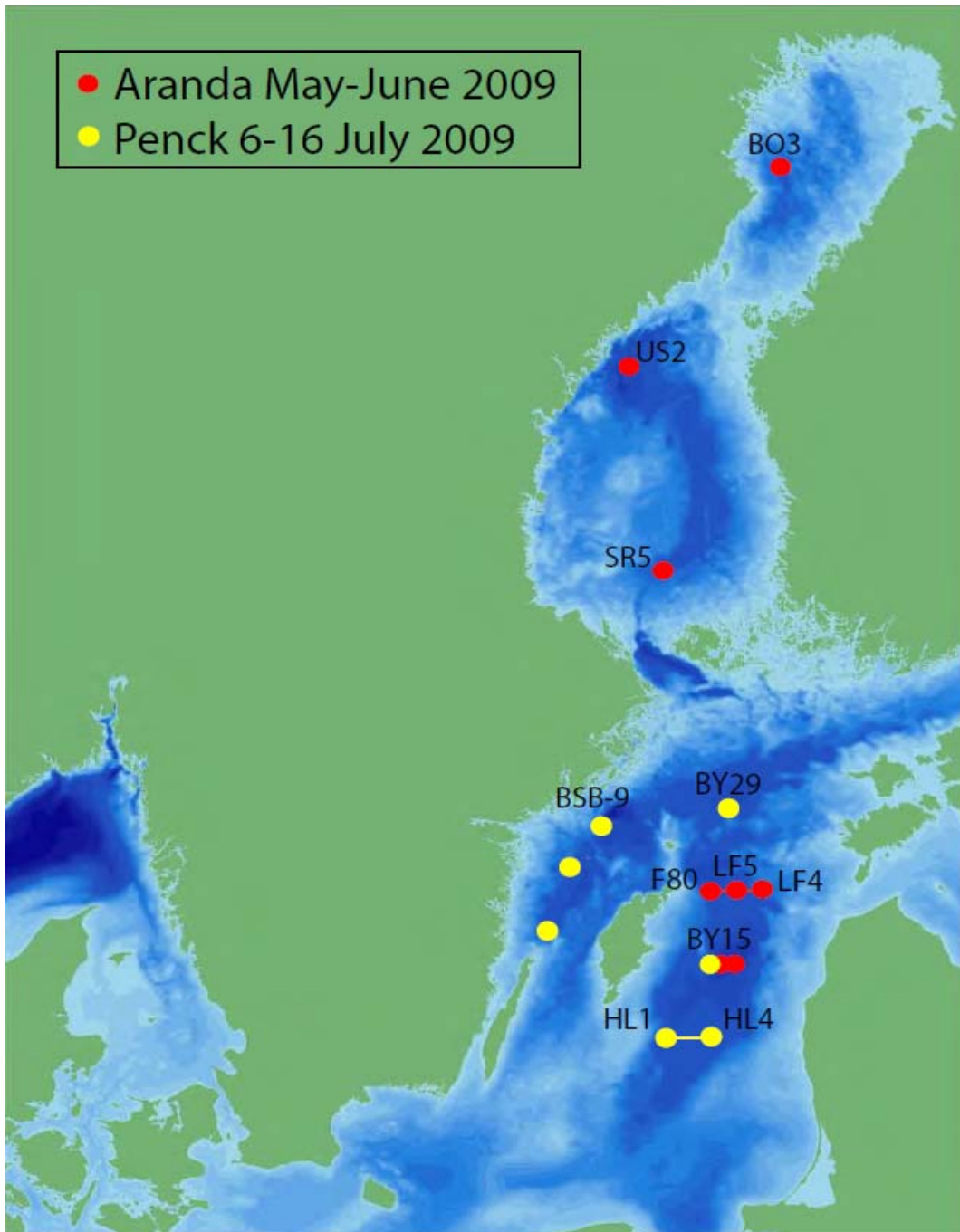


Cruise report

Aranda cruise 4th -17th June 2009

To The Gotland Basin, The Bothnian Sea and The Bothnian Bay



Participants from the BONUS project Baltic Gas

Maja Reinholdsson, Marine Geochemistry PhD student, Lund University, Sweden (4th – 18th June, 2009)

Thang, Nguyen Manh, Marine Biogeochemistry PhD student, Max Planck Institute for Marine Microbiology, Bremen, Germany (4th – 12th June, 2009)

Objectives

The aim of BONUS program Baltic Gas is to understand how climate change and eutrophication can affect the accumulation, production and emission of methane and hydrogen sulfide from the seabed through the water column to the atmosphere. The objectives of this cruise were to obtain geochemical profiles of methane, sulfate, sulfide, dissolved inorganic carbon, metals, phosphate, volatile fatty acids and chlorine and so on from different parts of the Baltic Sea, especially with gradient salinity. Sediment samples were also planned to be taken for porosity measurements and other measurements. Seven stations were planned sampling to obtain our objectives from the North to the South of Baltic Sea in Gotland Basin, Bothnia Sea and Bothnia Bay in the Baltic Sea.

The gas, pore water and solid phase were collected in an extensive analysis in lab including:

- Solid sediment for methane gas gradients,
- Pore water gradient of the pore-water for sulfate, sulfide, dissolved inorganic carbon, metals, phosphate, volatile fatty acids and chlorine,
- And solid phase for porosity and sulfur cycle study.

Seven gravity corer were collected with the high resolution (20cm) of each kind of above sample.

Sampled stations/Cruise route

The cruise was divided into three legs where the long cores were going to be taken at the last two legs. The second leg was from Bornholm Basin (Rønne island, Denmark) through the Gotland basin and up to Rauma at the Finish coast. At this leg long gravity cores were taken at station BY15, F80, LF3 and SR5. Maja and Thang joined this leg from 5th to 12th June, 2009. From 13th to 18th the third leg was from Rauma heading north up through the eastern side of the Bothnian Sea and to the Bothnian Bay. On the way back the western side of the Bothnian Sea was covered before going back to Helsinki. During this leg station BO3 and US2 were sampled with long gravity cores. Only Maja jointed the third leg.



Figure 1: The route of the second and third leg of Aranda cruise

Material and methods

For both the pore water and the methane sampling predrilled holes in the core linear had to be done. The former, smaller, 4 mm, holes were drilled for the pore water sampling while the later, larger, 11 mm holes were drilled for the methane sampling were larger, 11 mm. Typical depths of the former in the core sections were 10, 30, 50, 70 and up 550 cm and these for the latter were 15, 35, 55, 75 and up to 555... from the top of the core section. A 3 cm³ cut off syringe were injected into sediment through big holes. The Rhizones for pore water sampler were also inserted into sediment through the small holes. The core was set aside to allow pore waters to collect in the syringe attached to the Rhizone sampler. After a sufficient amount of pore water was collected, typically after some hours (five to six hours), the Rhizones and methane samples was removed and the syringe brought to the laboratory for subsample of pore waters. In all days, the core linear was collected in cold room in board. One 3cm³ syringe of sediment was rapidly injected into 5.0 mL of NaCl 5M inside of a 20 mL serum vial, stopper with a thick black septum, and crimp-sealed as fast as possible. The pore water were subsampled in separated vials for DIC, heavy metals, sulfide, iron and one multiple tubes. DICs were preserved in no head space vials and keep them in cold room. H₂S was preserved in ZnCl₂ (5%), metals were preserved in HNO₃ (1:100 volume). Multiple tubes were frozen immediately. Belong to preservation of each indexes, each samples were kept in cold room or frozen. The samples were labelled from 1 to up to end.

Before coring the holes were taped by electric tape. When the core was onboard it was divided into sections of approximately 180 cm to be easier to work with in the cold room. (the first we cut the core in each 1m sections, however it was difficult to collect pore water, even we missed pore water sample at the top of each section.

3 ml cut off syringes were used to sample the core for methane. This was done as soon as possible after the core was taken. Approximately 3 ml of sediments were collected from each depth, put into a vial with 5 ml of NaCl 5M as fast as possible, sealed with a rubber stopper and crimps. Samples were stored in cold room. The holes were retaped immediately after completely each methane sample. The Rhizomes were injected afterward the methane sample. After 5 to 6 hours, the syringes for pore water were collected and subsample for DIC, SO₄²⁻, H₂S, and so on. 1 ml pore water were also collected for phosphate measurement (HEPER project).

The sediment samples for the porosity measurements were collected after the methane and pore-water sampling were done. 2 x 2 cm windows in the core linear were done and sediments were collected in 5 ml cutoff syringes for porosity, and 10ml cutoff syringes for solid phases. The porosity samples were keep in cold room and the solid phase were frozen immediately.

The analysis of methane concentration, also the pore water except for the phosphorus will be done at MPI, Bremen, Germany. The pore water analysis for phosphorus will be done at Utrecht University, The Netherlands. The porosity measurements will be done at Lund University, Sweden. Solid phase were also measured in MPI.

Cruise

4 June

The ship left the harbor of Bornholm in the afternoon at four o'clock. There was a visit by school class before departure.

5 June

Preparation of material for predrilling corer (poto 1).

6 June

Site: BY15

Coordinates:

Lat 57°19.20′

Long 20°03.00′

Water depth: 238 m

Salinity:

The core from this station did not include the top of the sediments. When the gravity corer hit the sediments the “locker” at the top did not close so we do not really know at what depth this core was taken. The long core for site BY 15 was collected in late afternoon at the 6th of June. It was sectioned in five 100 cm and one ~40 cm long section and stored in the cold room. The core was in total ~540 cm long. The syringes for the methane samples were put into the core after about one hour but were not removed from it until the pore-water samples were done,



Fig 3: The predrilling core linear for the gravity core

after about 7 hours. The first methane sample was taken from 10 cm depth and after that every 20 cm until 510 cm. The pore-water samples were collected from 15 cm depth and after that every 20 cm until 515 cm. However, we missed some pore water at the top of each cut sections.

We decided to section the next core into longer sections instead of 1m sections that made the pore-water of the top of sections unsuccessfully. We also decided to get the methane samples at once instead of when the pore-water was finished.

The sub sampling for the porosity and the solid sediments were done after the pore-water was collected. The first 235 cm were sub sampled with not a really good technique because we did not have the appropriate tools. This resulted in a loss of sediments which resulted in not accurate depths. The 0-180 cm is in reality 235 cm. After that depth we changed the technique and cut some holes with a saw instead of pushing out the core. This results in accurate depth from 235 cm and down. These samples were also collected at 20 cm interval starting at 10 cm and finishing at 540 cm which resulted in 24 samples each.

7 June

Site: F80

Coordinates:

Lat: 58°00.00′

Long: 19°53.81′

Water depth: 135,2 m

Salinity

The long core for site F80 was collected in the afternoon at the 7th of June and was sectioned into two 185 cm section and one 55 cm section and stored in the cold room. The core was in total 425 cm long. The syringes for the methane samples and Rhizomes for pore water were immediately put into the core but were not removed from it maybe a half hour later. The first methane sample was taken from 30 cm depth and after that every 20 cm until 410 cm. The pore-water samples were collected from 35 cm depth and after that every 20 cm until 415 cm with an additional one at 30 cm also. These processes resulted in 20 methane and 21 pore-water samples.

The sub sampling for the porosity and the solid sediments were done after the pore-water was collected. These samples were also collected at 20 cm (with some depths that could not be sampled) interval starting at 40 cm and finishing at 420 cm which resulted in 19 samples each.



Fig 5: Subsample for solid phase in core linear in Aranda shio

8 June

Site: LF3

Coordinates

Lat: 57°59.50′

Long: 20°46.00′

Water depth: 94,3 m

Salinity:

The long core for site LF3 was collected in the morning of the 8 of June. It was sectioned in one 180 cm and one 152 cm long section and stored in the cold room. The core was in total 332 cm long. The syringes for the methane samples and Rhizomes were immediately injected the core in each holes. The first methane sample was taken from 10 cm depth and after that every 20 cm until 310 cm. When sub sampling the solid phase we also took additional methane samples at every 20 cm (some depths could not be sampled), beginning at 20 cm and finishing at 300 cm. In total we took 30 methane samples, number 56-71 and 90-103. The pore-water sample were collected from 10 cm depth and after that every 20 cm until 315 cm resulting in 17 samples, number 49-65.

The sub sampling for the porosity and the solid sediments were done after the pore-water was collected. These samples were also collected at 20 cm (with some depths that could not be sampled) interval starting at 20 cm and finishing at 300 cm plus a “surface” sample which resulted in 16 samples each.

9 June

Site: SR5

Coordinates:

Long: 61°04.999′

Lat: 19°34.779′

Water depth: 125,7 m

Salinity: 5,5

Sea temperature: 8,8 C

The long core for SR5 station was collected in the evening of the 9th of June. It was sectioned in one 185 cm, one 180 cm and one 164 cm long section and stored in the cold room. The core was in total 529 cm long. The processes for methane and pore water samples were carried out as above station. The first methane sample was taken from 20 til 520 cm, each every 20cm. The pore-water sample were collected from 5 cm depth and after that every 20 cm until 525 cm resulting in 26 samples. When sub sampling the solid phase we also took additional methane samples at every 20 cm (some depths could not be sampled), beginning at 10 cm and finishing at 470 cm. In total we took 49 methane samples. The pore-water sample were collected from 5 cm depth and after that every 20 cm until 525 cm resulting in 26 samples. The sub sampling for the porosity and the solid sediments were done after the pore-water was collected. These samples were also collected at 20 cm (with some depths that could

not be sampled) interval starting at 10 cm and finishing at 470 cm, plus one sample at the surface, which resulted in 25 samples each.

10 June-12 June

No long core station. We packed samples and finished the second leg. Thang left out Rauma on 11th June. Just Maja continued the third leg of Aranda cruise.

13 June

Site: BO3

Coordinates:

Long: 022°20.593′

Lat: 64°18.126′

Water depth: 110,7 m

Salinity: 3,1

Sea temperature: 6° C

The gravity core for BO3 station was collected on the 13th of June. It was sectioned in one 180 cm, one 185 cm and one 60 cm long sections and stored in the cold room. The core was in total 425 cm long. The syringes for the methane samples and Rhizomes for pore water were immediately put into the core but were not removed from it maybe 10 minutes later. The former was collected from 5 cm depth and after that every 20 cm until 405 cm resulting in 21 methane samples. The pore-water sample were collected from 10 cm depth and after that every 20 cm until 410 cm resulting in 21 samples.

The sub sampling for the porosity and the solid sediments were done after the pore-water was collected. These samples were also collected at 20 cm (with some depths that could not be sampled) interval starting at 20 cm and finishing at 400 cm which resulted in 17 samples each.

14 June

No long core station.

15 June

Site: US2

Coordinates:

Long: 018°53.326′

Lat: 62°50.725′

Water depth: 204,3 m

Salinity: 5

Sea temperature: 7,2° C

The long core for site US2 was collected on the 15th of June. It was sectioned in one 180 cm and one 160 cm long section and stored in the cold room. The core was in total 340 cm long. The syringes for the methane samples and Rhizomes were immediately put into the core but were not removed from it maybe 10 minutes later. The first methane sample was taken from 5 cm depth and after that every 20 cm until 325 cm resulting in 16 methane samples. From 185 cm depth and to the bottom of the core there was a lot of gas escaping while sampling the core. The pore-water sample were collected from 10 cm depth and after that every 20 cm until 330 cm resulting in 17 samples.

The sub sampling for the porosity and the solid sediments were done after the pore-water was collected. These samples were also collected at 20 cm (with some depths that could not be sampled) interval starting at 20 cm and finishing at 320 cm which resulted in 14 samples each.

16 June-17 June

No long-core station.

Results:

Coring

Gravity coring and subsampling for methane, pore-waters and sediments were successfully done. 130 pore-water samples for each purpose were collected along with 187 methane samples and more than 100 sediment samples for porosity and solid phase. The methane, pore water, solid phase samples were measured at MPI and the porosity samples were measured in Lund Uni. We have some first results of these stations.

To think of next time

None of the cores were saved after subsampling so we can't correlate the cores with other which were taken at the same stations during this cruise and we don't know how the sediments looks like, e. g. if they are laminated or not. To subsample one half of the core and save the other half would be to recommend next time.

