selected by the Louvre Museum for an exhibition in the United States in 2007. The mosaic surface was meticulously cleaned, and its original backing received consolidation treatment. When work began, the ancient support was hardly visible under the mortar applied at the time the* emblema *was discovered in 1881. The mythological scene presented lacunae and was very grimy, making it difficult to read. A large crack crossed the upper right of the picture as well as the entire thickness of the backing. These various "parameters" determined the options for treatment and display of this work in its museographical context.*

Nous apporterons quelques informations sur les caractéristiques techniques de l'*emblema*, jusqu'à présent conservé dans les réserves du Musée, et nous aborderons le thème des réintégrations, qui semble d'actualité.

Cet *emblema*, sélectionné par le Département des Antiquités grecques, étrusques et romaines du Musée du Louvre[1] pour une exposition aux États-Unis en 2007, a fait l'objet d'un minutieux nettoyage de surface et d'un traitement de consolidation du support d'origine.

Lors de notre intervention, au cours de l'été 2005, le caisson antique conservé demeurait peu visible sous les mortiers appliqués au moment de la découverte de l'*emblema* en mars 1881. La scène mythologique lacunaire, très encrassée, se lisait difficilement (fig. 1). Une fissure importante traversait le tiers supérieur droit de la scène, ainsi que le caisson sur toute son épaisseur.

Ces divers paramètres ont déterminé les options prises pour le traitement et pour la présentation de cette pièce dans son contexte muséographique particulier.

L'*emblema*[2]

Cet *emblema* provenant d'Utique est entré au Musée Africain du Louvre en 1882 (Baratte 1971, 1978) où, selon la fiche informatique actuelle, il a été donné au musée en 1885, par la Société des fouilles d'Utique[3].

Datation : Fin du III^e - début du IV^e siècle. (datation du CMT mise en doute par Fr. Baratte.)

Décor : Scène mythologique érotique à cinq personnages, lacunaire, encadrée par deux rangées de tesselles noires. A gauche, un jeune homme ailé étreint une jeune femme nue, vue de dos ; à droite, deux femmes, elles-mêmes à demi dénudées, tentent de cacher le couple avec un pan de tissu ; au-dessus d'elles, un amour ailé tient une branche de rose ; la scène se déroule au bord d'une nappe d'eau figurée au premier plan. Interprétée comme une représentation d'Éros et Psyché par P. Gauckler.

Technique : Cet *emblema* de mosaïque figurée, repose dans un caisson de terre cuite. Il s'agit d'un *opus « quasi vermiculatum »* réalisé en tesselles de marbre et de calcaire polychromes sur fond clair. Les tesselles mesurent plus ou moins 3 mm de côté et la densité est de 400 cubes/dm².

Dimensions :

Face : - Caisson : 44,5 cm x 45,5 cm (nous supposons que le support de ciment réalisé le 10 mars 1881 correspond à des dimensions relevées lors de la découverte.

- *Opus quasi vermiculatum* : 41,5 cm × 41 cm.
- Épaisseur du caisson : 35 mm/40 mm. Fond irrégulier légèrement convexe. Un phénomène de rétraction à la cuisson est peut-être à l'origine de cette déformation.

Revers : Le caisson est d'une forme légèrement pyramidale (fig. 2), la base étant plus grande : 45 cm x 45,8 cm. Cette dernière dimension est aléatoire car l'un des bords est restitué.

Stratigraphie cachée de l'*emblema*

Après avoir éliminé le ciment qui colmatait la cassure du bord gauche de l'*emblema*, les épaisseurs des différentes strates du support d'origine ont été relevées :

Profondeur du caisson de céramique sous le *tessellatum* : 5 mm/8 mm.

La surface du support de terre cuite en contact avec le mortier de pose semble travaillée pour offrir un aspect rugueux facilitant l'accrochage du mortier. Il n'a toutefois pas été possible de déterminer si ce traitement a été appliqué avant ou après cuisson.

- Une couche d'environ 5 mm d'épaisseur de mortier de chaux blanc chargé de fragments de terre cuite de 1 mm/4 mm.
- Un lit de pose blanc d'environ 1 mm/2 mm d'épaisseur.

De la *profondeur* de la lacune

Les consolidations et le nettoyage achevés, différentes possibilités de présentation de l'*emblema* ont été envisagées, en considérant l'état de conservation de la partie gauche et la possibilité de présenter cette pièce *recto verso*.

Étant donnée la difficulté de lecture de la scène et la présence de l'importante fissure située à droite, il nous a semblé préférable de restituer le volume manquant, afin de recréer une certaine unité, recentrant la scène et permettant la conception d'un support moderne assurant la bonne conservation de la pièce et la présentation de son revers.

Des orifices, provoqués par des bulles d'air lors de la cuisson du caisson de céramique, ont été mis à profit pour ancrer une structure de tiges de fibres de verre et résine époxy, conçue pour recevoir les différentes couches de mortiers de réintégration de la grande lacune (fig. 3).

Côté face, la fissure a été comblée avec un enduit fin de chaux en pâte et poudre de

FIGURE 1 *Emblema* avant traitement. Photo Krougly/Monraval.

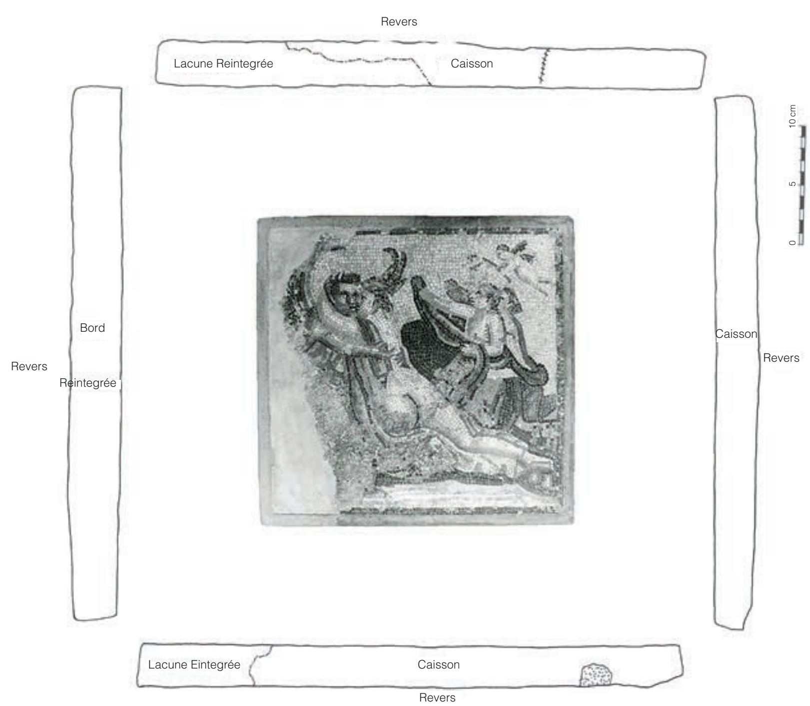


FIGURE 2 Relevé des tranches du caisson de terre cuite. Monraval.

FIGURE 3 *Emblema* traité. Photo Krougly/Monraval.

marbre, sur lequel a été peint un léger glacis à l'aquarelle.

Le type de réintégration dépend-il de l'objet, de son lieu d'exposition, de son public ? Peut-il exister un risque de mimétisme, un risque d'abandon du critère de distanciation comme valeur éducative ?

Les règles déontologiques que nous suivons depuis quelques décennies doivent-elles s'adapter à une nouvelle demande, liée à un public différent et « massifié » ?

Tant de questions ne sont-elles pas synonymes de la nécessité d'aborder chaque cas en fonction de sa spécificité et d'une décision pluridisciplinaire respectueuse de l'*objet* présenté dans son contexte actuel ?

Dans notre cas, la forme retrouvée participe au processus de consolidation et joue un rôle préventif.

Notes

1 Nous tenons à remercier Mme C. Giroire, conservateur aux AGER du Musée du Louvre, d'avoir accepté que nous présentions ce poster.

2 Nous tenons à remercier Mme V. Blanc-Bijon (CNRS, Centre Camille Jullian, UMR 6573, Aix-en-Provence), pour ses suggestions et informations

3 Nº catalogue : MA 1800. Nº inventaire : Utique 754 (Hérisson 1881: 160, 165). CMT265 (M. Alexander et M. Ennaïfer, 1976: 15–16, 73).

Références

Alexander, M. A., et M. Ennaïfer. 1976. *Corpus des mosaïques de Tunisie,* vol. 1, fasc. 3 : *Utique, Mosaïques sans localisation précise et El Alia.* Tunis : Institut National d'Archéologie et d'Arts.

Baratte, F. 1971. La mission Hérisson en Tunisie (1881). *Revue du Louvre* 21e année (6) : 335–46.

———. 1978. *Catalogue des mosaïques romaines et paléochrétiennes du Musée du Louvre*. Paris : Éditions de la RMN.

Daremberg, C., E. Saglio, E. Pottier et G. Lafaye. 1877–1919. *Dictionnaire des antiquités grecques et romaines : D'après les textes et les monuments*. 5 vols. Paris : Hachette.

Hérisson, M. I. 1881. *Relation d'une mission archéologique en Tunisie.* Paris : Société anonyme de publications périodiques.

Krougly, L., et J. M. Monraval. 2005. *Emblema Utica ma 1800. Nettoyage, consolidation et traitement du support.* Paris : Musée du Louvre, Dpt des AGR.

The Project for the Conservation, Maintenance, and Utilization of the Pavement of the Cathedral in Spoleto, Italy

Ilaria Pennati, Carlo Lalli, Annamaria Giusti, Giancarlo Raddi delle Ruote, Giordana Benazzi, and Michele Macchiarola

Abstract: *A multidisciplinary study was conducted to formulate an appropriate plan for the conservation, maintenance, and utilization of the pavement of the cathedral in Spoleto, which had undergone numerous rebuilding and restoration interventions beginning in the medieval period and ending in 1951. This study concerned principally the last sector in the center of the nave, where cosmatesque sections are located. In situ observations and various analytical techniques were employed for characterizing the pavement materials and identifying the products and mechanisms of deterioration. The thermo-hydrometric parameters in the cathedral were also investigated. In addition, several in situ and laboratory tests were carried out so that the best conservation materials and treatment methodology would be chosen. On the basis of the analytical study and liturgical requirements a conservation and utilization project was developed. Finally, an appropriate program of scheduled maintenance was proposed.*

Résumé : *Une étude multidisciplinaire a été réalisée pour dresser un plan de conservation, maintenance et utilisation du pavement de la Cathédrale de Spolète, qui a subi plusieurs reconstructions et restaurations dans le passé. L'étude concerna la section centrale de la nef comportant des sections de cosmatesque. Des observations* in situ *et des techniques analytiques ont servi à caractériser les matériaux constitutifs du pavement et à identifier les mécanismes de détérioration. Une étude des paramètres thermo-hydrométriques dans l'église a été faite ainsi que diverses analyses* in situ *et en laboratoire pour aider au choix des meilleurs produits de restauration.*

The beautiful pavement of the Spoleto Cathedral was constructed using the following techniques: *opus sectile, opus tessellatum, opus alexandrinum, niello,* and *cosmatesque.* A large number of different materials used in the pavement can be identified, including forty-three lithotypes (11 local stones and 32 stones from other locations), glass tesserae of many different colors, and various types of plasters and bedding mortars. The present appearance of the pavement is the result of various rebuilding and restoration interventions in the past. In fact, the coexistence of several floor sections, different in period and style, can be identified, such as those from the medieval (Guidobaldi and Angelelli 2002) and Renaissance periods, the seventeenth century, and the restoration work of the Opificio delle Pietre Dure in 1951.

Study of the Pavement

In situ observations and an archaeometric study using a number of analytic methodologies were performed in order to characterize the pavement materials, to identify the products and the mechanisms of deterioration, and to determine the different construction techniques. All these data enabled us to carry out an appropriate program of conservation and to answer some questions about the floor's history. Materials and the conservation operations were chosen on the basis of in situ and laboratory tests. In situ and laboratory analysis, obtained by means of nondestructive or microdestructive techniques, was also an indispensable base for developing the correct maintenance plan.

The multidisciplinary study was concerned principally with the last sector of the pavement in the center of the nave, where *cosmatesque* sections, consisting of marble slabs with glass or hard stone ornaments, are located (fig. 1). The study revealed that the sections were set in their current position during the second half of the sixteenth century. These marble slabs originally covered the external walls of the *schola maior,* which was built in the second half of

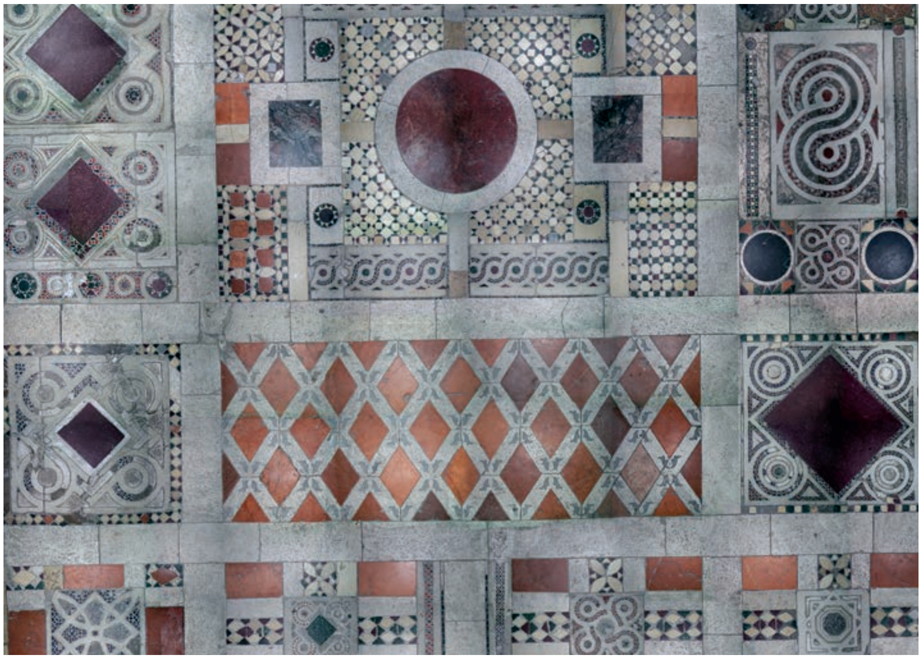


FIGURE 1 Detail of the floor located in front of the transept, where the cosmatesque-style sections are installed.

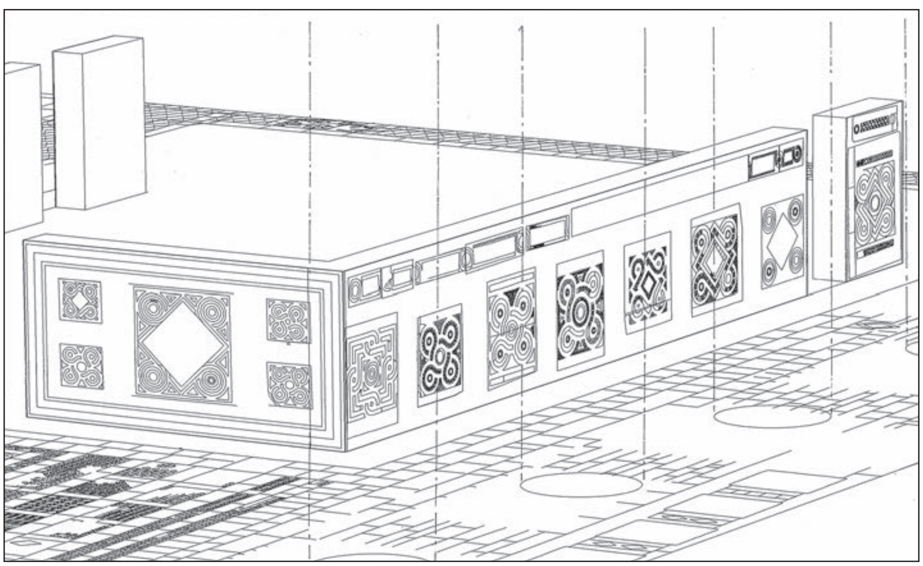


FIGURE 2 Hypothetical reconstruction of the *schola cantorum.*

the twelfth century, but were removed and subdivided in 1535. A digital 3-D reconstruction of the ancient *schola* was obtained from the data collected during the recording by 1:1 scale tracing and from comparisons with a few similar examples (fig. 2).[1] The analysis of the glass tesserae confirmed their suspected historical dating and the homogeneity of the cosmatesque sections and revealed their poor condition, especially the gold leaf tesserae.[2] In fact, some of these tesserae had completely lost both the protective *cartellina* and the gold leaf (fig. 3).[3]

The study showed that the floor was in poor condition. One can observe deposits of salts (fig. 4), the fracturing of glass tesserae, the disintegration of mortars, the detachment of tesserae from the bedding mortar, and large lacunae. Several of the deterioration processes identified are the result of the use in the past of restoration materials (e.g., cement, gypsum) incompatible with the original materials. The relative humidity measured in the cathedral is very high and extremely variable. The frequent cycles of condensation/evaporation are a serious threat to the conservation of glass. In addition, the high levels of humidity prevent the polymerization of some consolidation and protection products.

Conservation of the Pavement

Several cleaning tests were performed (Lazzarini and Tabasso 1986: 135–37; Bandini 1988). The best result was shown by poultices of ammonium bicarbonate (Matteini and Moles 1989: 131) at different lengths of time and in different percentages (fig. 5).

Two typologies of reintegration of lacunae on movable supports have been proposed: one using tesserae made of resin, the other using glass tesserae contained by a frame composed of small glass fragments (figs. 6–8).

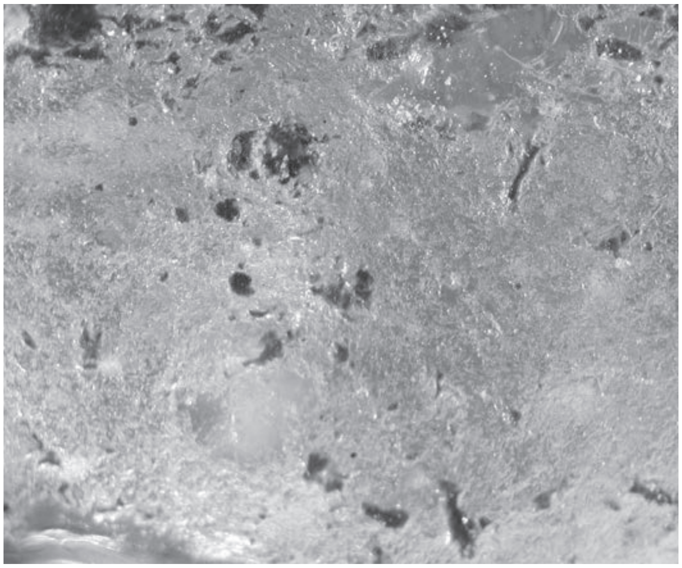


FIGURE 3 OM microphotograph. Detail of what is probably the glass base support of a gold leaf tessera. The glass tessera base has completely lost both the *cartellina* and the gold leaf. Corrosion phenomena and blackish deposits are visible on the surface.

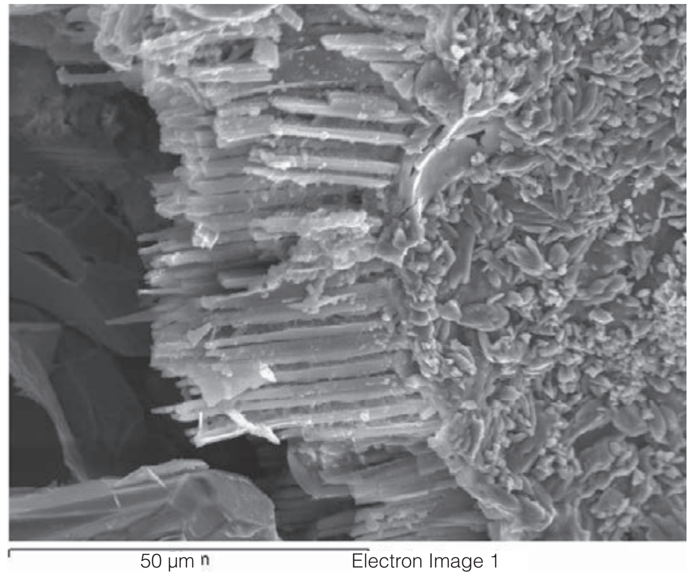


FIGURE 4 SEM microphotograph. Gypsum crystal deposit on the surface of a red glass tessera.

One particular intervention has been developed for the conservation of the plasters that decorate the rectangular slabs in *niello* style. The analytical study has distinguished different types of original plasters: those that are red in color are pigmented with cinnabar, the black ones with coal. A number of plasters present several lacunae, and in these cases the intervention is limited to maintaining the material as found, without imitating the ancient technique.[3]

A program of cleaning, consolidation, use of mortar for the filling of lacunae, and protection was planned. Periodic maintenance interventions and the prohibition of people walking on some parts of the floor were also decided on.

FIGURE 5 Result of cleaning test with a poultice of a 7 percent ammonium bicarbonate solution applied for fifteen minutes.

Conclusion

The utilization and maintenance program for the pavement in the Spoleto cathedral considers both the liturgical and the conservation requirements. Fixed itineraries

FIGURE 6 Lacunae in a cosmatesque-style section.

FIGURE 7 Removable reintegration of lacunae placed in situ.

FIGURE 8 Different typologies of reintegration on removable supports: resin tesserae or glass tesserae contained by a frame of small glass fragments.

for both tourists and worshipers will be requested. Project information will be collected in databases, and didactic panels on different technological, historical, and conservation aspects of the cathedral pavement also will be prepared.

Notes

1 For example, a typical medieval *schola* can be observed in Giotto's fresco in the cathedral of Assisi showing the Creche of Greggio.

2 In ancient mosaics the glass bases of the gold leaf tesserae are generally transparent and colorless or transparent and amber in color. But sometimes they can be green or red, and more or less transparent; in this way the gold leaf tesserae have different color qualities. This study detected three kinds of glass bases of gold leaf tesserae in the pavement of the cathedral in Spoleto: (1) transparent and colorless, (2) green and transparent, and (3) pale green and trasparent with red opaque laminas.

3 We preferred to fill lacunae with a reversible material in order to restore visual unity to the reading of the work of art, without creating a historical forgery. For this reason we decided to fill the numerous gaps with a fluorinated resin (Akeogard CO, a reversible product soluble in acetone and delifrene) mixed with coal in the case of the black plasters or with cinnabar for the red ones.

References

Bandini, G. 1988. Sul restauro dei vetri dorati siti presso il Museo Nazionale Romano (Roma). *Kermes: Arte e tecnica del restauro* 1 (2): 38–42.

Guidobaldi, F., and C. Angelelli. 2002. Il pavimento medievale e le modificazioni successive. In *La cattedrale di Spoleto: Storia, arte, conservazione,* ed. G. Benazzi and G. Carbonara, 220–39. Milan: Motta.

Lazzarini, L., and M. L. Tabasso. 1986. *Il restauro della pietra.* Padova: CEDAM.

Matteini, M., and A. Moles. 1989. *La chimica nel restauro: I materiali dell'arte pittorica.* Arte e Restauro. Florence: Nardini.

Problématique posée par les réintégrations des lacunes dans la mosaïque des Monstres Marins de Lambèse-Tazoult, Algérie

Aurélie Martin

Résumé : *A l'occasion de la restauration par l'Atelier du Musée de l'Arles et de la Provence antiques de l'exceptionnelle mosaïque dite des Monstres marins provenant de Lambèse et conservée dans le musée du site, s'est posé le problème du traitement des lacunes. Découverte en 1905 dans un état extrêmement fragmentaire (plus d'une centaine de fragments effondrés dans un hypocauste), cette véritable « peinture de pierres » de très grandes dimensions – 4,39 x 1,24 m – nécessitait une réflexion spécifique quant au rendu final de la restauration menée en coopération avec les restaurateurs algériens, dans le cadre de « Djazaïr, l'Année de l'Algérie en France ». Devant l'exceptionnelle finesse de la mosaïque réalisée en* opus vermiculatum *(tesselles de 2 à 3 mm de côté ; densité max. : 670 tesselles/dm²), une technique pointilliste à l'aquarelle a été mise en œuvre pour réduire l'effet de fragmentation de l'ensemble de la scène.*

Abstract: *The problem of the treatment of lacunae arose when the workshop of the Musée de l'Arles et de la Provence antiques undertook the restoration of the exceptional mosaic from Lambèse known as the "marine monsters mosaic," which is conserved in the site museum. Discovered in 1905 in a very fragmentary state (more than a hundred fragments collapsed in a hypocaust), this true "stone painting" of exceptional size—4.39 by 1.24 meters—required special consideration with respect to the final appearance of the mosaic after restoration, carried out in cooperation with the Algerian restorers within the framework of "Djazair, l'Année de l'Algérie en France" (Algeria Year in France). In view of the exceptional fineness of the mosaic, executed in* opus vermiculatum*, a pointillist technique in watercolors was used to reduce the fragmentary aspect of the overall composition.*

Mosaïque et peinture se définissent toutes deux par une image bidimensionnelle. Au-delà de la valeur documentaire et esthétique de l'image, mosaïque et peinture se présentent aussi comme un volume, avec une superposition de strates aux composants variés.

La restauration de la mosaïque des Monstres marins a offert la possibilité de rendre visibles ces multiples dimensions. En effet, à côté de l'exceptionnelle qualité de la représentation, le mortier antique de ce pavement, toujours présent, est apparent dans les lacunes et les fissures.

L'aspect très fragmentaire de la mosaïque nous a amenés à réfléchir sur des interventions de réintégrations qui permettraient une lecture plus large et plus affinée de l'œuvre, de sa technique et de son support. Ceci afin que celui qui regarde, n'étant pas forcement spécialiste, puisse comprendre et apprécier l'objet dans son intégralité.

Des comblements par des mortiers de chaux ont été réalisés sur plusieurs niveaux en suivant les strates d'origine. La couleur est alors intervenue sur des zones précises, soit par glacis, soit par juxtaposition de petits points pour un rendu presque illusionniste (fig. 1, 2).

Présentation de la mosaïque des Monstres marins

Opus vermiculatum
H : 1,26 m / L : 4,35 m
Tesselles de marbre, calcaire et verre, dimensions : 2 à 5 mm
Densité : 480 à 670 tesselles au dm²
Épaisseur du support antique conservé : 3 cm
Fin du IIe - début du IIIe siècle de notre ère
Lambaesis (Lambèse-Tazoult)
Musée de Tazoult (Algérie)

Cette mosaïque a été découverte en 1905 à Lambèse, dans les ruines d'une *domus* romaine. Elle pavait une salle rectangulaire à hypocauste. Les nombreuses fractures sont dues à l'histoire et à la fonction même du pavement qui a été retrouvé brisé en fragments, au niveau des pilettes de l'hypocauste.

FIGURE 1 Mosaïque des Monstres marins, travail de réintégration des lacunes. Photo © ACRM / MAPA.

La scène présente trois Néréides portées par des monstres marins – un tigre, une panthère et un *ketos,* de gauche à droite –, et servies par des amours. Une inscription en lettres grecques est placée sous la patte de la panthère : « les monstres d'Aspasios », donnant peut-être le nom d'un peintre de l'époque hellénistique.

Contexte des interventions – Traitement spécifique des lacunes

Après sa découverte, cette mosaïque conservée en une centaine de fragments reposant sur leur assise antique (*rudus*, *nucleus*, lit de pose) a été reconstituée au Musée de Lambèse. Les fragments ont été maintenus au mur par des tenons métalliques bloqués par des mortiers de chaux et de ciment en 1906. En 2002, l'état de ce pavement présentait des risques pour sa conservation : fissurations, perte et décollement de tesselles. C'est pourquoi la mosaïque a été prélevée du musée en deux grands panneaux. Après

FIGURE 2 Détail de la technique picturale mise en œuvre. Photo © ACRM / MAPA.

démontage à l'Atelier de Conservation et Restauration du Musée de l'Arles et de la Provence Antiques, fragment par fragment, la mosaïque a été transférée sur un support aérolame.

Pour la conservation du *tessellatum*, un premier comblement a été nécessaire, avec un mortier de chaux, dans les lacunes et les fissures. Après ces interventions, la mosaïque des Monstres marins présentait encore une surface divisée, fissurée, offrant une image parasitée (cassures créées par l'effondrement de l'hypocauste). Se posait alors la question des réintégrations. Celles-ci étaient indispensables pour obtenir une meilleure lecture, l'objectif étant de mettre en évidence le potentiel pédagogique de cette mosaïque et de proposer ainsi un voyage à travers tous les aspects documentaires énumérés ci-dessous :

Aspects picturals

- Finesse des tesselles.
- Variété des couleurs et précision de leur utilisation : traitements des volumes, des reliefs, de l'ombre et de la lumière, des détails.
- Composition s'appuyant entièrement sur les courbes et contre-courbes : courbes des corps féminins, courbes des voiles, courbes des monstres marins.
- Présence d'un rythme spécifique : trois néréides, trois voiles, trois monstres marins, trois amours.

Aspects techniques

- Superposition du *rudus*, du *nucleus* et du lit de pose, empreintes des tesselles dans le lit de pose.
- Par endroit, traces colorées sur le lit de pose (résultant d'une esquisse préparatoire ?).

Traces d'une histoire et d'une fonction

- Montage sur pilettes de l'hypocauste : salle chaude.
- Usure de la zone centrale (?) : possible zone de passages.

Les différents types de réintégrations réalisées (tableau 1 et fig. 3)

Pour l'évolution de ces choix, les discussions se sont d'abord effectuées en équipe, se basant sur des formations et des compétences variées ; puis, des tests sur

TABLEAU 1 Tableau des différents niveaux de comblements et réintégrations picturales correspondantes

Strates originales	Objectifs	Niveaux des Mortiers de restauration	Réintégrations picturales correspondantes
		Mortier de comblement	
1 *Rudus*	• Rendre l'idée de l'épaisseur et du volume en laissant apparaître les strates originales	• Mortier de fond dans les grandes lacunes Niveau laissant apparaître le *rudus* (sable, terre cuite, chaux hydraulique, liant acrylique)	
2 *Nucleus* Lit de pose	• Différencier des strates Harmoniser les tons et le dessin • Atténuer l'aspect fragmentaire	• Mortier de comblement des fissures et petites lacunes peu importantes • Niveau en retrait par rapport à celui des tesselles et du lit de pose (sable, terre cuite, chaux hydraulique, liant acrylique)	• Mortier atténué par un glacis dans les zones sujettes à interprétation (pigments et liant acrylique)
		Mortier fin de réintégration	
3 Lit de pose Tesselles	• Lecture des lignes principales de la composition • Atténuer les ruptures dans les courbes • Lecture harmonieuse des différentes figures et parties de la mosaïque inégalement lacunaires • Respecter les vibrations colorées créées par les différents composants du pavement	• Par-dessus le mortier de comblement, niveau légèrement en retrait par rapport à celui des tesselles et du lit de pose (chaux hydraulique, poudre de marbre, liant acrylique)	• Réintégrations picturales par juxtaposition de points de couleurs dans les zones non sujettes à interprétation (aquarelle)

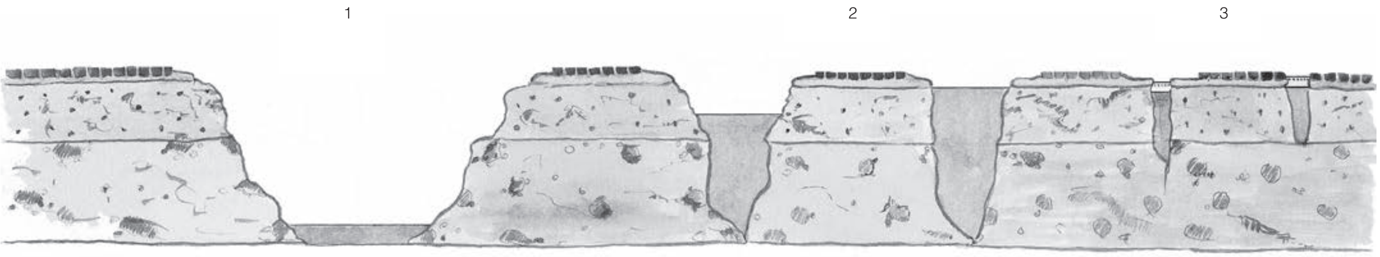


FIGURE 3 Schéma de la coupe stratigraphique du pavement et des différents niveaux de comblement et de réintégrations (cf tableau). © ACRM / MAPA.

maquette ont été réalisés. Nous avons tenu à garder des limites bien définies respectant le document archéologique : image, technique, histoire et fonction.

Nos interventions picturales se veulent aisément repérables de près, et totalement réversibles. Elles sont effectuées dans des zones qui n'étaient pas sujettes à interprétation, respectueuses de la vibration d'une infinité de nuances colorées, du volume des strates originales volontairement conservées (fig. 4 – 6).

Note : La restauration de la mosaïque des Monstres marins a été effectuée dans le cadre d'une coopération franco-algérienne réunie autour de la préparation de plusieurs expositions archéologiques pour « Djezaïr 2003. L'Année de l'Algérie en France », sous la co-direction de Kader Ben Salah, responsable de l'Atelier de restauration des musées de Cherchell, et de Patrick Blanc, responsable de l'Atelier de conservation et de restauration (Musée de l'Arles et de la Provence antiques - Conseil général des Bouches-du-Rhône).

Ont participé à cette restauration pour la partie française Marie-Laure Courboulès, Élise Devidal, Patricia Jouquet, Ali Aliaoui, Gilles Ghiringhelli et Hafed Rafaïf, et pour la partie algérienne Zineb Rebzani, Abdelmajid Belkares, Mohamed Chérif Hamza, Mouloud Derram, Ahmed Djellilahine, Moussa Djemmal, Hassiba Kaci, Mourad Zerarka.

FIGURE 4 – 6 Évolution du travail de réintégration à l'emplacement d'une large fracture située dans le *kétos*. Photo © ACRM / MAPA.

The Byzantine Painted Floor in Salamiya, Syria: Possibilities for Conservation and Presentation

Ewa Parandowska

Abstract: *Salamiya (ancient Salamias) lies about 30 kilometers east of Hama in Syria. In the 1990s a Byzantine painted pavement with floral motifs was discovered during ground-leveling work around the Fatimid-period Imam Ismail mosque and subsequently reburied. In 2001 it was reexcavated with the intention of transferring it to the Archaeological Museum in Hama, but lifting the thin layer of plaster involved a high degree of risk. The pavement was therefore reburied following documentation and protective measures. To exhibit the floor, a permanent roof that would respect the surrounding Islamic architecture was envisaged, but for several reasons the idea was abandoned, and it remains uncertain if the pavement will ever be presented to the public.*

Résumé : *Salamiya (ancienne Salamias) se trouve à environ 30 kilomètres de Hama, Syrie. Dans les années 90, un pavement byzantin peint avec des motifs floraux fut découvert au cours des travaux autour de la mosquée fatimide d'Imam Ismail et aussitôt réenfoui. En 2001, il fut de nouveau dégagé pour le transférer au Musée archéologique de Hama, mais la dépose de la fine couche de plâtre comportait un grand risque. Il fut donc réenfoui après documentation et traitement de protection. Afin de présenter le pavement, un toit permanent qui respecterait l'architecture islamique environnante a été envisagé, mais pour plusieurs raisons, l'idée a été abandonnée et on ne sait si le pavement sera jamais présenté au public.*

Archaeological Information and Technical Data

Salamiya (ancient Salamias) lies about 30 kilometers east of Hama in Syria (fig. 1). Syrian archaeologists first discovered and reburied the Byzantine painted floor from Salamiya in the 1990s. In May 2001 a team of Polish restorers undertook rescue measures at the request of the former director of the Archaeological Museum in Hama, Abdel Razzaq Zagzoug, who had discovered the pavement. Upon exploration of the fill, the preserved fragment (290 by 310 cm) was found to be no more than 20 percent of the original pavement surface (fig. 2). The decoration was composed of circular and square medallions with various species of fruit trees (fig. 3). Acanthus scrolls and stylized plant motifs were used as a border (fig. 4). The painting was executed in a water-resistant technique on thin lime plaster (0.5–3 cm), perfectly flattened on the surface, and applied on a thick (25–40 cm) bedding layer composed of large pebbles, gravel, and soil. Red, yellow, green, black, white, and blue colors were used for decoration.

Pottery finds give a provisional late-sixth-century date for the pavement. It is about 1 meter below ground level, and its northern edge was covered by the Fatimid foundation of the mosque's south wall (fig. 5). During a short, one-week campaign, the pavement was recorded and treated. The team of Polish restorers unearthed, cleaned, and protected the pavement. For documentation purposes, 1:1 tracing of a pattern on a transparent sheet and color photography were done (figs. 6, 7). After mechanical cleaning with soft brushes and moistened sponges, cracks and lacunae were filled with a mortar composed of lime, sand, and marble powder. The same mortar was also used to protect the southern edge of the pavement and the edges of large lacunae.

While awaiting the final decisions regarding the pavement, it was decided to rebury it. The surface was covered with a layer of washed and sifted sand (20 cm thick) isolated with polyethylene sheets from an 80-centimeter stratum of soil and paving stones on the top. In spite of its fragmentary preservation, the high artistic quality of the decoration and unusual execution

FIGURE 1 Map of Syria. Map drawn by Emil Askey, GCI. © J. Paul Getty Trust.

would qualify this important discovery for display. Representatives of the Directorate General of Antiquities and Museums and local authorities discussed two options with us: transfer the pavement to the museum in Hama or preserve and exhibit it in situ on the original bedding.

The option of transferring the pavement was rejected because of the technical complexity involved and because of lack of interest by the local inhabitants. It was suggested that it be left in place, protected by a simple permanent roof. The protective structure would have to be designed with respect for the existing environment (the mosque). But this option also seemed risky because the pavement lies below the paved walkway along the south wall of the mosque and beneath the mihrab foundations, the lowest point of the area. This left it in danger of deterioration from water penetration. Neither the authorities nor the residents of Salamiya see any need to exhibit this fragment of Byzantine decoration that is within an Islamic architectural surrounding.

FIGURE 2 The fragment of painted floor beneath the mihrab foundation.

FIGURE 3 Detail of an *emblema* representing a tree.

FIGURE 4 Detail of a frame with an acanthus scroll.

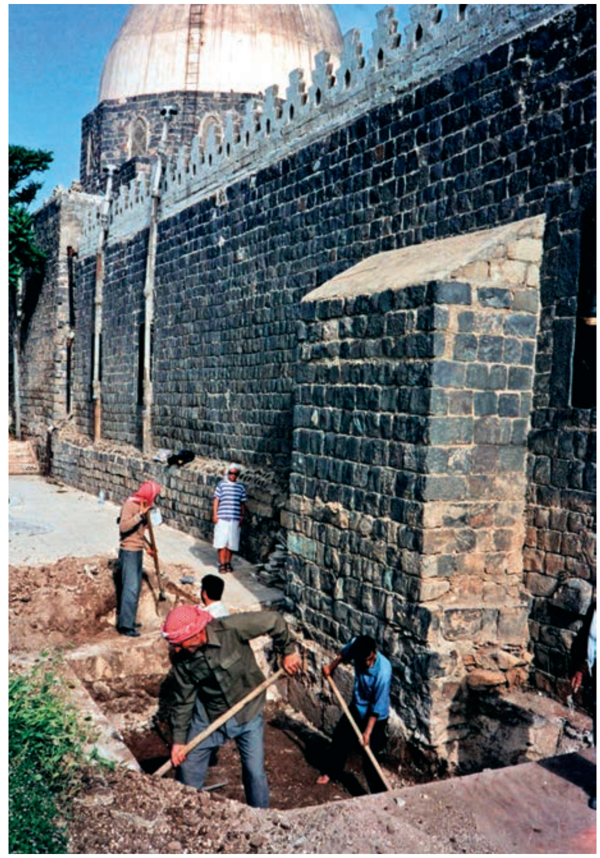


FIGURE 5 Uncovered fragment of the floor after cleaning.

FIGURE 6 Documenting the floor by tracing the decoration.

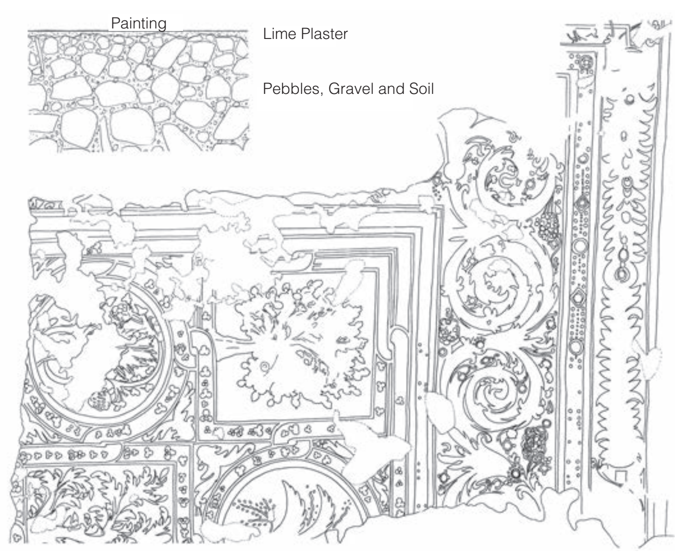


FIGURE 7 Scale drawing of a decorative pattern.

Conclusion

Social and economic factors limited the scope of the research, making it impossible to exhibit the pavement to the public. A permanent shelter and an exhibition will not be possible without a budget for an aesthetic design that will secure access, take into consideration the lighting and rainwater runoff, and include a proper maintenance schedule. With decisions for the project pending, reburial of the pavement is the cheapest and safest solution for its temporary protection. Thus, for the time being, the painted floor remains hidden beneath the ashlars of a walking path that encircles the mosque (fig. 8).

FIGURE 8 The decorated floor reburied below the pavement.

The Syrian Mosaic Pavement Documentation Training Program

Konstantinos D. Politis, Amr Al-Azm, and Charalambos Bakirtzis

Abstract: *A mosaic documentation training program that uses modern methods has been established in Syria. It is jointly sponsored by the Syrian and Greek governments in an effort to increase collaboration between the two countries and further the study of mosaic art.*

Résumé : *Un programme de formation en documentation sur la mosaïque a été mis en place en Syrie. Utilisant des méthodes modernes, il est soutenu conjointement par les gouvernements syrien et grec, pour faire avancer l'étude de l'art mosaïque.*

FIGURE 1 Trainee calculating tessera density of a mosaic at the Damascus Museum. Photo by Konstantinos D. Politis.

In 2004 a collaborative training program was begun to prepare Syrian personnel to fully document mosaic pavements in the Syrian Arab Republic. The trainees are University of Damascus archaeology students and postgraduates. The participating institutions are the European Centre for Byzantine and Post-Byzantine Monuments (EKBMM) and the Centre for Archaeological Research of the Department of Archaeology at the University of Damascus. The program has the full cooperation of the Syrian Directorate of Antiquities and Museums (DGAM) and is funded by EKBMM with additional support from the above-mentioned institutions.

The main aims of the program are to establish a new database in order to fully document mosaic pavements in Syria using modern methods and to conduct a training course for Syrians to carry out this process (fig. 1). The end product will be the publication of a usable corpus of mosaics from Syria for future analysis and study.

Initial Work

In 2004–5, the first year of the program, a database was formulated and training courses were held at Damascus University and at the Damascus and Mara'at Nama'an

FIGURE 2 Damascus University training students measuring the dimensions of a mosaic at Mara'at Nama'an Museum. Photo by Konstantinos D. Politis.

museums involving eight Syrian trainees who will be carrying out the bulk of the mosaic documentation (fig. 2).[1] Several hundred mosaic pavements were photographed, many of which were recorded in the new database. The training program was conducted by Konstantinos Politis, program coordinator and chairperson of the Hellenic Society of Near Eastern Studies; Amr Al-Azm, program coordinator and lecturer in archaeology at Damascus University; Vicken Abajian, database programmer at DGAM; and Ma'amoun Abdelkarim, lecturer in classical archaeology at Damascus University. Charalambos Bakirtzis of the Greek Ministry of Culture acted as liaison with the EKBMM.

A series of lectures on the history of mosaics and their documentation process was begun and continued into 2006. A summary of these lectures will be published by EKBMM as a handbook to aid the documentation process in the future.

A Memorandum of Understanding for the collaborative program was signed by the presidents of Damascus University and EKBMM. It was agreed that the first phase of the program would be concluded by September 2006.

Recording Strategy

The recording process aims to collect all available information on both treated and untreated mosaic pavements found in Syria. The main sources of information are the mosaic pavements themselves, either on display or in storage, but records kept by the DGAM were also used. The DGAM records include original plans and photographs of the mosaics in situ prior to their removal. In order to present the information in a meaningful way, it was necessary to formulate a standardized, systematic method for describing and recording the mosaic pavements. However, this documentation procedure is intended not to include comprehensive analyses, but rather to act as an aid for that purpose.

A relational database was created for optimal data storage and management. It is designed to record, retrieve, search, compare, and cross-reference data quickly and accurately. The information can then be made widely available by permitting access to the database through the Internet.

Conclusion and Future Prospects

The first year of the program successfully established a new database for all available information on the mosaics of Syria. Eight young Syrian archaeologists began training to accurately document and record the mosaics using this database. This process was first applied to mosaics in the Damascus and Mara'at Nama'an museums.

In order to further the understanding of mosaics and the methods to more accurately record them, the lecture series was continued and expanded during 2006. It grew to include the principles of conservation and heritage management and a basic course in ancient Greek.

Notes

1 The trainees were Khaled Hiatlih, Rasha Haqi, Nivin Saad al Deen, Basel Zeno, Ola Abu Rached, Manal Ganem, Samara Ramadan, and Lorna Asaad.

Étude sur l'état de conservation des mosaïques du Musée National d'Iran à partir de vestiges du site archéologique sassanide de Bîchâpour

Elyas Saffaran

Résumé : *Au cours des diverses civilisations antiques, la mosaïque a été utilisée pour décorer le sol, les murs ou les voûtes d'un édifice. En Iran, lors de la période sassanide, de 241 à 272 apr. J.-C., la mosaïque a été utilisée dans le palais de Chapour I*[er] *à Bîchâpour (province du Fars). La plupart des vestiges archéologiques de cette époque sont conservés au Musée National d'Iran à Téhéran. La mosaïque de Bîchâpour possède de magnifiques éléments artistiques d'influence sassanide. Une étude scientifique a été réalisée pour déterminer son état de conservation et ses éléments historiques et artistiques. Cette présentation concerne les résultats de cette étude, notamment la découverte du site archéologique de Bîchâpour et de ses mosaïques ; l'étude scientifique pour déterminer les causes de détérioration des mosaïques ; et les travaux de conservation et de restauration des mosaïques, de leur* tessellatum *et de leur environnement.*

Abstract: *In antiquity various civilizations used mosaics to decorate the floors, walls, or vaults of buildings. In Iran during the Sassanid period, from 241 to 274 C.E., mosaics were used in the palace of Chapour I in Bîchâpour (Fars province). Most archaeological remains from this period are conserved in the National Museum in Tehran. The Bîchâpour mosaic has magnificent artistic features of Sassanid influence. A scientific study was made of its condition and historical and artistic features. This paper discusses the discovery of the archaeological site of Bîchâpour and its mosaics, the scientific study to determine the causes of deterioration, and conservation and restoration work on mosaics, their* tessellatum, *and their environment.*

Aspects historiques et artistiques de la découverte du site archéologique de Bîchâpour et de ses mosaïques

Les recherches et les documents archéologiques mis au jour nous ont révélé de nombreuses informations historiques et artistiques (fig. 1).

L'art sassanide, à ses débuts, hérite en totalité du passé iranien. L'art des provinces orientales romaines va faire intervenir un style qui modifiera l'agencement des formes. Tout en étant composite et éclectique, l'art iranien, fondu et retravaillé, va s'affirmer au niveau national en s'associant à un programme politique encore influencé par le prestige des fastes achéménides.

Peu après, ou peut-être avant sa victoire sur Valérien, le roi Chapour se fait construire une résidence dans sa province natale du Fars (l'ancienne Perside). Il choisit un paysage qui rappelle celui où son père éleva la ville de Firozâbâd. Ce lieu prend le nom de Bîchâpour – « la belle (ville de) Chapour ». Son plan n'est plus celui des villes circulaires parthes mais s'inscrit dans un quadrilatère délimité par un mur d'enceinte et des fossés. La ville s'appuie sur la montagne où la protège une forteresse, avec tout un réseau de murailles et de fortins. Elle est en outre bordée par la rivière (fig. 2).

La découverte et l'exploration du site royal de Bîchâpour ont commencé en 1935 et ont été reprises en 1939, 1940 et 1941 (fig. 3).

À Bîchâpour, le sol d'un triple *iwan* (vaste porche voûté), ouvert sur une large cour à l'est de la grande salle, était dallé de pierres et entouré de panneaux de mosaïque. Ce décor – mélange d'éléments iraniens et romains – s'inspire peut-être d'un tapis persan de l'époque (fig. 4). Il est essentiellement évocateur et tend à illustrer, avec son répertoire d'images, l'ambiance de ces lieux où se tenaient les banquets. On y voit des dames de la cour, les unes mollement accoudées sur des coussins, les autres, vêtues de longues robes, tenant des bouquets et des couronnes de fleurs et participant à la cérémonie (fig. 5, 6). Figurent aussi des portraits de personnalités de la famille royale ou des classes privilégiées (fig. 7). Des danseuses, joueuses de harpe et tresseuses de couronnes, leur nudité à peine voilée d'une écharpe, animent la scène et en précisent le sens.

FIGURE 1 Carte de l'Empire sassanide. E. Saffaron et R. Ramani, avec le soutien de M. Karegar, directeur Musée National d' Iran à Téhéran.

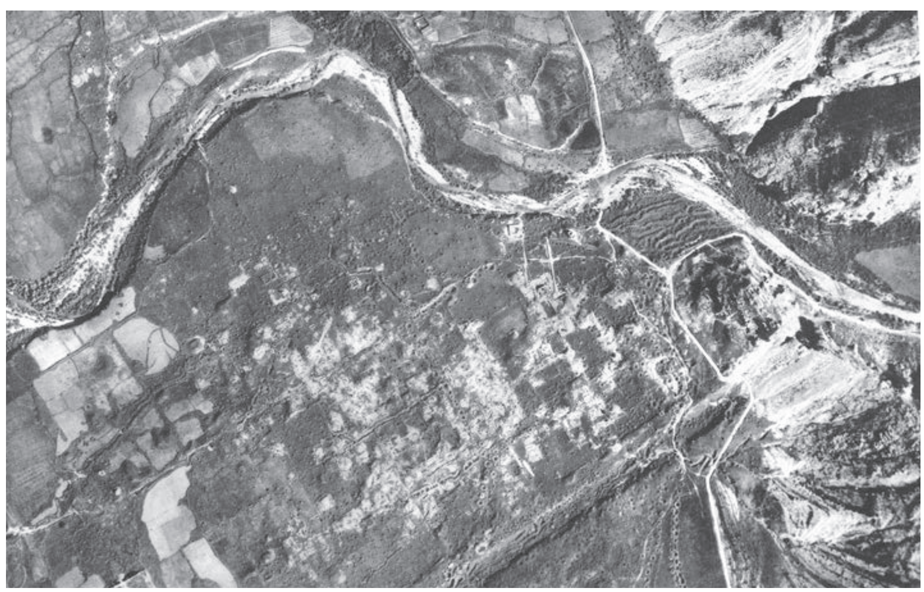


FIGURE 2 Vue aérienne de Bîchâpour. E. Saffaron et R. Ramani, avec le soutien de M. Karegar, directeur Musée National d' Iran à Téhéran.

Étude scientifique et pratique pour déterminer les causes de détérioration des mosaïques

Mes études et celles de Mme Ghourgie montrent toute la difficulté qu'a représenté l'enlèvement des mosaïques après les fouilles archéologiques. On manquait à la fois à cette époque d'outillage approprié et de personnel compétent. Les panneaux ont été séparés à la scie, qui, après l'enlèvement d'une rangée de tesselles, a traversé l'épaisseur du mortier. Des tranchées ont été creusées sous les fondations de galets et les panneaux enlevés l'un après l'autre. L'état actuel des mosaïques est suffisamment stable pour en

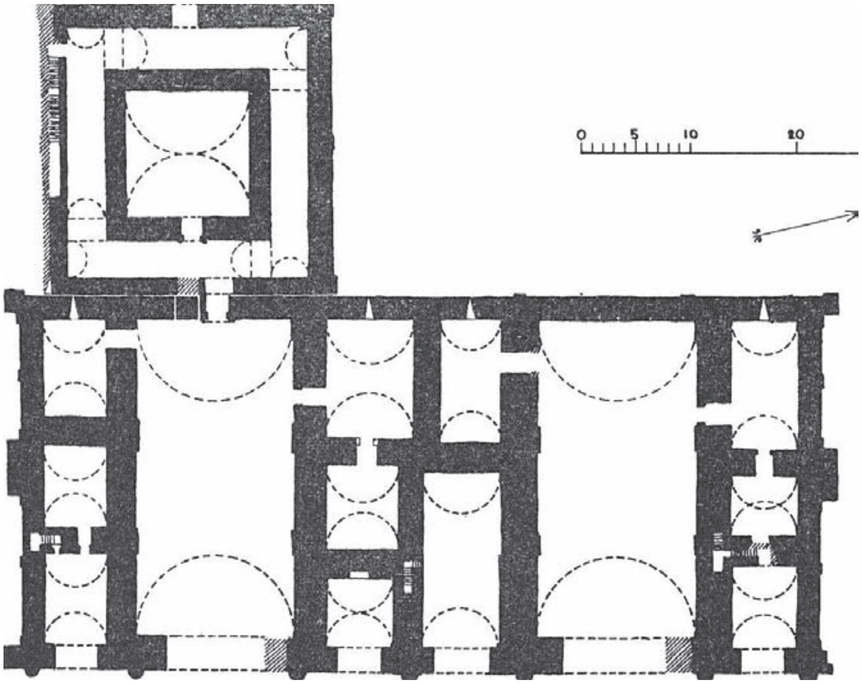


FIGURE 3 Plan du palais de Bîchâpour. E. Saffaron et R. Ramani, avec le soutien de M. Karegar, directeur Musée National d' Iran à Téhéran.

FIGURE 4 Carafe en argent doré sassanide. E. Saffaron et R. Ramani, avec le soutien de M. Karegar, directeur Musée National d' Iran à Téhéran.

autoriser le dépôt ou l'exposition au Musée National de Téhéran (fig. 8).

Travaux de conservation et restauration des mosaïques

Lors de leur découverte, les mosaïques étaient en très mauvais état, y compris celles des panneaux complets ou quasi complets. Le mortier de couleur grise censé maintenir les tesselles formait une surface unie avec celles-ci mais les tesselles n'y adhéraient plus. De plus, des formations calcaires recouvraient un grand nombre de panneaux. Notre premier soin a donc été de consolider les tesselles en coulant du ciment très liquide dans les interstices. Cela fait, nous avons renforcé au ciment les bords abîmés, puis nous avons procédé au ponçage de toutes les parties envahies par les sels. Depuis, l'état de la mosaïque s'est stabilisé et ne pose plus de problème.

Conclusion

La mosaïque de Bîchâpour est romaine par sa technique et par son style, iranienne par sa composition et ses particularités nationales. C'est là un des aspects les plus caractéristiques de l'art iranien qui reprend les apports artistiques de pays voisins ou éloignés pour s'en inspirer, sans jamais se limiter à une simple imitation. Adoptés et refondus dans le creuset iranien, retravaillés et acclimatés, idées et motifs étrangers vont renaître sous un nouvel aspect qui se veut national. Ainsi, par exemple, le masque représenté sur ces mosaïques renouvelle la vieille tradition de l'art iranien de Sialk et du Luristan.

Il faut donc commencer par prendre les mesures nécessaires pour mieux comprendre les œuvres et maîtriser les causes de leur détérioration si l'on veut en améliorer l'état et en assurer la pérennité.

FIGURE 5 Fragment d'un panneau de mosaïque de Bîchâpour. E. Saffaron et R. Ramani, avec le soutien de M. Karegar, directeur Musée National d' Iran à Téhéran.

FIGURE 6 Fragment d'un panneau de mosaïque de Bîchâpour. E. Saffaron et R. Ramani, avec le soutien de M. Karegar, directeur Musée National d' Iran à Téhéran.

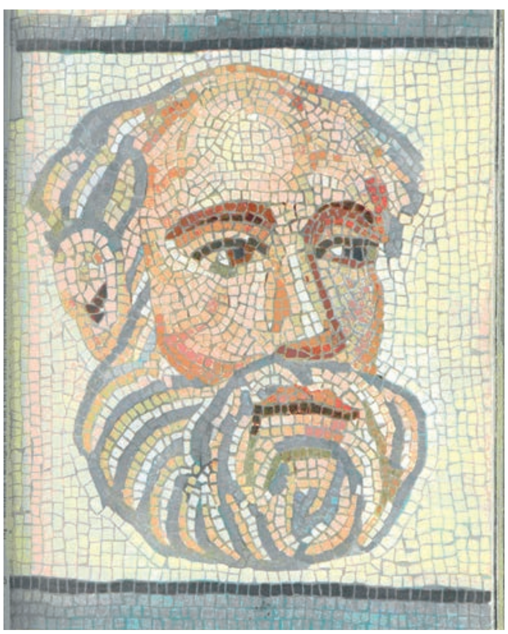


FIGURE 7 Fragment d'un panneau de mosaïque de Bîchâpour. E. Saffaron et R. Ramani, avec le soutien de M. Karegar, directeur Musée National d' Iran à Téhéran.

FIGURE 8 Differents fragments des panneaux de mosaïque de Bîchâpour au Musée National d'Iran. E. Saffaron et R. Ramani, avec le soutien de M. Karegar, directeur Musée National d' Iran à Téhéran.

Reférences

Bussagli, M., et U. Schrato. 2002. *Histoire de l'art de l'Iran – L'art parthe et sassanide*. Téhéran : Éditions Mola.

Ghirshman, R. 1938. *Fouilles de Sialk, près de Kachan.* Musée du Louvre, Département des antiquités orientales. Série archéologique, vol. 4. Paris : P. Geuthner.

———. 1939. *Fouilles de Sialk, près de Kachan*. Musée du Louvre, Département des antiquités orientales. Série archéologique, vol. 5. Paris : P. Geuthner.

———. 1946. *Begram ; Recherches archéologiques et historiques sur les Kouchans*. Mémoires de la Délégation archéologique française en Afghanistan, vol. 12. Le Caire : Impr. de l'Institut français d'archéologie orientale.

———. 1954. *Village perse-achéménide.* Mémoires de la Mission archéologique en Iran, vol. 36. Paris : Presses Universitaires de France.

———. 1956. *Les mosaïques sassanides*. Musée du Louvre, Département des antiquités orientales. Série archéologique, vol. 7. Paris : P. Geuthner.

———. 1962. *Iran : Parthes et Sassanides*. L'Univers des Formes, vol. 3. Paris : Gallimard.

———. 1963. *Perse : Proto-Iraniens, Mèdes, Achéménides.* L'Univers des Formes, vol. 5. Paris : Gallimard.

———. 1971. *Bichâpour.* Musée du Louvre, Département des Antiquités Orientales. Série archéologique, vol. 6. Paris : P. Geuthner.

———. 1976. *L'Iran des origines à l'Islam.* Paris : Albin Michel.

Schrato, U. Sassanian art. *Encyclopedia of World Art,* vol. 12 : 702–30.

Stefanaggi, M., et al. 2001. *Préserver les objets de son patrimoine.* Sprimont : Mardaga.

Archaeometric Analysis and Weathering Effects on Pompeii's *Nymphaea* Mosaics

Cristina Boschetti, Anna Corradi, Bruno Fabbri, Cristina Leonelli, Michele Macchiarola, Andrea Ruffini, Sara Santoro, and Paolo Veronesi

Abstract: *The archaeological and archaeometric study of the mosaics of Pompeii's* nymphaea a scala, *conducted since 2003, have provided an opportunity to collect data to build a database on glass tesserae used during the first century A.D. The observation of different kinds of vitreous materials also provides an understanding of the deterioration processes and agents.*

Résumé : *L'analyse archéologique et archéométrique des mosaïques des nymphées de Pompéi « a scala » en cours depuis 2003, a permis de collecter des données pour constituer une base de données sur les tesselles en verre utilisées au cours du 1er siècle ap. J.-C. L'étude de différents types de matériaux vitreux a également permis de comprendre les processus et les agents de détérioration.*

The Project

The present work characterizes and evaluates the conservation status of the mosaic materials that comprise Pompeii's *nymphaea a scala.* It has been conducted within the framework of the Interuniversity National Project, funded by the Italian Ministry of University Education and Research (MIUR) and aimed at the multidisciplinary study of the architectural heritage of Pompeii, for both surveying and conservation purposes.[1] The project is directed by the Bologna University Archaeology Department and involves a number of operational units. In the first stage it focused on a specific block of the town (Insula del Centenario). The *nymphaea a scala,* or *a scaletta,* are architectonic structures typical of open spaces encircled by tall walls, such as gardens or triclinia for summer use. In Pompeii thirteen *nymphaea a scala* (dated from A.D. 35 to the years before the eruption in A.D. 79) have been discovered. They constitute a fountain niche with stairs (usually made of marble); the niche is decorated with mosaics made of glass tesserae, stone pieces, and shells (fig. 1). The analytic study of the tesserae and fragments of mortar from the *nymphaea* was started two years ago and provided an exhaustive database of color measurements, characterization of materials, and evaluation of the degradation.

FIGURE 1 The Casa del Centenario's *nymphaeum a scala.*

Deterioration Phenomena in Pompeii's Glass Tesserae: An Example of Color Change

The analytic data detected the following degradation phenomena in the glass tesserae: leaching, erosion, exfoliation, iridescence, change of color, formation of deterioration deposits, reduction in thickness, loss of surface gloss, and a general decrease in mechanical properties. Some glass tesserae were subjected to profound surface degradation: they appear to be covered by a green layer of a few micrometers on each side and are vivid red inside. This paper discusses this unusual case of degradation on an archaeological site. The tesserae are made of leaded glass with a high amount of copper and discrete concentrations of antimony. The concentrations of magnesium and potassium are very low. This glass was obtained by melting a batch composed of silicocalcareous sand with lead and natron, the glass technology used by the Romans. The red color is due to dendritic cuprite crystals formed inside the glass during the fusion; the green surface layer is the result of copper and lead ions migrating to the surface. This type of red glass, usually called "sealing wax glass" in the literature,[2] has been known in ancient Egypt since the Nineteenth Dynasty in the Mesopotamian area (Lucas and Harris 1962–99). Thanks to an extensive study conducted by the British Museum, it is possible to compare Pompeii's tesserae with a glass cake from a workshop found in Nimrud's Royal Palace dated to about the fourth century B.C. (tables 1, 2) (Cable and Smedley 1987).

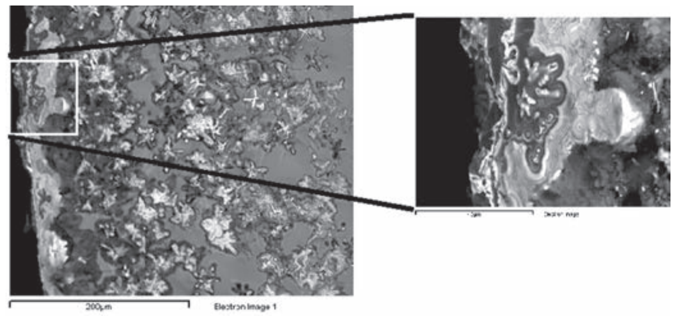


FIGURE 2 SEM image of a cross section of the red tessera with the green surface: it is possible to see the dendritic cuprous oxide crystals and, on the left, its deterioration layer. In the magnification, crystal sulphures, with a characteristic mammillary shape, are detected as deterioration products.

Table 1 ICP analysis on Pompeii's tesserae

Elements	(%)
SiO_2	43.97
Na_2O	11.84
CaO	3.16
PbO	27.67
K_2O	0.25
Al_2O_3	1.63
CuO	8.18
Fe_2O_3	0.68
MgO	0.51
Sb_2O_3	1.13
SnO_2	0.54
ZnO	0.10

Table 2 EDS analysis on Nimrud glass

Elements	(%)
SiO_2	42.28
Na_2O	9.46
CaO	3.82
PbO	24.96
K_2O	1.43
$Al_2O_3 + Fe_2O_3$	1.11
Cu_2O	8.58
Sb_2O_3	4.19

The energy dispersion X-ray fluorescence analysis of the Nimrud sample shows that it is a leaded glass with high concentrations of copper and antimony; the discrete concentrations of potassium indicate the use of coastal plant ashes. According to the glass technology of this period and area, the Nimrud red glass was obtained from a batch composed of siliceous sand, lead, and coastal plant ashes. The two types of glass have the same color and texture due to the presence of cuprite crystals in the lead vitreous matrix (fig. 2). The main disparity between the two types is the use of different sodic fluxes together with lead: natron, in Pompeii's red tessera; coastal plant ashes, in the Nimrud red sample.

The Iridescence Phenomenon

In a group of blue tesserae it is possible to see the iridescence phenomenon in two stages of deterioration, iridescence and low iridescence. In the scanning electron microscope (SEM) images one can see the different structural details (fig. 3). In the iridescent blue it was possible to detect a leached surface with the formation of a deterioration deposit, while in the low iridescent sample it is, in fact, only an exfoliation phenomenon.

The Brown Deterioration Layer

Some glass tesserae (green and light blue) and the Egyptian blue tesserae are covered with a brown deterioration layer, a deposit of carbonates and sulfates formed as a consequence of leaching effect (tables 3, 4; fig. 4). The highly porous structure of the Egyptian blue is strictly connected to the decomposition of calcium and copper carbonate during the thermal cycle used for its production. Some crystals have turned green, forming the so-called Egyptian green (Bianchetti et al. 2000). The highly blistered structure of the green glass is correlated to the deterioration layer. Here it is possible to recognize the deterioration phenomenon on the surface and in the inner part of the glass. X-ray diffraction (XRD) indicated the presence of different sulfates and carbonates.

Conclusion

The analytic data detected particular degradation phenomena, leading to a surface chromatic alteration of some glass tesserae. The characterization of the materials used for the mosaics, together with the identification of degradation products and processes, is a prerequisite for defining appropriate restoration techniques and for the future maintenance of the mosaics.

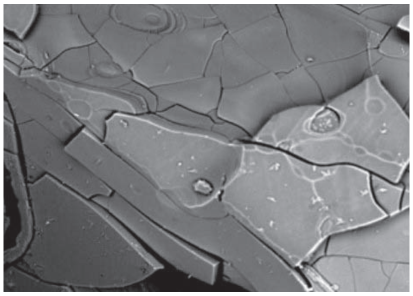
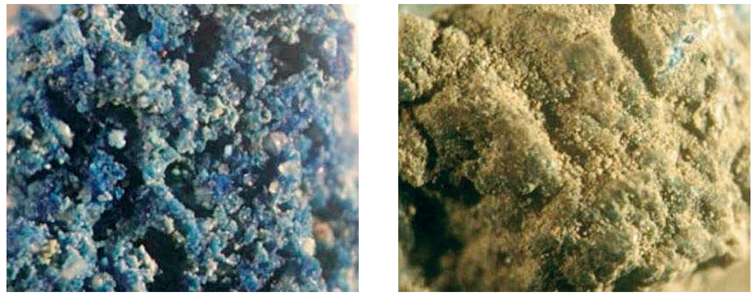


FIGURE 3 SEM image of the surface exfoliation in the blue tessera.



(a) (b)

FIGURE 4A, B Optical microscopy images of the Egyptian blue sample: the nondeteriorated inner part (a) and the brown deterioration layer on the surface (b).

Table 3 ICP analysis on low iridescent blue tesserae

Elements	(%)
SiO_2	63.57
Al_2O_3	2.41
BaO	0.03
CaO	8.04
CoO	0.14
CuO	0.43
Fe_2O_3	1.81
K_2O	0.61
MgO	0.57
MnO	0.34
Na_2O	16.67
P_2O_5	0.08
Sb_2O_3	5.16
SnO	0.01
SrO	0.05
TiO_2	0.06
ZnO	0.01
ZrO_2	0.01
	100.00

Table 4 ICP analysis on semiopaque green

Elements	(%)
SiO_2	65.65
Al_2O_3	2.54
CaO	7.09
CuO	1.76
Fe_2O_3	1.07
K_2O	1.05
MgO	0.95
MnO	0.46
Na_2O	16.45
P_2O_5	0.30
PbO	2.25
Sb_2O_3	0.25
SrO	0.05
TiO_2	0.14
ZrO_2	0.01
	100.00

Notes

1 The aims of the project were drawn up in the proceedings of the 10th AISCOM Congress (Santoro et al. 2005). The results from the second year of research were presented at the 11th Congress (Santoro et al. 2005). A detailed archaeometric study on the mosaic of the fountain in Casa del Centenario (Pompei, IX, VIII) will be published, along with the results from five years of research on Pompeii's Insula (Boschetti et al. forthcoming[a]). An early report on the archaeometric analysis and archaeological investigation of Pompeii's *nymphaea a scala* was presented in a thesis at Parma University (Speranza 2005).

2 "Sealing wax" red glass in Egypt is mentioned only in the Lucas and Harris work on Egyptian materials (Lucas and Harris 1962–99); for the Middle East, the first investigation is in Brill 1970. An experiment reproducing Nimrud's glass cakes was conducted in the 1980s by scientists from the British Museum (Cable and Smedley 1987). Nimrud glass was analyzed again in 2000 by Raman spectroscopy (Withnall et al. 2000). Problems linked to the technique of producing opaque red glass are treated in a paper on Sardis's red glass (Brill and Cahill 1988) and in two other contributions about the relationship between glassmaking and metallurgy (Mass, Wypyski, and Stone 2002; Rehren 2003). According to Brun and Pernot (1992), Roman-age sealing wax glass seems to have been reused during the Middle Ages for cloisonné enamels. There is currently

little in the literature on Roman-age sealing wax red glass. During the characterization of Pompeii's *nymphaea a scala* it was possible to study sealing wax red glass used in mosaic tesserae (Corradi et al. 2005; Santoro et al. 2005; Boschetti et al. forthcoming[a]) and also in glassware (Boschetti et al. forthcoming[b]) during the period between the end of the second century B.C.E. and the second half of the first century C.E.

3 Egyptian blue is a synthesized material used for wall mosaics between the end of the first century B.C.E. and the first half of the first century C.E.; if powdered, it can be used as a pigment for painting. The sharp blue color is due to a copper and calcium silicate called cuprorivaite. A first-century C.E. workshop for the production of Egyptian blue in Liternum, near Puteoli, has been documented (Gargiulo 1998; Platania et al. 1999).

References

Bianchetti, P., F. Talarico, M. G. Vigliano, and M. Fuad Ali. 2000. Production and characterization of Egyptian blue and Egyptian green frit. *Journal of Cultural Heritage* 1 (2): 179–88.

Boschetti, C., A. Corradi, B. Fabbri, C. Leonelli, M. Macchiarola, A. Ruffini, S. Santoro, M. Speranza, and P. Veronesi. Forthcoming[a]. Caratterizzazione archeometrica dei mosaici del ninfeo della domus del Centenario. In *Indagini diagnostiche e geofisiche e analisi archeometriche su muri, malte, pigmenti, colori, mosaici,* ed. S. Santoro. Florence: Al'Insegna del Giglio.

———. Forthcoming[b]. Impiego di vasellame vitreo nei mosaici dei ninfei pompeiani: Aspetti archeologici e archeometrici. In *Colloque international pour l'étude de la mosaïque antique: La mosaïque gréco-romaine X: X^e Colloque international pour l'étude de la mosaïque antique, Conimbriga, Portugal, 20 octobre–3 novembre 2005.*

Brill, H., and N. Cahill. 1988. A red opaque glass from Sardis and some thoughts on red opaques in general. *Journal of Glass Studies* 30: 16–27.

Brill, R. H. 1970. The chemical interpretation of the texts. In *Glass and Glassmaking in Ancient Mesopotamia: An Edition of the Cuneiform Texts Which Contain Instructions for Glassmakers with a Catalogue of Surviving Objects,* ed. A. L. Oppenheim, 105–28. Corning Museum of Glass Monographs. Corning, N.Y.: Corning Museum of Glass.

Brun, N., and M. Pernot. 1992. The opaque red glass of Celtic enamels from continental Europe. *Archaeometry* 34 (2): 235–52.

Cable, M., and J. W. Smedley. 1987. The replication of an opaque red glass from Nimrud. In *Early Vitreous Materials,* ed. M. Bimson and I. C. Freestone, 151–64. British Museum Occasional Paper, 56. London.

Corradi, A., C. Leonelli, P. Veronesi, B. Fabbri, M. Macchiarola, A. Ruffini, C. Boschetti, and S. Santoro. 2005. Ancient glass deterioration in Pompeii's mosaics. *Surface Engineering* 21 (5–6): 402–5.

Gargiulo, P. 1998. Contenitori con depositi di colore blu egiziano e officine vetrarie nell'area dell'antica Liternum e nel territorio flegreo: Aspetti tecnologici e prospettive di studio. In *Il vetro dall'antichità all'età contemporanea: Aspetti tecnologici, funzionali e commerciali: Atti 2e Giornate nazionale di studio AIHV–Comitato Nazionale Italiano, 14–15 dicembre 1996, Milano,* 61–65.

Lucas, A., and J. R. Harris. 1962–99. *Ancient Egyptian Materials and Industries.* London: Dover Publications.

Mass, J. L., M. T. Wypyski, and R. E. Stone. 2002. Malkata and Lisht glassmaking technologies: Towards a specific link between second millennium B.C. metallurgists and glassmakers. *Archaeometry* 44 (1): 67–82.

Platania, R., A. Armiento, D. Attanasio, and L. Cinquegrana de Divitiis. 1999. Caratterizzazione chimico fisica di un blu egizio proveniente da Liternum. In *5a Giornata le Scienze della terra e l'archeometria,* ed. C. D'Amico, 323–28. Bologna: Pàtrona.

Rehren, Th. 2003. Comments on J. L. Mass, M. T. Wypyski, and R. E. Stone, "Malkata and Lisht glassmaking technologies: Towards a specific link between second millennium B.C. metallurgists and glassmakers," *Archaeometry* 44 (1): 67–82; and Reply, *Archaeometry* 45 (1): 185–90.

Santoro, S., C. Boschetti, M. Speranza, B. Fabbri, M. Macchiarola, A. Ruffini, A. Corradi, C. Leonelli, and P. Veronesi. 2005. Un progetto di ricerca archeologico ed archeometrico sui componenti ceramici, lapidei e vetrosi dei mosaici dei ninfei pompeiani. In *Atti del X Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico: Lecce, 18–21 febbraio 2004,* ed. C. Angelelli, 539–47. Tivoli: Scripta manent.

Santoro, S., C. Boschetti, M. Speranza, B. Fabbri, M. Macchiarola, A. Ruffini, A. Corradi, C. Leonelli, P. Veronesi, and V. De Giorgio. 2006. Nuovi sviluppi nelle indagini archeometriche sui mosaici dei ninfei a scala pompeiani. In *Atti del XI Colloquio dell'Associazione italiana per lo studio e la conservazione del mosaico: Ancona, 16–19 febbraio 2005,* ed. C. Angelelli, 537–46. Tivoli: Scripta manent.

Speranza, M. 2005. I ninfei a scala di Pompei: Idagini archeologiche e archeometriche. Thesis, Parma University.

Withnall, R., A. Derbyshire, S. Thiel, and M. J. Huges. 2000. Raman microscopic analysis in museology. In *Proceedings of SPIE—The International Society for Optical Engineering* 4098: 217–31.

An Assessment of Recent in Situ Conservation Treatments of Mosaics in Turkey

Y. Selçuk Sener

Abstract: *There has been a dramatic increase in the conservation and restoration of mosaics excavated in Turkey. There has also been an increase in problems emerging in different stages of conservation treatment. This poster discusses studies carried out during the in situ conservation of mosaics, focusing on certain finds from Aizanoi, Sagalassos, Bodrum, Side, and Zeugma in Turkey. The case studies and discussions of the conservation-restoration approaches demonstrate that although the methods appear to have been appropriate at the time they were carried out, it is not necessarily true that they have proven to be the best ones.*

Résumé : *Une augmentation substantielle de travaux de conservation et restauration sur les mosaïques mises au jour en Turquie a été constatée ainsi qu'une multiplication des problèmes à différents stades des traitements de conservation. Cette étude réalisée lors de la conservation in situ des mosaïques, se penchera sur des découvertes à Aizanoi, Sagalassos, Bodrum, Side et Zeugma en Turquie. Ces études de cas et discussions sur les approches choisies en matière de conservation-restauration montrent que si ces approches semblaient appropriées à l'époque, elles ne se sont pas nécessairement avérées être les plus adéquates.*

During archaeological excavations in Turkey, countless finds have been unearthed whose value to the history of art and culture is indisputable. As much as the finds themselves, the preservation of the materials obtained during these excavations is gaining importance. Efforts to restore and preserve the excavated mosaics are on the rise. Unfortunately, however, some of these interventions aimed at preservation have caused problems. This type of work needs to be revised in terms of planning and implementation. The aim here is not to present problems encountered during the in situ conservation of mosaics but to lay the ground for a discussion on the subject by presenting examples of errors in planning and ill-advised interventions done in the past that were identified during more recent mosaic conservation work carried out at different times in the ancient towns of Aizanoi, Sagalassos, Bodrum, Side, and Zeugma.

Preservation Problems

The first example is the floor mosaic at the Roman baths in the ancient city of Aizanoi (modern Cavdarhisar, Kutahya). The first intervention aimed at conserving the mosaic was carried out in the early 1980s. During later conservation work, it was determined that in 1993 liquid cement mortar had been poured into those interstices where the original grout had worn away on the surface of the mosaic; that areas with lacunae, both large and small (some 10–15 cm square), had been filled with cement mortar; and that this had resulted in active water movement from the ground that concentrated in other areas, causing localized bulging and depressions. Interventions aimed at solving these problems were carried out from 1994 to 1995 (Kökten 1997: 467–71). The restoration process on the Aizanoi mosaic demonstrates how applying the wrong material can lead to greater damage within as few as ten years (figs. 1–3).

The floor mosaic of the Neon Library in Sagalassos, which has been dated to the Roman era, is another case in which the wrong material was used. After the protective building was constructed, on a request from the director of the excavation, permanent conservation work was started in 1996. What was encountered while uncovering the mosaic and determining the existing state of preservation was quite surprising: the borders of the lacunae had been edged with cement mortar in the initial intervention (in the early 1990s), and large cracks and fractures had been filled, not with lime mortar, as was specified in the

FIGURE 1 Aizanoi, Roman bath. Filling of interstices with cement mortar (1994). Photo by Y. Selçuk Sener.

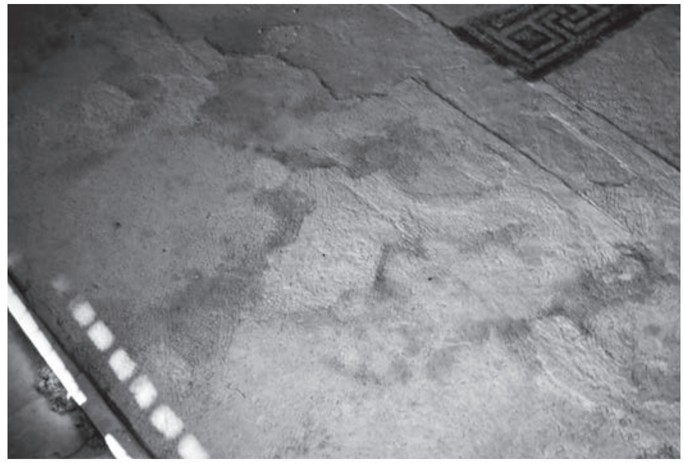


FIGURE 2 Aizanoi, Roman bath. Localized wet surfaces due to active rising damage (1994). Photo by Y. Selçuk Sener.

operational report, but with cement mortar as well (Waelkens et al. 2000: 419–47). This treatment was ill-advised in that white cement mortar, which is not appropriate for the original material, was used. Given the time and effort spent cleaning the applied mortar, it presents an example of unnecessary work that was done in haste and that runs counter to proper planning practice (figs. 4, 5).

Conservation of the mosaics at the late Roman–early Byzantine necropolis at Myndos Gate, Bodrum, was carried out in March–April 1999, and mosaics on the colonnaded avenue and mausoleum in the ancient town of Side underwent conservation treatment in December 2002–February 2003. After the treatment, no protective roof was erected over either of the mosaics. In fact, it was determined in our investigations of 2004 in Bodrum that mortar fills on the restored areas of the mosaic had deteriorated to a great extent.

The mosaics at the colonnaded avenue in the ancient town of Side shared the same fate. Here, the protective cover was not built because it was felt that it would mar the overall appearance of the site. Instead, the mosaics were covered with a layer of geotextile, sand, and soil (Sener 2005: 53–66).

Most of the mosaics uncovered at Zeugma in 1999–2000 (Zone A) were retrieved and transported to the museum in spring and early summer 2000. We know that some of the mosaics uncovered during the excavations carried out in summer 2000 (Zone B) were left at the site. However, on our visits to Zeugma in 2004 and 2005, it was observed that the retaining wall was ruined, the reburial fill on the mosaics was

FIGURE 3 Aizanoi, Roman bath. Detachment of tesserae (1994). Photo by Y. Selçuk Sener.

FIGURE 4 Sagalassos, Neon Library. Grouting of the cracks with cement mortar, general view (1996). Photo by Y. Selçuk Sener.

FIGURE 5 Sagalassos, Neon Library. Grouting of the cracks with cement mortar, detailed view (1996). Photo by Y. Selçuk Sener.

FIGURE 6 Zeugma. Condition of the shoreline where the mosaics have been reburied (2004). Photo by Y. Selçuk Sener.

FIGURE 7 Zeugma. Condition of mosaics after reburial in 2000 and subsequent flooding (2004). Photo by Y. Selçuk Sener.

no longer in place, and the mortar applied on the surface for protection had crumbled away and/or was damaged along with the mosaics (figs. 6–8). Zeugma stands as an example of bad planning that should be carefully examined as it shows us the damage that can be caused by the implementation of an in situ preservation decision that may seem right in theory but has not been successful.

Conclusion

Problems related to in situ mosaic preservation in Turkey were examined through the conservation work on the mosaics at Aizanoi, Sagalassos, Bodrum, Side, and Zeugma. The principal problems encountered in these examples are as follows:

1. New damage was caused over time by previous conservation interventions.

FIGURE 8 Zeugma. Condition of mosaics after reburial in 2000 and subsequent flooding (2004). Photo by Y. Selçuk Sener.

2. Overzealous interventions on mosaics that were completely excavated had been carried out when what was required instead was planning for active conservation treatments at a later date.
3. During rescue excavations, it was determined that mosaics that could not be preserved on-site for various reasons were nonetheless subjected to in situ preservation and left to their fate without the necessary and sufficient preservation measures.

In conclusion, however much interventions aimed at preservation may be regarded as proper and sufficient during their implementation, they do not always result in the preservation of the mosaics as intended and can even lead to new damage or complicate subsequent preservation projects.

Given the diversity of the problems, the solutions require a series of different approaches, ranging from educational to legal measures. Nevertheless, the most effective solution might still be the monitoring and evaluation of conservation efforts.

References

Kökten, H. 1997. Konservierungs und Restaurierungsarbeiten am Thermenmosaik in Aizanoi. 1994–1995. *Archäologischer Anzeiger, 3:* 364–71.

Sener, Y. S. 2005. Side antik kenti sutunlu cadde mozaiklerinin konservasyonu. In *20. Arkeometri Sonuçlari Toplantisi, 24–28 Mayis 2004, Konya,* ed. K. Olsen, 53–66. Ankara: Kültür ve Turizm Bakanligi Dösimm Basimevi.

Waelkens, M., H. Kökten Ersoy, K. Severson, F. Martens, and S. Sener. 2000. The Sagalassos Neon Library mosaic and its conservation. In *Sagalassos V: Report on the Survey and Excavation Campaigns of 1996 and 1997,* ed. M. Waelkens, 419–47. Acta Archaeologica Lovaniensia. Leuven: Leuven University Press.

An Evaluation of the Preservation of Reburied Mosaics in Cilicia

Füsun Tülek

Abstract: *The corpus of mosaics in Cilicia covers all the known mosaics from the region. Many aspects of the mosaics are evaluated in the corpus, including their state of preservation. Most of them seem to have received preliminary maintenance and consolidation. There are five principal methods used to preserve the Cilician mosaics. Among these, reburial was the most common method. However, in most cases reburial has been practiced as an intuitive preservation strategy. Reburial implementation in Cilicia needs to be examined further in order to identify what factors determined the choice of this method.*

Résumé : *Le corpus de mosaïques en Cilicie couvre toutes les mosaïques connues de la région, en évalue plusieurs aspects et fournit une base de données sur leur état de conservation. La plupart de celles-ci semblent avoir reçu un entretien et une consolidation préalable. Cinq méthodes principales existent pour conserver les mosaïques ciliciennes. Parmi celles-ci, le réenfouissement constituait la solution la plus usuelle. Cependant, dans la plupart des cas, le réenfouissement a été pratiqué en tant que stratégie de conservation intuitive. Le réenfouissement en Cilicie nécessite d'être approfondi afin de comprendre les facteurs qui ont déterminé la décision de recourir à cette méthode.*

The corpus of Cilician mosaics encompasses more than 150 individual panels from forty-two sites (Tülek 2004). Each site either constitutes a single structure carpeted with floor mosaics or is an ancient settlement yielding numerous structures decorated with floor mosaics. Some of these mosaics are available for hands-on examination, though most are inaccessible, and others are lost. The mosaic corpus documents the present state of Cilician mosaics and provides an account of the preservation methods (if any) (fig. 1). Among the preservation methods that have been recorded, reburial was the most common solution chosen in Cilicia. In some cases reburial was implemented as a temporary solution but turned out to be a long-term one.

Examination of the Cilician mosaics reveals two types of interventions: lifting mosaics to museums or leaving them in situ. Lifting was the least common. Eighteen floor mosaics from seven locations were lifted to museums. Of these, fifteen are on display; the others are stored. Nineteen floor mosaics from eleven sites have been categorized as "lost." This category comprises primarily those mosaics that were left in situ and could not be found during the field survey. They may have been looted or destroyed, or they may have deteriorated as a result of being exposed to the weather, as in the case of the mosaic left in situ at Imbriogon kome, whose tesserae disintegrated into "sugar lumps." Further, two of the Cilician floor mosaics were found in chunks, mixed into the soil during the cultivation of wheat and cotton fields.

The in situ mosaics have been found in the following five conditions:

- displayed in situ in a museum;
- reused as floors of modern village houses built over them;
- exposed without maintenance;
- recorded in the survey but not yet excavated;
- reburied.

The Misis, Narlıkuyu, and Anazarbus mosaics are displayed in situ as distant related exhibits of the local archaeology museums. The Misis and Narlıkuyu mosaics have received full conservation and restoration and are sheltered by protective structures built over them; the two figural panels of Anazarbus have been protected only by a shelter supported on four posts. Three of the in situ mosaics belong to a single monument and are being reused as the floors of present-day homes. These mosaics have been kept in fairly good

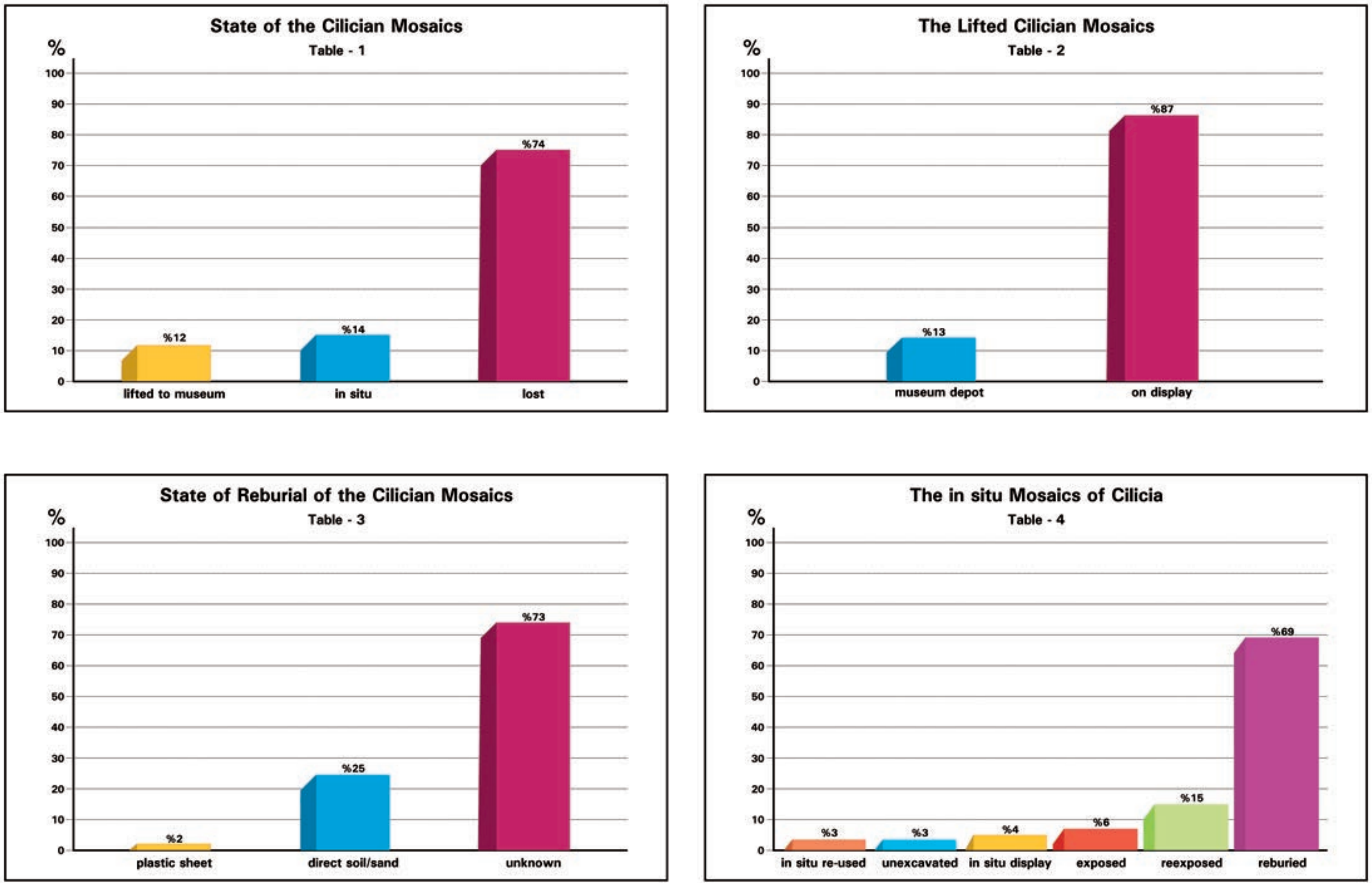


FIGURE 1 State of the Cilician mosaics.

condition compared to the exposed in situ floor mosaics, which have received little or no maintenance or protection. Five of the in situ floor mosaics have been exposed via natural causes or human vandalism, yet there has been no intervention to maintain and preserve them.

Reburied floor mosaics belong to twenty sites and number up to thirty-two mosaic panels. Some of the reburied mosaics have been reexposed. The reexposed mosaics come from sites such as Al Oda, Konacık, and the ancient settlement of Anemurium (figs. 2–4). The excavations of these sites have been concluded. These mosaics had once received consolidation

FIGURE 2 Anemurium mosaic.

FIGURE 3 Anemurium mosaic.

FIGURE 4 Anemurium mosaic.

and backfilling but were recently exposed due to erosion of the backfill by rains or the curiosity of tourists or tour guides. The present situation of the Anemurium mosaics indicates that reburial was chosen as the major strategy to preserve most of the floor mosaics, except for a few that were lifted to the museum.

The reburial practices implemented for these mosaics are varied. Since all the reburied mosaics are not available for examination—for example, those at Korykos, Meryemlik, and Dağ Pazarı—all the types of reburial are unknown. The mosaics available for examination have three backfill materials: sand, soil, and gravel. They were mostly used in direct contact with the mosaic surface. The use of a plastic sheet or geotextile as a horizon marker could not be detected. Maintenance and intervention records of these mosaics were not available for the present study. It was observed that the edges of the mosaic panels were consolidated with cement. Tall grass encloses these mosaic panels, some of which have been cracked and fragmented, and each fragment has also been surrounded by grass that dissects the mosaics and destroys the unity of the designs. However, there is no vegetation trailing over the surface of the mosaics. It is not clear whether pesticide was applied to the mosaics. On some, plastic sheets were used as horizon markers, though most of the sheets have decayed.

The Anemurium mosaics had no horizon markers on them. It is not clear whether they existed at the outset and were removed by the locals. However, the floor mosaic of Burial B1 16b at Anemurium had a deep backfill. The Alacami and Domuztepe floor mosaics were reburied with sand. The Domuztepe mosaic was covered with a layer of soil laid over the sand. Plastic sheet was not used in the maintenance and preservation of either mosaic. In Karlık a plastic sheet covers the mosaic, on top of which

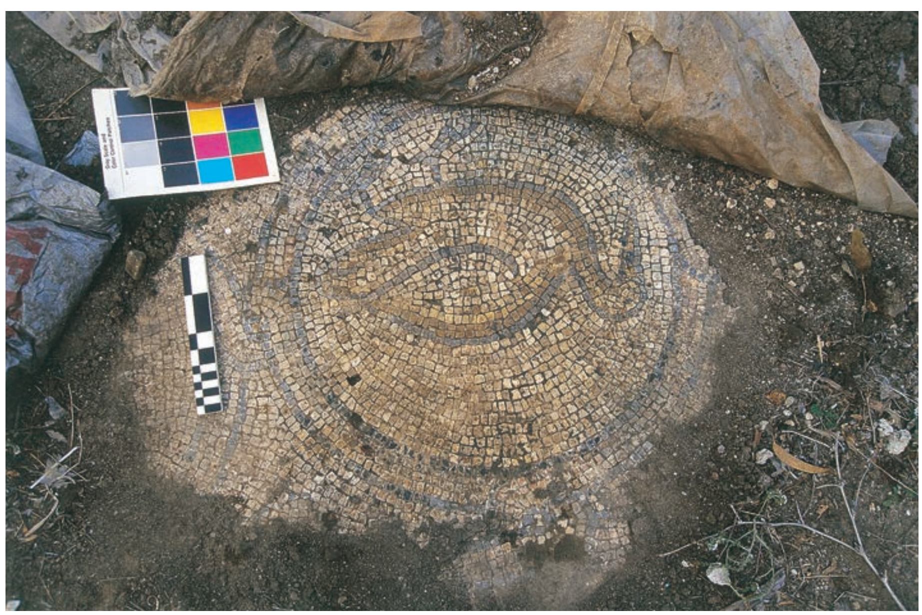


FIGURE 5 Karlık mosaic.

FIGURE 6 Soli mosaic.

is a layer of sand (fig. 5). In Kadıpaşa and Güneyköy river sand is in direct contact with the surface of the mosaic. One of the two Kadıpaşa mosaics, the one reburied beneath the road, has also been covered with a deep layer of soil to protect it. The Ovacık floor mosaic is also covered with river sand in direct contact with the mosaic surface and has no plastic sheet for protection.

The mosaics at ongoing excavations such as Celenderis and Elaiussa are backfilled with sand and receive annual maintenance. Similarly, the Soli mosaic (fig. 6) receives annual maintenance and was initially covered with a plastic sheet, on top of which was a layer of sand. In this case the plastic sheet promoted deterioration by sealing the damp and humidity over the surface of the mosaic, already heavily damaged when found. Roots and moss covered the surface of the mosaics like a spider web. The tesserae of the mosaic were in flakes, making it impossible to discern the figures depicted on it. However, the other half of the mosaic, excavated during my study, was in a fairly good state, with some effects of salt and roots on the surface. After consolidation and maintenance, 12-denier-thick woven geotextile was used as the horizon marker.

In conclusion, archaeologists at Cilicia preferred to preserve the floor mosaics in situ by backfilling them. The decision-making process is not clear. However, it seems that the reburial practices were mostly intuitive. In particular, the reburials implemented with soil or sand in direct contact with the mosaic surface seem planned as short-term strategies. There is still the intention to display some of the mosaics as in situ exhibits. Practitioners are aware of the damage caused by plastic sheets, and there is a conscious tendency not to use them as horizon markers. The use of geotextile as horizon markers is quite new for Cilician mosaics. Future examination of the Soli mosaic will provide more experience in the application of this material in the region.

References

Tülek, Füsun. 2004. Late Roman and early Byzantine floor mosaics in Cilicia. Ph.D. dissertation, University of Illinois at Urbana-Champaign.

The Lifting of a Mosaic from the Site of Letoon and Its Replacement with a Replica

Şehrigül Yeşil Erdek

Abstract: *When a mosaic floor is treated as an architectural decoration, the preferred method is to preserve it in situ, to be displayed as a whole in its architectural context. However, occasionally, for reasons such as weathering and insufficient protection, an in situ mosaic needs to be removed and displayed at a local museum. It is for these reasons that it was decided to lift the Letoon mosaic and preserve it in the Fethiye Archaeological Museum and replace it on-site with a replica in order to enable visitors to appreciate the mosaic in its original setting. This poster presents how these operations were carried out.*

Résumé : *Lorsqu'un pavement en mosaïque constitue un décor architectural, la méthode préférée est celle de la préservation* in situ, *afin de le montrer dans l'ensemble de son contexte architectural. Cependant, il arrive que pour des raisons liées au milieu ou à l'insuffisance de protection, une mosaïque* in situ *doive être déposée et exposée dans un musée local. Pour ces raisons, il a été décidé de déposer et de préserver la mosaïque de Letoon dans le musée et de la remplacer par une réplique afin de permettre aux visiteurs d'apprécier la mosaïque dans son cadre d'origine.*

FIGURE 1 The Temple of Apollo in Letoon with the original mosaic pavement in the foreground. Photo by the author, with the permission of Dr. Didier LaRoche, Letoon project director.

A mosaic was found during the excavation of the Temple of Apollo in the ancient city of Letoon/Lykia, near modern Fethiye in southwestern Turkey (fig. 1). The mosaic is 226.2 by 111.8 centimeters, and the area between the mosaic panel and the surrounding walls is paved with *opus signinum* consisting of lime-based mortar. The mosaic contains three symbols of Apollo in three individual panels: a bow and quiver, a rosette, and a lyre. The panel is framed by three bands, the central one of which is made of terracotta tesserae. Lead contours

FIGURE 2 The mosaic of the Temple of Apollo. Photo from Letoon Project archive with the permission of Dr. Didier LaRoche, Letoon project director.

were used to separate each figure and panel from the others (fig. 2).

Conservation Process

The conservation of the mosaic was carried out in five stages over a period of three years, 2003 to 2005. Due to weathering and insufficient protection, this in situ mosaic had to be removed and protected at the local museum. In order to show visitors the original decoration of the temple the mosaic has been replaced with a replica.

Documentation

Prior to the lifting process, the mosaic was photographed using planar photography. The photo-editing software Adobe Photoshop 7.0 was used to merge the obtained images so as to generate precise drawings of the mosaic using the latest CAD software. The colors of the mosaic were transferred to drawings generated from digital photographs using the same software.

Lifting the Original Mosaic

The mechanical strength of the terracotta tesserae was improved by applying the acrylic resin Paraloid B 72 at 10 percent in acetone by brush. A 6- to 7-centimeter-wide strip from the *opus signinum* pavement around the mosaic was removed. Cotton gauze and canvas were glued onto the mosaic surface with polyvinyl acetate. The mosaic was detached by inserting five metal rods, 150 centimeters long and spaced 40 centimeters apart, between the nucleus and the bedding layer. The wooden panel used for transportation and temporary storage was placed on the upper side of the mosaic and then turned upside down in order to lift the entire panel in one piece.

Replacement with the Replica

The original location of the mosaic was cleaned of the remaining mortar. New *statumen* and *rudus* layers were prepared and applied to the ground where the mosaic was located. In order to place the replica, a wooden frame was first temporarily fixed onto the *rudus* layer. As the replica was made in eleven sections, smaller temporary frames were formed insider the larger frame prior to placing each section. For each frame, the nucleus, bedding layer, and *tessellatum* layer were placed respectively. After placement, the smaller frames were removed and the same procedure applied for the other pieces. Lead strips were mounted to separate the main figures from each other as in the original mosaic (fig. 3). The space between the *opus signinum* pavement and the mosaic was leveled to obtain a smooth transition surface. Parts of the pavement damaged during the lifting process were reconstructed and indicated by creating a slightly different texture (fig. 4).

Conservation of the Original Mosaic

Conservation work was carried out in 2004. The mortar behind the tesserae was removed while the mosaic surface was supported by the cotton gauze/canvas already applied during the lifting process. Damage, such as cracks on lead strips, was strengthened by applying Paraloid B 72 at 10 percent in acetone by injection and brush. The *tessellatum* bedding layer was applied on the back of the mosaic using lime mortar. In 2005, after the curing process of the mortar was completed and it had reached adequate mechanical strength, the mosaic was glued to an aluminum honeycomb panel with epoxy resin, Eposet R5 and its hardener. The cotton gauze/canvas applied during the lifting process was then removed by a solvent mixture of alcohol:acetone:hot water (1:1:2). The space between the tesserae and tesserae surfaces was cleaned of the adhesive mechanically. Areas with lost tesserae were filled with new ones also used for the replica (fig. 5). Larger lacunae were filled with lime mortar (fig. 6). The composition of this mortar was sand, brick dust, and limestone dust (1:1:1) as aggregates and slaked lime and hydraulic lime (0.75:0.25) as binders. The mortar used to fill the lacunae was engraved in the form of tesserae so as to preserve the general aesthetic appearance.

FIGURE 3 The mosaic reproduction. Lead strips were mounted to separate the main figures from each other, as in the original mosaic. Photo from Letoon Project archive with the permission of Dr. Didier LaRoche, Letoon project director.

FIGURE 4 The replica mosaic on-site in the Temple of Apollo. Photo by the author, with the permission of Dr. Didier LaRoche, Letoon project director.

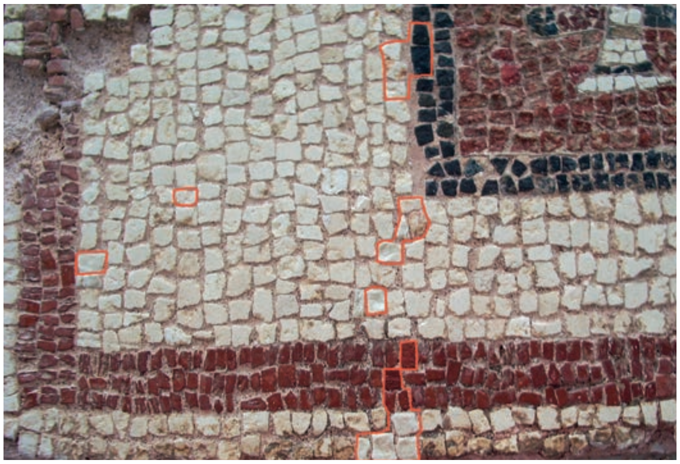


FIGURE 5 Areas of surface loss have been reconstructed with new tesserae. Photo by the author, with the permission of Dr. Didier LaRoche, Letoon project director.

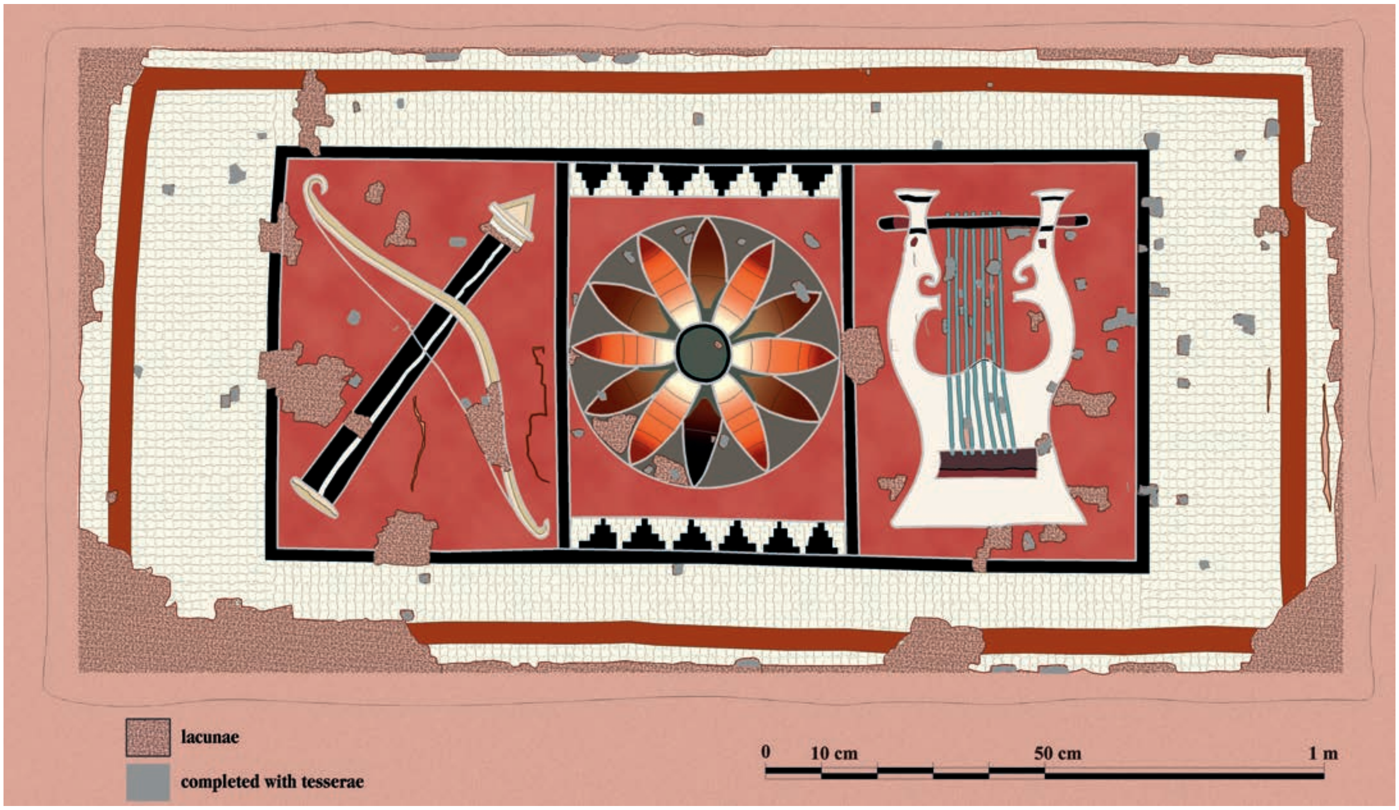


FIGURE 6 Graphic documentation of lacunae filled with mortar and those filled with tesserae. Drawing by the author.

Installation of the Original Mosaic in the Museum

The mosaic was moved to an exhibition hall in the museum and framed with specially constructed stainless steel (fig. 7). The metal construction used for the installation has been designed so that it can be easily dismantled from the mosaic. The mosaic was installed at a 10° angle from the floor for better viewing (fig. 8). The original function of the mosaic is described on the adjacent information panel.

Conclusion

The mosaic was small enough to be lifted as a single piece. This method conserved the lead strips that otherwise could have been damaged. Replacing the original mosaic with a replica enables visitors to appreciate the mosaic within its architectural environment in an ancient city. The materials used to conserve the mosaic were selected based on the compatibility of their mechanical, chemical, and aesthetic properties with the original. Mortar-filled lacunae were engraved in the shape of tesserae in order to obtain the continuation of the patterns, and small losses on the surface of the mosaic were filled with tesserae similar to those used in the replica to assure aesthetic unity. At the museum the installation of the mosaic and the information panel has been organized to direct visitors to the ancient city; and at the site the exhibition of the mosaic has been organized to direct visitors to the museum.

Acknowledgments

The author would like to thank Mehmet Uğuryol for his contributions to the project in 2003 and Serpil Sezer Ersoy for her contributions in 2004–5.

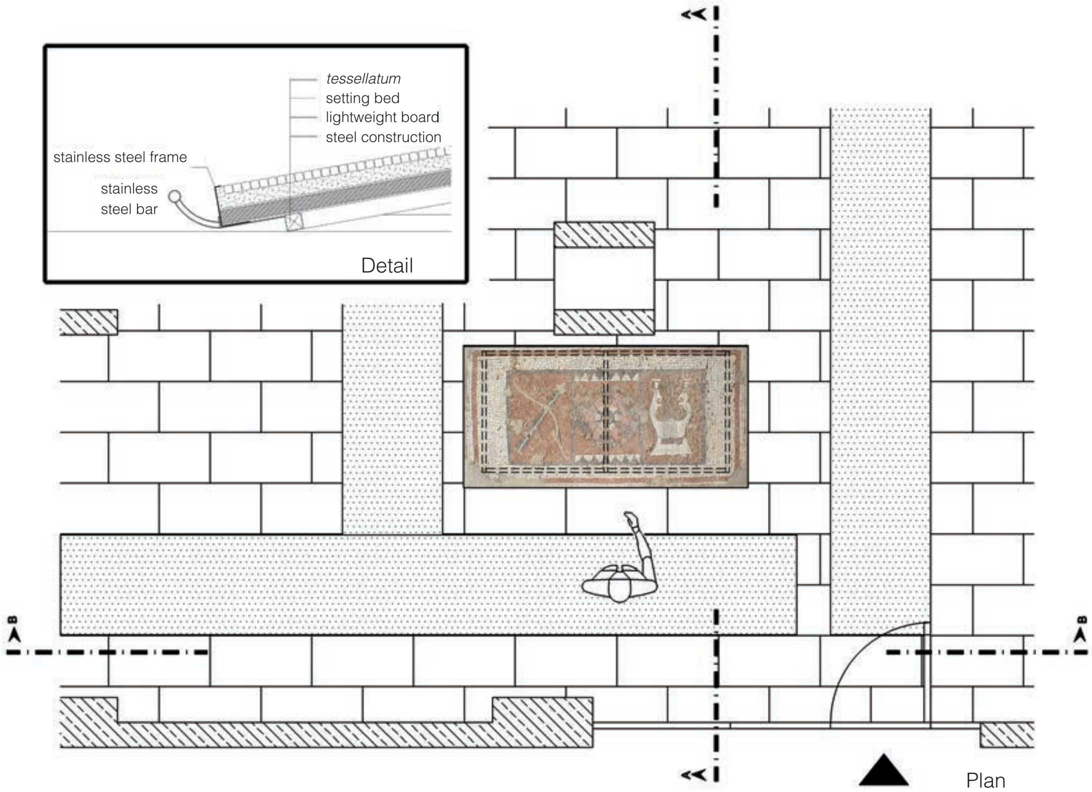


FIGURE 7 The installation plan of the original mosaic in the museum. Drawing by the author.

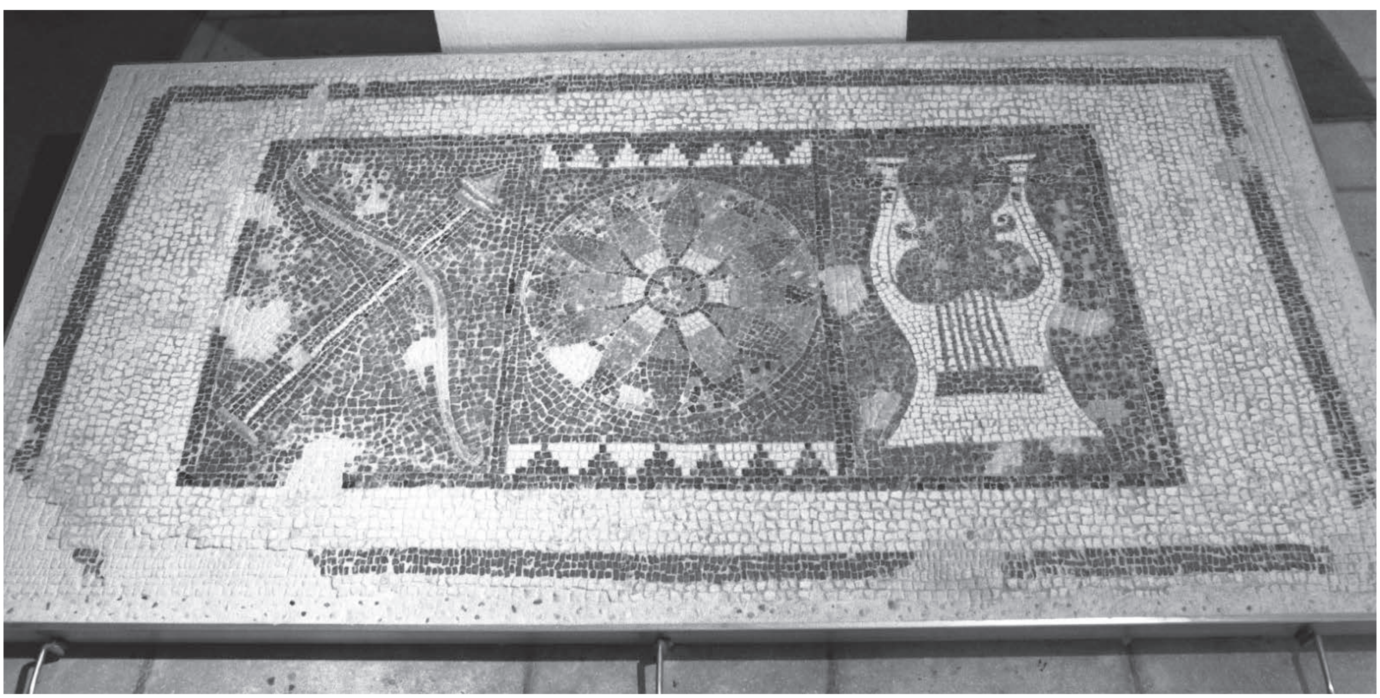


FIGURE 8 The original mosaic installed in the exhibition hall of the Fethiye Archaeological Museum. Photo by the author, with the permission of Dr. Didier LaRoche, Letoon project director.

Authors / Auteurs

Maria de Fátima Abraços a obtenu son magistère et son doctorat d'histoire de l'art à la Faculté des Lettres de l'Université classique de Lisbonne, Portugal. Ses spécialités : l'histoire de l'archéologie romaine, le patrimoine, l'histoire de l'art, la conservation et la restauration de la mosaïque romaine.

Neville Agnew is principal project specialist at the Getty Conservation Institute. He came from the Queensland Museum, Australia, in 1988, where he headed the conservation section. Prior to that his career had been in academic and research chemistry. Among his interests are archaeological site protection methods, the preservation of adobe, rock art, and culture-nature conservation. Agnew has led and participated in many of the GCI's international conservation projects.

Amr Nawar Al Muayyad Al-Azm was educated in the United Kingdom, reading archaeology of western Asia at the University of London, Institute of Archaeology, and graduating with a doctoral degree in 1991. He has excavated a number of sites, including Tell Hamoukar in Syria and the supposed final burial place of Ghengis Khan in Mongolia. From 1999 to 2004 Al-Azm was director of Scientific and Conservation Laboratories at the General Department of Antiquities and Museums. Currently he is a lecturer at the University of Damascus and a visiting professor at Brigham Young University in the United States.

Livia Alberti is a graduate of the Istituto Centrale per il Restauro in Rome and for more than twenty years has worked as a professional conservator in Italy and in the Mediterranean area, in private practice and as a member of Consorzio Arke. She has worked primarily on mosaics and wall paintings, including training in these fields. Since 2001 Alberti has been a consultant to the Getty Conservation Institute on its mosaic maintenance technician training project.

Yael Alef, an architectural conservator, has been with the Israel Antiquities Authority Conservation Department since 1994. Alef is currently head of the Planning Unit there, managing surveys, documentation, and planning of archaeological sites and historic buildings and towns. Prior to that position, she worked for a year on a management plan for Khirbet Minya in the Mosaics Project at the Getty Conservation Institute. She studied architecture at the University of Tel Aviv and conservation at the Raymond Lemaire International Center for Conservation, Katholieke Universiteit, Leuven, where she focused on evaluation of shelters over mosaics.

Marc Amouric is a professor of mineralogy at the Aix-Marseille III University, France. He specializes in nanogeosciences related to the environment. He has published numerous scientific papers in international journals on the transformation and alteration mechanisms in minerals (mainly clays) and on earth surface evolution. At present his interest is Roman mosaic materials and their weathering as deterioration processes.

Panayota Assimakopoulou-Atzaka is a professor at the Center for Byzantine Research, Aristotle University, Thessaloniki, Greece, and author of the corpus of the early Christian mosaic pavements in Greece. Her interests are late antiquity, in particular, internal decoration of buildings, and Roman and Christian texts, especially concerning terminology, artists, and artisans, as well as the persistence of idolatry in the Christian world.

Charalambos Bakirtzis has been Ephor of Byzantine Antiquities of Thessaloniki since 1997. Previously he was professor of Byzantine archaeology at Aristotle University, Thessaloniki, Greece, and director of Byzantine Antiquities of Eastern Macedonia and Thrace.

Craig Barnes is president of CBI Consulting, Inc., a multidisciplinary engineering and architectural consulting firm located in Boston, Massachusetts. He is registered to practice as both a civil and a structural engineer in seventeen jurisdictions. Barnes has been in consulting practice for more than thirty years.

Fathi Bejaoui est directeur de la division de la recherche à l'Institut National du Patrimoine et conservateur du site et du Musée de Carthage. Spécialiste de la période paléochrétienne et byzantine en Tunisie, il a publié plusieurs articles sur l'iconographie chrétienne (céramique, mosaïque, sarcophages) et l'architecture des églises de Tunisie.

Aïcha Ben Abed est directrice des monuments et des sites à l'Institut National du Patrimoine. Elle est responsable de quatre sites antiques et codirige trois fouilles tuniso-françaises. Ancien conservateur du Musée du Bardo, elle est auteur et co-auteur de six fascicules du *Corpus des mosaïques de Tunisie* et de plusieurs ouvrages et articles sur l'architecture domestique et les mosaïques tunisiennes. Elle est l'initiatrice d'une collaboration INP-GCI visant à former des techniciens à la restauration de mosaïques *in situ*.

Giordana Benazzi is an art historian. For about thirty years she worked in Perugia as a conservator for the Architectural, Environmental, Historical, Artistic and Anthropological Heritage Service. She has overseen the restoration of many paintings, sculptures, and monuments, including the cathedral and castle in Spoleto, frescoes of "Gentile da Fabriano" in Palazzo Trinci (Foligno), and mural paintings and other artworks in Gubbio.

Carla Benelli, art historian, is the cultural heritage sector coordinator of the Italian NGO Cooperazione Internazionale Sud Sud (CISS), which since 1999 has been supporting projects to safeguard cultural heritage in the Middle East. Since 2000 she has been the coordinator of the Bilad al-Sham training course in ancient mosaic restoration.

Philip Bethell is an archaeologist who has been working for the United Kingdom's National Trust, Europe's largest conservation charity, since 1994. During this time he has been the manager of the Chedworth Roman Villa, one of the best-surviving country houses dating from the late Roman period in Britain. Previously he worked as a field archaeologist, in archaeological science research, and at museums. Currently he is developing his interest in conservation management and contributes to teaching at University College London as an honorary research fellow.

Véronique Blanc-Bijon est au Centre National de la Recherche Scientifique, Centre Camille Jullian (UMR 6573), Aix-en-Provence.

Patrick Blanc est responsable de l'Atelier de Conservation et de Restauration intégré au Musée de l'Arles et de la Provence antiques et dépendant du Conseil général des Bouches-du-Rhône, France.

Cristina Boschetti has a degree in archaeological heritage conservation and paintings and stone restoration. She holds a grant at Modena and Reggio Emilia University, where she is involved in the study of glossy materials in Roman mosaics. Currently she is a Ph.D. candidate at Padova University and works with the Italian archaeological mission in Dürres for the study of the mosaics.

Yasmine Makaroun Bou Assaf is an architect and archaeologist. She has a Ph.D. in archaeology from the University of Paris, Sorbonne College (2002), and a DEA in ancient history, languages, and civilizations from the University of Lyon (1993). She has been involved in several restoration and site management projects, and teaches at the Lebanese University in Tripoli (postgraduate program on the conservation of monuments and sites) and St. Joseph University in Lebanon.

Elsa Bourguignon obtained master's degrees in analytical chemistry (École Nationale Supérieure de Chimie de Montpellier and Queen's University of Belfast) and architectural conservation (University of Pennsylvania). Between 2000 and 2005 she worked as an architectural conservator at the Getty Conservation Institute, where she participated in the training of technicians for the conservation and maintenance of in situ mosaics in Tunisia and the development of a conservation plan for the hieroglyphic stairway at the Maya site of Copan in

Honduras. She is currently pursing a Ph.D. on the desalination of porous building materials by poulticing.

Rachel Burch is a freelance wall painting conservator with a particular interest in conservation on archaeological sites. She has an undergraduate degree in archaeology from the University of Newcastle-upon-Tyne and a postgraduate diploma in the conservation of wall paintings from the Courtauld Institute of Art, London (1997). She is co–managing editor of the journal *Conservation and Management of Archaeological Sites*. Burch is currently based in Los Angeles.

Giorgio Capriotti is director of the Conservation Laboratory of the province of Viterbo, Italy, and teaches at the University of Tuscia in Viterbo. He received his training at the Istituto Centrale per il Restauro in Rome and has specialized in polychrome surfaces and mosaics. Capriotti carries out conservation treatments and is a consultant for international organizations such as UNESCO, ICCROM, and the Getty Conservation Institute.

Évelyne Chantriaux est conservatrice et dirige l'équipe de l'Atelier de restauration de mosaïques et d'enduits peints de Saint-Romain-en-Gal. Cette structure publique réalise des interventions *in situ*, remontages sur de nouveaux supports, restaurations et présentations et reprise de restaurations anciennes de mosaïques pour des commanditaires publics comme les musées et les services régionaux d'archéologie en France, voire à l'étranger.

Abdelkader Chergui holds a master's degree in urbanism. He is currently site conservator at Volubilis, employed by the Ministry of Cultural Affairs of Morocco, Office of Cultural Heritage.

Eleni Chrysafi is an archaeologist at the Center for Byzantine Research, Aristotle University, Thessaloniki, Greece. She is interested in Byzantine iconography and painting and is currently preparing her Ph.D. dissertation on the iconography of angels in Byzantine art.

Anna Corradi is a professor of environmental chemistry at the Modena and Reggio Emilia University. In 2001 she became head of the Department of Materials and Environmental Engineering. She is a member of the Interuniversity Network on Archaeometry and specializes in the characterization of ancient inorganic materials.

Marie-Laure Courboulès est conservatrice-restauratrice à l'Atelier de Conservation et de Restauration du Musée de l'Arles et de la Provence antiques.

Carmen Dávila Buitrón holds a bachelor's degree in archaeology from the Autónoma University of Madrid. She has collaborated on projects on Arabic archaeology and architecture in Spain, as well as on archaeological excavations of Bronze Age, Roman, and medieval sites. She completed a course of study in conservation and restoration at the Official School of Conservation and Restoration of Cultural Goods and participated in various conservation projects in Spain. Since 1991 she has been a restorer in the National Archaeological Museum of Madrid.

Gaël de Guichen began his career as engineer in charge at the prehistoric cave of Lascaux. In 1969 he joined ICCROM, where he completed his career. He launched three major programs: one on preventive conservation, one on the development of African museums, and one involving the public. He contributed to the creation of ICCM in 1977 and is now honorary chairman.

Abdelilah Dekayir is a professor in the Department of Earth Science at the Meknes Faculty of Sciences, Morocco. He received his Ph.D. in geochemistry of earth surface process from the University of Marseille, France. He is author and coauthor of several papers in international scientific journals in the field of earth surface process. His current research interests include the deterioration and conservation of Roman mosaics and other historical monuments.

Martha Demas is a senior project specialist at the Getty Conservation Institute. She received her Ph.D. in Aegean archaeology from the University of Cincinnati and an M.A. in historic preservation at Cornell University, specializing in the conservation of archaeological heritage. In addition to the GCI's Mosaics in Situ Project, she is currently involved in conservation projects in China and Egypt.

Mouloud Derram est responsable du service de restauration du Musée national des Antiquités d'Alger, Algérie.

Jarosław Dobrowolski is a conservation architect who graduated from the Technical University of Warsaw, Poland. He has worked on various archaeological sites in Egypt and the Sudan and has directed architectural conservation projects in Egypt. Since 1996 he has been the technical director of the American Research Center in Egypt's USAID-funded conservation program, which carried out more than fifty conservation projects.

Salvador Domínguez-Bella has a Ph.D. in geology from the Universidad Complutense de Madrid. He is a professor of crystallography and mineralogy at the Universidad de Cádiz, where he also teaches in the areas of general geology, raw materials in industry, architectural heritage and the environment, and archaeometry. He is the scientist responsible for the XRD-XRF Division in the Servicio Central de Ciencia y Tecnología at the university and the Geoarchaeology and Archaeometry Unit Applied to Historical, Artistic and Monumental Patrimony (UGEA-PHAM).

Ana Durante Macias teaches at the secondary school Huerta del Rosario in Chiclana, Cádiz, Spain. She has a degree in philology and collaborates in this and other archaeometric studies of ancient Roman heritage.

Bruno Fabbri is a geologist with the National Research Council (CNR) of Italy. Since 1977 he has been a researcher in the field of industrial ceramics at the Institute of Science and Technology for Ceramics (ISTEC) in Faenza. Since 1980 he has also been interested in ancient ceramics and is currently group leader of the Cultural Heritage sector of the institute.

Sabah Ferdi est conservateur des sites et du Musée de Tipasa, Algérie. Spécialiste de l'Antiquité classique et tardive, elle est l'auteur d'ouvrages et d'articles sur le patrimoine et codirige le *Corpus des mosaïques d'Algérie*.

Gianluigi Fiorella has a degree certificate in cultural heritage (archaeological sector), a degree in the conservation of cultural heritage from the University of Bologna, and a diploma from the School for Mosaic Restoration in Ravenna. His recent activities include the conservation of the wall remains in the archaeological park of Classe (Ravenna) for the Department of Archaeology at the University of Bologna and preparing mortars for the conservation of mosaics in collaboration with CNR–Institute of Science and Technology for Ceramics (ISTEC), Faenza.

Maja Frankovic is conservator at the National Museum in Belgrade, specializing in mosaic conservation. She graduated from the Academy for Arts and Conservation of the Serbian Orthodox Church in Belgrade in 2002 and completed internships at the Musée de l'Arles et de la Provence antiques in 2002 and 2004. She is currently doing postgraduate studies in conservation at the Faculty of Applied Arts in Belgrade.

Diane Fullick received an M.S. degree in conservation from the University of Delaware/Winterthur Museum. She participated in the Harvard/Cornell Sardis Expedition as special projects conservator for mosaics during the 2001–4 seasons. Previously she worked at the Worcester Art Museum in preparation for the exhibition *Antioch: The Lost Ancient City*. At present she works in private practice in Baltimore, Maryland.

Annamaria Giusti has been director of the Bronzes and Metallic Materials, Mosaics, and Florentine Mosaics section at the Opificio delle Pietre Dure (Florence) since 1976. In addition, she is currently director of the Opificio's museum and teaches at the Opificio's high school. She directed the restoration of the Florentine Baptistery Doors and Michelangelo's David, among other conservation works.

José Lourenço Gonçalves received a bachelor's degree in archaeological conservation and restoration from Lisbon University in 1997, with an internship at the Conímbriga Museum, and graduated from the Polytechnic Institute of Tomar in 2002 with a specialization in conservation of archaeological landscapes. He joined the Archaeological Municipalities Service of Sintra in 1999 and is now in charge of conservation work at the São Miguel de Odrinhas Archaeological Museum.

Osama Hamdan, architect, is professor of architectural restoration at the Higher Institute of Islamic Archaeology of Al-Quds University (Palestine). He is director of the Palestinian Mosaic Workshop, Committee for the Promotion of Tourism, in the Jericho Governorate. Since 1991 he has directed various conservation and restoration projects, and since 2000 he has been the director of the Bilad al-Sham training course in ancient mosaic restoration.

Mohamed Cherif Hamza est attaché de conservation et de restauration auprès du Musée de Tipasa, Algérie, chargé du service de conservation. Il est doctorant en conservation et restauration des mosaïques de Tipasa.

Mervat Ma'moun Khaleel Ha'obsh has a master's degree in architectural engineering from the University of Jordan. She is senior urban planner and heritage and environmental specialist at SIGMA Consulting Engineers in Jordan. In 2006 she was director of the Land Use Zoning for Jordan Project at the Ministry of Municipal Affairs. From 2001 to 2006 she served as senior conservation architect, director of site management, and director of the Protection and Promotion of Cultural Heritage Project in the Ministry of Tourism and Antiquities.

Pamela Hatchfield is head of objects conservation at the Museum of Fine Arts, Boston, where she has been employed since 1985. She holds a master's degree in art history and a certificate in conservation from New York University. She served as site conservator on the New York University Apis Expedition at Memphis, Egypt, and the Museum of Fine Arts, Boston, Expedition to the Western Cemetery at Giza in Egypt. She is the author of *Pollutants in the Museum Environment* (2002).

Işıl R. Işıklıkaya is a Ph.D. candidate at Istanbul University, Department of Classical Archaeology. Her areas of specialization are Roman mosaics and Hellenistic sculpture. She is a member of the Association Internationale pour l'Étude della Mosaïque Antique (AIEMA), Turkey, and a correspondent for the *Bulletin d'AIEMA* for Turkey.

Werner Jobst received his doctorate at the Austria Archaeology Institute. He is guest professor at the Catholic University in Trnava (SK). His research interests include the mosaics of ancient Turkey.

Hande Kökten studied classical archaeology at Ege University (İzmir) and archaeological conservation and materials science at the Institute of Archaeology, University College London. She received her Ph.D. in archaeology and archaeological conservation in 1994. She has been teaching at the conservation program of Baskent Vocational School, Ankara University, since 1991 and is currently its director.

Christine Kondoleon has been George D. and Margo Behrakis Senior Curator of Greek and Roman Art at the Museum of Fine Arts (MFA), Boston, since 2001. In 2004 she was curator for MFA's exhibition *Games for the Gods: The Olympic Spirit.* Formerly she was curator of Greek and Roman art at the Worcester Museum, where she curated the exhibition *Antioch: The Lost City* (2001), and a professor of art at Williams College.

Laurence Krougly est diplômée de l'Université de Paris I Panthéon-Sorbonne et spécialisée en conservation-restauration de mosaïque et peinture murale.

Carlo Galliano Lalli has a degree in biological sciences. Since 1982 he has been associated with the Opificio delle Pietre Dure (Florence), where he teaches and performs diagnostic investigations of works of art. Among the various investigations he has undertaken are analyses of works by Leonardo, Michelangelo, Donatello, and Giotto. His main interest is the development of new methods of cleaning.

Cristina Leonelli is a professor of chemistry in the Department of Materials and Environmental Engineering, Modena and Reggio Emilia University. She has specialized for twenty years in glass science and ceramic technology, in particular, in the preparation and characterization of new and ancient glass and glass-ceramic systems and optimizing methods for ceramic materials testing.

Hassan Limane is a researcher at the Institut National des sciences de l'Archéologie et du Patrimoine in Rabat. He is director of a number of archaeological and conservation projects in Morocco, including excavations in the southwest quarter of Volubilis, with Elisabeth Fentress. He was also director of the site of Volubilis from 1988 to 2000 and director of the museum department of the Division of Cultural Heritage, Ministry of Culture, from 2000 to 2002.

Luc Long est chercheur auprès du Département des recherches archéologiques subaquatiques et sous-marines (DRASSM), Ministère de la Culture, Marseille.

Michele Macchiarola has a degree in geological sciences from the University of Bologna. He is research project leader for CNR's Institute of Science and Technology for Ceramics in Faenza, Italy, and lecturer on mineralogical and petrographic applications for cultural heritage at Foggia University. His main interests are the characterization of ancient mosaic materials, the study of their deterioration processes, and the development of restoration mortars.

Amina-Aïcha Malek est chargée de recherche au Centre Henri Stern de Recherche sur la Mosaïque, dépendant du laboratoire Archéologies d'Orient et d'Occident du CNRS-ENS; elle est responsable du Projet Lambèse.

Pelagia Mastora is an archaeologist with the Ephorate of Byzantine Antiquities of Thessaloniki, Greece. She received a master's degree in Byzantine archaeology from Aristotle University, Thessaloniki, and is currently a Ph.D. candidate in management of antiquities at the University of Athens.

Demetrios Michaelides is director of the Archaeological Research Unit and professor of classical archaeology at the University of Cyprus. He studied at the University of London: History of European Art (B.A., Courtauld Institute) and Archaeology of the Roman Provinces (M.A., Institute of Archaeology). His Ph.D. from the Institute of Archaeology (1981) dealt with the pavements of Roman Benghazi, Libya. He specializes in the study of Hellenistic and Roman mosaics, as well as issues relating to their conservation.

María Luisa Millán Salgado has a degree in fine arts (conservation and restoration) from the Universidad de Sevilla. She works as a restorer on excavations and in public institutions. She has been collaborating on various restoration and rescue interventions on Roman monumental and artistic heritage, such as mosaics and wall paintings. She also works in the restoration of historic altarpieces.

Antonia Moreno Cifuentes has worked in the restoration laboratory of the National Archaeological Museum of Madrid since 1992. She is a member of several scientific research projects on the conservation of archaeological sites, including a project on the Roman paintings of Tiermes, Spain, and the Spanish archaeological missions in Pompeii and Herakleopolis Magna, Egypt.

Roberto Nardi was trained in archaeology at the University of Rome and in conservation at the Istituto Centrale per il Restauro in Rome. In 1982 he founded the Centro di Conservazione Archeologica (CCA), a private company that undertakes conservation and training projects (in Italy, South America, the Middle East, and countries of the Mediterranean area), which emphasize in situ conservation, preventive measures and maintenance, and raising awareness of cultural heritage.

Jacques Neguer graduated from the Polytechnic of Sofia, Bulgaria, in 1986 with an M.S. in engineering science in chemistry. Between 1979 and 1992 he was conservator at the National Institute for Historical Monuments, Sofia. Neguer has also specialized in mosaics conservation at the Istituto Centrale per il Restauro (ICR), Rome, Italy. Since 1993 he has worked as a conservator in the Conservation Department of the Israel Antiquities Authority. He became head of the Art Conservation Section of the department in 1994. He has been a member of ICCM since 1996.

Juan Olives is a researcher at the French CNRS and also works at the Aix-Marseilles II University, France. He has a Ph.D. in physical mineralogy and specializes in condensed matter and nanosciences. He is the author of many papers on nanostructures and thermodynamic properties in minerals, especially clays.

Gaetano Palumbo is director of archaeological conservation at the World Monuments Fund. He was senior lecturer at the Institute of Archaeology of University College London from 2000 to 2002, when he also codirected the Volubilis project with Hassan Limane and Elizabeth Fentress. Previously, he was project specialist at the Getty Conservation Institute in Los Angeles.

Christine Papakyriakou is a Ph.D. candidate at the University of Athens, Greece, and works in the Department of History and Archaeology at Aristotle University in Thessaloniki. She is preparing a dissertation titled "Public Spectacles in the East during Late Antiquity."

Ewa Parandowska is head of the Stone Sculpture Conservation Studio at the National Museum in Warsaw, Poland. She has fieldwork experience in the preservation and conservation of archaeological finds (architectural details, mosaics, wall paintings). She collaborates with the Polish Center of Mediterranean Archaeology, Warsaw University, and has participated in several conservation projects supervised by ICCROM, Leiden University, and the American Research Center in Cairo.

Magda Parcharidou-Anagnostou is a Ph.D. archaeologist in the 12th Ephorate of Byzantine Antiquities, Kavala (Hellenic Ministry of Culture). She specializes in Byzantine and post-Byzantine iconography (mosaics, mural paintings, and portable icons). She is also interested in the relationship between iconography and written sources (texts and inscriptions).

David Parrish received his Ph.D. in classical art history and archaeology from Columbia University. He is currently professor of art history at Purdue University. His research interests include the mosaics of ancient Turkey, and he serves as a codirector of the Turkish Mosaic Corpus. He also specializes in the history of domestic architecture and its decoration in Asia Minor.

Ilaria Pennati is a Ph.D. candidate in archaeology at the University of Foggia, Foggia, Italy. She has a degree in conservation of cultural heritage (historical-artistic sector) from the University of Siena. She also has a diploma from the Opificio delle Pietre Dure (Florence) mosaic and *commesso* technique sector. At present she works as a restorer on the conservation of stone surfaces of the cathedral in Noto, Sicily.

Francesca Piqué received a degree in physical chemistry from the University of Florence and a postgraduate diploma in the conservation of wall paintings (1988–91) from the Courtauld Institute of Art, University of London. She also received an M.S. degree in science for conservation (1992) from the Courtauld Institute. From 1993 to 2004 Piqué was on staff at the GCI and worked on several projects in her dual role as conservator and scientist, including the earthen bas-reliefs at the Royal Palaces of Abomey; the hominid trackway in Laetoli, Tanzania; and the Cave 85 Project at Mogao, China. Since 2004 she has been based in Italy, working as a private professional in conservation.

Nikos Pitsalidis is a conservator in the Ninth Ephorate of Byzantine Antiquities (Hellenic Ministry of Culture).

Anastassia Pliota is an archaeologist at the Center for Byzantine Research, Aristotle University, Thessaloniki, Greece. She is mainly interested in the domestic architecture and decoration of late antiquity as well as in everyday life of the same period.

Konstantinos D. Politis, chair of the Hellenic Society for Near Eastern Studies, has directed several excavations in Jordan and Oman, most notably the Sanctuary of St. Lot about which a book has recently been published by the British Museum Press. He leads a heritage management program in Jordan, conserving mosaics from St. Lot's for exhibition in the new on-site museum that he has designed. Politis also coordinated the Syrian mosaic documentation program and is currently developing the Ras al-Hadd castle for visitors with the Omani government.

Giancarlo Raddi delle Ruote has been technical director and a teacher at the Opificio delle Pietre Dure (Florence) since 1978. He works in the Department of Restoration of Mosaics and is an expert in Florentine *commesso* technique. He has supervised many mosaic restoration interventions in Italy and abroad. In addition, he collaborates as lecturer and adviser with many institutions and universities.

Thomas Roby is an architectural conservator with training from the University of Virginia, the University of York, and ICCROM. He has worked for twenty years on archaeological sites in the Mediterranaean area, primarily as a private conservator on excavation projects. Since 2001 he has worked for the Getty Conservation Institute and has managed the training project for mosaic maintenance technicians in collaboration with the Institut National du Patrimoine of Tunisia.

Andrea Ruffini has a Ph.D. in chemistry from the University of Bologna and in 2004 undertook a postdoctorate at the CNR's Institute of Science and Technology for Ceramics in Faenza, Italy. Ruffini's major research interests are chemical, physical, and structural studies of ceramic materials, stones, glass, and pigments; and developing and applying combinatorial nondestructive and micro-destructive methods for ancient ceramics.

Derya Şahin received her doctorate in classical archaeology from the Science and Literature Faculty at Selçuk University in Konya. She is currently a lecturer in classical archaeology in the Science and Literature Faculty at Uludag University in Bursa. Her research interests include Roman mosaics.

Mustafa Şahin received his B.A. in 1985 from Atatürk University. His M.A. thesis is titled "Hermogenes" (1988), and his Ph.D. dissertation is titled "Grave and Votive Steels from Miletopolis" (1994). In 1990 he was a research assistant in the Archaeology Department at Selçuk University and became a professor in the department in 2003. Currently, he is head of the Archaeology Department and director of the Center of Mosaic Research (AIEMA-Turkey) at Uludag University.

Sara Santoro is a professor of Greek and Roman archaeology at Parma University. Since 2004 she has been scientific director of the Italian archeological mission in Dürres, Albania. She has directed archaeological excavations in Pompeii and in

Castelraimondo. She is involved in national and international projects on Roman workshop production, archaeometric analysis, and mosaic technique and conservation.

Elyas Saffaran est directeur du département d'archéologie et d'art de l'Université de Sharekord, Iran, où il est également professeur après avoir dirigé le département de conservation et de restauration de l'Université d'Art de Téhéran. Titulaire d'un doctorat en archéologie et art, il est membre du comité scientifique de plusieurs universités à Téhéran et fait partie de plusieurs centres de recherche et d'associations scientifiques. Auteur de plus de 55 articles scientifiques dans des revues et magazines scientifiques et lors de conférences nationales et internationales, il a aussi publié plusieurs livres.

J. M. Monraval Sapiña est archéologue diplômée de l'Université de Valence, Espagne, et spécialisée en conservation-restauration de mosaïque et peinture murale.

Niki Savvides is currently a research student at the Institute of Archaeology, University College London (UCL). She received her master's degree in managing archaeological sites in 2002 from the Institute of Archaeology, UCL. Her M.A. thesis was titled "Methods of Protection of Mosaics Floors in the Mediterranean: An Overview of Current Practice."

Y. Selçuk Şener received his B.A., M.A., and Ph.D. degrees from the Department of Art History, Ankara University. He studied archaeological conservation at the College of Antonino de Stefano in Sicily and received a certificate in conservation of stone (from the Istituto Centrale per il Restauro, Rome) and in wall paintings (from the Centre d'Étude des Peintures Murales Romaines [CEPMR], Soissons, France). In addition to teaching, he is director of the Restoration and Conservation Program and vice-director of Baskent Vocational School at Ankara University.

Kent Severson completed conservation training at the New York University Institute of Fine Arts Center for Conservation and Technical Studies in 1985. Since then he has participated in fieldwork in Greece, Turkey, and Egypt and is currently senior field conservator for the New York University Aphrodisias Excavations. He maintains a private conservation practice in Boston, Massachusetts.

Taghrid Shaaban, an expert in mosaic art, is a professor at the Damascus University in Syria. Since 2003 she has been the local coordinator for Syria of the Bilad al-Sham training course in ancient mosaic restoration.

Isabelle Skaf is a conservator who began art history studies in the United States and then graduated from the University of London (B.Sc. archaeological conservation, 1985). Formerly, she was head of the Conservation Laboratory at the Directorate General of Antiquities, Lebanon. She has completed an M.B.A. at the École Supérieure des Affaires in Beirut. Currently in private practice, she is working on archaeological material and sites and coordinating conservation projects.

John Stewart is senior architectural conservator at English Heritage, London, and board member of the International Committee for the Conservation of Mosaics. He has experience with mosaics throughout England and the Mediterranean and is undertaking a survey of shelters in England.

Jeanne Marie Teutonico is associate director, Programs, at the Getty Conservation Institute in Los Angeles. An architectural conservator with over twenty years of experience in the conservation of buildings and sites, she was previously on the staff of the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM) in Rome and later of English Heritage in London.

Sibylla Tringham completed her M.A. in the conservation of wall paintings at the Courtauld Institute in 2004. After working briefly at English Heritage, she undertook an internship at the Getty Conservation Institute, where she joined the Conservation of Mosaics in Situ project team. Tringham is a freelance conservator currently working with the Courtauld Institute on projects in India and China.

C. Mei-An Tsu is an associate conservator in objects conservation at the Museum of Fine Arts, Boston. She graduated from the University of Delaware/Winterthur Museum with an M.S. in art conservation in 1995. She specializes in the conservation of archaeological materials and has worked as a field conservator in Turkey, Pakistan, Israel, and Honduras.

Füsun Tülek received a B.A. in fine arts at Dokuz Eylül University, İzmir, in 1984 and an M.A. in the history of art at Ege University, İzmir, in 1996. In 2004 he received his Ph.D. from the University of Illinois at Urbana-Champaign. Tülek currently teaches the history of architecture and art, mythology, and humanities at Kocaeli University.

Styliani Vassiliadou is an archaeologist with the Ephorate of Byzantine Antiquities of Eastern Macedonia and Thrace. He received a master's degree in Byzantine archaeology from Aristotle University in Thessaloniki and is currently a Ph.D. candidate in Byzantine archaeology there.

Paolo Veronesi has a Ph.D. in materials engineering from Modena and Reggio Emilia University, where he has been a researcher in metallurgy since January 2005. His research activity is focused on materials science, studying and experimenting with new processing routes using microwave-assisted heating and electromagnetic field-matter interaction modeling. He is the author of more than fifty papers on metallic and ceramic materials processing and characterization.

Robert (Chip) Vincent Jr., as cultural heritage manager at the American Research Center in Cairo, Egypt, directed more than fifty conservation projects (most now completed) over a period of twelve years. He was educated at Yale University and the University of Pennsylvania Law School and pursued a career in archaeological and conservation fieldwork and project management, mostly in the Middle and Near East. For five years he was president of the Institute of Nautical Archaeology at Texas A&M University.

Şehrigül Yeşil Erdek has an undergraduate degree from Mimar Sinan University, Institute for Architectural Restoration, and a graduate degree from Istanbul University's Department of Restoration and Conservation of Artifacts. She specializes in the conservation of mosaics and wall paintings.

Denis Weidmann est archéologue cantonal depuis 1977, responsable du patrimoine archéologique du Canton de Vaud, Suisse, où il est chargé de la protection et de la conservation des sites, de l'organisation des interventions et des études. Après des études classiques et scientifiques et une Licence en sciences naturelles, il mène, depuis 1963, des investigations archéologiques en Suisse et en Égypte (archéologie préhistorique, gallo-romaine, copte, médiévale).

Konstantinos L. Zachos is an archaeologist specializing in Aegean prehistory and Roman archaeology and the region of Epirus. After graduate studies at Boston University, he entered the Greek Archaeological Service. Since 1998 he has been director of the 12th Ephorate of Prehistoric and Classical Antiquities in Ioannina and president of the Scientific Committee of Nikopolis at Preveza. He has excavated widely in Epirus, the Peloponnesus, and, most recently, Albania.

Chiara Zizola is certified in paintings and mosaics conservation from the Istituto Centrale per il Restauro in Rome (ICR). She is a senior conservator and project manager at the Centro di Conservazione Archeologica (CCA), Rome, where she has been employed since 1989. She has led several conservation projects in the Middle East.

List of Conference Participants

Affiliations are given as of the time of the conference.

First name	Last name	Affiliation	Country
Ahmed	Abd Alla Ahmed Ibrahim	Roman Museum, Alexandria	Egypt
Amira	Abou Baker El Khousht	Supreme Council of Antiquities	Egypt
Maria de Fátima	Abraços		Portugal
Carole	Acquaviva	Conservator in private practice	France
Bechir	Al Aloui	Institut National du Patrimoine	Tunisia
Amr Nawar	Al Muayyad Al-Azm	Department of Archaeology, University of Damascus	Syria
Livia	Alberti	Consorzio ARKE	Italy
Eftychia	Alevizou	Aristotle University of Thessaloniki	Greece
Maria Elena	Alfano	Centro Regionale per la Progettazione e il Restauro, Palermo-Sicilia	Italy
Marc	Amouric	Centre National de Recherche Scientifique	France
Aristodemos	Anastassiades	Ministry of Education and Culture	Cyprus
Rana	Andari	Direction Générale des Antiquités, Service des Musées	Lebanon
Paula	Artal-Isbrand	Worcester Museum	USA
Despoina	Asikoglou	Ancient Theatre of Dodoni	Greece
Panayiota	Assimakopoulou-Atzaka	Aristotle University of Thessaloniki	Greece
Zornitsa	Atanassova-Putoux	Association “Devaculture” France-Bulgarie	France
Francesca	Attardo	Soprintendenza per i Beni Archeologici della Toscana.	Italy
Ali	Badawi	Direction Générale des Antiquités, Service des Musées	Lebanon
Britton	Baine	Superstructures Engineers & Architects (SSEA)	USA
Charalambos	Bakirtzis	Ephorate of Byzantine Antiquities of Thessaloniki	Greece
Khaldoun	Balboul	Jericho Institute for Mosaic Restoration	Palestine
Catherine	Balmelle	Centre National de Recherche Scientifique	France
Donna	Beckage	Getty Research Institute	USA
Anthony	Beeson	Bristol Art Library	UK
Fathi	Bejaoui	Institut National du Patrimoine	Tunisia
Jonathan	Bell	Getty Conservation Institute	USA
Aïcha	Ben Abed	Institut National du Patrimoine	Tunisia
Moez	Ben Hassine	Institut National du Patrimoine	Tunisia
Imed	Ben Jerbania	Institut National du Patrimoine	Tunisia
Mohamed Béji	Ben Mami	Institut National du Patrimoine	Tunisia
Habib	Ben Younes	Institut National du Patrimoine	Tunisia
Faouzia	Ben Zahra	Institut National du Patrimoine	Tunisia

First name	Last name	Affiliation	Country
Carla	Benelli	Cooperazione Internazionale Sud Sud	Italy
Abdelkader	Bensallah	Musée de Cherchell	Algeria
Ulrike	Besch	Editor, Infos für Restauratoren	Germany
Philip	Bethell	The National Trust	UK
Sami	Bettahar	Institut National du Patrimoine	Tunisia
Véronique	Blanc-Bijon	Centre National de la Recherche Scientifique	France
Patrick	Blanc	Musée de l'Arles et de la Provence antiques	France
Peder	Boellingtoft	The Royal Danish Academy of Fine Arts	Denmark
Elsa	Bourguignon	Ecole Nationale des Ponts et Chaussées, Laboratoire des Matériaux et Structures du Génie Civil, Paris	France
Nelly	Breuil	Institut National du Patrimoine	France
Rachel	Burch	Conservator in private practice	USA
Jacqueline	Cabrera	J. Paul Getty Museum	USA
Claudia	Cancino	Getty Conservation Institute	USA
Nadia	Chaabane		Tunisia
Mohamed	Chalby		Tunisia
Évelyne	Chantriaux	Atelier de Restauration de Mosaïques de Saint-Romain-en-Gal	France
Moheddine	Chaouali	Institut National du Patrimoine	Tunisia
Jarir	Chbili	Institut National du Patrimoine	Tunisia
Yosra	Chebbi	Institut National du Patrimoine	Tunisia
Eleni	Chrysafi	Aristotle University of Thessaloniki	Greece
James	Cocks	Architectural Resources Group	USA
Neil	Cookson	North East Archaelogical Research	UK
Daniel	Coslett	Davidson College	USA
Marie-Laure	Courboulès	Musée de l'Arles et de la Provence antiques	France
Theodoros	Damianou	12th Ephorate of Byzantine Antiquities	Greece
Jean-Pierre	Darmon	Centre National de la Recherche Scientifique	France
Pamela	Davenport	University of Queensland	Australia
Carmen	Dávila Buitrón	National Archaeological Museum	Spain
Gaël	de Guichen	Consultant in private practice	Italy
Abdelilah	Dekayir	Faculté des Sciences de l'Université de Meknes	Morocco
Martha	Demas	Getty Conservation Institute	USA
Neoptolemos	Demetriou	Paphos Museum	Cyprus
Françoise	Descamps	Getty Conservation Institute	USA
Jarosław	Dobrowolski	American Research Center in Egypt	Egypt
Ioana	Doganis	Lithou Sintirissis, Inc.	Greece
Salvador	Domínguez-Bella	University of Cádiz	Spain
Fouzia	Dridi	Institut National du Patrimoine	Tunisia
Noel	Duval	Université Paris-Sorbonne	France
Khaireddine	El Annabi	Institut National du Patrimoine	Tunisia
Lamia	El Hadidy	Cairo University, Faculty of Archaeology	Egypt
Mongi	Ennaïfer	Institut National du Patrimoine	Tunisia
Pauline	Eveillard	Tufts University	USA
Sabah	Ferdi	Musée de Tipasa	Algeria
Robert	Field	Association Internationale pour l'Étude de la Mosaïque Antique	UK
Verena	Fischbacher	Musée Romain Avenches	Switzerland
Kecia	Fong	Getty Conservation Institute	USA
Roussano	Fontanelli		Italy

First name	Last name	Affiliation	Country
Salma	Frabelsi	Institut National du Patrimoine	Tunisia
Maja	Frankovic	National Museum Belgrade	Serbia and Montenegro
Diane	Fullick	Conservator in private practice	USA
Milun	Garcevic		Croatia
Roberto	Garufi	Centro Regionale per la Progettazione e il Restauro, Palermo-Sicilia	Italy
Fatma	Ghanmi	Institut National du Patrimoine	Tunisia
Astrid	Girardet	RINO Saril	Switzerland
Fred	Girardet	RINO Saril	Switzerland
Tania	Goffee	Superstructures Engineers & Architects (SSEA)	USA
Carmen	Gomez	Conservator in private practice	Spain
José Lourenço	Gonçalves	Museu Arqueologico de S.Miguel de Odrinhas	Portugal
Janet	Grossman	J. Paul Getty Museum	USA
Federico	Guidobaldi	Istituto per la Conservazione e la Valorizzazione dei Beni Culturali, Roma	Italy
Anne-Marie	Guimier-Sorbets	Université Paris X	France
Reham	Haddad	Madaba Mosaics School	Jordan
Riadh	Hadj Saïd	Institut National du Patrimoine	Tunisia
Catreena	Hamarneh	Madaba Mosaics School	Jordan
Osama	Hamdan	Palestinian Mosaic Workshop	Palestine
Mohammed Cherif	Hamza	Musée de Tipasa	Algeria
Mouïd	Hani	Universite Paris-Sorbonne	France
Roger	Hanoune	Université de Lille	France
Mervat	Ha'obsh	Ministry of Tourism and Antiquities	Jordan
Marten	Harris	Association for the Study and Preservation of Roman Mosaics	UK
Marion	Hayes	Atelier de Restauration de Mosaïques de Saint-Romain-en-Gal	France
Antonis	Hiotis	Technological Institute of Athens of Antiquities and Works of Art	Greece
Mohamed Ali	Hnaïni		Tunisia
Işil Rabia	Işiklikaya	Istanbul University	Turkey
Badr	Jabbour Gedeon	Conservator in private practice	Lebanon
Maher	Jbaee	General Directorate of Antiquities and Museums	Syria
Ezzat	Kadous	Alexandria University	Egypt
Elena	Kantareva-Decheva	Eirene On-site Archaeological Museum, Plovdiv	Bulgaria
Samar	Karam	Direction Générale des Antiquités	Lebanon
Khaled	Karaoui	Institut National du Patrimoine	Tunisia
Anna	Karatzani	University College London	UK
Arja	Karivieri	Stockholm University	Sweden
Mustapha	Khanoussi	Institut National du Patrimoine	Tunisia
Kenza	Kharim	Getty Conservation Institute	USA
Nidal	Khatib	Jericho Institute for Mosaic Restoration	Palestine
Zoi	Kobogiannopoulou	Traditional Museum of Larisa	Greece
Hande	Kökten	Ankara University	Turkey
Myriam	Krieg	Hochschule der Kunste	Switzerland
Hajer	Krimi	Institut National du Patrimoine	Tunisia
Maria	Krini	Hellenic Ministry of Culture	Greece
Laurence	Krougly	Conservator in private practice	France
Hassan	Limane	Institut National des Sciences de l'Archeologie et du Patrimoine	Morocco
Bettina	Lucherini	Soprintendenza per i Beni Archeologici della Toscana.	Italy
Alessandro	Lugari	Soprintendenza Archeologica di Roma	Italy
Cynthia	Luk	Williamstown Art Conservation Center	USA

First name	Last name	Affiliation	Country
Michele	Macchiarola	Consiglio Nazionale delle Ricerche, Istituto di Scienza e Tecnologia dei Materiali Ceramici	Italy
Luda	Mahfoud	General Directorate of Antiquities and Museums	Syria
Amina	Malek	Centre National de Recherche Scientifique	France
Antonia	Mangou	Ministry of Culture	Greece
Elizavet	Mantzana	Ministry of Culture	Greece
Ze'ev	Margalit	Israel Nature and Park Authority	Israel
Pelagia	Mastora	9th Ephorate of Byzantine Antiquities	Greece
Katerina	Mavrommati	Ministry of Culture	Greece
Hela	Mekki	Institut National du Patrimoine	Tunisia
Jose Manuel	Melchor Monserrat	Museo de Prehistoria, Corona	Spain
Guido	Meli	Centro Regionale per la Progettazione e il Restauro, Palermo-Sicilia	Italy
Demetrios	Michaelides	University of Cyprus	Cyprus
Julian	Molteno	Association for the Study and Preservation of Roman Mosaics	UK
J. Magdalena	Monraval	Archaeologist/Conservator	Spain
Derram	Mouloud	Musée National des Antiquités d'Alger	Algeria
Houda	Moussa	General Directorate of Antiquities and Museums	Syria
Jesus	Moya	University of the Basque Country	Spain
Roberto	Nardi	Centro di Conservazione Archeologica	Italy
Andreina	Nardi-Costanzi Cobau	Centro di Conservazione Archeologica	Italy
Jacques	Neguer	Israel Antiquities Authority	Israel
Meliha Ceren	Odabasoglu	Conservator in private practice	Turkey
Jean	Olives	Centre National de la Recherche Scientifique	France
Mohamed Badr	Osman Aly	Supreme Council of Antiquities	Egypt
Anastasia	Panagiotopoulou	5th Ephorate of Prehistoric and Classical Antiquities	Greece
Elias	Papadopoulos	12th Ephorate of Byzantine Antiquities	Greece
Christina	Papakyriakou	Aristotle University of Thessaloniki	Greece
Ewa	Parandowska	National Museum in Warsaw	Poland
Maria	Parani	University of Cyprus	Cyprus
Trinidad	Pasies Oviedo	Museo de Prehistoria, Valencia	Spain
Lorella	Pellegrino	Centro Regionale per la Progettazione e il Restauro, Palermo-Sicilia	Italy
Miran	Pflaum	National Museum of Slovenia	Slovenia
Andreas	Phoungas	Atelier de Restauration de Mosaïques de Saint-Romain-en-Gal	France
Adeline	Pichot	Université de Lausanne, Institut d'Archeologie et des Sciences de l'Antiquité	Switzerland
Robin	Piercy	Institute of Nautical Archaeology	Turkey
Francesca	Piqué	Conservator in private practice	Italy
Nikolaos	Pitsalidis	9th Ephorate of Byzantine Antiquities	Greece
Anastasia	Pliota	Aristotle University of Thessaloniki	Greece
Konstantinos	Politis	Hellenic Society for Near Eastern Studies	Greece
Zahra	Qninba	Institut National des Sciences de l'Archeologie et du Patrimoine	Morocco
Giancarlo	Raddi delle Ruote	Opificio delle Pietre Dure di Firenze	Italy
Maria del Carmen	Rallo Gruss	Ministerio de Cultura	Spain
Konstantinos	Raptis	9th Ephorate of Byzantine Antiquities	Greece
Samir	Rebeiz	Lebanese Center for Conservation and Restoration Studies	Lebanon
Amida	Rhouma	Institut National du Patrimoine	Tunisia
Thomas	Roby	Getty Conservation Institute	USA
Luca	Rocchi	Opificio delle Pietre Dure di Firenze	Italy
Elyas	Saffaran	Share-Kord University	Iran

First name	Last name	Affiliation	Country
Mustafa	Sahin	Uludag University	Turkey
Ghada	Salem	Conservation s.a.r.l.	Lebanon
Eduardo	Sanchez	J. Paul Getty Museum	USA
Niki	Savvides	ICCM Secretariat, University of Cyprus	Cyprus
Yasar Selçuk	Şener	Ankara University	Turkey
Kent	Severson	Conservator in private practice	USA
Tagreed	Shaaban	University of Damascus	Syria
Maurice	Simon	Atelier de Restauration de Mosaïques de Saint-Romain-en-Gal	France
Isabelle	Skaf	Atelier Conservation	Lebanon
Sonia	Slim Hadj	Institut National du Patrimoine	Tunisia
Nacer	Soltani	Institut National du Patrimoine	Tunisia
Nicholas	Stanley-Price	ICCROM (International Centre for the Study of the Preservation and Restoration of Cultural Property)	Italy
John	Stewart	English Heritage	UK
Alexandros	Stratis	Ministry of Culture	Greece
Sappho	Tambaki	Aristotle University of Thessaloniki	Greece
Laura Melpomeni	Tapini	Conservator in private practive	Greece
Jeanne Marie	Teutonico	Getty Conservation Institute	USA
Hanaa Mohamed	Tewfik	Alexandria Museum	Egypt
Sarah	Thoelen	Academy of Antwerp	Belgium
Carrie	Tovar	J. Paul Getty Museum	USA
Sibylla	Tringham	Courtauld Institute of Art	UK
Caroline Mei-An	Tsu	Museum of Fine Arts, Boston	USA
Fusun	Tulek	Kocaeli University	Turkey
Stiliani	Vasiliadou	9th Ephorate of Byzantine Antiquities	Greece
Robert	Vincent	American Research Center in Egypt	Egypt
Alain	Wagner	Musée Romain- Avenches	Switzerland
Georgette	Webb	Association for the Study and Preservation of Roman Mosaics	UK
Denis	Weidmann	Archéologie Cantonale, Vaud	Switzerland
Timothy	Whalen	Getty Conservation Institute	USA
Patricia	Witts	Association Internationale pour l'Étude de la Mosaïque Antique	UK
Julie	Wolfe	J. Paul Getty Museum	USA
Şerhigül	Yeşil Erdek	Istanbul University	Turkey
Konstantinos	Zachos	Greek Archeological Service	Greece
Yosra Selcuk	Zalita	Institut National du Patrimoine	Tunisia
Chiara	Zizola	Centro di Conservazione Archeologica	Italy
Karima	Zoghlami	Institut National du Patrimoine	Tunisia

Errata for *Lessons Learned: Reflecting on the Theory and Practice of Mosaic Conservation*

PAGE 185
Figure 2. Courtesy Society of Antiquaries, London.

PAGE 210
Figure 4. Courtesy of Ramboll.