



**National
Oceanography Centre**

NATURAL ENVIRONMENT RESEARCH COUNCIL

National Oceanography Centre

Cruise Report No. 28

RV Pelagia Cruise 64PE372

27 JUN - 11 JUL 2013

Flow dynamics and sedimentation in an active
submarine channel: a process-product approach

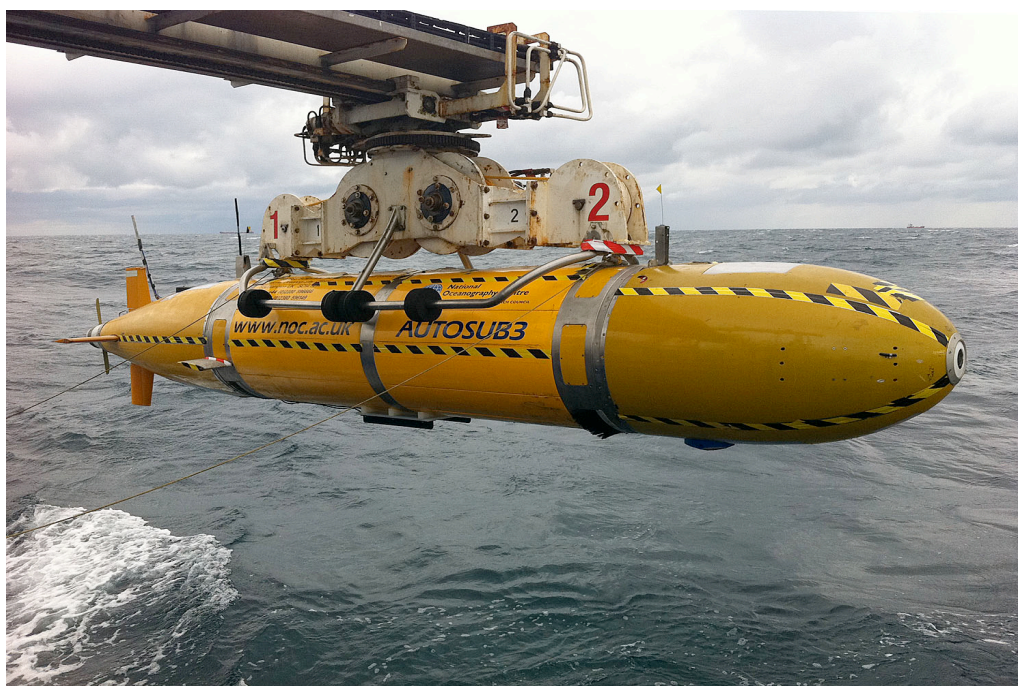
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2014



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DOCUMENT DATA SHEET

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ABSTRACT <p>Novel technologies are providing new opportunities to study the structure and dynamics of submarine sediment-gravity flows; these flows are the dominant process for transfer of sediment into the deep ocean, but are very hard to monitor due their destructive and unpredictable character. The primary aim of 64PE372 was to image the 3D structure of submarine flows passing through a rare example of an active submarine channel system in the southeast Black Sea. The channel system is maintained by through-flow of relatively dense, saline water coming from the Bosphorus Strait outflow. ADCP mapping of internal flow structure within and outside the channel was achieved using the NERC Autosub3 Autonomous Underwater Vehicle (AUV), supplemented by vertical, vessel-based, CTD profiling, and a fixed CTD mooring in the proximal channel for the duration of the cruise. Sedimentary features associated with the channel were imaged using towed high-resolution sidescan sonar, supported by vessel-based multibeam bathymetry and backscatter, AUV subbottom profiler data, and gravity cores. The 64PE372 cruise built upon a previous cruise to the study area in spring 2010, but was far more successful due to the increased capability of the barter vessel and the improved performance of the AUV.</p>	
KEYWORDS Bosphorus, Black Sea, RV <i>Pelagia</i> , Autosub3, submarine channel, submarine flows, bedforms, sediment cores	
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1. Cruise Personnel

Ship Master, Officers and Crew

J.C. Ellen	Master	NIOZ
E.A. Puijman	Chief Officer	NIOZ
A.D.H. Fockema	2 nd Officer	NIOZ
J. Seepma	Chief Engineer	NIOZ
J.F.E. Lips	2 nd Engineer	NIOZ
C. Stevens	Boatswain	NIOZ
R. van der Heide	AB	NIOZ
J.A. Israel Vitoria	AB	NIOZ
M.J. de Vries	AB	NIOZ
I. den Breejen	Cook	NIOZ
A. Bakker	Steward	NIOZ
M.C. Bakker	Technician	NIOZ
B Boersen	Technician	NIOZ

Scientific Party

R.B. Wynn	Principal Scientist	NOC
D. Parsons	Scientist	U. Hull
S.E. Darby	Scientist	U. Southampton
E.J. Sumner	Scientist	U. Southampton
T.P. Le Bas	Scientist	NOC
V. Hühnerbach	Scientist	NOC
P. Bailey	Scientist	U. Southampton
D. Tezcan	Scientist	METU, Turkey
E. Hacıoglu	Scientist/Observer	METU, Turkey

Technical Support Staff

M. Furlong	MARS Engineer	NOC
J.R. Perrett	MARS Engineer	NOC
D.R. Matthew	MARS Engineer	NOC
D. Paxton	MARS Technician	NOC

NIOZ = Royal Netherlands Institute for Sea Research

NOC = National Oceanography Centre

METU = Middle East Technical University

U. = University

2. Itinerary

Departed Istanbul, Turkey: 27 June

Returned Istanbul, Turkey: 11 July

3. Scientific Objectives

Submarine channels are spectacular features that can extend for thousands of kilometres across the seafloor, and are often kilometres wide and up to hundreds of metres deep. They are formed by density currents: underwater flows of sand, mud and water that are denser than sea water and therefore flow along the seafloor. These channels are the major transport pathway for moving sediments to the deep sea and they host some of the largest sedimentary deposits on Earth. Channel-fill deposits can hold significant hydrocarbon reserves and hold key information on past climate change and mountain building episodes. Such flows are difficult to study, typically being infrequent and highly destructive; they pose a major hazard to seafloor infrastructure such as cables and pipelines, and have previously destroyed scientific measurement equipment. Consequently, our knowledge of such flows comes mainly from laboratory experiments, and understanding of their deposits from studies of ancient examples now exposed on land. As a consequence there are no detailed studies of these flows in natural channels, and no studies that link flow measurements to the deposits that are produced. There is almost no other environment on Earth where we do not have any knowledge of how flow processes are linked to their sedimentary deposits, and this in the largest deposits on Earth!

Consequently, there is an urgent need to improve our understanding of the interactions between flow, morphology and deposits within an active submarine channel. However, in addition to the technical problems associated with monitoring these density-driven flows, most submarine channels actually formed when sea-levels were much lower than today; present-day flows are typically much smaller than those that formed the channels/deposits, making study of interactions impossible. Furthermore, innovative techniques are required to measure detailed flow patterns within these channels.

Around 6,000 years ago, sea level approached its present level, and dense salty fluid (10-15 m thick) from the Mediterranean started flowing through the Bosphorus Strait (past Istanbul) into the Black Sea, forming an almost constantly active seafloor channel network. The first spectacular images of this system and its sedimentary deposits were only obtained in 2005. This system provides a unique opportunity to study both flows and deposits in an active seafloor channel for the very first time and to use this knowledge to formulate and test predictive models. We have assembled a world-leading group of UK and international scientists to tackle this challenge. We will use Autosub3, NERC's new state-of-the-art autonomous submarine (yellow, of course!) to 'fly' our measurement equipment just above the bottom, allowing us to map channel morphology and the three dimensional (3D) flows in unprecedented detail compared to what is possible from traditional ship-based methods. The flow data will be linked to measurements of seabed properties, smaller morphological features such as bedforms, and seismic data that images through sediment to reveal the internal structure of the deposits. These data will be used as input conditions for an innovative computer simulation model of flow and deposition in submarine channels. The numerical modelling and field-data will be combined to enable us to: i) assess bedforms in the channels with respect to the flows forming them, allowing reconstruction of past flows from preserved bedforms in older rocks for the very first time; ii) model bend flow to enable sediment patterns in the deposits to be predicted, and, iii) develop a new understanding of how flow and morphology is linked to long-

term sediment deposition. These data will revolutionise our understanding of both flows and deposits in submarine environments, with key applications to: i) geohazard analysis, ii) design criteria for seafloor engineering, and, iii) prediction of sedimentary deposit types and distributions.

4. Cruise Narrative (all times GMT)

26/06/13

UK science party arrive on RV *Pelagia* at 1630 hrs.

27/06/13

Science party prepare equipment and secure additional supplies. Turkish scientist and observer arrive on board. H&S and science meeting held from 1630-1830 hrs. RV *Pelagia* leaves port at 1900 hrs for the short transit through Bosphorus Strait.

The ship MBES and 3.5 kHz SBP were switched on and recording at 2028 hrs. Work Area 1, focussing on the proximal Bosphorus Channel and main bend, was reached at 2122 hrs. MBES Area 1 was aiming to cover 15 km² of the proximal channel, including a series of large channel-floors scours. The Reson 7125 MBES system was not operational due to a faulty cable connection - despite trouble-shooting it couldn't be fixed quickly, so the ship MBES survey started at 2234 hrs (Station #1). The 3.5 kHz SBP was recording, but a quick check of the data suggested low quality with little or no sub-bottom information.

28/06/13

Ship MBES survey continued overnight. Some issues with shipping traffic saw the NE-SW survey lines switch from the west to east side of the survey box. MBES survey finished at 0452 hrs, with about 30% of MBES Area 1 covered.

The ship then transferred to Station #2 for a seabed lander deployment in the axis of the proximal Bosphorus Channel, arriving at 0520 hrs. The 600 kHz ADCP was prepared for lander deployment and was pinging at 0520 hrs. The lander was in the water at 0546 hrs (location 41°14.720N / 29°09.017E; WD 61 m), and the ship then moved ~100 m away for a series of CTD deployments in the channel axis.

The ship arrived at Station #3 for CTD deployment at 0549 hrs. The CTD was prepared and then deployed as follows:

Station #3 - CTD

In water at 0718 hrs (41°14.655N / 29°09.011E)

On seabed at 0724 hrs (41°14.669N / 29°09.017E; WD 60.7 m)

Station #4 - CTD

In water at 0727 hrs (41°14.681N / 29°08.992E)

On seabed at 0729 hrs (41°14.677N / 29°08.998E; WD 60.8 m)

The SVP was then lashed on to the interior of the CTD frame.

Station #5 - CTD/SVP

In water at 0738 hrs (41°14.641N / 29°09.021E)

On seabed at 0741 hrs (41°14.693N / 29°09.002E; WD 60.7 m)

Station #6 - CTD/SVP

In water at 0743 hrs (41°14.652N / 29°09.009E)

On seabed at 0746 hrs (41°14.675N / 29°08.994E; WD 60.9 m)

Station #7 - CTD/SVP

In water at 0749 hrs (41°14.675N / 29°09.011E)

On seabed at 0752 hrs (41°14.667N / 29°09.031E; WD 60.4 m)

The provision of a weight on the end of the CTD frame ensured that it was obvious when the rig hit seabed, which was typically with a wire out value a couple of metres greater than water depth. The last CTD was on deck at 0758 hrs and the SVP and CTD data were quickly uploaded and analysed. These data revealed an expected profile with a thin high-density flow at the base of the channel. The LISST was then prepared for deployment later in the day.

At 1045 hrs the AUV team tested the acoustic towfish at a range of different vessel speeds, up to about 5 knots. The towfish was back on deck by 1135 hrs. The sea state was not suitable for AUV testing, or for sidescan sonar deployment, so at 1329 hrs the ship transited to a site on the channel floor with an inner and outer bend bar. After arrival at 1400 hrs, both bars were targeted with a CTD, SVP and LISST combination on a single frame, and a short 3 m gravity corer, as follows:

Inner bend bar

Station #8 - CTD/SVP/LISST

In water at 1402 hrs (41°17.516N / 29°10.737E)

On seabed at 1408 hrs (41°17.513N / 29°10.740E; WD 67 m)

On deck at 1412 hrs

Station #9 - 3 m gravity core (core 64PE372#1)

In water at 1426 hrs (41°17.488N / 29°10.760E)

On seabed at 1432 hrs (41°17.515N / 29°10.729E; WD 67 m)

On deck at 1440 hrs

Outer bend bar

Station #10 - CTD/SVP/LISST

In water at 1537 hrs (41°17.544N / 29°11.180E)

On seabed at 1541 hrs (41°17.544N / 29°11.176E; WD 70 m)

On deck at 1544 hrs

Station #11 - 3 m gravity core (core 64PE372#2)

In water at 1559 hrs (41°17.545N / 29°11.180E)

On seabed at 1600 hrs (41°17.543N / 29°11.180E; WD 72 m)

On deck at 1606 hrs

The water column data indicated active flow in the proximal channel (5-10 m thick). The core recovered from the inner bend bar contained 57 cm of coarse shelly gravel, with some blackish mud mixed in the top few cm. The core targeting the outer bend bar failed to penetrate, with a small amount of very coarse shelly sand in the core catcher (sample retained and photo taken).

At 1631 hrs the ship then moved to the MBES Area 1 from the previous night (Station #12) and proceeded to fill in the remaining ~70% of the survey box.

29/06/13

MBES Area 1 was completed at ~0500 hrs and the ship then moved to a location in the shipping separation zone (adjacent to the proximal channel-bend bar forms) for an AUV in-water test at Station #13 (location 41°17.6N / 29°10.7E).

The AUV test was completed at 0550 hrs and the ship then steamed to a site >12 NM offshore to release the ship's grey water. The site, located in the distal channel in Work Area 3, was reached at 0735 hrs and the CTD/SVP/LISST deployed as follows:

Station #14 - CTD/SVP/LISST

In water at 0736 hrs (41°28.498N / 29°01.331E)

On seabed at 0740 hrs (41°28.489N / 29°01.306E; WD 90 m) wire out 94 m

On deck at 0742 hrs

The CTD data indicated active near-bed flow in the distal channel (a few metres thick). The ship then proceeded to empty the grey water tanks, and by 0835 hrs was on transit back south to Work Area 1 for a sidescan sonar survey across the main channel bend and inner/outer bend bars surveyed the previous day. The ship was on Station #15 at 1010 hrs and the sidescan was deployed at 1036 hrs (41°19.304N / 29°13.048E; WD 69.5 m).

The sidescan sonar survey was completed at 1546 hrs and the ship turned on to the recovery line (41°17.65N / 29°11.87E; WD 54 m). Logging was stopped at 1556 hrs and the vehicle was recovered at 1557 hrs (41°17.988N / 29°11.683E; WD 56 m). The ship then transferred to the AUV launch site, also known as the 'safe waypoint'.

Station #16 was reached at 1641 hrs (41°24.120N / 29°10.631E; WD 87 m) and the AUV was in the water at 1705 hrs (41°24.129N / 29°10.607E). The acoustic fish was in the water at 1707 hrs and the AUV started its test mission at 1719 hrs. The aim was to run a couple of long test lines outside of the main channel, before AUV Mission 1 started with a series of repeat runs across the main channel bend.

The first batch of data received during the test mission indicated that the AUV was running a bit heavy in the water, the SBP was not working, and the ADCP data were not recording high-quality data in the near-bed region. However, the second data download at 2100 hrs indicated that things were looking better, and the AUV therefore proceeded to the start of Mission 1.

30/06/13

The AUV crossed the channel bend several times overnight and, by the third data download at 0400 hrs, it was clear that the ADCP data being recorded were of high quality and the profiles included the full water column to the seabed.

The ship remained at a location close to the AUV until 0650 hrs, at which point it moved a short distance to begin a transect of combined CTD/SVP/LISST deployments across the channel bend close to where the AUV was collecting data (Line 4).

The first station was reached at 0704 hrs, and deployments commenced shortly after as follows:

Station #17 - CTD/SVP/LISST

On station at 0704 hrs (41°18.034N / 29°10.142E; WD 67 m)

In water at 0706 hrs; on seabed at 0708 hrs; on deck at 0711 hrs

Station #18 - CTD/SVP/LISST

On station at 0721 hrs (41°18.084N / 29°10.420E; WD 64 m)

In water at 0723 hrs; on seabed at 0726 hrs; on deck at 0728 hrs

Station #19 - CTD/SVP/LISST

On station at 0735 hrs (41°18.104N / 29°10.561E; WD 66 m)

In water at 0736 hrs; on seabed at 0740 hrs; on deck at 0742 hrs

Station #20 - CTD/SVP/LISST

On station at 0747 hrs (41°18.142N / 29°10.708E; WD 76 m)

In water at 0748 hrs; on seabed at 0752 hrs; on deck at 0755 hrs

Station #21 - CTD/SVP/LISST

On station at 0802 hrs (41°18.160N / 29°10.829E; WD 82 m)

In water at 0803 hrs; on seabed at 0807 hrs; on deck at 0810 hrs

Station #22 - CTD/SVP/LISST

On station at 0818 hrs (41°18.180N / 29°11.004E; WD 82 m)

In water at 0818 hrs; on seabed at 0822 hrs; on deck at 0825 hrs

Station #23 - CTD/SVP/LISST

On station at 0829 hrs (41°18.195N / 29°11.090E; WD 81 m)

In water at 0831 hrs; on seabed at 0834 hrs; on deck at 0836 hrs

Station #24 - CTD/SVP/LISST

On station at 0838 hrs (41°18.221N / 29°11.161E; WD 57 m)

In water at 0839 hrs; on seabed at 0842 hrs; on deck at 0844 hrs

Station #25 - CTD/SVP/LISST

On station at 0849 hrs (41°18.254N / 29°11.299E; WD 61 m)

In water at 0850 hrs; on seabed at 0853 hrs; on deck at 0855 hrs

Station #26 - CTD/SVP/LISST

On station at 0859 hrs (41°18.281N / 29°11.460E; WD 64 m)

In water at 0900 hrs; on seabed at 0902 hrs; on deck at 0904 hrs

After the CTD casts were completed the ship moved a short distance inshore to meet a small boat bringing out a replacement cable for the Reson multibeam system. This task was completed by 1030 hrs, and the ship then moved to the AUV Mission 1 area to meet the sub during its next visit to the surface. However, upon reaching the AUV at 1242 hrs it was clear that the sub was still having problems surfacing due to excess weight. In addition, with a worsening weather forecast due over the next 24 hours, the decision was made to abort the mission at 1258 hrs (Station #27; 41°19.448N / 29°11.326E; WD 69 m). The towfish was recovered at 1308 hrs and the AUV was recovered in a very smooth operation at 1339 hrs.

The next aim was to undertake a further CTD/SVP/LISST transect across the main channel bend (Line 6), and by 1408 hrs the ship was on site for the first station:

Station #28 - CTD/SVP/LISST

On station at 1408 hrs (41°17.510N / 29°10.322E; WD 63 m)

In water at 1410 hrs; on seabed at 1413 hrs; on deck at 1415 hrs

The ship then moved to Station #29 and hove to while the new cable for the Reson multibeam system was fitted. This was successfully completed by 1550 hrs and the remaining CTD deployments undertaken as follows:

Station #29 - CTD/SVP/LISST

On station at 1550 hrs (41°17.514N / 29°10.464E; WD 59 m)

In water at 1552 hrs; on seabed at 1553 hrs; on deck at 1555 hrs

Station #30 - CTD/SVP/LISST

On station at 1613 hrs (41°17.552N / 29°11.455E; WD 54 m)

In water at 1613 hrs; on seabed at 1616 hrs; on deck at 1617 hrs

Station #31 - CTD/SVP/LISST

On station at 1623 hrs (41°17.546N / 29°11.288E; WD 72 m)

In water at 1623 hrs; on seabed at 1625 hrs; on deck at 1627 hrs

Station #32 - CTD/SVP/LISST

On station at 1633 hrs (41°17.542N / 29°11.186E; WD 71 m)

In water at 1633 hrs; on seabed at 1636 hrs; on deck at 1637 hrs

Station #33 - CTD/SVP/LISST

On station at 1645 hrs (41°17.532N / 29°11.011E; WD 76 m)

In water at 1645 hrs; on seabed at 1647 hrs; on deck at 1649 hrs

Station #34 - CTD/SVP/LISST

On station at 1654 hrs (41°17.532N / 29°10.885E; WD 73 m)

In water at 1655 hrs; on seabed at 1657 hrs; on deck at 1659 hrs

Station #35 - CTD/SVP/LISST

On station at 1705 hrs (41°17.526N / 29°10.760E; WD 70 m)

In water at 1706 hrs; on seabed at 1708 hrs; on deck at 1710 hrs

Once the CTD transect (eight casts) was completed, the ship moved to the second MBES survey area in Work Area 1 (Station #36). After a couple of hours spent trying to calibrate the Reson MBES, the survey started at ~2000 hrs and continued overnight.

01/07/13

The weather at daybreak was better than expected so the MBES survey was finished at 0320 hrs and the ship moved to the AUV deployment site (41°19.38N / 29°10.626E; station #37) in order to complete the remainder of AUV Mission 1. The ship was on site from 0350 hrs and hove to while the AUV was prepared for launch (this was delayed due to problems with one of the Argos beacons). At 0556 hrs the Argos beacon on the AUV was still not working, so the ship moved a short distance away to start a third CTD transect across the channel bend (Line 2), as follows:

Station #38 - CTD/SVP/LISST

On station at 0606 hrs (41°18.526N / 29°09.792E; WD 62 m)

In water at 0607 hrs; on seabed at 0609 hrs; on deck at 0611 hrs

Station #39 - CTD/SVP/LISST

On station at 0618 hrs (41°18.651N / 29°10.085E; WD 68 m)

In water at 0619 hrs; on seabed at 0621 hrs; on deck at 0623 hrs

Station #40 - CTD/SVP/LISST

On station at 0632 hrs (41°18.698N / 29°10.178E; WD 71 m)

In water at 0633 hrs; on seabed at 0636 hrs; on deck at 0637 hrs

Station #41 - CTD/SVP/LISST

On station at 0643 hrs (41°18.762N / 29°10.263E; WD 78 m)

In water at 0644 hrs; on seabed at 0646 hrs; on deck at 0649 hrs

Station #42 - CTD/SVP/LISST

On station at 0653 hrs (41°18.763N / 29°10.367E; WD 80 m)

In water at 0654 hrs; on seabed at 0657 hrs; on deck at 0659 hrs

Station #43 - CTD/SVP/LISST

On station at 0704 hrs (41°18.808N / 29°10.456E; WD 74 m)

In water at 0705 hrs; on seabed at 0708 hrs; on deck at 0710 hrs

The Argos beacon was fixed at 0650 hrs (the pressure switch was faulty and therefore replaced), so the CTD transect was aborted at 0715 hrs and the ship returned to the AUV launch position (Station #37). The vessel was on station at 0724 hrs, the AUV was in the water at 0740 hrs and the towfish was deployed at 0743 hrs. The vessel was then positioned to communicate with the AUV to ensure all systems were operational. The towfish was subsequently recovered at 1030 hrs and the ship then returned to the earlier CTD transect (Line 2) as follows:

Station #44 - CTD/SVP/LISST

On station at 1110 hrs (41°19.051N / 29°11.034E; WD 58 m)

In water at 1111 hrs; on seabed at 1113 hrs; on deck at 1115 hrs

Station #45 - CTD/SVP/LISST

On station at 1125 hrs (41°18.920N / 29°10.706E; WD 59 m)

In water at 1126 hrs; on seabed at 1128 hrs; on deck at 1129 hrs

Station #46 - CTD/SVP/LISST

On station at 1136 hrs (41°18.890N / 29°10.604E; WD 71 m)

In water at 1137 hrs; on seabed at 1139 hrs; on deck at 1141 hrs

Station #47 - CTD/SVP/LISST

On station at 1147 hrs (41°18.845N / 29°10.551E; WD 74 m)

In water at 1148 hrs; on seabed at 1151 hrs; on deck at 1153 hrs

The CTD transect finished at 1153 hrs and the ship then transferred to a new transect (Line 10). The first cast was at Station #48 and the transect progressed as follows:

Station #48 - CTD/SVP/LISST

On station at 1248 hrs (41°15.781N / 29°11.285E; WD 46 m)

In water at 1250 hrs; on seabed at 1251 hrs; on deck at 1253 hrs

Station #49 - CTD/SVP/LISST

On station at 1305 hrs (41°16.015N / 29°10.779E; WD 52 m)

In water at 1306 hrs; on seabed at 1308 hrs; on deck at 1310 hrs

Station #50 - CTD/SVP/LISST

On station at 1317 hrs (41°16.027N / 29°10.707E; WD 65 m)

In water at 1318 hrs; on seabed at 1320 hrs; on deck at 1321 hrs

Station #51 - CTD/SVP/LISST

On station at 1326 hrs (41°16.054N / 29°10.632E; WD 68 m)

In water at 1327 hrs; on seabed at 1329 hrs; on deck at 1331 hrs

Station #52 - CTD/SVP/LISST

On station at 1339 hrs (41°16.072N / 29°10.555E; WD 74 m)

In water at 1340 hrs; on seabed at 1342 hrs; on deck at 1343 hrs

Station #53 - CTD/SVP/LISST

On station at 1353 hrs (41°16.109N / 29°10.416E; WD 75 m)

In water at 1354 hrs; on seabed at 1357 hrs; on deck at 1358 hrs

Station #54 - CTD/SVP/LISST

On station at 1407 hrs (41°16.143N / 29°10.329E; WD 73 m)

In water at 1408 hrs; on seabed at 1411 hrs; on deck at 1413 hrs

Station #55 - CTD/SVP/LISST

On station at 1425 hrs (41°16.168N / 29°10.218E; WD 57 m)

In water at 1426 hrs; on seabed at 1427 hrs; on deck at 1429 hrs

Station #56 - CTD/SVP/LISST

On station at 1435 hrs (41°16.217N / 29°10.069E; WD 50 m)

In water at 1437 hrs; on seabed at 1438 hrs; on deck at 1439 hrs

CTD Line 10 was completed at 1440 hrs and the ship moved to an area of overbank scours and sediment waves for a further three casts, in order to assess whether there was active flow in this area. The three casts were as follows:

Station #57 - CTD/SVP/LISST

On station at 1537 hrs (41°18.350N / 29°12.567E; WD 69 m)

In water at 1538 hrs; on seabed at 1542 hrs; on deck at 1544 hrs

Station #58 - CTD/SVP/LISST

On station at 1555 hrs (41°18.151N / 29°12.306E; WD 61 m)

In water at 1557 hrs; on seabed at 1559 hrs; on deck at 1601 hrs

Station #59 - CTD/SVP/LISST

On station at 1607 hrs (41°18.224N / 29°12.211E; WD 63 m)

In water at 1608 hrs; on seabed at 1610 hrs; on deck at 1613 hrs

The data indicated little or no flow in the overbank area, apart from a small zone of enhanced density in the base of a large scour. Once these casts were completed at 1614 hrs, the ship then moved a short distance for three further CTD casts repeating earlier sites in the channel bend apex, as follows:

Station #60 - CTD/SVP/LISST

On station at 1638 hrs (41°17.537N / 29°11.186E; WD 72 m)

In water at 1639 hrs; on seabed at 1642 hrs; on deck at 1644 hrs

Station #61 - CTD/SVP/LISST

On station at 1644 hrs (41°17.532N / 29°11.016E; WD 74 m)

In water at 1651 hrs; on seabed at 1654 hrs; on deck at 1657 hrs

Station #62 - CTD/SVP/LISST

On station at 1701 hrs (41°17.531N / 29°10.901E; WD 75 m)

In water at 1702 hrs; on seabed at 1705 hrs; on deck at 1707 hrs

Once completed, the ship then moved to Station #63 at 1707 hrs to start an overnight MBES survey, with the aim of completing the MBES area started the previous night.

02/07/13

The overnight MBES survey was successfully completed at 0420 hrs, and the ship then moved to start a new CTD transect (Line 8) across the main channel:

Station #64 - CTD/SVP/LISST

*On station at 0507 hrs (41°16.748N / 29°11.674E; WD 61 m)
In water at 0508 hrs; on seabed at 0510 hrs; on deck at 0512 hrs*

*Station #65 - CTD/SVP/LISST
On station at 0522 hrs (41°16.805N / 29°11.221E; WD 62 m)
In water at 0523 hrs; on seabed at 0526 hrs; on deck at 0527 hrs*

*Station #66 - CTD/SVP/LISST
On station at 0535 hrs (41°16.824N / 29°11.120E; WD 70 m)
In water at 0535 hrs; on seabed at 0538 hrs; on deck at 0540 hrs*

*Station #67 - CTD/SVP/LISST
On station at 0544 hrs (41°16.826N / 29°11.022E; WD 75 m)
In water at 0544 hrs; on seabed at 0547 hrs; on deck at 0550 hrs*

*Station #68 - CTD/SVP/LISST
On station at 0554 hrs (41°16.833N / 29°10.924E; WD 76 m)
In water at 0554 hrs; on seabed at 0557 hrs; on deck at 0559 hrs*

*Station #69 - CTD/SVP/LISST
On station at 0604 hrs (41°16.852N / 29°10.751E; WD 75 m)
In water at 0605 hrs; on seabed at 0608 hrs; on deck at 0610 hrs*

*Station #70 - CTD/SVP/LISST
On station at 0615 hrs (41°16.853N / 29°10.638E; WD 74 m)
In water at 0616 hrs; on seabed at 0618 hrs; on deck at 0620 hrs*

*Station #71 - CTD/SVP/LISST
On station at 0623 hrs (41°16.864N / 29°10.569E; WD 66 m)
In water at 0624 hrs; on seabed at 0626 hrs; on deck at 0628 hrs*

*Station #72 - CTD/SVP/LISST
On station at 0632 hrs (41°16.870N / 29°10.469E; WD 59 m)
In water at 0633 hrs; on seabed at 0635 hrs; on deck at 0636 hrs*

*Station #73 - CTD/SVP/LISST
On station at 0642 hrs (41°16.903N / 29°10.721E; WD 58 m)
In water at 0643 hrs; on seabed at 0645 hrs; on deck at 0646 hrs*

Once Line 8 was completed at 0647 hrs, the ship transferred to the area of large-scale scours in the proximal channel floor for a further line of CTD casts as follows:

*Station #74 - CTD/SVP/LISST
On station at 0725 hrs (41°14.845N / 29°09.488E; WD 59 m)
In water at 0726 hrs; on seabed at 0729 hrs; on deck at 0730 hrs*

*Station #75 - CTD/SVP/LISST
On station at 0743 hrs (41°15.592N / 29°10.067E; WD 80 m)
In water at 0744 hrs; on seabed at 0748 hrs; on deck at 0749 hrs*

*Station #76 - CTD/SVP/LISST
On station at 0753 hrs (41°15.744N / 29°10.170E; WD 73 m)
In water at 0754 hrs; on seabed at 0756 hrs; on deck at 0759 hrs*

Station #77 - CTD/SVP/LISST

*On station at 0802 hrs (41°15.785N / 29°10.197E; WD 87 m)
In water at 0802 hrs; on seabed at 0807 hrs; on deck at 0808 hrs*

Station #78 - CTD/SVP/LISST

*On station at 0811 hrs (41°15.846N / 29°10.253E; WD 77 m)
In water at 0811 hrs; on seabed at 0814 hrs; on deck at 0816 hrs*

Station #79 - CTD/SVP/LISST

*On station at 0819 hrs (41°15.917N / 29°10.301E; WD 77 m)
In water at 0820 hrs; on seabed at 0822 hrs; on deck at 0824 hrs*

Station #80 - CTD/SVP/LISST

*On station at 0828 hrs (41°16.083N / 29°10.419E; WD 76 m)
In water at 0829 hrs; on seabed at 0831 hrs; on deck at 0834 hrs*

Station #81 - CTD/SVP/LISST

*On station at 0842 hrs (41°16.630N / 29°10.698E; WD 77 m)
In water at 0843 hrs; on seabed at 0845 hrs; on deck at 0847 hrs*

Once the CTDs were finished at 0847 hrs the ship moved to the AUV rendezvous site, arriving at 0932 hrs at Station #82 (41°19.112N / 29°11.110E). The acoustic towfish was deployed and the opportunity taken to test the emergency receiver for the AUV. The test was completed at 1034 hrs and, as contact had successfully been established with the AUV, recovery was initiated. The AUV arrived at surface at 1119 hrs (41°19.316N / 29°10.605E), and was recovered and on deck at 1141 hrs. An initial look at the ADCP data indicated that the data obtained during AUV Mission 1 were of high quality.

At 1144 hrs the ship started a short transit to Line 4 across the channel, for a series of repeat CTD casts as follows:

Station #83 - CTD/SVP/LISST

*On station at 1211 hrs (41°18.284N / 29°11.466E; WD 63 m)
In water at 1212 hrs; on seabed at 1214 hrs; on deck at 1216 hrs*

Station #84 - CTD/SVP/LISST

*On station at 1226 hrs (41°18.265N / 29°11.327E; WD 60 m)
In water at 1227 hrs; on seabed at 1229 hrs; on deck at 1230 hrs*

Station #85 - CTD/SVP/LISST

*On station at 1240 hrs (41°18.225N / 29°11.170E; WD 57 m)
In water at 1241 hrs; on seabed at 1243 hrs; on deck at 1245 hrs*

Station #86 - CTD/SVP/LISST

*On station at 1251 hrs (41°18.207N / 29°11.075E; WD 77 m)
In water at 1252 hrs; on seabed at 1255 hrs; on deck at 1256 hrs*

Note that a further four repeat casts were undertaken at Station #86 between 1257 and 1316 hrs.

Station #87 - CTD/SVP/LISST

*On station at 1323 hrs (41°18.177N / 29°10.988E; WD 80 m)
In water at 1324 hrs; on seabed at 1326 hrs; on deck at 1328 hrs*

Station #88 - CTD/SVP/LISST

*On station at 1335 hrs (41°18.153N / 29°10.820E; WD 80 m)
In water at 1336 hrs; on seabed at 1339 hrs; on deck at 1341 hrs*

Station #89 - CTD/SVP/LISST

*On station at 1347 hrs (41°18.140N / 29°10.715E; WD 75 m)
In water at 1347 hrs; on seabed at 1350 hrs; on deck at 1352 hrs*

Note that a further four repeat casts were undertaken at Station #89 between 1352 and 1410 hrs. The Reson MBES system imaged the density interface in the channel a few metres above the seabed during these casts, by increasing the gain on the display.

Station #90 - CTD/SVP/LISST

*On station at 1417 hrs (41°18.112N / 29°10.547E; WD 64 m)
In water at 1418 hrs; on seabed at 1420 hrs; on deck at 1422 hrs*

Station #91 - CTD/SVP/LISST

*On station at 1427 hrs (41°18.078N / 29°10.423E; WD 62 m)
In water at 1428 hrs; on seabed at 1430 hrs; on deck at 1432 hrs*

Station #92 - CTD/SVP/LISST

*On station at 1443 hrs (41°18.028N / 29°10.144E; WD 64 m)
In water at 1444 hrs; on seabed at 1446 hrs; on deck at 1448 hrs*

CTD Line 4 was completed at 1448 hrs and the ship then transferred to a new CTD transect (Line 5) as follows:

Station #93 - CTD/SVP/LISST

*On station at 1541 hrs (41°17.930N / 29°11.598E; WD 55 m)
In water at 1543 hrs; on seabed at 1545 hrs; on deck at 1547 hrs*

Station #94 - CTD/SVP/LISST

*On station at 1555 hrs (41°17.894N / 29°11.318E; WD 56 m)
In water at 1555 hrs; on seabed at 1557 hrs; on deck at 1559 hrs*

Station #95 - CTD/SVP/LISST

*On station at 1605 hrs (41°17.888N / 29°11.246E; WD 64 m)
In water at 1605 hrs; on seabed at 1608 hrs; on deck at 1610 hrs*

Station #96 - CTD/SVP/LISST

*On station at 1615 hrs (41°17.872N / 29°11.140E; WD 75 m)
In water at 1615 hrs; on seabed at 1618 hrs; on deck at 1620 hrs*

Station #97 - CTD/SVP/LISST

*On station at 1627 hrs (41°17.861N / 29°11.024E; WD 75 m)
In water at 1627 hrs; on seabed at 1630 hrs; on deck at 1632 hrs*

Station #98 - CTD/SVP/LISST

*On station at 1637 hrs (41°17.842N / 29°10.927E; WD 77 m)
In water at 1638 hrs; on seabed at 1640 hrs; on deck at 1642 hrs*

Station #99 - CTD/SVP/LISST

*On station at 1647 hrs (41°17.833N / 29°10.867E; WD 75 m)
In water at 1647 hrs; on seabed at 1650 hrs; on deck at 1652 hrs*

Station #100 - CTD/SVP/LISST

On station at 1656 hrs (41°17.821N / 29°10.767E; WD 70 m)

In water at 1657 hrs; on seabed at 1659 hrs; on deck at 1701 hrs

Station #101 - CTD/SVP/LISST

On station at 1709 hrs (41°17.787N / 29°10.536E; WD 62 m)

In water at 1710 hrs; on seabed at 1712 hrs; on deck at 1713 hrs

CTD Line 5 was completed at 1714 hrs and the ship moved in position to start the third MBES survey box in Work Area 1 (Station #102).

03/07/13

The MBES survey box was finished at ~0445 hrs and the ship then moved to CTD Line 7 as follows:

Station #103 - CTD/SVP/LISST

On station at 0509 hrs (41°17.231N / 29°10.276E; WD 62 m)

In water at 0510 hrs; on seabed at 0512 hrs; on deck at 0514 hrs

Station #104 - CTD/SVP/LISST

On station at 0519 hrs (41°17.236N / 29°10.489E; WD 61 m)

In water at 0520 hrs; on seabed at 0522 hrs; on deck at 0525 hrs

Station #105 - CTD/SVP/LISST

On station at 0533 hrs (41°17.237N / 29°10.612E; WD 68 m)

In water at 0534 hrs; on seabed at 0536 hrs; on deck at 0538 hrs

Station #106 - CTD/SVP/LISST

On station at 0545 hrs (41°17.221N / 29°10.719E; WD 74 m)

In water at 0546 hrs; on seabed at 0549 hrs; on deck at 0551 hrs

Station #107 - CTD/SVP/LISST

On station at 0559 hrs (41°17.218N / 29°10.994E; WD 75 m)

In water at 0559 hrs; on seabed at 0602 hrs; on deck at 0604 hrs

Station #108 - CTD/SVP/LISST

On station at 0610 hrs (41°17.222N / 29°10.989E; WD 75 m)

In water at 0611 hrs; on seabed at 0614 hrs; on deck at 0615 hrs

Station #109 - CTD/SVP/LISST

On station at 0621 hrs (41°17.213N / 29°11.116E; WD 75 m)

In water at 0622 hrs; on seabed at 0624 hrs; on deck at 0626 hrs

Station #110 - CTD/SVP/LISST

On station at 0633 hrs (41°17.212N / 29°11.260E; WD 70 m)

In water at 0634 hrs; on seabed at 0636 hrs; on deck at 0637 hrs

Station #111 - CTD/SVP/LISST

On station at 0645 hrs (41°17.212N / 29°11.389E; WD 60 m)

In water at 0645 hrs; on seabed at 0647 hrs; on deck at 0649 hrs

Station #112 - CTD/SVP/LISST

On station at 0659 hrs (41°17.205N / 29°11.760E; WD 61 m)

In water at 0700 hrs; on seabed at 0702 hrs; on deck at 0704 hrs

CTD Line 7 was finished at 0704 hrs, and the ship then moved to a new CTD transect (Line 9) as follows:

Station #113 - CTD/SVP/LISST

On station at 0725 hrs (41°16.298N / 29°11.534E; WD 50 m)

In water at 0726 hrs; on seabed at 0728 hrs; on deck at 0730 hrs

Station #114 - CTD/SVP/LISST

On station at 0755 hrs (41°16.315N / 29°11.301E; WD 53 m)

In water at 0756 hrs; on seabed at 0757 hrs; on deck at 0759 hrs

Station #115 - CTD/SVP/LISST

On station at 0807 hrs (41°16.406N / 29°11.056E; WD 60 m)

In water at 0808 hrs; on seabed at 0810 hrs; on deck at 0812 hrs

Station #116 - CTD/SVP/LISST

On station at 0816 hrs (41°16.415N / 29°10.930E; WD 67 m)

In water at 0817 hrs; on seabed at 0819 hrs; on deck at 0821 hrs

Station #117 - CTD/SVP/LISST

On station at 0824 hrs (41°16.435N / 29°10.817E; WD 73 m)

In water at 0825 hrs; on seabed at 0827 hrs; on deck at 0829 hrs

Station #118 - CTD/SVP/LISST

On station at 0833 hrs (41°16.465N / 29°10.648E; WD 78 m)

In water at 0833 hrs; on seabed at 0836 hrs; on deck at 0838 hrs

Station #119 - CTD/SVP/LISST

On station at 0844 hrs (41°16.479N / 29°10.462E; WD 65 m)

In water at 0844 hrs; on seabed at 0846 hrs; on deck at 0849 hrs

Station #120 - CTD/SVP/LISST

On station at 0851 hrs (41°16.508N / 29°10.359E; WD 57 m)

In water at 0852 hrs; on seabed at 0854 hrs; on deck at 0855 hrs

Station #121 - CTD/SVP/LISST

On station at 0904 hrs (41°16.549N / 29°10.131E; WD 56 m)

In water at 0905 hrs; on seabed at 0907 hrs; on deck at 0909 hrs

CTD Line 9 was completed at 0909 hrs, and the ship then moved to a new CTD transect (Line 11) as follows:

Station #122 - CTD/SVP/LISST

On station at 1032 hrs (41°15.573N / 29°10.829E; WD 50 m)

In water at 1033 hrs; on seabed at 1035 hrs; on deck at 1037 hrs

CTD Line 11 was abandoned shortly after as one of the scientific party (Dan Parsons) required a boat transfer to shore to attend a family emergency. The transfer was completed at 1120 hrs. The vessel then returned to the seabed lander site for a CTD deployment as follows:

Station #123 - CTD/SVP/LISST

On station at 1155 hrs (41°14.684N / 29°08.995E; WD 60 m)

In water at 1155 hrs; on seabed at 1157 hrs; on deck at 1200 hrs

A further two repeats were undertaken at this site between 1501 and 1508 hrs. The ship then transferred to a location on the outer bend of the channel in order to undertake a sidescan sonar survey in Work Area 2, targeting a sediment wave field. The ship arrived at Station [#124](#) (41°17.841N / 29°10.706E; WD 68 m) and the sidescan sonar was in the water at 1248 hrs. The survey was terminated at 1542 hrs once five lines were completed, and the sidescan was back on deck at 1548 hrs (41°19.574N / 29°11.665E).

The vessel then transferred to the safe waypoint for AUV Mission 2, again targeting overbank sediment waves on both sides of the channel. The ship arrived at Station [#125](#) at 1602 hrs (41°19.384N / 29°10.585E). Deployment was delayed slightly due to a faulty emergency light on the AUV, but the vehicle was in the water at 1653 hrs (41°19.403N / 29°10.586E) and the acoustic towfish was deployed at 1655 hrs. It soon became clear that the circling vehicle was struggling to dive deeper than 25-30 m, so a CTD was deployed nearby at Station [#126](#) to assess water column density at this depth:

Station [#126](#) - CTD/SVP/LISST

On station at 1737 hrs (41°19.507N / 29°10.607E; WD 60 m)

In water at 1737 hrs; on seabed at 1740 hrs; on deck at 1741 hrs

The CTD profile showed the expected density increase at ~25 m WD, which was evidently hindering the ability of the AUV to dive to the required depth. However, it was decided to proceed with the mission in the hope that, once underway, the AUV would eventually reach the required depth. By 1830 hrs the vehicle had reached a depth of ~50 m and by 1900 hrs it was 'on mission' and acoustic contact was terminated. The ship then transferred to the second MBES survey area in Work Area 2, which extended the area of coverage to the northeast.

04/07/13

MBES survey finished at 0455 hrs. A series of CTDs were then taken across the overbank sediment waves as follows:

Station [#127](#) - CTD/SVP/LISST

On station at 0515 hrs (41°18.128N / 29°11.684E; WD 60 m)

In water at 0516 hrs; on seabed at 0520 hrs; on deck at 0522 hrs

Station [#128](#) - CTD/SVP/LISST

On station at 0542 hrs (41°19.211N / 29°10.742E; WD 63 m)

In water at 0543 hrs; on seabed at 0545 hrs; on deck at 0547 hrs

Station [#129](#) - CTD/SVP/LISST

On station at 0557 hrs (41°19.569N / 29°11.342E; WD 75 m)

In water at 0557 hrs; on seabed at 0600 hrs; on deck at 0602 hrs

Station [#130](#) - CTD/SVP/LISST

On station at 0620 hrs (41°18.465N / 29°12.240E; WD 59 m)

In water at 0621 hrs; on seabed at 0623 hrs; on deck at 0625 hrs

Station [#131](#) - CTD/SVP/LISST

On station at 0637 hrs (41°18.809N / 29°12.802E; WD 73 m)

In water at 0638 hrs; on seabed at 0640 hrs; on deck at 0643 hrs

Station [#132](#) - CTD/SVP/LISST

On station at 0700 hrs (41°19.874N / 29°11.847E; WD 75 m)

In water at 0700 hrs; on seabed at 0703 hrs; on deck at 0705 hrs

The vessel then moved to the AUV safe waypoint to meet the vehicle, and arrived on station [#133](#) at 0755 hrs (41°19.383N / 29°10.617E). Data were downloaded while the vehicle was in the water and it soon became clear that the 1200 kHz ADCP data were of low quality and had not captured the base of the overbank flow. The issue with the AUV failing to penetrate the denser mid-water layer was partly attributed to a weight change generated during the previous battery change; some of the replacement batteries were apparently lighter, leading to the vehicle running with excess buoyancy. The vehicle was therefore recovered in order to change the buoyancy and repair the SBP, and the remainder of AUV Mission 2 was abandoned.

The ship arrived on station [#134](#) at 0901 hrs in order to complete the sidescan sonar survey of the overbank sediment waves. The survey started at 41°19.81N / 29°12.25E at 71 m WD, and finished at 1314 hrs at station [#135](#) at 41°18.13N / 29°11.83E at 63 m WD. The vessel then awaited a visit from Turkish customs and immigration officials, who boarded the vessel at 1630 hrs and departed at 1800 hrs for a routine check following the earlier boat transfer of Dan Parsons. The ship then moved to Work Area 3 to the northwest, arriving at ~2000 hrs for the start of an MBES survey over the distal Bosphorus Channel and a series of channel-floor sediment waves and bar forms. The ship also discharged grey water at this time, as the 12 NM limit had been passed.

05/07/13

The overnight MBES survey finished at ~0430 hrs. A sidescan sonar survey was then started within the core of the MBES survey area, again targeting the channel-floor sediment waves. The sidescan was in the water at 0531 hrs at Station [#136](#) (41°27.603N / 29°01.981E; WD 85 m). The survey was terminated at 0915 hrs with about 50% of the area covered, in order to deploy the AUV. Survey data were of good quality, with a number of interesting features imaged.

The AUV deployment site, Station [#137](#), was reached at 1011 hrs (41°28.786N / 29°01.718E; WD 92 m). The aim was to run the AUV with a 1200 kHz profiler at very low altitude over a series of migrating flow-perpendicular bedforms in the distal channel. AUV Mission 3a began at 1029 hrs when the AUV was deployed in the water, followed by the acoustic towfish at 1034 hrs. The first line, at 10 m altitude, was completed at 1120 hrs and the ADCP were of high quality with good imaging of the lower few metres of the water column (including the top of the density flow ~5 m above seabed). The second line, at 7 m altitude, was also completed successfully at 1205 hrs. A series of further repeat lines at 10 m, 7 m and 5 m altitude were then undertaken from 1234 hrs until the towfish was recovered at 1655 hrs and the AUV at 1717 hrs (Station [#138](#); 41°28.932N / 29°01.722E). Initial data also indicated that the SBP on the AUV was now working. The ship then continued the MBES survey from the previous night over the distal channels (Station [#139](#)).

06/07/13

The MBES survey box was completed at ~0355 hrs, and the ship then undertook the first of a series of repeat Reson MBES surveys across the bedforms in the distal channel (Station [#140](#)). The survey ended at 0639 hrs (41°27.598N / 29°00.607E), and the next target was to take a longitudinal transect of CTDs along the channel in the sediment wave field, as follows:

Station [#141](#) - CTD/SVP/LISST

On station at 0700 hrs (41°28.207N / 29°01.232E; WD 94 m)

In water at 0701 hrs; on seabed at 0704 hrs; on deck at 0706 hrs

Station #142 - CTD/SVP/LISST

On station at 0710 hrs (41°28.231N / 29°01.288E; WD 94 m)

In water at 0710 hrs; on seabed at 0713 hrs; on deck at 0715 hrs

Station #143 - CTD/SVP/LISST

On station at 0718 hrs (41°28.318N / 29°01.336E; WD 94 m)

In water at 0719 hrs; on seabed at 0721 hrs; on deck at 0724 hrs

Station #144 - CTD/SVP/LISST

On station at 0725 hrs (41°28.354N / 29°01.354E; WD 94 m)

In water at 0726 hrs; on seabed at 0728 hrs; on deck at 0730 hrs

Station #145 - CTD/SVP/LISST

On station at 0732 hrs (41°28.401N / 29°01.397E; WD 94 m)

In water at 0732 hrs; on seabed at 0735 hrs; on deck at 0738 hrs

Station #146 - CTD/SVP/LISST

On station at 0739 hrs (41°28.452N / 29°01.434E; WD 94 m)

In water at 0740 hrs; on seabed at 0743 hrs; on deck at 0745 hrs

Station #147 - CTD/SVP/LISST

On station at 0748 hrs (41°28.497N / 29°01.460E; WD 94 m)

In water at 0748 hrs; on seabed at 0751 hrs; on deck at 0754 hrs

Station #148 - CTD/SVP/LISST

On station at 0755 hrs (41°28.516N / 29°01.493E; WD 95 m)

In water at 0756 hrs; on seabed at 0759 hrs; on deck at 0801 hrs

Station #149 - CTD/SVP/LISST

On station at 0803 hrs (41°28.550N / 29°01.524E; WD 94 m)

In water at 0803 hrs; on seabed at 0806 hrs; on deck at 0809 hrs

Station #150 - CTD/SVP/LISST

On station at 0812 hrs (41°28.588N / 29°01.553E; WD 95 m)

In water at 0813 hrs; on seabed at 0815 hrs; on deck at 0818 hrs

Station #151 - CTD/SVP/LISST

On station at 0819 hrs (41°28.609N / 29°01.574E; WD 94 m)

In water at 0820 hrs; on seabed at 0823 hrs; on deck at 0825 hrs

Station #152 - CTD/SVP/LISST

On station at 0827 hrs (41°28.630N / 29°01.598E; WD 94 m)

In water at 0828 hrs; on seabed at 0831 hrs; on deck at 0834 hrs

Station #153 - CTD/SVP/LISST

On station at 0840 hrs (41°28.724N / 29°01.665E; WD 95 m)

In water at 0841 hrs; on seabed at 0843 hrs; on deck at 0847 hrs

The next target was to undertake a series of CTD casts across the channel in the same area, as follows:

Station #154 - CTD/SVP/LISST

On station at 0908 hrs (41°28.314N / 29°01.750E; WD 92 m)

In water at 0909 hrs; on seabed at 0911 hrs; on deck at 0913 hrs

Station #155 - CTD/SVP/LISST

On station at 0921 hrs (41°28.367N / 29°01.665E; WD 94 m)

In water at 0922 hrs; on seabed at 0924 hrs; on deck at 0926 hrs

Station #156 - CTD/SVP/LISST

On station at 1005 hrs (41°28.498N / 29°01.304E; WD 95 m)

In water at 1006 hrs; on seabed at 1008 hrs; on deck at 1011 hrs

Station #157 - CTD/SVP/LISST

On station at 1021 hrs (41°28.588N / 29°01.159E; WD 95 m)

In water at 1022 hrs; on seabed at 1025 hrs; on deck at 1027 hrs

Station #158 - CTD/SVP/LISST

On station at 1039 hrs (41°28.776N / 29°00.721E; WD 95 m)

In water at 1040 hrs; on seabed at 1043 hrs; on deck at 1046 hrs

Station #159 - CTD/SVP/LISST

On station at 1056 hrs (41°28.855N / 29°00.573E; WD 91 m)

In water at 1057 hrs; on seabed at 1100 hrs; on deck at 1103 hrs

The CTDs were completed at 1103 hrs and the ship then moved to the AUV launch location in order to undertake the long shelf-crossing lines for the Turkish partners (with the 600 kHz ADCP and SBP). Station #160 was reached at 1141 hrs and the AUV and towfish were in the water by 1200 hrs (41°28.945N / 29°03.526E; WD 92 m).

The ship then undertook the second pass of the repeat Reson MBES survey over the channel-floor sediment waves, starting at ~1300 hrs (Station #161). Once this was completed the overnight MBES survey was started at 1618 hrs, targeting the shelf edge and upper slope canyons distal of the Bosphorus Channel (Station #162).

07/07/13

The overnight MBES survey finished at 0430 hrs, revealing some striking canyon-head features at the shelf edge, with obvious headwall erosion and scattered landslides. The ship then started the third pass of the repeat Reson MBES survey over the channel-floor sediment waves at 0515 hrs (Station #163). The survey was completed at 0709 hrs and the ship then moved to Station #164 for recovery of the AUV (41°29.143N / 29°03.561E). The AUV was at the surface at 0749 hrs and the vehicle was on deck at 0810 hrs. An initial look at the data indicated that the SBP had worked extremely well, with spectacular imaging of mud volcanoes and erosional surfaces (unconformities) on the outer shelf.

The ship then transferred to Station #165 in order to complete the second half of the sidescan sonar survey over the distal channel-floor sediment waves. The station was reached at 0838 hrs and the sidescan was deployed immediately (41°27.526N / 29°01.395E; WD 92 m). The sidescan survey finished at 1229 hrs (41°28.022N / 29°00.623E). Data quality was reduced compared to the first half due to the higher sea state (SS 5), but the west side of the channel was clearly imaged.

The sidescan sonar and multibeam bathymetry data were then used to select a series of five box core sites within and adjacent to the channel-floor sediment waves, in order to calibrate acoustic facies. The box cores were as follows:

Station #166 - Box Core 1 (64PE372-BC1)

On station at 1251 hrs (41°28.503N / 29°01.403E; WD 91 m), on deck at 1300 hrs Targeted high backscatter sediment wave crest. Disrupted sample, so no stratigraphy preserved but sample retained. Silty grey mud with abundant mm-scale shell fragments and complete cm-scale shells. Occasional large bivalve shells up to ~6 cm long.

Station #167 - Box Core 2 (64PE372-BC2)

On station at 1322 hrs (41°28.349N / 29°01.413E; WD 92 m), on deck at 1328 hrs Targeted moderate backscatter sediment wave trough. 17 cm core sub-sample obtained. Silty grey mud with abundant shells up to ~5 mm across.

Station #168 - Box Core 3 (64PE372-BC3)

On station at 1349 hrs (41°28.043N / 29°01.477E; WD 92 m), on deck at 1356 hrs Targeted area of high backscatter on eastern channel floor. 22 cm core sub-sample obtained. Silty grey mud with scattered shells underlain by mud-poor, very shell-rich layer at ~20 cm depth.

Station #169 - Box Core 4 (64PE372-BC4)

On station at 1413 hrs (41°28.029N / 29°01.592E; WD 88 m), on deck at 1419 hrs Targeted low backscatter levee crest. 45 cm core sub-sample obtained. Grey mud with few shells.

Station #170 - Box Core 5 (64PE372-BC5)

On station at 1438 hrs (41°28.643N / 29°01.849E; WD 92 m), on deck at 1444 hrs Targeted moderate backscatter mottled area of channel floor. 43 cm core sub-sample obtained. Grey mud with abundant small shells.

Box coring was completed at ~1500 hrs and the ship then moved to Station #171 for a second night of MBES survey over the shelf edge, slightly east of the area covered the previous evening.

08/07/13

The overnight MBES survey was completed at ~0200 hrs, with some excellent images obtained of canyon heads. The ship then transferred to the distal channels area in order to take some cores for the Turkish partners. The first site was targeting the distal distributary channel network, and Station #172 was reached at 0506 hrs (41°29.207N / 29°05.156E; WD 92 m). The box core was back on deck at 0516 hrs and two duplicate 42 cm-long stratigraphy samples were recovered (64PE372-BC6). A 6 m-long gravity core was then deployed at 0600 hrs at the same location (Station #173; 41°29.222N / 29°05.185E; WD 92 m). The corer was back on deck at 0615 hrs and had clearly penetrated to the core head, with grey mud all the way up the barrel. Core 64PE372-GC3 was ~5 m long.

The ship then transferred to a further core site for the Turkish partners targeting an area of the outer shelf. Station #174 was reached at 0730 hrs and the corer was in the water at 0737 hrs (41°29.978N / 29°10.643E; WD 114 m). The corer returned on deck at 0745 hrs and had again clearly penetrated to the core head with grey mud on the barrels. Core 64PE372-GC4 was ~5 m long, and contained grey muds with abundant shell-rich layers and hydrogen sulphide gas. The next aim was to deploy the AUV for testing at a nearby location on the outer shelf, but the AUV failed to get a GPS fix so the ship returned to the previous core site in order to obtain a duplicate core for the Turkish partners. The ship was on Station #175 at 1011 hrs and the corer was in the water at 1024 hrs (41°29.970N / 29°10.630E; WD 114 m). The corer was on deck at 1032 hrs but this time Core 64PE372-GC5 was only 1.3 m long.

The AUV GPS was now working so the ship transferred to the deployment waypoint on the upper slope, arriving at Station #176 at 1110 hrs (41°30.629N / 29°12.616E; WD 184 m). The AUV was in the water at 1121 hrs and an emergency beacon test was initiated at 1135 hrs. The AUV submerged at 1140 hrs to begin testing, which was completed by 1625 hrs. At this point the final mission was uploaded, however, the AUV was indicating a motor fault so it was recovered for overnight checks. The ship then filled in a few gaps in previous MBES surveys while transiting south, and also offloaded the grey water tanks while outside the 12 NM limit.

09/07/13

The ship arrived in the proximal channel bend area at breakfast, in order to undertake a CTD transect across the overbank sediment waves. This was in preparation for a planned AUV deployment over the waves later in the morning. The CTD casts were as follows:

Station #177 - CTD/SVP/LISST

On station at 0513 hrs (41°18.358N / 29°10.864E; WD 80 m)

In water at 0514 hrs; on seabed at 0517 hrs; on deck at 0519 hrs

Station #178 - CTD/SVP/LISST

On station at 0523 hrs (41°18.424N / 29°11.015E; WD 73 m)

In water at 0524 hrs; on seabed at 0527 hrs; on deck at 0529 hrs

Station #179 - CTD/SVP/LISST

On station at 0532 hrs (41°18.463N / 29°11.054E; WD 61 m)

In water at 0532 hrs; on seabed at 0536 hrs; on deck at 0537 hrs

Station #180 - CTD/SVP/LISST

On station at 0545 hrs (41°18.585N / 29°11.288E; WD 63 m)

In water at 0546 hrs; on seabed at 0548 hrs; on deck at 0550 hrs

Station #181 - CTD/SVP/LISST

On station at 0556 hrs (41°18.628N / 29°11.436E; WD 65 m)

In water at 0556 hrs; on seabed at 0559 hrs; on deck at 0601 hrs

Station #182 - CTD/SVP/LISST

On station at 0607 hrs (41°18.652N / 29°11.468E; WD 65 m)

In water at 0607 hrs; on seabed at 0610 hrs; on deck at 0612 hrs

Station #183 - CTD/SVP/LISST

On station at 0618 hrs (41°18.711N / 29°11.561E; WD 65 m)

In water at 0619 hrs; on seabed at 0622 hrs; on deck at 0624 hrs

Station #184 - CTD/SVP/LISST

On station at 0629 hrs (41°18.716N / 29°11.606E; WD 67 m)

In water at 0630 hrs; on seabed at 0633 hrs; on deck at 0635 hrs

Station #185 - CTD/SVP/LISST

On station at 0641 hrs (41°18.759N / 29°11.673E; WD 66 m)

In water at 0642 hrs; on seabed at 0644 hrs; on deck at 0645 hrs

Station #186 - CTD/SVP/LISST

On station at 0650 hrs (41°18.798N / 29°11.749E; WD 65 m)

In water at 0650 hrs; on seabed at 0653 hrs; on deck at 0655 hrs

Station #187 - CTD/SVP/LISST

On station at 0701 hrs (41°18.834N / 29°11.831E; WD 68 m)

In water at 0702 hrs; on seabed at 0705 hrs; on deck at 0706 hrs

Station #188 - CTD/SVP/LISST

On station at 0711 hrs (41°18.859N / 29°11.867E; WD 70 m)

In water at 0712 hrs; on seabed at 0715 hrs; on deck at 0717 hrs

Once the CTD transect was completed the ship transferred to the nearby AUV launch site (Station #189; 41°18.959N / 29°12.122E; WD 70 m). The AUV was in the water at 0753 hrs, and was equipped with the 1200 kHz ADCP in order to image flow across the overbank sediment waves. Unfortunately, the motor fault reappeared and the AUV was failing to dive, so the AUV was recovered at 0840 hrs and the mission was abandoned. The fault could not be fixed during the day so the subsequent overnight SBP survey was also abandoned, marking the end of AUV operations during the cruise.

The contingency plan was to undertake further CTD transects across the large scours in the proximal channel floor, and Line 11 was completed as follows:

Station #190 - CTD/SVP/LISST

On station at 1004 hrs (41°15.570N / 29°10.841E; WD 49 m)

In water at 1008 hrs; on seabed at 1010 hrs; on deck at 1012 hrs

Station #191 - CTD/SVP/LISST

On station at 1029 hrs (41°15.696N / 29°10.425E; WD 56 m)

In water at 1030 hrs; on seabed at 1032 hrs; on deck at 1034 hrs

Station #192 - CTD/SVP/LISST

On station at 1043 hrs (41°15.704N / 29°10.351E; WD 67 m)

In water at 1030 hrs; on seabed at 1032 hrs; on deck at 1034 hrs

Station #193 - CTD/SVP/LISST

On station at 1055 hrs (41°15.727N / 29°10.270E; WD 78 m)

In water at 1055 hrs; on seabed at 1058 hrs; on deck at 1100 hrs

Station #194 - CTD/SVP/LISST

On station at 1106 hrs (41°15.737N / 29°10.244E; WD 80 m)

In water at 1106 hrs; on seabed at 1110 hrs; on deck at 1112 hrs

Station #195 - CTD/SVP/LISST

On station at 1116 hrs (41°15.750N / 29°10.196E; WD 85 m)

In water at 1117 hrs; on seabed at 1120 hrs; on deck at 1122 hrs

Station #196 - CTD/SVP/LISST

On station at 1126 hrs (41°15.765N / 29°10.124E; WD 80 m)

In water at 1127 hrs; on seabed at 1130 hrs; on deck at 1132 hrs

Station #197 - CTD/SVP/LISST

On station at 1139 hrs (41°15.781N / 29°10.075E; WD 83 m)

In water at 1140 hrs; on seabed at 1143 hrs; on deck at 1144 hrs

Station #198 - CTD/SVP/LISST

On station at 1152 hrs (41°15.804N / 29°10.008E; WD 70 m)

In water at 1153 hrs; on seabed at 1155 hrs; on deck at 1158 hrs

Station #199 - CTD/SVP/LISST

On station at 1205 hrs (41°15.819N / 29°09.951E; WD 60 m)

In water at 1206 hrs; on seabed at 1208 hrs; on deck at 1210 hrs

Station #200 - CTD/SVP/LISST

On station at 1221 hrs (41°15.865N / 29°09.768E; WD 47 m)

In water at 1222 hrs; on seabed at 1224 hrs; on deck at 1226 hrs

CTD Line 11 was completed at 1227 hrs and the ship then transferred to a location over the largest channel-floor scour in order to undertake a high-resolution Reson MBES imaging experiment and further CTDs. The ship arrived on Station #201 at 1303 hrs (41°15.828N / 29°10.233E; WD 78 m) and the Reson MBES survey conducted from 1303-1337 hrs. A series of six repeat CTD casts were undertaken at this location from 1304-1332 hrs.

From 1340-1730 hrs the ship remained in the traffic separation zone to avoid a period of heavy shipping activity, and at 1730 hrs an overnight Reson MBES survey was initiated over the proximal channel area (Station #202; 41°16.006N / 29°11.001E).

10/07/13

The overnight Reson MBES survey continued until 0620 hrs, and the ship then relocated to the lander recovery site (Station #203; 41°14.579N / 29°09.078E). The ship was on station at 0635 hrs, the lander recovery was initiated at 0639 hrs, the lander was at surface at 0640 hrs, and was on deck at 0646 hrs (the ADCP was still pinging on recovery).

A final CTD cast was undertaken at the lander recovery site as follows:

Station #204 - CTD/SVP/LISST

On station at 0652 hrs (41°14.516N / 29°09.254E; WD 57 m)

In water at 0652 hrs; on seabed at 0654 hrs; on deck at 0656 hrs

Once the CTD was completed the ship then moved to an anchorage site at 0700 hrs, in preparation for passage through the Bosphorus Strait later in the day. The scientific party started equipment packing and data archiving. The passage in to port started just before midnight.

11/07/13

The ship arrived in port early in the morning, and the scientific party departed in the late afternoon.

5. Full Station List

Station	Date	Time (GMT)	Latitude	Longitude	Depth (m)	Activity
01	27-Jun-13	22:34	See map	See map	N/A	Ship MBES Area 1a
02	28-Jun-13	05:46	41°14.720	29°09.017	61	ADCP lander deployed
03	28-Jun-13	07:18	41°14.655	29°09.011	60.7	CTD
04	28-Jun-13	07:27	41°14.681	29°08.992	60.8	CTD
05	28-Jun-13	07:38	41°14.641	29°09.021	60.7	CTD/SVP
06	28-Jun-13	07:43	41°14.652	29°09.009	60.9	CTD/SVP
07	28-Jun-13	07:49	41°14.675	29°09.011	60.4	CTD/SVP
08	28-Jun-13	14:02	41°17.516	29°10.737	67	CTD/SVP/LISST
09	28-Jun-13	14:32	41°17.515	29°10.729	67	Gravity core 1 (3 m)
10	28-Jun-13	15:37	41°17.544	29°11.180	70	CTD/SVP/LISST
11	28-Jun-13	16:00	41°17.543	29°11.180	72	Gravity core 2 (3 m)
12	28-Jun-13	16:31	See map	See map	N/A	Ship MBES Area 1a (cont.)
13	29-Jun-13	05:00	41°17.6	29°10.7	N/A	AUV in-water test
14	29-Jun-13	07:36	41°28.498	29°01.331	90	CTD/SVP/LISST
15	29-Jun-13	10:36	41°19.304	29°13.048	69.5	Sidescan sonar Area 1
16	29-Jun-13	17:05	41°24.129	29°10.607	N/A	AUV Mission 1a deployment
17	30-Jun-13	07:06	41°18.034	29°10.142	67	CTD/SVP/LISST
18	30-Jun-13	07:23	41°18.084	29°10.420	64	CTD/SVP/LISST
19	30-Jun-13	07:36	41°18.104	29°10.561	66	CTD/SVP/LISST
20	30-Jun-13	07:48	41°18.142	29°10.708	76	CTD/SVP/LISST
21	30-Jun-13	08:03	41°18.160	29°10.829	82	CTD/SVP/LISST
22	30-Jun-13	08:18	41°18.180	29°11.004	82	CTD/SVP/LISST
23	30-Jun-13	08:31	41°18.195	29°11.090	81	CTD/SVP/LISST
24	30-Jun-13	08:39	41°18.221	29°11.161	57	CTD/SVP/LISST
25	30-Jun-13	08:50	41°18.254	29°11.299	61	CTD/SVP/LISST
26	30-Jun-13	09:00	41°18.281	29°11.460	64	CTD/SVP/LISST
27	30-Jun-13	12:58	41°19.448	29°11.326	69	AUV Mission 1a recovery
28	30-Jun-13	14:10	41°17.510	29°10.322	63	CTD/SVP/LISST
29	30-Jun-13	15:52	41°17.514	29°10.464	59	CTD/SVP/LISST
30	30-Jun-13	16:13	41°17.552	29°11.455	54	CTD/SVP/LISST
31	30-Jun-13	16:23	41°17.546	29°11.288	72	CTD/SVP/LISST
32	30-Jun-13	16:33	41°17.542	29°11.186	71	CTD/SVP/LISST
33	30-Jun-13	16:45	41°17.532	29°11.011	76	CTD/SVP/LISST
34	30-Jun-13	16:55	41°17.532	29°10.885	73	CTD/SVP/LISST
35	30-Jun-13	17:06	41°17.526	29°10.760	70	CTD/SVP/LISST
36	30-Jun-13	20:00	See map	See map	N/A	Ship MBES Area 1b
37	01-Jul-13	07:40	41°19.380	29°10.626	N/A	AUV Mission 1b deployment
38	01-Jul-13	06:07	41°18.526	29°09.792	62	CTD/SVP/LISST
39	01-Jul-13	06:19	41°18.651	29°10.085	68	CTD/SVP/LISST
40	01-Jul-13	06:33	41°18.698	29°10.178	71	CTD/SVP/LISST
41	01-Jul-13	06:44	41°18.762	29°10.263	78	CTD/SVP/LISST
42	01-Jul-13	06:53	41°18.763	29°10.367	80	CTD/SVP/LISST
43	01-Jul-13	07:05	41°18.808	29°10.456	74	CTD/SVP/LISST
44	01-Jul-13	11:11	41°19.051	29°11.034	58	CTD/SVP/LISST
45	01-Jul-13	11:26	41°18.920	29°10.706	59	CTD/SVP/LISST
46	01-Jul-13	11:37	41°18.890	29°10.604	71	CTD/SVP/LISST
47	01-Jul-13	11:48	41°18.845	29°10.551	74	CTD/SVP/LISST
48	01-Jul-13	12:50	41°15.781	29°11.285	46	CTD/SVP/LISST
49	01-Jul-13	13:06	41°16.015	29°10.779	52	CTD/SVP/LISST
50	01-Jul-13	13:18	41°16.027	29°10.707	65	CTD/SVP/LISST
51	01-Jul-13	13:26	41°16.054	29°10.632	68	CTD/SVP/LISST
52	01-Jul-13	13:40	41°16.072	29°10.555	74	CTD/SVP/LISST
53	01-Jul-13	13:54	41°16.109	29°10.416	75	CTD/SVP/LISST
54	01-Jul-13	14:08	41°16.143	29°10.329	73	CTD/SVP/LISST
55	01-Jul-13	14:26	41°16.168	29°10.218	57	CTD/SVP/LISST

Station	Date	Time (GMT)	Latitude	Longitude	Depth (m)	Activity
56	01-Jul-13	14:37	41°16.217	29°10.069	50	CTD/SVP/LISST
57	01-Jul-13	15:38	41°18.350	29°12.567	69	CTD/SVP/LISST
58	01-Jul-13	15:57	41°18.151	29°12.306	61	CTD/SVP/LISST
59	01-Jul-13	16:08	41°18.224	29°12.211	63	CTD/SVP/LISST
60	01-Jul-13	16:39	41°17.537	29°11.186	72	CTD/SVP/LISST
61	01-Jul-13	16:51	41°17.532	29°11.016	74	CTD/SVP/LISST
62	01-Jul-13	17:02	41°17.531	29°10.901	75	CTD/SVP/LISST
63	01-Jul-13	17:07	See map	See map	N/A	Ship MBES Area 1b (cont.)
64	02-Jul-13	05:08	41°16.748	29°11.674	61	CTD/SVP/LISST
65	02-Jul-13	05:23	41°16.805	29°11.221	62	CTD/SVP/LISST
66	02-Jul-13	05:35	41°16.824	29°11.120	70	CTD/SVP/LISST
67	02-Jul-13	05:44	41°16.826	29°11.022	75	CTD/SVP/LISST
68	02-Jul-13	05:54	41°16.833	29°10.924	76	CTD/SVP/LISST
69	02-Jul-13	06:05	41°16.852	29°10.751	75	CTD/SVP/LISST
70	02-Jul-13	06:16	41°16.853	29°10.638	74	CTD/SVP/LISST
71	02-Jul-13	06:24	41°16.864	29°10.569	66	CTD/SVP/LISST
72	02-Jul-13	06:33	41°16.870	29°10.469	59	CTD/SVP/LISST
73	02-Jul-13	06:43	41°16.903	29°10.721	58	CTD/SVP/LISST
74	02-Jul-13	07:26	41°14.845	29°09.488	59	CTD/SVP/LISST
75	02-Jul-13	07:44	41°15.592	29°10.067	80	CTD/SVP/LISST
76	02-Jul-13	07:54	41°15.744	29°10.170	73	CTD/SVP/LISST
77	02-Jul-13	08:02	41°15.785	29°10.197	87	CTD/SVP/LISST
78	02-Jul-13	08:11	41°15.846	29°10.253	77	CTD/SVP/LISST
79	02-Jul-13	08:20	41°15.917	29°10.301	77	CTD/SVP/LISST
80	02-Jul-13	08:29	41°16.083	29°10.419	76	CTD/SVP/LISST
81	02-Jul-13	08:43	41°16.630	29°10.698	77	CTD/SVP/LISST
82	02-Jul-13	11:19	41°19.316	29°10.605	N/A	AUV Mission 1b recovery
83	02-Jul-13	12:12	41°18.284	29°11.466	63	CTD/SVP/LISST
84	02-Jul-13	12:27	41°18.265	29°11.327	60	CTD/SVP/LISST
85	02-Jul-13	12:41	41°18.225	29°11.170	57	CTD/SVP/LISST
86	02-Jul-13	12:52	41°18.207	29°11.075	77	CTD/SVP/LISST (5 casts)
87	02-Jul-13	13:24	41°18.177	29°10.988	80	CTD/SVP/LISST
88	02-Jul-13	13:36	41°18.153	29°10.820	80	CTD/SVP/LISST
89	02-Jul-13	13:47	41°18.140	29°10.715	75	CTD/SVP/LISST (5 casts)
90	02-Jul-13	14:18	41°18.112	29°10.547	64	CTD/SVP/LISST
91	02-Jul-13	14:28	41°18.078	29°10.423	62	CTD/SVP/LISST
92	02-Jul-13	14:44	41°18.028	29°10.144	64	CTD/SVP/LISST
93	02-Jul-13	15:43	41°17.930	29°11.598	55	CTD/SVP/LISST
94	02-Jul-13	15:55	41°17.894	29°11.318	56	CTD/SVP/LISST
95	02-Jul-13	16:05	41°17.888	29°11.246	64	CTD/SVP/LISST
96	02-Jul-13	16:15	41°17.872	29°11.140	75	CTD/SVP/LISST
97	02-Jul-13	16:27	41°17.861	29°11.024	75	CTD/SVP/LISST
98	02-Jul-13	16:38	41°17.842	29°10.927	77	CTD/SVP/LISST
99	02-Jul-13	16:47	41°17.833	29°10.867	75	CTD/SVP/LISST
100	02-Jul-13	16:57	41°17.821	29°10.767	70	CTD/SVP/LISST
101	02-Jul-13	17:10	41°17.787	29°10.536	62	CTD/SVP/LISST
102	02-Jul-13	17:14	See map	See map	N/A	Ship MBES Area 2
103	03-Jul-13	05:10	41°17.231	29°10.276	62	CTD/SVP/LISST
104	03-Jul-13	05:20	41°17.236	29°10.489	61	CTD/SVP/LISST
105	03-Jul-13	05:34	41°17.237	29°10.612	68	CTD/SVP/LISST
106	03-Jul-13	05:46	41°17.221	29°10.719	74	CTD/SVP/LISST
107	03-Jul-13	05:59	41°17.218	29°10.994	75	CTD/SVP/LISST
108	03-Jul-13	06:11	41°17.222	29°10.989	75	CTD/SVP/LISST
109	03-Jul-13	06:22	41°17.213	29°11.116	75	CTD/SVP/LISST
110	03-Jul-13	06:34	41°17.212	29°11.260	70	CTD/SVP/LISST
111	03-Jul-13	06:45	41°17.212	29°11.389	60	CTD/SVP/LISST
112	03-Jul-13	07:00	41°17.205	29°11.760	61	CTD/SVP/LISST

Station	Date	Time (GMT)	Latitude	Longitude	Depth (m)	Activity
113	03-Jul-13	07:26	41°16.298	29°11.534	50	CTD/SVP/LISST
114	03-Jul-13	07:56	41°16.315	29°11.301	53	CTD/SVP/LISST
115	03-Jul-13	08:08	41°16.406	29°11.056	60	CTD/SVP/LISST
116	03-Jul-13	08:17	41°16.415	29°10.930	67	CTD/SVP/LISST
117	03-Jul-13	08:25	41°16.435	29°10.817	73	CTD/SVP/LISST
118	03-Jul-13	08:33	41°16.465	29°10.648	78	CTD/SVP/LISST
119	03-Jul-13	08:44	41°16.479	29°10.462	65	CTD/SVP/LISST
120	03-Jul-13	08:52	41°16.508	29°10.359	57	CTD/SVP/LISST
121	03-Jul-13	09:05	41°16.549	29°10.131	56	CTD/SVP/LISST
122	03-Jul-13	10:33	41°15.573	29°10.829	50	CTD/SVP/LISST
123	03-Jul-13	11:55	41°14.684	29°08.995	60	CTD/SVP/LISST (3 casts)
124	03-Jul-13	12:48	41°17.841	29°10.706	68	Sidescan sonar Area 2
125	03-Jul-13	16:53	41°19.403	29°10.586	N/A	AUV Mission 2 deployment
126	03-Jul-13	17:37	41°19.507	29°10.607	60	CTD/SVP/LISST
127	04-Jul-13	05:16	41°18.128	29°11.684	60	CTD/SVP/LISST
128	04-Jul-13	05:43	41°19.211	29°10.742	63	CTD/SVP/LISST
129	04-Jul-13	05:57	41°19.569	29°11.342	75	CTD/SVP/LISST
130	04-Jul-13	06:21	41°18.465	29°12.240	59	CTD/SVP/LISST
131	04-Jul-13	06:38	41°18.809	29°12.802	73	CTD/SVP/LISST
132	04-Jul-13	07:00	41°19.874	29°11.847	75	CTD/SVP/LISST
133	04-Jul-13	07:55	41°19.383	29°10.617	N/A	AUV Mission 2 recovery
134	04-Jul-13	09:01	41°19.81	29°12.25	71	Sidescan sonar Area 3
135	04-Jul-13	13:14	41°18.13	29°11.83	63	Sidescan sonar recovery
136	05-Jul-13	05:31	41°27.603	29°01.981	85	Sidescan sonar Area 4a
137	05-Jul-13	10:29	41°28.786	29°01.718	92	AUV Mission 3 deployment
138	05-Jul-13	17:17	41°28.932	29°01.722	N/A	AUV Mission 3 recovery
139	05-Jul-13	N/A	See map	See map	N/A	Ship MBES survey
140	06-Jul-13	03:55	41°27.598	29°00.607	N/A	Reson MBES repeat survey
141	06-Jul-13	07:01	41°28.207	29°01.232	94	CTD/SVP/LISST
142	06-Jul-13	07:10	41°28.231	29°01.288	94	CTD/SVP/LISST
143	06-Jul-13	07:19	41°28.318	29°01.336	94	CTD/SVP/LISST
144	06-Jul-13	07:26	41°28.354	29°01.354	94	CTD/SVP/LISST
145	06-Jul-13	07:32	41°28.401	29°01.397	94	CTD/SVP/LISST
146	06-Jul-13	07:40	41°28.452	29°01.434	94	CTD/SVP/LISST
147	06-Jul-13	07:48	41°28.497	29°01.460	94	CTD/SVP/LISST
148	06-Jul-13	07:56	41°28.516	29°01.493	95	CTD/SVP/LISST
149	06-Jul-13	08:03	41°28.550	29°01.524	94	CTD/SVP/LISST
150	06-Jul-13	08:13	41°28.588	29°01.553	95	CTD/SVP/LISST
151	06-Jul-13	08:20	41°28.609	29°01.574	94	CTD/SVP/LISST
152	06-Jul-13	08:28	41°28.630	29°01.598	94	CTD/SVP/LISST
153	06-Jul-13	08:41	41°28.724	29°01.665	95	CTD/SVP/LISST
154	06-Jul-13	09:09	41°28.314	29°01.750	92	CTD/SVP/LISST
155	06-Jul-13	09:22	41°28.367	29°01.665	94	CTD/SVP/LISST
156	06-Jul-13	10:06	41°28.498	29°01.304	95	CTD/SVP/LISST
157	06-Jul-13	10:22	41°28.588	29°01.159	95	CTD/SVP/LISST
158	06-Jul-13	10:40	41°28.776	29°00.721	95	CTD/SVP/LISST
159	06-Jul-13	10:57	41°28.855	29°00.573	91	CTD/SVP/LISST
160	06-Jul-13	12:00	41°28.945	29°03.526	92	AUV Mission 4 deployment
161	06-Jul-13	13:00	See map	See map	N/A	Reson MBES repeat survey
162	06-Jul-13	16:18	See map	See map	N/A	Ship MBES survey
163	07-Jul-13	05:15	See map	See map	N/A	Reson MBES repeat survey
164	07-Jul-13	08:10	41°29.143	29°03.561	N/A	AUV Mission 4 recovery
165	07-Jul-13	08:38	41°27.526	29°01.395	92	Sidescan sonar Area 4b
166	07-Jul-13	12:51	41°28.503	29°01.403	91	Box core 1
167	07-Jul-13	13:22	41°28.349	29°01.413	92	Box core 2
168	07-Jul-13	13:49	41°28.043	29°01.477	92	Box core 3
169	07-Jul-13	14:13	41°28.029	29°01.592	88	Box core 4

Station	Date	Time (GMT)	Latitude	Longitude	Depth (m)	Activity
170	07-Jul-13	14:38	41°28.643	29°01.849	92	Box core 5
171	07-Jul-13	15:00	See map	See map	N/A	Ship MBES survey
172	08-Jul-13	05:06	41°29.207	29°05.156	92	Box core 6
173	08-Jul-13	06:00	41°29.222	29°05.185	92	Gravity core 3 (6 m)
174	08-Jul-13	07:37	41°29.978	29°10.643	114	Gravity core 4 (6 m)
175	08-Jul-13	10:24	41°29.970	29°10.630	114	Gravity core 5 (6 m) repeat
176	08-Jul-13	11:21	41°30.629	29°12.616	184	AUV Mission 5 (aborted)
177	09-Jul-13	05:14	41°18.358	29°10.864	80	CTD/SVP/LISST
178	09-Jul-13	05:24	41°18.424	29°11.015	73	CTD/SVP/LISST
179	09-Jul-13	05:32	41°18.463	29°11.054	61	CTD/SVP/LISST
180	09-Jul-13	05:46	41°18.585	29°11.288	63	CTD/SVP/LISST
181	09-Jul-13	05:56	41°18.628	29°11.436	65	CTD/SVP/LISST
182	09-Jul-13	06:07	41°18.652	29°11.468	65	CTD/SVP/LISST
183	09-Jul-13	06:19	41°18.711	29°11.561	65	CTD/SVP/LISST
184	09-Jul-13	06:30	41°18.716	29°11.606	67	CTD/SVP/LISST
185	09-Jul-13	06:42	41°18.759	29°11.673	66	CTD/SVP/LISST
186	09-Jul-13	06:50	41°18.798	29°11.749	65	CTD/SVP/LISST
187	09-Jul-13	07:02	41°18.834	29°11.831	68	CTD/SVP/LISST
188	09-Jul-13	07:12	41°18.859	29°11.867	70	CTD/SVP/LISST
189	09-Jul-13	07:53	41°18.959	29°12.122	70	AUV Mission 6 (aborted)
190	09-Jul-13	10:08	41°15.570	29°10.841	49	CTD/SVP/LISST
191	09-Jul-13	10:30	41°15.696	29°10.425	56	CTD/SVP/LISST
192	09-Jul-13	10:40	41°15.704	29°10.351	67	CTD/SVP/LISST
193	09-Jul-13	10:55	41°15.727	29°10.270	78	CTD/SVP/LISST
194	09-Jul-13	11:06	41°15.737	29°10.244	80	CTD/SVP/LISST
195	09-Jul-13	11:17	41°15.750	29°10.196	85	CTD/SVP/LISST
196	09-Jul-13	11:27	41°15.765	29°10.124	80	CTD/SVP/LISST
197	09-Jul-13	11:40	41°15.781	29°10.075	83	CTD/SVP/LISST
198	09-Jul-13	11:53	41°15.804	29°10.008	70	CTD/SVP/LISST
199	09-Jul-13	12:06	41°15.819	29°09.951	60	CTD/SVP/LISST
200	09-Jul-13	12:22	41°15.865	29°09.768	47	CTD/SVP/LISST
201	09-Jul-13	13:03	41°15.828	29°10.233	78	Reson MBES and 6 x CTD
202	09-Jul-13	17:30	41°16.006	29°11.001	N/A	Reson MBES survey
203	10-Jul-13	06:40	41°14.579	29°09.078	N/A	ADCP lander recovered
204	10-Jul-13	06:52	41°14.516	29°09.254	57	CTD/SVP/LISST

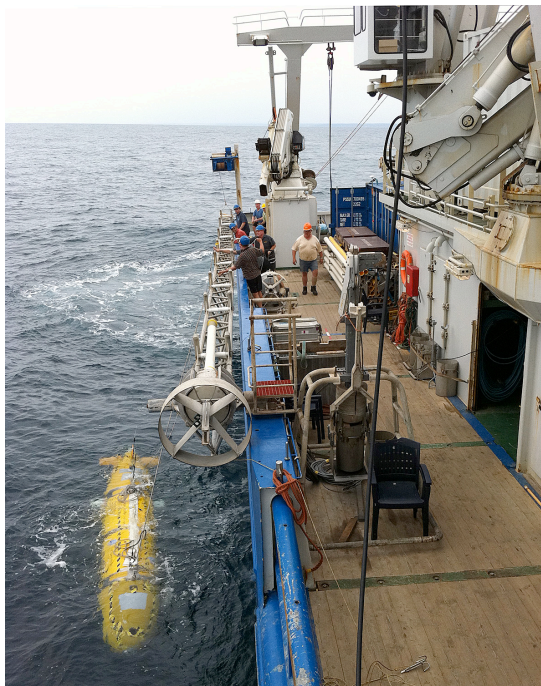
6. Equipment Photos



The NIOZ box corer (left) and gravity corer (right)



The CTD/SVP/LISST instruments (left) and the seabed lander (right)



Autosub3 being recovered (left) and the EdgeTech sidescan sonar (right)

Appendix 1: Location maps

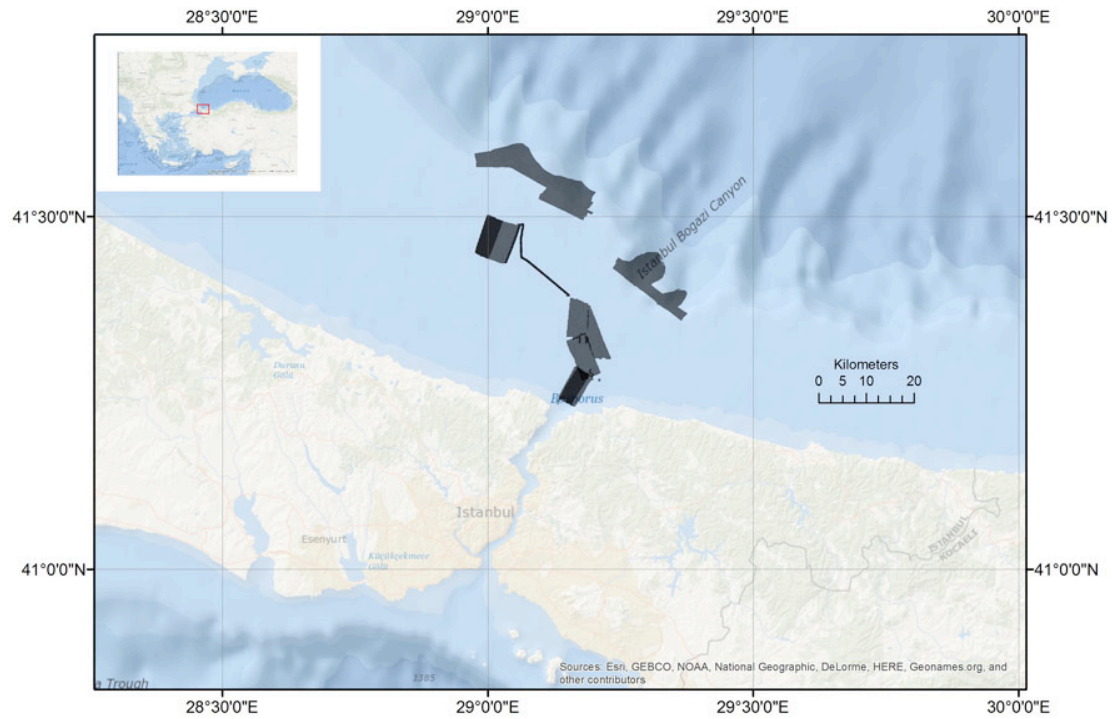


Figure A1: Location map, showing the position of the study area in the southwest Black Sea. Shaded blocks represent locations of geophysical mapping data (MBES, sidescan sonar) shown in Fig. A2.

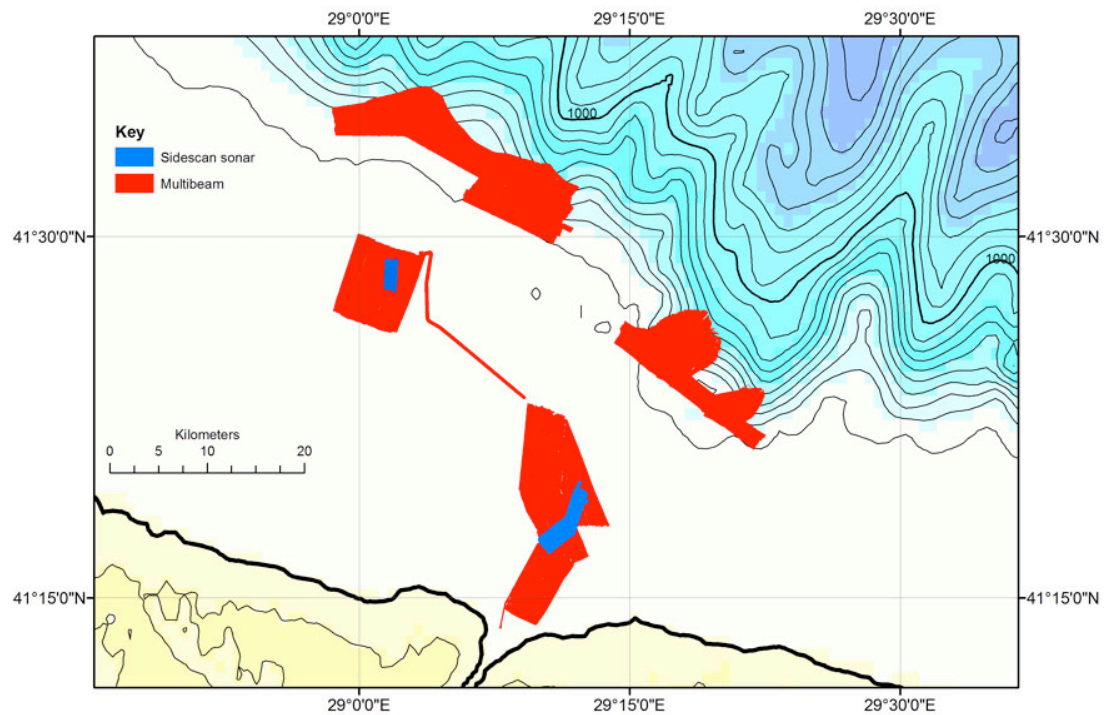


Figure A2: Location map, showing geophysical mapping data coverage (MBES and sidescan sonar). Bathymetric contours at 100 m intervals.

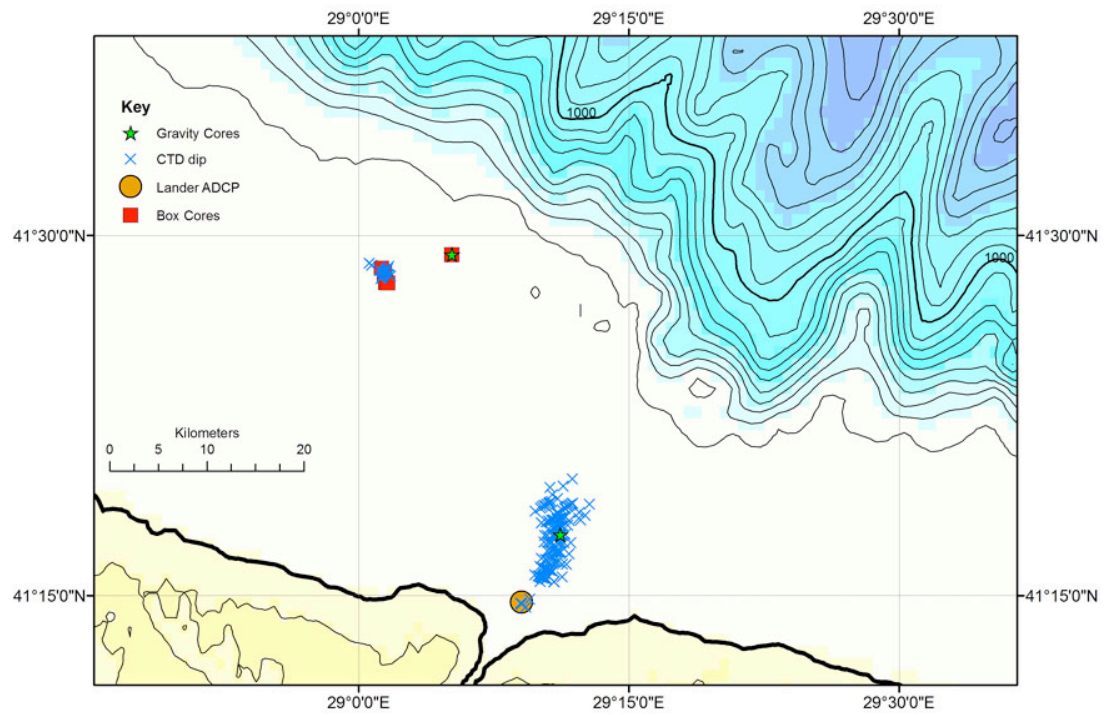


Figure A3: Location map, showing positions of sample data (CTD, gravity cores, box cores, ADCP lander). Bathymetric contours at 100 m intervals.

Appendix 2: Sediment core metadata

Station	Core no.	Latitude	Longitude	Depth (m)	Equipment	Recovery
09	64PE372-GC1	41°17.515	29°10.729	67	3 m gravity corer	0.57 m
11	64PE372-GC2	41°17.543	29°11.180	72	3 m gravity corer	Catcher sample
166	64PE372-BC1	41°28.503	29°01.403	91	Box corer	Sample only
167	64PE372-BC2	41°28.349	29°01.413	92	Box corer	0.17 m
168	64PE372-BC3	41°28.043	29°01.477	92	Box corer	0.22 m
169	64PE372-BC4	41°28.029	29°01.592	88	Box corer	0.45 m
170	64PE372-BC5	41°28.643	29°01.849	92	Box corer	0.43 m
172	64PE372-BC6	41°29.207	29°05.156	92	Box corer	0.42 m
173	64PE372-GC3	41°29.222	29°05.185	92	6 m gravity corer	5.0 m
174	64PE372-GC4	41°29.978	29°10.643	114	6 m gravity corer	5.0 m
175	64PE372-GC5	41°29.970	29°10.630	114	6 m gravity corer	1.3 m

Appendix 3: CTD metadata

Station	Longitude	Latitude	Depth (m)	Date	Time	CTD Name
Sta03	29.15018333	41.24425	60.7	28-Jun-13	07:18	bs001
Sta04	29.14996667	41.24468333	60.8	28-Jun-13	07:27	bs002
Sta05	29.15035	41.24401667	60.7	28-Jun-13	07:38	bs003
Sta06	29.15015	41.2442	60.9	28-Jun-13	07:43	bs004
Sta07	29.15018333	41.24458333	60.4	28-Jun-13	07:49	bs005
Sta08	29.17895	41.29193333	67	28-Jun-13	14:02	bs007
Sta10	29.18633333	41.2924	70	28-Jun-13	15:37	bs008
Sta14	29.02218333	41.47496667	90	29-Jun-13	07:42	bs009
Sta17	29.16903	41.300575	67	30-Jun-13	07:08	bs010
Sta18	29.17366667	41.3014	64	30-Jun-13	07:23	bs011
Sta19	29.17601667	41.30173333	66	30-Jun-13	07:36	bs012
Sta20	29.17846667	41.30236667	76	30-Jun-13	07:48	bs013
Sta21	29.18048333	41.30266667	82	30-Jun-13	08:07	bs014
Sta22	29.1834	41.303	82	30-Jun-13	08:22	bs015
Sta23	29.18483333	41.30325	81	30-Jun-13	08:34	bs016
Sta24	29.18601667	41.30368333	57	30-Jun-13	08:42	bs017
Sta25	29.18831667	41.30423	61	30-Jun-13	08:50	bs018
Sta26	29.19099833	41.30467833	64	30-Jun-13	09:00	bs019
Sta28	29.17202667	41.29184	63	30-Jun-13	14:10	bs020
Sta29	29.1744	41.2919	59	30-Jun-13	15:52	bs021
Sta30	29.19091667	41.29253333	54	30-Jun-13	16:13	bs022
Sta31	29.18813333	41.29243333	72	30-Jun-13	16:23	bs023
Sta32	29.18643333	41.29236667	71	30-Jun-13	16:33	bs024
Sta33	29.18351667	41.2922	76	30-Jun-13	16:45	bs025
Sta34	29.18141667	41.2922	73	30-Jun-13	16:55	bs026
Sta35	29.17933333	41.2921	70	30-Jun-13	17:06	bs027
Sta38	29.1632	41.30876667	62	01-Jul-13	06:07	bs028
Sta39	29.16808333	41.31085	68	01-Jul-13	06:19	bs029
Sta40	29.16963333	41.31163333	71	01-Jul-13	06:33	bs030
Sta41	29.17105	41.3127	78	01-Jul-13	06:44	bs031
Sta42	29.17278333	41.31271667	80	01-Jul-13	06:54	bs032
Sta43	29.17426667	41.31346667	74	01-Jul-13	07:05	bs033
Sta44	29.1839	41.31751667	58	01-Jul-13	11:11	bs034
Sta45	29.17843333	41.31533333	59	01-Jul-13	11:26	bs035
Sta46	29.17673333	41.31483333	71	01-Jul-13	11:37	bs036
Sta47	29.17585	41.31408333	74	01-Jul-13	11:48	bs037
Sta48	29.18808333	41.26301667	46	01-Jul-13	12:50	bs038
Sta49	29.17965	41.26691667	52	01-Jul-13	13:06	bs039
Sta50	29.17845	41.26711667	65	01-Jul-13	13:18	bs040
Sta51	29.1772	41.26756667	68	01-Jul-13	13:27	bs041
Sta52	29.17591667	41.26786667	74	01-Jul-13	13:40	bs042
Sta53	29.1736	41.26848333	75	01-Jul-13	13:54	bs043
Sta54	29.17215	41.26905	73	01-Jul-13	14:08	bs044
Sta55	29.1703	41.26946667	57	01-Jul-13	14:26	bs045
Sta56	29.16781667	41.27028333	50	01-Jul-13	14:37	bs046
Sta57	29.20945	41.30583333	69	01-Jul-13	15:38	bs047
Sta58	29.2051	41.30251667	61	01-Jul-13	15:57	bs048
Sta59	29.20351667	41.30373333	63	01-Jul-13	16:08	bs049
Sta60	29.18643333	41.29228333	72	01-Jul-13	16:39	bs050
Sta61	29.1836	41.2922	74	01-Jul-13	16:51	bs051
Sta62	29.18168333	41.29218333	75	01-Jul-13	17:02	bs052
Sta64	29.19456667	41.27913333	61	02-Jul-13	05:08	bs053
Sta65	29.18701667	41.28008333	62	02-Jul-13	05:22	bs054
Sta66	29.18533333	41.2804	70	02-Jul-13	05:35	bs055
Sta67	29.1837	41.28043333	75	02-Jul-13	05:44	bs056

Sta68	29.18206667	41.28055	76	02-Jul-13	05:54	bs057
Sta69	29.17918333	41.28086667	75	02-Jul-13	06:04	bs058
Sta70	29.1773	41.28088333	74	02-Jul-13	06:16	bs059
Sta71	29.17615	41.3144	66	02-Jul-13	06:24	bs060
Sta72	29.17448333	41.28116667	59	02-Jul-13	06:33	bs061
Sta73	29.17868333	41.28171667	58	02-Jul-13	06:43	bs062
Sta74	29.15813333	41.24741667	59	02-Jul-13	07:26	bs063
Sta75	29.16778333	41.25986667	80	02-Jul-13	07:44	bs064
Sta76	29.1695	41.2624	73	02-Jul-13	07:54	bs065
Sta77	29.16995	41.26308333	87	02-Jul-13	08:02	bs066
Sta78	29.17088333	41.2641	77	02-Jul-13	08:11	bs067
Sta79	29.17168333	41.26528333	77	02-Jul-13	08:20	bs068
Sta80	29.17365	41.26805	76	02-Jul-13	08:29	bs069
Sta81	29.1783	41.27716667	77	02-Jul-13	08:43	bs070
Sta83	29.1911	41.30473333	63	02-Jul-13	12:12	bs071
Sta84	29.18878333	41.30441667	60	02-Jul-13	12:27	bs072
Sta85	29.18616667	41.30375	57	02-Jul-13	12:41	bs073
Sta86_1	29.18458333	41.30345	77	02-Jul-13	12:52	bs074
Sta86_2	29.18458333	41.30345	77	02-Jul-13	12:57	bs075
Sta86_3	29.18458333	41.30345	77	02-Jul-13	13:01	bs076
Sta86_4	29.18458333	41.30345	77	02-Jul-13	13:06	bs077
Sta86_5	29.18458333	41.30345	77	02-Jul-13	13:11	bs078
Sta87	29.18313333	41.30295	80	02-Jul-13	13:24	bs079
Sta88	29.18033333	41.30255	80	02-Jul-13	13:36	bs080
Sta89_1	29.17858333	41.30233333	75	02-Jul-13	13:47	bs081
Sta89_2	29.17858333	41.30233333	75	02-Jul-13	13:52	bs082
Sta89_3	29.17858333	41.30233333	75	02-Jul-13	13:56	bs083
Sta89_4	29.17858333	41.30233333	75	02-Jul-13	14:00	bs084
Sta89_5	29.17858333	41.30233333	75	02-Jul-13	14:05	bs085
Sta90	29.17578333	41.30186667	64	02-Jul-13	14:18	bs086
Sta91	29.17371667	41.3013	62	02-Jul-13	14:28	bs087
Sta92	29.16906667	41.30046667	64	02-Jul-13	14:44	bs088
Sta93	29.19328333	41.29883333	55	02-Jul-13	15:43	bs089
Sta94	29.18863333	41.29823333	56	02-Jul-13	15:55	bs090
Sta95	29.18743333	41.29813333	64	02-Jul-13	16:05	bs091
Sta96	29.18566667	41.29786667	75	02-Jul-13	16:15	bs092
Sta97	29.18373333	41.29768333	75	02-Jul-13	16:27	bs093
Sta98	29.18211667	41.29736667	77	02-Jul-13	16:38	bs094
Sta99	29.18111667	41.29721667	75	02-Jul-13	16:47	bs095
Sta100	29.17945	41.29701667	70	02-Jul-13	16:57	bs096
Sta101	29.1756	41.29645	62	02-Jul-13	17:10	bs097
Sta103	29.17126667	41.28718333	62	03-Jul-13	05:10	bs098
Sta104	29.17481667	41.28726667	61	03-Jul-13	05:20	bs099
Sta105	29.17686667	41.28728333	68	03-Jul-13	05:34	bs100
Sta106	29.17865	41.28701667	74	03-Jul-13	05:46	bs101
Sta107	29.18323333	41.28696667	75	03-Jul-13	05:59	bs102
Sta108	29.18315	41.28703333	75	03-Jul-13	06:11	bs103
Sta109	29.18526667	41.28688333	72	03-Jul-13	06:22	bs104
Sta110	29.18766667	41.28686667	67	03-Jul-13	06:34	bs105
Sta111	29.18981667	41.28686667	60	03-Jul-13	06:45	bs106
Sta112	29.196	41.28675	61	03-Jul-13	07:00	bs107
Sta113	29.19223333	41.27163333	50	03-Jul-13	07:26	bs108
Sta114	29.18835	41.27191667	53	03-Jul-13	07:56	bs109
Sta115	29.18426667	41.27343333	60	03-Jul-13	08:08	bs110
Sta116	29.18216667	41.27358333	67	03-Jul-13	08:17	bs111
Sta117	29.18028333	41.27391667	73	03-Jul-13	08:25	bs112
Sta118	29.17746667	41.27441667	78	03-Jul-13	08:33	bs113
Sta119	29.17436667	41.27465	65	03-Jul-13	08:44	bs114

Sta120	29.17265	41.27513333	57	03-Jul-13	08:52	bs115
Sta121	29.16885	41.27581667	56	03-Jul-13	09:05	bs116
Sta122	29.18048333	41.25955	50	03-Jul-13	10:33	bs117
Sta123_1	29.14991667	41.24473333	60	03-Jul-13	14:55	bs118
Sta123_2	29.14991667	41.24473333	60	03-Jul-13	15:01	bs119
Sta123_3	29.14991667	41.24473333	60	03-Jul-13	15:04	bs120
Sta126	29.17678333	41.32511667	25	03-Jul-13	17:40	bs121
Sta127	29.19473333	41.30213333	60	04-Jul-13	05:16	bs122
Sta128	29.179035	41.32017667	63	04-Jul-13	05:43	bs123
Sta129	29.18903333	41.32615	75	04-Jul-13	05:57	bs124
Sta130	29.204	41.30775	59	04-Jul-13	06:21	bs125
Sta131	29.21336667	41.31348333	73	04-Jul-13	06:38	bs126
Sta132	29.19745	41.33123333	75	04-Jul-13	07:00	bs127
Sta141	29.02053333	41.47011667	94	06-Jul-13	07:01	bs128
Sta142	29.02146667	41.47051667	94	06-Jul-13	07:10	bs129
Sta143	29.02226667	41.47196667	92	06-Jul-13	07:19	bs130
Sta144	29.02256667	41.47256667	94	06-Jul-13	07:26	bs131
Sta145	29.02328333	41.47335	94	06-Jul-13	07:32	bs132
Sta146	29.0239	41.4742	94	06-Jul-13	07:40	bs133
Sta147	29.02433333	41.47495	94	06-Jul-13	07:48	bs134
Sta148	29.02488333	41.47526667	95	06-Jul-13	07:56	bs135
Sta149	29.0254	41.47583333	94	06-Jul-13	08:03	bs136
Sta150	29.02588333	41.47646667	95	06-Jul-13	08:13	bs137
Sta151	29.0262	41.47681667	94	06-Jul-13	08:20	bs138
Sta152	29.02663333	41.47716667	94	06-Jul-13	08:28	bs139
Sta153	29.02775	41.47873333	95	06-Jul-13	08:40	bs140
Sta154	29.02916667	41.4719	92	06-Jul-13	09:09	bs141
Sta155	29.02775	41.47278333	94	06-Jul-13	09:22	bs142
Sta156	29.02173333	41.47496667	95	06-Jul-13	10:06	bs143
Sta157	29.01931667	41.47646667	95	06-Jul-13	10:22	bs144
Sta158	29.01201667	41.4796	95	06-Jul-13	10:40	bs145
Sta159	29.00955	41.48091667	91	06-Jul-13	10:57	bs146
Sta177	29.18106667	41.30596667	80	09-Jul-13	05:14	bs147
Sta178	29.18358333	41.30706667	65	09-Jul-13	05:24	bs148
Sta179	29.18423333	41.30771667	60	09-Jul-13	05:32	bs149
Sta180	29.18813333	41.30975	62	09-Jul-13	05:46	bs150
Sta181	29.1906	41.31046667	60	09-Jul-13	05:56	bs151
Sta182	29.19113333	41.31086667	64	09-Jul-13	06:07	bs152
Sta183	29.19268333	41.31185	63	09-Jul-13	06:19	bs153
Sta184	29.19343333	41.31193333	66	09-Jul-13	06:29	bs154
Sta185	29.19455	41.31265	64	09-Jul-13	06:42	bs155
Sta186	29.19581667	41.3133	64	09-Jul-13	06:50	bs156
Sta187	29.19718333	41.3139	64	09-Jul-13	07:02	bs157
Sta188	29.19778333	41.31431667	69	09-Jul-13	07:12	bs158
Sta190	29.18068333	41.2595	48	09-Jul-13	10:04	bs159
Sta191	29.17375	41.2616	55	09-Jul-13	10:29	bs160
Sta192	29.17251667	41.26173333	63	09-Jul-13	10:44	bs161
Sta193	29.17116667	41.26211667	77	09-Jul-13	10:55	bs162
Sta194	29.17073333	41.26228333	76	09-Jul-13	11:06	bs163
Sta195	29.16993333	41.2625	82	09-Jul-13	11:16	bs164
Sta196	29.16873333	41.26275	75	09-Jul-13	11:27	bs165
Sta197	29.16791667	41.26301667	80	09-Jul-13	11:40	bs166
Sta198	29.1668	41.2634	66	09-Jul-13	11:52	bs167
Sta199	29.16585	41.26365	56	09-Jul-13	12:06	bs168
Sta200	29.1628	41.26441667	43	09-Jul-13	12:22	bs169
Sta201_1	29.17055	41.2638	78	09-Jul-13	13:04	bs170
Sta201_2	29.17055	41.2638	78	09-Jul-13	13:08	bs171
Sta201_3	29.17055	41.2638	78	09-Jul-13	13:13	bs172

Sta201_4	29.17055	41.2638	78	09-Jul-13	13:17	bs173
Sta201_5	29.17055	41.2638	78	09-Jul-13	13:21	bs174
Sta201_6	29.17055	41.2638	78	09-Jul-13	13:27	bs175
Sta204	29.15423333	41.24193333	57	10-Jul-13	06:52	bs176

Appendix 4: SVP metadata

Station	Longitude	Latitude	Depth (m)	Date	Time	SVP ID	SVP Filename
Sta05	29.15035	41.24401667	60.7	28-Jun-13	07:38	SVP-1	v000001
Sta06	29.15015	41.2442	60.9	28-Jun-13	07:43	SVP-2	v000001
Sta07	29.15018333	41.24458333	60.4	28-Jun-13	07:49	SVP-3	v000001
Sta08	29.17895	41.29193333	67	28-Jun-13	14:02	SVP-4	v000007
Sta10	29.18633333	41.2924	70	28-Jun-13	15:37	SVP-5	v000010
Sta14	29.02218333	41.47496667	90	29-Jun-13	07:42	SVP-6	v000012
Sta17	29.16903	41.300575	67	30-Jun-13	07:08	SVP-7	v000017
Sta18	29.17366667	41.3014	64	30-Jun-13	07:23	SVP-7	v000017
Sta19	29.17601667	41.30173333	66	30-Jun-13	07:36	SVP-7	v000017
Sta20	29.17846667	41.30236667	76	30-Jun-13	07:48	SVP-7	v000017
Sta21	29.18048333	41.30266667	82	30-Jun-13	08:07	SVP-7	v000017
Sta22	29.1834	41.303	82	30-Jun-13	08:22	SVP-7	v000017
Sta23	29.18483333	41.30325	81	30-Jun-13	08:34	SVP-7	v000017
Sta24	29.18601667	41.30368333	57	30-Jun-13	08:42	SVP-7	v000017
Sta25	29.18831667	41.30423	61	30-Jun-13	08:50	SVP-7	v000017
Sta26	29.1909833	41.30467833	64	30-Jun-13	09:00	SVP-7	v000017
Sta28	29.17202667	41.29184	63	30-Jun-13	14:10	SVP-8	v000018
Sta29	29.1744	41.2919	59	30-Jun-13	15:52	SVP-8	v000018
Sta30	29.19091667	41.29253333	54	30-Jun-13	16:13	SVP-8	v000018
Sta31	29.18813333	41.29243333	72	30-Jun-13	16:23	SVP-8	v000018
Sta32	29.18643333	41.29236667	71	30-Jun-13	16:33	SVP-8	v000018
Sta33	29.18351667	41.2922	76	30-Jun-13	16:45	SVP-8	v000018
Sta34	29.18141667	41.2922	73	30-Jun-13	16:55	SVP-8	v000018
Sta35	29.17933333	41.2921	70	30-Jun-13	17:06	SVP-8	v000018
Sta38	29.1632	41.30876667	62	1-Jul-13	06:07	SVP-9	v000020
Sta39	29.16808333	41.31085	68	1-Jul-13	06:19	SVP-10	v000021
Sta40	29.16963333	41.31163333	71	1-Jul-13	06:33	SVP-11	v000022
Sta41	29.17105	41.3127	78	1-Jul-13	06:44	SVP-12	v000023
Sta42	29.17278333	41.31271667	80	1-Jul-13	06:54	SVP-13	v000024
Sta43	29.17426667	41.31346667	74	1-Jul-13	07:05	SVP-14	v000025
Sta44	29.1839	41.31751667	58	1-Jul-13	11:11	SVP-15	v000029
Sta45	29.17843333	41.31533333	59	1-Jul-13	11:26	SVP-16	v000030
Sta46	29.17673333	41.31483333	71	1-Jul-13	11:37	SVP-17	v000031
Sta47	29.17585	41.31408333	74	1-Jul-13	11:48	SVP-18	v000032
Sta48	29.18808333	41.26301667	46	1-Jul-13	12:50	SVP-19	v000033
Sta49	29.17965	41.26691667	52	1-Jul-13	13:06	SVP-20	v000034
Sta50	29.17845	41.26711667	65	1-Jul-13	13:18	SVP-21	v000035
Sta51	29.1772	41.26756667	68	1-Jul-13	13:27	SVP-22	v000036
Sta52	29.17591667	41.26786667	74	1-Jul-13	13:40	SVP-23	v000037
Sta53	29.1736	41.26848333	75	1-Jul-13	13:54	SVP-24	v000038
Sta54	29.17215	41.26905	73	1-Jul-13	14:08	SVP-25	v000039
Sta55	29.1703	41.26946667	57	1-Jul-13	14:26	SVP-26	v000040
Sta56	29.16781667	41.27028333	50	1-Jul-13	14:37	SVP-27	v000041
Sta57	29.20945	41.30583333	69	1-Jul-13	15:38	SVP-28	v000042
Sta58	29.2051	41.30251667	61	1-Jul-13	15:57	SVP-29	v000043
Sta59	29.20351667	41.30373333	63	1-Jul-13	16:08	SVP-30	v000044
Sta60	29.18643333	41.29228333	72	1-Jul-13	16:39	SVP-31	v000045
Sta61	29.1836	41.2922	74	1-Jul-13	16:51	SVP-32	v000046
Sta62	29.18168333	41.29218333	75	1-Jul-13	17:02	SVP-33	v000047
Sta64	29.19456667	41.27913333	61	2-Jul-13	05:08	SVP-34	v000050
Sta65	29.18701667	41.28008333	62	2-Jul-13	05:22	SVP-35	v000051
Sta66	29.18533333	41.2804	70	2-Jul-13	05:35	SVP-36	v000052
Sta67	29.1837	41.28043333	75	2-Jul-13	05:44	SVP-37	v000053
Sta68	29.18206667	41.28055	76	2-Jul-13	05:54	SVP-38	v000054

Sta69	29.17918333	41.28086667	75	2-Jul-13	06:04	SVP-39	v000056
Sta70	29.1773	41.28088333	74	2-Jul-13	06:16	SVP-39a	v000057
Sta71	29.17615	41.3144	66	2-Jul-13	06:24	SVP-39a	v000057
Sta72	29.17448333	41.28116667	59	2-Jul-13	06:33	SVP-39a	v000057
Sta73	29.17868333	41.28171667	58	2-Jul-13	06:43	SVP-39a	v000057
Sta74	29.15813333	41.24741667	59	2-Jul-13	07:26	SVP-40	v000058
Sta75	29.16778333	41.25986667	80	2-Jul-13	07:44	SVP-41	v000059
Sta76	29.1695	41.2624	73	2-Jul-13	07:54	SVP-42	v000060
Sta77	29.16995	41.26308333	87	2-Jul-13	08:02	SVP-43	v000061
Sta78	29.17088333	41.2641	77	2-Jul-13	08:11	SVP-44	v000062
Sta79	29.17168333	41.26528333	77	2-Jul-13	08:20	SVP-45	v000063
Sta80	29.17365	41.26805	76	2-Jul-13	08:29	SVP-46	v000064
Sta81	29.1783	41.27716667	77	2-Jul-13	08:43	SVP-47	v000065
Sta83	29.1911	41.30473333	63	2-Jul-13	12:12	SVP-48	v000068
Sta84	29.18878333	41.30441667	60	2-Jul-13	12:27	SVP-49	v000069
Sta85	29.18616667	41.30375	57	2-Jul-13	12:41	SVP-50	v000070
Sta86_1	29.18458333	41.30345	77	2-Jul-13	12:52	SVP-51	v000071
Sta86_2	29.18458333	41.30345	77	2-Jul-13	12:57	SVP-51	v000071
Sta86_3	29.18458333	41.30345	77	2-Jul-13	13:01	SVP-51	v000071
Sta86_4	29.18458333	41.30345	77	2-Jul-13	13:06	SVP-51	v000071
Sta86_5	29.18458333	41.30345	77	2-Jul-13	13:11	SVP-51	v000071
Sta87	29.18313333	41.30295	80	2-Jul-13	13:24	SVP-52	v000072
Sta88	29.18033333	41.30255	80	2-Jul-13	13:36	SVP-52a	v000073
Sta89_1	29.17858333	41.30233333	75	2-Jul-13	13:47	SVP-53	v000074
Sta89_2	29.17858333	41.30233333	75	2-Jul-13	13:52	SVP-53	v000074
Sta89_3	29.17858333	41.30233333	75	2-Jul-13	13:56	SVP-53	v000074
Sta89_4	29.17858333	41.30233333	75	2-Jul-13	14:00	SVP-53	v000074
Sta89_5	29.17858333	41.30233333	75	2-Jul-13	14:05	SVP-53	v000074
Sta90	29.17578333	41.30186667	64	2-Jul-13	14:18	SVP-54	v000075
Sta91	29.17371667	41.3013	62	2-Jul-13	14:28	SVP-55	v000076
Sta92	29.16906667	41.30046667	64	2-Jul-13	14:44	SVP-56	v000077
Sta93	29.19328333	41.29883333	55	2-Jul-13	15:43	SVP-57	v000079
Sta94	29.18863333	41.29823333	56	2-Jul-13	15:55	SVP-58	v000080
Sta95	29.18743333	41.29813333	64	2-Jul-13	16:05	SVP-59	v000081
Sta96	29.18566667	41.29786667	75	2-Jul-13	16:15	SVP-60	v000082
Sta97	29.18373333	41.29768333	75	2-Jul-13	16:27	SVP-61	v000083
Sta98	29.18211667	41.29736667	77	2-Jul-13	16:38	SVP-62	v000084
Sta99	29.18111667	41.29721667	75	2-Jul-13	16:47	SVP-63	v000085
Sta100	29.17945	41.29701667	70	2-Jul-13	16:57	SVP-64	v000086
Sta101	29.1756	41.29645	62	2-Jul-13	17:10	SVP-65	v000087
Sta103	29.17126667	41.28718333	62	3-Jul-13	05:10	SVP-66	v000092
Sta104	29.17481667	41.28726667	61	3-Jul-13	05:20	SVP-67	v000093
Sta105	29.17686667	41.28728333	68	3-Jul-13	05:34	SVP-68	v000094
Sta106	29.17865	41.28701667	74	3-Jul-13	05:46	SVP-69	v000095
Sta107	29.18323333	41.28696667	75	3-Jul-13	05:59	SVP-70	v000096
Sta108	29.18315	41.28703333	75	3-Jul-13	06:11	SVP-71	v000097
Sta109	29.18526667	41.28688333	72	3-Jul-13	06:22	SVP-72	v000098
Sta110	29.18766667	41.28686667	67	3-Jul-13	06:34	SVP-73	v000099
Sta111	29.18981667	41.28686667	60	3-Jul-13	06:45	SVP-74	v000100
Sta112	29.196	41.28675	61	3-Jul-13	07:00	SVP-75	v000101
Sta113	29.19223333	41.27163333	50	3-Jul-13	07:26	SVP-76	v000102
Sta114	29.18835	41.27191667	53	3-Jul-13	07:56	SVP-77	v000103
Sta115	29.18426667	41.27343333	60	3-Jul-13	08:08	SVP-78	v000104
Sta116	29.18216667	41.27358333	67	3-Jul-13	08:17	SVP-79	v000105
Sta117	29.18028333	41.27391667	73	3-Jul-13	08:25	SVP-80	v000106
Sta118	29.17746667	41.27441667	78	3-Jul-13	08:33	SVP-81	v000107
Sta119	29.17436667	41.27465	65	3-Jul-13	08:44	SVP-82	v000108
Sta120	29.17265	41.27513333	57	3-Jul-13	08:52	SVP-83	v000109

Sta123_1	29.14991667	41.24473333	60	3-Jul-13	11:55	SVP-86	v000134
Sta123_2	29.14991667	41.24473333	60	3-Jul-13	12:04	SVP-86	v000134
Sta123_3	29.14991667	41.24473333	60	3-Jul-13	12:08	SVP-86	v000134
Sta127	29.19473333	41.30213333	58	4-Jul-13	05:15	SVP-87	v000201
Sta128	29.179035	41.32017667	62	4-Jul-13	05:42	SVP-88	v000203
Sta129	29.18903333	41.32615	73	4-Jul-13	05:57	SVP-89	v000204
Sta130	29.204	41.30775	57	4-Jul-13	06:21	SVP-90	v000205
Sta131	29.21336667	41.31348333	73	4-Jul-13	06:38	SVP-91	v000206
Sta132	29.19745	41.33123333	74	4-Jul-13	07:00	SVP-92	v000207
Sta141	29.02053333	41.47011667	93	6-Jul-13	07:01	SVP-93	v000208
Sta142	29.02146667	41.47051667	92	6-Jul-13	07:10	SVP-94	v000209
Sta143	29.02226667	41.47196667	94	6-Jul-13	07:19	SVP-95	v000210
Sta144	29.02256667	41.47256667	93	6-Jul-13	07:26	SVP-96	v000211
Sta145	29.02328333	41.47335	92	6-Jul-13	07:32	SVP-97	v000212
Sta146	29.0239	41.4742	92	6-Jul-13	07:40	SVP-98	v000213
Sta147	29.02433333	41.47495	93	6-Jul-13	07:48	SVP-99	v000214
Sta148	29.02488333	41.47526667	93	6-Jul-13	07:56	SVP-100	v000215
Sta149	29.0254	41.47583333	92	6-Jul-13	08:03	SVP-101	v000216
Sta150	29.02588333	41.47646667	92	6-Jul-13	08:13	SVP-102	v000217
Sta151	29.0262	41.47681667	92	6-Jul-13	08:20	SVP-103	v000218
Sta152	29.02663333	41.47716667	92	6-Jul-13	08:28	SVP-104	v000219
Sta153	29.02775	41.47873333	92	6-Jul-13	08:41	SVP-105	v000220
Sta154	29.02916667	41.4719	90	6-Jul-13	09:09	SVP-106	v000221
Sta155	29.02775	41.47278333	92	6-Jul-13	09:22	SVP-107	v000222
Sta156	29.02173333	41.47496667	92	6-Jul-13	10:06	SVP-108	v000223
Sta157	29.01931667	41.47646667	92	6-Jul-13	10:22	SVP-109	v000224
Sta158	29.01201667	41.4796	93	6-Jul-13	10:40	SVP-110	v000225
Sta159	29.00955	41.48091667	89	6-Jul-13	10:57	SVP-111	v000226
Sta177	29.18106667	41.30596667	80	9-Jul-13	05:14	SVP-112	V000303
Sta178	29.18358333	41.30706667	65	9-Jul-13	05:24	SVP-113	V000304
Sta179	29.18423333	41.30771667	60	9-Jul-13	05:32	SVP-114	V000305
Sta180	29.18813333	41.30975	62	9-Jul-13	05:46	SVP-115	V000306
Sta181	29.1906	41.31046667	60	9-Jul-13	05:56	SVP-116	V000307
Sta182	29.19113333	41.31086667	64	9-Jul-13	06:07	SVP-117	V000308
Sta183	29.19268333	41.31185	63	9-Jul-13	06:19	SVP-118	V000309
Sta184	29.19343333	41.31193333	66	9-Jul-13	06:29	SVP-119	V000310
Sta185	29.19455	41.31265	64	9-Jul-13	06:42	SVP-120	V000311
Sta186	29.19581667	41.3133	64	9-Jul-13	06:50	SVP-121	V000312
Sta187	29.19718333	41.3139	64	9-Jul-13	07:02	SVP-122	V000313
Sta188	29.19778333	41.31431667	69	9-Jul-13	07:12	SVP-123	V000314
Sta190	29.18068333	41.2595	48	9-Jul-13	10:04	SVP-124	V000315
Sta191	29.17375	41.2616	55	9-Jul-13	10:29	SVP-125	V000316
Sta192	29.17251667	41.26173333	63	9-Jul-13	10:44	SVP-126	V000317
Sta193	29.17116667	41.26211667	77	9-Jul-13	10:55	SVP-127	V000318
Sta194	29.17073333	41.26228333	76	9-Jul-13	11:06	SVP-128	V000319
Sta195	29.16993333	41.2625	82	9-Jul-13	11:16	SVP-129	V000320
Sta196	29.16873333	41.26275	75	9-Jul-13	11:27	SVP-130	V000321
Sta197	29.16791667	41.26301667	80	9-Jul-13	11:40	SVP-131	V000322
Sta198	29.1668	41.2634	66	9-Jul-13	11:52	SVP-132	V000323
Sta199	29.16585	41.26365	56	9-Jul-13	12:06	SVP-133	V000324
Sta200	29.1628	41.26441667	43	9-Jul-13	12:22	SVP-134	V000325
Sta201	29.17055	41.2638	78	9-Jul-13	13:03	SVP-135	V000326
Sta204	29.15423333	41.24193333	57	10-Jul-13	06:52	SVP-136	V000403

Appendix 5: LISST metadata

Station	Longitude	Latitude	Depth (m)	Date	Time	LISST ID	LISST Filename
Sta08	29.17895	41.29193333	67	28-Jun-13	14:02	LIST-1	L1791401
Sta10	29.18633333	41.2924	70	28-Jun-13	15:37	LIST-2	L1791536
Sta17	29.16903	41.300575	67	30-Jun-13	07:08	LIST-4	L0011003
Sta18	29.17366667	41.3014	64	30-Jun-13	07:23	LIST-5	L0011021
Sta19	29.17601667	41.30173333	66	30-Jun-13	07:36	LIST-6	L0011034
Sta20	29.17846667	41.30236667	76	30-Jun-13	07:48	LIST-7	L0011046
Sta21	29.18048333	41.30266667	82	30-Jun-13	08:07	LIST-8	L0011101
Sta22	29.1834	41.303	82	30-Jun-13	08:22	LIST-9	L0011116
Sta23	29.18483333	41.30325	81	30-Jun-13	08:34	LIST-10	L0011129
Sta24	29.18601667	41.30368333	57	30-Jun-13	08:42	LIST-11	L0011137
Sta26	29.19099833	41.30467833	64	30-Jun-13	09:00	LIST-13	L0011158
Sta28	29.17202667	41.29184	63	30-Jun-13	14:10	LIST-15	L0011708
Sta29	29.1744	41.2919	59	30-Jun-13	15:52	LIST-16	L0011849
Sta30	29.19091667	41.29253333	54	30-Jun-13	16:13	LIST-17	L0011912
Sta31	29.18813333	41.29243333	72	30-Jun-13	16:23	LIST-18	L0011921
Sta32	29.18643333	41.29236667	71	30-Jun-13	16:33	LIST-19	L0011934
Sta34	29.18141667	41.2922	73	30-Jun-13	16:55	LIST-21	L0011953
Sta35	29.17933333	41.2921	70	30-Jun-13	17:06	LIST-22	L0012004
Sta38	29.1632	41.30876667	62	1-Jul-13	06:07	LIST-23	L0010008/11
Sta39	29.16808333	41.31085	68	1-Jul-13	06:19	LIST-24	L0010020
Sta40	29.16963333	41.31163333	71	1-Jul-13	06:33	LIST-25	L0010035
Sta41	29.17105	41.3127	78	1-Jul-13	06:44	LIST-26	L0010045
Sta42	29.17278333	41.31271667	80	1-Jul-13	06:54	LIST-27	L0010055
Sta43	29.17426667	41.31346667	74	1-Jul-13	07:05	LIST-28	L0010106
Sta44	29.1839	41.31751667	58	1-Jul-13	11:11	LIST-29	L0010513
Sta45	29.17843333	41.31533333	59	1-Jul-13	11:26	LIST-30	L0010529
Sta46	29.17673333	41.31483333	71	1-Jul-13	11:37	LIST-31	L0010538
Sta47	29.17585	41.31408333	74	1-Jul-13	11:48	LIST-32	L0010549
Sta48	29.18808333	41.26301667	46	1-Jul-13	12:50	LIST-33	L0010651
Sta49	29.17965	41.26691667	52	1-Jul-13	13:06	LIST-34	L0010707
Sta50	29.17845	41.26711667	65	1-Jul-13	13:18	LIST-35	L0010719
Sta51	29.1772	41.26756667	68	1-Jul-13	13:27	LIST-36	L0010728
Sta52	29.17591667	41.26786667	74	1-Jul-13	13:40	LIST-38	L0010741
Sta53	29.1736	41.26848333	75	1-Jul-13	13:54	LIST-39	L0010755
Sta54	29.17215	41.26905	73	1-Jul-13	14:08	LIST-40	L0010810
Sta55	29.1703	41.26946667	57	1-Jul-13	14:26	LIST-41	L0010827
Sta56	29.16781667	41.27028333	50	1-Jul-13	14:37	LIST-42	L0010837
Sta57	29.20945	41.30583333	69	1-Jul-13	15:38	LIST-43	L0010935
Sta58	29.2051	41.30251667	61	1-Jul-13	15:57	LIST-44	L0010958
Sta59	29.20351667	41.30373333	63	1-Jul-13	16:08	LIST-44A	L0011010
Sta60	29.18643333	41.29228333	72	1-Jul-13	16:39	LIST-45	L0011040
Sta61	29.1836	41.2922	74	1-Jul-13	16:51	LIST-46	L0011053
Sta62	29.18168333	41.29218333	75	1-Jul-13	17:02	LIST-47	L0011103
Sta65	29.18701667	41.28008333	62	2-Jul-13	05:22	LIST-50	L0010030
Sta66	29.18533333	41.2804	70	2-Jul-13	05:35	LIST-51	L0010042
Sta67	29.1837	41.28043333	75	2-Jul-13	05:44	LIST-52	L0010052
Sta68	29.18206667	41.28055	76	2-Jul-13	05:54	LIST-53	L0010102
Sta69	29.17918333	41.28086667	75	2-Jul-13	06:04	LIST-54	L0010112
Sta70	29.1773	41.28088333	74	2-Jul-13	06:16	LIST-55	L0010123
Sta71	29.17615	41.3144	66	2-Jul-13	06:24	LIST-56	L0010131
Sta72	29.17448333	41.28116667	59	2-Jul-13	06:33	LIST-57	L0010140
Sta73	29.17868333	41.28171667	58	2-Jul-13	06:43	LIST-58	L0010150
Sta74	29.15813333	41.24741667	59	2-Jul-13	07:26	LIST-59	L0010234
Sta75	29.16778333	41.25986667	80	2-Jul-13	07:44	LIST-60	L0010251
Sta76	29.1695	41.2624	73	2-Jul-13	07:54	LIST-61	L0010302

Sta77	29.16995	41.26308333	87	2-Jul-13	08:02	LIST-62	L0010309
Sta78	29.17088333	41.2641	77	2-Jul-13	08:11	LIST-63	L0010318
Sta79	29.17168333	41.26528333	77	2-Jul-13	08:20	LIST-64	L0010327
Sta80	29.17365	41.26805	76	2-Jul-13	08:29	LIST-65	L0010336
Sta81	29.1783	41.27716667	77	2-Jul-13	08:43	LIST-66	L0010351
Sta83	29.1911	41.30473333	63	2-Jul-13	12:12	LIST-67	L0010719
Sta84	29.18878333	41.30441667	60	2-Jul-13	12:27	LIST-68	L0010734
Sta85	29.18616667	41.30375	57	2-Jul-13	12:41	LIST-69	L0010748
Sta86_1	29.18458333	41.30345	77	2-Jul-13	12:52	LIST-69A	L0010759
Sta87	29.18313333	41.30295	80	2-Jul-13	13:24	LIST-72	L0010831
Sta88	29.18033333	41.30255	80	2-Jul-13	13:36	LIST-73	L0010843
Sta89_1	29.17858333	41.30233333	75	2-Jul-13	13:47	LIST-74	L0010855
Sta90	29.17578333	41.30186667	64	2-Jul-13	14:18	LIST-75	L0010925
Sta92	29.16906667	41.30046667	64	2-Jul-13	14:44	LIST-77	L0010950
Sta103	29.17126667	41.28718333	62	3-Jul-13	05:10	LIST-87	L0010006
Sta104	29.17481667	41.28726667	61	3-Jul-13	05:20	LIST-88	L0010017
Sta105	29.17686667	41.28728333	68	3-Jul-13	05:34	LIST-89	L0010031
Sta106	29.17865	41.28701667	74	3-Jul-13	05:46	LIST-90	L0010043
Sta107	29.18323333	41.28696667	75	3-Jul-13	05:59	LIST-91	L0010056
Sta108	29.18315	41.28703333	75	3-Jul-13	06:11	LIST-92	L0010108
Sta109	29.18526667	41.28688333	72	3-Jul-13	06:22	LIST-93	L0010119
Sta110	29.18766667	41.28686667	67	3-Jul-13	06:34	LIST-94	L0010130
Sta111	29.18981667	41.28686667	60	3-Jul-13	06:45	LIST-95	L0010142
Sta112	29.196	41.28675	61	3-Jul-13	07:00	LIST-96	L0010156
Sta113	29.19223333	41.27163333	50	3-Jul-13	07:26	LIST-97	L0010223
Sta114	29.18835	41.27191667	53	3-Jul-13	07:56	LIST-98	L0010252
Sta115	29.18426667	41.27343333	60	3-Jul-13	08:08	LIST-99	L0010305
Sta116	29.18216667	41.27358333	67	3-Jul-13	08:17	LIST-100	L0010313
Sta117	29.18028333	41.27391667	73	3-Jul-13	08:25	LIST-101	L0010322
Sta118	29.17746667	41.27441667	78	3-Jul-13	08:33	LIST-102	L0010331
Sta119	29.17436667	41.27465	65	3-Jul-13	08:44	LIST-103	L0010341
Sta120	29.17265	41.27513333	57	3-Jul-13	08:52	LIST-104	L0010349
Sta121	29.16885	41.27581667	56	3-Jul-13	09:05	LIST-105	L0010402
Sta122	29.18048333	41.25955	50	3-Jul-13	10:33	LIST-106	L1841033
Sta123_1	29.14991667	41.24473333	60	3-Jul-13	11:55	LIST-107	L1841155
Sta127	29.19473333	41.30213333	58	4-Jul-13	05:15	LIST-108	L1850515
Sta128	29.179035	41.32017667	62	4-Jul-13	05:42	LIST-109	L1850542
Sta129	29.18903333	41.32615	73	4-Jul-13	05:57	LIST-110	L1850556
Sta130	29.204	41.30775	57	4-Jul-13	06:21	LIST-111	L1850620
Sta131	29.21336667	41.31348333	73	4-Jul-13	06:38	LIST-112	L1850637
Sta132	29.19745	41.33123333	74	4-Jul-13	07:00	LIST-113	L1850659
Sta141	29.02053333	41.47011667	93	6-Jul-13	07:01	LIST-114	L1870659
Sta142	29.02146667	41.47051667	92	6-Jul-13	07:10	LIST-115	L1870710
Sta143	29.02226667	41.47196667	94	6-Jul-13	07:19	LIST-116	L1870718
Sta144	29.02256667	41.47256667	93	6-Jul-13	07:26	LIST-117	L1870725
Sta145	29.02328333	41.47335	92	6-Jul-13	07:32	LIST-118	L1870732
Sta146	29.0239	41.4742	92	6-Jul-13	07:40	LIST-119	L1870739
Sta147	29.02433333	41.47495	93	6-Jul-13	07:48	LIST-120	L1870748
Sta148	29.02488333	41.47526667	93	6-Jul-13	07:56	LIST-121	L1870755
Sta149	29.0254	41.47583333	92	6-Jul-13	08:03	LIST-122	L1870803
Sta150	29.02588333	41.47646667	92	6-Jul-13	08:13	LIST-123	L1870812
Sta151	29.0262	41.47681667	92	6-Jul-13	08:20	LIST-124	L1870819
Sta152	29.02663333	41.47716667	92	6-Jul-13	08:28	LIST-125	L1870827
Sta153	29.02775	41.47873333	92	6-Jul-13	08:41	LIST-126	L1870841
Sta154	29.02916667	41.4719	90	6-Jul-13	09:09	LIST-127	L1870908
Sta155	29.02775	41.47278333	92	6-Jul-13	09:22	LIST-128	L1870921
Sta156	29.02173333	41.47496667	92	6-Jul-13	10:06	LIST-129	L1871004
Sta157	29.01931667	41.47646667	92	6-Jul-13	10:22	LIST-130	L1871021

Sta158	29.01201667	41.4796	93	6-Jul-13	10:40	LIST-131	L1871040
Sta159	29.00955	41.48091667	89	6-Jul-13	10:57	LIST-132	L1871056
Sta177	29.18106667	41.30596667	80	9-Jul-13	05:14	LIST-133	L1900513
Sta178	29.18358333	41.30706667	65	9-Jul-13	05:24	LIST-134	L1900524
Sta179	29.18423333	41.30771667	60	9-Jul-13	05:32	LIST-135	L1900532
Sta180	29.18813333	41.30975	62	9-Jul-13	05:46	LIST-136	L1900545
Sta181	29.1906	41.31046667	60	9-Jul-13	05:56	LIST-137	L1900555
Sta182	29.19113333	41.31086667	64	9-Jul-13	06:07	LIST-138	L1900607
Sta183	29.19268333	41.31185	63	9-Jul-13	06:19	LIST-139	L1900618
Sta184	29.19343333	41.31193333	66	9-Jul-13	06:29	LIST-140	L1900628
Sta185	29.19455	41.31265	64	9-Jul-13	06:42	LIST-141	L1900640
Sta186	29.19581667	41.3133	64	9-Jul-13	06:50	LIST-142	L1900649
Sta187	29.19718333	41.3139	64	9-Jul-13	07:02	LIST-143	L1900700
Sta188	29.19778333	41.31431667	69	9-Jul-13	07:12	LIST-144	L1900711
Sta190	29.18068333	41.2595	48	9-Jul-13	10:04	LIST-145	L1901007
Sta191	29.17375	41.2616	55	9-Jul-13	10:29	LIST-146	L1901029
Sta192	29.17251667	41.26173333	63	9-Jul-13	10:44	LIST-147	L1901043
Sta193	29.17116667	41.26211667	77	9-Jul-13	10:55	LIST-148	L1901054
Sta194	29.17073333	41.26228333	76	9-Jul-13	11:06	LIST-149	L1901105
Sta195	29.16993333	41.2625	82	9-Jul-13	11:16	LIST-150	L1901116
Sta196	29.16873333	41.26275	75	9-Jul-13	11:27	LIST-151	L1901126
Sta197	29.16791667	41.26301667	80	9-Jul-13	11:40	LIST-152	L1901139
Sta198	29.1668	41.2634	66	9-Jul-13	11:52	LIST-153	L1901152
Sta199	29.16585	41.26365	56	9-Jul-13	12:06	LIST-154	L1901205
Sta200	29.1628	41.26441667	43	9-Jul-13	12:22	LIST-155	L1901221
Sta204	29.15423333	41.24193333	57	10-Jul-13	06:52	LIST-156	L1910651