Late medieval pottery production in South Western Crimea: laboratory investigations of ceramics from Cembalo (region of Sebastopol / Chersonesos)

S.Y. Waksman, N. Ginkut

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CERÂMICA E COMÉRCIO
CERAMICS AND TRADING

*Sylvie Yona WAKSMAN | Natlia GINKUT**

LATE MEDIEVAL POTTERY PRODUCTION IN SOUTH WESTERN CRIMEA: LABORATORY INVESTIGATIONS OF CERAMICS FROM CEMBALO (REGION OF SEBASTOPOL / CHERSONESOS)*

Abstract: *Evidence of pottery manufacture in the late medieval period in the Genoese fortress of Cembalo (Balaklava, Crimea) gave the opportunity to define a new chemical reference group and to reconsider pottery production in South Western Crimea, in the region of Chersonesos.*

Résumé: *Les vestiges d'ateliers de potiers datés de la fin de la période médiévale mis au jour par les fouilles de la forteresse génoise de Cembalo (Balaklava, Crimée) ont donné la possibilité de définir un nouveau groupe de référence chimique et de reconsidérer les productions de céramiques du Sud Ouest de la Crimée, dans la région de Chersonèse.*

Recent excavations carried out by the National Preserve of Tauric Chersonesos in the Genoese fortress of Cembalo (Balaklava, district of Sebastopol, Crimea) provided evidence of glazed pottery production dated back to the second half of the 14th - 15th centuries (Ginkut, 2012). These finds give the opportunity to reconsider the question of pottery production in the region of Chersonesos in the late medieval period, as part of more extensive research on local and imported pottery in the Crimea in the framework of a French-Ukrainian "Dnipro" program[1].

Chemical analyses carried out at the "Laboratoire de Céramologie" in Lyon were used to investigate ceramics productions. The definition of a new chemical reference group, based on the analysis of kiln furniture and unfinished wares from Cembalo, would give a new perspective on previous data on Crimean material, and especially on ceramics found in Chersonesos (Waksman and François, 2004-2005; Waksman and Romantchuk, 2007). For the latter, we could not rely on reference material *stricto sensu*, but used specific categories of amphorae (Sazanov *et al.*, 1995; Sazanov, 1997: type 56), tiles and common wares assumed to be local as potential local references.

SAMPLING

Reference samples for Cembalo consisted of tripod stilts (BZY166-168) and biscuit fired wares (BZY159-165, Fig.1 top left). The sampling also included a range of finished products (BZY169-187), several of which were found together with their unfinished counterpart (Fig.1 middle left and bottom right). Samples presented various techniques of decoration: plain glazed wares (BZY178-179, Fig.1 top right), monochrome and polychrome sgraffito wares (BZY169-177, 180, 184-187, Fig.1), slip painted wares (BZY181-184, Fig.1 bottom right) sometimes associated with notches (BZY181-182). Two examples presenting the same monogram (BZY186-187, Fig.1 middle right) were included in the sampling as well (BZY186: Mytz 2005, p.303 fig.7).

Samples previously analyzed from Chersonesos are presented elsewhere (BYZ295-300, 310-330, 334, 357, 361-366, 368: Waksman and Romantchuk 2007). They included table wares with styles and techniques of decoration fairly similar to Cembalo's examples, together with fragments of amphorae, tiles, common wares and a fishing net weight (BYZ357, 361-366, 368) taken as potential representatives of the local production. The latter point was justified by the close chemical features of these different functional categories (Waksman and Romantchuk, 2007). Furthermore, the particularly fine texture of the amphorae and common wares fabric made them suitable as comparative material for table wares. This feature was true to a lesser extent for the tiles and fishing net weight, and is not the general case, as different raw material are commonly used at a given production site to manufacture different categories of wares.

CHEMICAL ANALYSIS AND CLASSIFICATION OF SAMPLES ACCORDING TO CHEMICAL COMPOSITION

Chemical analysis of the samples was carried out by Wavelength Dispersive - X Ray Fluorescence (WD-XRF) at the "Laboratoire de Céramologie" in Lyon (e.g. Waksman, 2011). Twenty-four elements are quantified, seventeen of which are usually taken as active variables in multivariate statistical treatments used to classify ceramics into groups of similar chemical composition. These include eight major and minor elements in ceramics (MgO, Al_2O_3, SiO_2, K_2O, CaO, TiO_2, MnO, Fe_2O_3) and nine trace elements (V, Cr, Ni, Zn, Rb, Sr, Zr, Ba, Ce).

Classification of samples was obtained by hierarchical clustering analysis applied to standardized data, using euclidean distance and average linkage (e.g. Picon, 1984). The corresponding diagram, called a dendrogram, initially represents each sample as a vertical bar at the bottom of the figure (Fig.2). The two samples the most alike in elemental composition are connected by a horizontal link, which

* With the collaboration

1 This project is directed by I. Teslenko (Academy of Science of Ukraine) and S.Y. Waksman (CNRS). The support of the French Ministry of National Education, the French Ministry of Higher Education and Research and the State Agency for the Problems of Science, Innovation, and Informatization of Ukraine is gratefully acknowledged.

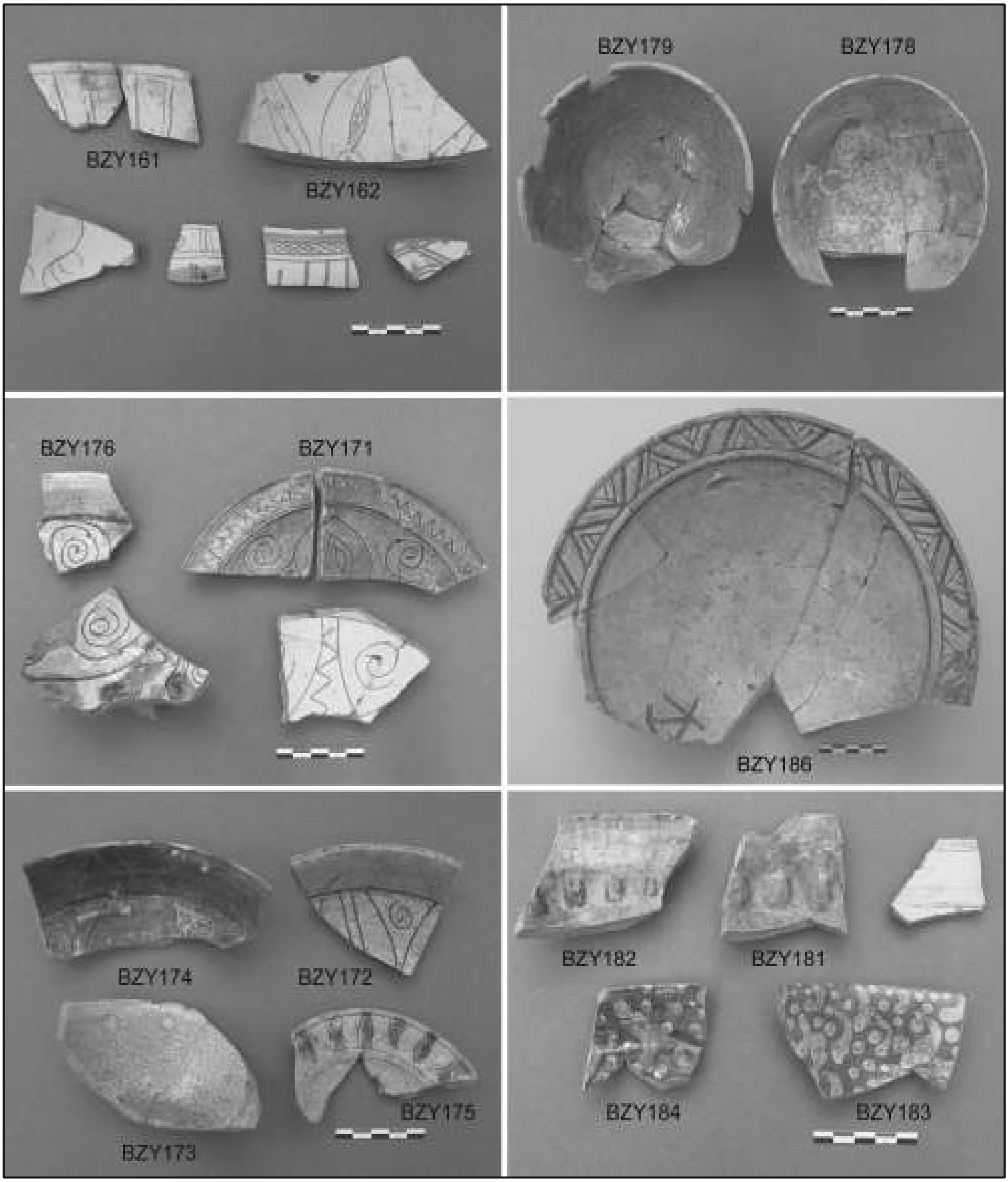

Fig.1 *Examples of ceramics analyzed from Cembalo, some shown with their unfinished counterpart: top left, middle left (bottom right), bottom right (top right).*

lies all the lower as the samples are chemically similar. The two samples are then fused into a "pseudo sample" of average composition. The same process is repeated, with the linkage being formed at growing heights, until all the samples are connected. The resulting diagram constitutes the dendrogram. It shows clusters of samples of similar composition linked at a lower level, all the clusters being ultimately linked together at the top of the diagram. This representation is however not sufficient in itself to define compositional groups, as it does not take into account the significance of elemental differences between clusters. Further examination of the raw data is still needed in order to be able to interpret classifications in terms of pottery productions and workshops (Picon, 1993).

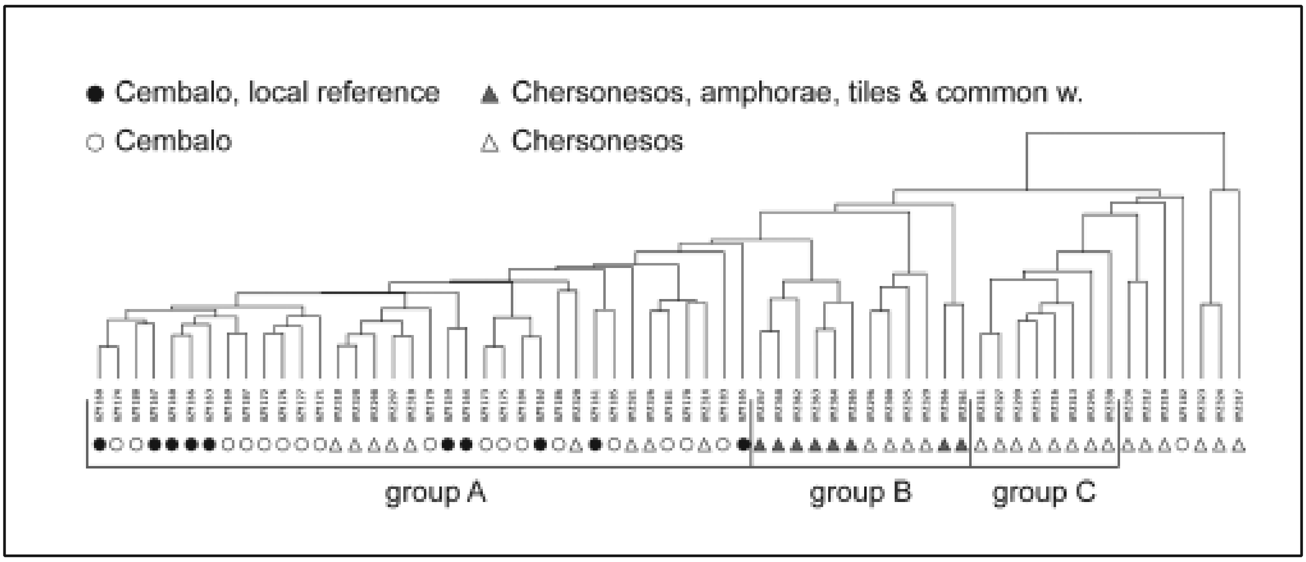

Fig.2 *Classification according to chemical compositions of ceramics found in Cembalo and Chersonesos. Symbols indicate sites, point out local references, or indicate amphorae, tiles and common wares in the case of Chersonesos. The main chemical group (A) and sub-groups (B, C) are underlined.*

RESULTS

The classification (Fig.2) does not show well differentiated groups. It consists of a main group, two smaller structures and a number of marginal samples which appear on the right hand side of the figure. The main group (group A) gathers some samples from Chersonesos and all those from Cembalo except one, including the local references (indicated by black dots in figure 2). The structure indicated as "group B" is distinguished from group A by its lower contents of manganese and strontium (Fig.3). These elements are usually not considered discriminant, especially as they may be affected by pollutions (e.g. Picon, 1987)[2]. However, the fact that this group gathers all the amphorae, common wares, etc. likely to represent Chersonesos products (indicated by grey triangles in figure 2), together with some of the glazed wares, may be significant. Another possible structure (group C) is characterized by lower manganese and higher magnesium contents, compared to group A (Fig.3). It includes samples found in Chersonesos, but ongoing research suggests that it shares chemical features with wares from other sites as well, related to "Caffa style". The binary plot magnesium - manganese (Fig.4) shows some features distinguishing the three structures, together with samples marginals to each of them.

All three groups may correspond to pottery manufactured with clays taken from the same geological formations, whose chemical composition would slightly differ from one location to another. In the case of Cembalo and Chersonesos, related to groups A and B respectively, it is very likely the case given the close proximity of the two sites. Furthermore, archaeological evidence for pottery production in the region of Chersonesos in the late medieval period was found in the outskirts of the city, closer to Cembalo, rather than in the city itself. Ceramics from Chersonesos previously considered local (Waksman and Romantchuk, 2007) should rather be attributed to "the region of Chersonesos", including Cembalo.

Similar geological formations occur in a large part of the Crimea, where they reach the southern coast in the regions of Sebastopol / Chersonesos and of Feodosia / Caffa[3]. Whether group C could correspond to the products of Caffa would request further research. In any case, these features call for caution in the attribution of ceramic manufactured in sites located within or close to these geological contexts.

CONCLUDING REMARKS

Laboratory investigations of late medieval ceramics, including wasters, excavated in the Genoese fortress of Cembalo (Crimea) made it possible to propose a new chemical reference for the region. The clay material used in Cembalo may however not be very different from the one used in other workshops, located in the same area of Sebastopol / Chersonesos in South Western Crimea, or in other areas sharing similar geological features such as the region of Caffa. Our results also gave the opportunity to reconsider previous attribution to late medieval Chersonesos, and to propose instead an attribution to the "region of Chersonesos", including Cembalo. They are consistent with archaeological evidence, pointing out the development of more rural workshops in the area at that time.

2 but the ratio Ca/Sr may be significant (Waksman 1995, Schneider and Japp 2009).

3 Detailed geological information on the Crimea was however not available to us. We would like to thank Dr. Grytsenko (Department of geology, Kiev National Taras Shevchenko University) for giving us the opportunity to take pictures of a geological map of the Crimea (scale 1/200.000, 1984).

id.	CaO	Fe_2O_3	TiO_2	K_2O	SiO_2	Al_2O_3	MgO	MnO	(Na_2O)	(P_2O_5)	Zr	Sr	Rb	Zn	Cr	Ni	Ba	V	(Ce)
groupe A																			
BZY168	6.61	7.31	0.815	3.61	57.48	20.69	1.99	0.1541	0.76	0.16	164	239	174	134	117	76	425	161	98
BZY174	6.45	7.19	0.813	3.60	57.57	20.69	2.03	0.1474	0.86	0.12	163	222	175	133	119	75	422	169	95
BZY180	6.47	7.29	0.821	3.63	57.59	20.83	2.04	0.1361	0.78	0.17	159	232	177	134	117	85	432	166	108
BZY167	7.27	7.28	0.807	3.62	56.92	20.55	2.09	0.1538	0.96	0.17	162	232	172	135	112	80	475	160	104
BZY160	6.98	7.45	0.812	3.67	56.74	20.88	2.03	0.1410	0.84	0.27	156	231	174	143	120	80	426	150	98
BZY166	6.57	7.36	0.819	3.57	57.25	20.98	2.09	0.1335	0.88	0.09	160	226	178	144	119	85	416	155	93
BZY163	6.62	7.45	0.815	3.46	57.05	20.92	2.10	0.1488	1.09	0.11	158	226	173	142	115	78	449	142	101
BZY169	8.12	7.44	0.805	3.56	56.44	20.35	2.00	0.1560	0.82	0.12	157	250	171	136	117	80	428	157	90
BZY187	7.05	7.34	0.813	3.61	56.93	20.94	2.04	0.1367	0.74	0.17	155	242	178	136	117	78	439	162	90
BZY172	6.56	7.48	0.818	3.68	57.11	20.87	2.03	0.1655	0.95	0.12	161	228	181	136	118	82	418	170	94
BZY176	6.44	7.50	0.819	3.68	57.08	21.06	2.06	0.1609	0.82	0.13	160	228	180	130	120	86	444	158	87
BZY177	6.00	7.48	0.813	3.64	57.29	20.99	2.02	0.1492	0.90	0.11	161	212	174	138	124	80	390	164	93
BZY171	5.20	7.37	0.818	3.71	58.63	20.73	2.07	0.1829	0.95	0.11	163	215	174	132	122	83	491	168	98
BYZ318	6.76	7.37	0.815	3.80	56.33	21.24	2.08	0.1441	1.09	0.13	161	232	186	137	120	88	440	171	82
BYZ328	6.95	7.31	0.807	3.76	56.26	21.15	2.02	0.1456	1.19	0.12	162	228	182	128	120	87	452	175	86
BYZ298	7.01	7.36	0.811	3.71	56.00	21.11	2.10	0.1400	1.34	0.15	159	232	176	140	121	87	440	176	92
BYZ297	6.68	7.38	0.820	3.79	56.35	21.14	2.07	0.1371	1.30	0.15	166	236	182	127	114	87	432	175	87
BYZ310	7.32	7.38	0.812	3.71	56.32	20.99	2.00	0.1461	1.01	0.12	165	245	181	131	114	89	421	166	94
BZY179	6.48	7.36	0.815	3.68	57.20	21.00	2.01	0.1570	0.86	0.11	161	224	179	126	118	98	427	165	93
BZY159	6.62	7.46	0.820	3.52	57.05	20.71	2.10	0.1992	1.16	0.12	163	234	173	139	118	94	423	153	95
BZY164	6.28	7.62	0.819	3.40	57.17	21.00	2.08	0.1684	1.04	0.22	160	238	173	140	114	91	417	162	93
BZY173	6.72	7.43	0.814	3.69	57.21	20.69	2.02	0.1804	0.90	0.14	160	232	174	132	117	84	474	164	69
BZY175	6.69	7.44	0.817	3.74	57.20	20.67	1.95	0.1739	0.91	0.16	162	224	175	125	117	81	444	160	65
BZY184	6.98	7.36	0.812	3.56	56.98	20.81	2.02	0.1508	0.86	0.19	160	250	174	137	119	86	429	167	70
BZY162	7.12	7.30	0.808	3.50	56.90	20.73	2.09	0.1417	1.09	0.11	158	233	174	137	125	85	441	164	73
BZY186	7.34	7.30	0.804	3.70	56.52	20.76	2.06	0.1268	0.83	0.34	157	246	174	143	114	77	660	165	90
BYZ320	7.31	7.22	0.799	3.62	55.85	20.82	2.11	0.1405	1.33	0.11	151	222	163	132	117	84	509	185	86
BZY161	8.06	7.24	0.803	3.58	56.51	20.13	2.03	0.1812	1.07	0.20	159	241	170	124	112	86	405	168	111
BZY185	7.58	7.29	0.805	3.49	56.35	20.77	2.04	0.1538	1.17	0.10	156	240	174	140	115	84	434	158	119
BYZ321	6.96	7.31	0.812	3.66	55.98	21.07	2.17	0.1369	1.35	0.10	156	221	176	134	131	88	471	178	96
BYZ326	8.56	7.20	0.786	3.55	55.13	20.68	2.05	0.1443	1.03	0.13	149	218	155	132	113	79	398	166	90
BZY181	8.54	7.11	0.791	3.55	55.80	20.34	2.12	0.1241	1.18	0.11	154	231	164	133	118	85	436	154	82
BZY170	10.10	7.11	0.784	3.46	55.14	20.12	1.98	0.1267	0.79	0.19	154	261	170	121	115	87	474	161	91
BYZ314	9.13	7.23	0.785	3.68	54.97	20.49	2.08	0.1309	1.09	0.12	159	241	174	129	113	84	425	175	80
BZY183	6.20	7.67	0.793	3.57	58.08	19.96	1.95	0.1926	1.03	0.19	164	220	165	120	119	70	440	166	88
BZY165	3.84	7.37	0.840	3.79	59.77	20.99	2.08	0.1710	0.81	0.13	170	184	176	132	123	84	471	171	88
m	**6.99**	**7.35**	**0.810**	**3.63**	**56.81**	**20.77**	**2.05**	**0.1522**	**0.99**	**0.15**	**160**	**231**	**174**	**134**	**118**	**84**	**445**	**165**	**91**
σ	**1.07**	**0.12**	**0.011**	**0.10**	**0.93**	**0.30**	**0.05**	**0.0188**	**0.18**	**0.05**	**4**	**13**	**6**	**6**	**4**	**5**	**45**	**8**	**11**
sous-groupe B																			
BYZ357	8.95	7.22	0.810	3.42	55.96	20.58	1.77	0.0793	0.93	0.11	155	164	172	112	113	80	469	172	84
BYZ368	9.67	7.30	0.802	3.29	55.33	20.71	1.79	0.0825	0.76	0.09	153	164	177	116	113	77	524	182	86
BYZ362	8.54	7.03	0.820	3.37	57.40	20.04	1.72	0.0897	0.66	0.13	160	173	172	122	107	78	514	170	82
BYZ363	7.24	7.50	0.792	3.69	56.51	21.25	1.75	0.0867	0.85	0.15	158	164	185	128	114	77	506	176	76
BYZ364	7.50	7.58	0.804	3.61	56.01	21.58	1.77	0.0805	0.74	0.14	154	177	186	126	118	82	493	175	82
BYZ365	7.75	7.49	0.821	3.49	56.06	21.36	1.77	0.0752	0.92	0.11	155	159	180	112	117	79	427	160	84
BYZ296	5.56	7.10	0.847	3.36	58.92	21.11	1.75	0.0584	0.88	0.11	175	170	180	136	114	88	*757	178	84
BYZ300	6.21	7.11	0.849	3.55	58.02	21.22	1.79	0.0511	0.84	0.13	175	174	185	139	117	86	558	186	90
BYZ325	6.20	7.21	0.860	3.22	58.16	21.25	1.78	0.0676	0.79	0.11	177	179	160	129	111	86	*824	176	83
BYZ329	5.89	7.46	0.826	3.68	57.95	21.01	1.88	0.0967	0.75	0.13	175	185	178	128	118	88	739	160	83
BYZ366	6.34	8.03	0.791	3.72	55.39	22.69	1.78	0.0784	0.84	0.14	157	172	197	111	122	85	628	193	89
BYZ361	6.27	7.88	0.797	3.75	55.96	22.13	1.75	0.0864	1.04	0.15	154	158	193	128	126	84	505	186	80
m	**7.18**	**7.41**	**0.818**	**3.51**	**56.81**	**21.24**	**1.78**	**0.0777**	**0.83**	**0.13**	**162**	**170**	**180**	**124**	**116**	**83**	**536**	**176**	**84**
σ	**1.33**	**0.31**	**0.023**	**0.18**	**1.22**	**0.69**	**0.04**	**0.0131**	**0.10**	**0.02**	**10**	**8**	**10**	**9**	**5**	**4**	**89**	**10**	**4**
sous-groupe C																			
BYZ311	7.88	6.81	0.778	3.77	57.16	18.94	2.59	0.0820	1.32	0.17	160	231	158	111	111	71	502	144	76
BYZ327	6.94	7.08	0.778	3.85	57.40	19.16	2.56	0.0782	1.35	0.16	162	213	157	111	111	73	534	141	77
BYZ299	5.76	7.13	0.801	4.00	58.39	19.41	2.53	0.0600	1.55	0.15	173	221	179	108	111	75	494	164	84
BYZ315	6.46	6.91	0.801	4.00	58.07	19.24	2.57	0,0461	1.39	0.21	166	212	178	113	115	74	583	158	88
BYZ316	6.25	7.09	0.803	3.97	57.93	19.51	2.59	0.0673	1.39	0.14	172	231	181	113	108	77	662	148	82
BYZ313	6.98	7.08	0.785	3.87	57.90	19.28	2.42	0.0859	1.23	0.15	167	213	177	105	107	76	474	162	80
BYZ295	7.36	6.91	0.788	3.86	57.57	19.16	2.61	0.0802	1.23	0.18	166	*333	173	115	114	72	602	151	86
BYZ330	8.85	7.00	0.761	3.79	56.52	18.97	2.45	0.1060	1.09	0.18	162	265	168	106	107	72	*843	146	78
m	**7.06**	**7.00**	**0.787**	**3.89**	**57.62**	**19.21**	**2.54**	**0.0757**	**1.32**	**0.17**	**166**	**227**	**171**	**110**	**111**	**74**	**550**	**152**	**81**
σ	**0.98**	**0.11**	**0.015**	**0.09**	**0.59**	**0.20**	**0.07**	**0.0181**	**0.14**	**0.02**	**5**	**19**	**9**	**4**	**3**	**2**	**68**	**9**	**4**
BYZ334	8.92	7.29	0.784	3.63	56.27	19.98	1.87	0.0798	0.84	0.12	168	315	174	122	111	89	721	162	79
BYZ312	6.53	7.35	0.793	3.63	58.61	19.90	1.85	0.0867	0.84	0.11	174	278	173	124	108	90	881	148	84
BYZ319	7.16	6.41	0.790	3.52	57.32	19.89	2.31	0.0789	1.44	0.12	152	197	136	108	118	76	623	171	82
BZY182	6.13	6.64	0.761	3.32	59.40	19.38	1.82	0.1339	0.86	0.10	179	197	159	118	116	69	471	153	81
BYZ323	12.47	7.70	0.761	2.90	53.04	19.36	2.01	0.1720	1.06	0.13	162	232	137	116	113	77	750	154	80
BYZ324	12.33	7.26	0.768	2.95	53.61	19.39	2.06	0.1201	1.00	0.12	163	224	138	117	107	77	740	153	85
BYZ317	11.10	6.82	0.755	3.45	55.09	18.39	2.52	0.1286	1.37	0.15	162	358	151	111	105	69	612	134	73

Fig.3 *Chemical compositions of samples from Cembalo and Chersonesos, ranked as in the dendrogram (Fig.2). Major and minor elements are given in oxides weight %, trace elements in parts per million (ppm); m: mean, sigma: standard deviation. Elements between brackets are indicative, values tagged with an asterisk were not taken into account to calculate m and sigma.*

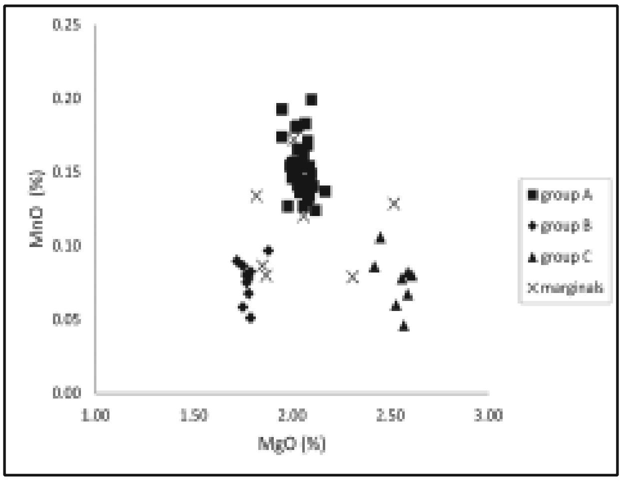

Fig.4 *Binary plot magnesium - manganese, showing how the sub-structures groups B and C may be differentiated from each other and from group A. Samples marginal to one or another structure are also shown.*

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