MNF Voyage Summary

Voyage #:	**IN2020_V09**
Voyage title:	**SOTS:** Southern Ocean Time Series automated moorings for climate and carbon cycle studies southwest of Tasmania
Mobilisation:	Friday, 21 - Saturday, 22 August 2020
Depart:	Hobart, 1200 Thursday, 26 August 2020
Return:	Hobart, 0900 Sunday, 13 September 2020
Demobilisation:	Hobart, Monday, 14 September 2020
Voyage Manager:	Linda Gaskell
Chief Scientist:	Elizabeth Shadwick
Affiliation:	CSIRO Oceans&Atmosphere
Principal Investigators:	Stephen R. Rintoul
Project name:	Recovery of moorings deployed on IN2018_V05 to investigate Antarctic Circumpolar Current dynamics
Affiliation:	CSIRO Oceans&Atmosphere

Scientific objectives

Shadwick: SOTS

The Southern Ocean has a predominant role in the movement of heat and carbon dioxide into the ocean interior moderating Earth's average surface climate. SOTS uses a set of two automated moorings to measure these processes under extreme conditions, where they are most intense and have been least studied. The atmosphere-ocean exchanges occur on many timescales, from daily insolation cycles to ocean basin decadal oscillations and thus high frequency observations sustained over many years are required. The current context of anthropogenic forcing of rapid climate change adds urgency to the work.

The primary objectives are; recovery of SOFS 8, deployment of SOFS 9, deployment of SAZ 22 and recovery of SAZ 21. Each of the SOTS moorings delivers to specific aspects of the atmosphere-ocean exchanges:

- the SAZ sediment trap mooring collects samples to quantify the transfer of carbon and other nutrients to the ocean interior by sinking particles and investigate their ecological controls.
- the Southern Ocean Flux Station (SOFS) mooring measures meteorological and ocean properties important to air-sea exchanges, ocean stratification, waves, currents and biological productivity and ecosystem structure. Water samples are collected for more detailed nutrient and plankton investigations after recovery.

Rintoul: ACC

Obtain observations to examine how Southern Ocean currents respond to changes in wind.

Voyage objectives

Shadwick: SOTS

1. Deploy SOFS-9 meteorology/biogeochemistry mooring
2. CTD cast/ship observations next to the SOFS-9 mooring/spool/rest
3. Deploy SAZ-22 sediment trap mooring
4. Recover SAZ-21 sediment trap mooring
5. Recover SOFS-8 meteorology/biogeochemistry mooring
6. Conduct aerosol and rain sampling (Chief Scientist)
7. Tow CPR to SOTS site
8. Deployment of 3 x ARGO floats (MNF)

Rintoul: ACC

1. Recover an oceanographic mooring deployed during IN2018_V05 at 56°S, 151°E
2. Collect a full-depth CTD station at the mooring site.
3. Deploy three EM-APEX floats

Results

All goals of the voyage were successfully achieved.

The existing SOFS-8 and SAZ-21 moorings were successfully recovered and replaced by new SOFS-9 and SAZ-22 moorings which are scheduled to be recovered in April 2021. The planned 2 CTDs were also completed to support moored sensor interpretations. The Continuous Plankton Recorder was towed along the Hobart-SOTS transit leg. Three temperature and salinity profiling floats were successfully deployed for the IMOS Argo Australia facility, and three EM-Apex current measuring profiling floats for UTAS participants in the Rintoul Antarctic Circumpolar Current (ACC) project. The lower section of the ACC mooring was recovered.

Deployed Mooring Locations	Latitude	Longitude	48.02Depth
SOFS-9	46° 59.09' S 46.98476°S	141° 48.70' E 141.81169°E	4209 m
SAZ-22	46° 47.14'S 46.7857040 °S	141° 48.02'E 141.80028°E	4663 m

**post-deployment triangulated positions*

The sensor records and sample collections achieved with these moorings build our understanding of climate and carbon cycle processes in Subantarctic waters – which are now recognized as globally important in removing CO_2 from the atmosphere. This oceanic service comes with a cost - ocean acidification, and here we show the first estimates of the associated decrease in pH from the SOTS mooring pCO_2 and salinity sensors, and the long-term alkalinity-salinity relationship established at SOTS from CTD Niskin samples (Figure 1, *Shadwick et al., in preparation*). The addition of a new pH sensor to the SOFS-9 mooring will be used to verify and refine these estimates.

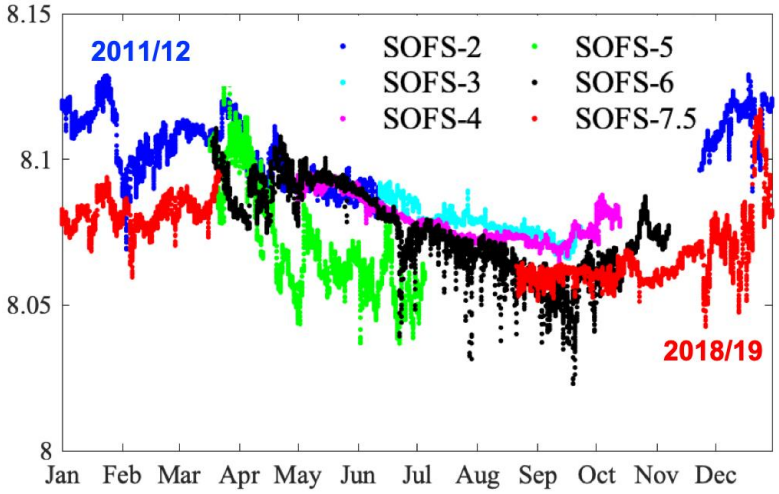


Figure 1. Changing ocean pH at the Southern Ocean Time Series

Ocean acidification is expected to impact many organisms ranging from bacteria to fish, via a wide variety of mechanisms. Perhaps the best understood is difficulty in precipitating carbonate shells (the mineral in common sea shells). Phytoplankton known as coccolithophores produce these shells and are among the most ubiquitous types of phytoplankton globally, and thus their susceptibility to

ocean acidification has received much attention, particularly for the best known species, *Emiliania huxleyii*. Examination of SAZ mooring sediment trap samples at SOTS, has shown that *E. huxleyii* is by far the most abundant, but is not nearly as important as other less well known species in terms of the amount of carbonate that it precipitates (Figure 2; *Rigual-Hernandez et al., 2020*). This nuance is important to the assessment of probable ecosystem impacts of ocean acidification, and also their feedbacks to climate change (because changing carbonate removal by organisms affects the ability of the ocean to remove atmospheric CO_2).

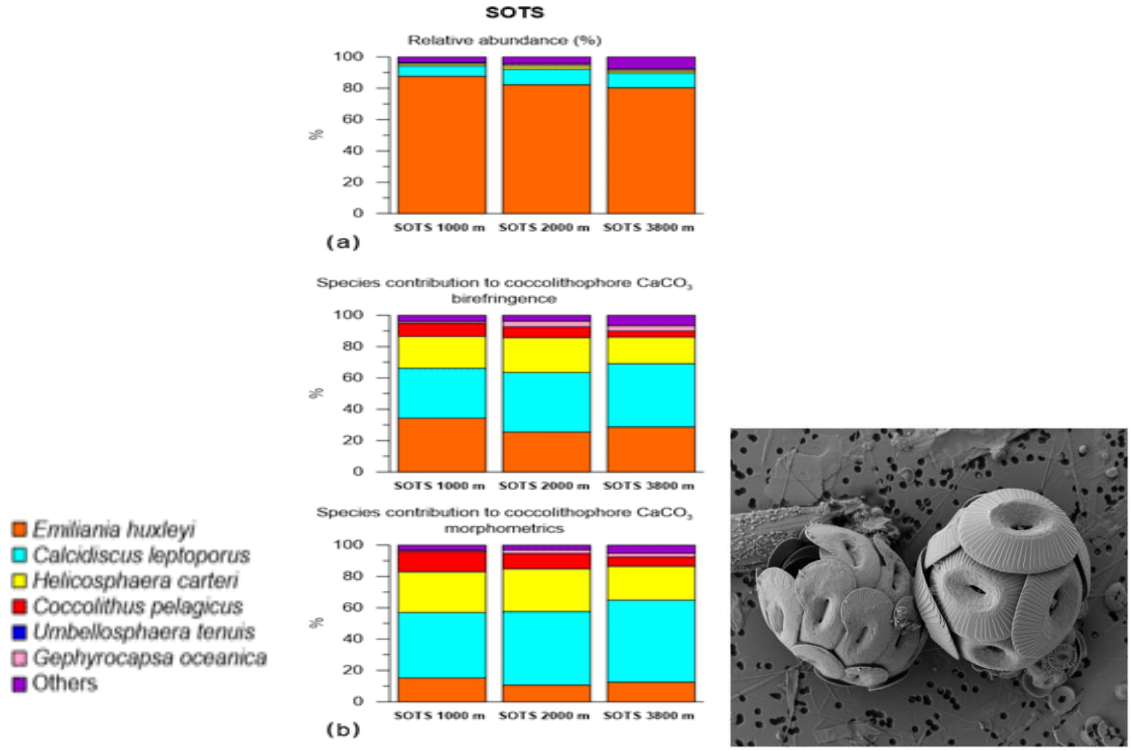


Figure 2. Coccolithophore species abundances (top panel) and their relative contributions to carbonate removal fluxes as measured using two techniques, birefringence (middle panel) and morphometrics (bottom panel). At right, an example of the coccolithosphere shells formed by these organisms, consisting of many plates known as coccoliths, as seen in a scanning electron microscope. Each sphere is only a few 10's of microns in diameter (similar to the widt of human hair). See Rigual-Hernandez et al., 2020 for details.
Rigual Hernández, A.S., Trull, T.W., Nodder, S.D., Flores, J.A., Bostock, H., Abrantes, F., Eriksen, R.S., Sierro, F.J., Davies, D.M., Ballegeer, A.-M., 2020. Coccolithophore biodiversity controls carbonate export in the Southern Ocean. Biogeosciences 17, 245-263.

Voyage narrative

We departed Thursday into rough seas that cancelled the first night plans for a test CTD. We deployed the Continuous Plankton Recorder south of Bruny Island and recovered it as we arrived at the SOTS site at ~7 AM local time on Saturday 29 August 2020. We completed the test CTD that afternoon in moderately rough conditions, with all sensors performing well except the transmissometer, which showed noisy data that was improved by replacing the instrument cable. We then completed a CTD Cast to 2250m and finished sampling it about 2300.

Sunday 30 August at 0600 we deployed the drogue to start the SOFS-9 deployment but determined that the weather was likely to become too rough for mooring work, and we retrieved it and began again and hour earlier at 0500 Monday August 31st and completed the deployment by about 2000 (the Stevenson screen on one of the two ar temperature-humidity modules and one the two ultra-sonic wind sensors were lost when snagged by the release line).

Tuesday was again too rough for mooring work, but did allow us to complete a second CTD to 2250m. This revealed that the transmissometer output still had a residual problem (of unreasonably low transmissivity deeper than 1000m) a large offset (~10dB), and also that there was an offset between the CTD pressure sensor and the surface atmospheric pressure, which was only partiallly corrected by entering the updated calibration information (both problems were left for later resolution).

Wednesday 2 September we deployed SAZ-22, with some difficulty as a result of large swells near midday which pummelled the dance floor from the stern (knocking down the bosun with minor injury). The conditions also led to snagging of the anchor release line and breakage of the parachute trip cord, so we deployed without it. Thursday was lost to weather and Friday we recovered SAZ-21, but with loss of the final float pack, acoustic releases, and CTD as a result of wear through of the spectra line during recovery (presumably as a result of tangling after release from the seafloor). Saturday we recovered SOFS-8, using a pole to attach a tag line to the lifting strop because the pickup line release mechanism had been damaged by the sea. This completed operations for the SOTS project and about 2000 we started the transit to the Rintoul mooring site.

After a day of waiting for calmer weather (during which we did a CTD to calibrate the recovered SOTS sensors), the ACC current meter mooring was successfully recovered, with loss of only 1 CTD which had occurred during the earlier failure of the top section of the mooring. The 3 EM-APEX floats were deployed that day to begin their missions of autonomous measurement of current profiles and we began the return transit to Hobart at dusk on Wednesday 9 September. The final activities of the voyage were a CTD to check calibrations on the sensors recoved from the ACC mooring, the launch of 3 Argo floats, hourly launches of XBTs, and a CTD test cast to address persisting issues with the transmissometer cable.

Outreach, education and communications activities

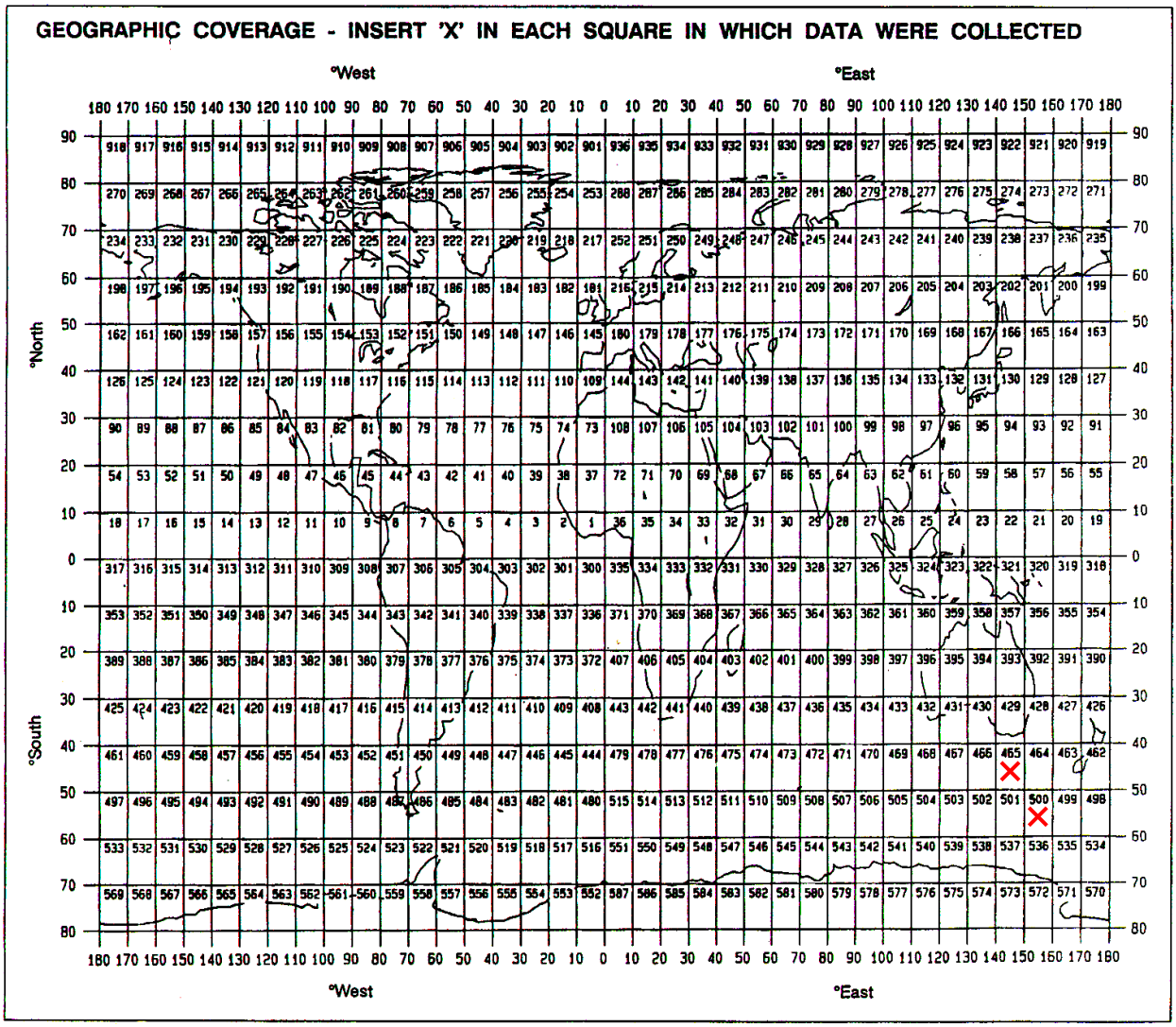
Outreach included:

1. ABC Radio Hobart “Drive” interview with Lucy Breaden on Tuesday 25 August 2020 discussing the importance of the ocean south of Australia to the modulation of climate change via its uptake of CO_2.
2. ABC New-24 on Thursday 27 August 2020 noting the resumption of Investigator voyages and its importance to maintaining the SOTS observations.
3. Planned student training efforts were not possible under the COVID-19 restrictions.

Voyage Summary

The voyage was fully and efficiently successful.

Marsden Squares



Moorings, bottom-mounted gear and drifting systems

Item Name, Identifier (e.g. serial number)	Principal Investigator (see Title Page)	APPROXIMATE POSITION (as degrees, decimal minutes)						DATA TYPE enter code(s) from list in Appendix A	DESCRIPTION
		deg	min	N/S	deg	min	E/W		
1	E.Shadwick & E.Schulz	46	53.6	S	142	20.7	E	MO2 M71 M90 H17 D01 D71	Southern Ocean Times Series (SOTS) site: **Recovered** SOFS-8 surface buoy mooring deployed in April 2019. See diagram in appendix detailing instruments and depths.
2	E.Shadwick	46	49.6	S	141	38.9	E	H17 B73 D01	Southern Ocean Times Series (SOTS) site: **Recovered** SAZ-21 sub-surface sediment trap mooring deployed in April 2019. See diagram in appendix detailing instruments and depths.
3	E.Shadwick	46	48	S	141	47,7	E	H17 B73 D01	Southern Ocean Times Series (SOTS) site: **Deployed** SAZ-22 sub-surface sediment trap mooring, for recovery in April 2021. See diagram in appendix detailing instruments and depths.
4	E.Shadwick & E.Schulz	47	0	S	142	14	E	MO2 M71 M90 H17 D01 D71	Southern Ocean Times Series (OTS) site: **Deployed** SOFS-9 surface buoy mooring, for recovery in April 2021) See diagram in appendix detailing instruments and depths.
5	S. Rintoul	56		S	151		E	D01	Recovered Antarctic Circumpolar Physical Oceanography Mooring. See diagram in appendix detailing instruments and depths.

Summary of data and samples collected

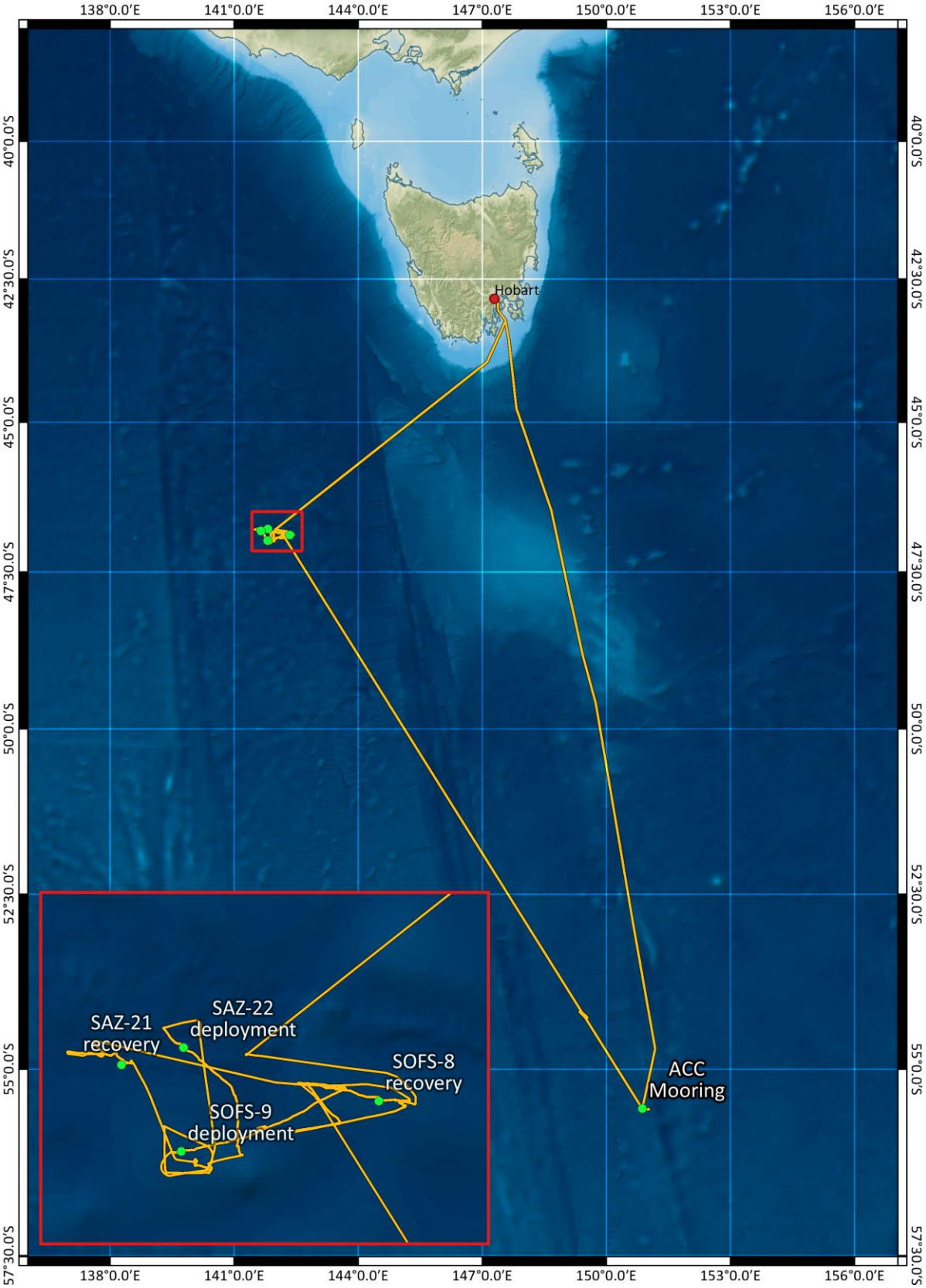
Item Name, Identifier (e.g. serial number)	Principal Investigator (see Title Page)	NO (see above)	UNITS (see above)	DATA TYPE Enter code(s) from list in Appendix A	DESCRIPTION
1	Elizabeth Shadwick	48	Discrete samples from CTD casts	H10	Salinity, nutrients (nitrate, phosphate, silicate), and dissolved oxygen measurements performed onboard on water samples taken from 2 CTD-Rosette Niskin bottles
2	Bronte Tilbrook	20	days		Continuous pCO2 measurements
3	Elizabeth Shadwick	24	Discrete samples from CTD casts	H74, H27	12 samples for each DIC and Alk on 2 deep CTD casts. Samples will be analysed for DIC (coulometry) and Alk (potentiometric titration) at CSIRO in Hobart.
	Elizabeth Shadwick	63	SAZ sediment trap cups (250ml)	B73	Unfiltered oceanic seawater and particulate matter samples in 250ml cups (n=3*21), collected with three McLane Parflux sediment traps at 1000m, 2000m and 3800m nominal depth for shore-based biogeochemical analysis.
	Elizabeth Shadwick	12	Filters	B71	12 pairs of 13mm diameter QMA filters) (n=98) for shore-based destructive particulate organic carbon (POC) analysis and 25mm GF/F filters for shore-based destructive pigment analysis, taken from CTD Niskin bottles, and 2 POC blank filters.
	Elizabeth Shadwick	12	Filters	B08	13mm filters (pore size 0.8um) for phytoplankton taxonomy identification (coccolithophores) and enumeration, taken from CTD Niskin bottles.

Item Name, Identifier (e.g. serial number)	Principal Investigator (see Title Page)	NO (see above)	UNITS (see above)	DATA TYPE Enter code(s) from list in Appendix A	DESCRIPTION
	Elizabeth Shadwick	12	1L bottles	B08	1L plastic bottles, poisoned with 500ul saturated mercuric chloride for phytoplankton taxonomy identification and enumeration, taken from CTD Niskin bottles.
	Elizabeth Shadwick	48	RAS	H74, H27, B08	48 x 500ml Tedlar sample bags of unfiltered open ocean seawater, poisoned with mercuric chloride for shore-based analysis of nutrients, DIC, Alk and phytoplankton taxonomy identification and enumeration.
	Elizabeth Shadwick	12	filters	B08	Cartridge filters with particles ffrom 2L seawater taken from CTD-Nisken bottles for eDNA analyses onshore. (stored at -80 C)

Curation Report

Item #	DESCRIPTION
1.	SOTS Project: Water and particle samples collected from the CTD, underway seawater supply, and the SOFS-8 RAS water sampler are returned to CSIRO Marine and Atmospheric Research for chemical analyses and then discarded following quarantine protocols.
2.	SOTS Project: Moored sediment trap samples recovered from the SAZ-21 mooring are processed at the University of Tasmania IMAS/AAPP laboratories. 7/10 of each sample is consumed by analyses for particulate organic carbon, particulate inorganic carbon, and biogenic silica. These results are provided for public use via the IMOS Ocean Data Portal. 2/10 of each sample is archived and can be made available for biogeochemical/biological studies by various groups via agreement with SOTS Chief Scientist Elizabeth Shadwick. 1/10 is archived at the IMAS/AAPP laboratories.

Track Chart


138°0.0'E
141°0.0'E
144°0.0'E
147°0.0'E
150°0.0'E
153°0.0'E
156°0.0'E
40°0.0'S
42°30.0'S
45°0.0'S
47°30.0'S
50°0.0'S
52°30.0'S
55°0.0'S
57°30.0'S
Hobart
SAZ-21 recovery
SAZ-22 deployment
SOFS-8 recovery
SOFS-9 deployment
ACC Mooring

Acknowledgements

Thanks to IMOS, CSIRO, AAPP, MNF, BOM, and ASP for their support of this research and their efforts to make it possible under COVID restrictions.

Appendix A – CSR/ROSCOP Parameter Codes

	METEOROLOGY
M01	Upper air observations
M02	Incident radiation
M05	Occasional standard measurements
M06	Routine standard measurements
M71	Atmospheric chemistry
M90	Other meteorological measurements

	PHYSICAL OCEANOGRAPHY
H71	Surface measurements underway (T,S)
H13	Bathythermograph
H09	Water bottle stations
H10	CTD stations
H11	Subsurface measurements underway (T,S)
H72	Thermistor chain
H16	Transparency (eg transmissometer)
H17	Optics (eg underwater light levels)
H73	Geochemical tracers (eg freons)
D01	Current meters
D71	Current profiler (eg ADCP)
D03	Currents measured from ship drift
D04	GEK
D05	Surface drifters/drifting buoys
D06	Neutrally buoyant floats
D09	Sea level (incl. Bottom pressure & inverted echosounder)
D72	Instrumented wave measurements
D90	Other physical oceanographic measurements

	MARINE BIOLOGY/FISHERIES
B01	Primary productivity
B02	Phytoplankton pigments (eg chlorophyll, fluorescence)
B71	Particulate organic matter (inc POC, PON)
B06	Dissolved organic matter (inc DOC)
B72	Biochemical measurements (eg lipids, amino acids)
B73	Sediment traps
B08	Phytoplankton
B09	Zooplankton
B03	Seston
B10	Neuston
B11	Nekton
B13	Eggs & larvae
B07	Pelagic bacteria/micro-organisms
B16	Benthic bacteria/micro-organisms
B17	Phytobenthos
B18	Zoobenthos
B25	Birds
B26	Mammals & reptiles
B14	Pelagic fish
B19	Demersal fish
B20	Molluscs
B21	Crustaceans
B28	Acoustic reflection on marine organisms
B37	Taggings
B64	Gear research
B65	Exploratory fishing
B90	Other biological/fisheries measurements

	CHEMICAL OCEANOGRAPHY
H21	Oxygen
H74	Carbon dioxide
H33	Other dissolved gases
H22	Phosphate
H23	Total - P
H24	Nitrate
H25	Nitrite
H75	Total - N
H76	Ammonia
H26	Silicate
H27	Alkalinity
H28	PH
H30	Trace elements
H31	Radioactivity
H32	Isotopes
H90	Other chemical oceanographic measurements

	MARINE CONTAMINANTS/POLLUTION
P01	Suspended matter
P02	Trace metals
P03	Petroleum residues
P04	Chlorinated hydrocarbons
P05	Other dissolved substances
P12	Bottom deposits
P13	Contaminants in organisms
P90	Other contaminant measurements

	MARINE GEOLOGY/GEOPHYSICS
G01	Dredge
G02	Grab
G03	Core - rock
G04	Core - soft bottom
G08	Bottom photography
G71	In-situ seafloor measurement/sampling
G72	Geophysical measurements made at depth
G73	Single-beam echosounding
G74	Multi-beam echosounding
G24	Long/short range side scan sonar
G75	Single channel seismic reflection
G76	Multichannel seismic reflection
G26	Seismic refraction
G27	Gravity measurements
G28	Magnetic measurements
G90	Other geological/geophysical measurements

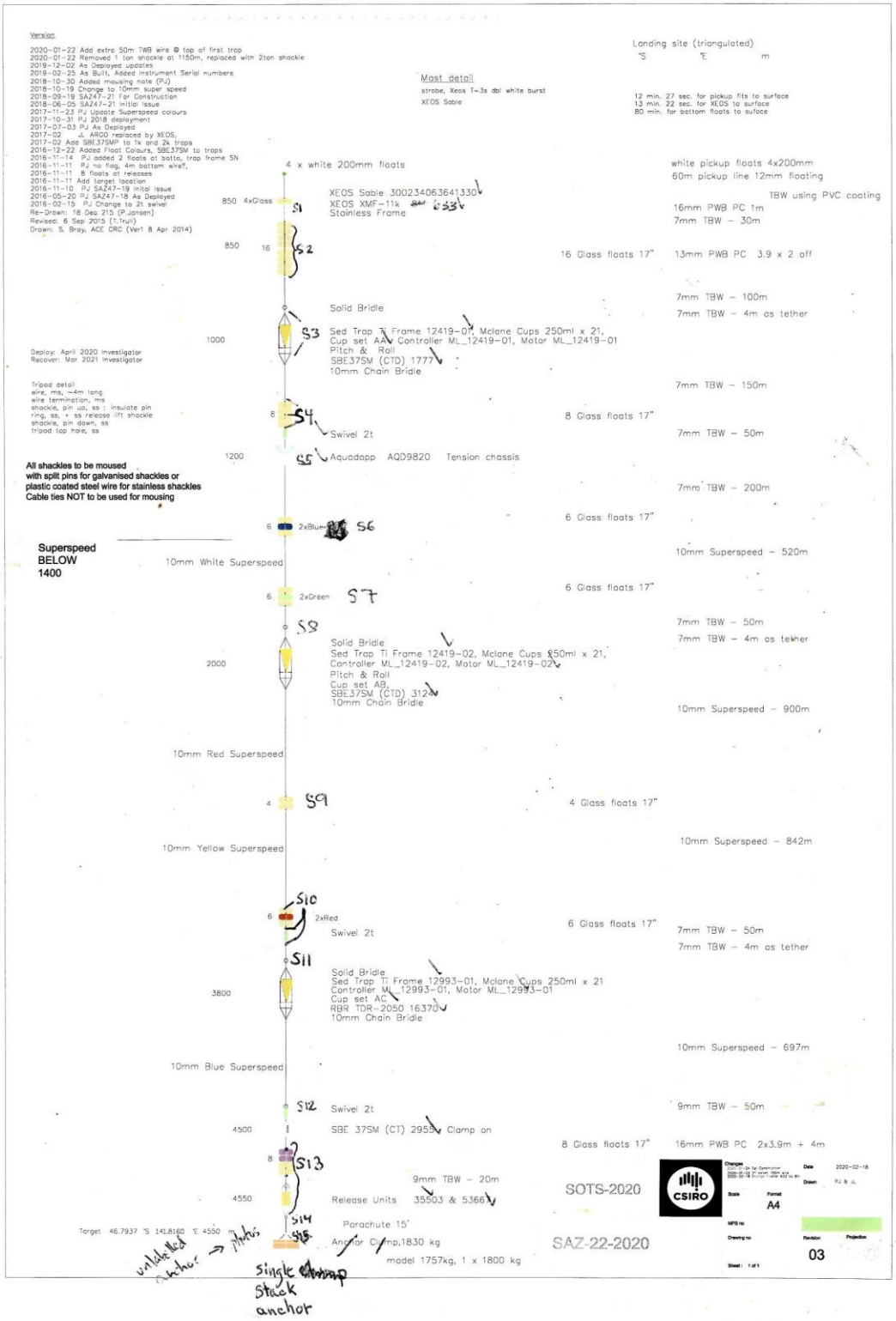
Appendix B – Photographs

Figure 1. Working conditions at SOTS in winter – deploying the SAZ sediment trap mooring. Left to Right: Phil De Boer, Jim LaDuke, Matthew Schmierer (kneelng), James Hogg, Tim Lane, and the last sediment trap ready to go (yellow funnel). Photo Peter Jansen.

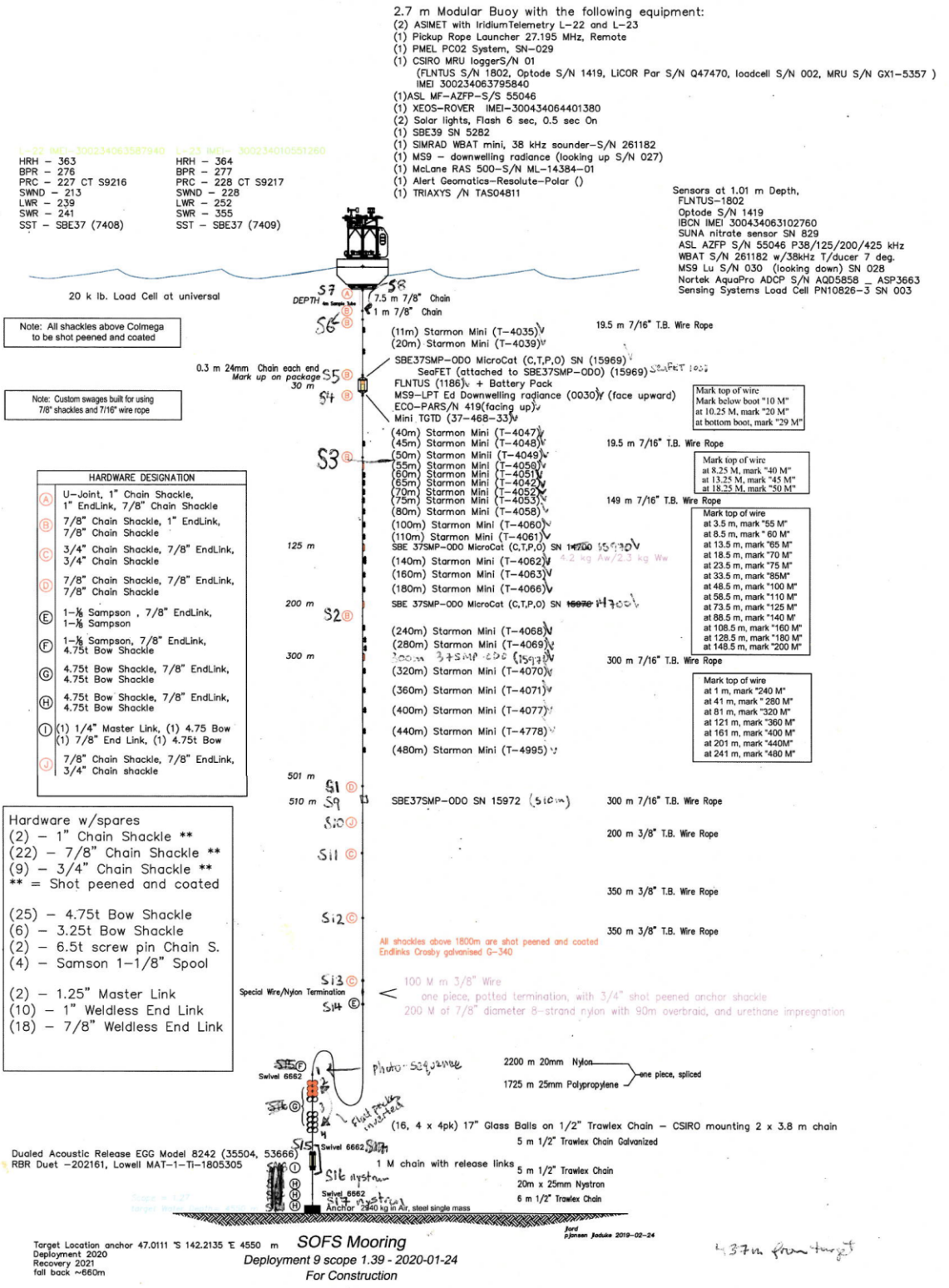
Figure 2. Recovering the SAZ sediment trap mooring – must be out the back there under the rainbow? Left to Right: Matthew Schmierer, James Hogg, Phil de Boer, Tim Lane, and Jim LaDuke, Photo: Elizabeth Shadwick

Appendix C Mooring Diagrams

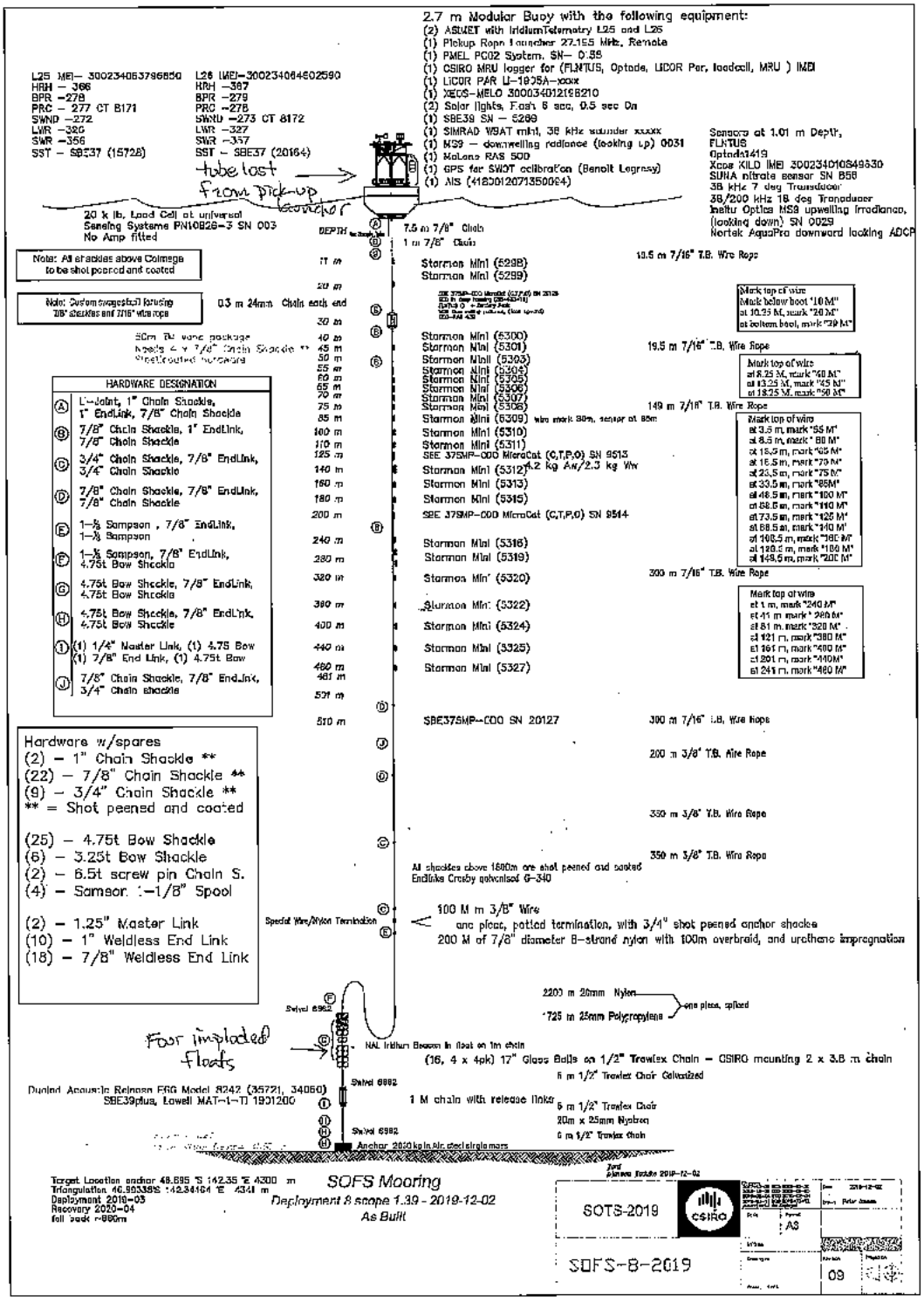
SAZ-22 as deployed



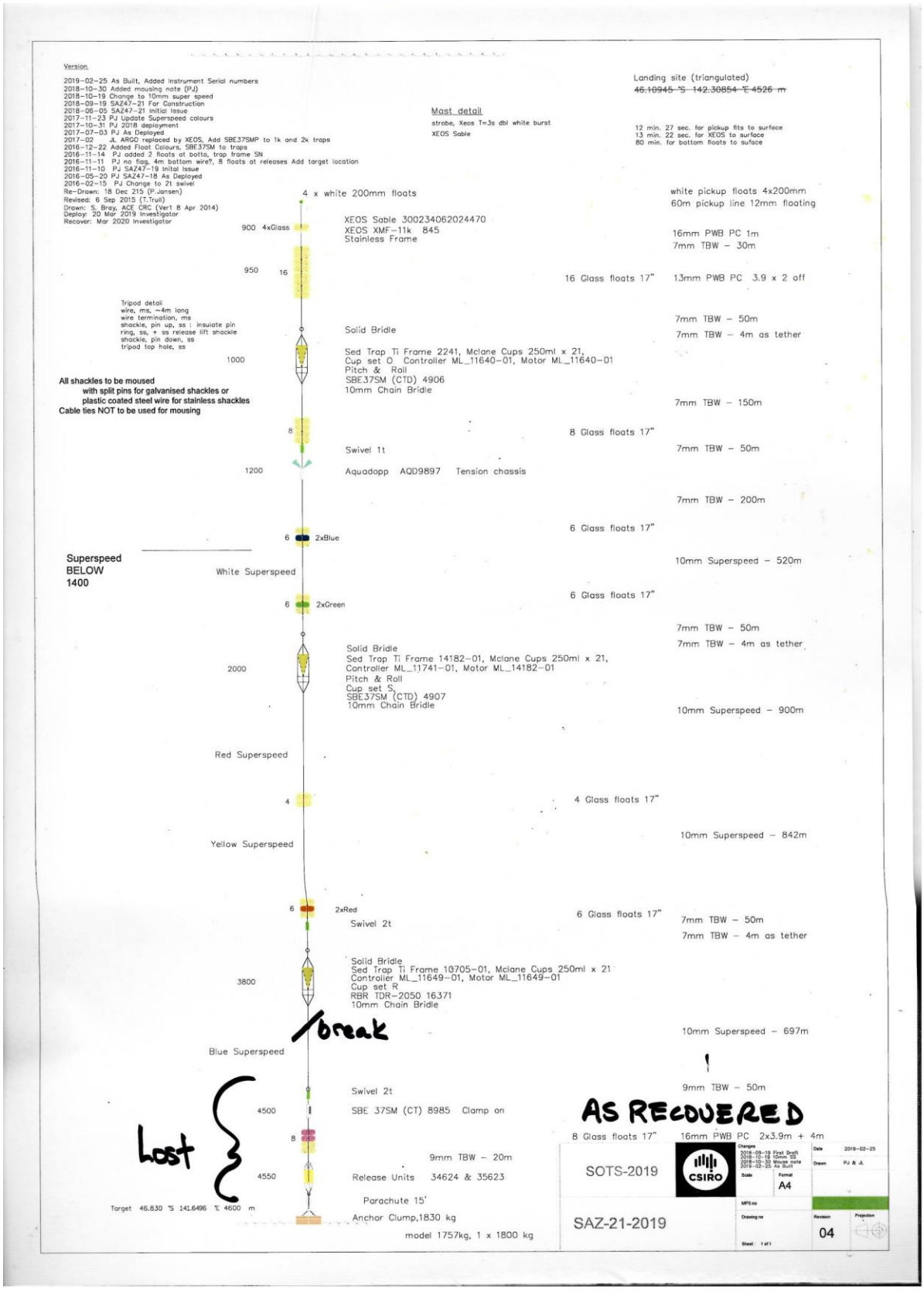
SOFS-9 as deployed



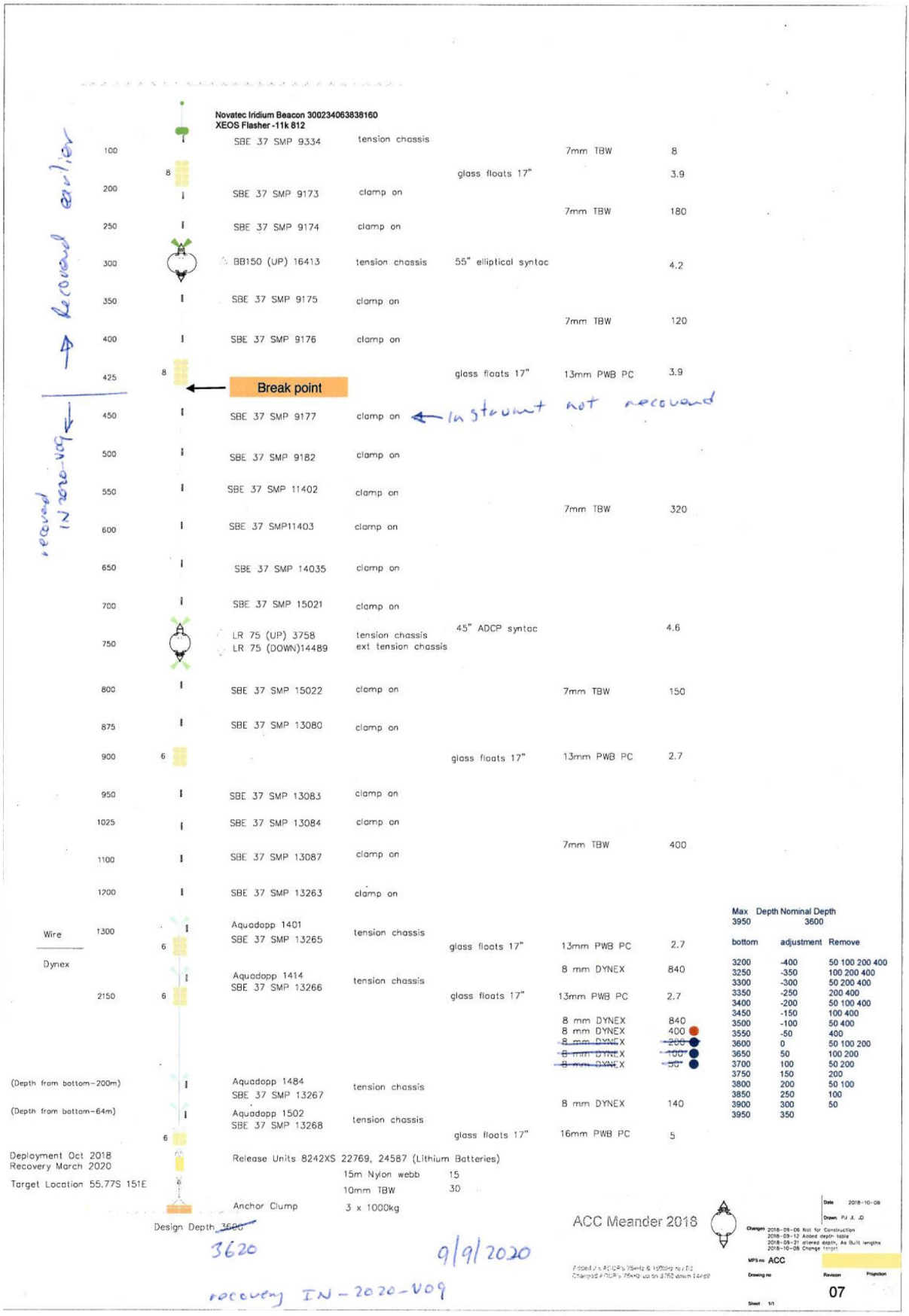
SOFS-8 as recovered



SAZ-21 as recovered



ACC as recovered



Appendix F. CTD Sample Logsheets

Test Cast for the CTD bottles and to dip the SOFS-9 Sensors									
Deployment	Position	Bottle label	Nominal dep	Pressure	Temperature	Salinity	Time	Salt bottle	Oxygen bottl
1	24	1224	0	5.2	9.825	34.732	29-08-2020T2020-08-29T03:42:09Z		
1	23	1223	0	4.4	9.826	34.732	29-08-2020T2020-08-29T03:42:05Z		
1	22	1222	0	4.1	9.826	34.732	29-08-2020T2020-08-29T03:42:04Z		
1	21	1221	5	5.1	9.825	34.732	29-08-2020T2020-08-29T03:42:02Z		
1	20	1220	5	6.4	9.825	34.732	29-08-2020T2020-08-29T03:42:00Z		
1	19	1219	300	311	9.944	34.759	29-08-2020T2020-08-29T03:24:32Z		
1	18	1218	300	310.9	9.944	34.759	29-08-2020T2020-08-29T03:24:28Z		
1	17	1217	600	634.9	8.048	34.533	29-08-2020T2020-08-29T03:08:14Z		
1	16	1216	600	635.2	8.047	34.533	29-08-2020T2020-08-29T03:08:10Z		
1	15	1215	600	635.4	8.047	34.533	29-08-2020T2020-08-29T03:08:08Z		
1	14	2114	600	635.6	8.047	34.533	29-08-2020T2020-08-29T03:08:06Z		
1	13	1213	600	635.4	8.047	34.533	29-08-2020T2020-08-29T03:08:04Z		
1	12	1212	600	635.1	8.047	34.533	29-08-2020T2020-08-29T03:08:03Z		
1	11	1211	600	635	8.048	34.533	29-08-2020T2020-08-29T03:08:01Z		
1	10	1210	600	635.1	8.047	34.533	29-08-2020T2020-08-29T03:07:59Z		
1	9	1209	600	635	8.048	34.533	29-08-2020T2020-08-29T03:07:58Z		
1	8	1208	600	635.1	8.047	34.533	29-08-2020T2020-08-29T03:07:56Z		
1	7	1207	600	635.4	8.047	34.533	29-08-2020T2020-08-29T03:07:55Z		
1	6	1206	600	635.4	8.047	34.533	29-08-2020T2020-08-29T03:07:53Z		
1	5	1205	600	635.2	8.047	34.533	29-08-2020T2020-08-29T03:07:52Z		
1	4	1204	600	634.8	8.048	34.533	29-08-2020T2020-08-29T03:07:50Z		
1	3	1203	600	634.7	8.049	34.532	29-08-2020T2020-08-29T03:07:49Z		
1	2	1202	600	635.3	8.047	34.532	29-08-2020T2020-08-29T03:07:47Z		
1	1	2007	600	635.5	8.047	34.533	29-08-2020T2020-08-29T03:07:45Z		

Cast 001 – Test dip of the SOFS-9 Sensors

Date/Time	Cast	Ros.Pos	Depth	Pressure	Sensor T	Sensor S	O2	DIC	ALK	salt	nuts	POC filt#	POC Vol	Micro scopy	Coccos filt#	HPLC filt#	HPLC vial#	HPLC Vol	eDNA
	vol						0.75	0.8	0.8	0.5	0.05	4		2		8			4
29-08-2020T2020-08-29T08:33:29Z	2	24	15	5.1	9.778	34.719	✓	✓	12	✓	✓	153	4500	5	PC008				
29-08-2020T2020-08-29T08:33:26Z	2	23	15	4.6	9.777	34.72	✓			✓	✓								0123
29-08-2020T2020-08-29T08:33:24Z	2	22	15	3.4	9.777	34.72	✓			✓	✓					6	0122	10200	
29-08-2020T2020-08-29T08:30:19Z	2	21	25	14.9	9.778	34.719	✓	✓	11	✓	✓	31	5400	4	PC005				
29-08-2020T2020-08-29T08:30:15Z	2	20	25	14	9.778	34.719	✓			✓	✓								0120
29-08-2020T2020-08-29T08:30:14Z	2	19	25	13.9	9.778	34.719	✓			✓	✓					5	0119	10050	
29-08-2020T2020-08-29T08:26:32Z	2	18	50	41.7	9.794	34.723	✓	✓	✓	✓	✓	109	8000						
29-08-2020T2020-08-29T08:26:28Z	2	17	50	41.3	9.794	34.723	✓			✓	✓					2	0118	9950	
29-08-2020T2020-08-29T08:22:35Z	2	16	75	68.1	9.83	34.732	✓	✓	✓	✓	✓	37	4050						
29-08-2020T2020-08-29T08:22:30Z	2	15	75	68.2	9.829	34.732	✓			✓	✓					3	0115	10300	
29-08-2020T2020-08-29T08:19:05Z	2	14	100	96.4	9.856	34.739	✓			✓	✓	42	4000						0114
29-08-2020T2020-08-29T08:18:58Z	2	13	100	95.9	9.854	34.738	✓			✓	✓					8	0113	8500	
29-08-2020T2020-08-29T08:18:54Z	2	12	100	95.3	9.854	34.738	✓	✓	✓	✓	✓								
29-08-2020T2020-08-29T08:15:07Z	2	11	125	123.4	9.863	34.74	✓			✓	✓								
29-08-2020T2020-08-29T08:04:38Z	2	10	200	203.5	9.905	34.749	✓	✓	✓	✓	✓								
29-08-2020T2020-08-29T08:01:00Z	2	9	250	256.5	9.93	34.754	✓	✓	✓	✓	✓								
29-08-2020T2020-08-29T07:57:24Z	2	8	300	310	9.94	34.759	✓	✓	✓	✓	✓								
29-08-2020T2020-08-29T07:54:14Z	2	7	325	337.8	9.411	34.683	✓	✓	✓	✓	✓			3	PC007				
29-08-2020T2020-08-29T07:50:16Z	2	6	400	419.5	9.076	34.643	✓			✓	✓								0106
29-08-2020T2020-08-29T07:45:42Z	2	5	500	527	8.629	34.579	✓	✓	✓	✓	✓								
29-08-2020T2020-08-29T07:34:40Z	2	4	750	792	6.897	34.447	✓	✓	✓	✓	✓								
29-08-2020T2020-08-29T07:26:53Z	2	3	1000	1066.4	4.645	34.393	✓			✓	✓			2	PC004				0103
29-08-2020T2020-08-29T07:15:02Z	2	2	1500	1605.1	2.789	34.555	✓	✓	✓	✓	✓								
29-08-2020T2020-08-29T07:02:10Z	2	1	2000	2145.4	2.371	34.709	✓			✓	✓			1	PC001				0201
Notes: HPLC vial and eDNA cartridges should have all been labelled 02nn because this was CTD cast 2, but most were labelled 01nn because this was the first cast sampled. In addition, to this general error, HPLC vial labelled 0118 was taken from Rosette posn 17, and should have been labelled 0. (TT)																			

Cast 002- At the SOTS site

Date/Time	Cast	Rosette Posi	Depth	Pressure	Sensor T	Sensor S	O2	DIC	ALK	salt	nuts	POC filt#	POC Vol	Microscopy	Cocco filt#	HPLC filt#	HPLC vial#	HPLC Vol	eDNA
	LITRES NEEDED						1	1	0.8	1	0		4	2		8			2
01-09-2020T2020-09-01T02:54:53Z	2	24	15	3.7	9.938	34.765	✓	✓	12	✓	✓	PC053	5600	10	5				
01-09-2020T2020-09-01T02:54:49Z	2	23	15	3.9	9.938	34.765	✓			✓	✓								0323
01-09-2020T2020-09-01T02:54:48Z	2	22	15	3.3	9.937	34.765	✓			✓	✓					3	0322	9500	
01-09-2020T2020-09-01T02:51:34Z	2	21	25	15.2	9.942	34.765	✓	✓	11	✓	✓	PC052	4550	9	4				
01-09-2020T2020-09-01T02:51:30Z	2	20	25	14.6	9.942	34.765	✓			✓	✓								0320
01-09-2020T2020-09-01T02:51:26Z	2	19	25	13.9	9.942	34.765	✓			✓	✓					6	0319	9950	
01-09-2020T2020-09-01T02:48:01Z	2	18	50	41	9.939	34.764	✓	✓	✓	✓	✓	PC192	4150	8	3				
01-09-2020T2020-09-01T02:47:57Z	2	17	50	40.6	9.938	34.764	✓			✓	✓					7	0317	9900	
01-09-2020T2020-09-01T02:44:43Z	2	16	75	67.9	9.947	34.765	✓	✓	✓	✓	✓	PC033	5200						
01-09-2020T2020-09-01T02:44:39Z	2	15	75	69.3	9.948	34.766	✓			✓	✓					2	0315	9500	
01-09-2020T2020-09-01T02:41:11Z	2	14	100	95.7	9.957	34.768	✓			✓	✓	PC083	5000						0314
01-09-2020T2020-09-01T02:41:07Z	2	13	100	95.9	9.959	34.768	✓			✓	✓					9	0313	10050	
01-09-2020T2020-09-01T02:37:56Z	2	12	125	122.7	9.959	34.768	✓	✓	✓	✓	✓	PC035	5150						
01-09-2020T2020-09-01T02:37:52Z	2	11	125	122.7	9.96	34.768	✓			✓	✓					4	0311	10950	
01-09-2020T2020-09-01T02:33:15Z	2	10	200	204.2	9.975	34.77	✓	✓	✓	✓	✓								
01-09-2020T2020-09-01T02:29:21Z	2	9	250	258.2	9.984	34.77	✓	✓	✓	✓	✓								
01-09-2020T2020-09-01T02:25:19Z	2	8	300	311.6	9.991	34.77	✓	✓	✓	✓	✓								
01-09-2020T2020-09-01T02:20:56Z	2	7	360	377.1	9.986	34.774	✓	✓	✓	✓	✓								
01-09-2020T2020-09-01T02:16:59Z	2	6	400	418.5	9.556	34.727	✓			✓	✓								0306
01-09-2020T2020-09-01T02:11:17Z	2	5	500	527.7	8.759	34.602	✓	✓	✓	✓	✓								
01-09-2020T2020-09-01T02:01:48Z	2	4	750	796.8	6.886	34.463	✓	✓	✓	✓	✓								
01-09-2020T2020-09-01T01:52:23Z	2	3	1000	1067.6	4.716	34.389	✓			✓	✓			7	2				0303
01-09-2020T2020-09-01T01:35:48Z	2	2	1500	1606.2	2.779	34.546	✓	✓	✓	✓	✓								
01-09-2020T2020-09-01T01:19:20Z	2	1	2000	2147.1	2.357	34.706	✓			✓	✓			6	6				0301
												PC086	blank						
												PC123	blank						

Cast 003 – At the SOTS site

Post-dip of the SOFS-8 Sensors									
Deployment	Position	Bottle label	Nominal dep	Pressure	Temperature	Salinity	Time	Salt bottle	Oxygen bottl
4	24	1224	5	8.1	1.98	33.832	08-09-2020T2020-09-08T04:22:34Z		
4	23	1223	5	7.8	1.984	33.832	08-09-2020T2020-09-08T04:22:30Z		
4	22	1222	15	7.6	1.984	33.832	08-09-2020T2020-09-08T04:22:28Z		
4	21	1221	25	8.6	1.984	33.832	08-09-2020T2020-09-08T04:22:27Z		
4	20	1220	25	8.7	1.983	33.832	08-09-2020T2020-09-08T04:22:25Z		
4	19	1219	25	7.3	1.984	33.832	08-09-2020T2020-09-08T04:22:23Z		
4	18	1218	50	6.3	1.984	33.832	08-09-2020T2020-09-08T04:22:22Z		
4	17	1217	50	7.1	1.984	33.832	08-09-2020T2020-09-08T04:22:21Z		
4	16	1216	100	101.5	1.194	33.858	08-09-2020T2020-09-08T04:15:53Z		
4	15	1215	100	101.2	1.193	33.858	08-09-2020T2020-09-08T04:15:49Z		
4	14	2114	100	101.5	1.194	33.858	08-09-2020T2020-09-08T04:15:46Z		
4	13	1213	100	102	1.196	33.858	08-09-2020T2020-09-08T04:15:44Z		
4	12	1212	100	101.3	1.194	33.858	08-09-2020T2020-09-08T04:15:42Z		
4	11	1211	100	101.4	1.193	33.858	08-09-2020T2020-09-08T04:15:39Z		
4	10	1210	100	101.3	1.193	33.858	08-09-2020T2020-09-08T04:15:37Z		
4	9	1209	100	101.2	1.194	33.858	08-09-2020T2020-09-08T04:15:35Z		
4	8	1208	100	101.3	1.194	33.858	08-09-2020T2020-09-08T04:15:33Z		
4	7	1207	100	101.4	1.194	33.858	08-09-2020T2020-09-08T04:15:32Z		
4	6	1206	350	354.1	2.328	34.334	08-09-2020T2020-09-08T04:00:06Z		
4	5	1205	350	353.7	2.315	34.333	08-09-2020T2020-09-08T04:00:02Z		
4	4	1204	350	354.2	2.321	34.334	08-09-2020T2020-09-08T04:00:00Z		
4	3	1203	350	354.5	2.321	34.334	08-09-2020T2020-09-08T03:59:58Z		
4	2	1202	350	354.5	2.336	34.334	08-09-2020T2020-09-08T03:59:56Z		
4	1	2007	350	354	2.319	34.333	08-09-2020T2020-09-08T03:59:54Z		

Cast 004 – Post-dip of the SOFS-8 Sensors

Deployment	Position	Bottle label	Nominal dep	Pressure	Temperature	Salinity	Time	Salt bottle	Oxygen bottl
5	24	1224	5	16.1	6.131	34.033	09-09-2020T2020-09-10T00:07:08Z		
5	23	1223	5	15.8	6.132	34.033	09-09-2020T2020-09-10T00:07:05Z		
5	22	1222	15	15.8	6.134	34.033	09-09-2020T2020-09-10T00:07:04Z		
5	21	1221	25	15.7	6.135	34.033	09-09-2020T2020-09-10T00:07:03Z		
5	20	1220	25	15.4	6.135	34.033	09-09-2020T2020-09-10T00:07:02Z		
5	19	1219	25	15.1	6.135	34.033	09-09-2020T2020-09-10T00:07:01Z		
5	18	1218	50	15.2	6.134	34.033	09-09-2020T2020-09-10T00:07:00Z		
5	17	1217	50	15.5	6.135	34.033	09-09-2020T2020-09-10T00:07:00Z		
5	16	1216	100	15.9	6.134	34.033	09-09-2020T2020-09-10T00:06:59Z		
5	15	1215	100	16.1	6.135	34.033	09-09-2020T2020-09-10T00:06:58Z		
5	14	2114	100	16.1	6.135	34.033	09-09-2020T2020-09-10T00:06:57Z		
5	13	1213	100	15.8	6.134	34.033	09-09-2020T2020-09-10T00:06:56Z		
5	12	1212	100	15.6	6.135	34.033	09-09-2020T2020-09-10T00:06:55Z		
5	11	1211	100	15.6	6.135	34.033	09-09-2020T2020-09-10T00:06:54Z		
5	10	1210	15	15.7	6.135	34.033	09-09-2020T2020-09-10T00:06:53Z		
5	9	1209	1000	1002.1	2.707	34.4	09-09-2020T2020-09-09T23:38:40Z		
5	8	1208	1000	1002.4	2.703	34.4	09-09-2020T2020-09-09T23:38:36Z		
5	7	1207	1000	1002.6	2.7	34.4	09-09-2020T2020-09-09T23:38:34Z		
5	6	1206	1000	1002	2.703	34.4	09-09-2020T2020-09-09T23:38:32Z		
5	5	1205	1000	1001.8	2.704	34.4	09-09-2020T2020-09-09T23:38:30Z		
5	4	1204	1000	1002.4	2.701	34.4	09-09-2020T2020-09-09T23:38:28Z		
5	3	1203	1000	1002.4	2.701	34.4	09-09-2020T2020-09-09T23:38:26Z		
5	2	1202	1000	1002.2	2.7	34.4	09-09-2020T2020-09-09T23:38:25Z		
5	1	2007	1000	1002.3	2.7	34.4	09-09-2020T2020-09-09T23:38:23Z		

Cast 005 – Post-dip of the ACC sensors