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ORIGINAL PAPER

Common ware production at *Thamusida*: dating and characterisation of Roman and Islamic pottery

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Abstract Twenty-one samples of likely Roman, likely Islamic and unknown common ware from the archaeological site of *Thamusida* (Rabat, Morocco) were analysed in order to anchor selected types of pottery to a limited time span and, possibly, to a production area and technology. Analytical techniques were thermoluminescence, optical microscopy, scanning electron microscopy and X-ray fluorescence. The results arising from this research are definitely useful for the study of the site of *Thamusida* as well as for all researchers involved in archaeological and archaeometrical research in Morocco. Chronologies proposed on a typological base have been denied twice: a likely Islamic cup dates back to the second century A.D.; vice versa, a stewpot, framed into the Roman period, resulted to be an eighth century A.D. production. Moreover, the identification of an eighteenth century ceramic production is of outstanding importance, as it characterises a completely unknown production. Regarding the production area, four samples of both Roman and Islamic periods have been recognised as local productions of *Thamusida*.

Keywords Roman tableware · Islamic tableware · Ceramic · *Thamusida* (Morocco)

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Archaeological background and issues

In the frame of a comprehensive study of archaeological findings from *Thamusida* (Rabat, Morocco), common ware of both Roman and Islamic periods deserves a special attention. The archaeological investigations brought to light both pottery and production plants, offering a privileged situation for studying ceramic production and imports (Camporeale 2008; Cerri 2008).

On the other hand, the study of common ware has been often neglected, yet favouring well-known and informative ceramic categories such as Roman *terra sigillata* or Islamic glazed pottery. Archaeological studies on excavations performed in Morocco examined common ware from defined stratigraphical context only occasionally. Very few typological studies stand for comparison, making hard to indicate a precise chronological framework for this ceramic production or even to distinguish Roman common ware from Islamic one.

References are currently available for findings from the necropolis of *Sala* (Rabat, Morocco), for the archaeological sites *Thamusida* (Rabat, Morocco), *Lixus* (Larache, Morocco), Qsar es-Seghir and al-Basra and for the territories of Qsar es-Seghir, al-Basra, Badis, Madinat En-Nakur, Jebila and Moulay Bou Selham (Fig. 1).

Ceramic materials from the Roman tombs at *Sala* were studied by J. Boube (1999); however, a typology is lacking

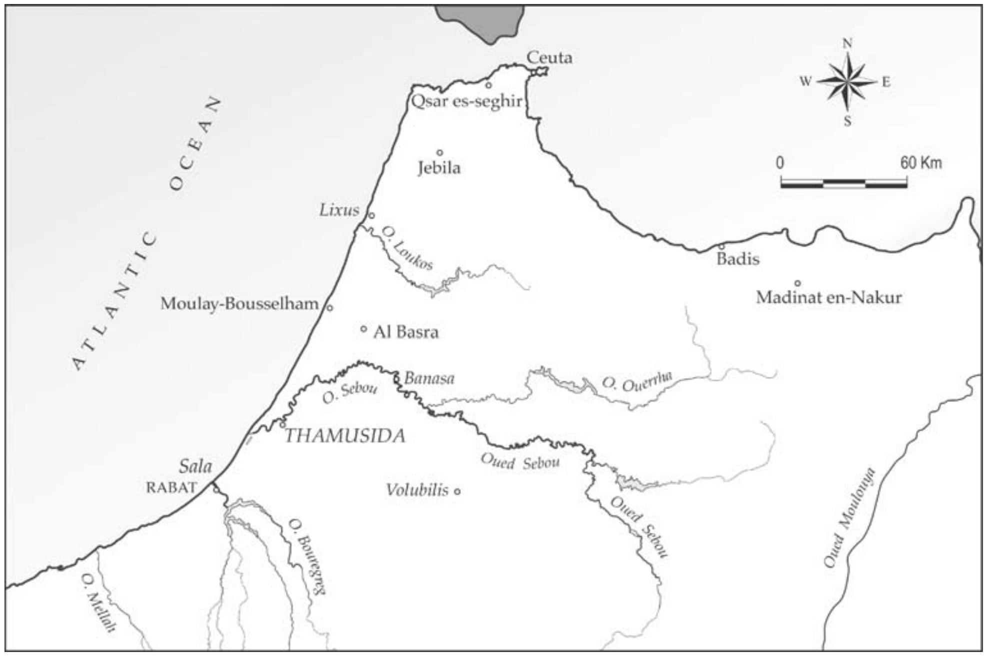

Fig. 1 Geographical map of northern Morocco where archaeological sites cited in text have been indicated

and most of objects are generically indicated as cinerary urns only. The systematic study performed on common pottery from the archaeological investigations of *Thamusida* (D'Aco 2005) offers a vast and articulated collection of vase morphologies and types with a known chronology. The investigations conducted on the archaeological site of *Lixus* were mainly focused on Phoenician, Mauro and Roman periods; nevertheless, a typological study of Islamic pottery, especially of Almohad period (twelfth–thirteenth century A.D.) was performed, even though leaving a part the most part of the non-coated productions (Aranegui Gascó 2001, 2005). The publication of the archaeological excavation of Qsar es-Seghir (Redman et al. 1977–1978, 1979–1980) included a study on medieval pottery (Redman 1979–1980) where numerous Islamic and Portuguese decorated and glazed productions were described. Redman (1983–1984) further provided some plates showing numerous types of pottery (including tableware and cooking ware) found during the archaeological excavations and landscape examination of the Islamic sites of Qsar es-Seghir, al-Basra, Badis, Madinat En-Nakur, Jebila and Moulay Bou Selham. Lastly, the ceramic materials from al-Basra, the chief town of Morocco under the Idrisid dynasty (eight–tenth century A.D.), were studied by Benco (1987, 2002).

Hence, the state of the archaeological research on common ware from Morocco is in the very early stage, rarely providing information on the most common and diffused class of pottery of both Roman and Islamic world. Furthermore, it is worth considering that political and economic relationships between the above listed sites and *Thamusida* are only partially known, for Roman age almost exclusively.

In the context of archaeometric research, chemical and mineralogical–petrographical reference groups for local Moroccan productions are limited to the archaeological sites of Ceuta (Roman stamped bricks; Bernal Casasola 1994) and *Thamusida* (Roman bricks and amphoras, Islamic bricks; Gliozzo and Camporeale 2009; Gliozzo and Cerri 2009). Chronological measurements have never been performed for the ceramic class under investigation.

By the way, the chronological limits stated of Islamic period in Morocco must be preliminary clarified. At *Thamusida*, the beginning of the post-Roman age could correspond to the north transfer of the *limes*, which provoked the abandon of the camp in the last quarter of the third century A.D. (Sigman 1977; Decret and Fantar 1981; Villaverde Vega 2001). In the same period, the Vandals arrived in Morocco from the Iberian peninsula (429 A.D.), but they were defeated by *Belisarius* in 533 A.D., leading to the annexation of Morocco to the Byzantine Empire. However, based on chronology proposed by Lugan (2000), the Islamic age starts in 683 A.D. when Uqba ibn Nafi conquered the north African coastal plain.

In light of these preliminary remarks, the research is aimed at providing an insight on Roman and Islamic common ware in order to anchor selected types of pottery to a limited time span and, possibly, to a production area and technology. Chronological issues are thus strictly linked to provenance and technological issues for a complete characterisation of the whole sample set.

Materials and methods

Considering the stated objectives, a total of 21 samples were selected based on proposed chronology and typology

(Table 1 and Fig. 2). Three sample sets were enucleated: likely Roman, likely Islamic, unknown. The latter group includes vessels that cannot be considered of Roman age but available references do not allow comparison with Islamic productions. Within each group, those vessel types more frequently attested in the territory of *Thamusida* were selected.

Six samples are likely of Roman age and include two bottles, one jug, two stewpots and one jar. Morphologically, they can all be compared to objects found in the necropolis of *Sala* (Boube 1999). The two selected bottles, D2074 and D2077, resemble the morphology of the *olpai* found in numerous tombs (Boube 1999, p. 117, Fig. U) and that of the *lekythos* found in tomb no. 3 (Boube 1999, p. 117, Fig. U and p. 213), respectively. The former were dated to the Flavian age; the latter between the Claudian and Flavian dynasties. The jug D2076 can be compared to the urn found in tomb no. 186, dated between the age of Nero and that of Vespasian (Boube 1999, p. 46, Fig. E^3, S. 186 and p. 384–385). Among stewpots, D2075 and D2078 are for cooking, whilst the jar D2079 is for storage. D2075 shows a flared rim, similar to that of urn found in tomb no. 310 and dated back to the mid second century A.D. (Boube 1999, p. 47, Fig. E^4, S. 310 and p. 486). D2078 shows a very popular shape that derived from Hellenistic tradition and was widely diffused in Roman age in all Mediterranean world. Lastly, D2079 partially resembles the shape of the urn found in tomb no. 105, dated back to the Claudian/Vespasian age (Boube 1999, p. 46, Fig. E^3, S. 105 and p. 303).

Five samples are likely of Islamic age and include one cup, three jugs and one basin. Typological comparisons with pottery found in archaeological sites of Islamic age are never decisive. The shape of the rim of cup D2067 is similar to that of a cup found at Badis (Redman 1983–1984, p. 338, Fig. 26h). The jugs D2069, D2071 and D2072 can be all compared to different types of "storage jars" found at the site of al-Basra; in particular, D2069 is similar to shape no. 43, D2071 and D2072 to shape no. 41 (Benco 2002, p. 336, Fig. 11g–h and p. 336, Fig. 11a–c). Proposed chronology for these fragments ranges from the sixth to the ninth century A.D. for the former, between the tenth and eleventh century A.D. for the latter (Benco 2002, p. 307 and pp. 320–323). Lastly, the basin D2073 find a reasonable comparison with a basin from the archaeological site of Badis (Redman 1983–1984, p. 338, Fig. 26).

Ten samples are of unknown chronology and include three basins, four cups, two pans and one jug. For these fragments, any attempt of typological comparison fails. Selection was made based on different morphologies (cup, basin, etc.) and, within each type of morphology, types. Considering the conservation state of the examined collection, the shape of the rim was used as a principal selection criterion: brimmed in D2081 and D2085, retracted brim in D2086 and D2087, moulded in D2082 and D2089, indistinct in D2083 and D2084, thickened in D2088, flanged in D2090.

Table 1 Sample list and description

	Sample	Shape	Type	Proposed chronology	TL	XRF	OM/SEM
Likely Roman	D2074	Bottle	63	Second half 1st cen. A.D.	X	X	X
	D2075	Stewpot	156	Mid 2nd cen. A.D.	–	X	
	D2076	Jug	46	Second half 1st cen. A.D.	X	X	X
	D2077	Bottle	60	Second half 1st cen. A.D.	X	X	X
	D2078	Stewpot	148	Roman age	X	X	X
	D2079	Jar	114	Second half 1st cen. A.D.	–	X	
Likely Islamic	D2067	Cup	84	Islamic	X	X	X
	D2069	Jug	38	6th–9th cen. A.D.	X	X	X
	D2071	Jug	41	10th–11th cen. A.D.	X	X	X
	D2072	Jug	52	10th–11th cen. A.D.	X	–	X
	D2073	Basin	6	Islamic	–	X	
Unknown	D2081	Basin	31	–	–	X	
	D2082	Basin	30	–	–	X	
	D2083	Cup	80	–	X	–	X
	D2084	Basin	17	–	X	X	X
	D2085	Cup	77	–	X	X	X
	D2086	Cup	129	–	X	X	
	D2087	Pan	135	–	–	X	X
	D2088	Cup	81	–	X	X	
	D2089	Jug	49	–	–	X	
	D2090	Pan	138	–	X	X	X

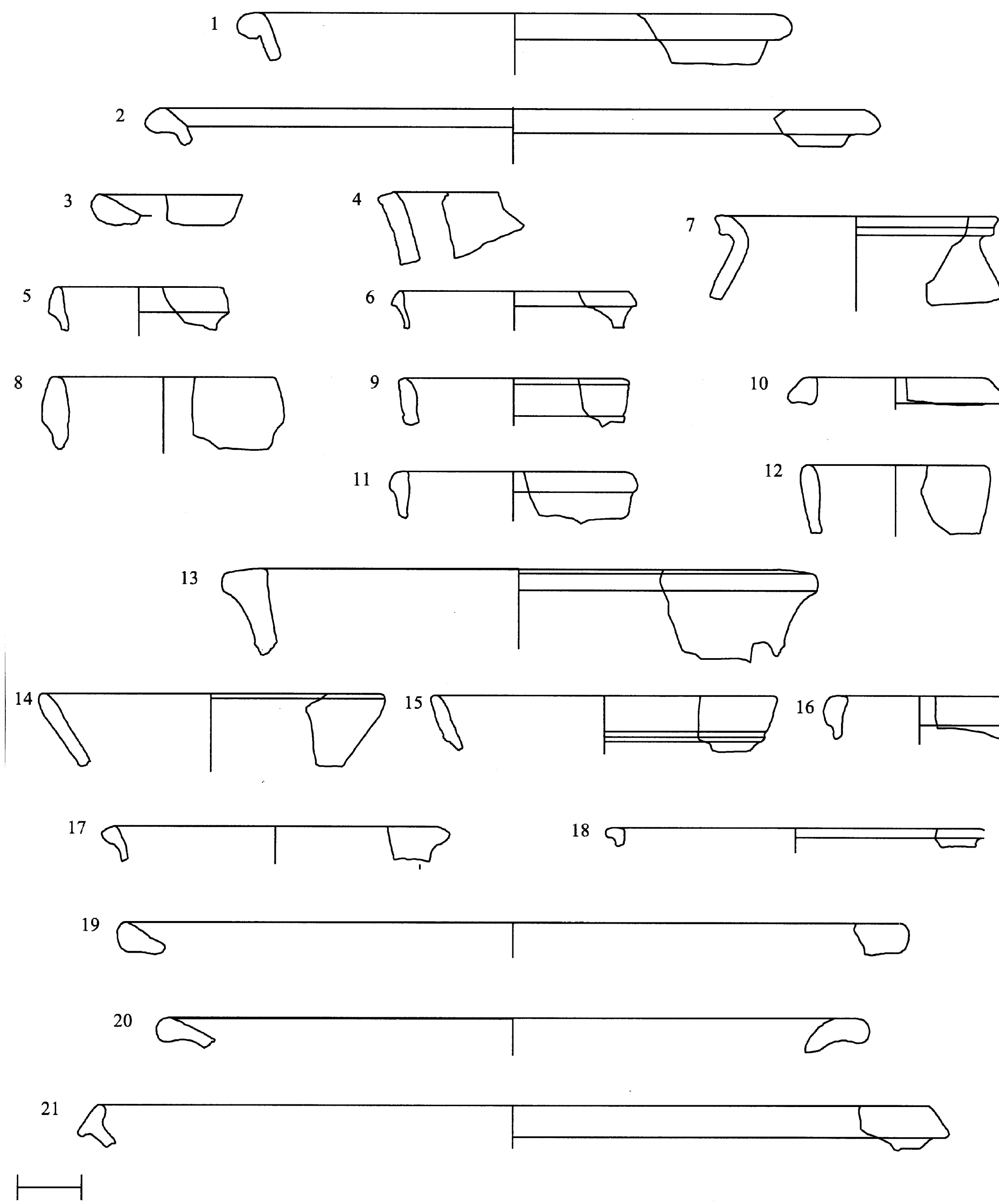

Fig. 2 Samples and typology. Basins: *1* Type 6, D2073; *2* Type 17, D2084; *3* Type 30, D2082; *4* Type 31, D2081. Jugs; *5* Type 38, D2069; *6* Type 41, D2071; *7* Type 46, D2076; *8* Type 49, D2089; *9* Type 52, D2072. Bottles: *10* Type 60, D2077; *11* Type 63, D2074. Cups: *12* Type 77, D2085; *13* Type 80, D2083; *14* Type 81, D2088; *15* Type 84, D2067; *16* Type 129, D2086. Jar: *17* Type 114, D2079. Pan: *18* Type 135, D2087; *19* Type 138, D2090. Stewpots: *20* Type 148, D2078; *21* Type 156, D2075

Experimental

Investigations were performed by means of different analytical techniques: thermoluminescence (TL) dating for absolute chronology, optical microscopy (OM), scanning electron microscopy (SEM-EDS) and X-ray fluorescence (XRF) for chemical and mineralogical–petrographical characterisation.

The method of dating by thermoluminescence is, in principle, quite simple (Aitken 1985), being expressed by the following equation:

$$\text{Age (years)} = \text{Paleodose(Gy)}/\text{annual dose(Gy per year)}$$

where the paleodose is the total dose absorbed by the pottery since its last heating in Antiquity, whilst the annual dose is the sum of the internal and external contributions from alpha and beta radiation and from gamma and cosmic radiation, principally due to the presence of uranium-238, thorium-232 and potassium-40 in the pottery and its surrounding environment. In the pottery, the accumulated dose is recorded by quartz, feldspars and other TL-emitting minerals.

TL measurements were performed using an oven with controlled heating system; the samples were heated in an ultra-pure N_2 atmosphere (heating rate 15°C/s) and the TL intensity was detected using an EMI 9635QB photomultiplier tube coupled to Corning BG12 blue filters. Beta irradiations were carried out using a 1,400-MBq ^{90}Sr–^{90}Y beta source (1.20 Gy min^{-1}) and alpha irradiations with a 37-MBq ^{241}Am source (14.8 Gy min^{-1}). The sample preparation and the evaluation of the absorbed dose with a multi-aliquot additive procedure were made following the standard fine-grain technique (2–8 µm; Zimmermann 1971). For the pre-dose procedure, a modified protocol was adopted (Galli et al. 2006). Annual dose rates were obtained by total alpha counting with ZnS scintillator discs and flame photometry performed on the ceramic samples as well as on excavation soils and local clays. To account for the cosmic radiation dose, which could not be directly measured, a contribution of 150 µGy/year was added (Aitken 1985). In calculating the dose rates, water contents corresponding to the 70±20% of water saturation were used.

For SEM investigations, a SEM Philips XL30 equipped with an energy-dispersive spectrometer (EDS) Philips EDAX DX4 was used. A variety of natural and synthetic materials were used as primary and quality control standards. Operating conditions were as follows: accelerating voltage 20 kV, beam current ~30–40 mA, work distance 10–15 mm. Quantitative analyses with the theoretical inner pattern were obtained using the ZAF method of correction.

For X-ray fluorescence, samples were mechanically crushed in a planetary mill and manually ground into a powder in an agate mortar. Quantitative analyses were performed on powder discs obtained by pressing 0.5 g of sample on a support of boric acid. The XRF apparatus was a Philips MagiX-Pro. Background and mass absorption intensities were calculated using calibrations based on 24 international geological reference materials. Loss on ignition was determined by thermogravimetric way, heating samples—previously dried to 110°C for 2 h—to 1050°C for about 1 h.

Small dimensions and lightweight of samples did not allow performing all analytical techniques for each sample (Table 1).

Results

Thermoluminescence dating

The results of radioactivity measurements together with the corresponding dose rates are reported in Table 2. Table 3

Table 2 Results of radioactivity measurements

Sample	Saturation water (%; ±5%)	K_2O (%; ±3%)	a value	U^{238} (ppm; ±5%)	Th^{232} (ppm; ±5%)	Dose Rate (µGy/year)	Dose rate α (%)	Dose Rate β (%)	Dose rate γ (%)	Equivalent dose (Gy)
D2066	24.6	2.5	0.200	3.10	9.80	5.16±0.27	47	38	14	2.40±0.24
D2067	21.2	0.7	0.203	2.74	8.67	3.76±0.23	58	24	18	6.87±0.44
D2069	21.9	2.8	0.182	2.99	9.47	5.14±0.25	43	43	14	6.35±0.48
D2071	19.4	1.6	0.215	2.13	6.74	3.98±0.19	47	35	18	3.96±0.21
D2072	22.6	1.7	0.205	2.74	8.67	4.48±0.24	50	34	16	4.52±0.28
D2074	25.9	1.7	0.215	1.98	6.26	3.64±0.19	45	36	19	7.31±0.51
D2076	16.4	1.9	0.159	2.54	8.03	4.19±0.19	42	41	17	8.18±0.55
D2077	11.4	2.2	0.130	2.94	9.31	4.47±0.20	39	45	16	8.43±0.49
D2078	13.9	1.2	0.162	1.98	6.26	3.45±0.15	43	35	22	4.44±20
D2083	20.7	2.1	0.215	2.08	6.58	4.13±0.20	45	38	17	0.93±0.10
D2084	15.4	2.5	0.225	2.69	8.51	4.50±0.26	48	38	14	1.09±0.10
D2085	17.6	1.4	0.181	2.39	7.55	3.92±0.16	48	34	18	1.00±0.09
D2086	10.7	0.9	0.080	2.64	8.35	2.86±0.13	34	41	25	0.6±0.05
D2088	16.9	0.8	0.080	1.93	6.10	2.45±0.11	32	42	26	0.65±0.05
D2090	11.5	1.5	0.110	1.62	5.14	3.23±0.14	33	44	23	0.84±0.08
D2094 soil		1.1		1.57	4.98					
D2095 clay		0.8		1.63	5.14					

The *a* value is the relative efficiency of alpha vs. beta radiation inducing TL

Table 3 Samples listed based on the absolute chronology obtained by thermoluminescence dating

Sample	Shape	Type	Proposed chronology	TL	Chronology
D2074	Bottle	63	Second half 1st cen. A.D.	45±140 d.C.	Roman
D2076	Jug	46	Second half 1st cen. A.D.	55±130 d.C.	
D2077	Bottle	60	Second half 1st cen. A.D.	120±125 d.C.	
D2067	Cup	84	Islamic	180±120 d.C.	
D2078	Stewpot	148	Roman period	720±90 d.C.	Islamic
D2069	Jug	38	6th–9th cen. A.D.	770±85 d.C.	
D2071	Jug	41	10th–11th cen. A.D.	1,010±80 d.C.	
D2072	Jug	52	10th–11th cen. A.D.	995±85 d.C.	
D2083	Cup	80	–	1,780±25 d.C.	
D2084	Basin	17	–	1,805±20 d.C.	
D2085	Cup	77	–	1,750±30 d.C.	
D2086	Cup	129	–	1,795±30 d.C.	
D2088	Cup	81	–	1,740±35 d.C.	
D2090	Pan	138	–	1,745±30 d.C.	

reports the dating results obtained on 14 of the 21 samples submitted to dating. Seven samples could not be dated due to the absence of natural TL emission and poor dosimetric characteristics.

The attempt to circumvent these problems using the pre-dose technique also failed. This technique is an alternative way of determining the equivalent dose. It is based on the changes in sensitivity of the low temperature peak of quartz (110°C at a heating rate 15°C/s) after irradiation and heating cycles, which is proportional to the archaeological dose. Whilst a few samples did not show any sensitisation, in others, the observed changes in sensitivity were not linear. This could suggest that in the grain size range 2–8 μm, quartz was not the main mineralogical phase present in these samples.

TL dating results essentially confirmed the proposed archaeological chronology, except in two cases. It is worth observing that the six samples of unknown period resulted coeval and dated with high precision 1770+25 A.D.

X-ray fluorescence

Results are reported in Table 4. Samples show variable CaO contents: five specimens contain less than 2 wt.%, seven contain 4.7–9.44 wt.% and seven contain 10.2–15.9 wt.%. The ample variations in SiO_2 (49.5–71.5 wt.%), Al_2O_3 (11.2–19.1 wt.%), Fe_2O_3 (4–10 wt.%), MgO (0.5–3.6 wt.%), Na_2O (0.3–1.7 wt.%) and K_2O (1.1–3.1 wt.%) contents, and in both minor and trace elements, are such to describe a heterogeneous context. Based on major, minor and trace element contents, compositional groupings can be weakly established between (a) D2074, 2078, D2067 and D2076, (b) D2071, D2072 and D2088, (c) D2089, D2085, D2079 and D2081, (d) D2083, (e) D2075, D2087 and D2077, (f) D2069 and D2084, (g) D2086, (h) D2090. Groups a, b and f are rather homogeneous, groups c and e show a wider heterogeneity, groups d, g and h include one sample each. D2090 greatly differs from all other samples, especially based on Fe_2O_3, V, Cr, Co, Y, La and Ce contents.

Optical microscopy and scanning electron microscopy

Textural observations performed by OM and SEM suggest to distinguish ceramic bodies into very fine (D2069, D2082), fine (D2067, D2077, D2083, D2084), medium (D2071-D2072, D2074, D2076), coarse (D2078) and very coarse (D2085, D2090). D2087 and D2090 further show an oriented matrix.

Matrix prevails on skeleton in D2069 and D2082 (90% matrix) and in D2071 and D2074 (70% matrix). Mean grain size is of ~100 μm in the skeleton of the first couple, whilst it increases in the second couple up to ~200 μm. Approximately the same percentage of matrix and skeleton can be observed in D2077, D2083 and D2084. Mean grain size is of ~60 and ~150 μm in the skeleton of D2083 and of D2077 and 2084, respectively. Skeleton prevails on matrix in D2078, D2085 and D2090, being mainly constituted by quartz (mean dimensions, 200–250 μm) in D2078, lithic fragments (mean dimensions, 800 μm) in D2085, quartz (mean dimensions, 250 μm) and lithic fragments (mean dimensions, 600 μm) in D2090.

Quartz represents the main mineralogical phase in all samples, whilst the assemblages varies considerably per sample. K-feldspars are ubiquitous, always prevalent on plagioclases. The latter vary considerably in composition: albite in D2071, D2074, D2076-2078, D2087 and D2090, from albite to andesine in D2083, from albite to labradorite D2069, D2072, D2085. Calcite is often abundant as secondary phase, whilst primary calcite has been rarely observed. Phyllosilicates are ubiquitous, mainly represented

Table 4 Bulk chemical analysis performed on 19 ceramic samples, listed by compositional groupings

	Sample	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	LOI	V	Cr	Co	Ni	Zn	Rb	Sr	Y	Zr	Ba	Nb	La	Pb	Ce	Th	U
a	D2074	49.54	0.52	11.25	4.01	0.05	1.89	15.33	0.55	1.29	0.17	15.29	89	90	13	30	68	54	266	20	157	245	10	23	19	27	6	2
	D2078	52.78	0.67	12.67	4.46	0.02	2.08	15.89	0.61	1.71	0.30	8.66	86	108	14	24	56	73	355	22	203	374	14	22	31	30	9	2
	D2076	58.22	0.64	13.03	4.42	0.04	2.86	11.27	0.65	2.36	0.37	6.00	76	94	12	29	71	97	322	25	215	494	15	26	32	42	10	3
	D2067	58.34	0.73	15.19	5.05	0.05	3.57	10.24	0.47	1.41	1.64	3.17	80	112	15	34	66	46	313	26	175	409	46	30	25	48	11	2
	Mean	54.7	0.6	13.0	4.5	0.0	2.6	13.2	0.6	1.7	0.6	8.3	82.8	101.0	13.5	29.3	65.3	67.5	314.0	23.3	187.5	380.5	21.3	25.3	26.8	36.8	9.0	2.3
	SD	4.3	0.1	1.6	0.4	0.0	0.8	2.8	0.1	0.5	0.7	5.2	5.9	10.6	1.3	4.1	6.5	22.7	36.7	2.8	26.4	103.4	16.6	3.6	6.0	9.9	2.2	0.5
b	D2071	59.73	0.86	15.80	7.03	0.12	2.21	7.69	1.06	1.97	0.97	2.57	119	102	20	66	117	83	331	30	170	530	18	36	19	62	9	3
	D2072	57.47	0.81	16.86	6.95	0.05	3.00	7.28	0.99	2.36	0.35	3.71	120	123	19	45	85	107	286	38	196	569	16	34	54	60	12	4
	D2088	57.28	0.78	15.35	6.88	0.09	2.34	8.81	0.47	1.93	0.61	5.32	117	129	20	46	103	75	204	26	174	361	15	26	22	59	8	3
c	D2089	58.44	0.81	15.62	7.00	0.08	2.19	11.32	1.38	1.64	0.25	1.13	127	139	21	49	102	56	291	29	186	276	17	29	11	68	9	3
	D2085	58.75	0.73	15.16	5.66	0.08	2.80	12.12	1.10	1.91	0.19	1.37	126	125	16	41	100	82	281	24	143	319	16	28	22	24	8	3
	D2079	55.29	0.72	14.79	5.70	0.06	3.06	12.80	0.71	1.95	0.25	4.53	103	124	15	42	94	115	317	25	158	335	15	23	91	54	1	3
	D2081	61.32	0.92	16.94	7.59	0.08	1.38	8.31	0.78	1.70	0.22	0.62	179	162	19	49	132	81	244	30	183	322	20	33	21	55	9	4
d	D2083	59.22	0.78	15.63	5.09	0.05	2.72	9.44	0.66	2.30	0.24	3.73	87	109	14	27	71	169	234	29	265	319	15	26	24	61	0	4
e	D2075	71.53	0.68	13.53	6.78	0.07	0.51	1.48	0.27	1.10	0.24	3.72	123	113	23	35	49	60	53	22	228	190	11	25	37	45	7	3
	D2087	69.27	0.86	16.81	7.29	0.04	1.30	0.92	0.44	1.39	0.08	1.47	95	111	19	36	71	73	99	26	276	311	21	38	28	81	12	3
	D2077	67.56	1.16	18.99	5.27	0.03	1.25	0.92	0.82	2.53	0.22	1.26	143	97	15	41	79	89	209	32	331	248	30	39	27	54	15	3
f	D2069	54.61	1.08	19.66	8.30	0.23	2.45	4.78	0.98	3.14	0.84	3.94	137	101	25	82	117	130	199	36	158	450	20	36	34	53	14	5
	D2084	59.99	0.91	18.16	8.11	0.14	2.61	4.77	0.91	2.51	0.13	1.60	157	120	24	53	105	135	191	30	198	486	18	39	48	68	14	5
g	D2086	63.43	0.82	19.11	6.84	0.06	1.58	1.06	1.75	2.73	0.14	2.34	118	87	17	29	75	143	159	28	219	566	21	31	45	35	15	5
h	D2090	61.48	0.84	17.89	10.04	0.12	3.04	1.52	1.11	1.96	0.18	1.66	187	165	31	62	79	109	163	46	155	481	12	49	28	93	9	4
	THA	53.9	0.7	12.6	5.1	0.1	2.3	15.4	0.6	1.5	0.2	7.5	99.4	112.3	15.7	42.3	85.1	68.0	328.7	24.8	193.4	406.5	13.8	24.0	23.2	47.8	8.3	1.8
	N=35	1.6	0.0	0.8	0.4	0.0	0.5	1.4	0.1	0.2	0.1	2.0	11.8	10.6	2.3	2.5	6.8	7.4	50.4	1.2	13.2	91.1	1.1	2.2	2.7	7.8	1.3	0.4

Major elements are reported as weight percent of oxides. Minor and trace elements are expressed in ppm. Mean contents and standard deviations for the first compositional group and for *Thamusida* reference group (THA) for ceramics have been also included by muscovite, particularly abundant in D2090, and biotite, sometimes chloritised (D2069, D2083, 2087) or particularly rich in Al (D2090). Abundant in D2076 and D2084 and frequent in all other samples, chlorites shows a Mg- and Fe-rich composition. Pyroxenes have been observed in D2071, D2072, D2074, D2078 and D2085, mainly represented by augite; sporadic crystals show intermediate composition between enstatite and pigeonite (D2069). Garnets show intermediate composition between almandine and pyrope in D2074 and D2078. Amphiboles are sporadically observed in D2076, D2074 and D2078, whilst they are abundant in D2069 and D2090. In the former sample, the amphiboles show variable compositions between anthophyllite and Mg–hornblende; in the latter, abundant hornblende is present in granitoid inclusions. Epidotes are sporadically observed but frequent in D2071, D2074, D2076 and D2078. Fe and Ti oxides are ubiquitous, as well as titanite, apatite and zircon. D2085 further shows a chromiferous spinel. Lithic fragments are generally infrequent, show small dimensions and are mainly represented by argillaceous rock fragments, limestones and sandstones; on the contrary, D2090 shows abundant granitoid inclusions up to 1 mm, made of quartz, K-feldspar, biotite, hornblende and minor plagioclase. Microphauna is generally very rare, with the exception of D2087, characterised by abundant microfossil content.

Discussion

Proposed chronologies have been denied twice. Thermoluminescence demonstrated that D2067 dates back to the second century A.D., whilst archaeological typology suggested a comparison with the production from the Islamic archaeological site of Badis. Vice versa, the stewpot D2078, framed into the Roman period, resulted to be an eighth century A.D. production. The unknown productions can be now dated within the eighteenth century A.D.

As far as characterisation, present data must be discussed in relation to *Thamusida* reference groups for bricks and amphoras (Gliozzo and Camporeale 2009; Gliozzo and Cerri 2009). Bulk chemical composition suggests indicating samples D2074, D2078, D2067 and D2076 as local productions. Mineralogical–petrograhical observations seem to further confirm this hypothesis. Quartz prevalent on all remaining phases, K-feldspars prevalent on plagioclases (from albite to labradorite), rare primary calcite, abundant secondary calcite, frequent phyllosilicates (muscovite, biotite and Mg- and Fe-rich chlorites), sporadic to frequent amphiboles (antophyllite, gedrite/Fe-gedrite, edenite/Fe-edenite, pargasite/Fe-pargasite), rare to sporadic garnets (with intermediate compositions between pyrope and almandine), rare pyroxenes (augite), abundant epidote, Fe and Ti oxides and other accessory minerals such as titanite, apatite and zircons are the principal characteristics of *Thamusida* local ceramic productions. The same assemblages have been observed in those four samples showing a bulk chemical correspondence with *Thamusida* local production.

Lithic fragments content is decisive for sample D2090. The granitoid inclusions definitely exclude the territory of *Thamusida* as an option, whilst they can maybe address the Hercynian granitoids of the Central Palaeozoic Massif of Morocco (see, e.g. Mahmood and Bennani 1984). Microphauna content further help in distinguishing D2087 both from *Thamusida* local production and all other samples here analysed.

From a technological standpoint, there is no apparent relation between composition and function. For instance, calcareous clays have been mainly used for tableware, but also for D2078 which is a stewpot. The supply of raw materials seems to reflect the available outcrops surrounding production plant more than a technological choice. Pan D2090 represents an exception again, showing well-suited raw materials, with little plasticity and consisting of prevalently sandy matrices rich in quartz, iron oxides and lithic inclusions and poor in Ca-bearing minerals.

Conclusions

The general purpose of this study has been to improve knowledge on common ware over different time periods. Notwithstanding the limited number of samples, it is clear that there are problems in dating common ware from Morocco, mainly due to the scarcity of available archaeological typologies. Hence, the data collected will be used to guide the typological study, bearing in mind that numerous shapes of common ware have been widely reproduced for centuries. The information arising from this research are definitely useful for the study of the site of *Thamusida*, but they are also of great relevance for all researchers involved in archaeological and archaeometrical research in Morocco. The identification of an eighteenth century ceramic production is of outstanding importance, as it characterises a completely unknown production and opens new opportunities of study.

Regarding the geography of production, four samples of both Roman and Islamic periods have been recognised as local productions of *Thamusida*. The majority of the remaining samples could be ascribed to a nearby territory, as mineralogical and petrographical investigations do not show significant differences from products of *Thamusida*. The provenance of pans D2087 and D2090 remain obscure; however, the granitoid inclusions in D2090 could indicate the areas of Ment, Zaer or Oulmes.

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