This is the published version of a paper published in ECORD Newsletter.

Citation for the original published paper (version of record):

IODP Expedition 347: Paleoenvironmental evolution of the Baltic Sea Basin through the last glacial cycle.
ECORD Newsletter, (19): 14-15, 23

Access to the published version may require subscription.
N.B. When citing this work, cite the original published paper.

Permanent link to this version:
http://urn.kb.se/resolve?urn=urn:nbn:se:sh:diva-20521
IODP Expedition 347: Paleoenvironmental evolution of the Baltic Sea Basin through the last glacial cycle

Thomas Andrén\(^1\), Bo Barker Jørgensen\(^2\), Carol Cotterill\(^3\) and Sally Morgan\(^4\)

The Baltic Sea Basin (BSB) is a brackish sea located in northern Europe (Figure 1). Its location, in the heartland of past Scandinavian Ice Sheet advances and retreats, has resulted in the formation of a rare geological and microbiological archive, with a unique high-resolution paleoenvironmental record. The sediments within this largest of the European intracontinental basins have been subjected to repeated glacial fluxes, sensitivity responses to sea level and gateway threshold changes and large shifts in sedimentation patterns, which when coupled with high sedimentation rates (1-5 m/ky), gives scientists an unparalleled insight into four overarching themes:

- **Coupling of the North European terrestrial record with the North Atlantic climate record through analysis of MIS 5.** The main aim of this theme is to understand the history of the BSB during the last interglacial period (Eemian interglacial) 130,000 years ago, with a particular focus on how it terminated in the onset of the last ice age (Weichselian glacial). This will make it possible to make some predictions about the future of the Baltic Sea. In addition, information about the climatic development of the region will be acquired, allowing the coupling of the North European terrestrial and North Atlantic climate records (Figure 2).

- **The complexities of the Weichselian glacial period, covering MIS stages 4 - 2.** During the most recent glacial, the Baltic Sea Basin was intermittently free of ice, at which point lakes occupied the basin. This theme will focus on the advances and retreats of the Scandinavian Ice Sheet (SIS) between 100,000 and 20,000 years ago. Most notably, it is hoped to better understand whether the SIS was an active player in climate fluctuations or whether it simply responded to those climate changes. It is clear from site-survey data that the final ice advance over the southern Baltic did not disturb the lake deposits. Drilling of these deposits will provide new and exciting information on the climatic development of a previously poorly understood time period.

![Figure 1: Location of the proposed sites for Expedition 347. MBio = Microbiology.](image1)

The sediments within this largest of the European intracontinental basins have been subjected to repeated glacial fluxes, sensitivity responses to sea level and gateway threshold changes and large shifts in sedimentation patterns, which when coupled with high sedimentation rates (1-5 m/ky), gives scientists an unparalleled insight into four overarching themes:

**Figure 2: Illustration of the correlation between the Baltic Sea varved clays and the \(^{18}\)O curve from the Greenland GRIP ice core (Redrawn after Andrén et al., 2002).**
• Deep biosphere responses to glacial - interglacial cycles.
This theme aims to better understand how the present and past microbial communities have responded to the environmental and depositional history of the BSB during the transitions between glacial and interglacial periods (Figure 3). Specifically the expedition will study the microbiological and biogeochemical responses to major shifts between limnic, brackish and marine phases, and also shifts between marine and terrestrial material.

Figure 3: Microbial cell numbers in marine sediments from the Baltic Sea (R. J. Parker, unpublished) and the Peru shelf (ODP, Leg 201) plotted against the age of the sediment. The double-log plot illustrates how cell numbers decrease with increasing age of the buried organic matter. Few data exist for the time window 10^4-10^5 years covered by the Baltic Sea Paleoenvironment Exp. 347.

• Glacial and Holocene climate forcing. This theme will elucidate the history of the BSB during the last 20,000 years and show how the ecosystem has responded to climate changes prior to any anthropogenic influence. The opportunity to recover sediments from deeper than 20 m below the seafloor will greatly expand the record recovered to date. A unique series of annually varved sediments from the Ångermanälven River will provide a high-resolution dataset including proxies for both precipitation and temperature.

Reconstruction of climatic variability based on cores acquired during this expedition will be of significant importance both regionally and globally. Analysis of terrestrial, marine and ice archives combined with numerical modelling (e.g. Levine and Bigg, 2008) have shown that the North Atlantic Ocean circulation plays an important role in the global climate systems, affecting North America and Europe in particular. The position of the BSB, with a watershed drainage area roughly four times the size of its 373,000 km² area, halfway between North Atlantic Greenland and Asia, represents a depositional sink with the ability to record the high-resolution and complex continental responses to oceanic and climatic forcings and links to the Asian monsoon system (e.g. Wang et al., 2001).

To date, knowledge of the development of the BSB is based on a combination of remote sensing methods, short cores (up to 20 m long, covering mainly the Late Pleistocene and Holocene) and regional interpretations, largely based on the terrestrial geological record. In 2004 a group of scientists, predominantly from the Baltic states, submitted a pre-proposal to IODP with a view to extending knowledge of the marine record back to 130,000 years. This pre-proposal was ultimately submitted as a proposal (#672) and received a positive evaluation from the IODP Science Planning Committee (SPC) who recognised it as being strongly related to the Initial Science Plan. And so Expedition 347 was born, being led by Co-chief Scientists Thomas and Bo, with Carol as Expedition Project Manager and Sally as Petrophysics Staff Scientist. Unlike the other IODP platforms, MSPs have both an offshore and an onshore phase. The offshore phase to the Baltic Sea is planned to take place in spring/summer 2013 and will involve coring and logging activities as well as the acquisition of essential ephemeral measurements and microbiological sub-sampling. The Onshore Science Party (OSP) will take place at the Bremen Core Repository and will likely be scheduled in the fall of 2013. During this phase the cores will be split, described and sampled.

IODP Expedition 347 will be the fifth mission-specific platform (MSP) expedition managed by the ECORD Science Operator (ESO) and will utilise the services of a geotechnical drillship to core and wireline-log six of the sub-basins within the BSB (page 5). To obtain the most complete record of the paleoceanographic and microbiological history recorded within the sediments from the last 130,000 years, a series of holes will be cored at six sites in different water depths (Figure 1), adopting an offset coring methodology, to ensure as complete a composite section as possible is recovered at each site. These records will be supplemented by a series of short cores that will capture an undisturbed record of the water / sediment interface and upper 0.75m. Four sites (BSB 1, 3, 8 and 9) have been identified as being critical for the investigations into the response of the deep biosphere to the climatic changes within this basin, and so at each of these sites an additional hole will be cored and dedicated to microbiological sampling.

Figure 4: Example of laminated sediments from the Littorina Sea (Photograph courtesy of Thomas Andrén).

BSB 1 or alternate (Anholt Loch) and BSB 3 or alternate (Little Belt) will target Eemian interglacial records whilst also providing a deglacial - Holocene sequence encompassing the time period of linkage between the BSB and the open Atlantic oceanic system. Hanö Bay and Bornholm Basin (BSB 5 and 8 respectively or alternates) will highlight the development of a southern Baltic Sea lake that existed from the Eemian interglacial to ice advance over the area in the Weichselian, in both littoral and deep phases (Figure 4).
Canada

IODP Canada presents IODP and ECORD at GAC-MAC. IODP-Canada had an exhibition booth at the joint annual meeting of the Geological Association of Canada and the Mineralogical Association of Canada (GAC-MAC) on May 27-29, 2012 (photo, right). This year, the conference was held in St. John’s Newfoundland, and over 900 Earth scientists were in attendance. Some popular topics of discussion at the booth were drilling in the Arctic Ocean, Canada’s role in the programme post-2013, and the upcoming Newfoundland Sediment Drifts Expedition 342. Many outreach materials (e.g. New Science Plan, Scientific Drilling) were distributed and subscribers to the Canadian mailing list increased by about 10%.

Diane Hanano (CCOD Scientific Co-ordinator)
coordinator@mail.iodpcanada.ca
http://www.iodpcanada.ca

References


Continued from page 15

The Landsort Deep (BSB 9) is an excellent sediment trap, preventing sediments from glacial erosion, thereby providing not only a record of early Weichselian development, but also expanded late Weichselian and Holocene sequences. The Ångermanälven River Estuary (BSB 10 and /or 11) is known to have a high-resolution record of Holocene varved sequences that can be correlated to Swedish Time Scale (STS) late glacial varve chronologies, providing a unique record of Holocene sedimentation and access to proxies for temperature (pollens) and precipitation (river discharge).

1School of Life Sciences, Södertörn University, SE-141 89 Huddinge, Sweden
2Center for Geomicrobiology, Department of Bioscience, Aarhus University, DK-8000, Aarhus C, Denmark
3ECORD Science Operator, British Geological Survey, Murchison House, West Mains Road, Edinburgh, EH9 3LA, UK
4Borehole Research Group, Department of Geology, University of Leicester, Leicester, LE1 7RH, UK

A view of the Baltic Sea near the Kalmar Strait (Kalmarsund) between mainland Sweden and the island of Öland. The small island on the horizon is Blå Jungfrun (Blue Virgin Island) (photo Thomas Andrén).