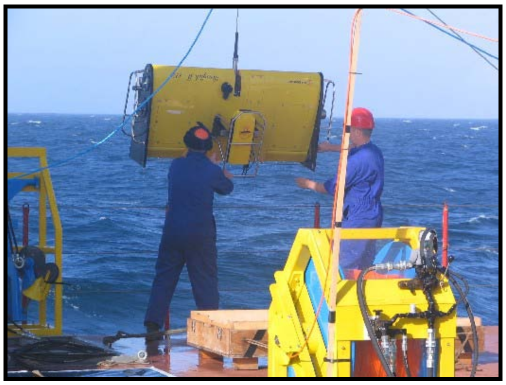
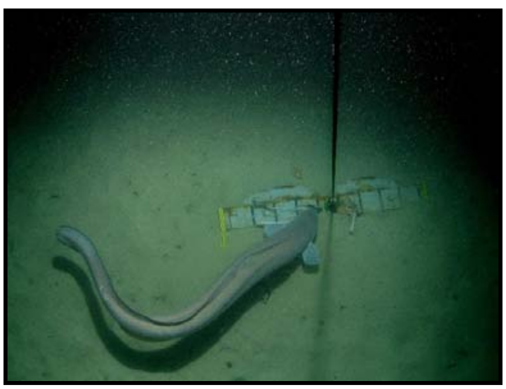
JC025

Cruise Report





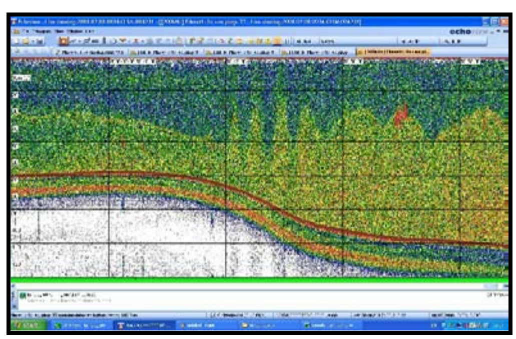
Celtic Sea

2nd July – 27th July 2008

PI: Jonathan Sharples

Proudman Oceanographic Laboratory, UK

Master: Peter Sargeant

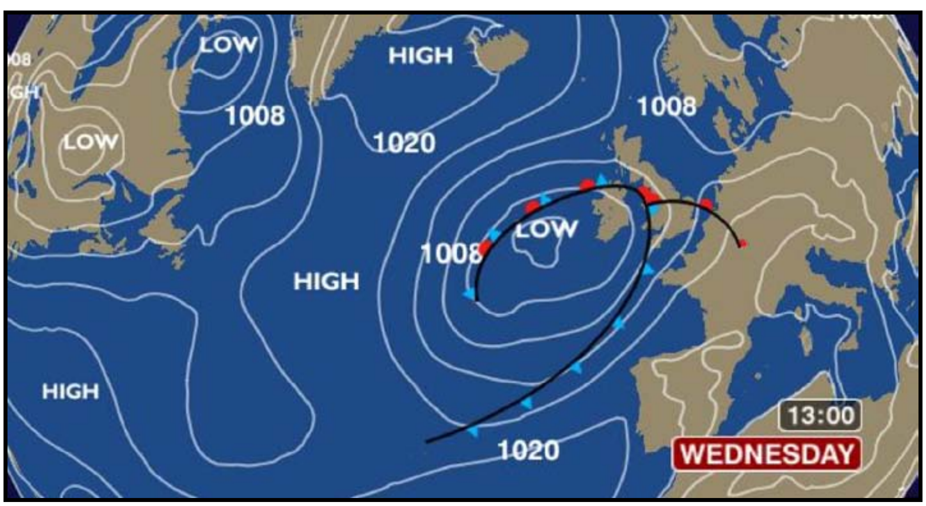


Contents:

Cruise Summary.

The overall cruise objective was to investigate the impacts of a large seabed bank (Jones Bank, Celtic Sea) on the physical, chemical, biological and ecological characteristics of a stratified shelf sea. Previous evidence (cruise CD173, July/August 2005) had indicated the bank to be a site of enhanced sub-surface mixing. This cruise aimed to determine the physical processes driving that mixing, and the consequences for (1) nutrient supply to the thermocline phytoplankton, (2) growth and distribution of the phytoplankton, (3) distributions of zooplankton, (4) sediment biochemistry, (5) fish distributions and behaviour, and (6) seabird and marine mammal distributions and behaviour. The vessel sailed from Southampton at 1800 on 2/7/08, and spent most of 3/7/08 conducting EK60 calibrations near Portland. Once out at Jones Bank moorings were deployed (hampered by some unseasonably rough weather), followed by a series of station occupations (turbulence, biochemistry), dye release experiments, Scanfish surveys, and seabed grabs and cores. Observations for fish (EK60) and seabirds/mammals (visual) were made throughout the cruise. Towards the end of the cruise 2 Newquay fishing vessels carried out some fishing for us. Moorings were recovered around July 22/24, followed by 3 CTD stations across the shelf edge to the south of Jones Bank. The vessel docked in Falmouth on 27/7/08.

The cruise was funded through Oceans2025 core funding to the Proudman Oceanographic Laboratory and the Scottish Association for Marine Science, along with support from a NERC-Defra Sustainable Marine Bioresources Targetted Project (NE/F001983/1 to Aberdeen University, NE/F002017/1 to the Proudman Oceanographic Laboratory). Our thanks to the crew of the RRS James Cook, and to the tireless technical support provided by the National Marine Facilities.



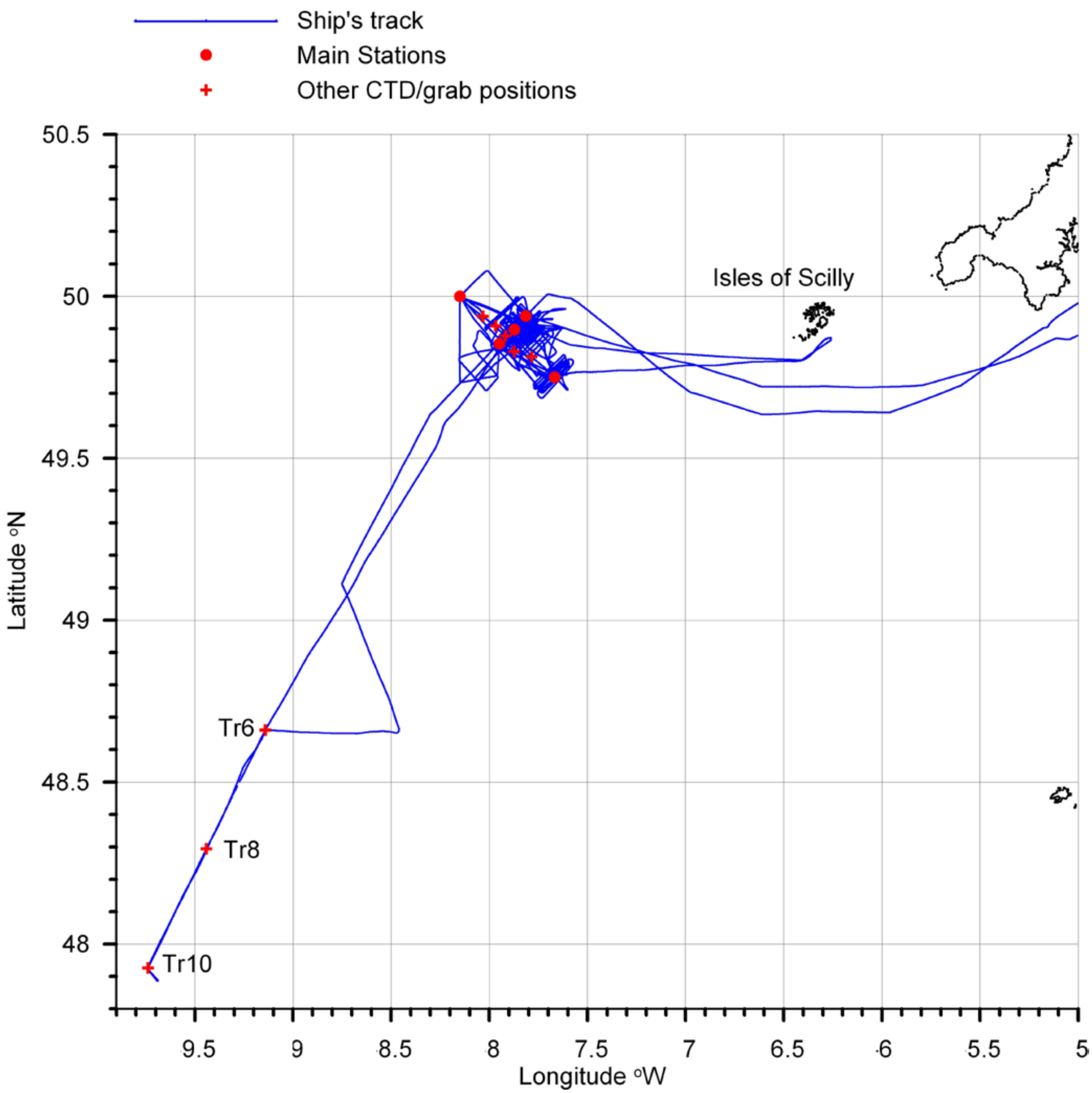
A typical weather map for the first half of the cruise.

Cruise Participants.

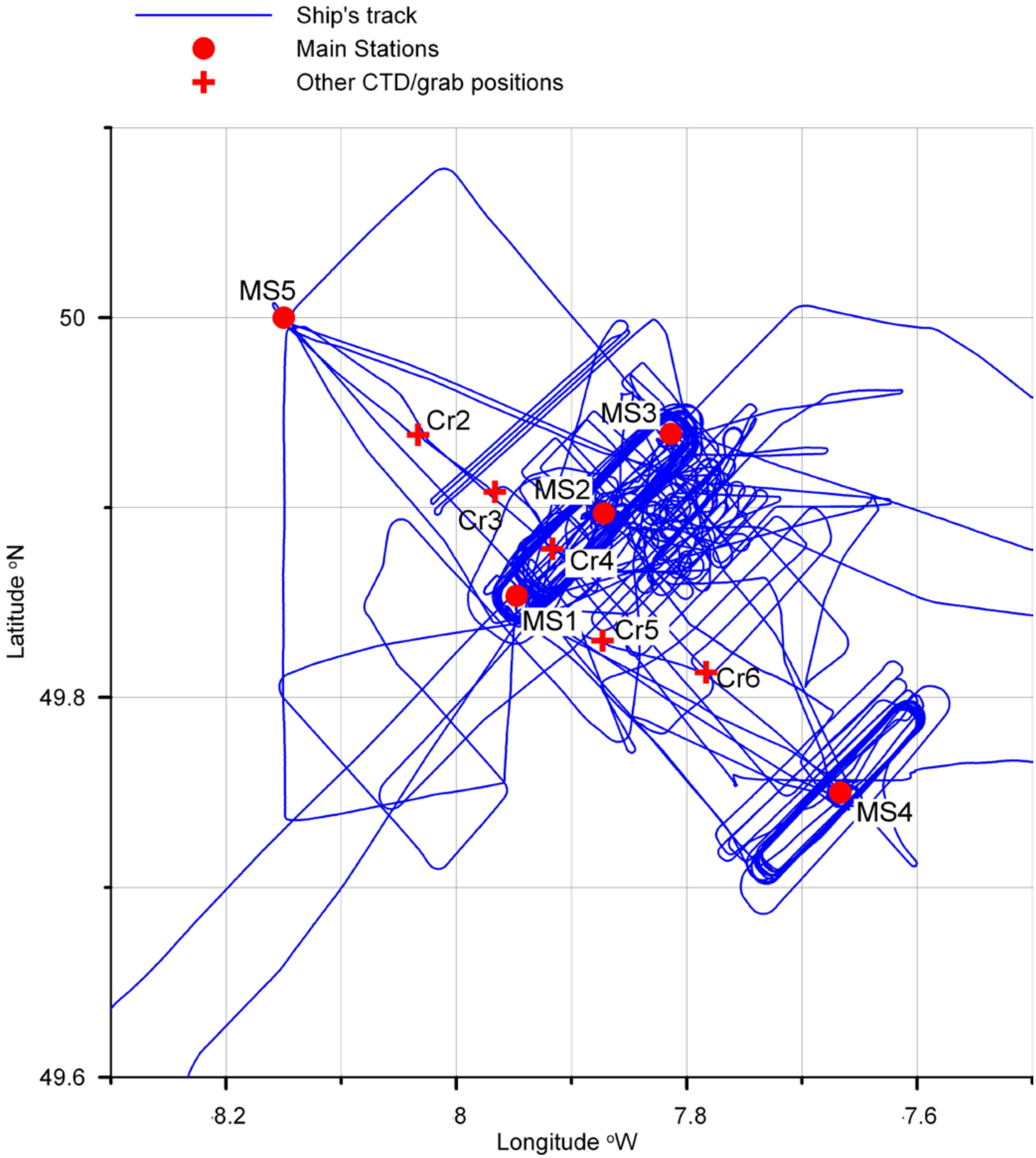
Name	Affiliation
Jonathan Sharples (PI)	Proudman Oceanographic Laboratory
Mark Inall (co-PI)	SAMS
Beth Scott (co-PI)	University of Aberdeen
Chris Balfour	Proudman Oceanographic Laboratory
Adam Batty	JNCC
John Beaton	SAMS
Jeff Benson	National Marine Facilities
Debra Brennan	SAMS
Keith Davidson	SAMS
Clare Davis	University of Liverpool
Claire Embling	University of Aberdeen
Linda Gilpin	Napier University
Dave Green	SAMS
Angela Hatton	SAMS
Eleanor Howlett	Proudman Oceanographic Laboratory
Colin Hutton	National Marine Facilities
Emlyn Jones	Proudman Oceanographic Laboratory
Gareth Knight	National Marine Facilities
Morten Larsen	SAMS
Mark Lewis	JNCC
Inigo Martinez	Marine Laboratory, Aberdeen
Susan McKinlay	SAMS
Sharon McNeill	SAMS
Clare Neil	University of Strathclyde
Nick Owen	Trinity College Dublin
Matthew Palmer	Proudman Oceanographic Laboratory
Romain Pete	SAMS/University Montparse
Jason Scott	National Marine Facilities
Mike Smithson	Proudman Oceanographic Laboratory
Dave Teare	National Marine Facilities
Andy Webb	JNCC

Cruise Maps.

(i) Full cruise track.



(ii) Detailed cruise track over Jones Bank.



Main Positions.

Name	Latitude N	Longitude W	Station type
MS1	49° 51.21’	07° 56.87’	T and ADCP mooring, PP, CTD, cores, grab, camera, bongo
MS2	49° 53.82’	07° 52.58’	T and ADCP mooring, VMP, PP, CTD, cores, grab, camera, bongo
MS3	49° 56.33’	07° 48.83’	T and ADCP mooring, PP, CTD, cores, grab, camera, bongo
MS4	49° 45.00’	07° 40.00’	ADCP mooring, VMP, PP, CTD, cores, grab, camera, bongo
MS5	50° 00.00’	08° 09.00’	PP, CTD, cores, grab, camera, bongo
CR2	49° 56.30’	08° 02.00’	CTD and grab
CR3	49° 54.50’	07° 58.00’	grab
CR4	49° 52.70’	07° 55.00’	CTD and grab
CR5	49° 49.80’	07° 52.40’	grab
CR6	49° 48.80’	07° 47.00’	CTD and grab
TR6	48° 39.65’	09° 08.48’	CTD, grab, bongo
TR8	48° 17.64’	09° 26.43’	CTD, grab, bongo
TR10	47° 55.54’	09° 44.29’	CTD, bongo, SAPS

Key:

T	Temperature loggers
ADCP	Acoustic Doppler Current Profiler
VMP	Free-fall shear microstructure profiler, with T-Chl (temperature-chlorophyll logger) chain
PP	Primary production, nitrate uptake, bacterial production, DMS
CTD	Conductivity-Temperature-Depth sensor package
Cores	Mega-corer
Grab	Day grab
Camera	Seabed camera (typical deployment time 12 – 24 hours)
Bongo	Zooplankton vertical hauls
SAPS	Stand-alone pump (always used with PP)

Cruise narrative (Jonathan Sharples).

Date	Time (BST)	
Wednesday 2nd July	1830	Vessel leaves NOC and begins slow steam to Portland.
		Weather: calm.
Thursday 3rd July	0500	EK60 calibration begins.
	0800	Move vessel into shallower water to try to reduce tidal current effects on the calibration target.
	1300	Science briefing meeting.
	2000	EK60 calibration completed.
	2100	Boat transfer to take Sophie Fielding off and get Andy Webb and Eleanor Howlett aboard. Start steam to Jones Bank.
		Weather: westerly 10 m s^{-1}, partial cloud, slight sea within lee of Portland harbour.
Friday 4th July	2030	CTD JC025_001 on MS3 at 2030.
	2130	Mooring operations begin at MS3.
		Weather: am southeasterly 10 m s^{-1}, full cloud, slight swell. pm increases to SE'ly force 6/7, moderate sea.
Saturday 5th July	0030	Mooring complete: 49º 56.3' N, 7º 48.9 W.
	0400	MS2 mooring complete: 49º 53.84' N, 7º 52.48 W.
		Mooring operations stopped after deployment of MS2 due to weather. Ship heaves to on DP by MS2.
	1245	Begin to move to MS1. Swell slackened slightly, winds 30 knots.
	1400	Mooring deployment begins at MS1. Guard buoy first. ADCP lander second. Temperature line 3rd.
	1710	MS1 complete: 49º 51.21' N, 7º 56.82 W
		Steam to MS4.
	1930	MS4 complete: 49º 44.98' N, 7º 40.05 W
		Overnight: Carry out tests of sonar buoys and of EK60 with drop keel down.
		Weather: SW'ly force 9 – 10, gusting to >50 knots, full cloud,

		very rough sea.
Sunday 6th July	0430	Pre-dawn CTD cast JC025_002 on MS2.
		SAPS following CTD.
		Bongo plankton nets deployed.
	0930	Grab sampling and 3 megacorer deployments begin.
	1150	Final megacorer onboard.
	1240	CTD JC025_CTD003.
	1430	CTD JC025_CTD004. CTD stopped communicating during upcast – 6 useful samples for nutrients taken.
	1445	T-Chl chain deployed over starboard side.
	1515	VMP deployment begins. EK60 on and drop keel down, vessel ADCPs off.
	1545	First VMP profile.
	1630	First good VMP profile.
	2045	VMP recovered to do CTD cast.
	2145	CTD JC025_CTD005 finished. Delayed due to CTD pc rebooting itself. Also, CTD deployment system is good, robust, but agonisingly slow. Not great for a tidal environment!
	2200	VMP redeployed.
		Weather: W'ly 25 – 30 knots. Rough sea. Some sunshine.
Monday 7th July		Weather conditions marginal for VMP – heavy swell and resultant heaving of the aft deck. VMP cable sometimes loops and catches around profiler.
		VMP brought aboard.
	0400	Pre-dawn CTD JC025_CTD006
	0555	VMP redeployed.
	0700	VMP cable break. VMP recovered. Requires 200m cable removed and then re-terminated.
		Vessel remains in position 0.4 miles from mooring, T-Chl chain still deployed.
	0930	JC025_CTD007
	1030	VMP redeployed.
	1130	VMP producing noisy data. Recovered to re-terminate.
	1300	JC025_CTD008

	1400	VMP redeployed.
	1530	VMP cable snagged again, data noisy, possibly a shear probe needs replacing. Decision made to stop VMP work.
	1600	Recover T-Chl chain.
	1700	JC025_CTD009
	1745	2 bongo net hauls.
	1830	Begin test deployment and recovery of seabed camera system.
	1930	Begin deployment of seabed camera at MS2.
	2100	MVP deployed and pre-survey tests begin.
		Weather: am WNW'ly 15 – 18 knots, moderate swell, patchy sunshine; pm WNW'ly 20 – 25 knots (up to 30 knots in squalls), full cloud, moderate sea and swell.
Tuesday 8th July	0100	MS1, beginning of first complete MVP circuit.
		NB: some circuits only sampled on 1 leg due to weather/tide pushing MVP cable under counter.
		MVP continues all day, approx. 2 hours per circuit.
		Guard buoy at MS3 missing, but main mooring still there.
		Seabed camera buoys visible at MS2.
		Weather: am SW'ly 15 – 20 knots, moderate swell, mainly sunny; pm SW'ly 15 knots, slight sea and swell, cloudy.
Wednesday 9th July	0200	End MVP survey and recover MVP at MS1.
	0430	JC025_CTD010 pre-dawn cast.
		SAPS
		Bongo nets
		Grab
		Megacores attempted, but failed due to sandy seabed.
		Day grabs taken instead.
		JC025_CTD011 to collect bottom water.
	1300	Recovered seabed camera.
	1500	Deploy and test Scanfish. Very successful.
	1830	Recovered Scanfish.
	2000	Dye injected into thermocline.
		Deploy Scanfish.

		1st dye patch survey with Scanfish started. Begin bathymetry survey overnight. Weather am: SSW'ly 30 knots, moderate swell, rough sea, rain; pm wind decreasing, SSW'ly 20 knots (1300 BST).
Thursday 10th July	0300	Scanfish snagged on something. Scanfish recovered and will require retermination.
	1100	Seabed camera deployed at MS1
	1240	T-Chl chain deployed, EK60 drop keel raised and ADCP drop keel lowered; ADCPs switched on. Problem with T-Chl wire going under vessel – decide to deploy using spare cable over stern.
	1400	T-Chl chain deployed over stern, begin 3.5 knot tow to MS3 (arr. 1630) and back to MS1, then through: 49º 42.6' N, 7º 44.0 W to: 49º 47.6' N, 7º 35.8 W to: MS4 Weather: SSW'ly 15 – 20 knots, sunny, slight/moderate swell, moderate sea.
Friday 11th July	0330	Recovered T-Chl chain.
	0430	Pre-dawn CTD JC025_CTD012 at MS4. Bongo nets SAPS Grab Megacorer
	1130	CTD JC025_CTD013
	1200	Begin steam to MS1.
	1400	Recover seabed camera.
	1530	Deploy Scanfish and begin search for dye.
	2300	Recover Scanfish. Weather: NW'ly 10 – 15 knots, increasing 15 – 18 knots by midday. Moderate sea, slight swell. Mainly sunny.
Saturday 12th July	0200	CTD JC025_CTD014

		Deploy seabed camera MS4
		Deploy T-Chl chain
	0315	First VMP profile at MS4
	0830	VMP recovered for CTD profile.
	0900	CTD JC025_CTD015
	0930	CTD complete. VMP redeployed.
	1400	VMP held at surface for CTD JC025_CTD016.
	2200	CTD JC025_CTD017
		Weather: am NW'ly 5 – 10 knots, slight swell, cloudy;
Sunday 13th July	0415	VMP recovered
		T-Chl chain recovered
	0500	CTD JC025_CTD018 (delayed due to winch problem)
		Bongo nets
		Recover seabed camera
	0730	Scanfish deployed
	0750	Scanfish towing between:
		49º 47.6' N, 7º 36.2 W
		49º 42.6' N, 7º 44.0 W
		Tow circuit shortened slightly, by approx. 0.75 miles at each end, around 0900 to maintain 2 hr 5 min period.
	2100	Begin to survey across Jones Bank through:
		50º 00.0' N, 8º 09.0 W
		50º 04.8' N, 8º 00.8 W
		49º 47.6' N, 7º 36.2 W
		Weather: very light winds, calm sea.
Monday 14th July	0400	Recover Scanfish at:
		49º 49.91' N, 7º 39.65 W
		Begin search for drogued drifter.
	0620	Drifter recovered.
	0800	Arrive MS1 and deploy seabed camera.
	0900	Arrive MS2 and begin bongo net hauls.
		Meagacores.
	1145	CTD JC025_CTD019

	1230	T-Chl chain deployed.
	1300	VMP profiling begins at MS2.
	1900	JC025_CTD020
		Weather: light winds, calm sea, hazy/cloudy; pm wind W'ly 5 – 10 knots, light cloud, poor visibility.
Tuesday 15th July	0230	VMP communications problems. VMP brought inboard, decision made to end station as we have a full tidal cycle.
	0400	Pre-dawn CTD cast JC025_CTD021
	0600	Recover T-Chl chain
	0645	Recover seabed camera
		Steam to MB1 to begin swath bathymetry survey.
	0900	Survey begins at MB1, first line to SW towards MB4
	1030	Muster drill
	1325	End of swath line, turn to head for MS3.
	1415	Seabed camera deployed MS3
	1600	Scanfish circuit begins at MS3.
		Weather: calm, full cloud, occasional squall with winds > 15 knots.
Wednesday 16th July		Scanfish circuit around moorings continues.
	1700	Scanfish survey completed.
	1830	Seabed camera recovered.
	1900	Grab and coring operations begin.
		CTDJC025_022
		Bongo haul
		Weather: NW'ly 10 knots, calm sea, moderate swell, sunny with patchy high cloud.
Thursday 17th July	0200	Dye released into thermocline.
	0300	Seabed camera deployed at MS3
	0400	JC025_CTD023 (pre-dawn) + SAPS MS3
	0800	Scanfish deployed to begin 1st dye patch survey.
	1215	1st survey completed.
		Steam to MS3.

	1345	JC025_CTD024 (Scanfish calibration CTD)
		Scanfish vertical haul (cal.dat)
	1435	JC025_CTD025 (Scanfish calibration CTD)
	1545	Recover seabed camera from MS3
		Scanfish deployed – begin 2nd dye survey
	2300	End dye survey, Scanfish recovered.
		Weather: am W'ly 15 knots, slight swell, slight-moderate sea, mainly high cloud; pm W'ly 5 – 10 knots.
Friday 18th July		Run echo sounder lines through:
		49º 47.2' N, 7º 53.0 W
		49º 53.5' N, 8º 02.4 W
		49º 50.5' N, 8º 05.0 W
		49º 45.3' N, 7º 57.5 W
		49º 42.8' N, 8º 01.4 W
		49º 48.0' N, 8º 09.0 W
	0800	Begin 3rd dye patch survey.
	1300	3rd dye survey ends, steam to MS5 (50º 00.0' N, 8º 09.0 W)
	1500	Arrive MS5.
		Deploy seabed camera.
	1540	JC025_CTD026
	1600	Begin steam back to dye patch area.
	1845	Scanfish profiling at start of 4th dye survey.
		Weather: W'ly 15 – 20 knots, moderate sea, moderate swell, cloudy.
Saturday 19th July	0030	Dye survey ends, Scanfish recovered.
		Steam to MS5
	0430	JC025_CTD027 pre-dawn
		Bongo haul
		Grab
		Megacores
	1000	JC025_CTD028
		Seabed camera recovered.
	1235	JC025_CTD029 and grab at: 49º 56.3' N, 8º 02.0' W

	1445	Grab at: 49º 54.5’ N, 7º 58.0’ W
	1615	Grab and JC025_CTD030 at: 49º 52.7’ N, 7º 55.0’ W
	1730	Seabed camera deployed MS1
		Grab at: 49º 49.8’ N, 7º 52.4 W
		Grab and JC025_CTD031 at: 49º 48.8’ N, 7º 47.0 W
	2100	JC025_CTD32 at MS4
		Begin series of closely-spaced circuits near MS4, using EK60 and echo sounder.
		Weather: am NW’ly 20-23 knots, moderate swell, rough sea, sunny with patchy cloud; pm NW’ly 15 – 20 knots, moderate swell, rough sea, mainly sunny.
Sunday 20th July	0500	Scanfish deployed. Begin repeated circuit at MS4.
	2030	Turn off circuit and head over bank through 49º 52.7’ N, 7º 55.0’ W towards MS5.
	2300	Scanfish recovered.
		Weather: am N’ly 13 knots, moderate sea and swell, sunny.
Monday 21st July	0430	MS1 JC025_CTD033 pre-dawn
		Bongo hauls
		Recovered seabed camera.
	0745	MS2 JC025_CTD034 sampled for nutrients.
	0820	T-Chl chain deployed.
	0900	First profile with VMP for MS2 25 hour station.
	1400	JC025_CTD035
	2100	JC025_CTD036
		Weather: am NNW’ly 10 – 12 knots, slight sea and swell, sunny; pm NW’ly <5 knots increasing to 10 knots, calm, slight swell, sunny.
Tuesday 22nd July	0000	VMP recovered for re-termination.
	0100	MSS profiler deployed (drops not all the way to the seabed)
	0500	VMP re-deployed.
	1030	VMP station finished.
	1040	Recover T-Chl chain

	1100	JC025_CTD037
	1130	Trawler *Crystal Sea* informs us that a French trawler, while closely cutting in front of him, has managed to pick up the seabed ADCP at MS3.
		French trawler gets impatient! Dumps ADCP back into sea.
		Crystal Sea provides position.
		Over ADCP position.
		ADCP released and retrieved on board.
	1345	Steam for MS4.
	1430	Crewman on *Crystal Sea* chopped off end of his finger. We turn round to make for *Crystal Sea* in case he requires medical assistance.
	1530	Helicopter arrives to pick up crewman.
		Head for MS4.
	1650	Seabed camera deployed
	1705	JC025_CTD038, T-chl chain deployed.
	1810	First VMP profile.
		Weather: am calm, wind 0 – 5 knots, cloudy; pm glass calm.
Wednesday 23rd July	0400	JC025_CTD039 pre-dawn
	0700	VMP station finished.
	0715	JC025_040 plus T-Chl chain recovered.
	0830	Seabed camera recovered.
	0915	MS4 ADCP recovered.
	1130	MS3 T-logger mooring recovered.
	1315	Initial attempts to contact/fire ADCP release are ambiguous – nothing sighted on surface. Decide to pick up T logger mooring first.
	1430	T logger mooring aboard.
		Communication with ADCP mooring patchy. Several attempts from different positions made.
	1550	Decide to leave MS2 and head for MS1 while we still have light to collect all of the moorings there.
	1600	We hear that Crystal Sea requires assistance – they have something wrapped around their propeller and cannot move.

		We expect to have to tow them at least part of the way back to Cornwall.
	1800	Tow lines passed over to the *Crystal Sea*.
		Weather: ESE'ly 15 knots, moderate swell, moderate sea, sunny.
Thursday 24th July	0900	Meet St. Mary's lifeboat off Isles of Scilly.
		Tow transferred.
	1000	Begin steam back to Jones Bank.
	1550	Arrive MS2. EK60 drop keel lowered.
	1610	ADCP lander released and on surface.
	1630	ADCP lander on board.
		Steam to MS1.
	1730	Arrive MS1.
	1800	Guard buoy recovered.
	1840	ADCP recovered.
	1930	T logger mooring recovered.
		Begin steam to Tr6.
		Weather ESE 10 knots, slight sea and swell, generally cloudy.
Friday 25th July	0700	JC025_CTD041 at Tr6 (48º 39.65' N, 9º 08.48 W)
		Bongo hauls
	0845	Grab
	0910	Begin steam to Tr8 (48º 17.64' N, 9º 26.43 W)
	1245	JC025_CTD042 at Tr8
		Bongo hauls
	1445	Grab sample (slightly off position to avoid a cable)
	1500	Steam for Tr10 (47º 55.54' N, 9º 44.29 W).
	1815	JC025_CTD043 at Tr10 (to 1500 metres)
		Bongo hauls.
	2200	SAPS complete.
	2315	Scanfish deployed and undulating 5 – 120 metres.
		Weather: am W'ly 10 knots, calm, slight swell, mainly cloudy; pm W'ly <10 knots, calm, slight swell, sunny.

Saturday 26th July	0745	Navigation error spotted. Tr2 had been input incorrectly on the bridge, so that after Tr6 we turned eastward. Turned NW to regain the line.
	1600	Steaming over SW slope of bank, clear internal waves in EK60, slicks on sea surface, also slicks visible in ship's radar.
	1840	Begin Scanfish recovery. Steam for Falmouth. Weather: little wind, very calm, sunny with high cloud.

CTD Data (Jonathan Sharples and Dave Teare)**.**

A Seabird Electronics 911 CTD, attached to a rosette of 20 litre Niskin bottles was used throughout the cruise. The package had instruments for chlorophyll fluorescence, beam attenuation, dissolved oxygen and PAR, along with LADCP. Only the chlorophyll fluorescence and PAR were assessed for our work. The primary C-T sensors were place out on the fin attached to the CTD frame in an attempt to improve temperature and salinity data quality. Details on instrument serial numbers and manufacturers' calibrations are held by National Marine Facilities Sea Systems, and have been logged by NMF-SS with BODC.

Processed data logged with BODC

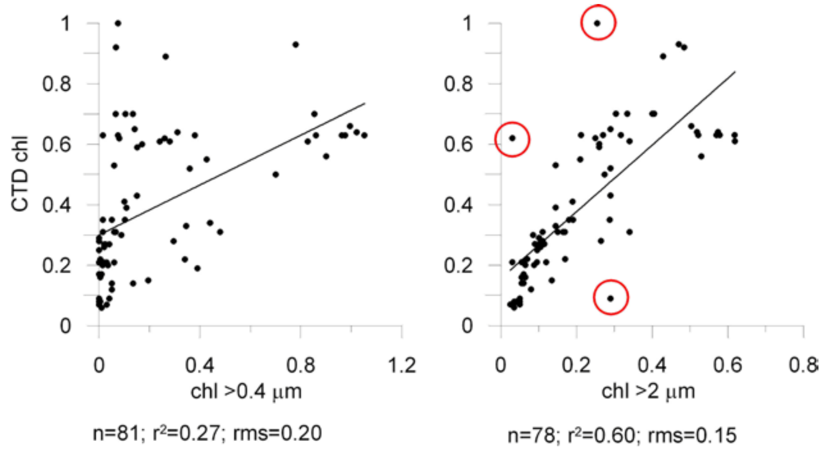
Raw CTD data was acquired at 24Hz. Data was processed to 2 Hz by National Marine Facilities according the NMF and BODC SOLAS protocols. Both raw and processed CTD data is lodged at BODC, as are details on the Seabird routines used to process the data.

Salinity calibration

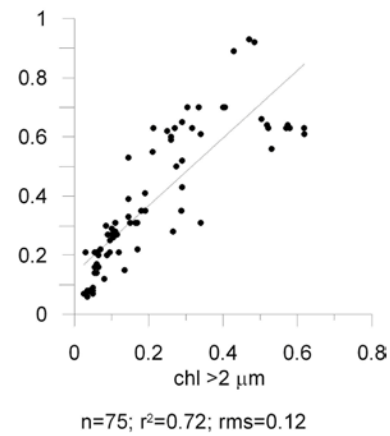
Water samples for salinity analyses were collected from most CTD casts. A total of 47 samples were analysed by NMF using a laboratory Autosal against standard seawater. Both primary and secondary salinity measurements made by the CTD were found to have an average offset of 0.0004 $\pm$0.0010 (PSS78) (i.e. Autosal salinity = CTD salinity + 0.0004). This calibration has not been applied to the processed CTD data sent to BODC.

Chlorophyll calibration

Samples were collected for chlorophyll analyses. Standard filtering through gff filters provided chlorophyll concentrations with a low size limit of about 0.4 μm. Size-fractionated filtering through polycarbonate filters of 20 and 2 μm was also carried out. The scatter plot below illustrates the quality of the fits to both the gff samples and to the sum of the 20 and 2 μm samples. The regression against the 20 and 2 μm samples is far better. Extraction of chlorophyll from gff filters is often incomplete, while extraction is more efficient from the polycarbonate filters. At the low chlorophyll concentrations experienced during the cruise it may be that the gff filter extractions were too noisy to provide sufficient good data for the calibration.



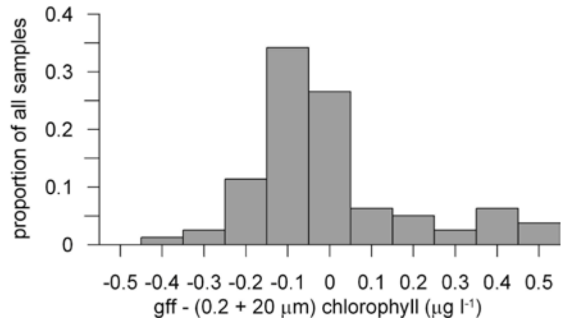
Without the circled outliers, the regression on the 20 plus 2 µm samples is:



Using this regression the equation to calibrate the CTD chlorophyll to the concentrations seen during the cruise is:

$$CHL_{cal} = 0.88 \times CHL_{CTD} - 0.12 \quad \mu g\ l^{-1}$$

The rms error of the regression is 0.12 µg l^{-1}. Use of this calibration ignores chlorophyll in cells < 2 µm. Errors in the gff analysis are unlikely to be systematic, but assessment of the differences between gff and the 2 + 20 µm sample analyses can provide some bounds on the potential impacts of poor gff results. The histogram below illustrates the spread of the magnitudes of the discrepancies between the two approaches to chlorophyll determination.



The significant tail towards positive discrepancies (gff samples higher than the 2 + 20 μm samples) is consistent with the gff analysis expected to yield more chlorophyll by catching the < 2 μm cells. The histogram provides an estimate of an upper bound on the “missed” chlorophyll: 0.5 μg l^{-1}.

Note that CHL_{CTD} is the chlorophyll concentration reported in the raw and processed CTD data supplied to BODC.

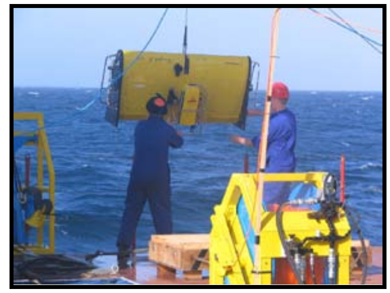
Only chlorophyll samples collected in the vicinity of Jones Bank (i.e. the majority of the cruise) have been used for the calibration. Previous experience has shown often markedly different fluorescence characteristics at the shelf edge compared to the rest of the Celtic Sea. The calibration is therefore valid for CTDs 001 to 040. CTDS 041 to 043 were at the shelf edge and should be treated as uncalibrated.

Data problems

Considerable problems were experienced with the quality of data from the CTD. The winch heave-compensation mechanism did not operate at <100m wire out. Combined with the size of the CTD package and the heavy weather experienced through much of the cruise, this had a detrimental impact on the progression of the CTD sensors downward through undisturbed water. It was clear from the raw data that heaving of the CTD as it passed through the thermocline was causing previously-sampled water to reappear at the C-T sensors. The CTD data is not suitable for detailed physical analyses (e.g. overturn scales); it is adequate from a broad representation of water column characteristics only.

Scanfish Data (Jonathan Sharples and Dave Teare)**.**

Apart from a few hours during NMF sea trials, this was the first use of the NMF Scanfish. The vehicle performed exceptionally well, with smooth dive-return profiles and a handy ability to avoid sudden changes in bathymetry.



The Scanfish cable needed to be re-terminated once following a collision with, we assume, some fishing gear. For all tows the vehicle was fitted with a Chelsea Instruments Aquatracka fluorometer configured for rhodamine, with a small Turner Designs chlorophyll fluorometer attached to the outside of the vehicle. Calibration of the chlorophyll fluorometer (see below) refers to the Turner Designs instrument, providing “voltage 4” in the processed Seabird files.

Scanfish sensor information (Jef Benson, NMF):

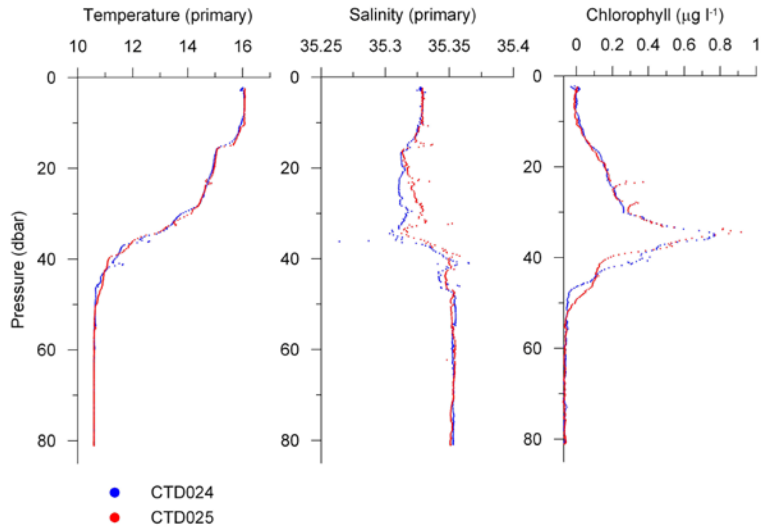
SENSOR / SYSTEM TYPE	SERIAL No	Service / Cal	Cruise Notes
Seabird 9+ underwater unit	09P-24680-0636	Service 13 May 2010	9600 baud uplink
Seabird 3P temperature sensor	03P-4105	Cal 4 September 2008	
Seabird 4C conductivity sensor	04C-3052	Cal 4 September 2008	
Digiquartz pressure sensor	83008	Cal 13 May 2008	Fitted in 0636 (pre-cruise calibration check at NOC)
Simrad Mesotech Altimeter	0105119		
Chelsea Aquatracka Mk3 Fluorometer	88-2615-126	Cal 2 January 2009	(Swapped for rhodamine Aquatracka)
Chelsea Aquatracka Mk3 Rhodamine Fluorometer	06-5706-001	Cal 16 October 2008	SAMS supplied
Turner SCUFA Cyclops-7 Fluorometer	2100432		
Seabird 5T pump	5T-4513	Service 2 October 2011	
Sea-Bird 11plus Deck unit	11P-24680-0588		9600 baud uplink
Seabird 43 DO sensor	43-0862	Cal 2 October 2010	
Focal Optical Plankton Counter			

Processed data logged with BODC

Raw and processed data have been logged at BODC. Processing was carried out by NMF to BODC SOLAS requirements. The oxygen advance was determined to be 3 seconds.

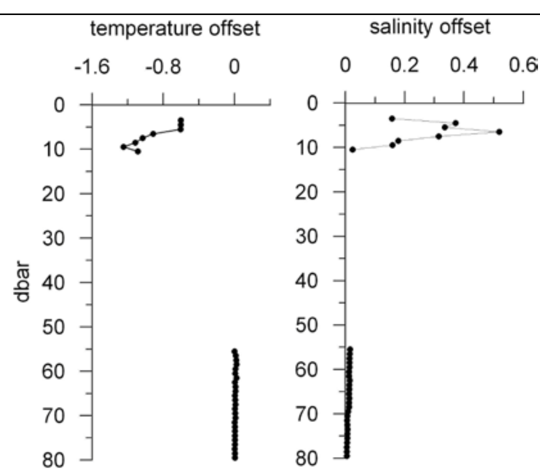
Calibration

Calibration of the temperature, salinity, and chlorophyll fluorescence was carried out by profiling the Scanfish vertically and comparing the data with CTD profiles (CTD024 and CTD025) carried out immediately before and after the Scanfish profile on July 17th.



Profiles CTD024 and CTD025 used for Scanfish calibration.

Data from both CTD profiles and the Scanfish profile were bin averaged into 1 dbar intervals. Salinity and temperature calibrations were carried out by assessing the mean differences between Scanfish and mean of the data from the two CTD profiles for pressure bins in regions of the water column where the two CTD profiles indicated homogeneous and consistent conditions (between pressures 3 – 10 dbar and 55 – 80 dbar). Only the primary sensor data was used from the CTD profiles. The results (see plot below) showed marked and drifting offsets in the surface water, probably attributable to a delay in the Scanfish reaching ambient temperature conditions during the slow vertical descent.



Temperature offset (Scanfish–CTD) in mixed regions of the water column.

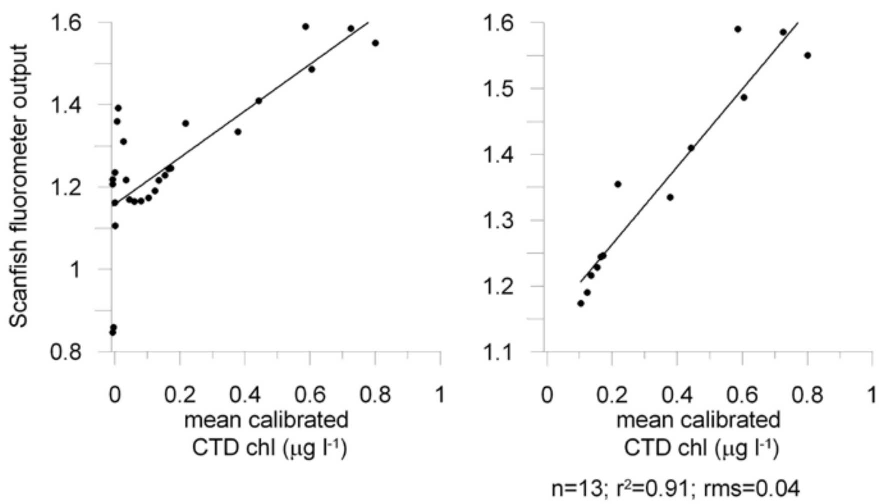
Using only the data from 57 – 80 dbar indicates:

For salinity: mean Scanfish–CTD offset = +0.01 ± 0.00

For temperature: mean Scanfish–CTD offset = +0.009 ± 0.006

Note that the uncalibrated processed CTD data was used for the above calibration. The salinity calibration (page *) was not applied to the CTD data as it was felt to be negligible. These offsets have not been applied to the data logged with BODC.

Chlorophyll calibration was performed by using the CTD fluorometer data from the upper 37 dbar, minus a few outliers evident in the CTD025 profile (e.g. near pressures of 23 and 27 dbar). This covered almost all of the full range of chlorophyll measurements within the water column.



Scatter plots of Scanfish fluorometer output versus the mean of CTD024 and CTD025 calibrated chlorophyll output. Data from 2 – 37 dbar was used, with spikes evident in CTD025 between 22-25 and 27-30 dbar removed. The plot on the right also removes all data below chl = 0.1 µg l^{-1}.

The calibration data (see plot above) shows very noisy Scanfish fluorometer output at low chl concentrations. All of this data came from the upper few dbar of the Scanfish profile. Without this data the regression (left plot above) that allows estimation of chlorophyll concentrations from Scanfish data is:

$$CHL_{Scanfish\ cal} = 1.69 \times CHL_{Scanfish} - 1.95 \quad \mu g\ l^{-1}$$

with $CHL_{Scanfish}$ the output from the Turner fluorometer on Scanfish. The rms error about this regression is 0.04 μg l^{-1}. As the calibration was performed using the calibrated CTD chlorophyll concentration, the total error in Scanfish chlorophyll estimates is $\sqrt{0.12^2 + 0.04^2} = 0.13\,\mu g$ l^{-1}. Note the problems described in the CTD fluorometer calibration concerning the analysis of the gff filtered chlorophyll samples and potential under-estimation of truw chlorophyll concentrations based on the calibrations. Again, that the Scanfish data provided to BODC has not had this calibration applied.

Data problems (Dave Teare, NMF)

The CTD and instruments generally performed well. The salinity, however, suffered from what initially appeared to be ‘salinity spiking’. Closer observation of the data, both the underway and vertical calibration profiles, shows that the salinity takes approximately one minute to stabilise after going through a step change (the thermocline). This slow response is due to conductivity rather than temperature. After going from warm to cool water the salinity value stabilises to a lower salinity value, the reverse happens when going from cool to warm water. The following hypothesis seems reasonable:

The instrument bay, where the temperature and conductivity sensors are fitted, is not in a free water flow and is relatively enclosed. The water in the bay primarily comes from the outlet of the Seabird pump. It is therefore reasonable to assume that after passing through the thermocline, the water in the bay is either warmer or cooler than the outside water. This entrained water causes adverse warming\cooling of the conductivity cell which in turn affects the conductivity of the water within the cell. The temperature sensor, however, is barely affected due to its relatively low thermal mass and being totally enclosed within the water of the inlet duct tubing.

Remedy: Move the temperature and conductivity sensors to the outside of the vehicle.

There was also a small amount of spiking on the oxygen, this was coincident with the vehicle passing through the thermocline.

There were a number of problems with the OPC instrument. The main problem is that the Seabird CTD modifies the serial data output from the OPC, which causes data synchronisation errors in the OPC software. This causes the OPC ‘elapsed time’ counter to run erratically (gains approximately 3 minutes per hour) and also causes the position data to fail to update for periods of up to 10 seconds. The OPC utilises the rarely used ‘stick parity’ function. Stick parity hijacks the normal data transfer checking function of parity and allows the parity bit to be artificially set high or low. The OPC unit uses the stick parity, set to high, as a beginning of frame marker. Most modern serial output instruments have dispensed with the parity bit checking protocol, consequently the Seabird serial data does not transmit the parity bit.

Remedies:

1. Ask Seabird to provide a serial board with parity enabled.
2. Run the OPC independently of the Seabird, using its own data transfer system.

The pressure\depth sensor only gave several fixed values over the depth cycle. This may be a sensor malfunction or may be associated with the above data transfer problem.

<u>Data from this instrument should be treated with caution!</u>

MVP data (Jonathan Sharples and Jef Benson)**.**

The MVP was used once during the cruise. Given the success of Scanfish and the better horizontal resolution of profiles achieved with Scanfish, the MVP was subsequently regarded as a back-up vehicle.

MVP Sensor Information:

FORWARDING INSTRUCTIONS / ADDITIONAL INFORMATION:
MVP initial configuration instruments

CHECKED BY: J. Benson	DATE: 27 June 2008

SENSOR / SYSTEM TYPE	SERIAL No	Service / Cal	Cruise Notes
AML Micro CTD underwater unit	7027	Cal 13 June 2008	Post-cruise calibration
AML Micro DO2 sensor	7517	Cal 19 May 2008	Post-cruise calibration
MSFFF-I Fish Multiplexer	10113	Service 9 January 2010	
Controller Interface Box	10619	Service 4 April 2010	
Winch Control Box	036415	Service 4 April 2010	
Chelsea Minitracka2 Fluorometer	175222	Cal 12 January 2009	
PML Tilt and Roll sensor	TR02 (P01)		
MSFFF-I Fish	10112		
Satlantic OCR 507 Irradiance sensor	074	Cal 31 March 2008	Post-cruise calibration
Satlantic OCR 507-ICSW Irradiance sensor	136	Cal 31 March 2008	Post-cruise calibration

The MVP data in the *.m1 files includes 4 analog channels. These were connected as:

Analg 1 ------ Fluorometer
Analg 2 ------ Oxygen
Analg 3 ------ not connected
Analg 4 ------ Roll

No attempts have yet been made to carry out calibrations on the MVP data.

Ships Computing and Data Listings (Gareth Knight)**.**

RVS LEVEL C System

Ifremer TECHSAS System

The Ifremer TECHSAS system is the primary data logger for all navigation, surfmet and winch data. The TECHSAS software is installed on an industrial based system with a high level of redundancy. The operating system is Red Hat Enterprise Linux Edition Release 3.3 . The system itself logs data on to a RAID 0 disk mirror and also logs to the backup logger. The TECHSAS interface displays the status of all incoming data streams and provides alerts if the incoming data is lost. The ability exists to broadcast live data across the network via NMEA.

The storage method used for data storage is NetCDF (binary which is a self describing file and is OS independent) and also pseudo-NMEA (ASCII). The NetCDF data files are currently manually parsed through an application in order to convert them to RVS Format for data processing.

The TECHSAS data logging system was used to log the following instruments:

1) Applanix POSMV System (Converted to RVS Format as posmvpos, posmvatt, posmvsat)
2) Applanix POSMV System Heading
3) Kongsberg Seatex DPS-116 (Converted to RVS Format as dps116p and dps116s)
4) Chernikeef EM speed log (converted to RVS format as log_chf)
5) Skipper EM Speed Log (converted to RVS Format as log_skip)
6) Ships Gyrocompass (converted to RVS format as gyronmea)
7) Simrad EA600 Precision Echo Sounder (Converted to RVS Format as ea600)
8) NMFD Surface-water and Meteorology instrument suite (Converted to RVS as sm_surf, sm_met and sm_light)
9) ASHTECH ADU-5 Altitude Detection Unit Converted to RVS Format as adu5pat and adu5pos)
7) NMFSS Cable Logging and Monitoring (Converted to RVS as winch)

Techsas NetCDF to RVS Data Conversion

During this cruise there is no reliance upon the data provided by TECHSASechsas, however it has been included on the data archive in the standard rvs form using a piece of software used to make it compatible with the RVS ASCII data structure

An in house application was used to handle the conversion of NetCDF files to the RVS format. This was then parsed back to the data file and was processed as normal. These 2 new applications being ncvars and nclistit.

These new binaries require to environment variables in order to function:

$NCBASE – the base for the NetCDF binaries system, set to /rvs/def9
$NCRAWBASE – the base for the raw data files, set to /rvs/pro_data/TECHSAS/D321/NetCDF

The existing $PATH variable must also include the path to the NC binaries, the path /rvs/def9/bin was appended to the $PATH variable.

All Techsas data file names are in the format of YYYYMMDD-HHMMSS-name-type.category with the data/timestamp being the time the file was created by Techsas.

The files were each processed in the following way for this cruise:

nclistit 20060813-000001-gyro-GYRO.gyr - | titsil Gyronmea -

This output gyro data from TECHSAS in the listit output format that is then read in by the titsil application.

<u>Data Processing</u>

Applanix POSMV System

The Ships primary GPS System for scientific data and also part of the Dynamic Positioning system is the Applanix POSMV. The POSMV includes a intertial measurement unit capable of providing heading pitch and roll data to the bridge, logged by the techsas system and displayed in the main lab. The POSMV data is also used by the ADCP systems in order to account for ships motion.

The Applanix IMU is located at the ships centre point and is used as reference for all offsets for instruments on board the RRS James Cook The GPS antenna positions are held within the POSMV and the GPS position is corrected for the position of the MRU and so the GPS position that is recorded is the position of the MRU itself.

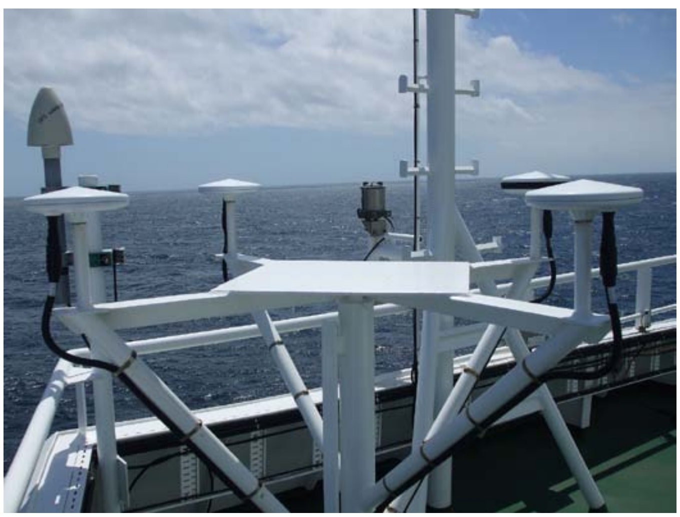
System Specifications

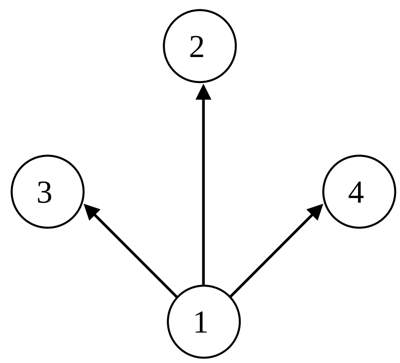
	Specification (With Differential Correction	During GPS Outages
Roll, Pitch Accuracy	0.02 º (1 sigma with GPS or DGPS	0.02 º
Heave Accuracy	5cm or 5% whichever is greater for periods of 20 seconds or less	5cm or 5% whichever is greater for wave periods of 20 seconds or less
Heading Accuracy	0.02 º with 2m antenna baseline	Drift less than 1 º per hour (negligible for outages < 60

		seconds)
Position Accuracy	0.5 – 2m (1 sigma) dependant on differential correction quality	Ddegredation 2.5m (1 sigma for outages < 30s) <6m (1 sigma for outages < 60s)
Velocity Accuracy	0.03 m/s horzontal	

Magellan Ashtech ADU-5

This is a four antenna GPS system that can produce attitude data from the relative positions of each antenna and is used to correct the VMADCP for ship motion. The antenna array is located on the port side of the ships monkey island. The ADU-5 system worked reliably throughout the cruise with some gaps that are quite usual with this system due to the amount of calculations necessary and the roll of the ship causing bad satellite communication. No Large data gaps are present. The ADU-5 forms part of the bestnav system which is an assembly of multiple GPS signals including the gyronmea and emlog stream in order to calculate the best possible position, speed heading pitch and roll of the ship.





Here the ADU5 Platform on the Starboard Side. Black surrounded Antenna indicates AFT. This is the primary antenna which sits behind all 3 other antennas.

ADU5 Offsets with reference to Antenna 1 (used internally by ADU5 for HPR Calculations

Vector	X(Right Positive)	Y(Forward Positive)	Z(Up Positive)
1-2	0.000	1.203	0.010
1-3	-0.599	0.600	0.010
1-4	0.597	0.598	0.012

Antenna Position on James Cook From MRU (0,0,0)

Antenna	X (Positive Starboard)	Y (Positive Forward)	Z (Positive Up)
1	9.265	1.541	19.416
2	10.463	1.537	19.419
3	9.863	0.932	19.426
4	9.870	2.138	19.419

SeaTex DPS 116

This DPS116 is a GPS system that was installed primarily as a backup for the POSMV to provide information for the ships DP system for ships use which we now receive an output from. The Seatex is only configured to output a single GPGGA message which we record on the TECHSAS System.

The DPS 116 is located at the top of the ships Main mast.

Ship's Gyrocompass

The Gyronmea is a file that receives its data from the Ships gyro compass located in the Bridge Electronics Space. There are two such Gyros on the bridge and we are able to use either one of them as a source of heading. The selected Gyro is logged by the TECHSAS system and is used as part of the bestnav calculation.

Chernikeef EM log

The Chernikeef EM log is a 2-axis electromagnetic water speed log. It measures both longitudinal (forward-aft) and transverse (port – starboard) ships water sped.

The EM log system was not showing the correct data following the last calibration attempt. The system has been highly unreliable since its installation within the ship and continues to be an ongoing issue that we are attempting to get support from the manufacturer for, however they are not so forth coming.

Skipper Doppler Log

The Skipper Doppler log is the ship fitted speed indicator mainly used by the bridge. It was repeated to the science systems due to the failure of the Chernikeef log to produce reasonable data for the first year and a half of the ships operation. The Skipper is continually logged as it provides good data quality and is a good comparison with the Chernikeef system.

Simrad EA600 Precision Echo Sounder (PES)

The EA600 Precision Echo Sounder is the ships primary depth readout. The EA600 output is passed to TECHSAS and also to the green display screens in the main lab. The EA600 is mounted on the port drop keel.

Surfmet System

This is the NMFD surface water and meteorology instrument suite. The surface water component consists of a flow through system with a pumped pickup at approx 5m depth. TSG flow is approx 18 litres per minute whilst fluoriometer and transmissometer flow is approx 1.5 l/min. Flow to instruments is degassed using a debubbler with 24 l/min inflow and 10/l min waste flow.

The meteorology component consists of a suite of sensors mounted on the foremast at a height of approx 16.4m above the waterline. Parameters measured are wind speed and direction, air temperature, humidity and atmospheric pressure. There is also a pair of optical sensors mounted on gimbals on each side of the ship. These measure total irradiance (TIR) and photo-synthetically active radiation (PAR). The gimbals were removed and had new bearings installed at the beginning of the cruise prior to sailing.

The Non Toxic system was enabled as soon as we were far enough away from land and switched off during the port call in the Azores in order to protect the sea surface sensors from pollution which generally occurs close to land.

CASIX PCO2 System

This system is an autonomous pCO2 system developed by PML and Dartcom. I advise that you contact Nick Hardman-Muntford at PML for information. The system was run at the same time as the Surfmet system. The System was cleaned on a weekly basis in order to remove fouling from the system as per the manual.

Network Services

The network itself worked well without any issues. Ports required patching through to enable scientists to use the ports.

The Wireless system, which failed during a previous cruise, was connected to a PC power supply as a means to test the Wireless system was still in working condition. The wireless system was used during the cruise and power supplies are hopefully on route.

Data Storage

This cruise a new device was installed, known as a Drobo or Disk Robot. It was installed on the network and the Drobo 1 share was used by scientists to share data. The Drobo has a hot swap spare to ensure that the storage remains functional and secure at all times. The Drobo was backed up daily to LTO tape using SMB Tar on the Cook3 workstation.

The Level C data was backed up to LTO daily and included the TECHSAS mount from the TECHSAS data logger.

<u>Surfmet Sensor Calibration Information</u>

Ship	RRS James Cook
Cruise	JC024
Technician	Chris Barnard
Date	21/05/2008

Manufacturer	Sensor	Serial no	Comments
FSI	OTM temperature	1361	Housing
FSI	OTM temperature	1376	Remote
Wetlabs	fluorometer	WS3S-117	(Replaced prior to Cruise)
Seatech	transmissometer	T1022D	No Cal Sheet
Vaisala	Barometer PTB100A	RO45005	(Replaced prior to Cruise)
Vaisala	Temp/humidity HMP45A	D1330038	(Replaced prior to Cruise)
Skye	PAR	28563	PORT Side
Skye	PAR	28558	STARBOARD Side
Kipp and Zonen	TIR CMB6	047462	PORT Side
Kipp and Zonen	TIR CMB6	047463	STARBOARD Side
Sensors without cal			
FSI	OCM Conductivity	1358	
Gill Windsonic	Anemometer Option 3	064537	
Nudam 6017	+/- 5v		
Nudam 6018	+/- 5v		

<u>SPARES</u>

Manufacturer	Sensor	Serial no	Comments
FSI	OTM temperature	1333 1379	1333 No Cal Sheet, Not used before
FSI	OTM temperature	1339	
Wetlabs	fluorometer		
Seatech	transmissometer	T1019D	No Cal Sheets
Vaisala	Barometer PTB100A	Z4740021	
Vaisala	Temp/humidity HMP45A	B4950011	

Skye	PAR	28556	
Skye	PAR		
Kipp and Zonen	TIR CMB6	962276	
Kipp and Zonen	TIR CMB6		
Sensors without cal			
FSI	OCM conductvity	1333	
Gill Windsonic	Anemometer Option 3	064538	
NUDAM 6017	+/- 5v		
NUDAM 6018	+/- 5v		

<u>Surfmet : The Sensor List</u>

Met Platform Sensors

Wind Speed and Direction

Manufacturer : Gill
Model : Windsonic (Option 3)

Ultrasonic Output Rate	1, 2, 4Hz
Wind Speed	Range 0-60 m/s
Wind Direction Range	0-359 no dead band
Operating Temp Range	-35 ºC to +70 ºC
Moisture Protection	IP65
External Construction	Luran
Digital O/P Options	RS232 / 422 / 485 / SDI-12
NMEA O/P	Yes
Analogue Outputs	2 (optional)
Calibration	Generic

Total Irradiance

Manufacturer : Kipp and Zonen
Model Number : CM6B

Spectral range	305...2800 nm (50%points)
Sensitivity	9...15 μV/Wm-2
Impedance	70...100 Ohm
Response time	1/e 5 s, 99 % 55 s
Non-linearity	<1.5 % (<1000 W/m 2)
Tilt error	<1.5 % at 1000 W/m 2
Operating temperature	-40...+90 _C
Temperature dependence of sensitivity	_2 % (-10...+40_C)
Maximum irradiance	2000 W/m2
Directional error	< _20 W/m2 at 1000 W/m2
Weight	0.85 kg
Cable length	10 m

Temperature and Humidity

Manufacturer : Vaisala
Model Number HMP45A

Relative humidity measurement

HMP45A	
Measurement range	0.8 ... 100 % RH
Accuracy at +20 °C (+68 °F)	± 2 % RH (0 ... 90 % RH)
	± 3 % RH (90 ... 100 % RH)
Sensor	Vaisala HUMICAP® 180

Temperature measurement

HMP45A	
Measurement range	-39.2 ... +60 °C (-38.6 ... +140 °F)
Accuracy +20 °C (+68 °F)	± 0.2 °C (± 0.36 °F)
Sensor	Pt 1000 IEC 751

Operating environment

Temperature	
operation	-40 ... +60 °C (-40 ... +140 °F)
storage	-40 ... +80 °C (-40 ... +176 °F)

Inputs and outputs

Operating Voltage	7 ... 35 VDC
Power consumption	< 4 mA
Output load	> 10 kohm (to ground)
Output scale	-40 ... +60 °C (-40 ... +140 °F) equals to 0...1V
Output signal	resistive 4-wire connection

Photosynthetic Active Radiation

Manufacturer : Skye Instruments
Model Number : SKE 510

Spectral Range	400-700nm
Sensitivity Current	3.5µA/100Wm^2
Sensitivity Voltage	1mV/100Wm^2
Working Range	0 – 5000Wm^2
Linear Error	<0.2%
Absolute Calibration Error	typ <3% max 5%
Cosine Error	3%
Azimuth Error	<1%
Temperature coefficient	+/-0.1%/ºC
Longterm Stability	+/-2%
Response Time	10ns
Internal Resistance	300Ohms
Temperature Range	-35ºC … +70ºC
Humidity Range	0 – 100% RH

Barometric Pressure

Barometric pressure measurement

Pressure range	800 ... 1100 hPa
Accuracy at +20 °C (+68 °F)	±0.3 hPa
Sensor	Vaisala BAROCAP®

Operating environment

Temperature range	-5 ... +45 °C (+23 ... +113 °F)
Humidity range	<80 % RH

Inputs and outputs

Operating voltage	9 ... 16 VDC
Power consumption:	
operation mode	2 mA (typical)
shutdown mode	150 µA (typical)
Output voltage	0 … 2.5 VDC

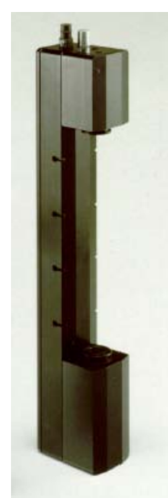
Sea Surface Instruments

Fluorimeter

Manufacturer : WetLabs
Model Number : WetStar

Temperature Range	0-30 C
Depth Rating	600m
Response time	0.17s
Input Voltage	7-15vdc
Current Draw	< 40 mA
Output	0-5VDC

Transmissometer



Manufacturer : WetLabs
ModelNumber : WetStar

Pathlength	25cm
Wavelength	660nm
Bandwidth	~ 20nm
Rated Depth	600m
Temperature	0-30ºC
Power Input	7-15VDC
Current Draw	< 40mA
Data Output	0-5Volts
Time Constant	0.167 sec
Temperature Error	0.02 percent F.S./deg C

Temperature Sensor

Manufacturer : Falmouth Scientific
Model : OTM

Probe Reference Grade	Falmouth Scientific Platinum Resistance Thermometer
Range	-2 – 32 Celsius
Accuracy	+/- 0.003
Stability	+/- 0.0005 Celsius / month
Resolution	0.0001 C
Sampling Rate Programmable	4 – 32 Samples / sec
Response Time	400-500 ms
Self heating	< 0.0003 C @ 1 meter / second flow
Power	12 +/- 20% VDC @ 60mA
Warm-up	2.0 Seconds from Power Up

Conductivity Sensor

Manufacturer : Falmouth Scientific
Model : OCM

Probe	Falmouth Scientific Inductive Conductivity Sensor
Range	0 – 65 mmho / cm (0-6.5 S/m)
Accuracy	+/-0.003 mmho/cm (+/-0.0003 S/m)
Stability	+/0.0005 mmho/cm/month (+/- 0.5 mS/m)
Resolution	0.0002 mmho/cm
Sampling Rate	4 - 32 Samples / sec
Response Time	5.0cm (50milliseconds at 1meter/second flow)

VMP Turbulence Microstructure Profiling (Matthew Palmer)**.**

Microstructure measurements were made using two different profilers. A list of filenames, deployment times and positions can be found in the appendix at the end of this section. The first of these instruments, the VMP750 was used for the majority of deployments and the second instrument, MSS90 was used as a backup during a short period of instrument failure with the VMP750.

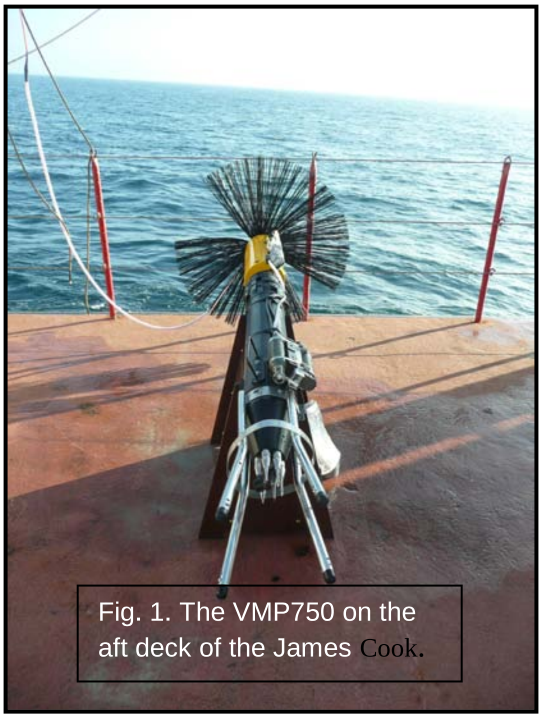


Fig. 1. The VMP750 on the aft deck of the James Cook.

The descent of the instrument is controlled by buoyancy and brushes to maintain an optimal fall-speed ~0.75ms^{-1} whilst keeping the instrument falling vertically. With a typical water depth of 80-130m each profile therefore took ~2-3 minutes descent time with a similar time for recovery to the surface from which the next profile was made.

The VMP750 weighs ~50kg in air and is connected to a winch via a line thrower system (figure 2), both of which are hydraulically powered.

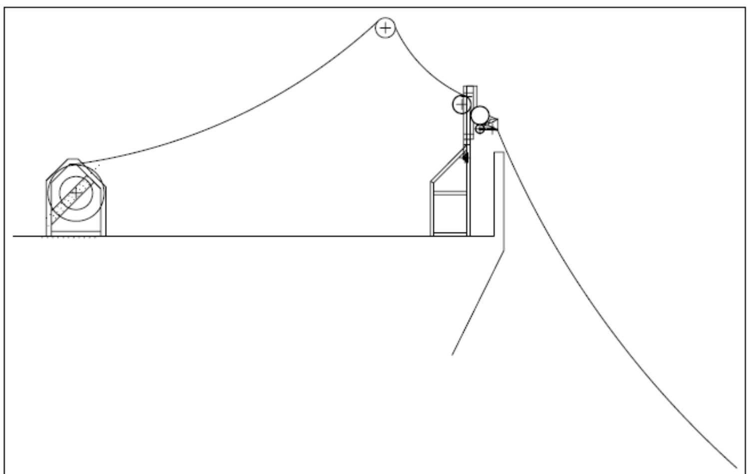


Figure 2. Typical setup of winch, sheave and line-puller when the VMP is profiling down. Notice that there is slack in the tether between the winch and line-puller. There is also slack in the tether in the water near the ship so that the VMP can descend freely.

1. Rockland Scientific International manufactured **V**elocity **M**icrostructure **P**rofiler (VMP750) provided by Proudman Oceanographic Laboratory (POL): The VMP750 (figure 1) is a free-falling instrument rated to 750m depth that was deployed from the aft of the RRS James Cook, connected via a neutrally buoyant Kevlar tether which is fed sufficiently fast over the ship's stern to prevent any interference with the free-fall of the instrument from the surface to the seabed. To ensure safe deployment of the loose tether the ship moves forward slowly through the water during deployment which can result in some movement around the station position

depending on wind and tide. During descent the instrument simultaneously measures shear microstructure, from which the dissipation rate of turbulent kinetic energy can be derived (Dewey et al, 1987), temperature and conductivity microstructure, fluorescence, optical backscatter, pressure, tri-axis acceleration and temperature, conductivity and oxygen.

2. ISW Wassermesstechnik manufactured MSS90 (figure 3) provided by the Scottish Association for Marine Science (SAMS):

This is a similar but less well equipped instrument to the VMP750, it measures shear microstructure, temperature microstructure, temperature, conductivity, pressure and tri-axis acceleration. The instrument is lightweight, ~15kg in air, and is operated in a similar manner to the VMP750 from a simple electronic winch (figure 4). The instrument was not permitted to collide with seabed to protect the sensor package, instead profiling to within 20m of the bed.

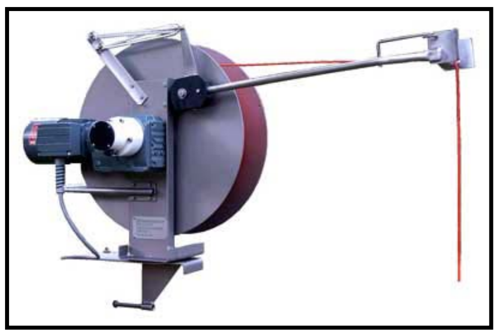


Figure 4: ISW Wassermesstechnik swm1000 electric winch

Figure 3: MSS90 microstructure profiler

Microstructure measurements were made during 5 different stations at 2 locations:

1. 6/7/08: Station MS2.
Started 1449 6/7/08 (GMT)
Ended 0545 7/7/09 (GMT)

Some problems were experienced with deployment during the first hour of operation which resulted in a number of unsuccessful casts being made. This was traced to incorrect settings on the winch hydraulics. Following adjustment the winch and line thrower system worked well throughout the rest of the cruise. The start of the 25hr station was adjusted to 1559 (GMT), VMP profile #017.

Due to bad weather profiling was only possible in one direction to remain within acceptable proximity of the mooring station. Occasional breaks were therefore required to reposition the ship. VMP profiles were made every 6-7 minutes.

Breaks in profiling were made at the following times:

1. 1611 – 1706 repositioning
2. 1937 – 2056 CTD
3. 2133 – 2218 repositioning
4. 0043 – 0127 repositioning
5. 0314 – 0514 CTD followed by repositioning

The tether managed to get entangled with the VMP on a number of occasions, subsequently a break in the connecting cable was suspected due to continual 'bad buffer' signals in the VMP software. The decision was made to stop profiling at 07/07/08 0545 (cast #111) reterminate the VMP connection. Termination undertaken by Chris Balfour (POL). The station was aborted with over 1 tidal cycle of data collected including 86 full depth VMP profiles. It was noticed during post-processing that the O2 sensor was performing poorly following cast #105 (0514 07/07/08). On inspection one of the power connections on the instrument had completely corroded and was not repairable.

2. 12/7/08: Station MS4.
Started 0217 12/7/08 (GMT) VMP profile #124
Ended 0314 13/7/09 (GMT) VMP profile #375

VMP profiles were made every 6-7 minutes.
Breaks in profiling were made at the following times (GMT):

1. 0606 – 0640 repositioning
2. 0726 – 0841 CTD
3. 1254 – 1347 CTD
4. 2051 – 2139 CTD

The slow response time of the Seabird CT sensors indicated a pump problem. On inspection the pump was found to be working intermittently and was removed, depending on free flow for the next deployment. No significant problems were experienced with the microstructure measurements during this deployment period. A 25hr dataset was successfully collected with minimal stops. A total of 238 full depth VMP profiles were made.

3. 14/7/08: Station MS2.

Started 1153 14/7/08 (GMT) VMP profile #376

Ended 0032 15/7/09 (GMT) VMP profile #533

VMP profiles were made every 5-6 minutes.

Breaks in profiling were made at the following times (GMT):

1. 1745– 1844 CTD

At 0036 15/07/09 all communication was lost with the VMP. Station aborted after 152 full depth profiles over 1 full tidal cycle. Instrument brought on board for retermination by Chris Balfour (POL).

4. 21/7/08: Station MS2.

Started 0756 21/07/08 (GMT) VMP profile #539

Ended 0923 22/07/08 (GMT) VMP profile #754

VMP profiles every 5-6 minutes.

Breaks in profiling were made at the following times (GMT):

1. 1252– 1349 CTD
2. 1954 – 2047 CTD
3. 2309 – 2355 switch from VMP to MSS90 profiler

‘Bad buffer signals were received from 1634 (#630) to 1756 (#644) 21/07/08 indicating a poor connection/data feed. The problem went away for some time returning intermittently until it was decided to recover the instrument at 2309 21/07/08 for retermination by Chris Balfour (POL). During this break the replacement MSS90 profiler (SAMS) was deployed to minimize gaps in the microstructure time series. 51 microstructure profiles were made from near surface to ~100m depth using the MSS90 between 2355 21/07/08 and 0344 22/07/08.

VMP profiling recommenced at 0354 22/07/08 (profile #697) and continued successfully until 0923 when the 25 hour station was complete. A total of 256 microstructure profiles were made, 205 from the VMP and 51 from the MSS90.

5. 22/07/08: Station MS4.

Started 1710 22/07/08 (GMT) VMP profile #755

Ended 0537 23/07/08 (GMT) VMP profile #870

VMP profiles every 6-7 minutes.

Breaks in profiling were made at the following times (GMT):

1. 0258– 0355 CTD

Successful 1 tidal cycle deployment, no errors or problems. 112 full depth profiles made.

Appendix:

1.Filename	2.date	3.Time(bst)	4.Longitude (°E)	5.Latitude(°N)
POL_004_JC25_017.p	06-Jul-2008	17:02:34	-7.812138e+000	4.980318e+001
POL_004_JC25_018.p	06-Jul-2008	17:08:08	-7.795689e+000	4.979798e+001
POL_004_JC25_019.p	06-Jul-2008	17:14:38	-7.777689e+000	4.979137e+001
POL_004_JC25_020.p	06-Jul-2008	18:09:34	-7.666795e+000	4.975023e+001
POL_004_JC25_021.p	06-Jul-2008	18:15:26	-7.666710e+000	4.974998e+001
POL_004_JC25_022.p	06-Jul-2008	18:21:08	-7.666842e+000	4.975001e+001
POL_004_JC25_023.p	06-Jul-2008	18:27:14	-7.667398e+000	4.974972e+001
POL_004_JC25_024.p	06-Jul-2008	18:33:14	-7.668645e+000	4.974938e+001
POL_004_JC25_025.p	06-Jul-2008	18:39:04	-7.669056e+000	4.974916e+001
POL_004_JC25_026.p	06-Jul-2008	18:45:02	-7.669201e+000	4.974917e+001
POL_004_JC25_027.p	06-Jul-2008	18:51:04	-7.669324e+000	4.974911e+001
POL_004_JC25_028.p	06-Jul-2008	18:56:30	-7.669139e+000	4.974906e+001
POL_004_JC25_029.p	06-Jul-2008	19:02:18	-7.669106e+000	4.974903e+001
POL_004_JC25_030.p	06-Jul-2008	19:08:14	-7.669117e+000	4.974900e+001
POL_004_JC25_031.p	06-Jul-2008	19:13:56	-7.669072e+000	4.974913e+001
POL_004_JC25_032.p	06-Jul-2008	19:19:56	-7.669071e+000	4.974904e+001
POL_004_JC25_033.p	06-Jul-2008	19:25:32	-7.669068e+000	4.974909e+001
POL_004_JC25_034.p	06-Jul-2008	19:31:06	-7.669160e+000	4.974912e+001
POL_004_JC25_035.p	06-Jul-2008	19:37:24	-7.669087e+000	4.974909e+001
POL_004_JC25_036.p	06-Jul-2008	19:42:56	-7.669017e+000	4.974905e+001
POL_004_JC25_037.p	06-Jul-2008	19:48:46	-7.669078e+000	4.974902e+001
POL_004_JC25_038.p	06-Jul-2008	19:52:04	-7.669104e+000	4.974915e+001
POL_004_JC25_039.p	06-Jul-2008	19:55:28	-7.669048e+000	4.974905e+001
POL_004_JC25_040.p	06-Jul-2008	20:02:20	-7.669060e+000	4.974906e+001
POL_004_JC25_041.p	06-Jul-2008	20:06:36	-7.668968e+000	4.974909e+001
POL_004_JC25_042.p	06-Jul-2008	20:12:04	-7.668992e+000	4.974907e+001
POL_004_JC25_043.p	06-Jul-2008	20:17:50	-7.668962e+000	4.974909e+001
POL_004_JC25_044.p	06-Jul-2008	20:22:58	-7.668900e+000	4.974907e+001
POL_004_JC25_045.p	06-Jul-2008	20:28:44	-7.668854e+000	4.974914e+001
POL_004_JC25_046.p	06-Jul-2008	20:34:28	-7.669438e+000	4.974934e+001
POL_004_JC25_047.p	06-Jul-2008	20:39:54	-7.669635e+000	4.974948e+001
POL_004_JC25_048.p	06-Jul-2008	21:59:44	-7.698888e+000	4.980323e+001
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POL_004_JC25_050.p	06-Jul-2008	22:10:42	-7.708686e+000	4.980656e+001
POL_004_JC25_051.p	06-Jul-2008	22:15:30	-7.713058e+000	4.980809e+001
POL_004_JC25_052.p	06-Jul-2008	22:20:40	-7.717826e+000	4.980951e+001
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POL_004_JC25_057.p	06-Jul-2008	23:27:16	-7.775152e+000	4.982989e+001
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POL_004_JC25_059.p	06-Jul-2008	23:38:40	-7.782403e+000	4.983295e+001
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POL_004_JC25_064.p	07-Jul-2008	00:09:36	-7.802232e+000	4.984253e+001
POL_004_JC25_065.p	07-Jul-2008	00:15:44	-7.805308e+000	4.984493e+001
POL_004_JC25_066.p	07-Jul-2008	00:23:26	-7.810058e+000	4.984832e+001
POL_004_JC25_067.p	07-Jul-2008	00:27:06	-7.812017e+000	4.984993e+001
POL_004_JC25_068.p	07-Jul-2008	00:31:38	-7.814573e+000	4.985201e+001
POL_004_JC25_069.p	07-Jul-2008	00:35:18	-7.816760e+000	4.985362e+001
POL_004_JC25_070.p	07-Jul-2008	00:38:26	-7.818624e+000	4.985499e+001
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POL_004_JC25_078.p	07-Jul-2008	01:26:56	-7.846054e+000	4.988129e+001
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POL_004_JC25_103.p	07-Jul-2008	05:55:04	-7.869369e+000	4.989835e+001
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POL_004_JC25_106.p	07-Jul-2008	06:22:04	-7.869258e+000	4.989846e+001
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POL_004_JC25_108.p	07-Jul-2008	06:31:46	-7.869223e+000	4.989847e+001
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POL_004_JC25_112.p	07-Jul-2008	06:57:12	-7.869139e+000	4.989856e+001
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POL_004_JC25_115.p	07-Jul-2008	10:48:46	-7.864407e+000	4.989770e+001
POL_004_JC25_116.p	07-Jul-2008	10:54:32	-7.864313e+000	4.989759e+001
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POL_004_JC25_118.p	07-Jul-2008	14:07:38	-7.865485e+000	4.989801e+001
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POL_004_JC25_120.p	07-Jul-2008	14:18:32	-7.864678e+000	4.989598e+001
POL_004_JC25_121.p	07-Jul-2008	14:23:04	-7.865519e+000	4.989603e+001
POL_004_JC25_122.p	07-Jul-2008	14:26:30	-7.865864e+000	4.989601e+001
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POL_004_JC25_135.p	12-Jul-2008	04:35:30	-7.672471e+000	4.974936e+001
POL_004_JC25_136.p	12-Jul-2008	04:40:56	-7.672491e+000	4.974937e+001
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POL_004_JC25_139.p	12-Jul-2008	04:57:20	-7.672472e+000	4.974936e+001
POL_004_JC25_140.p	12-Jul-2008	05:02:36	-7.672492e+000	4.974937e+001
POL_004_JC25_142.p	12-Jul-2008	05:08:04	-7.672409e+000	4.974927e+001
POL_004_JC25_143.p	12-Jul-2008	05:13:36	-7.672432e+000	4.974930e+001
POL_004_JC25_144.p	12-Jul-2008	05:19:14	-7.672445e+000	4.974926e+001
POL_004_JC25_145.p	12-Jul-2008	05:24:48	-7.672422e+000	4.974929e+001
POL_004_JC25_146.p	12-Jul-2008	05:30:26	-7.672425e+000	4.974928e+001
POL_004_JC25_147.p	12-Jul-2008	05:35:28	-7.672430e+000	4.974928e+001
POL_004_JC25_148.p	12-Jul-2008	05:40:48	-7.672435e+000	4.974927e+001
POL_004_JC25_149.p	12-Jul-2008	05:46:50	-7.672427e+000	4.974928e+001
POL_004_JC25_150.p	12-Jul-2008	05:52:10	-7.672427e+000	4.974930e+001
POL_004_JC25_151.p	12-Jul-2008	05:57:40	-7.672413e+000	4.974932e+001
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POL_004_JC25_153.p	12-Jul-2008	06:08:30	-7.672419e+000	4.974930e+001
POL_004_JC25_154.p	12-Jul-2008	06:14:02	-7.672404e+000	4.974936e+001
POL_004_JC25_155.p	12-Jul-2008	06:18:52	-7.672429e+000	4.974932e+001
POL_004_JC25_156.p	12-Jul-2008	06:23:46	-7.672488e+000	4.974933e+001
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POL_004_JC25_158.p	12-Jul-2008	06:33:48	-7.672419e+000	4.974930e+001
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POL_004_JC25_160.p	12-Jul-2008	06:43:52	-7.672425e+000	4.974931e+001
POL_004_JC25_161.p	12-Jul-2008	06:47:04	-7.672425e+000	4.974931e+001
POL_004_JC25_162.p	12-Jul-2008	06:52:18	-7.672392e+000	4.974934e+001
POL_004_JC25_163.p	12-Jul-2008	06:58:30	-7.672393e+000	4.974933e+001
POL_004_JC25_164.p	12-Jul-2008	07:04:14	-7.672406e+000	4.974935e+001
POL_004_JC25_165.p	12-Jul-2008	07:09:14	-7.672397e+000	4.974934e+001
POL_004_JC25_166.p	12-Jul-2008	07:44:04	-7.672401e+000	4.974934e+001
POL_004_JC25_167.p	12-Jul-2008	07:49:08	-7.672402e+000	4.974933e+001
POL_004_JC25_168.p	12-Jul-2008	07:54:34	-7.672402e+000	4.974933e+001
POL_004_JC25_169.p	12-Jul-2008	07:58:22	-7.672402e+000	4.974933e+001

POL_004_JC25_170.p	12-Jul-2008	08:05:02	-7.672393e+000	4.974934e+001
POL_004_JC25_171.p	12-Jul-2008	08:10:12	-7.672390e+000	4.974934e+001
POL_004_JC25_172.p	12-Jul-2008	08:14:48	-7.672392e+000	4.974935e+001
POL_004_JC25_173.p	12-Jul-2008	08:19:34	-7.672401e+000	4.974933e+001
POL_004_JC25_174.p	12-Jul-2008	08:24:20	-7.672441e+000	4.974936e+001
POL_004_JC25_175.p	12-Jul-2008	08:29:18	-7.672407e+000	4.974935e+001
POL_004_JC25_176.p	12-Jul-2008	09:45:16	-7.672391e+000	4.974935e+001
POL_004_JC25_177.p	12-Jul-2008	09:50:36	-7.672389e+000	4.974931e+001
POL_004_JC25_178.p	12-Jul-2008	09:55:44	-7.672387e+000	4.974931e+001
POL_004_JC25_179.p	12-Jul-2008	10:01:00	-7.672394e+000	4.974931e+001
POL_004_JC25_180.p	12-Jul-2008	10:06:00	-7.672439e+000	4.974934e+001
POL_004_JC25_181.p	12-Jul-2008	10:11:48	-7.672406e+000	4.974932e+001
POL_004_JC25_182.p	12-Jul-2008	10:14:00	-7.672392e+000	4.974931e+001
POL_004_JC25_183.p	12-Jul-2008	10:24:46	-7.672399e+000	4.974934e+001
POL_004_JC25_184.p	12-Jul-2008	10:30:04	-7.672420e+000	4.974941e+001
POL_004_JC25_185.p	12-Jul-2008	10:35:40	-7.672413e+000	4.974937e+001
POL_004_JC25_186.p	12-Jul-2008	10:41:20	-7.672396e+000	4.974934e+001
POL_004_JC25_187.p	12-Jul-2008	10:47:06	-7.672409e+000	4.974935e+001
POL_004_JC25_188.p	12-Jul-2008	10:52:34	-7.672418e+000	4.974937e+001
POL_004_JC25_189.p	12-Jul-2008	10:59:28	-7.672382e+000	4.974933e+001
POL_004_JC25_190.p	12-Jul-2008	11:05:24	-7.677087e+000	4.974964e+001
POL_004_JC25_191.p	12-Jul-2008	11:11:00	-7.689197e+000	4.975287e+001
POL_004_JC25_192.p	12-Jul-2008	11:16:08	-7.696720e+000	4.975481e+001
POL_004_JC25_193.p	12-Jul-2008	11:19:26	-7.703568e+000	4.975660e+001
POL_004_JC25_194.p	12-Jul-2008	11:24:04	-7.716217e+000	4.976120e+001
POL_004_JC25_195.p	12-Jul-2008	11:42:26	-7.773105e+000	4.978271e+001
POL_004_JC25_196.p	12-Jul-2008	11:47:58	-7.789951e+000	4.978913e+001
POL_004_JC25_197.p	12-Jul-2008	11:50:52	-7.798570e+000	4.979235e+001
POL_004_JC25_198.p	12-Jul-2008	11:53:56	-7.808315e+000	4.979594e+001
POL_004_JC25_199.p	12-Jul-2008	11:59:30	-7.825177e+000	4.980246e+001
POL_004_JC25_200.p	12-Jul-2008	12:05:06	-7.842251e+000	4.980946e+001
POL_004_JC25_201.p	12-Jul-2008	12:12:46	-7.865195e+000	4.981880e+001
POL_004_JC25_202.p	12-Jul-2008	12:18:12	-7.881179e+000	4.982521e+001
POL_004_JC25_203.p	12-Jul-2008	12:23:34	-7.897119e+000	4.983168e+001
POL_004_JC25_204.p	12-Jul-2008	12:28:28	-7.912016e+000	4.983776e+001
POL_004_JC25_205.p	12-Jul-2008	12:33:40	-7.927974e+000	4.984402e+001
POL_004_JC25_206.p	12-Jul-2008	12:39:10	-7.936265e+000	4.984880e+001
POL_004_JC25_207.p	12-Jul-2008	12:44:00	-7.936976e+000	4.985047e+001
POL_004_JC25_208.p	12-Jul-2008	12:49:10	-7.937747e+000	4.985167e+001
POL_004_JC25_209.p	12-Jul-2008	12:54:04	-7.938249e+000	4.985243e+001
POL_004_JC25_210.p	12-Jul-2008	12:59:22	-7.938143e+000	4.985239e+001
POL_004_JC25_211.p	12-Jul-2008	13:01:36	-7.939176e+000	4.985319e+001
POL_004_JC25_212.p	12-Jul-2008	13:05:10	-7.940581e+000	4.985721e+001
POL_004_JC25_213.p	12-Jul-2008	13:11:02	-7.939006e+000	4.986470e+001
POL_004_JC25_214.p	12-Jul-2008	13:16:36	-7.937059e+000	4.987164e+001
POL_004_JC25_215.p	12-Jul-2008	13:21:54	-7.928218e+000	4.986816e+001
POL_004_JC25_216.p	12-Jul-2008	13:27:08	-7.917869e+000	4.985947e+001
POL_004_JC25_217.p	12-Jul-2008	13:32:18	-7.906979e+000	4.985062e+001
POL_004_JC25_218.p	12-Jul-2008	13:37:26	-7.896359e+000	4.984175e+001
POL_004_JC25_219.p	12-Jul-2008	13:42:20	-7.889779e+000	4.983205e+001
POL_004_JC25_220.p	12-Jul-2008	13:47:46	-7.883598e+000	4.982241e+001
POL_004_JC25_221.p	12-Jul-2008	13:52:44	-7.879451e+000	4.981563e+001
POL_004_JC25_222.p	12-Jul-2008	13:57:58	-7.874616e+000	4.980813e+001
POL_004_JC25_223.p	12-Jul-2008	14:50:58	-7.873395e+000	4.980402e+001
POL_004_JC25_224.p	12-Jul-2008	14:55:56	-7.863958e+000	4.981123e+001
POL_004_JC25_225.p	12-Jul-2008	15:03:10	-7.839832e+000	4.981615e+001
POL_004_JC25_226.p	12-Jul-2008	15:08:30	-7.823768e+000	4.982175e+001
POL_004_JC25_227.p	12-Jul-2008	15:13:46	-7.808563e+000	4.982830e+001
POL_004_JC25_228.p	12-Jul-2008	15:15:20	-7.804649e+000	4.983042e+001
POL_004_JC25_229.p	12-Jul-2008	15:15:20	-7.804649e+000	4.983042e+001
POL_004_JC25_230.p	12-Jul-2008	15:18:50	-7.795208e+000	4.983527e+001
POL_004_JC25_231.p	12-Jul-2008	15:23:50	-7.782606e+000	4.984285e+001
POL_004_JC25_232.p	12-Jul-2008	15:29:06	-7.769026e+000	4.985129e+001
POL_004_JC25_233.p	12-Jul-2008	15:34:04	-7.756630e+000	4.985884e+001
POL_004_JC25_234.p	12-Jul-2008	15:39:18	-7.742964e+000	4.986726e+001
POL_004_JC25_235.p	12-Jul-2008	15:44:32	-7.729783e+000	4.987546e+001
POL_004_JC25_236.p	12-Jul-2008	15:48:56	-7.718601e+000	4.988291e+001
POL_004_JC25_237.p	12-Jul-2008	15:53:50	-7.706530e+000	4.989097e+001
POL_004_JC25_238.p	12-Jul-2008	15:58:36	-7.694208e+000	4.989896e+001
POL_004_JC25_239.p	12-Jul-2008	16:03:42	-7.679658e+000	4.989455e+001
POL_004_JC25_240.p	12-Jul-2008	16:09:00	-7.675135e+000	4.988241e+001
POL_004_JC25_241.p	12-Jul-2008	16:14:36	-7.687848e+000	4.987210e+001
POL_004_JC25_242.p	12-Jul-2008	16:19:28	-7.700193e+000	4.986382e+001
POL_004_JC25_243.p	12-Jul-2008	16:24:08	-7.712103e+000	4.985561e+001
POL_004_JC25_244.p	12-Jul-2008	16:28:38	-7.723606e+000	4.984772e+001
POL_004_JC25_245.p	12-Jul-2008	16:33:10	-7.734986e+000	4.983994e+001
POL_004_JC25_246.p	12-Jul-2008	16:37:40	-7.746270e+000	4.983237e+001
POL_004_JC25_247.p	12-Jul-2008	16:42:52	-7.759467e+000	4.982379e+001
POL_004_JC25_248.p	12-Jul-2008	16:47:42	-7.771464e+000	4.981637e+001
POL_004_JC25_249.p	12-Jul-2008	16:51:56	-7.783501e+000	4.981227e+001
POL_004_JC25_250.p	12-Jul-2008	16:57:06	-7.795654e+000	4.981928e+001
POL_004_JC25_251.p	12-Jul-2008	17:01:52	-7.784959e+000	4.982644e+001
POL_004_JC25_252.p	12-Jul-2008	17:05:38	-7.774894e+000	4.983200e+001
POL_004_JC25_253.p	12-Jul-2008	17:11:26	-7.760044e+000	4.984097e+001
POL_004_JC25_254.p	12-Jul-2008	17:16:18	-7.747824e+000	4.984856e+001
POL_004_JC25_255.p	12-Jul-2008	17:23:16	-7.729888e+000	4.985952e+001
POL_004_JC25_256.p	12-Jul-2008	17:28:10	-7.717137e+000	4.986716e+001
POL_004_JC25_257.p	12-Jul-2008	17:33:22	-7.703126e+000	4.987494e+001
POL_004_JC25_258.p	12-Jul-2008	17:38:36	-7.700383e+000	4.988382e+001
POL_004_JC25_259.p	12-Jul-2008	17:43:48	-7.713312e+000	4.989217e+001
POL_004_JC25_260.p	12-Jul-2008	17:54:36	-7.741801e+000	4.988405e+001
POL_004_JC25_261.p	12-Jul-2008	17:59:54	-7.754527e+000	4.987583e+001
POL_004_JC25_262.p	12-Jul-2008	18:05:14	-7.767866e+000	4.986731e+001
POL_004_JC25_263.p	12-Jul-2008	18:09:44	-7.778886e+000	4.986025e+001
POL_004_JC25_264.p	12-Jul-2008	18:14:18	-7.790396e+000	4.985298e+001
POL_004_JC25_265.p	12-Jul-2008	18:18:44	-7.801159e+000	4.984632e+001
POL_004_JC25_266.p	12-Jul-2008	18:23:48	-7.814172e+000	4.983811e+001
POL_004_JC25_267.p	12-Jul-2008	18:28:34	-7.825430e+000	4.983056e+001
POL_004_JC25_268.p	12-Jul-2008	18:33:08	-7.837232e+000	4.982332e+001
POL_004_JC25_269.p	12-Jul-2008	18:38:02	-7.851077e+000	4.982482e+001
POL_004_JC25_270.p	12-Jul-2008	18:42:48	-7.846160e+000	4.983418e+001
POL_004_JC25_271.p	12-Jul-2008	18:47:40	-7.833457e+000	4.984201e+001
POL_004_JC25_272.p	12-Jul-2008	18:52:08	-7.821547e+000	4.984948e+001
POL_004_JC25_273.p	12-Jul-2008	18:56:46	-7.809679e+000	4.985703e+001
POL_004_JC25_274.p	12-Jul-2008	19:01:12	-7.798602e+000	4.986420e+001
POL_004_JC25_275.p	12-Jul-2008	19:05:42	-7.797170e+000	4.987337e+001
POL_004_JC25_276.p	12-Jul-2008	19:10:14	-7.808224e+000	4.987244e+001
POL_004_JC25_277.p	12-Jul-2008	19:14:36	-7.818866e+000	4.986603e+001
POL_004_JC25_278.p	12-Jul-2008	19:19:12	-7.829774e+000	4.985932e+001
POL_004_JC25_279.p	12-Jul-2008	19:24:18	-7.842487e+000	4.985151e+001
POL_004_JC25_280.p	12-Jul-2008	19:28:56	-7.853680e+000	4.984423e+001
POL_004_JC25_281.p	12-Jul-2008	19:33:30	-7.864202e+000	4.983710e+001
POL_004_JC25_282.p	12-Jul-2008	19:38:14	-7.877938e+000	4.983674e+001
POL_004_JC25_283.p	12-Jul-2008	19:42:50	-7.879166e+000	4.984566e+001
POL_004_JC25_284.p	12-Jul-2008	19:47:40	-7.866068e+000	4.985352e+001
POL_004_JC25_285.p	12-Jul-2008	19:52:24	-7.854043e+000	4.986108e+001
POL_004_JC25_286.p	12-Jul-2008	19:57:04	-7.842172e+000	4.986859e+001
POL_004_JC25_287.p	12-Jul-2008	20:01:56	-7.829322e+000	4.987660e+001
POL_004_JC25_288.p	12-Jul-2008	20:08:24	-7.829331e+000	4.988798e+001
POL_004_JC25_289.p	12-Jul-2008	20:19:26	-7.855722e+000	4.987745e+001
POL_004_JC25_290.p	12-Jul-2008	20:24:34	-7.866056e+000	4.986952e+001
POL_004_JC25_291.p	12-Jul-2008	20:33:28	-7.885433e+000	4.985576e+001
POL_004_JC25_292.p	12-Jul-2008	20:38:12	-7.897875e+000	4.985311e+001
POL_004_JC25_293.p	12-Jul-2008	20:43:20	-7.905345e+000	4.986193e+001
POL_004_JC25_294.p	12-Jul-2008	20:52:40	-7.882022e+000	4.987687e+001
POL_004_JC25_295.p	12-Jul-2008	20:57:32	-7.868804e+000	4.988369e+001
POL_004_JC25_296.p	12-Jul-2008	21:02:32	-7.855243e+000	4.989090e+001
POL_004_JC25_297.p	12-Jul-2008	21:04:26	-7.848210e+000	4.989192e+001
POL_004_JC25_298.p	12-Jul-2008	21:07:24	-7.838810e+000	4.988964e+001
POL_004_JC25_299.p	12-Jul-2008	21:12:48	-7.821196e+000	4.989012e+001
POL_004_JC25_300.p	12-Jul-2008	21:17:42	-7.819198e+000	4.989926e+001
POL_004_JC25_301.p	12-Jul-2008	21:22:24	-7.830960e+000	4.990300e+001
POL_004_JC25_302.p	12-Jul-2008	21:27:26	-7.844716e+000	4.989838e+001
POL_004_JC25_303.p	12-Jul-2008	21:32:18	-7.858449e+000	4.989418e+001
POL_004_JC25_304.p	12-Jul-2008	21:37:18	-7.872873e+000	4.988953e+001
POL_004_JC25_305.p	12-Jul-2008	21:42:22	-7.882641e+000	4.988114e+001
POL_004_JC25_306.p	12-Jul-2008	21:47:40	-7.871911e+000	4.987064e+001
POL_004_JC25_307.p	12-Jul-2008	21:54:32	-7.852721e+000	4.985924e+001
POL_004_JC25_308.p	12-Jul-2008	22:43:00	-7.810210e+000	4.978638e+001
POL_004_JC25_309.p	12-Jul-2008	22:48:30	-7.817083e+000	4.978202e+001
POL_004_JC25_310.p	12-Jul-2008	22:53:40	-7.824659e+000	4.978132e+001
POL_004_JC25_311.p	12-Jul-2008	22:59:02	-7.833135e+000	4.978321e+001
POL_004_JC25_312.p	12-Jul-2008	23:04:46	-7.839230e+000	4.978585e+001
POL_004_JC25_313.p	12-Jul-2008	23:10:08	-7.840972e+000	4.978622e+001
POL_004_JC25_314.p	12-Jul-2008	23:15:32	-7.843543e+000	4.978704e+001
POL_004_JC25_315.p	12-Jul-2008	23:21:24	-7.846239e+000	4.978807e+001
POL_004_JC25_316.p	12-Jul-2008	23:29:08	-7.834473e+000	4.978767e+001
POL_004_JC25_317.p	12-Jul-2008	23:34:36	-7.819388e+000	4.978331e+001
POL_004_JC25_318.p	12-Jul-2008	23:40:08	-7.801550e+000	4.977831e+001
POL_004_JC25_319.p	12-Jul-2008	23:45:34	-7.782093e+000	4.977289e+001
POL_004_JC25_320.p	12-Jul-2008	23:50:42	-7.763073e+000	4.976761e+001
POL_004_JC25_321.p	12-Jul-2008	23:57:00	-7.739952e+000	4.976102e+001
POL_004_JC25_322.p	13-Jul-2008	00:04:18	-7.713066e+000	4.975383e+001
POL_004_JC25_323.p	13-Jul-2008	00:09:26	-7.693753e+000	4.975111e+001
POL_004_JC25_324.p	13-Jul-2008	00:14:34	-7.678407e+000	4.974666e+001
POL_004_JC25_325.p	13-Jul-2008	00:19:36	-7.667351e+000	4.974417e+001
POL_004_JC25_326.p	13-Jul-2008	00:25:12	-7.661164e+000	4.974653e+001
POL_004_JC25_327.p	13-Jul-2008	00:30:28	-7.665211e+000	4.974917e+001
POL_004_JC25_328.p	13-Jul-2008	00:35:32	-7.665098e+000	4.974897e+001
POL_004_JC25_329.p	13-Jul-2008	00:40:44	-7.665133e+000	4.974898e+001
POL_004_JC25_330.p	13-Jul-2008	00:42:46	-7.665165e+000	4.974900e+001
POL_004_JC25_331.p	13-Jul-2008	00:46:44	-7.665073e+000	4.974902e+001
POL_004_JC25_332.p	13-Jul-2008	00:51:36	-7.665118e+000	4.974900e+001
POL_004_JC25_333.p	13-Jul-2008	00:56:32	-7.665202e+000	4.974898e+001
POL_004_JC25_334.p	13-Jul-2008	01:01:52	-7.665128e+000	4.974897e+001
POL_004_JC25_335.p	13-Jul-2008	01:07:40	-7.665151e+000	4.974895e+001
POL_004_JC25_336.p	13-Jul-2008	01:12:52	-7.665098e+000	4.974899e+001
POL_004_JC25_337.p	13-Jul-2008	01:18:08	-7.665197e+000	4.974895e+001
POL_004_JC25_338.p	13-Jul-2008	01:23:38	-7.665147e+000	4.974902e+001
POL_004_JC25_339.p	13-Jul-2008	01:28:50	-7.665066e+000	4.974911e+001
POL_004_JC25_340.p	13-Jul-2008	01:34:34	-7.665281e+000	4.974963e+001
POL_004_JC25_341.p	13-Jul-2008	01:40:02	-7.665525e+000	4.974972e+001
POL_004_JC25_342.p	13-Jul-2008	01:45:10	-7.667988e+000	4.974963e+001
POL_004_JC25_343.p	13-Jul-2008	01:50:26	-7.667864e+000	4.974796e+001
POL_004_JC25_344.p	13-Jul-2008	01:56:08	-7.667205e+000	4.974607e+001
POL_004_JC25_345.p	13-Jul-2008	01:58:20	-7.667234e+000	4.974545e+001
POL_004_JC25_346.p	13-Jul-2008	02:01:50	-7.668217e+000	4.974501e+001
POL_004_JC25_347.p	13-Jul-2008	02:07:54	-7.668387e+000	4.974495e+001
POL_004_JC25_348.p	13-Jul-2008	02:13:00	-7.668488e+000	4.974503e+001
POL_004_JC25_349.p	13-Jul-2008	02:18:14	-7.668377e+000	4.974495e+001
POL_004_JC25_350.p	13-Jul-2008	02:23:10	-7.668392e+000	4.974490e+001
POL_004_JC25_351.p	13-Jul-2008	02:28:00	-7.668474e+000	4.974513e+001
POL_004_JC25_352.p	13-Jul-2008	02:33:14	-7.668571e+000	4.974556e+001
POL_004_JC25_353.p	13-Jul-2008	02:38:18	-7.668597e+000	4.974572e+001
POL_004_JC25_354.p	13-Jul-2008	02:42:58	-7.668606e+000	4.974586e+001
POL_004_JC25_355.p	13-Jul-2008	02:47:54	-7.668711e+000	4.974601e+001
POL_004_JC25_356.p	13-Jul-2008	02:52:46	-7.668744e+000	4.974627e+001
POL_004_JC25_357.p	13-Jul-2008	02:57:36	-7.668894e+000	4.974651e+001
POL_004_JC25_358.p	13-Jul-2008	03:02:24	-7.668925e+000	4.974677e+001
POL_004_JC25_359.p	13-Jul-2008	03:07:18	-7.668943e+000	4.974721e+001
POL_004_JC25_360.p	13-Jul-2008	03:12:22	-7.669014e+000	4.974733e+001
POL_004_JC25_361.p	13-Jul-2008	03:17:32	-7.669144e+000	4.974759e+001
POL_004_JC25_362.p	13-Jul-2008	03:19:28	-7.669139e+000	4.974769e+001
POL_004_JC25_363.p	13-Jul-2008	03:22:18	-7.669175e+000	4.974786e+001
POL_004_JC25_364.p	13-Jul-2008	03:27:22	-7.669274e+000	4.974812e+001
POL_004_JC25_365.p	13-Jul-2008	03:32:16	-7.669266e+000	4.974843e+001

POL_004_JC25_366.p	13-Jul-2008	03:37:00	-7.669301e+000	4.974903e+001
POL_004_JC25_367.p	13-Jul-2008	03:41:52	-7.669373e+000	4.974940e+001
POL_004_JC25_368.p	13-Jul-2008	03:46:34	-7.669494e+000	4.975000e+001
POL_004_JC25_369.p	13-Jul-2008	03:51:34	-7.669533e+000	4.975048e+001
POL_004_JC25_370.p	13-Jul-2008	03:56:30	-7.669500e+000	4.975112e+001
POL_004_JC25_371.p	13-Jul-2008	04:01:42	-7.669390e+000	4.975160e+001
POL_004_JC25_372.p	13-Jul-2008	04:06:40	-7.669334e+000	4.975213e+001
POL_004_JC25_373.p	13-Jul-2008	04:11:30	-7.669241e+000	4.975260e+001
POL_004_JC25_374.p	13-Jul-2008	04:14:06	-7.669029e+000	4.975281e+001
POL_004_JC25_375.p	13-Jul-2008	04:17:40	-7.668806e+000	4.975302e+001
POL_004_JC25_376.p	14-Jul-2008	12:56:58	-7.707678e+000	4.973797e+001
POL_004_JC25_377.p	14-Jul-2008	13:01:44	-7.695855e+000	4.974552e+001
POL_004_JC25_378.p	14-Jul-2008	13:06:22	-7.684595e+000	4.975312e+001
POL_004_JC25_379.p	14-Jul-2008	13:11:26	-7.672399e+000	4.976140e+001
POL_004_JC25_380.p	14-Jul-2008	13:16:18	-7.660551e+000	4.976897e+001
POL_004_JC25_381.p	14-Jul-2008	13:21:44	-7.647349e+000	4.977724e+001
POL_004_JC25_382.p	14-Jul-2008	13:26:58	-7.633987e+000	4.978546e+001
POL_004_JC25_383.p	14-Jul-2008	13:31:44	-7.622602e+000	4.979258e+001
POL_004_JC25_384.p	14-Jul-2008	13:36:24	-7.609263e+000	4.979775e+001
POL_004_JC25_385.p	14-Jul-2008	13:41:12	-7.596865e+000	4.979207e+001
POL_004_JC25_386.p	14-Jul-2008	13:46:08	-7.602527e+000	4.978280e+001
POL_004_JC25_387.p	14-Jul-2008	13:50:38	-7.612621e+000	4.977509e+001
POL_004_JC25_388.p	14-Jul-2008	13:55:30	-7.623793e+000	4.976713e+001
POL_004_JC25_389.p	14-Jul-2008	14:00:12	-7.635001e+000	4.975964e+001
POL_004_JC25_390.p	14-Jul-2008	14:04:44	-7.646013e+000	4.975253e+001
POL_004_JC25_391.p	14-Jul-2008	14:09:42	-7.658254e+000	4.974467e+001
POL_004_JC25_392.p	14-Jul-2008	14:14:24	-7.669824e+000	4.973735e+001
POL_004_JC25_393.p	14-Jul-2008	14:14:30	-7.670229e+000	4.973709e+001
POL_004_JC25_394.p	14-Jul-2008	14:20:16	-7.684658e+000	4.972787e+001
POL_004_JC25_395.p	14-Jul-2008	14:25:16	-7.697102e+000	4.972002e+001
POL_004_JC25_396.p	14-Jul-2008	14:31:26	-7.712544e+000	4.971024e+001
POL_004_JC25_397.p	14-Jul-2008	14:36:08	-7.728209e+000	4.970935e+001
POL_004_JC25_398.p	14-Jul-2008	14:41:00	-7.735210e+000	4.971910e+001
POL_004_JC25_399.p	14-Jul-2008	14:45:44	-7.725490e+000	4.972779e+001
POL_004_JC25_400.p	14-Jul-2008	14:50:42	-7.713161e+000	4.973576e+001
POL_004_JC25_401.p	14-Jul-2008	14:55:14	-7.702304e+000	4.974279e+001
POL_004_JC25_402.p	14-Jul-2008	14:59:38	-7.691479e+000	4.974989e+001
POL_004_JC25_403.p	14-Jul-2008	15:04:26	-7.679609e+000	4.975743e+001
POL_004_JC25_404.p	14-Jul-2008	15:09:16	-7.667412e+000	4.976472e+001
POL_004_JC25_405.p	14-Jul-2008	15:14:24	-7.654982e+000	4.977231e+001
POL_004_JC25_406.p	14-Jul-2008	15:19:44	-7.641691e+000	4.978030e+001
POL_004_JC25_407.p	14-Jul-2008	15:23:54	-7.631298e+000	4.978650e+001
POL_004_JC25_408.p	14-Jul-2008	15:28:30	-7.619557e+000	4.979342e+001
POL_004_JC25_409.p	14-Jul-2008	15:33:08	-7.605057e+000	4.979291e+001
POL_004_JC25_410.p	14-Jul-2008	15:37:38	-7.601083e+000	4.978469e+001
POL_004_JC25_411.p	14-Jul-2008	15:42:02	-7.608047e+000	4.977713e+001
POL_004_JC25_412.p	14-Jul-2008	15:46:38	-7.618202e+000	4.977013e+001
POL_004_JC25_413.p	14-Jul-2008	15:51:00	-7.627949e+000	4.976352e+001
POL_004_JC25_414.p	14-Jul-2008	15:55:22	-7.637792e+000	4.975702e+001
POL_004_JC25_415.p	14-Jul-2008	15:59:54	-7.648219e+000	4.975034e+001
POL_004_JC25_416.p	14-Jul-2008	16:03:58	-7.658020e+000	4.974431e+001
POL_004_JC25_417.p	14-Jul-2008	16:08:00	-7.667650e+000	4.973839e+001
POL_004_JC25_418.p	14-Jul-2008	16:11:52	-7.676939e+000	4.973276e+001
POL_004_JC25_419.p	14-Jul-2008	16:15:42	-7.686379e+000	4.972710e+001
POL_004_JC25_420.p	14-Jul-2008	16:19:30	-7.695773e+000	4.972137e+001
POL_004_JC25_421.p	14-Jul-2008	16:23:20	-7.704933e+000	4.971557e+001
POL_004_JC25_422.p	14-Jul-2008	16:27:10	-7.714234e+000	4.970992e+001
POL_004_JC25_423.p	14-Jul-2008	16:30:56	-7.726651e+000	4.970897e+001
POL_004_JC25_424.p	14-Jul-2008	16:34:54	-7.734648e+000	4.971525e+001
POL_004_JC25_425.p	14-Jul-2008	16:39:04	-7.730176e+000	4.972365e+001
POL_004_JC25_426.p	14-Jul-2008	16:43:08	-7.720257e+000	4.973039e+001
POL_004_JC25_427.p	14-Jul-2008	16:47:08	-7.710539e+000	4.973694e+001
POL_004_JC25_428.p	14-Jul-2008	16:51:12	-7.700660e+000	4.974326e+001
POL_004_JC25_429.p	14-Jul-2008	16:55:12	-7.690919e+000	4.974961e+001
POL_004_JC25_430.p	14-Jul-2008	16:59:16	-7.680707e+000	4.975617e+001
POL_004_JC25_431.p	14-Jul-2008	17:03:16	-7.670948e+000	4.976255e+001
POL_004_JC25_432.p	14-Jul-2008	17:07:16	-7.661151e+000	4.976891e+001
POL_004_JC25_433.p	14-Jul-2008	17:11:30	-7.650623e+000	4.977533e+001
POL_004_JC25_434.p	14-Jul-2008	17:15:20	-7.640974e+000	4.978124e+001
POL_004_JC25_435.p	14-Jul-2008	17:19:12	-7.631290e+000	4.978705e+001
POL_004_JC25_436.p	14-Jul-2008	17:23:10	-7.621404e+000	4.979324e+001
POL_004_JC25_437.p	14-Jul-2008	17:27:06	-7.610295e+000	4.979813e+001
POL_004_JC25_438.p	14-Jul-2008	17:30:52	-7.598749e+000	4.979604e+001
POL_004_JC25_439.p	14-Jul-2008	17:34:54	-7.594764e+000	4.978812e+001
POL_004_JC25_440.p	14-Jul-2008	17:38:54	-7.602012e+000	4.978093e+001
POL_004_JC25_441.p	14-Jul-2008	17:42:46	-7.611165e+000	4.977451e+001
POL_004_JC25_442.p	14-Jul-2008	17:46:50	-7.620558e+000	4.976813e+001
POL_004_JC25_443.p	14-Jul-2008	17:50:52	-7.629877e+000	4.976175e+001
POL_004_JC25_444.p	14-Jul-2008	17:54:54	-7.639184e+000	4.975533e+001
POL_004_JC25_445.p	14-Jul-2008	17:58:44	-7.648202e+000	4.974930e+001
POL_004_JC25_446.p	14-Jul-2008	18:02:28	-7.657566e+000	4.974347e+001
POL_004_JC25_447.p	14-Jul-2008	18:06:10	-7.666610e+000	4.973793e+001
POL_004_JC25_448.p	14-Jul-2008	18:10:06	-7.676462e+000	4.973202e+001
POL_004_JC25_449.p	14-Jul-2008	18:13:46	-7.685636e+000	4.972672e+001
POL_004_JC25_450.p	14-Jul-2008	18:17:32	-7.694988e+000	4.972148e+001
POL_004_JC25_451.p	14-Jul-2008	18:21:20	-7.704401e+000	4.971576e+001
POL_004_JC25_452.p	14-Jul-2008	18:25:14	-7.713754e+000	4.971001e+001
POL_004_JC25_453.p	14-Jul-2008	18:29:00	-7.723375e+000	4.970435e+001
POL_004_JC25_454.p	14-Jul-2008	18:32:48	-7.735586e+000	4.970350e+001
POL_004_JC25_455.p	14-Jul-2008	18:36:26	-7.743426e+000	4.970920e+001
POL_004_JC25_456.p	14-Jul-2008	18:40:16	-7.740084e+000	4.971701e+001
POL_004_JC25_457.p	14-Jul-2008	18:44:10	-7.730722e+000	4.972305e+001
POL_004_JC25_458.p	14-Jul-2008	18:47:52	-7.721835e+000	4.972895e+001
POL_004_JC25_459.p	14-Jul-2008	19:48:04	-7.613456e+000	4.977374e+001
POL_004_JC25_460.p	14-Jul-2008	19:52:08	-7.623702e+000	4.976709e+001
POL_004_JC25_461.p	14-Jul-2008	19:55:56	-7.633152e+000	4.976103e+001
POL_004_JC25_462.p	14-Jul-2008	19:59:42	-7.642176e+000	4.975532e+001
POL_004_JC25_463.p	14-Jul-2008	20:04:28	-7.654098e+000	4.974794e+001
POL_004_JC25_464.p	14-Jul-2008	20:08:54	-7.664547e+000	4.974125e+001
POL_004_JC25_465.p	14-Jul-2008	20:13:04	-7.674530e+000	4.973490e+001
POL_004_JC25_466.p	14-Jul-2008	20:17:52	-7.686173e+000	4.972748e+001
POL_004_JC25_467.p	14-Jul-2008	20:22:22	-7.696888e+000	4.972050e+001
POL_004_JC25_468.p	14-Jul-2008	20:26:50	-7.707555e+000	4.971351e+001
POL_004_JC25_469.p	14-Jul-2008	20:31:06	-7.717646e+000	4.970686e+001
POL_004_JC25_470.p	14-Jul-2008	20:35:58	-7.731117e+000	4.970198e+001
POL_004_JC25_471.p	14-Jul-2008	20:40:14	-7.742518e+000	4.970628e+001
POL_004_JC25_472.p	14-Jul-2008	20:44:24	-7.749643e+000	4.971410e+001
POL_004_JC25_473.p	14-Jul-2008	20:46:04	-7.752231e+000	4.971734e+001
POL_004_JC25_474.p	14-Jul-2008	20:48:34	-7.756421e+000	4.972210e+001
POL_004_JC25_475.p	14-Jul-2008	20:52:52	-7.764154e+000	4.973012e+001
POL_004_JC25_476.p	14-Jul-2008	20:56:58	-7.772946e+000	4.973718e+001
POL_004_JC25_477.p	14-Jul-2008	21:01:02	-7.782063e+000	4.974366e+001
POL_004_JC25_478.p	14-Jul-2008	21:05:08	-7.791793e+000	4.975029e+001
POL_004_JC25_479.p	14-Jul-2008	21:09:12	-7.800961e+000	4.975676e+001
POL_004_JC25_480.p	14-Jul-2008	21:13:40	-7.811146e+000	4.976410e+001
POL_004_JC25_481.p	14-Jul-2008	21:36:20	-7.863520e+000	4.980074e+001
POL_004_JC25_482.p	14-Jul-2008	21:38:10	-7.867941e+000	4.980372e+001
POL_004_JC25_483.p	14-Jul-2008	21:40:38	-7.873870e+000	4.980775e+001
POL_004_JC25_484.p	14-Jul-2008	21:44:52	-7.883723e+000	4.981463e+001
POL_004_JC25_485.p	14-Jul-2008	21:49:14	-7.893808e+000	4.982184e+001
POL_004_JC25_486.p	14-Jul-2008	21:53:26	-7.903436e+000	4.982935e+001
POL_004_JC25_487.p	14-Jul-2008	21:57:54	-7.912775e+000	4.983686e+001
POL_004_JC25_488.p	14-Jul-2008	22:02:14	-7.921918e+000	4.984436e+001
POL_004_JC25_489.p	14-Jul-2008	22:06:42	-7.931499e+000	4.985206e+001
POL_004_JC25_490.p	14-Jul-2008	22:11:06	-7.940816e+000	4.985991e+001
POL_004_JC25_491.p	14-Jul-2008	22:15:16	-7.949491e+000	4.986710e+001
POL_004_JC25_492.p	14-Jul-2008	22:19:26	-7.958620e+000	4.987394e+001
POL_004_JC25_493.p	14-Jul-2008	22:23:44	-7.968501e+000	4.988041e+001
POL_004_JC25_494.p	14-Jul-2008	22:27:50	-7.978553e+000	4.988683e+001
POL_004_JC25_495.p	14-Jul-2008	22:34:04	-7.993399e+000	4.989637e+001
POL_004_JC25_496.p	14-Jul-2008	22:36:50	-8.000328e+000	4.990074e+001
POL_004_JC25_497.p	14-Jul-2008	22:37:50	-8.002743e+000	4.990229e+001
POL_004_JC25_498.p	14-Jul-2008	22:51:12	-8.035045e+000	4.992301e+001
POL_004_JC25_499.p	14-Jul-2008	22:55:32	-8.045516e+000	4.992958e+001
POL_004_JC25_500.p	14-Jul-2008	23:00:10	-8.056812e+000	4.993676e+001
POL_004_JC25_501.p	14-Jul-2008	23:05:04	-8.068487e+000	4.994436e+001
POL_004_JC25_502.p	14-Jul-2008	23:09:42	-8.079398e+000	4.995195e+001
POL_004_JC25_503.p	14-Jul-2008	23:14:16	-8.090382e+000	4.995954e+001
POL_004_JC25_504.p	14-Jul-2008	23:18:42	-8.100473e+000	4.996658e+001
POL_004_JC25_505.p	14-Jul-2008	23:23:12	-8.111077e+000	4.997379e+001
POL_004_JC25_506.p	14-Jul-2008	23:27:30	-8.121289e+000	4.998077e+001
POL_004_JC25_507.p	14-Jul-2008	23:31:54	-8.131375e+000	4.998779e+001
POL_004_JC25_508.p	14-Jul-2008	23:36:54	-8.142291e+000	4.999638e+001
POL_004_JC25_509.p	14-Jul-2008	23:41:26	-8.138293e+000	5.000604e+001
POL_004_JC25_510.p	14-Jul-2008	23:46:20	-8.126125e+000	5.001360e+001
POL_004_JC25_511.p	14-Jul-2008	23:51:04	-8.114427e+000	5.002087e+001
POL_004_JC25_512.p	14-Jul-2008	23:55:54	-8.102341e+000	5.002855e+001
POL_004_JC25_513.p	15-Jul-2008	00:01:46	-8.087321e+000	5.003768e+001
POL_004_JC25_514.p	15-Jul-2008	00:06:30	-8.075529e+000	5.004493e+001
POL_004_JC25_515.p	15-Jul-2008	00:10:50	-8.064478e+000	5.005138e+001
POL_004_JC25_516.p	15-Jul-2008	00:15:22	-8.052703e+000	5.005805e+001
POL_004_JC25_517.p	15-Jul-2008	00:19:46	-8.041015e+000	5.006466e+001
POL_004_JC25_518.p	15-Jul-2008	00:24:10	-8.029634e+000	5.007090e+001
POL_004_JC25_519.p	15-Jul-2008	00:28:38	-8.017353e+000	5.007733e+001
POL_004_JC25_520.p	15-Jul-2008	00:32:52	-8.003630e+000	5.007701e+001
POL_004_JC25_521.p	15-Jul-2008	00:37:14	-7.993662e+000	5.006988e+001
POL_004_JC25_522.p	15-Jul-2008	00:41:44	-7.984027e+000	5.006187e+001
POL_004_JC25_523.p	15-Jul-2008	00:46:00	-7.974517e+000	5.005422e+001
POL_004_JC25_524.p	15-Jul-2008	00:50:28	-7.963862e+000	5.004675e+001
POL_004_JC25_525.p	15-Jul-2008	00:54:52	-7.953491e+000	5.003956e+001
POL_004_JC25_526.p	15-Jul-2008	00:59:40	-7.942447e+000	5.003151e+001
POL_004_JC25_527.p	15-Jul-2008	01:04:42	-7.931017e+000	5.002314e+001
POL_004_JC25_528.p	15-Jul-2008	01:09:38	-7.919533e+000	5.001480e+001
POL_004_JC25_529.p	15-Jul-2008	01:14:34	-7.908428e+000	5.000680e+001
POL_004_JC25_530.p	15-Jul-2008	01:19:24	-7.897244e+000	4.999896e+001
POL_004_JC25_531.p	15-Jul-2008	01:24:48	-7.884655e+000	4.999000e+001
POL_004_JC25_532.p	15-Jul-2008	01:29:56	-7.872804e+000	4.998162e+001
POL_004_JC25_533.p	15-Jul-2008	01:36:12	-7.858649e+000	4.997141e+001
POL_004_JC25_534.p	15-Jul-2008	01:39:44	-7.850597e+000	4.996557e+001
POL_004_JC25_535.p	15-Jul-2008	01:59:34	-7.791662e+000	4.995194e+001
POL_004_JC25_536.p	15-Jul-2008	02:00:54	-7.789147e+000	4.994956e+001
POL_004_JC25_537.p	15-Jul-2008	02:01:32	-7.788416e+000	4.994822e+001
POL_004_JC25_539.p	21-Jul-2008	09:00:50	-7.617364e+000	4.979313e+001
POL_004_JC25_540.p	21-Jul-2008	09:05:04	-7.628006e+000	4.978702e+001
POL_004_JC25_541.p	21-Jul-2008	09:10:26	-7.641403e+000	4.977897e+001
POL_004_JC25_542.p	21-Jul-2008	09:16:02	-7.653055e+000	4.976988e+001
POL_004_JC25_543.p	21-Jul-2008	09:21:06	-7.666017e+000	4.976300e+001
POL_004_JC25_544.p	21-Jul-2008	09:27:18	-7.681140e+000	4.975374e+001
POL_004_JC25_545.p	21-Jul-2008	09:35:02	-7.700166e+000	4.974227e+001
POL_004_JC25_546.p	21-Jul-2008	09:41:14	-7.715300e+000	4.973298e+001
POL_004_JC25_547.p	21-Jul-2008	09:46:32	-7.728693e+000	4.972511e+001
POL_004_JC25_548.p	21-Jul-2008	09:51:42	-7.734492e+000	4.971550e+001
POL_004_JC25_549.p	21-Jul-2008	09:57:16	-7.721067e+000	4.970801e+001
POL_004_JC25_550.p	21-Jul-2008	10:02:36	-7.708952e+000	4.971384e+001
POL_004_JC25_551.p	21-Jul-2008	10:08:18	-7.695513e+000	4.972183e+001
POL_004_JC25_552.p	21-Jul-2008	10:13:34	-7.683546e+000	4.972930e+001
POL_004_JC25_553.p	21-Jul-2008	10:18:54	-7.671189e+000	4.973704e+001
POL_004_JC25_554.p	21-Jul-2008	10:24:20	-7.658503e+000	4.974502e+001
POL_004_JC25_555.p	21-Jul-2008	10:29:46	-7.645752e+000	4.975296e+001
POL_004_JC25_556.p	21-Jul-2008	10:35:06	-7.633525e+000	4.976078e+001
POL_004_JC25_557.p	21-Jul-2008	10:40:32	-7.621279e+000	4.976888e+001
POL_004_JC25_558.p	21-Jul-2008	10:46:14	-7.608313e+000	4.977753e+001
POL_004_JC25_559.p	21-Jul-2008	10:51:54	-7.596425e+000	4.978578e+001
POL_004_JC25_560.p	21-Jul-2008	10:56:46	-7.602341e+000	4.979389e+001
POL_004_JC25_561.p	21-Jul-2008	11:09:58	-7.636267e+000	4.978223e+001
POL_004_JC25_562.p	21-Jul-2008	11:15:46	-7.650072e+000	4.977386e+001

POL_004_JC25_563.p	21-Jul-2008	11:21:30	-7.663482e+000	4.976585e+001
POL_004_JC25_564.p	21-Jul-2008	11:24:38	-7.671143e+000	4.976139e+001
POL_004_JC25_565.p	21-Jul-2008	11:27:18	-7.677451e+000	4.975752e+001
POL_004_JC25_566.p	21-Jul-2008	11:32:56	-7.690415e+000	4.974898e+001
POL_004_JC25_567.p	21-Jul-2008	11:38:32	-7.702720e+000	4.974064e+001
POL_004_JC25_568.p	21-Jul-2008	11:44:28	-7.715651e+000	4.973195e+001
POL_004_JC25_569.p	21-Jul-2008	11:50:06	-7.727826e+000	4.972369e+001
POL_004_JC25_570.p	21-Jul-2008	11:55:40	-7.734274e+000	4.971442e+001
POL_004_JC25_571.p	21-Jul-2008	12:01:16	-7.723147e+000	4.970844e+001
POL_004_JC25_572.p	21-Jul-2008	12:06:28	-7.711447e+000	4.971318e+001
POL_004_JC25_573.p	21-Jul-2008	12:11:30	-7.698138e+000	4.971879e+001
POL_004_JC25_574.p	21-Jul-2008	12:16:28	-7.686819e+000	4.972611e+001
POL_004_JC25_575.p	21-Jul-2008	12:21:28	-7.675446e+000	4.973351e+001
POL_004_JC25_576.p	21-Jul-2008	12:26:28	-7.663730e+000	4.974079e+001
POL_004_JC25_577.p	21-Jul-2008	12:31:22	-7.652387e+000	4.974793e+001
POL_004_JC25_578.p	21-Jul-2008	12:36:16	-7.641416e+000	4.975508e+001
POL_004_JC25_579.p	21-Jul-2008	12:40:52	-7.631847e+000	4.976155e+001
POL_004_JC25_580.p	21-Jul-2008	12:45:30	-7.621770e+000	4.976848e+001
POL_004_JC25_581.p	21-Jul-2008	12:50:08	-7.611752e+000	4.977537e+001
POL_004_JC25_582.p	21-Jul-2008	12:54:44	-7.602238e+000	4.978193e+001
POL_004_JC25_583.p	21-Jul-2008	13:00:08	-7.603055e+000	4.979116e+001
POL_004_JC25_584.p	21-Jul-2008	13:04:58	-7.617248e+000	4.979317e+001
POL_004_JC25_585.p	21-Jul-2008	13:09:50	-7.629088e+000	4.978710e+001
POL_004_JC25_586.p	21-Jul-2008	13:14:36	-7.639463e+000	4.977975e+001
POL_004_JC25_587.p	21-Jul-2008	13:19:34	-7.650536e+000	4.977266e+001
POL_004_JC25_588.p	21-Jul-2008	13:24:20	-7.661427e+000	4.976586e+001
POL_004_JC25_589.p	21-Jul-2008	13:29:06	-7.672350e+000	4.975884e+001
POL_004_JC25_590.p	21-Jul-2008	13:33:42	-7.682211e+000	4.975247e+001
POL_004_JC25_591.p	21-Jul-2008	13:38:26	-7.692876e+000	4.974560e+001
POL_004_JC25_592.p	21-Jul-2008	13:41:02	-7.698562e+000	4.974182e+001
POL_004_JC25_593.p	21-Jul-2008	13:44:46	-7.707227e+000	4.973620e+001
POL_004_JC25_594.p	21-Jul-2008	13:47:18	-7.712756e+000	4.973268e+001
POL_004_JC25_595.p	21-Jul-2008	13:49:50	-7.718221e+000	4.972907e+001
POL_004_JC25_596.p	21-Jul-2008	13:54:46	-7.729866e+000	4.972218e+001
POL_004_JC25_597.p	21-Jul-2008	13:59:46	-7.738511e+000	4.971407e+001
POL_004_JC25_598.p	21-Jul-2008	14:52:08	-7.618414e+000	4.977002e+001
POL_004_JC25_599.p	21-Jul-2008	14:57:24	-7.606992e+000	4.977783e+001
POL_004_JC25_600.p	21-Jul-2008	15:02:16	-7.599349e+000	4.978606e+001
POL_004_JC25_601.p	21-Jul-2008	15:02:18	-7.599349e+000	4.978606e+001
POL_004_JC25_602.p	21-Jul-2008	15:07:18	-7.607744e+000	4.979373e+001
POL_004_JC25_603.p	21-Jul-2008	15:12:16	-7.621741e+000	4.979144e+001
POL_004_JC25_604.p	21-Jul-2008	15:18:08	-7.634696e+000	4.978310e+001
POL_004_JC25_605.p	21-Jul-2008	15:24:16	-7.648227e+000	4.977394e+001
POL_004_JC25_606.p	21-Jul-2008	15:28:54	-7.658289e+000	4.976738e+001
POL_004_JC25_607.p	21-Jul-2008	15:34:30	-7.671046e+000	4.975913e+001
POL_004_JC25_608.p	21-Jul-2008	15:39:14	-7.681506e+000	4.975223e+001
POL_004_JC25_609.p	21-Jul-2008	15:44:22	-7.693097e+000	4.974471e+001
POL_004_JC25_610.p	21-Jul-2008	15:49:18	-7.704189e+000	4.973749e+001
POL_004_JC25_611.p	21-Jul-2008	15:55:42	-7.718426e+000	4.972843e+001
POL_004_JC25_612.p	21-Jul-2008	16:00:08	-7.728396e+000	4.972205e+001
POL_004_JC25_613.p	21-Jul-2008	16:05:48	-7.736937e+000	4.971279e+001
POL_004_JC25_614.p	21-Jul-2008	16:11:56	-7.720499e+000	4.970669e+001
POL_004_JC25_615.p	21-Jul-2008	16:16:56	-7.707677e+000	4.971435e+001
POL_004_JC25_616.p	21-Jul-2008	16:22:02	-7.694933e+000	4.972234e+001
POL_004_JC25_617.p	21-Jul-2008	16:27:00	-7.682104e+000	4.973021e+001
POL_004_JC25_618.p	21-Jul-2008	16:32:02	-7.669377e+000	4.973772e+001
POL_004_JC25_619.p	21-Jul-2008	16:37:00	-7.656732e+000	4.974530e+001
POL_004_JC25_620.p	21-Jul-2008	16:42:12	-7.643785e+000	4.975318e+001
POL_004_JC25_621.p	21-Jul-2008	16:47:54	-7.629554e+000	4.976218e+001
POL_004_JC25_622.p	21-Jul-2008	16:53:14	-7.616530e+000	4.977097e+001
POL_004_JC25_623.p	21-Jul-2008	16:58:34	-7.603498e+000	4.977974e+001
POL_004_JC25_624.p	21-Jul-2008	17:03:48	-7.595660e+000	4.978958e+001
POL_004_JC25_625.p	21-Jul-2008	17:09:08	-7.607921e+000	4.979643e+001
POL_004_JC25_626.p	21-Jul-2008	17:14:58	-7.622778e+000	4.978993e+001
POL_004_JC25_627.p	21-Jul-2008	17:20:22	-7.635010e+000	4.978179e+001
POL_004_JC25_628.p	21-Jul-2008	17:26:02	-7.648504e+000	4.977332e+001
POL_004_JC25_629.p	21-Jul-2008	17:31:54	-7.662185e+000	4.976466e+001
POL_004_JC25_630.p	21-Jul-2008	17:37:28	-7.675701e+000	4.975642e+001
POL_004_JC25_631.p	21-Jul-2008	17:44:14	-7.691518e+000	4.974659e+001
POL_004_JC25_632.p	21-Jul-2008	17:49:20	-7.703746e+000	4.973909e+001
POL_004_JC25_633.p	21-Jul-2008	17:55:20	-7.717707e+000	4.973018e+001
POL_004_JC25_634.p	21-Jul-2008	18:01:12	-7.731250e+000	4.972152e+001
POL_004_JC25_635.p	21-Jul-2008	18:07:04	-7.737113e+000	4.971120e+001
POL_004_JC25_636.p	21-Jul-2008	18:12:44	-7.720015e+000	4.970759e+001
POL_004_JC25_637.p	21-Jul-2008	18:18:20	-7.704901e+000	4.971659e+001
POL_004_JC25_638.p	21-Jul-2008	18:24:00	-7.689666e+000	4.972539e+001
POL_004_JC25_639.p	21-Jul-2008	18:29:46	-7.675300e+000	4.973360e+001
POL_004_JC25_640.p	21-Jul-2008	18:35:26	-7.661287e+000	4.974174e+001
POL_004_JC25_641.p	21-Jul-2008	18:41:40	-7.646564e+000	4.975113e+001
POL_004_JC25_642.p	21-Jul-2008	18:47:12	-7.633580e+000	4.975958e+001
POL_004_JC25_643.p	21-Jul-2008	18:53:02	-7.620347e+000	4.976876e+001
POL_004_JC25_644.p	21-Jul-2008	18:58:40	-7.607752e+000	4.977776e+001
POL_004_JC25_645.p	21-Jul-2008	19:05:38	-7.600635e+000	4.978954e+001
POL_004_JC25_646.p	21-Jul-2008	19:11:16	-7.615165e+000	4.979542e+001
POL_004_JC25_647.p	21-Jul-2008	19:16:46	-7.631823e+000	4.979828e+001
POL_004_JC25_648.p	21-Jul-2008	19:22:24	-7.645637e+000	4.979021e+001
POL_004_JC25_649.p	21-Jul-2008	19:27:50	-7.658512e+000	4.978149e+001
POL_004_JC25_650.p	21-Jul-2008	19:33:20	-7.671035e+000	4.977325e+001
POL_004_JC25_651.p	21-Jul-2008	19:38:52	-7.683824e+000	4.976502e+001
POL_004_JC25_652.p	21-Jul-2008	19:44:22	-7.696312e+000	4.975677e+001
POL_004_JC25_653.p	21-Jul-2008	19:50:32	-7.711246e+000	4.974846e+001
POL_004_JC25_654.p	21-Jul-2008	19:56:14	-7.724862e+000	4.975395e+001
POL_004_JC25_655.p	21-Jul-2008	20:02:56	-7.740254e+000	4.976483e+001
POL_004_JC25_656.p	21-Jul-2008	20:08:36	-7.752720e+000	4.977377e+001
POL_004_JC25_657.p	21-Jul-2008	20:14:26	-7.765831e+000	4.978304e+001
POL_004_JC25_658.p	21-Jul-2008	20:21:14	-7.780288e+000	4.979336e+001
POL_004_JC25_659.p	21-Jul-2008	20:26:58	-7.793123e+000	4.980238e+001
POL_004_JC25_660.p	21-Jul-2008	20:33:10	-7.806788e+000	4.981172e+001
POL_004_JC25_661.p	21-Jul-2008	20:39:00	-7.819812e+000	4.982101e+001
POL_004_JC25_662.p	21-Jul-2008	20:44:26	-7.832147e+000	4.982974e+001
POL_004_JC25_663.p	21-Jul-2008	20:51:28	-7.844471e+000	4.983824e+001
POL_004_JC25_664.p	21-Jul-2008	20:57:26	-7.855015e+000	4.984534e+001
POL_004_JC25_665.p	21-Jul-2008	21:50:24	-7.992165e+000	4.991822e+001
POL_004_JC25_666.p	21-Jul-2008	21:56:46	-8.009823e+000	4.992740e+001
POL_004_JC25_667.p	21-Jul-2008	22:02:58	-8.025978e+000	4.993644e+001
POL_004_JC25_668.p	21-Jul-2008	22:07:50	-8.032725e+000	4.994388e+001
POL_004_JC25_669.p	21-Jul-2008	22:13:26	-8.039392e+000	4.995091e+001
POL_004_JC25_670.p	21-Jul-2008	22:19:10	-8.044384e+000	4.995574e+001
POL_004_JC25_671.p	21-Jul-2008	22:24:30	-8.047796e+000	4.995887e+001
POL_004_JC25_672.p	21-Jul-2008	22:30:08	-8.055553e+000	4.996327e+001
POL_004_JC25_673.p	21-Jul-2008	22:35:26	-8.062803e+000	4.996639e+001
POL_004_JC25_674.p	21-Jul-2008	22:40:54	-8.074461e+000	4.997109e+001
POL_004_JC25_675.p	21-Jul-2008	22:46:08	-8.089180e+000	4.997721e+001
POL_004_JC25_676.p	21-Jul-2008	22:51:44	-8.104747e+000	4.998398e+001
POL_004_JC25_677.p	21-Jul-2008	22:54:26	-8.112679e+000	4.998743e+001
POL_004_JC25_678.p	21-Jul-2008	22:54:36	-8.113153e+000	4.998767e+001
POL_004_JC25_679.p	21-Jul-2008	22:57:02	-8.119850e+000	4.999055e+001
POL_004_JC25_680.p	21-Jul-2008	23:03:04	-8.138912e+000	4.999485e+001
POL_004_JC25_681.p	21-Jul-2008	23:08:54	-8.148163e+000	4.998578e+001
POL_004_JC25_682.p	21-Jul-2008	23:14:48	-8.149109e+000	4.997229e+001
POL_004_JC25_683.p	21-Jul-2008	23:20:28	-8.149430e+000	4.995978e+001
POL_004_JC25_684.p	21-Jul-2008	23:26:30	-8.149969e+000	4.994652e+001
POL_004_JC25_685.p	21-Jul-2008	23:32:46	-8.149690e+000	4.993292e+001
POL_004_JC25_686.p	21-Jul-2008	23:38:42	-8.149705e+000	4.992031e+001
POL_004_JC25_687.p	21-Jul-2008	23:45:00	-8.149372e+000	4.990658e+001
POL_004_JC25_688.p	21-Jul-2008	23:48:00	-8.149218e+000	4.990011e+001
POL_004_JC25_689.p	21-Jul-2008	23:50:36	-8.149369e+000	4.989405e+001
POL_004_JC25_690.p	21-Jul-2008	23:56:20	-8.149798e+000	4.988145e+001
POL_004_JC25_691.p	22-Jul-2008	00:02:10	-8.150222e+000	4.986899e+001
POL_004_JC25_692.p	22-Jul-2008	00:07:08	-8.150341e+000	4.985831e+001
POL_004_JC25_693.p	22-Jul-2008	00:12:32	-8.150274e+000	4.984669e+001

**********start of MSS90 data**

jc250005.mrd	21-Jun-2008	23:55:02	-1.394698e+000	5.089169e+001
jc250006.mrd	22-Jun-2008	00:01:32	-1.394698e+000	5.089169e+001
jc250007.mrd	22-Jun-2008	00:16:00	-1.394698e+000	5.089169e+001
jc250008.mrd	22-Jun-2008	00:20:50	-1.394698e+000	5.089169e+001
jc250009.mrd	22-Jun-2008	00:25:04	-1.394698e+000	5.089169e+001
jc250010.mrd	22-Jun-2008	00:28:54	-1.394698e+000	5.089169e+001
jc250011.mrd	22-Jun-2008	00:37:38	-1.394698e+000	5.089169e+001
jc250012.mrd	22-Jun-2008	00:41:30	-1.394698e+000	5.089169e+001
jc250013.mrd	22-Jun-2008	00:45:00	-1.394698e+000	5.089169e+001
jc250014.mrd	22-Jun-2008	01:05:44	-1.394698e+000	5.089169e+001
jc250015.mrd	22-Jun-2008	01:09:14	-1.394698e+000	5.089169e+001
jc250016.mrd	22-Jun-2008	01:12:36	-1.394698e+000	5.089169e+001
jc250017.mrd	22-Jun-2008	01:16:52	-1.394698e+000	5.089169e+001
jc250018.mrd	22-Jun-2008	01:23:28	-1.394698e+000	5.089169e+001
jc250019.mrd	22-Jun-2008	01:27:10	-1.394698e+000	5.089169e+001
jc250020.mrd	22-Jun-2008	01:34:34	-1.394698e+000	5.089169e+001
jc250021.mrd	22-Jun-2008	01:38:18	-1.394698e+000	5.089169e+001
jc250022.mrd	22-Jun-2008	01:41:54	-1.394698e+000	5.089169e+001
jc250023.mrd	22-Jun-2008	01:45:22	-1.394698e+000	5.089169e+001
jc250024.mrd	22-Jun-2008	01:48:42	-1.394698e+000	5.089169e+001
jc250025.mrd	22-Jun-2008	01:52:14	-1.394698e+000	5.089169e+001
jc250026.mrd	22-Jun-2008	01:56:00	-1.394698e+000	5.089169e+001
jc250027.mrd	22-Jun-2008	01:59:26	-1.394698e+000	5.089169e+001
jc250028.mrd	22-Jun-2008	02:03:12	-1.394698e+000	5.089169e+001
jc250029.mrd	22-Jun-2008	02:06:22	-1.394698e+000	5.089169e+001
jc250030.mrd	22-Jun-2008	02:10:02	-1.394698e+000	5.089169e+001
jc250031.mrd	22-Jun-2008	02:13:52	-1.394698e+000	5.089169e+001
jc250032.mrd	22-Jun-2008	02:17:18	-1.394698e+000	5.089169e+001
jc250033.mrd	22-Jun-2008	02:20:50	-1.394698e+000	5.089169e+001
jc250034.mrd	22-Jun-2008	02:24:38	-1.394698e+000	5.089169e+001
jc250035.mrd	22-Jun-2008	02:28:14	-1.394698e+000	5.089169e+001
jc250036.mrd	22-Jun-2008	02:31:46	-1.394698e+000	5.089169e+001
jc250037.mrd	22-Jun-2008	02:35:16	-1.394698e+000	5.089169e+001
jc250038.mrd	22-Jun-2008	02:38:52	-1.394698e+000	5.089169e+001
jc250039.mrd	22-Jun-2008	02:42:24	-1.394698e+000	5.089169e+001
jc250040.mrd	22-Jun-2008	02:46:14	-1.394698e+000	5.089169e+001
jc250041.mrd	22-Jun-2008	02:49:44	-1.394698e+000	5.089169e+001
jc250042.mrd	22-Jun-2008	02:55:32	-1.394698e+000	5.089169e+001
jc250043.mrd	22-Jun-2008	02:59:22	-1.394698e+000	5.089169e+001
jc250044.mrd	22-Jun-2008	03:03:16	-1.394698e+000	5.089169e+001
jc250045.mrd	22-Jun-2008	03:07:08	-1.394698e+000	5.089169e+001
jc250046.mrd	22-Jun-2008	03:10:54	-1.394698e+000	5.089169e+001
jc250047.mrd	22-Jun-2008	03:14:34	-1.394698e+000	5.089169e+001
jc250048.mrd	22-Jun-2008	03:18:10	-1.394698e+000	5.089169e+001
jc250049.mrd	22-Jun-2008	03:22:00	-1.394698e+000	5.089169e+001
jc250050.mrd	22-Jun-2008	03:27:12	-1.394698e+000	5.089169e+001
jc250051.mrd	22-Jun-2008	03:29:20	-1.394698e+000	5.089169e+001
jc250052.mrd	22-Jun-2008	03:33:06	-1.394698e+000	5.089169e+001
jc250053.mrd	22-Jun-2008	03:36:44	-1.394698e+000	5.089169e+001
jc250054.mrd	22-Jun-2008	03:40:16	-1.394698e+000	5.089169e+001
jc250055.mrd	22-Jun-2008	03:44:00	-1.394698e+000	5.089169e+001

**************end of MSS90 data**

POL_004_JC25_697.p	22-Jul-2008	04:57:36	-7.932486e+000	4.984876e+001
POL_004_JC25_698.p	22-Jul-2008	05:02:44	-7.932714e+000	4.984871e+001
POL_004_JC25_699.p	22-Jul-2008	05:07:58	-7.933573e+000	4.984815e+001
POL_004_JC25_700.p	22-Jul-2008	05:13:30	-7.934308e+000	4.984776e+001
POL_004_JC25_701.p	22-Jul-2008	05:18:50	-7.932841e+000	4.984678e+001
POL_004_JC25_702.p	22-Jul-2008	05:24:20	-7.930294e+000	4.984782e+001
POL_004_JC25_703.p	22-Jul-2008	05:29:42	-7.924255e+000	4.985203e+001
POL_004_JC25_704.p	22-Jul-2008	05:35:18	-7.915017e+000	4.985837e+001
POL_004_JC25_705.p	22-Jul-2008	05:40:50	-7.905301e+000	4.986559e+001
POL_004_JC25_706.p	22-Jul-2008	05:46:38	-7.894981e+000	4.987328e+001
POL_004_JC25_707.p	22-Jul-2008	05:52:06	-7.885961e+000	4.988086e+001
POL_004_JC25_708.p	22-Jul-2008	05:57:46	-7.877413e+000	4.988883e+001

POL_004_JC25_709.p	22-Jul-2008	06:03:24	-7.872982e+000	4.989327e+001
POL_004_JC25_710.p	22-Jul-2008	06:08:58	-7.872840e+000	4.989337e+001
POL_004_JC25_711.p	22-Jul-2008	06:14:26	-7.872801e+000	4.989341e+001
POL_004_JC25_712.p	22-Jul-2008	06:20:10	-7.872838e+000	4.989343e+001
POL_004_JC25_713.p	22-Jul-2008	06:25:58	-7.872787e+000	4.989342e+001
POL_004_JC25_714.p	22-Jul-2008	06:31:24	-7.872803e+000	4.989341e+001
POL_004_JC25_715.p	22-Jul-2008	06:37:06	-7.872781e+000	4.989340e+001
POL_004_JC25_716.p	22-Jul-2008	06:42:28	-7.872780e+000	4.989340e+001
POL_004_JC25_717.p	22-Jul-2008	06:48:06	-7.872784e+000	4.989340e+001
POL_004_JC25_718.p	22-Jul-2008	06:53:48	-7.872787e+000	4.989340e+001
POL_004_JC25_719.p	22-Jul-2008	06:59:26	-7.872797e+000	4.989341e+001
POL_004_JC25_720.p	22-Jul-2008	07:05:14	-7.872776e+000	4.989336e+001
POL_004_JC25_721.p	22-Jul-2008	07:11:04	-7.872887e+000	4.989339e+001
POL_004_JC25_722.p	22-Jul-2008	07:16:56	-7.872793e+000	4.989342e+001
POL_004_JC25_723.p	22-Jul-2008	07:22:48	-7.872793e+000	4.989341e+001
POL_004_JC25_724.p	22-Jul-2008	07:28:34	-7.872789e+000	4.989339e+001
POL_004_JC25_725.p	22-Jul-2008	07:34:00	-7.872782e+000	4.989340e+001
POL_004_JC25_726.p	22-Jul-2008	07:39:48	-7.873079e+000	4.989349e+001
POL_004_JC25_727.p	22-Jul-2008	07:45:20	-7.874146e+000	4.989376e+001
POL_004_JC25_728.p	22-Jul-2008	07:51:50	-7.875289e+000	4.989406e+001
POL_004_JC25_729.p	22-Jul-2008	07:57:38	-7.875964e+000	4.989423e+001
POL_004_JC25_730.p	22-Jul-2008	08:03:04	-7.876475e+000	4.989437e+001
POL_004_JC25_731.p	22-Jul-2008	08:10:42	-7.877023e+000	4.989463e+001
POL_004_JC25_732.p	22-Jul-2008	08:16:40	-7.877463e+000	4.989482e+001
POL_004_JC25_733.p	22-Jul-2008	08:22:54	-7.877896e+000	4.989501e+001
POL_004_JC25_734.p	22-Jul-2008	08:29:04	-7.878334e+000	4.989520e+001
POL_004_JC25_735.p	22-Jul-2008	08:35:36	-7.878833e+000	4.989539e+001
POL_004_JC25_736.p	22-Jul-2008	08:41:52	-7.879257e+000	4.989562e+001
POL_004_JC25_737.p	22-Jul-2008	08:47:34	-7.879702e+000	4.989574e+001
POL_004_JC25_738.p	22-Jul-2008	08:54:46	-7.880183e+000	4.989598e+001
POL_004_JC25_739.p	22-Jul-2008	09:00:26	-7.880613e+000	4.989614e+001
POL_004_JC25_740.p	22-Jul-2008	09:06:00	-7.881002e+000	4.989631e+001
POL_004_JC25_741.p	22-Jul-2008	09:11:46	-7.881459e+000	4.989647e+001
POL_004_JC25_742.p	22-Jul-2008	09:17:34	-7.881844e+000	4.989665e+001
POL_004_JC25_743.p	22-Jul-2008	09:23:02	-7.881942e+000	4.989698e+001
POL_004_JC25_744.p	22-Jul-2008	09:28:16	-7.882019e+000	4.989728e+001
POL_004_JC25_745.p	22-Jul-2008	09:34:30	-7.882055e+000	4.989741e+001
POL_004_JC25_746.p	22-Jul-2008	09:40:16	-7.882056e+000	4.989767e+001
POL_004_JC25_747.p	22-Jul-2008	09:45:38	-7.882125e+000	4.989775e+001
POL_004_JC25_748.p	22-Jul-2008	09:51:24	-7.882107e+000	4.989791e+001
POL_004_JC25_749.p	22-Jul-2008	09:57:02	-7.882159e+000	4.989808e+001
POL_004_JC25_750.p	22-Jul-2008	10:02:44	-7.882175e+000	4.989823e+001
POL_004_JC25_751.p	22-Jul-2008	10:08:44	-7.882205e+000	4.989840e+001
POL_004_JC25_752.p	22-Jul-2008	10:14:20	-7.882216e+000	4.989854e+001
POL_004_JC25_753.p	22-Jul-2008	10:20:24	-7.882285e+000	4.989874e+001
POL_004_JC25_754.p	22-Jul-2008	10:26:28	-7.882298e+000	4.989890e+001
POL_004_JC25_755.p	22-Jul-2008	18:14:02	-7.876109e+000	4.989410e+001
POL_004_JC25_756.p	22-Jul-2008	18:20:06	-7.876543e+000	4.989417e+001
POL_004_JC25_757.p	22-Jul-2008	18:26:08	-7.877054e+000	4.989424e+001
POL_004_JC25_758.p	22-Jul-2008	18:32:30	-7.877276e+000	4.989429e+001
POL_004_JC25_759.p	22-Jul-2008	18:38:26	-7.877568e+000	4.989434e+001
POL_004_JC25_760.p	22-Jul-2008	18:44:28	-7.877736e+000	4.989438e+001
POL_004_JC25_761.p	22-Jul-2008	18:50:06	-7.877992e+000	4.989444e+001
POL_004_JC25_762.p	22-Jul-2008	18:53:20	-7.878080e+000	4.989447e+001
POL_004_JC25_763.p	22-Jul-2008	18:57:38	-7.878254e+000	4.989452e+001
POL_004_JC25_764.p	22-Jul-2008	19:03:20	-7.878480e+000	4.989460e+001
POL_004_JC25_765.p	22-Jul-2008	19:09:20	-7.878709e+000	4.989467e+001
POL_004_JC25_766.p	22-Jul-2008	19:15:14	-7.878915e+000	4.989474e+001
POL_004_JC25_767.p	22-Jul-2008	19:21:14	-7.879174e+000	4.989481e+001
POL_004_JC25_768.p	22-Jul-2008	19:27:04	-7.879365e+000	4.989484e+001
POL_004_JC25_769.p	22-Jul-2008	19:33:40	-7.879638e+000	4.989497e+001
POL_004_JC25_770.p	22-Jul-2008	19:39:26	-7.879835e+000	4.989505e+001
POL_004_JC25_771.p	22-Jul-2008	19:45:26	-7.880035e+000	4.989516e+001
POL_004_JC25_772.p	22-Jul-2008	19:51:18	-7.880242e+000	4.989524e+001
POL_004_JC25_773.p	22-Jul-2008	19:57:02	-7.880436e+000	4.989534e+001
POL_004_JC25_774.p	22-Jul-2008	20:03:06	-7.880628e+000	4.989543e+001
POL_004_JC25_775.p	22-Jul-2008	20:11:22	-7.880662e+000	4.989544e+001
POL_004_JC25_776.p	22-Jul-2008	20:18:20	-7.880622e+000	4.989539e+001
POL_004_JC25_777.p	22-Jul-2008	20:25:22	-7.880616e+000	4.989539e+001
POL_004_JC25_778.p	22-Jul-2008	20:32:24	-7.880616e+000	4.989537e+001
POL_004_JC25_779.p	22-Jul-2008	20:39:16	-7.880679e+000	4.989540e+001
POL_004_JC25_780.p	22-Jul-2008	20:46:40	-7.880958e+000	4.989551e+001
POL_004_JC25_781.p	22-Jul-2008	20:53:34	-7.881174e+000	4.989561e+001
POL_004_JC25_782.p	22-Jul-2008	20:59:44	-7.881376e+000	4.989568e+001
POL_004_JC25_783.p	22-Jul-2008	21:06:12	-7.881517e+000	4.989587e+001
POL_004_JC25_784.p	22-Jul-2008	21:13:22	-7.881670e+000	4.989601e+001
POL_004_JC25_785.p	22-Jul-2008	21:21:12	-7.881869e+000	4.989624e+001
POL_004_JC25_786.p	22-Jul-2008	21:28:26	-7.882029e+000	4.989641e+001
POL_004_JC25_787.p	22-Jul-2008	21:34:06	-7.882169e+000	4.989655e+001
POL_004_JC25_788.p	22-Jul-2008	21:41:00	-7.882274e+000	4.989677e+001
POL_004_JC25_789.p	22-Jul-2008	21:46:58	-7.882240e+000	4.989687e+001
POL_004_JC25_790.p	22-Jul-2008	21:53:00	-7.882308e+000	4.989704e+001
POL_004_JC25_791.p	22-Jul-2008	21:59:28	-7.882250e+000	4.989721e+001
POL_004_JC25_792.p	22-Jul-2008	22:06:28	-7.882231e+000	4.989741e+001
POL_004_JC25_793.p	22-Jul-2008	22:12:16	-7.882240e+000	4.989757e+001
POL_004_JC25_794.p	22-Jul-2008	22:18:36	-7.882212e+000	4.989778e+001
POL_004_JC25_795.p	22-Jul-2008	22:24:34	-7.882225e+000	4.989790e+001
POL_004_JC25_796.p	22-Jul-2008	22:30:58	-7.882215e+000	4.989810e+001
POL_004_JC25_797.p	22-Jul-2008	22:37:14	-7.882193e+000	4.989826e+001
POL_004_JC25_798.p	22-Jul-2008	22:43:24	-7.882202e+000	4.989842e+001
POL_004_JC25_799.p	22-Jul-2008	22:49:50	-7.882236e+000	4.989861e+001
POL_004_JC25_800.p	22-Jul-2008	22:56:10	-7.882172e+000	4.989871e+001
POL_004_JC25_801.p	22-Jul-2008	23:02:12	-7.882061e+000	4.989893e+001
POL_004_JC25_802.p	22-Jul-2008	23:08:40	-7.882005e+000	4.989912e+001
POL_004_JC25_803.p	22-Jul-2008	23:15:18	-7.881960e+000	4.989928e+001
POL_004_JC25_804.p	22-Jul-2008	23:22:20	-7.881916e+000	4.989945e+001
POL_004_JC25_805.p	22-Jul-2008	23:25:42	-7.881861e+000	4.989952e+001
POL_004_JC25_806.p	22-Jul-2008	23:28:48	-7.881984e+000	4.989953e+001
POL_004_JC25_807.p	22-Jul-2008	23:32:26	-7.881972e+000	4.989949e+001
POL_004_JC25_808.p	22-Jul-2008	23:35:38	-7.881955e+000	4.989946e+001
POL_004_JC25_809.p	22-Jul-2008	23:42:16	-7.881978e+000	4.989948e+001
POL_004_JC25_810.p	22-Jul-2008	23:48:34	-7.881948e+000	4.989950e+001
POL_004_JC25_811.p	22-Jul-2008	23:56:12	-7.881666e+000	4.990011e+001
POL_004_JC25_812.p	23-Jul-2008	00:02:24	-7.881540e+000	4.990062e+001
POL_004_JC25_813.p	23-Jul-2008	00:09:44	-7.881215e+000	4.990098e+001
POL_004_JC25_814.p	23-Jul-2008	00:15:34	-7.880970e+000	4.990126e+001
POL_004_JC25_815.p	23-Jul-2008	00:21:22	-7.880647e+000	4.990155e+001
POL_004_JC25_816.p	23-Jul-2008	00:27:14	-7.880303e+000	4.990174e+001
POL_004_JC25_817.p	23-Jul-2008	00:32:50	-7.879908e+000	4.990195e+001
POL_004_JC25_818.p	23-Jul-2008	00:39:24	-7.879480e+000	4.990219e+001
POL_004_JC25_819.p	23-Jul-2008	00:45:16	-7.879037e+000	4.990239e+001
POL_004_JC25_820.p	23-Jul-2008	00:51:20	-7.878602e+000	4.990252e+001
POL_004_JC25_821.p	23-Jul-2008	00:57:22	-7.878149e+000	4.990267e+001
POL_004_JC25_822.p	23-Jul-2008	01:02:58	-7.877710e+000	4.990279e+001
POL_004_JC25_823.p	23-Jul-2008	01:08:56	-7.877249e+000	4.990293e+001
POL_004_JC25_824.p	23-Jul-2008	01:14:52	-7.876775e+000	4.990304e+001
POL_004_JC25_825.p	23-Jul-2008	01:22:04	-7.876208e+000	4.990318e+001
POL_004_JC25_826.p	23-Jul-2008	01:28:28	-7.875693e+000	4.990330e+001
POL_004_JC25_827.p	23-Jul-2008	01:34:50	-7.875188e+000	4.990336e+001
POL_004_JC25_828.p	23-Jul-2008	01:41:38	-7.874620e+000	4.990342e+001
POL_004_JC25_829.p	23-Jul-2008	01:47:26	-7.874150e+000	4.990347e+001
POL_004_JC25_830.p	23-Jul-2008	01:53:16	-7.873642e+000	4.990351e+001
POL_004_JC25_831.p	23-Jul-2008	01:58:58	-7.873130e+000	4.990357e+001
POL_004_JC25_832.p	23-Jul-2008	02:05:02	-7.872706e+000	4.990359e+001
POL_004_JC25_833.p	23-Jul-2008	02:11:10	-7.872436e+000	4.990360e+001
POL_004_JC25_834.p	23-Jul-2008	02:17:18	-7.872176e+000	4.990358e+001
POL_004_JC25_835.p	23-Jul-2008	02:23:34	-7.871941e+000	4.990355e+001
POL_004_JC25_836.p	23-Jul-2008	02:29:48	-7.871681e+000	4.990350e+001
POL_004_JC25_837.p	23-Jul-2008	02:35:48	-7.871463e+000	4.990344e+001
POL_004_JC25_838.p	23-Jul-2008	02:42:00	-7.871189e+000	4.990340e+001
POL_004_JC25_839.p	23-Jul-2008	02:47:56	-7.871075e+000	4.990336e+001
POL_004_JC25_840.p	23-Jul-2008	02:53:28	-7.870906e+000	4.990333e+001
POL_004_JC25_841.p	23-Jul-2008	02:59:12	-7.870572e+000	4.990314e+001
POL_004_JC25_842.p	23-Jul-2008	03:04:50	-7.870434e+000	4.990303e+001
POL_004_JC25_843.p	23-Jul-2008	03:10:50	-7.870258e+000	4.990292e+001
POL_004_JC25_844.p	23-Jul-2008	03:16:52	-7.870121e+000	4.990278e+001
POL_004_JC25_845.p	23-Jul-2008	03:22:16	-7.870083e+000	4.990268e+001
POL_004_JC25_846.p	23-Jul-2008	03:27:48	-7.869879e+000	4.990255e+001
POL_004_JC25_847.p	23-Jul-2008	03:33:38	-7.869783e+000	4.990240e+001
POL_004_JC25_848.p	23-Jul-2008	03:39:18	-7.869699e+000	4.990226e+001
POL_004_JC25_849.p	23-Jul-2008	03:44:48	-7.869614e+000	4.990212e+001
POL_004_JC25_850.p	23-Jul-2008	03:50:16	-7.869530e+000	4.990196e+001
POL_004_JC25_851.p	23-Jul-2008	03:55:54	-7.869433e+000	4.990183e+001
POL_004_JC25_852.p	23-Jul-2008	04:01:38	-7.869317e+000	4.990170e+001
POL_004_JC25_853.p	23-Jul-2008	04:58:06	-7.890825e+000	4.989592e+001
POL_004_JC25_854.p	23-Jul-2008	05:03:42	-7.891212e+000	4.989526e+001
POL_004_JC25_855.p	23-Jul-2008	05:09:24	-7.891026e+000	4.989412e+001
POL_004_JC25_856.p	23-Jul-2008	05:15:10	-7.889454e+000	4.989436e+001
POL_004_JC25_857.p	23-Jul-2008	05:20:52	-7.887829e+000	4.989472e+001
POL_004_JC25_858.p	23-Jul-2008	05:26:34	-7.886020e+000	4.989522e+001
POL_004_JC25_859.p	23-Jul-2008	05:32:26	-7.883830e+000	4.989569e+001
POL_004_JC25_860.p	23-Jul-2008	05:38:26	-7.880952e+000	4.989655e+001
POL_004_JC25_861.p	23-Jul-2008	05:44:34	-7.878952e+000	4.989621e+001
POL_004_JC25_862.p	23-Jul-2008	05:50:34	-7.876609e+000	4.989612e+001
POL_004_JC25_863.p	23-Jul-2008	05:56:42	-7.875831e+000	4.989477e+001
POL_004_JC25_864.p	23-Jul-2008	06:02:52	-7.872360e+000	4.989506e+001
POL_004_JC25_865.p	23-Jul-2008	06:09:18	-7.871545e+000	4.989521e+001
POL_004_JC25_866.p	23-Jul-2008	06:15:38	-7.871736e+000	4.989493e+001
POL_004_JC25_867.p	23-Jul-2008	06:21:48	-7.871998e+000	4.989478e+001
POL_004_JC25_868.p	23-Jul-2008	06:28:16	-7.872245e+000	4.989468e+001
POL_004_JC25_869.p	23-Jul-2008	06:34:22	-7.872455e+000	4.989458e+001
POL_004_JC25_870.p	23-Jul-2008	06:40:26	-7.872691e+000	4.989450e+001
POL_004_JC25_871.p	23-Jul-2008	06:59:54	-7.873415e+000	4.989428e+001

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Temperature-Chlorophyll Chain (Mike Smithson)**.**

The towed temperature-chlorophyll (T-Chl) chain consists of a series of self-contained internally-recording fluorometers and temperature loggers attached to a 10mm diameter galvanised steel wire. The chain is designed to be towed through the water at speeds up to 4 knots. A 380 kg lead sphere shackled to the bottom end of the wire acts as a depressor to prevent the line of instruments from streaming out behind the ship. Copper ferrules are crimped onto the wire at 1 m intervals and are used as mounting points to attach the instruments. Specially designed clamps allow for quick attachment and release of instruments at these mounting points. The clamps reduce deployment and recovery times for the chain from an estimated 2 hours or more to about 10 minutes. The time saving over the total number of deployments on this cruise is estimated to be of the order of 24 hours.

The fluorometers were Wetlabs FLB self-logging, internally-powered fluorometers. Two types of temperature logger were used, both manufactured by Star-Oddi. Mounted at the same position on the wire as the fluorometers were Star-Oddi Centi-TD temperature and depth loggers. Interspersed were Star-Oddi Starmon-mini temperature loggers.

6 deployments were carried out during the cruise. All but the second deployment were in conjunction with the VMP turbulence profiles, when the ship was making headway at about 0.5 knot. For the second deployment the chain was towed along Jones Bank at a nominal speed of 3.5 knots. The deployments in conjunction with the VMP were made using the starboard-side davit. The towed deployment was made using the stern gantry.

Tables 1, 2 and 3 give details and specifications of the fluorometers and temperature loggers. Details of each deployment are given in Tables 4 to 9. Instrument positions are counted from the deepest ferrule (i.e. the first instrument attached to the wire during deployment). Start and end times refer to the start and end of logging for individual instruments. The times for the start and end of useful data (i.e. when the chain was finally in position and when recovery began) are also given. All times are in GMT. Instrument types are F – Wetlabs FLB fluorometer, T – Star-Oddi Starmon-mini temperature logger, TP – Star-Oddi Centi-TD temperature and pressure logger.

Data return for the six deployments was 100%.

Table 1: Details of Wetlabs FLB chlorophyll fluorometers

Excitation wavelength: 470 nm Sensitivity: 0.01 µg l^{-1}

Emission wavelength: 695 nm Range: 0.01 to 125 µg l^{-1}

Serial number	Calibration date
775	28-Jun-2007
776	28-Jun-2007
777	28-Jun-2007
778	28-Jun-2007
779	28-Jun-2007
780	09-Jul-2007
906	14-Feb-2008
907	14-Feb-2008
937	14-Feb-2008
938	14-Feb-2008

Table 2: Details of Star-Oddi Centi-TD temperature loggers

Temperature accuracy: ±0.1 ºC Depth accuracy: ±0.4 m

Temperature resolution: 0.032 ºC Depth resolution: 0.03 m

Temperature range: –1 ºC to +40 ºC Depth range: 0 to 100 m

Temperature time constant: 20 s

Serial number	Calibration date
3268	29-Jun-2007
3269	29-Jun-2007
3270	29-Jun-2007
3271	29-Jun-2007
3272	29-Jun-2007
3273	29-Jun-2007
3275	29-Jun-2007
3276	29-Jun-2007
3278	29-Jun-2007
683*	06-Nov-2007

*Centi-PR – has pitch and roll sensors in addition to temperature and pressure

Table 3: Details of Star-Oddi Starmon-mini temperature loggers

Accuracy: ±0.05 ºC Range: –2 ºC to +40 ºC

Resolution: 0.013 ºC Time constant: 18 s

Serial number	Calibration date
2604	30-May-2007
2605	30-May-2007
2606	30-May-2007
2608	30-May-2007
2610	30-May-2007
2611	30-May-2007
2612	30-May-2007
2613	30-May-2007
2614	30-May-2007
2617	29-Jun-2007
2618	29-Jun-2007
2619	29-Jun-2007
2621	29-Jun-2007
2622	29-Jun-2007
2624	29-Jun-2007

Table 4: 1st T-Chl chain deployment (MS2)

Logging interval: 30 s

Start of useful data: 13:50:00 on 6-Jul-08
End of useful data: 15:00:30 on 7-Jul-08

Position	Nominal depth (m)	Instrument type	Serial Number	6-Jul-08 Start time (GMT)	*7/8-Jul-08 End time (GMT)
1	65	F TP	780 3272	11:14:00 12:00:00	21:34:04(7) 12:10:23(8)
5	61	T	2613	12:00:00	13:21:52(8)
8	58	T	2617	12:00:00	13:25:08(8)
11	55	T	2612	12:00:00	12:30:33(8)
14	52	T	2604	12:00:00	13:01:45(8)
16	50	F TP	776 3268	11:21:00 12:00:00	18:09:40(7) 10:04:33(8)
18	48	T	2606	12:00:00	12:50:40(8)
20	46	F TP	777 3269	11:17:00 12:00:00	17:26:25(7) 10:17:33(8)
22	44	T	2605	12:00:00	12:57:44(8)
24	42	F TP	938 3271	11:19:00 12:00:00	21:00:00(7) 11:49:29(8)
26	40	T	2611	12:00:00	13:17:41(8)
28	38	F TP	906 3273	11:21:00 12:00:00	21:26:00(7) 12:03:09(8)
30	36	T	2622	12:00:00	13:13:05(8)
32	34	F TP	937 683	11:23:00 12:00:00	18:39:31(7) 09:55:02(8)
34	32	T	2610	12:00:00	12:44:00(8)
36	30	F TP	775 3270	11:12:00 12:00:00	21:16:57(7) 11:56:44(8)
38	28	T	2624	12:00:00	12:54:28(8)
40	26	F TP	778 3278	11:10:00 12:00:00	21:08:23(7) 10:29:59(8)
42	24	T	2619	12:00:00	12:37:34(8)
44	22	T	2608	12:00:00	13:04:29(8)
46	20	F TP	779 3276	11:17:00 12:00:00	21:43:45(7) 12:15:54(8)
48	18	T	2621	12:00:00	12:47:05(8)
51	15	F TP	907 3275	11:19:00 12:00:00	21:53:00(7) 12:21:57(8)
55	11	T	2618	12:00:00	12:40:28(8)
59	7	T	2614	12:00:00	13:07:29(8)

*Figure in parentheses indicates end date

Table 5: 2nd T-Chl chain deployment (towed along Jones Bank)

Logging interval: 30 s
Nominal towing speed: 3.5 knots

Start of useful data: 13:02:00 on 10-Jul-08
End of useful data: 02:05:00 on 11-Jul-08

				10-Jul-08	11-Jul-08
Position	Nominal depth (m)	Instrument type	Serial Number	Start time (GMT)	End time (GMT)
1	65	F TP	778 3275	10:22:00 11:00:00	07:24:10 17:50:25
5	61	T	2619	11:00:00	15:34:26
8	58	T	2618	11:00:00	15:59:32
11	55	T	2612	11:00:00	15:55:33
14	52	T	2610	11:00:00	15:57:28
16	50	F TP	907 3276	10:17:00 11:00:00	07:16:33 17:45:45
18	48	T	2606	11:00:00	16:05:38
20	46	F TP	938 3272	10:15:00 11:00:00	06:18:15 17:39:14
22	44	T	2624	11:00:00	15:40:38
24	42	F TP	780 3273	10:13:00 11:00:00	06:06:13 17:23:57
26	40	T	2621	11:00:00	15:51:41
28	38	F TP	906 3270	10:10:00 11:00:00	05:06:00 17:36:31
30	36	T	2605	11:00:00	15:49:23
32	34	F TP	779 3271	10:06:00 11:00:00	06:26:10 16:39:53
34	32	T	2604	11:00:00	15:53:37
36	30	F TP	776 3278	10:03:00 11:00:00	05:30:50 17:28:22
38	28	T	2611	11:00:00	15:29:30
40	26	F TP	937 3269	10:00:00 11:00:00	05:55:15 17:32:21
42	24	T	2613	11:00:00	16:03:51
44	22	T	2617	11:00:00	15:46:47
46	20	F TP	777 3268	09:56:00 11:00:00	05:30:50 17:41:45
48	18	T	2608	11:00:00	16:01:52
51	15	F TP	775 683	09:53:00 11:00:00	05:45:05 17:53:26
55	11	T	2614	11:00:00	15:38:36
59	7	T	2622	11:00:00	15:42:47

Table 6: 3rd T-Chl chain deployment (MS4)
Logging interval: 30 s

Start of useful data: 01:52:00 on 12-Jul-08
End of useful data: 03:05:30 on 13-Jul-08

				*11/12-Jul-08	13-Jul-08
Position	Nominal depth (m)	Instrument type	Serial Number	Start time (GMT)	End time (GMT)
1	65	F TP	775 3271	20:12:00(11) 01:00:00(12)	05:54:45 07:51:30
5	61	T	2619	01:00:00(12)	06:17:24

8	58	T	2618	01:00:00(12)	06:10:20
11	55	T	2612	01:00:00(12)	06:23:16
14	52	T	2610	01:00:00(12)	06:20:19
16	50	F TP	937 3273	20:06:00(11) 01:00:00(12)	05:47:15 07:45:09
18	48	T	2606	01:00:00(12)	06:25:49
20	46	F TP	776 3278	20:00:00(11) 01:00:00(12)	05:18:25 07:35:47
22	44	T	2624	01:00:00(12)	06:13:53
24	42	F TP	906 3269	19:52:00(11) 01:00:00(12)	05:03:30 07:33:11
26	40	T	2621	01:00:00(12)	06:31:59
28	38	F TP	780 3270	19:47:00(11) 01:00:00(12)	04:36:45 07:20:25
30	36	T	2605	01:00:00(12)	06:34:12
32	34	F TP	938 3272	19:42:00(11) 01:00:00(12)	05:39:45 07:40:59
34	32	T	2604	01:00:00(12)	06:42:08
36	30	F TP	779 3268	19:36:00(11) 01:00:00(12)	04:48:05 07:25:12
38	28	T	2611	01:00:00(12)	06:36:04
40	26	F TP	777 3276	19:28:00(11) 01:00:00(12)	04:55:20 07:29:26
42	24	T	2613	01:00:00(12)	06:37:57
44	22	T	2617	01:00:00(12)	06:28:00
46	20	F TP	907 3275	19:23:00(11) 01:00:00(12)	05:32:00 07:38:19
48	18	T	2608	01:00:00(12)	06:44:23
51	15	F TP	778 683	19:16:00(11) 01:00:00(12)	05:11:05 07:54:30
55	11	T	2614	01:00:00(12)	06:30:05
59	7	T	2622	01:00:00(12)	06:39:53

*Figure in parentheses indicates start date

Table 7: 4th T-Chl chain deployment at (MS2)

Logging interval: 30 s

Start of useful data: 11:41:00 on 14-Jul-08
End of useful data: 03:57:30 on 15-Jul-08

				14-Jul-08	13-Jul-08
Position	Nominal depth (m)	Instrument type	Serial Number	Start time (GMT)	End time (GMT)
1	65	F TP	775 3270	08:00:00 07:00:00	08:42:25 10:56:06
5	61	T	2619	07:00:00	09:31:26
8	58	T	2618	07:00:00	09:02:48
11	55	T	2612	07:00:00	10:21:40
14	52	T	2610	07:00:00	10:13:06
16	50	F TP	937 3278	07:55:00 07:00:00	08:14:10 10:46:33
18	48	T	2606	07:00:00	09:05:09
20	46	F TP	776 3268	07:51:00 07:00:00	07:14:10 10:44:00
22	44	T	2624	07:00:00	10:19:33
24	42	F TP	906 3271	07:21:00 07:00:00	08:35:40 10:53:34

26	40	T	2621	07:00:00	08:57:25
28	38	F TP	780 3275	07:47:00 07:00:00	08:21:50 10:48:55
30	36	T	2605	07:00:00	10:24:03
32	34	F TP	938 3269	07:43:00 07:00:00	06:07:10 10:35:30
34	32	T	2604	07:00:00	09:33:42
36	30	F TP	779 3272	07:39:00 07:00:00	07:06:10 10:41:18
38	28	T	2611	07:00:00	10:17:12
40	26	F TP	777 3273	07:35:00 07:00:00	06:58:00 10:38:23
42	24	T	2613	07:00:00	09:17:26
44	22	T	2617	07:00:00	10:26:21
46	20	F TP	907 3276	07:31:00 07:00:00	08:29:10 10:51:13
48	18	T	2608	07:00:00	09:20:58
51	15	F TP	778 683	07:26:00 07:00:00	05:55:14 10:30:52
55	11	T	2614	07:00:00	10:10:13
59	7	T	2622	07:00:00	10:07:25

*Figure in parentheses indicates start date

Table 8: 5th T-Chl chain deployment (MS2)

Logging interval: 30 s

Start of useful data: 07:30:00 on 21-Jul-08
End of useful data: 09:37:30 on 22-Jul-08

Position	Nominal depth (m)	Instrument type	Serial Number	21-Jul-08 Start time (GMT)	22-Jul-08 End time (GMT)
1	65	F TP	775 3270	05:18:00 07:00:00	11:29:10 12:56:15
5	61	T	2619	07:00:00	13:46:07
8	58	T	2618	07:00:00	13:48:50
11	55	T	2612	07:00:00	13:50:48
14	52	T	2610	07:00:00	13:53:51
16	50	F TP	937 3278	05:22:00 07:00:00	11:38:45 13:00:51
18	48	T	2606	07:00:00	13:56:48
20	46	F TP	776 3268	05:38:00 07:00:00	11:46:25 13:04:00
22	44	T	2624	07:00:00	13:59:37
24	42	F TP	906 3271	05:29:00 07:00:00	11:56:20 13:12:01
26	40	T	2621	07:00:00	14:02:39
28	38	F TP	780 3275	05:25:00 07:00:00	12:03:50 13:16:52
30	36	T	2605	07:00:00	14:05:25
32	34	F TP	938 3269	05:58:00 07:00:00	12:10:35 13:21:30
34	32	T	2604	07:00:00	14:09:22
36	30	F TP	779 3272	05:42:00 07:00:00	12:24:05 13:25:00
38	28	T	2611	07:00:00	14:11:50
40	26	F	777	05:51:00	12:30:55

		TP	3273	07:00:00	13:28:26
42	24	T	2613	07:00:00	14:14:12
44	22	T	2617	07:00:00	14:16:32
46	20	F TP	907 3276	05:34:00 07:00:00	12:37:05 13:31:13
48	18	T	2608	07:00:00	14:19:17
51	15	F TP	778 683	06:06:00 07:00:00	12:46:10 13:34:31
55	11	T	2614	07:00:00	14:22:43
59	7	T	2622	07:00:00	14:24:56

Table 9: 6th T-Chl chain deployment (MS4)
Logging interval: 30 s

Start of useful data: 16:22:00 on 22-Jul-08
End of useful data: 06:10:00 on 23-Jul-08

				22-Jul-08	23-Jul-08
Position	Nominal depth (m)	Instrument type	Serial Number	Start time (GMT)	End time (GMT)
1	65	F TP	775 3270	11:37:00 14:00:00	10:47:50 12:14:35
5	61	T	2619	15:00:00	09:09:56
8	58	T	2618	15:00:00	08:35:13
11	55	T	2612	15:00:00	09:07:53
14	52	T	2610	15:00:00	08:55:32
16	50	F TP	937 3278	11:44:00 14:00:00	09:37:10 11:53:30
18	48	T	2606	15:00:00	08:37:56
20	46	F TP	776 3268	11:54:00 14:00:00	10:30:15 12:04:04
22	44	T	2624	15:00:00	09:04:33
24	42	F TP	906 3271	12:02:00 14:00:00	09:46:05 11:56:38
26	40	T	2621	15:00:00	08:41:10
28	38	F TP	780 3275	12:09:00 14:00:00	10:23:10 12:09:17
30	36	T	2605	15:00:00	08:33:04
32	34	F TP	938 3269	12:17:00 14:00:00	10:03:05 11:58:51
34	32	T	2604	15:00:00	08:47:06
36	30	F TP	779 3272	12:29:00 14:00:00	10:09:45 12:01:47
38	28	T	2611	15:00:00	08:57:44
40	26	F TP	777 3273	12:36:00 14:00:00	10:16:55 12:06:22
42	24	T	2613	15:00:00	08:51:17
44	22	T	2617	15:00:00	08:48:59
46	20	F TP	907 3276	12:45:00 14:00:00	10:37:50 12:11:50
48	18	T	2608	15:00:00	08:59:57
51	15	F TP	778 683	12:51:00 14:00:00	09:56:05 12:16:59
55	11	T	2614	15:00:00	08:43:11
59	7	T	2622	15:00:00	08:53:43

Moorings (Colin Hutton)**.**

General notes :

1. All times in this moorings report are in GMT.
2. All configurations were supplied by Matthew Palmer (POL).
3. All latitudes and longitudes were taken from the ships log.
4. All deployment times were taken from the ships log.
5. Despite flashing prior to deployment it was noticed that several of the navigation lights attached to the buoys failed to function when in the water.

MOORINGS were deployed using the aft cranes with a release hook and the deck winch

MS1 (top slope bank mooring)

Deployed : 15.45 GMT on 5/7/08

Depth : 78m

Position : 49 51.25N, 7 56.94W

Acoustic Release S/N : 120

Recovered : 18.48 GMT on 24/7/08

Temperature chain configuration :

Top wire :

Depth (m)	Type	Sensor	S/N
Top	Microcat	CTD	3276
1	Starmon	T	2839
3	Starmon	T	2838
5	Starmon	T	2837
7	Starmon	T	2836
9	Starmon	T	2835
11	Starmon	T	2834
13	Starmon	T	2833
15	Starmon	T	2840
17	Starmon	T	2841
19	Starmon	T	2842
21	Starmon	T	2843
23	Starmon	T	2844
25	Starmon	T	2845
27	Starmon	T	2846
29	Starmon	T	2847
31	Starmon	T	2848

33	Starmon	T	2849
35	Star Odi	TP	3661

Bottom wire :

Distance from sphere (height above microcat (m))	Type	Sensor	S/n
0 (40)	Star Odi	TP	3662
5 (35)	Starmon	T	2850
10 (30)	Vemco	T	2699
15 (25)	Vemco	T	2701
20 (20)	Starmon	T	2851
25 (15)	Vemco	T	9714
30 (10)	Vemco	T	9756
35 (5)	Starmon	T	2852
40 (0)	Microcat	CTD	3218

The mooring was recovered in full using aft cranes and deck winch.

MS2 (mid slope bank mooring)

Deployed : 02.23 GMT on 5/7/08

Depth : 114m

Position : 49 53.90N, 07 52.57W

Acoustic Release S/N : 122

Recovered : 13.25 GMT on 23/7/08

Temperature chain configuration :

Top wire

Depth (m)	Type	Sensor	S/N
Top	Microcat	CTD	3481
0	Star Odi	T	3615
2	Star Odi	T	3616
4	Star Odi	T	3617
6	Star Odi	T	3618
8	Star Odi	T	3619
10	Star Odi	T	3598
12	Star Odi	T	3599
14	Star Odi	T	3600
16	Star Odi	T	3601

18	Star Odi	T	3602
20	Star Odi	T	3604
22	Star Odi	T	3605
24	Star Odi	T	3606
26	Star Odi	T	3607
28	Star Odi	T	3608
30	Star Odi	T	3609
32	Star Odi	T	3610
34	Star Odi	T	3611
36	Star Odi	T	3613
38	Star Odi	T	3614
40	Star Odi	T	3217
42	Star Odi	T	3211
44	Star Odi	T	3222
46	Star Odi	T	3239
48	Star Odi	T	3233
50	Star Odi	T	3235
52	Star Odi	T	3212
54	Microcat	CTD	4550

Bottom wire :

Distance from sphere (height above microcat (m))	Type	Sensor	S/N
0 (60)	Star Odi	TP	3655
5 (55)	Star Odi	T	3130
10 (50)	Star Odi	T	3218
15 (45)	Star Odi	T	3131
20 (40)	Star Odi	T	3231
25 (35)	Star Odi	T	3132
30 (30)	Star Odi	T	3125
35 (25)	Star Odi	T	3135
40 (20)	Star Odi	T	3237
45 (15)	Star Odi	T	3216
50 (10)	Star Odi	T	3250
55 (5)	Star Odi	T	3133
59 (1)	Microcat	CTD	4549

The release was activated part way through the recovery as the rope had snagged around the Microcat and had caused abrasion in the line.

Two of the mini-loggers were lost during recovery (s/n 3130 and s/n 3655.)

Recovery was by means of aft cranes and deck winch.

MS3 (off slope bank mooring)

Deployed : 21.47 GMT on 4/7/07

Depth : 122m

Position : 49 56.40N, 07 49.00W

Acoustic Release S/N : 118

Recovered : 11.40 GMT on 23/7/08

Temperature chain configuration :

Top wire :

Depth (m)	Type	Sensor	S/N
Top	Microcat	CTD	3250
0	Vemco	T	1061
5	Vemco	T	1062
10	Vemco	T	1063
12	Vemco	T	1064
14	Vemco	T	1069
16	Vemco	T	1070
18	Vemco	T	1078
20	Vemco	T	1079
22	Vemco	T	1080
24	Vemco	T	1081
26	Vemco	T	1082
28	Vemco	T	1083
30	Vemco	T	1084
32	Vemco	T	1085
34	Vemco	T	1086
36	Vemco	T	1087
38	Vemco	T	6175
40	Vemco	T	6176
42	Vemco	T	6177
44	Vemco	T	6178
46	Vemco	T	7334
50	Vemco	T	8517
55	Vemco	T	5591
60	Star Odi	TP	3653

Bottom wire :

Distance from sphere (height above microcat (m)	Type	Sensor	S/N
0 (60)	Star Odi	TP	3654
10 (50)	Vemco	T	5592
20 (40)	Vemco	T	5593
30 (30)	Vemco	T	5594
40 (20)	Vemco	T	3021
50 (10)	Vemco	T	3022
59 (1)	Microcat	CTD	4607

The mooring was recovered in full using aft cranes and deck winch.

MS4

Deployed : 18.29 GMT on 5/7/08

Depth : 110m

Position : 49 44.99N, 07 40.05W

Acoustic Release S/N : 123

ADCP S/N : 1032

Recovered : 07.59 GMT on 23/7/08

ADCP Configuration :

CR1
CF11101
EA0
EB0
ED1100
ES35
EX00000
EZ1111111
WA50
WB0
WD111100000
WF176
WN45
WP1
WS200
WV129
TE00:00:02.00
TP00:02.00
CK
CS

Instrument = Workhorse Sentinel
Frequency = 307200
Water Profile = Yes
Bottom Track = No

High Res Modes = No
High Rate Pinging = No
Shallow Bottom Mode = No
Wave Gauge = No
Lowered ADCP = No
Beam Angle = 20
Temperature = 10.00
Deployment Hours = 504.00
Battery Packs = 2
Automatic TP = Yes
Memory Size (MB) = 2000
Saved Screen = 3

Consequences generated by PlanADCP version 2.04 :
First cell range = 4.38m
Last cell range = 92.38m
Max range = 89.48m
Standard deviation = 6.02 cm/s
Ensemble size = 1054 bytes
Storage required = 911.89 MB (956188800 bytes)
Power usage = 400.15 Wh
Battery usage = 0.9

The mooring was interrogated at 07.40 GMT , the range was 114m, it was released at 07.44.GMT and surfaced at 07.45.GMT.

Recovery was by means of aft cranes and deck winch.

LANDER FRAME MOORINGS deployed with the aft crane and release hook

MS1 Lander

Deployed : 13.39 GMT on 5/7/08

Depth : 78m

Position : 49 51.21N, 07 56.82W

Acoustic Release S/N : 347 (pyro)

ADCP S/N : 2666

Recovered : 17.50 GMT on 24/7/08

Configuration :

CR1
CF11101
EA0
EB0
ED800
ES35
EX00000

EZ1111111
WA50
WB0
WD111100000
WF176
WN40
WP2
WS200
WV130
TE00:00:02.00
TP00:01.00
CK
CS

Instrument = Workhorse Sentinel
Frequency = 307200
Water Profile = Yes
Bottom Track = No
High Res. Modes = No
High Rate Pinging = No
Shallow Bottom Mode = No
Wave Gauge = No
Lowered ADCP = No
Beam Angle = 20
Temperature = 10.00
Deployment Hours = 504.00
Battery Packs = 2
Automatic TP = Yes
Memory Size (MB) = 1000
Saved Screen = 2

Consequences generated by PlanADCP version 2.04 :
First cell range = 4.38m
Last cell range = 82.38m
Max range = 89.30m
Standard deviation = 4.29 cm/s
Ensemble size = 954 bytes
Stowage required = 825.38 MB (865468800 bytes)
Power usage = 724.09 Wh
Battery usage = 1.6

The mooring was interrogated at 17.30 GMT, the range was 167m, it was released at 17.31 GMT and surfaced at 17.34 GMT.

Recovery was by means of a snap hook onto the frame and lifting by the aft crane.

MS2 Lander

Deployed : 03.07 GMT on 5/7/08

Depth : 114m

Position : 49 53.85N, 07 52.48W

Acoustic Release S/N : 318 (pyro)………..also marked as S/N :57 (pyro)

ADCP S/N : 1903

Recovered : 15.40 GMT on 24/7/08

Configuration :

CR1
CF11101
EA0
EB0
ED1150
ES35
EX00000
EZ1111111
WA50
WB0
WD111100000
WF176
WN52
WP2
WS200
WV130
TE00:00:02.00
TP00:01.00
CK
CS

Instrument = Workhorse Sentinel
Frequency = 307200
Water Profile = Yes
Bottom Track = No
High Res Modes = No
High Rate Pinging = No
Shallow Bottom Mode = No
Wave Gauge = No
Lowered ADCP = No
Beam Angle = 20
Temperature = 10.00
Deployment Hours = 504.00
Battery Packs = 2
Automatic TP = Yes
Memory Size (MB) = 2000
Saved Screen = 2

Consequences generated by PlanADCP version 2.04 :
First cell range = 4.38m
Last cell range = 106.38m
Max range = 89.51m
Standard deviation = 4.29 cm/s
Ensemble size = 1194 bytes
Storage required = 1033.02 MB (1083196800 bytes)
Power usage = 798.39 Wh
Battery usage = 1.8

The mooring was interrogated at 15.10 GMT, the range was 159m, it was released at !5.12 GMT and surfaced at !5.14 GMT. Recovery was by means of a snap hook onto the frame and lifting by the aft crane.

Note : Attempts to release this mooring failed on both 23/7/08 and 24/7/08 using the codes for Release S/N 57 which had been noted prior to deployment. It was subsequently discovered that the Release S/N 318 was, in fact, the one deployed on the mooring. On recovery it was noted that two different serial numbers were affixed to the release.

MS3 Lander

Deployed : 22.28 GMT on 4/7/08

Depth : 122m

Position : 49 56.30N, 07 48.90W

Acoustic Release S/N : 42

ADCP S/N : 10628

Recovered : 12.24 GMT on 22/7/08

Configuration :

CR1
CF11101
EA0
EB0
ED1150
ES35
EX00000
EZ1111111
WA50
WB0
WD111100000
WF176
WN30
WP1
WS400
WV130
TE00:00:02.00
TP00:02.00
CK
CS

Instrument = Workhorse Sentinel
Frequency = 307200
Water Profile = Yes
Bottom Track = No
High RES Modes = No
High Rate Pinging = No
Shallow Bottom Mode = No
Wave Gauge = No

Lowered ADCP = No
Beam Angle = 20
Temperature = 10.00
Deployment hours = 504.00
Battery Packs = 2
Automatic TP = Yes
Memory Size (MB) = 2000
Saved Screen = 2

Consequences generated by PlanADCP version 2.04
First cell range = 6.38m
Last cell range = 122.38m
Max range = 99.40m
Standard deviation = 3.07 cm/s
Ensemble size = 754 bytes
Storage required = 652.34 MB (684028800 bytes)
Power usage = 481.46 Wh
Battery usage = 1,1

Recovery was by means of a snap hook onto the frame and lifting with the aft crane.

This mooring was trawled by a French vessel and was thrown back into the sea.

The recovery line and lifting lines had been cut and a length of trawl line was attached to the remainder of the recovery line. Once recovered it was noted that two of the glass buoyancy spheres were missing and several others were damaged. The frame of the lander showed signs of severe scuffing.

GUARD BUOYS deployed using aft crane and a release hook

MS1

Deployed : 13.16 GMT on 5/7/08

Depth : 114m

Position : 49 51.15N, 07 56.66W

Recovered : 17.17 GMT on 24/7/08

The mooring was recovered in full using the aft crane and deck winch

MS3

Deployed : 23.27 GMT on 4/7/08

Depth : 122m

Position : 49 56.21N, 07 48.80W

Recovered : not recovered

This mooring was reported as missing on 8/7/08. The reasons why are not known and likewise the current whereabouts of the buoy is unknown.

Dye Release Experiment (Mark Inall).

Two dye release experiments were carried out during the cruise. The dye used was Rhodamine WT, diluted with propan-2-ol (also known as Iso-propyl-alcohol, or IPA) to achieve the required density for injection into the seasonal thermocline. A total mass of 50kg of Rhodamine WT used, with 23 kg released on the first experiment and the remaining 27 kg release on the second. Rhodamine WT fluoresces at 590 nm and was detected *in situ* by using a Chelsea instruments Aquatraka III Rhodamine-tuned fluorimeter (SN:06-3598R-06) which was fitted to the Scanfish towed undulating vehicle.

In both experiments the dye was injected on the σ_θ = 26.5 isopycnal (at approximately 35 m water depth) at a position approximately 1 km NE of station MS2. The dye mixture was pumped from storage tanks on the deck through a 25mm diameter hose attached to a weight lowered from the stern. Multiple small holes at the end of the hose acted to diffuse the dye and a seabird SMP37 microcat (SN:4609) was attached to the diffusing end of the hose to measure the precise injection depth and *in situ* density.

Scanfish surveys of the dye-patch were carried out a various time intervals after each release. Serial output from the Rhodamine-tuned fluorimeter was fed in real time from the CTD deck unit PC into a second PC. This second PC was running a matlab script written to visualise the dye concentrations on a geographical grid survey pattern.

To enable the dye to be tracked in an environment with strong tidal and inertial currents two mini lagrangian drifters were deployed. These were WOCE standard SVP-B drifters manufactured by Marlin-Yug Ltd with the drogue depth modified from the standard 50m depth to the dye release depth of 35m. The buoys (SN: IMEI639400 & IMEI632400) take a GPS fix on the hour every hour then transmit their position via the Iridium satellite network. Positions were received on-board via the internet.

Dye Release #1 (R1)

Time: July 9th 2008, 19:00 – 19:04 BST

Position: 49.94749N 07.798127W

Release: 23 kg Rhodamine WT specific gravity = 1.0245 at 18ºC at 37m water depth.

Drifter buoy deployed: SN639400

Scanfish Surveys (R1S1 and R1S2)

1. R1S1

- Start: 49.944N 7.743W JDAY 191.91836
- End: 49.884N 7.765W JDAY 192.05447

2. R1S2
    - Start: 49.786N 7.860W JDAY 193.59250
    - End: 49.805N 7.778W JDAY 193.93503

Due to termination failure of the scanfish survey survey R1S1 was aborted early and the planned time-gap of 12 hours between surveys was not possible. Due to the low concentrations detected during R1S2 it was agreed that it was not worthwhile conducting a third survey of the first dye release.

Dye Release #2 (R2)

Time: July 17th 2008, 02:12 – 02:18 BST

Position: 49.90615N 07.859162W

Release: 27 kg Rhodamine WT specific gravity = 1.0245 at 18ºC at 35m water depth.

Drifter buoys deployed: SN639400 and SN632400

Scanfish Surveys (R2S1 to R2S4)

1. R2S1
    - Start 49.9617N 7.6245W JDAY 199.28942
    - End 49.8608N 7.7894W JDAY 199.47736
2. R2S2
    - Start 49.9316N 7.6930W JDAY 199.66991
    - End 49.8540N 7.8195W JDAY 199.90988
3. R2S3
    - Start 49.9070N 7.7773W JDAY 200.23618
    - End 49.8445N 7.8481W JDAY 200.47024
4. R2S4
    - Start 49.9006N 7.6653W JDAY 200.74497
    - End 49.8980N 7.7881W JDAY 200.97295

Figure 1: Dye release No. R1. dye mixing and storage tanks next to coiled deployment hose on the aft deck.

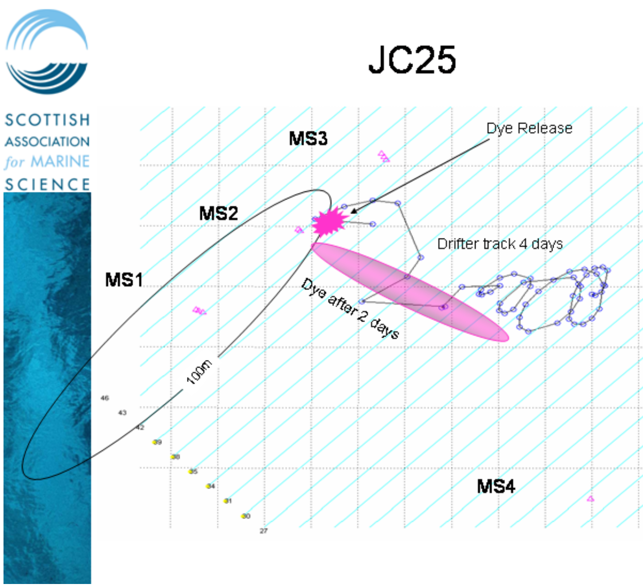


Figure 2: Cartoon showing the estimated extent of the dye patch 2 days after the first release. Mooring positions MS1 to MS4 are shown for reference.

Vessel Mounted ADCPs (Mark Inall).

James Cook is fitted with two vessel mounted ADCPs (VMADCPs), an RDI Ocean Surveyor 75 kHz and an RDI Broadband 150 kHz. Both are mounted in the port drop-keel, and can operate with the keel in the up or down position. However, due to acoustic interference with the EK60 multi-frequency fisheries acoustic sounder, the VMADCPs were only switched on for relatively short periods during JC25.

Both ADPCs were in bottom track range for the entire cruise (except for the very start of the final scanfish line from the Porcupine Abyssal Plane to the shelf break), so navigational correction from ship-relative velocities to fixed earth-relative coordinates was not necessary.

Both VMADPC PCs were running the RDI acquisition software 'VMDAS'. The VMDAS setups for each Doppler are given below. RDI binary format files with the 'ENX' extension were read directly into matlab for visualisation and post-processing.

Under hull aeration was a problem during bad weather, with the OS75 affected more severely than the 150BB. The VMADCPs were principally used during the dye release surveys and the final scanfish line from the shelf break to Jones Bank. The ship steamed at 8 knots during these times and the weather was favourable, therefore reasonable VMADCP data were returned.

<u>OS75 Setup:</u>

No. Bins: 25; Bin size: 8m; Blank after transmit: 8m; Ping rate: 1 s^{-1}

All times in BST

File name	**Start date/time**	**End date/time**	**Comments**
000.	3/7/08 – 21:22	4/7/08 – 06:41	
001	4/7/08 – 06:43	5/7/08 – 07:27	
002	5/7/08 – 07:29	5/7/08 – 15:44	
003	5/7/08 – 15:49	5/7/08 – 16:15	EK60 sync test
004	5/7/08 – 16:15	5/7/08 – 19:21	Ek60 sync text over
005 and 006			Unknown tests
007	9/7/08 – 21:51	10/7/08 – 02:02	
008	10/7/08 – 11:46	11/7/08 – 14:30	
009	11/7/-8 – 14:31	11/7/08 – 22:51	Dye R1S2
010	17/7/08 – 06:17	18/7/08 – 11:37	R2S1 to R2S3
011	18/7/08 – 17:24	19/7/08 – 11:14	R2S4
012	25/7/08 – 20:07		Shelf brk to Jones Bk

150 BB Setup

No. Bins: 50; Bin size: 4m; Blank after transmit: 4m; Ping rate: 1 s^{-1}

All times in BST

File name	Start date/time	End date/time	Comments
000.	3/7/08 – 21:23	4/7/08 – 09:10	
001	4/7/08 – 09:11	5/7/08 – 07:30	
002	5/7/08 – 07:31	5/7/08 – 15:04	
003 to 007	5/7/08 – 15:04	5/7/08 – 19:22	EK60 sync tests
008	9/7/08 – 21:52	10/7/08 – 02:02	
009	10/7/08 – 11:46	11/7/08 – 14:30	
010	11/7/-8 – 14:30	11/7/08 – 22:49	Dye R1S2
011	17/7/08 – 06:17	18/7/08 – 11:37	R2S1 to R2S3
012	18/7/08 – 17:24	19/7/08 – 11:14	R2S4
013	25/7/08 – 20:07		Shelf brk to Jones Bk

Inorganic Nutrients Measurements (Sharon McNeill).

To determine the level of inorganic nutrients (nitrate, phosphate, silicate and ammonium) in the continental shelf and shelf edge waters of the Celtic Sea.

Methodology

Measurements were made using standard colorimetric methods with a Lachat Autoanalyser.

Primary standards were prepared as follows:

Ammonium 10013.27μm

Phosphate 10028.95μm

Nitrate 10072.30μm

Silicate 10511.86μm

A mixed nutrient stock was prepared from adding 1ml NH_4, 0.5ml PO_4, 2ml SiO_2 and 3ml NO_3 of primary standards and diluting to 100ml. Five working stocks then were prepared by diluting down the mixed nutrient stock, giving the highest concentration of 5μM NH_4, 2.5μM PO_4, 10.5μM SiO_2 and 15.1μM NO_3. Analyses of triplicate samples showed that results were reproducible to within 5% at concentrations >1μM, with errors increasing at lower concentrations.

Table 1: CTD sampling locations

Date	Station	Cast no	Location	Time on deck (GMT)	No. Depths
06/07/08	MS2	002	49°53.9N 7°52.15W	05:16	8
06/07/08	MS2	004	49°53.87N 7°51.93W	14:49	6
06/07/08	MS2	005	49°53.75N 7°52.92W	21:13	10
07/07/08	MS2	006	49°54.415N 7°52.502W	05:31	12
07/07/08	MS2	007	49°54.02N 7°52.02W	09:06	9
07/07/08	MS2	008	49°53.57N 7°52.18W	12:31	10
09/07/08	MS1	010	49°51.535N 7°56.627W	04:16	8
			49°44.957N		

11/07/08	MS4	012	7°40.354W 49°44.939N	04:14	12
12/07/08	MS4	014	7°39.915W 49°45.15N	01:11	9
12/07/08	MS4	015	7°39.11W 49°44.61N	08:26	9
12/07/08	MS4	016	7°40.19W 49°44.602N	13:41	10
12/07/08	MS4	017	7°39.001W 49°45.252N	21:37	10
13/07/08	MS4	018	7°39.745W 49°53.86N	04:40	9
14/07/08	MS2	019	7°51.85W 49°54.14N	11:24	11
14/07/08	MS2	020	7°52.99W 49°53.553N	18:40	9
15/07/08	MS2	021	7°52.424W 49°56.165N	03:52	10
17/07/08	MS3	023	7°49.534W 49°59.611N	03:40	9
19/07/08	MS5	027	8°08.615W 49°56.31N	04:05	8
19/07/08	transect 1	029	8°20.3W 49°52.75N	12:00	6
19/07/0	transect 2	030	7°54.90W 49°48.48N	15:40	8
19/07/08	transect 3	031	7°46.59W 49°45.158N	19:11	8
19/07/08	trans 4 MS4	032	7°40.187W 49°50.675N	20:45	8
21/07/08	MS1	033	7°56.883W 49°53.602N	04:04	9
21/07/08	MS2	034	7°52.377W 49°54.16N	07:05	11
21/07/08	MS2	035	7°52.62W 49°53.723N	13:39	10
21/07/08	MS2	036	7°52.847W	20:41	11

22/07/08	MS2	037	49°53.72N 7°52.79W	10:25	11
22/07/08	MS4	038	49°44.81N 7°40.22W	16:35	9
23/07/08	MS4	039	49°45.237N 7°39.950W	03:50	10
23/07/08	MS4	040	49°45.070N 7°39.913W	06:43	9
25/07/08	Shelf edge1	041	48°39.64N 9°08.48W	06:45	8
25/07/08	Shelf edge2	042	48°17.57N 9°26.57W	12:00	7
25/07/08	Shelf edge3	043	47°55.54N 9°44.29W	18:48	10

Samples were collected from CTD casts and analysed within 24hours. Figure 1 shows a typical profile with low nutrient concentrations in the surface waters due to their uptake by primary producers, nutrients then becoming more plentiful in the deeper waters. Zooplankton excretion and NH4 cycling in the surface waters give a different profile for ammonium where the concentrations are higher in shallower depths.

Figure 1: Station MS4 CTD017

Chlorophyll determination (Keith Davidson)**.**

Collection and analysis of chlorophyll samples provides an estimate of the autotrophic biomass within the water column and allows calibration of fluorometric data collected by CTD.

Sample Collection

Water samples were collected from pre dawn CTD casts (Table 1) and transferred into one litre pre washed polycarbonate bottles. These bottles were kept in the dark until processing.

On all CTD casts that primary production measurements were conducted samples were collected for chlorophyll determination at the same six depths at those sampled for primary production, equivalent to 100%, 50%, 25%, 15%, 3% and 1% of surface light intensity. On occasions when the fluorescence maximum did not coincide with one of these depths, a further sample was collected at this depth. On all sampling occasions a sub thermoclyne sample was also collected by CTD for chlorophyll analysis.

For CTDs 041-043 close to or at the shelf edge at from which samples for chlorophyll determination were collected but at which primary production was not conducted, sampling depths are detailed in Table 1.

Sample Processing

Two 500ml sub samples from each depth were filtered under low vacuum through pre ashed GFF glass fibre filters (effective pore size 0.4µm). These filters were stored frozen in eppindorf tubes.

A further two 500ml sub samples from each depth were filtered sequentially through 20µm and 2µm pore size polycarbonate membrane filters. These filters were stored frozen in eppindorf tubes.

Sample Analysis

Samples will be transported frozen to SAMS for post cruise analysis.

Analysis will be conducted by extraction of chlorophyll overnight in the dark at 4^{o}C in 90% acetone. Subsequently samples will be sonicated and then centrifuged to release the pigment into solution. Analysis of pigment concentrations will be conducted using a Turner Designs Trilogy fluorometer.

Table 1: Sampling locations & depths

Date	Station	Cast number	Location	Time of deployment (GMT)	Main sampling depths (m)	Sub thermoclyde sampling depth (m)	Chlorophyll maximum sampling depth (m)
06/07/2008	MS2	002	49° 53.9' N 7° 52.15' W	03:40	As primary production*	107	27
07/07/2008	MS2	006	49° 54.4' N 7° 52.5' W	03:47	As primary production*	100	No defined chlorophyll maximum
09/07/2008	MS1	010	49° 51.5N 7° 56.7W	03:42	As primary production*	68	25
11/07/2008	MS4	012	49° 45'N 7° 40.36' W	03:45	As primary production*	107	27
13/07/2008	MS4	018	49° 45.3'N 7° 39.8' W	04:06	As primary production*	125	30
15/07/2008	MS2	021	49° 53.6' N 7° 52.4' W	03:09	As primary production*	108	38
17/07/2008	MS3	023	49° 56.17'N 7° 49.54' W	03:00	As primary production*	113	30 at 3% PP light depth
19/07/2008	MS5	027	49 ° 56.61'N 8° 8.62' W	03:30	As primary production*	123	33 at 3% PP light depth
21/07/2008	MS1	033	49° 51.5N 7° 56.7W	03:00	As primary production*	73	36
23/07/2008	MS4	039	49° 45.3'N 7° 39.8' W	03:30	As primary production*	128	33 at 3% PP light depth
25/07/2008	-	041	48° 39.4'N 9° 08.28'W	06:04	4	52	34
25/07/2008	-	042	48° 17.6'N 9° 26.6'W	11:37	3	73	22
25/07/2008	-	043	47° 55.6'N 9° 44.3'W	12:12	8	56	36

*All stations were sampled at six depths corresponding to 100%, 50%, 25%, 15%, 3% and 1% of surface light intensity.

Primary Production (Linda Gilpin)**.**

General protocol

Estimates of size fractionated column integrated primary production were made at stations MS1 – MS5 during cruise JC025 using 24 hour on-deck incubations with ^{14}C.

Details of methodology

Where light profiles were available for sampling stations, they indicated the euphotic zone depth to vary from 40 to 44m. Due to the relative proximity of the stations to Jones Bank, 40m was used for those stations where a light profile was not available prior to sampling. CTD casts were made predawn between 0300 and 0400GMT and four 60mL polycarbonate bottles were filled with water from each of six depths equivalent to the 100, 50, 25, 15, 3 and 1% light depth. The water was pre-screened with a 200μm mesh. Each bottle was spiked with 10 μCi (370kBq) of $NaH^{14}CO_3$. Triplicate bottles from each depth were incubated on-deck in tanks shaded with neutral density filters to reproduce the in situ light regimes. The fourth bottle from each depth was incubated in a dark tank; all tanks were cooled with a continuous flow of seawater from the non-toxic supply. The samples were incubated for 24 hours. Between dusk and dawn the samples were placed in a coldroom in a dark box in order to eliminate the effects of light spill from deck lighting. Following incubation, each sample was filtered sequentially under low vacuum through 20, 2 and 0.2μm polycarbonate membrane filters, fumed for ~1hour over HCl and desiccated for atleast 24hours prior to the addition of 3mL of Optiphase Hisafe III scintillation cocktail. The incorporation of ^{14}C into the particulate phase was established using a Perkin Elmer Tricarb 3100TR scintillation counter. The spikes of ^{14}C were standardised for each experiment using a mix of Optiphase Hisafe cocktail, Carbosorb and deionised water in a ratio of 30:10:1 by volume.

Stations sampled

Date	Stn name	CTD cast	Expt. name	Depths sampled (m)
6/7/08	MS2	2	OD1	2, 6, 13, 17, 32, 41
7/7/08	MS2	6	OD2	2, 5, 12, 17, 32, 40
9/7/08	MS1	10	OD3	2, 5, 12, 16, 30, 40
11/7/08	MS4	12	OD4	2, 7, 14, 18, 32, 42
13/7/08	MS4	18	OD5	2, 8, 15, 19, 33, 43
15/7/08	MS2	21	OD6	2, 7, 13, 17, 32, 43
17/7/08	MS3	23	OD7	2, 5, 12, 16, 30, 43
19/7/08	MS5	27	OD8	2, 7, 13, 18, 33, 44
21/7/08	MS1	33	OD9	3, 8, 15, 19, 30, 42
23/7/08	MS4	39	OD10	2, 7, 14, 18, 32, 42

Preliminary results

Preliminary results indicate column production values were low, ranging from 230 – 415 mgC m^{-2}. Size fractionation generally demonstrates production dominated by cells less than 20μm with negligible production in the larger fraction. However, a marked exception to this pattern was observed at MS2 during the first two visits on 6^{th} and 7^{th} July when rates in the >20μm fraction were comparable to those in the other fractions. This pattern was not observed on a later visit to the station on 15^{th} July when the contribution by the >20μm fraction was negligible (Figure 1). This feature will be interpreted in relation to other biological and physical datasets as they emerge.

Figure 1: Depth profiles of primary production at MS2 on 7^{th} and 15^{th} July 2008 demonstrating different fractionation patterns.

Nitrogen Uptake (Keith Davidson)**.**

To obtain an estimate of contribution of new (nitrate) and regenerated (ammonium) to production determination was made of the rate of uptake of nitrate and ammonium using ^{15}N stable isotopes of nitrogen.

Sample Collection

Water samples were collected from pre dawn CTD casts (Table 1) and stored in thermos flasks until processing. Samples were pre filtered through 200µm mesh to remove large zooplankton grazers.

Samples were collected at three depths (Table 1) representative of the surface mixed layer (collected at 25% surface irradiance), within the thermocylne (collected at 3% surface irradiance) and sub thermoclyne water (0% surface irradiance).

From each depth eight 200ml sub samples were transferred into 250ml polycarbonate bottles.

Four bottles received spike additions of ^{15}N Sodium nitrate and four bottles received spike additions of ^{15}N ammonium chloride. Bottles were then incubated for four hours on deck in tanks with flow through seawater and neutral density screens to simulate different irradiance levels.

For samples collected form both the surface mixed layer and the thermoclyne duplicate bottles of both $^{15}NO_3$ and $^{15}NH_4$ spiked water were incubated at light intensities simulating their depth of collection and also in the dark. Water collected from below the euphotic zone was incubated in the dark and also in 100% surface irradiance. On deck incubations are summarised in Table 2.

In all cases the concentration of the ^{15}N spike was set as 10% of the known or estimated concentration of nitrate or ammonium (as appropriate) at the particular depth.

After incubation, samples were filtered through 13mm pre ashed GFF filters. Filters were stored frozen in eppindorf tubes for post cruise analysis at SAMS.

Sample Analysis

Samples will be transported frozen to SAMS for post cruise analysis.

Analysis will be conducted using a PDZ Europa ANCA 20-20 GSL mass spectrometer. Defrosted samples will be oven dried (60^{o}C) for 4 hours and then wrapped in tin disks prior to analysis.

Table 1: Sampling locations & depths

Date	Station	Cast number	Location	Time of deployment (GMT)	collection depth (m) Sub thermocyle	Thermoclyne	Surface mixed layer
06/07/2008	MS2	002	49^o 53.9' N 7^o 52.15' W	03:40	107	32	13
07/07/2008	MS2	006	49^o 54.4' N 7^o 52.5' W	03:47	100	40	17
09/07/2008	MS1	010	49^o 51.5N 7^o 56.7W	03:42	68	30	12
11/07/2008	MS4	012	49^o 45'N 7^o 40.36' W	03:45	107	32	13
13/07/2008	MS4	018	49^o 45.3'N 7^o 39.8' W	04:06	125	33	15
15/07/2008	MS2	021	49^o 53.6' N 7^o 52.4' W	03:09	108	32	13
17/07/2008	MS3	023	49^o 56.17'N 7^o 49.54' W	03:00	113	30	13
19/07/2008	MS5	027	49^o 56.61'N 8^o 8.62' W	03:30	123	33	13
21/07/2008	MS1	033	49^o 51.5N 7^o 56.7W	03:00	73	36	15
23/07/2008	MS4	039	49^o 45.3'N 7^o 39.8' W	03:30	128	33	14

Table 2: On deck light regime

Characteristics of sampling depth	Spike Addition	On deck light regime
Surface mixed layer	$^{15}NO_3$	2 bottles at 25% surface irradiance
		2 bottles at 0% surface irradiance
Surface mixed layer	$^{15}NH_4$	2 bottles at 25% surface irradiance
		2 bottles at 0% surface irradiance
Thermoclyne	$^{15}NO_3$	2 bottles at 3% surface irradiance
		2 bottles at 0% surface irradiance
Thermoclyne	$^{15}NH_4$	2 bottles at 3% surface irradiance

		2 bottles at 0% surface irradiance
Sub thermoclyne	$^{15}NO_3$	2 bottles at 100% surface irradiance
		2 bottles at 0% surface irradiance
Sub thermoclyne	$^{15}NH_4$	2 bottles at 100% surface irradiance
		2 bottles at 0% surface irradiance

Pelagic Phytoplankton, Bacteria & microheterotroph Enumeration (Debra Brennan)**.**

Samples were collected for the enumeration of:

1) Phytoplankton including diatoms, dinoflagellates and ciliates by light microscopy
2) Bacteria, heterotrophic and phototrophic nanoflagellates (HNAN and PNAN), cyanobacteira and bacterial functional groups by fluorescence microscopy.

Phytoplankton

Sample collection:

Phytoplankton samples were collected from the pre dawn CTD casts indicated in Table 1, up to 8 depths. Separate sub samples were fixed with 1% final concentration of Lugol's Iodine and 1% final concentration of glutaradehyde for post cruise analysis by microscopy.

A 20µm phytoplankton net was deployed at a number of stations (Table 1) to a approximate depth of 20m. Collected samples were fixed with both glutaradehyde and Lugol's iodine as above.
A live phytoplankton sample was distributed between three different nutrient growth media recipes each favouring growth of certain algal groups e.g. diatoms or dinoflagellates. These samples will be returned to SAMS where cells will be isolated and grown into pure cultures.

Preliminary identification of phytoplankton observed during JC25 is listed below:

Dinoflagellates:
Ceratium symmetricum, C. *contortum*, C. *declinatum*, C. *furca*, C. *fusus*
Dinophysis tripos, D. *norvegica*
Protoperidium sp.
Gonyaulax sp.
Prorocentrum lima, P. *micans*
Some naked dinoflagellates

Diatoms:
Pseudo-nitzschia sp.
Straitella sp.
Rhizosolenia sp.
Coscinodiscus sp.
Various small centric diatoms

Others

Silicoflagellates- *Dictyocha* sp.

Phaeocystis sp.

Radiolaria sp.

It was noted that station MS3 had a lower abundance of all species compared with the other stations.

<u>Other Pelagic microbes</u>

HNAN/PNAN & CYANOBACTERIA

Sample collection:

Samples were collected from pre- dawn CTD casts at 8 depths (6 primary production depths, chlorophyll maximum and sub thermoclye).

All samples were immediately fixed with 1% (final conc) glutaraldehyde.

HNAN/PNAN

15ml of fixed sample was filtered through a 0.8µm polycarbonate filter with a 0.8µm cellulose nitrate backing filter. The sample was filtered under low vacuum to maintain an even distribution of cells across the filter.

25µl of the fluorescent stain DAPI was added to the final 5ml and incubated for 4 min before re-commencing filtration. Subsequently 5ml of milli-Q water (pre sterilised by 0.2µm filtration) was added to rinse down any remaining sample from the tower.

The filter was then mounted on a microscope slide and frozen at –21 degrees for later analysis.

CYANOBACTERIA

Samples were processed using a similar filtration procedure as for HNAN/PNAN but in this case cells were collected following filtration of 5ml of fixed sample onto a 0.2µm white polycarbonate filter. No stain is required for enumeration as the cyanobacteria auto fluoresce when viewed under ultra violet illumination.

Sample analysis:

Slides will be kept frozen and transported to SAMS for post cruise enumeration by fluorescent microscopy.

BACTERIAL ABUNDANCE

5ml of fixed sample placed in a cryovial and snap frozen with liquid nitrogen prior to freezing at –80 degrees. Post cruise, bacterial abundance analysed by flow cytometry.

BACTERIAL FUNCTIONAL GROUP BY FISH (fluorescent in situ hybridisation)

Samples were collected from 3 depths from pre dawn CTD casts: 1% light depth, chlorophyll maximum and 50% light depth.

A 10ml sub sample from each depth was fixed with paraformaldehyde and incubated for at least 4 hours before filtration.

Samples were filtered onto a 0.2µm white polycarbonate filter with0.8µm cellulose backing filter . Filters were air dried and place in a petri dish before freezing at -21 degrees for post cruise analysis. Samples will be processed following FISH procedure where specific probes are used to identify specific bacterial types using fluorescence microscopy.

Table 1: sampling protocol

Date	Station	Depths	HNAN/ PNAN	Cyano- bacteria	Bacterial abundance	FISH	Phytoplankton	Net sample
6.7.08	MS2	8	•	•	•	•	•	
7.7.08	MS2	7	•	•	•		•	
9/7/08	MS1	8	•	•	•	•	•	•
11/7/08	MS4	8	•	•	•	•	•	
13/7/08	MS4	8	•	•	•		•	•
15/7/08	MS2	8	•	•	•	•	•	
17/7/08	MS3	8	•	•	•	•	•	
19/7/08	MS5	8	•	•	•	•	•	•
21/7/08	MS1	8	•	•	•	•	•	
23/7/08	MS4	8	•	•	•	•	•	
25/7/08	TR6	3					•	•
25/7/08	TR8	3					•	
25/7/08	TR10	3					•	•

Sediment Biogeochemistry (Morten Larsen and Susan McKinlay).

The SOC-GDD Megacorer was deployed during the cruise: No modifications and full ballast was used. Eight carriages were used at most stations, unless more penetration of the sea bed was required to get longer cores, then two or four carriages were removed.

Site MS2- Full ballast, 8 tubes. Compact mud after 2cm and occasional shells .Overlying water clear and, worm tubes on the surface, also small decapods in most cores .To obtain pore, water, samples had to be doubles up after 2cm, and centrifuged at 4500 RPM for 10 minutes

Site MS1- Full ballast, 8 tubes –Failed to recover any core due to firing mechanism being hampered by the sandy sediment. Removed half of the carriages to try and increase penetration, but still failed to capture the cores, due to bubbling and the firing mechanism malfunctioning. Decided to use the Day Grab and sub core. 3 small mini cores taken varying from 4cm to 10 cm, from 3 different drops. These couldn't be worked up in the glove bag, so sliced in the cold room for possible PSA, TOC, ACID Microwave digestion and Gamma detection

Site MS3- Sediment softer at this station, but sill compacted after 8cm, Mega corer preformed well, with some nice cores obtained. Pore water still hard to achieve after 10cm, from sediment surface.

Site MS4- Ref Site- Full ballast, 8 tubes. Sediment similar to MS 2, the majority of the cores from this station had disturbed sediment surfaces .This was caused by the corer bouncing on the sea bed or bubbling as the corer came on board.

Site MS5- New Ref Station- The day Grab was used as a visual, and found to contain fine mud. So a full ballast core was sent down and obtained 7/8 nice cores.

6 MUC Cores from each station (excluding MS1) were closed and incubated at in situ temperature (~10.5°C) and O_2 concentration (88%- 91% atmospheric saturation). The six cores were used to measuring the following:

- Fluxes of ammonia, nitrate and phosphate between sediment and water.
- Rates of denitrification – using the isotope paring technique (addition of $^{15}NO_3^-$)
- Total oxygen uptake rates of the sediment. .
- Microprofiles of oxygen and nitrate.
- Sediment production rates of DIC (Dissolved Inorganic Carbon)

Sediment from 3-6 cores from each station (excluding MS1) were used for following:

- Sulfate reduction rates – 3 sub-cores injected with S-35.
- Potential anammox (anaerobe oxidation of ammonia)
- Pore water profiles of DIC and sulfate- in 1 cm intervals.
- Sediment porosity and organic matter – in 1 cm intervals.

At MS1 only the following measurements were carried out with sediment from Day grab:

- Sulfate reduction rates – 3 sub-cores injected with S-35.
- Pore water profiles of sulfate
- Anammox
- Microprofiles of oxygen and nitrate.

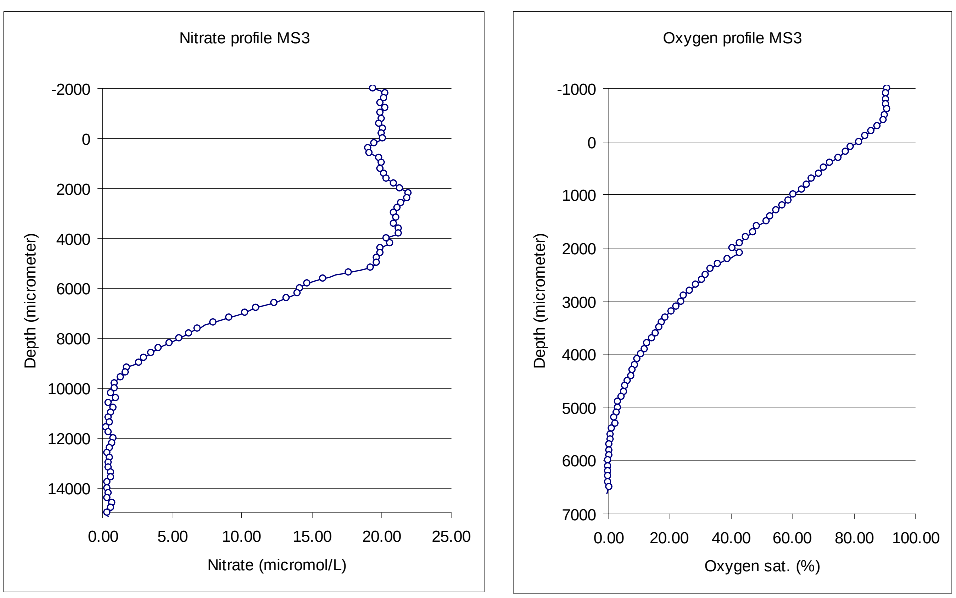


Fig 1. 2 selected microprofiles of nitrate and oxygen from MS3. Sediment surface is found a zero micrometer. The nitrate profile is measured in steps of 200 micrometer and the oxygen profile with a step size of 100 micrometer. Nitrate profiles from all stations showed a nitrate penetration depth of ~ 10 mm. Oxygen profiles from all stations showed an oxygen penetration depth greater 6mm.

Collected samples will be returned to the Scottish Association for Marine Science, for further analysis.

Photograph 1: A daytime megacorer deployment.

Photograph 2. A Day Grab, landing on deck

Photograph 3. Day grab sample from MS2, Celtic Sea

Deployments of megacorer and Day grab:

Station	Site	Date	Time (UTC)	Lat (DN)	Lat (MN)	Lon (DN)	Lon (MN)	Depth	Comment
Jones Bank	MS 2	06/07/08	08.20	53	87	51	85	113	Day Grab, used for visual only
Jones Bank	MS 2	06/07/08	09.00	53	871:78	51	855:54	113	5/8 very short cores, 3 bubbled
Jones Bank	MS 2	06/07/08	09.40	53	869:91	51	855:59	112.4	3/8 poor, discarded
Jones Bank	MS 2	06/07/08	10.00	53	849:77	51	860:21	112.1	6/8 3 bubbled
Jones Bank	MS 2	06/07/08	10.36	53	863:49	51	865:13	112	6/8 2 bubbled
Jones Bank	MS 1	09/07/08	08.28	51	54566	56	56552	82	3/8 All bubbled. Discarded
Jones Bank	MS 1	09/07/08	08.55	51	54617	56	56558	82	0/8 Discarded- removed 4
Jones Bank	MS 1	09/07/08	09.25	51	54470	56	56623	82	0/4 Discarded try Day Grab
Jones Bank	MS 1	09/07/08	09.53	51	54485	56	56582	82	Mini-core Day grab
Jones Bank	MS 1	09/07/08	10.07	51	54321	56	56590	81	Mini-core Day grab
Jones Bank	MS 1	09/07/08	10.18	51	54329	56	56587	82	Mini-core Day grab (Discard)
Jones Bank	MS 1	09/07/08	10.29	51	54098	56	56401	83	Mini-core Day grab
Jones Bank	MS 1	11/07/08	07.30	44	96	40	35	132	Day grab used visual only
Jones Bank	MS4	11/07/08	07.49	44	95808	40	35323	132	8/8 Bounced- Discarded
Jones Bank	MS4	11/07/08	08.17	44	95763	40	35378	132	4/8.Core1, Gamma & spare.
Jones Bank	MS4	11/07/08	08.56	44	95731	40	35325	132	3/8 Bounced –None taken
Jones Bank	MS4	11/07/08	09.15	44	95683	40	35365	133	7/8 Core 2 (Morten remainder)
Jones Bank	MS4	11/07/08	09.50	44	95612	40	35339	133	6/8 Core 3 (Morten remainder)
Jones Bank	MS2	14/07/08	08.25	53	76708	52	96213	107	Off Station
Jones Bank	MS2	14/07/08	09.36	53	86987	51	84904	117	2/4 Morten 1 D.Green 1
Jones Bank	MS2	14/07/08	10.02	53	86879	51	85092	117	3/4 1 bubbled Morten
Jones Bank	MS2	14/07/08	10.30	53	86165	51	85077	117	5/6 5 Nice cores Morten
Jones Bank	MS3	16/07/08	18.03	56	03345	48	68897	126	Day Grab, visual only
Jones Bank	MS3	16/07/08	18.25	56	03646	48	68751	126	MS3- Core 1 taken
Jones Bank	MS3	16/07/08	18.58	56	03286	48	68762	123	MS3 Core 2 , PLUS Gamma core
Jones Bank	MS3	16/07/08	19.25	56	03439	49	68766	123	MS3 Spare core taken
Jones Bank	MS3	16/07/08	19.56	56	03411	48	68801	123	MS3 Core 3 taken
Ref Jones Bank	MS 5	19/07/08	06.58	59	61245	08	61437	130	Day grab Visual
Ref Jones Bank	MS 5	19/07/07	07.20	59	61265	08	61653	130	Mega corer 7/8, core 1, gamma & spare
Ref Jones Bank	MS 5	19/07/08	07.50	59	61178	08	61529	130	Mega Corer 7/8, Core 2
Ref Jones Bank	MS 5	19/07/08	08.29	59	61290	08	61758	129	Mega corer 7/8 , Core 3 (2 bubbled)

Zooplankton sampling with Bongo nets (Beth Scott)**.**

Bongo nets, a set of 200 µm and 95 µm nets were deployed using the starboard winch for straight vertical tows. Two tows were taken at each station (except the first test of the system at MS2). It takes 3 people to deploy, 1 to run the winch, 1 to hold the weight/keel, 1 to hold the bongos vertical until over the side until bongos are fully swung out and read to drop. The wire goes in and out at 0.25 m /s and as the recommended speed for vertical or oblige tows is 0.5 m/s this is a bit slow and takes more time than it needs to. The timing of entry, timing at bottom and to start hauling back and time it hits surface are recorded. When the first net is recovered, the nets are washed down with a salt water hose, cod ends removed, second set put on and 2nd tow deployed immediately.

Volume swept is calculated by

Volume = circular area * depth of sample (Circular area of net = 0.0707 m2)

Processing samples: Contents of cod ends are collected and put into labelled bottles with approximately 200 ml of 4% formalin solution. The labelling protocol is JC025 00# (number of CTD cast) and 95 µm or 200 µm, sample number 1 or 2 and the station label (i.e. MS1 or Tr1).

Table 1 Bongo Net Samples at Main Stations

Locations	Depth of tow/ Volume swept	Spring No of samples	Neap No of samples	Total
MS1	60-68 m 4.24-4.81 m^3	4		4
MS2	90-95 m 6.36-6.72 m^3	3	2	5
MS3	110 m 7.78 m^3		2	2
MS4	110 m 7.78 m^3		4	4
MS5	110 m 7.78 m^3	2		2
Totals		9	8	**17**

Table 2 Bongo Net Samples at Shelf edge

Locations	Depth of tow/ Volume swept	No of samples
Tr1 Shelf Edge shallow	130 m 9.19 m^3	2
Tr2 Shelf Edge edge	140 m 9.90 m^3	2
Tr3 Shelf Edge deep	196 m 13.86 m^3	2
Totals		6

Fisheries acoustics (Clare Embling, Beth Scott & Sophie Fielding (BAS)).

Fisheries acoustics was used on the *James Cook* to record fish schools within the water column throughout the survey, but in particular during the scanfish boxes (12.5 or 25 hour long circuits of the same 'oval' circuit repeated 6 or 12 times respectively), and during the 12.5 or 25 hour turbulence stations. This was carried out with the aim of studying fish behaviour over the diurnal and tidal cycles. The EK60 also proved to have a good capability for visualising internal waves from the patterns of zooplankton density above & within the thermocline.

The ship EK60 fish echosounder system is positioned on the starboard drop keel on the *James Cook*, and comprises 5 transponders, at 18, 28, 70, 120 and 200 kHz. It was synchronised with the EA500 (another ship echosounder) using the SIMRAD Synchronisation Unit (SSU), but could not be worked synchronously with the shipboard ADCP due to a believed software problem that controls the ADCP ping rate. The ADCP operated at 75 & 150 kHz so contaminated the 70, 120 and 200 kHz of the EK60 returns. In addition, the EK60 was obscured by bubbles (especially at the lower frequencies) if operated with the keel up – mainly due to the bulbous bow, combined with a flat bottom to the ship forcing air bubbles along the bottom of the hull. Since the EK60 and the ADCP transponders were on opposite keels, only one was able to work optimally at any one time. Therefore, although the EK60 was operated continuously during the survey, the data during which the EK60 keel was up & the ADCP operational is not as good quality as that collected in the rest of the survey. The bridge also operated an echosounder that was not synchronised with the EK60, and that produced noise on the 38 kHz, so by co-ordination with the bridge it was ensured that this was used to a minimum during the key data collection phases (it was mainly used for the deployment & retrieval of various bits of kit).

A key part in ensuring that the data could be used for fish abundance estimation and fish species recognition is the calibration of the five transponders – this was carried out by Sophie Fielding, an acoustician from the British Antarctic Survey (BAS) on Thursday 3rd July. Due to problems in trying to calibrate the system in an area of high tidal current (which made it extremely difficult to position the small carbon tungsten ball within the narrow beam of each of the transponders), we were only able to calibrate three of the five frequencies: 38, 120 and 200 kHz. A full report is provided by Sophie and is included as an appendix.

Core data collected (EK60 starboard keel down, ADCP switched off) is listed in the table below, activities in italics are those data collected supplementary to the core stationary & box survey data.

Start date & time (GMT)	End date & time (GMT)	Task
6th July 2008 04:30	7th July 2008 17:30	MS2 stationary turbulence monitoring (25 hr: spring)
8th July 2008 00:00	9th July 2008 01:00	Bank 'box' repeat survey (25 hr: spring)[1]
9th July 2008 19:30	*9th July 2008 21:30*	*Small 'box' perpendicular to bank box survey*
10th July 2008 03:00	*10th July 2008 08:30*	*Transects perpendicular to bank box between MS2&3*
12th July 2008 02:15	13th July 2008 04:15	MS4 stationary turbulence monitoring (25 hr: neap)
13th July 2008 06:45	13th July 2008 20:30	MS4 'box' repeat survey (12 hr: neap)[2]
13th July 2008 20:30	*14th July 2008 03:00*	*Transect MS4-across bank-MS5-bank*
14th July 2008 12:00	15th July 2008 01:30	MS2 stationary turbulence monitoring (12 hr: neap)
15th July 2008 15:00	16th July 2008 16:00	Bank 'box' repeat survey (25 hr: neap)
18th July 2008 12:04	*18th July 2008 17:30*	*Transect to & from MS5 from bank*
19th July 2008 10:27	*19th July 2008 20:00*	*CTD & grab survey over top of bank MS5-MS4*
19th July 2008 20:00	*20th July 2008 04:00?*	*Bathymetry transects over MS4 area*
20th July 2008 04:00	20th July 2008 19:30	MS4 'box' repeat survey (15 hr: spring)
21st July 2008 08:00	22nd July 2008 09:30	MS2 stationary turbulence monitoring (25 hr: spring)
22nd July 2008 17:10	23rd July 2008 06:00	MS4 stationary turbulence monitoring (12 hr: spring)
23rd July 2008 17:00	*24th July 2008 08:00*	*Towed transect from Jones Bank – Scilleys[3]*
24th July 2008 19:30	*25th July 2008 14:30*	*Jones Bank to Shelf edge transect[4]*

On the spring tide bank box, nice clear progression of internal waves at the steep slope on the turn of the most south-easterly point of the 'box' (see following figures):

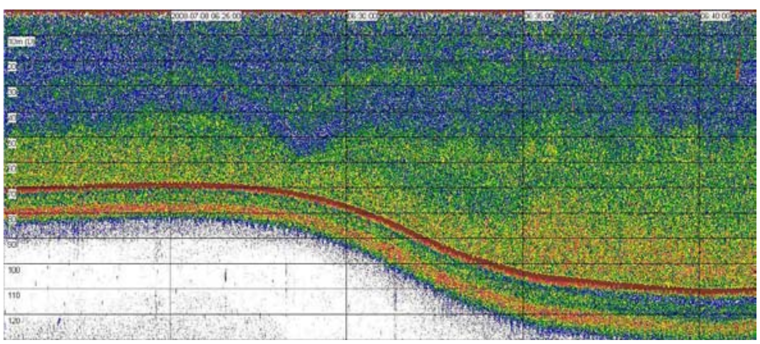


Figure 1 – Slope (dark red line is the echo from the bottom) & zooplankton layers at 06:30 (GMT) on 8Jul08 (the more intense the colour the more energy is reflected from the target from blue -> green -> yellow -> red) (shown is the output from the 200 kHz echosounder)

[1] Weather and swell made it too difficult to run the MVP up the edge (SW) so the decision was made to run it only on downward track until the weather improved. This way the ship could make it around the track (and all three moorings) in 2 hours. First circuit well off-course, subsequent circuits much better. At 07:15 the MVP was able to be towed on both sides of the 'box', but still had to be brought in for the turns.
[2] First circuit of box too large & doesn't match the subsequent circuits of MS4.
[3] May have lost some files during the night due to a full EK60 disk, Echoview stopped receiving data at 03:00, but the EK60 computer said 'low disk space'. Gareth freed up space on the disk & restarted the ER60 computer which seems to have resolved the problem – may therefore have no loss of data.
[4] EK60 doesn't work at depth: 200 kHz doesn't work below 200m – only the 18 kHz echosounder was able to detect to the bottom when we were off the shelf edge (when we were in water 2800m deep).

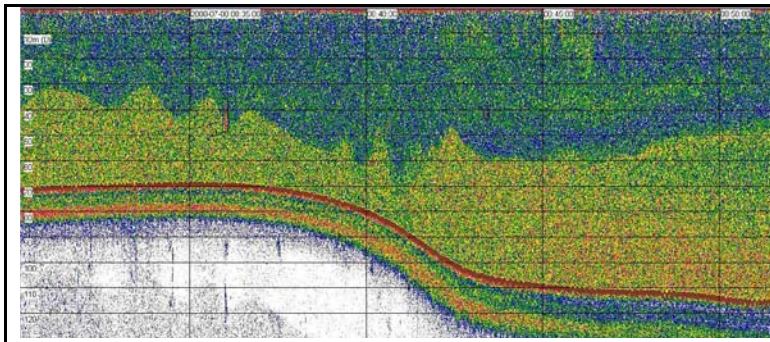


Figure 2 – Slope & zooplankton layers at 08:40 (GMT) on 8Jul08: depression of thermocline (shown is the output from the 200 kHz echosounder)

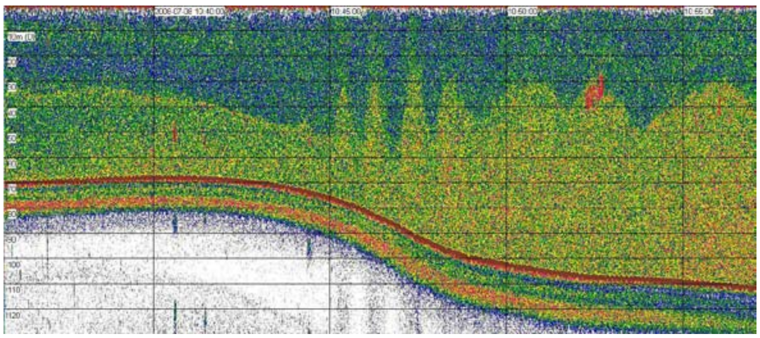


Figure 3 – Slope & zooplankton layers at 10:45 (GMT) on 8Jul08: rapid & steep internal waves at slope. Clear fish school at top of thermocline (intense red marks) just off slope (shown is the output from the 200 kHz echosounder).

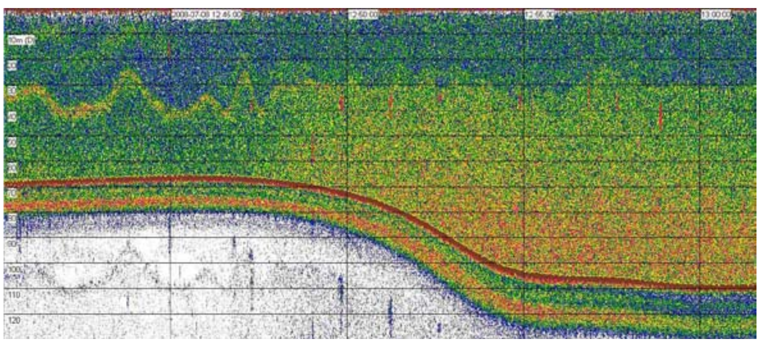


Figure 4 – Slope & zooplankton layers at 12:50 (GMT) on 8Jul08. Clear fish schools within & below the thermocline (intense red marks) on & off slope (shown is the output from the 200 kHz echosounder)

The clustering of internal waves over the bank edge is clearly visible in the transect carried out over the whole bank on returning from the shelf break. There is clearly higher density of scatters (fish/zooplankton) within the thermocline on one side of the bank, in which internal waves are visible. Also of note is the deeper high density layer on the edges of the bank at around 100m depth on the deeper side and 90m depth on the shallower side of the bank.

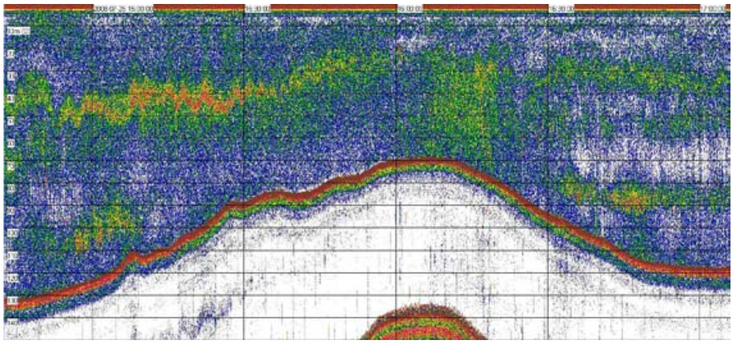


Figure 5 – Jones Bank & fish/zooplankton layers between 14:45-17:00 (GMT) on 26Jul08 (from 38 kHz echosounder)

A preliminary look at the data showed a clear diurnal change in behaviour, with fish schools concentrated mainly on & around Jones Bank during the day, but dispersing at night. There were very few fish schools visible off the bank (in MS4 & MS5), but clear marks of individual fish rising off the bottom during the day off the bank (and fewer of these 'bottom' fish marks on the bank).

Records of keel up/down & ADCP on/off

Date & Time (GMT)	Action	Comments
3rd July 2008 04:00	Keel down, ADCP off	Start of calibration
3rd July 2008 08:00?	Keel up, ADCP off	Move into shallower water for calibration so keel brought up
5th July 2008 20:35	Keel down, ADCP off	For MS2 turbulence & bank box
9th July 2008 21:30	Keel up, ADCP on	Brought up for dye release experiment
10th July 2008 02:00	Keel up, ADCP off	Scanfish snagged on something, dye tracking stopped
10th July 2008 02:53	Keel down, ADCP off	
10th July 2008 11:46	Keel up, ADCP on	For T-Chl chain tow from MS1-MS3-MS1-MS4
11th July 2008 03:08	Keel down, ADCP on	T-Chl tow ended.
11th July 2008 14:30	Keel up, ADCP on	Search for dye
11th July 2008 22:50	Keel down, ADCP off	End of dye search
15th July 2008 07:30	Keel up, ADCP off, SWATH on	Start of SWATH bathymetry survey
15th July 2008 12:41	Keel down, ADCP off, SWATH off	End of SWATH bathymetry survey
16th July 2008 18:53	Keel up, ADCP off	Keels changed ready for dye release
17th July 2008 02:00?	Keel up, ACCP on	Ask Mark Inall when ADCP switched on
18th July 2008 12:04	Keel down, ADCP off	Steaming to MS5 & back
18th July 2008 17:30	Keel up, ADCP on	For final dye tracking survey
19th July 2008 10:15	Keel up, ADCP off	End of dye experiment
19th July 2008 10:27	Keel down, ADCP off	
24th July 2008 08:03	Keel up, ADCP off	Keel taken up to steam back from Scilleys
24th July 2008 14:56	Keel down, ADCP off	Keel dropped once back on Jones Bank
25th July 2008 19:30	Keel up, ADCP off	Keel raised, dropped, and raised again (confusion!)
25th July 2008 20:30?	Keel up, ADCP on	ADCP run with scanfish on return transect

Baited Underwater Camera (Inigo Martinez, FRS Marine Laboratory and Aberdeen University.

The FRS Baited Underwater Camera (BUC) is a Lander frame fitted with a Kongsberg 5 mega pixel underwater camera, flash unit and a 24 v battery pack (fig 1). The lander is deployed on a free fall both on tethered mode or on legged mode. On JC_025 all deployments were on tethered mode where the BUC is suspended 2 m above the seabed by a flotation package. The lander is attached to a ballast with a 1m scale (fig 2) where a standard 500 g of fresh mackerel bait is placed. In this case to make the life of the bait longer a second bait was placed frozen, on a seawater dissolving bag and wrapped on a mesh bag (fig 4). The camera was programmed to take one picture each minute.

Fig 1 (left). Baited camera frame fitted with camera, flash, battery and acoustic releases.
Fig 2 (right). deploying lander with ballast attach by 2 m wire.

The BUC was deployed on 9 occasions of which 7 were successful, one being obscured by continuous sediment resuspension. A total of 6186 pictures were collected over 103 hours (table 1). All sampling stations at the bank and on the flanks were covered (fig 3).

JC025	James Bank					
deployment	date	site	depth	lat	lon	images
JC025_01	07-09/08/2008	MS2	115	49.9	-7.9	469
JC025_02	10-11/07/08	MS1	84	49.9	-7.9	76
JC025_03	12-13/07/08	MS4	115	49.7	-7.7	828
JC025_04	14-15/07/08	MS1	95	49.8	-7.9	400
JC025_05	15-16/07/08	MS3	127	49.9	-7.8	893
JC025_06	17/07/2018	MS3	125	49.9	-7.8	771
JC025_07	18-19/07/08	MS5	124	50.0	-8.2	899
JC025_08	19/07/2008	MS1	102	49.8	-7.9	928
JC025_09	22-23/07/08	MS4	134	49.7	-7.7	922

Table 1. Baited underwater camera deployment dates, sampling station, depth, position and number of images on each deployment.

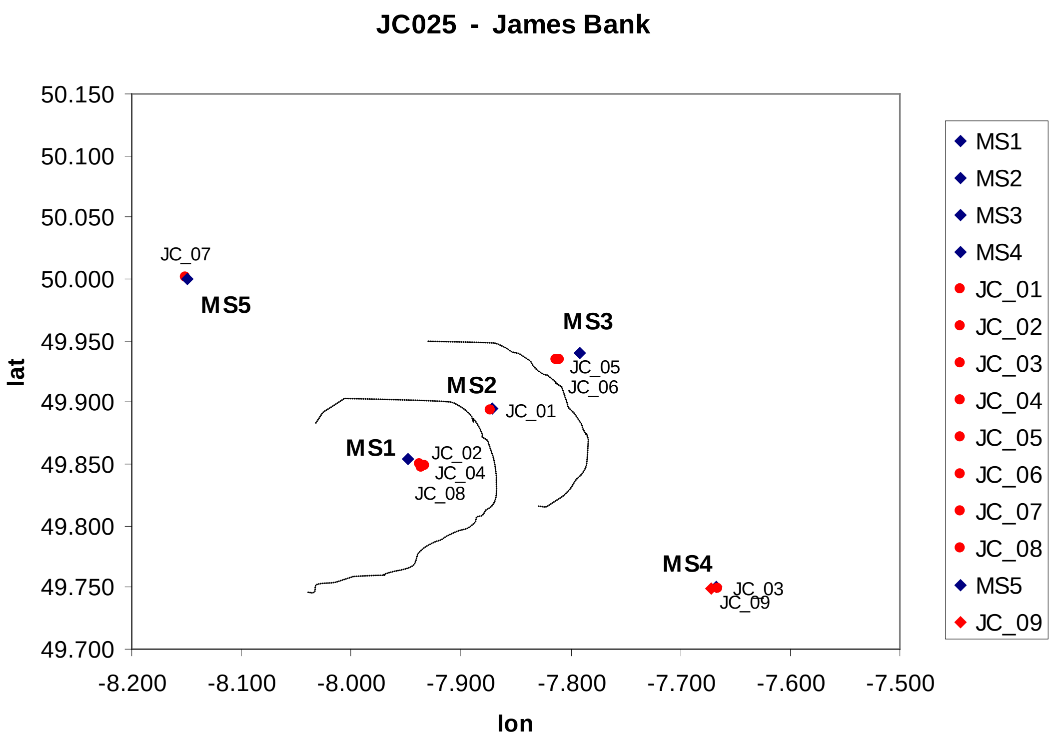
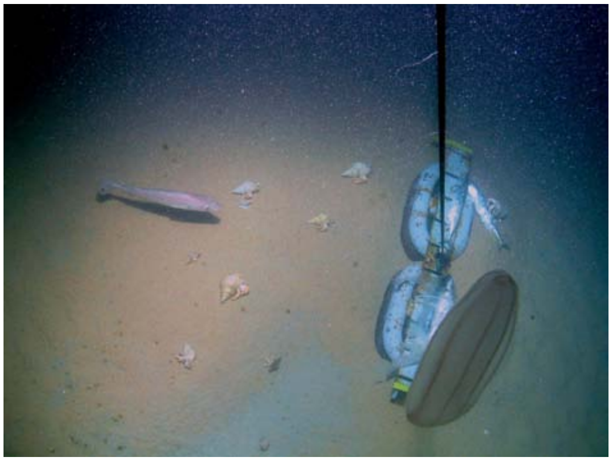


Fig 3. Sampling Stations and baited underwater camera deployments at the James Bank's top (MS1), slope (MS2), bottom (MS3), and on the flanks (MS4 and MS5).

From each picture all species are identified and individuals within species counted on spreadsheets. Once all data is summarised 4 main biological indicators are obtained; Species Richness, First arrival time for each specie, Maximum number of individuals in one shoot per specie and Time of maximum number within each deployment. All this indicators can be crossed or modelled with other biological and oceanographic variables.

Other useful information obtained from the pictures is the length frequency of individuals (separated by 10 pictures/10 min to avoid pseudoreplication), speed track of invertebrates and permanence on the bait area. Individual images can be imported on ImageJ to calibrate the picture with the scale in view and individual fish can be measured by drawing its dorsal line (fig. 5).



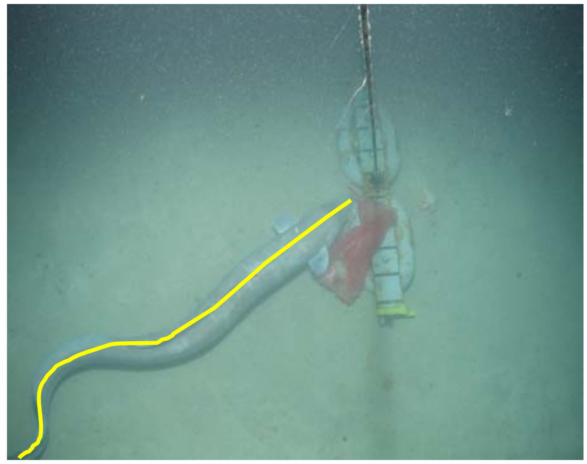


Fig. 4 (left) Whiting (*Merlangius merlangus*) and invertebrates attracted to the bait over the scale attached to the ballast..

Fig 5 (right) Measuring length of a conger (*Conger conger*) close to the scale attracted by the frozen bait wrapped on the red mesh bag.

Cetacean acoustics (Clare Embling).

Three different methods were used on the *James Cook* to listen for the vocalizations of cetaceans (whales, dolphins and porpoises): C-PODs, sonobuoys and a vertical hydrophone array.

C-PODs

C-PODs (POrpoise Detectors – Chelonia Ltd) detect the clicks of dolphins and porpoises and record the data within a memory card, with sufficient battery power to monitor for up to 4 months. C-PODs were placed on each of the ADCP moorings to examine whether there was a change in the behaviour of porpoises and dolphins in the area over diurnal and tidal cycles. An additional C-POD was deployed on the camera lander mooring line.

C-POD deployment details:

Mooring location	Position	Deployment depth	CPOD ID	Clock start time	Clock stop time
MS1 (ADCP)	49º 51.21’ N, 7º 56.82 W	70m[5]	051	04/07/08 18:10	26/07/08 19:06
MS2 (ADCP)	49º 53.84’ N, 7º 52.48 W	120m[1]	050	04/07/08 18:11	24/07/08 18:56[6]
MS3 (ADCP)	49º 56.30’ N, 7º 48.90 W	130m[1]	049	04/07/08 17:02	22/07/08 13:49[2]
MS4 (ADCP)	49º 44.98’ N, 7º 40.05 W	130m[1]	077	04/07/08 19:50	23/07/08 09:56[2]
MS2 (camera lander)	49º 53.74’ N, 7º 52.68 W	110m[1]	078	07/07/08 17:52	09/07/08 14:24[2]
MS4 (camera lander)	49º 44.95’ N, 7º 39.91 W	120m[1]	078	09/07/08 23:47	13/07/08 21:10
MS1 (camera lander)	49º 50.83’ N, 7º 56.12 W	60m[1]	078	13/07/08 21:34	15/07/08 11:40
MS3 (camera lander)	49º 56.07’ N, 7º 46.61 W	120m[1]	078	15/07/08 10:46	16/07/08 10:46[2]
MS3 (camera lander)	49º 56.06’ N, 7º 48.74 W	120m[1]	078	16/07/08 22:49	17/07/08 18:57
MS5 (camera lander)	50º 00.09’ N, 8º 09.01 W	100m[1]	078	18/07/08 13:36	19/07/08 11:37
MS1 (camera lander)	49º 50.93’ N, 7º 56.01 W	60m[1]	078	19/07/08 15:46	22/07/08 11:08
MS4 (camera lander)	49º 44.98’ N, 7º 40.05 W[7]	120m[1]	078	22/07/08 12:02	23/07/08 10:52
“	“	20m	049	22/07/08 15:28	23/07/08 10:26

[5] Any record of depth at each of the moorings? Exact depth will be obtained from the corrected EK60 data (once corrected for the draft of the ship & the depth of the keel.

[6] Duff deployment (no data recorded on the memory card)

[7] Check exact position of camera lander with Inigo

Three out of four of the 3-week ADCP mooring deployments, and 2 out of 9 of the camera lander mooring deployments failed. It is not completely clear why the deployments failed, however the C-PODs are version 0, straight off the production line so teething problems are, perhaps, to be expected. Part way through the cruise Chelonia issued a new set-up procedure (inserting the memory card with the batteries disconnected), after which there have been no C-POD failures recorded. One of the 3-week ADCP mooring C-POD deployments was successful, and managed to collect data for 7 days, it is not clear why it failed after 7 days (the memory card wasn't full, however the LED was no longer flashing on retrieval). All files were sent to Nick Tregenza (Chelonia Ltd), of those files examined so far, porpoises were recorded during short episodes on several deployments (see figure 1).

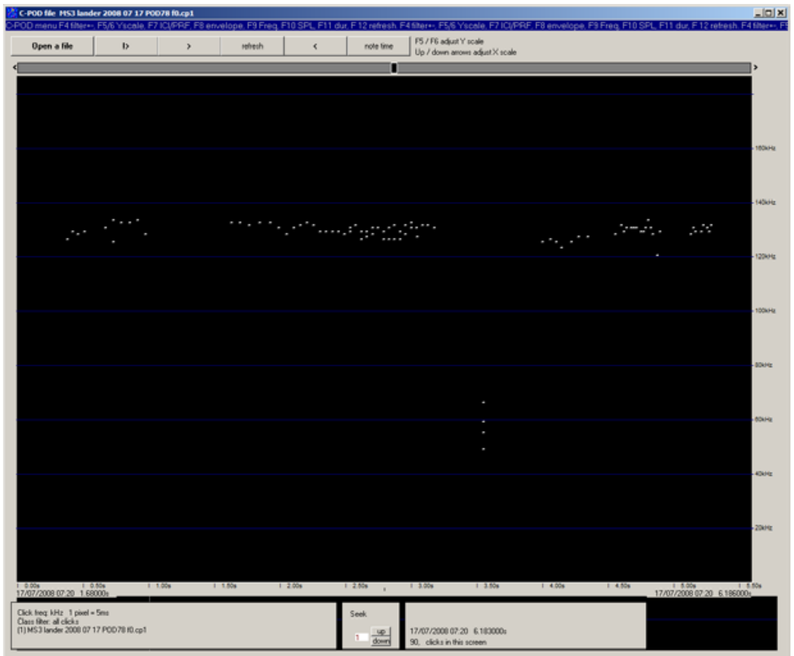


Figure 1 – Clear harbour porpoise train (narrowband clicks at around 130 kHz) at 07:20 (GMT) on 17Jul08 recorded by C-POD deployed on camera lander mooring (10m off bottom) at MS3

Sonobuoys

Sonobuoys are ex-military devices that when thrown into the sea will deploy a hydrophone (underwater microphone) to a set depth (30m or 140m), and inflate a float with a VHF antenna that transmits the sounds recorded on the hydrophones back to a VHF receiver on the ship. The devices are expendable so do not need to be retrieved (but do litter the ocean). Sonobuoys can pick up the sounds of whales and dolphins (low to medium frequency) but not porpoises which produce sound at higher frequencies than the hydrophones are designed to detect. The aim was to be able to continue to detect whales and dolphins during the night at the stationary monitoring locations, times at which observers are unable to see any animals. However, ideally it does need detections of cetaceans during daylight by which to calibrate the recordings (evidence suggests that cetaceans will also change their vocalization patterns diurnally). On the *James Cook* we had many problems trying to get the antenna positioned and connected such that we were able to hear the sonobuoy transmissions – this meant that we missed out on the first stationary monitoring at MS2. The antenna was initially connected through the ship coax cable trunking up to the top of the bridge; it is thought that this did not work due to the loss of signal at each of the cable junctions. A single long cable was used to avoid this problem, but it wasn't until the antenna was moved to alternative location, that we were finally able to get receive the sounds from the sonobuoys. Also, many of the sonobuoys no longer worked (one sank, and others just didn't transmit sound back), so overall, the sonobuoy deployments were not a huge success. However, the deployments that were able to record data are listed in the table below (sampled at 48 kHz). All deployments were set to drop hydrophones to 30m, except for the final deployment off the shelf edge which was set to 140m:

Date & time (GMT)	Location	Sonobuoy channel	Recordings	Comments
06/07/08 13:13	MS2	20	JC2520080706_131236.wav JC2520080706_135514.wav JC2520080706_155144.wav	Not convinced it was working properly
06/07/08 19:48	MS2	20	JC2520080706_195018.wav JC2520080706_211856.wav	Not convinced it was working properly
12/07/08 13:50	MS4	16	JC2520080712_125229.wav JC2520080712_133120.wav JC2520080712_141010.wav JC2520080712_144901.wav JC2520080712_152751.wav	After antenna fixed
13/07/08 03:20	MS4	79	JC2520080713_022837.wav JC2520080713_030729.wav JC2520080713_034620.wav JC2520080713_042511.wav JC2520080713_050402.wav JC2520080713_054253.wav JC2520080713_062144.wav	Started fading in and out quite rapidly
14/07/08 11:47	MS2	79	JC2520080714_115613.wav JC2520080714_123504.wav JC2520080714_131900.wav JC2520080714_135805.wav JC2520080714_143708.wav	
19/07/08 13:40	49º 54.5' N, 7º 58.0' W	90	JC2520080719_134050.wav JC2520080719_141941.wav	Deployed after seeing dolphins feeding
25/07/08 16:35	Tr8	85 & 90	JC2520080725_163852.wav JC2520080725_171742.wav JC2520080725_175632.wav JC2520080725_183523.wav JC2520080725_191415.wav JC2520080725_195306.wav JC2520080725_203156.wav	Deployed 2 sonobuoys to make sure at least one worked! Surrounded by fin whales, so hoping to have recorded their low frequency 'moans'.

Vertical hydrophone array

A vertical hydrophone array was built that comprised of 4 hydrophones spaced along 65 metres of cable, spaced at 5m, 15m, 55m and 65m depth. The cable was cable-tied to a rope on which weights were placed to ensure the hydrophone was held as vertical as possible within the water column. VEMCO loggers were placed next to each of the hydrophones to record the depth of each of the hydrophones. The cable was brought back to a MOTU Ultralite soundcard (sampling at 96 kHz) and the sounds recorded onto laptop. All equipment was powered by a 12V sealed battery & were contained within a waterproof pelicase. The hydrophone is deployed over the side of a small boat in the vicinity of feeding dolphins, with the aim of recording the depth at which the dolphins were diving during their feeding activity. It was known that this would be challenging as it required (i) calm weather; (ii) feeding dolphins within the vicinity of the ship, and (iii) only possible during turbulence profiling when the ship was stationary. A test run was carried out on the morning of 12th July 2008. The rescue boat was launched, and we motored off to around 500m from the ship, launched the ship drogue & deployed the hydrophone. The ship drogue was not very effective, so the boat drifted quite a lot during the deployment and rolled badly, making for unpleasant working conditions (made us all quite green). However, the hydrophone worked fine, although the only sound to be heard in the depths was the ship echosounder. There was also some high pitched electrical noise from the soundcard which could not be resolved by earthing the hydrophone (may need a better earthing contact). The data from the VEMCO loggers showed that the hydrophone dragged a little behind the boat, and was not vertical in the water column, so more weight would need to be attached on subsequent deployments.

There were no conditions in which dolphins were in the vicinity of the ship in which it was possible to launch the rescue boat to record their vocalizations. However, given more stationary work, and a higher density of dolphins (perhaps in more coastal areas which have lower swell), the concept has been proven possible.

Fishing Vessel – Fishing Observer Report (Beth Scott).

Two commercial fishing vessels the Crystal Sea , Skipper Dave Stevens, and the Imogen, Skipper Roger Nowell, were chartered (see attached contracts) to collect representative samples of demersal, benthic and pelagic fish. The Cornish Fisherman's Producers Organisation, with our contact, Andy Wheeler, were an invaluable part of the logistics of the set up this co-operation.

Two fisheries observers, James Roberts and David Hughes were contracted from MRAG via James Clark to identify and enumerate species as well as take length frequency data for the top 10 species (by biomass for demersal species, by number for pelagic species). See attached documents for the design of the fishing for each vessel.

The original plan was to have the boats come out in sequence with the pelagic boat first on the grounds on the 21st of July. Unfortunately due to engine trouble the Imogen could not make it to the grounds until the 25th. Once arriving at the Jones Bank, Imogene successfully deployed 4 tows at each of the MS1-3 and MS4 sites. Night time tows were not done due to concerns with the amount of trawling going on and the amount of mackerel in the water column. At the time of this report Imogen was on her way to MS5 to complete 4 more tows and attempt a night time tow if the conditions allowed.

The Crystal Sea came to the grounds on the 22nd and completed MS1-MS3 and 3 out of 4 tows of the MS4 site. However on the 23rd they picked up a trawl net in their propeller and the James Cook ended up towing them to just off the Scillies. As they could not return to the area the region of MS5 will not be fished demersaly.

In total 7 tows were completed by the Crystal Sea and to date 8 tows have been completed by Imogen (with another 4 expected). A full report from MRAG will be available in a week's time.

Seabird and cetacean sightings surveys (Andy Webb).

Three surveyors were recruited by the Joint Nature Conservation Committee to carry out standardised visual surveys of seabirds, cetaceans and any other surface-dwelling animals during JC025. All surveyors were trained to standards set by the European Seabirds at Sea Co-ordinating group.

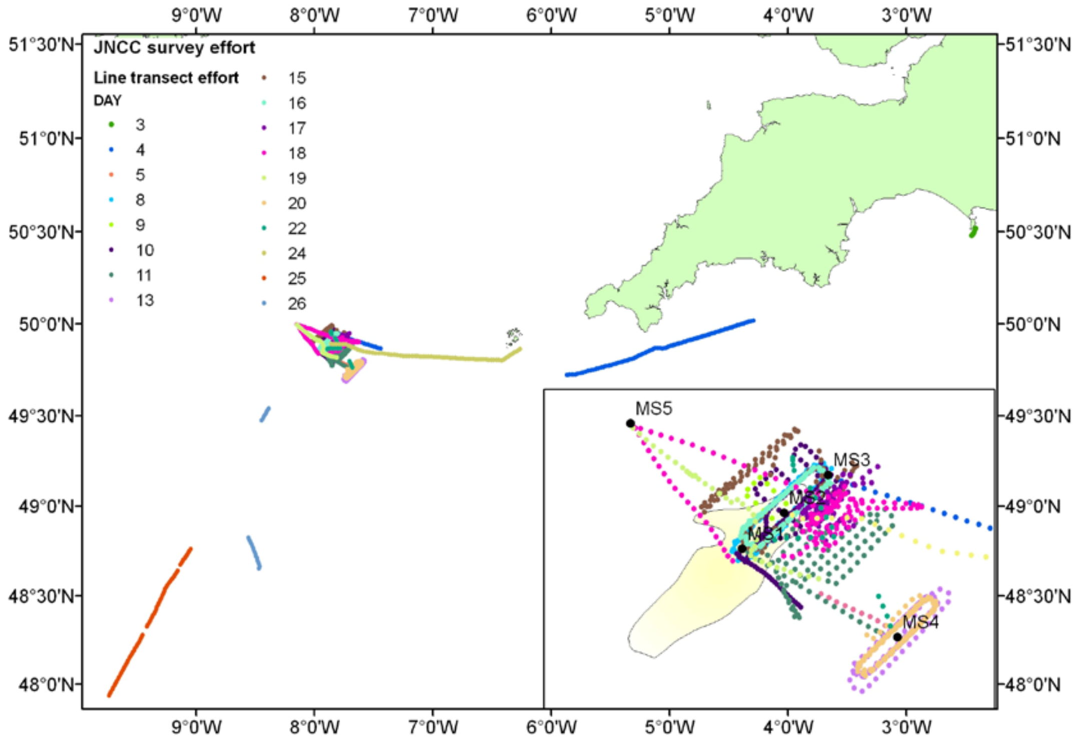
The methods used were standard line-transect methods with distance estimation, as described by Camphuysen *et al.* (2004). Two observers were used at most times to record all seabird, cetacean and fish species while the James Cook was steaming. Sightings were binned into 5-minute time periods. Distance travelled was calculated from the ship's navigation data.

Table 1. Detailed summary of line transect survey of seabirds and cetaceans on RSS James Cook, 3 – 26 July 2008.

Date	**Line transect data**		
	Total time (HH:MM)	**Km**	**Notes**
03/07/2008	00:15	6.6	Leaving Portland
04/07/2008	09:35	173.6	Steaming to Jones Bank
05/07/2008	00:50	11.6	Steaming MS1 to MS4
06/07/2008			
07/07/2008			
08/07/2008	15:45	259.2	MPV circuit around MS1 - MS3
09/07/2008	01:05	15.5	Exploratory dye-release survey
10/07/2008	04:40	43.4	Dye release survey
	07:20	43.7	Towing t-chain at 3kn
11/07/2008	08:05	125.3	Dye-release survey
12/07/2008			
13/07/2008	13:50	206.0	Scanfish circuit around MS4
14/07/2008			
15/07/2008	05:00	73.3	General steaming and Swath bathymetry survey
	07:00	90.6	Scanfish circuit around MS1 - MS3
16/07/2008	11:15	166.7	Scanfish circuit around MS1 - MS3
17/07/2008	13:05	114.9	Dye release survey
18/07/2008	13:15	181.3	Dye release survey
19/07/2008	03:05	34.8	Steaming between CTD stations
20/07/2008	15:25	217.5	MS4 circuit
22/07/2008	01:45	23.8	Steaming between stations
23/07/2008	0	0	Most of day recovering moorings
24/07/2008	06:00	119.2	Scillies to moorings
25/07/2008	06:15	98.4	Transect to shelf-break
26/07/2008	02:05	31.9	Return from shelf break
TOTAL	146:35	1863.6	

In total, 18 seabird species, four cetacean, one seal and two fish species were recorded during line transect surveys.

Figure 1. Location by date of line transect survey data in relation to the Jones Bank during surveys from RSS James Cook, 3 – 26 July 2008.



At fixed stations, a different sampling method was employed and was derived from point sampling methods described in Buckland *et al.* (2001). In essence, these were point samples taken at 5-minute time intervals in a 90º arc, in which observations were assigned to four binned distances from the ship.

Table 2. Detailed summary of point counts of seabirds and cetaceans on RSS James Cook, 3 – 26 July 2008.

Date	**Point counts**		
	Total time (HH:MM)	**N points**	**Notes**
03/07/2008			
04/07/2008			
05/07/2008	01:00	12	Trial at MS1. Problem with ship associates
	01:00	12	MS4. Poor weather
06/07/2008	07:35	91	MS2. Marginal weather
07/07/2008	10:35	127	MS2. Marginal weather
08/07/2008			
09/07/2008	00:00	0	MS1 aborted because of heavy rain
10/07/2008			

11/07/2008	00:20	4	MS1
12/07/2008	16:00	193	MS4
13/07/2008			
14/07/2008	08:30	102	MS2
15/07/2008			MS2 stationary counts aborted due to profiler malfunction
16/07/2008			
17/07/2008			
18/07/2008	01:00	12	MS5
19/07/2008	05:50	70	MS5
	00:30	6	MS1
	04:20	55	Miscellaneous CTD stations between MS5, MS1 and MS4
20/07/2008			
21/07/2008	01:40	20	MS2
	03:00	36	MS4
TOTAL	61:35	740	

A total of 14 seabird, one cetacean and one fish species were recorded during point counts.

Camphuysen CJ, Fox AD, Leopold MF, and Petersen IK, 2004. Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the U.K.: a comparison of ship and aerial sampling methods for marine birds, and their applicability to offshore wind farm assessments. Netherlands Institute for Sea Research, Texel. COWRIE – BAM-02-2002

Buckland S.T., Anderson D.R., Burnham K.P., Laake J.L., Borschers D.L. & Thomas L. 2001. Introduction to Distance Sampling. Estimating the abundance of biological populations. University Press, Oxford.

Epilogue:

At the completion of this report we have just agreed with Elsevier to produce a special issue of Progress in Oceanography based on the results from this cruise. Likely date for completion of manuscripts is June 2010, with publication hopefully during 2011.

Jonathan Sharples
Proudman Oceanographic Laboratory
July 31st 2009
