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LOCAL PRODUCTION OF POTTERY AND CLAY LAMPS AT *EMONA* (ITALIA, REGIO X)

Introduction

Emona (the present day Ljubljana, the capital of Slovenia) was a Roman colony (*colonia Iulia Emona*) on the eastern fringe of Italy (*regio X Venetia et Histria*). Current historical and epigraphic studies suggest that it was probably already in existence by the reign of Octavian.[1]

From the foundation of the town, the most important settlers in economic terms were craftsmen and merchants, mostly connected with North Italian trading families, especially those from *Aquileia*. The strategic position of *Emona*, on the route between the Italian and the Balkan peninsula and on the so called Amber Route between north-eastern Italy and north-eastern Europe, as well as its vicinity to the large and extremely important emporium at *Aquileia*, made *Emona* an ideal place for conducting trade.[2]

Excavations at *Emona* have revealed more than 3,000 graves, in addition to very large parts of the occupation area. While most of the graves are published,[3] the excavations of the settlement remain largely unpublished.[4] The typology and chronology of the local pottery, which are based on grave-finds,[5] should therefore be applied with caution.[6]

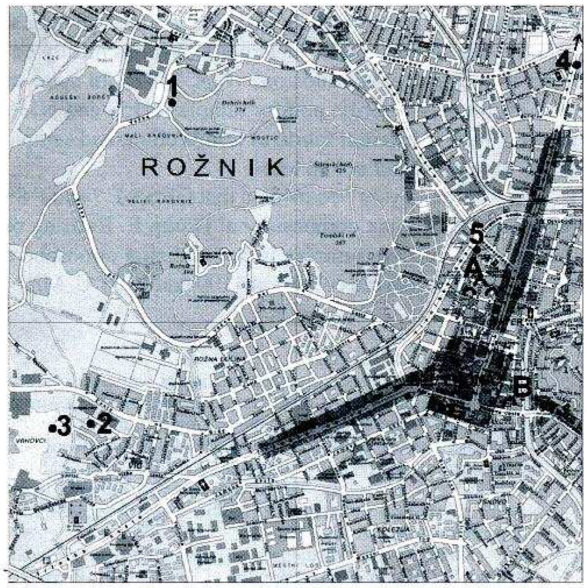

Fig. 1: Map of Ljubljana, indicating the city walls of *Emona*, its roads, cemeteries and potters' quarters:
A the partially excavated pottery kiln published by Istenič/Plesničar-Gec 2001. —
B a small pottery kiln excavated in 2000/2001. —
1–5 locations where clay samples were taken (**1**: samples N672, N673; **2**: samples N504, N505; **3**: samples N508, N670, N671; **4**: samples N506, N507; **5**: samples N674, N675).

The study of local pottery production through an examination of the fabrics did not start until recently. Encouraged by the good results derived from fabric-based pottery research combined with scientific analyses at *Poetovio* (*Pannonia Superior*, present-day Ptuj in north-eastern Slovenia),[7] our aim was to define the most common local fabrics at *Emona*.

Objectives

The archaeological evidence for pottery production at *Emona* is poor in comparison with that available at *Poetovio*.[8] The potters' quarter at *Emona* was situated in its northern suburb. It is known from brief reports mentioning several pottery kilns and a workshop, which were destroyed during various construction works at the beginning of the 19th century.[9]

Two pottery kilns at *Emona* have been archaeologically investigated: a partially excavated pottery kiln in the potters' quarter (**fig. 1,A**),[10] and a small pottery kiln situated to the east of the town walls, which was excavated in 2000/2001 by the City Museum of Ljubljana (**fig. 1,B**; unpublished). There were no definite 'wasters', but some of the pottery had been backfilled into the first pottery kiln mentioned.[11] Nor are there any stamps incorporating the trademarks of local potters.

1 M. Šašel Kos, Caesar, Illyricum, and the hinterland of Aquileia. In: G. Urso (ed.), L'ultimo Cesare. Atti del convegno internazionale, Cividale del Friuli, 16–18 settembre 1999 (Roma 2000) 296. — M. Šašel Kos, Je bila Emona nekdanji tabor 15. legije in veteranska kolonija? Zgodovinski časopis 52, 1998, 325–326.

2 Cf. Šašel 1968, 565–566.

3 Main publications: Plesničar-Gec 1972. — Petru 1972.

4 This applies to the 'old' excavations by Walter Schmid in 1909–1912, as well as the later ones which were particularly intensive after WW II. Of the excavations within the town walls at *Emona*, only the research in insula 32 is published; this includes the finds: L. Plesničar-Gec *et al.*, Starokrščanski center v Emoni /Old christian center in Emona. Kat. in monogr. 21 (Ljubljana 1983) 68–70. The only publications of Roman settlement finds at Ljubljana, which deal with stratigraphically excavated material, relate to the pre-Augustan to 1st century AD settlement outside the city walls (B. Vičič, Zgodnjerimsko naselje pod Grajskim gričem v Ljubljani. Gornji trg 15. Arh. vestnik 44, 1993, 153–201. — B. Vičič, Zgodnjerimsko naselje pod Grajskim gričem v Ljubljani. Gornji trg 30, Stari trg 17 in 32. Arh. vestnik 45, 1994, 25–80).

5 Plesničar-Gec 1977.

6 For examples showing what great care must be taken over the chronological interpretation of pottery in graves, see M. Tuffreau-Libre, Pottery assemblages in Gallo-Roman cemeteries. In: J. Pearce/M. Millett/M. Struck (eds.), Burial, society and context in the Roman world (Exeter 2000) 54; 60.

7 Istenič 1999, 41–42; 85–202. — Daszkiewicz/Schneider 1999.

8 For the rich archaeological evidence for pottery production at Poetovio see Istenič 1999, 15–16; 42; 167–170; 191–202.

9 W. Schmid, Emona ni bila vojaški tabor. Glasnik muz. društva za Slovenijo 22, 1941, 52 note 18. — Šašel 1968, 556 with references.

10 Istenič/Plesničar-Gec 2001.

11 Cracks were evident on most of the jugs (Istenič/Plesničar-Gec 2001, figs. 5; 6,1–2) and on some of the other pottery fragments from the kiln (cf. Istenič/Daszkiewicz/Schneider forthcoming, figs. 3–6). They suggest that these jugs and other pottery from this kiln may be regarded as wasters and had been backfilled into it for this reason.

Methodology

A macroscopic survey of the pottery from *Emona* showed that the majority of utilitarian vessels (platters and dishes, cups, beakers, jugs, flagons, fine ware jars, tazze etc.) have the same characteristics. This fabric was named F 7 and its grey (reduced) version F 8. Vessels in the same fabrics were found back-filled into the pottery kiln in the potters' quarter,[12] so it was assumed that these fabrics were produced locally.

Chemical (WD-XRF) and mineralogical (thin-section examination under a polarizing microscope) analyses, and also matrix-grouping by refiring (MGR[13]) were applied to verify the homogeneity of the fabrics established macroscopically (F 7 and F 8). Various vessels, including thin-walled beakers, imitations of terra sigillata and Aegean cooking ware, jugs, flagons, jars and tazze as well as lamps, a tile and a fragment of kiln lining (35 items *in toto*), were sampled for chemical analyses (cf. **tables 1–2, figs. 2–6**).[14] Sixteen thin-sections were studied and fourteen MGR-analyses were undertaken. In **table 1**, these samples are marked with a letter after the sample number ('d' for a thin section, 'r' for refiring).

The reference-points for the local sources of fabrics F 7 and F 8 comprised eleven samples of clay (N504–508.670–675) from various locations in Ljubljana. These were chosen utilizing information on geological and soil maps, the sites of recently abandoned brickworks, as well as the very valuable observations of Franc Vidic (pers. comm.) who was responsible for the geotechnical research in advance of the (re)construction of various buildings in the centre of Ljubljana (*i.e.* in the territory of *Emona* and its suburbs). The clay samples were analysed chemically in the same way as the pottery samples and fired at eight different temperatures from 400 to 1200°C, in order to compare them with the pottery. Unfortunately, we were unable to obtain a piece of a recently excavated Emona pottery kiln, which could have provided another reference point for the identification of local production.

Macroscopic description of fabrics F 7 an F 8

The colour of fabric F 7 varies from very light brown to yellowish-red, and the surface of the vessels is frequently mottled. Grey mottling also occurs (fabric F 7/8). The fabric is porous in fracture. It contains very fine flakes of colourless sparkling mica, rare or moderately dense, red-brown, rounded porous inclusions (rarely larger than 1 mm in diameter), which are softer than the surrounding fabric (perhaps lumps of clay with a high iron content), and also rare, large particles of quartzite (no reaction with HCl) of translucent to milky white colour, ranging from medium size to more than 1mm in diameter. The hardness is 3 on the Mohs scale. The untreated surface is usually dusty and occasionally soapy.

Fabric F 8 is much less frequent. It differs from fabric F 7 in its colour, which is dark grey to black, sometimes with grey-brown mottling (fabric F 8/7). Many of the sherds found in the kiln were harder than usual (4–7 on the Mohs scale), and often no mica could be observed (fabric F 8*). It was assumed that this might be the result of overfiring.[15]

Archaeometric analyses

The results of chemical analyses (**table 2**) showed that all the pottery samples from the kiln formed a homogeneous group in composition. Phosphorus contents above about 0.7% P_2O_5 are usually connected with higher calcium and barium contents, and were almost certainly due to the absorption of these elements when the sherds were buried in the ground. Most of the other pottery analysed and two of the clay samples were very similar to the kiln group. Together they form a reference group (Group E) for local Emona pottery. Its average composition and standard deviation was calculated from seventeen pottery samples[16] (**table 2**). Eight *Firmalampen*, from a series of samples of lamps analysed from various contexts at *Emona*, matched the composition of the local reference Group E. These lamps were definitely made at *Emona*.[17]

The tile from the kiln (N148), two beakers (E531, E750) and one of the imitations of Aegean cooking ware (J032) deviated significantly in composition from Group E (e.g. in their lower levels of potassium), but, in view of the large variation in the composition of the clay samples analysed from Ljubljana (N504–508, N670–675), these were also considered to be local products. This was confirmed by the thin-section studies and the MGR-analyses, which also showed the similarities in all the pottery samples. The kiln lining (N149), however, was made of a different material which had a high calcium and magnesium content.

The thin-section studies showed that the matrix of the pottery sherds consisted of a non-calcareous fine micaceous clay, with more or less silty or fine sandy quartz and mica, up to 0.3 mm in diameter. The larger inclusions mostly derived from a siliceous sandstone (**figs. 7–8**).[18] In spite of their chemical similarity, pottery samples N158 and N159 showed quite a different fabric in thin-section, and sample N159, at least, might not be local.

The MGR analyses[19] confirmed that fabrics F 7 and F 8* belonged to the same compositional Group E. Refiring of the grey and reddish samples in an oxidizing atmosphere resulted in identical red colours at 1100 and 1200°C. Minor

12 Istenič/Plesničar-Gec 2001.

13 MGR-analysis involves systematic refiring at various ascending steps of temperature up to 1200°C, and is based on the assumption that, given the same raw material (matrix) and exactly the same firing conditions, the sintering or melting behaviour, and the colours of the refired fragments should be identical (M. Daszkiewicz/G. Schneider, Klassifizierung von Keramik durch Nachbrennen von Scherben. Zeitschr. Schweizer. Arch. u. Kunstgesch. 58, 2001, 25–32).

14 Analyses were done by wavelength-dispersive X-ray fluorescence (Philips PW1400) on samples ignited at 880° C; loss of ignition (loi) is given in per cent; major elements were normalized to a constant sum of 100% and are expressed in percentages, with the original total given in the last column; traces are in ppm; elements in brackets were determined with low precision.

15 Istenič/Plesničar-Gec 2001, 141–142.

16 E746–749, E751, E753–755, N145–147, N150–151, N153–155, E506.

17 According to the chemical analyses, other *Firmalampen* were mostly imports from the neighbourhood of *Mutina* (Modena).

18 For figures in colour cf. Istenič/Daszkiewicz/Schneider forthcoming.

19 For figure in colour cf. Istenič/Daszkiewicz/Schneider forthcoming.

Table 1: List of the samples included in the present study, all of which were analysed chemically (WD-XRF). c = object cracked during firing, d = items examined also in thin-section, r = items examined also by MGR, MM = Mestni muzej, Ljubljana, NMS = Narodni muzej Slovenije

Sample No.		Museum + Inv.No.	Description
1. Group E (local production at Emona)			
1.1 Pottery from the partially excavated kiln (Istenić/Plesničar-Gec 2001)			
E746	c r	MM 2247:A	body sherd of a jug/flagon, fabric F 7
E747		MM 2139:A	jug, fabric F 7, form Istenić/Plesničar-Gec 2001, fig. 6,1–2 (**fig. 2,2**)
E748	c	MM 2248:A	sherd, probably of a jar, fabric F 7/8 (**fig. 2,6**)
E749	r d	MM 2216:A	basal sherd of a jar/flagon/jug, fabric F8*/7
E751		MM 2235:A	sherd of a jar, fabric F 7/8, form Istenić/Plesničar-Gec 2001, fig. 6,3
E753	c	MM 2215:A	sherds of a jug, fabric F 8*, form probably Istenić/Plesničar-Gec 2001, fig. 6,1–2
E754	c	MM 2214:A	sherds of a jug/flagon, fabric F 8* (**fig. 2,3**)
E755	c	MM 2253:A	sherd of a jar/jug/flagon, fabric F 7
N145	r d	MM 2159:A	sherd of a pot with a handle, fabric F 8*/7, form as Istenić/Plesničar-Gec 2001, fig. 6,3 (**fig. 2,5**)
N146	r d	MM 2220:A	sherd of a platter with a foot-ring, imitation terra sigillata, fabric F 8* (**figs. 2,1; 8**)
N147	r d	MM 2272:A	part of the bottom of a jug (?), fabric F 7 (**fig. 2,4**)
1.2 Tile and kiln lining from the partially excavated kiln (Istenić/Plesničar-Gec 2001)			
N148	r d	MM 2346:A	part of a tegula, fabric F 7
N149	r d	MM 2171:A	frag. of kiln lining
1.3 Pottery from the pit adjacent to the partially excavated kiln (Istenić/Plesničar-Gec 2001)			
E750	d	MM 2206:A	sherds of a beaker, fabric and form as E531
E752		MM 2198:A	sherd of a beaker, fabric and form as E531
1.4 Pottery from various contexts at *Emona*			
N150	r d	NMS R9865	jar, fabric F 7, red painted decoration (**figs. 3,10; 4**); Petru 1972, 89 grave 951 (no drawing)
N151	r d	NMS R10192	sherds of a tazza, fabric F 7 (**figs. 3,9; 4**)
N153	r d	NMS R9750	flagon, fabric F 7 (**figs. 3,7; 4**); Petru 1972, 84 grave 900 (no drawing)
N154	r d	NMS R9701	pot with a handle, fabric F 7, red slip, form Istenić/Plesničar-Gec 2001, fig. 6,3 (**figs. 3,8; 4**); Petru 1972, 79 grave 856 (no drawing)
N155	r d	NMS R6734	thin-walled beaker with barbotine decoration, fabric F 7, red slip (**figs. 3,1; 5**); Petru 1972, 98, grave 62 (1067) pl. 85,18
E506	d	NMS R9376	beaker, fabric F 7 (**figs. 3,3**); Petru 1972, 58 grave 605 pl. 39,6
E531	d	NMS R8056	beaker, fabric F 7 (**fig. 3,2**); Petru 1972, 122 grave 13 (1040) (on pl. 119,13 is illustrated a pot, inv. no. R8057, which was not found in this grave)
J028		NMS R3896	small jar, imitation of Aegean cooking-ware, fabric F 7 (**fig. 3,6**); Istenić/Schneider 2000, fig. 3,4; Petru 1972, 138 pl. 109,43
J031		NMS R5918	small jar, imitation of Aegean cooking-ware, fabric F 7 (**figs. 3,4; 5** left); Istenić/Schneider 2000, fig. 3,6; Petru 1972, 66 grave 657 pl. 43,30
J032		NMS R3399	small jar, imitation of Aegean cooking-ware, fabric F 7 (**figs. 3,5; 5** right); Istenić/Schneider 2000, fig. 3,5; Petru 1972, 139 pl. 110,28
1.5 *Firmalampen* from various contexts at *Emona*			
E482		~~MM~~ G.1195	Buchi Xa, FORTIS, fabric F 7, no slip
E490		MM G.3604	Buchi Xb/c, nonsense stamp, fabric F 7/8, traces of brownish-red slip; Plesničar-Gec 1972, 45 grave 198 pl. 56,8
E491		MM G.1494	Buchi Xa/b, FORTIS, fabric F 7, no traces of slip visible on the badly preserved surface; Plesničar-Gec 1972, 104 grave 610 pl. 140,16
E499		NMS R6449	Buchi Xc, no stamp, fabric F 7, traces of brownish-red slip (**fig. 6,2**)
E504		NMS R5337	Buchi Xb, QGC, fabric F 7/8, remains of brownish-red to dark grey slip (**fig. 6,3**); Petru 1972, 28 grave 104b pl. 14,53
E510		NMS R5827	Buchi Xa/b, FORTIS, fabric F 7, traces of red-brown slip (**fig. 6,1**); Petru 1972, 57–58 grave 569 pl. 38,26
E525		NMS R2434	Buchi Xb, VERI, fabric F 7/8, (**fig. 6,5**), no traces of slip; Petru 1972, 134 pl. 100,1
E537		NMS R5522	Buchi Xb, VIBIANI, fabric F 7, slight traces of brown slip (fig. 6,4); Petru 1972, 39 grave 237 pl. 23,30
2. Pottery similar to Group E			
N158	r d	NMS R10298d	sherd of a dish, fabric F 8, form Istenić 1999, 117 fig. 102,PD1–3 (**fig. 3,11**)
N159	r d	NMS R19289	sherd of a dish, fabric F7 and 8/7, form as N159, traces of red slip on interior and exterior (**fig. 3,12**)
3. Clay samples similar to local pottery at *Emona* (chemical Group E)			
N672			sample from the area around the former brick-factory at Koseze (**fig. 1,1**), depth 0.7–0.9 m
N673			as N672, depth 0.90–1.1 m
4. Other clay samples			
N504			sample from the area around the former brick-factory at Vič, 'Grba' (**fig. 1,2**), depth *c.* 0.5–0.8 m
N505			as N504, depth *c.* 1–1.3 m
N506			sample from the clay-pit of the former brick-factory Črnuče (**fig. 1,4**), depth *c.* 1 m
N507			as N506, depth *c.* 1.5 m
N508			sample from the area around the former brick-factory at Vič, 'Grba' (**fig. 1,3**), depth *c.* 0.5 m.
N670			as N672, depth 0.3–0.5 m
N671			as N672, depth 0.5–0.7 m
N674			sample from Delavski dom (**fig. 1,5**), depth *c.* 7.5 m
N675			as N674, depth *c.* 8.5 m

Table 2: Results of the chemical analyses of the samples listed in table 1 (WD-XRF of samples ignited at 880°C).

Sample	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	V	Cr	Ni	(Cu)	Zn	Rb	Sr	Y	Zr	(Nb)	Ba	(La)	(Ce)	(Pb)	loi	total
1. Group E																										
1.1 Pottery from the partially excavated kiln (Istenič/Plesničar-Gec 2001)																										
E746	67.14	1.179	21.69	5.94	0.015	0.77	0.35	0.31	2.45	0.125	116	123	52	19	69	145	77	34	282	27	437	54	111	43	0.99	100.62
E747	66.01	1.215	22.47	5.10	0.005	0.35	1.20	0.27	2.35	0.981	117	117	47	19	53	156	75	34	279	25	621	48	94	38	1.07	100.03
E748	66.39	1.179	22.96	5.43	0.018	0.86	0.42	0.30	2.23	0.184	150	115	52	20	59	155	66	33	284	30	429	40	82	41	1.06	99.08
E749	65.11	1.212	23.62	5.83	0.010	0.78	0.23	0.26	2.83	0.079	173	123	52	13	64	171	72	31	271	33	476	56	92	45	0.46	101.01
E751	64.24	1.216	23.87	6.02	0.010	0.80	0.39	0.48	2.79	0.159	157	124	54	14	64	183	69	31	268	29	460	44	100	37	0.92	100.86
E753	68.65	1.211	21.36	4.53	0.010	0.71	0.19	0.31	2.94	0.056	154	118	46	5	60	160	73	33	290	26	452	51	111	43	0.45	100.70
E754	67.80	1.175	21.31	5.55	0.012	0.76	0.25	0.30	2.74	0.067	147	118	53	13	61	160	79	35	282	27	448	44	107	50	0.59	99.90
E755	63.94	1.191	23.34	6.40	0.010	0.41	1.25	0.26	2.38	0.783	121	121	51	20	61	159	75	30	257	25	627	50	89	42	0.91	99.91
N145	68.76	1.198	21.19	4.65	0.014	0.79	0.25	0.29	2.72	0.114	144	126	40	26	76	151	80	34	296	18	455	49	78	28	0.89	99.62
N146	65.40	1.187	23.32	5.64	0.012	0.90	0.24	0.32	2.85	0.099	145	131	45	27	76	157	76	31	271	19	457	46	105	37	0.51	99.64
N147	68.42	1.247	21.16	3.80	0.008	0.63	1.20	0.27	2.45	0.790	133	130	35	31	59	151	80	35	298	20	695	47	102	36	3.56	99.28
1.2 Tile and kiln lining from the partially excavated kiln (Istenič/Plesničar-Gec 2001)																										
N148	70.56	1.078	19.05	4.09	0.018	1.02	0.31	0.70	3.01	0.145	102	99	35	30	114	132	62	39	291	14	551	37	78	44	0.96	99.22
N149	49.80	0.702	13.89	4.11	0.063	4.15	23.96	0.46	1.72	1.104	57	56	32	33	81	49	154	30	206	11	356	25	72	23	17.34	98.37
1.3. Pottery from the pit adjacent to the partially excavated kiln (Istenič/Plesničar-Gec 2001)																										
E750	68.58	1.394	21.31	5.59	0.016	0.65	0.40	0.16	1.40	0.472	101	115	37		70	90	52		344		462		96		1.38	99.20
E752	68.36	1.258	21.25	4.83	0.014	0.77	0.39	0.40	2.41	0.289	103	103	47	27	70	128	68	39	319	25	506	43	101	41	0.98	99.97
1.4 Pottery from various contexts at *Emona*																										
N150	68.21	1.222	20.59	4.58	0.014	0.78	1.33	0.38	1.96	0.912	101	122	43	29	92	115	66	34	319	16	596	28	72	31	5.95	98.98
N151	63.50	1.227	24.41	4.02	0.011	0.81	1.21	0.41	2.73	1.649	132	135	45	41	76	136	100	38	256	19	849	55	110	42	3.62	98.84
N153	67.69	1.239	21.98	4.85	0.016	1.03	0.34	0.35	2.36	0.112	122	128	46	47	74	126	76	37	296	17	493	39	104	34	0.95	99.49
N154	64.57	1.225	24.20	4.17	0.009	0.61	1.19	0.36	2.59	1.035	149	138	43	27	73	128	74	38	269	18	700	47	111	34	5.60	98.99
N155	66.33	1.346	22.95	5.41	0.013	0.97	0.48	0.30	1.96	0.207	99	145	45	31	86	92	61	39	328	19	404	41	115	37	1.88	99.51
E506	64.83	1.336	23.69	4.65	0.013	0.75	0.85	0.34	2.58	0.862	115	145	45		92	118	78		293		726		90		5.66	96.67
E531	61.49	1.360	25.80	4.89	0.015	1.20	1.15	0.30	1.64	2.125	170	129	43		82	64	83		307		565		128		4.34	98.15
J028	69.76	1.175	20.86	4.11	0.012	0.97	0.48	0.34	2.09	0.186	148	133	45	22	59	122	80	39	350	19	441	53	93	112	1.46	99.54
J031	67.24	1.200	22.40	4.26	0.021	0.67	1.16	0.27	1.95	0.871	123	154	51		63	145	58	40	326		612		136		6.01	97.52
J032	70.63	1.456	20.13	4.28	0.010	0.82	0.38	0.27	1.58	0.417	125	148	41		71	101	45	43	402		365		149		2.01	96.58
1.5 *Firmalampen* from various contexts at *Emona*																										
E482	64.18	1.159	20.59	4.45	0.038	0.78	2.65	0.37	2.63	3.124	137	98	35		85	125	163		281		1043		115		6.34	99.47
E490	68.20	1.288	22.39	3.80	0.009	0.55	0.77	0.29	2.39	0.277	143	117	33		47	106	73		307		610		90		7.55	99.23
E491	68.72	1.213	20.67	5.36	0.022	0.95	0.28	0.36	2.29	0.110	130	111	44		62	110	70		300		482		93		1.40	100.14
E499	67.01	1.189	21.85	4.72	0.010	0.54	0.90	0.47	2.52	0.760	123	118	24		60	126	66		311		658		94		6.73	100.47
E504	61.63	1.389	26.49	5.08	0.015	0.97	1.24	0.44	2.15	0.562	192	145	48		95	129	86		241		772		121		9.02	98.74
E510	68.02	1.253	22.22	4.71	0.015	1.01	0.53	0.31	1.60	0.283	124	149	52		60	85	63		306		399		119		3.78	97.42
E525	66.69	1.303	20.25	7.04	0.018	0.70	1.74	0.33	1.81	0.094	159	122	36		58	90	89		314		562		130		8.40	99.69
E537	70.11	1.218	18.91	4.61	0.008	0.61	0.87	0.33	2.13	1.190	116	108	28		51	98	69		306		712		94		6.42	100.31

Sample	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	V	Cr	Ni	(Cu)	Zn	Rb	Sr	Y	Zr	(Nb)	Ba	(La)	(Ce)	(Pb)	loi	total
2. Pottery similar to Group E																										
N158	70.19	1.045	18.11	4.02	0.012	0.90	1.49	0.73	2.20	1.275	113	115	35	29	77	106	97	33	275	15	648	30	68	27	4.80	99.11
N159	68.70	1.244	19.69	4.60	0.027	1.09	0.84	1.20	2.20	0.381	125	129	47	41	89	112	107	40	346	18	609	37	119	41	1.25	99.45
3. Clay samples similar to local pottery at *Emona* (chemical Group E)																										
N672	70.88	1.187	20.44	2.96	0.013	0.98	0.41	0.54	2.44	0.126	144	123	40	15	64	126	76	46	325	18	471	54	116	42	8.79	99.69
N673	72.25	1.220	19.10	3.03	0.013	0.92	0.27	0.62	2.49	0.054	153	115	35	10	59	122	78	42	343	17	490	46	90	33	6.38	99.74
4. Other clay samples																										
N670	80.68	1.114	11.94	2.94	0.014	0.64	0.27	0.54	1.79	0.047	96	78	31	3	36	84	57	39	438	14	324	35	80	23	3.38	99.19
N671	80.87	1.161	11.75	2.92	0.015	0.69	0.30	0.53	1.67	0.057	97	86	27	3	39	81	58	39	458	15	314	33	89	25	3.94	99.33
N504	71.88	1.291	18.39	3.98	0.022	1.19	0.35	0.43	2.37	0.068	133	121	44	20	76	127	80	41	381	21	452	43	105	29	9.04	98.74
N505	70.25	1.303	18.48	5.09	0.028	1.44	0.34	0.61	2.34	0.076	145	125	46	16	77	121	84	35	373	21	501	40	86	27	5.20	99.47
N508	71.81	0.895	18.83	4.10	0.012	0.74	0.11	0.42	3.00	0.045	117	95	41	29	76	142	57	39	255	15	463	46	65	24	4.28	99.12
N506	63.17	1.231	21.75	9.53	0.019	0.86	0.18	0.38	2.74	0.108	156	117	50	24	77	169	69	37	326	20	568	51	101	39	5.85	99.90
N507	61.82	1.208	21.30	11.41	0.021	0.82	0.19	0.37	2.70	0.120	164	123	49	28	76	156	67	38	320	21	559	41	98	38	6.01	99.85
N674	67.60	1.048	18.33	6.42	0.061	2.04	0.97	0.91	2.40	0.174	149	127	59	22	118	136	112	38	291	16	451	41	96	28	6.96	99.73
N675	69.20	0.938	17.16	7.67	0.402	1.41	0.69	0.29	2.05	0.168	134	97	63	35	122	124	66	29	235	16	405	14	98	40	5.95	99.34
Emona reference Group E																										
Group average (n = 17)																										
	66.5	1.22	22.5	5.11	0.012	0.75	0.61	0.33	2.52	0.37	133	125	47	24	69	145	73	35	286	18	516	46	99	39		
Standard deviation																										
±	1.8	0.04	1.2	0.76	0.003	0.17	0.45	0.06	0.30	0.37	22	10	5	11	11	22	6	3	21	2	98	7	13	6		

differences in the colours at 1100 or 1200°C were connected with variations in the iron content (between 3.8 and 6.5% Fe_2O_3). The grey colour of sample N146 (fabric F 8*) disappeared at above 1000° C, indicating that this sherd had originally been fired in a reducing atmosphere. The grey colour in this case was mainly due to the presence of black hercynite and magnetite, which were formed instead of red hematite. In another grey sample (E749), however, the grey colour disappeared after refiring at 400°C. This suggests that it had originally been fired in an oxidizing atmosphere, but cooled in a smoke-laden kiln atmosphere, causing carbon to be deposited on the surface and interior of the sherd. The original firing temperatures of these two samples, however, were the same as for samples N145 and E746 of fabric 7 (and for tile N148), that is, between 1000 and 1100° C. The original firing temperature of sample N147 was between 900 and 1000° C.

From the few samples studied, there was no indication of the use of a different raw material for fabrics F 7, F 8 and F 8*. The differences in the macroscopic visibility of mica may have been due to minor differences in the grain sizes or the firing temperatures. A slightly higher firing temperature or a longer firing time within temperature range of 1000 to 1100°C can result in the decomposition of mica. To establish reasons for the macroscopic differences in fabrics F 8 and F 8*,[20] additional thin sections and MGR analyses would be needed.

The clay used for vessels in fabrics F 7 and F 8 most probably originated from the weathering of the Permo-Carboniferous slates, sandstones and conglomerates of the hills west and east from *Emona*, which was washed out and deposited as a more or less sandy clay sediment at the lower levels e.g. around *Emona*. From the information provided by Franc Vidic there seems to have been a layer of clay very close to the surface, up to 4 metres thick on the west (near Ro nik hill) and thinning out towards east. Unfortunately, the samples taken for the original geological survey had been thrown away, and it was impossible in the densely built-up area to take new samples for the purpose of our research. Nevertheless, a new clay sample was taken from deposits on the other side of Ro nik hill (**fig. 1,1**). It originated from the same material as the hypothetical clay from *Emona*, washed off from this hill. Archaeometric analyses showed that this clay was remarkably similar to fabrics F 7 and F 8, both chemically and in its firing behaviour (MGR-analysis) (**N672** and **N673**, **tables 1–2**). The upper part of this clay layer is more sandy (higher contents of SiO_2) and thus less suitable for pottery making (N670, N671). Clay samples from three other spots (**fig. 1,2–4**) within the area of the Pleistocene clayey-sandy fluvio-glacial deposits covering the region of Ljubljana are less similar to the composition of the pottery, and sample N508 corresponds to another

[20] The essential difference between F 8 and F 8* is the greater hardness of the latter (cf. ISTENIČ/PLESNIČAR-GEC 2001, 141–142).

type of clay (less Ti and Cr, more K). Another clay deposit in the area of *Emona* lies much deeper and is separated from the more superficial clay deposit by a layer of alluvium laid down by the river Sava. This deeper layer of clay was also sampled (cf. **N674** and **N675, tables 1–2; fig. 1,5**). Its composition differs significantly from that of the pottery (Mg, Ni, Zn), and it was probably not used by the Roman potters.

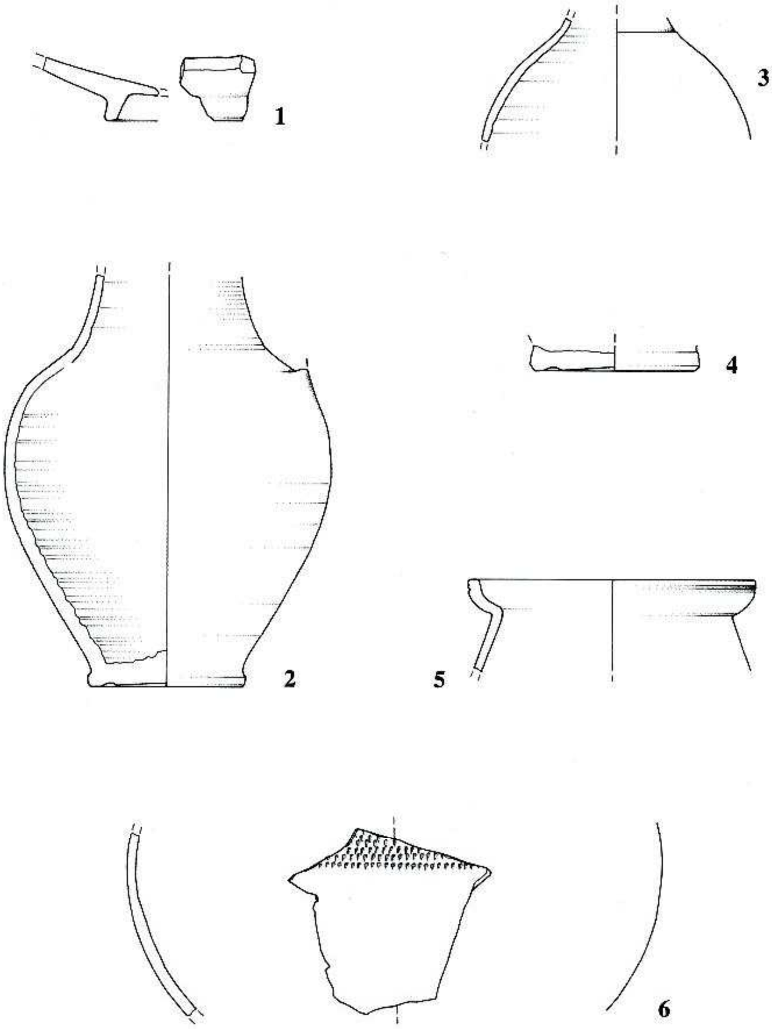

Fig. 2: Local Emona pottery; vessels analysed from the kiln. **1** sherd of a platter with a foot-ring (N146). — **2** jug (E747). — **3** sherds of a jug or flagon (E754). — **4** part of the bottom of a jug? (N147). — **5** sherd of a pot with a handle (N145). — **6** sherd, probably of a jar (E748). — Scale 1:3.

Further discussion and conclusions

Fabrics F 7 and F 8 form a chemically homogeneous Group E. Thin-section studies have shown that they also have the same mineralogical composition. Investigations by MGR confirmed that the differences in their appearance were due to different conditions of firing. The firing temperatures had generally been between 1000 and 1100°C.

The clay used for vessels in fabrics F 7 and F 8 had most probably originated in the area of *Emona* and its suburbs.

Fabrics F 7 and F 8 had been used to make utilitarian pottery (for example flagons and jars, dishes, fine ware jars, tazze, dishes), fine table-ware such as thin-walled beakers and imitations of terra sigillata and lamps, as well as tile. To define the full spectrum of this output, as well as to date the beginning of production, would require further research. Although the samples analysed were chosen randomly, regardless of their date, their evidence indicates that local pottery production in fabrics F 7 and F 8 was well established from the Flavian period until the second half of the 2nd century (N150, N154, N155,[21] E506, E531, E750, E752,[22] J028, J031, J032,[23] **fig. 3,1–6.8.10**).

The results of the present research advance our knowledge of local production of thin-walled pottery at *Emona*. This had originally been postulated by Plesničar-Gec[24] because of the presence of thin-walled ware[25] in the pit adjacent to the pottery kiln. During a detailed examination of the pottery from this pit, fragments of seven thin-walled cups were identified. Macroscopic examination of these sherds revealed that six[26] of them, all in reduced grey ware, were most probably imports from Italy. A fragment of a rouletted cup in oxidised ware with a brown-red slip[27] seems more likely to be an import than a local product, although local production can not be excluded without analyses. Thus Plesničar-Gec's arguments for local manufacture of thin walled pottery at *Emona*[28] are not appropriate. On the other

[21] Dated by grave contexts: Petru 1972, 89 grave 951 pl. 73; 79 grave 856 pl. 59; 98 grave 62 (1067) pl. 85.
[22] See below.
[23] See below.
[24] Plesničar-Gec 1987, 459 fig. 8.
[25] Inv. nos. 2150:A, 2151:A, 2208:A, 2209:A, 2210:A, 2211:A and 2212:A; four of them are illustrated in Plesničar-Gec 1987 fig. 8 (all the inventory numbers quoted refer to Mestni muzej, Ljubljana and are preceded by 510:LJU;).
[26] Inv. nos. 2150:A and 2151:A (illustrated on the lower row of fig. 8 in Plesničar-Gec 1987 and in Istenič/Plesničar-Gec 2001 fig. 7,1–2) and probably also 2212:A (illustrated in Istenič/Plesničar-Gec 2001 fig. 7,1) and 2208:A (illustrated in Istenič/Plesničar-Gec 2001 fig. 7,2 as well as in Plesničar-Gec 1987 fig. 8, upper row, left to right), as well as 2210:A and 2211:A. Cf. Istenič/Daszkiewicz/Schneider forthcoming, fig. 11.
[27] Inv. no. 2209:A.
[28] Plesničar-Gec 1987, 459.

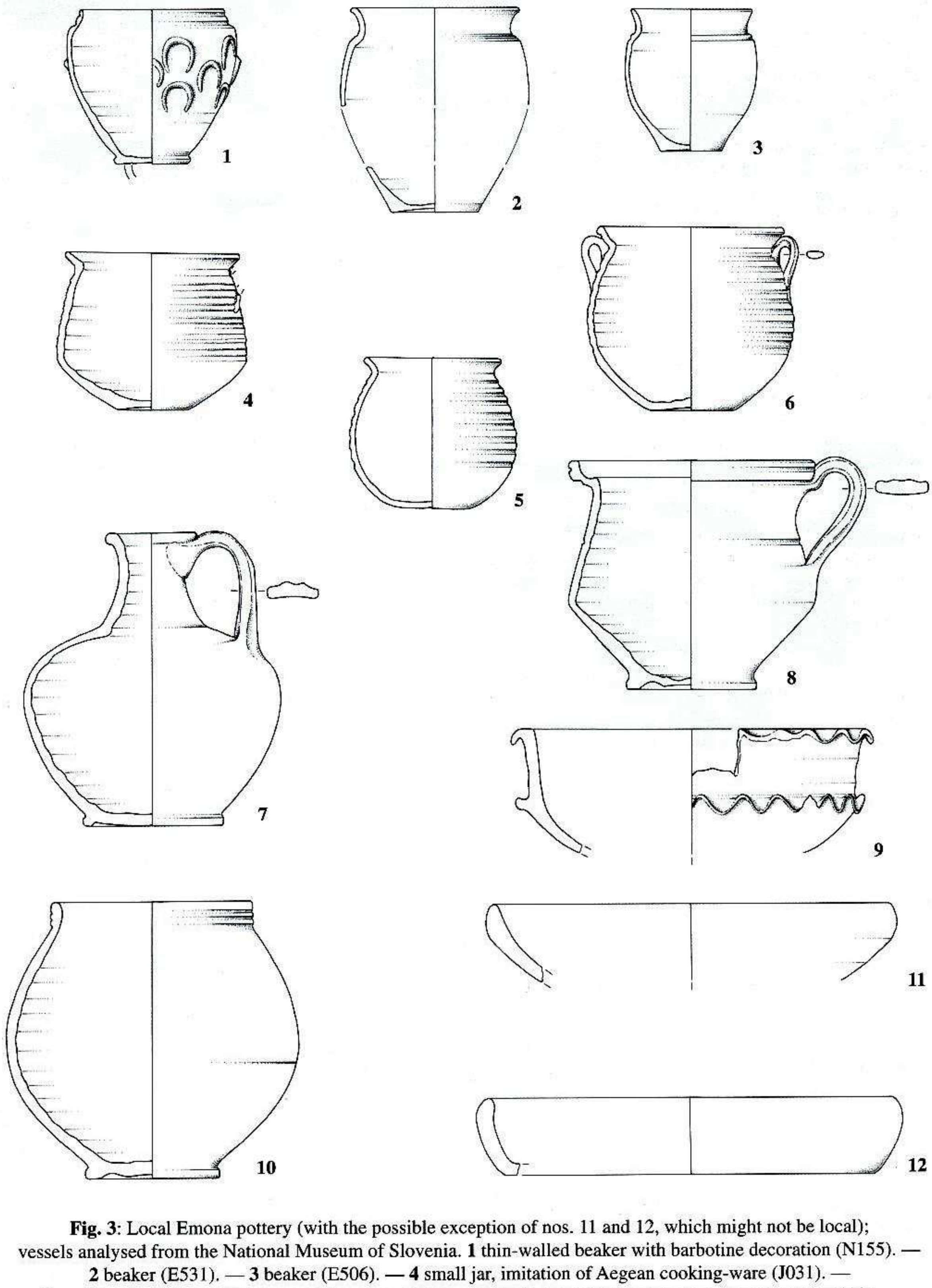

Fig. 3: Local Emona pottery (with the possible exception of nos. 11 and 12, which might not be local); vessels analysed from the National Museum of Slovenia. **1** thin-walled beaker with barbotine decoration (N155). — **2** beaker (E531). — **3** beaker (E506). — **4** small jar, imitation of Aegean cooking-ware (J031). — **5** small jar, imitation of Aegean cooking-ware (J032). — **6** small jar, imitation of Aegean cooking-ware (J028). — **7** flagon (N153). — **8** pot with a handle (N154). — **9** sherds of a tazza (N151). — **10** jar (N150). — **11** sherd of a dish (N158). — **12** sherd of a dish (N159). — Scale 1:3.

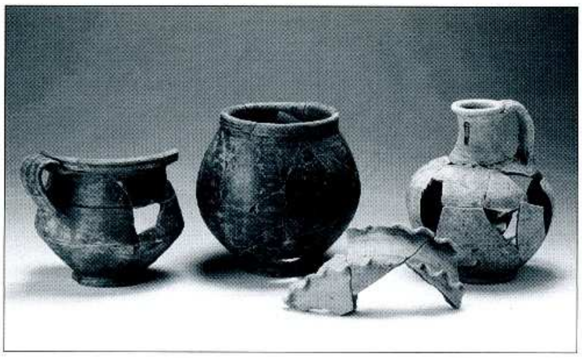

Fig. 4: Local Emona vessels from various contexts: N154, N150, N151 and N153. Not to scale.

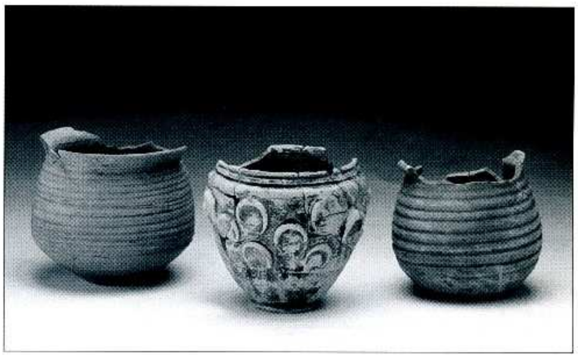

Fig. 5: Local Emona vessels from various contexts: J031, N155 and J032. Not to scale.

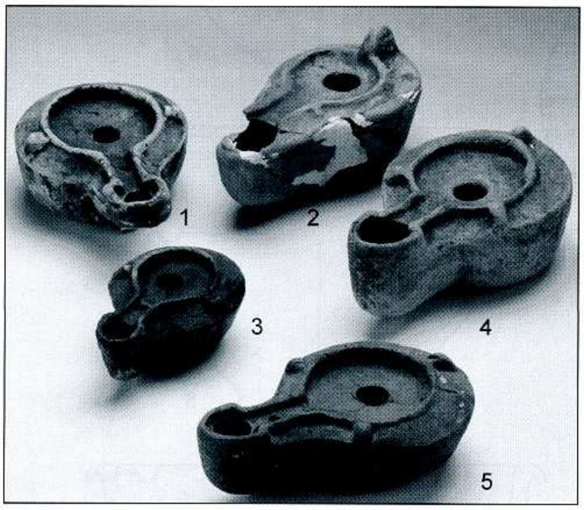

Fig. 6: Local Emona lamps: **1** E510. — **2** E499. — **3** E504. — **4** E537. — **5** E525. — Not to scale.

hand, the beaker with barbotine decoration (**figs. 3,1; 5**), classified as local macroscopically and confirmed by chemical analysis and thin-section as well as MGR (**N155, tables 1–2**), seems to provide a good argument for the existence of local production of thin-walled wares at *Emona*. It came from a grave dated to the Flavian period or the beginning of the 2[nd] century.[29]

The locally produced beakers **fig. 3,2–3 (E750, E752, E506, E531 tables 1–2)** which were analysed have relatively thin walls, usually with a vertically trimmed surface on the body and date to the period from the second half of the 1[st] to the first half of the 2[nd] century. These have very good analogies among contemporary beakers locally produced at *Poetovio*.[30] A common ancestry, most probably in Italian pottery, may be assumed for these beakers.[31]

The small ribbed jars (**fig. 3,4–6**), local Emona products,[32] are probably imitations of Aegean cooking-ware jars, common in the period *c.* 60–250 AD.[33]

It should occasion no surprise that *Firmalampen* (**fig. 6**) were also produced at *Emona*.[34] Potters' name-stamps known from the vicinity of *Mutina*/Modena (FORTIS, QGC, VIBIANI[35] and probably also VERI[36]), as well as a nonsense stamp (E490) are represented there. Among the locally-made lamps analysed, are several examples of relatively high (Buchi Xa and Xa/b; **table 1,E482.E491.E510**) and medium (Buchi Xb; **table 1,E504.E525.E537**) quality, as well as degenerate lamps (Buchi Xb/c and Xc; **table 1,E490.E499**). It is remarkable that while most of the locally made lamps at *Emona* and elsewhere are slipped, two of the locally made high quality lamps at *Emona* (E482 and E491) are not slipped. This unslipped surface makes these lamps even more similar to the imported lamps from the vicinity of *Mutina*/ Modena.

Macroscopically, it is not easy to distinguish fabrics F 7 and F 8 local to *Emona* from fabrics F 7 and F 8 local to *Poetovio*. The differences, which cannot always be observed on a single vessel/lamp or sherd, seem to be in greater quantities and larger-sized particles of mica, larger particles of iron-rich inclusions, as well as larger inclusions of quartzite in Poetovian fabrics. Chemically, the *Emona* reference Group E (i.e. fabrics F 7 and F 8 local to *Emona*) can be clearly differentiated from the *Poetovio* Groups A and B (i.e. fabrics F 7 and F 8 local to *Poetovio*)[37] by the higher quantities of Mn, Mg, Na, Rb, Sr, Zr in the pottery from *Poetovio*. Mineralogically, the fabrics F 7 and F 8 local to *Poetovio* consist of a more silty clay with a higher quantity of fine mica. Additionally, iron-rich inclusions are more abundant in the fabrics from *Poetovio* than in those local to *Emona*.

Acknowledgements

To Toma· Verbič we are grateful for putting us in contact with Franc Vidic; we are indebted to the latter for giving us

[29] The dating derives from the probable north Italian *Firmalampe* of type Loeschcke IXb: PETRU 1972, 98 grave 62 (1067) pl. 85,11. — For classification and dating see ISTENIČ 1999, 150–152.
[30] Cf. ISTENIČ 1999, 115.
[31] Cf. ISTENIČ 1999, 114–115 form B4 figs. 100; 102.
[32] Cf. ISTENIČ/SCHNEIDER 2000, 341 note 7.
[33] ISTENIČ/SCHNEIDER 2000, 341 fig. 3,4–6; 346–347.
[34] Cf. ISTENIČ 1999, 152; 155–159. — DASZKIEWICZ/SCHNEIDER 1999, 184–190.
[35] Cf. ISTENIČ 1999, 154 with references. — DASZKIEWICZ/SCHNEIDER 1999, 184–185; 190. — SCHNEIDER/WIRZ 1992, 44 table 7a.
[36] BUCHI 1975, 158–159. — SCHNEIDER/WIRZ 1992, 44 table 7a.
[37] DASZKIEWICZ/SCHNEIDER 1999.

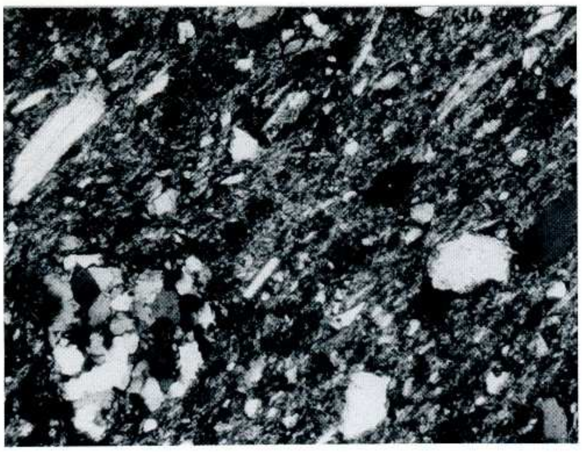

Fig. 7: Photomicrograph of a thin-section of a typical fabric F 7 (sample N153, XPL, width of field 1 mm).

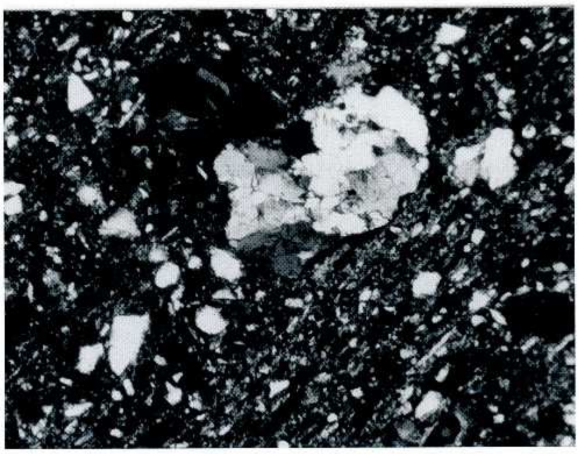

Fig. 8: Photomicrograph of a thin-section of a typical fabric F 8* (sample N146, XPL, width of field 1 mm).

extremely valuable information on clay deposits in the centre of Ljubljana. Dr. Mateja Gosar and Dr. Robert Šajn (Geological Survey of Slovenia) kindly took the clay samples at Koseze with the aid of a special drill. Dr. Mateja Gosar also took the remainder of the clay samples, helped us with information and discussed with us the geology of Ljubljana. She also read a draft of the paper and provided useful comments. Drawings were made by Uroš Stiškovki and Ida Murgelj, the photographs by Toma· Lauko (National Museum of Slovenia). The help of Dr. Vivien Swan who improved the English text was especially valuable.

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