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REPORT AND PRELIMINARY RESULTS OF R/V POSEIDON CRUISE P317/4 ISTANBUL-ISTANBUL 16 OCTOBER - 4 NOVEMBER 2004

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Content

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Standing: Günay Çifçi, Derman Dondurur, Serhan Çorpur, Dietmar Bürk, Jens Renken, Thorsten Schott, In front: Nona Lursmanashvili, Ingo Klaucke, Seda Okay, Heiko Sahling, Valentina Blinova (from left to right).

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1 Introduction

1.1 Objectives

Heiko Sahling

Methane is twenty times more effective as greenhouse gas than CO_2; however, its concentration within the atmosphere is much smaller. In contrast, methane generated by microbial decay and thermogenic breakdown of organic matter seems to be a large pool in geological reservoirs. Numerous features such as shallow gas accumulations, pockmarks, seeps, and mud volcanoes are present in a wide variety of oceanographic and geological environments (Judd 2003). Release and uptake of methane by such sources may provide positive and negative feedback to global warming and/or cooling and are therefore focal points of current research (Kvenvolden 2002).

Studying methane emission sites will elucidate how stable these reservoirs are and how the pathways to the atmosphere are working. Because of their high methane density, gas hydrates are of special interest, when occurring close to the seafloor. Previous investigations have shown that hydrates generate extremely high and variable fluxes of methane to the overlying water column due to their exposed position close to the sediment/water interface. Not only do they influence their immediate environment, but they may also contribute substantially to the transfer of methane to the atmosphere.

The R/V POSEIDON cruise 317/4 takes place in the framework of the German-Russian WTZ cooperation and the German BMBF program METRO (METhane and methane hydRates within the Black Sea: Structural analyses, quantification and impact of a dynamic methane reservOir). The focus of the METRO program is to investigate near-surface methane and methane hydrates in the Black Sea in order to understand their origin, structure, and behavior as well as their interaction with the sedimentary and oceanic environment. This is critical for evaluating and quantifying their importance in the global carbon cycle. Research activities of METRO are concentrated in the Black Sea for various reasons. It is the largest anoxic basin with much higher methane concentrations than in any other marginal sea. Sediments of 10-19 km thickness reveal a potential reservoir for methane generation and hundreds of methane emission sites are known from water-column investigations of our Russian and Ukraine colleagues (Fig. 1.1.1). In addition, fluid venting, active mud volcanoes pockmarks and gas-bearing sediments have been found and reported in the literature (Ivanov et al. 1998; Bouriak and Akhmezjanov, 1998). It was in the Black Sea and Caspian Sea that samples of gas hydrates were recovered for the first time in marine sediments (Yefremova and Zhizchenko, 1974). Based on the stability field of methane hydrate, areas deeper than 700 m water depth are of particular interest.

R/V POSEIDON cruise 317/4 is the first cruise followed by several other research cruises to the Black Sea within the next couple of years of METRO. Using different techniques of seafloor mapping (multibeam bathymetry, deep-towed sidescan sonar and video observation) the aim of R/V POSEIDON cruise 317/4 is to identify and map various facies and environments that are related to near-surface gas hydrates and methane seeps off the coast of Georgia and Turkey. Besides the need for quantification of the total amount of methane bound in gas hydrates, it is important to determine the portion of gas hydrates and free gas that are reactive. Hydrates occur in subseafloor depth of several tens of meters down to the base of the methane hydrate stability field which is reached around 500 m in the deep Black Sea area (Bohrmann et al. 2003). Gas released from the seafloor or hydrate outcrops are known from few locations, where they may interact with the ocean, or may even reach the atmosphere in form of gas bubbles. The determination of the extent of these 'reactive' locations and understanding their formation is crucial in assessing the potential impact of gas hydrates and their dissociation on the isotopic chemistry of the ocean and on climate.

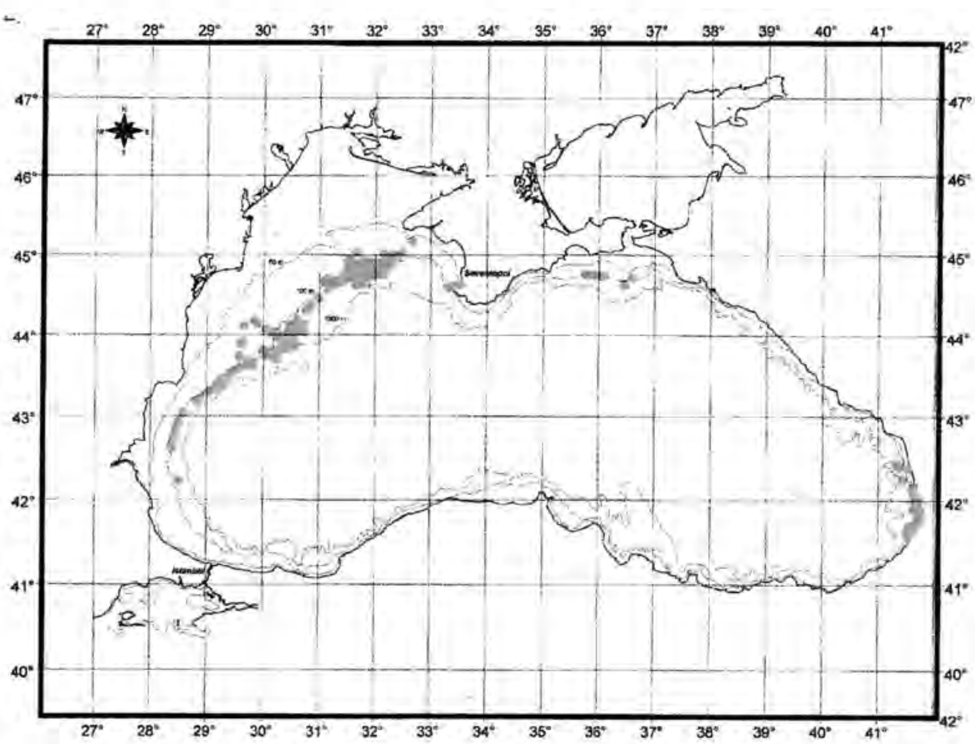

Fig. 1.1.1: Distribution of methane plumes in the water column detected by acoustic imaging within the water column (Egorov, unpublished data IBSS, Sevastopol).

The R/V POSEIDON cruise P317/4 focuses on methane seeps off Georgia and Turkey. Previously, mud volcanoes in the central part of the Black Sea and the Sorokin Trough were investigated during R/V METEOR cruise M52/1 (MARGASCH, January 2002). Different geological settings will be studied during future expeditions using pressurized sampling techniques and remotely operated vehicles (ROVs). Since gas hydrates react rapidly to changes in pressure and temperature, pressurized autoclave sampling technology and investigations and experiments under *in situ* conditions are essential. Beside the Ocean Drilling Program, the technical development of these capabilities were first shown by the former project OMEGA and the applications of the autoclave technology greatly improved the understanding of gas hydrate dynamics (Abegg et al. 2003).

1.2 Investigation Areas

Working area *Batumi* off Georgia
Heiko Sahling

Several geological background informations in the area offshore Georgia was kindly provided by Leonid Meisner, NIPI Okeangeophysika, Gelenshik, Russia. Gas flares, ascending methane gas bubbles recorded by echosounder were discovered at several sites offshore Batumi and offshore Suchumi (Fig. 1.2.1).

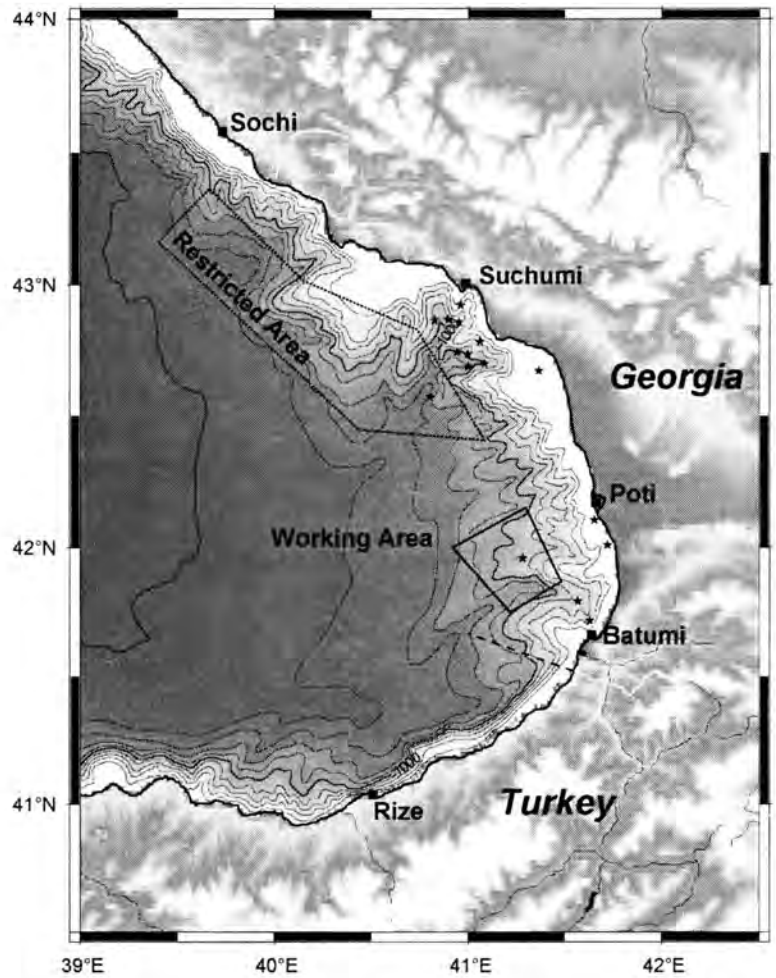

Fig. 1.2.1: The working area off Georgia. The locations of gas flares (stars) were provided by Leonid Meisner.

The flares off Batumi are connected to the Guriisky depression, a geological province that is characterised by updoming of the underlying Miocene sediments. This province reaches from off Poti west-south-west and can be traced morphologically to about 30 nm offshore off Rize and Trabzon (Turkey). The flares of Suchumi are associated to the provinces Gundautsky uplift, Eshersky and Ochamchira uplift.
During the P 317/4 cruise we focused on the area off Batumi where gas bubbles were detected

in about 800 m water depth. The flares in shallower water are all located within the 12 nm limit of Georgia. During the P317/4 cruise period we were not allowed to work in the restricted area off Suchumi.

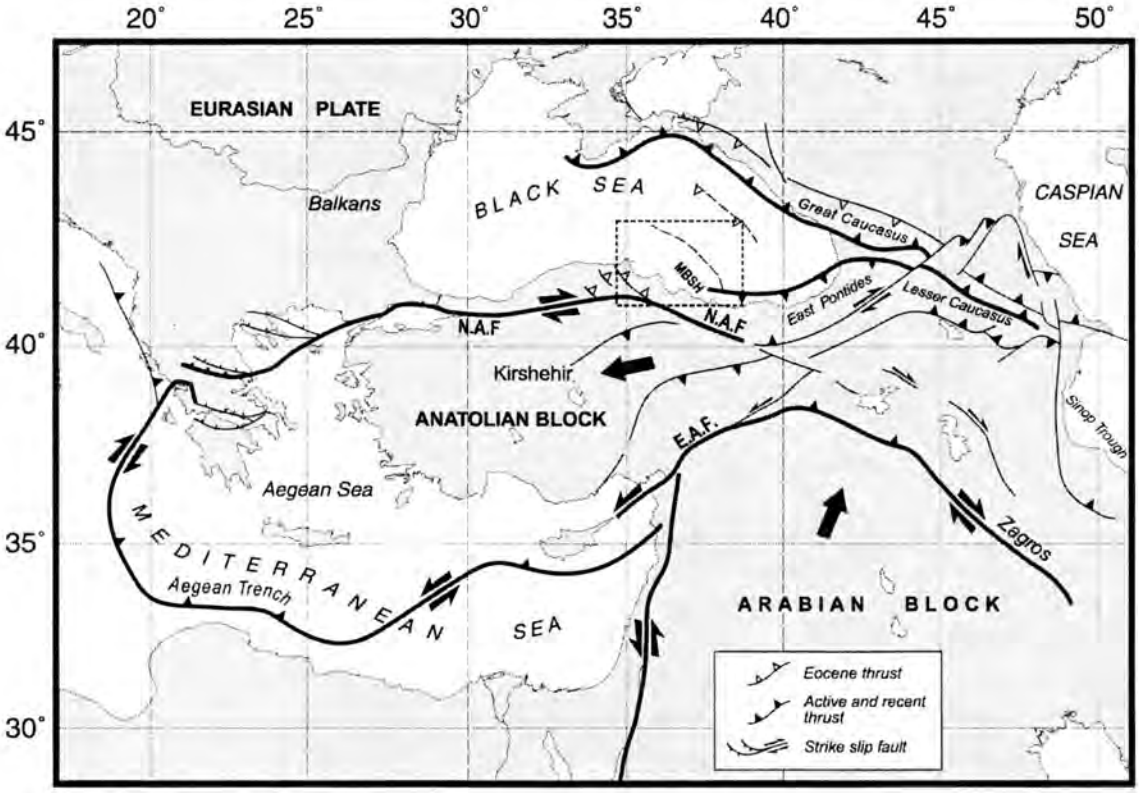

Fig. 1.2.2: Simplified tectonic map of the Arabia/Eurasia collision zone (from Rangin et al. 2002). The Eastern Black Sea Basin is located directly north of the tectonic escape of Anatolia.

Working area *Samsun* (Area 3) off Turkey

Günay Çifci, Derman Dondurur, Heiko Sahling

The working area Samsun (Area 3 of the originally proposed three working areas off Turkey) is located at the central part of the southern Black Sea Turkish margin (Fig. 1.2.2). The tectonics of the area is mainly controlled by the southernmost part of the Mid-Black Sea Ridge (Fig. 1.2.3; Rangin et al., 2002). The ridge crest is extensively affected by normal faulting at the shelf break and sediment sliding occurs in the continental slope region along rotational faults.

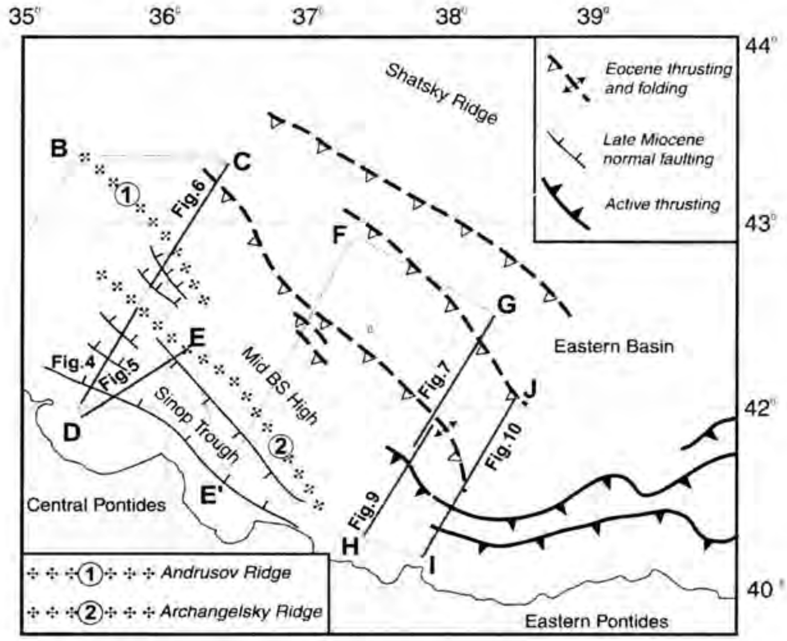

Fig. 1.2.3: Structural map based on the interpretation of the BLACKSIS profiles, illustrating the three distinct tectonic events identified in the area (from Rangin et al. 2002).

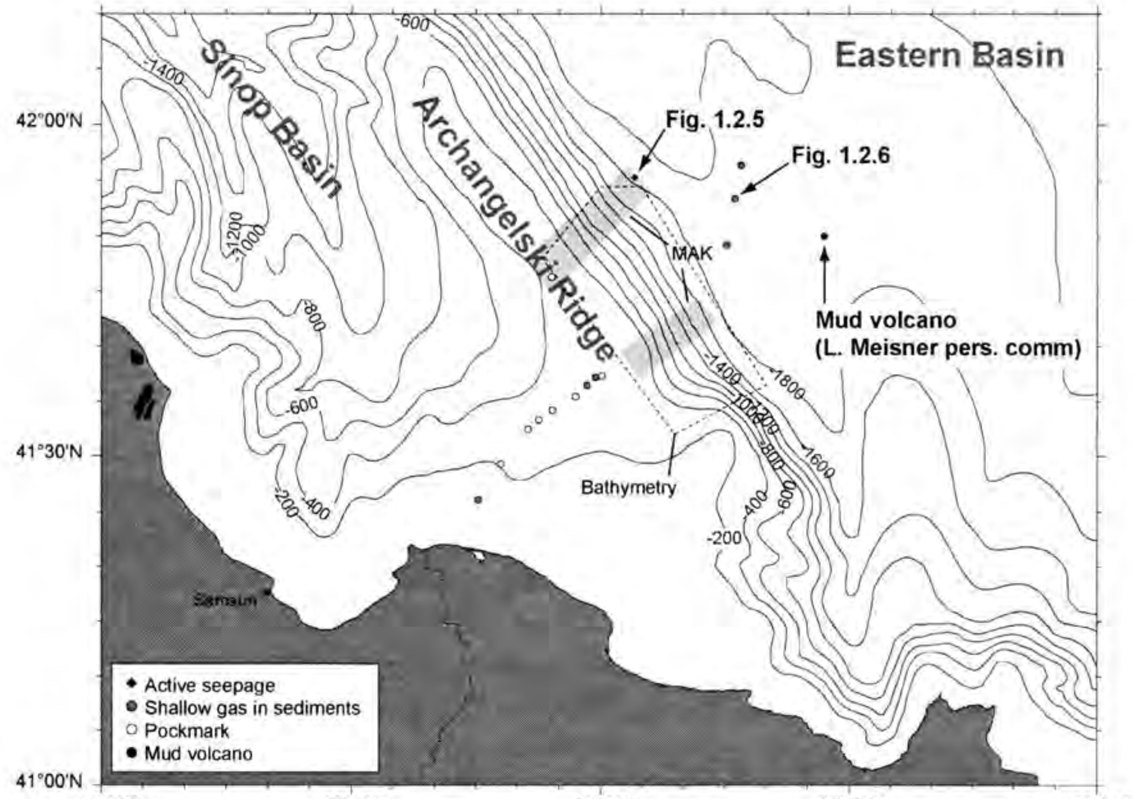

Fig. 1.2.4: Location of potential sites with methane seepage in the working area Samsun. This area was intensively studied by the Turkish colleagues during earlier investigations (Ergün et al., 2002). MAK sidescan sonar and bathymetry images exist from the slope of Archangelski Ridge; unfortunately, they are not available as digital data. Seismic lines indicated pockmarks and shallow gas in sediments.

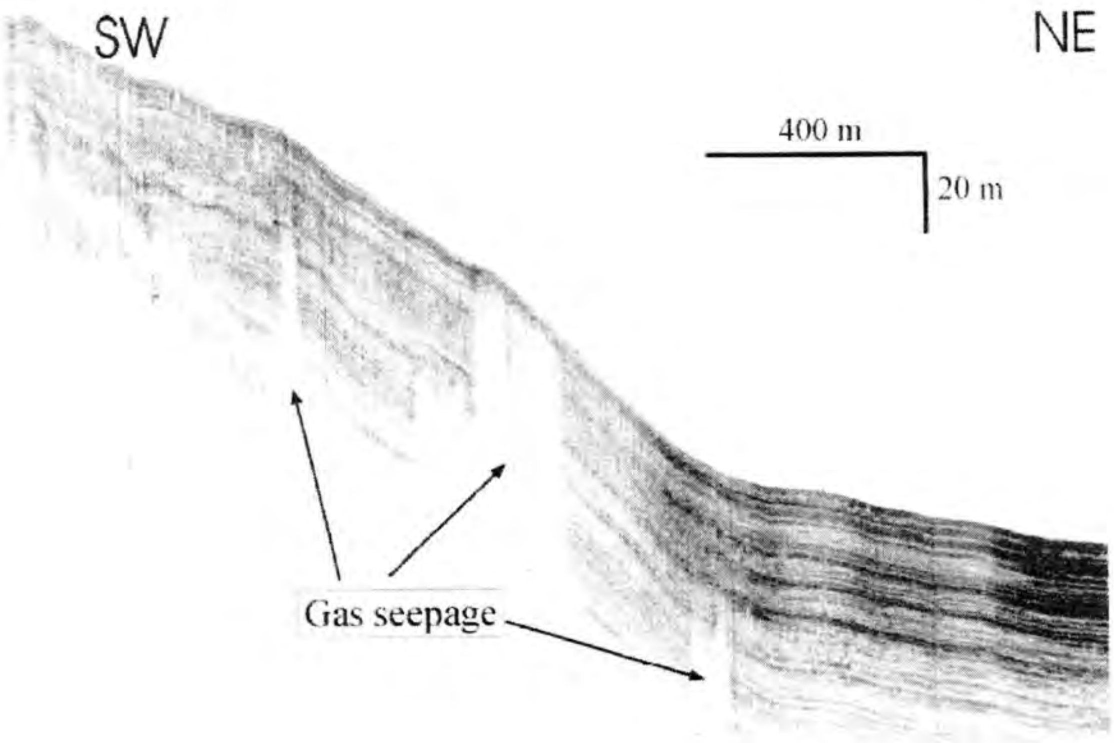

Fig. 1.2.5: Gas seepage on subbottom profiler record from the transition zone of the continental slope to abyssal plane (Ergün et al., 2002).

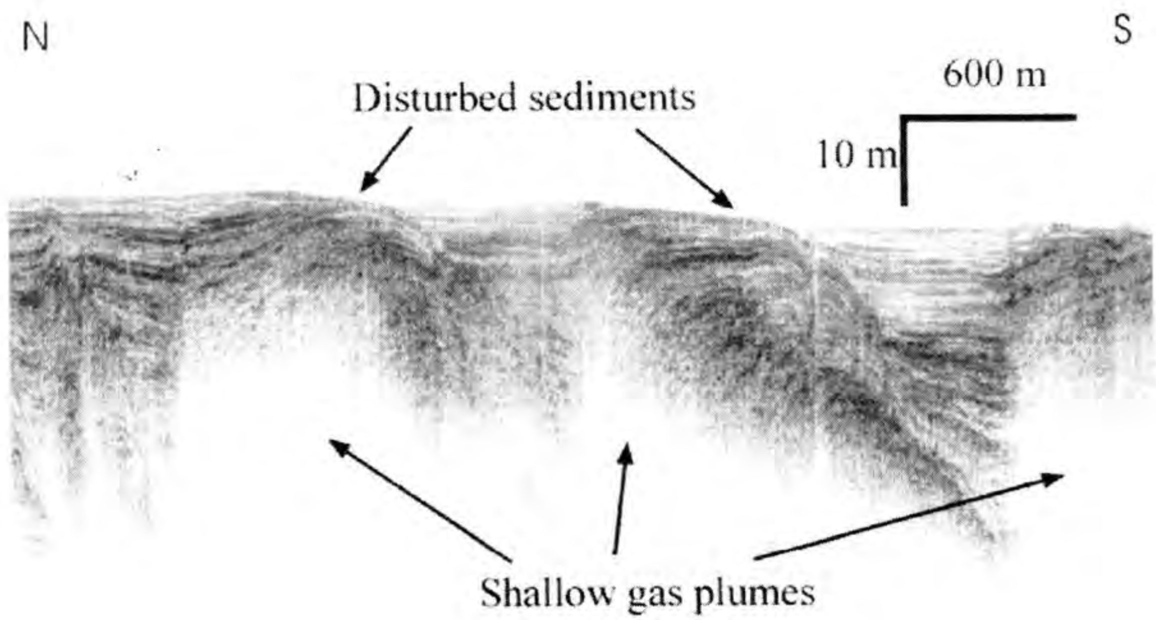

Fig. 1.2.6: Subbottom profiler from the Turkish apron region. Uplifting of shallow gas plumes has disturbed the uppermost sediments (Ergün et al., 2002).

Side scan sonar and high resolution subbottom profiler (MAK-1) data indicate the presence of shallow gas-filled sediments in the coastal region at about 100 m water depths, and in the continental rise region at about 1700 to 2000 m water depths (Fig. 1.2.5 and 1.2.6; Ergün et al., 2002). The gas in the sediments in these regions causes extensive acoustic turbidity effects on the subbottom profiler sections by masking the sedimentary layers. The flanks of the gas charged sediments are quite sharp in the coastal region, while the gas filled sediments exhibit more or less dome like structure with concave upper surfaces on the continental rise. The upper surface of the gas front in this region is located in a subbottom depth of generally less than 10 m (Ergün et al., 2002). Some of the gas columns seem to reach the seabed surface and possibly forming a zone of active gas seepage into the water column (Çifçi et al., 2002). There is also an extensive plateau in the shelf area showing a number of pockmarks that consist of several circular and elongated structures (Çifçi et al., 2003).

Working area *Kozlu* (Area 2) off Turkey

Günay Çifci, Serhan Çopur, Seda Okay, Heiko Sahling

The study area is located in the southern part of the western Black Sea basin and forms a part of the Northern Pontides region called Istanbul Zone (Sunal & Tüysüz., 2002). The area contains numerous potential hydrocarbon anomalies which are geologically similar to other gas or oil discoveries in the western Black Sea Basin (Fig. 1.2.7). There are both structural and stratigraphic structures in the study area. The Kozlu mega structure and eastern fold belt structures are composed of mainly pre-rift sediments. Pliocene and Miocene aged submarine fan systems associated with the Danube and Sakarya Rivers are present in the area and most likely include potential reservoir rocks overlying the prolific Maykopian source rocks (Fig. 1.2.8).

Further near-shore and to the east of the study area compressional Eocene structures are present. These compressional structures are developed on top of Cretaceous units (Şengör., 1995). In the offshore well Akçakoca-1, which was located in the vicinity of the study area some 10 miles offshore in 90 m of water depth, gas was discovered in Eocene turbidities in 1976. Conventional multi-channel seismic data also indicate gas accumulations in water depths greater than 1000 m, and some bottom simulating reflectors (BSR) are observed at relatively deeper waters of the area with significant gas accumulations below the gas hydrate stability zone (Fig. 1.2.9 and 1.2.10; TPAO, unpublished data).

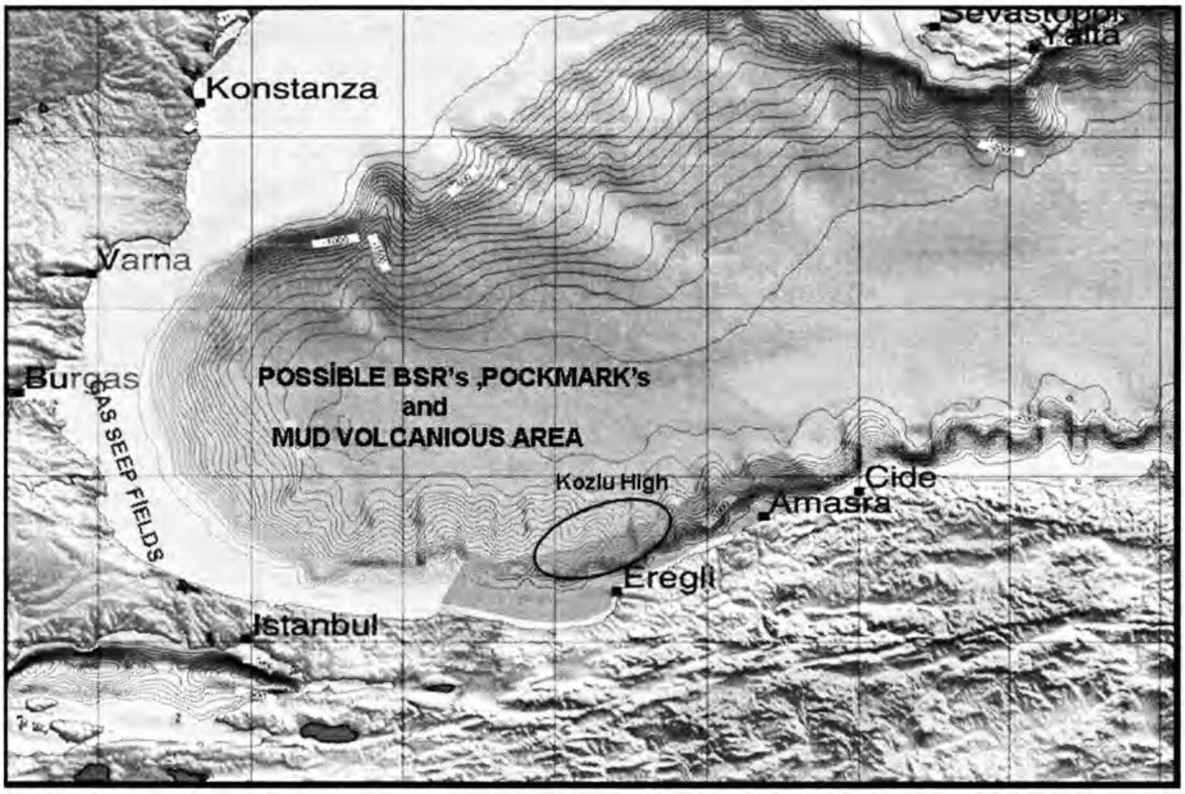

Fig. 1.2.7: General overview of geological provinces in the western Black Sea. This overview is based on the interpretation of seismic lines kindly provided by TPAO. Examples for "pockmark" and "mud volcano"-like features are given in Fig. 1.2.9 and 1.2.10.

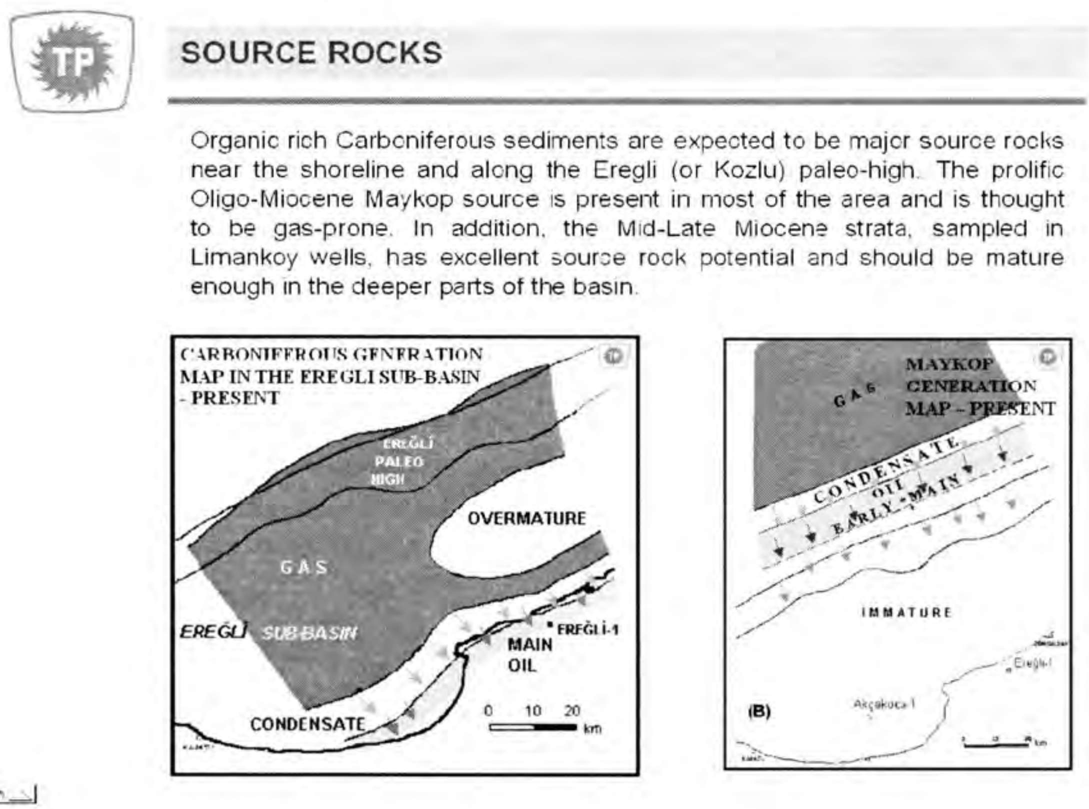

Fig. 1.2.8: Scheme of source rocks in the area of Kozlu High kindly provided by TPAO.

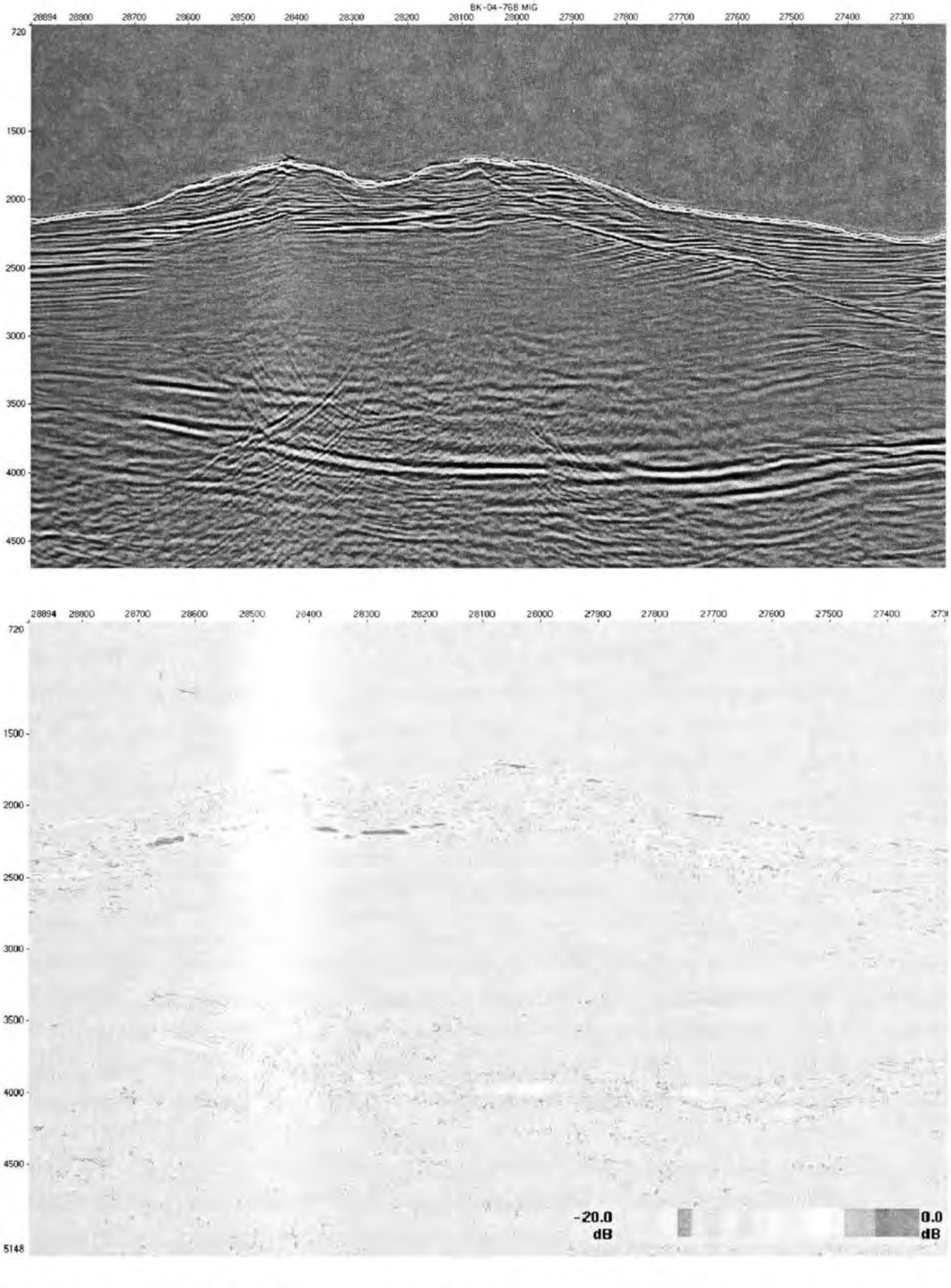

Fig. 1.2.9: Seismic profile (upper) and amplitude display (lower) showing a ridge structure in the area of Kozlu High kindly provided by TPAO. The BSR is interrupted below the local heights, which could indicate the ascending gas, giving the structure the appearance of a "mud volcano".

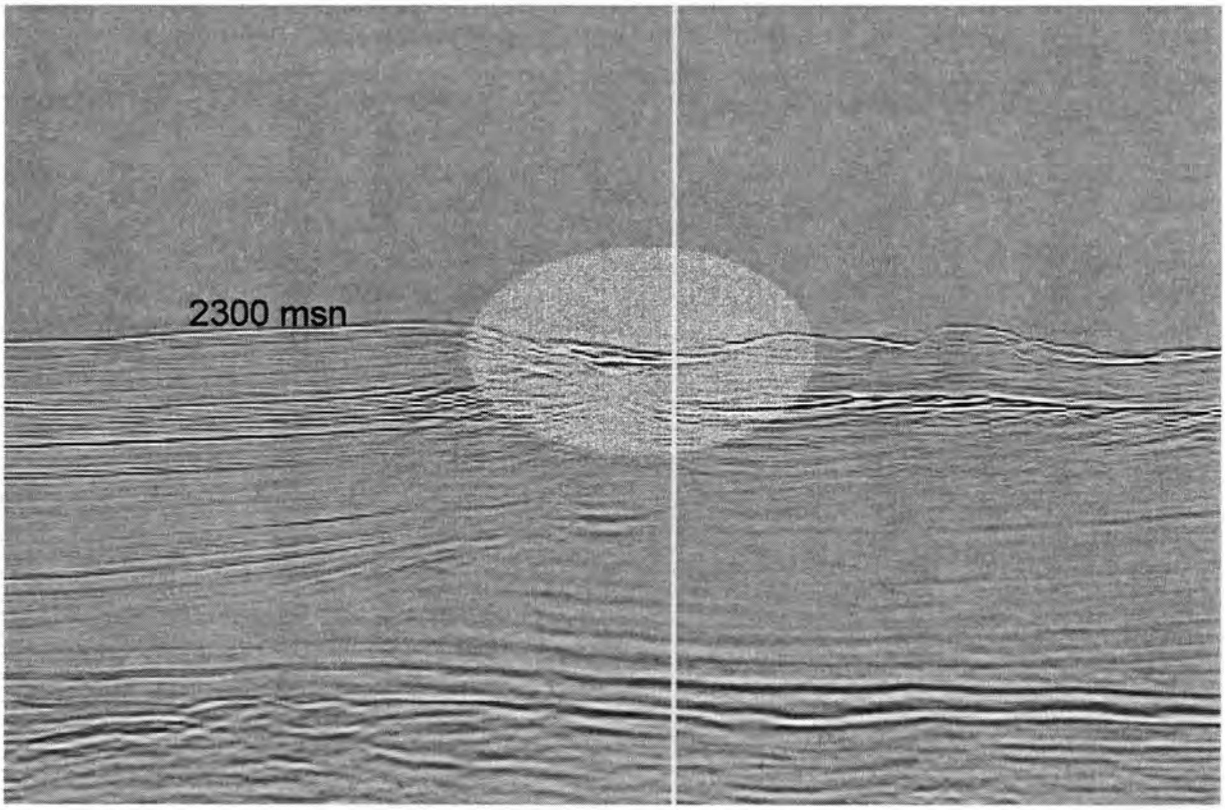

Fig. 1.2.10: Seismic line showing a slump structure in the area of Kozlu High kindly provided by TPAO. A well-developed BSR below the slump body (right side of line) fades out towards the side of the slump (left side of the line) indicating the possible ascent of gas, giving the structure the appearance of a large-scale "pockmark".

1.3 General description of upper Quaternary sediment sections in the Black Sea

Valentina Blinova

The laminated sediments of the Black Sea were discovered more than 100 year ago (Androusov, 1890). But only after the Atlantis II cruise in 1969 the general features of the sedimentology of the Black Sea became widely known (Ross et al., 1970; Degens and Ross, 1972; Ross and Degens, 1974). Five main lithological units can be recognised (Limonov et al. 1994; Fig. 1.3.1):

Unit 1 – The top of this unit is very water-saturated and sloppy. Some cores show thin horizons of pale-grey structureless mud at the very top. Below this mud a fine (usually less than 1 mm) laminated sequence of alternating white coccolith-rich laminae, sapropelic mud and pale-grey mud. The lower boundary is very sharp. The formation of these laminae depends upon seasonal variations in the generation and transport of particles in the basin. The light coccolith laminae are almost entirely comprised of the nannofossil *Emiliania huxleyi*, whereas terrigenous material largely comprises the darker laminae (Hay and Honjo, 1989).
Organic carbon values in this unit vary, reaching 4% by weight (Calvert and Fontughe, 1987). The $\delta^{13}C$ signature shows that the origin of the organic matter is about 25% terrestrial (the $\delta^{13}C$ of modern Black Sea marine plankton is -23‰) (Limonov et al., 1994).
Very fine grained turbidites (up to 20 cm thick) occur in this unit. Although these turbidites do not seem to be laterally extensive, they highlight the importance of lateral transport processes in the basin.

Unit 2 – This unit is characterised by sapropels and sapropelic mud, interbedded with very soft, pale-greenish grey mud. The upper part of the first sapropel contains a few very fine coccolith ooze laminae, and the sapropels sometimes contained fish and plant remains. The boundary between unit 1 and 2 is often abrupt (Ross and Degens, 1974). Unit 2 also includes turbidites.
The sapropel contains more than 14 (weight) % of organic carbon (Calvert and Fontugne, 1987). This unit displays very heavy $\delta^{13}C$ signature, which coincided with maximum accumulation of organic carbon, which indicates that the organic matter in the sapropel has an almost entirely marine origin. The $\delta^{13}C$ value shows increasing proportion of terrestrial organic matter towards the base of the sapropel. This continues down into unit 3.

Unit 3 – Below the sapropel is a series of laminated moderately calcareous clays, with turbidite intercalations characterised by low organic carbon content (about 0.6%). These laminations, or fine beds, are shown by slight colour variations between shades of grey.
Unit 3 has organic carbon with a $\delta^{13}C$ signature that is terrestrial in origin. The lacustrine facies of this unit has been deposited at a time when the Black Sea has been isolated from the Mediterranean by eustatic sea level lowering. After this period, climatic changes and reconnection to the Mediterranean some 9000 year before present has led to the influx of saline water. It resulted in displacement of nutrient-rich deep waters into the photic zone and a pulse of increased marine productivity marked by unit 2 (sapropel). In the last stage, full

marine conditions are characterised by the invasion of the coccolithophorid species *Emiliania huxleyi*. Sapropel deposition is believed to have commenced across the Black Sea some 6000 yeas ago, deposition ended in the shallow waters some 4000 years ago, persisting in the deep waters until 1600 years ago (Calvert and Fontugne, 1987, based on the 14C dating). Based on the varve counting, sapropel deposition began 5100 years ago and persisted until 1000 years ago (Hay, 1988; Limonov et al., 1994).

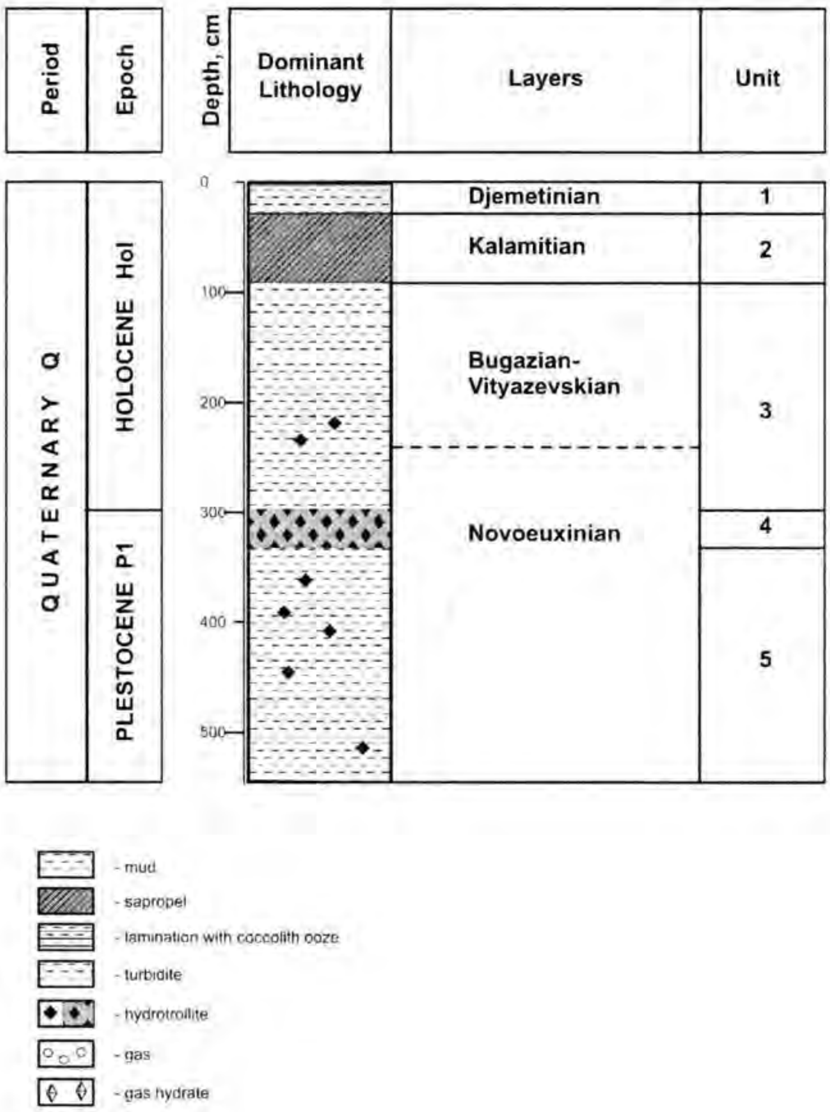

Fig. 1.3.1: Major lithological unites in the Black Sea (Limonov et al., 1994).

Unit 4 – This unit comprises black to dark grey mud which is very rich in reduced iron, or hydrotroilite. These can be either massive or show a colour banding caused by a variable concentration of hydrotroilite.

Unit 5 – This unit is characterised by grey finely bedded mud with occasional fine silt laminae and spots of black hydrotroilite. Down this unit the silts become thicker and show sharp, erosive bases and grade downwards into mud. This unit may also contain debris flow deposits.

2 Cruise narrative

Heiko Sahling

Thursday, 14 October 2004

Around 20:45h local time (local time = UTC + 3 hours) German scientists arrive at R/V POSEIDON which took berth in the Port of Haydarpasa at the Anatolian side of Istanbul. They received a warm welcome by captain, chief mate and crew.

Friday, 15 October

For most of the day everyone awaited the arrival of the truck with the scientific equipment. Although the truck was expected to arrive in Istanbul two days earlier, the truck finally arrived at 17:00h. The scientific equipment was quickly unloaded but unpacking and installation of the instruments continued until late that night. In the meantime, the colleagues from Russia and Georgia embark at 15:00h.

Saturday, 16 October

Set up of the scientific equipment continued during the day. The scientific party was complete with the arrival of the Turkish scientists at 09:00h. Unfortunately, the departure that was originally scheduled at 10:00h was repeatedly postponed due to heavy traffic in the Istanbul Strait. Finally, permission for the passage was given and R/V POSEIDON left Istanbul at about 20:00h. Everyone enjoyed the beautiful passage through the Bosphorus at night. After about three hours we reached the Black Sea and headed for our first working area off Georgia. As we did not have a Turkish research permit by that time, we had to leave all sensors switched off during the transit.

Sunday, 17 October

The transit to Georgia is used for further installation of the scientific equipment, for introduction to the ships features and equipment as well as security. The weather conditions are ideal with calm winds and sea. In the afternoon at 15:20h a first scientific meeting was used to get to know each other and for a first presentation of the scientific program. At 19:00h scientists and crew came together for a first introduction of the tools used during the cruise and for outlining mutual responsibilities.

Monday, 18 October

The transit continued with sunshine and smooth sea. Dolphins are around the ship and many different migrating birds visit us. The ships speed is about 8.5 knots. In addition about 1 knot of surface currents from the west pushes us forward. At 10:20h a fire drill took place. In the evening a telephone call from the Maritime Transport Administration of Georgian (MTAG) caused some irritation. Although we believed to have a valid work permit the Georgian administration is concerned about our proposed work. First, the points of interest in the northern sector (offshore Ochamchira) are in a restricted area and, second, the administration asked whether or not we had permission to carry out research from the ministry of ecology.

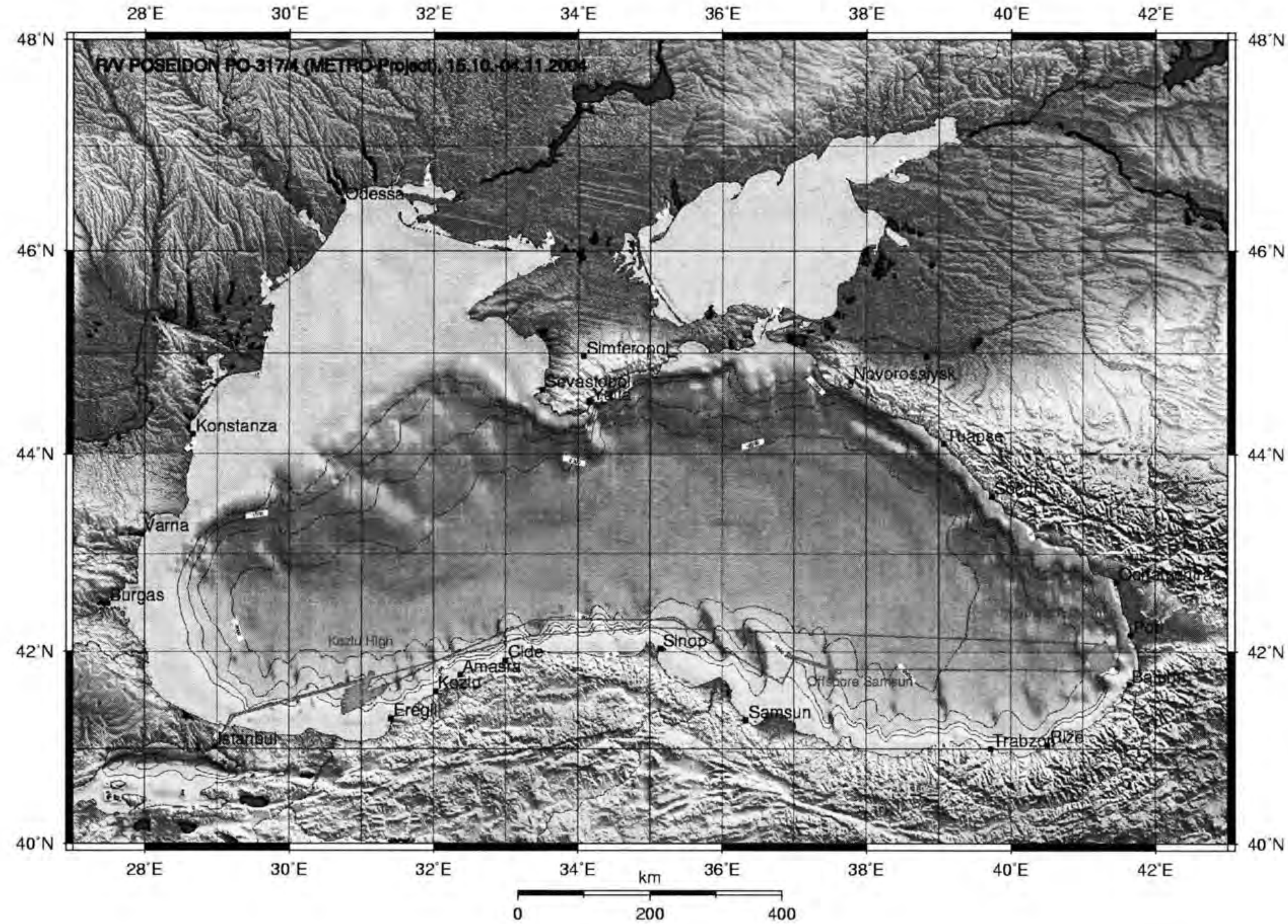

Fig. 2.1: The trackplot of P 317/4.

Tuesday, 19 October

Several telephone calls and emails from our Georgian and Russian guests as well as from Dr. Evgeny Sakvarelidze / Tbilisi to the Georgia administration during the last night and in the morning clarified the concerns raised the day before and scientific work started at 09:00h with the deployment of the deep-towed side scan sonar (DTS # 1, Stat. 835) and starting the ELAC multibeam system for swath mapping. Based on information provided by Leonid Meisner we knew that in this area off Batumi gas escapes from the seafloor causing acoustic anomalies in the water column and that were previously recorded by echosounding systems. Most of these so-called flares occur at continental shelf depths within the 12 nm zone of Georgia for which we do not have a research permit. The DTS survey was planned to cover the only known deep-water flare location in about 860 m water depth. The weather conditions are perfect and despite some earlier problems with the winch the survey was carried out as planned with only a small loss of data at the beginning of the profile.

Wednesday, 20 October

The scientific program of this cruise started with a scientific highlight. During the DTS #1 survey we confirmed the presence of the known gas flares and discovered about five other flares. Gas in the water column causes acoustic anomalies in the water column of the sidescan sonar record. They are not observed in the subbottom profiler record. Given that these anomalies are only seen when the tow fish passes over the flares we assume that more flares may be present in the area but were not imaged. In the absence of high resolution bathymetry we used the global GEBCO 1-min dataset as the basis for the DTS survey. Our own ELAC multibeam bathymetry data showed significant differences in the general morphology and the absolute depth derived from the global GEPCO data set. A ridge 300 m higher than expected ridge caused stressful sidescan watches and resulted in a bottom contact of the depressor on the last profile. Fortunately, the sidescan sonar instrument was not damaged. After retrieval of the DTS the night was spent with ELAC swath mapping (Stat. 836).

Thursday, 21 October

During the night the wind increased to a good 7 Bft from Northwest. Based on the DTS observations we planned to survey an area of gas seeping we named Batumi Seep in about 860 m water depth using the video sled OFOS. Based on cable length, water depth and ships position the location of the seep site was derived from the DTS online data. Due to the weather conditions we were forced to run the OFOS from E to W over the structure. OFOS # 1 (Stat. 837) revealed the presence of bacterial mats in an area of about 10 m wide. OFOS # 2 (Stat. 838) showed rocks on the sediment surface that we interpret as authigenic carbonate precipitations. The extent of the carbonates was limited to only a few meters. As shown later after thorough analysis of the navigation and bathymetry data we probably only touched the periphery of the seep. A gravity corer GC # 1 with a plastic bag was attempted in the area where the bacterial mats were observed (Stat. 839). The core degassed significantly when it came close to the water surface. After retrieving the plastic bag from the corer the bag was immediately cut open releasing a watery sediment suspension that probably represents to the uppermost first meter of the sediments. The other 3 m of sediment were degassing and may have contained disseminating gas hydrates. The remaining part of the core was well stratified and remarkable colour changes and sapropel layers were also present. During the following night the ELAC survey (Stat. 840) was continued.

Friday, 22 October

In the morning, wind lessens (Bft 4 NW) and in the course of the day wave heights are decreasing. A series of three gravity cores were taken from the presumed centre of the seep area, at the margin and a reference core outside the seep (Stat. 841-843, GC # 2-4). These three locations were chosen in order to sample three different backscatter signatures imaged during DTS # 1: high backscatter at the centre, intermediate backscatter at the margin and low background backscatter intensity at the reference station. These cores were taken in plastic liners that were cut in 1-m pieces and than sealed for later sedimentological studies in Kiel. However, the sediments of the core catcher and between the 1-m core segments clearly indicated the following succession: in the central core small cm-size chips of gas hydrate occurred below sediments that contained small carbonate pieces. At the margin, the sediment was soft but contained also pieces of gas hydrate. The reference core did only contain soft sediment. A fourth gravity corer (Stat. 844, GC # 5) with a plastic bag was taken at the same location as GC # 3 in order to study the distribution of gas hydrates in the sediments. Unfortunately, the core only contained about 30 cm of sediment. We speculate that too much gas hydrate has destabilised during the recovery and pushed the remaining sediments back through the core catcher, which was turned insight out. Thanks to the much improved weather we were able to run the OFOS # 3 (Stat. 845) along the side scan sonar track from South to North over the seep site. We found at the small-scale summit evidence for the fault imaged by side scan: small steps were observed and various types of carbonates occurred. After safe recovery of OFOS we continued the ELAC survey further to the north (Stat. 846).

Saturday, 23 October

After the experience that R/V POSEIDON is moving heavily in rough seas, everyone on board appreciates that the wind ceased and we have perfectly calm sea. At 08:00h DTS # 2 (Stat. 847) was deployed in order to extend the already surveyed area with one additional profile to the Northeast. After the successful completion of the profile, a high resolution DTS profile over Batumi Seep was attempted. This profile should give a more detailed image of the small scale distribution of carbonates and gas hydrates in the sediments. With a short ELAC survey (Stat. 848) we closed last gaps in the bathymetry before we had to leave the extremely interesting working area off Georgia. As a grand finale in the working area of Georgia, perfectly clear visibility offered a spectacular view of the Caucasus and Eastern Pontides around sunset.

Sunday, 24 October

Very calm sea, no wind, sunshine for most of the day. At 10:20h a person-over-board manoeuvre took place.

We finally received the Turkish research permission dated October 18, 2004 after a memorandum of understanding between the Turkish Petroleum Corporation (TPAO) and the

University of Bremen was signed. TPAO had objected against research of the oil seeps off Rize and, therefore, we passed over this area which we originally wanted to study leaving the ELAC echosounding system off. Alternatively, three working areas were defined at which we plan to carry out scientific research. At the working area 3 off the Yesihirmak River northeast of the Archangelsky Ridge our Turkish colleagues found several evidences for methane seepage. Based on side scan sonar and seismic data active seepage, pockmarks and sediments containing gas were identified. In addition, unpublished data kindly provided by Leonid Meisner indicate a mud volcano. We arrive at Area 3 on the Turkish continental margin at about 17:30h and start our program with DTS # 3 (Stat. 848). Together with the DTS survey we run the ELAC swath mapping system. Two DTS profiles were planned at the slope apron in order to map some of the selected targets. During the survey a third line was added in order to cover a larger part of this very interesting area.

Monday, 25 October
Sunshine, no wind, no waves, perfect conditions for scientific work. We continue the DTS profile throughout the day and the following night without problems.

Tuesday, 26 October
The DTS lines revealed a highly dynamic slope apron influenced by faulting and folding with sinuous sediment waves, faults with throws between a few meters to more than 40 m, and some landsliding. An area of active seepage was identified by high backscatter on the seafloor associated with a linear fault. At this site acoustic anomalies, although minor, on the sidescan record of the DTS probably indicate free gas in the water column. Furthermore, low penetration of the sub bottom profiler also indicated gas in the sediments. We surveyed this area with OFOS # 4 (Stat. 850) following the DTS line from East to West. We did not find any evidence for methane seepage. However, the potential seep area was then sampled by GC # 6 (Stat. 851) recovering well-stratified sediments. After these two stations that did not reveal evidence for methane seepage we left this working area in the evening. During the transit to area 2 we followed a route passing over several features which we wanted to map with ELAC multibeam system. As it turned out later, the ships speed of about 8 knots does not produce good bathymetry data. In the evening the very successful first half of the cruise was celebrated by the crew and the scientists.

Wednesday, 27 October
During the transit to the next working area we have very good weather conditions. The transit time is used to analyse the data obtained so far and to optimise plans for the upcoming research in area 2.

Thursday, 28 October
Upon arrival in the working area 2 at 03:00 a short ELAC survey (Stat. 852) was conducted. DTS # 4 (Stat. 853) was scheduled for 08:00 but due to winch problems that luckily could be fixed immediately it was deployed at 09:30 in order to survey the lower slope region for the next 48 hours. We have chosen this area solely based on seismic lines which were provided

by our colleague from the Turkish Petroleum Company (TPAO). Several lines show a bottom simulating reflector (BSR) that is interrupted or bend upwards at specific structures. We planned four long DTS # 4 profiles in order to survey two potential seep areas. Excitingly, gas flares and hard reflectors above gas-filled sediments were found immediately during the first profile. The weather conditions continue to be perfect.

Friday, 29 October
DTS # 4 continues very successfully revealing several methane seepage sites. Meanwhile, the sidescan data of the day before were processed and geo referenced. Targets were selected for detailed video sled observations and gravity corer sampling.

Saturday, 30 October
The sidescan was recovered at 08:00h after the successful completion of the four profiles. After 3 hours transit GC # 7 (Stat. 854) was taken at a position where a gas flare was observed. On the backscatter image the flare is connected to a very small linear fault system of about 0.2 nm length and 0.05 nm widths. Strong currents of up to 0.8 knots made it difficult to position the ship exactly. The core was full but did not show any evidence for being influenced by methane seepage. OFOS # 5 was deployed at a fault that showed three individual flares, which we named TPAO flares. Again, the ship had difficulties to navigate along the planned profile and nothing was observed during the first perpendicular crossing. Thanks to the calm weather conditions and increasing experience with the towing behaviour of the video sled the ship was able to turn and bring the sled at slow speed over the area of interest. Down slope (northwest) of the faults we observed irregular sediment surface with changing colours and cm-size crater-like holes. One possible explanation for these holes could be vigorous gas escape that leaves those openings behind. However, such an intensive escape has never been observed so far and requires future studies. With GC # 8 (Stat. 856) we attempted to sample this crater-rich area, unfortunately, current speeds of up to 1 knot made it impossible for the ship to hold the position. Therefore, the first mate suggested trying a drift technique: the gravity corer came into the water 0.4 nm before the target position and was lowered down to about 100 m above the ground at 1440 m. Meanwhile, the ship drifted to the point of interest and the corer was dropped when we passed over it based on the ship position. Despite this sophisticated sampling technique we recovered only background sediments. The same drift technique was applied for GC # 9 (Stat. 857) at the circular feature that is characterised by high backscatter at the surface and a strong reflector overlaying acoustically impenetrable gas-rich sediments. The recovered core was about 2 m long and contained gas and probably disseminated gas hydrates. At about 21:30 the ELAC # 6 (Stat. 858) survey started. In the night the clocks were set one hour back.

Sunday, 31 October
During the night, the ridges further upslope of the previous DTS profiles were mapped by swath bathymetry. OFOS # 6 (Stat. 859) surveyed the circular high backscatter structure were GC # 9 was taken the day before. The seafloor observations did not reveal any conclusive indications for methane seepage. GC # 10 (Stat. 860) was taken at the same position as GC #

9 and recovered similar sediments. Three gravity corer (GC # 11-13, Stat. 861-863) were taken in order to sample sediments for investigation in the lab in Kiel. The objective was to sample different sediment types that caused different backscatter patterns on the sidescan sonar image obtained during DTS # 4. DTS # 5 (Stat. 864) was deployed in order to extent the previous DTS # 4 survey.

Monday, 1 November

DTS # 5 survey was continued the whole day. It revealed that the seafloor is highly structured and that mass wasting processes such as creeping sediments and slumps occur. In addition, one additional gas flare was recorded in an area where the previous DTS survey had shown other flares and one more flare was shown further to the north.

Tuesday, 2 November

DTS # 6 continued until 15:00 in the afternoon. After the successful recovery we continued with ELAC # 7 mapping (Stat. 865). During the day wind and wave intensity increased which unfortunately decreased the data quality of the ELAC system.

Wednesday, 3 November

GC # 14 and # 15 (Stat. 866-867) were taken at the northern part of the area mapped with DTS # 5 where a gas flare was imaged. Despite optimal positioning of the ship both cores did not reveal any evidence for methane seepage. They contained well-stratified sediments. During the afternoon the area east of the DTS # 5 profiles was surveyed (ELAC # 8 Stat. 868). The station was finished at 20:00 and R/V POSEIDON left the working area for the transit to Istanbul. Meanwhile, some highlights of the cruise were presented during an end-of-the-cruise come-together of scientists and crew.

Thursday, 4 November

After a very nice passage through the Istanbul channel R/V POSEIDON took berth on the passenger pier at Karaköy on the European side of Istanbul. At 13:00 the scientists from Turkey left the ship. The German scientists packed up the scientific equipment. The video sled, the winch and the gravity corer are planned to be used. All equipment is left on the ship and is planed to be unloaded and shipped back to Germany after the next cruise leg in Algeciras, Spain. In the afternoon the chief scientist of the next leg, Warner Brückmann, arrived.

Friday, 5 November

In the morning the German, Russian and Georgian scientists leave the ship at 09:00.

3 Methods

GC – Sediment sampling

Valentina Blinova

A conventional gravity corer (GC) of 6-m length with a weight of about one ton was used for bottom sampling (Fig. 3.1). Two different liners were used. The first is a hard plastic liner for preservation of 1-m segments of sediments for further investigation at IFM-GEOMAR, Kiel. Those cores will be studied in order to calibrate the sidescan sonar images. The second liner is a plastic bag for description and subsampling procedure on board. The advantage is the very fast access to the sample, which is important when recovering gas hydrates. After pulling the tubing out of the barrel it is simply cut open and sampling could start immediately.

Figure 3.1: The 6-m long gravity corer used during the R/V POSEIDON cruise P317/4.

OFOS - Seafloor observations

Heiko Sahling

The **O**cean **F**loor **O**bservation **S**ystem (OFOS) is a towed camera sled for observing the ocean floor and map geological and biological features (Fig. 3.2). OFOS is equipped with two xenon lamps (OKTOPUS), a monochrome video camera (OKTOPUS), and a still camera with flash system (BENTHOS). Power is supplied and data are transmitted by a telemetry (ADITEC). A memory CTD (SEABIRD 19) is mounted on the sled prior to deployment and is used to obtain depth, temperature and salinity data. There is a considerable offset between the CTD depth data and the depth given in the bathymetry (bathymetry 15 m deeper than CTD depth). The sled is towed at about 0.5 knots. A weight of 20 cm length is suspended 1.6 m below the sled in order to help the winch operator to maintain a constant height above the seafloor by manually adjusting the cable length. The field of view at the bottom is about 4 m^2. The online video signal is recorded on tape. The still camera (aperture 4, focus 1-1.5 m) was loaded with 33.5 m of slide film (KODAK EKTACHROME, 100 ASA) yielding about 800 photos. For quality control, part of the slide films has been developed on board using a commercial standard E6 development kid. On each photo, the time when it was taken is displayed. In addition, three parallel laser pointer set 0.5 m apart allow scaling the photos.

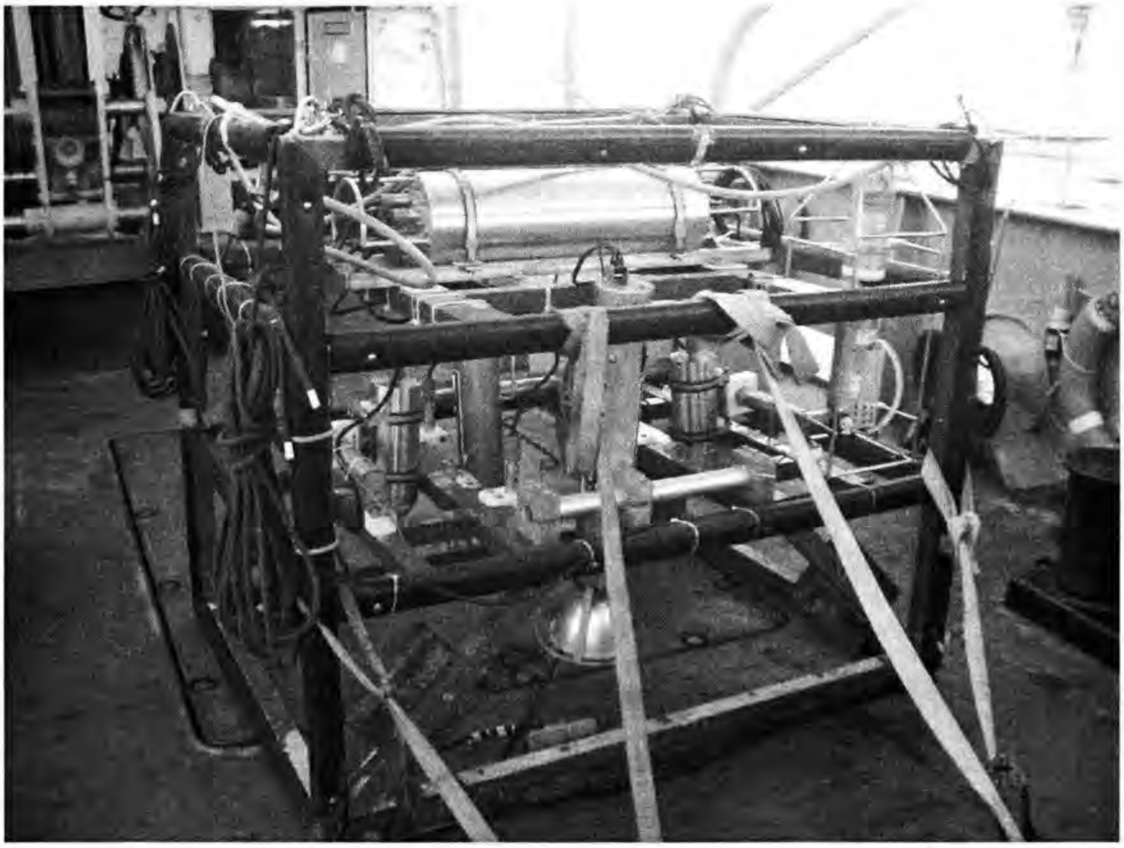

Figure 3.2: The Ocean Floor Observation System (OFOS).

ELAC – Swath bathymetry

Dietmar Bürk

Multibeam data were collected with a portable ELAC BottomChart MkII system, consisting of 50 kHz transducers/receivers which were mounted in the moonpool of the ship, the electronics in a hard case and two PCs, one for the acquisition and one for data processing.

This system can be operated in several modes in combination with different transducers and receivers. For the ones mounted in the moonpool, a frequency of 50 kHz and a maximum opening angle of 120 degrees was chosen. The opening angle could then later be reduced to 100 or 80 degrees via the settings menu. With a narrower opening angle the swath width decreases, but the ping interval time becomes shorter and the quality of the data increases. Therefore, an opening angle of 80 degrees was chosen, when surveying in water depths greater than 1000 m. The number of beams of the system is 129 with a beam angle of 1.5 degrees. The maximum water depth which can be mapped with this configuration is somewhere between 2000 m and 2500 m.

For the acquisition of the data the HydroStar Software package from ELAC Nautik in the Version 3.4.0 was used. The data was stored in the native ELAC format, as well as in the ELAC xse-format. File numbering was continuously throughout the cruise, until a breakdown of the software in the Kozlu Area, where it had to be restarted again (Table 3.1).

The first processing of the data was done with the software MB-System in combination with GMT (General Mapping Tools).

Table 3.1: Overview of ELAC multibeam recordings

Date/Time Start	Date/Time End	Survey Type	Station Number	File Numbers	Survey Area
19.10.04 08:00	20.10.04 12:45	DTS #1	835	004 - 060	Offshore Georgia
20.10.04 12:45	21.10.04 05:00	ELAC #1	836	061 - 091	Offshore Georgia
21.10.04 05:00	21.10.04 14:49	OFOS, GC	837 - 839	092 - 105	Offshore Georgia
21.10.04 14:49	22.10.04 05:10	ELAC #2	840	106 - 130	Offshore Georgia
22.10.04 05:10	22.10.04 15:10	GC, OFOS	841 - 845	131 - 135	Offshore Georgia
22.10.04 15:10	23.10.04 04:15	ELAC #3	846	136 - 220	Offshore Georgia
23.10.04 05:46	23.10.04 14:03	DTS #2	847	221 - 296	Offshore Georgia
23.10.04 15:35	23.10.04 18:05	ELAC #4	848	297 - 312	Offshore Georgia
23.10.04 18:05	24.10.04 13:00	TRANSIT	-	-	No recording
24.10.04 13:17	26.10.04 08:12	DTS #3	849	313 - 491	Offshore Samsun
26.10.04 09:40	26.10.04 15:11	OFOS, GC	850 -851	492 - 534	Offshore Samsun
26.10.04 15:11	27.10.04 22:25	TRANSIT	-	535 - 726	Recording
27.10.04 22:25	28.10.04 05:00	ELAC #5	852	727 - 759	Kozlu High
28.10.04 06:17	30.10.04 05:06	DTS #4	853	760 - 1008	Kozlu High
30.10.04 07:55	30.10.04 17:50	GC, OFOS	854 - 857	1009 - 1074	Kozlu High
30.10.04 18:30	31.10.04 05:15	ELAC #6	858	1075 - 1125	Kozlu High
31.10.04 06:06	31.10.04 08:06	OFOS, GC	859 - 863	1126 – 1137 stop recording after OFOS	Kozlu High
31.10.04 16:08	02.11.04 13:50	DTS #5	864	1138 – 1275 002 - 076	Kozlu High
02.11.04 14:40	03.11.04 06:00	ELAC #7	865	080 - 159	Kozlu High
03.11.04 06:15	03.11.04 09:30	GC	866 - 867	-	No recording
03.11.04 09:35	03.11.04 17:00 (planned)	ELAC #8	868	160 - ??	Kozlu High
03.11.04 17:00	04.11.04 08:00	TRANSIT	-	??	Recording

For the dedicated bathymetric surveys the ship speed was 6 knots. During other operations or transits, the ship speed was bound to the needs of these surveys.
The quality of the data strongly depends on weather conditions. Rough sea leads to the formation of bubbles underneath the ships hull and, therefore, reduced data quality. Fortunately the sea was very calm most of the time.

Initial processing of the raw data
The onboard processing of the raw data was done with MB-System. The files in the xse-format can be read by MB-System (MB-Format 94). Several routines were applied to the data, mainly to correct for pings with wrong time stamps or without any geographical position or for depths outside a certain depth range. In detail the routines *mbcopy* and *mbclean* were applied. The depth ranges in the single areas were:

Batumi off Georgia:	min 200 m / max 1400 m
Samsun off Turkey:	min 800 m / max 2400 m
Kozlu High off Turkey:	min 800 m / max 2400 m

Finally a grid was calculated out of the raw data with a cell size of 50 m by 50 m.

DTS – Deep-Towed Sidescan
Ingo Klaucke

Underwater set-up
The DTS-1 sidescan sonar (Fig. 3.3) is an *EdgeTech Full-Spectrum (FS-DW)* dual-frequency, chirp sidescan sonar working with 75 and 410 kHz centre frequencies. The 410 kHz sidescan sonar emits a pulse of 40 kHz bandwidth and 2.4 ms duration (giving a range resolution of 1.8 cm) and the 75 kHz sidescan sonar provides a choice between two pulses of 7.5 and 2 kHz bandwidth and 14 and 50 ms pulse length, respectively. They provide a minimum across-track resolution of 6-10 cm. Due to towing speeds around 2.5 knots and a range of 750 metres during this cruise maximum along-track resolution is on the order of 0.75 metres. In addition to the sidescan sonar sensors, the DTS-1 contains a 2-16 kHz, chirp subbottom penetrator providing a choice of three different pulses of 20 ms pulse length each: a 2-10 kHz pulse, a 2-12 kHz pulse and a 2-15 kHz pulse giving nominal vertical resolution between 6 and 10 cm. The sidescan sonars and the subbottom penetrator can be run with different trigger modes: internal, external, coupled and gated triggers. Coupled and gated trigger modes also allow to specify trigger delays. The sonar electronics provide four serial ports (RS232) in order to attach up to four additional sensors. One of these ports is used for a Honeywell attitude sensor providing information on heading, roll and pitch. Finally, there is the possibility of recording data directly in the underwater unit through a mass-storage option with a total storage capacity of 30 Gbyte. The sonar electronics are housed in a titanium pressure vessel mounted on a towfish of 2.8m x 0.8m x 0.9m in dimension (Fig. 3.3). The towfish houses a second titanium pressure vessel containing the wet-end of the *SEND DSC-Link telemetry system*. In addition, an *OCEANO releaser* with separate receiver head and a *NOVATECH emergency flash and sender* are included in the towfish.

Figure 3.3: The DTS sidescan sonar vehicle during deployment onboard R/V POSEIDON.

The towfish is connected to the sea cable via the depressor (750 kg weight) through a 40 m long umbilical cable. The umbilical cable is tied to a buoyant rope that takes up the actual towing forces. An additional rope has been taped to the buoyant rope and serves to pull in the instrument during recovery.

Laboratory set-up

The laboratory set-up consists of three elements: the dry-end of the *SEND DSC-Link telemetry*, the *EdgeTech surface interface unit FS-IU* and the topside unit running *ELAC Hydrostar Online* software (Fig. 3.4). *Hydrostar Online* allows general running of the sidescan sonar and subbottom penetrator operations as well as onscreen display of a subset of the acquired data. Unfortunately some additional settings such as the trigger mode can only be changed by accessing the underwater electronics directly via the *FS-IU*. The *FS-IU* also runs *JStar*, a diagnostic software tool that also allows running some basic data acquisition and data display functions.

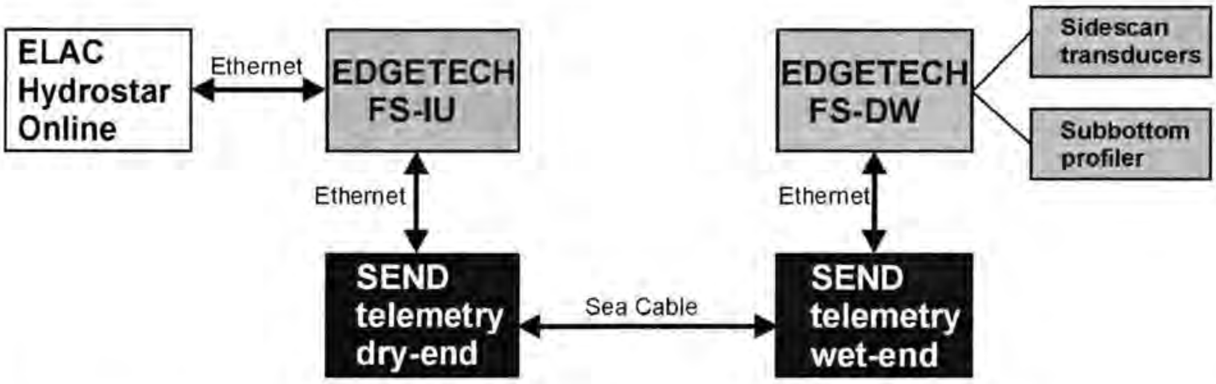

Figure 3.4: The electronic configuration of the DTS-1 system during R/V POSEIDON cruise P317/4.

Software

The main operations of the DTS-1 sidescan sonar are essentially run using *Hydrostar Online*: a multibeam bathymetry software developed by *ELAC Nautik GmbH* and adapted to the acquisition of *EdgeTech* sidescan sonar data. HydroStar Online version 3.3.4 with improved onscreen data representation and time synchronisation has been available. This software package allows onscreen representation of the data and of the fish's attitude. It also allows setting some principle parameters of the sonar electronics, such as the selected pulse, the range, the power output, the gain, the ping rate, and the range of registered data. However, this version does not allow setting of the trigger mode or the master subsystem in coupled trigger mode. *HydroStar Online* also allows starting and stopping data storage either in XSE-format on the *HydroStar Online* computer on in JSF-format on the *FS-DW*. Simultaneous storage in both XSE and JSF-formats is also possible. *HydroStar Online* creates a new XSE-file when a file size of 10 Mb is reached, while a new JSF-file is created every 40 Mb. How fast this file size is reached depends on the amount of data generated, which in turn essentially depends on the use or not of the high-frequency sidescan sonar. The amount of data generated is also a function of the sidescan sonar and subbottom pulses and of the data window that is specified in the sonar.ini file on the *FS-DW*. The data window specifies the range over which data are sampled. Proper selection of this parameter strongly depends on the selected range of the sidescan sonar system in order to avoid good data to be cut-off, or to prevent too large amounts of useless data using up storage space. It also proved practical to switch off data recording during turns. Two datasets were recorded, one directly in the fish and another one transmitted in real time to the ship. The data were then copied on CD-ROM and DVD+R.

Processing of the sidescan sonar data requires altitude detection, slant range correction and geographic representation of the data. Preliminary processing of the sidescan sonar data was carried out onboard using *CARAIBES* v2.5 (a software package from IFREMER). During the time of the cruise the development team of Caraibes in Brest (IFREMER) was working on an improved version for handling the DTS-1 sidescan sonar data. The data will be further processed in Kiel (IFM-Geomar) or Izmir (Eylül Dokuz University) using either this new version of *CARAIBES* or *PRISM* (a software package from Southampton Oceanography Centre). Processing of the subbottom profiler data is still problematic, but efforts are underway in Brest (IFREMER) and Kiel (IFM-GEOMAR) to correct the subbottom profiler data for varying tow depths of the sonar fish and to properly display the data.

Data quality

A total of 30 Gbyte of data have been acquired during 6 deployments of the DTS-1 sidescan sonar. Of these deployments one was dedicated to very high resolution studies using the 410 kHz sidescan sonar sensor. The remainder of the deployments used 75 kHz sidescan sonar using the broad bandwidth but short 14ms ping. During deployments the subbottom profiler was run continuously using a 2-10 kHz ping of 20 ms duration.

The quality of the data obtained was excellent. Thanks to a new version of the *SEND Telemetry* system noise in the data was significantly reduced. This strongly increased the signal-to-noise ratio and improved data quality, especially at far range. The subbottom penetrator reached penetrations of up to 50 meters while still showing fine-scale features.

4 Preliminary Results

4.1 Working area *Batumi* off Georgia

Summary

Based on unpublished data kindly provided by Leonid Meisner one working area during this cruise were the gas seeps off Batumi. An area offshore the 12 nm economic exclusive zone of Georgia was intensively studied by ELAC swath bathymetry, DTS side scan sonar, OFOS video sled and gravity corer (GC).

The continental slope is structured by two major canyons that intensify the morphology of three west-east trending ridge systems. The backscatter image shows that the canyon in the south has been recently active. About six gas seeps were recorded as acoustic anomalies by DTS, two at the ridge in between the canyons, the others at the pronounced southern ridge that rises to water depths of about 300 m.

We concentrated the seafloor observations and sediment sampling on one of the gas seeps which we named Batumi Seep. It is placed on the ridge between the canyons and is placed on a local high that rises about 10 m at 855 m water depth (bathymetry). This was also imaged by a high resolution 410 kHz side scan sonar survey. The backscatter image shows three clearly distinguishable backscatter patterns. Firstly, side scan imaged a linear fault with considerable offset trending West to East. OFOS revealed outcropping bedded sediments, lithified sediments and/or carbonates in this area at this fault. Second, in direct vicinity around the fault high backscatter occurs that probably correspond to sediments with precipitated authigenic carbonates as revealed by gravity corer. These cores as well as the cores taken at the third type of backscatter pattern contained cm-size gas hydrates. It is likely that the entire area around the fault is influenced by methane seepage that causes the occurrence of gas hydrates.

Table 4.1.1: Stations in the working area off Georgia conducted during cruise P317/4.

Stat	Tool	Site	Remarks
835	DTS # 1	6 profiles	
836	ELAC # 1		
837	OFOS # 1	Batumi Seep	
838	OFOS # 2	Batumi Seep	
839	GC # 1	Batumi Seep	Bag
840	ELAC # 2		
841	GC # 2	Batumi Seep	Liner
842	GC # 3	Batumi Seep	Liner
843	GC # 4	Batumi Seep	Liner
844	GC # 5	Batumi Seep	Bag
845	OFOS # 3	Batumi Seep	Bag
846	ELAC # 3		
847	DTS # 2	1 profile and 410 kHz at Batumi Seep	
848	ELAC # 4		

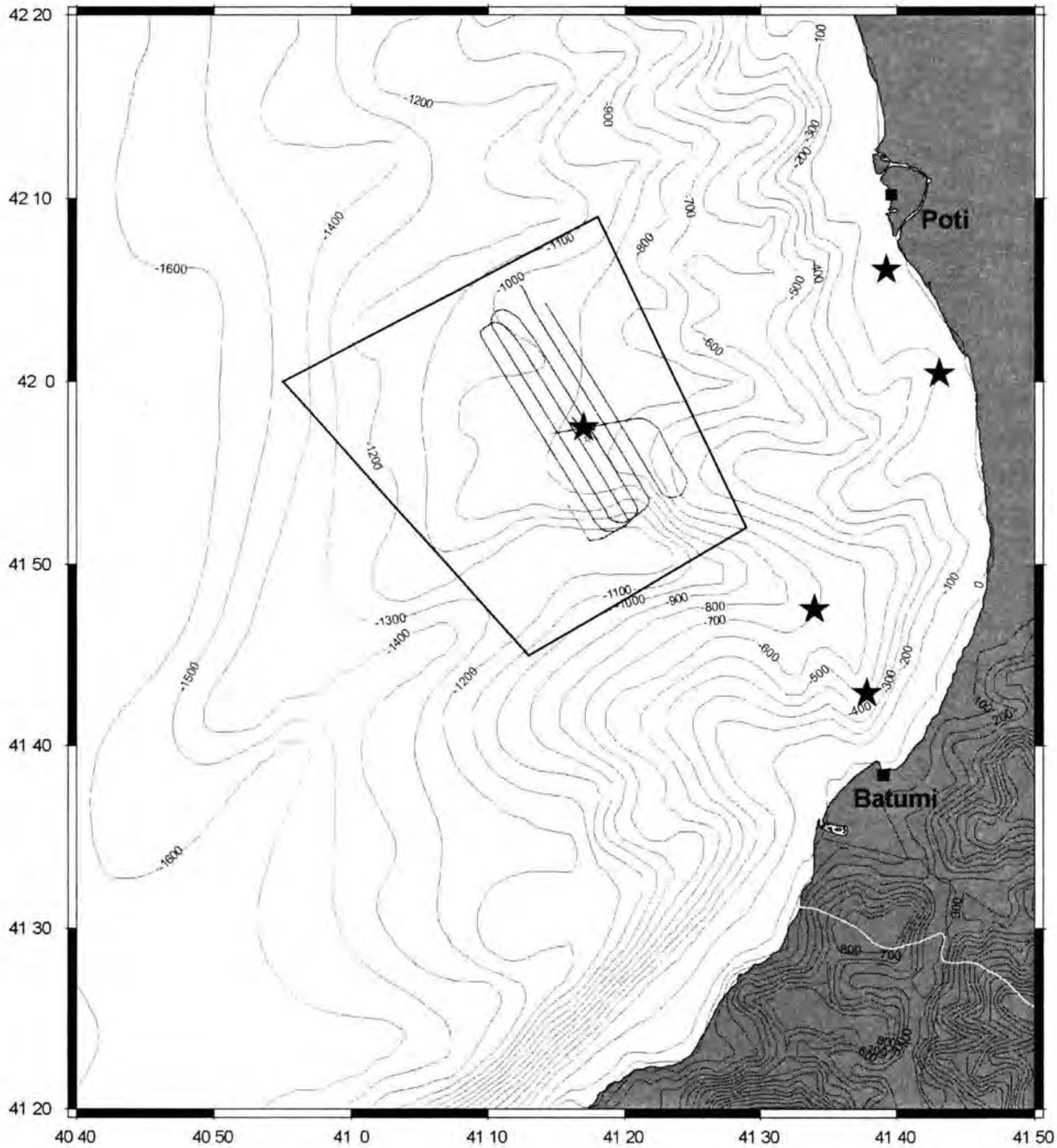

Figure 4.1.1: Map of the continental margin of southern Georgia showing the working area and DTS-1 surveys during R/V POSEIDON cruise 317/4. The locations of gas seeps (stars) were provided by L. Meisner.

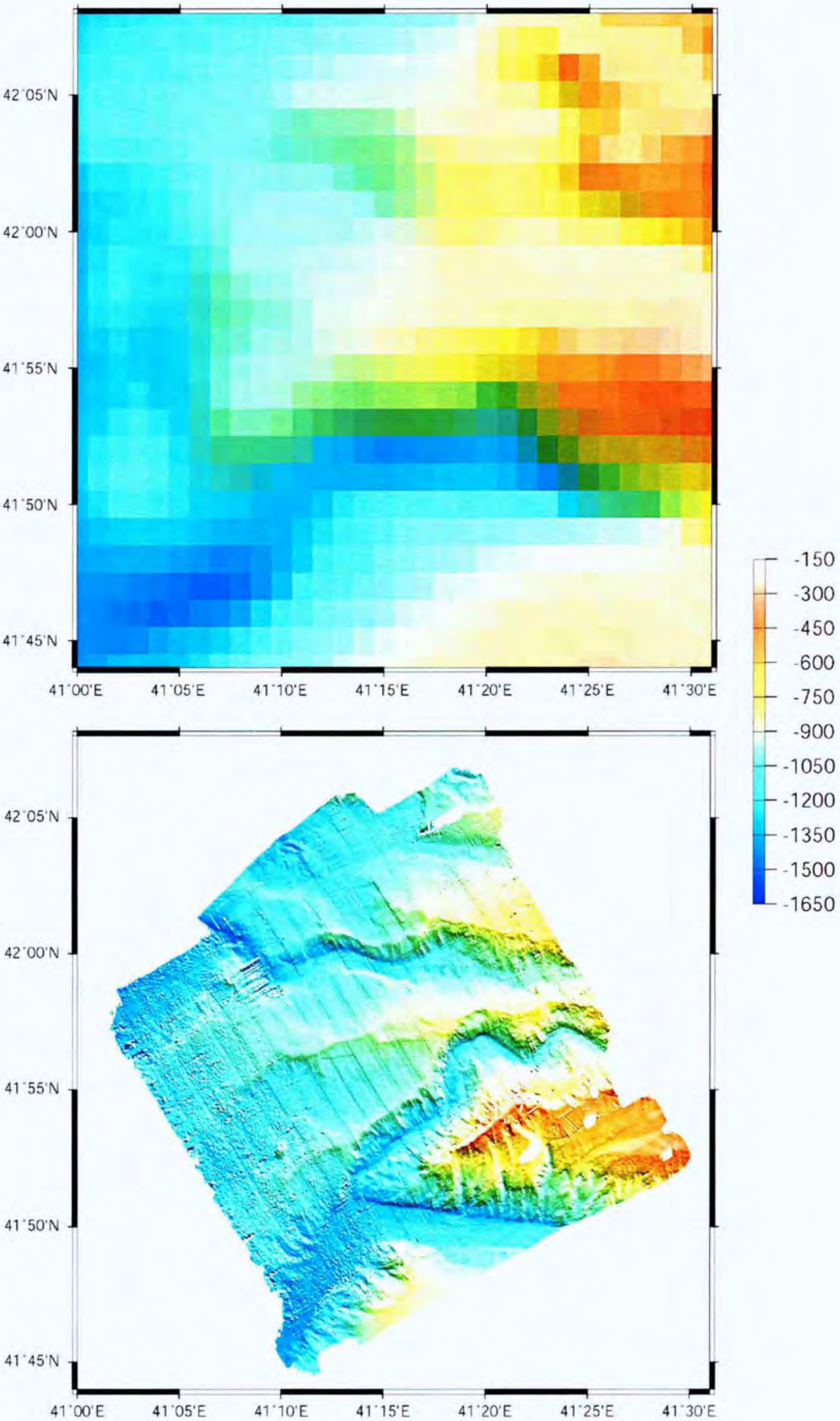

Figure 4.1.2: Comparison between the global GEPCO 1-min data set (upper map) and the bathymetry obtained by ELAC swath mapping during cruise P317/4 (lower map).

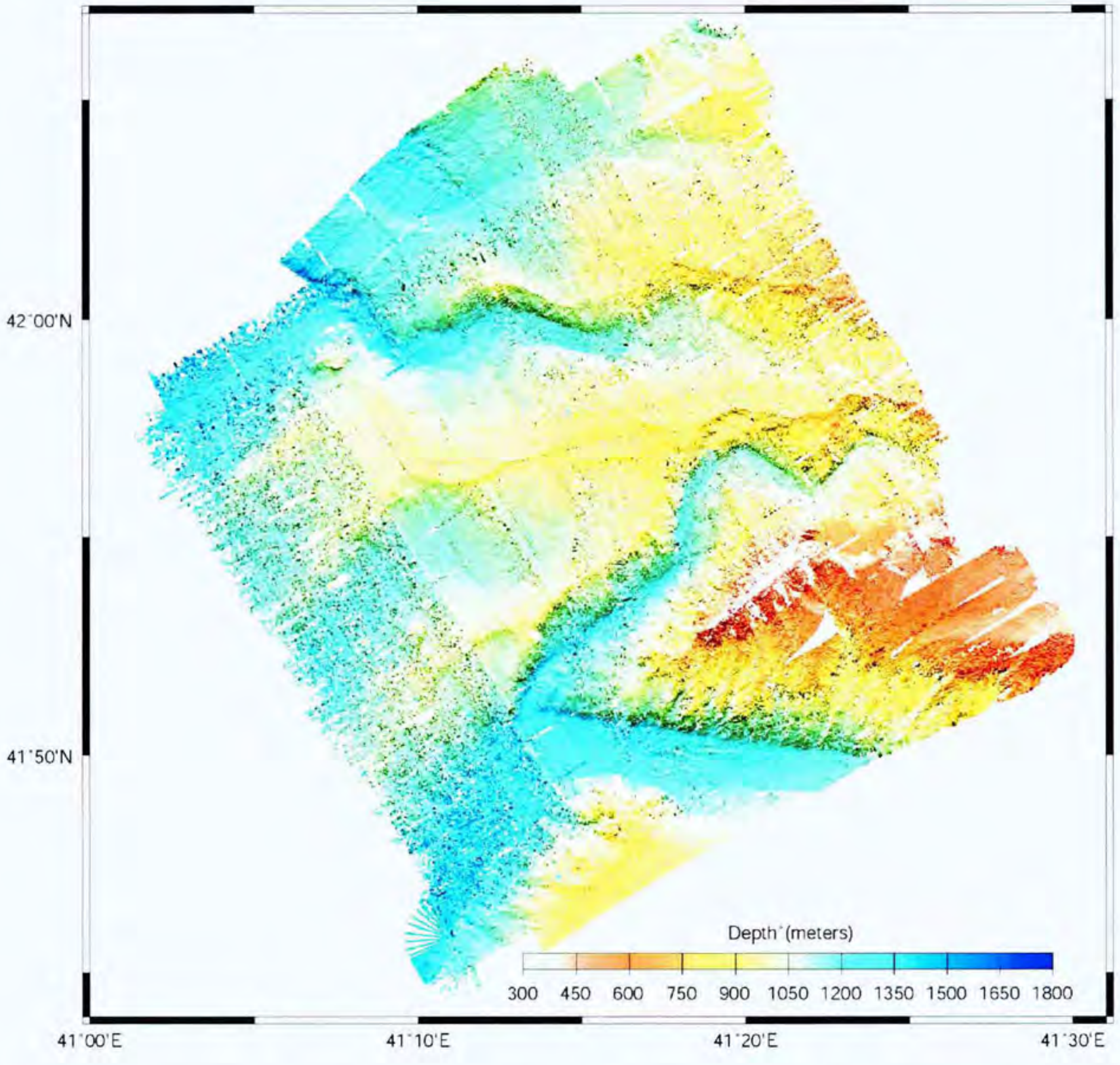

Fig. 4.1.3: XY plot of filtered raw data of the ELAC swath bathymetry survey offshore southern Georgia.

ELAC – Swath bathymetry

The bathymetric data offshore Georgia were acquired during two DTS and four ELAC surveys. The total area mapped is approximately 900 square kilometers, roughly 30 km by 30 km in size (Fig. 4.1.2 – 4.1.4). The depths ranged from 330 m to 1400 m. Data coverage and quality is generally good. However, in the eastern parts at shallow water depths the data coverage decreases and in the western part the data quality is bad due to stormy weather during the survey. The total acquired data size was 1.02 GigaByte.

In the area two sinuous canyons are visible. The northwestern canyon has a relief height of approximately 200 m deep while the south-eastern canyon has up to 250 m relief. The southern canyon is bounded to the south by a large ridge, reaching up to water depths of only 330 m. This ridge itself is cut in the south by a sharp and straight line, probably a fault. Along the sides of the canyons, several slump scars can be recognized.

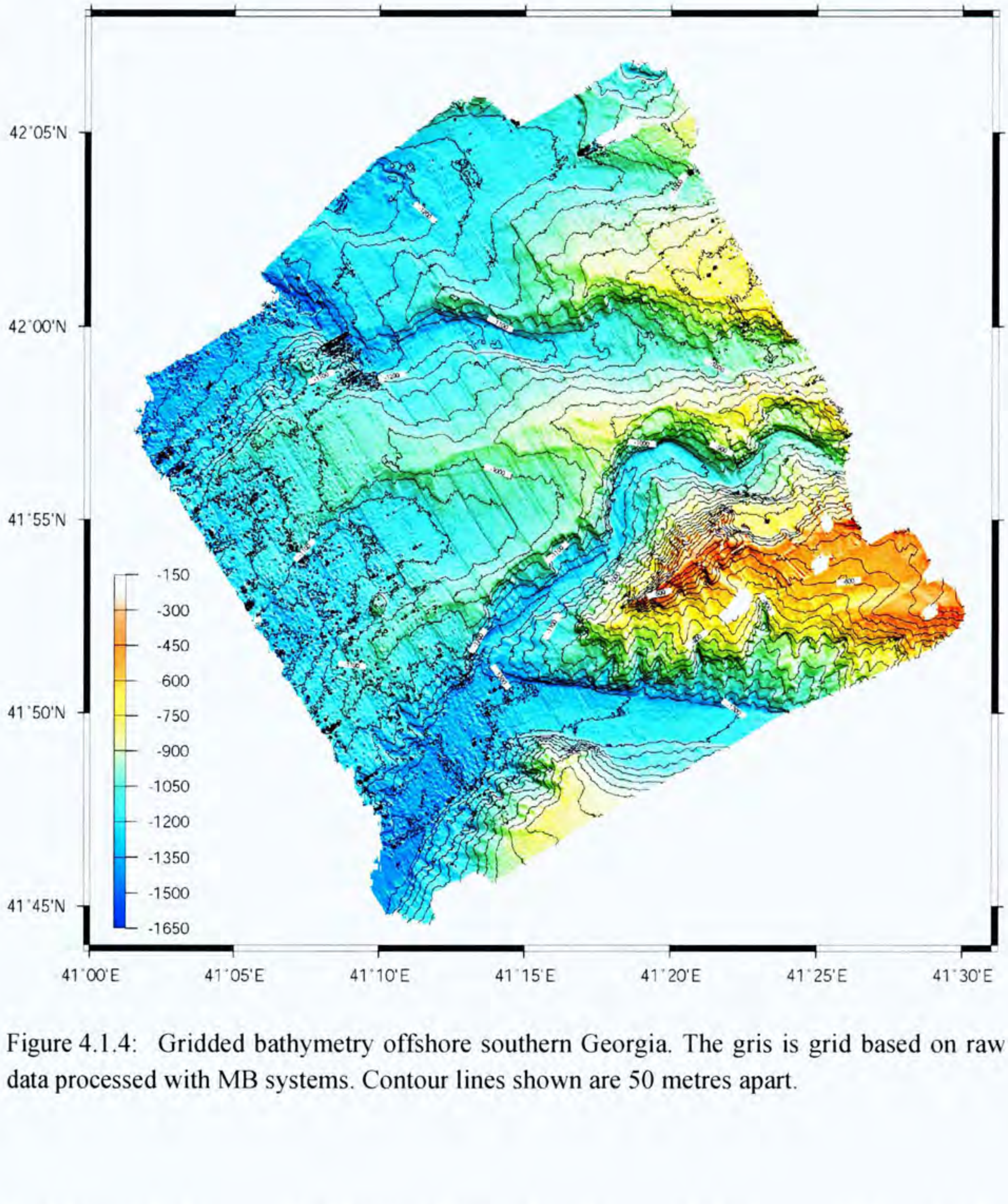

Figure 4.1.4: Gridded bathymetry offshore southern Georgia. The gris is grid based on raw data processed with MB systems. Contour lines shown are 50 metres apart.

In addition to bathymetry, the ELAC multibeam data also provide backscatter information for each beam. A map display of these data (Fig. 4.1.5) underlines the presence of the canyons that appear with very high amplitudes.

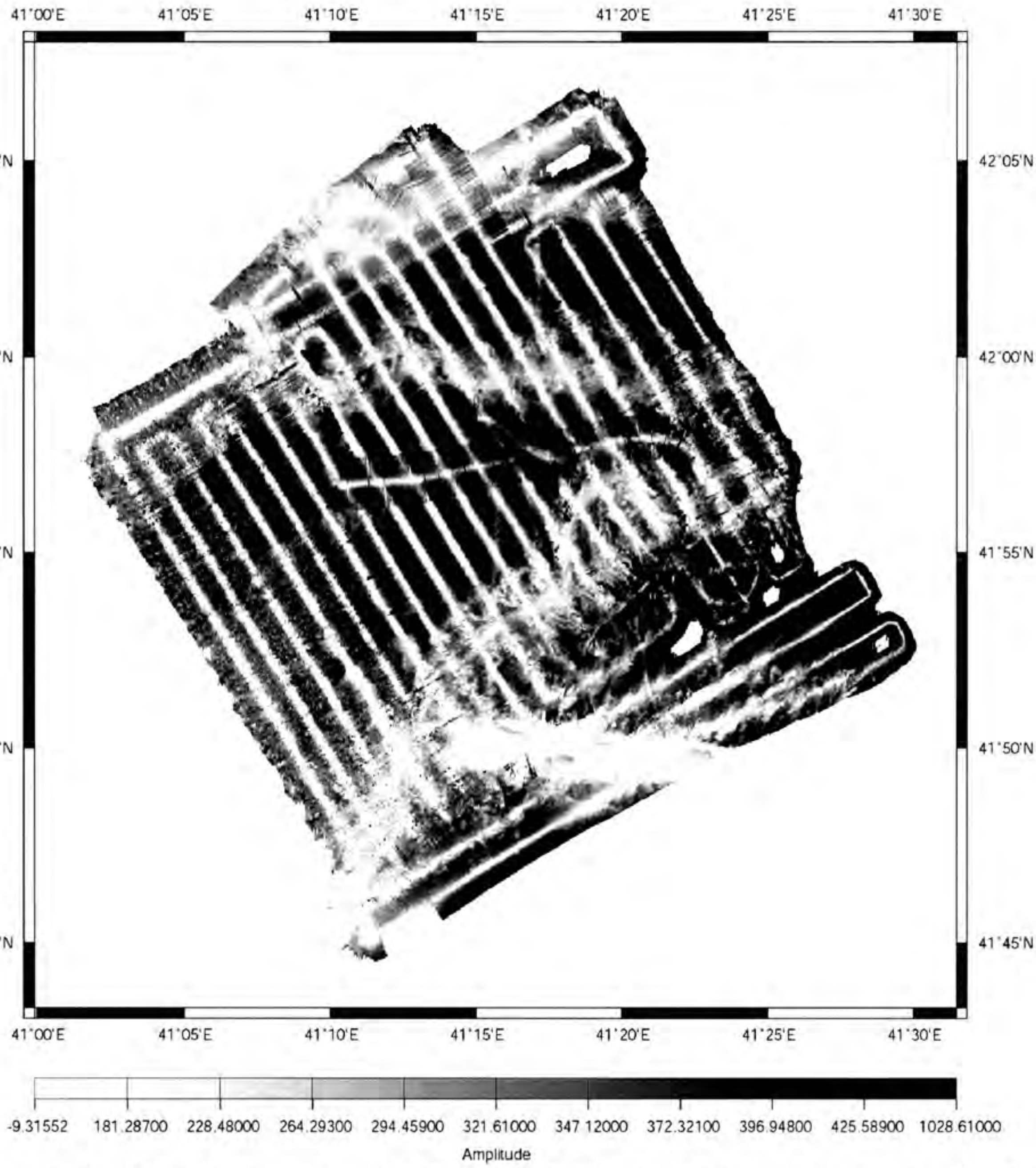

Figure 4.1.5: Map showing the amplitudes of ELAC backscatter data corresponding the the bathymetry grid in figure 4.1.4.

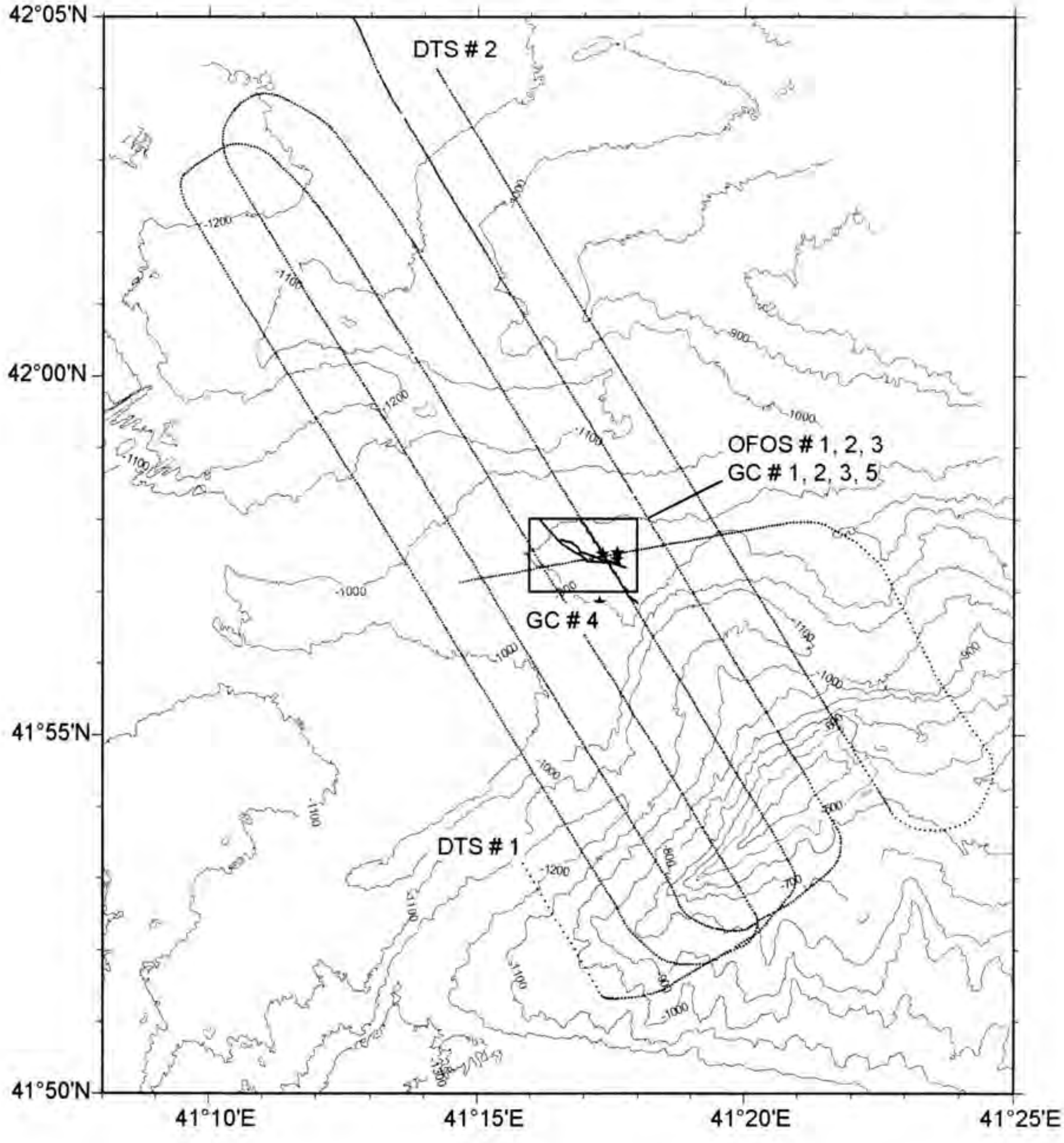

Figure 4.1.6: DTS surveys and stations in the working area offshore southern Georgia. Detailed seafloor observations and sampling was conducted at "Batumi Seep". The map is based on the ELAC swath bathymetry.

DTS – Deep-towed sidescan

The area of the Georgian seeps was covered with six parallel DTS-1 tracks (each 0.8 nm apart) and one oblique high resolution profile covering a total area of 30 km^2. The six main tracks are oriented NW-SE and some major morphological elements are easily recognizable in the backscatter pattern.

There are two major canyons visible with probably a third canyon the extreme north-west of the mosaic touched by two of the profiles. The northwestern canyon that was covered by all profiles shows high backscatter intensity on the canyon floor with features resembling sediments waves in some locations (Fig. 4.1.7). The flanks of this canyon are fairly smooth compared to the other canyon in the south-east. Here canyon walls are steep and show numerous signs of sediment failure ranging from small-scale gullying to large slump scars. The floor of the canyon shows a feature that probably represents the thalweg, which is underlined by strong lineations perpendicular to the slope (Fig. 4.1.8). Terraces are also present and commonly appear on the sidescan mosaic by high backscatter marking the difference in slope of the terrace steps. This canyon seems to be more active or with activity having occurred more recently than its counterpart in the north-west.

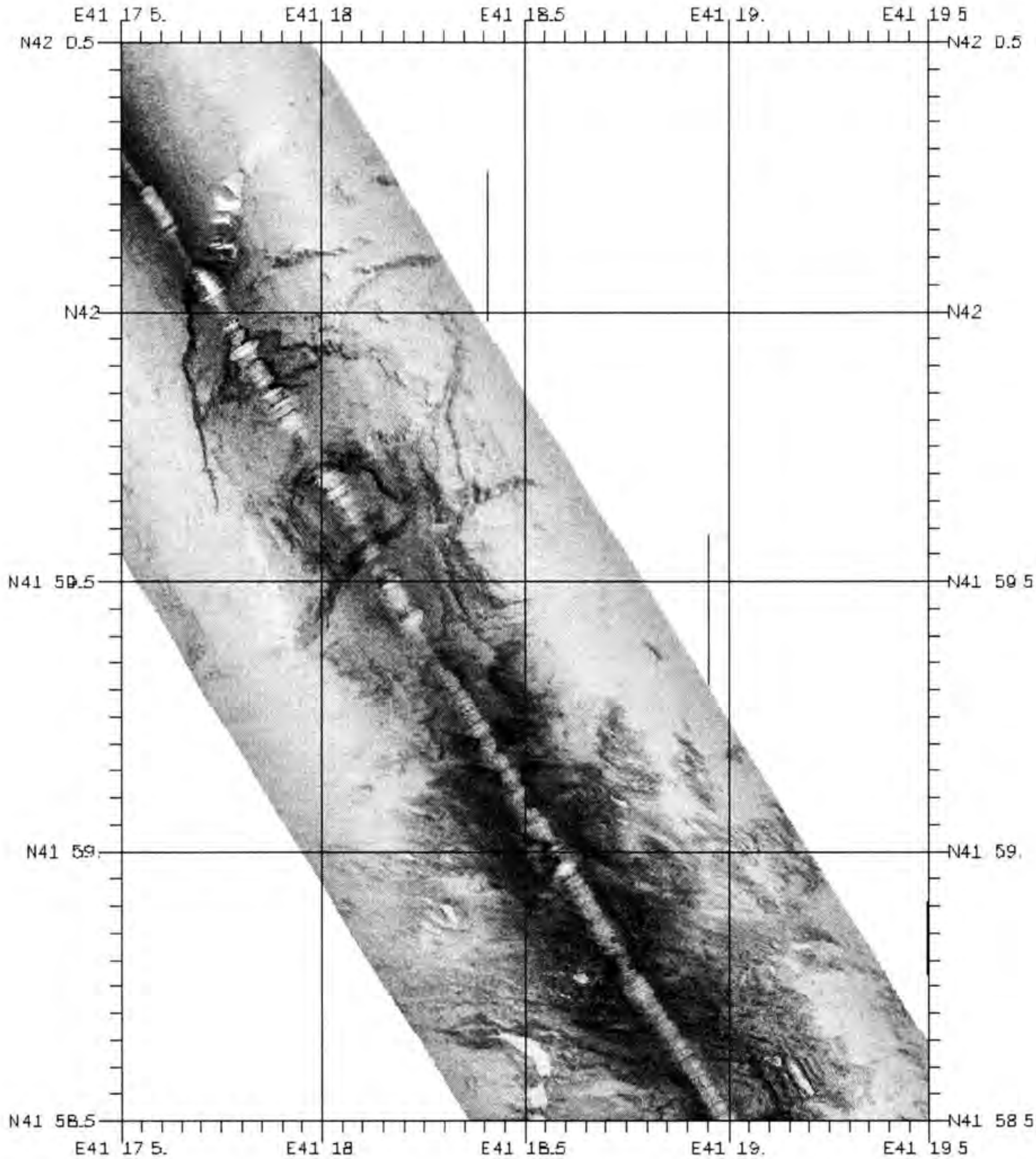

Figure 4.1.7: Sidescan sonar profile across the nothwestern canyon showing high backscatter intensity (=black) on the seafloor with some lineations perpendicular to the canyon floor. The northern margin of this channel shows terraces with small sediment failures.

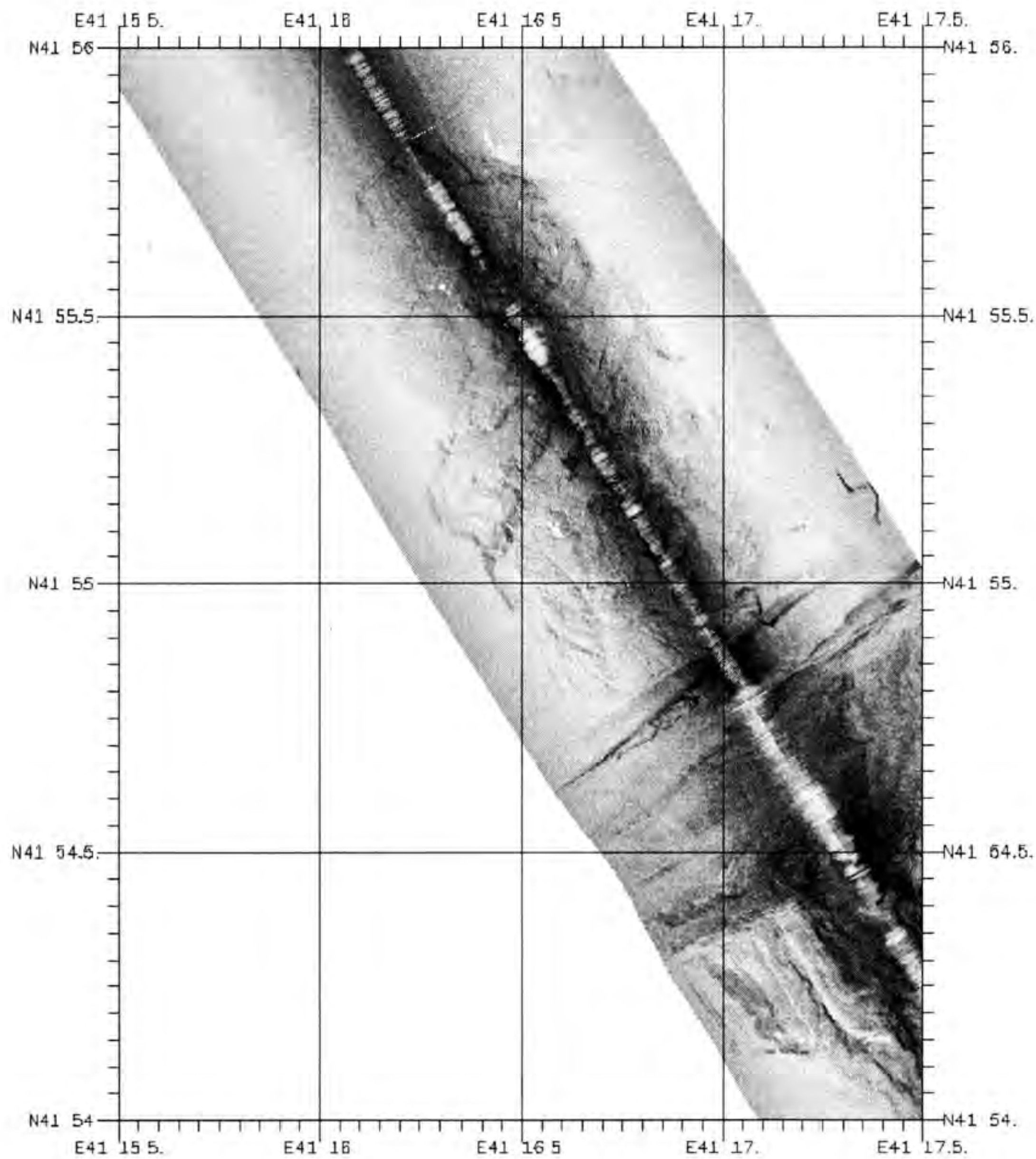

Figure 4.1.8: Sidescan sonar profile across the southeastern canyon showing high backscatter intensity (=black) on the seafloor with some lineations parallel to the canyon floor. The northern margin of this channel shows signs of sediment failures.

The area between the two canyons is marked by generally low backscatter intensity that is, however, interrupted at several prominent locations in mid-slope. At these locations high backscatter anomalies correspond to areas where gas flares in the water column have been observed in the sidescan sonar data (Fig. 4.1.9 and 4.1.10). These gas seeps generally have very high backscatter intensity in their centre that probably corresponds to mixed gas hydrates and carbonates (Fig. 4.1.11). Small-scale faulting also appears to be a common feature at these sites (Fig. 4.1.11). The larger one of these seep sites called Batumi seep also shows a more marginal area of intermediate backscatter that seems to correlate to gas hydrates in a matrix of fine-grained sediments. An additional area of this type of backscatter can be seem to the east of Batumi flare and one may speculate about finding similar sediments in that location. Also, at present we cannot rule out that inappropriate gain settings during the preliminary processing reduced the backscatter intensity of this mid-range location, while all other seep areas were by chance covered at near range. In addition to these seep locations at the crest of this central ridge, gas flares have been observed at the southern, very steep margin of the southeastern canyon.

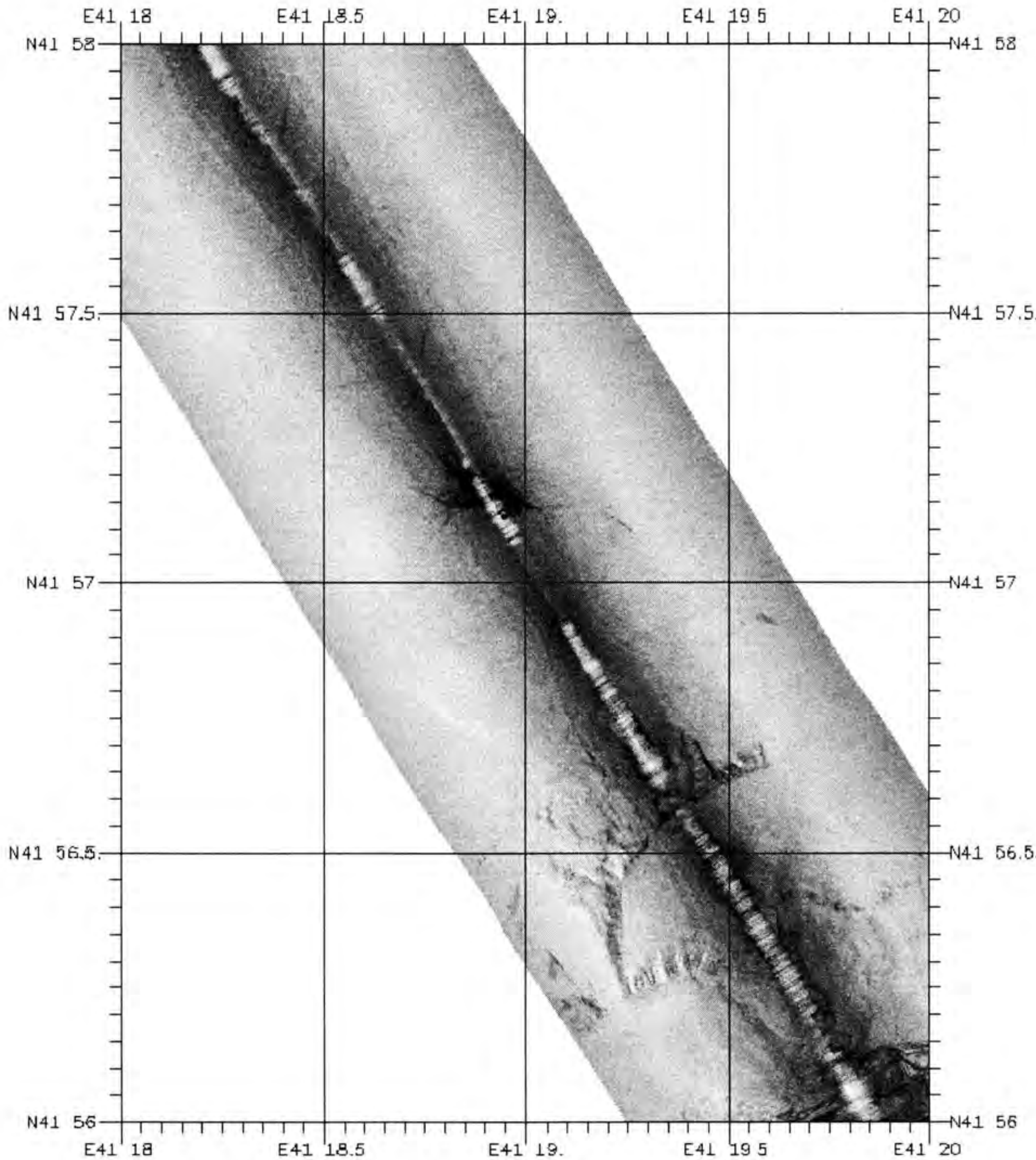

Figure 4.1.9: Sidescan sonar profile across the central ridge between the two canyons showing generally low backscatter intensity (=white) with one area of very high backscatter intensity (=black) corresponding to a flare in the water column (Fig. 4.1.10A). Also shown are terraces bordering the southeastern canyon.

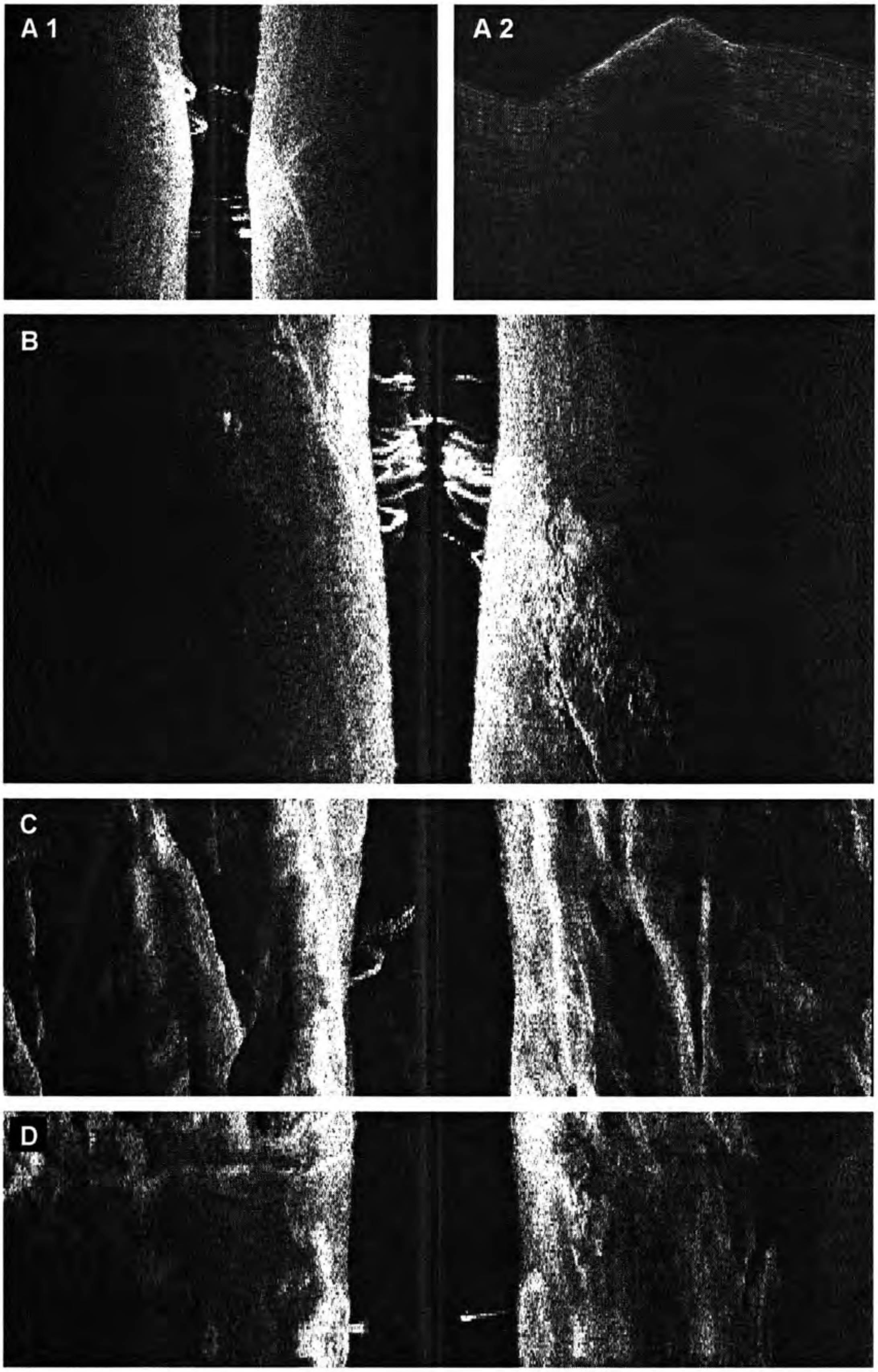

Figure 4.1.10: Examples of acoustic anomalies in the water column indicating seepage of gas bubbles ("flares") and an image of the subbottom profiler (A 2). The images are parts of screenshots from HydroStar Online (the DTS recording software). A1 and 2 Batumi Seep.

Table 4.1.2: Gas seeps offshore Georgia surveyed during R/V POSEIDON cruise P317/4

No.	Latitude	Longitude	Remarks
1.	41°57.50'N	41°17.35'E	Batumi Seep and flare on Central Ridge
2.	41°57.25'N	41°17.85'E	On Central Ridge medium backscatter (possibly flare)
3.	41°57.15'N	41°18.90'E	On Central Ridge (high backscatter)
4.	41°52.90'N	41°18.70'E	Southern flank of canyon (near crest)
5.			Southern flank of canyon (mid-wall)
6.			Southern flank of canyon (base of canyon wall)

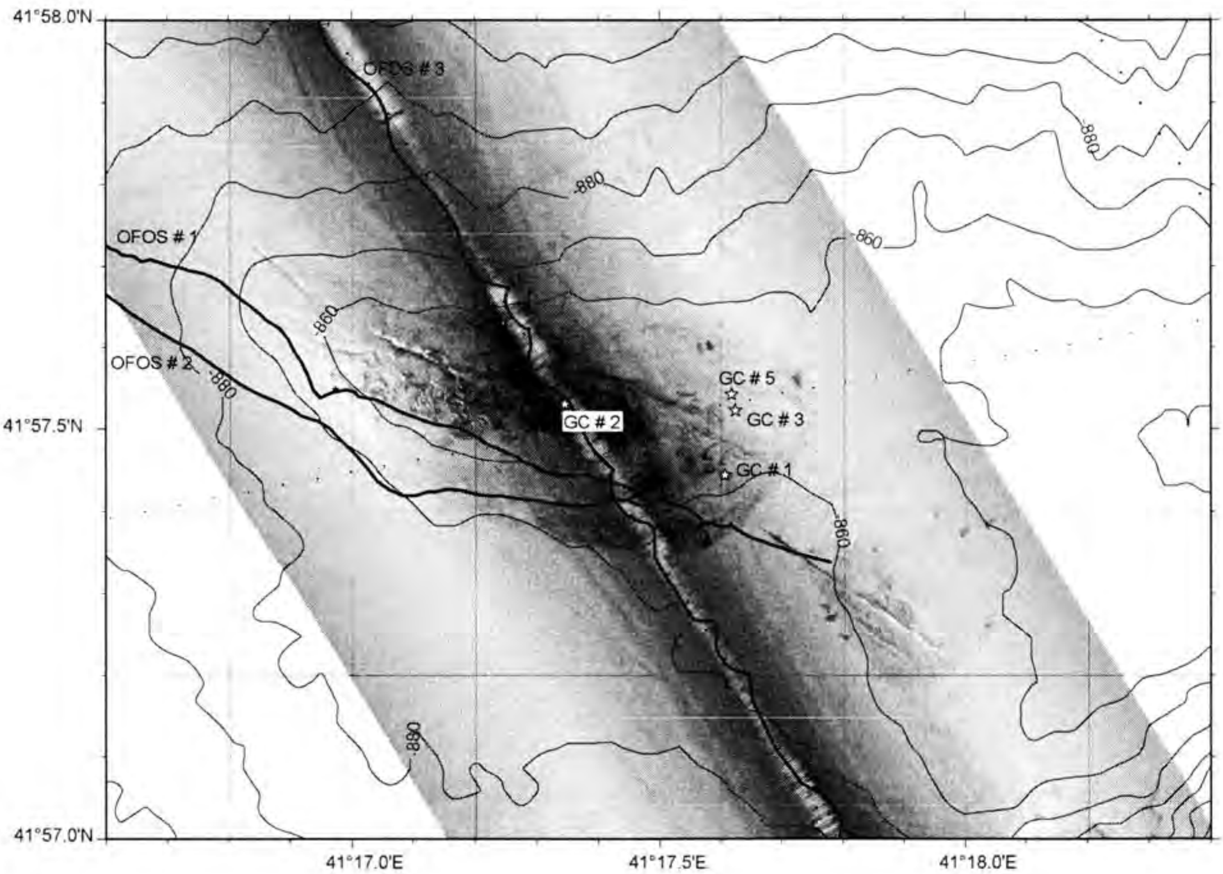

Figure 4.1.11: Map of Batumi Seep showing DTS backscatter (high backscatter = black), ELAC bathymetry, OFOS surveys (ship positions) and GC sampling locations.

OFOS – Seafloor observations

Batumi Seep was surveyed by three OFOS tracks. Strong winds and waves required to tow OFOS # 1 and # 2 from East to West (Northwest) over Batumi Seep (Fig. 4.1.11). With those two lines we surveyed only the southern margin of the seep site where we observed a small area about 10 m large and covered by a whitish (probably bacterial) mat and a small area with outcrops. OFOS # 3 was deployed the next day at calm weather conditions; therefore, we were able to tow the video sled along the DTS line. Outside the seepage area the sediments were evenly coloured, smooth and very soft. Around the Batumi Seep the sediments showed patches of slightly varying colour for which we have no explanation. A patch of a few meter of blackish coloured sediments probably indicated strong sulfidic/anoxic conditions. The observations revealed that the sediments are displaced and disturbed at the summit of the fault.

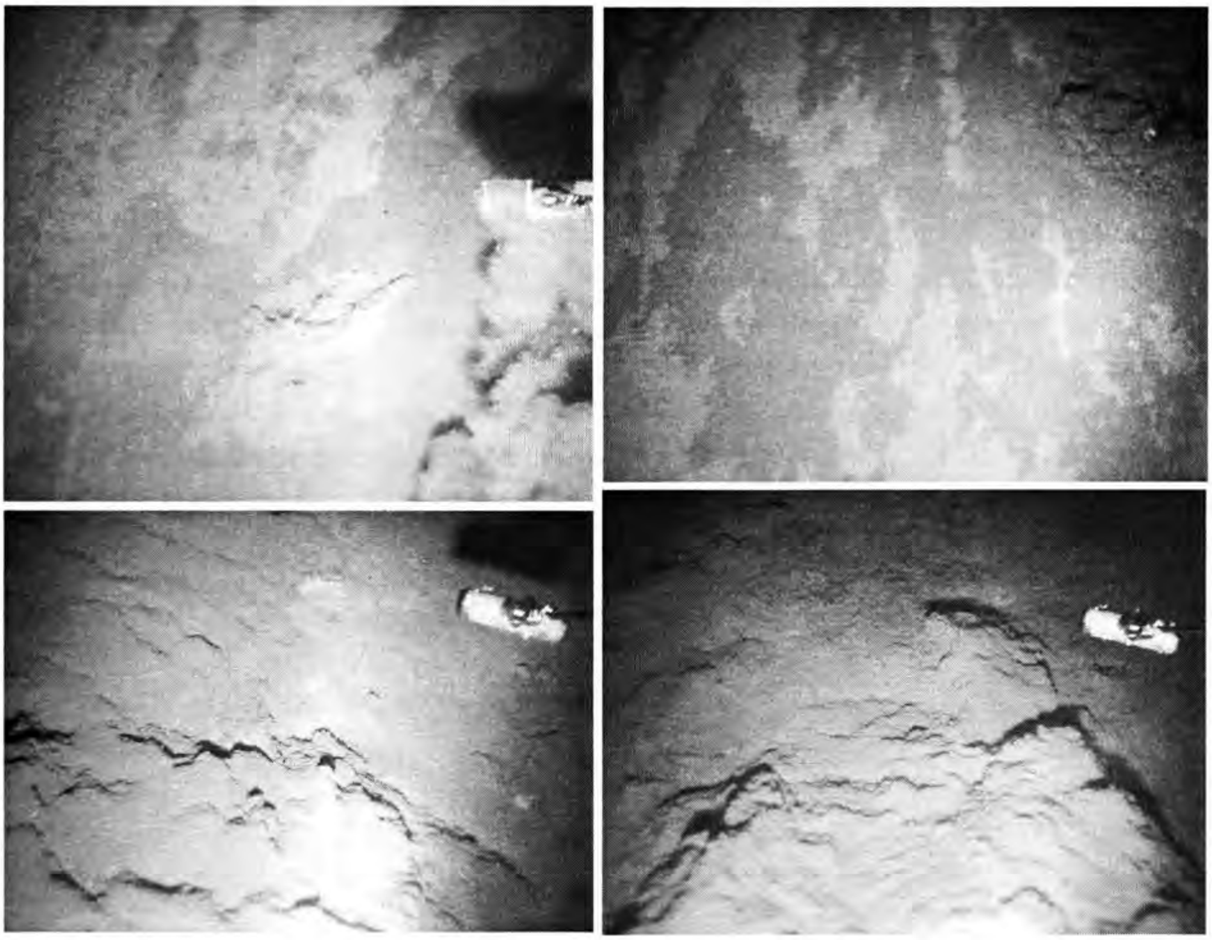

Figure 4.1.12: Seafloor pictures of the still camera mounted on the video sled OFOS at Batumi Seep. The changing sediment colors and outcrops are probably related to faulting and methane release.

GC – Sediment sampling

5 gravity corers were taken off Georgia (Guriiskii depression) (Fig. 4.1.6 and 4.1.11).

GC # 1 was taken at the eastern part of Batumi Seep. The uppermost sediments were characterized by very water-saturated, sloppy, structure-less, grey mud (Core description see appendix). Below (from 10 to 20 cm) finely (less than 1 mm) laminated sequence of alternating white coccolith-rich laminae was observed. Below it - grey mud, stiffer, highly gas-saturated. There are very dark grey sapropels with some plant remains from 35 to 80 cm, with some lamination with coccolith ooze at 80-105 cm. Deeper thickly laminated mud, shown by slight colour variations between shades of grey (light - dark grey) are observed.

And from 140 to 260 cm: light grey mud, enriched in hydrotroilite (reduced iron) (200 cm), highly gas-saturated, with strong smell of hydrogen sulfide.
GC # 2, # 3, and # 4 were taken for acoustic calibration and were stored without opening. But based on the sediments which were seen in core catcher and during cutting sequences, we can make several assumptions. At the forth segment (GC # 2) small thin chips of gas hydrates (up to 2 cm) were found in the grey water-saturated mud matrix (Fig. 4.1.13). The entire core contained small (up to 1 cm) angular light grey carbonate concretions.
Gas hydrates about 3 cm in diameter were found in the core GC # 3. They are larger and massive. Also strong smell of sulfide was detected. GC # 4 was taken at the eastern side of the seeps area as a reference station. Most probable we will find there same lamination as in core GC # 1.

GC # 5 was taken at the same location as GC # 2 in order to sample gas hydrates. Unfortunately, due to very high pressure of gas hydrate dissociation most of the sediment sequence was push out from the core. Only 50 cm was recovered. The sediment sequence is similar to GC # 1 core: at the top - very water-saturated, sloppy, structureless, grey mud and deeper - finely laminated (less than 1 mm) sequence of alternating white coccolith-rich laminate.

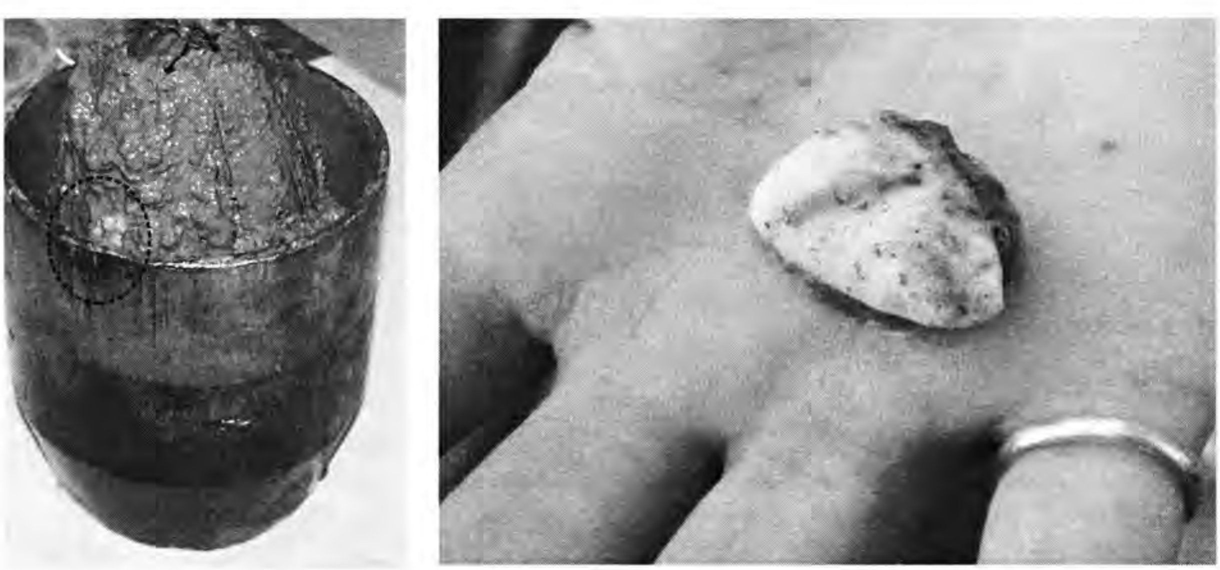

Figure 4.1.13: Small chips of gas hydrates in a gravity corer form Batumi Seep.

4.2 Working area *Samsun* (Area 3) off Turkey

Summary

A DTS survey was conducted in order to survey three sites of interest on the slope apron of Archangelski Ridge and the adjacent plain. Previous investigations by our Turkish colleagues indicated active seepage and shallow gas occurrences in the sediments. In addition, unpublished results kindly provided by Leonid Meisner suggested the presence of a mudvolcano in that same area. DTS # 3 imaged several features associated to sediment transport processes as well as fault scars. Hard reflectors in the subbottom profiler overlaying probably gas-rich sediments pinch out at the scars and methane seepage might be expected there. We found only one location with a small acoustic anomaly probably indicating gas bubbles. In the area high backscatter occurs. However, neither the observations during OFOS # 4 nor the sediments retrieved by GC # 6 revealed evidence for methane seepage.

ELAC – Swath bathymetry

There was no dedicated ELAC multibeam survey in the working area Samsun (Area 3), but the multibeam bathymetry system was started with the DTS deployment and was running continuously throughout the sidescan survey. This survey consisted of three DTS lines with a length of approximately 55 km and a line spacing of 1200 m. The area covered was therefore roughly 200 square kilometres. The total amount of data acquired is 725 megabytes.

The profiles were crossing a large plain with a water depth of around 2000 m. At the western end of the profiles water depth decreases, indicating the foot of Archangelsky Ridge. With the degree of processing carried out onboard the basin plain appears as essentially flat, although numerous small steps are visible in the sidescan sonar data. The final processing of the ELAC data will proof, if they are also shown by the bathymetric data. The eastern margin of the survey shows a pronounced step towards lower water depth associated with a more rough terrain. The origin and significance of these features are not yet known. Finally, the area of the presumed mudvolcano by L. Meisner shows slightly smaller water depth than the surrounding seafloor. To date, the presence of a mudvolcano at this location can neither be confirmed nor rejected. Future work and the combination of bathymetric and backscatter information will be necessary.

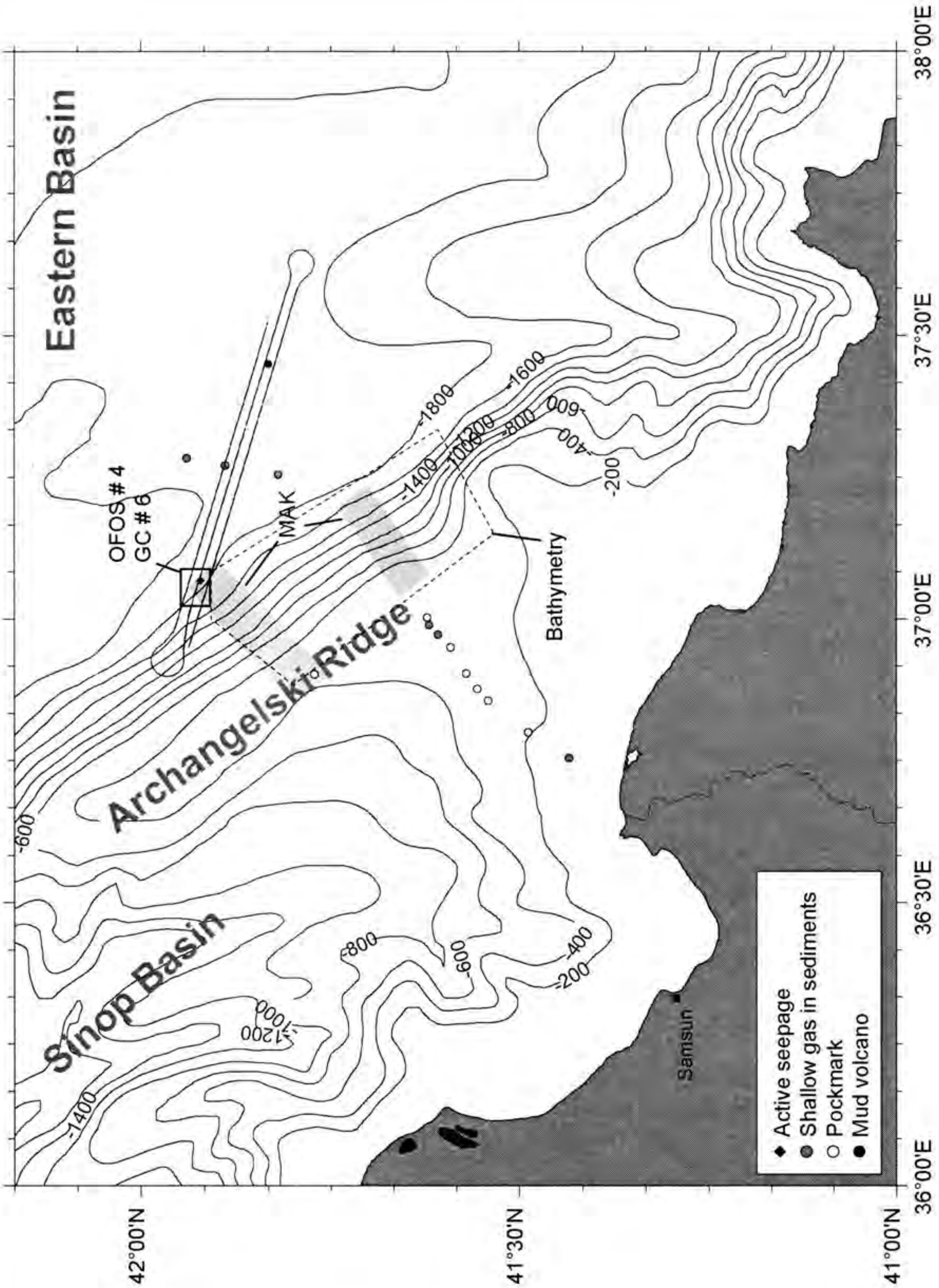

Fig 4.2.1: The working area "Samsun" at the slope apron and plain off Archangelski Ridge with DTS surveys and locations of OFOS and GC also shown in Fig. 4.2.6. This area was intensively studied by the Turkish colleagues during earlier investigations. MAK sidescan sonar and bathymetry images exist from the slope of Archangelski Ridge, unfortunately, they are not available as digital data. Seismic lines indicated pockmarks and shallow gas in sediments.

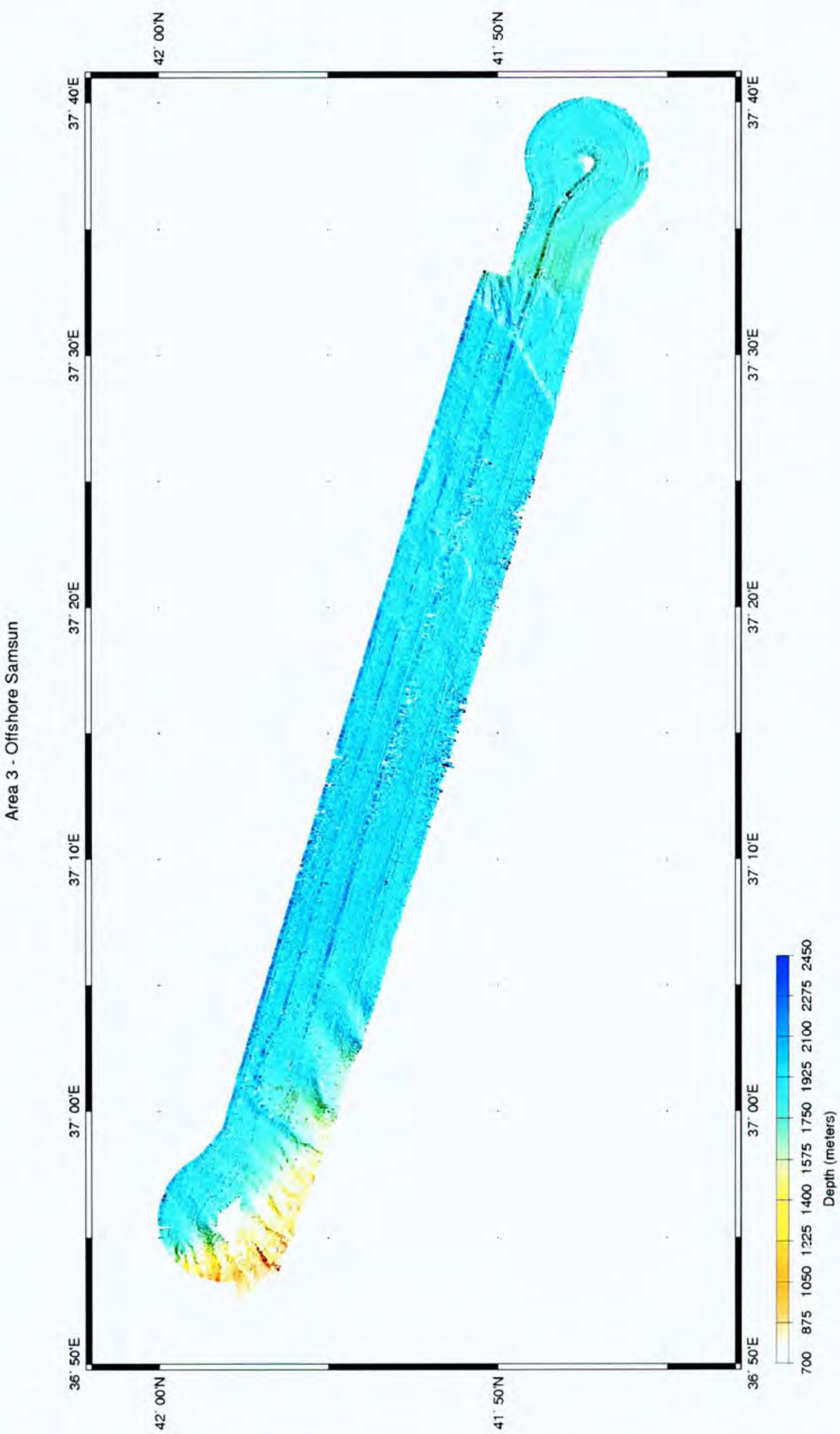

Fig 4.2.2: Bathymetry obtained in the working area "Samsun" at the slope apron and plain off Archangelski Ridge.

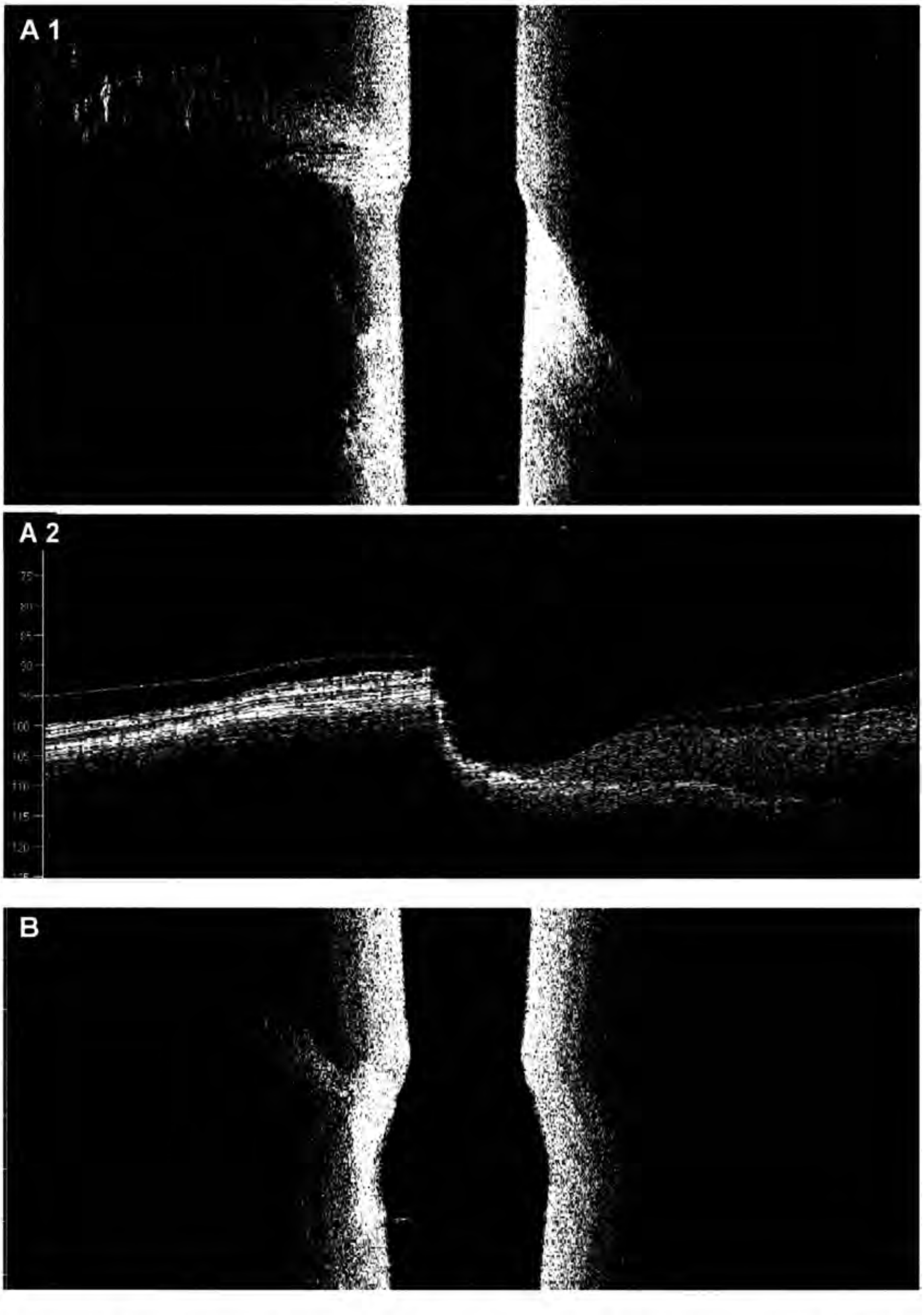

Fig 4.2.3: Parts of screenshots from DTS # 3 in the working area "Samsun". Backscatter (A 1) and subbottom profiler (A 2) image of a 20-m high fault scar. A small acoustic anomaly (B) may indicate gas in the water column. This area was subsequently surveyed and sampled by OFOS # 4 and GC # 6, but did not reveal any evidence for methane seepage.

DTS – Deep-towed sidescan

The Samsun area is located at the lower slope apron of the Archangelsky Ridge and was surveyed with three long parallel profiles that were 0.75 nm apart. This area is essentially flat and showed some surprising features on the backscatter imagery (Fig. 4.2.3).A number of slump scars have been observed in the surveyed area. These slump scars are up to 60 metres high and extend laterally for up to 1 km. Both concave- and convex-shaped slump scars have been observed and the general sediment transport direction is towards the north-west (Figs. 4.2.3 and 4.2.4). In addition, numerous indications of so-called sinuous waves are visible in the data (Fig. 4.2.5). They probably represent initial tensional cracks that could point towards future sediment failures, or may show the failed sediments, or they represent the outline of exhumed sediment layers.

Indications for fluid seepage are extremely rare in this working area. Although many locations along the profiles show bright reflections in the subsurface that may indicate possible gas accumulations, only one location with possible active fluid seepage has been observed (Fig. 4.2.3 and 4.2.6). This area shows high backscatter intensity that appears to be related to an underlying fault. There are, however, a few more locations (especially in the north-west of the surveyed area), where small high backscatter anomalies are present (Fig. 4.2.7). Whether or not these anomalies are related to fluid venting remains unclear.

Table 4.2.1: Gas seeps offshore Samsun surveyed during R/V POSEIDON cruise P317/4

No.	Latitude	Longitude	Remarks
1.	41°55.47'N	37°04.05'E	Small area of high backscatter in conjunction with a fault. Very small acoustic anomaly in the water column (Fig. 4.2.3. B).

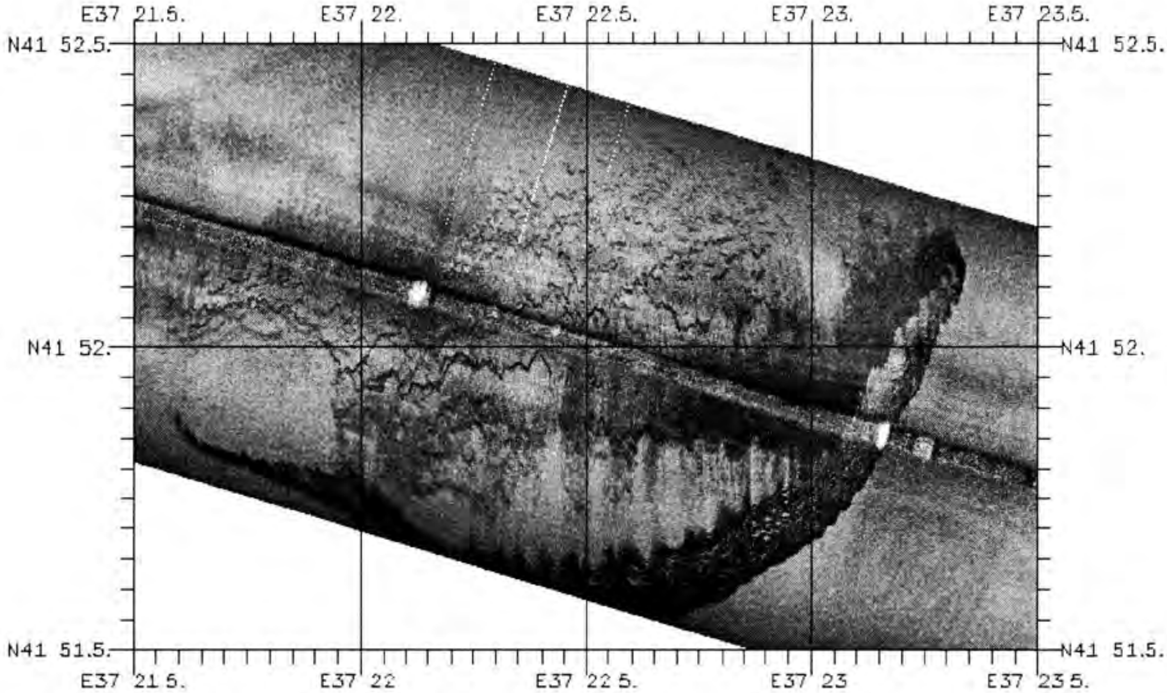

Fig 4.2.4: DTS 75 kHz sidescan sonar profile from the Samsun area showing a large concave-shaped slump scar with sediment transport direction towards the Northwest.

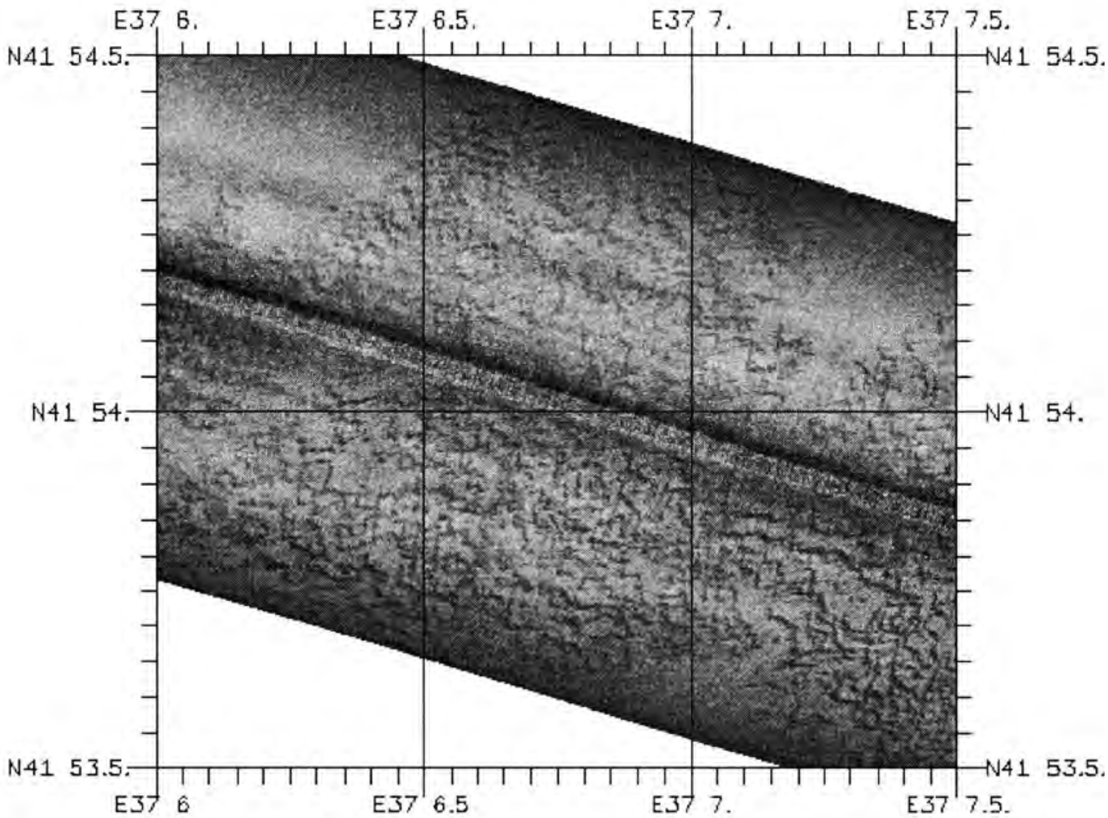

Fig 4.2.5: DTS 75 kHz sidescan sonar profile from the Samsun area showing so-called 'sinus waves'.

OFOS – Seafloor observations and GC – Sediment sampling

We followed with OFOS # 4 the sidescan sonar profile where a small acoustic anomaly was observed (Fig. 4.2.6). The seafloor observations did not reveal any evidence for methane seepage. Throughout the entire profile yellowish flocculent material was observed (Fig. 4.2.8). This material appeared to be soft. We speculate that this is organic material from the sea surface that aggregates at depths. Furthermore, sediments of varying colour and texture was observed, sometimes it looked like small m-scale debris flows of different sediments. GC # 6 was deployed a bit to the North of the OFOS track. It recovered more than 6 m of well-stratified mud that did not reveal any evidence for methane seepage.

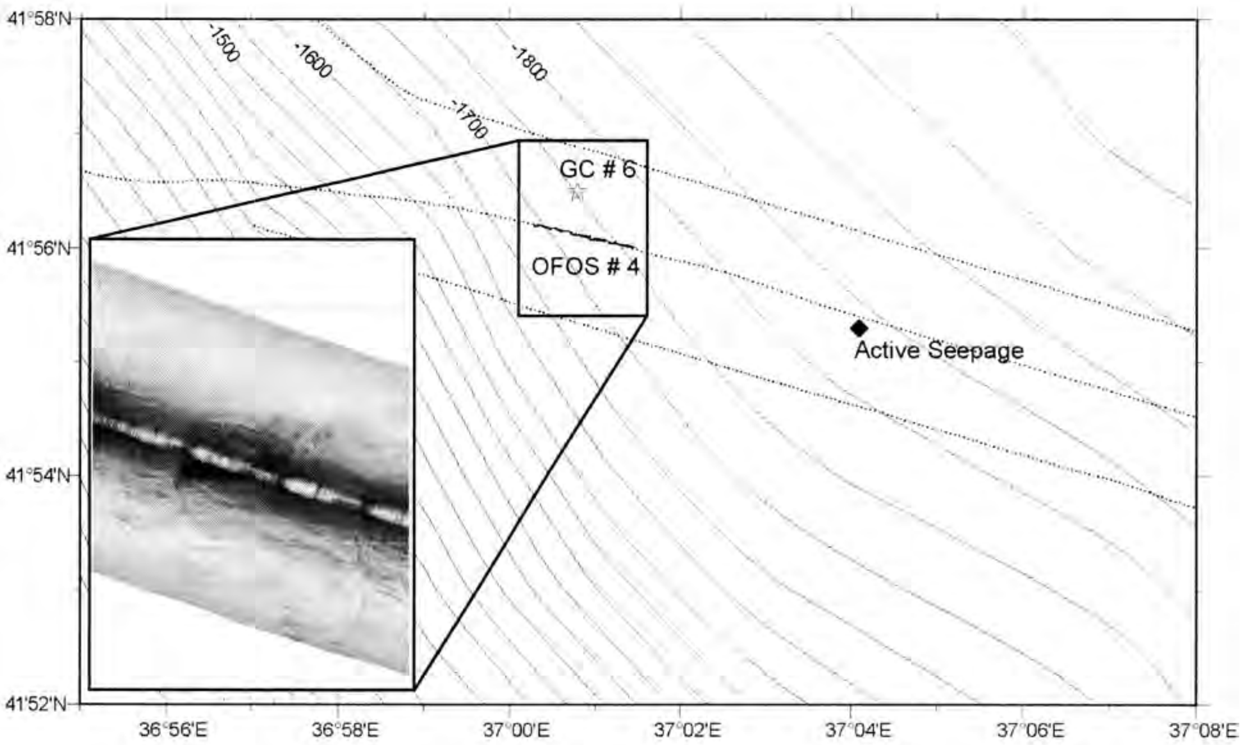

Fig 4.2.6: Map showing the backscatter image (inset) and the bathymetry as well as the locations of OFOS # 4 and GC # 6. "Active seepage" marks the location shown in Fig. 1.2.5, however, no evidence for seepage was found there.

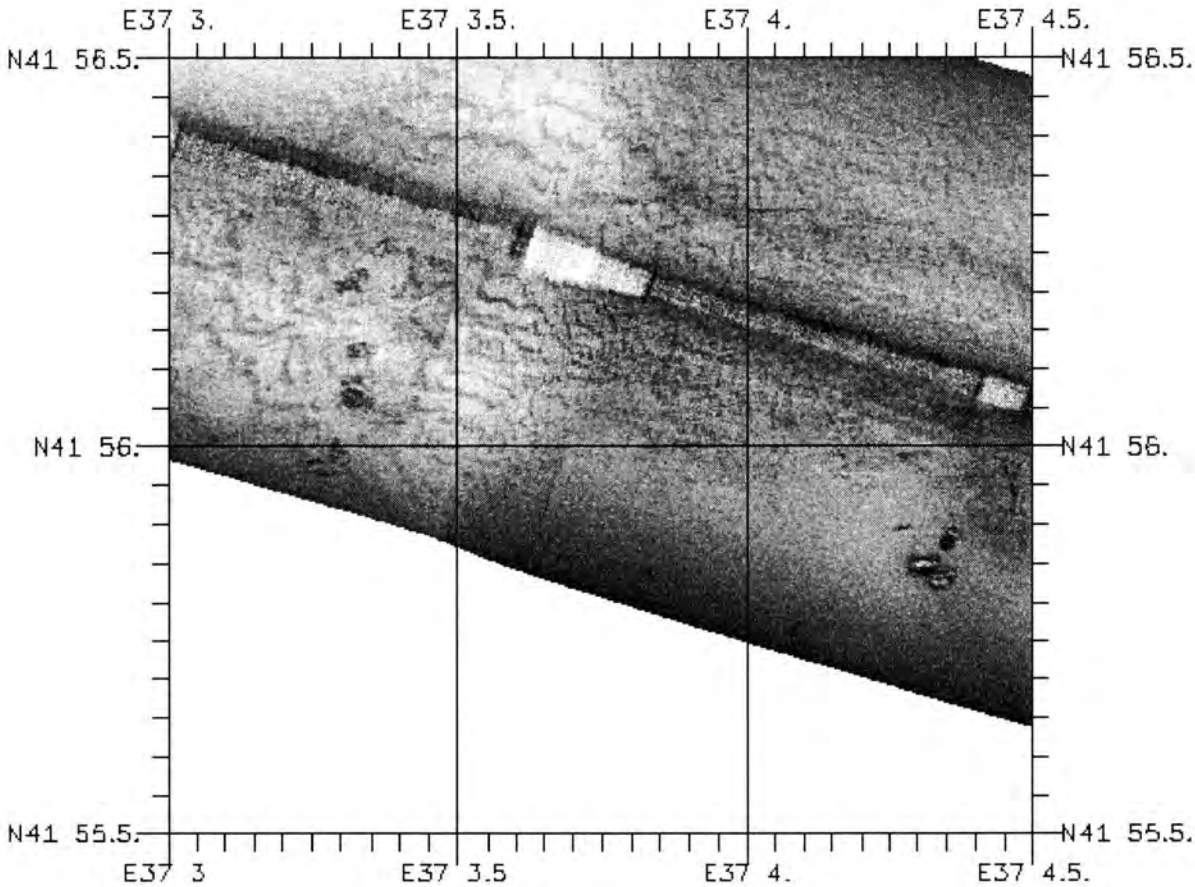

Fig 4.2.7: DTS 75 kHz sidescan sonar profile from the western limit of the Samsun area showing several high backscatter anomalies that might be related to fluid venting.

Fig. 4.2.8: Seafloor pictures taken during OFOS # 4. Yellowish flocculent material of unknown origin was observed throughout the survey. We found no evidence for methane seepage.

4.3 Working area *Kozlu High* (Area 2) off Turkey

Summary

Seismic images provided by the Turkish Petroleum Company (TPAO) show evidence for possible gas seepage in the area of the seaward extension of the Kozlu High. Based on this indications two DTS surveys were conducted that revealed abundant evidences for methane seepage, such as gas flares, backscatter anomalies and gas in the sediments. The methane seeps listed in Table 4.3.1 are connected to the prominent ridges (Fig. 4.3.4): the large ridge at 30°52'E with the seeps (3), (6), and (7), the smaller ridge at 31°E with seeps (8), (9), and (10). Seeps (1) and (2) occur at the W-flank of the large ridge and (4) and (5) at a small depression (canyon?) at greater depth. Despite the clear evidence for seepage based on the hydroacoustic anomalies recorded by DTS at the flare locations "TPAO Flares", "Kozlu Flare" and an unnamed flare we were not fortunate to sample sediments that were influenced by methane seepage. The OFOS surveys at the "TPAO Flares" as well as "Eregli Patch" were inconclusive. They showed variable sediment colours and small scale morphology in the area of high backscatter but how these features are related to past or present seepage is speculative until TV-guided sampling will shed light on this. The sediment samples at "Eregli Patch" clearly showed that the high backscatter and the surface-near hard reflectors in the subbottom profiler are associated with gas and probably gas hydrates in the sediments. GC # 9 and 10 recovered well stratified sediments that contained high amounts of gas. In addition, GC # 9 made after opening of the core fizzling sounds and contained dry mud that is typical for finely disseminated gas hydrates in the sediment. Three additional cores GC # 11 - 13 with plastic liner have been taken for calibration of the sidescan imagery. They indicated possible seafloor erosion in these specific areas.

Table 4.3.1: Overview of stations run at Kozlu High.

Station	Tool	Site	Remarks
852	ELAC # 5		
853	DTS # 4		
854	GC # 7	Gas Flare	Background sediments
855	OFOS # 5	TPAO-Flares	
856	GC # 8	TPAO-Flares	Background sediments
857	GC # 9	Eregli Patch	With finely disseminated gas hydrates
858	ELAC # 6		
859	OFOS # 6	Eregli Patch	
860	GC # 10	Eregli Patch	With gas
861	GC # 11		For backscatter calibration
862	GC # 12		For backscatter calibration
863	GC # 13		For backscatter calibration
864	DTS # 5		
865	ELAC # 7		
866	GC # 14	Kozlu Flare	Background sediments
867	GC # 15	Kozlu Flare	Background sediments
868	ELAC # 8		

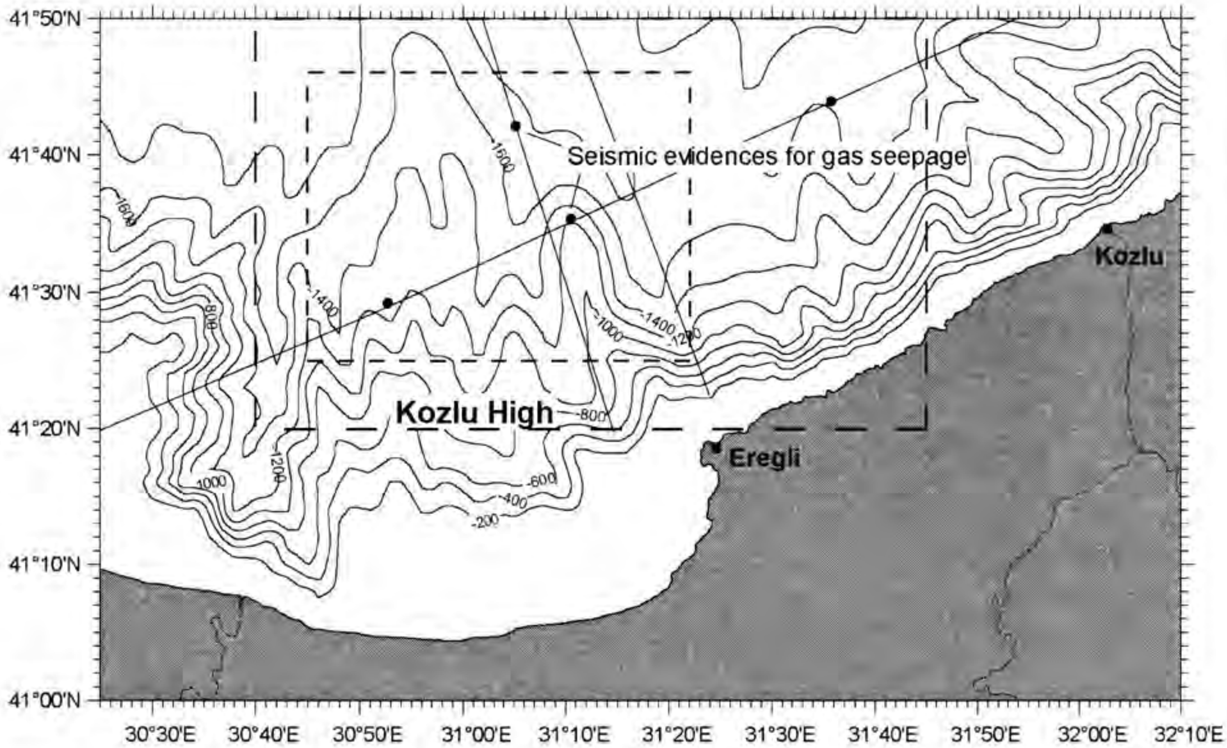

Figure 4.3.1: The working area "Kozlu High" with the seismic evidences for gas seepage that were provided by TPAO. The boxes indicate the area shown in Fig. 4.3.2 and 4.3.4.

ELAC-Swath bathymetry

The bathymetric data in the Kozlu Area was acquired during two 48 hours long DTS surveys and four additional ELAC surveys that were designed in order to extend the bathymetric coverage from the DTS surveys. The total area covered is roughly 1350 square kilometres, 45 km by 30 km. The goal of the ELAC surveys was to map the entire ridge system, which is the seaward extension of the Kozlu High on land and extends all the way from the slope in the South to the basin plain in the North. The total amount of data acquired during the surveys is approximately 2.5 Gigabyte.

A preliminary bathymetric map obtained from these data shows four south-north stretching ridges (Fig. 4.3.2). The easternmost of these ridges, which we called Kozlu Ridge, has a sharp crest and is shaped on all sides by numerous small gullies. The western part shows evidence for a large, plateau further upslope with fairly uniform water depth of around 800 metres. We suggest the name Ergeli plateau for this structure. This plateau is slightly inclined towards the north and appears to be eroded by several broad canyons or sediment pathways that have their origin just south of the surveyed area. Finally, towards the basin, several isolated positive structures are visible. If they correspond to erosional remnants of the observed ridges, or if they are implaced by material extruding from below cannot be distinguished at the moment.

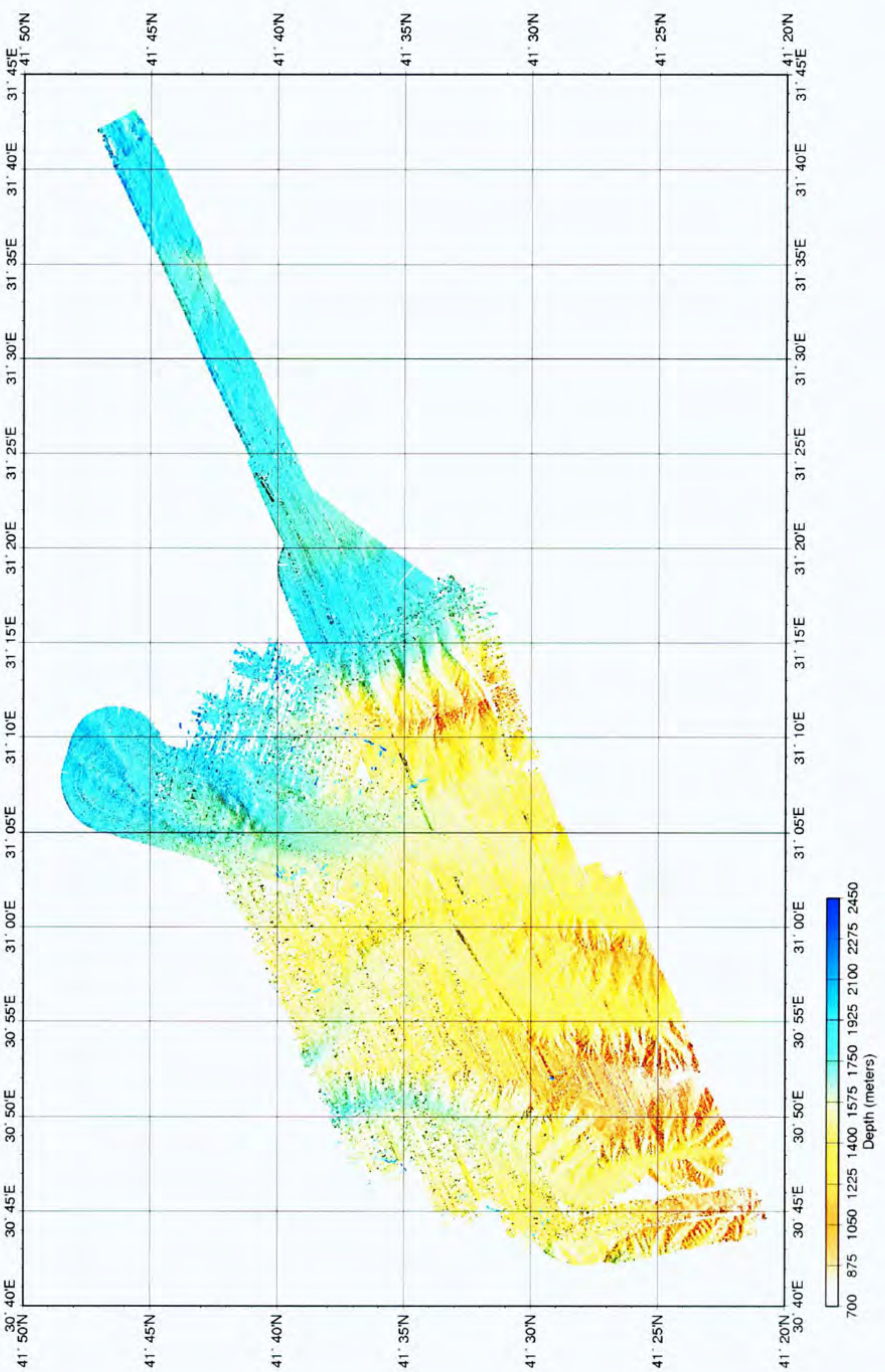

Figure 4.3.2: Filtered raw data of the ELAC swath bathymetry survey at the Kozlu High area (Area 2) off Turkey.

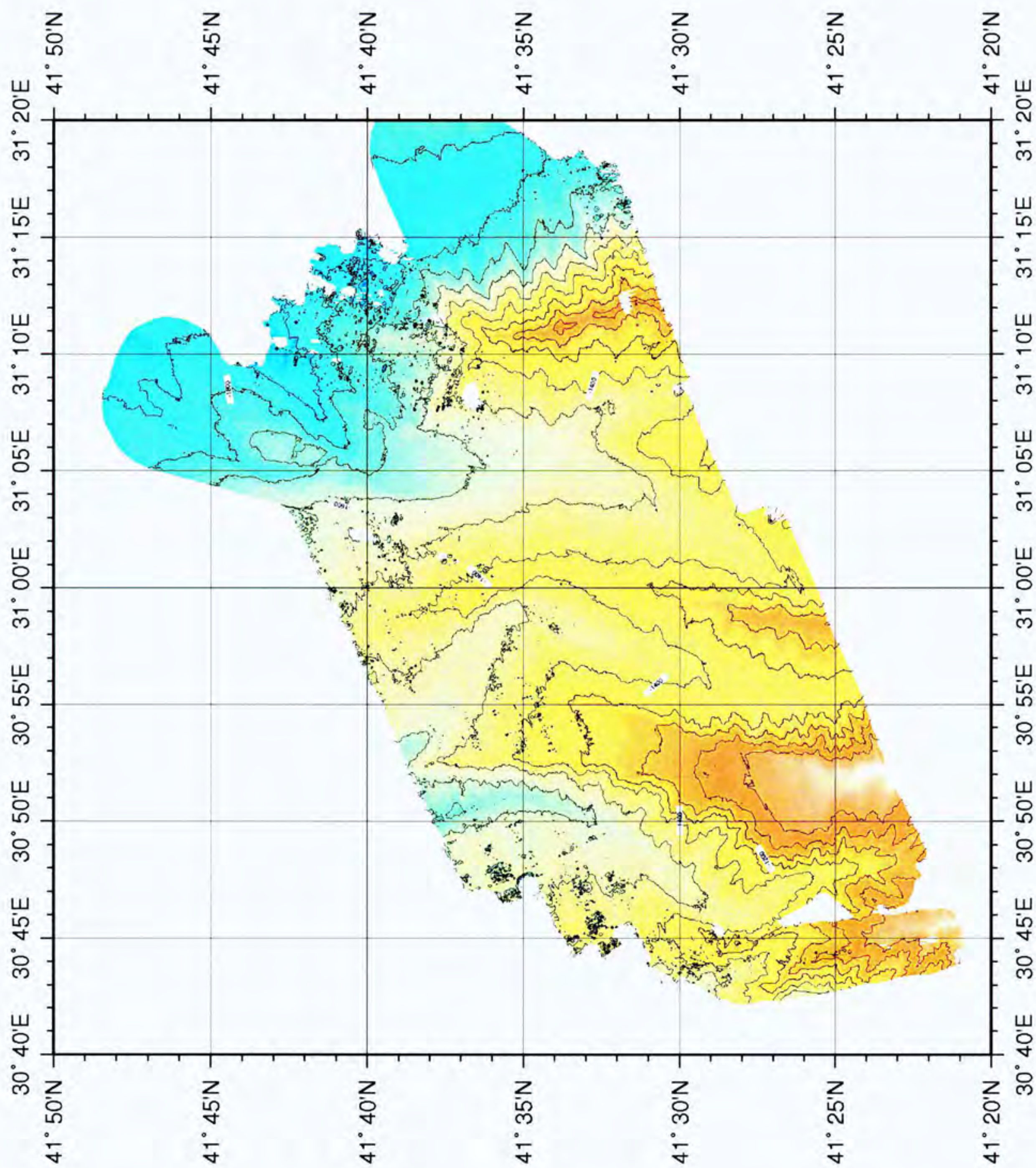

Figure 4.3.3: Gridded bathymetry at the Kozlu High area (Area 2) off Turkey.

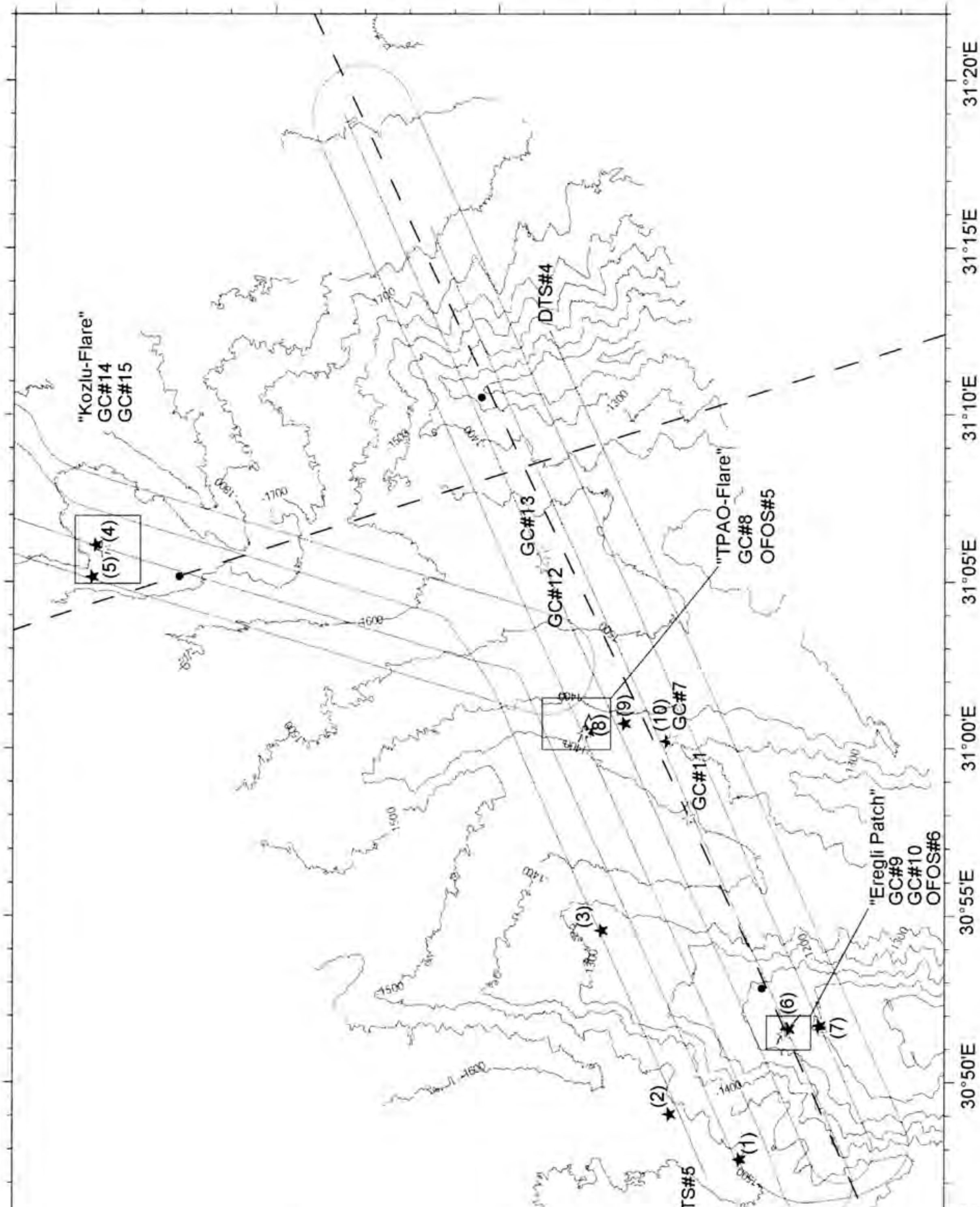

Figure 4.3.4: Map showing the track of DTS-1 sidescan sonar profiles together with the locations of OFOS and GC stations at Kozlu High. Filled circles = Survey targets picked on seismic profiles (dotted lines) provided by TPAO. Filled stars = Gas flares and evidence for gas in the shallow sediments (Numbers refer to Tab. 4.3.1).

DTS – deep-towed sidescan

The area covering the seaward extension of the Kozlu High offshore of Eregli was mapped in two deployments of approximately 48 hours each. The first deployment consisted of four 20-miles-long, parallel, ENE-WSW stretching profiles. Spacing between the profiles was 0.75 miles. During the second deployment this survey was extended in its western part by three additional profiles (one further upslope and two downslope of the previous profiles) and four shorter profiles with a more northerly orientation. These shorter profiles were intended to map the basinward extension of the easternmost ridge of the survey, an area that appeared as highly interesting on the seismic data and showed good potential for active gas seepage. During the two deployments a total of 19 Gbyte of sidescan sonar and subbottom profiler data have been gathered and need to be worked up.

Online observation together with a first, preliminary processing of the data revealed the presence of gas fronts in the subsurface of almost the entire survey area. In most cases however, these gas fronts remained in subbottom depths ranging between 10 and 25 metres. Only at a few locations did the gas front reach the seafloor and gas plumes or other features indicating active fluid seepage have been observed in the DTS-1 data (Table 4.3.1). These features include gas flares in the water column (Fig. 4.3.5 and 4.3.10), patches of very high backscatter intensity in a low backscatter environment (Fig. 4.3.11) and circular structures of intermediate-to-high backscatter intensity underlain by gas blanking in the subbottom profiler records (Fig. 4.3.6 and 4.3.7). Some of the observed gas flares did not show a distinctive backscatter pattern in the processed sidescan data, which could hint to either sporadic or very recent gas seepage (Fig. 4.3.8 and 4.3.9).

Table 4.3.1: Gas seeps on Kozlu High surveyed during R/V POSEIDON cruise P317/4.

No.	Latitude	Longitude	Remarks
1.	41°29.60'N	30°47.70'E	Small patch of high backscatter
2.	41°31.20'N	30°49.05'E	Several small patches of high backscatter (Fig. 4.3.11)
3.	41°32.70'N	30°54.55'E	Patch of high backscatter with flare
4.	41°44.02'N	31°06.10'E	"Kozlu Flare" (Fig. 4.3.9) Well developed flare without backscatter anomaly (GC # 14, 15 taken 0.2 nm South of flare)
5.	41°44.10'N	31°05.15'E	Possible flare associated with small high backscatter patch
6.	41°28.50'N	30°51.60'E	"Eregli Patch" (Fig. 4.3.6 and 4.3.7) Circular structure with intermediate backscatter and underlying gas blanking (GC # 9, 10; OFOS # 6)
7.	41°27.80'N	30°51.70'E	Circular structure with intermediate backscatter and underlying gas blanking
8.	41°33.00'N	31°00.50'E	"TPAO Flare" (Fig. 4.3.5) Ridge with flares and adjacent area of patchy backscatter (OFOS # 5, GC # 8)
9.	41°32.20'N	31°00.75'E	Small patch of high backscatter
10.	41°31.14'N	31°00.26'E	Gas Flare (Fig. 4.3.10) GC # 7

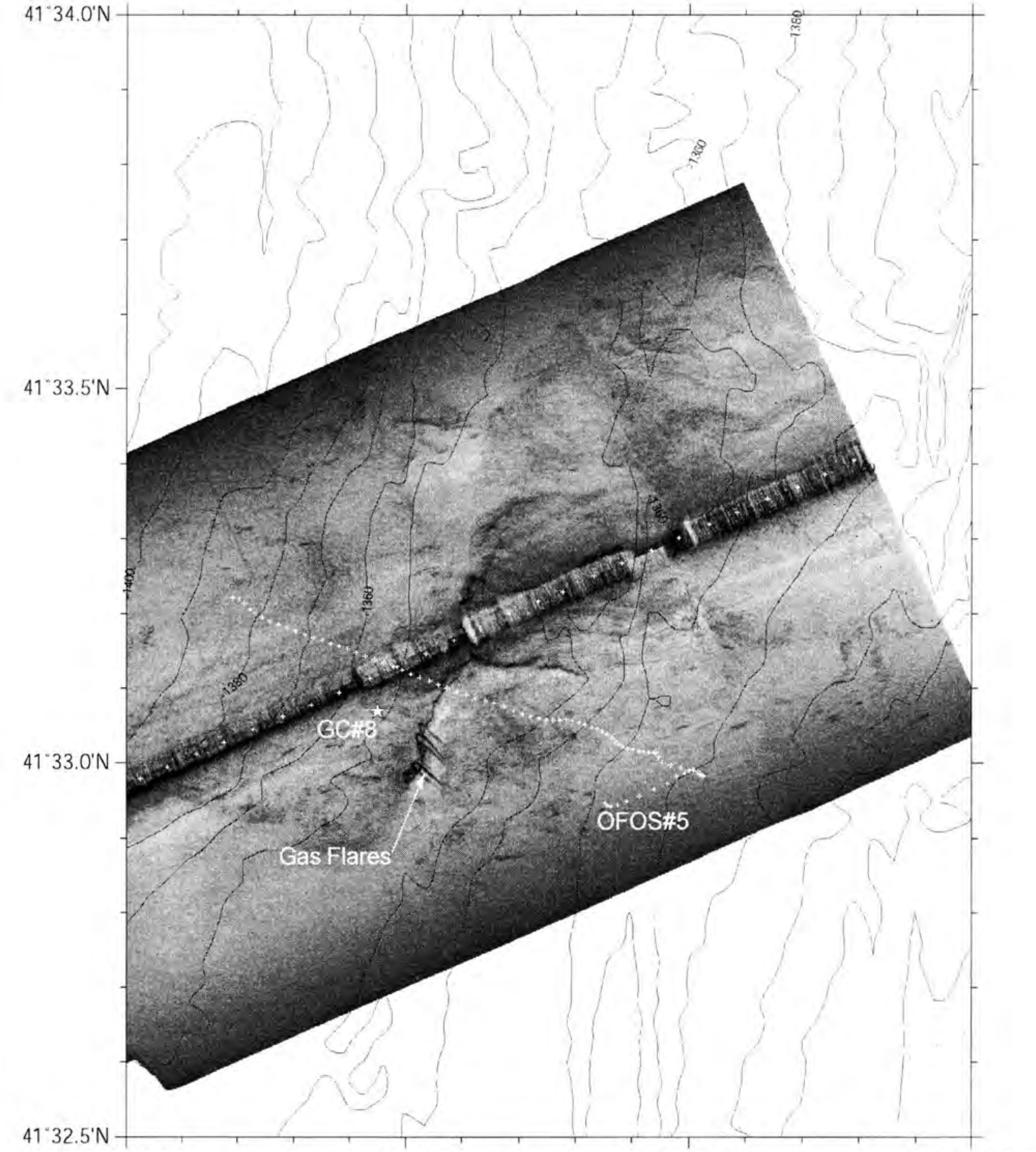

Figure 4.3.5: Map showing the backscatter image, bathymetry, and the locations of the OFOS survey and gravity cores at a linear feature associated with several gas flares and named "TPAO Flares" (No. 8 in Tab. 4.3.1).

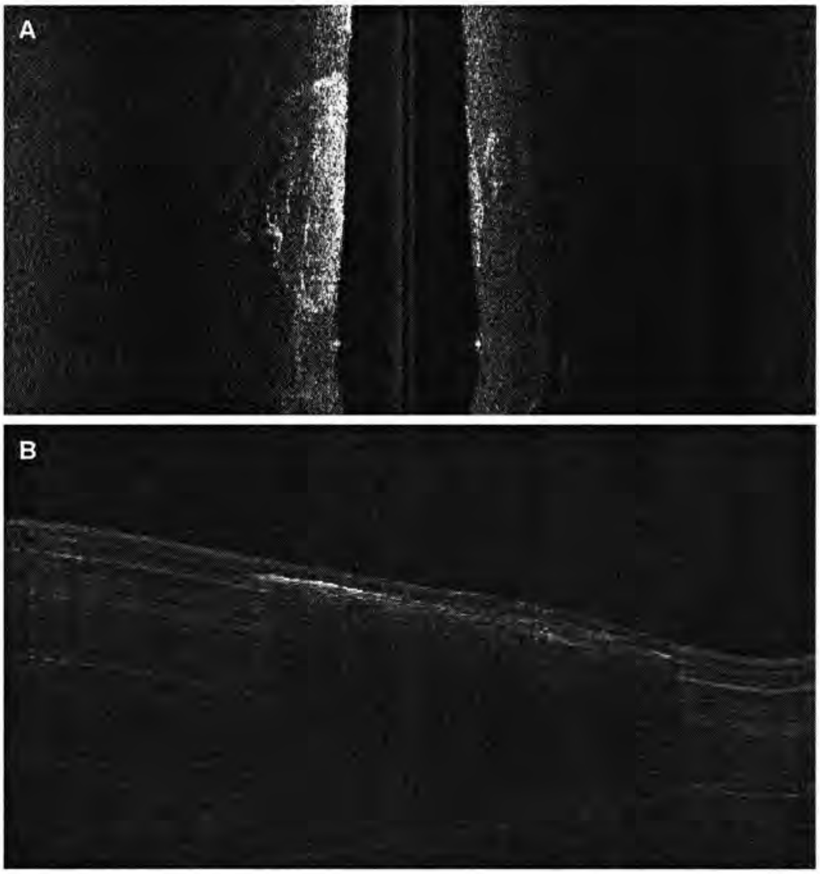

Figure 4.3.6: Online sidescan sonar image (A) of a circular feature with high backscatter which we named "Eregli Patch" in the area of Kozlu High (No. 6 in Tab. 4.3.1). The subbottom profiler (B) indicates the presence of gas. This area was surveyed by OFOS # 6 and sampled by GC # 9 & 10 (Fig. 4.3.7).

In addition to evidence for gas in the sediments and recent gas seepage, the DTS-1 data showed many indications for recent mass wasting, especially on the flanks of the ridges. There gullying is quite intense and cat-foot shaped slump scars are common. The deposits from this failure have not been observed. There are also signs for mass failure in the deeper parts of the survey area (Fig. 4.3.12) with only short-distance sediment transport and transport directions of various orientation including to the south.

Finally, the areas between the different ridges show a distinctive pattern with many patches of very high backscatter and many lineations that are commonly oriented parallel to the ridges (Fig. 4.3.13). These patterns have been interpreted as pathways for sediment gravity flows. They are particularly intense in the western part of the survey area and can be followed over several parallel sidescan sonar tracks. The ridges themselves and especially the easternmost ridge offshore of Kozlu show indications of steep flanks with erosional exposure of older deposits (Fig. 4.3.14).

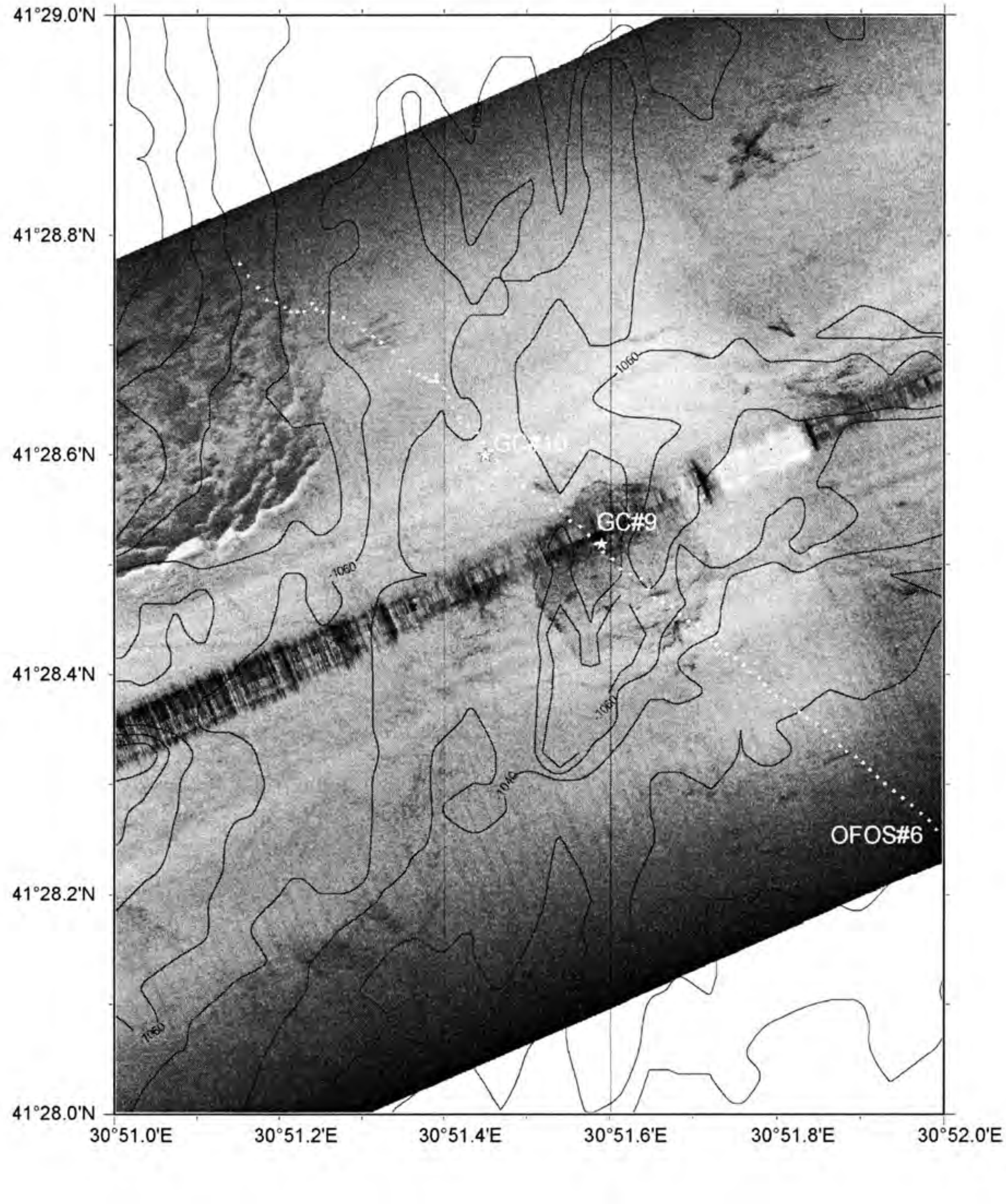

Figure 4.3.7: Map showing the backscatter image, bathymetry, and the locations of the OFOS survey and gravity corers at "Eregli Patch" (No. 6 in Tab. 4.3.1). Both gravity corers revealed evidences for gas and finely disseminated gas hydrates in the sediments.

OFOS – Seafloor observations and GC – Sediment sampling

The DTS-1 surveys revealed that methane seeps listed in Table 4.3.1 are connected to the prominent ridges (Fig. 4.3.4): the large ridge with the Eregli-Plateau at 30°52'E with the seeps (3), (6), and (7) as well as the smaller ridge at 31°E with seeps (8), (9), and (10).

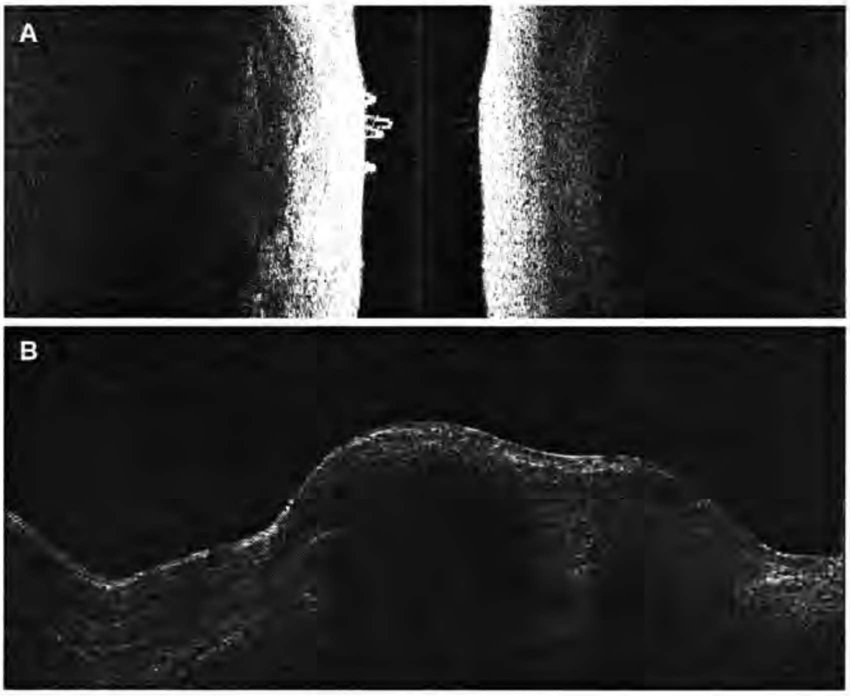

Figure 4.3.8: Online sidescan sonar image (A) of gas escapes which we named "Kozlu Flare" in the area of Kozlu High (No. 4 in Tab. 4.3.1). The subbottom profiler (B) indicates the presence of gas. This area was sampled by GC # 14 and 15. Unfortunately, none of the gravity corer revealed evidences for methane seepage.

Those seeps are characterized by gas in the sediments and/or flares. Seeps (1) and (2) occur at the W-flank of the large ridge and (4) and (5) at a small depression (canyon) at greater depth. The observations and sediment sampling were concentrated in three areas; on the smaller ridge at (8) "TPAO Flare" (Fig. 4.3.5) and (10) a prominent gas flare (Fig. 4.3.10), on the large ridge at (6) "Eregli Patch" (Fig. 4.3.6 and 4.3.7), and at greater depth at (4) "Kozlu Flare" (Fig. 4.3.8 and 4.3.9).

"TPAO Flare" is a gas escape at a linear feature at the crest of the ridge in 1350 m water depth. The sidescan images clearly show the escape of three individual gas flares. OFOS # 5 crossed over the crest as revealed by the memory CTD mounted on OFOS but did not show conclusive evidence for methane seepage. The sediments east of the fault scarp were irregularly coloured (Fig. 4.3.15) but GC # 8 which was taken there did not reveal evidence for methane seepage. The core contained background sediments. Similar results were obtained with GC # 7 at a prominent gas flare and with GC # 14 and # 15 at Kozlu Flare. We conclude that methane seepage is spatially very limited and that we were not successful in observing or sampling these small sites.

"Eregli Patch" is a circular feature with a shallow gas front in the sediment (Fig. 4.3.6) and high backscatter (Fig. 4.3.7) without an apparent gas flare. OFOS # 6 revealed irregular sediment surfaces in the area of the patch. GC # 9 retrieved high gas saturated sediments, probably, with small crystals of gas hydrates. GC # 10 was taken at the side of the structure and had a strong sulfidic smell.

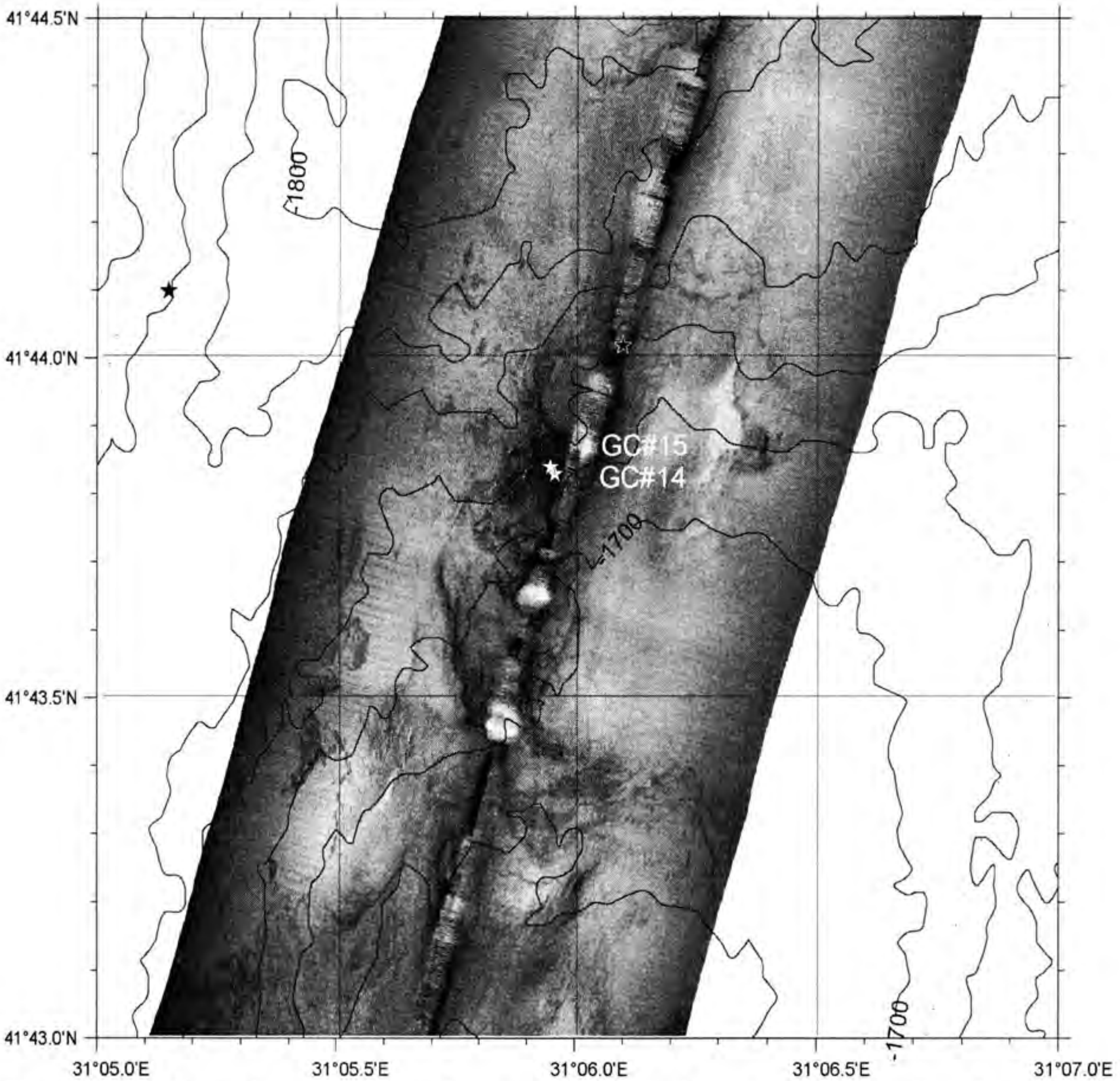

Figure 4.3.9: Map showing the backscatter image, bathymetry and sampling locations at "Kozlu Flare" (No. 4 in Tab. 4.3.1). The cores were taken in the area of high backscatter and not at the gas flare (stars). They did not show any signs for recent gas seepage.

In addition, three gravitycorer (GC # 11 – 13) were taken for calibration of the backscatter signal with the sediment physical properties. Coring sites are located in the area between ridges and coarse-grained sediments have been expected. Although the cores have not been studied yet it is clear, however, that no coarse-grained deposits are present. However, the recovered sediments are extremely stiff suggesting that older, already compacted sediments have been recovered. In this case, most of the area between the ridges is subject to intense erosion. Whether this is due to oceanic currents or sediment gravity flows is not yet determined.

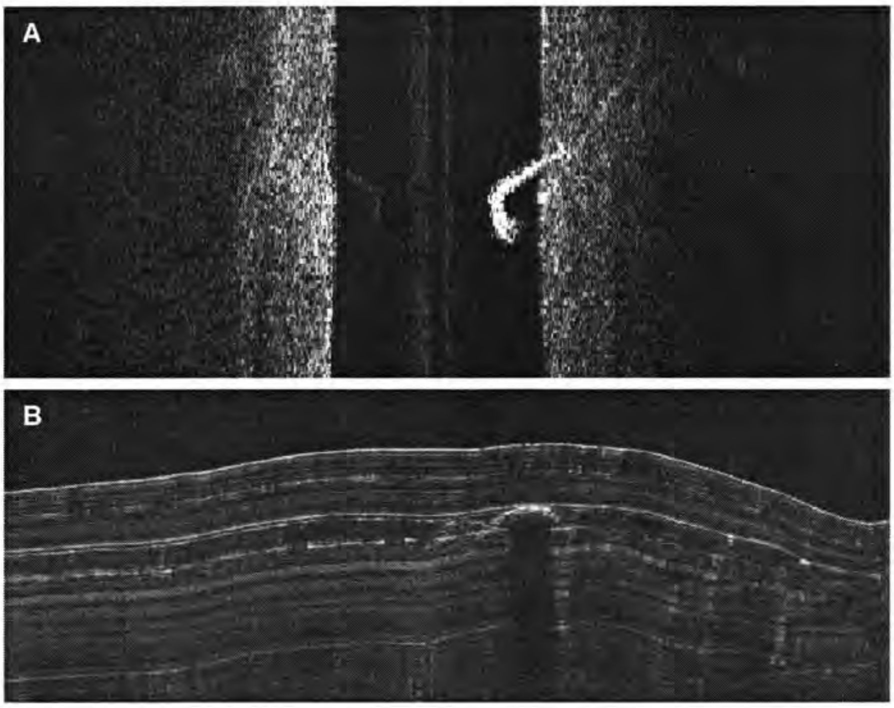

Figure 4.3.10: Online sidescan sonar (A) image of a gas flare (No. 10 in Tab. 4.3.1) in the area of Kozlu High. The subbottom profiler (B) indicates the presence of gas. The attempt to sample this site by GC # 7 unfortunately failed, as the core did not reveal any evidence for methane seepage.

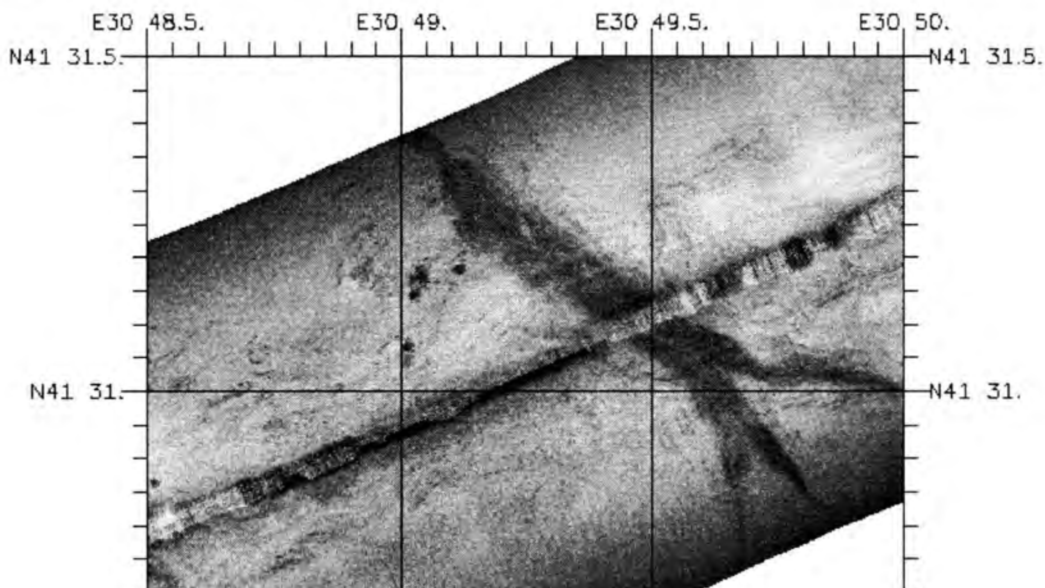

Figure 4.3.11: DTS-1 sidescan sonar image showing localised patches of very high backscatter in a low backscatter environment (No. 2 in Tab. 4.3.1). Such features could be related to gas seeps.

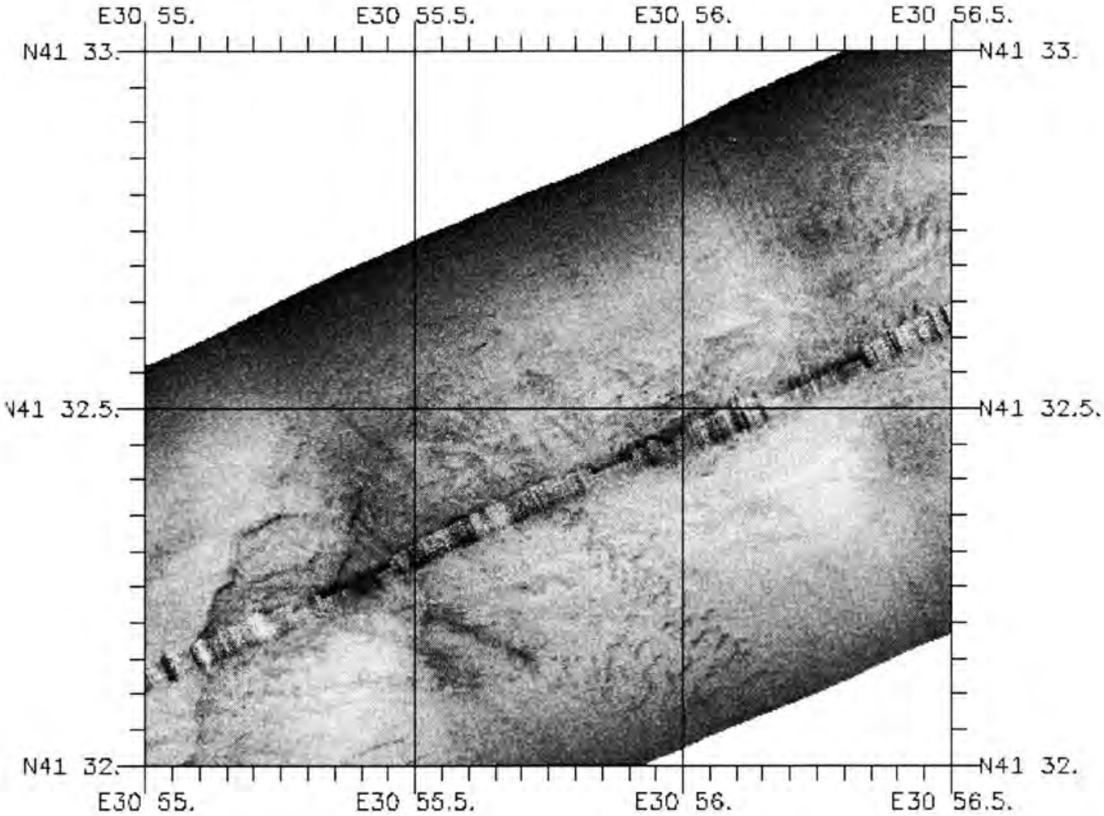

Figure 4.3.12: Sidescan sonar profile showing indications for mass failure in the deeper parts of the survey area. Sediment transport direction is towards the Southeast.

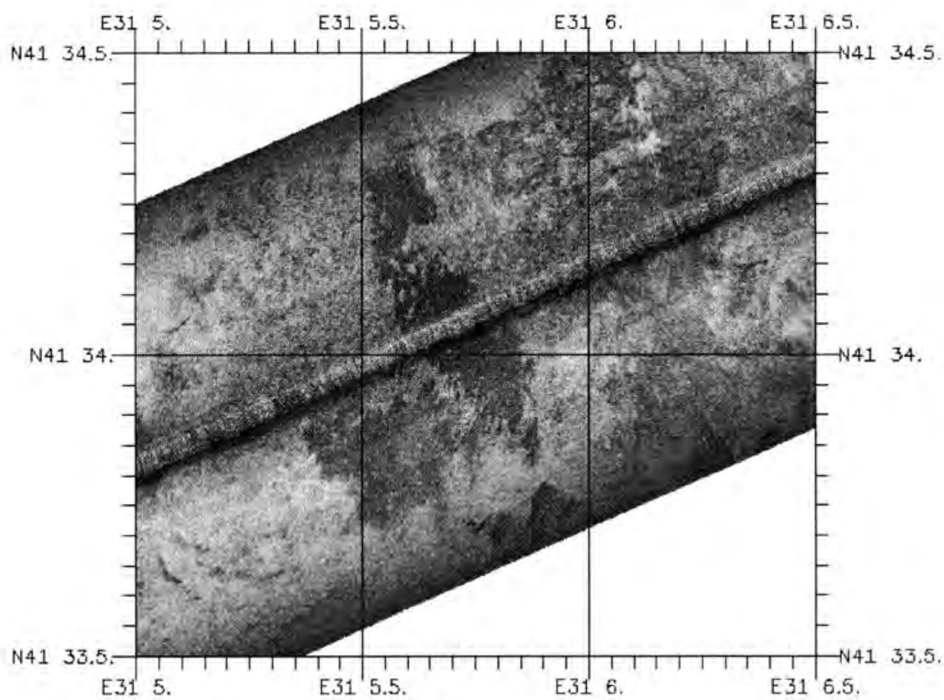

Figure 4.3.13: Sidescan sonar profile over the central part between two adjacent ridges. High backscatter in these areas probably corresponds to older, already compacted sediment that have been exposed during erosion through down slope currents.

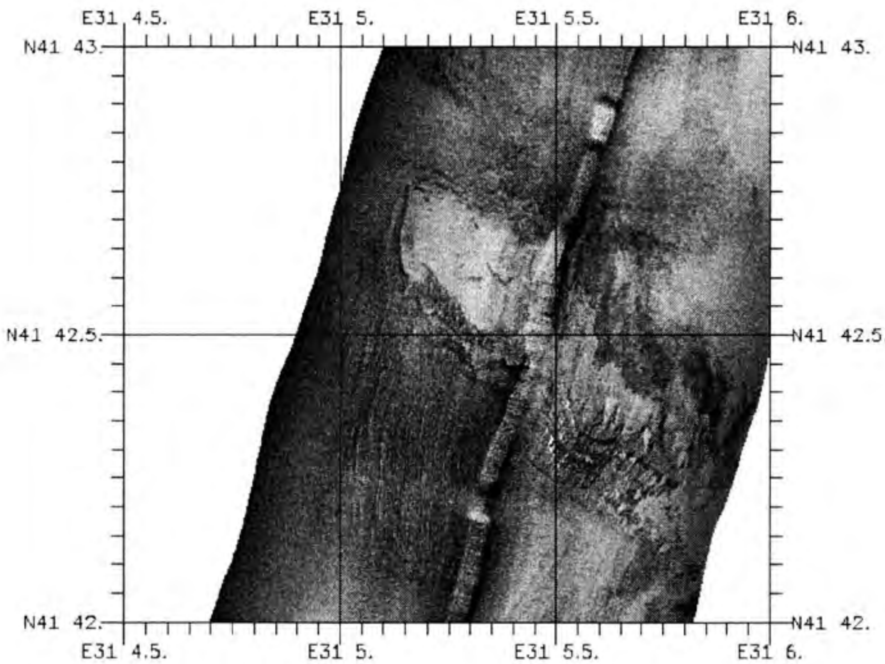

Figure 4.3.14: Sidescan sonar image showing the flank of Kozlu Ridge. Exposure of older deposits through erosion is well imaged. The lineation visible in the Southwest could correspond to sediments waves.

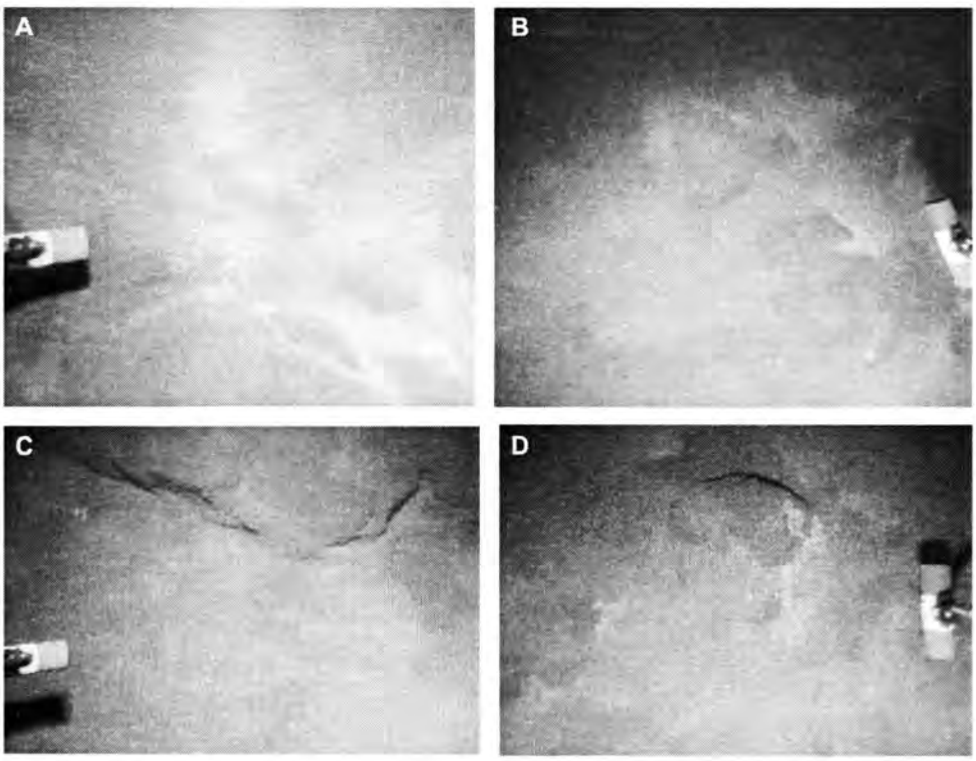

Fig 4.3.15: Seafloor images taken by OFOS # 5 at "TPAO Flare" (A, B) and at "Eregli Patch" (C, D) in the working area "Kozlu High". The images show irregular sediment coloration and small-scale morphology that may be caused by methane seepage.

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Appendix

Scientific station list
Ships station list
Core descriptions
Core correlation
CTD Profile

P 317/4													
					Time (UTC)			Begin / on seafloor		End / off seafloor			
Date	St: No:				Start Sci:	End Sci:		Latitude	Longitude	Latitude	Longitude	Water	Recovery
	P 317/4	Instrument	Number	Begin	Program	Program	End	N°	E°	N°	E°	depth (m)	Remarks
Georgia													
19.10.2004 - 20.10.2004	835	DTS	# 1	06:21			13:06	42:01.53	41:13.00	41:61.40	41:17.40	730	
20.10.2004 - 21.10.2004	836	ELAC	#1	13:06			05:00	41:51.99	41:16.85			1003	
20/10/2000	837	OFOS	#1	05:30	05:57	07:28'	07:54	41:57.80	41:75.17	41:16.75	41:18.17	860	
20/10/2000	838	OFOS	#2	08:20	08:50	09:55	10:31	41:57.41	41:18.02	41:58.03	41:16.12	858	
20/10/2000	839	GC	#1				12:10			41:57.44	41:17.61	860	2:45 m recovery, high gas saturated sediments/bag
21.10.2004 - 22.10.2004	840	ELAC	#2	14:49			05:10	41:48.71	41:14.70	41:57.53	41:17.31	1111	
21/10/2000	841	GC	#2				05:51			41:57.53	41:17.34	859	1:84 m recovery, carbonates, gas hydrates/ liner
21/10/2000	842	GC	#3				06:54			41:57.52	41:17.62	860	2:05 m recovery, gas hydrates/ liner
21/10/2000	843	GC	#4				08:00			41:56.85	41:17.29	913	6 m, background core/ liner
21/10/2000	844	GC	#5				09:01			41:57.54	41:17.61	861	50 cm recovery, pushout sediments due to gas hydrates/bag
21/10/2000	845	OFOS	#3	10:45	11:06	13:27		41:56.85	41:17.98	41:58.04	41:16.90	826	
22.10.2004 - 23.10.2004	846	ELAC	#3	15:10			04:15	41:52.45	41:18.11	42:00.82	41:06.86	779	
22/10/2000	847	DTS	#2	05:15	05:46	14:03	15:06	42:04.15	41:14.13	41:57.11	41:14.54	1138	
23.10.2004 - 24.10.2004	848	ELAC	#4	15:35			18:05	41:58.02	41:09.41	41:48.80	41:15.85	1026	
Samsun - Turkish Area 3													
24.10.2004 - 26.10.2004	849	DTS	#3	13:17	14:26	06:50	08:12	41:50.00	37:31.22	41:56.09	36:57.45	1935	
25/10/2000	850	OFOS	#4	09:40	10:26'	12:20	13:09	41:56.19	37:00.30	41:56.00	37:01.46	1755	
25/10/2000	851	GC	#6	14:01	14:38					41:56.15	37:00.80	1764	background core
Kozlu High - Turkish Area 2													
27.10.2004 - 28.10.2004	852	ELAC	#5		22:25	05:00		41:45.04	31:40.00	41:37.69	31:19.24	1960	
28.10.2004 - 30.10.2004	853	DTS	#4	06:17	07:25	03:34	05:06	41:36.57	31:15.74	41:40.36	31:24.86	1821	
29/10/2000	854	GC	#7	07:54	08:24		09:00			41:31.14	31:00.26	1311	background core
29/10/2000	855	OFOS	#5	10:16	11:03	12:25	13:00'	41:32:94	31:00.85	41:33.28	30:59.58	1375	
29/10/2000	856	GC	#8	13:53	14:28:14		15:13			41:33.07	31:00.45	1440	background core, weak smell of H2S

P 317/4													
				Time (UTC)				Begin / on seafloor		End / off seafloor			
Date	St: No:				Start Sci:	End Sci:		Latitude	Longitude	Latitude	Longitude	Water	Recovery
	P 317/4	Instrument	Number	Begin	Program	Program	End	N°	E°	N°	E°	depth (m)	Remarks
29/10/2000	857	GC	#9		18:03					41:28.52	30:51.59	1110	high gas saturated sediments, gas hydrates ?/bag
30.10.2004 - 31.10.2004	858	ELAC	#6		18:03		05:15	41:24.03	30:46.07	41:22.91	30:48.02	1187	
30/10/2000	859	OFOS	#6	06:06	06:18	07:41	09:16	41:28.64	30:51.41	41:28.24	30:52.03	1021	
30/10/2000	860	GC	#10				08:53			41:28.60	30:51.45	1046	background core/bag
30/10/2000	861	GC	#11				11:03			41:30.74	30:57.91	1419	liner
30/10/2000	862	GC	#12				13:01			41:34.00	31:05.45	1563	liner
30/10/2000	863	GC	#13				14:19			41:33.99	31:05.82	1557	liner
31.10.2004 - 01.11.2004	864	DTS	#5	16:08			12:36	41:33.84	31:12.47	41:29.07	30:43.66	1300	
01.11.2004 - 02:11.2004	865	ELAC	#7		14:04	06:00		41:27.43	30:43.13	41:37.13	30:57.35		
02:11.2004	866	GC	#14			06:49				41:43.83	31:06.0	1764	background core/bag
02:11.2004	867	GC	#15			08:24				41:43.84	31:05.95	1718	background core/bag
02:11.2004	868	ELAC	#8		09:35	11:35	20:00	41:44.07	31:06:46	41:28.47	30:48.73		

Cruise: PO 317/4
Principal Scientist: Dr. H. Sahling

Station-Log

Station Time: 288.63 h
Stations Total: 34
Wireline max.: 0 m

Station-No.	Date	Time UTC	Description	LAT	LONG	WD [m] +4,3m	Course [°]	v [kn]	Press. [hPa]	Weather	Wind [deg / knts]	Air Temp. [°C]	Water Temp. [°C]	Wire Length [m]	Remarks
	18/10/2004	11:00	Multibeam Echosounder to water												Test echosounder
	19/10/2004	**06:00**	**Start Scientific work**	42-05,1 N	041-12,4 E										
835	19/10/2004	06:21	DTS to water	42°05,3´ N	041°12,4´ E	1119	152	± 2,0	1018.7	b	217 / 11	19.0	18.6		Device towed with Werner winch
		06:50		42-04,5 N	041-12,9 E	1158	156	± 2,5	1018.7	b/c	203 / 9	19.1	18.5		
		06:59		42-04,2 N	041-13,2 E	1154	154	2.0	1018.8	b/c	212 / 8	19.1	18.6		
		07:56	DTS #1 WP 1	42-02,5 N	041-14,5 E	1065	148	2-2,5	1019.0	b/c	163 / 6	18.3	18.3		
		12:00	DTS #1 WP 2	41-54,0 N	041-21,5 E	435	148	± 2,5	1017.8	c	198/4	19.5	18.6		
		13:25	DTS #1 WP 3	41-52,7 N	041-18,8 E	644	329	± 2,5	1016.8	c	217/9	19.5	19.8		
		15:00		41-46,1 N	041-16,0 E	984	329	± 2,5	1017.2	c	235/9	19.3	18.5		
		17:24	DTS #1 WP 4	42-01,3 N	041-11,7 E	1081	329	± 2,5	1017.7	c	214 / 10	18.7	19.1		
		19:52	DTS #1 WP 5	42-02,1 N	041-13,6 E	1112	149	± 2,5	1017.6	c	220 / 13	19.0	19.3	1600	
		23:50	DTS #1 WP 6	41-53,6 N	041-20,6 E	495	149	± 2,5	1016.7	c/p	219/8	19.1	19.7		
	20/10/2004	01:16	DTS #1 WP 7	41-52,3 N	041-17,8 E	852	329	± 2,5	1016.5	c	253/5	19.2	19.7		
		05:10	DTS #1 WP 8	42-00,8 N	041-10,8 E	1132	329	± 2,5	1015.4	c	131 / 2	18.5	19.7		
		07:16	DTS #1 WP 9	42-01,7 N	041-12,7 E	1137	149	± 2,5	1014.2	o	132 / 4	18.9	19.8	2000	
		11:16	DTS #1 WP 10	41-53,2 N	041-19,7 E	520	149	± 2,5	1011.5	o	010/3	18.3	20.0		
		12:23	Start heaving DTS	41-51,3 N	41-17,6 E	720	div	± 2,5	1011.3	o	011/3	18.3	20.0		
		12:27	Riding weight on deck	41-51,4 N	41-17,4 E	725	div	2.0	1010.8	o	013/3	18.2	20.0		
		12:33	DTS on deck	41-51,4 N	41-17,4 E	730	div	1.5	1010.5	o	015/3	18.1	20.0		
		12:34	Station completed	41-51,4 N	41-17,4 E	730	div	1.5	1010.5	o	015/3	18.1	20.0		
836	20/10/2004	12:34	Begin of station	41-51,4 N	41-17,4 E	730	div	1.5	1010.5	o	015/3	18.1	20.0		Begin of ELAC Swath Bathimetry
		12:45	DTS #1 WP 11	41-51,9 N	041-16,9 E	1062	329	± 6,0	1010.4	o	016/3	18.0	20.1		Moonpool Swath sounder used
		14:25	DTS #1 WP 12	42-00,4 N	041-09,9 E	1160	329	± 6,0	1010.3	o	309/13	19.0	19.4		
		14:40	ELAC #1 WP 1	42-00,0 N	041-09,0 E	1234	149	± 6,0	1010.2	o	320/10	19.0	19.3		
		16:40	ELAC #1 WP 2	41-49,8 N	041-17,4 E	1263	149	± 6,0	1010.7	o	014/8	19.0	19.7		
		18:10	ELAC #1 WP 3	41-54,5 N	041-27,7 E	482	59	± 6,0	1011.0	o	000 / 9	19.5	20.1		
		18:23	ELAC #1 WP 4	41-53,8 N	041-28,3 E	499	239	± 6,0	1010.9	o	058 / 9	19.5	20.2		
		20:45	ELAC #1 WP 5	41-46,0 N	041-11,1 E	1336	239	± 6,0	1010.0	o/p	092 / 12	19.1	19.7		
		20:59	ELAC #1 WP 6	41-45,3 N	041-11,7 E	1153	59	± 6,0	1009.9	o	121 / 9	19.6	19.9		
		23:29	ELAC #1 WP 7	41-53,1 N	041-28,8 E	489	59	± 6,0	1009.0	o	142/7	20.1	20.3		
		23:42	ELAC #1 WP 8	41-52,4 N	041-29,4 E	520	239	± 6,0	1008.8	o	128/10	19.5	19.9		
	21/10/2004	00:54	ELAC #1 WP 9	41-48,5 N	041-20,8 E	1238	254	± 6,5	1008.7	c/q/t	240/25	17.0	20.0		Leaving track to avoid trouble with GECO TOPAZ, Waypoint 10 omitted
		01:27	ELAC #1 WP 11	41-49,3 N	041-16,6 E	1262	329	± 6,0	1009.3	p	249/23	17.5	19.7		Back on the track, continuing
		03:26	ELAC #1 WP 12	41-59,6 N	041-08,1 E	1048	329	± 6,0	1010.9	o	252/24	17.5	19.6		
		03:37	ELAC #1 WP 13	41-59,2 N	041-07,3 E	1044	149	± 6,0	1011.0	o	290/25	18.0	18.5		
		03:50	Station completed	41-58,2 N	041-08,1 E	1063	091	± 6,0	1011.2	o/p	287/27	16.4	18.6		Track ceased, heading to OFOS station
837	21/10/2004	05:31	OFOS 1 to water	41-57,3 N	041-18,2 E	899	299	± 0,5	1014.8	o/q	291/27	16.7	18.2		Video sled lowered by Werner winch

Cruise: PO 317/4
Principal Scientist. Dr. H. Sahling

Station-Log

Station Time: 288.63 h
Stations Total: 34
Wireline max.: 0 m

Station-No.	Date	Time UTC	Description	LAT	LONG	WD [m] +4,3m	Course [°]	v [kn]	Press. [hPa]	Weather	Wind [deg / knts]	Air Temp. [°C]	Water Temp. [°C]	Wire Length [m]	Remarks
		06:05	Lowering down	41-57,3 N	041-17,7 E	861	300	± 0,5	1016.1	o/c	295/24	16.9	18.1		Bottom sighted
		07:30	Heaving up	41-57,7 N	041-16,6 E	919	280	± 0,5	1017.6	c	284/17	17.1	18.2		Seabottom observation complete
		07:54	Station completed	41-57,8 N	041-16,1 E	910	280	± 0,5	1017.9	c	260/15	16.7	18.2		Video sled on deck
838	21/10/2004	08:21	OFOS 2 to water	41-57,4 N	041-18,2 E	868	265	± 0,5	1018.2	o/c	277/13	16.7	18.2		Video sled lowered by Werner winch
		08:50	Lowering down	41-57,4 N	041-17,5 E	858	270	± 0,5	1018.2	o/p	288/17	16.4	18.6		Bottom sighted
		09:55	Heaving up	41-58,0 N	041-16,2 E	930	330	± 0,5	1017.9	c	248 / 11	16.8	18.8		Seabottom observation complete
		10:32	Station completed	41-58,5 N	041-15,1 E	995	270	± 0,5	1017.6	c	236/11	16.7	19.0		Video sled on deck
839	21/10/2004	11:13	Arrival Station GC 1	41-57,41 N	041-17,64 E	867	255	± 0,0	1017.5	o	236 / 10	16.6	18.7		
		11:21	GC to water	41-57,4 N	041-17,6 E	867	255	± 0,0	1017.5	o	236 / 10	16.6	18.7		Slack w/ 0,8 - 0,5 m/s
		12:11	BoCo / Heave up	41-57,4 N	041-17,6 E	860	260	± 0,0	1017.7	o	275 / 12	16.8	18.5		Heaving w/ 0,5 m/s - 1,2 m/s
		12:19	GC on deck	41-57,5 N	041-17,6 E	856	280	± 0,0	1017.7	o	274 / 11	16.8	18.6		
		13:25	Station completed	41-57,8 N	041-16,5 E	901	250	± 0,0	1017.9	o	300 / 10	17.5	18.5		
840	21/10/2004	14:49	ELAC #1 WP 15	41-48,6 N	041-14,8 E	1165	328	6.0	1018.4	o	266/11	14.8	18.6		Back on ELAC Track
		16:49	ELAC #1 WP 16	41-58,8 N	041-06,4 E	1267	328	6.0	1018.4	o	286/9	15.2	18.5		
		17:01	ELAC #1 WP 17	41-58,3 N	041-05,5 E	1257	148	± 6,0	1018.4	o	301/10	15.2	18.7		
		19:02	ELAC #1 WP 18	41-48,1 N	041-13,9 E	1140	148	± 6,0	1018.4	o/c/l/t	304 / 29	14.1	19.4		
		19:16	ELAC #1 WP 19	41-47,7 N	041-13,0 E	1210	329	± 6,0	1018.2	o/c/l/t	326 / 18	15.1	19.4		
		21:18	ELAC #1 WP 20	41-57,9 N	041-04,6 E	1327	329	± 6,0	1017.5	o/p	302/17	16.2	19.0		
		21:32	ELAC #1 WP 21	41-57,5 N	041-03,7 E	1313	149	± 6,0	1017.5	o/p	251/13	16.4	19.1		
		23:30	ELAC #1 WP 22	41-47,2 N	041-12,1 E	1283	149	± 6,0	1017.7	o/p	289/18	16.5	18.5		
		23:44	ELAC #1 WP 23	41-46,9 N	041-11,3 E	1423	329	± 6,0	1017.6	o/p	309/15	16.3	18.6		
	22/10/2004	01:52	ELAC #1 WP 24	41-57,9 N	041-02,3 E	1391	329	± 6,0	1017.9	o/p	287/21	16.0	18.9		
		02:01	ELAC #1 WP 25	41-58,2 N	041-03,1 E	1391	066	± 6,0	1017.9	o/p	287/22	16.0	18.9		
		03:58	Station completed	42-04,3 N	041-16,8 E	1056	066	± 6,0	1018.7	c	312/15	14.8	18.9		Track ceased, heading to GC station
841	22/10/2004	05:00	Arrival Station GC 2	41-57,5 N	041-17,3 E	860	326	± 0,0	1019.2	c	299/13	14.3	17.1		
		05:29	GC to water	41-57,5 N	041-17,3 E	857	321	± 0,0	1019.3	c	301/13	15.1	17.2		Slack w/ 0,8 - 0,5 m/s
		05:49	BoCo / Heave up	41-57,5 N	041-17,3 E	858	340	± 0,0	1019.5	c	323/11	14.8	17.2		Heaving w/ 0,5 m/s - 1,2 m/s
		06:10	GC on deck	41-57,5 N	041-17,3 E	854	348	± 0,0	1019.6	o/c	317/11	14.8	17.3		
		06:15	Station completed	41-57,5 N	041-17,3 E	853	347	± 0,0	1019.6	o/c	311/13	14.7	17.3		
842	22/10/2004	06:32	Arrival Station GC # 3	41-57,5 N	041-17,6 E	860	345	± 0,0	1019.7	c	305/12	14.4	17.3		
		06:34	GC to water	41-57,5 N	041-17,6 E	860	345	± 0,0	1019.7	c	304/12	14.8	17.1		Slack w/ 0,8 - 0,5 m/s
		06:53	BoCo / Heave up	41-57,5 N	041-17,6 E	858	345	± 0,0	1019.9	c	293/11	14.9	17.2		Heaving w/ 0,5 m/s - 1,2 m/s
		07:13	GC on deck	41-57,6 N	041-17,6 E	857	330	± 0,0	1020.1	c	298/7	14.9	17.2		
		07:23	Station completed	41-57,6 N	041-17,5 E	868	303	± 0,0	1020.1	c	291/7	14.7	17.2		
843	22/10/2004	07:38	Arrival Station GC # 4	41-56,8 N	041-17,3 E	918	004	± 0,0	1020.2	o/c	310/11	15.1	17.0		
		07:40	GC to water	41-56,8 N	041-17,3 E	918	007	± 0,0	1020.2	o/c	305/10	15.1	17.0		Slack w/ 0,8 - 0,5 m/s
		08:00	BoCo / Heave up	41-56,8 N	041-17,3 E	912	017	± 0,0	1020.4	o/c	306/11	15.0	17.1		Heaving w/ 0,5 m/s - 1,2 m/s
		08:20	GC on deck	41-57,0 N	041-17,3 E	896	007	± 0,0	1020.5	o/c	307/11	14.9	17.0		

Cruise: PO 317/4
Principal Scientist: Dr. H. Sahling

Station-Log

Station Time: 288.63 h
Stations Total: 34
Wireline max.: 0 m

Station-No.	Date	Time UTC	Description	LAT	LONG	WD [m] +4,3m	Course [°]	v [kn]	Press. [hPa]	Weather	Wind [deg / knts]	Air Temp. [°C]	Water Temp. [°C]	Wire Length [m]	Remarks
		08:37	Station completed	41-57,5 N	041-17,7 E	861	355	± 0,0	1020.5	c	307/14	14.8	17.0		
844	22/10/2004	08:41	Arrival Station GC # 5	41-57,5 N	041-17,7 E	859	324	± 0,0	1020.5	c	305/11	14.9	17.0		
		08:43	GC to water	41-57,5 N	041-17,7 E	859	330	± 0,0	1020.5	c	318/11	14.9	16.9		Slack w/ 0,8 - 0,5 m/s
		09:00	BoCo / Heave up	41-57,7 N	041-17,6 E	859	328	± 0,0	1020.7	c	316/10	14.9	16.9		Heaving w/ 0,5 m/s - 1,2 m/s
		09:16	GC on deck	41-57,7 N	041-17,6 E	871	327	± 0,0	1020.8	c	305/10	14.4	17.0		
		09:23	Station completed	41-57,8 N	041-17,5 E	892	320	± 0,9	1020.4	c	313/11	14.5	16.9		
845	22/10/2004	10:42	OFOS # 3 to water	41-56,6 N	041-18,1 E	937	329,5	± 0,5	1021.2	c	291/11	14.9	17.6		
		10:42	Lowering down	41-56,6 N	041-18,1 E	937	329,5	± 0,5	1021.2	c	291/11	14.9	17.6		Video sled lowered by Werner winch
		11:08	Bottom visibility	41-56,9 N	041-18,0 E	885	277	± 0,5	1021.6	c/o	304 / 12	14.6	17.1		Bottom visibility
		13:28	Heaving up	41-58,0 N	041-16,9 E	921	300	± 0,5	1022.8	c	301/10	14.5	17.2		Seabottom observation complete
		14:03	Station completed	41-58,4 N	041-16,6 E	954	300	± 0,5	1023.2	c	300/13	14.8	17.0		Video sled on deck
846	22/10/2004	15:10	ELAC #1 WP 26	42-52,4 N	041-18,0 E	788	049	6,0	1023.7	c	285/10	14.6	18.1		Back on the track, continuing
		15:49	ELAC #1 WP 27	41-55,0 N	041-21,9 E	543	049	± 6,0	1024.1	b/c	284/12	14.6	17.7		
		16:23	ELAC #1 WP 28	41-57,0 N	041-25,6 E	933	053	± 6,0	1024.3	b/c	288/12	14.5	18.1		
		16:55	ELAC #1 WP 29	41-59,7 N	041-23,5 E	936	329	± 6,0	1024.5	b/c	292/11	14.5	18.4		
		17.45	ELAC #1 WP 30	42-04,1 N	041-19,9 E	991	329	± 6,0	1024.7		296 / 9	14.5	17.4		
		17.56	ELAC #1 WP 31	42-03,6 N	041-19,0 E	1036	149	± 6,0	1024.9		291 / 11	14.3	16.8		
		19.38	ELAC #1 WP 32	41-54,8 N	041-26,1 E	457	149	± 6,0	1025.2		312 / 10	14.1	18.3		
		19.44	ELAC #1 WP 33	41-54,4 N	041-25,1 E	512	329	± 6,0	1025.2		289 / 8	14.4	18.0		
		21.32	ELAC #1 WP 34	42-03,2 N	041-17,9 E	1006	329	± 6,0	1025.6	c	304/7	13.9	17.1		
		21.47	ELAC #1 WP 35	42-02,7 N	041-16,9 E	969	149	± 6,0	1025.7	c	310/7	14.0	17.4		
		23.31	ELAC #1 WP 36	41-53,8 N	041-24,2 E	578	149	± 6,0	1025.9	c/b	267/3	14.1	17.7		
		23.44	ELAC #1 WP 37	41-53,4 N	041-23,2 E	686	329	± 6,0	1025.8	c/b	301/2	13.9	17.7		
	23/10/2004	01:35	ELAC #1 WP 38	42-02,9 N	041-15,4 E	1030	329	± 6,0	1025.9	b	330/6	14.3	17.6		
		02:17	ELAC #1 WP 39	42-05,0 N	041-20,3 E	911	060	± 6,0	1026.0	b	328/5	14.3	18.0		
		02:24	ELAC #1 WP 40	42-05,7 N	041-19,6 E	972	322	± 6,0	1026.1	b	321/4	14.3	18.2		
		02:32	ELAC #1 WP 41	42-06,3 N	041-19,0 E	1051	328	± 6,0	1026.1	b	316/3	14.5	18.2		
		04:15	Track ceased	42-00,1 N	041-07,0 E	1400	238	± 6,0	1026.7	b	262/4	14.3	17.7		Heading to DTS Station
847	23/10/2004	05:10	DTS #2 / Arrival	42-05,5 N	041-13,2 E	1109	± 149	± 1,7	1027.1	b/c	198 / 2	14.6	17.9		DTS to water, using Werner Winch
		05:42		42-04,39 N	041-14,11 E	1116	± 149	± 2,5	1027.3	b/c	052 / 1	14.5	17.5	1000	
		06:03		42-03,69 N	041-14,70 E	1125	± 149	± 2,5	1027.3	b/c	187 / 5	14.6	16.8	1500	
		06:27	DTS #2 WP 1	42-02,9 N	041-15,4 E	1037	± 149	± 2,5	1027.3	b/c	239 / 1	14.6	16.9		
		10:21	DTS #2 WP 2	41-54,4 N	041-22,4 E	475	± 149	± 3,5	1026.5	b/c	025/5	14.7	18.3		large turn to WP 3
		12:16	DTS #2 WP 3	41-57,9 N	041-20,5 E	842	± 260	± 2,5	1025.9	b	009/6	14.9	17.7		
		12:53	DTS #2 WP 4	41-57,7 N	041-18,5 E	847	± 260	± 2,5	1026.0	b	009/6	14.8	17.6		
		13:50	DTS #2 WP 5	41-57,2 N	041-15,4 E	928	± 260	± 2,5	1025.5	b	047/15	14.8	18.0		
		14:05	Start heaving	41-57,1 N	041-14,5 E	938	± 260	± 2,5	1025.3	b	040/6	14.9	18.0		
		14:29		41-56,9 N	041-13,3 E	981	± 260	± 2,5	1025.4	b	040/6	14.9	18.0	1000	

Cruise: PO 317/4
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Station-Log

Station Time: 288.63 h
Stations Total: 34
Wireline max.: 0 m

Station-No.	Date	Time UTC	Description	LAT	LONG	WD [m] +4,3m	Course [°]	v [kn]	Press. [hPa]	Weather	Wind [deg / knts]	Air Temp. [°C]	Water Temp. [°C]	Wire Length [m]	Remarks
		15:04	DTS @ deck	41-56,8 N	041-11,0 E	994	± 275	± 2,0	1025.3	b	048 / 6	15.1	17.7		
		15:20	Station completed	41-56,7 N	041-10,4 E	1004	± 275	± 2,0	1025.3	b	062/6	15.1	17.3		
848	23/10/2004	15:35	ELAC #1 WP 11-2 a	41-57,9 N	041-09,5 E	1025	± 327	± 6,0	1025.2	b	073/5	15.1	16.9		Back on the ELAC track, continuing
		15:53	ELAC #1 WP 12-2	41-59,6 N	041-08,1 E	1207	± 327	± 6,0	1025.1	b	069/7	15.2	16.6		
		16:05	ELAC #1 WP 13-2	41-59,2 N	041-07,3 E	1080	± 239	± 6,0	1025.0	b	065/6	15.5	16.7		
		18:05	ELAC #1 WP 14-2	41-48,9 N	041-15,7 E	919	± 149	± 6,0	1024.1	b	076 / 10	15.9	17.3		Station completed, heading to work area 3
849	24/10/2004	13:12	Arrival on station	41-49,1 N	037-35,3 E	1796	± 287	± 1,6	1019.6	b	089 / 6	19.5	18.7		DTS to water, using Werner Winch
		13:18	Deploy DTS	41-49,2 N	037-34,7 E	1793	± 287	± 2,5	1019.6	b	089 / 6	19.5	18.7		Lowering DTS
		14:36		41-50,1 N	037-30,9 E	1955	± 287	± 2,5	1020.1	b	066 / 5	17.3	19.0	3000	Continuing
		15:15	DTS #3 - WP 1	41-50,58 N	037-28,83 E	1936	± 287	± 2,5	1020.4	b	112 / 4	17.7	18.7		Begin of profile
		15:34		41-50,82 N	037-27,70 E	1925	± 287	± 2,5	1020.4	b	090 / 3	17.5	18.7	4000	
		23:10	DTS #3 - WP 2	41-56,17 N	037-04,00 E	1936	± 287	± 2,5	1021.4	b	313 / 6	16.6	18.4	4200	End of Profile
	25/10/2004	00:02		41-56,8 N	037-01,4 E	1864	± 287	± 2,5	1021.3	b	312 / 4	16.5	18.2	4200	Start heaving up
		01:42	Start turning	41-57,2 N	036-59,2 E	1821	± 287	± 2,5	1021.3	b	323 / 4	16.5	18.1	3000	
		02:28	Half circle	41-58,2 N	036-53,9 E	1226	± 197	± 2,5	1021.4	b	283 / 4	16.3	18.2	2000	Turning circle diameter 2,5 nm
		02:50		41-57,2 N	036-54,2 E	1068	± 148	± 2,5	1021.5	b	279 / 4	16.3	17.8	1500	
		03:30	Start lowering	41-56,6 N	036-56,3 E	1365	± 090	± 2,5	1021.6	b	274 / 3	16.3	17.6	1019	Minimum cable length
		03:41		41-56,6 N	036-56,7 E	1516	± 092	± 2,5	1022.6	b	274 / 3	16.3	17.6	1500	
		05:37		41-55,64 N	037-03,12 E	1890	± 108	± 2,5	1022.6	b	328 / 4	16.8	18.2	3500	
		05:50		41-55,44 N	037-03,88 E	1878	± 106	± 2,5	1022.7	b	198 / 3	16.8	18.2	3750	
		05:53	DTS #3 - WP 3	41-55,42 N	037-04,00 E	1946	± 106	± 2,5	1022.8	b	292 / 2	18.4	18.3		
		06:38		41-54,86 N	037-06,51 E	1946	± 106	± 2,5	1022.8	b	292 / 2	18.4	18.3	4000	
		13:41	DTS #3 - WP 4	41-49,83 N	037-28,83 E	1950	± 107	± 2,5	1022.1	b	093/7	18.1	18.8		End of Track 1
		15:45	Start heaving	41-48,3 N	037-35,4 E	1797	± 107	± 2,5	1022.6	b	099/9	17.8	18.9		End of profile
		15:56	Start turning	41-48,2 N	037-35,9 E	1797	± 101	± 2,5	1022.7	b	111/8	17.9	18.9	3000	
		17:09	Half circle	41-47,0 N	037-38,9 E	1830	± 197	± 2,5	1021.9	b	099/11	17.8	18.7		Keep on turnin´
		18:14	Start lowering	41-47,70 N	037-34,70 E	1752	± 286	± 2,5	1022.9	b/c	118 / 8	18.7	18.8		
		18:29		41-47,89 N	037-33,91 E	1751	± 286	± 2,5	1023.1	b/c	119 / 6	18.0	18.6		
		18:43	Start profile	41-48,06 N	037-33,19 E	1742	± 286	± 2,5	1023.1	b/c	115 / 7	17.8	18.7		
		20:24	DTS #3 - WP 5	41-49,111 N	)37-28,535 E	1943	± 286	± 2,3	1023.1	b/c	111 / 6	18.0	18.6	3200	
	26/10/2004	04:36	DTS #3 - WP 6	41-54,703 N	)37-03,686 E	1894	± 287	± 2,3	1021.9	b	120 / 11	17.5	16.1		Track ended, continuing profile
		06:35	Start heaving	41-56,04 N	036-57,73 E	1530	± 287	± 2,3	1022.2	b/c	125 / 8	19.7	17.8		Profile ended
		08:11	DTS on deck	41-57,18 N	036-52,60 E	753	± 282	var	1022.2	b/c	108 / 9	17.8	17.9		
		08:12	Station completed	41-57,18 N	036-52,60 E	753	± 282	var	1022.2	b/c	108 / 9	17.8	17.9		Heading to OFOS Station
850	26/10/2004	09:35	Arrival on station	41-56,21 N	037-00,30 E	1761	var	± 0,0	1021.2	c	104 / 10	17.4	18.0		
		09:41	OFOS # 4 to water	41-56,21 N	037-00,30 E	1761	var	± 0,0	1021.2	c	104 / 10	17.4	18.0		
		10:24	Start track	41-56,21 N	037-00,30 E	1761	± 103	± 0,5	1020.8	c	105 / 11	17.4	18.0	1740	Bottom visibilty
		11:53	End of track	41-56,06 N	037-01,15 E	1799	± 103	± 0,5	1020.3	c/b	110/12	17.6	17.9	1767	

Cruise: PO 317/4
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Station-Log

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Stations Total: 34
Wireline max.: 0 m

Station-No.	Date	Time UTC	Description	LAT	LONG	WD [m] +4,3m	Course [°]	v [kn]	Press. [hPa]	Weather	Wind [deg / knts]	Air Temp. [°C]	Water Temp. [°C]	Wire Length [m]	Remarks
		12:21	Start heaving	41-56,0 N	037-01,46 E	1846	± 103	± 0,5	1020.4	b	108/12	17.8	17.8		
		13:10	OFOS # 4 on deck	41-55,9 N	037-02,1 E	1896	± 100	± 0,8	1019.9	b	111/12	17.9	17.8		
		13:14	Station completed	41-55,9 N	037-02,2 E	1899	± 100	± 0,8	1020.9	b	111/13	17.9	17.8		
851	26/10/2004	14:00	Arrival Station GC # 6	41-56,14 N	037-00,71 E	1775	± 115	± 0,0	1019.8	b	116/13	17.6	18.0		
		14:03	GC to water	41-56,14 N	037-00,71 E	1775	± 115	± 0,0	1019.8	b	116/13	17.6	18.0		Slack w/ 0,8 - 0,5 m/s
		14:39	BoCo / Heave up	41-56,15 N	037-00,73 E	1763	± 115	± 0,0	1019.7	b	111/12	17.8	18.0		Heaving w/ 0,5 m/s - 1,2 m/s
		15:13	GC on deck	41-56,0 N	037-00,7 E	1732	± 115	± 0,0	1019.8	b	109/12	17.9	17.9		
		15:27	Station completed	41-55,9 N	037-00,6 E	1715	± 115	± 0,0	1019.9	b	109/10	18.0	18.0		Commence with ELAC track
-		17:43	ELAC #2 WP 1	41-40,0 N	036-50,0 E	425	± 207	± 8,3	1019.3	b	101 / 13	18.3	19.1		
	27/10/2004	02:53	ELAC #2 WP 2	42-20,0 N	035-20,0 E	2015	301	8.8	1016.9	b	128/16	16.5	16.6		
		12:23	ELAC #2 WP 3	42-20,0 N	033-25,0 E	2179	270	8.9	1015.5	f	066/2	15.1	18.6		
		19:50	ELAC #2 WP 4	41-55,0 N	032-05,0 E	1641	247	8.0	1016.1	o	207/7	17.6	18.5		
852	27/10/2004	22:25	ELAC #3 WP 1	41-45,4 N	031-40,0 E	1960	245	6.0	1015.9	o	246/5	17.6	18.6		
	28/10/2004	00:46	ELAC #3 WP 2	41-39,4 N	031-22,5 E	1759	217	6.0	1015.4	o	269/3	17.7	18.2		
		01:52	ELAC #3 WP 3	41-34,0 N	031-17,0 E	1768	217	6.0	1015.3	m	Light Airs	17.8	18.3		
		03:00	Turnin´ round	41-31,3 N	031-08,8 E	1447	247	6.0	1015.2	c	152/7	17.6	18.2		Profile cut due to schedule
		03:12	Back on track	41-32,2 N	031-08,4 E	1472	337	6.0	1015.2	c	170/8	17.6	18.3		Continuing shortened profile
		04:17	ELAC #3 WP 6	41-34,9 N	031-16,3 E	1745	66	6.0	1015.2	b/c/m	175/4	17.8	18.2		Heading to DTS Station
853	28/10/2004	04:59	Arrival on station	41-37,74 N	031-19,3 E	1751	var	1.0	1015.6	m	Light Airs	17.7	183.0		
		06:12	Deploy DTS	41-37,75 N	031-19,31 E	1747	± 247	± 1,3	1016.4	m	218 / 4	17.9	18.4		DTS to water, using Werner Winch
		07:31	DTS # 4 - WP 1	41-36,48 N	031-15,48 E	1819	± 246	± 2,5	1016.7	c/m	207 / 6	17.9	18.3	3000	Lowering DTS; 11:17 UTC 3500 m
		15:59	DTS # 4 - WP 2	41-28,0 N	030-50,0 E	1168	± 246	± 2,5	1016.2	b	118/4	18.4	18.8		
		16:47	Start turning	41-27,2 N	030-47,5 E	1371	± 246	± 2,5	1016.1	b	127/4	18.5	18.8	1000	
		17:43	Half circle	41-28,6 N	030-48,7 E	1400	± 066	± 2,7	1016.0	b	135 / 5	18.4	19.0		Turning circle diameter 1380 m.
		18:23	Start logging	41-29,2 N	030-48,8 E	1461	± 066	± 2,5	1016.0	b	119 / 5	18.7	18.9		
		18:32	DTS # 4 - WP 3	41-29,37 N	030-49,19 E	1403	± 066	± 2,5	1016.0	b	117 / 6	18.4	18.9		
	29/10/2004	02:58	DTS # 4 - WP 4	41-37,87 N	031-14,7 E	1871	± 066	± 2,5	1016.1	b/m	094/6	17.6	18.3	3300	
		04:13	Start turning	41-39,1 N	031-18,4 E	1779	± 066	± 2,5	1015.8	b/c	101/10	17.6	18.4	2500	
		04:52	Half circle	41-38,5 N	031-20,4 E	1725	± 156	± 3,5	1016.0	b	090/8	17.7	18.5	1996	Turning circle diameter 2075 m.
		05:27	Start lowering	1-37,0 N	031-19,4 E		± 246	± 3,4	1016.2	b	091 / 7	17.8	18.4	2100	@ 0610 UTC Start logging, WL = 3200m
		06:35	DTS # 4 - WP 5	41-35,82 N	031-15,93 E	1787	± 246	± 2,5	1016.3	b/m	208 / 5	17.3	18.3	3200	
		14:58	DTS # 4 - WP 6	41-27,31 N	030-50,24 E	1019	± 246	± 2,5	1014.8	o/c	063/10	19.3	18.9		
		15:33	Start turning	41-26,7 N	030-48,5 E	1194	± 246	± 2,5	1014.9	o/c	070/10	18.0	18.7	1200	
		16:00	Half circle	41-27,1 N	030-47,1 E	1455	± 336	± 2,5	1015.0	o/c	083/10	17.3	18.6	960	Turning circle diameter 1330m
		16:31	Start lowering	41-28,1 N	030-47,9 E	1398	± 066	± 2,5	1015.0	c	088/8	17.9	18.7		1659 UTC Start logging, WL = 2000 m
		17:06	DTS # 4 - WP 7	41-28,68 N	030-49,61 E	1352	± 066	± 2,5	1014.9	c	082 / 7	17.4	18.6		
		01:42	DTS # 4 - WP 8	41-37,19 N	031-15,12 E	1842	± 066	± 2,5	1015.5	o/c	083/4	17.1	18.3	3200	
	30/10/2004	03:24	Start heaving	41-38,9 N	031-20,2 E	1733	± 066	± 2,5	1015.4	o/c	Light Airs	17.2	18.4	3650	Profile ended

Cruise: PO 317/4
Principal Scientist: Dr. H. Sahling

Station-Log

Station Time: 288.63 h
Stations Total: 34
Wireline max.: 0 m

Station-No.	Date	Time UTC	Description	LAT	LONG	WD [m] +4,3m	Course [°]	v [kn]	Press. [hPa]	Weather	Wind [deg / knts]	Air Temp. [°C]	Water Temp. [°C]	Wire Length [m]	Remarks
		05:06	DTS on deck	41-40,4 N	031-24,9 E	1810	± 063	± 1,5	1016.0	o	Light Airs	17.0	18.4		
		05:08	Station completed	41-40,5 N	031-24,10 E	1811	± 064	± 1,6	1017.0	o	Light Airs	17.0	18.4		Heading to GC 7 Station
854	30/10/2004	07:54	Arrival Station GC # 7	41-31,35 N	030-59,97 E	1314	var.	± 0,0	1016.8	o/c	120 / 3	17.2	18.6		
		07:56	GC to water	41-32,28 N	031-00,07 E	1308	var.	± 0,0	1016.9	c	055 / 4	17.1	18.6		Slack w/ 0,8 - 0,5 m/s
		08:24	BoCo / Heave up	41-34,14 N	031-00,25 E	1306	var.	± 0,0	1016.9	c	050 / 7	16.9	18.7	1386	Heaving w/ 0,5 m/s - 1,2 m/s
		08:54	GC on deck	41-31,09 N	031-00,42 E	1339	var.	± 0,0	1016.9	c	045 / 5	17.0	18.8		Drifting: ~ 130°/140° - 0,4/0,5 knts
		08:56	Station completed	41-31,00 N	031-00,44 E	1342	var.	± 0,0	1016.9	c	045 / 5	17.0	19.0		
855	30/10/2004	10:15	Arrival OFOS # 5	41-33,4 N	031-00,2 E	1389	± 140	± 0,5	1016.9	c	066 / 4	17.0	18.8		
		10:17	OFOS to water	41-33,4 N	031-00,2 E	1385	± 140	± 0,5	1016.4	c	066 / 4	17.0	18.8		
		11:17	Start track	41-33,0 N	031-00,6 E	1386	± 289	± 0,5	1016.4	c	071/6	17.1	18.9		
		12:27	End of track	41-33,2 N	031-00,2 E	1384	± 289	± 0,5	1016.4	c	041/5	17.2	18.9		
		12:27	Start heaving	41-33,2 N	031-00,2 E	1384	± 289	± 0,5	1016.4	c	041/5	17.2	18.9		
		13:00	OFOS on deck	41-33,3 N	030-59,6 E	1433	var.	± 0,7	1016.4	c	051/8	17.2	18.9		
		13:00	Station completed	41-33,3 N	030-59,6 E	1433	var.	± 0,7	1016.4	c	051/8	17.2	18.9		
856	30/10/2004	13:50	Arrival GC # 8	41-33,2 N	030-59,8 E	1407	± 070	± 0,0	1016.5	c	041/7	17.0	18.8		
		13:52	GC to water	41-33,1 N	030-59,8 E	1404	± 070	± 0,0	1016.5	c	041/7	17.0	18.8		Slack w/ 0,8 - 0,5 m/s
		14:27	BoCo / Heave up	41-33,1 N	031-00,5 E	1342	± 070	± 0,0	1016.6	c	058/6	16.9	18.8	1440	Heaving w/ 0,5 m/s - 1,2 m/s
		15:03	GC on deck	41-33,0 N	031-01,0 E	1365	± 070	± 0,0	1016.8	c	065/6	17.0	18.9		
		15:13	Station completed	41-32,9 N	031-01,2 E	1401	± 070	± 0,0	1016.9	c	082/8	17.0	18.8		
857	30/10/2004	16:48	Arrival GC # 9	41-28,3 N	030-51,5 E	1029	± 110	± 0,0	1017.5	b	092/9	17.1	18.6		
		16:56	GC to water	41-28,4 N	030-51,6 E	1032	± 070	± 0,0	1017.5	b	081/8	17.0	18.7		Slack w/ 0,8 - 0,5 m/s
		17:21	BoCo / Heave up	41-28,5 N	030-51,6 E	1040	± 060	± 0,0	1017.6	b	087/8	17.1	18.9	1092	Heaving w/ 0,5 m/s - 1,2 m/s
		17:45	GC on deck	41-28,54 N	030-51,56 E	1043	± 069	± 0,0	1017.7	b	094 / 9	17.1	18.8		
		17:47	Station completed	41-28,54 N	030-51,56 E	1043	± 069	± 0,0	1017.7	b	094 / 9	17.1	18.8		
858	30/10/2004	18:50	ELAC #4 WP 1	41-24,3 N	030-46,75 E	1110	± 220	± 6,0	1018.3	b	076 / 7	17.4	18.5		
		21:47	ELAC #4 WP 2	41-31,2 N	031-07,5 E	1463	± 066	± 6,0	1018.7	c	120/3	17.2	18.6		
		22:05	ELAC #4 WP 3	41-30,3 N	031-07,9 E	1436	± 247	± 6,0	1018.7	c	106/4	17.1	18.7		
	31/10/2004	00:53	ELAC #4 WP 4	41-23,6 N	030-47,2 E	1115	± 247	± 6,0	1018.7	c/b	097/3	17.1	18.6		
		01:08	ELAC #4 WP 5	41-23,0 N	030-47,5 E	1103	± 067	± 6,0	1018.6	c/b	115/2	16.7	18.6		
		03:06	ELAC #4 WP 6	41-27,7 N	031-02,05 E	1430	± 067	± 6,0	1019.1	b/m	Light Airs	16.8	18.5		
		03:18	ELAC #4 WP 7	41-27,0 N	031-02,4 E	1339	± 247	± 6,0	1019.1	b/m	Light Airs	16.7	18.5		
		05:12	Track ceased	41-22,5 N	030-48,2 E	1109	± 247	± 6,0	1019.8	b/m	Light Airs	16.6	18.5		Heading to OFOS station
859	31/10/2004	06:04	Arrival OFOS # 6	41-28,8 N	030-51,1 E	1069	var.	± 0,5	1020.0	b/m	Light Airs	17.0	18.6		
		06:07	OFOS to water	41-28,8 N	030-51,2 E	1067	± 130	± 0,6	1020.0	b/m	Light Airs	17.0	18.6		Video sled lowered by Werner winch
		06:41	Start track	41-28,60 N	030-51,45 E	1046	± 130	± 0,5	1019.9	b/m	150 / 2	17.2	18.5		0637 UTC Bottom visible (1046m)
		07:14	End track	41-28,41 N	030-51,75 E	1022	± 130	± 0,5	1020.2	b/m	163 / 3	17.5	18.6		@ 41-28,63 N 030-51,42 E
		07:43	Start heaving	41-28,23 N	030-52,06 E	1021	± 130	± 0,5	1020.2	b/m	163 / 2	17.5	18.6		
		08:06	OFOS on deck	41-28,12 N	030-52,31 E	1012	± 125	± 0,0	1020.4	b/m	163 / 1	17.8	18.6		

Cruise: PO 317/4
Principal Scientist: Dr. H. Sahling

Station-Log

Station Time: 288,63 h
Stations Total: 34
Wireline max.: 0 m

Station-No.	Date	Time UTC	Description	LAT	LONG	WD [m] +4,3m	Course [°]	v [kn]	Press. [hPa]	Weather	Wind [deg / knts]	Air Temp. [°C]	Water Temp. [°C]	Wire Length [m]	Remarks
		08:08	Station completed	41-28,12 N	030-52,32 E	1012	± 125	± 0,0	1020.4	b/m	163 / 1	17.8	18.6		
860	31/10/2004	08:30	Arrival GC # 10	41-28,61 N	030-51,45 E	1046	var.	± 0,0	1020.4	b/m	138 / 2	18.3	18.7		
		08:32	GC to water	41-28,61 N	030-51,45 E	1046	var.	± 0,0	1020.4	b/m	138 / 2	18.3	18.7		Slack w/ 0,8 - 0,5 m/s
		08:53	BoCo / Heave up	41-28,61 N	030-51,45 E	1045	var.	± 0,0	1020.0	b/m	136 / 3	17.8	18.8		Heaving w/ 0,5 m/s - 1,2 m/s
		09:20	GC on deck	41-28,62 N	030-51,45 E	1046	var.	± 0,0	1020.0	b/m	077 / 1	17.9	19.0		
		09:22	Station completed	41-28,62 N	030-51,45 E	1046	var.	± 0,0	1020.0	b/m	077 / 1	17.9	19.0		
861	31/10/2004	10:38	Arrival GC # 11	41-30,75 N	030-57,90 E	1420	var.	± 0,0	1019.5	b/m	017/3	17.7	19.2		
		10:40	GC to water	41-30,75 N	030-57,90 E	1420	var.	± 0,0	1019.5	b/m	017/3	17.7	19.2		Slack w/ 0,8 - 0,5 m/s
		11:03	BoCo / Heave up	41-30,75 N	030-57,90 E	1419	var.	± 0,0	1019.3	b/m	026/3	17.7	19.3		Heaving w/ 0,5 m/s - 1,2 m/s
		11:33	GC on deck	41-30,65 N	030-57,94 E	1414	var.	± 0,0	1019.3	b/m	046/3	17.8	19.4		
		11:38	Station completed	41-30,6 N	030-57,95 E	1408	var.	± 0,0	1019.2	b/m	039/4	17.9	19.5		
862	31/10/2004	12:36	Arrival GC # 12	41-34,0 N	031-05,45 E	1559	var.	± 0,0	1019.1	b/m	021/3	18.1	19.3		
		12:38	GC to water	41-34,0 N	031-05,45 E	1558	var.	± 0,0	1019.1	b/m	021/3	18.1	19.3		Slack w/ 0,8 - 0,5 m/s
		13:01	BoCo / Heave up	41-34,0 N	031-05,45 E	1563	var.	± 0,0	1019.0	b/m	048/4	18.3	19.1		Heaving w/ 0,5 m/s - 1,2 m/s
		13:29	GC on deck	41-33,8 N	031-05,6 E	1556	var.	± 0,0	1019.0	b/m	054/5	18.1	18.9		
		13:33	Station completed	41-33,8 N	031-05,6 E	1553	var.	± 0,0	1019.0	b/m	054/5	18.1	18.9		
863	31/10/2004	13:55	Arrival GC # 13	41-34,0 N	031-05,80 E	1556	var.	± 0,0	1019.0	b/m	064/6	18.2	19.2		
		13:57	GC to water	41-34,0 N	031-05,80 E	1556	var.	± 0,0	1019.0	b/m	064/6	18.2	19.2		Slack w/ 0,8 - 0,5 m/s
		14:18	BoCo / Heave up	41-34,0 N	031-05,80 E	1556	var.	± 0,0	1019.0	b/m	096/5	18.1	19.3		Heaving w/ 0,5 m/s - 1,2 m/s
		14:47	GC on deck	41-34,3 N	031-05,9 E	1559	var.	± 0,0	1019.1	b/m	115/4	18.2	19.1		
		14:59	Station completed	41-34,4 N	031-06,1 E	1560	var.	± 0,0	1019.1	b/m	124/5	18.1	19.1		Heading to DTS station
864	31/10/2004	15:51	Arrival DTS # 5	41-33,95 N	031-12,79 E	1419	± 246	± 2,5	1019.4	b/m	105/5	18.0	18.8		Deploy DTS
		16:42	Lowering down	41-33,3 N	031-10,9 E	1163	± 246	± 2,5	1019.3	m	103/6	17.8	18.9	1000	Continuing
		17:19	DTS # 5 - WP 1	41-32,73 N	031-09,13 E	1392	± 246	± 2,5	1019.3	m	105/6	18.0	18.8	2001	
		23:16	DTS # 5 - WP 2	41-26,63 N	030-50,83 E	950	± 246	± 2,5	1019.3	m	143/1	17.7	18.6	1800	
	01/11/2004	02:22	DTS # 5 - WP 3	41-30,06 N	030-48,79 E	1445	± 246	± 2,5	1019.1	m	192/4	17.1	18.5	2530	
		06:46	DTS # 5 - WP 4 *)	41-34,53 N	031-02,22 E	1439	± 040	± 2,5	1019.6	b	208 / 6	17.8	18.5		*) 41-34,54 N 031-02,21 E
		10:51	DTS # 5 - WP 5	41-44,10 N	031-06,11 E	1743	± 017	± 2,5	1018.6	b	225/5	18.5	18.6		
		14:22	Bottom in range	41-44,0 N	031-08,2 E	1781	± 197	± 2,5	1018.1	b	199/5	18.5	18.9	3127	Profile started
		14:35	DTS # 5 - WP 6	41-43,66 N	031-08,03 E	1775	± 197	± 2,5	1018.0	b	193/5	18.5	18.9	3219	
		18:00	Start heaving	41-35,4 N	031-04,7 E	1576	± 197	± 2,5	1018.4	b/m	182/4	18.6	18.8	3395	Stop logging
		18:35	DTS # 5 - WP 7	41-34,09 N	031-04,14 E	1525	± 196	± 2,5	1018.5	b/m	158 / 5	18.7	18.9		
		18:40	Start turning	41-33,66 N	031-03,95 E	1517	± 198	± 3,0	1018.4	b/m	155 / 6	19.0	18.9	1630	
		19:50	End Curve	41-34,31 N	031-01,09 E	1368	± 017	± 3,5	1018.8	b/m	205 / 4	18.5	18.6	1620	
		20:01	DTS # 5 - WP 8	41-34,75 N	031-01,27 E	1405	± 016	± 2,5	1018.8	b/m	209 / 4	18.5	18.6	1438	
		20:14	Start logging	41-35,38 N	031-01,52 E	1437	± 016	± 2,5	1018.8	b/m	209 / 4	18.5	18.6	2500	
		23:54	DTS # 5 - WP 9	41-44,32 N	031-05,16 E	1747	017	± 2,5	1019.1	b/m	256/4	18.2	18.4	3650	
	02/11/2004	03:19	Start lowering	41-44,6 N	031-07,4 E	1764	207	± 2,6	1020.2	o	012/12	16.5	18.5	2000	Back on the track

Cruise: PO 317/4
Principal Scientist: Dr. H. Sahling

Station-Log

Station Time: 288.63 h
Stations Total: 34
Wireline max.: 0 m

Station-No.	Date	Time UTC	Description	LAT	LONG	WD [m] +4,3m	Course [°]	v [kn]	Press. [hPa]	Weather	Wind [deg / knts]	Air Temp. [°C]	Water Temp. [°C]	Wire Length [m]	Remarks
		03:37	DTS # 5 - WP 10	41-43,88 N	031-07,08 E	1733	197	± 2,5	1020.2	o	017/11	16.4	18.4	1733	
		03:43	Start profiling	41-43,6 N	031-07,0 E	1731	197	± 2,5	1020.4	o	016/11	16.6	18.5		Start recording
		06:42	Start Curve	41-31,44 N	031-04,06 E	1578	± 198	± 2,5	1022.0	o/m	025 / 7	17.0	18.5		
		06:47	DTS # 5 - WP 11	41-36,22 N	031-03,97 E	1573	± 213	± 2,3	1022.0	o/m	028 / 8	17.1	18.6		
		06:52	End Curve	41-36,11 N	031-03,77 E	1555	± 236	± 2,2	1022.0	o/m	029 /7	17.2	18.5		
		07:35	Start Curve	41-35,15 N	031-01,87 E	1446	± 237	± 2,4	1022.0	o/m	030/7	17.2	18.5		
		07:37	DTS # 5 - WP 12	41-35,12 N	031-01,81 E	1440	± 242	± 2,3	1022.0	o/m	030/8	17.2	18.5		
		07:38	End Curve	41-35,11 N	031-01,77 E	1438	± 245	± 2,4	1022.0	o/m	030/8	17.2	18.6		End of Profile # 5 with DTS
		11:40	DTS # 5 - WP 13	41-31,15 N	030-49,61 E	1428	± 247	± 2,5	1021.7	o/m	038/8	17.5	18.6	2758	
		12:31	Start heaving	41-30,32 N	030-47,66 E	1524	± 247	± 2,6	1021.8	o/m	024/15	16.8	18.5	2800	
		13:50	DTS on deck	41-29,06 N	030-43,65 E	1405	± 030	± 0,3	1022.1	o	037/13	16.2	18.3		
		14:18	Station completed	41-29,0 N	030-43,9 E	1344	± 046	± 0,5	1022.4	o	041/13	16.2	18.3		
865	02/11/2004	14:40	ELAC #5 WP 1	41-27,60 N	030-43,10 E	1330	± 172	± 6,0	1022.4	o	033/14	16.2	18.3		Start recording
		15:43	ELAC #5 WP 2	41-21,40 N	030-44,30 E	979	± 172	± 6,0	1023.0	o	030/14	15.8	18.6		
		16:00	ELAC #5 WP 3	41-21,66 N	030-45,67 E	832	± 352	± 6,0	1022.9	o	038/14	16.0	18.3		
		17:30	ELAC #5 WP 4	41-30,25 N	030-44,00 E	1445	± 352	± 6,0	1023.4	o	042/14	16.1	18.3		
		19:54	ELAC #5 WP 5	41-36,08 N	031-01,20 E	1418	± 066	± 6,0	1024.2	o/c	049 / 14	16.0	18.4		
		20:10	ELAC #5 WP 6	41-37,06 N	031-00,64 E	1424	± 246	± 6,0	1024.2	o/c	024 / 15	16.1	18.4		
		22:10	ELAC #5 WP 7	41-32,15 N	030-45,80 E	1470	± 246	± 6,0	1023.8	o	042/12	16.3	18.5		
		22:27	ELAC #5 WP 8	41-33,15 N	030-45,20 E	1437	± 066	± 6,0	1023.6	o	039/9	16.2	18.4		
	03/11/2004	00:44	ELAC #5 WP 9	41-38,68 N	031-02,08 E	1545	± 066	± 6,0	1023.5	o	040/15	15.5	18.4		
		01:03	ELAC #5 WP 10	41-39,85 N	031-01,44 E	1549	± 246	± 6,0	1025.4	o	034/15	15.5	18.2		
		02:55	ELAC #5 WP 11	41-35,17 N	030-47,73 E	1535	± 246	± 6,0	1024.2	o	047/17	15.9	18.3		
		03:09	ELAC #5 WP 12	41-36,17 N	030-47,10 E	1535	± 065	± 6,0	1024.1	o	048/17	15.9	18.4		
		05:23	ELAC #5 WP 13	41-41,68 N	031-03,22 E	1599	± 065	± 6,0	1025.1	b/c	022/15	15.4	18.3		Profile ended, heading to GC station
866	03/11/2004	06:09	Arrival GC # 14	41-43,90 N	031-06,00 E	1714	var.	± 0,0	1025.4	b/c	032/15	14.9	18.3		
		06:15	GC to water	41-43,84 N	031-05,98 E	1716	var.	± 0,0	1025.4	b/c	019/13	14.6	18.3		Slack w/ 0,8 - 0,5 m/s
		06:49	BoCo / Heave up	41-43,84 N	031-05,96 E	1745	var.	± 0,0	1025.6	c	038/14	15.0	18.4	1803	Heaving w/ 0,5 m/s - 1,2 m/s
		07:21	GC on deck	41-43,85 N	031-05,97 E	1716	var.	± 0,0	1025.4	c	061/15	14.6	18.2		
		07:26	Station completed	41-43,84 N	031-05,97 E	1715	var.	± 0,0	1025.5	c	050/13	14.8	18.3		
867	03/11/2004	07:26	Arrival GC # 15	41-43,84 N	031-05,97 E	1715	var.	± 0,0	1025.5	c	050/13	14.8	18.3		
		07:50	GC to water	41-43,84 N	031-05,96 E	1714	var.	± 0,0	1025.4	c	047/14	14.4	18.4		Slack w/ 0,8 - 0,5 m/s
		08:23	BoCo / Heave up	41-43,84 N	031-05,96 E	1715	var.	± 0,0	1025.7	c	045/12	14.7	18.4	1804	Heaving w/ 0,5 m/s - 1,2 m/s
		08:55	GC on deck	41-43,84 N	031-05,95 E	1716	var.	± 0,0	1026.0	c	045/14	14.7	18.4		
		09:32	Station completed	41-43,85 N	031-05,97 E	1713	var.	± 0,0	1025.7	o/c	040/14	14.1	18.4		Heading to ELAC Track
868	03/11/2004	10:02	ELAC #6 WP 1	41-43,32 N	031-09,40 E	1918	196	± 6,0	1025.8	o	011/16	14.3	18.3		
		11:21	ELAC #6 WP 2	41-35,76 N	031-06,42 E	1582	196	± 6,0	1026.1	o	032/16	14.3	18.3		
		11:40	ELAC #6 WP 3	41-35,46 N	031-07,67 E	1500	017	± 6,0	1025.0	o	019/19	14.6	18.5		

Cruise: PO 317/4
Principal Scientist: Dr. H. Sahling

Station-Log

Station Time: 288.63 h
Stations Total: 34
Wireline max.: 0 m

Station-No.	Date	Time UTC	Description	LAT	LONG	WD [m] +4,3m	Course [°]	v [kn]	Press. [hPa]	Weather	Wind [deg / knts]	Air Temp. [°C]	Water Temp. [°C]	Wire Length [m]	Remarks
		12:55	ELAC #6 WP 4	41-42,34 N	031-10,53 E	1890	017	± 6,0	1026.4	o	023/20	13.7	18,1,		
		13:12	ELAC #6 WP 5	41-42,04 N	031-11,96 E	1854	197	± 6,0	1026.7	o	020/19	13.4	18.2		
		14:07	ELAC #6 WP 6	41-36,88 N	031-09,9 E	1475	197	± 6,0	1026.9	o	076/17	13.5	18.4		
		14:20	ELAC #6 WP 7	41-36,89 N	031-11,22 E	1574	018	± 6,0	1026.8	o	017/17	13.6	18.1		
		15:04	ELAC #6 WP 8	41-41,00 N	031-13,00 E	1845	018	± 6,0	1026.8	o	017/17	13.6	18.1		
		15:18	ELAC #6 WP 9	41-40,60 N	031-14,29 E	1910	196	± 6,0	1026.8	o	018/17	13.6	18.2		
		15:54	ELAC #6 WP 10	41-37,68 N	031-13,20 E	1639	144	± 6,0	1027.2	o	018/17	13.6	18.2		
		16:54	ELAC #6 WP 11	41-32,85 N	031-17,87 E	1763	144	± 6,0	1027.0	o	044/18	13.4	18.2		
		18:00	Station completed	41-30,6 N	031-10,4 E	1243	248	± 6,0	1027.7	o	020/15	13.6	18.4		Transit back to Istanbul
	03/11/2004	**18:00**	**Completion of Scientific work**												

R/V POSEIDON P317/4 CORE GC # 1

Location: Batumi Seep (off Georgia)

Latitude: 41:57.45N

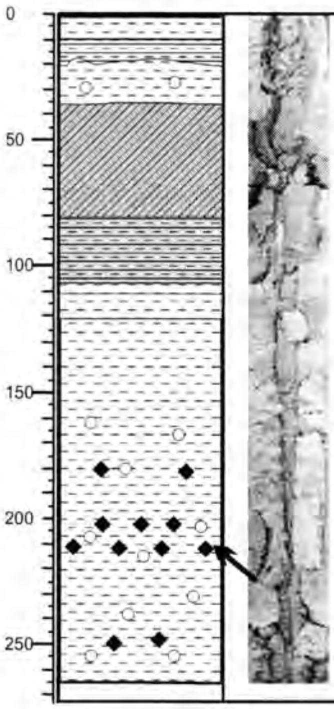
Longitude: 41:17.61E

Date: 21.10.04

Water Depth: 860 m

Recovery: 264 cm

Depth, cm	LITHOLOGY	UNIT



0-25 cm: very water-saturated, sloppy, structure-less, grey mud. From 10 to 20 cm finely laminated (less than 1 mm) sequence of alternating white coccolith-rich laminae
20-35 cm: grey mud, less water-saturated, highly gas-saturated — **Unit 1**

35-80 cm: very dark grey sapropels with some plant remains

80-105 cm: fine lamination of coccolith ooze and sapropel. Lower boundary is very sharp — **Unit 2**

105-140 cm: thickly laminated mud, shown by slight colour variations between shades of grey (light - dark grey)

140-260 cm: light grey mud, enriched in hydrotroilite (reduced iron) (200 cm), highly gas-saturated, with strong smell of H_2S. — **Unit 3**

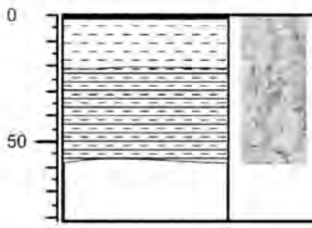
R/V POSEIDON P317/4 **CORE GC # 5**

Location: **Batumi Seep (off Georgia)**

Latitude: **41:57.54N**

Longitude: **41:17.61E** **Date: 22.10.04**

Water Depth: 861 m **Recovery: 55 cm**

Depth, cm	LITHOLOGY		UNIT
		0-25 cm: very water-saturated, sloppy, stuctureless, grey mud 10 to 20 25-55 cm finely laminated (less than 1 mm) sequence of alternating white coccolith-rich laminate All rest sequence was pushed out from the core because of high pressure of dissolving gas hydrates	1

R/V POSEIDON P317/4 **CORE GC # 6**

Location: **Samsun - Turkish Area 3**

Latitude: **41:56.15N**

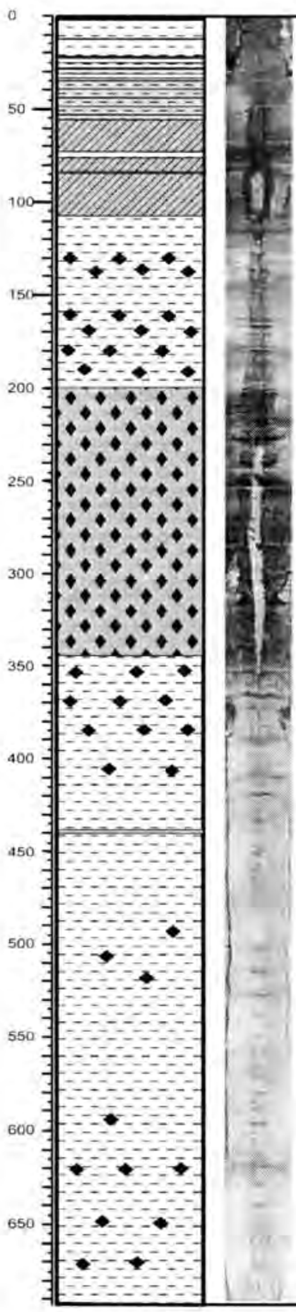
Longitude: **37:00.08E**

Date: 25.10.04

Water Depth: **1764 m**

Recovery: **680 cm**

Depth, cm	LITHOLOGY	UNIT



Description	UNIT
0-12 cm: very water-saturated, sloppy, structureless, grey mud	1
12-22 cm: light grey mud, stiffer, structureless 22-54 cm: finely laminated (less than 1 mm) sequence of sapropel with white coccolith-rich laminae. Several layers of light grey mud are observed in the sequence (22-26, 30-32 cm) 54- 105.5 cm: very dark grey sapropels with some plant remains. Through this sequence several layers of light grey mud (same as in previous section) are found at 73-75 cm, 83.5 cm.	2
105.5-200 cm: light grey mud with several hydrotroilite layers (130-143, 161, 165, 170, 177, 180, 185 cm)	3
200-345 cm: black hydrotroilite layer with several light grey stiff clay stratum (240, 265, 295, 314 cm, 254-275 cm thickly laminated light grey clay)	4
345-680 cm: light brownish grey clay, very stiff, thickly laminated with hydrotroilite at the top (345-355, 370, 385 cm) and delicate downwards the core	5

R/V POSEIDON P317/4	CORE GC # 7

Location: Gas Flare Kozlu High (Turkish Area 2)

Latitude: 41:31.14N

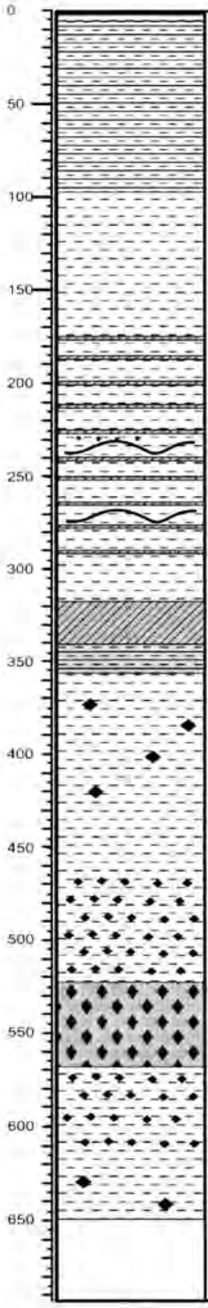
Longitude: 31:00.26E

Date: 30.10.04

Water Depth: 1307 m

Recovery: 650 cm

Depth, cm	LITHOLOGY	UNIT



0-2 cm: very water-saturated, sloppy, structureless, grey mud
2-97 cm: finely laminated (less than 1 mm) sequence of light grey mud with white coccolith-rich laminay

97-172 cm: light grey mud , structureless, less water-saturated, with some plant remains

172-318 cm: laminated sequence of light grey mud and dark greenish grey sapropel. At 230-236 and 272-282 cm slumping structures are observed. Sand layer was observed at 235 cm.

318-353 cm: sapropel layer with several light grey clay layers, from 340 to 353 cm fine lamination with cocolith-rich units

353-417 cm: light grey clay, structureless, stiff, with several patches of hydrotoilite

417-615 cm: black hydrotoilite layer, laminated in the upper (417-522 cm) and lower (567-615 cm) with light grey mud

615-650 cm: light grey homogenios, structureless clay with small patches of hydrotoilite

UNIT: 1, 2, 3, 4, 5

R/V POSEIDON P317/4 **CORE GC # 8**

Location: **TPAO-Flare, Kozlu High (Turkish Area 2)**

Latitude: **41:33.07N**

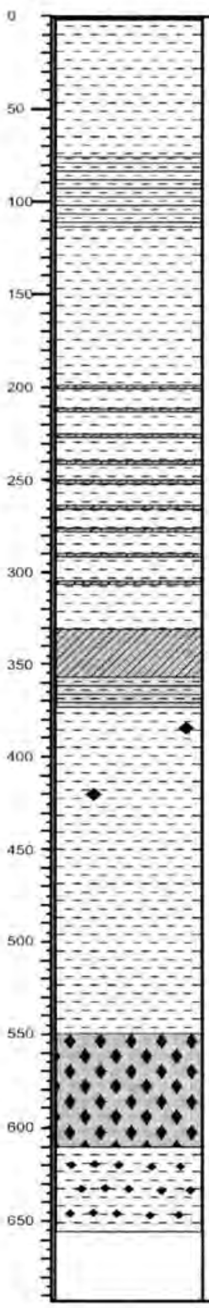
Longitude: **31:00.45E**

Date: 30.10.04

Water Depth: **1375 m**

Recovery: 655 cm

Depth, cm	LITHOLOGY	UNIT



0-75 cm: water-saturated, sloppy, structureless, light grey mud

75-111 cm: finely laminated (less than 1 mm) sequence of light grey mud with white coccolith-rich laminay

111-190 cm: light grey mud , structureless, less water-saturated

190-330 cm: laminated sequence of light grey mud and dark greenish grey sapropel.

330-372 cm: sapropel layer with several light grey clay layers, from 356 to 372 cm fine lamination with cocolith-rich units

372-550 cm: light grey homogenios clay, structureless, stiff

550-655 cm: black hydrotoilite layer, laminated in the lower part (612-655 cm) with light grey mud

UNIT: 1, 2, 3, 4, 5

R/V POSEIDON P317/4 **CORE GC # 9**

Location: **Circular feature, Koslu High (Turkish Area 2)**

Latitude: **41:28.52N**

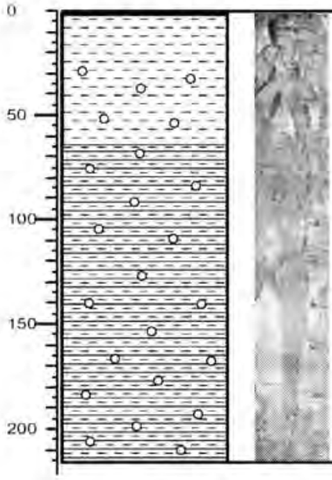
Longitude: **30:51.59E**

Date: 30.10.04

Water Depth: 1110 m

Recovery: 215 cm

Depth, cm	LITHOLOGY	UNIT



0-20 cm: high water-saturated, sloppy, structureless, light grey mud, gas saturated
20-215 cm: light grey structur-less homogenous mud highly gas saturated. 65-110cm: finely laminated (less than 1 mm) sequence of light grey mud with white coccolith-rich laminae, highly gas saturated. 100-215 cm: dry cold mud, probably due to gas hydrates dissociation

UNIT: 1

R/V POSEIDON P317/4 **CORE GC # 10**

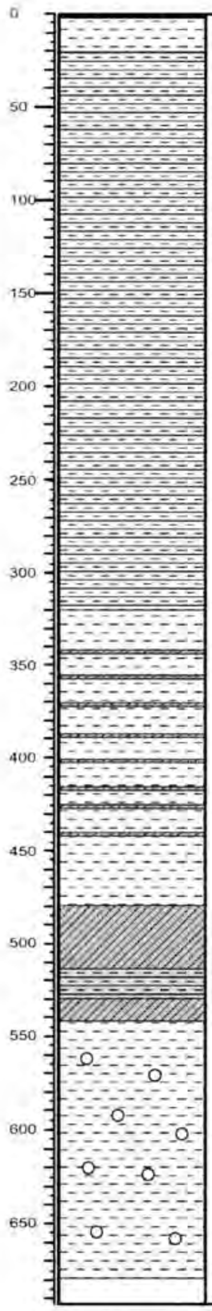
Location: **Circular feature, Kozlu High (Turkish Area 2)**

Latitude: **41:28.60N**

Longitude: **30:51.45E** **Date: 31.10.04**

Water Depth: 1375 m **Recovery: 655 cm**

Depth, cm	LITHOLOGY	UNIT



0-10 cm: water-saturated, sloppy, structureless, light grey mud
10-330 cm: finely laminated (less than 1 mm) sequence of light grey mud with white coccolith-rich laminay

330-480 cm: light grey mud , structureless, less water-saturated, laminated sequence of light grey mud and dark greenish grey sapropel.

480-541 cm: sapropel layer with several light grey clay layers, from 515 to 531 cm fine lamination with cocolith-rich units

372-550 cm: light grey homogenios clay, structureless, high gas-saturated

UNIT: 1 (0-480 cm), 2 (480-541 cm), 3 (541-655 cm)

R/V POSEIDON P317/4 **CORE GC # 14**

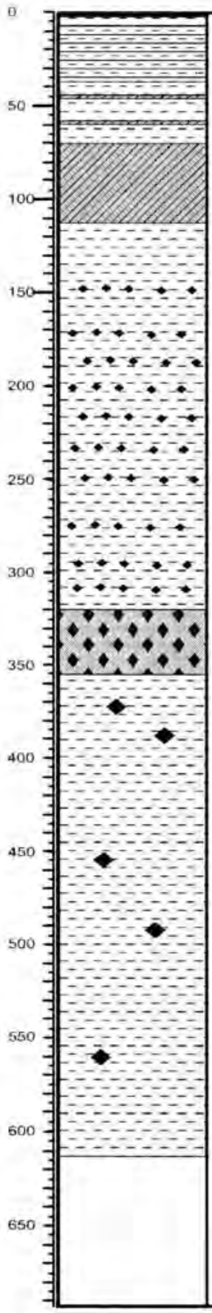
Location: **Gas flare, Koslu High (Turkish Area 2)**

Latitude: **41:43.83N**

Longitude: **31:05.96E** **Date: 03.11.04**

Water Depth: **1760 m** **Recovery: 612 cm**

Depth, cm	LITHOLOGY	UNIT



LITHOLOGY	UNIT
0-4 cm: water-saturated, sloppy, structureless, light grey mud 4-37 cm: finely laminated (less than 1 mm) sequence of light grey mud with white coccolith-rich laminay	1
37-70 cm: light grey mud , structureless, less water-saturated, laminated sequence of light grey mud and dark greenish grey sapropel. 70-115 cm: sapropel layer with several light grey and light braunish grey clay layers	2
115-320 cm: light grey homogenios clay, structureless with thin hydrotoilite layers	3
320-351 cm: black hydrotoilite layer, stiff, structureless	4
351-612 cm: horizontal lamination of clay varieted in color of grey (from braunish to light grey), at 468-472 cm cross bedding of clay	5

R/V POSEIDON P317/4	CORE GC # 15

Location: Gas flare, Koslu High (Turkish Area 2)

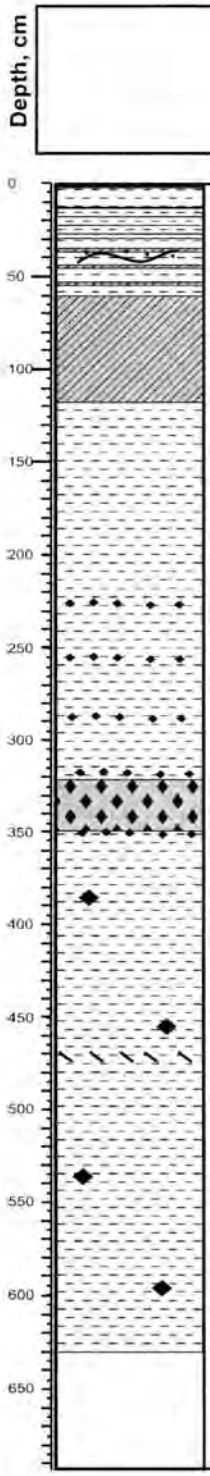
Latitude: 41:43.84N

Longitude: 31:05.95E

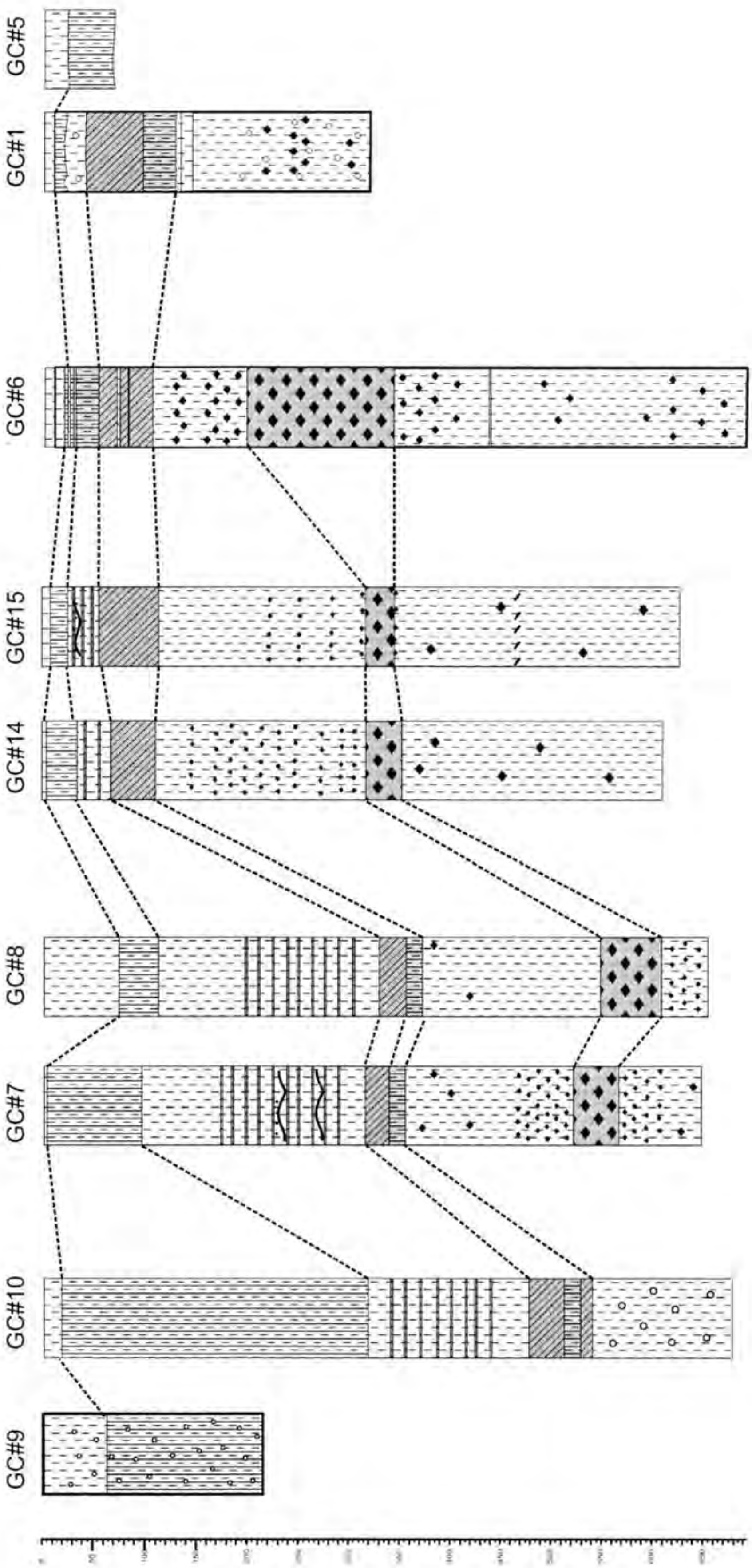
Date: 03.11.04

Water Depth: 1718 m

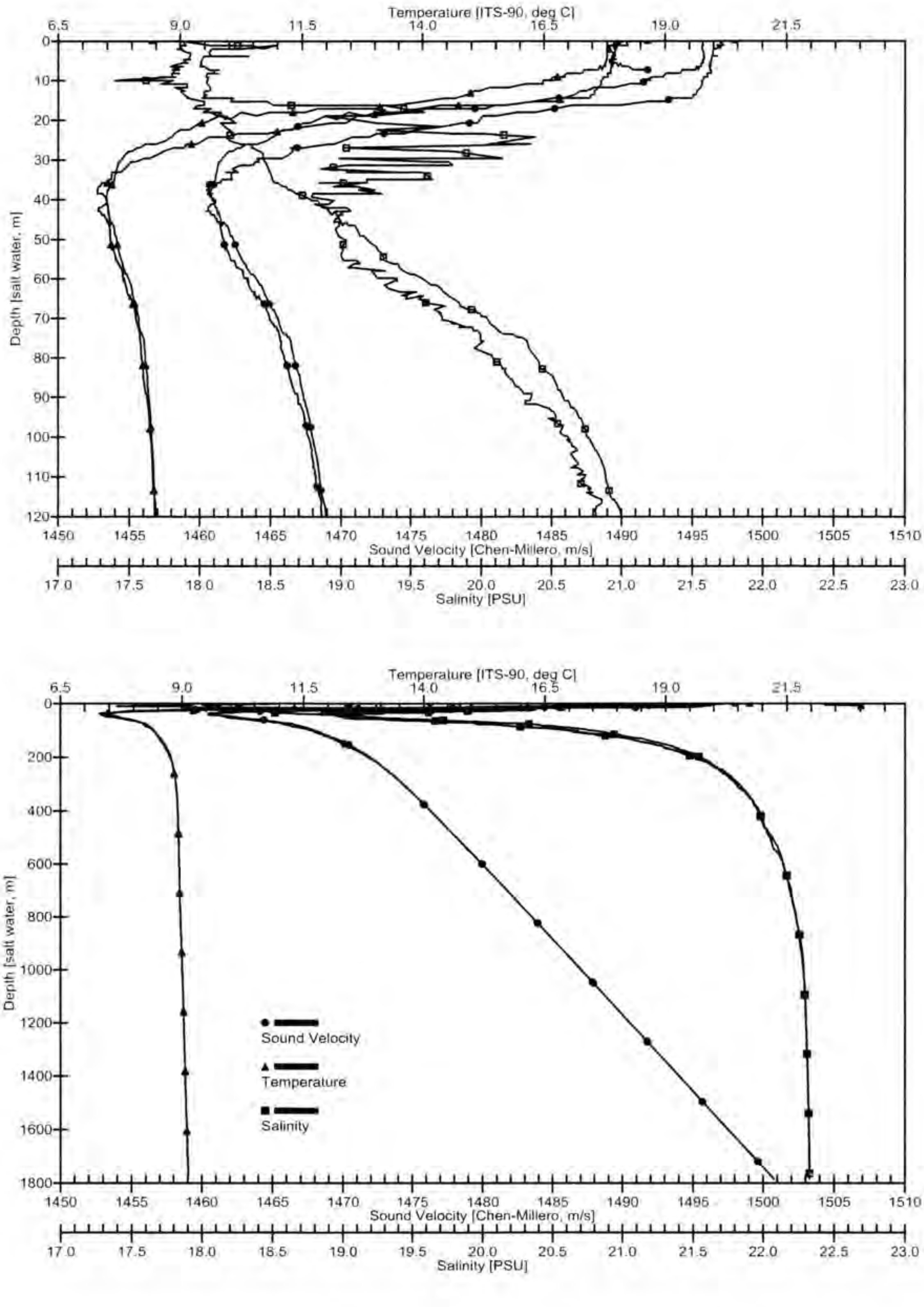
Recovery: 630 cm



LITHOLOGY	UNIT
0-12 cm: water-saturated, sloppy, structureless, light grey mud 12-29 cm: finely laminated (less than 1 mm) sequence of light grey mud with white coccolith-rich laminay	1
29-60 cm: light grey mud , structureless, less water-saturated, laminated sequence of light grey mud and dark greenish grey sapropel. Slump structure with sand layer at 40 cm.	2
60-116.5 cm: sapropel layer with several light grey and light braunish grey clay layers 116.5-204 cm: light grey homogenios clay, structureless 204-330 cm: light grey homogenios clay, structureless with thin hydrotoilite layers	3
330-353 cm: black hydrotoilite layer, stiff, structureless	4
353-630 cm: horizontal lamination of clay varieted in color of grey (from braunish to light grey), at 468-472 cm cross bedding of clay	5



Stratigraphic correlation of sediments recovered by gravity corer with plastic bag as liner (Batumi: GC # 1, 5; Samsun: GC # 6; Kozlu High: GC # 7-15).



Temperature, salinity and sound velocity recorded by the memory-CTD mounted on OFOS # 4 (Samsun Area). The profiles from the other OFOS deployments are nearly identical.