FS Poseidon
Cruise Report P392

(IOW-ID: 06PO0902)

Rostock-Warnemuende – Rostock-Marienehe

29.11.2009 – 17.12.2009

BALTIC GAS: Methane emission in the Baltic Sea: Gas storage and effects of climate change and eutrophication

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Cruise Report

Compiled by: Dr. Rudolf Endler, Prof. Dr. Gregor Rehder; IOW, Germany

R/V Poseidon Cruise No.: 392 (P392, IOW-ID: 06PO0902)

Dates of Cruise: 29.11.2009 – 17.12.2009

Research Topics: Marine geological, geophysical, hydrographic and biogeochemical investigations

Region: Baltic Sea: Mecklenburg Bay up to Gotland Basin

Port Calls: Rostock-Warnemünde – Rostock-Marienehe, Germany

Chief Scientist: Dr. Rudolf Endler, IOW, Germany

Number of Participants: 11 scientists

Project: Bonus - BALTIC GAS: Methane emission in the Baltic Sea: Gas storage and effects of climate change and eutrophication

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1 Research programme

The cruise is part of the research activities in the EU-funded project Baltic Gas: "Methane emission in the Baltic Sea: Gas storage and effects of climate change and eutrophication", which is coordinated by Prof. Bo Barker Jørgensen, Center for Geomicrobiology, University of Aarhus, Denmark. BALTIC GAS aims to understand how climate change and long-term eutrophication affect the accumulation of shallow gas and the emission of methane and hydrogen sulfide from the seabed to the water column and atmosphere. The outcome of the project will be a new understanding and quantitative synthesis of the dynamics and budget of methane in the seabed, an important but poorly understood component of the Baltic ecosystem response to natural and human- induced impacts. The multidisciplinary project involves 12 partner institutions from 5 nations (Germany, Denmark, Sweden, Poland. Russia and Netherland) and applies modern advanced technology and novel combinations of approaches. Seismo-acoustic mapping, water column studies and strategic sediment coring for geochemical analyses are combined in key areas. The key areas include Mecklenburg Bay, Arkona Basin, Bornholm Basin, Gdansk Basin and Gotland Basin. In the frame work of this program the question is addressed how the methane turnover is regulated in Baltic sediments. Thus the processes responsible for the formation, accumulation, transport and oxidation of methane in the Baltic Sea are studied and the position and efficiency of the sub-surface methane barrier relative to the total carbon flux are determined.

2 Scientific Team

2.1. List of Participants

Nr	Name	Function / working group	Institute
1	Endler, Rudolf	Chief scientist	IOW
2	Rehder, Gregor	Water column chemistry / CTD	IOW
3	Schneider v. D., Jens	Water column acoustics	IOW
4	Schmale, Oliver	Water column chemistry	IOW
5	Gülzow, Wanda	Water column chemistry	IOW
6	Kurth, Jörn	Sediment coring / CTD	IOW
7	Nickel, Gerald	Sediment acoustics	IOW
8	Frahm, Andreas	Sediment coring	IOW
9	Ferdelman, Timothy	Sediment biogeochemistry	MPI-MM
10	Fossing, Henrik	Sediment biogeochemistry	NERI - DK
11	Jensen, Joern Bo	Sediment acoustics	GEUS -DK

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GEUS –DK: Geological Survey of Denmark and Greenland, Øster Voldgade 10, DK-1350 Copenhagen K, Denmark; Tel.: +45 3814 2904

3 Cruise narrative

A detailed description of the research activities and events during the cruise is listed in the cruise progress table in the appendix 7.1 . The following remarks give a summary and an additional explanation.

In November 25, the novel 50 kHz multibeam SB3050 from L-3 ELAC Nautik GmbH was installed in Kiel harbor. The ship left Kiel harbor at the next morning heading to Warnemünde. During this transit first tests and calibrations of the multibeam echo sounder were performed. The ship arrived Warnemünde harbor in the late evening. The embarkment of the scientific crew, loading and installation of the scientific equipment occurred during November 27-28.

The general working sequence plan was to perform station work during daytime and acoustic echo sounding, including shallow seismic profiling during night time. The transition between the stations was used for multibeam and sediment echo sounding too.

The „standard" station program consisted of:

- CTD measurement and water sampling
- 3 * Short core ("Rumohr Lot") sampling for Geochemistry
- 1* Short core ("Frahm Lot") sampling for physical property measurements
- 1 *Long core (gravity corer) sampling for Geochemistry and physical property measurements

The cruise started in the morning of November 29 from Warnemünde harbor, heading for the first station in Mecklenburg Bay. This CTD station 373850 was primarily used for setting up and testing the equipment and the workflow. The first acoustic profile was run between station 373850 and station 373860 with the multibeam and sediment echo sounders. At station 373860 CTD measurements and short core sediment sampling for pore water and methane investigations were performed. At the evening the single channel sparker profiling system and the sediment echo sounder were deployed. Unfortunately there was no possibility to synchronize both systems. Therefore, the records of both systems were mutually impaired. The profiling lasted until next morning of November 30 continuing with station work. The research work had to be interrupted due to a damage of the engine steering at about 10:00 UTC. The ship navigated to the region off Warnemünde in order to board the needed service personal and spare parts. The repair lasted until late afternoon and at 18:42 UTC the research work was continued with acoustic flare imaging using the multibeam system. The station work (no 373870) was continued at early morning December 01 with CTD and short core sampling. Due to the shallow water depth and the drift of the ship the gravity corer was bended. At next station 373880 the full station program was performed with a gravity core recovery of 5.5m . The research was continued in Mecklenburg Bay until late evening of December 02.

The transition to the Arkona Basin was interrupted at stations 373980, 373990, 373400 for water column work. The standard station program in the Arkona Basin (see Fig. 4-3) started in the morning of December 03. The work in the central part of the Basin was interrupted because of increasing wind and rough sea and later continued with a small echo sounding grid over the old Oder river valley. A TV team was boarded off Saßnitz harbor in the early morning of December 04 for a interview regarding the role of greenhouse gases and the ongoing research. The station research program was demonstrated at station 374050. The TV team was disembarked at about noon of the same day. A CTD / short core transect (stations 374060 – 374100) was sampled after the transit back to the central basin. The work in the Arkona Basin ended with station 374160 at December 05.

The work in the Bornholm Basin (see Fig. 4-4) started in the early morning of December 06 with station 374170. The "full program" stations (CTD, short cores, long core) were placed along an acoustic profile crossing a mud ridge with shallow gas. Another CDT and short core stations transect was orientated mainly along a NW – SE line. The multibeam system was recalibrated in a flat region between Christiansoe and Bornholm on December 7. A number of seismo-acoustic lines were measured filling gaps in the profile coverage. The work in Bornholm Basin lasted until midnight December 9 at station 374330 near the entrance to the Stolpe Furrow. During the transit to Gotland Basin CTD measurements and water sampling were performed in the Stolpe Furrow at stations 374350 and 374360.

The work in the Stolpe Fore Delta started in the evening of December 10 with CTD station 374370 and a densely spaced, combined multibeam / seismo-acoustic grid over pockmark / furrow sea bottom structures. The positions for the "full program" stations 374380, 374390 and 374400, located inside and outside of a furrow, were selected based on the acoustic results. Neither flares nor other primary evidences of gas / fluid outflows causing these morphological features were found.

After this, the research program was extended on December 12 towards the centre of the eastern Gotland Basin with station work and seismo-acoustic profiling. A comprehensive CTD, water sampling and short core sampling program was completed at station 374430 in the centre of the eastern Gotland Basin. After a small acoustic profiling excursion to the NE, the main direction of the acoustic lines the stations turned backwards to SW. The last CTD / short core station 374450 was completed in the evening of December 15. Due to strong wind and waves the research work was stopped and the ship navigated back to Rostock . RV Poseidon arrived Rostock – Marienehe in the early morning of December 17. The scientific crew was embarked and the equipment unloaded. The ship left the harbour in the evening, heading for Kiel. The multibeam system and the transducer was demounted and unloaded.

4 Research areas

The research activities of the cruise were focused on the large mud covered basins in the western and central Baltic Sea: Mecklenburg Bay, Arkona Basin, Bornholm Basin, Gotland Basin (see Fig. 4-1). From previous cruises was known that extensive regions of their sediments contain big quantities of shallow gas. The following figures depict the track plots of the acoustic profiling lines and the positions of the stations. The locations of the stations were selected based on acoustic sediment profiling records, preferably along strong gas content gradients.

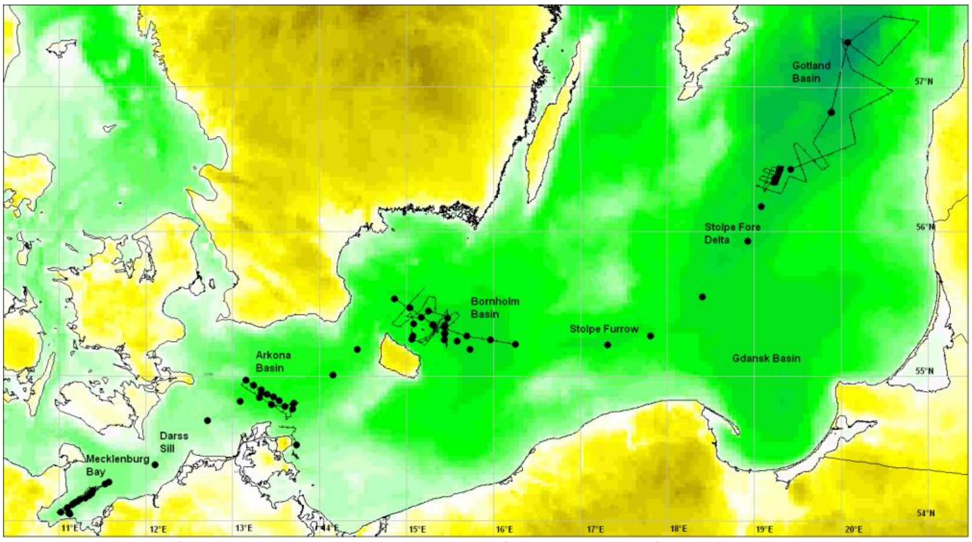

Fig. 4-1 Location of the working areas and track plot of all acoustic profiles and stations

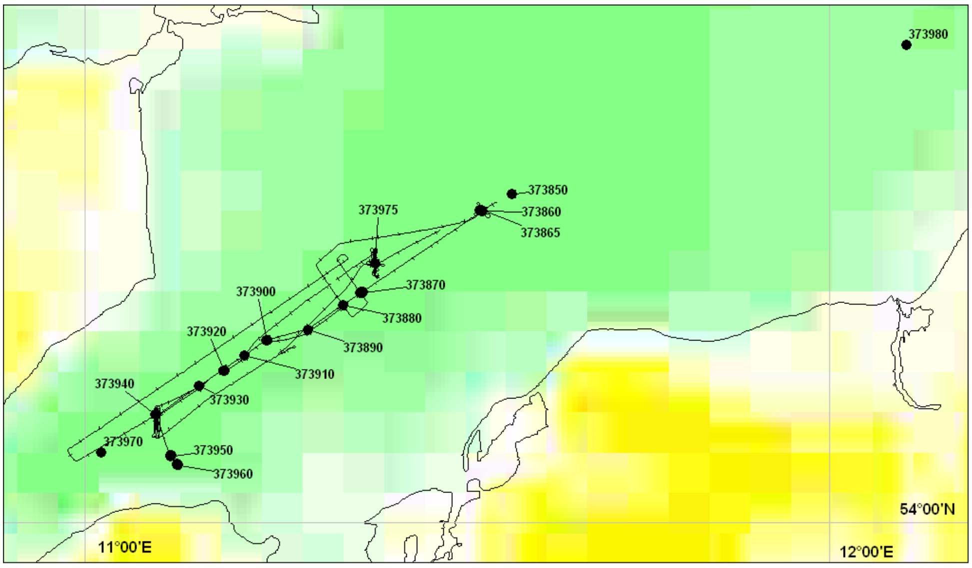

Fig. 4-2 Track plot of acoustic profiles and stations, Mecklenburg Bay

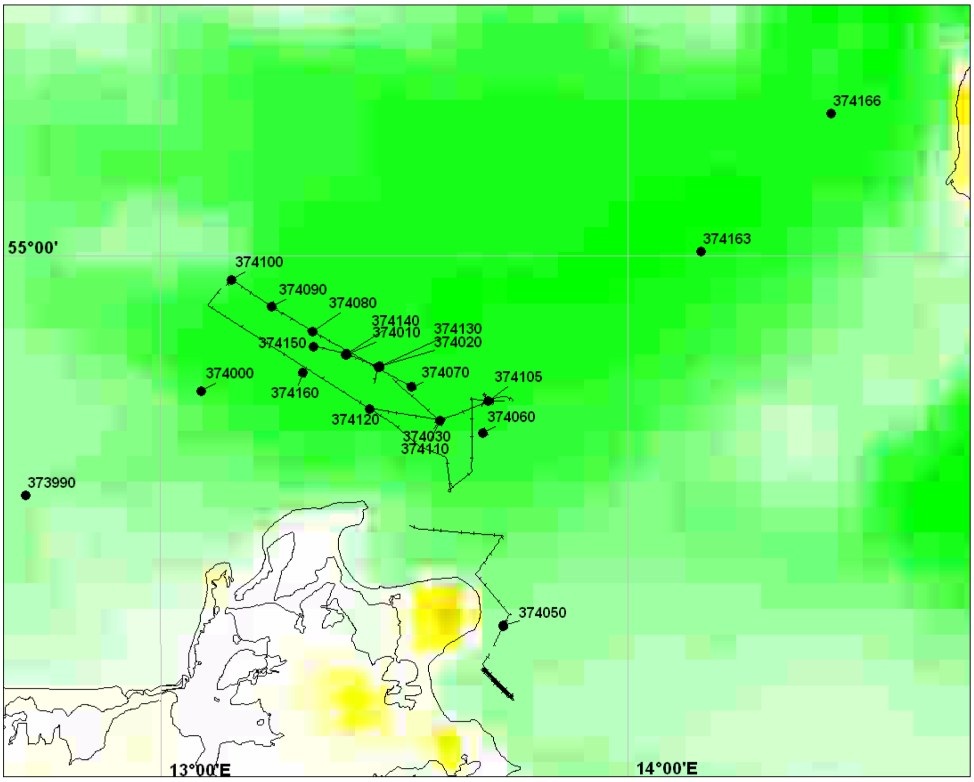

Fig. 4-3Track plot of acoustic profiles and stations, Arkona Basin

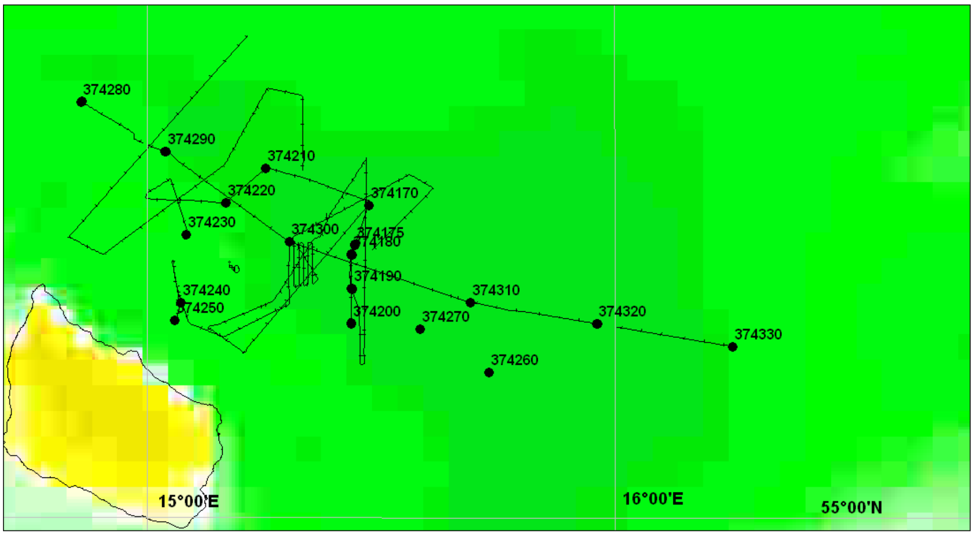

Fig. 4-4 Track plot of acoustic profiles and stations, Bornholm Basin

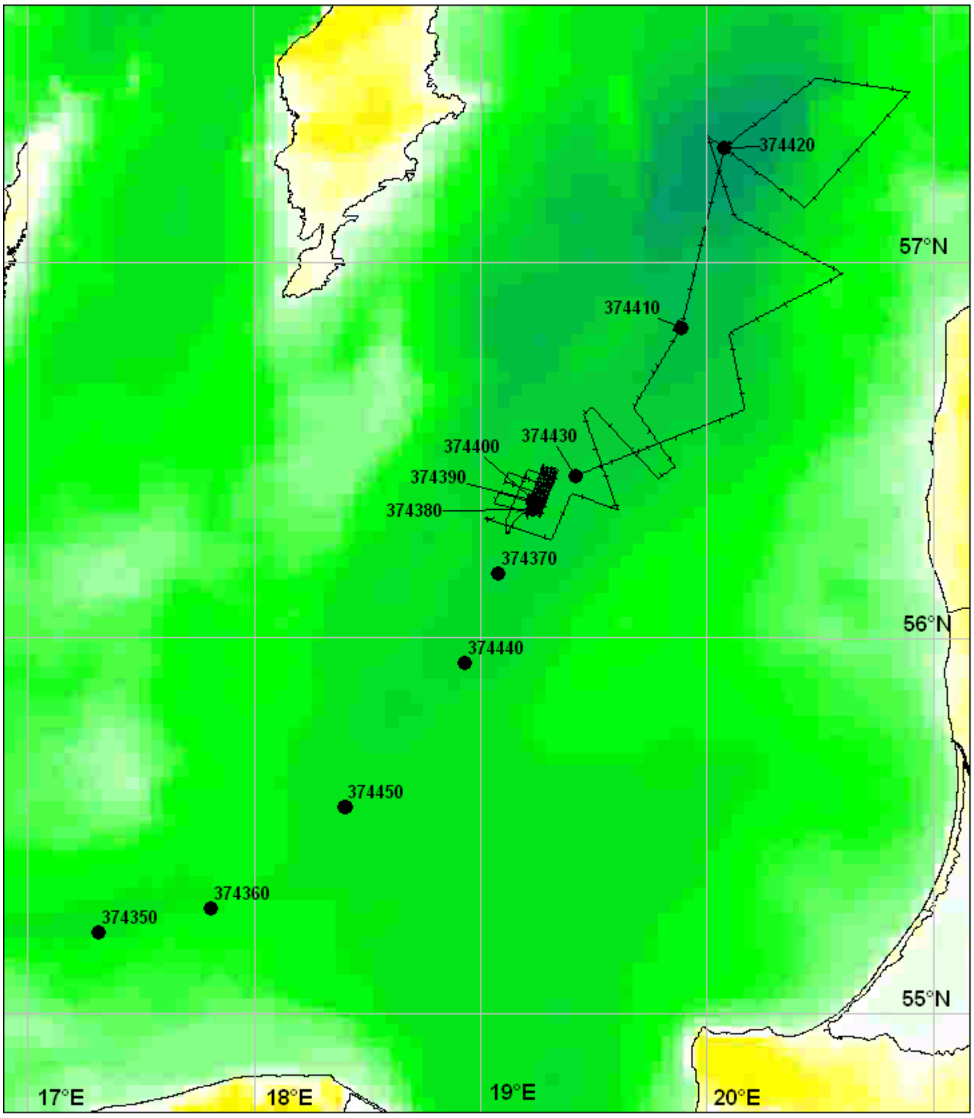

Fig. 4-5 Track plot of acoustic profiles and stations, Stolpe Furrow – Gotland Basin

5 First results, reports of the working groups

5.1. Multibeam echo sounding / acoustic water column imaging

(Jens Schneider von Deimling)

5.1.1. System installation

The novel 50 kHz multibeam SB3050 from L-3 ELAC Nautik GmbH was installed on POSEIDON prior to the cruise in Kiel harbor. The novel Mills-Cross geometry of the transmit- and receive-transducer required significant adaption on POSEIDON, because the setup does not fit into the moon pool. Consequently, a new moon pool plate was designed, lowered in the moon pool to supply an adapter flange 10 cm below the ships keel. Here the acoustic array (Fig. 5.1-1a) could be connected via divers underneath Poseidon (Fig. 5.1-1b).

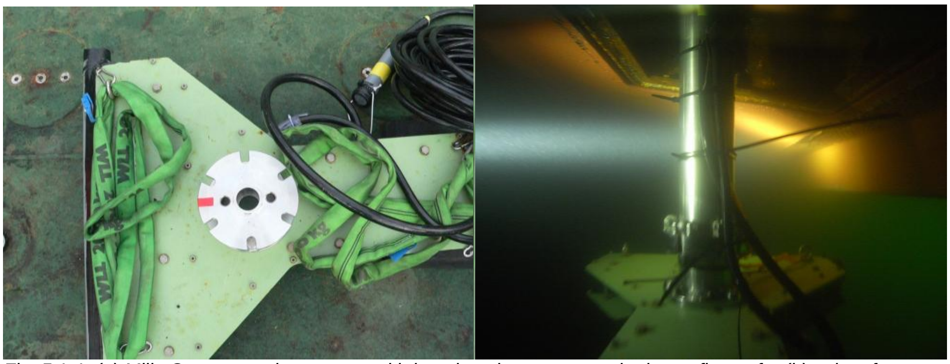

Fig. 5.1-1: (a) Mills-Cross transducer setup with housing plate on top and adapter flange for (b) subsurface installation

To compensate for ship motion the Coda Octopus MRU F180 provided real time roll, pitch, heave (TSS1), heading (NMEA-HDT) and positioning values (NMEA-GGA, VTG, ZDA) with up to 50 Hz update rate. Respective GPS antennas were placed on the upper deck and good satellite coverage was given during every course and time. The system was controlled via Hydrostar Online Version 3.5.8 and incoming data was sent to Hypack/Hysweep to allow for visualization, track planning and storage of the data. Hypack was also necessary to later export corrected xyz bathymetry. Later postprocessing was conducted by a combination of MBSYSTEMS, Fledermaus and GMT. Additionally, water column reflections where recorded and visualized by the new WCIviewer (WCI=Water Column Imaging) implemented in MATLAB/C and run under LINUX to visualize water column reflections online.
For sound speed correction several vertical profiles were calculated before or after each survey from the IOW CTD data and exported as an ‘asvp file’ with the REISEASSISTENT software.

5.1.2. System functioning

The SB3050 is a modern 50 kHz sonar with full WCI and Multi-Ping functionality allowing high survey speeds and full water column scan and storage with maximum range up to 3000 m water depth with a beam resolution of up to 0.5° x 0.5°. Due to the size of the mobile installation a 3°x2° beam resolution was used.
In single ping mode one transmission cycle is characterized by the formation of three simultaneously roll-stabilized transmit-sub fans. Yaw and pitch stabilization for the transmit fans were disabled during

this trip. The center transmit-sub fan has the frequency F1 slightly different from the respective outer sub fan frequency (F2) due to necessary reception signal separation. The system covers a maximum of 140° swath width.
In multi ping mode, two spatially separated acoustic swaths are formed along track with even three more transmit sub fans having frequencies F3 and F4. The multi ping mode was not used during the survey, due to the pulse length limitation of 0.4ms as the shortest possible pulse length in multi ping mode.
64 reception staves record the incoming echo signals. The electronic unit (SEE37) of the SB3050 then performs A/D conversion of the voltage and reception signal processing of the echo time series for further multibeam processing. 4 PCs (one for each frequency F1-F4) perform real-time hybrid time delay beam forming to generate up to 151 equi-angle beams (or up to 386 equidistant beams). On the one side, the beam formed data is processed in the bottom detection algorithm (BDA) and streamed to the "Operator PC" to display and store bathymetric data in the XSE file format. On the other side the uncompressed beam formed data is streamed to the "WCI PC" for each beam to visualize the water column backscattering data over travel time in each direction. Alternatively, raw stave data (not beam formed) can be recorded by the "WCI PC". The amount of stored WCI data depends on the calculated system depth, the manually configured or automatically determined beam spacing and the current pulse length.

5.1.3. Goals, System settings, and performance

The main goal of the multibeam studies during this cruise was to identify gas seep localities in the Baltic Sea by the use of multi-beam sounder. We concentrated on the detection of gas bubble-mediated echoes in the water column (flares) in a similar way, as was performed earlier using multibeam systems (NIKOLOVSKA et al., 2008; SCHNEIDER VON DEIMLING et al., 2007; SCHNEIDER VON DEIMLING et al., accepted 2009). Furthermore, special care was given to suspicious bathymetric features like pockmarks and elevated backscatter anomalies, which are often linked to methane seepage (JUDD and HOVLAND, 2007). However, recording of bathymetric data was often hindered by strong penetration effect in the mostly mud covered working areas.
Ideal operation for recording water column signals required high reception gain settings and may lead to confusion of the bottom detection algorithm (over-modulation of echo voltage). Thus pure water column and bathymetric surveys have most of the times been conducted separately.

5.1.4. Water column imaging (WCI)

Water column imaging surveys were performed with reduced ship speed (0.5-3 kn) to (1) lower the ship noise (2) reduce surficial bubble entrainment, and (3) not to loose track of rising gas bubbles. The pulse length was preferentially set for highest resolution to the system minimum value of 0.15 ms. Depending on the system depth, the transmission source level was either reduced with a power reduction of -20dB or 0dB and the reception gain and TVG were correspondingly adapted to visualize features in the water column. The water column data were streamed over an gigabit-ethernet to a Quad Core(TM)2 CPU Q8300 running 2.50Ghz. Even though fast ethernet was used for streaming, the high data rate of ~20MB/s caused some time latency between echo reception and WCI echogram visualization of approximately 5-10 seconds.

5.1.5. Bathymetry

Bathymetric surveys have been conducted together with subbottom profiling at ships speeds around 5 kn. The mapping performance was generally poor and bathymetric features could only be detected within an approximately 50° angle around the centre beam. We observed strong seafloor penetration of the 50 kHz in the WCI data and –especially if shallow gas was present -this caused major problems on correct bottom detection. The system suffered occasionally wrong heading output for hitherto unknown reasons.

5.1.6. Results

5.1.6.1. WCI sensitivity test

The WCI system sensibility was tested several times in regard to detection and identification of acoustic scatterers in the water column. One simple test was to acoustically track scientific gear (CTD-Rosette, Rumor Lot, Frahm Lot @ Poseidon winch #2), which was lowered within the acoustic swath close to the moonpool. The gear could precisely be tracked within the acoustic swath down to the seafloor (Fig. 5.1-2: a-c). In one particular case, the CTD-Rosette accidentally hit the gassy seafloor. A few seconds later a group of bubbles clearly escaped in the vicinity of the CTD-Rosette (Fig. 5.1-2: c). Subsequently, water currents displace the rising gas bubbles from one beam into the other (Fig. 5.1-2: d-f). The bubble rise velocity and 1D horizontal water current speed can be estimsted after postprocessing giving rise to approximate bubble sizes. Closer inspection of the data even shows bubble escape above scientific gear during downcasting, caused from expulsion of the minor void space kept in e.g the CTD-Rosette metal housing. Thus, the system is indeed sensitive enough to identify, track, and characterize even minor volumes of rising gas bubbles through the water column.

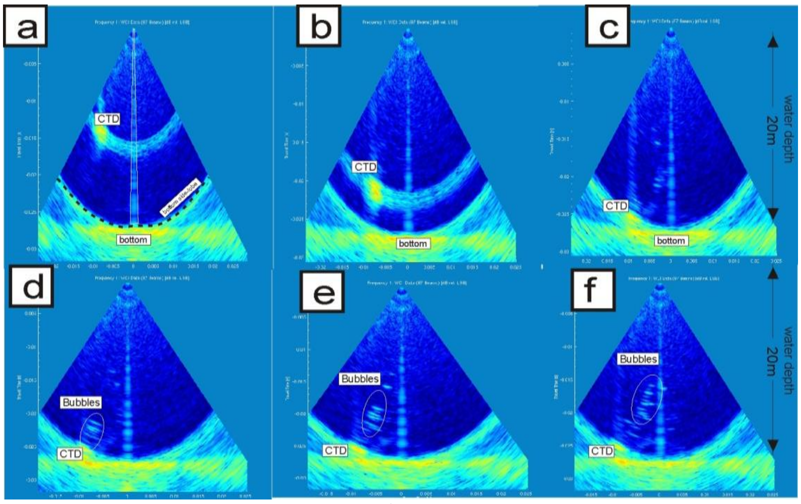

Fig. 5.1-2 CTD: Successive echo-image frames recorded during water column imaging with SB3050 showing (a-c) CTD-Rosette downcast, (d) contact with gassy sediments, and (d-f) induced bubble escape into the water column.

5.1.6.2. Mecklenburg Bay

The Mecklenburg Bay is a well examined shallow bay of approximately 25 m water depth in the western Baltic Sea with large areas of shallow gas close to the seafloor (LAIER and JENSEN, 2007, FIEDLER and WEVER, 1997). By courtesy of Rudolf Endler (IOW), Volkhard Spiess and Zsuzsi Stoth (University Bremen, Germany), a few indications of free gas ebullitions were given (EK 60 38kHz, flare images) prior to this cruise. These localities were surveyed in regard to backscatter anomalies (seafloor and water column). In one case, a flare like feature was recorded (Fig. 5.1-3). However, during a successive criss-crossing flare imaging survey over the same spot with reduced ship speed of 0.5 knots this feature was not found again and confusion with fish causing the anomaly can not be excluded. It is worth mentioning that the wind direction and speed during the work in Mecklenburg Bay changed from S to N and increasing water level and hydrostatic over-pressure may have suppressed further gas seepage during our Mecklenburg Bay surveys.

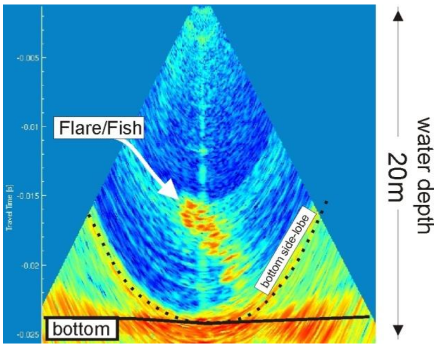

Fig. 5.1-3: Strong backscatter anomaly in the WCI at Mecklenburg Bay

Subsequently, a bathymetric survey was conducted around the potential gas ebullition site (Fig. 5.1-3) and we found significant features in both, bathymetry and seafloor backscatter. A distinct patch of elevated backscatter (not shown) arises 1.5 meters higher than the muddy and plain environment (Fig. 5.1-4, patch diameter ~150m). 800 m to the north of the centre of Fig. PATCH even more patches appeared. A seepage-related small reef built of methane derived authigenic carbonates could have caused this anomaly. However, the bathymetry performance was weak and the bathymetric elevation could also represent an artefact caused by penetration, i.e. the very shallow gas acoustically mimics the seafloor, whereas penetration around the patches leads to erroneous deeper depth determination of the bottom detection algorithm.

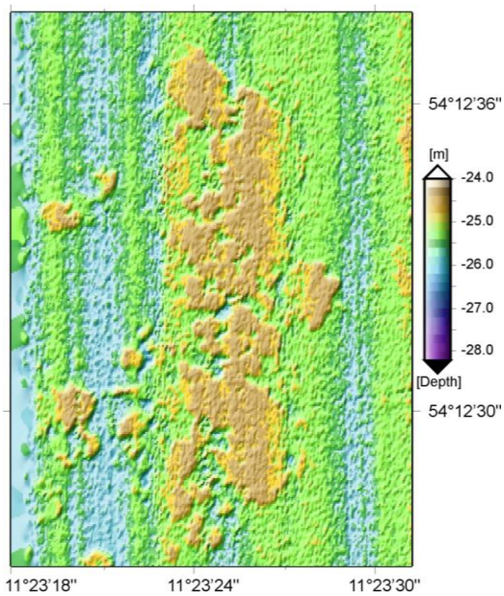

Fig. 5.1-4: Bathymetric chart of small elevated patches in muddy environment.

Kommentar [jschneid1]: check also backscatter patch 0212 02:52

5.1.6.3. Arkona and Bornholm Basin

Both basins are known to hold gassy sediments close to the seabed surface in the Holocene mud. However no natural flares could be observed during surveys and station work. Nevertheless, gas escape from the seafloor could be triggered at various stations after coring with the FRAHM, RUMOHR and gravity corers. Theses artificial seeps clearly show up in the WCI echograms lasting several minutes.

5.1.6.4. Stolpe Foredelta

Previous single-beam surveys in this area have indicated pockmark-like features to occur (XXX). Thus, a combined subbottom and multibeam survey was conducted in this area. Even though the system performance was poor, i.e. low resolution and vertical offsets on the outer beams (>50°), it could be shown, that the depressions formerly found in singlebeam data actually derive from crossing several channels striking SW-NE (Fig. 5.1-5).

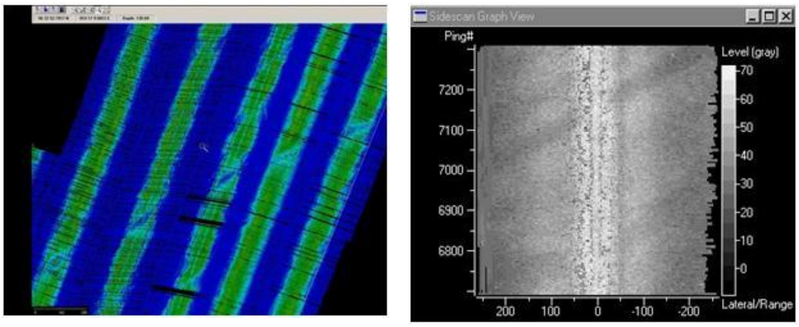

Fig. 5.1-5: (a) Multibeam bathymetry showing a channel striking WSW towards ENE with a depth of approximately 3m below the 132 m deep seefloor (centre of map is 56°22.879 N, 19°17.159). A strong artefact is present in the form of a systematic offset between centre (green) and outer (blue) beams parallel to the survey directions. (b) in multibeam sidescan data the striking direction is generally confirmed, even if the bathymetry appears flat.

5.2. Water column chemistry

(Wanda Gülzow, Gregor Rehder, Oliver Schmale, Jörn Kurth)

5.2.1. Water column methane analysis

For profiling sampling of the water column a Seabird 911 with a 12 Niskin bottle Rosette was used. The oxygen concentration of some samples was measured additionally via Winkler titration to calibrate the oxygen sensors. Hydrogen sulphide in the deep waters was analysed colorimetrically with the indophenol blue method.
During the cruise 59 CTD stations were sampled for vertical profiling of dissolved hydrocarbons in the water column. The water samples were generally analysed within 2 hours after the sampling. The CH4 concentration of the extracted gas was analysed on board while sub samples were taken for isotopic analyses (δ^{13} CCH_4) at the home laboratory. The sub-samples were sampled into pre-evacuated crim cap glass vials sealed with a butyl rubber septum. 2ml of supersaturated salt solution was added into each vial and the sample stored upside down to protect it for contamination from atmospheric gases during the storage.
For CH4 analysis aboard a modification of the vacuum degassing method described by Lammers and Suess (1994) was used (Rehder, 1999). 1000ml pre-evacuated glass bottles, closed with valve caps to avoid any air contamination caused by leakage were filled with 600 ml water sample from the rosette. For the determination of the exact water volume which was transferred into the glass bottles a flow meter (ENGOLIT Flow-Control 100S DMK) was used. The transfer of the water sample into pre-evacuated bottles leads to almost quantitative degassing. The extracted gas samples were injected into a gas chromatograph to detect methane by means of FID with a Shimadzu GC.

5.2.2. Obtaining absolute methane values

To convert ppm values of methane (gathered by GC measurements) into total amount of methane per volume (nM) we calculate the amount of methane using oxygen titration values while assuming nitrogen and argon being saturated. Since titration was not conducted for all samples we alternatively used the total amount of free gas measured during vacuum exhaustion.

5.2.3. Air methane analysis

Air samples were taken with a Hamilton gas syringe from the working deck and analyzed with the GC. At each sample station the heading of the ship was directed in such a way, that the wind was blowing side-onshore from the bow of the vessel to avoid air contamination caused by exhaust gas from the engine.

5.2.4. Results

In the Bornholm Basin sampling stations were placed in two transects over the gassy sediment field [oral consultation from J.B. Jensen; Laier et al., 2007, Metrol Report] as shown in Fig. 5.2-1. One question was, how does the released methane from the sediment influence the water column methane concentration and distribution. In Fig. 5.2-2 data of seven stations (transect) are shown for oxygen, methane, salinity and temperature.
In the working area of the Bornholm Basin surface waters are characterized by a salinity of 7.5psu, a temperature of 7.3°C, an oxygen concentration of 7.8ml/L and methane concentrations varying between 1.57-5.73nM. The mixed layer reaches till 50m depth. At the halocline, were temperatures and salinity start to enhance with increasing depth, oxygen decreases. At stations 374280 and 374290 salinity and oxygen concentrations increases rapidly in the bottom water. This can be explained with the recently monitored salt water inflow event from the North Sea. It can be assumed that the salt water front was located at the 9.12.2010 between station 374290 and station 374280.

Methane concentrations increase with depth and are highest between 50 and 60m with up to 60.35nM. At depths below 60m methane concentrations vary between 5.57 and 16.14nM. The depletion in methane concentrations in deeper water was observed during MSM0803 in June 2008 (unpublished data) already. The permanent halocline at 35 – 40 m water depth separates the surface water from the deep water. It hampers diapycnal eddy-diffusive methane transport into the well ventilated upper mixed layer. Assuming an methane source placed on the Bornholm slope, a lateral methane plume distribution occurs along bariometric currents. Gas bubble transport could not be verified in the Bornholm Basin. Elevated methane concentrations in the bottom water at station 374280, 374220 and 374190 have to be discussed further.

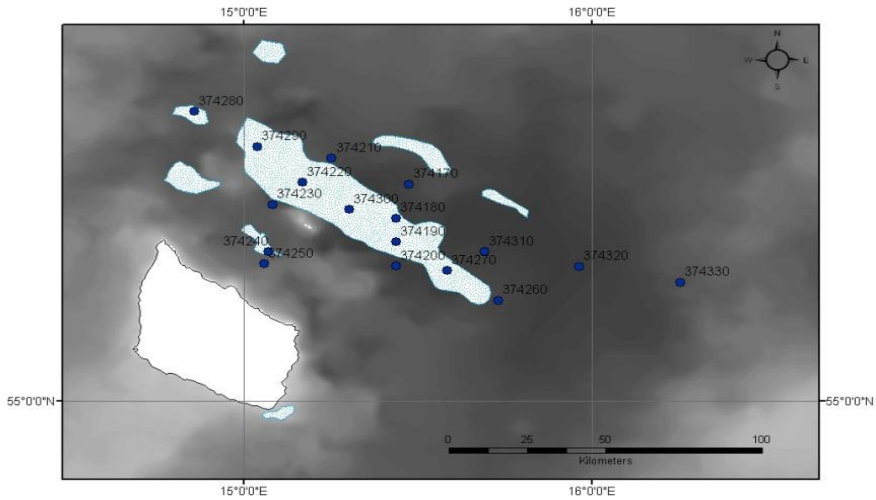

Fig. 5.2-1: CTD - stations over gassy sediments in the Bornholm Basin

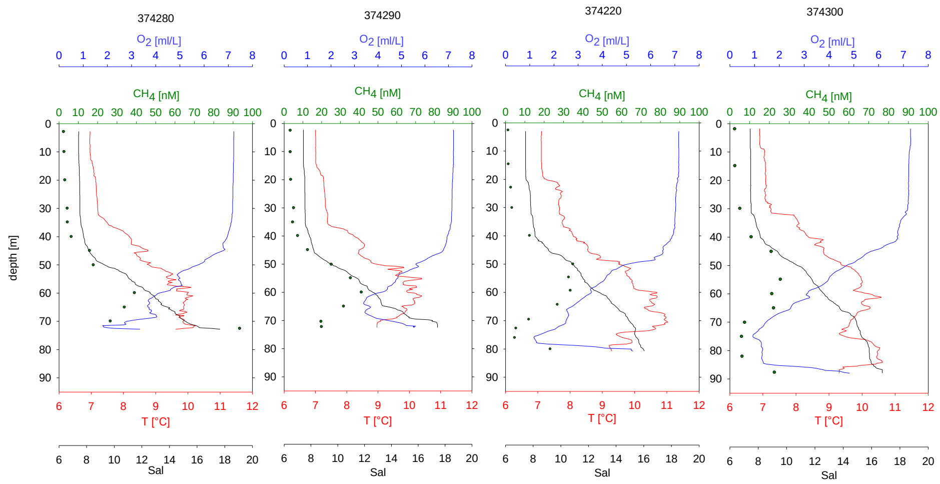

Fig. 5.2-2: Oxygen, methane, temperature and salinity concentrations over depth for the transect in the Bornholm Basin

Table 5.2-1: List of CTD / water sampling stations

CTD No.	Station	Date	Lat N	Long E	Location
CTD0	373850	29.11.2009			Mecklenburger Bay
CTD1	373850	29.11.2009	54 15,9402	11 34,434	
CTD2	373860	29.11.2009	54 15,1092	11 31,9422	Mecklenburger Bay
CTD3	373865	30.11.2009	54 15,117	11 31,951	Mecklenburger Bay
CTD4	373870	01.12.2009	54 11,1090	11 22,1988	Mecklenburger Bay
CTD5	373880	01.12.2009	54 10,5468	11 20,7768	Mecklenburger Bay
CTD6	373890	01.12.2009	54 9,3372	11 17,9442	Mecklenburger Bay
CTD7	373900	01.12.2009	54 8,8200	11 14,6340	Mecklenburger Bay
CTD8	373910	02.12.2009	54 8,0958	11 12,865	Mecklenburger Bay
CTD9	373920	02.12.2009	54 7,3692	11 11,1888	Mecklenburger Bay
CTD10	373930	02.12.2009	54 6,5970	11 9,1782	Mecklenburger Bay
CTD 11	373940	02.12.2009	54 5,2392	11 5,6688	Mecklenburger Bay
CTD12	373950	02.12.2009	54 3,2178	11 6,8778	Mecklenburger Bay
CTD13	373960	02.12.2009	54 2,800	11 7,4292	Mecklenburger Bay
CTD14	373970	02.12.2009	54 3,4092	11 1,2840	Mecklenburger Bay
CDT15	373975	02.12.2009	54 12,5760	11 23,3988	Mecklenburger Bay, Transit
CTD16	373980	03.12.2009	54 23,1672	12 6,2538	Transit
CTD17	373990	03.12.2009	54 41,5440	12 42,6822	Transit
CTD18	374000	03.12.2009	54 49,5882	13 5,1792	Arkona Basin, Transit
CTD19	374010	03.12.2009	54 42,20	13 23,8560	Arkona Basin
CTD 20	374020	03.12.2009	54 51,4722	13 28,0998	Arkona Basin
CTD21	374030	03.12.2009	54 47,3022	13 35,8248	Arkona Basin
CTD 22	374035	04.12.2009	54 31,4508	13 43,9638	Arkona Basin
CTD23	374060	04.12.2009	54 46,3170	13 41,3352	Arkona Basin
CTD24	374070	04.12.2009	54 49,8960	13 32,1600	Arkona Basin
CTD25	374080	04.12.2009	54 54,1902	13 19,5630	Arkona Basin
CTD26	374090	04.12.2009	54 56,0832	13 14,2212	Arkona Basin
CTD27	374100	04.12.2009	54 58,1682	13 9,1560	Arkona Basin
CTD28	374105	05.12.2009	54 48,8460	13 42,0750	Arkona Basin
CTD29	374160	05.12.2009	54 51,0270	13 18,2502	Arkona Basin
CTD30	374163	05.12.2009	55 0,3492	14 9,3588	Transit
CTD31	374166	05.12.2009	55 11,0550	14 26,0748	Transit
CTD32	374170	06.12.2009	55 24,0828	15 28,4028	Bornhom Basin
CTD33	371480	06.12.2009	55 20,3208	15 26,2122	Bornhom Basin
CTD34	374190	06.12.2009	55 17,6610	15 26,2722	Bornhom Basin
CTD35	374210	07.12.2009	55 26,9610	15 15,1560	Bornhom Basin
CTD36	374220	07.12.2009	55 24,2730	15 10,0518	Bornhom Basin
CTD37	374230	07.12.2009	55 21,8118	15 4,9608	Bornhom Basin
CTD38	374240	07.12.2009	55 16,5888	15 4,3080	Bornhom Basin
CTD39	374250	07.12.2009	55 15,2490	15 3,5610	Bornhom Basin
CTD40	374260	08.12.2009	55 11,1942	15 43,8342	Bornhom Basin
CTD41	374270	08.12.2009	55 14,5242	15 34,9920	Bornhom Basin
CTD42	374200	08.12.2009	55 14,9850	15 26,1618	Bornhom Basin

CTD43	374280	09.12.2009	55 32,0898	14 51,5580	Bornhom Basin
CTD44	374290	09.12.2009	55 28,2282	15 2,3520	Bornhom Basin
CTD45	374300	09.12.2209	55 21,3012	15 18,2160	Bornhom Basin
CTD46	374310	09.12.2009	55 16,5942	15 41,4822	Bornhom Basin
CTD47	374320	09.12.2009	55 14,9802	15 57,7272	Transit
CTD48	374330	10.12.2009	55 13,215	16 15,084	Transit
CTD49	374350	10.12.2009	55 12,8898	17 18,6948	Transit, Stolper Rinne
CTD50	374360	10.12.2009	55 16,7028	17 48,4548	Transit, Stolper Rinne
CTD52	374380	12.12.2009	56 20,6382	19 13,7400	Gotland Basin
CTD53	374390	12.12.2009	56 22,1460	19 13,9050	Gotland Basin
CTD54	374400	12.12.2009	56 21,8898	19 14,4960	Gotland Basin
CTD55	374410	13.12.2009	56 49,5630	19 53,2332	Gotland Basin
CTD56	374420	13.12.2009	57 18,4080	20 4,6398	Gotland Basin
CTD56_2		13.12.2009	57 18,4080	20 4,6398	Gotland Basin
CTD57	374430	15.12.2009	56 25,9260	19 25,0788	Gotland Basin
CTD58	374440	15.12.2009	55 55,9830	18 55,6458	Gotland Basin
CTD59	374450	15.12.2009	55 32,9742	18 23,9988	Gotland Basin

5.3. Sediment acoustics

(Rudolf Endler, Gerald Nickel, Joern Bo Jensen)

The goals of the sediment acoustic work were:

- Acoustic mapping of gas charged sediments
- Search for appropriate sampling station locations
- Collecting multi-frequency data for quantitative gas estimation experiments

Two different acoustic profiling devices were used. The multi-frequency parametric sediment echosounder SES96 (100/4-15kHz) was applied for the investigation of the uppermost deposits with a very high spatial resolution in the frequency ranges of about 100 kHz and 4 – 15 kHz.
The main features are:

- Primary frequency: 100 kHz
- Secondary frequencies: 4,5,6,8,10,12,15 kHz
- Beam width: +/- 1.8° for all frequencies
- Source Level: 240 dB/µPa re 1m
- Max. pulse repetition rate 50
- Pulse width 80-800µs
- Accuracy 100 kHz: 0.02m + 0.02% of depth, 10 kHz: 0.04m + 0.02% of depth
- Electronical beam steering, roll, pitch and heave compensation,
- Input for position data (NMEA), digital storing of raw and processed (envelope) signals
- Online processing and profile display (screen) and printing
- Portable system

A more detailed description of the system can be found at www.innomar.com.
The SES transducer array was mounted beside the ship, because the moon pool was already occupied by the multibeam transducer. Therefore, the maximum profiling speed was limited to about 6 knots. The online printout was used for the discussion and selection of the station positions.

A multi-tip sparker single channel shallow seismic profiler was used for the investigation of deeper structures. The system consisted of a GeoSpark1000 power supply, a GeoSpark200 multi-tip sparker, a single channel Geo-Sense Mini-Streamer (www.geo-resources.com) and a SonarWiz (www.chesapeaketech.com) recording system. The bandwidth of the source pulse ranged from about 0.7 kHz up to 3.5 kHz, with a centre frequency of about 2 kHz. The system was operated in parallel with the SES96 sediment echosounder. Unfortunately there was no possibility to synchronize both systems. Therefore, the records of both systems were mutually impaired. The sparker system was deployed only during longer profiling periods.

All seismo-acoustic profiling data were stored digitally and a copy was handed over to J.B. Jensen, (GEUS) for further processing and interpretation in the frame of the Baltic Gas project.

The following pictures display selected acoustic transects and stations in the different working regions. A more detailed information about the geological situation at most of the stations is depicted in the acoustic station plots in the appendix 7.3.

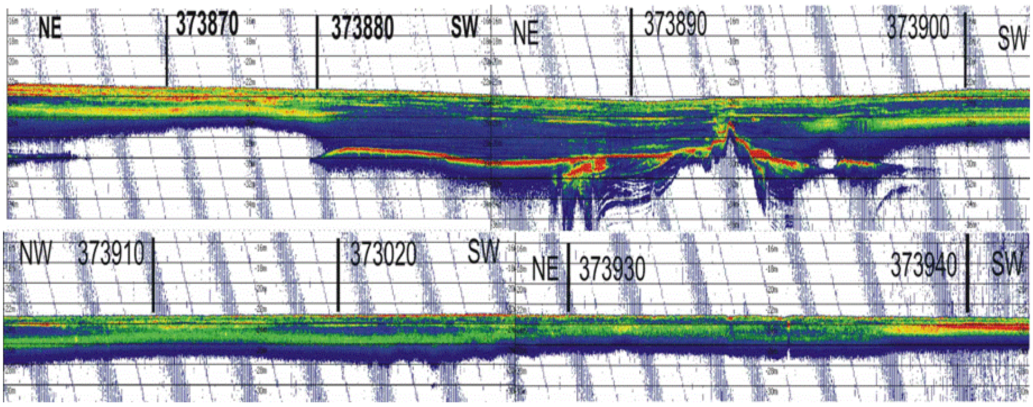

Fig. 5-1 SES96 record (15 kHz) and stations of Mecklenburg Bay transect from NE - SW

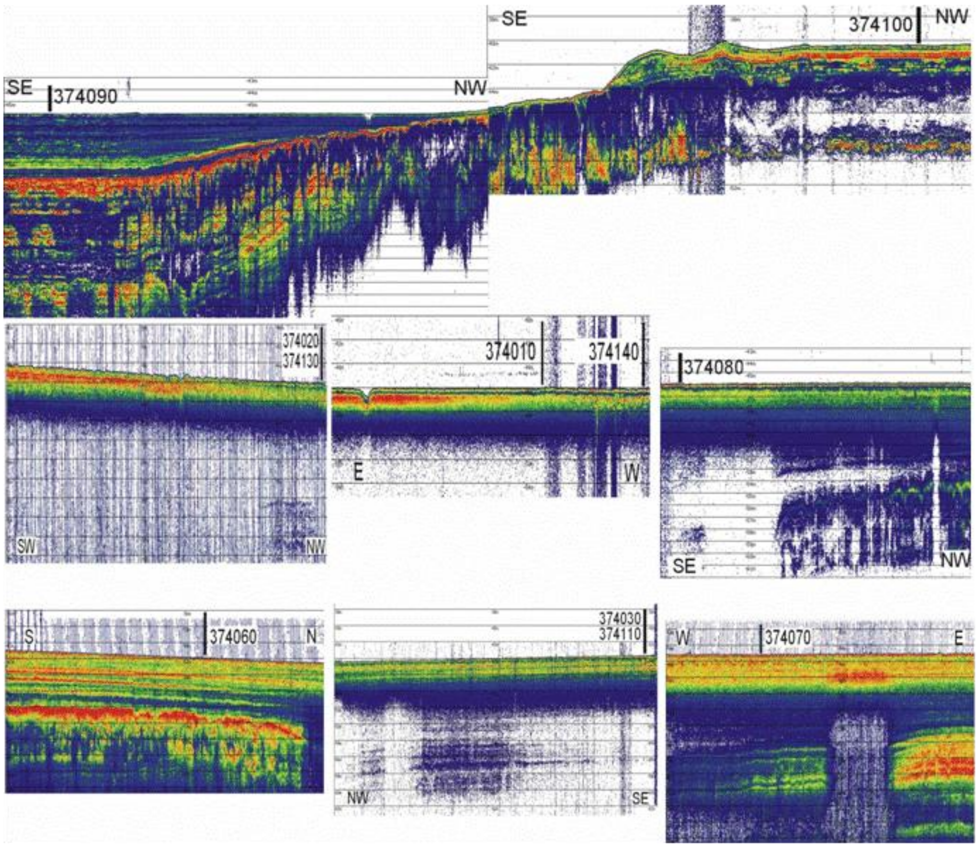

Fig. 5-2 SES96 records (15 kHz) of CTD/RL transect over sediment with different shallow gas contents in Arkona Basin

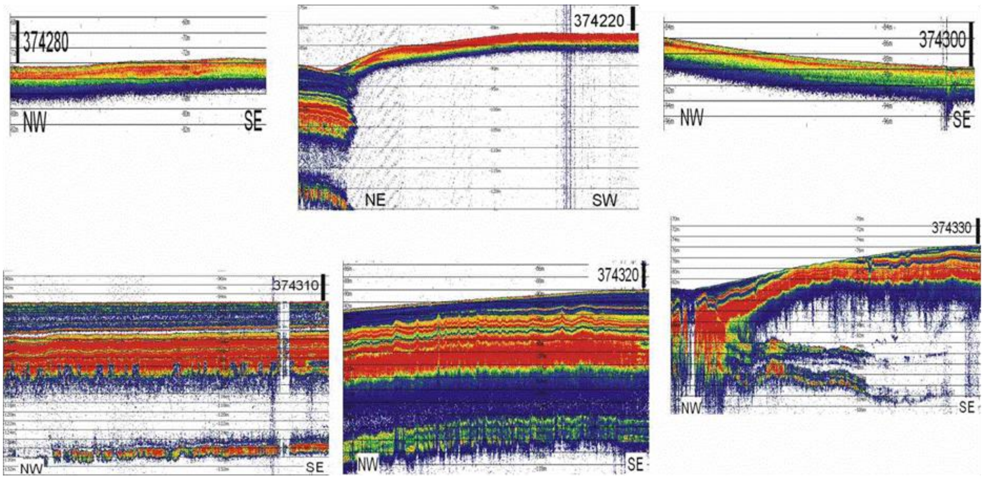

Fig. 5-3 SES96 records (15 kHz) of NW – SE CTD transect over sediment with different shallow gas contents in Bornholm Basin

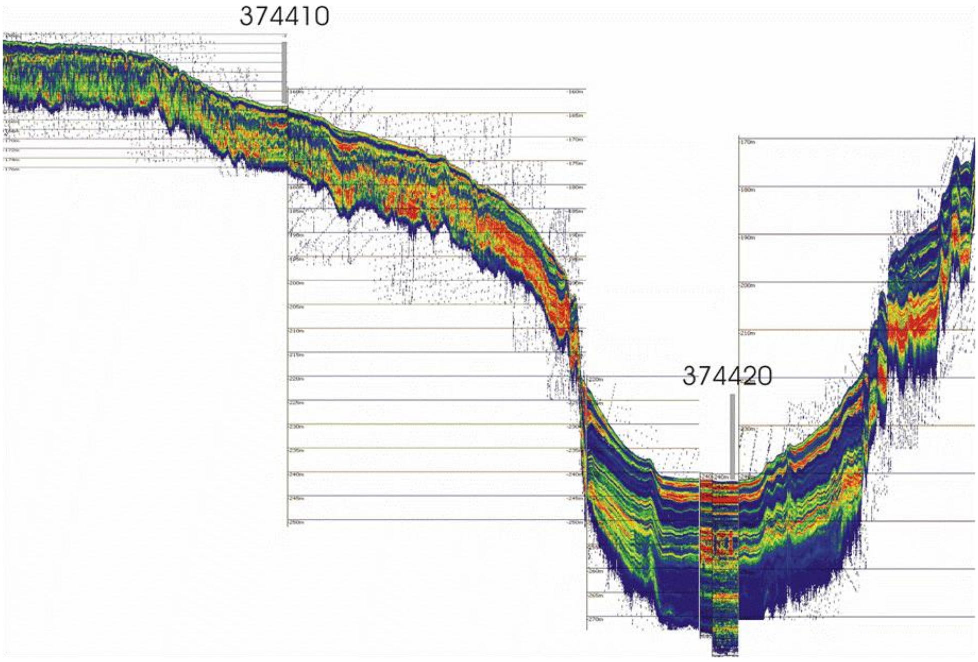

Fig. 5-4 Composite SES96 records (15 kHz) of SW – NW Gotland Basin transect with CTD stations

5.4. Sediment coring and core logging

(Rudolf Endler, Andreas Frahm, Jörn Kurth)

Sediment coring was performed at most of the stations with three types of coring devices.
After the CTD and water sampling a "Rumohr" type of short corer was used to sample the uppermost layer for geochemical investigations.

Fig. 5-5 „Rumohr" type short corer (RL)

In general tree cores were taken at each station:
RL1 pore water: SO42-, Cl-, H2S, Fe2+, PO43-, DIC, metals, and nutrients
RL2 210Pb, density/porosity and CN-content
RL3 CH4 and δ13CH4 (same sample) immediately upon retrieval
All liners were processed on board as soon as possible after recovery. See chapter 5.5.4 for more information about the geochemical sampling and onboard analyses.

Then another short coring device, the newly at IOW developed "Frahm Lot" was deployed to get a 60 cm core of the uppermost sediments for logging sediment physical properties. The liner length is 80 cm and the inner diameter is 10 cm. After retrieving, the liners were closed by pistons, labelled and stored in vertical position in a special lattice box.

Both short corers worked very reliably during the whole cruise and the core quality was very good.

Fig. 5-6 The newly at IOW developed "Frahm Lot" short corer

The last station activity was the deployment of the standard gravity corer. Depending on the expected hardness and thickness of the bottom deposits a corer barrel length of 6, 9 or 12 m was selected. Bending of the corer occurred at stations with hard ground and due to drift of the ship in shallow water.

Immediately after core recovery the small holes were drilled in the liner for geochemical sampling. Then the liner was cut in 1m sections, labelled and stored in lattice boxes. Pore water sampling was performed at selected cores in the lab.

All sediment samples were stored after the end of the cruise in the core cooling room of IOW for further processing.

The general long core processing procedure comprises

- the full core logging with a GEOTEK (www.geotek.co.uk) multi sensor core logger (wet bulk density, sound velocity, magnetic susceptibility),
- the splitting of the cores,
- the split core logging with a newly at IOW developed split core logger (core photo, electrical conductivity, vane shear strength, magnetic susceptibility)
- core description and sub sampling for further analyses

The short core processing procedure comprises

- the full core logging with a newly at IOW developed split core logger (acoustic full pwave form measurements, electrical conductivity, vane shear strength, magnetic susceptibility)
- core slicing / sub sampling for further analyses
- compaction tests with a newly at IOW developed compaction logger in order to investigate the parameter changes during the compaction procedure

First examples are given in the following two figures.

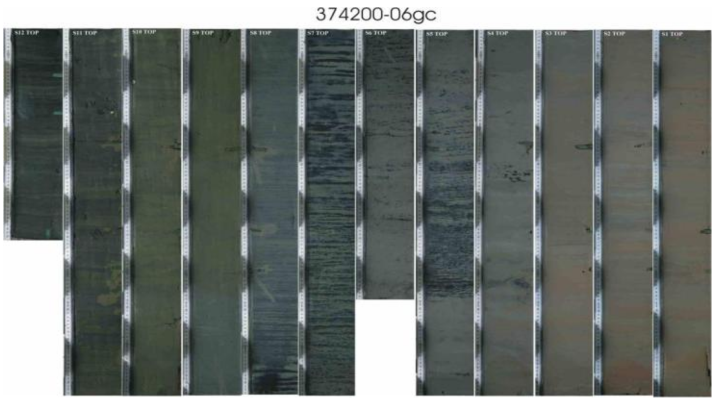

Fig. 5-7 Split core logger photo, 374200-06gc, Bornholm Basin, outside the shallow gas region

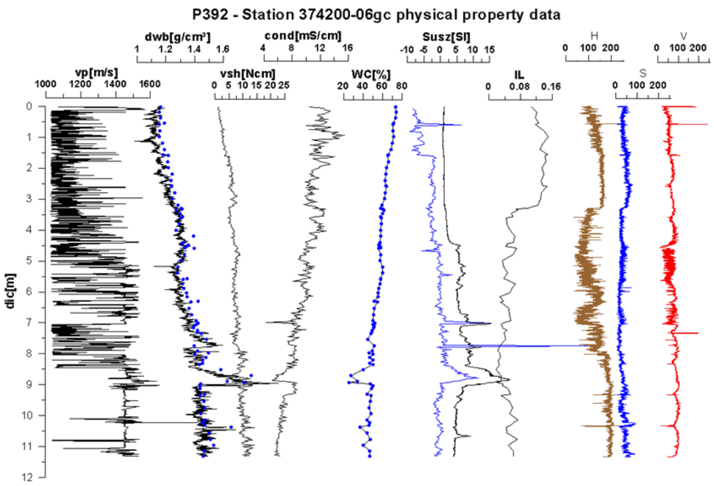

Fig. 5-8 Preliminary core logging data of gravity core 374200-06gc, Bornholm Basin, outside shallow gas. Vp-sound velocity, dwb-wet bulk density, vsh-vane shear strength, cond-electrical conductivity, wc-water content, Susz- magnetic volume susceptibility, IL- ignition loss, H,S,V – sediment colour values

5.5. Sediment chemistry

(Henrik Fossing (NERI), Tim Ferdelman (MPI) and Jørn Bo Jensen (GEUS))

5.5.1. Scope

Sediment sampling was done

- …to study the connection between the seismic signals observed in the sediment (i.e. seismic picture) and 'in situ' concentration profiles of methane, sulfate and other pore water constituents. Thus, targeted sediment sampling was performed based on seismic signals along transects reaching from sediments with deep or no 'methane-reflection' of the seismic signal (i.e. non-gaseous sediment) to sediments with me-thane saturation (and thus a sharp reflection, i.e. gaseous sediment) in the (surface) sediments.
- …to support methane concentration measurements in the water column (i.e. from CTD casts) by methane concentration measurements in the underlying sediment.

5.5.2. Analyses to be performed

Sediment was sampled for analyses of CH_4, $\delta^{13}CH_4$, density/porosity, CN-content, and pore water (i.e. SO_4^{2-}, Cl^-, H_2S, Fe^{2+}, PO_4^{3-}, DIC, metals, and nutrients), and ^{210}Pb. Additionally sediment temperature was measured.

5.5.3. Transects and sites studied

- Detailed biogeochemical studies compromising sediment subsampling from both Rumohr Lot (RL) and gravity corer (GC) were performed along two transects in Mecklenburg Bay and in Bornholm Basin, respectively, and at three sites in the Stolpe Vordelta area.
- Two transect with 'only' RL-coring were sampled in Arkona Basin and Bornholm Basin to support water column methane measurements in addition to two sites in the Gotland Deep.

5.5.4. Sediment coring and subsampling

(see table below for an overview of performed sediment sampling)
Detailed biogeochemical studies were done in 3 RL and 1 GC

- RL1 pore water: SO_4^{2-}, Cl^-, H_2S, Fe^{2+}, PO_4^{3-}, DIC, metals, and nutrients
- RL2 ^{210}Pb, density/porosity and CN-content
- RL3 CH_4 and $\delta^{13}CH_4$ (same sample) immediately upon retrieval
- GC sub-samples for all parameters except of ^{210}Pb.

Sediment sampling supporting water column studies was done in one RL at selected 'CTD-sites'
RL1 CH_4 and $\delta_{13}CH^4$ (same sample), density/porosity and CN-content immediately upon retrieval

5.5.4.1. Rumohr Lot sampling

Pore water was sampled by use Rhizons at 4 or 8 cm intervals. Pore water Fe2+ was measured immediately whereas all other pore water samples were preserved for later analyses.
Pore Water Distribution Scheme:

1. Dissolved Fe (II): 100 µl of pore water is pipetted into a 1 ml cuvette containing 800 µl of H2O plus 100 µl of Ferrozine reagent.
2. Sulfate/Dissolved Sulfide: 1,0 ml of pore water is pipetted into a 2 mL Eppendorf vial containing 100 µl of 5% $ZnCl_2$ solution and shaken.
3. Dissolved inorganic carbon (DIC): A 2 ml glass (Zinsser) vial is filled without head-space. Since the pore waters are essentially filtered through 0,2 µ filter (Rhizon) we no longer see any need to fix with mercuric chloride. Furthermore, the remaining solution after DIC measurement, can be used for anion/cation measurements (e.g., chloride).
4. Metal/Phosphate: approximately two ml of pore water is expressed into a 2 ml cryo-vial containing one drop (approximately 10-20 µl) of ultra-pure HCl.
5. Nutrients: The remainder is filled into a 5 ml scintillation (pico) vial and frozen.
6.

^{210}Pb samples were sliced in 2 cm resolution and stored frozen in labelled Petri dishes. Samples were taken at all depths down to 20 cm and in alternating slices down to 60 cm thereafter.

Density/porosity and C/N content (same sample) was sampled at discrete depths (e.g. 2, 20 and 100 cm) into 5 ml syringes with the luer-end cut off, wrapped with Parafilm and stored cold until analyses.

CH_4 concentration (and $\delta^{13}CH_4$) was sampled immediately upon through pre-drilled holes at 4 cm intervals. 3 cm3 sediment was sampled (from top to bottom of the RL) by use of a 5 ml syringe with the luer-lock end cut off. The sediment was immediately transferred to a 20 ml glass vial containing 6.0 ml 2.5% NaOH and 2-3 glass beads. The container was closed with a butyl rubber stopper, crimp capped, and stored upside down to reduce loss of CH_4 from the headspace. Methane concentration was measured onboard.

5.5.4.2. Gravity core sampling

CH_4 concentration (and $\delta^{13}CH_4$) was determined onboard form sediment sampled immediately upon retrieval of the GC. From the bottom of the GC (i.e. at the core catcher) 3 cm3 sediment was sampled and preserved (as described for the RL). The core liner was then pulled out of the core barrel meter by meter. For each meter, 3 cm3 sediment was sampled from the top of the sub-core and through pre-drilled holes at 1/3 and 2/3 m (i.e. 33 and 66 cm, respectively) and preserved as described. The temperature was measured at the top of each sub-core and 'holes' were re-sealed with tape. Top and bottom of the sub-cores were then closely capped. The cores were stored outside in a 'gitter'-box until further treatment (i.e. pore water sampling).

Pore water (SO_4^{2-}, Cl^-, H_2S, Fe^{2+}, PO_4^{3-}, DIC, metals, and nutrients) was sampled by use Rhizons at similar intervals as for the methane sampling but all the way from the sediment surface. Preservation was as above.

Density/porosity and CN-content (same sample) was sampled in the middle of each 1-meter subsection and as explained for the RL-samples.

5.5.5. Preliminary results

The major number of sites visited during the cruise were characterized by a high concentration of CH4 as also confirmed by the seismic measurements showing in situ CH4 saturation close to the sediment surface (i.e. 10 – 200 cm) – e.g. Mecklenburg Bay, Site 373950 at 21 m water depth (Fig. 5.4-1).

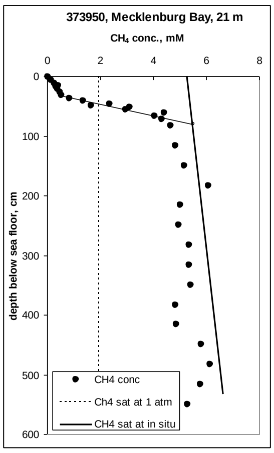

Fig. 5.4-1. Mecklenburg Bay. Methane concentration gradient at Site 373950 showing saturation at 80 cm. Composed of measurements in RL and GC.

However, at deeper sites the pressure decrease (up to 10 atmospheres in Bornholm Basin) released significant amounts of CH4 that degassed during retrieval and subsampling of the GC-core (lasting up to ¾ hour for a 12 m core). Hence, it was not possible at most sites to measure the 'true' in situ CH4 concentration profile. Thus, the depths of in situ methane saturation was estimated as the depth where the extension of the increasing gradient reached in situ methane saturation as calculated according to Yamamoto et al. (1976) based on in situ pressure, temperature and salinity. At Site 373950 saturation depth was estimated to 80 cm.

The transect in Bornholm Basin was composed of 5 sites of which 4 sites were studied in details (Fig. 5.4-2). Site 374190 was situated in the approximate center of a gas rich area. Estimated from the CH4 gradient methane reached in situ saturation at about 35 cm bsf. The CH4 concentration profile was composed of measurements in the RL and GC and it is obvious that the much faster sampling of RL (<15 min from pull out) retained

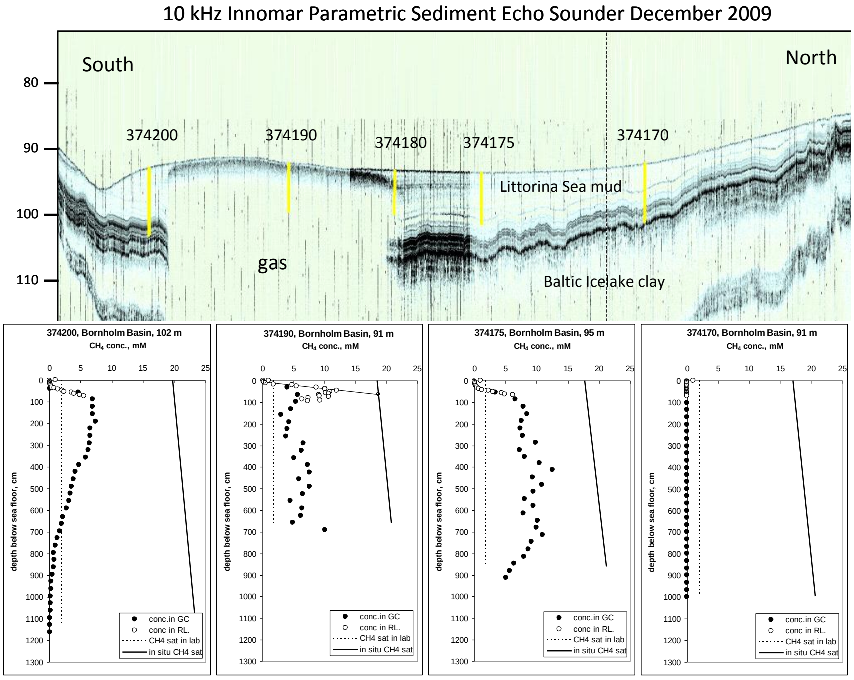

Fig. 5.4-2. Bornholm Basin transect crossing methane gas saturated sediment at site 374190. Upper panel shows the seismic profile with approximate penetration depth of the GC-corer. Lower panel shows the methane gradient at four sites: 374170, 374175, 374190 and 374200 (lower panel). Site 374180 was positioned at the transition between gas saturated and non-gas saturated sediment but appeared with the almost same CH4 concentration as Site 374190 (not shown).

more CH4 in the sediment than observed in the GC core that was sampled from the bottom (i.e. core catcher) and thus was on deck for more than 40 minutes before the last sediment sampled (near the sediment surface) was pre-served.

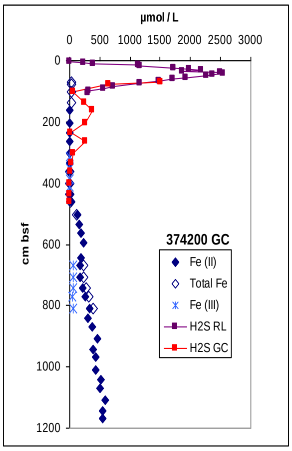

Fig. 5.4-3. Distribution of dissolved total iron, dissolved ferrous iron, and dissolved sulfide in pore waters obtained from RL and GC cores at Site 374200.

Site 374170 approx. 12 km north of the gassy area had no measurable CH4 in the sediment which was also confirmed by the seismic measurements. Nor was any methane saturation observed at the two sites closer to but north and south of the gassy area, Site 374175 and 374200, respectively. However, at these sites methane (below saturation of about 18 mM) was observed and interestingly with an declining methane concentration from about 7,5 m and 3,5 m at site 374175 and 374200, respectively the latter with < 0,1 mM CH4 at the bottom of the core. Figure 5.4-3 shows the distribution of dissolved sulfide and dissolved iron in the sediments from Site 374200 in the Bornholm Basin. Sulfide derives from sulfate reduction processes taking place in the uppermost Holocene sediments. Downward diffusing sulfide is rapidly consumed in the iron rich glacial clays. The flux of dissolved ferrous iron has a source from below the coring depth and is not apparently associated with the downward diffusion of methane.

6 References

Fiedler, H. M. and Wever, T. F., 1997. Kartierung gashaltiger Sedimente in der Mecklenburger BuchtTechnischer Bericht TB 1997-14 zum Forschungsvorhaben 7.2, 7.4. FWG, Kiel, Germany.

Judd, A. G. and Hovland, M., 2007. Seabed Fluid Flow. Cambridge University Press, New York.

Laier, T. and Jensen, J. B., 2007. Maps and acoustic profiles of free gas distribution, Western Baltic Sea and Kattgat-Skagerrak area. PANGAEA, Geological Survey of Denmark and Greenland.

Nikolovska, A., Sahling, H., and Bohrmann, G., 2008. Hydroacoustic methodology for detection, localization, and quantification of gas bubbles rising from the seafloor at gas seeps from the eastern Black Sea. Geochem. Geophys. Geosyst. 9.

Schneider von Deimling, J., Brockhoff, J., and Greinert, J., 2007. Flare imaging with multibeam sonar systems: Data processing for seep bubble detection. doi:10.1029/2007GC001577 Geochem., Geophys., Geosyst. (G3, g-cubed.org) 8, 1-7.

Schneider von Deimling, J., Greinert, J., Chapman, N. R., Rabbel, W., and Linke, P., accepted 2009. Acoustic imaging of natural gas seepage in the North Sea: Sensing bubbles under control of variable currents. Limnol. Oceanogr. Methods.

7 Appendix

7.1. Detailed cruise progress

ydeg	ymin	xdeg	xmin	stat_id-ship	stat_id_iow	device	date	time utc	remarks
								hh:mm	Boardtime = UTC+1h
							29.11.09	**9:30**	**Departure HRO-Warnemuende**
54	15.912	11	34.384	585-1	**373850-01**	ctd	29.11.09	13:33	gas free, water sampling
54	15.94	11	34.434	585-2	373850-02	ctd	29.11.09	13:57	
54	15.255	11	32.508	587-1	**pr20091129-1501**	ses-mb	29.11.09	15:01	start profiling
54	15.217	11	31.847				29.11.09	15:45	end profiling
54	15.109	11	31.942	588-1	**373860-01**	ctd	29.11.09	16:07	gas free, water sampling
54	15.104	11	31.984	589-1	373860-02	RL	29.11.09	16:34	MPI/NERI
54	15.144	11	31.849	589-2	373860-03	RL	29.11.09	16:43	MPI/NERI
54	15.139	11	31.808	589-3	373860-04	RL	29.11.09	16:48	MPI/NERI
54	15.549	11	33.200	590-1	**pr20091129-1856**	ses-spa	29.11.09	18:56	start acoustic profiling
54	13.116	11	19.802				30.11.09	5:30	end profiling
54	15.117	11	31.952	591-1	**373865-01**	ctd	30.11.09	7:43	water sampling
54	15.114	11	32.052	591-2	373865-02	FL	30.11.09	8:14	iow-sedpy
stop station working, problems with engine steering									
54	14.150	11	28.521		**pr20091130-1001**	ses-mb	30.11.09	10:01	ses-mb profile
54	12.465	11	23.288						mb -flare imaging
stop working, taking in ses-transducer,									
transit to Warnemünde for boarding service personal for repairing engine									
Transit back to working area MB									
54	12.776	11	23.286	592-1	**pr20091130-1842**	mb	30.11.09	18:42	mb -flare imaging
54	12.488	11	23.377	593-1	**pr20091201-0103**	mb	01.12.09	1:03	mb -flare imaging
54	12.285	11	22.68	594-1	**pr20091201-0208**	mb	01.12.09	2:08	mb -flare imaging
54	11.109	11	22.199	595-2	**373870-01**	ctd	01.12.09	8:43	full gas -water sampling
54	11.115	11	22.222	595-3	373870-02	RL	01.12.09	9:04	MPI/NERI-pw
54	11.147	11	22.348	595-4	373870-03	RL	01.12.09	9:01	MPI/NERI-Pb210
54	11.168	11	22.405	595-5	373870-04	RL	01.12.09	9:17	MPI/NERI-methane
54	11.174	11	22.399	595-6	373870-05	FL	01.12.09	9:24	iow-sedpy
54	11.181	11	22.243	595-7	373870-06	gc12	01.12.09	9:48	bending of corer due to drift of the ship, samples: MPI/NERI-methane, IOW-sedpy
54	10.547	11	20.777	596-1	**373880-01**	ctd	01.12.09	11:31	gas transition, water sampling
54	10.548	11	20.789	596-2	373880-02	RL	01.12.09	12:14	MPI/NERI-pw
54	10.533	11	20.799	596-3	373880-03	RL	01.12.09	12:22	MPI/NERI-Pb210
54	10.539	11	20.794	596-4	373880-04	RL	01.12.09	12:27	MPI/NERI-methane
54	10.550	11	20.779	596-5	373880-05	FL	01.12.09	12:32	iow-sedpy

54	10.542	11	20.793	597-1	373880-06	GC6	01.12.09	12:53	overpenetrated 8m, recov. 5.5m, samples: MPI/NERI-methane, IOW-sedpy
54	9.337	11	17.944	598-1	373890-01	ctd	01.12.09	14:02	gas free, water samples
54	8.820	11	14.634	599-1	373900-01	ctd	01.12.09	15:02	gas transition, IOW-water samples
54	8.830	11	14.571	599-2	373900-02	RL	01.12.09	15:29	MPI/NERI-methane
54	8.840	11	14.581	599-3	373900-03	FL	01.12.09	15:35	IOW-sedpy
54	8.833	11	14.592	599-4	373900-04	GC	01.12.09	15:48	overpenetrated 8m, recov. 6m, samples: MPI/NERI-methane, IOW-sedpy
54	5.5932	11	5.7552	600-1	**pr20091201-1930**	mb	01.12.09	19:30	Start mb/ses flare survey
54	4.3662	11	6.5538				02.12.09	6:27	end survey
54	8.096	11	12.865	603-1	373910-01	ctd	02.12.09	8:32	gas,IOW-water samples
54	7.369	11	11.189	604-1	373920-01	ctd	02.12.09	9:26	gas, IOW-water samples
54	7.362	11	11.163	604-2	373920-02	RL	02.12.09	9:43	MPI/NERI-methane
54	7.365	11	11.159	604-3	373920-03	FL	02.12.09	9:47	IOW-sedpy
54	7.366	11	11.153	604-4	373920-04	GC6	02.12.09	10:06	overpenetrated 8m, recov. 6m, samples: MPI/NERI-methane, IOW-sedpy
54	6.606	11	9.194	605-1	373930-01	ctd	02.12.09	10:56	gas, IOW-water samples
54	5.239	11	5.669	606-1	373940-01	ctd	02.12.09	12:11	gas, IOW-water samples
54	5.219	11	5.626	606-2	373940-02	RL	02.12.09	12:32	MPI/NERI-methane
54	5.229	11	5.628	606-3	373940-03	FL	02.12.09	12:37	IOW-sedpy
54	5.221	11	5.695	606-4	373940-04	GC6	02.12.09	13:16	failure no samples
54	5.230	11	5.684	606-5	373940-04	GC6	02.12.09	13:34	pen. 6m, recov. 5.8m, samples: MPI/NERI-methane, IOW-sedpy
54	3.218	11	6.878	607-1	373950-01	ctd	02.12.09	14:24	gas, IOW-water samples
54	3.229	11	6.856	607-2	373950-02	RL	02.12.09	14:41	MPI/NERI-pw
54	3.251	11	6.894	607-3	373950-03	RL	02.12.09	14:49	MPI/NERI-Pb210
54	3.260	11	6.895	607-4	373950-04	RL	02.12.09	14:53	MPI/NERI-methane
54	3.264	11	6.908	607-5	373950-05	FL	02.12.09	15:00	iow-sedpy
54	3.256	11	6.976	607-6	373950-06	GC6	02.12.09	15:12	pen. 7m, recov. 6m, samples: MPI/NERI-methane, IOW-sedpy
54	2.800	11	7.429	608-1	373960-01	ctd	02.12.09	15:54	gas free, IOW-water samples
54	2.823	11	7.425	608-2	373960-02	RL	02.12.09	16:11	MPI/NERI-pw
54	2.809	11	7.431	608-3	373960-03	RL	02.12.09	16:15	MPI/NERI-Pb210
54	2.813	11	7.432	608-4	373960-04	RL	02.12.09	16:19	MPI/NERI-methane
54	2.806	11	7.431	608-5	373960-05	FL	02.12.09	16:24	iow-sedpy
54	2.802	11	7.452	608-6	373960-06	GC	02.12.09	16:37	samples: MPI/NERI-methane, IOW-sedpy
54	3.409	11	1.284	609-1	373970-01	ctd	02.12.09	17:55	IOW-water samples
54	12.576	11	23.400	610-1	373975-01ctd	ctd	02.12.09	20:28	IOW-water samples
end working Mecklenburg Bay, transit AB									
54	23.167	12	6.254	611-1	373980-01	ctd	03.12.09	0:03	IOW-water samples
54	41.544	12	42.682	612-1	373990-01	ctd	03.12.09	4:05	IOW-water samples
54	49.588	13	5.179	613-1	374000-01	ctd	03.12.09	7:04	IOW-water samples
54	52.422	13	23.856	614-2	374010-01	ctd	03.12.09	9:12	IOW-water samples

54	52.466	13	23.836	614-3	374010-02	FL	03.12.09	9:37	iow-sedpy
54	52.431	13	23.832	614-5	374010-03	GC9	03.12.09	10:16	second trial, pen. 9m rec.5.7m
54	51.472	13	28.100	615-1	374020-01	ctd	03.12.09	11:45	IOW-water samples
54	51.471	13	28.140	615-2	374020-02	FL	03.12.09	12:15	iow-sedpy
54	51.458	13	28.104	615-5	374020-03	GC9	03.12.09	12:53	iow-sedpy
54	47.302	13	35.825	616-1	374030-01	ctd	03.12.09	15:10	IOW-water samples
54	47.291	13	35.824	616-3	374030-02	FL	03.12.09	15:29	iow-sedpy
stop station work rough weather wind > 14m/s									
transit off Sassnitz									
54	38.823	13	35.239	617-2	**pr20091203-1822**	ses mb	03.12.09	18:22	ses profiling-mb-grid
54	27.806	13	41.544				04.12.09	7:02	end of profiling
off Saßnitz harbour, boarding TV team, interview,									
54	31.451	13	43.964	619-1	374050-1	CTD	04.12.09	8:51	IOW-water samples
54	31.446	13	43.965	619-2	374050-2	RL	04.12.09	0:07	MPI/NERI-pw
54	31.446	13	43.968	619-3	374050-3	RL	04.12.09	9:12	MPI/NERI-methane
54	31.437	13	43.976	619-4	374050-4	FL	04.12.09	0:21	iow-sedpy
54	31.435	13	43.963	619-5	374050-5	GC6	04.12.09	9:22	pen. 5m, rec. 3.8m, iow-sedpy, MPI&NERI/methane
off Saßnitz harbour, disembarkation TV team									
transit to ctd-rl transekt									
54	46.317	13	41.336	620-1	374060-1	ctd	04.12.09	14:13	IOW-water samples
54	46.335	13	41.324	620-2	374060-2	RL	04.12.09	14:34	MPI/NERI-methane
54	49.896	13	32.160	621-2	374070-1	ctd	04.12.09	15:54	IOW-water samples
54	49.897	13	32.166	621-3	374070-2	RL	04.12.09	16:12	MPI/NERI-methane
54	54.190	13	19.563	622-1	374080-1	ctd	04.12.09	18:24	IOW-water samples
54	54.180	13	19.535	622-2	374080-2	RL	04.12.09	18:48	MPI/NERI-methane
54	56.083	13	14.221	623-1	374090-1	ctd	04.12.09	20:05	IOW-water samples
54	56.088	13	14.221	623-2	374090-2	RL	04.12.09	20:23	MPI/NERI-methane
54	58.168	13	9.156	624-1	374100-1	ctd	04.12.09	21:30	IOW-water samples
54	58.163	13	9.164	624-2	374100-2	RL	04.12.09	21:49	MPI/NERI
54	58.171	13	9.164	624-3	374100-3	RL	04.12.09	21:53	MPI/NERI
54	56.113	13	6.320	625-1	**pr20091204-2247**	spa ses	04.12.09	22:47	spa-ses profile
54	48.792	13	44.538				05.12.09	6:52	end profiling
54	48.964	13	42.493	626-1	**pr20091205-0727**		05.12.09	7:27	start ses-mb grid
54	48.664	13	42.435					8:12	end profiling
54	48.846	13	42.075	627-1	374105-01	ctd	05.12.09	8:37	IOW-water samples
54	47.295	13	35.839	628-1	374110-1	RL	05.12.09	9:53	MPI/NERI-methane
54	47.277	13	35.857	628-2	374110-2	GC9	05.12.09	10:05	IOW sedpy
54	48.212	13	26.780	629-1	374120-1	FL	05.12.09	11:31	IOW/sedpy
54	48.212	13	26.783	629-2	374120-2	GC9	05.12.09	11:50	2Tonns, 1.5m/s, 2m loose wire, pen.: 9m recov. 6.5, IOW sedpy
54	51.398	13	27.968	630-1	374130-1	RL	05.12.09	12:54	MPI/NERI-methane
54	52.386	13	23.736	631-1	374140-1	RL	05.12.09	13:47	MPI/NERI-methane

54	53.014	13	19.613	632-1	374150-1	FL	05.12.09	14:36	IOW/sedpy
54	53.019	13	19.681	632-2	374150-2	GC9	05.12.09	14:52	pen. 11m, IOW/sedpy
54	51.032	13	18.270	633-1	374160-1	CTD	05.12.09	15:53	IOW-water samples
54	51.024	13	18.277	633-2	374160-2	FL	05.12.09	16:07	IOW/sedpy
54	51.024	13	18.284	633-3	374160-3	GC9	05.12.09	16:16	IOW/sedpy
end station work AB, transit Bornholm Basin									
55	0.349	14	9.360	634-1	374163-1	ctd	05.12.09	20:42	IOW-water samples
55	11.055	14	26.075	635-1	374166-1	ctd	05.12.09	22:50	IOW-water samples
55	24.083	15	28.403	636-2	374170-1	ctd	06.12.09	7:31	IOW-water samples
55	24.087	15	28.401	636-3	374170-2	RL	06.12.09	7:56	MPI/NERI-pw
55	24.086	15	28.407	636-4	374170-3	RL	06.12.09	8:04	MPI/NERI-Pb210
55	24.087	15	28.406	636-6	374170-4	RL	06.12.09	8:18	second trial,MPI/NERI-methane
55	24.086	15	28.402	636-7	374170-5	FL	06.12.09	8:26	IOW-sedpy
55	24.094	15	28.397	636-9	374170-6	GC12	06.12.09	9:29	second trial, pen.13, rec.10.6, IOW Sedpy, MPI/NERI-methane
55	20.321	15	26.212	637-1	374180-1	ctd	06.12.09	11:22	IOW-water samples
55	20.314	15	26.235	637-2	374180-2	RL	06.12.09	11:54	MPI/NERI-pw
55	20.283	15	26.194	637-3	374180-3	RL	06.12.09	12:03	MPI/NERI-Pb210
55	20.272	15	26.205	637-4	374180-4	RL	06.12.09	12:12	MPI/NERI-methane
55	20.255	15	26.256	637-5	374180-5	FL	06.12.09	12:22	IOW-sedpy
55	20.329	15	26.237	637-6	374180-6	GC	06.12.09	12:42	pen. 11, recov. 6.8m, IOW-sedpy, MPI/NERI-methane, flushing of core liner by near bottom water, disturbance of methan sampling
55	17.661	15	26.272	638-1	374190-1	ctd	06.12.09	14:29	IOW-water samples
55	17.663	15	26.297	638-2	374190-2	RL	06.12.09	14:56	MPI/NERI-pw
55	17.646	15	26.304	638-3	374190-3	RL	06.12.09	15:03	MPI/NERI-Pb210
55	17.655	15	26.281	638-4	374190-4	RL	06.12.09	15:14	MPI/NERI-methane
55	17.672	15	26.275	638-5	374190-5	FL	06.12.09	15:22	IOW-sedpy
55	17.663	15	26.201	638-6	374190-6	GC12	06.12.09	15:34	pen. 13m, recov. 7m, IOW-sedpy, MPI/NERI-methane
55	12.853	15	27.818	639-2	pr2009120 6-1723	ses spa mb	06.12.09	17:23	ses sparker profiling
55	8.967	15	32.983				07.12.09	4:58	end profiling
55	26.961	15	15.156	640-1	374210-1	CTD	07.12.09	7:17	IOW-water samples
55	24.273	15	10.052	641-1	374220-1	CTD	07.12.09	8:44	IOW-water samples
55	26.089	15	2.827	642-1	pr2009120 7-1028	mb ses	07.12.09	10:28	start profiling
55	25.073	15	0.101				07.12.09	11:06	end profiling
55	21.812	15	4.961	643-1	374230-1	CTD	07.12.09	12:21	IOW-water samples
55	16.589	15	4.308	643-2	374240-1	CTD	07.12.09	14:14	IOW-water samples
55	15.249	15	3.561	644-1	374250-1	CTD	07.12.09	15:20	IOW-water samples
55	18.821	15	5.179	645-1	pr2009120 7-1619	mb	07.12.09	16:19	calibration of mb
55	17.952	15	5.182				07.12.09	17:17	
55	15.201	15	5.531	646-2	pr2009120 7-1812	ses-spa	07.12.09	18:12	ses-spa profile seep?? Region
55	20.723	15	29.040				08.12.09	5:39	stop profiling because of fishery

55	21.051	15	26.648	647-2	374175-1	RL	08.12.09	7:34	MPI/NERI-pw
55	21.071	15	26.611	647-3	374175-2	RL	08.12.09	7:42	MPI/NERI-Pb210
55	21.069	15	26.624	647-4	374175-3	RL	08.12.09	7:50	MPI/NERI-methane
55	21.066	15	26.632	647-5	374175-4	FL	08.12.09	7:58	IOW-sedpy
55	21.052	15	26.639	647-6	374175-5	GC12	08.12.09	8:10	IOW-sedpy,MPI/NERI-methane
55	11.194	15	43.834	648-1	374260-1	CTD	08.12.09	11:23	IOW- water sampling
55	14.524	15	34.992	649-1	374270-1	CTD	08.12.09	12:48	IOW- water sampling
55	14.985	15	26.162	650-2	374200-1	CTD	08.12.09	14:14	ses station rec
55	14.993	15	26.195	650-3	374200-2	RL	08.12.09	14:40	MPI/NERI-pw
55	15.010	15	26.168	650-4	374200-3	RL	08.12.09	14:50	MPI/NERI-Pb210
55	15.006	15	26.181	650-5	374200-4	RL	08.12.09	14:56	MPI/NERI-methane
55	14.976	15	26.200	650-6	374200-5	FL	08.12.09	15:03	IOW-sedpy
55	14.973	15	26.147	650-7	374200-6	GC12	08.12.09	15:16	IOW-sedpy,MPI/NERI-methane
55	16.794	15	26.178	651-1	pr2009120 8-1558	ses mb	08.12.09	15:58	profiling over last stations
55	21.088	15	26.654				08.12.09	16:58	
55	27.771	15	20.024	652-3	pr2009120 8-1558	ses mb spa	08.12.09	18:35	SES spa profiling
55	37.200	15	12.874				09.12.09	5:29	
55	32.090	14	51.558	653-2	374280-1	ctd	09.12.09	7:37	IOW- water sampling
55	32.132	14	51.590	653-3	374280-2	RL	09.12.09	7:58	MPI/NERI-methane
55	28.228	15	2.352	654-1	374290-1	ctd	09.12.09	9:51	IOW- water sampling
55	28.237	15	2.320	654-2	374290-2	RL	09.12.09	10:12	MPI/NERI-methane
55	21.301	15	18.216	655-1	374300-1	ctd	09.12.09	12:53	IOW- water sampling
55	21.318	15	18.239	655-2	374300-2	RL	09.12.09	13:17	MPI/NERI-methane
55	16.594	15	41.482	656-1	374310-1	ctd	09.12.09	17:02	dumping area, IOW-water sampling
55	14.980	15	57.727	657-1	374320-1	ctd	09.12.09	19:42	IOW- water sampling
55	14.962	15	57.780	657-3	374320-2	RL	09.12.09	20:14	MPI/NERI-methane
55	13.215	16	15.084	658-1	374330-1	ctd	09.12.09	22:48	IOW- water sampling
55	13.209	16	15.065	658-2	374330-1	RL	09.12.09	23:11	MPI/NERI-methane, last station in DK, end echosounding
10.12.2009; transit Gotland Basin, station 374340 canceled because of fishery									
55	12.890	17	18.695	660-1	374350-1	CTD		6:28	ctd transect, PL,IOW- water sampling
55	16.703	17	48.455	661-1	374360-1	CTD		9:03	IOW- water sampling
56	23.261	19	16.266	663-1	374370-1	CTD	10.12.09	18:46	working area STVD, SE
56	21.185	19	16.878	665-1	pr2009121 0-2133	ses spa mb	10.12.09	21:33	ses-spa-mb grid, pockmark/furrow region
56	20.177	19	7.673				12.12.09	4:56	end of profiling
56	20.638	19	13.740	666-1	**374380-1**	CTD	12.12.09	7:32	IOW- water sampling
56	20.636	19	13.747	666-2	374380-2	RL	12.12.09	8:00	MPI/NERI-pw
56	20.632	19	13.746	666-3	374380-3	RL	12.12.09	8:08	MPI/NERI-Pb210
56	20.636	19	13.741	666-4	374380-4	RL	12.12.09	8:16	MPI/NERI-methane
56	20.634	19	13.741	666-5	374380-5	FL	12.12.09	8:25	IOW-sedpy
56	20.635	19	13.746	666-6	374380-6	GC9	12.12.09	8:39	

56	22.146	19	13.905	667-1	**374390-1**	CTD	12.12.09	9:42	dome structure, IOW- water sampling
56	22.147	19	13.903	667-2	374390-2	RL	12.12.09	10:11	MPI/NERI-pw
56	22.145	19	13.904	667-3	374390-3	RL	12.12.09	10:17	MPI/NERI-Pb210
56	22.141	19	13.904	667-4	374390-4	RL	12.12.09	10:24	MPI/NERI-methane
56	22.136	19	13.898	667-5	374390-5	FL	12.12.09	10:32	IOW-sedpy
56	22.103	19	13.953	667-7	374390-6	GC6	12.12.09	11:59	first trial break of 9m tube, second trial with 6m
56	21.890	19	14.496	668-1	**374400-1**	CTD	12.12.09	12:59	IOW- water sampling
56	21.879	19	14.606	668-2	374400-2	RL	12.12.09	13:28	MPI/NERI-pw
56	21.877	19	14.507	668-3	374400-3	RL	12.12.09	13:27	MPI/NERI-Pb210
56	21.880	19	14.511	668-4	374400-4	RL	12.12.09	13:45	MPI/NERI-methane
56	21.870	19	14.503	668-5	374400-5	FL	12.12.09	13:53	IOW-sedpy
56	21.870	19	14.504	668-6	374400-6	GC6	12.12.09	14:04	
56	18.475	19	4.586	669-2	**pr2009121 2-1638**	ses spa mb	12.12.09	16:38	start profiling
56	49.451	19	53.129				13.12.09	11:42	end profiling
56	49.563	19	53.233	670-1	**374410-1**	CTD	13.12.09	11:55	IOW- water sampling
56	49.558	19	53.250	670-2	374410-2	RL	13.12.09	12:28	MPI/NERI-methane
56	49.539	19	53.219	670-3	374410-3	FL	13.12.09	12:37	IOW-sedpy
56	49.539	19	53.219	671-3	**pr2009121 3-1257**	spa ses	13.12.09	12:49	start profiling
57	18.403	20	4.646				13.12.09	19:10	end profiling
57	18.408	20	4.640	672-1	**374420-1**	CTD	13.12.09	19:37	at - 3016-TF271,
57	18.406	20	4.649	672-2	374420-2	CTD	13.12.09	20:50	IOW- water sampling
57	18.408	20	4.646	672-3	374420-3	RL	13.12.09	21:15	MPI/NERI-methane
57	18.405	20	4.653	672-4	374420-4	FL	13.12.09	21:30	IOW-sedpy
57	18.576	20	5.041	673-1	pr2009121 3-2144	spa ses mb	13.12.09	21:44	start profiling
56	26.298	19	26.675				15.12.09	6:11	end profiling
56	25.926	19	25.079	674-1	**374430-1**	ctd	15.12.09	7:01	IOW- water sampling
56	25.916	19	25.045	674-2	374430-2	RL	15.12.09	7:32	MPI/NERI-methane
56	25.917	19	25.098	674-3	374430-3	FL	15.12.09	7:48	IOW-sedpy
55	55.983	18	55.646	675-1	**374440-1**	ctd	15.12.09	12:39	dumping area, IOW- water sampling
55	32.970	18	23.992	676-1	**374450-1**	ctd	15.12.09	17:38	in PL, IOW- water sampling
55	33.008	18	24.019	676-2	**374450-2**	RL	15.12.09	17:58	MPI/NERI-methane
55	33.017	18	24.013	676-3	**374450-3**	FL	15.12.09	18:06	IOW-sedpy
stop working because of rough weather conditions, transit Rostock									
17.12.2009; 06:00; arrival Rostock Marienehe, disembarkation of scientific crew and equipment									

7.2. P392 – Station list

ydeg	ymin	xdeg	xmin	stat_id-ship	stat_id_iow	device	date	time utc	remarks
54	15.912	11	34.384	585-1	**373850-01**	ctd	29.11.09	13:33	gas free, water sampling
54	15.940	11	34.434	585-2	373850-02	ctd	29.11.09	13:57	
54	15.109	11	31.942	588-1	**373860-01**	ctd	29.11.09	16:07	gas free, water sampling
54	15.104	11	31.984	589-1	373860-02	RL	29.11.09	16:34	MPI/NERI
54	15.144	11	31.849	589-2	373860-03	RL	29.11.09	16:43	MPI/NERI
54	15.139	11	31.808	589-3	373860-04	RL	29.11.09	16:48	MPI/NERI
54	15.117	11	31.952	591-1	**373865-01**	ctd	30.11.09	7:43	water sampling
54	15.114	11	32.052	591-2	373865-02	FL	30.11.09	8:14	iow-sedpy
54	11.109	11	22.199	595-2	**373870-01**	ctd	01.12.09	8:43	full gas -water sampling
54	11.115	11	22.222	595-3	373870-02	RL	01.12.09	9:04	MPI/NERI-pw
54	11.147	11	22.348	595-4	373870-03	RL	01.12.09	9:01	MPI/NERI-Pb210
54	11.168	11	22.405	595-5	373870-04	RL	01.12.09	9:17	MPI/NERI-methane
54	11.174	11	22.399	595-6	373870-05	FL	01.12.09	9:24	iow-sedpy
54	11.181	11	22.243	595-7	373870-06	gc12	01.12.09	9:48	bending of corer due to drift of the ship, samples: MPI/NERI-methane, IOW-sedpy
54	10.547	11	20.777	596-1	**373880-01**	ctd	01.12.09	11:31	gas transition, water sampling
54	10.548	11	20.789	596-2	373880-02	RL	01.12.09	12:14	MPI/NERI-pw
54	10.533	11	20.799	596-3	373880-03	RL	01.12.09	12:22	MPI/NERI-Pb210
54	10.539	11	20.794	596-4	373880-04	RL	01.12.09	12:27	MPI/NERI-methane
54	10.550	11	20.779	596-5	373880-05	FL	01.12.09	12:32	iow-sedpy
54	10.542	11	20.793	597-1	373880-06	GC6	01.12.09	12:53	overpenetrated 8m, recov. 5.5m, samples: MPI/NERI-methane, IOW-sedpy
54	9.337	11	17.944	598-1	373890-01	ctd	01.12.09	14:02	gas free, water samples
54	8.820	11	14.634	599-1	373900-01	ctd	01.12.09	15:02	gas transition, IOW-water samples
54	8.830	11	14.571	599-2	373900-02	RL	01.12.09	15:29	MPI/NERI-methane
54	8.840	11	14.581	599-3	373900-03	FL	01.12.09	15:35	IOW-sedpy
54	8.833	11	14.592	599-4	373900-04	GC	01.12.09	15:48	overpenetrated 8m, recov. 6m, samples: MPI/NERI-methane, IOW-sedpy
54	8.096	11	12.865	603-1	373910-01	ctd	02.12.09	8:32	gas,IOW-water samples
54	7.369	11	11.189	604-1	373920-01	ctd	02.12.09	9:26	gas, IOW-water samples
54	7.362	11	11.163	604-2	373920-02	RL	02.12.09	9:43	MPI/NERI-methane
54	7.365	11	11.159	604-3	373920-03	FL	02.12.09	9:47	IOW-sedpy
54	7.366	11	11.153	604-4	373920-04	GC6	02.12.09	10:06	overpenetrated 8m, recov. 6m, samples: MPI/NERI-methane, IOW-sedpy

54	6.606	11	9.194	605-1	373930-01	ctd	02.12.09	10:56	gas, IOW-water samples
54	5.239	11	5.669	606-1	373940-01	ctd	02.12.09	12:11	gas, IOW-water samples
54	5.219	11	5.626	606-2	373940-02	RL	02.12.09	12:32	MPI/NERI-methane
54	5.229	11	5.628	606-3	373940-03	FL	02.12.09	12:37	IOW-sedpy
54	5.221	11	5.695	606-4	373940-04	GC6	02.12.09	13:16	failure no samples
54	5.230	11	5.684	606-5	373940-04	GC6	02.12.09	13:34	pen. 6m, recov. 5.8m, samples: MPI/NERI-methane, IOW-sedpy
54	3.218	11	6.878	607-1	373950-01	ctd	02.12.09	14:24	gas, IOW-water samples
54	3.229	11	6.856	607-2	373950-02	RL	02.12.09	14:41	MPI/NERI-pw
54	3.251	11	6.894	607-3	373950-03	RL	02.12.09	14:49	MPI/NERI-Pb210
54	3.260	11	6.895	607-4	373950-04	RL	02.12.09	14:53	MPI/NERI-methane
54	3.264	11	6.908	607-5	373950-05	FL	02.12.09	15:00	iow-sedpy
54	3.256	11	6.976	607-6	373950-06	GC6	02.12.09	15:12	pen. 7m, recov. 6m, samples: MPI/NERI-methane, IOW-sedpy
54	2.800	11	7.429	608-1	373960-01	ctd	02.12.09	15:54	gas free, IOW-water samples
54	2.823	11	7.425	608-2	373960-02	RL	02.12.09	16:11	MPI/NERI-pw
54	2.809	11	7.431	608-3	373960-03	RL	02.12.09	16:15	MPI/NERI-Pb210
54	2.813	11	7.432	608-4	373960-04	RL	02.12.09	16:19	MPI/NERI-methane
54	2.806	11	7.431	608-5	373960-05	FL	02.12.09	16:24	iow-sedpy
54	2.802	11	7.452	608-6	373960-06	GC	02.12.09	16:37	samples: MPI/NERI-methane, IOW-sedpy
54	3.409	11	1.284	609-1	373970-01	ctd	02.12.09	17:55	IOW-water samples
54	12.576	11	23.400	610-1	373975-01	ctd	02.12.09	20:28	IOW-water samples
54	23.167	12	6.254	611-1	373980-01	ctd	03.12.09	0:03	IOW-water samples
54	41.544	12	42.682	612-1	373990-01	ctd	03.12.09	4:05	IOW-water samples
54	49.588	13	5.179	613-1	374000-01	ctd	03.12.09	7:04	IOW-water samples
54	52.422	13	23.856	614-2	374010-01	ctd	03.12.09	9:12	IOW-water samples
54	52.466	13	23.836	614-3	374010-02	FL	03.12.09	9:37	iow-sedpy
54	52.431	13	23.832	614-5	374010-03	GC9	03.12.09	10:16	second trial, pen. 9m rec.5.7m
54	51.472	13	28.100	615-1	374020-01	ctd	03.12.09	11:45	IOW-water samples
54	51.471	13	28.140	615-2	374020-02	FL	03.12.09	12:15	iow-sedpy
54	51.458	13	28.104	615-5	374020-03	GC9	03.12.09	12:53	iow-sedpy
54	47.302	13	35.825	616-1	374030-01	ctd	03.12.09	15:10	IOW-water samples
54	47.291	13	35.824	616-3	374030-02	FL	03.12.09	15:29	iow-sedpy
54	31.451	13	43.964	619-1	374050-1	CTD	04.12.09	8:51	IOW-water samples
54	31.446	13	43.965	619-2	374050-2	RL	04.12.09	0:07	MPI/NERI-pw
54	31.446	13	43.968	619-3	374050-3	RL	04.12.09	9:12	MPI/NERI-methane
54	31.437	13	43.976	619-4	374050-4	FL	04.12.09	0:21	iow-sedpy
54	31.435	13	43.963	619-5	374050-5	GC6	04.12.09	9:22	pen. 5m, rec. 3.8m, iow-sedpy, MPI/NERI/methane

54	46.317	13	41.336	620-1	374060-1	ctd	04.12.09	14:13	IOW-water samples
54	46.335	13	41.324	620-2	374060-2	RL	04.12.09	14:34	MPI/NERI-methane
54	49.896	13	32.160	621-2	374070-1	ctd	04.12.09	15:54	IOW-water samples
54	49.897	13	32.166	621-3	374070-2	RL	04.12.09	16:12	MPI/NERI-methane
54	54.190	13	19.563	622-1	374080-1	ctd	04.12.09	18:24	IOW-water samples
54	54.180	13	19.535	622-2	374080-2	RL	04.12.09	18:48	MPI/NERI-methane
54	56.083	13	14.221	623-1	374090-1	ctd	04.12.09	20:05	IOW-water samples
54	56.088	13	14.221	623-2	374090-2	RL	04.12.09	20:23	MPI/NERI-methane
54	58.168	13	9.156	624-1	374100-1	ctd	04.12.09	21:30	IOW-water samples
54	58.163	13	9.164	624-2	374100-2	RL	04.12.09	21:49	MPI/NERI
54	58.171	13	9.164	624-3	374100-3	RL	04.12.09	21:53	MPI/NERI
54	48.846	13	42.075	627-1	374105-1	ctd	05.12.09	8:37	IOW-water samples
54	47.295	13	35.839	628-1	374110-1	RL	05.12.09	9:53	MPI/NERI-methane
54	47.277	13	35.857	628-2	374110-2	GC9	05.12.09	10:05	IOW sedpy
54	48.212	13	26.780	629-1	374120-1	FL	05.12.09	11:31	IOW/sedpy
54	48.212	13	26.783	629-2	374120-2	GC9	05.12.09	11:50	2Tonns, 1.5m/s, 2m loose wire, pen.: 9m recov. 6.5, IOW sedpy
54	51.398	13	27.968	630-1	374130-1	RL	05.12.09	12:54	MPI/NERI-methane
54	52.386	13	23.736	631-1	374140-1	RL	05.12.09	13:47	MPI/NERI-methane
54	53.014	13	19.613	632-1	374150-1	FL	05.12.09	14:36	IOW/sedpy
54	53.019	13	19.681	632-2	374150-2	GC9	05.12.09	14:52	pen. 11m, IOW/sedpy
54	51.032	13	18.270	633-1	374160-1	CTD	05.12.09	15:53	IOW-water samples
54	51.024	13	18.277	633-2	374160-2	FL	05.12.09	16:07	IOW/sedpy
54	51.024	13	18.284	633-3	374160-3	GC9	05.12.09	16:16	IOW/sedpy
55	0.349	14	9.360	634-1	374163-1	ctd	05.12.09	20:42	IOW-water samples
55	11.055	14	26.075	635-1	374166-1	ctd	05.12.09	22:50	IOW-water samples
55	24.083	15	28.403	636-2	374170-1	ctd	06.12.09	7:31	IOW-water samples
55	24.087	15	28.401	636-3	374170-2	RL	06.12.09	7:56	MPI/NERI-pw
55	24.086	15	28.407	636-4	374170-3	RL	06.12.09	8:04	MPI/NERI-Pb210
55	24.087	15	28.406	636-6	374170-4	RL	06.12.09	8:18	second trial,MPI/NERI-methane
55	24.086	15	28.402	636-7	374170-5	FL	06.12.09	8:26	IOW-sedpy
55	24.094	15	28.397	636-9	374170-6	GC12	06.12.09	9:29	second trial, pen.13, rec.10.6, IOW Sedpy, MPI/NERI-methane
55	20.321	15	26.212	637-1	374180-1	ctd	06.12.09	11:22	IOW-water samples
55	20.314	15	26.235	637-2	374180-2	RL	06.12.09	11:54	MPI/NERI-pw
55	20.283	15	26.194	637-3	374180-3	RL	06.12.09	12:03	MPI/NERI-Pb210
55	20.272	15	26.205	637-4	374180-4	RL	06.12.09	12:12	MPI/NERI-methane

55	20.255	15	26.256	637-5	374180-5	FL	06.12.09	12:22	IOW-sedpy
55	20.329	15	26.237	637-6	374180-6	GC	06.12.09	12:42	pen. 11, recov. 6.8m, IOW-sedpy, MPI/NERI-methane, flushing of core liner by near bottom water, disturbance of methan sampling
55	17.661	15	26.272	638-1	374190-1	CTD	06.12.09	14:29	IOW-water samples
55	17.663	15	26.297	638-2	374190-2	RL	06.12.09	14:56	MPI/NERI-pw
55	17.646	15	26.304	638-3	374190-3	RL	06.12.09	15:03	MPI/NERI-Pb210
55	17.655	15	26.281	638-4	374190-4	RL	06.12.09	15:14	MPI/NERI-methane
55	17.672	15	26.275	638-5	374190-5	FL	06.12.09	15:22	IOW-sedpy
55	17.663	15	26.201	638-6	374190-6	GC12	06.12.09	15:34	pen. 13m, recov. 7m, IOW-sedpy, MPI/NERI-methane
55	26.961	15	15.156	640-1	374210-1	CTD	07.12.09	7:17	IOW-water samples
55	24.273	15	10.052	641-1	374220-1	CTD	07.12.09	8:44	IOW-water samples
55	21.812	15	4.961	643-1	374230-1	CTD	07.12.09	12:21	IOW-water samples
55	16.589	15	4.308	643-2	374240-1	CTD	07.12.09	14:14	IOW-water samples
55	15.249	15	3.561	644-1	374250-1	CTD	07.12.09	15:20	IOW-water samples
55	21.051	15	26.648	647-2	374175-1	RL	08.12.09	7:34	MPI/NERI-pw
55	21.071	15	26.611	647-3	374175-2	RL	08.12.09	7:42	MPI/NERI-Pb210
55	21.069	15	26.624	647-4	374175-3	RL	08.12.09	7:50	MPI/NERI-methane
55	21.066	15	26.632	647-5	374175-4	FL	08.12.09	7:58	IOW-sedpy
55	21.052	15	26.639	647-6	374175-5	GC12	08.12.09	8:10	IOW-sedpy,MPI/NERI-methane
55	11.194	15	43.834	648-1	374260-1	CTD	08.12.09	11:23	IOW- water sampling
55	14.524	15	34.992	649-1	374270-1	CTD	08.12.09	12:48	IOW- water sampling
55	14.985	15	26.162	650-2	374200-1	CTD	08.12.09	14:14	ses station rec
55	14.993	15	26.195	650-3	374200-2	RL	08.12.09	14:40	MPI/NERI-pw
55	15.010	15	26.168	650-4	374200-3	RL	08.12.09	14:50	MPI/NERI-Pb210
55	15.006	15	26.181	650-5	374200-4	RL	08.12.09	14:56	MPI/NERI-methane
55	14.976	15	26.200	650-6	374200-5	FL	08.12.09	15:03	IOW-sedpy
55	14.973	15	26.147	650-7	374200-6	GC12	08.12.09	15:16	IOW-sedpy,MPI/NERI-methane
55	32.090	14	51.558	653-2	374280-1	ctd	09.12.09	7:37	IOW- water sampling
55	32.132	14	51.590	653-3	374280-2	RL	09.12.09	7:58	MPI/NERI-methane
55	28.228	15	2.352	654-1	374290-1	CTD	09.12.09	9:51	IOW- water sampling
55	28.237	15	2.320	654-2	374290-2	RL	09.12.09	10:12	MPI/NERI-methane
55	21.301	15	18.216	655-1	374300-1	CTD	09.12.09	12:53	IOW- water sampling
55	21.318	15	18.239	655-2	374300-2	RL	09.12.09	13:17	MPI/NERI-methane
55	16.594	15	41.482	656-1	374310-1	CTD	09.12.09	17:02	dumping area, IOW-water sampling
55	14.980	15	57.727	657-1	374320-1	CTD	09.12.09	19:42	IOW- water sampling
55	14.962	15	57.780	657-3	374320-2	RL	09.12.09	20:14	MPI/NERI-methane

55	13.215	16	15.084	658-1	374330-1	CTD	09.12.09	22:48	IOW- water sampling
55	13.209	16	15.065	658-2	374330-1	RL	09.12.09	23:11	MPI/NERI-methane, last station in DK, end echosounding
55	12.890	17	18.695	660-1	374350-1	CTD	10.12.09	6:28	ctd transect, PL,IOW- water sampling
55	16.703	17	48.455	661-1	374360-1	CTD	10.12.09	9:03	IOW- water sampling
56	23.261	19	16.266	663-1	374370-1	CTD	10.12.09	18:46	working area STVD, SE
56	20.638	19	13.740	666-1	**374380-1**	CTD	12.12.09	7:32	IOW- water sampling
56	20.636	19	13.747	666-2	374380-2	RL	12.12.09	8:00	MPI/NERI-pw
56	20.632	19	13.746	666-3	374380-3	RL	12.12.09	8:08	MPI/NERI-Pb210
56	20.636	19	13.741	666-4	374380-4	RL	12.12.09	8:16	MPI/NERI-methane
56	20.634	19	13.741	666-5	374380-5	FL	12.12.09	8:25	IOW-sedpy
56	20.635	19	13.746	666-6	374380-6	GC9	12.12.09	8:39	
56	22.146	19	13.905	667-1	**374390-1**	CTD	12.12.09	9:42	dome structure, IOW- water sampling
56	22.147	19	13.903	667-2	374390-2	RL	12.12.09	10:11	MPI/NERI-pw
56	22.145	19	13.904	667-3	374390-3	RL	12.12.09	10:17	MPI/NERI-Pb210
56	22.141	19	13.904	667-4	374390-4	RL	12.12.09	10:24	MPI/NERI-methane
56	22.136	19	13.898	667-5	374390-5	FL	12.12.09	10:32	IOW-sedpy
56	22.103	19	13.953	667-7	374390-6	GC6	12.12.09	11:59	first trial break of 9m tube, second trial with 6m
56	21.890	19	14.496	668-1	**374400-1**	CTD	12.12.09	12:59	IOW- water sampling
56	21.879	19	14.606	668-2	374400-2	RL	12.12.09	13:28	MPI/NERI-pw
56	21.877	19	14.507	668-3	374400-3	RL	12.12.09	13:27	MPI/NERI-Pb210
56	21.880	19	14.511	668-4	374400-4	RL	12.12.09	13:45	MPI/NERI-methane
56	21.870	19	14.503	668-5	374400-5	FL	12.12.09	13:53	IOW-sedpy
56	21.870	19	14.504	668-6	374400-6	GC6	12.12.09	14:04	
56	49.563	19	53.233	670-1	**374410-1**	CTD	13.12.09	11:55	IOW- water sampling
56	49.558	19	53.250	670-2	374410-2	RL	13.12.09	12:28	MPI/NERI-methane
56	49.539	19	53.219	670-3	374410-3	FL	13.12.09	12:37	IOW-sedpy
57	18.408	20	4.640	672-1	**374420-1**	CTD	13.12.09	19:37	at - 3016-TF271,
57	18.406	20	4.649	672-2	374420-2	CTD	13.12.09	20:50	IOW- water sampling
57	18.408	20	4.646	672-3	374420-3	RL	13.12.09	21:15	MPI/NERI-methane
57	18.405	20	4.653	672-4	374420-4	FL	13.12.09	21:30	IOW-sedpy
56	25.926	19	25.079	674-1	**374430-1**	CTD	15.12.09	7:01	IOW- water sampling
56	25.916	19	25.045	674-2	374430-2	RL	15.12.09	7:32	MPI/NERI-methane
56	25.917	19	25.098	674-3	374430-3	FL	15.12.09	7:48	IOW-sedpy
55	55.983	18	55.646	675-1	**374440-1**	CTD	15.12.09	12:39	dumping area, IOW- water sampling
55	32.970	18	23.992	676-1	**374450-1**	CTD	15.12.09	17:38	in PL, IOW- water sampling
55	33.008	18	24.019	676-2	**374450-2**	RL	15.12.09	17:58	MPI/NERI-methane
55	33.017	18	24.013	676-3	**374450-3**	FL	15.12.09	18:06	IOW-sedpy

7.3. Acoustic records at sampling stations

7.3.1. Mecklenburg Bay

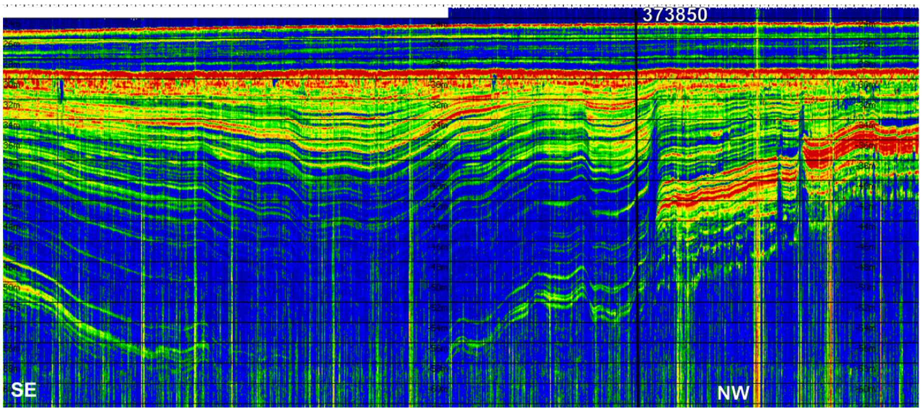

Fig. 7-1 SES96 record across station 373850

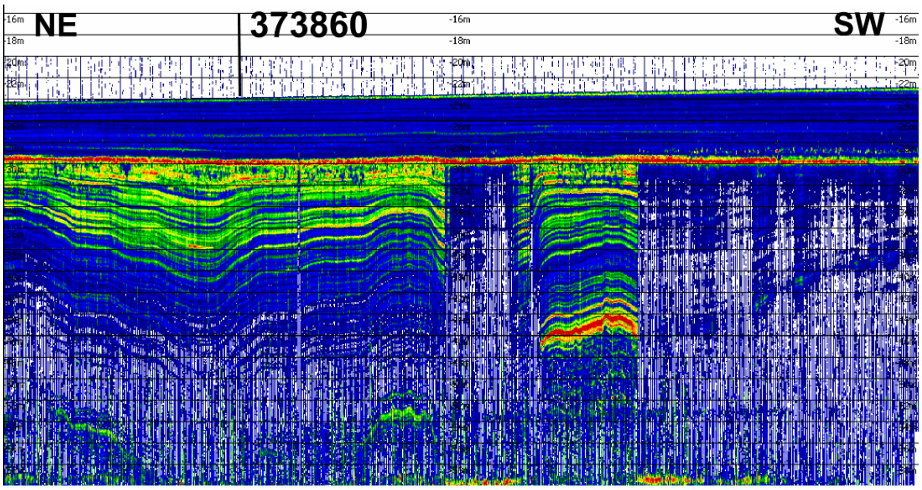

Fig. 7-2 SES96 record across station 373860 Mecklenburg Bay

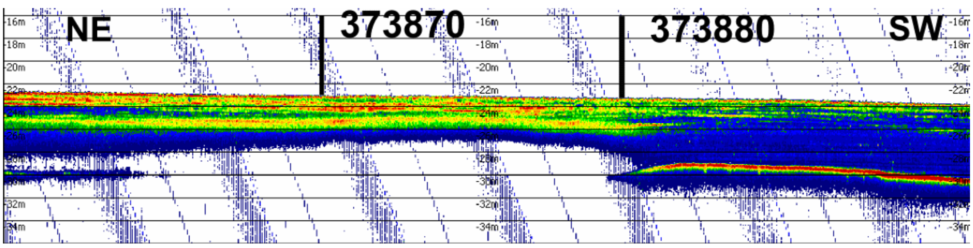

Fig. 7-3 SES96 record across stations 373870 and 373880 Mecklenburg Bay

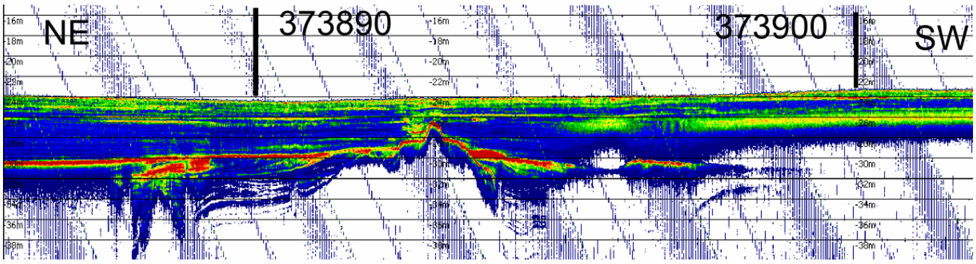

Fig. 7-4 SES96 record across station 373890 (no/weak shallow gas indications) and station 373900 (shallow gas at about 2m depth in sediment); Mecklenburg Bay

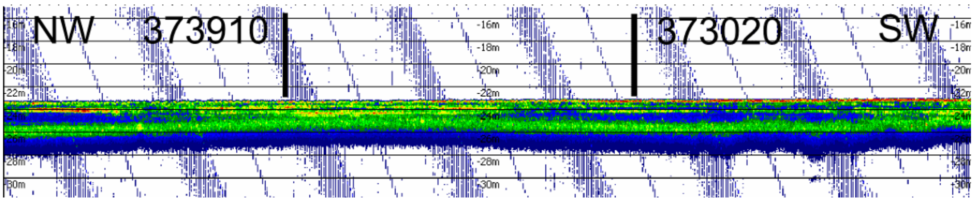

Fig. 7-5 SES96 record across stations 373910 and 373020 Mecklenburg Bay

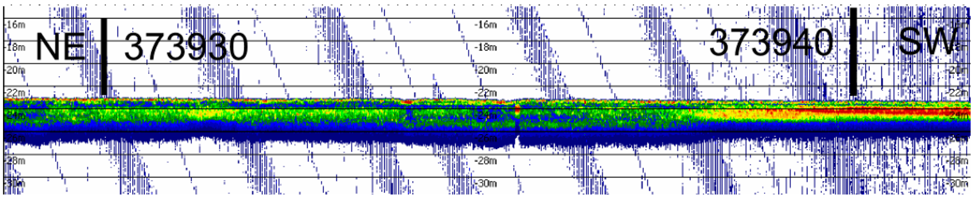

Fig. 7-6 SES96 record across stations 373930 and 373940 Mecklenburg Bay

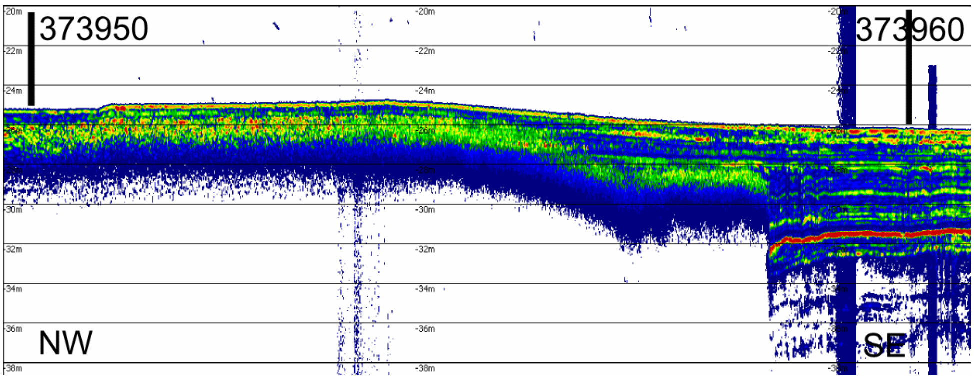

Fig. 7-7 SES96 record across stations 373950 and 373960 Mecklenburg Bay

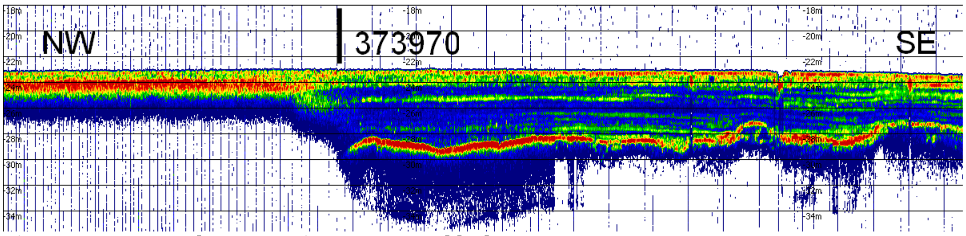

Fig. 7-8 SES96 record across station 373970 Mecklenburg Bay

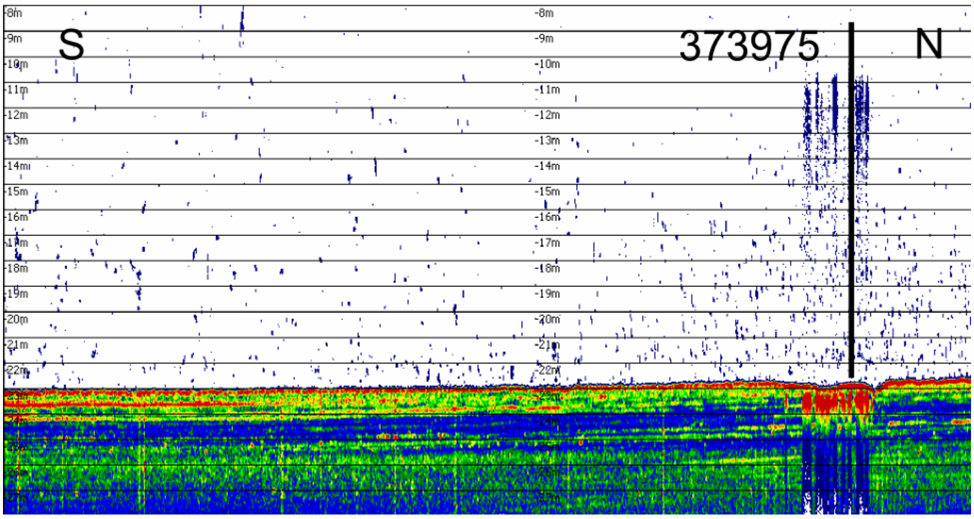

Fig. 7-9 SES96 record across (possible seep / flare) ctd station 373975 Mecklenburg Bay

7.3.2. Darss Sill

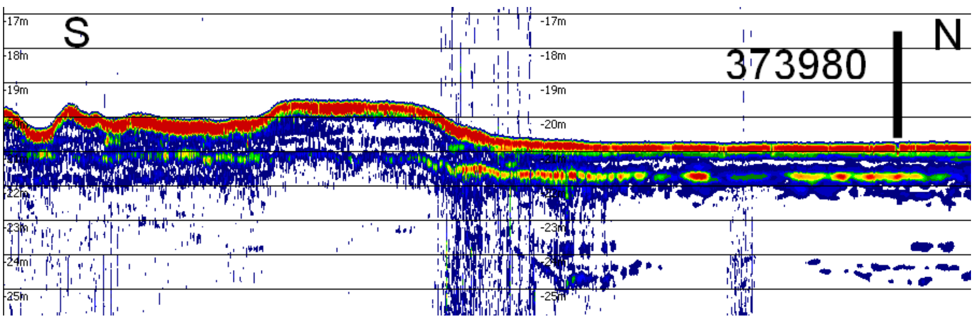

Fig. 7-10 SES96 record across station 373980 Darss Sill

7.3.3. Arkona Basin

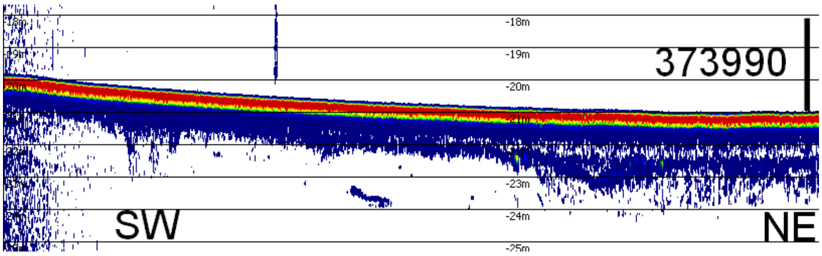

Fig. 7-11 SES96 record across station 373990 Transition Darss Sill – Arkona Basin

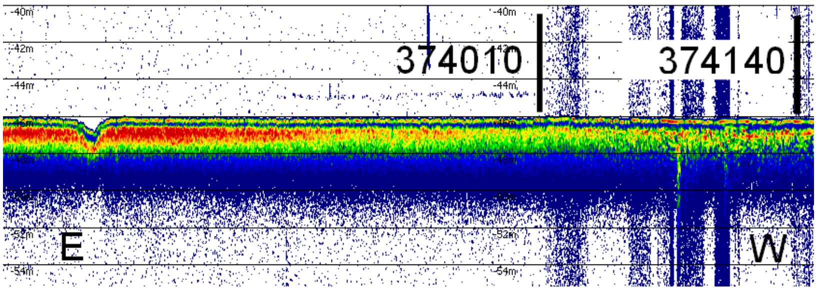

Fig. 7-12 SES96 record across station 374010 and 374140 with strong near bottom shallow gas indication

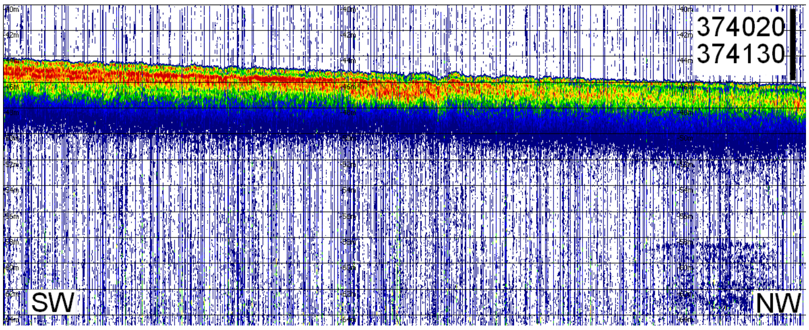

Fig. 7-13 SES96 record across stations 374010 and 374140 with strong shallow gas indication; Arkona Basin

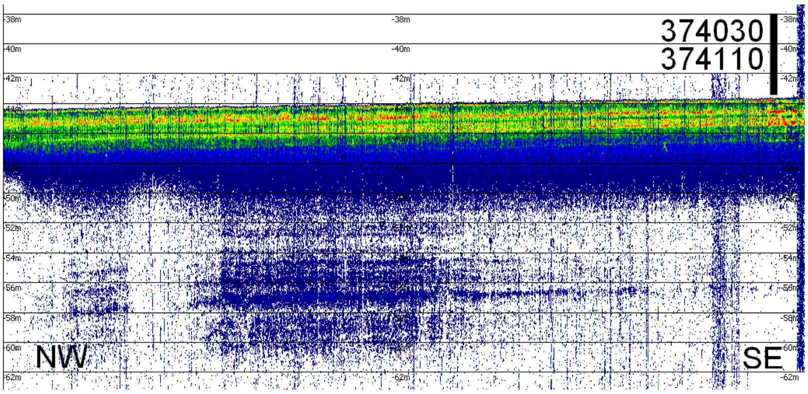

Fig. 7-14 SES96 record across stations 374030 and 374110 (near bottom shallow gas); Arkona Basin

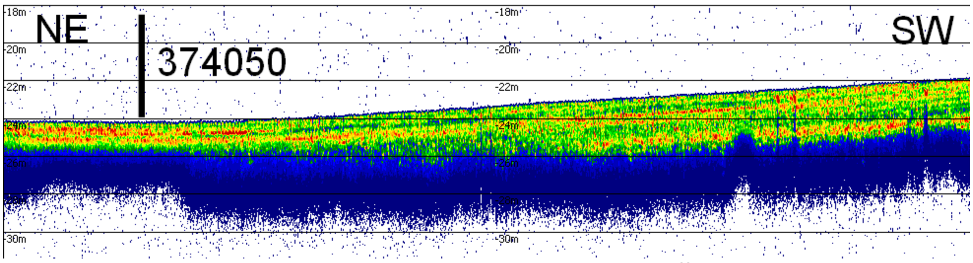

Fig. 7-15 SES96 record across station 374050 (near bottom shallow gas); off Rügen island, old Oder river path

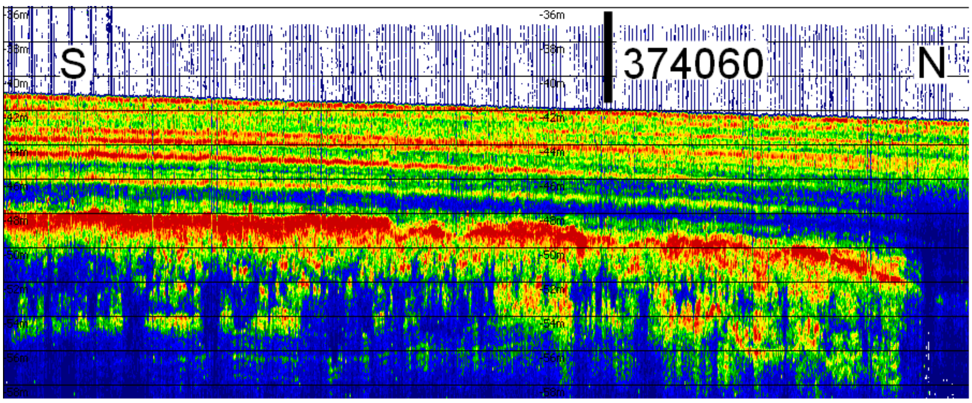

Fig. 7-16 SES96 record across station 374060 (near a shallow gas indication at the right picture side), Arkona Basin

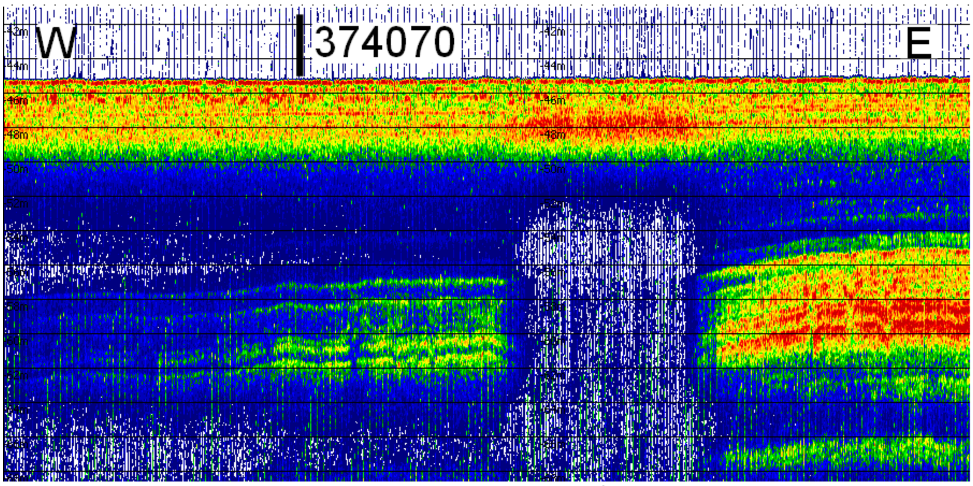

Fig. 7-17 SES96 record across station 374070 , between a week (left) and a strong (right) shallow gas indication, Arkona Basin

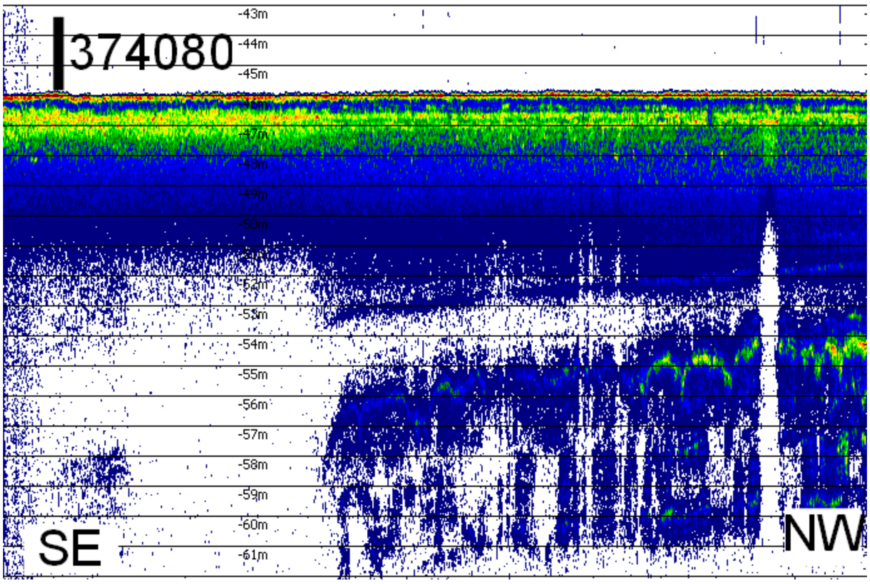

Fig. 7-18 SES96 record across station 374080, (shallow gas), Arkona Basin

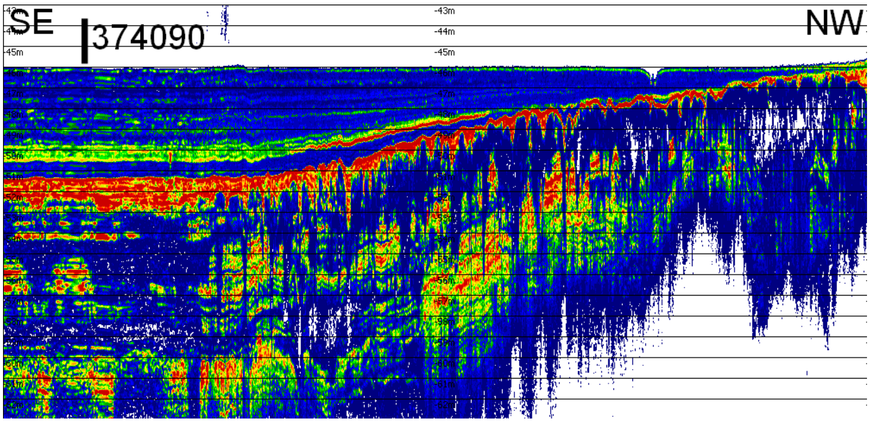

Fig. 7-19 SES96 record across station 374090 (mud, no shallow gas) , Arkona Basin

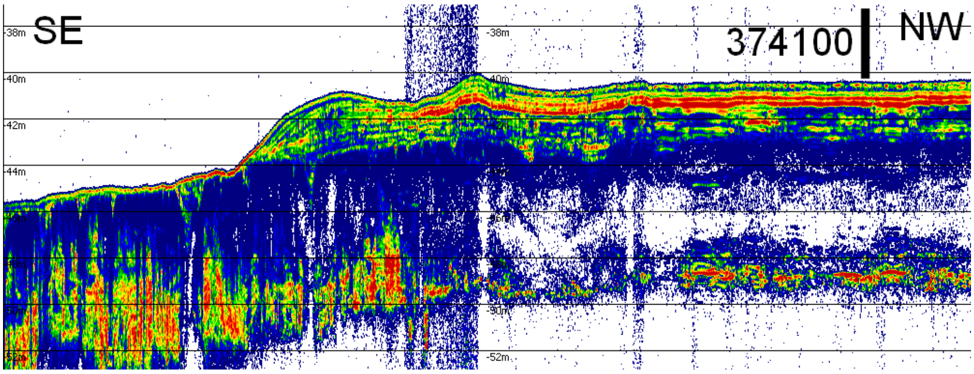

Fig. 7-20 SES96 record across station 374100, (clay, no shallow gas), Arkona Basin

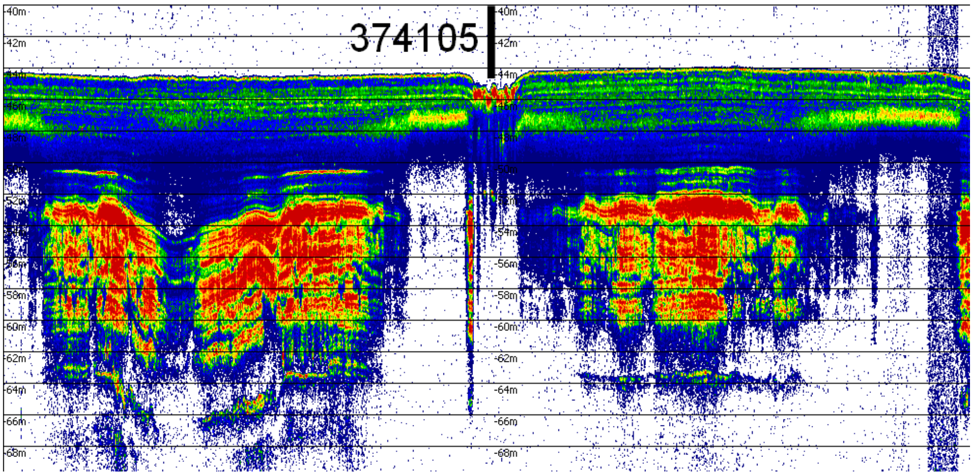

Fig. 7-21 SES96 record across station 374105, (mud, shallow gas, possible pock mark structure) Arkona Basin

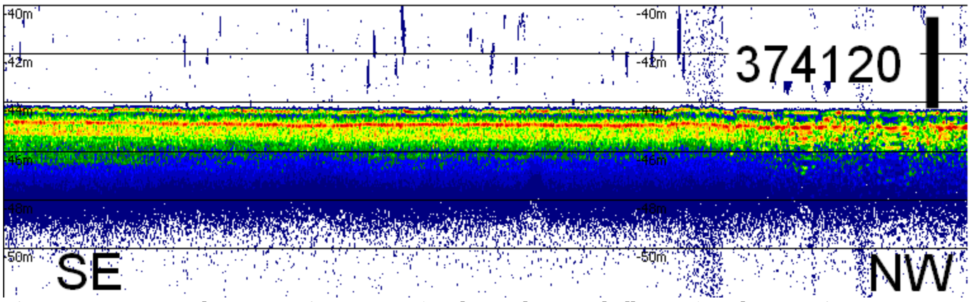

Fig. 7-22SES96 record across station 374120, (mud, near bottom shallow gas), Arkona Basin

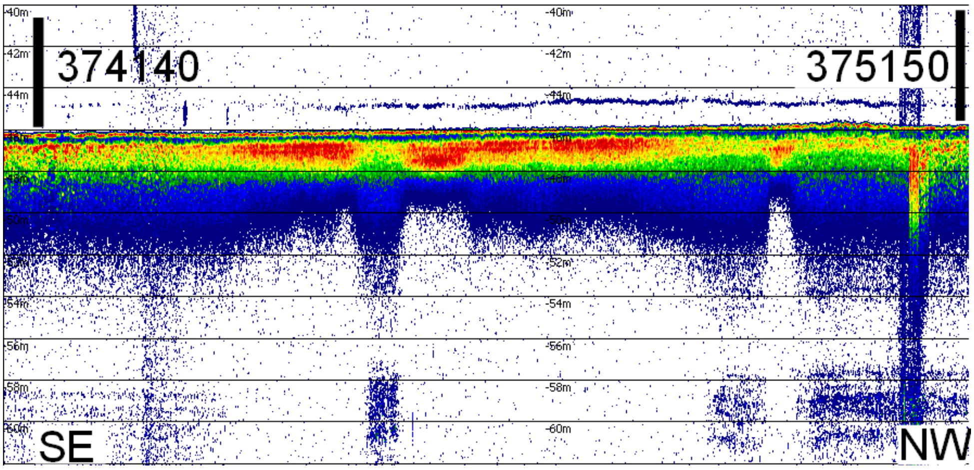

Fig. 7-23v 7-24SES96 record across station 374140 and 374150, (mud, near bottom shallow gas), Arkona Basin

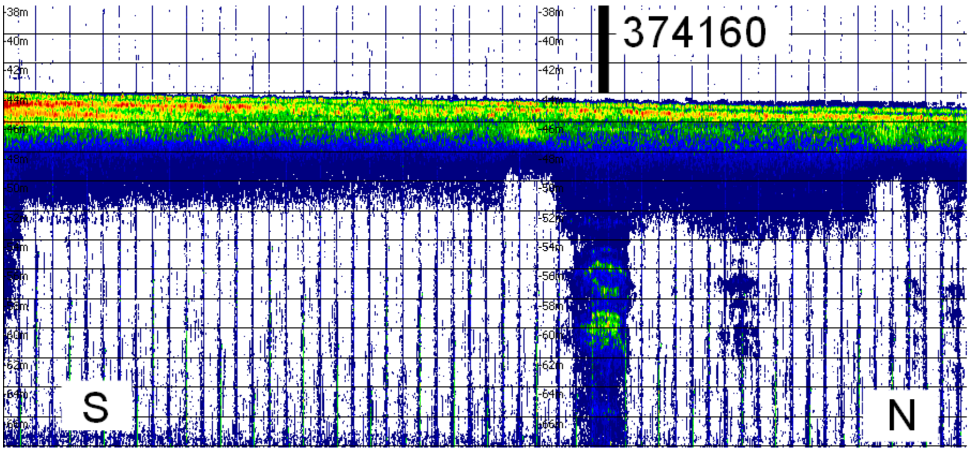

Fig. 7-25 7-26SES96 record across station 374160, (mud, near bottom shallow gas), Arkona Basin

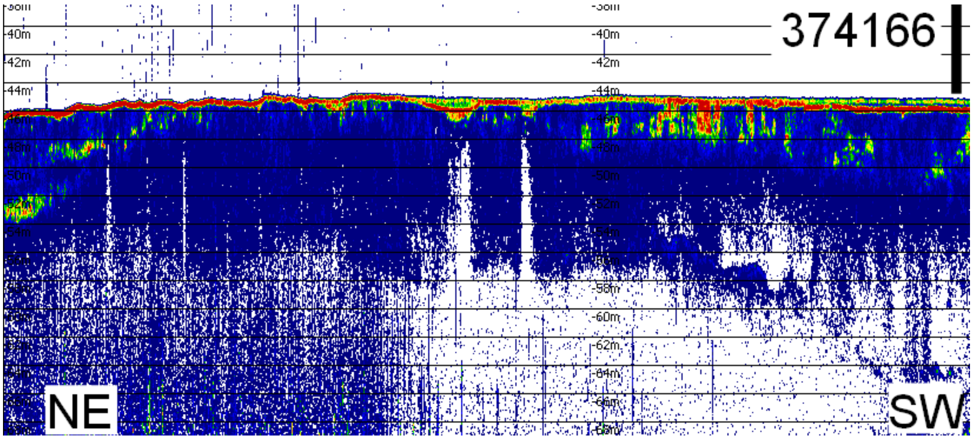

Fig. 7-27 SES96 record across station 374166, (late glacial clay), Arkona Basin, northern part

7.3.4. Bornholm Basin

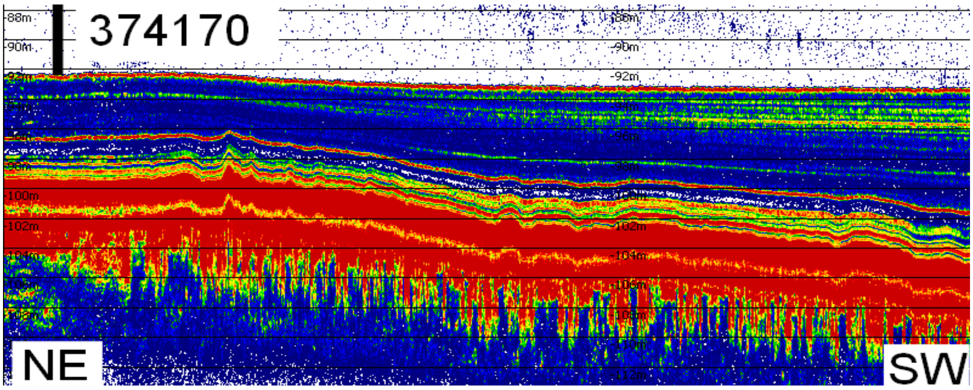

Fig. 7-28 SES96 record across station 374170, (mud, no shallow gas), Bornholm Basin

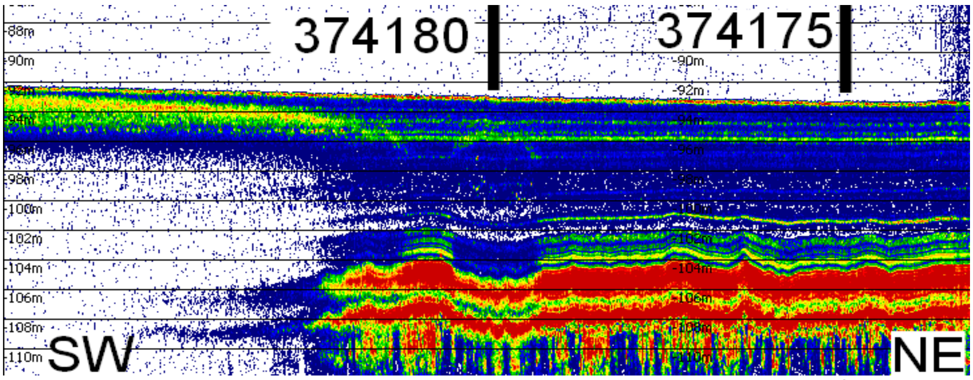

Fig. 7-29 SES96 record across station 374175 and 374180, (mud, transition to shallow gas, left side), Bornholm Basin

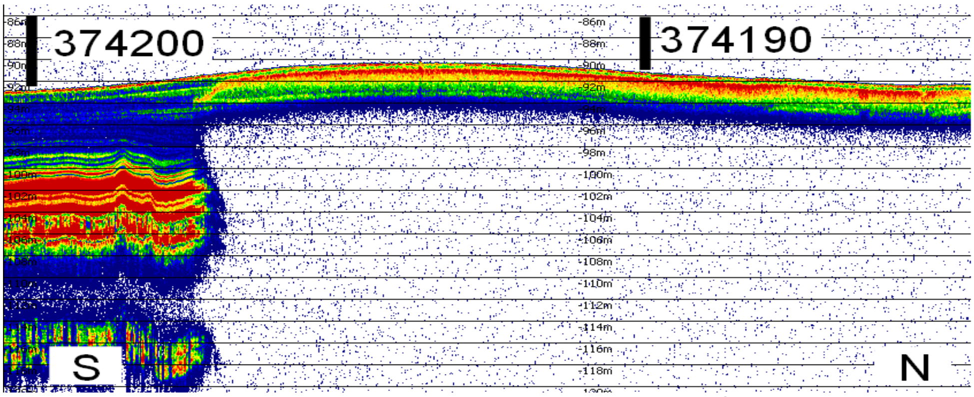

Fig. 7-30 SES96 record across station 374190 and 374200, (mud, transition gas free to shallow gas), Bornholm Basin

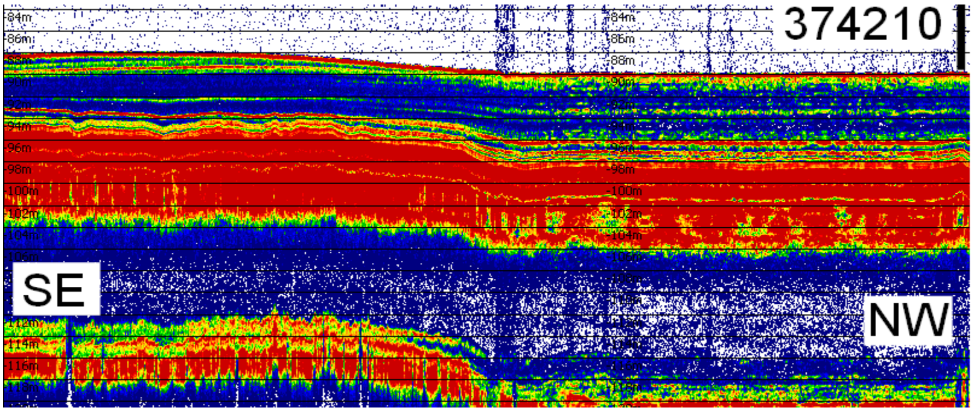

Fig. 7-31 SES96 record across station 374210, (mud, no shallow gas), Bornholm Basin

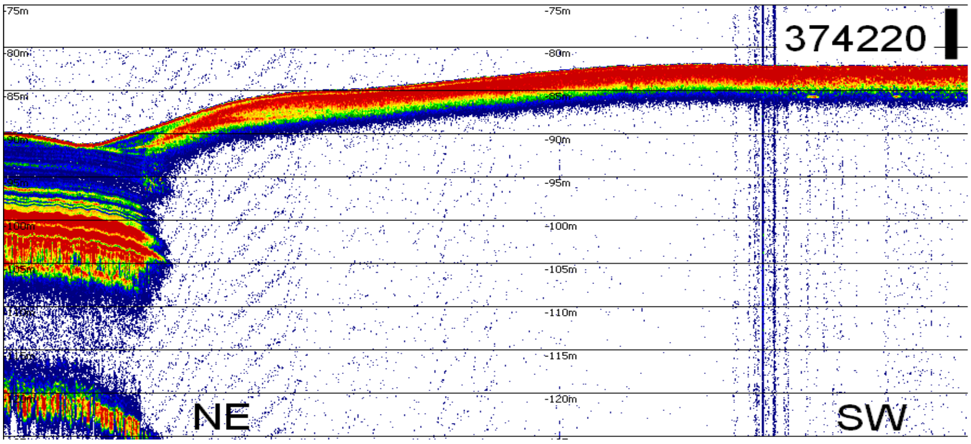

Fig. 7-32 SES96 record across station 374220, (mud, strong very near surface shallow gas), Bornholm Basin

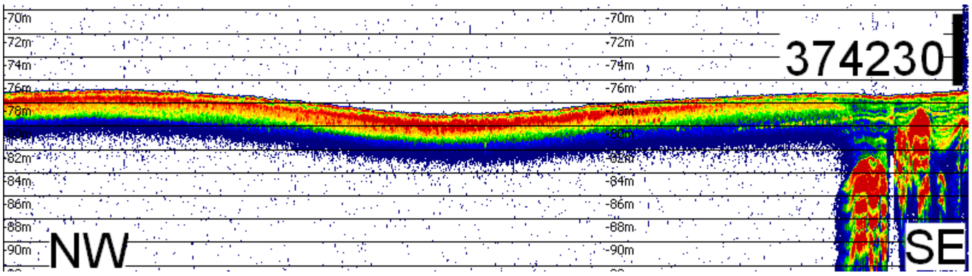

Fig. 7-33 SES96 record across station 374230, (mud, outside the shallow gas region), Bornholm Basin

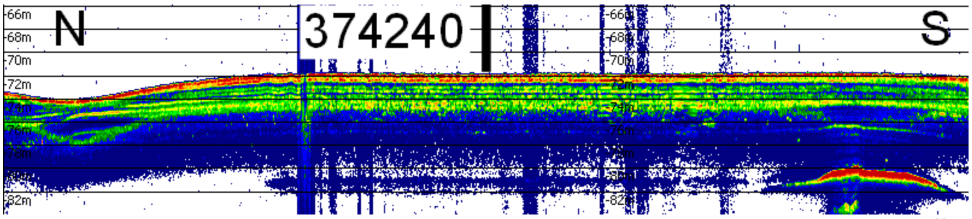

Fig. 7-34 SES96 record across station 374240, (mud, weak shallow gas indications), Bornholm Basin, off Bornholm

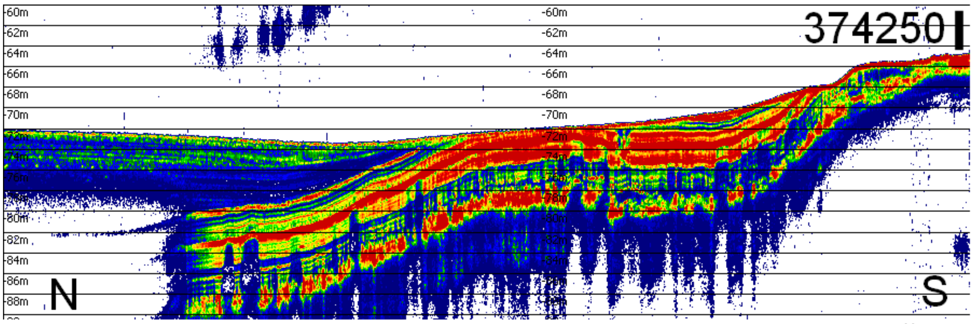

Fig. 7-35 SES96 record across station 374170, (late glacial caly, no shallow gas), Bornholm Basin, off Bornholm

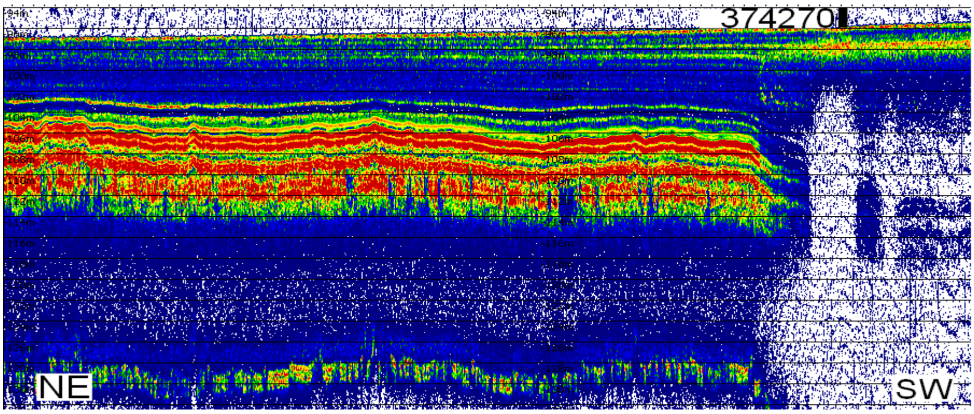

Fig. 7-36 SES96 record across station 374270, (mud, inside shallow gas), central Bornholm Basin

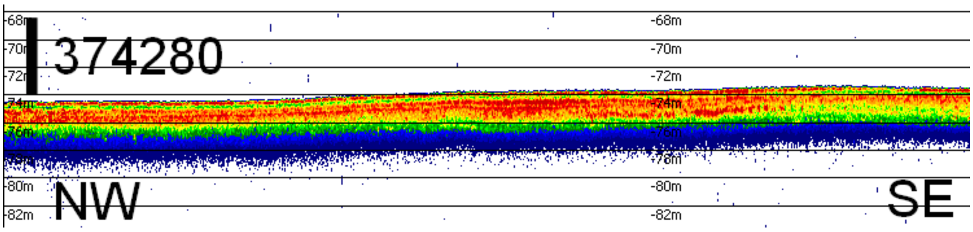

Fig. 7-37 SES96 record across station 374280, (mud, inside strong near surface shallow gas), NE part of Bornholm Basin

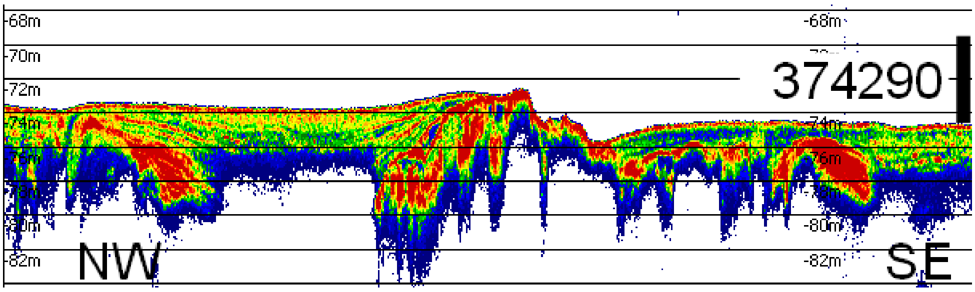

Fig. 7-38 SES96 record across station 374290, (mud, shallow gas), Bornholm Basin

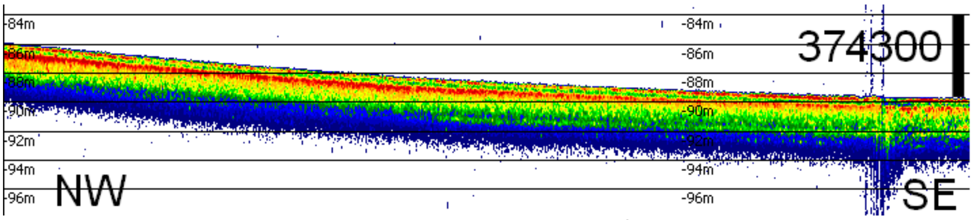

Fig. 7-39 SES96 record across station 374300, (mud, strong near surface shallow gas), Bornholm Basin

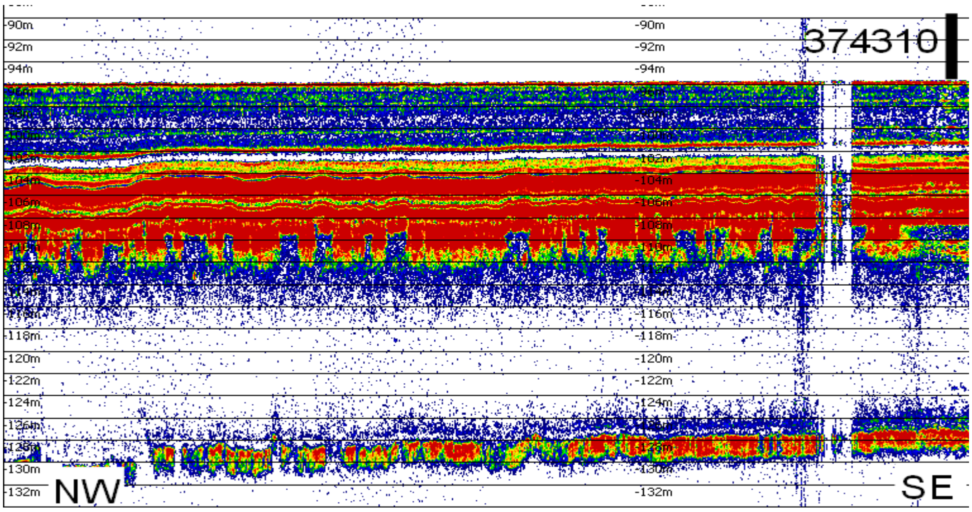

Fig. 7-40 SES96 record across station 374310, (mud, no shallow gas), Bornholm Basin, central part

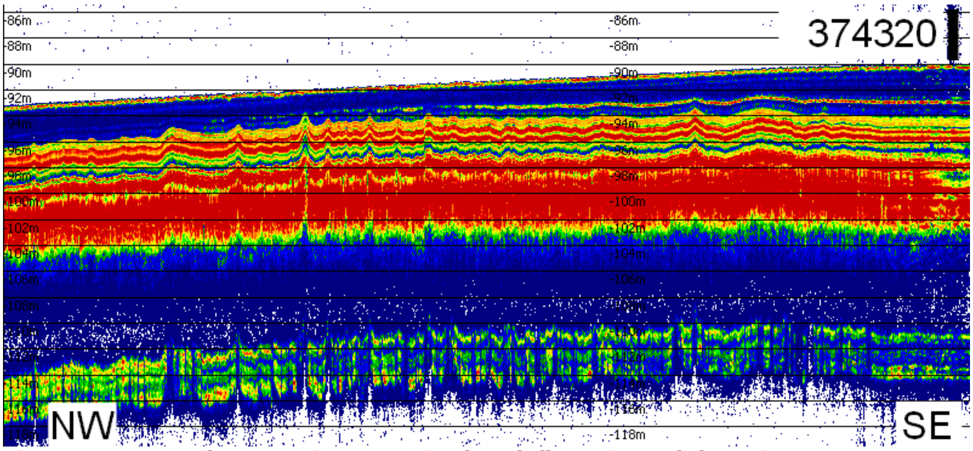

Fig. 7-41 SES96 record across station 374320, (mud, no shallow gas), Bornholm Basin

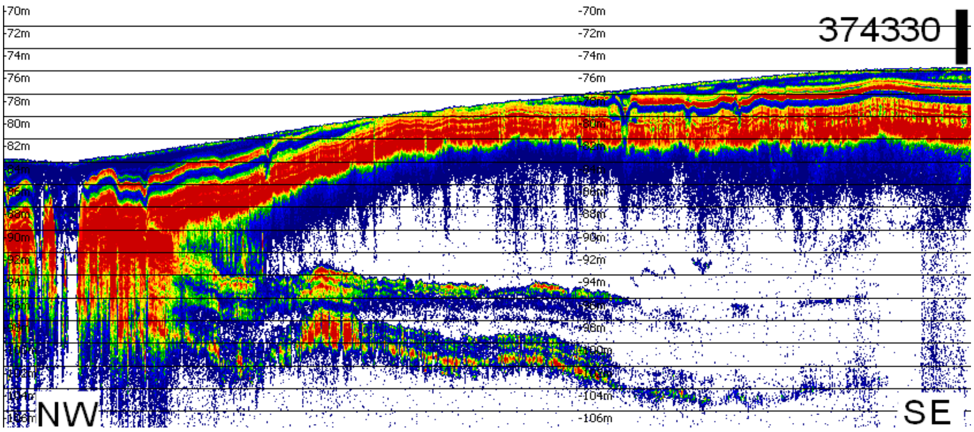

Fig. 7-42 SES96 record across station 374330, (2 m mud, no shallow gas), Bornholm Basin, eastern border

7.3.5. Stolpe Furrow

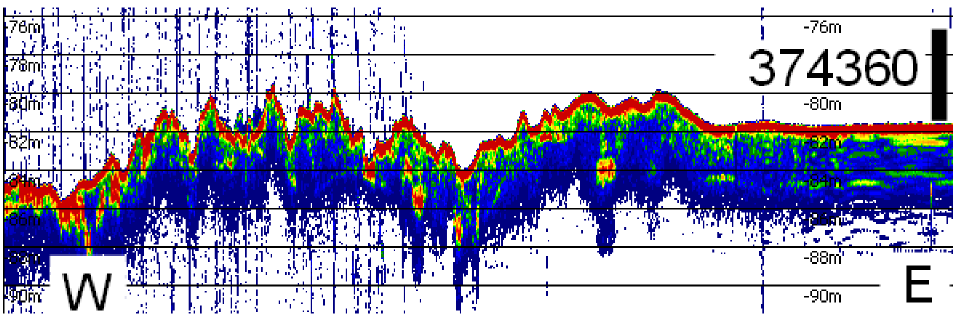

Fig. 7-43 SES96 record across station 374360, (mud, no shallow gas), Stolpe Furrow, eastern part

7.3.6. Stolpe Fore Delta and Gotland Basin

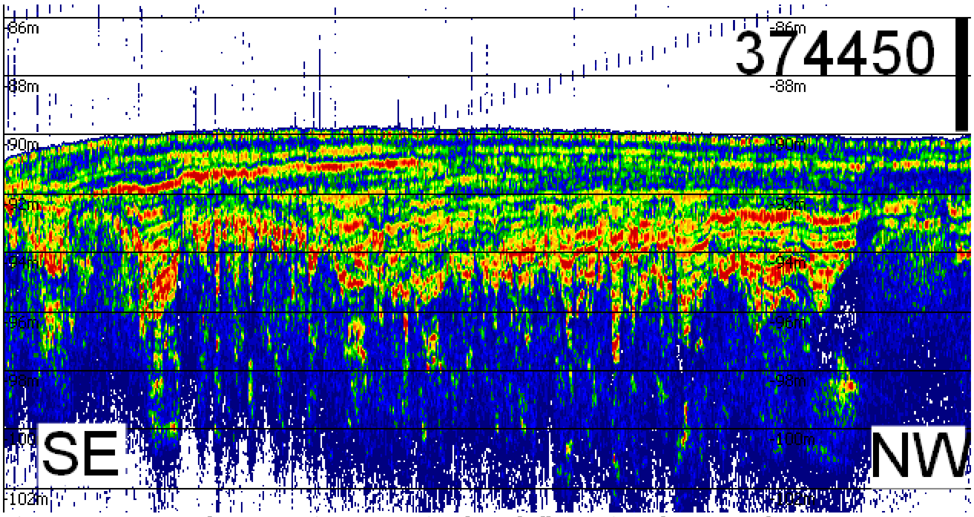

Fig. 7-44 SES96 record across station 374450, (mud, no shallow gas), Stolpe Fore Delta

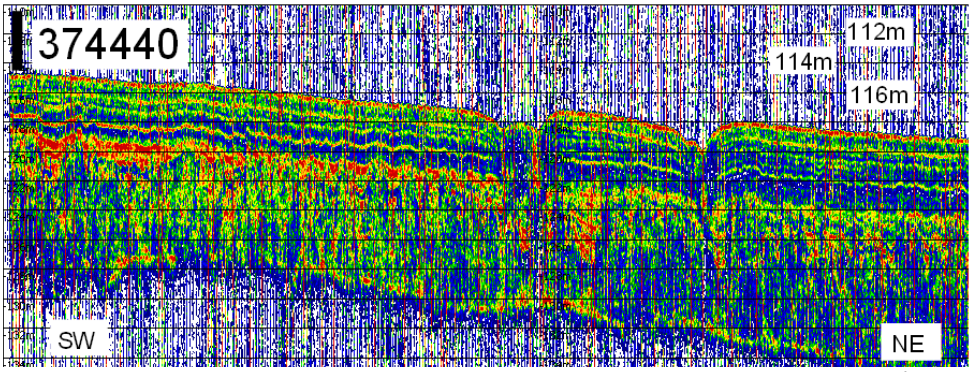

Fig. 7-45 SES96 record across station 374440, (mud, no shallow gas), Stolpe Fore Delta, pockmark/furrow region

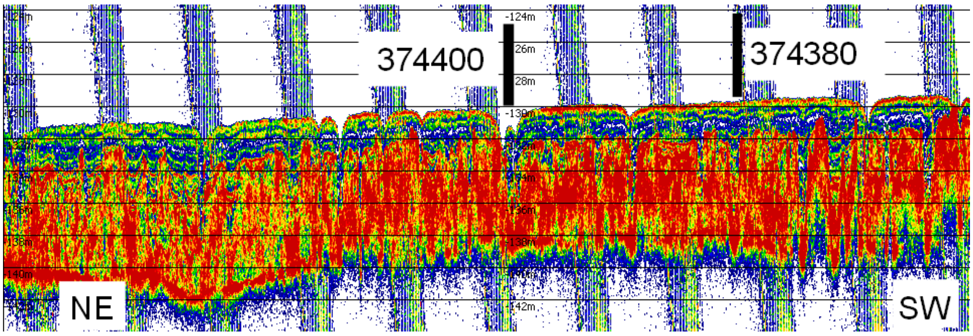

Fig. 7-46 SES96 record across station 374380 (outside furrow structure) and 374400 (inside furrow structure) , (mud, no shallow gas), Stolpe Fore Delta

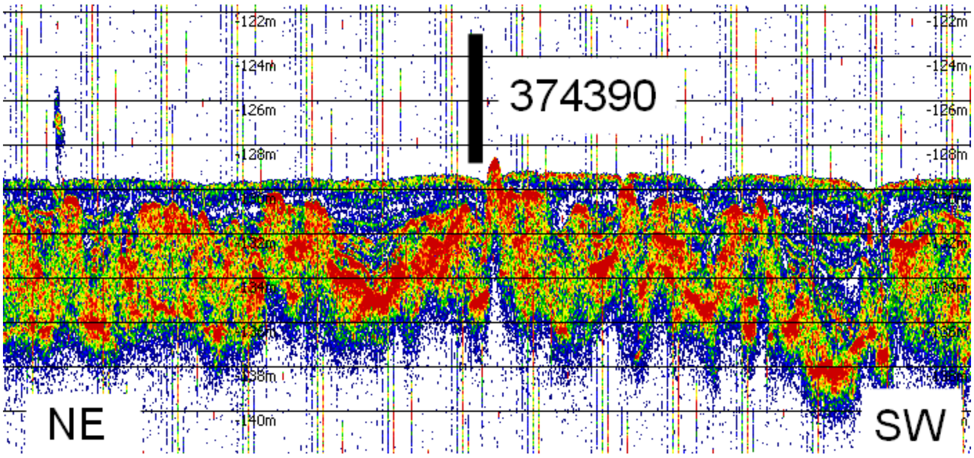

Fig. 7-47 SES96 record across station 374390 (, (mud over late glacial clay, no shallow gas), Stolpe Fore Delta

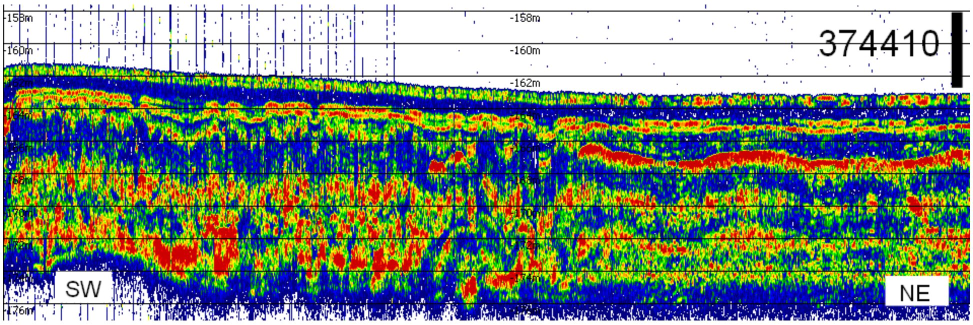

Fig. 7-48 SES96 record across station 374390 (, (mud over late glacial clay, no shallow gas), Gotland Basin

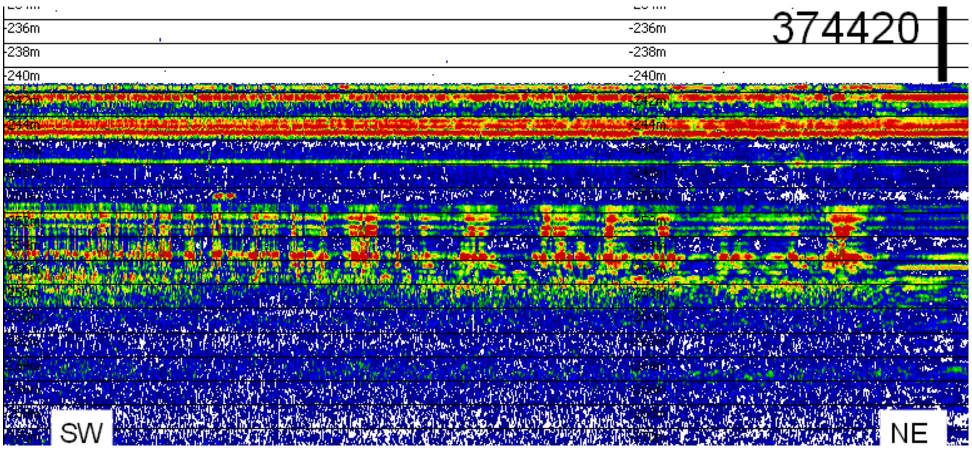

Fig. 7-49 SES96 record across station 374420 (, (mud over late glacial clay, no shallow gas), Gotland Basin, central part (TF272)