

**RV Prince Madog cruise 6/09**  
**POL Dee Experiment cruise (recovery)**  
**3–5 March 2009**

## **1. Objectives**

### **1.1 Coastal Observatory CTD station 12**

To recover: a sea bed frame containing a 600 kHz ADCP to measure the mean current profile, and a SeaBird SBE 16*plus* with pumped conductivity sensor, digiquartz pressure sensor and SeaPoint turbidity sensor. The frame was deployed 12:04 05/02/09 at 53°26.868'N 3°30.241'W in 17.3 m depth.

### **1.2 Welsh Channel**

- a) Conduct sidescan sonar survey and to take box core/grab samples.
- b) Conduct 18-hour CTD/LISST station. Obtain half-hourly profiles of salinity, transmittance, suspended sediment and chlorophyll. Obtain hourly calibration samples for salinity and near-surface and bottom water samples for suspended sediment determination.
- c) Half-hourly sampling of near-bottom and surface water for the INSSEV (IN Situ SETtling Velocity instrument, University of Plymouth) monitoring of cohesive sediment flocs.
- d) To recover: Mini-STABLE deployed 15:41 03/02/09 at 53°22.243'N 3°19.57'W in 12 m depth, with buoy at 53°22.237'N 3°19.520'W.

### **1.3 Hilbre Channel**

- a) Conduct sidescan sonar survey and to take box core/grab samples.
- b) Conduct 25-hour CTD/LISST station. Obtain half-hourly profiles of salinity, transmittance, suspended sediment and chlorophyll. Obtain hourly calibration samples for salinity and near-surface and bottom water samples for suspended sediment determination.
- c) Half-hourly sampling of near-bottom and surface water for the INSSEV monitoring of cohesive sediment flocs.
- d) To recover: STABLE (v3) deployed 09:51 02/02/09 at 53°22.525'N 3°14.198'W in 16 m depth, with chain clump at 53°22.540'N 3°14.199'W and spar buoy at 53°22.531'N 3°14.179'W.

## **2. Personnel**

### **2.1 Scientific personnel**

Andy Lane	(Principal scientist, POL)
Terry Doyle	(POL)
Ray Edun	(POL)
Ben Moate	(POL)
Darren Baylis	(BODC)
Nicola Clargo	(BODC)
Andrew Manning	(University of Plymouth)
Jaco Baas	(SOS, Bangor University)
Anne Hammerstein	(SOS, Bangor University)
Peter Hughes	(SOS, Bangor University)

## **2.2 Ship's officers and crew**

Eric Lloyd	(Master)
Nick Davies	(Chief Officer)
Arfon Williams	(Chief Engineer)
Andrew Westmore	(2nd Engineer)
Mick Callaghan	(Bosun)
Tommy Roberts	(A.B.)
Dominic Kelly	(A.B.)
Eifion Pritchard	(Cook)

## **3. Narrative (times in GMT)**

### **3.1 Monday 2nd March 2009**

Scientists arrived at RV Prince Madog at Menai Bridge Pier at 13:30. The Day Grab, table and other equipment were loaded by 14:30. This is a 'recovery' cruise hence no preparation of moorings was required. SOS staff prepared the CTD and set up the sediment filtering apparatus. The INSSEV water cell, camera, monitoring and recording system was assembled.

### **3.2 Tuesday 3rd March 2009**

RV Prince Madog departed from Menai Bridge at 06:21. The ship's surface monitoring package, ADCP, pCO<sub>2</sub> system was started at 07:09 on passing Puffin Island.

Site 12 was reached at 09:05, and recovery of the ADCP frame commenced. At 09:10, the release signal was sent (range 50 m increasing to 300 m, required repositioning of the ship). At 09:28, the release signal was sent again and the frame surfaced (range 30 m); the ADCP frame was recovered at 09:34 and the associated ballast frame by 09:38. Winds were force 3 from SW, with slight sea and low swell.

On arrival at Welsh Channel (via the west of North Hoyle wind farm and then Inner Passage), the ship's ADCP was stopped to avoid interference with the side scan sonar. The sidescan sonar survey began at 10:53 recording two lines, finishing at 11:19. Five grabs samples labelled W1–5, intended to be taken in a cross formation, were obtained between 11:38 and 12:04 (ADCP logging resumed at 11:45). Winds remained at force 3 from SW, with slight sea and low swell. Box cores were postponed until 16:35.

The ship anchored close to the mini-STABLE location at 12:10. The 18-hour station began with a CTD profile at 12:31. Profiles were taken each half-hour; surface and bottom water samples were also obtained with the profiles on the hour for suspended sediment filtration.

Between half-hourly CTDs, INSSEV sampling took place with a Van Dorn bottle lowered over the side of the ship – in the laboratory, a pipette sub-sample is held just below the surface in the water cell and sediment allowed to settle in front of the camera. Initially, bottom and then surface samples were taken; after 16:22, only bottom samples were taken as the surface samples contained little sediment. Westerly gale-force winds, wintry showers and swell prevented deployment of the INSSEV's Van Dorn bottle between 18:00 and 22:00.

Box cores were attempted at 16:45 and 16:58, but unsuccessfully because the jaw mechanism caught on the flanges of the box inserts and could not close. After modifications, successful box cores were made at 17:50 (first) and 18:46 (second).

Dee Experiment cruise (recovery), 3rd, 4th and 5th March 2009

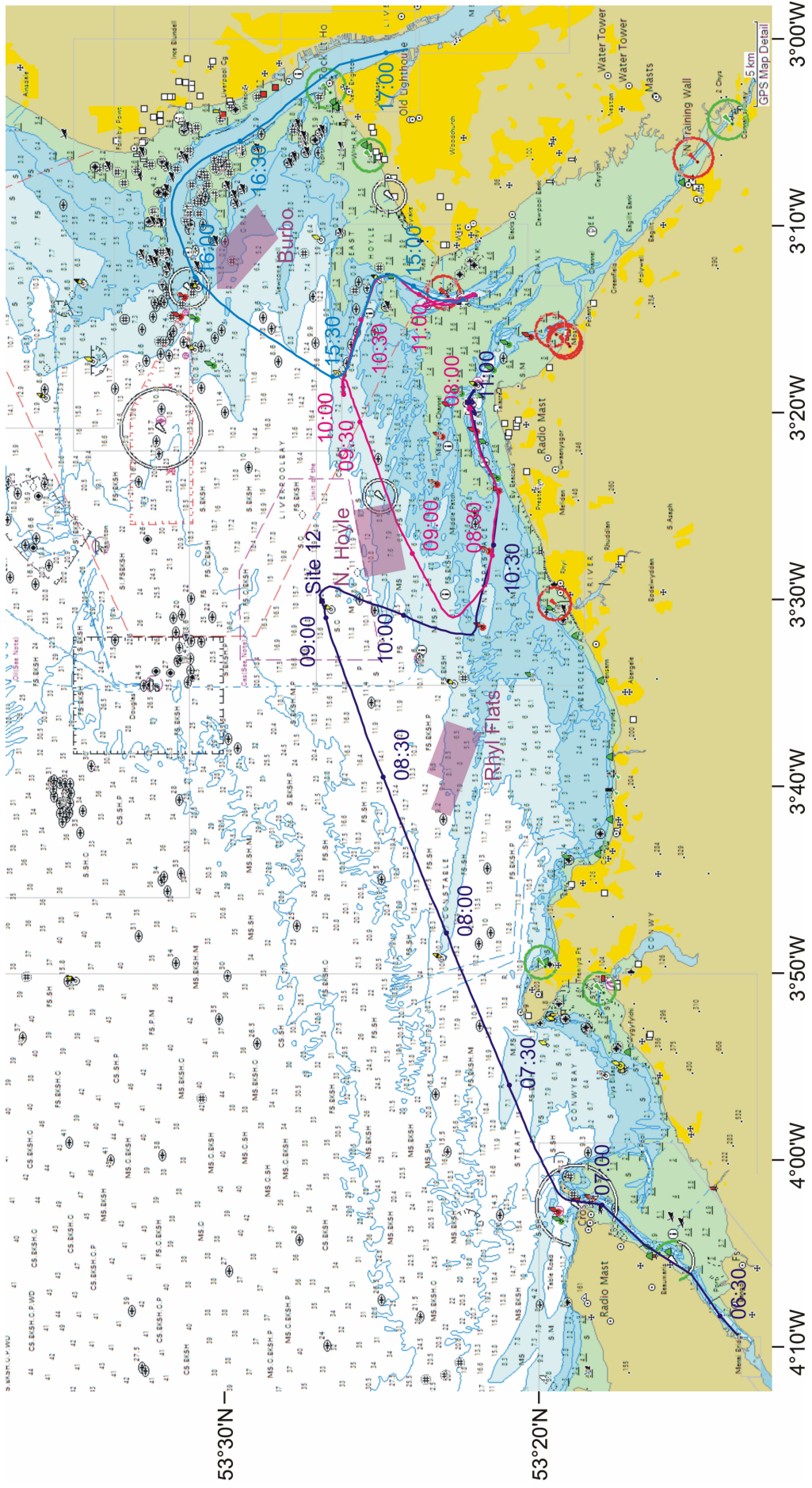


Figure 1. Cruise track

### **3.3 Wednesday 4th March 2009**

The 18-hour station ended with the CTD profile at 07:03. Winds were force 3 from SE, with moderate visibility, slight sea and low swell. The ship's anchor was raised at 07:13 ready for the recovery of mini-STABLE, which started at 07:29 and finished at 07:51.

RV Prince Madog sailed to Hilbre Channel via the south of North Hoyle wind farm and Hilbre Swash, arriving at 11:04. Two lines of the sidescan sonar survey were made between 11:05 and 11:53 (with ship's ADCP stopped between 11:05 and 12:19). This was followed by five grab samples, H1–5, between 12:09 and 12:32, again intended to be in a cross shape.

The ship anchored at 12:58 and the 25-hour station commenced at 13:02 with half-hourly CTD profiles, followed by INSSEV deployments, as in the previous 18-hour station.

A box core was obtained successfully at 13:09, but the sample spilt from the bottom while opening the jaws; another sample was obtained at 13:16 (third). The fourth box core was attempted at 13:30. Unfortunately the box corer detached from the cable; the box corer was not recovered.

Arrangements for its retrieval (while RV Prince Madog remained on station for a further 24 hours) were not straightforward because of neap tide conditions and logistical constraints. The box corer's approximate position will instead be marked with a buoy, so that divers can later attach it to the corer when conditions are more suitable.

### **3.4 Thursday 5th March 2009**

The final CTD profile of the 25-hour station was at 13:59. Winds were force 2, variable direction, with good visibility, slight sea and low swell.

A buoy with 50 m of rope attached to a shackle and two lead weights was placed about 20 m east of the box corer's last known position. This is estimated as 53°22.333'N 3°14.087'W, i.e., 18 m on bearing 160° from the ship's mid-point at the time of loss.

The recovery of STABLE began at 14:20 and finished at 14:48. RV Prince Madog sailed to Birkenhead Vittoria Dock via Queens Channel and Crosby Channel, arriving at Alfred Lock just before 17:20. The ship's ADCP, pCO<sub>2</sub> and surface monitoring was stopped on passing the Seaforth Radar Tower at 16:42. Unloading of equipment completed at 20:00.

With the exception of the loss of the box corer, all other cruise objectives were achieved.

## **4. Moorings (times in GMT)**

### **4.1 The setup of the recovered instruments**

Full descriptions of the instrument configurations and setups are given in a separate report (Cooke, 2009).

#### **a) Coastal Observatory CTD station 12**

ADCP frame connected by 200 m spooler line to the ballast weight and Benthos releases s/n 70358 Tx 12.0 kHz, Rx 11.0 kHz, Rc A; s/n 72382 Tx 12.0 kHz, Rx 10.0 kHz, Rc A.

- RDI ADCP 600 kHz s/n 5807  
started logging at 12:00 05/02/09, stopped at 10:59 10/03/09  
clock drift +1 minute 5 seconds over the deployment
- SeaBird SBE 16*plus* s/n 4597 with SeaPoint turbidity sensor  
started logging at 06:00 05/02/09, stopped at 15:36 10/03/09  
clock drift -1 second over the deployment

b) **Welsh Channel**

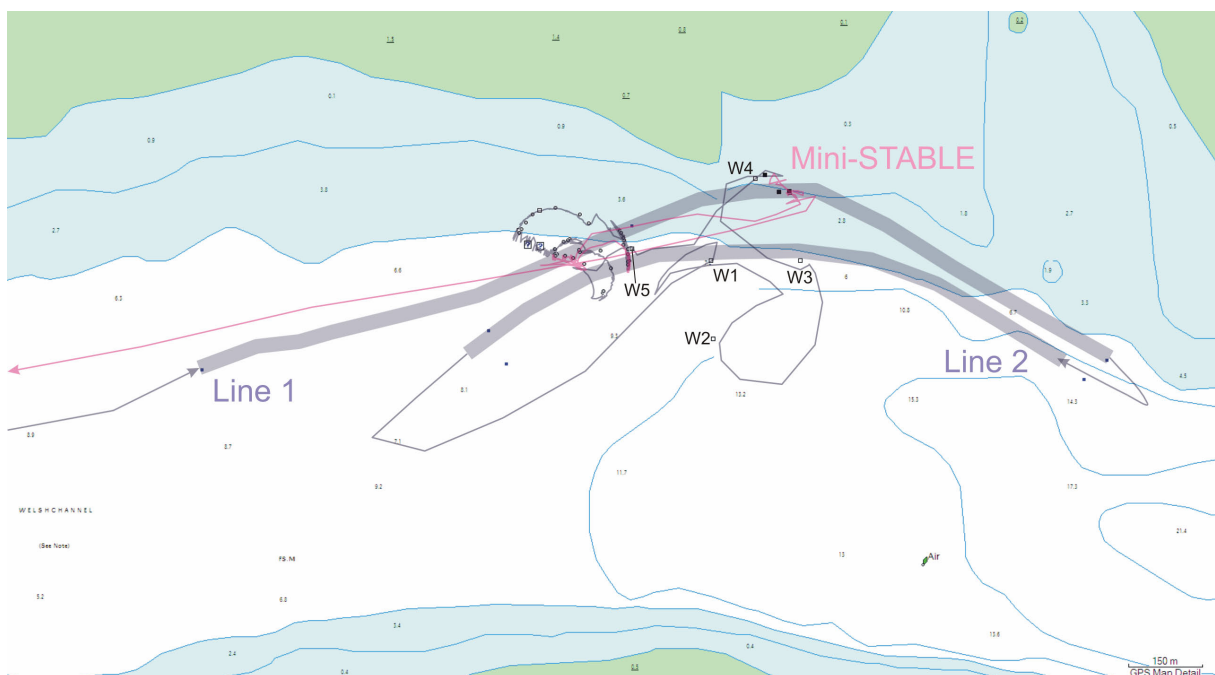
All instruments were programmed to start recording at 06:00 on 02/02/09 unless stated otherwise.

Toroid buoy

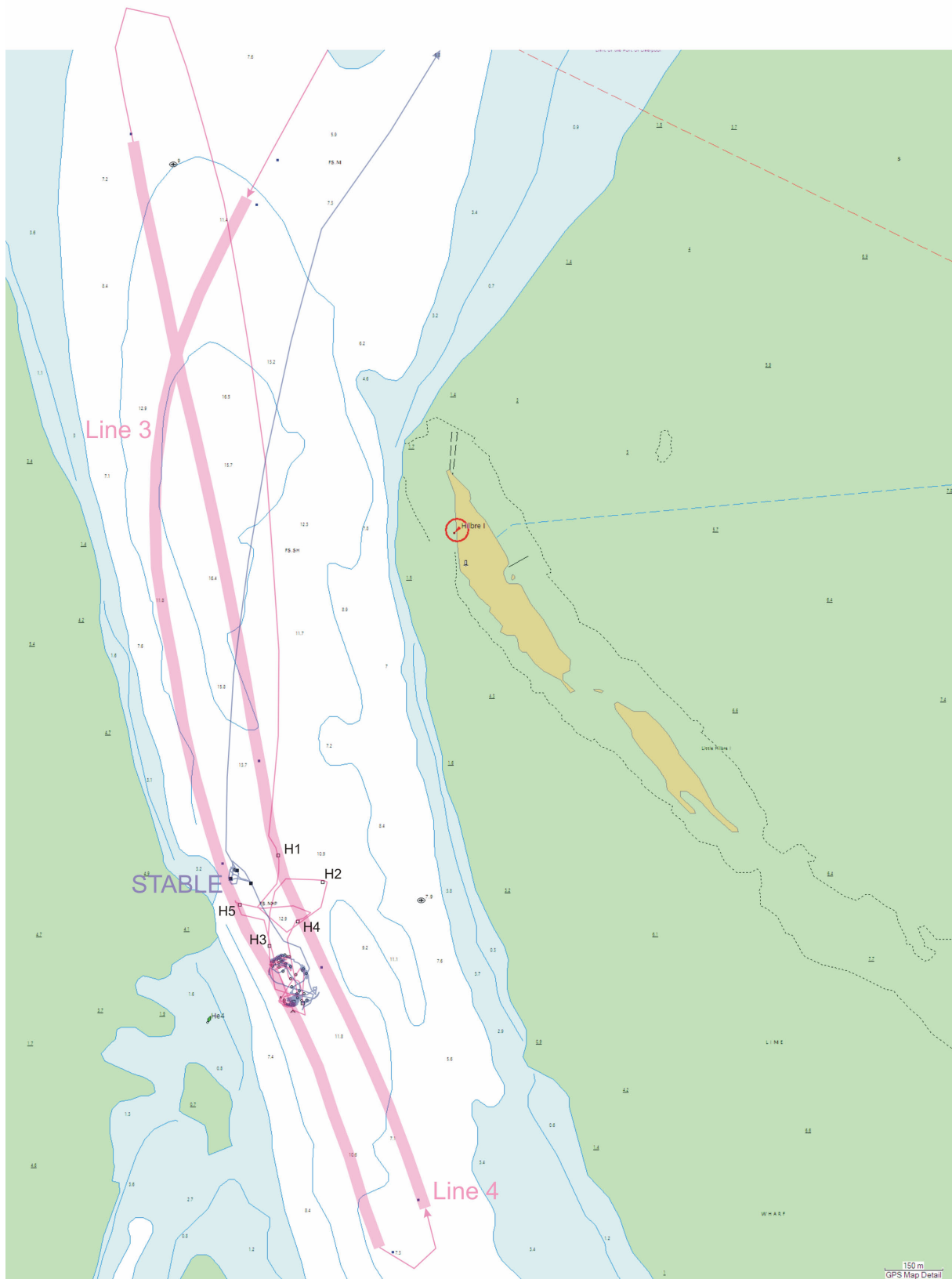
- Microcat SBE37 s/n 4966, stopped logging at 15:59:30 on 10/03/09  
clock drift +1 minute 10 seconds over the deployment

Mini-STABLE frame

- RDI ADCP 1200 kHz s/n 572, stopped logging at 13:22 on 10/03/09  
clock drift +44 seconds over the deployment
- Microcat SBE37 s/n 5595, stopped logging at 16:09 on 10/03/09  
clock drift +1 minute 17 seconds over the deployment
- Transonics ABS transducers: 1 MHz s/n 102; 2 MHz s/n 108; 4 MHz s/n 109
- POL ABS3
- POL SyncGen3
- Sontek ADVs: G250+B353, G258+B233, G412+B331
- Marine Electronics 2D ripple profiler  
started logging at 06:00 on 03/02/09 every 5 minutes, stopped 12:00 on 03/03/09
- LISST 100X s/n 1291
- Sediment settling tube



**Figure 2. Welsh Channel 18-hour station and sidescan sonar survey lines**



**Figure 3. Hilbre Channel 25-hour station and sidescan sonar survey lines**

c) **Hilbre Channel**

All instruments were programmed to start recording at 06:00 on 02/02/09 unless stated otherwise.

Spar buoy

- SeaBird SBE 16*plus* s/n 4736, stopped logging at 15:49 on 10/03/09  
clock drift +4 seconds over the deployment

STABLE

- Microcat SBE37 s/n 5596, stopped logging at 16:03 on 10/03/09  
clock drift +1 minute 13 seconds over the deployment
- RDI ADCP 600 kHz s/n 3644 in fixed mount
- RDI ADCP 1200 kHz s/n 6489 in gimbals mount
- Sontek ADVs: G355+B285, G358+B292, G496+B281
- D&A Instruments OBS3+ sensors: s/n T8193, s/n T8194, s/n T8195
- Paros Digiquartz pressure sensor s/n P98919
- Transonics ABS transducers: 1 MHz s/n 103; 2 MHz s/n 109; 4 MHz s/n 111
- POL ABS1
- POL SyncGen1
- LISST 100X s/n 1199
- AML MC7 CT logger s/n 1102
- AML microCT sensors: s/n 7216, s/n 7217, s/n 7218
- Marine Electronics 3D ripple profiler  
started logging at 06:30 on 02/02/09 every 2 hours, stopped 12:00 on 03/03/09
- Sediment settling tube

**Table 1. Recovered mooring positions and times**

	Latitude (N)	Longitude (W)	Water depth (m)	Recovered Time	Recovered Date
ADCP frame (Coast Obs. Stn12)	53°26.867'	3°30.222'	16.4	09:38	03/03/09
Mini-STABLE (Welsh Channel)	53°22.273'	3°19.568'	7.17	07:48	04/03/09
STABLE (Hilbre Channel)	53°22.529'	3°14.217'	18.6	14:48	05/03/09

**4.2 The setup of the deployed instruments**

No moorings were deployed during this cruise.

**5. CTD**

The Sea-Bird 911 CTD recorded downwelling PAR light levels, temperature, conductivity, transmittance and fluorescence at 24 Hz. The frame was fitted with an altimeter. The CTD temperature data was checked against a Sea-Bird SBE35 precision thermometer. Water samples were taken from a near bed bottle for calibration of the CTD salinity. Water samples were taken from the near surface (1 m) and near bed bottles and filtered to determine suspended sediment load concentration. Copies of the Sea-Bird binary files were taken off for processing and calibration at BODC / POL. A LISST-25 particle sizer was fitted to the CTD and its data logged on the Sea-Bird data logging system. Bottles used: No.3 salinity (bottom), No.4 suspended sediment (bottom), No.9 suspended sediment (surface).

## 6. Surface sampling

The intake for the surface sampling system is located underneath RV Prince Madog, at about 3 m below the sea surface. The WS Oceans Systems logger recorded the following parameters every minute: date, transmittance, hull temperature (°C), barometric pressure (mbar), fluorescence, turbidity, salinity, conductivity, sensor water temperature (°C). Sea surface temperature, salinity and transmittance were calibrated against the CTD by BODC. In addition a pCO<sub>2</sub> sensor is incorporated into the surface sampling system.

The meteorology package measured and recorded barometric pressure (mbar), solar radiation (W m<sup>-2</sup>), PAR (μmol m<sup>-2</sup>), air temperature (°C), relative humidity, relative wind speed (m s<sup>-1</sup>), relative wind direction (°) – zero indicates wind on the bow, minimum air temperature (°C), maximum air temperature (°C), wind gust (m s<sup>-1</sup>).

Underway data, pCO<sub>2</sub> and ship's ADCP data were recorded every minute. The ship is fitted with a 300 kHz ADCP set to record 25 × 2-m bins (with the bin nearest the surface at 5.1 m depth), every 30 seconds with 29 pings per ensemble. The systems were switched on at 07:09 on Tuesday 3rd March 2009 on passing Puffin Island. The ADCP and underway systems were switched off at 16:42 on Thursday 5th March 2009 on passing the Seaforth radar tower.

## 7. Sea bed sediment samples: Day grab and box corer

Five grab samples and two box cores were planned to be taken at each of the mini-STABLE and STABLE sites, as listed in Table 2.

A Day grab was deployed (Figures 4 and 5) at positions W1–5 in Welsh Channel and H1–5 in Hilbre Channel, in an approximate cross-shape.

**Table 2. Grab and box core nominal positions**

	Latitude (N)	Longitude (W)	Water depth (m)
<b>Welsh Channel</b>			
Grab W1	53°22.200'	3°19.699'	11.4
Grab W2	53°22.196'	3°19.806'	12.4
Grab W3	53°22.109'	3°19.685'	14.7
Grab W4	53°22.183'	3°19.500'	10.7
Grab W5	53°22.284'	3°19.643'	6.14
Box core 1	53°22.243'	3°19.570'	
Box core 2	53°22.243'	3°19.570'	
<b>Hilbre Channel</b>			
Grab H1	53°22.474'	3°14.217'	12.1
Grab H2	53°22.571'	3°14.158'	14.1
Grab H3	53°22.497'	3°14.013'	12.0
Grab H4	53°22.453'	3°14.094'	12.4
Grab H5	53°22.495'	3°14.128'	12.8
Box core 3	53°22.525'	3°14.198'	
Box core 4	53°22.525'	3°14.198'	





**Figure 4. Day grab being deployed**



**Figure 5. Grab sample**



**Figure 6. Preparing the box corer insert**



**Figure 7. Box corer being deployed**

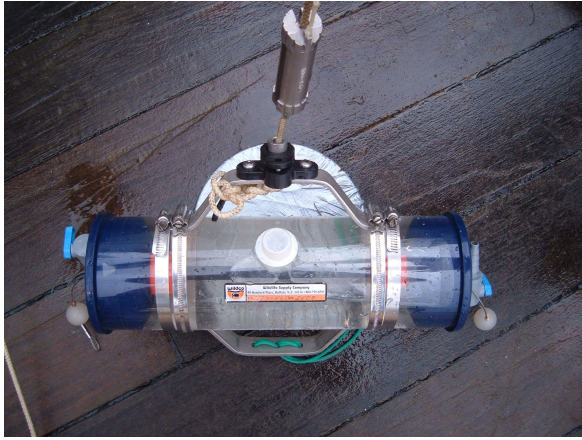
Cores were taken with a box corer into which a removable insert is placed before each deployment (Figures 6 and 7). After recovery, the jaws are carefully opened by rocking the corer on a wooden cradle while ensuring the contents remain within the box insert. The insert is separated by clamping its flanges and raising the corer. Box cores were made while the ship was at anchor, initially unsuccessful because the jaw mechanism caught on the flanges of the box inserts and could not close. After modifications, successful box cores were made.

## **8. Sidescan sonar**

Sidescan sonar surveys were undertaken with a C-MAX CM800 digital towfish system, towed behind the ship at a speed of approximately 4 knots. All data records were stored on optical disk. Two lines were completed in Welsh Channel (records 12 and 13). A further two lines were covered in Hilbre Channel (records 14 and 15).

## **9. INSSEV (IN Situ SETtling Velocity instrument)**

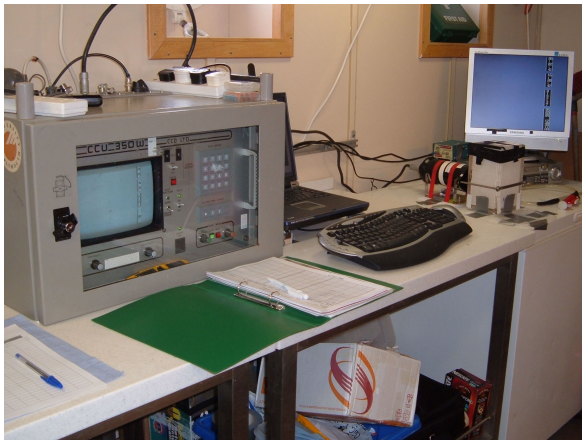
Determining the settling velocity of suspended (flocculated) sediment is in two stages. The first step is to obtain the water sample from near the sea bed or sea surface by using a Wildco Alpha Van Dorn horizontal water bottle, which consists of a 2.2-litre transparent acrylic cylinder with polyurethane end seals attached to latex tubing (Figure 8). The seals are kept



**Figure 8. Van Dorn bottle**



**Figure 9. Sub-sampling with pipette**



**Figure 10. INSSEV recording system**



**Figure 11. Water cell and camera**

open by looping the retaining wires around the trigger mechanism that is released using a messenger dropped down the safety line threaded through it.

During the 18-hour station in Welsh Channel, the Van Dorn bottle was deployed after the CTD profile; the bottle was lowered by the safety line directly over the side of the ship. In the 25-hour station in Hilbre Channel, a pulley suspended from the ship's crane was used, making deployments easier and faster

The second part involves transferring a quantity of the water sample to a video system in the laboratory. A screw-cap in the centre of the tube allows access to the water sample by a pipette: a sub-sample is drawn out, minimising disturbance of the contents (Figure 9). The tip of the pipette is held (without discharging it) just below the water surface in the water cell and the sediment is allowed to fall past the camera (Figures 10 and 11). Images are recorded onto video tapes for later calibration and analysis.

### **Acknowledgements**

The assistance of the Master, officers, and crew is appreciated in ensuring the success of this cruise.

### **Reference**

Cooke, R.D. (2009) River Dee Estuary Experiment 2009 deployment report, v1.0., 27pp.

**Table 4. Station log**

Date	Time Station	Latitude (N)	Longitude (W)	Water depth (m)	Activity	Data type
03/03/09	07:06 <b>Puffin Island</b>				Start: ship ADCP, pCO <sub>2</sub> , Enviro	<i>see (a) below</i>
	09:38 <b>CoastObs Station 12</b>	53°26.867'	3°30.222'	16.4	ADCP frame recovered	D09/D71/H16
	<b>Welsh Channel</b>					
	10:53 Sidescan sonar survey	53°22.059'	3°19.601'	11.41	Line 1 start (10:55, record 12)	G24
	11:07 Sidescan sonar survey	53°22.070'	3°18.941'	12.84	Line 1 end	
	11:09 Sidescan sonar survey	53°22.049'	3°18.983'	13.5	Line 2 start (11:10, record 13)	G24
	11:19 Sidescan sonar survey	53°22.102'	3°20.075'	13.3	Line 2 end	
	11:38 W1	53°22.179'	3°19.667'	12.35	Grab sample	G02
	11:44 W2	53°22.093'	3°19.663'	15.6	Grab sample	G02
	11:52 W3	53°22.179'	3°19.504'	12.15	Grab sample	G02
	11:57 W4	53°22.269'	3°19.586'	7.73	Grab sample	G02
	12:04 W5	53°22.192'	3°19.812'	13.4	Grab sample	G02
	12:31 WC1	53°22.144'	3°19.866'	15.4	CTD cast 001	B02/H10/H16/H17
	13:01 WC2	53°22.146'	3°19.865'	16.1	CTD cast 002; bottles 3, 4, 9	B02/H10/H16/H17
	13:32 WC3	53°22.171'	3°19.851'	16.2	CTD cast 003	B02/H10/H16/H17
	13:46 INSSEV			16.0	Settling velocity (bottom)	D90
	13:57 INSSEV				Settling velocity (surface)	D90
	14:01 WC4	53°22.190'	3°19.870'	15.8	CTD cast 004; bottles 3, 4, 9	B02/H10/H16/H17
	14:15 INSSEV			15.8	Settling velocity (bottom)	D90
	14:20 INSSEV				Settling velocity (surface)	D90
	14:30 WC5	53°22.191'	3°19.910'	15.9	CTD cast 005	B02/H10/H16/H17
	14:47 INSSEV			15.8	Settling velocity (bottom)	D90
	14:57 INSSEV				Settling velocity (surface)	D90
	15:01 WC6	53°22.203'	3°19.927'	15.6	CTD cast 006; bottles 3, 4	B02/H10/H16/H17
	15:10 WC7	53°22.202'	3°19.930'	16.0	CTD cast 007; bottle 9 only	B02/H10/H16/H17
	15:19 INSSEV			15.8	Settling velocity (bottom)	D90
	15:30 INSSEV				Settling velocity (surface)	D90
	15:31 WC8	53°22.200'	3°19.939'	15.7	CTD cast 008	B02/H10/H16/H17
	15:46 INSSEV			15.6	Settling velocity (bottom)	D90
	15:57 INSSEV				Settling velocity (surface)	D90
	16:00 WC9	53°22.192'	3°19.954'	15.3	CTD cast 009; bottles 3, 4, 9	B02/H10/H16/H17
	16:12 INSSEV			14.9	Settling velocity (bottom)	D90
	16:22 INSSEV				Settling velocity (surface)	D90
	16:31 WC10	53°22.189'	3°19.909'	14.8	CTD cast 010	B02/H10/H16/H17
	16:45 Box core	53°22.195'	3°19.981'	14.2	Box corer did not close	
	16:58 Box core	53°22.197'	3°20.003'	13.9	Box corer did not close	
	17:07 WC11	53°22.214'	3°20.016'	13.3	CTD cast 011; bottles 3, 4, 9	B02/H10/H16/H17
	17:19 INSSEV			12.97	Settling velocity (bottom)	D90
	17:32 WC12	53°22.210'	3°20.020'	12.88	CTD cast 012	B02/H10/H16/H17
	17:42 INSSEV			12.24	Settling velocity (bottom)	D90
	17:50 Box core 1	53°22.212'	3°20.020'	12.15	Box core 1 successful	G04
	18:01 WC13	53°22.221'	3°20.008'	12.02	CTD cast 013; bottles 3, 4, 9	B02/H10/H16/H17
	18:30 WC14	53°22.230'	3°19.995'	11.47	CTD cast 014	B02/H10/H16/H17
	18:46 Box core 2	53°22.234'	3°19.982'	11.06	Box core 2 successful	G04
	19:03 WC15	53°22.237'	3°19.953'	10.87	CTD cast 015; bottles 3, 4, 9	B02/H10/H16/H17
	19:34 WC16	53°22.230'	3°19.909'	10.24	CTD cast 016	B02/H10/H16/H17
	20:03 WC17	53°22.220'	3°19.892'	10.24	CTD cast 017; bottles 3, 4, 9	B02/H10/H16/H17
	20:34 WC18	53°22.202'	3°19.827'	10.66	CTD cast 018	B02/H10/H16/H17
	21:02 WC19	53°22.206'	3°19.829'	10.83	CTD cast 019; bottles 3, 4, 9	B02/H10/H16/H17
	21:32 WC20	53°22.212'	3°19.836'	10.54	CTD cast 020	B02/H10/H16/H17
	22:02 WC21	53°22.210'	3°19.832'	10.25	CTD cast 021; bottles 3, 4, 9	B02/H10/H16/H17
	22:11 INSSEV				Settling velocity (bottom) – void	
	22:33 WC22	53°22.176'	3°19.820'	11.53	CTD cast 022	B02/H10/H16/H17
	23:01 WC23	53°22.204'	3°19.828'	10.81	CTD cast 023; bottles 3, 4, 9	B02/H10/H16/H17
	23:09 INSSEV				Settling velocity (bottom) – void	
	23:31 WC24	53°22.192'	3°19.821'	11.75	CTD cast 024	B02/H10/H16/H17
	00:00 WC25	53°22.187'	3°19.819'	12.41	CTD cast 025; bottles 3, 4, 9	B02/H10/H16/H17
04/03/09	00:15 INSSEV			13.8	Settling velocity (bottom)	D90
	00:30 WC26	53°22.176'	3°19.820'	13.1	CTD cast 026	B02/H10/H16/H17
	00:41 INSSEV			14.6	Settling velocity (bottom)	D90
	00:59 WC27	53°22.175'	3°19.820'	14.8	CTD cast 027; bottles 3, 4, 9	B02/H10/H16/H17
	01:15 INSSEV			15.5	Settling velocity (bottom)	D90
	01:31 WC28	53°22.179'	3°19.818'	15.0	CTD cast 028	B02/H10/H16/H17
	01:40 INSSEV			15.3	Settling velocity (bottom)	D90

(continued...2)

**Table 4. Station log (continued...2)**

Date	Time	Station	Latitude (N)	Longitude (W)	Water depth (m)	Activity	Data type
<b>Welsh Channel (contd)</b>							
04/03/09	02:01	WC29	53°22.178'	3°19.820'	15.1	CTD cast 029; bottles 3, 4, 9	B02/H10/H16/H17
	02:12	INSSEV			15.0	Settling velocity (bottom)	D90
	02:31	WC30	53°22.187'	3°19.821'	16.0	CTD cast 030	B02/H10/H16/H17
	02:41	INSSEV			15.7	Settling velocity (bottom)	D90
	03:01	WC31	53°22.186'	3°19.821'	15.8	CTD cast 031; bottles 3, 4, 9	B02/H10/H16/H17
	03:14	INSSEV			16.4	Settling velocity (bottom)	D90
	03:31	WC32	53°22.197'	3°19.829'	15.5	CTD cast 032	B02/H10/H16/H17
	03:43	INSSEV			15.5	Settling velocity (bottom)	D90
	04:01	WC33	53°22.176'	3°19.900'	15.9	CTD cast 033; bottles 3, 4, 9	B02/H10/H16/H17
	04:15	INSSEV			15.9	Settling velocity (bottom)	D90
	04:31	WC34	53°22.182'	3°19.919'	15.9	CTD cast 034	B02/H10/H16/H17
	04:45	INSSEV			14.9	Settling velocity (bottom)	D90
	05:00	WC35	53°22.182'	3°19.921'	14.3	CTD cast 035; bottles 3, 4, 9	B02/H10/H16/H17
	05:16	INSSEV			14.2	Settling velocity (bottom)	D90
	05:31	WC36	53°22.185'	3°19.936'	14.0	CTD cast 036	B02/H10/H16/H17
	05:50	INSSEV			13.9	Settling velocity (bottom)	D90
	06:02	WC37	53°22.186'	3°19.951'	13.6	CTD cast 037; bottles 3, 4, 9	B02/H10/H16/H17
	06:14	INSSEV			13.0	Settling velocity (bottom)	D90
	06:32	WC38	53°22.186'	3°19.954'	13.1	CTD cast 038	B02/H10/H16/H17
	07:03	WC39	53°22.185'	3°19.953'	12.3	CTD cast 039; bottles 3, 4, 9	B02/H10/H16/H17
	07:48	Mini-STABLE site	53°22.273'	3°19.568'	7.17	Mini-STABLE recovered	<i>see (b) below</i>
<b>Hilbre Channel</b>							
	11:06	Sidescan sonar survey	53°23.456'	3°14.170'	14.2	Line 3 start (11:06, record 14)	G24
	11:27	Sidescan sonar survey	53°21.997'	3°13.853'	13.7	Line 3 end	
	11:30	Sidescan sonar survey	53°22.070'	3°13.793'	14.2	Line 4 start (11:30, record 15)	G24
	11:53	Sidescan sonar survey	53°23.555'	3°14.464'	12.55	Line 4 end	
	12:09	H1	53°22.550'	3°14.121'	18.7	Grab sample	G02
	12:16	H2	53°22.513'	3°14.017'	17.9	Grab sample	G02
	12:22	H3	53°22.424'	3°14.141'	17.5	Grab sample	G02
	12:27	H4	53°22.458'	3°14.075'	18.3	Grab sample	G02
	12:32	H5	53°22.481'	3°14.210'	16.7	Grab sample	G02
	13:02	HC1	53°22.353'	3°14.116'	17.0	CTD cast 040; bottles 3, 4, 9	B02/H10/H16/H17
	13:16	Box core 3	53°22.346'	3°14.083'	18.5	Box core successful	G04
	13:30	Box core 4	53°22.342'	3°14.093'	19.0	Box corer not recovered	
	13:33	HC2	53°22.342'	3°14.084'	19.4	CTD cast 041	B02/H10/H16/H17
	13:47	INSSEV			18.8	Settling velocity (bottom)	D90
	14:01	HC3	53°22.342'	3°14.098'	19.6	CTD cast 042; bottles 3, 4, 9	B02/H10/H16/H17
	14:24	INSSEV				Settling velocity (bottom)	D90
	14:31	HC4	53°22.343'	3°14.102'	19.7	CTD cast 043	B02/H10/H16/H17
	14:40	INSSEV				Settling velocity (bottom)	D90
	15:02	HC5	53°22.344'	3°14.104'	19.8	CTD cast 044; bottles 3, 4, 9	B02/H10/H16/H17
	15:18	INSSEV			20.0	Settling velocity (bottom)	D90
	15:31	HC6	53°22.346'	3°14.107'	20.2	CTD cast 045	B02/H10/H16/H17
	15:43	INSSEV			20.4	Settling velocity (bottom)	D90
	16:02	HC7	53°22.349'	3°14.107'	19.8	CTD cast 046; bottles 3, 4, 9	B02/H10/H16/P01
	16:10	INSSEV				Settling velocity (bottom)	D90
	16:31	HC8	53°22.379'	3°14.093'	19.7	CTD cast 047	B02/H10/H16/H17
	16:45	INSSEV			19.9	Settling velocity (bottom)	D90
	17:00	HC9	53°22.395'	3°14.119'	19.6	CTD cast 048; bottles 3, 4, 9	B02/H10/H16/H17
	17:15	INSSEV			20.0	Settling velocity (bottom)	D90
	17:31	HC10	53°22.397'	3°14.105'	19.9	CTD cast 049	B02/H10/H16/H17
	17:50	INSSEV				Settling velocity (bottom)	D90
	18:01	HC11	53°22.400'	3°14.103'	19.6	CTD cast 050; bottles 3, 4, 9	B02/H10/H16/H17
	18:10	INSSEV				Settling velocity (bottom)	D90
	18:31	HC12	53°22.406'	3°14.117'	18.5	CTD cast 051	B02/H10/H16/H17
	18:38	INSSEV				Settling velocity (bottom)	D90
	19:02	HC13	53°22.409'	3°14.095'	18.7	CTD cast 052; bottles 3, 4, 9	B02/H10/H16/H17
	19:11	INSSEV				Settling velocity (bottom)	D90
	19:32	HC14	53°22.409'	3°14.101'	18.1	CTD cast 053	B02/H10/H16/H17
	19:40	INSSEV				Settling velocity (bottom)	D90
	20:02	HC15	53°22.400'	3°14.104'	17.6	CTD cast 054; bottles 3, 4, 9	B02/H10/H16/H17
	20:11	INSSEV				Settling velocity (bottom)	D90
	20:32	HC16	53°22.411'	3°14.115'	16.9	CTD cast 055	B02/H10/H16/H17
	20:37	INSSEV				Settling velocity (bottom)	D90

(continued...3)

**Table 4. Station log (continued...3)**

Date	Time	Station	Latitude (N)	Longitude (W)	Water depth (m)	Activity	Data type
<b>Hilbre Channel (contd)</b>							
04/03/09	21:00	HC17	53°22.401'	3°14.137'	15.4	CTD cast 056; bottles 3, 4, 9	B02/H10/H16/H17
	21:08	INSSEV				Settling velocity (bottom)	D90
	21:32	HC18	53°22.405'	3°14.125'	15.8	CTD cast 057	B02/H10/H16/H17
	21:36	INSSEV				Settling velocity (bottom)	D90
	22:02	HC19	53°22.401'	3°14.120'	15.8	CTD cast 058; bottles 3, 4, 9	B02/H10/H16/H17
	22:09	INSSEV				Settling velocity (bottom)	D90
	22:31	HC20	53°22.400'	3°14.135'	14.9	CTD cast 059	B02/H10/H16/H17
	22:36	INSSEV				Settling velocity (bottom)	D90
	23:01	HC21	53°22.399'	3°14.130'	15.5	CTD cast 060; bottles 3, 4, 9	B02/H10/H16/H17
	23:09	INSSEV				Settling velocity (bottom)	D90
	23:32	HC22	53°22.397'	3°14.137'	15.5	CTD cast 061	B02/H10/H16/H17
	23:36	INSSEV				Settling velocity (bottom)	D90
05/03/09	00:00	HC23	53°22.396'	3°14.135'	16.0	CTD cast 062; bottles 3, 4, 9	B02/H10/H16/H17
	00:17	INSSEV			16.3	Settling velocity (bottom)	D90
	00:30	HC24	53°22.367'	3°14.090'	16.5	CTD cast 063	B02/H10/H16/H17
	00:43	INSSEV			16.5	Settling velocity (bottom)	D90
	01:00	HC25	53°22.358'	3°14.078'	16.5	CTD cast 064; bottles 3, 4, 9	B02/H10/H16/H17
	01:15	INSSEV			16.7	Settling velocity (bottom)	D90
	01:30	HC26			16.9	CTD cast 065	B02/H10/H16/H17
	01:51	INSSEV			17.4	Settling velocity (bottom)	D90
	02:08	HC27	53°22.346'	3°14.090'	19.0	CTD cast 066; bottles 3, 4, 9	B02/H10/H16/H17
	02:17	INSSEV			19.1	Settling velocity (bottom)	D90
	02:32	HC28			19.4	CTD cast 067	B02/H10/H16/H17
	02:42	INSSEV			19.2	Settling velocity (bottom)	D90
	03:01	HC29	53°22.344'	3°14.086'	19.9	CTD cast 068; bottles 3, 4, 9	B02/H10/H16/H17
	03:18	INSSEV			20.1	Settling velocity (bottom)	D90
	03:31	HC30	53°22.344'	3°14.087'	20.1	CTD cast 069	B02/H10/H16/H17
	03:43	INSSEV			20.4	Settling velocity (bottom)	D90
	04:00	HC31	53°22.348'	3°14.080'	20.2	CTD cast 070; bottles 3, 4, 9	B02/H10/H16/H17
	04:15	INSSEV				Settling velocity (bottom)	D90
	04:30	HC32	53°22.352'	3°14.076'	20.1	CTD cast 071	B02/H10/H16/H17
	04:45	INSSEV			20.1	Settling velocity (bottom)	D90
	05:01	HC33	53°22.362'	3°14.072'		CTD cast 072; bottles 3, 4, 9	B02/H10/H16/H17
	05:15	INSSEV			19.9	Settling velocity (bottom)	D90
	05:30	HC34	53°22.389'	3°14.110'	19.2	CTD cast 073	B02/H10/H16/H17
	05:52	INSSEV			19.2	Settling velocity (bottom)	D90
	06:02	HC35	53°22.396'	3°14.093'	20.0	CTD cast 074; bottles 3, 4, 9	B02/H10/H16/H17
	06:11	INSSEV			19.9	Settling velocity (bottom)	D90
	06:32	HC36	53°22.403'	3°14.112'	19.5	CTD cast 075	B02/H10/H16/H17
	06:37	INSSEV			19.5	Settling velocity (bottom)	D90
	07:01	HC37	53°22.404'	3°14.130'	18.3	CTD cast 076; bottles 3, 4, 9	B02/H10/H16/H17
	07:09	INSSEV			17.8	Settling velocity (bottom)	D90
	07:31	HC38	53°22.412'	3°14.115'	18.4	CTD cast 077	B02/H10/H16/H17
	07:36	INSSEV			18.0	Settling velocity (bottom)	D90
	08:02	HC39	53°22.412'	3°14.106'	18.3	CTD cast 078; bottles 3, 4, 9	B02/H10/H16/H17
	08:09	INSSEV			18.2	Settling velocity (bottom)	D90
	08:32	HC40	53°22.411'	3°14.111'	17.5	CTD cast 079	B02/H10/H16/H17
	08:36	INSSEV			16.4	Settling velocity (bottom)	D90
	09:01	HC41	53°22.411'	3°14.116'	16.6	CTD cast 080; bottles 3, 4, 9	B02/H10/H16/H17
	09:08	INSSEV			16.5	Settling velocity (bottom)	D90
	09:32	HC42	53°22.410'	3°14.116'	16.3	CTD cast 081	B02/H10/H16/H17
	09:36	INSSEV			16.1	Settling velocity (bottom)	D90
	10:02	HC43	53°22.403'	3°14.131'	15.1	CTD cast 082; bottles 3, 4, 9	B02/H10/H16/H17
	10:08	INSSEV			14.8	Settling velocity (bottom)	D90
	10:32	HC44	53°22.408'	3°14.120'	15.6	CTD cast 083	B02/H10/H16/H17
	10:36	INSSEV			15.4	Settling velocity (bottom)	D90
	11:01	HC45	53°22.409'	3°14.100'	16.1	CTD cast 084; bottles 3, 4, 9	B02/H10/H16/H17
	11:08	INSSEV			16.4	Settling velocity (bottom)	D90
	11:31	HC46	53°22.391'	3°14.065'	16.3	CTD cast 085	B02/H10/H16/H17
	11:35	INSSEV			16.1	Settling velocity (bottom)	D90
	11:59	HC47	53°22.392'	3°14.063'	16.2	CTD cast 086; bottles 3, 4, 9	B02/H10/H16/H17
	12:20	INSSEV			16.5	Settling velocity (bottom)	D90
	12:32	HC48	53°22.386'	3°14.056'	16.5	CTD cast 087	B02/H10/H16/H17
	12:43	INSSEV			16.1	Settling velocity (bottom)	D90

(continued...4)

**Table 4. Station log (continued...4)**

Date	Time	Station	Latitude (N)	Longitude (W)	Water depth (m)	Activity	Data type
<b>Hilbre Channel (contd)</b>							
05/03/09	13:00	HC49	53°22.358'	3°14.061'	15.2	CTD cast 088; bottles 3, 4, 9	B02/H10/H16/H17
	13:19	INSSEV			16.1	Settling velocity (bottom)	D90
	13:30	HC50	53°22.349'	3°14.055'	17.0	CTD cast 089	B02/H10/H16/H17
	13:47	INSSEV			17.3	Settling velocity (bottom)	D90
	13:59	HC51	53°22.348'	3°14.066'	17.5	CTD cast 090; bottles 3, 4, 9	B02/H10/H16/H17
	14:07	Box core 4	53°22.345'	3°14.064'		Buoy 20 m E of last known posn	
	14:48	STABLE site	53°22.529'	3°14.217'	18.6	STABLE recovered	<i>see (c) below</i>
	16:42	<b>Seaforth, radar tower</b>				Stop: ship ADCP, pCO <sub>2</sub> , Enviro	<i>see (a) below</i>

**NOTES:**

- a) Ship ADCP, pCO<sub>2</sub>, Enviro – B02/D71/H16/H71/M02/M06/M71
- b) Welsh Channel mini-STABLE – B73/D71/H10/H16/G90/P01
- c) Hilbre Channel STABLE – B73/D09/D71/H10/H16/G90/P01
- d) CTD profiles on the hour also include H09/P01
- e) INSSEV, cohesive sediment floc settling velocity – D90
- f) Ripple profiler, scanning of bedforms – G90

**Data type:**

B02	Phytoplankton pigment (e.g., chlorophyll, fluorescence)	H09	Water bottle stations
B73	Sediment traps	H10	CTD stations
D09	Sea level (incl. bottom pressure, inverted echo sounder)	H16	Transparency (e.g., transmissometer)
D71	Current profile (e.g., ADCP)	H17	Optics (e.g., underwater light levels)
D90	Other physical oceanographic measurements	H71	Surface measurements underway (T, S)
G02	Grab	M02	Incident radiation
G04	Core – soft bottom	M06	Routine standard (meteorology) measurements
G24	Long/short range sidescan sonar	M71	Atmospheric chemistry
G90	Other geological/geophysical measurements	P01	Suspended matter

**Glossary**

ABS	acoustic backscatter
ADV	acoustic Doppler velocimeter
ADCP	acoustic Doppler current profiler
BODC	British Oceanographic Data Centre
CTD	conductivity, temperature, depth
INSSEV	in situ settling velocity instrument
LISST	laser in situ scattering transmissometry – particle size analyzer
OBS	optical backscatter
PAR	photosynthetically active radiation
pCO <sub>2</sub>	partial pressure of carbon dioxide
POL	Proudman Oceanographic Laboratory
SOS	School of Ocean Sciences, Bangor University
STABLE	Sediment transport and boundary layer equipment