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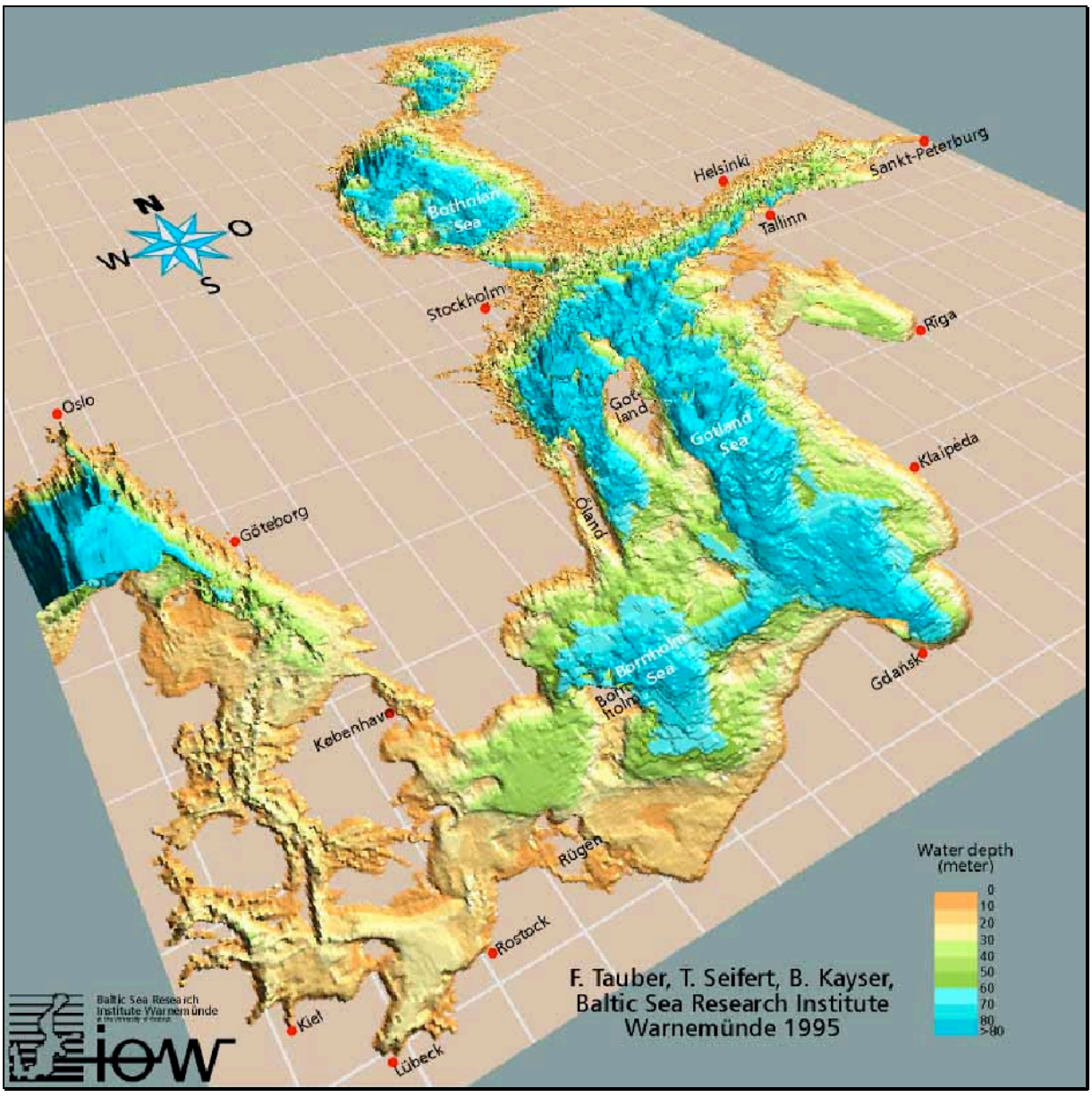
The Development of the Baltic Sea
–
A short historical Review



Original from: Dr. Wolfram Lemke
Institut für Ostseeforschung Warnemünde (Baltic Sea Research Institute Warnemünde)
Taken from the IOW-Homepage, www.io-warnemuende.de

Supplemented with excerpts from A. Rodeck: "Genese der Ostsee" (Genesis of the Baltic Sea) – http://home.t-online.de/A.Rodeck/genese-m.htm

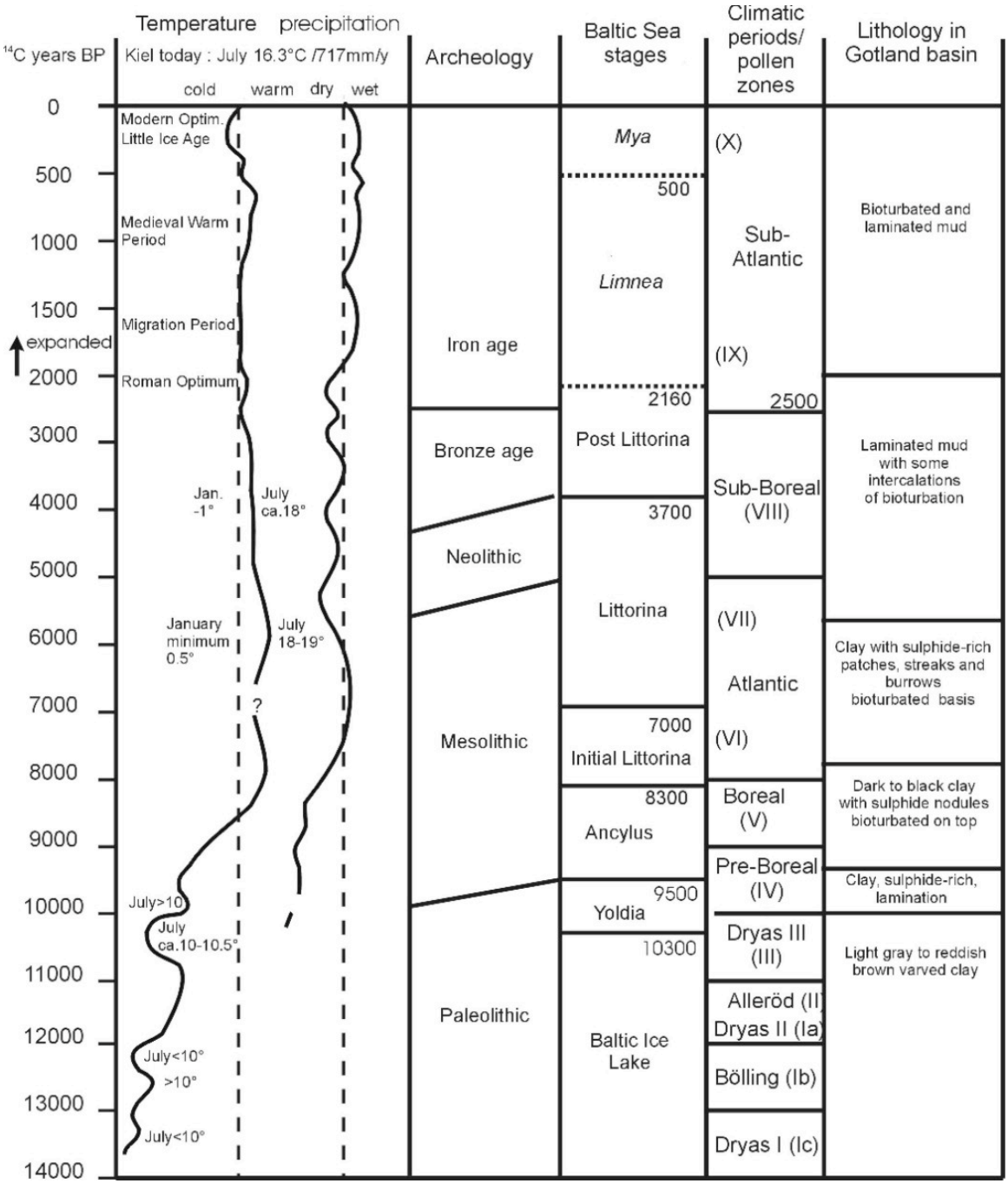
and **additional pictures** from Prof. S. Björck, University of Lund, Sweden, Prof. Dr. A. Körtzinger, University of Kiel, Germany

Compilated, translated, supplemented and layout modified by
AWI-Bremerhaven, U. Fritsche, METROL-Group

The history of the Baltic Sea is documented in the sediments which deposited after the last ice-age in the glacially formed basins.

In Table 1 below you find a compilation of the climatic development in NW Germany, archeological stages, Baltic Sea stages, climatic periods/pollen zones and the lithology in the Gotland basin. Note that the dating of the Baltic Sea stages is not consistent with new datings (e.g. S. Björck, see Fig. 2 a-f).

Table1:



The birth of the Baltic Sea began about 13000 to 14 000 years ago (Late Weichselian stage) with a rapid melting of the Scandinavian ice-shield leading to a northward retreat of the glaciers. The region of the present southwestern Baltic Sea was very shallow, the sea level of the world ocean was low and therefore no influx of seawater occurred. At that time a lake of glacial meltwaters formed some 12500 years ago in front of the ice – the Baltic Ice Lake. It did not attain the contours of todays southern Baltic – Bornholm, Rügen and the Danish isles still belonged to the mainland. Varved clays were deposited at the bottom of the lake, alternating light coloured horizons formed during the summer times and dark coloured winter-horizons. A clear change from brownish to greyish sediments marks a sudden lowering of the water-level in the lake. The continued retreat of the glaciers released the central Swedish valley and gave way for a connection with the North-Atlantic. The water-level of the Baltic Ice Lake was approximately 20 to 30 m above the one of the Atlantic / North Sea and the Lake emptied. At the Billingen mountain in central Sweden sedimentary testimonies of this event (Billingen Event) are preserved. During that time the world sea level rised and even overtook the isostatic uplift of Scandinavia that followed the stepward disappearance of the glacial load. This led to an inflow of seawater from the North-Atlantic into the Western Baltic – the Yoldia Sea (10300 – 9500 years ago, named after the saltwater clam *Yoldia arctica*, still be found in most areas of the present Baltic Sea, its present name is *Portlandia arctica*). The initial phase with brackish conditions lasted for about 300 years. Thin varved clays before this event give an indication for declining climatic conditions. The sediments of the Yoldia Sea are impregnated with the magnetic mineral *Greigit*. It is formed by bacterial reduction of seawater sulfate to sulfide and the reaction with iron. Its occurence leads to an increase of magnetic suszeptibility.

About 9500 years ago the isostatic uplift of the Scandinavian region became stronger than the eustatic rise of the sea-level. The connection between North-Atlantic and Yoldia Sea broke off. For a short time a brackish inland lake, the Echineis Sea, existed. With the inflow of glacial meltwaters a new stage of a freshwater lake began, the Ancylus Lake (9500 – 8300 years ago, named after *Ancylus fluvialis*, a freshwater snail). Step by step the Ancylus Lake retained the glacial meltwaters and the water –level rised above the world sea-level. An outflow occurred into the Kattegat along

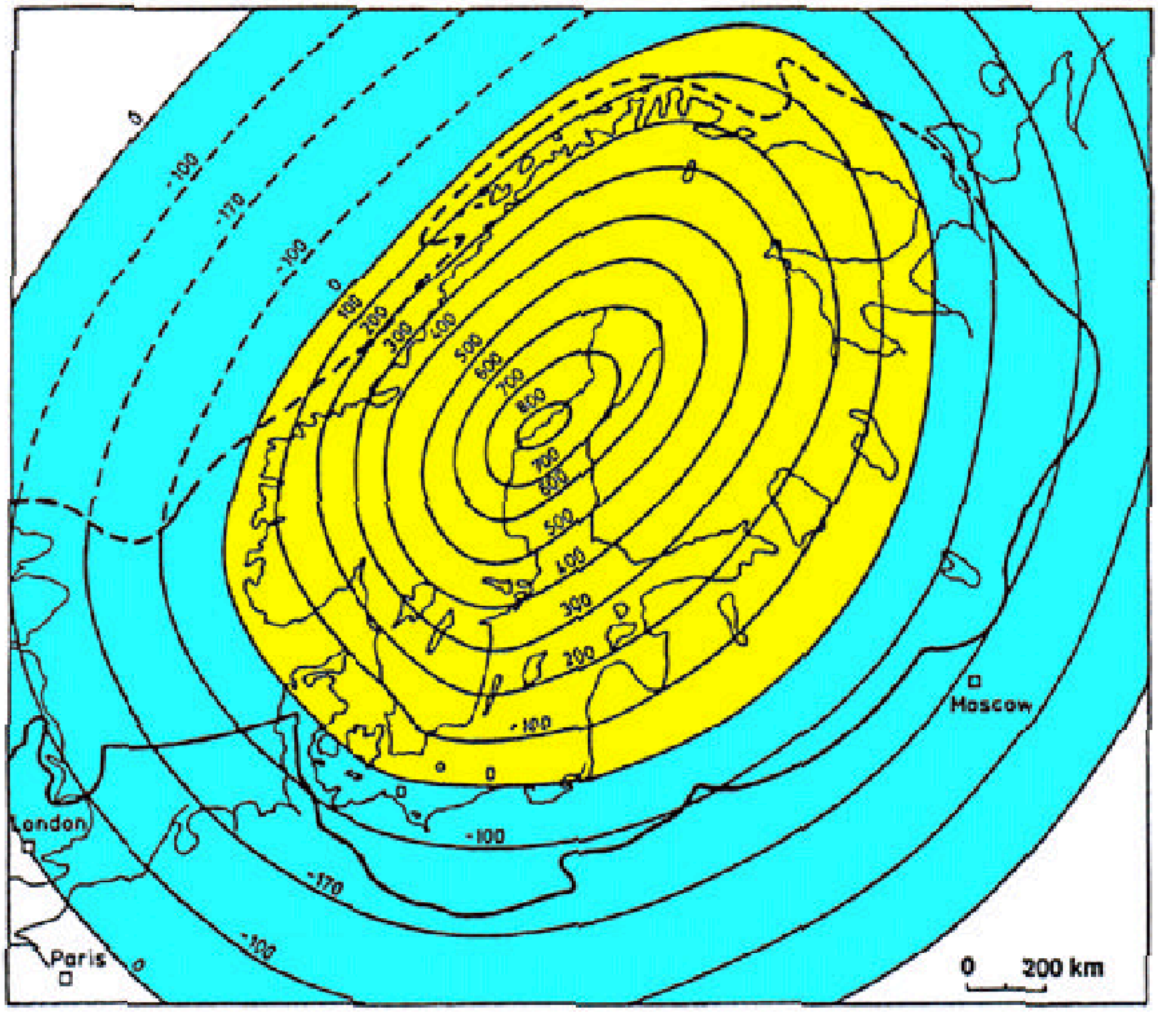
the Väner Lake in western Sweden. A proposed drainage system, the Dana River, is still not exactly proofed (Bennike,O. & Jensen, J.B., 1998). While the rising Lake caused no important coastline shifts in the Northern Baltic Sea because of the compensating isostatic uplift (see Fig. 1) the southern coast with less and no uplift was significantly flooded. The upper Ancylus sediments show clear laminations which are derived from a stable density layering in the water column with intervals of anoxic conditions at the bottom. The uppermost interval contains again *Greigit* (see above).

About 9000 - 8000 years ago marine ingressions (from the Kattegat) occurred – the initial phase of the brackish Littorina Sea (named after the seawater indicating snail Littorina littorea). Some 8000 years ago (at that time Scandinavia was completely ice-free) the world sea-level rised quickly and the regions of the Danish isles and the Mecklenburg Bay came under a pure marine influence (Belt Sea and Øresund flooded, seawater inflow via the Kattegat). The Littorina Sea had probably a higher salinity than the present Baltic Sea has. Since 4000 years the salinity is decreasing caused by continued freshwater inflow via the continental drainage systems. Within this aftermath of the Littorina stage two Sub-stages with ongoing coastline changes leading to the present state can be distinguished: the Limnea Sea (named after the brackish snail *Limnea ovata*) and the Mya Sea (named after the brackish beach clam *Mya arenaria*).
Like today the water column in the depositional basins was strongly stratified. Dark laminations with high contents of organic carbon formed during anoxic phases alternating with homogenously light-coloured sediments resulting from inflow of oxygen-rich waters.

The isostatic uplift is still active and will continue to change the shape of the Baltic Sea. Rates of 8 mm/year are detected at present at the Eastern coast of North Sweden (Botten Sea), the center of the former ice-shield with a maximum thickness of about 3000 m (Fig. 1)

Some Palaeogeographic images of the development are given in the figures 2 a-f.
These six maps are also made available as shapefiles (see the relevant folder in the “Members Area”).

Figure 1:



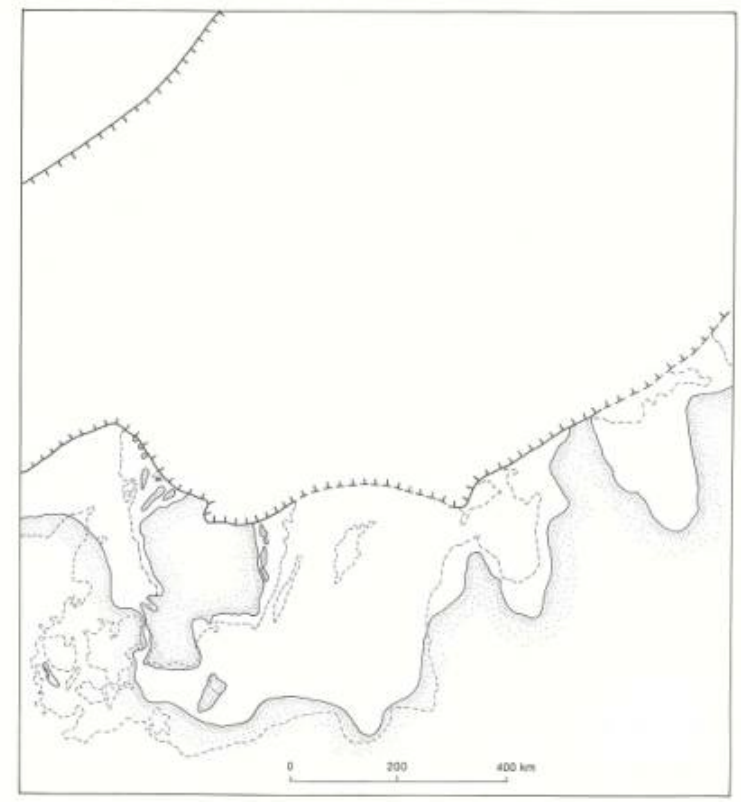
The release of the glacial load with thicknesses up to 3000m on the Scandinavian shield led to a glacio-isostatic uplift. Isolines give the amount of upward (yellow area) and downward (blue area) movement of the crust till the present time.

(taken from: Prof. Dr. A. Körtzinger, Lecture in “Biogeochemie ausgewählter Meeresgebiete”,SS 2003, [Biogeochemistry of selected marine regions, summer term 2003] / University of Kiel, Germany)

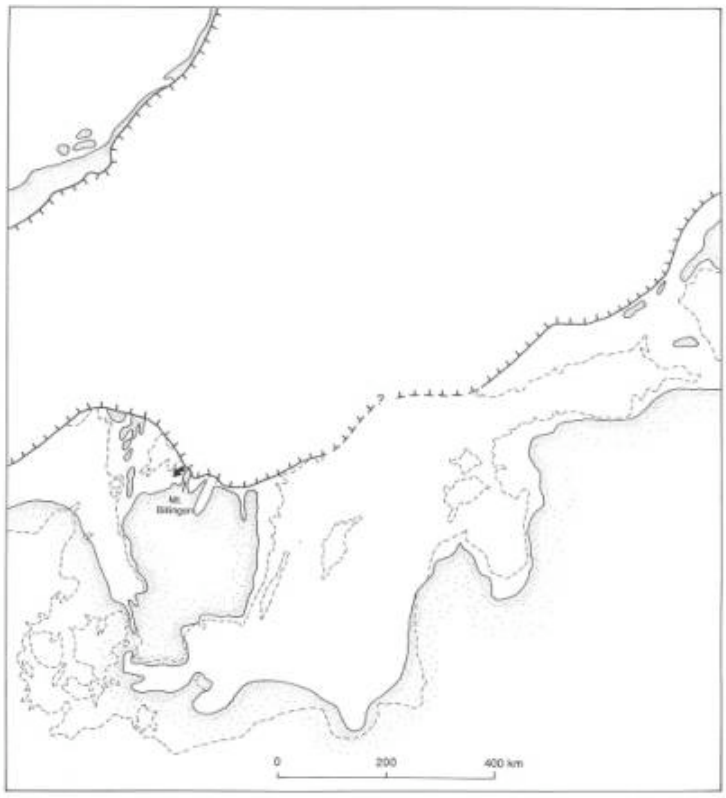
Fig. 2:

Maps of the Baltic`s early stages with revised ages compared to Björck (1995) and calibrated to calendar years BP
(from S. Björck, Homepage http://www.geol.lu.se/personal/seb/)

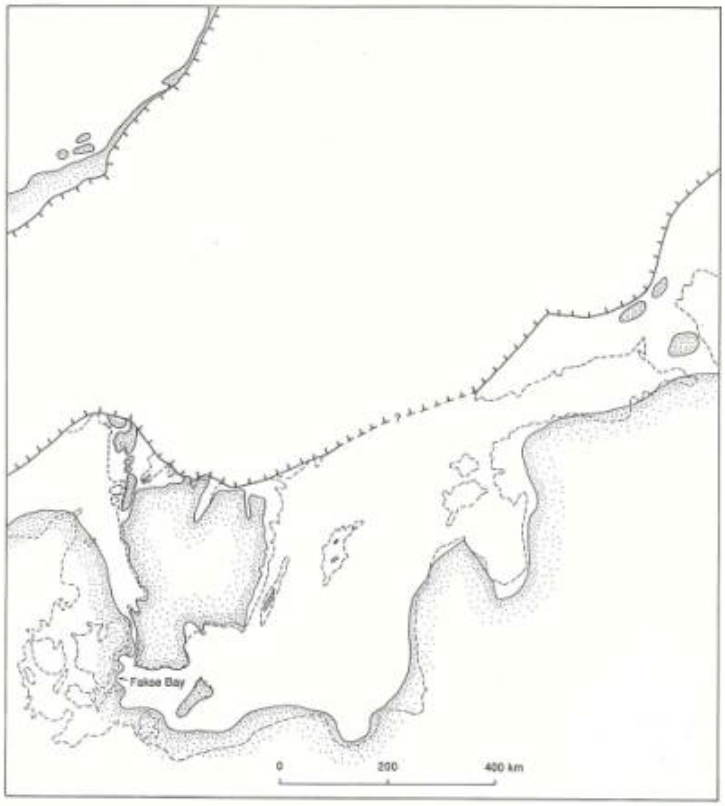
Prepared by AWI as shapefiles (see relevant folder in "Members Area")



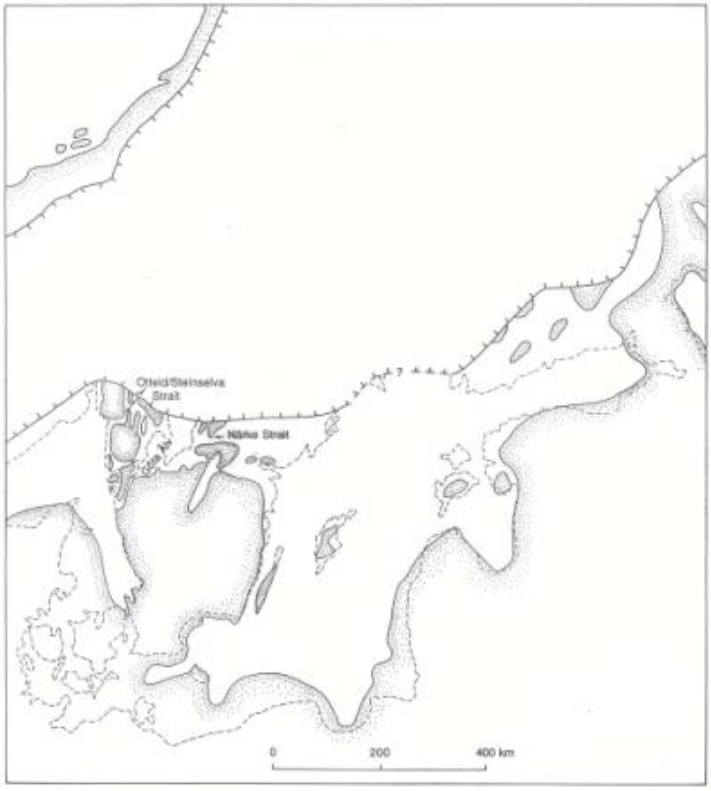
2a.
The Baltic Ice Lake 14000 yrs BP at the initial damming



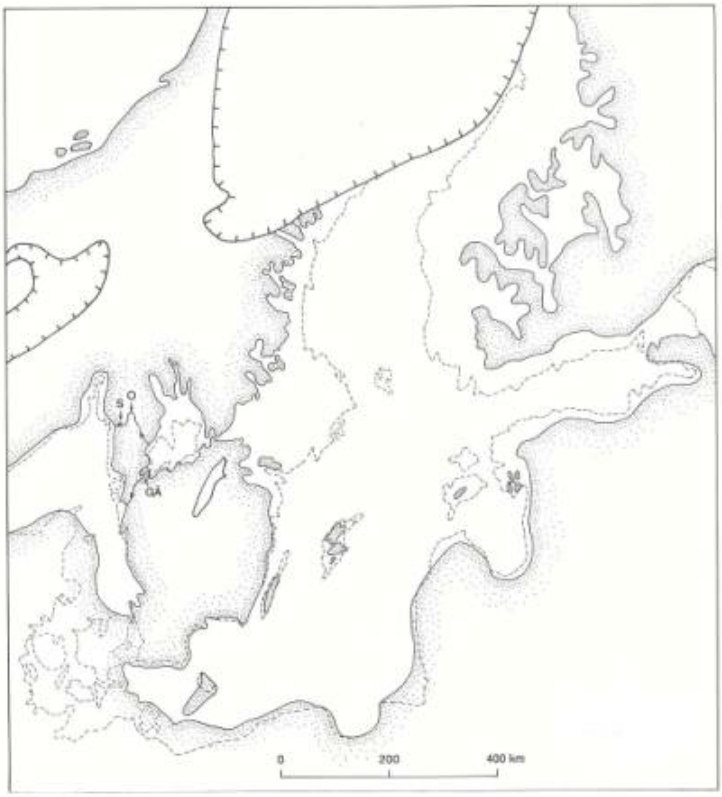
2b.
The Baltic Ice Lake 12800 yrs BP at the supposedly first drainage



2c.
The Baltic Ice Lake 11600 yrs BP, just prior to the final (25m) drainage.



2d.
The Baltic Yoldia stage at 11200 yrs BP during its brackish phase.



2e.
The Ancylus stage at 10600 yrs BP during the transgression.

2e.
The Ancylus lake at 10200 yrs BP just after the Ancylus regression (drainage → Dana River).
Note:
The Dana River is a proposed drainage system. No proofs have been found until now in the Mecklenburg Bay, see Bennike, O. & Jensen, J.B. (1998).

Proposed Literature:

Bennike, O. & Jensen, J. B.: Late- and postglacial shore level changes in the south-western Baltic Sea. Bulletin of the Geological Society of Denmark, Vol. 45, pp. 27–38. Copenhagen, 1998–09–25

Berglund, B. E., Bergsten, H., Björck, S., Kolstrup, E., Lemdahl, G. & Nordberg, K. 1994: Late Weichselian environmental change in southern Sweden and Denmark. *Journal of Quaternary Science 9,* 127-132

Björck, S. 1995: Late Weichselian to early Holocene development of the Baltic Sea - with implications for coastal settlements in the southern Baltic region. *In* (A. Fischer, ed.) *Man and Sea in the Mesolithic. Coastal settlements above and below present sea level,* 23-34. Oxbow Books, Oxford.