Ceramics International 43 (2017) 2182–2187

Contents lists available at ScienceDirect

Ceramics International

journal homepage: www.elsevier.com/locate/ceramint

Production technology and provenance study of brittle wares belonging to the late roman period from Harabebezikan/Turkey

Ali İssi[a,*], Melih Özçatal[b], Alpagut Kara[c], Ahmet Oğuz Alp[d]

[a] Dumlupınar University, Department of Materials Science and Engineering, Kütahya, Turkey
[b] Afyon Kocatepe University, Department of Metallurgical and Materials Engineering, Afyonkarahisar, Turkey
[c] Anadolu University, Department of Materials Science and Engineering, Eskişehir, Turkey
[d] Anadolu University, Department of Art History, Eskişehir, Turkey

ARTICLE INFO

Keywords:
Brittle Ware
Pottery
Technology
Provenance
Archaeometry
Characterization

ABSTRACT

This study represents analyses of Brittle Ware sherds dated back to the Late Roman period found in the Harabebezikan Mound (Şanlıurfa/Turkey). Wavelength dispersive X-ray fluorescence (WDXRF) was performed for chemical analysis, X-ray diffraction (XRD) was performed for mineralogical and phase analysis. Scanning electron microscopy (SEM) in combination with energy dispersive X-ray spectrometry (EDX) was performed for microstructural characteristics and microchemical analysis of 37 sherds. Chemical analysis results concluded two major groups of potteries. Raw materials used for the production, firing temperatures and conditions for the pottery sherds were discussed in the study. The results were compared to the previous studies from other Brittle Ware production centers.

1. Introduction

Favorite topics to study related to archaeological ceramics are production technology, provenance and dating. These topics are the answers to some archaeological questions such as I: how they were produced, II: where they were produced and III: when they were produced. The production technology studies of archaeological ceramics attempt to enlighten the initial raw material composition and other related processes of the production like firing temperature and atmosphere. The provenance studies of archaeological ceramics contribute to the knowledge about the old trade routes generated by past civilizations or confirm the production centers [1–3]. And also, it is quite important to know when all this happened in the past exactly by dating methods primarily based on thermoluminescence (TL) of archaeological ceramics and other dating methods [4]. This study represents detailed results of pottery production technology and the provenance of Brittle Wares excavated from the Harabebezikan Mound (Şanlıurfa/Turkey). The Harabebezikan Mound is located on the east bank of the Euphrates River in the Southeastern Turkey and 8 km north of the famous site of Carchemish and Turkish-Syrian border. Due to the construction of the Carchemish Dam, in 1999, shortly before the reservoir filling, an archaeological salvage project was carried out at the mound [5]. Archaeological excavations have shown that the mound was occupied from the Early Bronze Age to the Late Roman-Early Byzantine periods. The potteries and small findings indicated that the settlement may have been abandoned later in 7th century AD.

Brittle Wares are red or red-brown pottery wares, which can be easily distinguished from other contemporary wares by their fabric, surface colors and shape. They were produced from the Roman times to the Early Islamic periods in Syria, Jordan and Palestine. Northern Syria was one of the well-known distributions and production centers. Most of Brittle Wares in this study were obtained from the Late Roman levels in summit trenches and surface of the mound. It was noted that Brittle Wares were produced with non-calcareous clays and tempered heavily with minerals such as quartz, mica, feldspar, etc [6]. Two archaeometrical studies on the chemical and mineralogical analysis of Brittle Ware have been conducted in the last decade. The first archaeometrical study was carried out by Bartl and her colleagues. They have analyzed samples from different sites on the Euphrates, Khabur and Balikh river valleys in northern Syria and concluded five groups of pottery using X-ray fluorescence spectroscopy and thin section microscopy [7]. The second archaeometrical study was carried out by Schneider and his colleagues. The chemical analysis revealed the existence of six groups in Syria. One of these has been identified as situated towards the west of Aleppo, and another in the area of Apamea; and the other two which are in further east [8]. Discrimination of groups or workshops on ceramics concluded with different characterization techniques considering the variation in

* Correspondence to: Dumlupinar University, Faculty of Engineering, Department of Materials Science and Engineering, Evliya Celebi Campus, 43100 Kutahya, Turkey.
E-mail address: ali.issi@dpu.edu.tr (A. İssi).

http://dx.doi.org/10.1016/j.ceramint.2016.11.001
Received 13 October 2016; Received in revised form 31 October 2016; Accepted 1 November 2016
Available online 02 November 2016
0272-8842/

content of elements (mainly in chromium), mineralogical contents of the bodies such as clay type (calcareous/non-calcareous, iron rich/poor) and inclusions in fabric of sherds (calcareous/micaceous/siliceous) [7,8]. Unfortunately, no archaeometrical study was done on samples found in the archaeological excavations along the Euphrates River in Turkey. This study focuses on chemical, mineralogical/phase contents and microstructural characteristics of Brittle Wares from Harabebezikan/Turkey.

2. Materials and methods

2.1. Archaeological samples

Representative images of potsherds investigated in this study are given in Fig. 1. They belong to the rims of cooking pots and table wares. The body colors of Brittle Wares range from red to reddish-brown. The color of exterior surfaces ranges from beige to reddish-brown.

2.2. Methods

Determined parts of potsherds have been cut by diamond cutting discs and 1.5–2 gr of samples were obtained. Surfaces of samples have been abraded by SiC grinding papers and cleaned bodies were staying for two days in deionized water to remove impurities from burial deposition. Powders of the samples were prepared in an agate mortar in order to be analyzed by WDXRF and XRD techniques. The Rigaku ZSX primus instrument was used for chemical analysis of major, minor and some trace elements. Glass tablets were prepared by fluxing for the measurement with a ratio of 1:10 powder:$Li_2B_4O_7$ (wt%). The results were normalized into weight%. Calibration procedure of the instrument has been performed over 15 international standards of clays and geological samples. Due to instrumental detection limits, the results

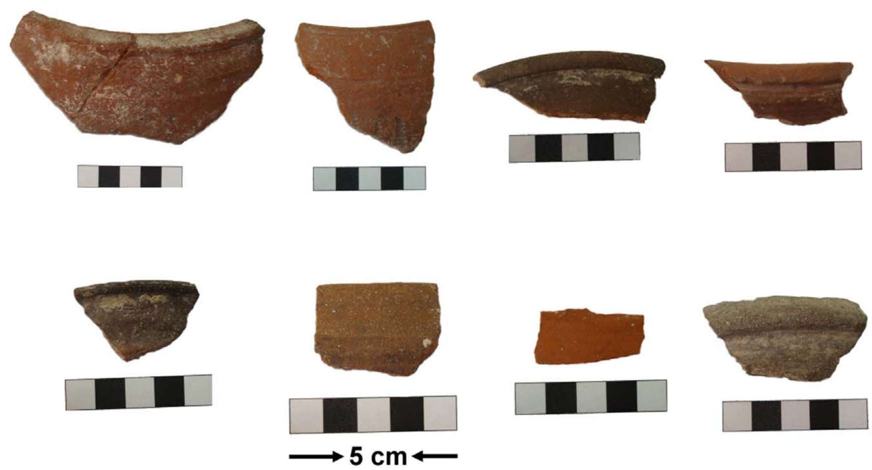

Fig. 1. The images of some selected Brittle Wares. (For interpretation of the references to color in this figure, the reader is referred to the web version of this article).

Table 1
WDXRF results of Brittle Wares belonging to group A.

	Samples											
Oxides	1	3	4	5	6	7	12	13	15	16	17	20
Na_2O	0.2147	0.2554	n.d.*	0.3010	0.3883	n.d.	n.d.	n.d.	0.2508	0.3371	0.1371	n.d.
MgO	1.0953	1.0084	0.9575	1.2906	0.9438	0.9283	1.0040	0.8724	1.0382	0.9736	0.9802	0.9927
Al_2O_3	17.4270	16.2728	17.0163	17.9896	17.7335	16.5010	17.3692	17.8737	17.2635	16.4379	17.6493	17.4853
SiO_2	66.0417	68.9682	67.8238	64.7478	65.6674	69.0851	66.8963	66.6264	67.7091	67.9157	67.0015	67.1228
P_2O_5	0.1341	0.1545	0.1255	0.1185	0.1398	0.1122	0.1689	0.1530	0.1153	0.1204	0.1230	0.1624
SO_3	0.0420	n.d.	0.0246	0.0507	0.1488	0.0327	n.d.	0.0252	0.0116	0.0316	0.0129	n.d.
CI	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	0.0382	n.d.	n.d.
K_2O	1.5433	1.4516	1.3529	2.3494	2.0786	1.2284	1.4091	1.4142	1.2508	1.8012	1.3827	1.4473
CaO	2.4692	1.4130	1.4703	1.8380	1.2636	1.3786	1.5589	1.5110	1.3058	1.5828	1.4047	1.3423
TiO_2	1.1529	1.1979	1.3471	1.2627	1.3992	1.3474	1.3772	1.4277	1.3531	1.4381	1.2948	1.4303
V_2O_5	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Cr_2O_3	0.1409	0.1605	0.1611	0.1459	0.1485	0.1285	0.1525	0.1540	0.1508	0.1518	0.1362	0.1531
MnO	0.1870	0.1940	0.2047	0.1821	0.2586	0.1739	0.1937	0.2093	0.2071	0.1441	0.1832	0.2420
Fe_2O_3	9.4105	8.7382	9.2992	9.5733	9.6198	8.9300	9.6984	9.5524	9.1657	8.8843	9.4952	9.4697
Co_2O_3	n.d.	n.d.	n.d.	0.0071	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
NiO	0.0391	0.0403	0.0415	0.0337	0.0486	0.0379	0.0402	0.0359	0.0374	0.0376	0.0411	0.0356
CuO	0.0137	0.0186	0.0162	0.0170	0.0155	0.0173	0.0177	0.0161	0.0154	0.0148	0.0206	n.d.
ZnO	0.0231	0.0198	0.0401	0.0202	0.0221	0.0374	0.0208	0.0171	0.0127	0.0193	0.0165	0.0167
Rb_2O	n.d.	0.0478	0.0550	n.d.	0.0581	n.d.	0.0338	0.0494	0.0501	n.d.	0.0611	0.0387
SrO	0.0202	0.0096	0.0131	0.0305	0.0169	0.0122	0.0139	0.0116	0.0123	0.0224	0.0114	0.0140
ZrO_2	0.0454	0.0492	0.0512	0.0419	0.0488	0.0492	0.0455	0.0507	0.0503	0.0491	0.0484	0.0471
BaO	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
SnO_2	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Nb_2O_5	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Total	100.0001	99.9998	100.0001	100.0000	99.9999	100.0001	100.0001	100.0001	100.0000	100.0000	99.9999	100.0000

n.d.*: Not detected or below detection limits.