

**DCH REPORTING FORM**

*Biogeochemistry, microbiology and stratigraphy of Holocene  
sediments in Aarhus Bay*

*Bo Barker Jørgensen, Professor, Dr.*

## **1 General section**

### **1.1 Grant holder,**

Bo Barker Jørgensen, Professor Dr., Head of Center for Geomicrobiology,  
Dept. of Biological Sciences, Aarhus University Ny Munkegade, Bld. 1540, DK-8000 Århus C  
+45 89 42 33 14; mobile +45 20 10 21 23; bo.barker@biology.au.dk

### **1.2 Project name**

Biogeochemistry, microbiology and stratigraphy of Holocene sediments in Aarhus Bay

### **1.3 Project number**

2010-02

### **1.4 Funding period**

Two days of transit plus three days of coring operation in Aarhus Bay: May 5-7, 2010

### **1.5 Significant deviations between budget and costs**

## **2 Qualitative report**

### **2.1 Description of cruise and results**

The working area was Aarhus Bay, Denmark, and the research vessel was “Susanne A”, operated by “J.A. Rederiet”. Ship-board operation was daytime only out of Aarhus Harbor (07:00-19:00 including transit to working area). The key activity at sea was gravity coring from the aft deck while the ship was held on position dynamically. The cores were processed on the deck simultaneous to coring, and all cores and samples were loaded off the ship at the end of each working day and transported to Aarhus University. Our major objective was to acquire undisturbed continuous sediment cores ranging from the sediment-water interface to the base of the Holocene deposits (at 11-15 m below seafloor) at several stations in Aarhus Bay.

Among the main scientific goals of the expedition were to understand the identity and function of microbial communities in subsurface marine sediments in relation to the geochemistry of their environment and the geological history and age of the deposits. The cruise was a part of an ongoing effort to establish Aarhus Bay as natural laboratory for the study of microbial and geochemical processes in deep sediments. The project was structured into individual sub-projects ranging in maturity from early methods development to final data acquisition for publication. For maximum synergy, the sub-projects were sharing coring stations in Aarhus Bay for which important key information was already available.

Common for the multiple specific studies was the focus on deep biosphere aspects, such as the diversity and metabolic function of bacteria and archaea in the subsurface sediments in relation to available energy sources from buried organic matter and available electron acceptors. The goal was and is to understand which microorganisms are responsible for the

main steps in the anaerobic carbon food chains, and how their genetic and physiological potential control the pathways and rates of mineralization processes.

A special focus was on the production and recycling of methane as an end product of anaerobic degradation and as a potential greenhouse gas which accumulates in areas of the Holocene mud in great quantities. This study was part of the international BONUS-funded research project BALTIC GAS. Data from the field and from laboratory analyses and experiments provide the basis for transport-reaction modelling of the methane cycle and of other biogeochemical processes in Aarhus Bay.

This cruise was well suited for students to learn about sediment coring and core description as well as sampling for geochemistry and microbiology. Three PhD students from the CfG and MPI were among the assigned cruise participants, and furthermore one PhD student (CfG) and one visiting project student (from MPI) joined as part of their research projects.

We are expecting many publications based on data collected on the cruise. A few already have a working title:

**Why does free methane gas accumulate where it does? – The mystery of Holocene mud thickness** (Working title. The authors are so far: Sabine Flury, Henrik Fossing, Hans Røy, Bo B. Jørgensen).

**Microbial growth and necromass turnover in Aarhus Bay Holocene sediments** (Working title. Bente Aa. Lomstein et al.)

## 2.2 Evaluation of ship used

The vessel used, "Susanne A", IMO no. 9099183, was a "multi-purpose salvage diving support vessel" operated by "J. A. Rederiet" v/ Kim Alfastsen, Brå Møllevvej 11, DK - 87 81 Stenderup. (General arrangement and fact-sheet attached to the application). The vessel has an overall length of 54 m, space for installment of a laboratory container and separation of coring operation and sampling, and a suitable crane capacity and large deck space to operate a 15 m gravity corer. It is equipped with an A-Frame and two offshore folding cranes with safe working load of 4 ton at 12 m outreach. The dual Voith Schneider propellers allow excellent dynamic positioning.

In the fall 2009, the Center for Geomicrobiology chartered "Susanne A" to test the vessel as a platform for deep gravity coring and for scientific work. The vessel proved capable of safe operation in adverse weather, and excellent cores were retrieved down to 11.5 m below seafloor. On the cruise in May 2010, we again achieved perfect coring results onboard "Susanna A" as we successfully retrieved all the samples planned in the proposal.

### 3 Short dissemination to be published

#### Mikroorganismers liv i havbunden

Havbundens sedimentlag gemmer på den største koncentration af organisk kulstof, vi kender til på jorden – og er befolket af mikroorganismer, der netop bruger kulstofforbindelserne som deres energikilde. De er små, men de spiller en stor rolle for havets kemi, for sammensætningen af gasser i atmosfæren og for klimaet på jorden i det hele taget.

For forskere fra Center for Geomikrobiologi og Biologisk Institut ved Aarhus Universitet er Aarhus Bugt et naturligt laboratorium. Her kan de sejle ud og tage kerner op, som indeholder sedimentlag, der er op til otte tusinde år gamle, og prøverne viser, hvad ældning generelt betyder for de biologiske processer i sedimenterne.

I foråret 2010 gjorde en bevilling fra Dansk Center for Havforskning det muligt for forskere fra flere danske universiteter og fra Max Planck Instituttet for Marin Mikrobiologi i Bremen at tage på en tre dages togt med forskningsskibet "Susanne A". I centrum for de atten forskere og deres forskellige forskningsprojekter var og er udforskningen af den dybe biosfære. Forskerne tog kerner op fra få arbejdsområder i bugten, men prøverne bliver i øjeblikket brugt i en lang række forskellige forskningsprojekter. Blandt andet arbejder nogle med molekylærbiologisk metoder og forsøger at svare på spørgsmål som: Hvem er de mikroorganismer, der lever i sedimenterne og omdanner kulstof? Og hvad kan vi sige om deres genetiske og fysiologiske sammensætning? For andre er perspektivet geokemisk, og undersøgelserne har mikroorganismernes metabolisme i fokus.

Hvordan mikroorganismene formår at leve under den ekstreme energibegrænsning, som kendetegner de dybere sedimentlag, er en fascinerende gåde og derfor også motivationsfaktor for flere af undersøgelserne på forårets forskningstogt. Blandt andet forsøger en forskergruppe at afprøve en ny metode til måling af mikroorganismernes respirationsrater for derigennem at løse gåden. Det fælles mål for forskerne på "Aarhus Bay Cruise 2010" er at forstå mikroorganismernes identitet og funktion i forhold til geokemien og den geologiske historie, som kendetegner det miljø, de lever i.

