INFLOW CRUISE REPORT:

FYTO 2009

The RV Aranda 3rd August – 10th August 2009

BONUS
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BONUS INFLOW

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Contents

1. FYTO 2009 Participants (3.-10.8.2009)

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GTK = Geological Survey of Finland, Espoo, Finland
SYKE = Marine Research Centre of the Finnish Environment Institute, Finland
VSEGEI= A.P Karpinsky Russian Geological Research Institute, St. Petersburg, Russia
FMI = Finnish Meteorological Institute

2. Introduction

Marine geologists from A. P. Karpinsky Russian Geological Research Institute (VSEGEI)/Russia and Geological Survey of Finland (GTK) participated in research vessel Aranda (Figure 1) FYTO 2009 –cruise to the Gulf of Finland 3.-10.8.2009. Altogether 28 scientists, 7 of them from INFLOW –project (3 VSEGEI and 4 GTK), participated in the cruise.

One of the main aims of the cruise was to collect surface sediment samples and long sediment cores for BONUS Research Programme INFLOW project purposes from the eastern Gulf of Finland. Sediment samples, as well as echo-sounding and side scan sonar data, were collected also for other geological studies (e.g. TRANSIT project) by GTK and VSEGEI.

Other activities of the FYTO 2009 included monitoring (hydrography, phytoplankton and zooplankton), phytoplankton taxonomy and toxin dynamics (chemical diversity) research, microbial biodiversity research, bio-optical research and alkalinity and carbon dioxide research.

The FYTO 2009 cruise was organized by Finnish Environment Institute (SYKE) and co-chiefed by Dr. Harri Kankaanpää.

Figure 1. Researh vessel Aranda in Kotka harbour. Photo: Aarno Kotilainen, GTK.

3. Study area

The study area of the FYTO 2009 Cruise was the eastern Gulf of Finland, the Baltic Sea (Figure 2), including both Finnish and Russian territorial waters. The areas within sedimentation basins were chosen at first in the base of analysis of existing VSEGEI surface sediment maps and field work results (93 stations, 1.5 - 3.7 m long sediment cores and 15 echosounding profiles, undertaken in 1999-2000) (Spiridonov et al., 2007).

The Leg 1 of the FYTO 2009 Cruise (from Kotka to St. Petersburg) was carried out from 3rd August to 7th August 2009. The Leg 2 of the FYTO 2009 Cruise (from St. Petersburg to Helsinki) was carried out from 8th August to 10th August 2009.

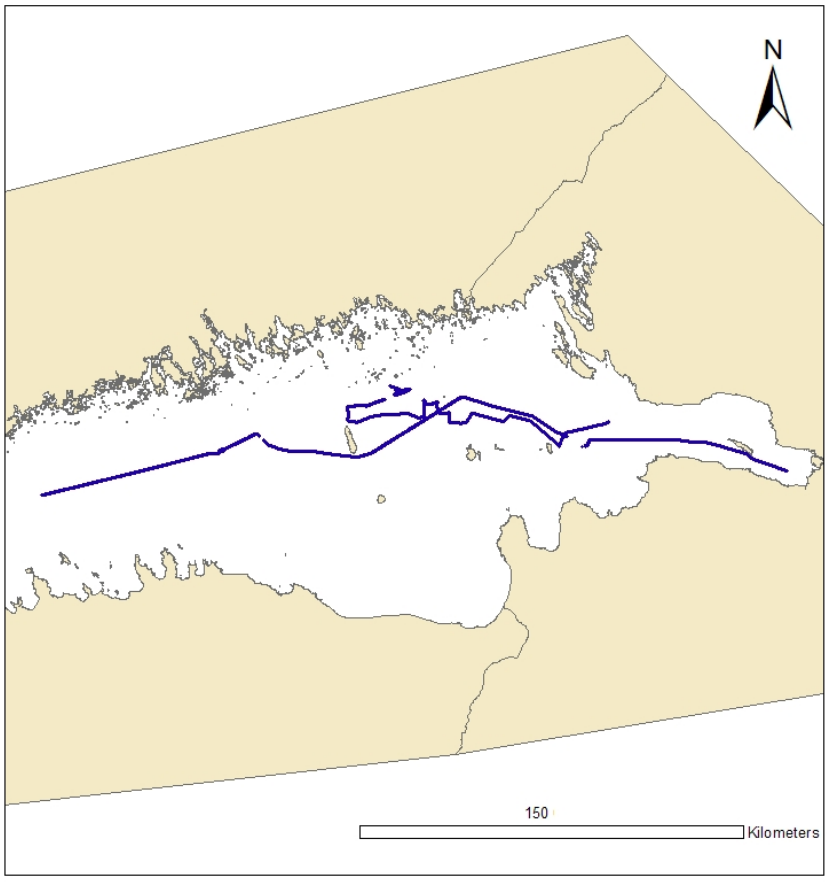

Figure 2. Echo-sounding track lines of the RV Aranda FYTO 2009 cruise in Finnish and Russian territorial waters (including the Finnish exclusive economic zone, EEZ).

4. Methods of study and sampling

4.1. Positioning

The RV Aranda as well as its survey systems in use were continuously positioned using the DGPS (Differential Global Positioning System) with ± 2 m accuracy. We used the WGS 84 as the geographic coordinate system with the UTM35 (center 27) as projection for all data.

4.2. Echo-sounding

The acoustic survey during the FYTO 2009 –cruise was performed using 12 kHz echo-sounder. The acoustic data was recorded and stored digitally by using a MD DSS sonar system©.

4.3. Side scan sonar imaging

Acoustic methods used for the marine geological survey included also side scan sonar (Klein SA 350, 100 kHz) imaging.

4.4. Sediment sampling methods

4.4.1. GEMAX –corer

Surface sediment samples from soft bottoms were recovered using a GEMAX twin barrelled gravity corer with an inner diameter of 90 mm of the core liner.

4.4.2. VanVeen grab sampler

Surface sediment samples from hard bottoms were recovered using a Van Veen grab sampler (suom. *pohjaäyskäri*).

4.4.3. Piston corer

Long sediment cores were recovered using GTK's 6 meters long Piston corer (Figure 3). The first sediment core was normally taken with plastic (inner) foil (or without liner) in order to check the type of sediment. Next sediment cores were recovered with liner. Piston corer MGML-2009-1 was recovered without a piston, as gravity corer, but other cores were recovered normally.

©MD DSS Multi-Mode Sonar System for Sub-Bottom Profiling, Meridata Finland Ltd

For the inner liner we used WEHONYL PVC-U plastic liner (4.3 mm thick), with an inner diameter of 90 mm. Additional weights of 4 x 48 kg were used in corer.

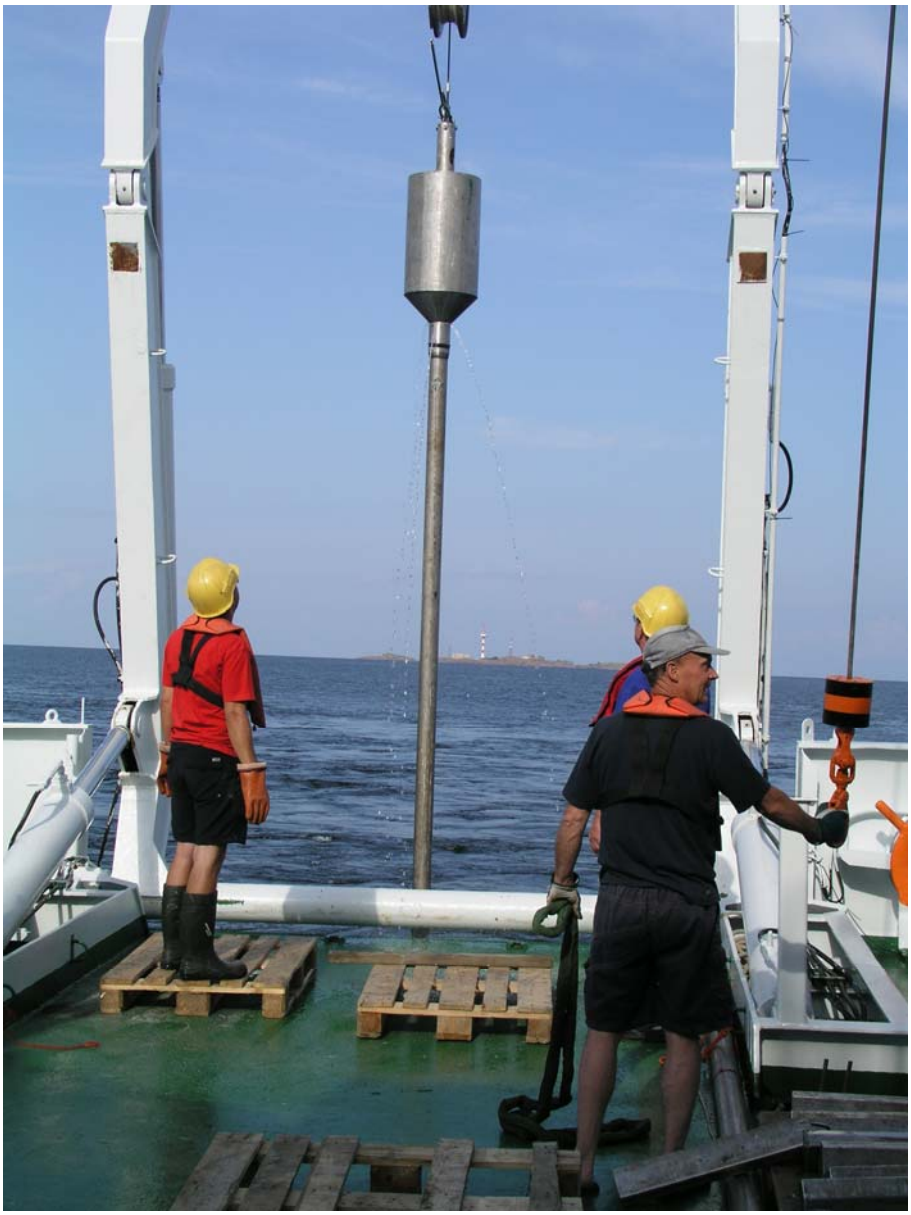

Figure 3. GTK's 6 m long gravity corer in use onboard the RV Aranda in the vicinity of Someri island, Russia. Photo: Aarno Kotilainen, GTK.

4.4.4. Mini ice finger (MIF)

To recover sediment samples for high-resolution studies of fluffy (i.e. very soft) surface sediments (e.g. taken using GEMAX corer) we employ the Mini Ice Finger (MIF) –method (suom. *Minijääsormi –näytteenotin*). The MIF –method has been developed in University of Turku, Department of Geology (Saarinen et al. 2005). Inner core/liner of MIF was 310 mm long, a 1 mm thick, rectangular, hollow aluminium bar with an inner diameter of 13 mm. Before sampling, the lowermost end of the aluminium bar is blocked e.g. with tape or wedge. MIF will then be pressed slowly into the sediment (that is in GEMAX core liner). Since MIF is in the sediment, it will be filled gingerly with dry ice (solid carbon dioxide, −78.5 °C)/ethanol mixture. As dry ice evaporates more mixture will be added into MIF gradually. MIF will be kept in sediment around 20-30 minutes, until enough sediment around MIF is frozen. Then the MIF will be removed (pulled out) carefully from the sediment core and the surface of the frozen sediment will be trimmed (using e.g. knife). The frozen sediment will be wrapped/packed, labelled and stored in a freezer. It is possible to remove MIF (aluminium bar) from the frozen sediment before packing e.g. pouring hot water carefully into MIF and pulling it out.

4.5. Sediment descriptions

All recovered surface sediment cores were photographed and documented onboard. Sedimentological descriptions of GEMAX cores were made both through the plastic core liner and from the splitted and trimmed sediment surfaces. After coring one of the two GEMAX cores obtained was usually split vertically for description and the other cores were used for sub-sampling. Standard GTK description forms were used.

Long sediment cores were cut into 100 cm sections, labelled and stored in the cold store.

4.6. Magnetic susceptibility (MS)

Immediately after the splitting of sediment cores (GEMAX) their surfaces were trimmed and covered with thin plastic film (©Elmukelmu). The magnetic susceptibility (MS) was then measured at 0.5 cm intervals using a Bartington Instruments Ltd MS2E1 surface scanning sensor that was interfaced to a PC.

4.7. Subsampling

All surface sediment cores (GEMAX cores) were subsampled onboard Aranda during the cruise. The surface sediment cores were sliced normally into 0.5 or 1 cm thick subsamples onboard and packed in plastic bags and boxes.

Continuous subsamples for the primary and biogenic sedimentary structure studies (for X-ray radiographs) were collected using plastic (electrical installation) liners (height of 1 cm, width of 5 cm). Plastic liners were pushed into trimmed core sections, cut out with a steel string and sealed. Plastic liners were taken from surface sediment cores. All sub-samples were kept refrigerated onboard (or frozen if needed).

5. Survey and sediment data

5.1. Survey data

Altogether over 500 km of acoustic (echo-sounding and side-scan sonar) data was collected during the FYTO 2009 –cruise (Figure 2 and Appendix 1). All data is stored in hard disk and in CD –disks. Echo-sounding data was collected also from research stations (Table 1). Collected acoustic data was of relatively good quality due to favourable weather conditions. Examples of echo-sounding data are shown in Figures 4 and 5. Side scan sonar image example is shown in Figure 5.

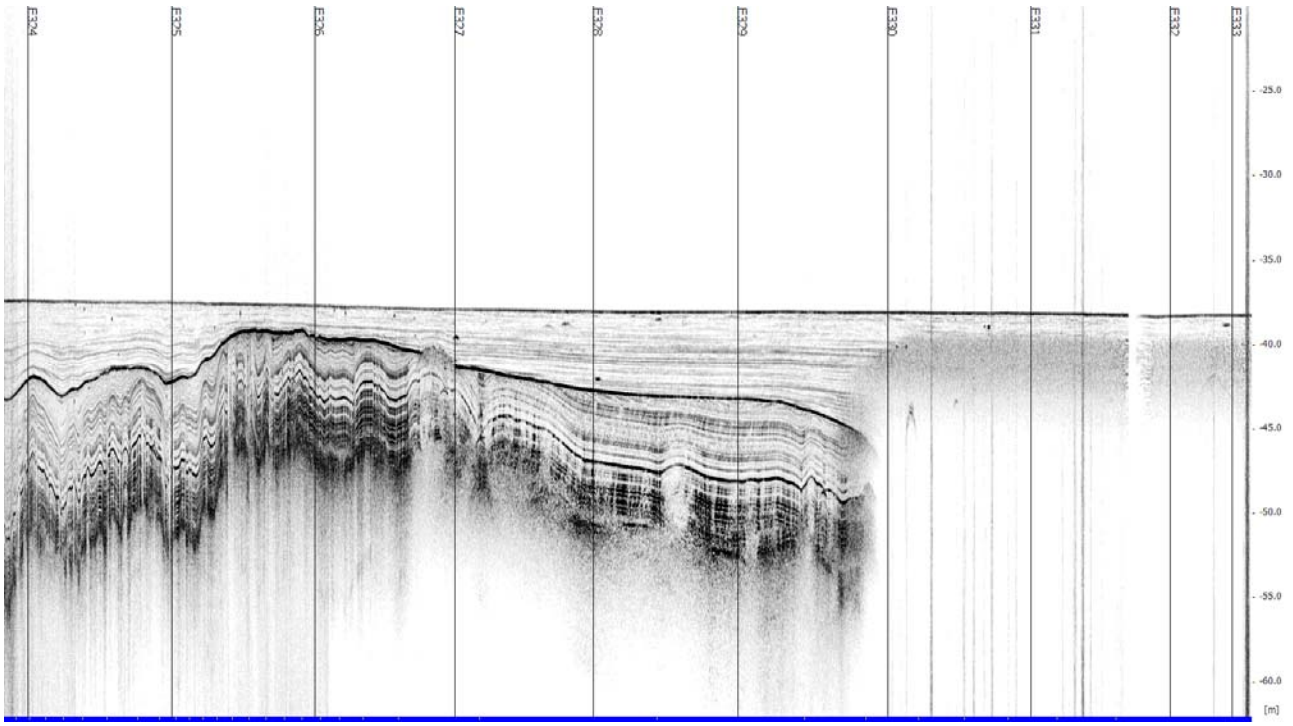

Figure 4. 12 kHz echo-sounding profile from the vicinity of Site F40, Russia. Vertical scale in meters is shown in the figure on the right-hand side. Horizontal scale between events (fix points) is approximately 600 meters.

Table 1. Stations surveyed using a 12 kHz echo-sounder during the FYTO 2009 cruise.

				WGS-84	WGS-84	
Station	Date	Time (UTC)	File	lat begin	lon begin	Notes
K19	3/8/2009	11:59	98031159	6019.754	2653.559	ev. 12-13
KILPI2	4/8/2009	11:36	98041136	6013.543	2722.368	ev. 70-71
PMONTTU	4/8/2009	16:00	98041600	6010.670	2705.770	ev. 84-85
SECTOR 3	5/8/2009	14:41	98051441	6011.225	2734.721	ev. 198-199
F41b	6/8/2009	07:37	98060737	6007.00	2803.926	ev. 257-258
F40	6/8/2009	16:19	98061619	6006.409	2847.521	ev. 338-339
SeskarE	8/8/2009	16:15	98081615	6001.921	2826.785	ev. 421-422
SeskarE_b	8/8/2009	16:39	98081639	6001.915	2826.793	ev. 423-424
SeskarE3	8/8/2009	17:41	98081741	6001.420	2836.774	ev. 425-426
LL3a	9/8/2009	08:50	98090850	6004.030	2620.800	ev. 515-516
LL3a sed	9/8/2009	12:46	98091246	6004.680	2619.734	ev. 522-523
LL4a	9/8/2009	13:49	98091349	6001.011	2604.811	Ev 524-539, LL3a→LL4a

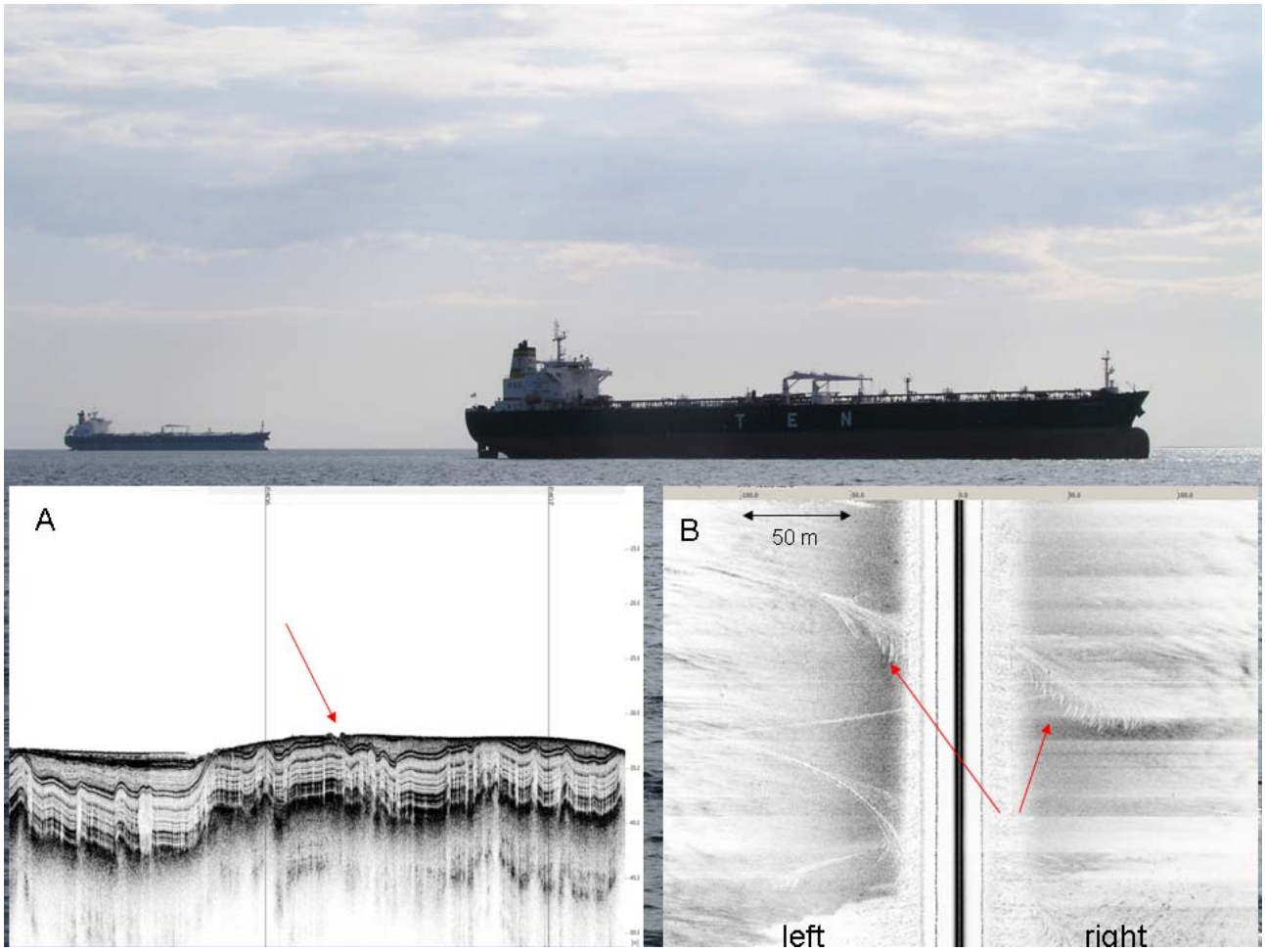

Figure 5. 12 kHz echo-sounding profile (A) and side scan sonar image (B) from the vicinity of Seskar Island, Russia, showing structures of the seabed. Red arrows in profiles A and B indicate anchoring marks at seafloor (at the same location). Photo: Aarno Kotilainen, GTK.

5.2. Sediment cores

A total of 10 Sites were sampled during the FYTO 2009 cruise (Table 1). Surface sediment samples from Sites KILPI2, SECTOR 3, F41b, F40, SeskarE3, LL3a and LL4a were recovered using a GEMAX corer. At SeskarE and SeskarE_b surface sediments were recovered using a Van Veen grab sampler.

Long sediment cores were recovered from 4 Sites; KILPI2, SECTOR 3, F40 and LL3a_sed. The longest sediment core recovered was 513 cm long (F40 Site).

5.3. Mini ice finger samples

Mini ice finger samples were collected from GEMAX surface sediment cores that were recovered from sites KILPI2, SECTOR 3 and F40.

5.4. Magnetic susceptibility data

Magnetic susceptibility (MS) was measured from GEMAX surface sediment cores MGGN-2009-18, MGGN-2009-19, MGGN-2009-20 and MGGN-2009-21.

Table 2. Sediment cores recovered from main stations during the FYTO 2009 -cruise.

Site	Core ID number	Corer type	Lat (N) Lon (E)	Core length (cm)	Depth (m)	Time (UTC)
KILPI2	MGGN-2009-18	GEMAX	60°13.543 27°22.368	48 cm	62 m	4.8.2009 10:10
KILPI2	MGML-2009-1	Piston corer	60°13.543 27°22.368	235 cm	62 m	4.8.2009 12:30
SECTOR 3	MGGN-2009-19	GEMAX	60°11.225 27°34.727		61 m	5.8.2009 15:18
SECTOR 3	MGML-2009-2	Piston corer	60°11.225 27°34.721	406 cm	61 m	5.8.2009 18:00
SECTOR 3	MGML-2009-3	Piston corer	60°11.226 27°34.719	542 cm	61 m	5.8.2009 19:15
F41b	MGGN-2009-20	GEMAX	60°06.999 28°03.929		51 m	6.8.2009 11:03
F40	MGGN-2009-21	GEMAX	60°06.408 28°47.521		38 m	6.8.2009 16:20
F40	MGGL-2009-4	Piston corer	60°06.408 28°47.521	513 cm	38 m	6.8.2009 17:00
F40	MGGL-2009-5	Piston corer	60°06.409 28°47.518	454 cm	38 m	6.8.2009 18:15
F40	MGGL-2009-6	Piston corer	60°06.402 28°47.481	336 cm	38 m	6.8.2009 19:20
SeskarE	MGVV-2009-1	vanVeen	6001.921 2826.783		25 m	8.8.2009 16:07
SeskarE	MGVV-2009-2	vanVeen	6001.921 2826.783		25 m	8.8.2009 16:11
SeskarE	MGVV-2009-3	vanVeen	6001.921 2826.783		25 m	8.8.2009 16:17
SeskarE_b	MGVV-2009-4	vanVeen	6001.915 2826.793		25.5 m	8.8.2009 16:40
SeskarE3	MGGN-2009-22	GEMAX	6001.420 2836.774		35 m	8.8.2009 17:41
LL3a	MGGN-2009-23	GEMAX	6004.020 2620.794		69 m	9.8.2009 11:19
LL3a sed	MGGL-2009-7	Piston corer	6004.680 2619.734	244 cm	63.5 m	9.8.2009 13:01
LL4a	MGGN-2009-24	GEMAX	6001.011 2604.811		58 m	9.8.2009 15:39

GEMAX = GEMAX corer for surface sediment sampling, GC = gravity corer

6. Conclusions

INFLOW –project partners from Geological Survey of Finland and VSEGEI/Russia participated in the RV Aranda FYTO 2009 -cruise to the eastern Gulf of Finland 3.-10.8.2009. The present cruise was the first RV Aranda cruise since 1999 to enter Russian waters to collect seafloor geological data of the region.

Altogether over 500 km of 12 kHz echo-sounding data, and side scan sonar data was collected during the FYTO 2009 –cruise. Collected acoustic data was of good quality due to good weather conditions.

Long sediment cores were recovered from 4 Sites (KILPI2, SECTOR 3, F40, LL3a) using GTK's 6 m long piston corer. A 513 cm long sediment core from the Site F40, located in the outer Neva estuary, is the longest ever recovered sediment core from that region. It will provide unique information on the development of the Neva River and the eastern Gulf of Finland. Surface sediment samples were collected from 7 sites using GEMAX corer.

We can summarize that BONUS Research Programme INFLOW -project participation in the RV Aranda FYTO 2009 cruise was successful. All the objectives proposed for this cruise were fulfilled, and even exeeded.

7. Acknowledgements

VSEGEI and GTK participants thank the staff and other scientists onboard the RV Aranda for their very valuable help during echo-sounding and side scan imaging survey, sediment coring and subsampling. Special thanks to Dr. Harri Kankaanpää for the possibility to participate in the FYTO 2009 cruise. In addition we would like to thank the ships staff for taking good care of us 24/7.

8. References

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Spiridonov, M., Ryabchuk, D., Kotilainen, A., Vallius, H., Nesterova, E., Zhamoida, V., 2007. The Quaternary deposits of the eastern Gulf of Finland. In: Holocene sedimentary environment and sediment geochemistry of the eastern Gulf of Finland, Baltic Sea. Geological Survey of Finland. Special Paper 45. Espoo: Geological Survey of Finland, 7-19.

Luotauspäiväkirja		**Aranda**						
R/V Aranda echo-sounder 12 kHz								
MD DSS								
WGS-84 UTM zone 35N center 27								
			WGS-84	WGS-84	WGS-84	WGS-84		
date	**time (UTC)**	**file**	**lat** beginn.	**lon** beginn.	**lat** end	**lon** end	**from …to…**	**note**
3.8.2009	10:46	98031046	6024.111	2657.25			from K15	ev. 1-11, no SS
					6019.755	2653.545	to K19	
	11:59	98031159	6019.754	2653.559			**K19**	ev. 12-13
	15:23	98031523	6019.7	2653.785				ev. 14-17
	15:43				6019.586	2658.673		
	15:58	98031558	6019.556	2658.21			to K3	ev. 18-25
					6018.018	2704.903		
	20:10	98032010	6014.407	2717.658			grid	ev. 26-27, 5 kn,
	20:22				6013.585	2719.022		
	20:24	98032024	6013.544	2719.151			grid	ev. 28-33, 3 kn
					6013.729	2720.863		
	20:42	98032042	6013.704	2720.917			grid	ev. 34-40
					6013.061	2717.803		
	21:11	98032111	6013061	2717.778			grid	ev. 41-54, ev. 49 the end of gas
					6013.993	2724.427		
	22:13	98032213	6014.014	2724.422			grid	ev. 55-59
	22:31				6014.122	2721884		
4.8.2009	8:42	98040842	6014.812	2715.773			XV1 --> KILPI2	ev. 60-69, no SS
	9:15				6013.543	2722.374		
	11:36	98041136	6013.543	2722.368			**KILPI2**	ev. 70-71, foil
	13:43	98041343	6011.93	2713.417			to P-Monttu	ev. 72-78
	14:30				6010.541	2705.771		
	14:32	98041432	6010.541	2705.771			to P-Monttu	ev. 80-83
	14:44				6010.67	2705.77		
	16:00	98041600	6010.67	2705.77			**P-Monttu**	ev. 84-85
	16:34	98041634	6010.732	2705.52				
					6010.75	2705.43	around P-Monttu	ev. 86-87
	17:33	98041733	6010.75	2705.419			to the border	ev. 88-97
	18:13				6009.28	2658.113		
	18:17	98041817	6009217	2658.092			to F42	ev. 98-101, towcable 23, trim 10m
	18:32				6008.447	2658.251	to F42	
	19:01	98041901	6008.42	2658.228			to F42	ev. 104-112
	19:42	98041942	6007.195	2706.09			to F42	ev. - 126
	20:45	98042045	6008.483	2709.971			to F42	ev. 127-138
	21:39	98042139	6008.781	2717.336			to F42	ev. 139-149
	22:25	98042225	6008.875	2723.777			to F42	ev. 150-159
	23:02				6007.972	2728.333	to F42	
5.8.2009	7:10	98050710	6008.04	2727.985			to sector III	ev. 160-171, with SSS

Appendix 1.
Acoustic survey index table

	8:03	98050803	6010.959	2730.067			"	ev.172-175
5.8.2009	8:15	98050815	6011.707	2730.047			"	ev.176-179
	8:29	98050829	6010.185	2731.105			"	ev.180-189, W to E
	9:06	98050906	6011.05	2736.15			"	ev. 190-197 E to W
					6011.22	2733.774		
	14:41	98051441	6011.225	2734.721			Sector 3	ev. 198-199
	17:46	98051746	6011.066	2735.411			Sector 3 --> F41B	ev. 200-209, SSS, SSTrig 500ms
	18:36	98051836	6008.95	2738.95			Sector 3 --> F41B	ev. 210-221, SSTrig 250ms, tow cable 23, trim 10
	19:30	98051930	6006.913	2742.473			Sector 3 --> F41B	ev. 222-229, SSS
	20:09	98052009	6007.005	2748.039			Sector 3 --> F41B	ev. 230-240 SSS
	21:00	98052100	6008.535	2753.235			Sector 3 --> F41B	ev. 241-256 SSS, saapuminen pisteelle
6.8.2009	7:37	98060737	6007	2803.926			F41B	ev.257-258
	8:19	98060819	6007	2803.9			F41B-->SeskarE	SSS
	9:25	98060925	6007.497	2812.111			F41B-->SeskarE	ev.-272 SSS
	9:49	98060949	6006.968	2815.401			F41B-->SeskarE	ev.279-285, SSS
	10:18	98061017	6005.627	2818.488			F41B-->SeskarE	ev.286-292, SSS
	10:46	98061046	6004.283	2821.475			F41B-->SeskarE	ev. 294-302, SSS
	11:24	98061124	6002.541	2825.401			F41B-->SeskarE	ev. 303-305, SSS
	11:33	98061133	6002.142	2826.281			F41B-->SeskarE	ev. 306- , SSS, tow cable 15
	11:44	98061144	6001.698	2827.246			F41B-->SeskarE	ev.309 - end of profile
	12:04	98061204	6001.64	2857.15			to F40	ev. 310-333, no SSS
	15:59	98061559	6006.454	2847.835	6006.409	2847.522	to sediment F40	ev. 334-337
	16:19	98061619	6006.409	2847.521			F40	ev. 338-339
8.8.2009	8:15	98080815	5954.908	3001.934			from St. Petersburg	ev. 340-355
	9:26	98080926	6000.017	2938.362			to SeskarE3	ev. 356-371
	10:37	98081037	6002.394	2915.506			to SeskarE3	ev. 372-384
	11:35	98081135	6002.54	2854.445	6001.492	2837.836	to SeskarE3	ev. 385-397
	12:42	98081242	6001.413	2836.823			SeskarE3-->SeskarE	ev. 398-415, SSS tow cable 24
	13:56	98081356	6002.065	2827.42				ev. 416-420
	16:15	98081615	6001.921	2826.785			SeskarE	ev. 421-422
	16:39	98081639	6001.915	2826.793			Seskar Eb	ev. 423-424
	17:41	98081741	6001.42	2836.774				ev. 425-426, ei SSS
siirtoajo	18:19	98081819	6003.7	2830.03			Seskar? -> LL3A	427-435, ei sss
	19:02	98081902	6007.774	2816.932			Seskar E3 - > LL3A	ev. 436-
	20:14	98082014						ev. -461
	21:05	98082105	6008.791	2734.539			to LL3A	ev. 462-475
			6002.947	2715.444			"	ev.476-499
	0:30	98090029	6002.13	2625.802	6003.321	2622.427	"	ev. 500-514
9.8.2009	8:50	98090850	6004.03	2620.8			LL3A	ev. 515-516
	12:25	98091225	6004.026	2620.773			to LL3A sed	517-521
	12:46	98091246	6004680	2619.735			LL3A sed	517-521
	13:49	98091349	6004.51	2619.03	6001.01	2604.81	LL3a sed -> LL4A	524-539
	16:19	98091619	6001.219	2604.57			Grid around LL4A	ev. 540-543, png ja ss, tow 24 trim ?
	16:34	98091634	6001.12	2603.39			"	544-548, tow cable 30m, trim 15m
	16:56	98091656					"	549-554

Appendix 1.
Acoustic survey index table

	17:21	98091721	6000.97	2603.7			"	555-560
	17:43	98091743	6000.87	2605.86			"	561-568
	18:15	98091815	6001.016	2603.777			"	569-574
	18:38	98091838	6001.067	2605.807			"	575-579
	18:55	98091855	6001.212	2604.807			"	580-582, end of grid
	19:14	98091914	6000.579	2604.564			LL4A to LL7	583-588, ei ss
	19:38	98091938	6000.3	2559.9			"	589-606
	21:02	98092102	5957.82	2541.5			"	607-630
	22:55	98092255	5953.589	2510.664			"	631-648

This report is a product of the ”INFLOW” project.

INFLOW (Holocene saline water inflow changes into the Baltic Sea, ecosystem responses and future scenarios) –project studies ongoing and past changes in both surface and deep water conditions and their timing by means of multi - proxy studies combined with state-of-the-art modelling approaches. INFLOW uses sediment proxy data on a transect from the marine Skagerrak to the freshwater dominated northern Baltic Sea. The validated ecosystem models can provide simulated data for extreme natural climatic conditions over the past thousands of years (e.g. Medieval Warm Period, Little Ice Age). Proxy reconstructions will be compared to results from model simulations. These evaluated models will be used to provide predictions of the Baltic Sea ecosystem state at the end of the 21st century for selected IPCC climate change scenarios. Those scenarios of the future development of the Baltic Sea can form the scientific basis for political strategies adapting to future climate change.

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The INFLOW Report Series included following reports on 28th of August 2009:

INFLOW Interim Report No. 1 “INFLOW Cruise Report, SEDU 2009, the RV Aranda 22.-29.4.2009”.

INFLOW Interim Report No. 2 “Floating University Report, the RV Aranda 22.-29.4.2009”.

INFLOW Interim Report No. 3 “INFLOW Cruise Report, FYTO 2009, the RV Aranda 3.-10.8.2009”.

For more information on INFLOW –project see (http://projects.gtk.fi/inflow/index.html).