Zeitschrift: Jahrbuch der Schweizerischen Gesellschaft für Ur- und Frühgeschichte = Annuaire de la Société Suisse de Préhistoire et d'Archéologie = Annuario della Società Svizzera di Preistoria e d'Archeologia

Herausgeber: Schweizerische Gesellschaft für Ur- und Frühgeschichte

Band: 84 (2001)

Artikel: Gallo-Roman Terra Sigillata Imitations : an attempt of attribution of some potters to their production centres

Autor: Zanco, Angela / Luginbühl, Thierry

DOI: https://doi.org/10.5169/seals-117664

Jahrbuch der Schweizerischen Gesellschaft für Ur- und Frühgeschichte 84, 2001, 71–86.

Angela Zanco and Thierry Luginbühl

Gallo-Roman Terra Sigillata Imitations: an attempt of attribution of some potters to their production centres

Abstract

This work deals with the archaeometric analysis of imperial age Gallo-Roman Terra Sigillata imitations (TSI) from Switzerland. The main aim of this study was to define the mineralogical and chemical characteristics of these ceramics in order to obtain information concerning raw materials and techniques used in the past.

In particular, this paper is part of a PhD thesis on TSI stamped ceramics coming from different sites in Switzerland. The dissertation investigated the origin of stamped sherds based on the establishment of three new reference groups consisting of local and homogeneous tableware produced at Lausanne Stade, Yverdon Faustus and Avenches N-E ateliers. These three homogeneous groups were used as reference to compare chemical composition of 47 fragments of stamped TSI found in Martigny, Lausanne, Avenches, Nyon, Vindonissa and Yverdon. The aim was to identify their production places as well as the working sites of the potter who signed them on the bottom.

The study did disclose that FAUSTUS worked in a homonymous workshop. It can also be affirmed that no potter worked in Avenches N-E. The results allow to suppose that QUINTUS, SABINUS and ILLANUA worked at Lausanne Stade, although this is not expressed by a perfect chemical correspondence.

Résumé

Ce travail porte sur l'étude archéométrique d'imitations de terre sigillée du 1er s. apr. J.-C. trouvées en Suisse. Le but de cette recherche était la définition des caractéristiques minéralogiques et chimiques de la céramique afin d'obtenir des informations sur les matières premières et la technique de production utilisées par les artisans gallo-romains.

En particulier, cette publication n'est qu'un extrait d'une thèse de doctorat qui s'était occupée d'abord de la définition de trois nouveaux groupes de référence de céramiques produites dans les ateliers de Lausanne Stade, Yverdon Faustus et Avenches N-E et deuxièmement de l'origine de productions estampillées. On ne discutera ici que les principaux résultats de cette deuxième partie.

Pour ce faire, les trois groupes ont été utilisés comme références pour comparer des tessons estampillés du même type de céramique et trouvés à Martigny, Lausanne, Avenches, Nyon, Vindonissa, Yverdon. Le but était de connaître les lieux de production ainsi que les ateliers des potiers qui signèrent ces céramiques. Cette étude montre qu'on peut associer la production de FAUSTUS à un atelier homonyme à Yverdon et qu'aucun des autres potiers n'a travaillé dans les ateliers du secteur NE d'Avenches. En ce qui concerne l'atelier du Stade à Lausanne, les résultats suggèrent que QUINTUS, SABINUS, ILLANUA, ont travaillé là, même si la correspondance chimique n'est pas parfaite.

1. Introduction: Terra sigillata imitations and analytical approach

Emblematic of the ceramic facies of the early Roman period on the Swiss Plateau, the «helvetic» sigillata imitations (TSI) consist of a group of orange or black tableware (Luginbühl/Schneiter 1994; Luginbühl 1995a, b) that was produced between the mid-Augustean and mid-Antonine periods (from about 15 BC–150 A.D). These wares imitate the techniques of imported sigillata, but a large part of the forms and shapes are of native tradition. Occasionally the ceramics present stamps of major interest for the study of the organisation of the production and history of the manufacturers. Well known since W. Drack's monograph (Drack 1945), this set of productions has recently been the subject of a doctoral thesis at the University of Lausanne (Luginbühl 2000). This work was accomplished simultaneously with a doctoral thesis at the University of Fribourg (Zanco 1999) dedicated to a large program of physical and chemical analyses. This paper presents the principal results of the PhD thesis of A. Zanco. Zanco's work focused on the study of production techniques (clay selection, slip preparation, firing temperature, etc....) and chemical composition of TSI from three major workshops in Switzerland: Lousonna Stade, Yverdon Faustus, and Avenches N-E. Her analysis results have permitted to determine three new reference groups from sets of wasters found in these three workshops. The mineralogical and chemical particularities of these reference groups specific to TSI which added to the ones earlier defined for the Lausanne workshop of *La Péniche* (Maggetti 1980), were subsequently compared to the stamped pieces to attempt to attribute them to production centres. The 92 analysed fragments bearing the names of 35 different potters allows only a few true demonstrations because of the rareness of workshop's reference groups. It gave nevertheless relevant information, that acquires its full significance when compared to workshops wasters and by the distribution of the different stamp types.

2. Research aims

This work describes a part of the analyses carried out on stamped sherds (figure 1) of various potters from the most important Gallo-Roman sites in Western Switzerland. From 92 samples excavated in different places and provided by local museums, only the most represented and important potters are discussed here. In fact, while some important and well-known potters (such as VILLO, VEPOTALUS, FAUSTUS and SABINUS) could be represented and studied by several analyses (from 7 to 12 samples), others (COIUS, GENIALIS, PINDARUS, QUINTUS, ASPRENAS, ILLANUA, IUCUNDUS, PINDARUS, IUVENIS) were only studied on a few sherds (between 2 and 7). Lastly, 22 stamps (CICUS, AEI CRITI, ALBINUS, C. SAT., SOILLUS, GENTILIS, SEXTIUS, MELUS, FRONTO, CINCE«SS», CIUS, IUSTUS, METILLIUS, MURRANUS, RESPECTUS, TERTIUS, CATU(SIUS), DIOMEDES, FELIX, LICCATUS, DABINATUS, FLORUS) provided only one ceramic sample. We discuss here the ceramics signed by VILLO, VEPOTALUS, FAUSTUS, SABINUS, QUINTUS and ILLANUA.

The aims of this study were to define the geographical provenance of products found at the different sites, attribute them to the workshops and evaluate the possible existence of workshop branches.

To define the geographical provenance of products found of different places, chemical data were compared with data from previously defined reference groups (see paragraph 4). Firstly the sherds were examined on their mineralogical and petrographic aspects. All the samples showed similar petrographic chareacteristics under the microscope. X-ray analysis revealed phases that indicate more than one particular production centre. Moreover, each potter seemed to have slightly differing «composition» recipes for his production, although the petrographic-mineralogical features are similar for sherds of different potters.

After a short description of the petrographic characteristics, the investigation will concentrate on the chemical approach: these results, here presented as bivariant diagrams of major and trace elements, were not exhaustive to ascertain provenance; for a successful interpretation, cluster and discriminant elaborations were necessary. In particular, Mahalanobis (M) distance histograms or their values were very helpful for comprehension.

Regarding the bivariant diagrams and the results of the discriminant analysis, only the most important and exhaustive will be discussed in the following pages.

For all the other potters' analyses and diagrams, refer to Zanco (1999) and Luginbühl (2000).

3. Sampling and analytical methods

Forty seven samples (tab. 1) excavated at different places were provided by local museums as follows:

20 samples from Lausanne («Musée Romain de Lousonna-Vidy»); 3 from Yverdon («Musée du Château d'Yverdon»); 1 from Atelier du Faustus, (Yverdon); 7 from Avenches («Musée Romain d'Avenches»); 10 from Vindonissa («Vindonissa-Museum») and 6 from Martigny («Office de recherches archéologiques de Martigny»).

The applied methods were the following:

- Quantitative chemical analysis by X-ray fluorescence (PHILIPS PW 2400 spectrometer, Institute of Mineralogy and Petrography, University of Fribourg) of major and minor elements (Si, Ti, Al, Fe, Mn, Mg, Ca, Na, K, P) and trace elements (Ba, Cr, Cu, Nb, Ni, Pb, Rb, Sr, Y, V, Zn, Zr). Samples were prepared as described in Zanco (1999). Chemical data are available in table 2.
- Phase analysis by powder X-ray diffraction (PHILIPS PW 1800 diffractometer, Institute of Mineralogy and Petrography, University of Fribourg), to investigate the mineralogical composition and evaluate the maximum firing temperature (Peters/Iberg 1978; Maggetti 1981).
- Polarisation microscopy for fabric analysis (matrix and temper characterisation).
- Statistical applications: uni- and bivariant analyses, cluster analysis with average and single linkage methods based on Euclidean distances calculated on 16 elements (SiO_2, TiO_2, $Al2O_3$, Fe_{tot} (as Fe_2O_3), MgO,

CaO, Na_2O, K_2O, Cr, Ni, Rb, Sr, V, Zn, and Zr), M distances calculated on the same elements and discriminant analysis based on Mahalanobis distances (Wilkinson 1989).

We assumed that an attribution could be stated if the M distance of a sherd of unknown origin shows values comprised between the minimum and maximum M distance values of the comparing reference group (Picon 1984).

FeO was determined only for the samples for which sufficient material was available. For FeO analysis the Di-pyridil method was employed (Koester 1979).

4. The Reference groups

The following section presents a short description of TSI reference group characteristics. Chemical data are available at the web site: http//www.unifr.ch/mineral.

- CH 39 represents the Lausanne Stade reference group, which was active during the 1st century A.D. This group comprises of 36 homogeneous calcium-rich samples with a mixed, fine matrix. Calcite is well developed in the porosities. Maximum firing temperatures are estimated at around 950°C. Besides this homogeneous group, 10 other sherds were characterised and, as they were not definitely imported, re-used in the attribution study. The local origin of this large number of TS imitations was attested by the presence of kiln fragments and loom weights.
- CH 40, or the Yverdon *Faustus* (30/60 A.C) workshop, a very homogeneous reference group with a chemical character not far from that of Lausanne Stade, consists of 28 samples, normally fired in an oxidising atmosphere and characterised by a fine matrix. Also in these textures, the porosities are filled by calcite, in mono- or poly-crystals. Firing temperature was in the range 850°–950°C, sometimes attaining >950°C.
- CH 41, Avenches N-E workshop. This centre was in activity during the second half of the 1st century A.D. It is represented by 25 samples, with a fine, temper-poor matrix. Many clay pellets and iron oxide spots are distributed in the groundmass. Most of the samples were fired in reducing conditions.

5. Attribution examples: major and minor potters

As CH 14 (La Péniche), CH 18 (Baden B; Jornet 1982) CH 19 (Baden + Augst), CH 22 (Bern; Jornet 1982) and CH 24 (Lausanne 2) were ceramic productions considered to be similar to TS imitations, attributions were made on these groups. They were carried out in two stages, comparing first stamped production with CH 18, 22, 24 and then with CH 14 and 19.

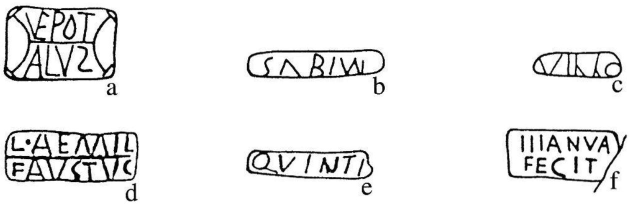


Fig. 1. Examples of the six studied potters' stamps. a VEPOTALUS; b SABINUS; c VILLO; d FAUSTUS; e QUINTUS; f ILLANUA.

CH 14 and 24 were established by Kaenel et al. (1982) in their study on several Gallo-Roman workshops found in the neighbourhood of Lausanne, presenting different ceramic categories and types. These production centres were not far from that of Lausanne Stade (especially La Péniche), and so it is not surprising to find more similarities with the production centres near Lausanne than with those of Bern, Baden B and Baden + Augst. The latter were too far away, and more difficult to reach or the potters. Also the results of discriminant analysis made on CH 18, 19 and 22 confirmed that no real possibility of attribution existed for these references. Moreover, none of the sample seems to belong to La Péniche workshop.

Only one reference group, CH 24 (Lausanne 2), consisting of CaO-rich TS from different sectors («Sector 25», «Sector 23», «Forum» and «Marchand»), shows correspondence with the stamped samples. Some similarity was found with ZA 114 from Lausanne, on which the signature *QUINTUS* can be read. It is worth noting that these similar appearances are always expressed by marginal M distance values. Table 3 shows the results of discriminant analysis.

The correlations of CH 39 (Lausanne Stade), CH 40 (Yverdon *Faustus*) and CH 41 (Avenches N-E) were first carried out considering each workshop and all the stamps by means of cluster analysis. Dendrograms (Zanco 1999) already provided an approximate description of what was later found with discriminant analysis. A sharp separation indicates that samples from Yverdon *Faustus* and Avenches N-E are each very homogeneous; no similarity put stamped sherds in relation with the Avenches N-E reference, while for the Yverdon *Faustus* group, only one sample, ZA 80, appears in its cluster. The situation is slightly different in Lausanne Stade, where the general pattern of the group is mixed with some stamped samples, indicating similar chemical characteristics.

MUSEUM OF PROVENANCE/ SHERD NUMBER	INVENTORY NUMBER	SAMPLE TYPE	CATE-GORY	SHAPE	STAMP TYPE	STAMPS/POTTER STAMPS	COLOUR	REFERENCE
Musée Romain de Lousonna-Vidy								
ZA 4	VS 90/6892/2	CUP	TSI	Ha-8	II	AEMILIUS FAUSTUS	average grey	Lousonna 9, 170, no 513
ZA 6	VS 90/8068/2	PLATE	TSI		I	VILO	light beige	Lousonna 9, 171, no 525
ZA 8	VY 90/6323/5	CUP	TSI	Ha8	III	AEMILIUS FAUSTUS	average beige	Lousonna 9, 170, no 511
ZA 10	VY 89/5899/2	PLATE	TSI-TG	Ha2/Drag17	II	ILLANUA FECIT	average grey	Lousonna 9, 171, no 517
ZA 12	VY 90/6669/2	CUP	TSI	Ha-8	IV	AEMILIUS FAUSTUS		Lousonna 9, 170, no 514
ZA 114	XLVII - C029	PLATE	TSI		I	QUINTUS		inédit
ZA 115	E62/3291	CUP	TSI	Drag24/25	I	QUINTUS	beige-orange	inédit
ZA 116	C435	CUP	TSI	Drag24/25	I	QUINTUS	average beige	inédit
ZA 120	Q49 - C287	PLATE	TSI-TG		VII	SABINUS	grey-beige	Luginbühl/Schneiter 1994, 51, no 44
ZA 121	E62/3573 - C435	PLATE	TSI		IV	SABINUS	light grey	inédit
ZA 126	60/00208 - C67	PLATE	TSI		VII	VEPOTALUS	average beige	inédit
ZA 132	C290				II	VILLO	beige-orange	inédit
ZA 133	C290		TSI?			FAUSTUS		inédit
ZA 149	E 62/992 (C443)	CUP	TSI		II	QUINTUS	average beige	Lousonna 1, 275, no 20
ZA 150	E 62/02079 (C700)	CUP	TSI	Ha-7	II	VEPOTALUS	beige orange	Lousonna 1, 275, no 33; Luginbühl/Schneiter 1994, 52, no 57
ZA 153	E 62/230 (C443)	CUP	TSI		V	VILLO	light beige	Lousonna 1, 276, no 38
ZA 154	...06 C211	PLATE	TSI		VIII	VEPOTALUS	average beige	inédit
ZA 156	E 62/33 (C443)	PLATE	TSI		II	QUINTUS	light beige	Luginbühl/Schneiter 1994, 50, no 37
ZA 157	3422/C596				V	VILLO	average beige	inédit
ZA 158	E 62/2541 (C443)	PLATE	TSI		V	VILLO	average beige	inédit
Yverdon Atelier du Faustus								
ZA 80	YV. 1991 CR-2-26					L. A. FAUSTUS		inédit
Musée du château d'Yverdon								
ZA 161	YV 1991	PLATE	TSI		VII	VEPOTALUS	average beige	inédit
ZA 162	Jordils-2042	CUP	TSI	Drag24/25	X	SABINUS	average beige	inédit
ZA 216	Ny. 13121-1					VEPOTALUS	light brown	inédit
Musée Romain d'Avenches								
ZA 173	AV. 79-7164	CUP	TSI-TG	Ha-8	I	ILLANUA	average beige	inédit
ZA 180	AV. 63-781		TSI-TG		II	QUINTUS	light beige	inédit
ZA 185	AV. 69-4269	CUP	TSI	Ha-8	II	VEPOTALUS	average beige	inédit
ZA 186	AV. 61-2908	CUP	TSI	Ha-7	VII	VEPOTALUS	average beige	inédit
ZA 187	AV. 73-41	PLATE	TSI		VII	VEPOTALUS	beige orange	inédit
ZA 188	AV. 69-4271	CUP	TSI		II	VILLO	beige orange	inédit
ZA 189	AV. 70-2865	CUP	TSI	Ha-8	I	VILLO	light beige	inédit
Vindonissa Museum								
ZA 196	ST.1727	PLATE	TSI		II	VILLO	average beige	Drack 1945, 120, no 132
ZA 197	ST. 2458	PLATE	TSI		VII	VILLO	beige orange	Drack 1945, 119, no 121
ZA 198	ST. 588	PLATE	TSI-TG	Imit.Ha3/ Drag 15/17	V	VILLO	dark grey	inédit
ZA 199	ST.741	CUP	TSI	Drag 24/25	VII	SABINUS	average grey	Drack 1945, 114, no 84
ZA 200	ST.2278	CUP	TSI	Drag 24/25	IX	SABINUS	average beige	Drack 1945, 114, no 80
ZA 201	ST.2158	CUP	TSI	Drag 27	VIII	SABINUS	beige orange	Drack 1945, 114, no 83
ZA 202	ST.2529	PLATE	TSI	Drack 4	III	L. AEMILIUS FAUSTUS	average beige	Drack 1945, 103, no 3
ZA 203	ST.2101	PLATE	TSI-TG	Ha 2	III	L. AEMILIUS FAUSTUS	dark grey	Drack 1945, 103, no 3 (sic!)
ZA 204	ST.3332	PLATE	TSI	Imit. Drag 15/17	II	QUINTUS	average beige	Drack 1945, 113, no 36
ZA 205	ST.9917	PLATE	TSI		VII	VEPOTALUS	average beige	-
Office de recherches archéologiques de Martigny								
ZA 207	3130 A/1	PLATE	TSI	Imit.Ha2	VII	VEPOTALUS	average beige	inédit
ZA 208	900/2 Délèze /3	PLATE	TSI	Imit.Ha2	VII	VEPOTALUS	beige orange	inédit
ZA 209	1273/1	PLATE	TSI		VII	VILLO	average grey	inédit
ZA 210	2402/1	PLATE	TSI	INDET.	INDET.	VILLO	beige orange	inédit
ZA 211	1622/1	CUP	TSI-TG	Drag 24/25	XIV	SABINUS	average grey	inédit
ZA 212	2773/3	INDET.	TSI-TG		X	SABINUS	average grey	inédit

Tab. 1. Sample list.

SAMPLE	P	NAME	SiO2	TiO2	Al2O3	Fetot	MnO	MgO	CaO	Na2O	K2O	Total	CO2	H2O	FeO	Ba	Cr	Cu	Ga	Nb	Ni	Pb	Rb	Sr	Th	V	Y	Zn	Zr
MAJOR POTTERS																													
ZA 4	L	FAUSTUS	57	0.9	20	7.56	0.1	2.8	7.3	0.93	3.2	100	4.8	5		847	116	45	18	16	81	20	126	280	1	114	31	145	152
ZA 8	L	FAUSTUS	63	0.9	19.4	6.77	0.1	2.34	3.1	1.18	3.3	100	2.4	3.2		995	123	46	18	15	93	4	168	192	1	133	29	157	168
ZA 12	Y	FAUSTUS	53	0.9	20.2	7.42	0.1	4.48	9.8	0.71	3	100	5.4	6.1		657	108	116	17	17	97	29	107	223	1	116	29	247	137
ZA 80	L	FAUSTUS	51	0.8	19.4	6.97	0.3	3.4	14	0.7	3.3		1.7	3		827	109	25	19	14	96	1	172	555	2	130	24	101	111
ZA 133	L	FAUSTUS	55	0.9	19.8	7.3	0.1	3.15	9.2	0.88	3.3	100	5.8	5.9		903	97	46	12	16	79	22	130	287	6	94	29	129	144
ZA 202	V	FAUSTUS	60	0.8	19	6.94	0.1	2.45	5.7	1.06	3.6	100				713	186	57		16	114	34	167	220	16	149	32	123	156
ZA 203	V	FAUSTUS	61	0.9	20	6.5	0.1	2.63	3.6	1.1	3.8	100			3.6	997	206	37		17	113	24	177	197	15	161	34	127	160
ZA 120	L	SABINUS	51	0.8	20.7	7.39	0.1	3.48	12	0.65	3.7	100	5.7	5.4	2	763	117	20	17	15	83	1	153	399	4	132	25	136	108
ZA 121	L	SABINUS	51	0.8	20.4	7.6	0.1	4.08	12	1.04	2.7	100	0.8	2.5	1	665	121	36	20	14	98	4	138	379	5	140	26	99	122
ZA 162	Y	SABINUS	52	0.8	18	6.45	0.2	3.23	15	0.78	3.4	100				679	139	41		14	102	25	157	423	15	102	26	113	124
ZA 199	V	SABINUS	53	0.8	19.4	6.85	0.1	3.33	12	0.78	3.9	100			1.4	767	156	50		16	100	29	171	373	14	124	27	114	124
ZA 200	V	SABINUS	53	0.8	17.2	6.33	0.1	3.21	15	0.88	3.6	100				664	134	38		15	85	25	150	339	13	117	26	110	131
ZA 201	V	SABINUS	60	0.9	19.7	6.86	0.1	2.82	4.4	1.17	3.9	100				662	195	49		17	111	3382	176	188	31	138	36	108	158
ZA 211	M	SABINUS	52	0.8	19.1	6.77	0.1	3.63	13	0.86	3.8	100			3	712	162	54		15	105	26	158	431	13	122	24	128	122
ZA 212	M	SABINUS	52	0.9	20.3	7.09	0.1	3.55	12	0.63	3.6	100			2.8	924	176	64		16	107	24	158	550	15	141	30	135	127
ZA 126	L	VEPOTALUS	63	0.9	17.8	7.16	0.1	2.25	5.3	0.93	2.9	100	3.6	3.7		845	118	41	15	16	92	4	134	183	6	122	31	126	138
ZA 150	L	VEPOTALUS	68	0.8	16.5	6.6	0.1	2.38	2.2	1.1	2.7	100	1.8	1.4		745	190	46		18	101	31	124	145	15	121	37	113	179
ZA 154	L	VEPOTALUS	61	0.8	16.3	6.7	0.1	2.44	8.8	0.97	2.7	100	4	1.6		635	162	50		17	95	26	124	226	12	103	33	110	151
ZA 161	Y	VEPOTALUS	66	0.8	15	6.35	0.1	2.09	6.1	1.18	2.7	100	3	2.1		1104	154	43		16	86	23	122	331	13	105	34	154	179
ZA 185	A	VEPOTALUS	59	0.8	16.4	6.75	0.2	2.19	10	0.85	2.9	100	5.4	3.7	0.9	995	154	40		16	90	24	125	303	14	97	32	156	142
ZA 186	A	VEPOTALUS	64	0.8	16.6	6.27	0.1	2.63	5.5	1.18	3	100	2.4	1.7		809	150	54		16	94	26	163	423	15	117	26	120	131
ZA 187	A	VEPOTALUS	69	0.8	15.5	6.12	0.1	2.2	2.3	1.29	2.7	100	0.6	1		538	176	42		17	97	158	130	117	14	123	36	100	186
ZA 205	V	VEPOTALUS	55	0.8	16.5	6.64	0.1	2.66	15	0.81	2.2	100	8	2.9		542	152	42		16	91	23	82	266	14	86	31	121	134
ZA 207	M	VEPOTALUS	67	0.8	15.9	6.29	0.1	2.17	3.9	1.13	2.8	100	2.4	3.1		627	173	51		17	103	27	131	174	15	124	33	128	170
ZA 208	M	VEPOTALUS	66	0.9	17.6	7.13	0.1	2.41	2.2	0.97	2.9	100				502	197	51		18	116	27	138	140	17	142	36	115	175
ZA 216	N	VEPOTALUS	61	0.8	16.5	6.42	0.1	2.56	8.9	0.91	2.9	100	0.7	0.8	0.8	457	167	40		16	96	40	143	210	13	128	31	107	148
ZA 6	L	VILLO	63	0.9	19.4	7.86	0.1	2.05	2.5	0.79	3.1	100	1.9	4.2		988	152	41	21	18	95	3	151	171	5	140	31	127	135
ZA 132	L	VILLO	61	0.8	14.7	6.1	0.1	1.93	11	0.89	2.7	100	5.1	3.2		604	84	26	9	14	61	1	115	259	2	70	31	69	129
ZA 153	L	VILLO	49	0.9	20.9	7.63	0.1	4.02	14	0.69	2.3	100	2.8	3.2		773	183	49		18	117	16	82	410	14	114	29	107	130
ZA 157	L	VILLO	54	0.8	17.7	6.69	0.2	2.75	14	0.85	3.3	100	10	3.7	0.2	635	115	52		16	102	26	140	301	15	100	28	120	144
ZA 158	L	VILLO	57	0.8	16.5	6.61	0.2	3.15	13	0.58	2.1	100	7	6		596	100	49		17	91	26	70	287	13	63	32	104	157
ZA 188	A	VILLO	60	0.7	14	5.62	0.1	2.14	14	0.95	2.5	100	7.4	3.2		730	125	40		15	78	33	109	298	12	76	31	86	162
ZA 189	A	VILLO	53	0.8	19.3	6.91	0.1	3.13	12	0.76	3.9	100	3.7	3.6		813	153	55		16	93	30	162	426	15	110	26	121	134
ZA 196	V	VILLO	62	0.8	15.8	5.99	0.1	2.08	10	0.83	2.3	100	5.7	4.6		613	152	57		16	88	26	79	258	15	87	36	82	173
ZA 197	V	VILLO	61	0.7	13.8	5.5	0.2	2.3	13	0.94	2.7	100	11	3.3		645	117	46		14	77	24	116	260	14	80	29	115	141
ZA 198	V	VILLO	66	0.8	16.3	5.26	0.1	2.06	5.5	1.09	2.7	100	4	4.1	1.1	652	139	37		17	75	29	129	225	16	124	36	119	243
ZA 209	M	VILLO	63	0.7	14.5	5.72	0.1	2.11	10	1.16	2.7	100	6.1	2.7	1.7	493	148	36		15	79	23	120	315	12	93	31	86	143
ZA 210	M	VILLO	62	0.7	13.9	5.81	0.1	1.81	13	1.02	2.5	100	7.8	3.4		675	108	46		15	83	25	105	362	12	85	31	107	151
MINOR POTTERS																													
ZA 114	L	QUINTUS	56	0.8	20	7.24	0.1	3.41	7.9	0.86	3.3	100	1	2.7	0.1	605	129	35	18	14	94	1	151	292	6	119	28	89	138
ZA 115	L	QUINTUS	57	0.8	19.6	7.44	0.1	3.55	8.3	0.76	2.8	100	1.5	2.8		624	145	33	18	13	107	1	114	311	4	114	27	87	151
ZA 116	L	QUINTUS	55	0.9	20.9	7.67	0.1	3.48	8.2	0.6	3.1	100	1.4	4.4		635	108	32	19	19	99	4	124	320	7	118	29	104	145
ZA 149	L	QUINTUS	54	0.9	20.7	7.7	0.1	3.33	10	0.54	2.8	100	3.6	4.2	0.7	646	190	44		18	117	31	99	359	16	109	30	89	150
ZA 156	L	QUINTUS	52	0.8	20.2	7.38	0.1	3.67	13	0.68	3	100	2	3		711	185	41		16	111	16	141	360	15	117	27	85	126
ZA 180	A	QUINTUS	59	0.9	17.1	6.21	0.1	2.06	12	0.74	2	100				1763	142	51		16	66	18	74	422	18	115	36	97	184
ZA 204	V	QUINTUS	53	0.8	19.2	7.02	0.1	3.31	13	0.72	3	100	3.1	3.4		654	164	43		16	100	27	126	463	14	103	28	103	144
ZA 10	L	ILLANUA	55	0.8	19.8	7.23	0.1	3.34	9.9	0.75	2.8	100			2.5	689	117	22	18	15	83	1	113	319	4	141	29	113	141
ZA 173	A	ILLANUA	55	0.8	19	7.03	0.3	3.03	11	0.86	3.5	100			2.4	1009	161	43		17	94	30	142	364	15	125	30	148	150

Tab. 2. Chemical data concerning stamped samples recalculated to 100%, without P_2O_5. Fe_{tot} as Fe_2O_3. L Lausanne; Y Yverdon; A Avenches; M Martigny; V Vindonissa.

CH 24 Lausanne 2	
M min.	4.486
M max.	25.884
QUINTUS	
ZA 114	**24.098**
ZA 115	53.406
ZA 116	38.631
ZA 149	107.181
ZA 156	87.333
ZA 180	94.281
ZA 204	90.875

Tab. 3. M distances of samples carrying the names of QUINTUS calculated in relation to Lausanne 2 reference group (CH 24). Distance obtained using SiO_2, TiO_2, Al_2O_3, MgO, CaO, Na_2O, K_2O, Fe_{tot}, Cr, Ni, Rb, Sr, Zn and Zr.

	Lausanne Stade	Yverdon Faustus	Avenches N-E
M min.	2.548	1.699	2.145
M max.	37.309	32.979	20.612
VEPOTALUS			
ZA 126	218.562	240.47	220.861
ZA 150	244.329	287.336	237.892
ZA 154	199.974	222.5	205.233
ZA 161	268.393	251.148	236.637
ZA 185	262.811	244.006	259.372
ZA 186	329.272	304.176	365.568
ZA 187	221.222	266.388	217.269
ZA 205	188.747	223.397	189.048
ZA 207	300.228	322.622	295.01
ZA 208	212.201	245.51	235.194
ZA 216	189.946	212.789	216.498

Tab. 4. M distances calculated for VEPOTALUS samples in relation to Lausanne Stade, Yverdon Faustus and Avenches N-E. Maximum and minimum values for the three groups are also included. Distances obtained using SiO_2, TiO_2, Al_2O_3, MgO, CaO, Na_2O, K_2O, Fe_{tot}, Cr, Rb, Sr, Zn and Zr.

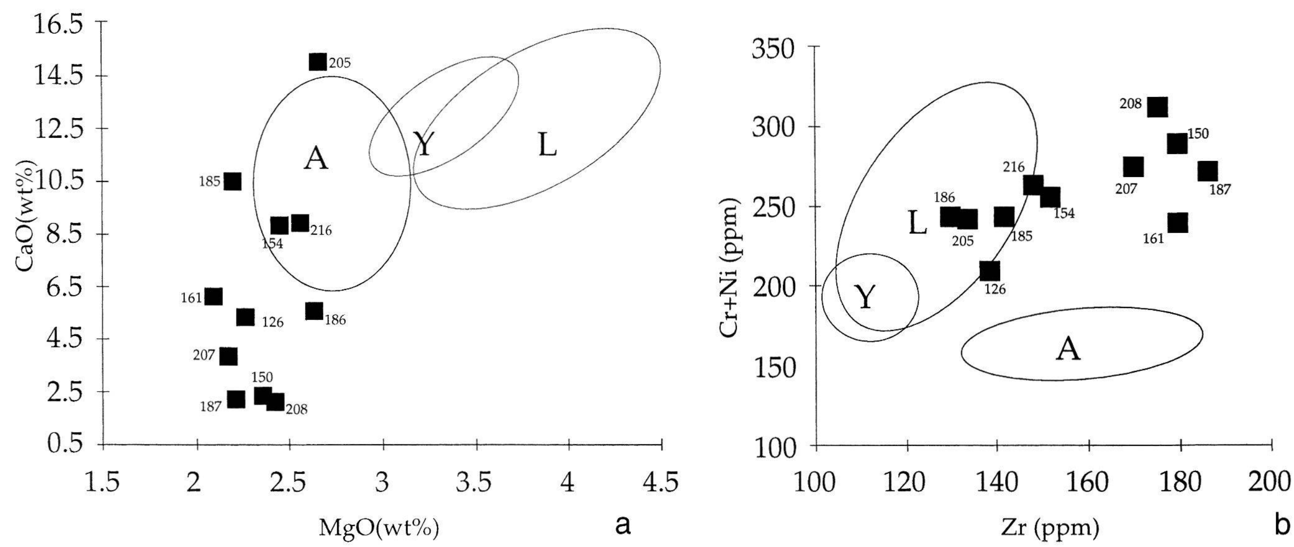


Fig. 2. CaO/MgO (a) and Cr+Ni/Zr (b) diagrams concerning distribution of VEPOTALUS (■) stamped sherds compared with three reference groups. L Lausanne Stade; Y Yverdon Faustus; A Avenches N-E.

5.1. Major potters

5.1.1. VEPOTALUS

Eleven samples, stamped with the name VEPOTALUS, were analysed: three were found in Lausanne (ZA 126, 150, 154), three in Avenches (ZA 185, 186, 187), two in Martigny (ZA 207, 208), one in Vindonissa (ZA 205), one in Yverdon (ZA 161) and one in Nyon (ZA 216). They are all cup or plate fragments, except ZA 216, which is indefinite.

All ceramic pastes stamped VEPOTALUS contain large amounts of quartz, plagioclase, K-feldspar and pyroxene. Illite is frequent. Calcite was detected in some samples. Phase analysis sometimes reveals hematite and gehlenite as well as spinel.

Under the microscope, the matrix appears fine-grained and temper-poor; it is mixed, siliceous-carbonatic. Small quartz and plagioclase crystals are observed, as well as small metamorphic rock fragments. Secondary calcite often occupies the porosity. Brownish-red grains, of various sizes and in different proportions, spot the ceramic paste.

The VEPOTALUS samples may be considered as being chemically heterogeneous. This characteristic indicates different provenances for the samples and therefore the existence of several production centres.

From the archaeological point of view (Luginühl 2001), the location of VEPOTALUS' *officina* at Avenches is very interesting, also because this potter, whose production began around 15–10 A.D., was the pioneer of TS imitations on the Helvetic territory. In spi-

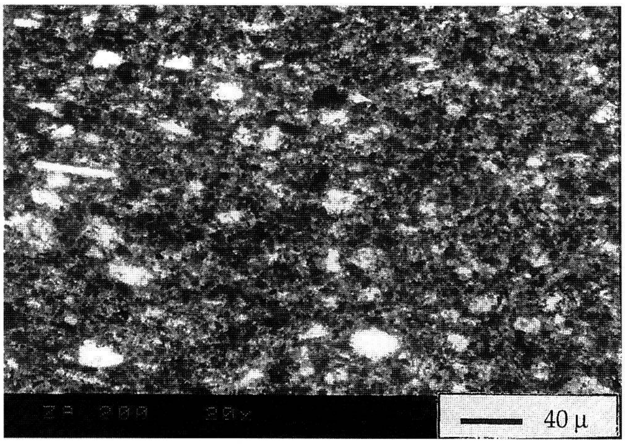


Fig. 3. ZA 200: microscopic aspect of a sherd carryng the name of SABINUS. Inside the fine and temper-poor matrix some quartz, plagioclase, chert and muscovite grains were detected. Calcite is often in the porosity. (Magnification 20×; PPL).

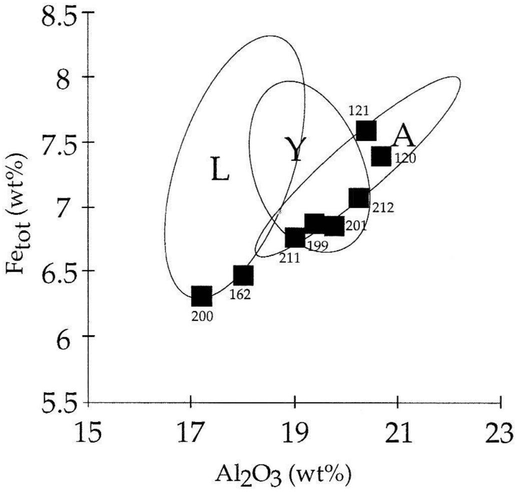


Fig. 5. Fe_{tot}/Al_2O_3 comparing Lausanne Stade, Yverdon Faustus and Avenches N-E with SABINUS samples. L Lausanne Stade; Y Yverdon Faustus; A Avenches N-E.

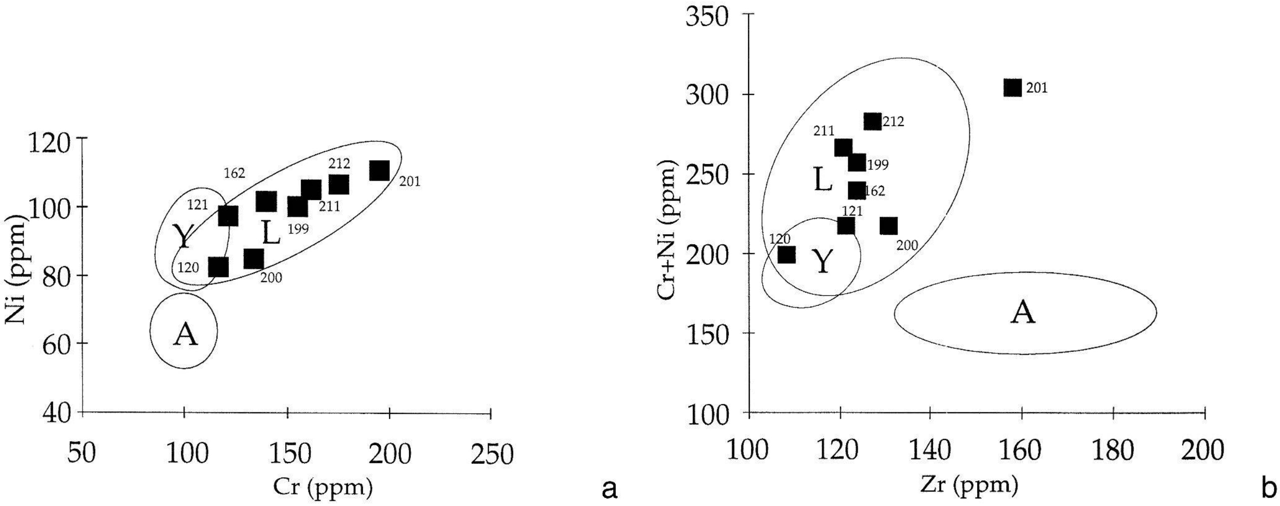


Fig. 4. SABINUS stamps and the three reference groups in the bivariant diagrams Ni/Cr (a) and Cr+Ni/Zr (b). SABINUS = ■. L Lausanne Stade; Y Yverdon Faustus; A Avenches N-E.

te of the great number of stamps of this potter in the *Caput Civitatis*, our results do not confirm that VEPOTALUS' workshop was located in the Avenches region. Considering the bivariant diagrams (CaO/MgO and Cr+Ni/Zr) of Figure 2 and the M distance distribution (tab. 4), this potter does not show any correspondance with the reference groups considered here. No attribution can be made, as far as the previously defined reference groups are concerned. Table 4 summarises M distances for VEPOTALUS samples and the three workshops. No sherd shows a value included within the patterns of the groups or marginal to them.

5.1.2. SABINUS

Eight SABINUS samples were analysed. Also in this case, they came from various places: Lousonna ZA 120, 121, Vindonissa (ZA 199, 200, 201), Martigny (ZA 211, 212) and Yverdon (ZA 162).

Contrary to the opinion of Drack (1945), who placed SABINUS' workshop at Vindonissa, Stähli (1975) supposed the centre of production to be in Lausanne Stade. His arguments are supported by the fact that this potter was the most important during the reigns of Tiberius and Claudius, when this workshop was at its peak.

The mineralogical composition of SABINUS products reveals the presence of quartz, plagioclase, K-feldspars, pyroxene and also illite in all samples. Their calcium-rich character is testified by the frequent detection

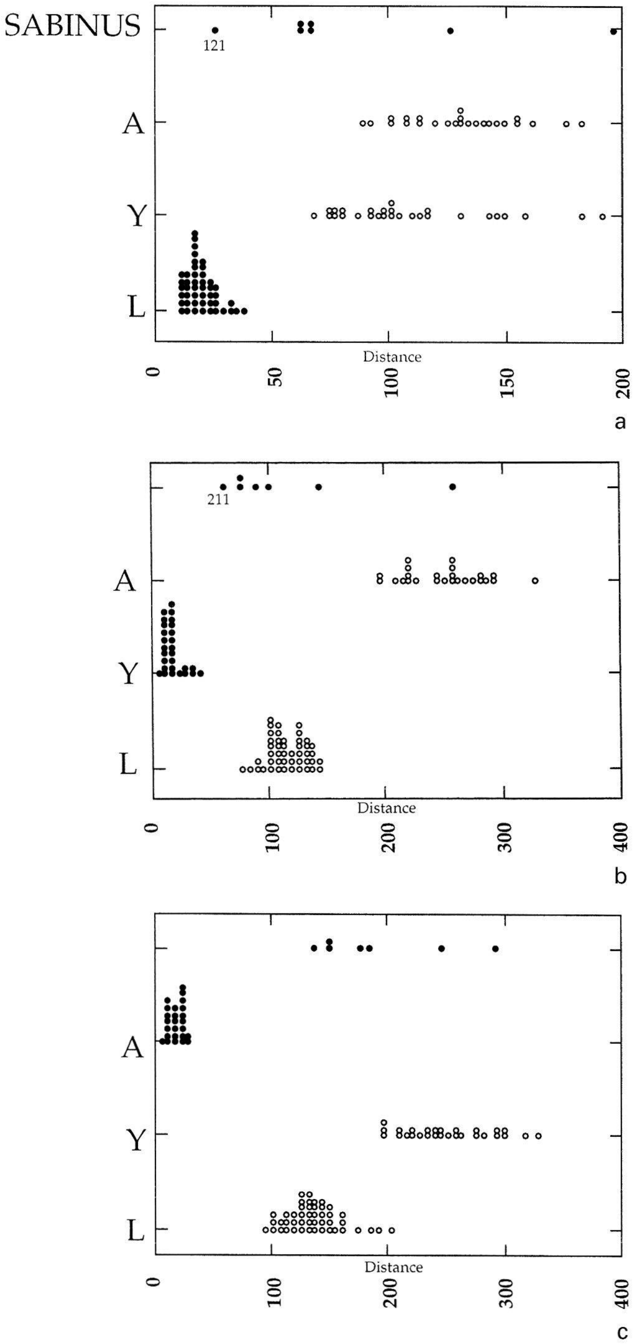


Fig. 6. M distances of SABINUS stamped sherds calculated in relation to the three reference groups of a) Lausanne Stade (= L), b) Yverdon Faustus (= Y), c) Avenches N-E (= A) concerning SiO_2, TiO_2, Al_2O_3, MgO, CaO, Na_2O, K_2O and Fe_{tot} as major elements, and Cr, Nb, Ni, Rb, Sr, Th, V, Y, Zn and Zr as trace elements.

of gehlenite and pyroxene (diopside). For most of the samples, the maximum firing temperature ranged between 850° and 950°C.

All the samples show a very fine carbonatic and temper-poor matrix. Small and rare quartz, plagioclase, chert and muscovite grains are visible. Calcite is often inside the pores. Sometimes clay pellets (especially in ZA 120, 121, 162, 200; fig. 3) are observed. The maximum diameter of the inclusions measures 0.5 mm, belonging to an argillaceous rock fragment in sample ZA 121. Although all samples show very similar petrographic characteristics, a further distinction is possible: ZA 120 with ZA 121 is identical and little temper-poorer than the others and ZA 211 and 212 (both found in Martigny). Another small group is represented by ZA 199, 200 and 201 found at Vindonissa. The temper-richest example is sample ZA 162.

The production centre in Lausanne Stade appears to be the closest to these stamped sherds as major and trace element diagrams Ni/Cr, Cr+Ni/Zr and Fe_{tot}/Al_2O_3, show (figs. 4.5), also because 21 occurrences were found in it. However, the eight SABINUS TS imitations are not chemically homogeneous. In particular, SABINUS sherds from Yverdon and Vindonissa (ZA 162, 199, 200, 201), whose chronology, quality and style allow to believe they have been produced by the same potter, show different behaviour from samples from Lausanne (ZA 120, 121) and Martigny (ZA 211, 212), especially considering their MgO and K_2O contents. In spite of these arguments, results of discriminant analysis (fig. 6) attest good similarity between sample ZA 121 and the Lausanne reference group, while ZA 211 is very marginally correlated to FAUSTUS' site in Yverdon.

5.1.3. VILLO

VILLO is the best represented potter, as 12 samples were available for analysis. ZA 188 and 189 are cup fragments and were found at Avenches; the others are all plate fragments. ZA 196, 197 and 198 come from Vindonissa; ZA 209 and 210 from Martigny. The others come from Lausanne.

Almost all the sherds stamped by VILLO were fired at a maximum temperature of 850°–950°C, as attested by the mineralogical phases of quartz, plagioclase, K-feldspars, illite and pyroxene. Calcite (considered as secondary mineral) is also often detected. Gehlenite confirms a maximum firing temperature of 950°C. Wairakite and hematite are sometimes found.

The ceramic pastes of VILLO may be divided into two groups on the basis of their petrographic characteristics. The first group contains ZA 158, 132, 197, 196, 209,

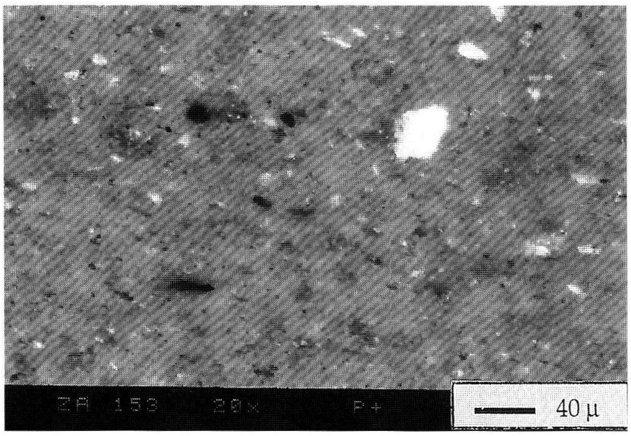


Fig. 7. ZA 153: this sample signed by VILLO is characterised by a mixed matrix very fine and temper-poor. Many iron oxyde grains spot the groundmass. (Magnification 20×; XPL).

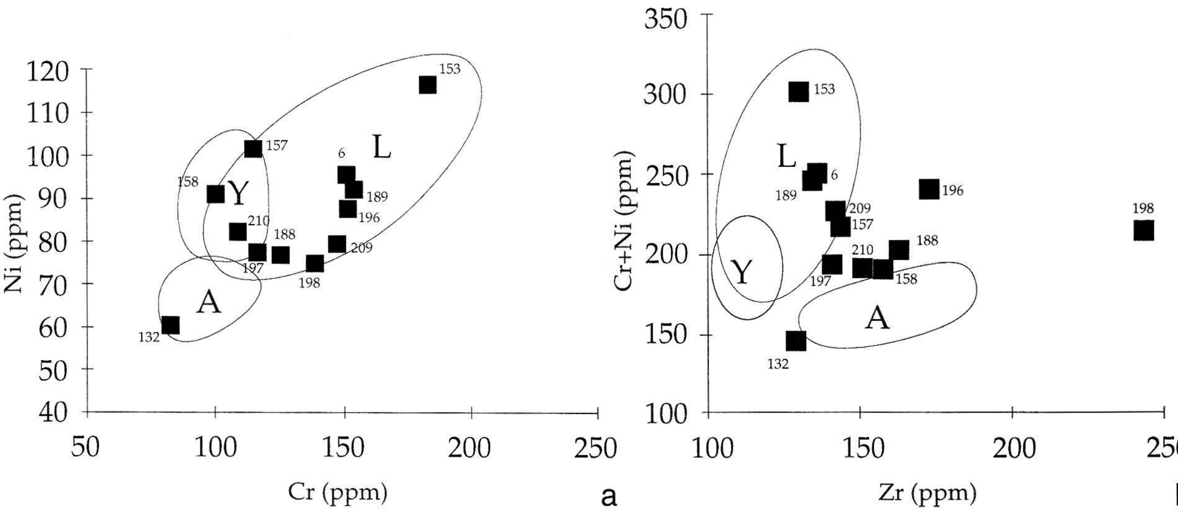


Fig. 8. Sample distribution for VILLO and the three new reference groups with bivariant diagrams Ni/Cr (a) and Cr+Ni/Zr (b). VILLO = ■. L Lausanne Stade; Y Yverdon Faustus; A Avenches N-E.

188 and 198: it shows a fine, porous matrix with a few quartz crystals homogeneously distributed in the groundmass. The second group (fig. 7) has a finer grained and mixed matrix. Both contain many red iron oxide spots.

VILLO specimens exhibit a heterogeneous chemical tendency, especially in Al_2O_3, MgO, CaO and Sr distribution. Sample ZA 153 is characterised by a behaviour similar to that of the Lausanne group, differentiating from its general pattern for the greater CaO content. In the diagrams MgO/Al_2O_3, CaO/MgO and Fe_{tot}/Al_2O_3, ZA 189 and 157 appear to be similar respectively to the Yverdon *Faustus* and Avenches N-E groups, but, according to immobile element diagrams (fig. 8) Ni/Cr and Cr+Ni/Zr, these products seem to originate from Lausanne Stade. Discriminant analysis (fig. 9) through M distance histograms confirm their marginal position to this production centre. Thus, no attribution can be ascertained: it can only be concluded that there is a greater similarity to Lausanne Stade (ZA 153) and Yverdon (ZA 189) than to Avenches.

5.1.4. FAUSTUS

Cup fragments ZA 8, 4, 12 were found at Lausanne; ZA 133 is an unidentified type of ceramic, and ZA 202 and 203 are fragments of plates coming from the Roman Museum in Avenches. ZA 80 is the stamped waste sample already described in the reference group definition.

Of the seven samples signed by FAUSTUS, six are composed of quartz, plagioclase, pyroxene, K-feldspar and illite. Calcite was also detected in all the samples. Only one, ZA 80 (a stamped waste), does not reveal the presence of illite, but it contains gehlenite, indicating a maximum firing temperature of about 950°C.

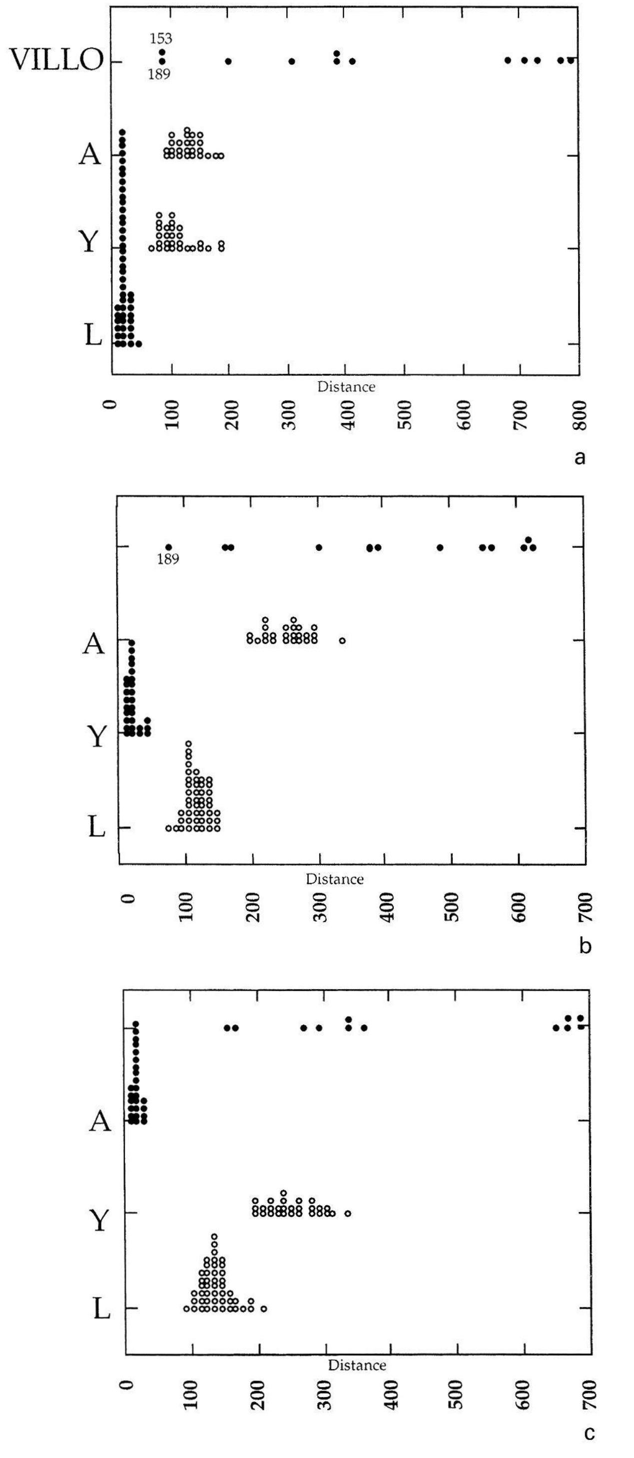


Fig. 9. M distances of VILLO stamped sherds calculated in relation to the three reference groups of a) Lausanne Stade (= L), b) Yverdon Faustus (= Y), c) Avenches N-E (= A) concerning SiO_2, TiO_2, Al2O₃, MgO, CaO, Na_2O, K_2O and Fe_{tot} as major elements, and Cr, Nb, Ni, Rb, Sr, Th, V, Y, Zn and Zr as trace elements.

Petrographic analysis revealed the fine carbonatic and temper-poor matrix characterising the production of FAUSTUS. Tempers are made up of small monocrystalline and polycrystalline quartz and feldspars. Rare muscovite and chert are also observed, as well as clay pellets. Calcite fills the pores. Maximum diameter is about 0.8 mm.

Sample ZA 80 is the only one really well linked to the reference group of Yverdon *Faustus:* as a matter of fact, from the archaeological point of view, it is a stamped waster, and the presence of FAUSTUS in the Yverdon production centre is undoubted.

In spite of this evidence, other sherds carrying the same signature seem to indicate a different attribution. They show different chemical characteristics compared with the Yverdon reference group and to ZA 80 (figs 10.11), as they contain more SiO_2, TiO_2 and Zn and less MnO, CaO and MgO. ZA 133 and 112 occupy a rather marginal position with reference to Lausanne Stade, as the M distance histograms show in figure 12.

5.2. Minor potters

5.2.1. QUINTUS

Seven samples with the name QUINTUS were submitted to analysis. ZA 114, 115, 116, 149 and 156 are from Lausanne, ZA 180 was found at Avenches, and ZA 204 at Vindonissa. All are plate or cup fragments.

From the mineralogical point of view, samples carrying QUINTUS' name are composed of quartz, plagioclase, K-feldspar and illite (except ZA 156) and a peak at 3.03 ° always reveals the presence of calcite. Hematite was also detected in all the samples.

This fact suggests a firing temperature between 850°–950°C for the majority of samples, and >950°C in the case of ZA 156. It was not possible to perform XRD analysis on sample ZA 180.

Three samples (ZA 114, 115, 116) show identical microscopic structures represented by a fine, siliceous temper-poor matrix. Quartz monocrystals and polycrystals, as well as plagioclase and muscovite, are observed. ZA 204 is characterised by a more temper-poor and finer matrix, and ZA 156 contains large amounts of secondary calcite in the porosities.

All the sherds were fired in oxidising conditions. This is evident from the presence of many red iron clots, distributed in the texture.

These samples, certainly produced by the same artisan (close stylistic similarity between the two known stamp's types), are heterogeneous and differ in their chemical behaviour when compared with the groups, but the M distance value list (tab. 5) calculated in comparison with

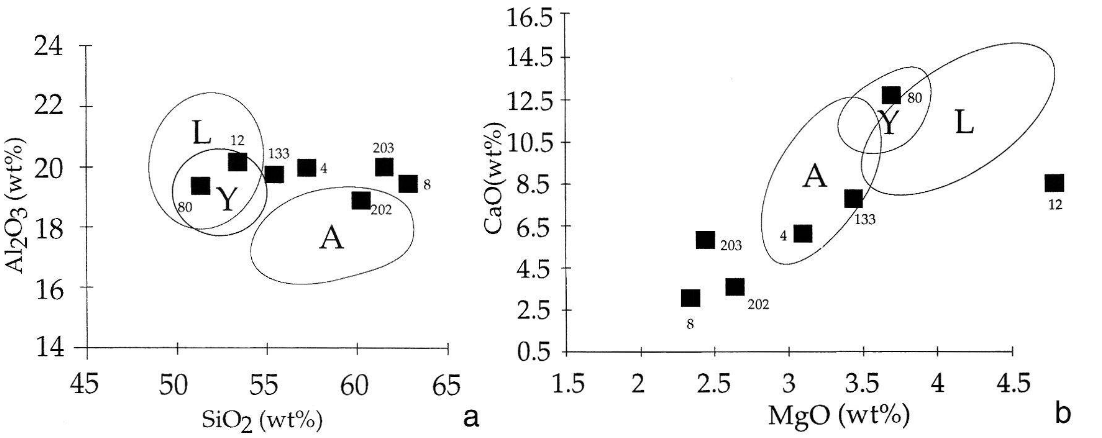


Fig. 10. Al_2O_3/SiO_2 (a) and CaO/MgO (b) bivariant diagrams showing reference groups and FAUSTUS samples. L Lausanne Stade; Y Yverdon Faustus; A Avenches N-E.

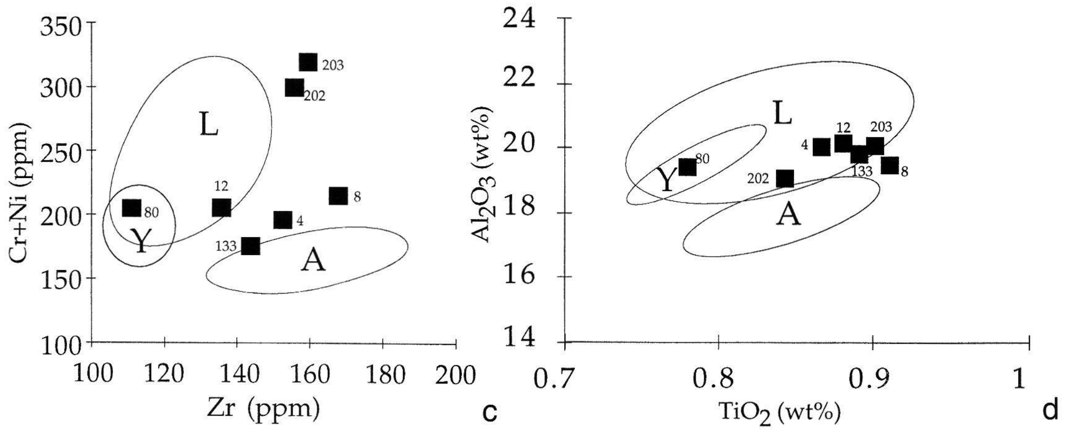
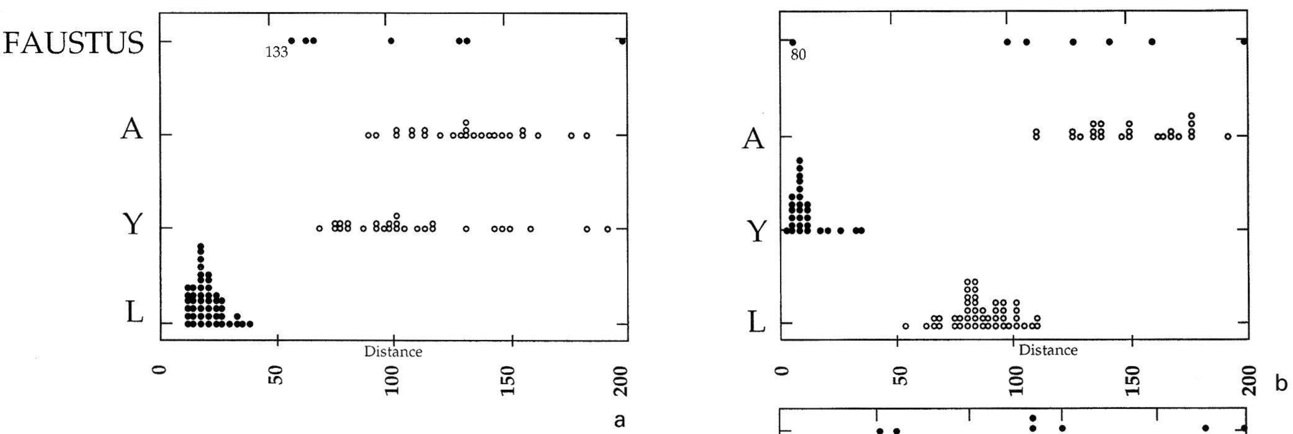


Fig. 11. Cr+Ni/Zr (c) and Al_2O_3/TiO_2 (d) showing distribution of FAUSTUS samples as compared with Lausanne Stade, Yverdon Faustus and Avenches N-E groups. FAUSTUS = ■. L Lausanne Stade; Y Yverdon Faustus; A Avenches N-E.



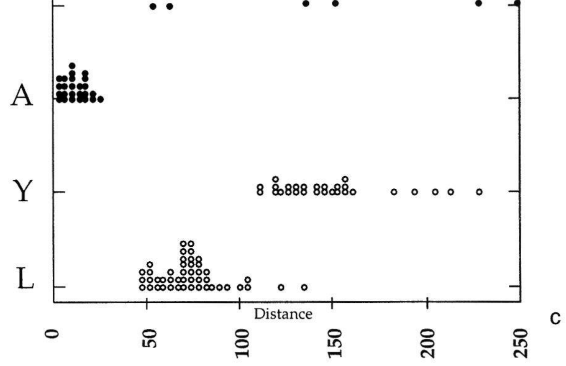


Fig. 12. M distances of FAUSTUS stamped sherds calculated in relation to the three reference groups of a) Lausanne Stade (= L), b) Yverdon Faustus (= Y), c) Avenches N-E (= A) concerning SiO_2, TiO_2, Al_2O_3, MgO, CaO, Na_2O, K_2O and Fe_{tot} as major elements, and Cr, Nb, Ni, Rb, Sr, Th, V, Y, Zn and Zr as trace elements.

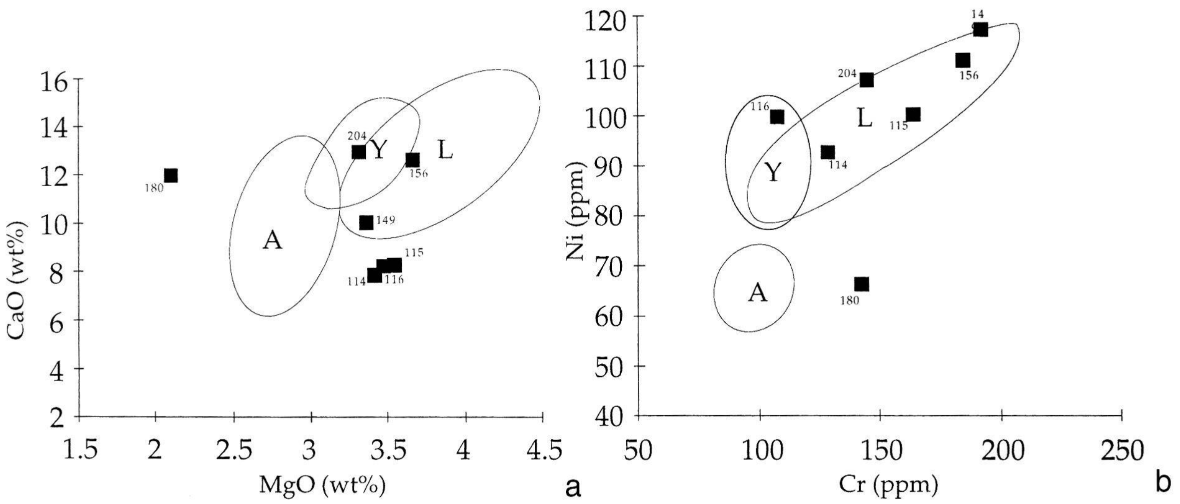


Fig. 13. CaO/MgO (a) and Ni/Cr (b) diagrams corresponding to the three workshops and samples of QUINTUS = ■. L Lausanne Stade; Y Yverdon Faustus; A Avenches N-E.

	Lausanne Stade	*Yverdon Faustus*	*Avenches N-E*
M min.	9.256	4.156	5.192
M max.	36.352	41.987	26.552
		QUINTUS	
ZA 114	**24.612**	124.333	134.203
ZA 115	73.118	186.025	192.822
ZA 116	52.782	164.755	149.69
ZA 149	52.365	139.474	151.917
ZA 156	**35.042**	114.05	172.184
ZA 180	238.859	233.859	190.417
ZA 204	**43.506**	69.792	153.654

Tab. 5. M distances calculated for QUINTUS samples in relation to Lausanne Stade, Yverdon Faustus and Avenches N-E. Maximum and minimum values for the three groups are also included. Distances obtained using SiO_2, TiO_2, Al_2O_3, MgO, CaO, Na_2O, K_2O, Fe_{tot}, Cr, Rb, Sr, Zn and Zr.

Lausanne Stade, Yverdon Faustus and Avenches N-E shows a high probability that *QUINTUS* was present in the first workshop. The bivariant diagrams of Figure 13 attest the chemical heterogeneity of these samples and their distribution corresponding to the reference groups. These results are confirmed by discriminant analysis: according to the M distances, ZA 114, 156 and 204 reflect, in decreasing order, the probability of originating from the Lausanne Stade workshop.

5.2.2. *ILLANUA*

The two sherds with the stamped name of ILLANUA, ZA 10 and 173, excavated respectively in Lausanne and Avenches, are fragments of a plate and a cup, both fired in a reducing atmosphere.

Under the microscope they are very similar showing a fine-grained, temper-poor matrix with only a few quartz crystals distributed in the groundmass. Secondary calcite covers the rims of the pores. A few, very small muscovite and feldspar crystals are also observed.

Looking at the position of ILLANUA stamps in the bivariant diagrams (fig. 14) and the results of discriminant analysis (tab. 6) it is clear that:

- ZA 10 is very close to the Lausanne Stade group;
- ZA 173 does not show constant behaviour compared with the groups;
- both samples, attesting ILLANUA's production, are not identical: they differ in their MgO, K_2O, Cr, Fe_{tot} and Al_2O_3 contents.

It may be concluded that only one of the ILLANUA sherds was made with a clay that was very similar to the raw material used in the Lausanne Stade worshop.

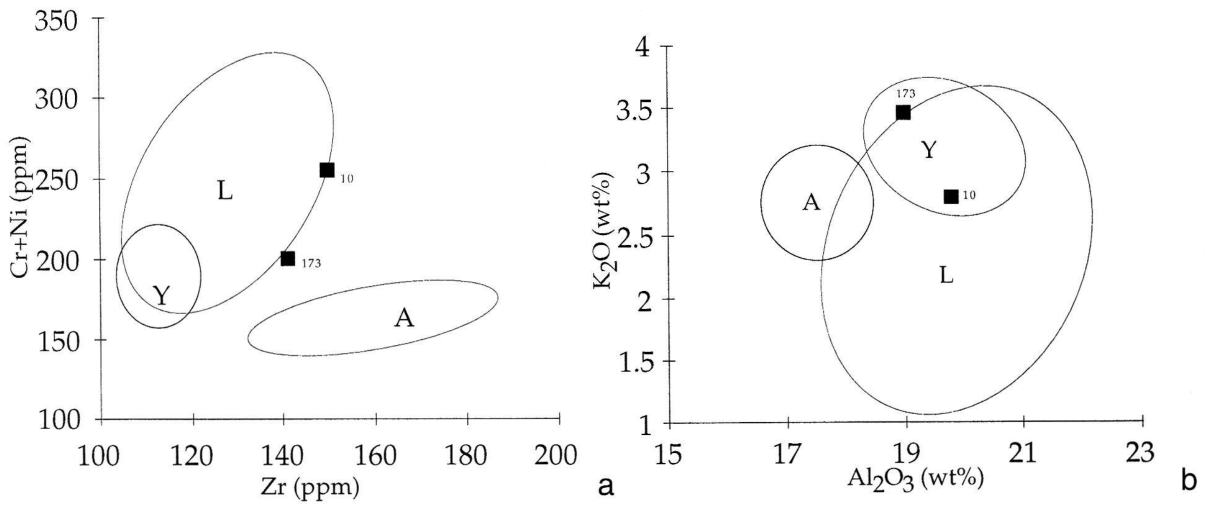


Fig. 14. Cr+Ni/Zr (a) and K_2O/Al_2O_3 (b) diagrams of ILLANUA samples. The three reference groups are also shown. ILLANUA = ■. L Lausanne Stade; Y Yverdon Faustus; A Avenches N-E.

	Lausanne Stade	*Yverdon Faustus*	*Avenches N-E*
M min.	3.265	1.915	2.297
M max.	38.549	37.621	27.771
		ILLANUA	
ZA 10	**12.56**	82.006	50.37
ZA 173	55.714	61.671	65.705

Tab. 6. M distances calculated for ILLANUA samples in relation to Lausanne Stade, Yverdon Faustus and Avenches N-E. Maximum and minimum values for the three groups are also included. Distances obtained using SiO_2, TiO_2, Al_2O_3, MgO, CaO, Na_2O, K_2O, Fe_{tot}, Cr, Rb, Sr, Zn and Zr.

6. Discussion

Attribution of a sherd to a specific group is no simple task. The decision to link a sample to a reference group of a specific area depends on affinity of composition, validity rules (mineralogical, petrographical and technical) and *a priori* probability (geological, geographical, historical and archaeological framework; Picon 1984). Attribution of a group of sherds of uncertain origin is generally easier, since more information is available on the distribution and average values of single elements. This was not the case for the sherds examined in this study as they formed groups which were too small to have statistical relevance. Moreover, the production of each potter is very heterogeneous, as may clearly be seen when comparing the M distance histograms.

If a sample shows no similarity with the reference groups used for the comparison, there may be different reasons for this fact. The choice of samples must be taken into consideration, since the material is sometimes not sufficient to be representative of a specific potter. The availability of reference groups is a further problem: for instance, if no sample seems to originate from the Avenches N-E group, this does not mean that unknown reference groups in Avenches could better meet similarity requirements for these samples. It may be concluded that samples of unknown provenance do not belong to Avenches N-E, but in the future some other Avenches reference groups may explain the origin of our stamped sherds.

Another problem is the contamination during burial, which may affect and change the original composition of the reference sherds and distort information on raw materials used in the past. This problem can be minimized

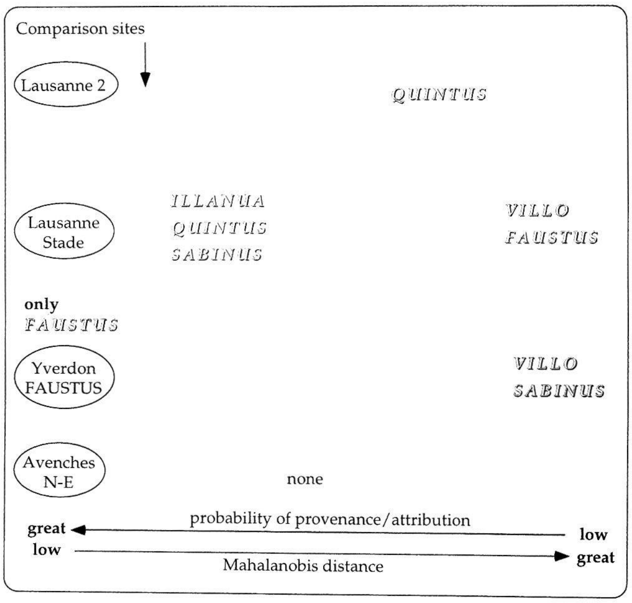


Fig. 15. Summary of results of attribution study and potters' hypothetical places of work.

using a mathematical correction on the major element totals (see Zanco 1999).

The production centre may have been located in different sub-workshops, in which ceramics were signed with the name of the leading founder, or the same potter may have worked in different places using different clays. These are some of the reasons for the heterogeneity of sherds made by VEPOTALUS or some other potters.

In the case of the Lausanne Stade workshops, the hypothesis of a potter moving between different sub-workshops does not appear strange especially if one considers the presence of several sites in that area.

It seems unlikely that SABINUS moved from Lausanne Stade to Yverdon *Faustus*.

To sum up, and to try to answer archaeological questions, considering the limitations of statistical models and representative significance, only a very small percentage of sherds produces results that information about their origin; of 47 stamped samples, only 6 seem to indicate their probability of provenance.

With the statistical package we used (Systat) every calculation is made on the basis of predefined homogeneous reference groups. However, the group of stamped sherds is not homogeneous and therefore the evaluation with this statistical programm was impossible: for potters represented with more than 6 sherds, every sample was compared with the three established reference groups, as a consequence of the heterogeneous chemical characteristics of most of the potters' production. This was also the only way of keeping the lower and upper limits of M distances of the reference in each correlation as constant as possible. Another limitation of this program is the obligation to use at least three and at most five groups. The program does not work with only two. Every discriminant calculation is a comparison between all the samples of all the groups.

Although some M distances are closer to a reference group, all the samples show a marginal character, and no real confirmation of their provenance can be made. Therefore, only in one case, concerning the Yverdon *Faustus* reference and ZA 80, a definite attribution could be made. For all the others, we may speak of higher or lower probabilities for a sherd belonging to one reference group rather than to another. A list of probabilities can be given to the archaeologists, who will confirm and interpret this outcome, according to their own knowledge.

Figure 15 summarises the probabilities of attribution (in decreasing order) of stamped samples in the various sites.

- Concerning the Yverdon site, only one sample (ZA 80) shows a value of distances close to the lower limit of the group and can definitely be attributed to it. VILLO and SABINUS are very marginal.
- Other samples seem to have a greater probability of belonging to the group of Lausanne Stade (with the names ILLANUA, QUINTUS, SABINUS).
- No sample gives evidence of coming from Avenches.

7. Conclusions and perspectives

The workshop reference groups are still too rare to fully exploit the results concerning the stamped pieces. The information furnished by the above analyses allow us to confirm or reinforce several hypotheses concerning the attribution of craftsmen to production centres, such as the one of the Sabinus Quintus and Illanua potters to the Lausanne workshop of the *Stade*. We will not elaborate here on the «historical results» of these investigations recently presented in the *Archéologie Suisse* journal (Luginbühl 2001), but it must be recalled that these analyses bring very interesting information about the careers of the potters mentioned (Vepotalus, Villo, Faustus, Sabinus, etc. …), as well as a large number of others, such as Pindarus, Florus, Coius or Asprenas. The archaeometric data are now completed by the data of studies concerning the distribution of the different stamp-types and by the stamps in a workshop context; together, they attest the existence of branches, movements and different types of craftsmen's associations. As far as the methodology is concerned, the analyses have demonstrated the great efficiency of the techniques employed and thus constitute a solid basis for future research on the sigillata imitations. One one hand there is no doubt that new analysis programs on groups of masters will allow to verify attribution hypotheses. On the other hand, new studies on the stamped ware, particularly comparisons between potters and no longer only between reference groups, would provide further evidence or confirmation of associations. The realisation of a small complementary program on the wares of Nyon and Augst (Zanco/Galetti 2000) has recently revealed that the Fronto potter had workshops in both agglomerations.

In archaeometry, as in other disciplines, the right questions bring the right answers.

Acknowledgments

The authors would like to thank the Museums that provided the samples: «Musée Romain de Lousonna-Vidy», «Musée du Château d'Yverdon», «Musée Romain d'Avenches, «Vindonissa-Museum» and «Office de recherches archéologiques de Martigny». Thanks are due to Prof. Marino Maggetti, of the Institute of Mineralogy and Petrography of the University of Fribourg, Switzerland, for helpful discussions.

Angela Zanco
Institute of Mineralogy and Petrography
Pérolles
CH-1700 Fribourg
Present address: Dipartimento di Mineralogia e Petrologia
C.so Garibaldi 37
I-35 137 Padova
e-mail: angela@dmp.unipd.it

Thierry Luginbhül
Archaeological and Ancient History Institute, BFSH2
University of Lausanne
CH-1015 Lausanne
e-mail: Thierry.Luginbuehl@iaha.unil.ch

References

Drack, W. (1945) Die helvetische Terra Sigillata-Imitation des I. Jahrhunderts n. Chr. Schriften des Instituts für Ur-und Frühgeschichte des Schweiz 2. Basel.

Kaenel, R./Paunier, D./Maggetti, M./Galetti, G. (1982) Les ateliers de céramique gallo-romaine de Lousonna (Lausanne-Vidy VD): analyses archéologiques, minéralogiques et chimiques. JbSGUF 65, 92–131.

Koester, H.M. (1979) Die chemische Silikatanalyse, Berlin, Heidelberg, New York,.

Iberg, R./Mumenthaler, Th. (1974) Structure de la brique de terre cuite et de la brique silico-calcaire. L'entreprise, 86.

Jornet, A. (1982) Analyse minéralogique et chimique de la céramique romaine suisse à enduit brillant. Institut de Minéralogie et de Pétrographie, Université de Fribourg, Unpublished PhD Thesis.

Lousonna 1 Martin, C./Bögli, H./Sitterding, M. et al. (1969) Lousonna. Bibliothèque historique vaudoise 42, 1969. Lausanne.

Lousonna 9 Luginbühl, Th./Schneiter, A. et al. Sous la direction de S. Berti et C. May Castella (1999) Trois siècles d'histoire à Lousonna-Vidy. La fouille de Vidy «Chavannes 11» 1989–1990. Le mobilier archéologique. Lousonna 9, CAR 74. Lausanne.

Luginbühl, T. (1995a) Lucius Aemilius Faustus, histoire d'un potier gallo-romain d'Yverdon. Groupe d'archéologie yverdonnoise et Institut d'archéologie yverdonnoise. Yverdon/Varsovie.

Luginbühl, T. (1995b) Rapport sur la fouille YP 95, Atelier L. Aemilius Faustus. Rapport non publié au service des Monuments Historiques et Archéologie du Canton de Vaud.

Luginbühl, T. (2000) Imitations de sigillée et potiers du Haut Empire en Suisse occidentaleArchéologie et Histoire d'un phénomène artisanal antique. Unpublished Ph.D. thesis, University of Lausanne, Switzerland.

Luginbühl, T. (2001) «Vepotalus, Villo, Faustus et les autres, du nouveau sur les potiers producteurs d'imitations de sigillée «helvétiques». AS 24, 2001, 1, 16–23.

Luginbühl, T./Schneiter, A. (1994) Les estampilles sur imitations de sigillée de Lousonna-Vidy, 300 marques pour approcher l'origine, le statut et l'organisation des potiers. Etudes de Lettres, 43–69.

Luginbühl, T./Schneiter, A. (1997) Graffiti et estampilles, inscription mineures de la *Colonia Iulia Equestris.* «Report to the Musée Romain de Nyon», 1997. Lausanne.

Maggetti, M. (1980) Recherches Minéralogiques, Chimiques et Technologiques sur la Terre Sigillée de l'atelier de la Péniche (Vidy/Lausanne). In: A. Laufer, La Péniche. Un atelier céramique à Lousonne. CAR 20, Lousonna 4, 81–95. Lausanne.

Maggetti, M. (1981) Composition of Roman pottery from Lousonna (Switzerland). In: M.J. Hughes (ed.) Scientific studies in ancient ceramics. British Museum Occasional Paper 19, 33–49. London.

Peters, T./Iberg, R. (1978) Mineralogical changes during firing of calcium-rich brick clays. *American Ceramic Society Bulletin,* 57, 503-506.

Picon, M. (1984) Traitement des données d'analyses. In: T. Hackens/M. Schvoerer (éds.) Datation et caractérisation des céramiques anciennes. Pact 10, 379–399.

Stähli, B. (1975) La ceramique de la villa romaine d'Essert-sous-Champvent. In: Eburodunum I, 192–205. Yverdon.

Wilkinson, L. (1989) SYGRAPH: The system for statistics. Evanston, IL.

Zanco, A. (1999) Provenance and Technology of Gallo-Roman Terra Sigillata Imitations from Western Switzerland, Unpublished Ph.D. thesis, University of Fribourg, Switzerland, 1209, 1999.

Zanco, A./Galetti, G. (2000) Terra Sigillata Imitations from Nyon (SW Switzerland): one of Fronto's workshops. Submitted to the Journal of Cultural Heritage, Elsevier.