NEW DATA ON SHORELINE DISPLACEMENT AND ARCHEOLOGICAL CHRONOLOGY IN SOUTHERN OSTROBOTHNIA AND NORTHERN SATAKUNTA

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Abstract

Shoreline displacement in southern Ostrobothnia (Pohjanmaa) and northern Satakunta was studied by using recent sediment, pollen and diatom data supplemented by radiocarbon dates from 12 lake basins at various altitudes that were successively cut off from the Baltic. The shoreline displacement shows a very rapid regression of more than 100 m from deglaciation to about 8000 B.P. after which a distinct retardation took place.

Two new stratigraphical Litorina sites, Lake Kalliojärvi (47.7 m) and Lake Tuorilampi (29.3 m a.s.l.) are reported here to supplement the earlier results. The stratigraphy of Tuorilampi shows a possible transregression around 3000 B.P., but the topographic reconstruction suggests a river estuary situation at that time.

The Stone Age coastal dwelling places from southern Ostrobothnia are dated with this shore displacement curve on the basis of their altitudes, and the chronology of different stylistic phases from the Mesoliticum to the Late Sub-Neolithic Kiukainen culture is thus obtained. The results are in accordance with the chronology obtained earlier by the time/gradient method. There are, however, some overlapping dates at Middle and Late Comb Ware sites.

Introduction

The studies of shoreline displacement in southern Pohjanmaa and northern Satakunta (Salomaa, 1982; Salomaa and Matiskainen, 1983) have used radiocarbon dated isolation stratigraphies from small lake basins situated at various altitudes in the direction of land uplift to establish a shore displacement curve from the early Ancylus Lake phase to middle Litorina Sea phase. Fig. 1 shows the location of the stratigraphical and archeological sites used in the present work. The present land uplift at the stratigraphical sites is a little more than 7.5 mm yr^{-1} (Suutarinen, 1983).

The stratigraphical data so far obtained shows a very rapid regression during the Ancylus period. The date of about 9400 B.P. for the highest morphological shore of about 203 m a.s.l. on the Lauhanvuori hill, is based on Sauramo's (1923, 1934) deglaciation chronology. The highest stratigraphically dated isolation horizons dated 9100—9000 B.P. show a typical Ancylus flora like *Melosira islandica ssp. helvetica* and *Stephanodiscus astraea* in the pelagic facies and *Gyrosigma attenuatum* and *Campylodiscus noricus + v. hibernica* in the littoral facies (Salomaa, 1982; Salomaa and Alhonen, 1983). Only a few marine diatoms were found. This is consistent at least with the

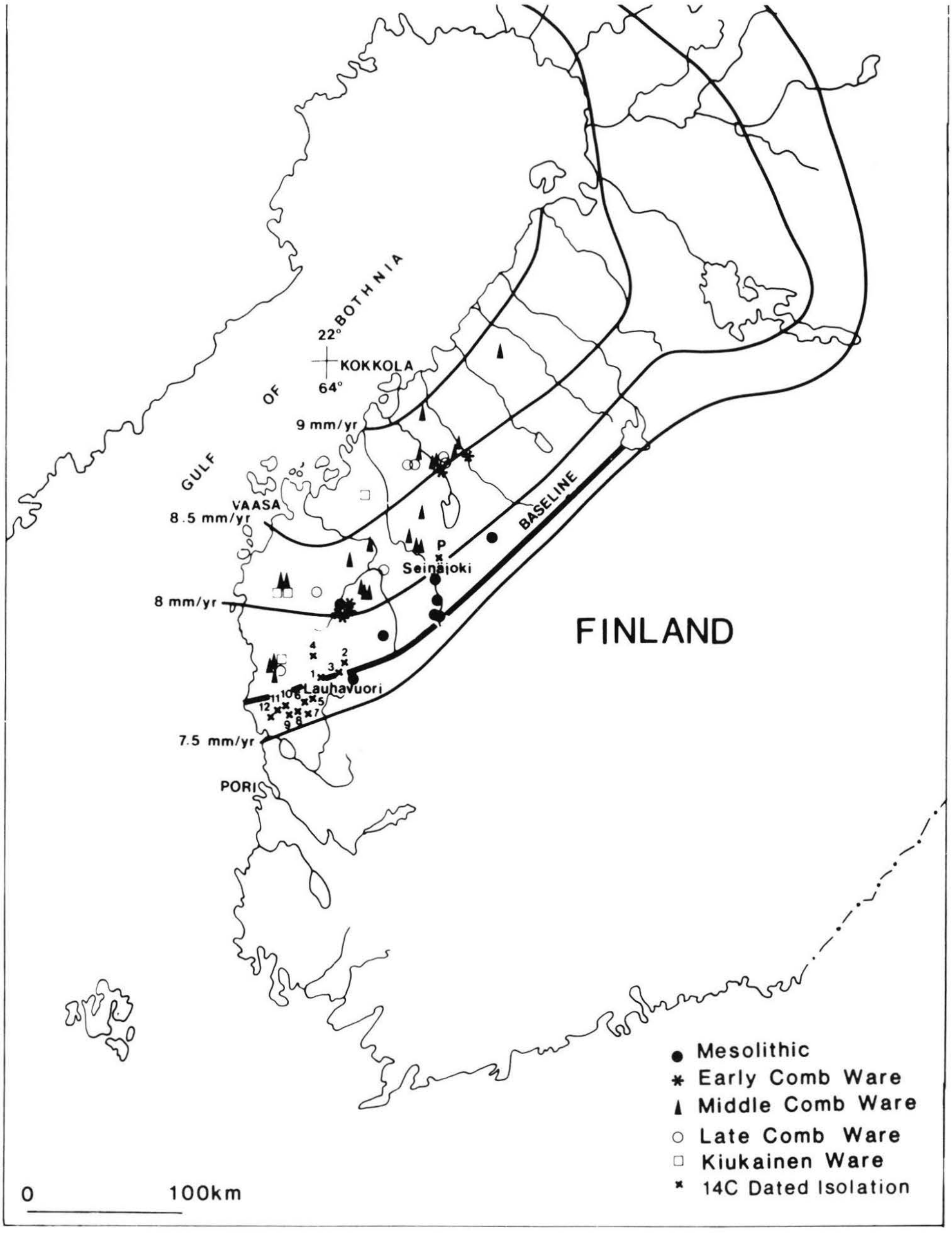

Fig. 1. Research area showing the sites used for constructing the shore displacement curve and dating the Stone Age dwelling sites. The stratigraphical sites 11 and 12 are introduced in detailed here. The baseline is adjusted according to recent land uplift isobases (Suutarinen, 1983), which include a correction of 0.8 mm for the assumed modern eustatic rise.

modern Finnish conceptions, that the Ancylus Lake stage began as early as around 9500 B.P. (Eronen, 1976; Eronen and Haila, 1982; Glückert and Ristaniemi, 1980, 1982; Ristaniemi, 1984), and was transgressive only on the lower side of the land uplift isobase going via Degerforss threshold.

At the end of the Ancylus phase a transition to slightly brackish Mastogloia phase took place. This is recorded only at one site, Rynkäkeidas bog (number 6 in fig. 1) at about 90 m a.s.l. The indicative brackish water elements in addition to dominating Ancylus Lake forms were *Mastogloia spp, Anomoeoneis sphaerophora* and *Synedra pulchella* (Aario, 1932). The isolation of the Rynkäkeidas basin from the Mastogloia Sea was dated 7450 ± 120 B.P. (Hel-1633) in Salomaa and Matiskainen (1983). The stratigraphy of Porraslampi (P in fig. 1) studied by Eronen (1974) showed no Mastogloia phase although the basin was situated only 1—2 m upon the highest Litorina limit. The beginning of the Mastogloia phase is connected with the flooding of the ocean over the Danish straits due to rapid eustatic rise. According to Berglund (1964) this happened already before 8000 B.P. but the salt water effect was not felt until considerably later in the Bothnian basin (see e.g. Eronen, 1974).

The abrupt bend in the regressive shoreline curve at about 8000 B.P. is the most conspicuous feature in all modern radiocarbon dated shoreline studies in the northern part of the Baltic (e.g. Möller and Stålhös 1969; Hyvärinen 1980, 1982; Saarnisto, 1981; Salomaa, 1982; Ristaniemi, 1984). In fact, the calibrated radiocarbon years (Klein et al. 1982) suggest that the culmination is not so abrupt as indicated by the ^{14}C-dates (see fig. 8). The bend was caused by the eustatic rise after the Ancylus regression together with slowing-down of glacio-isostacy. Possible also neotectonic movements in the Danish straits have contributed to this bend (see e.g. Sauramo, 1954; Köster, 1979).

Between 8000—6500 B.P. the rate of regression was only about 1 m/century increasing somewhat after that. Almost identical trends but lower absolute figures are presented by Hyvärinen (1980, 1982) for the Helsinki district. This is also supported by the »smooth Baltic eustatic curve» of Eronen (1974) showing a slowing-down of sea-level at about 6000 B.P. after a rapid initial rise. The beginning of the Litorina Sea proper is placed in southern Pohjanmaa around 7000 B.P. (Salomaa, 1982), corresponding to about 85 m a.s.l. in the Lauhanvuori area (Virkkala, 1959; Eronen, 1974).

This paper is mainly concerned with the stratigraphical data of the two new sites linked with the development during the late Litorina times between 5000—3000 B.P. This period is interesting because of two Litorina transgressions described in the Stockholm region (Florin, 1944; Miller and Robertsson, 1981, Miller, 1982). On the Finnish side of the Baltic there are no modern stratigraphical studies from that period, but the prevailing view, which is based on Eronen's (1974) work, argues that only one major transgression can be recognized in the area east of Helsinki towards the beginning of the Litorina period. This is also supported by Hyvärinen's (1980, 1982) data from the Helsinki district.

New stratigraphical data

Lake Kalliojärvi (number 11 in fig. 1, fig. 2) is a small longish basin measuring about 450 × 100 m and situated in a bedrock depression. The basin is surrounded by low till covered bedrock hillocks and peat bogs. The threshold of 47.7 m a.s.l. is situated at the northern end of the lake. It has been excavated and the original isolation level has been situated c. 0.8 m higher. The topographic construction indicates a sea side situation with open connections to the sea before isolation. The final isolation took place, however, in a rather sheltered environment inside till-covered islands in the west and Kuvaskangas glaciofluvial formation in the south.

The thickness of the whole sediment sequence measured from the ice cover range 3.5—1.2 m, but only the isolation sequence (2.6—2.1 m) was analysed in detail. The

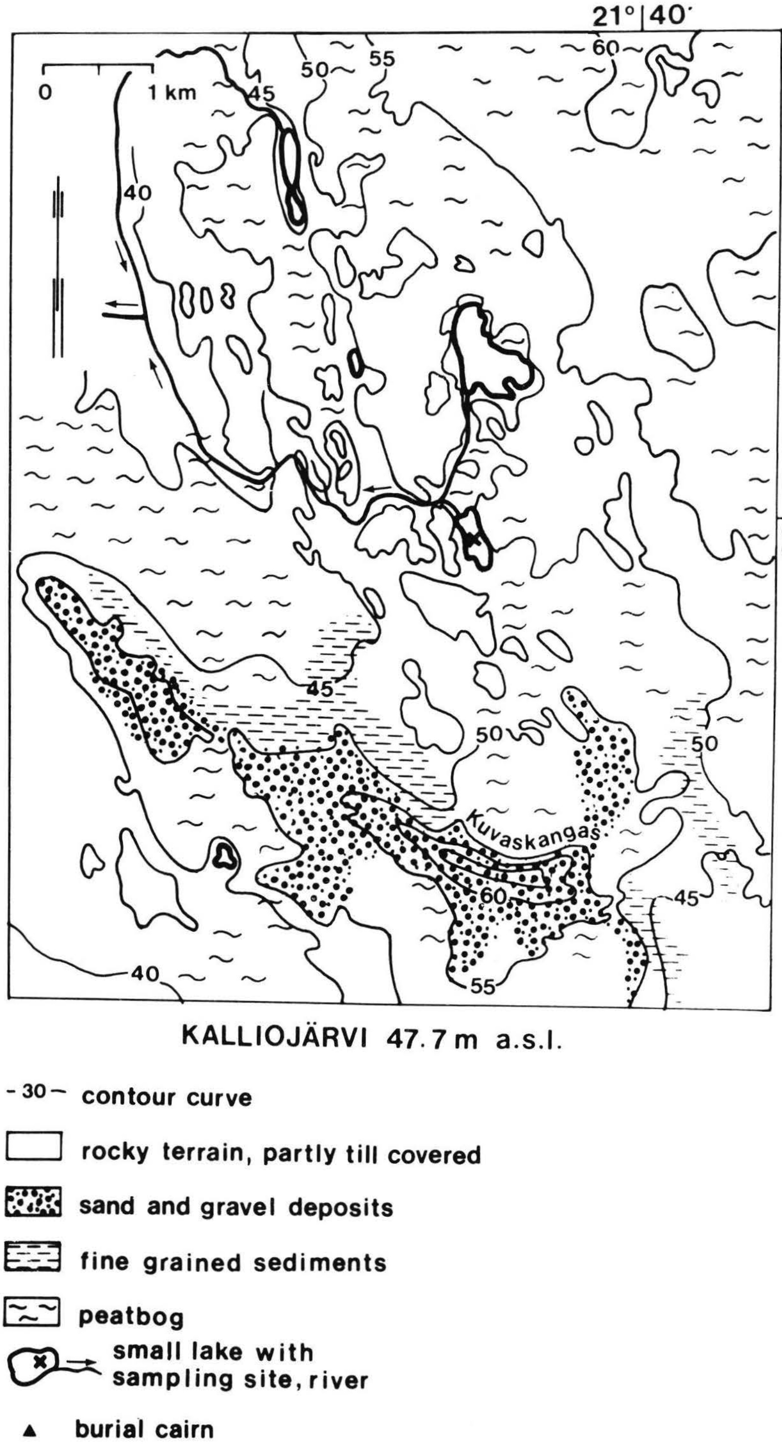

Fig. 2. Topography and surficial deposits in the Kalliojärvi area. The 50 m contour curve shows the approximate position of the shoreline shortly before the isolation of Lake Kalliojärvi from the Litorina Sea. The topographic map has been redrawn from a basic map of the General Survey Office, and the surficial deposits are slightly modified from Salonen and Kokkola (1981).

sediment stratigraphy was as follows: 3.5—2.4 m greenish-gray clay-gyttja with black sulphite laminations, plant remains were discovered at a depth of 3.0 m; 2.4—1.2 m dark brown lake mud. The loss-on-ignition curve shows a rapid increase in organic matter after 2.4 m. Except for the bottommost contact with the sand, the sediment changes were gradual, suggesting continuous sedimentation.

The shallow brackish water littoral forms like *Cocconeis scutellum, C. pediculus, Epithemia turgida var. westermanni, E. zebra var. porcellus* and *Navicula peregrina* are the most common diatom species in the pre-isolation phase with a rather strong pelagic component represented by *Hyalodiscus scoticus* and *Actinocyclus ehrenbergi.*

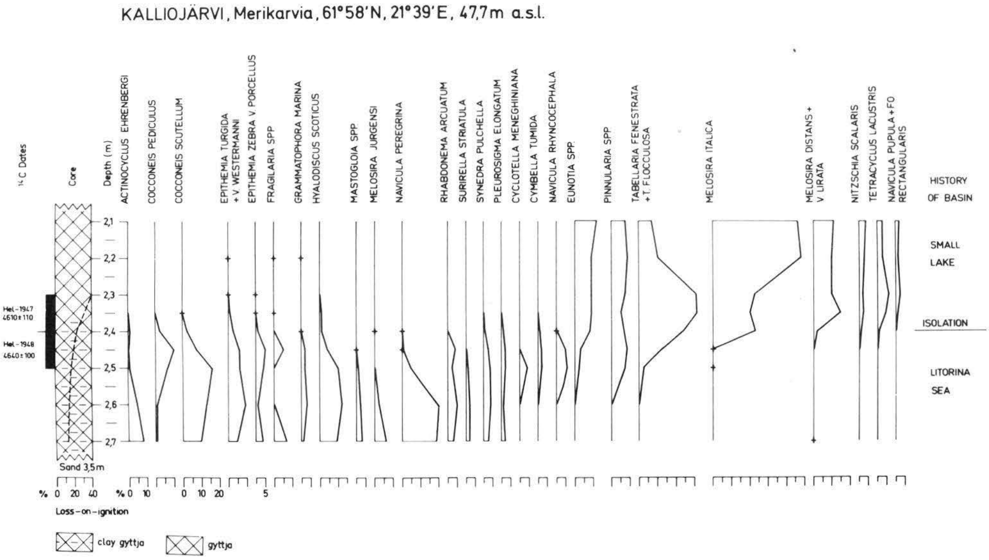

Fig. 3. Diatom and sediment stratigraphy for the isolation sequence of Lake Kalliojärvi. Selected species. 150—200 frustules are counted at each level. Ignition loss curve is shown in the sediment column. ^{14}C-dates, also shown, are obtained at the Radiocarbon Dating Laboratory of the University of Helsinki (Hel) and given as conventional radiocarbon years, ± 1σ.

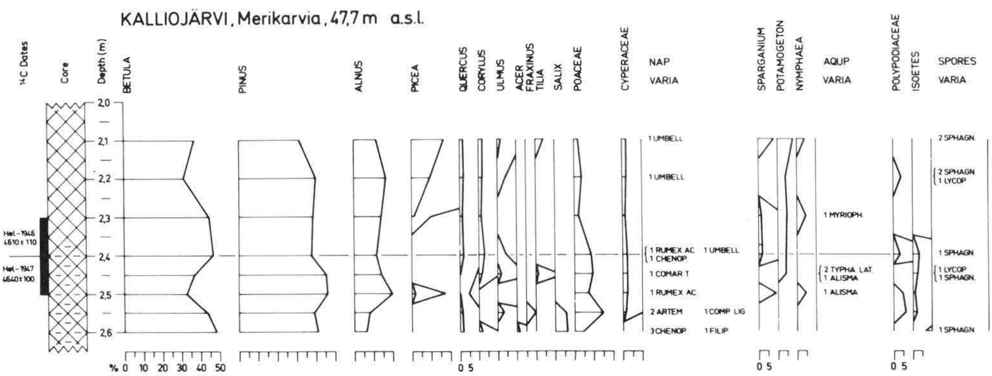

Fig. 4. Pollen stratigraphy of Lake Kalliojärvi. At each level about 300 arboreal pollen were counted, of which sum AP percentages were calculated. NAP percentages are based on the sum AP + NAP and AQUP and Spores AP + NAP + n (n = AQUP or Spores).

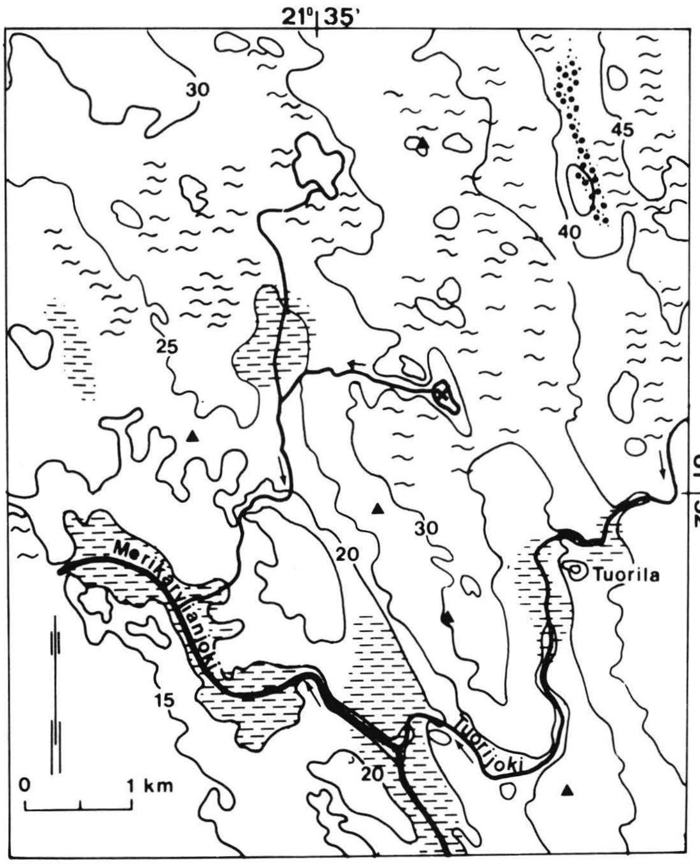

Fig. 5. Topography and surficial deposits in the Tuorilampi area. The location of the burial cairns is also shown. Lake Tuorilampi was located in a lagoon-like basin in the sphere of a river estuary after the water level fell to the level of the 30—35 m contour curves. For symbols, see fig. 2.

At or just below the isolation level *Fragilaria construens* + *var.* make its appearance like also *Navicula rhyncocephala.* After the 2.45—2.4 m level, a distinctive fresh water assemblage typical of a small lake environment appears. At this point also *Nitzschia scalaris* appears. Fig. 3 shows the main features of diatom stratigraphy.

The isolation horizon is dated by using samples upon and below 2.4 m. They gave almost identical results: 4610 ± 110 B.P. (Hel-1947) and 4640 ± 100 B.P. (Hel-1948) respectively. This indicates a rapid sedimentation with no hiatus points during the isolation.

According to pollen stratigraphy (fig. 4), the isolation sequence deposited in the birch-alder-hazel-elm P.A.Z. of southwestern Finland before the spread of spruce. The distinctive change in the relative shares of *Betula* and *Pinus* occurs at 2.45—2.4 m level with an increase in *Betula* and a decrease in *Pinus.* This may be connected to a change in the local conditions, with an invading coastal vegetation and more closed sedimentation basin.

Potamogeton and *Sparganium* make their appearance at 2.45—2.4 m level indicating a low-energy shallow water environment. *Isoetes* and *Polypodiaceae* have narrow peaks also at this level. Both of them require minerogenic beds which were present during the isolation and emergence.

Lake Tuorilampi (number 12 in fig. 1, fig. 5) is a small (250 × 100 m) basin located only seven kilometers inland from the present coast. The basin is surrounded by peat bogs. The topographic construction suggests that shortly before the isolation a lagoon-type of situation developed with a sea connexion into the west via the present outlet channel. At the same time there was also a broad connexion pointed south to the estuary of ancient Tuori-river. This shallow sea connexion existed at a very late stage judged by the low altitude of the peat covered isthmus lying south of Lake Tuorilampi.

The sediment stratigraphy of the lake was as follows: 3.6—2.38 m greenish-gray clay-gyttja, stained with sulphide; 2.38—2.35 m dark brown mud, lower boundary sharp; 2.35—2.1 m FeS-coloured clay-gyttja, very similar to the layer below the mud; 2.1—1.4 m dark brown lake mud. Humus content rises rapidly after 2.1 m level reaching 60 % at 1.9 m level

Only the isolation sequence (2.6 (2.5)—2.0 m) was studied biostratigraphically. The bottommost part below 2.4 m is characterized by brackish water diatom association. Epiphytic species like *Cocconeis scutellum* and *Epithemia turgida var. westermanni* dominated, but also planctic *Hyalodiscus scoticus* and resting spores of *Chaetoceros spp.* were frequent. Between 2.4—2.35 m the composition of the diatom flora radically changes with incoming and prevailing fresh water association composed mainly of *Melosira italica, Melosira distans + var. lirata, Pinnularia spp.* and *Tabellaria fenestrata.* Upon 2.35 m level brackish water littoral flora increases again reaching c. 30 % at 2.15 m level. From 2.1 m upwards all brackish water species except *Nitzschia scalaris* virtually disappear. At this level *Eunotica robusta* and *Navicula radiosa* make a strong appearance. Figure 6 illustrates the succession of the diatom composition.

The presence of halophilous *Nitzschia scalaris* in the lacustrine phase of the basin

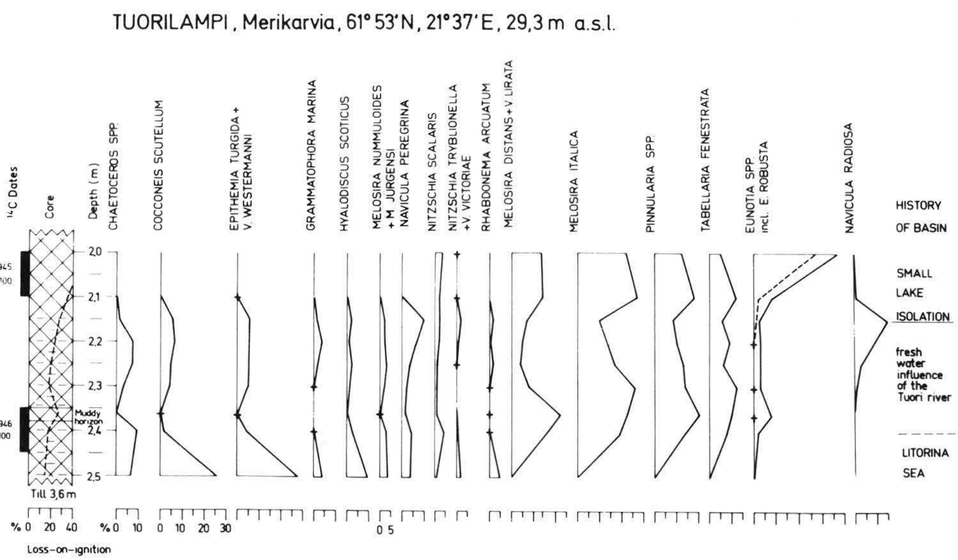

Fig. 6. Diatom and sediment stratigraphy for the isolation sequence of Lake Tuorilampi. The stratigraphy shows a double isolation with brackish water diatoms in the interbedded clay-gyttja. For sediment symbols and explanations, see fig. 3.

is a regular feature in the studied basins cut off from the Litorina Sea (Salomaa, 1982; Salomaa and Matiskainen, 1983). Fontell (1926) analysed recent diatom flora in newly isolated lakes and found that *N. scalaris* grew regularly in lakes with dominating small lake taxa (see also Florin, 1946). Its common existence at the beginning of the lacustrine phase is thought to reflect the abundant nutrient supply of the basin proximity to the Litorina shore (Eronen, 1974; Hyvärinen, 1980).

The pollen stratigraphy (fig. 7) shows that the relative proportions of *Betula* and also *Alnus* increase after 2.4 m level while *Pinus* decrease. *Picea* is spread after 2.2 m level, although some grains, possibly redeposited, occur at lower levels, too. *Typha latifolia, Alisma* and *Filipendula* are indicative of a rich shore vegetation during the isolation phase. The occurrence of green algae, *Pediastrum,* at 2.4 m level show clear indications of isolated fresh water environment (see e.g. Björck, 1979; Saarnisto, 1981).

The double isolation, shown in the stratigraphy of Tuorilampi, may indicate a marine transgression after a short lacustrine phase. It could also have been caused by other radically changed sea connections. For example, after the development of a lagoon-like situation with a narrow outlet in the west, the impact of the fresh water Tuori-river estuary may have become dominant because of broad, although shallow connections in the south. If the basin has several inlets and their functions have changed during the isolation process, the isolation may be a fairly complicated event. Two things seem clear: the basin was protected after 2.4 m level and the sulphide bearing sediments on both sides of the muddy layer are indicative of a marine coastal basin environment. However, in spite of a lagoon-like situation, no characteristic Clypeus-flora was present. With a single site of transgression-like stratigraphy without any evidence from nearby areas, the possible transgression has still to be left open.

Two datings have been carried out for the isolation sequence: A date of 3200 ± 100 B.P. (Hel-1946) was obtained at 2.35—2.45 m depth below the »transgression layer». A second date, 2830 ± 100 B.P. (Hel-1945), was obtained at 2.1—2.0 m depth upon the »transgression layer» where brackish water diatoms are finally replaced by fresh water diatoms of mainly acidophilous species.

Shore displacement

Figure 8 illustrates the shore displacement curve in the study area from deglaciation to late Litorina times. As pointed out earlier, it is based on stratigraphical data. The

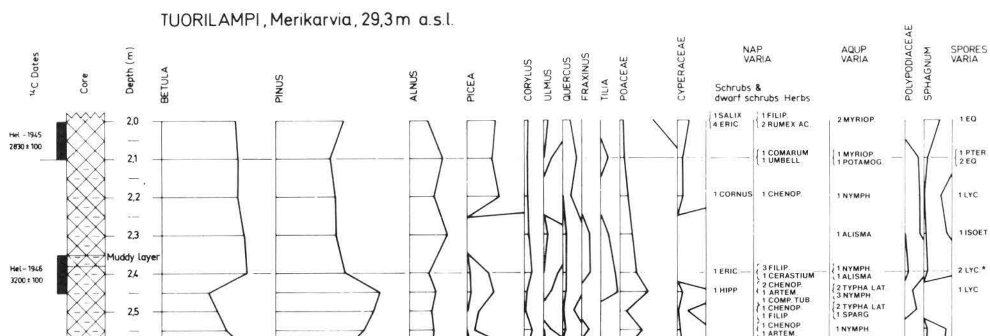

Fig. 7. Pollen stratigraphy of Lake Tuorilampi. Asterix marks *Pediastrum* findings. For other symbols and explanations, see figs. 3, 4.

definitions of the isolation contacts in the other basins referred to in this paper, are based on similar criteria.

Usually only slight corrections for unequal landuplift have been carried out for the altitudes of the basins, because they are situated very close to the same land uplift area. The threshold levels of the lakes have also been corrected, if valid evidence for former lake levels have been available (morphological shorelines and down-cutting thresholds have been observed in the field and supplemented by data from the Water District Office of Vaasa). Usually the original lake levels were situated a little higher than the present ones.

The rapid initial shoreline displacement, on the average 7.8 m/century, from deglaciation to 8000 B.P. is well documented, although it may consist of three parts showing a slower regression between 9000—8500 B.P. (Salomaa, 1982). Then it must be concluded that the date for Uuronjärvi, 8520 ± 130 B.P. (Hel-1634), is somewhat too old as compared to that for Kauhajärvi, 8510 ± 190 B.P. (Hel-1292, Salomaa, 1982), which is located about 16 m higher. This is also suggested by the early date of 8740 ± 130 B.P. (Hel-1635) for the spread of *Alnus* at Uuronjärvi. The isolation dates fit each other, however, within the dating accuracies. The time of possible slower regression can be correlated with the rising of Degerforss threshold above sea level in Central Sweden and the shifting of the outlet channel to Danish Sounds (if such outlet(s) existed, see Nilsson, 1970; Krog, 1979).

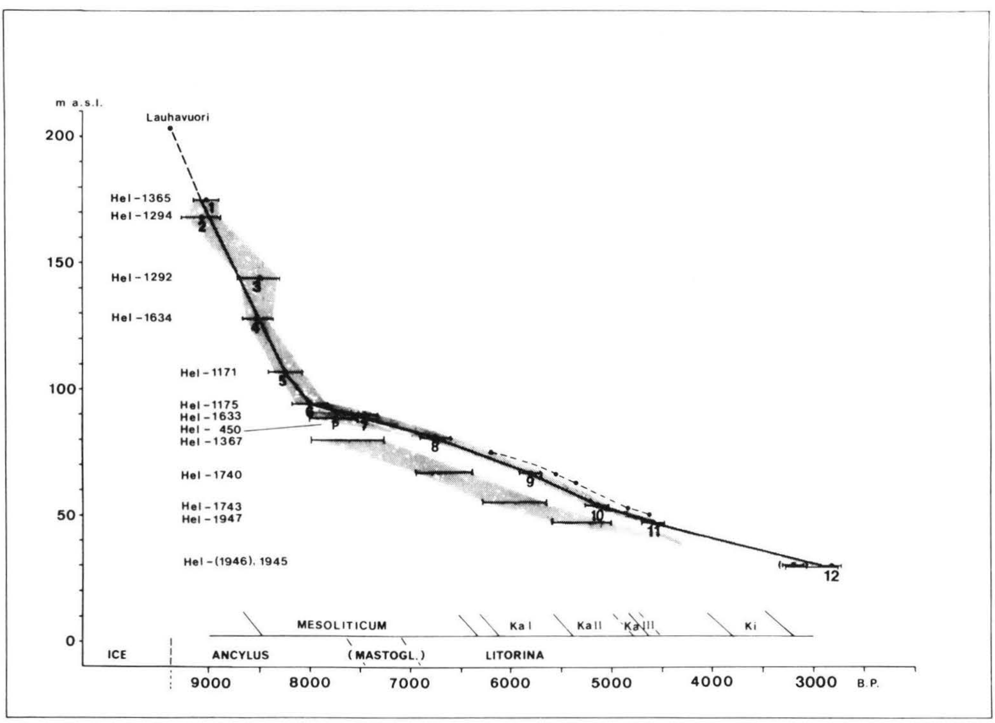

Fig. 8. A curve (zone) for shoreline displacement in southern Pohjanmaa and northern Satakunta. The curve represents the situation at about 7.5 mm yr^{-1} isobase of present land uplift corresponding to about 85 m highest Litorina Sea isobase. The shadowed zone below the curve shows the dendrochronological comparison. The broken line upon the curve has been projected from Siiriäinen's (1972) curve for the Kristiinankaupunki area.

The rate of regression retarded dramatically after 8000 B.P. being only about 1.0 m/century between 8000—6500 B.P. The dates for Porraslampi 7750 ± 260 B.P. (Hel-450, Eronen 1974) and Rynkäkeidas 7450 ± 120 B.P. (Hel-1633) are scarcely compatible with each other as Rynkäkeidas is located a little higher than Porraslampi when the altitudes are corrected. The mere dates and altitudes would suggest a transgression between them. There are, however, no stratigraphical evidence for transgression in the basins. The stratigraphy of Bakunkärträsket near Helsinki (Hyvärinen, 1979) shows clear fresh/brackish water fluctuations between 8000—7200 B.P., but the overall data from that period and area does not indicate, according to Hyvärinen (1979, 1980, 1982), any significant transgression at that time.

According to isolation dates the rate of regression was on the increase between 6500—4500 B.P., being about 1.6 m/century. This was followed once more by a slower regression being about 1.1 m/century between 4500—3000 B.P. The culmination dates are, of course, not exact culmination points, but depend on dating intervals. Even as such they show clear changes in shoreline displacement rates.

The transgressions at Björnlunda and Lilla Träsket near Stockholm date about 4700 B.P. and 3400 B.P. corresponding to Litorina transgressions L 3 and L 4 (Miller and Robertsson, 1981; Miller, 1982). In Finland Ramsay (1926) recognized »the Second Stone Age Transgression» around 4500 B.P. His data was based on archeological dwelling sites and artefacts buried beneath shore horizons. According to Eronen (1974) there was no biostratigraphical evidence for any significant transgression from that level and time. The stratigraphical sites studied by Miller and Miller and Robertsson (op. cit.) indicate, however, indisputable double isolations. The latter transgression (L 4) was also registrated with corroded and washed pottery. The amplitude of these transgressions can only be estimated to be about 3—4 m. In Gottne, Ångermanland, northern Sweden, Miller (Miller and Robertsson, 1979) were also able to find a slight transgression or standstill at about 4500 B.P. The shoreline displacement curve also shows very pronounced retardations at around 7000 B.P. and 5500 B.P., although without valid stratigraphical evidence.

The isolation date of Lake Kalliojärvi, about 4600 B.P., points very closely to L 3 transgression, but no stratigraphical evidence was found. The date of about 3000 B.P. for the possible transgression at Tuorilampi is somewhat younger than the L 4 transgression studied by Miller and Robertsson (1981) and Miller (1982).

In the Baltic, a single storm can create very high sea-levels, fluctuating in the present coast of southern Pohjanmaa well over ± 1 m around the mean height (Lisizkin, 1959). According to Simojoki (1957) a period of 11—12 and 22—23 years fluctuations can be demonstrated at the levels of the Baltic. Although the peaks are only of short duration, they produce pronounced shore features, like beach ridges (see e.g. Alestalo, 1979) and should be registrated also in the stratigraphy of the basins. Hyvärinen (1982) has taken a critical view of the stratigraphical evidences indicating transgressions.

The oscillating eustatic curves, shown for instance in Fairbridge (1961) and Ters (1973), do show rising sea-level peaks for instance at about 5000, 4000, 3400 and 2800 B.P., but »wave bottoms» at 4500 and 3000 B.P. Furthermore, the peaks are not always synchronous. This suggest that they are, at least partly, local features. This may also be the case in the Stockholm region, for the area might not be stable (Mörner, 1977).

Archeological data

The Stone Age water-side dwelling places used in this study are listed in table 1 and their locations are shown in figure 1. The data is collected from Luho (1967) and Siiriäi-

Table 1. List of the Stone Age dwelling sites in southern Pohjanmaa. The altitudes in parenthesis show corrected altitude due to uneven landuplift. The dates refer to shoreline at the lower limit of the dwelling sites. Those marked with asterixes are considered to be anomalous or unreal and abandoned in the chronology.

STONE AGE DWELLING SITES AT SOUTHERN OSTROBOTHNIA			
	Altitude m a.s.l.		Age B.P.
Mesoliticum			
Honkajoki, Myllyluoma	126		8500
Jalasjärvi, Kohtanen	110	(109)	8300
Alavus, Vasikkahaka and Rantalanvainio	103		8200
Alajärvi, Rasi	93	(91)	7700
Kuortane, Lahdenkangas	90	(88)	7400
Kuortane, Haavistonharju	82	(81)	6700
Kurikka, Palomäki	80	(76)	6400
Early Comb Ware (KaI)			
Veteli, Hautaketo	78	(68)	5800
Kurikka, Kuivamäki	75	(71.5)	6100
Kurikka, Puska	73.5	(70)	6000
Kurikka, Jäniskallio	72	(68.5)	5900
Kurikka, Keski-Jyrä	70	(66.5)	5700
Kurikka, Vierikko	68	(64.5)	5600
Evijärvi, Hautapelto	68.5	(60.5)	5400
Middle Comb Ware (KaII)			
Pirttikylä, Granliden (hearth)	67.5	(60.5)	5400
Evijärvi, Kotikangas	65	(58.5)	5300
Evijärvi, Anttikoski	62.5	(56)	5100
Evijärvi, Timonen	62.5	(56)	5100
Rautio, Kivimaa	61.5	(50.5)	4800
Ylistaro, Åberg	60	(55)	5100
Purmo, Stenvatten	60	(51.5)	4900
Kaarlela, Bläckisåsen	60	(49)	4700
Lapua, Riihimännikkö	58	(55)	5100
Lapua, Hämeenniemi	57.5	(54.5)	5000
Lapua, Pitkämäki	57.5	(54.5)	5000
Ilmajoki, Koskenkorva	57.5	(54.5)	5000
Ilmajoki, Piirtola	57	(54)	5000
Kaustinen, Kangas	55	(48)	4600
Lapväärtti, Bergåsen	55	(53)	4900
Lapväärtti, Björnåsen	55	(53)	4900
Ylistaro, Latva-Marttila	55	(50)	4700
* Pirttikylä, Granliden and Sidbäck	50	(43)	4300
Late Comb Ware (KaIII)			
* Lapväärtti, Granliden	57.5	(56)	5100
Purmo, Hundbacken	57.5	(50)	4700
Evijärvi, Isokangas	57.2	(51)	4800
Evijärvi, Kattilakoski	57	(51)	4800
Jurva, Närvijoki	55	(50.5)	4800
Seinäjoki, Aaprainmäki	49.5	(46.5)	4500
Kiukainen Ware			
Oravainen, Paljak	45	(40)	4000
Lapväärtti, Risåsen	40	(39)	3900
Pirttikylä, Langbacken	37.8	(33.5)	3300
Pirttikylä, Rainesåsen	37.7	(33.5)	3300

nen (1969), supplemented by excavation material by M. Miettinen from the National Board of Antiquities (cf. Miettinen, 1981, 1982, 1983a, 1983b). The sites represent the successive stylistic phases from the Mesolithic Suomusjärvi culture to the late Neolithic Kiukainen culture. The total number of dwelling sites is 42, which can be groupped as follows: 7 Mesolithic Suomusjärvi (S) culture, 7 Neolithic Early Comb Ware (Ka I), 19 Middle or Typical Comb Ware (Ka II), 6 Late Comb Ware (Ka III) and 4 Kiukainen Ware (Ki) sites. Their location at the sea-shore is sometimes disputable, as in some cases they may have been situated at the river-side or lake-shore, too (e.g. Meinander, 1946).

As the shoreline retreated, dwelling sites moved to progressively lower levels. In Pohjanmaa they moved to more rapid land uplift areas (see fig. 1). Only the Mesolithic sites are situated roughly at the same land uplift isobase as were the stratigraphical sites. The altitudes of the dwelling sites must therefore be corrected to correspond to those of the stratigraphical sites (see table 1). This has been carried out by using the gradients of Siiriäinen (1969, 1972), which are about the same as Donner's (1970) and Saarnisto's (1971) and are based on the assumption that land uplift has been regular and decreased evenly. The distances of the dwelling sites have been measured at right angles to the adjusted baseline going through the majority of the basins via Lauhanvuori hill in the direction of land uplift isobases. The version resembles Siiriäinen's (1969) construction and has been used instead of the conventional distance diagram because the sites are situated in a fairly wide area and the directions of land uplift isobases show a tendency to turn more westward near the coast (see fig. 1). The corrections include, however, a source of error, because land uplift isobases may also have changed in course of time.

The age range of the Stone Age Culture phases in southern Pohjanmaa are shown in fig. 8 and table 2. Because the curve for shoreline displacement actually forms a broad zone instead of a line depending on dating accuracies, the chronology and dates for each individual dwelling site should represent a more or less broad time zone.

The Mesolithic Stone Age in southern Pohjanmaa dates between approximately 8500—6400 B.P. according to the highest Mesolithic site at Myllyluoma, Honkajoki 126 m a.s.l. and the lowest site at Palomäki, Kurikka 80 m a.s.l. The period can be divided into two chronological zones; those situated on the Ancylus Lake shore and those on the Litorina Sea shore. The boundary between them can be placed around 7500 B.P. at about 90 m a.s.l. according to Mastogloia limit (Salomaa and Matiskainen, 1983). Similarly Ka I sites can be dated between 6100—5400 B.P., Ka II 5400—4600 B.P., Ka III 4800—4500 B.P. and Ki 4000—3300 B.P. The dates differ somewhat from those presented earlier by Salomaa and Matiskainen (1983) because of new sites, and because the sites at Kurikka have now corrected altitudes. As can be noticed, there exist hiatus periods of about 300 years between S/Ka I and 500 years between Ka III/Ki sites. The gaps may be unreal, but then the chronology of successive cultural phases depends on whether the boundaries are drawn according to the latest or the earliest manifestation of the successive phases.

The youngest Ka II dates of about 4600—4700 B.P. given for Kangas, Kaustinen and Bläckisåsen, Kaarlela, imply an overlap of about two hundred years between Ka II/Ka III phases. The age differences between the lowest Ka II sites and the highest Ka III sites fall, however, just within the acceptable margins of error, but the slight overlap may also be due to the fact that the young Ka II sites are situated far from the stratigraphical sites, so some misconstruction in their altitudes may have occurred. It is also possible that the different stylistic phases would be contemporanous at different sites. Nunez (1978a) found the same overlap in SE-Finland and suggested that style Ka III

Table 2. Stone Age Chronology compared with that of Siiriäinen (1974), Nunez (1978) and Matiskainen (1979).

	Southern Pohjanmaa	Siiriäinen S-Finland	Nunez SE-Finland	Matiskainen Päijänne area
Mesolithic Stone Age	8500—6400			
Neolithic Stone Age				
Early Comb Ware	6100—5400	6200—5300	6350—5400	6100—5500
Middle Comb Ware	5400—4600	5300—4750	5400—4750	5500—5000 includes
Late Comb Ware	4800—4500	4750—4400	4750—4300	Early Metal Age
Kiukainen Ware	4000—3300	4400—3300	4300—	—3300

originated already during the Ka II phase, but became dominant only at a later period. It should also be remembered that the overlapping dates fit the transgression dates (L 3) at Swedish sites, but without corresponding evidence in the study area.

Problematic altitudes for Ka II sites appear at Granliden and Dalshagen, Pirttikylä and for a Ka III site at Granliden, Lapväärtti. The lower limit for both of the dwelling sites at Pirttikylä is reported to be about 50 m a.s.l. (Miettinen, 1983b). This would date the sites about 4300 B.P. The date differs considerably from all the other Ka II sites and is even younger than the latest Ka III site. Granliden is a huge dwelling site and there is a radiocarbon dated hearth at 67.5 m a.s.l., which yielded the age of 5580 ± 140 B.P. (Hel-968). The corresponding sea-level can be dated with a shore displacement curve to be about 5400 B.P. The dates fall within the margins of error, but are in better agreement if it is assumed that old wood is used in fireplaces (Siiriäinen, 1972). The dated hearth, however, does not necessarily belong to the latest occupation period of that site because of its altitude. Dalshagen represent a multicomponent site, containing besides Ka II ceramics also Corded Ware ceramics, which does not necessarily represent a shore site. The Ka III site at Granliden, Lapväärtti, is situated 2.5 m higher than Ka II sites nearby at Björnåsen and Bergåsen and has also been abandoned when constructing the chronology.

It should be pointed out that there is very little typical Ka II ceramics most of it being crudely made and degenerate. One can only speculate on the reasons for the overlapping stylistic phases. The obtained dates for consecutive cultural phases are in accordance with the chronologies of Siiriäinen (1972, 1974), Nunez (1978a, 1978b) and Matiskainen (1979) achieved by different methods and/or in different areas (table 2). However, some local irregularities cannot yet be discarded.

Finally, with the shoreline displacement curve it is also possible to achieve the oldest possible date, the *terminus post quem,* for burial cairns near Tuorilampi (fig. 5). According to their altitudes (30—23 m a.s.l.) the cairns date about 3000—2300 B.P., i.e. the Bronze and Iron Age. The typological datings of the findings and the morphology of the ruins support these datings (M. Miettinen, pers. com., see also Siiriäinen, 1978).

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