

APPLICATIONS OF AAS AND DIATOM ANALYSIS AND STYLISTIC STUDIES OF FINNISH SUBNEOLITHIC POTTERY

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Ten prehistoric Comb Ceramic vessels found near Kotka have been studied with the aid of AAS and diatom analysis. Correspondence between stylistic and decorative groupings show that the variation in the elements determined by AAS is apparently due to the coarse sand temper added to the clay during the actual manufacture of the vessels. The composition of the Pit and Comb Ware vessel differs considerably from the others, the ornamentation suggesting East Karelian provenience. The diatom flora in the clay material of the vessels corresponds to the stylistic classification. The raw material was apparently either glacial or fresh water clay, whose technical properties correspond to those of clay in modern tile production.

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Introduction

The sherds studied in this paper are from the Comb Ceramic period dwelling site at Niskasuo in the former parish of Kymi (municipality of Kotka) in SE Finland (3024 07, x = 6719 73, y = 489 03). The site is located at the edge of a bog on the eastern shore of the Kymi river about 15 km NNW of Kotka at an elevation of c 20 m a.s.l. The terrain is mainly pine forest on sandy soil sloping gently to the SW. The site is bordered by open bedrock on one side and marshy ground on the other. Visible features are three possibly prehistoric hut-floors and a present-day sandpit. Surveys indicate a site area of c 350 m × 50 m running SE.

In 1966 Dr. Ville Luho conducted excavations over c 220 m² in the area adjacent to the sandpit in the central part of the site. Luho's finds consisted of ceramics, debris and artefacts of stone, quartz and flint as well as fragments of clay idols, amber and burnt bone. Luho's ceramic material has been further studied by Jyri Kokkonen (1978). Analyses of the bone material carried out by Mikael Fortelius in conjunction with this study indicated seal-hunting activities. Field phosphate survey and levelling performed by Kokkonen suggest a lower limit for the site at 20—20.5 m a.s.l., which corresponds to observations obtained on Comb Ceramic period II sites in the region.

¹ in alphabetical order

The ceramic material

The sherds (c 17 200 in number) were from approximately 190 (± 10) vessels, of which 106 were in such a state of preservation as to facilitate stylistic description and analysis. The vessels were defined according to rim sherds; complete reconstructions were not aimed at. Most of the sherds (98 vessels) corresponds to the stylistic criteria of the »Typical Comb Ceramic», particularly its earlier phase (hence Ka II:1) as defined by Äyräpää (1930, 1955). At least 10 vessels show features of Äyräpää's »Hochstil» with bordered geometric designs executed with comb stamps. Three vessels are from an earlier phase of the Late Comb Ceramic (hence Ka III:1) as defined by Äyräpää (1925, 1930). The Pit and Comb vessel corresponds to East Karelian finds and is the westernmost occurrence of the style found to date (cf. Pankrusev 1964, Brjussov 1957). The rest of the material could not be identified with reference to present classifications.

The Ka II:1 vessels from Niskasuo have close parallels in many Comb Ceramic finds in the Kymi region and in certain details in finds of Ka II:1 and 2 in SE Finland in general. Various ornamental details of the Niskasuo vessels can be shown to occur in Ka II finds from Häyrynmäki in Viipuri, the Kaukola sites on the Karelian isthmus and finds from the Leningrad region (Pälsi 1915, Gurina 1958). The present material is probably part of a broad Comb Ceramic tradition that thrived in the coastal region of SE Finland and in the eastern part of the Gulf of Finland.

In Kokkonen's study the Ka II:1 vessels were further classified taking the predominant decorative motif of the outer surface as the main criterium. The following main groups were established:

- A. Vessels with chevron-like and zig-zag designs executed with comb stamps, designs of either hatched and bordered fields or of single lines.

- B. Vessels with rectangular, rhomboid or lozenge-like designs of comb stamps.
- C. Vessels with horizontal rows of comb stamp impressions.

In addition there were two vessels with vertical chevron designs resembling a fish-spine (group D). The Ka II:1 material which did not correspond to the criteria for the above was designated »Other». The number of vessels in the main groups is as follows: A 23, B 26 and C 39. There is a striking similarity between the main groups and the material that did not facilitate vessel identification in the rim forms and the ornamentation of the upper part of the rim, and the designs of the first two ornamental zones. The distinguishing motif generally occurs first in the third ornamental zone and is then repeated along the outer surface of the vessel (Kokkonen 1978).

The sample vessels

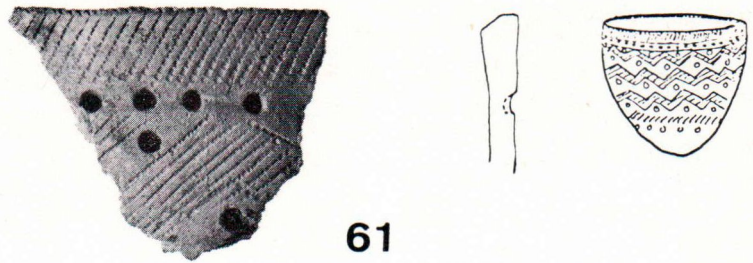
The sample vessels in this study were selected as follows (numbering according to Kokkonen 1978):

Ka II:1	
Group A:	Vessels 42 and 61, Fig. 1.
Group B:	Vessels 37 and 93, Fig. 2.
Group C:	Vessels 19 and 57, Fig. 3.
Ka III:1	Vessels 13 and 74, Fig. 4.
»Other»:	Vessel 71, Fig. 5.
Pit and Comb	
Ware:	Vessel 14, Fig. 5.

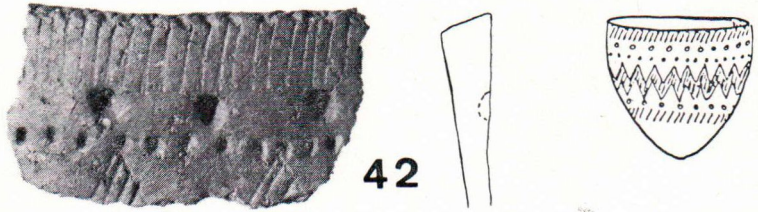
The main criterium of selection was the availability of sherds that could be destroyed in the analyses as well as the ready identifiability of the sample sherds. One of the main points of interest was whether classifications on the basis of stylistic similarity could be confirmed by analyses on the actual raw material of the vessels.

Stylistic analysis

In the sample at hand the Ka III vessels differ most clearly from the others; the rim



61

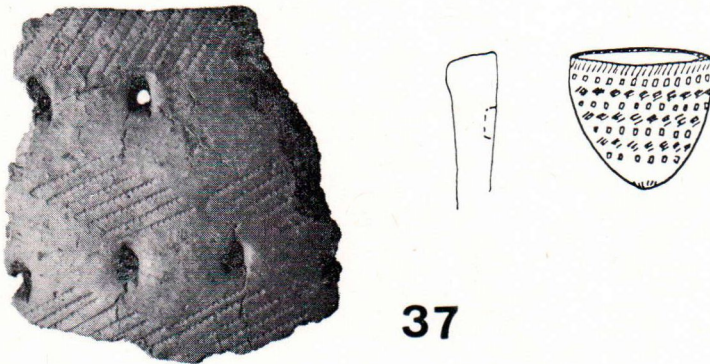


42

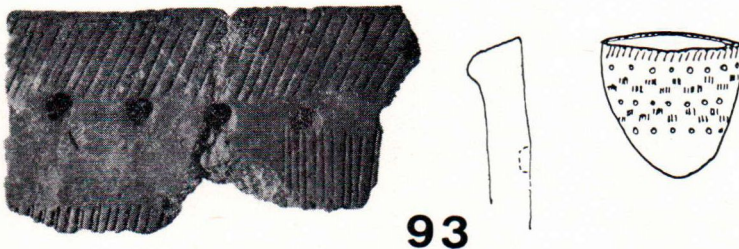
Fig. 1. Sample vessels of the Group A. (All fotos by Tapio Seger).

is straight and unaccentuated with small, possibly finger, impressions and a decoration of pit impressions on the outer edge. The outer surface bears a decoration consisting of pit impressions placed sparsely in rows. The Pit and Comb vessel differs stylistically only with respect to the predominance of deep

pits on the outer surface; both vessel and rim forms and the comb stamp ornaments on top of the rim and on the outer edge are similar to those in the Ka II vessels. The sample of Ka II »Other», vessel 71, is interesting in that, after the first two ornamental zones, which are similar to those in the main groups, the



37



93

Fig. 2. Sample vessels of the Group B.

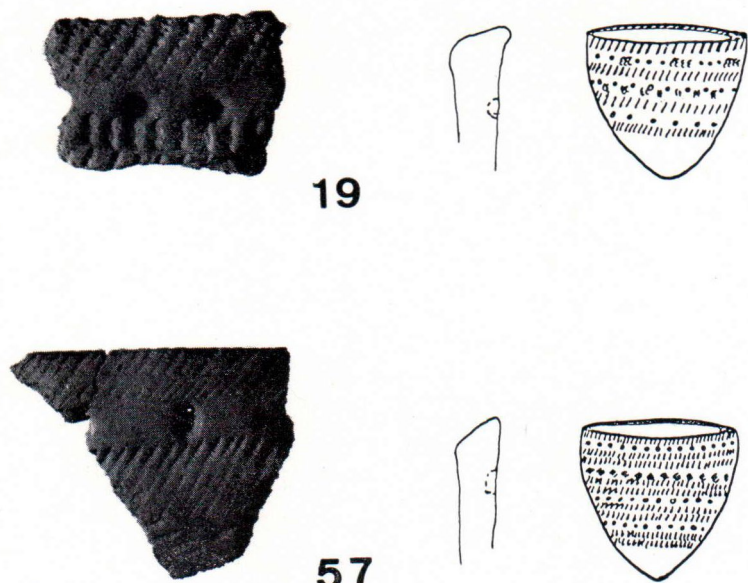


Fig. 3. Sample vessels of the Group C.

outer surface is sparsely decorated with groups of three pits. In an unpublished study, Luho has suggested that this ornamentation is chronologically comparable to Ka III (Luho 1959).

The Ka II vessels are similar chiefly with respect to the ornamentation of the upper parts of the rims. All have comb stamps on top of the rim in either single or double rows.

The first two ornamental zones are practically identical in nearly all of the Ka II vessels. The main differences are in the actual decorative elements and in minor details of composition, e.g. the addition of rows of short impressions and indentations and impressions on the outer edge. Variation also occurs in the thickness of the actual rim and in the possible accentuation of the form. Vessel 71,

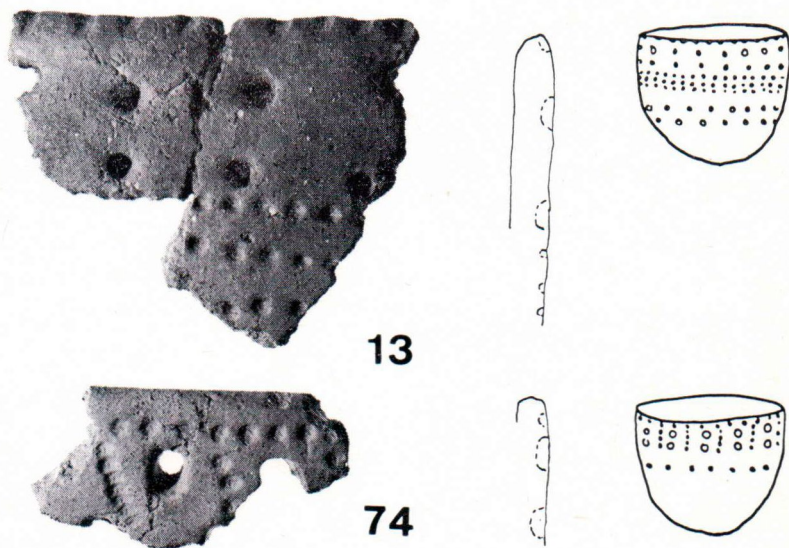


Fig. 4. Sample vessels of the Group Ka III.

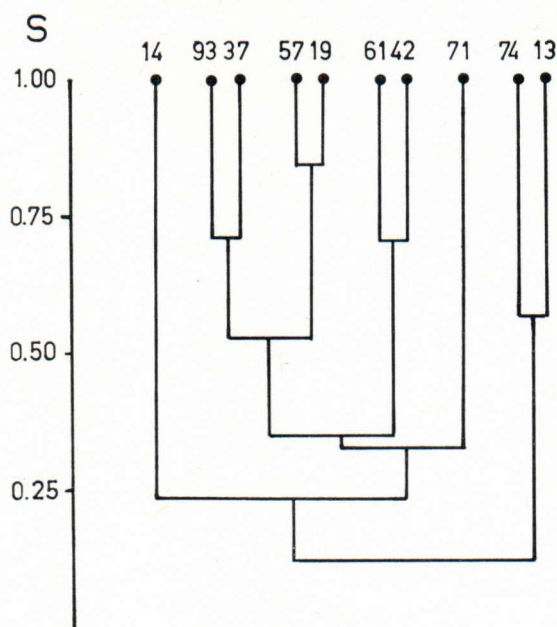


Fig. 6. Dendrogram indicating stylistic similarity between sample vessels (cf. Table 1). S = degree of similarity.

tinguishing motif gives the Pit and Comb vessel a lower score in this respect.

The results of the numerical comparison can further be shown in the form of a dendrogram (Fig. 6). Although the figure is a schematic representation of a multidimensional situation arrived at by a heuristic method, it serves to illustrate the nature of the sample studied and to demonstrate in graphic manner the similarity/dissimilarity between the O.T.U.s. The figure shows the clusters that are identifiable in the sample vessels and the mean level of similarity at which the clusters and single vessels can be linked to one another. The diagram shows the high level of similarity between the vessels of groups A, B and C, the links of the sample of Ka »Other» and the Pit and Comb vessel and the strong dissimilarity between the Ka III vessels and the rest of the samples.

Atomic absorption spectrometric analysis

In the study on the physical properties of prehistoric artefacts, especially ceramics, the geochemical and physical methods presently in use have been successfully applied. The most popular appear to be X-ray fluorescence and neutron activation analysis (cf. Pearlman and Asaro 1969; Stos-Fertner, Hedges and Evely 1979). Other methods that have been used in archaeology are X-ray powder diffraction, Moessbauer spectroscopy, differential thermal analysis and AAS, (Tite 1972; Shepard 1968; Bomgardner and Hatcher 1979; Hughes, Cowell and Craddock 1976). In this study it has been attempted with the help of AAS to define the division of elements in the sherds and to test the observed similarity between elements and the groups of vessels obtained on criteria of style and form.

The sherds were crushed carefully in an agate mortar to separate the fine clayey iron oxide material from the coarser silicate mineral material (quartz, feldspar, etc.) to which the iron oxides had affixed themselves. The samples were then sieved and fractioned on paper; the fractions obtained were < 0.2 mm and > 0.2 mm. The coarser fraction also contained clayey aggregates. The Fe oxides and the elements adsorbed by the fine matter were dissolved from the samples in $\text{HCl} + \text{HNO}_3$ (+ some HClO_4 to retain oxidizing conditions) on a sand bath in teflon dishes, (on the amounts of dissolved material see Table 2). The solutions were analyzed with a PERKIN-ELMER mod. 403 atomic absorption spectrometer. Hg was determined by the cold-gas method (Table 3a,b).

The colour of the coarse matter solution varied in relation to the humic concentration. The humic matter is generally determined by extraction with 0.5 % NaOH. An identical result, however is achieved with HCl extraction (Schnitzer & Skinner 1968) and the mild oxidation does not affect the humic

Table 2. Amounts of dissolved matter.

Vessels	Fine %	Coarse %
42	6.34	27.24
61	28.04	20.40
37	21.52	23.32
93	11.71	18.83
19	40.84	26.27
57	15.94	17.19
71	15.76	23.13
13	10.98	17.83
74	44.91	20.48
14	53.58	25.60
Corr/Fe	754	897

compounds very much. These occur together with Fe oxides. The absorbances of the humic compounds in the solution were measured by spectrometer at wavelengths 430, 490, 550, 600 and 680 nm, and the slope

coefficient of 430 and 550 were calculated. These reflect the degree of polymerisation of the humic compounds — the greater the value of the slope, the smaller the amount of polymerized compounds. The values of the slope coefficient also correlate with the concentration of humic compounds, and it was from these that the relative humic units were calculated taking into account the corrections caused by the colour of the Fe concentration. The samples were then weighed (Table 4).

To establish which elements were related to the various fractions, correlation coefficients were calculated for iron in relation to the dissolved matter and the relative humic concentration in the coarse fraction. For other elements, correlation coefficients were calculated in relation to iron in both

Table 3 a. Element contents.

COARSE FRACTION										
Vessels	Fe %	Al %	Mn ppm	Zn ppm	Cu ppm	Pb ppm	Co ppm	Ni ppm	Cd ppm	Hg ppb
42	5.08	4.49	541	64.5	20.3	18.2	19.3	41.4	0.4	14
61	3.59	3.25	415	57.8	15.7	16.9	12.3	24.4	0.4	7
37	4.91	4.11	347	53.8	22.8	17.2	18.6	37.2	0.3	32
93	3.38	3.00	583	45.4	17.1	16.0	14.4	22.8	0.6	10
19	4.86	4.61	1300	85.6	18.9	23.5	21.1	38.2	0.4	5
57	3.66	3.33	303	61.0	17.3	14.7	13.6	28.1	0.3	4
71	4.74	3.54	956	52.6	11.6	23.7	17.5	29.9	0.3	9
13	3.77	3.11	615	41.5	13.4	13.8	16.8	30.9	0.4	17
74	4.42	3.27	593	48.6	9.7	20.8	15.2	29.9	0.3	10
14	5.21	4.70	681	152.0	20.0	29.9	23.0	42.7	0.3	1

Table 3 b. Element contents.

FINE FRACTION										
Vessels	Fe %	Al %	Mn ppm	Zn ppm	Cu ppm	Pb ppm	Co ppm	Ni ppm	Cd ppm	Hg ppb
42	6.12	6.51	530	56.2	33.6	23.0	19.2	70.0	0.3	14
61	4.77	4.62	314	47.4	20.0	15.0	12.1	34.3	0.3	15
37	5.53	5.32	254	40.0	22.0	14.0	17.0	11.4	0.3	21
93	5.12	5.60	450	50.0	30.0	15.0	19.0	35.1	0.4	32
19	4.95	4.87	1000	56.3	16.4	20.0	16.6	42.5	0.6	12
57	5.00	4.89	357	62.0	23.0	15.0	15.0	42.3	0.3	10
71	5.33	4.52	690	36.1	12.4	26.0	15.1	32.1	0.3	13
13	6.30	6.30	690	44.0	28.4	21.0	25.0	62.5	0.5	26
74	5.67	4.11	430	33.2	10.4	24.0	14.0	34.1	0.3	6
14	4.76	4.54	450	103.0	20.0	12.0	17.0	42.2	0.2	11

Table 4. Relative contents of humic substance.

»Humic substance«	
Vessels	units
42	457.4
61	167.6
37	360.2
93	158.5
19	277.8
57	116.7
71	295.7
13	263.0
74	479.1
14	149.0

Table 5. Correlations/Fe in different fractions.

	COARSE	FINE	»HUMIC«
Mn	391	121	101
Co	867	670	205
Ni	928	489	360
Zn	553	-509	-307
Cu	365	60	-160
Pb	720	584	26
Cd	-522	180	-243
Hg	335	238	405
Al	878	675	209
CORRELATIONS/SOLUBLE			
Fe	879	754	583

the fine and coarse fractions and in relation to the humic units (Table 5). Zn and Cu correlate strongly with the coarse fraction, Cd with the fine fraction and Hg and Fe with the humic fraction. The correlation coefficients of the elements in both the fine and coarse fractions are given in Tables 6 a and b.

The enrichment coefficients in fine/coarse fractions were in the following order (Table 7) $Cu > Fe \geq Ni > Co \sim Pb > Zn \sim Mn$, which corresponds to the enrichment coefficients of elements in the fine fraction as compared to the coarse fraction in various soil materials from South Sweden except with respect to Zn: $Cu > Ni > Zn \geq Cr > Co >$

$Cd > Pb$ (Andersson 1979). Thus owing to similar climate conditions the materials may derived from similar soil.

The heavy metal concentrations enriched in the fine material and Fe oxides (Zn, Cu, Pb, Co, Ni) were calculated to compare the regional concentrations of the areas. The values for vessel 19 and 57 corresponded best to the values of the cluster analysis; vessel 14 differed most from the others (Fig. 8). The correspondence with single element concentrations was best in the fine fraction (Tables 4 and 5).

The main silicate minerals of the coarsest matter in the samples are given in Table 8.

Table 6 a. Correlations between elements in different fractions.

Coarse	Fe	Mn	Co	Ni	Zn	Cu	Pb	Cd	Hg
Fe	1000								
Mn	391								
Co	867	532							
Ni	923	275	915						
Zn	553	266	714	653					
Cu	365	-159	468	564	425				
Pb	720	571	723	569	807	59			
Cd	-522	73	-260	-415	-282	81	-372		
Hg	335	-357	329	399	-347	439	-251	-166	
Al	878	389	889	935	726	662	654	-304	202

Mn: $Pb > Co$
 Co: $Ni > Al, Fe, Pb, Mn$
 Ni: Al, Fe, Co, Zn, Pb, Cu
 Zn: Pb, Al, Co, Ni
 Cu: Al, Ni

Pb: Zn, Co, Fe, Al, Mn, Ni
 Cd: $-Fe$
 Hg: $-$
 Al: Ni, Co, Fe, Zn, Cu, Pb
 Fe: Ni, Al, Co, Pb, Zn

Table 6 b. Correlations between elements in different fractions.

FINE	Fe	Mn	Co	Ni	Zn	Cu	Pb	Cd	Hg
Fe	1000								
Mn	121								
Co	670	328							
Ni	489	402	559						
Zn	-509	-29	45	240					
Cu	-60	-356	650	541	185				
Pb	584	527	101	345	-579	-266			
Cd	180	761	446	244	-60	99	-191		
Hg	238	-48	635	254	-191	636	-254	343	
Al	675	112	813	612	-64	903	72	312	621

Fe: Al > Co > Pb (-Zn)

Mn: Cd > Pb

Co: Al > Fe > Cu > Hg > Ni

Ni: Al > Co > Cu

Zn: -Pb > -Fe

Cu: Al > Co > Hg > Ni

Pb: Fe > Mn (-Zn)

Cd: Mn

Hg: Cu ≥ Co > Al

Al: Cu > Co > Fe > Hg ≥ Ni

The results suggest that the materials of the vessels classified according to features of ornament and form differ from each other except in vessels 19 and 57 (group C).

Diatoms in sherd samples

Diatom analysis is especially popular in Finland for studying the raw material of prehistoric clay vessels (pioneering studies, e.g. Edgren 1966, 1970, also Foged 1968, Alhonen and Väkeväinen 1980, in print). The starting point of these studies has been the varying saline ecological requirements of diatoms (Diatomae). When preserved, diatoms indicate the formative environment of the

clay layers in question. In Finland these can be connected to the geological history of the development of the Baltic, the phases of which have been determined from series of layers with the help of diatom stratigraphy. Being well known, they need not be given here. Some typical diatom flora have been reported by Eronen (1974) and by Ignatius & Tynni (1978).

About 8–10 g of the sherds studied were crushed in a mortar. The pulverized matter was then treated in a routine manner with 30 % hydrogen peroxide (e.g. Alhonen 1967, p. 6). Matter hindering the determination of the diatoms was suspended and decanted as thoroughly as possible so that the whole

Table 7. Enrichment coefficients in FINE/COARSE fractions.

Vessels	Fe	Al	Mn	Zn	Cu	Pb	Co	Ni	Cd	Hg
42	1.20	1.45	0.98	0.87	1.70	1.26	0.99	1.64	0.75	1.00
61	1.33	1.42	0.76	0.82	1.68	0.89	0.98	1.41	0.75	2.14
37	1.23	1.29	0.73	0.74	1.10	0.82	0.91	0.30	1.00	0.66
93	1.51	1.87	0.77	1.10	2.16	0.94	1.32	1.54	0.67	3.20
19	1.02	1.06	0.77	0.66	1.11	0.85	0.79	1.11	1.50	2.40
57	1.37	1.47	1.18	1.02	1.68	1.02	1.10	1.50	1.00	2.50
71	1.12	1.29	0.72	0.68	1.27	1.10	0.86	1.07	1.00	1.44
13	1.67	2.03	1.12	1.06	2.12	1.52	1.49	2.02	1.25	1.53
74	1.28	1.26	0.74	0.68	1.20	1.15	0.92	1.14	1.00	0.60
14	0.91	0.97	0.66	0.68	1.33	0.40	0.74	0.99	0.67	> 11
MEDIAN	1.23	1.41	0.84	0.83	1.54	0.99	1.01	1.27	0.96	1.55

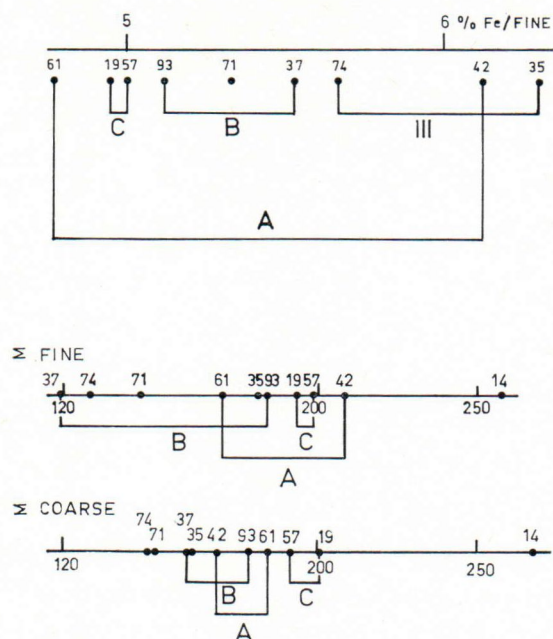


Fig. 8. Heavy metal concentrations and stylistic groups.

matter is represented by two preparations. The preparation slides mounted in »Caedax» were completely investigated microscopically. Each diatom shell and each fragment was determined. The results are given in the numbers of specimens (cf. Foged 1968).

The results of the diatom analysis of the investigated sherds are given in Table 7. It shows that the species are few in number especially since the numbers in the table also include fragments. Even so, the diatom flora is qualitatively useful with respect to the problem at hand as it contains both clear water forms (e.g. *Melosira arenaria* and *M. islandica* ssp. *helvetica*) and marine forms (*Campylodiscus echeneis* and *Cocconeis scutellum*). In the history of the Baltic both the above-mentioned *Melosira* species are characteristic of the Ancyclus Lake in general (e.g. Eronen 1974). *Campylodiscus echeneis* is a poly- or mesohalobic bottom form and *Cocconeis scutellum* is a marine epiphyte (Miller 1964). These suggest either the Yoldia

or Litorina Seas. The former has also been regarded as a typical microfossil of the Yoldia/Ancyclus boundary (e.g. Sauramo 1958; also Ignatius & Tynni 1978, Table 1, p. 9). The sherds are, however, from an area where salt water and brackish water diatoms occur in sediments of the Baltic formed during the period of pollen zone V (Alhonen 1971, Fig. 2). Hence, these clays were formed mainly in the Ancyclus Lake. Diatoms indicating salinity would thus be secondarily washed in the transgression of the Ancyclus Lake (Eronen 1976) from older layers, namely, those of the Yoldia Sea (Alhonen 1971, pp 7—8).

Taking into account the other fresh water diatoms (*Amphora ovalis*, *Eunotia lunaris*, *Melosira ambigua*, *M. granulata* var. *angustissima*, *M. italica*, *Navicula radiosa*, *Synedra ulna* and *Tabellaria fenestrata*), the diatom analytical interpretation of the origin of the raw material of the vessels being studied is clay deposited in relatively fresh water. In the history of the Baltic this would be mainly Ancyclus clay. This is valid as long as the salt water diatoms found in vessels 37, 93, 19, 57, 71, 74 and 14 do not indicate the primary environment of stratification. If these were primary with respect to their place of growth, the clay of which the vessels

Table 8. Main silicate minerals in the coarsest matter of the samples

Vessels	Q	Plg	Kfs	D-mica	C-mica	Dark
42	+	+			+	+
61	+	+	++	+	+	+
37	+	+	++			
93	(+)	+	++			
19	++	+		++		
57	+	+	++			
71	+	+	++		+	(+)
13	+	+	++			
74	+	+	++		++	++
14	+	+				

Q quartz; Plg plagioclase; Kfs potassium feldspar; D-mica dark mica; C-mica colourless mica; Dark dark mineral, probably amphibole.

Table 9. Diatoms found in sherds samples.

Taxa	Vessel									
	42	61	37	93	19	57	71	13	74	14
<i>Amphora ovalis</i>									1	
<i>Campylodiscus echeneis</i>			1	1	2	2	1			2
<i>Cocconeis scutellum</i>				1					1	
<i>Diploneis</i> sp.				1						
<i>Eunotia lunaris</i>			1			1				
<i>Melosira ambigua</i>									3	
<i>M. arenaria</i>	5	8						2	1	
<i>M. granulata</i> var. <i>angustissima</i>									2	
<i>M. islandica</i> ssp. <i>helvetica</i>						1	4	2	2	
<i>M. italica</i>							2			
<i>Navicula radiosa</i>							1			
<i>Navicula</i> sp.				1	1					
<i>Nitzschia</i> sp.		1			1		1		1	
<i>Pinnularia</i> sp.	1		1	1				1		
<i>Synedra ulna</i>		2								
<i>Tabellaria fenestrata</i>	1						2			

were made could also be from the *Yoldia* phase.

It is furthermore interesting to note that in vessel 71 in addition to diatoms two cell groups of *Pediastrum boryanum* were found. This Protococcales green algae, which occurs mainly in lake plankton, may indicate the use of tempers (for example pre-lake mud) in the manufacture of the vessels, as seems to have been the case at Östra Jansmyra in Åland (Alhonen and Väkeväinen 1980).

Few diatom analytical studies of prehistoric clay vessels have so far been carried out in Finland. The raw materials of the Jäkärälä Ware and the Cord Impressed Ware from Perkiö in Hauho (Edgren 1966, 1970) were interpreted as glacial clay, and most of the raw material of the Early Comb Ceramic pottery from Åland seems to have been Ancyclus clay (Alhonen and Väkeväinen 1980). The material investigated in this study supports the latter result. It is, however, quite evident that raw material for clay vessels most readily available in the environment of the stone age dwelling sites was taken from the clay in the surface sediments of the terrain.

Concluding remarks

The stylistic clustering of the vessels is based (cf. p. 194 ff.) on the motifs and variations of the decorated surfaces and the rim forms. The apparent physical properties of the vessels do not affect this classification. One of the most important factors in the AAS results is apparently the coarse sand temper added to the clay in the actual manufacture of the vessels. The main minerals of this matter are shown in Table 6. The correspondence between the Fe concentrations in the fine matter may be the result of the manufacturing technique which may have included the addition of red ochre to the raw material. Compared with the stylistic analysis a positive result is obtained only within group C. The Pit and Comb Ware vessel (nr. 14) differs considerably in composition from the other vessels and may have been made in East Karelia, a direction of origin that is borne out by the ornamentation.

Despite the sparsity of diatoms in the clay matter, their distribution is in accordance with the stylistic classification. The following diatoms »dominate» the stylistic groups:

- Group A = *Melosira arenaria*
 Group B = *Campylodiscus echeneis*
 Group C = » »
 Group III = *Melosira islandica* ssp. *helvetica*

Furthermore the group »Other» includes the *Pediastrum* algae, which are lacking in the other samples.

Variations in the stylistic details and forms depend on sites from which clay was obtained at the time of manufacture of the vessels. These changed along with the stylistic tradition. Luho's (1959) assumption that

the group »Other» is contemporaneous with Ka III is supported by the occurrence of *M. islandica* ssp. *helvetica* in both. Results obtained in different studies (cf. Foged 1968) show that the raw material was either glacial or fresh water clay. Marine flora of the Litorina Sea has not been found so far in any of the vessels studied. This may be attributed to either the salinity or humic consistency of the clay (Okko 1957, Romu 1977, 1978), which made the clay unsuitable for firing.

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Appendix

The sample vessels Stylistic description

Ka II: 1. Group A. Vessel 61. (Fig. 1). KM 17075: 329, 335, 336, 359, 376, 378. Identifiable outer surface 150 cm². Approximate diameter at mouth over 20 cm. Decorative elements: short fine comb stamps rows, rows of pits, chevron-like zig-zag figures bordered and hatched with comb stamp impressions. Corresponds to Äyräpää's definition of Ka »Hochstil».

Vessel 42. (Fig. 1). KM 17075: 153, 161. Identifiable outer surface 24 cm². Approximate diameter at mouth over 20 cm. Decorative elements: short comb stamps, pits. Motifs: rows of pits, geometric designs (cf. vessel 61) bordered and hatched with comb stamp impressions.

Group B. Vessel 93. (Fig. 2). KM 17075: 34, 409. Identifiable outer surface 15 cm². Approximate diameter at mouth over 20 cm. Decorative elements: short thick comb stamps, pits, finger impressions. Motifs: rows of comb stamps, rows of pits, rectangular fields of comb stamps.

Vessel 37. (Fig. 2). KM 17075: 249, 250, 252, 323, 329. Identifiable outer surface over 600 cm². Approximate diameter at mouth over 20 cm. Decorative elements: short fine comb stamps, pits of oblong form. Motifs: rows of comb stamps, rows of pits, lozenge-like fields of comb stamps in rows. Repaired with pitch.

Group C. Vessel 19. (Fig. 3). KM 17075: 143, 152, 244, 254, 262, 263. Identifiable outer surface 200 cm². Approximate diameter at mouth over 20 cm. Decorative elements: Fine and thick short comb stamps, two-part stamps resembling fish vertebrate impressions, pits. Motifs: rows of comb stamps, rows of pits, groups of two-part stamps and pits in rows. Indentation on top of rim.

Vessel 57. (Fig. 3). KM 17075: 324, 327. Identifiable outer surface 300 cm². Approximate diameter at mouth over 20 cm. Decorative elements: long and short fine comb stamps pits. Motifs: rows of comb stamps, rows of pits, solitary row of lozenge-like fields of comb stamps.

»Other» Vessel 71. (Fig. 5). KM 17075: 359, 367, 378, 379, 385. Approximate diameter at mouth over 20 cm. Identifiable outer surface 200 cm². Decorative elements: long impressions possibly executed with a comb stamp, indentations visible in places, pits. Motifs: rows of above impressions, rows of pits, groups of three pits forming triangular design.

Ka III: 1. Vessel 13. (Fig. 4). KM 17075: 115, 116, 205. Approximate diameter at mouth over 20 cm. Identifiable outer surface 450 cm². Decorative elements: large and small pits, finger

impressions. Motifs: row of finger impressions on edge of rim, rows of pits.

Vessel 74. (Fig. 4). KM 17075:365, 367. Diameter at mouth 10—20 cm. Identifiable outer surface 40 cm². Decorative elements: large and small pits. Motifs: vertical rows of interspaced large and small pits.

Pit and comb ware. Vessel 14. (Fig. 5). KM 17075: 124, 125, 132, 134, 160, 223, 350. Diameter at mouth over 20 cm. Identifiable outer surface over 200 cm². Decorative elements: short and thick comb stamps, pits. Motifs: rows of comb stamps, rows of pits placed close to another, groups of several pits forming triangular designs.