



Cistercian Pavements from Santa Maria de Alcobaça Abbey: first examples of tin-glazed tiles in Portugal

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SUMMARY: *The Mosteiro de Alcobaça (Alcobaça Monastery, founded in 1153) was built to the image of Clairvaux Abbey, founded by the Cistercian abbot St. Bernard. In many ways Alcobaça mirrored the original concepts of the Cistercian Order, with an austere architectural style and shedding signs of richness. The glazed tiles found on the pavement of the deambulatory and some adjacent chapels are some of the first examples of lead-tin glazes in Christian Portugal.*

For the first time, these tiles were analytically characterized, to determine their chemical composition, production technology and decoration technique. The analytical techniques used were μ -PIXE (particle-induced X-ray emission), SEM-EDS (scanning electron microscopy with energy-dispersive X-ray spectrometry), and μ -Raman spectroscopy.

KEY-WORDS: *Cistercian Order, Alcobaça, tin-glaze technology*



CISTERCIAN PAVEMENTS FROM SANTA MARIA DE ALCOBAÇA ABBEY: FIRST EXAMPLES OF TIN-GLAZED TILES IN PORTUGAL

The Mosteiro de Alcobaça (Alcobaça Monastery, founded in 1153) was built to the image of Clairvaux Abbey, founded by the Cistercian abbot St. Bernard. In many ways Alcobaça mirrored the original concepts of the Cistercian Order, with an austere architectural style and shedding signs of richness. The glazed tiles found on the pavement of the deambulatory and some adjacent chapels are some of the first examples of lead-tin glazes in Christian Portugal.

The technology used should be a testimony of mixing cultures, with the tradition of the Cistercian Order in terms of materials and techniques, but also the Islamic tin-glaze technology which was brought to the Iberian Peninsula in the 10th century.

These medieval tiles, all monochromatic, are believed to be 13th century examples and possess varied geometrical patterns (figure 1). They are decorated with lead glazes, some of them opaque lead-tin glazes. Although lead glazes have been extensively used in medieval pavements in North-Western Europe, the presence of opaque tin-glazes is much scarcer. On the other hand, most of the oldest surviving examples of tin-glazed pavement tiles in Europe belong to Cistercian Abbeys.

For the first time, these tiles were analytically characterized, to determine their chemical composition, production technology and decoration technique. The analytical techniques used were μ -PIXE (particle-induced X-ray emission), SEM-EDS (scanning electron microscopy with energy-dispersive X-ray spectrometry), and μ -Raman spectroscopy.

Samples selected for this study comprise all colours observed in Alcobaça tiles: white, amber, dark brown and several shades of green, including turquoise. Tin was identified in all glazes, although only white and turquoise ones show high amounts (ca. 5-20 wt. %). These are not homogenous glazes, showing tin agglomerates of various sizes and mineral inclusions. In green transparent glazes ($\text{SnO}_2 < 2$ wt.%), a white layer is observed between the glaze and the ceramic body, consistent with the use of a slip. This layer is mostly composed by potassium feldspars, as identified by μ -Raman.

The chemical analysis of the ceramic body identified a SiO_2 -rich composition, followed by high amounts of Al_2O_3 . These two oxides make up for ca. 83-93 wt.% of the total composition. Iron and potassium oxides are also present in amounts which do not exceed 5 wt.% each. Calcium contents are very low, mostly inferior to 3 wt.%, but there are two samples with 5 and 7 wt.% CaO. The ceramic body of these tiles is very thick (ca. 40 mm) and present different colours, as they show both orange/red and dark grey areas in the same tile. This is probably related to alterations in the atmosphere (oxidizing/reducing) of the kiln during firing.

These results will be compared with the lead-tin glaze technology of the time and the scarce studies on the Cistercian Order. With the opportunity to study such a unique collection, the patterns exhibited are also being systematized, and compared to other Cistercian monuments. The conservation state of these tiles is being assessed.

