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Composition of Byzantine glasses from Umm el-Jimal, northeast Jordan: Insights into glass origins and recycling

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ABSTRACT

Twenty glass samples collected from four structures at Umm el-Jimal, northeast Jordan were analysed using the electron probe microanalysis (EPMA). Except one ash-soda-lime-silica glass, all were natron soda-lime-silica glasses of Levantine origin. Most of the glasses compositionally resemble glass from the Byzantine tank furnaces at Apollonia-Arsuf (Arsuf), but four with lower lime are closer to Umayyad period production at Bet Eli'ezer (Hadera). The paper presents diagnostic information indicating recycling in a diagnostic recycling table (DRT) in which the analyses are ranked in a descending order of K_2O , a key contaminant in the recycling process. This allows the comparison of a range of contaminant elements and it is observed that in general glass contaminated with fuel ash components K_2O , P_2O_5 and CaO are also richer in transition metal oxides CuO , PbO , FeO and MnO , confirming that both sets of elements are important in identifying recycled glass. Chlorine is also identified as a component modified by recycling. The results ascertain that Umm el-Jimal was part of a major system of glass recycling in the Byzantine period, and emphasise the importance of recycled glass in its supply, in spite of its relative proximity to the location of raw glass production on the Syro-Palestinian coast.

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1. Introduction

The archaeological site of Umm el-Jimal is located in the north-east part of Jordan near the border with Syria (Fig. 1). Ancient Umm el-Jimal is built with the black (dark grey) basalt rock of Har-rat asham, which covers the area to the east of the site [1]. Four (Nabataean, Roman, Byzantine and Umayyad) cultures resided in the city for about 700 years and left behind them many of their structures including houses, temples, towers, churches, cemeteries, water cisterns, etc. [2,3]. These structures are located in different parts of the site while the cemeteries surround the site from three directions: the north, east and west. Excavations in the past years at three of the site's structures (the Cathedral, the Theophilus or double church and the Saint Maria church) and the north cemetery uncovered glass remains among other archaeological materials. The glasses were dated to the Roman, Roman-Byzantine and Byzan-

tine periods depending on the pottery and coins found in the same contexts.

Byzantine glass samples were selected for chemical analysis in this pioneer study to examine the glassmaking technology during the early (AD324–491) and late (AD491–636) Byzantine period at Umm el-Jimal and compare it to the glassmaking technology of the north Jordan area during the same period. The study explores whether the geographic location of Umm el-Jimal was part of a regional system of glass production and distribution during the Byzantine period.

2. Samples and structures

A set of 20 samples dated to the Byzantine period was selected for analysis from the four features mentioned below. One sample (sample 15) is green, while the rest of the samples vary in their colors from light to bluish to olive green (Table 1 reports a brief description of the samples).

2.1. The Cathedral

The cathedral is the largest church at the site and located at the site's center to the south of Commodus gate. Based on an inscription

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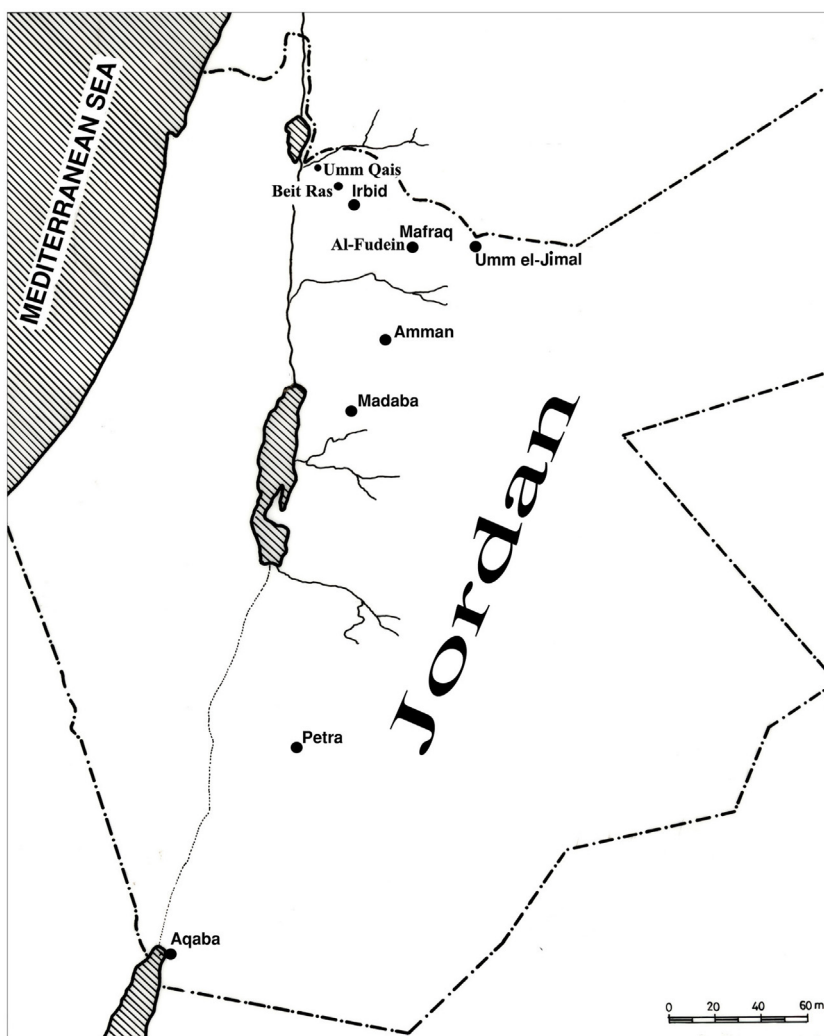


Fig. 1. Location map.

found upon the fallen cap of one of the piers of the apse arch, it was dated back to the sixth century AD (AD 556). The Cathedral has a nave, two aisles, adjoining room at the east end of the north aisle and eight entries (three are at the west wall and three are at the north wall, while two are at the east wall) [2: p.183]. Glass samples were excavated from the Baptistry of the Cathedral after the removal of thick layers of around 2 meters of rubble, debris and dirt. The glass artefacts were found on the ground of the Baptistry and its niches. In addition, Byzantine and some Umayyad lamps were uncovered from the same contexts. Samples 2, 3, 10, 17 were collected from the Cathedral (Table 1).

2.2. The Double church (or Theophilus)

The Double church is formed of two adjacent churches separated by a wall of two joint entries; the north basilica and the south hall church. The construction of the double church was dated to the sixth century AD based on its architecture and archaeological materials found in it, although it was reused in later periods [2]. It is located at the southeastern part of the site and quite surrounded by houses. During 2012–2013 excavations at the south hall church, an inscription of Theophilus written on the mosaics was uncovered; therefore, it was also named Theophilus church. The studied glass samples were dated to the Byzantine period based on the dates of ceramics, lamps, etc. that were collected during the same

excavations. The distinguished feature of this hall church is that its chancel screen was built with burnt bricks. Samples 4, 5, 6, 18, 19, 20 were selected from the Theophilus church (Table 1).

2.3. Saint Maria church (chapel)

The church is a small chapel of an entrance in its southern wall. An inscription of Agia Maria on a stone at its southern entrance was the reason to give it this name. Glass, tesserae, ceramics and lamps were uncovered during salvage excavations in 2012 and 2013 seasons. Because of the considerable amount of Umayyad ceramics found along with the Byzantine ceramics during the excavations, the chapel was dated by the site's excavator (Al-Housan) to the Late Byzantine–Early Umayyad period. Samples 7, 9, 12, 14, 15 were selected from Saint Maria church (Table 1).

2.4. The North cemetery

The North cemetery is located in the northeast part of the archaeological site and extends outside the city fence in certain points. It is suggested that it was used for seven centuries (1st–7th century AD) according to the ceramics, lamps and inscriptions uncovered from the tombs. The tombs are about 2–2.5 m deep, built and corbelled with basalt blocks and slabs. Some tombs have remnants of wooden coffins, where few of them were lined with bronze

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